

SYDFEF series 2X, 3X SYHDFEF series 1X

Pressure and flow control system

Operating instructions
RE 30013-B/08.2022

Replaces: 08.2020
English



The data specified only serve to describe the product. If information on the use of the product is given, it is only to be regarded as application examples and recommendations. Catalog information does not constitute warranted properties. The information given does not release the user from the obligation of own judgment and verification. Our products are subject to a natural process of wear and aging.

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The cover shows an example configuration. The product supplied may differ from the solution shown here.

The original operating instructions were prepared in German.

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1 About this documentation

1.1 Validity of the documentation

This documentation is valid for the following pressure/flow control systems:

- SYDFEF series 2X
- SYDFEF series 3X
- SYHDFEF series 1X

This documentation is intended for engineers, fitters, operators, service technicians and plant operators.

This documentation contains important information on the safe and appropriate installation, transport, commissioning, operation, use, maintenance, disassembly and simple troubleshooting of the pressure and flow control systems SYDFEF series 2X, 3X and SYHDFEF series 1X.

- Read this documentation thoroughly, especially chapter 2 “Safety instructions” and chapter 3 “General notes on damage to property and damage to the product”, before working with the pressure/flow control system.

1.2 Required and supplementary 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: Required and supplementary documentation

Title	Document number	Document type
 Order confirmation		
 Installation drawing		
 General operating instructions for axial piston units	RE 90300-B	Operating instructions
 Pressure/flow control system, type SYDFE1-2X, SYDFEE-2X, SYDFEC-2X, SYDFEF-2X, SYDFEN-2X	RE 30030	Data sheet
 Pressure-flow control system, type SYDFE1-3X, SYDFEE-3X, SYDFEC-3X, SYDFEF-3X, SYDFEN-3X	RE 30035	Data sheet
 Pressure-flow control system, type SYHDFEE-1X, SYHDFEC-1X, SYHDFEF-1X, SYHDFEN-1X	RE 30630	Data sheet
Axial piston variable displacement pump A10VSO series 31, sizes 18 to 140	RE 92711	Data sheet
Axial piston variable displacement pump A10VSO series 32, sizes 45 to 180	RE 92714	Data sheet
Axial piston variable pump A4VSO series 10, 11 and 30, sizes 40...1000	RE 92050	Data sheet
Axial piston variable pump A4VSO for HFC fluids	RE 92053	Data sheet
Hydraulic fluids based on mineral oils and related hydrocarbons - Application notes and requirements for Rexroth hydraulic components	RE 90220	Data sheet
Fire-resistant hydraulic fluids - containing water (HFAE, HFAS, HFB, HFC)	RE 90223	Data sheet
Axial piston units for operation with fire-resistant hydraulic fluids - water-free and water-containing (HFDR, HFUD, HFA, HFB, HFC)	RE 90225	Data sheet
Pump pre-load valve for the SYDFE control system	RE 29255	Data sheet

Title	Document number	Document type
3/3 proportional directional valves, direct operated, with electrical position feedback, as pilot valve for control systems SY(H)DFE., type VT-DFP	RE 29016	Data sheet
Swivel angle sensor type VT-SWA-1-1X/DFEE-G15	RE 30268	Data sheet
Pressure transducer with integrated electronics, type HM 20	RE 30272	Data sheet
Pressure transducer with integrated electronics, type HM 20	RE 30272-MON	Installation instructions
Installation, commissioning and maintenance of hydraulic systems	RE 07900	Data sheet
Declaration on environmental compatibility	RE 30030-U	Compliance data sheet
Rexroth HydraulicDrive Functions (firmware and software description)	www.boschrexroth.com/sydfc	Functional description
Rexroth HydraulicDrive Parameters (firmware and software description)	www.boschrexroth.com/sydfc	Parameter description
Rexroth HydraulicDrive Diagnostic Messages (firmware and software description)	www.boschrexroth.com/sydfc	Description of diagnostic messages
Rexroth HydraulicDrive HDx-20 pump control	RE 30237-Z	Supplementary information
IndraWorks 14VRS software installation	R911344286	Commissioning Manual

1.3 Representation of information

Uniform safety instructions, symbols, terms and abbreviations are used to ensure quick and safe working with the product using this documentation. For a better understanding, they are explained in the following sections.

1.3.1 Safety instructions

This documentation contains safety notes in chapter 2.6 “Product-specific safety instructions” and chapter 3 “General notes on damage to material and the product” as well as before a sequence of activities or instructions for action, which involve the risk of personal injury or damage to equipment. The hazard avoidance measures described must be observed.

Safety instructions are structured as follows:

 SIGNAL WORD
Type and source of danger! Consequences in case of non-compliance ▶ Hazard avoidance measures ▶ <Enumeration>

- **Warning symbol:** draws attention to a hazard
- **Signal word:** identifies the degree of hazard
- **Type and source of danger!:** specifies the type and source of hazard
- **Consequences:** describes the consequences in case of non-observance
- **Precaution:** specifies how the hazardous situation can be prevented

Table 2: Hazard Classifications according to ANSI Z535.6-2011

Warning sign, signal word	Meaning
 DANGER	Indicates a hazardous situation which, if not avoided, will certainly result in death or serious injury.
 WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Damage to property: The product or the environment could be damaged.

1.3.2 Symbols

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

Table 3: Meaning of the symbols

Symbol	Meaning
	If this information is disregarded, the product cannot be used or operated in an optimum manner.
	Individual, independent action
1.	Numbered instruction:
2.	The numbers indicate that the actions must be carried out one after the other.
3.	

1.3.3 Designations

The following terms are used in this documentation:

Table 4: Designations

Designation	Meaning
A10VSO	Axial piston variable displacement pump, open circuit
A4VSO	Axial piston variable displacement pump, open circuit
HDx	Firmware for HydraulicDrive
HM20	Pressure transducer type HM20
IndraWorks	Service tool for commissioning, parameterization and diagnostics HydraulicDrive
SYDFEF-2X	Pressure/flow control system, series 2X
SYDFEF-3X	Pressure/flow control system, series 3X
SYHDFEF-1X	Pressure/flow control system, high pressure, series 1X
VT-DFFP	Pilot valve with integrated, digital electronics
VT-SWA-1-1X/DFEE-G15	Swivel angle sensor

1.3.4 Abbreviations

The following abbreviations are used in this documentation:

Table 5: Abbreviations

Abbreviation	Meaning
DB	Pressure relief valve
PT	Pressure Transducer
EMC	Electromagnetic compatibility
GND	Ground (signal ground)
n.c.	Not connected
p	Pressure (symbol)
PC	Personal Computer
PCV	Precompression Volume
p_{Diff}	Control deviation between pressure command value and actual pressure value
PE	Protective Earth
p_{act}	Actual pressure value
p_{comm}	Pressure command value
RE	Rexroth document in English language
A/F	Swivel Angle
SWA_{act}	Actual swivel angle value
SWA_{comm}	Swivel angle command value
U_B	Supply voltage

2 Safety instructions

2.1 About this chapter

The SY(H)DFEF control system has been manufactured according to good engineering practice. However, there is still a risk of personal injury and damage to property if you do not observe this chapter and the safety instructions in this documentation.

- ▶ Read these instructions completely and thoroughly before working with the SY(H)DFEF control system.
- ▶ 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 pressure/flow control system is intended exclusively for being integrated in a machine or installation or for being assembled with other components to form a machine or system. Make sure that components supplied by the customer, e.g. electric drive, is sufficiently dimensioned. The product may be commissioned only if it is integrated in the machine/system for which it is designed.

The pressure/flow control system serves for electrohydraulic pressure and swivel angle control.

Observe the technical data, operating conditions and performance limits according to the data sheet and the order confirmation.

The SY(H)DFEF pressure and flow control system is technical equipment and is intended exclusively for professional use and not for private usage.

Operation according to the intended use also implies that you have read and understood this documentation completely, especially chapter 2 "General safety instructions".

Operating the product is only permitted, if you observe national EMC regulations for the application at hand. The manufacturer of the system or machine is responsible for complying with the limit values stipulated in national regulations:

- European countries: EU Directive 2014/30/EU (EMC Directive)
- USA: See National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA) as well as regional engineering regulations.

2.3 Improper use

Any use other than described in the section "Intended use" is considered as improper and is therefore not permitted.

The installation or use of inappropriate products in safety-relevant applications could result in unintended operating states in the application 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-protection areas or in safety-related parts of a control (functional safety).

Improper use includes, but is not limited to the following, foreseeable misuse:

- Non-observance of technical data, operating conditions and performance limits stated in the data sheet and the order confirmation
- Non-observance of national EMC regulations during operation for the application at hand
- If the SY(H)DFEF control system is used in a potentially explosive atmosphere
- Improper storage of the SY(H)DFEF control system
- Improper handling/transport of the SY(H)DFEF control system
- Lack of cleanliness during storage and mounting
- Improper installation of the SY(H)DFEF control system
- Use of unsuitable/non-approved media
- Exceeding of the specified maximum pressures
- Operation outside the permissible temperature range

The SY(H)DFEF pressure and flow control system is not intended for private usage. Bosch Rexroth AG does not assume any liability for damage caused by improper use. The user assumes all risks involved with improper use.

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. For transporting and handling the product, additional knowledge of how to handle lifting gear and the necessary attachment devices is required. In order to ensure safe use, these activities may only be carried out by an expert in the respective field or an instructed person under the direction and supervision of an expert.

Experts are those who are able to 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 requirements pertaining to the work to be undertaken. An expert must observe the relevant specific professional rules and have the necessary expert knowledge.

Expert knowledge means for example for hydraulic products:

- Reading and completely understanding hydraulic circuit diagrams,
- in particular, completely understanding the correlations regarding safety equipment and
- knowledge of the function and structure of hydraulic components.



Bosch Rexroth offers training courses that support your qualification in specific fields. You can find an overview of training contents on the Internet at: <http://www.boschrexroth.com>

2.5 General safety instructions

- Observe the valid regulations on accident prevention and environmental protection.
- Observe the safety regulations and provisions of the country in which the product is used/applied.
- Exclusively use Rexroth products in technically perfect condition.
- Observe all notices on the product.

- Persons who install, commission, operate, demount or maintain Rexroth products must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to respond.
- Only use genuine Rexroth accessories and spare parts in order to exclude any hazard to persons due to unsuitable spare parts.
- Comply with the technical data and ambient conditions specified in the product documentation.
- You may commission the product only when it has been established that the final product (for example, a machine or system), in which the Rexroth product is installed, complies with national regulations, safety regulations and standards relevant for the application.

2.6 Product-specific safety instructions



WARNING

System parts under pressure and ejecting hydraulic fluid!

When working on hydraulic systems with stored energy (e.g. accumulators) hydraulic components may still be under pressure even after the pressure supply was switched off. During installation and demounting, components or parts may be hurled around and cause personal injuries and/or damage to property. There is moreover the risk of serious injury caused by a powerful, ejecting hydraulic fluid jet.

- ▶ Before working on the hydraulic product ensure that the hydraulic system is depressurized and the electrical control de-energized.
- ▶ Completely unload the pressure of machines and systems before working on hydraulic products.

Non-compliance with functional safety!

Hydraulic components control movements in machines or systems. In the event of mechanical and electrical faults, e.g. power supply due to lightning or fluctuations in the power supply, the machine can start up unexpectedly and thus cause personal injuries.

- ▶ When setting up your circuit, observe functional safety, e.g. according to EN ISO 13849.

Control system falling down!

SY(H)DFEF control systems are heavy. When improperly handled, they can fall down and cause severe injuries and crushing, because the parts can be, for example, sharp-edged, heavy, oily, loose or bulky.

- ▶ Transport the SY(H)DFEF control system using suitable lifting gear at the points provided for this purpose.
- ▶ Ensure a stable position during transport to the place of installation.
- ▶ Wear personal protective equipment when handling the control system.
- ▶ Comply with the national laws and regulations regarding occupational health and safety for transporting/handling.

WARNING

Faulty fastening!

Mounting of hydraulic components using mounting screws of reduced strength, improper mounting or mounting with insufficient stability may cause the hydraulic components to become loose and fall down. Consequently, hydraulic fluid may leak and lead to personal injuries and/or damage to property. Hydraulic components with heavy weight may cause bruises or fatal injury.

- ▶ Completely mount hydraulic components according to the mounting specifications using suitable mounting aids.
- ▶ Only mount the SY(H)DFEF control system at places suitable for the weight of the SY(H)DFEF control system.
- ▶ Observe the tightening torques and bolt strengths.

Unexpected machine movements!

Working on running systems poses a danger to life and limb. The work steps described in these operating instructions may only be performed on shut down systems. Before beginning work:

- ▶ Make sure that the drive motor cannot be switched on.
- ▶ Make sure that all power-transmitting components and connections (electrical, pneumatic, hydraulic) are switched off according to the manufacturer's instructions and are secured against being switched on again. If possible, remove the main fuse of the system.
- ▶ Ensure that the system is completely hydraulically unloaded and depressurized. Please follow the system manufacturer's instructions.
- ▶ The SY(H)DFEF control system may be mounted exclusively by qualified personnel (see chapter 2.4 "Qualification of personnel" on page 11).

Lines under pressure!

Risk of injury.

- ▶ Never disconnect, open or cut pressurized lines!
- ▶ Before carrying out any installation or other work, depressurize the control system.

High electrical voltage!

Danger to life and risk of injury caused by electric shock.

- ▶ The SY(H)DFEF control system may only be connected by or under the supervision of a specialized electrician.
- ▶ Switch off the voltage supply before all maintenance, repair or installation work and secure it against restarting.
- ▶ Before starting installation work, plugging and unplugging connectors and carrying out any work, switch the control system off. Secure the electrical equipment against restarting.
- ▶ Before switching the control system on, check the protective conductor on all electrical devices for proper connection according to the wiring diagram.



WARNING

Penetrating water and humidity!

In case of use in humid or wet environments, water or humidity may penetrate at electrical plug-in connectors or hydraulic components. This case may lead to malfunction of the valve or the pump and to unexpected movements in the hydraulic system which may result in personal injury and damage to property.

- ▶ Only use the hydraulic valve within the intended IP protection class or lower.
- ▶ Ensure before the installation that all seals and caps of the plug-in connections are present and intact.

High noise emission during operation!

The noise emission of SY(H)DFEF control systems depends, among others, on speed, operating pressure and the installation situation. Under normal operating conditions, the noise pressure level may rise above 70 dB(A). This can cause hearing damage.

- ▶ Always wear hearing protection when you work in the vicinity of a running SY(H)DFEF control system.

Hot surfaces!

Risk of burning.

The SY(H)DFEF control system heats up considerably during operation. The pilot valve of the SY(H)DFEF control system gets even so hot during operation that you may burn yourself. This may cause burns when you touch the surfaces or, when the surface gets into contact with non-heat-resistant or combustible material, this may result in damage to property or fire.

- ▶ Keep non-heat-resistant or combustible material away from the SY(H)DFEF control system.
- ▶ Let the SY(H)DFEF control system cool down before touching it.
- ▶ Protect yourself by wearing heat-resistant protective clothing, e.g. gloves.

Health-damaging hydraulic fluid!

Risk of intoxication and injury! Contact with hydraulic fluids can be damaging to your health (e.g. eye injuries, skin damage, intoxication upon inhalation and swallowing).

- ▶ Always check the lines for wear and damage before each commissioning.
- ▶ When doing so, wear protective gloves, safety goggles and suitable working clothes.
- ▶ If nevertheless hydraulic fluid comes into contact with the eyes or penetrates the skin, consult a doctor immediately.
- ▶ When handling hydraulic fluids, strictly observe the safety notes of the hydraulic fluid manufacturer.

Easily inflammable hydraulic fluid!

In connection with fire or other hot heat sources, leaking hydraulic fluid mist, which results from defective or incompletely mounted valves and their connections, may lead to fire or explosions.

- ▶ Do not use the SY(H)DFEF control system in areas with open fire and only at a sufficient distance to hot heat sources.
- ▶ Ensure sufficient ventilation.

CAUTION

Improperly laid lines and cables!

Risk of stumbling!

- ▶ Lay cables and lines so that no one can stumble over them.

Uncontrolled system behavior!

The failure of individual components can lead to malfunction of the assembly and therefore to unforeseeable behavior!

- ▶ Replace or have defective components replaced immediately.

Contaminated hydraulic fluid!

Contamination in the hydraulic fluid may cause functional failures e.g. jamming or blocking of hydraulic components. In the worst case, this may result in unexpected system movements and thus constitute a risk of injury.

- ▶ Ensure sufficient cleanliness of the hydraulic fluid according to the cleanliness class for the hydraulic valve over the entire operating range.

Corrosion!

If the hydraulic valve is used in humid environments or water, the hydraulic valves and mounting screws may corrode. Thus, both the mounting screws and the hydraulic valves lose their stability and may become loose and thus constitute a risk of injury.

- ▶ Use mounting screws with adequate corrosion protection and exchange mounting screws that show serious corrosion damage.
- ▶ Provide for adequate corrosion protection and exchange valves with serious corrosion damage at an early stage.

2.7 Personal protective equipment

Personal protective equipment for users of the product consists of:

- Protective gloves and safety shoes for handling the SY(H)DFEF control system.
- Hearing protection for working in the direct vicinity of the running system.

All components of personal protective equipment must be intact.

2.8 Operator's obligations

The operation of installations, systems and machines basically requires the implementation of a holistic IT security concept which is state-of-the-art in terms of technology. Accordingly, Bosch Rexroth products and their properties must be considered as components of installations, systems and machines for their holistic IT security concept.

Unless otherwise documented, Bosch Rexroth products are designed for operation in local, physically and logically secured networks with access restrictions for authorized persons, and they are not classified according to IEC 62443-4-2.

3 General notes on damage to material and the product

The warranty only applies to the delivered configuration.

Warranty claims will be rejected in the case of improper installation, commissioning and operation as well as in the case of use not in accordance with the intended purpose and/or improper handling.

NOTICE

Impermissible mechanical loading!

Impacts or impulsive forces on the drive shaft or the pilot valve can damage or even destroy the SY(H)DFEF control system.

- ▶ Do not hit on the coupling or drive shaft of the axial piston unit.
- ▶ Do not set/place the axial piston unit on the drive shaft or the pilot valve.
- ▶ Never use the SY(H)DFEF control system as a handle or step. Do not place/put any objects on top of it.

Foreign bodies and contaminants in the control system!

Risk of damage, wear and malfunctions due to ingress of dirt and foreign particles.

- ▶ During installation, ensure utmost cleanliness in order to prevent foreign particles such as welding beads or metal chips from getting into the hydraulic lines.
- ▶ Before commissioning, make sure that all hydraulic connections are tight and that all seals and closing elements of plug-in connections are correctly installed and not damaged.
- ▶ Take care that no cleaning agents enter the hydraulic system.
- ▶ Do not use cotton waste or linty cloths for cleaning.

Wear!

Wear may lead to malfunctions.

- ▶ Carry out the prescribed maintenance work at the time intervals specified in the operating instructions.

Environmentally harmful hydraulic fluid!

Leaking hydraulic fluid leads to environmental pollution.

- ▶ Immediately remedy any leakage.
- ▶ Dispose of the hydraulic fluid in accordance with the national regulations in your country.

Insufficient pressure!

If the pressure falls below the specified value, damage can occur or the product be destroyed.

- ▶ Make sure that the pressure cannot fall under the prescribed minimum value.

NOTICE

Insufficient hydraulic fluid!

If you commission or operate the SY(H)DFEF control system without or with insufficient hydraulic fluid, the control system is immediately damaged or even destroyed.

- When commissioning or re-commissioning a machine or system, make certain that the housing chamber as well as the suction and working lines of the control system are filled with hydraulic fluid and remain filled during operation.

Corrosion due to water and saltwater

Contact with saltwater leads to increased corrosion at the SY(H)DFEF control system. Thus, mounting screws and plug screws as well as moveable components may be chemically corroded and damaged and thus cause leakage and oil getting into the environment.

- Therefore, take suitable corrosion protection measures, e.g. by applying an anti-corrosion coating.

Damage to the internal memory (flash) caused by acyclic parameter access (write accesses to the flash)!

In the case of acyclic parameter access, data are written to the internal memory (flash), too. This memory, however, only allows a limited number of write accesses.

- For this reason, see to it that such write accesses are not carried out too often (maximum of approx. 100,000 writing cycles).

4 Scope of delivery

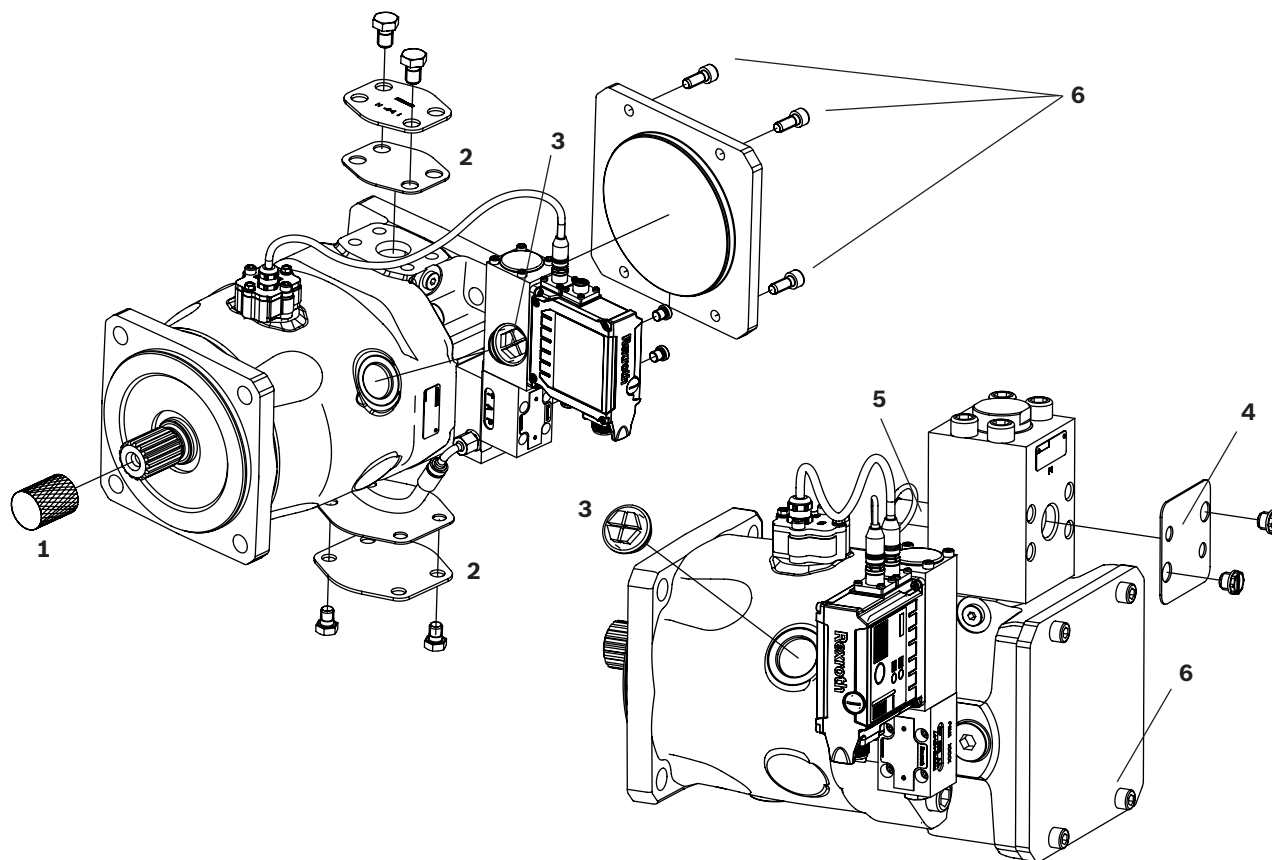


Fig. 1: Control system SYDFEF

The following is included in the scope of delivery:

- 1 control system SY(H)DFEF

When delivered, the following parts are mounted additionally:

- Transport protection for drive shaft end (1) in the case of keyed shaft
- Protective caps (2, 4)
- Plastic plugs/plug screws (3)
- Pressure transducer (optional) (5)
- The connection flange is closed operationally safe with a cover (optionally on variant with through-drive) (6)

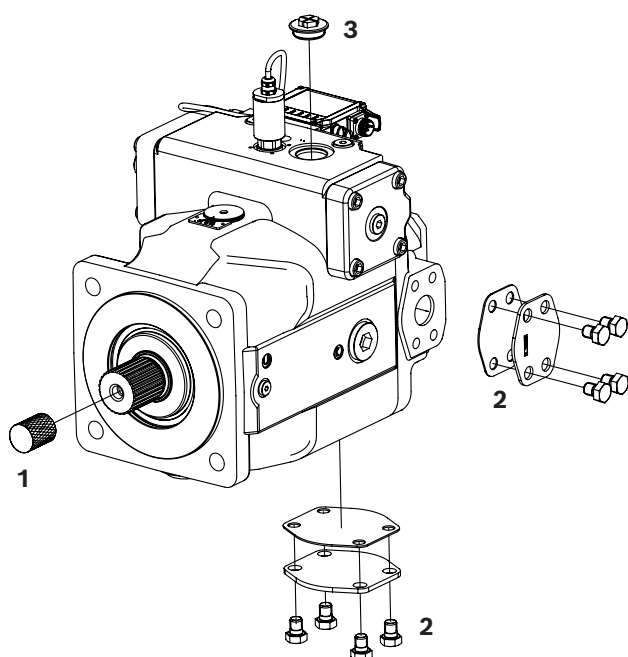


Fig. 2: Control system SYHDFEF

5 Product description

5.1 Performance description

The SY(H)DFEF control system is used for the electrohydraulic control of swivel angle, pressure and power/torque of an axial piston unit. It is intended for stationary applications.

Please refer to the data sheet and order confirmation for the technical data, operating conditions and operating limits of the SY(H)DFEF control system.

5.2 Device description

The SY(H)DFEF control system is based on an axial piston variable displacement pump of swashplate design for hydrostatic drives in the open circuit. The flow is proportional to drive speed and displacement. The flow can be steplessly varied by adjusting the swashplate.

Open circuit

In an open circuit, the hydraulic fluid flows from the tank to the variable displacement pump and is transported from there to the consumer via a directional valve. From the consumer, the hydraulic fluid flows via the directional valve back to the tank. In the regenerative operating mode (see chapter 5.3.4.1 “Regenerative operation“ on page 26) the hydraulic fluid can also flow from the consumer through the pump to the tank.

5.2.1 Functional description, sectional drawing of SY(H)DFEF

In the following description, the numbers in brackets refer to Fig. 3, Fig. 4 and Fig. 5 on page 21 and 22.

The pressure and swivel angle of the A10VSO variable displacement pump of the SY(H)DFEF control system is controlled using an electrically operated proportional valve (2). The proportional valve determines the position of the swashplate (1) by means of the actuating piston (4). The displaced flow is proportional to the position of the swashplate. The counter-piston (3), which is preloaded by a spring (5), is permanently pressurized to pump pressure.

While the pump is not rotating and the actuating system is depressurized, spring (5) holds the swashplate in position +100 %. With a driven pump and a de-energized proportional solenoid (8) the system swivels to zero stroke pressure as the valve spool (9) is pushed to the initial position by the spring (10) and, therefore, pump pressure p is applied to the actuating piston (4) via valve port “A”. A balance between the pump pressure on the actuating piston and the spring force (5) is achieved at a pressure of 8 to 12 bar. This basic position (= zero stroke operation) is obtained e.g. when the valve electronics is de-energized.



In contrast to this, a pump with external supply swivels to the negative limit stop (regenerative operation). See also section 5.3.4.1 “Regenerative operation“ on page 26.

The proportional valve is controlled by digital electronics (11), which is integrated in the valve. This closed-loop control electronics processes all of the control signals required to operate the A10VSO respectively A4VSO variable displacement pump under closed-loop pressure and flow control.

The control electronics receives its command values for pressure, swivel angle and torque limit over the field bus systems (for the selection, see order option 13 in the type code) **(14)**. Alternatively, the command values for pressure and swivel angle can be provided via one analog input each. A pressure transducer can be connected to the central plug **(12)**. Alternatively, an HM20 pressure transducer can be connected to port P of the pump or, if a SYDZ preload valve is used, installed in port MP1 and connected to X2N.

A position transducer with integrated electronics **(7)** fitted to the pump establishes the actual swivel angle value. The acquired actual values are processed in the amplifier and compared with the given command values. A minimum value comparator ensures that automatically only the controller assigned to the desired working point is active. Thereby, a system variable (pressure, swivel angle or torque) is exactly corrected, the other two variables are below the specified command values. The output signal of the minimum value comparator becomes the command value for the valve control loop.

The actual value of the valve spool position is sensed using an inductive position transducer **(6)**. The output value of the valve position controller determines via the amplifier output stage the current through the proportional solenoid **(8)**. As soon as the working point is reached the control spool **(9)** of the proportional valve is held in the centered position.

When the higher-level controllers demand an increase in the swivel angle (increase in flow), the valve spool **(9)** must be moved away from the central position (connection of the actuating piston **(4)** A → T) until the swivel angle has reached the required value. The movement of the valve spool against the force of the spring **(10)** is achieved by a corresponding increase in the electrical current through the proportional solenoid **(8)**.

A reduction of the swivel angle (reduction in flow) is achieved by connecting the actuating piston **(4)** from P → A.

The actuating system of the pump can be supplied with pilot oil in three different ways:

1. Internally, without pre-load valve (only possible for operating pressures >20 bar)
2. Internally, with pre-load valve (operating pressure 0...100 %)
3. External supply via a shuttle valve - automatic switching between internal/external via a shuttle valve sandwich plate! (Refer to chapter 5.3.6 "Internal/external pilot oil", page 29)

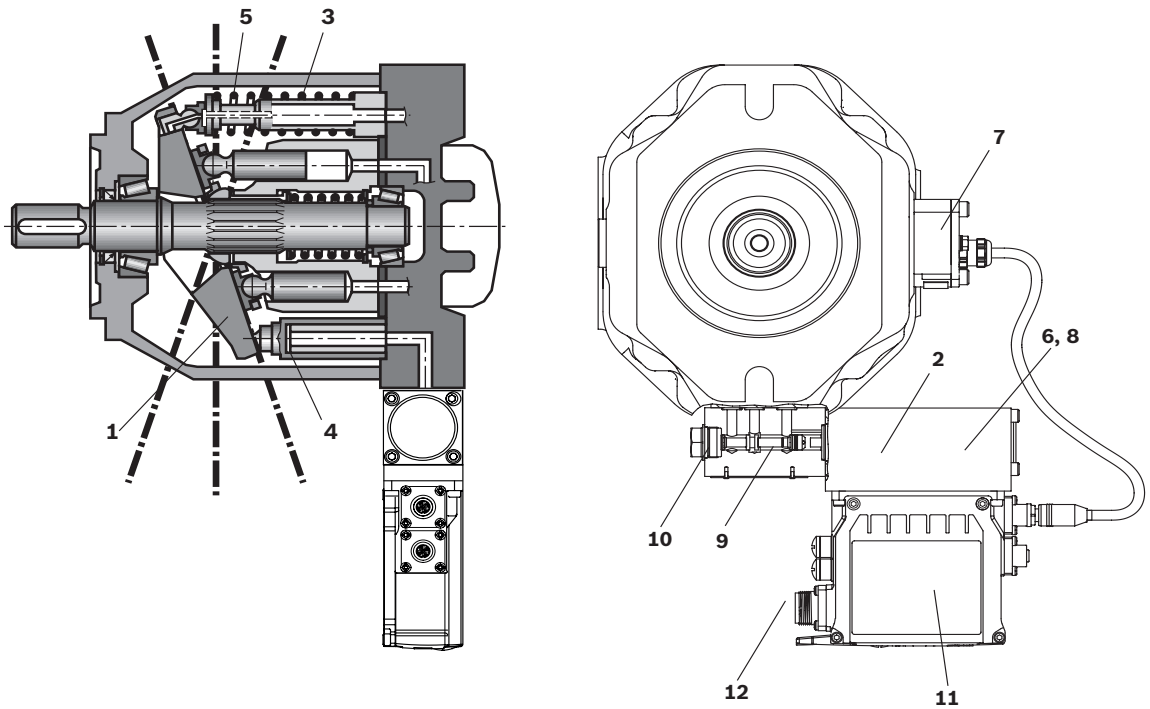


Fig. 3: Sectional drawing of SYDFEF, series 2X

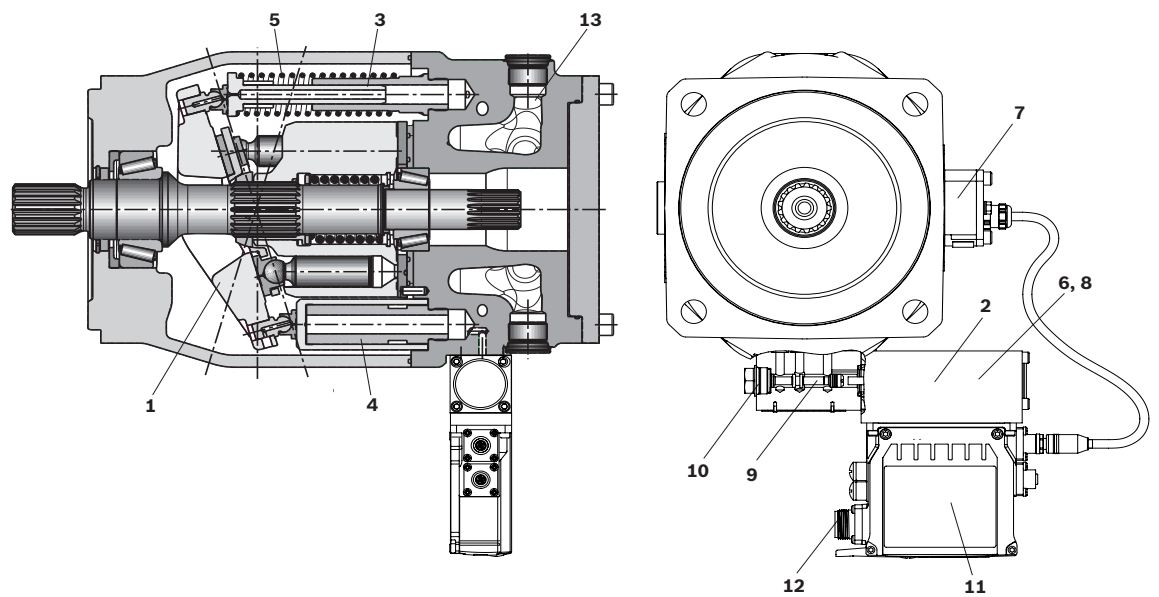


Fig. 4: Sectional drawing of SYDFEF, series 3X

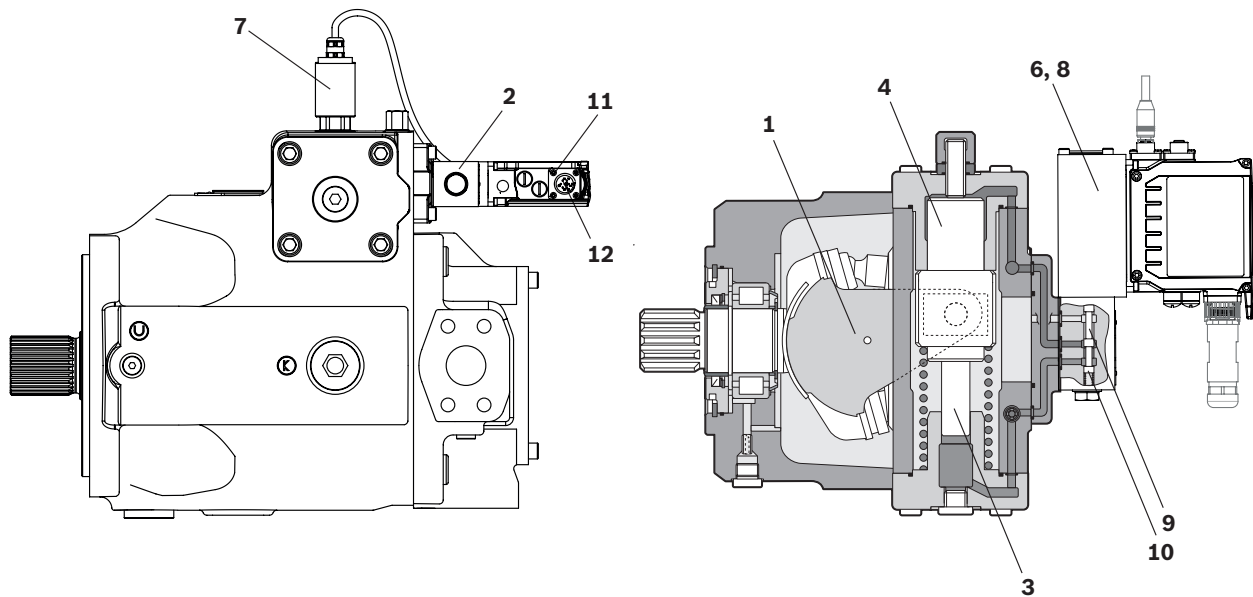


Fig. 5: Sectional drawing of SYHDFEF, series 1X

Item		Item	
1	Swashplate	2	Proportional valve VT-DPPF
3	Counter-piston	4	Actuating piston
5	Spring	6	Inductive position transducer
7	Swivel angle position transducer	8	Proportional solenoid
9	Proportional valve spool	10	Spring
11	Digital electronics	12	Central connector
13	Pre-compression volume PCV		

The sectional drawings above show the mechanical basic position “+100 %“ of the pump (depressurized, drive at rest). This corresponds to the maximum swivel angle of the pump.

Zero stroke pressure: Pressure, which the pump with internal supply generates for its own supply without activation of the pilot valve. The pressure level is usually within the range of 8 to 12 bar. This pressure level can only be achieved when the maximum oil flow, which the pump can deliver, is not exceeded. The pump with **internal supply** automatically swivels in to zero stroke operation after the electric drive was started and when the control electronics is de-energized, provided that the required pilot pressure can build up (consumer line is closed).

In contrast to this, the pump with **external supply** swivels in to the **negative limit stop “-100 %“**!

NOTICE! Cavitation of the pump!

Risk of damage to the pump in the case of systems with external supply.

- To prevent damage to the pump, provide a pressure relief/anti-cavitation valve for systems with external supply. If a fault occurs during operation - not during start-up - the motor must be switched off.

5.3 Control of the SY(H)DFEF control system

Basic operating modes

Up to two controllers are continuously active in the possible operating modes:

- Swivel angle controller
- Pressure controller

These controllers alternate automatically and jerk-free through the changeover logic.

In general, for the transition of a system from a given initial state to a given final state, a fast transition and steady state are envisaged. To meet this requirement, various control algorithms are used in closed-loop control technology.

The digital control SY(H)DFEF is provided with 4 controller parameter sets for optimum adjustment to the system-specific requirements. For this purpose, up to 4 instances of the parameters relevant for controlling are created in the HydraulicDrive after the relevant controller parameter set was activated. The setting of the individual controller parameters depends on the control properties of the entire system. The following factors must be taken into account for this:

- Hydraulic structure of the system (e.g. piping, branches)
- Connected oil volume

5.3.1 Structure of the control

The following control structure is used in the HydraulicDrive:

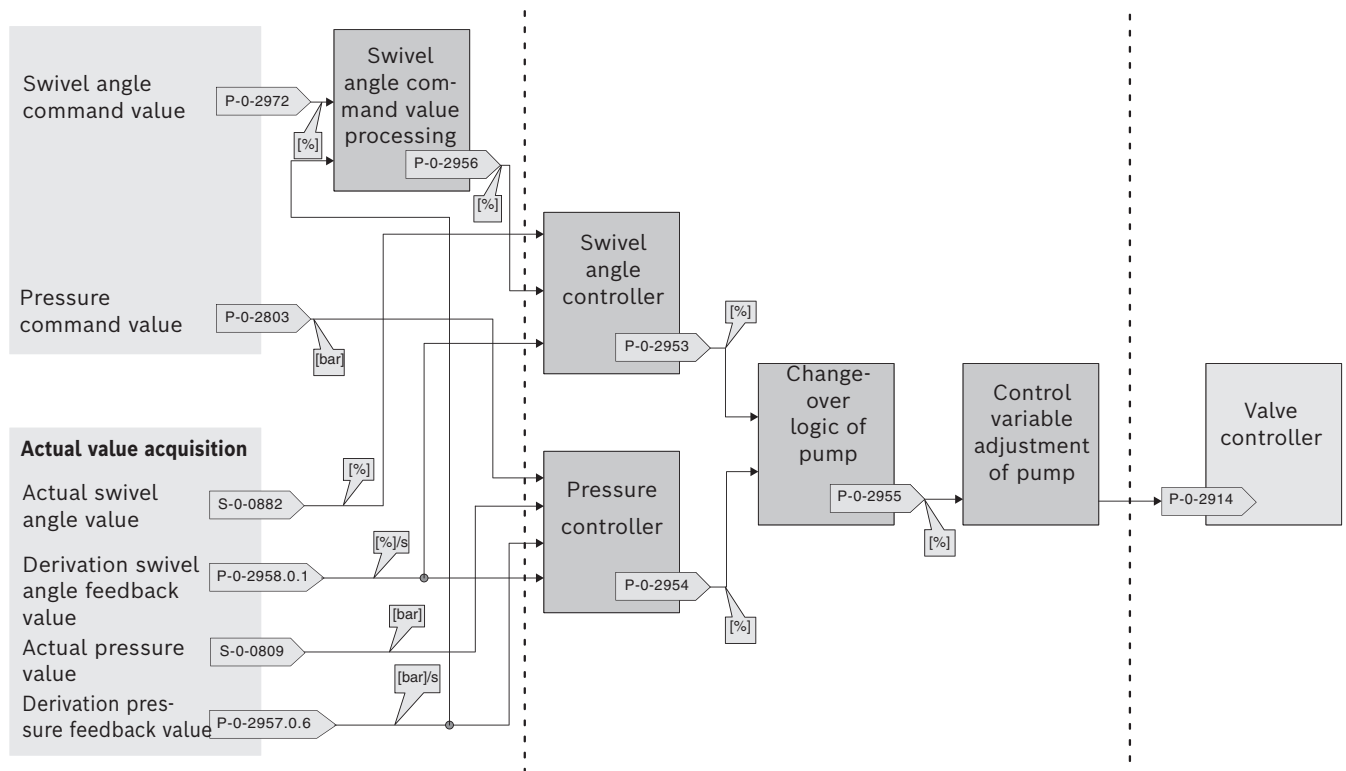


Fig. 6: Overview of controllers in parallel structure

The parallel structure with pressure controller and swivel angle controller is called in the operating mode “pressure/swivel angle control” or “pressure/flow control”. The swivel angle command value is adjusted in swivel angle command value processing, before it is fed to the actual swivel angle controller. In pump control the pressure and the swivel angle controller are simultaneously active and both generate an actuating value. In standard cases, the changeover logic of the pump passes on the smallest control variable of both controllers (minimum value comparator function). This minimum value comparator ensures that always only one of the two variables of pressure or swivel angle is used for controlling and that it is possible to switch between the two control types. The output variable of the pump changeover logic can be modified using various characteristic curves and functions in output adjustment of the pump before the variable is handed over to the valve controller as valve command value. Apart from the parallel structure, the pump controller offers a further control concept, the cascade structure, which can be activated as required.

5.3.2 Controller parameters

The following controller parameters are involved in pressure and swivel angle control in the parallel structure:

Table 6: Controller parameters

Description of the controller parameter	Parameter number
Pressure controller P-gain 1 positive	P-0-2963
Pressure controller P-gain 1 negative	P-0-2964
Pressure controller pos. factor for D-component, parallel	P-0-2969
Pressure controller neg. factor for D-component, parallel	P-0-2970
Pressure controller time constant swivel angle feedback	P-0-2971
Gate time derivation actual pressure value 1 or A	P-0-2960
Gate time derivation actual pressure value 2 or B	P-0-2979
Swivel angle controller P-gain	P-0-2977
Swivel angle controller time constant D-component	P-0-2978
Time constant for feedback of act. pressure value derivative	P-0-2974
Filter time for feedback of actual pressure value derivative	P-0-2973

After the extended pressure controller with inflected characteristic curve was activated, the following controller parameters are active additionally:

Table 7: Controller parameters

Description of the controller parameter	Parameter number
Pressure controller P-gain 2 positive	P-0-2965
Pressure controller P-gain 2 negative	P-0-2966
Pressure controller control deviation threshold positive	P-0-2967
Pressure controller control deviation threshold negative	P-0-2968

5.3.3 Controller parameter sets

The SY(H)DFEF offers the possibility of configuring and using up to four different parameter sets. With the help of these parameter sets the control behavior of the SY(H)DFEF can be optimized to suit different connected oil volumes. The following table lists various settings as guideline for the controller parameters in conjunction with different oil volumes:

Table 8: Controller parameters for different oil volumes

Controller parameters	Oil volume [l]	Universal (default setting)	0 l	1 l	2.5 l	5 l	7.5 l	10 l
Pressure controller P-gain 1 positive (P-0-2963)		2.8	2.8	4.3	4.3	4.7	5	4.3
Pressure controller P-gain 1 negative (P-0-2964)		2.8	2.8	4.3	4.3	4.7	5	4.3
Pressure controller pos. factor for D-component, parallel (P-0-2969)		0.19 s	0.04 s	0.2 s	0.31 s	0.41 s	0.44 s	0.45 s
Pressure controller neg. factor for D-component, parallel (P-0-2970)		0.23 s	0.04 s	0.2 s	0.31 s	0.41 s	0.44 s	0.45 s
Pressure controller time constant swivel angle feedback (P-0-2971)		0.07 s	0.04 s	0.07 s	0.07 s	0.075 s	0.05 s	0.06 s
Gate time derivation actual pressure value 1 (P-0-2960)		22.5 ms	13.5 ms	13.5 ms	22.5 ms	22.5 ms	22.5 ms	22.5 ms

Controller parameters	Oil volume [l]	12.5 l	15 l	20 l	25 l	30 l	40 l
Pressure controller P-gain 1 positive (P-0-2963)		4.4	4.4	3.8	3.6	3.6	3.5
Pressure controller P-gain 1 negative (P-0-2964)		4.4	4.4	3.8	3.6	3.6	3.5
Pressure controller pos. factor for D-component, parallel (P-0-2969)		0.52 s	0.535 s	0.59 s	0.68 s	0.7 s	0.72 s
Pressure controller neg. factor for D-component, parallel (P-0-2970)		0.52 s	0.535 s	0.59 s	0.68 s	0.7 s	0.72 s
Pressure controller time constant swivel angle feedback (P-0-2971)		0.07 s	0.07 s	0.07 s	0.07 s	0.07 s	0.07 s
Gate time derivation actual pressure value 1 (P-0-2960)		22.5 ms	22.5 ms	22.5 ms	22.5 ms	22.5 ms	22.5 ms

5.3.4 Special operating modes

This chapter describes certain applications. In these cases, the basic operating modes (see page 23) are active.

Starting up at zero pressure

For starting up SY(H)DFEF systems, no hydraulic circuit needs to be provided for the classical start-up at zero pressure.

When small command values for pressure and swivel angle are provided, starting up under almost no-load conditions is possible.

Circulation operation (by-pass filtration, cooling)

In the case of systems with internal supply and without pre-load valve, hydraulic circulation circuits must be dimensioned so that a minimum pressure of between 8 and 12 bar is available, because the pump requires this pressure level to be able to respond to electrical control signals.

Stand-by operation

Operating mode of the pump, in which an operating point is steadily closed-loop-controlled with a corresponding command value over a longer period of time.

Observe the notes on permitted pressures in chapter 5.3.6 "Internal/external pilot oil" (page 29).

Zero stroke operation

Operating mode of the pump that refers to the smallest achievable swivel angle and to which the pump usually changes over when no closed-loop control is active. Zero stroke operation can be definitely achieved only by means of a minimum command value feedforward in the closed swivel angle control loop.

The feedforward of "0 bar" via the pressure command value branch is not permitted. This is valid for both, actuating systems with internal and external supply.

The following is valid when the valve electronics is de-energized:

- Zero stroke operation for the internally supplied pump
- Swiveling out to "-100%" of the externally supplied pump

5.3.4.1 Regenerative operation

Regenerative operation is a special operating mode of the SY(H)DFEF control system, since in this case the SY(H)DFEF control system is operated as both, generator and motor.

Continuous regenerative operation

We can distinguish between continuous regenerative operation and brief regenerative operation. In the first case, by this we understand coupling of the variable displacement pump with a fixed displacement pump. Here, the two pump displacements are fed together to a common consumer.

This operating mode can be utilized in conjunction with a fixed displacement pump in order to increase the displacement. To achieve “zero” displacement, the closed-loop-controlled pump must “take over” the entire flow from the fixed displacement pump and therefore swivels to the negative swivel angle range (motor operation). It must be noted here that both pump sizes must be matched to each other so that the controlled pump (in regenerative operation) must swivel in to max. –70 %. The fixed displacement pump should be mounted to a through-drive of the SY(H)DFEF control system.

The following pump variants are available for continuous regenerative operation:

0487: Continuous regenerative operation with external supply

0541: Continuous regenerative operation without external supply (for SYDFEF-3X only)



The operating mode “regenerative operation with external supply” is somewhat complicated in terms of design and commissioning, because a pump swiveling in too far (e.g. -75 % instead of -70 %) causes cavitation.

We therefore recommend master/slave operation as an alternative with two closed-loop controlled SY(H)DFEF systems or a pump variant designed for continuous regenerative operation without external supply (SO 0541 in the case of SYDFEx-3X).

Continuous operation is possible when the given operating limits are adhered to. However, at a total displacement of “zero” (that is, at a negative swivel angle of the SY(H)DFEF pump) and at high pressures, the noise level increases and efficiency deteriorates.



For working points with a negative swivel angle of the control pump, continuous regenerative operation features a poorer overall efficiency than a comparable master/slave pump system or a comparable single pump. In the case of an energy-saving machine, continuous regenerative operation would reduce the energy-saving effect. A comparable master/slave pump system or a comparable single pump would provide higher energy savings in such an application.

For pumps with external supply, the use of a pressure relief and anti-cavitation valve as shown below in Fig. 7 is indispensable to prevent the pump’s running dry.

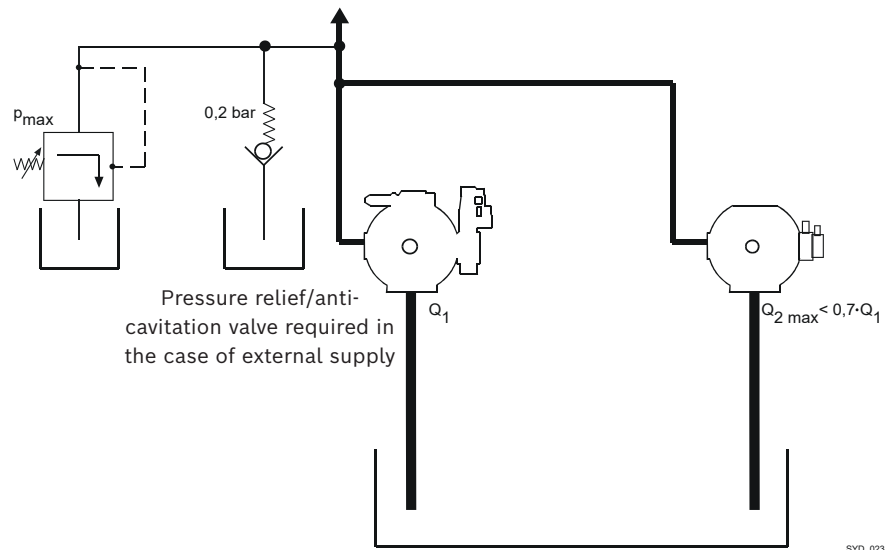


Fig. 7: Circuit diagram for continuous regenerative operation

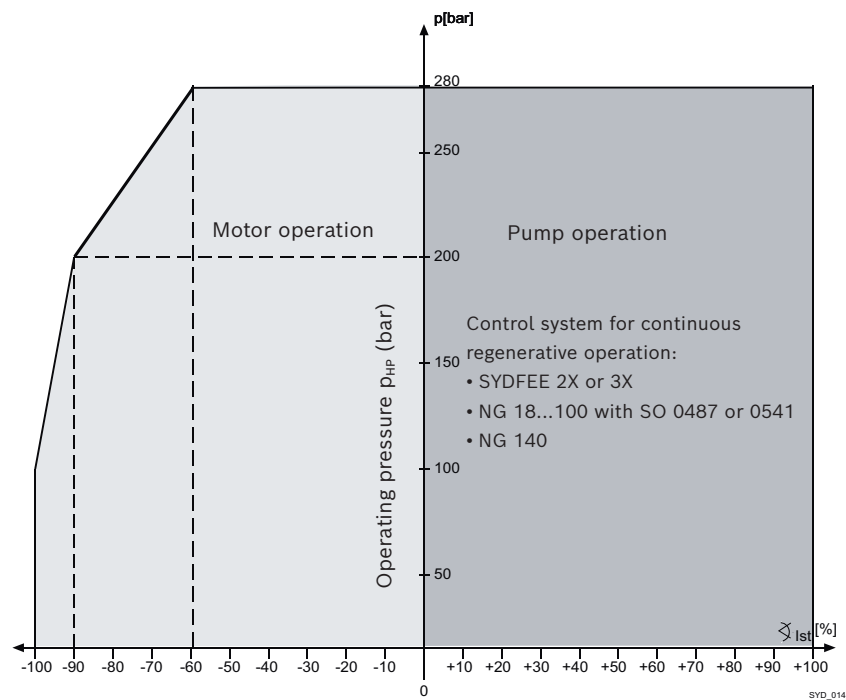


Fig. 8: Operating limits for continuous regenerative operation for series SYDFEF-2X and SYDFEF-3X for special rotary groups

Brief regenerative operation

During brief regenerative operation the variable displacement pump changes over to motor operation for a limited period of time, e.g. for pressure unloading or for lowering a load. If the requirement profile remains within the limits according to Fig. 9, the standard version of the pump with standard rotary group 0000 or 0479 can be used.

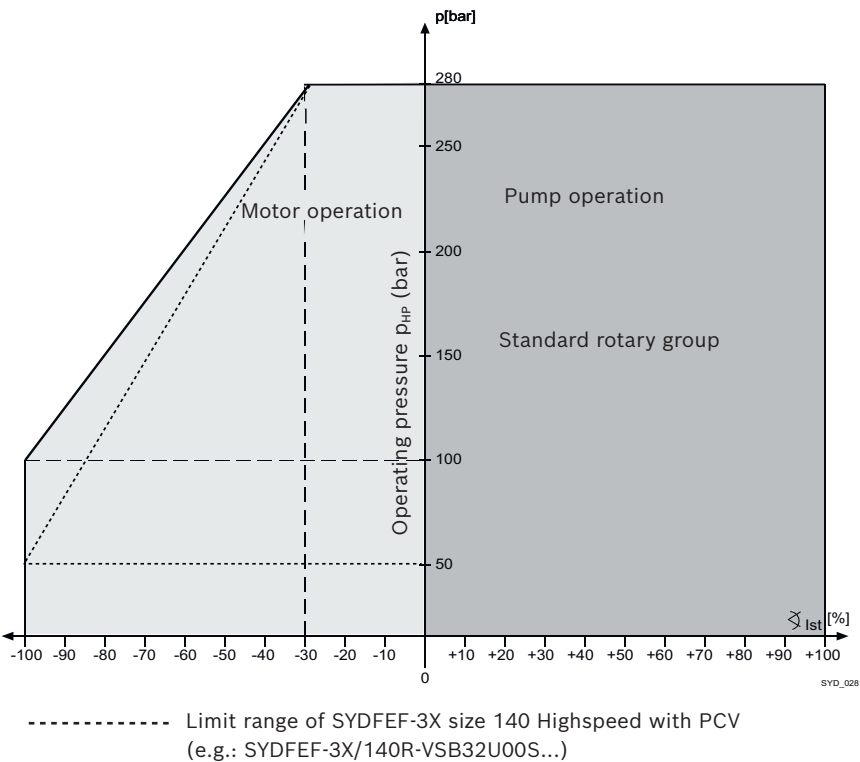


Fig. 9: Operating limits for continuous regenerative operation for series SYDFEF-2X and SYDFEF-3X for standard rotary groups

**Regenerative operation
for SYHDFEF-1X**

With series SYHDFEF-1X we do not differentiate between brief and continuous regenerative operation. The operating limits are shown in Fig. 10; otherwise observe the notes given on continuous regenerative operation and brief regenerative operation on the previous pages.

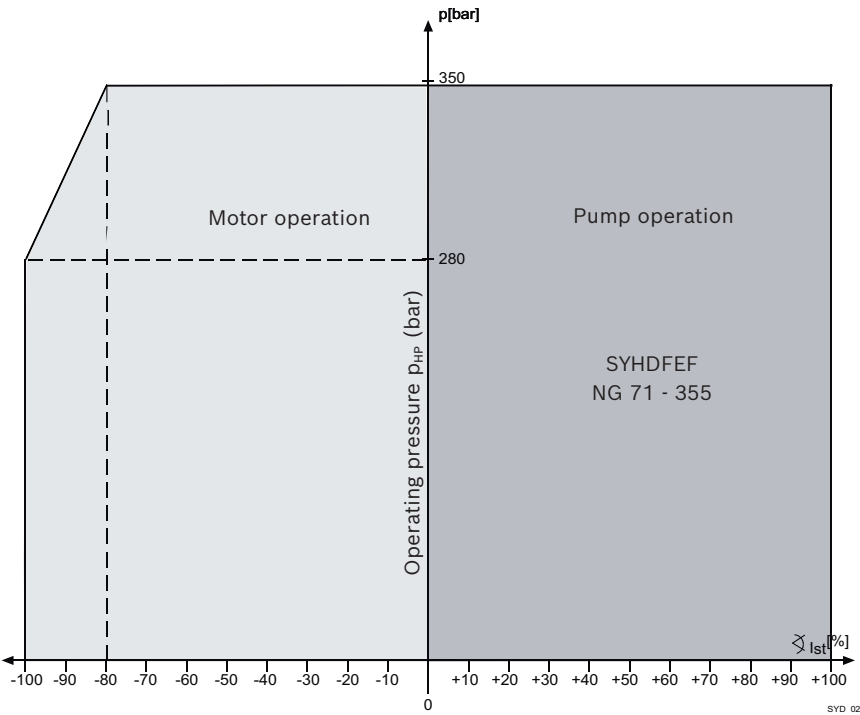


Fig. 10: Operating limits for SYHDFEF

5.3.5 Operating pressure limits

WARNING

Forcefully ejected parts and hydraulic fluid jet!

Risk of severe injury! The electrical pressure control does not assume a pressure relief function.

- ▶ Make certain that the maximum operating pressure is not exceeded.
- ▶ If a pre-load valve is installed, you can use its pressure relief function. If no pre-load valve is provided, install a pressure relief valve in the pressure line, the pressure setting of which is 10 % (recommended) higher than the operating pressure. Operating the system without this valve can lead to malfunction.

Maximum operating pressure

The maximum operating pressure specified in the data sheet must not be exceeded.



At a pressure of ≥ 250 bar the following restrictions must be observed for SYDFEF (**not for SYHDFEF**):

- The pressure transducer must be located downstream of a pulsation damper or the high-pressure hose.
- When a standard pilot valve spool is used (version "A"), the pressure controller P-gain may have to be reduced. This has an influence on the accuracy and dynamics of the closed pressure control loop.

Minimum operating pressure

The minimum operating pressure depends on the pilot oil supply and is explained in more detail in the following chapter.

5.3.6 Internal/external pilot oil

Internal pilot oil supply

If the operating pressures of the application are always >20 bar, the version with internal pilot oil supply should be selected, because no cavitation due to too small command values can occur with this version.

Operation is also possible at pressures higher than approximately 12 bar, but dynamics is restricted within the range below 20 bar.

This minimum (pilot) pressure level ensures that the pump can respond to the electrical swivel signal at any time. When the consumer line is blocked, the smallest achievable steady-state swivel angle is the zero stroke angle.

For applications, in which lower operating pressures occur or are to be controlled, a pre-load valve (SYDZ for SYDFEF) can be used. For this solution, the minimum pressure is ≥ 1 bar

Pre-load valve

The advantage of the pre-load valve is that the pilot oil pressure of the pump cannot fall below the value preset on the pre-load valve and that pressures ≤ 12 bar on the output side can be continuously controlled.

Being equipped with a pre-load valve the pump cannot permanently swivel back over zero, irrespective of electrical actuating signals or any control errors. The smallest achievable swivel angle during steady-state operation therefore is the zero stroke. This is not valid for applications, in which, for example, a suspended load can cause operating pressures ≥ 12 bar. In such cases the pump can also be used

in motor operation (for lowering the load). A check valve integrated in the pre-load valve permits, within certain limits, a reversal of the direction of oil flow.



When using pump combinations

- NG45 with 45/28/18 or
- NG28 with 28/18 or
- NG18 with 18

In conjunction with the SYDZ pre-load valve on the main pump, there is a mechanical conflict between port “P1” of the pre-load valve and the swivel angle transducer housing of the built-on rear pump. For this reason, we suggest that the main pump of the above combinations be equipped with an SAE flange plate $\frac{3}{4}$ “ (NG28) or 1“ (NG45) having a height of $h = 45$ mm. The construction height of the pump assembly therefore changes by dimension “h”.

External pilot oil supply

An additionally built-on sandwich plate with shuttle valve automatically switches the pilot oil supply between the internal or external pilot oil source, with always the higher pressure level being selected.

A pump with external pilot oil supply can be recognized by

- the sandwich plate mounted below the pilot valve and
- the hose routed around the pump case.

With external pilot oil supply, the actuating system of the SY(H)DFEF pump works independently of the actual high-pressure circuit, thus allowing an adjustment also below an operating pressure of 12 bar within the range of “ ± 100 %” (change in the direction of displacement!).



When the control electronics is deactivated, the pump swivels to position “-100 %” (motor operation) in an uncontrolled manner. This can lead to cavitation and damage to the pump.

For this reason, special features are to be provided such as a pressure relief and anti-cavitation valve as well as swivel angle actual value monitoring.

The pressure relief and anti-cavitation valve diminishes the risk of the pump’s running dry, which results in a reduction in the pump’s service life.

The actual swivel angle value monitor could, for example, switch off the entire drive or selectively shut off the pilot oil flow.

The following is valid for the actuating pressure:

SYDFEF: Pilot oil pressure $\leq$ minimum operating pressure + 30 bar

SYHDFEF: max. 50 bar

Recommendation: Absolute pilot oil pressure ≈ 20 bar



Further notes on the operation with external supply:

- In the case of external supply, the pump does not swivel to zero stroke when the pilot valve is de-energized.
- Command values for pressure and flow must always be greater than 1 bar or 5 %, because there is no exact “zero” pressure or “zero” swivel angle due to drift or inaccurate settings. For this reason, selections equal to zero or only slightly greater can lead to cavitation in the worst case.
- In order to ensure sufficient lubrication for the pump system at all times, the actual pressure value must not be less than 10 bar for longer than 10 minutes!

Notes on dimensioning

At a pilot oil pressure of 20 bar the brief pilot oil requirement during swiveling is ca. 17 l/min, at 50 bar it is ca. 25 l/min. In practice, this amount of pilot oil is needed only, if the operating pressure is less than 20 bar during the entire swiveling process and thus the entire pilot oil demand must be supplied by the external source.

In the steady-state, balanced condition, the pilot oil requirement is less than 1 l/min. Experience has shown that, depending on the operating pressure and swiveling frequency, the actual pilot oil demand is in the order of 5...15 l/min. In the case of external pilot oil supply, the pump size may be reduced by installing an accumulator.

5.4 Ambient conditions**5.4.1 Oil-immersed applications**

Only the SY(H)DFE1 control system is suitable for oil-immersed applications. SY(H)DFEx systems with integrated electronics must not be immersed.

5.4.2 Ambient temperature

The permissible maximum ambient temperature for SY(H)DFEF control systems is 60 °C. Strictly observe the data in the valid RE data sheets for SY(H)DFEF control systems.



We recommend the installation within a ventilated area with moved ambient air, e.g. in the air flow of an electric motor.

This is valid in particular in view of the place of installation of the integrated on-board electronics.

5.5 Notes on the selection of hydraulic fluids

The SYDFEF control system is designed for operation with hydraulic fluids in accordance with DIN 51 524 (HL/HLP). The use of HFC is permitted only for SYHDFEF.

- Adhere to all limits specified in the data sheet regarding temperature, viscosity, cleanliness of the hydraulic fluid.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) be within the following range, which is optimum in terms of efficiency and service life:

- Select v_{opt} = optimum operating viscosity 16...36 mm²/s.

This range is referred to the tank temperature in the open circuit.

Viscosity limits

The following values are valid for limiting operating conditions:

- v_{min} = 10 mm²/s

Briefly, at max. permissible case drain oil temperature of 90 °C

- v_{max} = 1000 mm²/s

Briefly, during cold start

Temperature range

The temperature of the hydraulic fluids lies between the following values: (cf. selection diagram)

- t_{min} = -20 °C

- t_{max} = 70 °C

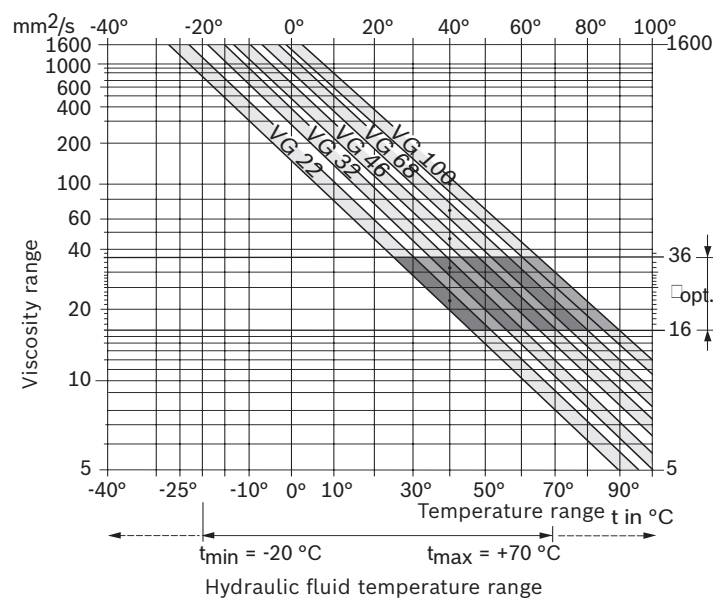


Fig. 11: Selection diagram for the hydraulic fluid



Notes on the selection:

In order to be able to select the correct hydraulic fluid, the operating temperature in the tank (open circuit) in relation to the ambient temperature must be known.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity is within the optimal range (v_{opt}). This range is shown as gray area in the selection diagram.

We recommend that you select the next higher viscosity class.

Example:

At an ambient temperature of X °C, the resulting temperature in the tank is 60 °C. Within the optimum operating viscosity range (v_{opt} ; gray area) this corresponds to viscosity classes VG 46 and VG 68. You should select: VG 68.



The case drain oil temperature, which is subject to the influence of pressure and pump revving speed, is always higher than the tank temperature. However, the temperature must not exceed 90 °C at any point in the system.

If the conditions described above cannot be complied with due to extreme operating parameters or high ambient temperatures, please consult us.

Filtration of the hydraulic fluid

The finer the filtration of the hydraulic fluid, the better is the achieved cleanliness class, which, in turn, prolongs the service life of the SY(H)DFEF control system. To ensure functional reliability of the SY(H)DFEF control system, the hydraulic fluid must comply at least with cleanliness class 18/16/13 according to ISO 4406 (for particle sizes 4/6/14 μm).

5.5.2.1 HFC fluids

The use of HFC fluids is permitted only for SYHDFEF control systems with option "F". For applications with HFC fluids, it must be noted that, due to the reduced lubrication ability of HFC fluids, the service life of the SYHDFEF control system is reduced compared with the standard application.

For applications with HFC fluids, the 4-groove spool has to be used for the pilot valve. The spool is identified by "C" in the ordering code of the SYHDFEF control system.

For commissioning pump systems that are operated with HFC fluids, please read the relevant commissioning instructions (among others, RE 92053), which are available as separate documents.

5.6 Noise generation

Compared to, for example, vane pumps, axial piston pumps generate greater changes in flows and thus pressure pulsations for design-inherent reasons. Apart from the propagation of air and structure-borne noise, this can have an influence on fluid-borne noise. In the end, these factors together result in the general perception of "noise". Noise often induces vibration on other components, which, in turn, also generate noise. For example, on check valves possibly used in the system, the integrated springs may have to be adapted to the conditions of the systems, if this is a cause of excitations leading to the generation of noise.

5.6.1 Generation of noise in the power unit

"Noise" is composed of various elements. The total "noise" is influenced not only by air-borne noise, but also by structure- and fluid-borne noise.

As a result of unfavorable installation and piping conditions, the noise pressure level of the complete system can be 5 to 10 dB(A) higher than the value of the pump alone.

Noise can be reduced by taking, for example, the following measures:

- Low-noise tank
- Damping ring between pump and pump mounting bracket
- Flexible pipe conduit
- Anti-vibration rails under the motor
- Installation of the pump at a sufficient distance to the tank wall

5.6.2 Pulsation damper

For some special applications, we recommend the use of a pulsation damper. Due to the reduction of typical pump pressure pulsation, this has a positive effect on the noise level of the hydraulic system as a whole.

Further information can be found in data sheet RE 50142.

5.7 Shaft variants

The SY(H)DFEF control system is available with keyed or splined shafts. Compared with the keyed shaft, the splined shaft is not only advantageous with regard to its degrees of freedom during assembly and operation, but also due to its increased torque load carrying capacity and its stability under changing loads.

This is advantageous in particular when pump combinations are to be installed. In the case of multiple pumps, all built-on units are fitted with splined shafts.

In view of the dynamic load carrying capacity and standardization, we recommend the use of standard types with splined shafts. This offers advantages with regard to availability and future spare parts requirements.

When a splined shaft is selected, a clamp coupling must be used for the mechanical connection to the electric motor. Otherwise, frictional corrosion may occur that leads to damage to the pump.

Notes on the transmission of permissible maximum torques can be found in the data sheet.

Keyed shaft Due to the advantages of the splined shaft, keyed shafts are not recommended for new applications. The keyed shaft is no longer used for applications with through-drive.

If a single pump is to be used later as “end pump” in a multiple-pump system, a splined shaft must be selected.

Splined shaft Splined shaft profiles depend on the size (NG) of the pump. Two different splined shaft profiles are therefore available in conjunction with SY(H)DFEx:

5.8 Spool variant of pilot valve VT-DFFP-X-1X

The standard spool according to the ordering code is spool type “A” (360° spool). The 4-groove spool of type “C” is also allocated to SYHDFEF as standard for applications using HFC media.

5.9 Master/slave operation

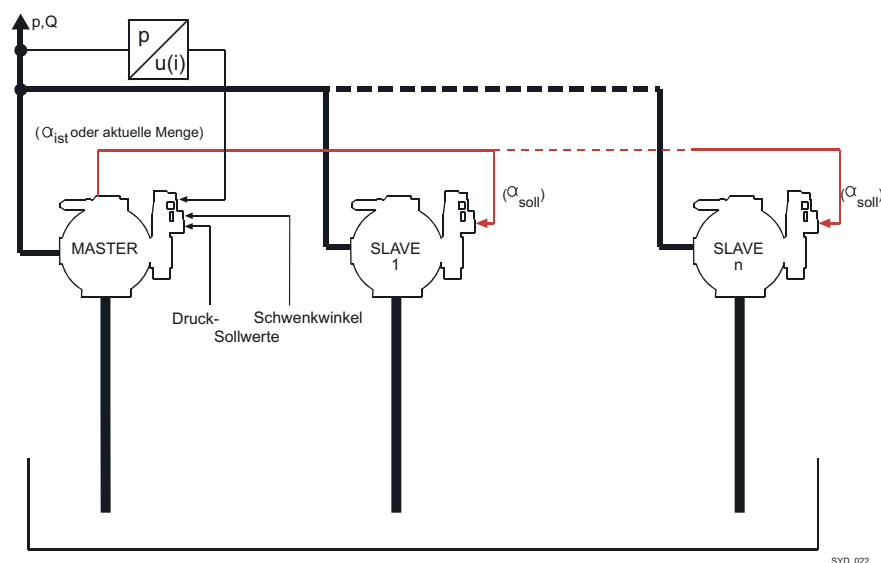


Fig. 12: Hydraulic coupling of SY(H)DFEF control systems

Theoretically, an optional number of SY(H)DFEF control systems can be hydraulically coupled to achieve greater flows.

In this case, it is just required to determine a master pump to which the pressure transducer has to be connected.

The master then controls both, pressure and swivel angle, in accordance with the externally provided command values and passes its actual swivel angle value on to the slave pumps. Based on this input the slave pumps calculate their own swivel

angle command value. This ensures smooth and synchronous swiveling of the pumps.

The command values for the master and the slave pumps are provided digitally via master communication. To this end, the actual swivel angle value of the master pump has to be read in by the field bus master and transmitted to the slave pumps as swivel angle command value.

5.9.1 Circuitry of SY(H)DFEF

Signal transmission via a field bus system is standard for master/slave operation of the SY(H)DFEF. In this case, the field bus master in the machine control has to send the pressure and flow command values to the master pump and read the actual swivel angle value of the master pump. This actual swivel angle value of the master pump has to be sent to all slave pumps as swivel angle command value. You can find more detailed information on this system in the functional description of the HDx firmware in chapter 7.3.4 “Common functions” in the sub-section “Master/slave function”. In conjunction with data transmission over field bus, please note that data are transmitted from the master to the slave in 2 - 5 ms. If this cannot be achieved, the workaround with analog signals shown below may be used.

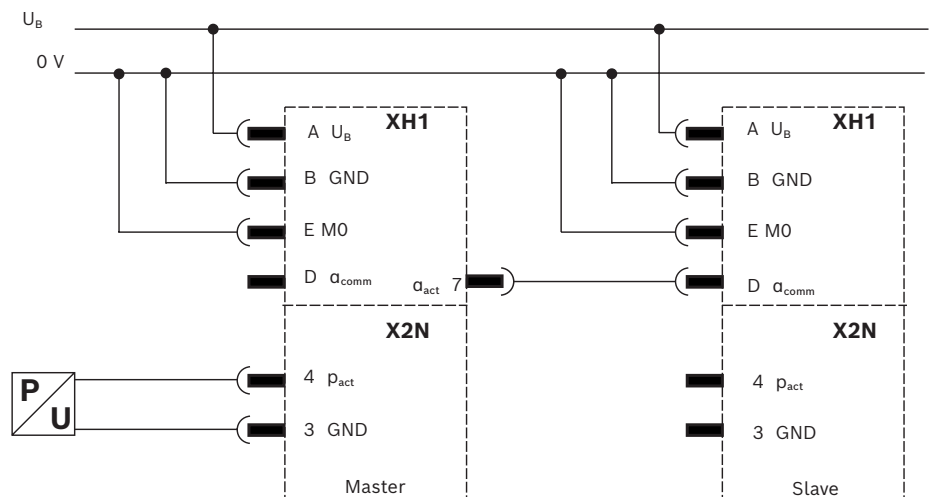


Fig. 13: Workaround in case of slow data transmission - circuitry of SY(H)DFEF for master/slave operation (analog)



- For configuration of analog and digital command value provision, see the functional description of HydraulicDrive
- The connection for the position transducer of the pump is not drawn here.
- If closed-loop pressure control is to be realized also in the master/slave operating mode, only the pressure transducer of the master is evaluated for controlling purposes. If hydraulically separated operation should be possible, too, a separate pressure transducer is required for the slave.

5.9.1.1 Changing over to master/slave operation (analog)

Starting point

For analog master/slave operation the actual swivel angle value S-0-0882.0.0 (or, in case of cascade structure, P-0-2992) has to be assigned to analog output 1. On the slave, P-0-2935 has to be assigned to analog output 1. This ensures that the swivel angle command value is transmitted from the master to the slave in analog form as shown in Fig. 13.

- Shortly **before** the changeover takes place, switch both pumps to pressure control (low, identical pressure level), while they are hydraulically still uncoupled from each other. Approximately identical actual swivel angle values would be optimal. The two flow command values (usually 100 %) still are provided by the control.



Connect M0 and GND in the control cabinet to prevent potential shifts. When a pre-load valve is used, the pump with the pre-load valve should preferably be the master pump.

Changing over to master/slave operation

At low operating pressure, bit 5 is to be set in pump controller control word P-0-2950 in the slave pump to switch the pump to the slave mode. In a next step, the hydraulic short-circuit valve (connection of the previously separated pressure circuits) can also be activated. The activation of this valve may have to be delayed depending on whether this would improve the system characteristics in the changeover process (the activation would also be conceivable with a hydraulic switching delay).

Deactivating master/slave operation

In the master/slave operating mode it is also useful that the control keeps the two swivel angle command values for the master and the slave pump synchronized in order that striking differences in the signal level are prevented when the swivel angle command value source for the slave pump is switched (from actual swivel angle value of the master pump back to swivel angle command value over field bus).

The pressure command value of the slave pump should be set to the same level as that of the master pump before the slave pump is changed over to individual operation (jerk-free changeover). Switching is accomplished by separating the two pressure circuits and then deleting bit 5 in pump control word P-0-2950 on the slave pump.

5.10 Description of the commissioning tool IndraWorks

The SY(H)DFEF control system can be configured and parameterized in two different ways:

1. Connection to an Ethernet-based field bus system. (For the selection of the possible systems, see type code in the data sheet).
2. Use of the Bosch Rexroth software IndraWorks. For the SY(H)DFEF system, IndraWorks version 14V24 or a higher version must be used.

The IndraWorks Ds software is available free of charge on the Rexroth website in the section "SY(H)DFEF".

<http://www.boschrexroth.com/sydfef>

5.10.1 System requirements

The system requirements and supported operating systems for IndraWorks are described in the commissioning manual R911344286 "Software Installation". You can download the installation notes in the Media Directory or on the Rexroth website <http://www.boschrexroth.com/indraworks> in the section "IndraWorks".

5.10.2 Firmware update

CAUTION

Uncontrolled movements of the drive!

Risk of injury! All data in the control are overwritten and a software reset is executed on the control.

- Switch the drive motor off! A software reset corresponds to a power-on reset of the control and may only be carried out when the system is in a safe condition.

Current firmware is made available by Rexroth together with the project files. New firmware can be transmitted to the control under menu item "Service" -> "Firmware management".

Current firmware projects can also be downloaded from the Rexroth website in the section "SYDFEF" under "Download": <http://www.boschrexroth.com/sydfef>

5.11 Switch-on sequence of electronics/hydraulics

Due to various monitoring routines implemented in the electronic assemblies, fault messages may be generated in the case of an unfavorable order of switching on. These error messages cause uncertainties, although they have no "real" cause of fault.

In principle, it is valid that all SY(H)DFEF control systems that are provided with internal pilot oil supply automatically swivel to the operationally safe zero stroke position in the event of a power failure. However, a precondition for zero stroke is a minimum pressure between 8 and 12 bar, which the pump has to build up as pilot pressure. This can always be ensured, when no oil can flow away from the pump output (e.g. actuator line hydraulically blocked).

Observe the special case of suspended loads!

Order of switching the digital SYDFEF electronics on/off

Switching on

1. Voltage supply of the electronics
2. Set controller enable
3. Switch motor on
4. Open check valve (if provided)
5. Suppress warnings until target speed has been reached

Switching off

1. Command value provision: $a_{comm} = 5\%$ and $p = 10\text{ bar}$
2. Close check valve (if provided)
3. Suppress warnings
4. Switch el. motor off
5. Switch voltage supply of electronics off

5.12 Identification of the product

All SY(H)DFE control systems can be identified on the nameplate. The figure below shows an example of a SY(H)DFEE nameplate

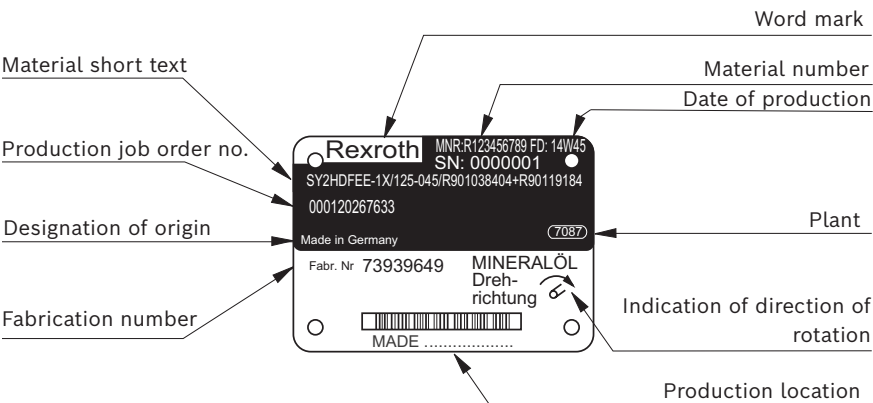


Fig. 14: Nameplate



For queries with regard to the pump combination you must indicate the material number and the fabrication number.

6 Transport and storage

WARNING

Non-secured hydraulic components toppling over or falling down!

An unsecured SY(H)DFEF control system can topple over or fall down and, in the case of heavy weight, bruise or strike persons dead.

- ▶ Use the original packaging for transport.
- ▶ Ensure a stable position during transport to the place of installation.
- ▶ Before it is completely installed, handle and secure the SY(H)DFEF control system at the lifting eyes provided for this purpose, and not at parts of little stability such as solenoids, connectors and cables.
- ▶ Use only suitable lifting gear for handling.
- ▶ Wear personal protective equipment.
- ▶ Comply with the national laws and regulations regarding occupational health and safety and transport.

6.1 Transporting the SY(H)DFEF control system

Transport the SY(H)DFEF control system by means of a fork lift truck or suitable lifting gear observing the safety instructions.

Weights

Table 9: Weights

SYDFEF 2X / size			18	28	45	71	100	140
Weight	Pump without through-drive, incl. pilot valve	kg	14	17	23	35	47	62
	In addition, pre-load valve	kg	3.3	3.3	3.3	6.3	6.3	6.3
	In addition, in case of external actuating system supply	kg	2	2	2	2	2	2
SYDFEF 3X / size			45	71	100	140	180	
Weight	Pump without through-drive, incl. pilot valve	kg	32	49	71	75	80	
	In addition, pre-load valve	kg	3.3	6.3	6.3	6.3	6.3	
	In addition, in case of external actuating system supply	kg	2	2	2	2	2	
SYHDFEF 1X / size			40	75	125	180	250	355
Weight	Pump without through-drive, incl. pilot valve	kg	39	53	100	115	197	220

Dimensions vary depending on optional equipment. The values applicable to your SY(H)DFEF control system can be found on the installation drawing or in the data sheet of the control system.

Carrying the SY(H)DFEF control system

SY(H)DFEF control systems with low weight up to 15 kg may briefly be transported manually.

CAUTION! Danger caused by heavy loads!

Carrying heavy control systems can cause health damage!

- ▶ When carrying the control system, apply suitable techniques for lifting, lowering and relocating or use suitable lifting gear.
- ▶ Put the control system carefully on the supporting surface in order that it is not damaged.

6.1.1 Transport using lifting gear



WARNING

Danger caused by suspended loads!

Injury caused by control system falling down.

- ▶ Make sure that the control system is safely fastened.
- ▶ You may guide the control system by hand only for fine positioning and for preventing swinging of the load.
- ▶ Never walk under or reach out for suspended loads.

Please observe the following points for transporting:

- Properties of the load (e.g. weight, center of gravity, mounting and attachment points).
- Way of attaching or suspending the load.
- Make sure that the load carrying capacity of the lifting gear is sufficient for transporting the SY(H)DFEF control system without any risks.
- Use textile slings according to DIN EN 1492-2.



For further information on transportation, please contact Bosch Rexroth.

For transporting, the SY(H)DFEF control system can be connected to a lifting device using a ring screw or a lifting strap.

Transport with ring screw

The drive shaft can be used to transport the SY(H)DFEF control system as long as only outward axial forces occur. Consequently, you can suspend the SY(H)DFEF from the drive shaft.

- ▶ To do this, screw a ring screw completely into the thread on the drive shaft. The size of the thread is stated in the installation drawing.
- ▶ Make sure that each ring screw can bear the total weight of the SY(H)DFEF control system plus approx. 20 %.

You can lift the SY(H)DFEF control system without any risk of damage as shown in Fig. 15 using the ring screw screwed into the drive shaft.

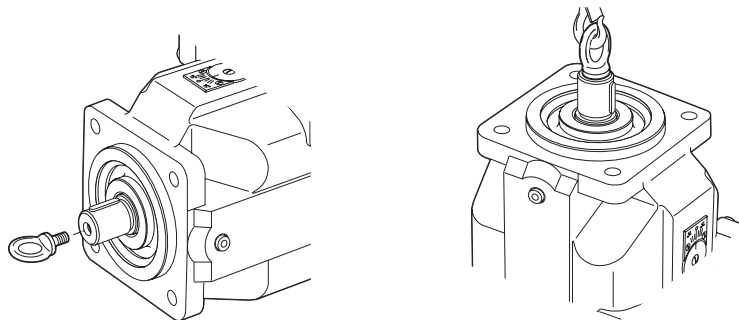


Fig. 15: Fixing the ring screw

Transport with lifting strap

During transport with a lifting device, the control system can fall out of the lifting strap and cause injuries.

- Use the widest possible lifting strap.

Place the lifting strap around the SY(H)DFEF control system in such a way that it neither passes over the attached parts (e.g. valves) nor such that the SY(H)DFEF control system is hung from attached parts (see Fig. below).

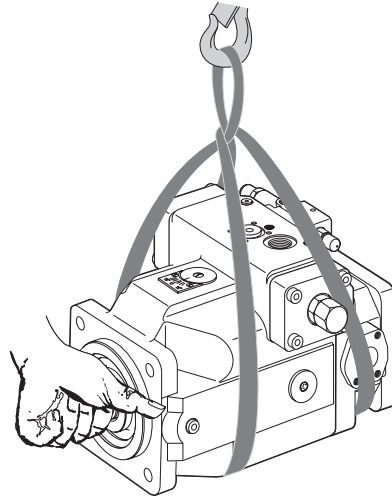


Fig. 16: Transport with lifting strap



Transport damage must be reported to your contact in the sales organization within one week. The addresses of the sales locations can be found on the Internet at: <http://www.boschrexroth.com/addresses>

6.2 Storing the SY(H)DFEF control system

Some SY(H)DFEF control systems are shipped in an anti-corrosion foil (max. storage time: 12 months). Without anti-corrosion foil, corrosion protection is limited to transport (a few days). If these control systems are to be stored, then you must provide preservation like for storage after demounting (see below).

Requirement

- The storage rooms must be free from corrosive materials and gases.
 - The storage rooms must be dry.
 - The ideal temperature for storage lies between +5 °C and +20 °C.
 - Avoid intense light.
 - Do not stack SY(H)DFEF control systems and store them shock-proof and slip-proof.
 - SY(H)DFEF control systems are very heavy (see also “Transport the SY(H)DFEF control system by means of a fork lift truck or suitable lifting gear observing the safety instructions.” on page 39). In this connection observe the admissible load-bearing capacities of your storage system.
- Check the SY(H)DFEF control system monthly for proper storage.

After delivery

Procedure after expiration of the maximum storage time:

1. Check the entire SY(H)DFEF control system for damage and corrosion prior to installation.
2. Check the SY(H)DFEF control system for proper function and leaks during a test run.
3. When the storage time of 24 months is exceeded, change the shaft seal ring.



After expiration of the maximum storage time, we recommend that you have the SY(H)DFEF control system inspected by your responsible Rexroth Service partner.

Should you have questions regarding spare parts, contact your Rexroth Service partner responsible for SY(H)DFEF control systems, see chapter 10.5 "Spare parts", page 74.

Following demounting

If a dismantled SY(H)DFEF control system is to be stored, it must be preserved against corrosion for the duration of storage.



The following instructions only refer to SY(H)DFEF control systems, which are operated with a hydraulic fluid based on mineral oil. Other hydraulic fluids require preservation methods that are specifically tailored to them. In such a case, consult with the Rexroth Service (for address, see chapter 10.5 "Spare parts", page 74.).

Rexroth recommends the following proceeding:

1. Drain the SY(H)DFEF control system completely.
2. Clean the SY(H)DFEF control system, see chapter 10.1 "Cleaning and care" on page 72.
3. For storage times up to 12 months: Wet the SY(H)DFEF control system internally with mineral oil by filling in about 100 ml of mineral oil.
For storage times up to 24 months: Fill the SY(H)DFEF control system with anti-corrosion agent VCI 329 (20 ml).
Filling via the case drain port.
4. Plug all ports air-tight.
5. Wet unpainted external metal surfaces of the SY(H)DFEF control system with a suitable anti-corrosion agent.
6. Pack the SY(H)DFEF control system air-tight together with a desiccant in an anti-corrosion foil.
7. Protect the SY(H)DFEF control system against impacts during storage. For further conditions, refer to "Requirements" in this chapter.

Always observe the general laws and regulations when handling water-endangering and harmful substances.

7 Installation

Before starting to install the system, have the following documents at hand:

- Hydraulic circuit diagram for the system (made available by the machine manufacturer)
- Data sheet of the SY(H)DFEF control system (contains the technical data)

7.1 Unpacking

CAUTION

Parts falling out!

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

- ▶ Put the packaging on level, bearing ground.
- ▶ Only open the packaging from the top.

Some SY(H)DFEF control systems are shipped in an anti-corrosion foil.

- ▶ Dispose of the packaging in accordance with the national regulations of your country.

7.2 Installation conditions

- ▶ To achieve favorable noise values, decouple all connecting lines from all components that can vibrate (e.g. tank) using elastic elements.
- ▶ Make certain that the suction line, case drain line, and return line flow into the tank below the minimum fluid level in all operational states.
- ▶ Strictly observe utmost cleanliness. The SY(H)DFEF control system must be installed without any contamination. Contamination of the hydraulic fluid can significantly affect the service life of the SY(H)DFEF control system.
- ▶ Do not use cotton waste or linty cloths for cleaning.
- ▶ Use suitable liquid detergents to remove lubricants and other difficult-to-remove dirt. Detergents must not penetrate the hydraulic system.

7.3 Installation positions and piping of SY(H)DFEF systems

7.3.1 General

- The installation orientation and installation position of the SY(H)DFEF control system essentially determine the procedures during installation and commissioning (such as for filling the axial piston unit).
- Note that you can expect certain installation positions to affect the control behavior or the adjustment feature. Because of gravity, dead weight and case pressure, minor characteristic curve offsets and changes in actuating time may occur.

The installation instructions are tailored to the use of the SY(H)DFEF control system. Adhering to these instructions is one of the decisive factors for the service life of the units.

The instructions refer to standard types and standard installation situations. Particular installation situations require additional measures to be taken on the unit, which are documented separately.

In the following, we distinguish between the installation position (pump/motor in relation to tank) and the installation orientation (position of the pump/motor shaft end vertical, horizontal, etc.).

Installation position

The following installation positions are possible (see Fig. below):

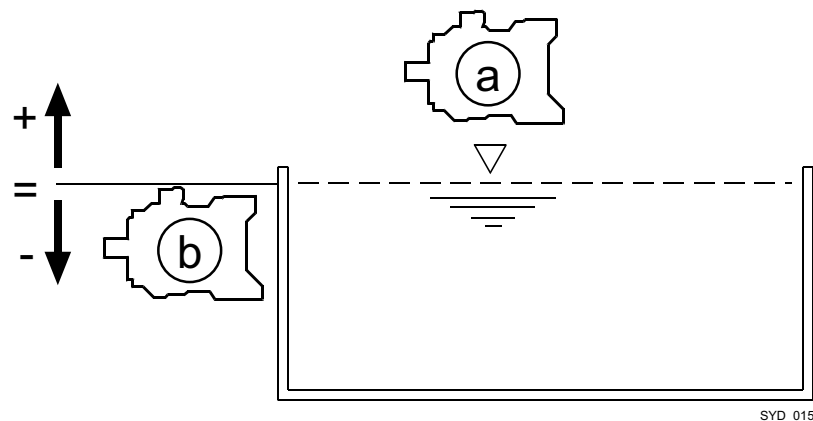
- Pos. a): Pump/motor above the tank (above minimum oil level)

NOTICE: Risk of damage due to loss of hydraulic fluid! With an installation position above the tank, the case interior may drain through the case drain line after longer standstill periods (air enters via the shaft seal ring) or via the service line (gap leakage). The bearings are thus insufficiently lubricated when the pump is restarted.

- ▶ Check the hydraulic fluid level in the pump case at regular intervals; if required, carry out re-commissioning.

- Pos. b): Pump/motor next to or below the tank (below minimum oil level), with the upper edge of the case corresponding to the minimum oil level.
- SY(H)DFEF control systems cannot be installed in the tank. Use control system SY(H)DFE1 for oil-immersed applications.

The following installation positions are permitted. The pipe routing shown represents the general routing.



SYD 015

Fig. 17: Installation position

Installation orientation

The following installation orientations are possible:

- Pos.1 horizontal: Shaft end horizontal
- Pos.2 vertical: Shaft end upwards
- Pos.3 vertical: Shaft end downwards

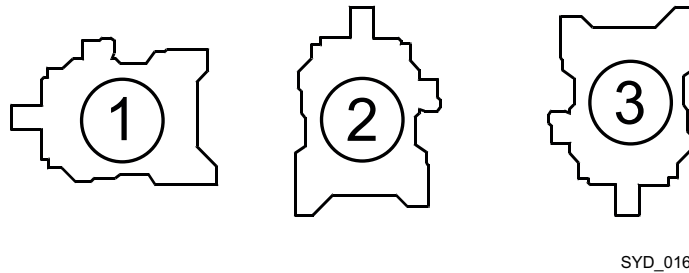


Fig. 18: Installation orientations

7.3.2 Piping

The installation positions and installation orientations shown in Figs. Fig. 17 and Fig. 18 determine the installation of

- suction lines
- case drain lines
- bleed lines

Make sure for all installation positions that always the higher of drain ports “L” or “T” is piped. Moreover, the distance between the end of installed pipes and the minimum oil level must not be shorter than the specified minimum distance (immersion depth “E”)

Special points

When installing suction and case drain lines, take care that the routing is straight and short and has as few bends as possible.

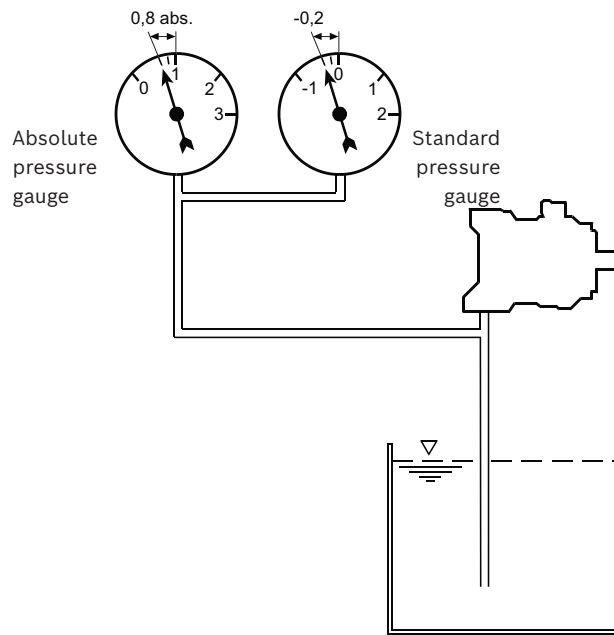
When the system is at rest, the lines drain automatically in the course of time due to the own weight of the hydraulic fluid.

Moreover, the different specific densities of hydraulic fluids must be taken into account, since fluids with a higher density are more difficult to aspire and also flow down more quickly. The limit speeds for HFC hydraulic fluids are specified in RE 92053.

For pumps, a minimum suction pressure is prescribed for port “S” irrespective of installation positions and installation orientations:

$$\text{minimum suction pressure} \geq 0.8 \text{ bar abs.}$$

To establish the suction pressure (inlet pressure) p_{abs} in dependence on the displacement or speed, please observe the technical data given in data sheets RE 30030, 30035 and 30630.



SYD 017

Fig. 19: Minimum suction pressure**Case drain piping**

Dynamic swiveling processes result in increased case pressures that are caused by the acceleration phase of the case drain oil column. They occur within milliseconds and must not exceed 6 bar_{abs.}. They are influenced by the inductive resistance of the case drain line ($\Delta p_i = f(\text{diameter, length})$). Here, the flow resistance at the case drain fitting on the pump case plays a subordinate role.



The Δp_i value can only be improved by a larger nominal width of the case drain line.

Generally, the following must be observed:

- ▶ Each pump should preferably be piped with a separate case drain line.
- ▶ Direct the case drain fluid in the case chamber via the highest case drain port and as shortly as possible (ca. 1 m) directly to the tank. Use a line size, which matches the port.
- ▶ When the specified line lengths are exceeded we recommend that the nominal width be increased by one size per additional meter.
- ▶ The nominal width of the case drain line determined by the threaded connection on the pump case must not be reduced. Use “light series” pipes only.
- ▶ Do not use check valves in case drain lines.
- ▶ The case drain line should always enter the tank in the return flow chamber below the oil level. For tank designs without direct separation of the suction chamber, the drain line should be returned to the tank as far away as possible from the suction port.
- ▶ External influences of pressure, e.g. from manifold tank lines, on the pump drain port or the pump case are not permitted.

7.4 Installing the SY(H)DFEF control system

NOTICE

Damage caused by missing seals and plugs!

Liquids and foreign particles may penetrate and damage the product.

- Before starting the installation make sure that all seals and plugs of the connections are tight.

Fluid entering the system!

Fluids in the product can cause a short-circuit.

- Do not install the SY(H)DFEF control system in a tank below the fluid level (in-tank installation)!

7.4.1 Preparation

1. Check the scope of delivery for completeness and transport damage.
2. Compare the material number and designation (ordering code) with the details on the order confirmation.



If the material number for the SY(H)DFEF control system does not correspond to the one on the order confirmation, contact Rexroth Service for clarification, see chapter 10.5 “Spare parts“, page 74.

3. Drain the SY(H)DFEF control system completely prior to installing it in order to prevent mixing with the fluid used in the machine.
4. Check the direction of rotation of the SY(H)DFEF control system (on the nameplate) and make sure that this corresponds to the direction of rotation of the motor.



The direction of rotation as specified on the nameplate shows the direction of rotation of the SY(H)DFEF control system as viewed on the drive shaft. For information on the direction of rotation of the drive motor, please refer to the motor manufacturer's operating instructions.

7.4.2 Dimensions of connections

The data sheet contains the dimensions for all connections to the SY(H)DFEF control system. Also observe the instructions provided by the manufacturers of the other components when selecting the required tools.

7.4.3 General notes

When installing or removing the SY(H)DFEF control system, observe the following general notes and instructions for action:

- Mount the SY(H)DFEF control system so that the expected forces and torques can be transmitted without any risks.
- The permissible axial and radial loading of the drive shaft, the permissible torsional vibration, the optimum direction of load force, as well as the limit speeds can be found in the data sheet.

7.4.4 Installation with coupling

The SY(H)DFEF control system is usually flange-mounted to a motor with a coupling. If you plan to install the unit otherwise, please consult us.

How to install the SY(H)DFEF control unit with a coupling is described in detail in the following:

1. Mount the relevant coupling half onto the drive shaft of the SY(H)DFEF control system according to the instructions of the coupling manufacturer.



The drive shaft end of the SY(H)DFEF control system is provided with a threaded bore. Use this threaded bore to mount the coupling element on the drive shaft. Refer to the installation drawing for the dimensions of the threaded bore.

2. Make sure that the installation location is clean and free from dirt and foreign particles.
3. Positively clamp the coupling hub on the drive shaft or ensure permanent lubrication of the drive shaft. This prevents the formation of frictional corrosion and associated wear.
4. Transport the SY(H)DFEF control system to the place of installation.
5. Mount the coupling to the drive in accordance with the instructions of the coupling manufacturer.



The SY(H)DFEF control system must not be tightened down until the coupling has been correctly assembled.

6. Mount the SY(H)DFEF control system at the installation location.
7. If necessary, details on the required tools and tightening torques for the mounting screws are available from the machine or system manufacturer.
 - For bell housing mounting, check the axial play of the coupling through the bell window according to the manufacturer's instructions.
 - For flange installation, align the support of the SY(H)DFEF control system with the drive.
8. When using flexible couplings, check that the drive is free of resonance after having completed the installation.

7.4.5 Completing the installation



CAUTION

Ejected plastic plugs!

Risk of injury. Operating the SY(H)DFEF control system with plastic plugs can cause injuries or damage to the SY(H)DFEF control system.

- Before commissioning, remove all plastic plugs and plug all non-connected ports with suitable, pressure-proof metal plug screws, because plastic plugs are not pressure-proof.

1. Remove any transport screws, if fitted.
2. Remove transport protection.

The axial piston unit of the SY(H)DFEF control system was delivered with protective covers and plastic plugs or plug screws. These must be removed before the system can be connected. Use appropriate tools for this.
3. Make certain that the sealing and functional surfaces are not damaged.



Setscrews, if provided, are protected against unauthorized resetting by means of protective caps. Removing protective caps will void the warranty. If you need to modify the setting, please contact the responsible Rexroth Service (for address, see chapter 10.5 “Spare parts“, page 74)).

For the variant with through-drive, mount the auxiliary pump in accordance with the instructions of the pump manufacturer.

7.5 Connecting the SY(H)DFEF control system hydraulically

NOTICE

Hydraulic pipes and hoses installed under stress!

Hydraulic pipes and hoses, which are installed under mechanical stress, generate additional mechanical forces during operation, which reduces the service life of the SY(H)DFEF control system and the machine or system as a whole.

- Install pipes and hoses stress-relieved.

Insufficient suction pressure!

Generally, a minimum permissible suction pressure in port “S” is prescribed for SY(H)DFEF control systems in all installation positions. If the pressure in port “S” drops below the specified values, damage may occur which may lead to the destruction of the SY(H)DFEF control system.

- Make sure that the required suction pressure is achieved.

This is influenced by:

- appropriate piping of the suction cross-sections
- appropriate pipe diameters
- appropriate position of the tank
- appropriate viscosity of the hydraulic fluid

The machine or system manufacturer is responsible for dimensioning the lines. The SY(H)DFEF control system must be connected to the rest of the hydraulic system in accordance with the hydraulic circuit diagram of the machine or system manufacturer.

Notes on the routing of lines

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

- See to it that the suction line (pipe or flexible hose) is as short and straight as possible.
- The line cross-section of the suction line is to be dimensioned so that the pressure in the suction port does not fall below the minimum permissible value and the maximum permissible pressure is not exceeded.
- Observe air tightness of the junctions and pressure resistance of the hose, also with respect to the atmospheric pressure.
- In conjunction with the pressure lines, make certain that the pipes, hoses and connecting elements are approved for the operating pressure range.
- Always route case drain lines so that the housing is constantly filled with hydraulic fluid and ensure that no air gets through the shaft seal ring even during extended standstill periods. Under no operating conditions may the pressure inside the case exceed the limit values specified for the SY(H)DFEF control system in the data sheet. The case drain line in the tank must in any case end up below the minimum fluid level (see chapter 7.3 “Installation positions and piping of SY(H)DFEF systems“, page 43).



The ports and mounting threads are rated for the operating pressures specified in the data sheet. The machine or system manufacturer must ensure that the connecting elements and lines comply with the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

The pressure port of the SY(H)DFEF control system of size 71 is provided with threads for two standard flange patterns:

SAE 1" (dot-dashed line) for pressures above 250 bar and

SAE 1 1/4" (dotted line) for pressures up to 250 bar.

Because standard flanges according to SAE 1 1/4" are permitted up to 250 bar only, the porting pattern to SAE 1" must be used in the case of operating pressures higher than 250 bar.

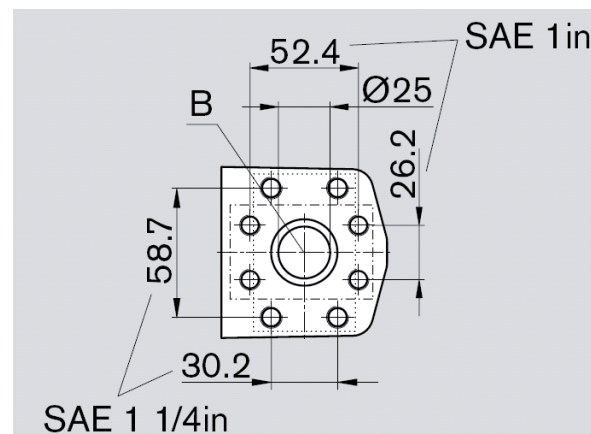


Fig. 20: Flange pattern

Procedure

To connect the SY(H)DFEF control system to the hydraulic system:

1. Remove the plug screws from the ports that are to be connected according to the hydraulic circuit diagram.
2. Use only clean hydraulic lines.
3. Connect the lines according to the hydraulic circuit diagram.

Either pipes or hoses must be connected to all ports according to the installation drawing and machine or system circuit diagram, or the ports plugged using suitable plug screws.



The installation drawing contains the dimensions of all connections and ports on the SY(H)DFEF control system. Also observe the instructions provided by the manufacturers of the other hydraulic components when selecting the required tools.

4. Make sure
 - that the cap nuts are correctly tightened on the fittings and flanges (observe tightening torques!). that all checked fittings are marked using e.g. a permanent marker.
 - that the pipes and hose lines and every combination of connecting pieces, couplings or connecting points with hoses or pipes have been inspected by a technically qualified person for their safe working condition.

Tightening torques

The tightening torques for the SY(H)DFEF control system are listed in the following Table 10:

- Threaded hole in the axial piston unit:

The maximum permissible tightening torques M_{Gmax} are the maximum values of the threaded holes and must not be exceeded. For values, see the following table.

- Fittings:

Observe the manufacturer's instructions regarding tightening torques for the fittings used.

- Mounting screws:

For mounting screws according to DIN 13/ISO 68, we recommend checking the tightening torque in each individual case as per VDI 2230.

- Plug screws:

For the metal plug screws that come with the axial piston unit, the required tightening torques of plug screws M_v apply. For values, see the following table.

Risk of mix-ups with threaded connections

SY(H)DFEF control systems are used in applications with metric as well as with imperial systems of units.

Both, the system of units as well as the size of threaded hole and threaded plug (e.g. plug screw) must match.

Since the systems cannot be distinguished visually, there is a risk of mixing up.

 WARNING
Wrong threaded plug!

Risk of serious injury, if a threaded plug is used that differs from the threaded hole in terms of unit system and size and is pressurized. The threaded plug may loosen itself or even be ejected from the hole in a projectile-like manner.

Hydraulic fluid can be discharged from this leakage point.

- Use the drawings (installation drawing/data sheet) to determine the required threaded plug for each fitting.
- Make certain that there are no mix-ups when assembling valves, mounting screws and plug screws.
- For all threaded holes, use a threaded plug from the same system of units and of the correct size.

Table 10: Tightening torques of threaded holes and plug screws

Thread size of ports		Max. permissible tightening torque of threaded holes M_{Gmax}	Required tightening torques for plug screws M_V	A/F hexagon socket
M10x1	DIN 3852	30 Nm	12 Nm	5 mm
M12x1.5	DIN 3852	50 Nm	25 Nm	6 mm
M14x1.5	DIN 3852	80 Nm	35 Nm	6 mm
M16x1.5	DIN 3852	100 Nm	50 Nm	8 mm
M18x1.5	DIN 3852	140 Nm	60 Nm	8 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M26x1.5	DIN 3852	230 Nm	120 Nm	12 mm
M27x2	DIN 3852	330 Nm	135 Nm	12 mm
M33x2	DIN 3852	540 Nm	225 Nm	17 mm
M42x2	DIN 3852	720 Nm	360 Nm	22 mm
5/16-24 UNF-2B	ISO 11926	10 nm	7 Nm	1/8 in
3/8-24 UNF-2B	ISO 11926	20 Nm	7 Nm	5/32 in
7/16-20 UNF-2B	ISO 11926	40 Nm	15 Nm	3/16 in
9/16-18 UNF-2B	ISO 11926	80 Nm	25 Nm	1/4 in
3/4-16 UNF-2B	ISO 11926	160 Nm	62 Nm	5/16 in
7/8-14 UNF-2B	ISO 11926	240 Nm	127 Nm	3/8 in
1 1/16-12 UN-2B	ISO 11926	360 Nm	147 Nm	9/16 in
1 5/16-12 UN-2B	ISO 11926	540 Nm	198 Nm	5/8 in
1 5/8-12 UN-2B	ISO 11926	960 Nm	320 Nm	3/4 in
1 7/8-12 UN-2B	ISO 11926	1200 Nm	390 Nm	3/4 in

7.6 Connecting the SY(H)DFEF control system electrically

The machine or system manufacturer is responsible for setting up the electrical control.

For electrically controlled SY(H)DFEF control systems, the electrical control must be connected according to the circuit diagram of the machine or system manufacturer.



Damage to the control system caused by incorrect installation is not covered by the warranty!

1. Disconnect the relevant system part from the power supply.
2. Connect the SY(H)DFEF control system electrically (24 V).

7.6.1 Cabling of electronic components



Generally, the following is valid:

- Keep the number of intermediate terminals to a minimum.
- The arrangement of electromagnetic sources of interference in the direct vicinity of the pilot valve is not permitted.
- Installing power cables in the vicinity of the pilot valve is not permitted.
- Due to the use in a hydraulic environment, use only cable material that is specified as “oil-proof”. Otherwise, possible hardening of the cable jacket could lead to embrittlement and thus to breaking of individual wires.
- Select only cables that have the actually required number of wires (avoid superfluous wires).
- Cables for command values and actual values should be as short as possible.
- The signal cables to the pilot valve must in any case be shielded. The cable shield must be connected to ground on one end in the control cabinet. Strip the shield as short as possible and connect it in accordance with the data given in the RE data sheets.
- The contacts on the mating connector must not be exposed to mechanical stress. This can lead to a defective connection between the mating connector and the plug-in connector.

Due to the fact that the control electronics is integrated in the valve housing in the factory, no additional cabling is required for the position transducer systems of the pump and the valve.

Cabling of the control system is therefore restricted to the connection of the 7-pin central connector of the integrated electronics to the customer's control, the pressure sensor and the field bus connection, if provided.

For this connection, ready-to-connect and standardized cable kits are available in different lengths. On request, the 7-pin mating connector can be supplied separately for individual designs. See data sheet.

The HM20-2X/...-F-C13 pressure transducer is fitted with a ready-to-connect, standardized connection cable for direct connection to the X2N connection port.

7.6.2 Electrical connection of the pilot valve

The pilot valve VT-DFPF is supplied with 24 V DC voltage. If this voltage supply is not provided on the part of the system, power supply unit VT-NE30-2X/ according to RE 29929 (mat. no. R901082348) can be used. The 24 V supply of the power supply unit is to be connected to connections A (+24 V) and B (GND) of the mating connector.

In the case of the connection cable that can be ordered, the brown wire has to be connected to +24 V and the yellow wire to GND. Connect the yellow/green wire to ground.

**Recommendation:**

The voltage supply for the VT-DFPF pilot valve should be protected with a 4 A/ slow-blowing fuse on the system side.

The pilot valve is not provided with an enable input to block the function of the valve.

In the event of an error, the controller enable should be withdrawn via field bus. All further, safety-relevant interventions must be made by the higher-level control (e.g. switching the drive motor OFF, closing the shut-off valves,).

Pinout of central connector

The following table shows the pinout of the central connector 6+PE pilot valve VT-DFPF. The column "code" refers to the cable kit that can be ordered as optional accessories.

Bosch Rexroth offers the following cable kits:

Type: Plug-in connector 6+PE for central connector XH1

- Without cable (construction kit) Mat. no. R900021267
- With cable kit 1 x 5 m Mat. no R901420491
- With cable kit 1 x 10 m Mat. no. R901420496

Table 11: Signals to the central connector

Pin	Signal	Description	Signal direction	Signal level	Code
A	+ UB	Power supply	IN	+24 V	Brown
B	GND	Reference potential for voltage supply	-	-	Yellow
		Ground connection for the electronics	-	-	Yellow/green
C	-	Do not use	-	-	Green
D	AI 1	Analog input 1	IN	+/- 10 V or 0-20 mA	Blue
E	M0	Reference potential for analog signals	-	-	Gray
F	AO 1	Analog output 1	OUT	+/- 10 V or 0-20 mA	White



Connect M0 and GND in the control cabinet to prevent potential shifts.

7.6.3 Connection to the swivel angle sensor

The swivel angle of the pump is acquired by swivel angle sensor VT-SWA...G15, which is directly connected to pilot valve VT-DFPF in the factory. The sensor is supplied by pilot valve VT-DFPF.



The signal levels are monitored for plausible values.

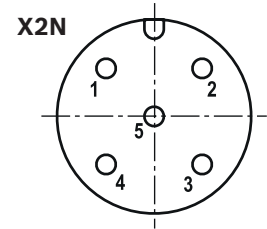
Disconnected or completely interrupted cables are recognized.

Break of the supply cable and internal electronics errors are not detected!

7.6.4 X2N: Analog sensor interface (coding A), M12, 5-pin, socket

Table 12: Pinout X2N

Pin	Assignment
1	+24 V voltage output (sensor supply) ¹⁾
2	Analog input 2 voltage (0 ... 10 V)
3	GND
4	Analog input 4 voltage (0 ... 10 V)
5	Analog input 3 voltage (0 ... 10 V)

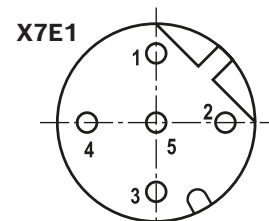


¹⁾ Maximum load-carrying capacity 3 x 25 mA, voltage output identical to the voltage supply applied to input XH1.

7.6.5 X7E1 and X7E2: Plug pinout for Ethernet interface (coding D), M12, 4-pin, socket

Table 13: Pinout of X7E1 and X7E2:

Pin	Assignment
1	TxD +
2	RxD +
3	TxD -
4	RxD -
5	Not assigned



Use a shielded data cable as bus cable. The shield should be connected to the connector housing.

7.6.6 LED status indicator lamps

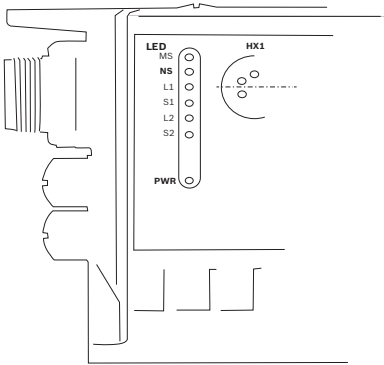
Table 14: LED indicator lamps

LED	Interface	Sercos	EtherNet/IP	EtherCAT	PROFINET RT	POWERLINK	VARAN
MS	Electronics module	Module status	Module status	Module status	Module status	Module status	Module status
NS		S	Network status and others	Network status and others	Network status and others	Status/error	Network status and others
L1	X7E1	Link and others	Link and others	Link/activity	Link and others	Link/data activity	Link and others
S1		Activity and others	Activity and others	not used	Activity and others	not used	Activity and others
L2	X7E2	Link and others	Link and others	Link/activity	Link and others	Link/data activity	not used
S2		Activity and others	Activity and others	not used	Activity and others	not used	not used
PWR	XH1	Power	Power	Power	Power	Power	Power

Table 15: Indication of status LED

Power LED (LED PWR)	Indication status
Off	No voltage supply
Green	Operation

Module status LED MS	Indication status
Off	no voltage supply
Flashing green/red	Initialization
Flashing green	Drive ready for operation
Green	Drive active
Flashing orange	Warning
Green	Drive active
Flashing red	Error
Fast blinking green	Firmware has to be loaded



For connection to M12 sockets we recommend the use of self-locking mating connectors.

The module status LED MS refers to the electronics module

The network status LED NS signals the status of the individual master communications, with the light patterns differing depending on the bus system used

LEDs L1, S1, L2 and S2 refer to the interfaces “X7E1“ and “X7E2“

- Link: cable plugged, connection established (permanent on)
- Activity: Data sent/received (blinking)

For a detailed description of diagnostics LEDs, please refer to the application manual Rexroth HydraulicDrive, RE 30338-FK.

7.6.7 **Selection, place of installation and mounting orientation of the pressure transducer**

Selection of the pressure transducers

To reduce the number of variants, only pressure rating “315 bar” is given in the ordering code of the SY(H)DFEF control systems. If required, other pressure ratings can be combined (with the correct selection of the relevant electrical interface!). Such pressure transducers must, however, be ordered separately for the SY(H)DFEF control system.

In terms of signals, the sensors have to be distinguished as follows:

- Sensors with current interface and
- Sensors with voltage interface

Here, the usual signal limits are between 0...20 mA or 0...10 V, respectively. Within these limits, there are further modifications that depend on required options such as monitoring for cable break.

From a technical point of view, the efficiency of the pressure transducer must be adapted to the SY(H)DFEF system in order that the best possible results can be obtained with regard to accuracy, dynamics and repeatability.

The pressure transducers recommended by us are listed in the RE data sheets of the relevant SY(H)DFEF system.

- Our pressure transducer model “HM20-2X” with current interface (4...20 mA) is provided with a 2-conductor connection and allows the fail-safe transmission of signals – even over greater distances (depending on the cable used and the permitted load of the pressure transducer).
Further pick-offs can be looped in taking into account the relevant input resistances.
- Our pressure transducer model “HM20-2X” with voltage interface (0...10 V) has a 3-conductor connection and an integrated DC/DC converter, which effectively rules out disturbances on the analog signal caused by the voltage supply. The transmission of the signal over longer distances should be avoided. The advantage of the pressure transducer lies in the simple checking of the signals by measurement using a voltmeter without intervention into the connection cables.
- The “HM20-2X/...F-C13” pressure transducer has a voltage interface (0.5...5 V) with a ready-to-connect, standardized connection cable for direct connection to X2N.

CAUTION! Uncontrolled increase in pressure!

- The pressure transducer must be wired so that it cannot be short-circuited, because in the event of a missing pressure signal, the control electronics can no longer detect the pressure, which causes an uncontrolled increase in pressure.

Place of installation of the pressure transducer

Favorable places of installation of pressure transducers turned out to be not in the direct vicinity of the pump, but, for example, downstream of the (flexible) pressure hose:

- Always between pump and check valve (if fitted)
- Do not use minimess lines



The installation in port “MP1” of pre-load valve SYDZ is only possible with pressure transducer HM20-2X/...F-C13 for reasons of dimensions. In this case, it may be required to reduce the pressure controller gain due to higher pressure pulsation.

Mounting orientation of the pressure transducer

We recommend suspended mounting of the pressure transducer so that bleeding problems (and hence control oscillations) can be ruled out right from the start.



If, due to the installation orientation of the pump, a pressure transducer must be installed “vertically” directly in the pump or in the pre-load valve, we recommend another place of installation for the pressure transducer.

Pressure transducer HM20 (current)

HM20 pressure transducers are provided with a 2-wire current interface and can be connected to the pilot valve using the central plug-in connection.

The voltage supply for the pressure transducer must be provided in accordance with the specification.

For more details on the pressure transducer, see data sheet 30272.

Pressure transducer HM20 (voltage)

Pressure transducers of type HM20 are provided with a voltage output as actual pressure value signal and can be connected to the pilot valve.

The voltage supply for the pressure transducer must be provided in accordance with the specification.

For more details on the pressure transducer, see data sheet 30272.

8 Commissioning



WARNING

Working in the danger zone of a machine or system!

Risk of serious injury caused by unsafe work in the danger zone of a machine or system.

- ▶ The machine or system may only be commissioned when safe working is ensured.
- ▶ Pay attention to and eliminate potential danger sources before commissioning the machine or system.
- ▶ Nobody may stand in the danger zone of the machine or system.
- ▶ The emergency stop button for the machine or system must be within the operator's reach.
- ▶ Always strictly observe the instructions of the machine or system manufacturer during commissioning.

Uncontrolled system behavior!

Non-connected electrical and hydraulic connections can cause malfunctions and hydraulic fluid jets to be ejected, which can injure you.

- ▶ Only commission a completely installed product.

NOTICE

Loss of protection class due to missing seals and plugs!

Liquids and foreign particles may penetrate and damage the product.

- ▶ Before commissioning, make sure that all seals and plugs of plug-in connections are tight.

Insufficient hydraulic fluid!

Insufficient amounts of hydraulic fluid can lead to destruction of the product.

- ▶ Make sure that the housing of the SY(H)DFEF control system is filled with hydraulic fluid during commissioning and in operation. This must also be observed during longer periods of standstill, because the SY(H)DFEF control system may drain via the hydraulic lines.

Ingress of dirt!

Damage to the SY(H)DFEF control system! Contamination of the hydraulic fluid results in wear and malfunction. Especially foreign bodies such as welding beads and metal chips in the hydraulic lines can damage the SY(H)DFEF control system.

- ▶ Observe utmost cleanliness during commissioning.
- ▶ When closing measuring ports, make sure that no contamination can enter.

NOTICE

Air pockets around the bearings!

The device can be destroyed.

- ▶ Make certain that with installation orientation “drive shaft up” the pump housing is completely filled with hydraulic fluid during commissioning and in operation.
- ▶ Check the hydraulic fluid level in the pump case at regular intervals. If required, carry out recommissioning. For tank-top installation, the case chamber can run dry through the case drain line (ingress of air via the shaft seal ring) or via the working line (gap losses). The bearings are thus insufficiently lubricated when the pump is restarted.
- ▶ Ensure that the suction line is always filled with hydraulic fluid during commissioning and operation.

8.1 Initial commissioning

- ▶ When carrying out any work in conjunction with commissioning of the SY(H)DFEF control system, observe the general safety instructions and intended use in chapter 2 “Safety instructions” on page 10.
- ▶ Let the product acclimate itself for several hours before commissioning, otherwise water may condense in the housing.

8.1.1 Filling the SY(H)DFEF control system

NOTICE

Spilled hydraulic fluid!

Environmental pollution and contamination of the groundwater by hydraulic fluid leaking while the SY(H)DFEF control system is filled.

- ▶ When filling in and changing the hydraulic fluid, always place an oil drain pan under the SY(H)DFEF control system.
- ▶ Observe the information in the safety data sheet for the hydraulic fluid and the instructions provided by the system manufacturer.

You will require an approved hydraulic fluid:

The machine or system manufacturer can provide you with precise data of the hydraulic fluid. Details on minimum requirements for HFC hydraulic fluids (for SYHDFEF only) are available in the Rexroth publication 92053.

To ensure functional reliability of the SY(H)DFEF control system, the hydraulic fluid must comply at least with cleanliness class 18/16/13 according to ISO 4406 for particle sizes 4/6/14 µm. For permissible temperatures, see data sheet of the relevant control system.



The SY(H)DFEF control system should be filled using a filling and filtration unit (10 µm filtration rating). The control system must not be powered when being filled.

1. Fill and air-bleed the SY(H)DFEF control system via the appropriate ports, see chapter 7.3 "Installation positions and piping of SY(H)DFEF systems", page 43. The hydraulic lines of the system must also be filled.
2. Test the direction of rotation of the motor. To do this, rotate the motor briefly at the lowest rotational speed (inching). Make sure that the direction of rotation of the SY(H)DFEF control system corresponds to the indication on the nameplate, see chapter 5.12 "Identification of the product", Fig. 14 on page 38.
3. Operate the SY(H)DFEF control system at low speed (inching mode) until the pump system is completely filled and bled. For checking purposes, drain the hydraulic fluid at the case drain port and wait until fluid flows out without any bubbles.
4. Make certain that all ports are either connected to pipes or plugged according to the general circuit diagram.

8.1.2 Testing the hydraulic fluid supply

The SY(H)DFEF control system must always be supplied with sufficient hydraulic fluid. For this reason, the supply of hydraulic fluid must be ensured at the start of the commissioning process.

When you test the hydraulic fluid supply, constantly monitor the noise generation and check the hydraulic fluid level in the tank. If the SY(H)DFEF control system becomes louder (cavitation) or the case drain fluid flows out with bubbles, this is an indication that the SY(H)DFEF control system is not being sufficiently supplied with hydraulic fluid.

Notes on troubleshooting can be found in chapter 15 "Troubleshooting" on page 79.

To test the hydraulic fluid supply:

1. Allow the drive motor to run at lowest speed.
The SY(H)DFEF control system must be operated under no-load conditions. Pay attention to leakage and noise.
2. Check the SY(H)DFEF control system's case drain line during the test. The case drain fluid should not contain any bubbles.
3. Check the suction pressure at port "S" of the SY(H)DFEF control system pump. Refer to data sheets 92711, 92714 and 92050 for permissible values.
4. Check the case drain pressure at connected port "K₁" or "K₂". Refer to data sheets 92711, 92714 and 92050 for permissible values.

8.1.3 Performing a flushing cycle

To remove foreign particles from the system, perform a flushing run for the entire system.

- Carry out flushing using an additional flushing unit.
- Observe the instructions of the flushing unit manufacturer for the detailed procedure for carrying out flushing.

8.1.4 Connection to the control (IndraWorks)

It is assumed that IndraWorks is already installed. Otherwise, install IndraWorks as described in instructions R911344286. Then connect the SY(H)DFEF system to the Ethernet port of the PC and set the IP address (TCP/IPv4) of the network connection to the IP address range of the SY(H)DFEF system. The default address of the SY(H)DFEF system is set to 192.168.0.1. After having configured the network connection you can open IndraWorks and start a network search:

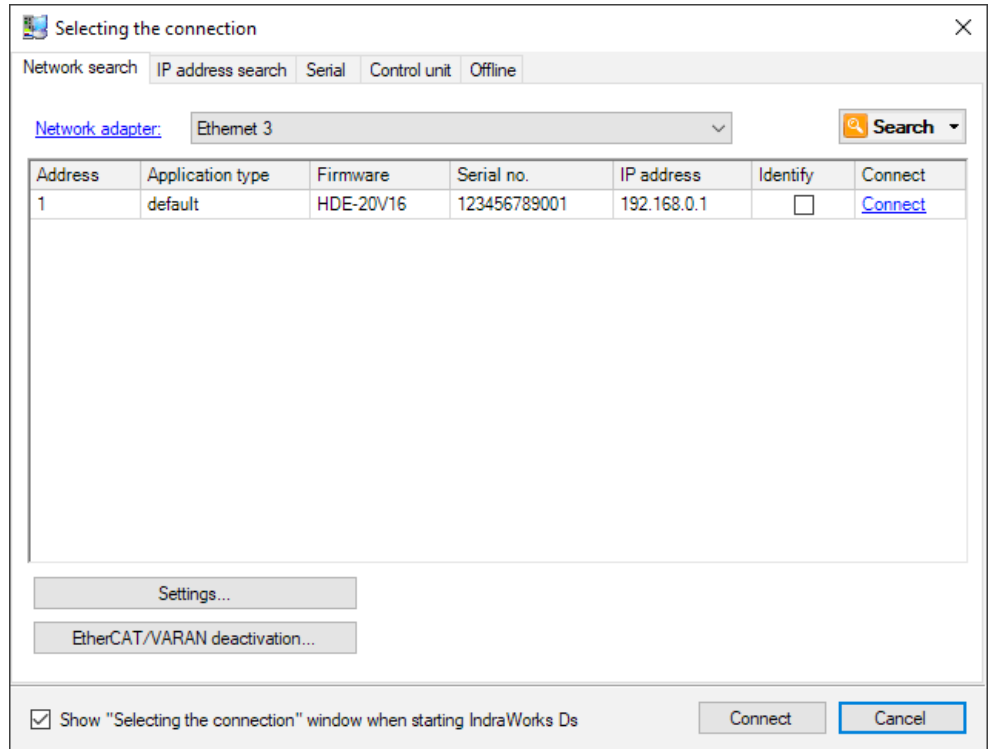


Fig. 21: Connection selection

To establish a connection to the selected system, click the OK button.



Should EtherCAT or VARAN be activated as field bus system, you can deactivate these bus systems for direct communication with IndraWorks. To this end, send the deactivation command by clicking the button “EtherCAT/VARAN Deactivation”. Alternatively, with these bus systems you can access the SY(H)DFEF system directly via the Engineering port of the control.

8.1.5 Making basic settings on the control electronics

To be able to adjust the control electronics, you must have installed the engineering tool IndraWorks. The user has to configure the SY(H)DFEF control system according to the customer-specific requirements. This refers mainly to the following settings:

- Settings for the pressure transducer
- Settings for the swivel angle sensor
- Entry of pump and motor values

To set the enable for a test during commissioning, you can use the Easy Startup Mode. It is configured and started using IndraWorks.

8.1.6 Initial parameterization

Initial parameterization is supported by a wizard, which leads you step by step through the setting and parameterization of a pump controller. The objective behind the wizard is to create an operable pump controller setting, which can be used as starting point for machine-specific optimizations of the control parameters. The “first steps” of the wizard are shown on the following figures. To have a defined starting position after first opening of the program we recommend that basic parameters be loaded in a first step. If initial parameterization is called repeatedly in order to adjust the settings made, this step must be skipped, since otherwise all settings made before will be overwritten with default values. The initial parameterization wizard offers a simple and clear representation of the current pump controller configuration and is a useful tool for beginners, who are not yet familiar with the tree structure of the HydraulicDrive.

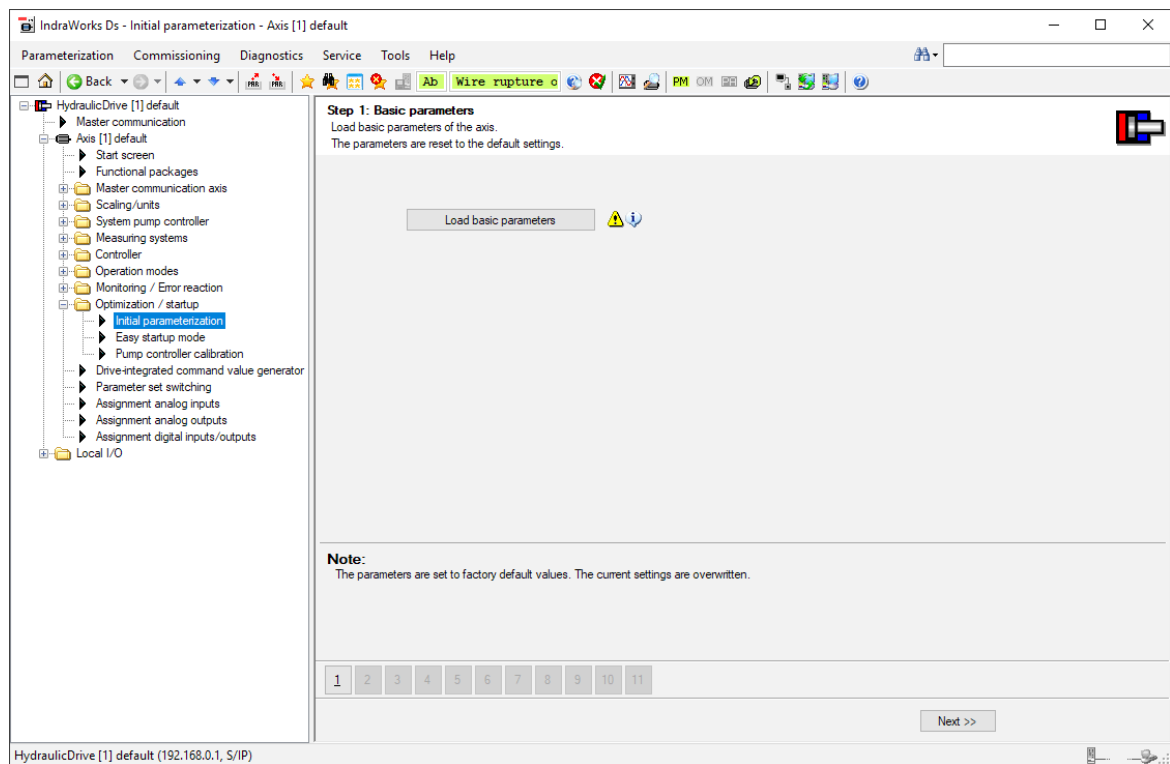


Fig. 22: Initial parameterization, step 1: Basic parameters

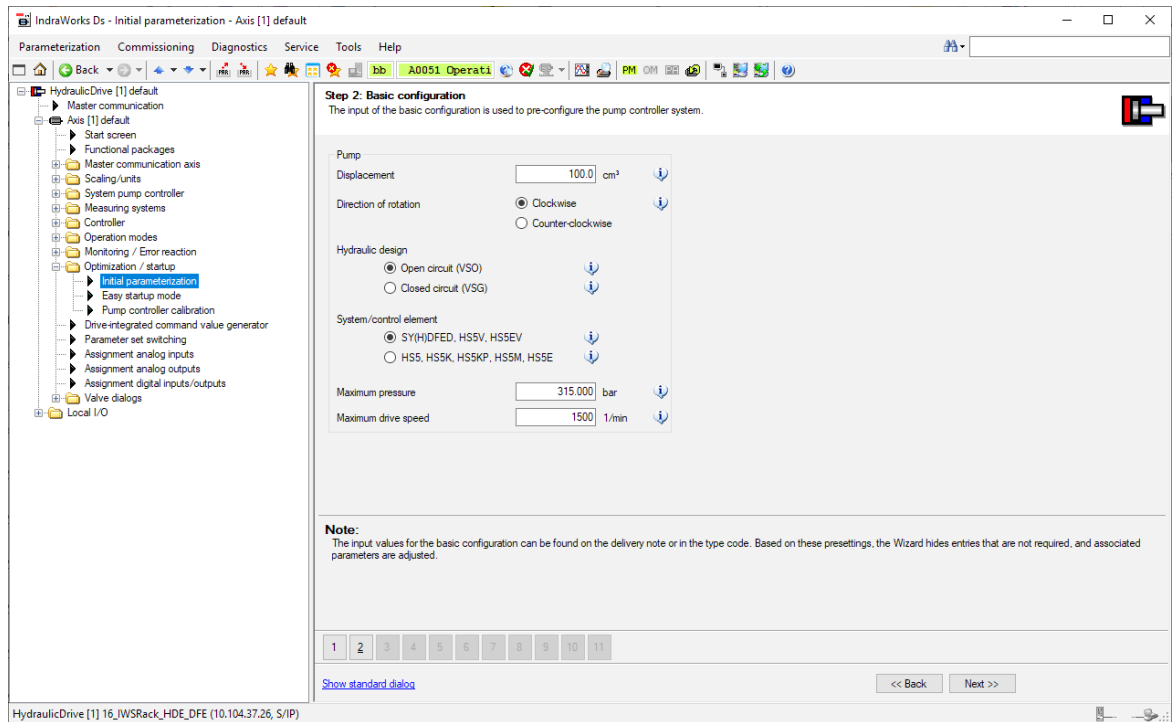


Fig. 23: Initial parameterization, step 2: Basic configuration

8.1.7 Switching on the drive motor of the pump

To prevent undefined states, the power supply of the valve electronics should be switched on first, then the drive motor of the pump (see chapter 5.11, “Switch-on sequence of electronics/hydraulics” on page 37).

Then check the following (motor still switched off!):

1. No error messages are present and the controller enable is set.
2. The actual swivel angle value (SWA_{act}) of the pump is in the order of $+100\% \pm 3\%$ (mechanical limit stop)



In this state, the warning E2282, “Control deviation pump controller” can be output, because the drive motor is still at rest. Later, when the motor is running, this warning should no longer be issued. To suppress the warning while the motor is at rest, you can enter a swivel angle command value of $>95\%$.

Table 16: Errors and their remedy/cause

Fault	Remedy/cause
No voltage supply available	Check voltage supply at the central plug of the electronics
Field bus does not work	Check cabling Check IP address
Fault in the pressure measurement branch	Read out the actual pressure value (p_{act}); it must be 0 bar. The output signal of the pressure transducer must be compatible with the type of the control electronics (current, voltage, zero point).
Fault in the swivel angle measurement branch	Read out the actual swivel angle value (SWA_{act}). In the case of deviations from value $+100\% \pm 3\%$, check the cable connection of the swivel angle sensor.

Further explanations on the fault analysis can be found in chapter 15 “Troubleshooting” on page 79.

1. Close all directional valves upstream of consumers.
2. Open directional valve to the oil tank for pressureless circulation.
3. Before activating the motor, feed forward small command values (e.g. $p = 15$ bar, $SWA = 10\%$).

In this state the VT-DFPF pilot valve signals an error (excessive control error). When the electronics works properly, the error message disappears when the motor is switched on (control error now equal to zero).

- Switch on the drive motor of the pump!

8.1.8 Bleeding the pre-load valve



WARNING

Case interior under high pressure!

Risk of injury! Loosening the screw too far can cause parts and jets of hydraulic fluid to be ejected.

- Do not turn the bleed screw out too far (max. 2 turns)!

If a pump unit is operated with a pre-load valve, this valve has to be air-bled for the initial start-up, provided that the pump does not deliver and aspire oil. Bleeding is not required, when the pump displaces oil. Bleed the pump while the system is running at low operating pressure. To this end, loosen the screw (see Figure below) by a maximum of 2 turns and wait until bubble-free oil flows out. Then, re-tighten the screw.

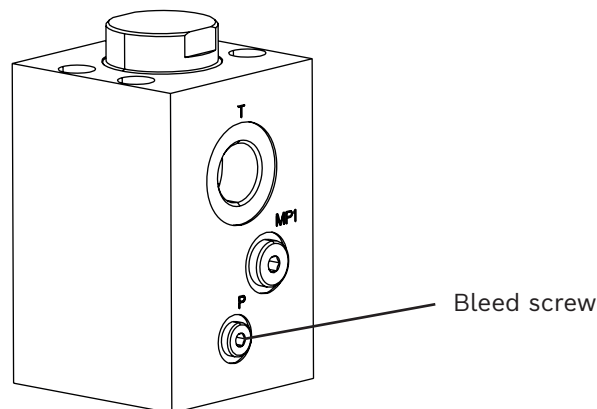


Fig. 24: Bleeding the pre-load valve

8.1.9 Setting controller parameters

The following description is to simplify setting of the controller parameters. Depending on the application, not all of the parameters listed here must be modified.

8.1.9.1 P-gain (proportional gain)

Table 17: P-gain

Parameter	Designation
P-0-2963	Pressure controller P-gain 1 positive
P-0-2964	Pressure controller P-gain 1 negative
P-0-2977	Swivel angle controller P-gain

These controller parameters represent a linear gain, i.e. the output signal and the control deviation are in a proportional relationship. It must be noted here that the positive controller parameter (P-0-2963) is used for building up pressure, whereas the negative controller parameter (P-0-2964) is used for reducing the pressure. The smaller this value is set, the slower is the controller's response. If you select an excessively high value, the system can become unstable.

8.1.9.2 Second P-gain

Table 18: Second P-gain

Parameter	Designation
P-0-2967	Pressure controller control deviation threshold positive
P-0-2965	Pressure controller P-gain 2 positive
P-0-2968	Pressure controller control deviation threshold negative
P-0-2966	Pressure controller P-gain 2 negative

With the extended pressure controller, an inflected characteristic curve for the P-gain is activated. Through targeted gain, optimum controlling can be achieved. As can be seen in the figure below, the second P-gain becomes effective only above the threshold to be set.

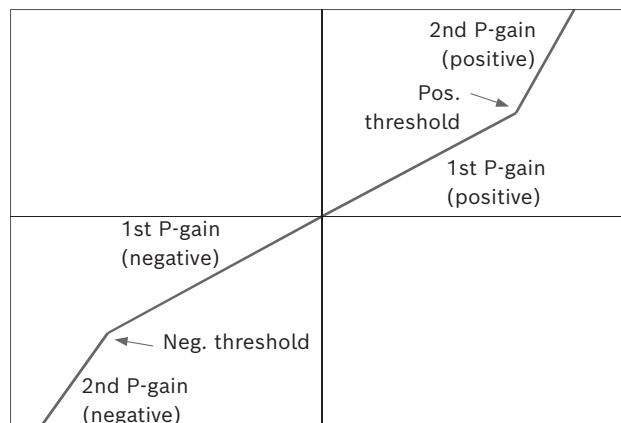


Fig. 25: Second P-gain

8.1.9.3
D-component

Table 19: D-component

Parameter	Designation
P-0-2969	Pressure controller pos. factor for D-component, parallel
P-0-2970	Pressure controller neg. factor for D-component, parallel
P-0-2971	Pressure controller time constant swivel angle feedback
P-0-2978	Swivel angle controller time constant D-component

The D-component scales the change of the actual value signal and ensures a damped transient response of the pressure or swivel angle controller. Differentiation results in a very high sensitivity, which responds also to undesirable signals such as interference and can make the system unstable. In the case of a constant actual value, the D-component does not respond, since the change rate is zero. The higher the D-component, the slower is the system’s response. However, values that are too small cause instability due to the gain of disturbances in the actual pressure value signal.

8.1.9.4
Setting the pressure controller PD-gain

The PD-gain corresponds to the summation of the P-gain and D-components mentioned before, as described in chapter 5.3.1 “Structure of the control“ on page 23.

The values of the P/D-parameters to be set (P-0-2963, P-0-2964, P-0-2969, P-0-2970) vary depending on the application at hand. In general, it is valid that higher values lead to a faster responding control. However, an excessive increase leads to unstable characteristics, since the actual value that is fed back is continuously increasing or decreasing (oscillation). The optimum value of the entire control gain is a compromise between balancing characteristics and stability.

Notes on the setting of the individual parameters are given in the following:

Example 1

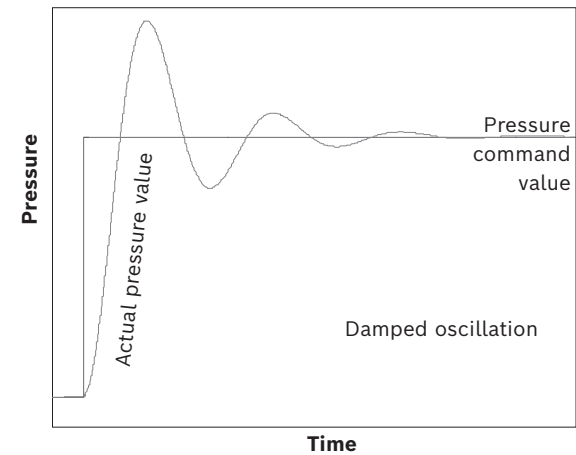
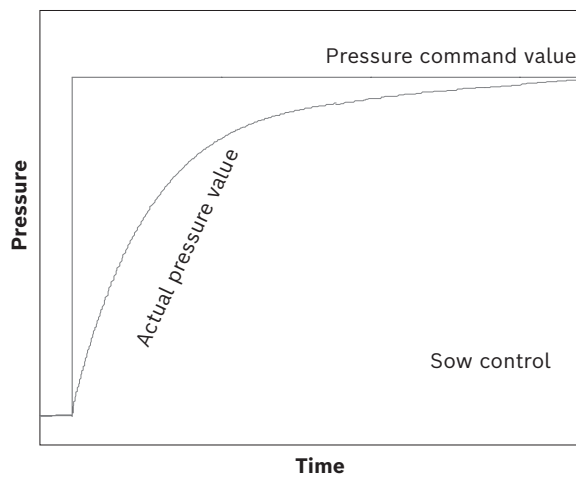


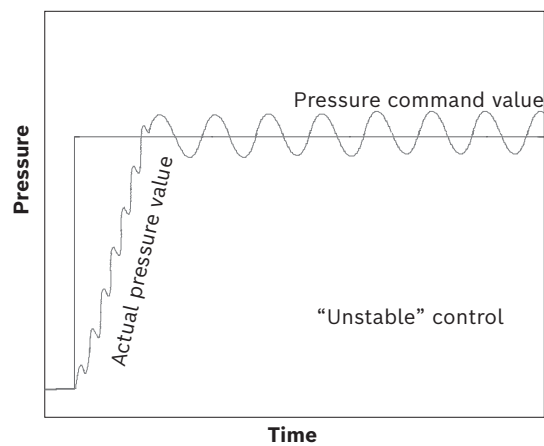
Fig. 26: Damped oscillation

Table 20: Setting of damped oscillation

Step	Behavior/result	Measure
1	Overshoots (damped oscillation)	Increase D-component
2	Actual pressure value still overshooting	Reduce P-gain

Example 2**Fig. 27: Slow control****Table 21: Slow control**

Step	Behavior/result	Measure
1	Slow reaction	Increase P-gain
2	Reaction still slow	Reduce D-component

Example 3**Fig. 28: Unstable control****Table 22: Steps in the case of fast, but unstable reaction**

Step	Behavior/result	Measure
1	Fast, but unstable reaction	Reduce P-gain
2		Reduce D-component

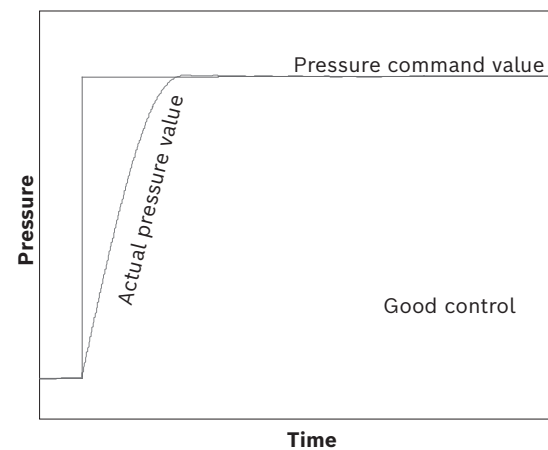


Fig. 29: Good control

If the control behavior is good, no measures need to be taken.

- Gate time**
- The gate time exclusively influences the D-component and reduces the sensitivity to disturbances. These parameters are used to set the number of actual values to be acquired. It must be noted that an increase in the gate time means a time delay of the averaged actual value, which may, under certain circumstances, result in phase shifting and thus in instability. Moreover, the gate time should be a multiple of the pump pulsation (225 Hz at 1500 rpm), i.e. for

 - 50-Hz machines→ gate time 4.4 ms / 8.9 ms / ... / 22.2 ms / ...
 - 60-Hz machines → gate time 3.7 ms / 7.4 ms / ... / 22.2 ms / ...

Table 23: Gate time

Parameter	Designation
P-0-2960	Gate time derivation actual pressure value 1
P-0-2979	Gate time derivation actual pressure value 2

8.1.9.5 Selecting the active actual pressure value

Table 24: Selection of the active actual pressure value

Parameter	Designation
P-0-2950	Pump controller control word

For some applications it may be advantageous to be able to switch between two pressure transducers. This changeover can be carried out with the help of the pump controller control word (P-0-2950, bit 8) and in IndraWorks in the dialog “Actual pressure value acquisition“. With the factory setting, pressure feedback value “1“ is activated.

8.1.9.6 Feedback of actual pressure derivative

Table 25: Feedback of actual pressure derivative

Parameter	Designation
P-0-2973	Filter time for feedback of actual pressure value derivative
P-0-2974	Time constant for feedback of act. pressure value derivative

In the case of low-frequency systems, e.g. cylinders with long strokes or large moved masses, poorly damped vibrations can occur in SWA control. By feeding back the derivative of pressure this vibration can be actively dampened. To this end, the derivative of pressure with negative sign is added to the swivel angle command value. For the derivation of pressure the gate time is used and the value is then filtered using P-0-2973.

In the condition as supplied, the feedback of the pressure derivative is set to the default value of 0, i.e. the function is disabled.

8.1.9.7 Feedforward control factor for slave

Table 26: Reducing the swivel angle difference between master and slave

Parameter	Designation
P-0-2984	Control variable adjustment, scaling feedforward positive
P-0-2985	Control variable adjustment, scaling feedforward negative

The displacement can be increased by coupling several SY(H)DFEx pumps. In order that this SY(H)DFEx system operates approximately synchronously, the valve command value of the master can be provided as feedforward value for the slaves. This reduces the swivel angle difference between master and slave.

Detailed information about the setup of master/slave operation can be found in chapter 5.9 "Master/slave operation" from page 34 onwards and the functional description "HydraulicDrive".

8.1.10 Calibrating the SY(H)DFEF control system

With the help of regular calibration with the calibration functions of the SY(H)DFEF control system, stable system characteristics can be achieved, because long-term drifts are compensated for.

For the calibration of the SYDFEF control system we recommend the following order:

1. Calibration of pressure transducer
2. Calibration of valve
3. Calibration of swivel angle sensor offset
4. Calibration of swivel angle sensor gain
5. Calibration of leakage compensation

Further details on the configuration and activation of calibration functions can be found in the description of the HydraulicDrive firmware.

The individual calibration functions can be started via IndraWorks and the dialog "Pump controller calibration".

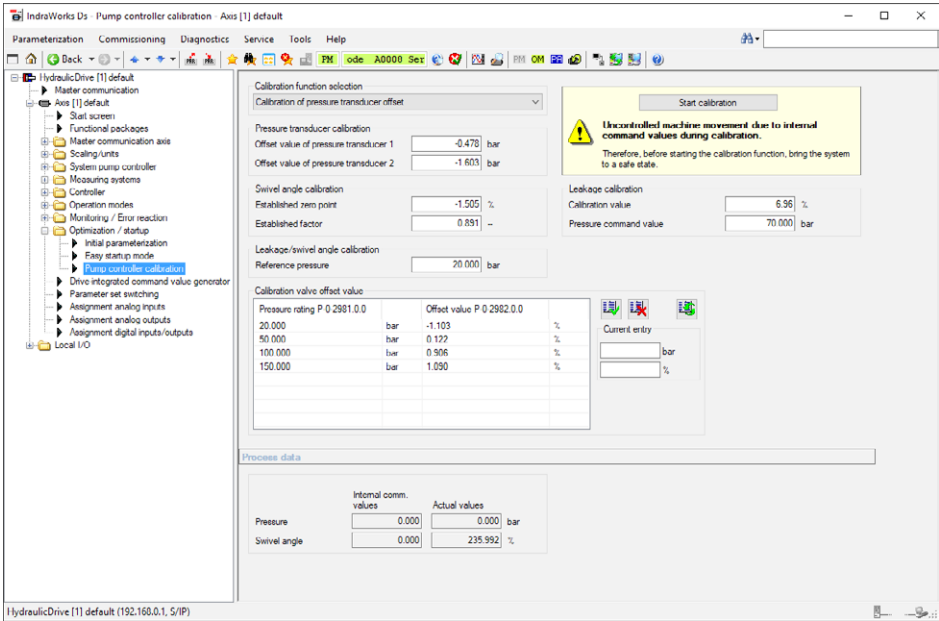


Fig. 30: Calibration



For calibrating the SY(H)DFEF control system, the hydraulic fluid must have reached operating temperature.

8.2 **Recommissioning after standstill**

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

Among others, the following criteria may result in the necessity for recommissioning:

- Air in the hydraulic system
- Water in the hydraulic system
- Aged hydraulic fluid
- Contamination

- For recommissioning, proceed as described in chapter 8.1 “Initial commissioning” on page 59.

8.3 **Running-in phase**

NOTICE

Viscosity too low!

Risk of damage! The increased temperature of the hydraulic fluid during the running-in phase can cause the viscosity to drop to impermissible levels.

- Monitor the operating temperature during the running-in phase.
- Reduce the loading (pressure, speed) of the SY(H)DFEF control system, if impermissible operating temperatures and/or viscosities occur.

Bearings and sliding surfaces are subject to a running-in phase. Increased friction at the start of the running-in phase results in increased heat generation which decreases with increasing operating hours. The volumetric and mechanical-hydraulic efficiency rises as well by the end of the running-in phase of approx. 10 operating hours.



In the case of HFC fluids you must observe the notes on the running-in phase/commissioning in RE 92053!

9 Operation

The SY(H)DFEF control system is a component which requires no adjustments or changes to be made during operation. For this reason, this chapter of the manual does not contain any information on adjustment options. Only use the product within the performance range provided in the technical data. The machine or system manufacturer is responsible for the correct project planning of the hydraulic system and its control.

10 Maintenance and repair

10.1 Cleaning and care

NOTICE

Solvents and aggressive cleaning agents!

Aggressive cleaning agents can damage the seals of the SY(H)DFEF control system and make them age faster.

- ▶ Never use solvents or aggressive cleaning agents.

Penetrating dirt and liquids!

This will result in the fact that safe operation of the SY(H)DFEF control system can no longer be ensured.

- ▶ When carrying out any work on the SY(H)DFEF control system, observe strictest cleanliness.
- ▶ Do not use high-pressure cleaners.

- For cleaning and care of the SY(H)DFEF control system, observe the following:
- ▶ Plug all openings with suitable protective caps/devices.
 - ▶ Check whether all seals and plugs of the plug-in connections are securely seated to ensure that no moisture can enter the SY(H)DFEF control system during cleaning.
 - ▶ Use only water and, if necessary, a mild cleaning agent to clean the SY(H)DFEF control system.
 - ▶ Remove external coarse dirt and keep sensitive and important parts like solenoids, valves and indicators clean.
 - ▶ Do not use high-pressure cleaners for cleaning the SY(H)DFEF control system.

10.2 Inspection

In order that the SY(H)DFEF control system works reliably and for a long time, Rexroth recommends that you inspect the SY(H)DFEF control system regularly at the following maintenance intervals and document the following operating conditions:

Table 27: Inspection schedule

Work to be carried out		Interval
Hydraulic system	Check level of hydraulic fluid in the tank.	Daily
	Check operating temperature (comparable load state).	Weekly
	Analyze quality of the hydraulic fluid.	Annually or every 2000 h (whichever occurs first)
SY(H)DFEF control system	Inspect the SY(H)DFEF control system for leakage. The early detection of hydraulic fluid loss can help identify and rectify faults on the machine or system. For this reason, Rexroth recommends that the SY(H)DFEF control system and the system as a whole always be kept in a clean condition.	Daily
	Check the SY(H)DFEF control system for the generation of noise.	Daily
	Check mounting elements for proper fit.	Monthly
	Inspect all mounting elements while the system is switched off, depressurized and cooled down.	

10.3 Maintenance

SY(H)DFEF control systems require little maintenance when used as intended. The service life of the SY(H)DFEF control system is heavily dependent on the quality of the hydraulic fluid. For this reason, we recommend changing the hydraulic fluid at least once a year or every 2000 operating hours (whichever occurs first) or having it analyzed by the hydraulic fluid supplier or a laboratory to determine its suitability for further use.

The service life of the SY(H)DFEF control system is limited by the service life of the built-in bearings. The service life can be requested on the basis of the load cycle from the responsible Rexroth Service partner, see chapter 10.5 "Spare parts" below. Based on these details, a maintenance interval is to be determined by the system manufacturer for the replacement of the bearings and included in the maintenance schedule of the hydraulic system.

Depending on the order variant, SY(H)DFEx systems contain flexible hoses. Check flexible hoses for their operational safety at regular intervals. According to DIN 20066, the period of use of a flexible hose, including any storage time, should not exceed six years. When this time has elapsed, the flexible hose has to be replaced. Using the flexible hoses at the limits of permissible stress (e.g. high temperatures, frequent load cycles, extremely high pulse frequency, ozone-containing atmospheres), the period of use can be reduced.

If the firmware needs to be updated, see chapter 5.10.2 "Firmware update" on page 37.

10.4 Repair



Rexroth offers a comprehensive range of services for repairing Rexroth SY(H)DFEF control systems.

Repairs of the SY(H)DFEF control system may only be performed by authorized, skilled and instructed staff.

- Use exclusively genuine spare parts from Rexroth for repairs of the Rexroth SY(H)DFEF control system.

Partially tested and pre-assembled original Rexroth assemblies allow for successful repairs within a minimum of time.

- Please state the following data from the nameplate when servicing or repairs are to be carried out:
 - Material number
 - Serial number
 - Production job order number
 - Date of production

10.5 Spare parts

At www.boschrexroth.com you can order spare parts for your pressure/flow control systems directly in the eShop.

When ordering spare parts, please state the material number of the relevant spare parts.

On most of the components, the material number is shown on a nameplate or a label.

At www.boschrexroth.com/en/xc/service/spare-parts/index you can have spare parts shown that can be ordered for your pressure/flow control system and order it directly.

Please address all questions regarding spare parts to your responsible Rexroth Service partner.

Bosch Rexroth AG
Service Hydraulics
Bgm.-Dr.-Nebel-Str. 8
97816 Lohr am Main
Tel: +49 (0) 9352 - 40 50 60
service@boschrexroth.de

For the addresses of foreign subsidiaries, please refer to

www.boschrexroth.com/addresses

10.5.1 Replacement of components

The replacement of some components of the SY(H)DFEF control system is described in the following.

Any further repairs by the user are not permitted!

Swivel angle sensor VT-SWA-...G15 for SYDFEF systems

The operating principle of VT-SWA-...G15 swivel angle sensors, which work with a Hall sensor, is based on the evaluation of a magnetic field related to the rotary angle. The system operates contactless and is therefore wear-free.

In case that repairs have to be carried out on the swivel angle transducer of the SY(H)DFEF system, observe the installation notes for the VT-SWA-...G15 swivel angle sensor and its magnet carrier.

The material number for the kit, magnet carrier and seals included, is R901396459.

General

The magnet carrier is a sensitive component and must therefore be handled with care. It must not be subjected to impacts and be kept away from magnetizable or magnetic parts! Until the carrier is installed in the pump housing, the original packaging is the safest place of storage.

Installing the magnet carrier

- Installation orientation with clockwise rotating pump:
The locating pin of the magnet carrier points towards the subplate of the pump (away from the drive motor). The bore for the locating pin is marked with a color point.
- Insert the magnet carrier into the receptacle provided for it in the housing of the A10 pump.

A special tool (plastic mounting sleeve, material no. R900846331) is required for inserting and tightening the countersunk screw! If this mounting sleeve is not available, use a suitable tool made of non-magnetic material for inserting the mounting screw and for guiding a screw driver between the poles of the magnet.

- ▶ Tighten the countersunk screw M6 x 12 to 10.5 Nm.
- ▶ After having installed the magnet carrier, check with your fingers, whether the magnets positively adhere to the carrier.

Installing the VT-SWA-...-G15 swivel angle sensor

- ▶ “Glue in” the O-ring of the kit in the groove using some grease.
- ▶ Tighten mounting screws M6 x 35 with washers to 15.5 Nm.
- ▶ Adjust the swivel angle sensor. Notes on the adjustment can be found in chapter 15.3.1 “Swivel angle measurement check” on page 83 and in the functional description of the HydraulicDrive firmware in the chapter “Pump controller calibration”.

Miscellaneous

- ▶ If the magnet carrier has to be removed, also use a suitable mounting sleeve for loosening the countersunk screw (see note on “Installing the magnet carrier” above).



If the swivel angle sensor fails, proper operation of the SY(H)DFEF system is no longer possible.

Swivel angle sensor VT-SWA-LIN-...-G15 for SYHDFEF systems

General

The prod is a sensitive component and must therefore be handled with care. In particular with regard to the magnetic properties, the prod must not be subjected to hard impacts and has to be kept away from metal parts! Until the carrier is installed in the pump housing, the original packaging is the safest place of storage.

Installing the VT-SWA-LIN-...-G15 swivel angle sensor

- ▶ Tighten sensor to 25 +5 Nm (27 mm A/F)
- ▶ Adjust the swivel angle sensor. Notes on the adjustment can be found in chapter 15.3.1 “Swivel angle measurement check” on page 83.

Seal kits for the pump

Stating the Mat. no. of the pump you can order seal kits, which are either tailored to certain individual components or offered as complete packages.

Pilot valve VT-DFFP-X-1X

The pilot valve is a component, which is sensitive to contamination. When replacing it, take care that no contaminants can enter fluid-carrying parts of the valve and the pump. To replace the pilot valve loosen the 4 screws at the recessed corners of the nameplate on the pilot valve. After the replacement, tighten the screws to a tightening torque of 9 Nm $\pm$ 1.8 %. Newly installed valves with integrated electronics need to be adjusted:

- ▶ If the parameter settings in the replaced valve differ from the factory setting, the settings have to be adjusted on the valve to be newly installed.

- Carry out a calibration as described in 8.1.10 “Calibrating the SY(H)DFEF control system” on page 69.

Pre-load valve To replace the pre-load valve, loosen the mounting screws and remove the pre-load valve.

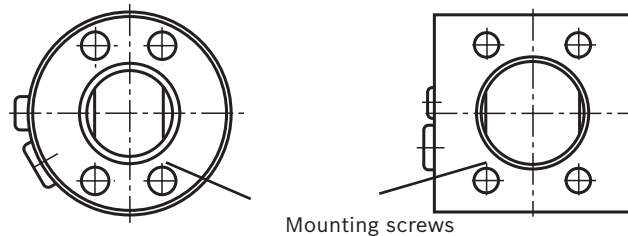


Fig. 31: Mounting bores: left-hand side (round) for NG 18, 28, 25; right-hand side (rectangular) for NG 71, 100, 140, 180

When mounting a new pre-load valve, take care that the seal on the pump side of the pre-load valve is positioned in the recess provided for this purpose. Tighten the mounting screws to the following torque:

Sizes 18, 28 and 45:	45 Nm
Size 71:	55 Nm
Sizes 100, 140 and 180:	100 Nm

After having mounted the pre-load valve on the pump, connect the high pressure and case drain oil pipes as described in chapter 7.3 “Installation positions and piping of SY(H)DFEF systems” on page 43. During re-commissioning, bleed the pre-load valve. Notes on the bleeding procedure can be found in chapter 8.1.8 “Bleeding the pre-load valve” on page 64.

Pressure transducer HM20-X Disconnect the electrical connection on the pilot valve. Replace the pressure transducer by turning out the existing pressure transducer and screwing in a new one. Tighten the pressure transducer to a torque of max. 20 - 25 Nm.

Mounting tool for swivel angle transducer VT-SWA-1 (Hall sensor) for SYDFEF-2X The following fitting tool is available for the magnet carrier:

- For mounting: Plastic sleeve Mat. no. R900846331

11 Decommissioning

The SY(H)DFEF control system is a component that does not require decommissioning. For this reason, this chapter of the present instructions does not contain any information.

12 Demounting and replacement

12.1 Required tools

The product can be demounted using standard tools. No special tools are necessary.

12.2 Preparing demounting

1. Decommission the entire system as described in the general instructions for the machine or system.
2. Depressurize the hydraulic system according to the instructions of the machine or system manufacturer.

12.3 Demounting the SY(H)DFEF control system

CAUTION

Spilled or discharged hydraulic fluid!

Risk of slipping and risk of environmental pollution and contamination of the groundwater!

- ▶ When draining the hydraulic fluid, always place an oil drain pan under the SY(H)DFEF control system.
- ▶ Observe the information in the safety data sheet for the hydraulic fluid and the instructions provided by the system manufacturer.

Proceed as follows to demount the SY(H)DFEF control system:

1. Make sure that the hydraulic system is depressurized.
2. Check that the SY(H)DFEF control system has cooled down sufficiently so that it can be removed without any risks.
3. Place an oil drain pan under the SY(H)DFEF control system to collect any hydraulic fluid that may escape.
4. Loosen the lines and collect the escaping hydraulic fluid in the collector provided for this purpose.
5. Demount the SY(H)DFEF control system. Use suitable lifting gear for this.
6. Drain the SY(H)DFEF control system completely.
7. Plug all openings.

12.4 Preparing the components for storage or further use

- ▶ Proceed as described in chapter 6.2 “Storing the SY(H)DFEF control system” on page 41.

13 Disposal

For disposing of the SY(H)DFEF control system observe the following points:

1. Drain the control system completely.
2. Dispose of the hydraulic fluid in accordance with the national regulations of your country and in accordance with the safety data sheet for the hydraulic fluid.
3. Disassemble the control system to recycle the individual parts.
4. Separate by:
 - Cast iron
 - Steel
 - Non-ferrous metals
 - Electrical waste
 - Plastics
 - Seals

13.1 Environmental protection

Careless disposal of the SY(H)DFEF control system, the hydraulic fluid and the packaging material could lead to pollution of the environment.

- Therefore, dispose of the SY(H)DFEF control system, the hydraulic fluid and the packaging material in accordance with the currently applicable regulations in your country.
- Dispose of hydraulic fluid residues according to the applicable safety data sheets for these hydraulic fluids.

14 Extension and modification

The SY(H)DFEF control system may only be converted or extended in the cases described below using genuine Rexroth SY(H)DFEF components. Other conversions or extensions, also the re-setting of lead-sealed adjustment components, render the warranty void. The replacement of a component with a component of identical design is described in chapter 10.5 “Spare parts” on page 74.

An extension by adding a SYDZ pre-load valve is possible on the SYDFEF control system, but not on the SYHDFEF control system. Please ensure that the size of the pre-load valve and the size of the pump are identical. If an HM20 pressure transducer is already mounted to the pump in the factory, the pressure transducer must be removed and re-mounted to the pre-load valve, because the pressure at the pump and the pressure in pressure port P1 of the pre-load valve may be different.

If an HM20 pressure transducer is mounted on the pre-load valve or the pump of the control system, the pressure transducer can be removed and re-mounted at another position within the system. In this case, the connection for the pressure transducer must be plugged with a plug, which is suitable for high pressure applications. For the installation, observe the notes given in chapter 7.6.7 “Selection, place of installation and mounting orientation of the pressure transducer” on page 56.

15 Troubleshooting

The following table may assist you in troubleshooting. The table is not exhaustive. In practice, problems which are not listed here may also arise.

15.1 How to proceed for troubleshooting

- ▶ Always work systematically and purposefully, even when under time pressure. Random and imprudent disassembly and changing of settings can, in the worst-case scenario, result in the inability to determine the original cause of error.
- ▶ First obtain a general overview of how your product works in conjunction with the entire system.
- ▶ Try to find out whether the product has functioned properly in conjunction with the overall system before the fault occurred.
- ▶ Try to determine any changes of the overall system in which the product is integrated:
 - Were there any changes to the product's operating conditions or operating range?
 - Were there any changes (e.g. retrofit) or repairs carried out on the complete system (machine/system, electrics, control) or on the product? If yes: What were they?
 - Was the product or machine used as intended?
 - How did the fault become apparent?
- ▶ Try to get a clear idea of the error cause. If possible, ask the direct (machine) operator.
- ▶ If you cannot rectify the error, contact one of the contact addresses which can be found at:

www.boschrexroth.com/addresses

15.2 Error/diagnostic message memory

For diagnosis purposes, the SY(H)DFEF control system is fitted with an internal error and diagnostic message memory. To open the error memory, select **"Diagnostics"** → **"Error/diagnostic memory"**.

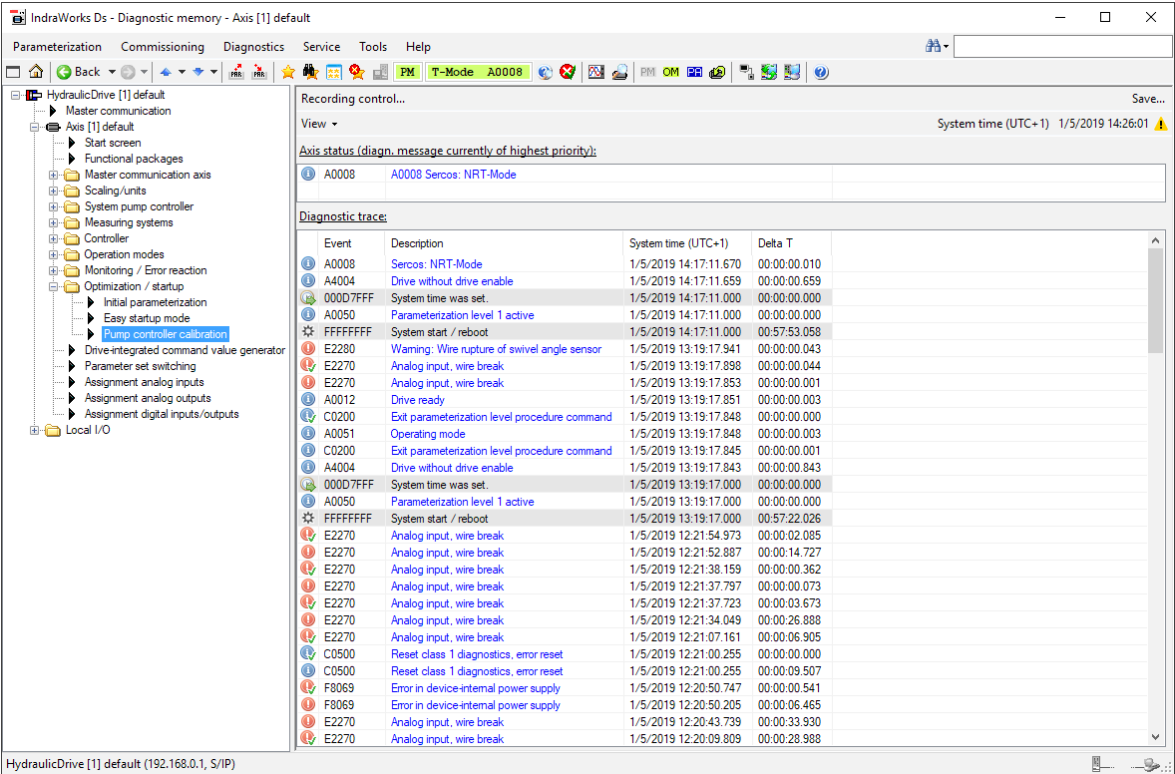


Fig. 32: Error/diagnostic message memory

Table 28: Messages

Meaning of the message	Status of bit 1 of P-0-0115.0.0
Electronics OK	1
Error message present or no controller enable set	0

15.3 Fault table

Table 29: Fault table of SY(H)DFEF control systems

Fault	Possible cause	Remedy
Message “analog input, wire break” at actual pressure value input	Actual pressure value of the relevant pressure transducer fell below or exceeded the limit value, that is, the value is outside the permissible measuring range of the A/D converter.	Test actual pressure value signal (wire rupture, working range, signal type, polarity)
Message “Wire rupture of swivel angle sensor”	Defective swivel angle sensor cable (visual inspection)	Replace swivel angle sensor
	Defective swivel angle sensor	Replace swivel angle sensor
	Internal electronics fault	Have the pilot valve repaired by Rexroth Service or replace pilot valve
Message “Valve error pump controller” (deviation between command and actual position of the valve spool)	Valve spool jams due to contamination	Replace pilot valve (see page 75), contact Rexroth Service
	Internal electronics fault	Replace pilot valve, see page 75

Table 29: Fault table of SY(H)DFEF control systems

Fault	Possible cause	Remedy
Message "Control deviation pump controller"	Backpressure cannot be built up (minimum pressure at the pump 8...10 bar)	Check that the hydraulic system is leak-free and there is no excessive oil consumption
	Drive motor switched off or speed too low	Check electrical control and motor control
	Valve spool does not move as a result of electronics fault	Replace pilot valve, see page 75
	Valve spool jams due to contamination	Replace pilot valve (see page 75), contact Rexroth Service
Humming noise in the pressure control or fluctuations in pressure/flow	Air cushion around the sensor	Bleed control system, pre-load valve (see chapter 8.1.8 on page 64) and pipes completely
	Problem with the cable shield	Connect shield to ground
	Incorrect protective earth connection in the control cabinet	Properly connect protective earth connector
	No connection from M0 to GND	Connect M0 (XH1, pin E) and GND (XH1, pin B) in the control cabinet
	Unfavorable place of installation/mounting technique for the pressure transducer	Change place of installation (e.g. suspended mounting, no minimess line, no throttling point between pump and pressure transducer), see page 57.
	Improperly high gain of the actual pressure value	Reduce P-gain, see chapter 8.1.9.1 on page 65
Screaming noise	Oil level in the tank too low; pump partly aspires air	Top up oil
	Pump aspires air	Change routing of the suction line
	Suction line leaky	Seal suction line
	Pump cavitates when pressure is reduced Diagnosis: Measure, whether the pressure in the pressure line overshoots	Optimize controller, reduce the command value via a ramp or in steps
	Fluid in the tank mixed with air; cooling and/or filtration circuit leaky	Seal
Other unusual noise	Input speed too high	Machine or system manufacturer
	Wrong direction of rotation	Machine or system manufacturer
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too great, suction pressure too low, foreign body in the suction line	Check, whether shut-off valves are open Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid) Air-bleed control system completely, fill suction line with hydraulic fluid Remove foreign particles from the suction line
	Improper mounting of the control system	Check mounting of the control system according to the instructions given by the machine or system manufacturer. Observe tightening torques
	Improper mounting of attachment parts, e.g. coupling and hydraulic lines	Mount attachments in accordance with the instructions of the coupling or fitting manufacturer
	Air in the pump or in the pre-load valve	Bleed pump and pre-load valve
	Wear/mechanical damage to the control system	Replace control system, contact Rexroth Service

Table 29: Fault table of SY(H)DFEF control systems

Fault	Possible cause	Remedy
No or insufficient pressure (< 4 bar)	Faulty mechanical drive (e.g. defective coupling)	Machine or system manufacturer
	Hydraulic fluid not within the optimum viscosity range	Use suitable hydraulic fluid (machine or system manufacturer)
	Drive unit defective (e.g. hydraulic motor or cylinder)	Machine or system manufacturer
	Wear/mechanical damage	Replace control system, contact Rexroth Service
Pressure fixed, ca. 5...12 bar, cannot be changed	Supply voltage not within the permissible range Diagnosis: Check status LEDs	Check, whether central plug XH4 is connected to the pilot valve Check voltage at the last interconnection point (terminal strip) upstream of the pilot valve
	Command value for pressure, swivel angle or power (optional) is 0 bar or 0 %, respectively	If you use, for example, exclusively closed-loop pressure control, provide a swivel angle command value of 100 %
	Swivel angle sensor defective	Check swivel angle measurement, see 15.3.1 on page 83
	Spool jams in pilot valve	Contact Rexroth Service
Pressure too low	Actual pressure value acquisition incorrectly configured	Check actual pressure value in IndraWorks and, if required, correct configuration of actual pressure value acquisition Replace pressure transducer, see page 76 Change the place of installation of the pressure transducer (do not install upstream of the pre-load valve; where appropriate, close to the consumer)
	Pressure transducer defective/not connected Diagnosis: Measure signal from PT and compare with indication on the pressure gauge	Replace pressure transducer, see page 76 Connect pressure transducer
	Control system does not work in closed-loop pressure control	Increase swivel angle command value Check that the hydraulic system is leak-free and there is no excessive oil consumption
	Pilot valve defective	Replace pilot valve, see page 75
Pressure too high	Actual pressure value acquisition incorrectly configured	Check actual pressure value in IndraWorks and, if required, correct configuration of actual pressure value acquisition Replace pressure transducer, see page 76
	Pressure transducer defective/not connected Diagnosis: Measure signal from PT and compare with indication on the pressure gauge	Replace pressure transducer, see page 76 Connect pressure transducer
	Pilot valve defective	Replace pilot valve, see page 75
Insufficient flow	Pressure controller active	Increase pressure command value
	Actual swivel angle acquisition improperly set	Recalibrate swivel angle sensor
	Drive speed too low (slip, incorrect frequency, wrong motor)	Contact machine or system manufacturer
	Damage to the pump (excessive pump leakage)	Rotary group damaged Contact Rexroth Service
	Wear/mechanical damage to the control system	Replace control system, contact Rexroth Service

Table 29: Fault table of SY(H)DFEF control systems

Fault	Possible cause	Remedy
Drive motor shuts down due to overloading	Excessive power consumption of the pump	Reduce torque limit
		Reduce swivel angle command value
		Check actual pressure value acquisition
	Overcurrent protection of motor does not work properly	Check setting and function
	Spool jams in pilot valve Diagnosis: Compare actual value and valve command value in IndraWorks	Replace pilot valve, see page 75
	Actual swivel angle value acquisition maladjusted or not working properly	Swivel angle measurement check
Hydraulic fluid temperature too high	Valve electronics defective	Replace pilot valve, see page 75
	Inlet temperature at control system too high	Inspect system, e.g. for malfunction of the cooler, insufficient hydraulic fluid in the tank
	DB in pre-load valve opens Diagnosis: Pipe to the tank heats up	Pressure must be lower than the cracking pressure of the pre-load valve. Keep overshoots and pressure pulsation to a minimum.
	Malfunction of pressure control valves (e.g. high pressure relief valve, pressure cut-off valve, pressure controller)	Contact Rexroth Service
	Control system worn out	Replace control system, contact Rexroth Service

15.3.1 Swivel angle measurement check

The settings for swivel angle measurement are made in the factory. The settings described below must only be made after a replacement of the swivel angle transducer.

Depending on circumstances, a calibration of the swivel angle “100 %” can be conducted while the drive motor is running or at rest.

15.3.1.1 Checking swivel angle “zero” (while system is running)

1. Close all directional valves
2. Apply a swivel angle command value of >50 %
3. Apply a pressure command value of 20 bar
4. Check, whether the actual swivel angle value (α_{act}) is $0\text{ V} \pm 1\text{ mV}$ The resulting actual pressure value must be ca. 20 bar.
5. In case of deviations start the calibration of the swivel angle sensor zero point.

15.3.1.2 Checking swivel angle “100%” (while system is running)

1. Apply a pressure command value of 100 bar, activate pressure controller only in changeover logic
2. Direct the full flow via the actuator, e.g. activate hydraulic motor or set pressure relief valve to ca. 20 bar; in this case, the pilot valve deliberately signals a warning (excessive control deviation)
3. Check, whether the actual swivel angle value (α_{act}) is $100\% \pm 1\%$ In the case of deviations start the calibration of the swivel angle sensor factor.

15.3.1.3 Checking swivel angle “100%“ (while drive motor is switched off)

1. Switch the hydraulic system off and wait for ca. 5 min until the pump has swiveled out mechanically (wait until pressure reduction is completed).
2. Check, whether the actual swivel angle value (α_{act}) is 100 % $\pm$ 1 % In the case of deviations, observe point 3.
3. In some cases, the pump will not swivel out to the positive stop. For this reason, switch the motor on briefly, then switch off, wait until the pump has swiveled out and check the actual swivel angle value. If the actual swivel angle value of 100 % $\pm$ 1 % cannot be reached, switch on drive motor and start calibration of swivel angle sensor factor.

16 Technical data

The technical data of your SY(H)DFEF system are contained in the following data sheets:

SYDFEF series 2X RE 30030

SYDFEF series 3X RE 30630

SYHDFEF series 1X RE 30035

You can find the data sheets on the Internet at

www.boschrexroth.com/ics

The pre-set technical data of your SY(H)DFEF control system are listed in the order confirmation.

Further descriptions and information as well as the engineering tool IndraWorks can be found on the Rexroth website in the product portal “SY(H)DFEF”:

<http://www.boschrexroth.de/sydfef>

<http://www.boschrexroth.de/indraworks>

17 Annex

17.1 List of addresses

Contact for service and spare parts Bosch Rexroth AG
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Bürgermeister-Dr.-Nebel-Strasse 8
97816 Lohr am Main
Germany

Phone +49 (0) 9352/40 50 60
E-mail service@boschrexroth.de

Outside Germany you will find service subsidiaries in your vicinity on the Internet at www.boschrexroth.com

Headquarters Bosch Rexroth AG
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Email my.support@boschrexroth.com

The addresses of our sales and service network and sales organizations can be found at www.boschrexroth.com/addresses

Email address for support Email support.nc-systems@boschrexroth.com

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