

Electric Drives  
and Controls

Hydraulics

Linear Motion and  
Assembly Technologies

Pneumatics

Service

**Rexroth**  
Bosch Group

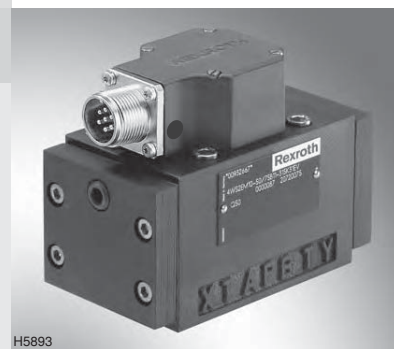
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## 4/3 directional servo-valve with mechanical position feedback

**RE 29583-XH-102-B2/12.11**  
Replaces: 07.11

**Type 4WS2EM 10...XH...-102**

Size 10  
Component series 5X  
Maximum operating pressure 315 bar  
Maximum flow 180 l/min



**ATEX units**  
**For explosive areas**

**Part II Data sheet**



### Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

**II 1G:** Type of protection Ex ia IIC T4 Ga according to EN 60079-0:2009 / EN 60079-11:2007

### What you need to know about these operating instructions

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

- Part I General information 07010-X-B1
- Part II Data sheet 29583-XH-102-B2
- Part III Product-specific instructions 29583-XH-102-B3

**Operating instructions 29583-XH-102-B0**

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

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## Features

- Directional servo-valve for proper use in explosive areas of zone 0
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting, porting pattern according to ISO 4401-05-05-0-05 with ports X and Y subplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:  
External control electronics in modular design, additional safety barrier (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1<sup>st</sup> stage freely accessible from the outside

## Ordering code and scope of delivery

4WS2E	M	10-5X/	B	11	XH				K31		V-102
Electrically operated 2-stage servo valve in 4/3 directional design for <b>external</b> control electronics									102 = Special number <sup>6)</sup>		
Mechanical feedback = M									V = <b>Seal material</b> FKM seals Suitable for mineral oil (HL, HLP) according to DIN 51524		
Size = 10									<b>Spool overlap</b> <sup>5)</sup>		
Component series 50 to 59 (50 to 59: unchanged installation and con- nection dimensions)									E = 0 ... 0.5 % negative		
									D = 0 ... 0.5 % positive		
									C = 3 ... 5 % positive		
<b>Rated flow</b> <sup>1)</sup>									K31 = <b>Electrical connection via connector</b>		
5 l/min = 5									Order mating connector separately, see page 7		
10 l/min = 10									<b>Inlet pressure range to the 1<sup>st</sup> stage</b> <sup>4)</sup>		
20 l/min = 20									210 = 10 to 210 bar		
30 l/min = 30									315 = 10 to 315 bar		
45 l/min = 45									<b>Pilot oil supply and return</b> <sup>3)</sup>		
60 l/min = 60									- = Supply external, return external		
75 l/min = 75									E = Supply internal, return external		
90 l/min = 90									T = Supply external, return internal		
Valve for <b>external</b> control electronics									ET = Supply internal, return internal (ET = Standard version)		
Coil no. 11 (30 mA/85 Ω per coil) <sup>2)</sup>									XH = Explosion protection "type ia"		
									For details see information on the explosion protection, page 6		

### Included in the delivery:

- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

### 1) Rated flow

The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

### 2) External control electronics

The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal. Control electronics (servo amplifier) see page 6.

### 3) Pilot oil

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

### Important:

The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

### 4) Inlet pressure range

Care should be taken that the system pressure is as constant as possible.

Pilot pressure range: 10 ... 210 bar or 10 ... 315 bar

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

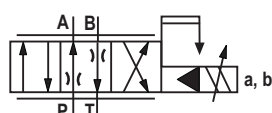
### 5) Spool overlap

The spool overlap is specified in % of the control spool stroke.

### 6) Special number "102"

Without actuation (de-energized condition), channels P → A and B → T are open for 10 % of the nominal quantity.

## Symbol



## Function, section

### 4WS2EM 10...XH...-102

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

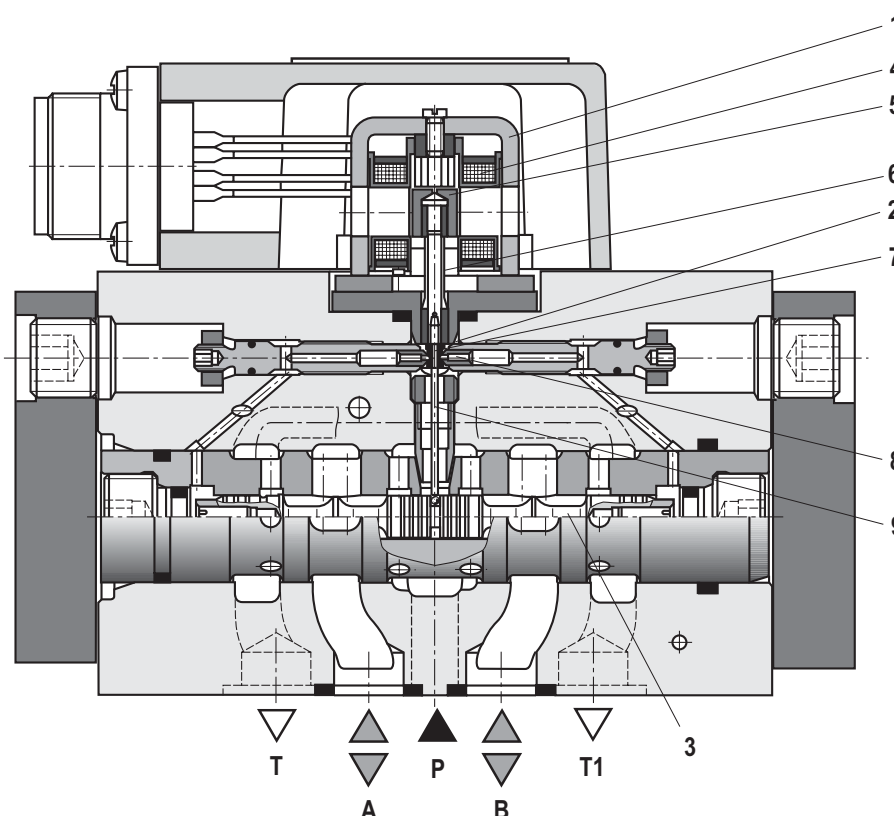
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

#### External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

### Type 4WS2EM 10...XH...-102



## Technical data

### general

Porting pattern	ISO 4401-05-05-0-05
Installation position	Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure ( $\geq 10$ bar!))
Surface protection	Valve body, cover, filter screw Cap
	Nitro-carburated Anodized
Storage temperature range	°C -20 ... +70
Ambient temperature range	°C -20 ... +60
Weight	kg 3.56

### hydraulic (measured with HLP 32, $\vartheta_{oil} = 40$ °C $\pm$ 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 ... 210 or 10 ... 315
	Main valve, ports P, A, B	bar	up to 315
Return flow pressure	Port T		
	Pilot oil return internal	bar	Pressure peaks < 100 permitted
	Pilot oil return external	bar	up to 315
	Port Y	bar	Pressure peaks < 100 permitted, static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	-15 ... +60; preferably +40 ... +50
Viscosity range		mm <sup>2</sup> /s	15 ... 380; preferably 30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 <sup>1)</sup>
Zero flow $q_{V,L}$ <sup>2)</sup> with spool overlap E measured without dither signal		l/min	$\frac{p_p^{(4)}}{70 \text{ bar}} \cdot 0.7 \frac{\text{l}}{\text{min}}$ $\frac{p_p^{(4)}}{70 \text{ bar}} \cdot 0.9 \frac{\text{l}}{\text{min}}$ $\frac{p_p^{(4)}}{70 \text{ bar}} \cdot 1.2 \frac{\text{l}}{\text{min}}$ $\frac{p_p^{(4)}}{70 \text{ bar}} \cdot 1.5 \frac{\text{l}}{\text{min}}$ $\frac{p_p^{(4)}}{70 \text{ bar}} \cdot 1.7 \frac{\text{l}}{\text{min}}$
Rated flows $q_{V, rated}$ <sup>3)</sup> , tolerance $\pm 10$ % with valve pressure differential $\Delta p = 70$ bar (35 bar/edge)		l/min	5 10 20 30 45 60 75 90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 ... 170 120 ... 150
Feedback system			Mechanical
Hysteresis (dither-optimized)		%	$\leq 1.5$
Range of inversion (dither-optimized)		%	$\leq 0.3$
Response sensitivity (dither-optimized)		%	$\leq 0.2$
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of $p_p^{(4)}$	$\geq 30$ $\geq 60$ $\geq 80$
Zero adjustment flow over the entire operating pressure range		%	$\leq 3$ , long-term $\leq 5$
Zero shift upon change of:			
Hydraulic fluid temperature	% / 20 K		$\leq 1$
Ambient temperature	% / 20 K		$\leq 1$
Operating pressure 80 ... 120 % of $p_p^{(4)}$	% / 100 bar		$\leq 2$
Return flow pressure 0 ... 10 % of $p_p^{(4)}$	% / bar		$\leq 1$

<sup>1)</sup> The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see [www.boschrexroth.com/filter](http://www.boschrexroth.com/filter)

<sup>2)</sup>  $q_{V,L}$  = Zero flow in l/min

<sup>3)</sup>  $q_{V, rated}$  = Rated flow in l/min

<sup>4)</sup>  $p_p$  = Operating pressure in bar

## Technical data

### electric

Protection class according to EN 60529:1991+A1:2000	IP 65 with mating connector correctly mounted and locked
Type of signal	Analog
Rated current per coil	mA 30
Resistance per coil	$\Omega$ 85
Inductivity with 60 Hz and 100 % rated current	Connection in parallel H 0.25

In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal

## Information on explosion protection

Range of application as per directive 94/9/EC	II 1G
Type of protection according to EN 60079-0:2009 / EN 60079-11:2007	Ex ia IIC T4 Ga
Ambient temperature range	$^{\circ}\text{C}$ -20 ... +60
Hydraulic fluid temperature range	$^{\circ}\text{C}$ -15 ... +60
Electric supply of the valve only from certified, intrinsically safe electrical circuits with the following maximum values	$U_{\max}$ V 9.3
	$I_{\max}$ mA 390
	$P_{\max}$ mW 907
Conditions for use in zone 0	<p>The valve cap consists of die-cast aluminum. For the use as device of category 1 in zone 0, the valve cap must be protected so that even with rarely occurring malfunctions, no ignitable sparks from friction, impact or grinding can be produced.</p> <p><b>Important:</b> The ignition temperature of the hydraulic fluid used must at least be 150 <math>^{\circ}\text{C}</math>.</p>
Necessary clearance area for burst protection	The specified clearance area for the burst protection (see page 12) must remain free so that in case of error, overpressure can leak through the blanking plug from the valve cap.

## External control electronics

Servo amplifier <sup>1)</sup> in modular design	Analog	Type VT 11021 according to data sheet 29743
Recommended safety barrier <sup>1)</sup>	Single-channel	Company Stahl, type 9001/02-093-390-101

### **⚠ WARNING – Risk of explosion**

– The servo amplifier and the safety barrier must be operated outside the explosive area!

<sup>1)</sup> Order separately

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## Mating connector

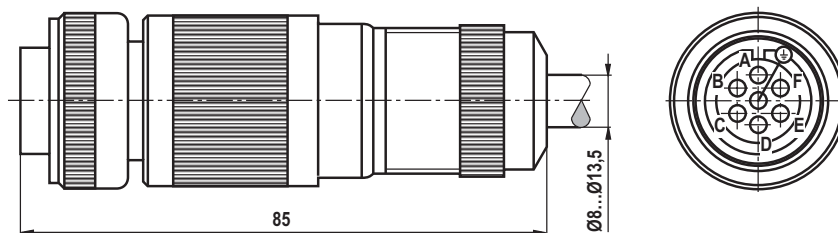
Mating connector according to EN 175201-804

Metal version

Separate order under the Material no. **R900223890**

### Connection:

Solder contacts with connection cross-section  
for litz wires 0.5 ... 1.5 mm<sup>2</sup>



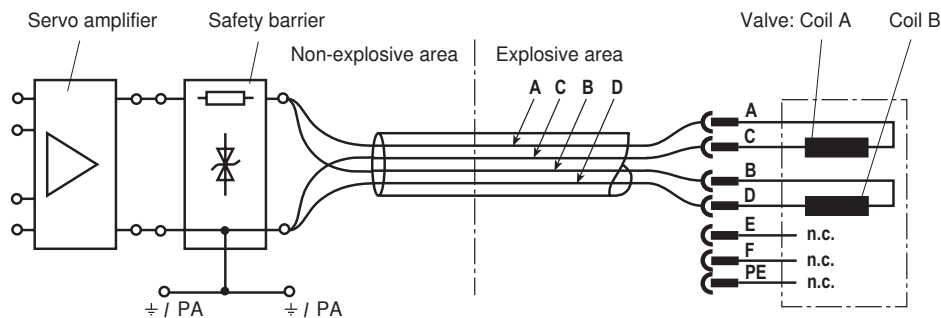
## Electrical connection

The coils may **only be connected in parallel**.

The electrical control with plus (+) at A and B and minus (-) at C and D results in the flow direction P → A and B → T.

The reverse electrical control causes flow direction from P → B and A → T.

Pins E, F and PE at the connector are not connected.



### Important

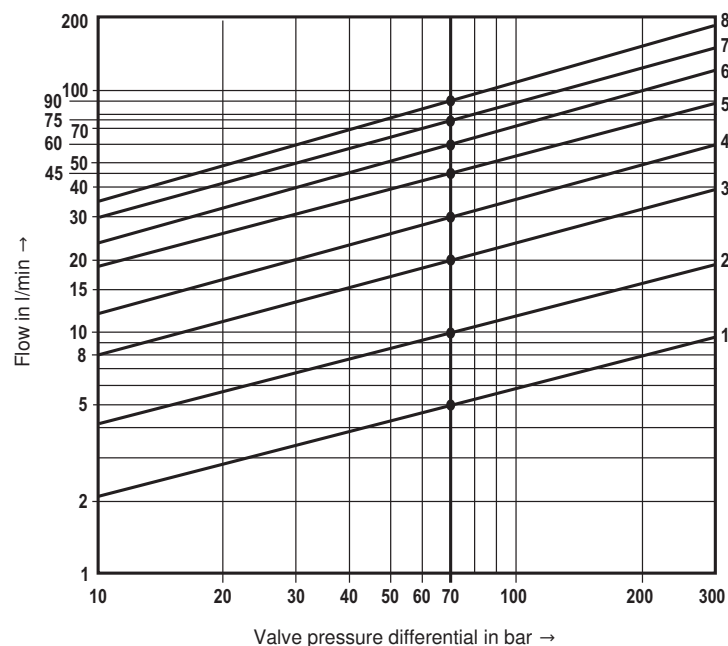
For intrinsically safe electric circuits, only cables and lines approved for that purpose may be used.

## Characteristic curves (measured with HLP32, $\vartheta_{oil} = 40\text{ °C} \pm 5\text{ °C}$ )

**Flow/load function** (tolerance  $\pm 10\%$ ) with 100 % command value signal

Important:

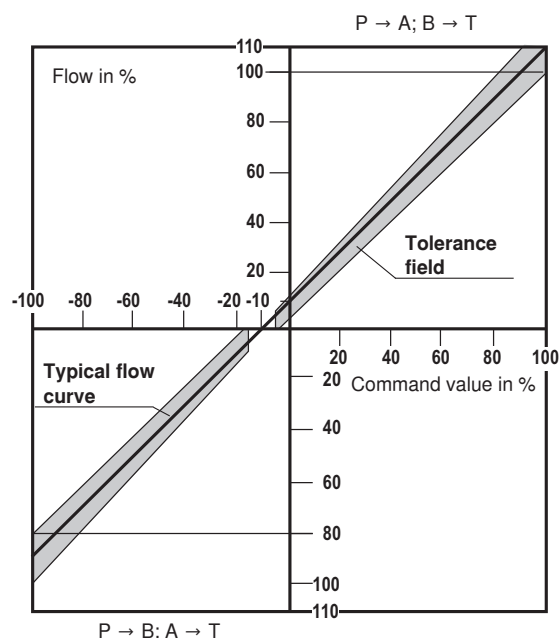
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

$\Delta p$  = Valve pressure differential  
(inlet pressure  $p_p$  minus  
load pressure  $p_L$  minus  
return flow pressure  $p_r$ )

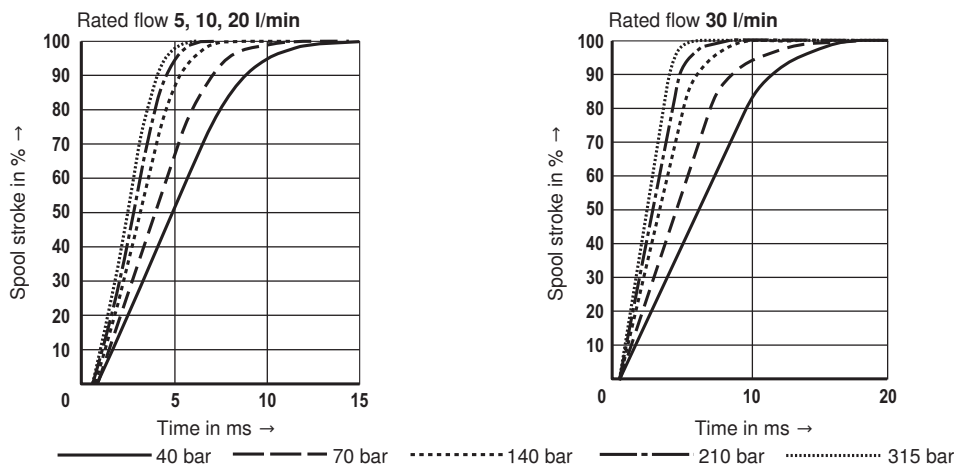
**Tolerance field of the flow/signal function** at constant valve pressure differential  $\Delta p$



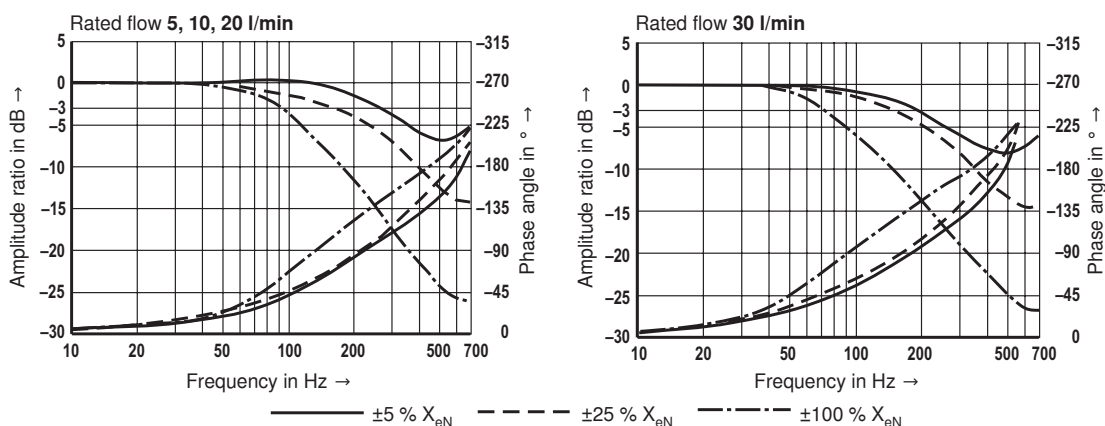


## Characteristic curves (measured with HLP 32, $\vartheta_{oil} = 40 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ )

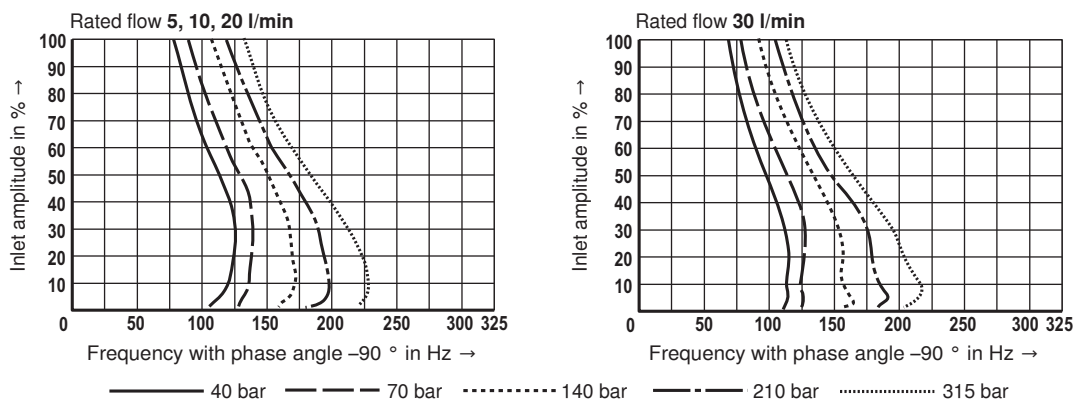
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier <sup>1)</sup>)



Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier <sup>1)</sup>)



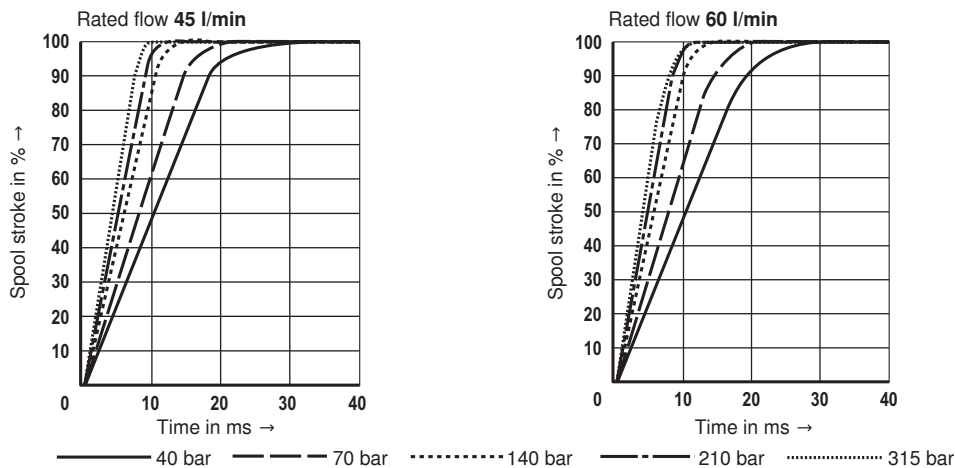
Dependency of the frequency  $f_{at -90^{\circ}}$  on the operating pressure  $p$  and the inlet amplitude (measured with safety barrier <sup>1)</sup>)



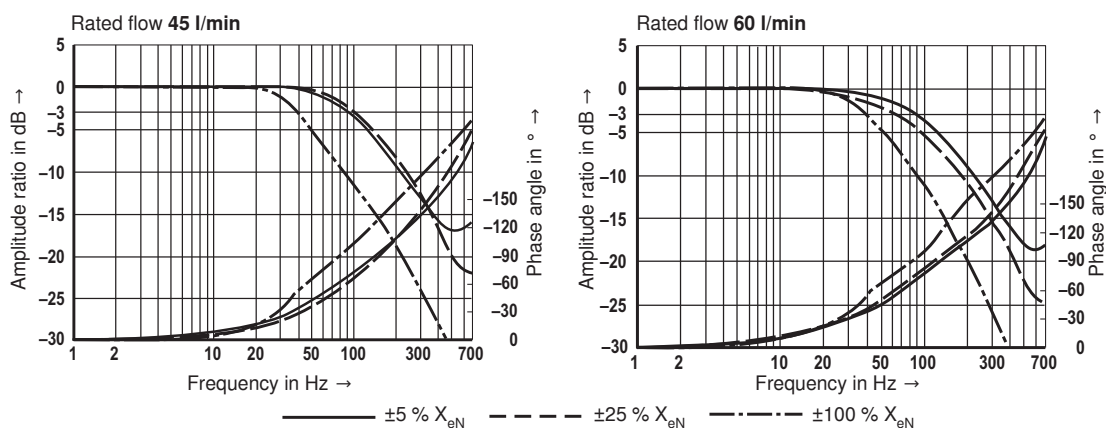
<sup>1)</sup> For information on the safety barrier see page 6 and 7

## Characteristic curves (measured with HLP 32, $\vartheta_{oil} = 40 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ )

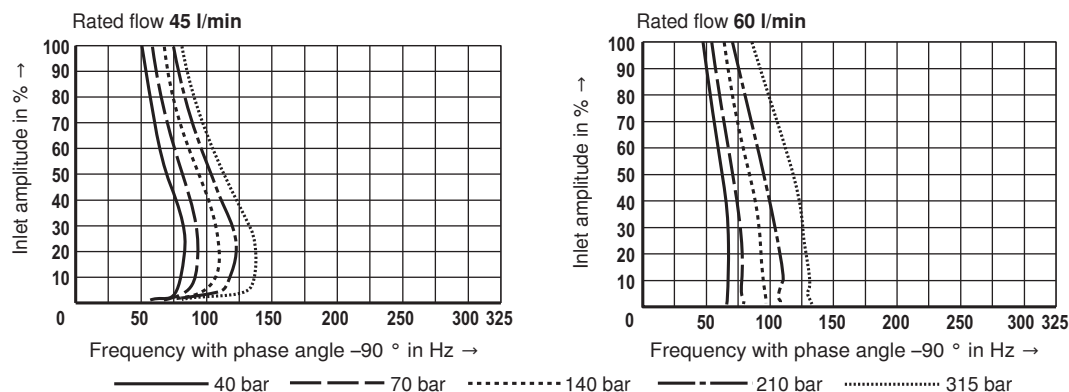
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier <sup>1)</sup>)



Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier <sup>1)</sup>)



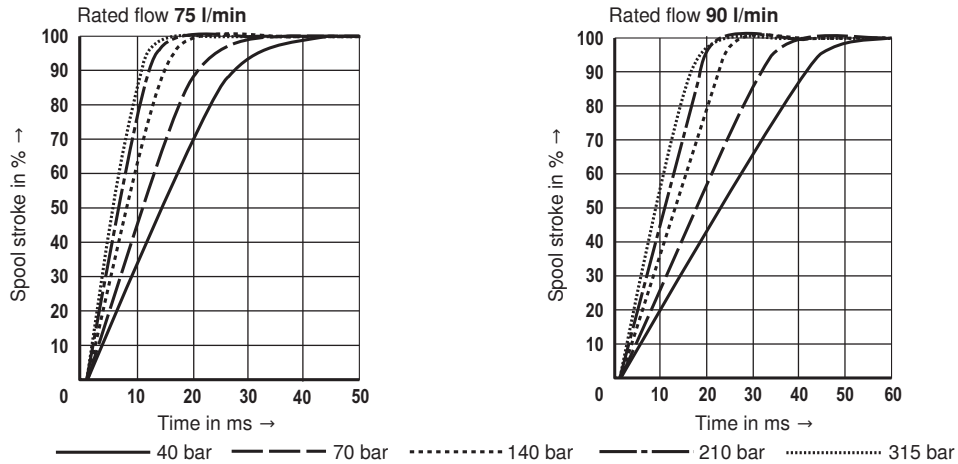
Dependency of the frequency  $f$  at  $-90^{\circ}$  on the operating pressure  $p$  and the inlet amplitude (measured with safety barrier <sup>1)</sup>)



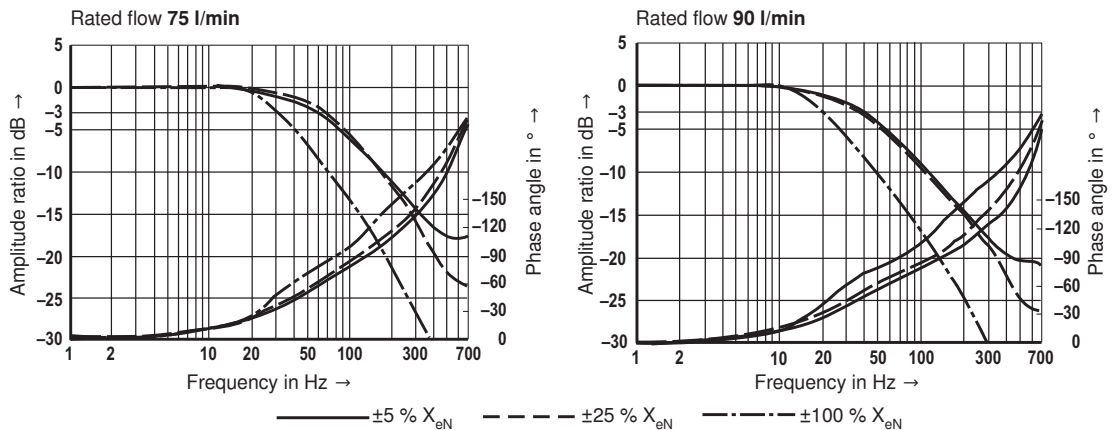
<sup>1)</sup> For information on the safety barrier see page 6 and 7

## Characteristic curves (measured with HLP 32, $\vartheta_{oil} = 40 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ )

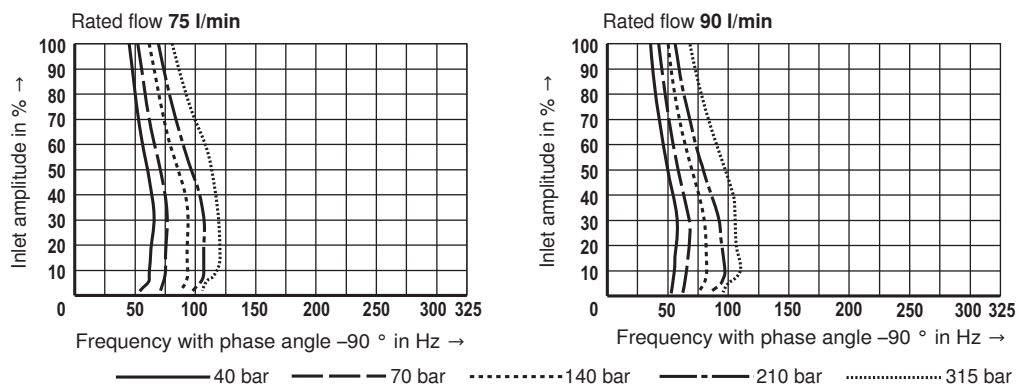
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier <sup>1)</sup>)



Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier <sup>1)</sup>)

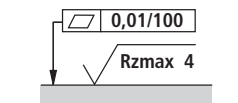
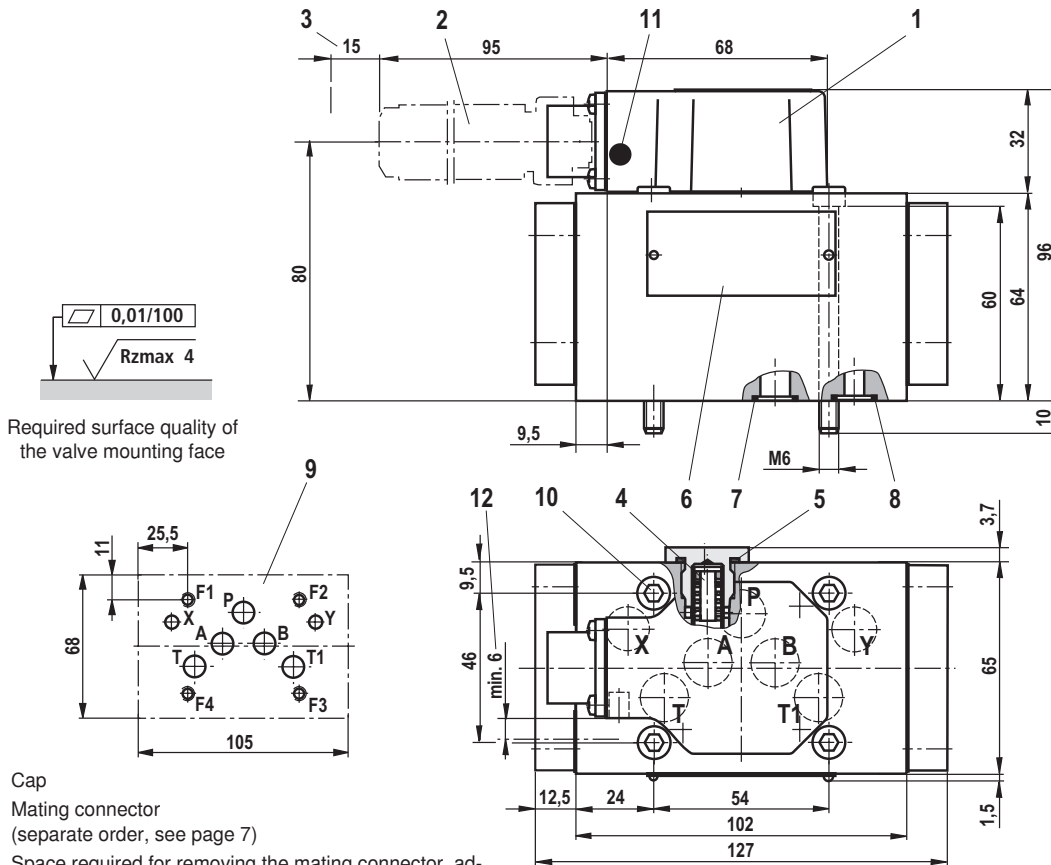


Dependency of the frequency  $\text{fat } -90^{\circ}$  on the operating pressure  $p$  and the inlet amplitude (measured with safety barrier <sup>1)</sup>)



<sup>1)</sup> For information on the safety barrier see page 6 and 7

## Unit dimensions (dimensions in mm)



Required surface quality of the valve mounting face

- 1 Cap
- 2 Mating connector (separate order, see page 7)
- 3 Space required for removing the mating connector, additionally observe the bending radius of the connection line
- 4 Exchangeable filter element with seals  
Material no.: **R961001950**
- 5 Profile seal for filter screw M16 x 1.5, part of item 4
- 6 Name plate
- 7 Identical seal rings for ports P, A, B, T and T1
- 8 Identical seal rings for ports X and Y  
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
- 9 Processed valve mounting face  
Porting pattern according to ISO 4401-05-05-0-05  
Port T1 is optional and is recommended for reducing the pressure differential from B → T with rated flows > 45 l/min.
- 10 Valve mounting screws  
For reasons of stability, exclusively the following valve mounting screws may be used:  
**4 hexagon socket head cap screws  
ISO 4762-M6x70-10.9-fZn-240h-L  
(Friction coefficient 0.09 – 0.14 according to  
VDA 235-101) (included in the delivery)**

- 11 Burst protection
- 12 Clearance area for burst protection

### Subplates

G 66/01 FE/ZN (G3/8)  
G 67/01 FE/ZN (G1/2)  
with ports X and Y:  
G 535/01 FE/ZN (G3/4)  
G 535/02 FE/ZN (M27 x 2)  
G 536/01 FE/ZN (G1)  
G 536/02 FE/ZN (M33 x 2)  
with dimensions like in data sheet 45054 (must be ordered separately)

### Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

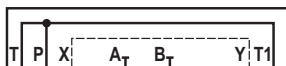
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

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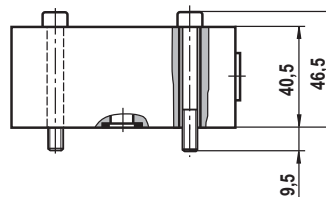
## Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol



### Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws  
For reasons of stability, exclusively the following mounting screws may be used:  
**4 hexagon socket head cap screws**  
**ISO 4762-M6x50-10.9-flZn-240h-L**  
(friction coefficient 0.09 - 0.14 according to VDA 235-101)  
(included in the delivery)



### Important

Before the assembly, observe the information in the Product-specific instructions 29583-XH-102-B3, section 3.2.

## Notes

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