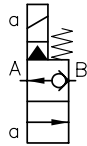


# 2/2-way directional seated valves type EM and EMP

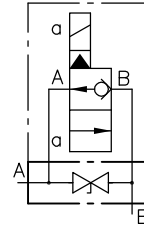
for oil hydraulic systems, zero leakage in blocked state, available as on/off, soft-shift or proportional valve

Operation pressure  $p_{max}$  = 450 bar  
Flow  $Q_{max}$  = 160 lpm



Cartridge valve  
(see section 2)

Example: **EMP 21 V**



Cartridge valve with indiv. connection block for pipe connection or by means of a banjo bolt (see section 3)

Example: **EM 31 V - 3/4 F - G 24**



## 1. General

These 2/2-way directional cone seated valves show zero leakage while in blocked shifting position. The following versions are available:

### Basic version

- Directly actuated, two sizes for up to 5 lpm (type EM..D.. and EM..DS..).  
Application, as piloting or discharge valves for hydraulic consumers, e.g. idle circulation circuit for 2/2-way cartridge valves, 3-way flow control valves or piloted pressure limiting valves.
- Piloted, four sizes for up to 160 lpm.

### Basic flow pattern symbol

- Blocked in idle position, opening when energized (NC-characteristic)
- Open in idle position, blocking when energized (NO-characteristic)

### Switching characteristics

- On/Off, version with defined flow direction (type EM 11 ... EM 41) as well as for arbitrary flow direction (type EM 12 ... EM 42)
- Soft-shift, hydraulically dampened shifting "hydraulic ramp" (type EMP.. VG.. and EMP.. SG..)
- Proportional, prop. throttle (type EMP.. V.. and EMP.. S..)

### Versions

- Cartridge valve
- Cartridge valve with indiv. connection block for direct pipe connection with various additional functions, e.g. drain valve, throttle valve or as manifold mounting valve
- Valve bank – series connection of several valves

The actuation solenoid is a wet armature type, i.e. all moving parts of the valve and the solenoid are lubricated by the hydraulic fluid, the coil cavity is sealed to the outside at the armature tube by means of O-rings. Therefore the solenoid is highly protected against ambient influences e.g. corrosion. The valves are bled automatically during operation.

A tapered pin directly opens or closes the valvular passage with the directly actuated type. Whereas a tapered pin opens (NC) or closes (NO) the piloting duct of a stepped piston with the piloted type. Thereby creating an opening (lifting off from the valve seat) or closing force at the opposing cross section and annular areas which open or close the main valvular passage.

The solenoid acts either on the tapered pin (directly actuated valves) or on the tapered piloting pin (piloted valves) thereby pulling with NC-valves or pushing with NO-valves and always acting against the spring return.

The valve is designed to be self-locking i.e. it is vibration save.

There are various passage cross sections available with type EMP.. to enable a customized shifting characteristic, see curves in sect. 2.2.1.

Control of the prop. valve is via a proportional amplifier (see sect. 5.4). The mounting hole is a simple stepped hole where the transition from one to the next diameter shows a chamfer of 118° (std. point angle of drills). All valve versions of identical size (ON/OFF, soft-shift or prop.) do share the same mounting hole pattern - only exception are non-piloted valves

## 2. Available versions, main data

### 2.1 Directional seated valves, ON/OFF-characteristic

Order example:

**EM 21 S** - **AMP 24 - M**  
**EM 32 V - 3/4 F** - **G 24** - **AT** — Seal spec., see table 5

Function lock, see table 1a

Actuation solenoid, see table 4

**Table 1:** Basic type, ON/OFF — Indiv. connection block, see sect. 2.4

**Note:** Max. permissible pressure only with manifolds made of steel. Observe the reduced strength of the thread for other materials e.g. cast iron, light alloy!

Basic symbol	Basic type	Pressure $p_{\max}$ (bar)	Flow $Q_{\max}$ approx. (lpm)	Flow direction	Symbol	Note
NC-valve	<b>EM 11 D</b> <b>EM 11 D 0,8</b> <b>EM 11 D 1,2</b> <b>EM 21 D</b>	450 150 60 400	1 2.5 5 3	A → B B → A = inadmissible		Non-piloted • For piloting applications
	<b>EM 11 V</b> <b>EM 21 V</b> <b>EM 31 V</b> <b>EM 41 V</b>	400 400 400 350	20 40 80 160	A → B B → A = Free flow, solenoid must be deenergized		Piloted
	<b>EM 12 V</b> <b>EM 22 V</b> <b>EM 32 V</b> <b>EM 42 V</b>	400 400 400 350	20 40 80 160	Any		Piloted
NO-valve	<b>EM 11 DS</b> <b>EM 11 DS 0,8</b> <b>EM 21 DS</b>	450 150 400	1 2.5 3	A → B B → A = inadmissible		Non-piloted • For piloting applications
	<b>EM 11 S</b> <b>EM 11 ST</b> <b>EM 21 S</b> <b>EM 31 S</b> <b>EM 41 S</b>	400 400 400 400 350	20 20 40 80 160	A → B B → A = inadmissible		Piloted • With manual emergency actuation (not detailed) • Type .ST with actuation button, see sect. 4.1
	<b>EM 12 S</b> <b>EM 22 S</b> <b>EM 32 S</b> <b>EM 42 S</b>	400 400 400 350	20 40 80 160	Any		

**Table 1a:** Function lock (e.g. for emergency- or initial operation)

**Note:** Only available with type EM 11 DS, EM 21 DS, EM 1. S and EM 2. S!

Coding	Description
(without)	No function lock (std.) but incl. manual emergency actuation
<b>M</b>	Winged nut (fixed laterally via lead seal)

## 2.2 Directional seated valves, soft-shift

**Application:** For delayed activation and deactivation of consumers, e.g. for preventing pressure surges

Order example:

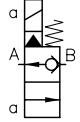
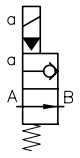
**EMP 21 VG 10 - WG 230**  
**EMP 31 SG - 3/4 - G 24**

Actuation solenoid, table 4

Connection blocks, sect. 2.4

**Table 2:** Basic type, soft-shift

**Note:** Max. permissible pressure only with manifolds made of steel. Observe the reduced strength of the thread for other materials e.g. cast iron, light alloy.

Basic symbol	Basic type	Pressure P <sub>max</sub> (bar)	Flow Q <sub>max</sub> approx. (lpm)	Flow direction	Symbol	Note
NC-valve	<b>EMP 21 VG</b>	400	40	A → B B → A = Free flow, solenoid must be deenergized		Piloted <ul style="list-style-type: none"> <li>Type .VG 10(20) with customized throttling characteristic (see Δp-Q-curve in sect. 4.1)</li> </ul>
	<b>EMP 21 VG 10</b>	400	40			
	<b>EMP 21 VG 20</b>	400	40			
	<b>EMP 31 VG</b> <b>EMP 41 VG</b>	400 350	80 160			
NO-valve	<b>EMP 21 SG</b>	400	40	A → B B → A = inadmissible		Piloted <ul style="list-style-type: none"> <li>With manual emergency actuation (not detailed)</li> <li>Type .SG 10(20) with customized throttling characteristic, see sect. 4.1</li> </ul>
	<b>EMP 21 SG 10</b>	400	40			
	<b>EMP 21 SG 20</b>	400	40			
	<b>EMP 31 SG</b>	350	80			

## 2.3 Prop. directional seated valves, prop. throttle valves

Order example:

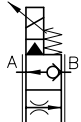
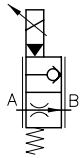
**EMP 21 S 20 - AMP 24 - M**  
**EMP 31 V - 1/4 - G 24**

Actuation solenoid, table 4

**Table 3:** Basic type, prop.

Connection blocks, sect. 2.4

**Note:** Max. permissible pressure only with manifolds made of steel. Observe the reduced strength of the thread for other materials e.g. cast iron, light alloy.  
 A proportional amplifier is mandatory for this valve type. For recommended components, see sect. 5.4.

Basic	Basic type	Pressure P <sub>max</sub> (bar)	Flow Q <sub>max</sub> approx. (lpm)	Flow direction	Symbol	Note
NC-valve	<b>EMP 21 V</b>	400	40	A → B B → A = Free flow, solenoid must be deenergized		Piloted <ul style="list-style-type: none"> <li>Type ..V 10(20,70,80) with customized throttling characteristic (see Δp-Q-curve in sect. 4.1)</li> </ul>
	<b>EMP 21 V 10</b>	400	40			
	<b>EMP 21 V 20</b>	400	40			
	<b>EMP 31 V</b>	400	80			
	<b>EMP 31 V 80</b>	400	80			
	<b>EMP 41 V</b>	400 350	80 160			
NO-valve	<b>EMP 21 S</b>	400	40	A → B B → A = inadmissible		Piloted <ul style="list-style-type: none"> <li>With manual emergency actuation (not detailed)</li> <li>Type .S 10(20) with customized throttling characteristic, see sect. 4.1</li> </ul>
	<b>EMP 21 S 10</b>	400	40			
	<b>EMP 21 S 20</b>	400	40			
	<b>EMP 31 S</b>	400	80			

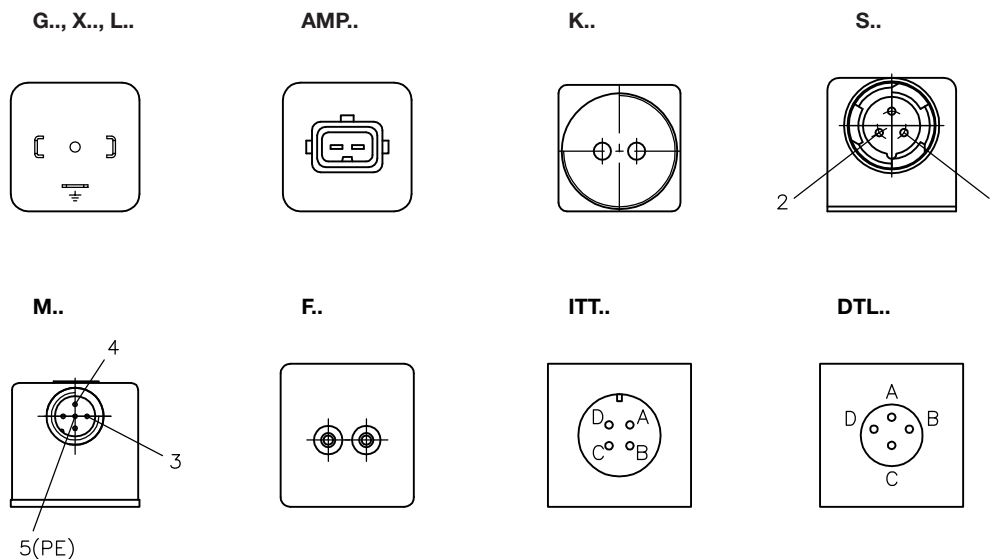
**Table 4:** Actuation solenoid

**Note:**

- The specified protection class is only valid when the plug is properly mounted.
- Type EMP... only 12V DC and 24V DC

Electrical connection	Coding and nom. voltage					Basic valve type			Protection class (IEC 60529)
	12 V DC	24 V DC	48 V DC	110 V 50/60 Hz	230 V 50/60 Hz	EM 1 EM 2 EM 3	EMP 2 EMP 3 EM 4	EMP 4	
DIN EN 175 301-803 A with plug	<b>G 12</b>	<b>G 24</b>	<b>G 48</b>	<b>WG 110</b>	<b>WG 230</b>	•	•	•	IP 65
DIN EN 175 301-803 A without plug	<b>X 12</b>	<b>X 24</b>	<b>X 48</b>	<b>X 98</b>	<b>X 205</b>	•	•	•	(IP 65)
DIN EN 175 301-803 A with LED-plug	<b>L 12</b>	<b>L 24</b>	--	--	--	•	•	•	IP 65
Co. AMP Junior Timer	<b>AMP 12</b>	<b>AMP 24</b>	<b>AMP 48</b>	--	--	•	•	•	IP 65
Co. KOSTAL	<b>K 12</b>	<b>K 24</b>	--	--	--	•	•		IP 67
Co. SCHLEMMER (quarter-turn PA 6)	<b>S 12</b>	<b>S 24</b>	--	--	--	•	•		IP 67
M12x1	--	<b>M 24</b>	--	--	--	•	•		IP 67
With lead ends	--	<b>F 24</b>	--	--	--		•		(IP 67)
MIL-VG 95234	--	<b>ITT 24</b>	--	--	--	•			IP 67
MIL-DTL-38999 series III	--	<b>DTL 24</b>	--	--	--	•			IP 67

**Connection pattern**



**Table 5:** Seal specification, for fluid exposed seals

Coding	Note
(without)	Standard, fluid seals made of NBR or AU, e.g. suited for mineral oil and synth. Ester HEES
<b>PYD</b>	Fluid seals made of FKM
<b>AT</b>	Fluid seals made of EPDM, e.g. suited for glycol based brake fluid (DOT4)

**2.4 Indiv. connection blocks**

Suited for direct pipe connection of manifold mounting

**2.4.1 Indiv. connection blocks without and with drain valve**

Order example:

**EMP 21 S - 1/4 - G 24**

Basic type acc. to table 1, 2, 3

Actuation solenoid, table 4

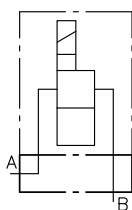
**Table 6a:** Indiv. connection blocks

Coding	Description	Ports A, B (BSPP)	Basic types					
			EM 11 D EM 11 DS	EM 1. V EM 1. S	EM 21 D EM 21 DS	EM. 2. V EM. 2. S	EM. 3. V EM. 3. S	EM. 4. V EM. 4. S
<b>1/4</b>	For pipe connection	G 1/4	•	•	•			
<b>3/8</b>		G 3/8		•		•		
<b>1/2</b>		G 1/2				•	•	
<b>3/4</b>		G 3/4					•	•
<b>1</b>		G 1						•
<b>1 5/16-12 UN</b>		1 5/16-12UN-2B						•
<b>1/4 A</b>	For pipe connection with (accumulator) discharge valve	G 1/4		•				
<b>3/8 A</b>		G 3/8		•		•		
<b>1/2 A</b>		G 1/2				•	•	
<b>3/4 A</b>		G 3/4					•	•
<b>1 A</b>		G 1						•
<b>3/8 N 0,8</b>	For pipe connection with manual bypass valve	G 3/8				•		
<b>3/8 N 1,5</b>						•		
<b>P</b>	For manifold mounting	--			•		•	

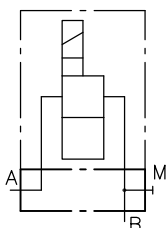
**Symbols**

Below symbols are only exemplary and have to be completed with the flow pattern symbols, see table 1, 2, 3

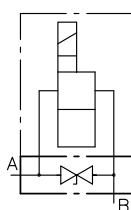
Coding  
**1/4**  
**3/8**  
**1/2**  
**3/4**



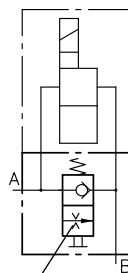
Coding  
**1 5/16-12UN**



Coding  
**1/4 A**  
**3/8 A**  
**1/2 A**  
**3/4 A**  
**1 A**

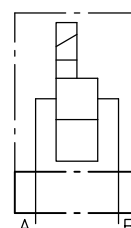


Coding  
**3/8 N 0,8**  
**3/8 N 1,5**



Orifice 0.8 mm or 1.5 mm

Coding  
**P**



**2.4.2 Connection block with additional functions**

Order example: EM 21V - **1/2 F** - K 12  
 EM 11S - **3/8 F - SB15H - 6,3** - G 24  
 EM 11V - **1/4 D** - K 12  
 EM 11S - **3/8 DG 35** - G 24

Basic type acc. to table 1, 2, 3

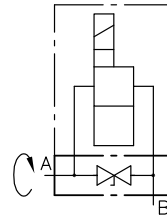
**Table 6b:** Indiv. connection blocks

Coding	Description	Tapped ports conforming ISO 228/1 (BSPP)		Basic type				
		A, F	B	EM 1. V EM 1. S	EM. 2. V EM. 2. S	EM. 3. V EM. 3. S		
<b>3/8 F</b>	Banjo bolt version with (accumulator) discharge valve	G 3/8 A	G 3/8	●	-	-		
<b>16 F</b>		M16x1.5	G 3/8	●	-	-		
<b>1/2 F</b>		G 1/2 A	G 1/2	-	●	-		
<b>3/4 F</b>		G 3/4 A	G 3/4	-	-	●		
<b>3/8 F - SB 1 . H -..</b>	Banjo bolt version with (accumulator) discharge valve and drop-rate braking valve acc. to D 6920 <b>Note:</b> p <sub>max</sub> = 315 bar	G 3/8 A	G 3/8	●	-	-		
<b>1/2 F - SB 2 . H -..</b>		G 1/2 A	G 1/2	-	●	-		
		Desired flow rate setting acc. to the selected flow rate coding. Flow rate from ... to ... (lpm)						
			<b>1</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>90</b>
		SB 1	2.5 ... 4	4 ... 6.3	6.3 ... 10	10 ... 16	16 ... 25	25 ... 35
		SB 2	16 ... 21	21 ... 28	28 ... 37	37 ... 50	50 ... 57	---
<b>1/4 D</b>	With bypass throttle	G 1/4	G 1/4	●	-	-		
<b>3/8 D</b>		G 3/8	G 3/8	-	●	-		
<b>3/8 DG ..</b>	With pressure switch acc. to D 5440	G 3/8	G 3/8	●	-	-		
		Pressure range coding. Pressure range from ... to ... (bar)						
			<b>33</b>	<b>34</b>	<b>35</b>	<b>36</b>	<b>364</b>	<b>365</b>
		200 ... 700	100 ... 400	20 ... 250	4 ... 12	4 ... 50	4 ... 12	12 ... 170
<b>3/8 SJ 0. C..</b>	With load independent flow limitation B → F via flow control valve type SJ acc. to D 7395. <b>Note:</b> p <sub>max</sub> = 315 bar	G 3/8	G 3/8	-	●	-		
		Desired flow setting acc. to the selected flow range coding. Flow range from ... to ... (lpm)						
			<b>1</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>90</b>
		1.0 ... 1.6	1.6 ... 2.5	2.5 ... 4.0	4.0 ... 6.4	6.4 ... 10.0	6.4 ... 10.0	10.0 ... 15.0

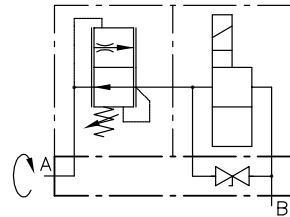
**Symbol**

Symbols to be completed by the flow pattern symbol acc. to sect. 2.1

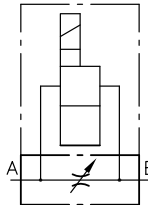
Coding **..F**



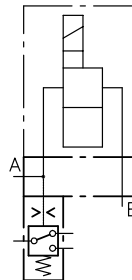
Coding **..F - SB**



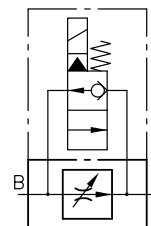
Coding **..D**



Coding **..DG**



Coding **..SJ**



## 2.5 Valve combinations

### 2.5.1 Valve banks type BEM

Order example: BEM 11 - SS - 1/4 - G 12  
 BEM 11 - SS/SS/S - 1/4 - G 24

Basic type and size  
 $Q_{max} = 20 \text{ lpm}$   
 $P_{max} = 400 \text{ bar}$

Actuation solenoid

**Note:** Only available are actuations for 12 or 24 V DC, type G..., X..., L... (see table 4)!

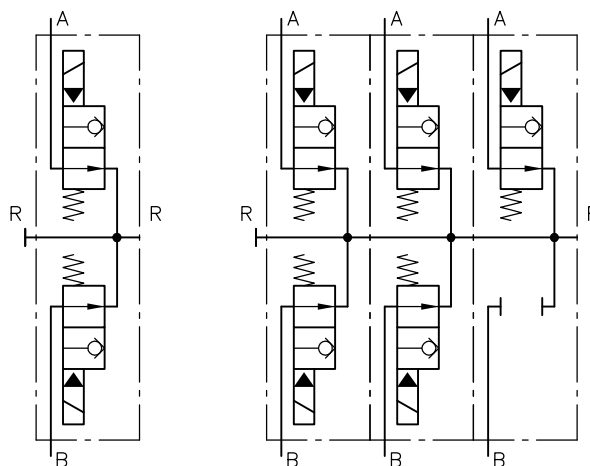
Ports A, B, R = G 1/4 (BSPP)

**Table 7:** Valve sections (max. 10 valve sections can be combined)

Coding	Description
<b>SS, VV, SV, VS</b>	Double valve, (port A = first letter, port B = second letter) S = NO-valve type EM 11 S V = NC-valve type EM 11 V
<b>S, V</b>	Indiv. valve (B-side is blocked)

**Note:** The solenoid coils utilized are not standard as they show a flat side (see also sect. 5.3)

#### Symbols



### 2.5.2 Valve bank type BEMD 21

**Application:** Various different pressure stages can be arbitrarily activated as over-load protection e.g. for the changing operation conditions of cranes

Order example: BEMD 21 - DS 80/DS 140/DS 180 - G 24

Basic type  
 $Q_{max} = 3 \text{ lpm}$   
 $P_{max} = 400 \text{ bar}$

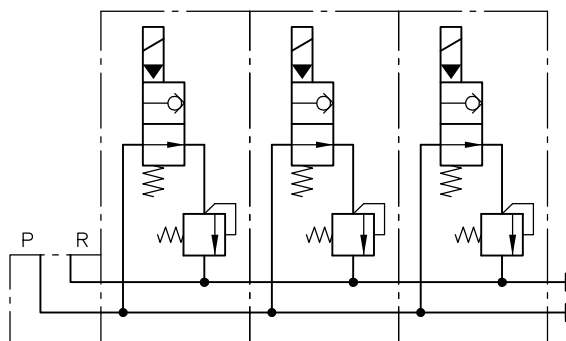
Actuation solenoid table 4

Pressure setting per valve section

**Table 8:** Valve sections (max. 10 valve sections can be combined)

Coding	Description
<b>D</b>	NC-valve, type EM 21 D
<b>DS</b>	NO-valve, type EM 21 DS

#### Symbol



### 3. Further parameters

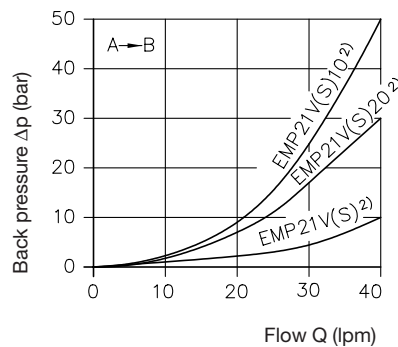
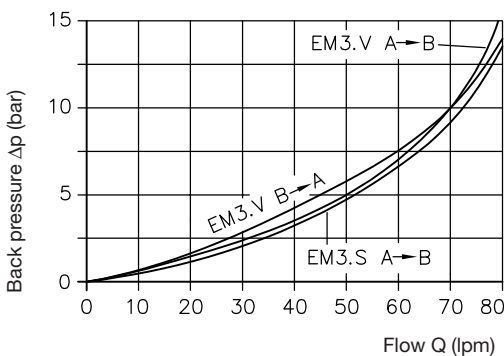
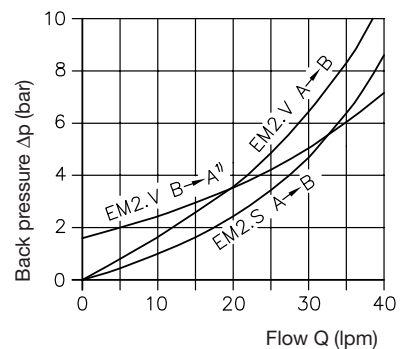
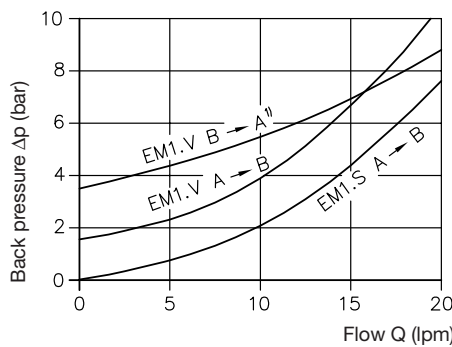
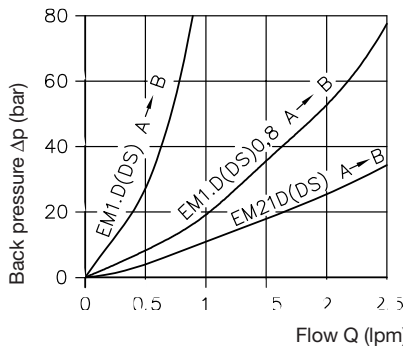
#### 3.1 General and hydraulic data (type EM.. and EMP..)

Nomenclature and design	2/2-way solenoid actuated seated valve (cone seated design)
Installed position	Arbitrary
Operation pressure	$p_{max} = 450 \text{ bar}$ (see restrictions in sect. 2.1); With type EM..V: $p_{min} = 2 \text{ bar}$
Perm. flow	Depending on type (section 2.)
Pressure fluid	Standard (without coding acc. to table 5), hydraulic fluid (DIN 51524 table 1 to 3); ISO VG 10 to 68 acc. to (DIN 51519). The compatibility with the seal material has to be checked, when other pressure fluid types are intended (see table 5)!
Viscosity range	min. 4; max. 1500 mm <sup>2</sup> /s; optimal operation range: 10...300 mm <sup>2</sup> /s Also suitable are biodegradable pressure fluids of the type HEPG (Polyalkylenglycol) and HEES (synth. Ester) at operation temperatures up to +70°C. HETG (seed oil) is not suited. Not suited for water based pressure fluids and see oil (HETG).
Temperatures	Ambient: -40...+80°C Fluid: -25...+80°C, pay attention to the viscosity range! Start temperature down to -40°C are allowable (Pay attention to the viscosity range during start-up!), as long as the operation temperature during consequent running is at least 20K (Kelvin) higher. Biodegradable pressure fluids: Pay attention to manufacturer's information. With regard to the compatibility with sealing materials do not exceed +70°C. <b>Attention:</b> Observe the restrictions regarding the max. permissible operation of the solenoid specified in sect. 3.2 !

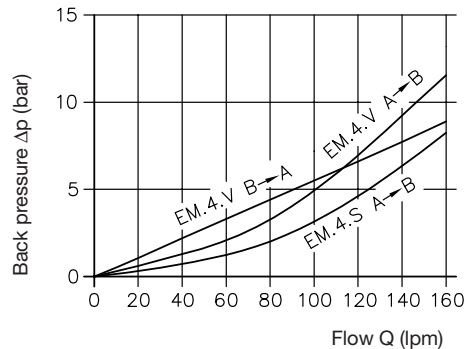
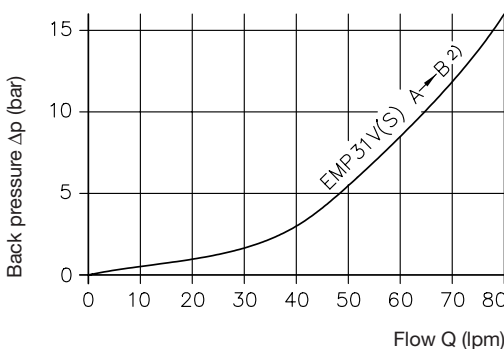
Mass (weight)	Cartridge valves
	EM 1   0.3 kg
	EM 2, EMP 2   0.35 kg
	EM 3, EMP 3   0.4 kg
	EM 4   0.6 kg
	EMP 4   0.7 kg

Indiv. connection blocks, see sect. 4.3  
Valve banks, see sect. 4.4

$\Delta p$ -Q-curves



A→B (EMP)...V energized solenoid  
EM11D(S)..; EM21D(S); EM(P)...S  
deenergized solenoid



- 1) Only with EM...V:  
Free flow B→A, only while solenoid is deenergized
- 2) Applies also to type EMP.. VG..(SG..)  
Non illustrated flow directions are like type EM.. of similar size

Fluid viscosity during measurement 60 mm<sup>2</sup>/s

### 3.2 Electrical data (type EM.. and EMP..)

Nom. voltage	$U_N$		12 V DC	24 V DC	98 V DC	205 V DC
Nom. power	$P_N$	EM 1.., EM 2.., EM 3.. EMP 2.., EMP 3.., EM 4.. EMP 4..	21 W 32 W 30 W	21 W 32 W 30 W	21 W 32 W	21 W 32 W
Nom. current	$I_N$	EM 1.., EM 2.., EM 3.. EMP 2.., EMP 3.., EM 4.. EMP 4..	1.75 A 2.67 A 2.5 A	0.89 A 1.33 A 1.25 A	0.2 A 0.3 A	0.1 A 0.15 A
Max. current	$I_{lim.}$	EM 1.., EM 2.., EM 3.. EMP 2.., EMP 3.., EM 4.. EMP 4..	1.23 A 1.87 A 1.75 A	0.62 A 0.93 A 0.88 A	-- -- --	-- -- --

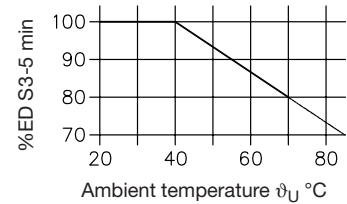
Switching time approx. ms  
 EM..S: On 150 Off 50  
 EM..V: On 50 Off 150  
 The switching times with version WG.. are 2 to 3 times and with type EMP.. VG.. and EMP.. SG.. 5 to 10 times longer

Relative duty cycle: 100% ED (Specification on the solenoid)

Switchings / h approx. 2000 (rather even distributed)

Reference value and restriction in the operation

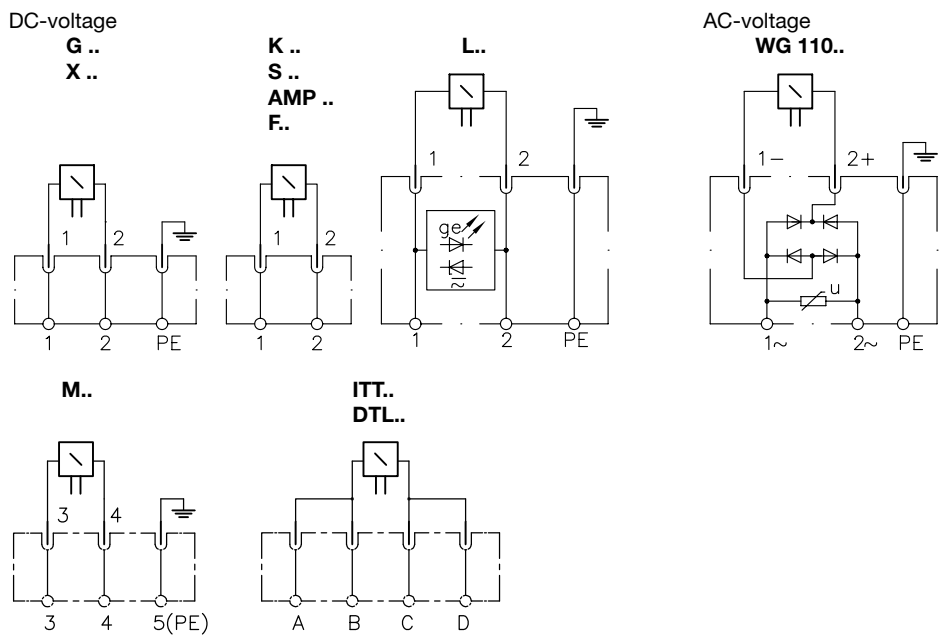
Insulation material class F; Contact temperature approx. 85 ... 95°C (solenoid housing) with an ambient temperature of 20°C. Classification F permits a max. winding temperature of approx. 150°C; This won't be exceeded if the guideline figures for %ED are observed during operation. The thermal load of the coil may be reduced when an economy circuit is employed (see sect. 5.4).



Protection class Depending on actuation solenoid, see table 4

Connector and connection Depending on actuation solenoid, see table 4

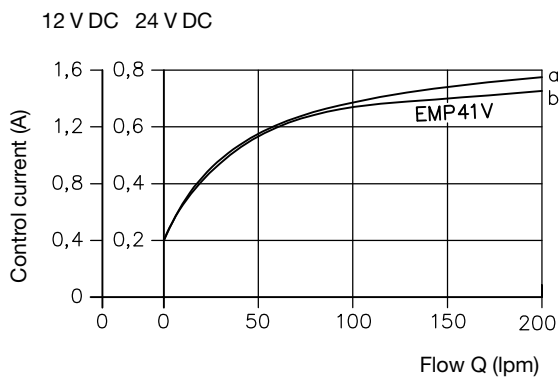
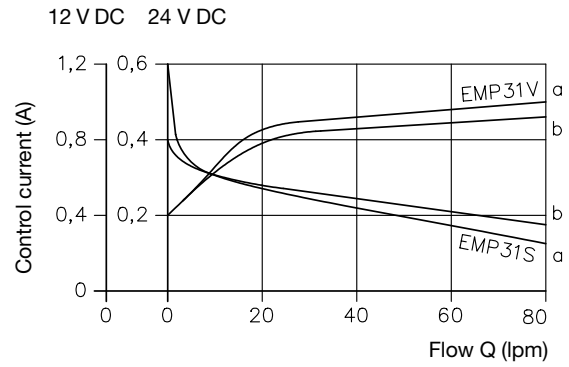
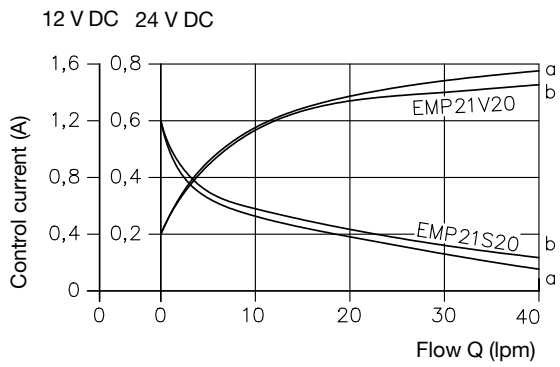
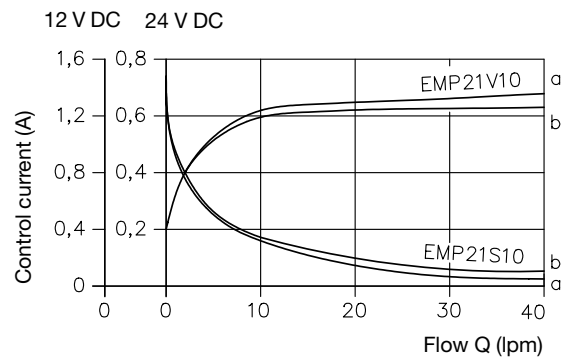
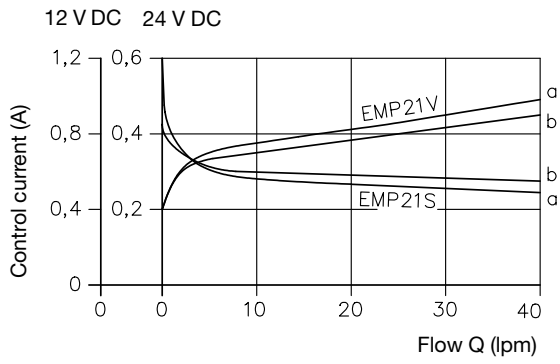
Required connectors  
 Coding K..  
 03888005 Co. KOSTAL  
 Coding S..  
 Taper with quarter-turn 10 SL  
 Co. SCHLEMMER  
 Coding AMP..  
 Co. AMP Junior 2-pole,  
 Coding 1  
 Coding G.., X.., L..  
 DIN EN 175 301-803 A  
 Coding F..  
 Lead length approx. 600 mm



Cut-off energy Guideline for max: approx. < 10 Ws + approx. 10% when measuring at  $U_N$

Dither frequency for type EMP..V(S) 50 ...150 Hz

I-Q-curve



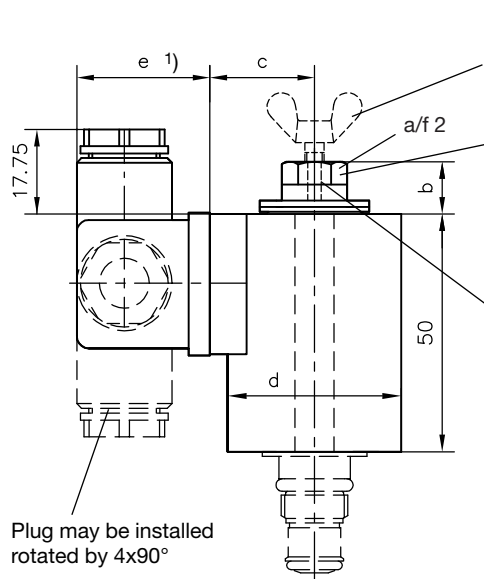
Curve a: Load pressure  $p = 50$  bar;  
 Curve b: Load pressure  $p = 200$  bar

#### 4. Unit dimensions

All dimensions in mm, subject to change without notice

#### 4.1 Valve and actuation solenoid

Coding G..., WG..., X..., L...



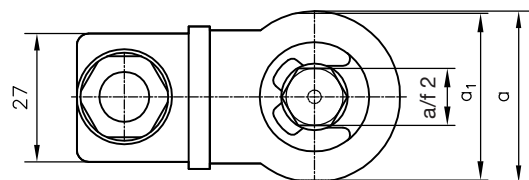
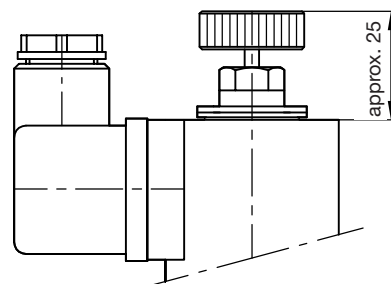
Function lock coding M  
Winged nut is laterally fixed  
at a/f 2, when delivered  
from HAWE

Manual emergency  
actuation with  
EM(P)...S

Actuation force  
at pressure 100 bar  
at A = approx. 70 N

Type	a/f 2	☛ (Nm)
EM 1..	12	30
EM 2..	12	30
EM 3..	12	60
EM 4..	14	90
EMP 2..	14	30
EMP 3..	14	60
EMP 4..	14	90

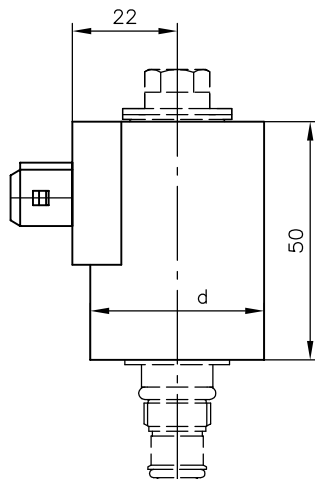
Type EM 11 ST stop coding



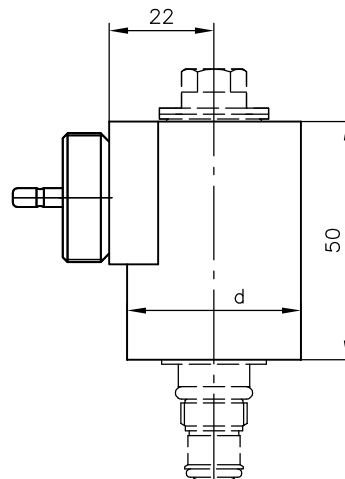
	Type EM 1 EM 2 EM 3	EM 4 EMP 2 EMP 3	EMP 4
a	36.5	---	∅37
a1	---	37.5	-
b	12	15	18.3
c	22	25	28
d	∅36.5	∅38.5	∅37
e	Version	G: WG: L:	29 1) 34 1) 40

1) This dimension depends on the manufacturer  
(of the plug) and may be up to 40 mm acc. to  
DIN EN 175301-803!

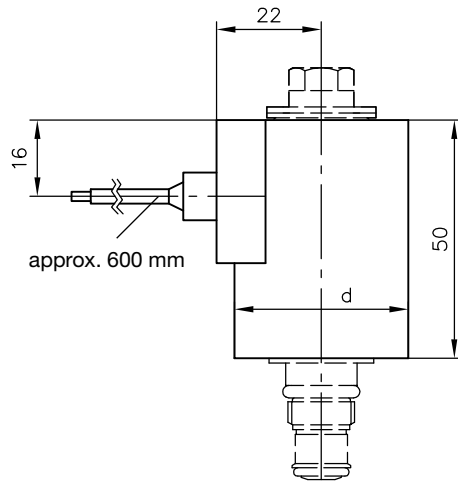
Actuation solenoid  
Coding AMP..



Coding K..

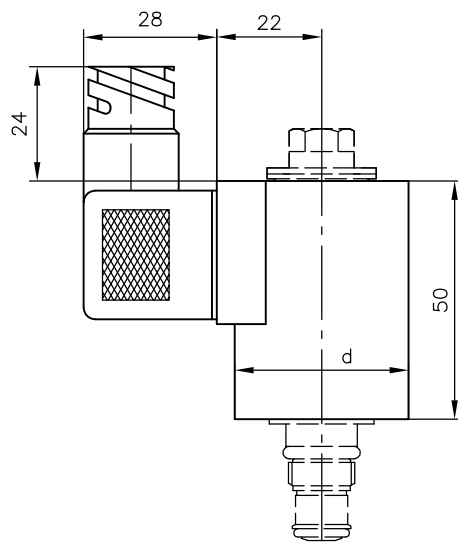


**Coding F..**

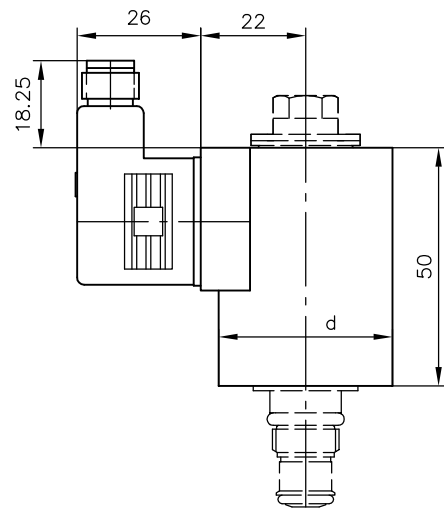


	Type	EM 4	EMP 4
	EM 1	EM 2	
	EM 2	EMP 2	
	EM 3	EMP 3	
d	∅36.5	∅38.5	∅37

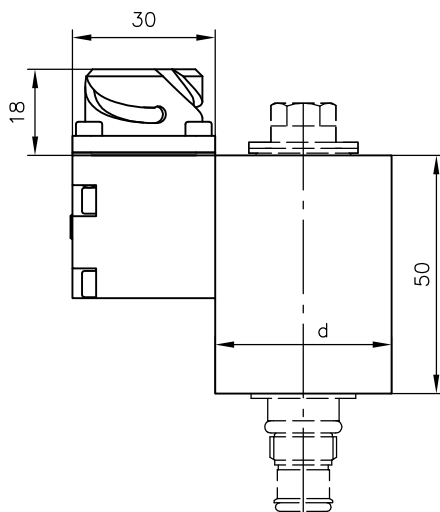
**Coding S..**



**Coding M..**



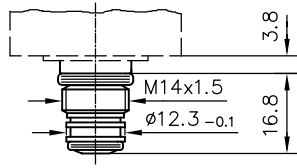
**Coding ITT..  
DTL..**



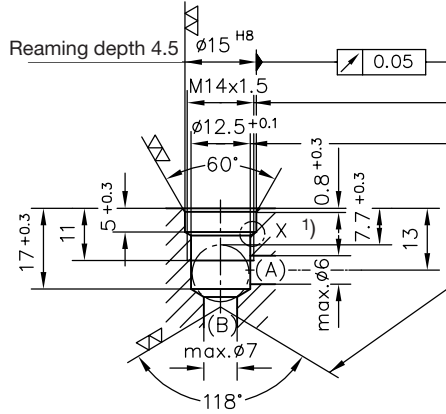
	Type
	EM 1
	EM 2
d	∅37

**4.2 Screwed-in section of the valve**

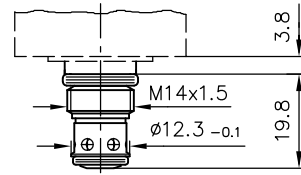
**Type EM 11 D, EM 11 DS**  
**EM 11 D 0,8, EM 11 DS 0,8**



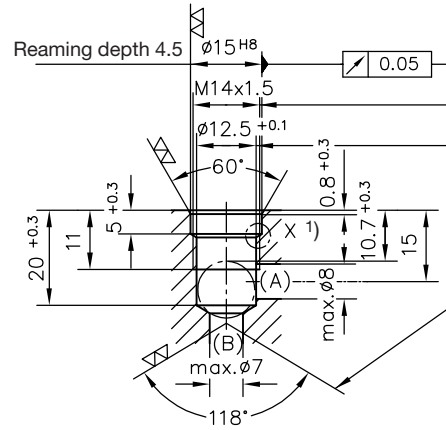
Mounting hole:



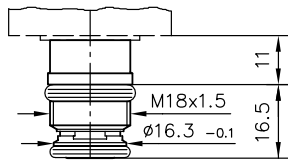
**Type EM 1. V, EM 1. S**



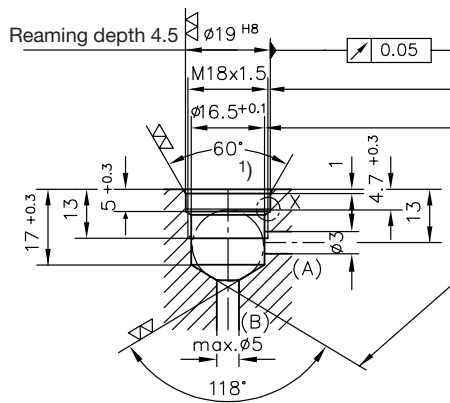
Mounting hole:



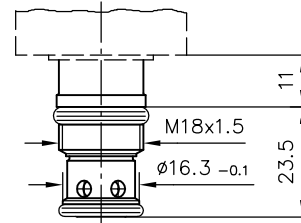
**Type EM 21 D, EM 21DS**



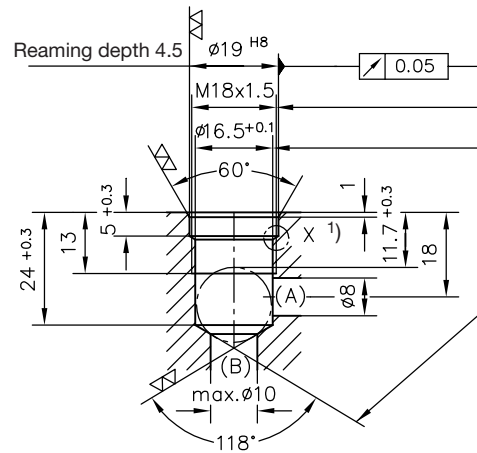
Mounting hole:



**Type EM 2. V, EM 2. S**  
**EMP 21 VG, EMP 21 SG**  
**EMP 21 V., EMP 21 S.**

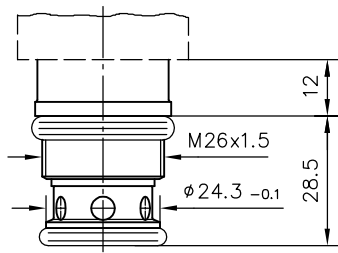


Mounting hole:

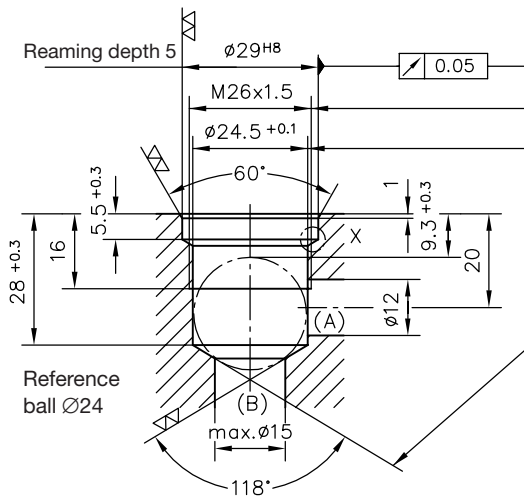


1) Detail "X" see page 14

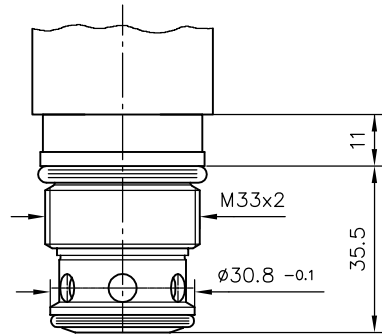
**Type EM 3. V, EM 3. S**  
**EMP 31 VG, EMP 31 SG**  
**EMP 31 V., EMP 31 S..**



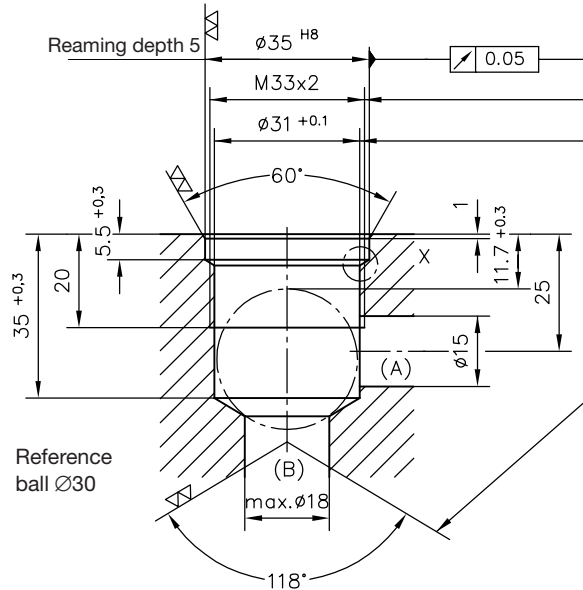
Mounting hole:



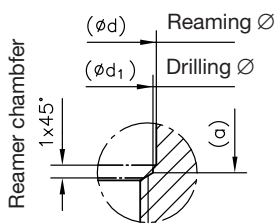
**Type EM 4. V, EM 4. S**  
**EMP 41 V..**



Mounting hole:



**Detail X M 2:1**



Type	$\phi d^{H8}$	$\phi d_1$	$a^{+0.3}$
EM 11(12)	15	14.75	5
EM(P) 21(22)	19	18.75	5
EM(P) 31(32)	29	28.75	5.5
EM(P) 41(42)	35	34.75	5.5

**Attention:**

The angularity of the 118° chamfer of the stepped bore are tolerated with reference to the reamed core diameter  $\phi d^{H8}$  (reaming depth). The stated tolerance must be observed. Also see section 5.1!

### 4.3 Connection blocks

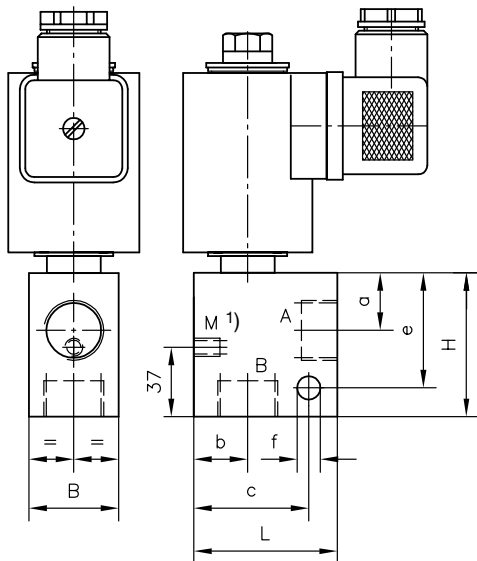
Note regarding the provision for mounting (dimension f):

∅.. -thru-hole, thread M.. on both sides (exception -3/8 N.. only rear side)

Basic type acc.to sect. 2	Coding	Port A and B ISO 228/1 (BSPP)	Main dimensions (mm)									Order No. Connection block with- out valve	Mass (weight) approx. (kg)
			L	B	H	a	b	c	c <sub>1</sub>	e	f		
EM 11 D.. EM 11 DS..	- 1/4	G 1/4	35	20	40	14.5	10	25	--	30	∅ 6.5	7490 013	0.3
EM 1. V(S)	- 1/4	G 1/4	35	20	40	16	10	25	--	30	∅ 6.5	7490 010	0.3
	- 3/8	G 3/8	40	25	40	16	15	32	--	32	∅ 6.5	7490 011	0.3
EM 21 D(DS)	- 1/4	G 1/4	45	30	50	13	14	30	--	35	∅ 8.5	7902 310	0.45
EM 2. V(S) EMP 2. V.(S.)	- 3/8	G 3/8	45	30	50	18	14	30	--	35	∅ 8.5	7491 012	0.35
	- 1/2	G 1/2	50	30	50	18	14	32	--	35	∅ 8.5	7491 013	0.35
EM 3. V(S) EMP 3. V.(S.)	- 1/2	G 1/2	55	40	60	20	20	37	--	38	∅ 10.5	7590 011	0.45
	- 3/4	G 3/4	60	40	60	20	20	40	--	40	∅ 10.5	7590 012	0.45
EM 4. V(S) EMP 4. V.(S.)	- 3/4	G 3/4	65	40	70	25	22	50	--	55	∅ 12.5	7591 011	0.6
	- 1	G 1	70	50	70	25	22	55	--	55	∅ 12.5	7591 012	0.6
	- 1 5/16-12 UN	- 1 5/16-12 UN-2B	81	51	85	25	28	63	--	60	M 12, 12 deep	7591 018	0.7
EM 1. V(S)	- 1/4 A	G 1/4	40	20	45	13	10	35	27	25	∅ 6.3	7490 038	0.3
	- 3/8 A	G 3/8	45	25	45	13	15	40	33	27	∅ 6.3	7490 039	0.3
EM 2. V.(S.. EMP 2. V.(S.. )	- 3/8 A	G 3/8	45	30	50	14	14	28	33	32	M 8, 8 deep	7491 015	0.4
	- 1/2 A	G 1/2	50	30	50	14	14	31	36	32	M 8, 8 deep	7491 016	0.4
EM 3. V.(S.. EMP 3. V.(S.. )	- 1/2 A	G 1/2	56	40	60	20	20	34	42	36	M 10, 10 deep	7590 015	0.5
	- 3/4 A	G 3/4	60	40	60	20	20	40	46	40	M 10, 10 deep	7590 016	0.5
EM 4. V(S)	- 3/4 A	G 3/4	65	40	70	25	22	41	49	45	M 12, 12 deep	7591 015	0.6
	- 1 A	G 1	70	50	70	25	22	47	52	50	M 12, 12 deep	7591 016	0.6
EM 2. V.(S.. EMP 2. V.(S.. )	- 3/8 N 0,8	G 3/8	50	40	50	18	14	25	--	--	M 8, 10 deep	7902 150	0.4
	- 3/8 N 1,5												
EM 21 D(DS) - P EM(P) 3. - P	P	---										7902 360	0.3
												7903 140B	0.6

#### Coding

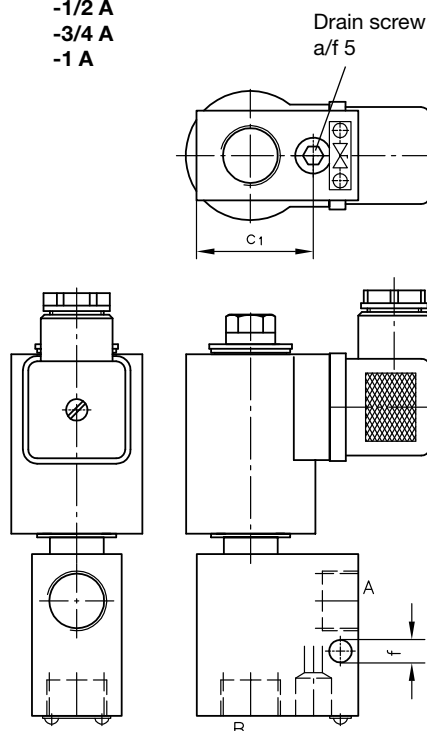
-1/4  
-3/8  
-1/2  
-3/4  
-1  
-1 5/16-12 UN



1) only coding - 1 5/16-12 UN  
M = 7/16-20 UNF-2B

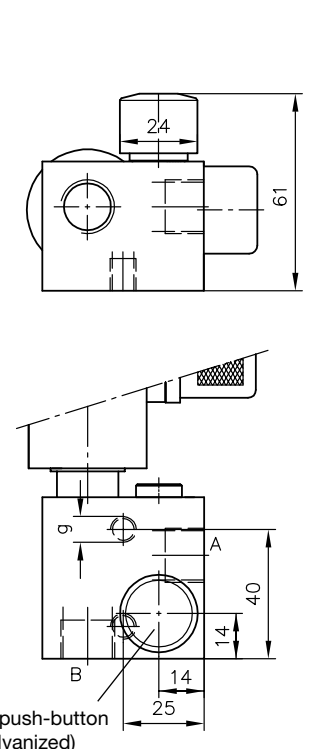
#### Coding

-1/4 A  
-3/8 A  
-1/2 A  
-3/4 A  
-1 A

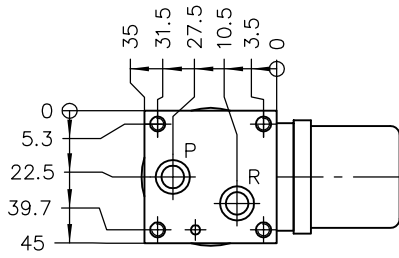


#### Coding

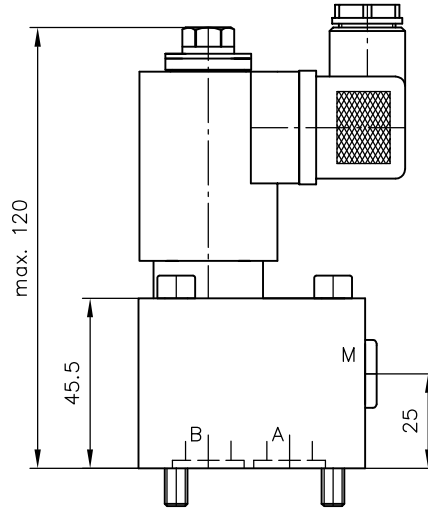
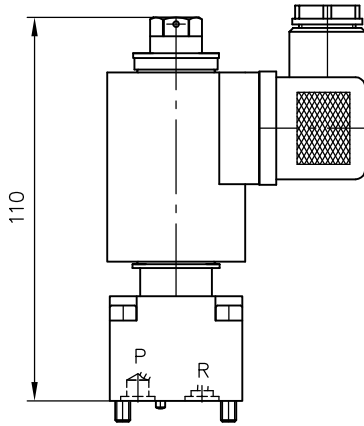
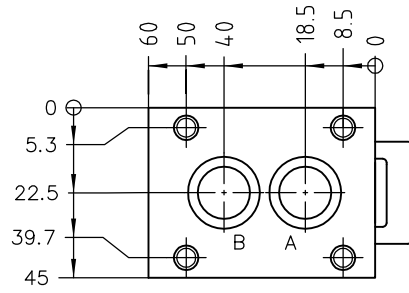
-3/8 N 0,8  
-3/8 N 1,5



Type EM 21 D - P  
EM 21 DS - P

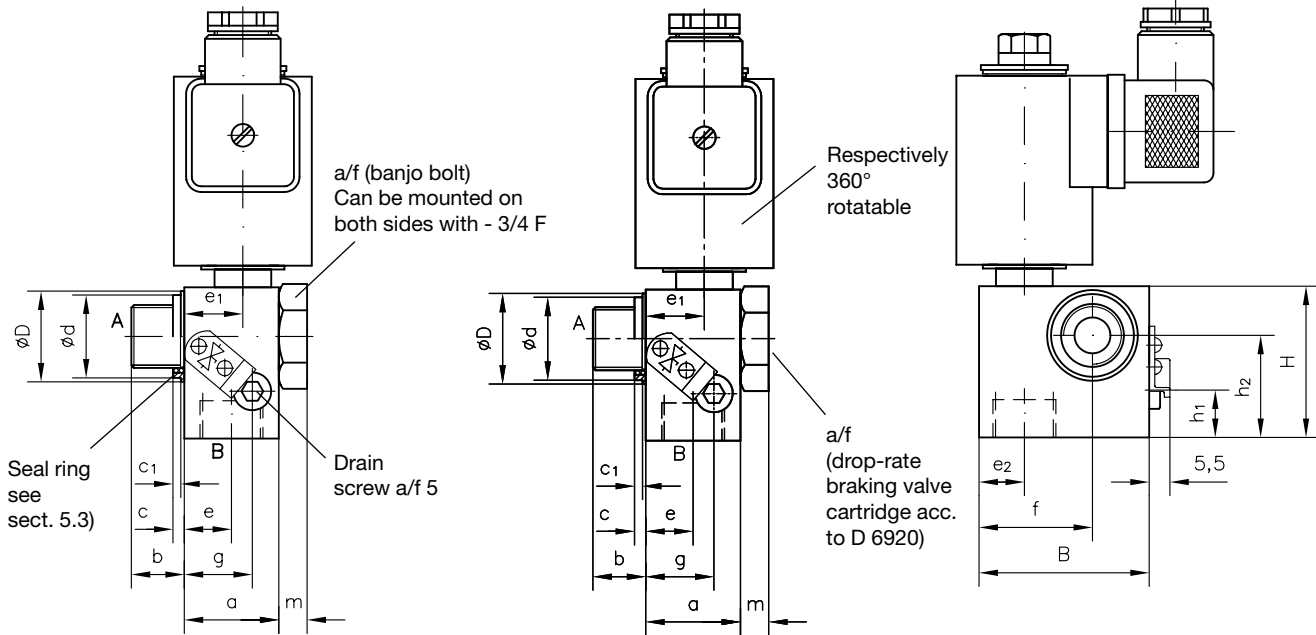


Type EM 3. - P  
EMP 3. - P



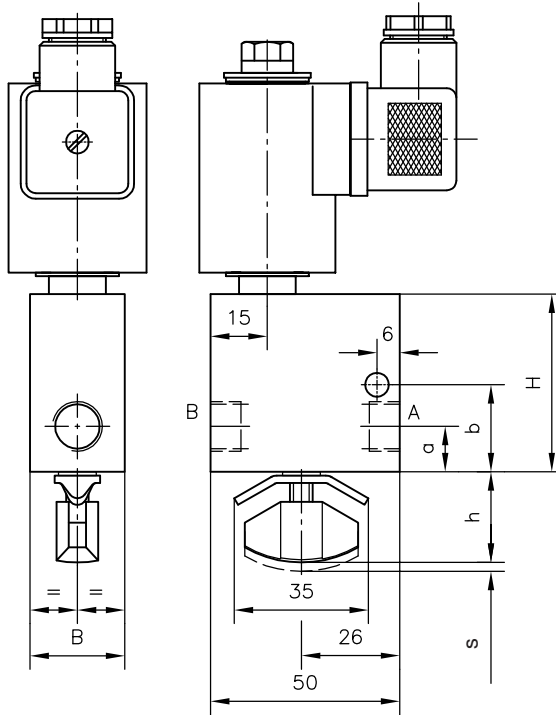
Type EM 1. - .F  
EM 2. - .F  
EM 3. - .F  
EMP 2. - .F  
EMP 3. - .F

Type EM 1. - .F - SB 1. H  
EM 2. - .F - SB 2. H  
EMP 2. - .F - SB 2. H

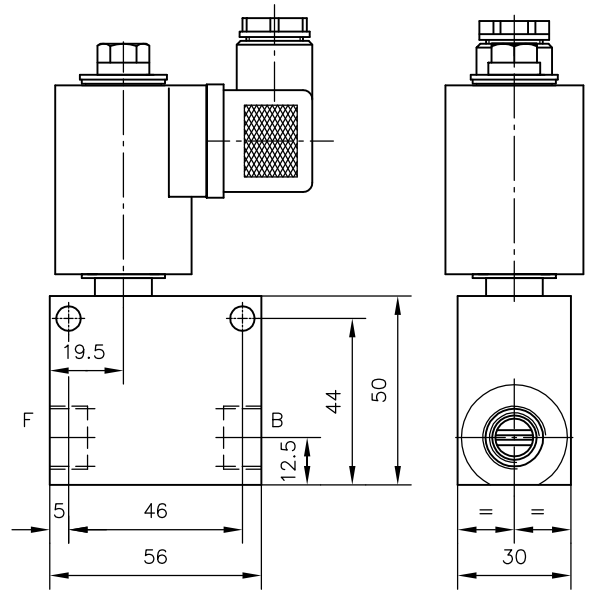


Type	Ports ISO 228/1 (BSPP)		Dimensions																	Mass (weight) approx. (kg)
	A	B	B	H	D	a	b	c	c1	d	e	e1	e2	f	h1	h2	g	m	a/f	
EM 1.. - 3/8 F																			7.5	1.0
EM 1.. - 3/8 F - SB1..	G 3/8 A	G 3/8	45	40	24	25	15	3	2.1	21.9	12.5	15.5	12	30	12.5	27	18	11	24	1.0
EM 1.. - 16 F	M16x1.5	G 3/8	45	40	24	25	15	3	2.1	21.9	12.5	15.5	12	30	12.5	27	18	7.5	24	1.0
EM(P) 2.. - 1/2 F																			9.5	1.3
EM(P) 2.. - 1/2 F-SB2..	G 1/2 A	G 1/2	52	50	30	30	20.7	4.5	2.6	26.9	15	15	14	35	15	30	22	12.5	30	1.4
EM(P) 3.. - 3/4 F	G 3/4 A	G 3/4	70	60	--	40	19.5	5	--	36	20	20	20	50	18	40	20	10	36	1.7

**Type EM 1.. - 1/4 D**  
**EM 2.. - 3/8 D**  
**EMP 2.. - 3/8 D**



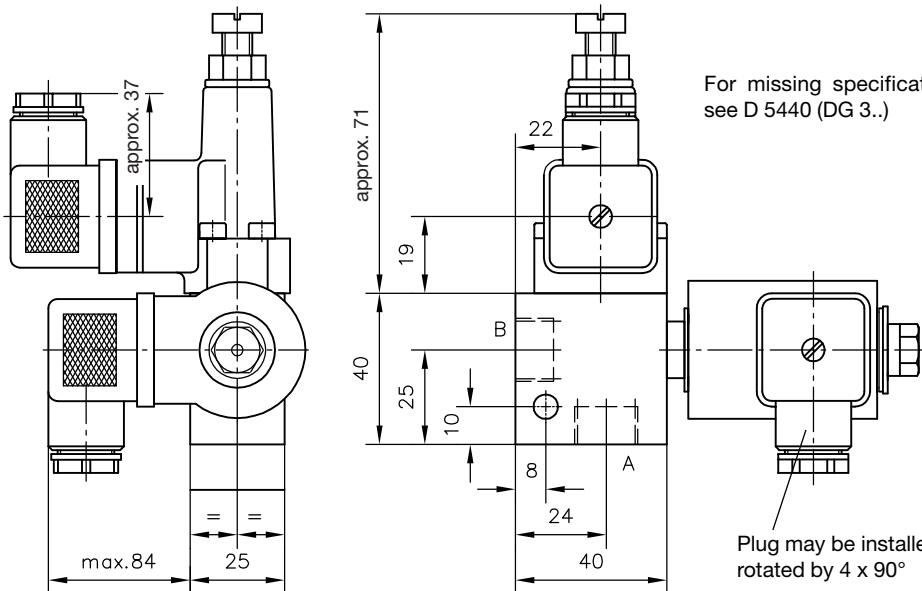
**Type EM 2.. - 3/8 - SJ 0..**  
**EMP 2.. - 3/8 - SJ 0..**



Mass (weight) = approx. 0.9 kg

Type	B	H	a	b	h	s	Mass (weight) approx. (kg)
<b>EM 1.. - 1/4 D</b>	25	47	12	23	21.5	2	0.7
<b>EM 2.. - 3/8 D</b> <b>EMP 2.. - 3/8 D</b>	55	62	13.5	34	27	3	0.9

**Type EM 1.. - 3/8 DG**



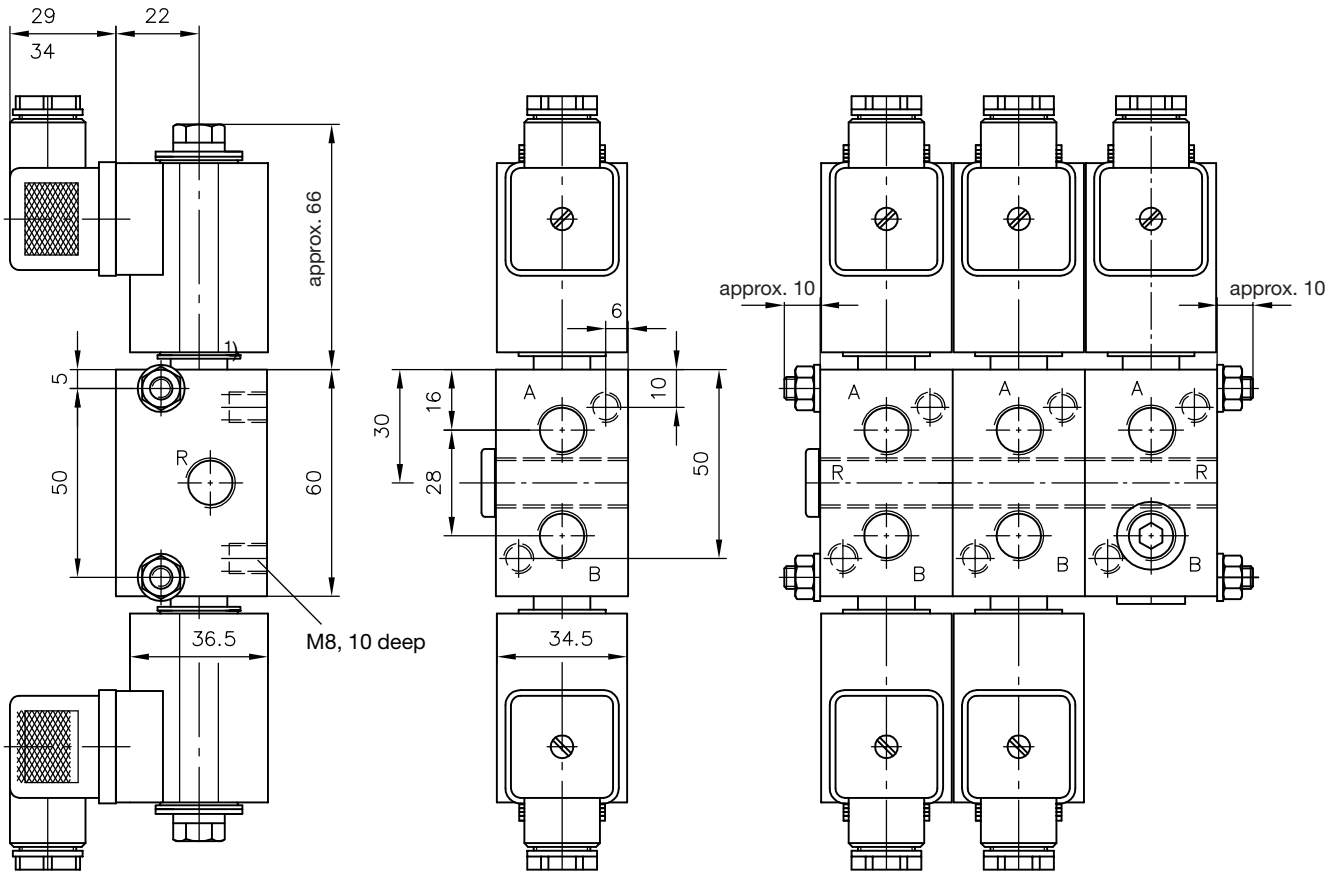
For missing specifications see D 5440 (DG 3..)

Plug may be installed rotated by 4 x 90°

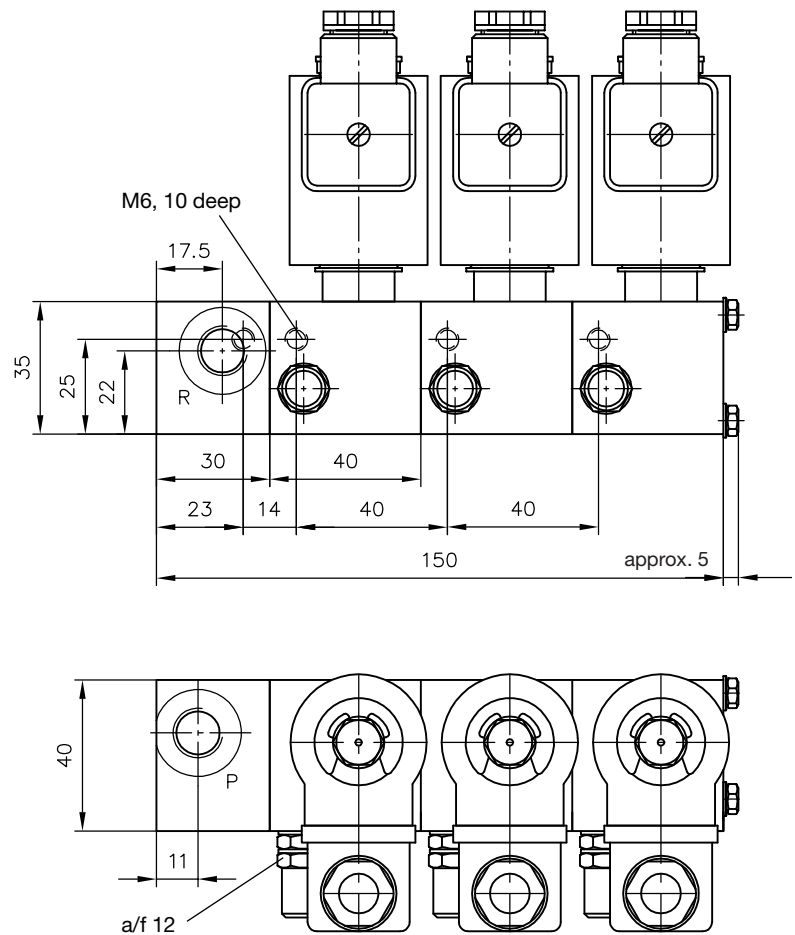
Mass (weight) = approx. 0.9 kg

### 4.4 Valve combination

#### Type BEM 11

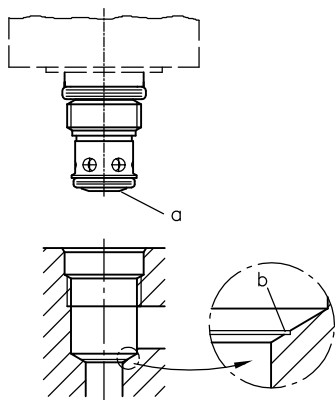


#### Type BEMD 21



## 5. Appendix

### 5.1 Notes for initial operation



The angularity of the 118° chamfer of the stepped bore tolerance is in reference to the reamed core diameter  $\varnothing d^{H8}$  (reaming depth). The stated tolerance must be observed. Also see section 4.2!

This enables a max. edge force on the facial area of the tapped journal when the valve is screwed in with the correct torque and it also prevents distortion of functional valve parts which might cause malfunction (sticking).

The correct angular orientation may be checked when the valve is installed the first time and can be remachined in case of minor deviation.

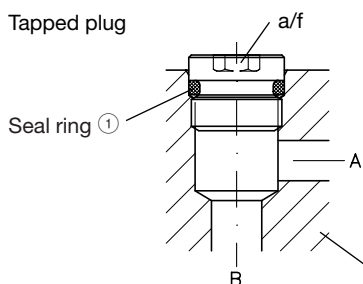
1. Screw in the valve and tighten steadily with the correct torque (see sect. 4.1).
2. Remove the valve again and check whether the journal of the valve a has produced an annular impact b at the chamfer of the stepped bore. When this impact is even everything is correct and the valve can be reinstalled as described above.
3. When the annular impact is not evenly distributed over its length or not complete the valve should be reinstalled but with up to 120 % of the specified torque (see sect. 2.3.1). Remove the valve and check the annular impact again whether it is correct now (see above); It will be so in most cases and the valve can be reinstalled with the torque specified in sect. 2.  
If it is still not correct after above procedure it will be necessary to remachine the bore.

### 5.2 Tapped plugs

Mounting holes in the manifold may be blocked if required by tapped plugs e.g. if uniform manufactured manifolds should be equipped with or without cartridge valves depending on application.

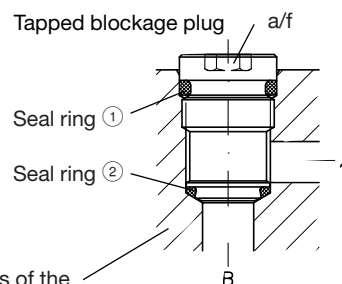
#### Passage open

Tapped plug



#### Passage blocked

Tapped blockage plug



Dimensions of the mounting holes acc. to sect. 2.3.2 !

Type	Tapped plug 1)	Tapped blockage 1) plug	a/f	Torque (Nm)	Seal ring ① P5001 94±5 Shore	Seal ring ② HNBR 90 Sh
EM 1... V(S)	7490 105 b	7490 105 a	6	30	10.3x2.4	7.65x1.78
EM 11 D(DS)	7490 105 b	7490 105 c	6	30	10.3x2.4	7.65x1.78
EM(P) 2... V(S)	7491 105 b	7491 105 a	8	30	14.03x2.61	12.42x1.78
EM 21 D(DS)	7491 105 b	7902 315 a	8	30	14.03x2.61	12.42x1.78
EM(P) 3...	7590 105 b	7590 105 a	12	40	21x3.53	18.72x2.62
EM(P) 4...	7904 019	7904 018	14	60	28.17x3.53	25.07x2.62

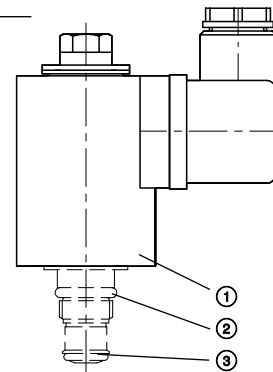
1) Complete with seal ring

### 5.3 Order coding for spare parts (e.g. for replacement)

Actuation:

Coding	Order No. for type		
	EM 1 EM 2 EM 3	EM 4 EMP 2 EMP 3	EMP 4
G 12, X 12, L 12	7590 061-12 V	7905 021	7329 820-12 V
G 24, X 24, L 24	7590 061-24 V	7905 022	7329 820-24 V
G 48, X 48	7590 061-48 V	7905 024	7329 820-48 V
G 98, X 98, WG 110	7590 061-98 V	7905 027	7329 820-98 V
G 205, X 205, WG 230	7590 061-205 V	7905 028	7329 820-205 V
AMP 12	7590 051-12 V	7905 051-12 V	7329 821-12 V
AMP 24	7590 051-24 V	7905 051-24 V	7329 821-24 V
AMP 48	7590 051-48 V	7905 051-48 V	7329 821-48 V
K 12	7590 081	7905 081	
K 24	7590 082	7905 082	
S 12	7590 075-12 V	7905 075-12 V	
S 24	7590 075-24 V	7905 075-24 V	
M 24		7905 076-24 V	
F 24		7905 040-24 V	
ITT 24	7329 871/ITT-24 V		
DTL 24	7329 871/DTL-24 V		
For type BEM			
G 12, X 12, L 12	7490 061-112 a		
G 24, X 24, L 24	7490 061-122 b		

Plug coding/coding	Order coding
G..:	MSD 3-309
L..:	SVS 3129020
L5K	L5K
L10K	L10K
WG..:	MSD 4-209 P 10



Seal kit (seal rings):

Order coding	For valve type	①	②	③
<b>DS 7490-11</b>	EM 11(12)..	12 x 3 FPM 70 Sh	10.3 x 2.4 P 5001 94 Sh A	7.65 x 1.78 HNBR 90 Sh
<b>DS 7490-21</b>	EM 21(22)..	12 x 3 FPM 70 Sh	14.03 x 2.61 P 5001 94 Sh A	12.42 x 1.78 HNBR 90 Sh
<b>DS 7490-21P</b>	EMP 21..	16 x 2 NBR 90 Sh	15 x 2 P 5001 94 Sh A	12.42 x 1.78 HNBR 90 Sh
<b>DS 7490-31</b>	EM 31(32)..	12 x 3 FPM 70 Sh	21 x 3.53 P 5001 94 Sh A	18.3 x 2.4 NBR 70 Sh
<b>DS 7490-31P</b>	EMP 31..	16 x 2 NBR 90 Sh	21 x 3.53 P 5001 94 Sh A	18.3 x 2.4 NBR 70 Sh
<b>DS 7490-41</b>	EM(P) 41(42)..	16 x 2 NBR 90 Sh	28.17 x 3.53 P 5001 94 Sh A	25.0 x 2.5 NBR 70 Sh

Seals for connection blocks with banjo bolt (acc. to sect. 2.4.2)

Order coding	For valve type
<b>KDS 16 A 3 C</b>	EM 1... - F..
<b>KDS 22 A 3 C</b>	EM(P) 2... - F..
<b>7590 018</b>	EM(P) 3... - F..

### 5.4 Additional components

These components have to be ordered separately!

Additional plugs available

Economy circuit plugs	MSD 4 P 55 MSD 4 P 53 MSD 4 P 63	24 V DC 230 V DC 115 V DC	acc. to D 7833 acc. to D 7813 acc. to D 7813
Plugs with LED and protective circuitry	MSE 28026 SVS 3129020	24 V DC 24 V DC	acc. to D 7832 acc. to D 7163
Plugs with clamp diode	MSD 3-209 C 1	150 V DC	acc. to D 7163
Recommended prop. amplifier for type EMP.. V(S):	EV 22 K 2-12/24 EV 1 G 1-12/24 EV 1 M 2-12/24 EV 1 D	(card) (module with housing) (module) (module)	acc. to D 7817/1 acc. to D 7837 acc. to D 7831/1 acc. to D 7831 D