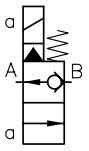
2/2-way directional seated valves type EM and EMP

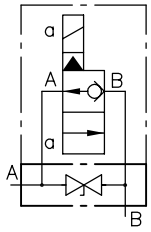
for oil hydraulic systems, zero leakage in blocked state, available as on/off, soft-shift or proportional valve

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.
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

- **- AT** — Seal spec., see table 5
- Function lock, see table 1a
- Actuation solenoid, see table 4
- Indiv. connection block, see sect. 2.4
- **EM 32 V** — Basic type, ON/OFF

Table 1: Basic type, ON/OFF

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!

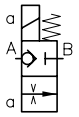
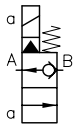
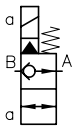
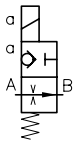
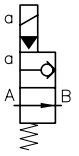
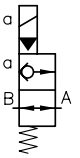
Basic symbol	Basic type	Pressure p_{max} (bar)	Flow Q_{max} approx. (lpm)	Flow direction	Symbol	Note
NC-valve	**EM 11 D** **EM 11 D 0,8** **EM 11 D 1,2** **EM 21 D**	450 150 60 400	1 2.5 5 3	A → B B → A = inadmissible		Non-piloted ● For piloting applications
	EM 11 V **EM 21 V** **EM 31 V** **EM 41 V**	400 400 400 350	20 40 80 160	A → B B → A = Free flow, solenoid must be deenergized		Piloted
	EM 12 V **EM 22 V** **EM 32 V** **EM 42 V**	400 400 400 350	20 40 80 160	Any		Piloted
NO-valve	**EM 11 DS** **EM 11 DS 0,8** **EM 21 DS**	450 150 400	1 2.5 3	A → B B → A = inadmissible		Non-piloted ● For piloting applications
	EM 11 S **EM 11 ST** **EM 21 S** **EM 31 S** **EM 41 S**	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. 3.1
	EM 12 S **EM 22 S** **EM 32 S** **EM 42 S**	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
M	Winged nut (fixed laterally via lead seal)

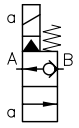
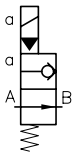
2.2 Directional seated valves, soft-shift

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

- EMP 21 VG 10 / EMP 31 SG — Basic type, soft-shift (Table 2)
- 3/4 — Connection blocks, sect. 2.4
- G 24 — Actuation solenoid, table 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	**EMP 21 VG** **EMP 21 VG 10** **EMP 21 VG 20** **EMP 31 VG** **EMP 41 VG**	400 400 400 400 350	40 40 40 80 160	A → B B → A = Free flow, solenoid must be deenergized		Piloted ● Type .VG 10(20) with customized throttling characteristic (see Δp-Q-curve in sect. 3.1)
NO-valve	**EMP 21 SG** **EMP 21 SG 10** **EMP 21 SG 20** **EMP 31 SG**	400 400 400 350	40 40 40 80	A → B B → A = inadmissible		Piloted ● With manual emergency actuation (not detailed) ● Type .SG 10(20) with customized throttling characteristic, see sect. 3.1

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

- EMP 21 S 20 / EMP 31 V — Basic type, prop. (Table 3)
- 1/4 — Connection blocks, sect. 2.4
- G 24 — Actuation solenoid, table 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.

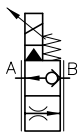
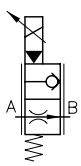
Basic	Basic type	Pressure p_{max} (bar)	Flow Q_{max} approx. (lpm)	Flow direction	Symbol	Note
NC-valve	**EMP 21 V** **EMP 21 V 10** **EMP 21 V 20** **EMP 31 V** **EMP 31 V 80** **EMP 41 V**	400 400 400 400 400 400 350	40 40 40 80 80 80 160	A → B B → A = Free flow, solenoid must be deenergized		Piloted ● Type ..V 10(20,70,80) with customized throttling characteristic (see Δp-Q-curve in sect. 3.1)
NO-valve	**EMP 21 S** **EMP 21 S 10** **EMP 21 S 20** **EMP 31 S**	400 400 400 400	40 40 40 80	A → B B → A = inadmissible		Piloted ● With manual emergency actuation (not detailed) ● Type .S 10(20) with customized throttling characteristic, see sect. 3.1

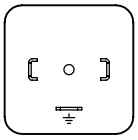
Table 4: Actuation solenoid

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

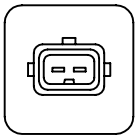
Electrical connection	Coding and nom. voltage					Basic valve type			Protection class (IEC 60529)
	12 V DC	24 V DC	48 V DC	110 V 50/60 HZ	230 V 50/60 Hz	**EM 1 EM 2 EM 3**	**EMP 2 EMP 3 EM 4**	**EMP 4**	
DIN EN 175 301-803 A with plug	**G 12**	**G 24**	**G 48**	**WG 110**	**WG 230**	●	●	●	IP 65
DIN EN 175 301-803 A without plug	**X 12**	**X 24**	**X 48**	**X 98**	**X 205**	●	●	●	(IP 65)
DIN EN 175 301-803 A with LED-plug	**L 12**	**L 24**	--	--	--	●	●	●	IP 65
Co. AMP Junior Timer	**AMP 12**	**AMP 24**	**AMP 48**	--	--	●	●	●	IP 65
Co. DEUTSCH (DT 04-2P)	**DT 12**	**DT 24**	--	--	--	●	●		IP 67
Co. KOSTAL	**K 12**	**K 24**	--	--	--	●	●		IP 67
Co. SCHLEMMER (Bajonett PA 6)	**S 12**	**S 24**	--	--	--	●	●		IP 67
M12x1	--	**M 24**	--	--	--		●		IP 67
With lead ends	--	**F 24**	--	--	--		●		(IP 67)
MIL-VG 95234	--	**ITT 24**	--	--	--	●			IP 67
MIL-DTL-38999 series III	--	**DTL 24**	--	--	--	●			IP 67

Connection pattern

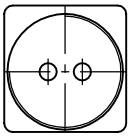
G .., X .., L ..



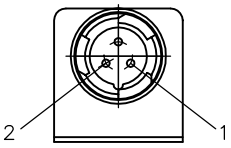
AMP ..



K ..

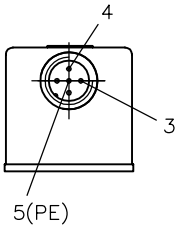


S ..

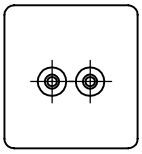


DT ..

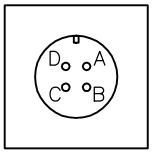
M ..



F ..



ITT ..



DTL ..

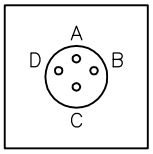


Table 5: Seal specification, for fluid exposed seals

Coding	Note
(without)	Standard, fluid seals made of NBR or AU, e.g. suited for mineral oil and synth. Ester HEES
PYD	Fluid seals made of FKM
AT	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

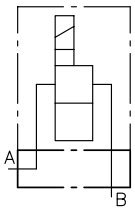
Table 6a: Indiv. connection blocks

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**
1/4	For pipe connection	G 1/4	●	●	●			
3/8		G 3/8		●		●		
1/2		G 1/2				●	●	
3/4		G 3/4					●	●
1		G 1						●
1 5/16-12 UN		1 5/16-12UN-2B						●
1/4 A	For pipe connection with (accumulator) discharge valve	G 1/4		●				
3/8 A		G 3/8		●		●		
1/2 A		G 1/2				●	●	
3/4 A		G 3/4					●	●
1 A		G 1						●
3/8 N 0,8	For pipe connection with manual bypass valve	G 3/8				●		
3/8 N 1,5						●		
P	For manifold mounting	--			●		●	

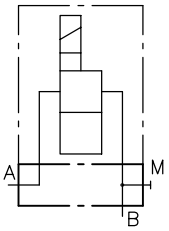
Symbols

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

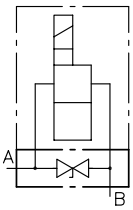
Coding
1/4
3/8
1/2
3/4



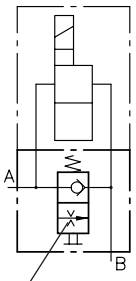
Coding
1 5/16-12UN



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

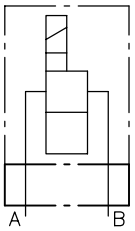


Coding
3/8 N 0,8
3/8 N 1,5



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) A, F	Tapped ports conforming ISO 228/1 (BSPP) B	Basic type EM 1. V EM 1. S	Basic type EM. 2. V EM. 2. S	Basic type EM. 3. V EM. 3. S
3/8 F	Banjo bolt version with (accumulator) discharge valve	G 3/8 A	G 3/8	●	-	-
16 F		M16x1.5	G 3/8	●	-	-
1/2 F		G 1/2 A	G 1/2	-	●	-
3/4 F		G 3/4 A	G 3/4	-	-	●
3/8 F - SB 1 . H -..	Banjo bolt version with (accumulator) discharge valve and drop-rate braking valve acc. to D 6920 **Note:** p_{max} = 315 bar	G 3/8 A	G 3/8	●	-	-
1/2 F - SB 2 . H -..		G 1/2 A	G 1/2	-	●	-

Desired flow rate setting acc. to the selected flow rate coding.
Flow rate from ... to ... (lpm)

	1	**3**	**5**	**7**	**9**	**90**
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	---

1/4 D	With bypass throttle	G 1/4	G 1/4	●	-	-
3/8 D		G 3/8	G 3/8	-	●	-
3/8 DG ..	With pressure switch acc. to D 5440	G 3/8	G 3/8	●	-	-

Pressure range coding.
Pressure range from ... to ... (bar)

33	**34**	**35**	**36**	**364**	**365**
200 ... 700	100 ... 400	20 ... 250	4 ... 12	4 ... 50	12 ... 170

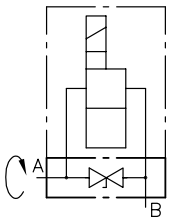
3/8 SJ 0. C..	With load independent flow limitation B → F via flow control valve type SJ acc. to D 7395. **Note:** p_{max} = 315 bar	G 3/8	G 3/8	-	●	-

Desired flow setting acc. to the selected flow range coding.
Flow range from ... to ... (lpm)

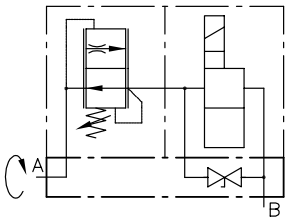
1	**3**	**5**	**7**	**9**	**90**
1.0 ... 1.6	1.6 ... 2.5	2.5 ... 4.0	4.0 ... 6.4	6.4 ... 10.0	10.0 ... 15.0

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

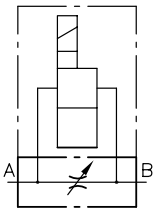
Coding **..F**



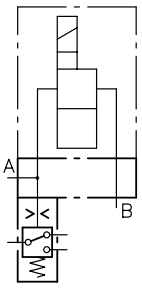
Coding **..F - SB**



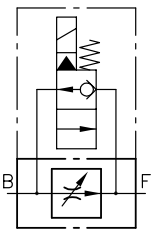
Coding **..D**



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 lpm
p_{max} = 400 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)

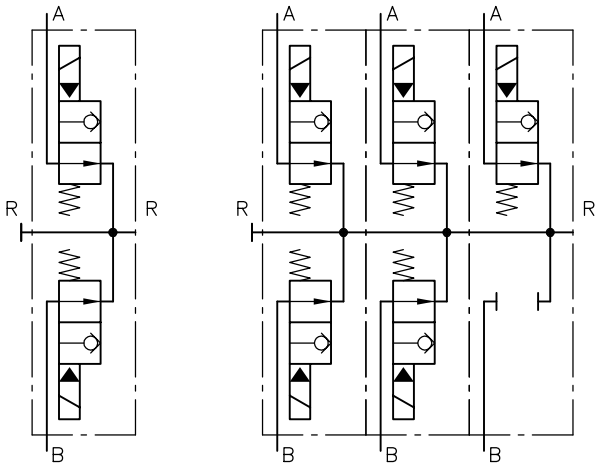
Valve sections (max. 10 valve sections can be combined)

Table 7:

Coding	Description
SS, VV, SV, VS	Double valve, (port A = first letter, port B = second letter) S = NO-valve type EM 11 S V = NC-valve type EM 11 V
S, V	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 lpm
p_{max} = 400 bar

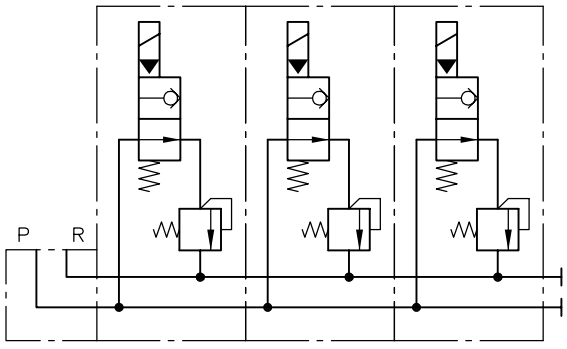
Actuation solenoid table 4

Pressure setting per valve section

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

Coding	Description
D	NC-valve, type EM 21 D
DS	NO-valve, type EM 21 DS

Symbol



3. Further parameters

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

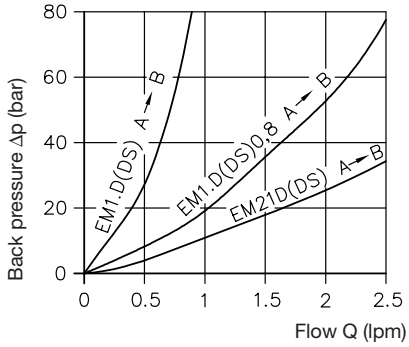
Nomenclature and design	2/2-way solenoid actuated seated valve (cone seated design)
Installed position	Arbitrary
Operation pressure	p_{max} = 450 bar (see restrictions in sect. 2.1); With type EM..V: p_{min} = 2 bar
Perm. flow	Depending on type (section 2.)
Pressure fluid	Standard (without coding acc. 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 mm²/s; optimal operation range: 10...300 mm²/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. **Attention:** Observe the restrictions regarding the max. permissible operation of the solenoid specified in sect. 3.2 !

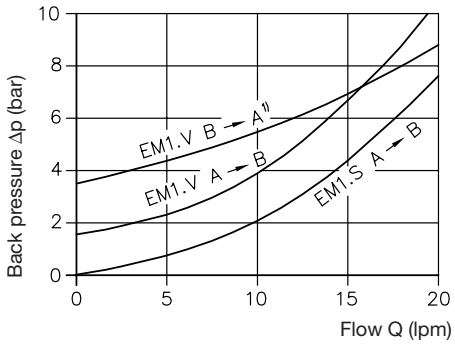
Mass (weight)

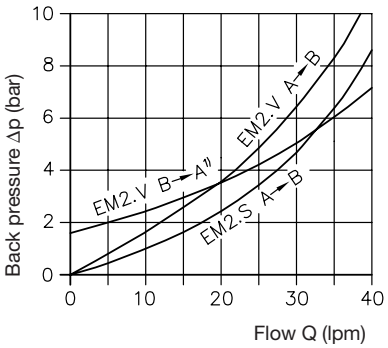
Cartridge valves	
EM 1	0.3 kg
EM 2, EMP 2	0.35 kg
EM 3, EMP 3	0.4 kg
EM 4	0.6 kg
EMP 4	0.7 kg

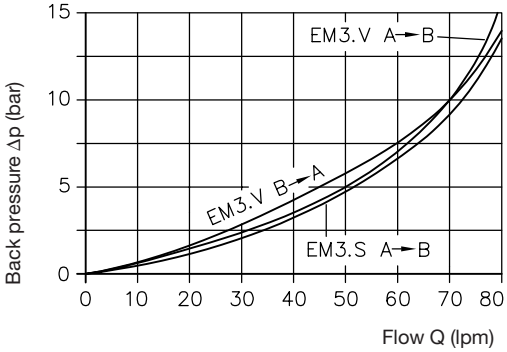
Indiv. connection blocks, see sect. 4.3
Valve banks, see sect. 4.4

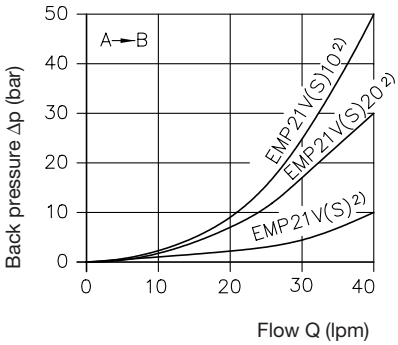
Δp-Q-curves



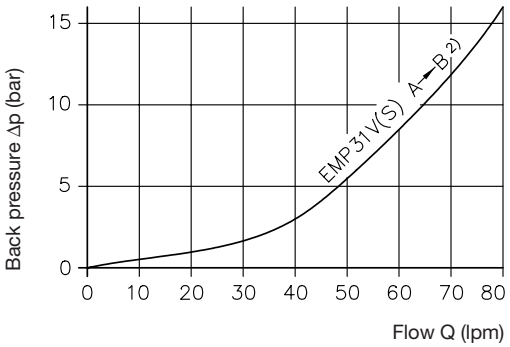


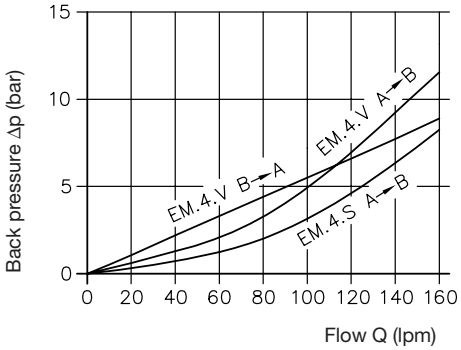






A→B EM(P)...V energized solenoid
EM11D(S)..; EM21D(S); EM(P)...S deenergized solenoid





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 mm²/s

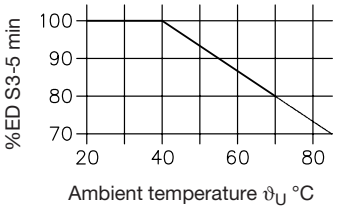
3.2 Electrical data (type EM.. and EMP..)

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
Switchings / h	approx. 2000 (rather even distributed)
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).

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

Reference value and restriction in the operation



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

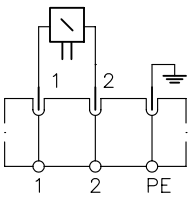
Coding AMP..
Co. AMP Junior 2-pole,
Coding 1

Coding G.., X.., L..
DIN EN 175 301-803 A

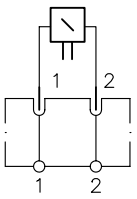
Coding F..
Lead length approx. 600 mm

DC-voltage

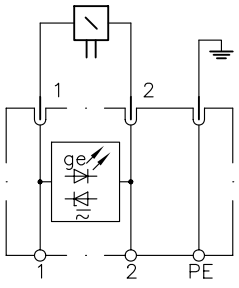
G ..
X ..



DT ..
K ..
S ..
AMP..
F ..

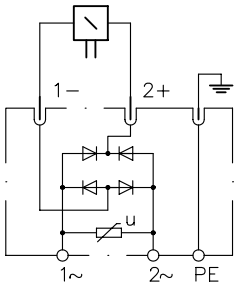


L..

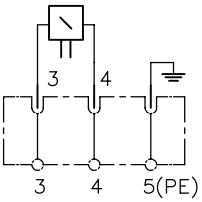


AC-voltage

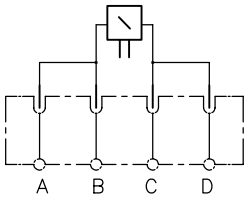
WG 110..



M..



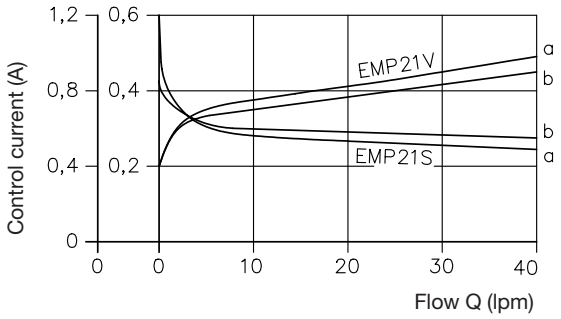
ITT..
DTL..



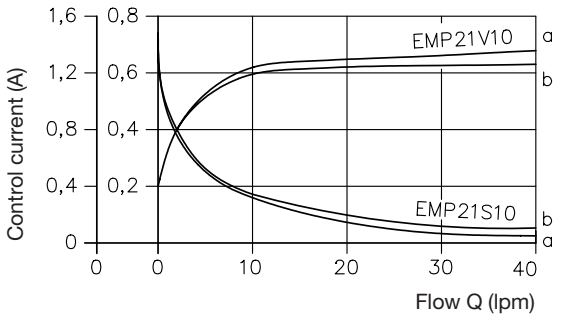
Cut-off energy	Guideline for max: approx. < 10 Ws + approx. 10% when measuring at U_N
Dither frequency for type EMP..V(S)	50 ...150 Hz

I-Q-curve

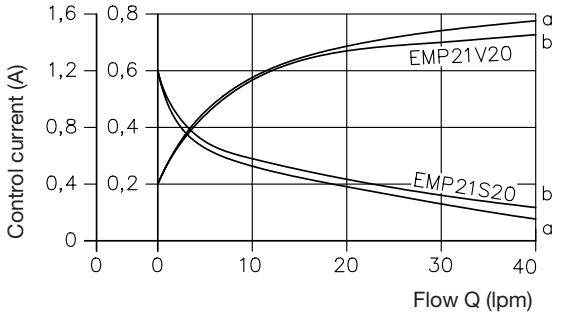
12 V DC 24 V DC



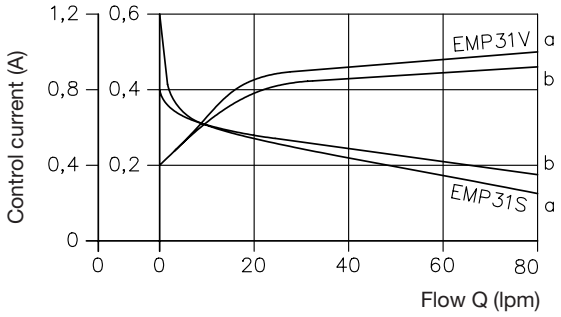
12 V DC 24 V DC



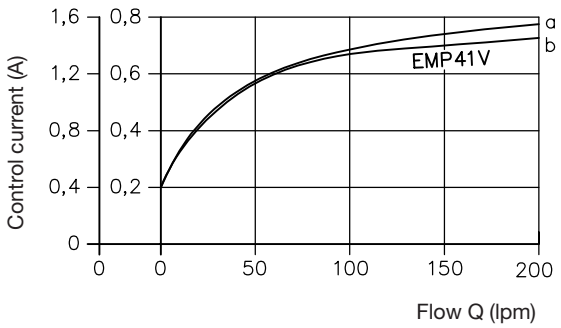
12 V DC 24 V DC



12 V DC 24 V DC



12 V DC 24 V DC



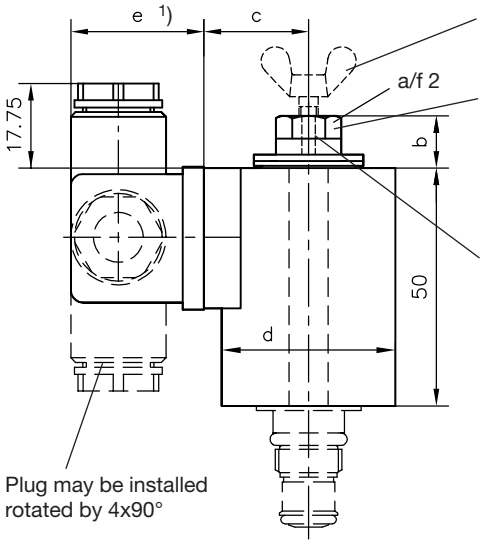
Curve a: Load pressure p = 50 bar;
Curve b: Load pressure p = 200 bar

4. Unit dimensions

All dimensions in mm, subject to change without notice

4.1 Valve and actuation solenoid

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



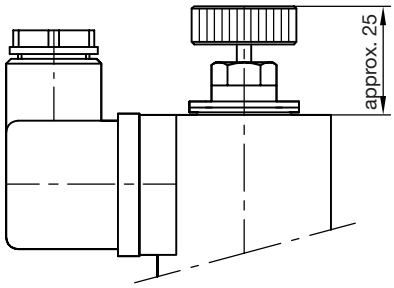
Function lock coding M
Winged nut is laterally fixed at a/f 2, when delivered from HAWE

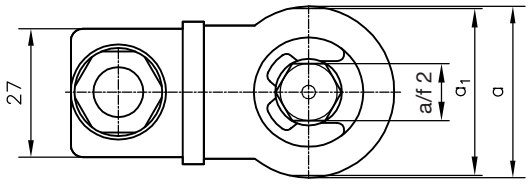
Manual emergency actuation with EM(P)...**S**

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

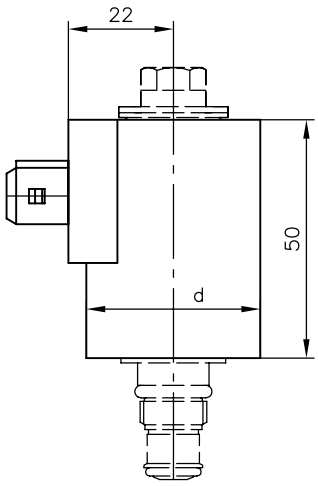




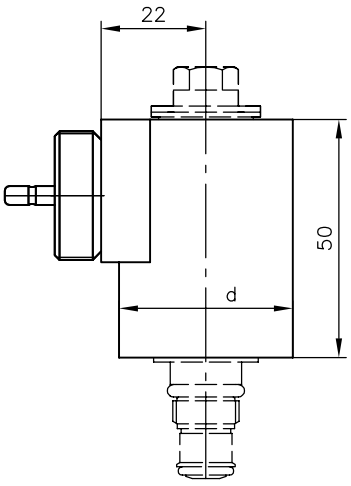
	Type EM 1 EM 2 EM 3	EM 4 EMP 2 EMP 3	EMP 4
a	36.5	---	⌀37
a_1	---	37.5	-
b	12	15	18.3
c	22	25	28
d	∅36.5	∅38.5	⌀37
e	Version	G: WG: L:	28 1) 34.5 1) 40

1) This dimension depends on the manufacturer (of the plug) and may be up to 40 mm acc. to DIN EN 175 301-803!

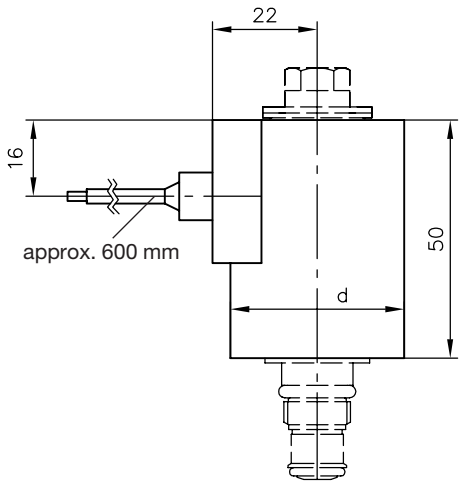
Actuation solenoid
Coding AMP..



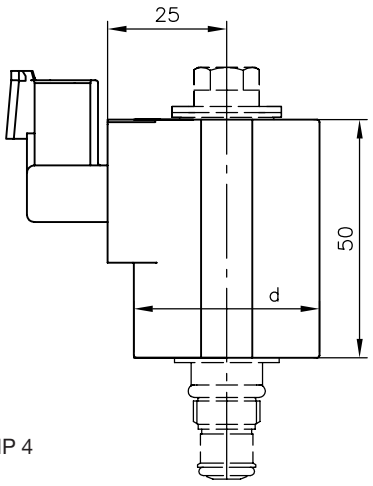
Coding K..



Coding F..

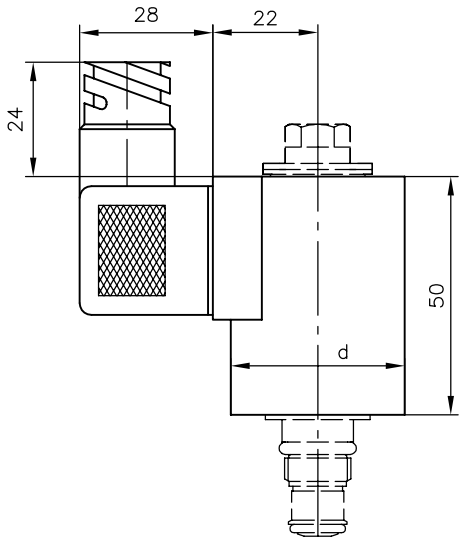


Coding DT..

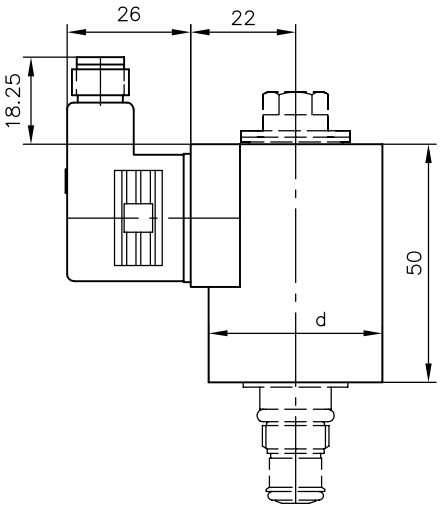


	Type EM 1 EM 2 EM 3	EM 4 EMP 2 EMP 3	EMP 4
d	∅36,5	∅38,5	⌽37
d (DT)	∅36,5	∅39	

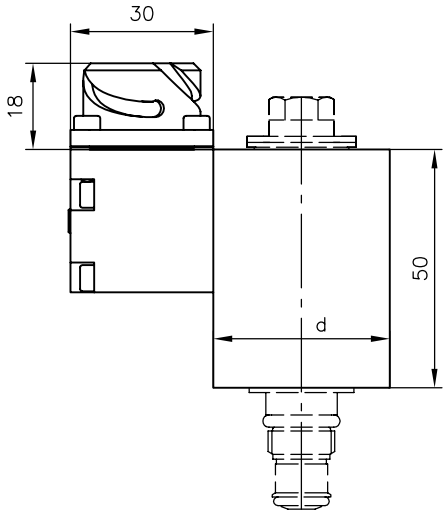
Coding S..



Coding M..



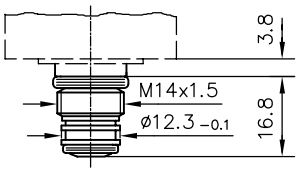
Coding **ITT..**
DTL..



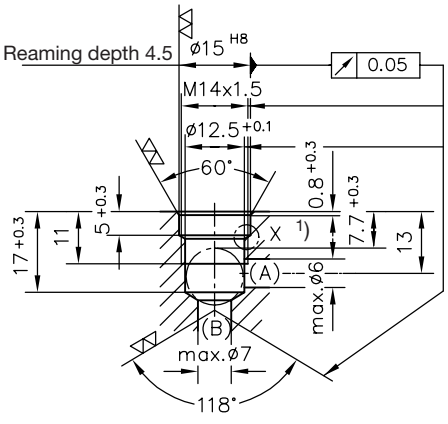
	Type EM 1 EM 2
d	∅37

4.2 Screwed-in section of the valve

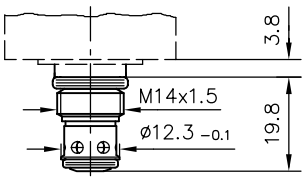
Type EM 11 D, EM 11 DS
EM 11 D 0,8, EM 11 DS 0,8



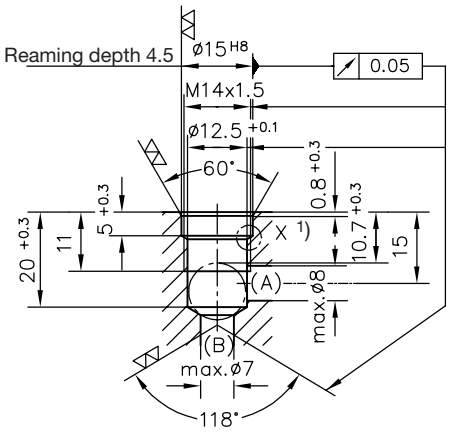
Mounting hole:



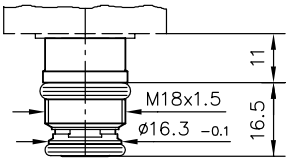
Type EM 1. V, EM 1. S



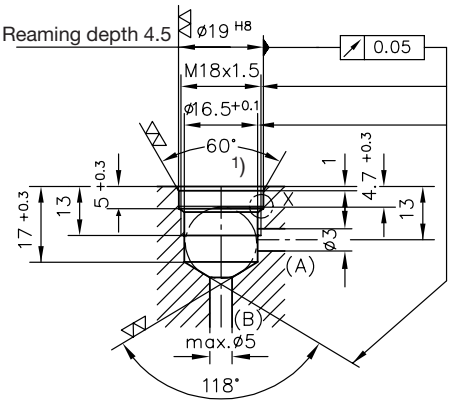
Mounting hole:



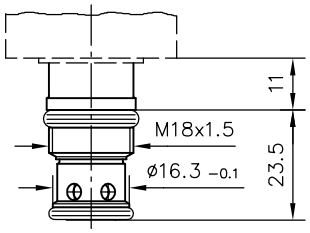
Type EM 21 D, EM 21DS



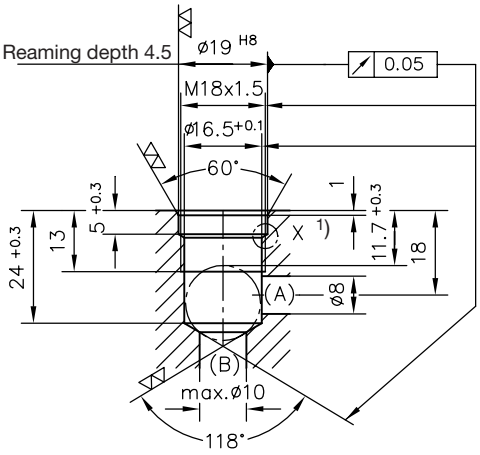
Mounting hole:



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

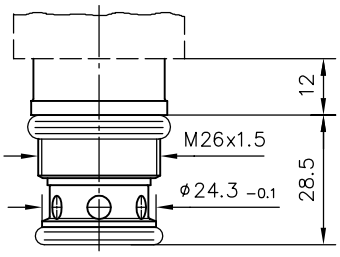


Mounting hole:

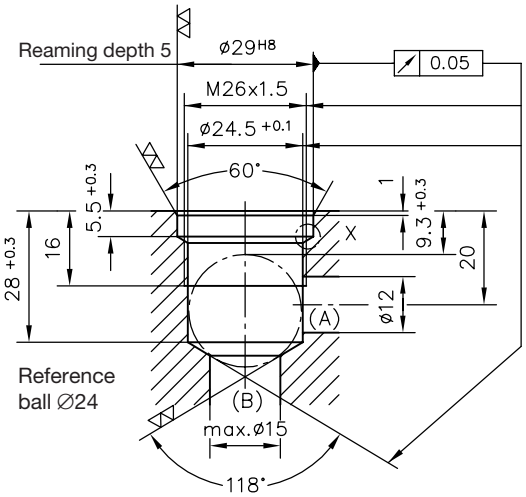


1) Detail “X” see page 14

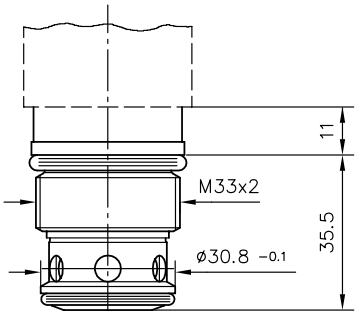
Type EM 3. V, EM 3. S
EMP 31 VG, EMP 31 SG
EMP 31 V.., EMP 31 S..



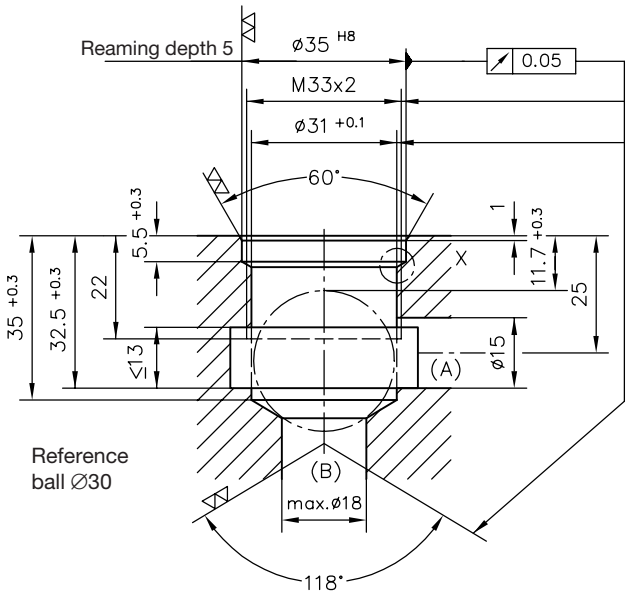
Mounting hole:



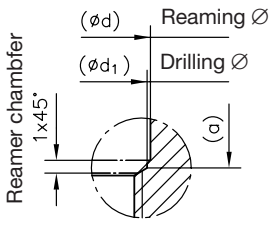
Type EM 4. V, EM 4. S
EMP 41 V..



Mounting hole:



Detail X M 2:1



Type	Ød^{H8}	Ød$_1$	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

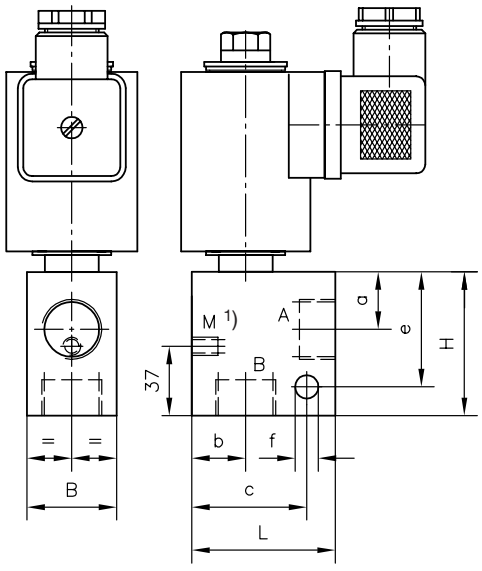
Attention:
The angularity of the 118° chamfer of the stepped bore are tolerated with reference to the reamed core diameter Ød^{H8} (reaming depth). The stated tolerance must be observed. Also see section 5.1!

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)

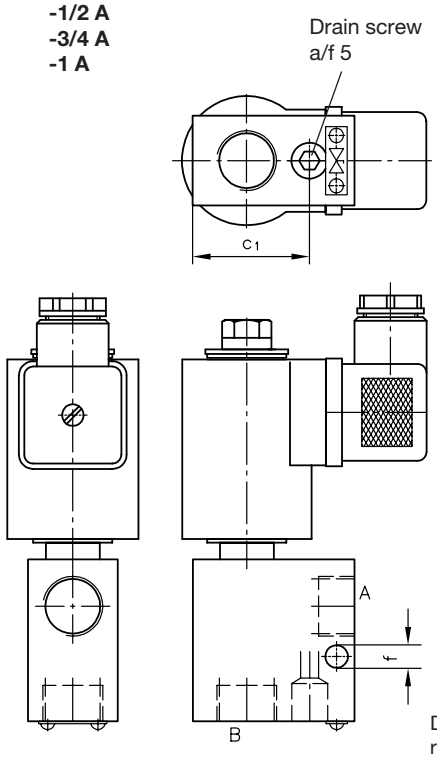
Basic type acc.to sect. 2	Coding	Port A and B ISO 228/1 (BSPP)	Main dimensions (mm)									Order No. Connection block without valve	Mass (weight) approx. (kg)
			L	B	H	a	b	c	c_1	e	f		
EM 11 D.. EM 11 DS..	**- 1/4**	G 1/4	35	20	40	14.5	10	25	--	30	∅6.5	7490 013	0.3
EM 1. V(S)	**- 1/4**	G 1/4	35	20	40	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	M12, 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	M8, 8 deep	7491 015	0.4
	- 1/2 A	G 1/2	50	30	50	14	14	31	36	32	M8, 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	M10, 10 deep	7590 015	0.5
	- 3/4 A	G 3/4	60	40	60	20	20	40	46	40	M10, 10 deep	7590 016	0.5
EM 4. V(S)	**- 3/4 A**	G 3/4	65	40	70	25	22	41	49	45	M12, 12 deep	7591 015	0.6
	- 1 A	G 1	70	50	70	25	22	47	52	50	M12, 12 deep	7591 016	0.6
EM 2. V..(S..) EMP 2. V..(S..)	**- 3/8 N 0,8** **- 3/8 N 1,5**	G 3/8	50	40	50	18	14	25	--	--	M8, 10 deep	7902 150	0.4
EM 21 D(DS) - P EM(P) 3. - P	**P**	--	--	--	--	--	--	--	--	--	--	7902 360 7903 140B	0.3 0.6

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

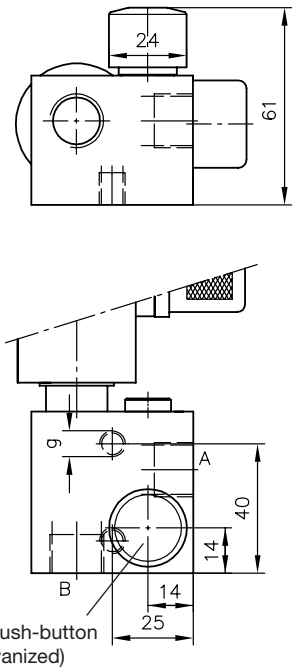


1) only coding -1 5/16-12 UN
M = 7/16-20 UNF-2B

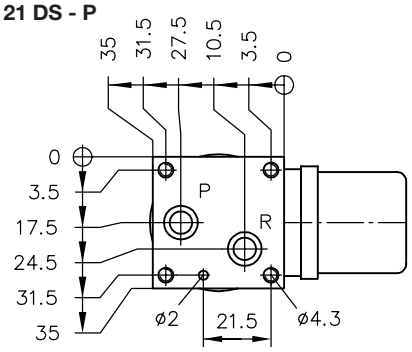
Coding
-1/4 A
-3/8 A
-1/2 A
-3/4 A
-1 A

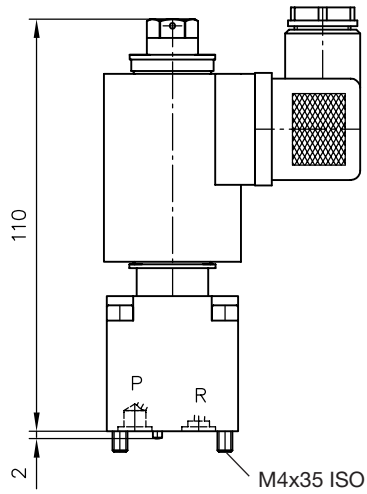


Coding
-3/8 N 0,8
-3/8 N 1,5

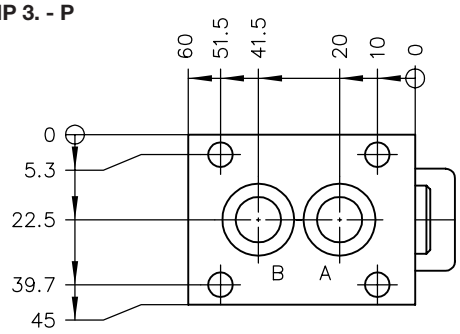


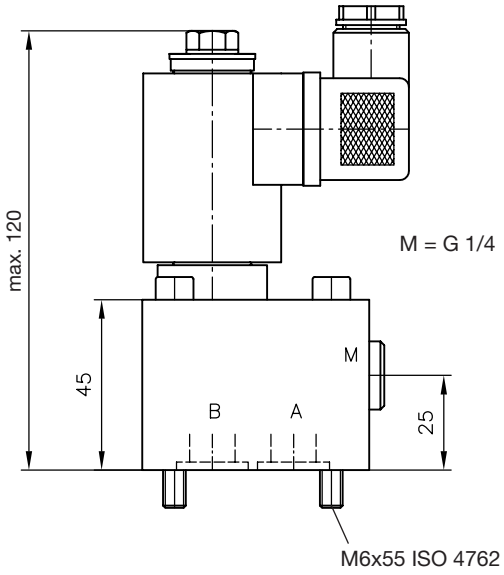
Type EM 21 D - P
EM 21 DS - P



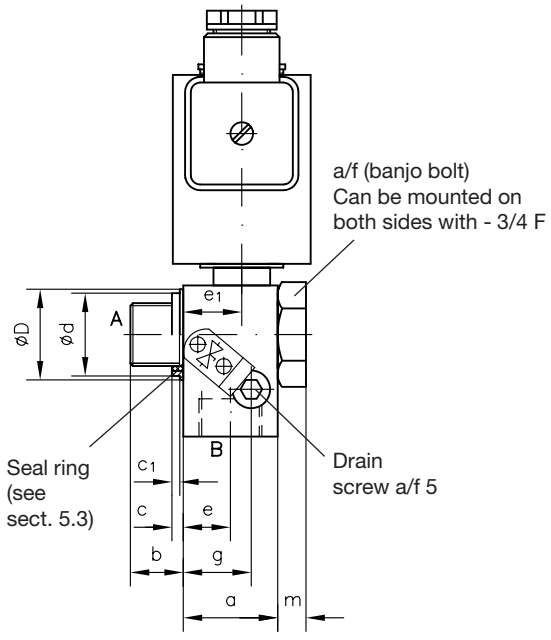


Type EM 3. - P
EMP 3. - P

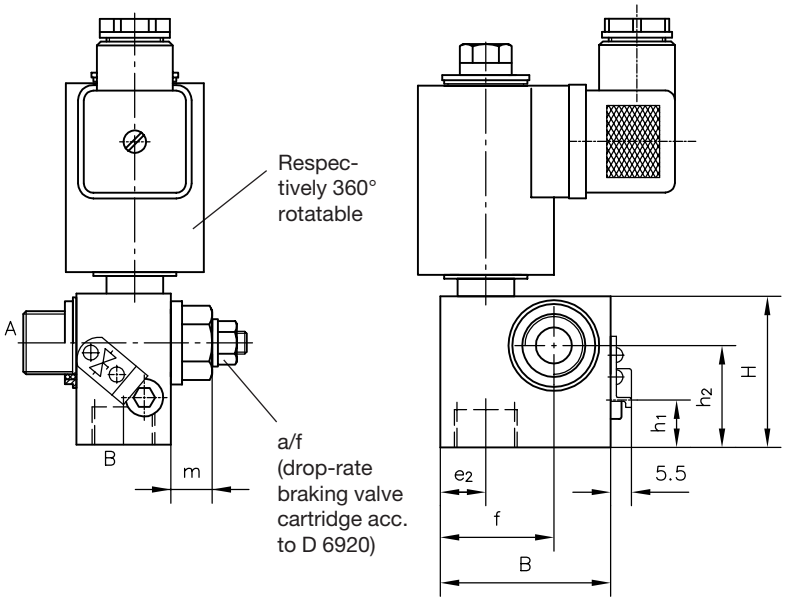




Type EM 1. - .F
EM 2. - .F
EM 3. - .F
EMP 2. - .F
EMP 3. - .F

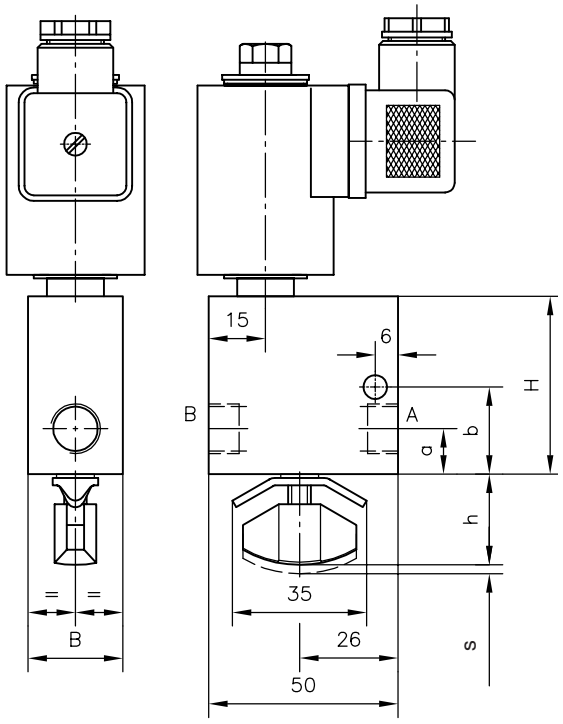


Type EM 1. - .F - SB 1. H
EM 2. - .F - SB 2. H
EMP 2. - .F - SB 2. H

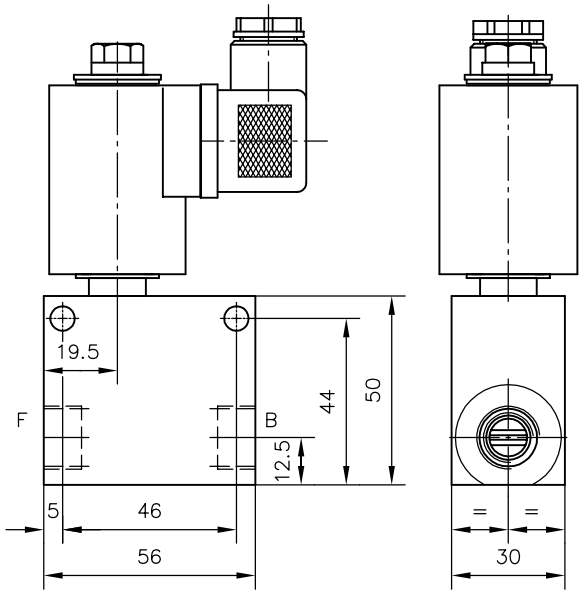


Type	Ports ISO 228/1 (BSPP) A	B	Dimensions B	H	D	a	b	c	c1	d	e	e1	e2	f	h1	h2	g	m	a/f	Mass (weight) approx. (kg)
EM 1.. - 3/8 F																		7.5		1.0
EM 1.. - 3/8 F - SB1..	G 3/8 A	G 3/8	45	40	24	25	15	3	2.1	21.9	12.5	15.5	12	30	12.5	27	18	11	24	1.0
EM 1.. - 16 F	M16x1.5	G 3/8	45	40	24	25	15	3	2.1	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



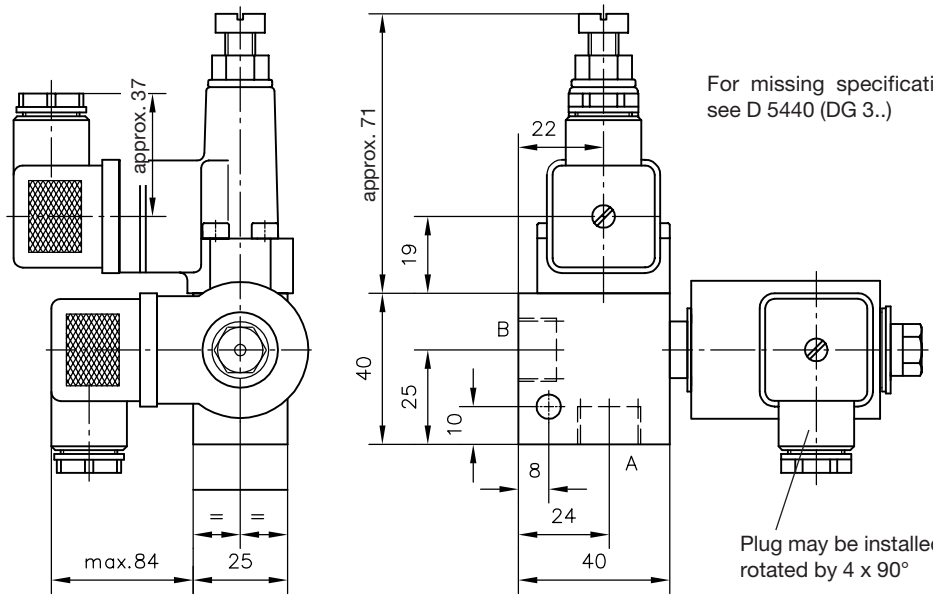
Type EM 2.. - 3/8 - SJ 0..
EMP 2.. - 3/8 - SJ 0..



Mass (weight) =
approx. 0.9 kg

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

Type EM 1.. - 3/8 DG



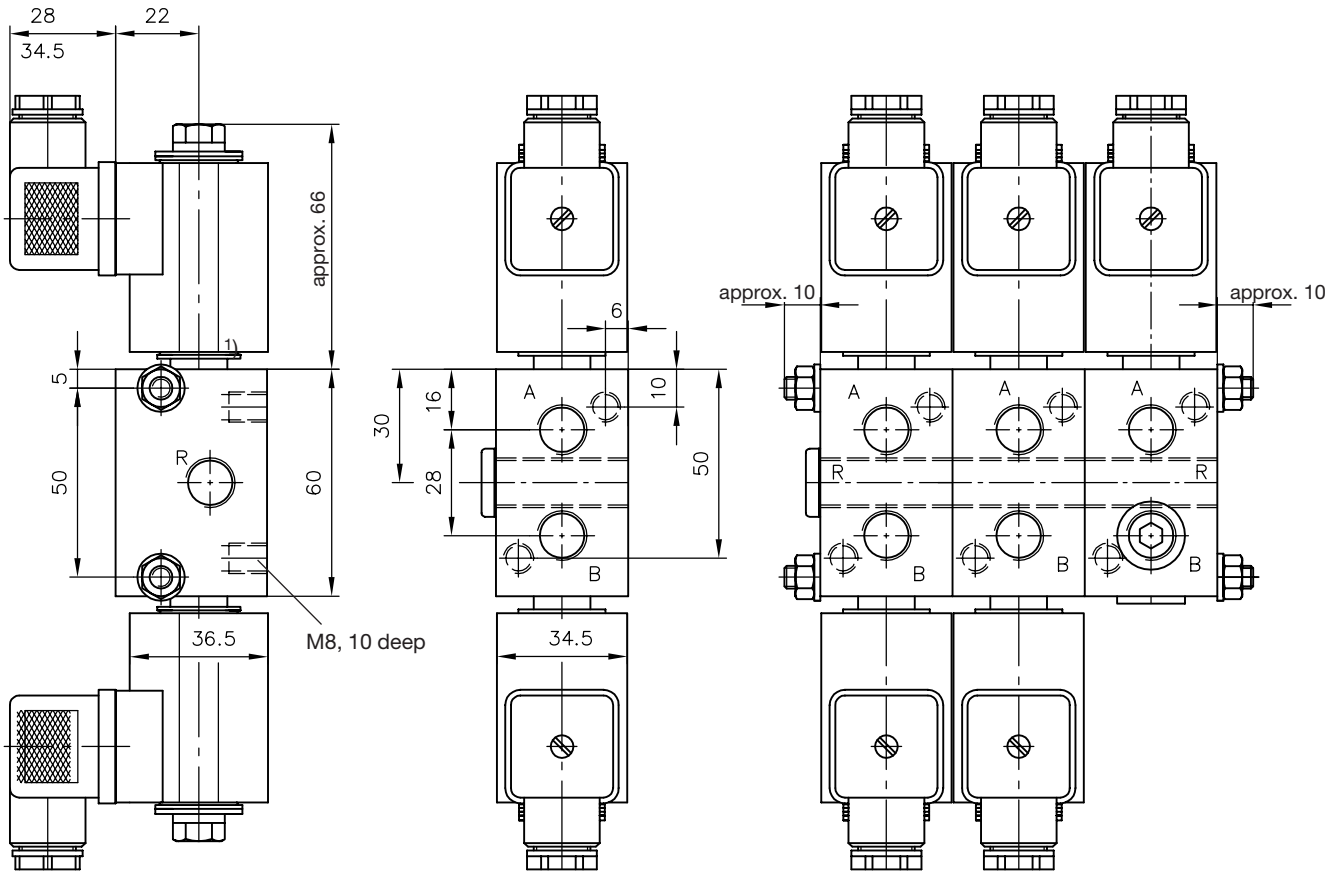
For missing specifications
see D 5440 (DG 3..)

Plug may be installed
rotated by 4 x 90°

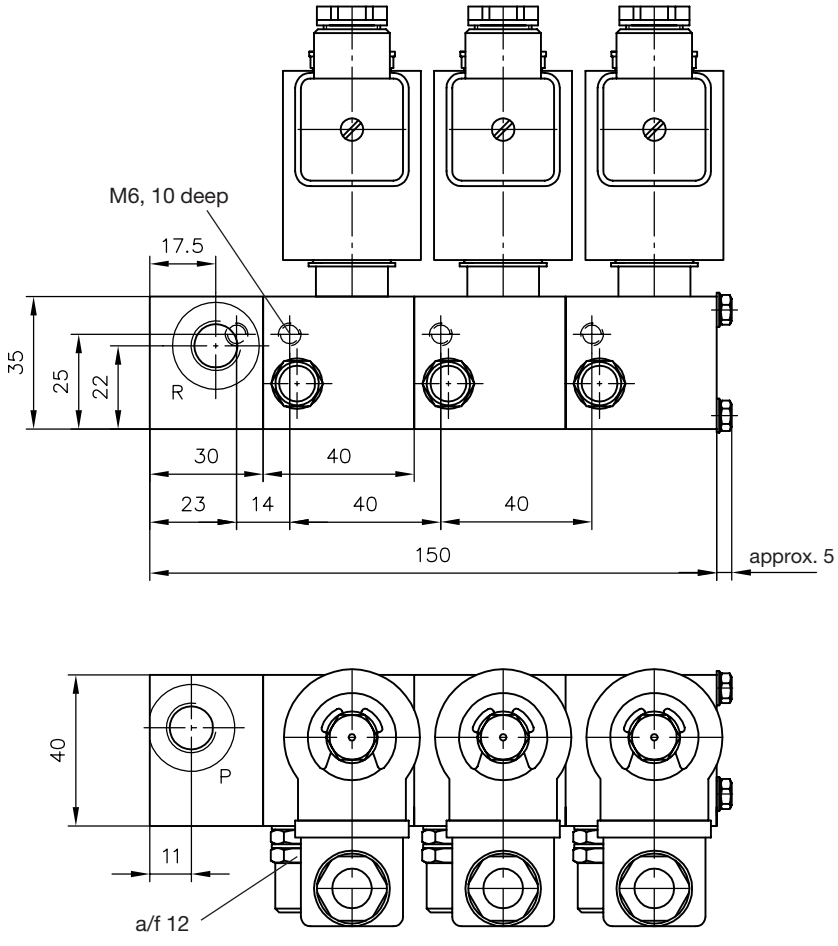
Mass (weight) =
approx. 0.9 kg

4.4 Valve combination

Type BEM 11

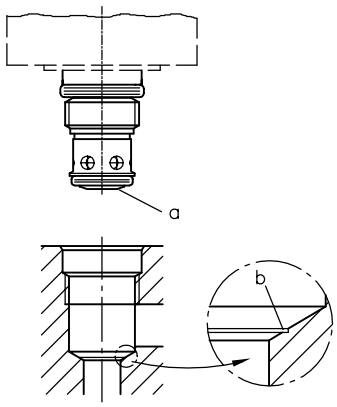


Type BEMD 21



5. Appendix

5.1 Notes for initial operation



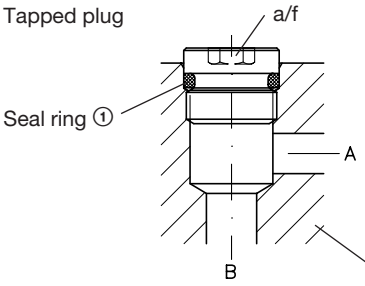
The angularity of the 118° chamfer of the stepped bore tolerance is in reference to the reamed core diameter ∅d^{H8} (reaming depth). The stated tolerance must be observed. Also see section 4.2!
This enables a max. edge force on the facial area of the tapped journal when the valve is screwed in with 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.

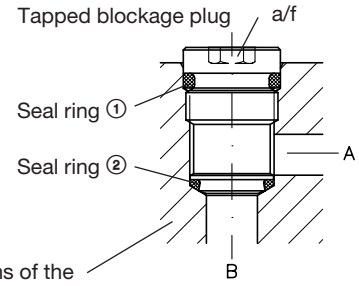
5.2 Tapped plugs

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



Passage blocked



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 Seal kit

Seal kit:

Type	Order coding
EM 11(12)..	DS 7490-11
EM 21(22)..	DS 7490-21
EMP 21..	DS 7490-21P
EM 31(32)..	DS 7490-31
EMP 31..	DS 7490-31P
EM(P) 41(42)..	DS 7490-41

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

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

5.4 Additional components

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

These components have to be ordered separately!

Additional plugs available

Economy circuit plugs	MSD 4 P 55	24 V DC	acc. to D 7833
	MSD 4 P 53	230 V DC	acc. to D 7813
	MSD 4 P 63	115 V DC	acc. to D 7813
Plugs with LED and protective circuitry	MSE 28026	24 V DC	acc. to D 7832
	SVS 3129020	24 V DC	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	(card)	acc. to D 7817/1
	EV 1 G 1-12/24	(module with housing)	acc. to D 7837
	EV 1 M 2-12/24	(module)	acc. to D 7831/1
	EV 1 D	(module)	acc. to D 7831 D