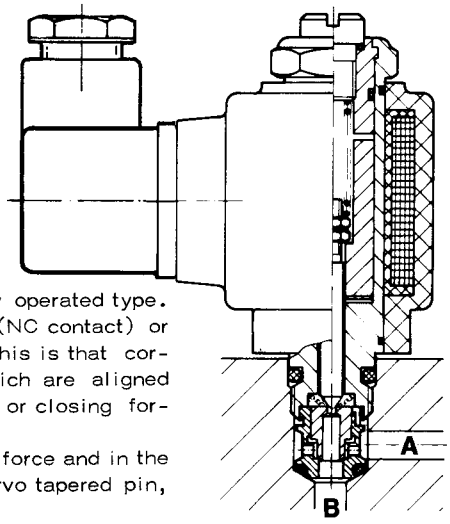
2/2-way solenoid seated valve Type EM for screwing in

for oil-hydraulic systems, free-leakage

Operating pressure p_{max} = 315 bar



1. General

The 2/2-way directional control valves are conical seat valves. They are available in two varieties: Blocked in zero setting, opening (NC contact) with solenoid excitation or open in zero setting, closing (NO contact) with solenoid excitation. The operating solenoid is designed as a pressure sealed wet armature solenoid. i.e. in addition to all moving internal solenoid parts are also lubricated without maintenance by the hydraulic oil and the coil chamber is sealed to the outside on the armature pipe with O-rings. This gives the solenoid very good protect. against corrosion e.g. arising from ambient influences.

A tapered pin directly opens or closes the valve opening on the directly operated type. In the case of the indirectly operated type, the servo bore is opened (NC contact) or closed (NO contact) in a step piston with the tapered pin. The result of this is that corresponding pressure differences form on its full and ring surfaces which are aligned against each other in such a way that opening (lifting off from the seat) or closing forces arise on the piston and therefore for the main opening.

In the case of the NC contact, the solenoid operates exerting a pulling force and in the case of the NO contact is operates exerting a pushing force on the servo tapered pin, in each case against a resetting spring.

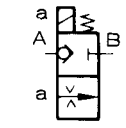
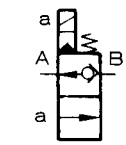
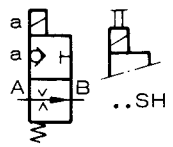
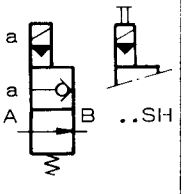
Types EM 1D or EM 1DA are preferably used as pilot control valves (relief valves) for hydraulic units which are controllable by way of pressure relief, e.g. circulation circuit of 2/2-way built-in valves, 3-way flow control valves and indirectly operated pressure limiting valves etc. Types EM...V (S, SH) can be generally used with controllable flow direction A ⟶ B.

The location hole in the unit body into which the valve is screwed is an uncomplicated step hole with standard 118° drill point angles on the diameter changeovers.

2. Types available, type code

2.1. Screw-in solenoid valve

Coding example: **EM20V - G24** Version with subblock for pipe connection, see Sect. 2.2

Function type	Pressure p_{max} bar	Flow Q_{max} approx. l/min	Mass (weight) appr. kg	Basic type, size and symbols EM 1D.. = directly operated EM 20..-EM 4.. = indirectly operated	Prescribed flow direction
NC contact	315	1	0,3	**EM 1 D** only for pilot control purposes 	A ⟶ B Impermissible: B ⟶ A
		20	0,3	**EM 1 V** 	A ⟶ B B ⟶ A free flow solenoid must be de-energized
		40	0,35	**EM 20 V**	
		60	0,45	**EM 3 V**	
		120	0,6	**EM 4 V**	
NO contact	315	1	0,3	**EM 1 DS** **EM 1 DSH** [1] only for pilot control purpose 	A ⟶ B
		20	0,3	**EM 1 S** **EM 1 SH** [1] 	Impermissible: B ⟶ A
		40	0,35	**EM 20 S** **EM 20 SH** [1]	
		60	0,45	**EM 3 S** **EM 3 SH** [1]	
		120	0,6	**EM 4 S** **EM 4 SH** [1]	

Operating solenoid

Normal plug	Kostal version [4]	Rated voltage U_N (V)	Rated power P_N (W)
G 12	**K 12**	12 DC	11,8
G 24	**K 24**	24 DC	13
G 98 [2]		98 DC	15,5
G 196 [2]		196 DC	17,3
WG 110 [3]		110 AC	15,5
WG 220 [3]		220 AC	17,3

[1] NO contact optionally also manual emergency operation

[2] For operation on alternating voltage mains 50 or 60 Hz via customer-furnished, separately located, e.g. in the control cabinet, bridge rectifier (silicon rectifier) G 98 for 110 V AC, G 196 for 220 V AC

[3] Bridge rectifier in the appliance plug, for 50 and 60 Hz

[4] Preferably for use in the mobile sector, connection part is not part of the scope of delivery

2.2. Connection blocks

For the direct connection of pipelines by way of standard threaded pipe connections with male fittings, shape DIN 3852, Sheet 2

Basic connection block

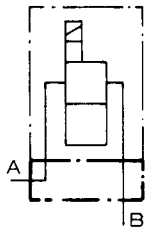
Coding example:

EM20 S **- 3/8** - G 24

Basic type in accord. with Sect. 2.1

Can be combined with valve type acc.to Sect.2.1	Code: Connection thread DIN ISO 228/1 G 1/4	G 3/8	G 1/2	G 3/4	G 1
EM 1 D, EM 1 DS, EM 1 DH	**-1/4**				
EM 1 V, EM 1 S, EM 1 S H		**-3/8**			
EM 20 V, EM 20 S, EM 20 SH			**-1/2**		
EM 3 V, EM 3 S, EM 3 SH				**-3/4**	
EM 4 V, EM 4 S, EM 4 SH					**-1**

Symbol: to be compl. by valve symbol from Sect. 2.1



Connection block with swivel bolts

Coding example:
Model with banjo bolt and drain valve

EM20V **- 1/2 F** - G 24

Basic type in accord. with Sect. 2.1

Connection size to A and B accord.with DIN ISO 228/1:

....-3/8 F and ....-SB 1-H-... = G 3/8 to B; G 3/8 A to A

....-1/2 F and ....-SB 2.H-... = G 1/2 to B; G 1/2 A to A

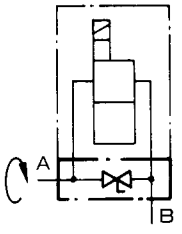
Can be combined with valve type acc.to Sect.2.1	with banjo bolt and drain valve	with load lowering valve SB 1.H and SB 2.H acc. to D 6920 Sect.2.2
EM 1 V, EM 1 S, EM 1 SH	**-3/8 F**	**-SB 1. H -..**
EM 20 V, EM 20 S, EM 20 SH	**-1/2 F**	**-SB 2. H -..**

desired flow in l/min in the range from ...to...

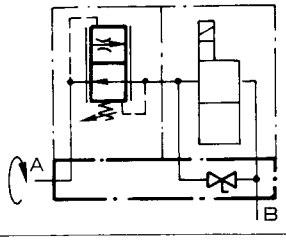
Specificat. for adjustment range

	SB 1..	SB 2..
1	2,5..4	16..21
3	4..6,3	21..28
5	6,3..10	28..37
7	10..16	37..50
9	16..25	50..57
90	25..35	

Symbol: to be compl. by valve symbol from Sect. 2.1



Mounting for A any 0...360°



Connection block with additional units

Coding example:
Version with DG 35 pressure switching unit

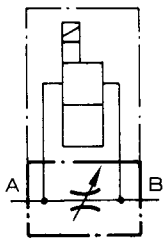
EM1S **- 3/8 DG 35** - G 12

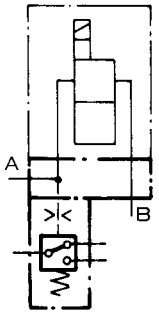
Basic type in accord. with Sect. 2.1

[1]) Pressure adjustment range appr. 20...210 bar. Other pressure ranges (e.g. DG 34 appr. 100...315 bar DG 356 appr. 12...130 bar on request. Max. pressure with DG 34 not to exceed 315 bar.

Can be combined with valve type acc.to Sect.2.1	with bypass throttle valve Code	Connection thread DIN ISO 228/1	with pressure switch unit DG 35 in accord.with D 5440 [1]) Code	Connection thread DIN ISO 228/1
EM 1 V, EM 1 S, EM 1 SH	**-1/4 D**	G 1/4	**-3/8 DG 35**	G 3/8
EM 20 V, EM 20 S, EM 20 SH	**-3/8 D**	G 3/8		

Symbol: to be compl. by valve symbol from Sect. 2.1





3. Further characteristic data

3.1. General and hydraulic

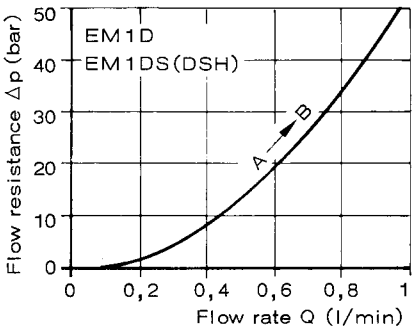
Designation and type	2/2-way solenoid seat valve in seated conical design
Installation position	as required. Note air bleeding necessary in various positions from vertical to horizontal, as specified in Section 6
Temperatures	- 40...+ 80°C (oil and ambient). Observe viscosity limits and permiss. duty cycle
Operating pressure	p_{max} = 315 bar (Section 2.1); p_{min} = 2 bar, with EM1V = 4 bar
Flow	Depending on type (Section 2.1)
Pressure medium	Hydraulic oil in accordance with DIN 51 524, Parts 1 and 2: 10...68 mm²/s at 40°C (ISO VG 10 to VG 68 in accord. with DIN 51 519) Viscosity range 4...800 mm²/s; opt. 10...300 mm²/s A greater increase in the flow resistance can be expected with viscosities in excess of approx. 500 mm²/s Not available for other pressure media apart from hydraulic oil

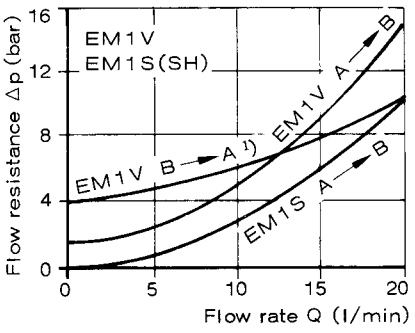
Δp-Q characteristics

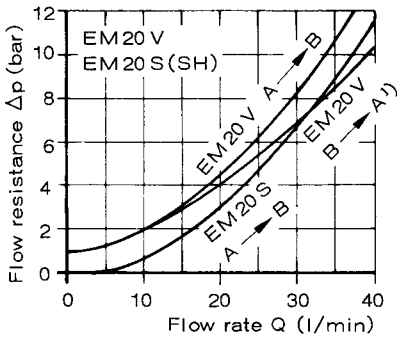
Oil viscosity during the measurement 60 mm²/s

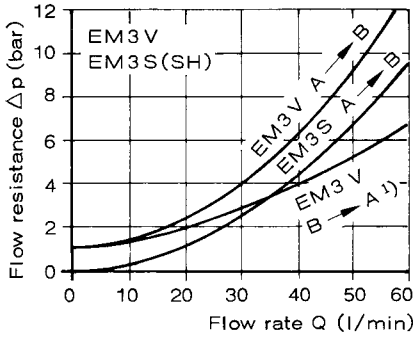
A ⟶ B
EM...V solenoid energized

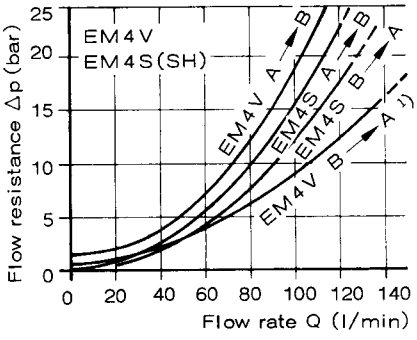
EM1DS(DSH)
EM...S(SH)
Solenoid de-energized





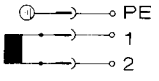
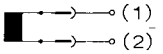
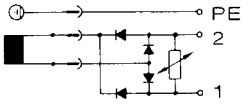






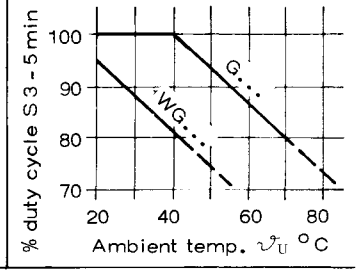
1) For EM...V only: Free flow from B ⟶ A possible only with de-energized solenoid

3.2. Electrical

Switching time	on appr. 60 ms; off appr. 120 ms
Switching operations / hr	appr. 2000, can be regarded as appr. equally distribut.
Insulation material class	F, contact temperature at 20° ambient temperature approx. 85...95°C (jacket) The permiss. winding limit temp. of appr. 150°C corresponding to insulation material class F is approximately reached as a steady-state temp. when the recommended value for % duty cycle are kept to in operation. The thermal load of the coil can be reduced and the service life can be increases if the supply voltage is lowered. For further details and possible restrict. of switchable press. A ⟶ B, more details on request.
Protection class DIN 40 050	IP65, correctly fitted plug
Plugs and circuit diagrams	Direct voltage Code G 12...G 196 Type A DIN 43 650 Part 1/83  Direct voltage: Code K 12 and K 24 Connection part 03 8880 05 Messrs. Kostal  Alternating voltage Code WG 110 and WG 220 50 and 60 Hz, Type A DIN 43 650, Part 1/83 with bridge rectifier 
Electrical time constant τ	Start of stroke ...appr. 7 ms End of stroke ...appr. 8 ms Inductivity L≈ τ · R (mH)

Relative duty cycle: 100% duty cycle (detail on solenoid)

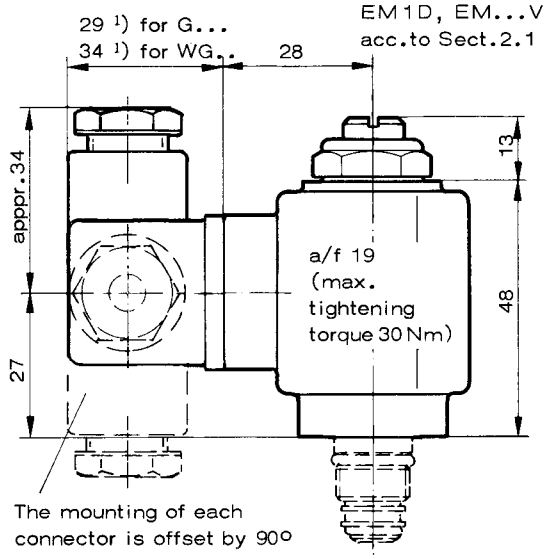
Recommended value and restriction in operation



4. Dimensions of units All dimensions are in mm, subject to change without notice !

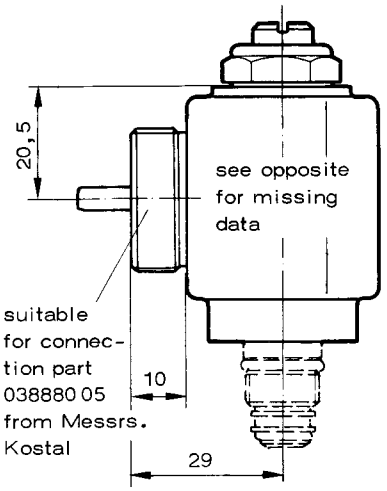
4.1. Operating solenoid

Type G... and WG...

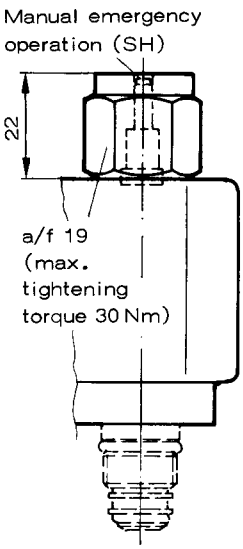


Type K12 and K24

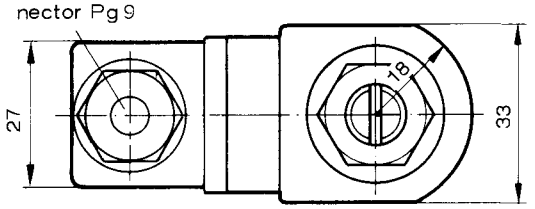
for NC and NO contacts in acc. with Sect.2.1

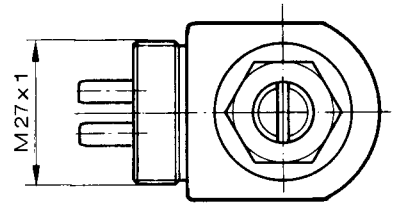


for NO contacts EM1DS, EM..S(SH) in acc.with Sect.2.1



Cable connector Pg 9





Manual emergency operation force at 100 bar pressure at A = appr. 70 N

1) These dimensions are possible up to max. 40 mm depending on the make (here Messrs. Klar und Beilschmidt, Landshut) in accordance with DIN 43 650

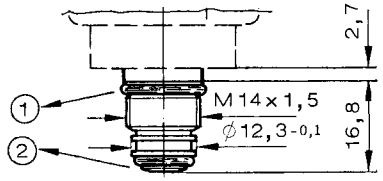
Order code for individual parts (e.g. for replacement)

Solenoid coil .... 7490 040/1 for ... V (series for standard plug DIN 43 650, state voltage 12, 24, 98, 196 V)
7490 060/1 for ... V (version for Kostal connection part, state voltage 12, 24 V)

Plug connector .... Code G...: MSD 3 - 309 (connection 3 remains unused)
Code WG...: MSD 4 - 209/P 10 (Messrs. Klar und Beilschmidt, Landshut)

4.2. Valve part

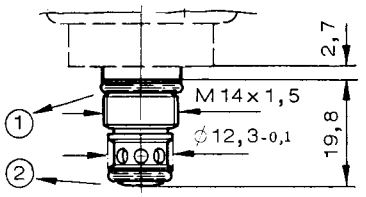
Type EM1D and EM1DS(DSH)



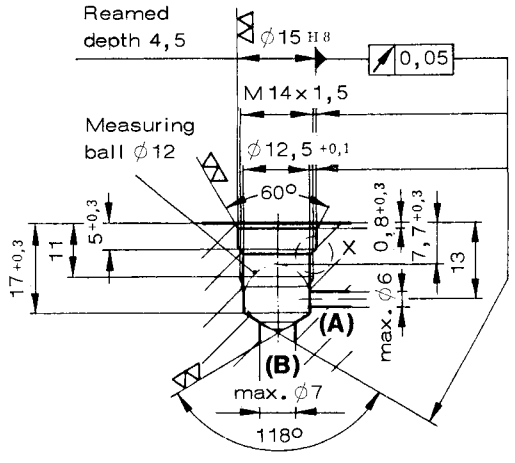
O-rings (e.g. for replacement). Unit body sealing in the location hole.
Material manufacturer and
PARKER - Prädifa
ULTRATHAN 90 Shore

(1) = 10,3 x 2,4
(2) = 7,65 x 1,78

Type EM1V and EM1S(SH)

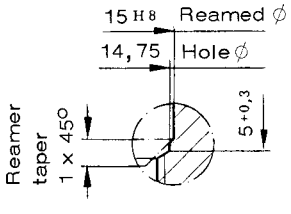


Location hole

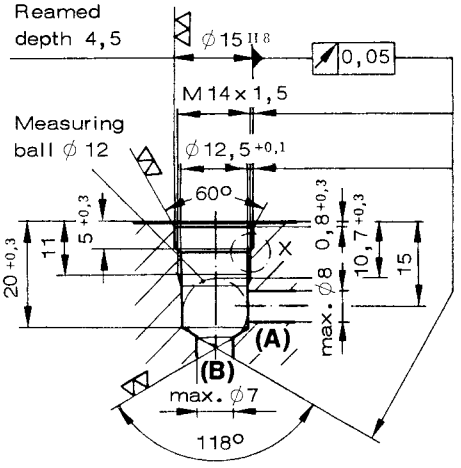


Detail for X:

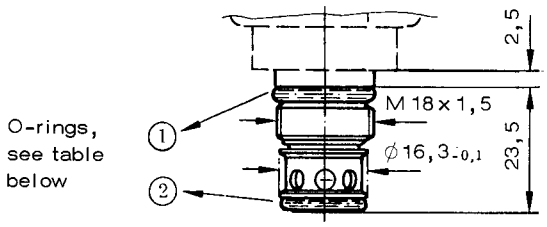
M2:1



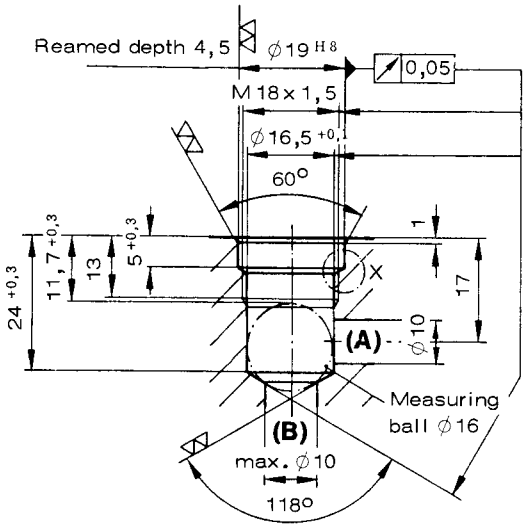
Location hole



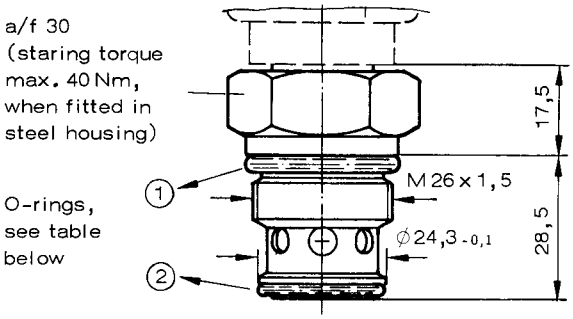
Type EM 20 V and EM 20 S(SH)



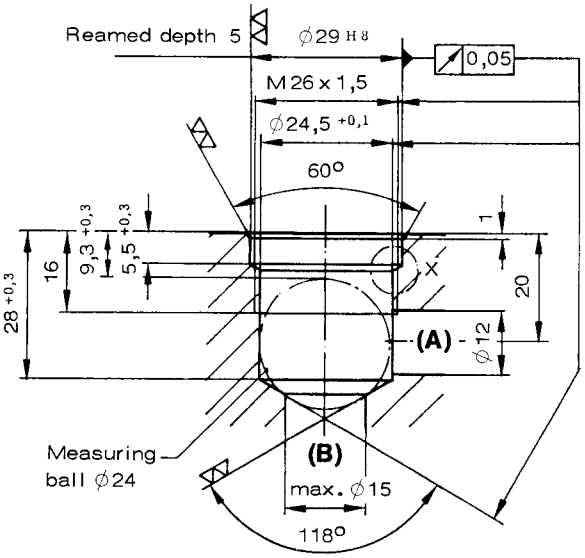
Location hole



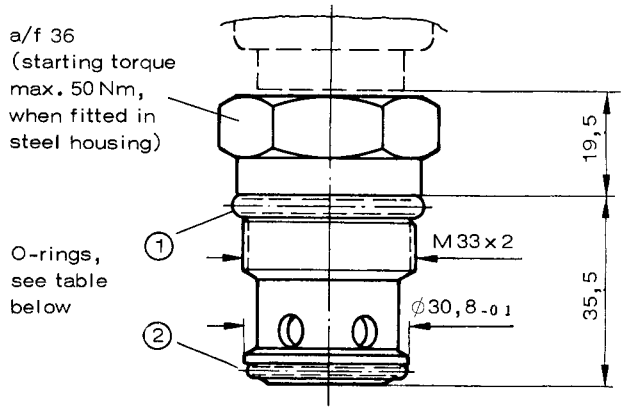
Type EM 3 V and EM 3 S(SH)



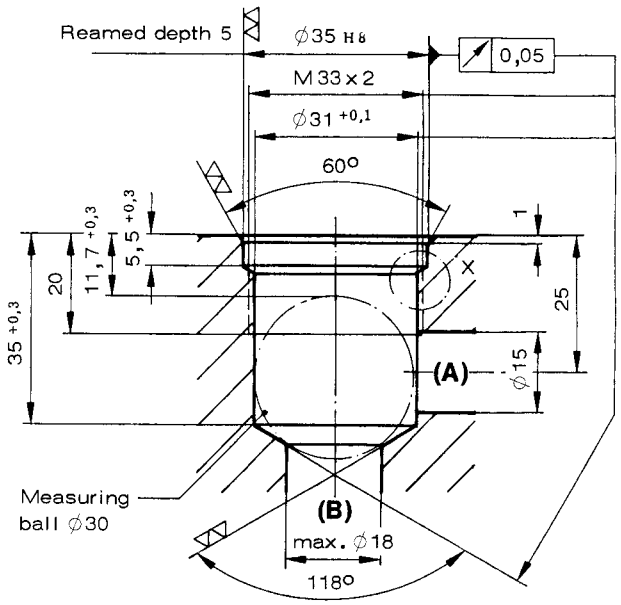
Location hole



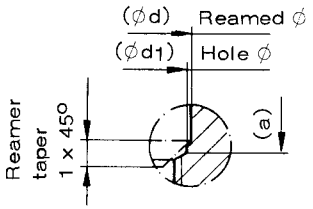
Type EM 4 V and EM 4 S(SH)



Location hole



Detail for X M2:1



Type	d	d_1	a
EM20...	19 H8	18,75	5 +0,3
EM3..	29 H8	28,75	5,5 +0,3
EM4..	35 H8	34,75	5,5 +0,3

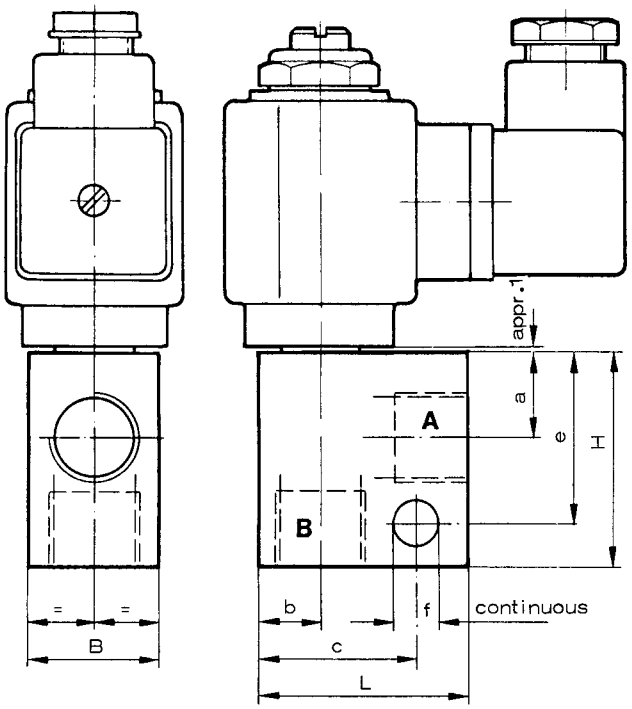
O-rings (e.g. for replacement)
Unit body sealing in the location hole
Material manufacturer and
PARKER-Prädifa ULTRATHAN 90 Shore

	EM20..	EM3..	EM4..
①	14,04x2,61	21x3,53	28,17x3,53
②	12,42x1,78	18,72x2,62	25,07x2,62

4.3. Connection blocks for pipe mounting

Dimensions of the EM..-valves, see Section 4.1

4.3.1. Basic version

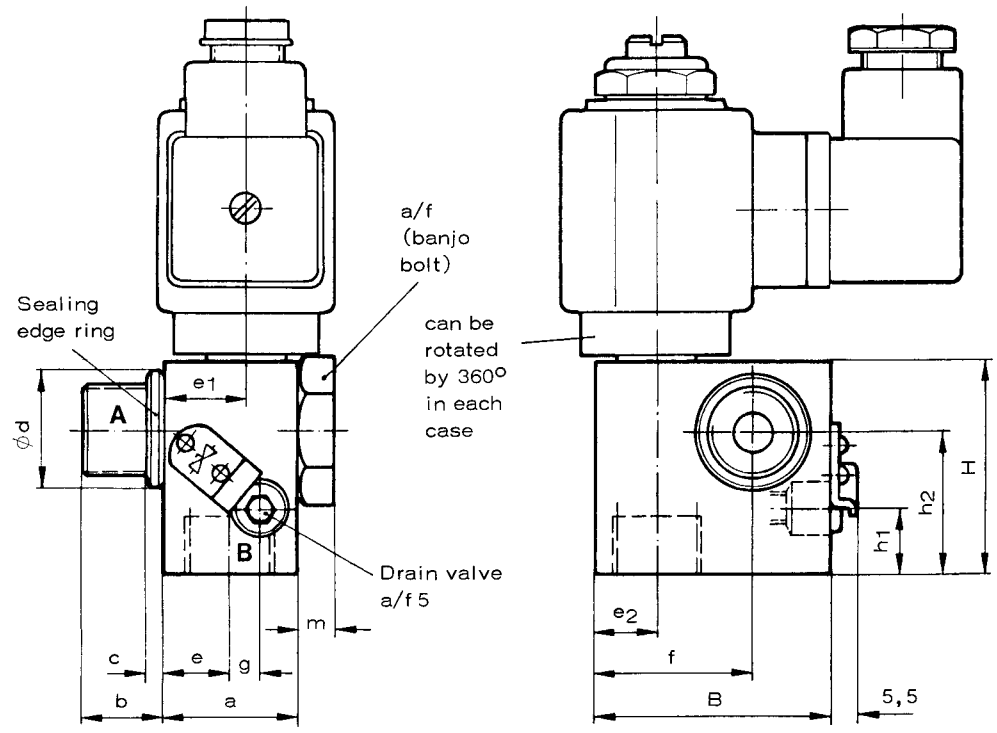


Type	Connect. A and B	L	B	H	a	b
EM 1 D (DS, DSH) - 1/4	G 1/4	35	20	40	14,5	10
EM 1 V (S, SH) - 1/4					16	
EM 1 V (S, SH) - 3/8	G 3/8	40	25	40	16	15
EM 20 V (S, SH) - 3/8	G 3/8	45	30	50	18	14
EM 20 V (S, SH) - 1/2	G 1/2	50				
EM 3 V (S, SH) - 1/2	G 1/2	55	40	60	20	20
EM 3 V (S, SH) - 3/4	G 3/4	60				
EM 4 V (S, SH) - 3/4	G 3/4	65	40	70	25	22
EM 4 V (S, SH) - 1	G 1	70	50			

Type	c	e	f	Order No. for individual order
EM 1 D (DS, DSH) - 1/4	25	30	6,5	7490 013
EM 1 V (S, SH) - 1/4				7490 010
EM 1 V (S, SH) - 3/8	32	32	6,5	7490 011
EM 20 V (S, SH) - 3/8	30	35	8,5	7491 012
EM 20 V (S, SH) - 1/2	32			7491 013
EM 3 V (S, SH) - 1/2	37	38	10,5	7590 011
EM 3 V (S, SH) - 3/4	40	40		7590 012
EM 4 V (S, SH) - 3/4	50	55	12,5	7591 011
EM 4 V (S, SH) - 1	55			7591 012

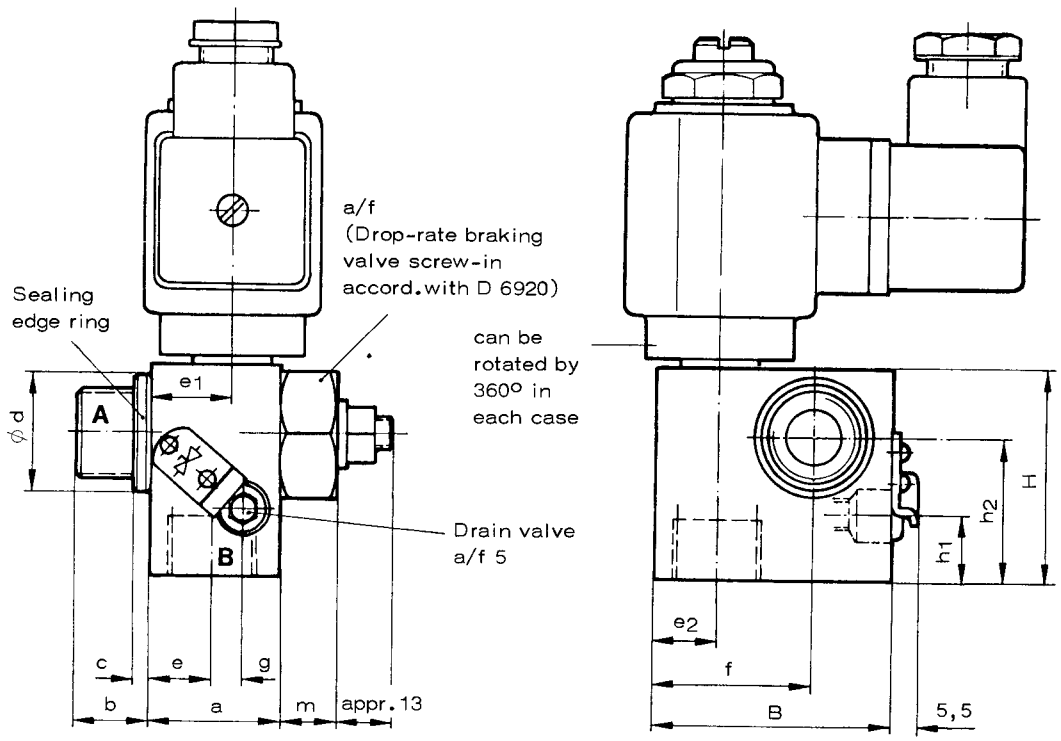
4.3.2. Swivel screw-in fitting

4.3.2.1. Version with banjo bolt and drain valve



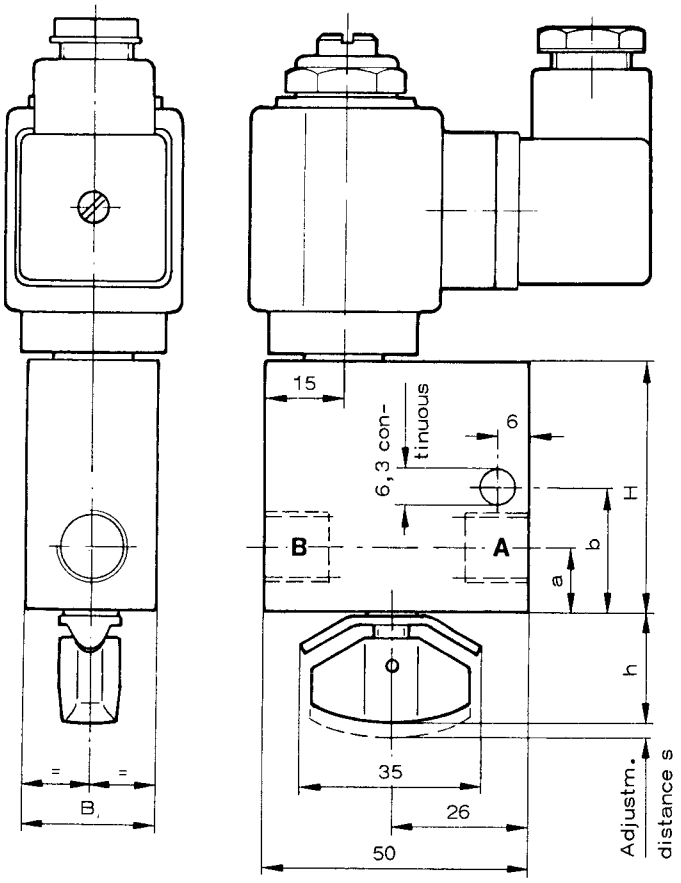
Type	Connections A	Connections B	B	H	a	b	c	d	e	e1	e2	f	h1	h2	g	m	a/f
EM 1 V - 3/8 F	G 3/8 A	G 3/8	45	40	25	15	3	22	12,5	15,5	12	30	12,5	27	5,5	7,5	24
EM 20 V - 1/2 F	G 1/2 A	G 1/2	52	50	30	18,5	4,5	26	15	15	14	35	15	30	7	9,5	30

4.3.2.2. Version with load lowering valve-screw-in cartridge and drain valve



Type	Connections A	Connections B	B	H	a	b	c	d	e	e1	e2	f	h1	h2	g	m	a/f
EM1V-3/8F-SB1.H-... EM1S(SH)-3/8F-SB1.H-..	G3/8A	G3/8	45	40	25	15	3	22	12,5	15,5	12	30	12,5	27	5,5	11	24
EM20V-1/2F-SB2.H-... EM20S(SH)-1/2F-SB2.H-..	G1/2A	G1/2	52	50	30	18,5	4,5	26	15	15	14	35	15	30	7	12,5	30

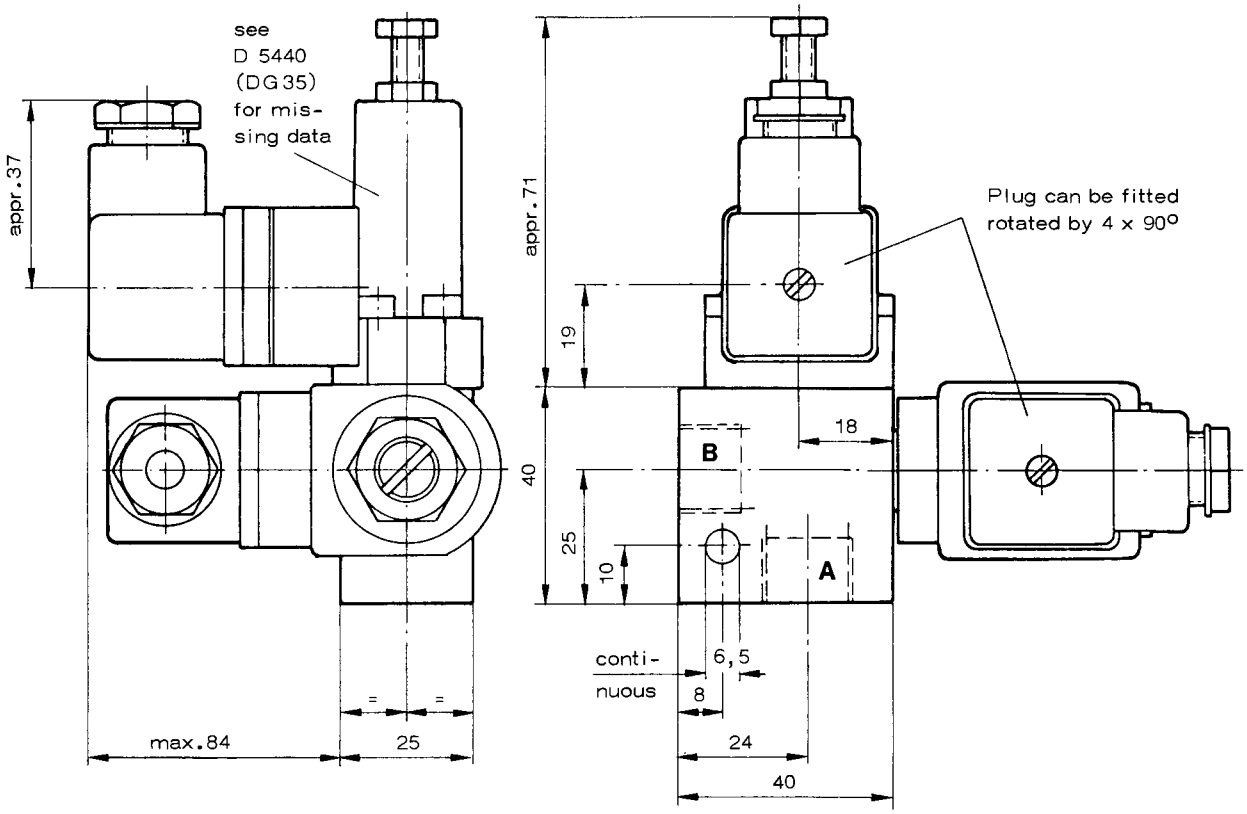
4.3.3. With bypass throttle



Type	Connect. A and B	B	H
EM1V-1/4D EM1S(SH)-1/4D	G1/4	25	47
EM20V-3/8D EM20S(SH)-3/8D	G3/8	30	62

Type	a	b	h	s
EM1V-1/4D EM1S(SH)-1/4D	12	23	21,5	2
EM20V-3/8D EM20S(SH)-3/8D	20,5	34	21	3

4.3.4. With pressure switch unit



5. Mass (weight) approx. in kg

Screw-in solenoid valve in accordance with Section 2.1

Type	appr.kg
EM1D(DS,DSH) EM1V EM1S(SH)	0,3
EM20V EM20S EM20SH	0,35
EM3V EM3S EM3SH	0,45
EM4V EM4S EM4SH	0,6

Connection blocks in accordance with Section 2.2 (complete with screw-in solenoid valve)

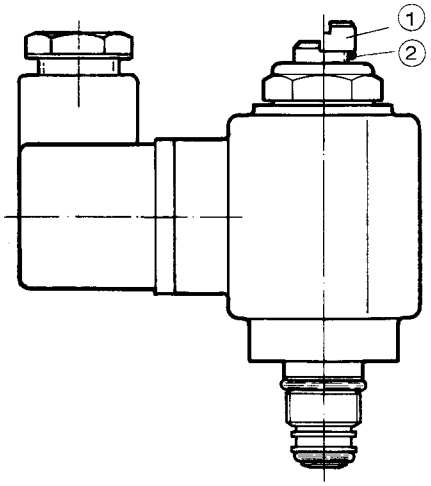
Type	appr.kg
EM1...-1/4	0,5
EM1...-3/8	0,6
EM20..-3/8 EM20..-1/2	0,85
EM3...-1/2 EM3...-3/4	1,25
EM4...-3/4	1,5
EM4...-1	1,9

Type	appr.kg
EM1V-3/8F	0,95
EM20V-1/2F EM20S(SH)-1/2F	1,25
EM1V-SB1.H-..	1,0
EM20V-SB2.H-..	1,4

Type	appr.kg
EM1V-1/4D	0,7
EM20V-3/8D EM20S(SH)-3/8D	0,9
EM1V-3/8DG35	0,9

6. Bleeding the solenoids

at upright to horizontal mounting position



In the case of EM1D, EM1 (20, 3 and 4) V, air cushions still in the armature chamber can cause pressure surges from the closed side A to briefly lift the piston when the valve is put into operation. This in turn causes a leakage surge which, desoite being slight, is still perceivable. This leakage surge can be practically prevented by bleeding (when putting into operation) the EM valve. To do this, undo the slotted screw (1) by approx. 1,5 turns, so that the O-ring (2) is exposed. In this state, the valve is no longer sealed against leakage oil. There is a slight leakage flow via the thread of the slotted screw (1). This flow flushes out to the air. Tighten the slotted screw (1) again afterwards.