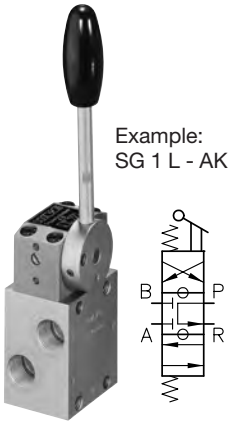
Directional spool valve type SG and SP

Versions for direct pipe connection or manifold mounting

Pressure p_{max} = 400 bar
Flow Q_{max} = 100 lpm

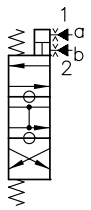
Version for pipe connection



Example:
SG 1 L - AK

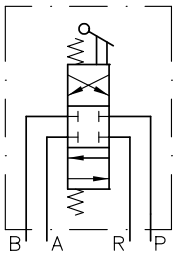
Size
0 and 1

Example:
SG 3 H - NM



Size
2, 3, and 5

Version for manifold mounting



Example: SP 3 G - AK

Actuation modes (illustration represents size 3)

Manual acc. to D 6511/1	Solenoid acc. to D 7055	Mechanical acc. to D 5870		Pressure acc. to D 6250
				
Shielded or un-shielded design	AC or DC voltage	Roller head	Ball head	Pneumatic or hydraulic and resp. combinations pneumatic/manual or hydraulic/manual

For brief description and main data, see table 4 in sect. 2.1!

1. General

Directional spool valves are generally employed in oil-hydraulic systems. They serve to control the oil flow and thus the direction of movement of the consumers (hydraulic cylinders and hydr. motors). These valves are designed for individual installation. They feature an internal leakage compensation, hence no leakage connection is required.
All valve versions are available either for:

- direct pipe connection or
- manifold mounting

Every directional spool valves consists of a control element (valve spool incl. housing) and a directly mounted actuation.
The valve unit is manufactured entirely of steel, thus rendering the housing insensitive to pressure surges and leakage as can sometimes be observed after prolonged periods of use with cast housings. This is caused usually by hairline cracks which form and migrate externally, especially when the permissible pressure range has been fully utilized. Such phenomena are ruled out right from the start. The housing bores are diamond-honed. The hardened and ground valve spools are polished/deburred. This preserves their roundness and exact geometric shape (the control edges are not worn down or widened) ensuring even sealing gaps with a minimum leakage rate.
Cast material (zinc and aluminum die casting) is used solely for non-pressurized components e.g. actuation housing, spring dome, base plates, etc. There is also a version available where the housing of the manual actuation is made of spheroidal cast iron which is intended especially for rough operation conditions or when these valves are connected in series.

2. Available versions, main data

2.1 Type coding

Order examples: Version for pipe connection **SG 3 L 3E - AK - 120**

Version for manifold mounting **SP 3 G - MD 23/24**

For actuation mode, see table 4

Desired pressure setting (bar) for the pressure limiting valve

Table 1: Basic type and size

Coding	Connection desig	Port size A, B, P	Port size R	Flow [1] Q_{max} (lpm)	Pressure p_{max} (bar) at ports A, B, P	Pressure p_{max} (bar) at ports R
SG 0	Pipe mounting acc. to ISO 228/1 (BSPP)	G 1/4	G 3/8	12	400	Dep. on actuation, see tab. 4 [2]
SG 1		G 3/8		20	400	
SG 2		G 3/8		30	400	
SG 3		G 1/2		50	400	
SG 5		G 1		100	315	
SP 1	Manifold mounting	See dimensional drawings in sect. 4 ++		12	400	
SP 3				50	400	
SP 5				100	315	

[1]) Recommended value; if the pump output flow is near the specified limits, the plunger side must be connected at A if differential cylinders are being used as consumers

[2]) In SP design with flow pattern for parallel connection depending on actuation, although not in excess of 100 bar

[3]) Standard material for models with pressure limiting valve

[4]) Normally only for special applications: Resistant to pressure surges up to 300 bar (pay attention to permissible pressures for actuations). For maritime versions, see D 6511/1

[5]) Port R must be connected to the tank as leakage drain

[6]) Not available for size 0 and 1

[7]) Without pressure limiting valve

[8]) Only available with manual actuation Y... acc. to D 6511/1 (detent, four switching positions)

[9]) Not available for SP.. manifold mounting

[10]) Not for size 5

[11]) Observe the position of the ports in the dimensional drawings, see also notes in sect. 3 ++

[12]) Version to the avoidance of decompression surges (only size 5), see sect. 2.2

[13]) Not available for type SG 5 with pressure limiting valve

[14]) Not available for type SG 0(1)

Table 3: Optional pressure limiting valve (only type SG)

Basic type	Spring housing made of Zinc die casting [3] perm. pressure at R = 20 bar: tool adjustable	manu. adjust.	Steel [4] pressure at R > 20 bar: tool adjustable	manu. adjust.	Pressure range (bar)
SG 0 SG 1	**1B**	**2B**	---	---	(315) ... 400
	1C	**2C**	---	---	(160) ... 315
	1E	**2E**	---	---	(80) ... 160
	1F	**2F**	---	---	20 ... 80
SG 2 SG 3 SG 5	**3B**	**4B**	**6B**	**7B**	(315) ... 400
	3C	**4C**	**6C**	**7C**	(160) ... 315
	3E	**4E**	**6E**	**7E**	(80) ... 160
	3F	**4F**	**6F**	**7F**	20 ... 80
	Coding is omitted for versions without pressure limiting valve!				

Essential note:

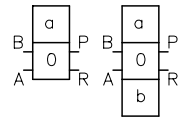
Permissible pressure at R depends on the spring housing material (see above). Connection R must always be the return, any pressure at R adds itself to the pressure setting. Do not use for series connections. In parallel connections, only equip one valve with a pressure limiting valve.

Attention: Pressure limiting valves are not available for all flow pattern symbols (see table 2).

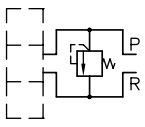
Table 2: Flow pattern symbols

Basic flow pattern symbols and switching positions

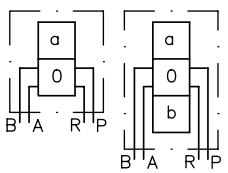
Avail. for type SG..



With pressure limiting valve

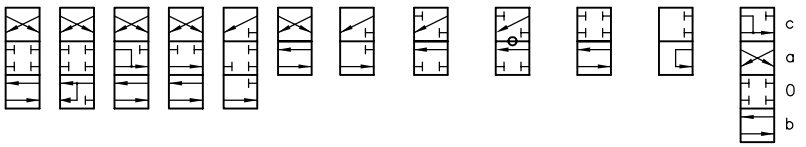


Avail. for type SP..



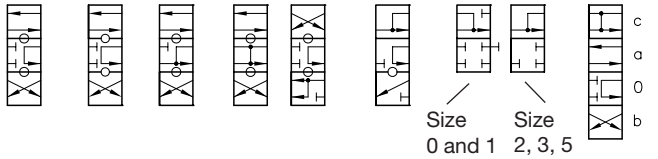
Suited for parallel connection

G	C	D	E	N	W	R	V [5]	Q [5] [6]	Z [6] [7] [10]	U [6] [7]	B [7] [8] [9] [10]



Suited for series connection

L [13] LS [12] [13]	P [13]	F [13] FS [12] [13]	H	Y [7] [11] [14]	S [13] SS [12] [13]	X [7]	K [6] [7] [8] [9] [10]

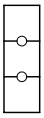


Size 0 and 1 — Size 2, 3, 5

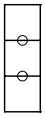
Overlap between two switching positions:

None (neutral)

Positive (intermediate blocked position)



Negative (slight intermediate blocked position)

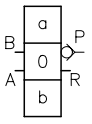


Remarks on use:

If several single valves are being used in a system, attention must be paid to the connection (parallel, series). In a series connection, the permissible system pressure = permissible pressure in the return!

Hence, not all modes of actuation are suitable for aseries connection (ect. 4).

Check valve insert type ER 21 optionally available for type SP 1:



The check valve type it 21 must be ordered separately.

The check valve insert type ER 21 acc. to D 7325 may be installed in port P, when required. This is advantageous when several directional spool valve sections (flow pattern symbols D, E, G, N, R, V, and W) are connected in parallel and situations might occur where two valve sections are actuated subsequently but simultaneous. Thereby preventing a pressure drop of the first actuated consumer.

Table 4: Actuation modes (Selection table, for more detailed information refer to the corresponding pamphlets)

Actuation	Coding						Pressure p_{max} (bar) at ports A, B, P	R [1]	Notes, remarks	Symbols
Manual (spring return/ detent) acc. to D 6511/1	Size	With spring return 0 and 1	With spring return 2, 3 and 5	With detent 0 and 1	With detent 2, 3 and 5				**AD, CD:** (zinc die cast.) for normal conventional use. Only for parallel connection! **AK, CK:** (spheroidal cast iron) for especially rough use. Suited for series connection **BX:** Sturdy but not shielded design; only for parallel connection; corrosion-protected by galvanized and nitrided components	A C AD CD AK CK BX
	Shielded design	**A**	**AD**	**C**	**CD**		400	50 (20)		
		AK(S)	**AK(S)**	**CK(S)**	**CK(S)**		400	315 (20)		
		AKS, CKS = Seaworthy version								
	Unshielded design	---	**BX** [2]	---	---		400	50 (20)		
	The manual actuation is also available without hand lever (add coding 1, e.g. A 1, CK 1 etc.)									
Solenoid acc. to D 7055	Voltage U_N: **12** 12 V DC; **24** 24 V DC; **110 W** 110 V AC 50 and 60 Hz; **230 W** 230 V AC 50 and 60 Hz									ME.. MD..
	Size 0 and 1	**ME 1** 12 V DC	Single stroke	Output 45 W 100% ED			200	200 (20)	Also available with emergency manual actuation. Suffix code N: MD2/... N, etc. **Attention:** Permis. pressure at R only approx. 40 bar during use. Pay attention to the special note for actuating emergency manual operation as explained in D 7055!	MU..
		ME 2 24 V DC								RE BE RD BD
		ME 81 110 V AC 50/60 Hz								
		ME 8 230 V AC 50/60 Hz								
		MD 1 12 V DC	Double stroke							
		MD 2 24 V DC								
		MD 81 110 V AC 50/60 Hz								
		MD 8 230 V AC 50/60 Hz								
	Size 2 and 3	**ME 2/...**	Single stroke	Output 60W 100% operating factor			200	200		NE ND NU
		MD 2/...	Double stroke							
		MU 2/...	Reverse stroke							
		ME 23/...	Single stroke	Output 150 W S3-35% ED 5 min			315 (size 2, 3)	200		
		MD 23/...	Double stroke							
		MU 23/...	Reverse stroke							
	Size 2, 3, and 5	**ME 3/...**	Single stroke	Output 65 W 100% ED			200 (size 5)	200		
		MD 3/...	Double stroke							
		MU 3/...	Reverse stroke							
Mechanical acc. to D 5870	Size 0 ... 5	Roller head	**RE**	Single stroke			400	100 (20)	Only for parallel connection ! In case of double stroke, idle pos. is determined by cam. Observe the note in D 5870	NM
			RD	Double stroke						
	Size 2, 3 and 5	Ball head	**BE**	Single stroke						KD KM
			BD	Double stroke						
Pressure acc. to D 6250 Control medium air or oil	Size 0 and 1	Standard design	Air or oil	**NE**	Single stroke		400	40 (20)	Only for parallel connection ! **NE, ND** and **NU:** also available with emergency manual operation, add coding H: NDH etc. Pressure-relieved version (D 6250) can be subjected to pressures up to 200 bar in the return	
				ND	Double stroke					
	Size 2, 3, and 5	Standard design	air	**NE**	Single stroke		400	30		
				ND	Double stroke					
				NU	Reserve stroke					
			oil	**NM**	Single stroke and Double stroke					
		Double stroke	hand/air	**KD**	Double stroke		400	12	Only for parallel connection !	
			hand/oil	**KM**	Double stroke					

[1] For versions fitted with a pressure limiting valve, observe table 3, the lower pressure applies. Furthermore, not more than 100 bar in SP

[2] Not for size 5

2.2 Additional parameters and notes

Design	Spool-type directional control valve
Mounting	Type SG: See unit dimensions in sect. 3.1 Type SP: Onto manifold
Pipe connection	Tapped ports conforming ISO 228/1 (BSPP) Suited for male fittings, shape B acc. to DIN 3852 P = Pump port A, B = Consumer ports R = Return port (pressure resistance dep. on the actuation, see also table 4)
Installed position	Any
Flow direction	According to symbol but also reverse, pay attention to permissible pressure at R
Operation pressure	p_{max} = 400 bar, dep. on size and actuation
Static overload capacity	approx. 2 x p_{max}

Pressure adjustment of the pressure limiting valve

Pressure range	SG 0(1)	SG 2(3)	SG 5
	Δp (bar) per 1 rev.		
B	100	80	80
C	55	35	35
E	19	17.5	17.5

Mass (weigth) approx. kg

Type	Pressure limiting valve	Complete incl. actuatuion											
		Manual			Solenoid						Mecha-nical	Pressure	
		AD	AK	BX	ME..	MD.. MU..	ME 2/.. ME 23/..	MD(U) 2/.. MD(U) 23/..	ME 3/..	MD 3/.. MU 3/..		Standard actuation	Combined actuation
SG 0(1) SP 1	without	1.0	1.0	---	1.4	1.7	---	---	---	---	1.1	0.9	---
	with	1.2	1.2	---	1.6	1.9	---	---	---	---	1.3	1.1	---
SG 2(3) SP 3	without	3.0	3.5	2.5	---	---	3.9	5.0	4.5	4.8	2.7	2.5	2.9
	with	3.3	3.8	2.8	---	---	4.2	5.3	4.8	5.0	3.0	2.8	3.2
SG 5	without	3.4	3.9	2.9	---	---	4.3	5.4	4.9	5.1	3.1	2.9	3.3
	with	4.7	5.2	---	---	---	5.6	6.7	6.2	7.0	4.4	4.2	4.6
SP 5	without	4.3	4.8	---	---	---	5.2	6.3	5.8	6.6	4.0	3.8	4.2

Pressure fluid	Hydraulic oil conf. DIN 51524 part 1 to 3: ISO VG 10 to 68 conf. DIN 51519 Viscosity limits: min. approx. 4, max. approx. 1500 mm^2/s Optimal operation: approx. 10 ... 500 mm^2/s Also suitable for biological degradable pressure fluids types HEPG (Polyalkylenglycol) and HEES (Synth. Ester) at service temperatures up to approx. +70°C
Temperature range	Ambient: approx. -40 ... +80°C Fluid: -25 ... +80°C, Note the viscosity range Permissible temperature during start: -40°C (observe start-viscosity!), as long as the service temperature is at least 20K higher for the following operation Biological degradable pressure fluids: Observe manufacturer's specifications. Considering the compatibility with seal material not over +70°C. **Attention:** Observe the restrictions regarding the permissible operation duration of the actuation solenoids, see sect. 3.1 in D 7055!

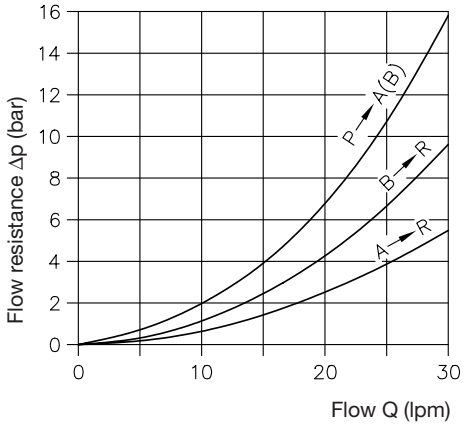
Notes for flow pattern symbols LS, FS, and SS:

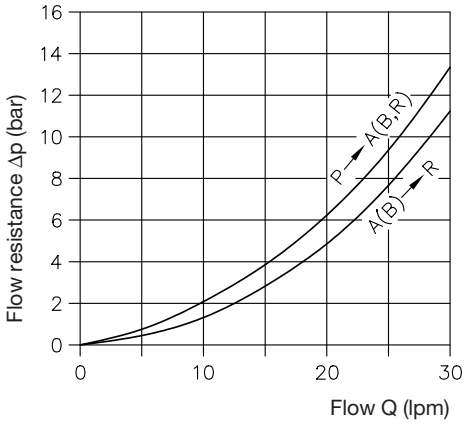
Directional spool valves to the avoidance of decompression surges (only available for type SG 5!)	It is common practice in the shipbuilding industry to utilize directional spool valves with big sized ports (even for very low flows) to minimize the back pressure within the usually very lengthy pipe system. Such high in-pipe volume usually cause pressure surges being very strainous for the complete hydraulic equipment. The directional spool valves versions type SG 5 ... S feature valve spools with long notches which cause a rather smooth pressure built-up during switching operations, thus minimizing such pressure surges. The big-port design (G 1) enables use of pipes ∅25 with accordingly low back pressure. Technical data: All technical data and dimensions are like with the standard version, beside the Δp-Q curve.

Δp - Q - characteristics
The flow resistance values (recommended values) are understood without pipe fittings (SG) and without manifold (SP)

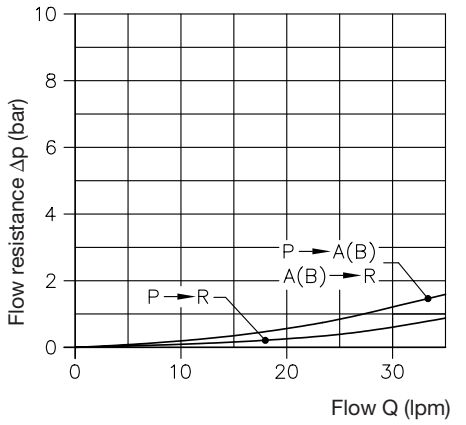
Type	Valves for parallel connections	Valves for series connections	Note

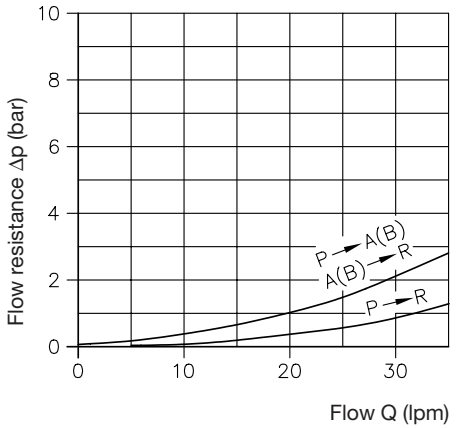
SG 0
SG 1
SP 1



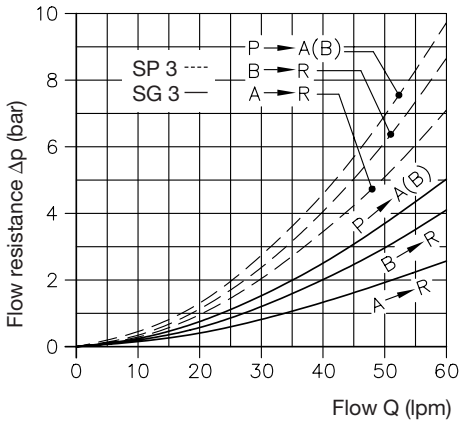


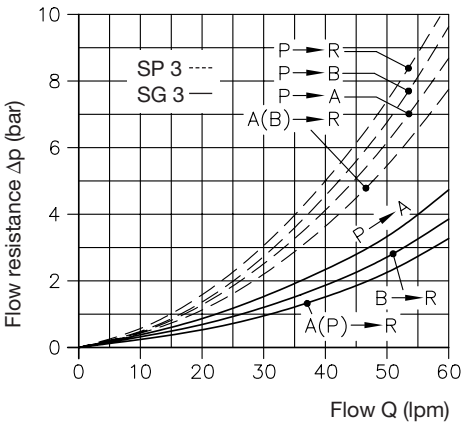
SG 2



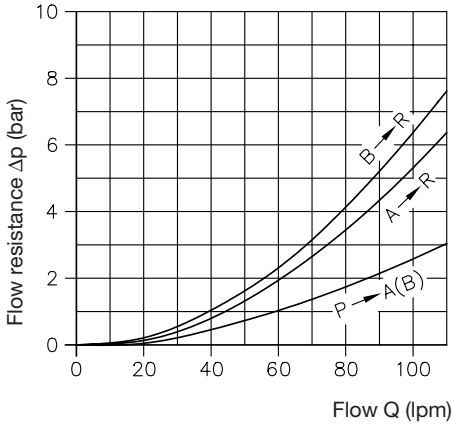


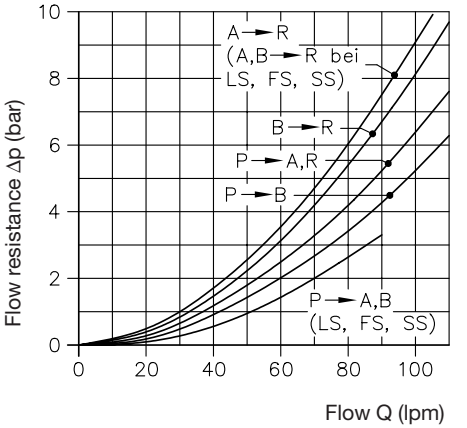
SG 3
SP 3





SG 5
SP 5

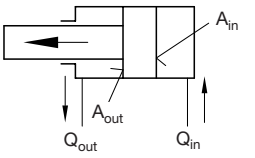


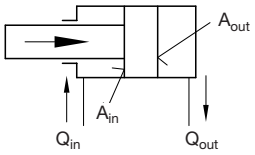


Double-acting consumers with unequal area ratios (differential cyl.):
The return flow Q_{return} may be lower or higher than the inlet flow Q_{inlet} (pump delivery flow) depending on the direction of movement. The flow resistance Δp_{total} of the directional spool valve must always be related to the inlet side (connection P):

$$\Delta p_{total} = \Delta p_{in} + \Delta p_{out} \frac{A_{out}}{A_{in}}$$

Directional spool valves for parallel connection:
The cylinder port of the piston side (larger surface) should always be connected to port A.





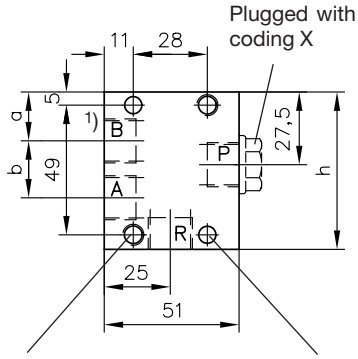
$$Q_{return} = Q_{in} \frac{A_{out}}{A_{in}}$$

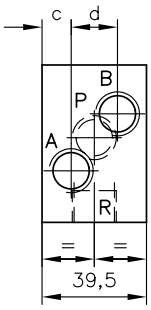
Fluid viscosity during tests approx. 60 mm²/s

3. Dimensions All dimensions in mm, subject to change without notice!

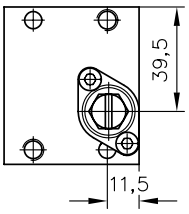
3.1 Directional spool valves for direct pipe connection (For actuations, see sect. 3.3, on page 8 ++)

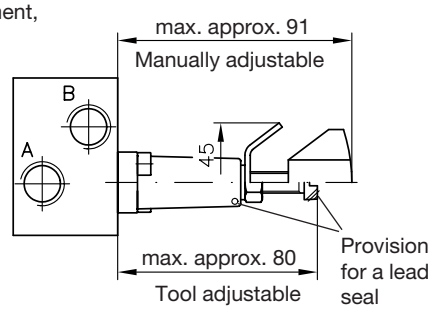
Type SG 0 and SG 1





Version with pressure limiting valve
(For pressure adjustment, see sect. 2.2)

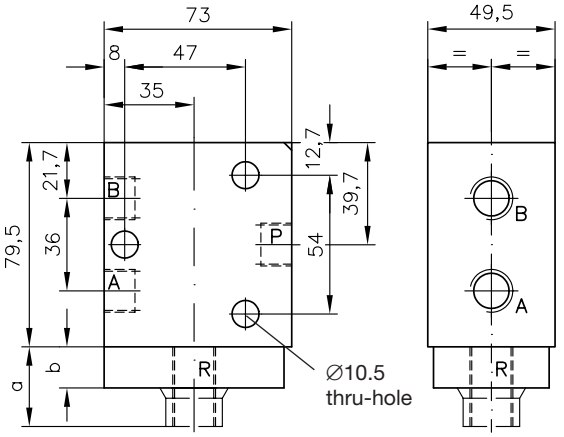




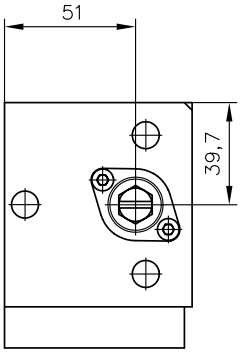
Size	Coding	a	b	c	d	h	Ports ISO 228/1 (BSPP) P, A, and B	R
0	D, E, G, W, N, R	17.5	20.5	9.5	20.5	59.5	G 1/4	G 3/8
	F, H, L, P, V, S, X	21.5	12	9.5	20.5	59.5	G 1/4	G 3/8
1	Y	18.5	21.5	11	17.5	70	G 3/8	G 3/8
	Other codings	18.5	21.5	11	17.5	59.5	G 3/8	G 3/8

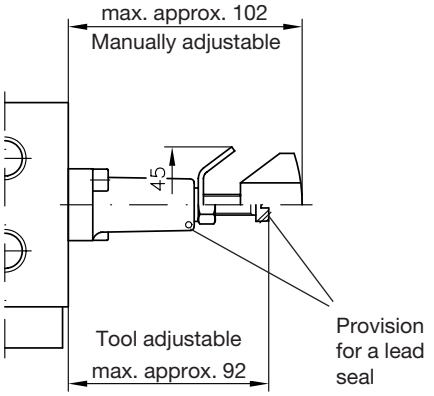
1) Port B is omitted with coding N, S, and R

Type SG 2 and SG 3 2)



Version with pressure limiting valve
(For pressure adjustment, see sect. 2.2)



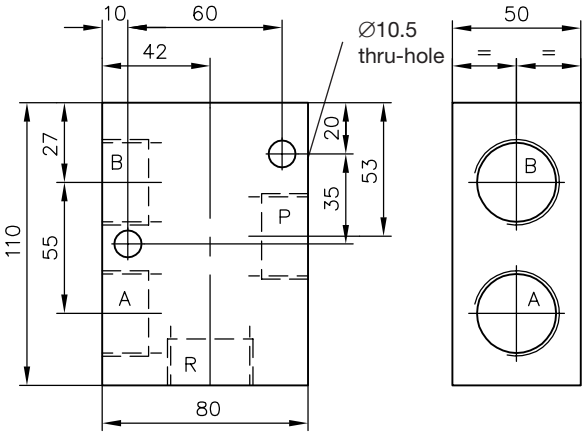


Dimension a = 30 for coding B, C, K, Y
Dimension b = 11 for coding U
16 for other codings

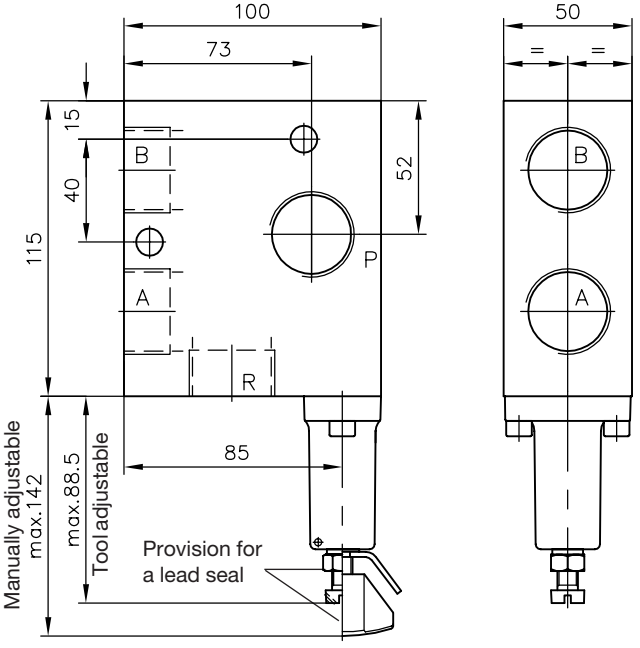
Pay attention to the differing dimensions of the base plate for the pressure compensated version with pressure actuatuation (see D 6250).

Ports ISO 228/1 (BSPP):
P, R, A, B = G 3/8 (SG 2)
G 1/2 (SG 3)

Type SG 5 2)



Version with pressure limiting valve
(For pressure adjustment, see sect. 2.2)



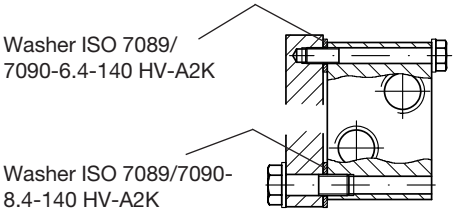
Ports ISO 228/1 (BSPP):
P, R, A, B = G 1

2) Port B is omitted with coding N, S, R, U, and X.
Ports P and A are mixed up with coding Y.
Port A is stamped R with coding U

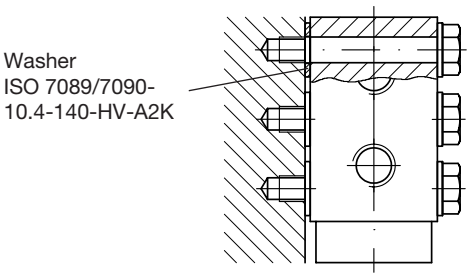
Important notes (for SG valves, all sizes)

Washers must be installed between valve and mounting area to prevent warping of the valve housing in case of uneven mounting surfaces.

Type SG 0 and SG 1



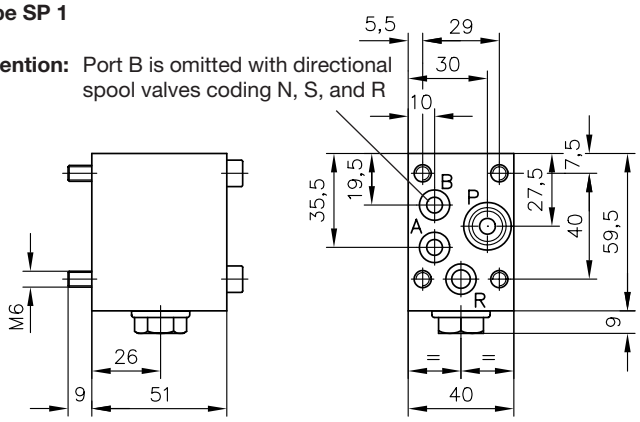
Type SG 3 and SG 5



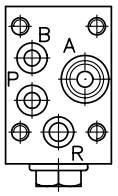
3.2 Directional spool valve for manifold mounting (For actuations, see sect. 3.3 on page 8 ++)

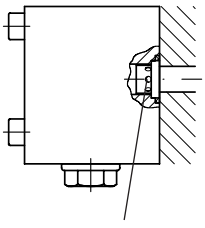
Type SP 1

Attention: Port B is omitted with directional spool valves coding N, S, and R



Position of the ports with coding Y

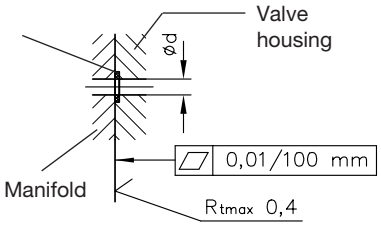




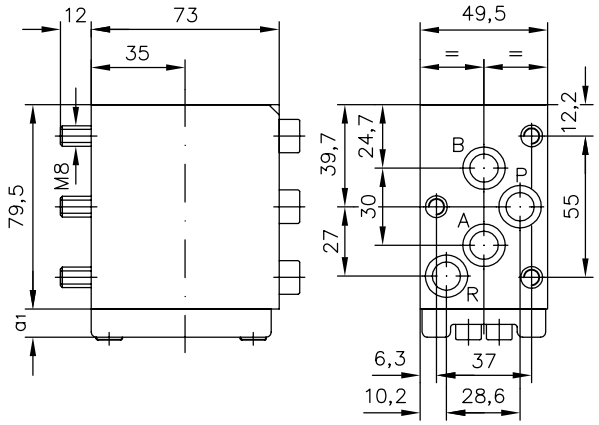
Check valve insert type ER 21 (not available with coding Y, see also sect 2.1, table 2).

Sealing of ports A, B, P, and R via O-rings NBR 90 Sh. (There is also a seal kit available, order no. DS 5650/1-1)

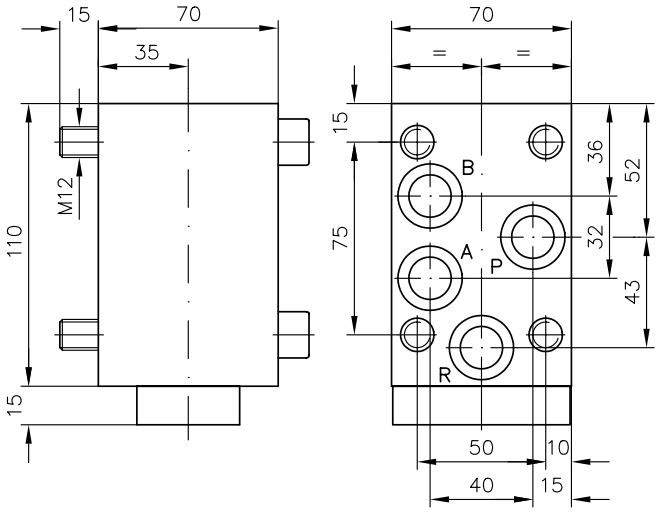
Ports	A, B, R	P
Ød	7	7 to 9
O-ring	8x2	14x2



Type SP 3 [1])



Type SP 5 [1])

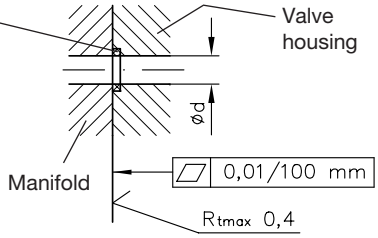


Dimensions a_1
= 11 with coding
D, E, G, N, R, U, V, W, X and Z
15 with coding
C, F, L, P, S, H

[1]) Port B is missing with coding N, S, R, U, and X.
Ports A and R can be used alternatively as return with coding U

Sealing of ports A, B, P, and R via O-rings NBR 90 Sh. (There is also a seal kit available, order No.)

Type	Ød	O-ring	Order no.
SP 3	11	12x2.5	DS 5650/1-3
SP 5	16.5	20x2.5	DS 5650/1-5

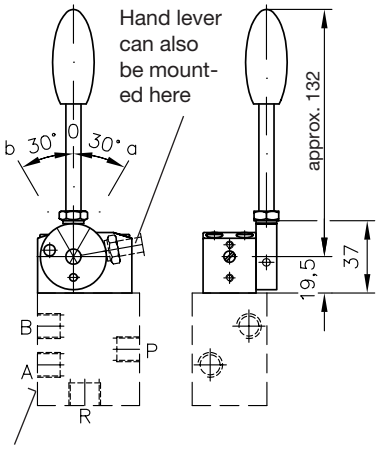


3.3 Actuation modes, orientation and main data

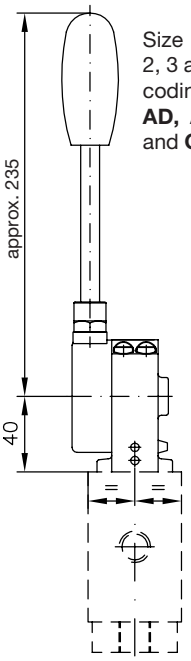
For missing specifications, see respective pamphlets!

Manual actuation

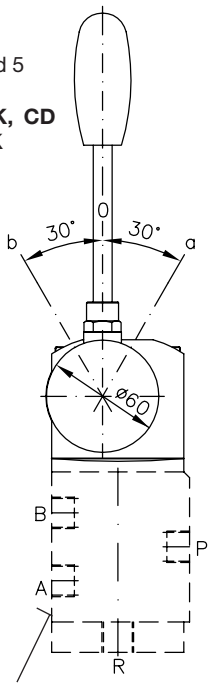
Size 0 and 1
coding
A, AK, C and **CK**



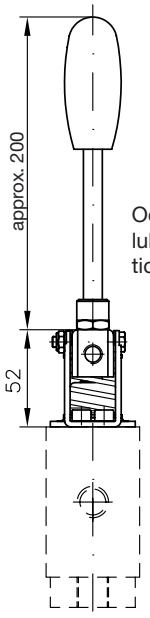
Flange (mounting) area with directional spool valve type SP 1



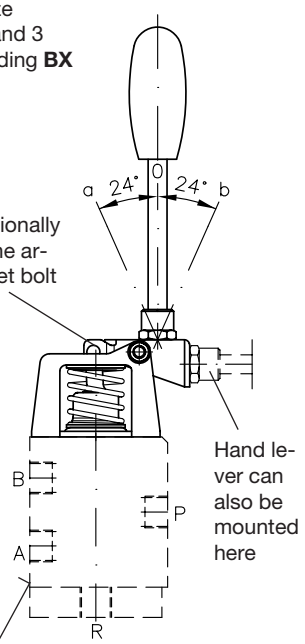
Size
2, 3 and 5
coding
AD, AK, CD and **CK**



Flange (mounting) area with directional spool valve type SP 3(5)

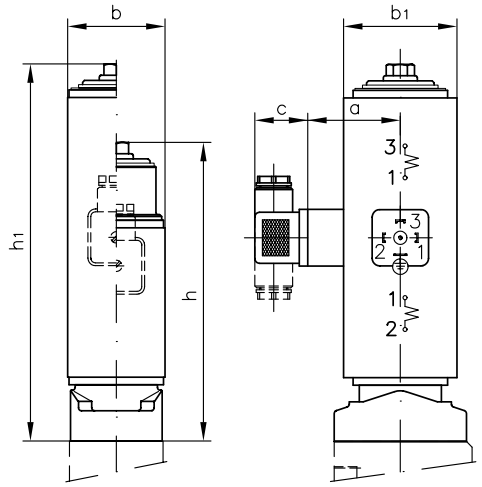


Size
2 and 3
coding **BX**



Flange (mounting) area with directional spool valve type SP 3

Solenoid actuation

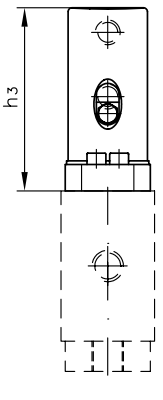


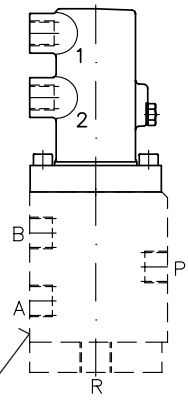
c = 28 for version with DC-solenoid
= 35 for version with AC-solenoid
This dimension depends on the manufacturer and may be max. 40 mm (acc. to DIN 43650)!

Size	Coding	a	b	b_1	h	h_1
0 a. 1	ME.. and MD..	32	39	51	104	135
2, 3 and 5	ME(D, U) 2/.. ME(D, U) 23/..	54	51.5	60	158	199
	ME(D, U) 3/..	54	Ø72	Ø72	158	199

Pressure actuation

Standard versions, coding **NE, ND, NU** and **NM**



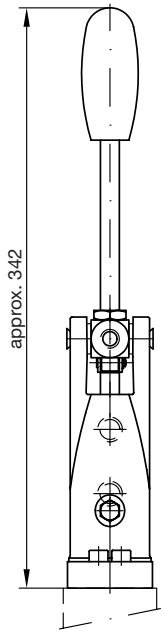


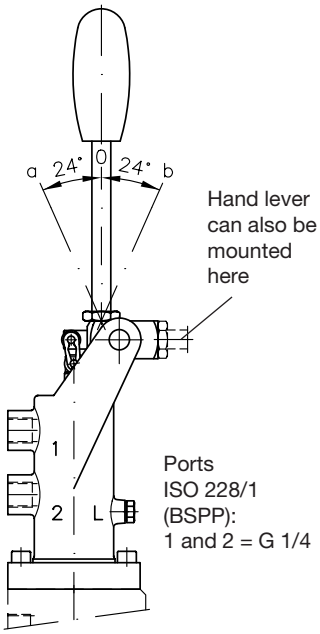
Ports
ISO 228/1
(BSPP):
1 and 2 = G 1/4

Size	h_3
0 and 1	60
2, 3 and 5	97

Flange (mounting) area with directional spool valve type SP..

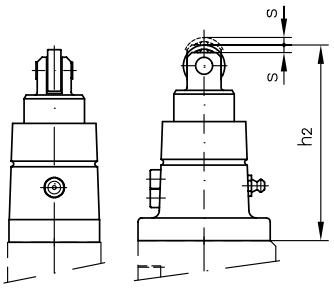
Double actuation coding **KM** and **KD**



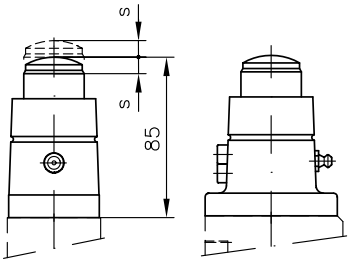


Mechanical actuation

Coding **RE** and **RD**



Coding **BE** and **BD**



Size	0 and 1	2, 3, and 5
h_2	66	102
s	5	10