

Directional seated valves

Directly actuated, leakagefree for hydraulic systems
For the assembly on connection sub-plates

Valve for sub-plate mounting Section 3
Valve with individual connection sub-plate Section 5
Directional valve bank D 7302

Pressure p_{\max} 350...500 (700) bar
Flow Q_{\max} 6...120 l/min

1. General information

Directional control valves are generally used for the direct, leakage free control of consumers and as pilot valves for hydraulically actuated valves (depending on the flow pattern). They are designed as spring returned ball seated valves. The valve elements are forced into their respective switching position against the spring force and fluid pressure by various actuation elements via an elbow lever acting on a pin. A strainer insert in the inlet port prevents the entry of coarse contamination.

The fluid ducts end as holes with O-ring seals at the ground, bottom surface of the valve body. Pipes may be connected either via customer furnished connection blocks or sub-plates (for individual valves with sub-plates see sect. 5 or for valve banks see D 7302). These valves do not show any leakage in blocked switching position. Reliable shifting is ensured, as these valves are designed as ball seated valves where there is no seizing or sticking in working position under full pressure. The leverage between actuation and valve element ensures low actuation forces and smooth shifting. To avoid interaction, most of these directional control valves are available with check valve inserts and return pressure stops or orifice inserts to limit the inflow of oil.

Individual valves with sub-plate, enabling direct pipe connection, may be equipped with a by-pass check valve, a pressure limiting valve, or a rectifier circuit by means of check valves.

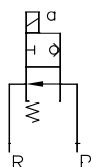
2. Overview

(For complete type overview, see sect. 8)

Individual valve for manifold mounting

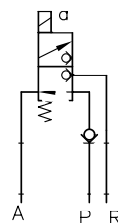
Individual valve with connection sub-plate for direct pipe connection

e.g. **GS 2-1-G 24**



Solenoid actuated
2/2-way directional
seated valve, size 1,
free flow when
deenergized

e.g. **GZ 3-2R-3/8-G 24**



Solenoid actuated 3/2-way
directional seated valve,
size 2 with check valve in-
sert in port P

Tapped ports in the
connection sub-plate, G 3/8

Actuation modes

For detailed data, see section 4++.

(Max. pressure rating depending on flow pattern and size, see sect. 3.1 table 2)

Code letter	Solenoid		Pressure		Mechanical		Manual	
	G	WG	hydraulic H	pneumatic P	roller K	pin T	feeler F	turn-knob D
Picture and symbol								

3. Individual valves, manifold mounting

3.1 Valve

Order example:

Solenoid actuation (acc. to sect. 4.1)

G = DC

WG = AC

For actuation modes **H, P, K, T, F, D**, see sect. 2 and 4.2 ++

GR 2 - 3 R - G 24

(For individual valves with connection sub-plate for pipe connection, see sect. 5)

solenoid voltage (standard)

G 24 = 24 V DC; **WG 230** = 230 V AC

see sect. 4.1

Additional element (see table 3)

Size and main data (see table 2)

Table 1: Flow pattern

Coding	2/2-way valve		3/2-way valve		3/3-way valve	4/3-way valve	4/2-way valve	
	R2 ³⁾	S2 ³⁾	3 ³⁾	Z3 ³⁾	21	22 ¹⁾	4 ^{2) 3)}	Z4 ^{2) 3)}
Detailed symbols (must be completed by actuation symbol)								
	1) Not available for size 4! Note the arrangement of solenoids a and b in relation to the ports A and B, see dim. drawings sect. 3.3.3							
	2) Only available for size 1							
	3) Size 1 also available as explosion-proof version, see sect. 4.1.3							
Simplified flow pattern symbol								

Table 2: Size, main data

Coding			0			1		2		3		4
Max. flow approx. lpm			6			12		25		65		120
Directional valves (... -way)			2/2; 3/2	3/3	4/3	2/2; 3/2; 3/3; 4/2	4/3	2/2; 3/2; 3/3	4/3	2/2; 3/2; 3/3	4/3	2/2; 3/2; 3/3
Pres- sure p _{max} (bar)	Solenoid actuation	Type G.. a. WG..	500		350	500 ⁴⁾	350	500 ⁴⁾	350	400	350	350
	Pressure actuation	Type H..	500		500	700	500	500	500	400	400	---
		Type P..	---		---	700	400	500	400	400	350	---
	Mechanical actuation	Type K..	---		---	700	400	500	400	400	350	---
		Type T..	---		---	700	400	500	400	---	---	---
	Manual actuation	Type F..	---		---	700	400	500	400	400	350	---
Type D..		500	---	---	700	400	500	---	---	---	---	

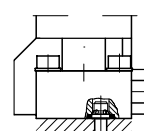
³⁾ For max. pressure during shifting, see sect. 4.1

Table 3: Additional elements to influence shifting operations, inserted in port P or R (can be retrofitted).

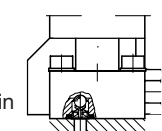
Coding and symbol	Additional element		Note
	for size	Type	
R	all	Insert check valves type ER acc. to D 7325 e.g. type ER 01 for valves size 0	Not avail. for 3/3- and 4/3-way directional spool valves type ...21 and ...22 The check valve prevents an uncontrolled impact or reflow $R \rightarrow P$ or $A \rightarrow P$, e.g. if the inlet pressure at P drops below the consumer pressure at A (during idle position or actuation of another consumer with a lower pressure requirement) when several valves are connected in parallel. A pressure reduction is prevented during such switching operations.
B	all	size 0 = EB 0-0,6 1 = EB 1-0,8 2 = EB 2-1,2 3 = EB 3-2,5 4 = EB 4-4,0 Insert orifices type EB acc. to D 6465	Not available for 4/3-way valves type ...22 ! The orifice serves to limit the flow (see $\Delta p-Q$ curves) and should be installed if flow rates higher than Q_{max} (table 2) can occur while switching from $P \rightarrow A(R)$: Hydraulic accumulators on the pump side P or in the case of hydr. servo operation of directional spool valves with control oil supply from the high flow main gallery.
S	0 1	7332 000a 7332 000b Return pressure stop	Only available for 3/2-way valves types ...3-.. or ...Z3-.. Check valves may be installed in the reflow ports R of 3/2-way valves size 0 and 1. With parallel shifting of several valves, they prevent pressure surges from migrating via the common reflow gallery into non-operated, easily moving and unloaded consumers if there is a connection $A \rightarrow R$, thus preventing uncontrolled extension movements. Such pressure surges can be caused by shifting operations. These check valves are not intended for blocking off hydraulic oil, which depending on the combination of switching operations of other valves, can arise at port R.
	A combination with check valve or orifice in port P is possible e.g. G 3-1 BS-G 24, GZ 3-1 RS-G 24		

Installation illustration

Check valve or orifice installed in port P



Return pressure stop installed in port R

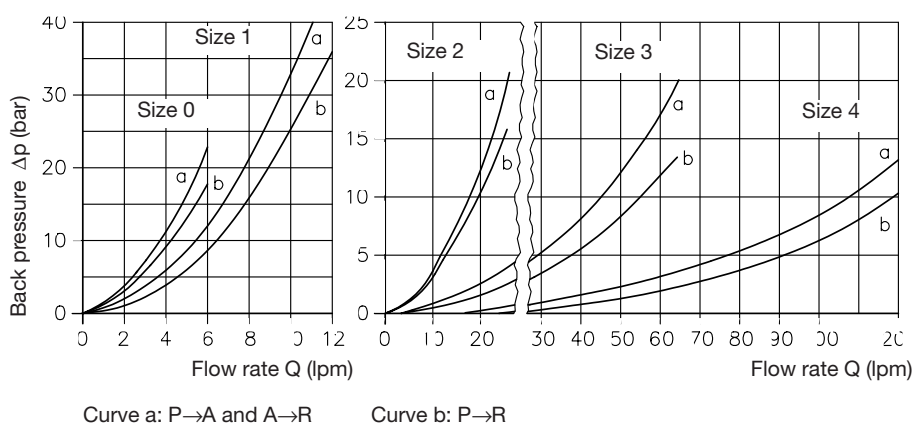


3.2 Further characteristic data

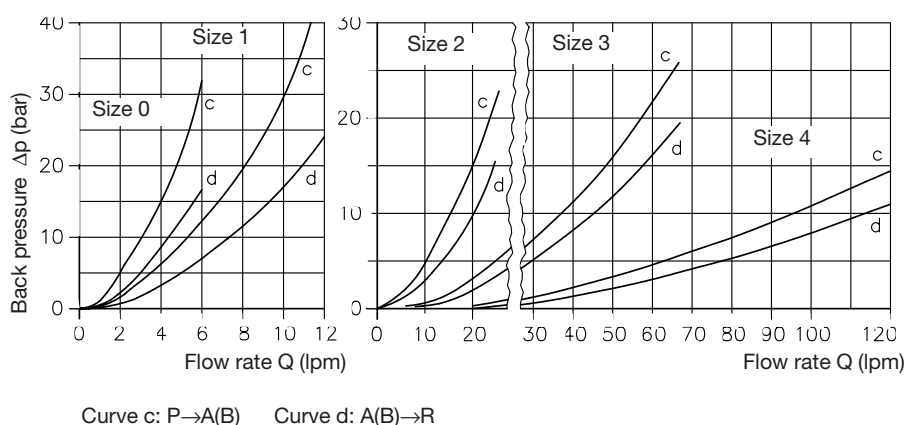
3.2.1 General and hydraulic parameters

Description	2/2-, 3/2-, 3/3, 4/3- and 4/2-way valve						
Design	Seated ball valve						
Mounting type and leads connection	Manifold mounting	Size	0	1	2	3	4
		corresp. to nom. size	4	6	10	15	20
Installation position	Any; Vertically with actuation up (best)						
Direction of flow	Only in arrow direction acc. to flow pattern in sect. 3.1 The location of ports P (pump), R (return flow), A and B (consumers) are dictated by the internal design and can't be readily interchanged.						
Overlap	Negative, i.e. the transition from shifting pos. 0 into a and vice versa is gradual, with 3/2-way valves all ports may be interconnected during this state. See also sect. 3.1 (table 3) „Additional orifice“ !						
Operation pressure	See sect. 3.1. All ports may be subject to the full oper. pressure, but a pressure drop must be maintained in flow direction acc. to the flow pattern in sect. 3.1, i.e. $P \geq A(B) \geq R$. With 4/3-way valves connection R must be employed as return flow only. For permissible pressure during switching operations, see sect. 4.1.						
Static overload capacity	Approx. $2 \times p_{\max}$, applies only to valves in idle position (p_{\max} from table 2 sect. 3.1)						
Flow rating	See sect. 3.1. Pay attention to the area ratio of double acting consumers (differtial cylinders), i.e. the return might be higher than the inflow.						
Pressure fluid	Hydraulic oil conforming DIN 51524 part 1 to 3: ISO VG 10 to 68 conforming DIN 51519 Viscosity limits: min. approx. 4, max. approx. 800 mm ² /s Optimal operation: Approx. 10 ... 200 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. For other fluids see sect. 6.2.						
Temperature range	Ambient: Approx. -40 ... +80 °C; Fluid: -25 ... +80°C, note the viscosity range ! Restriction for version with ex-proof solenoid: Ambient: max 40°C; Fluid: max 70°C 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 perm. duty cycles of the solenoids in sect. 4.1 and limits for the explosion-proof solenoids in sect. 4.1.2 !						

2/2- and 3/2-way valves



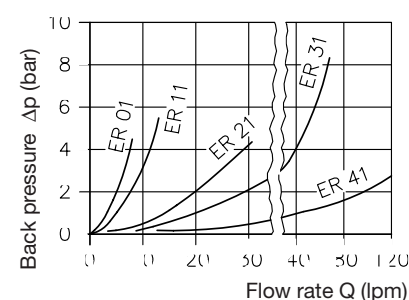
3/3-, 4/3- and 4/2-way valves



Additional elements

(the figures for Δp P→A(R) below are to be added !)

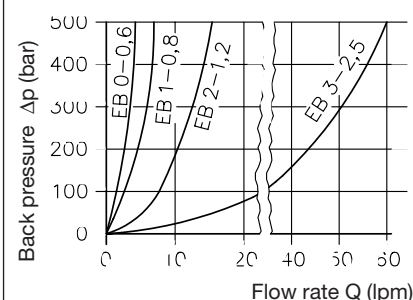
Check valve



Δp-Q curves (guideline)

Oil viscosity during tests approx. 60 mm²/s

Orifice



3.3 Dimensions,

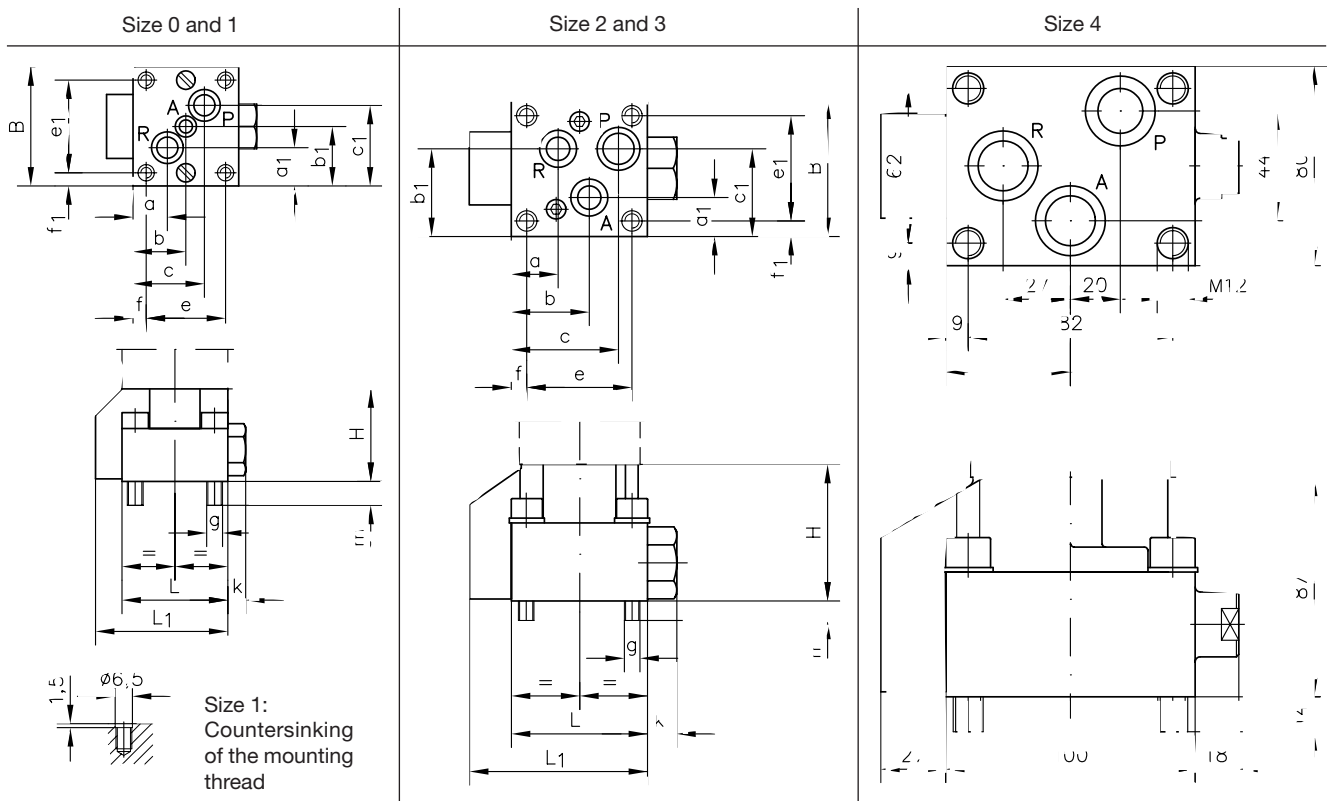
valve only. For the dimensions of the actuators see sect. 4.1 ++

All dimensions are in mm and are subject to change without notice!

3.3.1 2/2- and 3/2-way valves

Coding .R2-..., .S2-..., .3-..., .Z3-...

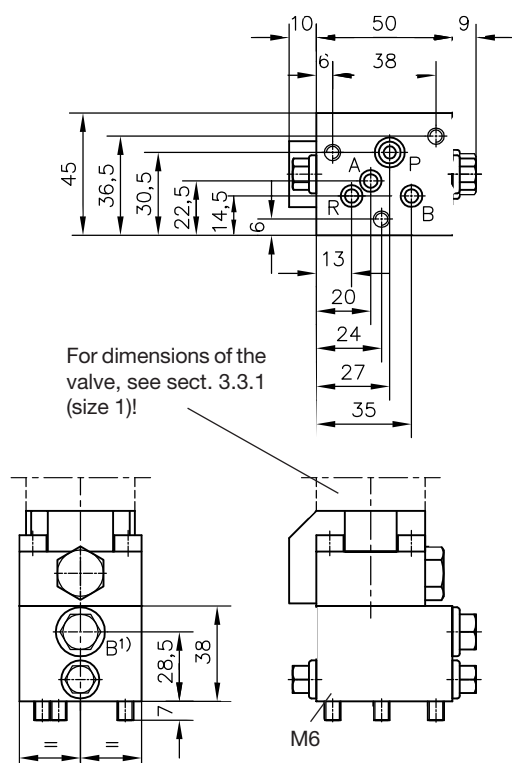
Port A is internally blocked at 2/2-way valves, but an O-ring must be installed if the valve is mounted on a sub-plate.



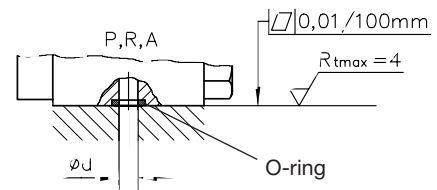
Size	L	L1	B	H	a	a1	b	b1	c	c1	e	e1	f	f1	g	k	m
0	32	41.5	36	27	10	12	16	18	22	24	24	28	4	4	M5	7	4
1	40	50	45	35	13	14.5	20	22.5	27	30.5	30	35	5	5	M6	8	9
2	50	62.5	56	55	16.6	18	26.6	31	38.8	32	39	43	5.1	6.5	M8	11	10
3	70	91.5	70	70	24	20	40	45	55	45	54	54	8	8	M10	17	10

3.3.2 4/2-way valve

Coding .4-... or .Z4-...



Holes in the manifold and sealing of the ports by O-rings 2)



	Size	Ports	Ød	O-ring NBR 90 Sh
2/2- and 3/2-way valve	0	P and R	3.5	6x1.5
		A	3	3.5x1.2
	1	P and R	4.5	8x1.5
		A	4.5	5x1.5
	2	P	9	14x2
		A and R	9	10x2.2
4/2- way valve	3	P	12	17.12x2.62
		A and R	12	13.95x2.62
	4	A, P and R	20	KANTSEAL seal ring 6096 5217-00
	1	P	4.5	8x1.5
		A, B and R	4.5	5x1.5

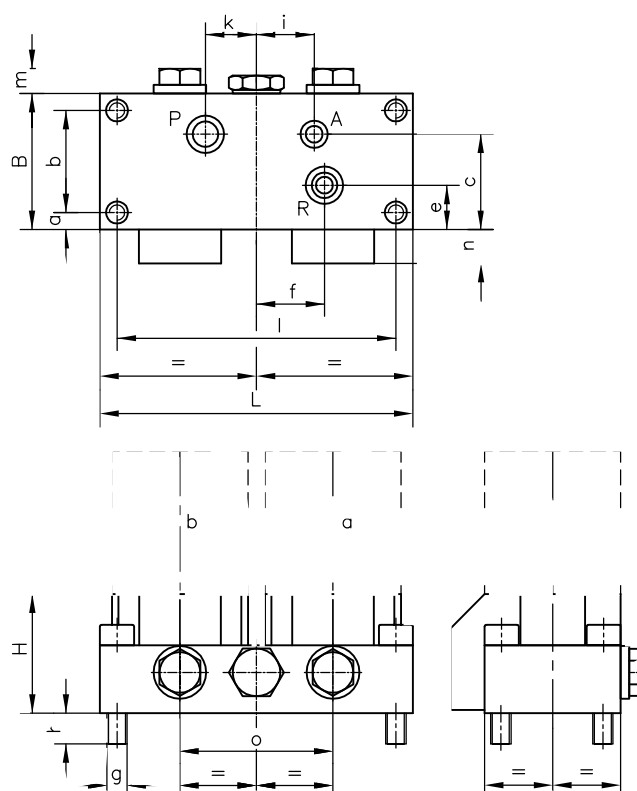
1) Port B (G1/4) is unplugged,
at versions with sub-plate acc. to section 5 or when installed
in a valve bank type VB11... acc. to D 7302

2) Available as a complete seal kit (see sect. 4.5).

3.3.3 3/- and 4/3-way valves

3/3-way valve

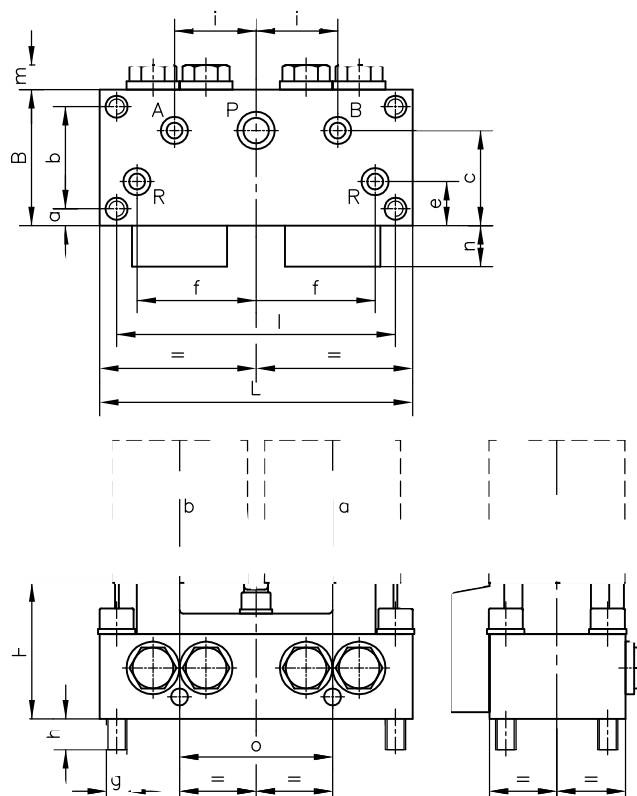
Coding .21-..



	Size				
	0	1	2	3	4
L	75	92	116	144	162
B	32	40	50	70	100
H	27	35	55	70	101
a	4	5	5.5	8	9
b	24	30	39	54	82
c	23	28	39	55	74
e	11	13	20	24	27
f	16	27	26	26	41
g	M5	M6	M8	M10	M12
h	3.5	9	10	10	16
i	19	20	26	20	25
k	13	15	22	20	25
l	66	82	103	128	144
m	7	8	11	17	18
n	10	10	13	22	26
o	38	45	53	72	82

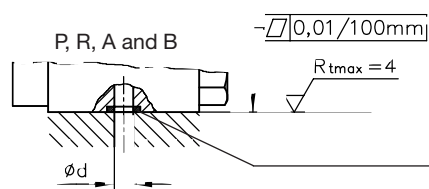
4/3-way valve

Coding .22-..



Attention: Both return ports R have to be connected, as there is no internal connection.

	Size			
	0	1	2	3
L	75	92	116	144
B	32	40	50	70
H	31	40	59	70
a	4	5	5.5	8
b	24	30	39	54
c	23	28	39	55
e	11	13	17	22
f	27	35	45	55
g	M5	M6	M8	M10
h	4.5	9	10	10
i	19	24	30	38
l	66	82	103	128
m	7	8	11	17
n	11	13	17	23
o	38	45	53	64



Holes in the manifold and sealing of the ports by O-rings ¹⁾

	Ports	Size 0	Size 1	Size 2	Size 3
Ø d	P, R, A a. B	3.5	4.5	9	12
O-ring	P	6x1.5	8x1.5	14x2	17.12x2.62
	R, A and B	6x1.5	5x1.5	10x2.2	13.95x2.62

¹⁾ Available as a complete seal kit (see sect. 4.5).

4. Actuation modes

4.1 Solenoid actuation (standard)

The solenoids are built and checked conforming to VDE 0580.

The standard solenoids are designed for the following voltage: 24V DC (type G..) or 230V AC 50 and 60 Hz (type WG..) acc. to sect. 3.1. It is not required to add these voltages to the order coding. Special voltages have to be specified in uncoded text or to be added to the order coding. See order examples in sect. 3.1 and "Special voltage" in sect. 4.1.2.

Valve type acc. to sect. 3.1	Size 0		Size 1		Size 2		Size 3		Size 4																					
	G...	WG... 1)	G...	WG... 1)	G...	WG...	G...	WG...	G...	WG...																				
Nom. voltage U _N	12 V DC, 24 V DC, 110 V DC, 230 V AC see also sect. 4.1.2																													
Nom. current I _N 2) (A)	0.67	0.08	0.83	0.1	1.1	0.13	2.1	0.26	3.6	0.44																				
Nom. power P _N 2) (W)	16	16	20	20	26	26	50	50	86	86																				
Switching time on (ms)	40	80	100	100	140	140	175	175	150	150																				
(guideline) off (ms)	40	100	50	125	55	150	65	200	100 4)	350 4)																				
Switchings per hour / h	Approx. 2000 (G.. and WG.. all sizes); approx. evenly distributed																													
Protection mode	IP 54 acc. to DIN VDE 0470 / EN 60529 / IEC 529 (readily assembled), IP 67 acc. to DIN VDE 0470 / EN 60529 / IEC 529 for explosion-proof version																													
Isolationsklasse	F						H																							
Cut-off energy (Ws)	0.16	0.16	0.24	0.24	0.38	0.38	1.59	1.59	3.4	3.4																				
Guideline for max. value + approx. 10% according to tests with nom. voltage and 20°C																														
Connection scheme of the plugs	①	⑤	②	④ 1)	③	④	③	④	③	④																				
Cable glands of all plugs Pg 9	<div>① Plug MSD 2 3)</div> <div>② Plug MSD 1 3)</div> <div>③ Socket A DIN EN 175301-803, e.g. MSD 3-309 3)</div> <div>④ Adapter + Socket A MSD 1-MSD 3 + MSD 4-209 P10 3)</div> <div>⑤ Adapter + Socket A MSD 2-MSD 3 WG + MSD 3-309 3)</div> <div><div>Type G...</div><div>Type WG...</div></div>																													
Adapters for size 0 and 1, see sect. 4.1.1																														
	These connectors 3) are part of the order coding as standard. For other connectors e.g. with clamp diode, economy circuit or LED's see D 7163.																													
Permissible operation conditions for outdoor use	The solenoid valves are suitable for normal outdoor use, if the solenoids are installed vertical (indicated by previous experience).																													
Rel. duty cycle	100% ED (stamped on the solenoid), however observe operating duty cycle !																													
Rel. duty cycle during operation	<div><div><div><div></div><div>t_{ein}</div><div>T (Cycle time)</div></div></div><div><div>Ambient temperature ϑ_u (°C)</div><div><div><div>Version for size 0 to 3</div><div>Version for size 4</div></div><div><div>T=5 min</div><div>T=15 min</div><div>T=30 min</div><div>T=60 min</div></div></div><div>Rel. duty cycle (%ED)</div><div>Continuous operation</div></div></div>																													
Rel. duty cycle	$t_r = \frac{t_{ein}}{T} \cdot 100(\%ED)$																													
Increased switchable pressure (other than listed in sect. 3.1) for size 1, 2 and 4	<div>With load cycles ≤ 10% ED Ambient temp. ≤ 40°C (not 4/3-way valves type ...22)</div> <table><tr><th rowspan="2">Type</th><th colspan="2">Valves size 1</th><th colspan="2">Valves size 2</th><th colspan="2">Valves size 4 type GR 2-4-G..</th></tr><tr><th>P_{max} (bar)</th><th>Q_{max} 5) (lpm)</th><th>P_{max} (bar)</th><th>Q_{max} 5) (lpm)</th><th>P_{max} (bar)</th><th>Q_{max} 5) (lpm)</th></tr><tr><td>G... a. WG..</td><td>700</td><td>8</td><td>700</td><td>12</td><td>400</td><td>60</td></tr></table>										Type	Valves size 1		Valves size 2		Valves size 4 type GR 2-4-G..		P _{max} (bar)	Q _{max} 5) (lpm)	P _{max} (bar)	Q _{max} 5) (lpm)	P _{max} (bar)	Q _{max} 5) (lpm)	G... a. WG..	700	8	700	12	400	60
Type	Valves size 1		Valves size 2		Valves size 4 type GR 2-4-G..																									
	P _{max} (bar)	Q _{max} 5) (lpm)	P _{max} (bar)	Q _{max} 5) (lpm)	P _{max} (bar)	Q _{max} 5) (lpm)																								
G... a. WG..	700	8	700	12	400	60																								

¹⁾ Only with adapter, see sect. 4.1.1.

²⁾ The electrical data for solenoids G and WG are only a guideline (max) and may vary depending on manufacturer.

³⁾ Co. K + B GmbH, D-84056 Rottenburg a.d.L.; This type of plug must be specified, when placing a separate orders.

⁴⁾ Possibly increased tolerance, above 250 bar.

⁵⁾ Attention: The storage capability of high pressure consumers has to be taken into consideration. Pressure surges during decharging, which might harm internal functional parts of the valve or fatigue fracture of other hydraulic components of the application can be prevented by installing orifices (see sect. 3.1) upstream.

4.1.1 Plugs for valves size 0 and size 1

The standard version comes with a plug (see dimensional drawing and connection scheme)

Order example:

GR 2-1 -A 24

Directional seated valve
acc. to section 3.1



Solenoid voltage 24V DC
Plug type

Coding	G	WG	A	N
Note	Central plugs (serie)	Valve with adapter and bridge rectifier (socket) The bridge rectifier is incorporated in the adapter for size 0	Valve with adapter for plugs shape A DIN EN 175301-803 is customer furnished	Valve with adapter and, plug shape A DIN EN 175301-803
Socket Size 0	MSD 2	MSD 2-MSD 3WG + MSD 3-309	MSD 2-MSD 3	MSD 2-MSD 3 + MSD 3-309
Size 1	MSD 1	MSD 1-MSD 3 + MSD 4-209 P10	MSD 1-MSD 3	MSD 1-MSD 3 + MSD 3-309

4.1.2 Solenoid voltage

Examples: GR 2-2 - G 24 ($I_{20} = 0.54 \text{ A}$)
G 3-0R - A 110 ($I_{20} = 0.15 \text{ A}$)
WGZ 4-1 - W 200 ($I_{20} = 0.11 \text{ A}$)

The indicated nominal power ratings are approximate reference values, which may differ insignificantly depending on the voltage and the manufacturer of the solenoid. The current rating in cold state is $I_{20} = P_N / U_N$ (see examples)

1) Notes for proper selection:

DC: The order specification (solenoid) should be identical with the one of the power supply (DC). If the supply voltage is lower it will reduce the force of the solenoid, if it is higher the solenoid will be heated up unpermissibly (tolerance $\pm 5\text{-}10\%$).

AC: The order specification should be identical with the one of the power supply (50/60 Hz AC). The voltage of the solenoid is approx. $0.9 U_{AC} - 2 \text{ V}$ due to the corresponding bridge rectifier. The table identifies the solenoids utilized in such cases (e.g. for 110 V AC 50 Hz; solenoid with $U_N = 98 \text{ V DC}$)

Attention: It is important to specify the voltage !

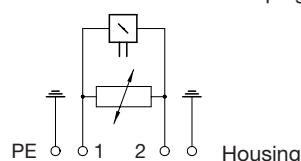
Order specification		Size 0	Size 1	Size 2	Size 3	Size 4
DC ¹⁾ ($\Delta U_N [\text{V}]$)	AC ¹⁾ 50/60 Hz	(Nominal power P_N)				
		(16 W)	(20 W)	(26 W)	(50 W)	(86 W)
G 12		x	x	x	x	x
G 12ex			x (23 W)			
G 24	WG...-WG 24	x	x	x	x	x
G 24ex			x (23 W)			
G 36	WG...-WG 42		x	x		
G 42	WG...-WG 48	x	x		x	
G 48		x	x	x	x	
G 80		x	x	x	x	
G 80ex			x (23 W)			
G 98	WG...-WG 110	x	x	x	x	x
G 110		x	x	x	x	
G 110ex			x (23 W)			
G 125		x	x		x	
G 185	WG...-WG 200	x	x	x (180V DC)	x	
G 205	WG...-WG 230	x	x	x	x	x
G 220		x	x	x		

Note:

Only 40 % ED are permissible if the valves are neighboring, it is additionally recommended that neighboring valves are not actuated simultaneously.

Explosion-proof solenoids

Connection scheme of the plugs



Attention:

- Flow pattern 21 and 22 not available with explosion-proof solenoids
- Protect the complete valve against direct sun light

Electrical data for explosion-proof solenoids

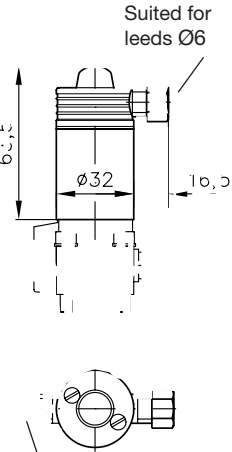
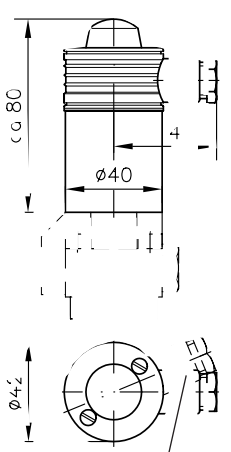
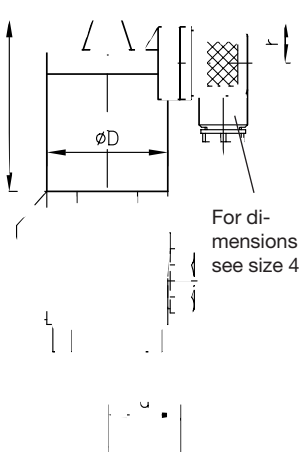
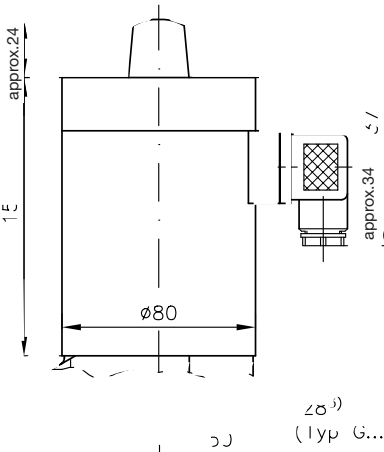
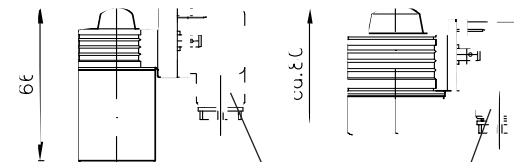
Letter of conformity	TÜV-A-03 ATEX 0017 X
Protection class	EEx d IIB T4 II2G
Duty cycle	100% ED
Protection class	IP 67 (DIN VDE 0470 / EN 60529 / IEC 529)
Nom. voltage U_N	24 V DC
Power, hot P_N	23 W

Restrictions for use:

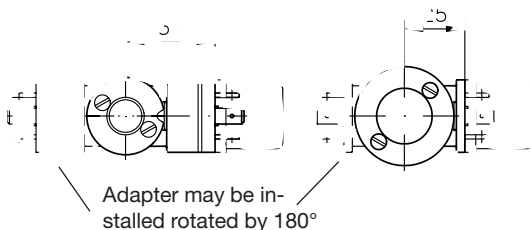
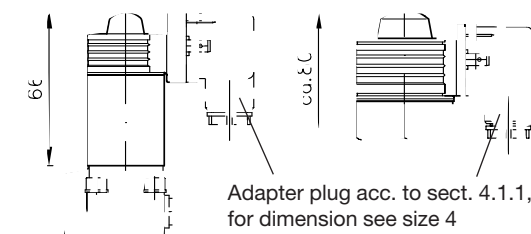
Temperature	Ambient: max. +40°C Fluid: max. +70°C
Required external fuse (conf. DIN IEC 127)	$I_N < 1.6 \text{ A-medium}$
Surface protection	Protect against direct sun light see also restrictions at "Temperature")
Electrical connection	3x0.5 mm ²
Cable length	3 m, Option 10 m
Observe the operation manuals B 02/2003 and B ATEX!	
Electrical lay-out and testing conforming EN 50014, VDE 0170/0171 T1 and T9.	

4.1.3 Unit dimensions

All dimensions are in mm and are subject to change without notice!

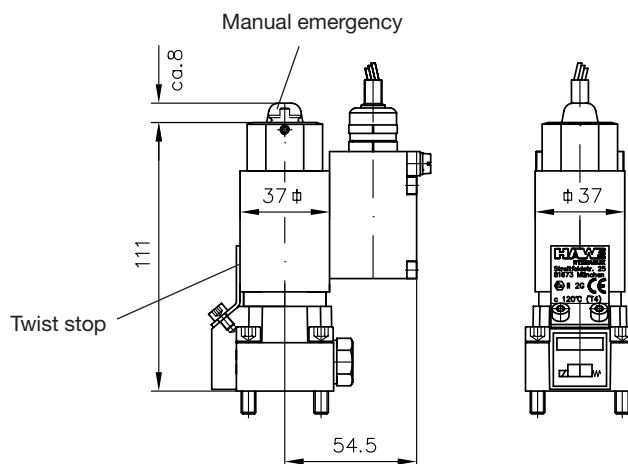
Size 0	Size 1	Size 2 and 3	Size 4															
<div><p>Suited for leads Ø6</p><p>Plug may be installed rotated by 180°</p></div>	<div><p>May be installed rotated by 22.5° 1)</p></div>	<div><p>For dimensions see size 4</p><p>May be installed rotated by 90° 2)</p></div> <table><tr><th>Size</th><th>D</th><th>H</th><th>h</th><th>a</th></tr><tr><td>2</td><td>50</td><td>71.5</td><td>18.5</td><td>30</td></tr><tr><td>3</td><td>62</td><td>92</td><td>27</td><td>46</td></tr></table>	Size	D	H	h	a	2	50	71.5	18.5	30	3	62	92	27	46	<div><p>approx. 24</p><p>approx. 34</p><p>May be installed rotated by 90° 2)</p></div>
Size	D	H	h	a														
2	50	71.5	18.5	30														
3	62	92	27	46														
<div>Adapter for plugs DIN (ISO 4400) 4)</div> <div><p>May be installed rotated by 90° 2)</p></div>																		

Adapter for plugs DIN (ISO 4400) 4)

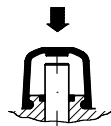
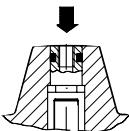
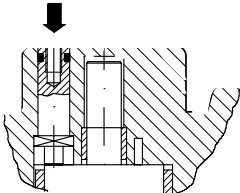
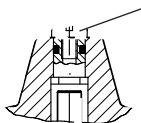


- 1) It is not possible to install the plug in any position if the valve is part of a valve bank (see D 7302)
- 2) Either in upward or downward valve bank (see D 7302)
- 3) This dimension is depending on the manufacturer and may be up to 40 mm more DIN 43650
- 4) The bridge rectifier is incorporated in the adapter with type WG.. size 0 and with size 1 it is part of the plug

Size 1 with explosion-proof solenoids



Manual emergency operation

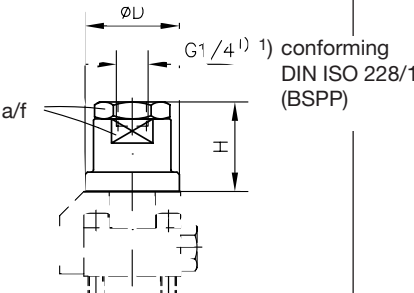
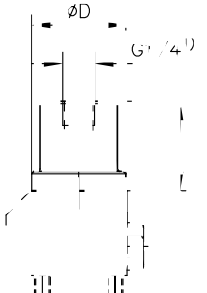
Size	0	1	4	2	3
Max. actuation force (N)	35	80	450	150	250
Cross sectional drawing	 <p>Size 0 and 1</p>				
Note	Press the actuation pin hidden under the rubber cap.			Push the emergency actuation pin inward by means of a screw driver or similar, if required	 <p>The manual emergency actuation may be put out of function by blocking the tapped hole by means of a screw M 3x5 DIN 92</p>

4.2 Hydraulic and pneumatic actuation

The actuation element is a single acting piston with spring return.

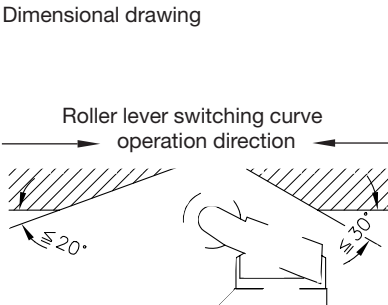
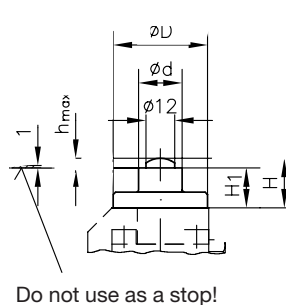
The valve will remain in its working position **a** as long as the control pressure prevails. It will return automatically in its idle position 0 if the control pressure is relieved.

The piston is sealed and operates without any leakage.

Actuation		Hydraulically (Size 0 ... 3)				Pneumatically (Size 1, 2, 3)		
Control medium		Oil				Compressed air, filtered and oiled		
Coding		H...				P...		
								
Size		0	1	2	3	1	2	3
Control pressure (bar)	max	500	700	500	400	15		
	min	16	12	9	9	4	2.5	2.5
Control volume (cm ³)		0.2	0.4	0.7	6.1	1	2.5	7
All dimensions are in mm and are subject to change without notice!	D	32	39	49	60	39	49	60
	H	44	36	52	77	36	39	52
	a/f	27	27	32	41	---	---	---
Temperature (ambient and control medium)		-40 to + 80°C				-20 to + 70°C		

4.3 Mechanical actuation

The actuation element is a pin (tracer) with spring return, which may be used either directly for vertical directions of operation or via a roller lever for lateral directions. The valve is in working position **a** if the actuation element is forced into the hatched area of the lever path.

Actuation mode		Roller lever (Size 1, 2, 3)			Feeler pin (Size 1 and 2)		
Code letter		K...			T...		
Dimensional drawing							
Size		1	2	3	1	2	
Switching force range		s (N)	25 to 28	42 to 47	55 to 80	51 to 57	95 to 120
Switch- ing path (mm)	Start of function	(H + h)	38.5 ±0.5	46.5 ±0.5	76 ±0.5	---	---
	Function path	h	10.5 ±0.5	15.5 ±0.5	30 ±0.5	4	5
	Switching position range	s	3±0.5	4 ±0.5	6 ±0.5	---	---
All dimensions are in mm and are subject to change without notice!		D	39	49	60	39	49
		d	25	25	35	18	22
		H	28	31	46	20.5	25.5
		H1	---	---	---	16.5	20.5
		a	42	41	62.5	---	---
		b	21	21	26	---	---
		c	12	12	15	---	---

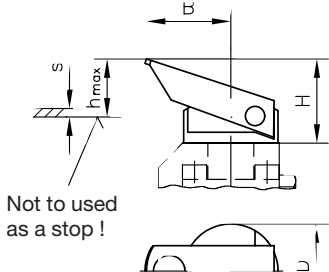
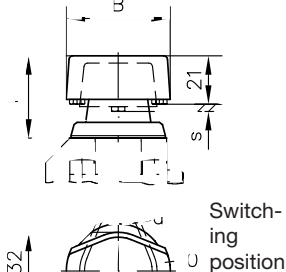
4.4 Manual actuation

Feeler lever coding F:

The actuation element is a feeler lever which acts on a spring loaded pin. Switching position a is retained as long as the feeler lever is pressed down within the hatched area.

Turn knob coding D:

This actuation element is with detent. Switching position a or 0 alternate as the knob is turned by 90°. The direction of rotation is arbitrary.

Actuation mode		Feeler lever (size 1, 2, 3)			Turn knob (size 0, 1, 2)		
Code letter		F...			D...		
Dimensional drawing							
Size		1	2	3	0	1	2
Actuation force in the range	s (N)	25 to 28	42 to 47	55 to 80	---	---	---
Switching torque	(Ncm)	---	---	---	45	63	98
Actuation travel (mm)	h_{max}	20,5	23,5	45	---	---	---
	s	3,5	4	10	3,5	3,5	5
All dimensions are in mm and are subject to change without notice!	D	39	49	60	---	---	---
	H	37	43	70	38	40	47
	B	34,5	32	56,5	43	43	52

4.5 Seal kits

These seal kits contain the O-rings listed in sect. 3.3 and additional parts and seals.

For more detailed information, see spare parts lists E 7300-0, E 7300-1, E 7300-2, E 7300-3 and E 7300-4.

Flow pattern	Size	Seal kit for actuation	
		G, WG, K, T, F and D	H and P
..R2 ..S2 ..3 ..Z3 ..4 ..Z4	0	1 x DS 7300-01	1 x DS 7300-01 1 x DS 7300-03
	1	1 x DS 7300-11	1 x DS 7300-11 1 x DS 7300-13
	2	1 x DS 7300-2N	1 x DS 7300-2N 1 x DS 7300-23
	3	1 x DS 7300-31	1 x DS 7300-31 1 x DS 7300-34
	4	1 x DS 7300-41	
..21	0	1 x DS 7300-02	1 x DS 7300-02 2 x DS 7300-03
	1	1 x DS 7300-12	1 x DS 7300-12 2 x DS 7300-13
	2	1 x DS 7300-21N	1 x DS 7300-21N 2 x DS 7300-23
	3	1 x DS 7300-32	1 x DS 7300-32 2 x DS 7300-34
	4	1 x DS 7300-42	
..22	0	1 x DS 7300-02	1 x DS 7300-02 2 x DS 7300-03
	1	1 x DS 7300-12	1 x DS 7300-12 2 x DS 7300-13
	2	1 x DS 7300-22	1 x DS 7300-22 2 x DS 7300-23
	3	1 x DS 7300-33	1 x DS 7300-33 2 x DS 7300-34

5. Individual valve with connection sub-plate

All ports of the 2/2-, 3/2-, 3/3- and 4/3-way directional seated valves acc. to section 3 are designed as holes with O-ring sealing at the ground bottom of the valve body. These valves have to be completed with sub-plates or customer furnished manifolds to enable pipe connection.

5.1 Available versions, main data

Order example: GR 2-2 - **1/2S** - G 12 - **220**

Valve coding
acc. to sect. 3

Desired pressure setting in bar
(Pressure range depending on spring, see ②)

	Coding	Ports con- forming DIN ISO 228/1 ¹⁾ (BSPP)	Avail- able for size	Flow pattern overview					
				2/2-way valve	3/2-way valve	3/3-way valve	4/2-way valve	4/3-way valve	
<div>①</div> <div>Connection block without additional features</div>	-1/4	G 1/4	0 and 1						
	-3/8 ²⁾	G 3/8	1 and 2						
	-1/2	G 1/2	2 and 3						
	-3/4	G 3/4	3 and 4						
	-1	G 1	4						
Suited for connection in series and in parallel, if the perm. pressure stated in section 3.2. "Operation pressure" for P, A, B and R are not exceeded.									
<div>②</div> <div>Connection with pressure limiting valve</div> <div>.../...S tool ad- justable</div> <div>.../...SR manually adjustable</div>	-1/4 S(R)	G 1/4	0 and 1			The connection block with pressure limiting valve is not available for 3/3- and 4/3-way directional valves!			
	-3/8 S(R)	G 3/8	1 and 2						
	-1/2 S(R)	G 1/2	2						
	Not available for other sizes !								
	Pressure range	Coding	Valve size	Press. (bar)	The pressure specification in the order coding determines the pressure range of the spring (size 0) and additionally the valve seat dimension for size 1 and 2.				
			-1/4 S(R)	0					(0) ... 350 (0) ... 500
				1					(0) ... 100 (0) ... 200
			-3/8 S(R)	1 and 2					(0) ... 400
			-1/2 S(R)	2					(0) ... 700
	Port R may be used only for unpressurized return flow to ensure proper function of the pressure reducing valve. Parallel connection of additional valves is only permissible with sub-plates acc. to ① but not with sub-plates acc. to ②								
<div>③</div> <div>Connection block with by- pass check valve</div> <div>Not available for other sizes !</div>	-1/4 C	G 1/4	0 and 1		This connection block is only available for 2/2-way directional valves! p _{max} (bar) and Q _{max} (l/min) are determined by the installed valve.				
	-3/8 C	G 3/8	1 and 2						
	-1/2 C	G 1/2	2						
	-3/4 C	G 3/4	3						
A by-pass check valve (RK 3 acc. to D 7445) is required to enable flow R → P. Pressure surges (decompression) in flow direction R → P should be avoided ! For pressure rating of R, see sect. 3.2.									
<div>④</div> <div>Connection block with rectifi- er circuit by means of check valves</div>	-1/4 G	G 1/4	0 and 1		This connection block is only available for 2/2-way directional valves! p _{max} (bar) and Q _{max} (l/min) are determined by the installed valve.				
	-3/8 G	G 3/8	2						
	-1/2 G	G 1/2	3						
	-3/4 G	G 3/4	4						
	Version with G 1 is not available								
The rectifier circuit by means of check valves enables both flow directions for the 2/2-way valves. Therefore the port codings P and R are not stamped on the sub-plate.									

¹⁾ For male pipe fittings with journals shape B DIN 3852 page 2.

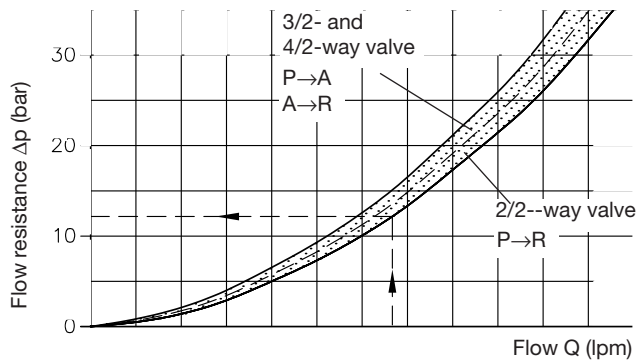
²⁾ Not available for flow pattern 4 and Z4 (table 1)

5.2 Δp - Q - curves

Guideline for valve including sub-plate and a fluid viscosity of approx. 60 mm²/s

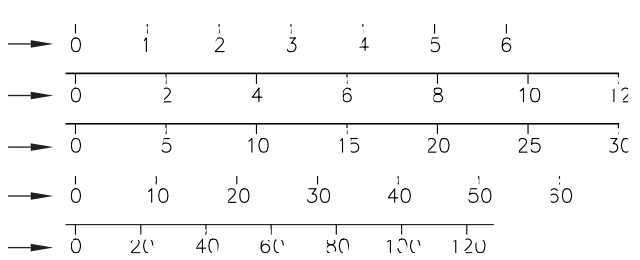
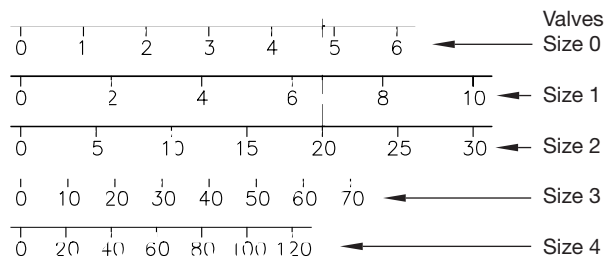
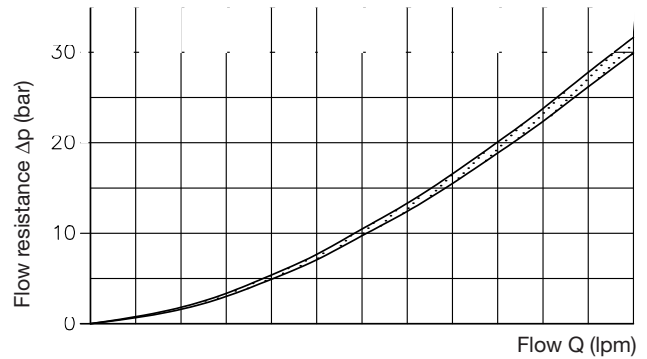
Flow direction P → R

sub-plates ①, ② and ③



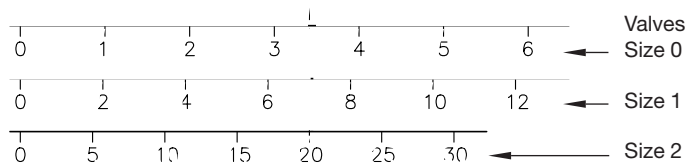
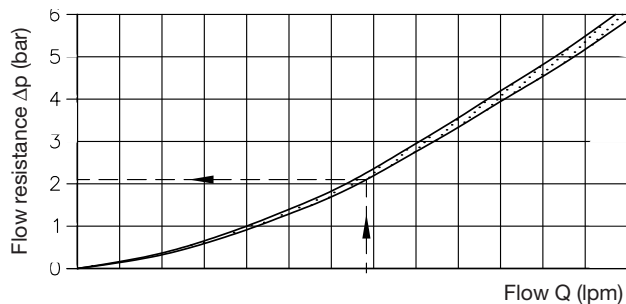
Flow direction P → R (R → P)

sub-plates ④



Flow direction R → P

sub-plates ③



Example :

A flow of 20 l/min is applied to valve type GR 2-2-1/2C (sub-plate ③)

$\Delta p_{P \rightarrow R} \approx 12 \dots 14$ bar acc. to table ;

$\Delta p_{R \rightarrow P} \approx 2$ bar acc. to table

5.3 Unit dimensions

All dimensions are in mm and are subject to change without notice!

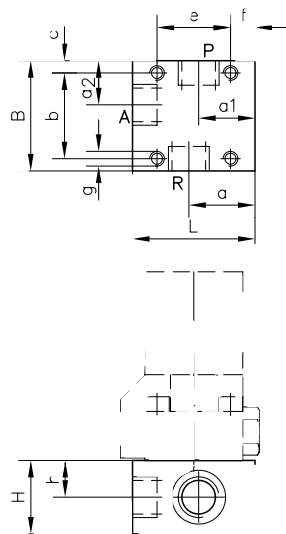
5.3.1 Connection sub-plates acc. to ① and ③

2/2- and 3/2-way valves

Attention: Port A is also let with 2/2-way valves, for all other dimensions see 3/2-way valve.

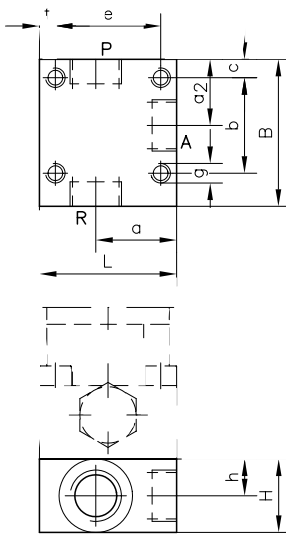
Size 0 and 1

Type : ..-1/4(C) or ..-3/8(C)
e.g. GZ 3-1-1/4C-G 24



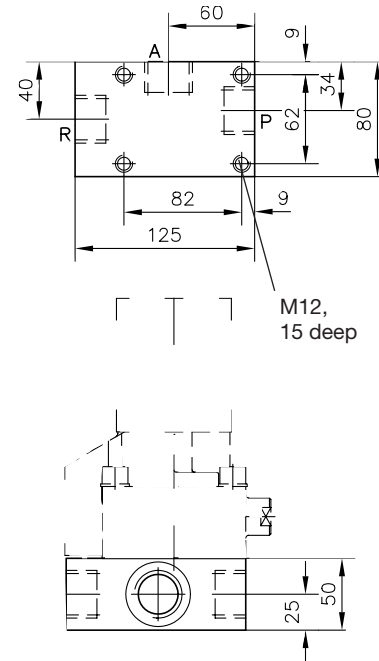
Size 2 and 3

Type : ..-3/8(C); ..-1/2(C); ..-3/4(C)
e.g. WG 3-3-1/2-G 24



Size 4

Type : ..-3/4 or ..-1
e.g. GS 2-4-1-G 24



Size	Port P, R a. A	L	B	H	a	a1	a2	b	c	e	f	g	h
0	G 1/4	40	36	25	16	16	18	28	4	24	4	M5, 6 deep	12.5
1	G 1/4	50	45	30	29	21	20	35	5	30	10	M6,	15
	G 3/8	50	45	30	27	23	18	35	5	30	10	10 deep	15
2	G 3/8	56	60	30	33	--	33	39	5.5	43	6.5	M8,	15
	G 1/2	56	60	30	33	--	27	39	7.5	43	6.5	10 deep	15
3	G 1/2	70	80	40	43	--	40	54	18	54	8	M10,	15
	G 3/4	70	80	40	41	--	40	54	18	54	8	10 deep	15

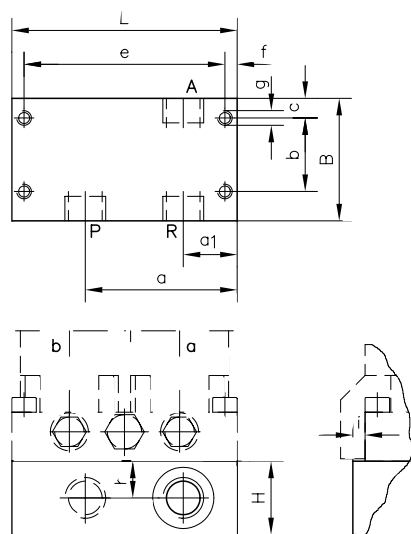
3/3-way valve

Type: ..21-0-1/4

to

..21-4 - 1

e.g. WG 21-2-3/8-WG 230

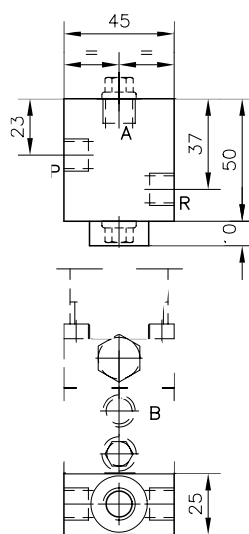


4/2-way valve

Type: ..4-1-1/4

..Z4-1-1/4

e.g. G 4-1-1/4-G 24



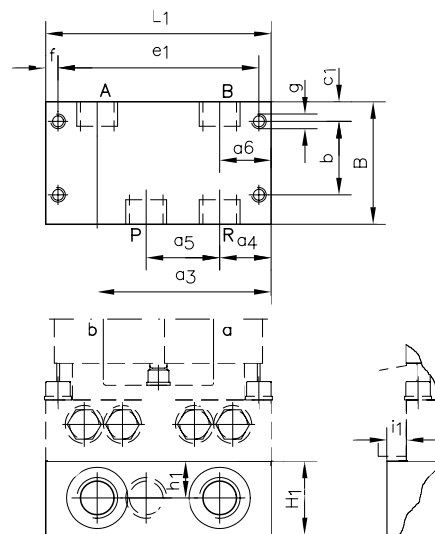
4/3-way valve

Type: ..22-0-1/4

to

..22-4 - 1

e.g. G 22-1-1/4-G 24



Size	L	L1	B	H	H1	a	a1	a2	a3	a4	a5	a6	b	c	c1	e	e1	f	g	h	h1	i	i1
0	75	75	40	25	25	50	20	30	56.5	15	25	18.5	24	8.5	9	66	66	4.5	M5, 6 deep	12.5	14	12.5	7.5
1	92	92	50	30	30	62	22	22	71	21	30	21	30	7	7	82	82	5	M6, 10 deep	15	15	8	8
2	116	116	60	30	30	81	31	31	88	24	38	28	39	12.5	12.5	103	103	6.5	M8, 10 deep	15	15	3	3
3	144	144	80	40	40	92	46	52	110	29	43	34	54	18	18	128	128	8	M10, 12 deep	20	20	10	10
4	162	182	100	63	63	106	40	56	141	31	60	41	82	9	9	144	164	9	M12, 12 deep	38	38	0	0

Size L	B	H	a	b	c	e	f	g	h	
0	44	50	30	24	30	10	10	9	M5, 5 deep	14
1	54	50	35	34	25	7	10	9	M6, 10 deep	12
2	60	60	40	35	30	8	12,5	9	M8, 10 deep	14
3	80	80	50	46	40	10	17	10,5	M10, 10 deep	18
4	100	112	63	55	50	15	22,5	4	M12, 15 deep	21

6. Appendix

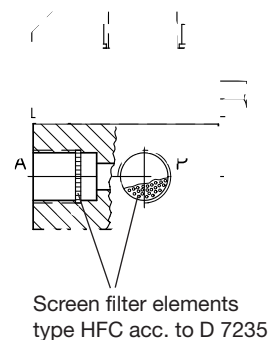
6.1 Protection of directional seated valves against coarse contamination

Directional seated valves are rather unsensitive to ultra fine contamination always evident in hydraulic fluids. Nevertheless directional seated valves are fitted with screen filter elements with 0.25 mm mesh width to prevent sudden disturbance caused by coarse contaminations that may occasionally be carried along in the oil (such as torn off particles of tubing, packing, scale swarf,) and which otherwise might get trapped at the valve seat gap.

The sub-plates for individual valves (sect. 5) are fitted with fine screen filter discs HFC 1/4F 1 or HFC 3/8 (acc. to D 7235) as standard at A and B with size 0, additionally in P with size 1. Valves size 2, 3 and 4 with port size G 3/8, G 1/2 and G 3/4 may be retrofitted-. These screen filters are not available for G 1.

These screen filter elements must not be understood as a replacement for usual hydraulic filters. In practice, however, they provide sufficient protection against malfunctions in small hydraulic systems. If such malfunctions should occur, the filter elements should be checked first.

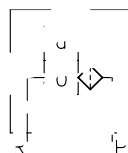
For the sake of simplicity, these filter elements are not explicitly shown in the diagrams.



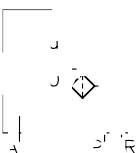
Symbols

Individual valves acc. to section 3:

2/2-way
valve

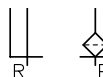


3/2-way
valve

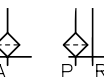


Connection sub-plates acc. to section 5:

2/2-way
valve



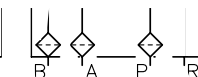
3/2-way
valve



3/3-way
valve



4/2- and 4/3-way
valve



6.2 Versions for special fluids

- HFA (water / glycol solution, conforming VDMA 24317)
The functionally essential parts are of stainless steel or tuffrided to prevent corrosion (valve balls, valve seat, actuation pin etc.). The valve body (size 3), external parts e.g. tapped plugs etc. are zinc galvanized.
There are only 2/2-, 3/2- and 4/2-way directional seated valves available with flow pattern R2, S2, 3, a, Z3, 4, Z4 (see table 1 in sect. 3.1)

Type coding: G 3-1-G 24 **HFA**

Size	Pres- sure p_{max} (bar)	Flow $Q_{perm.}$ (l/min) approx. with reflow back pressure		Note:
		1 bar	2 bar	
0	400	3	4	A slight compensating force in the return pipe may be created by installing the tank at the highest possible location within the system.
1		5	6	
2		14	18	
3		36	45	

Throttles (cascade type or a coiled, small diameter pipe) should be installed at the pressure inlet to limit the flow down to permissible values for the applied pressure. This is to prevent cavitation and applies to all valves with return connection (3/2- und 4/2-way valves and 2/2-way valve as by-pass to the tank) or valves in circuits connected to an accumulator.

- Brake fluid based on glycol
Versions equipped with EPDM (Ethylenpropylendien-rubber) seals suited for glycol based brake fluid or other special fluids.
Type coding: GR 2-2-G 24 **AT**
- Versions equipped with FKM (fluor rubber, Viton) seals suited for some HFD type fluids (fire inhibiting, conforming VDMA 24317)
Type coding: WGS 2-0-WG 230 **PYD**

7. Mass (weight) approx. in kg

Basic valve complete with actuation acc. to section 3 and 4

Actuation mode	Type	2/2- and 3/2-way valve size					3/3-way valve size					4/3-way valve size				4/2-way valve size
		0	1	2	3	4	0	1	2	3	4	0	1	2	3	1
Electrical	G..	0.4	0.65	1.2	3.1	7.2	0.8	1.4	2.9	5.9	16.3	0.9	1.6	3.0	6.0	1.9
	WG..	0.4	0.7	1.2	3.1	7.2	0.8	1.5	2.9	5.9	16.3	0.9	1.7	3.1	6.0	2.0
Hydraulic	H..	0.4	0.5	1.1	2.8	--	0.8	1.1	2.7	5.2	--	0.8	1.3	2.8	5.3	1,8
Pneumatic	P..	0.4	0.4	0.9	2.2	--	--	0.9	2.3	4.1	--	--	1.1	5.4	4.2	1.7
Mechanical	Act. roll	K..	--	0.4	0.8	2.0	--	--	0.9	2.1	3.7	--	--	1.1	5.2	3.8
	Act. pin	T..	--	0.4	0.8	--	--	--	0.8	2.1	--	--	--	1.0	5.2	--
Manual	Lever	F..	--	0.4	0.8	2.0	--	--	0.9	2.1	3.7	--	--	1.1	5.2	3.8
	Turn knob	D..	0.4	0.4	0.9	--	--	0.8	0.9	2.2	--	--	0.8	1.1	5.3	--

Connection sub-plates acc. to section 5

Connection block only, for weight of the directional seated valves see above!

	Size				
	0	1	2	3	4
Simple connection block ①	0.2	0.5	1.0	1.2	3.8
Connection block ② with pressure limiting valve	0.4	1.2	1.6	--	--
Connection block ③ with by-pass check valve	0.2	0.5	1.0	--	--
Connection block ④ with rectifying circuit by means of check valves	0.5	0.7	1.0	2.4	4.7

8. Type overview

G R 2 - 2 R - G 24

