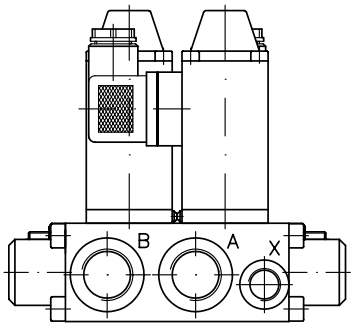
Directional spool valves type HSL

electro-hydraulic actuation, direct pipe connection for oil-hydraulic systems

Operating pressure p_{max} = 400 bar
Flow Q_{max} = 80 and 160 lpm



1. General

This pamphlet is a supplement to D 7493 covering the directional spool valve banks type HSR. The individual valves for direct pipe connection described here share the same functional principle, directional seated pilot valves and optional thread-type throttles for switching time adjustment, as outlined in the basic pamphlet D 7493. The switching time adjustment is detailed also there.

2. Available versions, main data

Order example: **HSL 3 G - G 24**

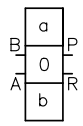
Table 1: Basic type and size

Coding	HSL 3	HSL 4
Ports P, R, A, B DIN ISO 228/1 (BSPP)	G 1/2	G 3/4
Flow Q_{max} (lpm)	80	160
Pressure p_{max} (bar)	400	

Table 3: Pilot valve

Solenoid actuated via pilot valve type WN 1H (for missing data, see D 7470 A/1)				Without pilot valve, for hydraulic remote control
Standard, with plug	Without plug	With plug featuring LED's	Nom. voltage	
G 12	**X 12**	**L 12**	12V DC	**X**
G 24	**X 24**	**L 24**	24V DC	Observe note in sect. 5.1 !
G 98	**X 98**	---	98V DC	
G 205	**X 205**	---	205V DC	
WG 110	---	---	110V AC 50 / 60 Hz	
WG 230	---	---	230V AC 50 / 60 Hz	

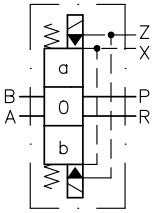
Table 2: Symbols

		Valve with blocked middle position, suitable for connection in parallel						Valve with middle position P→ R (circulation), suitable for connection in series			
Switching time adjustment	without	**G**	**D**	**E**	**C**	**W**	**W 2** [3]	**B**	**L**	**H**	**F**
	with [1]	**G 1**	**D 1**	**E 1**	**C 1**	**W 1**	**W 12** [3]	**B 1**	**L 1**	**H 1**	**F 1**
Simplified symbol [2]											

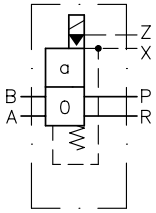
Attention: When several valves are connected in series, note that when the H(1) and F(1) valves are in their zero position, outlets connected to R are pressurized when a downstream valve is operated.

Without switching time adjustment

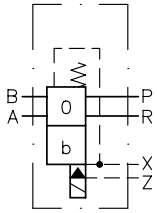
G, D, E, C, L, H, F



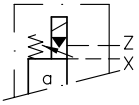
W



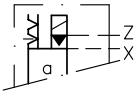
B



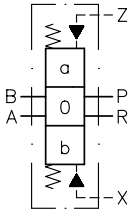
With switching time adjustment **G 1** to **F 1**



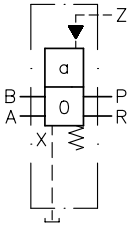
Version with detent **W 2, W 12**



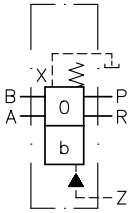
Without pilot valve **...G (D, E, C, L, H, F) - X**



...W - X



...B - X



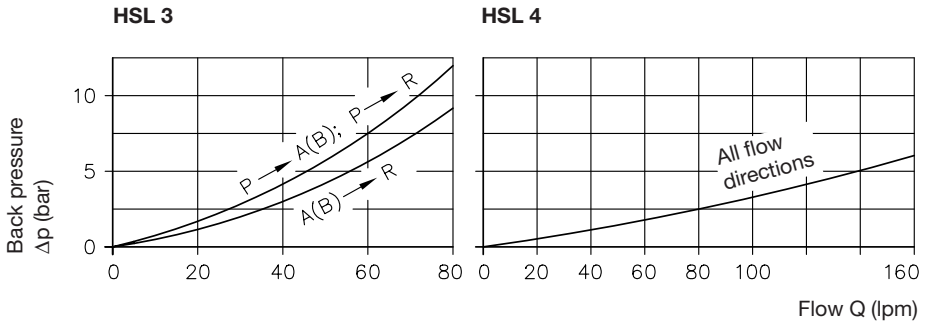
[1] Thread type throttle, see dimensional drawings.
[2] For detailed symbols i.e. to ease understanding of the function, see appendix in sect. 5 ++.
[3] Version with detent

2.1

3. Further data

Type and version	Directional spool valve, full steel design Valve spool hardened, ground, polished and deburred. An exactly circular sealing gap with a minimum leakage rate is achieved by the diamond-honed and polish-deburred housing bore. Directional ball seated valves type WN1H acc. to D 7470 A/1 are utilized as pilot valves.
Installation position	Any
Ports	P, R, A, B depending on size; X, Z = G 1/4 DIN ISO 228/1 (BSPP)
Port coding	P = Pump inlet R = Return **Attention:** 2 ports! (exception spool C). See sect. 5.1 A, B = Consumer Z = Control oil inlet X = Control oil outlet (tank) for version with solenoid actuation = Control oil inlet for version X with hydraulic remote control (table 3) at position a with 4/3-way directional spool valves (see sect. 5.1)
Overlapping	Zero
Switching times (guide line)	Without switching time adjustment (non-throttled) HSL 3: t_{on} = 30 ... 40 ms; t_{off} = 70 ... 100 ms HSL 4: t_{on} = 50 ... 60 ms; t_{off} = 110 ... 140 ms Necessary pulse duration for sure switching operations with coding W2(12) = approx. 200 ms
Mass (weight)	HSL 3 = 2.8 kg HSL 4 = 5 kg
Flow	HSL 3 = 80 lpm HSL 4 = 160 lpm
Pressure	P, A, B, and R = 400 bar; Z and X = 160 bar
Control pressure	max. 160 bar, min. 10 bar; optimum operation range 15 ... 40 bar, either tapped from individual control circuit or via a pressure reducing valve i.e. ADC 1-25 acc. to D 7458. Observe the notes regarding symbols L, F, and H in example 3.
Control volume	HSL 3 = approx. 1.8 cm^3 HSL 4 = approx. 5 cm^3
Surface	Gas nitrided
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/sec; opt. operation approx. 10 ... 500 mm^2/sec. Also suitable are biologically degradable pressure fluids types HEPG (Polyalkylenglycol) and HEES (Synth. Ester) at service temperatures up to approx. +70°C.
Temperature	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 20 K (Kelvin) higher for the following operation. Biologically degradable pressure fluids: Observe manufacturer's specifications. By consideration of the compatibility with seal material not over +70°C.
Pilot valves (Type WN1H acc. to D 7470 A/1)	Not over 60% duty cycle if the ambient temperature is 60°C and not over 35% duty cycle if the ambient temperature is 80°C. Heat generation of the solenoid can be reduced by reducing the supply voltage.This gives a temperature reserve as a balance for increased ambient temperatures and greater safety under normal conditions and if the ambient temperatures are fluctuating. Control pressure ≦ 160 bar → $U_{reduc.}$ = 0.75 U_{Nom}, permissible ambient temperature 60°C Control pressure 35 bar → $U_{reduc.}$ = 0.5 U_{Nom}, permissible ambient temperature 80°C

Δp-Q-curves (guideline)

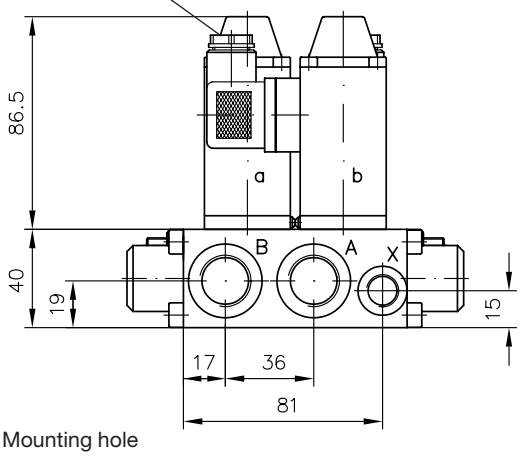


4. Unit dimensions

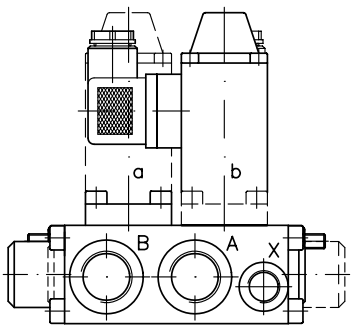
All dimension in mm and subject to change without notice!

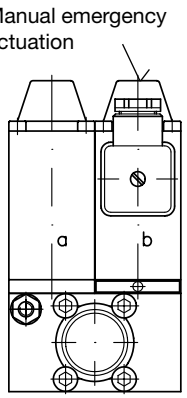
Type HSL 3...

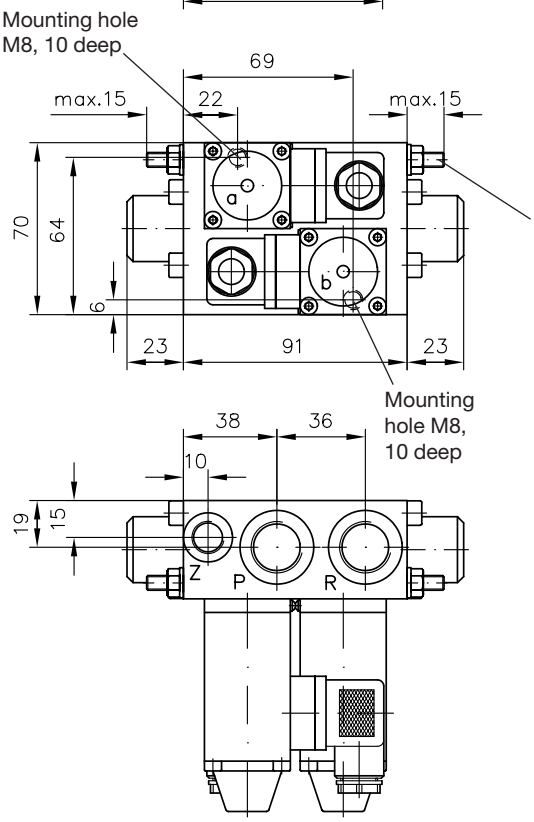
Coding
G, D, E, C, L, H, F, W2
(G1 to F1, W12)



Coding
B (B1) W (W1)





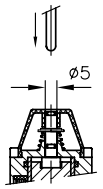


Set screw for switch-time adjustment: Allan key 3 mm and spanner a/f 10 for the lock nut

- Lock nut
  Loosen the SEAL-Lock nut prior to adjusting the throttle screw to prevent damage of the integrated thread seal.
- Blocked with tapped plug M6 for versions without switch-time adjustment.

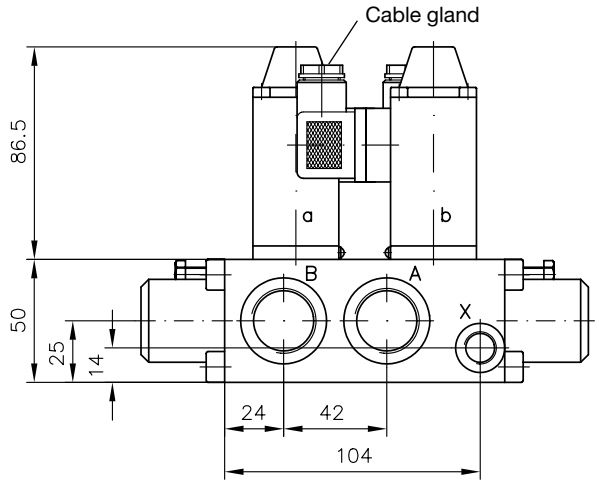
Manual emergency actuation

Actuation aid (do not use any sharp-edged tools)

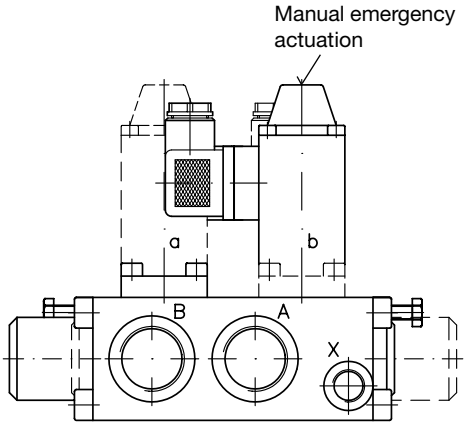


Type HSL 4...

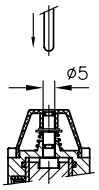
Coding
G, D, E, C, L, H, F, W2
(G1 to **F1, W12)**

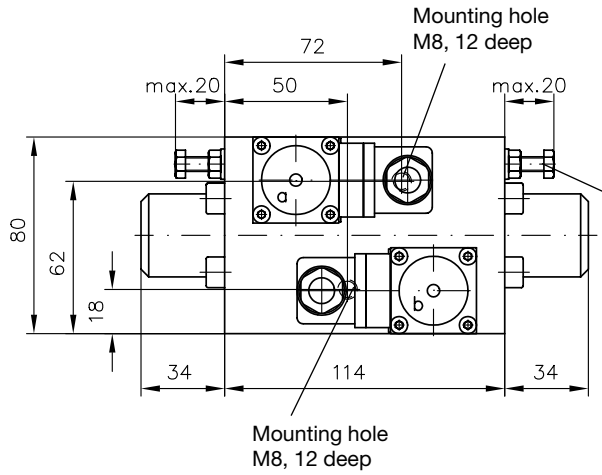


Coding
B (B1) **W (W1)**



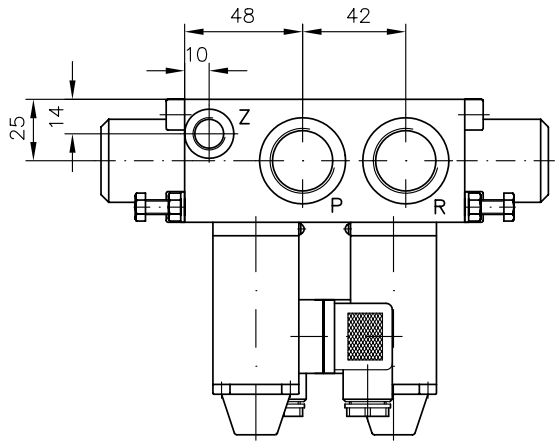
Manual emergency actuation
Actuation aid (do not use any sharp-edged tools)





Set screw for switch-time adjustment:
Two spanners a/f 10 for hexagon head screw and lock nut

- Lock nut
  Loosen the SEAL-Lock nut prior to adjusting the throttle screw to prevent damage of the integrated thread seal.
- Blocked with tapped plug M6 for versions without switch-time adjustment

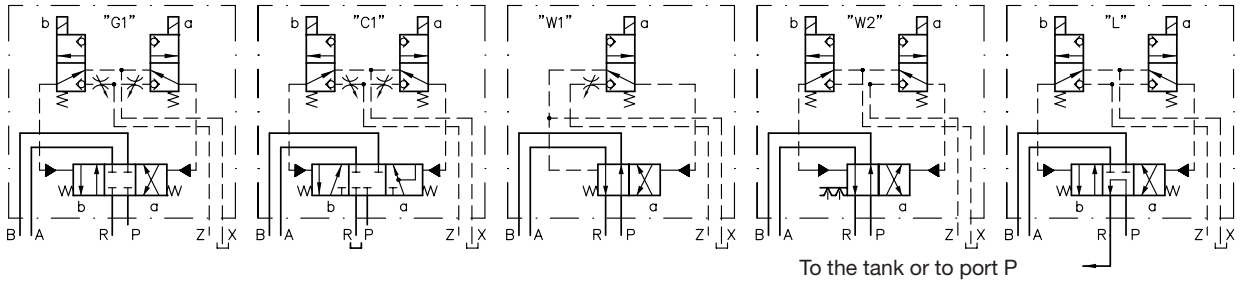


5. Appendix

5.1 Detailed flow illustrated symbols

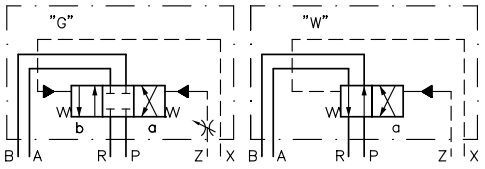
Examples not listed should be drawn accordingly. Control port X serves as drain/leakage port to the tank with spools W1 and B1.

Standard versions with pilot valves



Version ...**-X**, without pilot valve

In the case of 4/3-way versions with switching time adjustment (i.e. G1, D1 etc.), only the control port Z can be influenced via the throttle screw. In the case of control port X, it is necessary to install a throttle (i.e. FG or FG-S 6 acc. to D 7275) externally into the connected control line. The symbol illustration opposite, applies to valve coding G and W and analogously to D, E, C, B, L, H, and F.

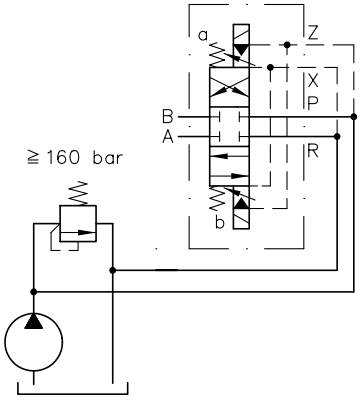


5.2 Example circuits

Example 1:

Most simple control with directional spool valves suited for parallel connection. Control oil pick-up and return are internal via ports X and Z. Permissible pressure is approx.160 bar (see control pressure in sect. 3) and when no pressure surges (decompression surges) are expected in the return line.

Type HSL 3 G1-G 24

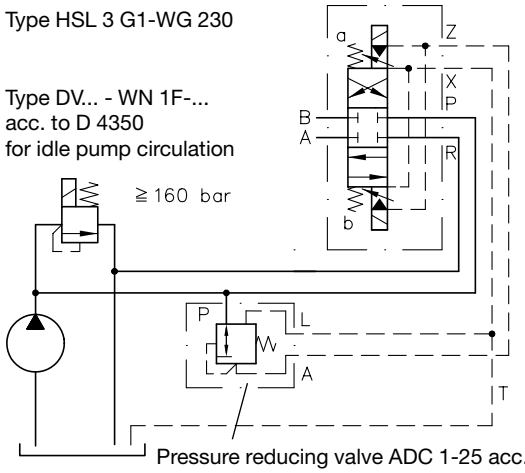


Example 2:

Same control task as example 1, but with control oil pick-up from a pressure circuit >160 bar. The pressure for the control oil circuit is reduced down to approx. 30 bar here via pressure reducing valve type ADC1-25 acc. to D 7458.
It is recommended to to provide an additional line for the control oil return (as illustrated), when pressure surges are expected in the main return line.

Type HSL 3 G1-WG 230

Type DV... - WN 1F-...
acc. to D 4350
for idle pump circulation



Example 3:

A direct control oil pick-up from the pump pressure line is not possible in most cases with flow pattern symbols L, H, and F as the back pressure in idle position does not exceed the minimum control pressure required for switching operations (particularly if there is only one single valve). It is therefore recommended to employ a pump, e.g. type R acc. to D 6010 S feeding a separate control oil circuit (see example). Another way is to use a completely separate control circuit pump, i.e. gear pump with approx. 0.5...1 lpm, limited to approx. 20 bar, making an ADC 1-25 superfluous. Otherwise, pay attention to the summation of the back pressure, particularly when several valves are connected in series.

Type HSL 3L- G 24