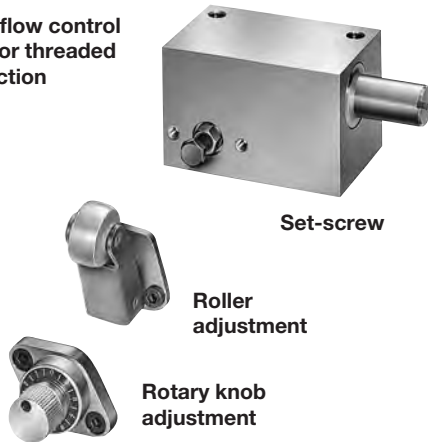


2- and 3-way flow control valves type SF, SD, SK, SKR

Pressure p_{\max} = 315 bar
Flow Q_{\max} = 130 lpm

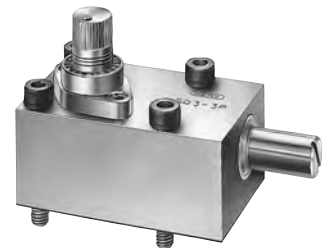
3-way flow control valve for threaded connection



2-way flow control valve for threaded connection



2- and 3-way flow control valve, for manifold mounting

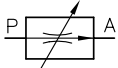
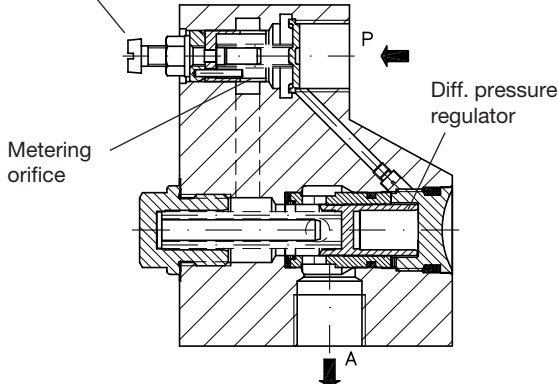
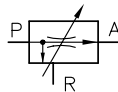
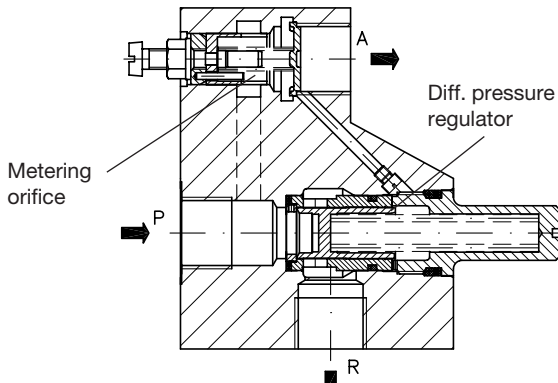


1. General

The type S flow control valves are flow valves (DIN ISO 1219-1) and serve for infinite adjustment of the flow into oil-hydraulic, hydrostatic system. Once set, the flow rate is constantly maintained at a tolerance of approx. $\pm 3\%$, regardless of the pressure within the system and the viscosity of the hydraulic fluid.

2. Overview

Typical configuration - System functions

Design	Schematic diagram	
<p>2-way flow control valve (flow control in serial arrangement, secondary pressure)</p> 	<p>Adjustment</p> <p>Set-screw</p> <p>Rotary knob</p> <p>Roller lever</p> <p>type SF..</p> <p>type SD..</p> <p>type SK.. and SKR..</p>  <p>Metering orifice</p> <p>Diff. pressure regulator</p> <p>P</p> <p>A</p>	<p>Design and configuration:</p> <p>Secondary flow control, meaning that the differential pressure regulator (pressure balance) is fitted downstream of the metering orifice to provide a good dynamic damping. A 2-way flow control valve will operate only in conjunction with a pressure relief valve on feed side P, and may therefore be used for both feed and drain control. Observe notes in sect. 3.1 and 6.1!</p> <p>Versions with by-pass check valve for unhindered return flow or check valve rectifier circuit (enabling flow control for both flow directions) are also available.</p>
<p>3-way flow control valve (flow control valve in parallel)</p> 	 <p>Metering orifice</p> <p>Diff. pressure regulator</p> <p>P</p> <p>A</p> <p>R</p>	<p>Design and configuration:</p> <p>The differential pressure regulator (pressure balance) and metering orifice are arranged in parallel. Contrary to the 2-way flow control valve, the flow is separated in the consumer flow ($\rightarrow A$) and residual flow ($\rightarrow R$), i.e. the 3-way valve can be used for controlling the feed flow only.</p> <p>The valve acts against the momentary consumer counter-pressure. Additional control functions for pressure limitation or idle circulation may be integrated via directly mounted piloting valves or remote control via control port Z.</p>

3. Types available, main data

3.1 2-way flow control valve

Order examples:

SD 2 - 3/15 R

SF 2 - 4/90 P

Table 1: Basic type and actuation



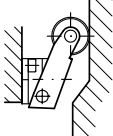
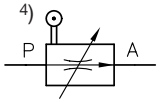
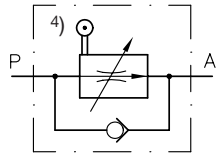
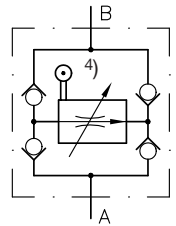
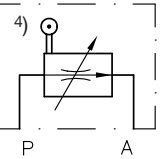
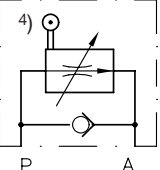
Set-screw	Rotary knob adjustment	Roller adjustment Non-shielded version	Shielded version
SF 2	SD 2	SK 2	SKR 2 ¹⁾
with lock nut for fixed setting 	with fine setting by 3.8 rotations Marking rings for counting the number of rotations 	with mechanical operation via cam 	

Table 2: Size and flow

Size	Nominal flow deenergized open ²⁾										Ports P and A Pipe con- nection ISO 228/1 (BSP) Manifold mounting	
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130		
	Nominal flow deenergized blocked ²⁾											
	-	/6F	/15F	/30F	/36F	/50F						
	Adjustment range Q _{A min} ... Q _{A max} (lpm)											
		0.3 to 6	0.3 to 15	0.3 to 30	0.3 to 36	0.3 to 50 ³⁾	0.3 to 60 ³⁾	0.3 to 70	0.3 to 90	1 to 130		
3	●	●	●	●	●	●	●				G 1/2	See di- men- sional drawing in sect. 5.2
4								●	●		G 3/4	
5										●	G 1	

Table 3: Connection pattern, symbols and auxiliary valves

Type of connection	Basic version	With auxiliary valve	
		Bypass check valve for free reflow A→P	Check valve rectifier circuit (only for pipe connection), flow control in both directions, see also footnote ³⁾ above
Pipe connection	(no coding) 	R 	B Only size 3! 
Manifold mounting	P 	PR 	

¹⁾ Suited for out door use, but not available for manifold mounting valves.

²⁾ To ensure optimum control, the flow at port P must always exceed the consumer flow in operation in order to build up an internal control pressure drop for activating the pressure balance.

³⁾ When used with auxiliary valve B, the flow range is 0.3 to 40 lpm

⁴⁾ Actuation symbol is omitted with type SF 2

3.2 3-way flow control valve

Order examples:

SF 3 - 3/15 P

SD 3 - 4/70 S - 100

SD 3 - 3/15 S - WN1F - G12 - 120

Pressure specification in bar, max. 315
(only in connection with auxiliary valve, coding **S**)

Table 4: Basic type and actuation



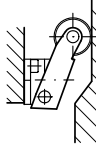
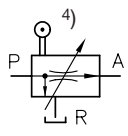
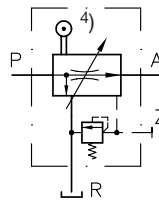
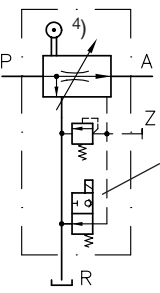
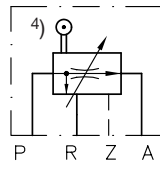
Set screw	Rotary knob adjustment	Roller adjustment	
		Non-shielded version	Shielded version
SF 3	SD 3	SK 3	SKR 3 ¹⁾
with lock nut for fixed setting	with fine setting by 3.8 rotations	with mechanical operation via cam	
	Marking rings for counting the number of rotations 		

Table 5: Size and flow

Size	Nominal flow deenergized open ²⁾										Ports P and A Pipe connection ISO 228/1 (BSPP)		Manifold mounting
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130			
	Nominal flow deenergized blocked ²⁾												
	-	/6F	/15F	/30F	/36F	50F							
	Adjustment range Q _{A min} ... Q _{A max} (lpm)												
		0.3 to 6	0.3 to 15	0.3 to 30	0.3 to 36	0.3 to 50	0.3 to 60	0.3 to 70	0.3 to 90	1 to 130	P, R, A	Z ³⁾	P, R, A Z ³⁾
3	●	●	●	●	●	●	●				G 1/2	G 1/4	
4								●	●		G 3/4	G 1/4	
5										●	G 1	G 1/4	

Table 6: Connection pattern, flow pattern symbols and auxiliary valves

Type of connection	Basic version	With auxiliary valve		Nominal voltage U_N	
		Pressure limiting valve	Pressure limiting valve with directly mounted 2-way direct. seated valve acc. to D 7470 A/1		
Pipe connection	(no coding)	S	S-WN 1 F-... S-WN 1 D-...	G 12	12V DC
				G 24	24V DC
			Circulation setting (circulation pressure 6...10 bar) S-WN 1 F S-WN 1 D	WG 110	110V AC 50 / 60 Hz
				WG 230	230V AC
Manifold mounting	P	See sect. 4.2 for main electrical data! For further data, see D 7470 A/1.			
					

¹⁾ Suited for out-door use, but not available for manifold mounting valves.

²⁾ To ensure optimum control, the flow at port P must always exceed the consumer flow in operation in order to built up an internal control pressure drop for activating the pressure balance.

³⁾ Z = Control port with type S.3-3(4.5)/...S... and ...-3(4.5)/...P(PS)
It is used when an arbitrary idle pump circulation P→R is intended via an externally connected 2/2-way directional valve e.g. type WN1D(F)-1/4-... acc. to D 7470 A/1 (see symbols above)

⁴⁾ Actuation symbol is omitted with type SF 2

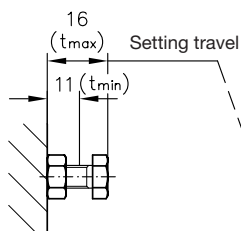
4. Further data

4.1 General and hydraulic data

Installation position	Any		
Ports	P = Inlet A and B = Consumer side R = Return Z = External control port, see ³⁾ in sect. 3.2		
Surface	Valve body gas nitrided, other parts zinc galvanized Solenoid (with type ...S-WN1..) zinc galvanized and olive passivated		
Direction of flow	Only in direction of arrow from P→A(R); opposite direction A→P only possible with by-pass check valve. With flow control valve in rectifier circuit A→B or B→A.		
Inflow	The pump delivery on the inlet side must exceed $Q_{A \max}$ by 10% when the full range will be exploited.		
Mass (weight) approx. kg	Size	Basic valve	With directly mounted 2-way directional seated valve acc. to D 7470 A/1
	3	1.4	2.0
	4	2.1	2.7
	5	3.1	3.7
Operating pressure	$p_{\max} = 315 \text{ bar}$; $p_{\min} = 10 \dots 20 \text{ bar}$, depending on flow rate pressure required for opening pressure balance approx. 6 bar. Counter-pressure at drain port R at 3-way flow control valves must always be lower than the feed pressure applied at port A (min. diff. 8 bar)		
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. 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 20K (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. Attention: Observe the restrictions in sect. 4.2 regarding the perm. duty cycles of the solenoids!		

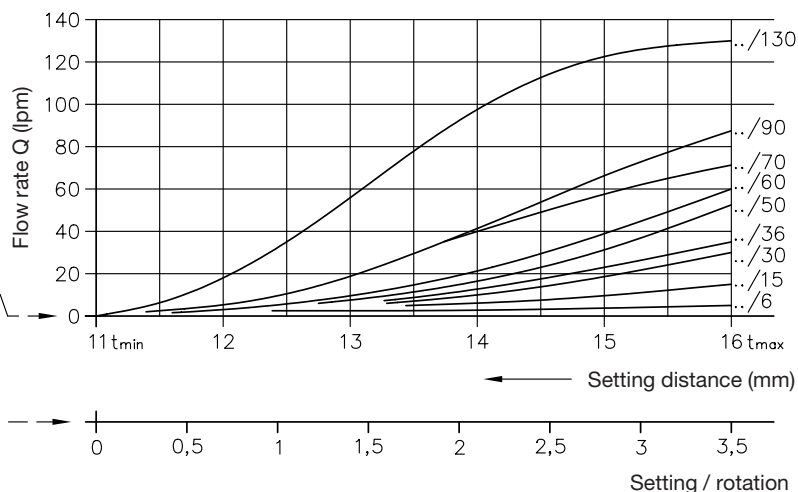
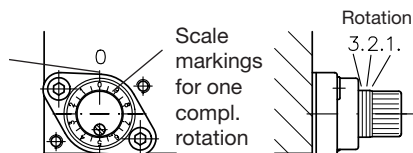
Setting curves
(basic values)

Type SF..



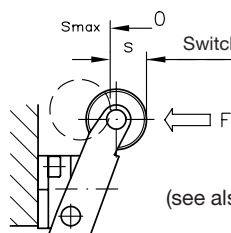
Type SD..

Notch for marking position 0

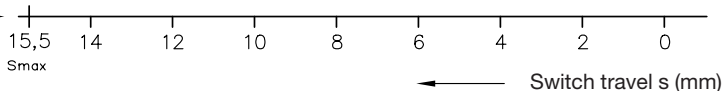


Type SK..
SKR..

Operating force F
(basic values) at
 0 bar ... approx. 30 N
 100 bar ... approx. 44 N
 200 bar ... approx. 56 N
 300 bar ... approx. 70 N

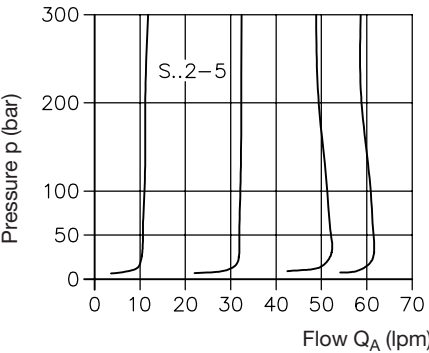
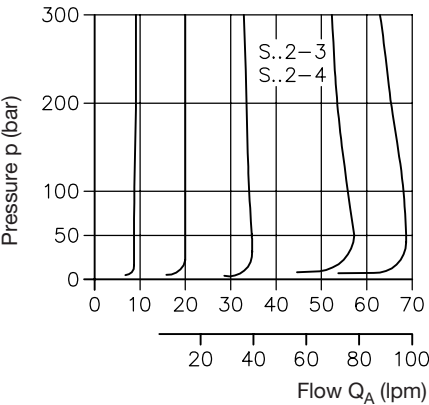


(see also sect. 4.1)

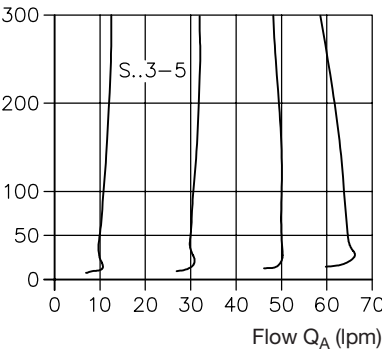
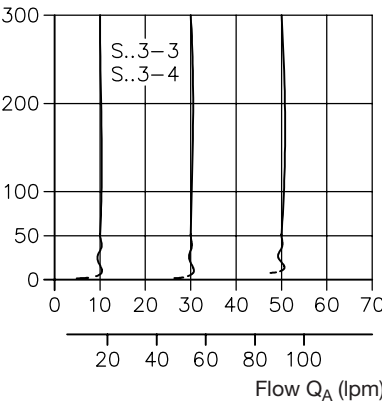


Δp-Q - curves

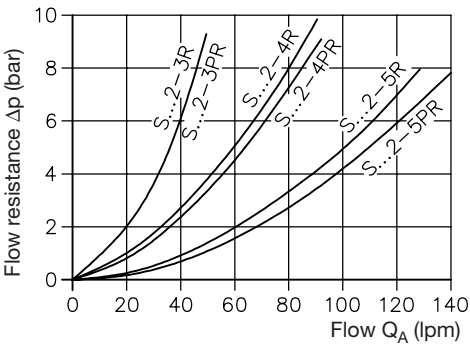
2-way flow control



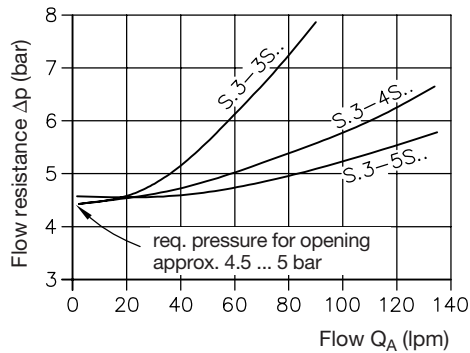
3-way flow control



2-way flow control with bypass relief valve, flow direction A→P



Circulation back pressure with relieved flow controller



Oil viscosity during measurement approx. 35 mm²/sec

4.2 Electrical data

of the solenoid valve with type S..3-3 (4, 5) as specified in sect. 3.2

Solenoid	Built and tested acc. to DIN VDE 0580, wet armature sealed to outside Basic rating at P _N nom. output ≈ 24.4 W ± 6% depending on nom. voltage U _N and manufacturer				
Coding	G 12	G 24	WG 110	WG 230	Other voltages on enquiry
Nom. voltage U _N	12V DC	24V DC	110V AC	230V AC 50/60 Hz	
Nom. current I ₂₀	2A	1A	0.22A	0.14A	
Plug (connection and circuitry)	DC-voltage coding G..		AC-voltage coding WG..		
All plugs with cable glands					
Relative duty cycle	100% ED Stamped on the solenoid body				
Protection class	IP 65 conf. DIN EN 60529 / IEC 60529 (in properly assembled state)				
Insulation material class	F				
Surface temperature	approx. 85°C at ambient temperature 20°				
Mounting	The solenoid can be easily exchanged in case of an electrical defect. Simply pull-off the solenoid after removing the 4 mounting screws and put on a new one.				

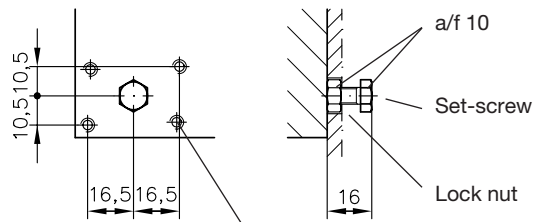
5. Dimensions

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

In the interest of simplicity, different drawings are provided for the adjustment versions and the valves. Just combine the individual drawings in order to obtain a drawing for the entire valve system. (See also photo on page 1).

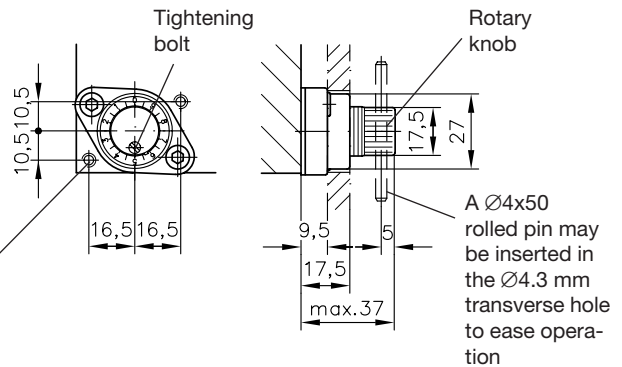
5.1 Adjustment versions

Type SF..

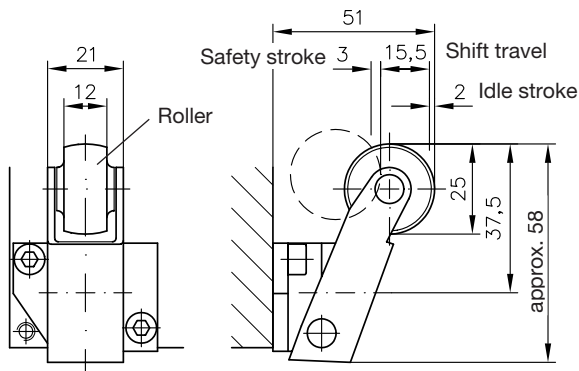


M5, 4 deep fastening thread for installing at an instrument console. Version for instrument console installation not possible with type S..2 - 3 B and with all types for manifold mounting.

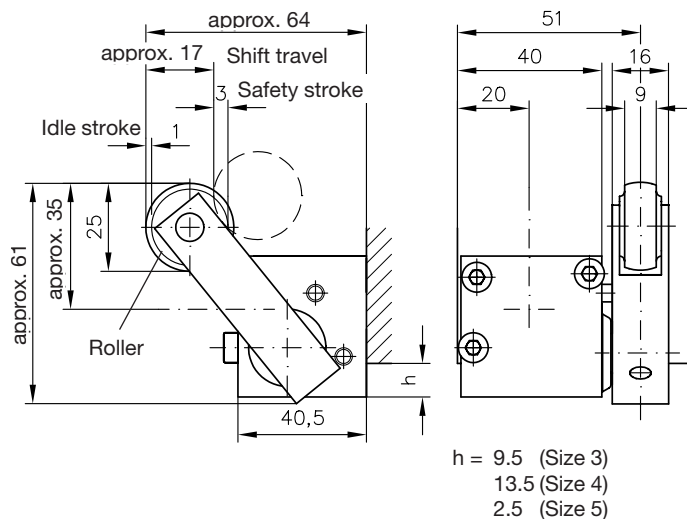
Type SD..



Type SK..



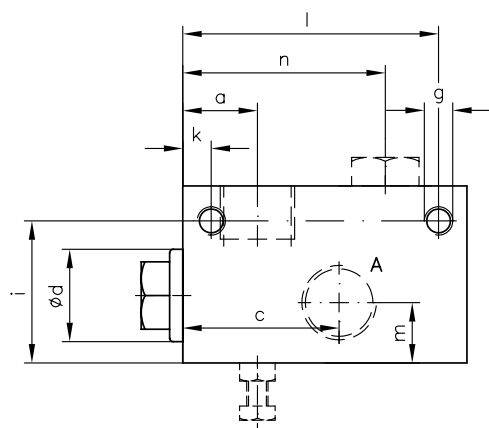
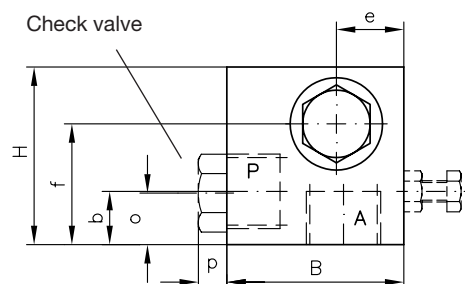
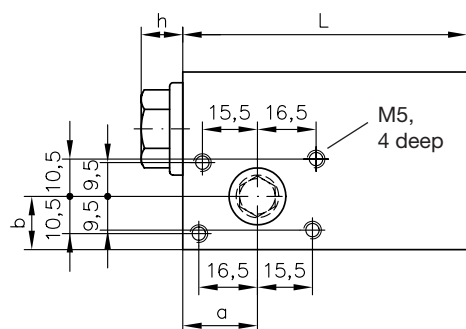
Type SKR..



5.2 2-way flow control valve

Version with tapped ports

Type S.. 2-3(4, 5) and S.. 2-3(4, 5)...R acc. to sect. 3.1

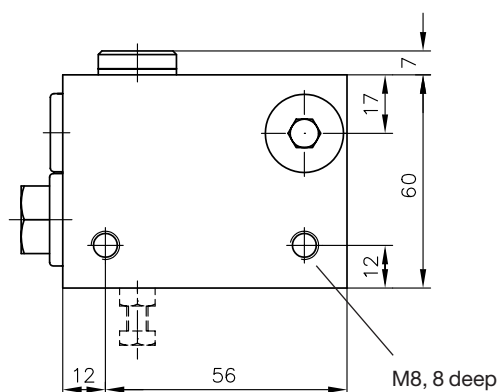
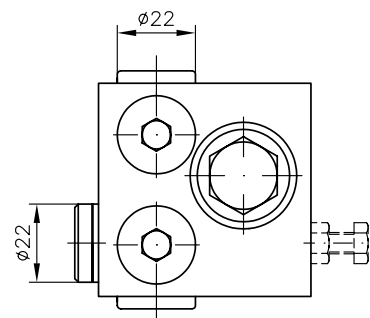
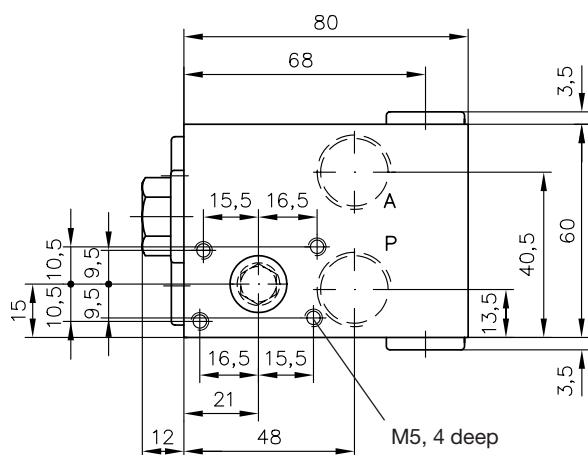


Size	Ports P and A ISO 228/1 (BSPP)	L	B	H	a	b	c	d	e	f
3	G 1/2	80	50	50	21	15	44	26	19	34
4	G 3/4	85	60	60	25	19	53	32	21	41
5	G 1	100	70	70	27	24	60	39	23	47

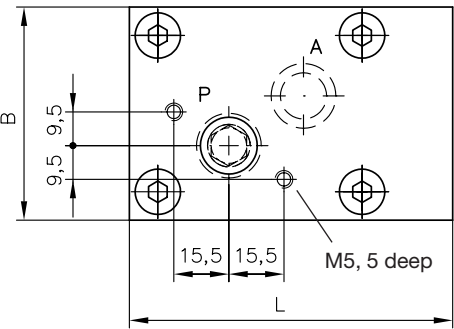
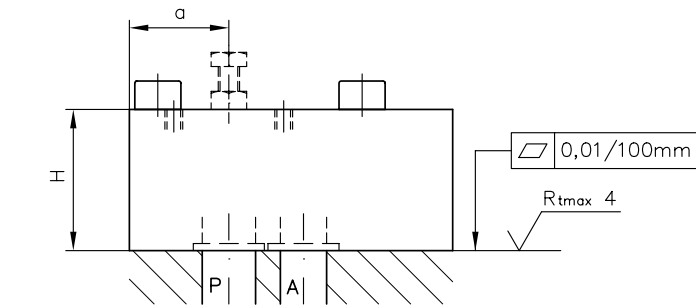
Size	g	h	i	k	l	m	n	o	p
3	M8, 8 deep	12	40	8	72	17	57	14.5	5.5
4	M8, 10 deep	14	48	10	75	21	68	18	5.5
5	M10, 12 deep	16	52	20	80	23	80	21	11

Version with tapped ports and rectifier circuit

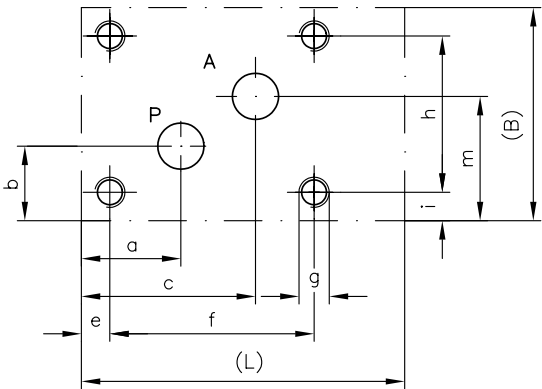
Type S.. 2-3...B acc. to sect. 3.1



Manifold mounting version
Type S.. 2-3(4, 5)..P and S.. 2-3(4, 5)..PR



Hole pattern of the manifold (top view)



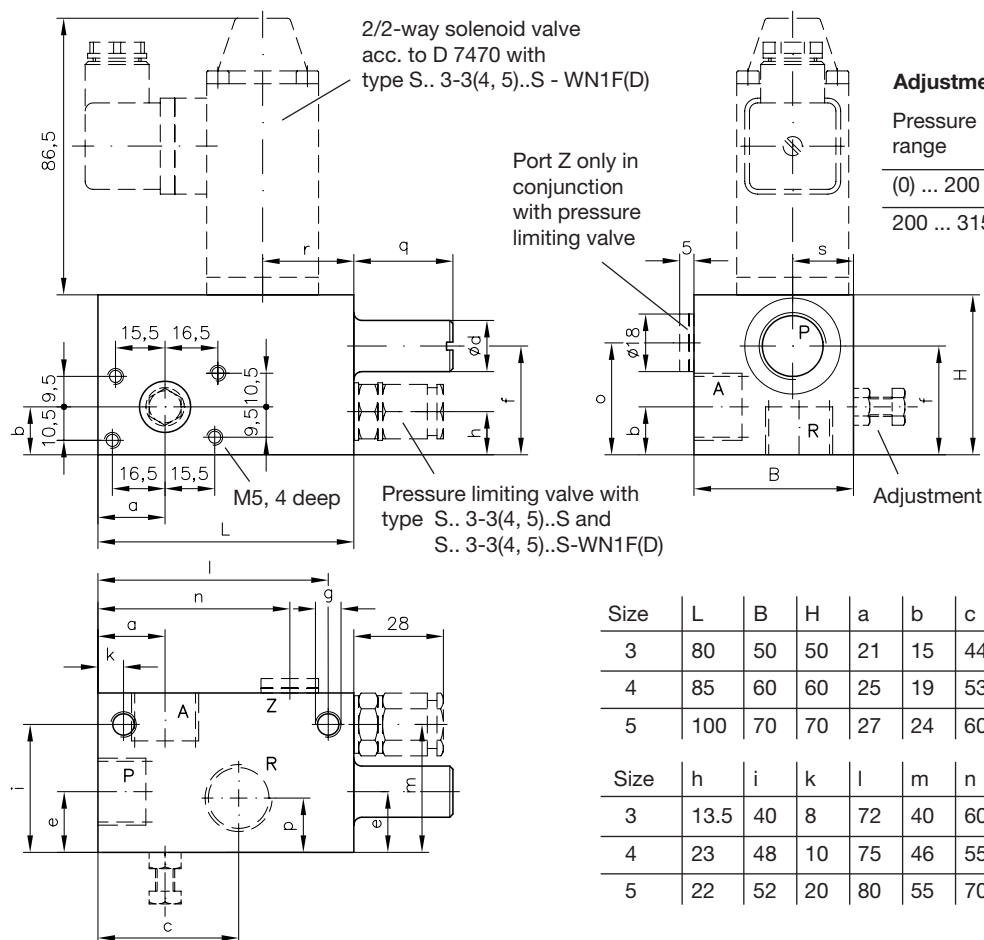
Size	L	B	H	a	b	c	e	f	g
3	93	60	40	28	21	49	8	57.5	M8, 10 deep
4	100	70	50	35	26	57	16	57	M10, 10 deep
5	106	80	50	33	28	65	9	88	M10, 10 deep

Size				Port Ø		Seals (O-ring NBR 90 Sh)	
	h	i	m	P	A	P	A
3	44	8	35	14	12	15x2.5	
4	52	9	42	17	17	18.75x2.62	
5	64	8	48	17	17	26x3	18.75x2.62

5.3 3-way flow control valve

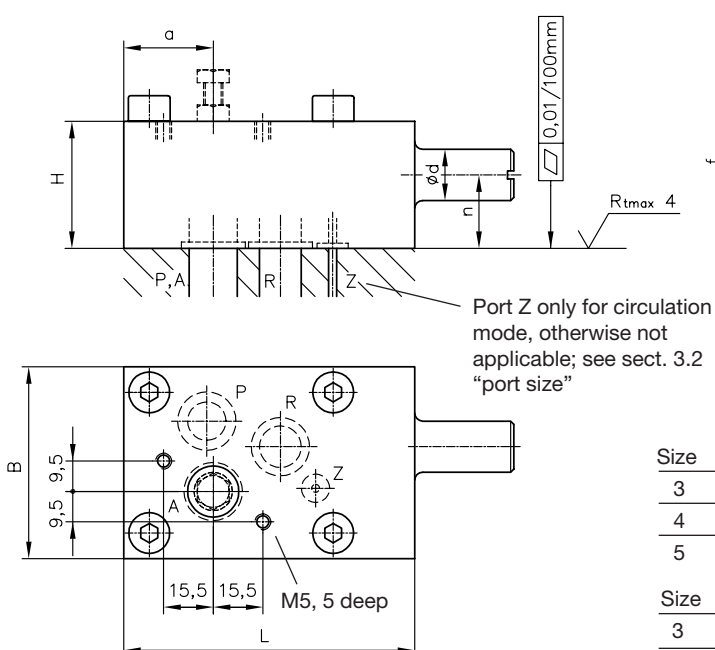
Version with tapped ports

Type S.. 3-3(4, 5); S.. 3-3(4, 5)...S; S.. 3-3(4, 5)...S - WN 1 F(D) acc. to sect. 3.2

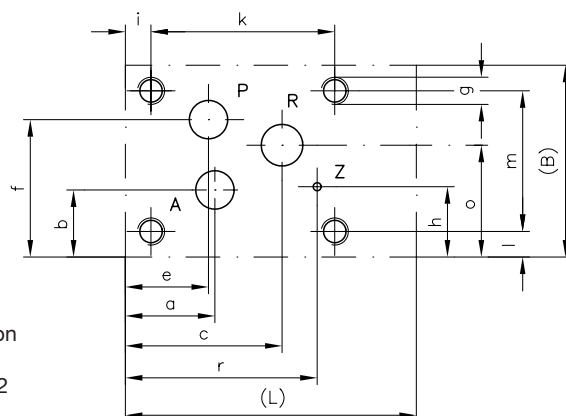


Manifold mounting version

Type S.. 3-3(4, 5)...P and S.. 3-3(4, 5)...PS acc. to sect. 3.2



Hole pattern of the manifold (top view)



Size	L	B	H	a	b	c	d	e	f	g
3	93	60	40	28	21	49	16.5	26	43	M8, 10 deep
4	100	70	50	35	26	57	16.5	33.5	53	M10, 10 deep
5	106	80	50	33	28	65	24	33	62	M10, 10 deep

Size	h	i	k	l	m	n	o	p	r
3	22	8	57.5	8	44	23	35	31	60
4	21	16	57	9	52	29	42	31	55
5	40	9	88	8	64	27	48	30	87

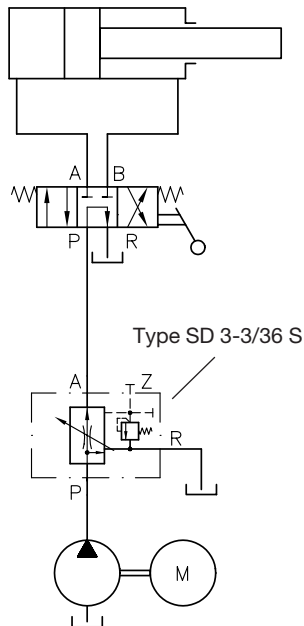
Size	Port \varnothing			Seals (O-ring NBR 90 Sh)		
	P, R	A	Z	P and R	A	Z
3	12	14	4	15x2.5		6x2
4	17		4	18.75x2.62		6x2
5	17		4	18.75x2.62	26x3	6x2

6. Appendix

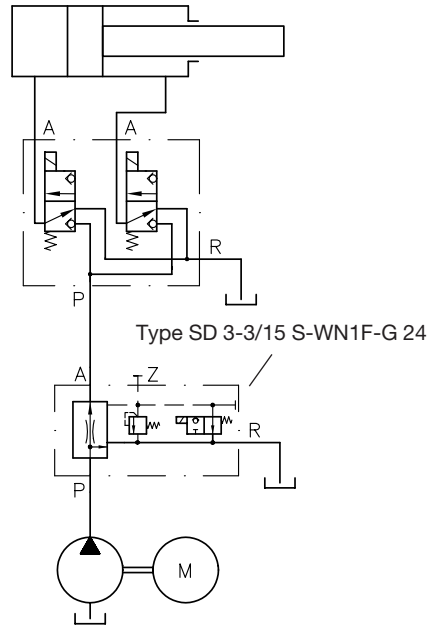
6.1 Typical circuitry

Feed control with 3-way flow control valve

Feed control with simultaneous pressure control

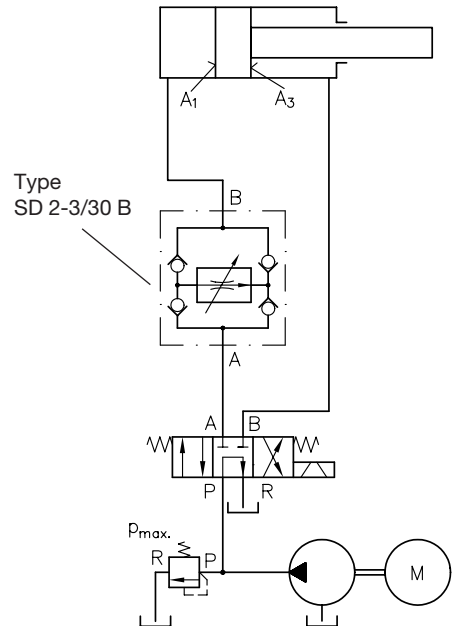


Feed control with simultaneous pressure control and idle circulation mode

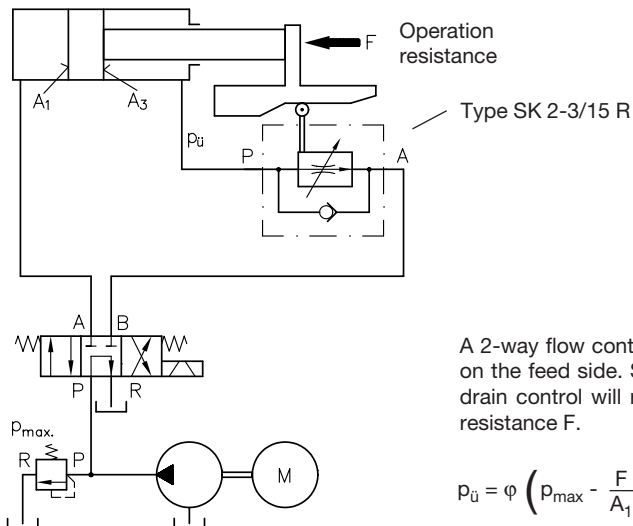


Speed control in both directions by rectifier circuit

Forward and reverse velocity are equal.
Attention: The pressure may be geared up when the flow control valve is connected to the rod side.



Control of flow out via a 2-way flow control valve



A 2-way flow control valve operates only in conjunction with a pressure relief valve on the feed side. Should the area ratio $\varphi = A_1/A_3$ (see wiring diagram) be unequal, drain control will result in a pressure transmission factor depending on operating resistance F .

$$p_u = \varphi \left(p_{\max} - \frac{F}{A_1} \right)$$

It follows that the pressure transmission factor may be excessive when running without load.

7. Type over view

Order examples:

SD 2 - 3 / 15 P

SKR 3 - 4 / 70 S-WN1F - G 12 - 120

