

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

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

**3-way flow control valve for threaded connection**



Set-screw



Roller adjustment



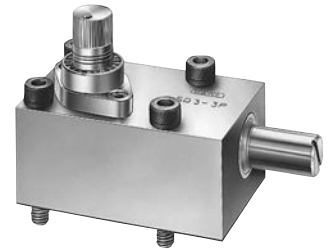
Rotary knob adjustment

**2-way flow control valve for threaded connection**



Adjustment as shown opposite left

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



Adjustment as shown in outside left picture

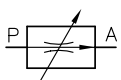
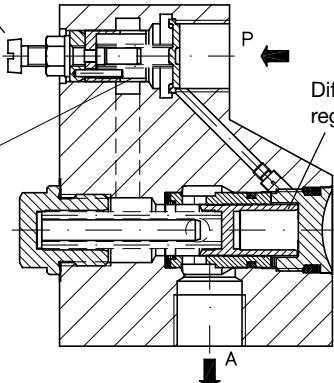
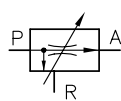
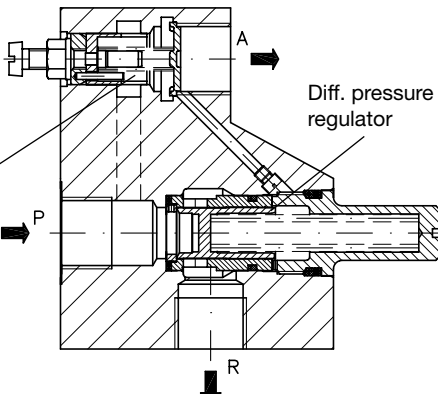
## 1. General

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.

It is possible to select electrically between two different flow rates with type SU (see sect. 3.3).

## 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>Metering orifice</p>  <p>Set-screw                      Rotary knob                      Roller lever</p> <p>type SF..                      type SD..                      type SK.. and SKR..</p> <p>Diff. pressure regulator</p>	<p><b>Design and configuration:</b>                      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!                      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><b>Design and configuration:</b>                      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 (<math>\rightarrow A</math>) and residual flow (<math>\rightarrow R</math>), i.e. the 3-way valve can be used for controlling the feed flow only.                      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>



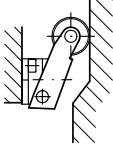
### 3. Types available, main data

#### 3.1 2-way flow control valve

Order examples:

**SD 2 - 3/15 R**  
**SF 2 - 4/90 P**

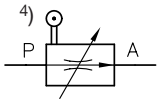
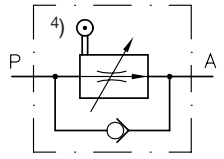
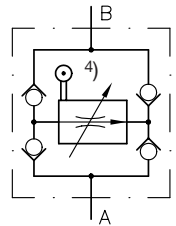
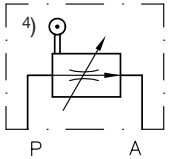
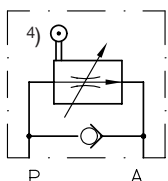
**Table 1:** Basic type and actuation

Set-screw	Rotary knob adjustment	Roller adjustment	
SF 2	SD 2	Non-shielded version	Shielded version
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 <sup>2)</sup>										Ports P and A	
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130		
	Nominal flow deenergized blocked <sup>2)</sup>											
	-	/6F	/15F	/30F	/36F	/50F						
Adjustment range $Q_{A \text{ min}} \dots Q_{A \text{ max}}$ (lpm)												
		0.3 to 6	0.3 to 15	0.3 to 30	0.3 to 36	0.3 to 50 <sup>3)</sup>	0.3 to 60 <sup>3)</sup>	0.3 to 70	0.3 to 90	1 to 130		
3	•	•	•	•	•	•	•				G 1/2	See dimensional drawing in sect. 5.2
4								•	•		G 3/4	
5										•	G 1	

**Table 3:** Connection pattern, symbols and auxiliary valves

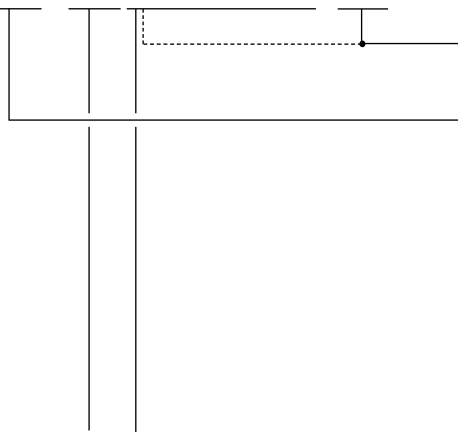
Type of connection	Basic version		With auxiliary valve	
			Bypass check valve for free reflow A→P	Check valve rectifier circuit (only for pipe connection), flow control in both directions, see also footnote <sup>3)</sup> above
Pipe connection	(no coding) 	<b>R</b>		<b>B</b> Only size 3! 
Manifold mounting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

- 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



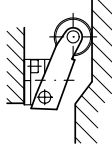
Order examples:

- 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**)

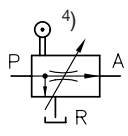
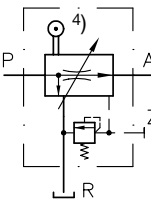
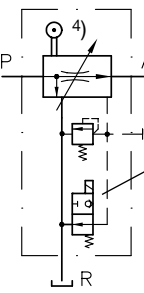
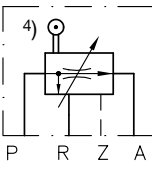
**Table 4:** Basic type and actuation

Set screw	Rotary knob adjustment	Roller adjustment	
SF 3	SD 3	Non-shielded version	Shielded version
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 5:** Size and flow

Size	Nominal flow deenergized open <sup>2)</sup>										Ports P and A		
	/3	/6	/15	/30	/36	/50	/60	/70	/90	/130	Pipe connection ISO 228/1 (BSPP)	Manifold mounting	
	Nominal flow deenergized blocked <sup>2)</sup>												
	-	/6F	/15F	/30F	/36F	50F							
Adjustment range $Q_{A \min} \dots Q_{A \max}$ (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 <sup>3)</sup>	P, R, A   Z <sup>3)</sup>
<b>3</b>	●	●	●	●	●	●	●				G 1/2	G 1/4	See dimensional drawing in sect. 5.3
<b>4</b>								●	●		G 3/4	G 1/4	
<b>5</b>										●	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 $U_N$	
	(no coding)	Pressure limiting valve	Pressure limiting valve with directly mounted 2-way direct. seated valve acc. to D 7470 A/1		
Pipe connection		<b>S</b> 	<b>S-WN 1 F-...</b> <b>S-WN 1 D-...</b> 	<b>G 12</b>	12V DC
				<b>G 24</b>	24V DC
				<b>WG 110</b>	110V AC 50 / 60 Hz
				<b>WG 230</b>	230V AC
				See sect. 4.2 for main electrical data! For further data, see D 7470 A/1.	
Manifold mounting	<b>P</b> 				

- 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.

<sup>3)</sup> 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)

<sup>4)</sup> Actuation symbol is omitted with type SF 2

### 3.3 2- and 3-way flow control valve type SU

Flow control valve where two constant flow rates can be selected electrically.

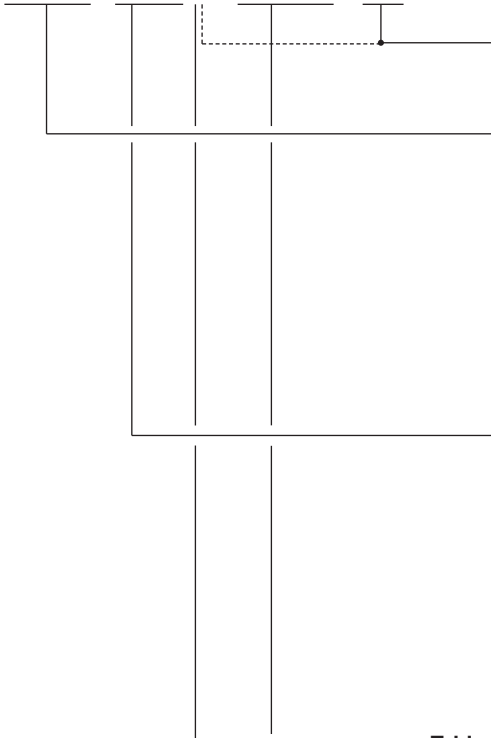
These flow control valves feature an additional solenoid as actuation, contrary to the versions specified in sect. 3.1 and 3.2. This way, plus a corresponding metering orifice, two different (constant) flow rates can be remotely activated by energizing or deenergizing the solenoid. This can be employed for e.g. creeping or rapid traverse. It also may make prop. flow control valves (e.g. type SE or SEH acc. to D 7557/1) and respective prop. amplifiers superfluous.

With some types (e.g. SU 2-3-0/40-G24) it is even possible to block the connection to the consumer ( $Q_A = 0$ ) when required.

Order examples:

**SU 2-3 - 4/ 16 - G 24**

**SU 3-3 - 25/10 S - WG 230 - 100**



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

**Table 7:** Basic type with actuation (only size 3!)

Coding	Design	Only tapped ports for direct pipe connection ISO 228/1 (BSPP) P, R, A   Z 1)	
		P, R, A	Z 1)
<b>SU 2-3</b>	2-way flow control valve	G 1/2	---
<b>SU 3-3</b>	3-way flow control valve	G 1/2	G 1/4

**Table 8:** Flow (= Effective consumer flow  $Q_A$  in lpm)  
Combinations are possible, dep. on requirement

0 2)	0,4	0,6	1	2,5	4	6	10	16	25	40	50
<b>4 / 16</b>											
First coding = Usable consumer flow $Q_A$ with deenergized solenoid Second coding = Usable consumer flow $Q_A$ with energized solenoid											

**Table 9:** Flow pattern symbols and auxiliary valves

Basic version	Pipe connection (no coding)	With auxiliary valve	
		Bypass check valve <b>R</b>	Pressure limiting valve <b>S</b>
2-way flow control valve			
3-way flow control valve			

**Table 10:** Operating voltage for the actuation solenoid

Coding	Nominal voltage $U_N$
<b>G 12</b>	12V DC
<b>G 24</b>	24V DC
<b>WG 110</b>	110V AC 50 and
<b>WG 230</b>	230V AC 60 Hz

For more detailed electrical data, see sect. 4.2

1) Z = control connection. To be used only if operation is to be switched at random to P→R pump circulation via an externally connected 2/2-way valve, e.g. WN 1D(F) - 1/4-.. according to D 7470 A/1; see symbol

2) Usable consumer flow  $Q_A = 0$  lpm (spool valve characteristic)

## 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 <sup>3)</sup> in sect. 3.2
Surface	Valve body gas nitrided, other parts zinc galvanized Solenoid (with type ...S-WN1.. and SU..) 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.

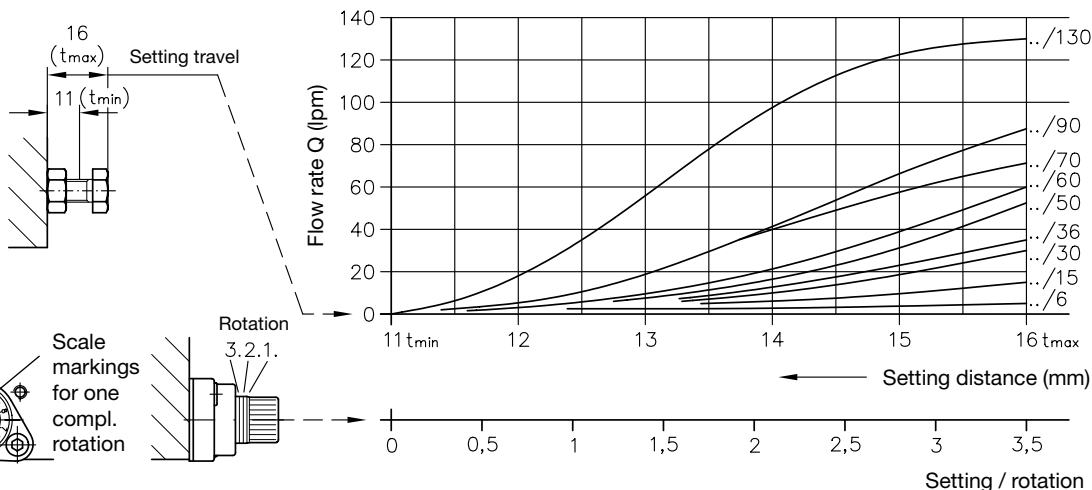
Mass (weight) approx. kg	Size	Basic valve	With directly mounted 2-way directional seated valve acc. to D 7470 A/1
	3	1.4 (2.0) <sup>1)</sup>	2.0
	4	2.1	2.7
	5	3.1	3.7

1) Figures in brackets apply to SU 2(3)-3

Operating pressure	$p_{max} = 315$ bar; $p_{min} = 10...20$ 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 <sup>2</sup> /sec; opt. operation: approx. 10... 500 mm <sup>2</sup> /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. <b>Attention:</b> Observe the restrictions in sect. 4.2 regarding the perm. duty cycles of the solenoids!

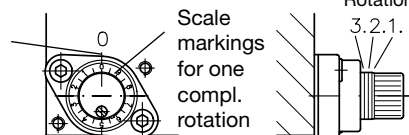
Setting curves (basic values)

Type SF..



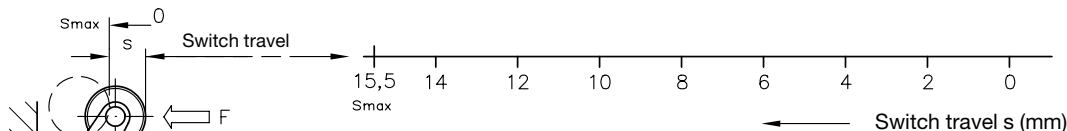
Type SD..

Notch for marking position 0



Type SK.. SKR..

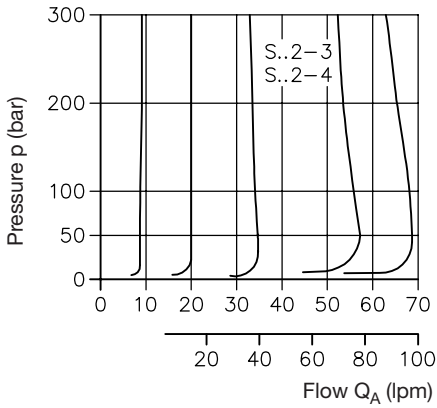
Operating force F (basic values) at  
0 bar ... approx. 30 N  
100 bar ... approx. 44 N  
200 bar ... approx. 56 N  
300 bar ... approx. 70 N



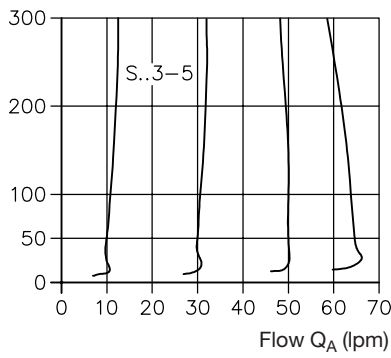
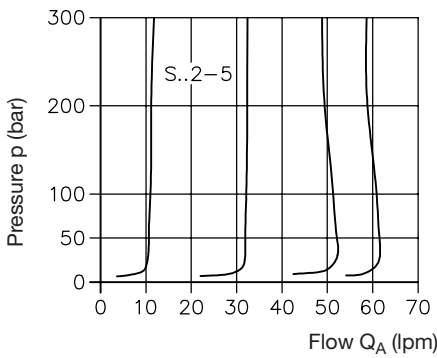
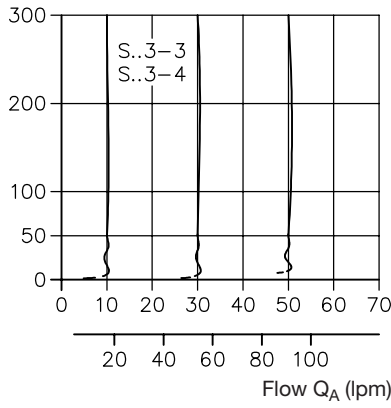
Type SU.. two fixed figures corresponding to the type coding

$\Delta p$ -Q - curves

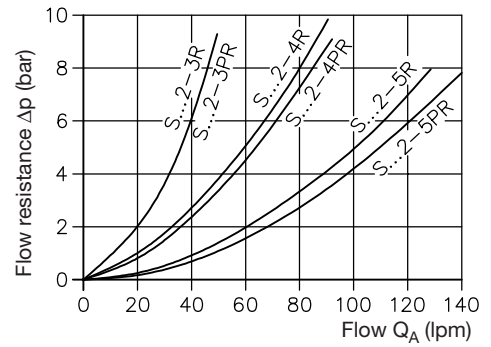
2-way flow control



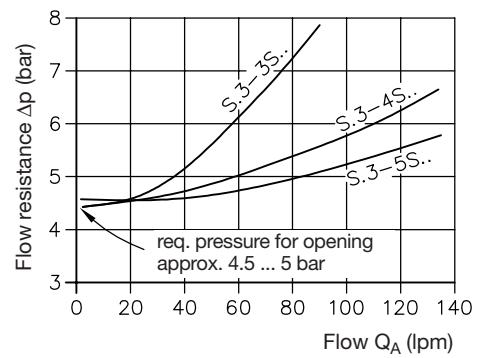
3-way flow control



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 mm<sup>2</sup>/sec

4.2 Electrical data

of the solenoid valve with type S..3-3 (4, 5) as specified in sect. 3.2 or 3.3

Solenoid	Built and tested acc. to DIN VDE 0580, wet armature sealed to outside Basic rating at P <sub>N</sub> nom. output ≈ 24.4 W ± 6% depending on nom. voltage U <sub>N</sub> and manufacturer			
Coding	G 12	G 24	WG 110	WG 230
Nom. voltage U <sub>N</sub>	12V DC	24V DC	110V AC	230V AC 50/60 Hz
Nom. current I <sub>20</sub>	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.			

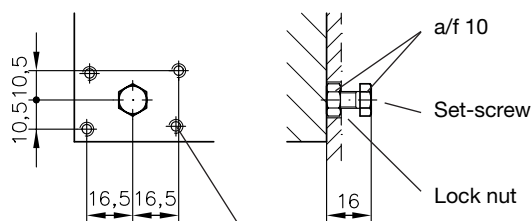
## 5. Dimensions

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

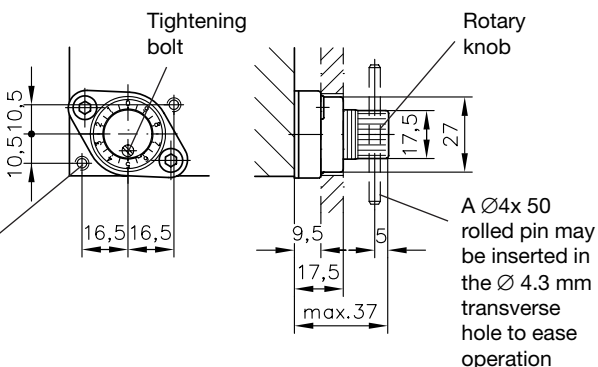
In the interest of simplicity, different drawings are provided for the adjustment versions and the valves. Just combine the individual drawings in order to obtain an drawing for the entire valve system. (See also photo on page 1).

### 5.1 Adjustment versions

#### Type SF..



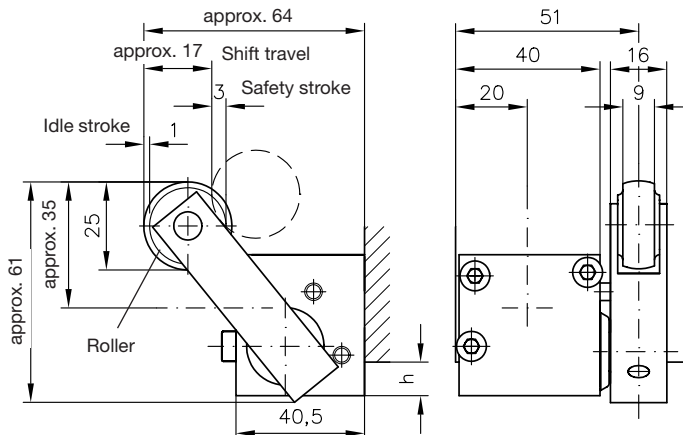
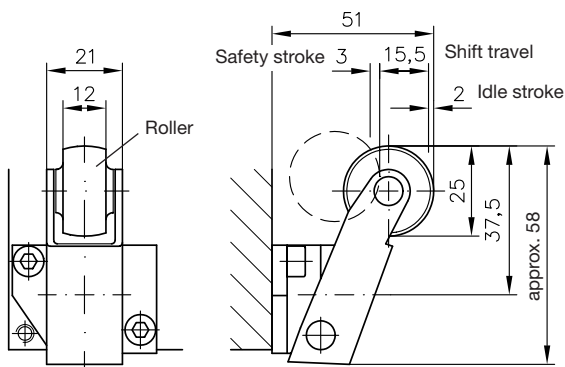
#### Type SD..



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.

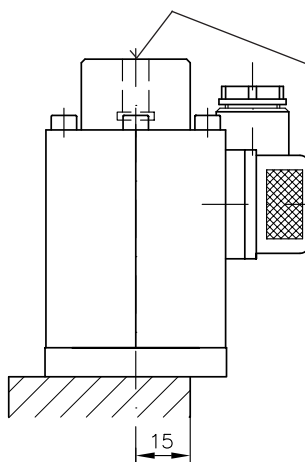
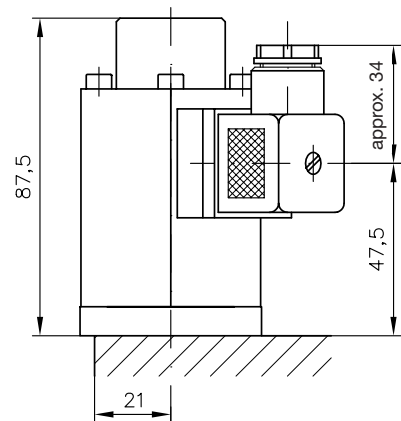
#### Type SKR..

#### Type SK..



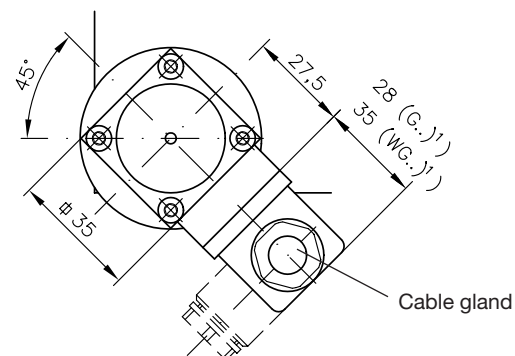
h = 9.5 (Size 3)  
13.5 (Size 4)  
2.5 (Size 5)

#### Type SU..



**Manual emergency actuation:**  
Push down the pin with an actuation aid (not sharp edged) when required.  
Actuation force  $\leq 10$  N.

Solenoid and plug may be fitted rotated by  $3 \times 90^\circ$



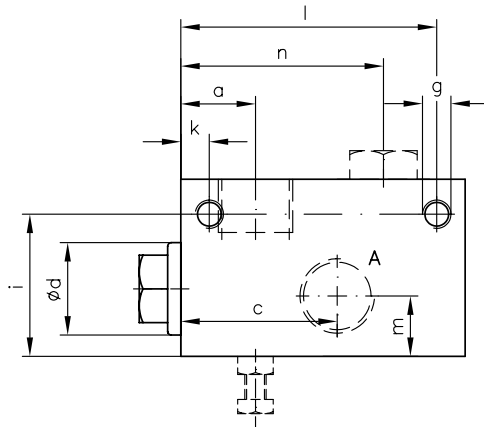
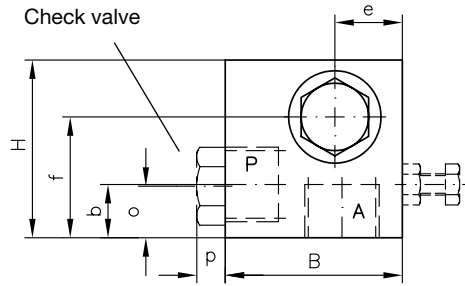
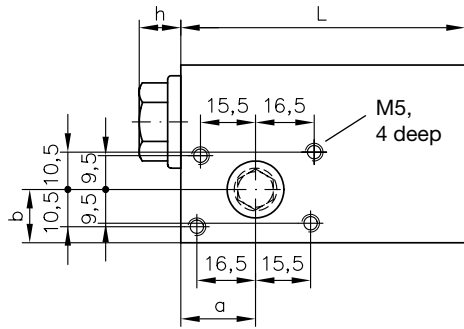
1) This dimension is depending on the manufacturer and can be max. 40 mm acc. to DIN EN 175 301-803.

## 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

Type SU 2-3...(R) acc. to sect. 3.3

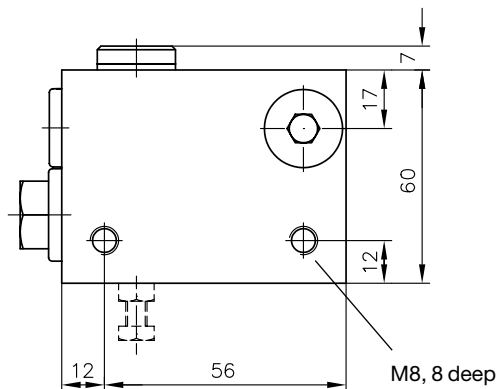
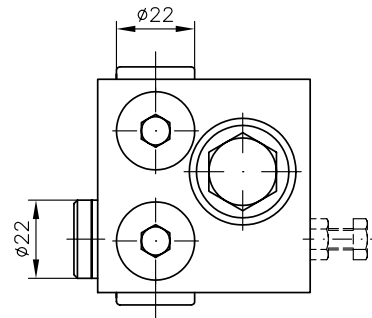
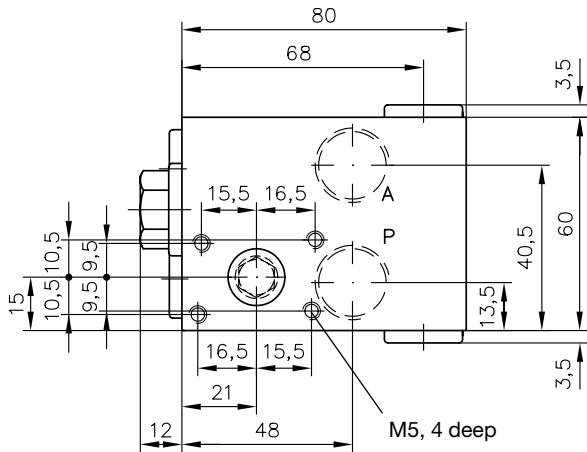


Size	Ports P and A ISO 228/1 (BSPP)									
		L	B	H	a	b	c	d	e	f
3	G 1/2	80	50	50	21	15	44	26	19	34
4	G 3/4	85	60	60	25	19	53	32	21	41
5	G 1	100	70	70	27	24	60	39	23	47

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

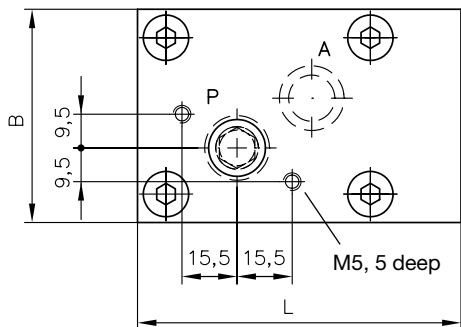
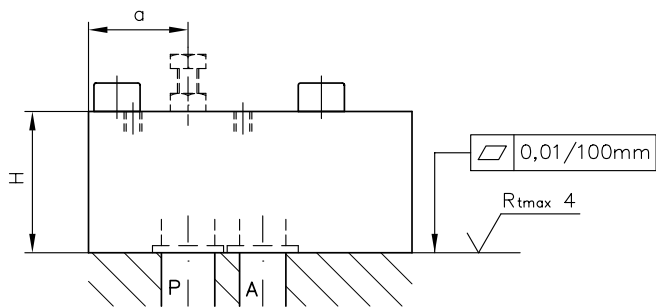
Version with tapped ports and rectifier circuit

Type S.. 2-3...B acc. to sect. 3.1 (not with type SU 2-3)

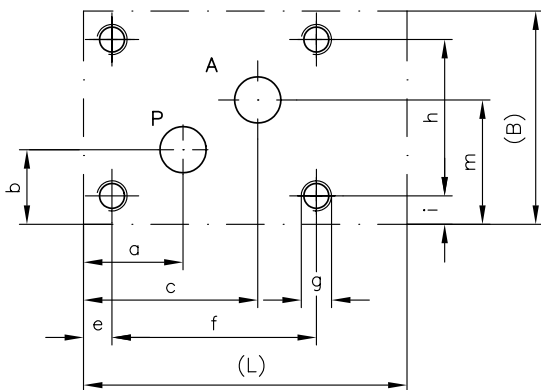




**Manifold mounting version**  
**Type S.. 2-3(4, 5)..P and S.. 2-3(4, 5)..PR (not with type SU 2-3)**



**Hole pattern of the manifold (top view)**



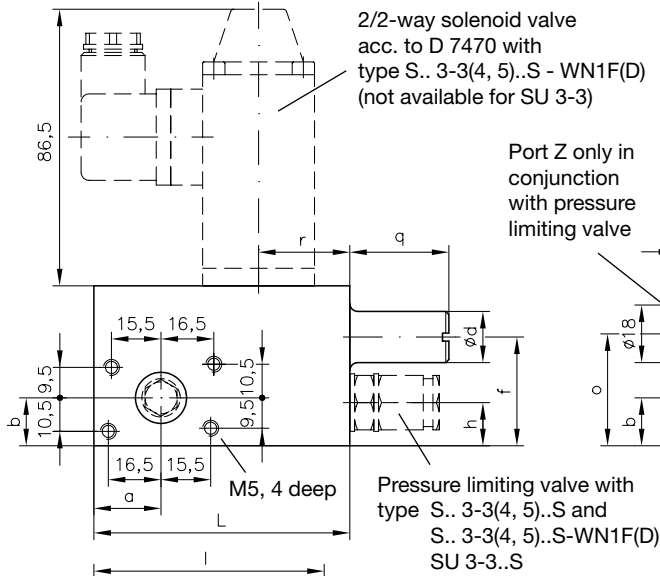
Size	L	B	H	a	b	c	e	f	g
3	93	60	40	28	21	49	8	57.5	M8, 10 deep
4	100	70	50	35	26	57	16	57	M10, 10 deep
5	106	80	50	33	28	65	9	88	M10, 10 deep

Size	Port Ø			Seals (O-ring NBR 90 Sh)			
	h	i	m	P	A		
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 and type SU 3-3...(S) acc. to sect. 3.3

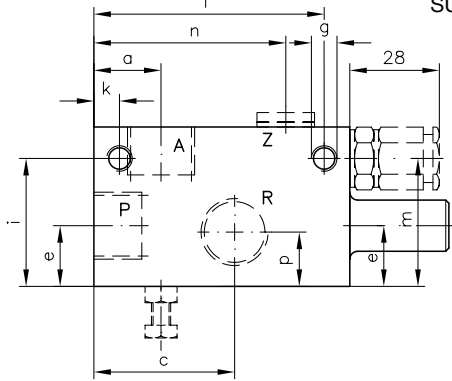


#### Adjustment of the pressure limiting valve

Pressure range	Travel $f_{max}$ (mm)	$\Delta p$ (bar) per turn
(0) ... 200 bar	4	90
200 ... 315 bar	4	150

Ports ISO 228/1 (BSPP):

Size	P, R, A	Z
3	G 1/2	G 1/4
4	G 3/4	
5	G 1	

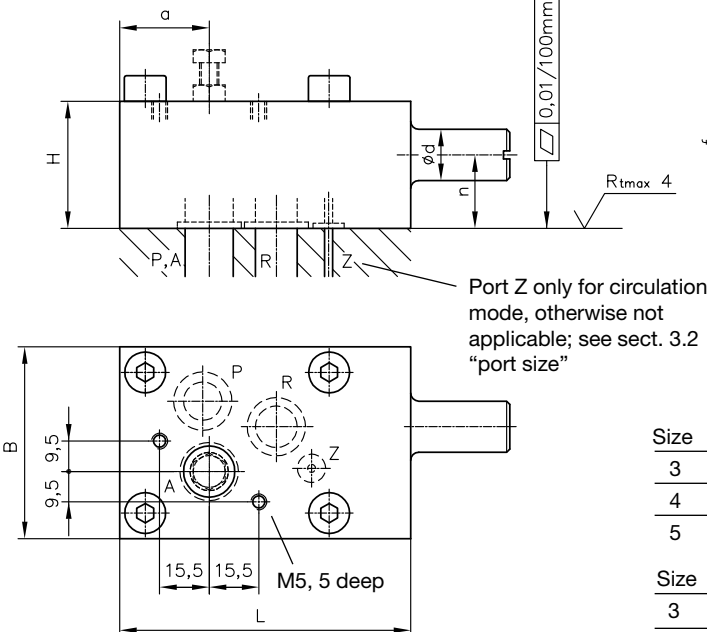
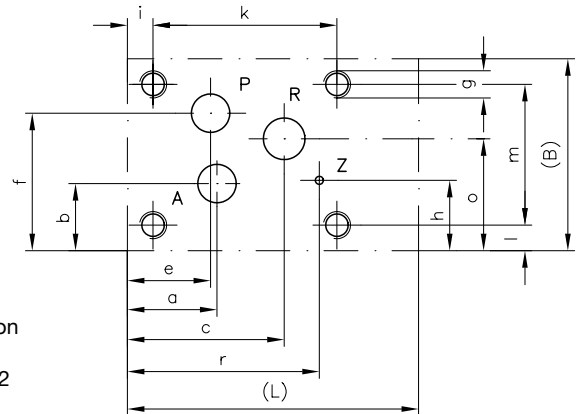


Size	L	B	H	a	b	c	d	e	f	g
3	80	50	50	21	15	44	16.5	19	34	M8, 8 deep
4	85	60	60	25	19	53	16.5	21	41	M8, 10 deep
5	100	70	70	27	24	60	24	23	47	M10, 12 deep

Size	h	i	k	l	m	n	o	p	q	r	s
3	13.5	40	8	72	40	60	35	17	31	28.5	19
4	23	48	10	75	46	55	41	21	31	28.5	21
5	22	52	20	80	55	70	47	23	30	29.5	23

#### 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

#### Adjustment of the pressure limiting valve

Pressure range	Travel $f_{max}$ (mm)	$\Delta p$ (bar) per turn
(0) ... 200 bar	6.3	40
200 ... 315 bar	4.5	95

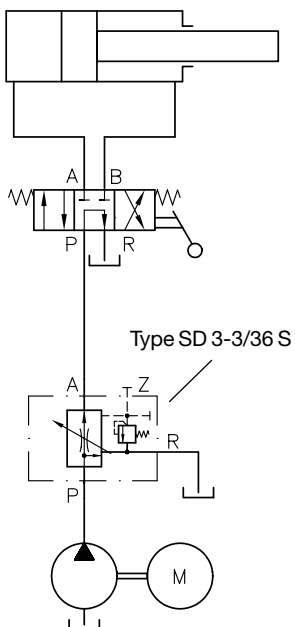
Size	Port $\varnothing$				Seals (O-ring NBR 90 Sh)		
	P, R	A	Z	P and R	A	Z	
3	12	14	4	15x2.5		6x2	
4	17		4	18.75x2.62		6x2	
5	17		4	18.75x2.62	26x3	6x2	

## 6. Appendix

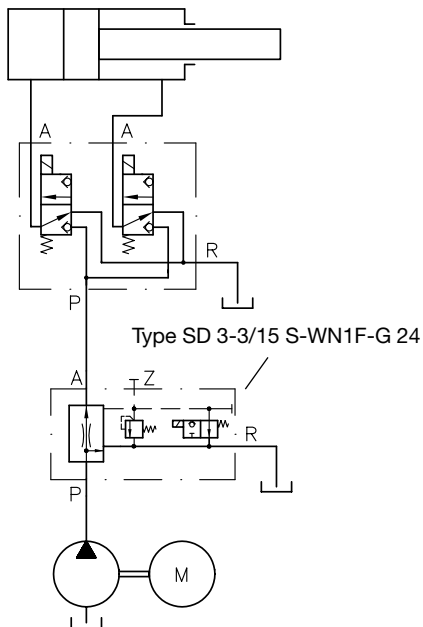
### 6.1 Typical circuitry

#### Feed control with 3-way flow control valve

Feed control with simultaneous pressure control

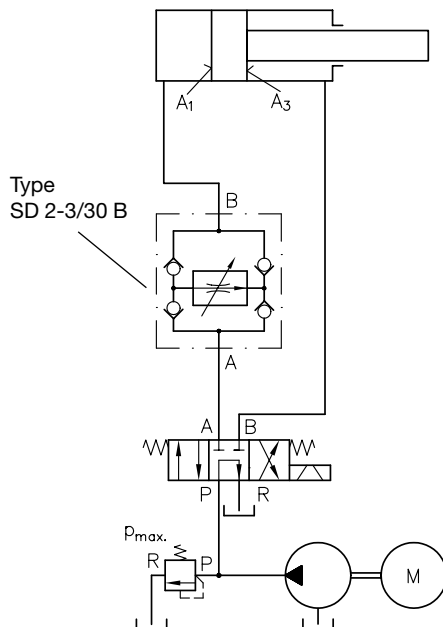


Feed control with simultaneous pressure control and idle circulation mode

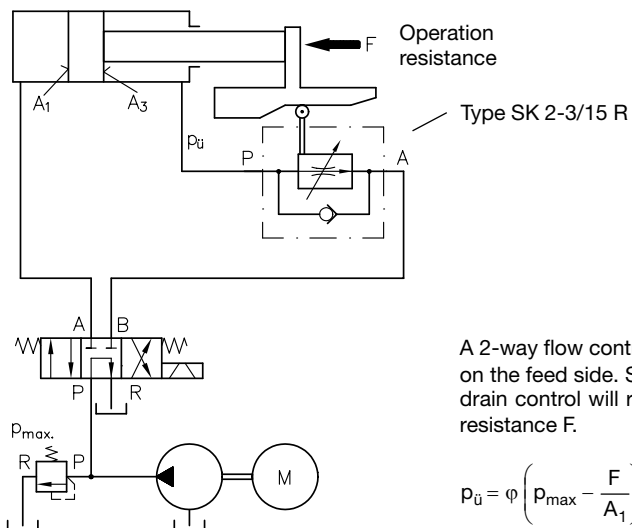


#### Speed control in both directions by rectifier circuit

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  $\varphi = A1/A3$  (see wiring diagram) be unequal, drain control will result in a pressure transmission factor depending on operating resistance F.

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

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**

**SU 2 - 3 - 25/10 - G 24**

