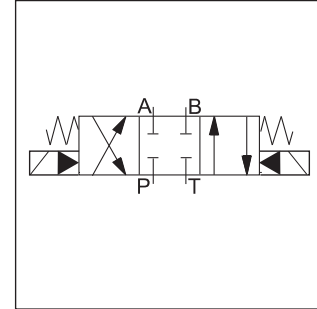
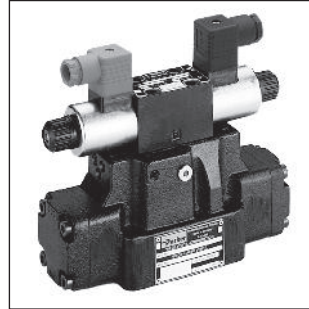


The D31, D41, D81, D91 and D111 are electrical controlled 4/3 or 4/2 way directional control valves. The valves are pilot-operated by an NG6 valve.

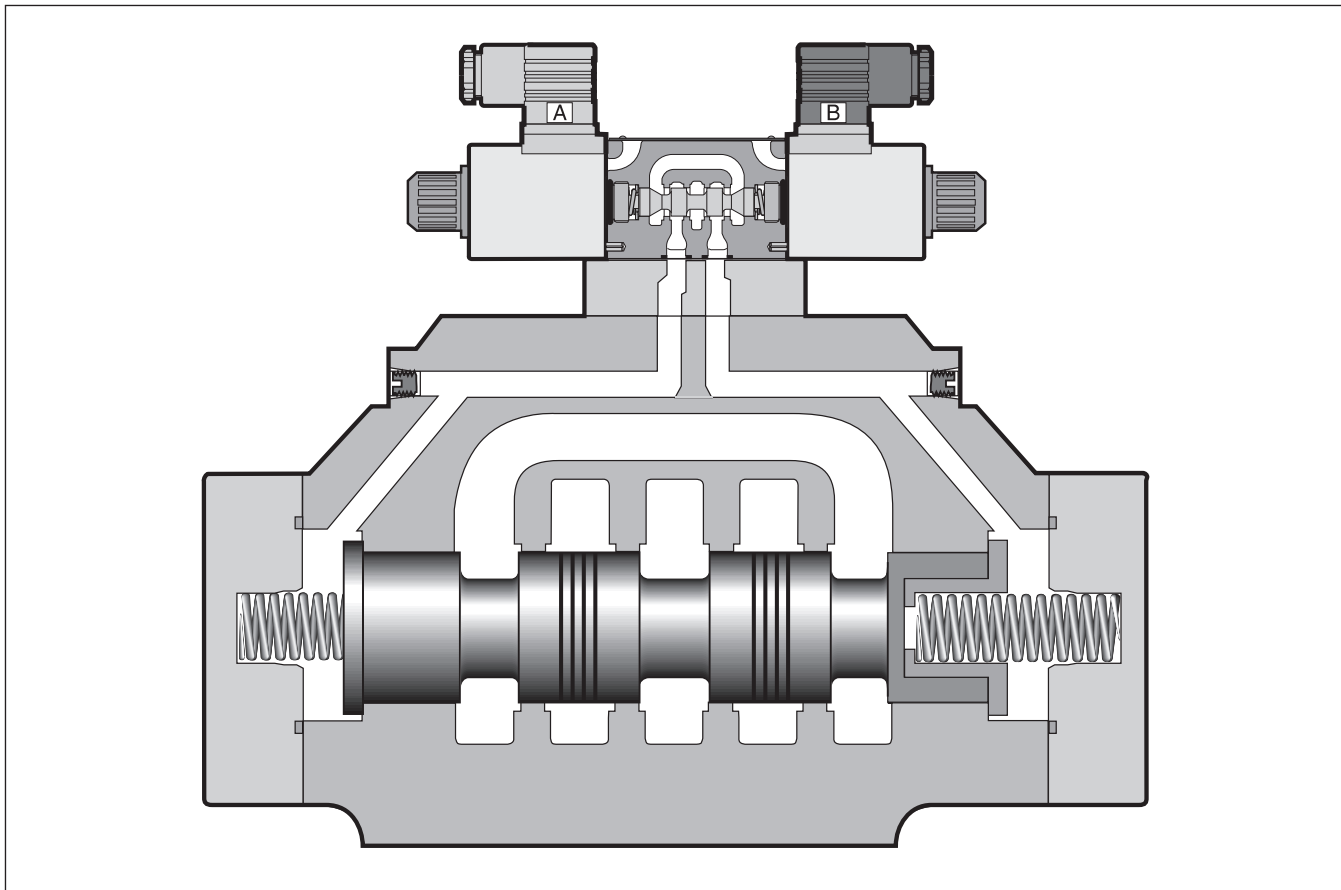
Pressure and flow of the pilot oil have a significant influence on the response time of the spool in the main stage.

In order to guarantee a save switching of the spool please choose the appropriate pilot oil supply and drain option. (Spools with a connection P to T need an external pressure supply or an integral check valve. For spools with negative cross-over position are the same options recommended.)

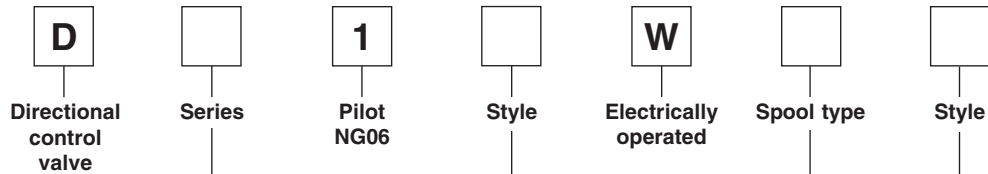
The minimum pilot pressure must be ensured for all operating condition of the directional valve.



2



2



Code	Bore	Size
3	Ø11mm	NG10
4	Ø20mm	NG16
8	Ø26mm	NG25
9	Ø32mm	NG25
11	Ø50mm	NG32

Code	Style
D	D3
V	D4, D8/9, D111

3 position spools	
Code	Spool type
1 ¹⁾	
2 ¹⁾	
3 ²⁾	
4 ²⁾	
5 ²⁾	
6 ²⁾	
7 ²⁾	
11 ²⁾	
14 ²⁾	
15 ²⁾	
16 ²⁾	
21 ²⁾	
22 ²⁾	
31 ⁴⁾	
32 ⁴⁾	
54 ³⁾	
81 ¹⁾	
82 ¹⁾	

3 position spools	
Code	Spool type
9 ¹⁾	

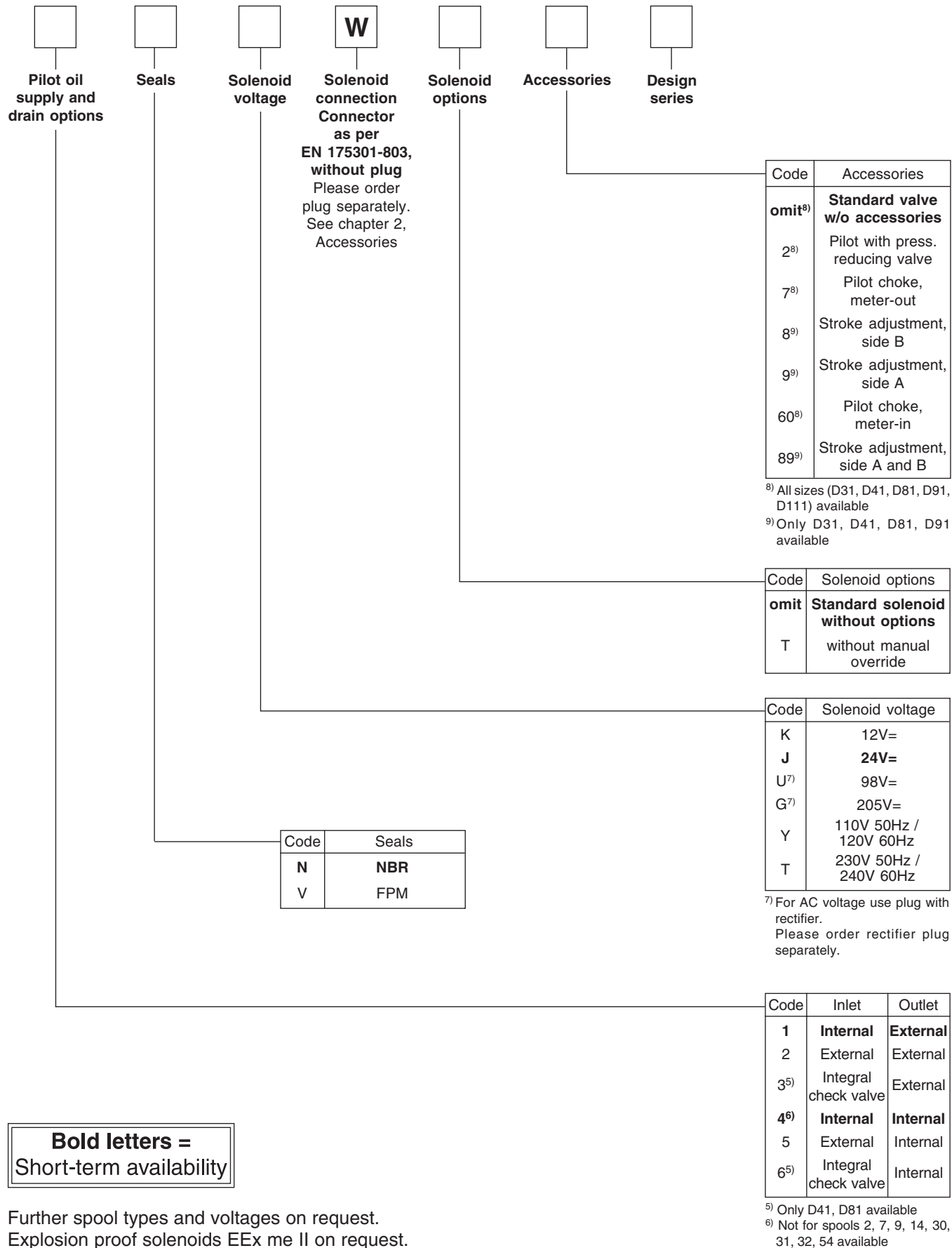
2 position spools	
Code	Spool type
20 ¹⁾	
26 ²⁾	
30 ¹⁾	

1) All sizes (D31, D41, D81, D91, D111) available
 2) Only D31, D41, D81, D91 available
 3) Only D41, D81, D91, D111 available
 4) Only D31, D81, D91 available

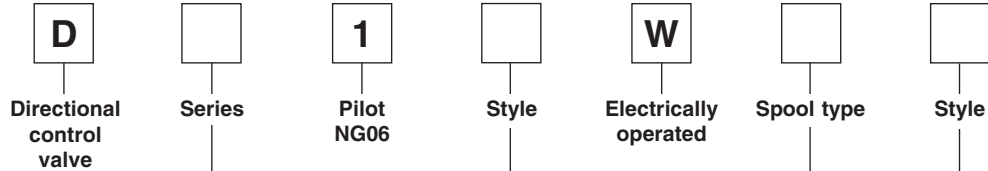
3 position spools (except spool 9)	
Code	Description
C ¹⁾	 3 positions. Spring offset in position "0". Operated in position "a" or "b".
E ¹⁾	 2 positions. Spring offset in position "0". Operated in position "a".
F ¹⁾	 2 positions. Spring offset in position "b". Operated in position "0".
K ¹⁾	 2 positions. Spring offset in position "0". Operated in position "b".
M ¹⁾	 2 positions. Spring offset in position "a". Operated in position "0".
R ²⁾	 2 positions, detent. Operated in position "0" or "b". No centre or offset position.
S ²⁾	 2 positions, detent. Operated in position "0" or "a". No centre or offset position.

3 position spools (only for spool 9)	
Code	Description
C ¹⁾	 3 positions. Spring offset in position "0". Operated in position "a" or "b".
E ¹⁾	 2 positions. Spring offset in position "0". Operated in position "b".
F ¹⁾	 2 positions. Spring offset in position "a". Operated in position "0".
K ¹⁾	 2 positions. Spring offset in position "0". Operated in position "a".
M ¹⁾	 2 positions. Spring offset in position "b". Operated in position "0".
R ²⁾	 2 positions, detent. Operated in position "0" or "a". No centre or offset position.
S ²⁾	 2 positions, detent. Operated in position "0" or "b". No centre or offset position.

2 position spools	
Code	Description
B ¹⁾	 Spring offset in position "b". Operated in position "a".
D ²⁾	 Detent, operated in position "a" or "b". No centre or offset position.
H ¹⁾	 Spring offset in position "a". Operated in position "b".



2



Code	Bore	Size
3	Ø11mm	NG10
4	Ø20mm	NG16
8	Ø26mm	NG25
9	Ø32mm	NG25
11	Ø50mm	NG32

Code	Style
D	D3
V	D4, D8/9, D111

3 position spools	
Code	Spool type
1 ¹⁾	
2 ⁴⁾	
3 ²⁾	
4 ²⁾	
7 ⁴⁾	
11 ⁴⁾	
14 ⁴⁾	
15 ²⁾	

3 position spools	
Code	Spool type
9 ³⁾	

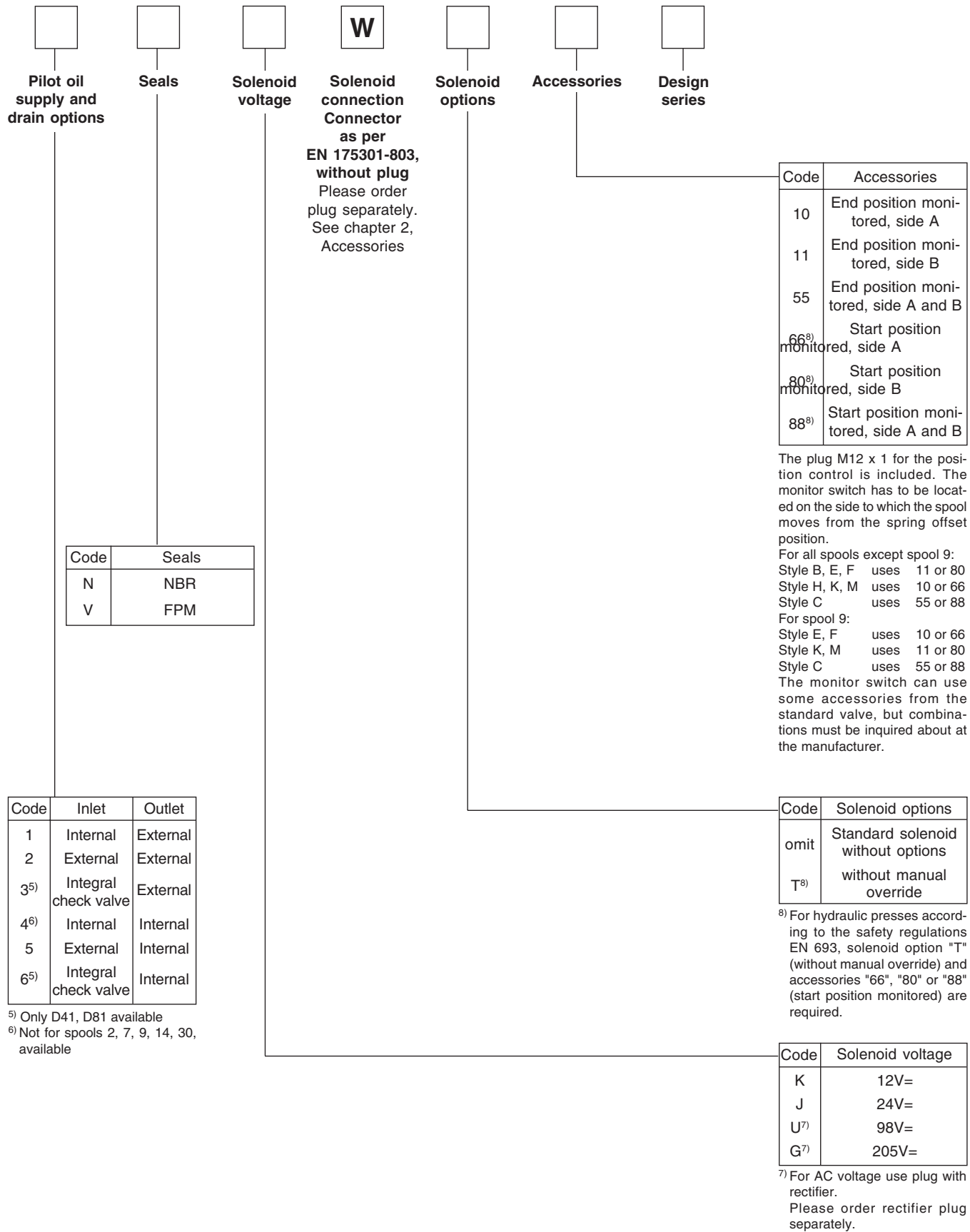
2 position spools	
Code	Spool type
20 ³⁾	
30 ⁴⁾	

¹⁾ All sizes (D31, D41, D81, D91, D111) available
²⁾ Only D31, D41, D81, D91 available
³⁾ Only D41, D81, D91, D111 available
⁴⁾ Only D41, D81, D91 available

3 position spools (except spool 9)	
Code	Description
C ¹⁾	3 positions. Spring offset in position "0". Operated in position "a" or "b".
E ¹⁾	2 positions. Spring offset in position "0". Operated in position "a".
F ²⁾	2 positions. Spring offset in position "b". Operated in position "0".
K ¹⁾	2 positions. Spring offset in position "0". Operated in position "b".
M ²⁾	2 positions. Spring offset in position "a". Operated in position "0".

3 position spools (only for spool 9)	
Code	Description
C ¹⁾	3 positions. Spring offset in position "0". Operated in position "a" or "b".
E ¹⁾	2 positions. Spring offset in position "0". Operated in position "b".
F ²⁾	2 positions. Spring offset in position "a". Operated in position "0".
K ¹⁾	2 positions. Spring offset in position "0". Operated in position "a".
M ²⁾	2 positions. Spring offset in position "b". Operated in position "0".

2 position spools	
Code	Description
B ¹⁾	2 positions. Spring offset in position "b". Operated in position "a".
H ¹⁾	2 positions. Spring offset in position "a". Operated in position "b".



2

2

General		Directional spool valve Solenoid					
Design							
Actuation							
Series		D31	D41	D81/91	D111		
Size		NG10	NG16	NG16	NG25	NG32	
Weight (1/ 2 solenoids)	[kg]	6.0 / 6.6	9.7 / 10.3	17.9 / 18.6	17.9 / 18.6	67.4 / 68.0	
Mounting interface		DIN 24340 A10 ISO 4401 NFPA D05	DIN 24340 A16 ISO 4401 NFPA D07	DIN 24340 A25 ISO 4401 NFPA D08	DIN 24340 A25 ISO 4401 NFPA D08	DIN 24340 A32 ISO 4401 NFPA D10	
		CETOP RP 121-H					
Mounting position		Unrestricted, preferably horizontal					
Ambient temperature	[°C]	-25...+50					
Hydraulic							
Max. operating pressure	[bar]	Pilot drain internal: P, A B, X: 350; T, Y: 105 Pilot drain external: P, A B, T, X: 350; Y: 105 Hydraulic oil in accordance with DIN 51524 / 51525					
Fluid							
Fluid temperature	[°C]	-25 ... +70					
Viscosity permitted	[mm ² /s]	2.8...400 (2.8...400 cSt)					
Viscosity recommended	[mm ² /s]	30...80					
Filtration		ISO 4406 (1999); 18/16/13 (meet NAS 1638: 7)					
Flow max.	[l/min]	150	300	700	700	2000	
Leakage at 350 bar (per flow path) *depending on spool	[ml/min]	up to 100*	up to 200*	up to 800*	up to 800*	up to 5000*	
Opening pressure integral check valve	[bar]	n.a.	see p/Q diagram	see p/Q diagram	see p/Q diagram	n.a.	
Minimum pilot supply pressure	[bar]	5					
Static / Dynamic							
Step response at 95%	[ms]	Energized / De-energized					
DC solenoids	Pilot pressure	50 bar	60 / 40	95 / 65	150 / 170	470 / 390	
		100 bar	55 / 40	75 / 65	110 / 170	320 / 390	
		250 bar	55 / 40	60 / 65	90 / 170	210 / 390	
		350 bar	55 / 40	60 / 65	85 / 170	200 / 390	
AC solenoids	Pilot pressure	50 bar	40 / 30	75 / 55	130 / 155	450 / 375	
		100 bar	35 / 30	65 / 55	90 / 155	300 / 375	
		250 bar	35 / 30	40 / 55	70 / 155	190 / 375	
		350 bar	35 / 30	40 / 55	65 / 155	180 / 375	
Electrical characteristics							
Duty ratio		100% ED; CAUTION: coil temperature up to 150 °C possible					
Protection class		IP 65 in accordance with DIN 40050 (plugged and mounted)					
Supply voltage / ripple	Code [V]	K 12 VDC	J 24 VDC	U 98 VDC	G 205 VDC	Y 110V at 50Hz/ 120V at 60Hz	T 230V at 50Hz/ 240V at 60Hz
Tolerance supply voltage	[%]	±10	±10	±10	±10	±5	±5
Current consumption	hold [A]	2.5	1.25	0.31	0.15	0.58 / 0.49	0.31 / 0.26
Current consumption	in rush [A]	2.5	1.25	0.31	0.15	2.1 / 2.0	1.05 / 1.0
Power consumption	hold [W]	30	30	30	30	64 / 59 VA	68 / 62 VA
Power consumption	in rush [W]	30	30	30	30	231 / 240 VA	231 / 240 VA
Solenoid connection		Connector as per EN 175301-803, solenoid identification as per ISO 9461.					
Wiring min.	[mm ²]	3 x 1.5 recommended					
Wiring length max.	[m]	50 recommended					

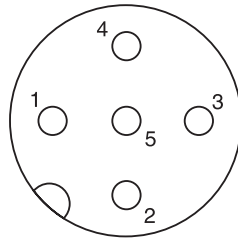
With electrical connections the protective conductor (PE ⚡) must be connected according to the relevant regulations.

Electrical characteristics of position control M12x1

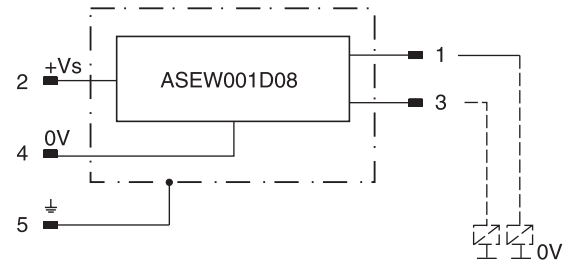
Protection class		IP 65 in accordance with DIN 40050 (plugged and mounted)
Ambient temperature	[°C]	0...+50
Supply voltage / ripple	[V]	18...42 / 10%
Current consumption without load	[A]	≤ 30
Max. output current per channel, ohmic	[mA]	400
Min. output load per channel, ohmic	[kOhm]	100
Max. output drop at 0.2A	[V]	≤ 1.1
Max. output drop at 0.4A	[V]	≤ 1.6
EMC		EN50081-1 / EN50082-2
Max. tolerance ambient field strength	[A/m]	<1200
Min. distance to next AC solenoid	[m]	>0.1
Interface		M12x1
Wiring min.	[mm ²]	5 x 0.25 brad shield recommended
Wiring length max.	[m]	50 recommended

2

M12 pin assignment



- 1 Normally open
- 2 + Supply 18...42V
- 3 Normally closed
- 4 0V
- 5 Earth ground



Definitions

Start position monitored:

The valve is de-energized. The inductive switch gives a signal at the moment (below 15% spool stroke) when the spool leaves the spring offset position.

End position monitored:

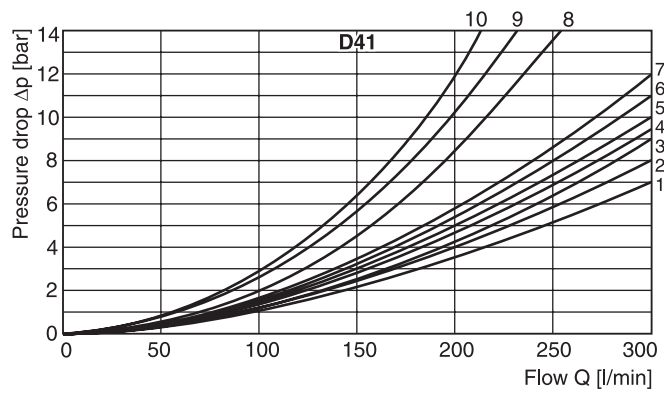
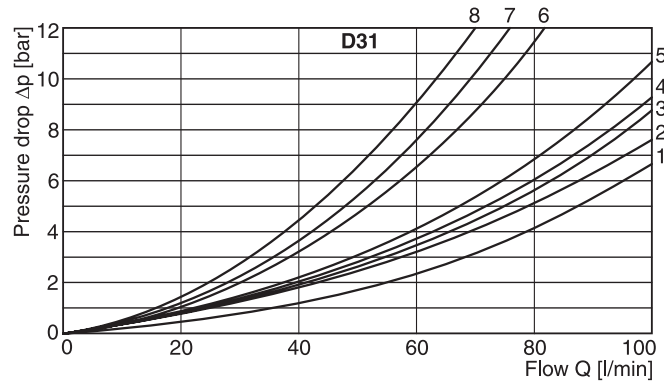
The inductive switch gives a signal before ending the stroke (above 85% spool stroke).

The flow diagrams shows the flow versus pressure drop curves for all spools. To read the values in the diagram, the

curve number for the selected spool and desired operating position must be determined from the table below first.

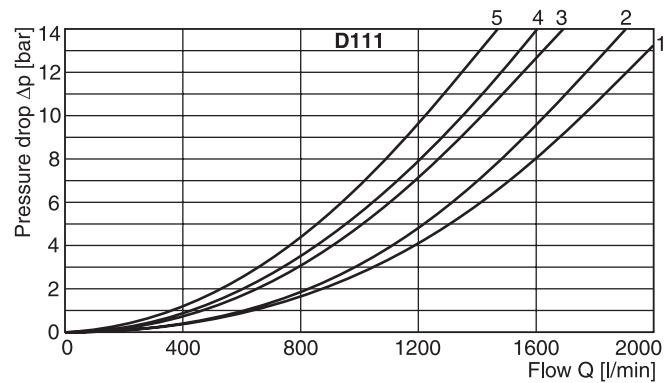
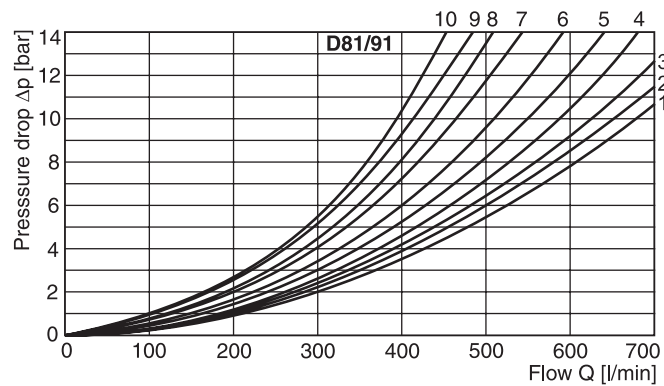
D31 and D41

Spool Code	Curve number									
	P-A		P-B		P-T		A-T		B-T	
	D3	D4	D3	D4	D3	D4	D3	D4	D3	D4
1	3	1	3	1	-	-	1	4	1	5
2	3	1	3	2	4	6	1	4	1	6
3	3	1	4	2	-	-	1	5	1	6
4	3	1	3	1	-	-	1	5	1	5
5	3	2	4	2	-	-	1	3	1	5
6	3	1	3	2	-	-	1	3	1	6
7	4	1	3	1	-	6	1	4	1	5
9	3	2	3	9	8	8	1	7	1	10
11	3	1	3	1	-	-	1	4	1	5
14	3	1	4	1	-	6	1	4	1	5
15	4	1	3	2	-	-	1	4	1	6
16	4	2	3	2	-	-	1	3	1	5
20	3	3	4	5	-	-	1	3	1	5
21	4	2	3	8	-	-	1	2	-	-
22	3	8	4	2	-	-	-	-	1	3
26	3	3	3	5	-	-	-	-	-	-
30	3	2	1	3	-	-	1	6	1	7
54	-	2	-	3	-	-	-	6	-	7



D81/D91 and D111

Spool Code	Curve number									
	P-A		P-B		P-T		A-T		B-T	
	D8/9	D11	D8/9	D11	D8/9	D11	D8/9	D11	D8/9	D11
1	3	5	2	5	-	-	3	4	5	1
2	2	5	1	5	1	5	3	4	5	1
3	4	-	2	-	-	-	3	-	6	-
4	4	-	3	-	-	-	3	-	5	-
5	1	-	2	-	-	-	4	-	5	-
6	2	-	2	-	-	-	4	-	6	-
7	3	-	1	-	7	-	3	-	5	-
9	4	3	8	3	9	2	4	3	10	1
11	3	-	2	-	-	-	3	-	5	-
14	1	-	2	-	8	-	3	-	5	-
15	3	-	3	-	-	-	4	-	5	-
16	3	-	3	-	-	-	4	-	5	-
20	6	5	5	5	-	-	6	3	8	1
21	5	-	10	-	-	-	3	-	-	-
22	10	-	5	-	-	-	-	-	5	-
26	6	-	5	-	-	-	-	-	-	-
30	3	5	2	5	-	-	3	4	5	1
54	4	5	3	5	-	-	3	4	5	1



D3-D11.PMD RH



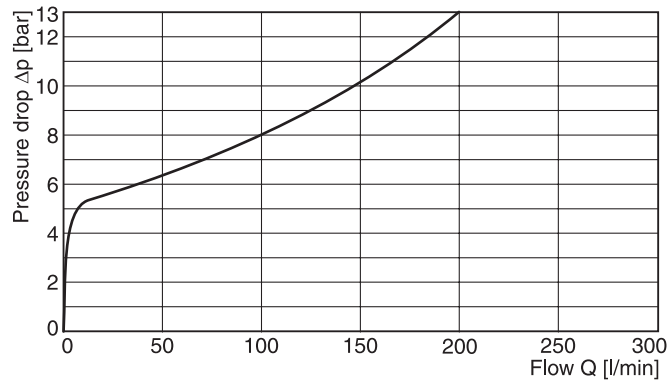
2

Integral check valve in the P port

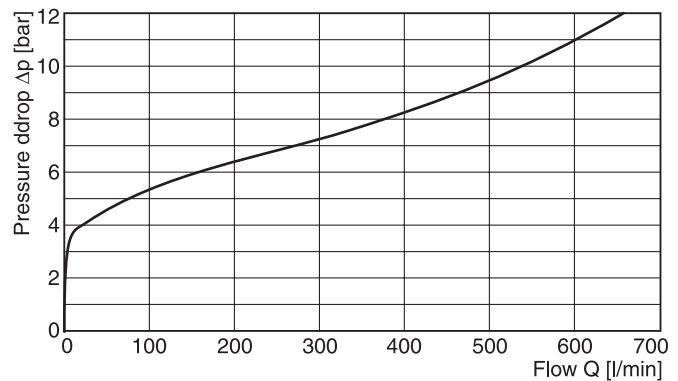
Mounting an integral check valve in the P port is necessary to build up the minimal pilot pressure for valves with P to T connection and internal pilot oil supply. The pressure difference at the integral check valve (see per-

formance curves) is to be added to all flow curves of the P-port of the main valve. Directional valves with an integral check valve are available for the series D41 and D81.

Flow curve D41



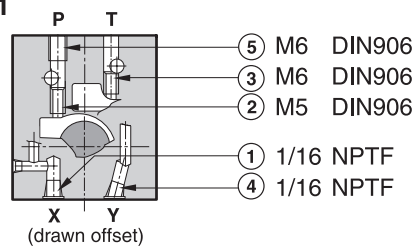
Flow curve D81



2

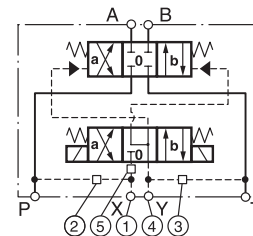
Pilot oil inlet (supply) and outlet (drain)

Series D31

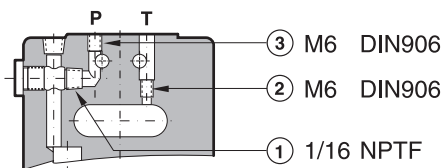


○ open, ● closed

Pilot oil		1	2	3	4	5
Inlet	Outlet					
internal	external	●	○	●	○	Orifice Ø1.2
external	external	○	●	●	○	Orifice Ø1.2
internal	internal	●	○	○	●	Orifice Ø1.2
external	internal	○	●	○	●	Orifice Ø1.2

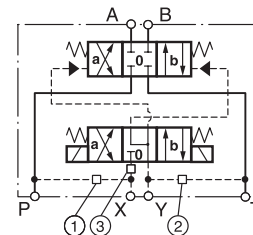


Series D41

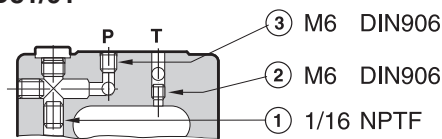


○ open, ● closed

Pilot oil		1	2	3
Inlet	Outlet			
internal	external	○	●	Orifice Ø1.5
external	external	●	●	Orifice Ø1.5
internal	internal	○	○	Orifice Ø1.5
external	internal	●	○	Orifice Ø1.5

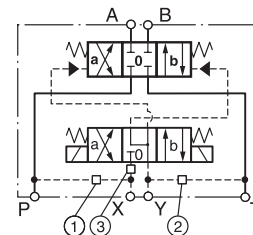


Series D81/91

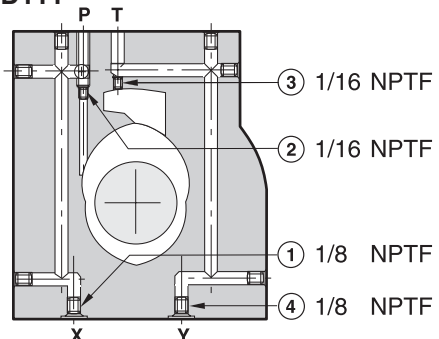


○ open, ● closed

Pilot oil		1	2	3
Inlet	Outlet			
internal	external	○	●	Orifice Ø1.5
external	external	●	●	Orifice Ø1.5
internal	internal	○	○	Orifice Ø1.5
external	internal	●	○	Orifice Ø1.5

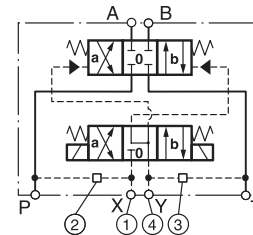


Series D111



○ open, ● closed

Pilot oil		1	2	3	4
Inlet	Outlet				
internal	external	●	Orifice Ø1.5	●	○
external	external	Orifice Ø1.5	●	●	○
internal	internal	●	Orifice Ø1.5	○	●
external	internal	Orifice Ø1.5	●	○	●

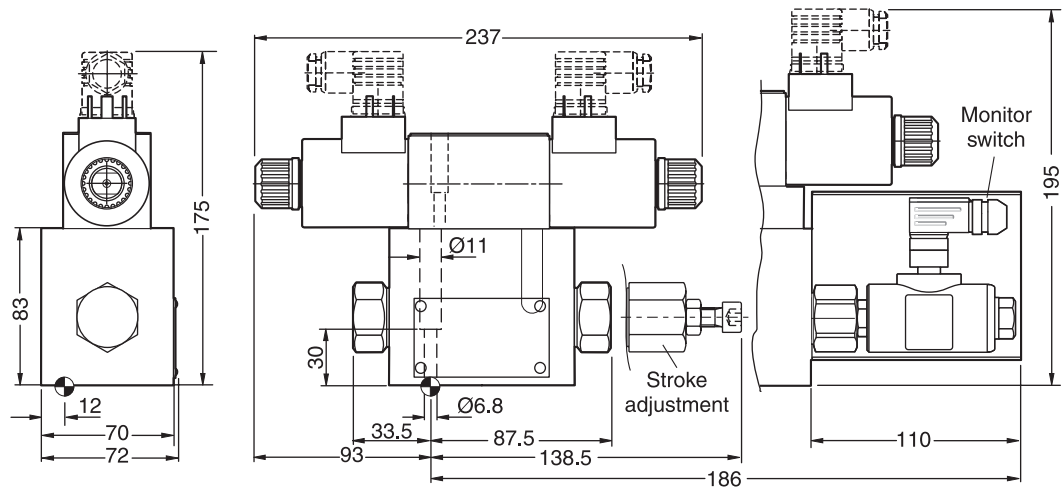


All orifice sizes for standard valves

D3-D11.PMD RH

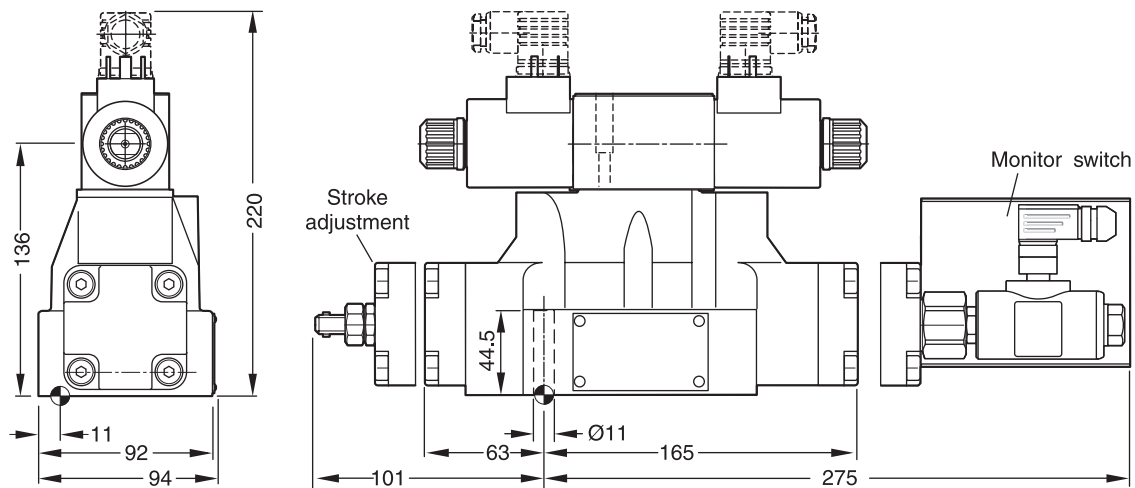
D31DW

2



Surface finish	Kit	Kit	Kit	Kit
	BK385	4x M6x40 DIN 912 12.9	11 Nm ± 15%	NBR: SK-D31DW-75 FPM: SK-D31DW-V75

D41VW



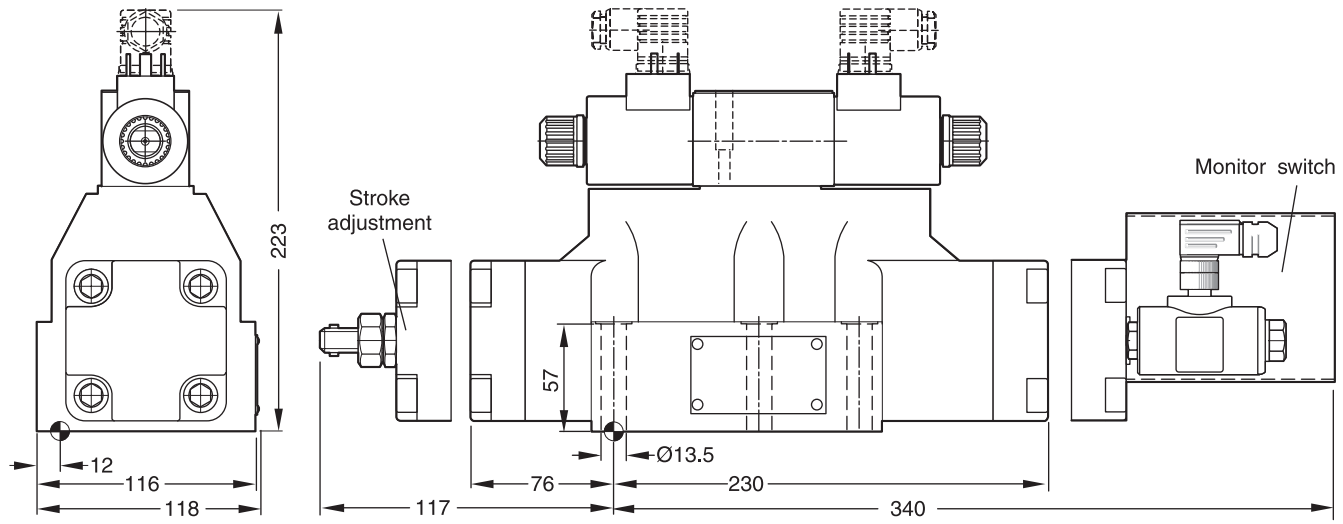
Surface finish	Kit	Kit	Kit	Kit
	BK320	4x M10x60 2 x M6x55 DIN 912 12.9	54 Nm ± 15% 11 Nm ± 15%	NBR: SK-D41VW-70 FPM: SK-D41VW-V70

The space necessary to remove the plug per EN 175301-803, design type AF is at least 15 mm.
 The torque for the screw M3 of the plug has to be 0.5 to 0.6 Nm.



D3-D11.PMD RH

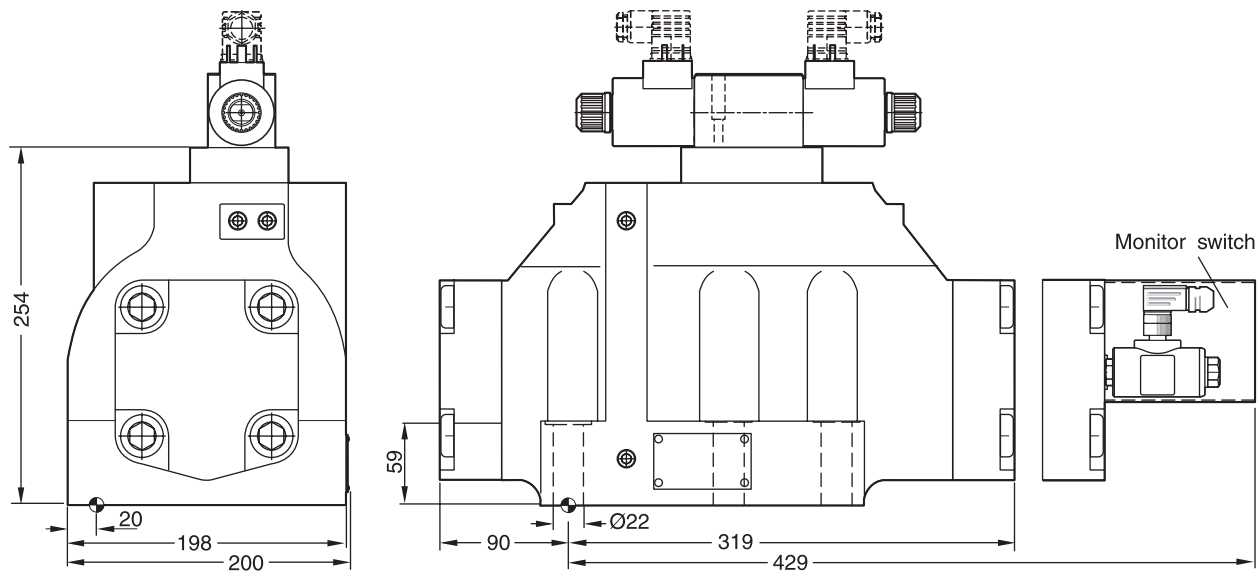
D81VW



2

Surface finish	Kit	Kit	Kit	Kit
$\sqrt{R_{max} 6.3}$ $\square 0.01/100$	BK360	6 x M12x75 DIN 912 12.9	94 Nm \pm 15%	NBR: SK-D81VW-70 / SK-D91VW-70 FPM: SK-D81VW-V70 / SK-D91VW-V70

D111VW



Surface finish	Kit	Kit	Kit	Kit
$\sqrt{R_{max} 6.3}$ $\square 0.01/100$	BK386	6 x M20x90 DIN 912 12.9	460 Nm \pm 15%	NBR: SK-D111VW-70 FPM: SK-D111VW-V70

The space necessary to remove the plug per EN 175301-803, design type AF is at least 15 mm.
 The torque for the screw M3 of the plug has to be 0.5 to 0.6 Nm.



D3-D11.PMD RH

