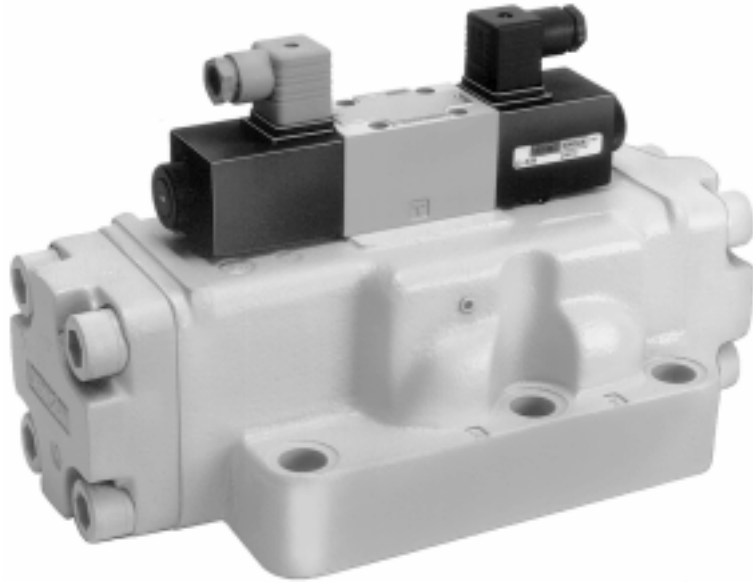
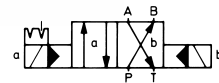


**Directional Control Valve
CETOP 10****Series 2D10**

Example:



2D10-3(5)-C03-04-03

Features

- direct or pilot operated directional control valve with solenoid, lever, stem or hydraulic operation.
- with or without manual override for solenoid operated valves.
- 6 standard spools.
- Mounting configuration according to CETOP, ISO and DIN.
- Spring centering, pressure centering or spring offset for spool return to neutral position, or detent version for mechanical operation.
- Wet pin solenoids for direct or alternating current.
- leakproof construction up to 140 bars.
- Solenoid coil can be positioned at 90° intervals in relation to body.
- Shifting time adjustment.
- Electrical connection is by a standard plug-in connector according to DIN 43650.
- Orifice to reduce the pilot oil flow.
- End position control by proximity switch.
- Normal position control by inductive detector.
- high shifting performance.
- smooth shifting-resulting in extended life.
- easy assembly – no dynamic loaded seals.
- each valve is factory tested prior to delivery.
- full interchangeability of spools with close tolerances.
- worldwide Denison-Service.

Item	Characteristics	Symbol of quantity	Symbol of SI unit	Technical data		
1.	General					
1.1	Type of unit	-	-	Directional Control Valve		
1.2	Model number	-	-	Refer to ordering code pages 4, 5, 6		
1.3	Design	-	-	Sliding spool valve		
1.4	Type of mounting	-	-	Subplate		
1.5	Type of port connections	-	-	Threads in subplate		
1.6	Port sizes	-	-	1 1/2" nominal		
1.7	Dimensions of unit	-	mm	Refer to pages 8-14		
1.8	Weight	-	kg	Refer to pages 8-14		
1.9	Mounting position	-	-	Optional but horizontal recommended		
1.10	Direction of flow	-	-	Refer to page 7		
1.11	Ambient temperature range	θ	°C	- 20 min		
		θ	°C	+ 50 max		
1.12	Suitability for special working conditions	-	-	Further information required		
2.	Hydraulic Characteristics					
2.1	Operating pressure range: Inlet (A, B, P, X) Outlet (T, Y)	p_i max p_o max	bar	350 350 for ext. drain; 140 for int. drain		
2.2	Fluid temperature range	θ	°C	- 18 min		
		θ	°C	+ 80 max		
2.3	Viscosity range	ν min ν max	cSt	10 650		
2.3.1	Recomm. operating viscosity	ν_n	cSt	30		
2.4	Max. flow	q_v	l/min	800 (refer to page 7) For pressure centred version more than 800 l/min dependent on allowable system pressure drop.		
2.5	Δp -Q-Characteristics	$\Delta p = f(q_v)$	-	Refer to page 5		
2.6	Permissible drain pressure	p_i	bar	140 (solenoid operation)		
2.6.1	Leakage max.	-	ml/min	1900...6900 (depends on spool type)		
2.7	Overlap, underlap	-	-	Refer to spool type page 7		
3.	Type of actuator					
3.1	Manual (Lever)	-	-			
3.1.2	Operating force	F	N	65 at lever		
3.1.5	Position of actuators	-	-	"B" end		
3.2	Mechanical	-	-	Stem		
3.2.1	Total linear movement	l	mm	34.8		
3.2.2	Operating force	F_{max}	N	600		
3.3	Electric	-	-	by solenoids		
3.3.1	Nominal voltage	U_n	V	Refer to ordering code pages 4 and 5		
	Permissible voltage difference		%	+ 5 - 10		
3.3.2	Type of current	-	-	Alternating current (AC) or direct current (DC)		
3.3.3	Input power	P_{20}	W	31		
3.3.4	Relative operating period	OP_{rel}	%	100		
3.3.5	Type of protection	-	-	IP 65		
3.4	Hydraulically	-	-			
3.4.1	Operating pressure range	p_p min p_p max	bar	~ 10 (spring offset) ~ 10...15 (pressure centred) 350		
3.4.2	Spool displacement	V	ml	33.3		
3.4.3	Connections	-	-	X, Y		
3.4.4	Port sizes X, Y, L (subplate)	-	-	G 1/4"		
4.	Response times (solenoid)			AC	DC	DC-quick energizing *
4.1	Energizing	t_e	ms	20	46	30
4.2	De-energizing	t_a	ms	18	27	30
If the performance characteristics outlined above do not meet your requirements, please consult your local Denison Office.						* double voltage

Description

The Denison 2D10 is a direct or pilot operated spool valve controlled by solenoids, lever, hydraulic pressure or stem. Subplate or manifold mounting is standard. The 2D10 is used for directing fluid flow in hydraulic systems.

The necessary pilot pressure for the pilot operated versions can be obtained from system pressure or from a separate pilot pressure source. Operational life is improved by the use of wet pin solenoids which are immersed in the system fluid and assist heat dissipation. The solenoids are available with a built in manual override device, and they are continuously rated for standard AC-or-DC supply.

Valves with manual override on the pilot control can also be operated mechanically in case of power failure. Electrical connection is by a standard plug-in connector.

Manual or stem operated valves are available with detents to hold the spool in the selected position. Hydraulically operated valves may be remotely controlled by separate pilot valves.

A light weight modular design, with a short spool travel, results in a fast response. When used for rapid cycling duties the 2D10 valve offers outstanding performance. Streamlined internal passages ensure minimum pressure drop at maximum flows. All bodies are manufactured from quality controlled cast iron, with spools of high quality steel. Every valve is subjected to a closely monitored functional test before delivery.

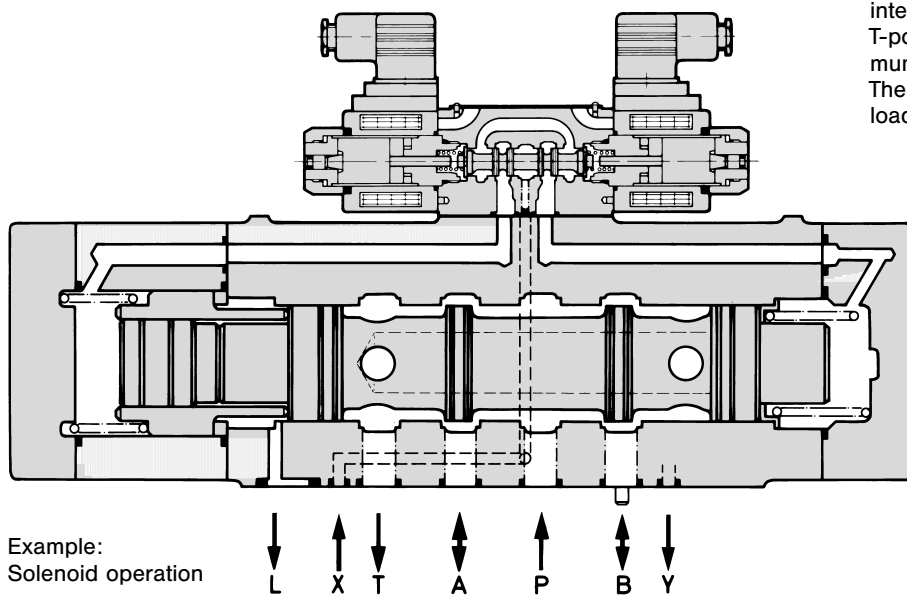
Economical manufacture to close tolerance ensures interchangeability or circuit modification without the necessity for selective assembly. This is also true for spare parts, which can be ordered independently from manufacturing sources through the world-wide service network.

For special applications, for instance fire resistant fluids or sea water protection special seal kits and solenoids are available. For applications not mentioned on the ordering code please use the free advisory service of your local Denison Office.

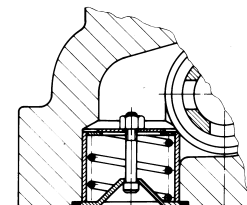
Integral Check

For valves with no-load flow (spools 01, 05, 07) and internal PP or external PD an integral check is recommended in the T-port of the main valve to obtain the minimum pilot pressure.

The integral check should not be used for load holding.



Example:
Solenoid operation



T (main valve)

Operation

The solenoid operated 4-way valve 2D10 consists of a main body with spool and a solenoid operated pilot control valve. The solenoid when energized shifts the pilot control spool, thus directing fluid to one end of the main spool, and moving it into the desired position. So fluid can pass from the main port P to the system ports A or B whilst the opposite port (B or A) is free to the tank port. De-energizing the solenoid allows both the pilot control and the main spool to return to their original positions.

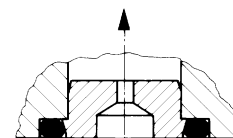
The main spool of the direct operated valves can be moved mechanically by means of a lever or stem, or hydraulically from a remote pilot source.

Pilot Valve Orifice

In certain operating conditions a higher flow-volume can take place than the valve permits.

Then an orifice is recommended in the P-port of the pilot valve.

For order details refer to pages 4 & 5 pilot accessories.



P (pilot valve)

Ordering Code 2D10 with DC-Solenoid

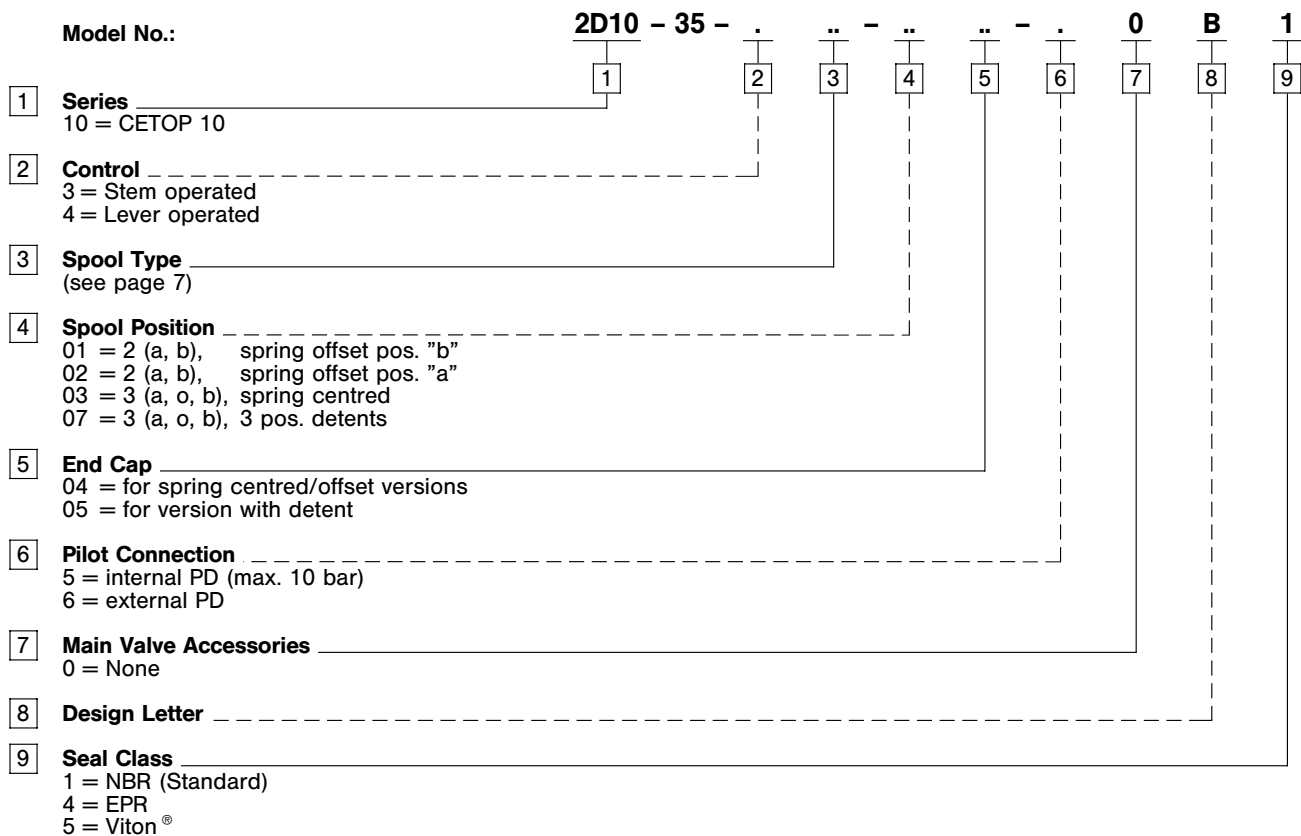
Model No.:	2D10 - 3	.	..	-	..	-	.	.	C	1	-	...	-
	1	2	3	4	5	6	7	8	9	10	11	12			
1 Series	10 = CETOP 10														
2 Control	A = Pilot operated, 1 solenoid (4D01) B = Pilot operated, 2 solenoids (4D01) C = Pilot operated, 2 solenoids (4D01) 2 pos. detent														
3 Spool Type	(see page 7)														
4 Spool Position	01 = 2 (a, b), spring offset pos. "b" 02 = 2 (a, b), spring offset pos. "a" 03 = 3 (a, o, b), pressure centred A3 = 3 (a, o, b), spring centred 04 = 2 (a, b), without spring, without detent (pilot with detent) 05 = 2 (o, b), pressure offset pos. "o" 06 = 2 (o, a), pressure offset pos. "o" 11 = 2 (b, o), spring offset pos. "b"; pos. "o" spool stop (blocked) 12 = 2 (a, o), spring offset pos. "a"; pos. "o" spool stop (blocked)														
5 End Cap	03 = for spring offset spool pos. (01/02, 11/12) and without spring (04) 06 = for pressure centred and offset spool pos. (03, 05 and 06) 0A = for spring centred spool pos. (A3) AD = with proximity switch on A-side AE = with proximity switch on B-side AF = with proximity switch on both sides SA = with inductive detector														
6 Pilot Connection	1 = internal PP, internal PD ²⁾ 2 = internal PP, external PD ¹⁾ 3 = external PP, internal PD 4 = external PP, external PD														
7 Main Valve Accessories	0 = None 1 = Shifting time adjustment (meter-in control) 2 = Shifting time adjustment (meter-out control) 4 = Integral check valve in "T" ¹⁾ 6 = Shifting time adjustment (meter-in control) & integral check in "T" ¹⁾ 8 = Shifting time adjustment (meter-out control) & integral check in "T" ¹⁾														
9 Design Letter															
Seal Class	1 = NBR (Standard) 4 = EPR 5 = Viton®														
10 Solenoid Voltage	GOR = 12 V } GOQ = 24 V } DC GOH = 48 V }														
1* Pilot Accessories / Modifications	10 = orifice 1.0 mm dia. in P-port, with manual override 1032 = orifice 1.0 mm dia. in P-port, without manual override 1052 = orifice 1.0 mm dia. in P-port, with manual override and rubber cover														

¹⁾ For valves with no-load flow and internal PP or external PD an integral check valve is recommended to obtain the minimum pilot pressure.

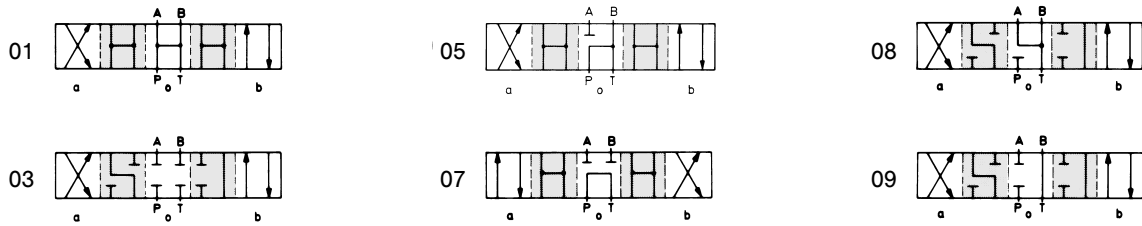
²⁾ For valves with no-load flow, internal PP and internal PD is **not** possible.

Attention: Integral check valve not to be used for load holding.

Ordering Code 2D10 Lever and Stem Operation



Spool type (with spool conditions during shifting)



for spools 01, 05 and 07 with internal PP and external PD an integral check is recommended in T.

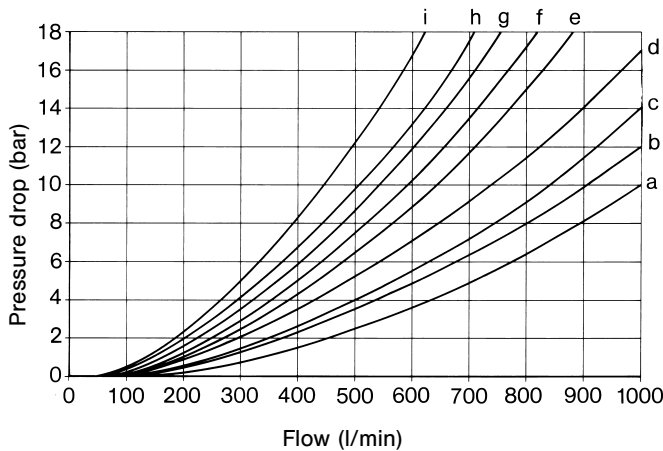
Functional Limits

The functional limits have been obtained with warm solenoid condition and at 10% undervoltage.

Spool type	Flow (l/min) at a pressure (bar) of				
	70	140	210	280	350
01, 03, 08, 09	800	800	800	700	700
05, 07	800	800	750	700	670

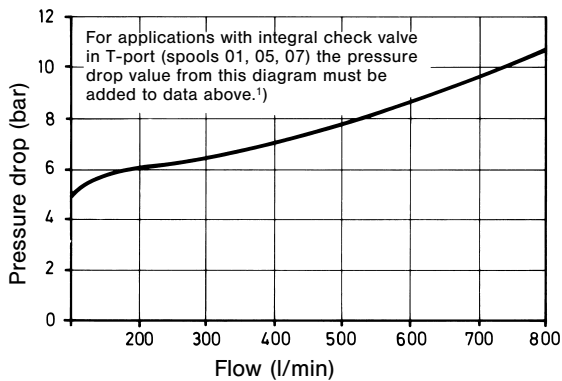
All flow data given is considered at a minimum pilot pressure of 13 bar and for 2 flow directions (e.g. from P→A and simultaneous from B→T).

Pressure drop



Spool type	Direction of flow				
	P-A	P-B	P-T	A-T	B-T
01	c	c	e	b	g
03	b	c		a	g
05	a	c	i	h	d
07	g	c	f	b	f
08	b	c		b	g
09	b	c		a	d

Integral check valve (opening pressure approx. 6 bar)



For applications with integral check valve in T-port (spools 01, 05, 07) the pressure drop value from this diagram must be added to data above.¹⁾

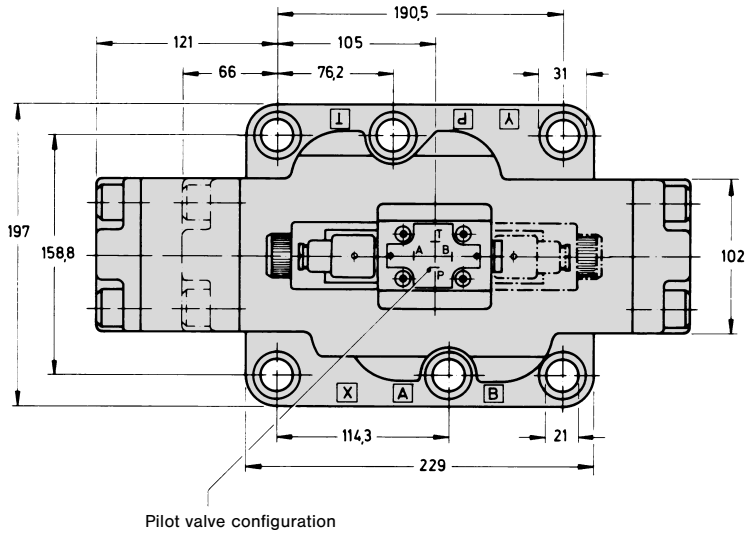
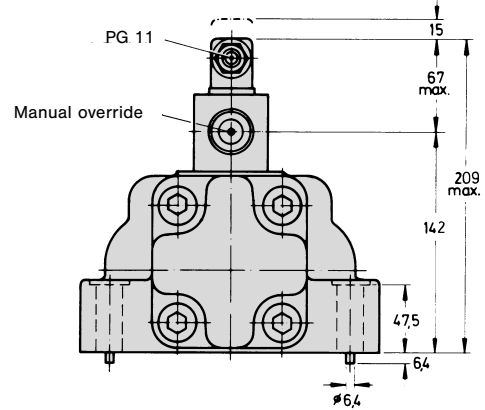
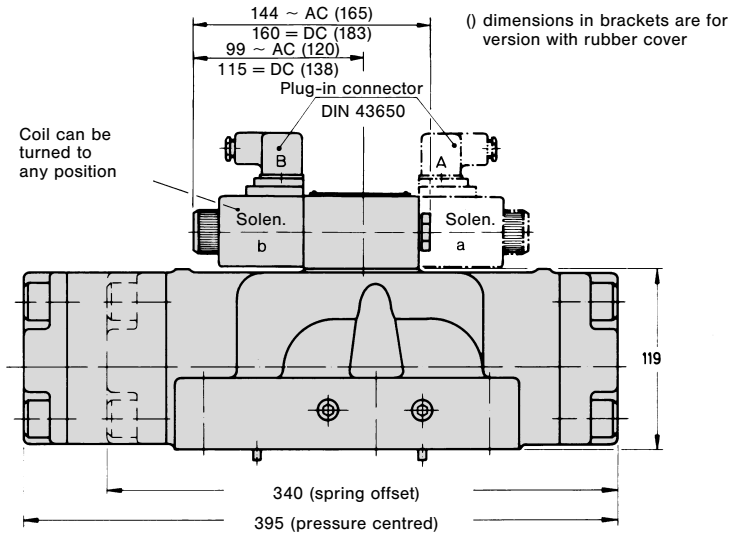
¹⁾ only for direction of flow P-T, A-T, B-T

All Performance Data given is typical and can be influenced by application.

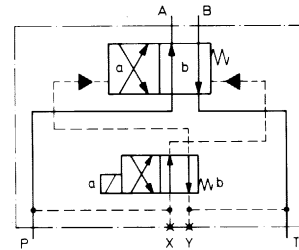
Oil temperature 50°C;
oil viscosity 36 cSt.

1 Solenoid – 2 Spool Positions – Pilot Operated

Weight: 35.5/39.5 kg



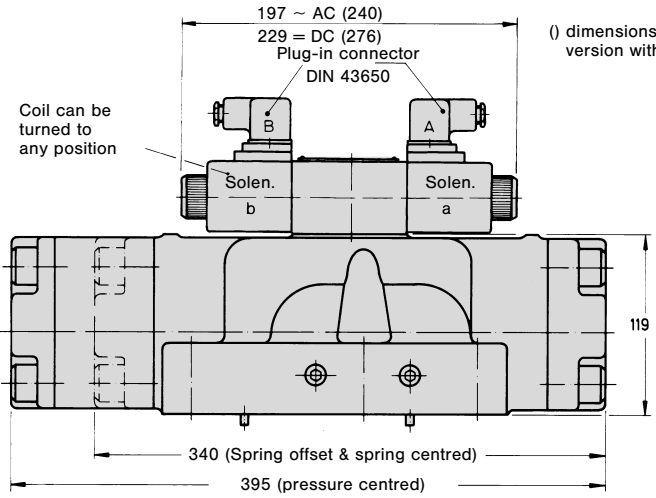
Example of Symbol detailed



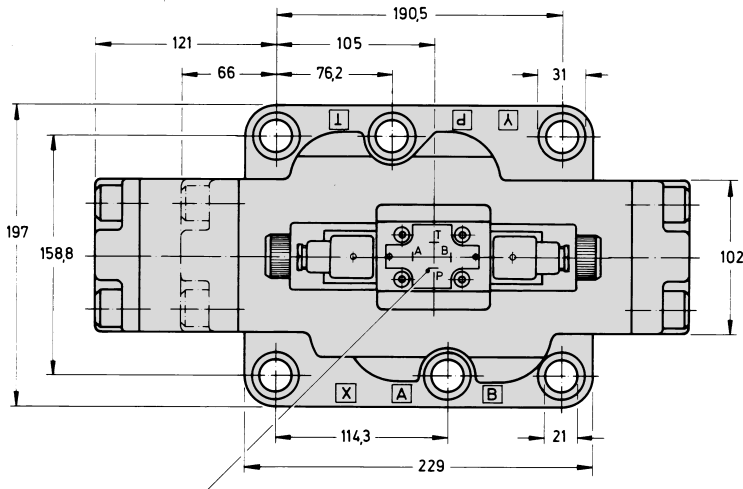
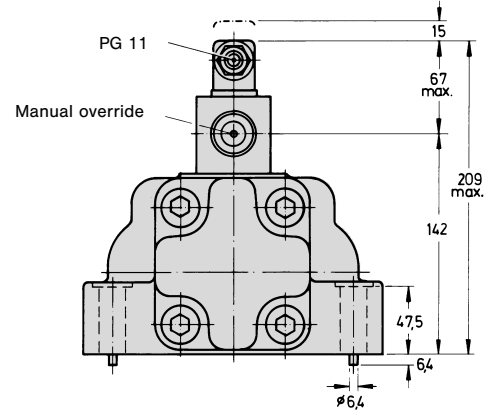
2D10-3(5)-A**-01-03-10

Symbol	Model-No.	Spool type** (also refer to page 7)	Symbol	Model-No.	Spool type** (also refer to page 7)
	2D10-3(5)-A**-01-03	01, 03		2D10-3(5)-A**-06-06	07
	2D10-3(5)-A**-02-03	01, 03		2D10-3(5)-A**-11-03	01, 03, 05, 08, 09
	2D10-3(5)-A**-05-06	01, 03, 05, 08, 09		2D10-3(5)-A**-11-03	07
	2D10-3(5)-A**-05-06	07		2D10-3(5)-A**-12-03	01, 03, 05, 08, 09
	2D10-3(5)-A**-06-06	01, 03, 05, 08, 09		2D10-3(5)-A**-12-03	07

o Symbol for neutral position depends on spool type, refer to page 7.

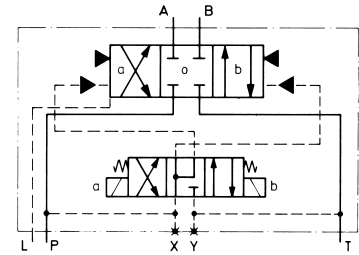


() dimensions in brackets are for version with rubber cover



Pilot valve configuration

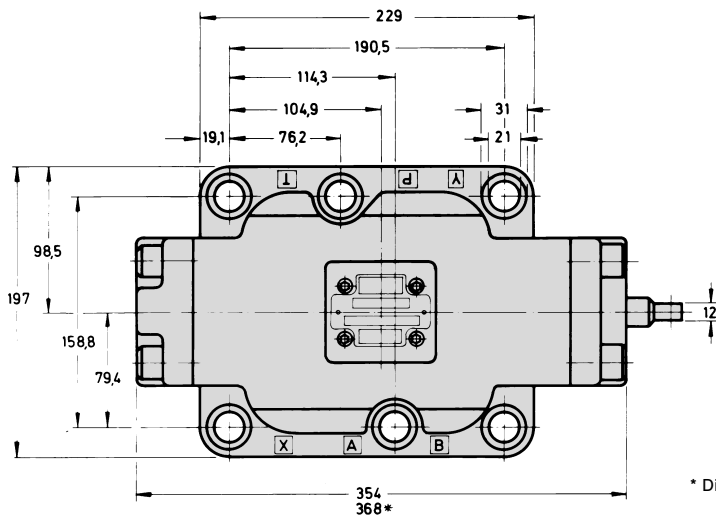
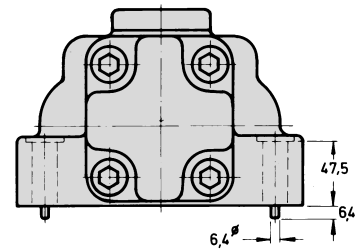
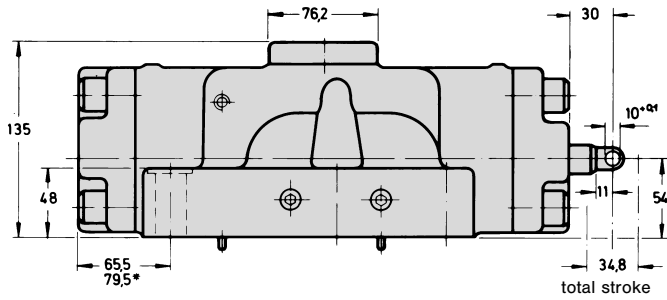
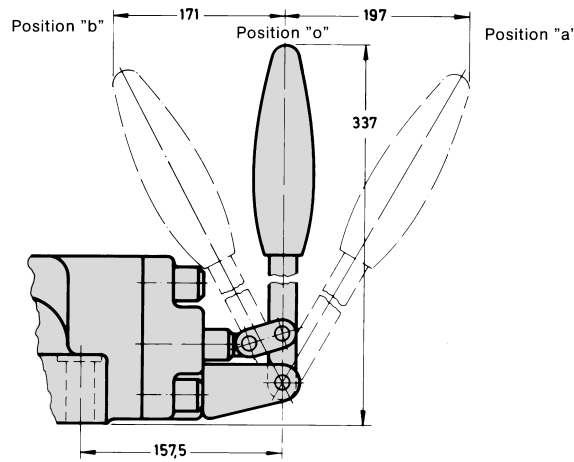
Example of Symbol detailed



2D10-3(5)-B03-03-06-10

Symbol	Model-No.	Spool type** (also refer to page 7)	Symbol	Model-No.	Spool type** (also refer to page 7)
	2D10-3(5)-B**-03-06	01, 03, 05, 08, 09		2D10-3(5)-C**-04-03	01, 03
	2D10-3(5)-B**-03-06	07		2D10-3(5)-C**-04-03	07

o Symbol for neutral position depends on spool type, refer to page 7.

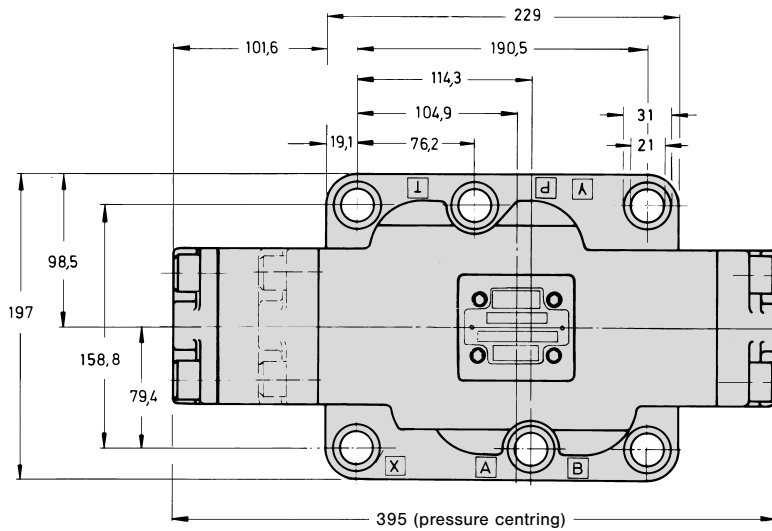
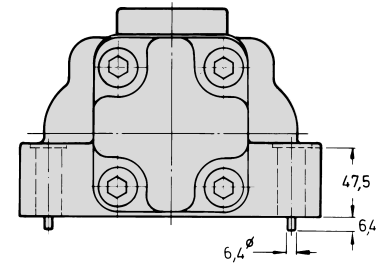
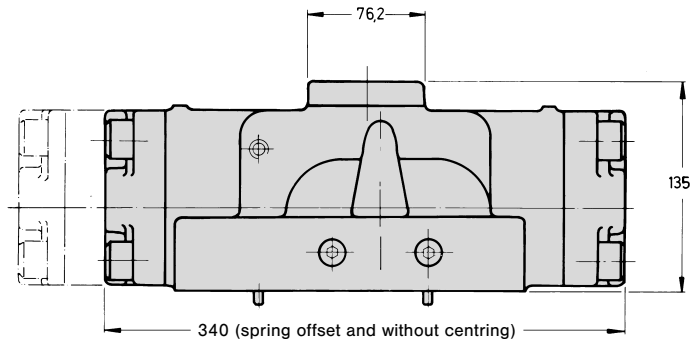


* Dimensions for detent version

Symbol	Model-No.	Spool type** (also refer to page 7)	Symbol	Model-No.	Spool type** (also refer to page 7)
	2D10-35 ³ / ₄ ** -02-04	01, 03		2D10-35 ³ / ₄ ** -07-05	07
	2D10-35 ³ / ₄ ** -03-04	01, 03, 05, 08, 09		2D10-35 ³ / ₄ ** -12-04	01, 03, 05, 08, 09
	2D10-35 ³ / ₄ ** -03-04	07		2D10-35 ³ / ₄ ** -12-04	07
	2D10-35 ³ / ₄ ** -07-05	01, 03, 05, 08, 09			

3 = Stem operation
4 = Lever operation

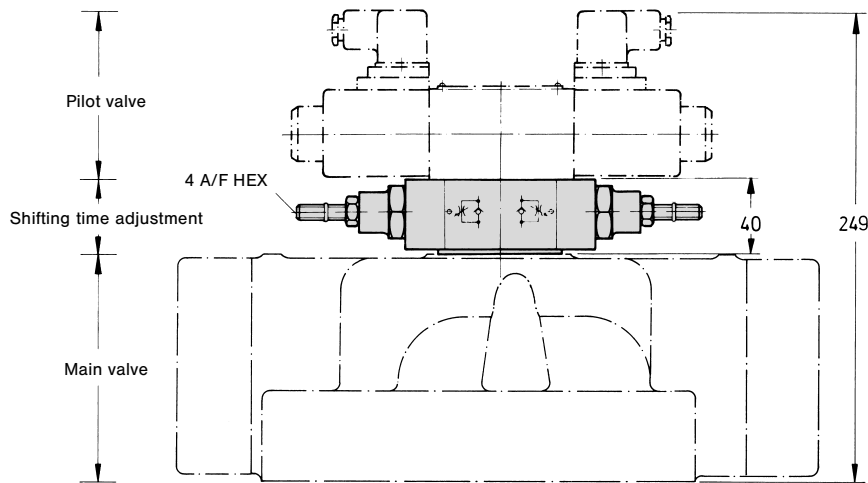
o Symbol for neutral position depends on spool type, refer to page 7.



Symbol	Model-No.	Spool type** (also refer to page 7)	Symbol	Model-No.	Spool type** (also refer to page 7)
	2D10-35-0**-01-03	01, 03		2D10-35-0**-04-03	07
	2D10-35-0**-02-03	01, 03		2D10-35-0**-11-03	01, 03, 05, 08, 09
	2D10-35-0**-03-06	01, 03, 05, 08, 09		2D10-35-0**-11-03	07
	2D10-35-0**-03-06	07		2D10-35-0**-12-03	01, 03, 05, 08, 09
	2D10-35-0**-04-03	01, 03, 05, 08, 09		2D10-35-0**-12-03	07

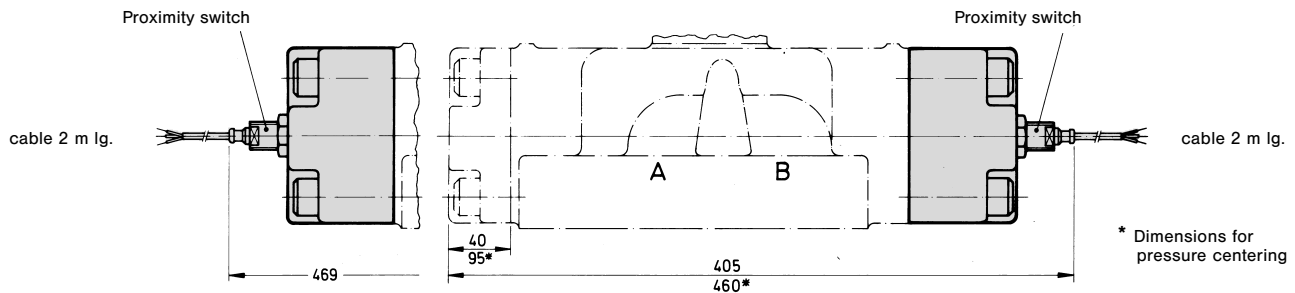
o Symbol for neutral position depends on spool type, refer to page 7.

Shifting Time Adjustment (1,2 kg)



The shifting time adjustment is affected by a double throttle valve with check, which is mounted between main and pilot valve. The illustration depicts the "meter out" control. For "meter in" invert the control.

End position control by proximity switch (incl. amplifier)



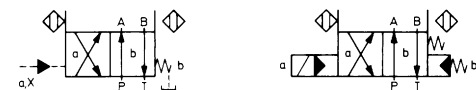
Technical Data (Proximity switch):

Function:	PNP; Contact
Supply voltage (U _S):	10...30 VDC
Supply voltage ripple:	≤ 10 %
Current consumption:	max. 8 mA
Residual voltage L-Signal:	U _S - 2.2 V at I _{max} .
Output current (I):	≤ 200 mA
Type of protection:	IP 67
Ambient temperature:	-25...+70 °C
Wire cross-sectional area:	3 x 0.5 mm ²

Please note:

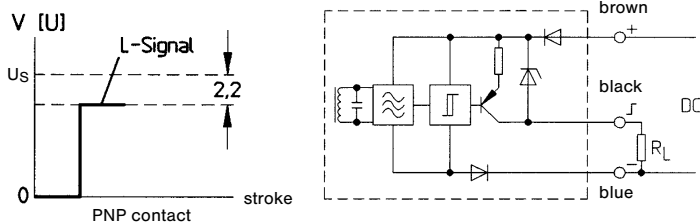
1. The proximity switch always controls the opposite spool position.
2. The proximity switch is not possible on mechanically operated valves.
On valves with pressure centering it is only possible on B-side.

Example of Symbols:



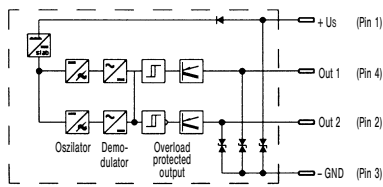
End Cap with Proximity Switch:

AD = Proximity switch on A-side
 AE = Proximity switch on B-side
 AF = Proximity switch on both sides

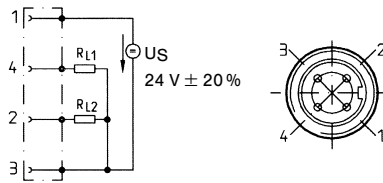


Neutral Position Control by Inductive Detector

Block diagram and connection of the inductive detector



Socket connector

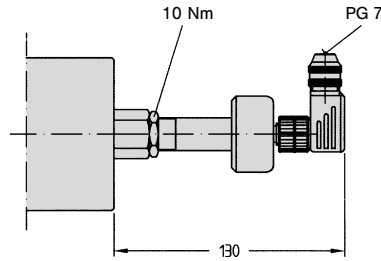


RL1, RL2 = e. g. coil resistance of the switch relay $\geq 60 \Omega$

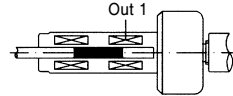
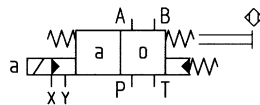
- Function
 - Supply voltage U_s (full wave bridge with capacitor)
 - Reverse polarity protection
 - Ripple voltage
 - Current consumption
 - Outputs
- P-channel FET, contact positive
 $24 V \pm 20\%$ (19.2 V...28.8 V)
 max. 300 V installed
 10%
 approx. 20 mA each circuit
- Out 1: NC contact positive (not short circuit protection)
 Out 2: NO contact positive
 $U_s - 2.5 V$
 $< 1.8 V$
 $< 400 mA$ at $U_s + 20\%$
 IP 65
 $0^\circ C \dots + 85^\circ C$
 $4 \times 0.5 mm^2$
 p dyn 140 bar
 00 02 002 9 93

Attention:

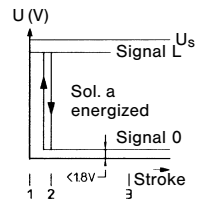
EMC only ensured when using screened cables and screened plug casing!



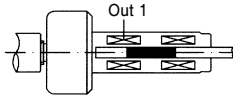
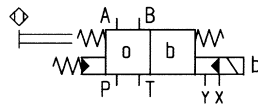
2D10-3(5) A..06SA



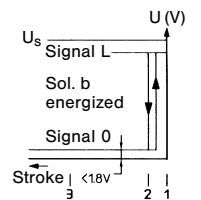
Neutral Pos.: Out 1 = L
 Sol. energized: Out 1 = 0



2D10-3(5) A..05SA

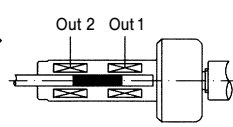
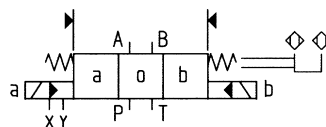


Sol. energized: Out 1 = 0
 Neutral Pos.: Out 1 = L

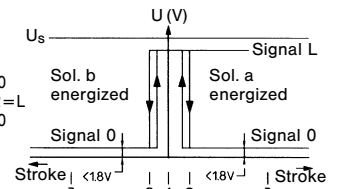


2D10-3(5) B..03SA

2D10-3(5) B..A3SA

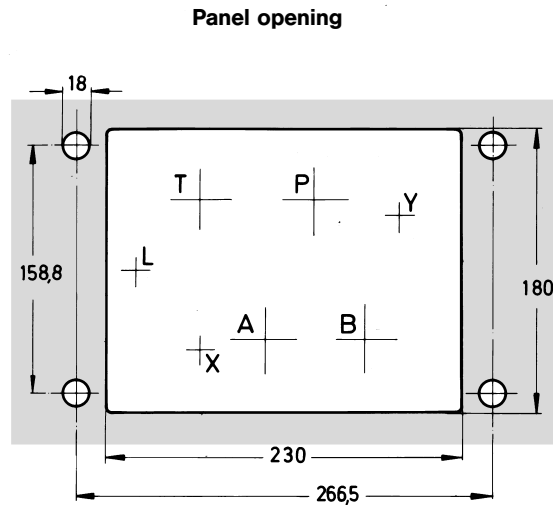
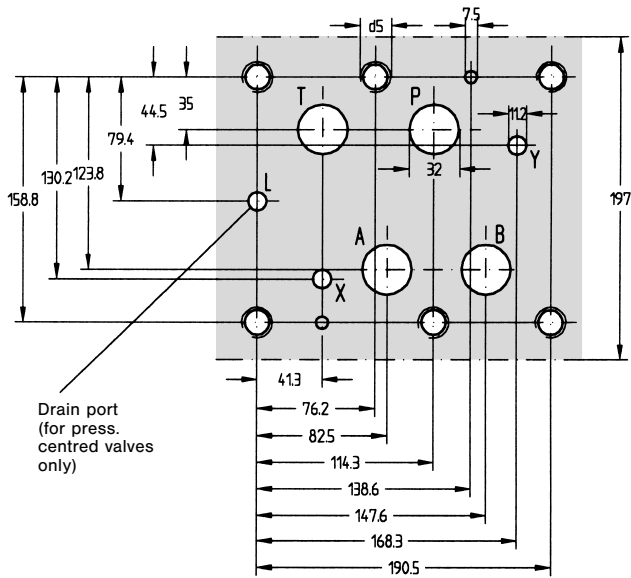


Sol. b energized: Out 2 = 0
 Neutral Pos.: Out 1 + 2 = L
 Sol. a energized: Out 1 = 0



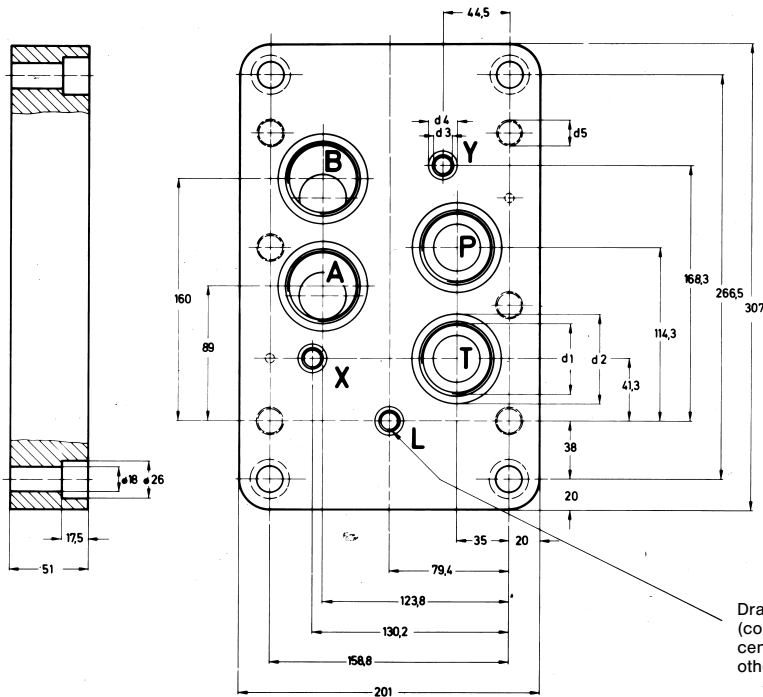
Pos. 1 = Neutral position
 Pos. 2 = Switch point
 Pos. 3 = End position

Mounting configuration according to CETOP, ISO and DIN



Block mounting face
 Flatness 0.01 mm/100 mm length
 Surface finish 0.8

Subplates (mount. configuration accord. to CETOP, ISO and DIN) Weight: ≈ 20 kg



Please note:
 Mounting screws are included in subplate order.
 For valves ordered without subplate, mounting screws must be ordered separately.
 Torque 570 Nm.

Qty.	Mounting screws	Order-No.
6	M 20 x 75 DIN 912; 10.9	700-70058-8

Portings

- P = Pressure port
- A & B = Actuator ports
- T = Tank port
- X = Pilot port (for hydr. operated and for pilot operated valves with external PP)
- Y = Drain port (for external PD: pilot operated and mech. operated valves)
- = Pilot port (for hydr. operated valves)
- L = Drain port (connect for pressure centred valves only, otherwise please close)

Model-No.	Order-No.	d ₁ (A, B, P, T)	d ₂	d ₃ (X, Y, L)	d ₄	d ₅
SS-B-24-46-157	S16-37920	G 1 1/2"	∅ 60; 0.5 dp.	G 1/4"	∅ 22; 0.5 dp.	M 20