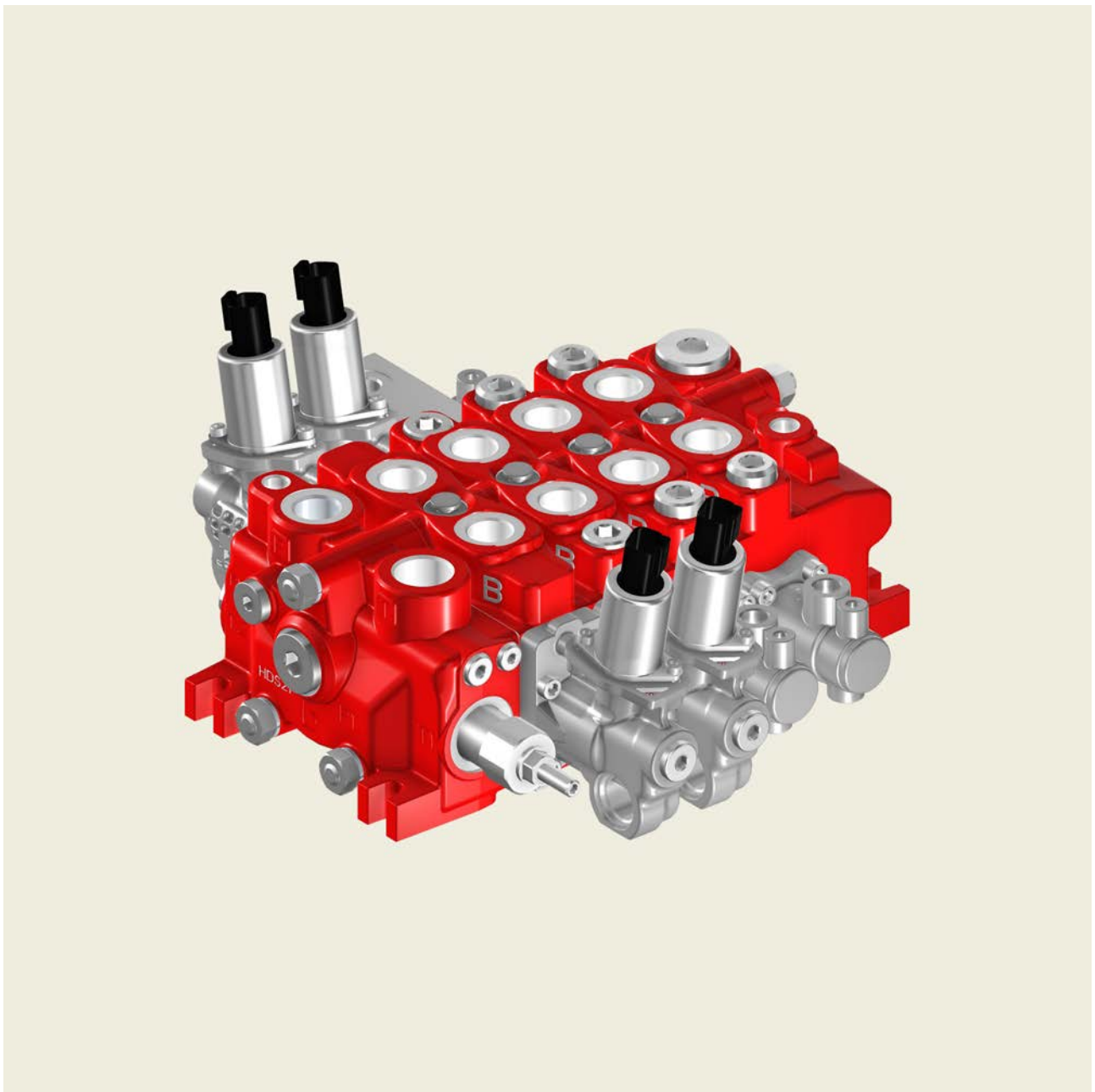


Directional Control Valve HDS21



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1 General information

1.1 Introduction

Several decades of leading presence and successful supplies in the earthmoving applications, the deep know-how gained in the material handling sector and the strong commitment to anticipate the upcoming technical and application needs of our customers, have guided Bucher Hydraulics in the development of HDS21.

The stackable construction with a wide range of inlet and outlet cover configurations, up to 10 parallel and series elements, possibility to utilize several different controls, gives the machine designer a high degree of freedom in the choice of the assembling position of the valve and of the hydraulic circuit which fits in the best way the machine requirements.

Each valve section can be equipped with various type of spools, in order to satisfy the application specific requirements in terms of hydraulic circuit and precise control of the machine functions.

HDS21 can be equipped with single levers or dual axis joystick, as well as hydraulic proportional and open loop electro-hydraulic proportional controls.

The wide range of controls combined with the compact dimensions makes the HDS21 a very flexible valve able to fulfill all the requirements of modern machines.



1.2 Directional valve installation

For the installation of the directional control valve on the equipment frame it is important to consider the following recommendations:

- the valve can be assembled in any position but, in order to avoid deformations and spool sticking, the surface on which the product is mounted has to be flat;
- before connecting pipelines, make sure that the pipeline hollows as well as fittings and seals are thoroughly clean; check also that the work ports are protected until the connection of the pipelines
- during assembly and servicing operations, it is

necessary to adopt clean procedures and work in an environment free of chips, swarf, dust and other possible source of pollution;

- if the spools are connected to the equipment controls through linkages, make sure that they do not affect their operations;
- before painting the valve, check that the work port plastic plugs are tightly in place;
- do not use high pressure jet washer directly on the valve to prevent water infiltration inside lever and spool caps.

1.3 Fittings

In the interest of safety, only fittings with STRAIGHT THREAD ENDS have to be used.

Fittings with TAPERED THREAD ENDS shall never be used, as they can cause deformation and cracks in the valve body.

Warranty conditions will not be valid in case tapered fittings are used.

The work port adaptors have to be fastened respecting the tightening torque values indicated in the following table (for different port types contact our Sales Dept.):

Cavity	Recommended tightening torque for work port fittings - Nm / <i>lbf</i>			
	M14X1.5	M18X1.5	M22X1.5	M27x2
Metric - ISO 261				
With O-Ring seal (ISO 6149-1)	30 / 22.1	40 / 29.5	60 / 44.3	90 / 66.4
With copper washer (ISO 9974-1)	30 / 22.1	40 / 29.5	60 / 44.3	90 / 66.4
With rubber washer or steel (ISO 9974-1)	25 / 18.4	35 / 25.8	60 / 44.3	70 / 51.7
BSP - ISO 228-1	1/4" BSP	3/8" BSP	1/2" BSP	3/4" BSP
With copper washer (ISO 1179-1)	30 / 22.1	40 / 29.5	60 / 44.3	90 / 66.4
With rubber washer or steel (ISO 1179-1)	25 / 18.4	35 / 25.8	60 / 44.3	70 / 51.7
UN-UNF - ISO 263	SAE6 - 9/16-18 UNF	SAE8 - 3/4-16 UNF	SAE10 - 7/8-14UNF	SAE12 - 1-1/16-12UNF
With O-Ring seal (ISO 11926-1)	30 / 22.1	40 / 29.5	60 / 44.3	90 / 66.4



IMPORTANT!: Tightening torques depend on several different factors including lubrication, coating and surfaces finish. The fitting manufacturer shall be consulted.

1.4 Hydraulic fluid

The main function of the fluid used in hydraulic systems is to transfer energy but it performs also other important functions: protect the components from corrosion, lubricate the directional valve moving parts, remove particles and heat from the system.

In order to ensure proper operation and long life of the system it is important to choose the correct hydraulic fluid with proper additives.

Bucher Hydraulics recommends to use a mineral based oil

according to type HM (ISO 6743/4) or type HLP (DIN 51524) only.

The system should be operated only with hydraulic oil containing anti-foaming and antioxidant additives. Before using other types of fluid, please contact our Sales Dept, since they can cause serious damage to the directional valve components and jeopardize the correct function of the system.

1.5 Filtration

In order to ensure proper operation and long life of the directional valve components it is extremely important to provide a proper and effective filtration of the hydraulic fluid. It is advisable to follow filter manufacturers instructions and recommendations.

The fineness of the filter should be selected in order to maintain the fluid contamination level according to the

values listed at section 1.6.1 (Technical specification)

Particular attention has to be paid to the cleanliness of the machine hydraulic circuit and its components before the first run-in, since the presence of foreign materials could cause damages to the directional valve components even if a proper filtration is provided.

1.6 Directives and standards

- PED (97/23/EC)

The pressure relief valves assembled into the directional control valve cannot be considered and/or confused with the safety valve when the PED Directive is applied to the hydraulic system.

- Atex



Attention: The equipment and protective systems of this catalogue ARE NOT intended for use in potentially explosive atmospheres. Ref: Directive 99/92/EC and Directive 2014/34/UE

- ISO 9001:2015 / ISO 14001:2015

Bucher Hydraulics S.p.A. is certified for research, development and production of directional control valves, power units, gear pumps and motors, electro-pumps, cartridge valves and integrated manifolds for hydraulic applications.

1.6.1 Technical specification



IMPORTANT!: Parameter values and diagrams shown in this catalogue have been measured with mineral oil having a viscosity of 23 mm²/s at 50° C

Features		
Nominal flow range		80 l/min (21 US gpm)
Max inlet pressure (P) ¹⁾		290 bar (4200 psi)
Max work port pressure (A/B) ¹⁾		320 bar (4640 psi)
Max back pressure (T)	standard	30 bar (430 PSI)
	with electro-hydraulic positioner (EHO)	10 bar (145 PSI)
	with ON/OFF control	20 bar (290 PSI)
Max internal leakage A/B→T (at 100 bar/1450 PSI, 23 mm ² /s) ²⁾	standard without port valves	16 cc/min (*) (0.976 Cu In/min)
	standard with port valves	21 cc/min (*) (1.281 Cu In/min)
	ON-OFF without port valves	45 cc/min (*) (2.746 Cu In/min)
	ON-OFF with port valves	50 cc/min (*) (3.051 Cu In/min)
Fluid		mineral based oil (see 1.4)
Fluid temperature (with NBR seals)		-20°C / +80°C (-4° to 176° F)
Contamination class		21/19/16 ISO4406:1999 (NAS 1638 class 10)
Contamination class with electro-hydraulic controls		20/18/15 ISO 4406:1999 (NAS 1638 class 9)
Viscosity operating range	recommended	from 15 to 75 mm ² /s
	admissible	from 12 to 400 mm ² /s
Max number of elements		10
Ambient temperature in operating conditions:	with mechanical/hydraulic/pneumatic controls	from -30 to +60 °C
	with electric/electrohydraulic devices	from -30 to +50 °C
Tie-rods tightening torque	standard	22.5±2.5 Nm

For different operating conditions, please contact our Sales Dept.

1) Fatigue tested according to internal procedure at 1.16x rated pressure on 5 samples for 1 000 000 cycles.

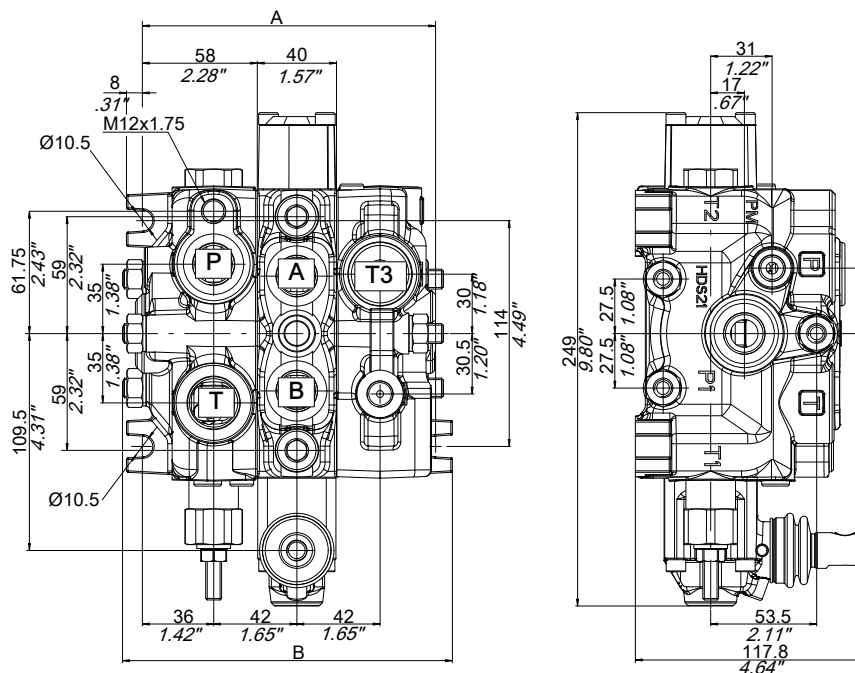
For work port sizes bigger than 1/2" BSP and for specific modules the rated pressure could be limited to a lower value (see correspondent paragraph)

2) Spool leakage values are strongly influenced by fluid viscosity with a linear inverted relationship: 10 cc/min at 100 bar and 23 cSt become roughly 5 cc/min at 100 bar and 46 cSt.

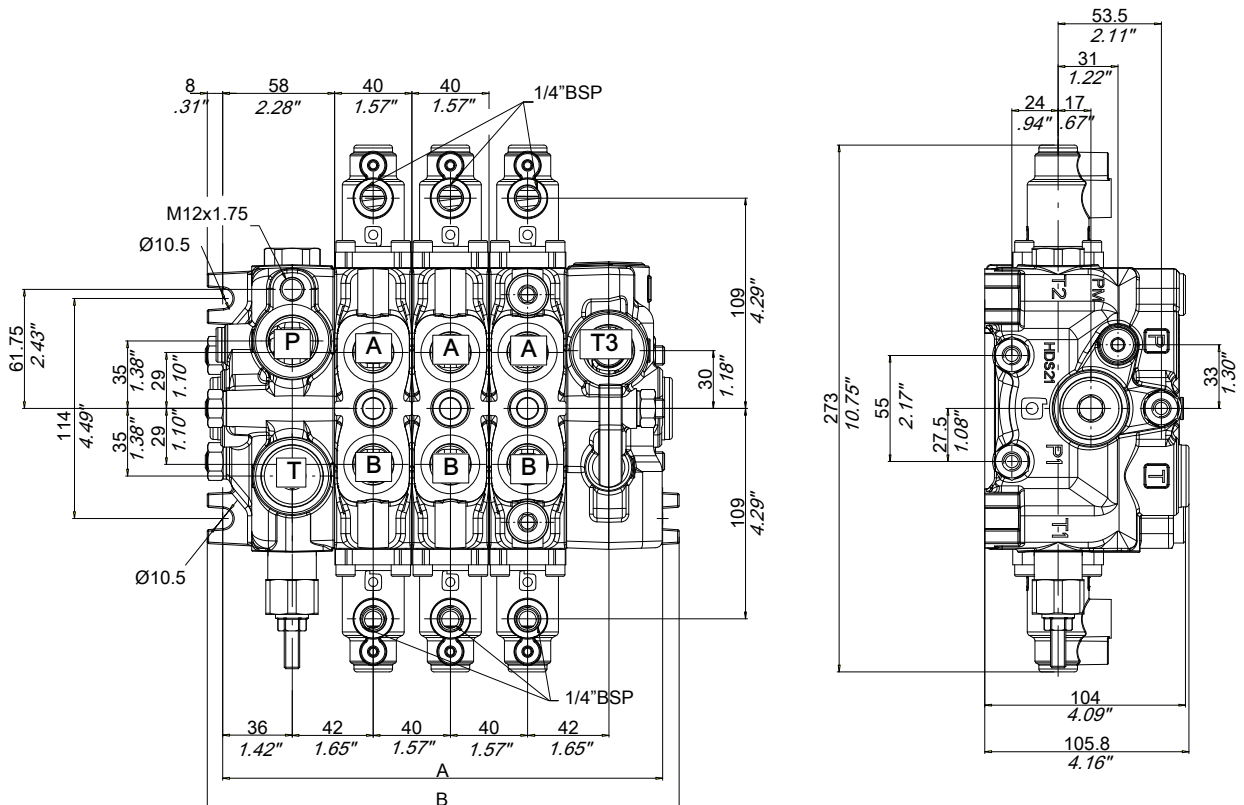
(*) Lower values can be provided on demand

1.7 Dimensional data

1.7.1 Manual operated



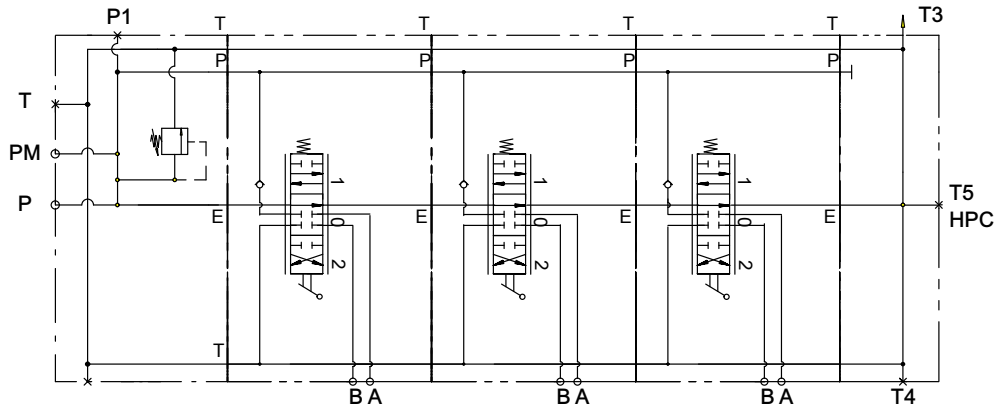
1.7.2 Hydraulic operated



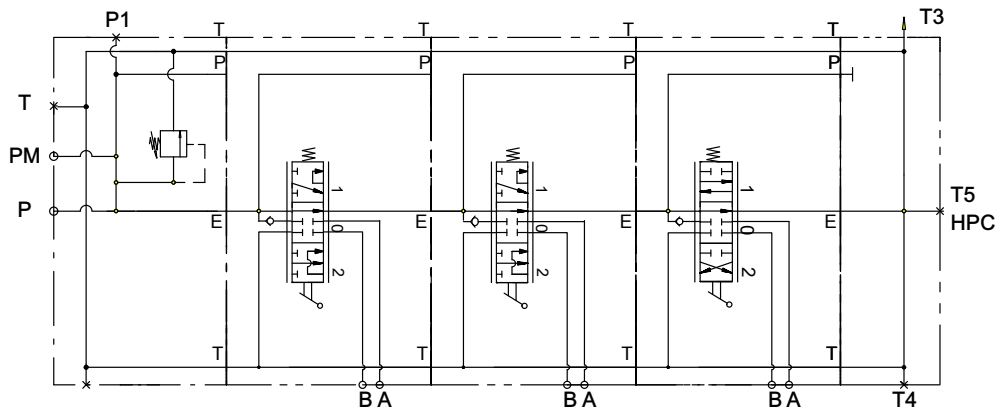
N° of section		/1	/2	/3	/4	/5	/6	/7	/8	/9	/10
A	mm	148	188	228	268	308	348	388	428	468	508
	inches	5.83	7.40	8.98	10.55	12.13	13.7	15.28	16.85	18.43	20
B	mm	165	205	245	285	325	365	405	445	485	525
	inches	6.50	8.07	9.65	11.22	12.8	14.37	15.94	17.52	19.09	20.67

1.7.3 Hydraulic circuits combination examples

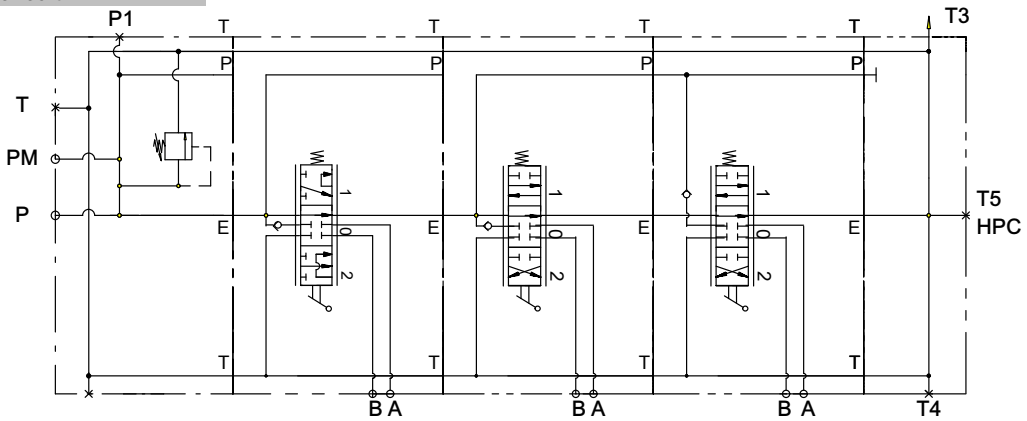
Parallel circuit



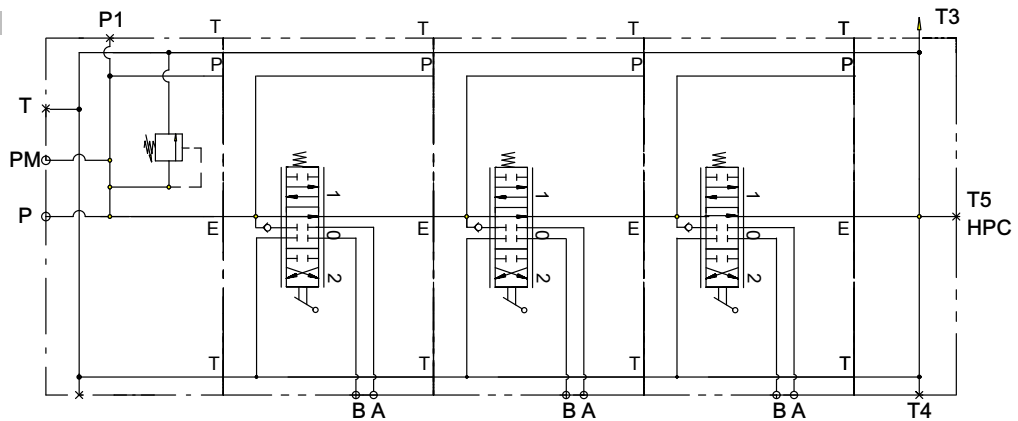
Series circuit



Series/parallel circuit

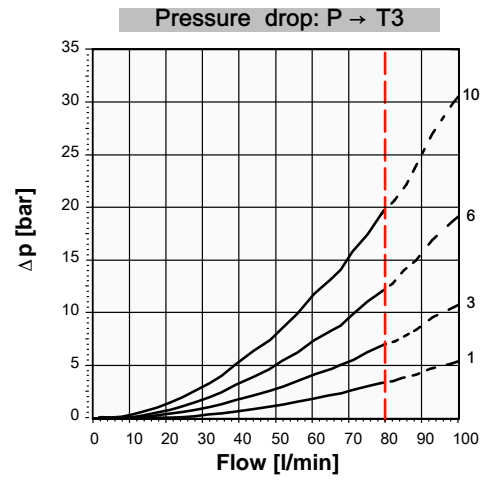
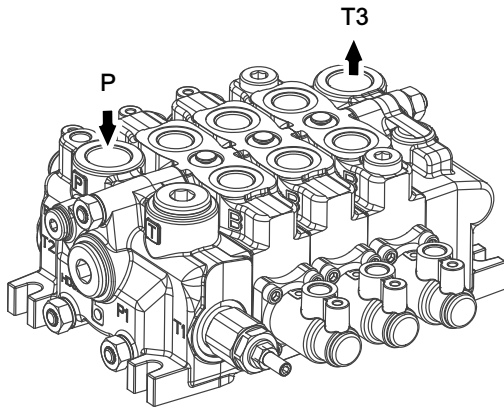


Tandem circuit

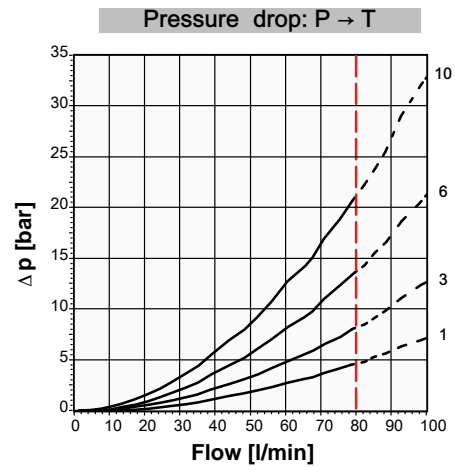
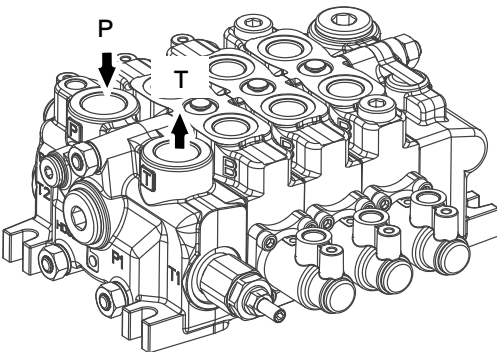


1.8 Performance data

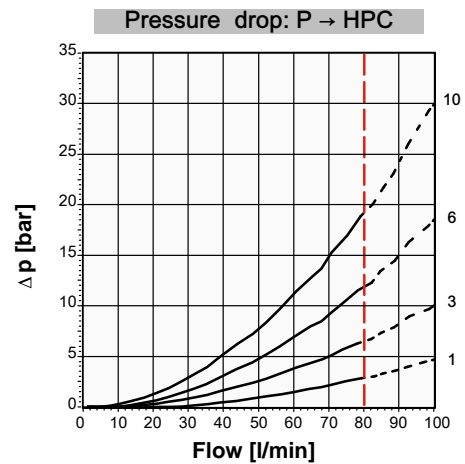
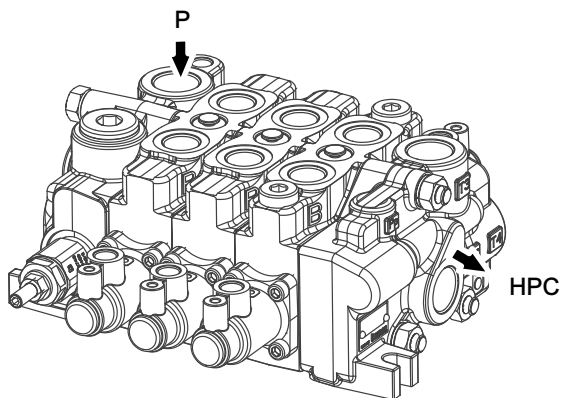
1.8.1 Open centre P → T3



1.8.2 Open centre P → T

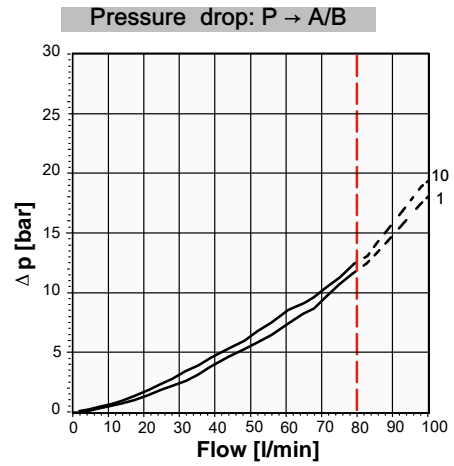
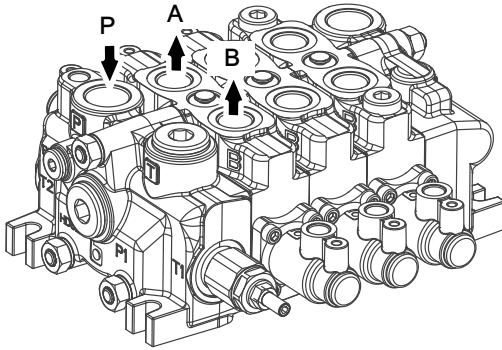


1.8.3 Carry over (HPC)



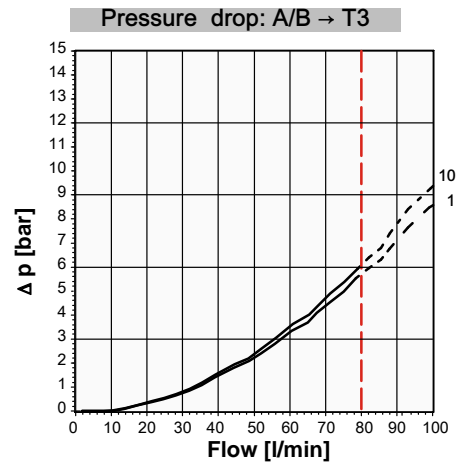
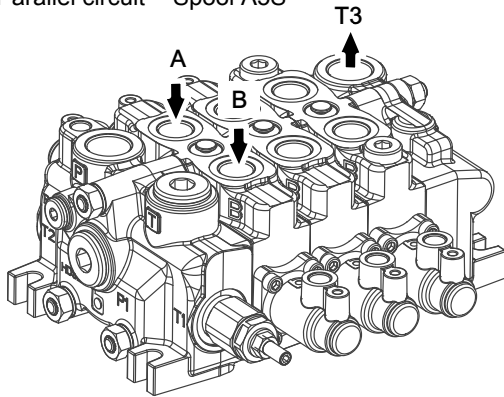
1.8.4 Inlet to work port A/B

Parallel circuit - Spool A5S



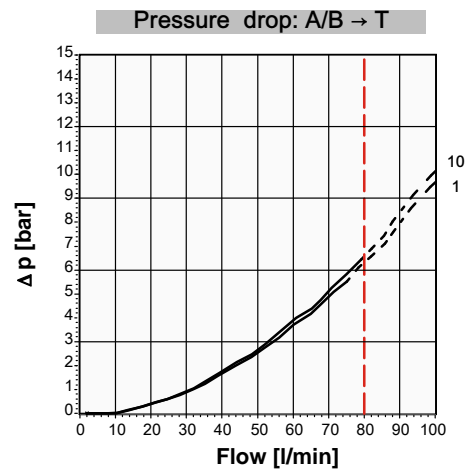
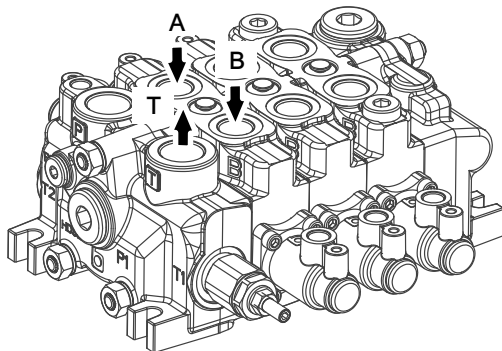
1.8.5 A/B work port to outlet "T3"

Parallel circuit - Spool A5S



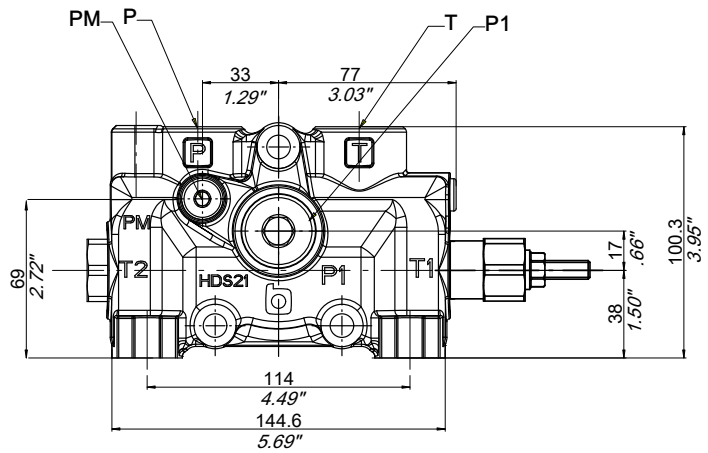
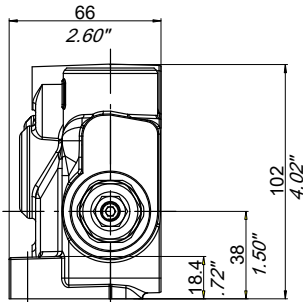
1.8.6 A/B work port to outlet "T"

Parallel circuit - Spool A5S

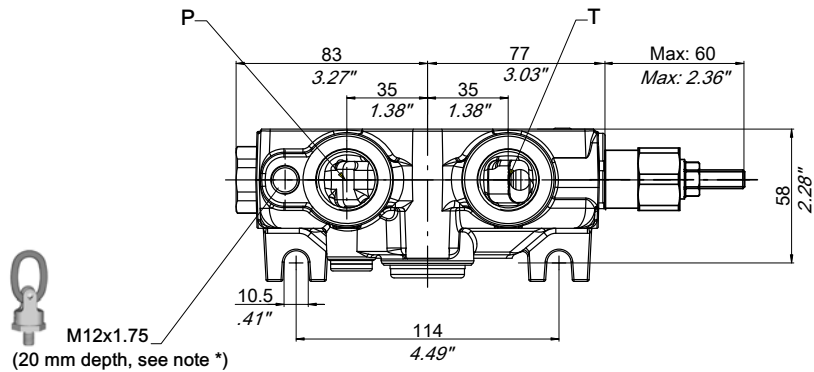
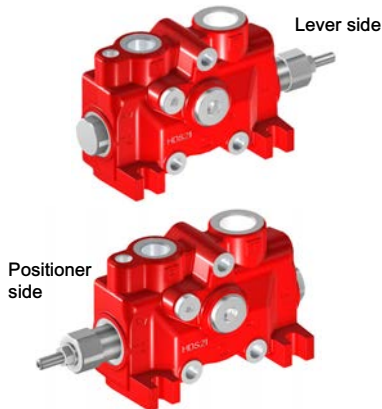


2 Inlet covers

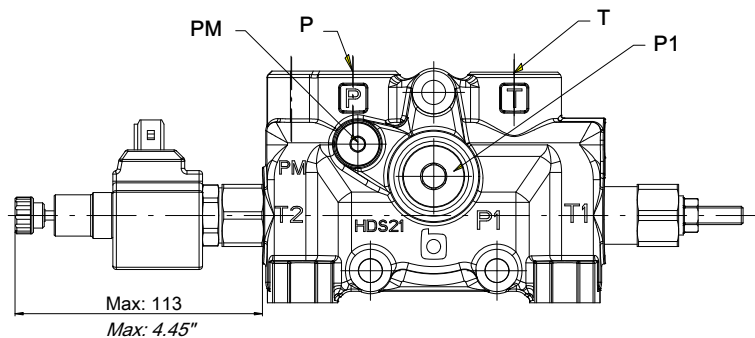
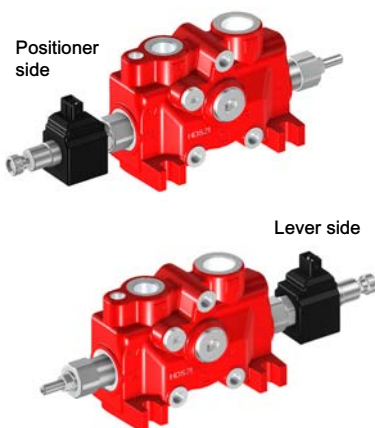
2.1 Dimensions and configurations



With relief valve RV



With BP valve



RV = adjustable relief valve
BP = by-pass valve



Attention: To handle the complete valve block use the M12x1,75 threaded hole. For the lifting operations use proper accessories like eye-bolts, cables, etc. certified and dimensioned for the weight to be lifted. Always handle with care and avoiding sudden accelerations.

2.1.1 Ports size without pilot lines (TM)

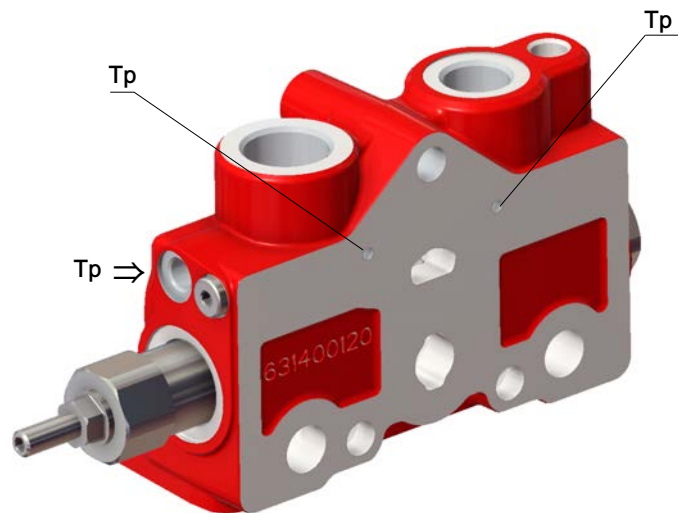
For fully manual controlled valve blocks.

Type	P	P1 (optional)	T	PM (optional)
TM 101	1/2" BSP	-	3/4" BSP	-
TM 102	1/2" BSP	1/2" BSP	3/4" BSP	1/4" BSP
TM 301	SAE10	-	SAE10	-
TM 302	SAE10	SAE10	SAE10	SAE6
TM 501	M22x1.5	-	M22x1.5	-
TM 502	M22x1.5	M22x1.5	M22x1.5	M14x1.5

2.1.2 Ports size with pilot lines (TH)

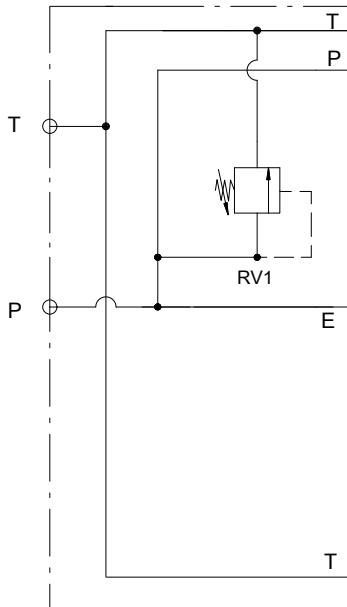
For valve blocks with electro-hydraulic controlled sections.

Type	P	P1 (optional)	T	PM (optional)	Tp
TH 101	1/2" BSP	-	3/4" BSP	-	M10x1
TH 102	1/2" BSP	1/2" BSP	3/4" BSP	1/4" BSP	M10x1
TH 301	SAE10	-	SAE10	-	M10x1
TH 302	SAE10	SAE10	SAE10	SAE6	M10x1
TH 501	M22x1.5	-	M22x1.5	-	M10x1
TH 502	M22x1.5	M22x1.5	M22x1.5	C	M10x1

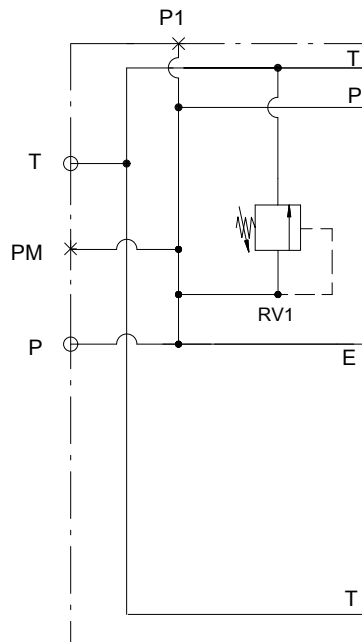


2.2 Inlet cover hydraulic schemes

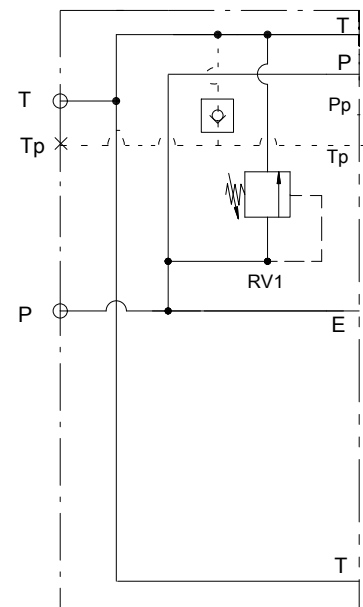
TM with main relief valve, P, T
Basic version



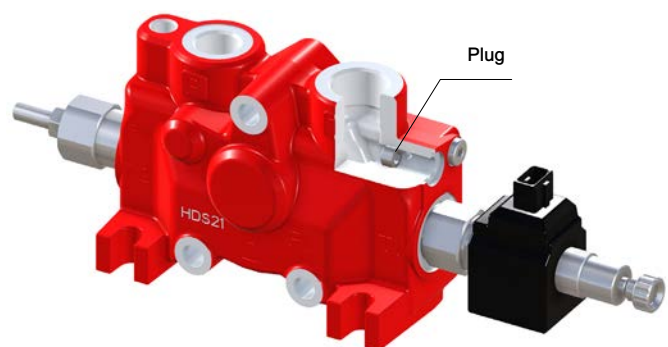
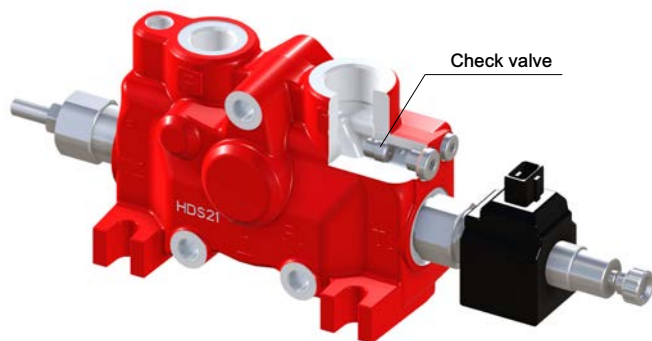
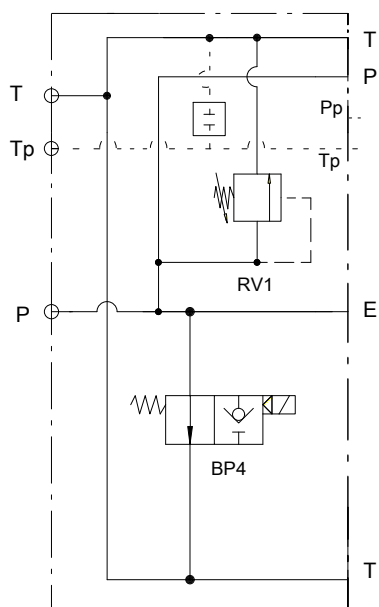
TM with main relief valve, P, P1, PM, T



TH with main relief valve, P, T and pilot lines check valve

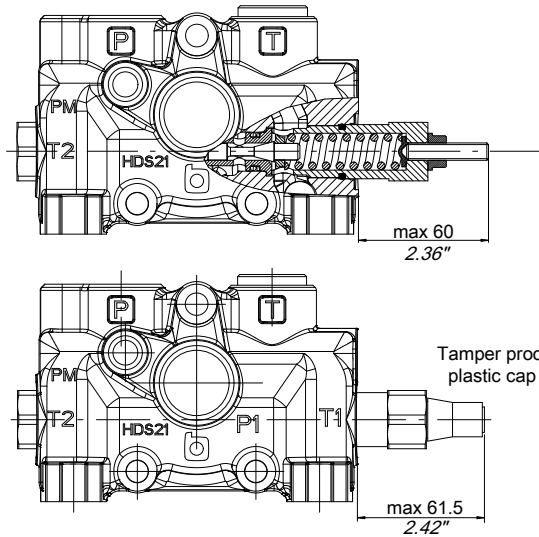
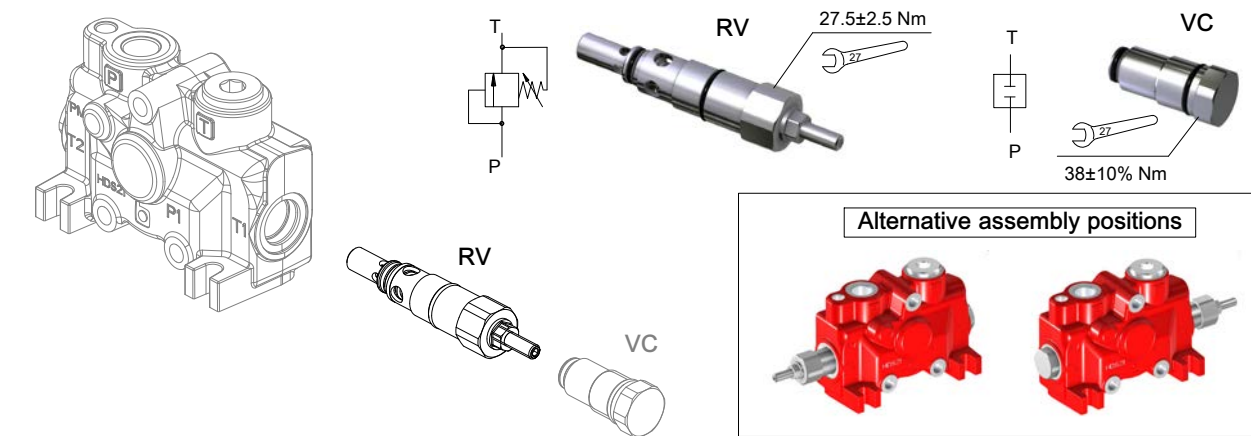


TH with main relief valve, P, T, BP solenoid valve normally open and Tp



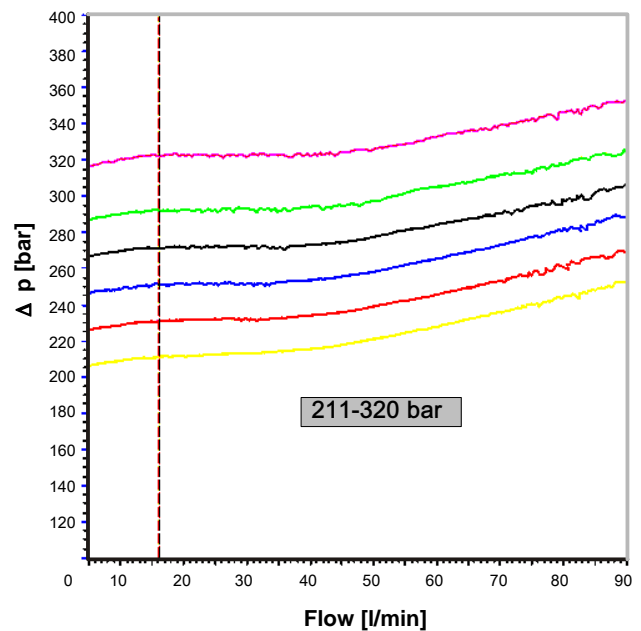
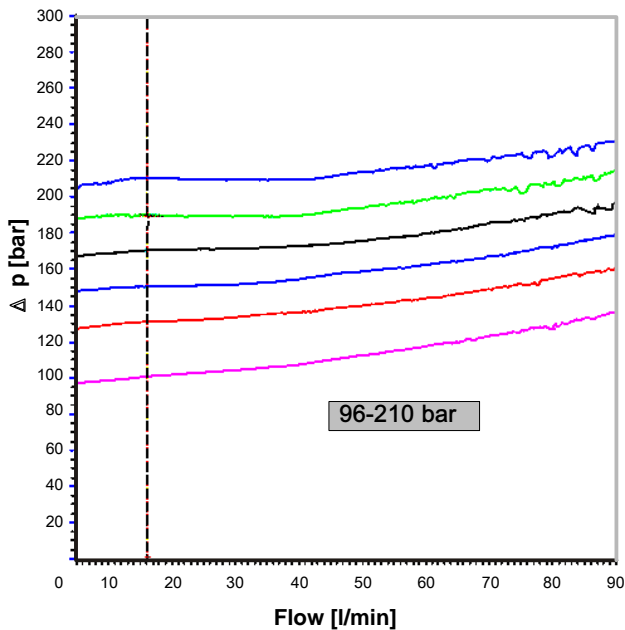
2.3 Inlet cover valves

2.3.1 Standard relief valve RV



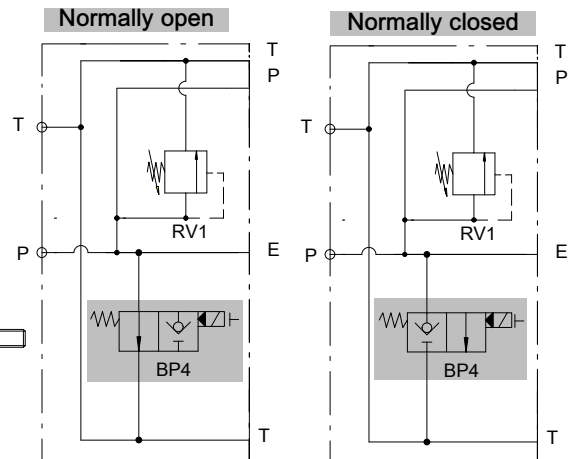
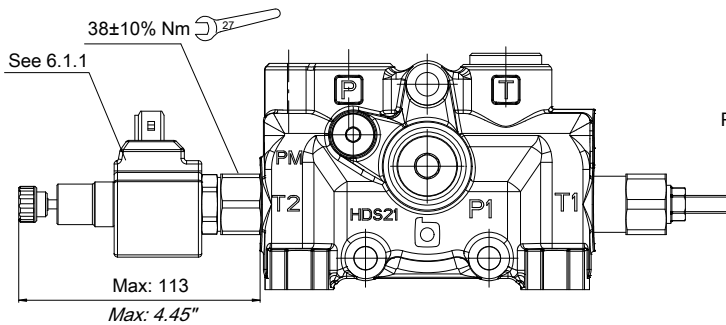
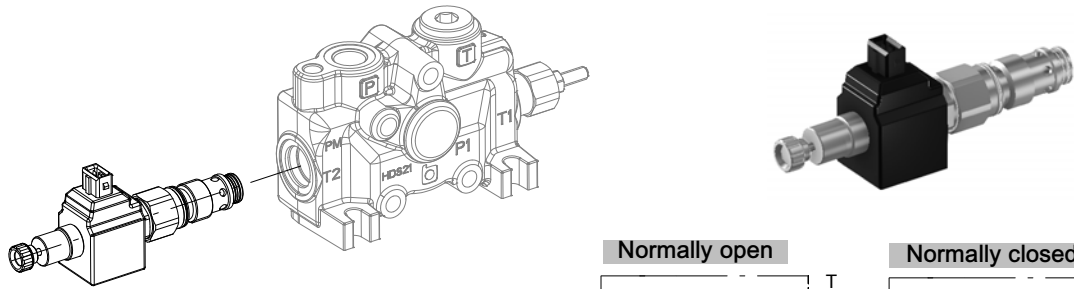
Pressure setting range bar (psi)	Type	Code
30 - 95 (435 - 1370)	YE	200787400782
96 - 210 (1390 - 3045)	GR	200787400802
211 - 320 (3060 - 4640)	BL	200787400762
Plug	VC	200778400160

* Supplied on demand. Code: 200527900006.



2.3.2 Unloading solenoid valve (BP4)

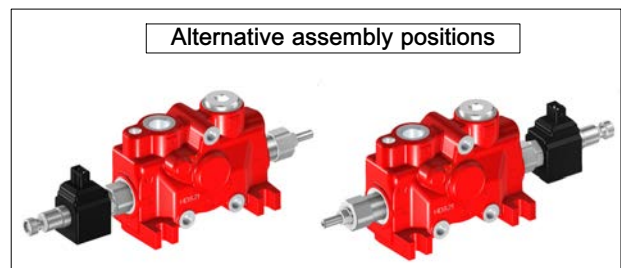
Max operating pressure 240 bar



Circuit	Manual override	Type	Code without coil
Normally open	With (*)	AE	200757200530
	Without	A	200757200510
Normally closed	With (*)	CE	200757200520
	Without	C	200757200500

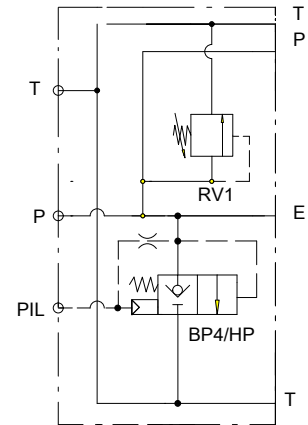
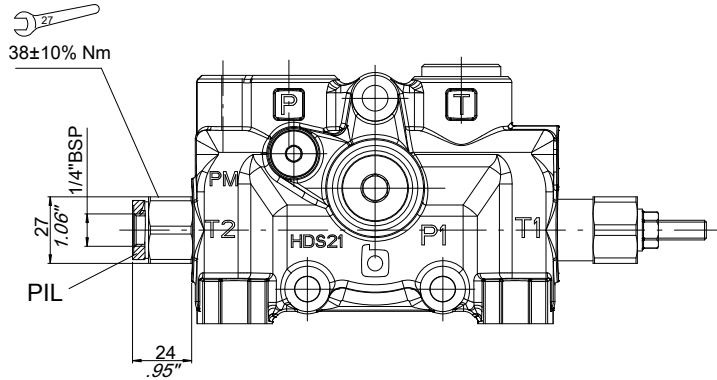
(*) Screw type override must not be used for continuous operation but for emergency only.

For available coil versions see 6.1.1

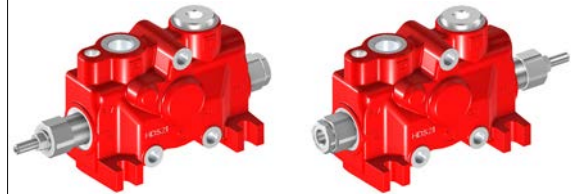


2.3.3 Hydraulic operated unloading valve (BP4/HP)

Type	Code
HP	200787202390

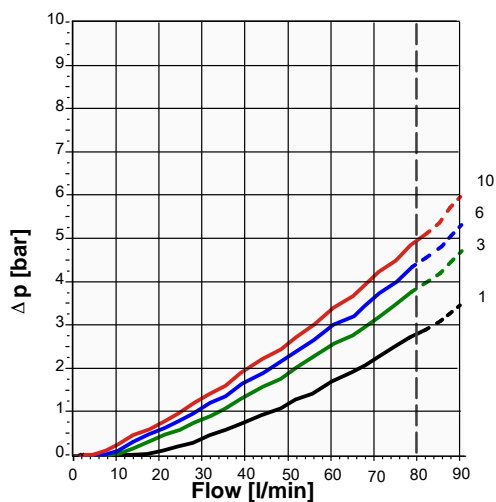


Alternative assembly positions

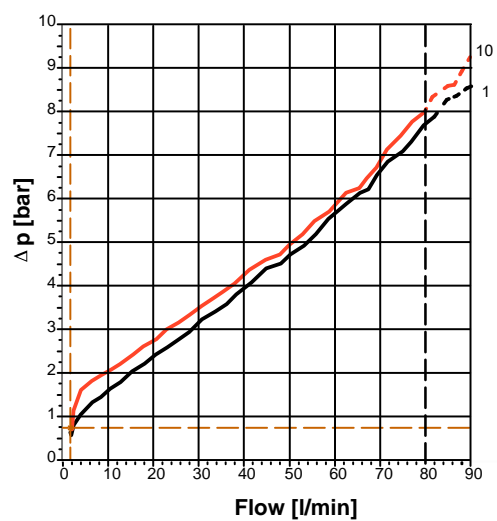


2.3.4 Pressure drop curves (BP4)

Pressure drop: P → T3
With by-pass valve open and spools in neutral position

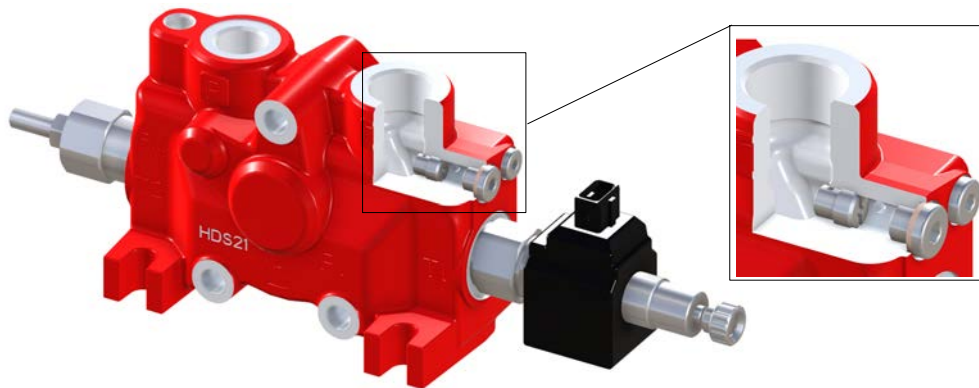
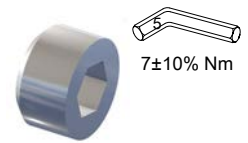
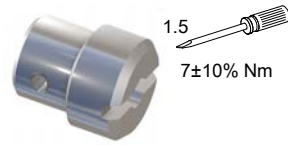


Pressure drop: P → T3
With by-pass valve open and neutral gallery close (one spool switched to full stroke) and A/B plugged

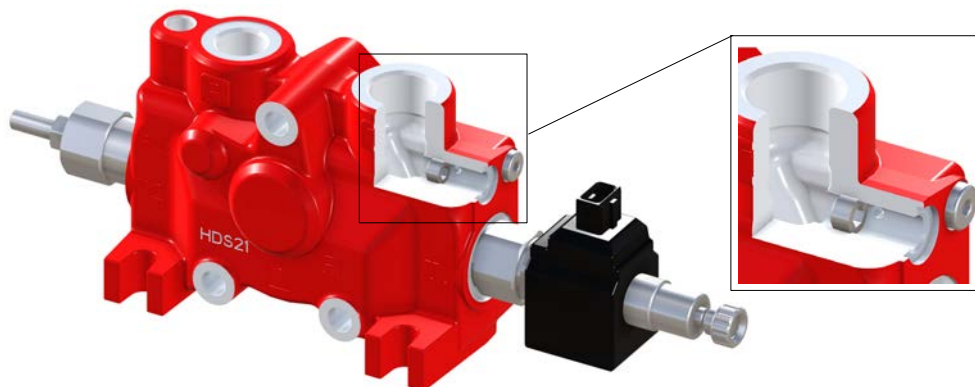


2.3.5 Check valve

Type	Code
C	200787603100
T	200678000110



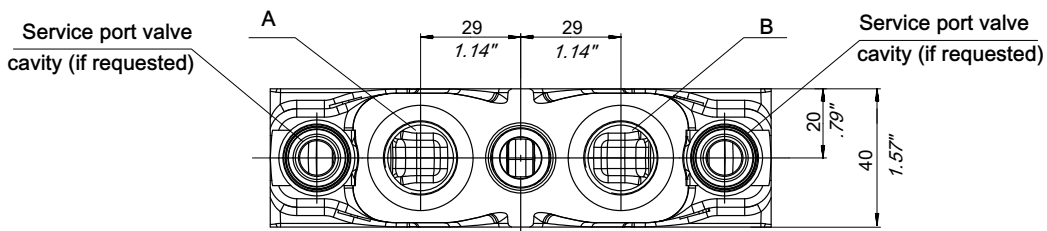
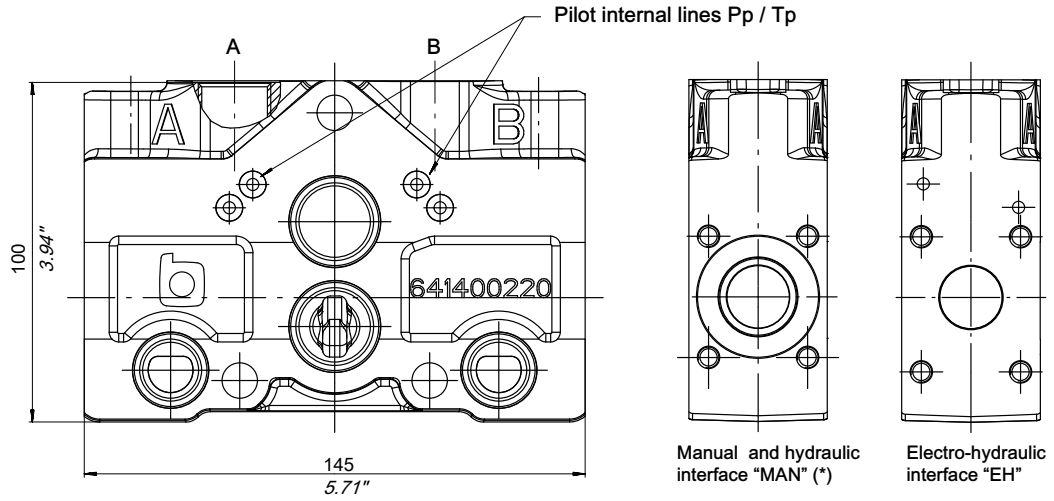
C= internal drain
(with check valve),
externally plugged



T= external drain,
internally plugged

3 Valve sections

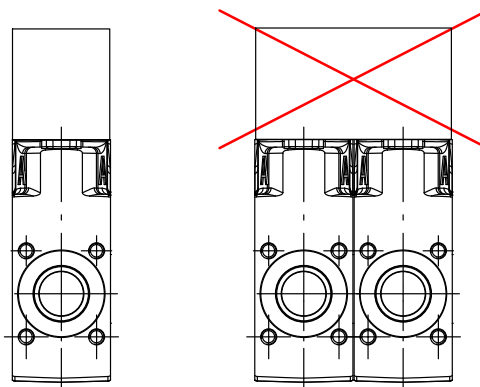
3.1 Characteristics and dimensions



(*) for Manual, HP and ON-OFF controls



Attention:
flanging manifolds on the top work port surface of a valve section is not allowed without previous approval by our Technical Department. Larger flanging manifolds that connect together two or more valve sections are forbidden.



3.1.1 Parallel valve bodies without pilot lines

To be used with TM and PM covers only.

Thread	Interface	Type	
		Without A/B service port valve cavities	With A/B service port valve cavities
1/2" BSP	MAN	K104	K103
SAE10	MAN	K304	K303
M22x1.5	MAN	K504	K503

3.1.2 Parallel valve bodies with pilot lines (Pp/Tp)

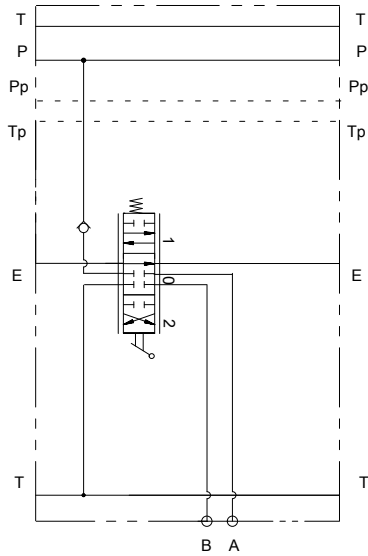
To be used with TH and PH covers only.

For valve blocks with electro-hydraulic controlled sections.

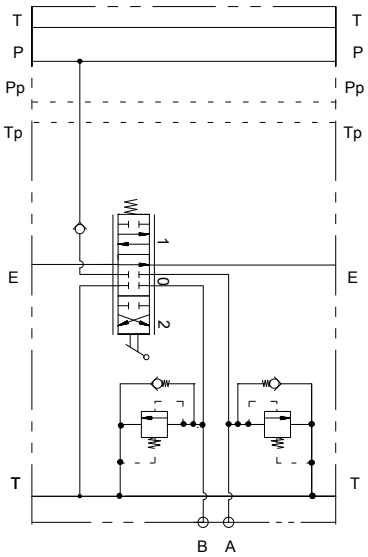
Thread	Interface	Type	
		Without A/B service port valve cavities	With A/B service port valve cavities
1/2" BSP	MAN	K102	K101
1/2" BSP	EH	K108	K107
SAE10	MAN	K302	K301
SAE10	EH	K308	K307
M22x1.5	MAN	K502	K501
M22x1.5	EH	K506	K505

3.1.3 Parallel circuits

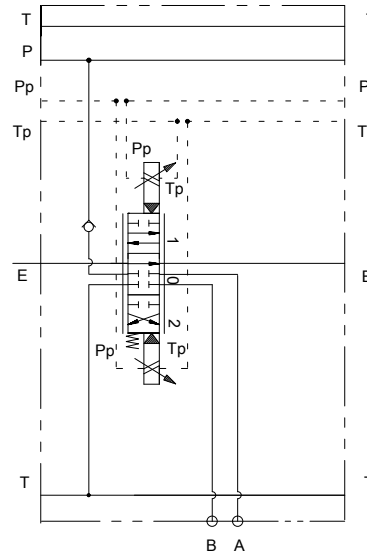
"MAN" with internal pilot line Pp, Tp



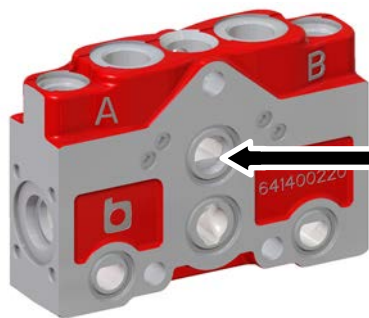
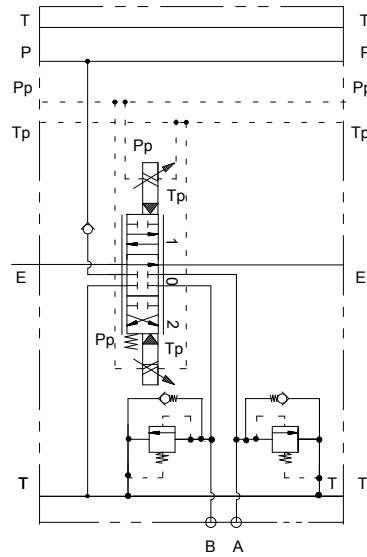
Same circuit with service port valves



"EH" with internal pilot line Pp, Tp



Same circuit with service port valves



OPEN with parallel circuit

3.1.4 Series and tandem valve bodies without pilot lines

To be used with TM and PM covers only.

Thread	Interface	Type	
		Without A/B service port valve cavities	With A/B service port valve cavities
1/2" BSP	MAN	K154	K153
SAE10	MAN	K354	K353
M22x1.5	MAN	K554	K553

3.1.5 Series and tandem valve bodies with pilot lines (Pp/Tp)

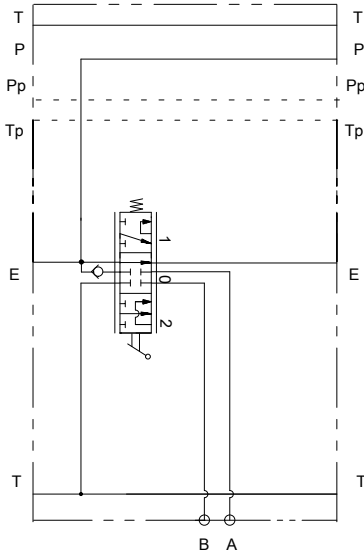
To be used with TH and PH covers only.

For valve blocks with electro-hydraulic controlled sections.

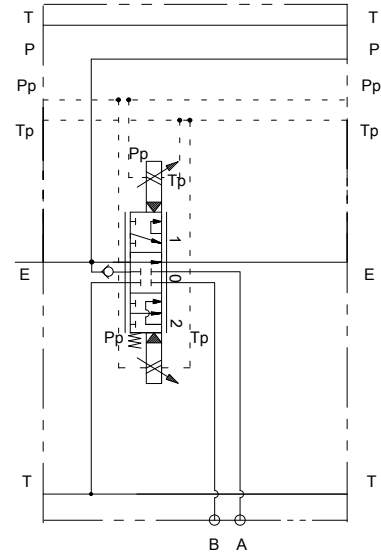
Thread	Interface	Type	
		Without A/B service port valve cavities	With A/B service port valve cavities
1/2" BSP	MAN	K152	K151
1/2" BSP	EH	K158	K157
SAE10	MAN	K352	K351
SAE10	EH	K358	K357
M22x1.5	MAN	K552	K551
M22x1.5	EH	K558	K557

3.1.6 Series circuits

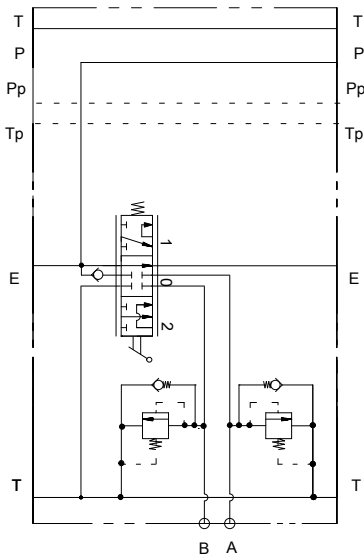
"MAN" with internal pilot line Pp, Tp



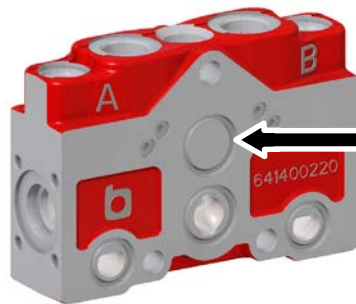
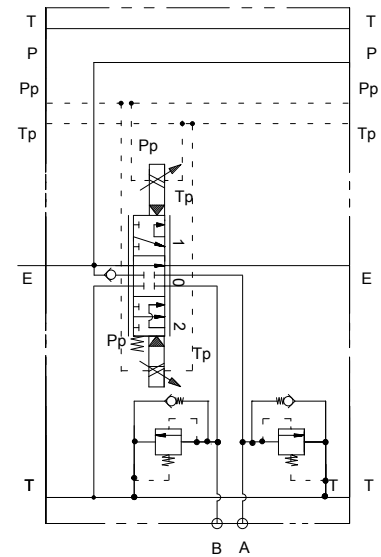
"EH" with internal pilot line Pp, Tp



Same circuit with service port valves



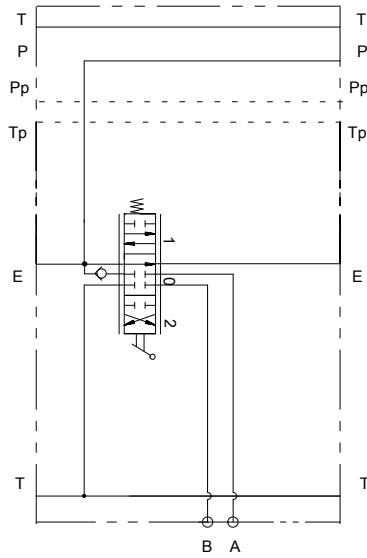
Same circuit with service port valves



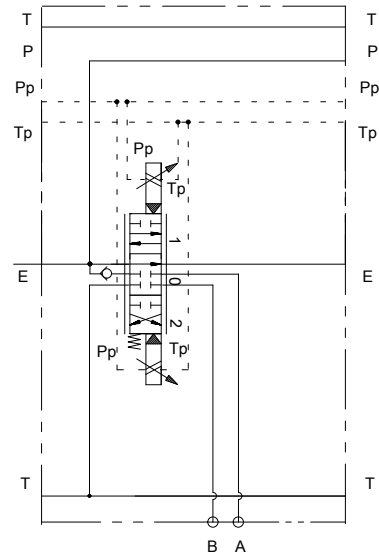
CLOSED with series circuit

3.1.7 Tandem circuits

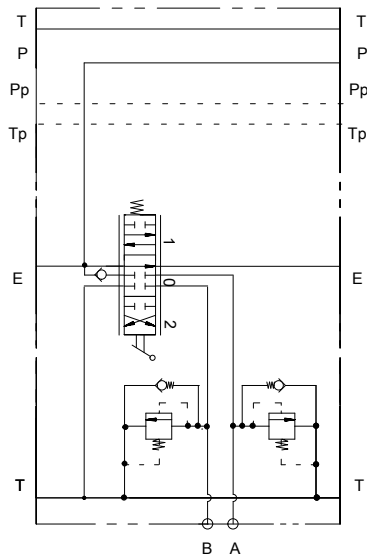
"MAN" with internal pilot line Pp, Tp



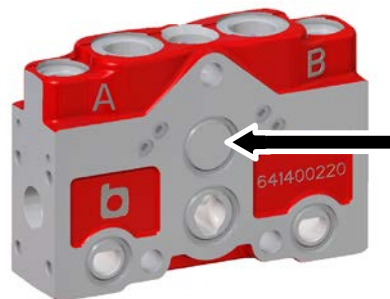
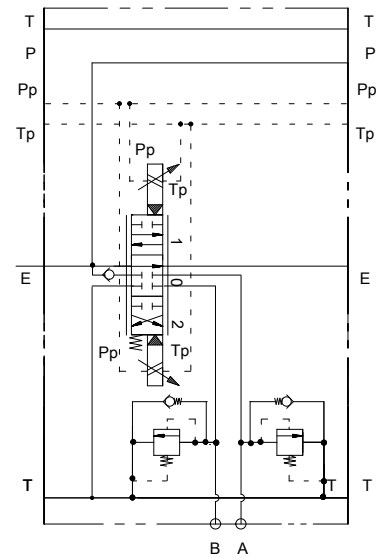
"EH" with internal pilot line Pp, Tp



Same circuit with service port valves



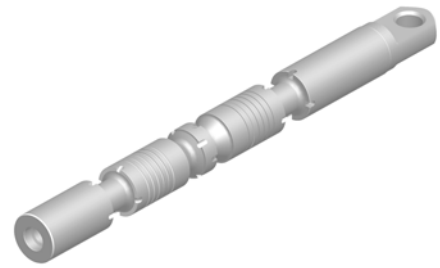
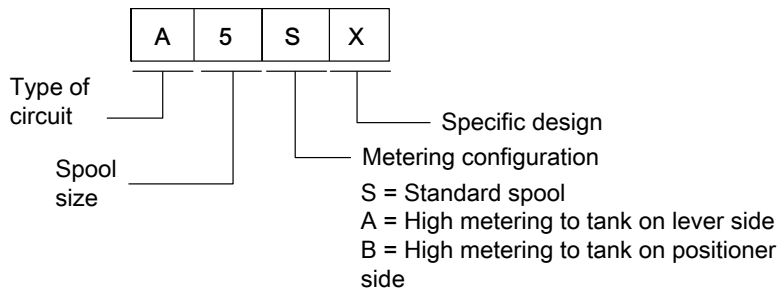
Same circuit with service port valves



CLOSED with tandem circuit

3.2 Spools

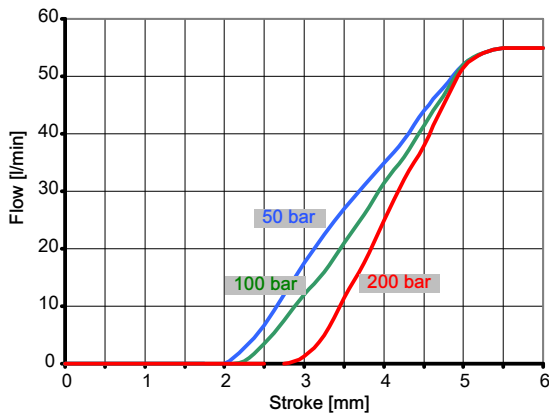
3.2.1 Standard spools



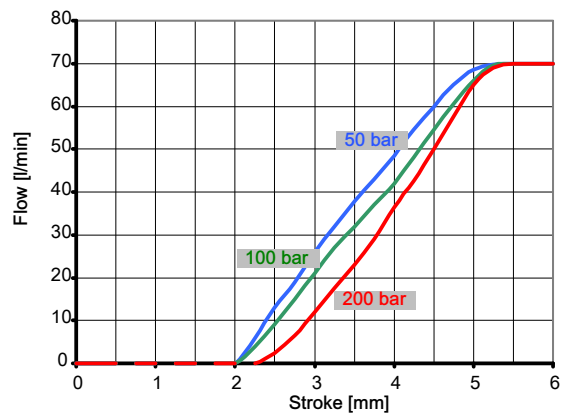
Spool Type	Hydraulic schematic	Features	Application examples
A5S A5B A5A		Double acting A/B closed	A5B - A5A LOADERS BOOM and BUCKET FUNCTION
C5S		Double acting A/B to tank	
G5S		Single acting B closed	Fork lift LIFTING FUNCTION
S5S		Single acting A closed	Fork lift LIFTING FUNCTION
Z5S		Double acting Floating in position 3	4th floating position by pulling the spool (Manual controls only)
X5S		Double acting A/B closed Series	
W5S		Double acting Floating in position 4	4th floating position by pushing the spool
R5B*		Double acting A/B closed Regen in position 4	
A5BP		Double acting A/B closed	LOADERS BOOM and BUCKET FUNCTION For HP controls only
W5P		Double acting Floating in position 4	4th floating position by pushing the spool LOADERS BOOM FUNCTION For HP controls only

* A special body is required

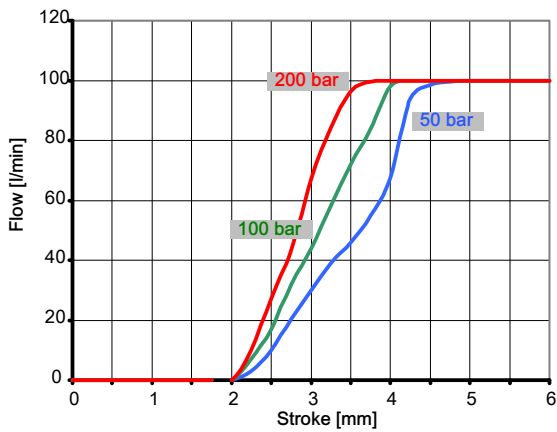
Spool size 5 metering: P → A/B (inlet flow 55 l/min)



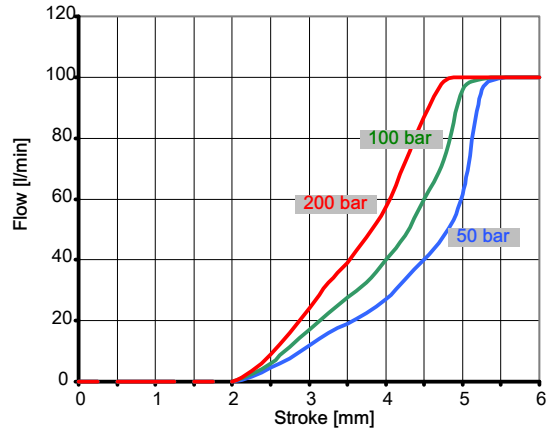
Spool size 5 metering: P → A/B (inlet flow 70 l/min)



Spool size 5 metering: A/B → T (port flow 100 l/min) metering configuration S

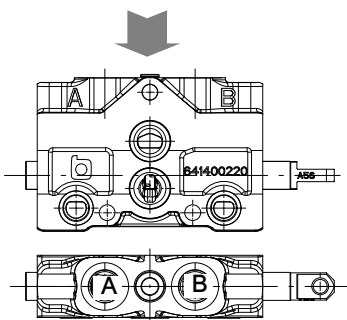


Spool size 5 metering: A/B → T (port flow 100 l/min) High metering to tank spools Metering configuration A and B and floating



Spool assembly direction

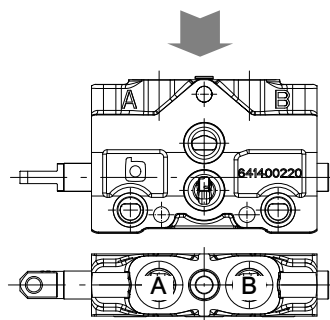
Positioner kit on A port - standard position



HDS21K101A5S79L1000000



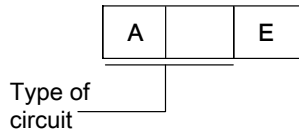
Positioner kit on B port - inverted spool



HDS21K101A5S79L1000000I



3.2.2 Direct acting ON/OFF spools

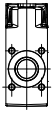


Spool Type	Hydraulic schematic	Features
AE		Double acting A/B closed
BE		Double acting A/B closed E closed
CE		Double acting A/B to tank
DE		Double acting A closed B to tank
GE		Single acting B closed
LE		Double acting B closed A to tank
SE		Single acting A closed
XE		Double acting A/B closed Series
XCE		Double acting A/B to tank Series

3.3 Manual positioners

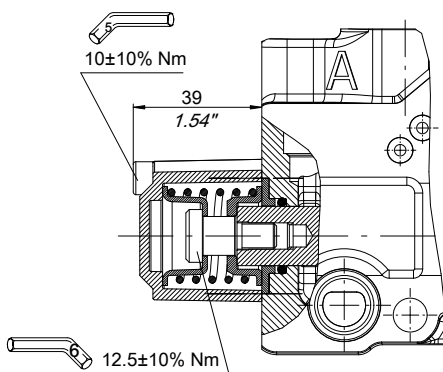
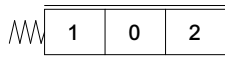
The standard position of positioner kits is on A port side

Body interface

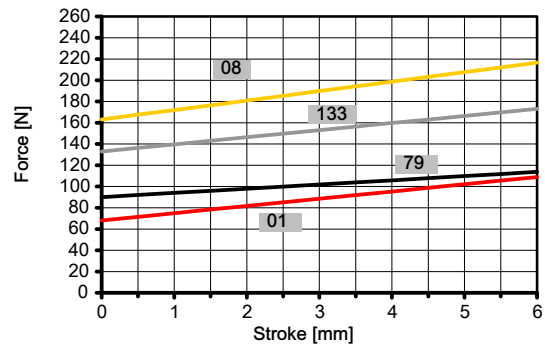


MAN

3.3.1 Spring return to neutral position



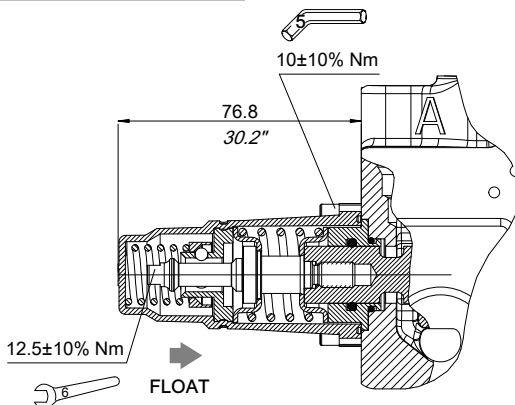
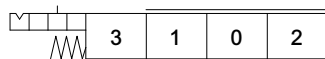
FORCE-STROKE DIAGRAM



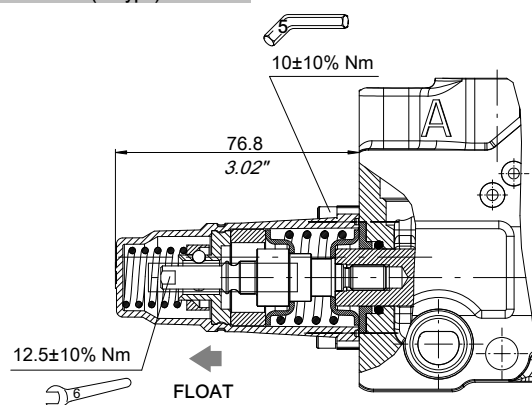
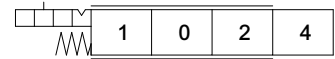
Type	Code	Spring colour
01	200768611722	RED
79	200768612070	BLACK
133	200768612050	WHITE
08	200768612060	YELLOW

3.3.2 Detent in floating position and spring return to neutral from position 1 and 2

Floating position
pulling the spool
(Z type)



Floating position
pushing the spool
(W type)

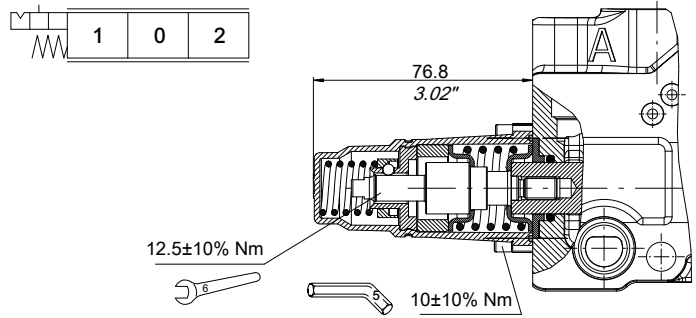
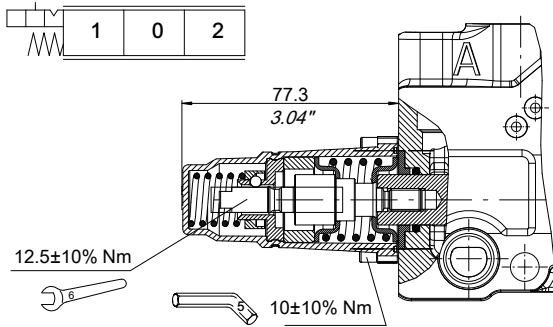


Type	Code	Main spring	Detent spring
04	200768640800	RED	BLACK
333	200768640830	BLACK	BLACK

Type	Code	Main spring	Detent spring

3.3.3 Detent in position 1 or 2 and spring return to neutral in both directions

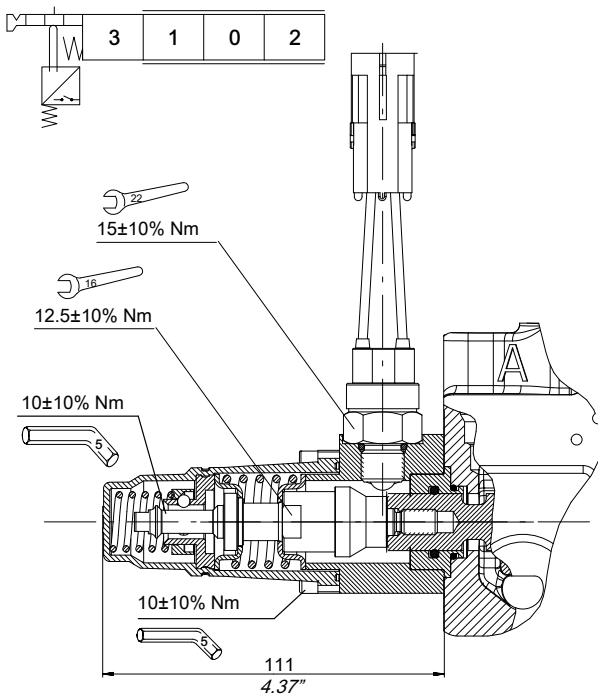
A pre-feeling (force increase) signals the operator that the detent position is going to be engaged



Type	Code	Main spring	Detent spring
359	200768630481	RED	BLACK

Type	Code	Main spring	Detent spring
340	200768640471	RED	BLACK

3.3.4 With microswitch in floating position

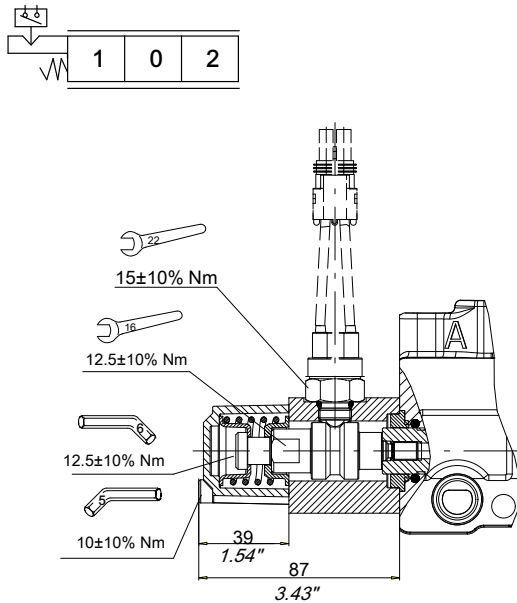


Microswitch specification	
Current rating	.01 - 5.0 DC Amp
Voltage rating	5.0 - 24.0 VDC
Connector	Packard Metri-pack
Electrical life max.	100.000 cycles - 7A/13.5 VDC
	50.000 cycles - 10A/12 VDC
	50.000 cycles - 3A/28 VDC
Mechanical life max.	500.000 cycles
Type	Normally Open, Encapsulated with Wire Leads

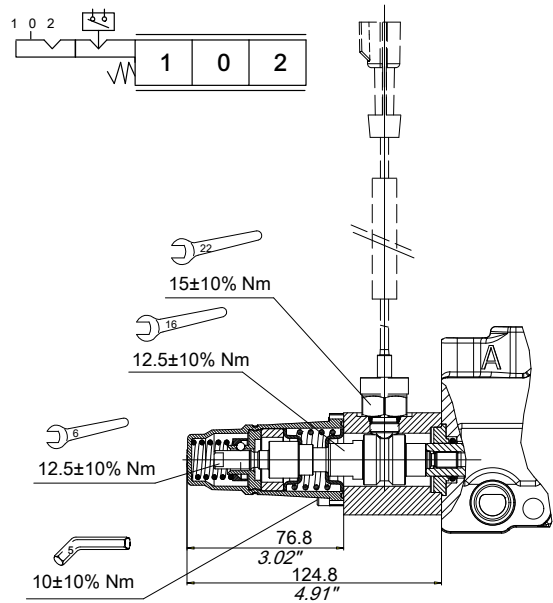
Type	Code	Main spring	Detent spring	Contact type

3.3.5 Microswitch positioners

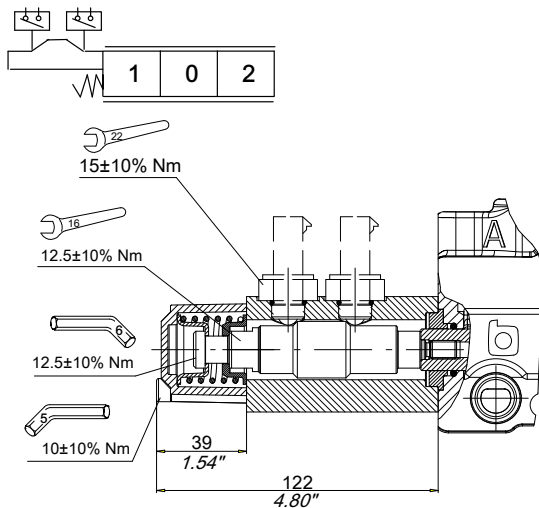
Spool movement detection






Spool movement detection with detent posit.











Spool direction detection



-  DE: microswitch operated in both directions
-  SE1: microswitch operated in POS.1
-  SE2: microswitch operated in POS.2

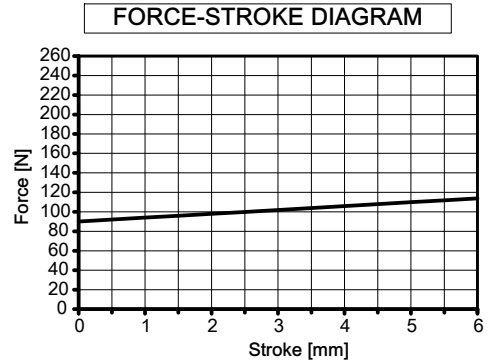
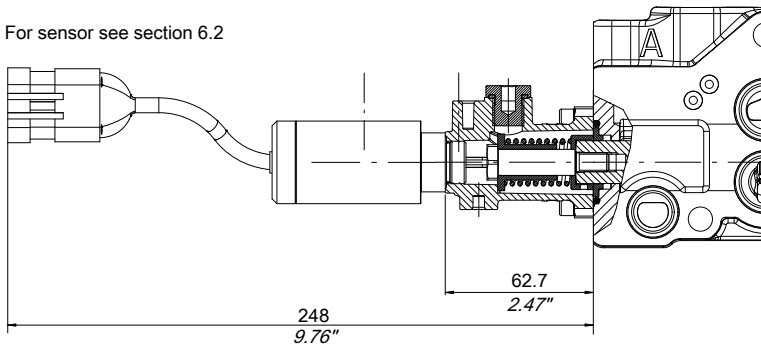
Microswitch control

Current rating	.01 - 5.0 DC Amp
Voltage rating	5.0 - 24.0 VD C
Mechanical life	500.000 cycles
Temperature range	-30 to 120° C

Switch	Type	Code	Hydraulic scheme	Description	Connector type	
SAE6 C21-478	C W -	200544124021		Normally Closed, Encapsulated with Wire Leads	Packard Weather Pack	
SAE6 O21-477	O W -	200544124022		Normally Open, Encapsulated with Wire Leads	Packard Weather Pack	
SAE6 O21-467	O M -	200544124023		Normally Open, Encapsulated with Wire Leads, Convoluted nylon wire shield	Packard Metri-pack	
SAE6 C21-462	C W I	200544124027		Normally Closed, Sealed Terminals	Packard Weather Pack	

3.3.6 Manual positioner with spool sensor

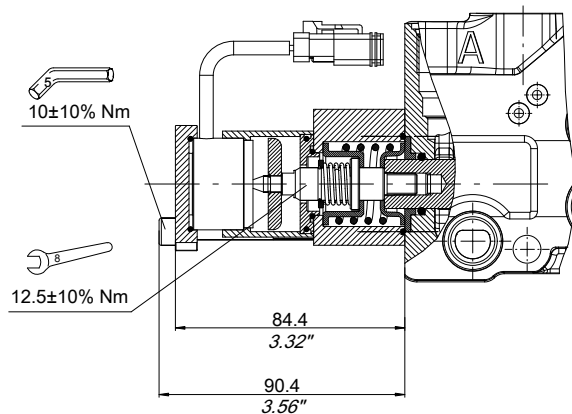
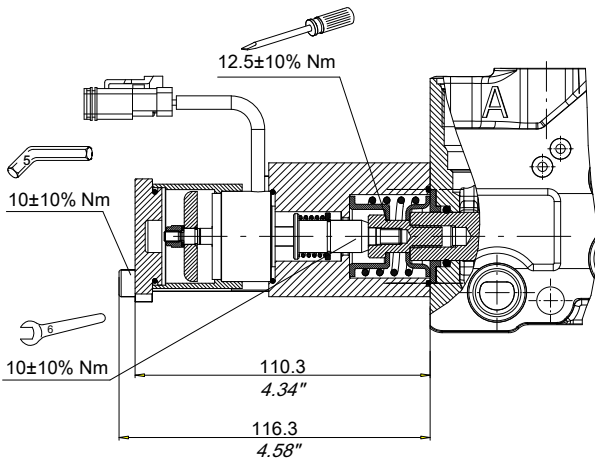
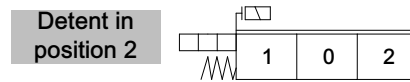
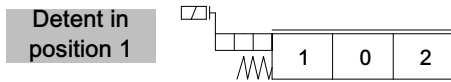
For sensor see section 6.2



Type	Code
70	200768612230

3.3.7 Electro-magnetic detent positioners (EMD)

A pre-feeling (force increase) signals the operator that the detent position is going to be engaged

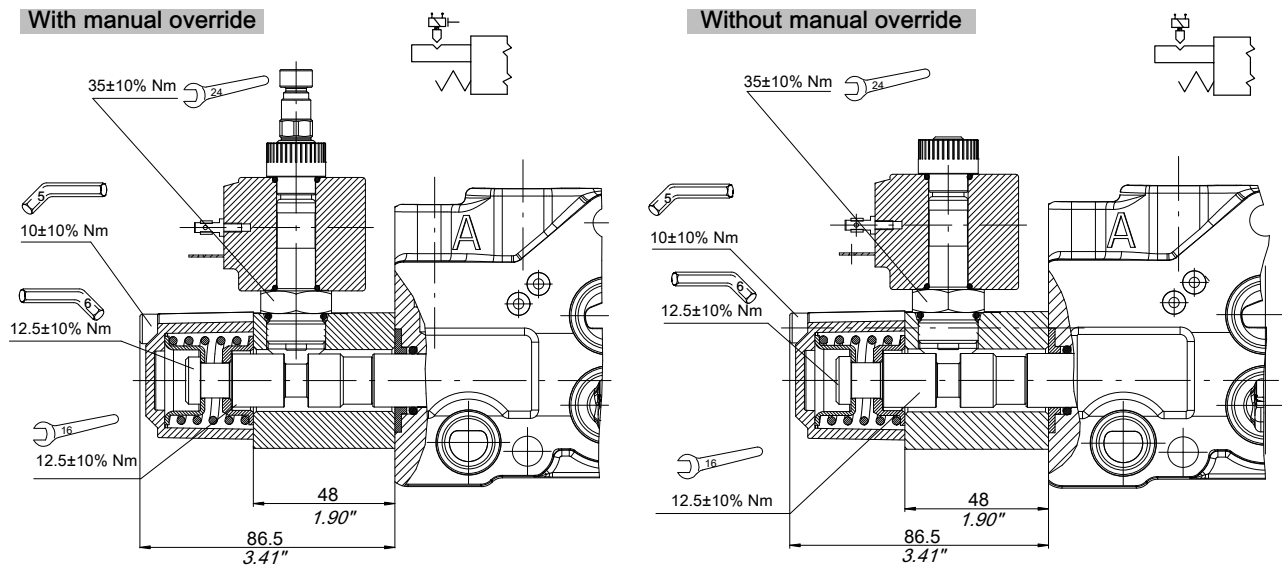


Coil operating features

Nominal voltage	12 VDC ± 10%
Power rating	7 W
Electrical resistance when holding (20°C)	21 ± 1.5 Ohm
Min. solenoid axial hold force	260 N
Duty cycle	100%
Standard cable length	500 mm

Type	Code	Spring	Voltage	Min. holding force	Connector	Detent position
336	200768670100	RED	12 VDC	137 N	DEUTSCH DT06-2S	2
363	200768670110	RED	12 VDC	137 N	DEUTSCH DT06-2S	1

3.3.8 Electro-mechanic locking system

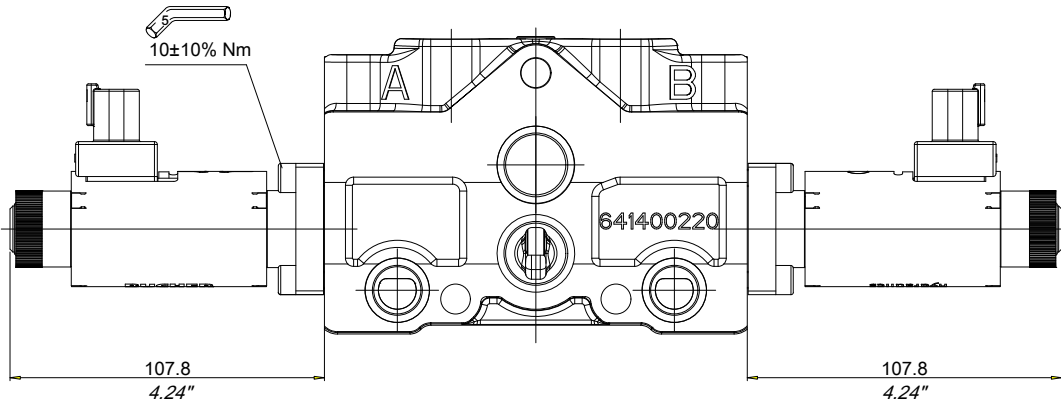
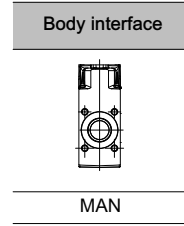


Type	Code	Colour	Manual override
178	200768690260	YELLOW	Y
179	200768690270	YELLOW	N

For types of coils see 6.1.1

For other types of springs see section 3.3.1

3.4 Direct acting ON-OFF control



Solenoid tube mechanical characteristics	
Max peak pressure	100 bar (1450 PSI)
Max static pressure	250 bar (3630 PSI)

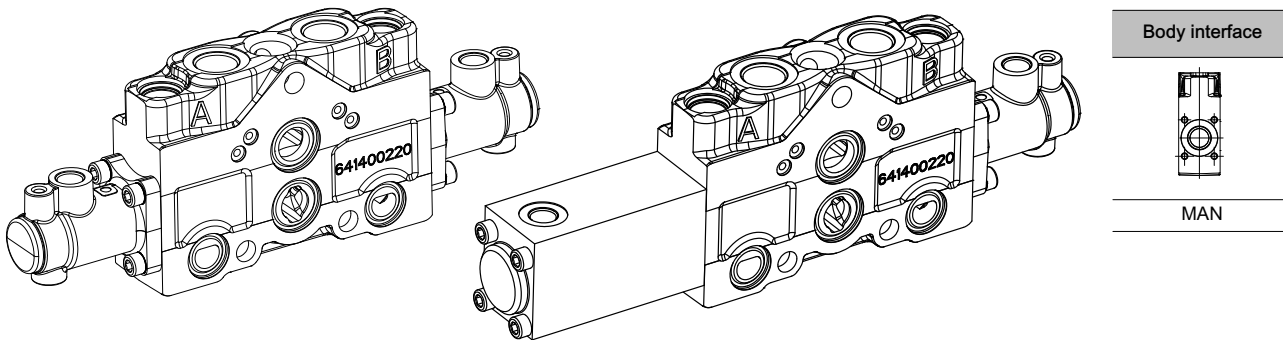
In operating conditions for a proper functionality of the directional valve the tank line pressure cannot exceed 20 bar.

Type	Double acting	Type	Single acting port "B"	Type	Single acting port "A"
01E		02E		03E	

For coils see section 6.1.2.

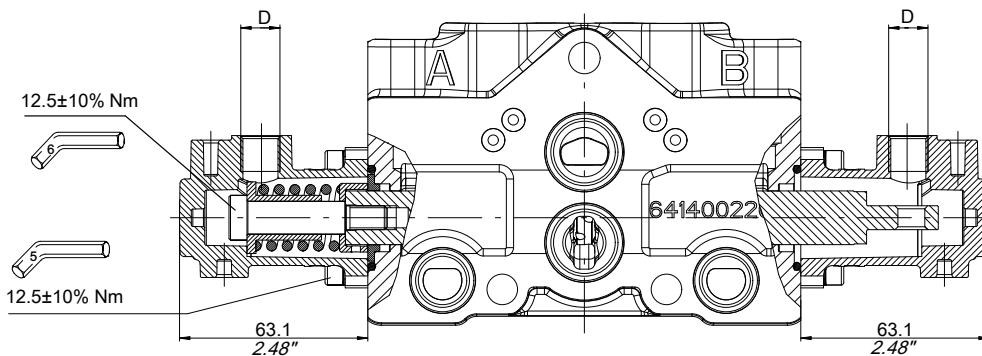
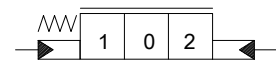
3.5 Hydraulic controls (HP)

The standard position of positioner kits is on A port side

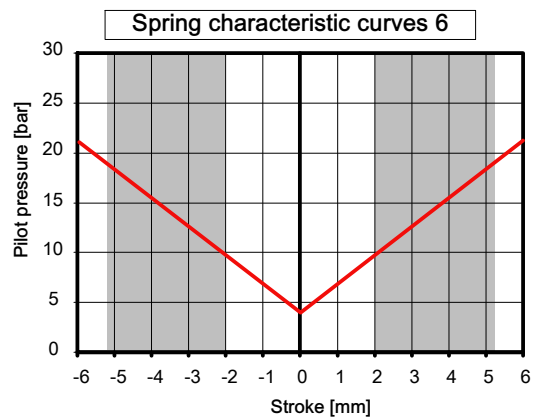
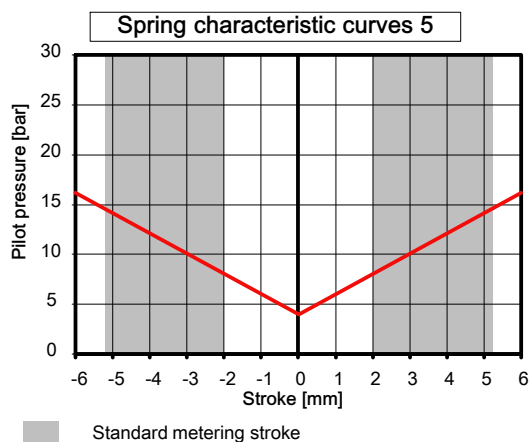
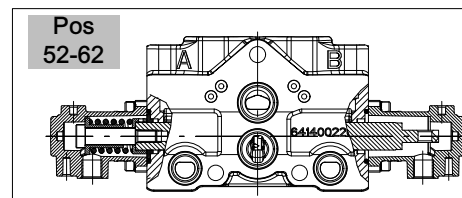


3.5.1 Standard positioners

$P_{max} = 40 \text{ bar (580 PSI)}$



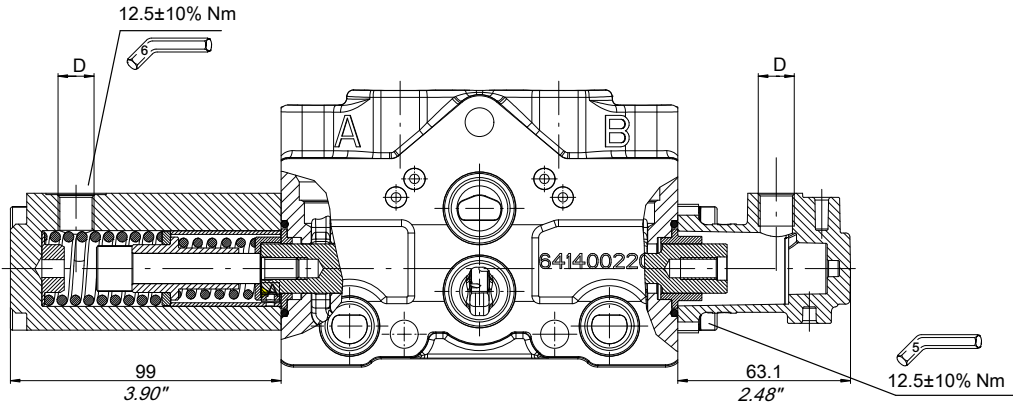
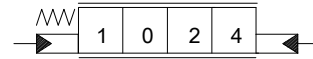
Type	D	Spring	Code	
50	52	1/4" BSP	5	200768650691
-	-	SAE6	-	-
60	62	1/4" BSP	6	200768650701
-	-	SAE6	-	-



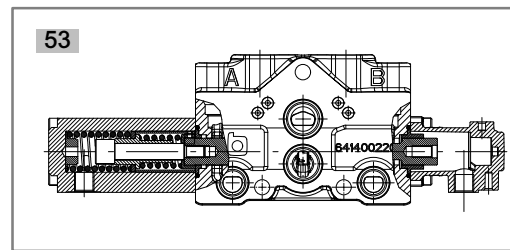
Spools for specific applications/functions could have different metering strokes

3.5.2 Floating positioners

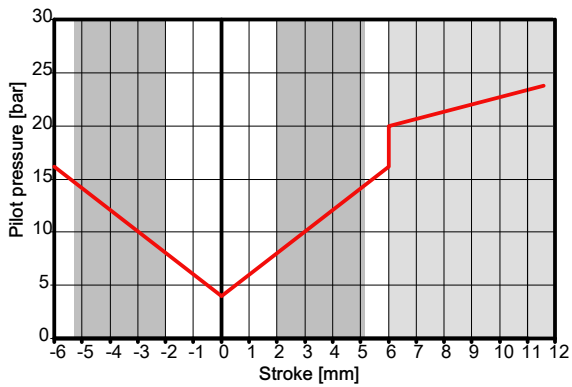
Pmax= 40 bar (580 PSI)



Type	D	Spring	Code	
51	53	1/4" BSP	5	200768650681
-	-	SAE6	-	-



Spring characteristic curve 5

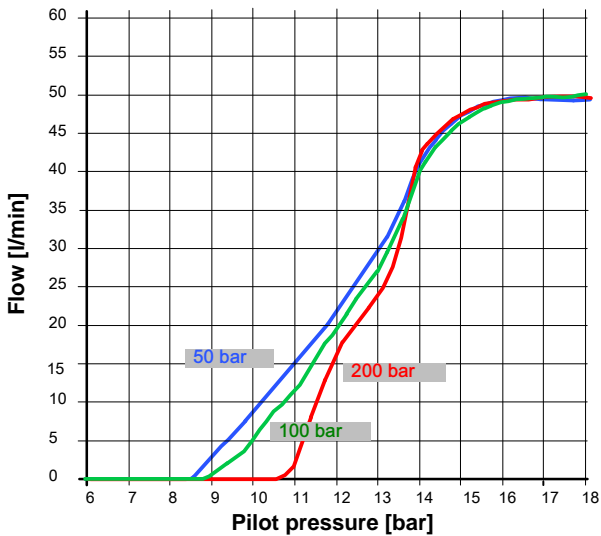


Standard metering stroke Floating

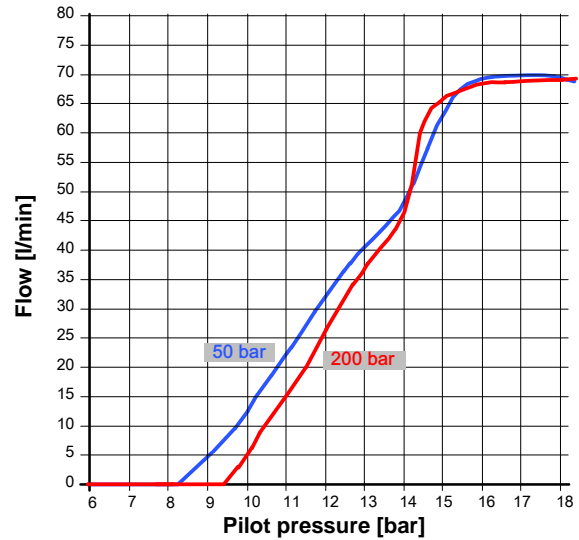
Spools for specific applications/functions could have different metering strokes
Only for W spool applications

3.5.3 Spool size 5 metering curves - Spring type 5

Spool metering: P→A→B→T (inlet flow 50 l/min)

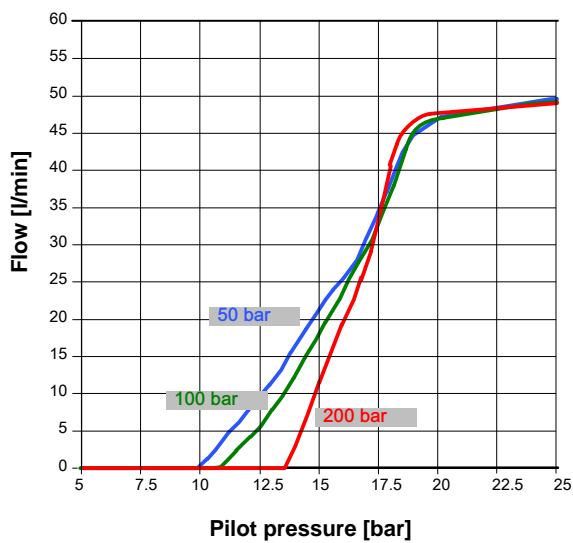


Spool metering: P→A→B→T (inlet flow 70 l/min)

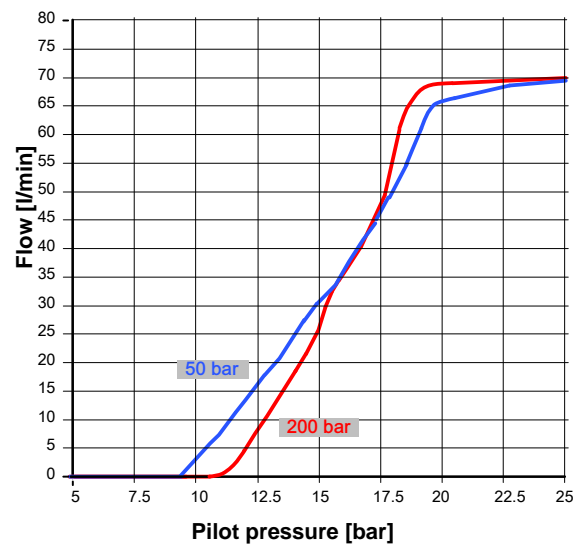


3.5.4 Spool size 5 metering curves - Spring type 6

Spool metering: P→A→B→T (inlet flow 50 l/min)

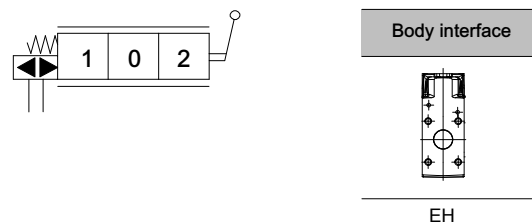
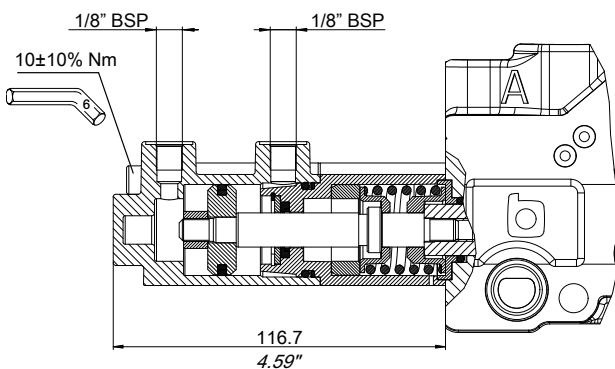


Spool metering: P→A→B→T (inlet flow 70 l/min)



3.6 Pneumatic control

The standard position of positioner kits is on A port side



Type	Code
24	200768650760

Operating conditions

Hydraulic control:

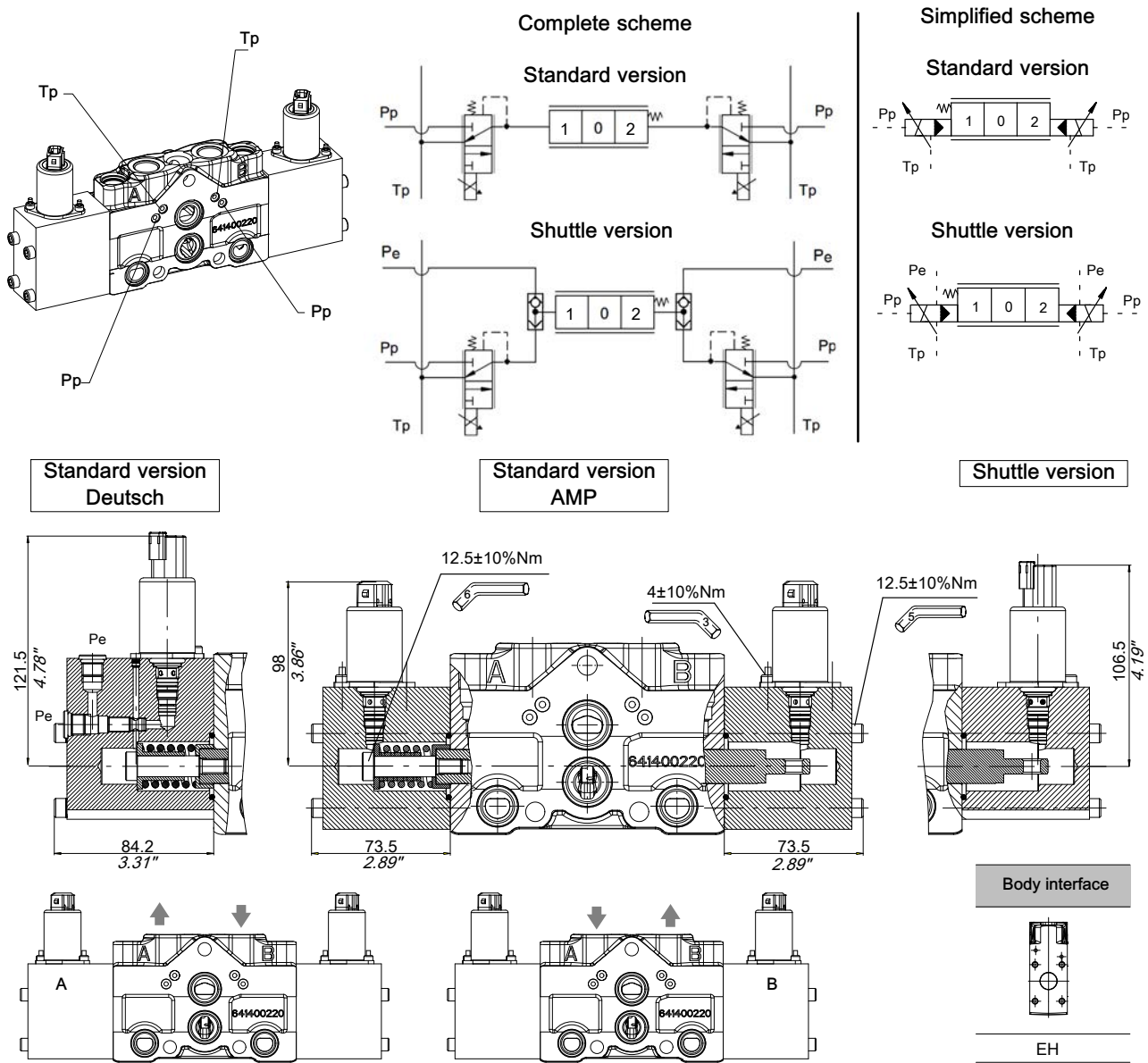
Pressure range: min. 6 bar (87 psi) - max. 15 bar (217 psi)

Pneumatic control:

Pressure range: min. 6 bar (87 psi) - max. 10 bar (145 psi)

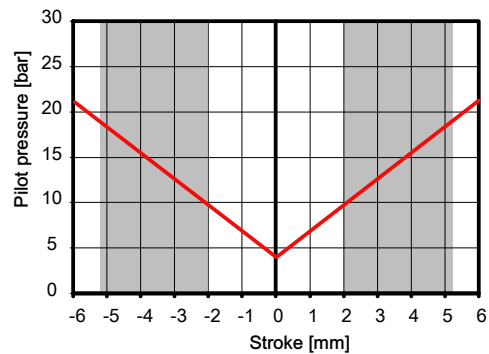
3.7 Electro-hydraulic open loop proportional / ON-OFF control (EHO)

The standard position of positioner kits is on A port side



EHO positioner spring curve 6

Type	Code	Voltage (VDC)	Connector	Version
310B	200768661030	12	AMP	Standard
311B	200768661300	24	AMP	
312B		12	Deutsch	
313B	200768660920	24	Deutsch	
343B	200768661051	24	Deutsch	Shuttle



Standard metering stroke

Spools for specific applications/functions could have different metering strokes

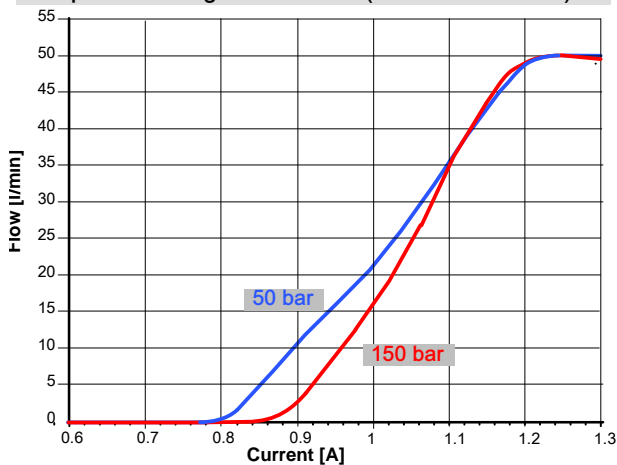
The pressure differential between pilot lines Pp and Tp should be > 25 bar in order to be sure to switch the spool to full stroke in all operating conditions

Electro-hydraulic specifications	12 V	24 V
Nominal flow rate	4 l/min (1 GPM)	
Max pilot pressure	40 bar (580 psi)	
Max pilot lines back pressure	10 bar (145 psi)	
Rated supply voltage	12 VDC	24 VDC
Current supply characteristic	PWM (Pulse width modul.)	
Maximal current	1500±10 mA	750±10 mA
Superimposed dither frequency	100 ÷ 150 Hz	
Degree of protection	AMP IP65 / Deutsch IP69K	
Pp filter screen	125 µm	
Coil resistance	4.7 Ohm ±5%	20.8 Ohm ±5%
Response time	< 50 ms	
Leakage from Pp to Tp	< 30 cc/min. at 35 bar and 50°C (< 0.9 cu.in./min. at 500 psi and 176 °F)	
Duty cycle	ED 100%	
Connector Type	AMP Junior timer (AMP84-9419) / DEUTSCH DT04-2P	
Connector colour	MOSSY-GREY	BLACK
Code (*)	200533960015 (DEUTSCH) 200533960016 (AMP)	200533960013 (DEUTSCH) 200533960014 (AMP)

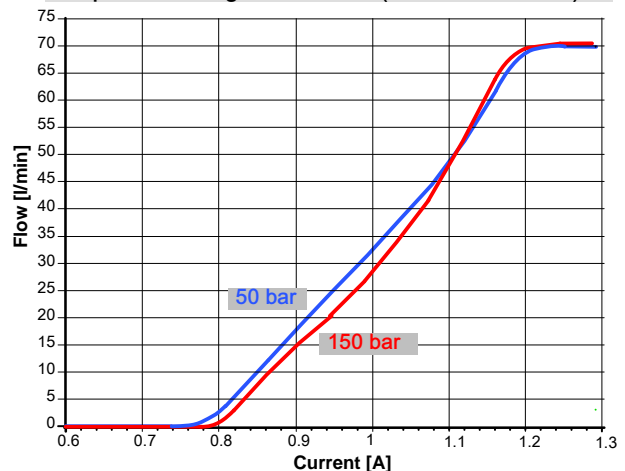
(*) nr. 2 screws M4x12 are not included

3.7.1 Spool metering curves 12 V

Spool metering : P→A→B→T (inlet flow 50 l/min)

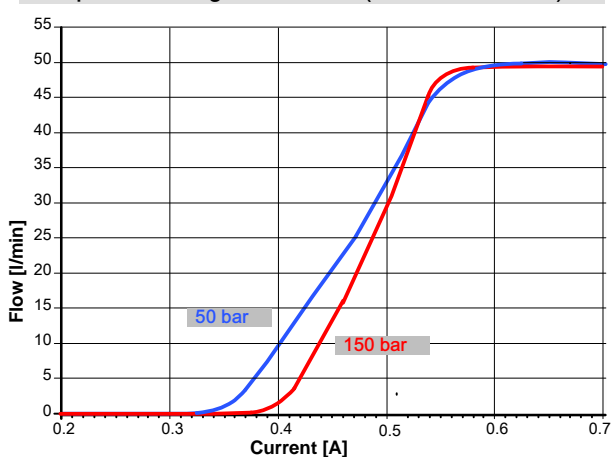


Spool metering: P→A→B→T (inlet flow 70 l/min)

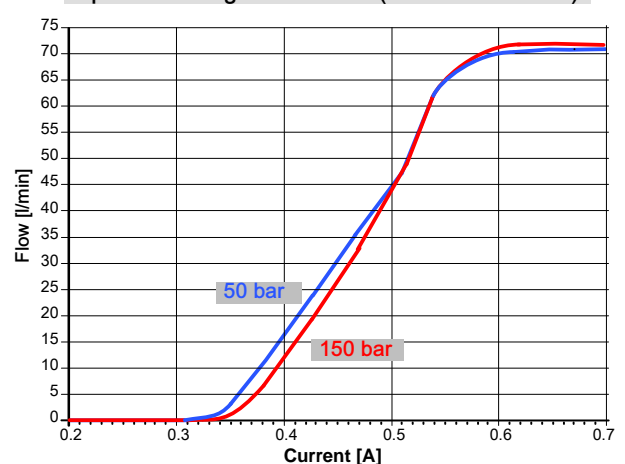


3.7.2 Spool metering curves 24 V

Spool metering: P→A→B→T (inlet flow 50 l/min)



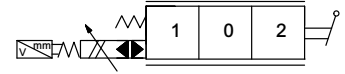
Spool metering: P→A→B→T (inlet flow 70 l/min)



3.8 Electro-hydraulic proportional control with lever option (EHM)

The standard position of positioner kits is on A port side

Type	Code	Voltage
390B	-	12/24 V DC

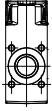


Lever side

Positioner side

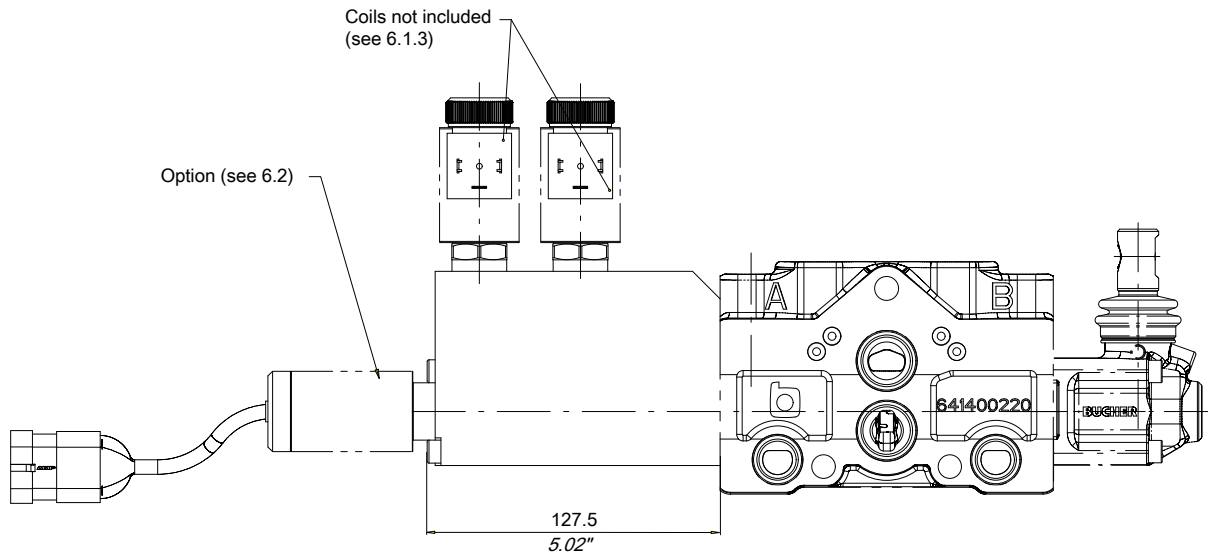
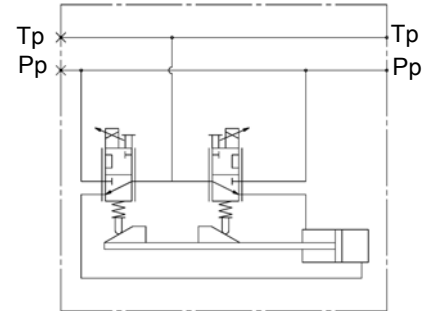
Body interface

Body interface



MAN

EH



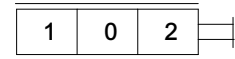
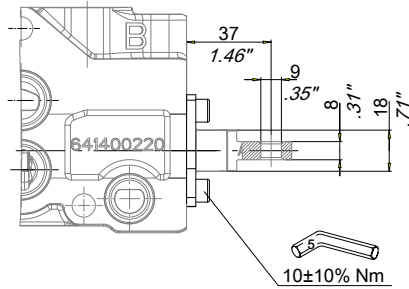
A special body is requested.

3.9 Levers

The standard position of lever kits is on B port side.

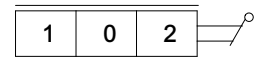
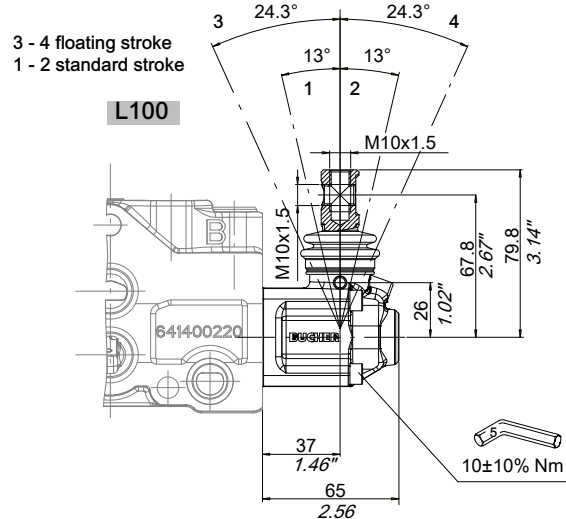
3.9.1 Free end spool with dust proof seal

Type	Code
L55	200707190050



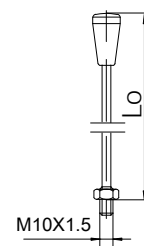
3.9.2 Standard lever group

Type	Code
L100 L300	200707120670



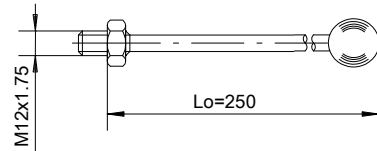
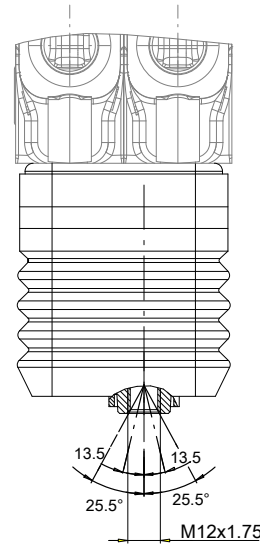
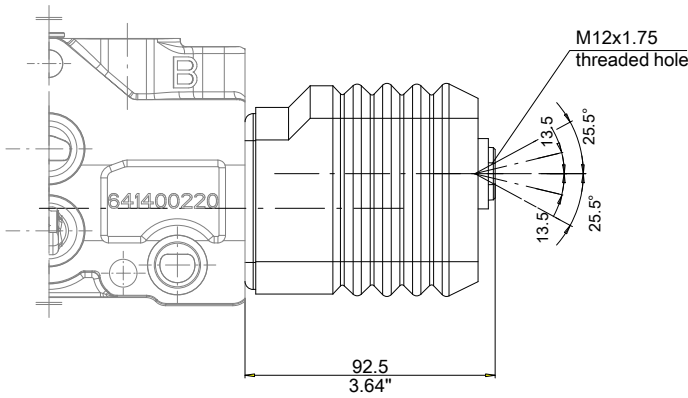
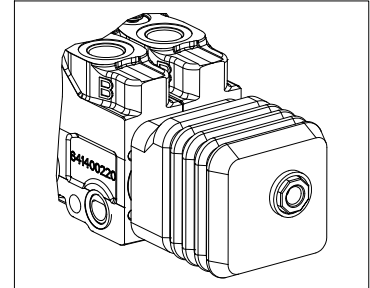
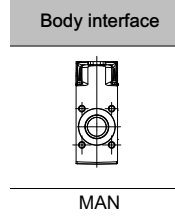
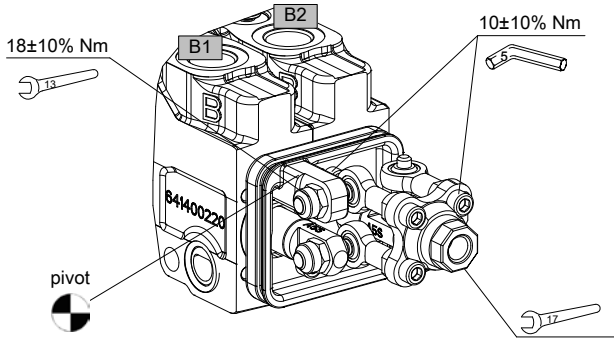
Lever stick

Lo		Type	Code
mm	inches		
190	7.48	AL001	200702220010
255	10.04	AL002	200702220030
300	11.81	AL003	200702220040
350	13.78	AL004	200702220050



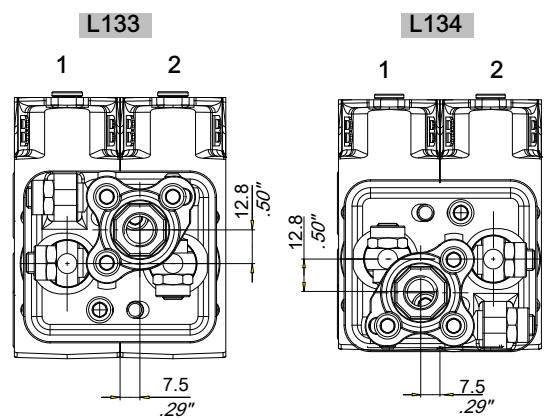
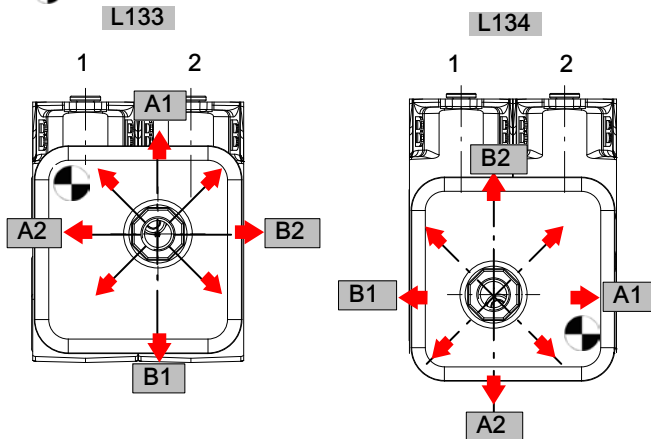
3.9.3 Standard joystick control (L133-134)

Type		Code
L133	L134	200775930470



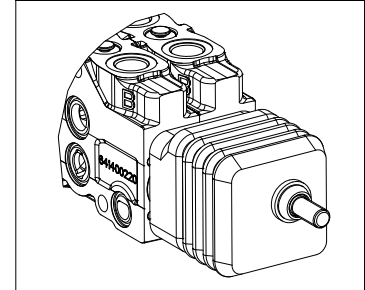
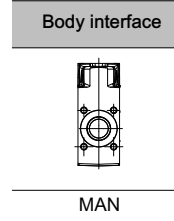
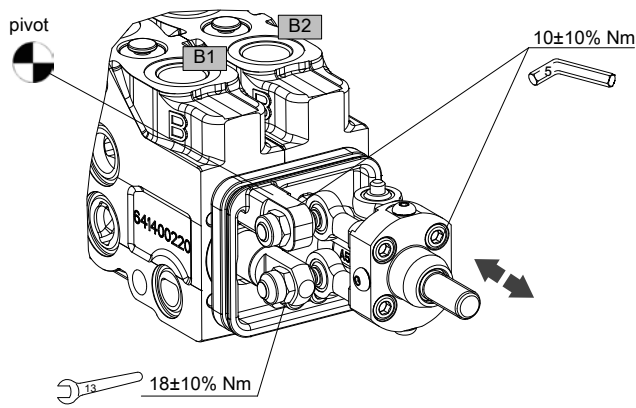
Type	Code
AL010	200702230040

Pivot

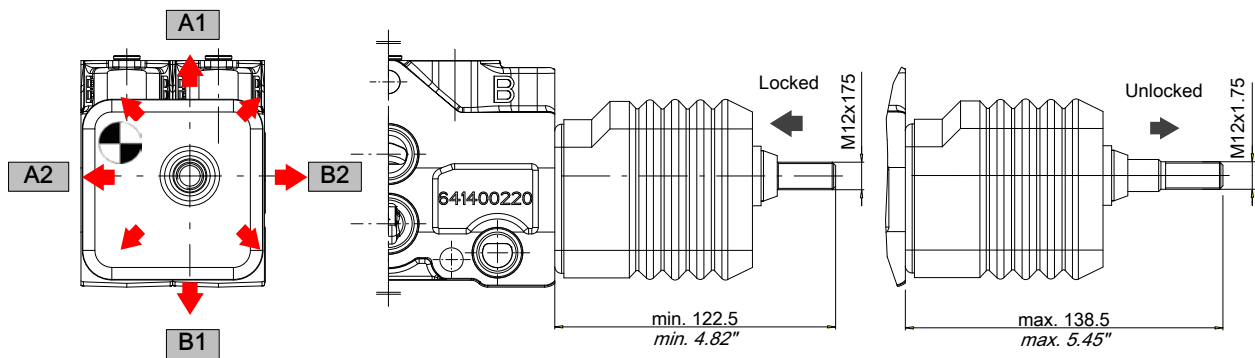


3.9.4 Joystick control with integrated locking system (L260-460)

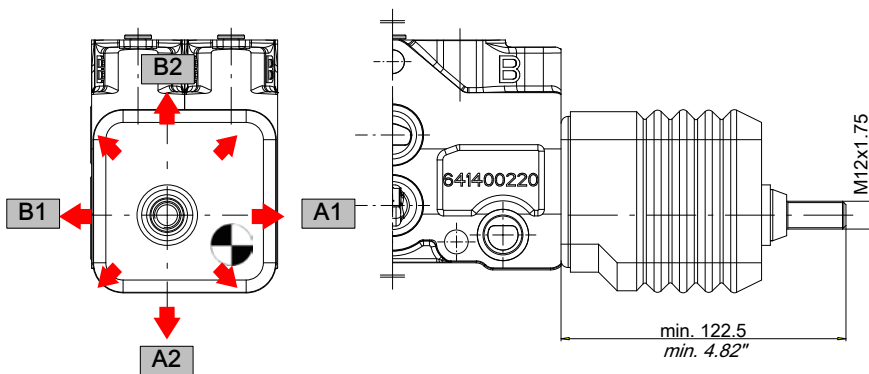
Type		Code
L260	L460	200775930480



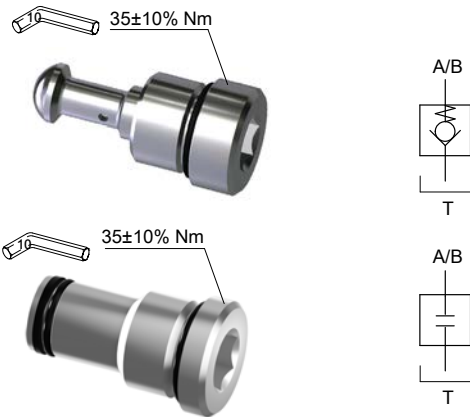
L260



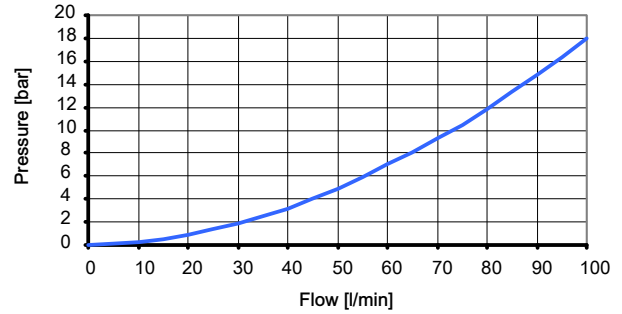
L460



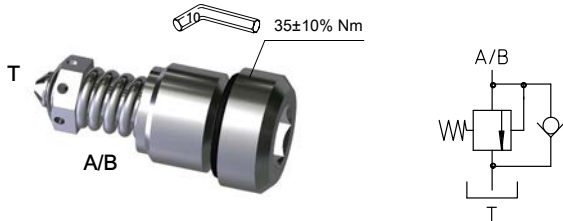
3.10 Anti-cavitation valves (C)



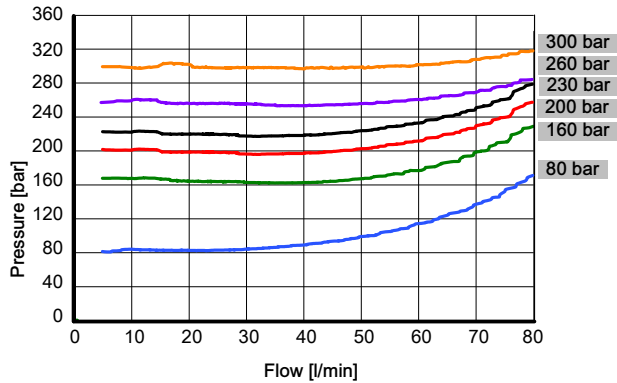
Type	Code
C	200787602560
00 (plug)	200778400310



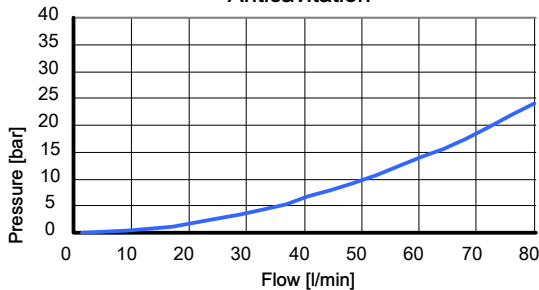
3.11 Anti-shock and anti-cavitation valves (UC)



Antishock



Anticavitation



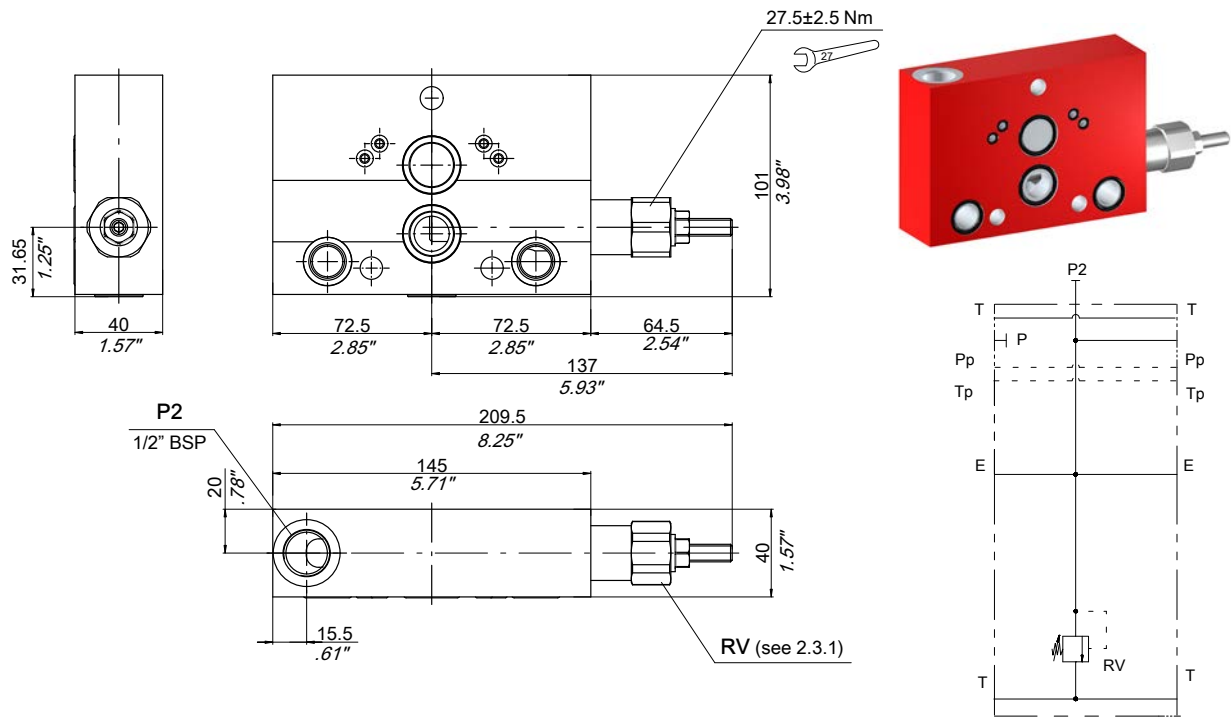
IMPORTANT!: The UC anti-shock valve is designed to absorb shock effects. Therefore, it should not be used as pressure relief valve

Setting/10	Pressure setting at 10 l/min (*) bar (psi)	Code
04	40 (580)	200533930068
06	60 (870)	200533930077
07	70 (1010)	200533930050
08	80 (1160)	200533930050
09	90 (1300)	200533930084
10	100 (1450)	200533930100
11	110 (1590)	200533930110
12	120 (1740)	200533930085
13	130 (1880)	200533930057
14	140 (2030)	200533930059
15	150 (2170)	200533930051
16	160 (2320)	200533930067
17	170 (2460)	200533930071
18	180 (2610)	200533930056
19	190 (2750)	200533930113
20	200 (2900)	200533930060
21	210 (3040)	200533930080
22	220 (3190)	200533930064
23	230 (3330)	200533930058
24	240 (3480)	200533930081
25	250 (3620)	200533930052
26	260 (3770)	200533930065
27	270 (3910)	200533930066
28	280 (4060)	200533930053
29	290 (4200)	200533930069
30	300 (4350)	200533930079
32	320 (4640)	200533930054
00	00 (plug)	200778400310

(*) For different pressure settings please contact our Sales Department

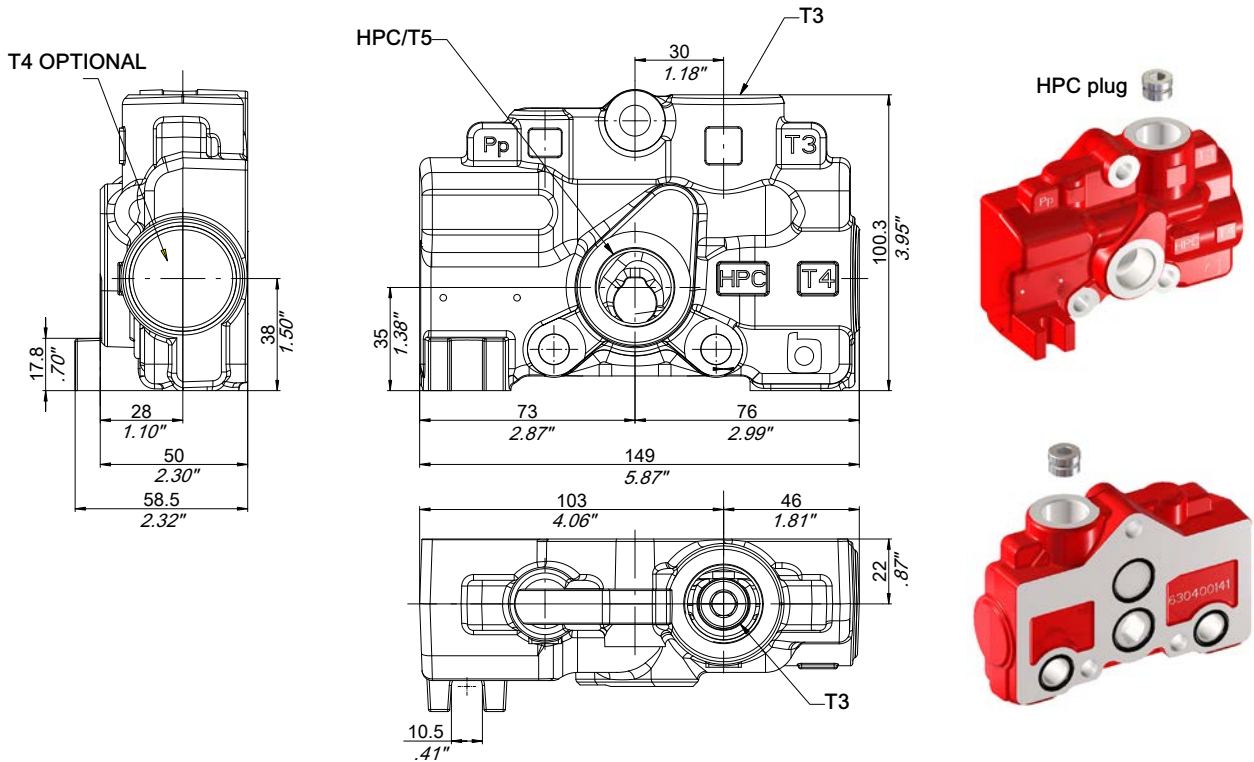
4 Intermediate sections

4.1 Intermediate inlet with relief valve (K84)

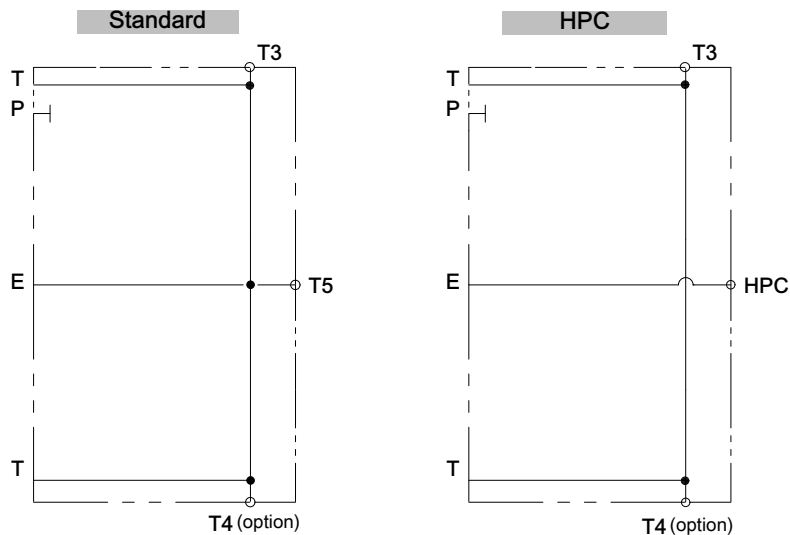


5 End covers

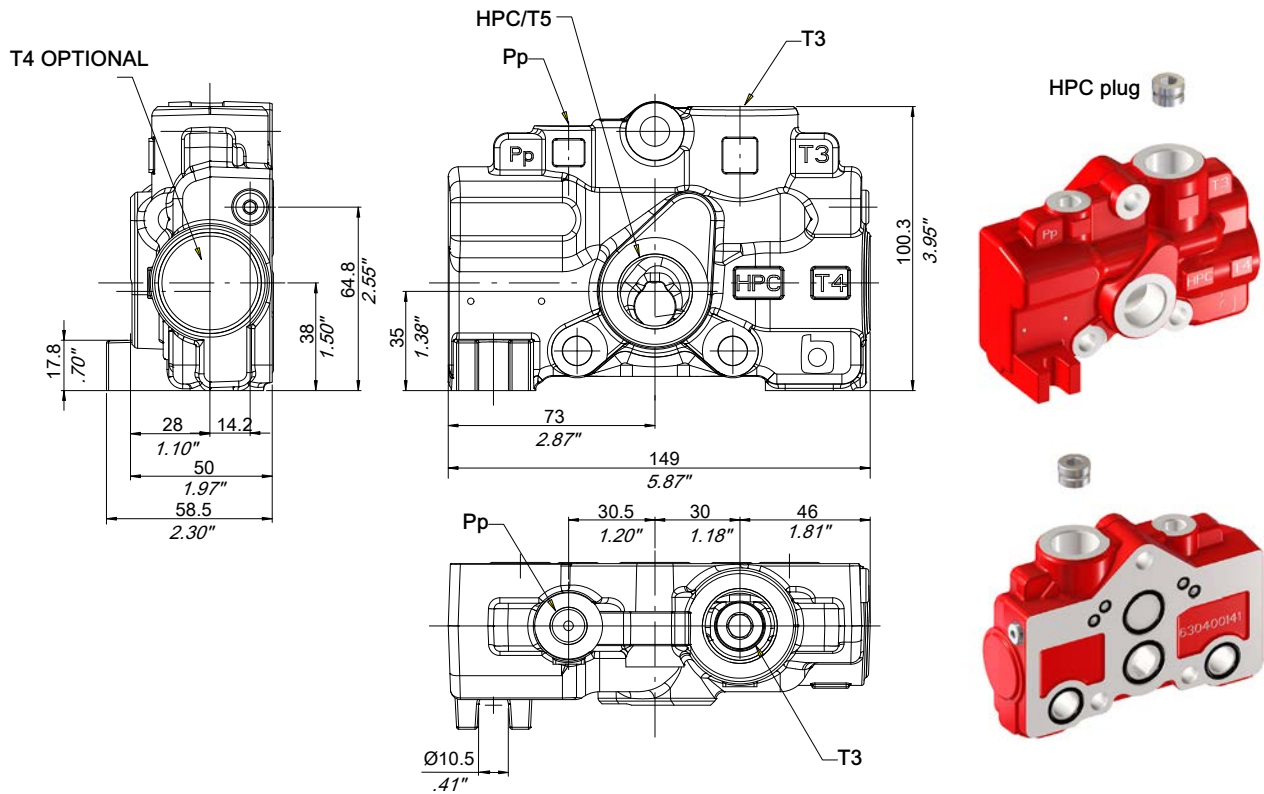
5.1 End cover without pilot lines (PM)



Type		HPC/T5	T3	T4 (Optional)
Standard	HPC			
PM 201	PM 211	3/4" BSP	3/4" BSP	-
PM 202	PM 212	3/4" BSP	3/4" BSP	3/4" BSP
PM 301	PM 311	SAE10	SAE10	-
PM 302	PM 312	SAE10	SAE10	SAE10
PM 501	PM 511	M22x1.5	M22x1.5	-
PM 502	PM 512	M22x1.5	M22x1.5	M22x1.5



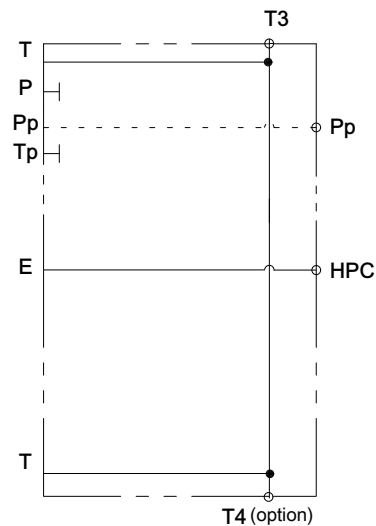
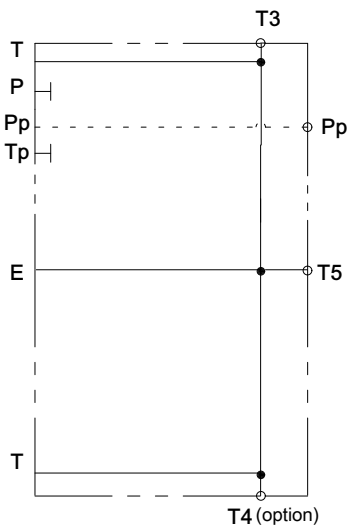
5.2 End cover with pilot lines (PH)



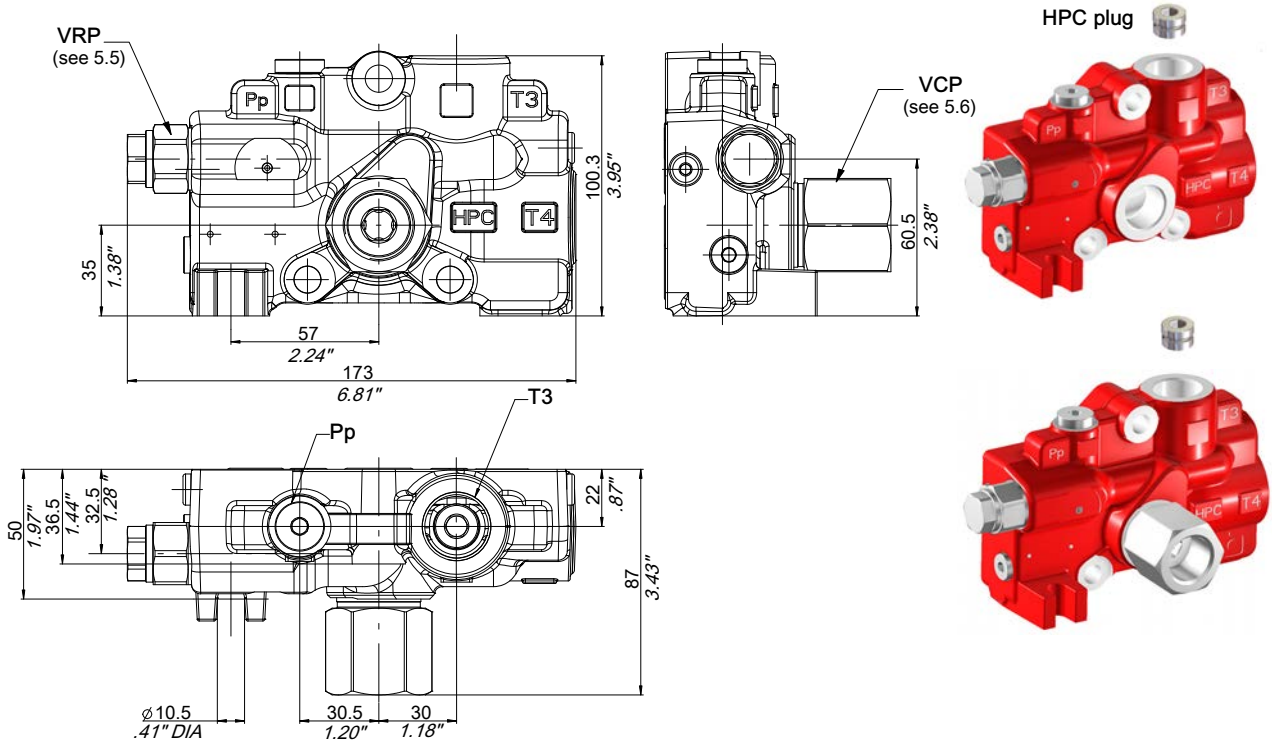
Type		HPC/T5	Pp	T3	T4 (Optional)
Standard	HPC				
PH 201	PH 211	3/4" BSP	1/4" BSP	3/4" BSP	-
PH 202	PH 212	3/4" BSP	1/4" BSP	3/4" BSP	3/4" BSP
PH 301	PH 311	SAE10	SAE6	SAE10	-
PH 302	PH 312	SAE10	SAE6	SAE10	SAE10
PH 501	PH 511	M22x1.5	M14x1.5	M22x1.5	-
PH 502	PH 512	M22x1.5	M14x1.5	M22x1.5	M22x1.5

Standard

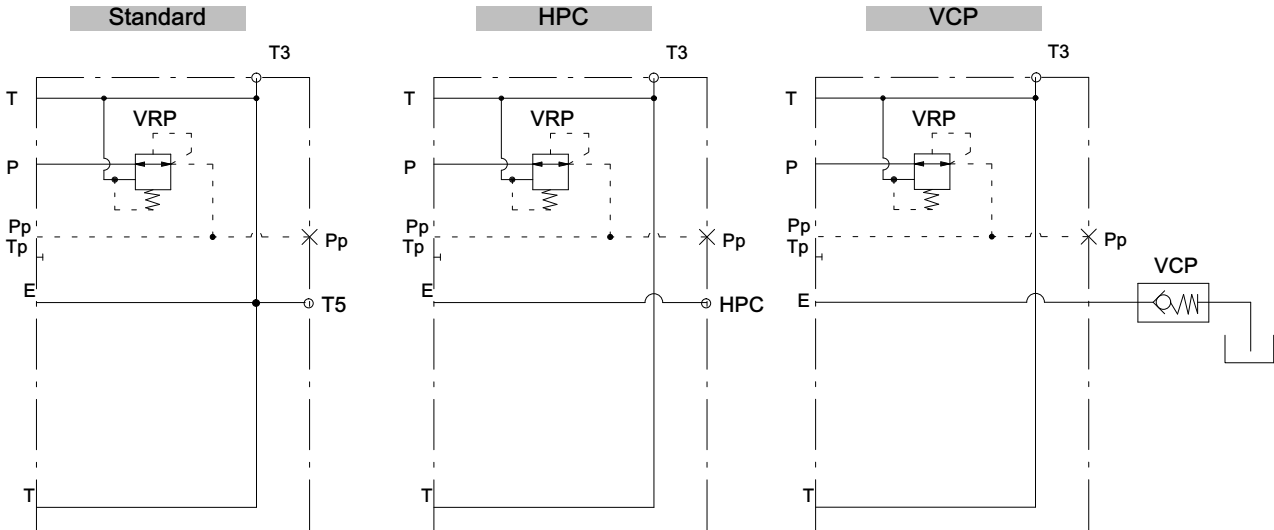
HPC



5.3 End cover with pilot lines and pilot oil supply pressure reducing valve (PH)



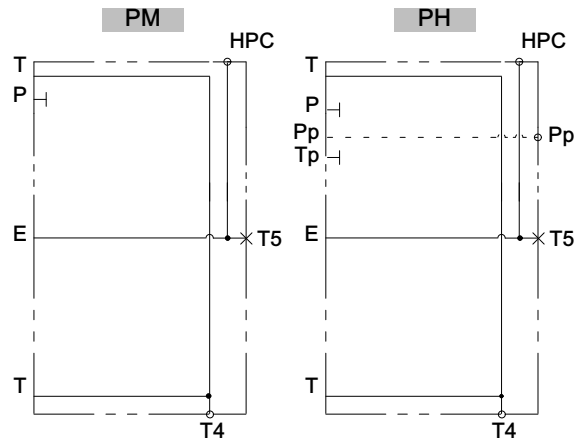
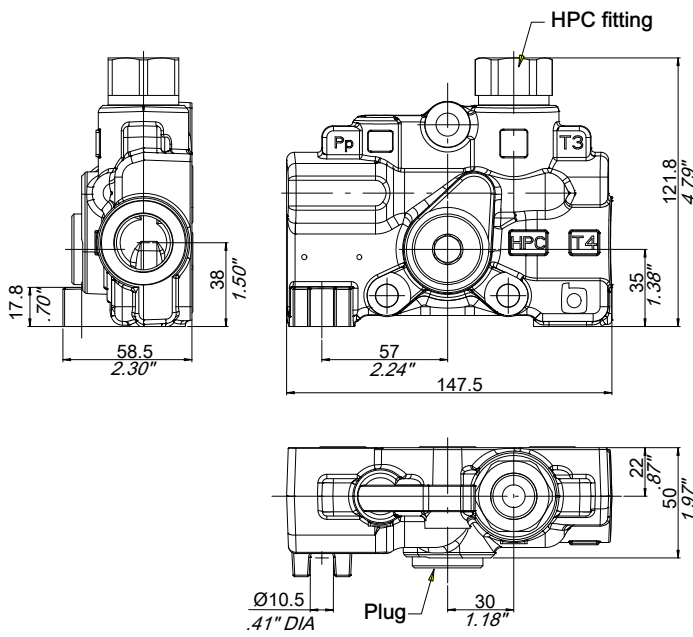
Type		HPC/T5	Pp	T3	T4 (Optional)
Standard	HPC				
PH 203	PH 213	3/4" BSP	1 / 4" BSP	3/4" BSP	-



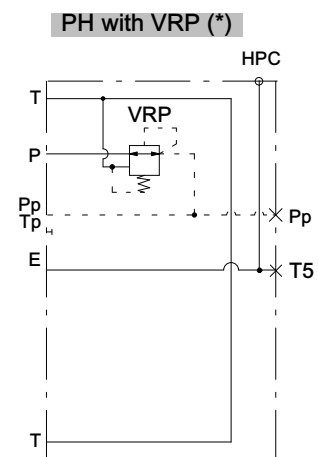
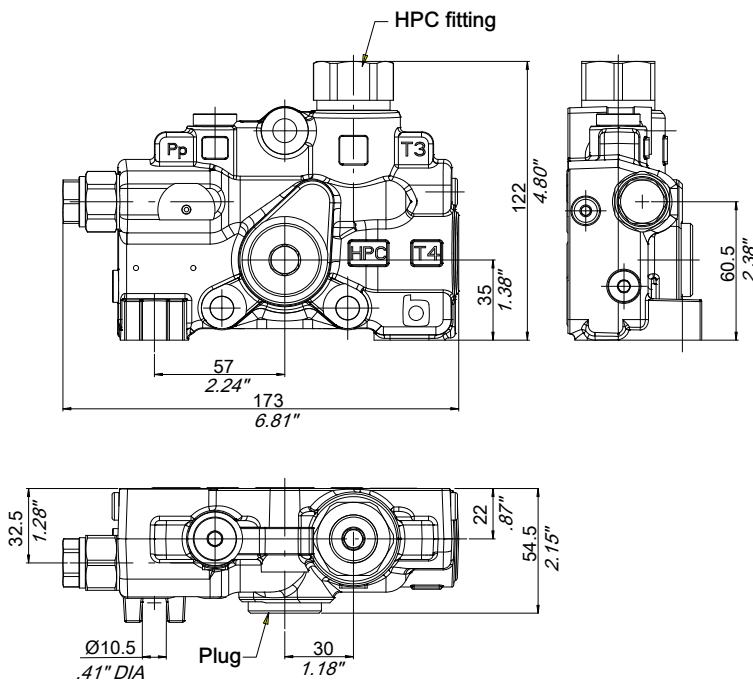
5.4 Upper HPC kit



5.4.1 PM/PH standard type (with T4)



5.4.2 PH standard with VRP type



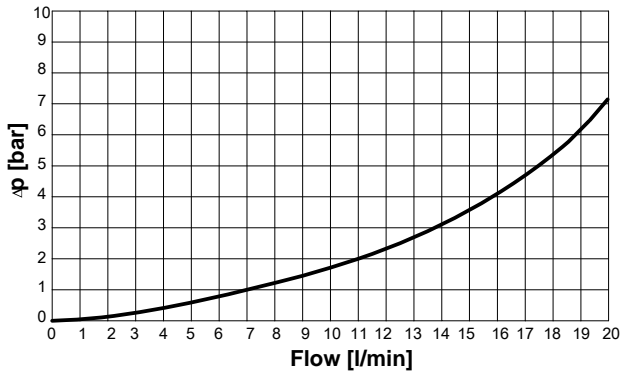
(*) the tank port in the inlet cover must be used.

5.5 Pressure reducing valve (VRP)

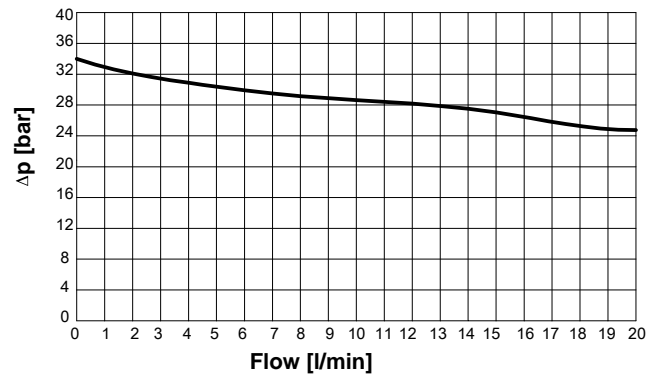


Type	Code	Nominal pressure (bar)
VRP32	200533930174	32

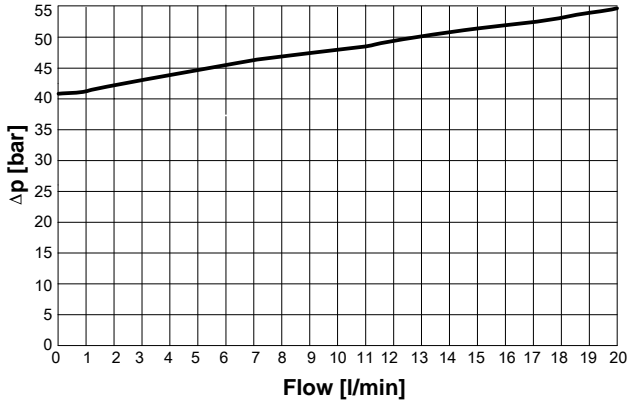
Pressure Vs. Flow Curve P → Pp (Fully open)



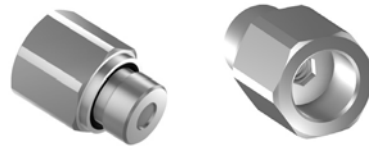
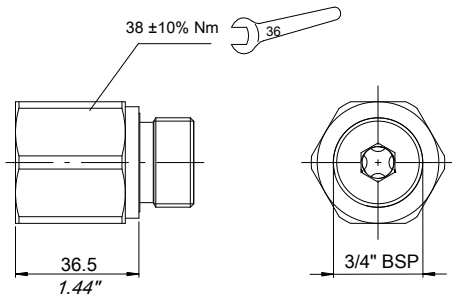
Pressure Vs. Flow Curve P → Pp (Reducing)



Pressure Vs. Flow Curve Pp → T (Relieving)

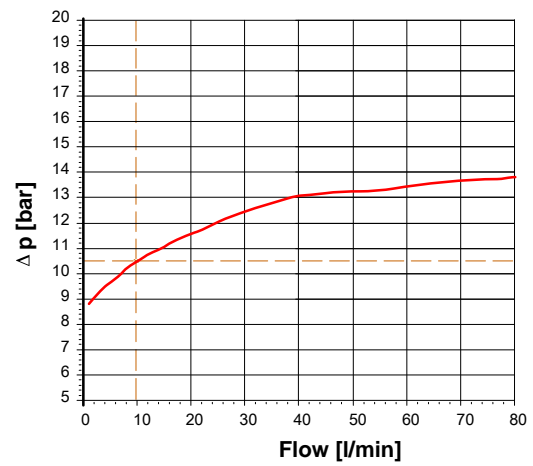


5.6 Back pressure valve (VCP)



Type	Code	Nominal pressure (bar)
VCP12	200787404340	12

VCP characteristic curve (cartridge valve only)
Valve set at 10 bar with 10 l/min.

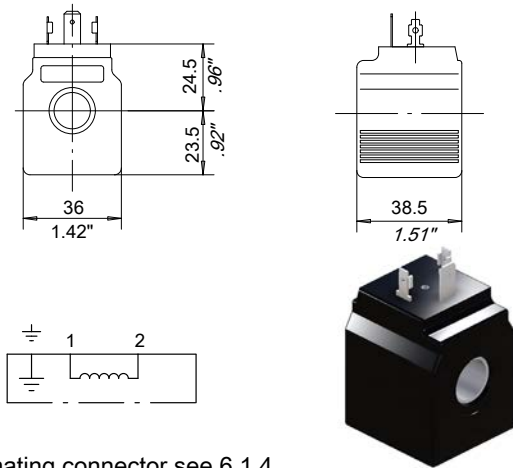


6 Additional electric and electronic devices

6.1 Coils and connectors

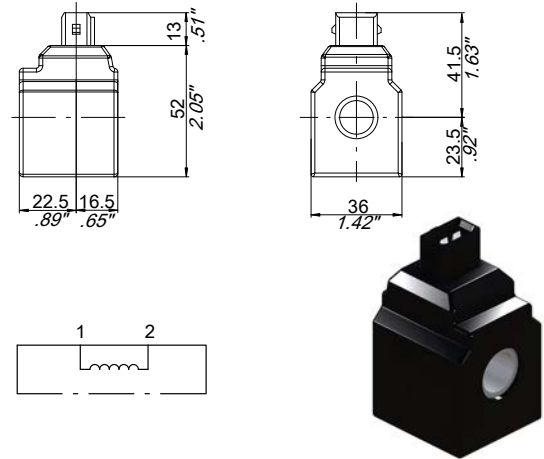
6.1.1 Solenoid valve coils (Ø13)

DIN 43650-A/ISO4400 connector

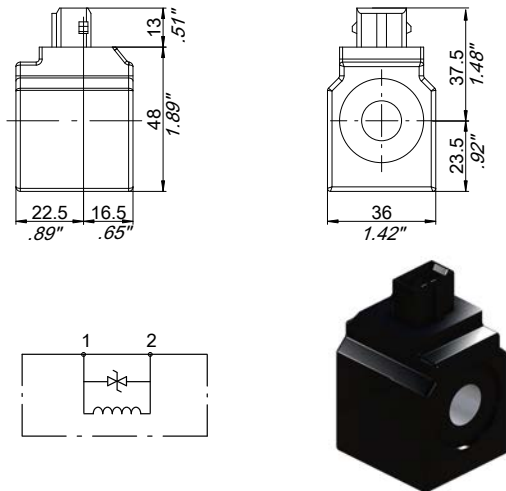


For mating connector see 6.1.4

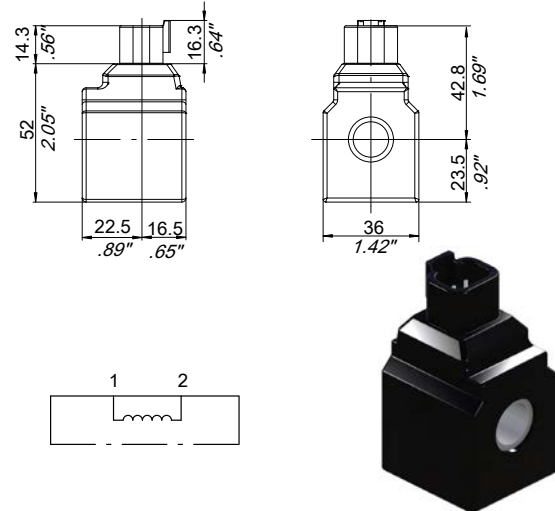
AMP JT 84-9414 connector



AMP JT 84-9419 connector



Deutsch DT04-2P connector



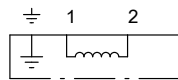
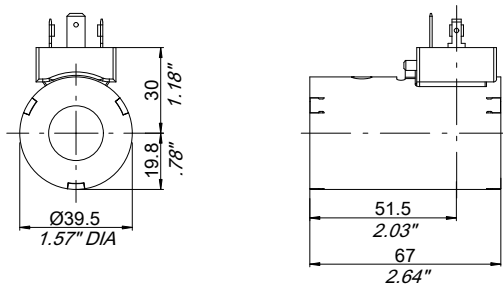
For solenoid valve series

Wire class	H (VDE0580)
Duty cycle	ED 100%
Voltage tolerance	± 10%

Connector style	Type	IP	Code	Nominal coil voltage (VDC)	Power (Watt)	Current consumption at 20°C (Ampere)	Resistance at 20°C (Ohm)
DIN	12 H -	65	200674910100	12	27.2	2.2	5.3
	24 H -		200674920080	24	27	1.12	21.3
AMP	12 A -	65	200674910250	12	27.2	2.2	5.3
	24 A -		200674920200	24	27	1.12	21.3
AMP + DIODE	12 A D	65	200541210032	12	21	1.75	6.85
	24 A D		200541220033	24	21	0.78	27
DT	12 D -	67	200674910370	12	27	2.2	5.3
	24 D -		200674920290	24	27.2	1.12	21.3

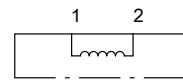
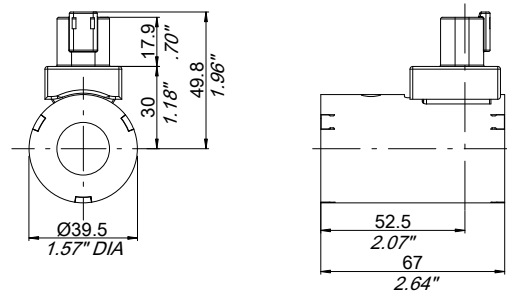
6.1.2 ON-OFF positioner coils (Ø19)

DIN 43650-A/ISO4400 connector

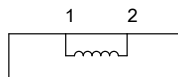
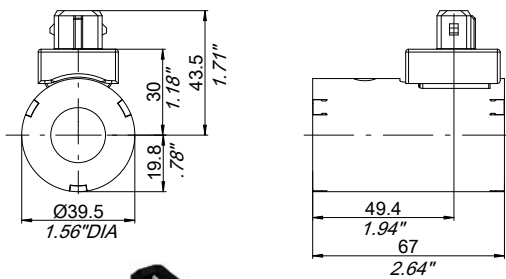


For mating connector see 6.1.4

Deutsch DT04-2P connector



AMP JT-84-9419 connector



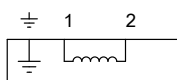
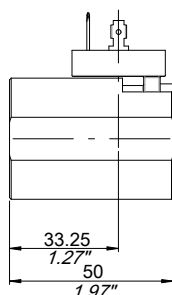
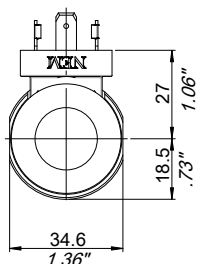
For solenoid valve series

Wire class	H (VDE0580)
Duty cycle	ED 100%
Voltage tolerance	± 10%
Magnetic frame protection	Fe/ZnNi5/Cn/T0 (DIN 50979)

Connector style	Type	IP	Code	Nominal coil voltage (VDC)	Power (Watt)	Current consumption at 20°C (Ampere)	Resistance at 20°C (Ohm)
DIN	12 H -	65	200674910430	12	29	2.35	5.1
	24 H -		200674920320	24	25	1.12	21.5
AMP	12 A -	65	200674910450	12	29	2.35	5.1
	24 A -		200674920340	24	25	1.12	21.5
DT	12 D -	67	200674910440	12	29	2.35	5.1
	24 D -		200674920330	24	25	1.12	21.5

6.1.3 EHM positioner coils (Ø19)

DIN 43650-A/ISO4400 connector



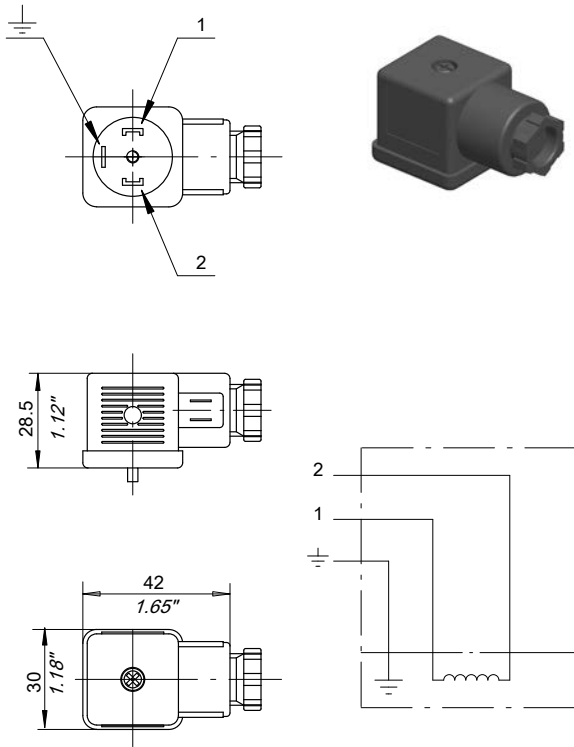
For solenoid valve series	
Wire class	H (VDE0580)
Duty cycle	ED 100%
Voltage tolerance	± 10%

For mating connector see 6.1.4

Connector style	Type	IP	Code	Nominal coil voltage (VDC)	Power (Watt)	Current consumption at 20°C (Ampere)	Resistance at 20°C (Ohm)
DIN	12 H -	65	200541210043	12	38	1.80	3.7
	24 H -		200541220042	24	38	0.9	15.5

6.1.4 DIN43650-A/ISO4400 connector

Type	Code
DIN43650-A/ISO4400	200544110009



For power input	D.C.
Number of poles	2 + \perp
Supply voltage	max. 220 V.
Nom. capacity at contacts	10 A.
Max capacity at contacts	16 A.
Resistance at contacts	≥ 4 mOhm
Max section of cable	1.5 mm ²
Outer material	Glass fibre reinforced Nylon
Contact mount material	
Color	Black
Armour clamp	Pg 9
Ø cable	6-8 mm.
Protection factor	IP65 (DIN40050)
Insulation class	C (VDE0110)
Temperature range	-40 / +90 °C

To be ordered separately, not included in the coil.

6.2 Spool position hall effect sensor

6.2.1 Proportional

Connector style	Type	Codes
AMP	PS A	200544124029
Deutsch	PS D	200544124033

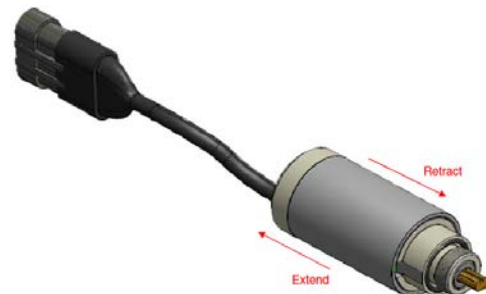
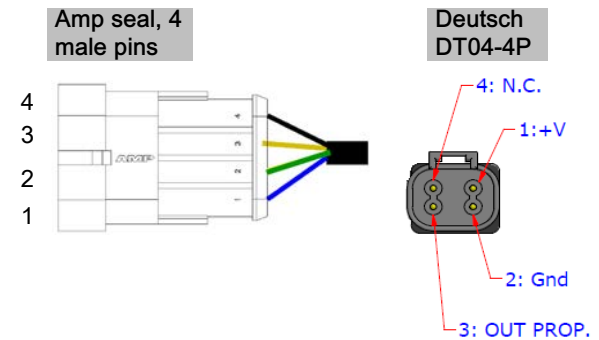
Mechanical specifications	
Maximum mechanical stroke	$\geq \pm 8.5$ mm
External diameter	35 mm
Body length	91 ± 8.5 mm
Cable length (including connector)	350 mm
Maximum operating pressure	5 MPa (50bar)
Operating temperature range	$-25^{\circ}\text{C} / +105^{\circ}\text{C}$
Protection class	IP 67

Electrical specifications - Linear, Hall-effect sensor	
Power Supply Voltage	$7 \div 32$ Vdc
Current Consumption	< 20 mA
Output signal in Neutral	2.5 V
Output signal range	$1 \text{ V} \div 4 \text{ V}$
Tolerance on output signal	± 0.1 V
Maximum linearity error ($-25 \div 105^{\circ}\text{C}$)	$\pm 2\%$
Max. Electrical stroke linearity range	± 7.5 mm (adjustable)
Insulation resistance	>500 M Ω @ 500 V

Statistical data (reliability)	
MTTFd	127 y
DC	low

Electrical Connections

1. Vcc - Blue
2. Gnd - Green/Yellow
3. Proportional Output - Brown
4. n.u. - Black

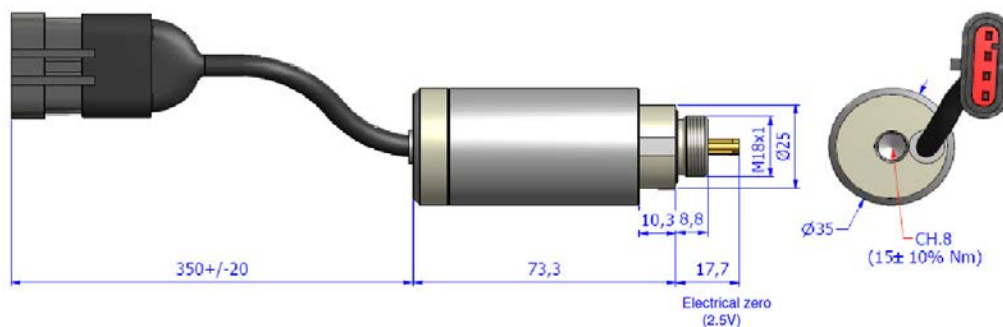


Output signal control characteristic (proportional version)



Red lines: $-25 / +85^{\circ}\text{C}$

Green lines: $85 / 105^{\circ}\text{C}$



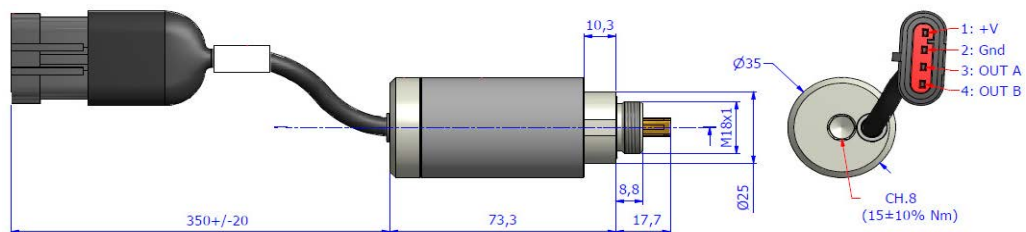
6.2.2 ON-OFF

Connector style	Type	Codes
AMP	OS A	200544124032

Mechanical specifications	
Maximum mechanical stroke	$\geq \pm 8.5$ mm
External diameter	35 mm
Body length	91 ± 8.5 mm
Cable length (including connector)	350 mm
Maximum operating pressure	5 MPa (50bar)
Operating temperature range	-25°C / +105°C
Protection class	IP 67
Connector	Amp seal, 4 male pins
Mechanical life	5 Million cycles

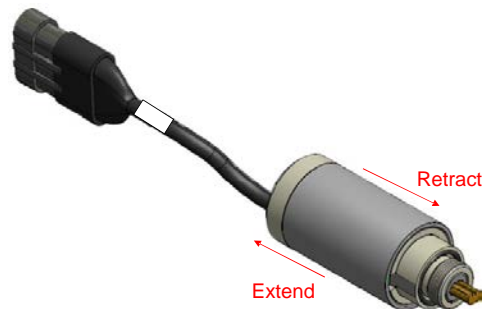
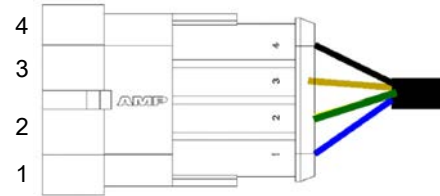
Electrical specifications - Linear, Hall-effect sensor	
Power Supply Voltage	$7 \div 32$ Vdc
Current Consumption	< 20 mA
Output signal (inactive)	> VBATT-1 V
Output signal (active, external pull-down)	< 1 V
Switching threshold	1 mm
Hysteresis on switching threshold	0.3 mm
Insulation resistance	>500 M Ω @ 500 V

Statistical data (reliability)	
MTTFd	127 y
DC	low

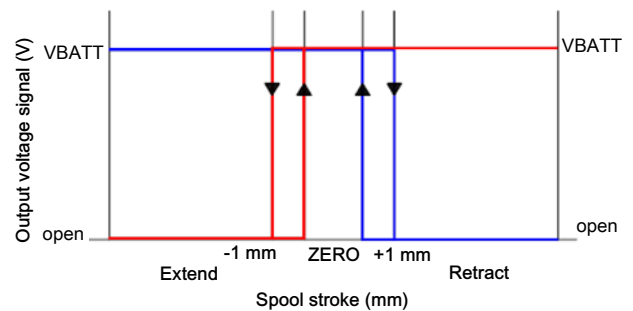


Electrical Connections (proportional version)

1. Vcc - Blue
2. Gnd - Green/Yellow
3. OUT A (Retract) - Brown
4. OUT B (Extend) - Black

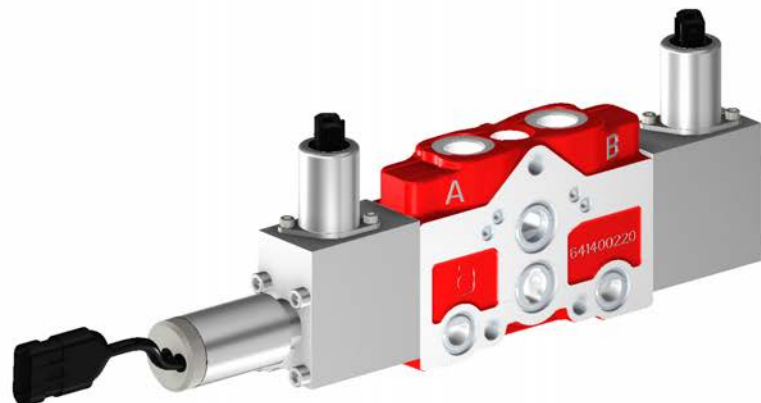
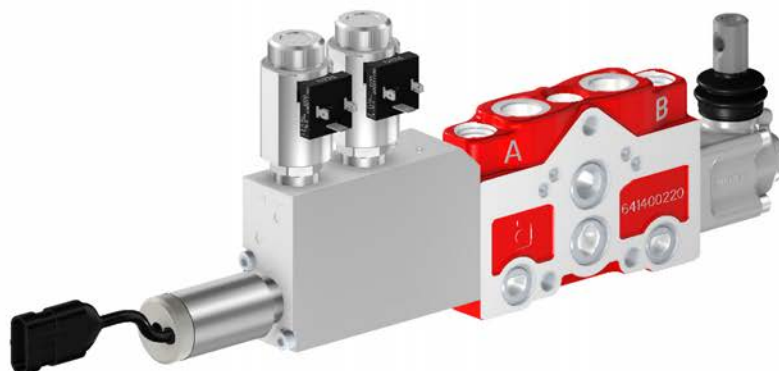
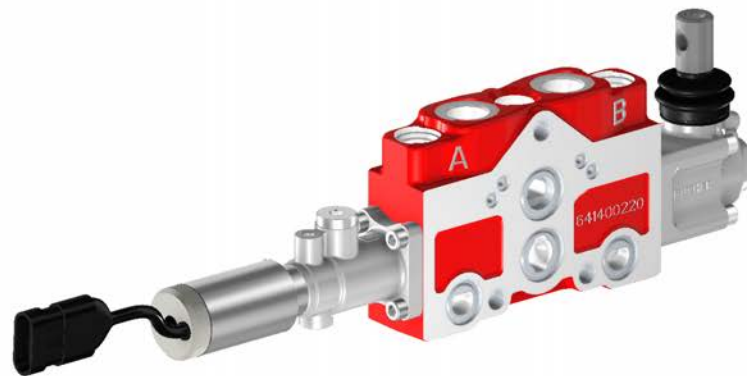
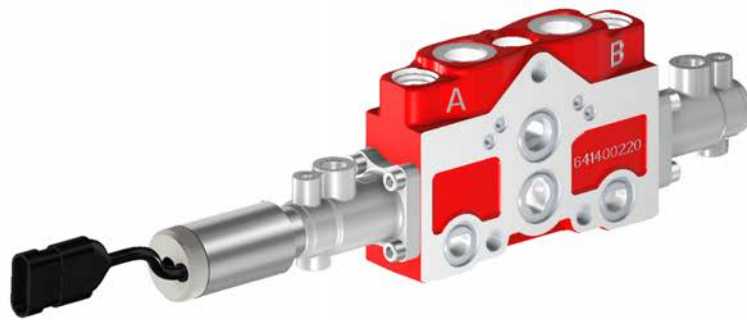


Output signal control characteristic (proportional version)



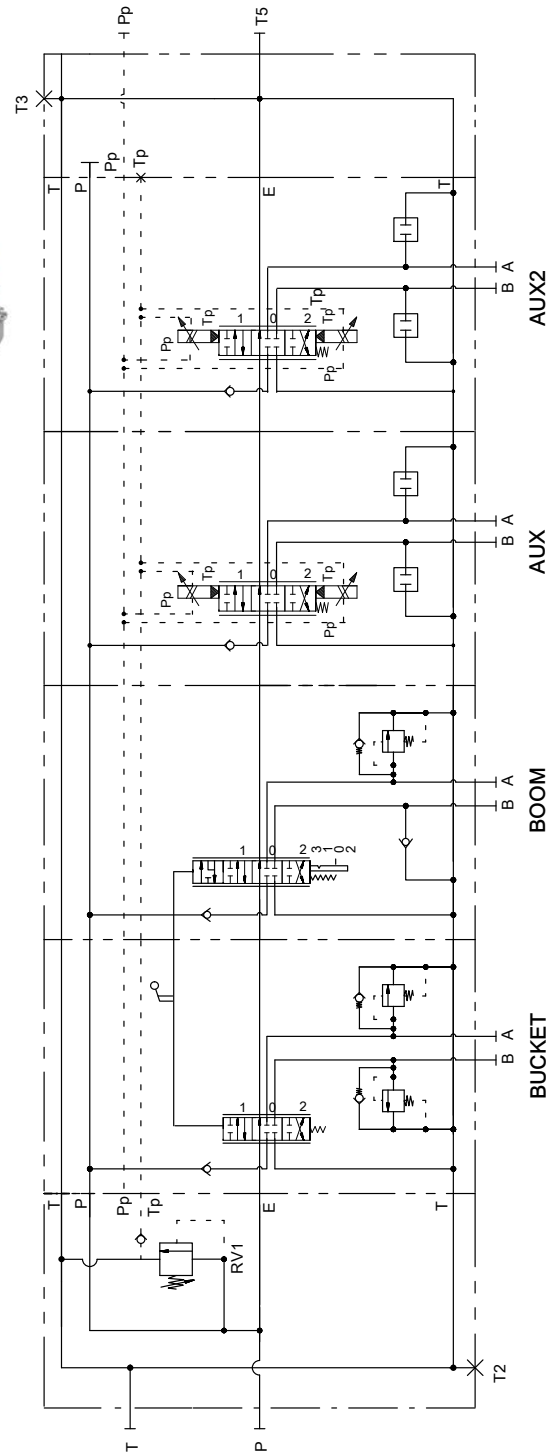
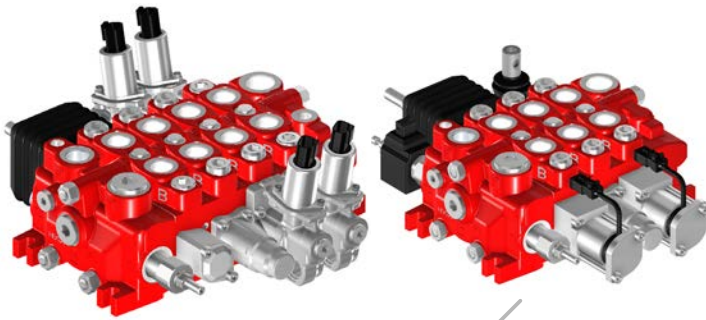
- NEUTRAL POSITION: Out A., Out B to VBATT,
- EXTEND (stem entering in the sensor): Out A (blue) to VBATT, Out B (red) goes open.
- RETRACT (stem exiting from the sensor): Out B (red) to VBATT, Out A (blue) goes open.
- The hysteresis keeps the switching threshold more stable

6.2.3 Examples

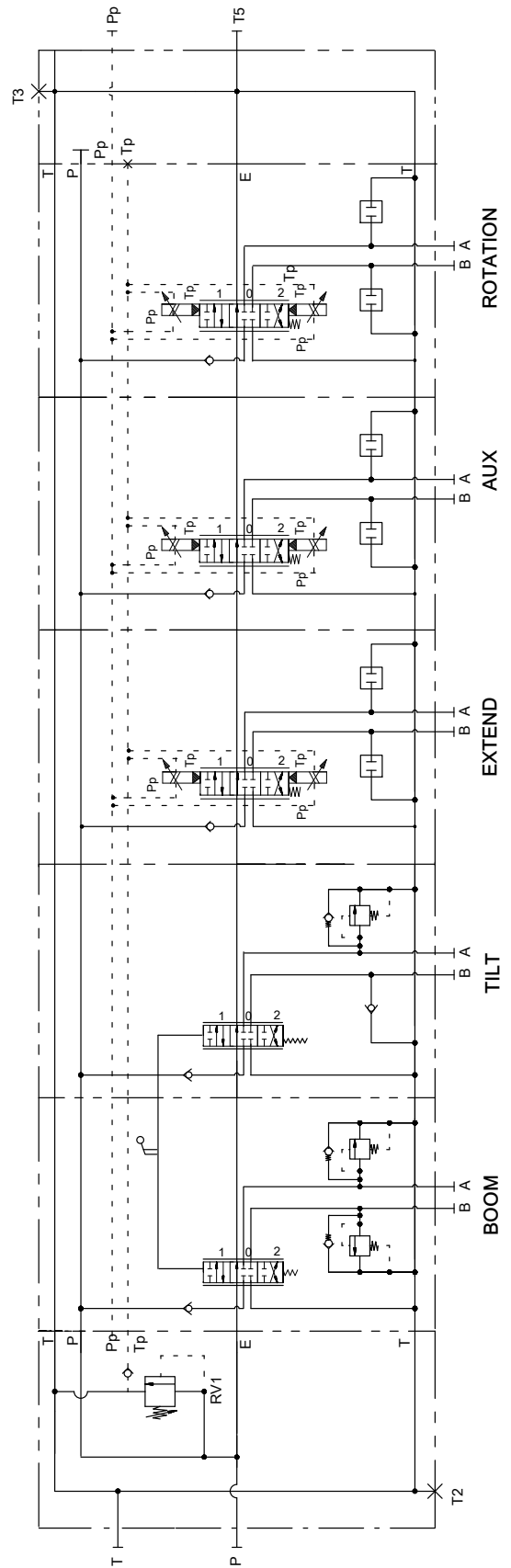
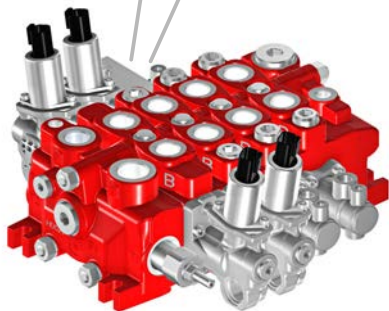
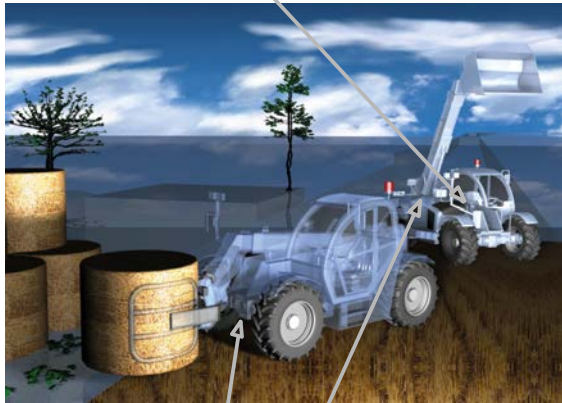
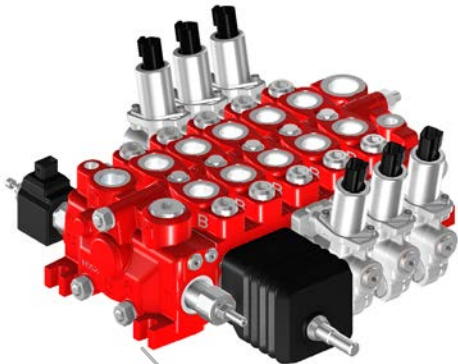


7 Suitable applications (examples)

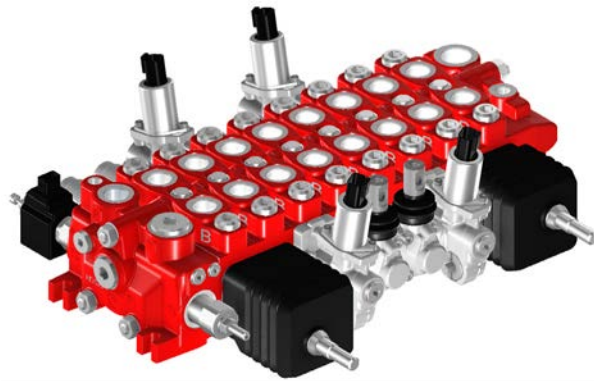
7.1 Wheel loaders



7.2 Telehandlers



7.3 Forestry & Backhoes



8 Composition of ordering code

8.1 Inlet cover

T	E	S	T	2	1	T	M	1	0	1	B	L	A	E	1	2	A	-	0	0	0	0	0	P	O	X	X
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

<p>Inlet cover type (see section 2.1.1)</p>	
<p>Lever side: RV or BP valves</p> <p>YE - GR - BL = RV setting range (see section 2.3.1)</p> <p>CE - AE - C - A = BP valve (see section 2.3.2)</p> <p>HP = BPHP valve (see section 2.3.3)</p> <p>VC = plug</p>	
<p>Positioner side: RV or BP valves</p> <p>YE - GR - BL = RV setting range (see section 2.3.1)</p> <p>CE - AE - C - A = BP valve (see section 2.3.2)</p> <p>HP = BPHP valve (see section 2.3.3)</p> <p>VC = plug</p>	
<p>Solenoid type and voltage (see section 6.1.1)</p>	
<p>P1 port (optional)</p> <p>00 = not present</p> <p>P1 = present, open (same thread type as P - see section 2.1.1)</p> <p>XX = plugged</p>	
<p>Gauge port (optional)</p> <p>00 = not present</p> <p>PM = present, open (see section 2.1.1)</p> <p>XX = plugged</p>	
<p>Pilot tank line check valve (see section 2.3.5)</p> <p>0 = without pilot lines TM</p> <p>T = external drain (internally plugged)</p> <p>C = internal drain (externally plugged)</p>	
<p>P port</p> <p>XX = plugged</p> <p>PO = open</p>	
<p>T port</p> <p>XX = plugged</p> <p>TO = open</p>	

Examples

TEST 21 TM101 BL AE 12A- 00 00 0 PO XX

TEST 21 TH102 CE YE 24AD P1 XX C PO TO

8.2 Valve sections

H	D	S	2	1	K	1	0	1	A	5	S		3	5	9		L	1	0	0	2	5	2	5	I			
---	---	---	---	---	---	---	---	---	---	---	---	--	---	---	---	--	---	---	---	---	---	---	---	---	---	--	--	--

Body type
(see sections 3.1.1 or 3.1.4)

Spool type (see section 3.2)

Positioner type (see section 8)

Lever type (see section 3.9)

Valve A port (see section 3.10 and 3.11)

25 = UC valve adjustment pressure (setting/10)
00 = plug
C = anticavitation

Valve B port (see section 3.10 and 3.11)

25 = UC valve adjustment pressure (setting/10)
00 = plug
C = anticavitation

Positioner kit side indication

Omitted with positioner kit on A port - standard position
I = positioner kit on B port - inverted spools

Additional information

ON-OFF controls solenoid (see section 6.1.2)
Electro-mechanic locking solenoid (see section 6.1.1)
Microswitch positioners (see section 3.3.5)
Positioners with sensor (see section 6.2)
EHM control solenoid (see section 6.1.3)

Examples

HDS21 K101 W5P 51 25 C

HDS21 K107 A5S 310B 00 00

8.3 End cover

C	O	P	2	1	P	M	2	0	1	T	5				T	3		0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	--	--	--	---	---	--	---	---	---	---	---	---

End cover type (see section 5)

Standard
HPC
Standard with VRP
HPC with VRP

T5/HPC port

Standard (with/without VRP) type

T5 = open
XX = plugged

HPC type

HPC = purely HPC (open)
CC = closed centre
VCP12 = with VCP (12: spring setting in bar)
needed with VRP valve only.

T3 port

T3 = open
XX = plugged
HPC = with upper HPC kit (optional)

T4 port (optional)

00 = not present
T4 = present, open (same thread type as T3 - see section 5)
XX = plugged

Pp port

00 = not present
PP = present, open (see section 5)
XX = plugged

Pilot supply pressure reducing valve VRP

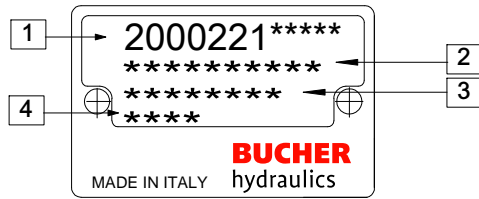
00 = not present
32 = pressure reducing valve adjustment in bar (see section 5.5)
XX = plugged

Examples

COP 21 PM212HPC XX T4 PP 00

COP 21 PH213 VCP12 T3 00 PP 32

8.4 Product identification plate



1 : BHRE Product Order Code

2 : Customer Code (on demand, only - if not requested manufacturing year and month are printed)

3 : WO : Production Work Order

4 : WO progressive number

Manufacturing month	Manufacturing year					
	2017	2018	2019	2020	2021	2021
January	7A	8M	9M	0M	1M	2M
February	7B	8N	9N	0N	1N	2N
March	7C	8P	9P	0P	1P	2P
April	7D	8Q	9Q	0Q	1Q	2Q
May	7E	8R	9R	0R	1R	2R
June	7F	8S	9S	0S	1S	2S
July	7G	8T	9T	0T	1T	2T
August	7H	8U	9U	0U	1U	2U
September	7I	8V	9V	0V	1V	2V
October	7J	8Z	9Z	0Z	1Z	2Z
November	7K	8X	9X	0X	1X	2X
December	7L	8Y	9Y	0Y	1Y	2Y

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Classification: 430.300.000