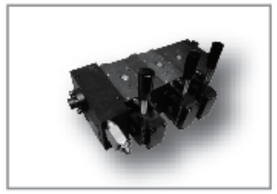
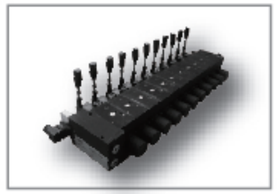
3 series 3 series HLPSL &HLPSV LOAD SENSING PROPORTIONAL MULTI-WAY VALVE

Manual+Electric proportional

Friction positioning

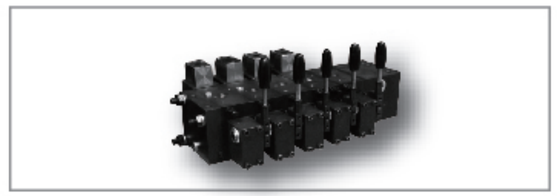


hydraulic control+Manual

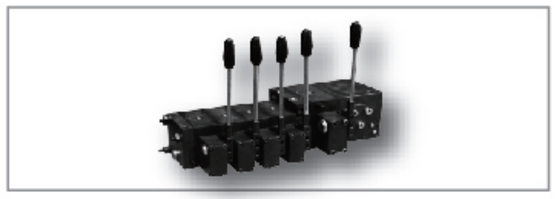


Manual control+Spring restoration

5 series 5 series HLPSL &HLPSV LOAD SENSING PROPORTIONAL MULTI-WAY VALVE



Manual+Electric proportional



5 series Via 3 series

www.kmhydraulic.com.cn

Add : Guangsheng Rd, Guangling Etdz,
Yangzhou, Jiangsu 225000, P.R.China
M.P : +86-18252702961
Tel : +86-514-80926363
Fax : +86-514-80926565
E-mail : sales@kmhydraulic.com.cn

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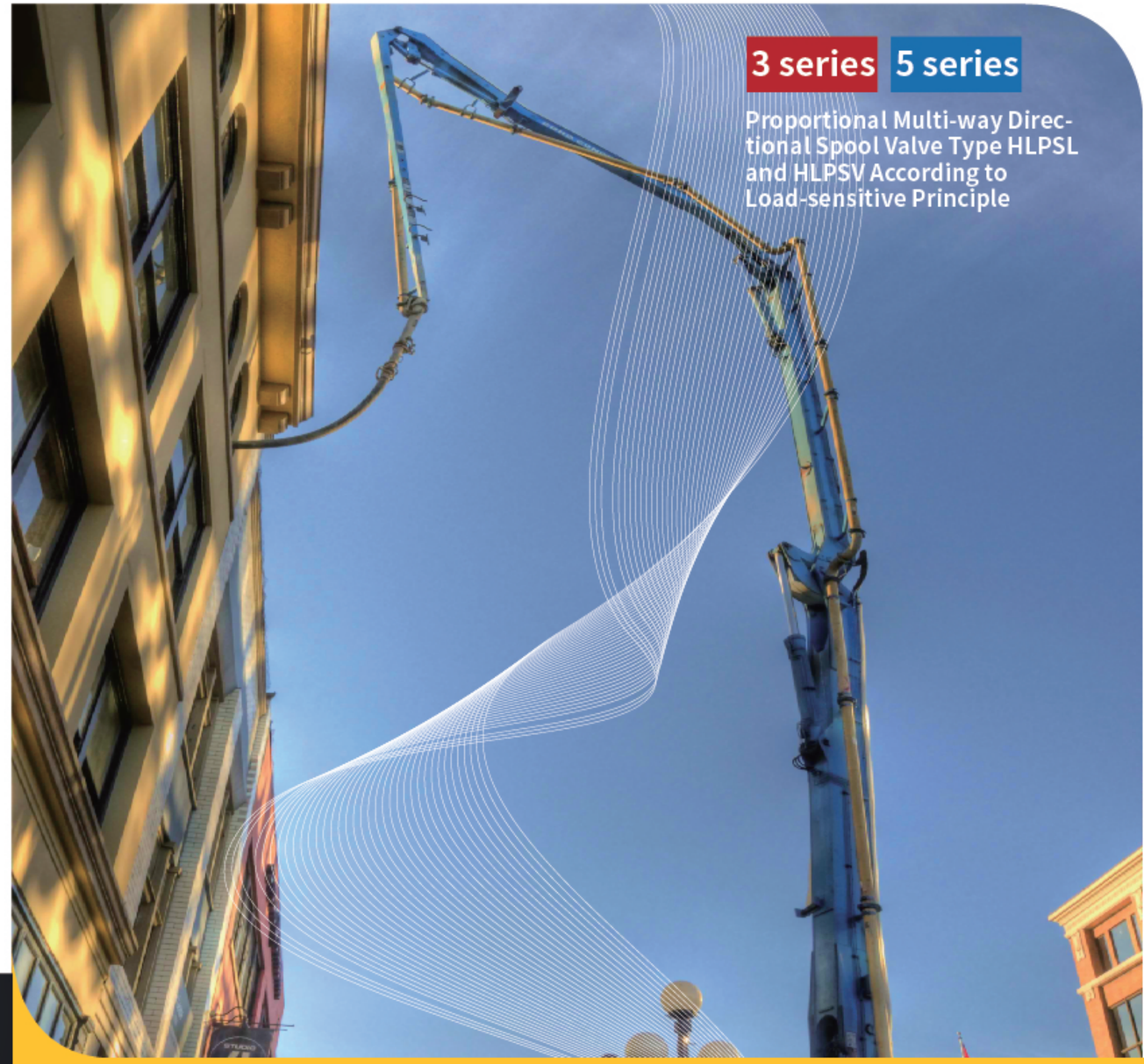

3 series 5 series

Proportional Multi-way Directional Spool Valve Type HLPSL and HLPSV According to Load-sensitive Principle

Jiangsu KM Hydraulic Control Sys. Co.,Ltd

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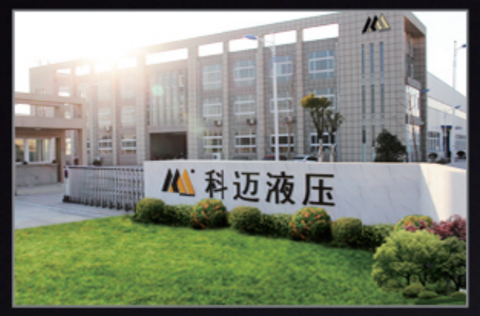
ABOUT US

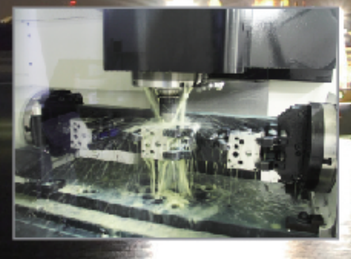


Jiangsu Kemai Hydraulic Control System Co., Ltd, was founded in 2011, it mainly engaged in R&D and manufacturing of high-level hydraulic system, hydraulic serve system and load sensing proportional multi-way valves.

Located in Yangzhou City of Jiangsu Province, It had many advanced manufacturing facilities, such as, machining center, CNC, grinders, millers, and honing machines and so on, totaling more than 30 sets. Additionally, it had dust-free assembly workshops and testing equipements.

With its professional team It holds two experts receiving a special state allowance, 3 Research Associate senior engineers, 10 hydraulic technology and process experts and 5 graduate students from leading higher education institutions at home and abroad. It also engages several production managers from famous hydraulic element factories in China in order to produce high quality products.
Beginning in 2014, Kemai manufactured truck/trailer unloading system and served a lot of famous company through out China.

Our products are widely used in engineering machinery, mining machinery, municipal machinery and agricultural machinery, exported to Asia, Latin-America.



- Energy Saving And Emission Reduction
- reducing heat generated in system
- More Delicate Manipulation;
- Remote control
- Flexible Expansion
- Cost-effective

Develop load feedback system with customers to improve machine quality.
Hydraulic load sensing technology to obtain control a higher level of performance

3 series

3 series HLPSL &HLPSV LOAD SENSING PROPORTIONAL MULTI-WAY VALVE

Table of Contents

Proportional Multi-way Directional Spool Valve Type HLPSL and HLPSV According to Load-sensitive Principle

Working pressure: Pmax.=420bar (6000psi); flow: Qmax.=100 L/min (32g/min)

Combined Type Size 3

I. Overview

Proportional multi-way directional spool valve type HLPSL and HLPSV according to load-sensitive principle are mainly applied to engineering machinery electric hydraulic control field to control the movement direction & speed of hydraulic oil cylinder or hydraulic motor. With various functions such as electric proportional control, electric switching value control, hydraulic control, pneumatic control, manual control, etc., such valves can realize stepless speed regulation and will not be influenced by load change. The characteristic of load sensing enables the multi-way actuators to run simultaneously and independently from each other at different speed and pressure ratings until the maximum flow of bumping source is reached.

Load-sensitive principle, applied in hydraulic system, can realize flow control of actuators without any influence of the load. Load-sensitive mechanism (fixed differential reducing valve) enables the outlet pressure to match with the changing load continuously during the working period. One side is with the function of load signal & spring force, while the other side is imposed on outlet pressure of fixed differential reducing valve which is equal to the sum of load pressure and the pressure generated by spring, namely, the differential pressure beside the throttle of proportional valve is a constant value and therefore the flow of proportional valve is only in proportional to control signal. As to the valve type HLPSL, the load pressure signal passes shuttle valve, and the damper exerts a function on the spring cavity of fixed differential overflow valve which will regulate the system pressure to the value of the sum of load pressure and spring force, so that the outlet pressure of pump can match with the load pressure. In case the load pressure is low, the outlet pressure of pump will be low and vice verse, so as to realize the energy conservation of the system.

As to multi-way directional spool valve type HLPSV, the directional spool valve of each way, after selection of load pressure by shuttle valve, will deliver the maximum load pressure signal to load-sensitive port X of the variable displacement pump, and make the output pressure & flow of variable displacement pump match with the system through the control of pump' s variable displacement mechanism, so as to realize the energy conservation of the system.

As to multi-way directional spool valve type HLPSV, the directional spool valve of each way, after selection of load pressure by shuttle valve, will deliver the maximum load pressure signal to load-sensitive port X of the variable displacement pump, and make the output pressure & flow of variable displacement pump match with the system through the control of pump' s variable displacement mechanism, so as to realize the energy conservation of the system.

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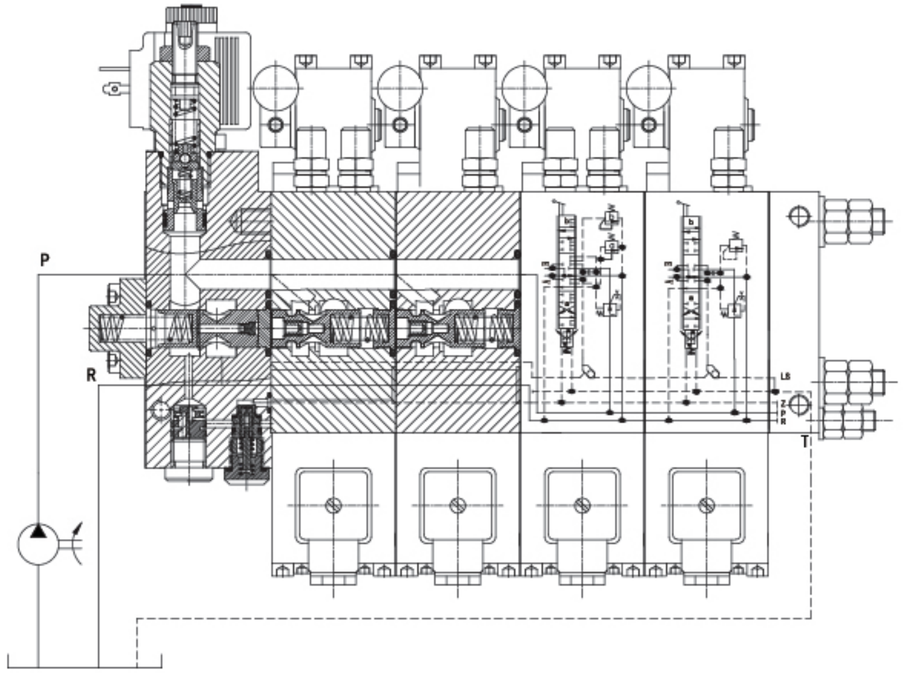


Proportional multi-way directional spool valve according to load-sensitive principle is a kind of combined-type valve, which generally consists of 3 functional elements, namely, connection block, directional spool valve and end plate. If necessary, ancillary block can be mounted on the directional spool valve additionally and intermediate block can be added between directional spool valves.

Connection block

Oil-taking way of multi-way valve is equipped with pressure oil inlet P and oil return tank port R, as well as control port LS and measurement ports Z & M. (Please refer to Section 3.1 for detailed information.)

Model selection

- In compliance with the variety of oil source, constant displacement pump and variable displacement pump
- In compliance with the specifications of connecting threads of port P and port R, G1/2, G3/4 & G1
- With or without pilot controlled oil supply
- With or without pressure limitation
- With or without electromagnetic unloading of the pump

Directional spool valve

Proportional directional valve shall be fixed between connection block and end plate by three screw stems (pull rods) and 12 directional spool valves can be mounted for a valve bank at most. Generally, the number of ways of the directional spool valve doesn't exceed 8. In case the number is equal to or larger than 9, it's suggested to divide the valves into two valve banks of multi-way valve. As to the directional spool valve with 9 or more ways, in case the system can't be divided into two valve banks of multi-way valve, it's required to add ZPL33/15 intermediate block or order corresponding enhanced-type pull rod accessory. (Please refer to Section 3.2 for detailed information.)

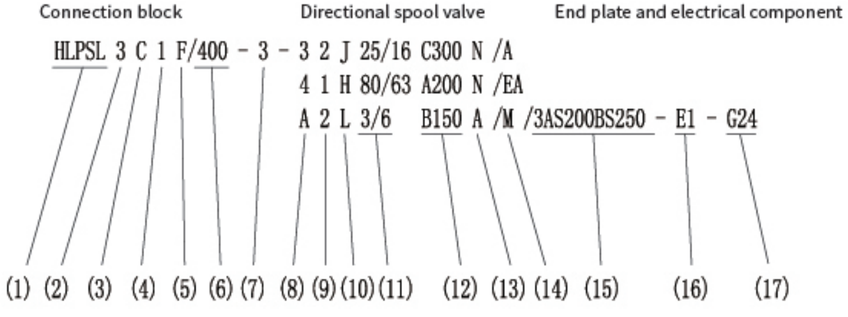
- In accordance with the size of working port of directional spool valve AB, G1/2 & G3/4
- In accordance with the neutral-position function and flow of directional spool valve
- With or without secondary pressure limitation, N no pressure limitation, C-type pressure limitation and AB-type pressure limitation
- In accordance with the operation manner, pure manual control, electronic control, hydraulic control & friction positioning
- With or without any auxiliary function

End plate

As the terminal of combined-type multi-way valve, the end plate shall be selected according to the characteristics as follows: with oil return port T controlling the internal discharge or external discharge of oil, with or without additional LS, oil inlet P, oil return port R, etc. (Please refer to Section 3.3 for detailed information.)

- With port T for pilot control of internal discharge or external discharge of return oil
- With or without additional LS inlet or cut-off of pump's circulation loop

II. Model Selection Code



Through internal LS oil way, 12 directional spool valves can comprise a valve bank or several valve banks at most through series connection. In case several directional spool valves shall be connected in series, external pipe connection is required.

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(1) Basic code of connection block (please refer to Table 1 in 3.1 for details)

HLPSL	used for oil supply system of constant displacement pump (open circuit);
HLPSV	used for oil supply system of variable displacement pump with flow regulator (closed circuit), or used in the same constant displacement pump system as a separate second multi-way valve bank

(2) Threaded coupling of port P & port R of the connection block (in compliance with ISO288/1 standard) (please refer to Table 1 in 3.1 for details)

3	G1/2
4	G3/4
5，55	G1
UNF4	1 1/16–12UN–2B(SAE12)

(3) Added component (please refer to Table 2 in 3.1 for details)

C	standard type
G	one-way throttle valve (only used for HLPSL)
S	damping hole added in LS-oil way (only used for standard-type HLPSV and HLPSL)
B	with throttling orifice in LS-oil way (only used for HLPSV)
Z	one-way throttle valve + unloading valve (only used for HLPSL)
H	fixed differential overflow valve for improving the circulating pressure (about 14bar, HLPSL)
Y	pressure oil outlet with excessive flow of fixed differential overflow valve (only used for HLPSL)

(4) Control oil supply pressure (please refer to Table 3 in 3.1 for details)

0	in case of no three-way reducing valve and directional spool valve of pure manual operation, or when pilot control oil is provided externally, the pilot control pressure shall be 20bar-40bar.
1	with three-way reducing valve, it's used for the supply of pilot control oil (control pressure shall be about 20bar).
2	with three-way reducing valve, it's used for the supply of pilot control oil (control pressure shall be about 40bar).

(5) Two-position two-way solenoid valve for system unloading (please refer to Table 4 in 3.1 for details)

C	without solenoid valve
F	normally open solenoid valve, in case of power supply, the pump is pressurized; in case of power failure, the pump carries out unloading
D	normally closed solenoid valve, in case of power supply, the pump carries out unloading; in case of power failure, the pump is pressurized
D. ./F. .	with pressure limiting valve, it can serve as secondary pressure (F50) with pressure value indicated

(6) Pressure setting of pressure limiting valve in the connection block

/···	regulated value of the pressure of pressure limiting valve (bar), such as 63, 120, 210, 280, 315, 350, 400 bar
/NF	without pressure limiting valve (only referring to type HLPSV)

(7) Specification

3	size 3

(8) Thread size of control oil ports A & B of directional spool valve, conforming to ISO228/1 standard (please refer to Table 5 in 3.2 for details)

3	G1/2	
4	G3/4	
UNF3	7/8–14UNF–2B (SAE10)	
A	suitable for the installation of ancillary block or intermediate transition block(intermediate block)	
ZPL 3S(V)/H	ZPL 3S(V)/H	Intermediate block
	ZPL 3S(V)/E	hydraulic control block valve
	ZPL 3P/–––	electronic control block valve
	ZPL 3D(S)	with pressure limiting valve (limiting the pressure for all downstream functions)
	ZPL 3D(S)/–––	able to reduce the flow at any time
	ZPL 33/5	able to reduce the flow at any time, realize safety protection by pressure limiting valve
	ZPL 33/15	transitional intermediate block, used for the installation of anti-explosion type proportional valve
	ZPL 3VQ1–3·0/3Q	preferential distribution of the flow

(9) Base block of directional spool valve and fixed differential reducing valve (please refer to Table 6 in 3.2 for details)

1	without inlet fixed differential reducing valve, only for single-way successive operation or multi-way asynchronous operation
2	(standard type) with inlet fixed differential reducing valve and load compensation function, multi-way synchronous operation can be realized
4	with inlet & outlet fixed differential reducing valve, only suitable for function N 3-position 3-way valve
5	with inlet fixed differential reducing valve which has enhanced spring, to obtain relatively large flow output
8	pre-selector valve (output of port A; closed externally of port B to supply oil for subsequent directional spool valves; without fixed differential reducing valve)

(10) Function symbol of spool (please refer to Table 7 in 3.2 for elementary function code)

Selectable with several types: L, M, F, H, J, B, R, O, N, etc.

(11) Output flow code of ports A & B (please refer to Table 8 in 3.2 for details)

Maximum output flow of ports A & B (generally select 3, 6, 10, 16, 25, 40, 63 & 80 (L/min), or select the maximum flow within the range of 3-80 L/min according to user' s requirement)

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(12) Secondary pressure limitation (please refer to Table 9 in 3.2 for details)

N	without pressure limiting protection
C·····	limit the pressure of actuator ports A & B at the same time, unit (bar)
A·····B·····	limit the pressure of actuator ports A & B respectively, unit (bar)

(13) Functional cut-off and pressure extraction (please refer to Table 10 in 3.2 for details)

N	without functional cut-off and pressure extraction
X	C-type pressure limitation, with pressure extraction port X, thread size of oil port is G1/8 respectively
S	AB-type pressure limitation, with pressure extraction ports U & W, thread size of oil port is G1/8 respectively
S1	AB-type pressure limitation, with flange plate extraction ports U & W, thread size of oil port is G1/8 respectively
F1	electrical cut-off on the side of actuator port A
F2	electrical cut-off on the side of actuator port B
F3	electrical cut-off on the side of actuator port A&B

(14) Operation manner (please refer to Table 11 in 3.2 for details)

/A(1,2)	manual operation with long handle (1=without handle, 2=with short handle)
/E	electric proportional control
/EA(1,2)	electric proportional control and manual operation (1=without handle, 2=with short handle)
/D	electric switching value control
/DA(1,2)	electric switching value control and manual operation (1=without handle, 2=with short handle)
/M	manual friction positioning with long handle
/H	pure hydraulic control (two pilot oil ports are in the same direction with oil ports A and B)
/F	pure hydraulic control (two pilot oil ports are perpendicular to oil ports A and B and outward respectively)
/HA (1,2)	hydraulic control and manual operation (two pilot oil ports are in the same direction with oil ports A and B; 1=without handle, 2=with short handle)
/FA (1,2)	hydraulic control and manual operation (two pilot oil ports are perpendicular to oil ports A and B and outward respectively; 1=without handle, 2=with short handle)
/ A (H)	manual control, or hydraulic control, be delivered out of the factory with manual control
/P	pneumatic control
/PA(1,2)	pneumatic control and manual operation (1=without handle, 2=with short handle)
/P1A(1,2)	pneumatic control and manual operation, pneumatic control port is in reverse direction with oil port A B (1=without handle, 2=with short handle)

(15) Ancillary block (please refer to Table 12 in 3.2 for details)

/3 and /4	ancillary block without any additional function, thread sizes of oil ports shall be G1/2 and G3/4respectively
/3AS...BS...	pressure limiting safety valve is mounted at ports A & B, thread size of oil ports is G1/2, with limitedpressure, unit: bar
/4AS...BS...	pressure limiting safety valve is mounted at ports A & B, thread size of oil ports is G3/4, with limited pressure, unit: bar
/4AN BN	with ancillary block of oil supplementary valve at ports A & B
/4AN...BN...	cushion valve and oil supplementary valve are installed at ports A & B, oil port size is G3/4, pressure limitation, bar

/3AN...BN...	cushion valve and oil supplementary valve are installed at ports A & B, oil port size is G1/2, pressure limitation, bar
/4AN...	with cushion valve at port A and ancillary block of oil supplementary valve at port B
/4BN...	with cushion valve at port B and ancillary block of oil supplementary valve at port A
/3AL,BL./3AL,/3BL,	with ancillary block of balance valve at ports A & B, with the pressure indicated, unit: bar
/3DRH	with ancillary block of hydraulic control one-way valve at ports A & B
/3DRHA	with ancillary block of hydraulic control one-way valve at port A
/3DRHB	with ancillary block of hydraulic control one-way valve at port B

(16) End plate (please refer to Table 13 in 3.3 for details)

E1	standard end plate, external discharge of pilot oil, connecting oil return control port T externally
E2	similar to E1, external discharge of pilot oil, port Y is attached additionally
E3	external discharge of pilot oil, a 2-position 3-way magnetic ball valve is mounted; in case of power supply, the system pressure rises to the pressure of safety valve
E4	similar to E1, internal discharge of pilot oil, port T can be sealed
E5	similar to E2, internal discharge of pilot oil, port T can be sealed
E6	similar to E3, internal discharge of pilot oil, port T can be sealed
E18	external discharge of pilot oil, with additional port Y, pressure oil port P and oil return port R
E19	internal discharge of pilot oil, but the oil return pressure shall be less than 15bar, with additional port Y, pressure oil port P and oil return port R
E20	external discharge of pilot oil, but the oil return pressure shall be less than 15bar, with additional port Y, pressure oil port P and oil return port R

(17) Control voltage and the length of anti-explosion type cable (please refer to Table 14 in 3.3 for details)

G12	12VDC
G24	24VDC
G24Ex–3m	24VDC (anti-explosion type, length of guide line: 3m, 5m, 10m, etc.)

III. key data for model section

3.1 Connection block

For example: HLPSL4 C 1 F/ 210–3–32L80/40B250A/E–E1–G24

Table1 Table2 Table3 Table4 ※

※ Please refer to the statement in previous section "Model Selection Code (6)" for the pressure of pressure limiting valve

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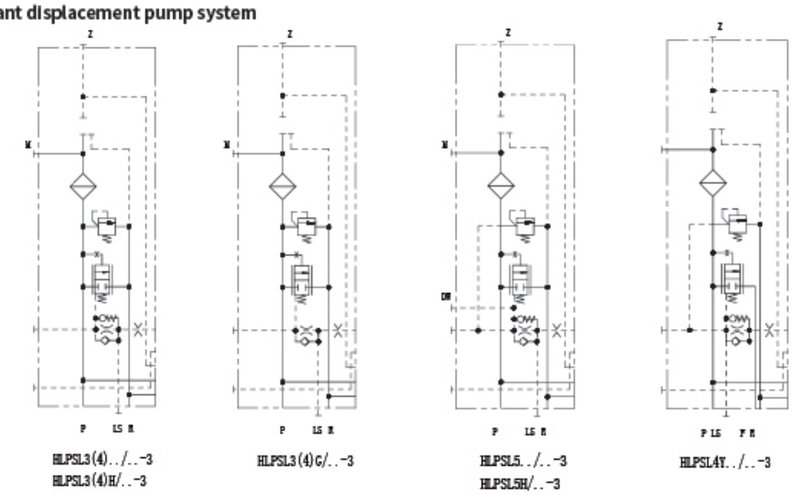
Table 1 Model of Connection Block and Thread Size of Oil Inlet & Oil Return Port

Code	Thread ports P & R	Maximum flow of the pump
HLPSL3, HLPSV3	G 1/2	80L/min
HLPSL4, HLPSV4	G 3/4	100L/min
HLPSVUNF4	1 1/16-12UN-2B(SAE-12)	130L/min
HLPSL5, HLPSV5	G 1	130L/min
HLPSV55		200L/min

Note: in case HLPSL5 and HLPSV55 are combined with the 1st directional spool valve with ancillary block, ZPL33/5 type transition plate shall be mounted behind the connection block, and otherwise the connector can't be mounted at port R.

For constant displacement pump system



For variable displacement pump system

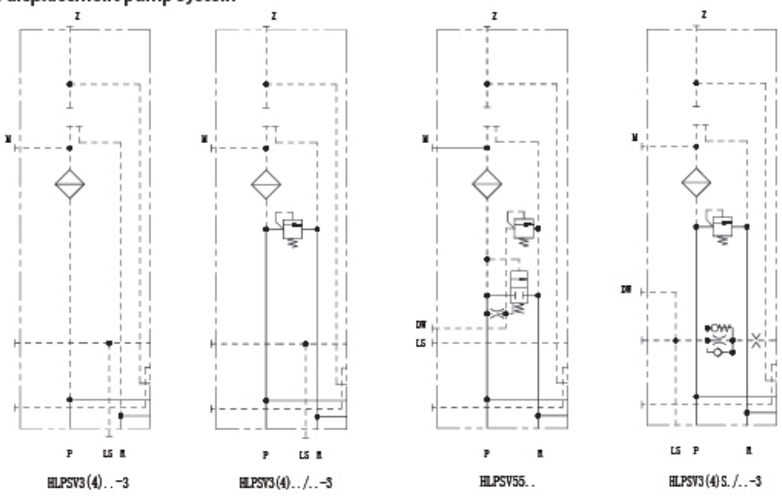
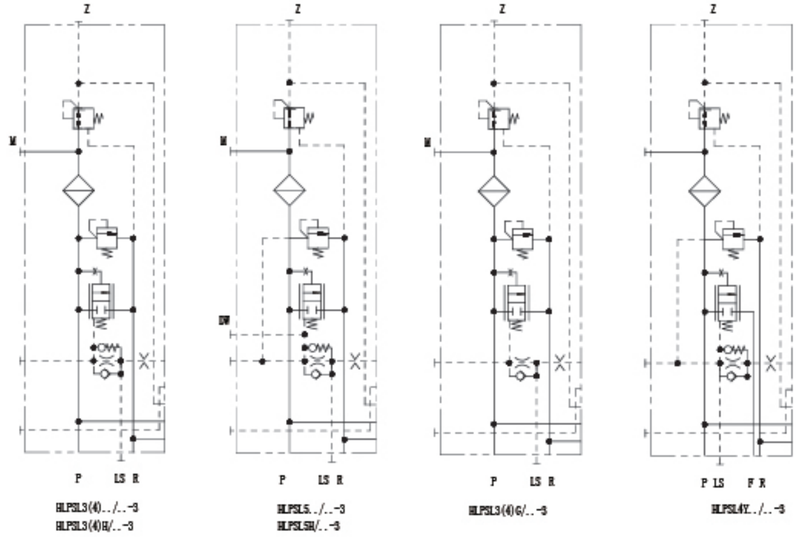


Table 2 Code of Added Components of the Connection Block

Code	Description
C	Standard type
S	Add damping hole in LS-oil way (only used for standard-type HLPSL and HLPSV)
B	With 0.8mm throttling orifice in LS-oil way (only referring to type HLPSV)
G	One-way throttle valve (only HLPSL)
Z	One-way throttle valve + unloading valve (HLPSL)
H	Fixed differential overflow valve for improving the circulating pressure (about 14 bar, HLPSL)
Y	Pressure oil outlet with excessive flow of fixed differential overflow valve (only used for HLPSL)

Table 3 Pilot Oil Supply Code

Code	In Description
0	case of no three-way reducing valve and directional spool valve of pure manual operation, or when control oil is provided externally, the pilot control pressure shall be 20bar-40bar.
1	With three-way reducing valve, it' s used for the supply of pilot control oil (control pressure shall be about 20bar).
2	With three-way reducing valve, it' s used for the supply of pilot control oil (control pressure shall be about 40bar).



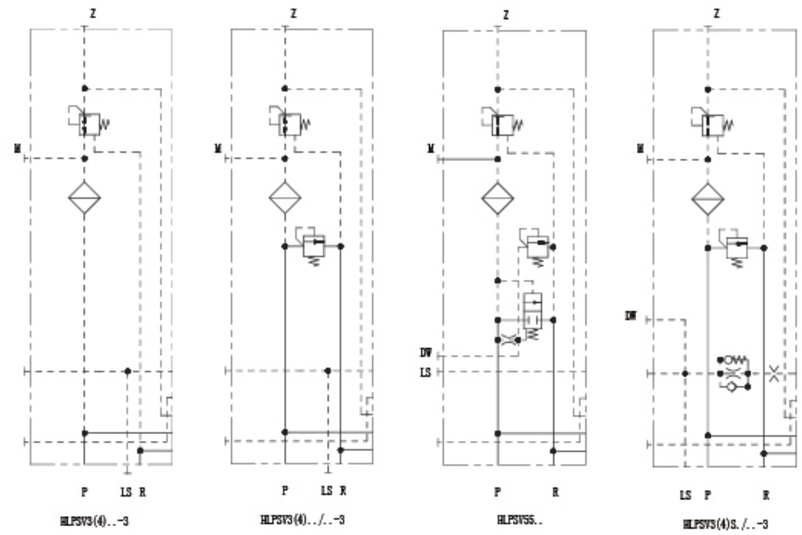
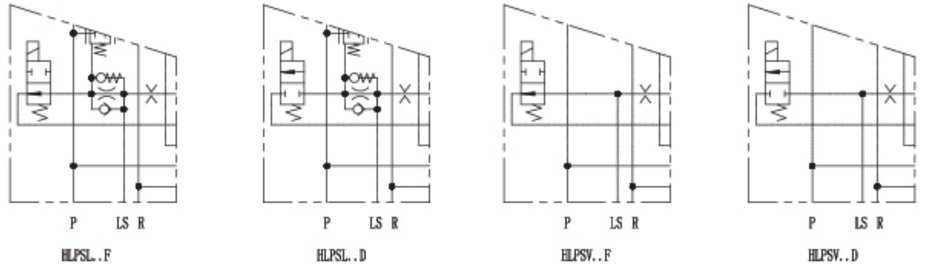


Table 4 Unloading solenoid Valve and Pilot Pressure Limitation of the System

Code	Description
C	Without solenoid vale
F	Normally open solenoid valve, in case of power supply, the pump is pressurized; in case of power failure, the pump carries out unloading (emergency stop)
D	Normally closed solenoid valve, in case of power supply, the pump carries out unloading; in case of power failure, the pump is pressurized
D. ./F..	With pressure limiting valve, it can serve as secondary pressure (F50) with pressure value indicated, for example: as to type HLPSL 41F100/350-3, in case of power failure, Pmax.=100bar; in case of power supply, Pmax.=350bar



3.2 Directional spool valve

For example: HLPSL4 C 1 F/210–3 3 2 – L 80/40 B250 A/ EA1 /3DRHA24E1– G

Table5 Table6 Table7 Table8 Table9 Table10 Table 11 Table 12

Table 5 Oil Port Size of the Directional Spool Valve

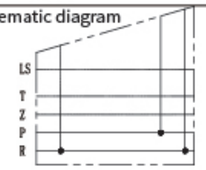
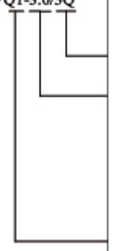
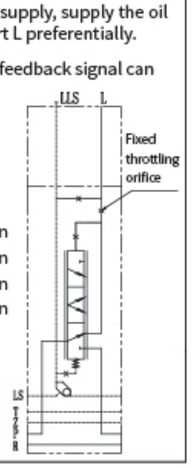
Thread code of oil port of directional spool valve	Thread ports A & B	Maximum flow and additional description
3	G 1/2	80L/min
4	G 3/4	100L/min
UNF3	7/8-14UNF-2B(SAE-10)	80L/min
A	Ancillary block port can be mounted	80L/min
ZPL 33/5 ZPL 33/15	In case the ZPL 33/15 intermediate block is used for multi-way valve of 9-12 ways, ancillary installation shall be added.	Schematic diagram 
ZPL 3VQ1-3.0/3Q 	Intermediate block for preferential oil supply, supply the oil to the actuator connecting with oil port L preferentially. Without any additional function, load feedback signal can passinternal fixed throttling orifice  Size and output flow of the fixed throttling orifice: In case of 2.0-Φ2mm, QL is about 8L/min In case of 3.0-Φ3mm, QL is about 18L/min In case of 4.0-Φ4mm, QL is about 30L/min In case of 5.0-Φ5mm, QL is about 40L/min In case of 6.0-Φ6mm, QL is about 60L/min Setting of base flow: 1-QLmax≤20L/min 2-QLmax≥50L/min 3-QLmax>50L/min	

Table 6 Functions of Valve Block of Directional Spool Valve

Code	Description
1	Without inlet fixed differential reducing valve, only for single-way successive operation or multi-way asynchronous operation
2	(Standard type) with inlet fixed differential reducing valve and load compensation function, multi-way synchronous operation can be realized
4	With oil-taking & oil return fixed differential reducing valve mounted on the 3-position 3-way directional spool valve, it can realize the regulation of output flow & return oil flow without any influence of the load
5	With inlet fixed differential reducing valve which has enhanced spring, to obtain relatively large flow output
8	Pre-selector valve (output of port A; closed externally of port B to supply oil for subsequent directional spool valves; without fixed differential reducing valve)

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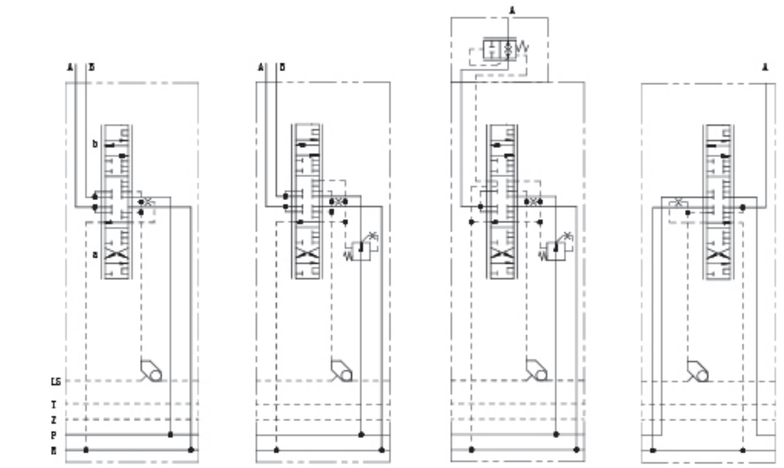


1.Directional spool valve without inlet fixed differential reducing valve

2,5.Directional spool valve with inlet fixed differential reducing valve

4.Directional spool valve with oil-taking & oil return fixed differential reducing valve

8.Directional spool valve as pre-selection switch

Table 7 Function Symbol of Spool

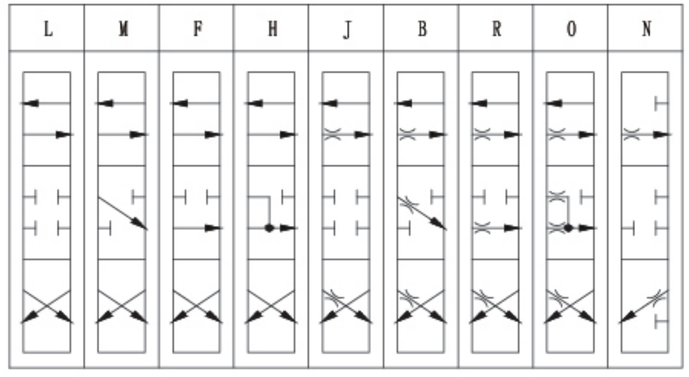
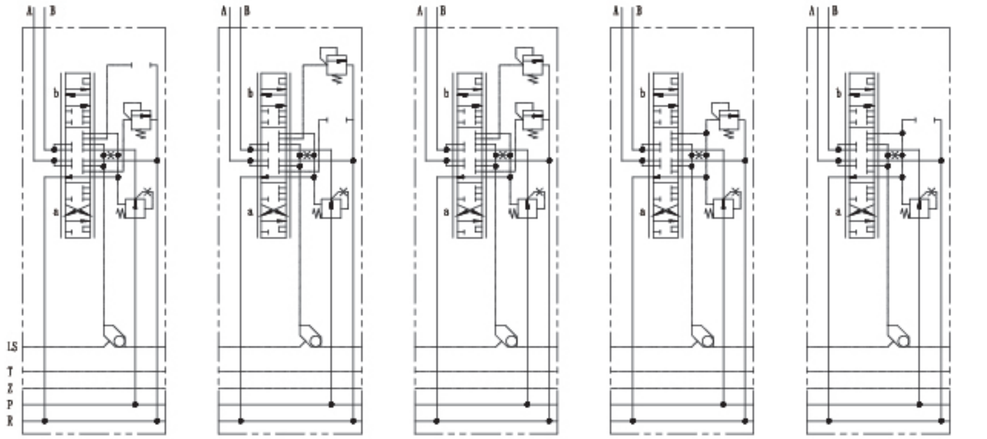


Table 8 Maximum Control Flow of Actuator P-A or P-B (L/min)

Base block of directional s pool valve	Flow code							
	3	6	10	16	25	40	63	80
1, 5	4	9	14	22	34	54	85	107
2	3	6	10	16	25	40	63	80
4	3	6	10	16	25	40	63	80
8	Only refer to the flow of port A, identical with the value of 1, 5 in the table							

Table 9 Pressure Limiting Valve

Code	Description
N	Without pressure limiting protection
C---	Limit the pressure of ports A & B, limited pressure value, unit (bar)
A---B---	Limit the pressure of ports A & B respectively, limited pressure value of port A, limited pressure value of port B, unit (bar)



Directional spool valve with A-type secondary pressure limitation

Directional spool valve with B-type secondary pressure limitation

Directional spool valve with AB-type secondary pressure limitation

Directional spool valve with C-type secondary pressure limitation

Directional spool valve without secondary pressure limitation

Table 10 Functional Cut-off and Pressure Extraction

Code	Description
N	Without functional cut-off and pressure extraction
X	C-type pressure limitation, with pressure extraction port X, thread size of oil port is G1/8 respectively
S	AB-type pressure limitation, with pressure extraction ports U & W, thread size of oil port is G1/8 respectively
S1	AB-type pressure limitation, with flange plate extraction ports U & W, thread size of oil port is G1/8 respectively
F1	Electrical cut-off on the side of actuator port A
F2	Electrical cut-off on the side of actuator port B

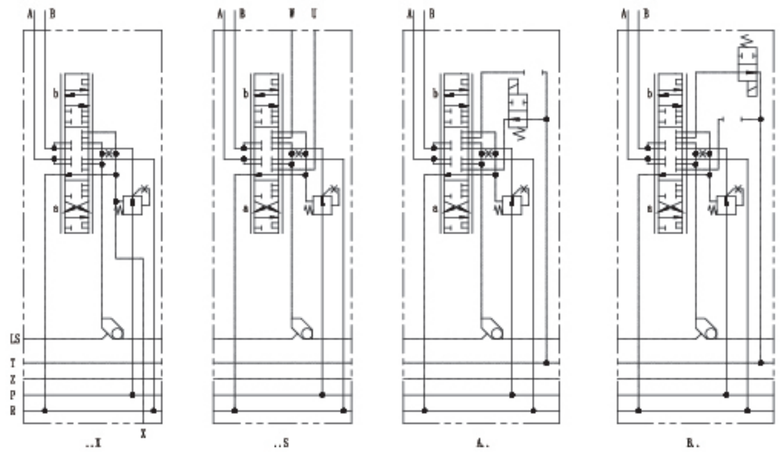


Table 11 Operation Manner

Code	Operation manner
A	Manual operation with long handle
A1	Manual operation without handle
A2	Manual operation with short handle
M	Manual friction positioning with long handle
E	Electric proportional control
EA	Combination of manual operation and electric proportional control with long handle
EA1	Combination of manual operation and electric proportional control without handle
EA2	Combination of manual operation and electric proportional control with short handle
D	Electric switching value control
DA	Combination of manual operation and electric switching value control with long handle
DA1	Combination of manual operation and electric switching value control without handle
DA2	Combination of manual operation and electric switching value control with short handle
H	Pure hydraulic control, two pilot oil ports are in the same direction with oil ports A and B
F	Pure hydraulic control, two pilot oil ports are perpendicular to oil ports A and B and outward respectively
HA	Hydraulic control and manual operation, two pilot oil ports are in the same direction with oil ports A and B with long handle
FA	Hydraulic control and manual operation, two pilot oil ports are perpendicular to oil ports A and B and outward respectively with long handle
HA1	Hydraulic control and manual operation, two pilot oil ports are in the same direction with oil ports A and B without handle
HA2	Hydraulic control and manual operation, two pilot oil ports are in the same direction with oil ports A and B with short handle
FA1	Hydraulic control and manual operation, two pilot oil ports are perpendicular to oil ports A and B and outward respectively without handle
FA2	Hydraulic control and manual operation, two pilot oil ports are perpendicular to oil ports A and B and outward respectively with short handle
P	Pneumatic control
PA	Combination of manual operation and pneumatic control with long handle
PA1	Combination of manual operation and pneumatic control without handle
PA2	Combination of manual operation and pneumatic control with short handle
P1A1	Combination of manual operation and pneumatic control without handle, pneumatic control port is in reverse direction with oil ports A & B
P1A2	Combination of manual operation and pneumatic control with short handle, pneumatic control port is in reverse direction with oil ports A & B

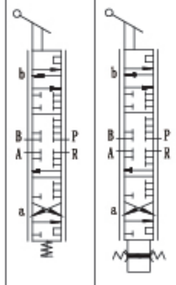
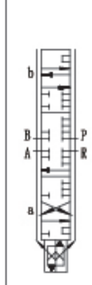
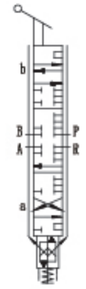
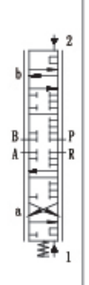
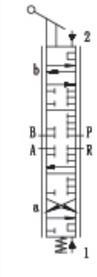
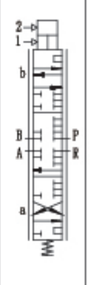
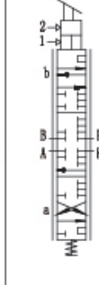
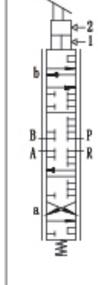
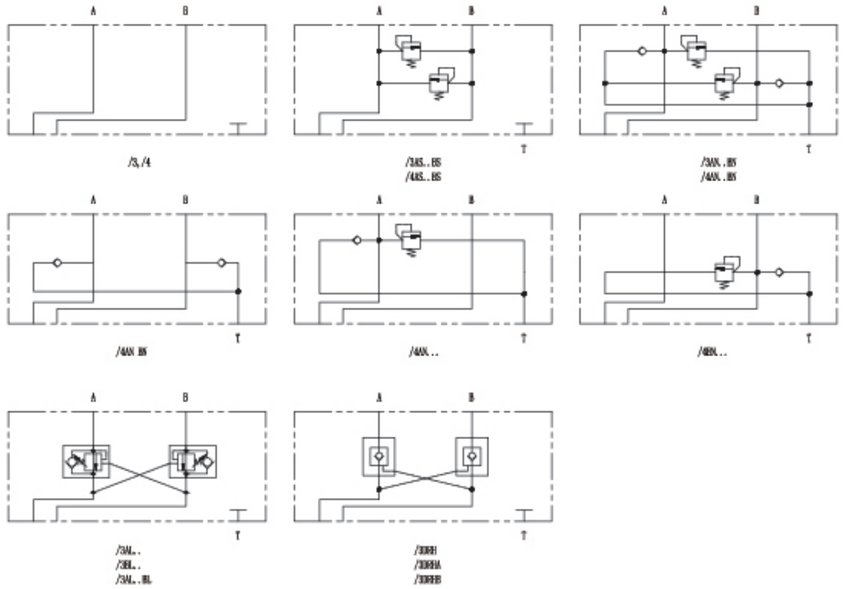
Name	Manual control		Electric hydraulic control		Hydraulic control		Pneumatic control		
	Spring restoration A(1,2)	Friction positioning M	Pure electric hydraulic control E	Combination with manual control EA(1,2)	Pure hydraulic control HA,FA	Combination with manual control HA(1,2)FA(1,2)	Pure pneumatic control P	Combination with pneumatic control PA(1,2)	Combination with pneumatic control PA(1,2)
Name and diagram code									
Operating parameter	Operating angle shall be 5°-30°;		Control current ratic I/I_N:0.2-1;		Control the pressure to 5bar-18bar and maximum operating pressure to 50bar		Control the control to 2.5bar-7bar		

Table 12 Ancillary Block

Code	Description
/3and/4	Pressure limiting safety valve is mounted at ports A & B, thread size of oil ports is G1/2, with limited pressure, unit: bar
/3AS...BS...	Pressure limiting safety valve is mounted at ports A & B, thread size of oil ports is G3/4, with limited pressure, unit: bar
/4AS...BS...	Pressure limiting safety valve is mounted at ports A & B, thread size of oil ports is G3/4, with limited pressure, unit: bar
/4AN BN	With ancillary block of oil supplementary valve at ports A & B
/4AN	With cushion valve at port A and ancillary block of oil supplementary valve at port B
/4BN	With cushion valve at port B and ancillary block of oil supplementary valve at port A
/3AL,BL./3AL, /3BL	With ancillary block of balance valve at ports A & B, with the pressure indicated, unit: bar
/3DRH	With ancillary block of hydraulic control one-way valve at ports A & B
/3DRHA	With ancillary block of hydraulic control one-way valve at port A
/3DRHB	With ancillary block of hydraulic control one-way valve at port B



3.3 End plate

For example: HLPSL4 C 1 F/210–3–32L 80/40 B250 A /E– E1– G24

Table 13 Table 14

Table 13 End Plate

Code	Pilot oil return manner	Description
E1	Return to oil tank directly through leakage oil port T	Standard end plate, external discharge of pilot oil, connecting oil return control port T externally
E2	Return to oil tank directly through leakage oil port T	Similar to E1, with additional port Y so that it can connect with port LS of valve type HLPSV arranged separately
E3	Return to oil tank directly through leakage oil port T	External discharge of pilot oil, a 2-position 3-way magnetic ball valve is mounted; in case of power supply, the system pressure rises to the pressure of safety valve
E4	Internal oil return or oil return through external connection	Similar to E1, internal discharge of pilot oil, port T can be sealed
E5	Internal oil return or oil return through external connection	Similar to E2, internal discharge of pilot oil, port T can be sealed
E6	Internal oil return	Similar to E3, internal discharge of pilot oil, port T can be sealed
E18	Return to oil tank directly through leakage oil port T	Similar to E2/E5, with additional load oil port Y, pressure oil port P and oil return port R
E19	Internal oil return or oil return through external connection	Similar to E1/E4, with additional load oil port Y, pressure oil port P and oil return port R
E20	Internal oil return or oil return through external connection	Similar to E2/E5, with additional load oil port Y, pressure oil port P and oil return port R

Note: the internal control oil return channel can only be used in the system with oil return pressure of less than 10bar.

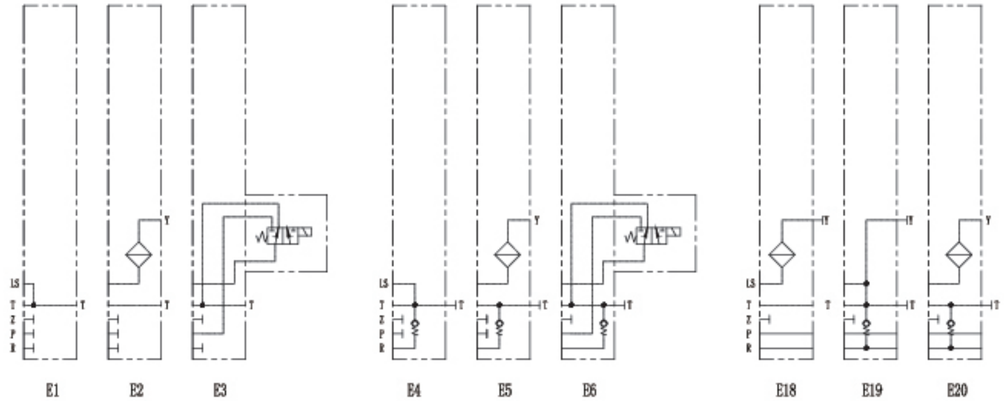


Table 14 Control Voltage and the Length of Anti-explosion Type Cable

G12	12VDC	The data of operation manner E is the same with those in Section 4.3. As to valve type HLPSL(V)-F or -D, the pump can be unloaded at any time.
G24	24VDC	
G24Ex-3m	24VDC,anti-explosion type, the guide line is 3m long	

IV. Other Parameters

4.1 Overview and hydraulic pressure

Model code	HLPSL and HLPSV		
Structure category	combined-type directional spool valve, 12 directional spool valves can be combined at most, the material shall be steel		
Fixed mode	threaded connection: M8		
Installation position	any		
	P= pressure oil inlet M= pressure gauge port R= oil return port Z= pilot pressure port (20 or 40bar) A, B= actuator port T= pilot control oil return port U, W, X= load pressure signal outlet Y= load pressure oil inlet (end plates E2, E5, E18 & E20) LS, DW= HLPSV-type load output port (note: not the pressure oil inlet)		
Port size	P, R, A, B= according to model code (please refer to 3.1) M, LS, Z, T, Y, DW=G1/4 (conforming to DIN ISO 228/1) U, W, X =G1/8 (conforming to DIN ISO 228/1)		
Surface treatment	all surfaces shall go through anti-corrosion surface phosphating.		
Quality (weight)	connection block	End plate	
	HLPSV3, 4, 5= about 3.5KG HLPSV3, 4, 5= about 3.9KG HLPSV55= about 4.5KG With magnetic ball valve, structural style of D../F.. + 0.5	E1, E2, E4, E5= about 1.0KG E3, E6= about 1.7KG E18, E19, E20= about 2.2KG	
	Directional spool valve Operation type	Standard type	Additional function C, A..B..S
	A, E, H, F EA HA, FA HEA	about 3.4KG about 3.6KG about 3.7KG about 4.2KG	about 3.5KG about 3.7KG about 3.8KG about 4.3KG
	Transition block	Ancillary block	
	ZPL33/5 = about 0.3KG ZPL33/15 = about 0.8KG	/3, /4 = about 0.7KG /3AS..BS.. = about 0.9KG /4AS..BS.. = about 1.8KG /4AN BN = about 0.9KG /4AN.., /4BN.. = about 1.7KG /3AL..BL.. = about 2.0KG /3AL.., /3BL.. = about 1.7KG /3DRH = about 2.0KG /3DRHA, /3DRHB = about 1.8KG	

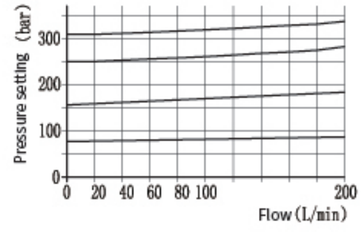
KM HYDRAULIC

Pressure medium	conform to ISO VG10-68 of DIN51519 Viscosity scope: about 4-1500mm2/s The best working range: about 10-500 mm2/s When the operating temperature doesn't exceed +70°C, HEPG-type synthetic medium (poly-alkyl ethylene glycol) and HEES-type synthetic ester can also be used, however, HETG medium (colza oil) isn't applicable.
Temperature	environment temperature: about -40…+80°C (note: it shall be about -40…+40°C for anti-explosion type structural style) Oil temperature: about -25…+80°C, pay attention to the viscosity scope (note: it shall be about -25…+70°C for anti-explosion type structural style) In case the operating temperature is higher than at least 20K during subsequent work, the starting temperature is allowed to be decreased to -40°C (note: pay attention to the viscosity scope during the starting)
Suggested pollution degree	ISO4406 18/14, NAS7~8 class
Working pressure	Pmax.=420bar, the maximum pressure of ports P, P1, A, B, LS, M & Y and slide valve actuator shall be reduced slightly, and the reduced value shall be equal to internal control pressure drop of fixed differential valve of the valve type HLPSL (please refer to "Load Pressure Flow Curve" on the next page) or internal control pressure drop at the pump flow regulating valve. Oil return port R (50bar): the oil can return to the oil tank without pressure through separate pipeline from port T. However, in case the oil return pressure is relatively high, it's suggested to use end plate type E1, E2 and E3 with additional leakage port. The pressure at port Z is about 20 or 40bar (depending on the code in Table 3) (outlet) and 40bar (inlet).
Control oil way	internal control oil way, through filtration of disk filter, can prevent the fault caused by pollution.
Flow	maximum flow of the actuator shall be 3-80 (120) l/min

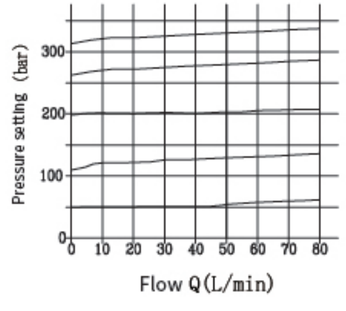
4.2 Characteristic curve

4.2.1 Pressure flow characteristics of pressure limiting valve

Pressure limiting valve (pilot type) in connection block of size 3

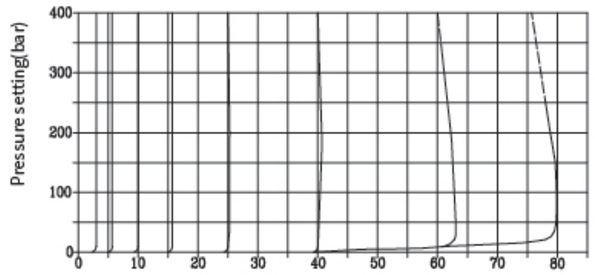


4.2.2 Secondary pressure limiting valve



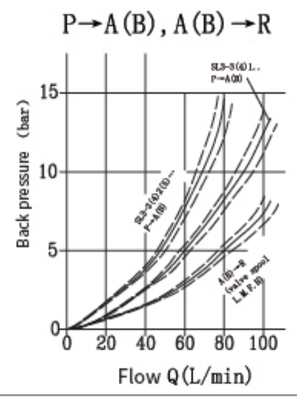
4.2.3 Secondary pressure limiting valve

Fixed differential reducing valve



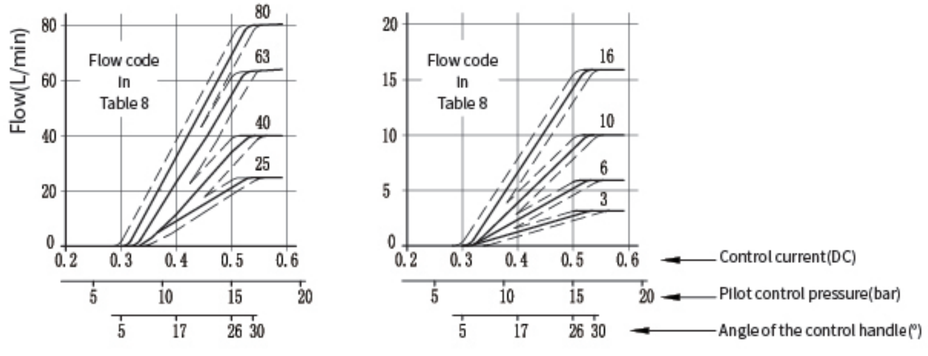
4.2.4 Back pressure flow curve

Directional spool valve



4.2.5 Input current-flow curve

Actuator flow control curve (an example of directional spool valve with inlet fixed differential reducing valve)



4.3 Operating parameters

4.3.1 Operating torque	Neutral position	Terminal position
Type A	about 1.3Nm	about 1.7Nm
Type HA	about 1.7Nm	about 3.3Nm
Type EA	about 1.3Nm	about 2.5Nm

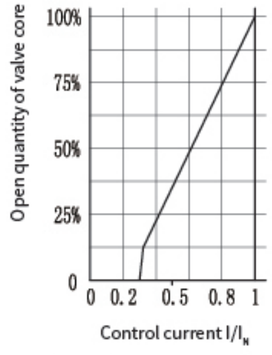
4.3.2 Operation manner

Operation manner M: friction positioning type, the valve core can be positioned in any expected position

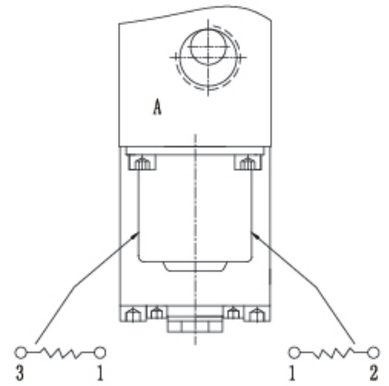
Operation manners E & EA: The dual-way electromagnet has a linking iron cavity connecting external seal and oil return way. Therefore lubrication and maintenance are unnecessary for the linking iron, and hydraulic oil can be used for rust prevention.

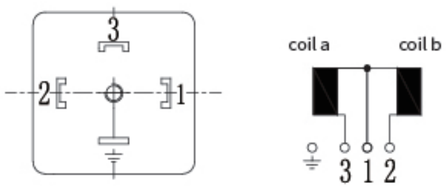
Rated voltage Un	24VDC	12VDC
Coil resistance R20	27.2Ω	6.7Ω
Rated control current IG	0.63A	1.26A
Rated control power PG=Un x IG	10.8W	10.6W
Switching energy Wa	⩽0.3Ws	⩽0.3Ws
Relatively continuous power supply	100%	100%
Level of protection (assembled)	IP65	
Flutter frequency	40…70Hz (55Hz is the best)	
Flutter amplitude	20%⩽Ad⩽35%	
Wiring of electric appliance	DIN 43650A	
Wiring diagram	coil a	coil b

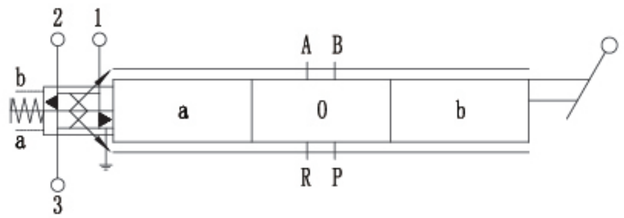
Current-valve core curve



The oil viscosity during the measurement is about 60mm²/s.







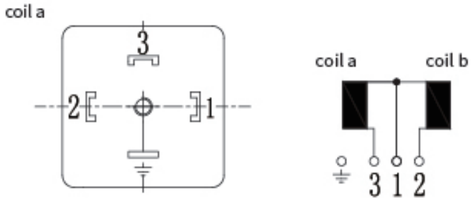
	Qualification certificate	CNEx16.4149X and CNEx16.4148X
Operation manners E & EA (HEA) Operation manners anti-explosion E & EA (Voltage specification G24ex)	Anti-explosion grade	Ex mb I Mb& Ex mb IIC T4 Gb
	Continuous power supply (ED)	100%ED, power supply for one coil of each electromagnet
	Level of protection	IP67
	Rated voltage Un	24VDC
	Rated control current IG	0.63A
	Rated control power PG	10.8W
	Residual pulsation of supply voltage	15%

	Service conditions: Maximum environment temperature 40℃ Maximum medium temperature 40℃ Each electromagnet shall be protected by fuse according Surface treatment The enclosure shall be galvanized, and the coil and wiring cavity shall be sealed by rolling. Note: prevent direct radiation of sunshine. Cross section of the cable 4x1mm² Cable length 3m/5m Please refer to "Operation manners E & EA" (standard type) for the wiring diagram.
Operation manner H, F, HA, FA	the control pressure is about 5bar (at the beginning of the travel) -18bar (in terminal position); maximum allowable pressure is 50bar; remote control pipeline of control ports 1 & 2 shall be external connection; control oil shall be provided through proportional pilot valve.

4.4 Functional cut-off control

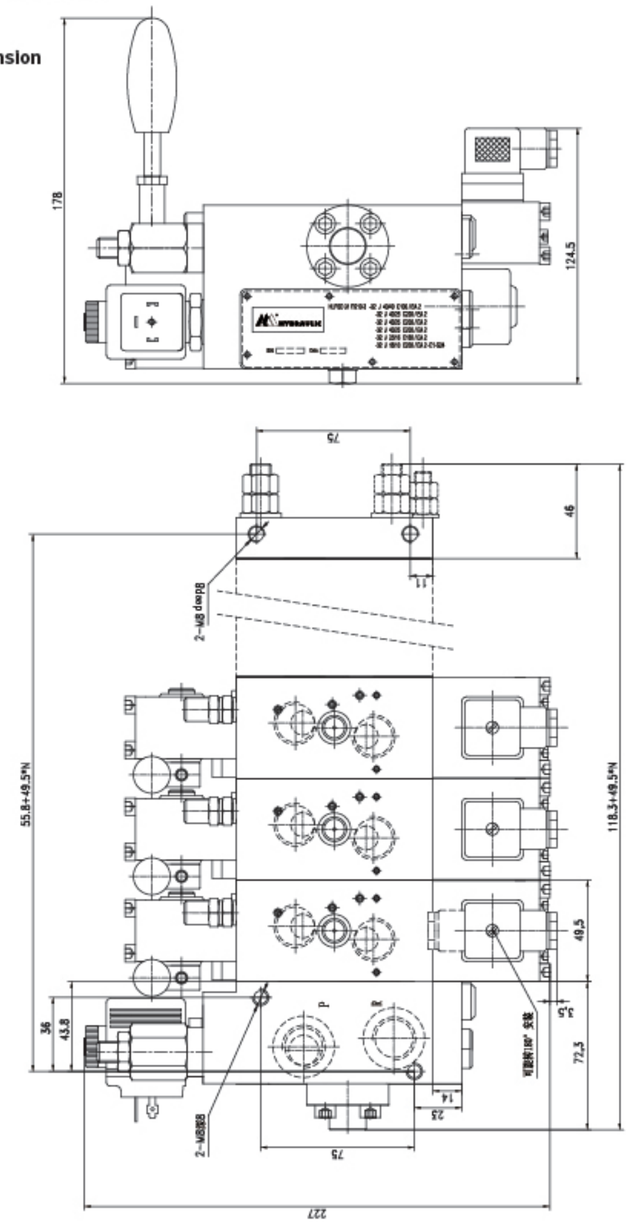
Switching-type electromagnet with manual emergency operation

Rated voltage Un	24VDC	12VDC
Coil resistance (R20)	34.8Ω	8.7Ω
Cold state current I20	0.68A	1.38A
Current gain I70	0.48A	0.97A
Power under normal temperature	16.6W	16.6W
Pn=Un x I20	IP 65	
Level of protection (assembled)	DIN 43650A	
Wiring mode		
Cut-off energy consumption WA	≤0.3Ws	
Wiring diagram	coil b coil a	



V. Outline Dimension

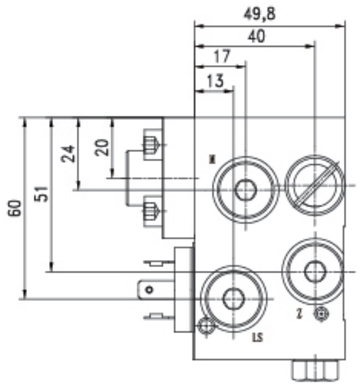
5.1. Overall dimension



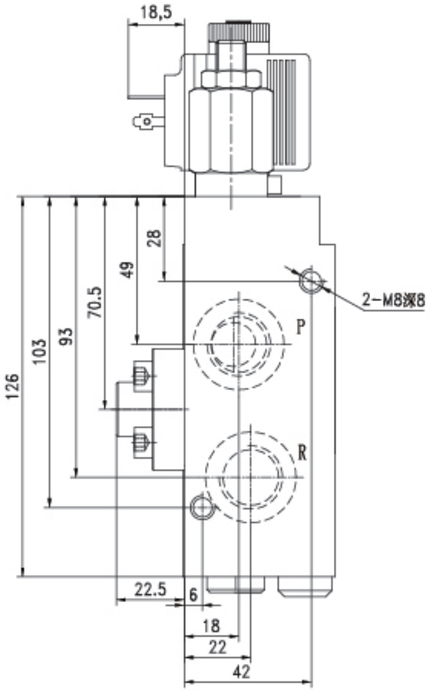
Note: mount the thread M8; "N" in the installation dimensions 55.8+49.5*N and 118.3+49.5*N refers to the number of ways of the directional spool valve. Users can confirm the installation dimension and outline dimension according to the actually required number of ways of the directional spool valve.

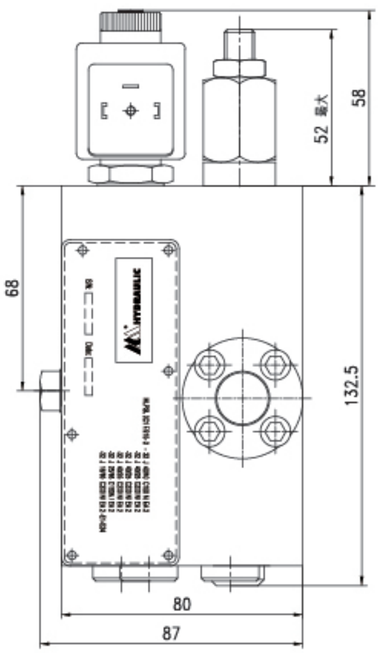
5.2 Connection block

5.2.1 HLPSL3 and HLPSL4

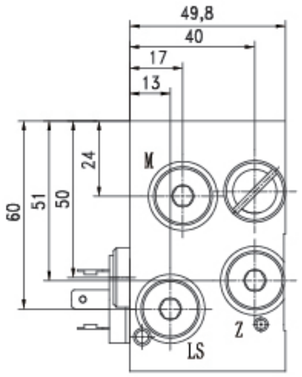


	HLPSV3..	HLPSV4..
a	126	126
b	93	93
c	18	21
d	22	22

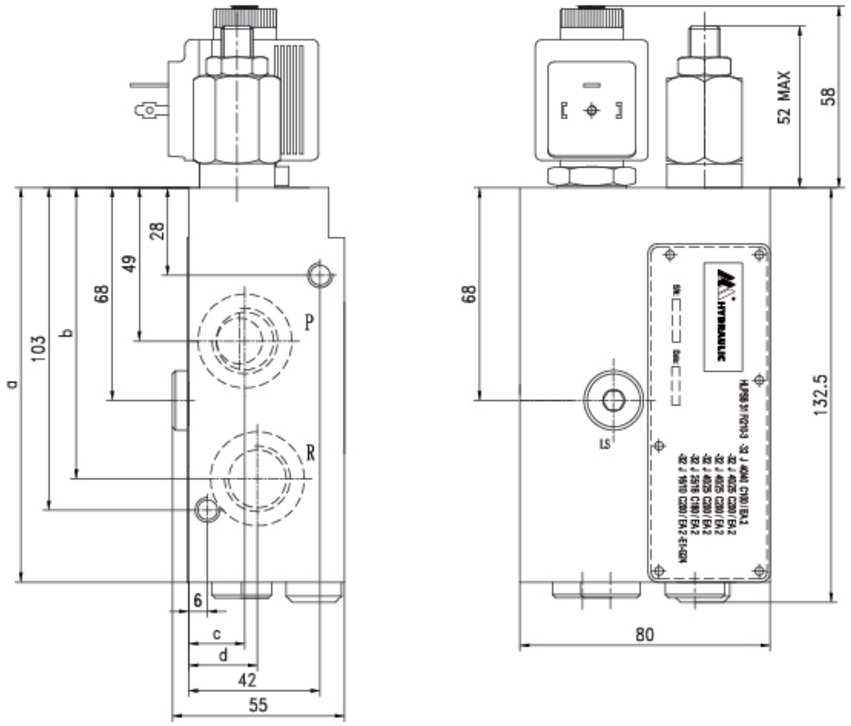




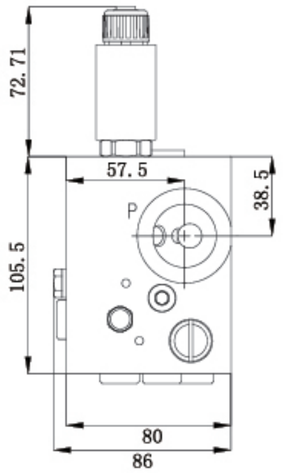
5.2.2 HLPSV3 and HLPSV4

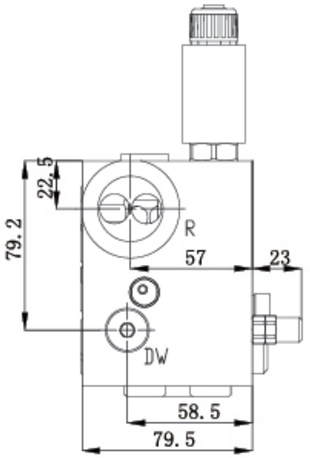


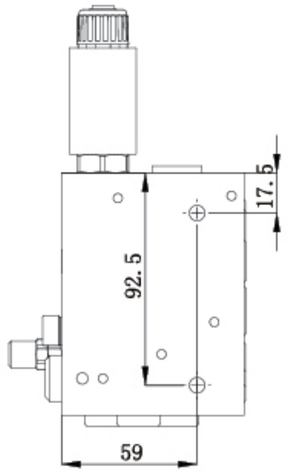
	P and R	LS, Z and M
HLPSL3/HLPSV3	G1/2	G1/4
HLPSL4/HLPSV4	G3/4	G1/4
HLPSL5/HLPSV5	G1	G1/4

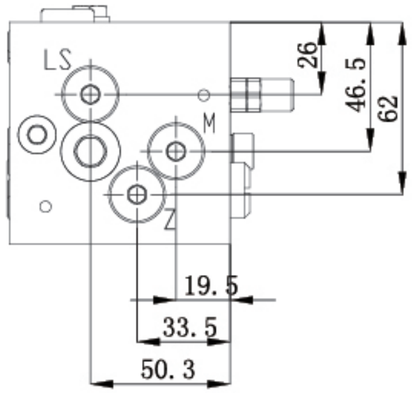


5.2.3 HLPSL5 and HLPSV5





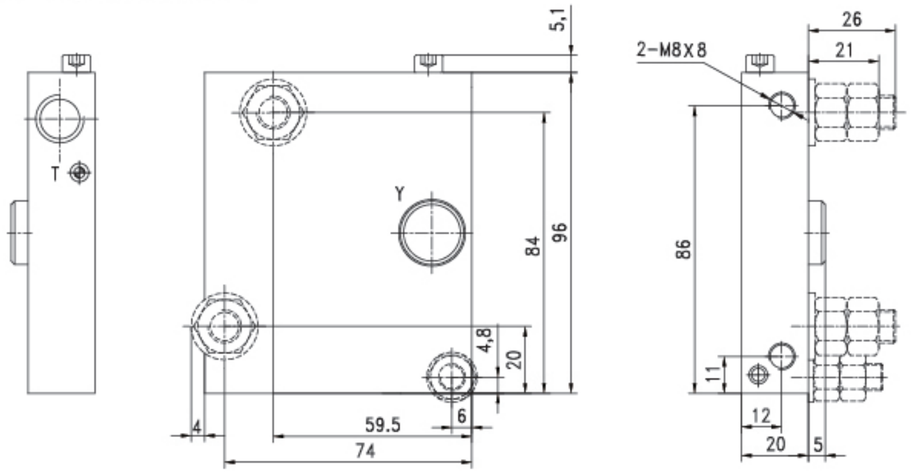




Note: mount the thread M8; when the connection block HLPSL5 or HLPSV5 connects with the directional spool valve with auxiliary functions, ZPL33/5, ZPL33/15 or ZPL33 transition plate shall be mounted between the connection block and directional spool valve according to actual demand. Otherwise pipe connector can' t be mounted on oil return port R.

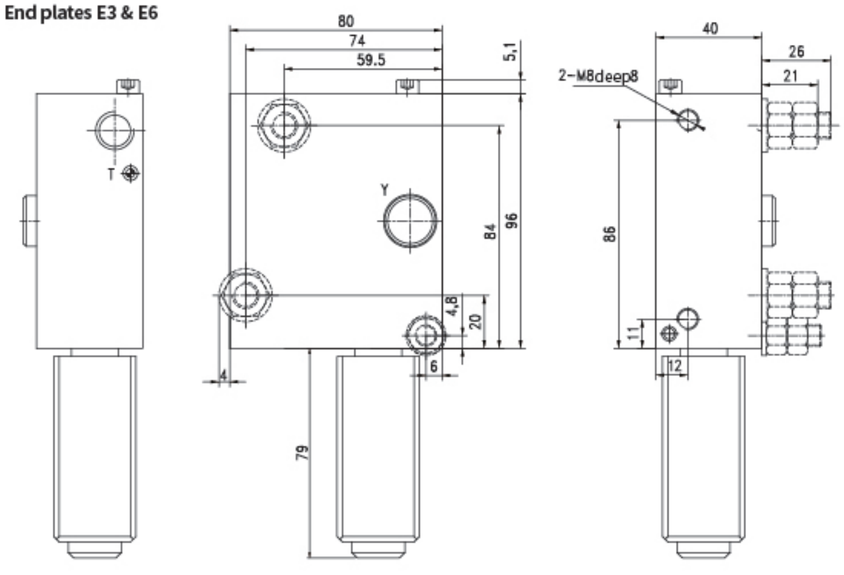
5.3 End plate

5.3.1 End plates E1, E2, E4 & E5



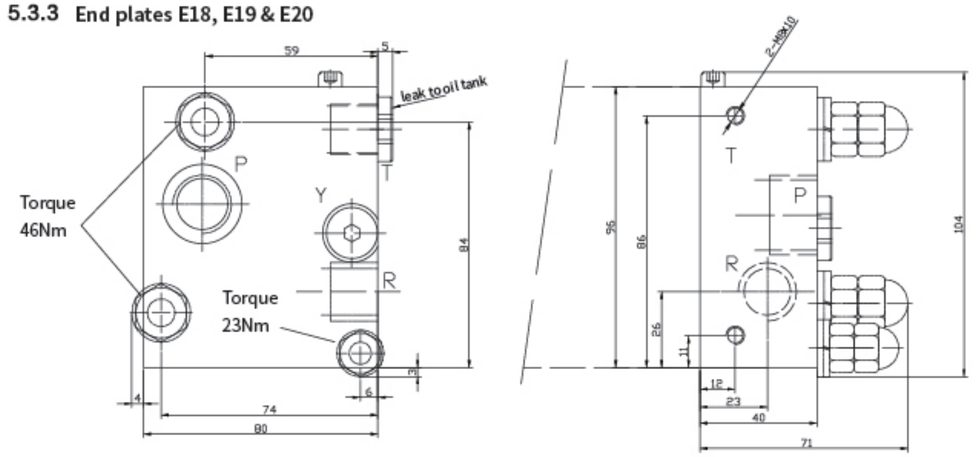
Oil port standard Please refer to DIN ISO 228/1 (BSPP) T & Y =G1/4

5.3.2 End plates E3 & E6



Oil port standard Please refer to DIN ISO 228/1 (BSPP) T & Y =G1/4

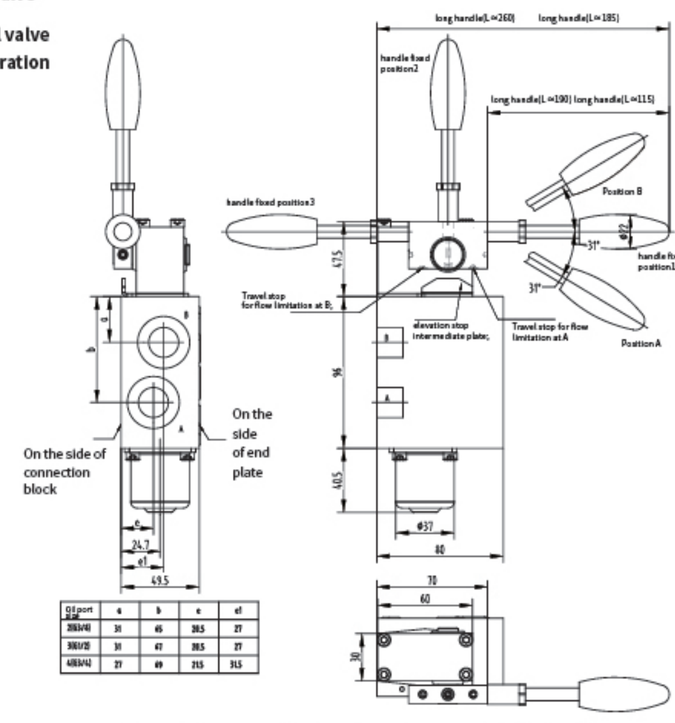
5.3.3 End plates E18, E19 & E20



Oil port standard Please refer to DIN ISO 228/1 (BSPP) T & Y =G1/4 P & R =G3/4

5.4 Directional spool valve

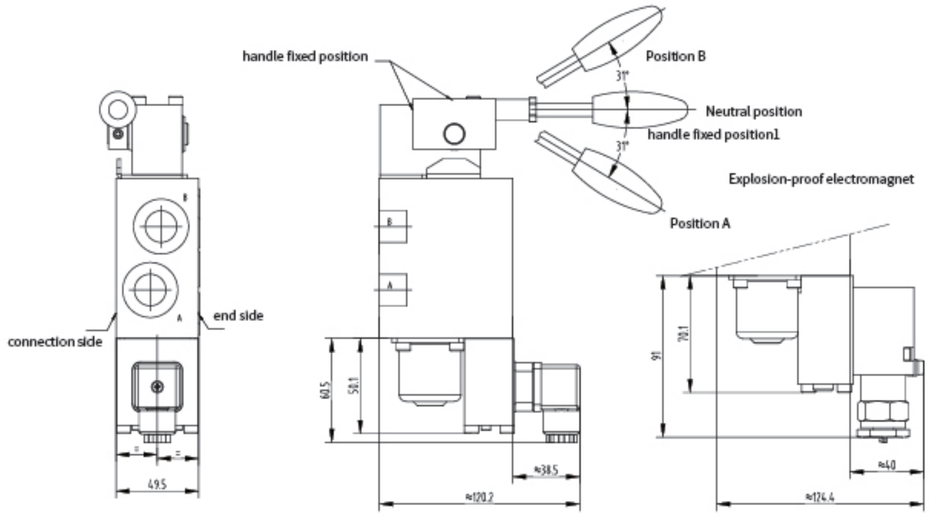
5.4.1 Directional spool valve with manual operation type A and M



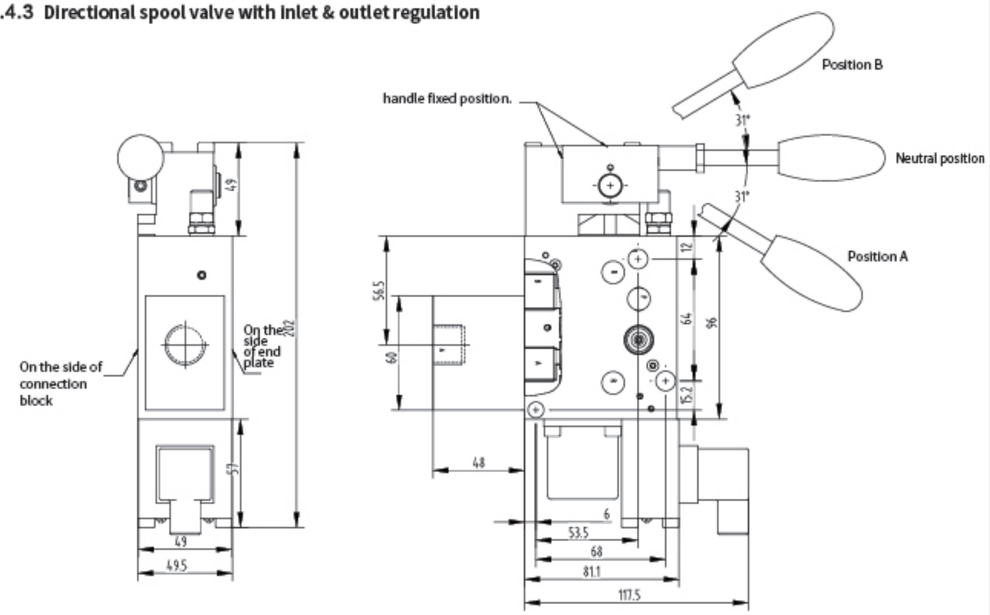
Oil port	a	b	e	e1
2(B)(A)	31	65	28.5	27
3(B)(P)	31	47	28.5	27
4(B)(A)	27	69	21.5	31.5

In case the multi-way valve with manual operation manner, the handle can be mounted in 3 directions.

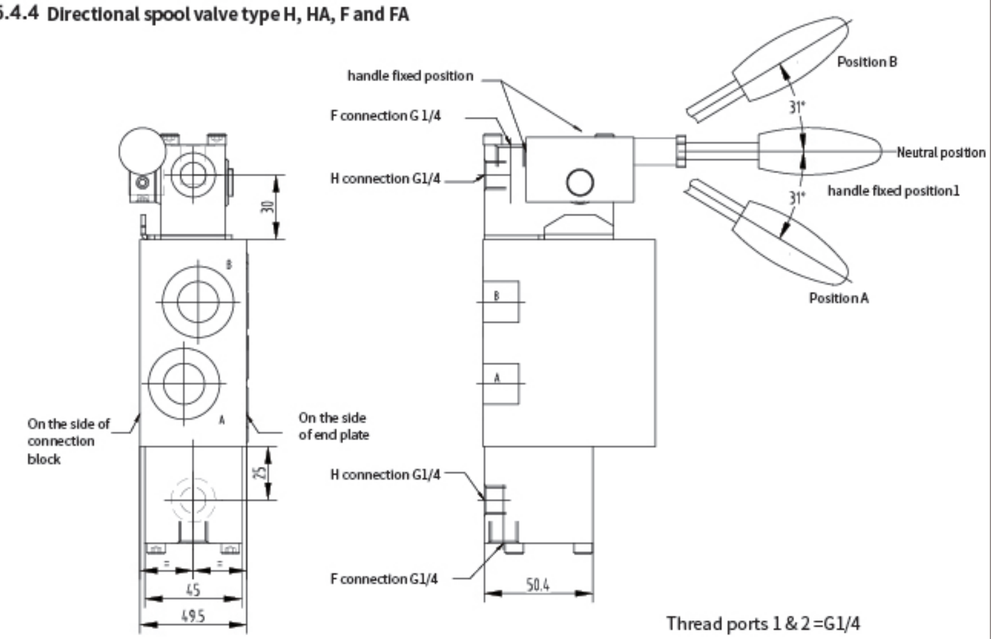
5.4.2 Directional spool valve with electric hydraulic control type E and EA



5.4.3 Directional spool valve with inlet & outlet regulation

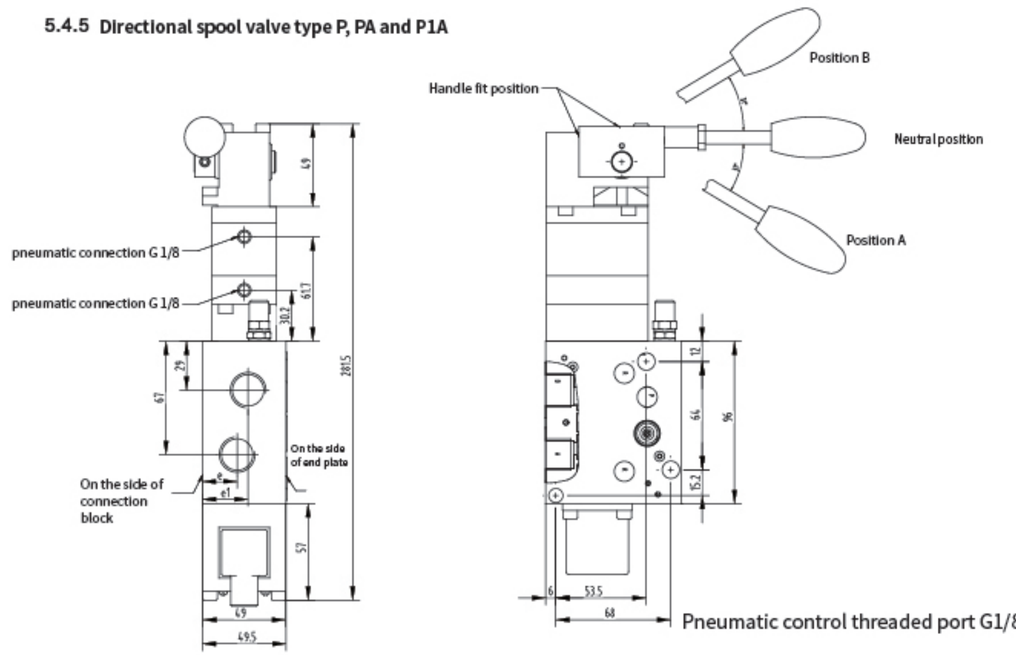


5.4.4 Directional spool valve type H, HA, F and FA



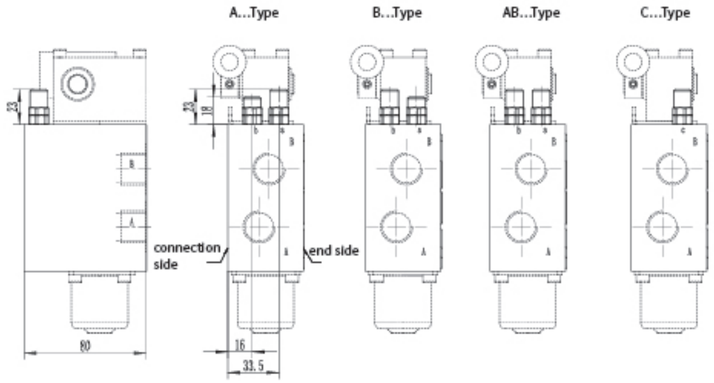
Thread ports 1 & 2 =G1/4

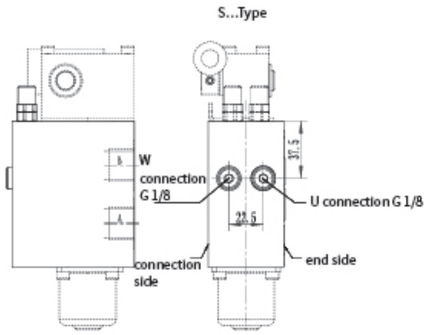
5.4.5 Directional spool valve type P, PA and P1A



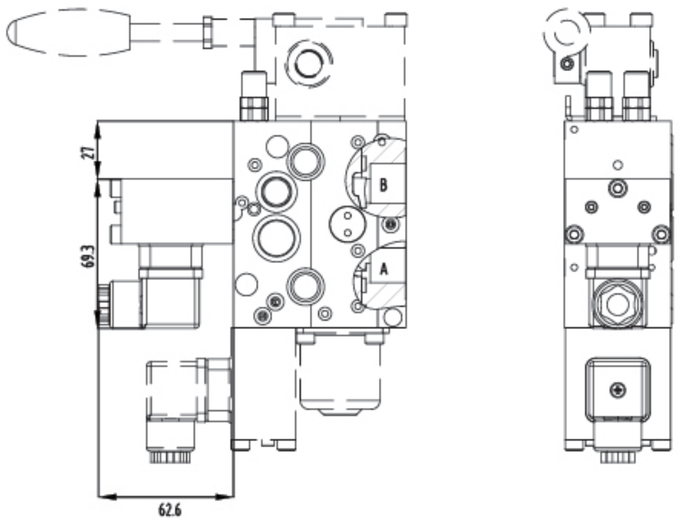
Pneumatic control threaded port G1/8

5.4.6 Spool valve equipped with sub-pressure valve、function open - off valve and proportional pressure limited valve;



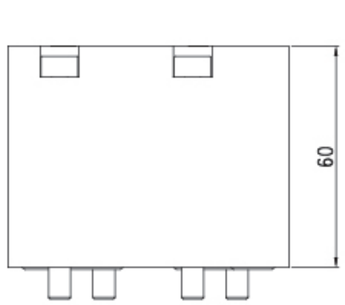


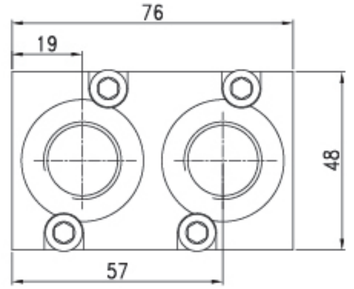
Type F1、F2、F3



5.5 Ancillary block

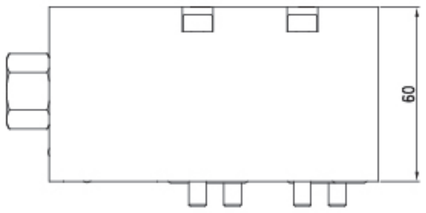
5.5.1 /3

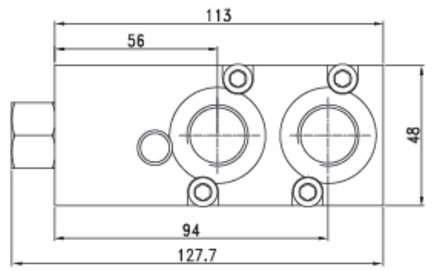




Thread port = G1/2

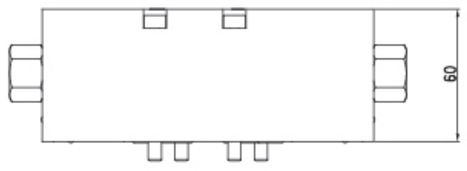
5.5.2 /3DRHA，3DRHB，/3AL..，/3BL..

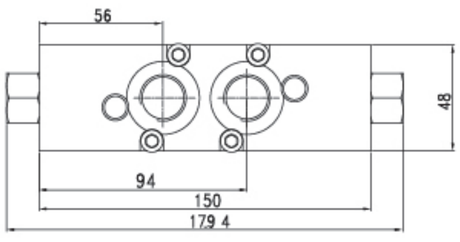




Thread port = G1/2

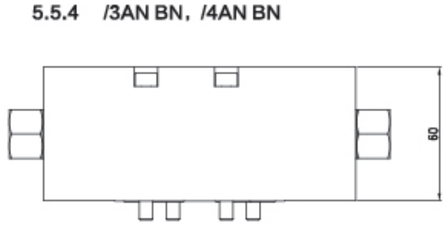
5.5.3 /3DRH，/3AL.. BL..

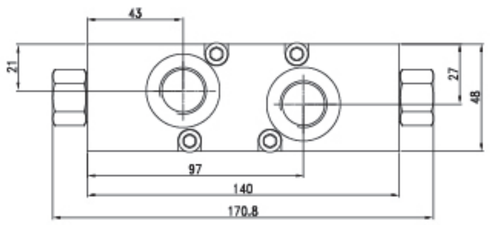




Thread port = G1/2

5.5.4 /3AN BN，/4AN BN





Thread port of /3AN BN =G1/2, Thread port of/4AN BN =G3/4

VI. Application Example

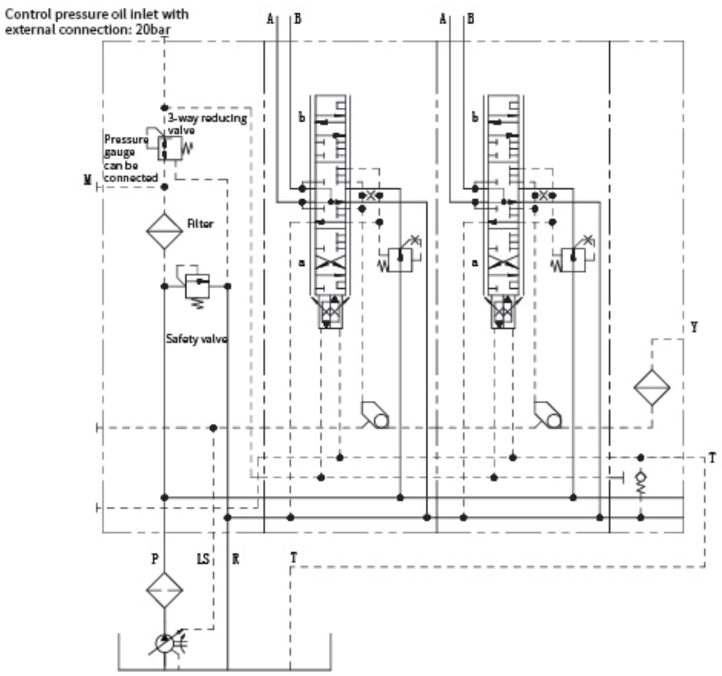
6.1 Application of proportional multi-way valve according to load-sensitive principle in flat car

Reference model used for controlling the steering of flat car

HLPSV3C1C/280–3–32H80/80NN/E

–32H80/80NN/E – E20–G24

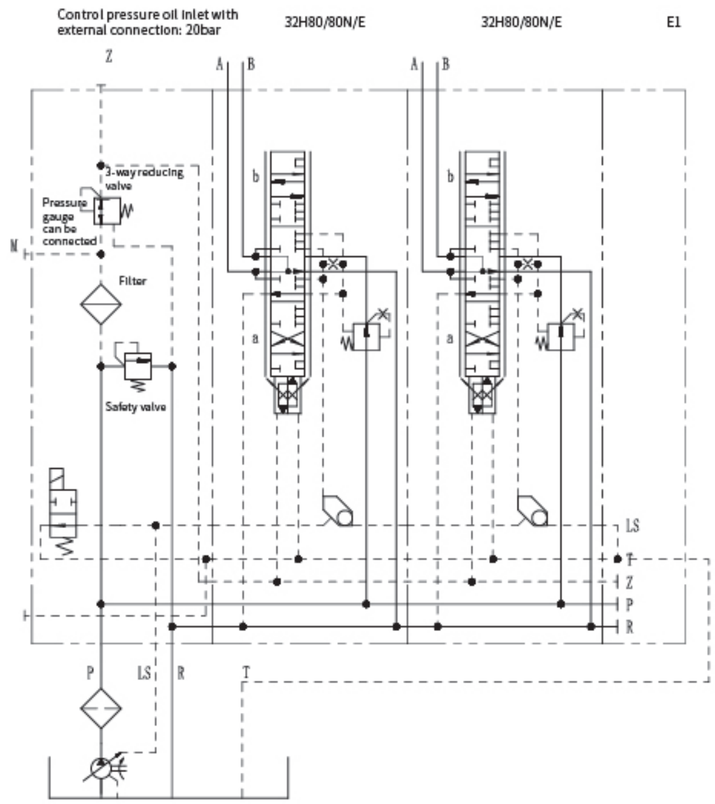
Connection block	Proportional directional spool valve 1	Proportional directional spool valve 2	End plate
HLPSV3C1C/280-3	32H80/80N/E	32H80/80N/E	E20



Reference model used for controlling the lifting of flat car:

HLPSV3C1F/280–3–32H80/80NN/E

–32H80/80NN/E – E1–G24



6.2 Application of proportional multi-way valve according to load-sensitive principle in concretepump truck

Reference model

HLPSL3C1C/350–3–38L63/80 NN/EA2

–32H16/16 C250N/EA2

–32J80/63 A300B300N/EA2

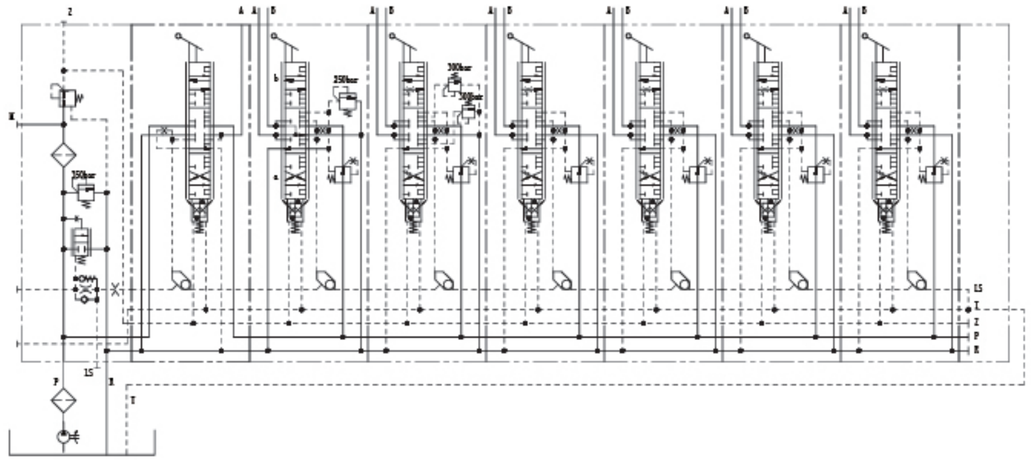
–32J63/40 NN/EA2

–32J40/25 NN/EA2

–32J25/25 NN/EA2

–32J16/16 NN/EA2

– E1–G24



6.3 Application of proportional multi-way valve according to load-sensitive principle in overhead working truck

Reference model

HLPSL3C1F/210–3–32H40/40 C100N/EA2

–32H40/25 C200N/EA2

–32H40/25 C200N/EA2

–32H40/25 C200N/EA2

–32H25/16 C200N/EA2

–32H16/10 C200N/EA2 – E1–G24

Since the schematic diagram is basically the same with that of concrete pump truck in previous diagram, it will not be set out hereby.

6.4 Application of proportional multi-way valve according to load-sensitive principle in lorry-mounted crane

Reference model

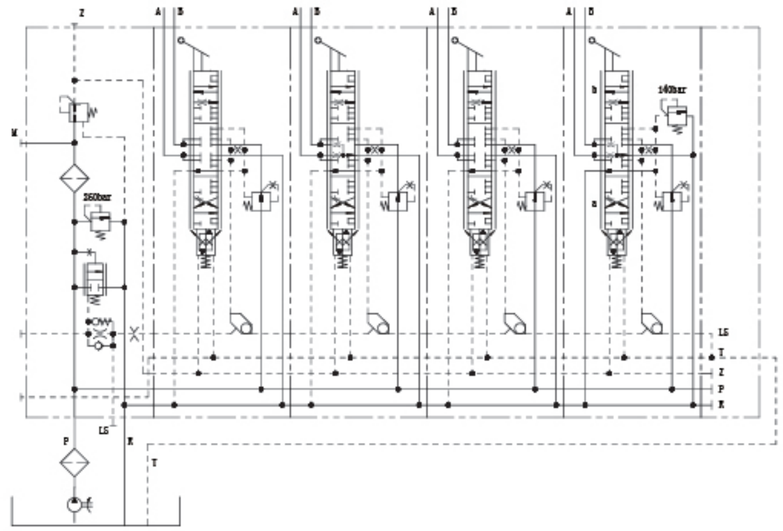
HLPSL4C1C/260-3-32J80/63 NN/EA2

-32O80/80 NN/EA2

-32J80/63 NN/EA2

-32O25/25C140N/EA2

-E1-G24



6.5 Load sensing proportional valve for bridge inspection vehicle

Reference model

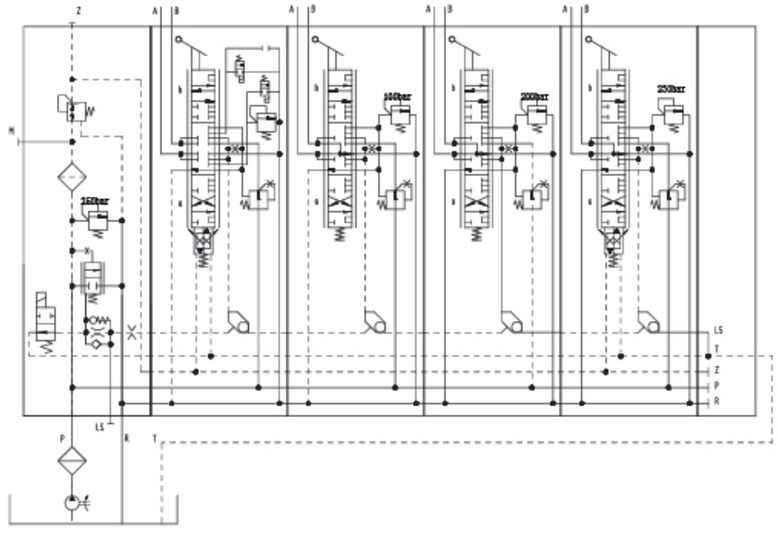
HLPSL3C1F/250-3-32L40/25A210F3/EA2

-32H16/16C100N/A2

-32H25/25C200N/A2

-32H63/63C230N/EA2

-E1-G24



VII. Other Characteristics

7.1 Model selection and design description

7.1.1 Modification for the use in special service conditions or with special requirements

Oceanic climate environment

In case of severe marine climate, all moving spare parts by manual operation manner shall go through sufficient anti-corrosion treatment. In this way, the hinge pin in handle operating rod bearing shall be made by stainless steel. All other spare parts shall either go through gas nitriding anti-corrosion treatment, or be made by stainless steel.

Pressure impact in oil return way

Since extremely high pressure impact (>150bar) will be generated in the loop when the actuator is connected or broken, and it will cause slight leakage of the spring shield, enhanced-type spring shield can be used to prevent such phenomenon.

Note: the allowable oil return pressure shall be less than 50bar. As to relatively high oil return pressure, the reliability for operating the electromagnet can' t be guaranteed.

7.1.2 Use of variable displacement pump

In case of using the load-sensitive control and variable displacement pump together, LS signal oil way of pump' s pressure-flow controller (load-sensitive regulator) shall be unloading in idling condition (when the actuator doesn' t work) to reduce the circulation loss. Such constraint is realized through proportional directional spool valve. In case of no such pressure relief, the pump will still work with all surplus flow and under the pressure set by pressure regulator safety valve in non-reversing position.

Since some directional spool valves don' t have such constraint, there shall be an internal bypass hole or throttle valve between the LS signal inlet and pressure release oil outlet on the pressure-flow controller of some varieties.

When using proportional directional spool valve type HLPSV, it' s unnecessary to use abovementioned controller, and otherwise it will cause excessive discharge of control oil and result in functional fault. Due to functional reasons, the flow of control oil is limited to 2L/min specially (actuator runs at low speed). Note: it' s required to block the possible bypass hole in pressure-flow controller.

7.1.3 Combination with balance valve

In case the three control elements (three-way flow regulating valve in the pump or connection block, two-way flow regulating valve in the directional spool valve, and balance valve) are connected in series, vibration may occur for the control system due to external load change and resonance.

7.1.4 Combination with over 12 directional spool valves

12 directional spool valves can be connected at most in the sequence of LS signal oil way no matter whether these directional spool valves are arranged in a valve bank or several valve banks. Such limitation is because the flow provided is limited (only can guarantee operation at low speed). In case over 12 directional spool valves are connected into several directional spool valve banks through LS signal respectively, chain oil way comprised of external shuttle valve shall be used.

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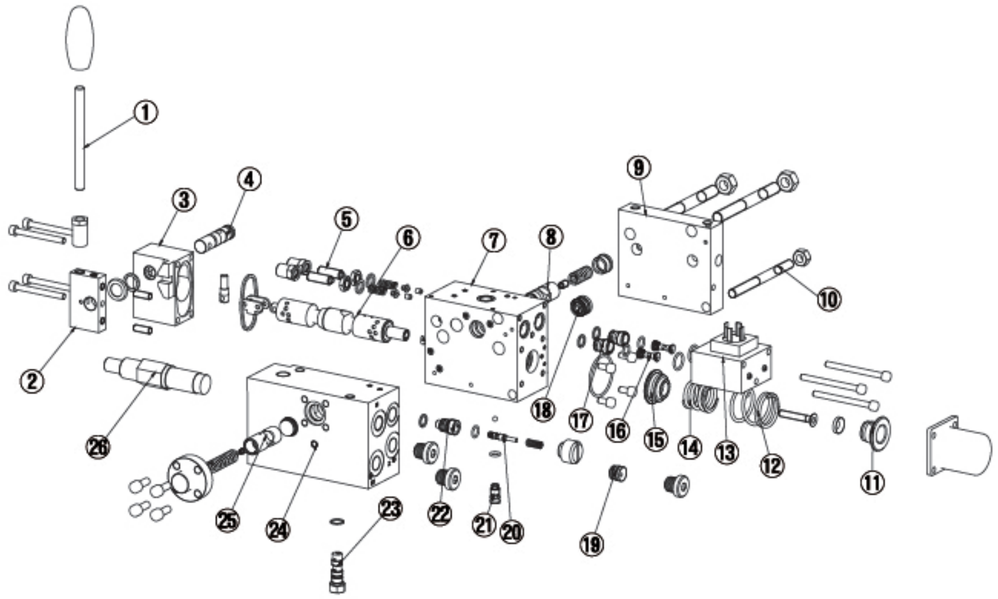
VIII. Explosive Drawing



① Handle lever
② Limit stop
③ Handle seat
④ Shaft
⑤ Secondary pressure limiting valve
⑥ Main valve core
⑦ Directional spool valve
⑧ Fixed differential reducing valve
⑨ End plate
⑩ Connecting rod
⑪ Spring collar A
⑫ Outer spring
⑬ Electromagnet
⑭ Inner spring
⑮ Spring collar B
⑯ Valve core of proportional reducing valve
⑰ Valve bush of proportional reducing valve
⑱ Pressure extraction plug
⑲ Filter
⑳ Valve core of three-way reducing valve
㉑ Shuttle valve
㉒ Valve bush of three-way reducing valve
㉓ Throttling damper
㉔ Connection block
㉕ Fixed differential overflow valve
㉖ Main safety valve

IX. Matters Needing Attention for Use

1、It' s required to design and install a **high-pressure pipeline filter with the precision of 5μ** between the outlet of hydraulic pump and port P of proportional multi-way valve according to load-sensitive principle, because the proportional multi-way valve according to load-sensitive principle is assembled on a forging valve block through plug-in mounting of several hydraulic control elements. Since the system structure is complex with multiple ways and high coordinating precision of slide valve, the proportional multi-way valve according to load-sensitive principle has relatively high requirement on the cleanliness of hydraulic medium. To realize reliable operation of proportional multi-way valve according to load-sensitive principle, pollution control shall be carried out for hydraulic medium.

Circulating washing shall be carried out for hydraulic pipeline generally. If necessary, use a set of ordinary multi-way valve connection system to carry out working cycle for the whole hydraulic system to realize complete cleaning of the system and remove early failure of the system. Then install the proportional multi-way valve according to load-sensitive principle officially and carry out system debugging and ex-factory acceptance.

2、As to end plate E1, E2, E3 and E18, **pilot oil return port T on the end plate shall be connected to oil return tank directly without back pressure and can' t be combined with oil return way!**

3、As to end plate E4, E5, E6, E19 and E20, it' s suggested to connect the pilot oil return port T on the end plate to oil return tank directly without back pressure. In this way, the working performance can be improved and service life can be prolonged.

4、When connecting & mounting the pipeline of proportional multi-way valve according to load-sensitive principle, oil port R on connection block of the multi-way valve is the general oil return inlet and shall be connected to the oil return tank without any mistake! **In case oil port R on the connection block is connected wrongly, which causes high pressure or unopened stop valve mounted on the oil return pipeline, oil leakage and even explosion of proportional multi-way valve according to load-sensitive principle will be caused!**

5、As to the multi-way valve according to load-sensitive principle with electric proportional control or electric switching value control, the two coils of double-end proportion electromagnet can' t be connected with power supply for control simultaneously and the two coil windings shall control two directions of multi-way directional spool valve respectively.

6、As to the multi-way valve according to load-sensitive principle with electric proportional control or electric switching value control, it' s required to check the parameters of control voltage and current at first, and then carry out control according to such parameters of multi-way valve to prevent any damage of double-end proportion electromagnet or electrical control equipment.

7、When the proportional multi-way valve according to load-sensitive principle is mounted on engineering machinery vehicle for use, **rain-proof dust cover shall be designed & mounted for protection** to prevent the multi-way valve from being exposed in rainy & sandy environment!

X. Treatment of Simple Faults

1. The whole system has no pressure: at first, make sure that the liquid level of oil tank is 150mm higher than oil inlet and the rotating direction of hydraulic pump is correct; then check the correctness of connection from pump outlet to multi-way valve and check if the high-pressure pipeline filter is blocked by any contaminant; besides, check if additional overflow valve (safety valve) is in zero-pressure state, except for the multi-way valve; as to proportional multi-way valve according to load-sensitive principle (type HLPSV) with variable displacement pump system according to load-sensitive principle, it' s also required to check if the oil way between oil port LS on connection block of the multi-way valve and port X on hydraulic pump is unblocked; check if the safety valve on connection block of the multi-way valve is in zero-pressure state; check if electromagnetic unloading valve on connection block of the multi-way valve powers on according to the requirement; in case the fault still can' t be removed upon abovementioned inspections are completed, check and clean the throttling orifice one-way valve (throttling plug) on connection block of the multi-way valve; in case the fault still can' t be removed, **It' s required to deliver the system back to Jiangsu KM Hydraulic Control System Co., Ltd. for repair.**

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2、One way of the multi-way valve has no pressure or output pressure is lower than the set pressure value: as to the directional spool valve with secondary pressure limitation, check if the secondary pressure limiting valve is loose at first; then check & clean the shuttle valve (between oil ports A and B) of the multi-way valve, check if the shuttle valve is polluted and if the steel ball is stuck. In case the fault can' t be removed, maybe the throttling orifice of pressure extraction plug is blocked and **It' s required to disassemble the multi-way valve for cleaning.**

3、One end (port A or port B) of one way of the multi-way valve has no pressure or output pressure is lower than the set pressure value: at first, check if the corresponding secondary pressure limiting valve is loose (what' s next to the end plate is the secondary pressure limiting valve of port A). In case the fault can' t be removed, maybe the throttling orifice of pressure extraction plug is blocked and it' s required to disassemble the multi-way valve for cleaning.

4、Electric proportional control of multi-way is insensitive, namely, the valve will not work with small control signal and carry out snap action with large signal, which is because the pilot proportional reducing valve of directional spool valve of the way is polluted and the movement of valve core of the pilot proportional reducing valve is insensitive. Steps for removing the fault: a) clean the dusts on related proportion electromagnet of multi-way valve and on surrounding outer surface; b) disassemble related proportion electromagnet and pay attention to not losing internal valve core of proportional reducing valve and conical spring; c) inspection: press the valve core of two proportional reducing valves by index finger and middle finger respectively, and check if the upper end face of valve core can move flexibly without any clamping stagnation from the position parallel with the plane of valve body to the area 1-2mm lower than the plane; d) disassemble the valve core of proportional reducing valve and conical spring for cleaning and mount them in corresponding valve seat again; e) re-inspection: press the valve core of two proportional reducing valves by index finger and middle finger respectively, and check if the upper end face of valve core can move flexibly without any clamping stagnation from the position parallel with the plane of valve body to the area 1-2mm lower than the plane; f) check if the push rod of proportion electromagnet can move flexibly; g) mount the proportion electromagnet on the valve block of directional spool valve; h) carry out experimental verification again to remove the fault.

5、Upon the multi-way valve according to load-sensitive principle with electric proportional control or electric switching value control is started up without power supply, the handle of multi-way valve moves on its own, namely, there is output of the multi-way valve, oil cylinder or motor begins to work, which is because the valve core of pilot proportional reducing valve of directional spool valve of the way is stuck. Please refer to above item 4 for the method for fault removal.

6、As to the multi-way valve according to load-sensitive principle with electric proportional control or electric switching value control, manual control is normal, while electronic control doesn' t work, namely, the directional spool valve of each way doesn' t work in case of electric operation. At first, check if the control electric signal is normal. In case the electric signal is normal, maybe the valve core of 3-way reducing valve on the connection block is stuck. Unscrew the valve seat (slotted) of 3-way reducing valve and clean the valve core. In this way, the fault can be removed.

7、Replacement of two rotary seal rings of the handle. Since the two seal rings are dynamic seal and oil leakage will occur after they' re used for 2 years generally, it' s required to replace them. Steps for replacement: a) disassemble spring shield of the directional spool valve; b) disassemble inner & outer springs and spring seat (or friction positioning mechanism); c) disassemble the handle seat; d) pull the main valve core out of the valve body; e) take the main valve core off; f) take the stop block of handle, check ring and its dust ring off; g) push the spindle respectively and replace rotary seal ring; h) recover the assembly according to reverse sequence of the disassembling order; I) matters needing attention for disassembling & assembling: check the seal ring of each part; prevent the entry of any contaminant; as to main valve core with the flow equal to or less than 16L/min, pay attention to the mounting direction of main valve opening, and the **pressure extraction groove on the step in the middle of main valve core shall face to the direction of end plate!**

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Thanks