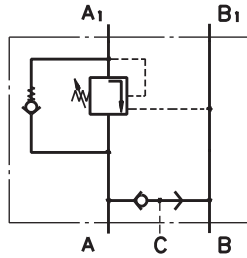


VALVES FOR HYDRAULIC MOTORS

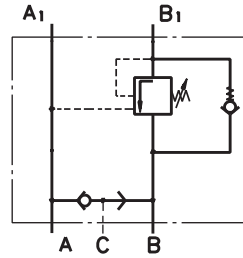
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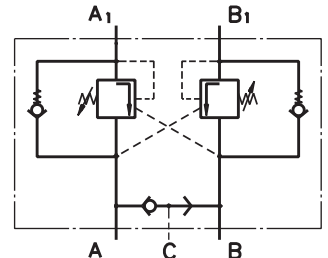
OVERCENTER VALVES WITH BRAKE CONTROL



Single Overcenter Valves with Brake Control type KPBR ... AE



Single Overcenter Valves with Brake Control type KPBR ... BE



Dual Overcenter Valves with Brake Control type KPBR ... D

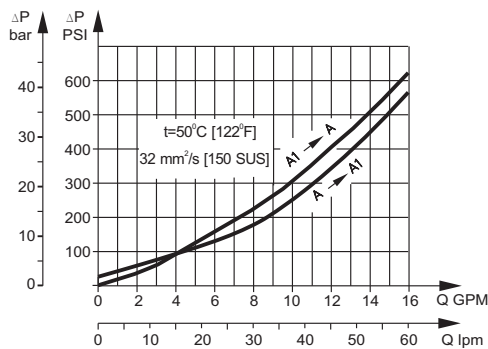
SPECIFICATION DATA

Parameters	Type											
	KPBR...E	KPBS...E	KPBR...D	KPBS...D	KPBW...E	KPBW...D	KPBHR...E	KPBHR...D	KPBT...E	KPBT...D	KPBV...E	KPBV...D
Flow Rate, lpm [GPM]	60 [15.85]						100 [26.4]		200 [52.8]			
Rated Pressure*, bar [PSI]	60÷280 [870÷4060]						70÷250 [1015÷3625]					
Pilot Ratio	4,25:1											
Weight, kg [lb]	3,020 [6.658]	2,900 [6.39]	3,060 [6.746]	2,920 [6.437]	3,050 [7.724]	3,140 [6.923]	2,300 [5.071]	2,400 [5.291]	5,400 [11.905]	5,800 [12.787]	9,200 [20.283]	9,750 [21.495]

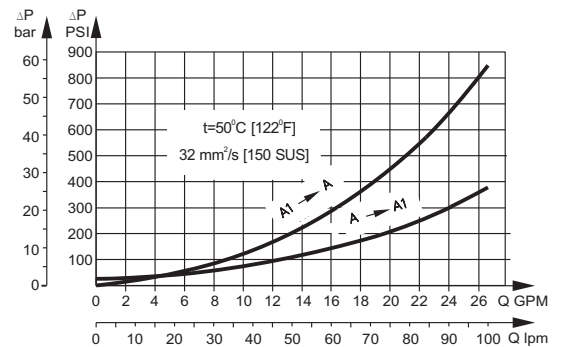
*Pressure Settings are at flow rate of 5 lpm [1.3 GPM] and viscosity 32 mm²/s [150 SUS] at 50 °C [122 °F].

PRESSURE LOSSES

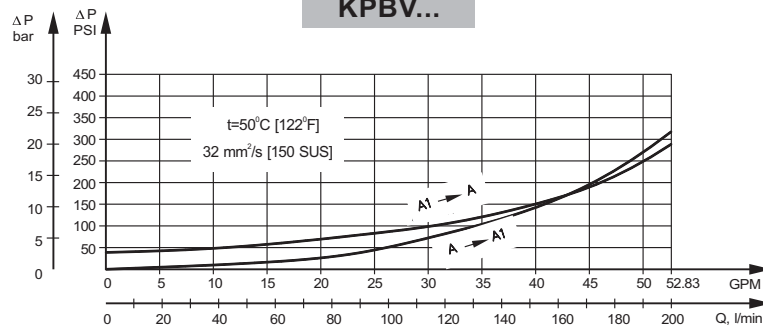
KPBR..., KPBS..., KPBW..., KPBHR...



KPBT...

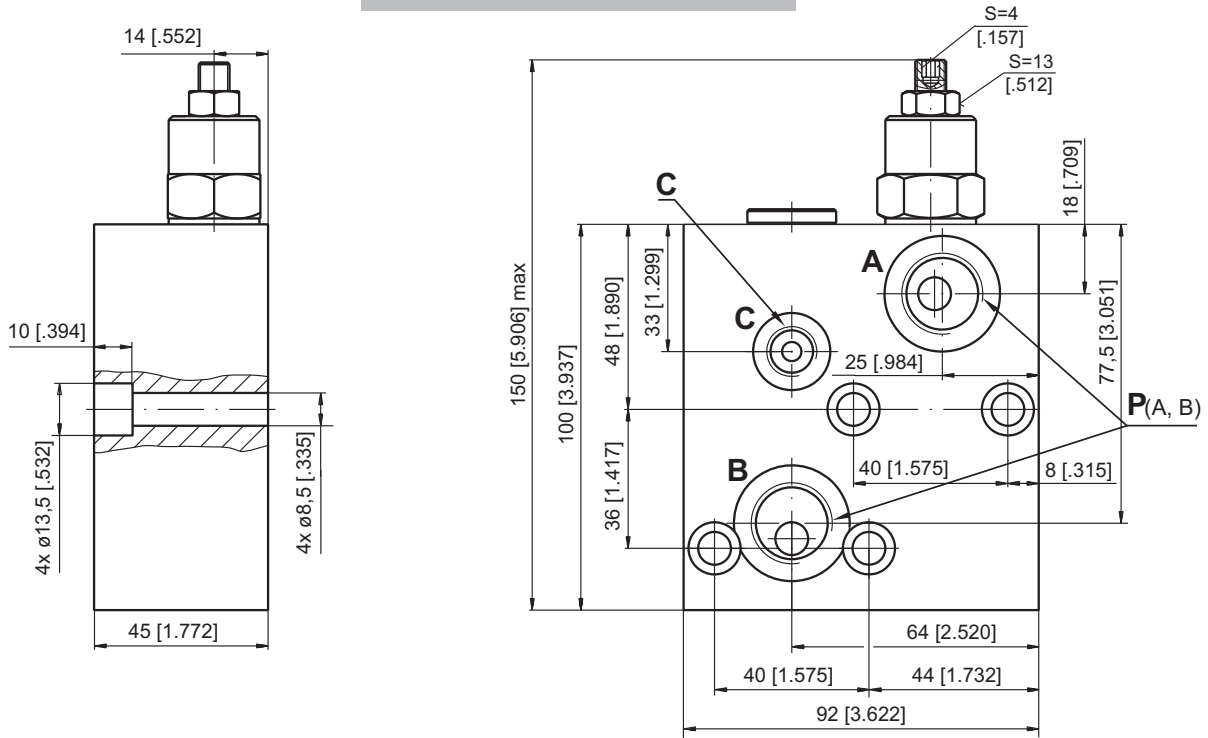


KPBV...

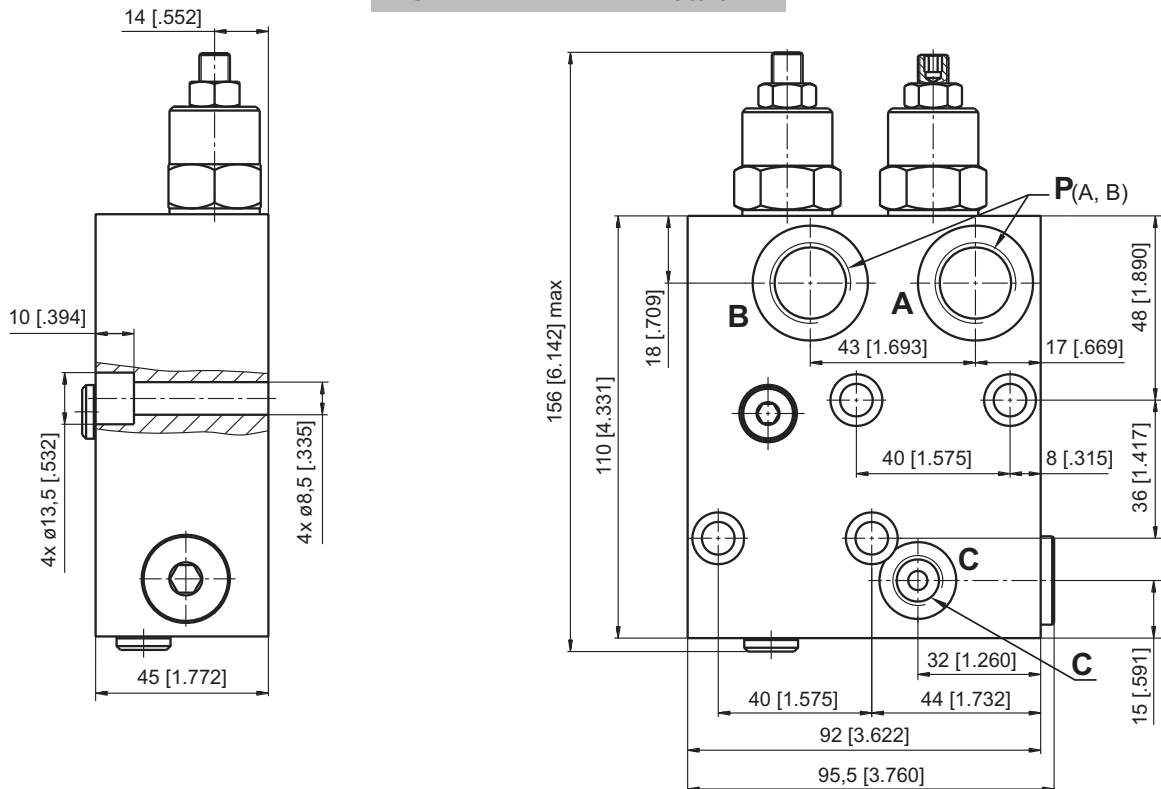


VALVES FOR MP, MR, MH HYDRAULIC MOTORS

SINGLE VALVE KPBR-250/1/E...



DUAL VALVE KPBR-250/1/D...



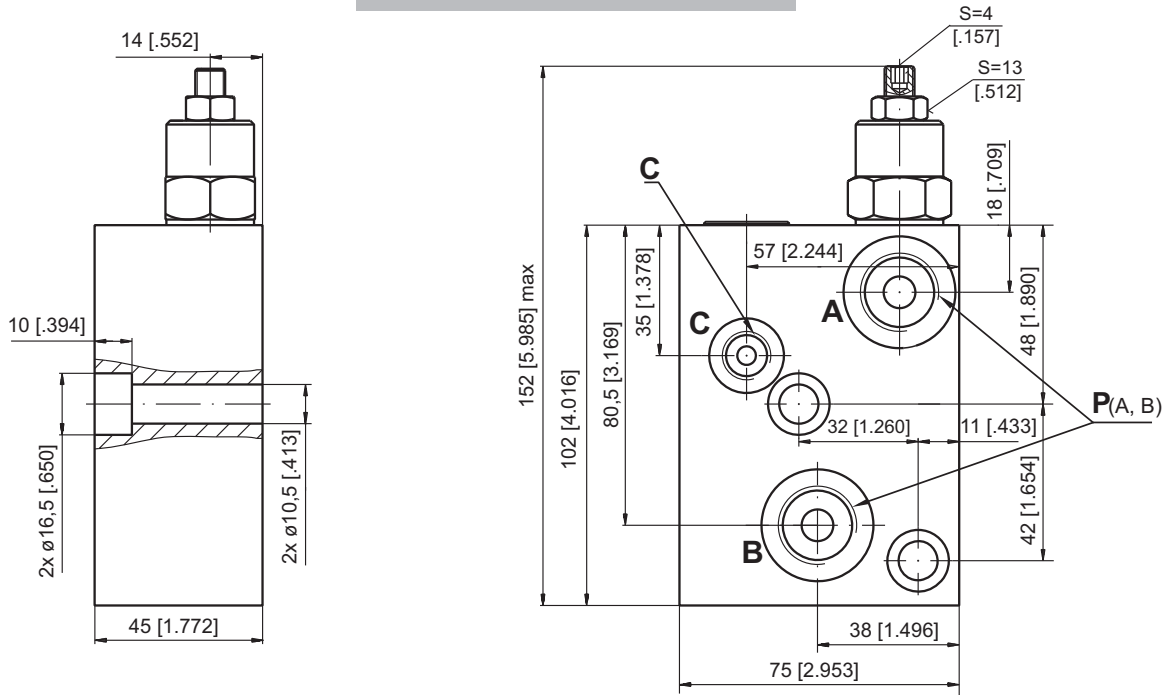
	Thread Ports - P _(A,B)	Thread Port - C
-	G1/2 16 [.63] depth	G1/4 12 [.47] depth
M	M22x1,5 16 [.63] depth	M14x1,5 12 [.47] depth
A	7/8 - 14 UNF O-ring 16 [.63] depth	7/16 - 20 UNF O-ring 12,7 [.50] depth



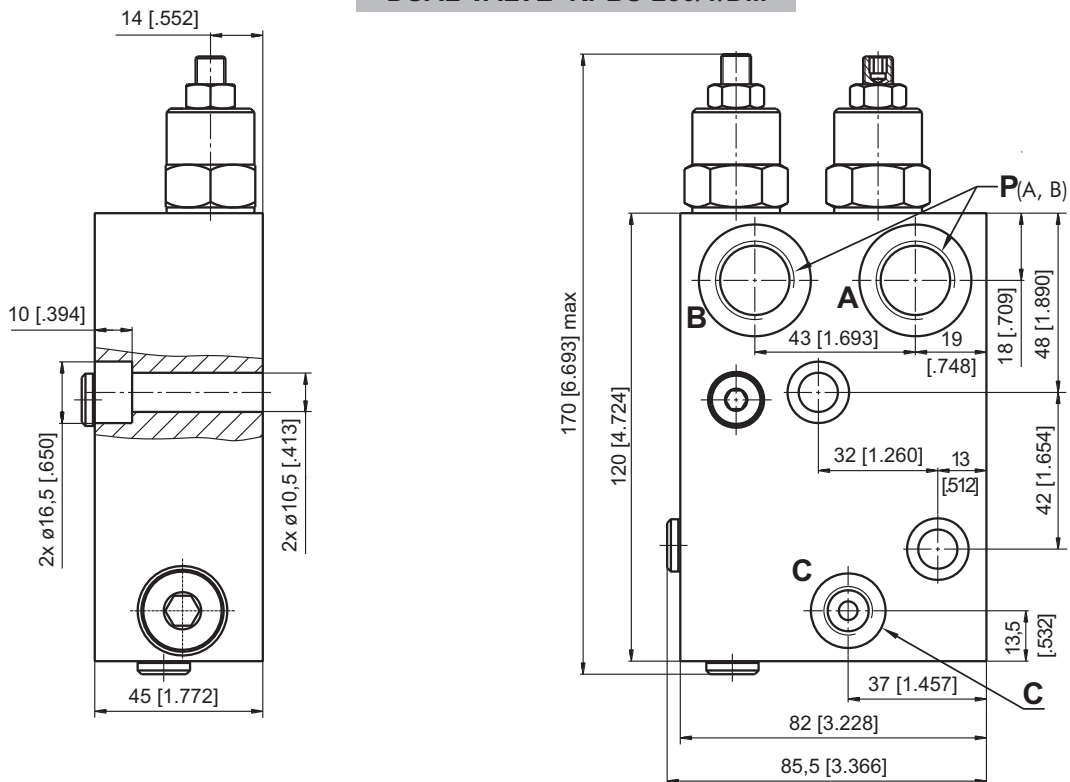
Note : KPBR Blocks are installed directly on MP, MR and MH Motors with four screws M8x45 - 8.8 DIN 912 or 5/16-18 UNC, 1.75 long ANSI B 18.3 . Tightening torque 2,0^{+0.5} daNm [177⁺⁴⁴ lb-in].

VALVES FOR MS HYDRAULIC MOTORS

SINGLE VALVE KPBS-250/1/E...



DUAL VALVE KPBS-250/1/D...



	Thread Ports - P _(A,B)	Thread Port - C
-	G1/2 16 [0.63] depth	G1/4 12 [0.47] depth
M	M22x1,5 16 [0.63] depth	M14x1,5 12 [0.47] depth
A	7/8 - 14 UNF O-ring 16 [0.63] depth	7/16 - 20 UNF O-ring 12,7 [0.50] depth

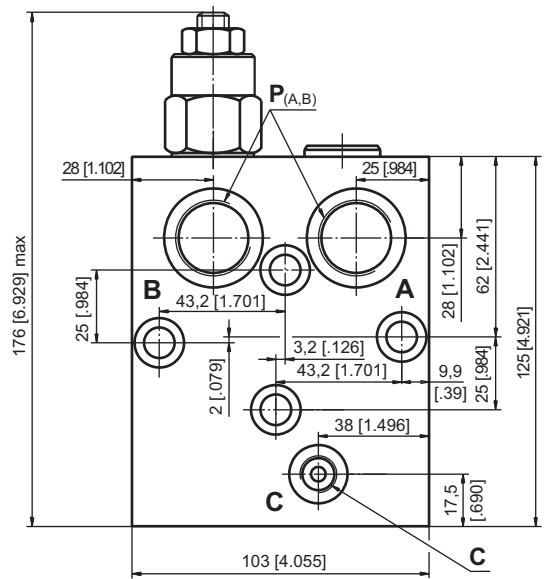
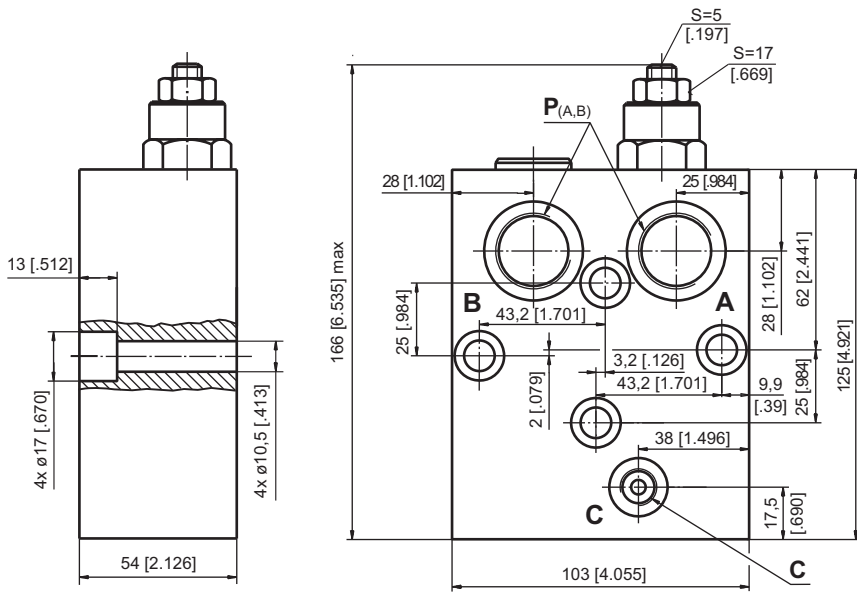


Note : KPBS Blocks are installed directly on MS Motors with two screws M10x45 - 8.8 DIN 912 or 3/8-16UNC, 1.75 long ANSI B 18.3 . Tightening torque 3,5 daNm [310 lb-in].

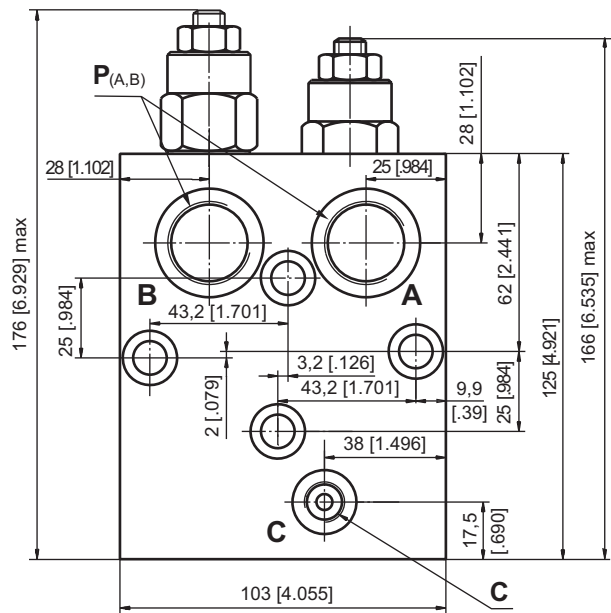
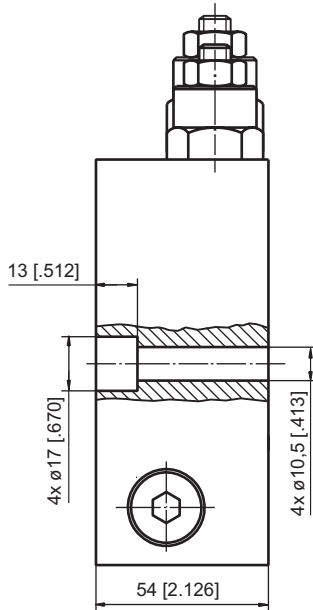
VALVES FOR MT HYDRAULIC MOTORS

SINGLE VALVE KPBT-250/1/AE...

SINGLE VALVE KPBT-250/1/BE...



DUAL VALVE KPBT-250/1/D...



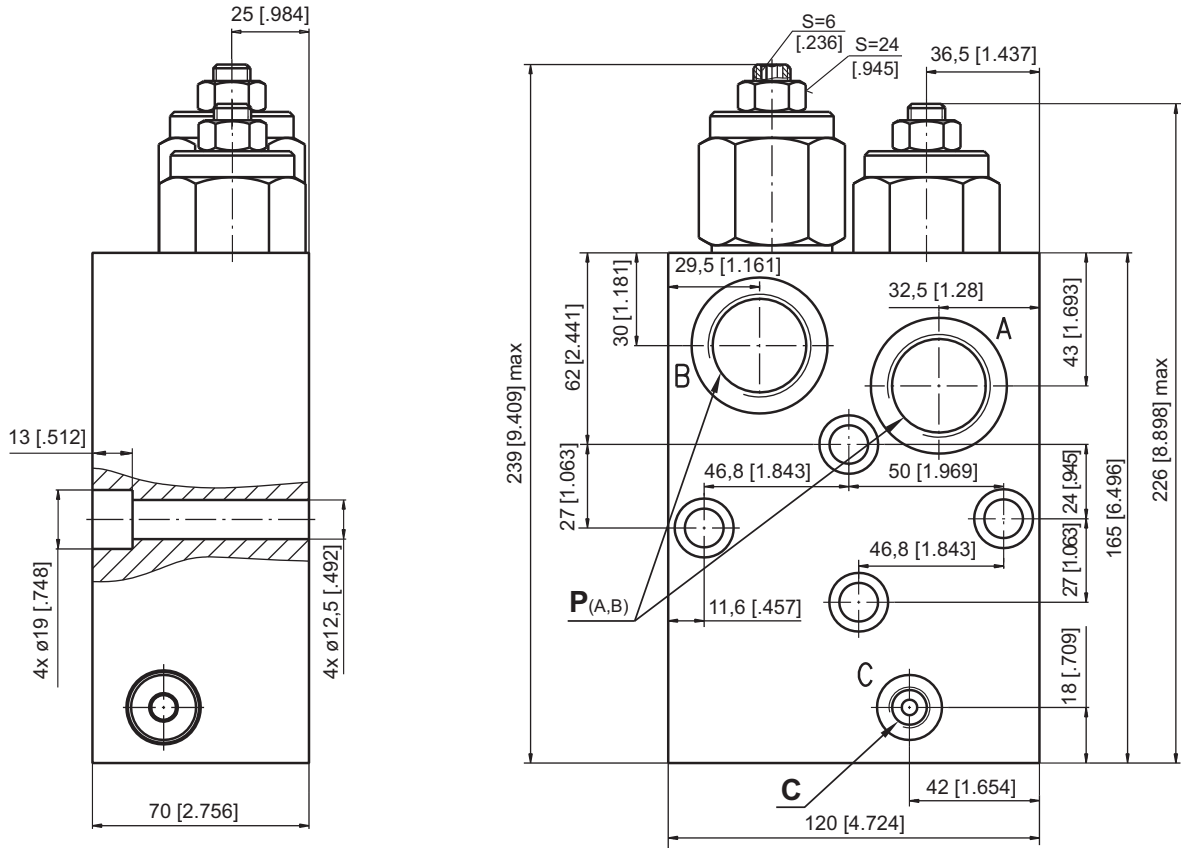
	Thread Ports - P _(A,B)	Thread Port - C
-	G3/4 17 [.67] depth	G1/4 14 [.55] depth
M	M27x2 17 [.67] depth	M14x1,5 14 [.55] depth
A	1 1/16-12 UN O-ring 17 [.67] depth	7/16 - 20 UNF O-ring 12,7 [.50] depth



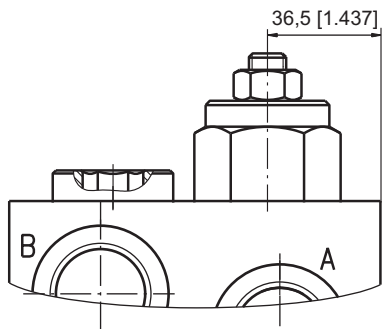
Note : KPBT Blocks are installed directly on MT Motors with four screws M10x50 - 8.8 DIN 912. Tightening torque 3,5 daNm [310 lb-in].

VALVES FOR MV HYDRAULIC MOTORS

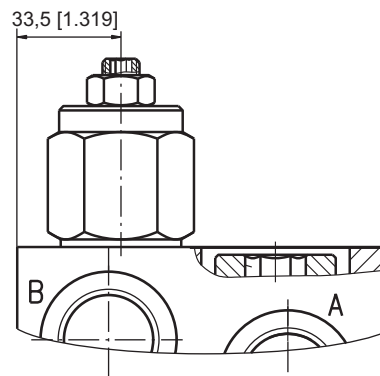
DUAL VALVE KPBV-250/1/D...



SINGLE VALVE KPBV-250/1/AE...



SINGLE VALVE KPBV-250/1/BE...



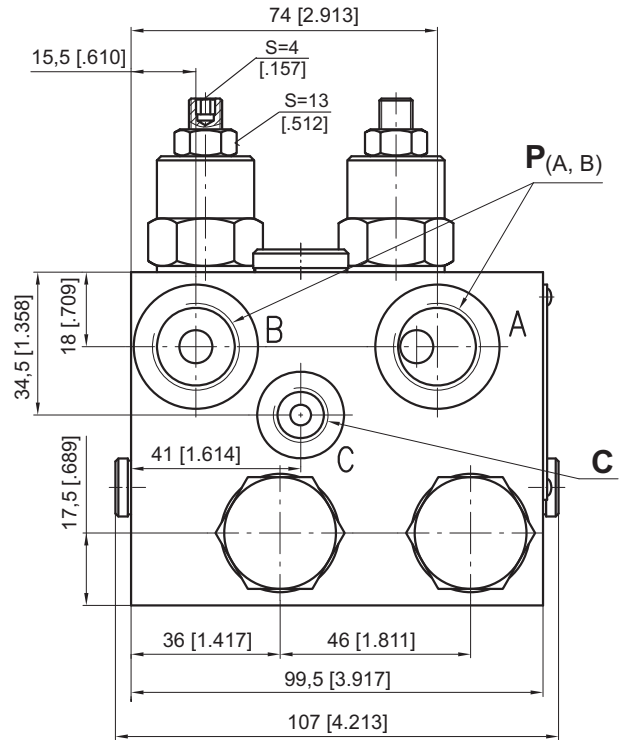
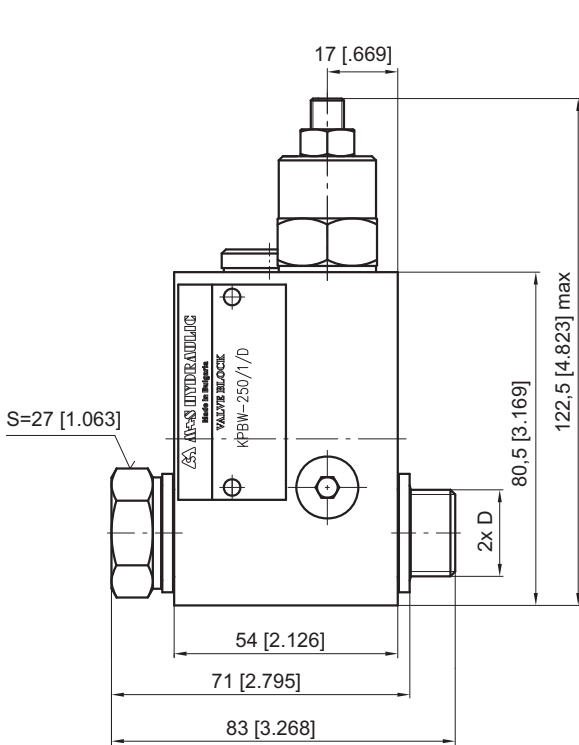
	Thread Ports - P _(A,B)	Thread Port - C
-	G 1 20 [0.79] depth	G1/4 14 [0.55] depth
M	M33x2 20 [0.79] depth	M14x1,5 14 [0.55] depth
A	1 5/16 - 12 UN O-ring 20 [0.79] depth	7/16 - 20 UNF O-ring 12,7 [0.50] depth



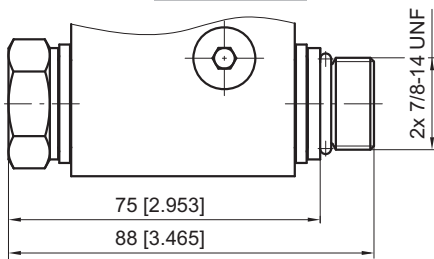
Note : KPBV Blocks are installed directly on MV Motors with four screws M12x70 - 8.8 DIN 912. Tightening torque 6,5 daNm [575 lb-in].

VALVES FOR RW and HW HYDRAULIC MOTORS

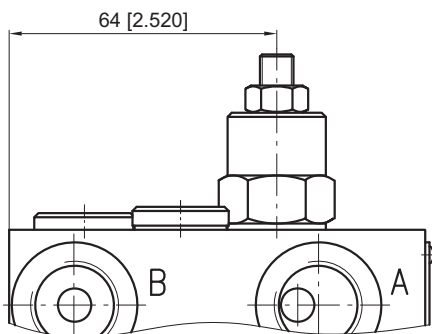
DUAL VALVE KPBW-250/1/D...



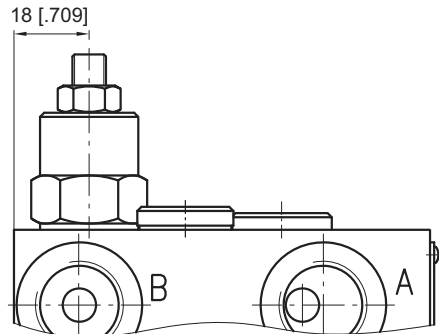
KPBW-...A



SINGLE VALVE KPBW-250/1/AE...



SINGLE VALVE KPBW-250/1/BE...



	Thread Ports - P _(A,B)	Thread Port - C	Thread Ports - D
-	G1/2 16 [.63] depth	G1/4 12 [.47] depth	G1/2 12 [.47] length
M	M22x1,5 16 [.63] depth	M14x1,5 12 [.47] depth	M22x1,5 12 [.47] length
A	7/8 - 14 UNF O-ring 16 [.63] depth	7/16 - 20 UNF O-ring 12,7 [.50] depth	7/8 - 14 UNF O-ring 13 [.51] length

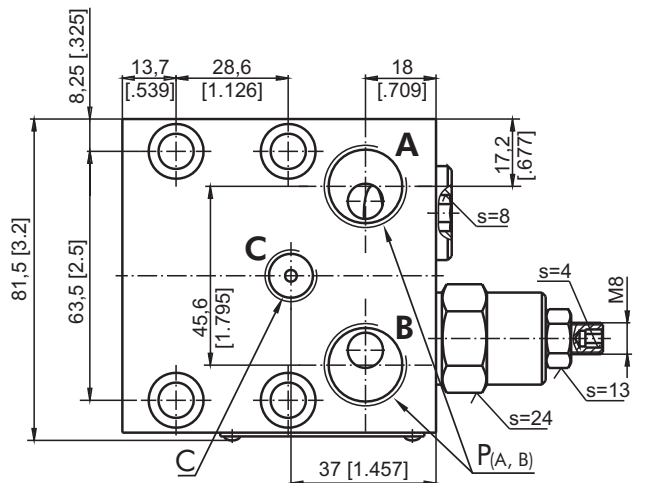
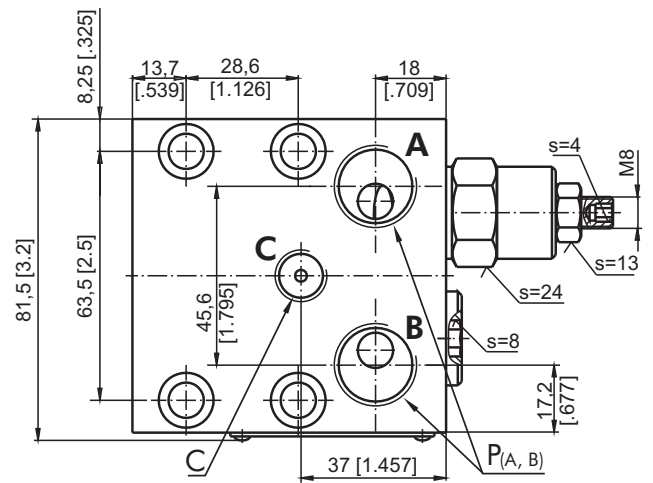
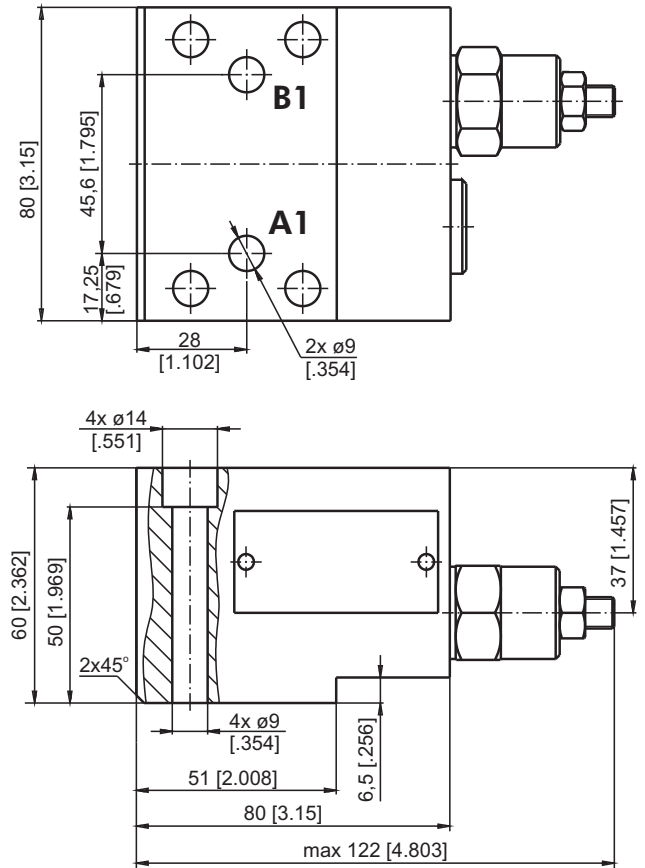
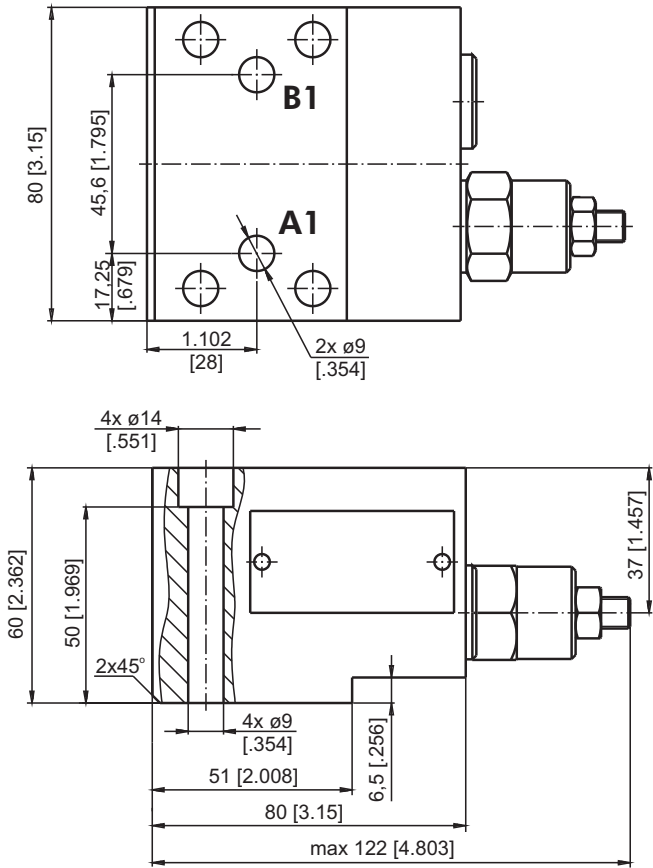


Note : KPBW Blocks assembly to RW or HW motors is done with two screws (thread D) included in the valve set. Tightening torque 8 daNm [710 lb-in].

VALVES FOR HP, HR HYDRAULIC MOTORS

SINGLE VALVE KPBHR-250/1/AE...

SINGLE VALVE KPBHR-250/1/BE...



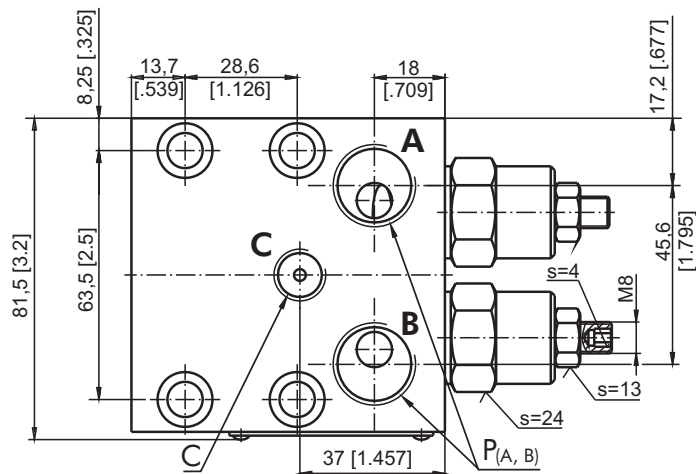
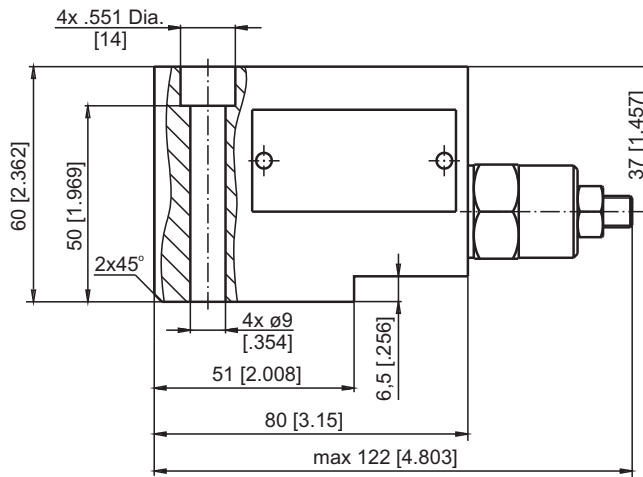
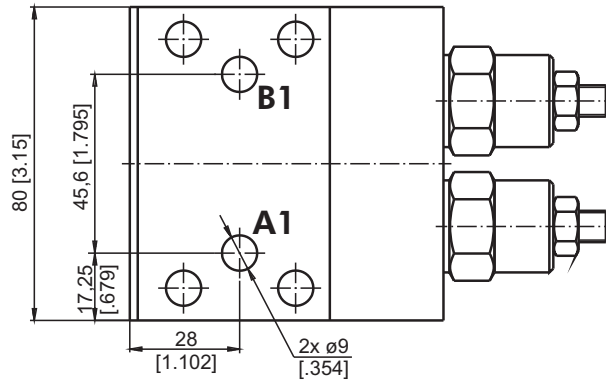
	Thread Ports - P _(A,B)	Thread Ports - C
A	7/8 - 14 UNF O-ring 17 [.67] deep	7/16 - 20 UNF O-ring 12,7 [.50] deep
-	G1/2 17 [.67] deep	G1/4 14 [.55] deep
M	M22x1,5 17 [.67] deep	M14x1,5 14 [.55] deep



Note : KPBHR Blocks are installed directly on HP and HR Motors with four bolts 5/16-18UNC, 2.36 long or M8x60 - 8.8 DIN 912. Tightening torque 2,0^{+0,5} daNm [177⁺⁴⁴ lb-in].

VALVES FOR HP, HR HYDRAULIC MOTORS

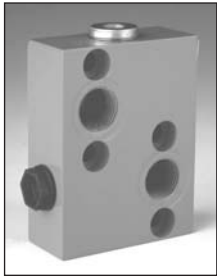
DUAL VALVE KPBHR-250/1/D...



	Thread Ports - P_(A,B)	Thread Ports - C
A	7/8 - 14 UNF O-ring 17 [.67] deep	7/16 - 20 UNF O-ring 12,7 [.50] deep
-	G1/2 17 [.67] deep	G1/4 14 [.55] deep
M	M22x1,5 17 [.67] deep	M14x1,5 14 [.55] deep

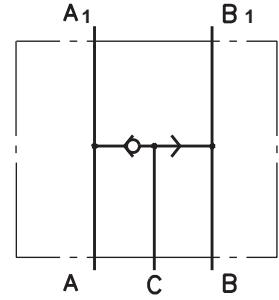


Note : KPBHR Blocks are installed directly on HP and HR Motors with four bolts 5/16-18UNC, 2.36 long or M8x60 - 8.8 DIN 912. Tightening torque 2,0^{+0.5} daNm [177⁺⁴⁴ lb-in].



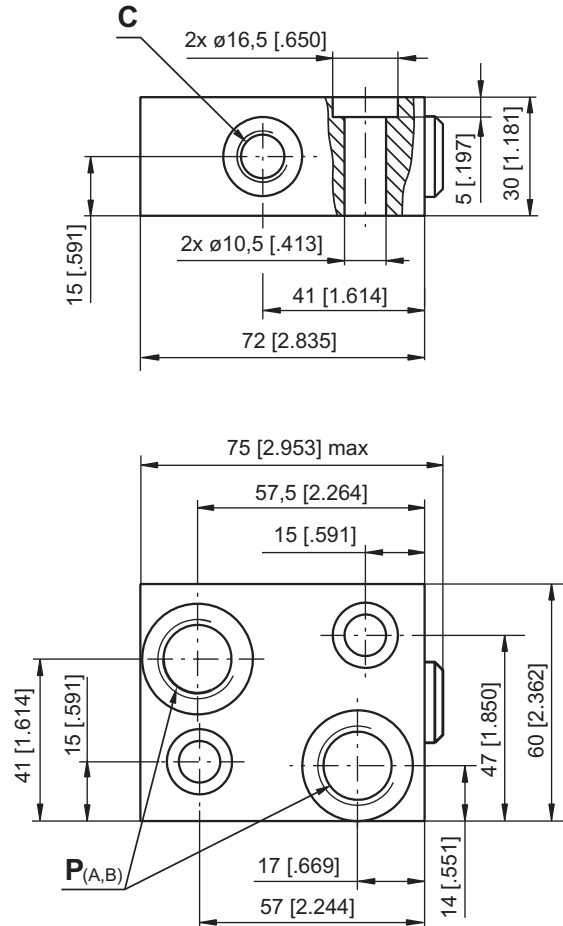
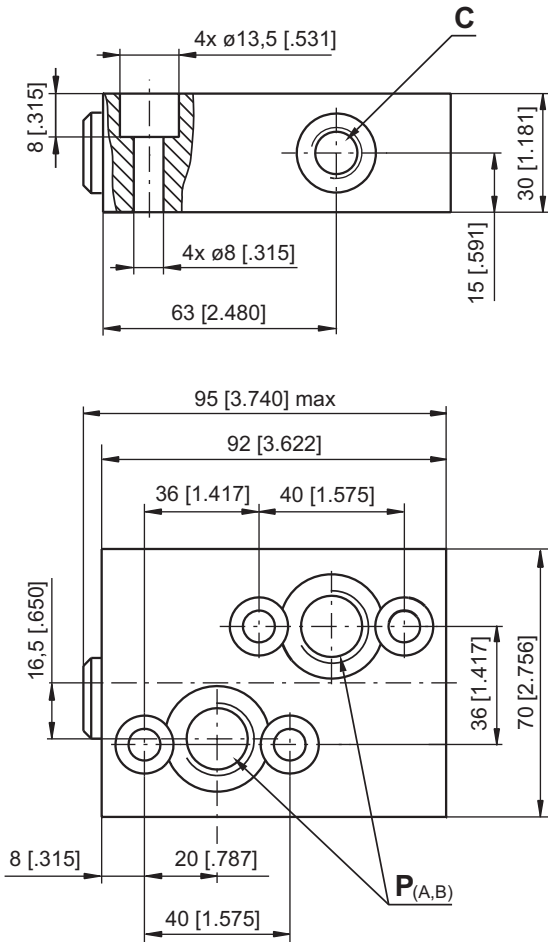
SPECIFICATION DATA

Parameters	Type	
	KPWR	KPWS
Flow Rate , l/min [GPM]	60	[15.85]
Rated Pressure , bar [PSI]	250	[3625]
Weight , kg	0,850	0,670
	[lb]	[1.874]
		[1.477]



**VALVE FOR MP, MR, MH HYDRAULIC MOTORS
KPWR**

**VALVE FOR MS HYDRAULIC MOTORS
KPWS**



	Thread Ports - P _(A,B)	Thread Port - C
-	G1/2 17 [6.7] depth	G1/4 14 [5.5] depth
M	M22x1,5 17 [6.7] depth	M14x1,5 14 [5.5] depth
A	7/8 - 14 UNF O-ring 17 [6.7] depth	7/16 - 20 UNF O-ring 12,7 [5.0] depth



Note : KPWR Blocks are installed directly on MP, MR and MH Motors with four screws M8x35 - 8.8 DIN 912 or 5/16-18UNC, 1.5 long ANSI B 18.3 . Tightening torque 2,0^{+0.5} daNm [177⁺⁴⁴ lb-in].

KPWS Blocks are installed directly on MS Motors with two screws M10x35 - 8.8 DIN 912 or 3/8-16UNC, 1.5 long ANSI B 18.3 . Tightening torque 3,5 daNm [336 lb-in].

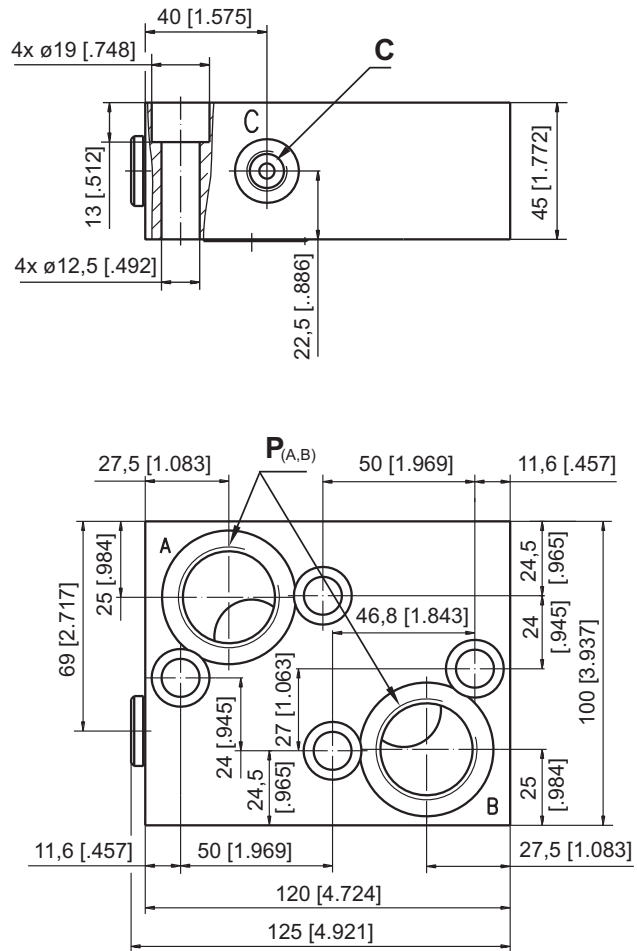
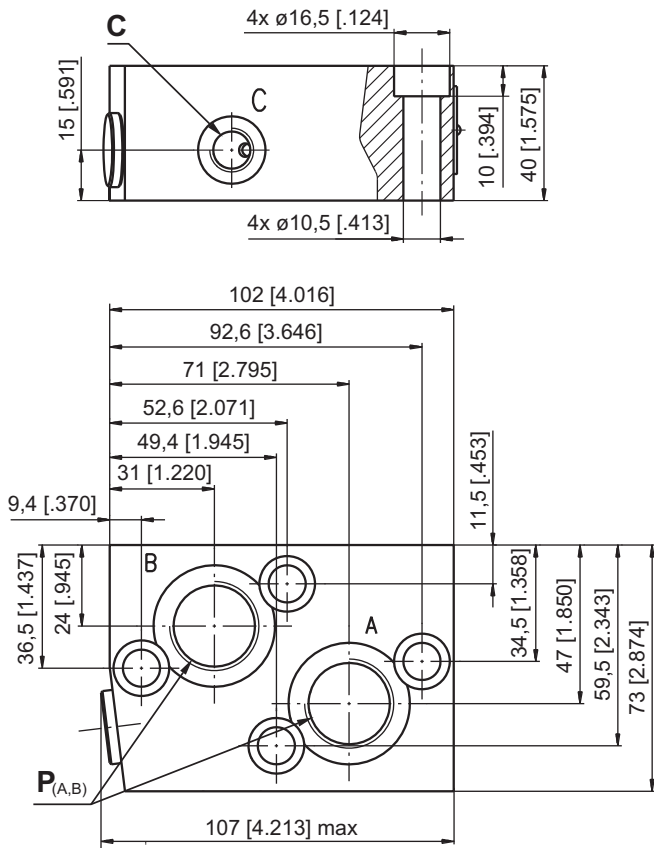
SWITCH VALVE (continued)

SPECIFICATION DATA

Parameters	Type	
	KPWT	KPWW
Flow Rate , l/min [GPM]	100 [26.4]	200 [52.8]
Rated Pressure , bar [PSI]	250	[3625]
Weight , kg [lb]	1,800 [3.968]	3,150 [6.945]

**VALVE FOR MT HYDRAULIC MOTORS
KPWT**

**VALVE FOR MV HYDRAULIC MOTORS
KPWW**



	Thread Ports - P _(A,B)	Thread Port - C
-	G3/4 17 [.67] depth	G1/4 14 [.55] depth
M	M27x2 17 [.67] depth	M14x1,5 14 [.55] depth
A	1 1/16-12 UN O-ring 17 [.67] depth	7/16 - 20 UNF O-ring 12,7 [.50] depth



	Thread Ports - P _(A,B)	Thread Port - C
-	G 1 20 [.79] depth	G1/4 14 [.55] depth
M	M33x2 20 [.79] depth	M14x1,5 14 [.55] depth
A	1 5/16 - 12 UN O-ring 20 [.79] depth	7/16 - 20 UNF O-ring 12,7 [.50] depth

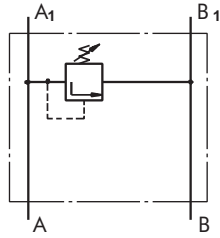
Note : KPWT Blocks are installed directly on MT Motors with four screws M10x40 - 8.8 DIN 912.

Tightening torque 3,5 daNm [336 lb-in].

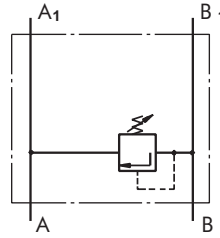
KPWW Blocks are installed directly on MV Motors with four screws M12x45 - 8.8 DIN 912.

Tightening torque 6,5 daNm [425 lb-in].

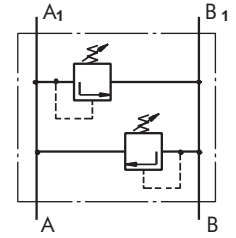
CROSSOVER RELIEF VALVES



Single Crossover Relief Valve type KPE ...



Single Crossover Relief Valve type KPE ...



Dual Crossover Relief Valve type KPD ...

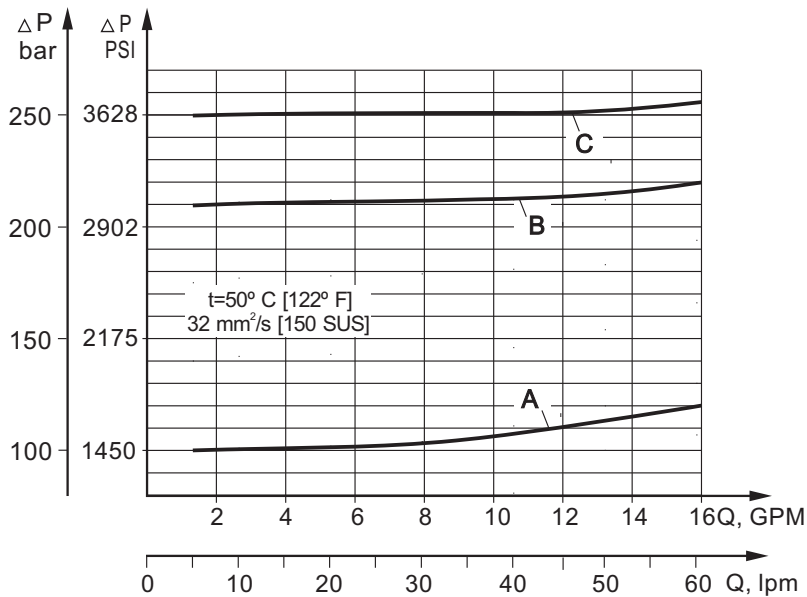
SPECIFICATION DATA

Parameters	Type			
	KPER	KPDR	KPES	KPDS
Flow Rate , lpm [GPM]	60 [15.85]			
Pressure Range* , bar [PSI]	30 ÷ 100; [435÷1450]	50 ÷ 210; [725÷3050]	80 ÷ 300 [1160÷4350]	
Weight , kg [lb]	1,55 [3.42]		1,50 [3.31]	

*Pressure Settings are at flow rate of 5 lpm [1.32 GPM] and viscosity 32 mm²/s [150 SUS] (50 °C [122° F]).

Rated Pressure

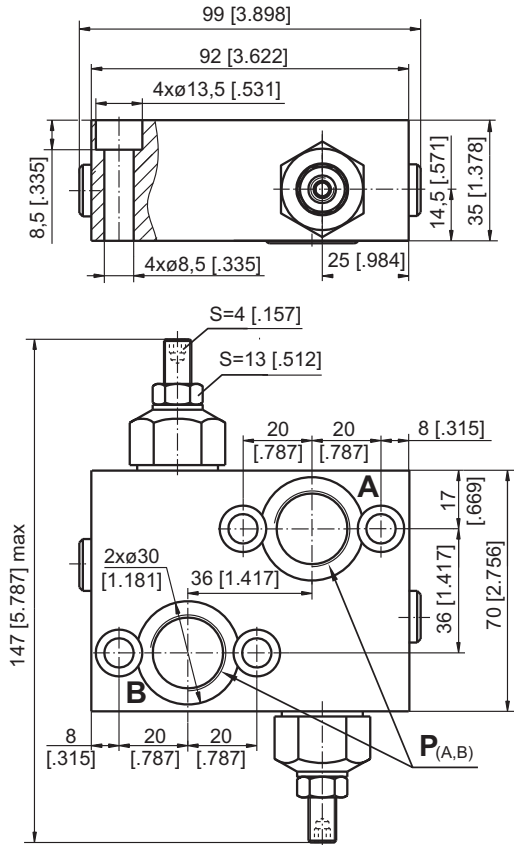
- A → 100 bar [1450 PSI]
- B → 210 bar [3050 PSI]
- C → 250 bar [3625 PSI]



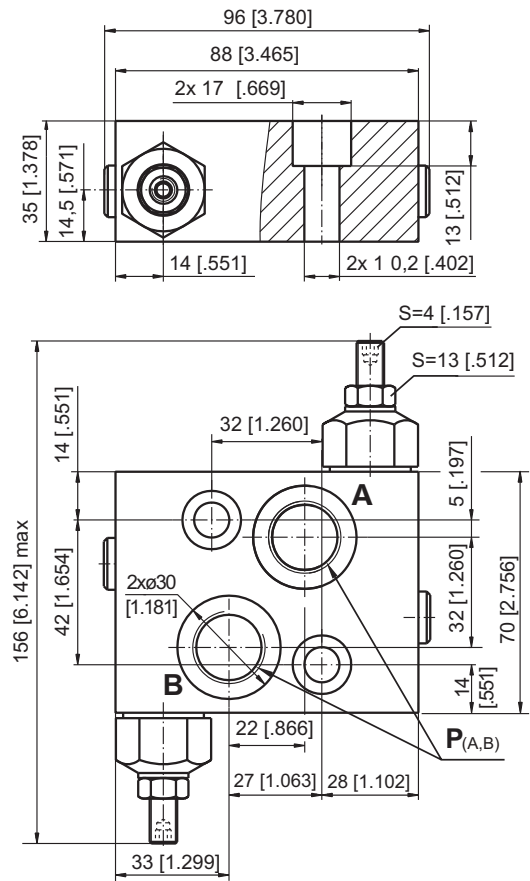
**VALVES FOR MP, MR, MH
HYDRAULIC MOTORS**

**VALVES FOR MS
HYDRAULIC MOTORS**

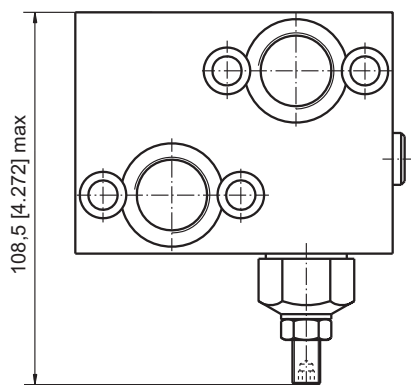
DUAL VALVE KPDR



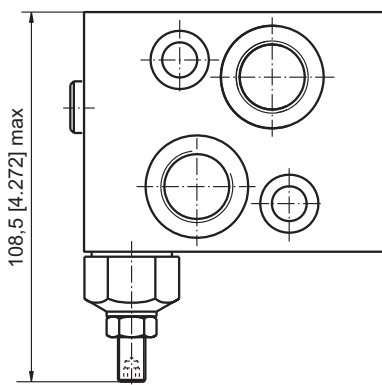
DUAL VALVE KPDS



SINGLE VALVE KPER



SINGLE VALVE KPES

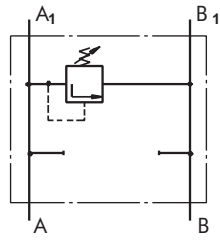


	Thread Ports - P _(A,B)
-	G1/2 20 [.79] depth
M	M22x1,5 20 [.79] depth
A	7/8 - 14 UNF O-ring 20 [.79] depth

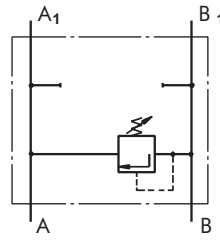
Note : **KPDR** and **KPER** Blocks are installed directly on MP, MR and MH Motors with four screws M8x35 - 8.8 DIN 912 or 5/16-18 UNC, 1.5 long ANSI B 18.3 . Tightening torque 2,0^{+0,5} daNm [177⁺⁴⁴ lb-in].

KPDS and **KPES** Blocks are installed directly on MS Motors with two screws M10x35 - 8.8 DIN 912 or 3/8-16 UNC, 1.5 long ANSI B 18.3 . Tightening torque 3,5 daNm [310 lb-in].

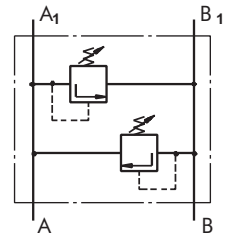
VALVES FOR MT HYDRAULIC MOTORS



Single Crossover
Relief Valve
type KPEAT ...



Single Crossover
Relief Valve
type KPEBT ...



Dual Crossover
Relief Valve
type KPDT ...

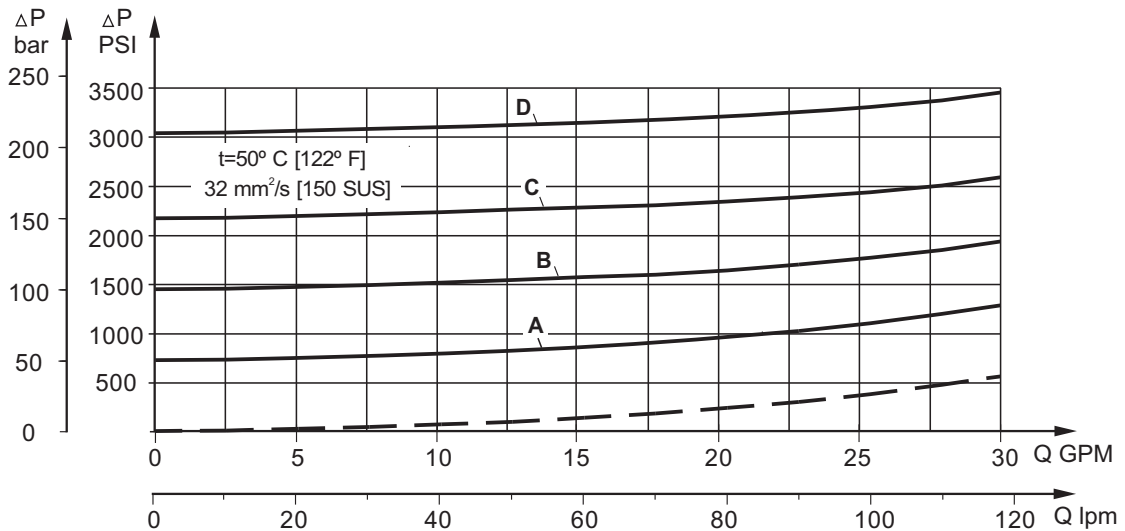
SPECIFICATION DATA

Parameters	Type	
	KPE...T	KPDT
Flow Rate , lpm [GPM]	120 [32]	
Pressure Range* , bar [PSI]	80÷210 [1160÷3050]	
Weight , kg [lb]	5,10 [11.24]	5,54 [12.21]

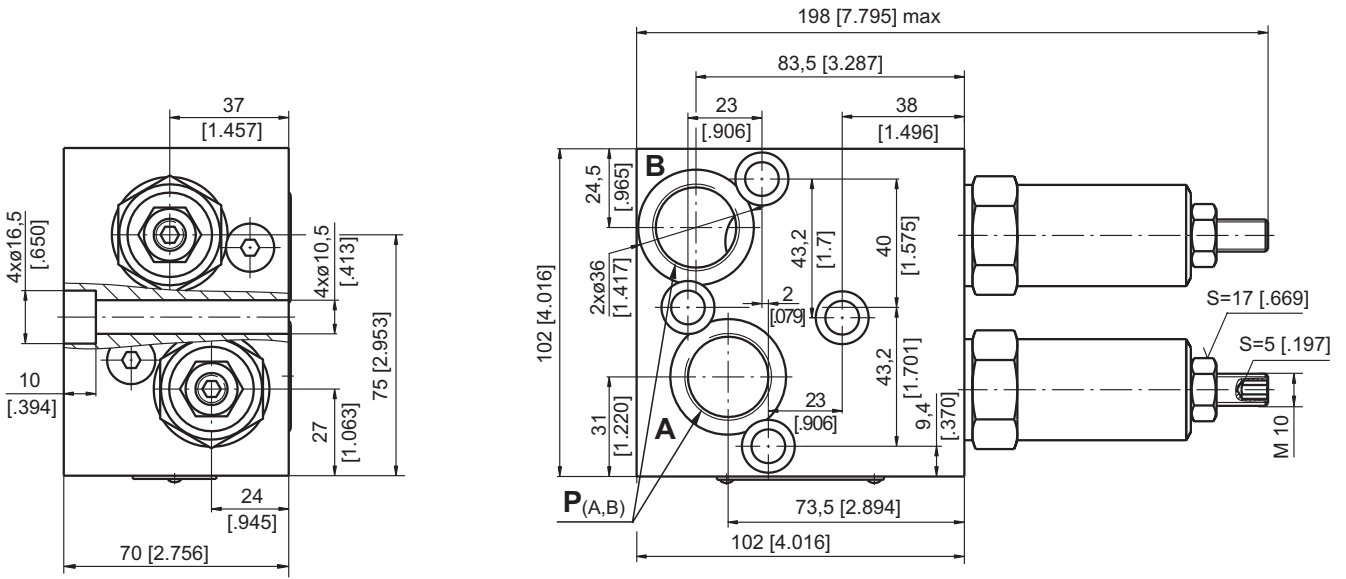
*Pressure Settings are at flow rate of 5 lpm [1.32 GPM] and viscosity 32 mm²/s [150 SUS] (50 °C [122° F]).

Rated Pressure

- A → 50 bar [725 PSI]
- B → 100 bar [1450 PSI]
- C → 150 bar [2175 PSI]
- D → 210 bar [3045 PSI]

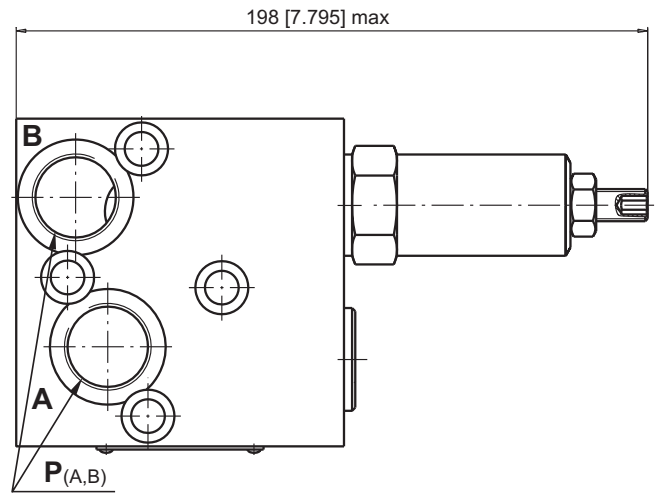
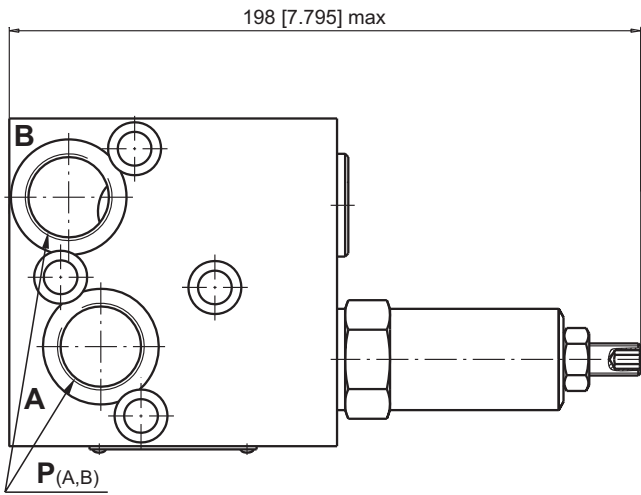


DUAL VALVE KPDT...



SINGLE VALVE KPEAT...

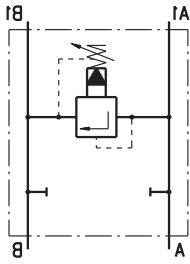
SINGLE VALVE KPEBT...



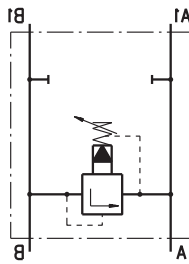
	Thread Ports - P _(A,B)
-	G3/4 20 [.79] depth
M	M27x2 20 [.79] depth
A	1 ¹ / ₁₆ -12 UN O-ring 20 [.79] depth

Note : KPDT and KPE...T Blocks are installed directly on MT Motors with four screws M10x70 - 8.8 DIN 912. Tightening torque 3,5 daNm [310 lb-in].

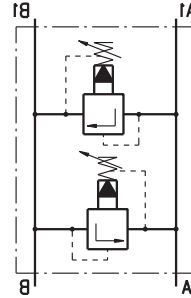
VALVES FOR MV HYDRAULIC MOTORS



Single Crossover Relief Valve type KPEAV ...



Single Crossover Relief Valve type KPEBV ...



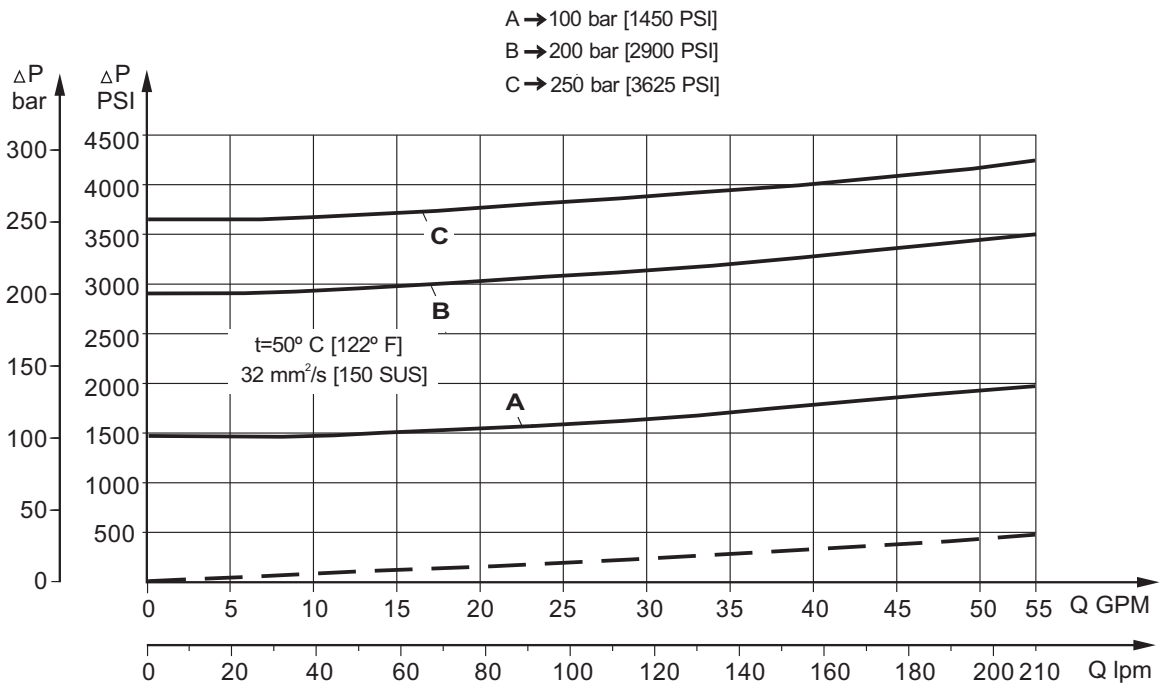
Dual Crossover Relief Valve type KPDRV ...

SPECIFICATION DATA

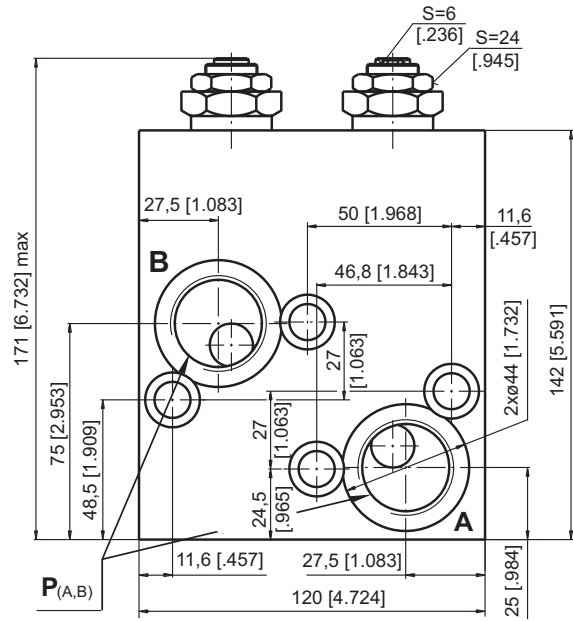
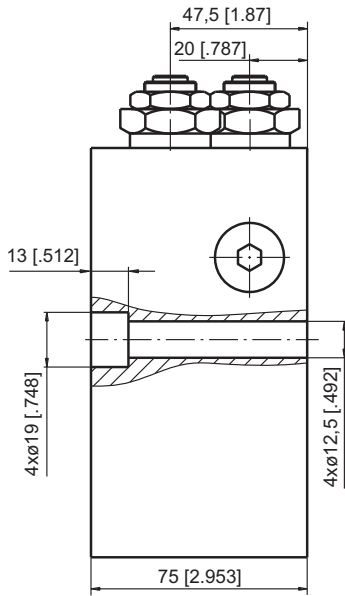
Parameters	Type		
	KPEAV	KPEBV	KPDRV
Flow Rate , lpm [GPM]	200 [53]		
Pressure Range* , bar [PSI]	10÷100; 20÷250 [145÷1450]; [290÷3625]		
Weight , kg [lb]	4,90 [10.8]	7,10 [15.65]	8,00 [17.64]

*Pressure Settings are at flow rate of 5 lpm [1.3 GPM] and viscosity 32 mm²/s [150 SUS] (50 °C [122° F]).

Rated Pressure

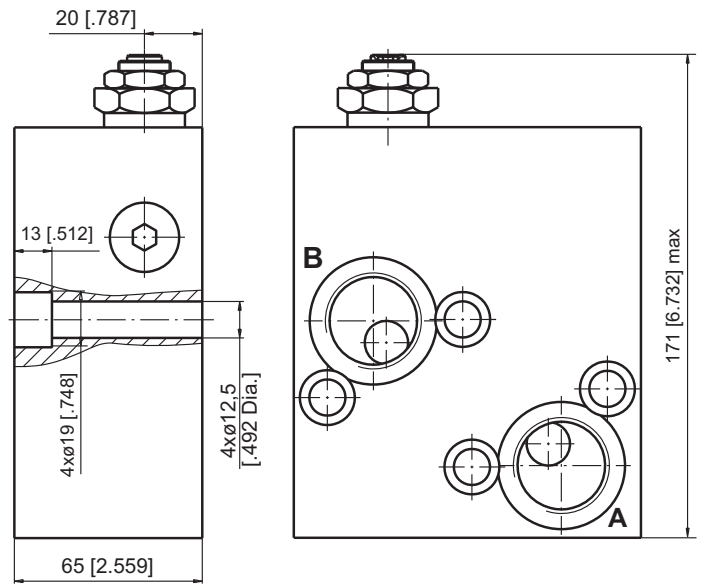
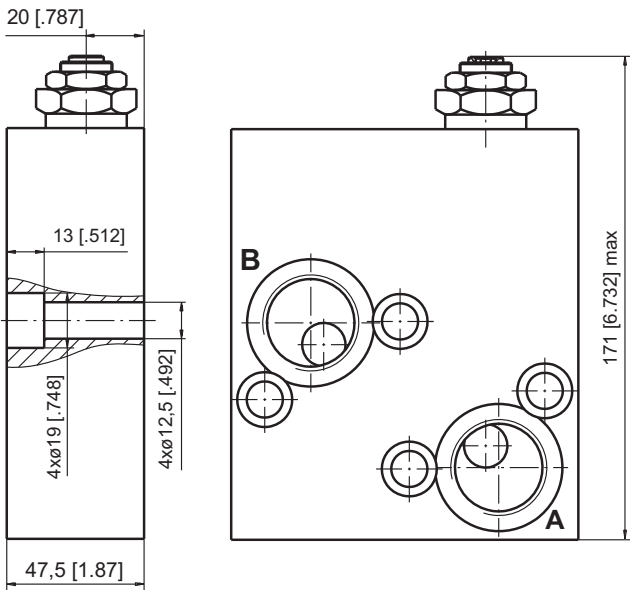


DUAL VALVE KPDV



SINGLE VALVE KPEAV

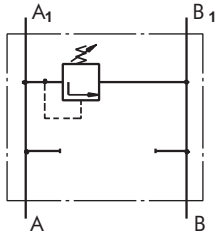
SINGLE VALVE KPEBV



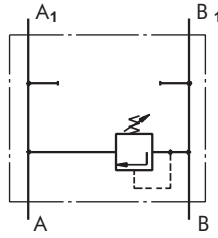
	Thread Ports - P _(A,B)
-	G1-A 20 [.79] depth
M	M33x2 20 [.79] depth
A	1 ⁵ / ₁₆ -12 UN O-ring 20 [.79] depth

Note : KPDV Blocks are installed directly on MV Motors with four screws M12x75 - 8.8 DIN 912.
 KPEAV Blocks are installed directly on MV Motors with four screws M12x50 - 8.8 DIN 912.
 KPEBV Blocks are installed directly on MV Motors with four screws M12x65 - 8.8 DIN 912.
 Tightening torque 7,5 daNm [665 lb-in].

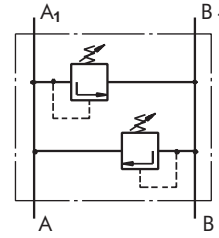
VALVES FOR RW and HW HYDRAULIC MOTORS



Single Crossover
Relief Valve
type KPEAW ...



Single Crossover
Relief Valve
type KPEBW ...



Dual Crossover
Relief Valve
type KPDW ...

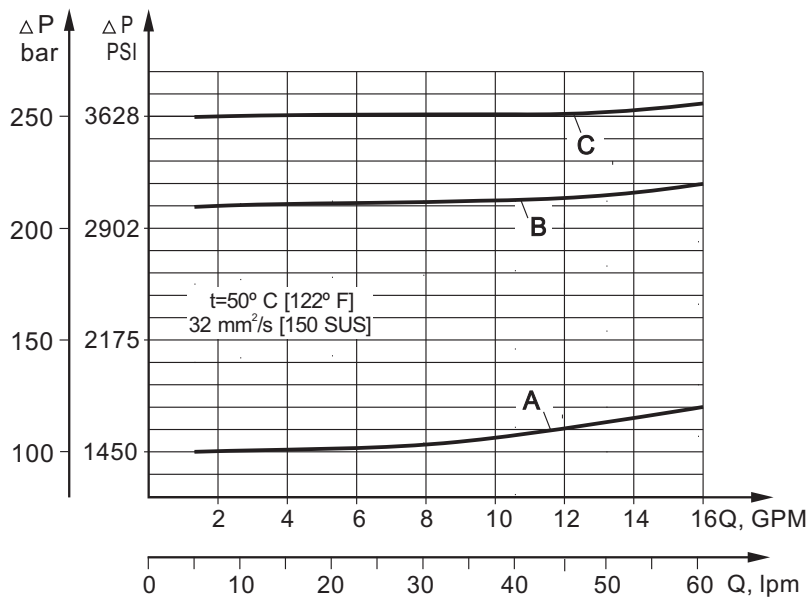
SPECIFICATION DATA

Parameters	Type	
	KPE...W	KPDW
Flow Rate , lpm [GPM]	60 [15.85]	
Pressure Range* , bar [PSI]	5 ÷ 40; 30 ÷ 100; 80 ÷ 250 [75÷580]; [435÷1450]; [1160÷3625]	
Weight , kg [lb]	2,700 [5.95]	2,800 [6.17]

*Pressure Settings are at flow rate of 5 lpm [1.32 GPM]
and viscosity 32 mm²/s [150 SUS] (50 °C [122° F]).

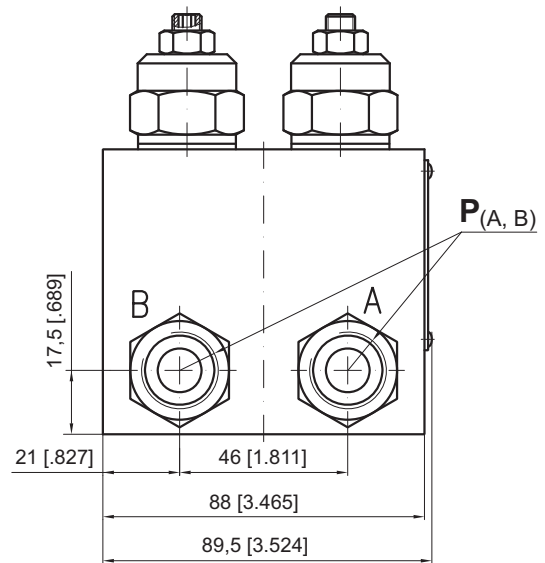
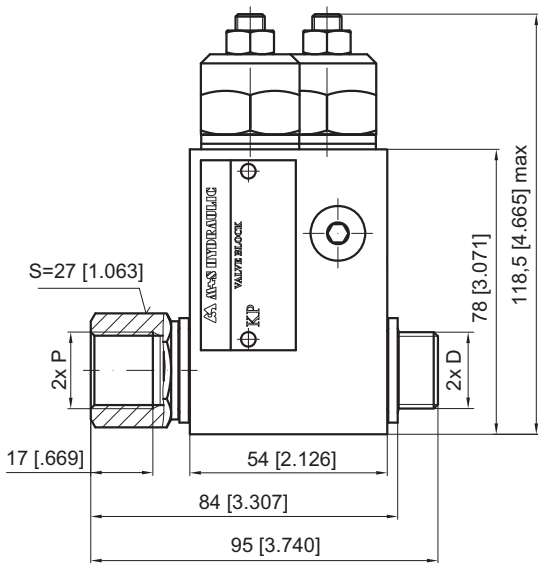
Rated Pressure

- A → 100 bar [1450 PSI]
- B → 210 bar [3050 PSI]
- C → 250 bar [3625 PSI]

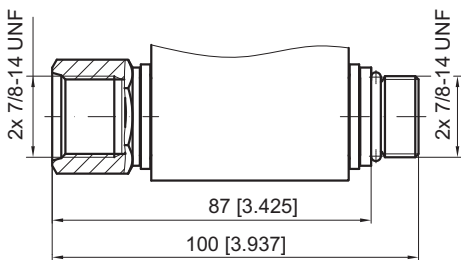


VALVES FOR RW and HW HYDRAULIC MOTORS

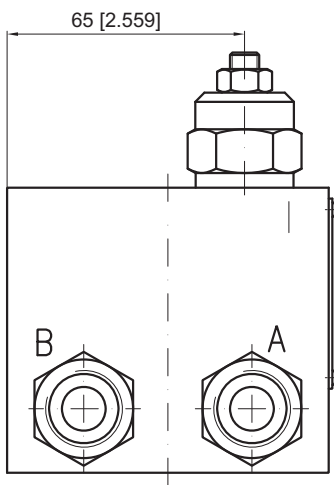
DUAL VALVE KPDW...



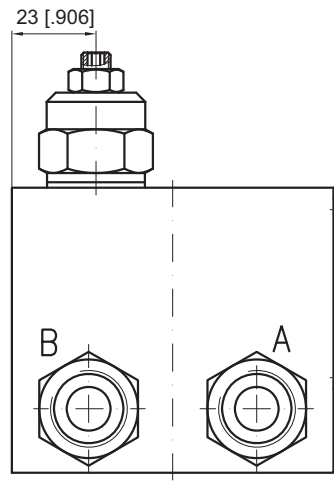
KPDW-...A



SINGLE VALVE KPEAW...



SINGLE VALVE KPEBW...

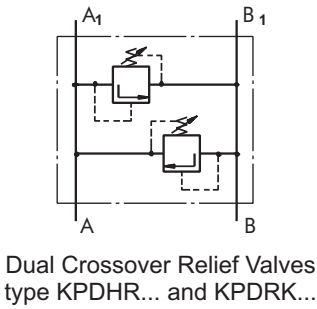


	Thread Ports - P _(A,B)	Thread Ports - D
-	G1/2 16 [.63] depth	G1/2 12 [.47] length
M	M22x1,5 16 [.63] depth	M22x1,5 12 [.47] length
A	7/8 - 14 UNF O-ring 16 [.63] depth	7/8 - 14 UNF O-ring 13 [.51] length

Note : KPDW and KPE..W Blocks assembly to RW or HW motors is done with two screws (thread D) included in the valve set. Tightening torque 8 daNm [710 lb-in].

CROSSOVER RELIEF VALVES

SPECIFICATION DATA

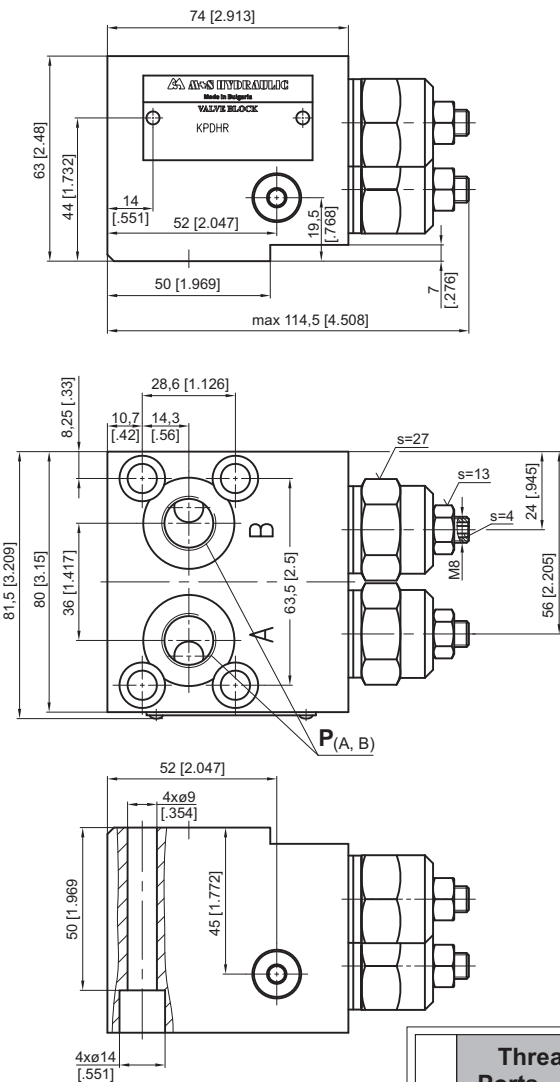


Parameters	Type					
	KPDHR			KPDRK		
Flow Rate, lpm [GPM]	60 [15.85]					
Pressure bar	5÷40	30÷100	80÷250	10÷40	30÷100	80÷250
Range*, [PSI]	[70÷580]	[435÷1450]	[1160÷3625]	[145÷580]	[435÷1450]	[1160÷3625]
Weight, kg [lb]	2,420 [5.34]			1,600 [3.53]		

*Pressure Settings are at flow rate of 5 lpm [1.3 GPM] and viscosity 32 mm²/s [150 SUS] (50 °C [122° F]).

VALVES FOR HP AND HR HYDRAULIC MOTORS

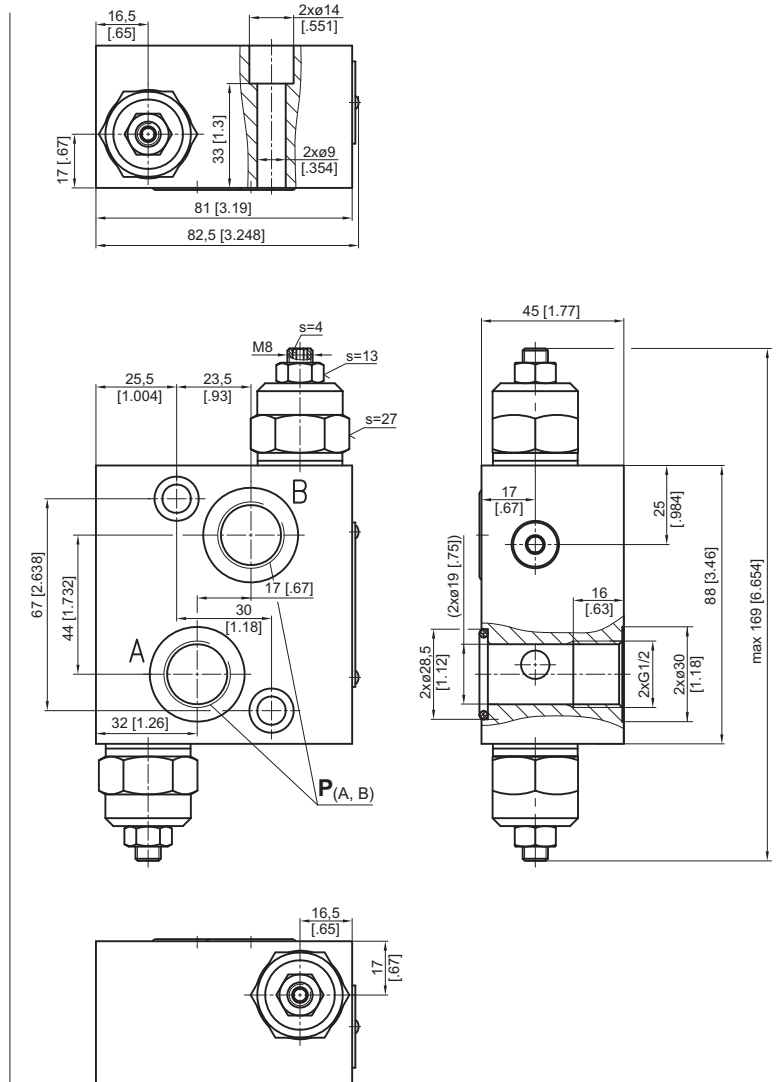
DUAL VALVE KPDHR



	Thread Ports - P _(A,B)
-	G3/8
M	M18x1,5
A	3/4-16 UNF O-ring

VALVES FOR RK HYDRAULIC MOTORS

DUAL VALVE KPDRK



	Thread Ports - P _(A,B)
-	G1/2

Note : KPDHR Blocks are installed directly on HP and HR Motors with four screws M8x60 - 8.8 DIN 912.
 KPDRK Blocks are installed directly on RK Motors with two screws M8x45 - 8.8 DIN 912.
 Tightening torque 2,0^{+0,5} daNm [177⁺⁴⁵ lb-in].

ORDER CODE - OVERCENTER VALVES WITH BRAKE CONTROL

	1		2		3		4		5		6		7
K P B		-		/		/							

Pos.1 - Housing Type

- R** - Valve block for MP, MR and MH Motors
- S** - Valve block for MS Motors
- W** - Valve block for RW and HW Motors
- T** - Valve block for MT Motors
- V** - Valve block for MV Motors
- HR** - Valve block for HP and HR Motors

Pos.2 - Pressure Range, bar [PSI]

- 250** - 70÷250 [1015÷3625], Std Setting 250 bar@5 lpm

Pos.3 - Pilot Ratio

- 1** - 4,25:1

Pos.4 - Number of Valves

- D** - Two Valves - Dual
- E** - One Valve - Single (for R and S only)
- AE** - One Valve on line A - Single (for T, V and W only)
- BE** - One Valve on line B - Single (for T, V and W only)

Pos.5 - Threaded Ports

- omit - BSPP thread - ISO 228
- M** - Metric thread - ISO 262
- A** - Unified inch screw threads ANSI B 1.1 - 1982

Pos.6 - Option [Paint]**

- omit - no Paint
- P** - Painted
- PC** - Corrosion Protected Paint

Pos.7 - Design Series

- omit - Factory specified

Notes: * Color at customer's request.

ORDER CODE - SWITCH VALVES

	1		2		3		4
K P W							

Pos.1 - Housing Type

- R** - Valve block for MP, MR and MH Motors
- S** - Valve block for MS Motors
- T** - Valve block for MT Motors
- V** - Valve block for MV Motors

Pos.2 - Threaded Ports

- omit - BSPP thread - ISO 228
- M** - Metric thread - ISO 262
- A** - Unified inch screw threads ANSI B 1.1 - 1982

Pos.3 - Option [Paint]**

- omit - no Paint
- P** - Painted
- PC** - Corrosion Protected Paint

Pos.4 - Design Series

- omit - Factory specified

Notes: * Color at customer's request.

ORDER CODE - CROSSOVER RELIEF VALVE

	1		2		3		4		5		6
K P					/						

Pos.1 - Number of Valves

- D** - Two Valves - Dual
- E** - One Valve - Single (for R and S only)
- EA** - One Valve on line A - Single (for T, V and W only)
- EB** - One Valve on line B - Single (for T, V and W only)

Pos.2 - Housing Type

- R** - Valve block for MP, MR and MH Motors
- S** - Valve block for MS Motors
- W** - Valve block for RW and HW Motors
- T** - Valve block for MT Motors
- V** - Valve block for MV Motors

Pos.3 - Pressure Range, bar [PSI]

- 100*** - 30÷100 [435÷1450], Std Setting 100 bar@5 lpm
- 210*** - 50÷210 [725÷3050], Std Setting 210 bar@5 lpm
- 300*** - 80÷300 [1160÷4350], Std Setting 250 bar@5 lpm
- 210**** - 80÷210 [1160÷3050], Std Setting 210 bar@5 lpm
- 100***** - 10÷100 [145÷1450], Std Setting 100 bar@5 lpm
- 250***** - 20÷250 [290÷3625], Std Setting 250 bar@5 lpm

Pos.4 - Threaded Ports

- omit - BSPP thread - ISO 228
- M** - Metric thread - ISO 262
- A** - Unified inch screw threads ANSI B 1.1 - 1982

Pos.5 - Option [Paint]****

- omit - no Paint
- P** - Painted
- PC** - Corrosion Protected Paint

Pos.6 - Design Series

- omit - Factory specified

Notes: * Useful for types R and S only.
 ** Useful for types T only.
 *** Useful for types V only.
 **** Color at customer's request.

The Valve Blocks are mangano phosphatized as standard.

ORDER CODE - CROSSOVER RELIEF VALVE

	1	2	3		4	5	6
KP				/			

Pos.1 - Number of Valves

D - Two Valves - Dual

Pos.2 - Housing Type

HR - Valve block for HR Motors

RK - Valve block for RK and GHM Motors

Pos.3 - Pressure Range, bar [PSI]

40 - 10÷ 40 [145÷ 580], Std Setting 100 bar@5 lpm

100 - 30÷100 [435÷1450], Std Setting 100 bar@5 lpm

250 - 80÷250 [1160÷3625], Std Setting 250 bar@5 lpm

Pos.4 - Threaded Ports

omit - BSPP thread - ISO 228

M - Metric thread - ISO 262

A - Unified inch screw threads ANSI B 1.1 - 1982

Pos.5 - Option [Paint]*

omit - no Paint

P - Painted

PC - Corrosion Protected Paint

Pos.6 - Design Series

omit - Factory specified

Notes: * Color at customer's request.

The Valve Blocks are mangano phosphatized as standard.

APPLICATION CALCULATION

VEHICLE DRIVE CALCULATIONS

1. Motor speed: n, RPM

$$n = \frac{2,65 \times v_{km} \times i}{R_m} \quad n = \frac{168 \times v_{mi} \times i}{R_{in}}$$

v_{km} - vehicle speed, km/h;

v_{mi} - vehicle speed, mil/h;

R_m - wheel rolling radius, m;

R_{in} - wheel rolling radius, in;

i - gear ratio between motor and wheels.

If no gearbox, use $i=1$.

2. Rolling resistance: RR, daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

G - total weight loaded on vehicle, daN [lbs];

ρ - rolling resistance coefficient (Table 1).

Table 1

Rolling resistance coefficient In case of rubber tire rolling on different surfaces	
Surface	ρ
Concrete- faultless	0.010
Concrete- good	0.015
Concrete- bad	0.020
Asphalt- faultless	0.012
Asphalt- good	0.017
Asphalt- bad	0.022
Macadam- faultless	0.015
Macadam- good	0.022
Macadam- bad	0.037
Snow- 5 cm	0.025
Snow- 10 cm	0.037
Polluted covering- smooth	0.025
Polluted covering- sandy	0.040
Mud	0.037÷0.150
Sand- Gravel	0.060÷0.150
Sand- loose	0.160÷0.300

3. Grade resistance: GR, daN [lbs]

$$GR = G \times (\sin \alpha + \rho \times \cos \alpha)$$

α - gradient negotiation angle (Table 2)

Table 2

Grade %	α Degrees	Grade %	α Degrees
1%	0° 35'	12%	6° 5'
2%	1° 9'	15%	8° 31'
5%	2° 51'	20%	11° 19'
6%	3° 26'	25%	14° 3'
8%	4° 35'	32%	18°
10%	5° 43'	60%	31°

4. Acceleration force: FA, daN [lbs]

Force FA necessary for acceleration from 0 to maximum speed v and time t can be calculated with a formula:

$$FA = \frac{v_{km} \times G}{3,6 \times t}, [daN] \quad FA = \frac{v_{mi} \times G}{22 \times t}, [lbs];$$

FA - acceleration force, daN [lbs];

t - time, [s].

5. Tractive effort: DP, daN [lbs]

Tractive effort DP is the additional force of trailer. This value will be established as follows:

-acc.to constructor's assessment;

-as calculating forces in items 2, 3 and 4 of trailer; the calculated sum corresponds to the tractive effort requested.

6. Total tractive effort: TE, daN [lbs]

Total tractive effort TE is total effort necessary for vehicle motion; that the sum of forces calculated in items from 2 to 5 and increased with 10 % because of air resistance.

$$TE = 1,1 \times (RR + GR + FA + DP)$$

RR - force acquired to overcome the rolling resistance;

GR - force acquired to slope upwards;

FA - force acquired to accelerate (acceleration force);

DP - additional tractive effort (trailer).

7. Motor Torque moment: M, daNm [lb-in]

Necessary torque moment for every hydraulic motor:

$$M = \frac{TE \times R_m [R_{in}]}{N \times i \times \eta_m}$$

N - motor numbers;

η_m - mechanical gear efficiency (if it is available).

8. Cohesion between tire and road covering: M_w, daNm [lb-in]

$$M_w = \frac{G_w \times f \times R_m [R_{in}]}{i \times \eta_m}$$

To avoid wheel slipping, the following condition should be observed $M_w > M$

f - frictional factor;

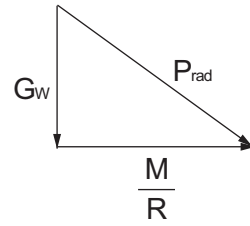
G_w - total weight over the wheels, daN [lbs].

Table 3

Surface	Frictional factor f
Steel on steel	0.15 ÷ 0.20
Rubber tire on polluted surface	0.5 ÷ 0.7
Rubber tire on asphalt	0.8 ÷ 1.0
Rubber tire on concrete	0.8 ÷ 1.0
Rubber tire on grass	0.4

9.Radial motor loading: P_{rad} , daN [lbs]

When motor is used for vehicle motion with wheels mounted directly on motor shaft, the total radial loading of motor shaft P_{rad} is a sum of motion force and weight force acting on one wheel.



- G_w - Weight held by wheel;
- P_{rad} - Total radial loading of motor shaft;
- M/R - Motion force.

$$P_{rad} = \sqrt{G_w^2 + \left(\frac{M}{R}\right)^2}$$

In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

Advantages in oil drainage from drain space: Cleaning; Cooling and Seal lifetime prolonging.

