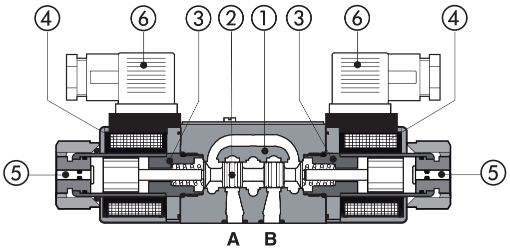
Solenoid directional valves type DHL

direct, spool type, compact execution



① Valve body
② Spool
③ Solenoid tube
④ Solenoid coil
⑤ Manual override pin
⑥ Electric connector (DIN43650) to be ordered separately

DHL-071*-DC

Spool type, 4/3, 4/2, 3/2 way version.

Wet type solenoids made by:

- screwed tube ③, different for AC and DC power supply
- interchangeable coils ④, specific for AC or DC power supply, easily replaceable without tools - see section 6 for available voltages

The valve body ① is 3 chamber type made by shell-moulding casting with wide internal passages ensuring low pressure drops.

Mounting surface: **ISO 4401 size 06**
Max flow: **60 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DHL - 0	**61**	**1**	**/**	**A**	**-**	**X**	**24 DC**	*****	**/**	*****

DHL - 0: Solenoid directional valves size 06

Valve configuration, see section 2

61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
70 = double solenoid, 2 external positions, without springs
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2

Options, see section 7

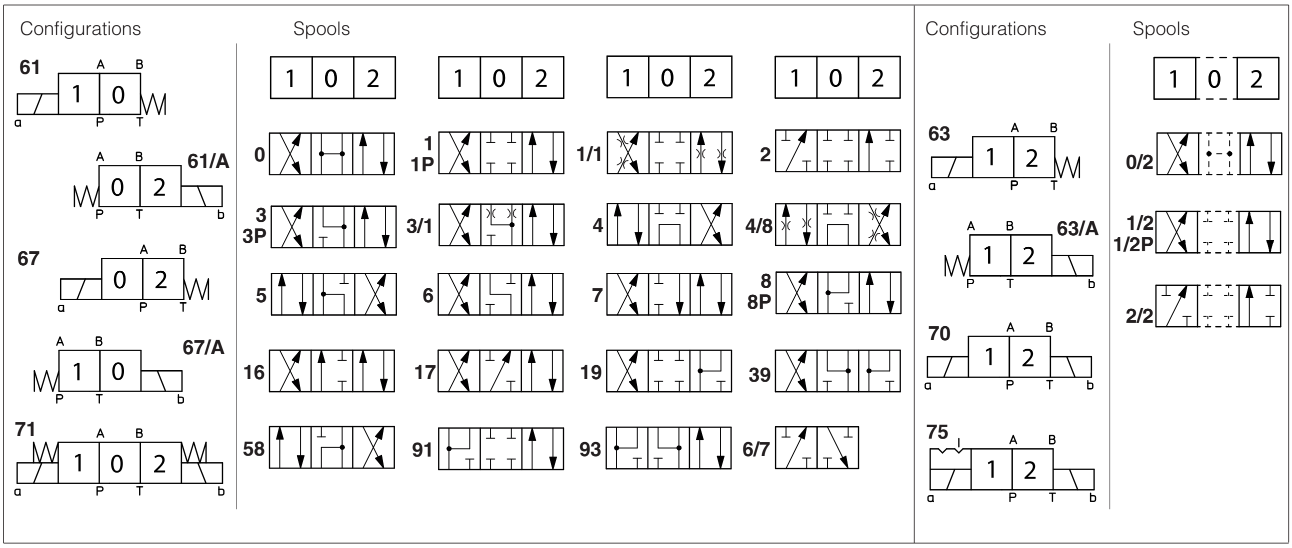
00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 12 for available connectors, to be ordered separately
Coils with special connectors, see section 13
XK = Deutsch connector

Voltage code, see section 6

Series number

Seals material, see section 14:
- = NBR
PE = FKM

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



Note: Spool type **6/7** is available only for configuration 61, not available for version /A
Spool type **3/1** has restricted oil passages in central position, from user ports to tank.
Spools type **1/1** and **4/8** are properly shaped to reduce water-hammer shocks during the swiching.
Spools type **1P, 3P, 8P** and **1/2P** reduced the valve internal leakages

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
Max flow	**60 l/min**, see Q/Δp diagram at section 8 and operating limits at section 9

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%

6 COIL VOLTAGE

External supply nominal voltage ± 10%	Voltage code	Type of connector	Power consumption (2)	Code of spare coil DHL
12 DC	**12 DC**	666 or 667	29W	COL-12DC
14 DC	**14 DC**			COL-14DC
24 DC	**24 DC**			COL-24DC
28 DC	**28 DC**			COL-28DC
110 DC	**110 DC**			COL-110DC
220 DC	**220 DC**			COL-220DC
110/50 AC (1)	**110/50/60 AC**		58VA (3)	COL-110/50/60AC
115/60 AC	**115/60 AC**			COL-115/60AC
230/50 AC (1)	**230/50/60 AC**			COL-230/50/60AC
230/60 AC	**230/60 AC**			COL-230/60AC
110/50 AC - 120/60 AC	**110 DC**	669	29W	COL-110DC
230/50 AC - 230/60 AC	**220 DC**			COL-220DC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 55 VA.

(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(3) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.

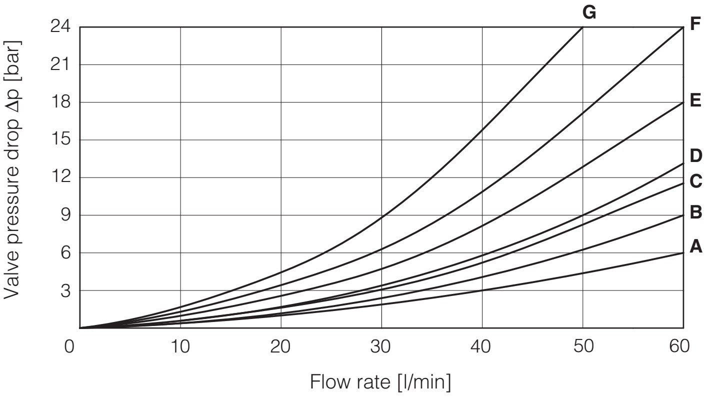
7 OPTIONS

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.
MV, MO = auxiliary hand lever positioned vertically (MV) or horizontally (MO). For available configuration and dimensions see section 18
WP = prolonged manual override protected by rubber cap.
WPD/HL = manual override override with detent, to be ordered separatelly, see section 18

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar

8 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

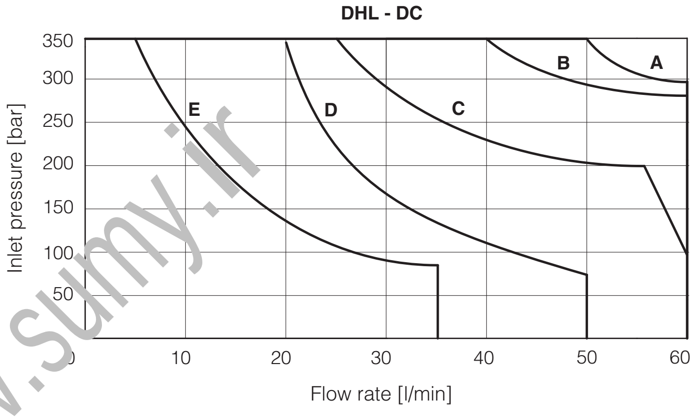
Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0	A	A	C	C	D
1, 1P, 1/1	C	C	C		
3, 3P, 3/1	D	D	A	A	
4, 4/8, 5	F	F	G	C	E
0/2, 1/2, 1/2P	D	D	D	D	
6, 7, 16, 17	D	D	D	D	
8, 8P	A	A	E	E	
2, 6/7	D	D			
2/2	F	F			
19, 91	E	E	D	D	
39, 93	F	F	G	G	



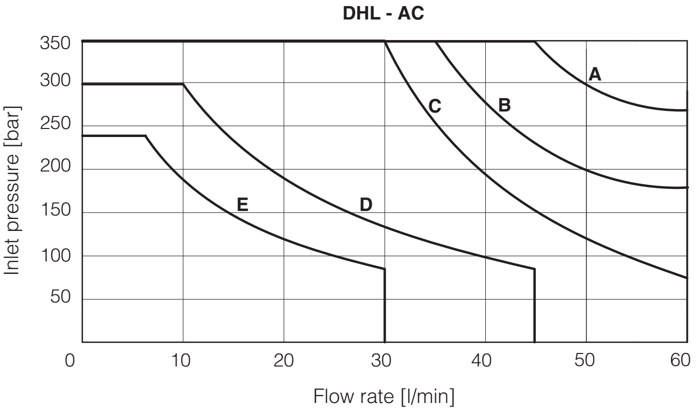
9 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V$_{nom}$ - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

Curve	**DC version, spool type:**
A	0, 0/2, 1/2, 1/2P, 8, 8P
B	1, 1P, 1/1
C	3, 3P, 3/1, 6, 7
D	4, 4/8, 16, 17, 5, 19, 39, 58, 91, 93
E	2, 2/2, 6/7



Curve	**AC version, spool type:**
A	0, 0/2, 1/2, 1/2P, 8, 8P
B	1, 1P, 1/1
C	3, 3P, 3/1, 6, 7
D	4, 16, 17, 4/8, 5, 19, 39, 58, 91, 93
E	2, 2/2, 6/7



10 **SWITCHING TIMES** (average values in msec)

Test conditions: - 20 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- mineral oil: ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

Valve	Switch-on AC	Switch-off AC	Switch-on DC	Switch-off DC
DHL	10 - 25	20 - 40	30 - 50	15 - 25

11 **SWITCHING FREQUENCY**

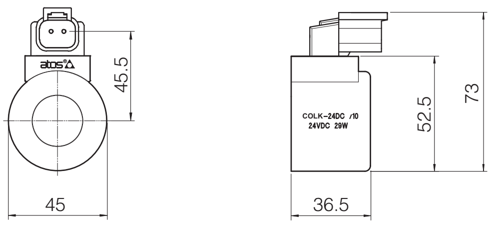
Valve	AC (cycles/h)	DC (cycles/h)
DHL + 666 / 667	7200	15000

12 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K500)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)
E-SD = electronic connector which eliminates electric disturbances when solenoid valves are de-energized

13 COILS WITH SPECIAL CONNECTORS only for voltage supply 12, 14, 24, 28 VDC

Deutsch connector DT-04-2P



Options -XK

Coil type COLK, Deutsch connector DT-04-2P male
Protection degree **IP67**

Note: For the electric characteristics refer to standard coils features - see section 6

14 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, reccomended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS 1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

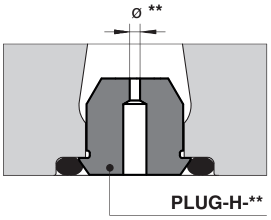
15 PLUG-IN RESTRICTOR (to be ordered separately)

The use of plug-in restrictors in valve's ports P or A or B may be necessary is case of particular conditions as long flexible hoses or the presence of accumulators which could cause at the valve switching instantaneous high flow peaks over the max valve's operating limits.

PLUG-H - ****** **A**

08, 10, 12, 15 calibrated orifice diameter in tenths of mm
Example PLUG-H-**12** = orifice diameter **1,2 mm**
Other orifice dimensions are available on request

Short calibrated orifice



16 FASTENING BOLTS AND SEALS

Fastening bolts	**Seals**
4 socket head screws M5x30 class 12.9 Tightening torque = 8 Nm	4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max)

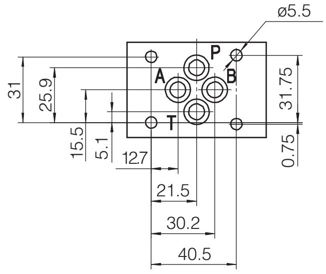
17 DIMENSIONS [mm]

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05

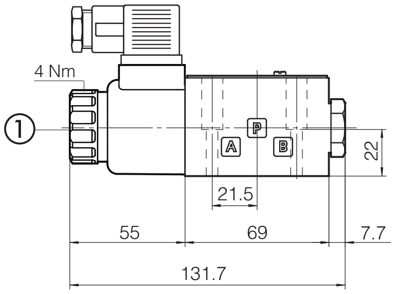
Mass (Kg)		
	DC	AC
DHL-06	1,3	1,2
DHL-07	1,6	1,4

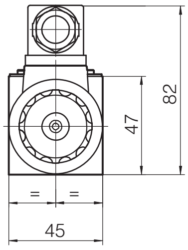
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

Valve's bottom view

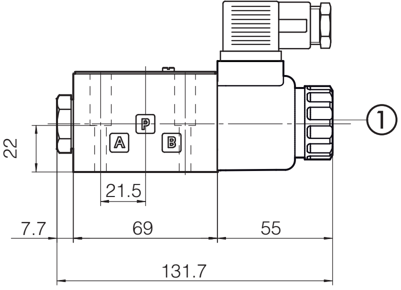


DHL-06 (DC)

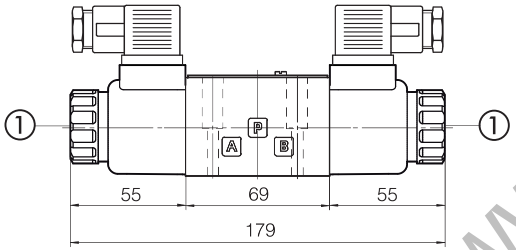




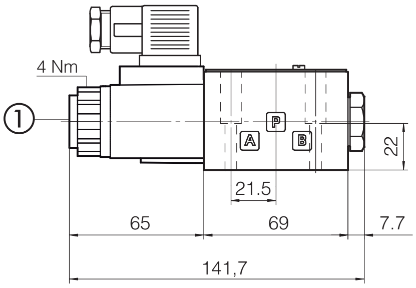
DHL-06*/A (DC)

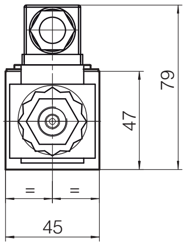


DHL-07 (DC)

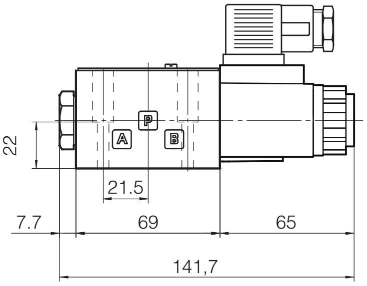


DHL-06 (AC)

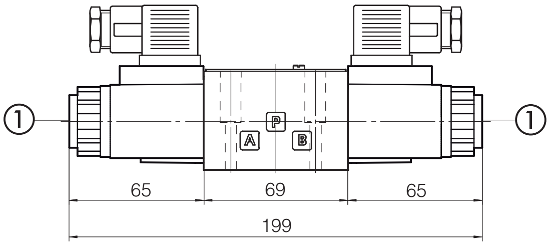




DHL-06*/A (AC)



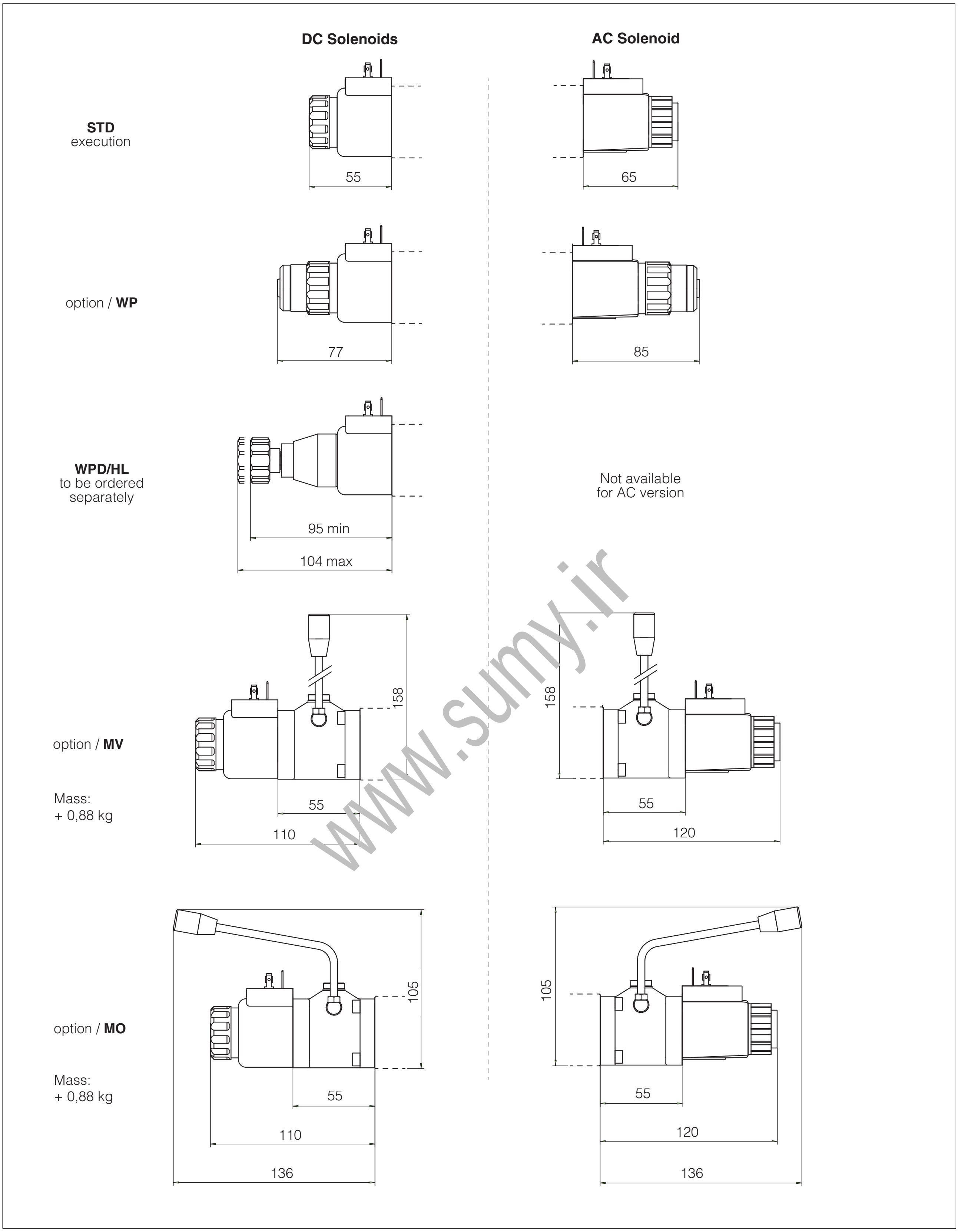
DHL-07 (AC)



① Standard manual override PIN

⚠ The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

18 MANUAL OVERRIDE

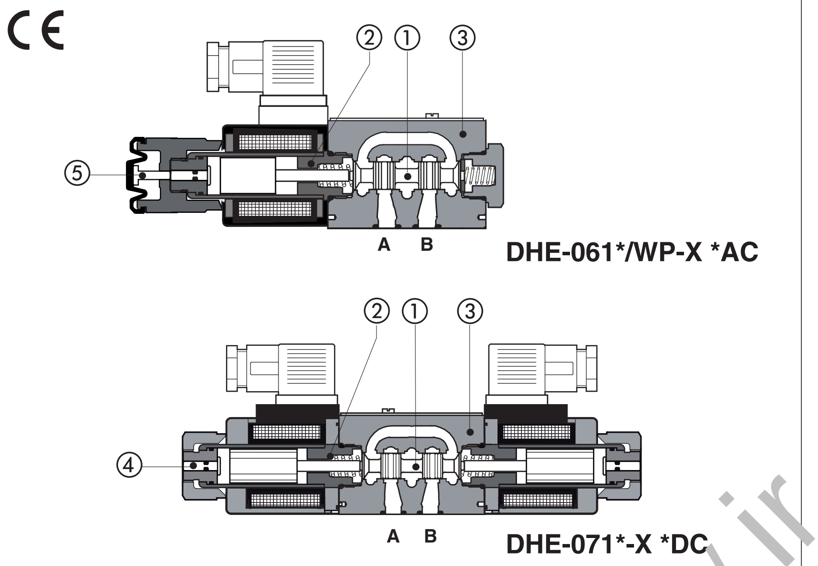


19 RELATED DOCUMENTATION

E001	Basics for solenoid directional valves	**P005**	Mounting surfaces for electrohydraulic valves
K150	Handweels for hydraulic controls	**E900**	Operating and maintenance information
K280	Single and modular subplates		
K800	Electric and electronic connectors		

Solenoid directional valves type DHE

direct, spool type, high flow



Spool type, two or three position direct operated valves with high performance threaded solenoids certified according the North American standard **cURus**.

Solenoids ② are made by:

- wet type screwed tube, different for AC and DC power supply, with integrated manual override pin ④
- interchangeable coils, specific for AC or DC power supply, easily replaceable without tools - see section 5 for available voltages

Standard coils protection **IP65** optional coils with IP67 AMP Junior Timer or lead wire connections.

Wide range of interchangeable spools ①, see section 2.

The valve body ③ is 3 chamber type made by shell-moulding casting with wide internal passages.

Mounting surface: **ISO 4401 size 06**
Max flow: **80 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DHE - 0 | **61** | **1** / **A** - | **X** | **24 DC** | ***** / | *****

Directional control valves size 06

Valve configuration, see section 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
70 = double solenoid, 2 external positions, without spring
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2.

Options, see note 1 at section 4.

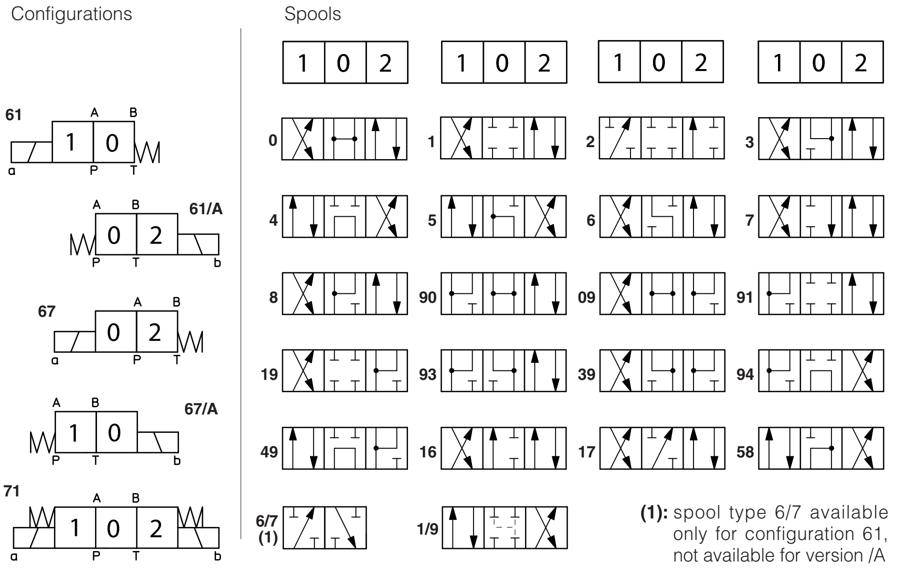
00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 14 for available connectors, to be ordered separately
Coils with special connectors, see section 11
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

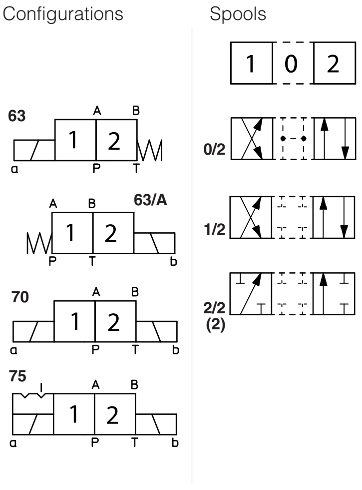
Voltage code, see section 5

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)





(1): spool type 6/7 available only for configuration 61, not available for version /A

(2): not available for configuration 75

Note: see also section 4, note 3, for special shaped spools

3 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
Rated flow	See diagrams Q/Δp at section 6
Maximum flow	**80 l/min**, see operating limits at section 7

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 5
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard

4 NOTES

1 Options

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.

WP = prolonged manual override protected by rubber cap.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar - see section 12.

L1, L2, L3 = (only for DHE-DC) device for switching time control, installed in the valve solenoid, see section 9.
For spools 4 and 4/8 only device L3 is available.

FI, FV = with proximity or inductive position switch for monitoring spool position: see tab. E110.

MV, MO = auxiliary hand lever positioned vertically (MV) or horizontally (MO). For available configuration and dimensions see table E138.

2 Accessories

WPD/HE-DC = (only for DHE-DC) manual override with detent, to be ordered separately, see tab. K150

3 Special shaped spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4, 5** and **58** are also available as **1/1, 4/8, 5/1** and **58/1.** They are properly shaped to reduce water-hammer shocks during the swiching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** to limit valve internal leakages.
- spool type **1/9** has closed center in rest position but it avoids the pressurization of A and B ports due to the internal leakages.
- Other types of spools can be supplied on request.

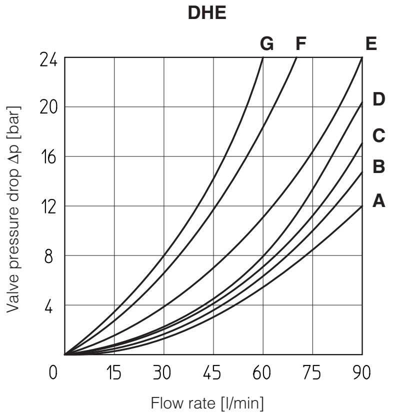
5 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil DHE
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
24/50 AC	**24/50/60 AC**		58 VA (3)	COE-24/50/60AC (1)
48/50 AC	**48/50/60 AC**			COE-48/50/60AC (1)
110/50 AC	**110/50/60 AC**			COE-110/50/60AC (1)
230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
115/50 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/60 AC**			COE-230/60AC
110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

6 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

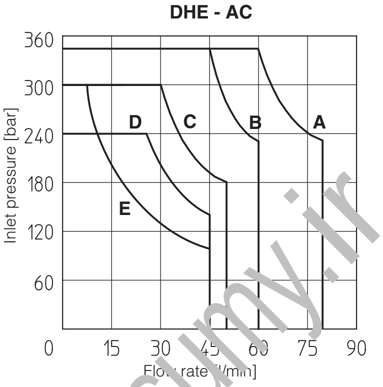
Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0, 0/1	A	A	C	C	D
1, 1/1	D	C	C	C	
3, 3/1	D	D	A	A	
4, 4/8, 5, 5/1, 49, 58, 58/1, 94	F	F	G	C	E
1/2, 0/2	D	D	D	D	
6, 7, 16, 17	D	D	D	D	
8	A	A	E	E	
2	D	D			
2/2	F	F			
09, 19, 90, 91	E	E	D	D	
1/9, 39, 93	F	F	G	G	

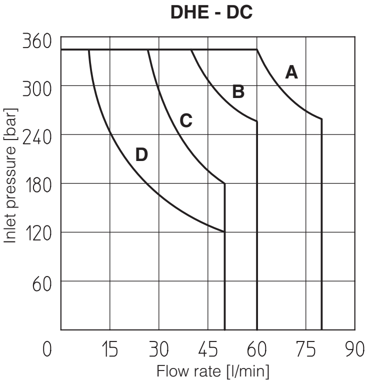


7 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

Curve	Spool type	
	AC	DC
A	1, 1/2, 8	0, 0/1, 1, 1/2, 3, 8
B	0, 0/1, 0/2, 1/1, 1/9, 3	0/2, 1/1, 6, 7, 1/9, 19
C	3, 3/1, 6, 7	3/1, 4, 4/8, 5, 5/1, 16, 17, 19, 39, 49, 58, 58/1, 09, 90, 91, 93, 94
D	4, 4/8, 5, 5/1, 16, 17, 19, 39, 58, 58/1, 09, 90, 91, 93, 94	2, 2/2
E	2, 2/2	-





8 SWITCHING TIMES (average values in msec)

Test conditions:
- 36 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- mineral oil: ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

Valve	Switch-on AC	Switch-off AC	Switch-on DC	Switch-off DC
DHE	10 - 25	20 - 40	30 - 50	15 - 25
DHE-*/L1	—	—	60	60
DHE-*/L2	—	—	80	80
DHE-*/L3	—	—	150	150

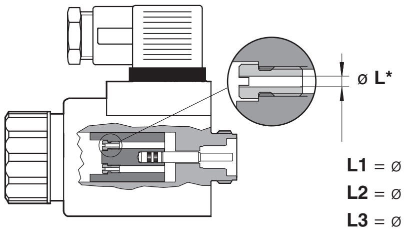
10 SWITCHING FREQUENCY

Valve	AC (cycles/h)	DC (cycles/h)
DHE + 666 / 667	7200	15000

9 DEVICES FOR THE SWITCHING TIME CONTROL

These devices are used to control the valve's switching time (only for DC version) and therefore reduce the hammering shocks in the hydraulic circuit.

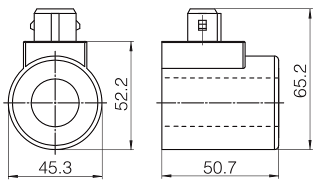
Options L1, L2, L3 control the switching time in both moving directions of the valve spool by means of calibrated restrictors installed in the solenoid anchor.

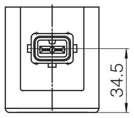


L1 = ø 1,1 mm
L2 = ø 0,9 mm
L3 = ø 0,7 mm

11 COIL WITH SPECIAL CONNECTORS only for voltage supply 12, 14, 24, 28 V_{DC}

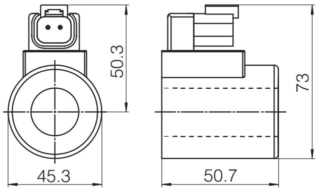
AMP Junior timer connector

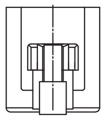




Options -XJ
Coil type COEJ
AMP Junior Timer connector
Protection degree **IP67**

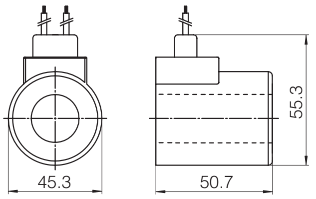
Deutsch connector DT-04-2P

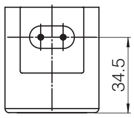




Options -XK
Coil type COEK
Deutsch connector
DT-04-2P male
Protection degree **IP67**

Lead Wire connection



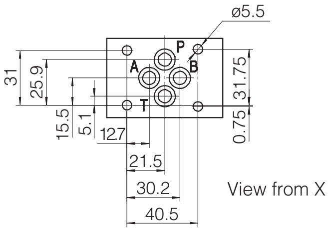


Options -XS
Coil type COES
Lead Wire connection
Cable lenght = 180 mm

Note: for the electric characteristics refer to standard coils features - see section 5

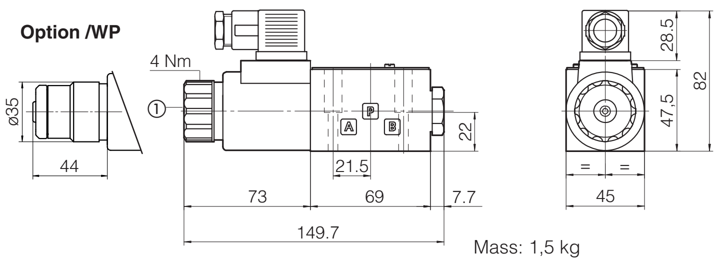
12 DIMENSIONS [mm]

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts: 4 socket head screws:
M5x30 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)



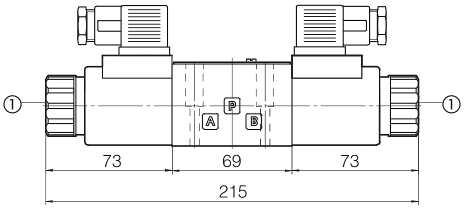
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

DHE-06(DC)



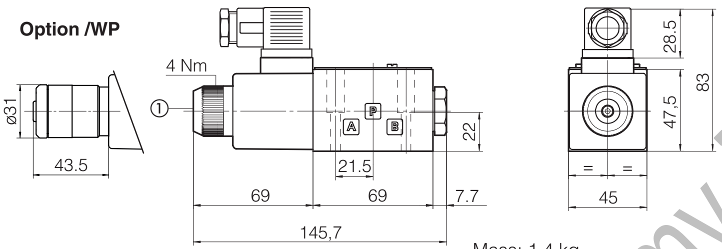
Mass: 1,5 kg

DHE-07(DC)



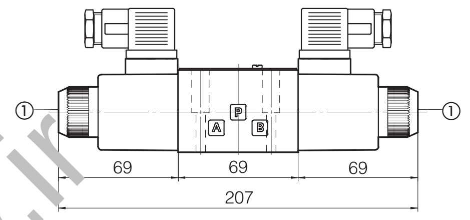
Mass: 2 kg

DHE-06(AC)



Mass: 1,4 kg

DHE-07(AC)



Mass: 1,8 kg

① Standard manual override PIN

⚠ The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

Overall dimensions refer to valves with connector 666

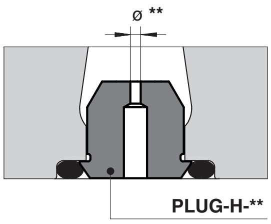
13 PLUG-IN RESTRICTOR (to be ordered separately)

The use of plug-in restrictors in valve's ports P or A or B may be necessary is case of particular conditions as long flexible hoses or the presence of accumulators which could cause at the valve switching instantaneous high flow peaks over the max valve's operating limits.

PLUG-H - ** **A**

08, 10, 12, 15 calibrated orifice diameter in tenths of mm
Example PLUG-H-**12** = orifice diameter **1,2 mm**
Other orifice dimensions are available on request

Short calibrated orifice



14 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)

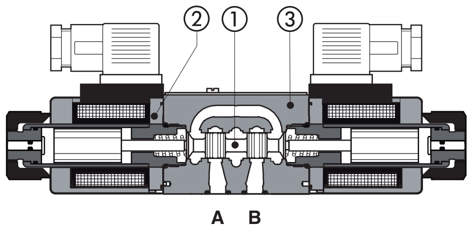
15 MOUNTING SUBPLATES

Model	Ports location	GAS Ports A-B-P-T	Ø Counterbore [mm] A-B-P-T	Mass [kg]
BA-202	Ports A, B, P, T underneath;	3/8"	–	1,2
BA-204	Ports P, T underneath; ports A, B on lateral side	3/8"	25,5	1,8
BA-302	Ports A, B, P, T underneath	1/2"	30	1,8

The subplates are supplied with 4 fastening bolts M5x50. Also available are multi-station subplates and modular subplates. For further details see table K280.

Solenoid directional valves Pmax 420 bar

direct operated, ISO 4401 size 06



DHEP-07*-DC**

① Spool
② Solenoid
③ Valve body

DHEP
Spool type, direct operated solenoid valves with max pressure up to 420 bar for heavy duty applications.

They are equipped with threaded solenoids certified according the North American standard **cURus**
Single and double solenoid valves are available in two or three position configurations and with a wide range of interchangeable spools ①, see section 2.

Solenoids ② are made by:
- wet type screwed tube, different for AC and DC power supply, with integrated manual override pin.
- interchangeable coils, specific for AC or DC power supply, easily replaceable without tools - see section 6 for available voltages

Standard coils protection IP65 (once correctly assembled with relevant electric connectors).
The valve body ③ is made by high strength cast iron.

Mounting surface ISO 4401 size **06**
Max flow up to **80** l/min
Max pressure: **420** bar

1 MODEL CODE

DHEP - 0	63	1/2	/A	X	24 DC	**	/*

Directional control valves
DHEP-0 = Size 06

Valve configuration, see table 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
71 = double solenoid, 3 positions, spring centered
75= double solenoid, 2 external positions, with detent

Spool type, see section 2

Options, see note 1 at section 7

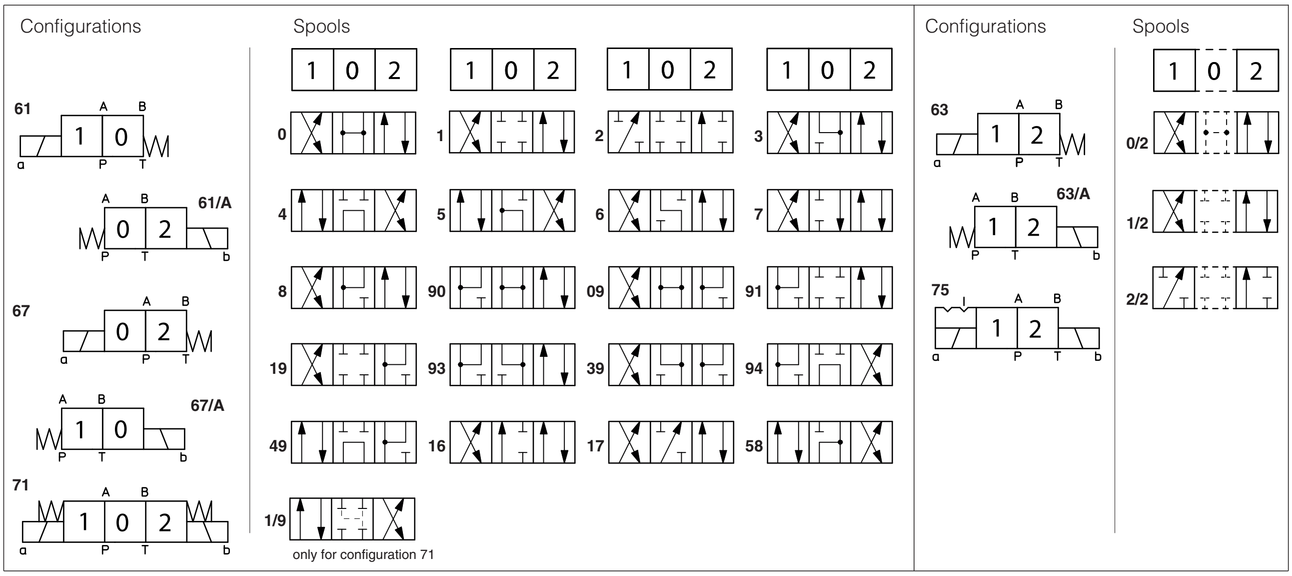
Seals material, see sect. 14:
- = NBR
PE = FKM
BT = NBR low temperature

Series number

Voltage code, see section 6

00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 12 for available connectors, to be ordered separately
Coils with special connectors, see section 13
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

2 CONFIGURATIONS and SPOOLS



only for configuration 71

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Operating pressure	Ports P,A,B: **420** bar; Port T **210** bar for DC version; **160** bar for AC version
Max flow	**80 l/min**, see Q/Δp diagram at section 8 and operating limits at section 9

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 or E-SD correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%

6 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
24/50 AC	**24/50/60 AC**		58 VA (3)	COE-24/50/60AC (1)
48/50 AC	**48/50/60 AC**			COE-48/50/60AC (1)
110/50 AC	**110/50/60 AC**			COE-110/50/60AC (1)
230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
115/50 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/60 AC**			COE-230/60AC
110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 NOTES FOR DHEP

1 Options

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.
WP = prolonged manual override protected by rubber cap.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar.

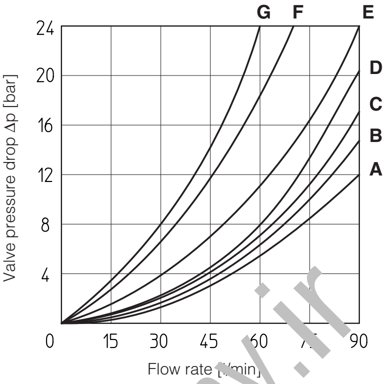
WPD/HE-DC = manual override with detent, to be ordered separately, see tab. K150

2 Special spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4, 5, 58** are also available as **1/1, 4/8, 5/1, 58/1.** They are properly shaped to reduce water-hammer shocks during the swiching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** to limit valve internal leakages.
- Other types of spools can be supplied on request.

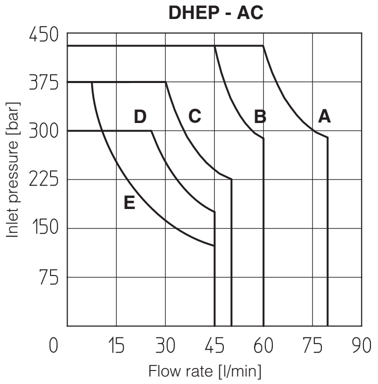
8 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

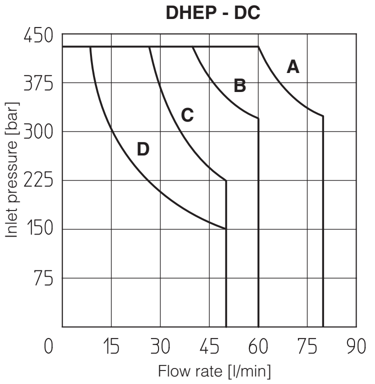
Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T
0, 0/1	A	A	C	C	D
1, 1/1	D	C	C	C	
3, 3/1	D	D	A	A	
4, 4/8, 5, 5/1, 58, 58/1 09, 90, 91, 93, 94	F	F	G	C	E
1/2, 0/2	D	D	D	D	
6, 7	D	D	D	D	
8	A	A	E	E	
2	D	D			
2/2	F	F			



9 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.





Curve	Spool type	
	AC	DC
A	1, 1/2, 8	0, 0/1, 1, 1/2, 3, 8
B	0, 0/1, 0/2, 1/1	0/2, 1/1, 6, 7
C	3, 3/1	3/1, 4, 4/8, 5, 5/1, 19, 39, 58, 90, 91, 93, 94
D	4, 4/8, 5, 5/1, 6, 7, 19, 39, 58, 91, 93, 94	2, 2/2
E	2, 2/2	-

10 SWITCHING TIMES (average values in msec)

Valve	Switch-on AC	Switch-off AC	Switch-on DC	Switch-off DC
DHEP	10 - 25	20 - 40	30 - 50	15 - 25

Test conditions:

- 36 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- mineral oil: ISO VG 46 at 50°C.

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

11 SWITCHING FREQUENCY

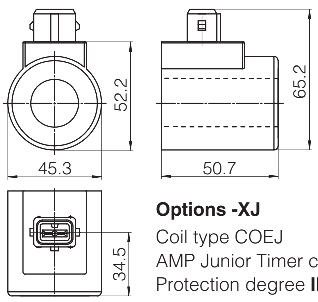
Valve	AC (cycles/h)	DC (cycles/h)
DHEP + 666 / 667	7200	15000

12 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)
E-SD = electronic connector which eliminates electric disturbances when solenoid valves are de-energized

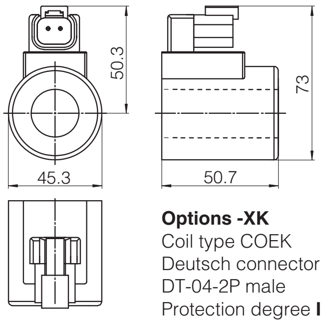
13 COIL WITH SPECIAL CONNECTORS only for voltage supply 12, 14, 24, 28 VDC

AMP Junior timer connector



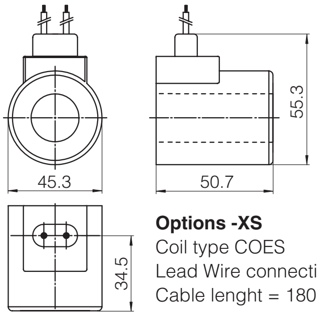
Options -XJ
Coil type COEJ
AMP Junior Timer connector
Protection degree **IP67**

Deutsch connector DT-04-2P



Options -XK
Coil type COEK
Deutsch connector
DT-04-2P male
Protection degree **IP67**

Lead Wire connection



Options -XS
Coil type COES
Lead Wire connection
Cable lenght = 180 mm

Note: for the electric characteristics refer to standard coils features - see section 6

14 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C NBR low temp. seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, NBR low temp.	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, NBR low temp.	HFC	

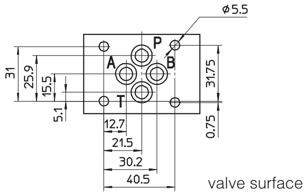
15 FASTENING BOLTS AND SEALS

Fastening bolts	Seals
4 socket head screws M5x30 class 12.9 Tightening torque = 8 Nm	4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max)

16 INSTALLATION DIMENSIONS [mm]

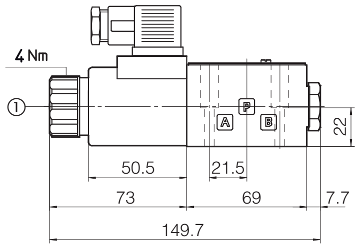
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05

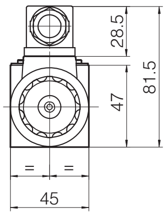
Mass (Kg)		
	DC	AC
DHEP-06	1,5	1,4
DHEP-07	2	1,8



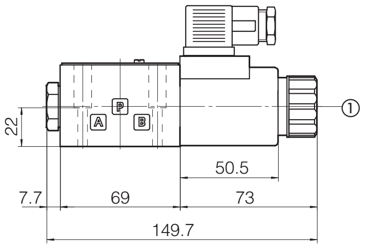
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

DHEP-06(DC)

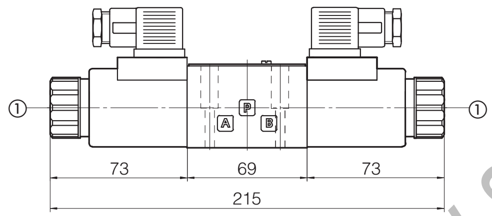




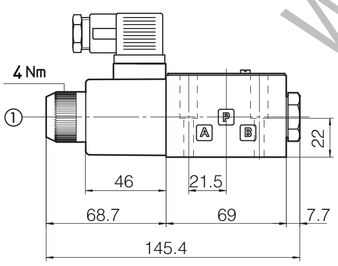
DHEP-06*/A(DC)

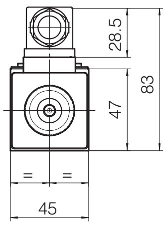


DHEP-07(DC)

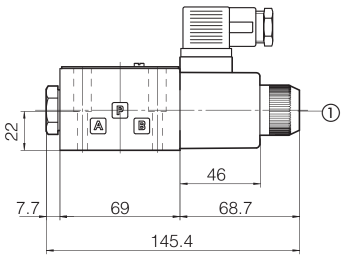


DHEP-06(AC)

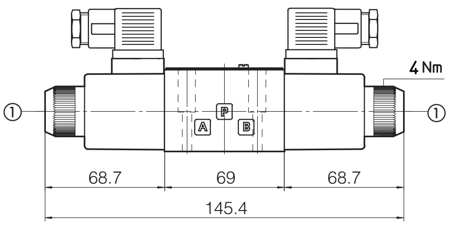




DHEP-06*/A(AC)



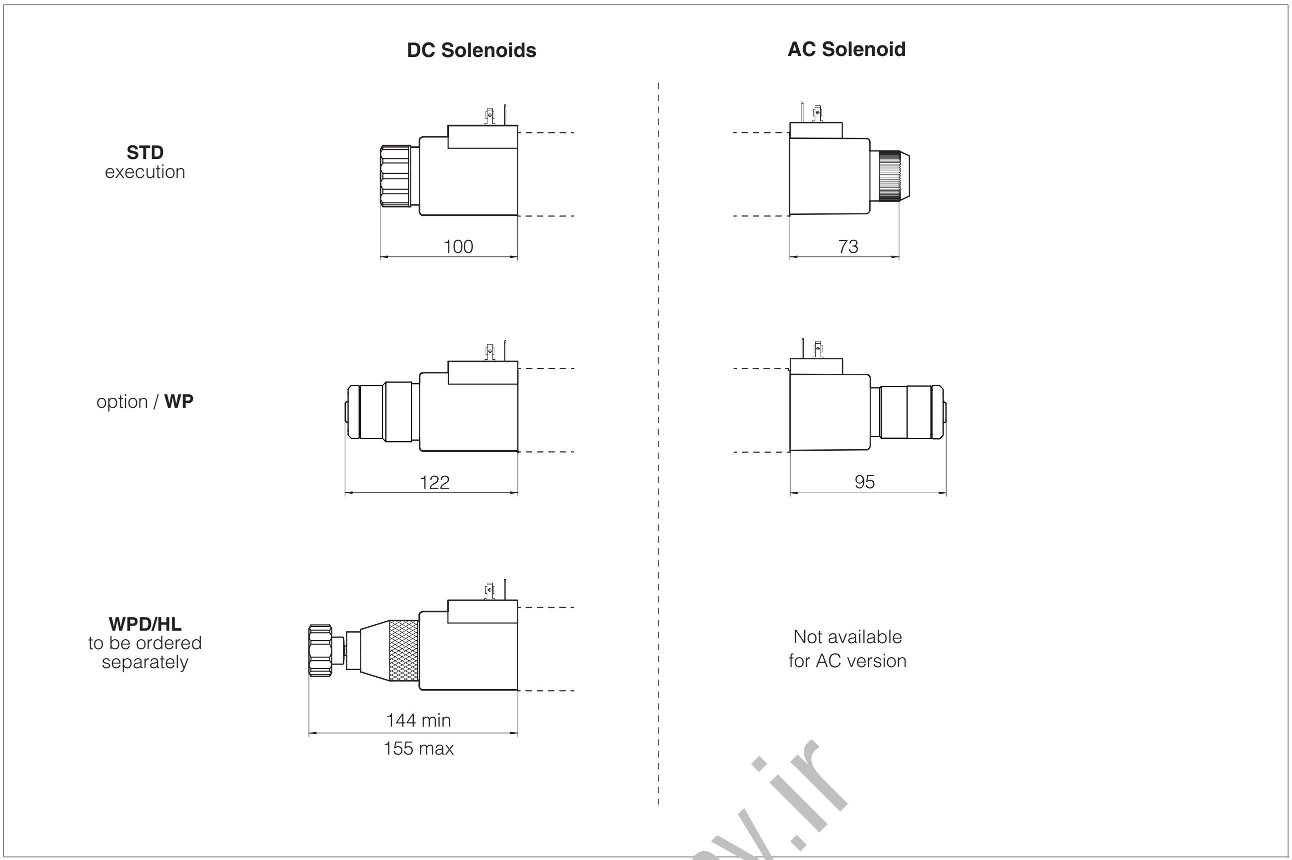
DHEP-07(AC)



Overall dimensions refer to valves with connectors type 666

① Standard manual override PIN. The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

17 MANUAL OVERRIDE

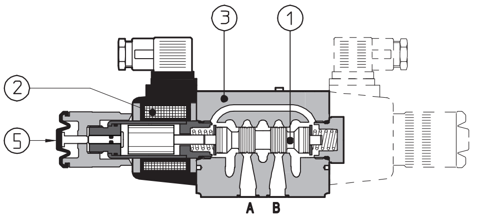


18 RELATED DOCUMENTATION

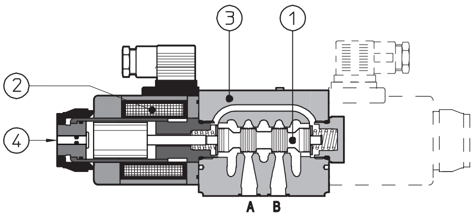
E001	Basics for solenoid directional valves	**P005**	Mounting surfaces for electrohydraulic valves
K150	Handweels for hydraulic controls	**E900**	Operating and maintenance information
K280	Single and modular subplates		
K800	Electric and electronic connectors		

Solenoid directional valves type DKE

direct, spool type



DKE-161*/WP-X *AC (3 CHAMBERS BODY)



DKE-17*-X *DC (5 CHAMBERS BODY)

Spool type, two or three position direct operated valves with threaded solenoids certified according the North American standard **cURus**.

Solenoids ② are made by:

- wet type screwed tube, different for AC and DC power supply, with integrated manual override pin ④
- interchangeable coils, specific for AC or DC power supply, easily replaceable without tools - see section 5 for available voltages.

Standard coils protection **IP65**, optional coils with IP67 AMP Junior Timer or lead wire connections.

The valve body ③ is 5 chamber type for all DC versions and for AC safety version /FI and FV

Standard AC version uses 3 chamber type body.

Wide range of interchangeable spools ①, see section 2.

The body is made by shell-moulding casting with wide internal passages ensuring low pressure drops.

Mounting surface: **ISO 4401 size 10**
Max flow: **150 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DKE - 1	61	1	/	A	-	X	24 DC	*	/	*

Directional control valves size 10

Valve configuration, see section 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
70 = double solenoid, 2 external positions, without springs
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2.

Options, see note 1 at section 4.

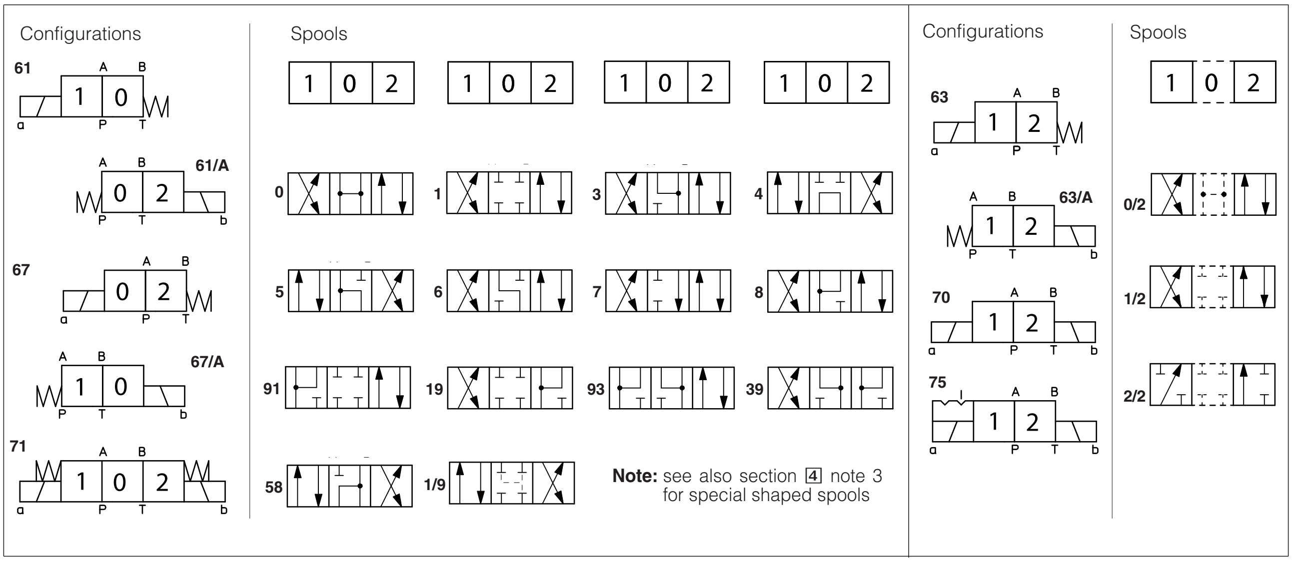
00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 14 for available connectors, to be ordered separately
Coils with special connectors, see section 11
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

Voltage code, see section 5

Series number

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



Note: see also section 4 note 3 for special shaped spools

3 MAIN CHARACTERISTCS, SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position for all valves except for type - 170* (without springs) that must be installed with horizontal axis if operated by impulses
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version (**250** bar with option /Y); **160** bar for AC version
Rated flow	See diagrams Q/Δp at section 6
Maximum flow	**150 l/min**, see operating limits at section 7

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 5
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard

4 NOTES

1 Options

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.
WP = prolonged manual override protected by rubber cap - see section 12.
L, L1, L2, L3, LR, L7, L8 see section 10 = device for switching time control (only for DC solenoids).
L7 and L8 are available only for spool type 0/1, 1/1, 3/1, 4 and 5.
FI, FV = versions with proximity switch for spool position monitoring: see tab. EY010.
Y = external drain, only for DC version, to be selected if the pressure at T port is higher than the max allowed limits.

2 Accessories

WPD/KE-DC = (only for DC supply) manual override with detent, to be ordered separately, see tab. K150

3 Special shaped spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spool type **1** is also available as **1/1**, properly shaped to reduce the water-hammer shocks during the switching.
- spool type **1/9** has closed center in rest position but it avoids the pressurization of A and B ports due to the internal leakages.

5 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	36 W	CAE-12DC
14 DC	**14 DC**			CAE-14DC
24 DC	**24 DC**			CAE-24DC
28 DC	**28 DC**			CAE-28DC
110 DC	**110 DC**			CAE-110DC
125 DC	**125 DC**			CAE-125 DC
220 DC	**220 DC**			CAE-220DC
110/50/60 AC	**110/50/60 AC**		100 VA (3)	CAE-110/50/60AC (1)
230/50/60 AC	**230/50/60 AC**			CAE-230/50/60AC (1)
115/60 AC	**115/60 AC**		130 VA (3)	CAE-115/60AC
230/60 AC	**230/60 AC**			CAE-230/60AC
110/50/60 AC	**110 DC**	669	36 W	CAE-110DC
230/50/60 AC	**220 DC**			CAE-220DC

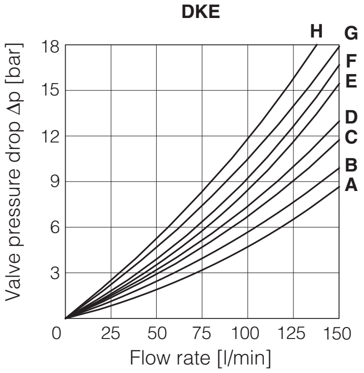
(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 90 VA

(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

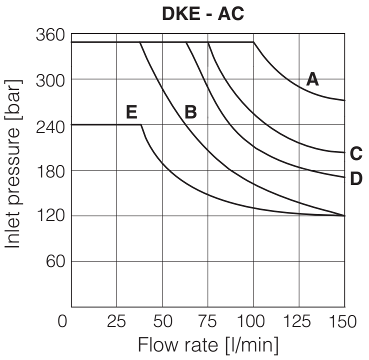
6 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

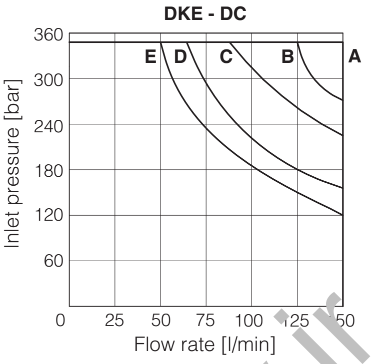
Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T	B→A
0, 0/1, 0/2, 2/2	A	A	B	B		
1, 1/1, 6, 8	A	A	D	C		
3, 3/1, 7	A	A	C	D		
4	B	B	B	B	F	
5, 58	A	B	C	C	G	
1/2	B	C	C	B		
19, 91	F	F	G	G		H
1/9, 39, 93	F	F	G	G		H

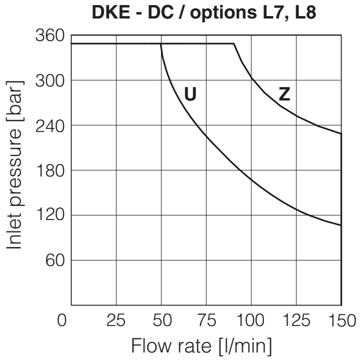


7 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.







Curve	Spool type AC	Spool type DC
A	0/1	0, 0/1, 1, 1/1, 3, 3/1, 1/2, 0/2, 8
B	4, 5, 19, 91	6, 7
C	0, 1/1, 3, 3/1	19, 91
D	1, 1/2, 0/2	4, 5
E	6, 7, 8, 2/2	2/2
U	-	4, 5
Z	-	0/1, 1/1, 3/1

8 **SWITCHING TIMES** (average values in msec)

Valve	Switch-on AC	Switch-on DC	Switch-off AC	Switch-off DC
DKE + 666 / 667	40	60	25	35
DKE + 669	60	—	90	—
DKE-*/L*	—	75÷150	—	45÷150
DKE-*/L7 - DKE-*/L8	—	100÷150	—	100÷150

Test conditions:

- 50 l/min; 150 bar
- nominal supply voltage
- 2 bar of back pressure on port T
- mineral oil ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

9 **SWITCHING FREQUENCY**

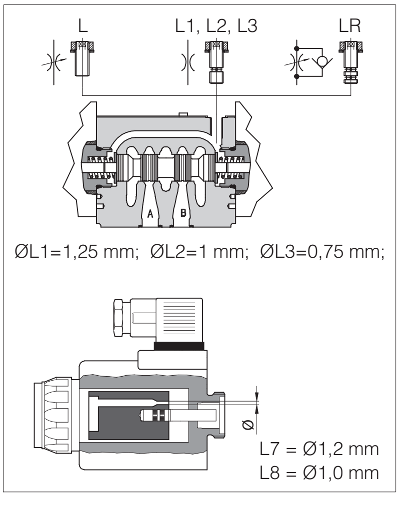
Valve	AC (cycles/h)	DC (cycles/h)
DKE + 666 / 667	7200	15000

10 **DEVICES FOR SWITCHING TIME CONTROL**

These devices are only available for DC valve version (5 chambers body) and can control the switching time and therefore reduce the coil hammering in the hydraulic circuit. The different types are available shown in the figure.

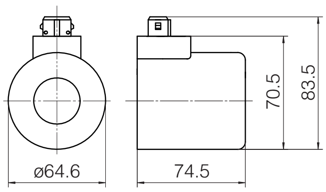
- **L**: controls and regulates the switching time in both moving directions of the spool: regulation is carried out by screwing/unscrewing the element itself (regulating choke);
- **L1/L2/L3**: controls the switching time in both moving directions of the spool by means of fixed calibrated restrictor (gauged flow). The restrictor is positioned in the valve's body ØL1 = 1,25 mm; ØL2 = 1 mm; ØL3 = 0,75 mm;
- **LR**: controls and regulates the switching time in the B→A direction of the spool movement. The device does not control the switching time (standard time) in the opposite direction A→B of the spool movement.
- **L7/L8**: controls the switching time in both moving directions of the spool by means of fixed calibrated restrictor (gauged flow). The restrictor is installed in the solenoid's anchor.

For a correct operation of the switching time control, the passage in which the control device is installed must be completely filled with oil.

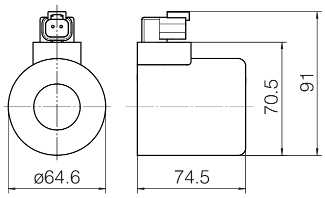


11 COILS TYPE CAE WITH SPECIAL CONNECTORS (only for 12DC, 14DC, 24DC and 28DC)

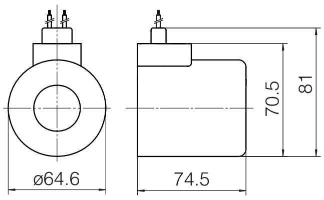
Options -XJ
Coil type CAEJ
AMP Junior Timer connector
Protection degree IP67



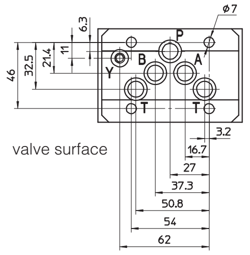
Options -XK
Coil type CAEK
Deutsch connector, DT-04-2P male
Protection degree IP67



Options -XS
Coil type CAES
Lead Wire connection
Cable lenght = 180 mm



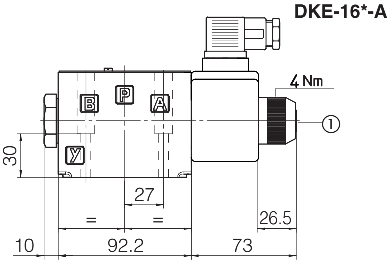
12 INSTALLATION DIMENSIONS [mm]

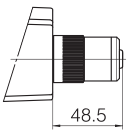


ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05
(without X port, Y port optional)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050 and 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

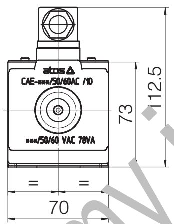
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT (only for option /Y)
For the max pressures on ports, see section 3

DKE-16*-AC

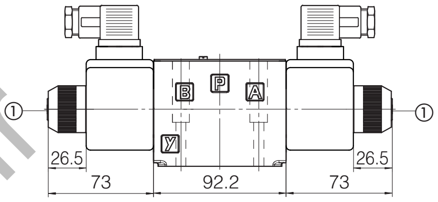




Option /WP



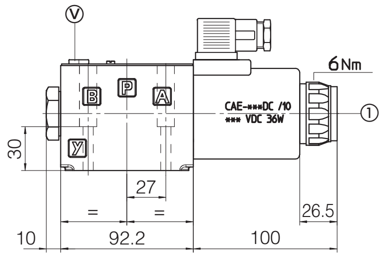
DKE-17*-AC

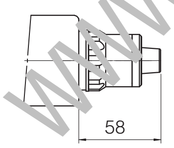


Mass: 3,9 kg

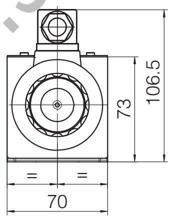
Mass: 4,7 kg

DKE-16*-DC

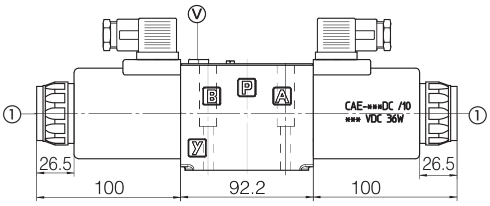




Option /WP



DKE-17*-DC



Mass: 4,5 kg

Mass: 6,1 kg

① Standard manual override PIN. The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

Ⓥ Option L, L1, L2, L3, LR

13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)

14 MOUNTING SUBPLATES

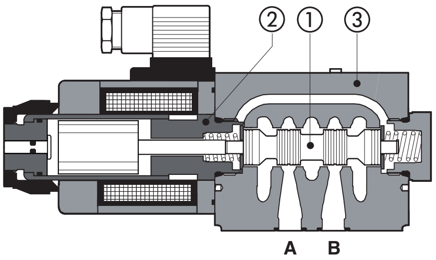
Model		Ports location	GAS Ports A-B-P-T (X-Y)	Ø Counterbore [mm] A-B-P-T (X-Y)	Mass [kg]
BA-308	(/Y)	Ports A, B, P, T (X, Y) underneath	1/2" (1/4")	30 (21,5)	2,5
BA-428	(/Y)	Ports A, B, P, T (X, Y) underneath	3/4" (1/4")	36,5 (21,5)	5,5
BA-434	(/Y)	Ports P, T, (X, Y) underneath; ports A, B on lateral side	3/4" (1/4")	36,5 (21,5)	8,5

The subplates are supplied with 4 fastening bolts M6x40. Also available are multi-station subplates and modular subplates.
For further details see table K280.

Solenoid directional valves Pmax 420 bar

direct operated, ISO 4401 size 10

CE



DKEP-16*-DC**

① Spool
② Solenoid
③ Valve body

DKEP
Spool type, direct operated solenoid valves with max pressure up to 420 bar for heavy duty applications.

They are equipped with threaded solenoids certified according the North American standard **cURus**
Single and double solenoid valves are available in two or three position configurations and with a wide range of interchangeable spools ①, see section 2.

Solenoids ② are made by:
- wet type screwed tube, different for AC and DC power supply, with integrated manual override pin.
- interchangeable coils, specific for AC or DC power supply, easily replaceable without tools - see section 6 for available voltages

Standard coils protection IP65 (once correctly assembled with relevant electric connectors).
The valve body ③ is made by high strength cast iron.

Mounting surface ISO 4401 size **10**
Max flow up to **150** l/min
Max pressure: **420** bar

1 MODEL CODE

DKEP - 1	61	0	/A	X	24 DC	**	/*

Directional control valves
DKEP-1 = Size 10

Valve configuration, see table 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
71 = double solenoid, 3 positions, spring centered
75= double solenoid, 2 external positions, with detent

Spool type, see section 2

Options, see note 1 at section 7

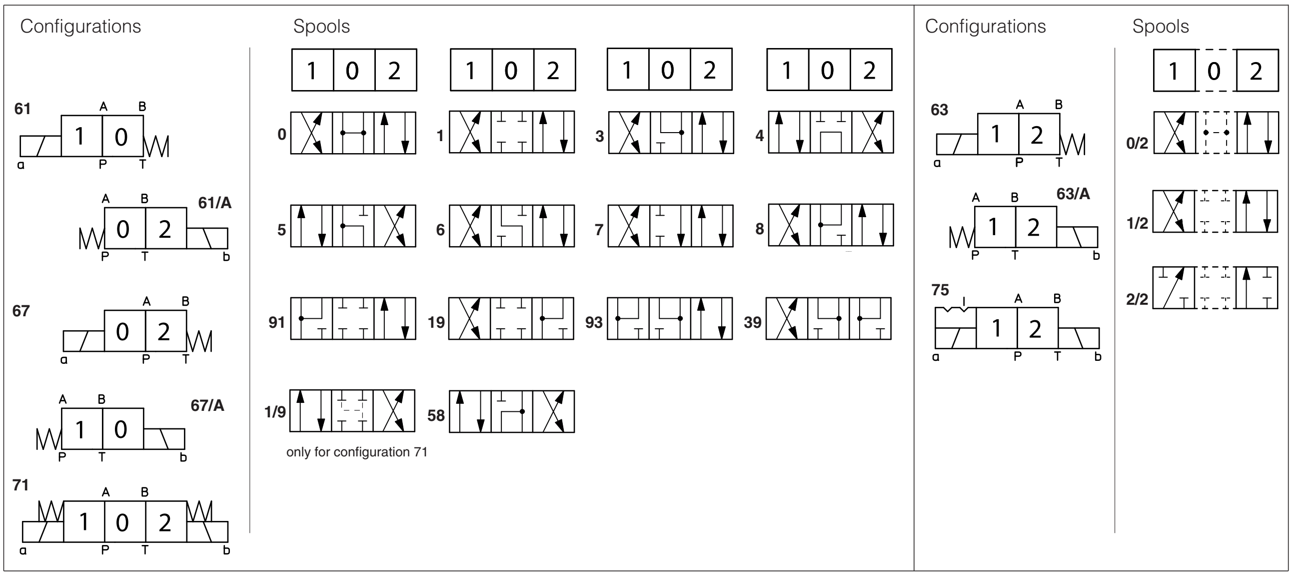
Seals material, see sect. 3, 4:
- = NBR
PE = FKM
BT = NBR low temperature

Series number

Voltage code, see section 6

00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 13 for available connectors, to be ordered separately
Coils with special connectors, see section 14
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

2 CONFIGURATIONS and SPOOLS



3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Operating pressure	Ports P,A,B: **420** bar; Port T **210** bar for DC version; **160** bar for AC version
Max flow	**150 l/min**, see Q/Δp diagram at section 9 and operating limits at section 10

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 or E-SD correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%

6 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	36 W	CAE-12DC
14 DC	**14 DC**			CAE-14DC
24 DC	**24 DC**			CAE-24DC
28 DC	**28 DC**			CAE-28DC
110 DC	**110 DC**			CAE-110DC
125 DC	**125 DC**			CAE-125DC
220 DC	**220 DC**			CAE-220DC
110/50/60 AC	**110/50/60 AC**		100 VA (3)	CAE-110/50/60AC (1)
230/50/60 AC	**230/50/60 AC**			CAE-230/50/60AC (1)
115/50 AC	**115/60 AC**		130 VA (3)	CAE-115/60AC
230/50 AC	**230/60 AC**			CAE-230/60AC
110/50/60 AC	**110 DC**	669	36 W	CAE-110DC
230/50/60 AC	**220 DC**			CAE-220DC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 90 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 NOTES FOR DKEP

1 Options

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.
WP = prolonged manual override protected by rubber cap.
L, L1, L2, L3, LR, L7, L8 see section 8 = device for switching time control (only for DC solenoids).
L7 and L8 are available only for spool type 0/1, 1/1, 3/1, 4 and 5.
Y = external drain, only for DC version, to be selected if the pressure at T port is higher than the max allowed limits.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar.

WPD/KE-DC = manual override with detent, to be ordered separately, see tab. K150

2 Special spools

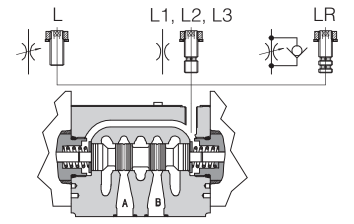
- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1** is also available as **1/1**, properly shaped to reduce the water-hammer shocks during the switching.
- spool type **1/9** has closed center in rest position but it avoids the pressurization of A and B ports due to the internal leakages.
- other types of spools can be supplied on request.

8 DEVICES FOR SWITCHING TIME CONTROL

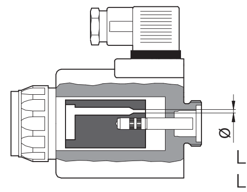
These devices are only available for DC valve version (5 chambers body) and can control the switching time and therefore reduce the coil hammering in the hydraulic circuit. The different types are available shown in the figure.

- **L**: controls and regulates the switching time in both moving directions of the spool: regulation is carried out by screwing/unscrewing the element itself (regulating choke);
- **L1/L2/L3**: controls the switching time in both moving directions of the spool by means of fixed calibrated restrictor (gauged flow). The restrictor is positioned in the valve's body ØL1 = 1,25 mm; ØL2 = 1 mm; ØL3 = 0,75 mm;
- **LR**: controls and regulates the switching time in the B→A direction of the spool movement. The device does not control the switching time (standard time) in the opposite direction A→B of the spool movement.
- **L7/L8**: controls the switching time in both moving directions of the spool by means of fixed calibrated restrictor (gauged flow). The restrictor is installed in the solenoid's anchor.

For a correct operation of the switching time control, the passage in which the control device is installed must be completely filled with oil.



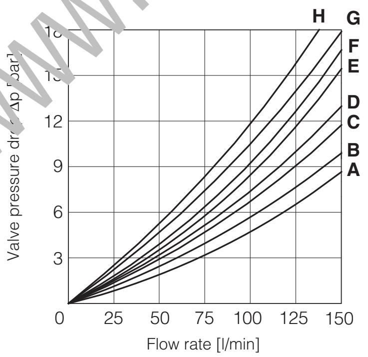
ØL1=1,25 mm; ØL2=1 mm; ØL3=0,75 mm;



L7 = Ø1,2 mm
L8 = Ø1,0 mm

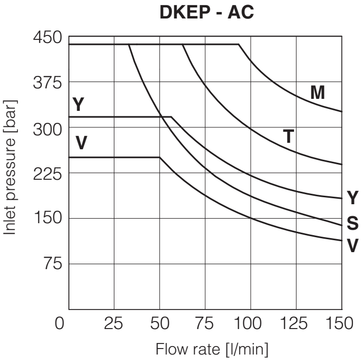
9 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

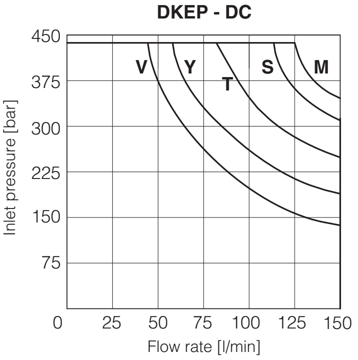
Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T	B→A
0, 0/1, 0/2, 2/2	A	A	B	B		
1, 1/1, 1/3, 6, 8	A	A	D	C		
3, 3/1, 7	A	A	C	D		
4	B	B	B	B	F	
5	A	B	C	C	G	
1/2	B	C	C	B		
2/7	D			F		
5/7	B			A	E	
19	A	D	C			H



10 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.





Curve	Spool type AC	Spool type DC
M	0/1, 5/7, 1/3	0, 0/1, 1, 1/1, 3, 3/1, 1/2, 0/2, 8
S	2/7, 4, 5, 19	1/3, 5/7, 6, 7
Y	1, 1/2, 0/2	4, 5, 2/7
V	6, 7, 8, 2/2	2/2
T	0, 1/1, 3, 3/1	19
U	-	4, 5
Z	-	0/1, 1/1, 3/1

11 SWITCHING TIMES (average values in msec)

Valve	Switch-on AC	Switch-on DC	Switch-off AC	Switch-off DC
DKEP + 666 / 667	40	60	25	35

Test conditions:

- 50 l/min; 150 bar
- nominal supply voltage
- 2 bar of back pressure on port T
- mineral oil ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

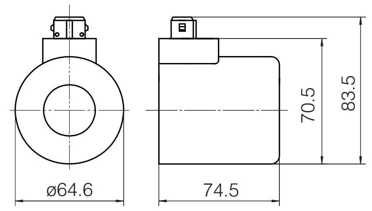
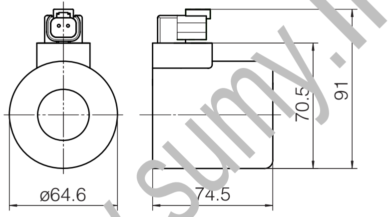
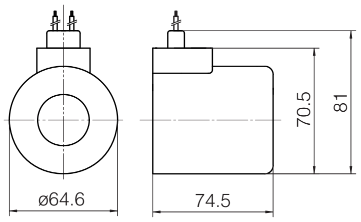
12 SWITCHING FREQUENCY

Valve	AC (cycles/h)	DC (cycles/h)
DKEP + 666 / 667	7200	15000

13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)

14 COIL WITH SPECIAL CONNECTORS only for voltage supply 12, 14, 24, 28 VDC

AMP Junior timer connector	Deutsch connector DT-04-2P	Lead Wire connection
		
Options -XJ Coil type CAEJ AMP Junior Timer connector Protection degree **IP67**	**Options -XK** Coil type CAEK Deutsch connector DT-04-2P male Protection degree **IP67**	**Options -XS** Coil type CAES Lead Wire connection Cable lenght = 180 mm

Note: for the electric characteristics refer to standard coils features - see section 6

15 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C NBR low temp. seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level normal operation	ISO4406 class 18/16/13 NAS1638 class 7		see also filter section at www.atos.com or KTF catalog
longer life	ISO4406 class 16/14/11 NAS1638 class 5		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, NBR low temp.	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, NBR low temp.	HFC	

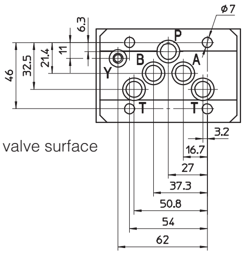
16 FASTENING BOLTS AND SEALS

Fastening bolts	Seals
4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm	5 OR 2050; (1 OR 108 for Y optional port); Diameter of ports A, B, P, T: Ø 11.5mm (max); Y: Ø 5mm (optional port)

17 INSTALLATION DIMENSIONS [mm]

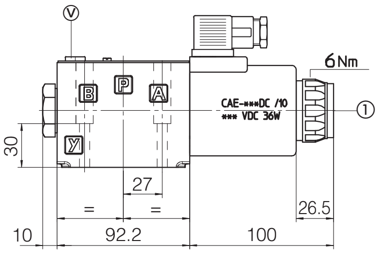
ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05
(without X port, Y port optional)

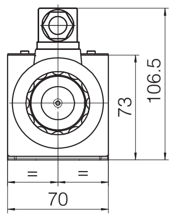
Mass (Kg)		
	DC	AC
DKEP-16	4,5	3,9
DKEP-17	6,1	4,7



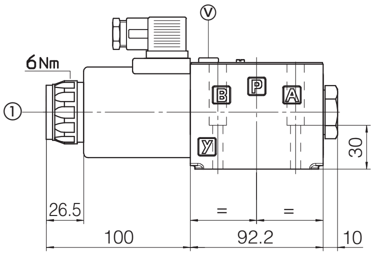
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT (optional)

DKEP-16*-DC

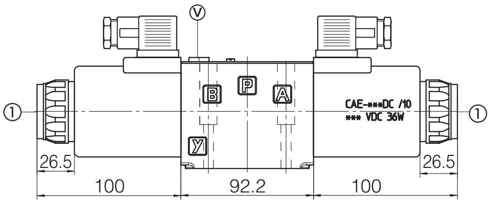




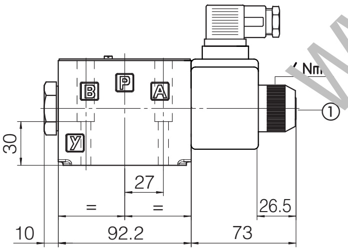
DKEP-16*/A-DC

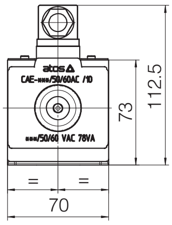


DKEP-17*-DC

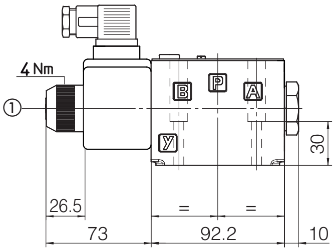


DKEP-16*-AC

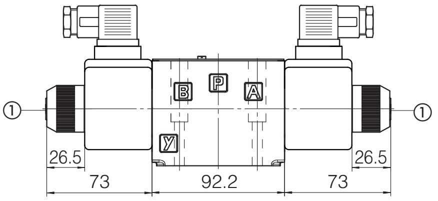




DKEP-16*-AC



DKEP-17*-AC

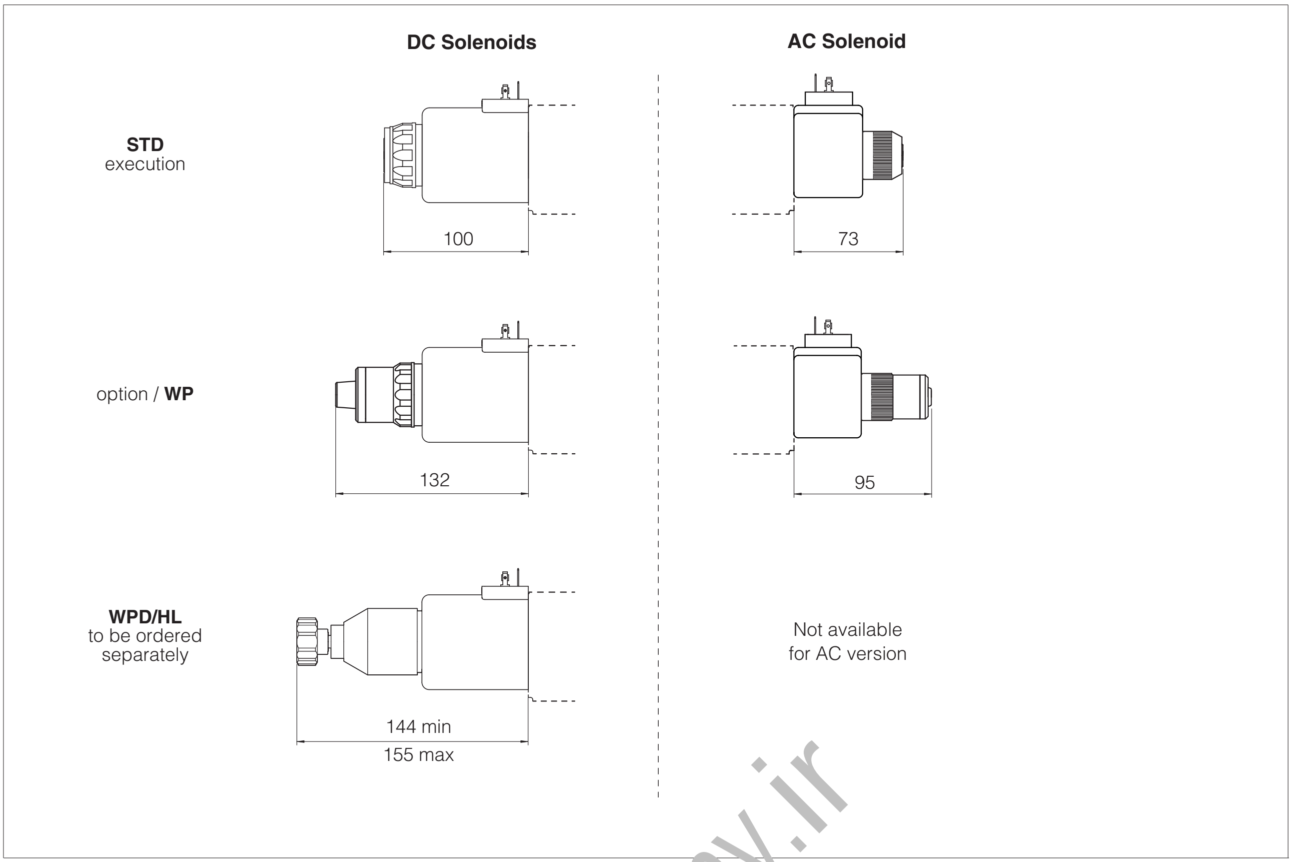


Overall dimensions refer to valves with connectors type 666

① Standard manual override PIN. The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

Ⓥ Option L, L1, L2, L3, LR

18 MANUAL OVERRIDE



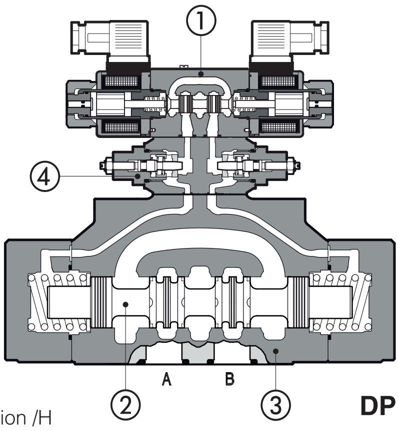
19 RELATED DOCUMENTATION

E001	Basics for solenoid directional valves	**P005**	Mounting surfaces for electrohydraulic valves
K150	Handweels for hydraulic controls	**E900**	Operating and maintenance information
K280	Single and modular subplates		
K800	Electric and electronic connectors		

Solenoid directional valves type DPHL

piloted, spool type

CE



DPHL-471*/H

① Solenoid pilot valve
② Main spool
③ Main body
④ Adjustable chokes - option /H

Spool type, pilot operated directional solenoid valves available in 4/3, 4/2, 3/2 way versions.
They are operated by a directional valve ① type DHL (see tech. table E018) equipped with compact solenoids for AC or DC power supply.
Spools ② are fully interchangeable and they are available in a wide range of hydraulic configurations.
The valve body is made by shell-moulding castings ③ with wide internal passages ensuring low pressure drops.

Mounting surface: **ISO 4401 size 10, 16, 25, 32**
Max flow: **160, 300, 700, 1000 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DPH	L	-	2	61	1	/	A	-	X	24 DC	**	/	*

Piloted directional valve

Solenoid pilot valve:
L = DHL compact execution, AC and DC supply

Valve size:
1 = 10 **2** = 16 **4** = 25 **6** = 32

Valve configuration, see section 2
61= single solenoid, center plus external position, spring centered
63= single solenoid, 2 external positions, spring offset
67= single solenoid, center plus external position, spring offset
71= double solenoid, 3 positions, spring centered
75= double solenoid, 2 external positions, with detent

Spool type, see section 2

Options, see section 7

00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 13 for available connectors, to be ordered separately

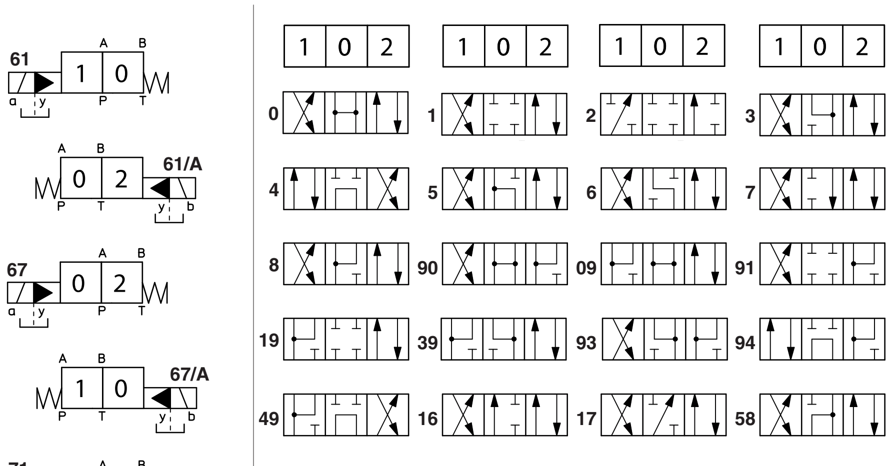
Voltage code, see section 6

Series number

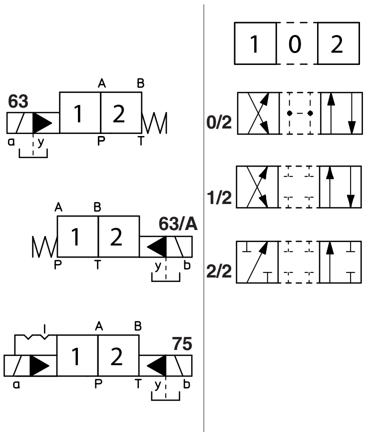
Seals material, see section 15 :
- = NBR
PE = FKM

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)

Configurations Spools



Configurations Spools



NOTES (see also section 7.1 for special shaped spools):
- For **DPHL-1** are available only spools: **0, 0/2, 1, 1/2, 3, 4, 5, 58, 6, 7**
- For **DPHL-6** are available only spools: **0, 1, 1/2, 2, 3, 4, 5, 58, 6, 7, 8, 19, 91**

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
Rated flow	See Q/Δp diagram at section 9 and operating limits at section 10
Max flow	DPHL-1: **160 l/min;** DPHL-2: **300 l/min;** DPHL-4: **700 l/min;** DPHL-6: **1000 l/min** (see rated flow at section 9 and operating limits at section 10)

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** with connectors correctly assembled
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%

6 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil **-X**
12 DC	**12 DC**	666 or 667	29W	COL-12DC
14 DC	**14 DC**			COL-14DC
24 DC	**24 DC**			COL-24DC
28 DC	**28 DC**			COL-28DC
110 DC	**110 DC**			COL-110DC
220 DC	**220 DC**			COL-220DC
110/50 AC (1)	**110/50/60 AC**		58VA (3)	COL-110/50/60AC
115/60 AC	**115/60 AC**			COL-115/60AC
230/50 AC (1)	**230/50/60 AC**			COL-230/50/60AC
230/60 AC	**230/60 AC**			COL-230/60AC
110/50 AC - 120/60 AC	**110 DC**	669	29W	COL-110DC
230/50 AC - 230/60 AC	**220 DC**			COL-220DC

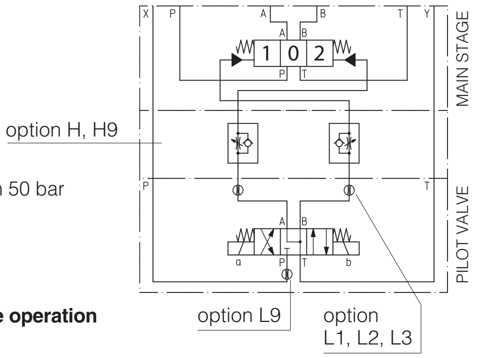
(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 55 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.

7 OPTIONS

/A = Solenoid mounted at side of port A of main body (only for single solenoid valves).
In standard version, solenoid is mounted at side of port B.
/D = Internal drain (standard configuration is external drain)
/E = External pilot pressure (standard configuration is internal pilot pressure).
/R = Pilot pressure generator 4 bar on port P - not for DPHL-1 see section 8
/S = Main spool stroke adjustment - not for DPHL-1.
/WP = Prolonged manual override protected by rubber cap.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar

FUNCTIONAL SCHEME (config. 71)
example of switching control options



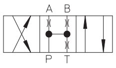
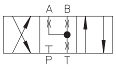
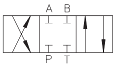
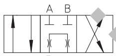
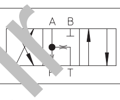
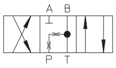
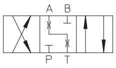
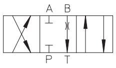
Devices for main spool switching control and to reduce the hydraulic shocks at the valve operation

/H = Adjustable chokes (meter-out to the pilot chambers of the main valve).
/H9 = Adjustable chokes (meter-in to the pilot chambers of the main valve).
/L1, /L2, /L3 = calibrated restrictors on A and B ports of the pilot valve: **L1** =0,8mm, **L2** =1mm, **L3** =1,25mm) - not for DPHL-1.
/L9 = plug with calibrated restictor in P port of pilot valve - see section 12 - only for DPHL-2 and DPHL-4.
Suggested for pilot pressure higher than 210 bar or to limit the hydraulics shocks caused by the fast main spool switching

7.1 Shaped spools

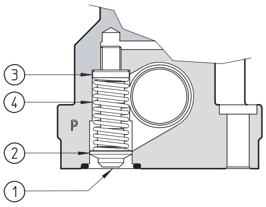
- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4, 5, 58, 6** and **7** are also available as **1/1, 4/8, 5/1, 58/1, 6/1** and **7/1** that are properly shaped to reduce water-hammer shocks during the switching (to use with option /L*).

Shaped spool availability

Shaped spool type	0/1	3/1	1/1	4/8	5/1	58/1	6/1	7/1
Hydraulic symbol								
DPHL-1	●	●		●				
DPHL-2, DPHL-4	●	●	●	●	●	●	●	●
DPHL-6		●	●	●				

8 PILOT PRESSURE GENERATOR (OPTION /R)

The device **/R** generates an additional pressure drop, in order to ensure the minimum pilot pressure, for correct operation of the valves with internal pilot and fitted with spools type **0, 0/1, 4, 4/8, 5, 58, 09, 90, 94, 49.** The device **/R** has to be fitted when the pressure drop in the valve, verified on flow versus pressure diagrams, is lower than the minimum pilot pressure value.

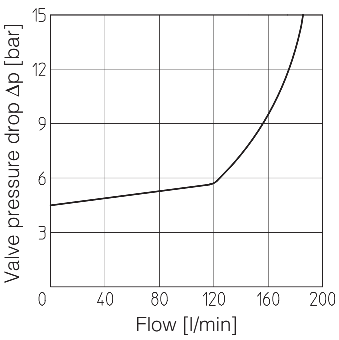


① Flapper-guide
② Flapper
③ Spring stop-washer
④ Spring

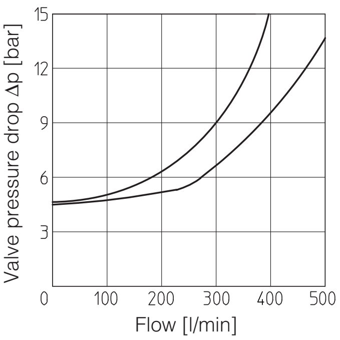
Ordering code of spare pilot pressure generator

R/DP	-	*
Pilot pressure generator		Size: **2** for DPHL-2 **4** for DPHL-4 **6** for DPHL-6

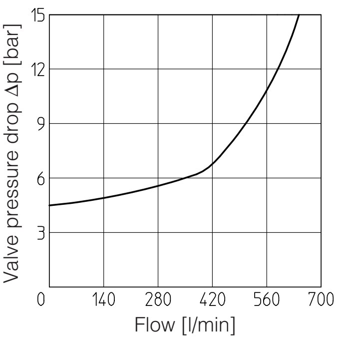
DPHL-2



DPHL-4



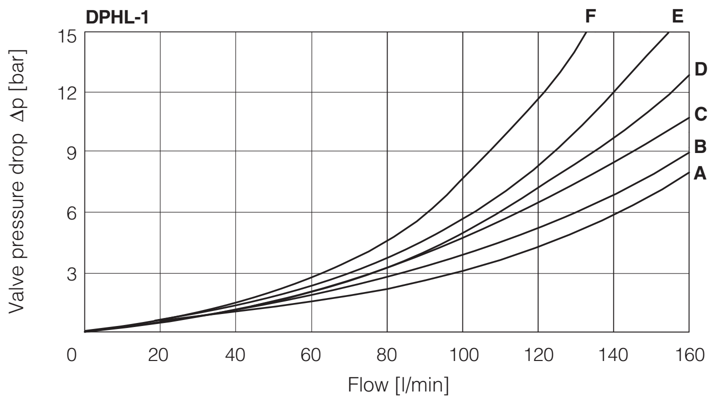
DPHL-6



9 FLOW VERSUS PRESSURE DIAGRAMS Based on mineral oil ISO VG 46 at 50°C

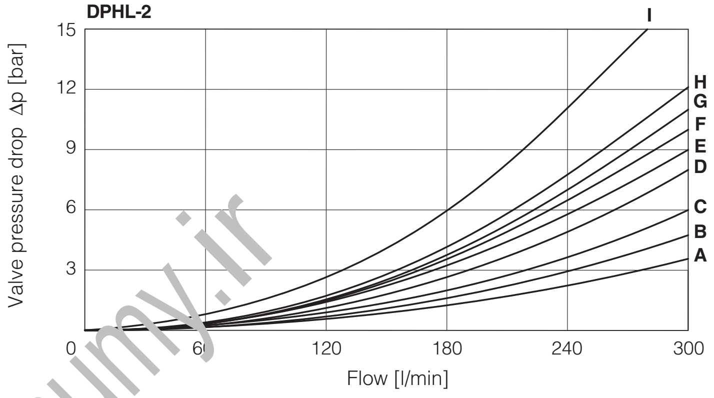
DPHL-1

Spool type	Flow direction				
	P→A	P→B	A→T	B→T	P→T
0/2, 1/2	D	E	D	C	-
0	D	E	C	C	E
1	A	B	D	C	-
3, 6, 7	A	B	C	C	-
4, 4/8	B	C	D	D	-
5, 58	A	E	C	C	F



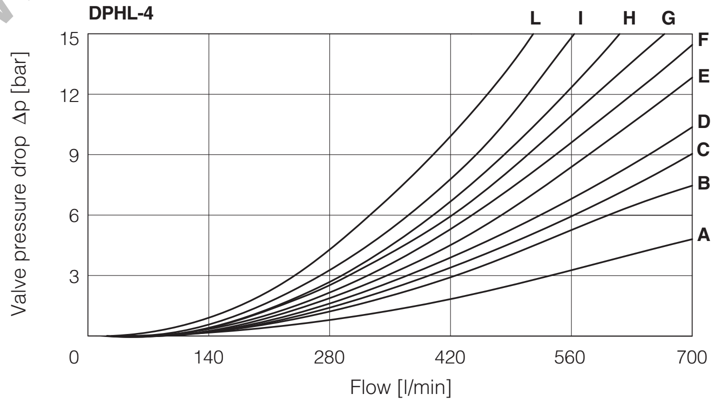
DPHL-2

Spool type	Flow direction				
	P→A	P→B	A→T	B→T	P→T
0/2, 1, 3, 6, 7, 8	A	A	C	D	-
1/1, 1/2, 7/1	B	B	D	E	-
0	A	A	D	E	C
0/1	A	A	D	-	-
2	A	A	-	-	-
2/2	B	B	-	-	-
3/1	A	A	D	D	-
4	C	C	H	I	F
4/8	C	C	G	I	F
5	A	B	F	H	G
5/1	A	B	D	F	-
6/1	B	B	C	E	-
09	A	-	-	G	-
16	A	C	D	F	-
17	C	A	E	F	-
19	C	-	-	G	-
39	C	-	-	H	-
49	-	D	-	-	-
58	B	A	F	H	H
58/1	B	A	D	F	-
90	A	A	E	-	D
91	C	C	E	-	-
93	-	C	D	-	-
94	D	-	-	-	-



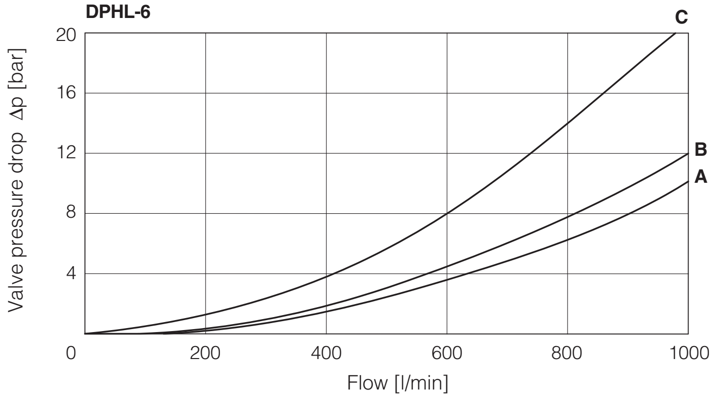
DPHL-4

Spool type	Flow direction				
	P→A	P→B	A→T	B→T	P→T
1	B	B	B	D	-
1/1	D	E	E	F	-
1/2	E	D	B	C	-
0	D	C	D	E	F
0/1, 3/1, 5/1, 6, 7	D	D	D	F	-
0/2	D	D	D	E	-
2	B	B	-	-	-
2/2	E	D	-	-	-
3	B	B	D	F	-
4	C	C	H	L	L
5	A	D	D	D	H
6/1	D	E	D	F	-
7/1	D	E	F	F	-
8	D	D	E	F	-
09	D	-	-	F	F
16	C	D	E	F	-
17	E	D	E	F	-
19	F	-	-	E	-
39	G	F	-	F	-
58	E	A	B	F	H
58/1	E	D	D	F	-
90	D	D	D	-	F
91	F	F	D		
93	-	G	D	-	-



DPHL-6

Spool type	Flow direction				
	P→A	P→B	A→T	B→T	P→T
0, 0/2	A	A	B	B	B
1, 1/2	A	A	A	B	-
3, 6, 7	A	A	A	B	-
4, 5, 58	A	A	C	C	C



10 OPERATING LIMITS

For a correct valve operation do not exceed the max recommended flow rates (l/min) shown in the below tables

DPHL-1

Spool	**Inlet pressure** [bar]			
	70	**160**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7	160	160	160	145
4, 4/8	160	160	135	100
5, 58	160	160	145	110
0/1, 0/2, 1/2	160	160	145	135

DPHL-2

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7, 8	300	300	300	300
2, 4, 4/8	300	300	240	140
5	260	220	180	100
0/1, 0/2, 1/2	300	250	210	180
16, 17, 56, *9, 9*	300	300	270	200

DPHL-4

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
1, 6, 7, 8	700	700	700	600
2, 4, 4/8	500	500	450	400
5, 0/1, 0/2, 1/2	600	520	400	300
0, 3	700	700	600	540
16, 17, 58, *9, 9*	500	500	500	450

DPHL-6

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
1, 3, 6, 7, 8	1000	950	850	700
0	950	900	800	650
2, 4, 4/8, 5	850	800	700	450
0/1, 58, 19, 91	950	850	650	450

11 SWITCHING TIMES (average values in m sec)

			Piloting pressure					
			70 bar		140 bar		250 bar	
Valve model	Configuration		Alternating current	Direct current	Alternating current	Direct current	Alternating current	Direct current
DPHL-1	71, 61, 67, 61*/A, 67*/A	Switch ON	35	50	30	45	20	35
		Switch OFF	50					
	63, 63*/A	Switch ON	50	75	40	65	30	50
		Switch OFF	80					
DPHL-2	71, 61, 67, 61*/A, 67*/A	Switch ON	40	55	30	50	20	40
		Switch OFF	60					
	63, 63*/A	Switch ON	55	80	45	70	35	55
		Switch OFF	95					
DPHL-4	71, 61, 67, 61*/A, 67*/A	Switch ON	60	80	45	60	30	45
		Switch OFF	80					
	63, 63*/A	Switch ON	95	115	75	95	50	65
		Switch OFF	130					
DPHL-6	71, 61, 67, 61*/A, 67*/A	Switch ON	70	95	55	70	40	55
		Switch OFF	150					
	63, 63*/A	Switch ON	115	145	95	110	70	90
		Switch OFF	280					

Notes:

1) For configuration 75, times of switching ON and switching OFF are the same: this value is equal to time of switch ON of configuration 63.

2) TEST CONDITIONS
- Nominal voltage supply DC (direct) and AC (alternating) with connector type SP-666. The use of other connectors can affect the switching time;
- 2 bar of counter pressure on port T;
- mineral oil: ISO VG 46 at 50°C

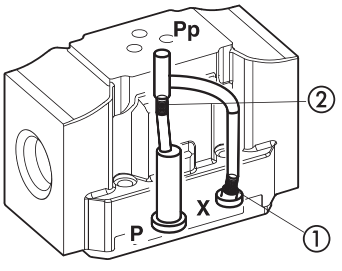
3) The response time is affected by elasticity of the hydraulic circuit, by variation of hydraulic characteristics and temperature.

12 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

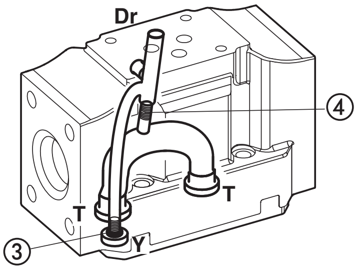
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain

DPHL-1

Pilot channels



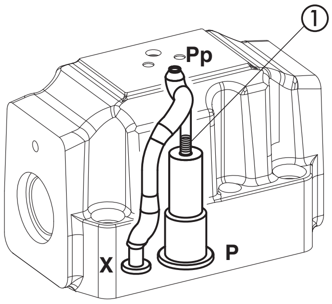
Drain channels



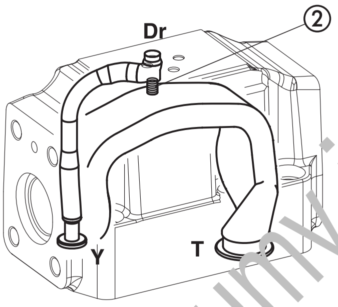
Internal piloting: blinded plug SP-X300F ① in X;
plug SP-X310F ② in Pp;
External piloting: blinded plug SP-X300F ② in Pp;
plug SP-X310F ① in X;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPHL-2

Pilot channels

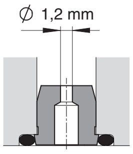


Drain channels



Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

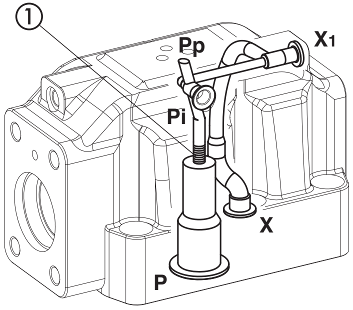
Option L9
This option provides a calibrated restrictor PLUG-H-12A (Ø 1,2 mm) in the P port of the pilot valve



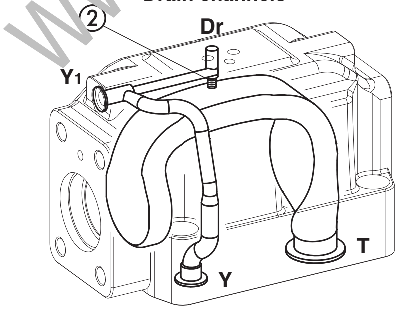
PLUG-12A

DPHL-4

Pilot channels

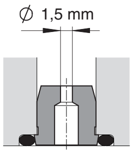


Drain channels



Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

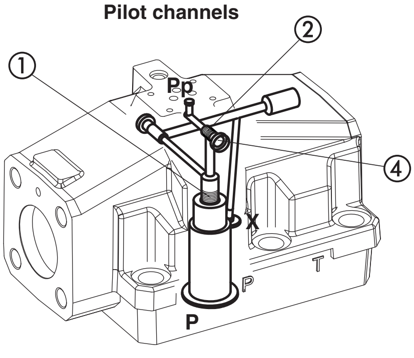
Option L9
This option provides a a calibrated restrictor PLUG-H-15A (Ø 1,5 mm) in the P port of the pilot valve



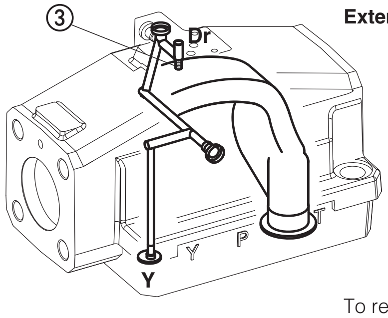
PLUG-15A

DPHL-6

Pilot channels



Drain channels



Internal piloting: Without plug ①;
plug SP-X325A in pos ②;
External piloting: Add DIN-908 M16x1,5 in pos ①;
plug SP-X325A in pos ②;
Internal drain: Without blinded plug SP-X300F ③;
External drain: Add blinded plug SP-X300F ③.

To reach the orifice ②, remove plug ④ = G 1/8"

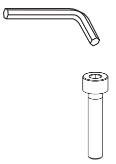
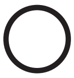
13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)
E-SD = electronic connector which eliminates electric disturbances when solenoid valves are de-energized

14 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

<table>
<tr><td>Seals, reccomended fluid temperature</td><td colspan="3">NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C
FKM seals (/PE option) = -20°C ÷ +80°C</td></tr>
<tr><td>Recommended viscosity</td><td colspan="3">15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s</td></tr>
<tr><td>Max fluid contamination level</td><td colspan="3">ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog</td></tr>
<tr><th>Hydraulic fluid</th><th>Suitable seals type</th><th>Classification</th><th>Ref. Standard</th></tr>
<tr><td>Mineral oils</td><td>NBR, FKM</td><td>HL, HLP, HLPD, HVLP, HVLPD</td><td>DIN 51524</td></tr>
<tr><td>Flame resistant without water</td><td>FKM</td><td>HFDU, HFDR</td><td rowspan="2">ISO 12922</td></tr>
<tr><td>Flame resistant with water</td><td>NBR</td><td>HFC</td></tr>
</table>

15 FASTENING BOLTS AND SEALS

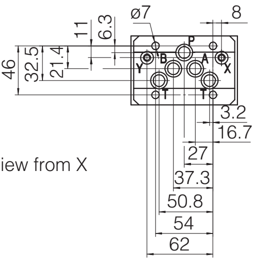
	DPHL-1	DPHL-2	DPHL-4	DPHL-6
	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm	**Fastening bolts:** 4 socket head screws M10x50 class 12.9 Tightening torque = 70 Nm 2 socket head screws M6x45 class 12.9 Tightening torque = 15 Nm	**Fastening bolts:** 6 socket head screws M12x60 class 12.9 Tightening torque = 125 Nm	**Fastening bolts:** 6 socket head screws M20x80 class 12.9 Tightening torque = 600 Nm
	**Seals:** 5 OR 2050 Diameter of ports A, B, P, T: Ø 11 mm (max) 2 OR 108 Diameter of ports X, Y: Ø 5 mm (max)	**Seals:** 4 OR 130 Diameter of ports A, B, P, T: Ø 20 mm (max) 2 OR 2043 Diameter of ports X, Y: Ø 7 mm (max)	**Seals:** 4 OR 4112 Diameter of ports A, B, P, T: Ø 24 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø 7 mm (max)	**Seals:** 4 OR 144 Diameter of ports A, B, P, T: Ø 34 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø 7 mm (max)

16 INSTALLATION DIMENSIONS [mm]

DPHL-1*

ISO 4401: 2005
Mounting surface: 4401-05-05-0-05

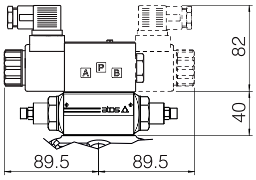
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

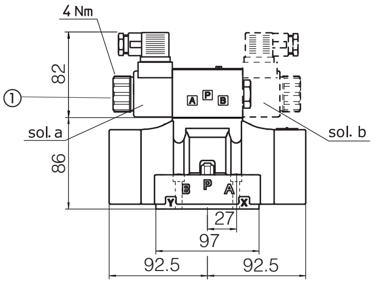


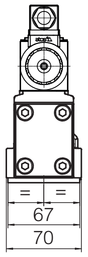
View from X

Mass (Kg)	
DPHL-16	6,9
DPHL-17	7,3
Option H, H9	+1,0

DPHL-1*/H
/H9





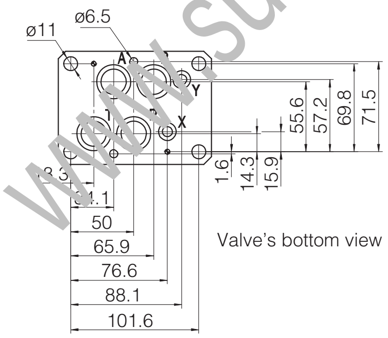


① Standard manual override PIN
Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHL-2*

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05

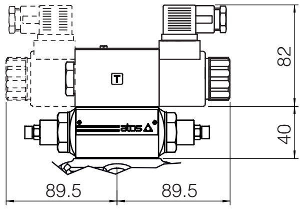
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



Valve's bottom view

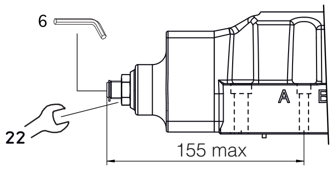
Mass (Kg)	
DPHL-26	9,7
DPHL-27	9,9
Option /S	+1,0
Option H, H9	+1,0

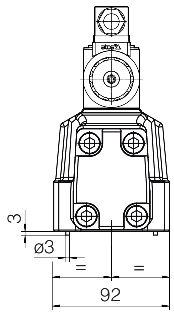
DPHL-2*/H

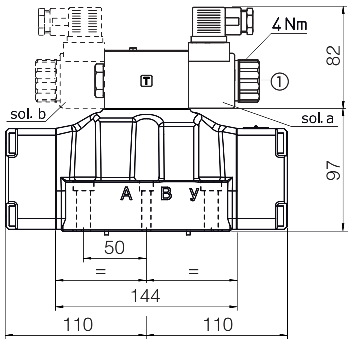


DPHL-2*

Stroke adjustment device for option /S





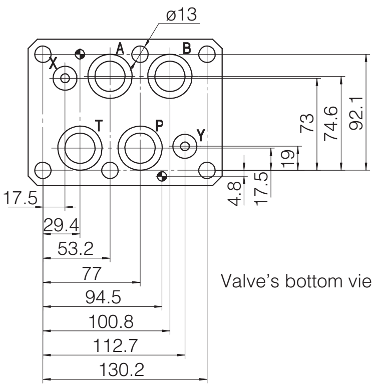


① Standard manual override PIN
Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHL-4*

ISO 4401: 2005
Mounting surface: 4401-10-09-0-05

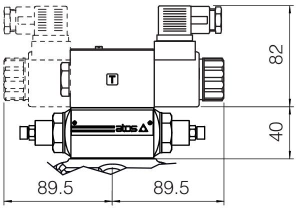
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

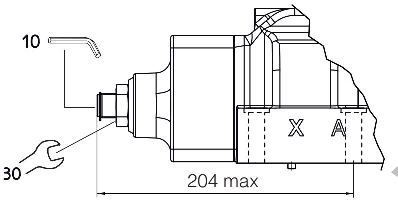


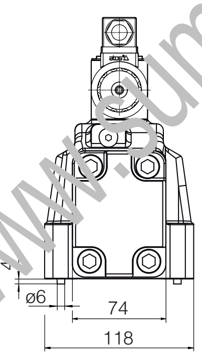
Valve's bottom view

Mass (Kg)	
DPHL-46	17,2
DPHL-47	17,4
Option /S	+1,5
Option H, H9	+1,0

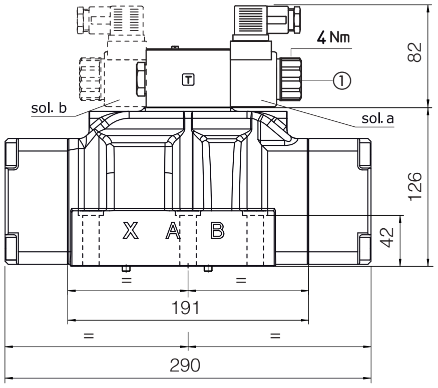
DPHL-4*/H







DPHL-4*



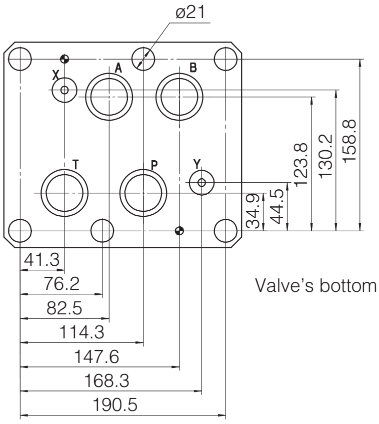
① Standard manual override PIN

Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHL-6*

ISO 4401: 2005
Mounting surface: 4401-10-09-0-05

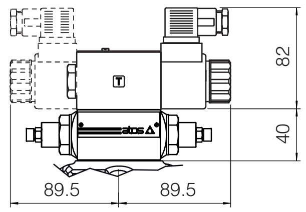
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



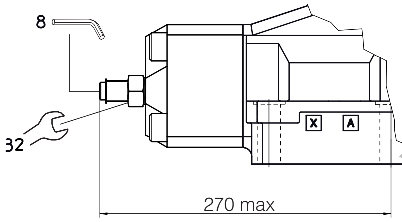
Valve's bottom view

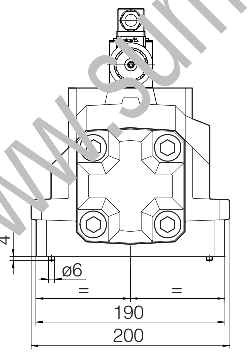
Mass (Kg)	
DPHL-66	44
DPHL-67	44,5
Option /S	+3,5
Option H, H9	+1,0

DPHL-6*/H
/H9

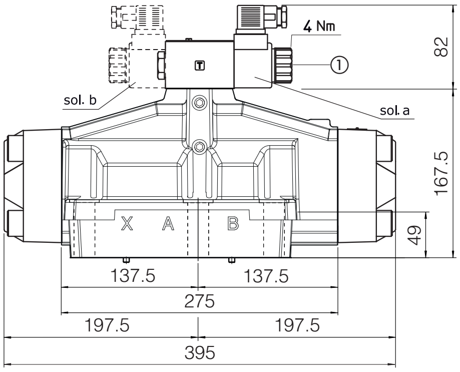


Stroke adjustment device for option/S





DPHL-6*



① Standard manual override PIN

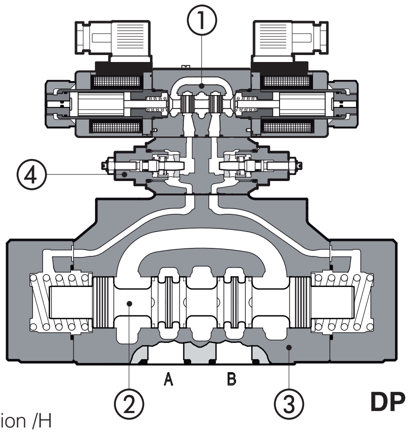
Overall dimensions refer to valves **DC** voltage, with connectors type 666

17 MOUNTING SUBPLATES

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y	A, B, P, T	X, Y	
DPHL-1	BA-428	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	5,6
DPHL-1	BA-434	Ports P, T, X, Y underneath; ports A, B on lateral side	G 3/4"	G 1/4"	36,5	21,5	5,5
DPHL-2	BA-418	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	3,5
DPHL-2	BA-518	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	8
DPHL-2	BA-519	Ports P, T, X, Y underneath; ports A, B on lateral side	G 1"	G 1/4"	46	21,5	8
DPHL-4	BA-508	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	7
DPHL-4	BA-509	Ports P, T, X, Y underneath; ports A, B on lateral	G 1"	G 1/4"	46	21,5	12,5
DPHL-6	BA-708	Ports A, B, P, T, X, Y underneath;	G 1 1/2"	G 1/4"	63,5	21,5	17

Solenoid directional valves type DPHE

piloted, spool type



① Solenoid pilot valve
② Main spool
③ Main body
④ Adjustable chokes - option /H

DPHE-471*/H

Spool type, pilot operated directional solenoid valves available in 4/3, 4/2, 3/2 way versions.
They are operated by a directional valve ① type DHE (see tech. table E015) equipped with high performance solenoids for AC or DC power supply, certified according to North American standard **cURus**.
Spools ② are fully interchangeable and they are available in a wide range of hydraulic configurations.
The valve body is made by shell-moulding castings ③ with wide internal passages ensuring low pressure drops.

Mounting surface: **ISO 4401, size 10, 16, 25, 32**
Max flow: **160, 300, 700, 1000 l/min.**
Max pressure: **350 bar**

1 MODEL CODE

DPH **E** - **2** **61** **1** / **A** - **X** **24 DC** ***** / *****

Piloted directional valve

Solenoid pilot valve:
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

Valve size:
1 = 10 **2** = 16 **4** = 25 **6** = 32

Valve configuration, see section 2
61= single solenoid, center plus external position, spring centered
63= single solenoid, 2 external positions, spring offset
67= single solenoid, center plus external position, spring offset
70= double solenoid, 2 external positions, without springs
71= double solenoid, 3 positions, spring centered
75= double solenoid, 2 external positions, with detent

Spool type, see section 2.

Options, see note 1 at section 7

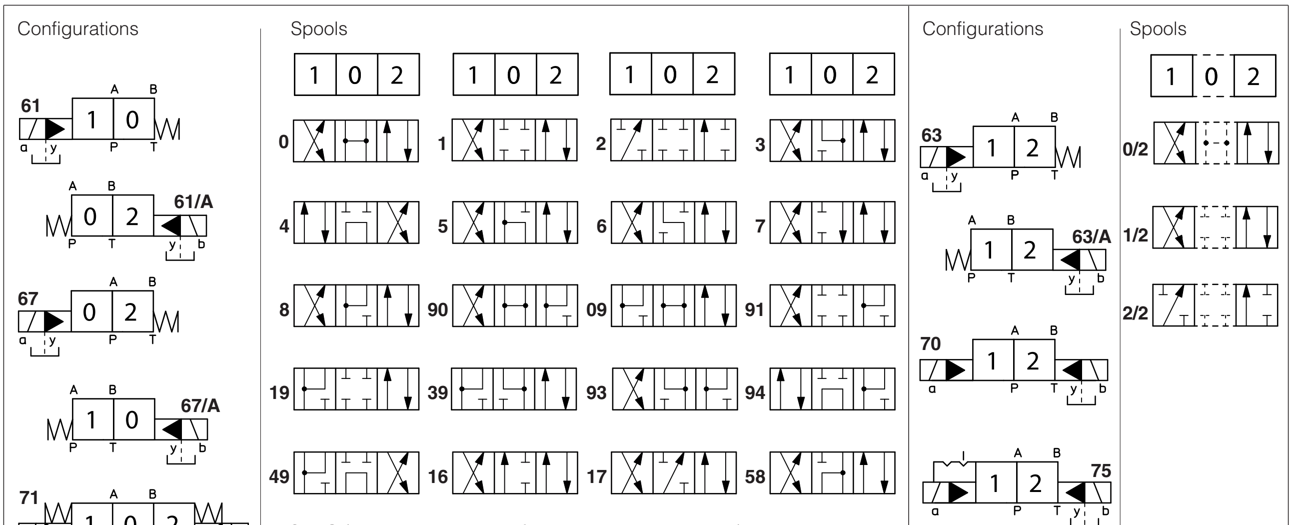
00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 13 for available connectors, to be ordered separately

Voltage code, see section 6

Series number

Seals material, see section 14 :
- = NBR
PE = FKM
BT = HNBR

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



NOTES (see also section 7,2 for special shaped spools):
- For **DP*-1** are available only spools: **0, 0/2, 1, 1/2, 3, 4, 5, 58, 6, 7**
- For **DP*-6** are available only spools: **0, 1, 1/2, 2, 3, 4, 5, 58, 6, 7, 8, 19, 91**

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years, for further details see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
Rated flow	See Q/Δp diagram at section 9 and operating limits at section 10
Max flow	DPHE-1: **160 l/min;** DPHE-2: **300 l/min;** DPHE-4: **700 l/min;** DPHE-6: **1000 l/min** see rated flow at section 9 and operating limits at section 10

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occurring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** with connectors correctly assembled
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%

6 COIL VOLTAGE

Valve code	External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil DHE
DPHE	12 DC	**12 DC**	666 or 667	30 W	COE-12DC
	14 DC	**14 DC**			COE-14DC
	24 DC	**24 DC**			COE-24DC
	28 DC	**28 DC**			COE-28DC
	48 DC	**48 DC**			COE-48DC
	110 DC	**110 DC**			COE-110DC
	125 DC	**125 DC**			COE-125DC
	220 DC	**220 DC**			COE-220DC
	24/50 AC	**24/50/60 AC**		58 VA (3)	COE-24/50/60AC (1)
	48/50 AC	**48/50/60 AC**			COE-48/50/60AC (1)
	110/50 AC	**110/50/60 AC**			COE-110/50/60AC (1)
	230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
	115/50 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
	230/50 AC	**230/60 AC**			COE-230/60AC
	110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
	230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

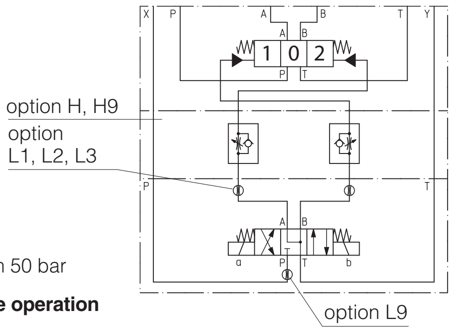
7 OPTIONS

7.1 Options

/A = Solenoid mounted at side of port A of main body (only for single solenoid valves).
In standard version, solenoid is mounted at side of port B.
/D = Internal drain (standard configuration is external drain)
/E = External pilot pressure (standard configuration is internal pilot pressure).
/FV = With proximity switch for spool position monitoring: see tab. EY030.
/R = Pilot pressure generator (4 bar on port P - not for DPHE-1, see section 9.
/S = Main spool stroke adjustment (not for DPHE-1).
/WP = Prolonged manual override protected by rubber cap.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar

FUNCTIONAL SCHEME (config. 71)
example of switching control options



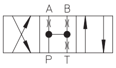
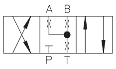
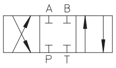
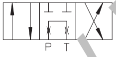
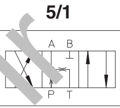
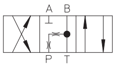
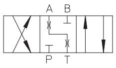
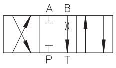
Devices for main spool switching control and to reduce the hydraulic shocks at the valve operation

/H = Adjustable chokes (meter-out to the pilot chambers of the main valve).
/H9 = Adjustable chokes (meter-in to the pilot chambers of the main valve).
/L1, /L2, /L3 = calibrated restrictors on A and B ports of the pilot valve: **L1** =0,8mm, **L2** =1mm, **L3** =1,25mm)
/L9 = (only for DPHE-2 and DPHE-4) plug with calibrated restictor in P port of pilot valve - see section 10
Suggested for pilot pressure higher than 210 bar or to limit the hydraulics shocks caused by the fast main spool switching

7.2 Special shaped spools

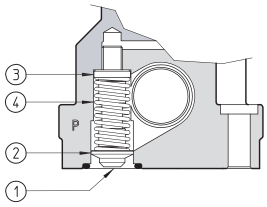
- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4, 5, 58, 6** and **7** are also available as **1/1, 4/8, 5/1, 58/1, 6/1** and **7/1** that are properly shaped to reduce water-hammer shocks during the switching (to use with option /L*).

Shaped spool availability

Shaped spool type	**0/1**	**3/1**	**1/1**	**4/8**	**5/1**	**58/1**	**6/1**	**7/1**
Hydraulic symbol								
DPHE-1	●	●		●				
DPHE-2, DPHE-4	●	●	●	●	●	●	●	●
DPHE-6		●	●	●				

8 PILOT PRESSURE GENERATOR (OPTION /R)

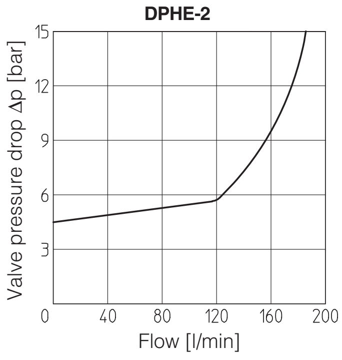
The device **/R** generates an additional pressure drop, in order to ensure the minimum pilot pressure, for correct operation of the valves with internal pilot and fitted with spools type **0, 0/1, 4, 4/8, 5, 58, 09, 90, 94, 49.** The device **/R** has to be fitted when the pressure drop in the valve, verified on flow versus pressure diagrams, is lower than the minimum pilot pressure value.

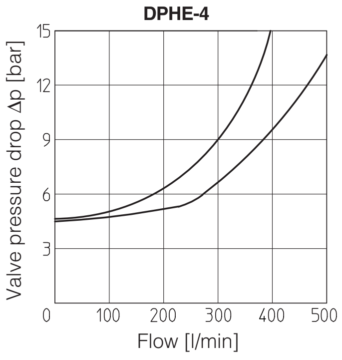


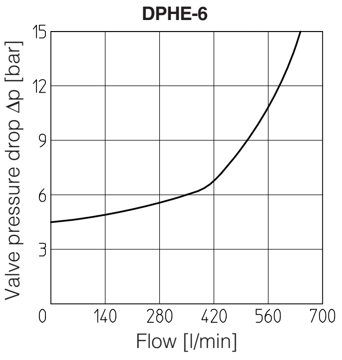
① Flapper-guide
② Flapper
③ Spring stop-washer
④ Spring

Ordering code of spare pilot pressure generator

R/DP	-	*
Pilot pressure generator		Size: **2** for DPHE-2 **4** for DPHE-4 **6** for DPHE-6


DPHE-2

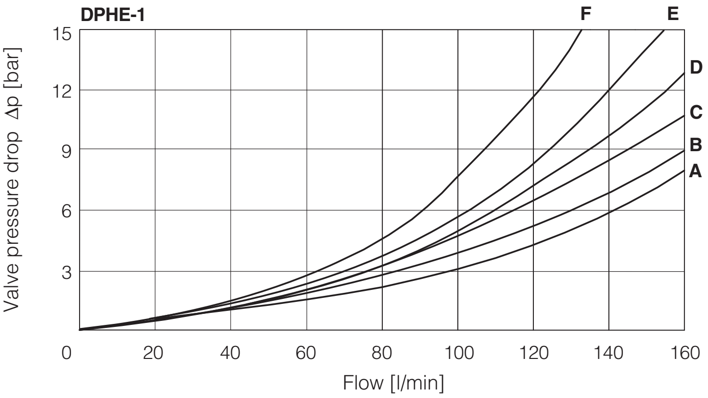

DPHE-4


DPHE-6

9 FLOW VERSUS PRESSURE DIAGRAMS Based on mineral oil ISO VG 46 at 50°C

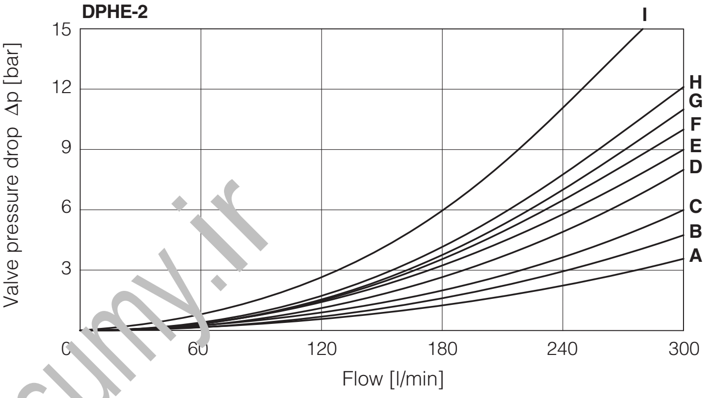
DPHE-1

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0/2, 1/2	D	E	D	C	-
0	D	E	C	C	E
1	A	B	D	C	-
3, 6, 7	A	B	C	C	-
4, 4/8	B	C	D	D	-
5, 58	A	E	C	C	F



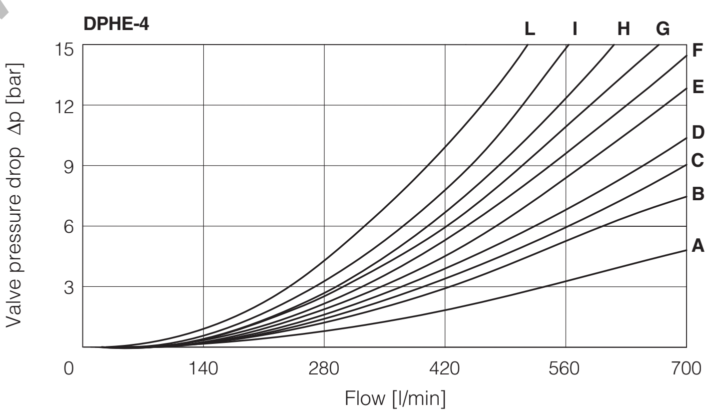
DPHE-2

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0/2, 1, 3, 6, 7, 8	A	A	C	D	-
1/1, 1/2, 7/1	B	B	D	E	-
0	A	A	D	E	C
0/1	A	A	D	-	-
2	A	A	-	-	-
2/2	B	B	-	-	-
3/1	A	A	D	D	-
4	C	C	H	I	F
4/8	C	C	G	I	F
5	A	B	F	H	G
5/1	A	B	D	F	-
6/1	B	B	C	E	-
09	A	-	-	G	-
16	A	C	D	F	-
17	C	A	E	F	-
19	C	-	-	G	-
39	C	-	-	H	-
49	-	D	-	-	-
58	B	A	F	H	H
58/1	B	A	D	F	-
90	A	A	E	-	D
91	C	C	E	-	-
93	-	C	D	-	-
94	D	-	-	-	-



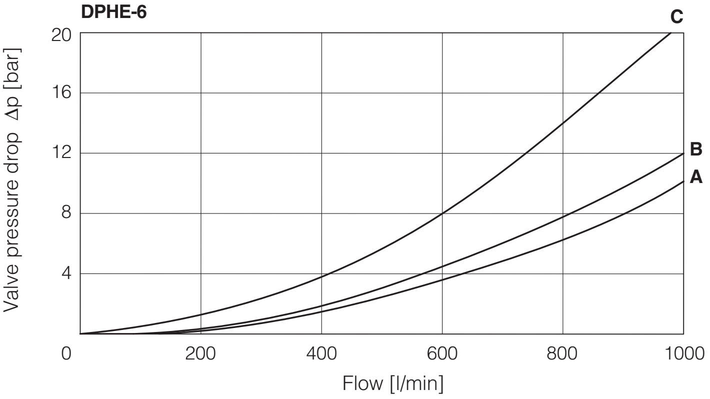
DPHE-4

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
1	B	B	B	D	-
1/1	D	E	E	F	-
1/2	E	D	B	C	-
0	D	C	D	E	F
0/1, 3/1, 5/1, 6, 7	D	D	D	F	-
0/2	D	D	D	E	-
2	B	B	-	-	-
2/2	E	D	-	-	-
3	B	B	D	F	-
4	C	C	H	L	L
5	A	D	D	D	H
6/1	D	E	D	F	-
7/1	D	E	F	F	-
8	D	D	E	F	-
09	D	-	-	F	F
16	C	D	E	F	-
17	E	D	E	F	-
19	F	-	-	E	-
39	G	F	-	F	-
58	E	A	B	F	H
58/1	E	D	D	F	-
90	D	D	D	-	F
91	F	F	D		
93	-	G	D	-	-



DPHE-6

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0	A	A	B	B	B
1	A	A	A	B	-
3	A	-	A	B	-
4	A	A	C	C	C



10 OPERATING LIMITS

For a correct valve operation do not exceed the max recommended flow rates (l/min) shown in the below tables

DPHE-1

Spool	**Inlet pressure** [bar]			
	70	**160**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7	160	160	160	145
4, 4/8	160	160	135	100
5, 58	160	160	145	110
0/1, 0/2, 1/2	160	160	145	135

DPHE-2

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7, 8	300	300	300	300
2, 4, 4/8	300	300	240	140
5	260	220	180	100
0/1, 0/2, 1/2	300	250	210	180
16, 17, 56, *9, 9*	300	300	270	200

DPHE-4

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
1, 6, 7, 8	700	700	700	600
2, 4, 4/8	500	500	450	400
5, 0/1, 0/2, 1/2	600	520	400	300
0, 3	700	700	600	540
16, 17, 58, *9, 9*	500	500	500	450

DPHE-6

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
1, 3, 6, 7, 8	1000	950	850	700
0	950	900	800	650
2, 4, 4/8, 5	850	800	700	450
0/1, 58, 19, 91	950	850	650	450

11 SWITCHING TIMES (average values in m sec)

			Piloting pressure					
			70 bar		140 bar		250 bar	
Valve model	Configuration		Alternating current	Direct current	Alternating current	Direct current	Alternating current	Direct current
DPHE-1	71, 61, 67, 61*/A, 67*/A	Switch ON	35	50	30	45	20	35
		Switch OFF	50					
	63, 63*/A	Switch ON	50	75	40	65	30	50
		Switch OFF	80					
DPHE-2	71, 61, 67, 61*/A, 67*/A	Switch ON	40	55	30	50	20	40
		Switch OFF	60					
	63, 63*/A	Switch ON	55	80	45	70	35	55
		Switch OFF	95					
DPHE-4	71, 61, 67, 61*/A, 67*/A	Switch ON	60	80	45	60	30	45
		Switch OFF	80					
	63, 63*/A	Switch ON	95	115	75	95	50	65
		Switch OFF	130					
DPHE-6	71, 61, 67, 61*/A, 67*/A	Switch ON	70	95	55	70	40	55
		Switch OFF	150					
	63, 63*/A	Switch ON	115	145	95	110	70	90
		Switch OFF	280					

Notes:

1) For configuration 75, times of switching ON and switching OFF are the same: this value is equal to time of switch ON of configuration 63.

2) TEST CONDITIONS
- Nominal voltage supply DC (direct) and AC (alternating) with connector type SP-666. The use of other connectors can affect the switching time;
- 2 bar of counter pressure on port T;
- mineral oil: ISO VG 46 at 50°C

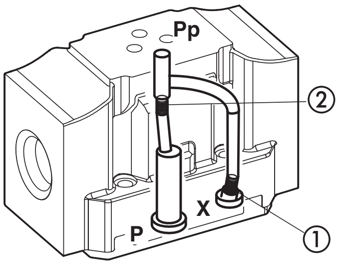
3) The response time is affected by elasticity of the hydraulic circuit, by variation of hydraulic characteristics and temperature.

12 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

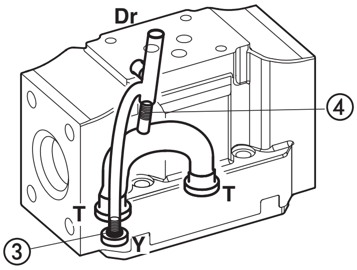
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain

DPHE-1

Pilot channels



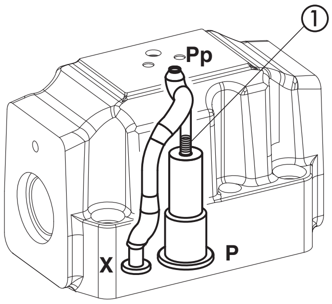
Drain channels



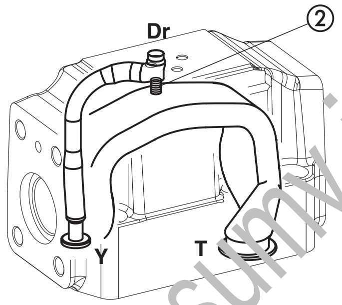
Internal piloting: blinded plug SP-X300F ① in X;
plug SP-X310F ② in Pp;
External piloting: blinded plug SP-X300F ② in Pp;
plug SP-X310F ① in X;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPHE-2

Pilot channels



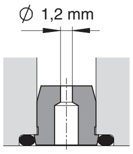
Drain channels



Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

Option L9

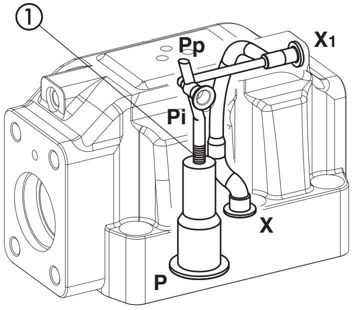
This option provides a calibrated restrictor PLUG-H-12A (Ø 1,2 mm) in the P port of the pilot valve



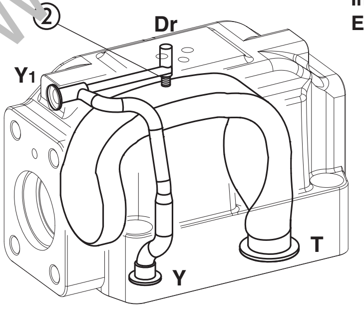
PLUG-12A

DPHE-4

Pilot channels



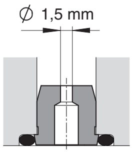
Drain channels



Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

Option L9

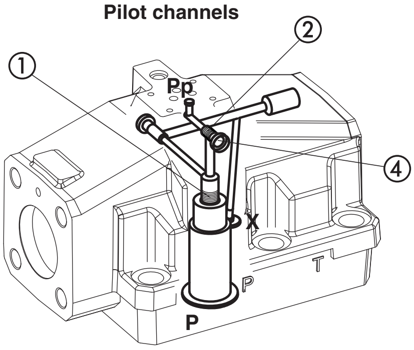
This option provides a a calibrated restrictor PLUG-H-15A (Ø 1,5 mm) in the P port of the pilot valve



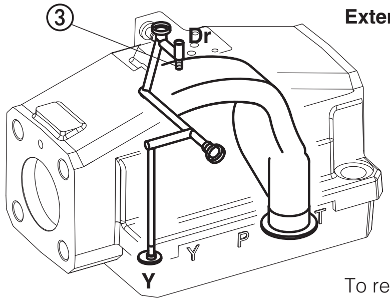
PLUG-15A

DPHE-6

Pilot channels



Drain channels



Internal piloting: Without plug ①;
plug SP-X325A in pos ②;
External piloting: Add DIN-908 M16x1,5 in pos ①;
plug SP-X325A in pos ②;
Internal drain: Without blinded plug SP-X300F ③;
External drain: Add blinded plug SP-X300F ③.

To reach the orifice ②, remove plug ④ = G 1/8”

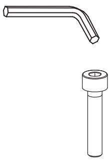
13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)
E-SD = electronic connector which eliminates electric disturbances when solenoid valves are de-energized

14 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

15 FASTENING BOLTS AND SEALS

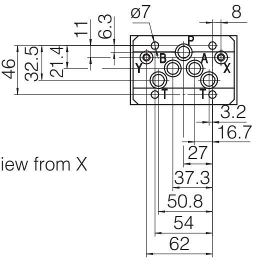
	DPHE-1	DPHE-2	DPHE-4	DPHE-6
	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm	**Fastening bolts:** 4 socket head screws M10x50 class 12.9 Tightening torque = 70 Nm 2 socket head screws M6x45 class 12.9 Tightening torque = 15 Nm	**Fastening bolts:** 6 socket head screws M12x60 class 12.9 Tightening torque = 125 Nm	**Fastening bolts:** 6 socket head screws M20x80 class 12.9 Tightening torque = 600 Nm
	**Seals:** 5 OR 2050 Diameter of ports A, B, P, T: Ø 11 mm (max) 2 OR 108 Diameter of ports X, Y: Ø 5 mm (max)	**Seals:** 4 OR 130 Diameter of ports A, B, P, T: Ø 20 mm (max) 2 OR 2043 Diameter of ports X, Y: Ø 7 mm (max)	**Seals:** 4 OR 4112 Diameter of ports A, B, P, T: Ø 24 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø 7 mm (max)	**Seals:** 4 OR 144 Diameter of ports A, B, P, T: Ø 34 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø 7 mm (max)

INSTALLATION DIMENSIONS [mm]

DPHE-1*

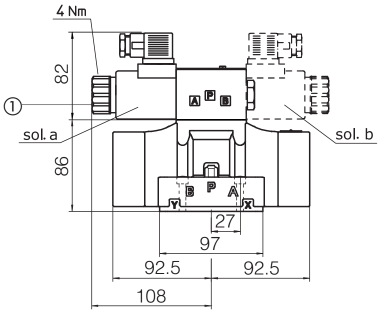
ISO 4401: 2005
Mounting surface: 4401-05-05-0-05

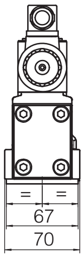
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



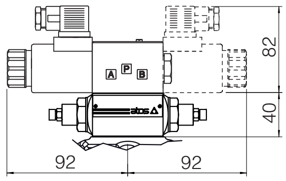
View from X

Mass (Kg)	
DPHE-16	6,9
DPHE-17	7,3
Option H, H9	+1,0





DPHE-1*/H
/H9



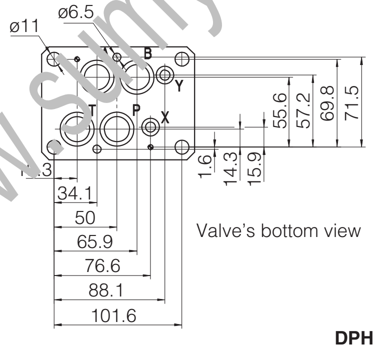
① Standard manual override PIN

Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHE-2*

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05

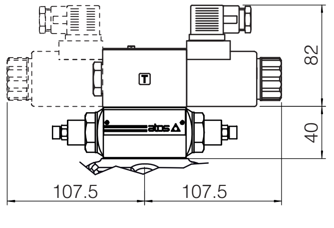
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



Valve's bottom view

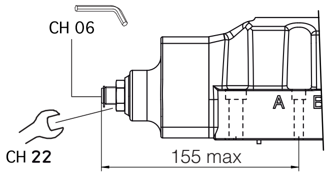
Mass (Kg)	
DPHE-26	9,9
DPHE-27	10,3
Option /S	+1,0
Option H, H9	+1,0

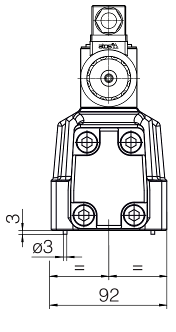
DPHE-2*/H
/H9

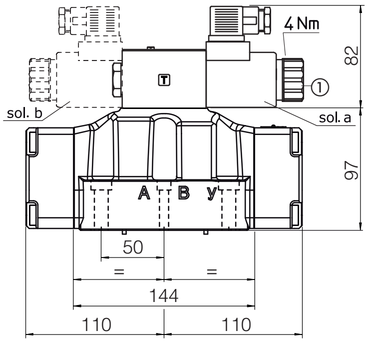


DPHE-2*

Stroke adjustment device for option /S







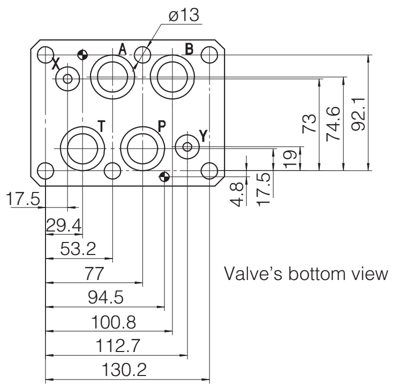
① Standard manual override PIN

Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHE-4*

ISO 4401: 2005
Mounting surface: 4401-08-08-0-05 (see table P005)

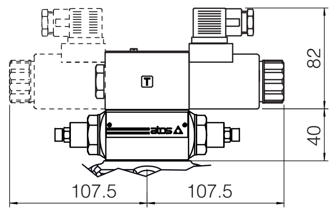
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



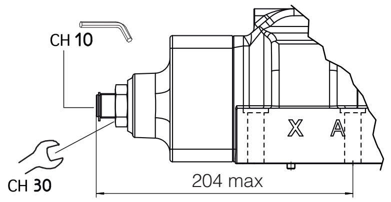
Valve's bottom view

Mass (Kg)	
DPHE-46	17,4
DPHE-47	17,8
Option /S	+1,5
Option H, H9	+1,0

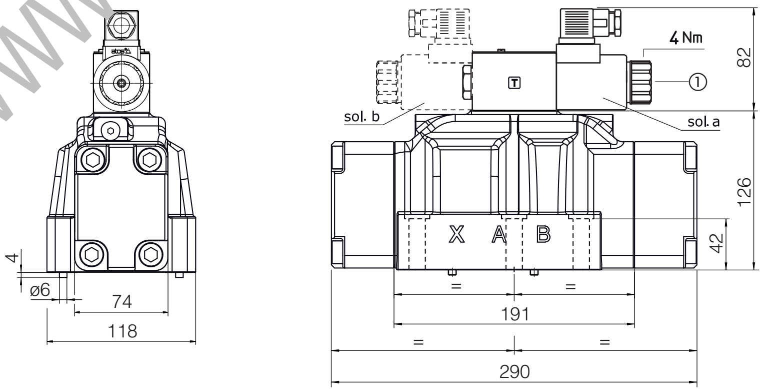
DPHE-4*/H
/H9



Stroke adjustment device for option /S



DPHE-4*



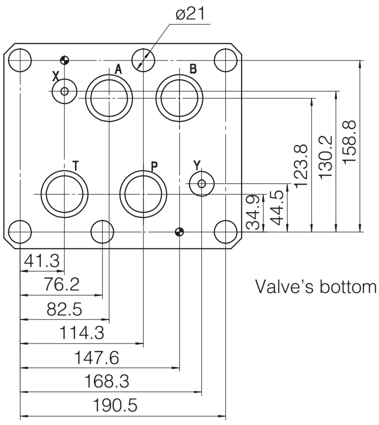
① Standard manual override PIN

Overall dimensions refer to valves **DC** voltage, with connectors type 666

DPHE-6*

ISO 4401: 2005
Mounting surface: 4401-10-09-0-05

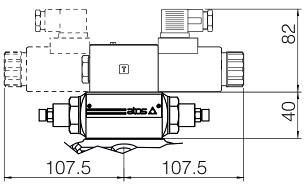
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT



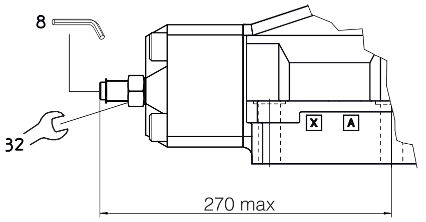
Valve's bottom view

Mass (Kg)	
DPHE-66	44
DPHE-67	44,5
Option /S	+3,5
Option H, H9	+1,0

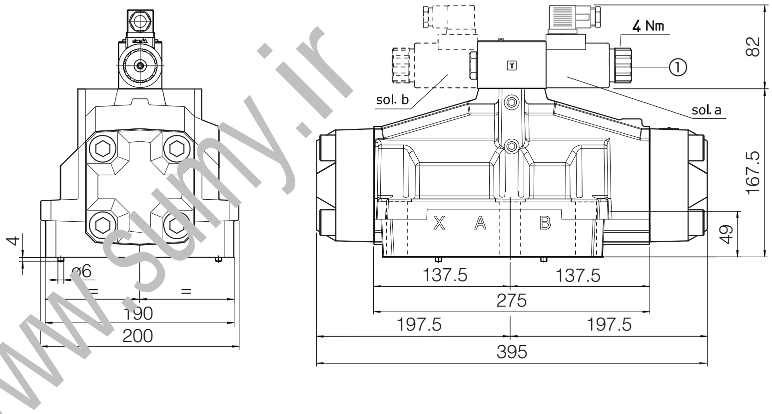
DPHE-6*/H
/H9



Stroke adjustment device for option/S



DPHE-6*



① Standard manual override PIN

Overall dimensions refer to valves **DC** voltage, with connectors type 666

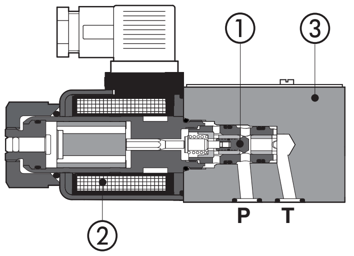
17 MOUNTING SUBPLATES

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y	A, B, P, T	X, Y	
DPHE-1	BA-428	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	5,6
DPHE-1	BA-434	Ports P, T, X, Y underneath; ports A, B on lateral side	G 3/4"	G 1/4"	36,5	21,5	5,5
DPHE-2	BA-418	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	3,5
DPHE-2	BA-518	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	8
DPHE-2	BA-519	Ports P, T, X, Y underneath; ports A, B on lateral side	G 1"	G 1/4"	46	21,5	8
DPHE-4	BA-508	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	7
DPHE-4	BA-509	Ports P, T, X, Y underneath; ports A, B on lateral	G 1"	G 1/4"	46	21,5	12,5
DPHE-6	BA-708	Ports A, B, P, T, X, Y underneath;	G 1 1/2"	G 1/4"	63,5	21,5	17

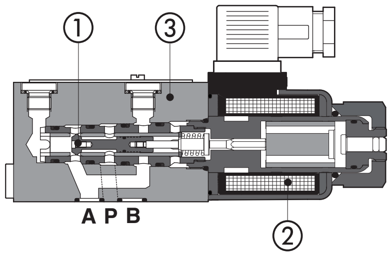
Solenoid directional valves type DLEH and DLEHM

direct, poppet type, leak free

C€



DLEH-2A



DLEHM-3A

Poppet type ① direct operated valves, designed for applications in oil hydraulic systems with leak free requirements.

Following models are available in a wide range of configurations, see section 2

size 06 subplate version
- **DLEH**: two and three way execution, Qmax 12 l/min
- **DLEHM**: three way execution, Qmax 30 l/min

M20 screw-in cartridge version for easy assembling in hydraulic blocks
- **CART LEH**: two and three way execution, Qmax 12 l/min
- **CART LEHM**: three way execution, Qmax 30 l/min

They are operated by wet type, screwed solenoids ② for DC or RC (rectified) current supply and certified according to the North American standard **cURus**

Standard coils protection **IP65**

Max flow:	**12 l/min (DLEH, LEH)** **30 l/min (DLEHM, LEHM)**
Max pressure:	**350 bar (DLEH, LEH)** **315 bar (DLEHM, LEHM)**

1 MODEL CODE

DLEH - **2** **A** / **WP** - **X** **24 DC** ***** / *****

Directional control valve poppet type:
DLEH = ISO size 06, max flow: 12 l/min
DLEHM = ISO size 06, max flow: 30 l/min
CART LEH = cartridge version max flow12 l/min
CART LEHM = cartridge version max flow 30 l/min

2 = two way (only DLEH and LEH)
3 = three way

Valve configuration, see table 2

Options, see section 4

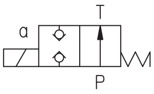
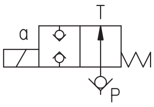
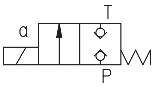
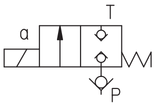
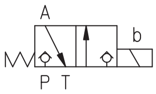
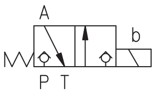
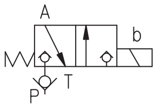
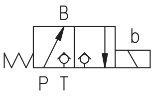
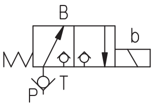
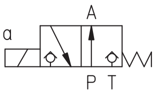
00-DC = DC solenoids without coils
X = without connector
See section 5 for available connectors, to be ordered separately

Voltage code, see section 6

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 VALVE CONFIGURATION

DLEH-2A **CART LEH-2A** 	**DLEH-2A/R** 	**DLEH-2C** **CART LEH-2C** 	**DLEH-2C/R** 	**DLEHM-3A** **CART LEHM-3A** 
DLEH-3A **CART LEH-3A** 	**DLEH-3A/R** 	**DLEH-3C** **CART LEH-3C** 	**DLEH-3C/R** 	**DLEHM-3C** **CART LEHM-3C** 

3 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	
Flow direction	As shown in the symbols of table 2		
Operating pressure	DLEH, LEH: Ports P, A, B **350 bar**; DLEHM, LEHM: Ports P, A **315 bar**; Port T **210** bar;		
Rated flow	See diagrams Q/Δp at section 7		
Max flow	DLEH, LEH: **12 l/min**, DLEHM, LEHM: **30 l/min**, see operating limits at section 8		
Internal leakage	Less than 5 drops/min (≤ 0,36 cm^3/min) at max working pressure		

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 5
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard

4 NOTES

Options

WP = prolonged manual override protected by rubber cap

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar

R = (only for DLEH) with check valve on P port, see section 2.

S = (only for DLEH and CART LEH) poppet with positive overlapping in the intermediate position to reduce the internal leakage at the valve switching and without manual override pin for safety applications (blind locking ring)

5 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K500)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)

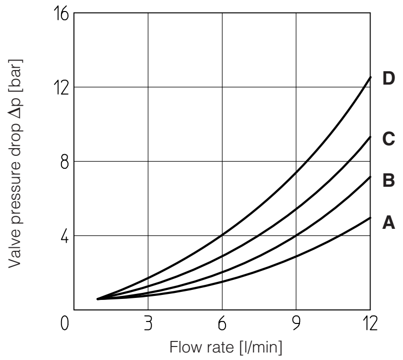
6 ELECTRIC FEATURES

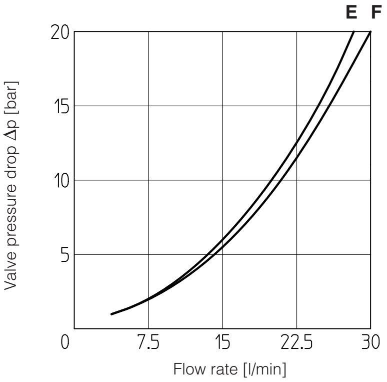
External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC - 120/60 AC	**110 RC**	669		COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

7 ∆p/Q DIAGRAM based on mineral oil ISO VG 46 at 50°C

Flow direction / Valve type	P → A (1) (P → B)	A → T (B → T)
DLEH-2A	B	–
DLEH-2C	C	–
DLEH-3A	D	C
DLEH-3C	C	A
DLEHM-3A	F	E
DLEHM-3C	F	E

(1) For two-way valves, pressure drop refers to PØT





8 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

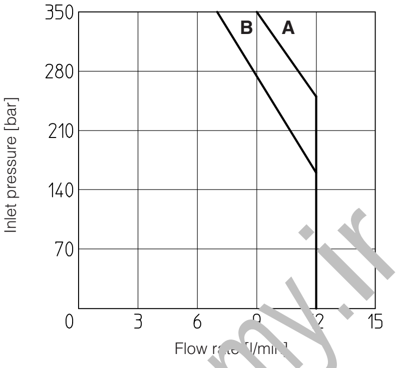
The diagram has been obtained with warm solenoids and power supply at lowest value (Vnom - 10%).

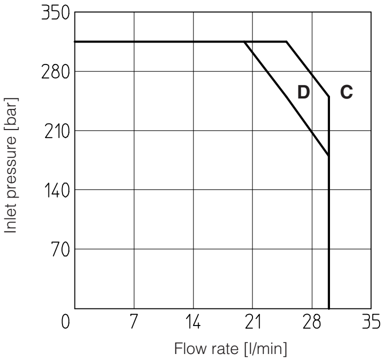
A = DLEH-3A, DLEH-2C

B = DLEH-2A, DLEH-3C

C = DLEHM-3A

D = DLEHM-3C





9 SWITCHING TIMES (average values in msec)

Valve type	Connector	Switch-on AC	Switch-on DC	Switch-off
DLEH(M)-* DC	666, 667	–	45	25
DLEH(M)-* RC	669	30	–	75

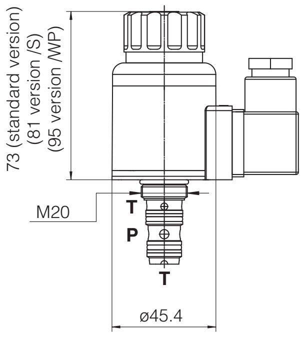
TEST CONDITIONS:

- 8 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- based on mineral oil ISO VG 46 at 50°C

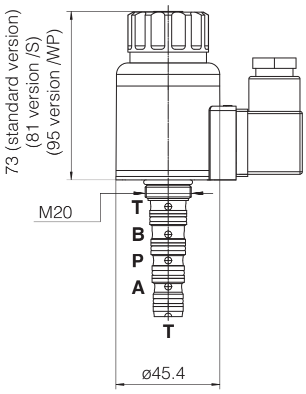
The response time is affected by elasticity of the hydraulic circuit, by variation of hydraulic characteristics and temperature

10 DIMENSIONS OF CARTRIDGE VERSIONS [mm] - for cavity dimensions see table P006

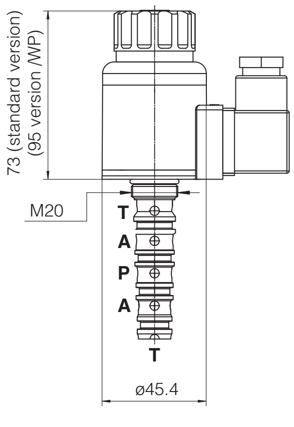
CART LEH-2A
CART LEH-2C



CART LEH-3A
CART LEH-3C

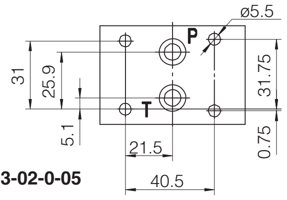


CART LEHM-3A
CART LEHM-3C



11 DIMENSIONS [mm]

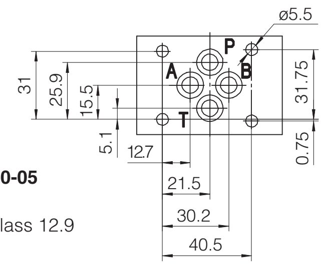
DLEH-2*
DLEH-2*/R



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
without A and B ports
Fastening bolts:
4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Seals: 2 OR 108
Ports P, T: Ø = 7,5 mm (max)

P = PRESSURE PORT
T = USE PORT
For the max pressures on ports, see section 3

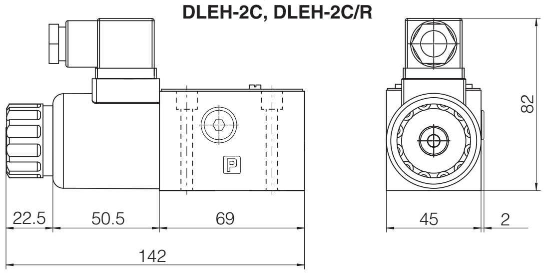
DLEH-3*
DLEH-3*/R
DLEHM-3*
DLEHM-3*/R



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P, A, B, T: Ø = 7,5 mm (max)

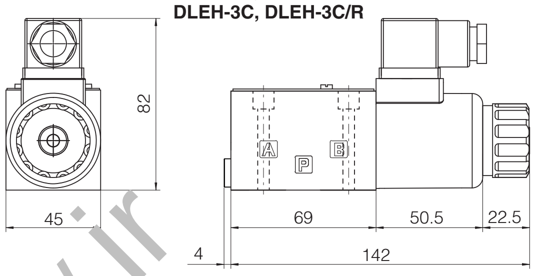
P = PRESSURE PORT
A = USE PORT (not used for DLEH and LEH -3C versions)
B = USE PORT (not used for DLEH and LEH -3A versions)
(not used for DLEHM and LEHM)
T = TANK PORT
For the max pressures on ports, see section 3

DLEH-2A, DLEH-2A/R
DLEH-2C, DLEH-2C/R



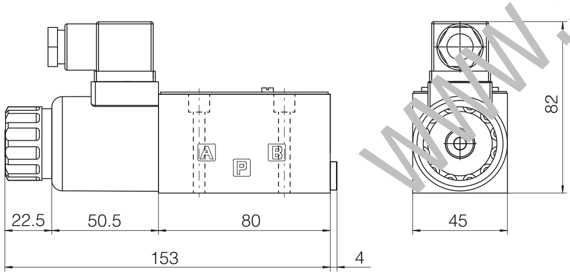
Mass: 1,5 Kg

DLEH-3A, DLEH-3A/R
DLEH-3C, DLEH-3C/R



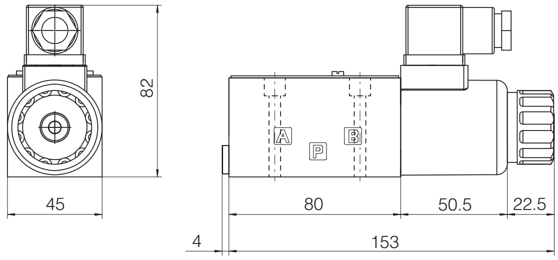
Mass: 1,5 Kg

DLEHM-3C



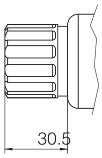
Mass: 1,7 Kg

DLEHM-3A

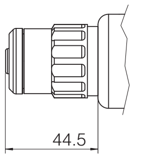


Mass: 1,7 Kg

Option /S



Option /WP



option /S = blind locking ring without manual override
option /WP = prolunged manual override, protected by rubber cap

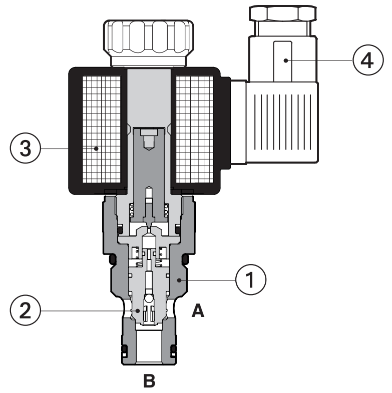
Overall dimensions refer to valves with connectors type 666

12 MOUNTING SUBPLATES - see table K280

Valve	Subplate model	Ports location	GAS ports A-B-P-T	Ø Counterbore [mm] A-B-P-T	Mass [Kg]
DLEH-* DLEHM-*	BA-202	Ports A, B, P, T underneath;	3/8"	–	1,2
	BA-204	Ports P, T underneath; ports A, B on lateral side	3/8"	25,5	1,8
	BA-302	Ports A, B, P, T underneath;	1/2"	30	1,8

Solenoid cartridge valves

screw-in, 2-way, poppet type, leak free



① cartridge body
② poppet
③ coil
④ coil connector (to be ordered separately)

JO-DL-4-2-X 24DC

JO-DL

Leak free, poppet type solenoid cartridges in screw-in execution normally used to cut off the hydraulic power supply line. They are available in normally closed NC, or normally open NO configurations.

Max flow: **300 l/min**
Max pressure: **350 bar**

1 MODEL CODE

JO	-	**D**	**L**	-	**4**	-	**2**	/	**NC**	-	**X**	**24 DC**	**	/	*

JO Cartridge valve screw-in type UNF

D = Directional control

L = Poppet type

Size:
4 = 3/4”-16UNF-2A
6 = 7/8”-14UNF-2A
10 = 1 5/16”-12UNF-2A

2 = Two-way

Version:
NC = normally closed in rest position
NO = normally open in rest position

X = Without connector, see section 5 for available connector

Voltage code:
12DC = 12 VDC
24DC = 24 VDC

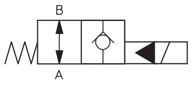
** Series number

* Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

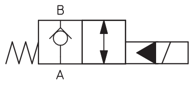
2 HYDRAULIC SYMBOL

Hydraulic symbols

/NO



/NC



3 GENERAL CHARACTERISTICS

Installation position	Any position
Cavity	JO-DL-4 = SAE-08-2N; JO-DL-6 = SAE-10-2N; JO-DL-10 = SAE-16-2N
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature	**Standard** execution = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +70°C
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Model			**JO-DL-4-2/NC**	**JO-DL-4-2/NO**	**JO-DL-6-2/NC**	**JO-DL-6-2/NO**	**JO-DL-10-2/NC**	**JO-DL-10-2/NO**
Operating pressure		[bar]	Ports A and B **350**					
Max flow		[l/min]	40		75		300	
Response time:	energizing	[ms]	35	50	30	50	35	150
	de-energizing	[ms]	50	35	60	35	70	35
Internal leakage			less than 5 drops/min (≤ 0,36 cm³/min) max at 350 bar					

5 ELECTRIC CHARACTERISTICS

Relative duty factor	100%	
Supply voltage	See model code at section 1	
Supply voltage tolerance	±10%	
Max power	20 Watt	
Power connector	666 (plastic - black); 3 pins, cable clamp PG11, cable max ø 11 mm	**to be ordered separately**
Connectors features	DIN 43650 - ISO 4400; IP65 (DIN 40050); VDE 0110C	

6 INSTALLATION NOTES

1) The assembling of cartridges inside manifolds must be done tightening the valve exagonal ring (for tightening torque, see section 10). Excessive values can cause anomalous deformation and poppet sticking.

2) The CE certification is valid only with shielded electric cables and connector. Consult also tab. P004.

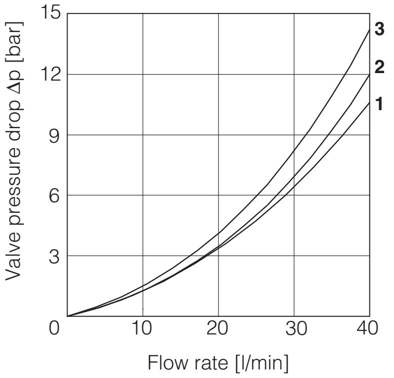
7 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult Atos Technical Office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

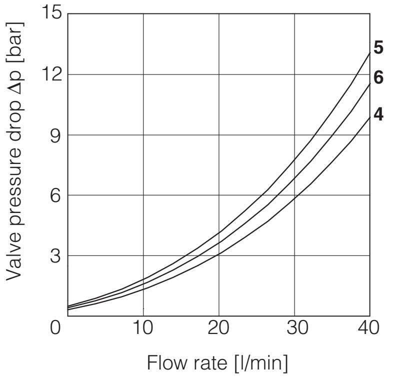
8 **DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

9.1 JO-DL-4

Valve pressure drop - NO version
1= A → B de-energized
2= B → A de-energized
3= B → A energized

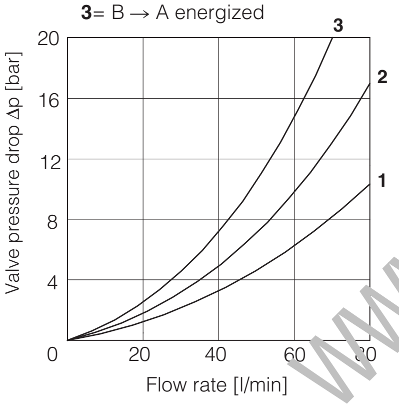


Valve pressure drop - NC version
4= A → B energized
5= B → A de-energized
6= B → A energized

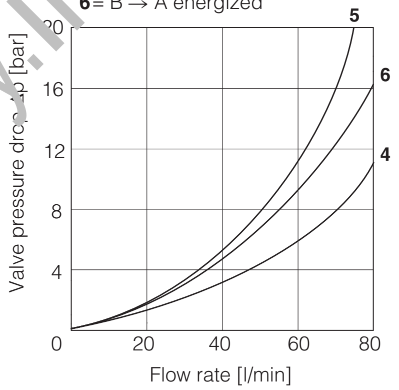


9.2 JO-DL-6

Valve pressure drop - NO version
1= A → B de-energized
2= B → A de-energized
3= B → A energized

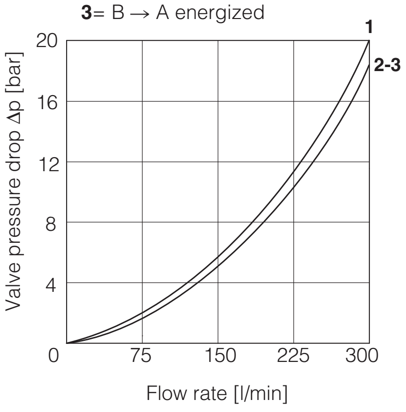


Valve pressure drop - NC version
4= A → B energized
5= B → A de-energized
6= B → A energized

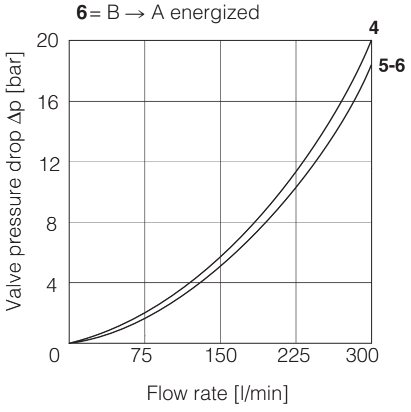


9.3 JO-DL-10

Valve pressure drop - NO version
1= A → B de-energized
2= B → A de-energized
3= B → A energized



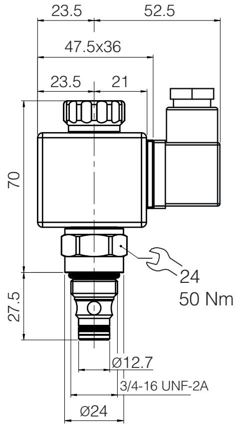
Valve pressure drop - NC version
4= A → B energized
5= B → A de-energized
6= B → A energized



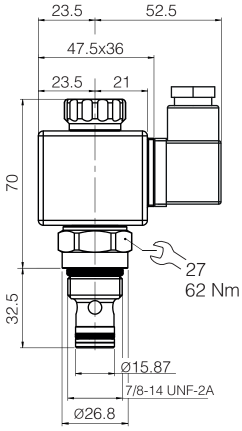
9 INSTALLATION DIMENSIONS [mm]

Version /NO and /NC

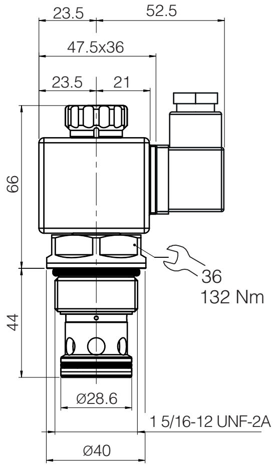
JO-DL-4-2/N*
Mass 0.35 Kg



JO-DL-6-2/N*
Mass 0.35 Kg

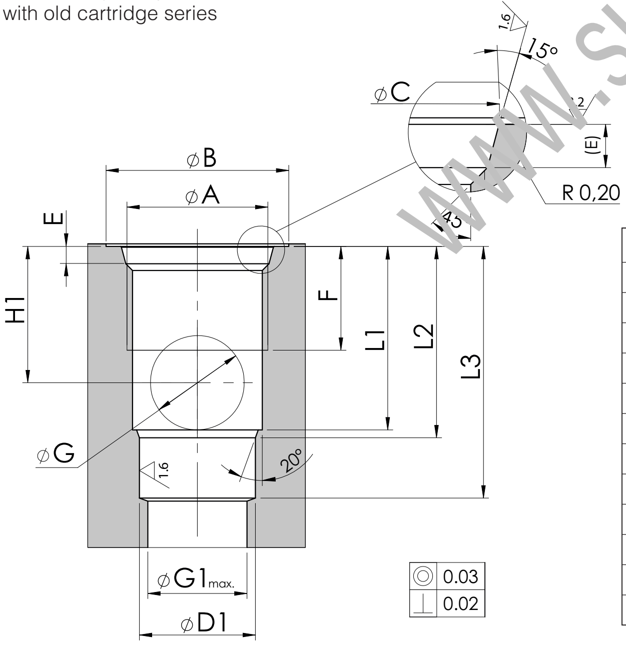


JO-DL-10-2/N*
Mass 0.4 Kg



10 CAVITY DIMENSIONS

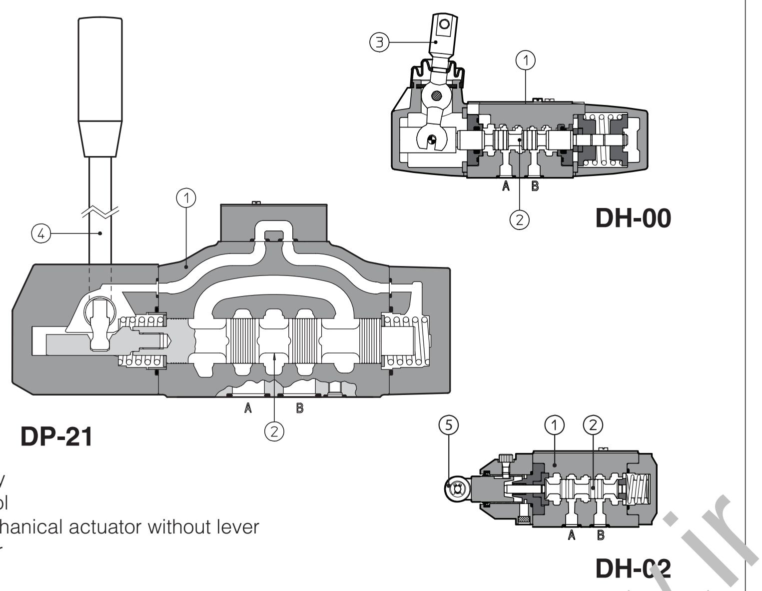
Note: cavity compatible
with old cartridge series



	JO-DL-4-2	JO-DL-6-2	JO-DL-10-2
A	3/4-16 UNF	7/8-14 UNF	1 5/16-12 UNF
B	26	30	42
C	$20.6^{+0.1}_{0}$	$23.9^{+0.1}_{0}$	$35.5^{+0.1}_{0}$
D1	$12.7^{+0.05}_{0}$	$15.87^{+0.05}_{0}$	$28.60^{+0.05}_{0}$
E	$2.6^{+0.3}_{0}$	$2.6^{+0.3}_{0}$	$3.3^{+0.3}_{0}$
F	13	15	20
G	9	12	19
G1	12	15	24
H1	14	18	25
L1	19.1	24.2	33.5
L2	20.5	25.5	36
L3	29	34.5	49

Hand & mechanical directional valves

ISO 4401 sizes 06, 10, 16 and 25



① body
② spool
③ mechanical actuator without lever
④ lever
⑤ cam

Hand & mechanical operated directional valves are spool type, three or four way, two or three position valves, available with following actuator types:
- mechanical actuator: general purpose execution for connection to customer device for the valve's remote operation
- hand-lever
- cam (only for DH and DK).

Valve sizes and max flow:

DH-0 = size 06, flow up to 50 l/min
DK-10 (11) = size 10, flow up to 100 l/min
DK-12 = size 10, flow up to 140 l/min
DP-2 = size 16, flow up to 300 l/min
DP-4 = size 25, flow up to 700 l/min

Max pressure:
350 bar for DH-0, DP-2, DP-4
315 bar for DK-1*

1 MODEL CODE

DH-0	**1**	**1**	**3**	**/**	**C**	**/**	**A**	**	**/**	*

Directional control valve, size:
DH-0 = 06
DK-1 = 10
DP-2 = 16
DP-4 = 25

Type of actuator:
0 = mechanical, without lever
1 = hand-lever
2 = cam (only for DH-0 and DK-1)

Valve configuration, see sections 2 and 3
0 = free, without springs
1 = spring centered, without detent
2 = retun to internal position
3 = return to external position
4 = 3 position, with detent
5 = 2 external positions, with detent
6 = centre plus external positions, with detent
7 = return to external position from the centre position
8 = return to the centre position from the external position

Spool type, see section 3

Only for DH-01 hand-lever valves:
/C = short hand - lever and reducend actuation force

Options:
/A = actuator device mounted on side of port B

Lever position to be specified for DH-00, DH-01 and DK-00, DK-01 with configuration 6, 7, 8, see section 3 for hydraulic connections:
/I = in rest position the lever is inclined towards the valve body
/E = in rest position the lever is inclined in opposite side

Only for DK-1:
/Y = external drain

Series number

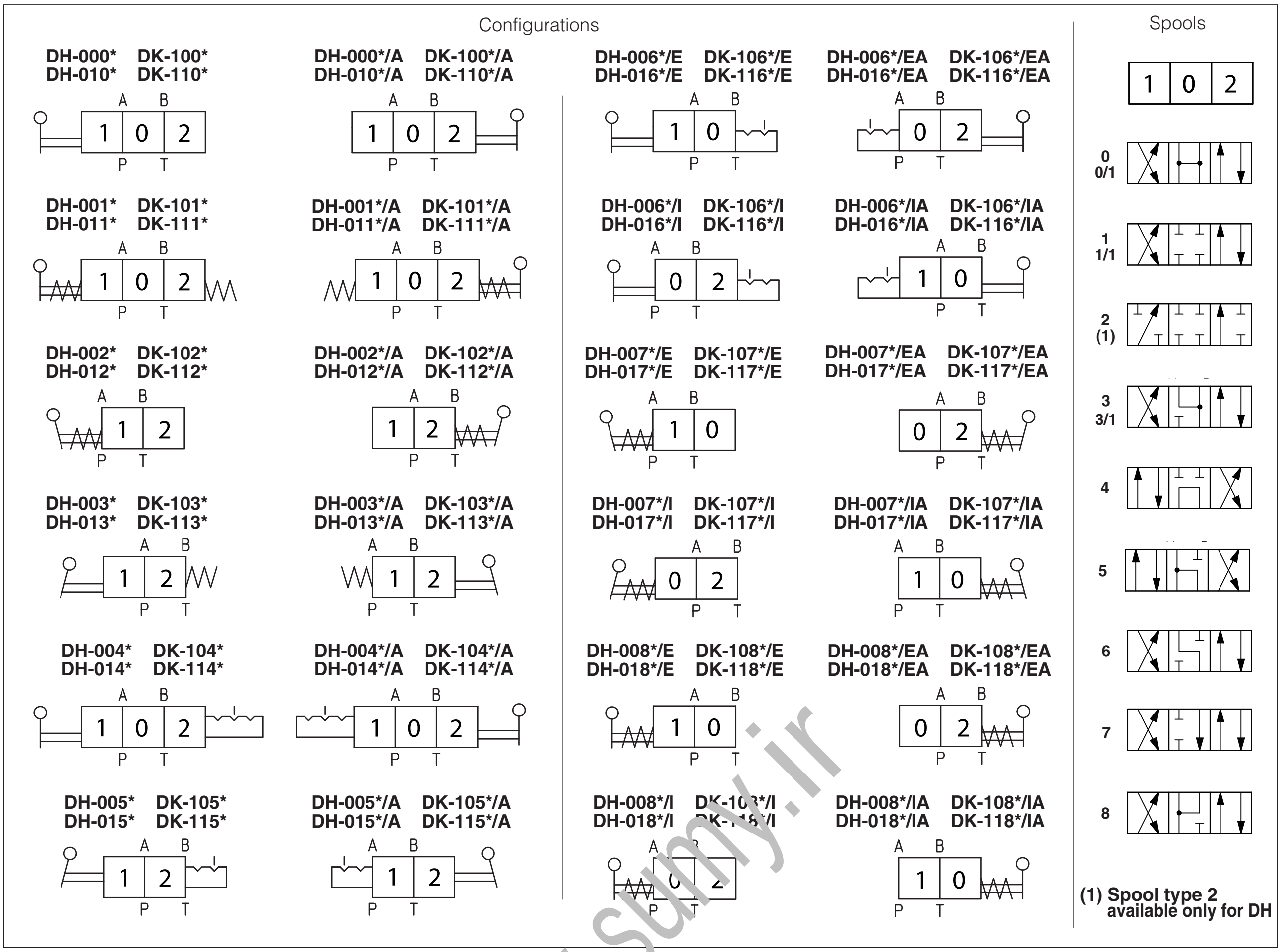
Seals material:
- = NBR
PE = FKM

2 RANGE OF VALVE'S MODELS

VALVE TYPE	SIZE	VALVE CONFIGURATION								
		0	1	2	3	4	5	6	7	8
DH-00	06	●	●	●	●	●	●	●	●	●
DH-01		●	●	●	●	●	●	●	●	●
DH-02					●				●	●
DK-10	10	●	●	●	●	●	●	●	●	●
DK-11		●	●	●	●	●	●	●	●	●
DK-12					●				●	●
DP-20	16		●		●	●	●			
DP-21			●		●	●	●			
DP-40	25		●		●	●	●			
DP-41			●		●	●	●			

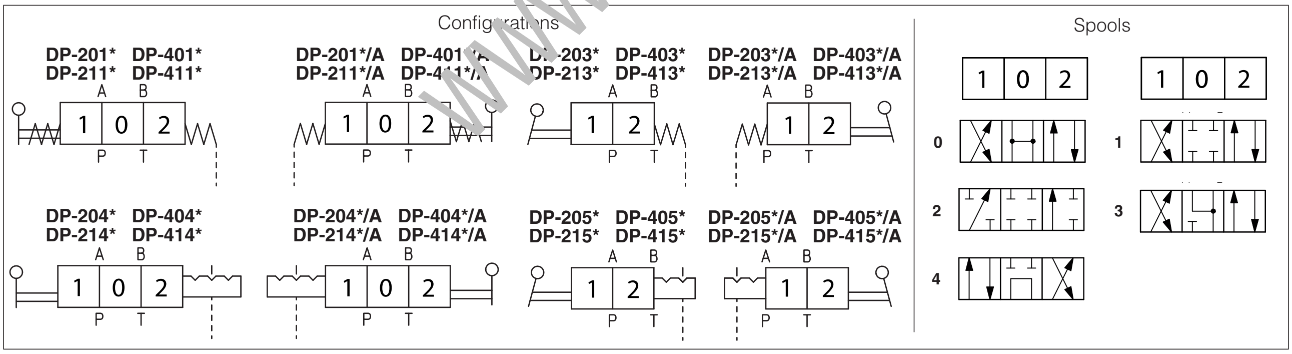
3 CONFIGURATIONS and SPOOLS - for intermediate passages, see tab. E001

DH-00*, DH-01* and DK-10*, DK-11* - mechanical and hand lever actuator

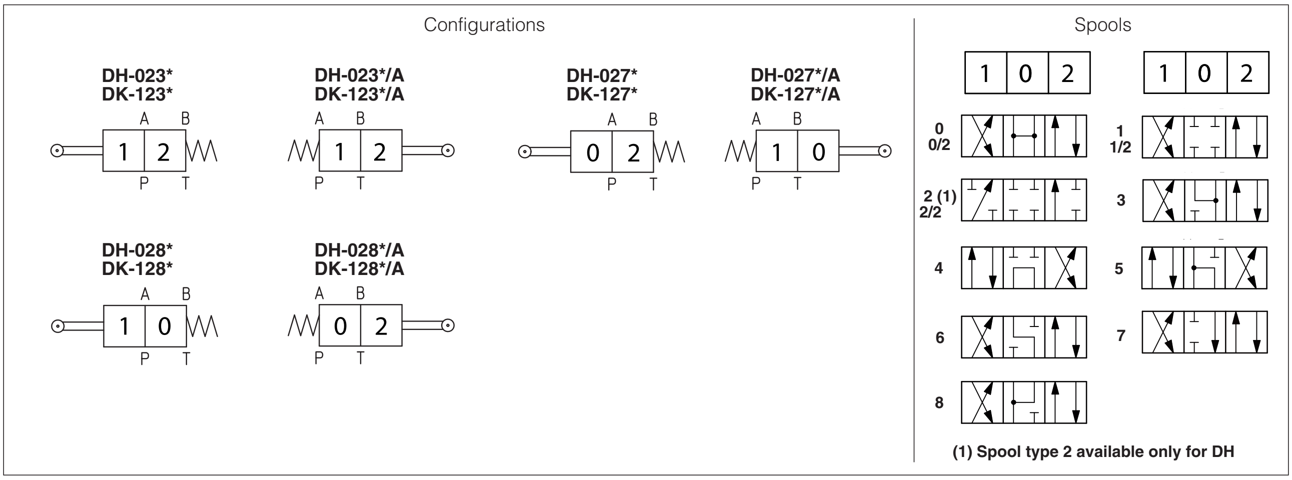


(1) Spool type 2 available only for DH

DP-20*, DP-21*, DP-40*, DP-41* - hand lever actuator



DH-02*, DK-12* - cam actuator



(1) Spool type 2 available only for DH

NOTE

- Spools type 0/2, 1/2, 2/2 are only used for valves type DH-023*/2 and DK 123*/2;

4 GENERAL CHARACTERISTICS

Assembly position		Any position except for configurtion 7 (without spring) that must be installed with horizontal axis
Subplate surface finishing to ISO 4401		Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849		150 years, see technical table P007
Ambient temperature range		**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range		**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Flow direction		As shown in the symbols of tables 3
Compliance		RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Operating pressure	**DH**	P, A, B = **350 bar** T = **160 bar**
	DK	P, A, B = **315 bar** T = **160 bar**
	DP	P, A, B, X = **350 bar** T = **250 bar** for external drain (standard); Ports Y = 0 bar
Maximum flow	**DH**	**50 l/min**
	DK-10, DK-11 **DK-12**	**100 l/min** **140 l/min**
	DP-2 **DP-4**	**300 l/min** **700 l/min**

5 SEALS AND HYDRAULIC FLUIDS - For other fluids not included in above table, consult our technical office

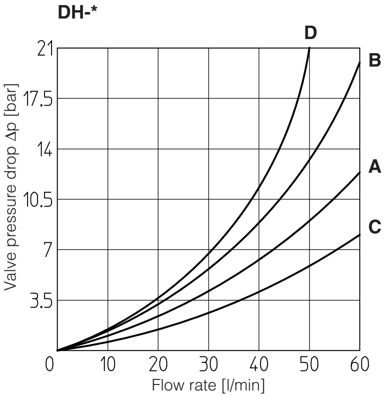
Seals, recommended fluid temperature	NBR seals = (standard) -30°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals = (/PE option) -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

6 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

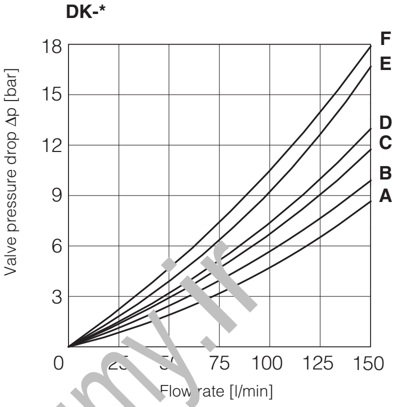
DH-*

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0, 0/1, 0/2	C	C	C	C	
1, 1/1, 1/2	A	A	A	A	
2, 2/2, 3, 3/1	A	A	C	C	
4, 5	D	D	D	D	A
6, 7	A	A	C	A	
8	C	C	B	B	



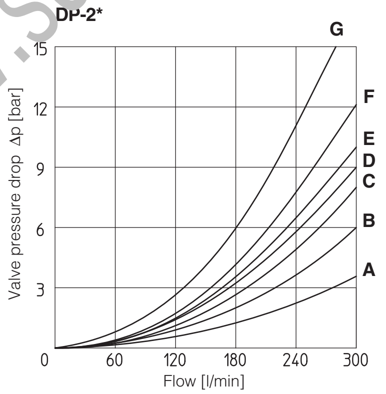
DK-*

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0, 0/1, 0/2	A	A	B	B	
1, 1/1, 1/2, 6, 8	A	A	D	C	
3, 3/1, 7	A	A	C	D	
4	B	B	B	B	E
5	A	B	C	C	F



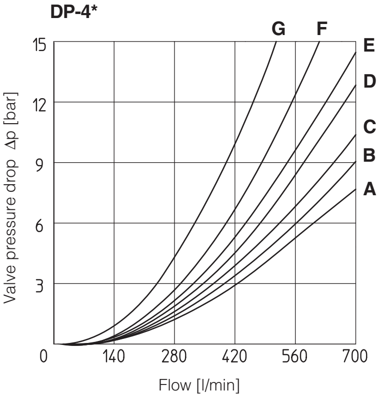
DP-2*

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
1, 3	A	A	C	A	-
0	A	A	C	D	B
2	A	A	-	-	-
4	B	B	F	G	E



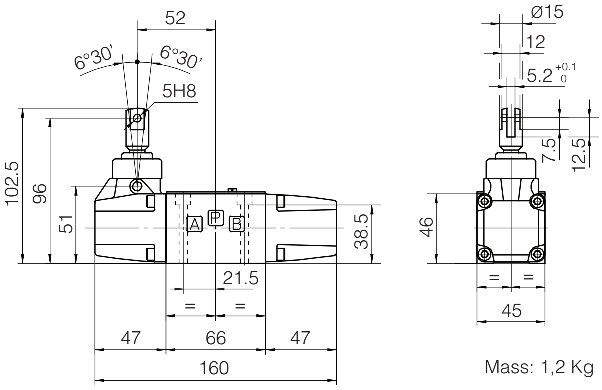
DP-4*

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
1	A	A	A	C	-
0	C	B	C	D	E
2	A	A	-	-	-
3	A	A	C	E	-
4	B	B	F	G	G



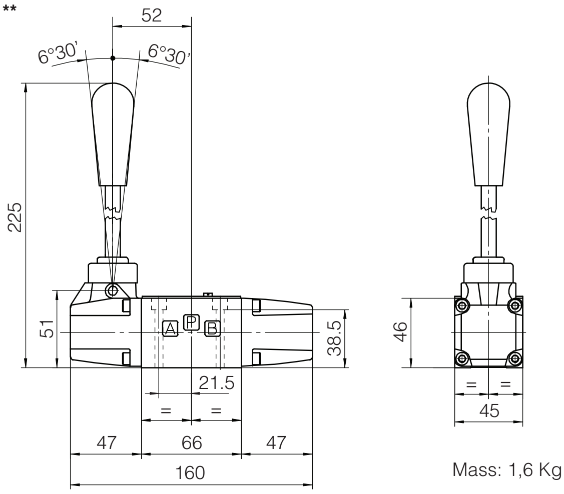
7 DIMENSIONS OF HAND & MECHANICAL OPERATED VALVES ISO 4401 SIZE 06 [mm]

DH-00**



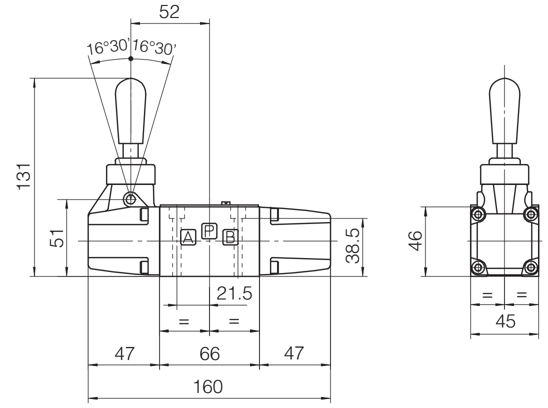
Mass: 1,2 Kg

DH-01**

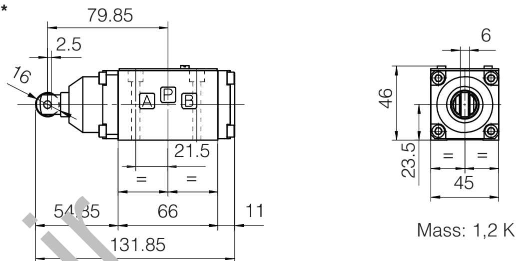


Mass: 1,6 Kg

DH-01/C**



DH-02**



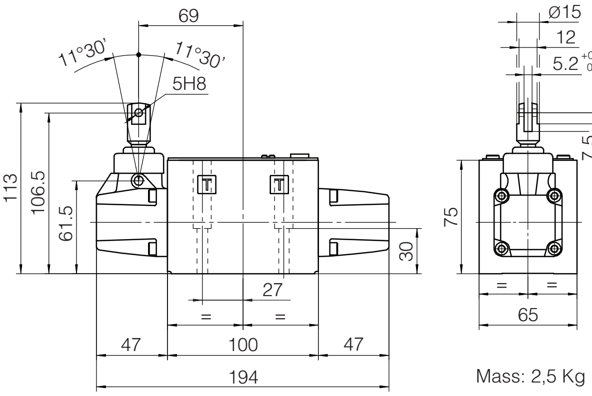
Mass: 1,2 Kg

Working stroke: 2,5 mm; extra-stroke: 0,5 mm max.

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see table P005)
Fastening bolts: 4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Diameter of ports A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

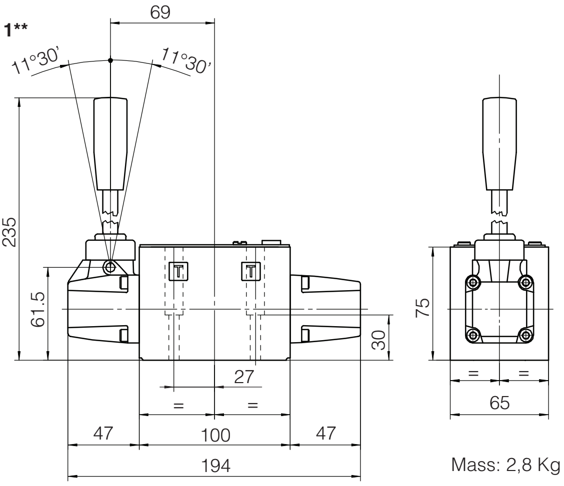
8 DIMENSIONS OF HAND & MECHANICAL OPERATED VALVES ISO 4401 SIZE 10 [mm]

DK-10**



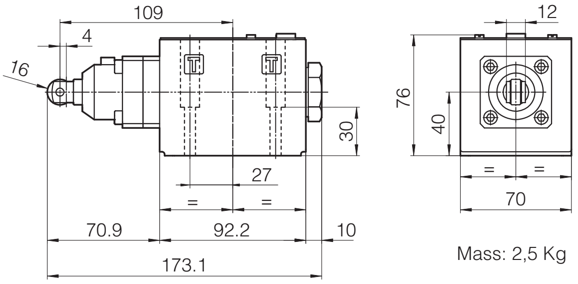
Mass: 2,5 Kg

DK-11**



Mass: 2,8 Kg

DK-12**



Mass: 2,5 Kg

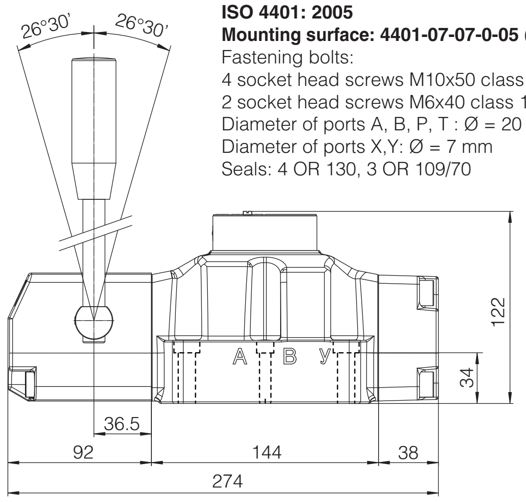
ISO 4401: 2005
Mounting surface: 4401-05-05-0-05 (see table P005)
(Without X port, Y port optional)
Fastening bolts: 4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 11,2 mm (max)
Seals: 5 OR 2050

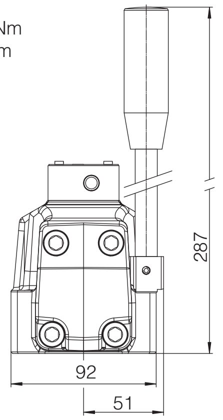
Working stroke: 4 mm; extra-stroke: 0,5 mm max.

9 DIMENSIONS OF HAND & MECHANICAL OPERATED VALVES ISO 4401 SIZE 16 [mm]

DP-21

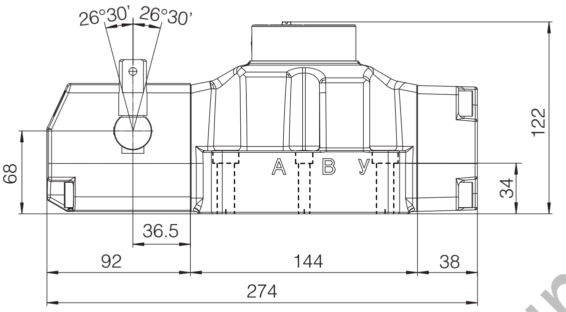
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05 (see table P005)
Fastening bolts:
4 socket head screws M10x50 class 12.9, Tightening torque = 70 Nm
2 socket head screws M6x40 class 12.9, Tightening torque = 15 Nm
Diameter of ports A, B, P, T : Ø = 20 mm
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 130, 3 OR 109/70

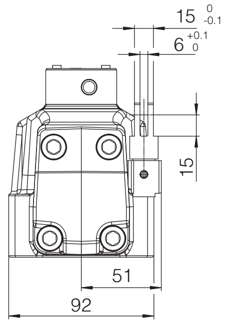




Mass: 10 Kg

DP-20



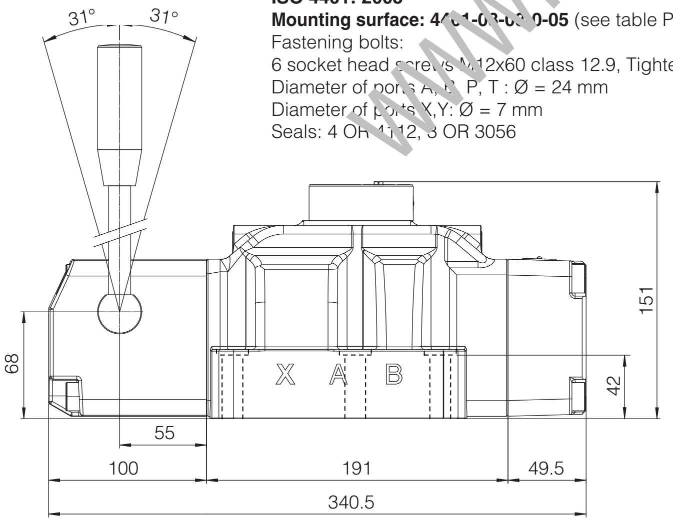


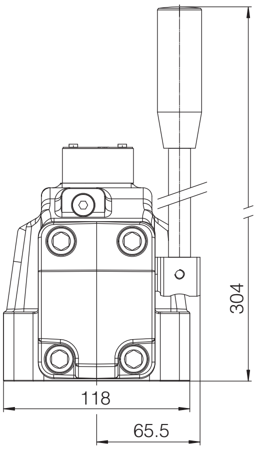
Mass: 9,7 Kg

10 DIMENSIONS OF HAND & MECHANICAL OPERATED VALVES ISO 4401 SIZE 25 [mm]

DP-41

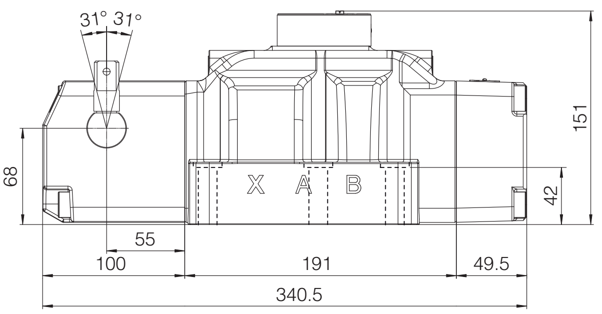
ISO 4401: 2005
Mounting surface: 4401-08-08-0-05 (see table P005)
Fastening bolts:
6 socket head screws M12x60 class 12.9, Tightening torque = 125 Nm
Diameter of ports A, B, P, T : Ø = 24 mm
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 4112, 3 OR 3056

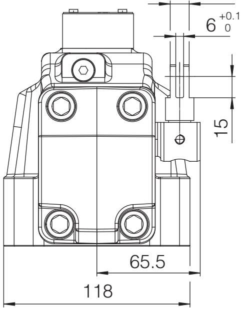




Mass: 15,5 Kg

DP-40

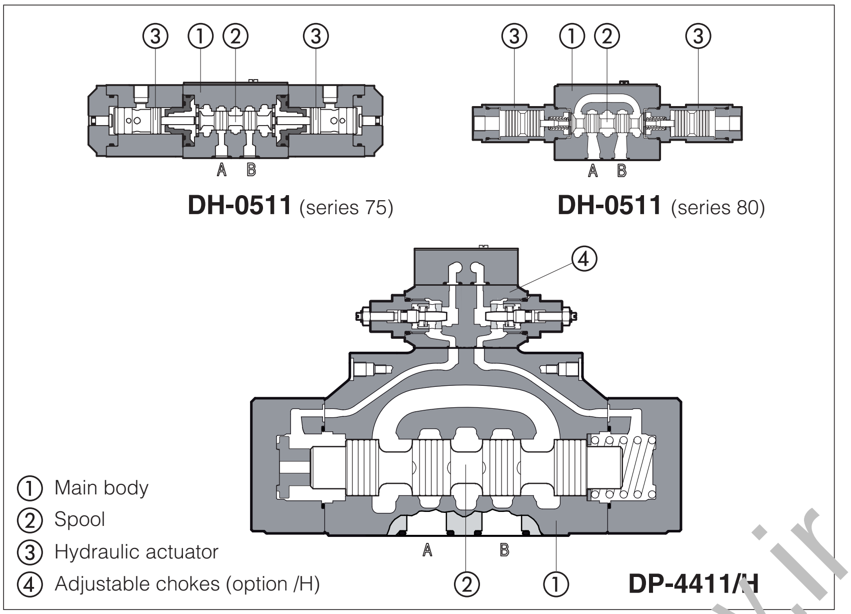




Mass: 15,2 Kg

Hydraulic operated directional valves

ISO 4401 size 06, 10, 16, 25 and 32



Hydraulic operated directional valves, spool type, three or four way, two or three positions.
Available with single or double hydraulic actuator.

Valve sizes and max flow:

DH-0 = size 06
series 80 flow up to 80 l/min
series 75 flow up to 50 l/min
DK-1 = size 10, flow up to 160 l/min
DP-1 = size 10, flow up to 160 l/min
DP-2 = size 16, flow up to 300 l/min
DP-4 = size 25, flow up to 700 l/min
DP-6 = size 32, flow up to 1000 l/min

Max pressure:
350 bar for DH-0, DP-1, DP-2, DP-4, DP-6
315 bar for DK-1

1 MODEL CODE

DH-0 | **4** | **1** | **3** | **/** | **A** | ****** | **/** | *****

Directional control valve, size:
DH-0 = 06
DK-1 = 10
DP-1 = 10
DP-2 = 16
DP-4 = 25
DP-6 = 32

Type of actuator:
4 = single actuator
5 = double actuator

Valve configuration, see section 5
0 = free, without springs
1 = spring centered, without detent
3 = spring offset external position
5 = 2 external positions, with detent (only for DH and DK)
7 = center and external positions

Spool type, see section 5

Options:
only for DH-04 and DK-14, see section 5:
/A = actuator device mounted on side of port B
only for DP:
/H = adjustable chokes for controlling the main spool shifting time (meter-out to the pilot chambers of the main valve)
/H9= adjustable chokes for controlling the main spool shifting time (meter-in to the pilot chambers of the main valve)
/R = with check valve on port P (not available for DP-1*)
/S = main spool stroke adjustment (not available for DP-1*)

Series number
Only for DH-0 to be specified in the order code:
80 new series
75 old series **(1)**

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

(1) DH series 75 is a phase-out component not recommended for new applications

2 HYDRAULIC CHARACTERISTICS

Valve model	DH-0 series 80	DH-0 series 75 (1)	DK-1	DP-1	DP-2	DP-4	DP-6
Max recommended flow [l/min]	80	50	160	160	300	700	1000
Max pressure on port P, A, B [bar]	350	350	315	350			
Max pressure on port T (also X, Y for DP) [bar]	see note **(2)**			250			
Minimum pilot pressure [bar]	5			4			
Max recommended pressure on piloting line[bar]	210	70	70	250			

(1) DH series 75 is a phase-out component not recommended for new applications
(2) The max pressure on port T has to be not over 50% of pilot pressure

3 GENERAL CHARACTERISTICS

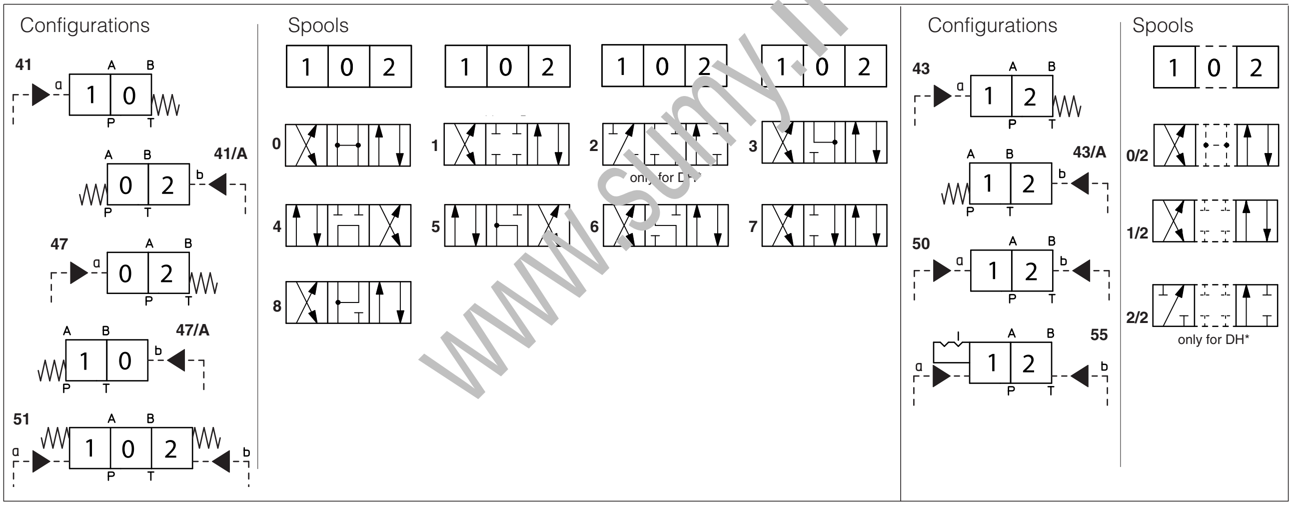
Assembly position	Any position except for valves type DH-050, DK-150, DP-*50 (without springs) that must be installed with their longitudinal axis horizontal
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C NBR low temp (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, NBR low temp	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, NBR low temp	HFC	

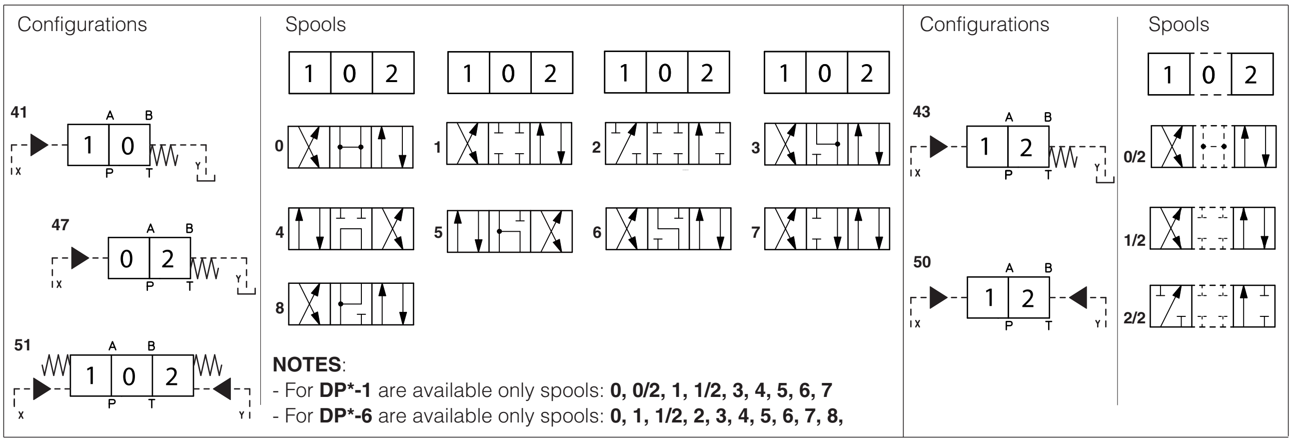
5 CONFIGURATIONS and SPOOLS valves type DH-*, DK-*



NOTES

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4** and **5** are also available as **1/1, 4/8** (only for DH), and **5/1.** They are properly shaped to reduce water-hammer shocks during the switching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** (only for DH-0) to limit valve internal leakages.

6 CONFIGURATIONS and SPOOLS valves type DP-*



NOTES:

- For **DP*-1** are available only spools: **0, 0/2, 1, 1/2, 3, 4, 5, 6, 7**
- For **DP*-6** are available only spools: **0, 1, 1/2, 2, 3, 4, 5, 6, 7, 8,**

Special shaped spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4** and **5** are also available as **1/1, 4/8** and **5/1** are properly shaped to reduce water-hammer shocks during the switching.

7 Q/Δp DIAGRAMS

DH-0 series **80**	See table E015 relating the DHE valve from which DH-0* are derivated
DK-1	See table E025 relating the DKE valve from which DK-1* are derivated
DP-1	See table E085 relating the DPH*-1 valve from which DP-1* are derivated
DP-2	See table E085 relating the DPH*-2 valve from which DP-2* are derivated
DP-4	See table E085 relating the DPH*-4 valve from which DP-4* are derivated
DP-6	See table E085 relating the DPH*-6 valve from which DP-6* are derivated

8 INSTALLATION DIMENSIONS OF DH-0 [mm]

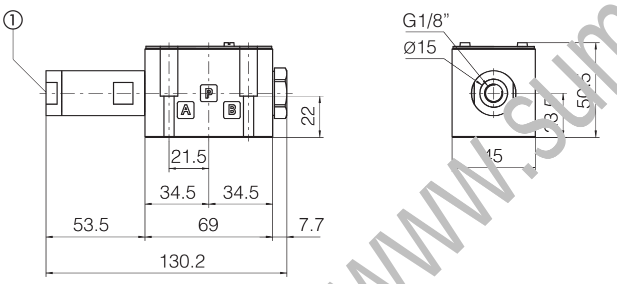
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see table P005)
Fastening bolts: 4 socket head screws M5x30 class 12.9
Tightening torque = 8 Nm
Diameter of ports A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

Mounting subplates: see tab. K280

DH-0* series 80

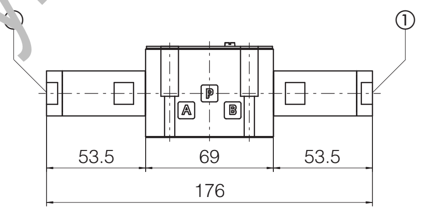
① Pilot pressure port G1/8”

DH-04



Mass: 1,2 Kg

DH-05

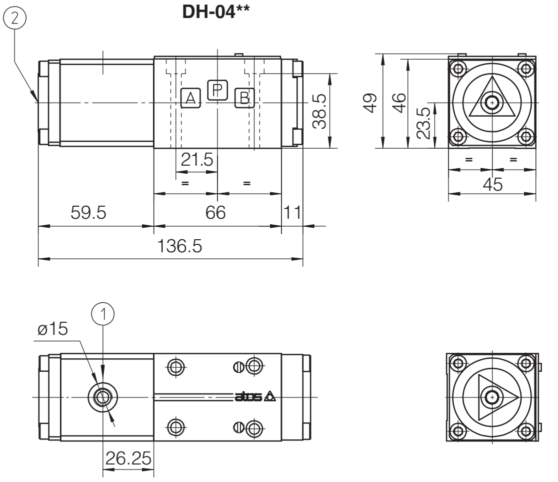


Mass: 1,5 Kg

DH-0* series 75 (phase out)

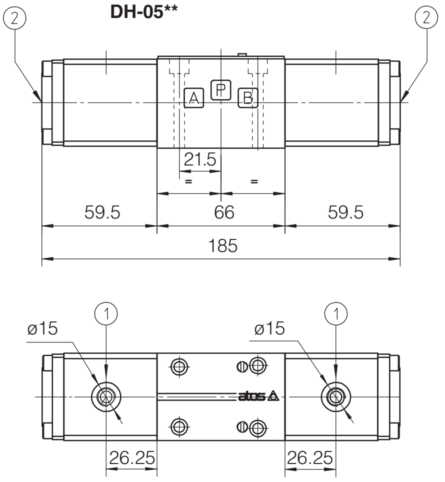
① Pilot pressure port G1/8”
② Manual override

DH-04



Mass: 1,2 Kg

DH-05



Mass: 1,6 Kg

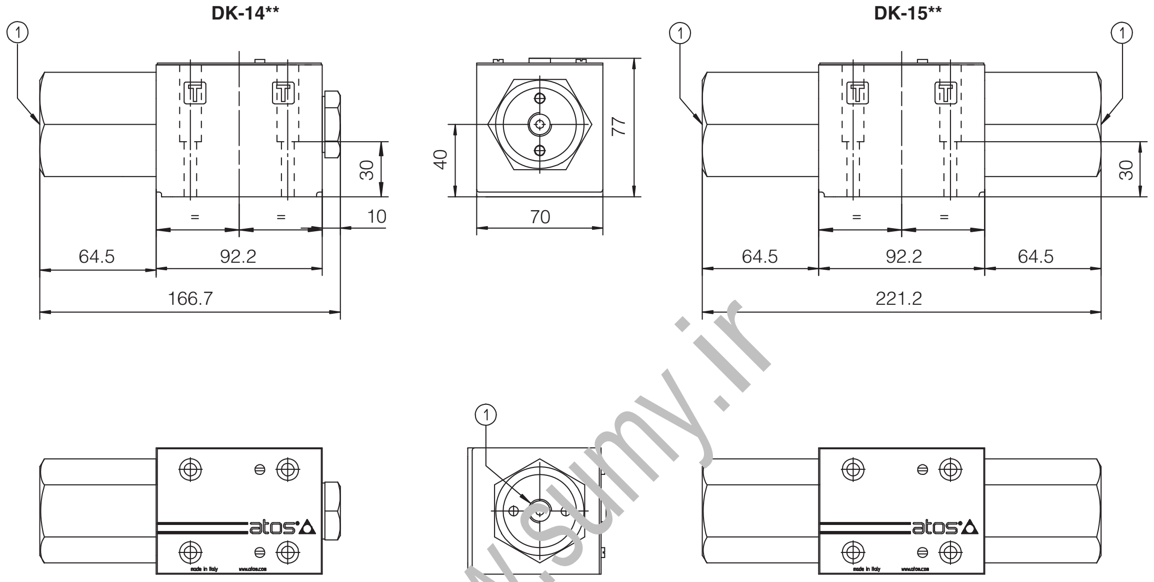
9 INSTALLATION DIMENSIONS OF DK-1 [mm]

ISO 4401: 2005
Mounting surface: 4401-05-05-0-05 (see table P005)
(without X port)
Fastening bolts: 4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 11,2 mm (max)
Diameter of port Y: Ø = 5 mm
Seals: 5 OR 2050, 1 OR 108

Mounting subplates: see tab. K280 (only version /Y)

Note: Line Y must be always present and no counter pressure are allowed on this line.

① Pilot pressure port G1/4”



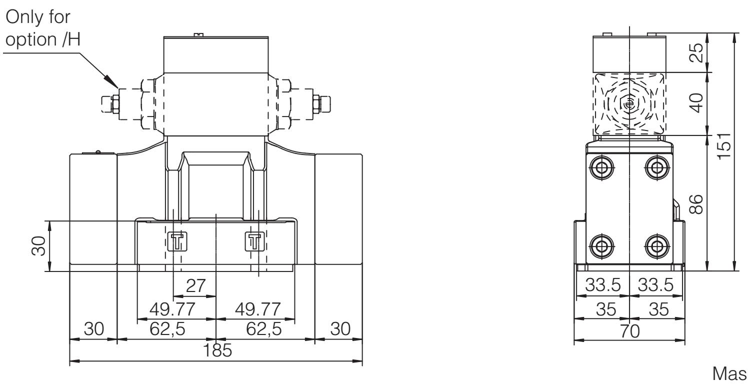
Mass: 3,4 Kg

Mass: 4,2 Kg

10 INSTALLATION DIMENSIONS OF DP-* [mm]

DP-1
ISO 4401: 2005
Mounting surface: 4401-05-05-0-05
(see table P005)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T : Ø = 11
Diameter of ports X,Y: Ø = 5 mm
Seals: 5 OR 2050, 2 OR 108

Mounting subplates: see tab. K280



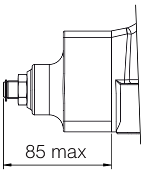
Mass: 7,1 Kg

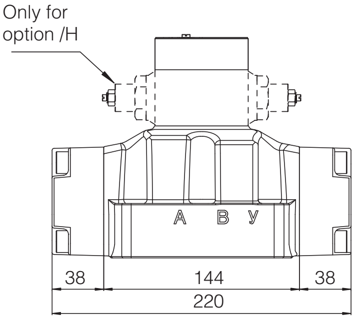
DP-2

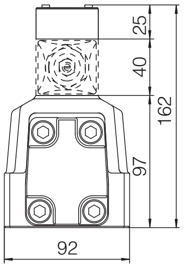
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 20
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 130, 2 OR 2043

Mounting subplates: see tab. K280

Stroke adjustment device for option /S







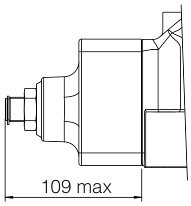
Mass: 10 Kg

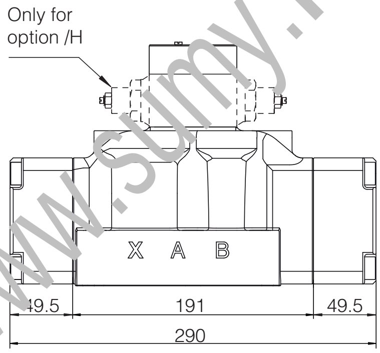
DP-4

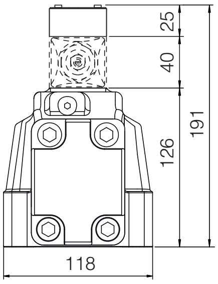
ISO 4401: 2005
Mounting surface: 4401-08-08-0-05
Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Diameter of ports A, B, P, T : Ø = 24
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 4112, 2 OR 3056

Mounting subplates: see tab. K280

Stroke adjustment device for option /S







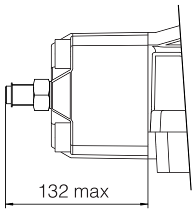
Mass: 16,5 Kg

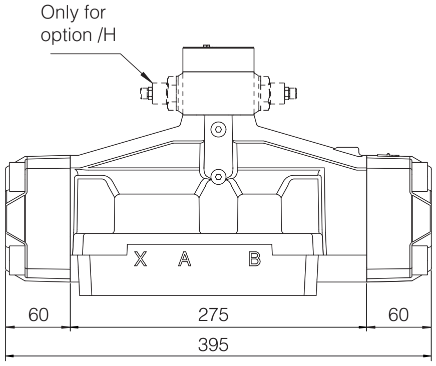
DP-6

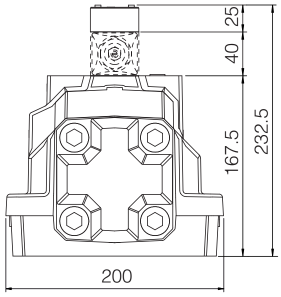
ISO 4401: 2005
Mounting surface: 4401-10-09-0-05
Fastening bolts:
6 socket head screws M20x80 class 12.9
Tightening torque = 600 Nm
Diameter of ports A, B, P, T : Ø = 34 mm
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 144, 2 OR 3056

Mounting subplates: see tab. K280

Stroke adjustment device for option /S



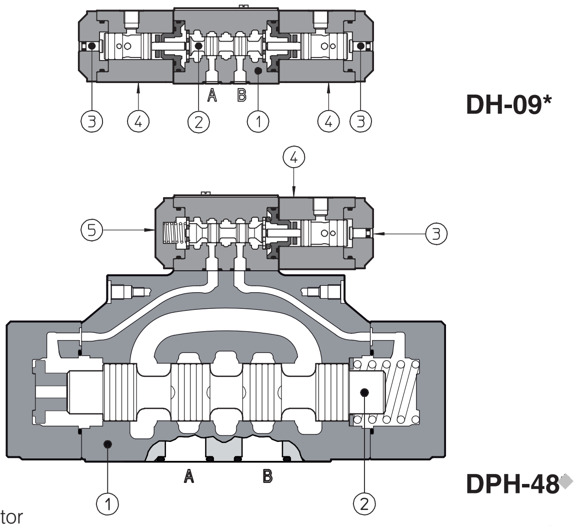




Mass: 38 Kg

Pneumatic operated directional valves

ISO 4401 sizes 06, 10, 16, 25 and 32



① Main body
② Spool
③ Manual override
④ Pneumatic actuator
⑤ Pilot valve

Pneumatic operated directional valves are spool type ②, three or four way, two or three position, designed to operate in oil hydraulic systems.
Available with single or double pneumatic actuator ④ with manual override.

Valve sizes and max flow:

DH-0 = size 06, flow up to 50 l/min
DK-1 = size 10, flow up to 160 l/min
DPH-2 = size 16, flow up to 300 l/min
DPH-4 = size 25, flow up to 700 l/min
DPH-6 = size 32, flow up to 1000 l/min

Max pressure:
350 bar for DH-0, DPH-2, DPH-4, DPH-6
315 bar for DK-1

1 MODEL CODE

DH-0 **8** **1** **3** **/** **A** ****** **/** *****

Directional control valve, size:
DH-0 = 06
DK-1 = 10
DPH-2 = 16
DPH-4 = 25
DPH-6 = 32

Type of actuator:
8 = single actuator
9 = double actuator

Valve configuration, see sections 4 and 5
0 = free, without springs
1 = spring centered, without detent
3 = spring offset external position
5 = 2 external positions, with detent
7 = center and external positions

Spool type, see sections 4 and 5

Options:
only for valve with single actuator:
/A = Actuator device mounted on side of port B (for DH and DK).
Actuator device mounted on side of port A of main body (for DPH)
only for DPH:
/D = internal drain
/E = external pressure
/H = adjustable chokes for controlling the main spool shifting time (meter-out to the pilot chambers of the main valve)
/H9= adjustable chokes for controlling the main spool shifting time (meter-in to the pilot chambers of the main valve)
/R = pilot pressure generator on port P at 4 bar
/S = main spool stroke adjustment

Series number

Seals material, see section 3:
- = NBR
PE = FKM

2 HYDRAULIC CHARACTERISTICS

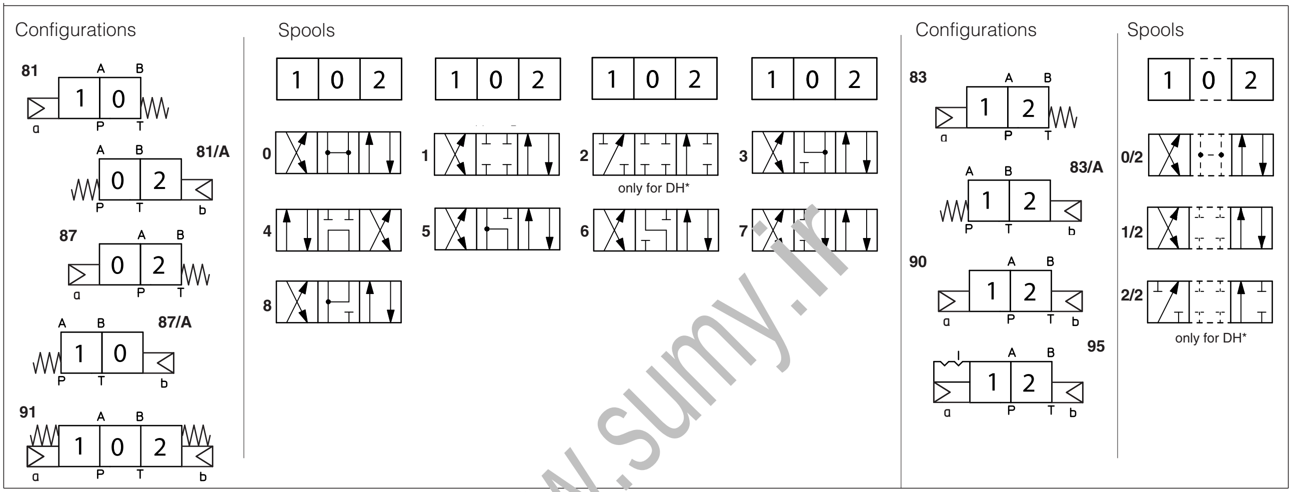
Valve model		**DH-0**	**DK-1**	**DPH-2**	**DPH-4**	**DPH-6**
Max recommended flow	[l/min]	50	160	300	700	1000
Max pressure on port P, A, B (also X for DP)	[bar]	350	315	350		
Max pressure on port T	[bar]	see note **(1)**		250		
Max pressure on port L and Y	[bar]	–		null pressure		
Recommended oil pressure on piloting line	[bar]	–		Min = 4 Max = 250 The device **/R** generates an additional pressure drop, in order to ensure the minimum pilot pressure, for correct operation of the valves with internal pilot and fitted with spools type **0, 0/1, 4, 4/8, 5.** The device **/R** has to be fitted when the pressure drop in the valve, verified on flow versus pressure diagrams, is lower than the minimum pilot pressure value.		
Recommended pneumatic pressure **(2)**	[bar]	Min = 5 Max = 12	Min = 2 Max = 12	Min = 5 Max = 12		

(1) The max pressure on port T has to be not over 200% of pilot pressure
(2) Filtered and lubricated air

3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position for all valves except for type -*90 (without springs) that must be installed with horizontal axis if operated by impulses.		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	Standard execution = -30°C ÷ +70°C; /PE option = -20°C ÷ +70°C;		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

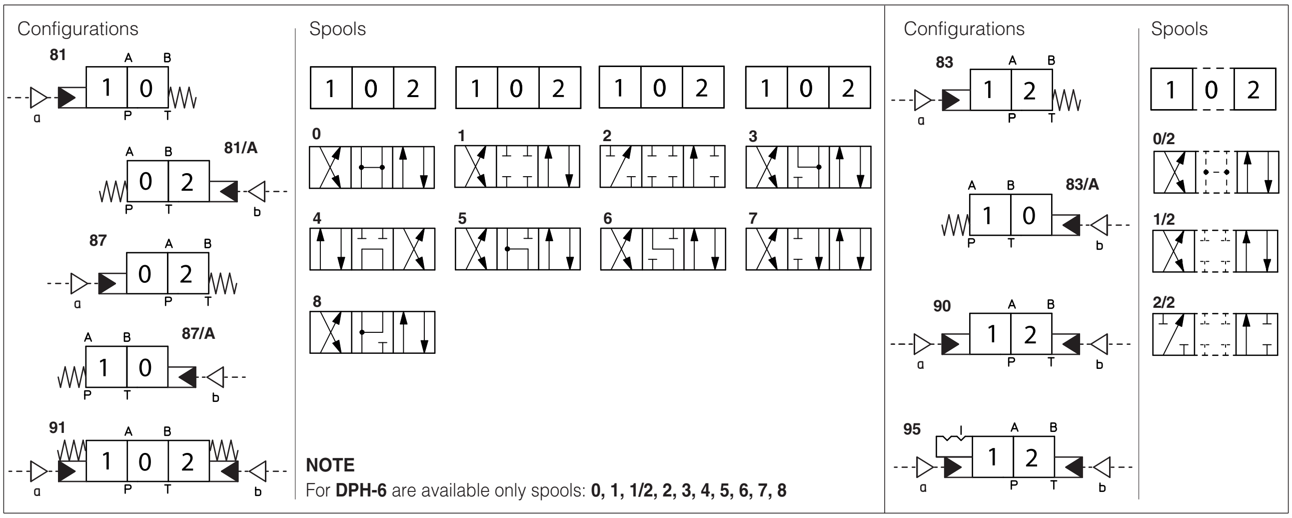
4 CONFIGURATIONS and SPOOLS of valves type DH-*, DK-*



NOTES

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4** and **5** are also available as **1/1, 4/8** (only for DH-0) and **5/1.** They are properly shaped to reduce water-hammer shocks during the swiching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** (only for DH-0) to limit valve internal leakages.

5 CONFIGURATIONS and SPOOLS of valves type DPH-*



NOTE

For **DPH-6** are available only spools: **0, 1, 1/2, 2, 3, 4, 5, 6, 7, 8**

Special shaped spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4,** and **5** are also available as **1/1, 4/8** and **5/1** are properly shaped to reduce water-hammer shocks during the switching.

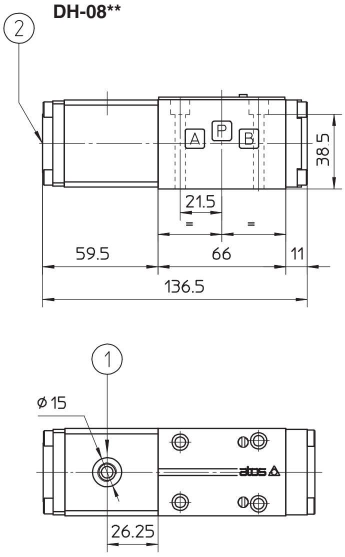
6 Q/∆p DIAGRAMS

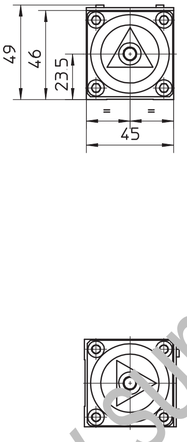
DH-0	See note and diagrams on table E010 relating the DH* valve from which DH-0* are derivated
DK-1	See note and diagrams on table E025 relating the DKE valve from which DK-1* are derivated
DPH-2	See note and diagrams on table E085 relating the DPH*-2 valve from which DP-2* are derivated
DPH-4	See note and diagrams on table E085 relating the DPH*-4 valve from which DP-4* are derivated
DPH-6	See note and diagrams on table E085 relating the DPH*-6 valve from which DP-6* are derivated

7 INSTALLATION DIMENSIONS of VALVES type DH and DK [mm]

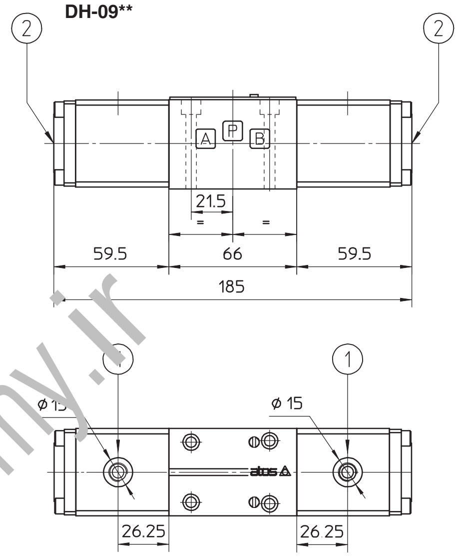
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts: 4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Diameter of ports A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

DH-08**





DH-09**



Mass: 1,2 Kg

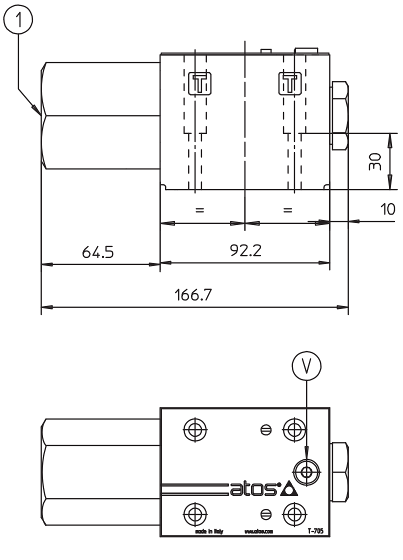
Mass: 1,6 Kg

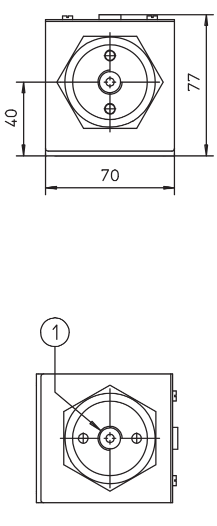
① Pilot pressure port G1/8”
② Manual override

Mounting subplates: see tab. E010

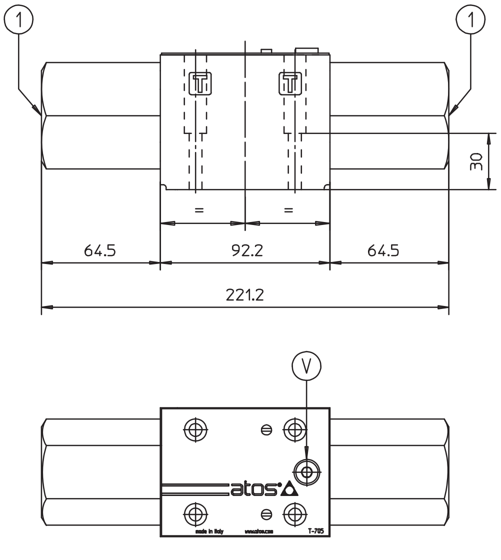
ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Fastening bolts: 4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 11,2 mm (max)
Seals: 5 OR 2050

DK-18**





DK-19**



Mass: 3,4 Kg

Mass: 4,2 Kg

① Pilot pressure port G1/4”
Ⓥ Air bleed

Mounting subplates: see tab. E025

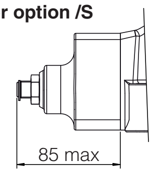
8 INSTALLATION DIMENSIONS of VALVES type DP [mm]

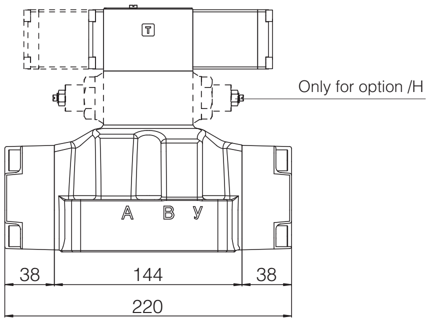
DPH-2

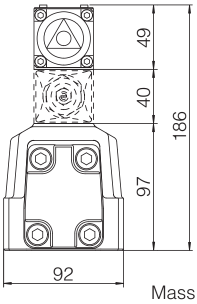
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05

Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T : Ø = 20
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 130, 2 OR 2043

Stroke adjustment device for option /S







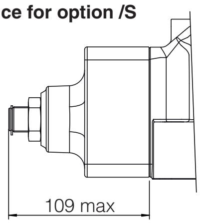
Mass: 11,5 Kg

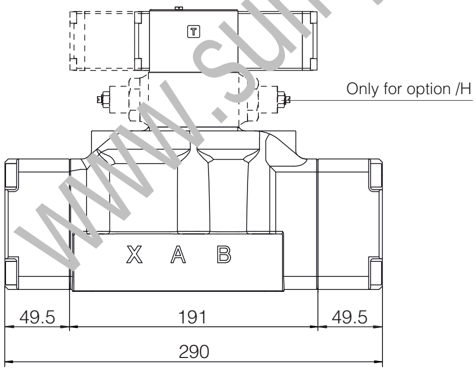
DPH-4

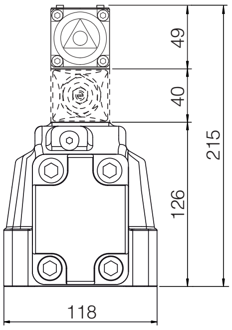
ISO 4401: 2005
Mounting surface: 4401-08-08-0-05

Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Diameter of ports A, B, P, T: Ø = 24
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 4112, 2 OR 3056

Stroke adjustment device for option /S







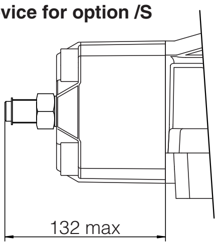
Mass: 18 Kg

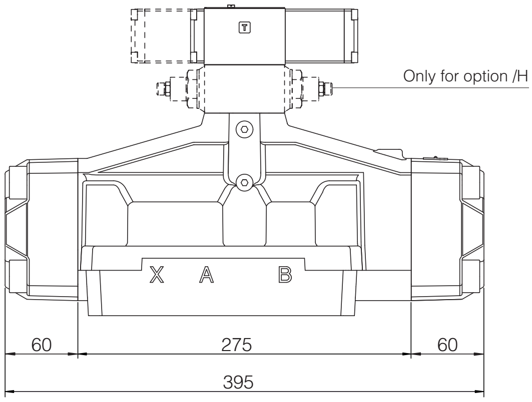
DPH-6

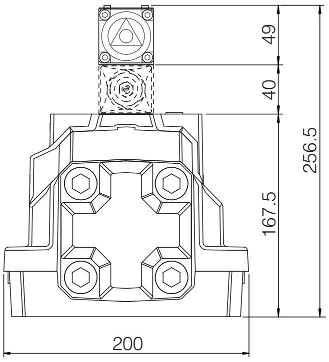
ISO 4401: 2005
Mounting surface: 4401-10-09-0-05

Fastening bolts:
6 socket head screws M20x80 class 12.9
Tightening torque = 600 Nm
Diameter of ports A, B, P, T: Ø = 34 mm
Diameter of ports X,Y: Ø = 7 mm
Seals: 4 OR 144, 2 OR 3056

Stroke adjustment device for option /S





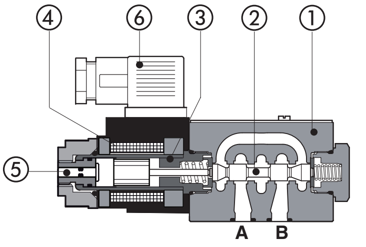


Mass: 39,5 Kg

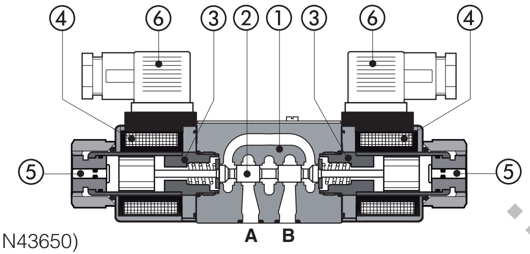
Solenoid directional valves type DHL8

direct operated, ISO 4401 size 06, **low leakage, compact execution**

Availability and price only on request



DHL8-0631/2-*-AC



DHL8-0711-*-DC

① Valve body
② Spool
③ Solenoid tube
④ Solenoid coil
⑤ Manual override pin
⑥ Electric connector (DIN43650)
to be ordered separately

Spool type, two or three position direct operated solenoid valves size 06 **in low leakage and compact execution** with reduced solenoids dimensions, ideal for hydraulic systems assisted by accumulators.

They are equipped with spool diameter 8mm accurately coupled to the body granting very low internal leakages, see section 10

Solenoids are made by:

- wet type screwed tube ③, different for AC and DC power supply, with integrated manual override pin ⑤
- interchangeable coils ④, specific for AC or DC power supply, easily replaceable without tools - see section 6 for available voltages

Coils protection **IP65**

Mounting surface: **ISO 4401 size 06**
Max flow: **30 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DHL8 - 0	71	1	/WP	-	X	24 DC	**	/*

Directional control valves size 06
low leakage, compact execution

Valve configuration, see section 2
63 = single solenoid, 2 external positions, spring offset
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2.

Options: **A**, **WP**, see section 5

Seals material, see section 4:
- = NBR
PE = FKM

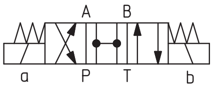
Series number

Voltage code, see section 6

X = without connector
See section 7 for available connectors, to be ordered separately

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)

710



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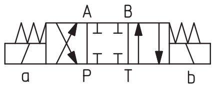

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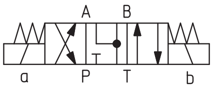
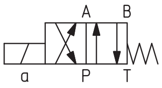
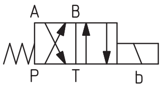


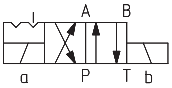
631/2



631/2/A



751/2



3 MAIN CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
Maximum flow	**30 l/min**, see Q/Δp diagram at section 8 and operating limits at section 9

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 6
Supply voltage tolerance	± 10%

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Fluid contamination class	ISO4406 class 20/18/15 NAS 1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

5 OPTIONS

Options

A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.

WP = prolonged manual override protected by rubber cap.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar

6 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil SDHL
12 DC	**12 DC**	666 or 667	29 W	COL-12DC
14 DC	**14 DC**			COL-14DC
24 DC	**24 DC**			COL-24DC
28 DC	**28 DC**			COL-28DC
110/50 AC (1)	**110/50/60 AC**		58 VA (3)	COL-110/50/60AC
230/50 AC (1)	**230/50/60 AC**			COL-230/50/60AC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.

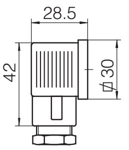
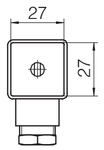
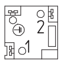
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately)

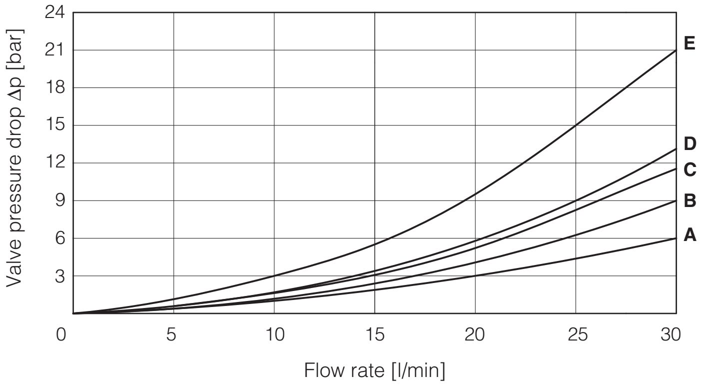
666 = standard connector IP-65, suitable for direct connection to electric supply source.

667 = as 666, but with built-in signal led.

<table>
<tr><th colspan="2">666, 667 (for AC or DC supply)</th><th colspan="2">CONNECTOR WIRING</th></tr>
<tr><td colspan="2" rowspan="4">   </td><td colspan="2">666, 667
1 = Positive ⊕
2 = Negative ⊖
⊕ = Coil ground</td></tr>
<tr><td colspan="2">SUPPLY VOLTAGES</td></tr>
<tr><td>666</td><td>667</td></tr>
<tr><td>All voltages</td><td>24 AC or DC
110 AC or DC
220 AC or DC</td></tr>
</table>

8 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

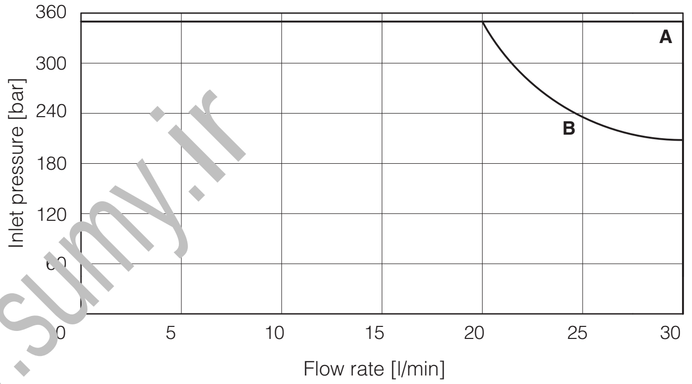
Spool type \ Flow direction	**P→A**	**P→B**	**A→T**	**B→T**	**P→T** center	**A→T B→T** center
0	A	A	A	A	E	
1	C	C	B	B		
1/2	D	B	D	B		
3	C	C	A	A		E



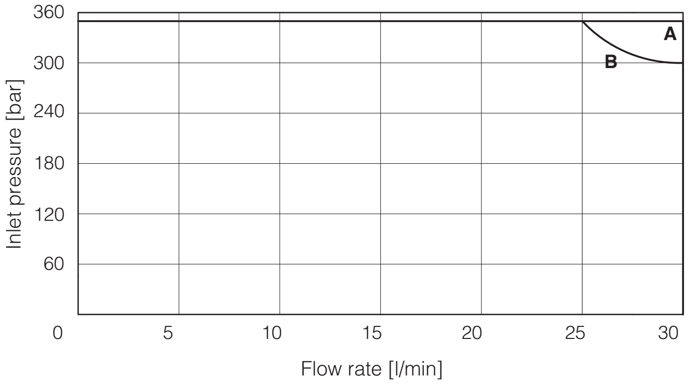
9 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V$_{nom}$ - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

Curve	**DC version, spool type**
A	1, 3
B	0, 1/2

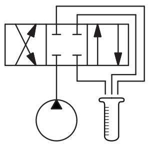


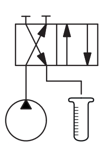
Curve	**AC version, spool type**
A	1, 1/2
B	0, 3

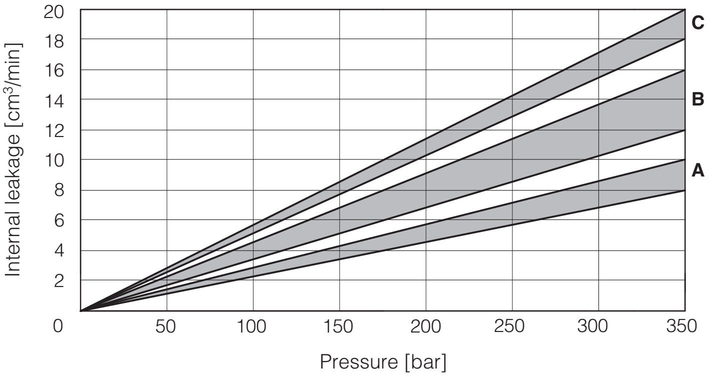


10 **INTERNAL LEAKAGES** based on mineral oil at viscosity 15 cSt

Spool type	center pos.	**P→A B→T**	**P→B A→T**
0		C	C
1	C	B	B
1/2		A	A
3	C	B	B







11 SWITCHING TIMES (average values in msec)

Test conditions: - 20 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- mineral oil: ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

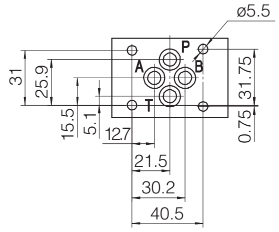
Switch-on AC	Switch-off AC	Switch-on DC	Switch-off DC
10-25	20-40	30-50	15-25

12 SWITCHING FREQUENCY

AC (cycles/h)	DC (cycles/h)
7200	15000

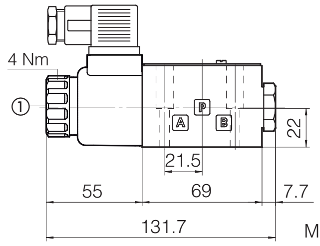
13 DIMENSIONS [mm]

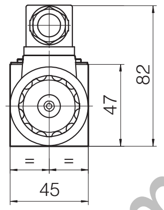
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts: 4 socket head screws:
M5x30 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)



P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

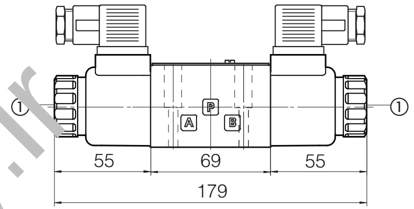
DHL8-06(DC)





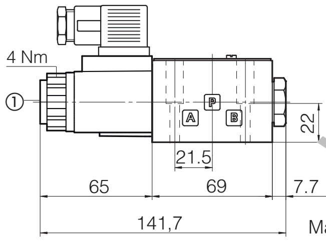
Mass: 1,3 kg

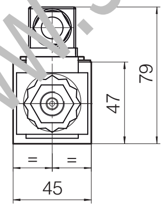
DHL8-07(DC)



Mass: 1,6 kg

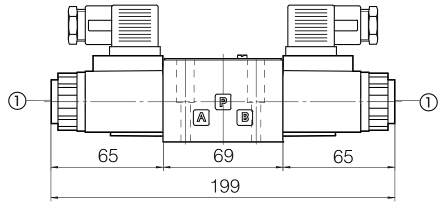
DHL8-06(AC)





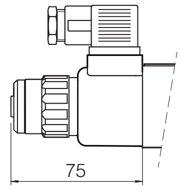
Mass: 1,2 kg

DHL8-07(AC)

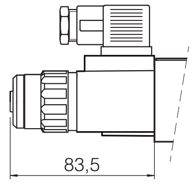


Mass: 1,4 kg

Option /WP
(DC version)



Option /WP
(AC version)



① Standard manual override PIN

⚠ The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

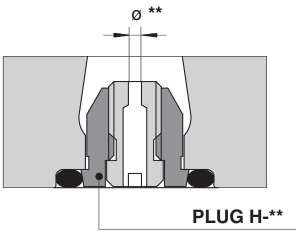
Overall dimensions refer to valves with connector 666

14 PLUG-IN RESTRICTOR (to be ordered separately)

The use of plug-in restrictors in valve's ports P or A or B may be necessary is case of particular conditions as long flexible hoses or the presence of accumulators which could cause at the valve switching instantaneous high flow peaks over the max valve's operating limits.

Ordering code: **PLUG H** - ******

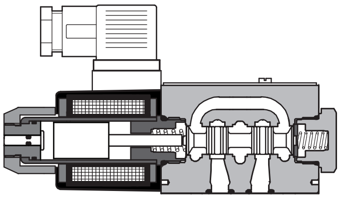
08, 10, 12, 15 calibrated orifice diameter in tenths of mm
Example PLUG-H-**12** = orifice diameter **1,2 mm**
Other orifice dimensions are available on request



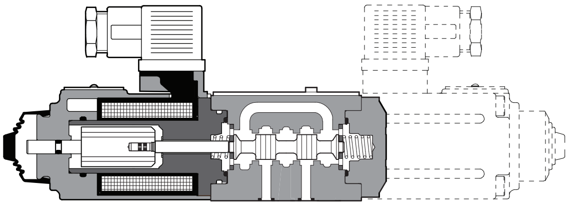
Solenoid directional valves with low power consumption

Direct operated, ISO 4401 size 06

Available only on request



DHE-0631/2/15W-X24DC



DHO-0611/8W-X24DC
DHO-0711/8W-X24DC (dotted line)

On-off directional valves derived from standard versions and equipped with low power consumption solenoids. They permits a considerable energy saving and they can be directly operated from the output stage of the machine control system (PLC I/O modules)

Two models are available:
- DHE, 15W power, spool type, max operating limits 40 l/min, 210 bar
- DHO, 8W power, spool type, max operating limits 50 l/min, 250 bar

For DHE the coils can be easily replaced without tools. The coils are fully encapsulated according to temperature class H.

Applicatons
Machine tools, marine system

Surface mounting ISO 4401 size 06

1 MODEL CODE OF SPOOL TYPE DIRECTIONAL VALVES

DHO - 0	61	1	/	8W	/	A	-	X	24DC	**	/*

Directional control valves
ISO 4401 size 06
DHE-0 = for DC supply
DHO-0 = for DC supply with improved performances

Valve configuration, see table 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
71 = double solenoid, 3 positions, spring centered
Other configurations are available on request

Spool type, see table 2

Solenoid power **15W** = for DHE **8W** = for DHO

Options
A = Solenoid mounted at side of port B (only for single solenoid valves).
In standard versions, solenoid is mounted at side of port A.

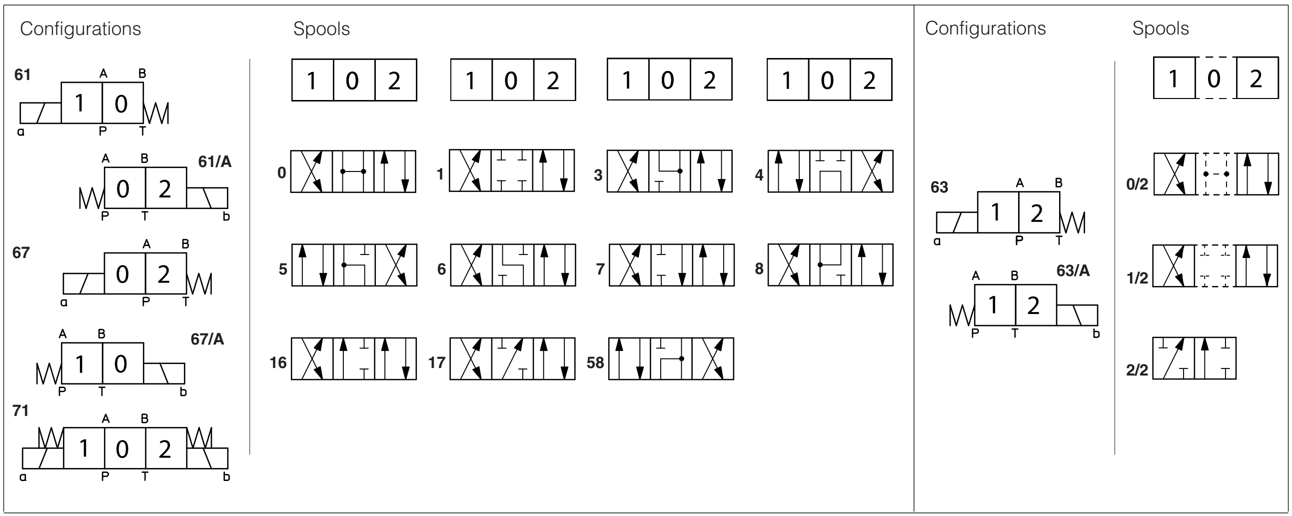
X = without connector
See note 1 at section 6 for available connectors, to be ordered separately

Voltage code
24DC = 24VDC

Series number

Seals material
- = NBR
PE = FKM

2 CONFIGURATIONS and SPOOLS



3 MAIN CHARACTERISTICS OF DHE /15W AND DHO /8W DIRECTIONAL VALVES

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524 .... 535; for other fluids see section 1
Recommended viscosity	15 ÷ 100 mm²/s at 40°C (ISO VG 15 ÷ 100)
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10, in line filters of 25 µm ($\beta_{25} \geq 75$ recommended)
Fluid temperature	-20°C +60°C (standard seals) -20°C +80°C (/PE seals)
Flow direction	As shown in the symbols of tables 2
Operating pressure **DHE, DHO**	Ports P,A,B: **350** bar; Port T: **210** bar
Rated flow	See diagrams Q/Δp at section 5
Maximum flow	**40 l/min** for DHE; **50 l/min** for DHO; see operating limits at section 6

3.1 Coils characteristics

Insulation class	**H** (180°C) Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Connector protection degree DIN 43650	IP 65
Relative duty factor	100%
Supply voltage tolerance	± 10%

4 NOTES

1 **Type of electric/electronic connector DIN 43650,** to be ordered separately

666 = standard connector IP-65, suitable for direct connection to electric supply source.
667 = as 666, but with built-in signal led.

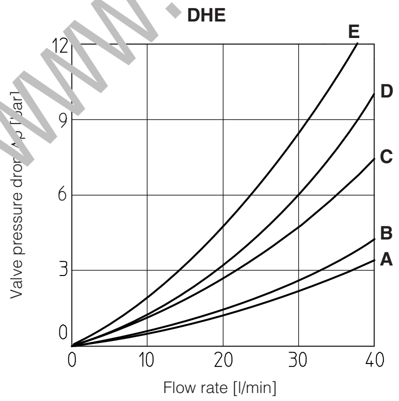
2 **Spools**

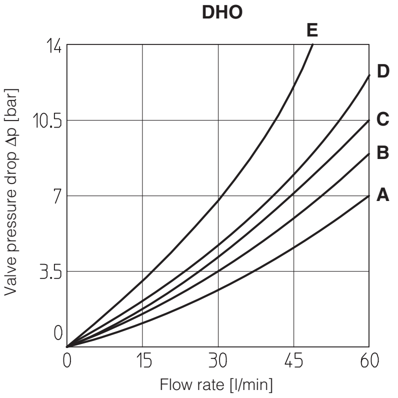
- spools type **0/2, 1/2** and **2/2** are only used for two position valves: single solenoid valves, type DH*-063*/2

5 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

Flow direction Spool type	P∅A	P∅B	A∅T	B∅T	P∅T
0, 0/1, 6, 7, 8	A	A	A	A	B
0/2, 1, 1/2, 2, 3	B	B	B	B	
4, 5	D	D	C	C	D
2/2	E	E			

Based on fluid viscosity of 43 mm²/s at 40°C.



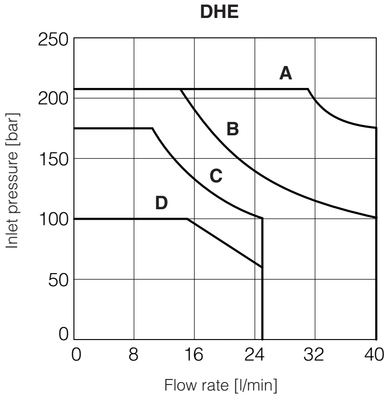


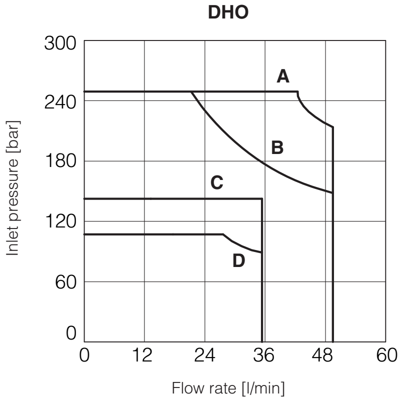
6 OPERATING LIMITS

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P∅A and B∅T). In case of asymmetric flow the operating limits must be reduced.

DHE, DHO

A = Spools 0, 1, 1/2, 8
B = Spools 0/2, 3, 6, 7
C = Spools 4, 5, 58, 16, 17
D = Spools 2/2

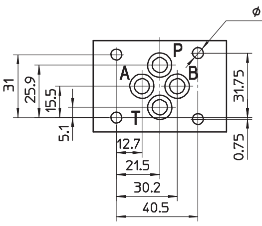




7 DIMENSIONS [mm]

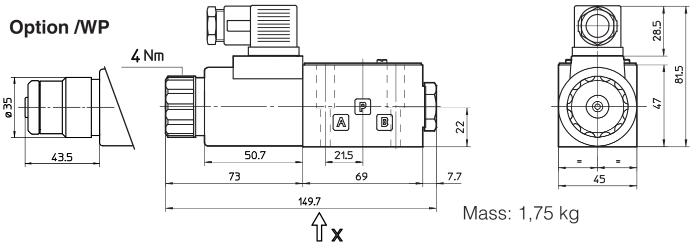
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
DHE: 4 socket head screws M5x30 class 12.9
DHO: 4 socket head screws M5x50 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max).

Overall dimensions refer to valves with connectors type 666



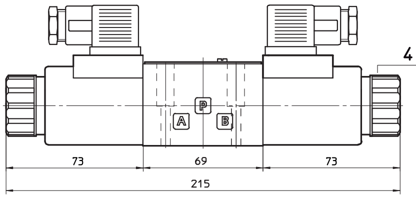
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
For the max pressures on ports, see section 5

DHE-06



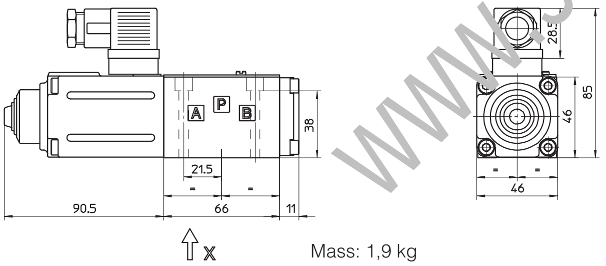
Mass: 1,75 kg

DHE-07



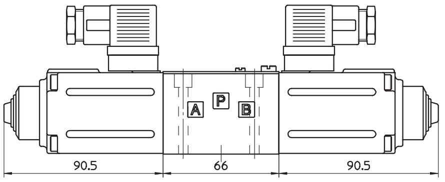
Mass: 2 kg

DHO-06



Mass: 1,9 kg

DHO-07



Mass: 2,6 kg

8 MOUNTING SUBPLATES

Model	Ports location	GAS Ports A-B-P-T	Ø Counterbore [mm] A-B-P-T	Mass [kg]
BA-202	Ports A, B, P, T underneath;	3/8"	–	1,2
BA-204	Ports P, T underneath; ports A, B on lateral side	3/8"	25,5	1,8
BA-302	Ports A, B, P, T underneath	1/2"	30	1,8

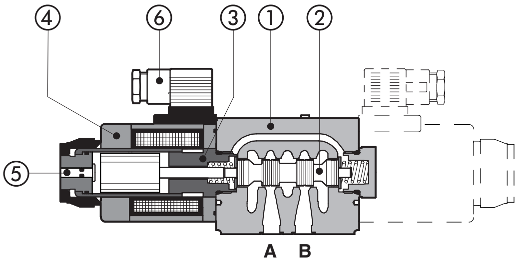
The subplates are supplied with 4 fastening bolts M5x50. Also available are multi-station subplates and modular subplates. For further details see table K280.

Solenoid directional valves type SDKL

direct operated, spool type, ISO 4401 size 10

Availability and price only on request

CE



SDKL-16*-DC

① Valve body
② Spool
③ Solenoid tube
④ Solenoid coil
⑤ Manual override pin
⑥ Electric connector (DIN43650) to be ordered separately

Spool type, two or three position direct operated valves size 10.

Wet type solenoids are made by:

- screwed tube ③, with integrated manual override pin ⑤
- interchangeable coils ④, specific for DC power supply, easily replaceable without tools - see section 6 for available voltages. Coils protection **IP65**.

Interchangeable spools ②, see section 2.

The valve body ① is 5 chamber type, made by shell-moulding casting with wide internal passages ensuring low pressure drops.

Mounting surface: **ISO 4401 size 10**
Max flow: **120 l/min**
Max pressure: **350 bar**

1 MODEL CODE

SDKL - 1 **61** **1** / **A** - **X** **24 DC** ** / *

Solenoid directional valves size 10 light execution

Valve configuration, see section 2
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
70 = double solenoid, 2 external positions, without springs
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2.

Options, see note 1 at section 4.

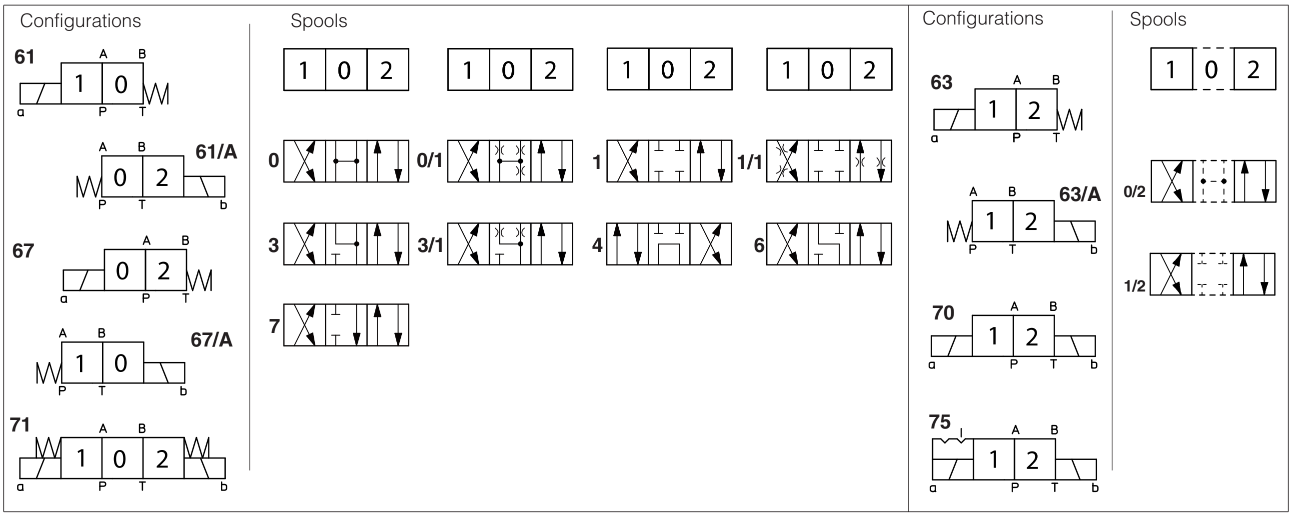
00-DC = DC solenoids without coils
X = standard coil without connector

Voltage code, see section 6

Series number

Seals material, see section 4:
- = NBR
PE = FKM

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



2.1 Special spools

- spools type **0/1** and **3/1** have restricted oil passages in central position, from user ports to tank.
- spool type **1/1** is properly shaped to reduce the water-hammer shocks during the switching.

3 MAIN CHARACTERISTCS

Assembly position / location	Any position for all valves except for type - 170* (without springs) that must be installed with horizontal axis if operated by impulses
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T **210** bar;
Rated flow	See diagrams Q/Δp at section 8
Maximum flow	**120 l/min**, see operating limits at section 9

3.1 Coils characteristics

Insulation class	**H** (180°C) Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 6
Supply voltage tolerance	± 10%

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

5 OPTIONS

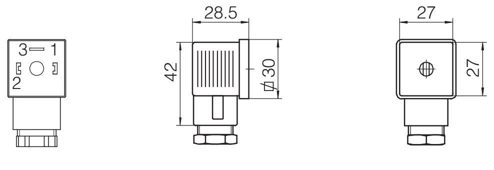
A = Solenoid mounted at side of port B (only for single solenoid valves). In standard versions, solenoid is mounted at side of port A.
WP = prolonged manual override protected by rubber cap - see section 12.

6 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption	Code of spare coil
12 DC	**12 DC**	666	38 W	CAL-12DC
24 DC	**24 DC**	or		CAL-24DC
28 DC	**28 DC**	667		CAL-28DC

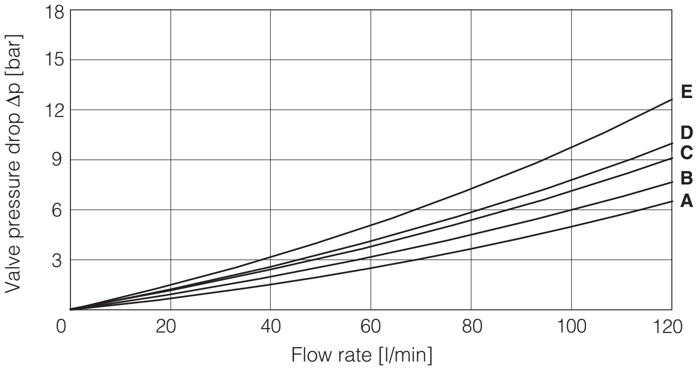
7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately)

666 = standard connector IP-65 for direct connection to electric supply source.
667 = as 666, but with built-in signal led.

666, 667	**CONNECTOR WIRING**
	**666, 667** 1 = Positive ⊕ 2 = Negative ⊖ ⏚ = Coil ground **SUPPLY VOLTAGES** **666** All voltages **667** only for 24 DC

8 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

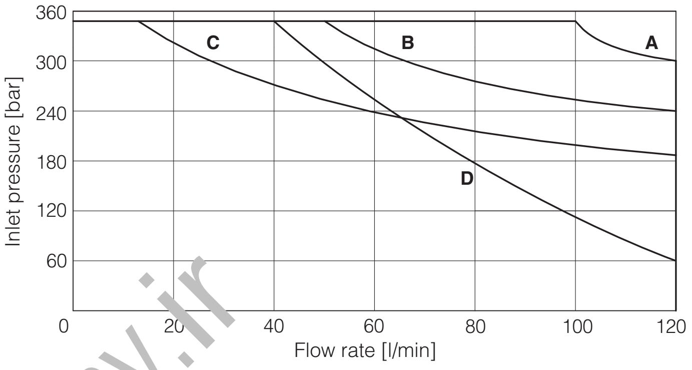
Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
0, 0/1, 0/2	A	A	B	B	
1, 1/1, 6	A	A	D	C	
3, 3/1, 7	A	A	C	D	
4	B	B	B	B	E
1/2	B	C	C	B	



9 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

Curve	Spool type
A	0/2, 1/1, 1/2, 3/1
B	1, 3
C	0, 0/1, 6, 7
D	4



10 **SWITCHING TIMES** (average values in msec)

Valve	Switch-on	Switch-off
SDKL + 666 / 667	60	35

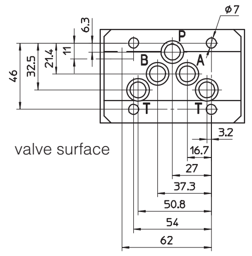
Test conditions:
- 50 l/min; 150 bar
- nominal supply voltage
- 2 bar of back pressure on port T
- mineral oil ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

11 **SWITCHING FREQUENCY**

Valve	DC (cycles/h)
SDKL + 666 / 667	15000

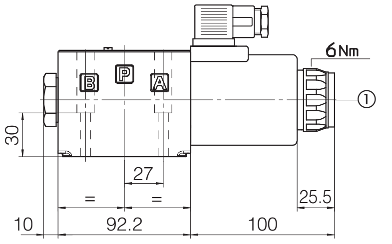
12 **INSTALLATION DIMENSIONS [mm]**



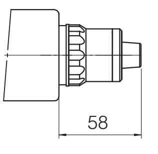
ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050 and 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
For the max pressures on ports, see section 3

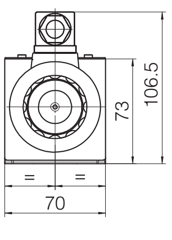
SDKL-16*-DC



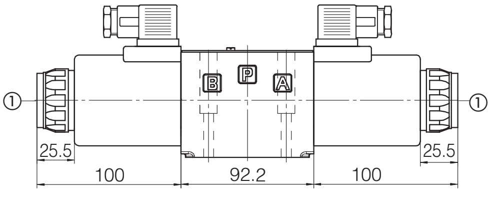
Mass: 4,5 kg



Option /WP



SDKL-17*-DC



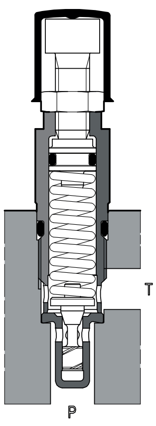
Mass: 6,1 kg

① Standard manual override PIN. The manual override operation can be possible only if the pressure at T ports is lower than 50 bar

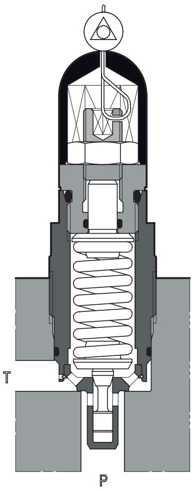
Cartridge pressure relief valves type CART

screw-in mounting, direct operated

CE



CART M-5/***



CART M-6/*/RS**

CART are screw-in, direct operated pressure relief valves.
They are used to limit the max pressure in the hydraulic systems or to protect part of the circuit from overpressure.
They are available in six sizes for different flow and pressure ranges.

The cartridge execution is specifically designed to reduce the dimension of blocks and manifolds, without penalizing the functional characteristics.

Option **RS**, conforms to the Machine Directive (2006/42/CE), with factory preset and lead sealed regulation.
The factory pressure setting required by the costumer corresponds to the valve's cracking pressure.

Max flow: **150 l/min**
Max pressure: up to **420 bar**

1 MODEL CODE

CART **M-6** / **420** / **RS** / * ** / *

CART
Screw-in relief cartridges

Size:
M-3 = G1/2 **(1)**
M-4 = M14x1
M-5 = M20x1,5
M-6 = M33x1,5 **(1)**
ARE-15 = M32x1,5
ARE-20 = M35x1,5 **(1)**

Max pressure:
see section 3

Options:
see section 5 for options availability and combination:
R = leak free execution **(2)**
RS = leak free execution plus lead sealed regulation conforming to 2006/42/CE

Manual override only for standard and /R option **(3)**:
V = regulating handwheel
VF = regulating knob
VS = regulating knob with safety locking

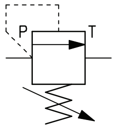
Only for RS option:
280 = factory pressure setting to be defined by the customer
min step: 1 bar - min pressure setting: 25 bar
(example 280 = 280 bar)

Series number

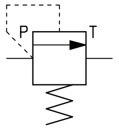
Seals material,
see section 4:
- = NBR
PE = FKM
BT = HNBR

For **PED** version see technical table CY010
(1) Available also in stainless steel execution, see technical table CW010
(2) Standard execution of CART M-4 and CART ARE-20 provides the leak free feature, then the /R is always present in the valve model code, with the exception in case of RS options
(3) For handwheel and knob features, see sections 7, 8. For their availability see section 5

2 HYDRAULIC SYMBOLS



CART
CART **/R



CART **/RS

3 HYDRAULIC CHARACTERISTICS

Valve model		CART M-3	CART M-4	CART M-5	CART M-6	CART ARE-15	CART ARE-20
Max pressure setting [bar]	**STANDARD**	50 100 210 350 420	100 210 350 420	50 100 210 250 350	50 100 210 350 500	15 50 75 150 250 350 420	50 100 210 315 400
	R				50 100 210 350 500	15 50 75 150 250 420	
	RS		220 270 350		220 270 330 350	150 190 230	
Pressure range [bar]	**STANDARD (1)**	4÷50 6÷100 7÷210 8÷350 15÷420	6÷100 7÷210 8÷350 15÷420	2÷50 3÷100 5÷210 7÷250 8÷350	2÷50 3÷100 8÷210 15÷350 15÷500	2÷15 3÷50 4÷75 8÷150 8÷250 8÷350 15÷420	3÷50 5÷100 6÷210 8÷315 10÷400
	R (1)				2÷50 3÷100 10÷210 15÷350 15÷500	2÷15 3÷50 4÷75 8÷150 8÷250 15÷420	
	RS (1)		210÷260 260÷300 300÷370		200÷250 250÷290 290÷350 310÷370	130÷170 170÷210 210÷250	
Max pressure on port T [bar]		50	50	50	50	50	50
Max flow [l/min]	**STANDARD, R**	2,5	15	35	40	75	120
	RS		15		60	100	

(1) The values correspond to the min and max regulation of the valve's craking pressure

4 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog

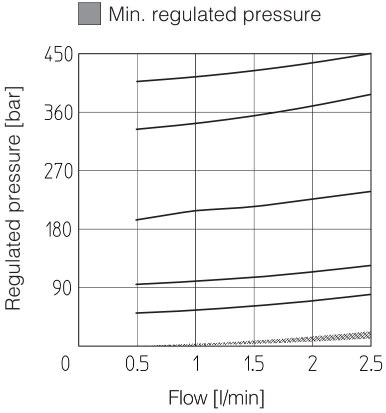
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

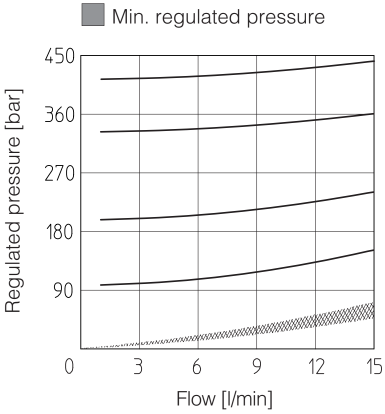
5 OPTIONS AVAILABILITY

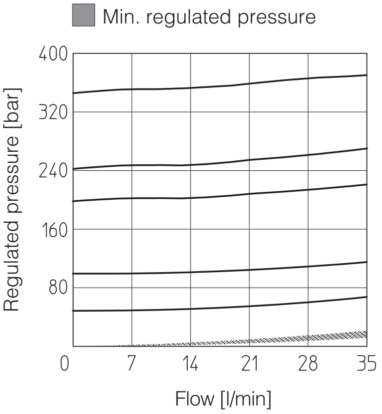
Valve model		CART M-3	CART M-4	CART M-5	CART M-6	CART ARE-15	CART ARE-20
Option	**/R**		STANDARD		●	●	STANDARD
	/RS		●		●	●	
	/V	●			●	●	●
	/VF				●	●	
	/VS				●	●	
Combinated option (1)	**/RV**				●	●	●
	/RVF				●	●	
	/RVS				●	●	

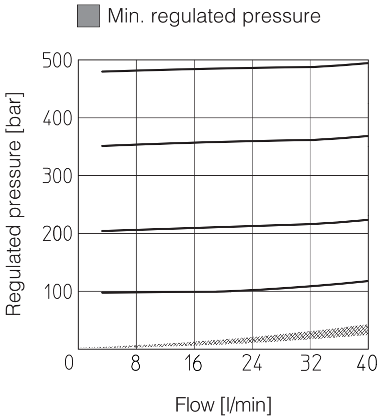
(1) RV = leak free and regulating handwheel
RVF = leak free and regulating knob
RVS = leak free and regulating knob with safety lock

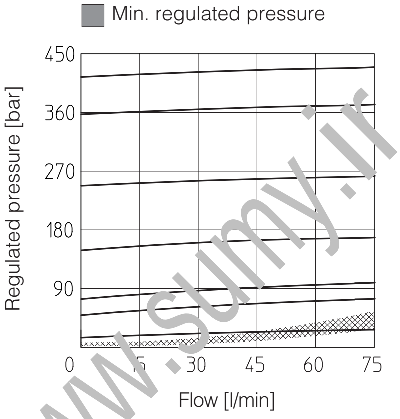
6 **REGULATED PRESSURE VERSUS FLOW DIAGRAMS** (based on mineral oil ISO VG 46 at 50°C)

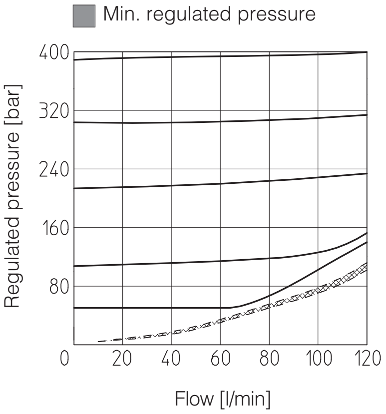

CART M-3

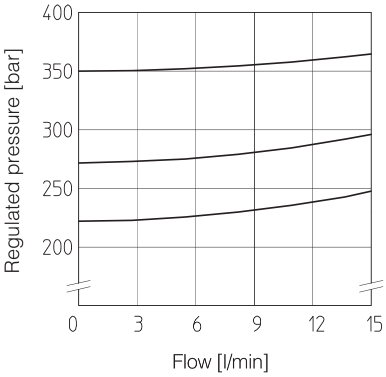

CART M-4 **/R

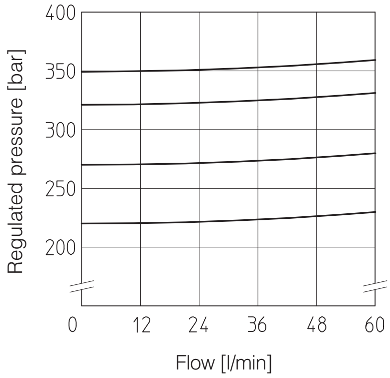

CART M-5

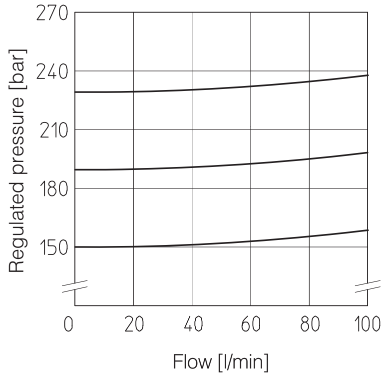

CART M-6


CART ARE-15


CART ARE-20 **/R

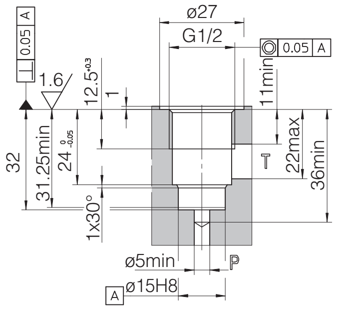

CART M-4 **/RS


CART M-6 **/RS

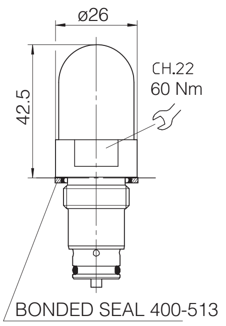

CART ARE-15 **/RS

7 CAVITY AND DIMENSIONS FOR CART M-3, M-4 AND M-5 [mm]

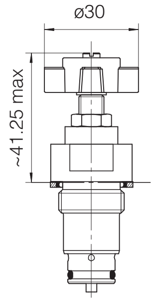
CART M-3



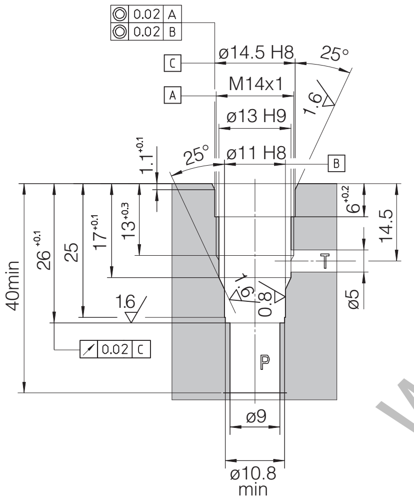
Standard



Option /V

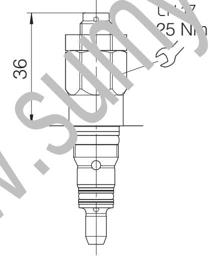


CART M-4

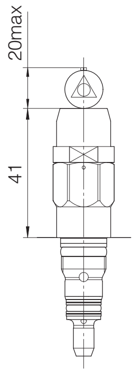


Cavity drawing not in scale
with the cartridge

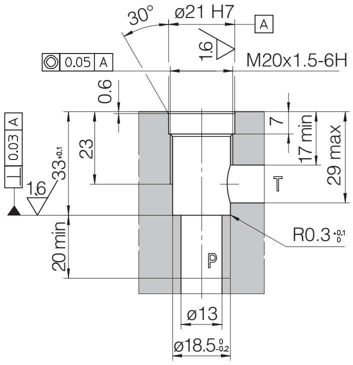
Standard



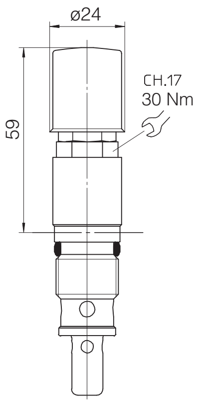
Option /RS



CART M-5

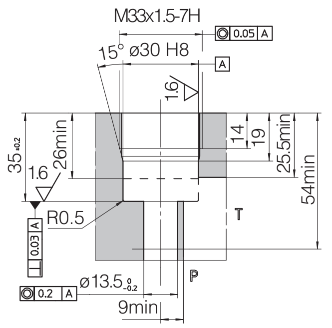


Standard

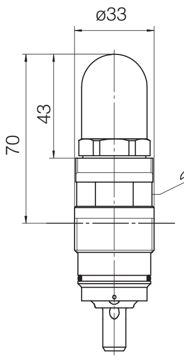


8 CAVITY AND DIMENSIONS FOR CART M-6, CART ARE-15 AND ARE-20 [mm]

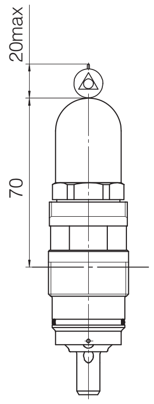
CART M-6



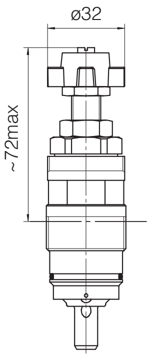
Standard



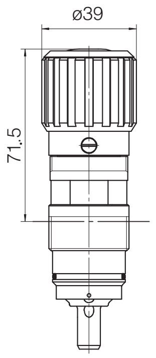
Option /RS



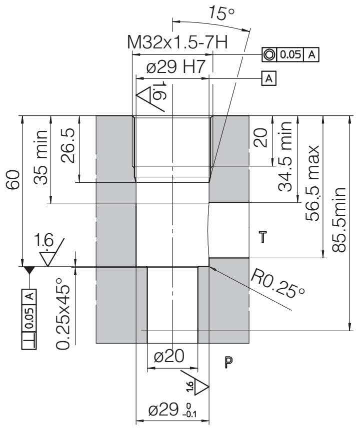
Option /V



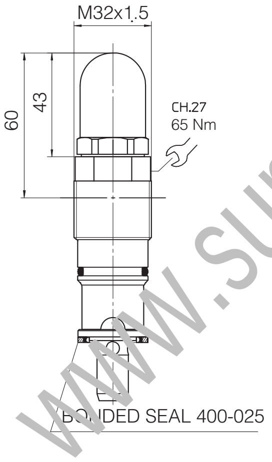
Option /VF /VS



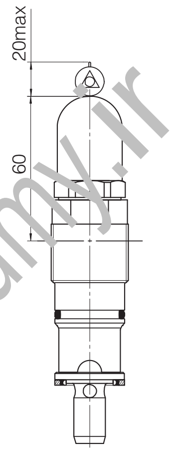
CART ARE-15



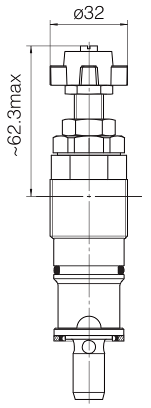
Standard



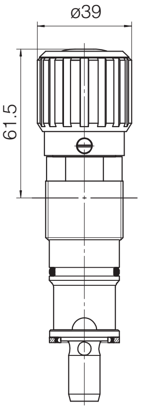
Option /RS



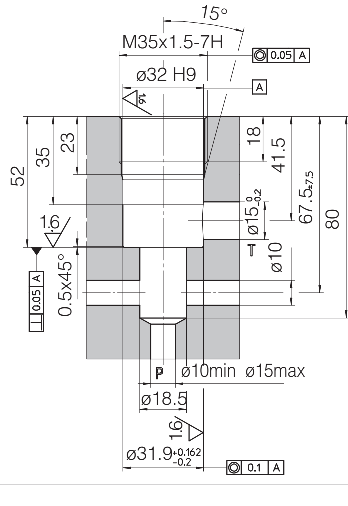
Option /V



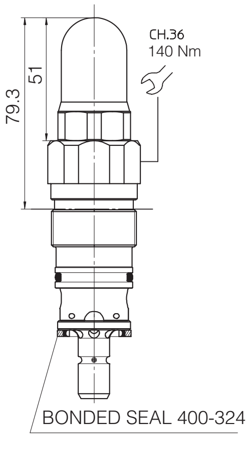
Option /VF /VS



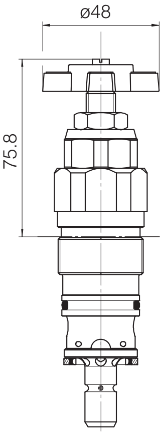
CART ARE-20



Standard

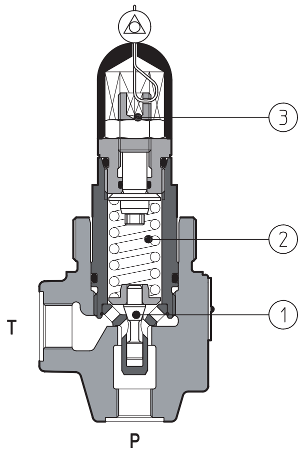


Option /V

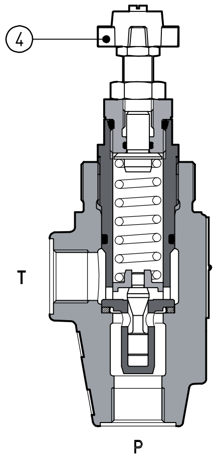


Pressure relief valves type ARE

direct operated, in line mounting



ARE-06-*/RS**



ARE-15-*/V**

ARE are poppet type, directed operated pressure relief valves, with threaded ports for in line mounting.

The flow P→T is permitted when pressure force acting on the poppet ① overcomes the force of the spring ②.

Regulation is operated by means of a screw ③ or optionally by means of a handwheel ④ acting on the spring.

Clockwise rotation increases the pressure.

These valves are available in two sizes, with port P=G 1/4" or G 1/2".

Option **RS**, conforms to the Machine Directive (2006/42/CE), with factory preset and lead sealed regulation.
The factory pressure setting required by the costumer corresponds to the valve's cracking pressure.

Max flow: **100 l/min**:
Max pressure: ARE-06 up to **500 bar**
ARE-15 up to **420 bar**

1 MODEL CODE

ARE	-	06	/	350	/	RS	/	*	**	/	*

ARE = pressure relief valve with thread connections

Available also in cartridge execution, see tab. C010

Size:
06 = port P G 1/4"
15 = port P G 1/2"

Max pressure:
see section 3

Options **(2)**:
R = leak free execution **(2)**
RS = leak free execution plus lead sealed regulation conforming to 2006/42/CE

Manual override only for standard and /R option:
V = regulating handwheel
VF = regulating knob
VS = regulating knob with safety locking

Only for RS options:
280 = factory pressure setting to be defined depending to the customer requirement (example 280 = 280 bar)

Series number

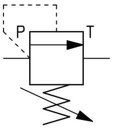
Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

For **PED** version see technical table CY020

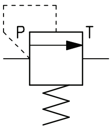
(1) Possible combined options:
RV = reduced leakages and regulating handweel
RVF = reduced leakages and regulating knob
RVS = reduced leakages and regulating knob with safety locking

2 HYDRAULIC SYMBOLS

Hydraulic symbol



ARE-06
ARE-15



ARE-06 **/RS
ARE-15 **/RS

3 HYDRAULIC CHARACTERISTICS

Valve model		ARE-06					ARE-15						
Max pressure setting [bar]	**Standard**	50	100	210	350	500	15	50	75	150	250	350	420
	/R	50	100	210	350	500	15	50	75	150	250	420	
	/RS	220	270	330	350				150	190	230		
Pressure range [bar]	**Standard**	2÷50	3÷100	10÷210	15÷350	30÷500	2÷15	3÷50	4÷75	8÷150	8÷250	30÷350	30÷420
	/R (1)	2÷50	3÷100	10÷210	15÷350	30÷500	2÷15	3÷50	4÷75	8÷150	8÷250	30÷420	
	/RS (1)	200÷250	250÷290	290÷350	310÷370				130÷170	170÷210	210÷250		
Max pressure port T [bar]		50					50						
Max flow [l/min]	**Standard, /R**	40					75						
	/RS	60					100						

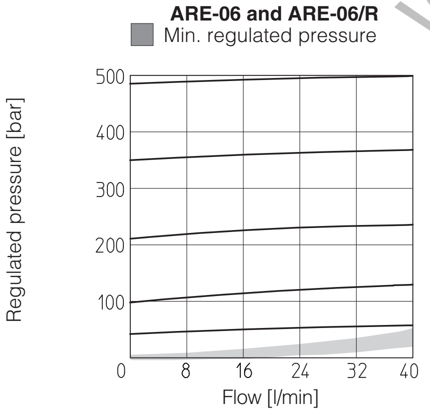
(1) The values correspond to the min and max regulation of the valve's craking pressure

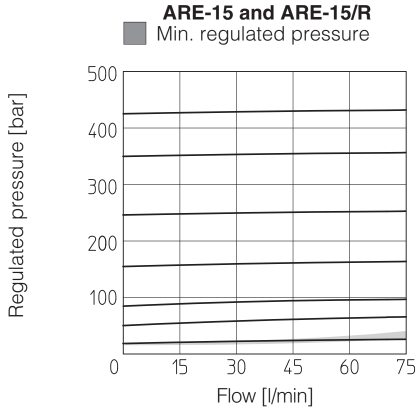
4 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

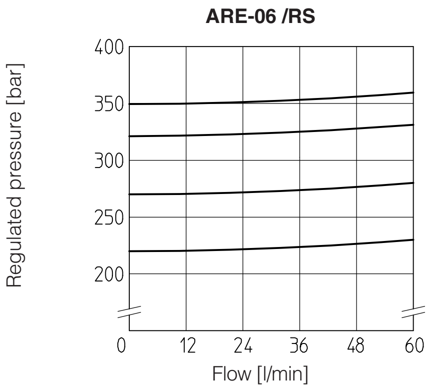
Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Fluid contamination class	ISO 4406 class 21/19/16 NAS 1638 class 10, in line filters of 25 μm (β25 ≥75 recommended)

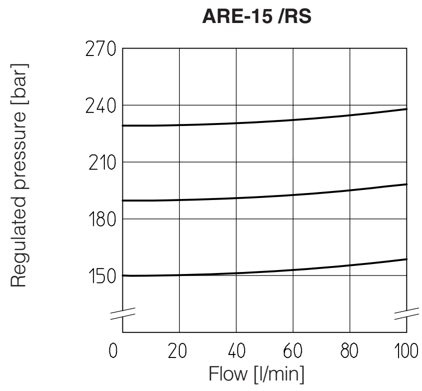
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

5 REGULATED PRESSURE VERSUS FLOW DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)


ARE-06 and ARE-06/R


ARE-15 and ARE-15/R

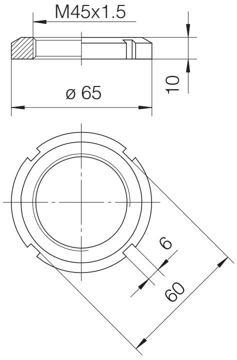

ARE-06 /RS

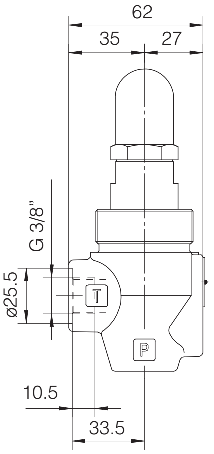

ARE-15 /RS

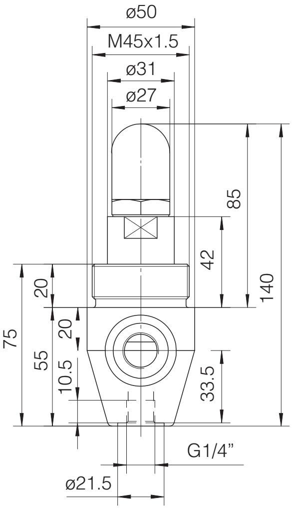
6 DIMENSIONS [mm]

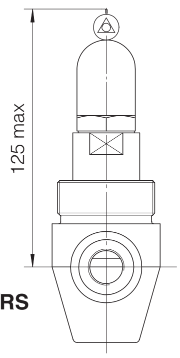
ARE-06

P = INLET PORT G 1/4”
T = OUTLET PORT G 3/8”
Locking ring for fastening the valve.
Model code: SP-6-RE-310030

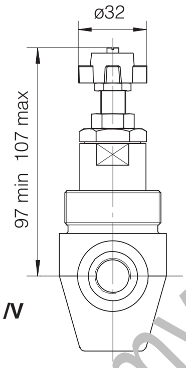




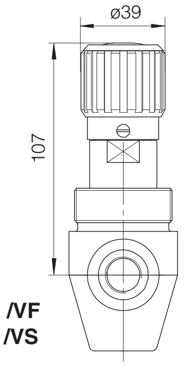




Option /RS



Option /V

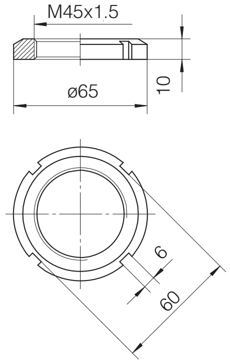


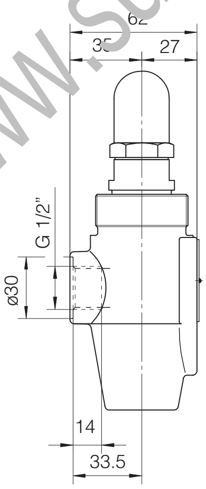
Option /VF
/VS

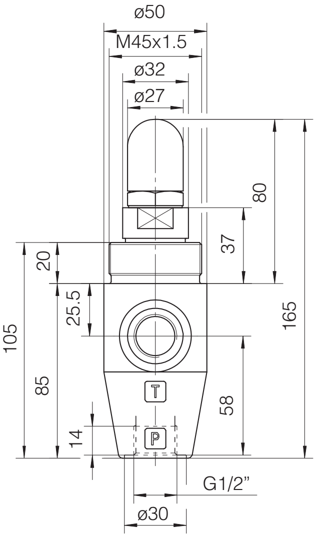
Mass: 1 Kg

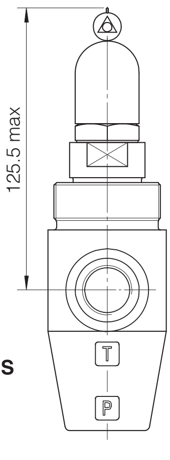
ARE-15

P = INLET PORT G 1/2”
T = OUTLET PORT G 1/2”
Locking ring for fastening the valve.
Model code: SP-6-RE-310030

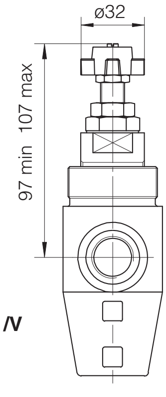




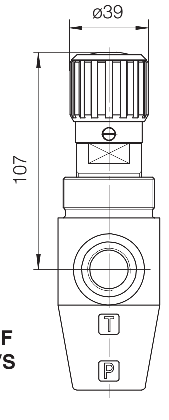




Option /RS



Option /V



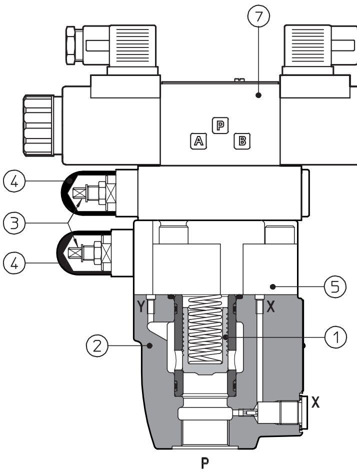
Option /VF
/VS

Note:
For handwheel features, see technical table K150.

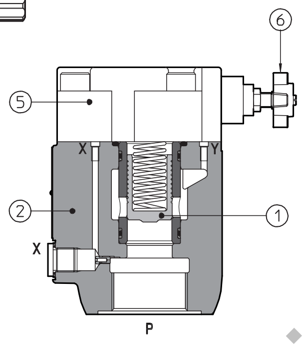
Mass: 1,3 Kg

Pressure relief valves type ARAM

two stage, in line mounting - G 3/4" and G 1¹/₄" threaded ports



ARAM-20/20...-E



ARAM-32..../V

ARAM are two stage pressure relief valves with balanced poppet, designed with threaded ports for in-line mounting.

In standard versions the piloting pressure of the poppet ① of the main stage ② is regulated by means of a grub screw ③ protected by cap ④ installed in the cover ⑤.

Optional versions with setting adjustment by handwheel ⑥ instead of the grub screw are available on request.
Clockwise rotation increases the pressure.

ARAM can be equipped with a pilot solenoid valve ⑦ for venting or for different pressure setting, type:

- DHE for AC and DC supply, high performances with **cURus** certified solenoids
- DHL for AC and DC supply, compact execution

Threaded ports: **G 3/4", G 1¹/₄"**
Max flow: **350, 500 l/min**
Max pressure up to **350 bar**

1 MODEL CODE

ARAM - **20** / **20** / **210** / **100/100** / **V** - **E** **X** **24DC** ****** / *****

ARAM = pressure relief valve threated port connections

Size:
20= port P - G 3/4"
32= port P - G 1¹/₄"

Setting pressure and venting option **(1)**:
- =one setting pressure without option
10=one setting pressure with venting, with de-energized solenoid
11=one setting pressure with venting, with energized solenoid
20=two setting pressure with venting, with de-energized solenoid
21=two setting pressure with venting, with energized solenoid
22=two setting pressure without venting
32=three setting pressure without venting

Setting: see section 4 for available setting

Pressure range of second/third setting **(1)**:

50 = 4÷50 bar	**100** = 6÷100 bar
210 = 7÷210 bar	**350** = 8÷350 bar

Options, see section 7
E **V** **WP** **Y**

Pilot valve **(1)**:
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids
L = DHL for AC and DC supply, compact execution

X = without connector **(1):**
See section 10 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Voltage code, see section 6 **(1)**:

Series number

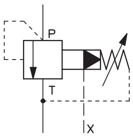
Seals material, see section 11 :
- = NBR
PE = FKM
BT = HNBR **(2)**

For **PED** version see technical table CY045

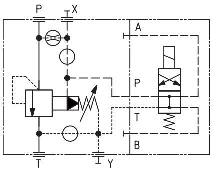
(1) Only for ARAM with solenoid valve for venting and/or for the selection of the setting pressure.
(2) Not available for -L version (DHL pilot valve)

2 HYDRAULIC SYMBOL

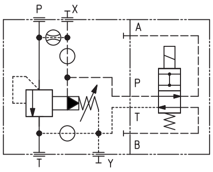
ARAM



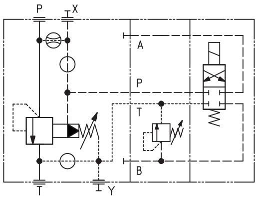
ARAM-/10**

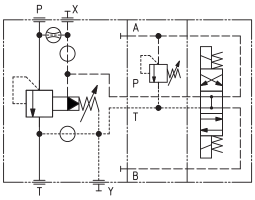


ARAM-/11**

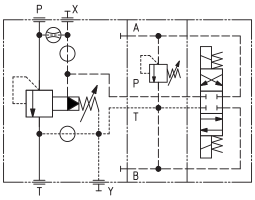


ARAM-/22**

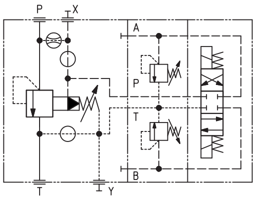




ARAM-/20**



ARAM-/21**



ARAM-/32**

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Valve model	**ARAM-20**	**ARAM-32**
Setting [bar]	50; 100; 210; 350	
Pressure range [bar]	4÷50; 6÷100; 7÷210; 8÷350	
Max pressure [bar]	Ports P, X = 350 Ports T, Y = 210 (without pilot solenoid valve) For version with pilot solenoid valve, see technical tables E015 and E018	
Max flow [l/min]	350	500

5 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard - only for DHE pilot valve

6 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	-EX Power consumption (2)	-LX Power consumption (2)	Code of spare coil -EX	Code of spare coil -LX
12 DC	**12 DC**	666 or 667	30W	29W	COE-12DC	COL-12DC
14 DC	**14 DC**				COE-14DC	COL-14DC
110 DC	**110 DC**				COE-110DC	COL-110DC
220 DC	**220 DC**				COE-220DC	COL-220DC
110/50 AC (1)	**110/50/60 AC**	666 or 667	58VA (3)	58VA (3)	COE-110/50/60AC	COL-110/50/60AC
115/60 AC	**115/60 AC**		80VA (3)		COE-115/60AC	COL-115/60AC
230/50 AC (1)	**230/50/60 AC**		58VA (3		COE-230/50/60AC	COL-230/50/60AC
230/60 AC	**230/60 AC**		80VA (3)		COE-230/60AC	COL-230/60AC

(1) For other supply voltages available on request see technical tables E015, E018.

(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHL) and 58 VA (DHE)

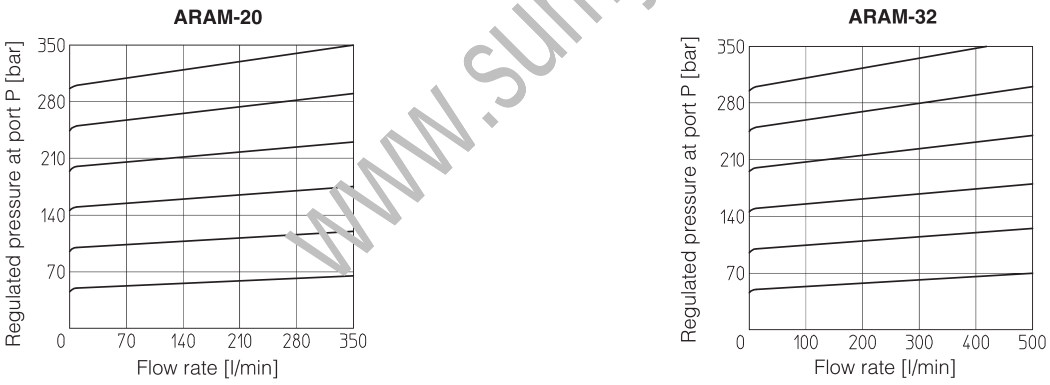
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

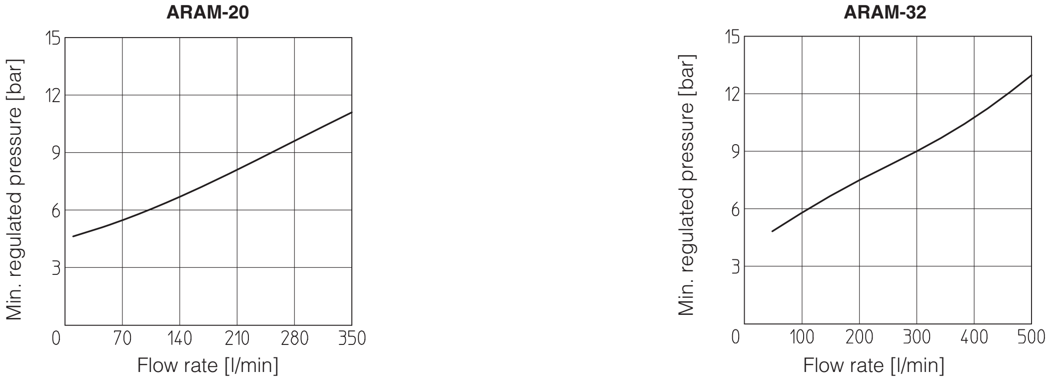
7 OPTIONS

/E = external pilot
/V = regulating handwheel instead of grub screw protected by cap (for handwheel features, see table K150)
/WP = prolunged manual override protected by rubber cap (only for ARAM with pilot solenoid valve)
/Y = external drain (only for ARAM with pilot solenoid valve)

8 REGULATED PRESSURE VERSUS FLOW DIAGRAMS based on mineral oil ISO VG 46 at 50°C



9 MINIMUM PRESSURE VERSUS FLOW DIAGRAMS based on mineral oil ISO VG 46 at 50°C



10 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 for ARAM with solenoid valve (to be ordered separately, see tech table K800)

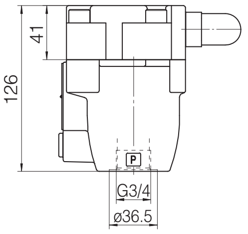
666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC

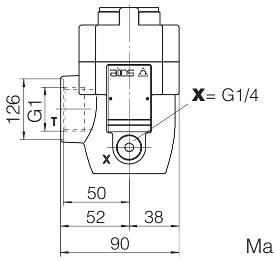
11 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, reccomended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

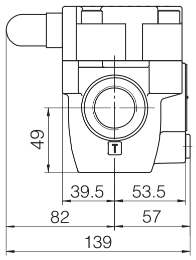
12 DIMENSIONS [mm]

ARAM-20

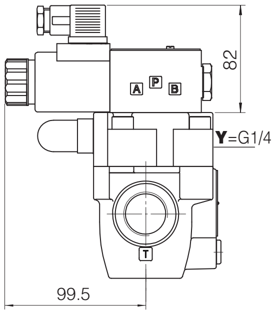




Mass: 3,9 Kg

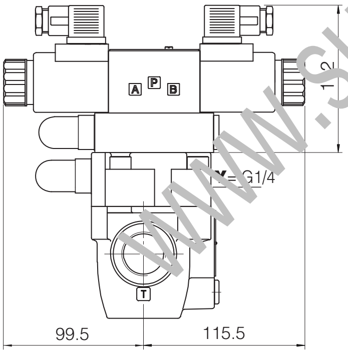


X = port connection for external pilot
Y = port connection for external drain



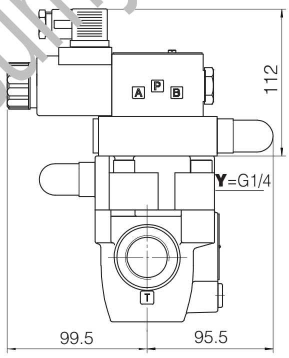
ARAM-20/10/-EX**
ARAM-20/11/-EX**

Mass: 5,7 Kg



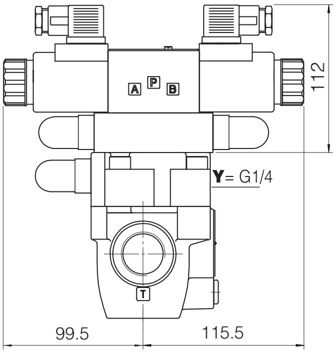
ARAM-20/20/-EX**
ARAM-20/21/-EX**

Mass: 7,7 Kg



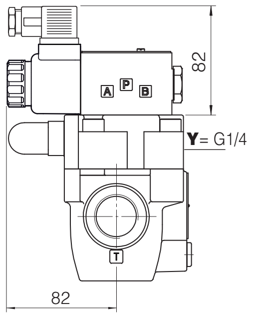
ARAM-20/22/-EX**

Mass: 7,2 Kg



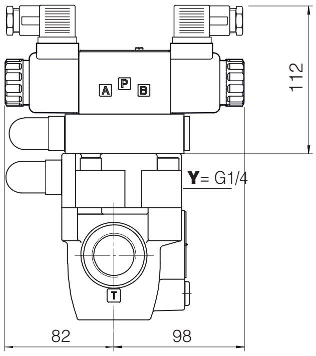
ARAM-20/32/-EX**

Mass: 8 Kg



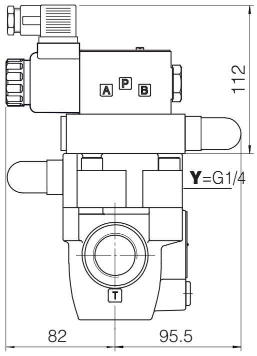
ARAM-20/10/-LX**
ARAM-20/11/-LX**

Mass: 5,5 Kg



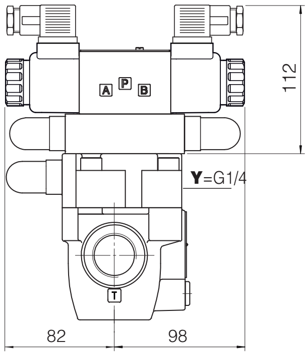
ARAM-20/20/-LX**
ARAM-20/21/-LX**

Mass: 7,3 Kg



ARAM-20/22/-LX**

Mass: 7 Kg

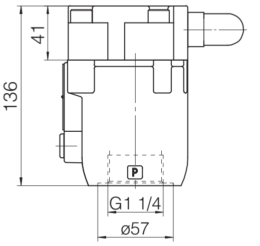


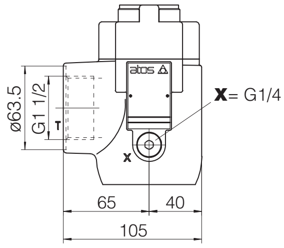
ARAM-20/32/-LX**

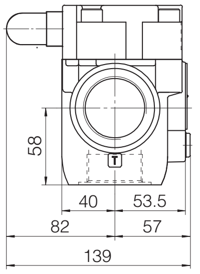
Mass: 7,6 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

ARAM-32

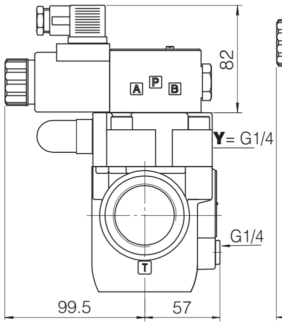






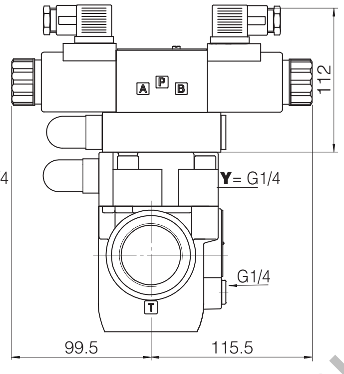
X = port connection for external pilot
Y = port connection for external drain

Mass: 4,7 Kg



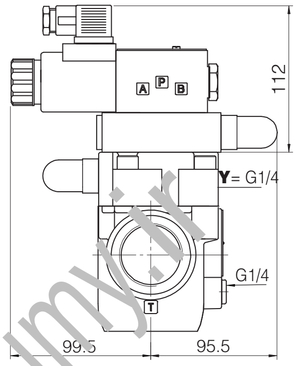
ARAM-32/10/-EX**
ARAM-32/11/-EX**

Mass: 6,5 Kg



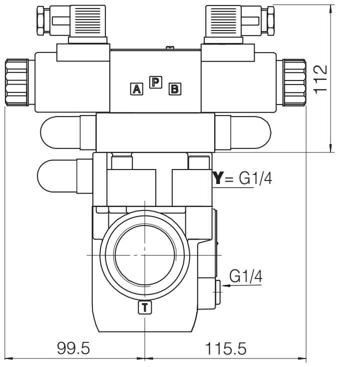
ARAM-32/20/-EX**
ARAM-32/21/-EX**

Mass: 8,5 Kg



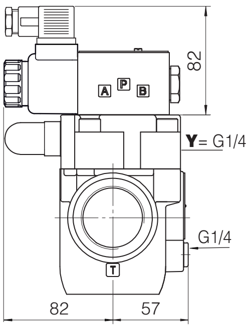
ARAM-32/22/-EX**

Mass: 7,9 Kg



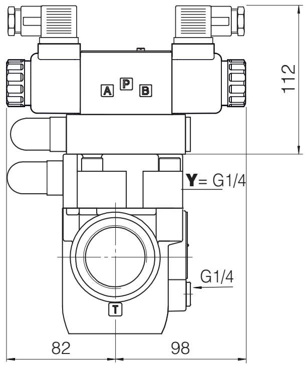
ARAM-32/32/-EX**

Mass: 8,8 Kg



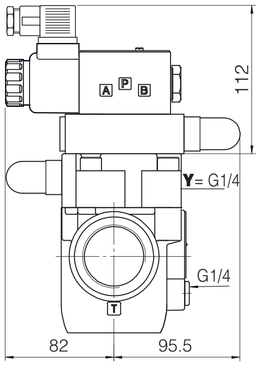
ARAM-32/10/-LX**
ARAM-32/11/-LX**

Mass: 6,3 Kg



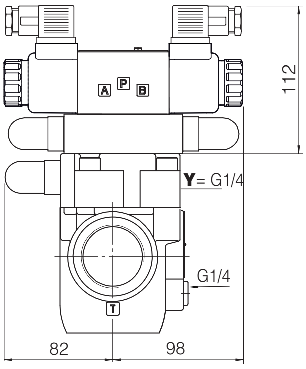
ARAM-32/20/-LX**
ARAM-32/21/-LX**

Mass: 8,1 Kg



ARAM-32/22/-LX**

Mass: 7,7 Kg



ARAM-32/32/-LX**

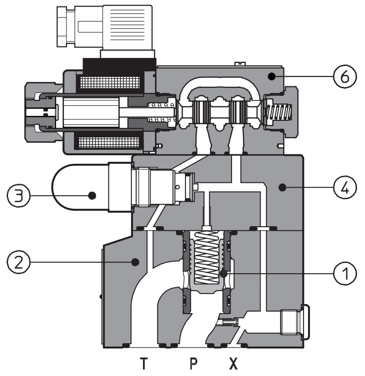
Mass: 8,4 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

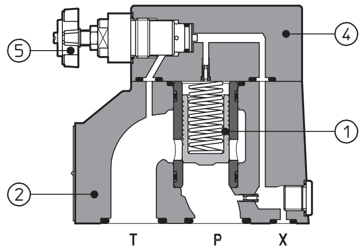
Pressure relief valves type AGAM

two stage, subplate mounting - ISO 6264 size 10, 20 and 32

CE



AGAM-10/11...-E



AGAM-20/..../V

AGAM are two stage pressure relief valves with balanced poppet, designed to operate in oil hydraulic systems.

In standard versions the piloting pressure of the poppet ① of the main stage ② is regulated by means of a grub screw protected by cap ③ in the cover ④.

Optional versions with setting adjustment by handwheel ⑤ instead of the grub screw are available on request.

Clockwise rotation increases the pressure.

AGAM can be equipped with a pilot solenoid valve ⑥ for venting or for different pressure setting type:

- DHE for AC and DC supply, high performances with **cURus** certified solenoids
- DHL for AC and DC supply, compact execution

Mounting surface: **ISO 6264 size 10, 20** and **32**
Max flow: **200, 400** and **600 l/min**
Max pressure up to **350 bar**

1 MODEL CODE

AGAM	-	20	/	20	/	210	/	100/100	/	V	-	E	X	24DC	**	/	*

AGAM = pressure relief valve subplate mounting

Size:
10 20 32

Setting pressure and venting option:
- = one setting pressure without option
10 = one setting pressure with venting, with de-energized solenoid
11 = one setting pressure with venting, with energized solenoid
20 = two setting pressure with venting, with de-energized solenoid
21 = two setting pressure with venting, with energized solenoid
22 = two setting pressure without venting
32 = three setting pressure without venting

Setting: see section 3 for available setting **(1)**

Pressure range of second/third setting **(1)**:
50 = 4÷50 bar **100** = 6÷100 bar
210 = 7÷210 bar **350** = 8÷350 bar

Options, see section 7
E V WP Y

Pilot valve **(1)**:
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids
L = DHL for AC and DC supply, compact execution

X = without connector **(1):**
See section 10 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Voltage code, see section 6 **(1)**:

Series number

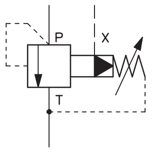
Seals material, see section 11:
- = NBR
PE = FKM
BT = HNBR **(2)**

For **PED** version see technical table CY066

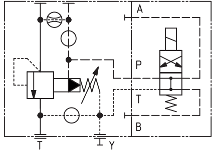
(1) Only for AGAM with solenoid valve for venting and/or for the selection of the setting pressure
(2) Not available for -L version (DHL pilot valve)

2 HYDRAULIC SYMBOLS

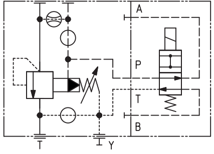
AGAM



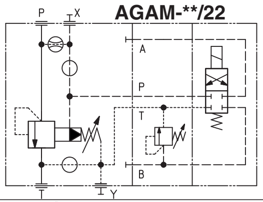
AGAM-/10**

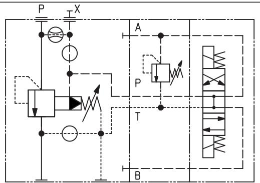


AGAM-/11**

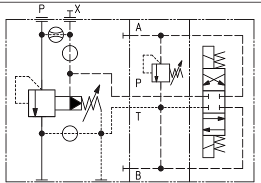


AGAM-/22**

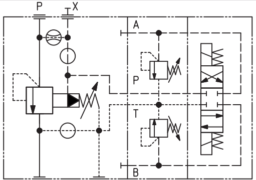




AGAM-/20**



AGAM-/21**



AGAM-/32**

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years for standard version, 75 years for venting option, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Valve model	**AGAM-10**	**AGAM-20**	**AGAM-32**
Setting [bar]	50; 100; 210; 350		
Pressure range [bar]	4÷50; 6÷100; 7÷210; 8÷350		
Max pressure [bar]	Ports P, X = 350 Ports T, Y = 210 (without pilot solenoid valve) For version with pilot solenoid valve, see technical tables E015 and E018		
Max flow [l/min]	200	400	600

5 ELECTRICAL CHARACTERISTICS (for AGAM with pilot solenoid valve)

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard - only for DHE pilot valve

6 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	-EX Power consumption (2)	-LX Power consumption (2)	Code of spare coil -EX	Code of spare coil -LX
12 DC	**12 DC**	666 or 667	30W	29W	COE-12DC	COL-12DC
14 DC	**14 DC**				COE-14DC	COL-14DC
110 DC	**110 DC**				COE-110DC	COL-110DC
220 DC	**220 DC**				COE-220DC	COL-220DC
110/50 AC (1)	**110/50/60 AC**	666 or 667	58VA (3)	58VA (3)	COE-110/50/60AC	COL-110/50/60AC
115/60 AC	**115/60 AC**		80VA (3)		COE-115/60AC	COL-115/60AC
230/50 AC (1)	**230/50/60 AC**		58VA (3		COE-230/50/60AC	COL-230/50/60AC
230/60 AC	**230/60 AC**		80VA (3)		COE-230/60AC	COL-230/60AC

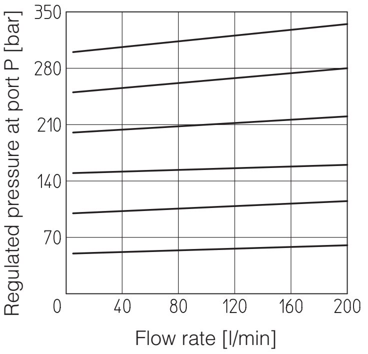
(1) For other supply voltages available on request see technical tables E015, E018.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHL) and 58 VA (DHE)
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 OPTIONS

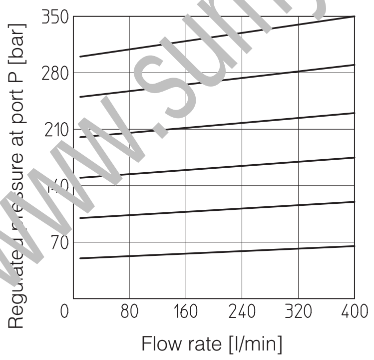
/E = external pilot
/V = regulating handwheel instead of grub screw protected by cap (for handwheel features, see table K150)
/WP = prolunged manual override protected by rubber cap (only for ARAM with pilot solenoid valve)
/Y = external drain (only for ARAM with pilot solenoid valve)

8 REGULATED PRESSURE VERSUS FLOW DIAGRAMS based on mineral oil ISO VG 46 at 50°C

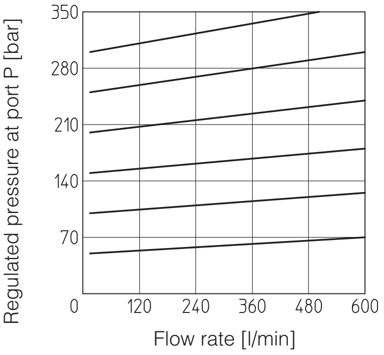
AGAM-10



AGAM-20

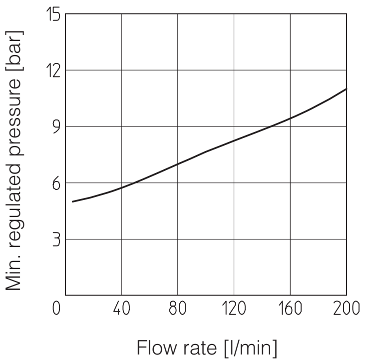


AGAM-32

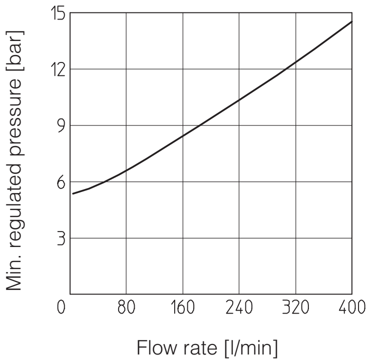


9 MINIMUM PRESSURE VERSUS FLOW DIAGRAMS based on mineral oil ISO VG 46 at 50°C

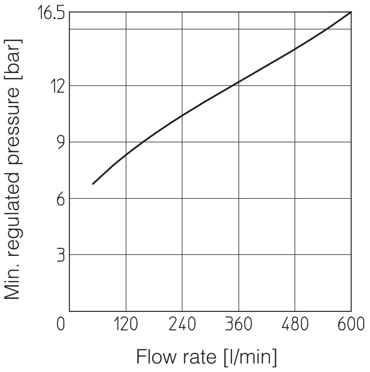
AGAM-10



AGAM-20



AGAM-32



10 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 for AGAM with solenoid valve (to be ordered separately, see tech table K800)

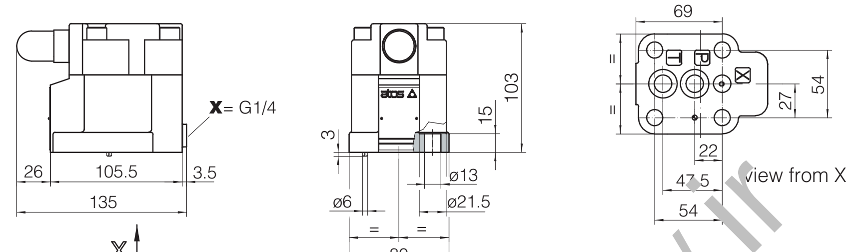
666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC

11 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, reccomended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

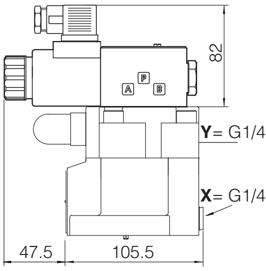
12 DIMENSIONS [mm]

AGAM-10

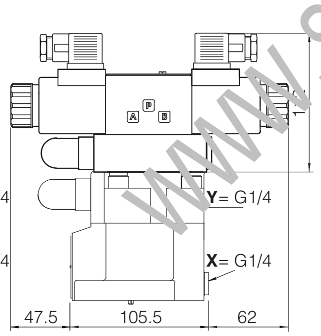


Mass: 3,6 Kg

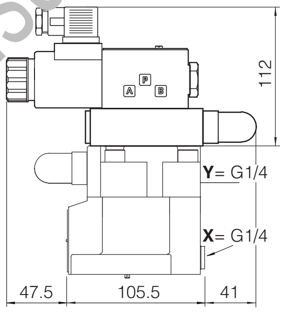
ISO 6264: 2007
Mounting surface: 6264-06-09-1-97
Fastening bolts:
4 socket head screws
M12x35 class 12.9
Tightening torque = 125 Nm
Seals: 2 OR 123; 1 OR 109/70
Ports P, T: Ø = 14,5 mm
Ports X: Ø = 3,2 mm



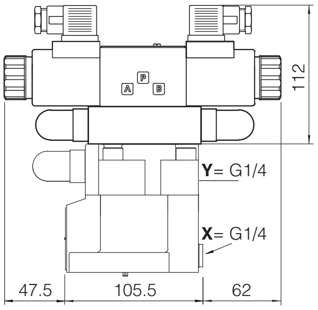
AGAM-10/10/-EX**
AGAM-10/11/-EX**
Mass: 5,1 Kg



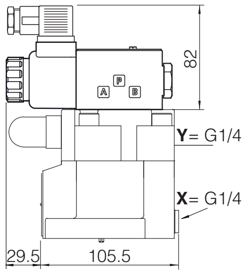
AGAM-10/20/-EX**
AGAM-10/21/-EX**
Mass: 6,2 Kg



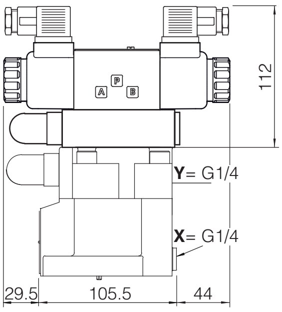
AGAM-10/22/-EX**
Mass: 5,9 Kg



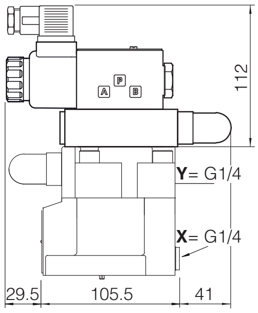
AGAM-10/32/-EX**
Mass: 6,3 Kg



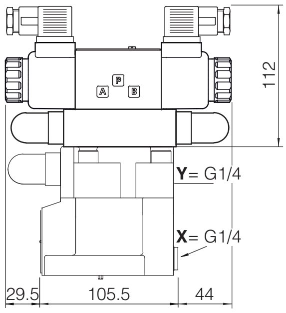
AGAM-10/10/-LX**
AGAM-10/11/-LX**
Mass: 4,8 Kg



AGAM-10/20/-LX**
AGAM-10/21/-LX**
Mass: 5,6 Kg



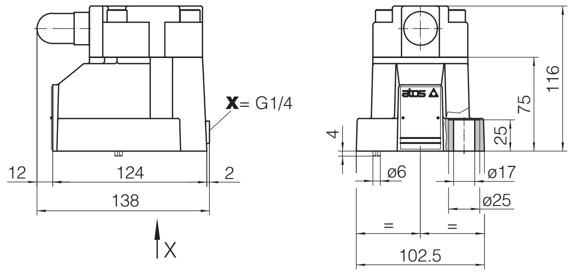
AGAM-10/22/-LX**
Mass: 5,6 Kg



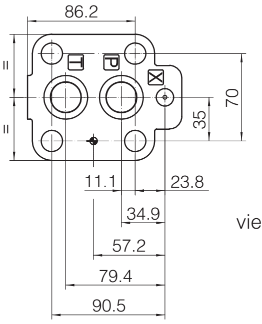
AGAM-10/32/-LX**
Mass: 5,7 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

AGAM-20

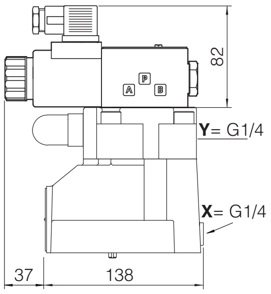


Mass: 4,8Kg



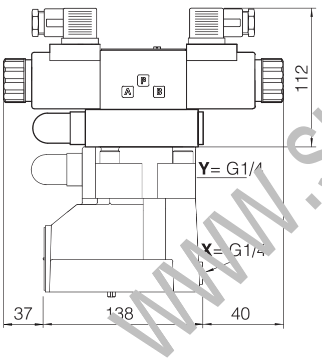
view from X

ISO 6264: 2007
Mounting surface: 6264-08-11-1-97
Fastening bolts:
4 socket head screws M16x50 class 12.9
Tightening torque = 300 Nm
Seals: 2 OR 4112; 1 OR 109/70
Ports P, T: Ø = 24 mm
Ports X: Ø = 3,2 mm



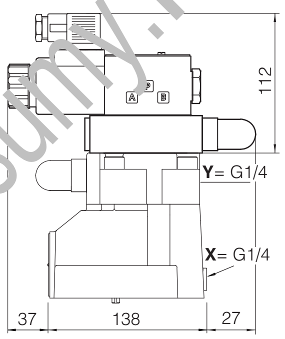
AGAM-20/10/-EX**
AGAM-20/11/-EX**

Mass: 6,3 Kg



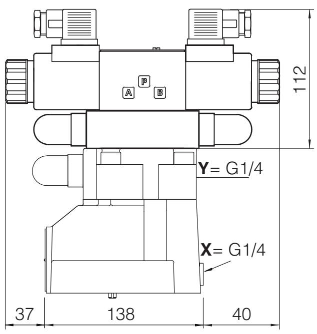
AGAM-20/20/-EX**
AGAM-20/21/-EX**

Mass: 7,4 Kg



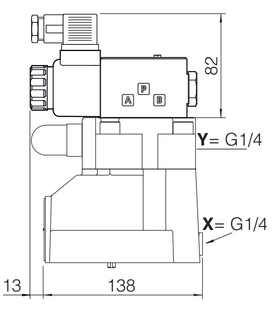
AGAM-20/22/-EX**

Mass: 7,1 Kg



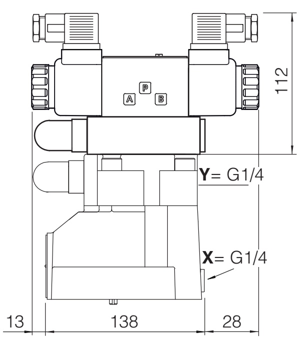
AGAM-20/32/-EX**

Mass: 7,5 Kg



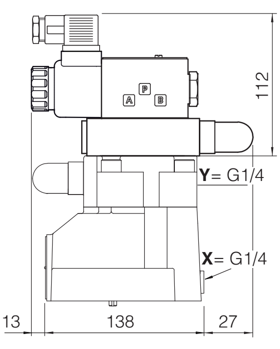
AGAM-20/10/-LX**
AGAM-20/11/-LX**

Mass: 6 Kg



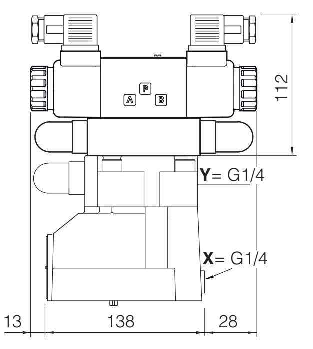
AGAM-20/20/-LX**
AGAM-20/21/-LX**

Mass: 6,8Kg



AGAM-20/22/-LX**

Mass: 6,8 Kg

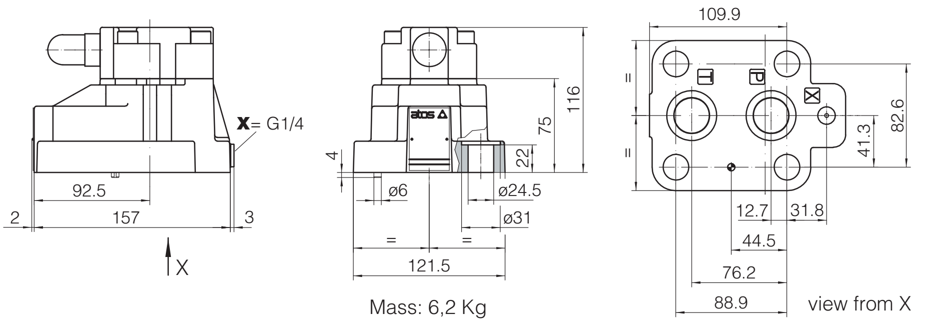


AGAM-20/32/-LX**

Mass: 7 Kg

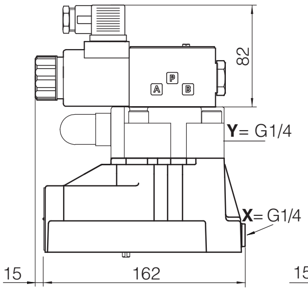
Overall dimensions refer to valves **DC** voltage, with connectors type 666

AGAM-32



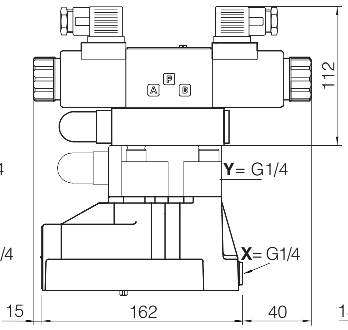
Mass: 6,2 Kg

ISO 6264: 2007
Mounting surface: 6264-10-17-1-97 (with M20 fixing holes instead of standard M18)
Fastening bolts:
4 socket head screws
M20x60 class 12.9
Tightening torque = 600 Nm
Seals: 2 OR 4131; 1 OR 109/70
Ports P, T: Ø = 28,5 mm
Ports X: Ø = 3,2 mm



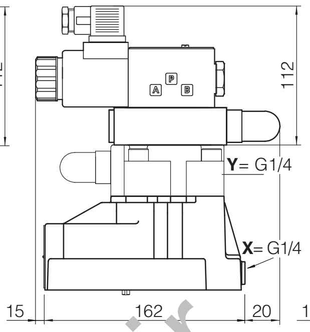
AGAM-32/10/-EX**
AGAM-32/11/-EX**

Mass: 7,7 Kg



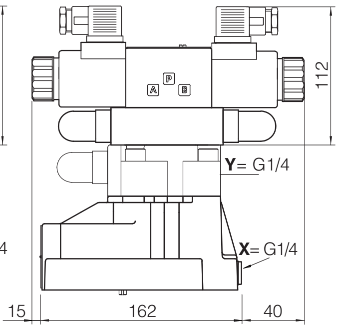
AGAM-32/20/-EX**
AGAM-32/21/-EX**

Mass: 8,8 Kg



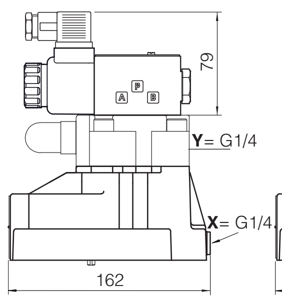
AGAM-32/22/-EX**

Mass: 8,5 Kg



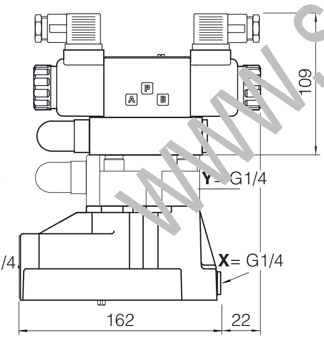
AGAM-32/32/-EX**

Mass: 8,9 Kg



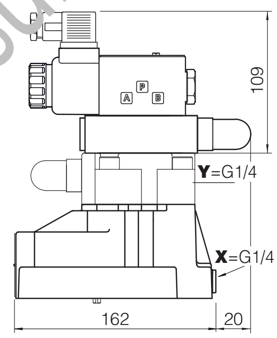
AGAM-32/10/-LX**
AGAM-32/11/-LX**

Mass: 7,4 Kg



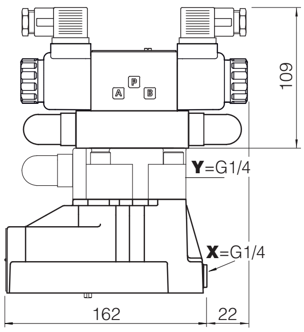
AGAM-32/20/-LX**
AGAM-32/21/-LX**

Mass: 8,2 Kg



AGAM-32/22/-LX**

Mass: 8,2 Kg



AGAM-32/32/-LX**

Mass: 8,4 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

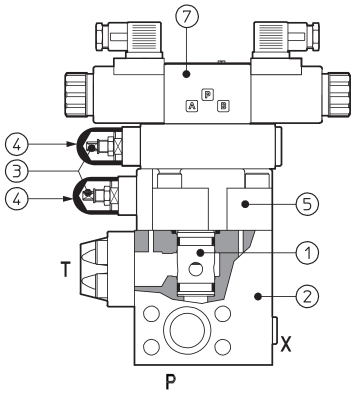
13 MOUNTING SUBPLATES

Valve	Subplate model	Port location	Ports			Ø Counterbore [mm]			Mass [Kg]
			P	T	X	P	T	X	
AGAM-10	BA-306	Ports P, T, X underneath;	G 1/2"	G 3/4"	G 1/4"	30	36,5	21,5	1,5
AGAM-20	BA-406		G 3/4"	G 3/4"	G 1/4"	36,5	36,5	21,5	3,5
	BA-506		G 1"	G 1"	G 1/4"	46	46	21,5	3,5
AGAM-32	BA-706		G 1 1/2"	G 1 1/2"	G 1/4"	63,5	63,5	21,5	6

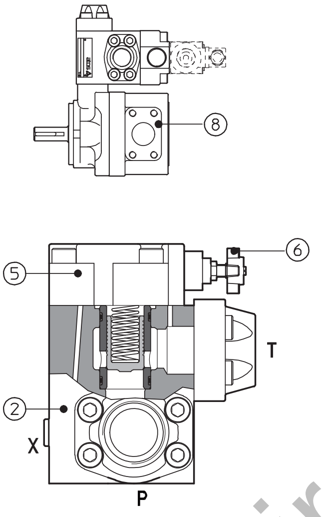
The subplates are supplied with fastening bolts. For further details see table K280

Pressure relief valves type REM

two stage, flange mounting SAE 3/4”, 1”, $1^{1}/_{4}$”



REM-3/20...-E



REM-4/210/V

REM are two stage pressure relief valves with balanced poppet and SAE flange connection, designed to operate in oil hydraulic systems.
They can be directly mounted with SAE flange attachments on the pumps outlet ports ⑧ and, in particular, on the PFE pumps (see tab. A005, A007).
In standard versions the piloting pressure of the poppet ① of the main stage ② is regulated by means of a grub screw ③ protected by cap ④ in the cover ⑤.
Optional versions with setting adjustment by handwheel ⑥ instead of the grub screw are available on request.
Clockwise rotation increases the pressure.
REM can be equipped with a venting solenoid valve ⑦ type:

- DHE for AC and DC supply, high performances, with **cURus** certified solenoids
- DHL for AC and DC supply, compact execution

Mounting surface:
SAE flange connection: **3/4", 1", $1^{1}/_{4}$"**
Max flow: **200, 400** and **600 l/min** respectively
Pressure up to **350 bar**

1 MODEL CODE

REM	-	4	/	20	210	/	100/100	/	V	-	E	X	24DC	**	/	*

REM = pressure relief valve SAE flange mounting

Size:
3 = SAE 3/4"
4 = SAE 1"
5 = SAE $1^{1}/_{4}$"

Setting pressure and venting option (1):
- = one setting pressure without option
10 = one setting pressure with venting, with de-energized solenoid
11 = one setting pressure with venting, with energized solenoid
20 = two setting pressure with venting, with de-energized solenoid
21 = two setting pressure with venting, with energized solenoid
22 = two setting pressure without venting
32 = three setting pressure without venting

Pressure range:
50 = 4÷50 bar;
100 = 6÷100 bar;
210 = 7÷210 bar;
350 = 8÷350 bar (only for REM-3)

Pressure range of second/third setting **(1)**:
50 = 4÷50 bar;
100 = 6÷100 bar;
210 = 7÷210 bar;
350 = 8÷350 bar (only for REM-3)

Options **(2)**:
WP = prolonged manual override protected by rubber cap (1)
V = regulating by handwheel instead of a grub screw protected by cap

Pilot valve **(1)**:
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids
L = DHL for AC and DC supply, compact execution

X = without connector **(1):**
See section 10 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Voltage code, see section 7

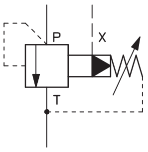
Series number

Seals material, see section 7:
- = NBR
PE = FKM
BT = HNBR

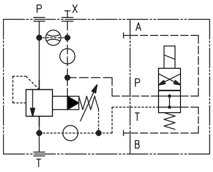
(1) Only for REM with solenoid valve for venting and/or for the selection of the setting pressure
(2) For handwheel features, see technical table K150

2 HYDRAULIC CHARACTERISTICS

REM



REM-*/10



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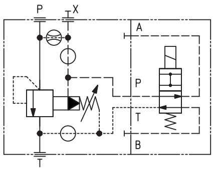
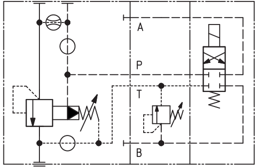
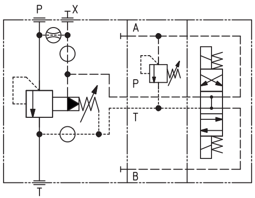
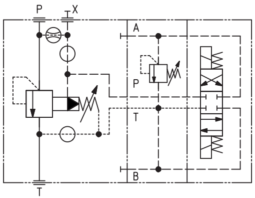


REM-*/22

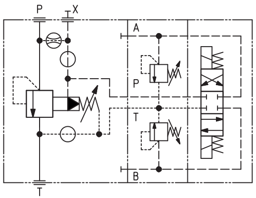




REM-*/20



REM-*/21



REM-*/32

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Valve model	**REM-3**	**REM-4**	**REM-5**
Max flow [l/min]	200	400	600
Pressure range [bar]	4-50; 6-100; 7-210; 8-350	4÷50; 6÷100; 7÷210	
Max pressure [bar]	Ports P, X = 350 Port T = 210 without pilot solenoid valve, for version -EX and -LX, see tech tables E015 and E018		

5 ELECTRICAL CHARACTERISTICS (for ARAM with pilot solenoid valve)

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 7
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard - only for DHE pilot valve

6 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, reccomended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

7 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	-EX Power consumption (2)	-LX Power consumption (2)	Code of spare coil -EX	Code of spare coil -LX
12 DC	**12 DC**	666 or 667	30W	29W	COE-12DC	COL-12DC
14 DC	**14 DC**				COE-14DC	COL-14DC
110 DC	**110 DC**				COE-110DC	COL-110DC
220 DC	**220 DC**				COE-220DC	COL-220DC
110/50 AC (1)	**110/50/60 AC**	666 or 667	58VA (3)	58VA (3)	COE-110/50/60AC	COL-110/50/60AC
115/60 AC	**115/60 AC**		80VA (3)		COE-115/60AC	COL-115/60AC
230/50 AC (1)	**230/50/60 AC**		58VA (3		COE-230/50/60AC	COL-230/50/60AC
230/60 AC	**230/60 AC**		80VA (3)		COE-230/60AC	COL-230/60AC

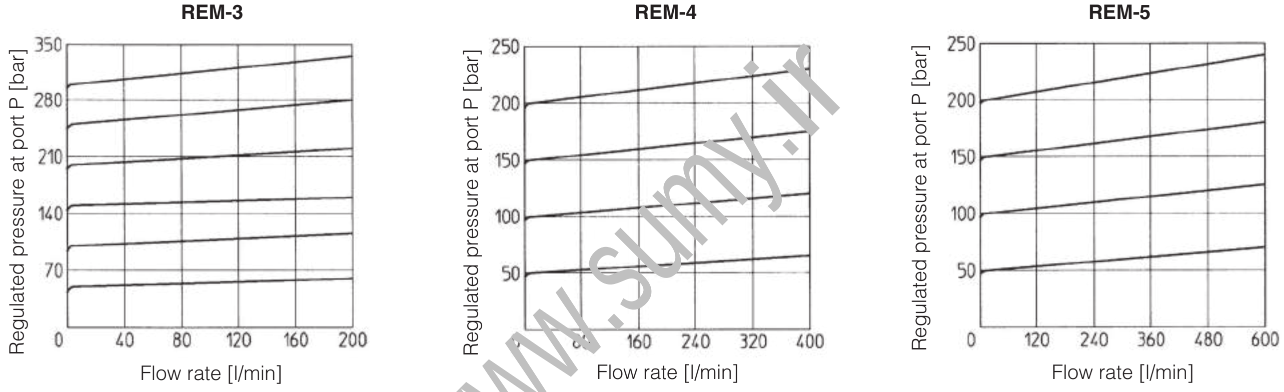
(1) For other supply voltages available on request see technical tables E015, E018.

(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHL) and 58 VA (DHE)

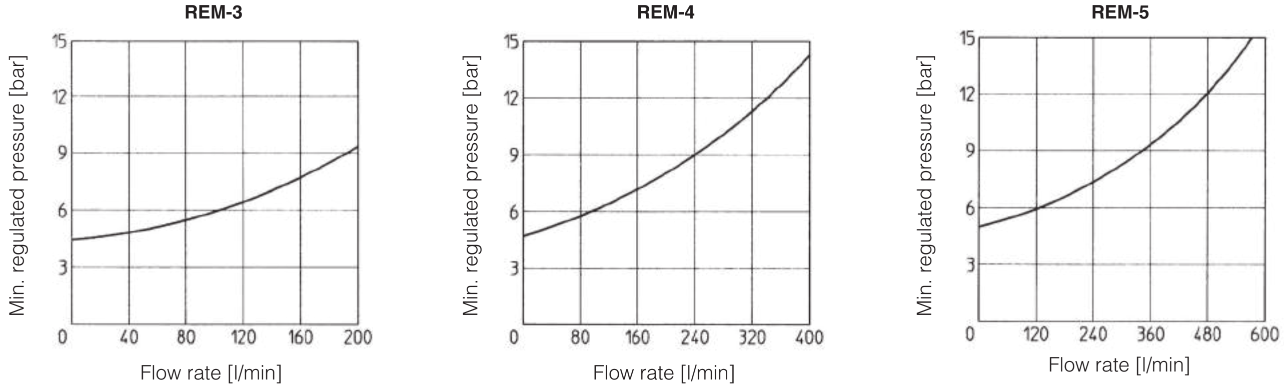
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

8 REGULATED PRESSURE VERSUS FLOW DIAGRAMS based on fluid viscosity of 25 mm²/s at 40°



9 MINIMUM PRESSURE VERSUS FLOW DIAGRAMS based on fluid viscosity of 25 mm²/s at 40° C



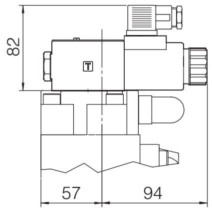
10 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 for REM with solenoid valve (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC

11 DIMENSIONS [mm]

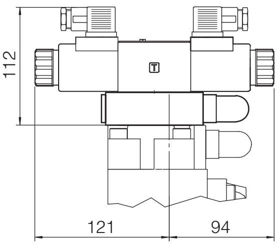
REM-3-*-EX

REM-3/10/-EX**
REM-3/11/-EX**

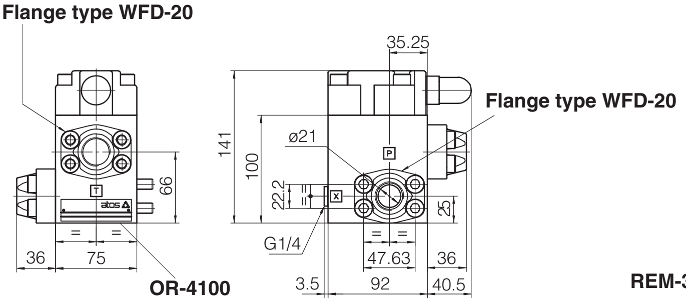


Mass: 8,1 Kg

REM-3/20/-EX**
REM-3/21/-EX**

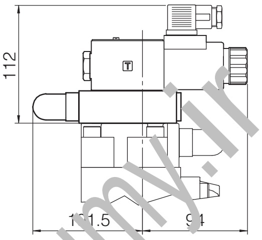


Mass: 9,2 Kg



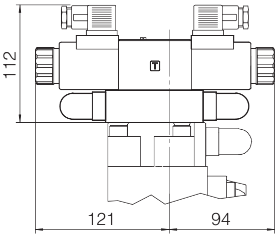
Mass: 6,6 Kg

REM-3/22/-EX**



Mass: 8,9 Kg

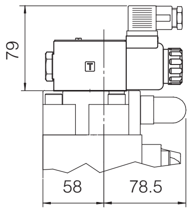
REM-3/32/-EX**



Mass: 9,3 Kg

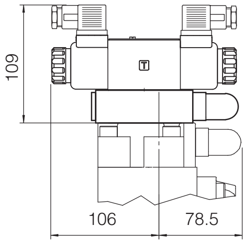
REM-3-*-LX

REM-3/10/-LX**
REM-3/11/-LX**

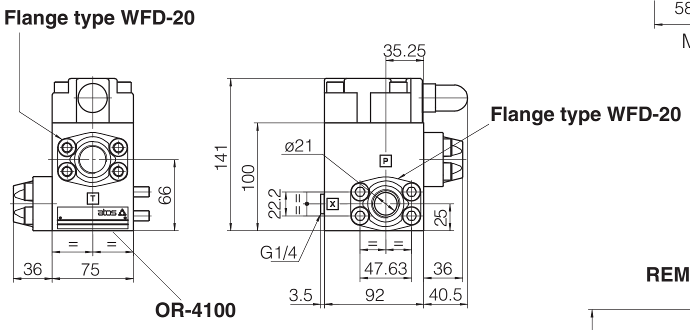


Mass: 7,9 Kg

REM-3/20/-LX**
REM-3/21/-LX**

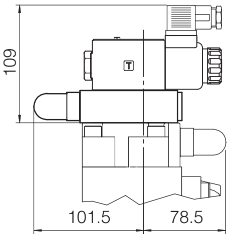


Mass: 8,8 Kg



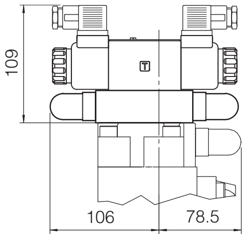
Mass: 6,6 Kg

REM-3/22/-LX**



Mass: 8,7 Kg

REM-3/32/-LX**

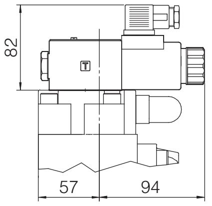


Mass: 8,9 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

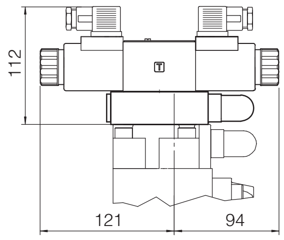
REM-4-*-EX

REM-4/10/-EX**
REM-4/11/-EX**

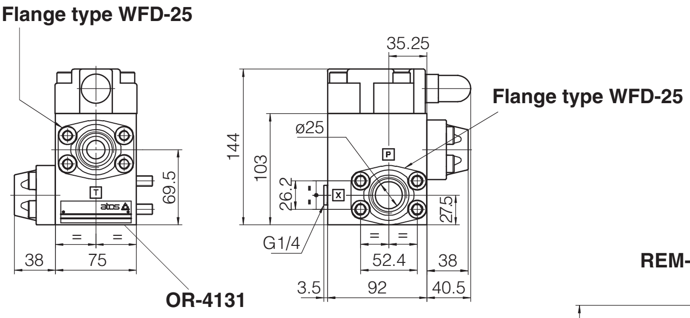


Mass: 8,3 Kg

REM-4/20/-EX**
REM-4/21/-EX**

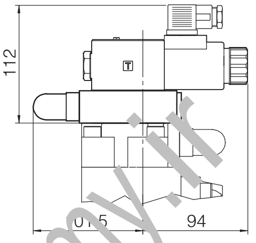


Mass: 9,4 Kg



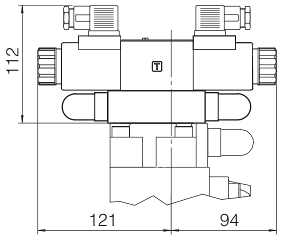
Mass: 6,8 Kg

REM-4/22/-EX**



Mass: 9,1 Kg

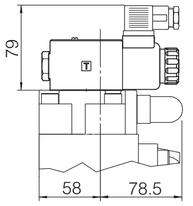
REM-4/32/-EX**



Mass: 9,5 Kg

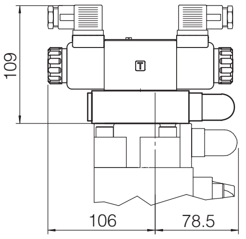
REM-4-*-LX

REM-4/10/-LX**
REM-4/11/-LX**

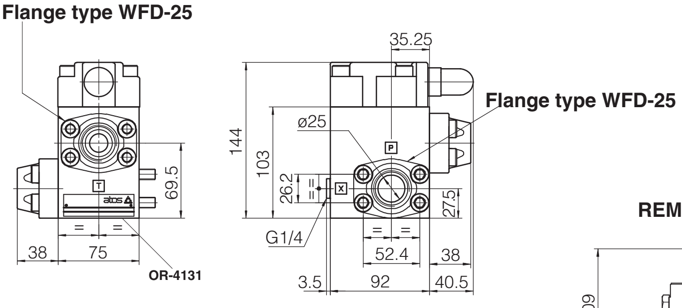


Mass: 8,1 Kg

REM-4/20/-LX**
REM-4/21/-LX**

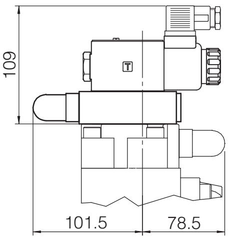


Mass: 9 Kg



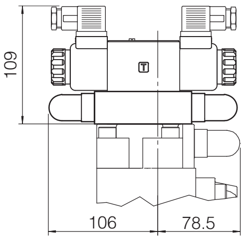
Mass: 6,8 Kg

REM-4/22/-LX**



Mass: 8,9 Kg

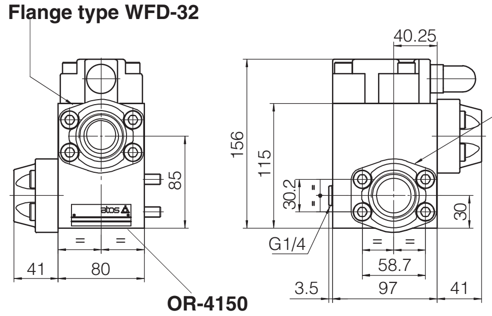
REM-4/32/-LX**



Mass: 9,1 Kg

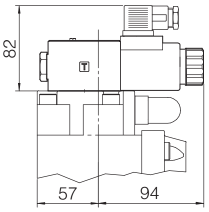
Overall dimensions refer to valves **DC** voltage, with connectors type 666

REM-5-*-EX



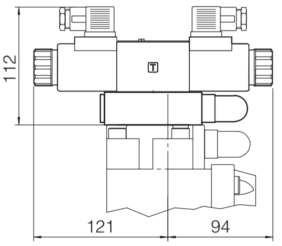
Mass: 8,2 Kg

REM-5/10/-EX**
REM-5/11/-EX**



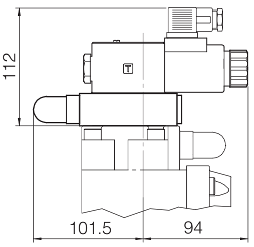
Mass: 9,7 Kg

REM-5/20/-EX**
REM-5/21/-EX**



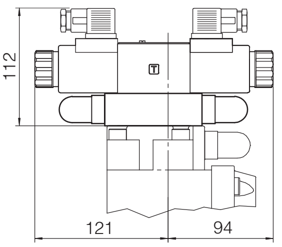
Mass: 10,8 Kg

REM-5/22/-EX**



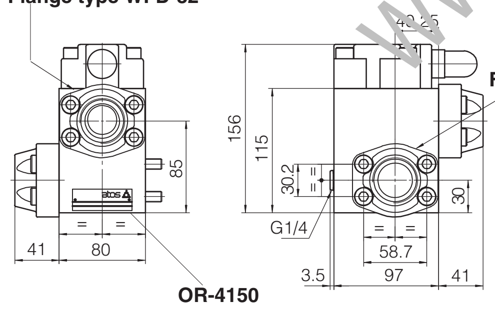
Mass: 10,5 Kg

REM-5/32/-EX**



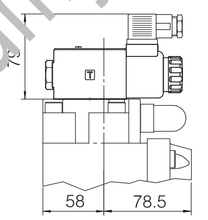
Mass: 10,9 Kg

REM-5-*-LX



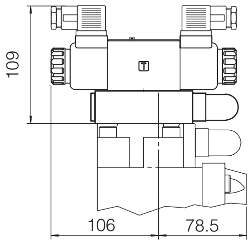
Mass: 8,2 Kg

REM-5/10/-LX**
REM-5/11/-LX**



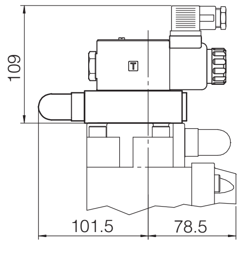
Mass: 9,5 Kg

REM-5/20/-LX**
REM-5/21/-LX**



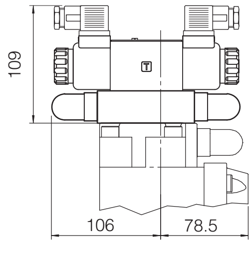
Mass: 10,4 Kg

REM-5/22/-LX**



Mass: 10 Kg

REM-5/32/-LX**

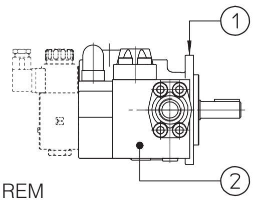


Mass: 10,5 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

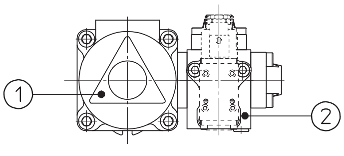
12 ASSEMBLY EXAMPLE OF A REM VALVE ON A PFE PUMP

LATERAL VIEW OF PUMP

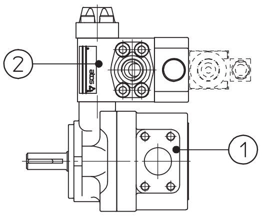


① Pump type PFE
② Relief valve type REM

REAR VIEW OF PUMP

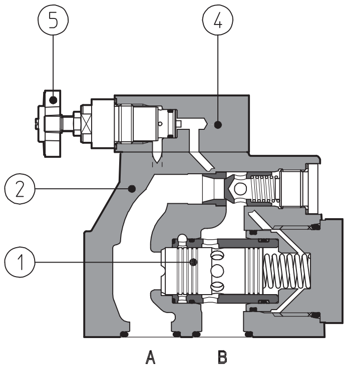


TOP VIEW OF PUMP

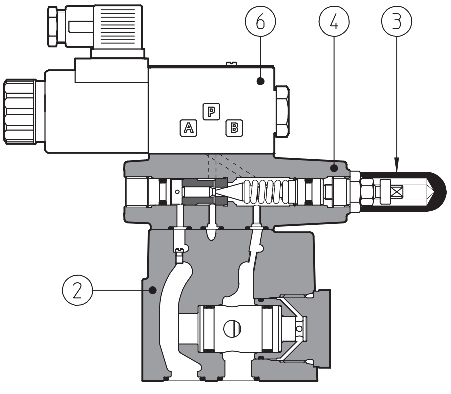


Pressure control valves type AGIR, AGIS, AGIU

two stage, subplate mounting, ISO 5781 sizes 10, 20 and 32



AGIRR-20/*/V**



AGIU-10/11...-E

Two stage pressure control valves with balanced poppet designed to operate in oil hydraulic systems.
AGIR: pressure reducing;
AGIS: sequence;
AGIU: unloading.
In standard versions the piloting pressure of the poppet ① of the main stage ② is regulated by means of a grub screw protected by cap ③ in the cover ④.
Optional versions with setting adjustment by handwheel ⑤ instead of the grub screw are available on request.
Clockwise rotation increases pressure.
Unloading valves AGIU can be equipped with a venting solenoid valve ⑥ type:

- DHE for AC and DC supply, high performances with **cURus** certified solenoids
- DHL for AC and DC supply, compact execution

Mounting surface: **ISO 5781 size 10, 20 and 32**
Max flow:
AGIR = 160, 300, 400 l/min
AGIS = 200, 400, 600 l/min
AGIU = 100, 200, 300 l/min
Pressure up to **350 bar**

1 MODEL CODE

AGIU * - **20** / **10** / **210** / **V** - **E** **X** **24DC** ** / *

Pressure control valves subplate mounting
AGIR = pressure reducing
AGIS = sequence
AGIU = unloading

Only for AGIR and AGIS:
R = with check valve
- = without check valve

Size: **10** **20** **32**

Optional solenoid valve for venting **(1)**
10 = venting with de-energized solenoid
11 = venting with energized solenoid

Pressure range:
50 = 4÷50 bar (AGIR*); **100** = 6÷100 bar;
210 = 7÷210 bar; **350** = 8÷350 bar

Options **(2)**:
V = regulating handwheel instead of a grub screw protected by cap
VF = regulating knob instead of a grub screw protected by cap (only for AGIS, AGIU)
VS = manual override with safety locking instead of a grub screw protected by cap (only for AGIS, AGIU)

Only for AGIU:
D = internal drain
WP = prolonged manual override protected by rubber cap **(2)**
- = standard unloading characteristics
5, 6, 7 = other unloading characteristics, see section 8

Pilot valve **(1)**:
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids
L = DHL for AC and DC supply, compact execution

X = without connector **(1):**
See section 9 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

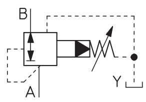
Voltage code, see section 10 **(1)**

Series number

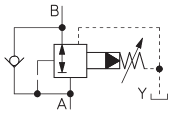
Seals material, see section 6:
- = NBR
PE = FKM
BT = HNBR **(3)**

(1) Only for AGIU with solenoid valve for venting
(2) For handwheel features, see technical table K150
(3) Not available for -L version (DHL pilot valve)

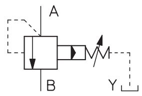
2 HYDRAULIC CHARACTERISTICS



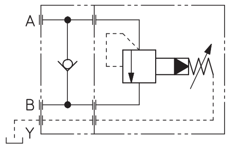
AGIR



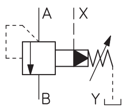
AGIRR



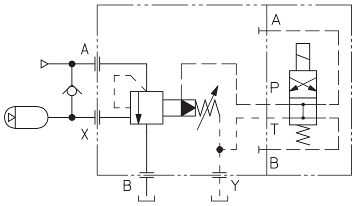
AGIS



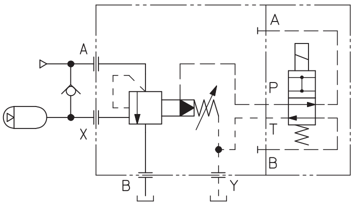
AGISR



AGIU



AGIU-/10**



AGIU-/11**

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years for standard version, 75 years for venting option, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Valve model	AGIR-10	AGIR-20	AGIR-32	AGIS-10	AGIS-20	AGIS-32	AGIU-10	AGIU-20	AGIU-32
Max flow [l/min]	160	300	400	200	400	600	100	200	300
Pressure range [bar]	4÷50 (AGIR*); 6÷100; 7÷210; 8÷350								
Max pressure [bar]	Ports A, B, X = 350 bar Port Y = 0								

5 ELECTRICAL CHARACTERISTICS (for AGAM with pilot solenoid valve)

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occurring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 10
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard - only for DHE pilot valve

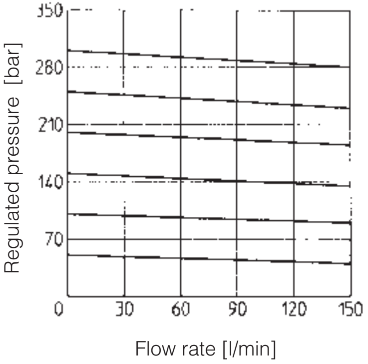
6 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

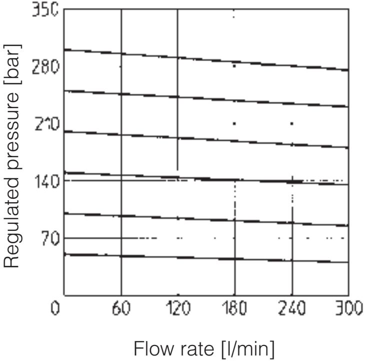
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

7 **REGULATED PRESSURE VERSUS FLOW DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

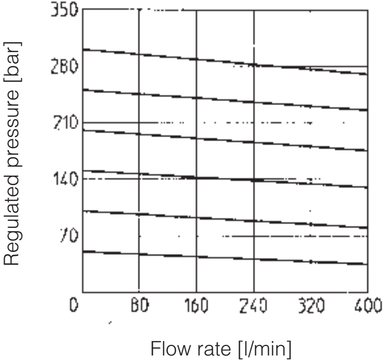
AGIR-10



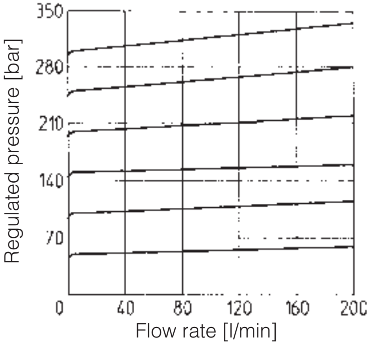
AGIR-20



AGIR-32

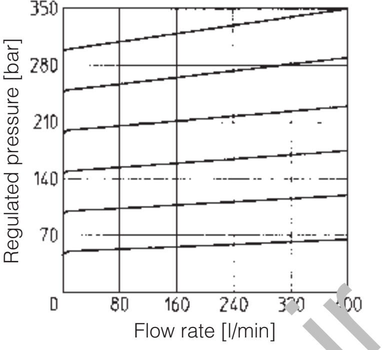


AGIS-10, AGIU-10



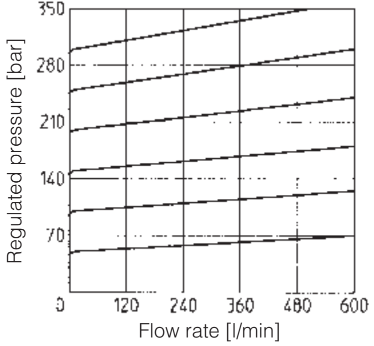
Note: for AGIU-10, the max flow rate is 100 l/min

AGIS-20, AGIU-20



Note: for AGIU-20, the max flow rate is 200 l/min

AGIS-32, AGIU-32



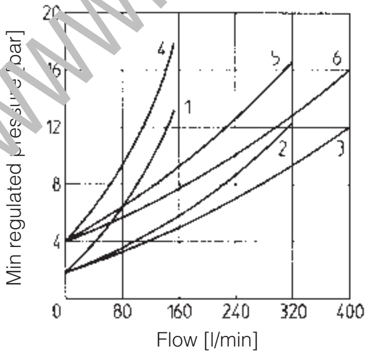
Note: for AGIU-32, the max flow rate is 300 l/min

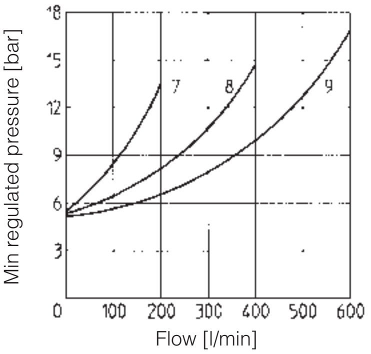
8 OPERATING DIAGRAM

based on mineral oil ISO VG 46 at 50°C

1 = AGIR-10 A → B
2 = AGIR-20 A → B
3 = AGIR-32 A → B
4 = AGIR-10 B → A
5 = AGIR-20 B → A
6 = AGIR-32 B → A

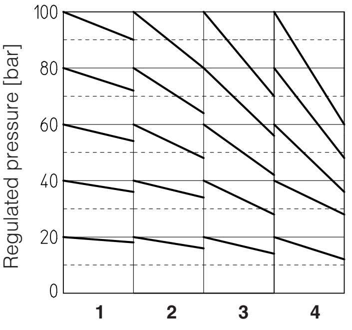
7 = AGIS-10
8 = AGIS-20
9 = AGIS-32

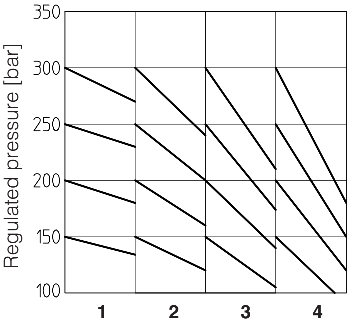




Opening/closing diagram for AGIU

1 = AGIU-**/...(standard) **3** = AGIU-**/.../6
2 = AGIU-**/.../5 **4** = AGIU-**/.../7





NOTES

1) Short pipes with low resistance must be used between the unloading valve and the accumulator;
2) When the resistance is high, the hydraulic pilot signal must be taken as closed as possible to the accumulator;
3) With high pump flow and small valve differential pressure of intervention it is advisable to use the version with external drain;
4) When to use the BA-*25 subplates:
   a) in applications with working frequencies >10 Hz use subplates type BA-*25/4 (spring with 4 bar of cracking pressure);
   b) in applications with working frequencies <10 Hz use subplates type BA-*25/2 (spring with 2 bar of cracking pressure);

9 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 for AGIU with solenoid valve (to be ordered separately, see tech table K800)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC

10 COIL VOLTAGE

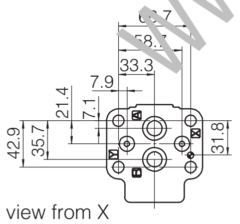
External supply nominal voltage ± 10%	**Voltage code**	Type of connector	-EX Power consumption (2)	-LX Power consumption (2)	Code of spare coil -EX	Code of spare coil -LX
12 DC	**12 DC**	666 or 667	30W	29W	COE-12DC	COL-12DC
14 DC	**14 DC**				COE-14DC	COL-14DC
110 DC	**110 DC**				COE-110DC	COL-110DC
220 DC	**220 DC**				COE-220DC	COL-220DC
110/50 AC (1)	**110/50/60 AC**	666 or 667	58VA (3)	58VA (3)	COE-110/50/60AC	COL-110/50/60AC
115/60 AC	**115/60 AC**		80VA (3)		COE-115/60AC	COL-115/60AC
230/50 AC (1)	**230/50/60 AC**		58VA (3		COE-230/50/60AC	COL-230/50/60AC
230/60 AC	**230/60 AC**		80VA (3)		COE-230/60AC	COL-230/60AC

(1) For other supply voltages available on request see technical tables E015, E018.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHL) and 58 VA (DHE)
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

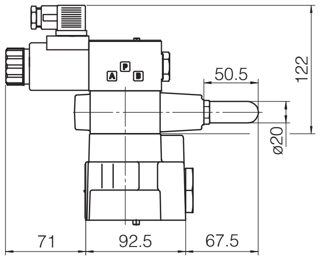
11 DIMENSIONS [mm]

AGIR, AGIS, AGIU size 10

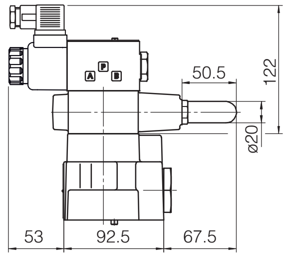
ISO 5781: 2000
Mounting surface: 5781-06-07-0-00
Fastening bolts:
4 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 109/70, 2 OR 3068
Ports A, B: Ø = 14 mm
Ports X, Y: Ø = 5 mm



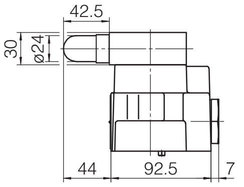
view from X

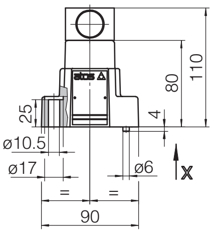


AGIU-10/10/-EX**
Mass = 5,6 Kg

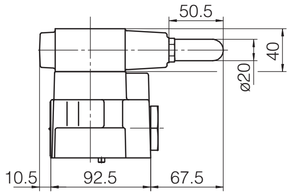


AGIU-10/10/-LX**
Mass = 5,4 Kg

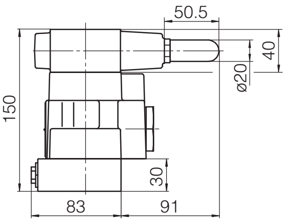




AGIR-10; Mass= 3,3 Kg
AGIRR-10; Mass= 3,5 Kg



AGIS-10; Mass= 3,8 Kg
AGIU-10; Mass= 3,8 Kg

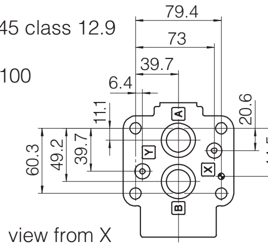


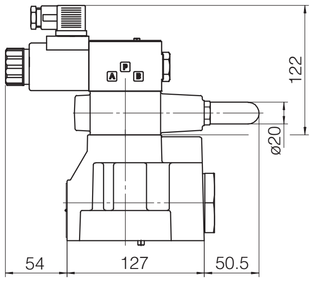
AGISR-10; Mass= 5,3 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

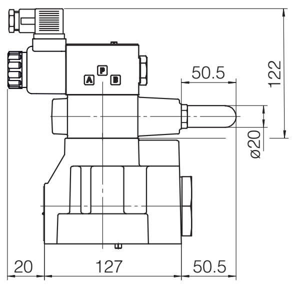
AGIR, AGIS, AGIU size 20

ISO 5781: 2000
Mounting surface: 5781-08-10-0-00
Fastening bolts:
4 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 109/70, 2 OR 4100
Ports A, B: Ø = 22 mm
Ports X, Y: Ø = 5 mm

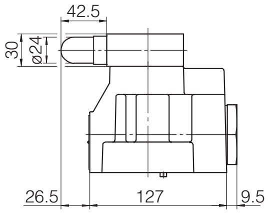


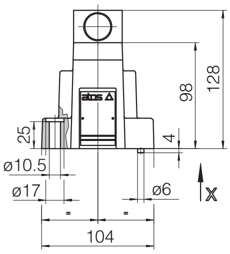


AGIU-20/10/-EX**
Mass = 7,8 Kg

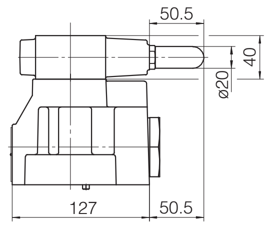


AGIU-20/10/-LX**
Mass = 7,6 Kg

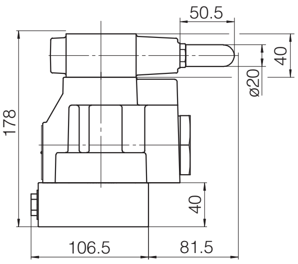




AGIR-20; Mass= 5,5 Kg
AGIRR-20; Mass= 5,7 Kg



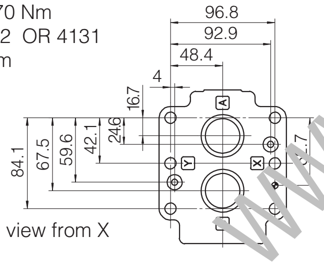
AGIS-20; Mass= 6 Kg
AGIU-20; Mass= 6 Kg

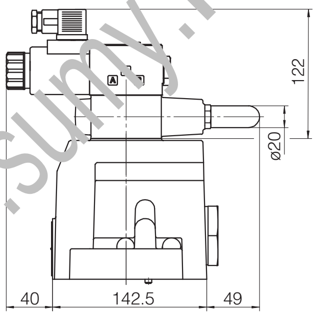


AGISR-20; Mass= 9 Kg

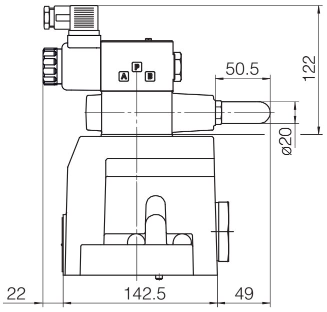
AGIR, AGIS, AGIU size 32

ISO 5781: 2000
Mounting surface: 5781-10-13-0-00
Fastening bolts:
6 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 109/70, 2 OR 4131
Ports A, B: Ø = 28 mm
Ports X, Y: Ø = 5 mm

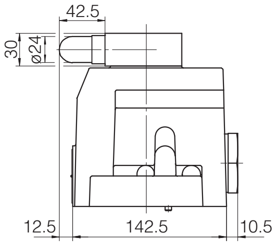


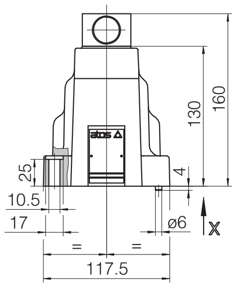


AGIU-32/10/-EX**
Mass = 11,7 Kg

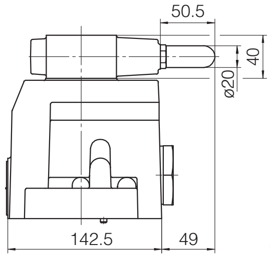


AGIU-32/10/-LX**
Mass = 11,5 Kg

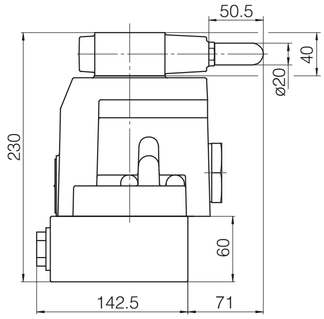




AGIR-32; Mass= 9,4 Kg
AGIRR-32; Mass= 9,6 Kg



AGIS-32; Mass= 9,9 Kg
AGIU-32; Mass= 9,9 Kg



AGISR-32; Mass= 15.5 Kg

Overall dimensions refer to valves **DC** voltage, with connectors type 666

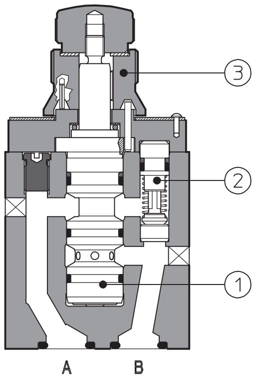
12 MOUNTING SUBPLATES

Valves	Subplate model	Port location	Ports				Ø Counterbore [mm]				Mass [Kg]
			A	B	X-Y	OUT	A	B	X-Y	OUT	
AGI*-10	BA-305	Ports A, B, Y underneath;	G 1/2"	G 1/2"	G 1/4"	-	30	30	21,5	-	1
AGI*-20	BA-505		G 1"	G 1"	G 1/4"	-	46	46	21,5	-	2
AGI*-32	BA-705		G 1 1/2"	G 1 1/2"	G 1/4"	-	63,5	63,5	21,5	-	7,5

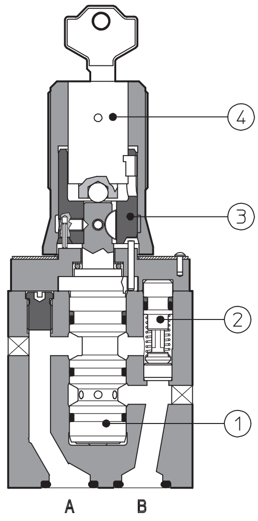
The subplates are supplied with fastening bolts. For further details see table K280

Flow control valves type QV-06

pressure compensated, two way, ISO 4401 size 06



QV-06



QV-06/*/K

QV are flow control valves with pressure compensator ①: the controlled flow rate is independent of pressure variations.

They are usually supplied with a built-in check valve ② to allow the free flow in the opposite direction.

The flow is regulated by turning a graduate micrometer knob ③. Clockwise rotation increases the flow regulation.
Optional versions with locking key ④ on the adjustment knob are available on request.

Valves designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

Size: **06** - ISO 4401
Max flow: **24 l/min**
Max pressure: **250 bar**

1 MODEL CODE

QV - **06** / **6** / **K** ****** / *****

QV: Pressure compensated flow control valve

Size: **06**

Maximum adjustable flow rate:
1 = 1,5 l/min
6 = 6 l/min
11 = 11 l/min
16 = 16 l/min
24 = 24 l/min

Options:
K = with lock key for the setting knob
V = without by-pass check valve

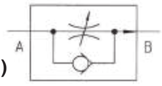
******: Series number

*****: Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

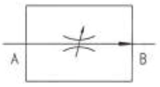
2 HYDRAULIC CHARACTERISTICS

Hydraulic symbols

with check valve (standard)



without check valve (option /V)



Valve model		**QV-06/1**	**QV-06/6**	**QV-06/11**	**QV-06/16**	**QV-06/24**
Max regulated flow	[l/min]	1,5	6	11	16	24
Min regulated flow	[cm³/min]	50				
Max flow B→A through check valve	[l/min]	24				
Regulating Δp	[bar]	3	3	5	6,5	8
Max flow on port A	[l/min]	24				
Max pressure	[bar]	250				

3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

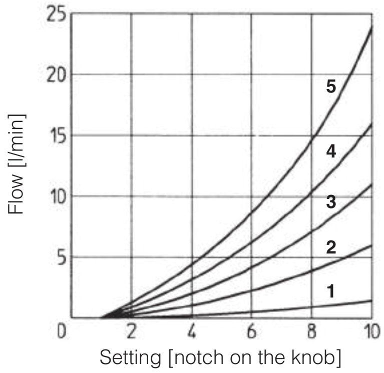
4 DIAGRAMS based on mineral oil ISO VG 46 at 50°C

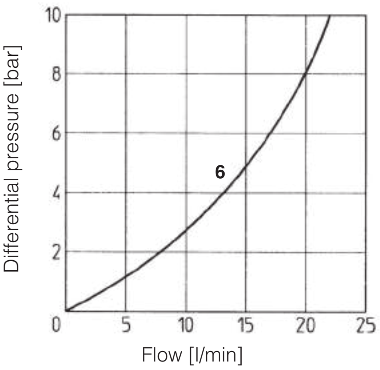
4.1 Regulation diagram

1 = QV-06/1
2 = QV-06/6
3 = QV-06/11
4 = QV-06/16
5 = QV-06/24

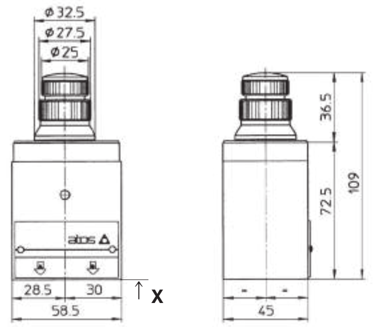
4.2 Q/Δp diagram through the check valve for free flow B→A

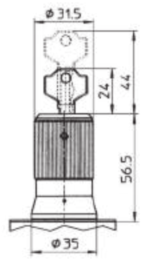
6 = QV-06/*





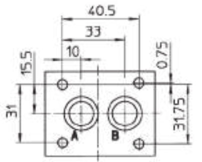
5 DIMENSIONS [mm]





Option /K

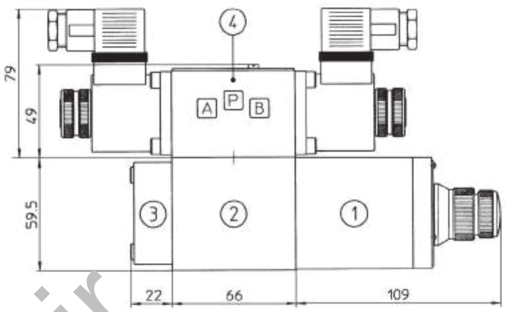
Mass: 1,2 Kg



view from X

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
(see note 1)
Fastening bolts:
4 socket head screws M5x70 class 12.9
Tightening torque = 8 Nm
Seals: 2 OR 117
Diameter of ports A, B: Ø = 7 mm

ASSEMBLY IN MODULAR STACK
see section 6



① = Flow control valve type QV-06
Note that the valve(s) is (are) mounted:
- on side port A for BHQ-011, BHQ-013, BHQ-016 and BHQ-023
- on side port B for BHQ-014 and BHQ-024
- on both sides for BHQ-012 and BHQ-022

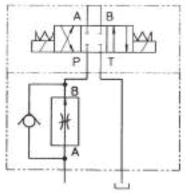
② = Modular plate type BHQ, see section 6
③ = Closing element. This element can be on side port A or side port B depending on models. It is not present on BHQ-011, BHQ-016, BHQ-012 and BHQ-022
④ = Directional valve type DH* (ISO 4401 size 06)

note 1: the manifold interface has to be provided only of the A and B ports.
The valve cannot be installed on manifolds with ISO 4401-AB-03 interface with P and T ports.

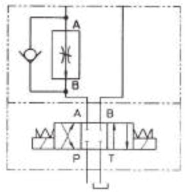
6 MODULAR PLATES TYPE BHQ

The modular plates type BHQ allow the assembling of valves type QV-06 in a modular stack with other components having ISO 4401 size 06 mounting surface. See below for model code and functional sketches; see section 5 for dimensions and example of assembly.

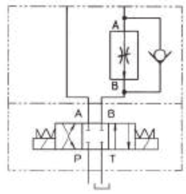
BHQ-011



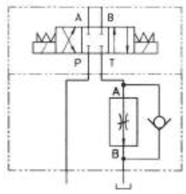
BHQ-013



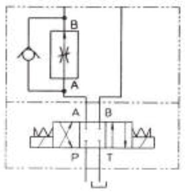
BHQ-014



BHQ-016



BHQ-023



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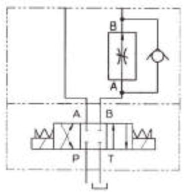
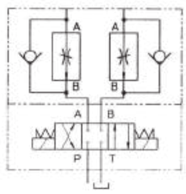
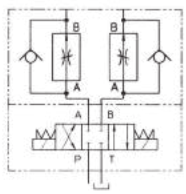


BHQ-012



BHQ-022



Available also version for phosphate ester (add /PE at the end of the model code).

7 MOUNTING PLATES TYPE BA

Valve	Subplate model	Ports location	Ports A, B, P, T	Ø Counterbore [mm] A, B, P, T	Mass [Kg]
QV-06	BA-202/Q	Ports A, B, P, T underneath;	G 3/8"	–	1,2
	BA-204/Q	Ports P, T underneath; Ports A, B on lateral side	G 3/8"	25,5	1,2
	BA-302/Q	Ports A, B, P, T underneath;	G 1/2"	30	1,8

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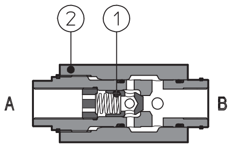
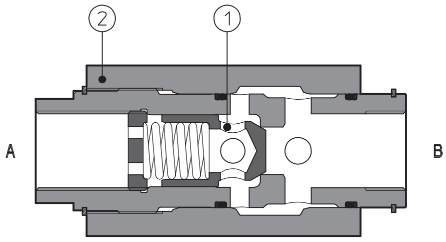
Table **C280-6/E**

Flow restrictor valves type AQFR

in-line mounting - from G 3/8" to G 1 1/4" threaded ports



AQFR-10



AQFR-32

AQFR are not compensated flow throttling valves with a built-in check valve ① to allow the free flow in the opposite direction.

The flow adjustement is done by turning the external exagon ②. Clockwise rotation increases the throttling (reduced passage). The regulated flow is a function of the pressure drop existing between the inlet and outlet ports.

They are available in five sizes: from 3/8” to 1 1/4” GAS with flow up 30, 50, 80, 160, 250 l/min respectively and pressure up to 400/350 bar (depending on size).

Max flow: **250 l/min**
Max pressure: **400 bar**

1 MODEL CODE

AQF **R** - **10** ****** / *****

Throtting valve in-line mounting

R = with check valve for free reverse flow

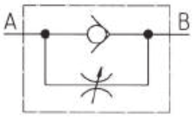
Size and ports dimensions:
10 = G 3/8" **15** = G 1/2" **20** = G 3/4" **25** = G 1" **32** = G 1 1/4"

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

Hydraulic symbol



Valve model	AQFR-10	AQFR-15	AQFR-20	AQFR-25	AQFR-32
Max recommended flow [l/min]	30	50	80	160	250
Max pressure [bar]	400	350			

3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

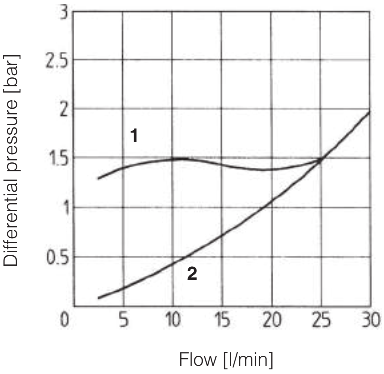
Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard execution = -30°C ÷ +70°C; /PE option = -20°C ÷ +70°C; /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

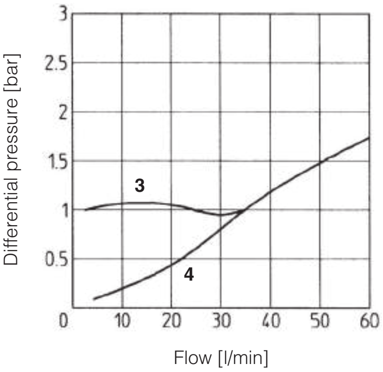
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

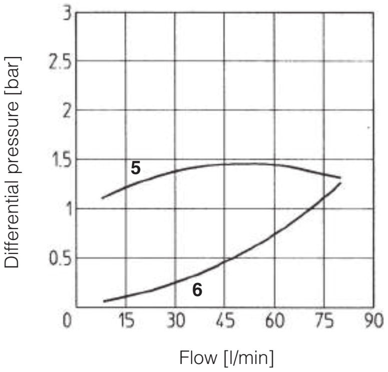
4 **DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

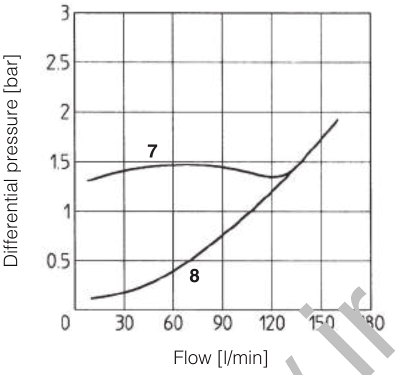
4.1 Q/Δp diagram through the chec valve for free flow B→A with the throttle valve fully open and fully closed

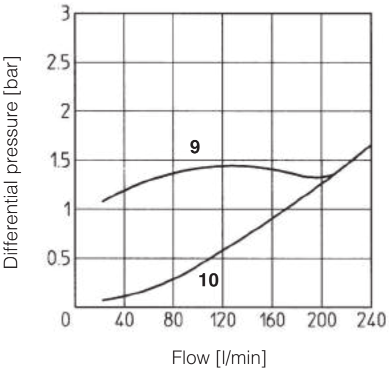
1 = AQFR-10 fully closed
2 = AQFR-10 fully open
3 = AQFR-15 fully closed
4 = AQFR-15 fully open
5 = AQFR-20 fully closed
6 = AQFR-20 fully open
7 = AQFR-25 fully closed
8 = AQFR-25 fully open
9 = AQFR-32 fully closed
10 = AQFR-32 fully open



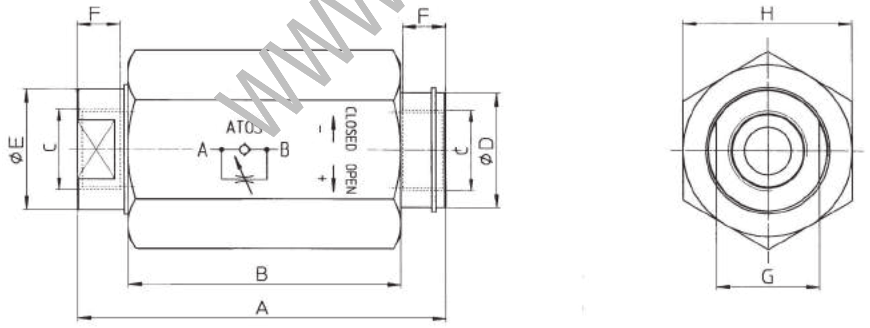








5 **DIMENSIONS [mm]**

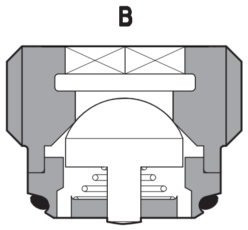


Valve model	**A**	**B**	**C**	**ØD**	**ØE**	**F**	**G**	**H**	**Mass [Kg]**
AQFR-10	93	68	G 3/8”	28	25	13	24	41	0,7
AQFR-15	105	78	G 1/2”	32	30	15	27	46	1
AQFR-20	127	95,5	G 3/4”	36	34	17	32	55	1,6
AQFR-25	153	112	G 1”	48	45	19	42	75	3,5
AQFR-32	196	145	G 1 1/4”	63	60	21	55	90	6,5

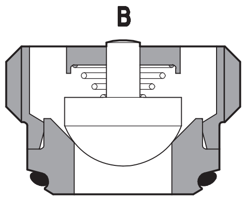
Table **C400-6/E**

Cartridge check valves type DB, DR

screw-in mounting - from G1/4” to G1/2”



DB-5/G



DR-5/G

DB, **DR** are direct operated check valves for screw-in mounting in cavities from G1/4” to G1/2”.
They are specifically designed to reduce the manifold dimensions and simplify the installation.
Cartridge designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

Flow up to **95 l/min**.

Max pressure: **350 bar**

1 MODEL CODE

D **B** - **10** / **G** ** / *

Screw-in check valve

B = function A → B
R = function B → A

Size/threated connections:
5 = G 1/4”   **10** = G 3/8”   **15** = G 1/2”

G = Gas threading

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

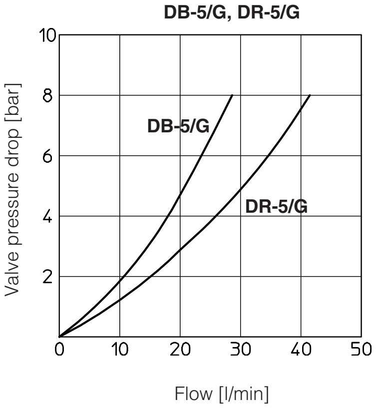
Hydraulic symbol	**DB-*/G** 			**DR-*/G** 		
Valve model	**DB-5/G**	**DR-5/G**	**DB-10/G**	**DR-10/G**	**DB-15/G**	**DR-15/G**
Nominal flow (at Δp = 8 bar) [l/min]	25	35	55	65	85	95
Max pressure [bar]	350					
Cracking pressure [bar]	0,3					

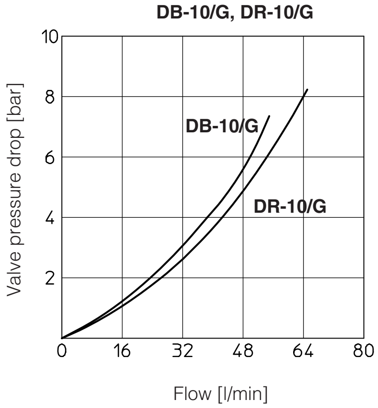
3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

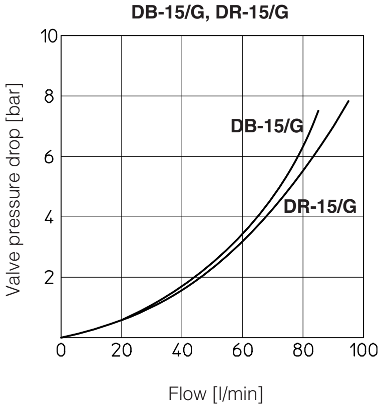
Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog
Flow direction	As shown in the symbol at section 2
Rated flow	See diagrams Q/Δp at section 4

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

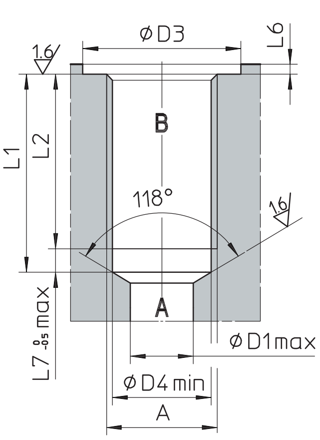
4 FLOW VERSUS PRESSURE DROP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

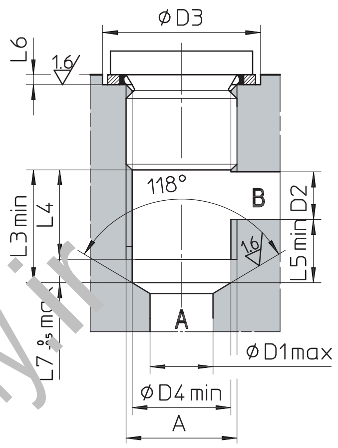






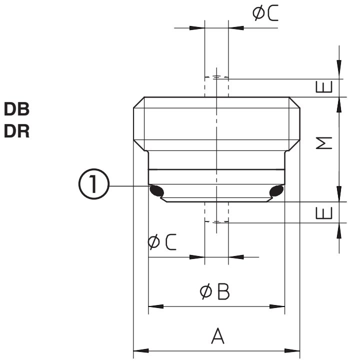
5 RECESS DIMENSIONS [mm]

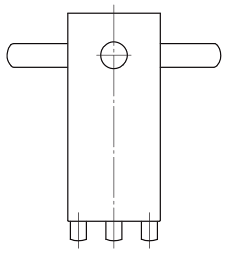




	A	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	L7
DB-5/G DR-5/G	G 1/4"	8	6	22	11,6	22	19	14	11	8	1,5	3
DB-10/G DR-10/G	G 3/8"	9	8	26	15	24	21	17	14	9	1,5	3
DB-15/G DR-15/G	G 1/2"	12	12	30	18,75	28	24,5	22	18,5	10	1,5	3,5

6 VALVE DIMENSIONS [mm]





***-DRG-205000**

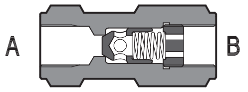
Note: this special key is required for
assembling the valve in the cavity

	A	B	C	E	M	①	Mass (Kg)
DB-5/G	G 1/4"	11,5	2,1	1,5	10,3	OR-9x1/70	0,060
DR-5/G			2,4		9		
DB-10/G	G 3/8"	15	2,8	2	11,3	OR-11x1,5/70	0,012
DR-10/G			3,3	2,5	11,4		
DB-15/G	G 1/2"	18,5	3,2	2,5	12,9	OR-14x1,5/70	0,020
DR-15/G			4	2,5	13,6		

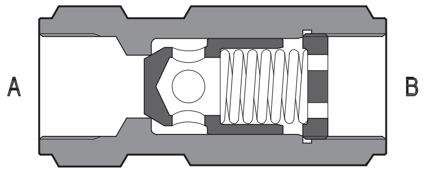
	A	KEY	Tightening torque (Nm)
DB-5/G	G 1/4"	CH 7 ⬡	15
DR-5/G		5-DRG-205000	
DB-10/G	G 3/8"	CH 6 ⬡	20
DR-10/G		10-DRG-205000	
DB-15/G	G 1/2"	CH 8 ⬡	40
DR-15/G		15-DRG-205000	

Check valves type ADR

in-line mounting - from G 1/4" to G 1 1/4" threaded ports



ADR-10



ADR-32

ADR are direct operated check valves for in-line mounting available with port size from 1/4” to 1 1/4” GAS.

Cartridge designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

Flow up to **500 l/min**
Pressure up to **400 bar**

1 MODEL CODE

ADR - **10** / **4** ** / **

ADR: Check valve in-line mounting

Size/threated connections:
06 = G 1/4”
10 = G 3/8”
15 = G 1/2”
20 = G 3/4”
25 = G 1”
32 = G 1 1/4”

Cracking pressure:
- =0,5 bar
/2 =2 bar
/4 =4 bar
/8 =8 bar

**: Series number

**: Fluid temperature:
- = -20°C ÷ +80°C
BT = -40°C ÷ +80°C

2 HYDRAULIC CHARACTERISTICS

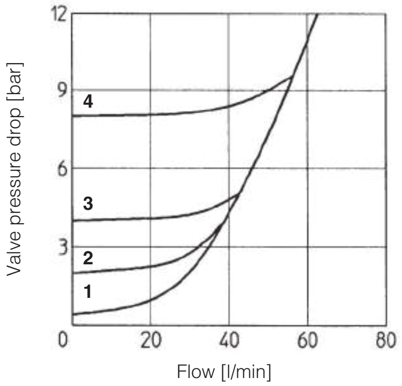
Hydraulic symbol						
Valve model	**ADR-06**	**ADR-10**	**ADR-15**	**ADR-20**	**ADR-25**	**ADR-32**
Max recommended flow [l/min]	40	80	150	300	360	500
Max pressure [bar]	400		350			

3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position	Any position
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Fluid	Hydraulic oil as per DIN 51524 ... 535;
Fluid temperature	Standard version = -20°C ÷ +80°C BT option = -40°C ÷ +80°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog
Flow direction	As shown in the symbol at section 2
Rated flow	See diagrams Q/Δp at section 4

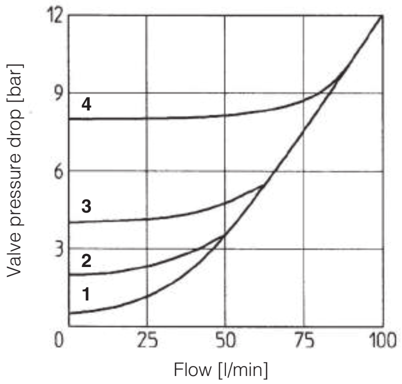
4 FLOW VERSUS PRESSURE DROP DIAGRAMS Based on based on mineral oil ISO VG 46 at 50°C

ADR-06



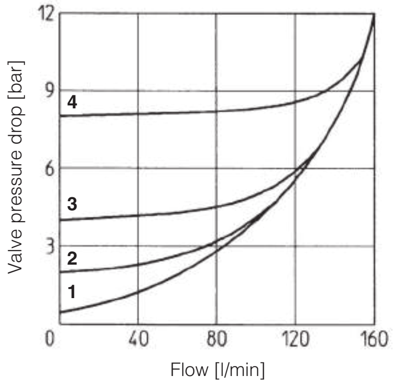
1 = ADR-06
2 = ADR-06/2
3 = ADR-06/4
4 = ADR-06/8

ADR-10



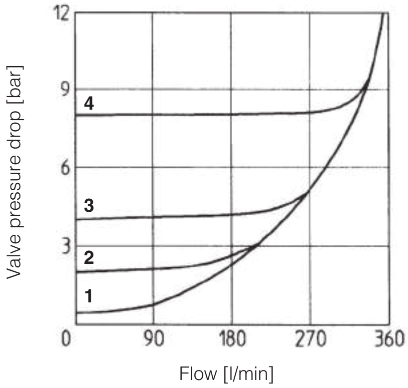
1 = ADR-10
2 = ADR-10/2
3 = ADR-10/4
4 = ADR-10/8

ADR-15



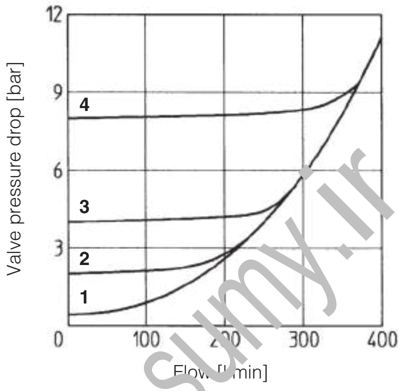
1 = ADR-15
2 = ADR-15/2
3 = ADR-15/4
4 = ADR-15/8

ADR-20



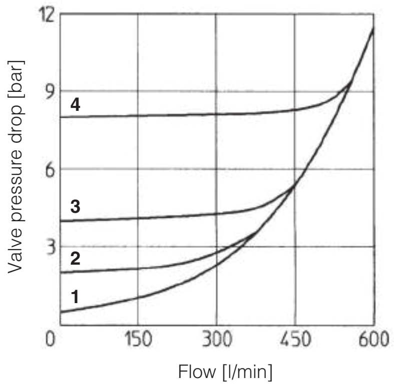
1 = ADR-20
2 = ADR-20/2
3 = ADR-20/4
4 = ADR-20/8

ADR-25



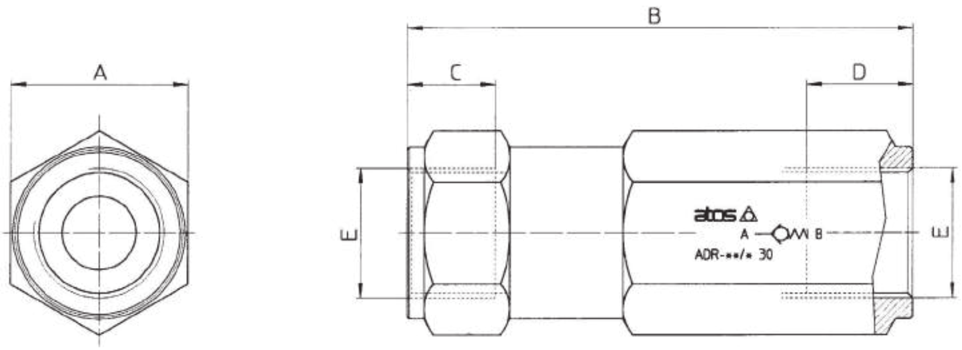
1 = ADR-25
2 = ADR-25/2
3 = ADR-25/4
4 = ADR-25/8

ADR-32



1 = ADR-32
2 = ADR-32/2
3 = ADR-32/4
4 = ADR-32/8

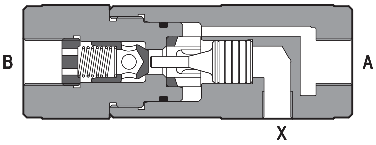
5 DIMENSIONS [mm]



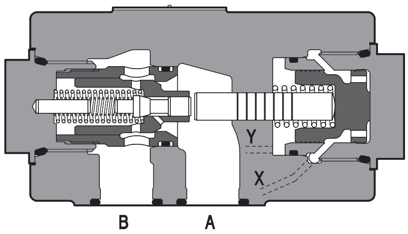
Model	A	B	C	D	E	Mass [kg]
ADR - 06	22	67	12	13	G 1/4”	0,2
ADR - 10	27	70	12	13	G 3/8”	0,4
ADR - 15	32	82,5	14	17	G 1/2”	0,6
ADR - 20	36	102,5	16	21,5	G 3/4”	0,9
ADR - 25	46	120	18	24,5	G 1”	2,1
ADR - 32	55	137,5	20	23	G 1 1/4”	2,5

Pilot operated check valves type ADRL, AGRL, AGRLE

in-line mounting, port size from G 3/8” to G 1 1/4”
subplate mounting, ISO 5781 size 10, 20 and 32



ADRL-15



AGRLE-20

ADRL are pilot operated (port X) check valves for in-line mounting available with port size from 3/8" GAS to 1 1/4" GAS.
Flow up to 300 l/min.
Pressure up to 400 bar.

AGRL and **AGRLE** are pilot operated (port X) check valves for subplate mounting available with mounting surface ISO 5781 size 10, 20 and 32.
Flow up to 500 l/min.
Max pressure: 315 bar.

AGRLE versions have an external drain (port Y) of the pilot chamber to permit a correct use of pilot operated check valve in systems where valve must open in presence of pressure at port A: infact pressure at port A, on regular pilot operated check valves, may affect the check opening by acting against the pilot device.

Valves designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

1 MODEL CODE

AGRL **E** - **10** / * ** / *

ADRL =pilot operated check valve in-line mounting
AGRL =pilot operated check valve subplate mounting

Only for AGRL:
- = without external drain
E = with external drain

Threaded connections for ADRL:
10 = G 3/8”
15 = G 1/2”
20 = G 3/4”
32 = G 1 1/4”

Size for AGRL and AGRLE:
10 **20** **32**

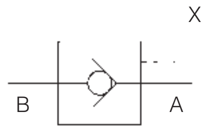
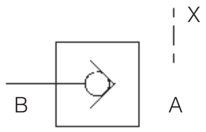
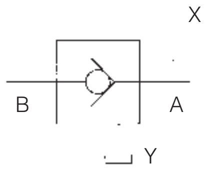
Cracking pressure

for ADRL	for AGRL
- = 0,5 bar	**-** = 0,5 bar
2 = 2 bar	
4 = 4 bar	
8 = 8 bar	

Series number

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

Hydraulic symbols										
Model	**ADRL-10**	**ADRL-15**	**ADRL-20**	**ADRL-32**	**AGRL-10**	**AGRL-20**	**AGRL-32**	**AGRLE-10**	**AGRLE-20**	**AGRLE-32**
Piloting ratio (1)	2,8	2,7	2,5	2,3	13,6	14,0	14,4	13,6	14,0	14,4
Max recommended flow [l/min]	30	60	100	300	160	300	500	160	300	500
Max pressure [bar]	400	350			315					

(1) Applying the pilot pressure through the pilot port X, the pilot spool opens the check valve, allowing free flow B→A.
The minimum pilot pressure for correct operation depends on the pilot ratio indicated in the table and on the pressure closing the check. i.e.: the pilot pressure for ADRL-20 is the pressure on the check divided by 2,5. The valves AGRL-* and AGRLE-*, are equipped with a decompression system.

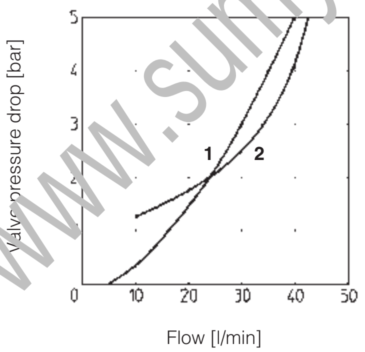
3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

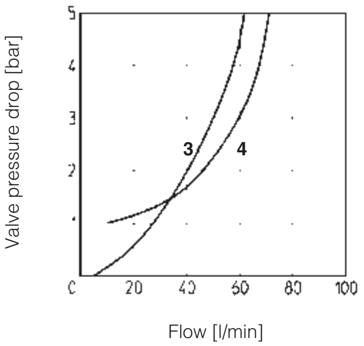
Assembly position	Any position. For AGRLE valves, the drain port Y has to be connected directly to the tank without counter pressure
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)

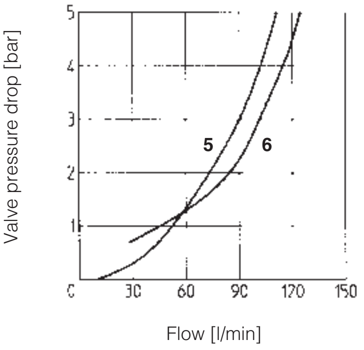
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

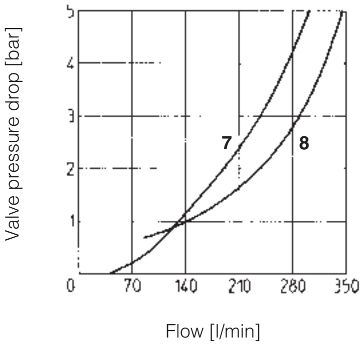
4 FLOW VERSUS PRESSURE DROP DIAGRAMS FOR ADRL based on mineral oil ISO VG 46 at 50°C

1 = **ADRL-10** B→A
2 = **ADRL-10** A→B
3 = **ADRL-15** B→A
4 = **ADRL-15** A→B
5 = **ADRL-20** B→A
6 = **ADRL-20** A→B
7 = **ADRL-32** B→A
8 = **ADRL-32** A→B



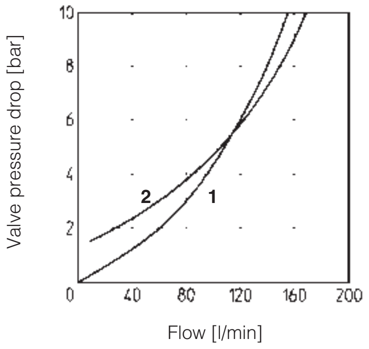


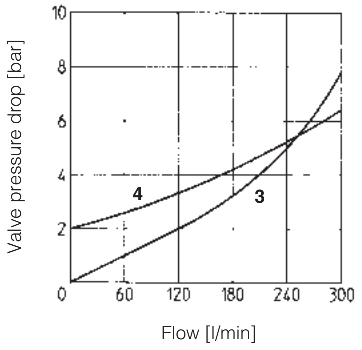


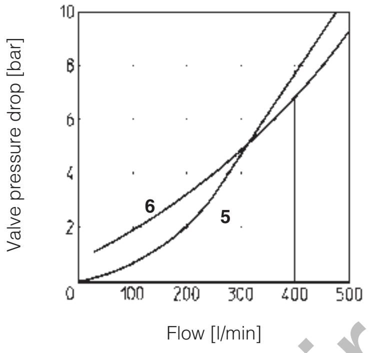


5 FLOW VERSUS PRESSURE DROP DIAGRAMS FOR AGRL AND AGRLE based on mineral oil ISO VG 46 at 50°C

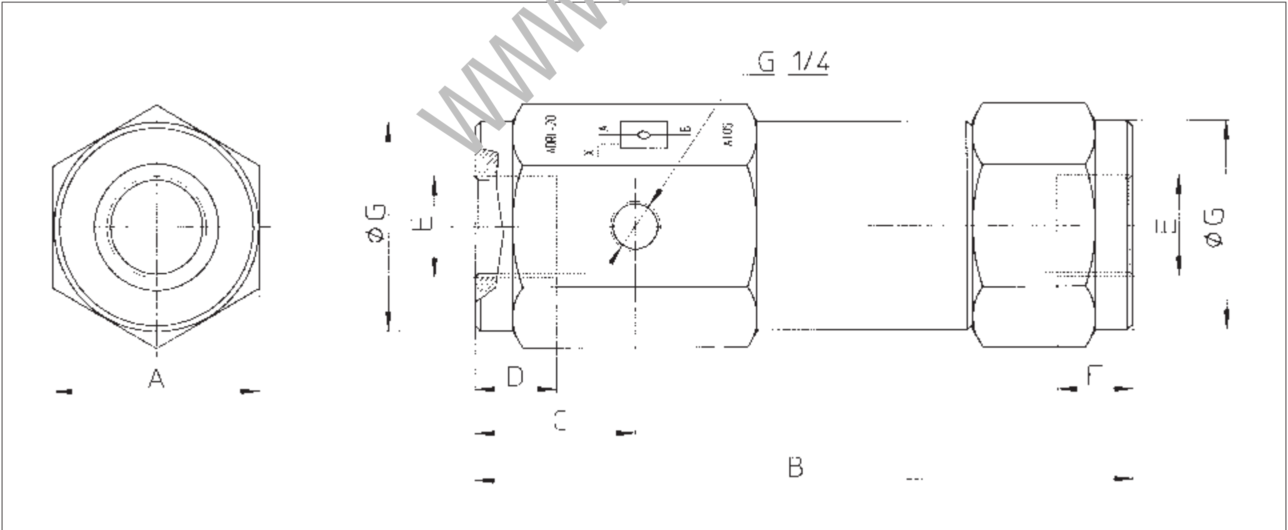
1 = **AGRL-10, AGRLE-10** B→A
2 = **AGRL-10, AGRLE-10** A→B
3 = **AGRL-20, AGRLE-20** B→A
4 = **AGRL-20, AGRLE-20** A→B
5 = **AGRL-32, AGRLE-32** B→A
6 = **AGRL-32, AGRLE-32** A→B







6 DIMENSIONS FOR ADRL VALVES [mm]

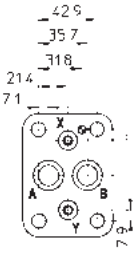


Model	A	B	C	D	E	F	ØG	Mass [Kg]
ADRL-10	41	120	30	14	G 3/8"	12	40	1
ADRL-15	50	145	33	16	G 1/2"	16	49	2
ADRL-20	55	175	42,5	18,5	G 3/4"	19	54,5	2,5
ADRL-32	90	245	53	23,5	G 1 1/4"	25	87,5	7

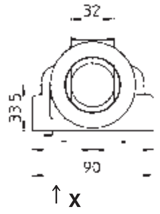
7 DIMENSIONS FOR AGRL AND AGRLE VALVES [mm]

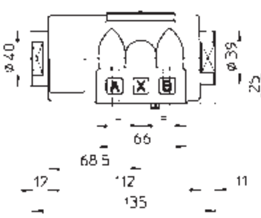
AGRL-10
AGRLE-10

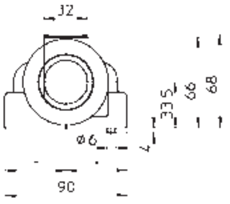
ISO 5781: 2000
Mounting surface: 5781-06-07-0-00
Fastening bolts: 4 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 3068; 2 OR 109/70
Ports A, B: Ø = 15 mm
Ports X, Y: Ø = 5 mm



view from X



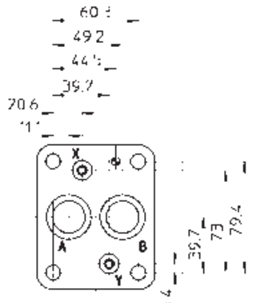




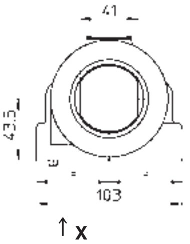
Mass: 4 Kg

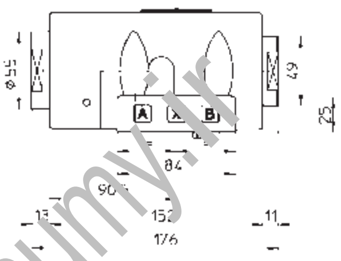
AGRL-20
AGRLE-20

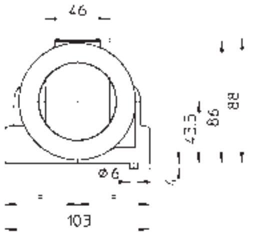
ISO 5781: 2000
Mounting surface: 5781-08-10-0-00
Fastening bolts: 4 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 4100; 2 OR 109/70
Ports A, B: Ø = 23 mm
Ports X, Y: Ø = 5 mm



view from X



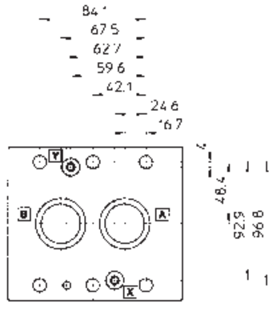




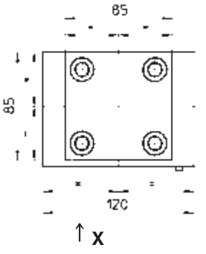
Mass: 7 Kg

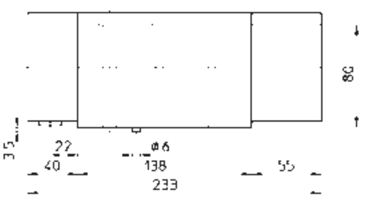
AGRL-32
AGRLE-32

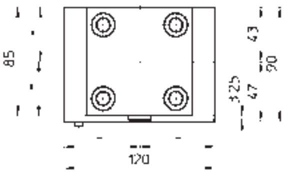
ISO 5781: 2000
Mounting surface: 5781-10-13-0-00
Fastening bolts: 6 socket head screws M10x100 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR [illegible]131; 2 OR 109/70
Ports A, B: Ø = 30 mm
Ports X, Y: Ø = 5 mm



view from X







Mass: 14,8 Kg

8 MOUNTING SUBPLATES FOR AGRL AND AGRLE VALVES

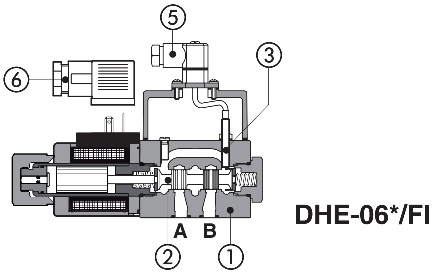
Valve	Subplate model	Port location	GAS ports				Ø Counterbore [mm]				Mass [kg]
			A	B	X	Y	A	B	X	Y	
AGRL-10, AGRLE-10	BA-305	Ports A, B, X, Y underneath;	1/2”	1/2”	1/4”	1/4”	30	30	21,5	21,5	1
AGRL-20, AGRLE-20	BA-505		1”	1”	1/4”	1/4”	46	46	21,5	21,5	2
AGRL-32, AGRLE-32	BA-705		1 1/2”	1 1/2”	1/4”	1/4”	63,5	63,5	21,5	21,5	7,5

The subplates are supplied with fastening bolts. For further details see table K280.

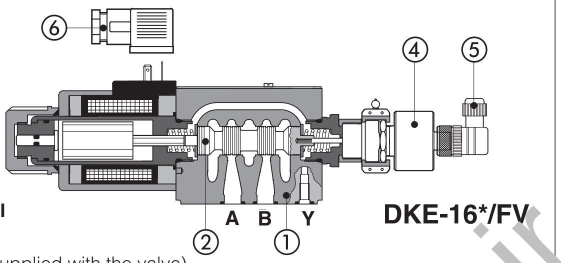
Safety directional valves with spool position monitoring

On-off, direct operated, conforming to Machine Directive 2006/42/EC - certified by

SAFETY
CERTIFIED



DHE-06*/FI



DKE-16*/FV

① Body
② Spool
③ Inductive proximity sensor **FI**
④ Inductive position switch **FV**
⑤ Sensor electric connector (supplied with the valve)
⑥ Coil electric connector (to be ordered separately)

Direct operated safety directional valves with spool position monitoring, **CE** marked and certified by **TÜV** in accordance with safety requirements of Machine Directive 2006/42/EC.

DHE, size 06, high performances, for AC and DC supply with cURus certified solenoids

DKE, size 10, for AC and DC supply with cURus certified solenoids

The valves are equipped with **FI** inductive proximity sensor or **FV** inductive position switch for the spool position monitoring, see section 1 and 11 for sensors availability and technical characteristics.

Certification
The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Mounting surface: **ISO 4401**, size **06** and **10**

Max flow:	**DHE**	**80 l/min**
	DKE	**150 l/min**

Max pressure: **350 bar**

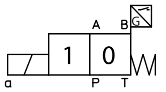
1 RANGE OF VALVE'S MODELS

Valve code	Size	Description	DC solenoids		AC solenoids	
			Sensor type			
			/FI	/FV	/FI	/FV
DHE-06	06	direct operated solenoid valves, on-off, single solenoid	•	•	•	•
DHE-07	06	direct operated solenoid valves, on-off, double solenoid	•	•	•	
DKE-16	10	direct operated solenoid valves, on-off, single solenoid	•	•	•	•
DKE-17	10	direct operated solenoid valves, on-off, double solenoid	•	•	•	

Notes:
FI = inductive proximity sensor, type NO (normally open) or NC (normally closed)
FV = inductive position switch providing both NO and NC contacts to be wired on the electric connector
See section 11 for sensor's characteristics

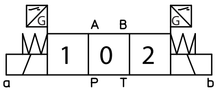
1.1 FI sensor & FV switch configurations

Single solenoid valves size 06 & 10 are provided with n°1 FI sensor or n° 1 FV switch for the spool position monitoring

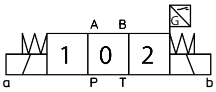


FI or FV

Double solenoid valves size 06 & 10 are provided with n° 2 FI sensors or n° 1 FV switch for the spool position monitoring

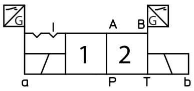


FI

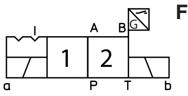


FV

Double solenoid valves size 06 with detent are provided with n°2 FI sensors or n° 1 FV switch for the spool position monitoring

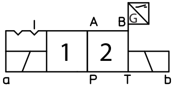


FI



FV

Double solenoid valves size 10 with detent are provided with n° 1 FI sensor or n° 1 FV switch for the spool position monitoring



FI or FV

For model code of DHE safety valves, see section 2
For model code of DKE safety valves, see section 4

2 MODEL CODE OF DHI AND DHE

DHE - **0** **63** **1/2** / **A** / **FV** ***** - **X** **24DC** ****** / *****

Directional control valve size 06
DHE = max flow 80 l/min

Size ISO 4401
0 = size 06

Valve configuration, see section 3
- **61** = single solenoid, central plus external position, spring centered
- **63** = single solenoid, 2 external positions, spring offset
- **67** = single solenoid, external plus central position, spring offset
- **71** = double solenoid, 3 positions, spring centered
- **75** = double solenoid, 2 external positions, with detent

Spool type, see section 3

Options, see section 8

Seals material see sect. 6,7
- **-** = NBR
- **PE** = FKM

Series number

Voltage code, see section 9

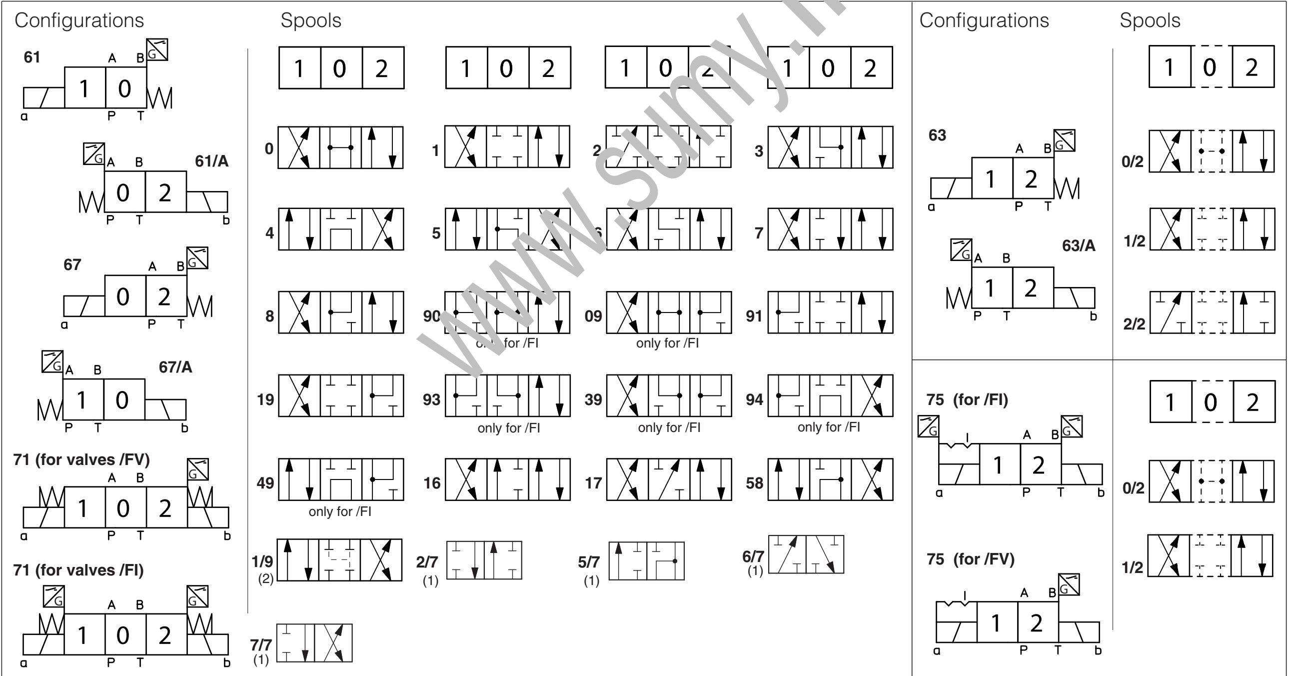
X = without connector, see section 10 for available connectors, to be ordered separately

Electrical signal - only for **FI** version (1):
- **/NC** = electric contact is closed when the valve is de-energized
- **/NO** = electric contact is open when the valve is de-energized

Spool position monitor:
- **FI** = inductive proximity switch
- **FV** = inductive position switch (double contact)

(1) the **FV** inductive position switch provides both NC and NO contacts

3 CONFIGURATIONS AND SPOOLS (representation according to ISO 1219-1)



(1) only for configuration 61, not available for configuration 61/A
(2) only for DHE-0711/9/FI

3.2 Special shaped spools for DHE

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4**, **5** and **58** are also available as **1/1, 4/8, 5/1** and **58/1**. They are properly shaped to reduce water-hammer shocks during the swiching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** to limit valve internal leakages.
- Other types of spools can be supplied on request.

3.1 Standard spool availability for DHE - spools not listed in the table are available for all valves models

Valve type	standard spool						
	09	90	39	93	49	94	1/9
DHE/FI	•	•	•	•	•	•	•
DHE/FV							

4 MODEL CODE OF DKE

DKE - **1** **63** **1/2** / **A** / **FV** ***** - **X** **24DC** ****** / *****

DKE = Directional control valve size 10

Size ISO 4401
1 = size 10

Valve configuration, see section 5
61 = single solenoid, central plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, external plus central position, spring offset
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 5

Options, see section 8

Spool position monitor:
FI = inductive proximity switch
FV = inductive position switch (double contact)

Electrical signal - only for **FI** version (1):
/NC = electric contact is closed when the valve is de-energized
/NO = electric contact is open when the valve is de-energized

X = without connector, see section 10 for available connectors, to be ordered separately

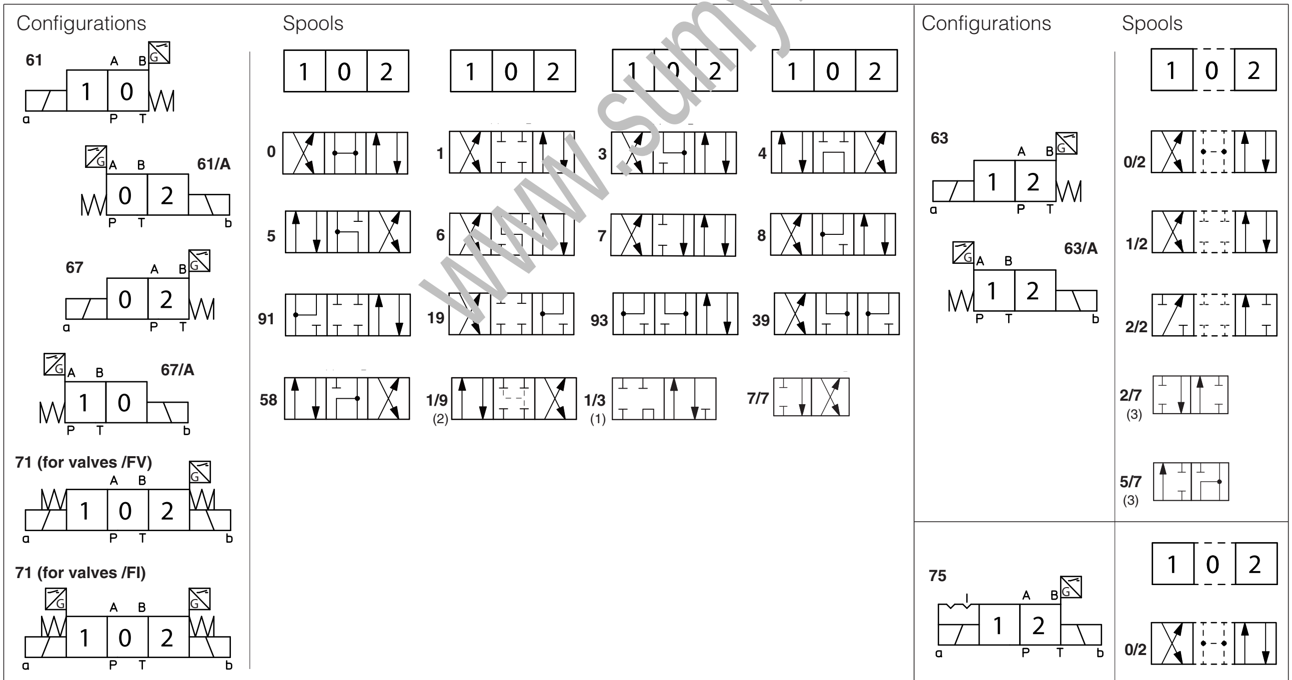
Voltage code, see section 9

Series number

Seals material see sect. 6,7
- = NBR
PE = FKM

DKE/FI and /FV are always provided with Y drain port
(1) the **FV** inductive position switch provides both NC and NO contacts

5 CONFIGURATIONS AND SPOOLS (representation according to ISO 1219-1)



(1) only for DKE-1611/3/*DC
(2) only for DKE-1711/9/FI
(3) only for configuration 63, not available for configuration 63/A

5.1 Special shaped spools for DKE

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1** is also available as **1/1**, properly shaped to reduce the water-hammer shocks during the switching.
- spool type **1/9** has closed center in rest position but it avoids the pressurization of A and B ports due to the internal leakages.
- other types of spools can be supplied on request.

6 MAIN CHARACTERISTICS

Assembly position / location		Any position
Subplate surface finishing		Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849		150 years, for further details see technical table P007
Compliance		CE to Machine Directive 2006/42/EC. -EC type-examination certificate for safety components **(1)** -ISO 13849 category 1, PLC in high demand mode CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC. RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature		**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction		As shown in the symbols of table 3 and 5
Operating pressure	**DHE**	P, A, B = **350 bar** T = **100 bar** (version /FI); **210 bar** (DC solenoid - version /FV); **160 bar** (AC solenoid - version /FV)
	DKE	P, A, B = **350 bar** T = (with Y port not connected to tank) **100 bar** (version /FI); **210 bar** (DC solenoid - version /FV); **120 bar** (AC solenoid - version /FV) T = (with Y port drained to tank) **250 bar**
Rated flow		see diagrams Q/Δp at section 14
Maximum flow	**DHE**	**80 l/min** see section 15
	DKE	**150 l/min** see section 15

(1) The type-examination certificate can be download from www.atos.com

6.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils (all versions) **F** (155°C) for AC coils (DHE, DKE) Due to the occuring surface temperature of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric features 9
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

7 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

8 OPTIONS

A = Single solenoid valves: solenoid mounted at side of port B. In standard versions the solenoid is mounted at side of port A.
Double solenoid valves DHE/FV(DC), DKE/FV(DC): FV inductive position switch mounted at side of port A. In standard versions the position switch is mounted at side of port B.

WARNING: the manual operation is not permitted for safety valves, than the valve is provided with solenoid blind rings to prevent the access to the manual override. The manual override protected by rubber cup (option /WP) is not available

WARNING: the inobservance of following prescriptions invalidates the certification and may represent a risk for personnel injury
Safety valves must be installed and commissioned only by qualified personnel
Safety valves must not be disassembled
The inductive proximity FI or the inductive position switch FV can be adjusted only by the valve's manufacturer or Atos authorized service centers
Valve's components cannot be interchanged
The valves must operate without switching shocks and spool vibrations

9 ELECTRIC FEATURES

9.1 COILS FOR DHE VALVES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/50/60 AC**		58 VA (3)	COE-230/50/60AC
230/60 AC	**230/60 AC**		80 VA (3)	COE-230/60AC
110/50 AC	**110RC**	669	30 W	COE-110RC
120/60 AC				
230/50 AC	**230RC**			COE-230RC
230/60 AC				

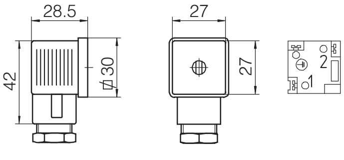
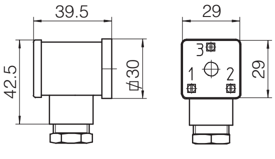
(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 58 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

9.2 COILS FOR DKE VALVE

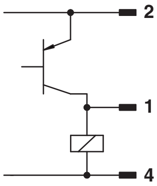
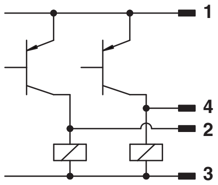
External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	36 W	CAE-12DC
14 DC	**14 DC**			CAE-14DC
24 DC	**24 DC**			CAE-24DC
28 DC	**28 DC**			CAE-28DC
110 DC	**110 DC**			CAE-110DC
125 DC	**125 DC**			CAE-125 DC
220 DC	**220 DC**			CAE-220DC
110/50/60 AC	**110/50/60 AC**		100 VA (3)	CAE-110/50/60AC (1)
230/50/60 AC	**230/50/60 AC**			CAE-230/50/60AC (1)
115/60 AC	**115/60 AC**		130 VA (3)	CAE-115/60AC
230/60 AC	**230/60 AC**			CAE-230/60AC
110/50/60 AC	**110 DC**	669	36 W	CAE-110DC
230/50/60 AC	**220 DC**			CAE-220DC

(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 90 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

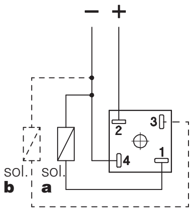
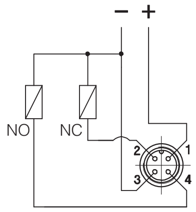
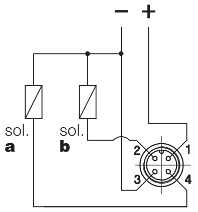
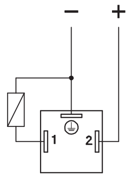
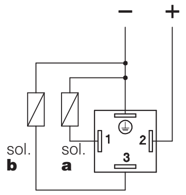
10 COILS ELECTRIC CONNECTORS - according to din 43650 (to be ordered separately)

<table>
<tr><th>666, 667 (for AC or DC supply)</th><th>669 (for AC supply)</th><th colspan="3">CONNECTOR WIRING</th></tr>
<tr><td rowspan="3"> </td><td rowspan="3"> </td><td colspan="2">666, 667
1 = Positive ⊕
2 = Negative ⊖
⊕ = Coil ground</td><td>669
1,2= Supply voltage VAC
3 = Coil ground</td></tr>
<tr><td colspan="3">SUPPLY VOLTAGES</td></tr>
<tr><td>666
All voltages</td><td>667
24 AC or DC
110 AC or DC
220 AC or DC</td><td>669
110/50 AC
110/60 AC
230/50 AC
230/60 AC</td></tr>
</table>

11 TECHNICAL CHARACTERISTICS OF INDUCTIVE PROXIMITY AND POSITION SWITCHES

Type of switch	**/FI** proximity sensor	**/FI** scheme	**/FV** position switch	**/FV** scheme
Supply voltage [V]	10÷30		20÷32	
Ripple max [%]	≤ 20		≤ 10	
Max current [mA]	200		400	
Max peak pressure [bar]	100		400	
Mechanical life	virtually infinite		virtually infinite	
Switch logic	PNP		PNP	
		1 output signal **2** supply +24 VDC **4** GND	**1** supply +24 VDC **2** output signal	**3** GND **4** output signal

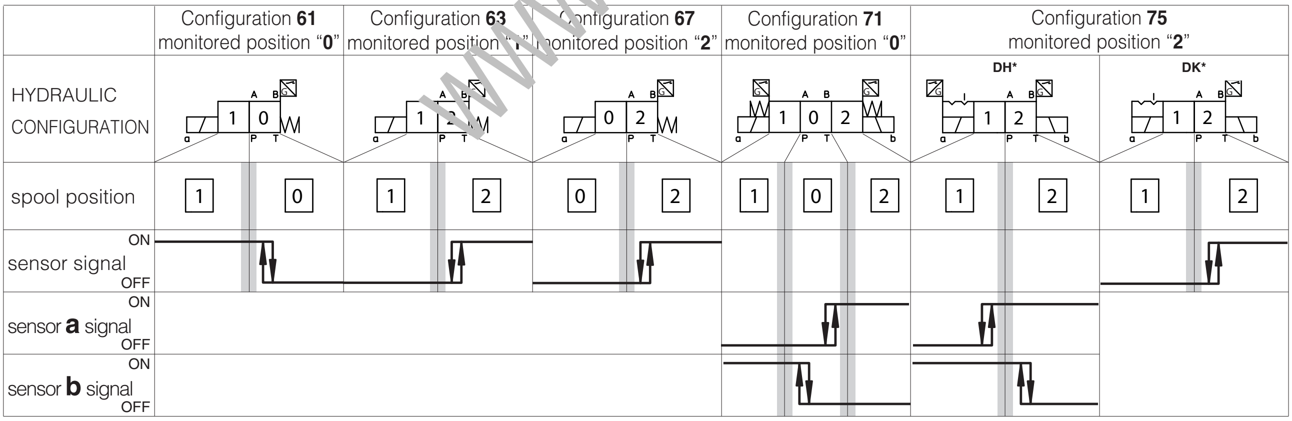
12 CONNECTING SCHEMES OF INDUCTIVE PROXIMITY AND POSITION SWITCHES - FI and FV sensor's connector are always supplied with the valve

DHE/FI single solenoid / double solenoid (dotted line)	**/FV (all valves)** single solenoid	**/FV (all valves)** double solenoid	**DKE/FI** single solenoid	**DKE/FI** double solenoid
Connector type **345** IP65 	Connector type **ZBE-06** IP65 	Connector type **ZBE-06** IP65 	Connector type **666** IP65 	Connector type **664** IP65 
1 =output signal 2 =supply +24 VDC 3 = output signal for double solenoid 4 = GND	1 = supply +24 VDC 2 = output signal NC 3 = GND 4 = output signal NO	1 = supply +24 VDC 2 = output signal sol.**b** 3 = GND 4 = output signal sol.**a**	1 = output signal S 2 = supply +24 VDC ⏚ = GND	1 = output signal sol.**a** 2 = supply +24 VDC 3 = output signal sol.**b** ⏚ = GND

NOTE: the /FI proximity and /FV position switch are not provided with a protective earth connection

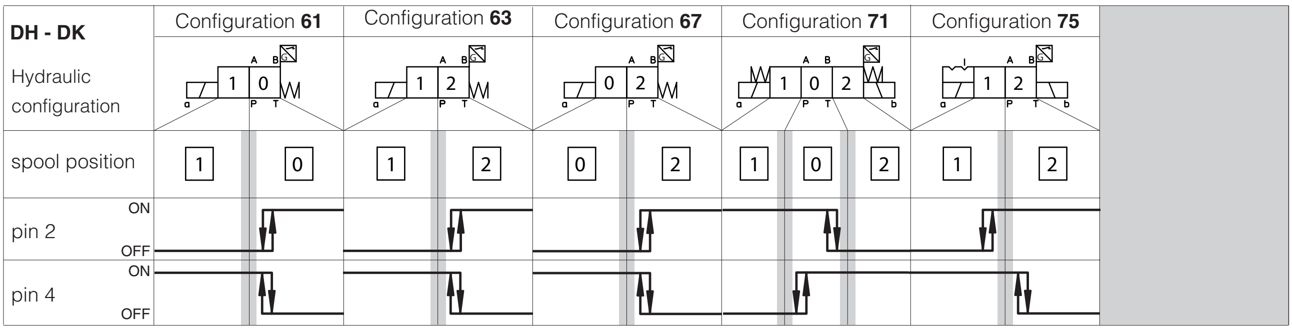
13 STATUS OF OUTPUT SIGNAL

13.1 Signal status for FI versions



Diagrams show the behaviour of the output signal for inductive switches type **FI/NO**.
For inductive switches type **FI/NC** the behaviour is opposite (high level signal instead of low level signal and viceversa)

13.2 Signal status for FV versions



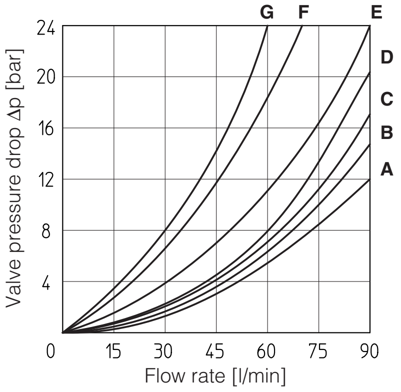
Note: FV position switch can be electrically wired by the customer as NO or NC and then the status of the output signal will be in accordance to the selected configuration

▨ = intermediate spool position corresponding to the hydraulic configuration change

14 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

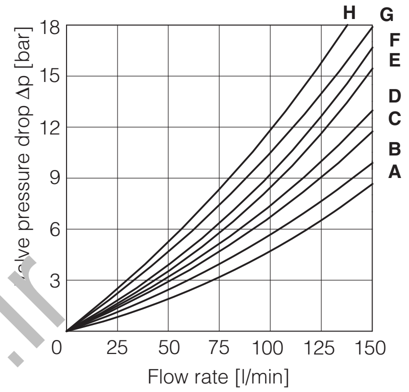
DHE

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0, 0/1	A	A	C	C	D
1, 1/1, 1/9	D	C	C	C	
3, 3/1	D	D	A	A	
4, 4/8, 5, 5/1, 49, 58, 58/1, 94	F	F	G	C	E
1/2, 0/2	D	D	D	D	
6, 7, 16, 17	D	D	D	D	
8	A	A	E	E	
2	D	D			
2/2	F	F			
09, 19, 90, 91	E	E	D	D	
39, 93	F	F	G	G	



DKE

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T	B→A
0, 0/1, 0/2, 2/2	A	A	B	B		
1, 1/1, 1/9, 6, 8	A	A	D	C		
3, 3/1, 7	A	A	C	D		
4	B	B	B	B	F	
5, 58	A	B	C	C	G	
1/2	B	C	C	B		
19, 91	E	E	G	G		H
39, 93	F	F	G	G		H



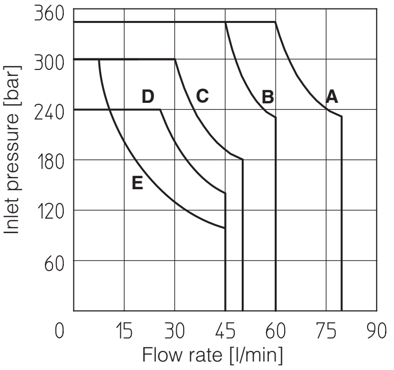
15 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

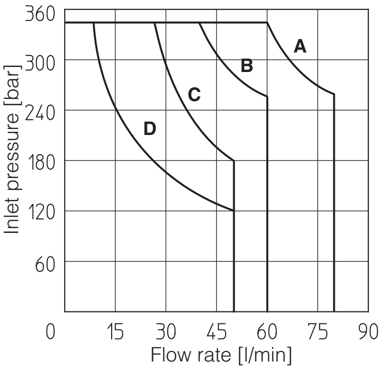
DHE

Curve	Spool type	
	AC	DC
A	1,1/2, 8	0, 0/1, 1, 1/2, 3, 8
B	0, 0/1, 0/2, 1/1, 1/9, 3	0/2, 1/1, 6, 7, 1/9, 19
C	3, 3/1, 6, 7	3/1, 4, 4/8, 5, 5/1, 16, 17, 19, 39, 49, 58, 58/1, 09, 90, 91, 93, 94
D	4, 4/8, 5, 5/1, 16, 17, 19, 39, 58, 58/1, 09, 90, 91, 93, 94	2, 2/2
E	2, 2/2	-

DHE - AC



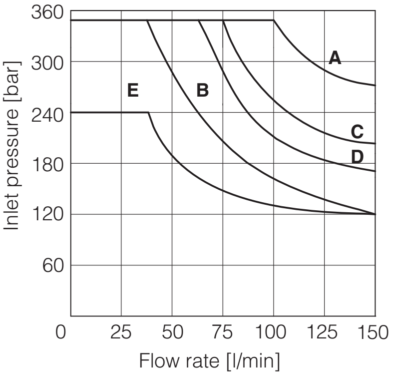
DHE - DC



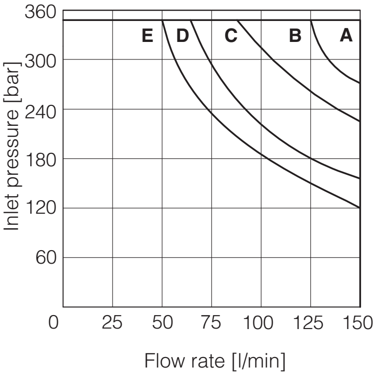
DKE

Curve	Spool type	
	AC	DC
A	0/1	0, 0/1, 1, 1/1, 3, 3/1, 1/2, 0/2, 8
B	4, 5, 19, 91	6, 7
C	0, 1/1, 3, 3/1	19, 91
D	1, 1/2, 0/2	4, 5
E	6, 7, 8, 2/2	2/2

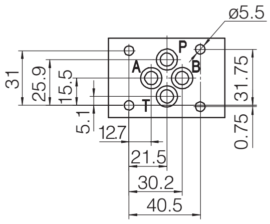
DKE - AC



DKE - DC



16 DIMENSIONS FOR DHI AND DHE SOLENOID SAFETY VALVES [mm]



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws: M5x50 class 12.9 (DHI)
M5x30 class 12.9 (DHE)
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)

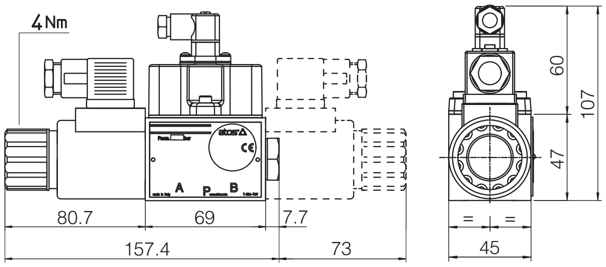
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

option /A

Single solenoid valves: solenoid mounted at side of port B.

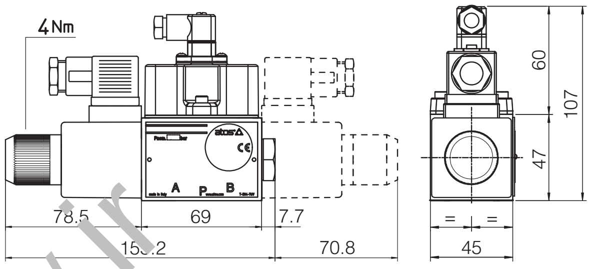
Double solenoid valves DHE/FV(DC): FV inductive position switch mounted at side of port A

DHE-06*/FI (DC)
DHE-07*/FI (DC) dotted line



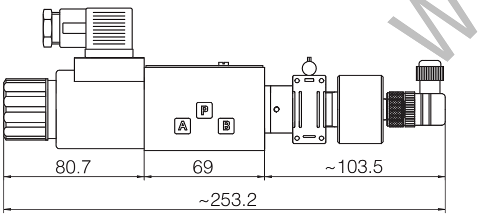
Mass:
kg 1,85 (one solenoid)
kg 2,1 (two solenoids)

DHE-06*/FI (AC)
DHE-07*/FI (AC) dotted line



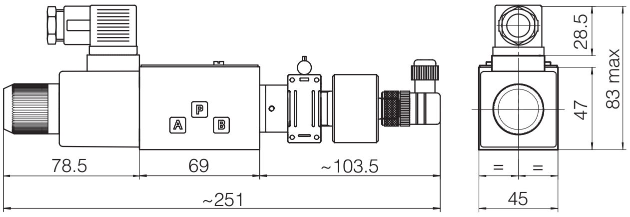
Mass:
kg 1,85 (one solenoid)
kg 2,1 (two solenoids)

DHE-06*/FV (DC)



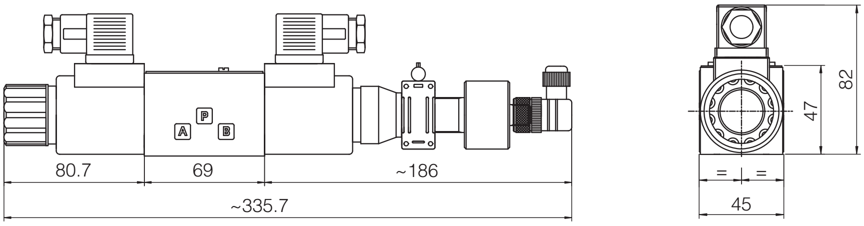
Mass: kg 1,95

DHE-06*/FV (AC)



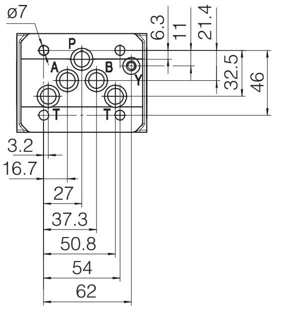
Mass: kg 1,8

DHE-07*/FV (DC)



Mass: kg 2,2

17 DIMENSIONS OF DKE SOLENOID SAFETY VALVES [mm]



ISO 4401: 2005
Mounting surface:
4401-05-05-0-05
(without port X)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050. 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

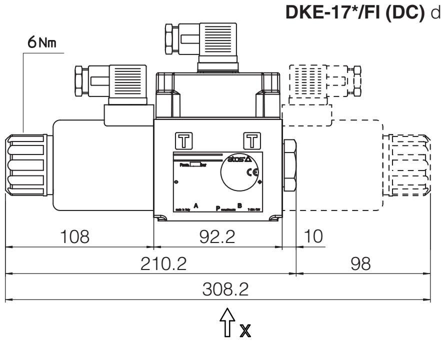
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT

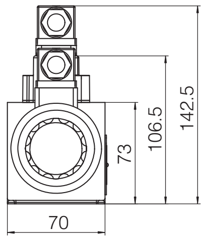
option /A

Single solenoid valves: solenoid mounted at side of port B.

Double solenoid valves DKE/FV(DC): FV inductive position switch mounted at side of port A

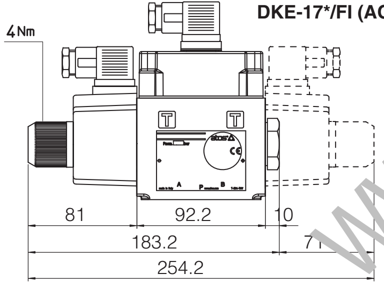
DKE-16*/FI (DC)
DKE-17*/FI (DC) dotted line

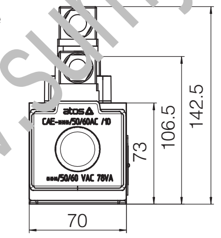




Mass:
kg 4,4 (one solenoid)
kg 5,8 (two solenoids)

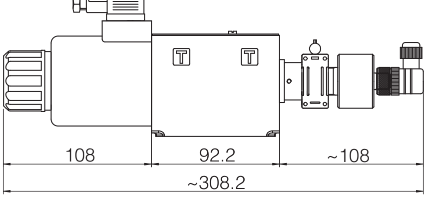
DKE-16*/FI (AC)
DKE-17*/FI (AC) dotted line





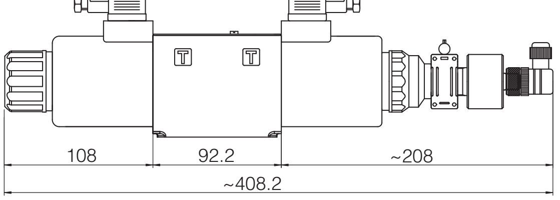
Mass:
kg 3,7 (one solenoid)
kg 4,4 (two solenoids)

DKE-16*/FV (DC)



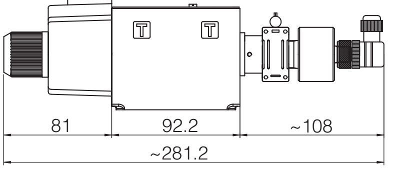
Mass: kg 4,4

DKE-17*/FV (DC)



Mass: kg 5,9

DKE-16*/FV (AC)

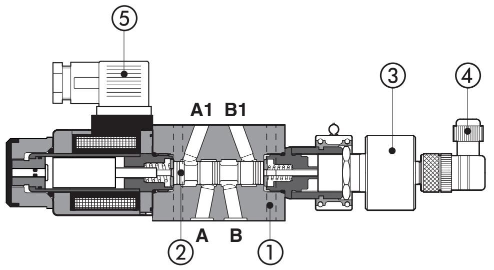


Mass: kg 3,8

Safety modular valves with spool position monitoring

On-off, direct, conforming to Machine Directive 2006/42/EC - certified by

SAFETY
CERTIFIED



HF-0611/FV

① Body
② Spool
③ Inductive position switch **FV**
④ Sensor electric connector (supplied with the valve)
⑤ Coil electric connector (to be ordered separately)

HF are spool type, direct operated solenoid valves in modular execution, normally used for safety functions to shut-off or to by-pass the hydraulic user lines.
They are provided with **FV** inductive position switch for spool position monitoring, **CE** marked and certified by **TÜV** in accordance with safety requirements of Machine Directive 2006/42/EC.

The modular execution permits to make compact functional circuits, by the stack mounting with other modular valves and solenoid valves size 06.

Applications
Syncro press brakes, vertical presses, plastic injection, ceramic presses.

Certification
The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Mounting Surface: **ISO 4401 size 06**
Max flow: **60 l/min**
Max pressure: **350 bar**

1 MODEL CODE

HF-0	61	1	/	A	/	FV	-	E	X	24DC	**	/*

Modular directional valve size 06

Valve configuration, see section 2
61 = single solenoid, central plus external position, spring centered
67 = single solenoid, central plus external position, spring offset

Spool type: **1**, **3**, **4** see section 2

Options:
A = solenoid mounted at side of port B
B = orientation of coil and proximity connectors rotated of 180°

Optional spool position monitor:
FV = inductive position switch (only for HF-0611, HF-0614, HF-0673)

E = solenoid OE for AC and DC supply

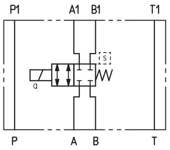
X = without connector
See section 6 for available connectors, to be ordered separately

Voltage code, see section 7

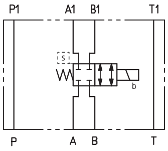
Series number

Seals material, see section 4:
- = NBR
PE = FKM

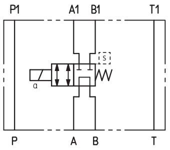
2 CONFIGURATION



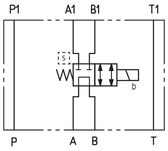
HF-0611/FV



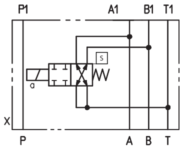
HF-0611/AFV



HF-0614/FV



HF-0614/AFV



HF-0673/FV

3 MAIN CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	CE to Machine Directive 2006/42/EC. -EC type-examination certificate for safety components **(1)** -ISO 13849 category 1, PLC in high demand mode CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC. RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T: **210** bar (DC solenoid); **160** bar (AC solenoid)
Maximum flow	**60 l/min**

(1) The type-examination certificate can be download from www.atos.com

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with mating connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric features 7
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

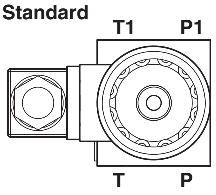
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

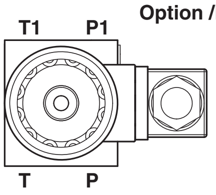
5 OPTIONS

A = Solenoid mounted at side of port B. In standard versions, solenoid is mounted at side of port A.
B = Orientation of coil and proximity connectors rotated of 180°

Standard

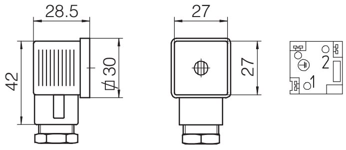
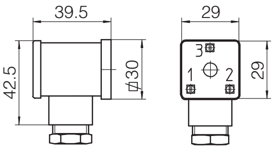


Option /B



⚠ the manual operation is not permitted for safety valves, than they are provided with solenoid blind rings to prevent the access to the manual override.

6 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately)

<table>
<tr><th rowspan="2">666, 667 (for AC or DC supply)</th><th rowspan="2">669 (for AC supply)</th><th colspan="3">CONNECTOR WIRING</th></tr>
<tr><th colspan="2">666, 667</th><th>669</th></tr>
<tr><td rowspan="4"> </td><td rowspan="4"> </td><td colspan="2">1 = Positive ⊕
2 = Negative ⊖
⏚ = Coil ground</td><td>1,2 = Supply voltage VAC
3 = Coil ground</td></tr>
<tr><td colspan="3">SUPPLY VOLTAGES</td></tr>
<tr><td>666</td><td>667</td><td>669</td></tr>
<tr><td>All voltages</td><td>24 AC or DC
110 AC or DC
220 AC or DC</td><td>110/50 AC
110/60 AC
230/50 AC
230/60 AC</td></tr>
</table>

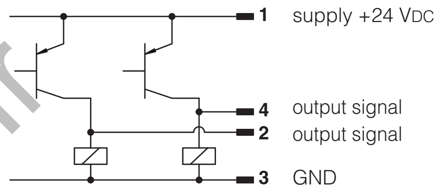
Note: for electronic connectors type **E-SD**, see tab. K500

7 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC (1)
230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/60 AC	**230/60 AC**			COE-230/60AC
110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

8 TECHNICAL CHARACTERISTICS OF FV INDUCTIVE POSITION SWITCH

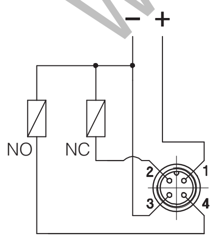
Type of switch	contactless inductive position switch with integrated amplifier	
Supply voltage [V]	20÷32	
Ripple max [%]	≤ 10	
Max current [mA]	400	
Reaction time [ms]	15	
Max peak pressure [bar]	400	
Mechanical life	virtually infinite	
Switch logic	PNP	

9 CONNECTING SCHEME OF FV INDUCTIVE POSITION SWITCH

single solenoid

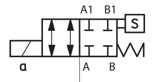
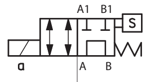
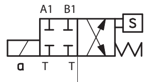
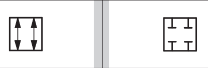
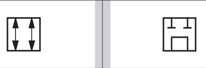
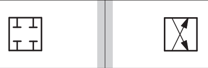
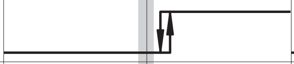
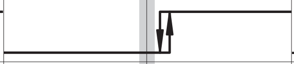
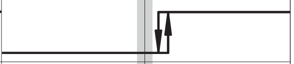
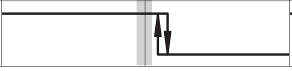
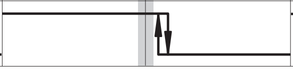
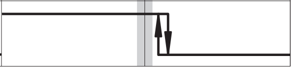
Connector type **ZBE-06**
(supplied with the valve)

1 = supply +24 VDC
2 = output signal NC
3 = GND
4 = output signal NO



Note: the /FV position switch is not provided with a protective earth connection

10 STATUS OF OUTPUT SIGNAL FOR MODULAR VALVES WITH /FV INDUCTIVE POSITION SWITCH

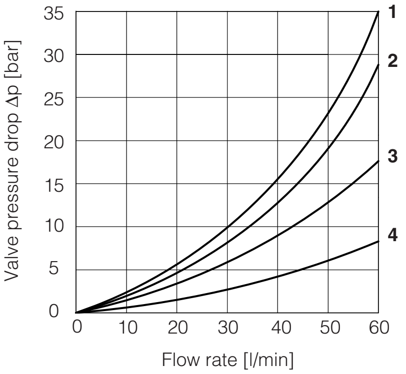
	Configuration **611**	Configuration **614**	Configuration **673**
Hydraulic configuration			
spool position			
pin 2 ON OFF			
pin 4 ON OFF			

Note: FV position switch can be electrically wired by the customer as NO or NC and then the status of the output signal will be in accordance to the selected configuration

▨ = intermediate spool position corresponding to the hydraulic configuration change

11 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

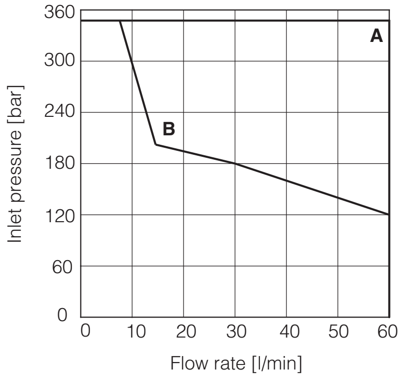
Flow direction Valve type	**A→A1**	**B→B1**	**A→B**	**A1→T**	**B1→T**
HF-0611	1	2			
HF-0614	1	2	3		
HF-0673	3	3		4	4



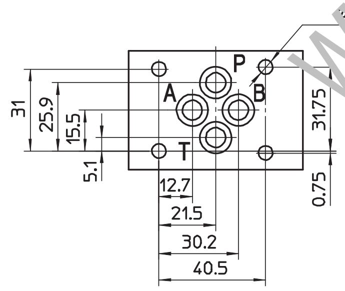
12 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%)

Valve type	Curve
HF-0611	**A**
HF-0614, HF-0673	**B**

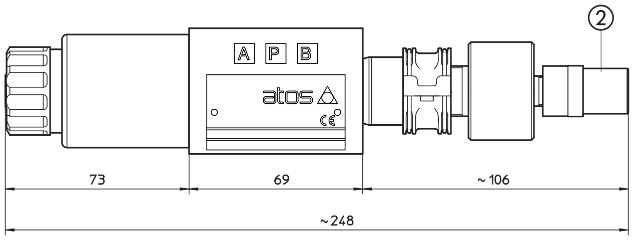


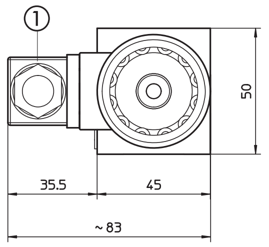
13 **DIMENSIONS [mm]**



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Seals: 4 OR 108
Ports P, A, B, T: Ø = 7.5 mm (max).

HF-0611/FV
HF-0614/FV
HF-0673/FV





① = Power supply connector code 666, 667 or 669, to be ordered separately

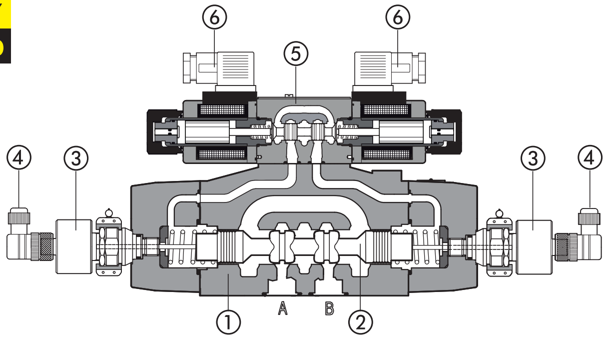
② = Inductive position switch connector code ZBE-06, supplied with the valve

Safety directional valves with spool position monitoring

On-off, pilot operated, conforming to Machine Directive 2006/42/EC - certified by

CE

SAFETY CERTIFIED



① Main body
② Main spool
③ Inductive position switch **FV**
④ Sensor electric connector (supplied with the valve)
⑤ Pilot solenoid valve
⑥ Coil electric connector (to be ordered separately)

DPHE-271*/FV

Pilot operated safety directional valves with main spool position monitoring, **CE** marked and certified by **TÜV** in accordance with safety requirements of Machine Directive 2006/42/EC.

DPHE high performances, for AC and DC supply, solenoid pilot valve ⑤ type DHE with cURUS certified solenoids, see tech. table E015

The valves are equipped with **FV** inductive position switch for the main spool position monitoring, see section 9 for sensor's technical characteristics.

Certification

The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Mounting surface: **ISO 4401, size 10, 16, 25**
Max flow: **160, 300, 700 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DPH	E	-	2	71	1	/	A	/	FV	X	24DC	**	/	*

DPH Pilot operated directional control valve

Solenoid pilot valve:
E = DHE for AC and DC supply, high performances with **cURUS** certified solenoids

Valve size, ISO 4401:
1 = 10 **2** = 16 **4** = 25

Valve configuration, see section 2:
61 = single solenoid, center plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, center plus external position, spring offset
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 2

Hydraulic options, see section 5
A, **D**, **E**, **R**
Optional devices for main spool switching control, see section 6
H, **H9**, **L9**

Spool position monitor
FV = inductive position switch (double contact)

X = without connector, see section 8 for available connectors, to be ordered separately

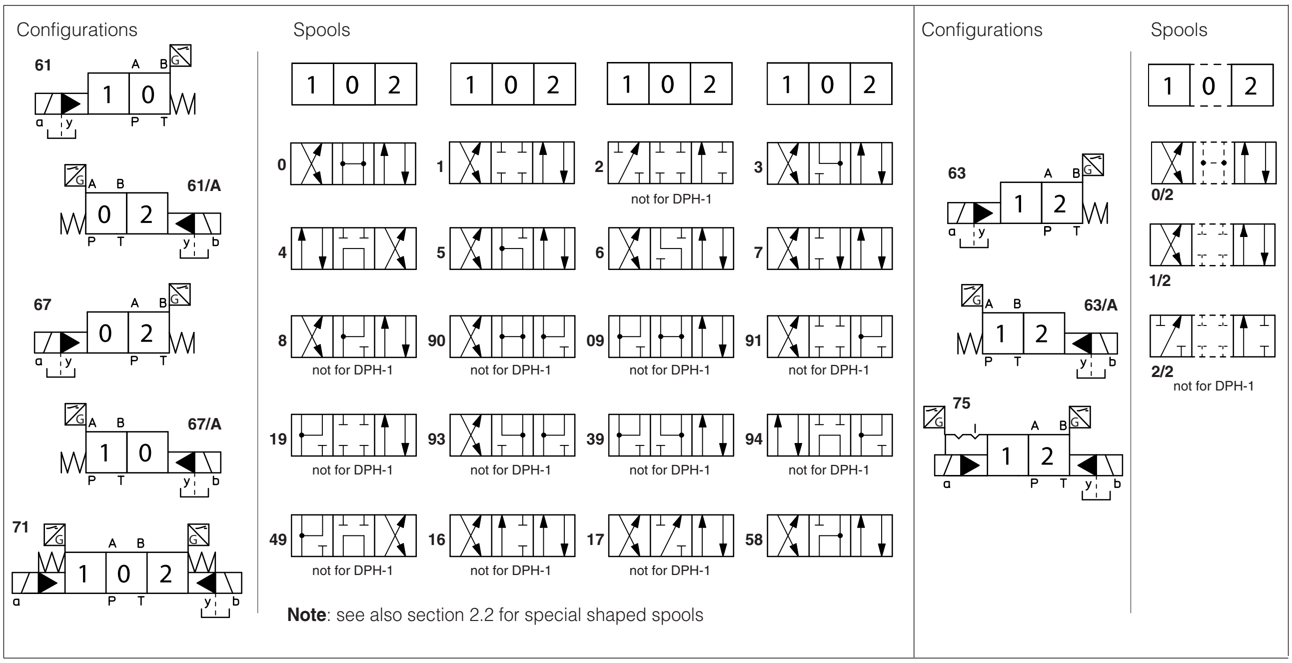
Voltage code, see section 7

Series number

Seals material see sect. 3,4
- = NBR
PE = FKM

Notes:
FV = inductive position switch providing both NO and NC contacts to be wired on the electric connector
The FV inductive position switch is directly connected to the valve main spool
In pilot operated valves only the main spool position is monitored; the pilot solenoid valve is not monitored

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



Note: see also section 2.2 for special shaped spools

2.1 Standard spools availability

- DPHE-1 are available only with spools **0, 0/2, 1, 1/2, 3, 4, 5, 58, 6, 7**
- DPHE-2 and DPHE-4 are available with all spools shown in the above table

2.2 Special shaped spools

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4, 5, 58, 6** and **7** are also available as **1/1, 4/8, 5/1, 58/1, 6/1** and **7/1** that are properly shaped to reduce water-hammer shocks during the switching.

2.3 Special spool availability

Valve size	special shaped spool							
	0/1	3/1	1/1	4/8	5/1	58/1	6/1	7/1
DPHE-1	•	•		•				
DPHE-2, DPHE-4	•	•	•	•	•	•	•	•

3 MAIN CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	75 years, for further details see technical table P007
Compliance	CE to Machine Directive 2006/42/EC. -EC type-examination certificate for safety components **(1)** -ISO 13849 category 1, PLC in high demand mode CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC. RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction	As shown in the symbols of table [2]
Operating pressure	P, A, B, X = **350 bar** (for pilot pressure see also option /L9 at section [6]) T = **250 bar** for external drain (standard) T with internal drain (option /D) = **210 bar** DPHE (DC); **160 bar** DPHE (AC) Y = 0 bar Minimum pilot pressure for correct operation is **8 bar**
Maximum flow	DPHE-1: **160 l/min;** DPHE-2: **300 l/min;** DPHE-4: **700 l/min** (see Q/Δp diagrams at section [12] and operating limits at section [13])

(1) The type-examination certificate can be download from www.atos.com

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric features 7
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

5 HYDRAULIC OPTIONS

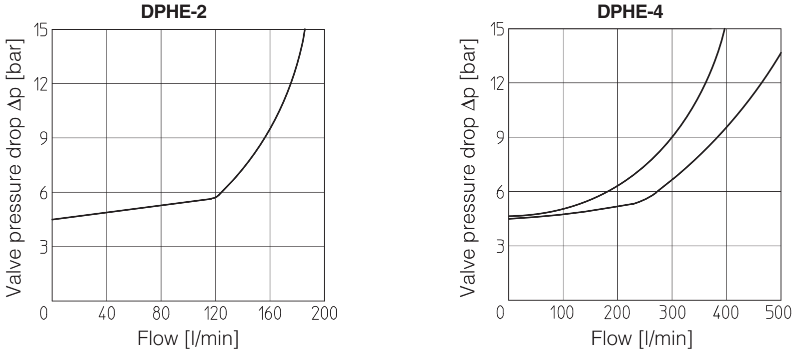
5.1 option /A = Solenoid mounted at side of port A of main body (only for single solenoid valves)
In standard version the solenoid is mounted at side of port B
For sensor position, see sect 16

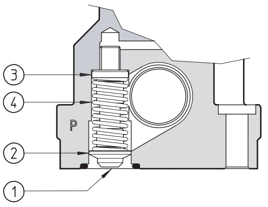
5.2 option /D = Internal drain (standard configuration is external drain)

5.3 option /E = External pilot pressure (standard configuration is internal pilot pressure)

5.4 option /R = Pilot pressure generator (4 bar on port P - not for DPHE-1)
The device **/R** generates an additional pressure drop, in order to ensure the minimum pilot pressure, for correct operation of the valves with internal pilot and fitted with spools type **0, 0/1, 4, 4/8, 5, 58, 09, 90, 94, 49.**
The device **/R** has to be fitted when the pressure drop in the valve, verified on flow versus pressure diagrams, is lower than the minimum pilot pressure value.

Pressure drop through the pilot pressure generator /R





① Flapper-guide ③ Spring stop-washer
② Flapper ④ Spring

Ordering code of spare pilot pressure generator

R/DP	**-**	*
Pilot pressure generator		Size: **2** for DPHE-2 **4** for DPHE-4

WARNING: the manual operation is not permitted for safety valves, than the valve is provided with solenoid blind rings to prevent the access to the manual override. The manual override protected by rubber cup (option /WP) is not available

⚠

WARNING: the inobservance of following prescriptions invalidates the certification and may represent a risk for personnel injury

⚠

Safety valves must be installed and commissioned only by qualified personnel
Safety valves must not be disassembled
The inductive position switch FV can be adjusted only by the valve's manufacturer or Atos authorized service centers
Valve's components cannot be interchanged
The valves must operate without switching shocks and spool vibrations

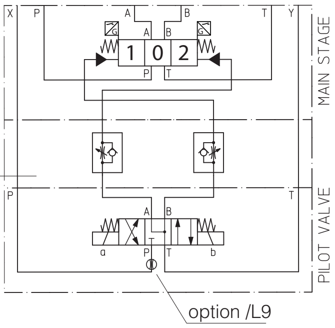
6 DEVICES FOR MAIN SPOOL SWITCHING CONTROL

Following options are suggested to reduce the hydraulic shocks at the valve operation

6.1 option /H = Adjustable chokes (meter-out to the pilot chambers of the main valve)
6.2 option /H9 = Adjustable chokes (meter-in to the pilot chambers of the main valve)
6.3 option /L9 = Only for DP-2 and DP-4: plug with calibrated restictor in P port of pilot valve, suggested in case of pilot pressure higher than 210 bar or to limit the hydraulics shocks caused by the fast main spool switching

Plug code:
PLUG-12A ø1,2 mm for DP-2
PLUG-15A ø1,5 mm for DP-4

FUNCTIONAL SCHEME (config. 71)
example of switching control options



option /H, /H9

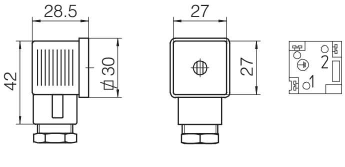
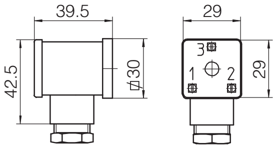
option /L9

7 COIL VOLTAGE

Valve code	External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil DHE
DPHE	12 DC	**12 DC**	666 or 667	30 W	COE-12DC
	14 DC	**14 DC**			COE-14DC
	24 DC	**24 DC**			COE-24DC
	28 DC	**28 DC**			COE-28DC
	48 DC	**48 DC**			COE-48DC
	110 DC	**110 DC**			COE-110DC
	125 DC	**125 DC**			COE-125DC
	220 DC	**220 DC**			COE-220DC
	24/50 AC	**24/50/60 AC**		58 VA (3)	COE-24/50/60AC (1)
	48/50 AC	**48/50/60 AC**			COE-48/50/60AC (1)
	110/50 AC	**110/50/60 AC**			COE-110/50/60AC (1)
	230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
	115/50 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
	230/50 AC	**230/60 AC**			COE-230/60AC
	110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
	230/50 AC - 230/60 AC	**230 RC**			COE-230RC

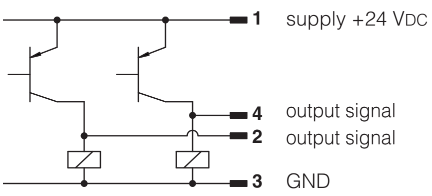
(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

8 COILS ELECTRIC CONNECTORS according to din 43650 (to be ordered separately)

<table>
<tr><th>666, 667 (for AC or DC supply)</th><th>669 (for AC supply)</th><th colspan="3">CONNECTOR WIRING</th></tr>
<tr><td rowspan="3"> </td><td rowspan="3"> </td><td colspan="2">666, 667
1 = Positive ⊕
2 = Negative ⊖
⊕ = Coil ground</td><td>669
1,2= Supply voltage VAC
3 = Coil ground</td></tr>
<tr><td colspan="3">SUPPLY VOLTAGES</td></tr>
<tr><td>666
All voltages</td><td>667
24 AC or DC
110 AC or DC
220 AC or DC</td><td>669
110/50 AC
110/60 AC
230/50 AC
230/60 AC</td></tr>
</table>

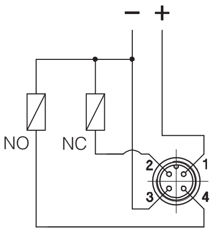
9 TECHNICAL CHARACTERISTICS OF FV INDUCTIVE POSITION SWITCH

Type of switch		contactless inductive position switch with integrated amplifier
Supply voltage	[V]	20÷32
Ripple max	[%]	≤ 10
Max current	[mA]	400
Reaction time	[ms]	15
Max peak pressure	[bar]	400
Mechanical life		virtually infinite
Switch logic		PNP



10 CONNECTING SCHEME OF FV INDUCTIVE POSITION SWITCH

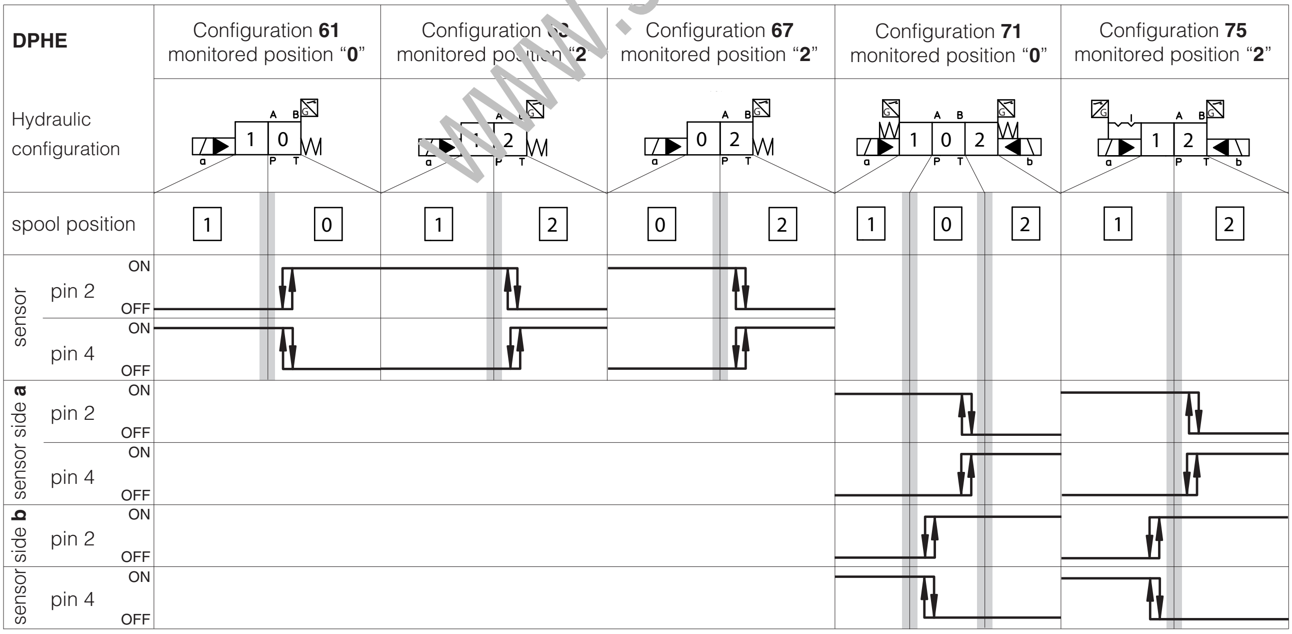
Connector type **ZBE-06** (supplied with the valve)



1 = supply +24 VDC
2 = output signal NC
3 = GND
4 = output signal NO

Note: the /FV position switch is not provided with a protective earth connection

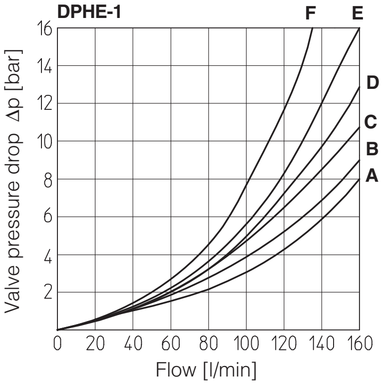
11 STATUS OF OUTPUT SIGNAL

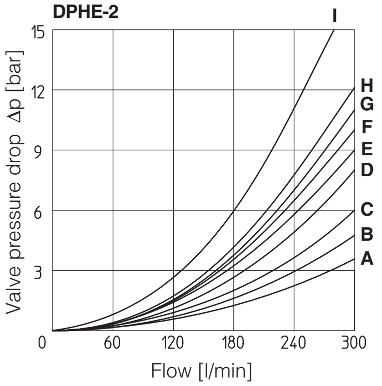


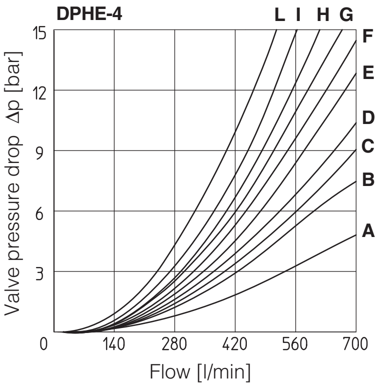
Note:
FV position switch can be electrically wired by the customer as NO or NC and then the status of the output signal will be in accordance to the selected configuration

▨ = intermediate spool position corresponding to the hydraulic configuration change

12 **Q/Δp DIAGRAMS** based on mineral oil ISO VG 46 at 50°C







DPHE-1

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0/2, 1/2	D	E	D	C	-
0	D	E	C	C	E
1	A	B	D	C	-
3, 6, 7	A	B	C	C	-
4, 4/8	B	C	D	D	-
5, 58	A	E	C	C	F

DPHE-2

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0/2, 1, 3, 6, 7, 8	A	A	D	A	-
1/1, 1/2, 7/1	B	B	D	E	-
0	A	A	D	E	C
0/1	A	A	D	-	-
2	A	A	-	-	-
2/2	B	B	-	-	-
3/1	A	A	D	D	-
4	C	C	H	I	F
4/8	C	C	G	I	F
5	A	B	F	H	G
5/1	A	B	D	F	-
6/1	B	B	C	E	-
09	A	-	-	G	-
16	A	C	D	F	-
17	C	A	E	F	-
19	C	-	-	G	-
39	C	-	-	H	-
49	-	D	-	-	-
58	B	A	F	H	H
58/1	B	A	D	F	-
90	A	A	E	-	D
91	C	C	E	-	-
93	-	C	D	-	-
94	D	-	-	-	-

DPHE-4

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
1	B	B	B	D	-
1/1	D	E	E	F	-
1/2	E	D	B	C	-
0	D	C	D	E	F
0/1, 3/1, 5/1, 6, 7	D	D	D	F	-
0/2	D	D	D	E	-
2	B	B	-	-	-
2/2	E	D	-	-	-
3	B	B	D	F	-
4	C	C	H	L	L
5	A	D	D	D	H
6/1	D	E	D	F	-
7/1	D	E	F	F	-
8	D	D	E	F	-
09	D	-	-	F	F
16	C	D	E	F	-
17	E	D	E	F	-
19	F	-	-	E	-
39	G	F	-	F	-
58	E	A	B	F	H
58/1	E	D	D	F	-
90	D	D	D	-	F
91	F	F	D		
93	-	G	D	-	-

13 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

For a correct valve operation do not exceed the max recommended flow rates (l/min) shown in the below tables

DPHE-1

Spool	**Inlet pressure** [bar]			
	70	**160**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7	160	160	160	145
4, 4/8	160	160	135	100
5, 58	160	160	145	110
0/1, 0/2, 1/2	160	160	145	135

DPHE-2

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
0, 1, 3, 6, 7, 8	300	300	300	300
2, 4, 4/8	300	300	240	140
5	260	220	180	100
0/1, 0/2, 1/2	300	250	210	180
16, 17, 56, *9, 9*	300	300	270	200

DPHE-4

Spool	**Inlet pressure** [bar]			
	70	**140**	**210**	**350**
	Flow rate [l/min]			
1, 6, 7, 8	700	700	700	600
2, 4, 4/8	500	500	450	400
5, 0/1, 0/2, 1/2	600	520	400	300
0, 3	700	700	600	540
16, 17, 58, *9, 9*	500	500	500	450

14 **SWITCHING TIMES** (average values in m sec)

TEST CONDITIONS:
- Nominal voltage supply DC (direct) and AC (alternating) with connector type SP-666. The use of other connectors can affect the switching time;
- 2 bar of counter pressure on port T;
- mineral oil: ISO VG 46 at 50°C

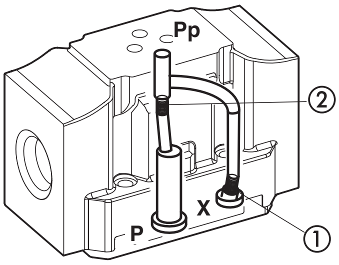
Piloting pressure		70 bar		140 bar		250 bar	
Valve model		Alternating current	Direct current	Alternating current	Direct current	Alternating current	Direct current
DPHE-1	Switch ON	35÷50	50÷75	30÷40	45÷65	20÷30	35÷50
	Switch OFF	50÷80					
DPHE-2	Switch ON	40÷55	55÷80	30÷45	50÷70	20÷35	40÷55
	Switch OFF	60÷95					
DPHE-4	Switch ON	60÷95	80÷115	45÷75	60÷95	30÷50	45÷65
	Switch OFF	80÷130					

15 **PLUGS LOCATION FOR PILOT/DRAIN CHANNELS**

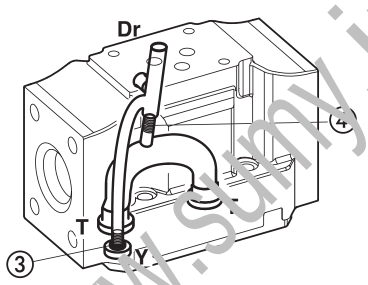
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain

DPHE-1

Pilot channels



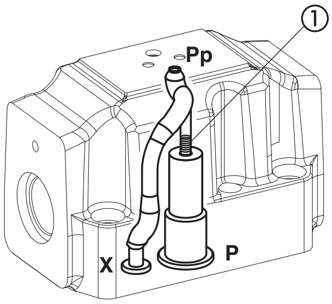
Drain channels



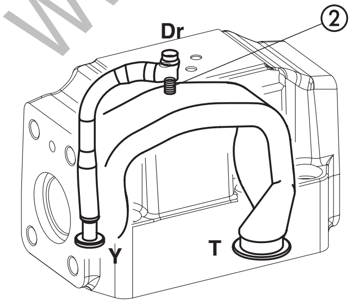
Internal piloting: blinded plug SP-X300F ① in X;
plug SP-X310F ② in Pp;
External piloting: blinded plug SP-X300F ② in Pp;
plug SP-X310F ① in X;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPHE-2

Pilot channels

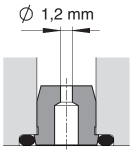


Drain channels



Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

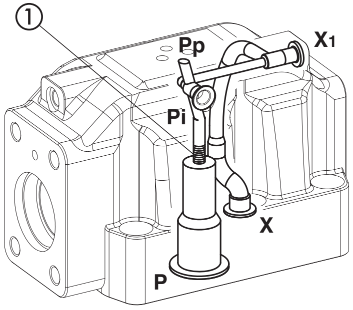
Option L9
This option provides a calibrated restrictor PLUG-H-12A (Ø 1,2 mm) in the P port of the pilot valve



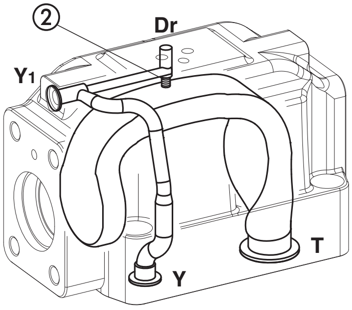
PLUG-12A

DPHE-4

Pilot channels

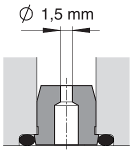


Drain channels



Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

Option L9
This option provides a a calibrated restrictor PLUG-H-15A (Ø 1,5 mm) in the P port of the pilot valve

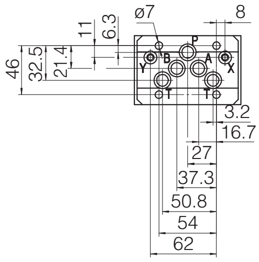


PLUG-15A

16 DIMENSIONS of DPHE PILOT OPERATED SAFETY VALVES [mm]

DPHE-1/FV

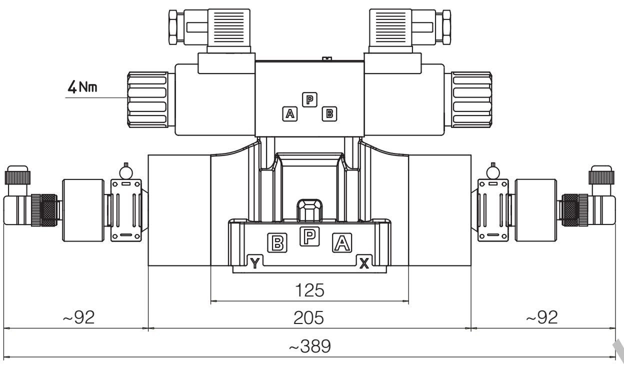
ISO 4401: 2005
Mounting surface:
4401-05-05-0-05
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050, 2 OR 108
Ports P,A,B,T: Ø = 11 mm (max)
Ports X, Y: Ø = 5 mm

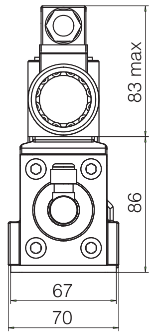


Mass (Kg)	
DPHE-16	7,2
DPHE-17	7,9
Option H, H9	+1,0

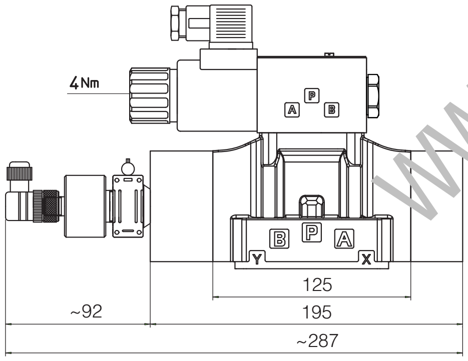
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

DPHE-171*
DPHE-175*

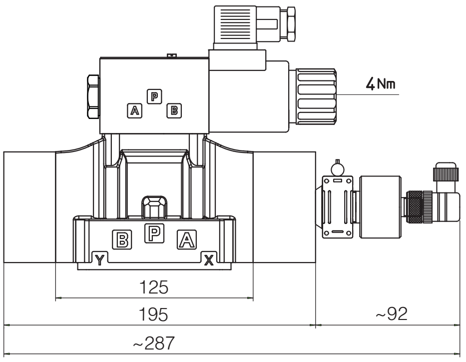




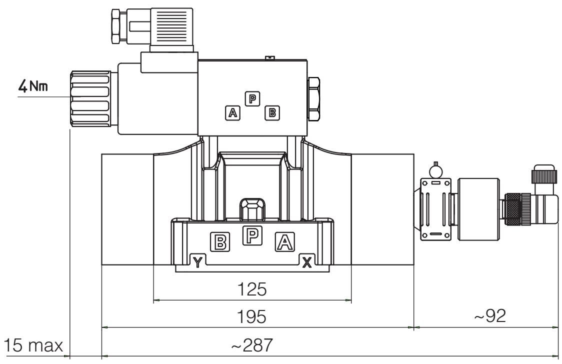
DPHE-161*



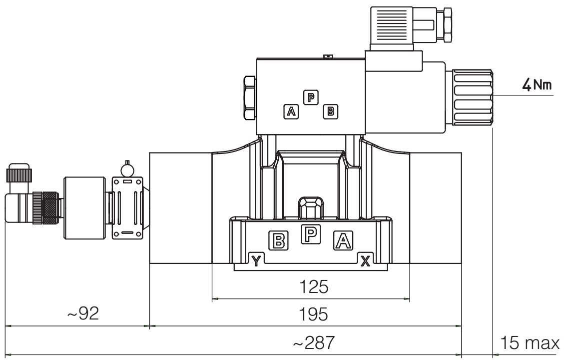
DPHE-161*/A



DPHE-163*
DPHE-167*



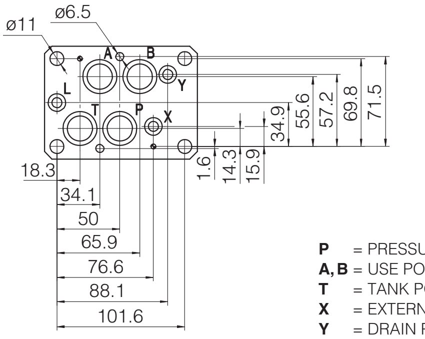
DPHE-163*/A
DPHE-167*/A



DPHE-2*/FV

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05

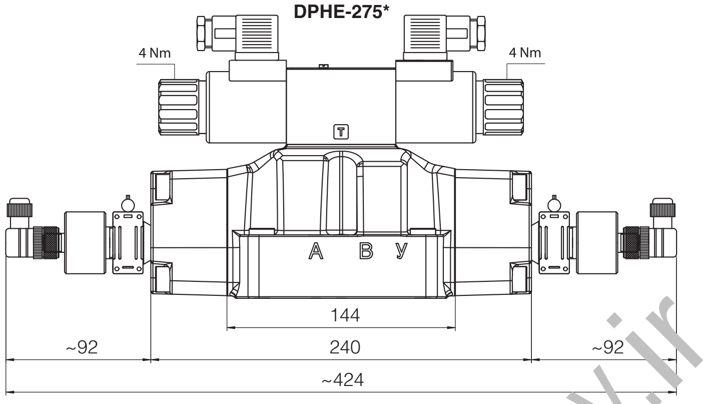
Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 20 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 130, 2 OR 2043

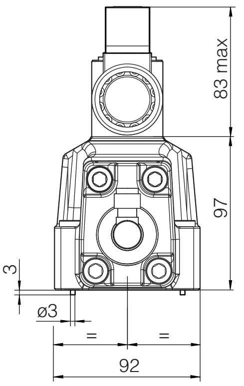


Mass (Kg)	
DPHI-26	10,1
DPHI-27	10,7
DPHE-26	10,2
DPHE-27	10,9
Option H, H9	+1,0

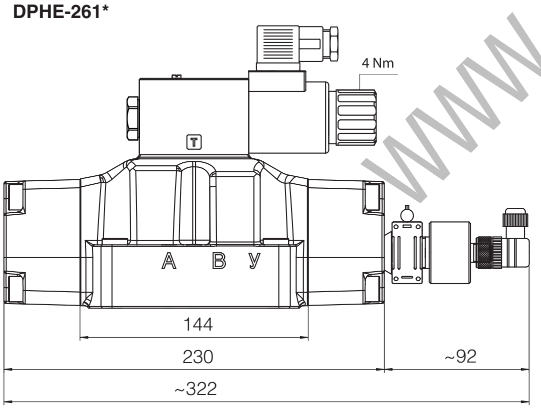
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

DPHE-271*
DPHE-275*

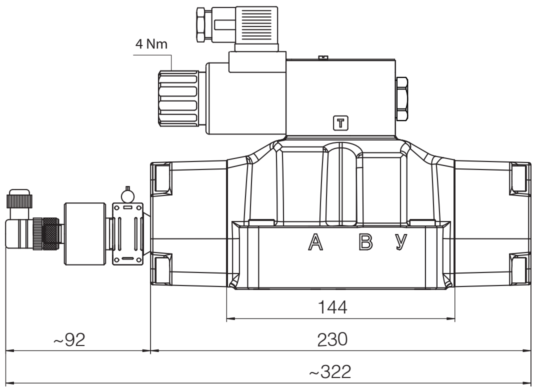




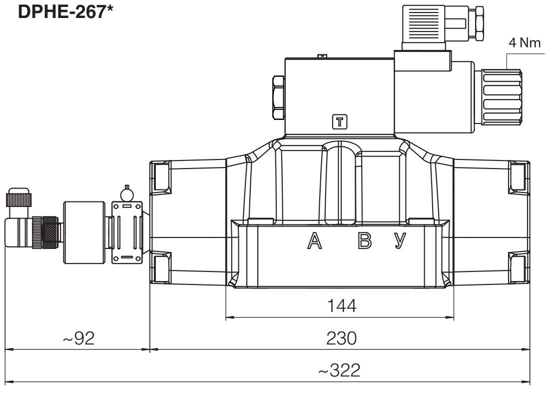
DPHE-261*



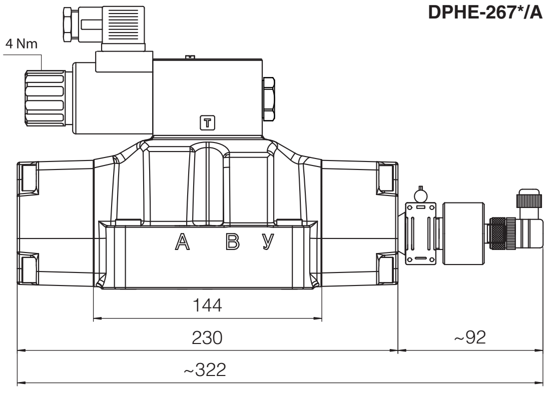
DPHE-261*/A



DPHE-263*
DPHE-267*



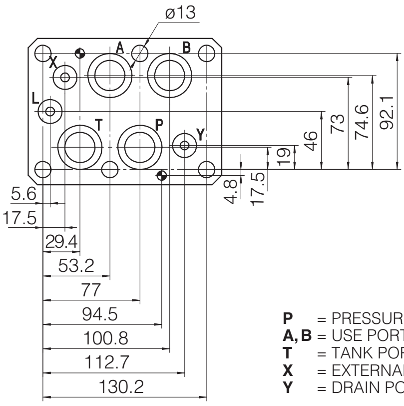
DPHE-263*/A
DPHE-267*/A



DPHE-4*/FV

ISO 4401: 2005
Mounting surface: 4401-08-08-0-05

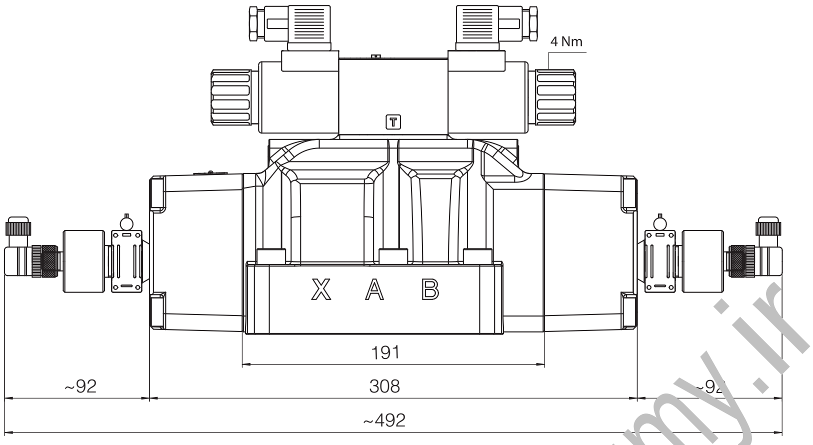
Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Diameter of ports A, B, P, T: Ø = 24 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 4112, 2 OR 3056

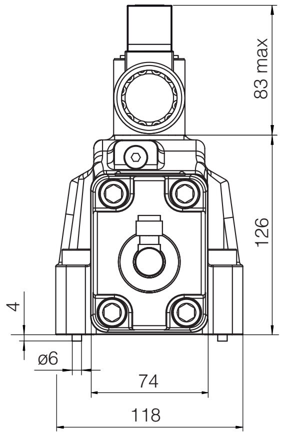


Mass (Kg)	
DPHI-46	17,6
DPHI-47	18,2
DPHE-46	17,7
DPHE-47	18,4
Option H, H9	+1,0

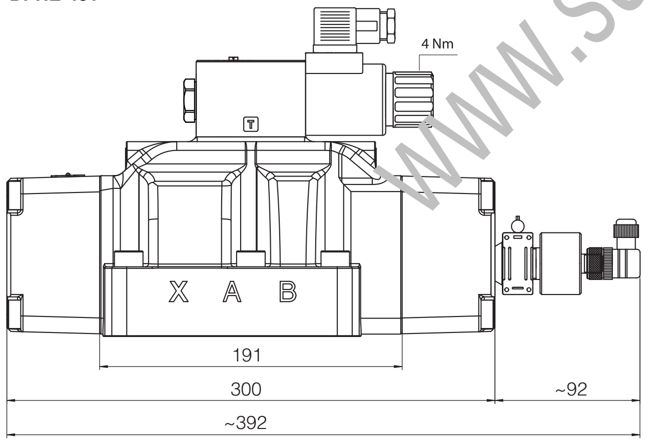
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

DPHE-471*
DPHE-475*

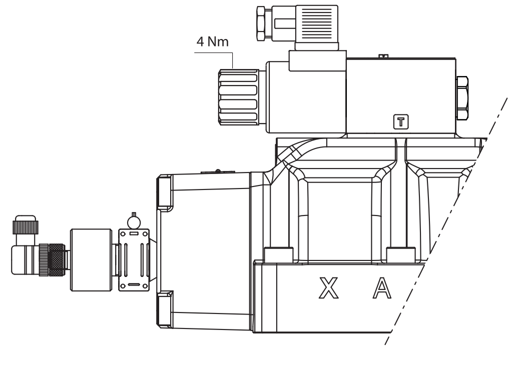




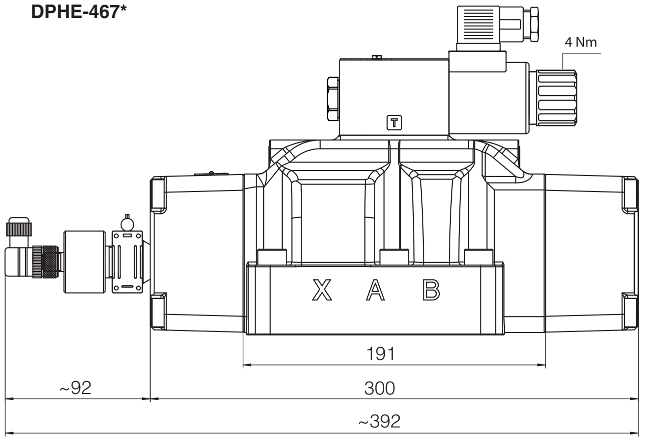
DPHE-461*



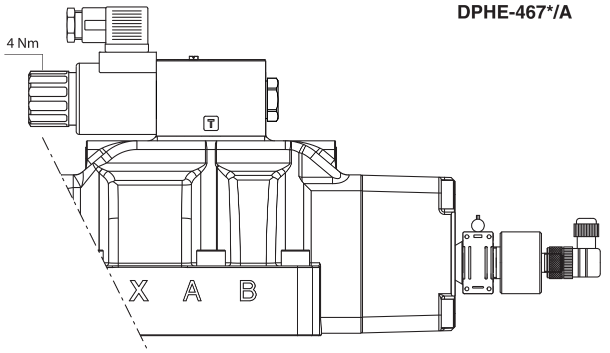
DPHE-461*/A



DPHE-463*
DPHE-467*



DPHE-463*/A
DPHE-467*/A

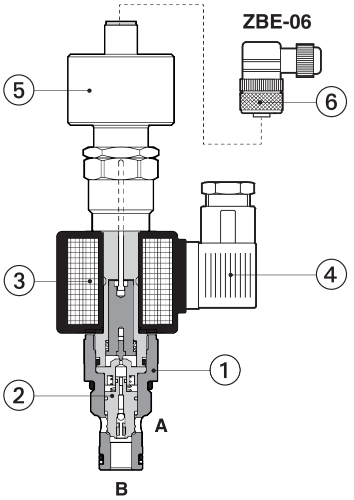


Safety cartridge valves with poppet position monitoring

screw-in, 2-way, poppet type, leak free, conforming to Machine Directive 2006/42/CE - certified by TÜV

CE

SAFETY CERTIFIED



① cartridge body
② poppet
③ coil
④ coil connectors
⑤ inductive position switch
⑥ sensor connector
(to be ordered separately)

JO-DL-4-2/FV-X 24DC

JO-DL are leak free, poppet type solenoid cartridges in screw-in execution normally used to cut off the hydraulic power supply line. They are available in normally closed NC configuration.

They are provided with **/FV** inductive position switch (double contact NC/NO) ⑤ wich supplies the output electrical on-off signal indicating the poppet ② position (open/closed), and therefore they can be used as safety valves for emergency conditions.

They are **CE** marked and certified by **TÜV** in accordance with safety requirements of Machine Directive 2006/42/CE.

Certification
The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Max flow: **300 l/min**
Max pressure: **350 bar**

1 MODEL CODE

JO	-	D	L	-	4	-	2	/	FV	-	X	24 DC	**	/	*

Cartridge valve screw-in type UNF

D = Directional control

L = Poppet type

Size:
4 = 3/4"-16UNF-2A
6 = 7/8"-14UNF-2A
10 = 1 5/16"-12UNF-2A

2 = Two-way

Version:
FV =normally closed in rest position, with inductive position switch (double contact)

X = Without connector, see section 5 for available connector

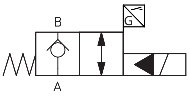
Voltage code:
12DC = 12 VDC
24DC = 24 VDC

Series number

Seals material, see section 4:
- = NBR
PE = FKM

2 HYDRAULIC CHARACTERISTICS

Hydraulic symbol



Model		JO-DL-4-2/FV	JO-DL-6-2/FV	JO-DL-10-2/FV
Operating pressure	[bar]	Ports A and B **350**		
Max flow	[l/min]	40	75	300
Response time: energizing	[ms]	35	30	35
de-energizing	[ms]	50	60	70
Internal leakage		less than 5 drops/min (≤ 0,36 cm³/min) max at 350 bar		

3 GENERAL CHARACTERISTICS

Installation position	Any position
Cavity	JO-DL-4 = SAE-08-2N; JO-DL-6 = SAE-10-2N; JO-DL-10 = SAE-16-2N
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	CE to Machine Directive 2006/42/EC. -EC type-examination certificate for safety components **(1)** -ISO 13849 category 1, PLC in high demand mode CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC.
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C

(1) The type-examination certificate can be download from www.atos.com

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult Atos Technical Office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s
Fluid contamination class	ISO 4406 class 21/19/16 NAS 1638 class 10, in line filters of 25 μm (β10 ≥75 recommended)

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

5 ELECTRIC CHARACTERISTICS

Relative duty factor	100%	
Supply voltage	See model code at section 1	
Supply voltage tolerance	±10%	
Max power	20 Watt	
Power connector	666 (plastic - black); 3 pins, cable clamp PG11, cable max ø 11 mm	**to be ordered separately**
Type of connector for /FV version	Type ZBE-06 (plastic); 4 pins, cable clamp PG9, cable max ø 8 mm	
Connectors features	666: DIN 43650 - ISO 4400; IP65 (DIN 40050); VDE 0110C	
	ZBE-06: M12 - IEC60947-5-2, IP67 (DIN 40050)	

6 INSTALLATION NOTES

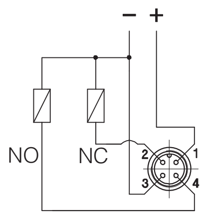
1) The assembling of cartridges inside manifolds must be done tightening the valve exagonal ring (for tightening torque, see section 10).
   Excessive values can cause anomalous deformation and poppet sticking.
   For the /FV versions avoid to tighten through the position sensor.
2) The CE certification is valid only with shielded electric cables and connector. Consult also tab. P004.
   These safety valves must be supplied only and always as one complete component, proximity sensor is factory adjusted.
   The supply of subcomponents invalidates the certification.

7 TECHNICAL CHARACTERISTICS AND CONNECTING SCHEME OF INDUCTIVE POSITION SWITCH /FV

Type of switch		position switch **/FV**
Supply voltage	[V]	20÷32
Ripple max	[%]	≤ 10
Max current	[mA]	400
Max peak pressure	[bar]	400
Mechanical life		virtually infinite
Switch logic		PNP

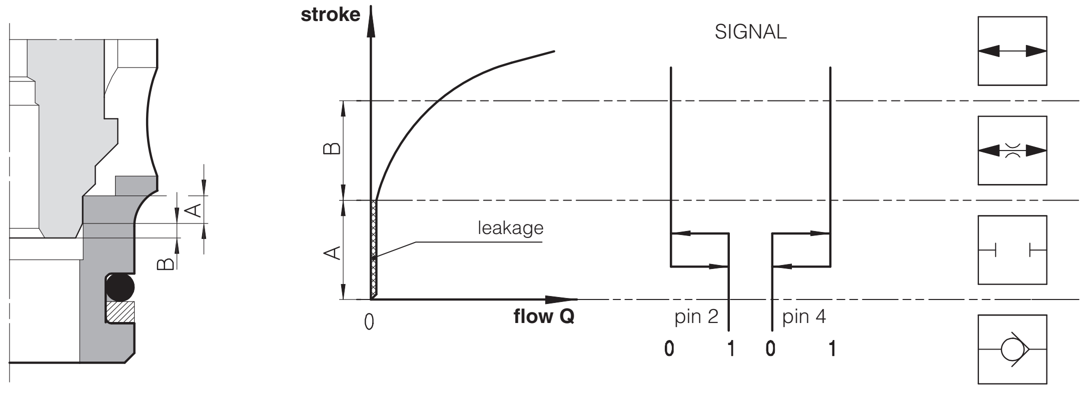
Note: the /FV position switch are not provided with a protective earth connection

Connector type **ZBE-06**



1 = supply +24 VDC
2 = output signal NC
3 = GND
4 = output signal NO

8 SIGNAL STATUS - VERSIONS /FV



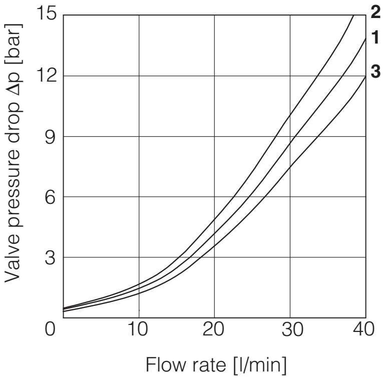
A: overlapping stroke
B: damping stroke

According the criteria of safety specifications, the poppet position signal must change its status inside the overlapping stroke (before the effective valve opening).

9 **DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

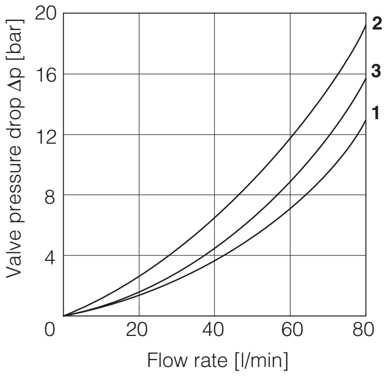
9.1 JO-DL-4

Valve pressure drop - FV version
1= A → B energized
2= B → A de-energized
3= B → A energized



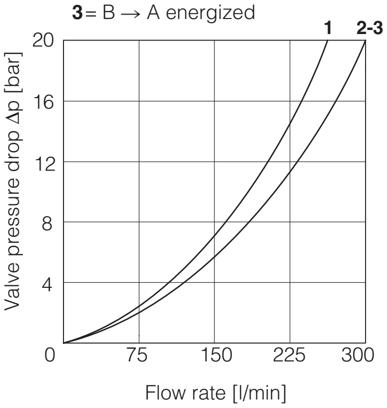
9.2 JO-DL-6

Valve pressure drop - FV version
1= A → B energized
2= B → A de-energized
3= B → A energized



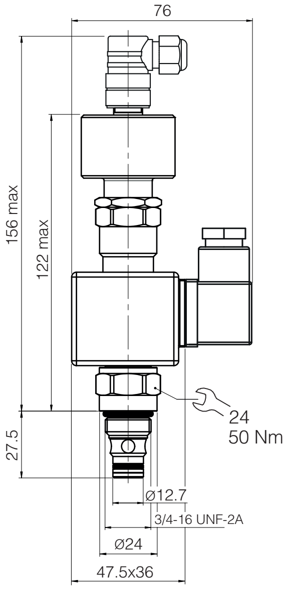
9.3 JO-DL-10

Valve pressure drop - FV version
1= A → B energized
2= B → A de-energized
3= B → A energized

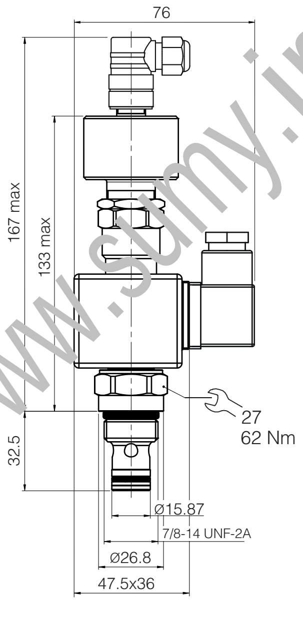


10 **DIMENSIONS [mm]**

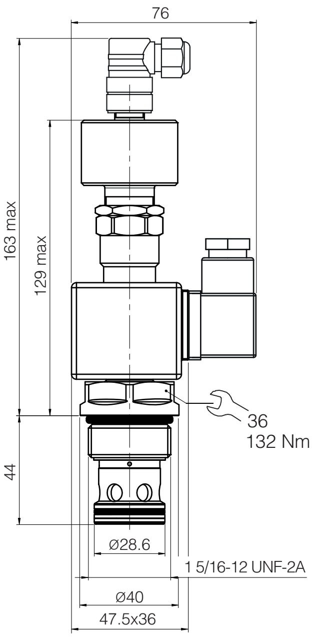
JO-DL-4-2-2/FV
Mass 0.5 Kg



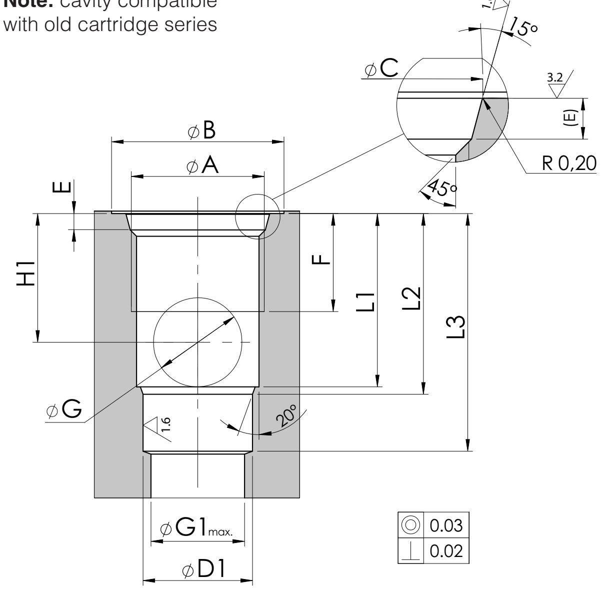
JO-DL-6-2/FV
Mass 0.5 Kg



JO-DL-10-2/FV
Mass 0.7 Kg



Note: cavity compatible
with old cartridge series



	JO-DL-4-2	JO-DL-6-2	JO-DL-10-2
A	3/4-16 UNF	7/8-14 UNF	1 5/16-12 UNF
B	26	30	42
C	$20.6^{+0.1}_{0}$	$23.9^{+0.1}_{0}$	$35.5^{+0.1}_{0}$
D1	$12.7^{+0.05}_{0}$	$15.87^{+0.05}_{0}$	$28.60^{+0.05}_{0}$
E	$2.6^{+0.3}_{0}$	$2.6^{+0.3}_{0}$	$3.3^{+0.3}_{0}$
F	13	15	20
G	9	12	19
G1	12	15	24
H1	14	18	25
L1	19.1	24.2	33.5
L2	20.5	25.5	36
L3	29	34.5	49

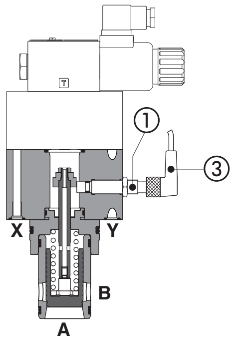
Table **EY120-8/E**

Safety cartridge valves with poppet position monitoring

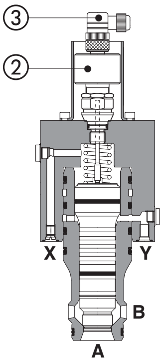
ISO standard, on-off, poppet type, conforming to Machine Directive 2006/42/EC - certified by TÜV

SAFETY CERTIFIED

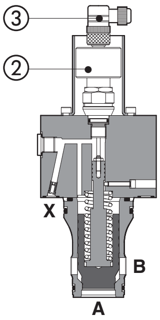
CE



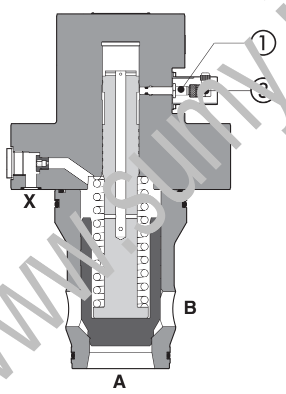
LIFI-3242*/NC



LIDAS-3243*/FV



LIDA-3243*/FV



LIDA-100433/FI

① Inductive proximity sensor **FI**
② Inductive position switch **FV**
③ Sensor electric connector (supplied with the valve)

Safety cartridge valves with poppet position monitoring, **CE** marked and certified by **TÜV**, in accordance with safety requirements of Machine Directive 2006/42/EC.
They are used to cut-off the hydraulic user line, preventing undesired movements of the machine actuators.

Contactless sensor type **FI** (inductive proximity) or **FV** (inductive position switch) monitors the poppet "closed" position so that the valve "safe" condition can be clearly verified by the machine controller

Available models:

LIFI: intermediate safety element and cartridge with sensor type **FI**, designed for coupling with functional covers type LIDA, LIDB, LIDEW, LIDBH, to realize different hydraulic schemes.

LIDA: integral cover design and cartridge with sensor type FV (size 16-50) or FI (size 63-100), typically used to intercept the flow in one direction.
LIDAH version with solenoid pilot valve to control the poppet opening / closing.

LIDAS: actively pilot operated valve with sensor type FV.
The valve's poppet is hydraulically controlled in both open or closed position by a pilot pressure though X and Y ports.
LIDASH version with sensor type FV (size 16-50) or FI (size 63-80) and solenoid pilot valve to control the poppet opening / closing.

Certification
The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Mounting surface & cavity:
ISO 7368 size **16** to **100**
Max flow: **6300 l/min** at Δp = 5 bar
Max pressure: up to **420 bar**

1 RANGE OF SAFETY CARTRIDGE MODELS

Valve code	size ISO 7368	Description	Max flow [l/min] at Δp 5 bar	Max pressure [bar]	Pilot valve	Sensor type	
						/FI	/FV
LIFI	16÷50	intermediate elements with cartridge, to be coupled with a functional cover	1800	420	-	●	
LIDA /FV	16÷50	cartridge valve, integral cover design	2200	420	-		●
LIDA /FI	63÷100		6300	420	-	●	
LIDAH /FV-E	16÷50	cartridge valve, integral cover design with pilot solenoid valve	2200	350	DHE		●
LIDAH /FV-EP	16÷50		2200	420	DHEP		●
LIDAS /FV	16÷50	cartridges valve, actively pilot operated	1800	420	-		●
LIDASH /FV-E	16÷50	cartridge valve, actively pilot operated with pilot solenoid valve	1800	350	DHE		●
LIDASH /FV-EP	16÷50		1800	420	DHEP		●
LIDASH /FI-E	63, 80		3000	350	DKE	●	
LIDASH /FI-EP	63, 80		3000	420	DKEP	●	

Notes: **FI** = inductive proximity sensor, type NC (normally closed)
FV = inductive position switch providing both NO and NC contacts to be wired on the electric connector
See section 18 and 19 for sensor's characteristics

2 MODEL CODE OF LIFI INTERMEDIATE SAFETY ELEMENT to be coupled with covers in section 3

LI **FI** - **25** **42** **1** / **NC** ****** / *****

LI: Intermediate saferty element and cartridge according to ISO 7368

Poppet position monitor:F
I = inductive proximity switch

Size ISO 7368
16; 25; 32; 40; 50
Other dimensions available on request

Type of poppet, see sect. 21 for Q/Δp diagrams
42 = with damping nose, area ratio 1:1,1
43 = with damping nose, area ratio 1:2 (size 16 and 25), 1:1,6 (size 32, 40, 50)

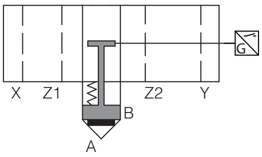
Spring cracking pressure:
1 = 0,3 bar for poppet 42; 0,6 bar for poppet 43
2 = 1,5 bar for poppet 42
3 = 3 bar for all poppets
6 = 5,5 bar for all poppets

/NC = closed contact with poppet in resting position

Series number

Seals material:
- = NBR
PE = FKM

2.1 Hydraulic symbols of LIFI



Note: in LIFI safety valves the cartridge and the intermediate element with poppet position sensor cannot be separated

3 MODEL CODE OF FUNCTIONAL COVERS to be coupled with LIFI safety valves (see also tech tables H030, H040)

LID **A** - **2** / ***** **F** - **E** **X** **24DC** ****** / ***** / *****

LID: Cover according to ISO 7368

Cover type, see section 3.1 for hydraulic configuration:
A = direct pilot
B = with shuttle valve for pilot selection;
EW* = with solenoid valve for pilot selection
BH** = as EW* but with shuttle valve for pilot selection;

Size ISO 7368
1 = 16; **2** = 25; **3** = 32; **4** = 40; **5**= 50;

Options:
B = cartridge piloted via port B of solenoid valve (only for LIDEW* and LIDBH**)
E = with external attachment X (1/4" GAS) and underneath port X plugged

F = prearranged for coupling with LIFI cover

Type of pilot solenoid valve only for LIDBH** and LIDEW*:
E = DHE Pmax **350 bar**
EP = DHEP Pmax **420 bar**

Only for LIDEW* and LIDBH**:
X = without connector, to be order separately see section 17

Voltage code only for LIDEW* and LIDBH**:
see section 16

Series number

Seals material:
- = NBR
PE = FKM

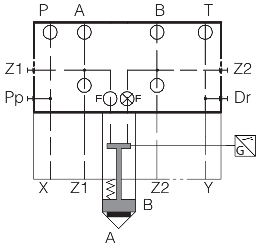
Optional different setting of calibrated plugs in the pilot channels (see tech. tables H030, H040)

For valve type LIDB, LIDEW (in the configuration with external pilot line) Atos can supply leak free poppet type directional pilot valves type DLEH-3*. Consult our technical office for detailed information.

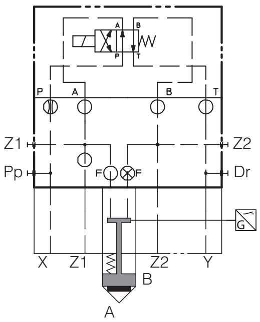
3.1 HYDRAULIC SYMBOLS OF FUNCTIONAL COVERS

the following symbols show the functional covers coupled with intermediate safety element type LIFI

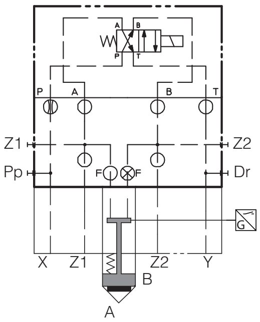
LIDEW-*



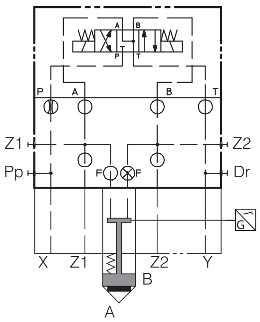
LIDEW1-*



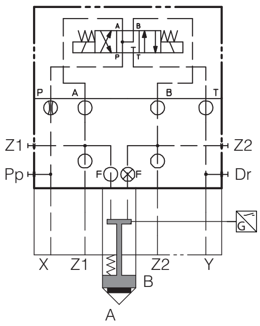
LIDEW2-*



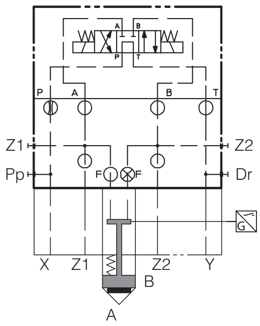
LIDEW4-*



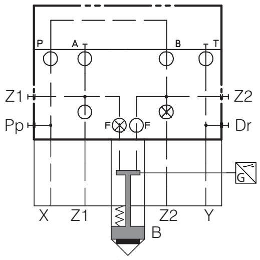
LIDEW5-*



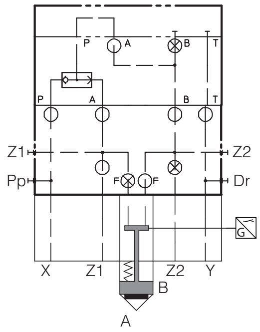
LIDEW6-*



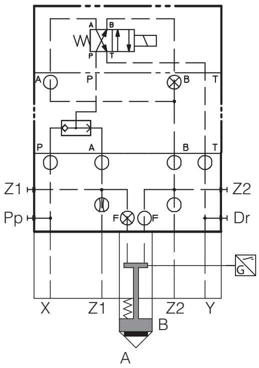
LIDA



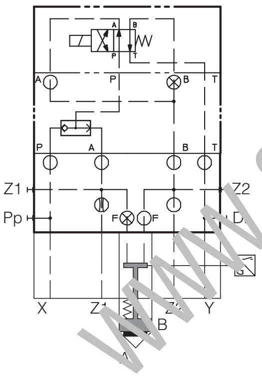
LIDB-*



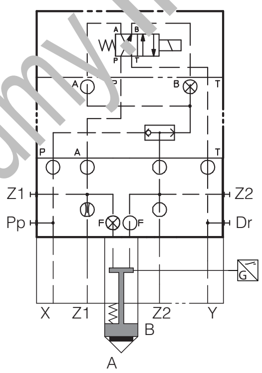
LIDBH1A-*



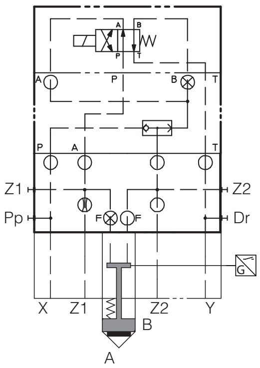
LIDBH1C-*



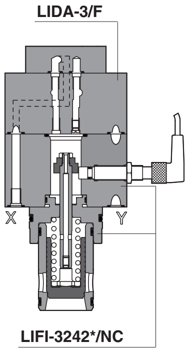
LIDBH2A-*

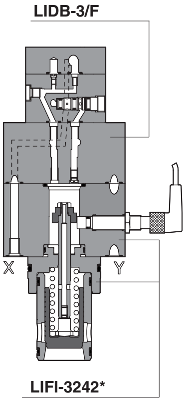


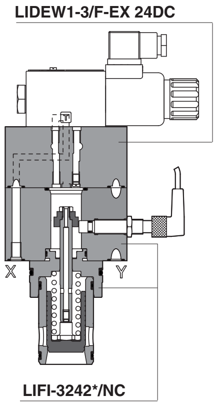
LIDBH2C-*

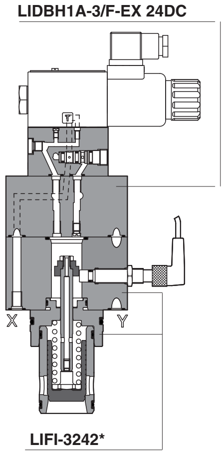


4 EXAMPLES OF LIFI COUPLED WITH OTHER COVERS (examples in size 32)









5 **MODEL CODE OF LIDA** integral cover design

LIDA - **25** **43** **3** / **FI** ****** / *****

Safety cartridge valve

Size ISO 7368:
16; **25**; **32**; **40**;
50; **63**; **80**; **100**;

poppet type:
43 = with damping nose area ratio 1:1,5

spring cracking pressure:
1 = 0,6 bar (not for size 63÷100)
3 = 3 bar
6 = 5,5 bar (not for size 63÷100)

Seals material:
- = NBR
PE = FKM

Series number

Poppet position monitor:
For size 16÷50
FV = inductive position switch (double contact)
For size 63÷100
FI = inductive proximity sensor

6 **MODEL CODE OF LIDAH** integral cover design, with pilot solenoid valve

LIDA **H** - **25** **43** **3** / **FV** - **E** **X** **24DC** ****** / *****

Safety cartridge valve

H = with pilot solenoid valve

Size ISO 7368:
16; **25**; **32**; **40**; **50**

poppet type:
43 = with damping nose area ratio 1:1,5

spring cracking pressure:
1 = 0,6 bar **3** = 3 bar **6** = 5,5 bar

Poppet position monitor:
FV = inductive position switch (double contact)

Seals material:
- = NBR
PE = FKM

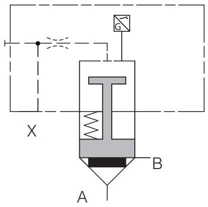
Series number

Voltage code, see section 16

X = without connector, to be order separately see section 17

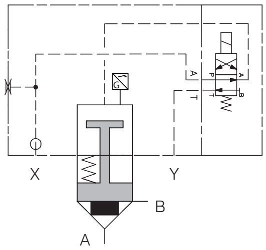
Pilot solenoid valve
E = DHE Pmax **350 bar**
EP = DHEP Pmax **420 bar**

6.1 HYDRAULIC SYMBOLS OF LIDA /FV (/FI) and LIDAH /FV



LIDA-43/FI**
(size 63÷100)

LIDA-43/FV**
(size 16÷50)



LIDAH-43/FV**
(size 16÷50)

7 MODEL CODE OF LIDAS actively pilot operated

LIDAS	**-**	**40**	**43**	**3**	**/**	**FV**	******	**/**	*****

Safety cartridges,
actively piloted operated

Size ISO 7368:
16; **25**; **32**; **40**; **50**

Poppet type:
43 = with damping nose

Spring cracking pressure
3 = 3 bar

Poppet position monitor:
FV = inductive position switch (double contact)

Series number

Seals material:
- = NBR
PE = FKM

8 MODEL CODE OF LIDASH actively pilot, with pilot solenoid valve

LIDAS	**H**	**-**	**40**	**43**	**3**	**/**	**FV**	**-**	**E**	**X**	**24DC**	******	**/**	*****

Safety cartridges,
actively piloted
operated

H = with pilot solenoid valve

Size ISO 7368:
16; **25**; **32**; **40**; **50**; **63**; **80**;

Poppet type:
43 = with damping nose

Spring cracking pressure
3 = 3 bar

Poppet position monitor:
For size 16÷50
FV = inductive position switch (double contact)
For size 63 and 80
FI = inductive proximity sensor

Pilot solenoid valve
E = DHE (size 16÷50) Pmax **350 bar**
DKE (size 63 and 80) Pmax **350 bar**
EP = DHEP (size 16÷50) Pmax **420 bar**
DKEP (size 63 and 80) Pmax **420 bar**

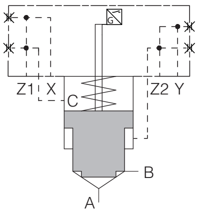
X = without connector, to be order separately
see section 17

voltage code, see section 16

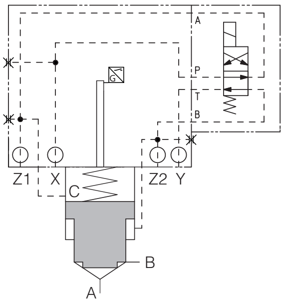
Series number

Seals material:
- = NBR
PE = FKM

8.1 HYDRAULIC SYMBOLS OF LIDAS



LIDAS/FV



LIDASH-*/FV
(size 16÷50)
LIDASH-*/FI
(size 63 and 80)

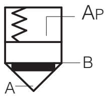
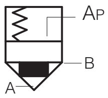
9 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years for LIFI, LIDA, LIDAS; 75 years for LIDAH, LIDASH for futher details see technical table P007
Ambient temperature range	**Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Surface protection	Zinc coating with black passivation, galvanic treatment (driver housing)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Vibration resistance	See technical table G004
Compliance	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

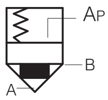
10 FLOW DIRECTION AND OPERATING PRESSURE

Flow direction	A→B or B→A
Operating pressure	**LIFI** A, B, X, Z1, Z2 = **420** bar;
	LIDA /FV (size 16÷50), **LIDA /FI** (size 63÷100) A, B, X = **420** bar;
	LIDAH /FV-E A, B, X = **350** bar; Y = **210** bar (DC), **160** bar (AC)
	LIDAH /FV-EP A, B, X = **420** bar; Y = **210** bar (DC), **160** bar (AC)
	LIDAS /FV A, B, X, Y, Z1, Z2 = **420** bar;
	LIDASH /FV-E A, B, X, Z1, Z2 = **350** bar; Y = **210** bar (DC), **160** bar (AC)
	LIDASH /FV-EP A, B, X, Z1, Z2 = **420** bar; Y = **210** bar (DC), **160** bar (AC)

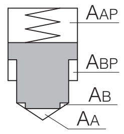
11 HYDRAULIC CHARACTERISTICS OF LIFI

Size		**16**	**25**	**32**	**40**	**50**
Poppet type **42** **Nominal flow** at Δp 5 bar (l/min)		140	300	550	1150	1800
Area ratio A:Ap		1:1,1				
Poppet type **43** **Nominal flow** at Δp 5 bar (l/min)		120	280	440	860	1370
Area ratio A:Ap		1:2		1:1,6		

12 HYDRAULIC CHARACTERISTICS OF LIDA, LIDAH

Size		**16**	**25**	**32**	**40**	**50**	**63**	**80**	**100**
Poppet type **43** **Nominal flow** at Δp 5 bar (l/min)		240	500	800	1400	2200	3300	4000	6300
Area ratio A:Ap		1:1,5							

13 HYDRAULIC CHARACTERISTICS OF LIDAS, LIDASH

Size		**16**	**25**	**32**	**40**	**50**	**63**	**80**
Maximum flow at Δp = 5 bar	[l/min]	200	300	550	1100	1800	2400	3000
Poppet characteristics			**Poppet areas** **A_A** = main flow (side A) **A_B** = main flow (side B) **A_{AP}** = piloting area (close) **A_{BP}** = piloting area (open)			Thanks to the areas ratio $A_{AP}/(A_A+A_B)$, the valve closing is always ensured with a piloting pressure (X port) equal to the line pressure (A or B line).		
A_A	[cm²]	1,43	3,46	5,30	8,04	13,85	30,19	35,68
A_B (% of A_A)		58,6	41,7	51,5	56,3	41,7	46,34	49,75
A_{BP} (% of A_A)		107,0	90,5	85,2	87,9	97,8	30,74	28,40
A_{AP} (% of A_A)		265,6	232,2	236,7	244,1	239,2	177,0	178,20
A_A / (A_A + A_B) poppet ratio		0,6					0,68	
A_{AP} / (A_A + A_B) piloting ratio		1,6					1,2	1,19

14 **SEALS AND HYDRAULIC FLUID** - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

15 COILS CHARACTERISTICS

Insulation class	Pilot valve **E**, **EP**: **H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature [10]
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard

16 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code** (1)	-EX, -EPX (DHE, DHEP) Power consumption (3)	-EPX (DKE, DKEP) Power consumption (3)	-EX, -EPX (DHE, DHEP) Code of spare coil pilot valve	-EX, -EPX (DKE, DKEP) Code of spare coil pilot valve
12 DC	**12 DC**	30W	36W	COE-12DC	CAE-12DC
24 DC	**24 DC**			COE-24DC	CAE-24DC
110 DC	**110 DC**			COE-110DC	CAE-110DC
220 DC	**220 DC**			COE-220DC	CAE-220DC
110/50 AC (2)	**110/50/60 AC**	58VA (4)	-	COE-110/50/60AC	-
110/50/60 AC		-	100VA (4)	-	CAE-110/50/60AC
115/60 AC (2)	**115/60 AC**	80VA (4)	130VA (4)	COE-115/60AC	CAE-115/60AC
230/50 AC (2)	**230/50/60 AC**	58VA (4)	-	COE-230/50/60AC	-
230/50/60 AC		-	100VA (4)	-	CAE-230/50/60AC
230/60 AC	**230/60 AC**	80VA (4)	130VA (4)	COE-230/60AC	CAE-230/60AC

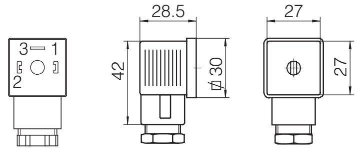
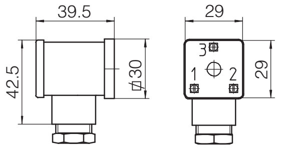
(1) For other supply voltages available on request see technical tables of specific pilot solenoid valve.

(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 58 VA (DHE*), 90 VA (DKE*)

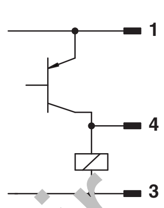
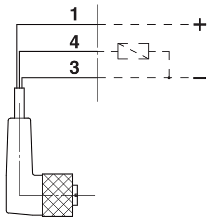
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

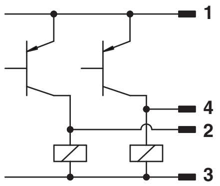
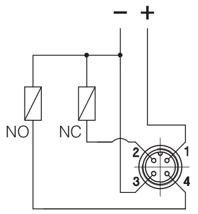
17 COILS ELECTRIC CONNECTORS FOR PILOT SOLENOID VALVES according to DIN EN 175201-804 (ex DIN 43651), to be ordered separately

666, 667 (for AC or DC supply)	**669** (for AC supply)	**CONNECTOR WIRING**		
		**666, 667** 1 = Positive ⊕ 2 = Negative ⊖ ⊕ = Coil ground		**669** 1,2= Supply voltage VAC 3 = Coil ground
		SUPPLY VOLTAGES		
		666	**667**	**669**
		All voltages	24 AC or DC 110 AC or DC 220 AC or DC	110/50 AC 110/60 AC 230/50 AC 230/60 AC

18 TECHNICAL CHARACTERISTICS OF /FI INDUCTIVE PROXIMITY SENSOR

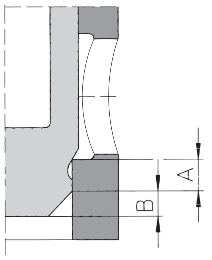
Valve type	**LIFI, LIDA*/FI, LIDAS*/FI**	**/FI** scheme	Connector type **BKS-B-20-4-03**
Type of switch	**/FI** proximity sensor	 **1** supply +24 VDC **3** GND **4** output signal	 **1** (brown) = supply +24 VDC **3** (blue) = GND **4** (black) = output signal CABLE LENGHT = 3 m
Supply voltage [V]	10÷30		
Ripple max [%]	≤ 20		
Max current [mA]	200		
Max peak pressure [bar]	500		
Mechanical life	virtually infinite		
Switch logic	PNP		

19 TECHNICAL CHARACTERISTICS OF /FV POSITION SWITCH

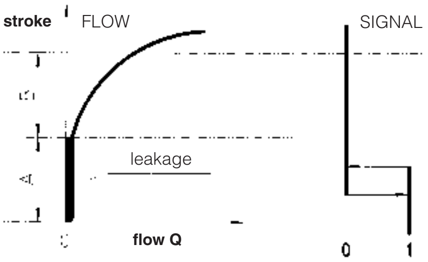
Valve type	**LIDA*/FV, LIDAS*/FV**	**/FV** scheme	Connector type **ZBE-06** IP65
Type of switch	**/FV** proximity sensor	 **1** supply +24 VDC **2** output signal **3** GND **4** output signal	 **1** = supply +24 VDC **2** = output signal NC **3** = GND **4** = output signal NO
Supply voltage [V]	20÷32		
Ripple max [%]	≤ 10		
Max current [mA]	400		
Max peak pressure [bar]	400		
Mechanical life	virtually infinite		
Switch logic	PNP		

20 STATUS OF OUTPUT SIGNALS

A: overlapping stroke
B: damping stroke



According the criteria of safety specifications, the poppet position signal must change its status inside the overlapping stroke (before the effective valve opening).



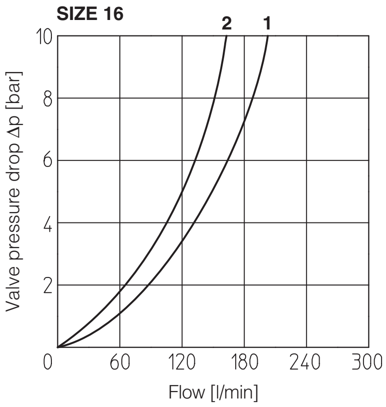
WARNING: the inobservance of following prescriptions invalidates the certification and may represent a risk for personnel injury

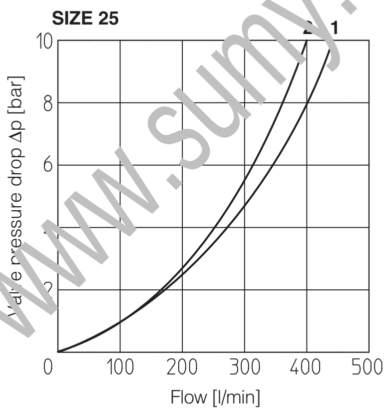
⚠

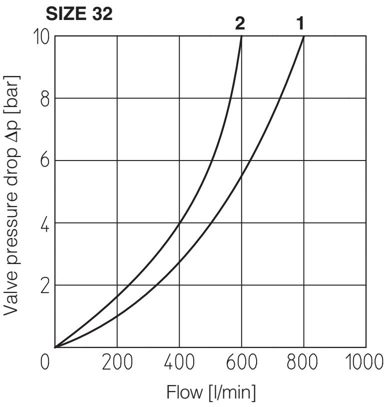
Safety valves must be installed and commissioned only by qualified personnel
Safety valves must not be disassembled
The inductive proximity FI or the inductive position switch FV can be adjusted only by the valve's manufacturer or Atos authorized service centers
Valve's components cannot be interchanged
The valves must operate without switching shocks and spool vibrations

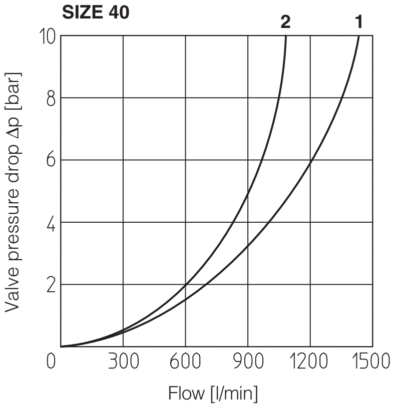
21 Q/Δp DIAGRAMS based on mineral oil ISO VG 46 at 50 °C

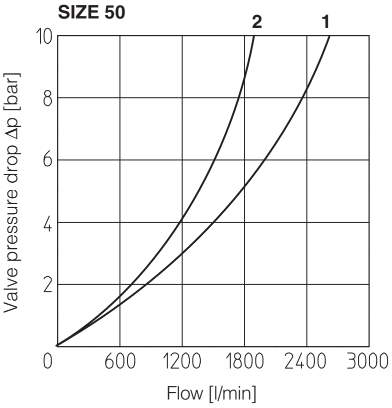
21.1 Q/Δp DIAGRAMS of LIFI







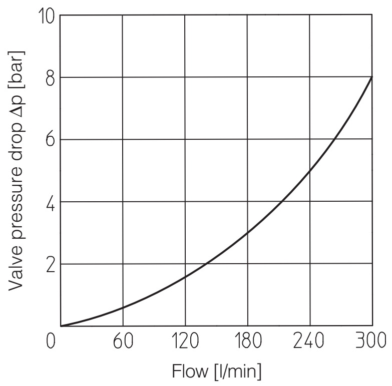




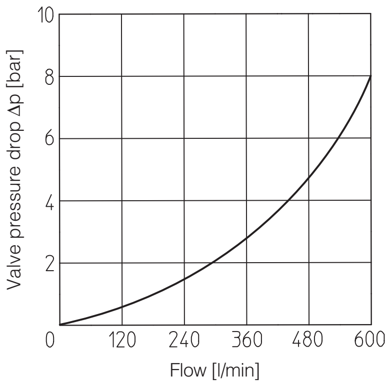
1 = poppet type 42
2 = poppet type 43

21.2 Q/∆p DIAGRAMS of LIDA /FV and LIDAH /FV

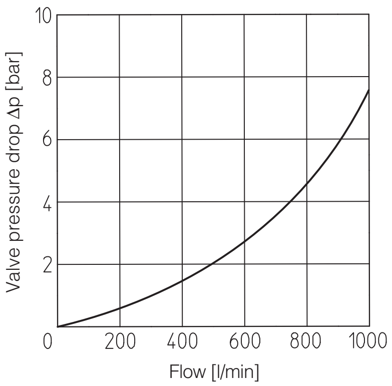
SIZE 16



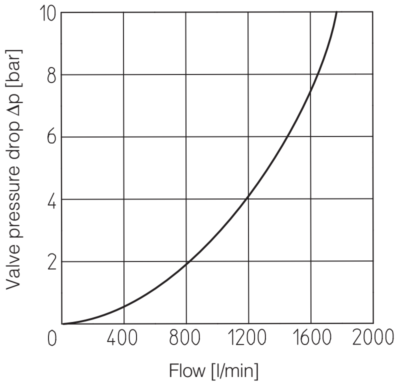
SIZE 25



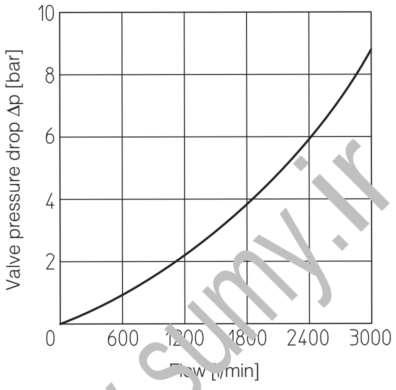
SIZE 32



SIZE 40

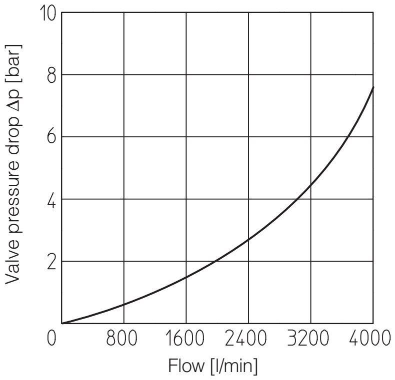


SIZE 50

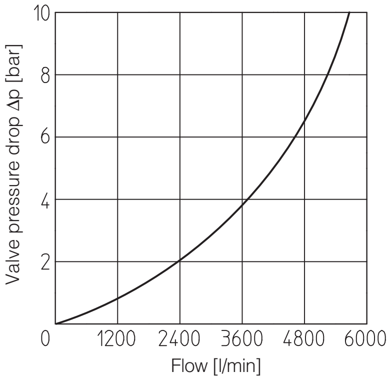


21.3 Q/∆p DIAGRAMS of LIDA /FI

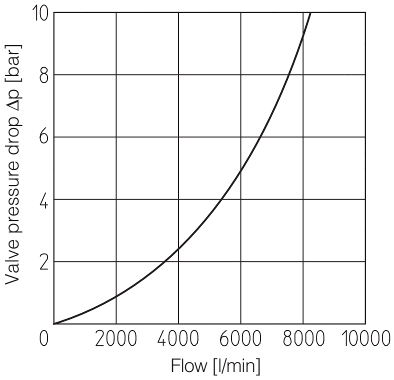
SIZE 63



SIZE 80

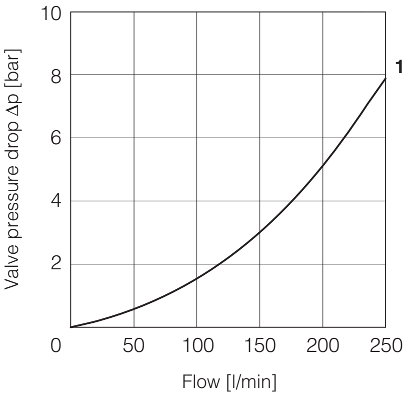


SIZE 100

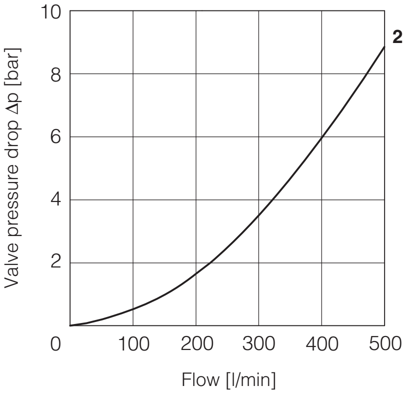


21.4 Q/∆p DIAGRAMS OF LIDAS /FV and LIDASH /FV

SIZE 16



SIZE 25



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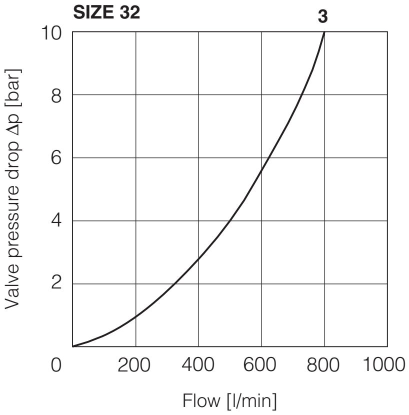
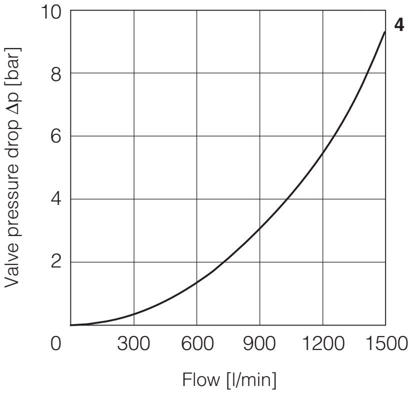
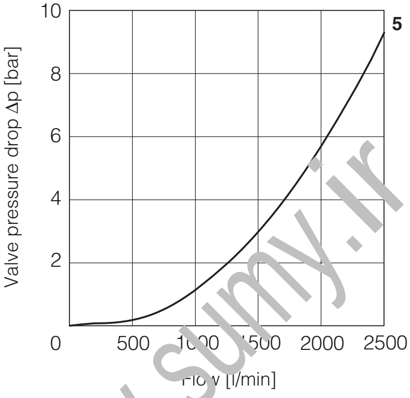


SIZE 40

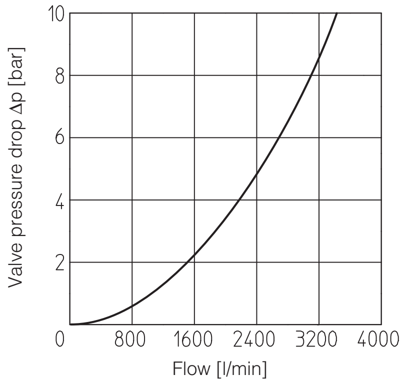


SIZE 50

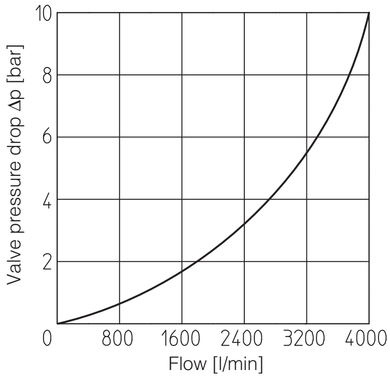


21.5 Q/∆p DIAGRAMS OF LIDASH/FI

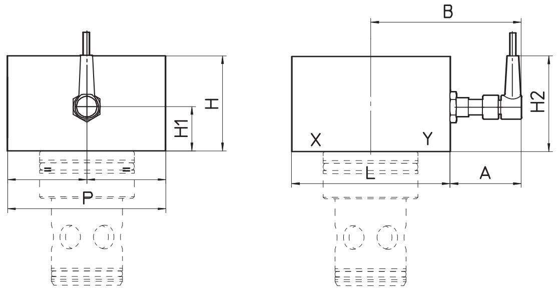
SIZE 63



SIZE 80



22 INSTALLATION DIMENSIONS of LIFI [mm]



	A	B	H	H1	H2	L	P
LIFI-16	54,5	94	50	25	56	72	65
LIFI-25	54,5	97	55	28	59	85	85
LIFI-32	47	97	60	28	59	100	100
LIFI-40	41	103,5	60	30	61	125	125
LIFI-50	44	114	70	30	61	140	140

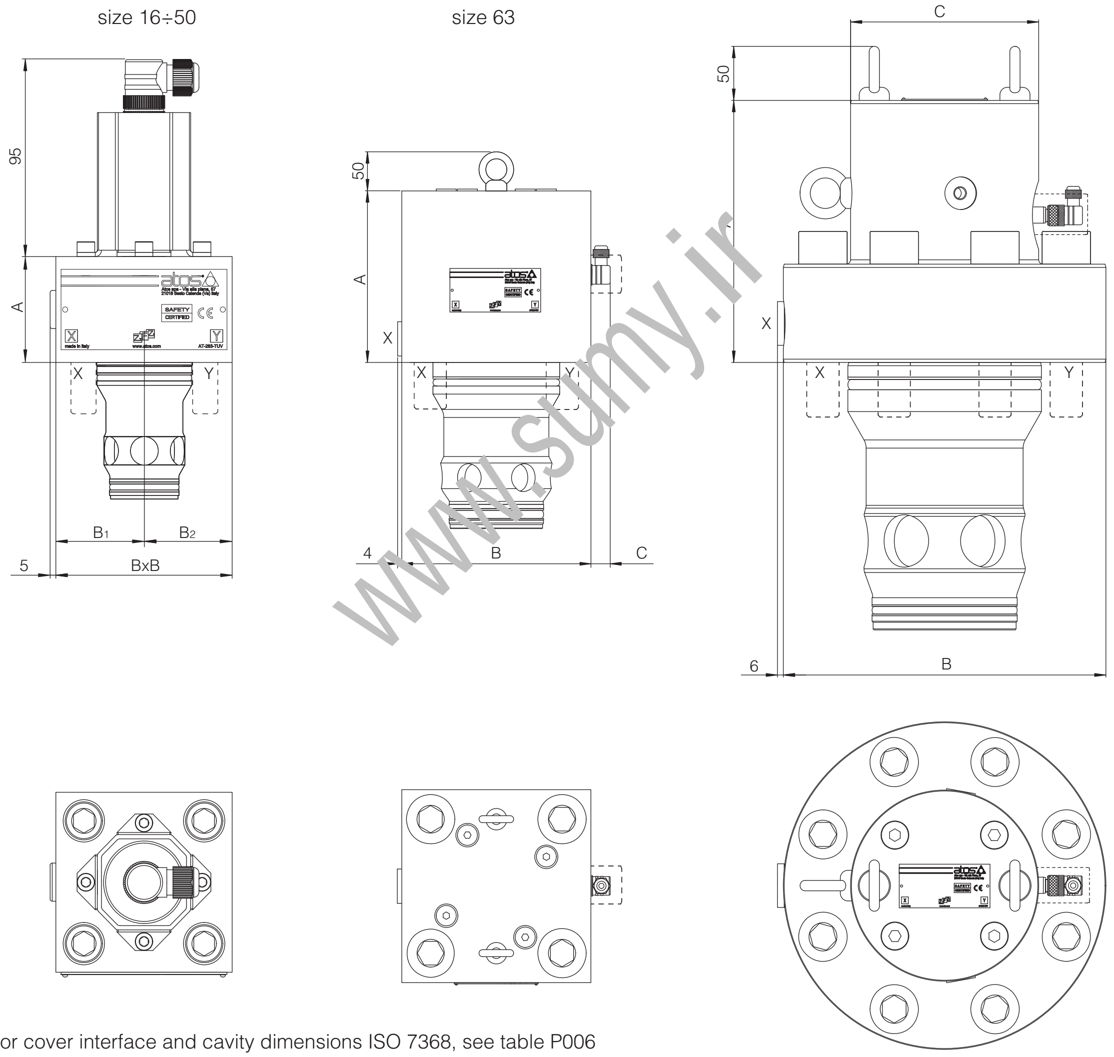
Note: for cover interface and cavity dimensions ISO 7368, see table P006

23 INSTALLATION DIMENSIONS of LIDA /FV and LIDA /FI [mm]

LIDA-*/FV
size 16÷50

LIDA-*/FI
size 63

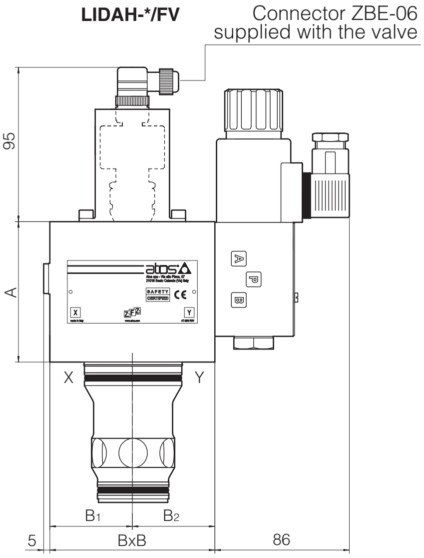
LIDA-*/FI
size 80



Note: for cover interface and cavity dimensions ISO 7368, see table P006
Ports Z_1, Z_2 not connected

Size	A	B	B1	B2	C	Seal	connection port X	Fastening bolts class 12.9	Mass (Kg)
16	56	65x72	32.5	32.5	-	4 OR 108	G1/4”	N°4 M8x50 35 Nm	2,7
25	60	85	42.5	42.5	-	4 OR 108	G1/4”	N°4 M12x60 125 Nm	4,5
32	70	100	50	50	-	4 OR 2043	G1/4”	N°4 M16x70 300 Nm	6,7
40	91.5	125	62.5	62.5	-	4 OR 3043	G1/4”	N°4 M20x80 600 Nm	13,7
50	95	140	70	70	-	4 OR 3043	G1/4”	N°4 M20x80 600 Nm	14,5
63	160	180	-	-	34	1 OR 3050	G3/4”	N°4 M30x120 2100 Nm	41
80	200	Ø250	-	-	160	1 OR 4075	G1/2”	N°8 M24x120 1000 Nm	60
100	240	Ø300	-	-	175	1 OR 4087	G1/2”	N°8 M30x140 2100 Nm	120

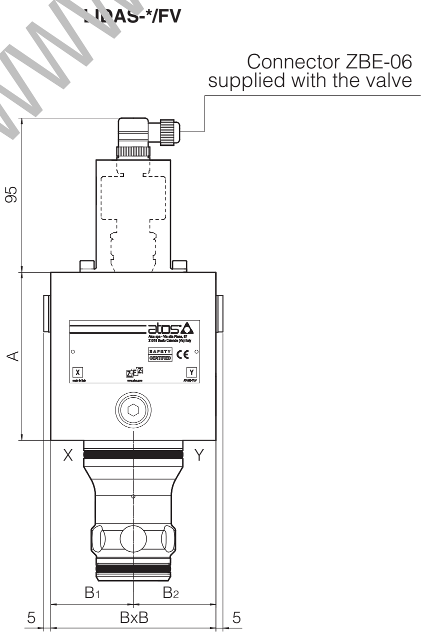
24 INSTALLATION DIMENSIONS of LIDAH /FV [mm] (with pilot solenoid valve)



Note: for cover interface and cavity dimensions ISO 7368, see table P006

Size	A	B	B1	B2	Seal	connection port X	Fastening bolts class 12.9	Mass (Kg)
16	80	65x72	32.5	32.5	4 OR 108	G1/4”	N°4 M8x90 35 Nm	4,5
25	80	85	42.5	42.5	4 OR 108	G1/4”	N°4 M12x80 125 Nm	7,0
32	85	100	50	50	4 OR 2043	G1/4”	N°4 M16x70 300 Nm	8,2
40	91.5	125	62.5	62.5	4 OR 3043	G1/4”	N°4 M20x80 600 Nm	14,2
50	95	140	70	70	4 OR 3043	G1/4”	N°4 M20x80 600 Nm	16

25 INSTALLATION DIMENSIONS of LIDAS /FV [mm]

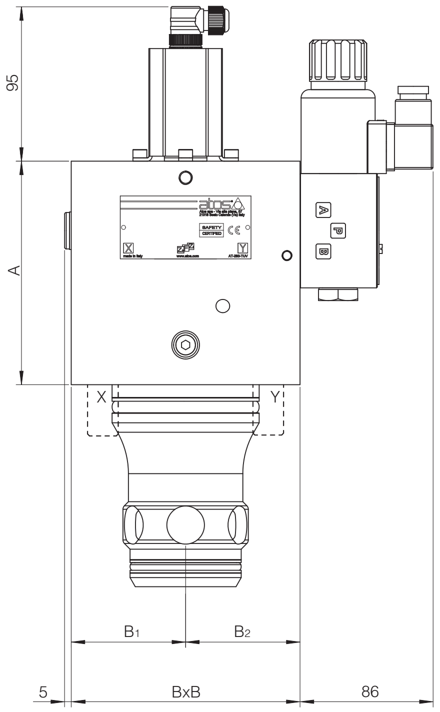


Note: for cover interface and cavity dimensions ISO 7368, see table P006

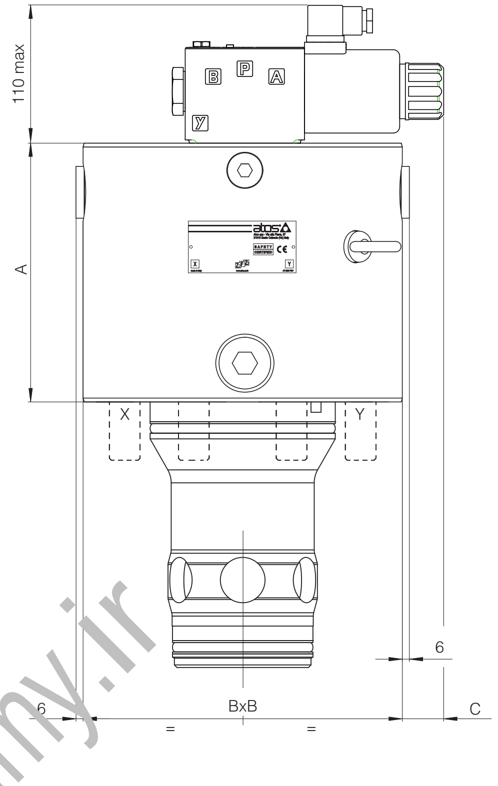
Size	A	B	B1	B2	Seal	connection port X, Y, Z1, Z2	Fastening bolts class 12.9	Mass (Kg)
16	85	65	39.5	39.5	4 OR 108	G1/8”	N°4 M8x80 35 Nm	3
25	102	85	42.5	42.5	4 OR 108	G1/8”	N°4 M12x95 125 Nm	5,9
32	104	100	50	50	4 OR 2043	G3/8”	N°4 M16x90 300 Nm	7,5
40	111	125	62.5	62.5	4 OR 2043	G3/8”	N°4 M20x70 600 Nm	14,7
50	135	140	70	70	4 OR 2043	G3/8”	N°4 M20x80 600 Nm	19,7

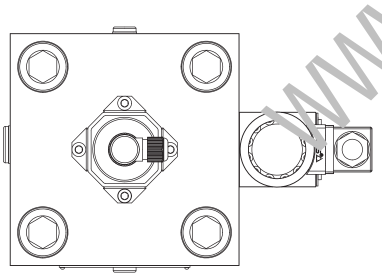
26 INSTALLATION DIMENSIONS of LIDASH /FV and LIDASH /FI [mm] (with pilot solenoid valve)

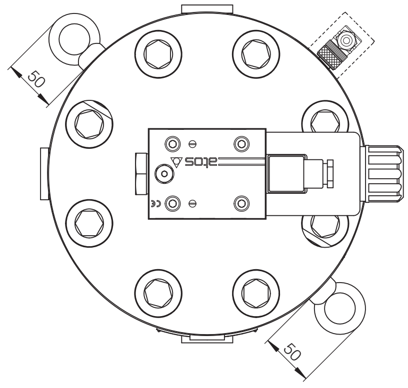
LIDASH-*/FV
size 16÷50



LIDASH-*/FI
size 63 and 80







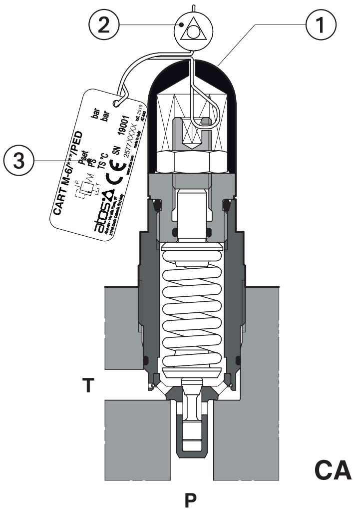
Note: for cover interface and cavity dimensions ISO 7368, see table P006

Size	A	B	B1	B2	C (max)	Seal	connection port X, Z1, Z2	Fastening bolts class 12.9	Mass (Kg)
16	96	65x72	32.5	39.5	-	4 OR 108	G1/8”	N°4 M8x80 35 Nm	4,6
25	115	85	42.5	42.5	-	4 OR 108	G1/8”	N°4 M12x95 125 Nm	7,6
32	116	100	50	50	-	4 OR 2043	G3/8”	N°4 M16x90 300 Nm	9,1
40	125	125	62.5	62.5	-	4 OR 2043	G3/8”	N°4 M20x70 600 Nm	15,8
50	135	140	70	70	-	4 OR 2043	G3/8”	N°4 M20x80 600 Nm	20,8
63	192	180	-	-	65	4 OR 3050	(X, Y, Z1, Z2) G3/8”	N°4 M30x120 2100 Nm	51
80	200	Ø250	-	-	15	4 OR 4106	(X, Y, Z1, Z2) G1”	N°8 M24x100 1000 Nm	80

Table **CY010-0/E**

Safety pressure relief valves

direct, screw-in, conforming to PED Directive 2014/68/EU - certified by DEKRA



CART M-6/420/PED

① plastic cap
② lead sealing
③ nameplate with factory pressure setting

CART /PED

Safety pressure relief valves, certified by DEKRA according to Pressure Equipment Directive 2014/68/EU (PED).

They are designed to operate as safety components, limiting the maximum system pressure or to protect parts of the hydraulic circuit and accumulators from overpressure.

The valves are factory set at the pressure level required by the costumer, see section 6.

The pressure adjustment screw is protected with a lead sealed plastic cap to avoid any tampering.

The screw-in execution is specifically designed to reduce the dimension of blocks and manifolds, without penalizing the functional characteristics.

Size: **G1/2" ÷ M35**
Max flow: **2,5 ÷ 150 l/min**
Max pressure: up to **420 bar**

1 MODEL CODE

CART **M-6** / **420** / **PED** / **280** * / *

CART: Safety pressure relief valves, screw-in

Size:
M-3 = G1/2 **(1)**
M-4 = M14x1
M-5 = M20x1,5
M-6 = M33x1,5 **(1)**
ARE-15 = M32x1,5
ARE-20 = M35x1,5 **(1)**

Max pressure (bar):
420 = for CART M-3, M-4, M-6, ARE-15
350 = for CART M-5
400 = for CART ARE-20

PED = EU Type examination to 2014/68/EU - certified by DEKRA

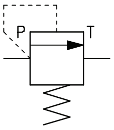
Factory pressure setting (bar):
to be defined by the customer
min step 1 bar (example **280** = 280 bar)
min pressure setting:
25 = for CART-M* and CART ARE-15
30 = for CART ARE-20

Series number

Seals material,
see section 5:
- = NBR
PE = FKM
BT = HNBR **(2)**:

(1) Available also in stainless steel execution, see technical table CWY010
(2) BT option is not available for **CART M5/PED** and **CART ARE-20/PED**

2 HYDRAULIC SYMBOL



CART* /PED

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Cavity	See section 9
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature range (not for CART M-5 and ARE-20)	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Ambient temperature range (only for CART M-5 and ARE-20)	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation - salt spray test (EN ISO 9227) > 200h
Compliance	PED Directive 2014/68/EU - EU type-examination certificate **(1)** RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

(1) The type-examination certificate can be download from www.atos.com

4 HYDRAULIC CHARACTERISTICS

Valve model	CART M-3	CART M-4	CART M-5	CART M-6	CART ARE-15	CART ARE-20
Max pressure on port P [bar]	420	420	350	420	420	400
Factory pressure setting range [bar]	25÷420	25÷420	25÷350	25÷420	25÷420	30÷400
Max pressure on port T [bar] **(1)**	50	50	50	50	50	50
Max flow [l/min] **(2)**	2,5	15	50	60	100	150

(1) The valves should be operated without counterpressure on T line, see note 2 at section 8

(2) Max flow without conterpressure on T line, see diagrams at section 8 for max ammissible flow

5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

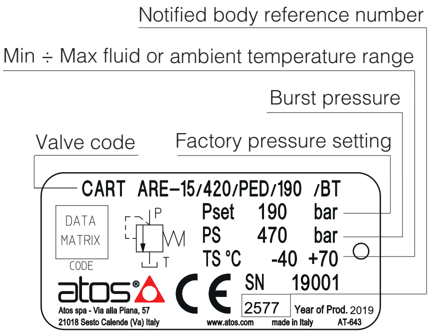
6 FACTORY PRESSURE SETTING

The /PED valves are factory set at the pressure level required by the costumer (min step: 1bar). The factory pressure setting is performed at the flow shown in the following table. The factory pressure setting is marked on the valve nameplate, see section 7

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
CART M-3	0.5
CART M-4	0.5
CART M-5	2
CART M-6	2
CART ARE-15	2
CART ARE-20	2

⚠ Any tampering of the lead sealing invalidates the certification

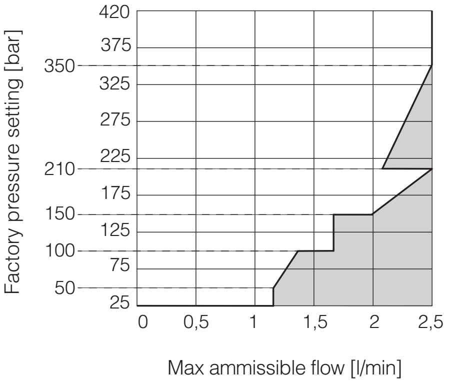
7 NAMEPLATE MARKING



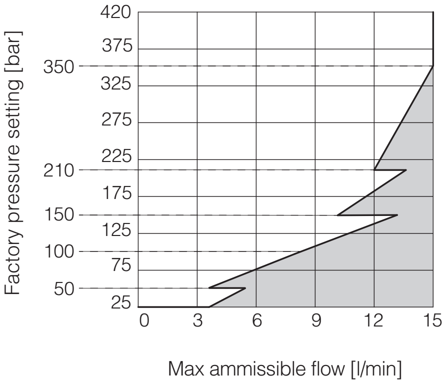
Note: **TS** values are referred to the extreme temperatures, regardless of whether the fluid or the ambient

8 PERMITTED WORKING RANGE (based on mineral oil ISO VG 46 at 50°C)

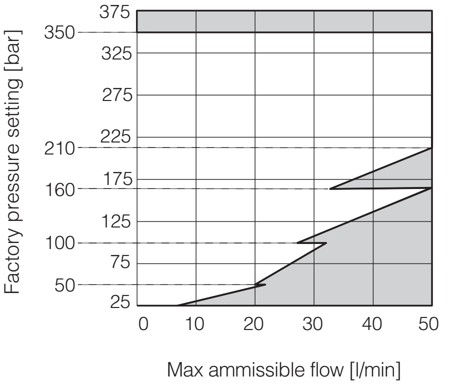
CART M-3 **/PED



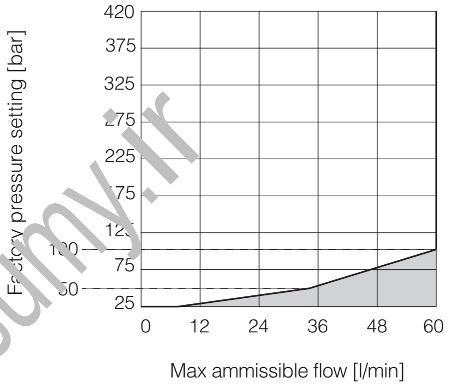
CART M-4 **/PED



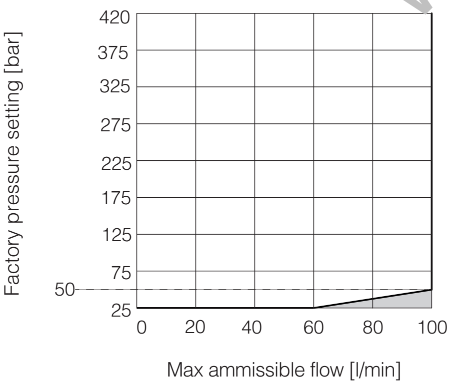
CART M-5 **/PED



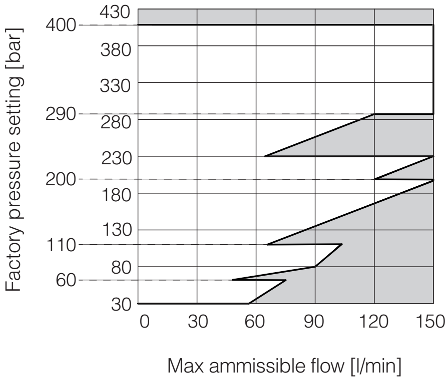
CART M-6 **/PED



CART ARE-15 **/PED



CART ARE-20 **/PED



Notes:

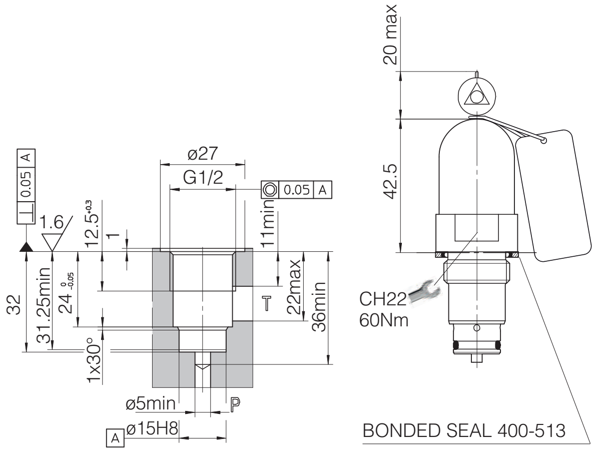
1) The valves can operate only in the white area of the above diagrams.
The max admissible flow values within the white area are those for which the pressure increase remains within **+10% with respect to the factory pressure setting.**
Pressure / flow values located in gray areas cannot be performed.

⚠ Before ordering the valve, check that the maximum admissible flow at the required pressure setting, is greater than the maximum flow rate of the system or the accumulator to be protected.

2) The working range in above diagrams is valid without counterpressure in T line.
The factory pressure setting is increased by the counterpressure valve in T line.
As general rule PED valves should be operated without counter pressure in the T line.
In case of counter pressure in T line, the maximum admissible flow has to be reduced with respect to the values reported in the diagram, so as not to exceed the limit of +10% with respect to the factory pressure setting. Contact Atos technical office for details.

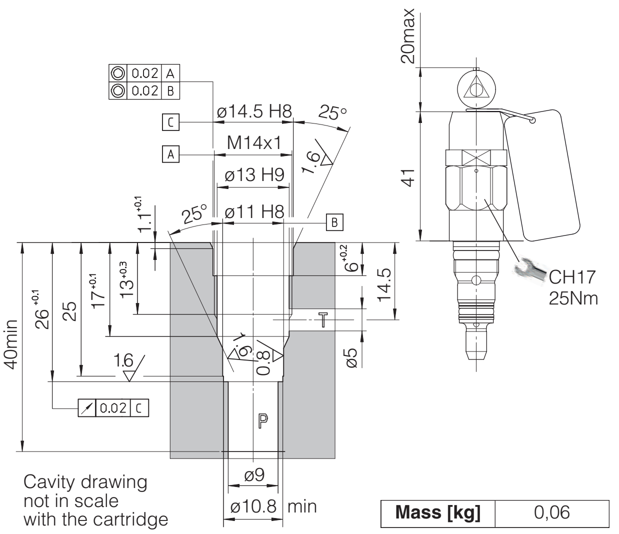
9 CAVITY AND INSTALLATION DIMENSIONS [mm]

CART M-3



Mass [kg]	0,12

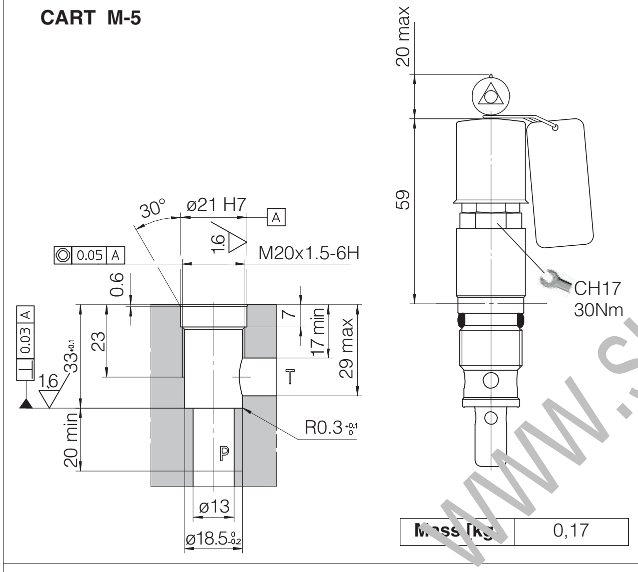
CART M-4



Cavity drawing
not in scale
with the cartridge

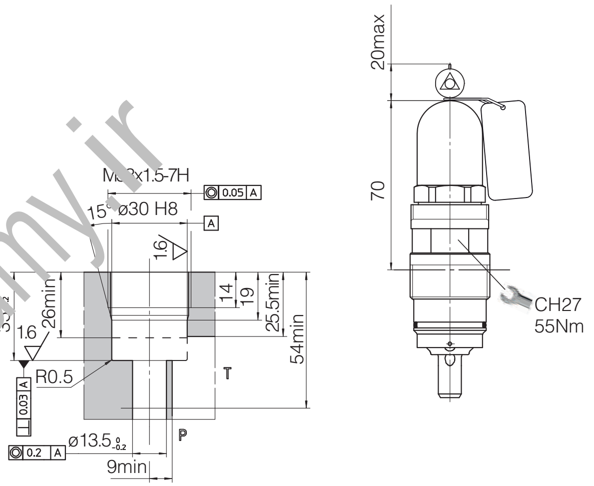
Mass [kg]	0,06

CART M-5



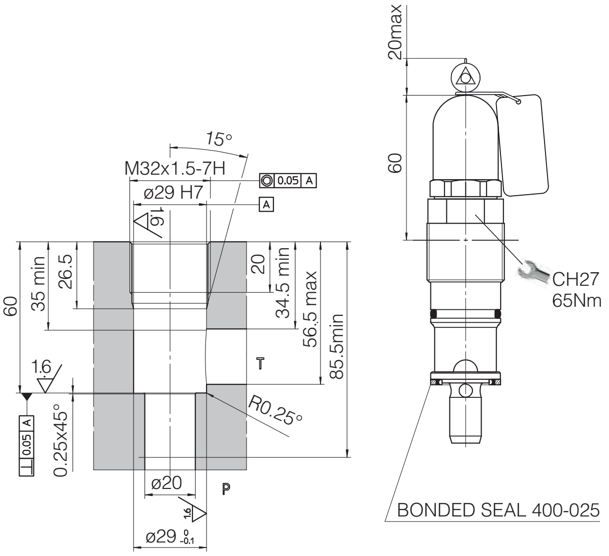
Mass [kg]	0,17

CART M-6



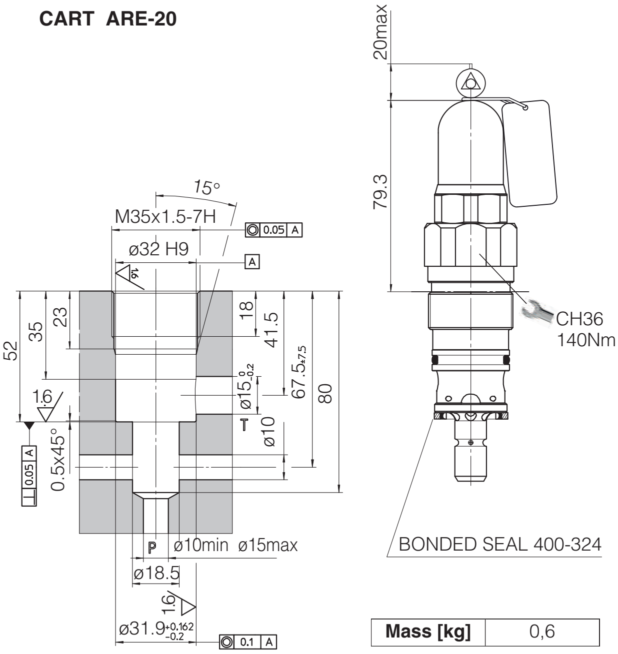
Mass [kg]	0,37

CART ARE-15



Mass [kg]	0,7

CART ARE-20



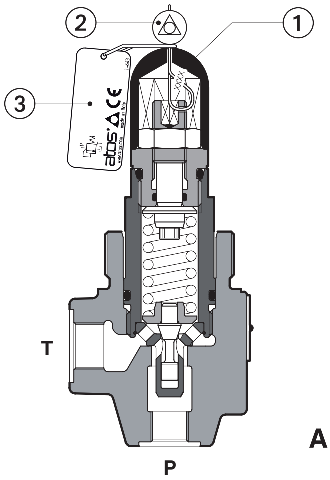
Mass [kg]	0,6

10 RELATED DOCUMENTATION

CY900	Operating and maintenance information for PED certified valves

Safety pressure relief valves

in line, direct, conforming to PED Directive 2014/68/EU - certified by DEKRA



ARE-06/420/PED

① plastic cap
② lead sealing
③ nameplate with factory pressure setting

ARE /PED

Safety pressure relief valves, certified by DEKRA according to Pressure Equipment Directive 2014/68/EU (PED).

They are designed to operate as safety components, limiting the maximum system pressure or to protect parts of the hydraulic circuit and accumulators from overpressure.

The valves are provided with threaded ports for in-line mounting.

The valves are factory set at the pressure level required by the costumer, see section 6.

The pressure adjustment screw is protected with a lead sealed plastic cap to avoid any tampering.

ARE-06: Size: **G 3/8**"
Max flow: **60 l/min**
Max pressure: **420 bar**

ARE-15: Size: **G 1/2**"
Max flow: **100 l/min**
Max pressure: **420 bar**

1 MODEL CODE

ARE - **06** / **420** / **PED** / **280** * / *

ARE = Safety pressure relief valves, in-line

Size:
06 = Port P G 3/8"
15 = Port P G 1/2"

Max pressure (bar):
420

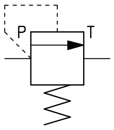
PED = EU Type examination to 2014/68/EU - certified by DEKRA

Factory pressure setting (bar):
to be defined by the customer
min step 1 bar (example **280** = 280 bar)
min pressure setting 25 bar

Series number

Seals material,
see section 5:
- = NBR
PE = FKM
BT = HNBR:

2 HYDRAULIC SYMBOL



ARE-06* /PED

ARE-15* /PED

3 GENERAL CHARACTERISTICS

Assembly position	Any position
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation - salt spray test (EN ISO 9227) > 200h
Compliance	PED Directive 2014/68/EU - EU type-examination certificate **(1)** RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

(1) The type-examination certificate can be download from www.atos.com

4 HYDRAULIC CHARACTERISTICS

Valve model	**ARE-06**	**ARE-15**
Max pressure on port P [bar]	420	420
Factory pressure setting range [bar]	25÷420	25÷420
Max pressure on port T **(1)** [bar]	50	50
Max flow **(2)** [l/min]	60	100

(1) Ped valves should be operated without counterpressure on T line, see note 2 at section 8

(2) For PED valves see diagrams at section 8

5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2,8 ÷ 500 mm^2/s
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

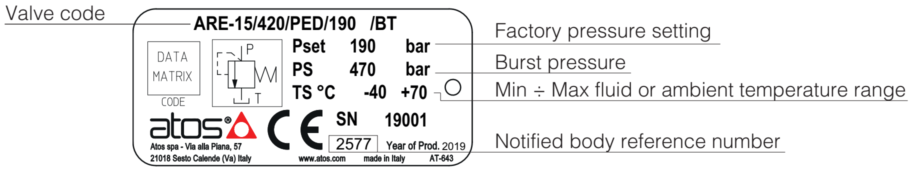
6 FACTORY PRESSURE SETTING

The /PED valves are factory set at the pressure level required by the costumer (min step: 1bar). The factory pressure setting is performed at the flow shown in the following table. The factory pressure setting is marked on the valve nameplate, see section 7

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
ARE-06	2
ARE-15	2

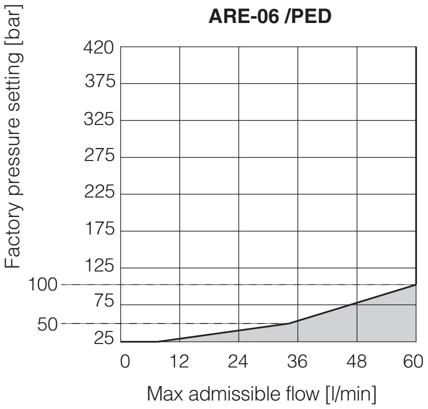
⚠ Any tampering of the lead sealing invalidates the certification

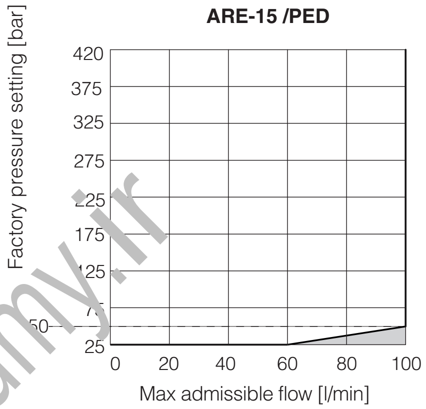
7 NAMEPLATE MARKING



Note: **TS** values are referred to the extreme temperatures, regardless of whether the fluid or the ambient

8 PERMITTED WORKING RANGE (based on mineral oil ISO VG 46 at 50°C)





Notes:

1) The valves can operate only in the white area of the above diagrams.
The max admissible flow values within the white area are those for which the pressure increase remains within **+10% with respect to the factory pressure setting.**
Pressure / flow values located in gray areas cannot be performed.

⚠ Before ordering the valve, check that the maximum admissible flow at the required pressure setting, is greater than the maximum flow rate of the system or the accumulator to be protected.

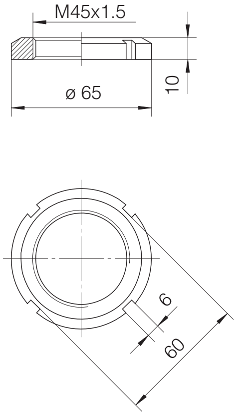
2) The working range in above diagrams is valid without counterpressure in T line.
The factory pressure setting is increased by the counterpressure valve in T line.
As general rule PED valves should be operated without counter pressure in the T line.
In case of counter pressure in T line, the maximum admissible flow has to be reduced with respect to the values reported in the diagram, so as not to exceed the limit of +10% with respect to the factory pressure setting. Contact Atos technical office for details.

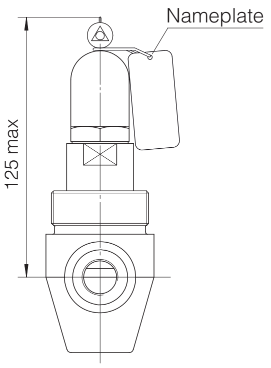
9 INSTALLATION DIMENSIONS [mm]

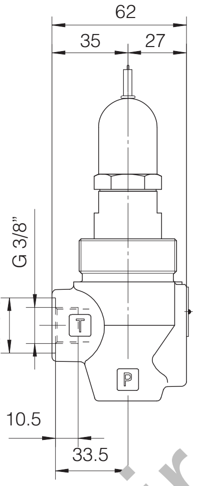
ARE-06

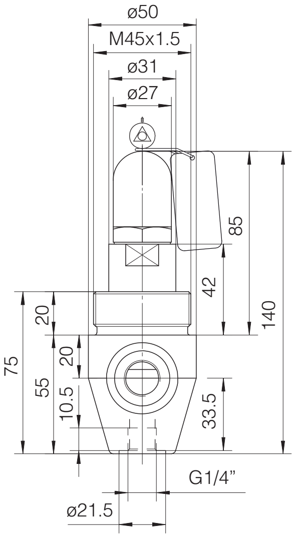
P = INLET PORT G 3/8”
T = OUTLET PORT G 3/8”
Locking ring for fastening the valve.
Model code: SP-6-RE-310030

Mass [kg]	
ARE-06	1,0





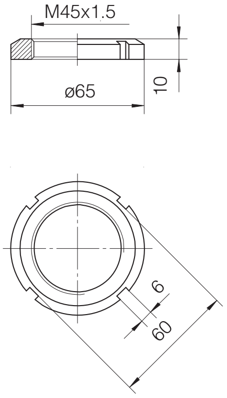


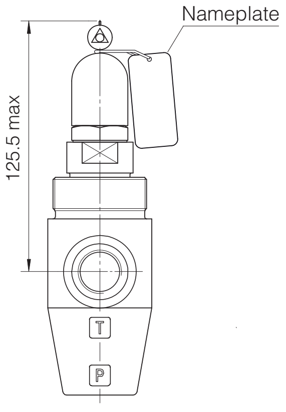


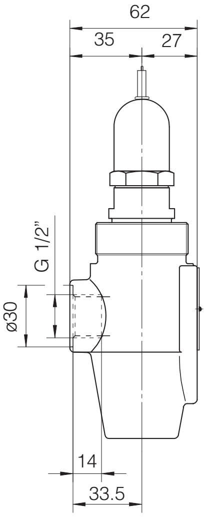
ARE-15

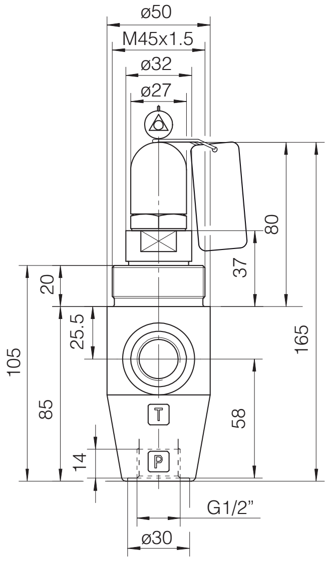
P = INLET PORT G 1/2”
T = OUTLET PORT G 1/2”
Locking ring for fastening the valve.
Model code: SP-6-RE-310030

Mass [kg]	
ARE-15	1,3







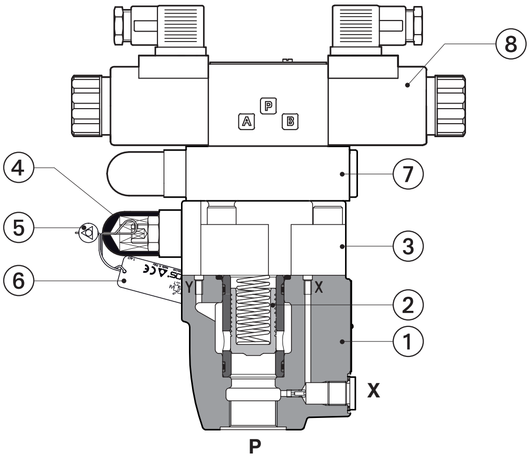


10 RELATED DOCUMENTATION

CY900	Operating and maintenance information for PED certified valves

Safety pressure relief valves

piloted, in-line, conforming to PED Directive 2014/68/EU - certified by DEKRA



① main body
② poppet
③ pilot stage
④ plastic cap
⑤ lead sealing
⑥ nameplate with factory pressure setting
⑦ second /third pressure setting
⑧ pilot solenoid valve for pressure selection

ARAM-20/20/*/PED

ARAM /PED

Safety pressure relief valves, certified by DEKRA according to Pressure Equipment Directive 2014/68/EU (PED).

They are designed to operate as safety components, limiting the maximum system pressure or to protect parts of the hydraulic circuit and accumulators from overpressure.

The valves are factory set at the pressure level required by the costumer, see section 10.

The pressure adjustment screw is protected with a lead sealed plastic cap to avoid any tampering.

ARAM can be equipped with a pilot solenoid valve for venting or for multiple pressure selection.

Size: **G 3/4”** and **G 1 1/4”**
Max flow: **350** and **500 l/min**
Max pressure: **350 bar**

1 MODEL CODE

ARAM - 20 / 20 / 350 / 210/100 / E / PED / 280 - E X 24DC * / *

ARAM: Piloted pressure relief valve, in-line

Valve size ISO 6264:
20 = port P - G 3/4”
32 = port P - G 1 1/4”

Configuration, see section 2:
- = without pilot solenoid valve
10, 11:
with pilot solenoid valve for venting
20, 21, 22, 32:
with pilot solenoid valve for multiple pressure selection

Max pressure:
350 = 350 bar

Pressure range of second / third setting (1):

50 = 50 bar	**100** = 100 bar
210 = 210 bar	**350** = 350 bar

Options, see section 9:
E **WP** **Y**

PED = EU Type examination to 2014/68/EU - certified by DEKRA

Factory pressure setting (bar):
to be defined by the customer min step 1 bar
(example **280** = 280 bar)
min pressure setting 30 bar

Pilot valve (1):
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

X = without connector **(2)**:
Connectors to be ordered separately:
see section 7
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Voltage code, see section 6 **(2)**:

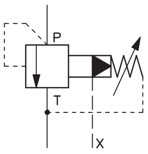
Series number

Seals material, see section 8:
- = NBR
PE = FKM

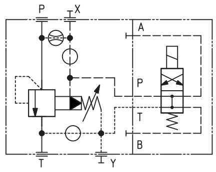
(1) Only for ARAM-* /20, /21, /22, /32
(2) Only for ARAM with pilot solenoid valve

2 CONFIGURATIONS AND HYDRAULIC SYMBOLS

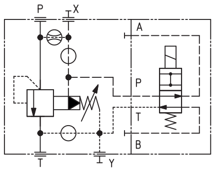
ARAM



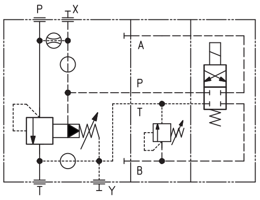
ARAM-/10**
one setting pressure + venting
with de-energized solenoid



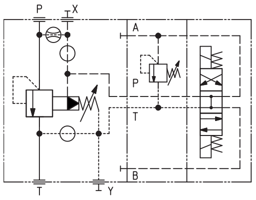
ARAM-/11**
one setting pressure + venting
with energized solenoid



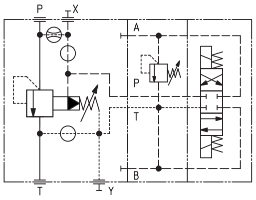
ARAM-/22**
two setting pressure
without venting



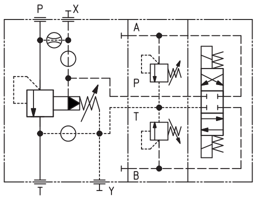
ARAM-/20**
two setting pressure + venting
with de-energized solenoid



ARAM-/21**
two setting pressure + venting
with energized solenoid



ARAM-/32**
three setting pressure
without venting



3 GENERAL CHARACTERISTICS

Assembly position / location	Any position
MTTFd values according to EN ISO 13849	75 years, for further details see technical table P007
Ambient temperature	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Surface protection	Zinc coating with black passivation -salt spray test (EN ISO9227) > 200h
Compliance	PED Directive 2014/68/EU - EU type-examination certificate **(1)** RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

(1) The type-examination certificate can be download from www.atos.com

4 HYDRAULIC CHARACTERISTICS

Valve model	**ARAM-20**	**ARAM-32**
Max pressure on ports P, X [bar]	350	
Max pressure on ports T, Y **(1)** [bar]	210 without pilot solenoid valve 210 with pilot solenoid valve -E with DC solenoid 160 with pilot solenoid valve -E with AC solenoid	
Factory pressure setting range [bar]	30÷350	
Max flow **(2)** [l/min]	350	500

(1) The valves should be operated without counterpressure on T line, see note 2 at section 12
(2) Max flow without conterpressure on T line, see diagrams at section 12 for max ammissible flow

5 ELECTRICAL CHARACTERISTICS - for ARAM with pilot solenoid valve

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

6 COIL VOLTAGE - for ARAM with pilot solenoid valve

External supply nominal voltage ± 10%	Voltage code	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/50/60 AC**		58 VA (3)	COE-230/50/60AC
230/60 AC	**230/60 AC**		80 VA (3)	COE-230/60AC
110/50 AC	**110RC**	669	30 W	COE-110RC
120/60 AC				
230/50 AC	**230RC**			COE-230RC
230/60 AC				

(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 58 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 - for ARAM with pilot solenoid valve

The connectors must be ordered separately.

Code of connector	Function
666	Connector IP-65, suitable for direct connection to electric supply source
667	As 666 connector IP-65 but with built-in signal led, suitable for direct connection to electric supply source

For other available connectors, see tech table K800

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 OPTIONS

E = external pilot
WP = prolunged manual override protected by rubber cap - only for ARAM with pilot solenoid valve
Y = external drain - only for ARAM with pilot solenoid valve

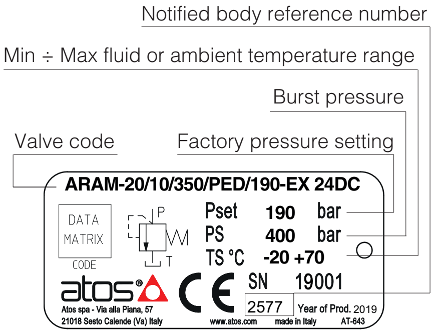
10 FACTORY PRESSURE SETTING

The /PED valves are factory set at the pressure level required by the costumer (min step: 1bar). The factory pressure setting is performed at the flow shown in the following table. The factory pressure setting is marked on the valve nameplate, see section 11 .

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
ARAM-10	25
ARAM-20	25

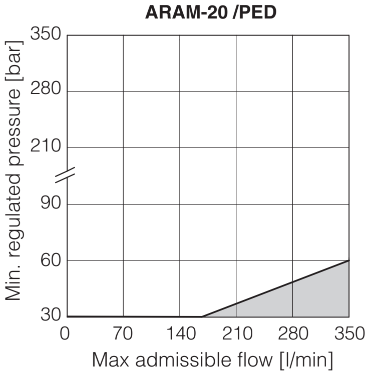
⚠ Any tampering of the lead sealing invalidates the certification

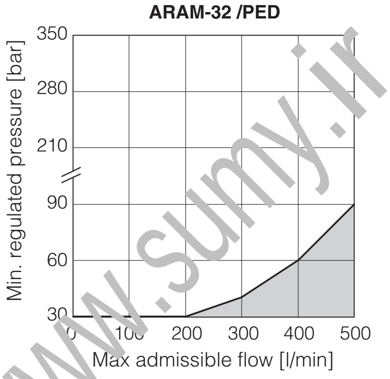
11 NAMEPLATE MARKING



Note: **TS** values are referred to the extreme temperatures, regardless of whether the fluid or the ambient

12 PERMISSIBLE RANGE - based on mineral oil ISO VG 46 at 50°C





Notes:

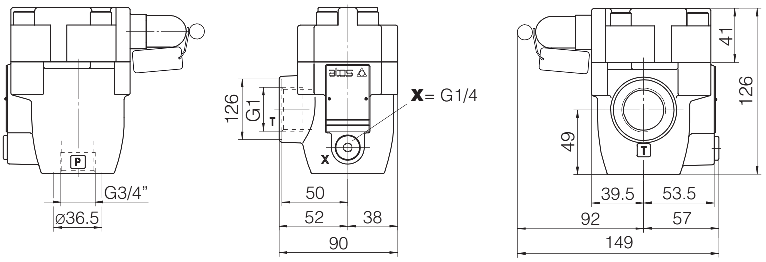
1) The valves can operate only in the white area of the above diagrams.
The max admissible flow values within the white area are those for which the pressure increase remains within **+10% with respect to the factory pressure setting.**
Pressure / flow values located in gray areas cannot be performed.

⚠ Before ordering the valve, check that the maximum admissible flow at the required pressure setting, is greater than the maximum flow rate of the system or the accumulator to be protected.

2) The working range in above diagrams is valid without counterpressure in T line.
The factory pressure setting is increased by the counterpressure valve in T line.
As general rule PED valves should be operated without counter pressure in the T line.
In case of counter pressure in T line, the maximum admissible flow has to be reduced with respect to the values reported in the diagram, so as not to exceed the limit of +10% with respect to the factory pressure setting. Contact Atos technical office for details.

13 INSTALLATION DIMENSIONS [mm]

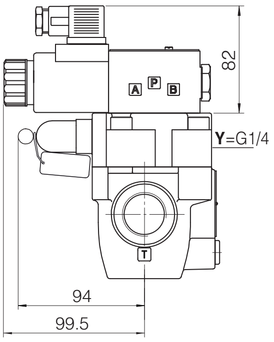
ARAM-20



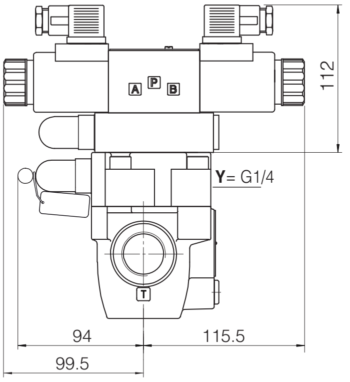
	Mass [kg]
ARAM-20	3,9

	Mass [kg] with option EX
ARAM-20/10	5,7
ARAM-20/11	
ARAM-20/20	7,7
ARAM-20/21	
ARAM-20/22	7,2
ARAM-20/32	8,0

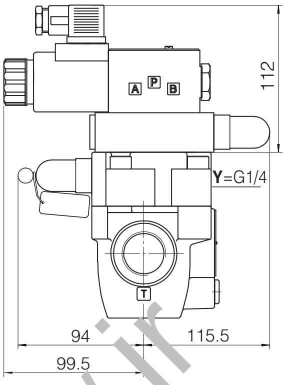
X = port connection for external pilot
Y = port connection for external drain



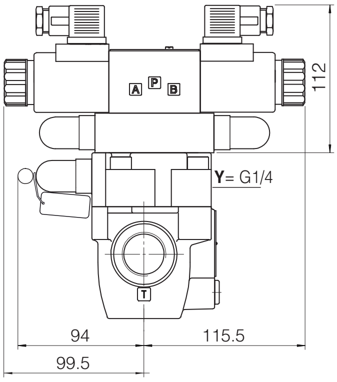
ARAM-20/10/-EX**
ARAM-20/11/-EX**



ARAM-20/20/-EX**
ARAM-20/21/-EX**

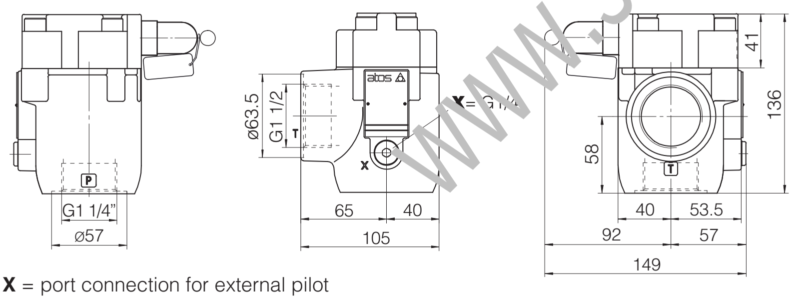


ARAM-20/22/-EX**



ARAM-20/32/-EX**

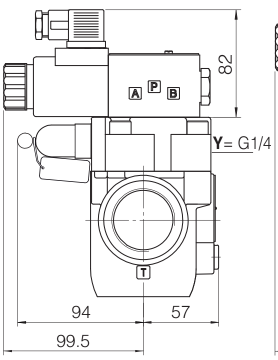
ARAM-32



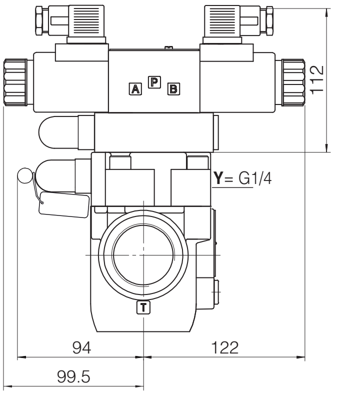
	Mass [kg]
ARAM-32	4,7

	Mass [kg] with option EX
ARAM-32/10	6,5
ARAM-32/11	
ARAM-32/20	8,5
ARAM-32/21	
ARAM-32/22	7,9
ARAM-32/32	8,2

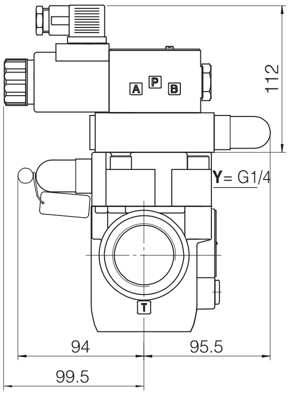
X = port connection for external pilot
Y = port connection for external drain



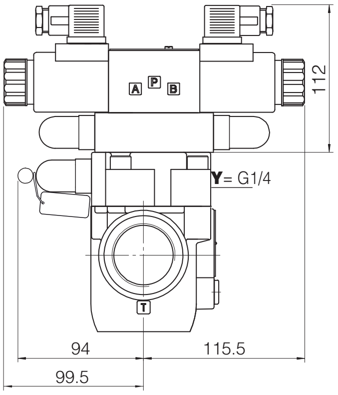
ARAM-32/10/-EX**
ARAM-32/11/-EX**



ARAM-32/20/-EX**
ARAM-32/21/-EX**



ARAM-32/22/-EX**



ARAM-32/32/-EX**

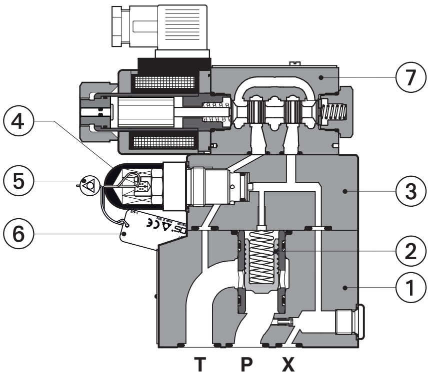
Overall dimensions refer to valves **DC** voltage, with connectors type 666

14 RELATED DOCUMENTATION

CY900	Operating and maintenance information for PED certified valves

Safety pressure relief valves

piloted, subplate, conforming to PED Directive 2014/68/EU - certified by DEKRA



① main body
② poppet
③ pilot stage
④ plastic cap
⑤ lead sealing
⑥ nameplate with factory pressure setting
⑦ pilot solenoid valve for pressure selection

AGAM-10/11/*/PED

AGAM /PED

Safety pressure relief valves, certified by DEKRA according to Pressure Equipment Directive 2014/68/EU (PED).

They are designed to operate as safety components, limiting the maximum system pressure or to protect parts of the hydraulic circuit and accumulators from overpressure.

The valves are factory set at the pressure level required by the costumer, see section 10.

The pressure adjustment screw is protected with a lead sealed plastic cap to avoid any tampering.

AGAM can be equipped with a pilot solenoid valve for venting or for different pressure selection.

Size: **10, 20** and **32** - ISO 6264
Max flow: **200, 400** and **600 l/min**
Max pressure: **350 bar**

1 MODEL CODE

AGAM - 20 / 20 / 350 / 210/100 / E / PED / 280 - E X 24DC * / *

AGAM: Piloted pressure relief valve, subplate

Valve size ISO 6264:
10 20 32

Configuration, see section 2 :
- = without pilot solenoid valve
10, 11:
with pilot solenoid valve for venting
20, 21, 22, 32:
with pilot solenoid valve for multiple pressure selection

Max pressure:
350 = 350 bar

Pressure range of second / third setting (1):
50 = 50 bar
100 = 100 bar
210 = 210 bar
350 = 350 bar

Options, see section 9 :
E WP Y

PED = EU Type examination to 2014/68/EU - certified by DEKRA

Factory pressure setting (bar):
to be defined by the customer min step 1 bar
(example **280** = 280 bar)
min pressure setting 30 bar

Pilot valve (2):
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

X = without connector **(2)**:
See section 7 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Voltage code, see section 6 **(2)**:

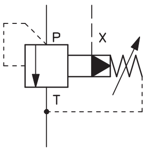
Series number

Seals material, see section 8:
- = NBR
PE = FKM

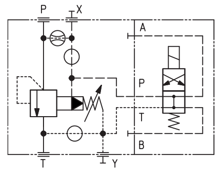
(1) Only for AGAM-* /20, /21, /22, /32
(2) Only for AGAM with pilot solenoid valve

2 CONFIGURATIONS AND HYDRAULIC SYMBOLS

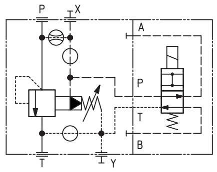
AGAM



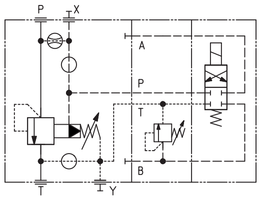
AGAM-/10**
one setting pressure + venting
with de-energized solenoid



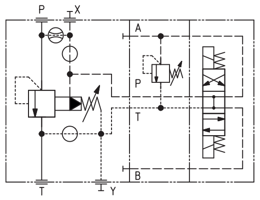
AGAM-/11**
one setting pressure + venting
with energized solenoid



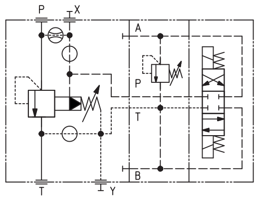
AGAM-/22**
two setting pressure
without venting



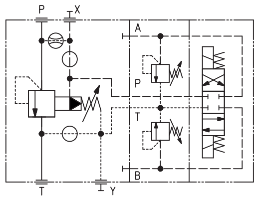
AGAM-/20**
two setting pressure + venting
with de-energized solenoid



AGAM-/21**
two setting pressure + venting
with energized solenoid



AGAM-/32**
three setting pressure
without venting



3 GENERAL CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd values according to EN ISO 13849	75 years, for further details see technical table P007
Ambient temperature	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range	**Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Surface protection	Zinc coating with black passivation -salt spray test (EN ISO9227) > 200h
Compliance	PED Directive 2014/68/EU - EU type-examination certificate **(1)** RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

(1) The type-examination certificate can be download from www.atos.com

4 HYDRAULIC CHARACTERISTICS

Valve model		**AGAM-10**	**AGAM-20**	**AGAM-32**
Max pressure on ports P, X	[bar]	350		
Max pressure on ports T, Y **(1)**	[bar]	210 without pilot solenoid valve 210 with pilot solenoid valve -E with DC solenoid 160 with pilot solenoid valve -E with AC solenoid		
Factory pressure setting range	[bar]	30÷350		
Max flow **(2)**	[l/min]	200	400	600

(1) The valves should be operated without counterpressure on T line, see note 2 at section 12
(2) Max flow without conterpressure on T line, see diagrams at section 12 for max ammissible flow

5 ELECTRICAL CHARACTERISTICS - for AGAM with pilot solenoid valve

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 6
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

6 COIL VOLTAGE - for AGAM with pilot solenoid valve

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/50/60 AC**		58 VA (3)	COE-230/50/60AC
230/60 AC	**230/60 AC**		80 VA (3)	COE-230/60AC
110/50 AC	**110RC**	669	30 W	COE-110RC
120/60 AC				
230/50 AC	**230RC**			COE-230RC
230/60 AC				

(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 58 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 - for AGAM with pilot solenoid valve

The connectors must be ordered separately.

Code of connector	Function
666	Connector IP-65, suitable for direct connection to electric supply source
667	As 666 connector IP-65 but with built-in signal led, suitable for direct connection to electric supply source

For other available connectors, see tech table K800

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 OPTIONS

E = external pilot
WP = prolunged manual override protected by rubber cap - only for AGAM with pilot solenoid valve
Y = external drain - only for AGAM with pilot solenoid valve

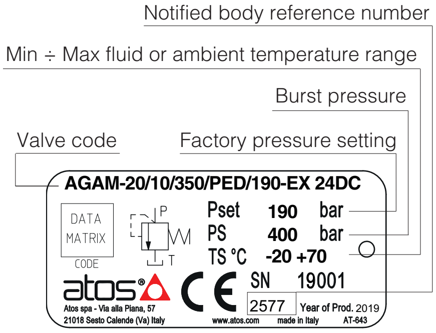
10 FACTORY PRESSURE SETTING

The /PED valves are factory set at the pressure level required by the costumer (min step: 1bar). The factory pressure setting is performed at the flow shown in the following table. The factory pressure setting is marked on the valve nameplate, see section 11 .

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
AGAM-10	25
AGAM-20	25
AGAM-32	25

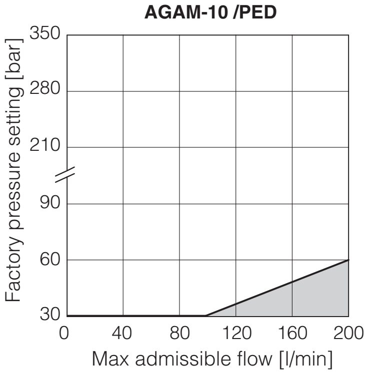
⚠ Any tampering of the lead sealing invalidates the certification

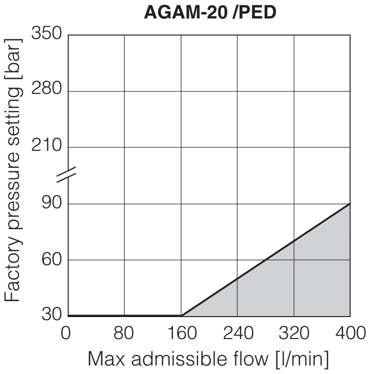
11 NAMEPLATE MARKING

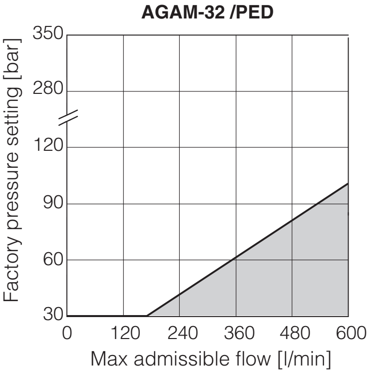


Note: **TS** values are referred to the extreme temperatures, regardless of whether the fluid or the ambient

12 PERMISSIBLE RANGE - based on mineral oil ISO VG 46 at 50°C


AGAM-10 /PED


AGAM-20 /PED


AGAM-32 /PED

Notes:

1) The valves can operate only in the white area of the above diagrams.
The max admissible flow values within the white area are those for which the pressure increase remains within **+10% with respect to the factory pressure setting.**

Pressure / flow values located in gray areas cannot be performed.

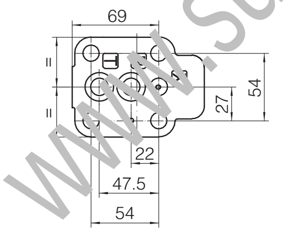
⚠ Before ordering the valve, check that the maximum admissible flow at the required pressure setting, is greater than the maximum flow rate of the system or the accumulator to be protected.

2) The working range in above diagrams is valid without counterpressure in T line.
The factory pressure setting is increased by the counterpressure valve in T line.
As general rule PED valves should be operated without counter pressure in the T line.
In case of counter pressure in T line, the maximum admissible flow has to be reduced with respect to the values reported in the diagram, so as not to exceed the limit of +10% with respect to the factory pressure setting. Contact Atos technical office for details.

13 INSTALLATION DIMENSIONS [mm]

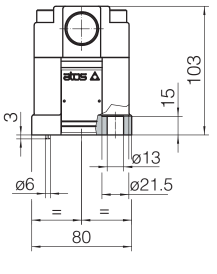
AGAM-10

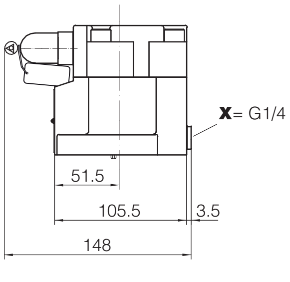
ISO 6264: 2007
Mounting surface: 6264-06-09-1-97
Fastening bolts:
4 socket head screws M12x35 class 12.9
Tightening torque = 125 Nm
Seals: 2 OR 123; 1 OR 109/70
Ports P, T: Ø = 14,5 mm
Ports X: Ø = 3,2 mm

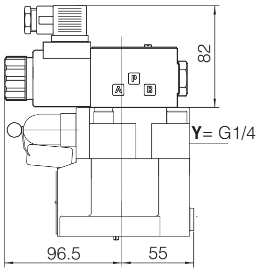


	Mass [kg]
AGAM-10	3,6

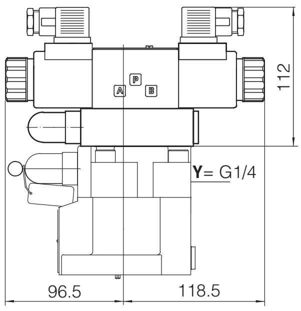
	Mass [kg] with option EX
AGAM-10/10	5,4
AGAM-10/11	
AGAM-10/20	6,2
AGAM-10/21	
AGAM-10/22	5,9
AGAM-10/32	6,3



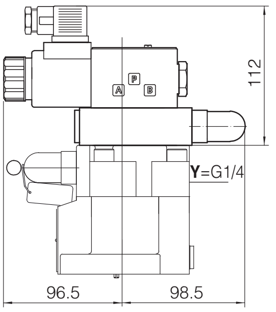




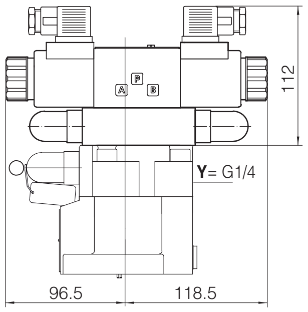
AGAM-10/10/-EX**
AGAM-10/11/-EX**



AGAM-10/20/-EX**
AGAM-10/21/-EX**



AGAM-10/22/-EX**

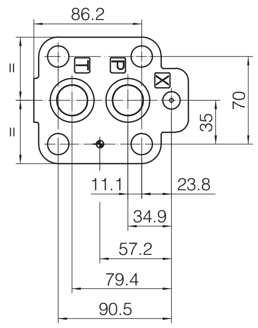


AGAM-10/32/-EX**

Overall dimensions refer to valves **DC** voltage, with connectors type 666

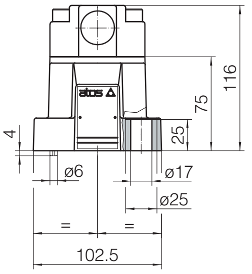
AGAM-20

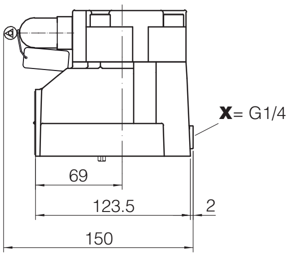
ISO 6264: 2007
Mounting surface: 6264-08-11-1-97
Fastening bolts:
4 socket head screws M16x50 class 12.9
Tightening torque = 300 Nm
Seals: 2 OR 4112; 1 OR 109/70
Ports P, T: Ø = 24 mm
Ports X: Ø = 3,2 mm

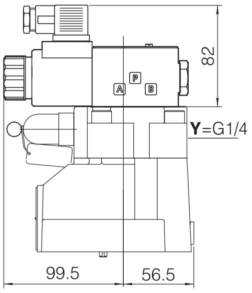


	Mass [kg]
AGAM-20	4,8

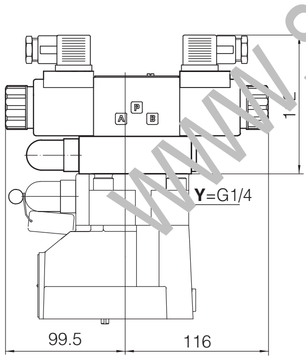
	Mass [kg] with option IX
AGAM-20/10	6,6
AGAM-20/11	
AGAM-20/20	7,7
AGAM-20/21	
AGAM-20/22	7,4
AGAM-20/32	7,8



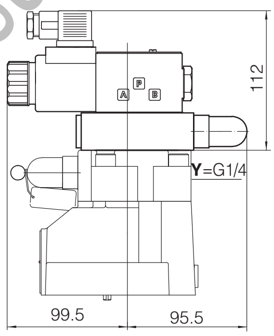




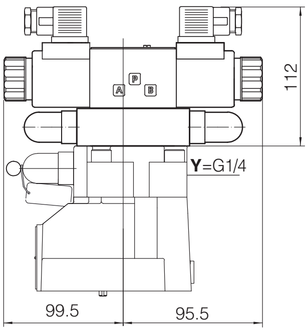
AGAM-20/10/-EX**
AGAM-20/11/-EX**



AGAM-20/20/-EX**
AGAM-20/21/-EX**



AGAM-20/22/-EX**

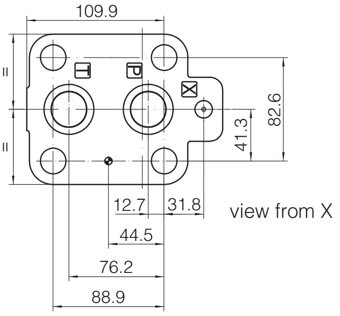


AGAM-20/32/-EX**

Overall dimensions refer to valves **DC** voltage, with connectors type 666

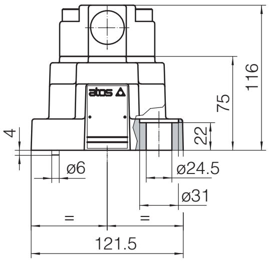
AGAM-32

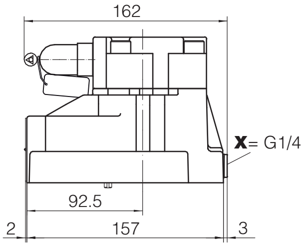
ISO 6264: 2007
Mounting surface: 6264-10-17-1-97
(with M20 fixing holes instead of standard M18)
Fastening bolts:
4 socket head screws M20x60 class 12.9
Tightening torque = 600 Nm
Seals: 2 OR 4131; 1 OR 109/70
Ports P, T: Ø = 28,5 mm
Ports X: Ø = 3,2 mm

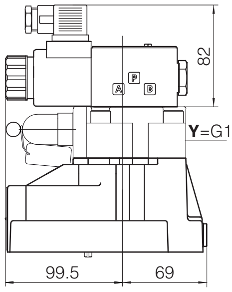


	Mass [kg]
AGAM-32	6.2

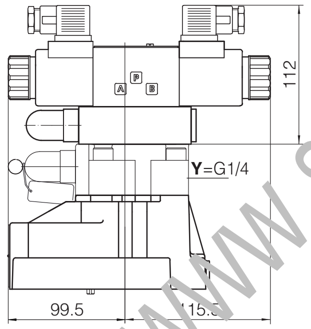
	Mass [kg]
	with option EX
AGAM-32/10	8
AGAM-32/11	
AGAM-32/20	8,1
AGAM-32/21	
AGAM-32/22	8,8
AGAM-32/32	9,5



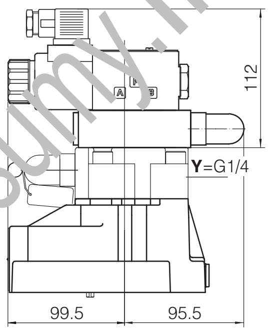




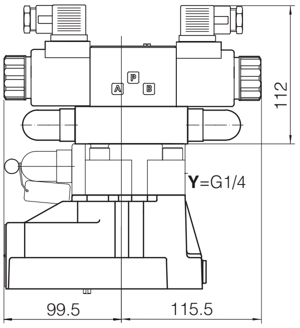
AGAM-32/10/-EX**
AGAM-32/11/-EX**



AGAM-32/20/-EX**
AGAM-32/21/-EX**



AGAM-32/22/-EX**



AGAM-32/32/-EX**

Overall dimensions refer to valves **DC** voltage, with connectors type 666

14 MOUNTING SUBPLATES - see table K280

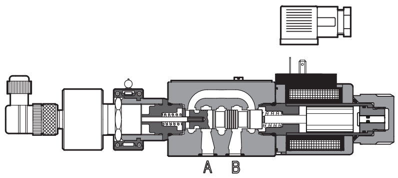
Valve	Subplate model	Port location	Ports			Ø Counterbore [mm]			Mass [Kg]
			P	T	X	P	T	X	
AGAM-10	BA-306	Ports P, T, X underneath;	G 1/2"	G 3/4"	G 1/4"	30	36,5	21,5	1,5
AGAM-20	BA-406		G 3/4"	G 3/4"	G 1/4"	36,5	36,5	21,5	3,5
	BA-506		G 1"	G 1"	G 1/4"	46	46	21,5	3,5
AGAM-32	BA-706		G 1 1/2"	G 1 1/2"	G 1/4"	63,5	63,5	21,5	6

15 RELATED DOCUMENTATION

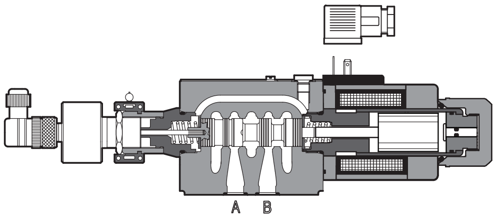
CY900	Operating and maintenance information for PED certified valves

Safety valves for vertical presses and torque bar press brakes with specific spool execution and inductive position switch

Availability and price only on request



130105 DHE-0612/7/AFV



130102 DKE-1612/7/AFV

Directional safety valves specifically designed for applications in vertical presses and torque bar press brakes, are provided with ON-OFF inductive position switch FV (double contacts NC/NO) indicating the position of the valve's spool

They are mainly used to intercept the hydraulic line to the beam cylinders in emergency conditions, in order to immediately stop their movement, particularly during the pressing phase.

At this subject the spool configuration is specifically designed to fulfill the particular application requirements.

By checking the position switch status, the machine controller can perform the safety function.

They are available in five different sizes:
- **130105 DHE**: size 06, direct
  max flow 50 l/min
- **130102 DKE**: size 10, direct
  max flow 150 l/min
- **130135 DPHE-1**: size 10, direct
  max flow 160 l/min
- **130133 DPHE-2**: size 10, direct
  max flow 300 l/min
- **130134 DPHE-4**: size 10, direct,
  max flow 700 l/min

Max pressure: **350 bar**

See the below section 4 for detailed p/Q performance limits.

1 MODEL CODE

130105 DHE-0 - **61** **2/7** / **A** / **FV** - **X** **24DC** ****** **/***

Type valve
130105 DHE-0 = size 06
130102 DKE-1 = size 10
140135 DPHE-1 = size 10
140133 DPHE-2 = size 16
140134 DPHE-4 = size 25

Valve configuration
61 = single solenoid, central plus external, spring centered

Spool type, see section 2

Solenoid mounted at side of port B

Type of switch:
FV = inductive position switch (double contacts)

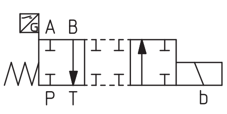
X =without solenoid connector, to be order separately (see tab. K500)

Voltage code
24 = 24 VDC (other voltages on request)

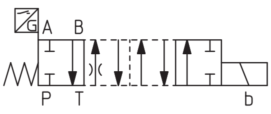
Series number

- = NBR
PE = FKM

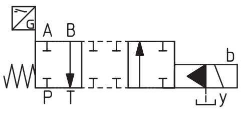
2 CONFIGURATIONS and SPOOLS



130105 DHE-0612/7/A/FV

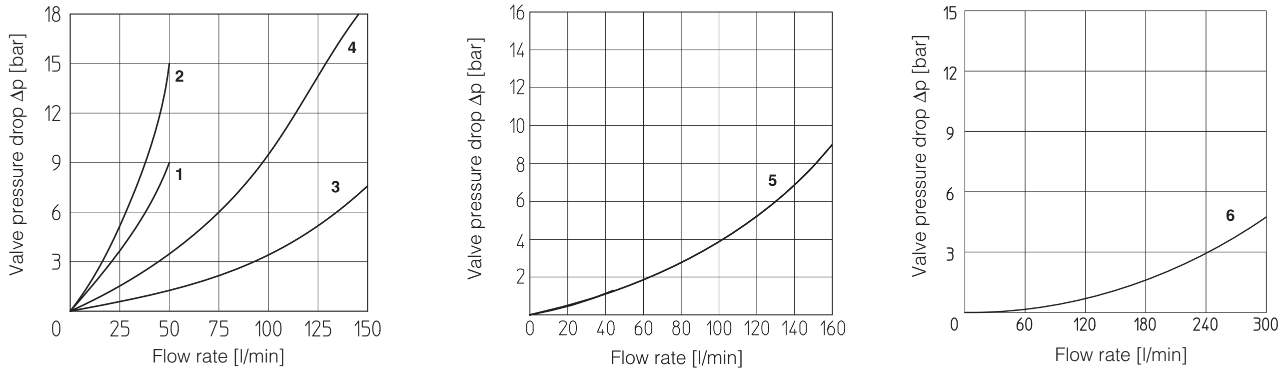


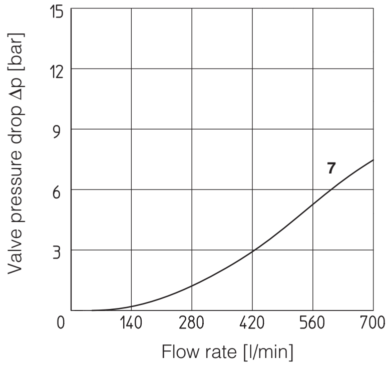
130102 DKE-1612/7/A/FV



140135 DPHE-1612/7/A/FV
140133 DPHE-2612/7/A/FV
140134 DPHE-4612/7/A/FV

3 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C





130105 DHE
1 = P-A **2** = B-T

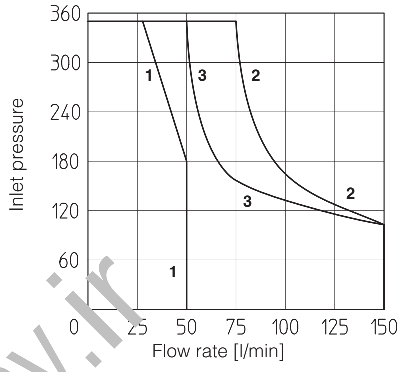
130102 DKE
3 = P-A **4** = B-T

140135 DPHE-1
5 = P-A, B-T

140133 DPHE-2
6 = P-A, B-T

140134 DPHE-4
7 = P-A, B-T

4 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C



130105 DHE
1 = P-A, B-T

130102 DKE
2 = P-A
3 = B-T

5 MAIN CHARACTERISTICS

Installation position		Any position
Subplate surface finishing		Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Ambient temperature		from -20°C to +70°C
Fluid		Hydraulic oils as per DIN 51524 .... 535; for other fluids see section 1
Recommended viscosity		15 ÷ 100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Fluid contamination class		ISO 4406 class 20/18/15 NAS 1638 class 9, see also filter section at www.atos.com or KTF catalog
Fluid temperature		-20°C +80°C (standard seals) -20°C +80°C (/PE seals)
Flow direction		As shown in the symbols of tables 2
Operating pressure	**DHE**	P, A, B = **350 bar** T = **210 bar**
	DKE	P, A, B = **350 bar** T = (with Y port not connected to tank) **210 bar** T = (with Y port drained to tank) **250 bar**
	DPHE	P, A, B, X = **350 bar** T = **250 bar** Ports Y = 0 bar Minimum pilot pressure for correct operation is 8 bar
Maximum flow	**DHE**	**50 l/min** see technical table E015, section 9, operating limits
	DKE	**150 l/min** see technical table E025, section 9, operating limits
	DPHE	DPHE-1: **160 l/min;** DPHE-2: **300 l/min;** DPHE-4: **700 l/min;**

5.1 Coils characteristics

Insulation class	**H** (180°C) Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 EN ISO 4413 must be taken into account
Connector protection degree	IP 65
Relative duty factor	100%
Supply voltage and frequency	See electric feature 6
Supply voltage tolerance	± 10%

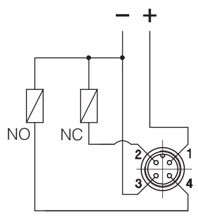
WARNING: the inobservance of following prescriptions invalidates the certification and may represent a risk for personnel injury
⚠ Safety valves must be installed and commissioned only by qualified personnel
Safety valves must not be disassembled
The inductive proximity switch or the position switch can be adjusted only by the manufacturer
Valve's components cannot be interchanged
The valves must operate without switching shocks and spool / poppet vibrations

6 TECHNICAL CHARACTERISTICS OF INDUCTIVE PROXIMITY AND POSITION SWITCHES

Type of switch	position switch **/FV**
Supply voltage [V]	20÷32
Ripple max [%]	≤ 10
Max current [mA]	400
Power consumption [mA]	-
Voltage drop [V]	-
Max switching frequency [Hz]	-
Max peak pressure [bar]	400
Mechanical life	virtually infinite
Switch logic	PNP

7 CONNECTING SCHEMES OF POSITION SWITCHES

Connector type **ZBE-06**

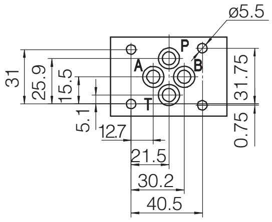


1 = supply +24 V_{DC}
2 = output signal NC
3 = GND
4 = output signal NO

NOTE: the /FV position switch are not provided with a protective earth connection

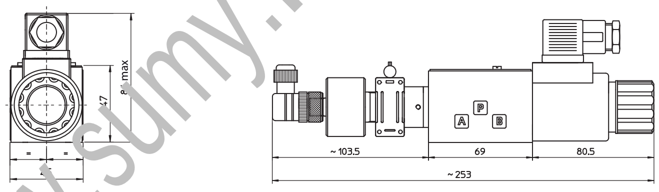
8 DIMENSIONS [mm]

130105 DHE-0612/7/A/FV



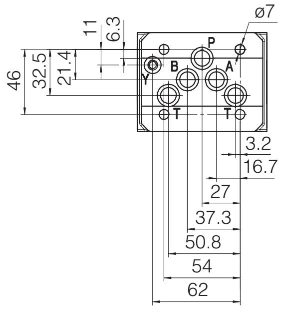
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws: M5x50 class 12.9 (DHI, DHU)
M5x30 class 12.9 (DHE, DHER)
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)



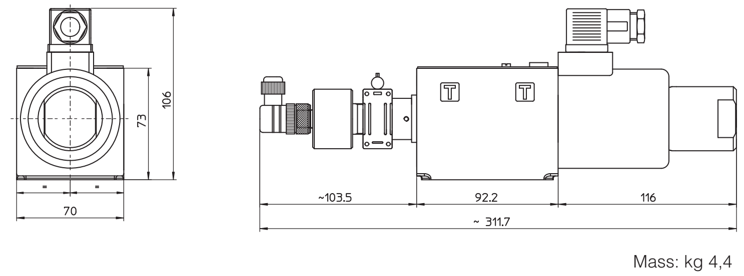
Mass: kg 1,7

130102 DKE-1612/7/A/FV

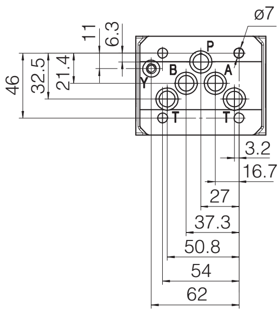


P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT

ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05
(without X port, Y port optional)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050 and 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm



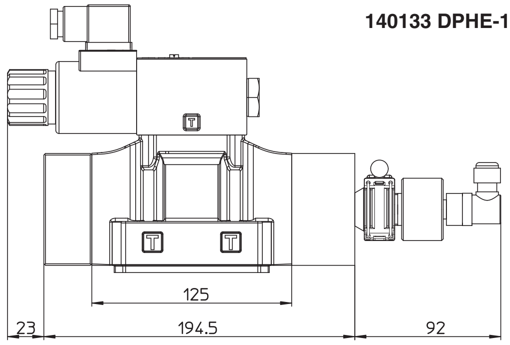
Mass: kg 4,4

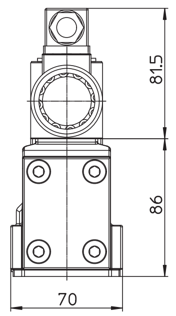


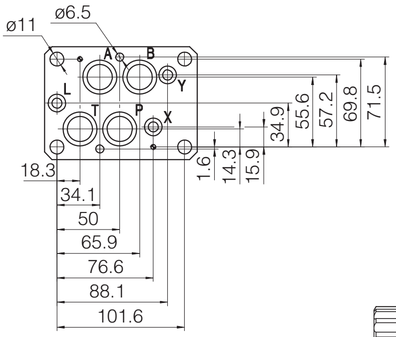
ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05 (without X port)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050 and 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT

140133 DPHE-1612/7/A/FV





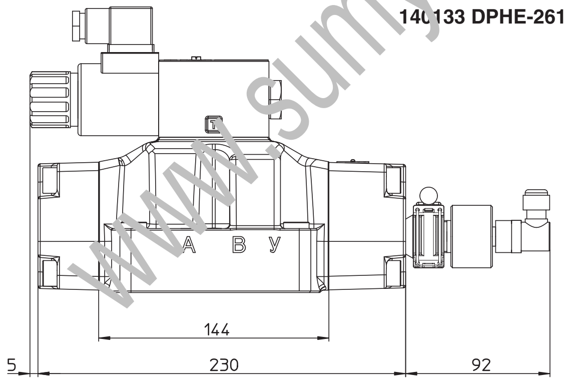


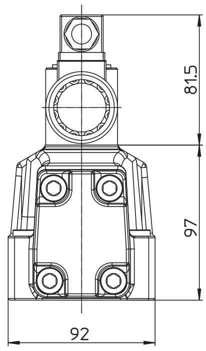
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05

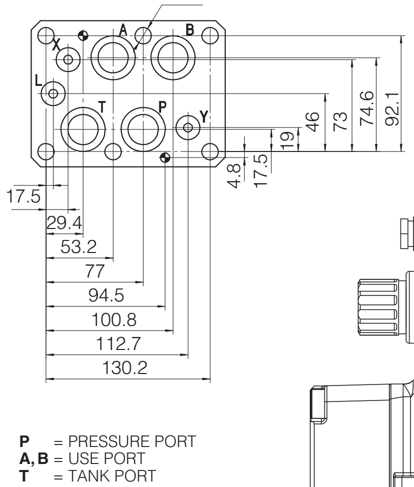
Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 20 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 130, 2 OR 2043

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

140133 DPHE-2612/7/A/FV



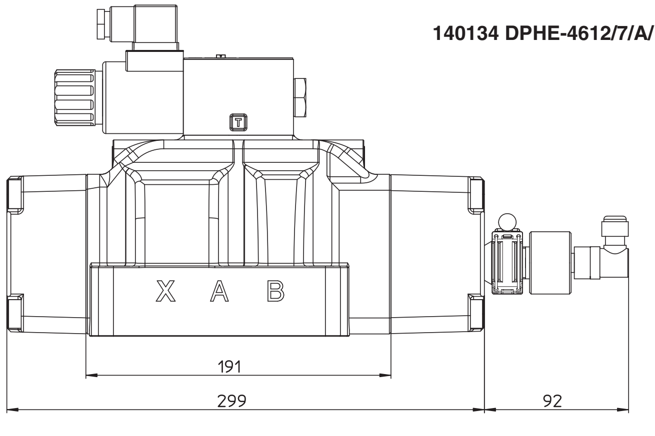


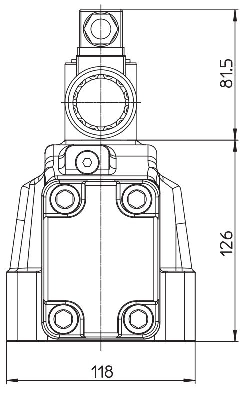


ISO 4401: 2005
Mounting surface: 4401-08-08-0-05

Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Diameter of ports A, B, P, T: Ø = 24 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 4112, 2 OR 3056

140134 DPHE-4612/7/A/FV



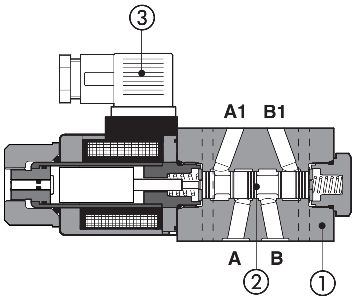


P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

Solenoid modular valves

direct, modular, spool type

CE



HF-0611

① Body
② Spool
③ Coil electric connector (to be ordered separately)

HF are spool type, direct operated solenoid valves in modular execution, normally used for shut-off or to by-pass the hydraulic user lines.

The modular execution permits to make compact functional circuits, by the stack mounting with other modular valves and solenoid valves size 06.

Mounting Surface: **ISO 4401 size 06**
Max flow: **60 l/min**
Max pressure: **350 bar**

1 MODEL CODE

HF-0 | **61** | **1** | **/** | **A** | **-** | **E** | **X** | **24DC** | ****** | **/***

HF-0: Modular directional valve, size 06

Valve configuration, see section 2
61 = single solenoid, central plus external position, spring centered
67 = single solenoid, central plus external position, spring offset

Spool type: **1**, **3**, **4** see section 2

Options:
A = solenoid mounted at side of port B
B = orientation of coil and proximity connectors rotated of 180°
WP = prolonged manual override protected by a rubber cap

E = solenoid OE for AC and DC supply

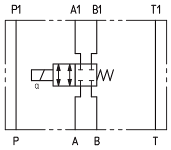
X = without connector
See section 6 for available connectors, to be ordered separately
Coils with special connectors
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

Voltage code, see section 7

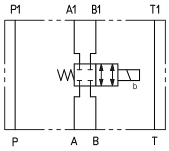
**: Series number

/*: Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR

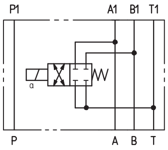
2 CONFIGURATION



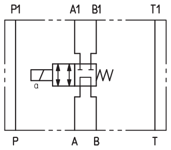
HF-0611



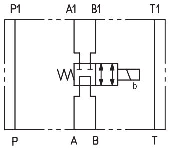
HF-0611/A



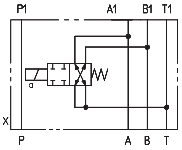
HF-0613



HF-0614



HF-0614/A



HF-0673

3 MAIN CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC. RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** -30°C ÷ +70°C **/PE** option -20°C ÷ +70°C **/BT** option -40°C ÷ +70°C
Flow direction	As shown in the symbols of table 2
Operating pressure	Ports P,A,B: **350** bar; Port T: **210** bar (DC solenoid); **160** bar (AC solenoid)
Maximum flow	**60 l/min**

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with mating connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric features 7
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

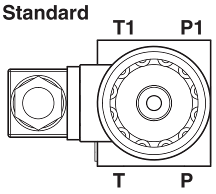
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

5 OPTIONS

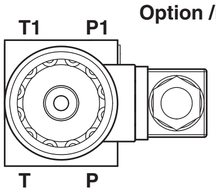
A = Solenoid mounted at side of port B. In standard versions, solenoid is mounted at side of port A.

B = Orientation of coil and proximity connectors rotated of 180°

Standard

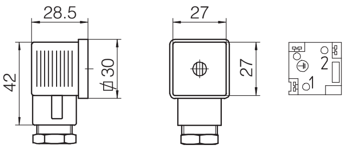
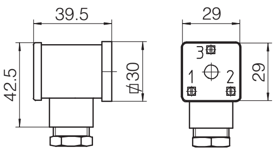


Option /B



WP = Prolunged manual override protected by a rubber cap (not for FV)

6 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately)

<table>
<tr><th>666, 667 (for AC or DC supply)</th><th>669 (for AC supply)</th><th colspan="3">CONNECTOR WIRING</th></tr>
<tr><td rowspan="4">
</td><td rowspan="4">
</td><td colspan="2">666, 667
1 = Positive ⊕
2 = Negative ⊖
⊕ = Coil ground</td><td>669
1,2 = Supply voltage V_{AC}
3 = Coil ground</td></tr>
<tr><td colspan="3">SUPPLY VOLTAGES</td></tr>
<tr><td>666</td><td>667</td><td>669</td></tr>
<tr><td>All voltages</td><td>24 AC or DC
110 AC or DC
220 AC or DC</td><td>110/50 AC
110/60 AC
230/50 AC
230/60 AC</td></tr>
</table>

Note: for electronic connectors type **E-SD**, see tab. K500

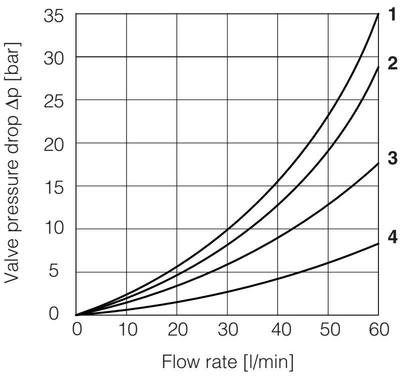
7 ELECTRIC FEATURES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC (1)
230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/60 AC	**230/60 AC**			COE-230/60AC
110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

8 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

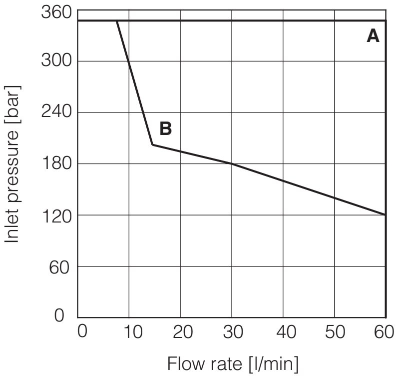
Flow direction / Valve type	**A→A1**	**B→B1**	**A→B**	**A1→T**	**B1→T**
HF-0611	1	2			
HF-0614	1	2	3		
HF-0673	3	3		4	4



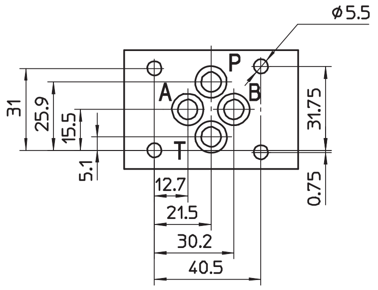
9 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%)

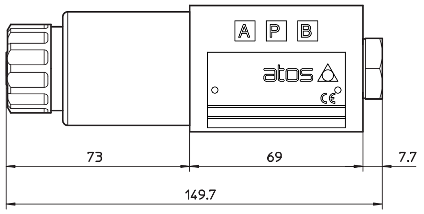
Valve type	Curve
HF-0611	**A**
HF-0614, HF-0673	**B**

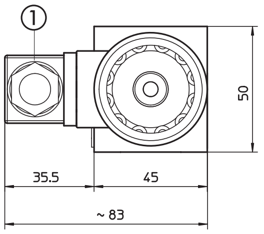


10 DIMENSIONS [mm]



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Seals: 4 OR 108
Ports P, A, B, T: Ø = 7.5 mm (max).



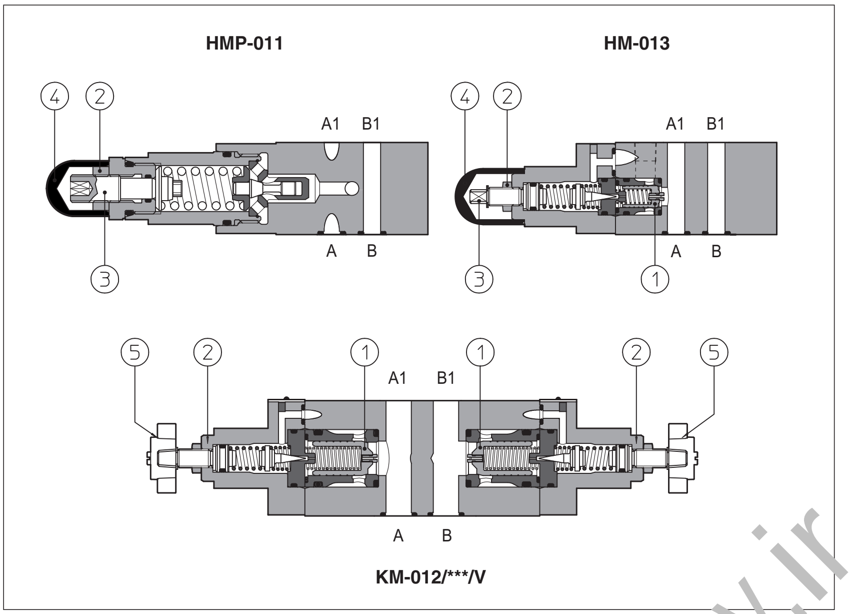


HF-0611
HF-0613
HF-0614
HF-0673

① = Power supply connector code 666, 667 or 669, to be ordered separately

Modular relief valves type HMP, HM, KM

ISO 4401 sizes 06 and 10



HMP are direct operated pressure relief valves.
HM and **KM** are double stage pressure relief valves with balanced poppet ①.

The pressure adjustment is operated by loosening the locking nut ② and turning the screw ③ protected by cap ④. Optional versions with setting adjustment by handwheel ⑤ instead of the screw are available on request. Clockwise rotation increases the pressure.

Valve size and max flow:

HMP = size 06, max flow: 35 l/min
HM = size 06, max flow: 60 l/min
KM = size 10, max flow: 120 l/min

Mounting surface: **ISO 4401 size 06, 10**
Max pressure: up to **350 bar**

1 MODEL CODE

HM - **011** / **210** / **V** ** / *

Modular pressure relief valve size:
HMP = 06
HM = 06
KM = 10

Configuration, see section 2
011 = single on port P, dicharge to port T
012 = double on ports A and B, discharge to port T
013 = single on port A, discharge to port T
014 = single on port B, discharge to port T
015 = double on ports A and B, with the relieved pressure cross-discharged

Pressure range
HMP:
50 = 2÷ 50 bar
100 = 3÷100 bar
210 = 10÷210 bar
350 = 15÷350 bar

HM and KM:
50 = 4÷ 50 bar
100 = 5÷100 bar
210 = 5÷210 bar
350 = 5÷350 bar

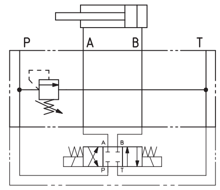
Options:
V = setting adjustment by handwheel instead of a grub screw protected by cap
Only for HMP:
R = reduced leakage for special applications
VF = regulating knob
VS = regulating knob with safety locking

Series number

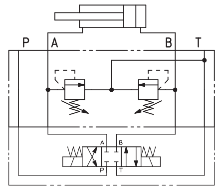
Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

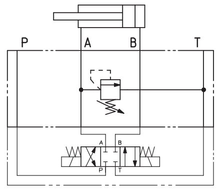
Hydraulic configuration



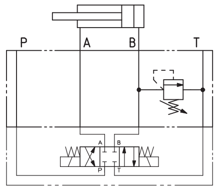
HMP-011
HM-011



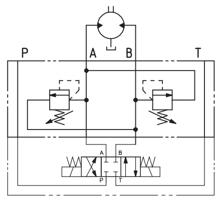
HMP-012
HM-012



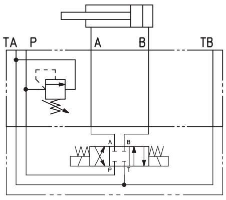
HMP-013
HM-013



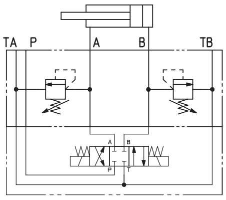
HMP-014
HM-014



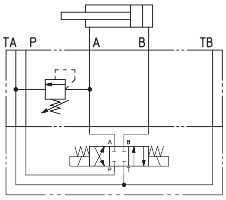
HMP-015
HM-015



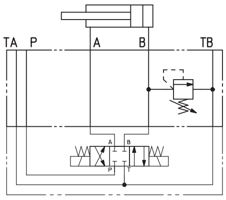
KM-011



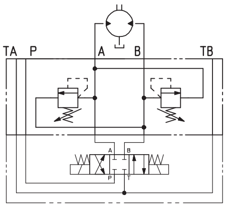
KM-012



KM-013



KM-014



KM-015

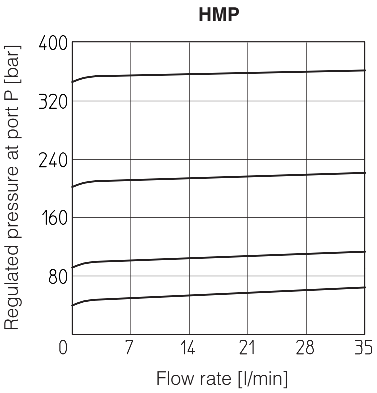
Valve model	**HMP**	**HM**	**KM**
Max flow [l/min]	35	60	120
Pressure range [bar]	2÷50; 3÷100; 10÷210; 15÷350	4÷50; 5÷100; 5÷210; 5÷350	

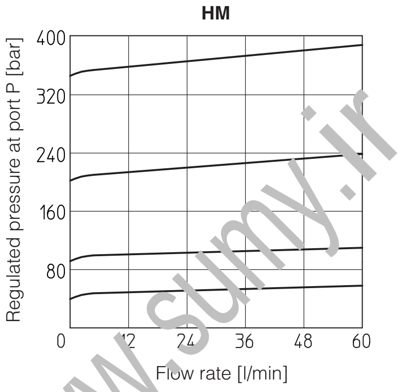
3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

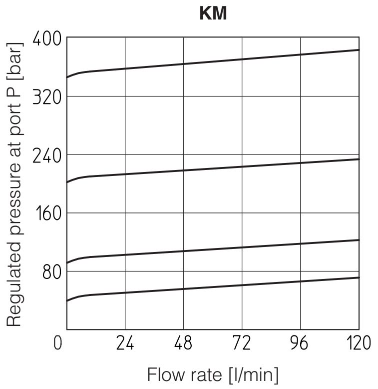
Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

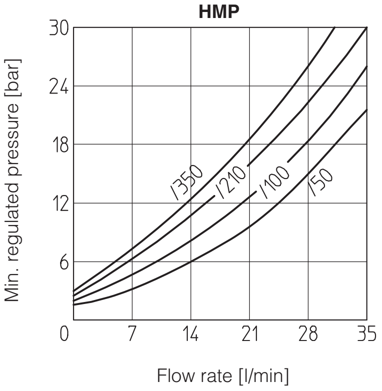
4 REGULATED PRESSURE VERSUS FLOW DIAGRAMS (Based on mineral oil ISO VG 46 at 50°C)

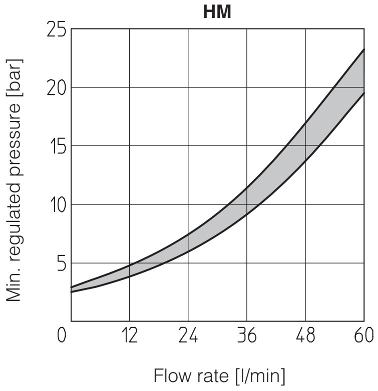


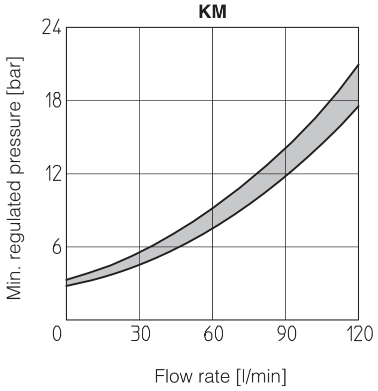




5 MINIMUM PRESSURE VERSUS FLOW DIAGRAMS (Based on fluid viscosity of 25 mm²/s at 40°C)

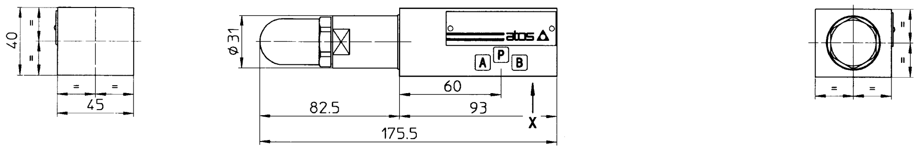






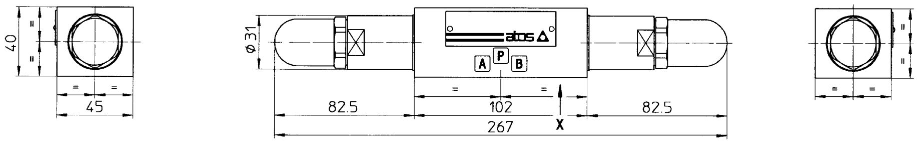
6 INSTALLATION DIMENSIONS OF HMP VALVES [mm]

HMP-011



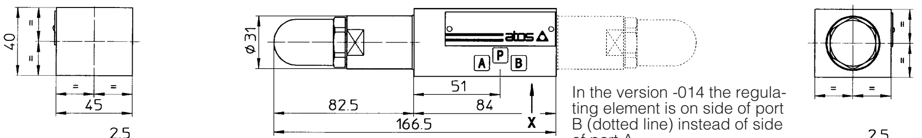
Mass: 1,4 Kg

HMP-012



Mass: 1,7 Kg

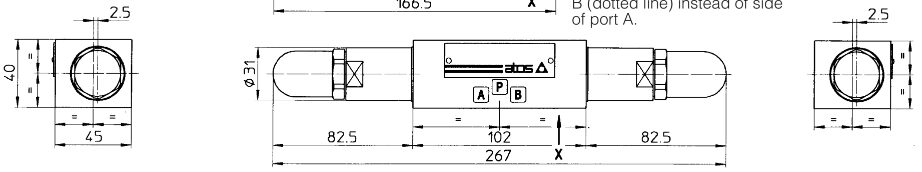
HMP-013
HMP-014



In the version -014 the regulating element is on side of port B (dotted line) instead of side of port A.

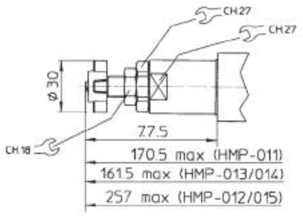
Mass: 1,2 Kg

HMP-015

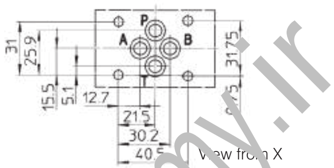


Mass: 1,7 Kg

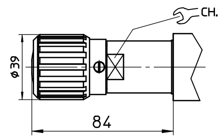
Adjustment device for option /V



ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108



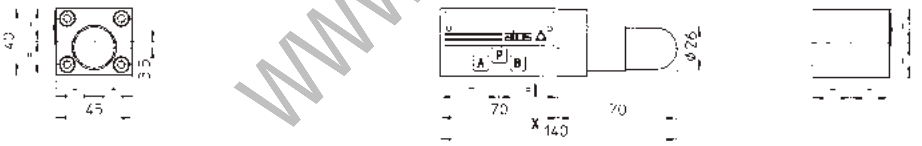
Adjustment device for option /VF and /VS



Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

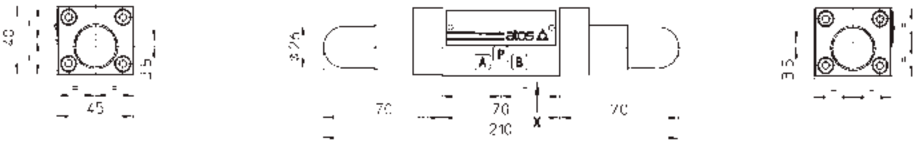
7 INSTALLATION DIMENSIONS OF HM VALVES [mm]

HM-011
HM-014



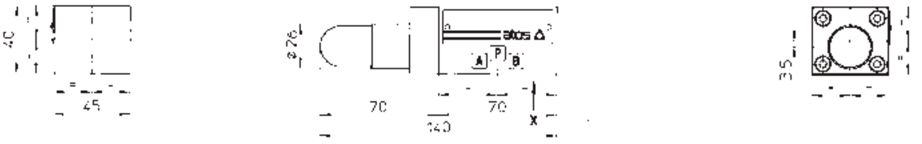
Mass: 1,1 Kg

HM-012
HM-015



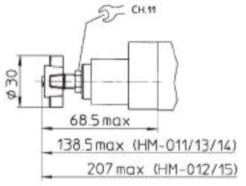
Mass: 1,3 Kg

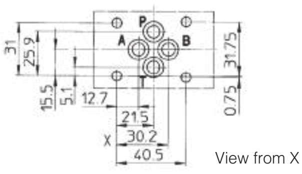
HM-013



Mass: 1,1 Kg

Adjustment device for option /V



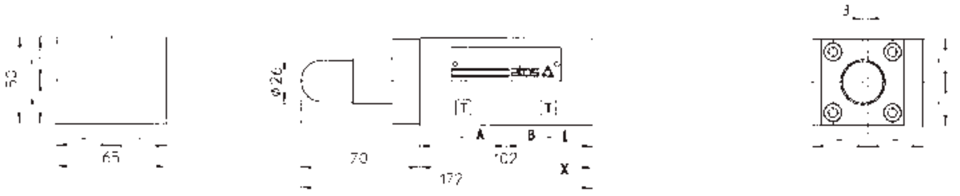


ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108

Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

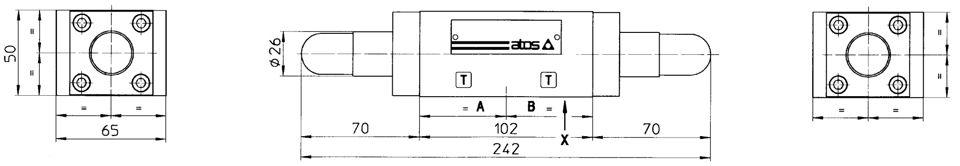
8 INSTALLATION DIMENSIONS OF KM VALVES [mm]

KM-011



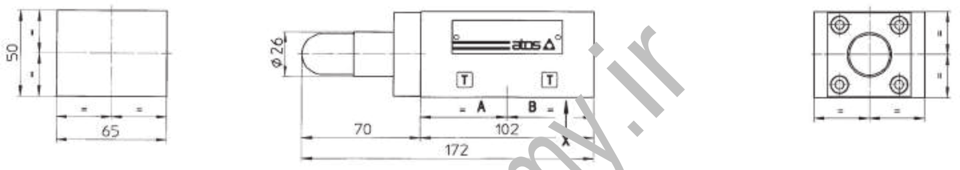
Mass: 2,5 Kg

KM-012



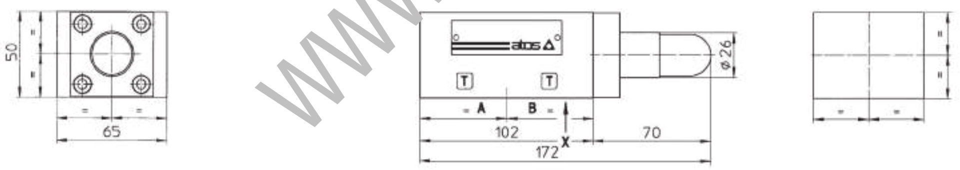
Mass: 2,8 Kg

KM-013



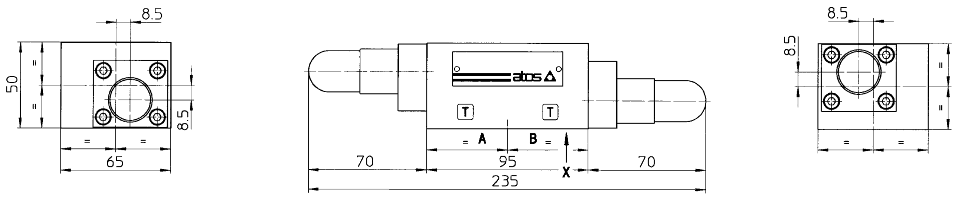
Mass: 2,5 Kg

KM-014



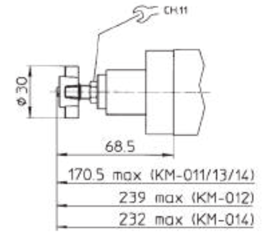
Mass: 2,5 Kg

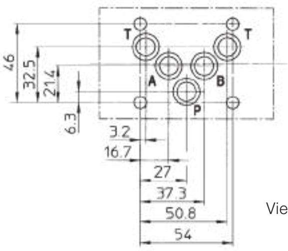
KM-015



Mass: 2,5 Kg

Adjustement device for option /V





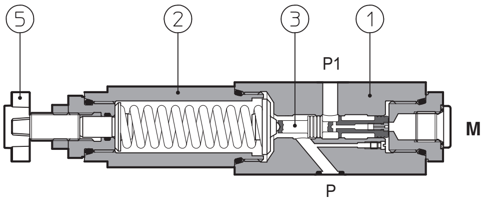
View from X

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports A, B, P, T: Ø = 11,2 mm
Seals: 5 OR 2050

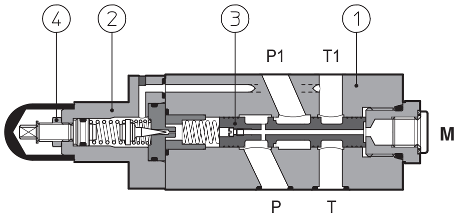
Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

Modular sequence valves type HS-011 and KS-011

spool type, ISO 4401 size 06 and 10



HS-011/*/V**



KS-011

HS are direct sequence valves, spool type ③.
KS are double stage ① ② sequence valves, spool type ③.

Pressure adjustment is operated by loosening the locking nut ④ and turning the setting screw in the normal model.
Optional versions with a handwheel ⑤ are available on request.
Clockwise rotation increases the pressure.

Valve size and max flow:

HS = size 06, flow up to 40 l/min
KS = size 10, flow up to 80 l/min

Mounting surface: **ISO 4401 size 06, 10**
Max pressure: **350 bar** (HS)
315 bar (KS)

1 MODEL CODE

HS - **011** / **210** / **V** ****** / *****

Modular sequence valve, size:
HS = 06
KS = 10

Configuration, see section 2
011 = single, acting on port P, drain to port T

Pressure range:

for HS:	**for KS:**
32 = 3 - 32 bar	
100= 20 - 100 bar	**100**= 7 - 100 bar
210= 50 - 210 bar	**210**= 8 - 210 bar

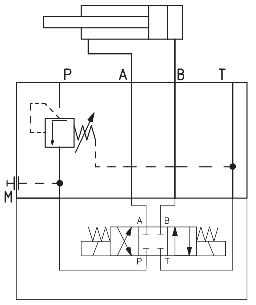
Options:
V = setting adjustment by handwheel instead of a grub screw protected by cap
Only for HS:
VF = regulating knob
VS = regulating knob with safety locking

Series number

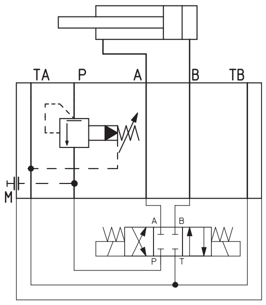
Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration



HS-011



KS-011

Valve model	**HS-011/32**	**HS-011/100**	**HS-011/210**	**KS-011/100**	**KS-011/210**
Max flow [l/min]	40			80	
Max drain [cm³/min]	50			50	
Pressure range [bar]	3 - 32	20 - 100	50 - 210	7 - 100	8 - 210
Max inlet pressure [bar]	350			315	
Max pressure on port T [bar]	160			160	

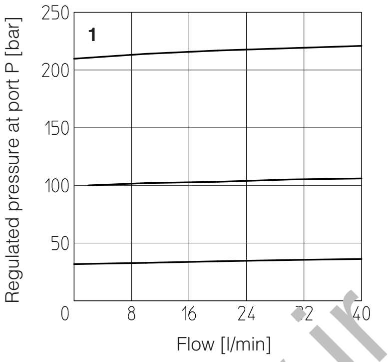
3 MAIN CHARACTERISTICS SEALS and HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

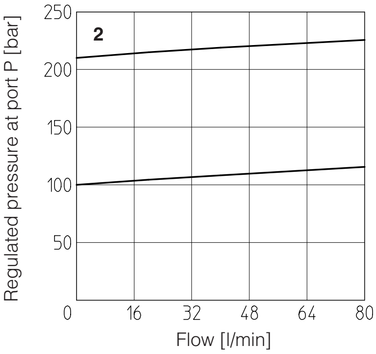
Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

4 REGULATED PRESSURE VERSUS FLOW DIAGRAMS based on mineral oil ISO VG 46 at 50°C

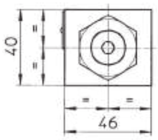
1 = HS
2 = KS

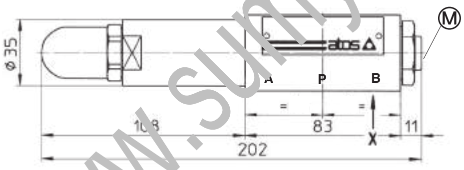


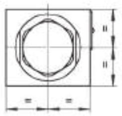


5 INSTALLATION DIMENSIONS [mm]

HS-011

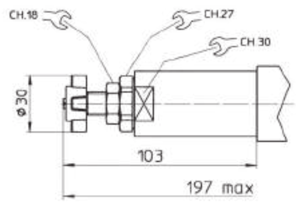




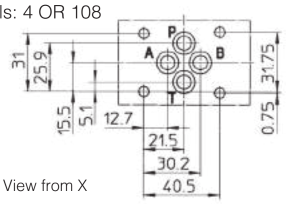


Ⓜ = Pressure gauge port = G 1/4”

Adjustment device for option/V

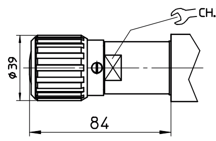


ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108



View from X

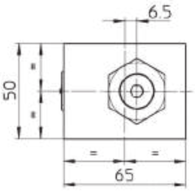
Adjustment device for option /VF and /VS

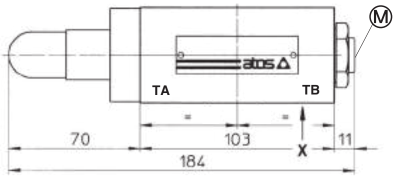


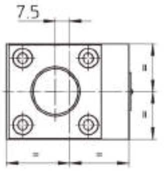
Fastening bolts: n°4 socket head screws M5. The lenght depends on number and type of modular elements associated.

Mass: 2 Kg

KS-011

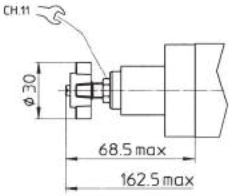


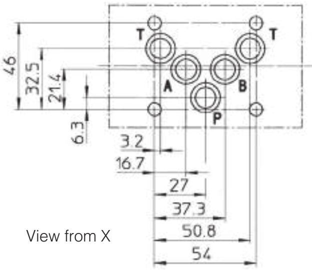




Ⓜ = Pressure gauge port = G 1/4”

Adjustment device for option/V





View from X

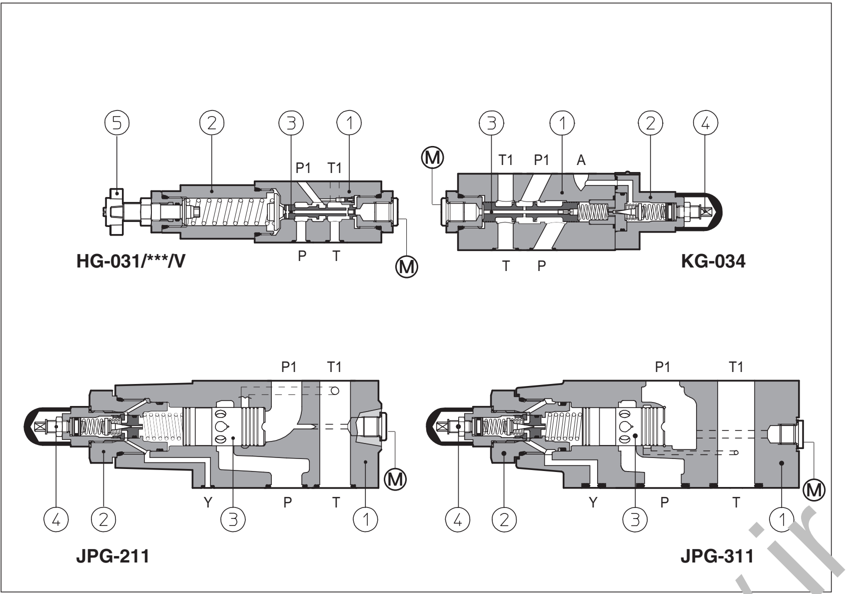
ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports A, B, P, T: Ø = 11,2 mm
Seals: 5 OR 2050

Fastening bolts: n°4 socket head screws M6. The lenght depends on number and type of modular elements associated.

Mass: 3 Kg

Modular reducing valves type HG, KG, JPG-2 and JPG-3

spool type, ISO 4401 sizes 06, 10, 16 and 25



HG, KG, JPG are pressure reducing valves, spool type ③, designed to operate in oil hydraulic systems.
HG are direct, three way valves;
KG are double stage ① ②, three way valves;
JPG are double stage ① ②, two way valves.
Clockwise rotation increases the pressure.

Valve size and max flow:

HG = size 06 flow up to 50 l/min;
KG = size 10 flow up to 100 l/min;
JPG-2 = size 16 flow up to 250 l/min;
JPG-3 = size 25 flow up to 300 l/min;

Mounting surface:
ISO 4401 size 06, 10, 16 and **25**

Max pressure: **350 bar** for HG
315 bar for KG and JPG

1 MODEL CODE

HG-0 **31** / **210** / **V** ** / *

Modular pressure reducing valve, size:
HG-0 = 06 **JPG-2** = 16
KG-0 = 10 **JPG-3** = 25

Configuration, see section 2
two way (**only for JPG**):
11 = reduced pressure on P port
three way (**only for HG-0 and KG-0**):
31 = reduced pressure on P port
33 = reduced pressure on A port
34 = reduced pressure on B port

Pressure range

	HG	KG	JPG
32 = 3 - 32 bar **50** = 2 - 50 bar **75** = 10 - 75 bar	**100** = 20 - 100 bar **210** = 50 - 210 bar	**100** = 7 - 100 bar **210** = 8 - 210 bar	**100** = 6 - 100 bar **210** = 70 - 210 bar

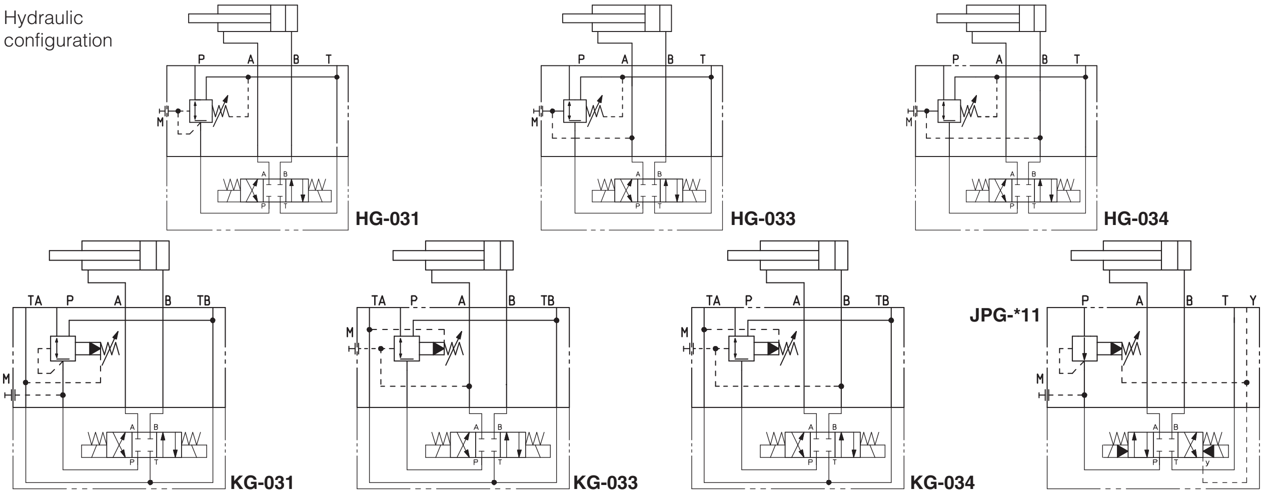
Options:
V = setting adjustment by handwheel instead of a grub screw protected by cap
Only for HG:
VF = regulating knob/**VS** = regulating knob with safety locking

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration



Valve model	HG-03*/32	HG-03*/50	HG-03*/75	HG-03*/100	HG-03*/210	KG-03*/100	KG-03*/210	JPG-211/100	JPG-211/210	JPG-311/100	JPG-311/210
Max flow [l/min]	50					100		250		300	
Pressure range [bar]	3 ÷ 32	2 ÷ 50	10 ÷ 75	20 ÷ 100	50 ÷ 210	7 ÷ 100	8 ÷ 210	6 ÷ 100	70 ÷ 210	6 ÷ 100	70 ÷ 210
Max inlet pressure [bar]	350					315		315		315	
Max pressure on port T [bar]	160					160		160		160	

3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

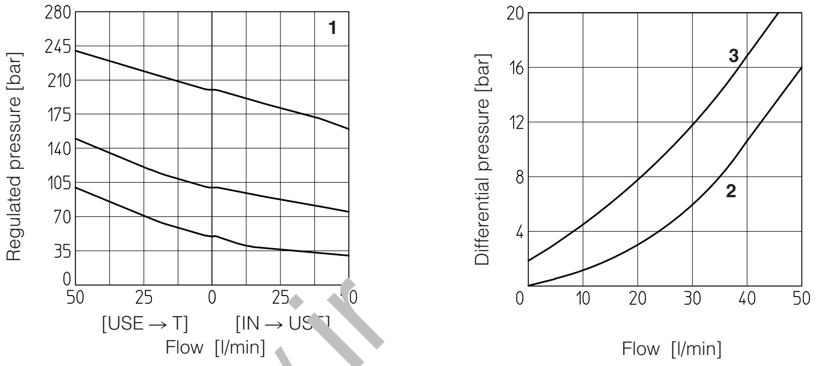
4 DIAGRAMS OF HG-03*

based on mineral oil ISO VG 46 at 50°C

1 = regulated pressure variation versus flow:
- between use port and discharge port
- between inlet port and use port

2 = differential pressure variation versus flow between inlet port and use port

3 = differential pressure variation versus flow between use port and discharge port



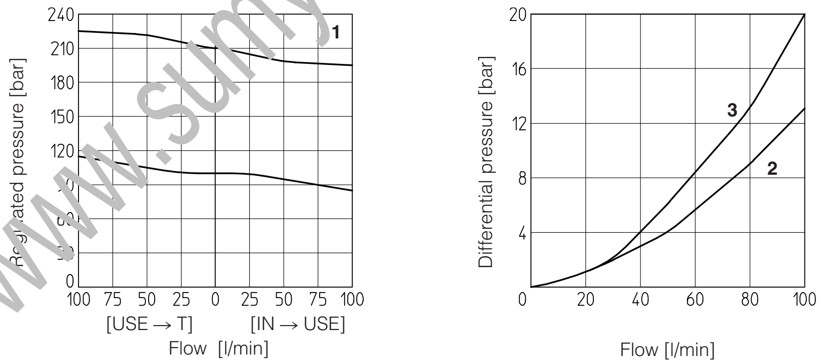
5 DIAGRAMS OF KG-03*

based on mineral oil ISO VG 46 at 50°C

1 = regulated pressure variation versus flow:
- between use port and discharge port
- between inlet port and use port

2 = differential pressure variation versus flow between inlet port and use port

3 = differential pressure variation versus flow between use port and discharge port

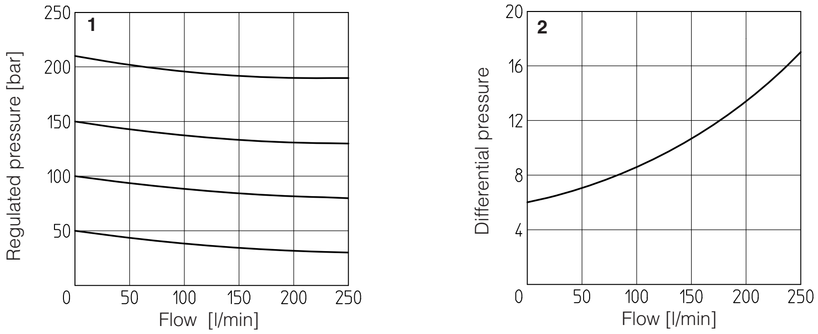


6 DIAGRAMS OF JPG-211

based on mineral oil ISO VG 46 at 50°C

1 = regulated pressure variation versus flow between inlet port and use port

2 = differential pressure variation versus flow between use port and discharge port

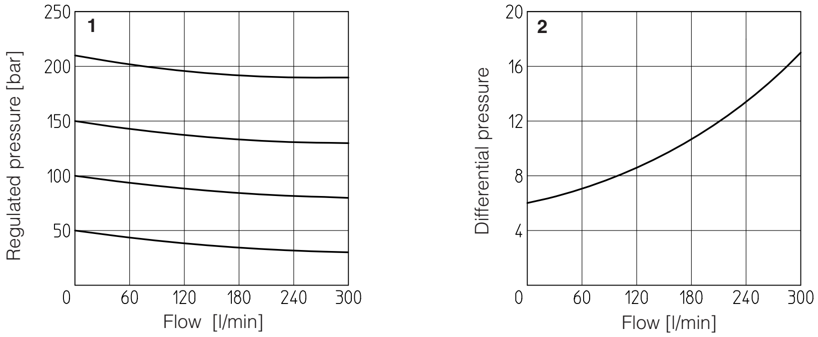


7 DIAGRAMS OF JPG-311

based on mineral oil ISO VG 46 at 50°C

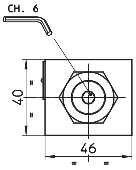
1 = regulated pressure variation versus flow between inlet port and use port

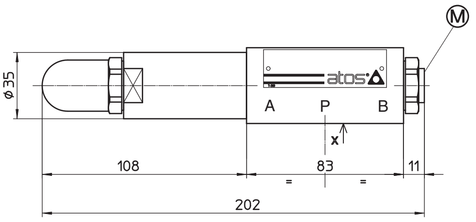
2 = differential pressure variation versus flow between use port and discharge port

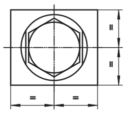


8 INSTALLATION DIMENSIONS OF HG-0 VALVES [mm]

HG-03*



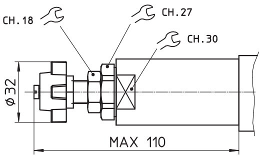




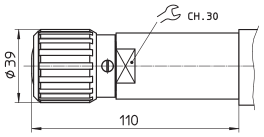
Ⓜ = Pressure gauge port = G 1/4"

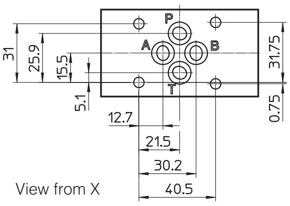
Mass: 2,3 Kg

Adjustment device for option /V



Adjustment device for option /VF and /VS





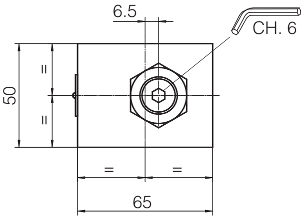
View from X

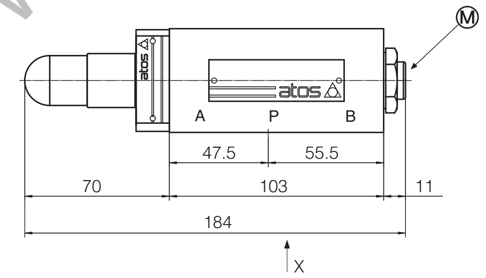
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108

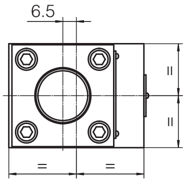
Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

9 INSTALLATION DIMENSIONS OF KG-0 VALVES [mm]

KG-03*



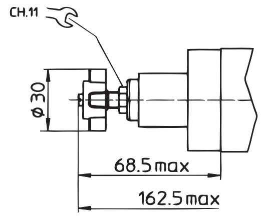


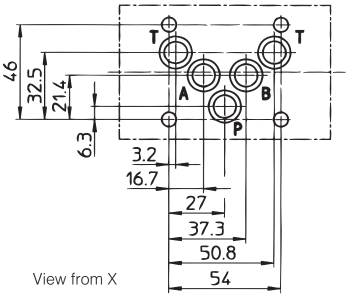


Ⓜ = Pressure gauge port = G 1/4"

Mass: 3,8 Kg

Adjustment device for option /V





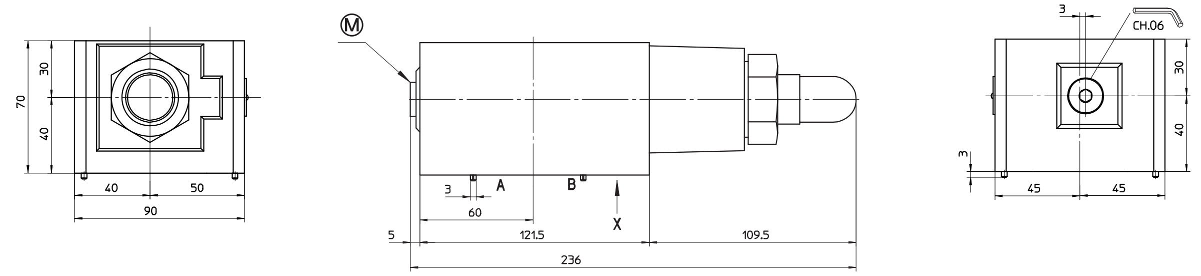
View from X

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports A, B, P, T: Ø = 11,2 mm
Seals: 5 OR 2050

Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

10 INSTALLATION DIMENSIONS OF JPG-2 VALVES [mm]

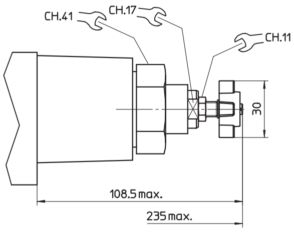
JPG-211

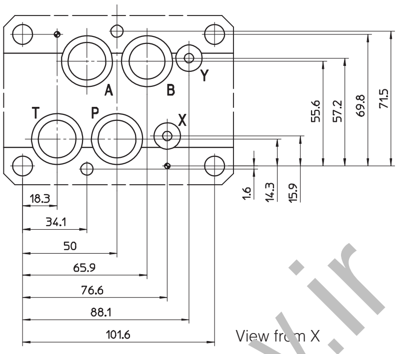


Ⓜ = Pressure gauge port = G 1/4”

Mass: 9 Kg

Adjustment device for option /V



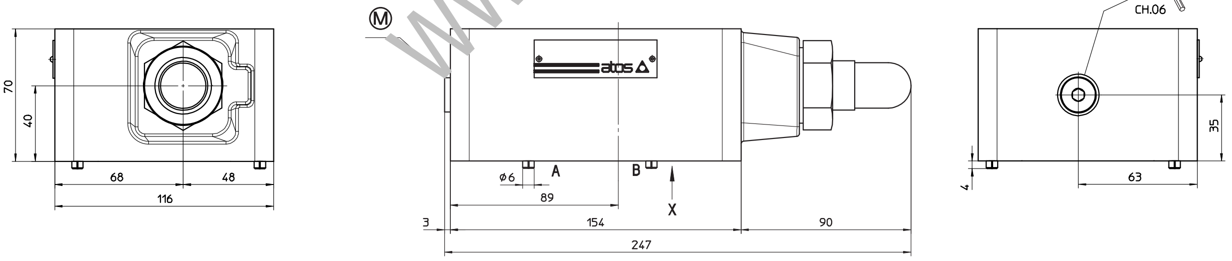


ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Diameter of ports A, B, P, T: Ø = 20 mm
Diameter of ports X, Y: Ø 7 mm
Seals: 4 OR 130: 2 OR 109

Fastening bolts: n° 4 socket head screws M10 and n° 2 M6. The lenght depends on number and type of modular elements associated.

11 INSTALLATION DIMENSIONS OF JPG-3 VALVES [mm]

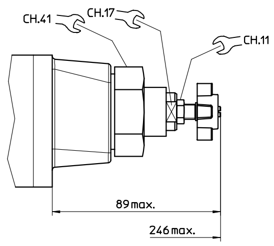
JPG-311

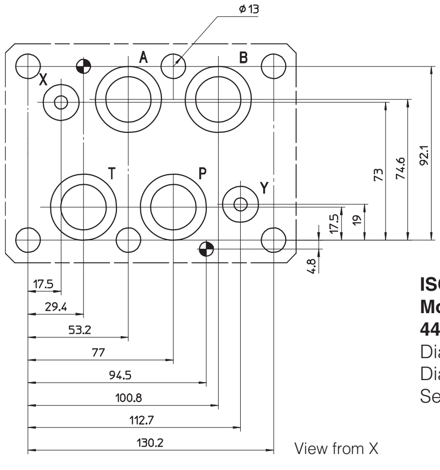


Ⓜ = Pressure gauge port = G 1/4”

Mass: 9 Kg

Adjustment device for option /V



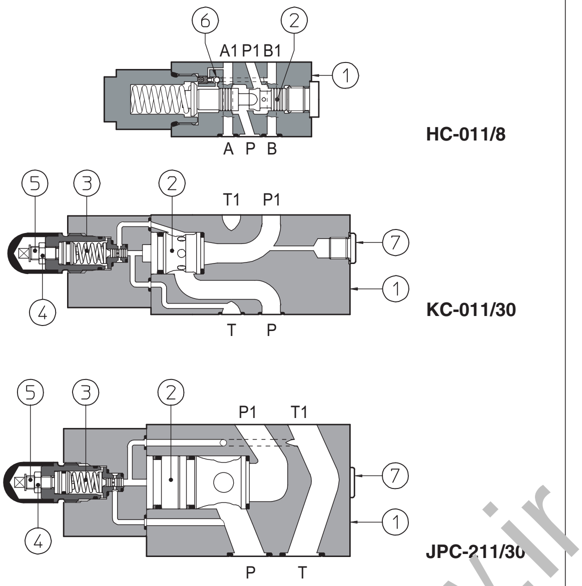


ISO 4401: 2005
Mounting surface:
4401-08-08-0-05 (without port L)
Diameter of ports A, B, P, T: Ø = 24 mm
Diameter of ports X, Y: Ø 7 mm
Seals: 4 OR 4112: 2 OR 3056

Fastening bolts: n° 6 socket head screws M12. The lenght depends on number and type of modular elements associated.

Modular pressure compensators type HC, KC, and JPC-2

ISO 4401 sizes 06, 10 and 16



① body
② poppet of main stage
③ pilot stage
④ locking nut
⑤ setting screw
⑥ check valve
⑦ pressure gauge port

HC, **KC** and **JPC** are two way pressure compensators for modular assembling with on/off and proportional directional control valves.

They keep a constant differential pressure (Δp) across port P and port A or B in order to maintain a constant flow rate against pressure variations. Automatic piloting selection ⑥ is included.

Fixed Δp is available only for size 06. Adjustment of desired Δp is operated by loosening the locking nut ④ and turning the setting screw ⑤ of pilot device.
Clockwise rotation increases Δp.

HC = size 06, flow up to 50 l/min.
KC = size 10, flow up to 100 l/min.
JPC = size 16, flow up to 200 l/min.

Mounting surface:
ISO 4401 size 06, 10, 16

Max pressure: **350 bar**

1 MODEL CODE

HC-0 - **11** **30** / **M** ** / *

Modular pressure compensator, size:
HC-0 = 06
KC-0 = 10 **(1)**
JPC-2 = 16

Configuration, see section 2:
11 = two way execution with constant Δp beetween P port and user port

Fixed Δp (only for size 06):
8 = 8 bar

Adjustable Δp (for all sizes):
30 = 5 - 35 bar

Option (only for HC-011/30)
M = fit for manometer port P1

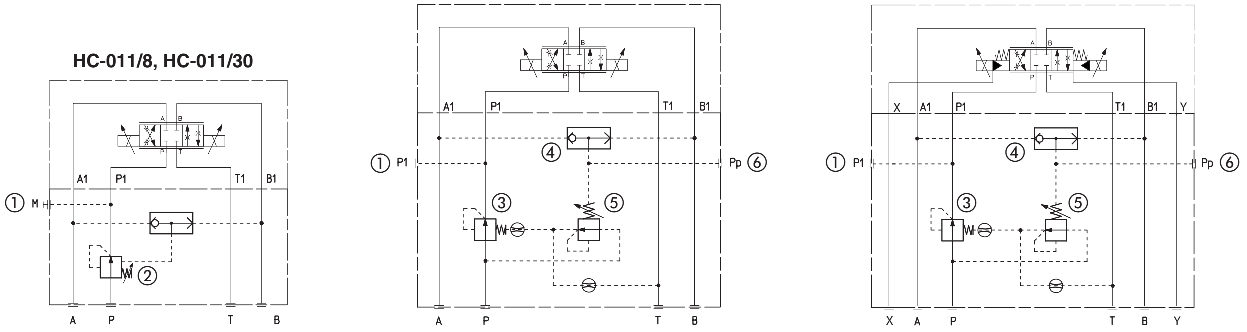
Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

(1) To be used only with direct valve type DKZOR

2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration



① Pressure gauge port (not for HC-011/8)
② Settable (not for HC-011/8)
③ Two way compensator
④ Piloting selection
⑤ Adjustment of Δp on pilot device
⑥ Pilot port Pp

Valve model		HC-011/8	HC-011/30	KC-011/30	JPC-211/30
Max flow	[l/min]	50		100	200
Max inlet pressure	[bar]	350			
Regulating Δp (1)	[bar]	8	5 - 35	5 - 35	

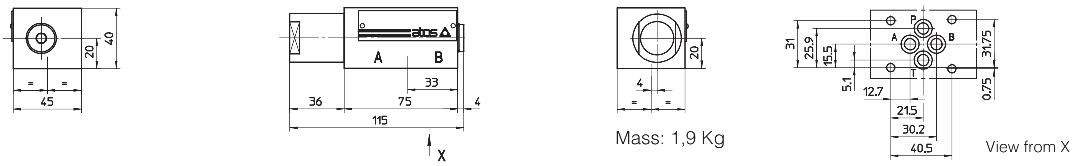
(1) The Δp for single flow path is fixed at 8 bar or is adjustable between 5 and 35 bar; it corresponds to values of total Δp across the valve of 16 bar or between 10 and 70 bar. Threaded plugged ports Pp and P1 are suitable for pressure adjustment or check of Δp value for single flow path (reading difference between Pp and P1 values).

3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
Compliance	RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

4 INSTALLATION DIMENSIONS [mm]

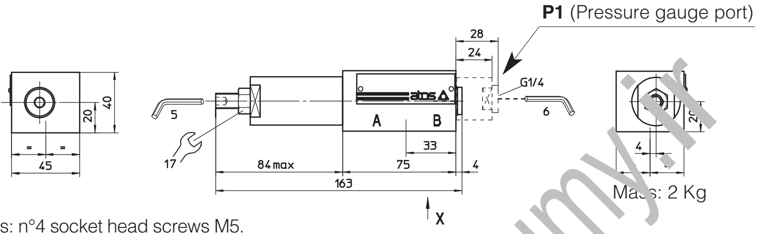
HC-011/8



Mass: 1,9 Kg

View from X

HC-011/30



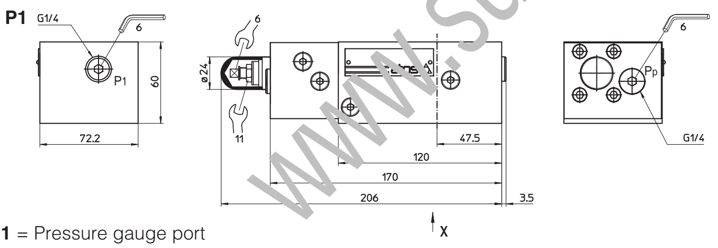
P1 (Pressure gauge port)

Mass: 2 Kg

Fastening bolts: n°4 socket head screws M5.
The lenght depends on number and type of modular elements associated.

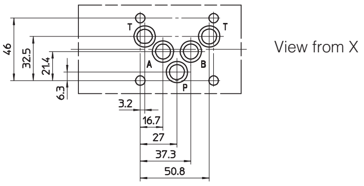
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports
A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

KC



Mass: 4,2 Kg

P1 = Pressure gauge port

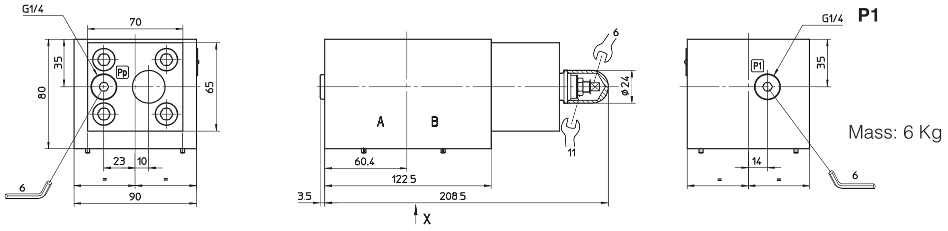


View from X

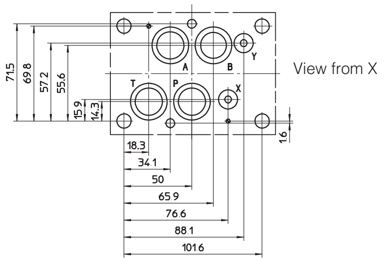
Fastening bolts: n°4 socket head screws M6.
The lenght depends on number and type of modular elements associated.

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports
A, B, P, T: Ø = 11,2 mm (max)
Seals: 2 OR 108, 5 OR 2050

JPC



Mass: 6 Kg



View from X

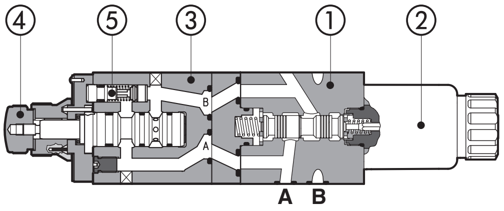
P1 = Pressure gauge port

Fastening bolts:
n°4 socket head screws M10 and n°2 M6.
The lenght depends on number and type
of modular elements associated.

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Diameter of ports
A, B, P, T: Ø = 20 mm
Diameter of ports X, Y: Ø = 7 mm
Seals: 4 OR 130; 2 OR 109

Modular fast/slow valves type DHQ

compensated flow control and by-pass solenoid valve, ISO 4401 size 06



DHQ-013/*-EX*

① by-pass solenoid valve for fast/slow speed switching
② solenoid coil
③ 2 way pressure compensated flow valve for slow speed regulation
④ graduated knob for flow adjustment
⑤ check valve for free reverse flow

DHQ are modular valves for fast/slow speed control of hydraulic actuators.

They combine a pressure compensated flow control valve ③ type QV-06 (Tab. C210) for the slow speed regulation and a solenoid operated by-pass valve ① for the fast/slow speed switching.

Depending on execution **C** or **O**, the low speed is performed with solenoid de-energized or energized.

The low speed regulation is obtained by turning the graduated micrometer knob ④ of flow control valve. Clockwise rotation decreases the flow Optional versions with locking key on the adjustment knob are available on request.

The flow control valve is provided with a built-in check valve ⑤ to allow the free flow in the opposite direction.

Mounting surface: **ISO 4401 size 06**
Max controlled flow: up to **1,5-6-11-16-24 l/min**
Free flow up to **40 l/min**.
Max pressure: up to **250 bar**

1 MODEL CODE

DHQ-0 13 / C / 6 / K - E X 24DC ** / *

DHQ-0: Modular flow control valve, pressure compensated

Configuration, see section 2
meter OUT control:
13 = on port A
14 = on port B
16 = on port T
meter IN control:
11 = on port P
23 = on port A
24 = on port B

Execution
C = flow controlled when solenoid is de-energized
O = flow controlled when solenoid is energized

Maximum adjustable flow (low speed)
00 = without flow control valve
1 = 1,5 l/min; **6** = 6 l/min; **11** = 11 l/min;
16 = 16 l/min; **24** = 24 l/min;

Options:
K = with lock key for the setting knob
V = without by-pass check valve

Type of solenoid:
E = solenoid OE for AC and DC supply with **cURus** certification

00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector
See section 10 for available connectors, to be ordered separately
Coils with special connectors, see section 11
XJ = AMP Junior Timer connector
XK = Deutsch connector
XS = Lead Wire connection

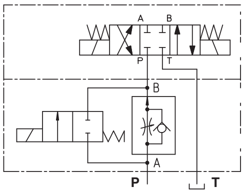
Voltage code, see section 7

Series number

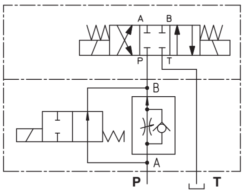
Seals material, see section 5:
- = NBR
PE = FKM
BT = HNBR

2 CONFIGURATIONS

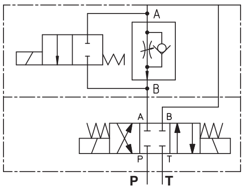
DHQ-11/C



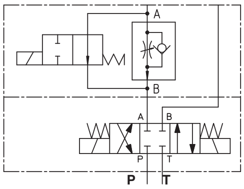
DHQ-11/O



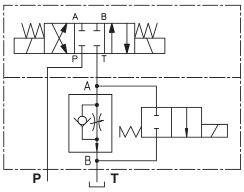
DHQ-13/C



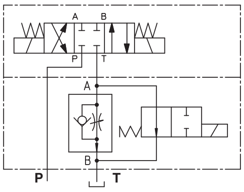
DHQ-13/O



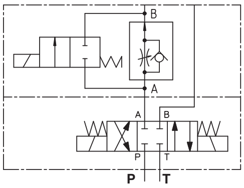
DHQ-16/C



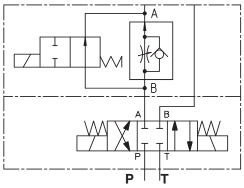
DHQ-16/O



DHQ-23/C



DHQ-23/O



DHQ-014/*, DHQ-024/* are similar to corresponding DHQ-013/*, DHQ-023/* but control the flow through port B of solenoid valve

3 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra 0,4 - flatness ratio 0,01/100
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Surface protection	Body: zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

4 HYDRAULIC CHARACTERISTICS

Valve model	**/1**	**/6**	**/11**	**/16**	**/24**
Max regulated flow [l/min]	1,5	6	11	16	24
Min regulated flow [cm³/min]	50	50	50	50	50
Regulating Δp [bar]	3	3	5	6,5	8
Max reverse flow through check valve [l/min]	24				
Max free flow through by-pass valve [l/min]	40				
Max pressure [bar]	250				

5 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

6 ELECTRICAL CHARACTERISTICS

Insulation class	**H** (180°C) for DC coils; **F** (155°C) for AC coils Due to the occurring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See section 7
Supply voltage tolerance	± 10%

7 COIL VOLTAGE

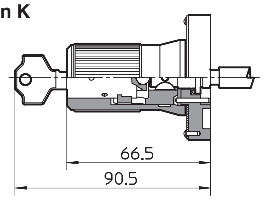
External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil DHE
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
24/50 AC	**24/50/60 AC**		58 VA (3)	COE-24/50/60AC (1)
48/50 AC	**48/50/60 AC**			COE-48/50/60AC (1)
110/50 AC	**110/50/60 AC**			COE-110/50/60AC (1)
230/50 AC	**230/50/60 AC**			COE-230/50/60AC (1)
115/50 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/60 AC**			COE-230/60AC
110/50 AC - 120/60 AC	**110 RC**	669	30 W	COE-110RC
230/50 AC - 230/60 AC	**230 RC**			COE-230RC

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷15% and the power consumption is 52 VA.
(2) Average values based on tests preformed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

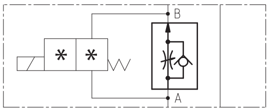
8 OPTIONS

K = lock key for the setting knob
V = without by-pass check valve

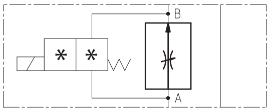
option K



standard version

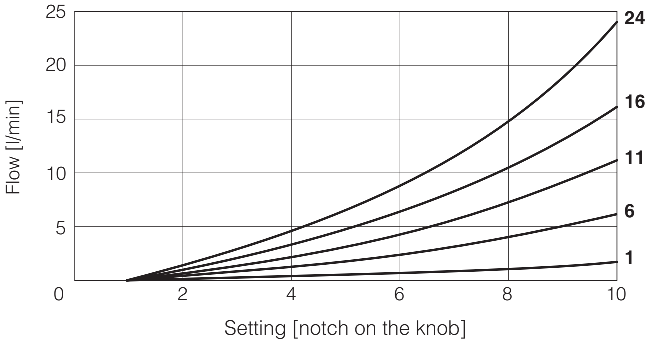


option /V



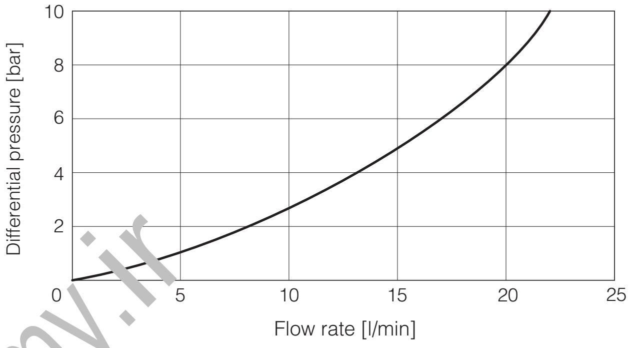
9 DIAGRAMS based on mineral oil ISO VG 46 at 50°C

9.1 Flow regulation diagram (low speed)

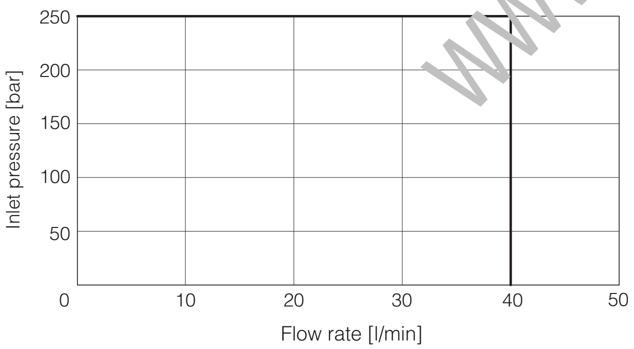


1 = DHQ-0*/*/1 **6** = DHQ-0*/*/6 **11** = DHQ-0*/*/11
16= DHQ-0*/*/16 **24** = DHQ-0*/*/24

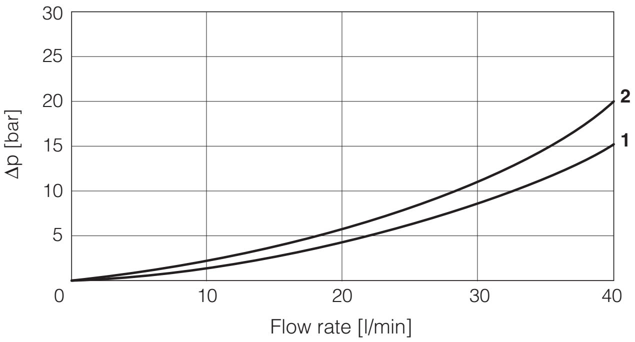
9.2 Q/Δp diagram through the check valve for reverse free flow



9.3 Operating limits of by-pass solenoid valve



9.4 Q/Δp diagram through the by-pass solenoid valve



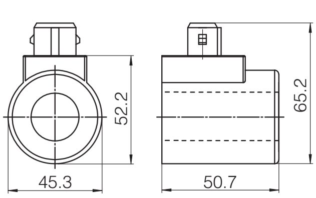
1 = DHQ-013, DHQ-014
2 = DHQ-011, DHQ-016, DHQ-023, DHQ-024

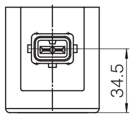
10 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (to be ordered separately, see tech table K500)

666 = standard connector IP-65, suitable for direct connection to electric supply source
667 = as 666, but with built-in signal led. Available for power supply voltage 24 AC or DC, 110 AC or DC, 220 AC or DC
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A)

11 COIL WITH SPECIAL CONNECTORS only for voltage supply 12, 14, 24, 28 VDC

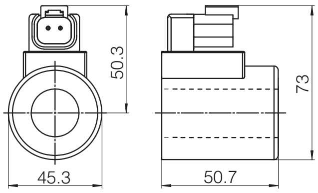
AMP Junior timer connector

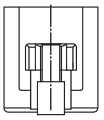




Options -XJ
Coil type COEJ
AMP Junior Timer connector
Protection degree **IP67**

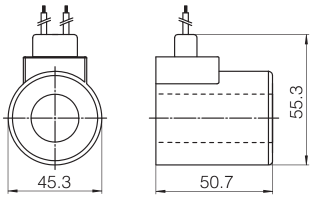
Deutsch connector DT-04-2P

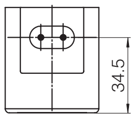




Options -XK
Coil type COEK
Deutsch connector
DT-04-2P male
Protection degree **IP67**

Lead Wire connection





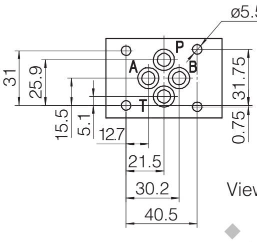
Options -XS
Coil type COES
Lead Wire connection
Cable length = 180 mm

Note: for the electric characteristics refer to standard coils features - see section 7

12 INSTALLATION DIMENSIONS [mm]

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports P, A, B, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

Fastening bolts: 4 socket head screws M5.
The length depends on number and type
of modular elements associated

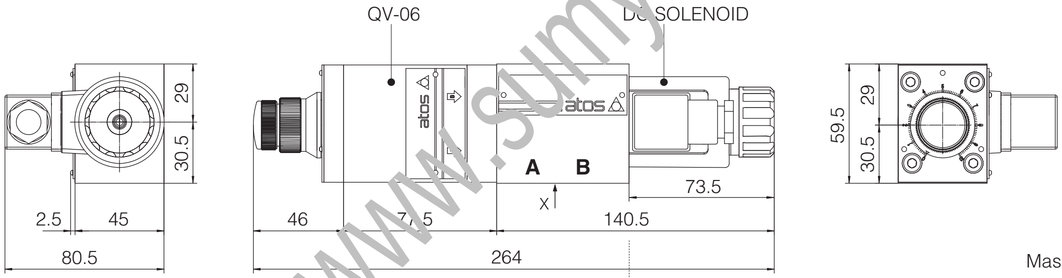


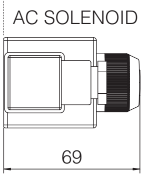
View from X

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

DHQ-011/*-EX
DHQ-016/*-EX

DHQ-013/*-EX
DHQ-023/*-EX

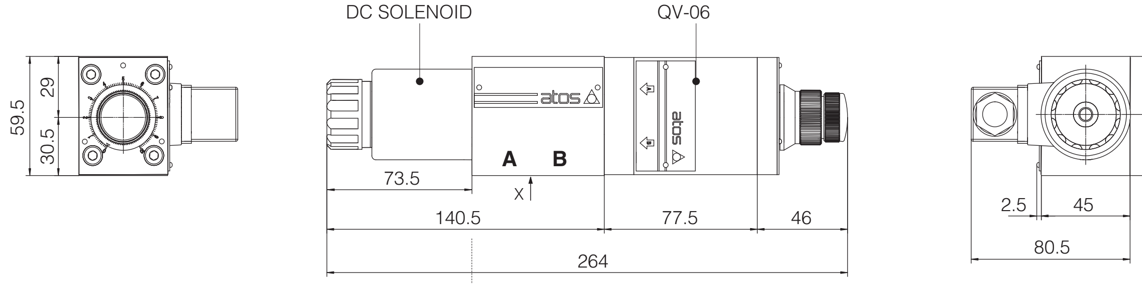


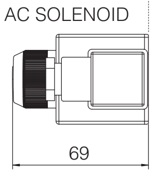


Mass: 2,5 kg

DHQ-014/*-EX

DHQ-024/*-EX





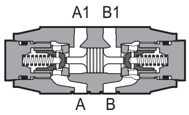
Mass: 2,5 kg

Overall dimensions refer to valves with connectors type 666

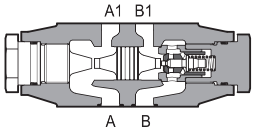
Modular check valves type HR, KR, JPR

direct or pilot operated, ISO 4401 sizes 06, 10, 16 and 25

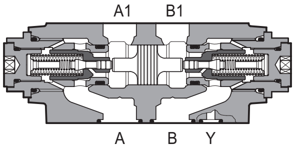
HR-012



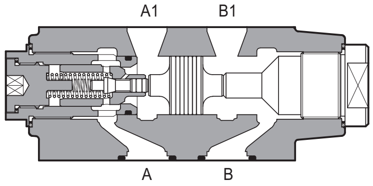
KR-014/D



JPR-212



JPR-313



HR, KR are check valves available as direct or pilot operated models.
JPR are pilot operated check valves.

Optional versions with decompression are available on request for some models of KR.

HR-0 = size 06: flow up to 60 l/min, pressure up to 350 bar.

KR-0 = size 10: flow up to 120 l/min, pressure up to 315 bar.

JPR-2 = size 16: flow up to 200 l/min, pressure up to 350 bar.

JPR-3 = size 25: flow up to 300 l/min, pressure up to 350 bar.

Valves are designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

1 MODEL CODE

HR-0	**12**	/	4	/	*	**	/	*

Modular check valve, size:
HR-0 = 06 **JPR-2** = 16
KR-0 = 10 **JPR-3** = 25

Configuration, see section 2
direct operated (only for HR and KR):
02 = double, acting on port A and B
03 = single, acting on port A
04 = single, acting on port B
11 = single, acting on port P
16 = single, acting on port T

pilot operated:
12 = double, acting on port A and B
13 = single, acting on port A
14 = single, acting on port B

Series number

Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

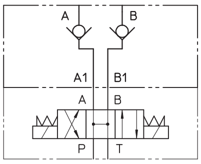
Options (only for KR-012, -013, -014):
D = with decompression (only with cracking pressure standard = 1 bar)

Spring cracking pressure:
for HR and KR
– = 0,5 bar (std.) **4** = 4 bar
2 = 2 bar **8** = 8 bar

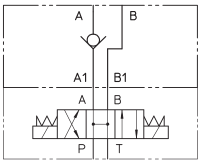
for JPR
– = 0,5 bar (std)

2 VALVE CONFIGURATION

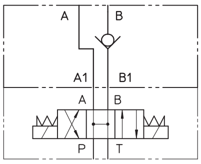
HR-002
KR-002

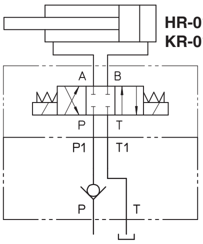


HR-003
KR-003

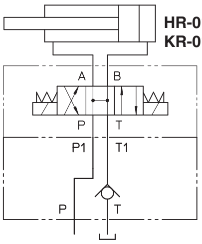


HR-004
KR-004



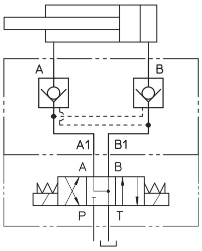


HR-011
KR-011

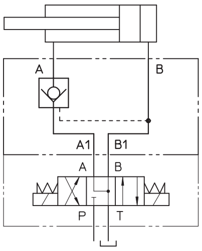


HR-016
KR-016

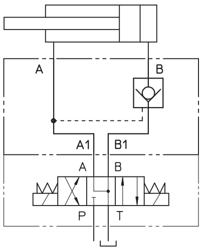
HR-012
KR-012
JPR-212
JPR-312



HR-013
KR-013
JPR-213
JPR-313



HR-014
KR-014
JPR-214
JPR-314



The pilote pressure applied through ports A or B opens the valve acting on ports B and A, respectively.
The minimum pilot pressure is a function of the area ratio, see the following table.

VALVE TYPE	AREA RATIO
HR	3,3:1
KR	3,3:1 (standard); 11:1 (option /D decompression system)
JPR-2	13,6:1 (standard version equipped with decompression system)
JPR-3	17:1 (standard version equipped with decompression system)

3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

4 DIAGRAMS OF HR-0

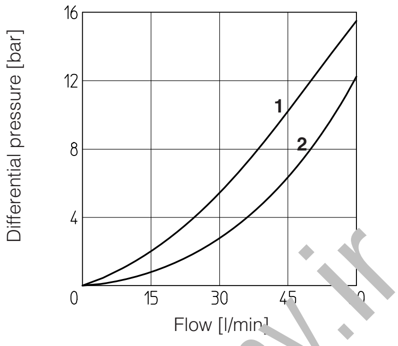
based on mineral oil ISO VG 46 at 50°C

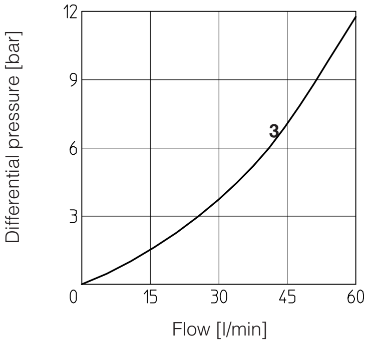
Flow through check valve:

1 = A→A1; B→B1 of HR-012, HR-013, HR-014

2 = A1→A; B1→B of HR-012, HR-013, HR-014

3 = HR-011, HR-016





5 DIAGRAMS OF KR-0

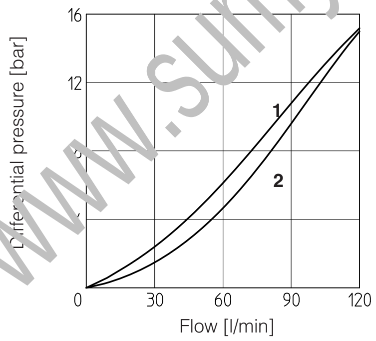
based on mineral oil ISO VG 46 at 50°C

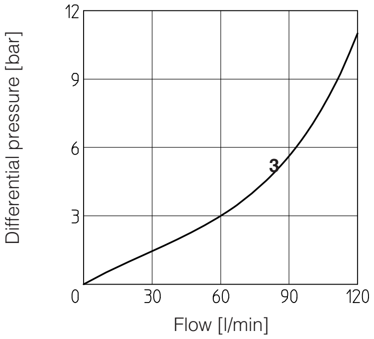
Flow through check valve:

1 = A→A1; B→B1 of KR-012, KR-013, KR-014

2 = A1→A; B1→B of KR-012, KR-013, KR-014

3 = KR-011, KR-016





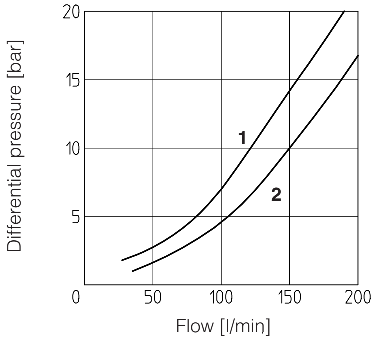
6 DIAGRAMS OF JPR-2

based on mineral oil ISO VG 46 at 50°C

Flow through check valve:

1 = A→A1; B→B1 of JPR-212, JPR-213, JPR-214

2 = A1→A; B1→B of JPR-212, JPR-213, JPR-214



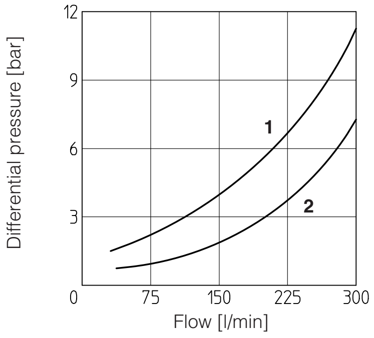
7 DIAGRAMS OF JPR-3

based on mineral oil ISO VG 46 at 50°C

Flow through check valve:

1 = A→A1; B→B1 of JPR-312, JPR-313, JPR-314

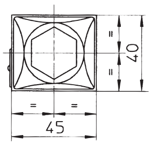
2 = A1→A; B1→B of JPR-312, JPR-313, JPR-314

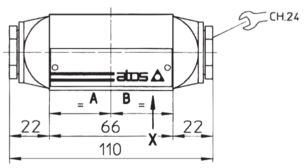


8 INSTALLATION DIMENSIONS OF HR-0 VALVES [mm]

HR-002
HR-003
HR-004
HR-012
HR-013
HR-014

LATERAL VIEW

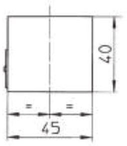


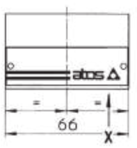


Mass: 1 Kg

HR-011
HR-016

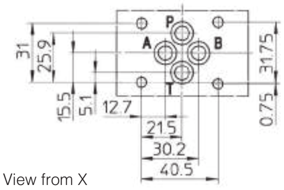
LATERAL VIEW





Mass: 0,7 Kg

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108



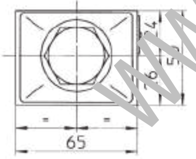
View from X

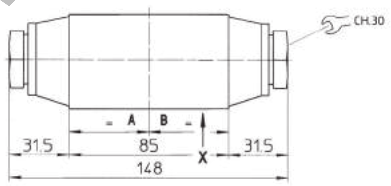
Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

9 INSTALLATION DIMENSIONS OF KR-0 VALVES [mm]

KR-012
KR-002
KR-003
KR-004
KR-013
KR-014

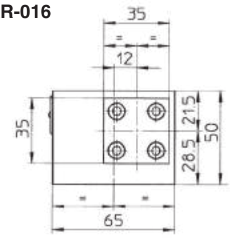
LATERAL VIEW



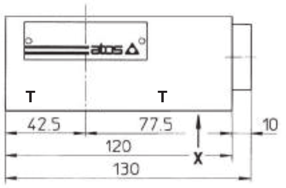


Massa: 2,3 Kg

KR-016



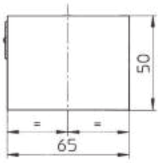
LATERAL VIEW

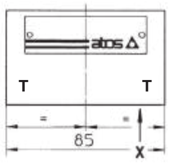


Mass: 2,5 Kg

KR-011

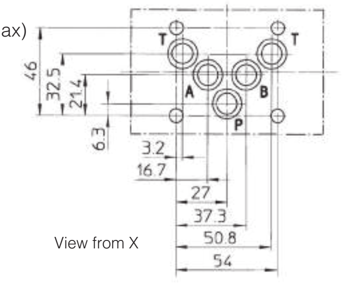
LATERAL VIEW





Mass: 1,7 Kg

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports, A, B, P, T: Ø = 11,2 mm (max)
Seals: 5 OR 2050



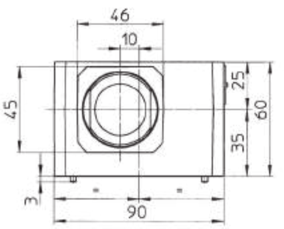
View from X

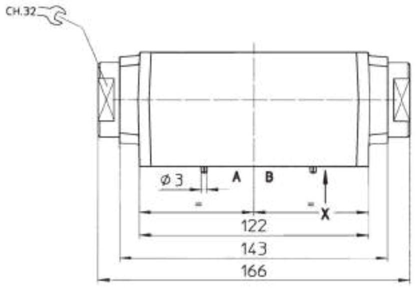
Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

10 INSTALLATION DIMENSIONS OF JPR-2 VALVES [mm]

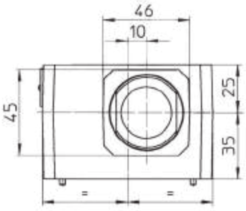
JPR-212
JPR-213
JPR-214

LATERAL VIEW



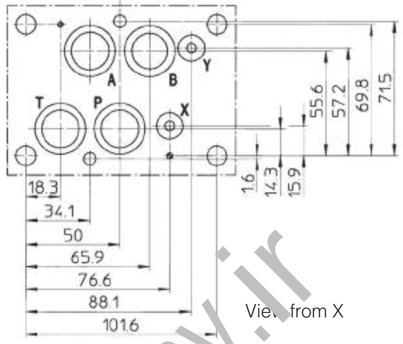


LATERAL VIEW



Mass: 4,4 Kg

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Diameter of ports A, B, P, T: Ø = 20 mm
Diameter of ports X, Y: Ø = 7 mm
Seals: 4 OR 130; 2 OR 109



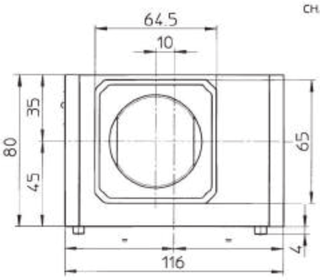
View from X

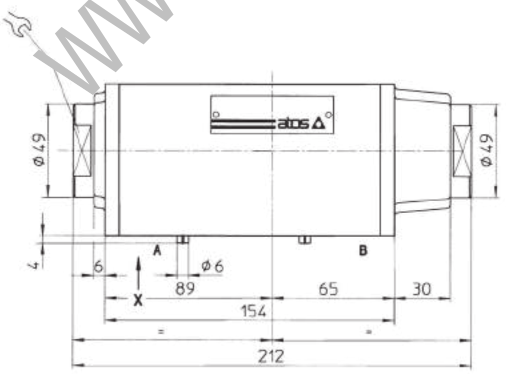
Fastening bolts: n° 4 socket head screws M10 and n° 2 M6. The lenght depends on number and type of modular elements associated.

11 INSTALLATION DIMENSIONS OF JPR-3 VALVES [mm]

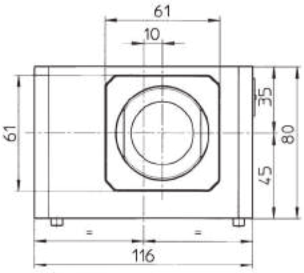
JPR-312
JPR-313
JPR-314

LATERAL VIEW B



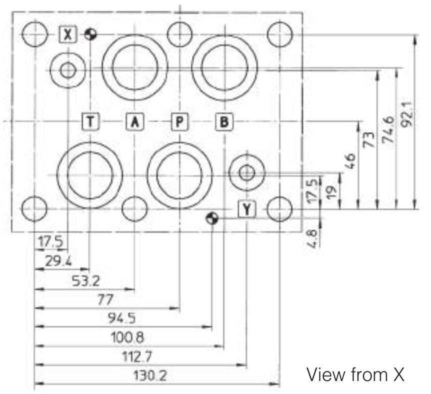


LATERAL VIEW A



Mass: 9,9 Kg

ISO 4401: 2005
Mounting surface: 4401-08-08-0-05
Diameter of ports A, B, P, T: Ø = 24 mm
Diameter of ports X, Y: Ø = 7 mm
Seals: 4 OR 4112; 2 OR 3056



View from X

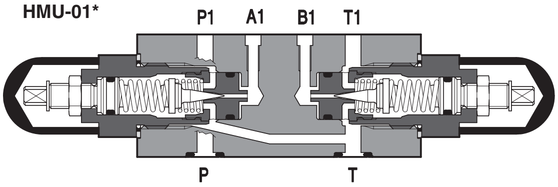
Fastening bolts: n° 6 socket head screws M12. The lenght depends on number and type of modular elements associated.

Modular valves HMU, RR-3/* and plates type HJ-012

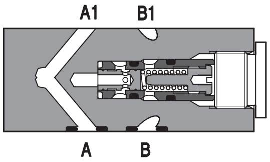
pressure relief, pressure reducing, pressure compensator, modular plate for cartridge valves

Availablility and price only on request

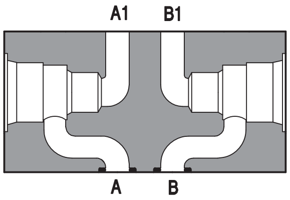
HMU-01*



RR-3/*



HJ-012



HMU-01 are pressure relief valves in modular execution with ISO4401 size 06 mounting surface, specific for fine pressure control at low flow.
They are mainly used for piloting lines and as pilot stage for AGAM and ARAM pressure relief valves.

RR-3/* are 2 way pressure reducing valves in modular execution with ISO4401size 06 mounting surface, specific for piloting lines.
The reduced pressure has a fixed setting correspondent to the load value of the regulation spring.
The standard setting is 30 bar, available optional settings 7, 14, 24 bar
They are mainly used on DPZO proportional valves to ensure a stable reduced pressure to the pilot valve.

HJ-012 is a modular plate with ISO4401size 06 mounting surface, predisposed for the installation on A and B lines of cartridge valves type JO-DL-4-2 (see KT, tab. E105)
In modular combination with directional valves they are used to intercept the A and B user lines and thus prevent the undesired movement of the actuator.

1 MODEL CODE of HMU pressure relief valve

HMU	-	011	/	210	/V	**	/*

HMU Modular pressure relief valve

Configuration, see section 2
011 = single; acting on port P, dicharge to port T
012 = double, acting on ports A and B, discharge to port T
013 = single, acting on port A, discharge to port T
014 = single, acting on port B, discharge to port T

Pressure range
50 = 2÷ 50 bar
210 = 10÷210 bar
100 = 3÷100 bar
350 = 15÷350 bar

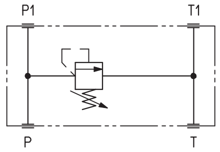
Options:
/V = setting adjustment by handwheel instead of a grub screw protected by cap

Series number

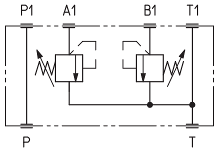
Seals material
- = NBR
PE = FKM

2 HYDRAULIC CHARACTERISTICS of HMU pressure relief valve

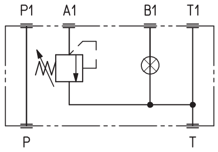
HMU-011/***



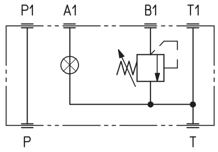
HMU-012/***



HMU-013/***



HMU-014/***



Setting	[bar]	/50	/100	/210	/350
Pressure range	[bar]	2÷50	3÷100	7÷210	8÷350
Max flow	[l/min]	2,5			

3 MODEL CODE of RR pressure reducing valve

RR - 3 / * ** /*

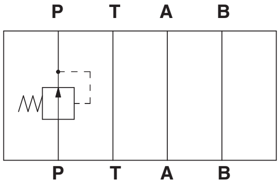
Modular
pressure reducing valve

Pressure setting:
- = omit for 30 bar
7 = 7 bar
14 = 14 bar
24 = 24 bar

Series number

Seals material
- = NBR
PE = FKM

4 HYDRAULIC CHARACTERISTICS of RR pressure reducing valve



Valve model	RR-3	RR-3/7	RR-3/14	RR-3/24
Reduced pressure [bar]	30	7	14	24
Max pressure [bar]	350			
Max flow [l/min]	4			

5 MODEL CODE of HJ modular plate

HJ - **012** ** /*

Modular plate

Predisposed for JO-DL-4 assembling on A and B users lines

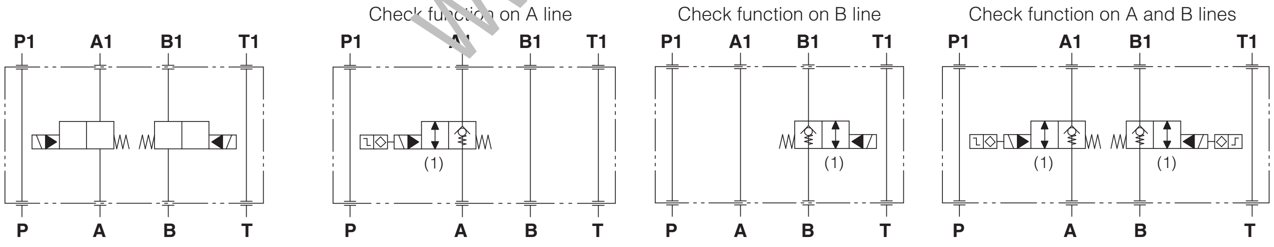
Series number

Seals material
- = NBR
PE = FKM

Y-207504 = model code of threaded plug

6 HYDRAULIC CHARACTERISTICS of HJ modular plate

EXAMPLES OF HYDRAULIC CONFIGURATIONS


Check function on A line

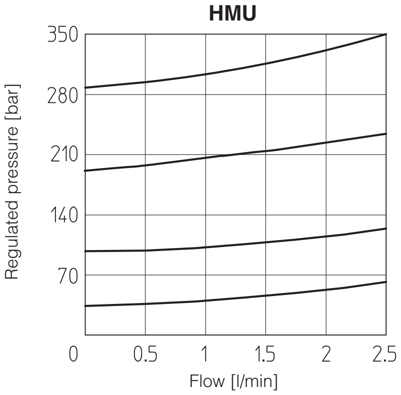
Check function on B line

Check function on A and B lines

Max pressure [bar]	250
Max flow [l/min]	40

(1) Poppet type, screw-in cartridge valves type JO-DL-4-2* to be ordered separately, see KT table E105

7 **DIAGRAMS** (based on mineral oil ISO VG 46 at 50°C)

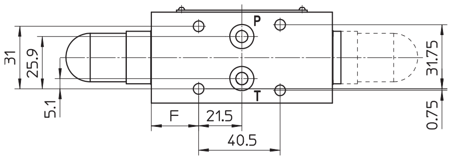


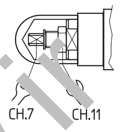
8 MAIN CHARACTERISTICS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	-20°C to +70°
Fluid	Hydraulic oil as per DIN 51524 ... 535
Recommended viscosity	15 ÷100 mm²/s at 40°C (ISO VG 15 ÷ 100)
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 μm value with $\beta_{25} \geq 75$ recommended)
Fluid temperature	-20°C +60°C (standard seals) -20°C +80°C (/PE seals)

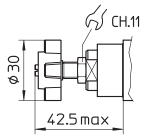
9 DIMENSIONS of HMU pressure relief valve

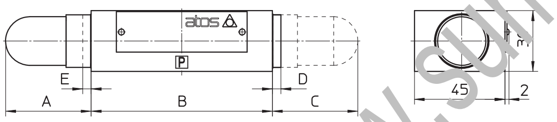
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see section 12)
Ports P,T: Ø = 7.5 mm (max)
Seals: 2 OR 108



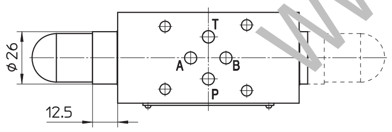


Option **/V**





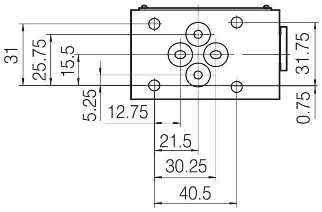
For version HMU-014/*** the regulating element is at side of port B (instead of A)

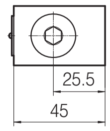


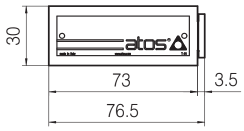
VALVE	A	B	C	D	E
HMU-011	42,5	71	-	-	-
HMU-012	42,5	90	42,5	-	-
HMU-013	42,5	90	-	4,5	-
HMU-014	-	90	42,5	-	4,5

10 DIMENSIONS of RR-3 pressure reducing valve

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see section 12)
Ports A, B, P, T: Ø = 7.5 mm (max)
Seals: 4 OR 108



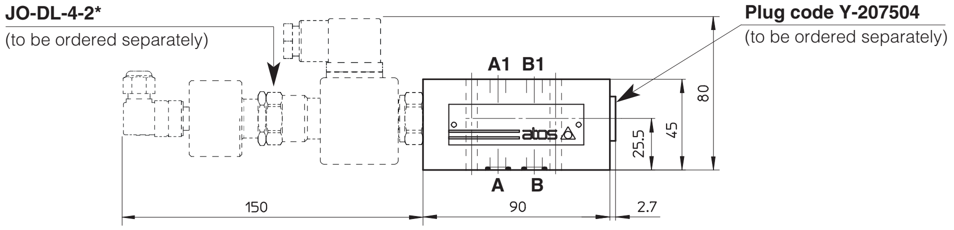




11 DIMENSIONS of HJ modular plate

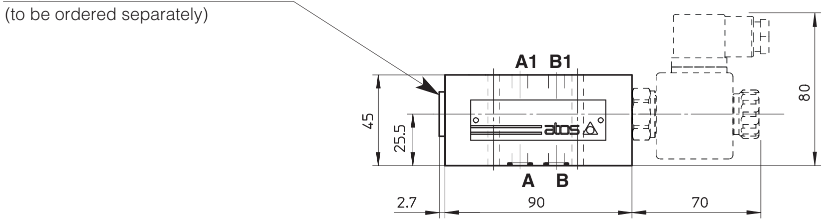
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see section 12)
Ports A, B: Ø = 7.5 mm (max)
Seals: 4 OR 108

Check function on **A** line

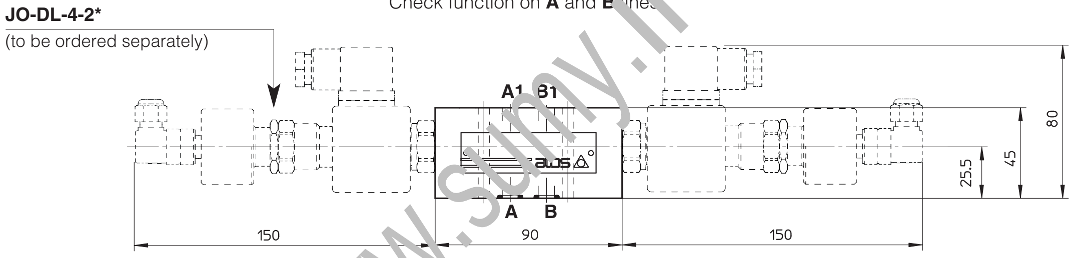

JO-DL-4-2*
(to be ordered separately)

Plug code Y-207504
(to be ordered separately)

Check function on **B** line

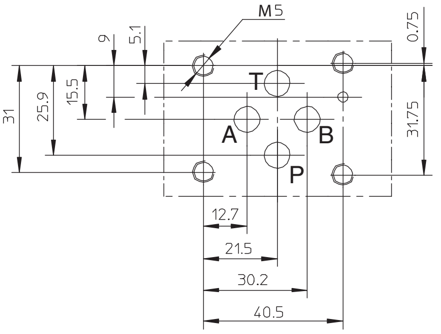

Plug code Y-207504
(to be ordered separately)

Check function on **A** and **B** lines


JO-DL-4-2*
(to be ordered separately)

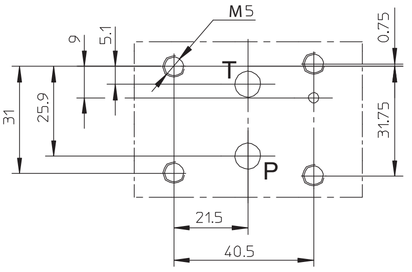
12 MOUNTING SURFACE dimensions [mm]

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws M5 class 12.9
Tightening torque = 8 Nm
Seals: OR 108
Ports P,A,B,T: Ø = 7.5 mm (max).



P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

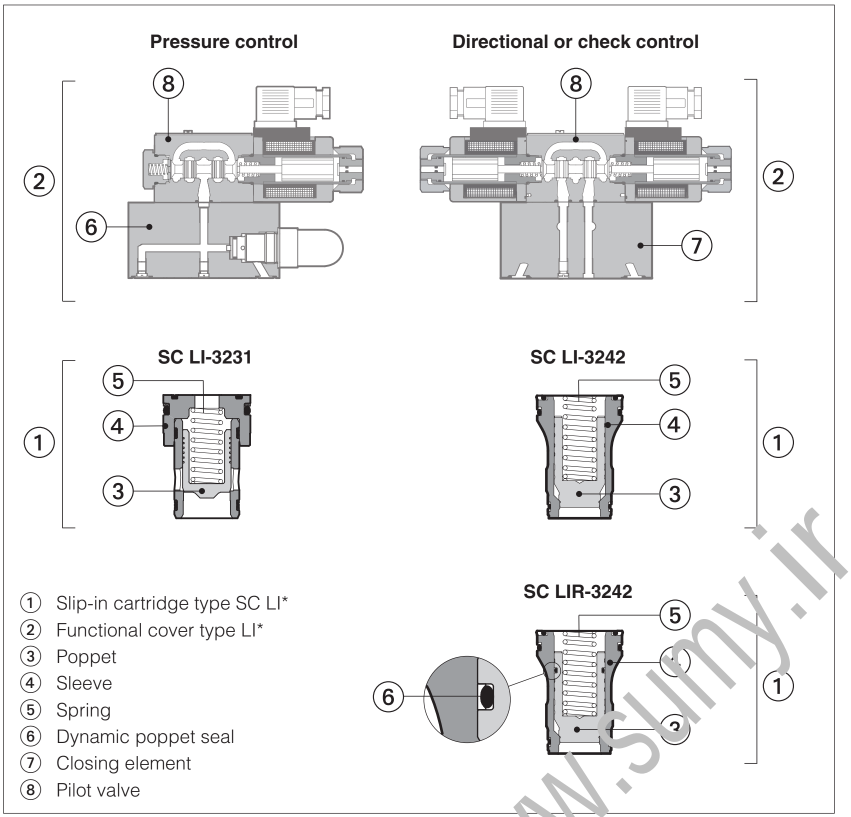
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
without ports A and B
Fastening bolts:
4 socket head screws M5 class 12.9
Tightening torque = 8 Nm
Seals: OR 108
Ports P,T: Ø = 7.5 mm (max).



P = PRESSURE PORT
T = TANK PORT

ISO cartridges type SC LI

2 way slip-in directional, pressure, flow, check controls



① Slip-in cartridge type SC LI*
② Functional cover type LI*
③ Poppet
④ Sleeve
⑤ Spring
⑥ Dynamic poppet seal
⑦ Closing element
⑧ Pilot valve

2way slip-in cartridges conforming with ISO 7368 standard cavities for installation in compact manifolds. They are available in several versions to perform directional, pressure, flow and check controls in combination with relevant functional covers.
They permit to control very high flow rates at low pressure drops, reducing the manifold dimensions respect to subplate valves.

The slip-in cartridge ① is made by a poppet ③ sliding into a sleeve ④ and kept in closed position by a spring ⑤ available with different cracking pressure valves.

Optional version **SC LIR** with sealed poppet execution is available for applications requiring inproved leak-free features as hydraulic circuits with accumulators or with vartical loads.

The functional covers ② are made by a closing element with ISO 7368 mounting surface ⑦ provided with internal piloting lines for the cartridge operation. They can be equipped with pilot valves ⑧ and devices performing the specific control (pressure relief, flow metering, directional, check)

Sizes: **16 to 100** ISO 7368

Max flow up to **9000 l/min** at Δp 5 bar
Max pressure **420 bar**

1 MODEL CODE

SC LI	**R**	-	**16**	**43**	**1**	*	/	*

Cartridge according to ISO 7368

- = standard execution
R = sealed poppet execution (only for poppet type 32, 33, 42, 43) poppet type 32 not available for size 100 - see section 6

Size - see section 6

16	**40**	**80**
25	**50**	**100**
32	**63**	

Type of poppet - see section 6

Pressure controls
31, 34, 35, 36, 37

Directional, flow and check controls
32, 33 normally closed, without domping nose
42, 43 normally closed, with damping nose

Check controls
52 normally closed
62, 63, 96 normally open

Spring cracking pressure - see section 7

Series number

Seals material:
- = NBR
PE = FKM
BT = NBR low temp.

2 GENERAL CHARACTERISTICS

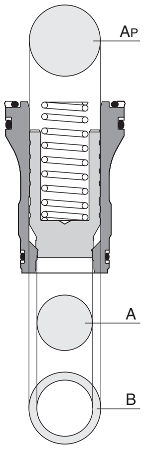
Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Storage temperature range	**Standard** = -30°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **/BT** option = -40°C ÷ +80°C
Compliance	RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

3 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C NBR low temp. seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	20÷100 mm^2/s - max allowed range 15 ÷ 380 mm^2/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, NBR low temp.	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, NBR low temp.	HFC	

4 SC LI CARTRIDGE AREAS

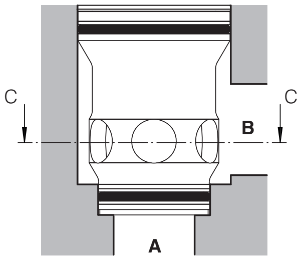
Area ratio	**A**	**B** (% of A)	**Ap** (% of A)
1:1	100%	0	100%
1:1,1	100%	10%	110%
1:1,5	100%	50%	150%
1:1,6	100%	60%	160%



Pressure applied to areas A and B acts to open the poppet.
Pressure applied to area AP plus the spring force act to close the poppet

A = seat area
B = anular area
AP = piloting area

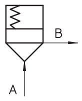
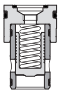
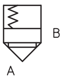
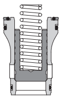
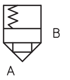
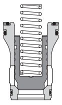
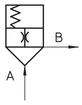
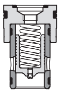
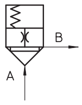
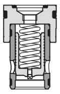
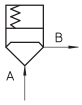
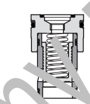
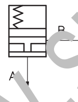
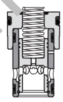
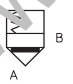
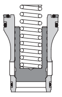
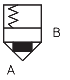
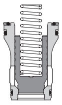
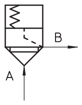
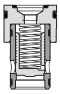
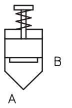
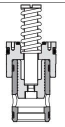
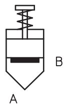
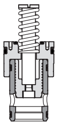
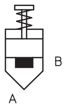
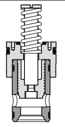
5 INSTALLATION - for cavity dimensions, see table P006



Correct cartridge orientation
(section C-C)

Mounting position with reduced power density
(section C-C)

6 TYPE OF POPPET FOR SC LI SLIP-IN CARTRIDGES

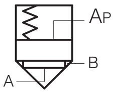
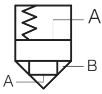
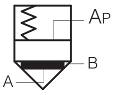
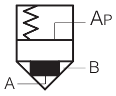
Size / Type	SC LI-16	SC LI-25	SC LI-32	SC LI-40	SC LI-50	SC LI-63	SC LI-80	SC LI-100	Functional sketch (hydraulic symbol)	Typical section	Area ratio	Related functional cover see section 9, 10, 11, 12
31	●	●	●	●	●	●	●	–			1 : 1	LIMM, LIMHA, LIMHC, LIC, LICM
Qmax [l/min] Δp = 5 bar	180	370	630	1100	1900	3100	4900					
32	●	●	●	●	●	●	●	(1) ●			1 : 1,1	LIDA, LIDD, LIDB, LIDBH, LIDEW
Qmax [l/min] Δp = 5 bar	270	550	1000	1700	2500	4000	5500	9000				
33	●	●	●	●	●	●	●	●			1 : 1,5	LIDA, LIDD, LIDB, LIDBH, LIDEW
Qmax [l/min] Δp = 5 bar	270	550	1000	1700	2500	4000	5500	9000				
34	●	○	○	–	–	–	–	–			1 : 1	LIMM, LIMHA, LIMHC
Qmax [l/min] Δp = 5 bar	180											
35	●	●	●	●	●	–	–	–			1 : 1,1	LIMM, LIMHA, LIMHC
Qmax [l/min] Δp = 5 bar	180	370	630	1100	1900							
36	●	●	●	●	●	●	●	–			1 : 1	LIC, LICM
Qmax [l/min] Δp = 5 bar	180	370	630	1100	1900	3100	4900					
37	●	●	●	●	–	–	–	–			1 : 1	LIRA
Qmax [l/min] Δp = 5 bar	140	250	500	750								
42	●	●	●	●	●	●	●	–			1 : 1,1	LIDA, LIDD, LIDB, LIDBH, LIDEW
Qmax [l/min] Δp = 5 bar	240	500	800	1400	2200	3300	4000					
43	●	●	●	●	●	●	●	●			1 : 1,5	LIDA, LIDD, LIDB, LIDBH, LIDEW
Qmax [l/min] Δp = 5 bar	240	500	800	1400	2200	3300	4000	6300				
52	●	●	●	●	●	–	–	–			1 : 1,1	LIDA
Qmax [l/min] Δp = 5 bar	160	400	600	1200	1800							
62	●	●	●	●	●	–	–	–			1 : 1,1	LIDO
Qmax [l/min] Δp = 5 bar	160	400	600	1200	1800							
63	●	●	●	●	●	–	–	–			1 : 1,1	LIDO
Qmax [l/min] Δp = 5 bar	160	400	600	1200	1800							
69	–	●	●	●	●	–	–	–			1 : 1,6	
Mass [kg]	0,2	0,5	0,9	1,7	3,0	7,0	13	22				

- ● normally available from stock
- ○ on request
- – not available

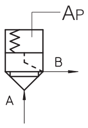
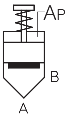
(1) not available for SC LIR

7 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

7.1 Type of poppets for directional and check controls

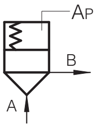
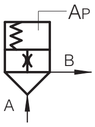
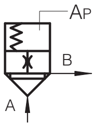
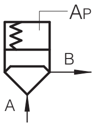
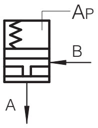
Type of poppet		**32**	**33**	**42**	**43**
Functional sketch (Hydraulic symbol)					
Operating pressure		**420 bar max**			
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 9	Size **16**	270	270	240	240
	25	550	550	500	500
	32	1000	1000	800	800
	40	1700	1700	1400	1400
	50	2500	2500	2200	2200
	63	4000	4000	3300	3300
	80	5500	5500	4000	4000
	100	9000	9000	-	6300
Area ratio A:Ap		**1:1,1**	**1:1,5**	**1:1,1**	**1:1,5**
Cracking pressure A→B	Spring **1**	0,3 bar	0,6 bar	0,3 bar	0,6 bar
	2	1,5 bar	-	1,5 bar	-
	3	3 bar	2,5 bar	3 bar	2,5 bar
	6	5,5 bar	5,5 bar	5,5 bar	5,5 bar
Cracking pressure B→A	Spring **1**	3 bar	1,2 bar	3 bar	1,2 bar
	2	12,8 bar	-	12,8 bar	-
	3	32,5 bar	6 bar	32,5 bar	6 bar
	6	54,5 bar	11 bar	54,5 bar	11 bar

7.2 Type of poppets for check controls

Type of poppet		**52**	**62**	**63**
Functional sketch (Hydraulic symbol)				
Operating pressure		**420 bar max**		
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 10	Size **16**	160		
	25	400		
	32	600		
	40	1200		
	50	1800		
Area ratio A:AP		**1 : 1,1**	**1 : 1,1**	**1 : 1,1**
Cracking pressure A→B (1)	Spring **1**	0,3 bar	-	-
	2	1,5 bar	-	-
	3	3 bar	-	-
	6	6 bar	-	-

(1) Depending on the spring cracking pressure and the area ratio of the poppet

7.3 Type of poppets for pressure controls

Type of poppet		**31**	**34**	**35**	**36**	**37**
Functional sketch (Hydraulic symbol)						
Operating pressure		**420 bar max**				
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 8	Size **16**	180	180	180	180	140
	25	370	-	370	370	250
	32	630	-	630	630	500
	40	1100	-	1100	1100	750
	50	1900	-	1900	1900	-
	63	3100	-	-	3100	-
	80	4900	-	-	4900	-
Area ratio A: AP		**1:1**	**1:1**	**1:1,1**	**1:1**	**1:1**
Cracking pressure A→B	Spring **1**	-	-	0,3 bar	-	-
	2	1,2 bar	1,2 bar	1,2 bar	-	-
	3	3 bar	3 bar	3 bar	-	-
	4	-	-	-	-	4 bar
	6	6 bar	6 bar	6 bar	6 bar	-
	7	-	-	-	-	7 bar
B→A	Spring **4**	-	-	-	-	4 bar
	7	-	-	-	-	7 bar

7.4 Poppet area

Area (cm^2)	Poppet type	Size (1)							
		16	**25**	**32**	**40**	**50**	**63**	**80**	**100**
A	31, 34	2.32	4.68	7.55	11.95	18.10	33.18	47.78	69.40
	36	2.27	4.52	8.04	12.57	19.63	20.43	-	-
	37	2.54	4.91	8.04	12.57	-	-	-	-
	32, 35, 42, 52, 63	2.87	5.60	9.35	15.07	25.97	40.15	51.53	86.43
	33, 43	2.09	4.08	6.79	11.04	19.63	30.19	38.48	63.62
B	31, 34	0.22	0.23	0.49	0.62	1.54	3.13	2.48	9.14
	36	0	0	0	0	0	0	-	-
	37	0	0	0	0	-	-	-	-
	32, 35, 42, 52, 63	0.28	0.56	0.83	1.55	2.31	4.03	5.22	8.61
	33, 43	1.05	2.07	3.39	5.57	8.64	13.99	18.26	31.42
Ap	31, 34	2.54	4.91	8.04	12.57	19.63	36.32	50.27	78.54
	36	2.54	4.91	8.04	12.57	19.63	20.43	–	–
	37	2.54	4.91	8.04	12.57	-	-	-	-
	32, 35, 42, 52, 63	3.14	6.16	10.18	16.62	28.27	44.18	56.75	95.03
	33, 43	3.14	6.16	10.18	16.62	28.27	44.18	56.75	95.03

7.5 Poppet stroke and pilot volume

	Poppet type	Size (1)							
		16	**25**	**32**	**40**	**50**	**63**	**80**	**100**
Stroke (cm)	31, 34	0.5	0.71	1.11	1.31	1.52	1.85	2.19	3.00
	36	0.52	0.82	1.15	1.30	1.52	1.27	-	-
	37	0.60	0.67	0.92	1.05	-	-	-	-
	32, 35, 42, 52, 63	0.80	1.00	1.31	1.70	2.10	2.61	2.80	3.80
	33, 43	0.90	1.11	1.40	1.90	2.30	2.80	3.00	3.87
Pilot volume (cm^3)	31, 34	1.27	3.49	8.93	16.46	29.85	67.19	110.08	235.62
	36	1.32	4.03	9.25	16.34	29.85	25.94	-	-
	37	1.53	3.29	7.40	13.19	-	-	-	-
	32, 35, 42, 52, 63	2.51	6.16	13.28	28.25	59.38	115.89	159.89	361.13
	33, 43	2.83	6.83	14.25	31.49	65.03	123.70	170.24	367.78
Theorical pilot flow **(2)** (l/min)	31, 34	7.63	20.91	53.56	98.77	179.07	403.12	660.49	1413.72
	36	7.94	24.15	55.49	98.02	179.07	155.66	-	-
	37	9.16	19.73	44.39	79.17	-	-	-	-
	32, 35, 42, 52, 63	15.08	36.95	79.70	169.51	356.26	690.51	953.32	2166.76
	33, 43	16.96	41.01	85.50	188.96	390.19	742.20	1021.41	2206.67

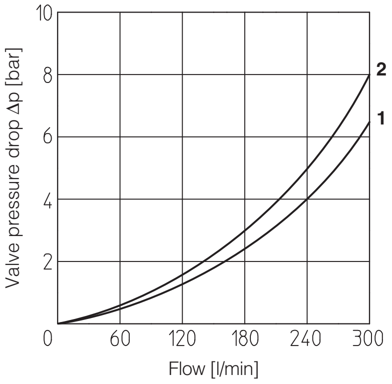
(1) See section 6 for the availability of different sizes for each poppet type

(2) Theoretical pilot flow with switching time = 10ms

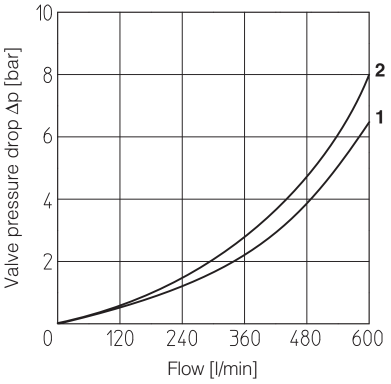
8 **FLOW /Δp DIAGRAMS** based on mineral oil ISO VG 46 at 50 °C

8.1 Poppets type 32, 33, 42, 43 for directional, flow and check controls

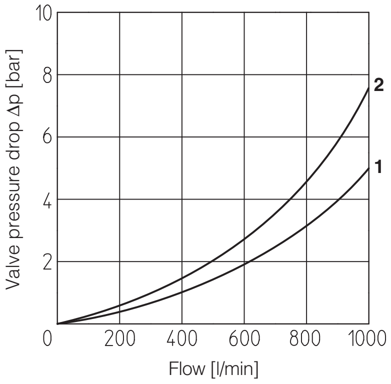
size 16



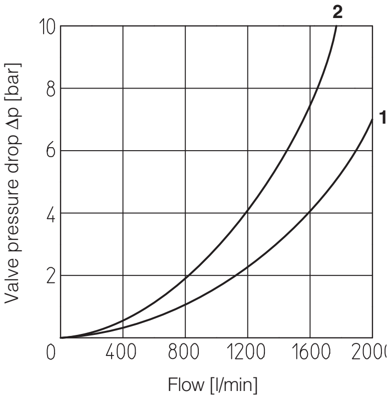
size 25



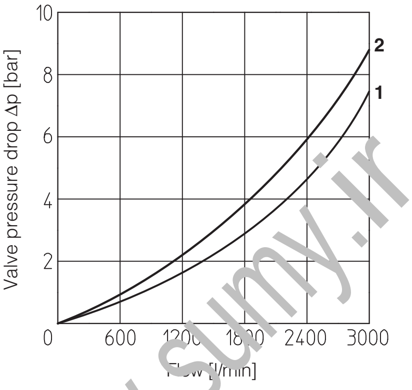
size 32



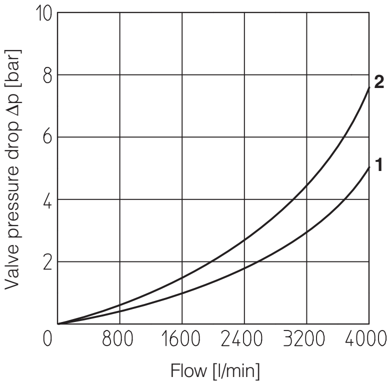
size 40



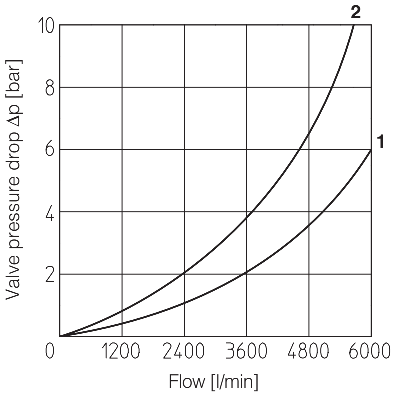
size 50



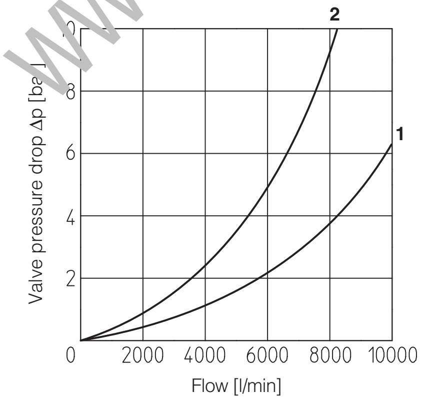
size 63



size 80



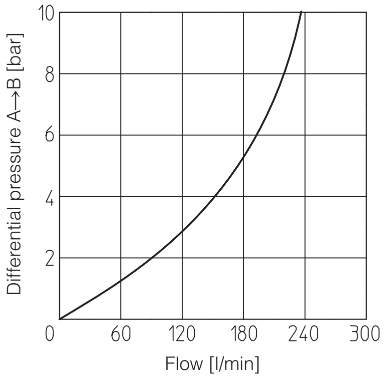
size 100



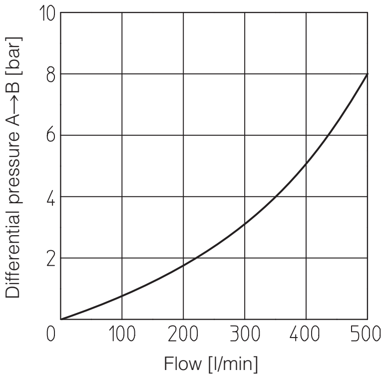
1 = poppet type 32 and 33
2 = poppet type 42 and 43

8.2 Poppets type 52, 62, 63 for check controls

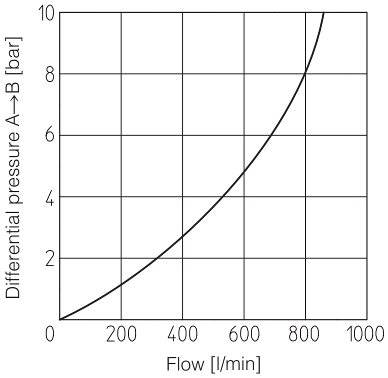
size 16



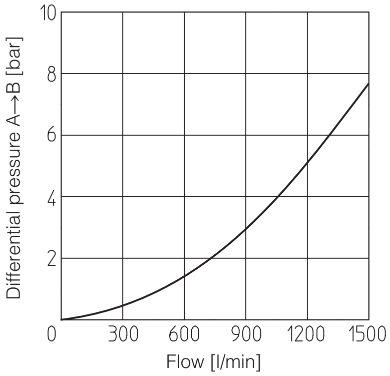
size 25



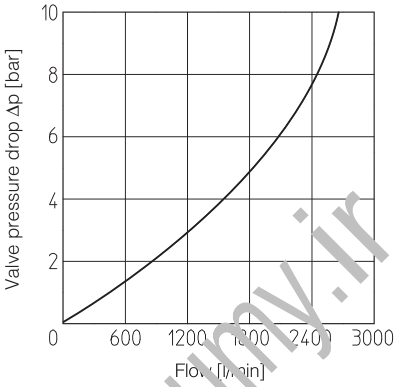
size 32



size 40

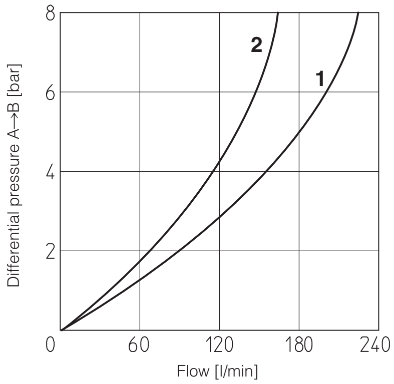


size 50

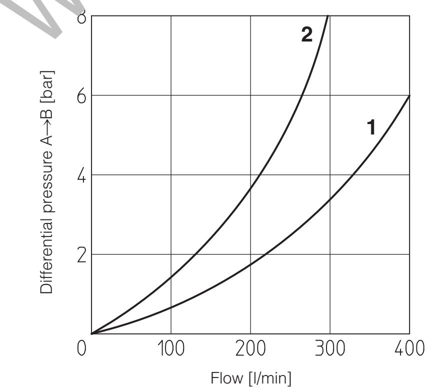


8.3 Poppets type 31, 34, 35, 36, 37 for pressure controls

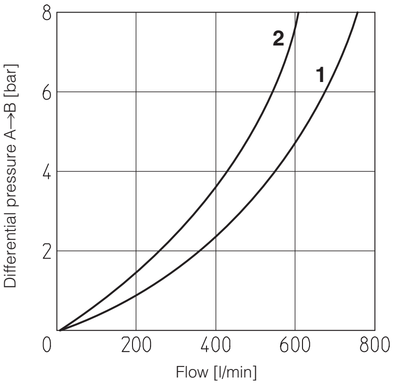
size 16



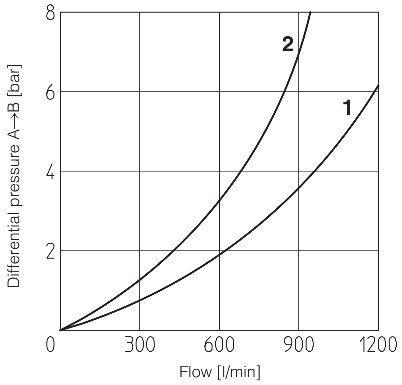
size 25



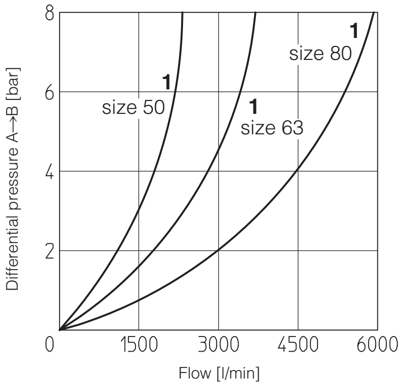
size 32



size 40



size 50, 63, 80

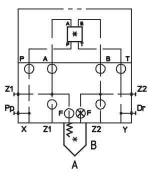
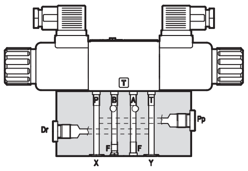
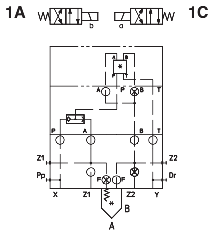
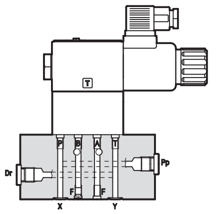
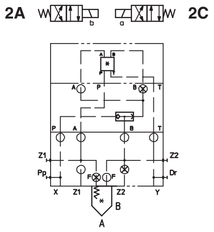


1 = poppet type 31, 34, 35, 36
2 = poppet type 37

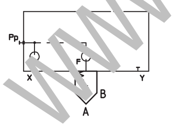
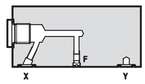
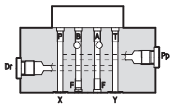
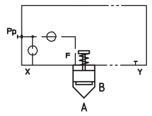
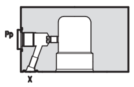
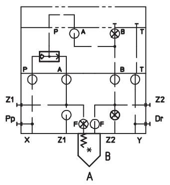
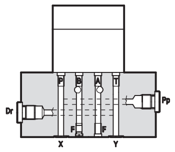
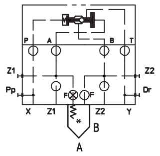
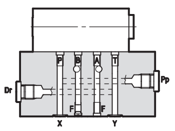
Note:

poppet type 34 only for size 16
poppet type 37 for size 16 to 50

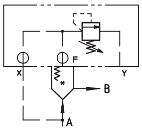
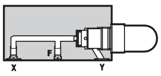
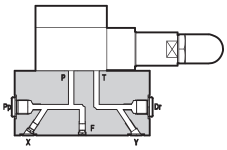
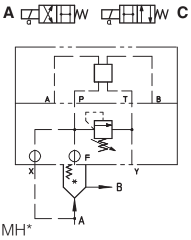
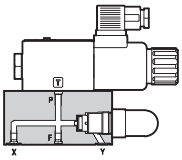
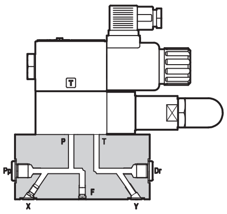
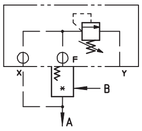
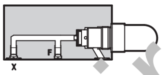
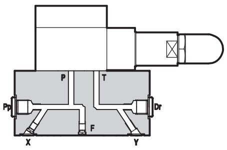
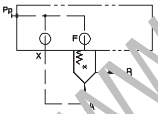
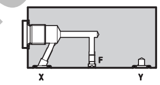
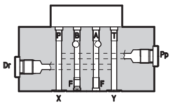
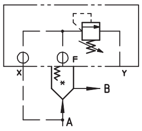
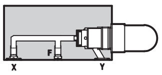
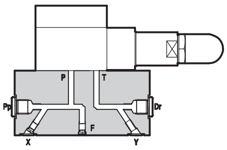
9 FUNCTIONALS COVERS - DIRECTIONAL CONTROL, see table H030

Function and type of control	Size	Hydraulic symbol	Functional cover size 16 ÷ 100	SC LI cartridges
Direct operated directional control valve with solenoid valve for pilot selection **LIDEW***	16 25 32 40 50 63 80 100			SC LI-**32* SC LI-**33* size 16 ... 100 SC LI-**42* size 16 ... 80 SC LI-**43* size 16 ... 100
Direct operated directional control valve with solenoid valve and shuttle valve for pilot selection **LIDBH1A** = open when solenoid is de-energized **LIDBH1C** = closed when solenoid is de-energized	16 25 32 40 50 63 80 100			SC LI-**32* SC LI-**33* size 16 ... 100 SC LI-**42* size 16 ... 80 SC LI-**43* size 16 ... 100
Direct operated directional control valve with solenoid and shuttle valve for pilot selection **LIDBH2A** = when solenoid is de-energized only connections X→F **LIDBH2C** = when solenoid is de-energized only connections Z1→F	16 25 32 40 50 63 80 100			SC LI-**32* SC LI-**33* size 16 ... 100 SC LI-**42* size 16 ... 80 SC LI-**43* size 16 ... 100

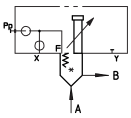
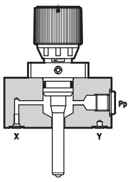
10 FUNCTIONALS COVERS - CHECK FUNCTION, see table H040

Function and type of control	Size	Hydraulic symbol	Functional cover size 16 ÷ 25	Functional cover size 32 ÷ 80	SC LI cartridges
Direct operated check valve normally closed **LIDA**	16 25 32 40 50 63 80				SC LI-**32* SC LI-**33* size 16 ... 80 SC LI-**42* SC LI-**43* size 16 ... 80 SC LI-**52* size 16 ... 50
Direct operated check valve normally open **LIDO**	16 25 32 40 50				SC LI-**62* SC LI-**63* size 16, 25, 32, 50
Direct operated check valve with shuttle valve for pilot selection **LIDB**	16 25 32 40 50 63				SC LI-**32* SC LI-**33* size 16 ... 63 SC LI-**42* SC LI-**43* size 16 ... 63
Direct operated check valve with hydraulically operated pilot check valve **LIDR**	16 25 32 40 50 63		01/20 		SC LI-**32* SC LI-**33* size 16 ... 63 SC LI-**42* SC LI-**43* size 16 ... 63

11 TYPICAL FUNCTIONS OF COVERS - PRESSURE CONTROL, see table H010

Function and type of control	Size	Hydraulic symbol	Functional cover size 16 ÷ 32	Functional cover size 40 ÷ 80	SC LI cartridges
Pressure relief control with manual setting **LIMM**	16 25 32 40 50 63 80				SC LI-**31* size 16... 80 SC LI-**34* size 16 SC LI-**35* size 16...50
Pressure relief control with solenoid valve for venting **LIMHA** = unloading when solenoid is de-energized **LIMHC** = unloading when solenoid is energized	16 25 32 40 50 63 80	 LIMH*			SC LI-**31* size 16...80 SC LI-**34* size16 SC LI-**35* size16...50
Pressure reducing control with manual setting. Open in resting position **LIRA**	16 25 32 40				SC LI-**37* size 16...40
Function and type of control	Size	Hydraulic symbol	Functional cover size 16 ÷ 25	Functional cover size 32 ÷ 80	SC LI cartridges
Pressure compensator to be coupled with flow control valves **LIC**	16 25 32 40 50 63 80				SC LI-**31* size 16...80 SC LI-**36* size 16...80
Pressure compensator with mechanical max pressure regulation to be coupled with flow control valves. **LICM**	16 25 32 40 50 63 80				SC LI-**31* size 16...80 SC LI-**36* size 16...80

12 FUNCTIONAL COVERS - FLOW CONTROL, see table H020

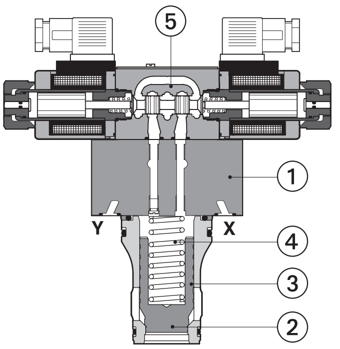
Function and type of control	Size	Hydraulic symbol	Functional cover size 16 ÷ 63	SC LI cartridges
Flow control with stroke limiter **LIDD**	16 25 32 40 50 63			SC LI-**32* SC LI-**33* size 16...63 SC LI-**42* SC LI-**43* size 16...63

13 RELATED DOCUMENTATION

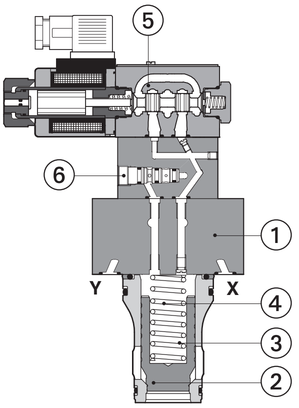
H010	ISO cartridge valves tipe LIM*, LIRA, LIC*
H020	ISO cartridge valves tipe LIDD
H030	ISO cartridge valves tipe LIDEW* and LIDBH*
H040	ISO cartridge valves tipe LID*

ISO cartridge valves type LIDEW* and LIDBH*

directional control, high flow, **Pmax 420 bar**



LIDEW4-3-E



LIDBH1C-3-E

① Functional cover
② Poppet
③ Sleeve
④ Spring
⑤ Pilot slenoid valve
⑥ Shuttle valve

Directional control valves in ISO cartridge design, used to intercept or to permit the flow passage according to the selected pilot control. They are made by a functional cover ① and a 2-way **SC LI** slip-in cartridge.

LIDEW: functional cover with or without pilot solenoid valve for cartridge operation, available in different configurations depending to the function to be performed.

LIDBH as LIDEW plus shuttle valve for pilot pressure selection.

The SC LI slip-in cartridge is available with different poppet shape to optimize the control, see section 6.

It is made by a poppet ② sliding into a sleeve ③ and kept in normally closed position by the spring ④ available with different cracking pressure values.

Size: **16** to **100** ISO 7368

Max flow up to **9000** l/min at Δp = 5 bar

Max pressure up to **420 bar**

1 MODEL CODE OF FUNCTIONAL COVERS - for model code of slip-in cartridge see section 5

LI	D	EW	1	-	3	/	*	-	E	X	24DC	**	/	*	*

Cover according to ISO 7368

D = directional function

EW = with or whithout pilot solenoid valve
BH = as EW plus shuttle valve for pilot selection

Cover configuration see section 2
LIDEW: **-** (without pilot valve)
LIDEW: **1**, **2**, **4**, **5**, **6**
LIDBH: **1A**, **1C**, **2A**, **2C**

Size:

1 = 16	**2** = 25	**3** = 32	**4** = 40
5 = 50	**6** = 63	**8** = 80	**10** = 100

Options, see section 3

Pilot solenoid valve (1)

for size 1 to 6:	**E**	= DHE, **Pmax 350 bar**
	EP	= DHEP, **Pmax 420 bar**
	L	= DHL, **Pmax 350 bar**
for size 8 and 10:	**E**	= DKE, **Pmax 350 bar**
	EP	= DKEP, **Pmax 420 bar**

X = without connector
See section 9 for available connectors, to be ordered separately
00-AC = AC solenoid valve without coils
00-DC = DC solenoid valve without coils

Voltage code see section 8

Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR **(2)**

Optional different setting of calibrated plugs in the pilot channels, see sections 3, 4

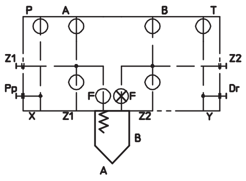
(1) for solenoid valve's characteristics, see following technical tables:

DHE	tech. table E015
DHEP	tech. table E030
DKE	tech. table E025
DKEP	tech. table E035
DHL	tech. table E018

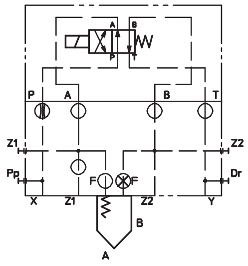
(2) Not available for LIDEW*-**L**

2 HYDRAULIC SYMBOLS (cover configuration)

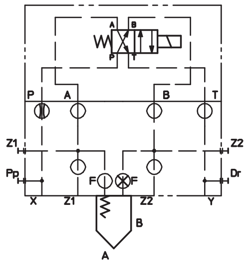
LIDEW



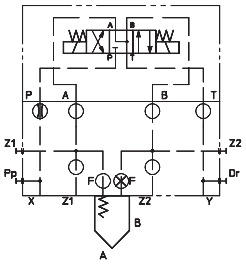
LIDEW-*



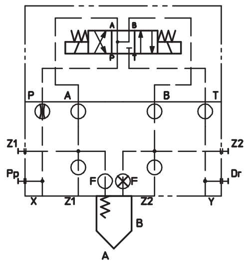
LIDEW1-*



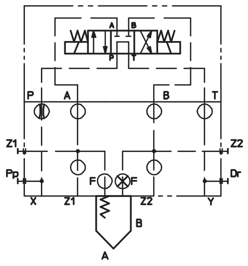
LIDEW2-*



LIDEW4-*

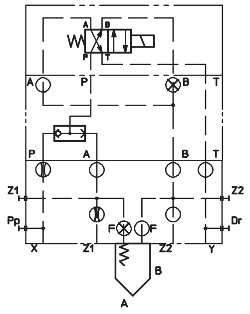


LIDEW5-*

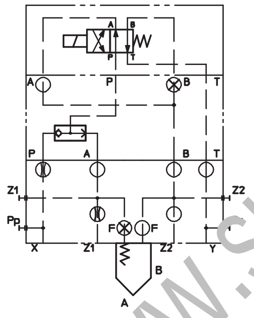


LIDEW6-*

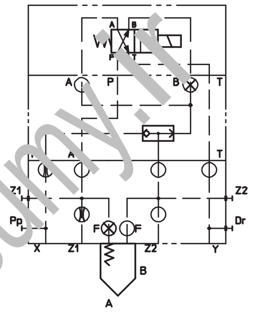
LIDBH



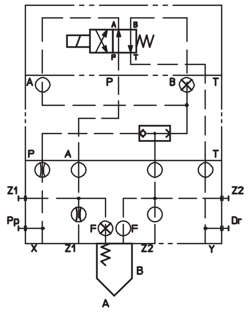
LIDBH1A-*



LIDBH1C-*



LIDBH2A-*



LIDBH2C-*

3 OPTIONS

For LIDEW*, LIDBH* covers (sizes 40…100):

/E = with external attachments Pp and underneath port X supplied plugged;

For all the models:

/B = cartridge piloted via port "B" of solenoid pilot valve;

/F = prearranged for coupling to an intermediate element with poppet position detector for safety function. See tab. EY120.

/WP = prolonged manual override protected by rubber cap for solenoid pilot valve. See table K150.

******* = Calibrated plugs different from standard ones reported in section 7. The restrictors configuration (if different from the standard) must be indicated at the end of the model code:

LIDEW2 - **1** **/*** - **EX** **24DC** ****** **P** **06**

P

Channel where the orifice has to be provided:

P = channel X, port P
Z1 = channel Z1
F = channel F
Z2 = channel Z2

06

Size of the throttling hole in teths of millimeters:

05 = 0,5 mm
10 = 1 mm
17 = 1,7 mm
06 = 0,6 mm
12 = 1,2 mm
20 = 2 mm
08 = 0,8 mm
15 = 1,5 mm

4 STANDARD ORIFICES CONFIGURATION

Cover **Port**	LIDEW*-1 LIDBH*-1	LIDEW*-2 LIDBH*-2	LIDEW*-3 LIDBH*-3	LIDEW*-4 LIDBH*-4	LIDEW*-5 LIDBH*-5	LIDEW*-6 LIDBH*-6	LIDEW*-8 LIDBH*-8	LIDEW*-10 LIDBH*-10
Z1 (only for LIDBH*-*)	M4 12A	M4 12A	M6 15A	M6 17A	M6 20A	M6 20A	M8 20A	M8 20A
P	M6 12A	M6 12A	M6 15A	M6 17A	M6 20A	M6 20A	M8 20A	M8 25A

M4 ÷ M8 = screw size; **12A ÷ 20A** = calibrated orifices diameter in tenths of mm; **A** = short calibrated hole

5 MODEL CODE OF SLIP-IN CARTRIDGES

SC LI	**-**	**16**	**43**	**1**	**40**	**/**	*****

SC LI = Cartridge according to ISO 7368

Size, the same of relevant cover:
16 25 32 40 50 63 80 100

Type of poppet

32, 33 (size 16 to 100) = without damping nose
42 (size 16 to 80) = as 32 but with damping nose
43 (size 16 to 100) = as 33 but with damping nose

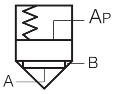
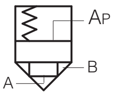
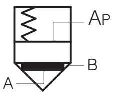
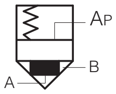
Spring cracking pressure:

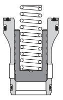
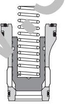
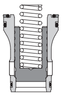
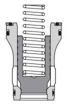
1 = 0,3 bar for poppet 32, 42
1 = 0,6 bar for poppet 33, 43
2 = 1,5 bar for poppet 32, 42
3 = 3 bar for all poppets
6 = 5,5 bar for all poppets

Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR

6 TYPE OF POPPET

Type of poppet	**32**	**33**	**42**	**43**
Functional sketch (Hydraulic symbol)				

Operating pressure		**420 bar max**			
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 9	Size **16**	270	270	240	240
	25	550	550	500	500
	32	1000	1000	800	800
	40	1700	1700	1400	1400
	50	2500	2500	2200	2200
	63	4000	4000	3300	3300
	80	5500	5500	4000	4000
	100	9000	9000	-	6300
Typical section					
Area ratio A:Ap		**1:1,1**	**1:1,5**	**1:1,1**	**1:1,5**
Cracking pressure A→B	Spring **1**	0,3 bar	0,6 bar	0,3 bar	0,6 bar
	2	1,5 bar	-	1,5 bar	-
	3	3 bar	2,5 bar	3 bar	2,5 bar
	6	5,5 bar	5,5 bar	5,5 bar	5,5 bar
Cracking pressure B→A	Spring **1**	3 bar	1,2 bar	3 bar	1,2 bar
	2	12,8 bar	-	12,8 bar	-
	3	32,5 bar	6 bar	32,5 bar	6 bar
	6	54,5 bar	11 bar	54,5 bar	11 bar

7 MAIN CHARACTERISTCS, SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

Flow direction		From A→B or B→A	
Functional cover operating pressure	Pilot valve **E, L**	Ports A, B, X, Z_1, Z_2: **350** bar	Port Y: **210** bar for DC version; **160** bar for AC version
	Pilot valve **EP**	Ports A, B, X, Z_1, Z_2: **420** bar	Port Y: **210** bar for DC version; **160** bar for AC version

7.1 Coils characteristics

Insulation class	(180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 8
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard (not for **-L**)

8 COIL VOLTAGE

External supply nominal voltage ± 10%	**Voltage code** (1)	-LX (DHL) Power consumption (3)	-EX, -EPX (DHE*) Power consumption (3)	-EPX (DKE*) Power consumption (3)	-LX (DHL) Code of spare coil pilot valve	-EX, -EPX (DHE*) Code of spare coil pilot valve	-EX, -EPX (DKE*) Code of spare coil pilot valve
12 DC	**12 DC**	29W	30W	36W	COL-12DC	COE-12DC	CAE-12DC
24 DC	**24 DC**				COL-24DC	COE-24DC	CAE-24DC
110 DC	**110 DC**				COL-110DC	COE-110DC	CAE-110DC
220 DC	**220 DC**				COL-220DC	COE-220DC	CAE-220DC
110/50 AC (2)	**110/50/60 AC**	58VA (4)	58VA (4)	-	COL-110/50/60AC	COE-110/50/60AC	-
110/50/60 AC		-	-	100VA (4)	-	-	CAE-110/50/60AC
115/60 AC (2)	**115/60 AC**	58VA (4)	80VA (4)	130VA (4)	COL-115/60AC	COE-115/60AC	CAE-115/60AC
230/50 AC (2)	**230/50/60 AC**	58VA (4)	58VA (4)	-	COL-230/50/60AC	COE-230/50/60AC	-
230/50/60 AC		-	-	100VA (4)	-	-	CAE-230/50/60AC
230/60 AC	**230/60 AC**	58VA (4)	80VA (4)	130VA (4)	COL-230/60AC	COE-230/60AC	CAE-230/60AC

(1) For other supply voltages available on request see technical tables E015, E018, E025.

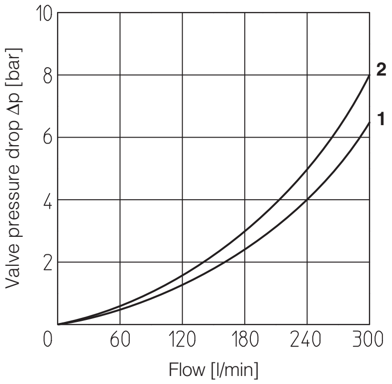
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHL), 58 VA (DHE*), 90 VA (DKE*)

(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(4) When solenoid is energized, the inrush current is approx 3 times the holding current.

9 **Q/Δp DIAGRAMS** based on mineral oil ISO VG 46 at 50 °C

size 16



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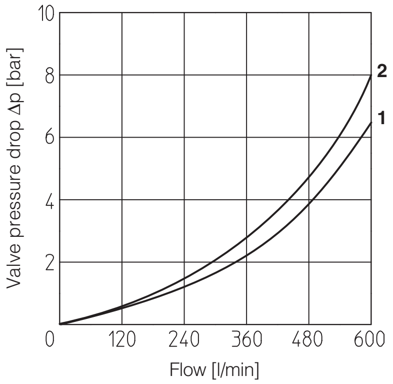
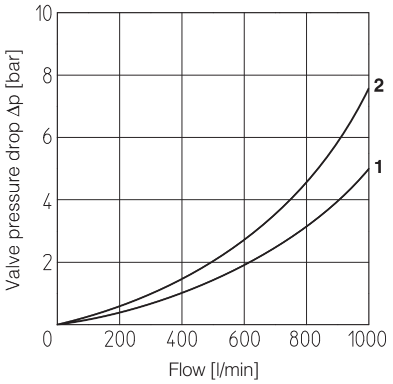


size 32



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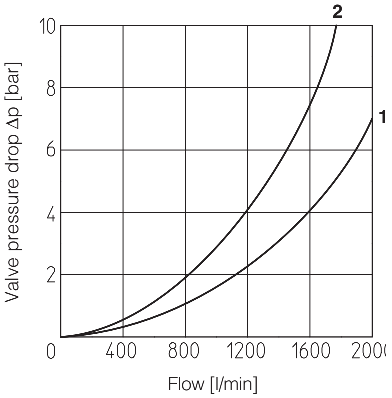
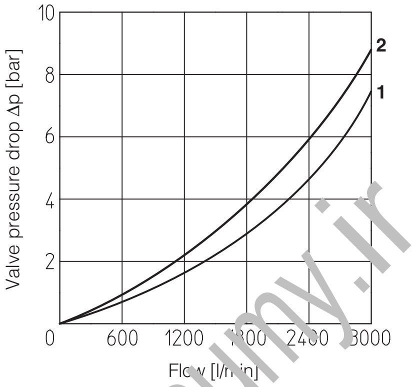
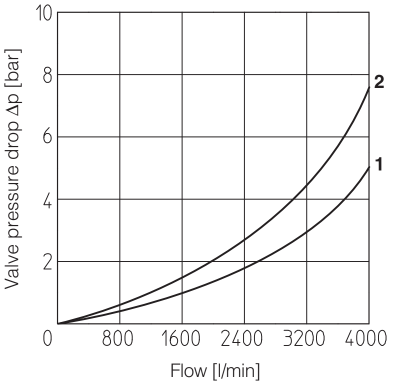


size 50



size 63



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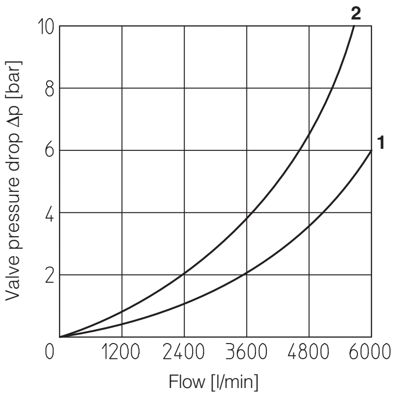
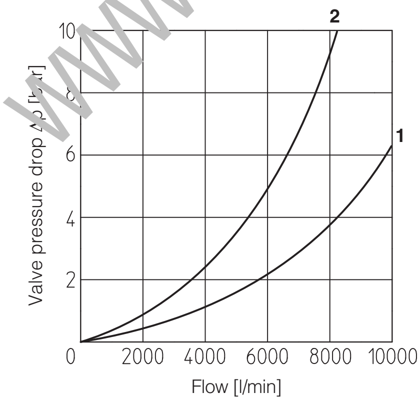


size 100



1 = poppet type 32 and 33
2 = poppet type 42 and 43

10 COVER DIMENSIONS [mm] - for mounting interface and cavity dimensions see tech. table P006

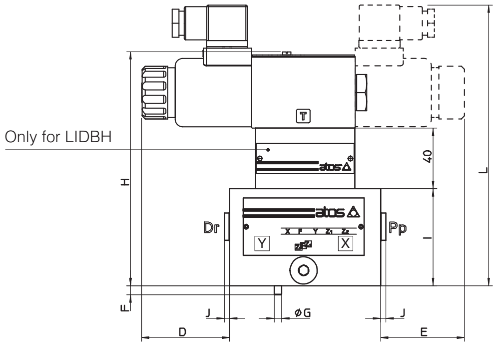
Size 16 ÷ 63

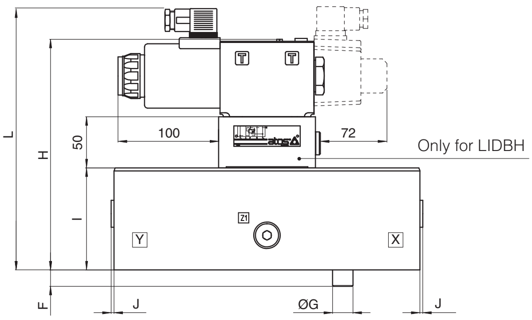
Drawing of size 50

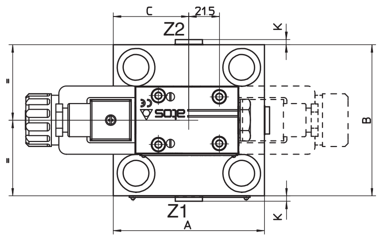
dotted line: example of double solenoid version

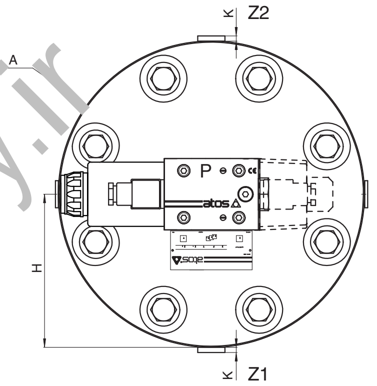
Size 80 and 100

dotted line: example of AC solenoid verison









Notes referred to the below table:

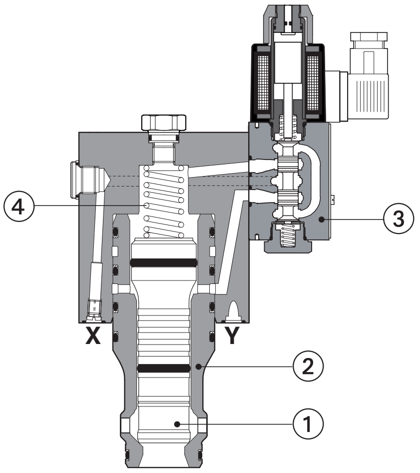
(1) LIDEW1*, LIDBH*C: solenoid at side of port Y of cover;
LIDEW2*, LIDBH*A: solenoid at side of port X of cover;

Size (1)	A	B	C	D max	E max	F	G	H max **LIDEW**	H max **LIDBH**	I	L max	J	K	Ports Pp-Dr	Ports Z_1-Z_2	Seals	Fastening bolts	Tightening torque [Nm]	Mass [Kg]
16	70	65	29	83,5	70,5	4	3	90,5	130,5	40	125	-	-	_	-	4 OR-108	Nr. 4 M8x45	35	2,6 ÷ 3
25	85	85	42,5	69,5	69,5	6	5	90,5	130,5	40	125	-	-	_	-	4 OR-108	Nr. 4 M12x45	125	3 ÷ 3,4
32	100	100	50	62,5	42,5	6	5	100,5	140,5	50	135	-	-	_	-	4 OR-2043	Nr. 4 M16x55	300	3,5 ÷ 4
40	125	125	62,5	49,5	49,5	6	5	110,5	150,5	60	145	3,5	-	G 1/4	-	4 OR-3043	Nr. 4 M20x70	600	6,4 ÷ 6,9
50	140	140	70	42	42	4	6	120,5	160,5	70	155	3,5	3,5	G 1/4	G 1/4	4 OR-3043	Nr. 4 M20x80	600	9,5 ÷ 10
63	180	180	90	22	22	4	6	130,5	170,5	80	165	3,5	3,5	G 3/8	G 3/8	4 OR-3050	Nr. 4 M30x90	2100	17,3÷17,7
80	Ø250	-	125	-	-	6	8	152,5	202,5	80	187	3,5	3,5	G 3/8	G 3/8	4 OR-4075	Nr. 8 M24x90	1000	27,1÷27,7
100	Ø300	-	150	-	-	8	10	182,5	222,5	100	217	3,5	3,5	G 1/2	G 1/2	4 OR-4093	Nr. 8 M30x120	2100	53÷54

Overall dimensions refer to the pilot valves with connectors type 666

On-off active cartridges type LIDAS, 2-way

directional control



CE

① = main poppet
② = cartridge sleeve
③ = solenoid pilot valve (LIDASH-*)
④ = spring

LIDASH-3231-EX

LIDAS are 2-way ISO cartridge valves with active pilot control, normally used to shut-off the hydraulic line.
The particular poppet sealing grants leak-free characteristics.

The poppet ① is hydraulically operated in both directions, ensuring in this way higher reliability and faster response time respect to the conventional spring operated cartridge valves.
The spring ④ ensures the valve closing in absence of pressure in the system.
They are available in different executions:
LIDAS: without pilot solenoid valve
LIDASH: with on-off pilot solenoid valve

Sizes:**16 to 50** ISO 7368

Max flow up to **2100 l/min** with Δp = 5 bar

Max pressure: up to **420 bar**

1 MODEL CODE

LIDAS **H** - **40** **43** **3** - **E** **X** **24DC** ** *

On-off active cartridges, according to ISO 7368

Pilot solenoid valve
- = without pilot solenoid valve
H = with pilot solenoid valve

Size: **16 25 32 40 50**

Poppet type: see section 2
31, **33**
43 (with damping nose)

3 = spring cracking pressure 3 bar

Only for LIDASH - Pilot solenoid valve:
E = DHE, **Pmax 350 bar**
EP= DHEP, **Pmax 420 bar**
L = DHL, **Pmax 350 bar**

Only for LIDASH
X = without connector
See section 4 for available connectors, to be ordered separately
-00-AC = AC solenoid valve without coils
-00-DC = DC solenoid valve without coils

Only for LIDASH
Voltage code, see section 6

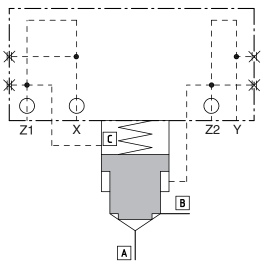
Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR **(1)**

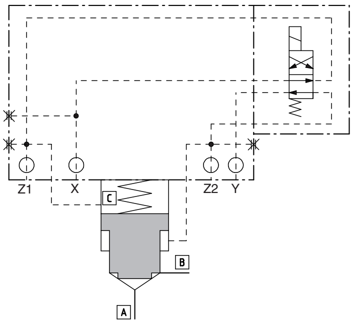
Note: for certified safety version conforming to 2006/42/EC, with inductive position switch (option /FV) see table EY120
(1) Not available for LIMH*-**L**

2 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Hydraulic symbols

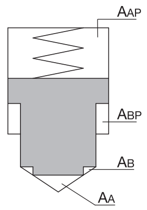


LIDAS



LIDASH

Cartridge areas



AA = main flow (side A)
AB = main flow (side B)
AAP = piloting area (close)
ABP = piloting area (open)

Thanks to the areas ratio AAP/(AA+AB), the valve closing is always ensured with a piloting pressure (X port) equal to the line pressure (A or B line).

3 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUIDS

Assembly position / location		Any position	
Subplate surface finishing		Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)	
MTTFd valves according to EN ISO 13849		LIDAS = 150 years	LIDASH = 75 years
Compliance		CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006	
Flow direction		B → A (preferred) or A → B	
Piloting	**LIDAS**	Pressure to **X** = **close**	Pressure to **Y** = **open**
	LIDASH	De-energized = **close**	Energized = **open**
Operating pressure	LIDAS	Ports A, B, X, Z_1, Z_2, Y: **420** bar	
	LIDASH Pilot valve **E, L**	Ports A, B, X, Z_1, Z_2: **350** bar	Port Y: **210** bar for DC version; **160** bar for AC version
	LIDASH Pilot valve **EP**	Ports A, B, X, Z_1, Z_2: **420** bar	Port Y: **210** bar for DC version; **160** bar for AC version

Size		**16**		**25**		**32**		**40**		**50**	
Maximum flow	Poppet **31**	240		450		700		1400		2100	
at Δp = 5 bar [l/min]	Poppet **33**	220		400		600		1300		2000	
	Poppet **43**	200		360		550		1100		1800	
Poppet characteristics	Poppet type	**31**	**33, 43**	**31**	**33, 43**	**31**	**33, 43**	**31**	**33, 43**	**31**	**33, 43**
A_A [cm^2]		2,27	1,43	4,91	3,46	8,04	5,30	12,56	8,04	19,63	13,85
A_B (% of A_A)		0	58,6	0	41,7	0	51,5	0	56,3	0	41,7
A_{BP} (% of A_A)		67,5	107,0	63,8	90,5	56,3	85,2	56,3	87,9	69	97,8
A_{AP} (% of A_A)		167,5	265,6	163,8	232,2	156,3	236,7	156,3	244,1	169	239,2
A_A / (A_A + A_B) poppet ratio		1 for poppet **31**					0,6 for poppet **33, 43**				
A_{AP} / (A_A + A_B) piloting ratio		1,6 for poppet **31**					1,6 for poppet **33, 43**				

3.1 Coils characteristics (only for LIDASH)

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 6
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard (not for **-L**)

4 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

5 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 - the connectors must be ordered separately

Code of connector	Function
666	Connector IP-65, suitable for direct connection to electric supply source
667	As 666 connector IP-65 but with built-in signal led, suitable for direct connection to electric supply source.
669	With built-in rectifier bridge for supplying DC coils by alternating current (AC 110V and 230V - Imax 1A).

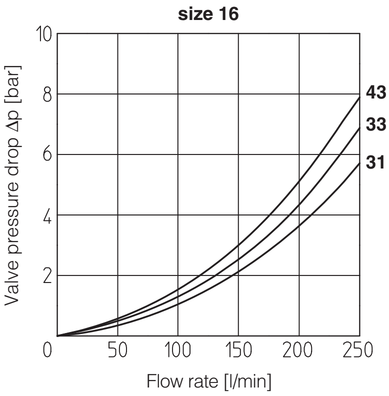
For other available connectors, see tab. K800

6 ELECTRIC FEATURES

Solenoid valve type	External supply nominal voltage ± 10% (1)		**Voltage code**	Type of connector	Power consumption (3)	Code of spare coil DHE, DHEP	Code of spare coil DHL
DHE DHEP DHL	DC	12 DC 24 DC 110 DC 220 DC	**12 DC** **24 DC** **110 DC** **220 DC**	666 or 667	29 W (DHL) 30 W (DHE, DHEP)	COE-12DC COE-24DC COE-110DC COE-220DC	COL-12DC COL-24DC COL-110DC COL-220DC
	AC	110/50 AC (2) 115/60 AC 120/60 AC 230/50 AC (2) 230/60 AC	**110/50/60 AC** **115/60 AC** **120/60 AC** **230/50/60 AC** **230/60 AC**	666 or 667	58 VA (4)	COE-110/50/60AC COE-115/60AC COE-230/50/60AC COE-230/60AC	COL-110/50/60AC COL-115/60AC COL-230/50/60AC COL-230/60AC

(1) For other supply voltages available on request see technical tables E015, E030, E018.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 55 VA for DHL and 52VA for DHE and DHEP
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.

7 Q/Δp DIAGRAMS based on mineral oil ISO VG 46 at 50 °C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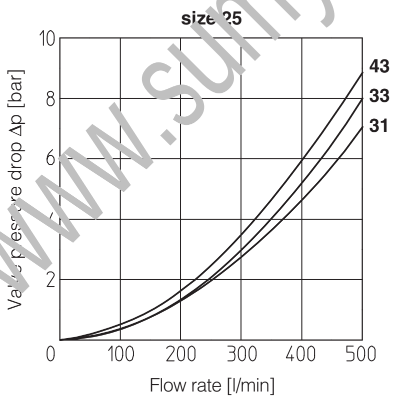
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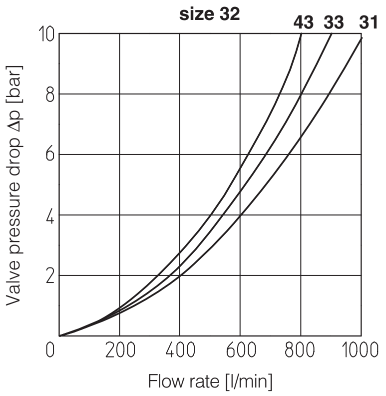
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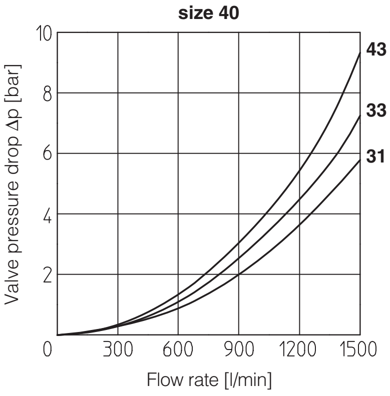
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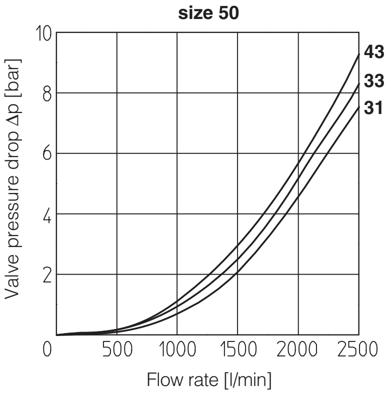
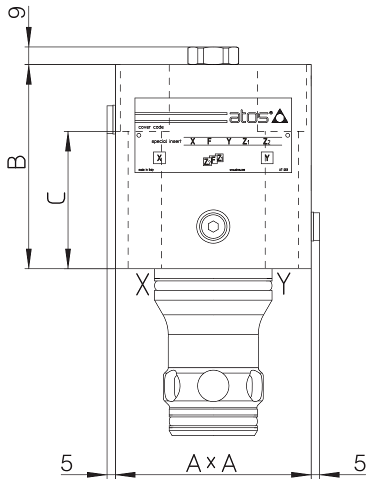
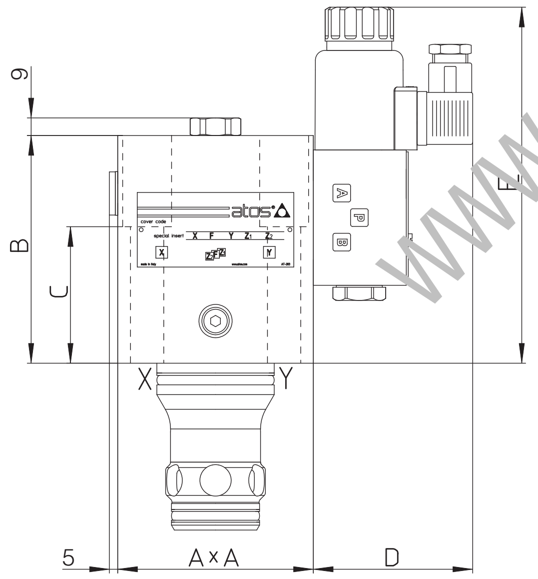

size 50

31 = poppet type 31
33 = poppet type 33
43 = poppet type 43

8 INSTALLATION DIMENSIONS [mm]



LIDAS						
Size	A	B	C	Fastening bolts class 12.9	connection port X, Y, Z1, Z2	Weight (Kg)
16	65	85	64	N°4 M8x80 35 Nm	G1/8”	2,8
25	85	102	75	N°4 M12x95 125 Nm	G1/8”	5,7
32	100	104	70	N°4 M16x90 300 Nm	G3/8”	7,3
40	125	111	39	N°4 M20x70 600 Nm	G3/8”	14,5
50	140	135	49	N°4 M20x80 600 Nm	G3/8”	19,5



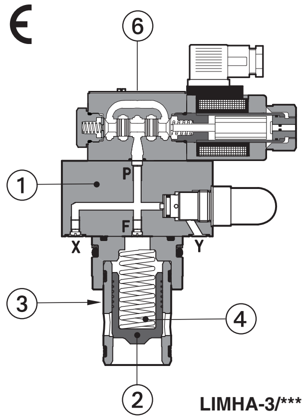
LIDASH									
Size	A	B	C	D max	E max	Fastening bolts class 12.9	connection port X	connection port Z1, Z2	Weight (Kg)
16	72x65	95	64	86	167	N°4 M8x80 35 Nm	G1/8”	G1/8”	4,4
25	85	115	77	86	181	N°4 M12x95 125 Nm	G1/8”	G1/8”	7,3
32	100	116	70	86	192	N°4 M16x90 300 Nm	G3/8”	G1/8”	8,9
40	125	125	39	86	196	N°4 M20x70 600 Nm	G3/8”	G1/8”	15,6
50	140	135	49	86	202	N°4 M20x80 600 Nm	G3/8”	G1/8”	20,6

Note: for mounting interface and cavity dimensions, see tech. table P006

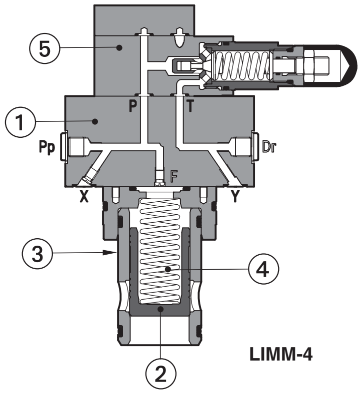
ISO cartridge valves type LIM*, LIRA, LIC*

Pressure controls: relief, reducing, compensator - **Pmax 420 bar**

CE



LIMHA-3/***-E



LIMM-4

① Functional cover
② Poppet
③ Sleeve
④ Spring
⑤ Pressure relief pilot valve
⑥ Solenoid pilot valve

Pressure control valves in ISO cartridge design specific for relief, reducing or compensator functions

They are made by a functional cover ① and a 2-way **SC LI** slip-in cartridge.

Depending to the type of control, the cover is equipped with a pilot relief valve ⑤ for the max pressure regulation and a solenoid valve ⑥ for venting.

The SC LI slip-in cartridge is available with different poppet shape to optimize the pressure control, see section 4

It is made by a poppet ② sliding into a sleeve ③ and kept in normally closed position by the spring ④ available with different cracking pressure values.

Size: **16 to 80** ISO 7368
Max flow up to **4900 l/min** at Δp = 5 bar
Max pressure: up to **420 bar**

1 MODEL CODE OF FUNCTIONAL COVERS - for model code of slip-in cartridge see section 5

LI	**MHA**	-	**1**	/	**210**	/	**V**	-	**E**	**X**	**24DC**	******	/	*****	**F****

Cover according to ISO 7368

Function:
MM = pressure relief control with manual setting;
MHA = pressure relief control with solenoid valve for venting. Unloading when solenoid is deenergized;
MHC = pressure relief control with solenoid valve for venting. Unloading when solenoid is energized;
RA = pressure reducing control with manual setting. Open in resting position;
C = pressure compensator to be coupled with flow control valves;
CM = pressure compensator with mechanical max pressure regulation to be coupled with flow control valves.

Size: **1** = 16; **2** = 25; **3** = 32; **4** = 40;
5 = 50; **6** = 63; **8** = 80
LIRA is available only in size 16, 25, 32, 40

Pressure range:
50 = 6 ÷ 50 bar;
100 = 8 ÷ 100 bar; **350** = 15 ÷ 350 bar;
210 = 10 ÷ 210 bar; **420** = 25 ÷ 420 bar **(1)**

Options: see section 3

Pilot solenoid valve only for LIMHA and LIMHC:
E = DHE, **Pmax 350 bar**
EP = DHEP, **Pmax 420 bar (1)**
L = DHL, **Pmax 350 bar**

Only for LIMHA and LIMHC
X = without connector
00-AC = AC solenoid valve without coils
00-DC = DC solenoid valve without coils
See tech. table K800 for available connectors, to be ordered separately

Voltage code only for LIMHA and LIMHC, see section 9

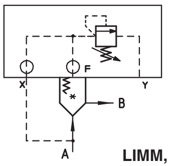
Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR **(2)**

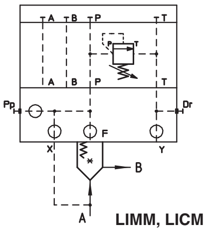
Optional different setting of calibrated plugs in the pilot channels, see section 3, 4

(1) Pressure range 420 bar not available for LIMH*-**E** and LIMH*-**L**; LIMH*-**EP** is available only for pressure range 420 bar
(2) Not available for LIMH*-**L**

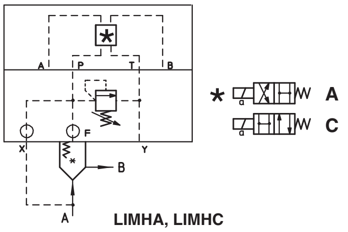
2 HYDRAULIC SYMBOLS



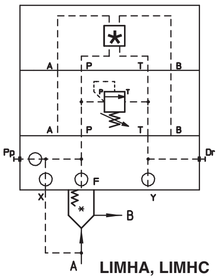
LIMM, LICM
size 16…32



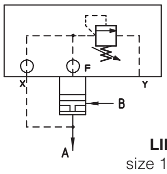
LIMM, LICM
size 40…80



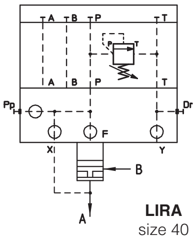
LIMHA, LIMHC
size 16…32



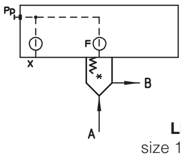
LIMHA, LIMHC
size 40…80



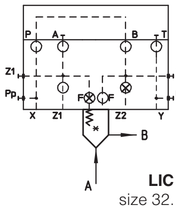
LIRA
size 16…32



LIRA
size 40



LIC
size 16…25



LIC
size 32…80

3 OPTIONS

Only for LIMM (size 16...32):
/P = predisposed for ISO 4401 size 06 mounting surface
Handwheel for pressure control, only for LIMM, LIMH*, LIRA, LICM (see tech. table K150):
/V = regulating handwheel (available for all the sizes)
/VF = regulating knob (available only for sizes 40…80)
/VS = manual override with safety locking (available only for sizes 40…80)
/WP = prolonged manual override protected by rubber cap for pilot solenoid valve

For all the models:
******* = calibrated plugs different from standard one. The restrictors configuration (if different from the standard) must be indicated at the end of the model code:

LIMHA - **1** / **210** - **EX** **24DC** ****** **F** **06**

F

Channel where the orifice has to be provided:
X = channel X
F = channel F

06

Size of the throttling hole in tenths of millimeters:
05 = 0,5 mm **10** = 1 mm
06 = 0,6 mm **12** = 1,2 mm
08 = 0,8 mm **15** = 1,5 mm
000 = without restrictors

4 STANDARD ORIFICES CONFIGURATION

Cover Port	LIM*-1	LIRA-1	LICM-1	LIC-1	LIM*-2	LIRA-2	LICM-2	LIC-2	LIM*-3	LIRA-3	LICM-3	LIC-3	LIM*-4	LIRA-4	LICM-4	LIC-4	LIM*-5	LICM-5	LIC-5	LIM*-6	LICM-6	LIC-6	LIM*-8	LICM-8	LIC-8
X	M4 10A	M4 08A	M4 08A	- -	M4 10A	M4 08A	M4 08A	- -	M6 10A	M6 08A	M6 12A	M6 10A	M6 10A	M6 12A	M6 10A	M6 10A	M6 10A	M6 10A	M6 10A	M6 10A	M6 10A	M6 10A	M8 10A	M8 10A	M8 10A
F	M4 12F	M4 12A	M4 05F	M4 05F	M4 12F	M4 12A	M4 05F	M4 05F	M6 12F	M6 12A	M6 12F	M6 05F	M6 12F	M6 08A	M6 12F	M6 12F	M6 12F	M6 12F	M6 12F	M6 12F	M6 12F	M6 12F	M8 12F	M8 12F	M8 12F

M4 ÷ M8 = screw size; **10A ÷ 12F** = calibrated orifice diameter in tenths of mm; **A** = short calibrated hole, **F** = long calibrated hole

5 MODEL CODE OF SLIP-IN CARTRIDGES

SC LI - **16** **31** **2** ****** **/***

SC LI: Cartridge according to ISO 7368

Size, the same of relevant cover:
16 = 16; **32** = 32; **50** = 50; **80** = 80
25 = 25; **40** = 40; **63** = 63;

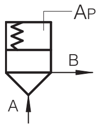
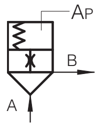
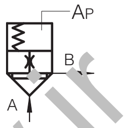
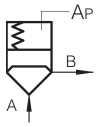
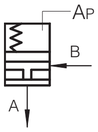
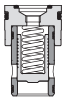
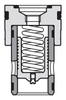
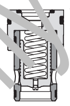
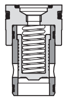
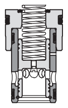
Type of poppet
31 = (sizes 16…80) = for LIMM, LIMH*, LIC, LICM
34 = (size 16) = for LIMM, LIMH*
35 = (sizes 16…50) = for LIMM, LIMH*
36 = (sizes 16…80) = for LIC, LICM
37 = (sizes 16…40) = for LIRA

Spring cracking pressure:
1 = 0,3 bar for poppet 35;
2 = 1,2 bar for poppet 31, 34, 35;
3 = 3 bar for poppet 31, 34, 35;
4 = 4 bar for poppet 37;
6 = 6 bar for poppet 31, 34, 35, 36;
7 = 7 bar for poppet 37;

******: Series number

/*: Seals material:
- = NBR
PE = FKM
BT = HNBR

6 TYPE OF POPPET

Type of poppet		**31**	**34**	**35**	**36**	**37**
Operating pressure				**420 bar**		
Nominal flow	Size **16**	180	180	180	180	140
at Δp 5bar	**25**	370	-	370	370	250
(l/min)	**32**	630	-	630	630	500
see	**40**	1100	-	1100	1100	750
diagrams Q/Δp	**50**	1900	-	1900	1900	-
at section 8	**63**	3100	-	-	3100	-
	80	4900	-	-	4900	-
Functional sketch (Hydraulic symbol)						
Typical section						
Area ratio A: AP		**1:1**	**1:1**	**1:1,1**	**1:1**	**1:1**

7 MAIN CHARACTERISTICS SEALS AND HYDRAULIC FLUIDS

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s
Fluid contamination class	ISO 4406 class 21/19/16 NAS 1638 class 10, in line filters of 25 µm ($\beta 25 \geq 75$ recommended)

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

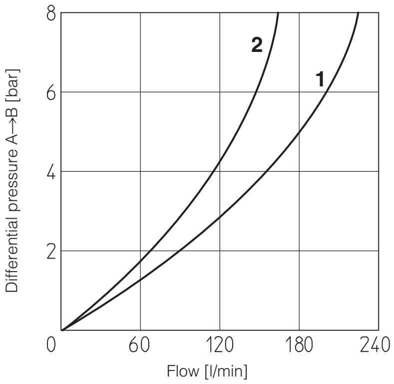
Flow direction		As shown in the symbols of table 2
Functional cover	all models except **LIMH***	Ports A, B, X: **420** bar;
operating	**LIMH*-E, LIMH*-L**	Ports A, B, X: **350** bar; Port T **210** bar for DC version; **160** bar for AC version
pressure	**LIMH*-EP**	Ports A, B, X: **420** bar; Port T **210** bar for DC version; **160** bar for AC version

7.1 Coils characteristics

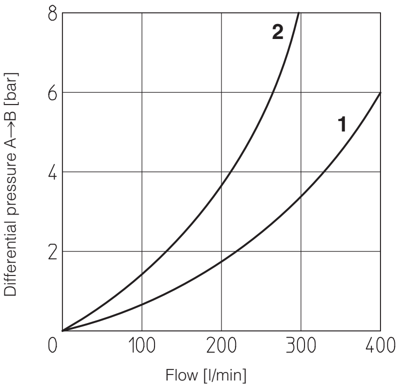
Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors 666, 667, 669 correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 9
Supply voltage tolerance	± 10%
Certification	**cURus** North American Standard (not for **-L**)

8 **FLOW /Δp DIAGRAMS** based on mineral oil ISO VG 46 at 50 °C

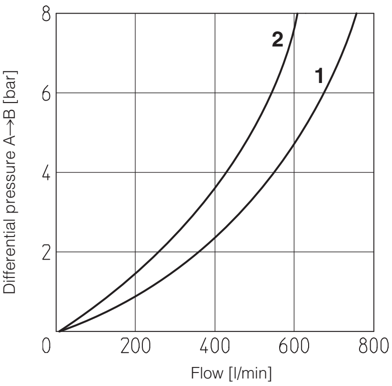
size 16



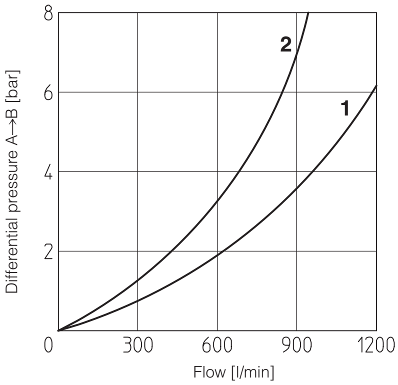
size 25



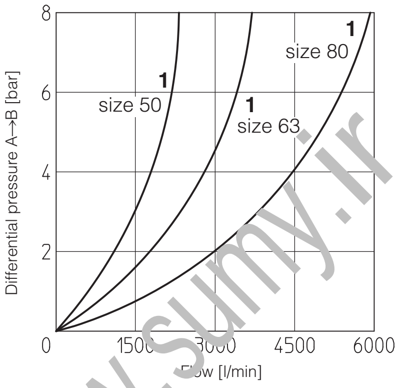
size 32



size 40



size 50, 63, 80



1 = poppet type 31, 34, 35, 36
2 = poppet type 37

Note:

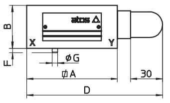
poppet type 34 only for size 16
poppet type 37 for size 16 to 50

9 ELECTRIC FEATURES

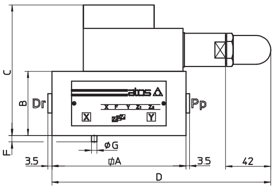
Solenoid valve type	External supply nominal voltage ± 10% (1)		**Voltage code**	Type of connector	Power consumption (3)	Code of spare coil DHE, DHEP	Code of spare coil DHL
DHE DHEP DHL	DC	12 DC 24 DC 110 DC 220 DC	**12 DC** **24 DC** **110 DC** **220 DC**	666 or 667	29 W (DHL) 30 W (DHE, DHEP)	COE-12DC COE-24DC COE-110DC COE-220DC	COL-12DC COL-24DC COL-110DC COL-220DC
	AC	110/50 AC (2) 115/60 AC 120/60 AC 230/50 AC (2) 230/60 AC	**110/50/60 AC** **115/60 AC** **120/60 AC** **230/50/60 AC** **230/60 AC**	666 or 667	58 VA (4)	COE-110/50/60AC COE-115/60AC COE-230/50/60AC COE-230/60AC	COL-110/50/60AC COL-115/60AC COL-230/50/60AC COL-230/60AC

(1) For other supply voltages available on request see technical tables E015, E030, E018.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 55 VA for DHL and 52VA for DHE and DHEP
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.

10 COVER DIMENSIONS [mm] - for mounting interface and cavity dimensions see tech. table P006

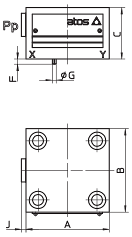


LIMM (size 16…32)
LIRA (size 16…32)
LICM (size 16…32)

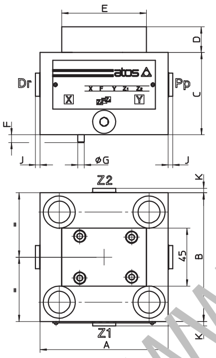


LIMM (size 40…80)
LIRA (size 40)
LICM (size 40…80)

Covers	A	B	C	D	F	G	Port Pp-Dr	Seals	Fastening bolts (2)	Tightening torque [Nm]	Mass [Kg]
LIMM-1 **LIRA-1** **LICM-1**	65	40	-	107,5	4	3	-	2 OR 108	Nr. 4 M8x45	35	1,7
LIMM-2 **LIRA-2** **LICM-2**	85	40	-	127,5	6	5	-	2 OR 108	Nr. 4 M12x45	125	2,2
LIMM-3 **LIRA-3** **LICM-3**	100	50	-	142,5	6	5	-	2 OR 2043	Nr. 4 M16x55	300	3,5
LIMM-4 **LIRA-4** **LICM-4**	125	60	122	195	6	5	G 1/4	2 OR 3043	Nr. 4 M20x70	600	8,9
LIMM-5 **LICM-5**	140	70	132	202,5	4	6	G 1/4	2 OR 3043	Nr. 4 M20x80	600	12,4
LIMM-6 **LICM-6**	180	80	142	222,5	4	6	G 3/8	2 OR 3050	Nr. 4 M30x90	2100	21,6
LIMM-8 **LICM-8**	Ø250	80	172	257,5	6	8	G 3/8	2 OR 4075	Nr. 8 M24x90	1000	30,5

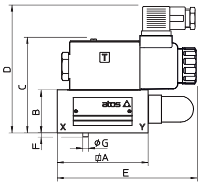


LIC (size 16 ÷ 25)

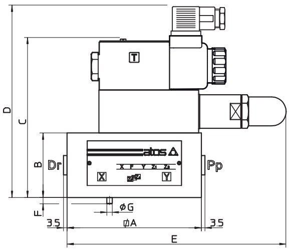


LIC (size 32…80)

Covers	A	B	C	D	E	F	G	K	J	Port Pp-Dr	Port Z1-Z2	Seals	Fastening bolts (2)	Tightening torque [Nm]	Mass [Kg]
LIC-1	65	65	40	-	-	4	3	-	3,5	G 1/4	-	2 OR 108	Nr. 4 M8x45	35	1,4
LIC-2	85	85	40	-	-	6	5	-	3,5	G 1/4	-	2 OR 108	Nr. 4 M12x45	125	1,8
LIC-3	100	100	50	20	66	6	5	-	3,5	G 1/4	-	4 OR 2043	Nr. 4 M16x55	300	2,3
LIC-4	125	125	60	20	66	6	5	-	3,5	G 1/4	-	4 OR 3043	Nr. 4 M20x70	600	6,2
LIC-5	140	140	70	20	66	4	6	3,5	3,5	G 1/4	G 1/4	4 OR 3043	Nr. 4 M20x80	600	9,3
LIC-6	180	180	80	20	66	4	6	3,5	3,5	G 3/8	G 3/8	4 OR 3050	Nr. 4 M30x90	2100	17,1
LIC-8	Ø 250	-	80	30	73	6	8	-	3,5	G 3/8	-	4 OR 4075	Nr. 8 M24x90	1000	27



LIMH* (size 16…32)



LIMH* (size 40…80)

Covers	A	B	C max	D max	E	F	G	Port Pp-Dr	Seals	Fastening bolts (2)	Tightening torque [Nm]	Mass [Kg]
LIMHA-1 **LIMHC-1**	65 (1)	40	87,5	123,5	124,5	4	3	-	2 OR 108	Nr. 4 M8x45	35	3
LIMHA-2 **LIMHC-2**	85	40	87,5	123,5	134,5	6	5	-	2 OR 108	Nr. 4 M12x45	125	3,3
LIMHA-3 **LIMHC-3**	100	50	130,5	153,5	142,5	6	5	-	2 OR 2043	Nr. 4 M16x55	300	5
LIMHA-4 **LIMHC-4**	125	60	150,5	183,5	195	6	5	G 1/4	2 OR 3043	Nr. 4 M20x70	600	9,2
LIMHA-5 **LIMHC-5**	140	70	160,5	193,5	202,5	4	6	G 1/4	2 OR 3043	Nr. 4 M20x80	600	13,2
LIMHA-6 **LIMHC-6**	180	80	170,5	203,5	222,5	4	6	G 3/8	2 OR 3050	Nr. 4 M30x90	2100	22,5
LIMHA-8 **LIMHC-8**	Ø 250	80	200,5	233,5	257,5	6	8	G 3/8	2 OR 4075	Nr. 8 M24x90	1000	31,3

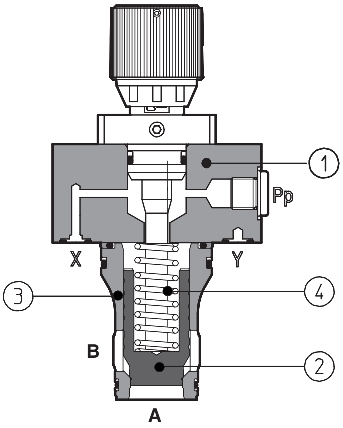
(1) Cover is not squared: 65x80

(2) Hexagon socket head screw according to DIN 912 class 12.9

Overall dimensions refer to the pilot valves with connectors type 666

ISO cartridge valves type LIDD

Flow control



LIDD-2

① Functional cover
② Poppet
③ Sleeve
④ Spring

LIDD are flow control valves not compensated, in ISO cartridge design, made by a functional "cover" ① and a 2-way SC LI slip-in cartridge.

Covers are provided with regulating screw to adjust the cartridge opening.

The cartridge is made by poppet ② sliding into a sleeve ③. The position of the spool or poppet and then the controlled flow, is manually set on the regulating screw of the cover; the cracking pressure value depends on poppet spring.

Size: **16 to 63** ISO 7368

Max flow up to **4000 l/min** at Δp 5 bar

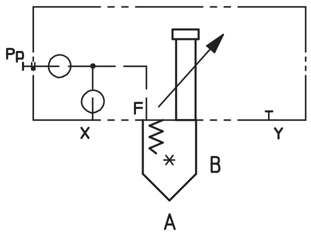
Max pressure: **LIDD 420 bar**

1 MODEL CODE FOR COVERS - for model code of slip-in cartridge/spool see section 3, 5

LI	DD	–	1	/	*	**	/*
Cover according to ISO 7368	Flow control valve: **DD** = normally closed with stroke limiter		Size for LIDD: **1** = 16 **2** = 25 **3** = 32 **4** = 40 **5** = 50 **6** = 63		Options: see section 6	Series number LIDD = **50** all sizes **(1)**	Seals material: **-** = NBR **PE** = FKM **BT** = HNBR

(1): New series 50 of LIDD cover is highly recommended in combination with new high flow cartridges series 40 The use of old cartridges series 10, 11 and 31 may cause the impossibility to fully close the poppet

2 HYDRAULIC SYMBOLS



3 MODEL CODE OF SLIP-IN CARTRIDGES - for LIDD

SC LI	**-**	**16**	**43**	**1**	**40**	**/**	*****

Cartridge according to ISO 7368

Size, the same of relevant cover:
16 25 32 40 50 63

Type of poppet
32, 33 (size 16 to 100) = without damping nose
42 (size 16 to 80) = as 32 but with damping nose
43 (size 16 to 100) = as 33 but with damping nose

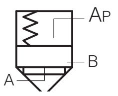
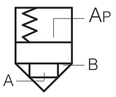
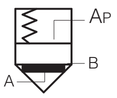
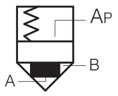
Spring cracking pressure:
1 = 0,3 bar for poppet 32, 42
1 = 0,6 bar for poppet 33, 43
2 = 1,5 bar for poppet 32, 42
3 = 3 bar for all poppets
6 = 5,5 bar for all poppets

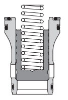
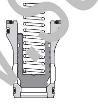
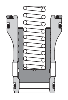
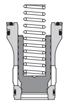
Series number **(1)**
40 = all sizes

Seals material:
- = NBR
PE = FKM
BT = HNBR

(1) New series 40 is mechanically interchangeable with standard flow series 31, 11 and 10 - cavity according to ISO 7368
New series 50 of LIDD cover is highly recommended in combination with new cartridges series 40
The use of old cartridges series 10, 11 and 31 may cause the impossibility to fully close the poppet

4 TYPE OF POPPET

Type of poppet	**32**	**33**	**42**	**43**
Functional sketch (Hydraulic symbol)				

Operating pressure		**420 bar max**			
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 7	Size **16**	270	270	240	240
	25	550	550	500	500
	32	1000	1000	800	800
	40	1700	1700	1400	1400
	50	2500	2500	2200	2200
	63	4000	4000	3300	3300
Typical section					
Area ratio A:Ap		**1:1,1**	**1:1,5**	**1:1,1**	**1:1,5**
Cracking pressure A→B	Spring **1**	0,3 bar	0,6 bar	0,3 bar	0,6 bar
	2	1,5 bar	-	1,5 bar	-
	3	3 bar	2,5 bar	3 bar	2,5 bar
	6	6 bar	6 bar	6 bar	6 bar
Cracking pressure B→A	Spring **1**	3 bar	0,9 bar	3 bar	0,9 bar
	2	12,8 bar	-	12,8 bar	-
	3	32,5 bar	3,8 bar	32,5 bar	3,8 bar
	6	59,4 bar	9 bar	59,4 bar	9 bar

5 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUID

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C		
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	
Flow direction	A to B or B to A		
Functional cover operating pressure	ports X, Y: **420** bar		

6 OPTIONS

/E = with external attachments X and underneath port X supplied plugged;

******* = Calibrated plugs different from standard ones. LIDD covers in standard executions are not equipped with restrictors in the pilot channels. When ordering covers equipped with restrictors, it must be indicated at the end of the model code:

LIDD	-	1	/E	X	06
				Channel where the restrictor has to be provided: **X** = channel X	Size of the throttling hole in tenths of millimeters: **05** = 0,5 mm **10** = 1 mm **06** = 0,6 mm **12** = 1,2 mm **08** = 0,8 mm **15** = 1,5 mm

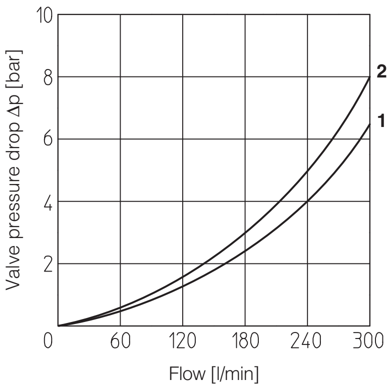
Note: For LIDD-***/E**, the calibrated orifices are located in the lateral port for external attachment
Calibrated orifices are not available for LIDD-1/E (size 16)

7 Q/ΔP DIAGRAMS - based on mineral oil ISO VG 46 at 50°C

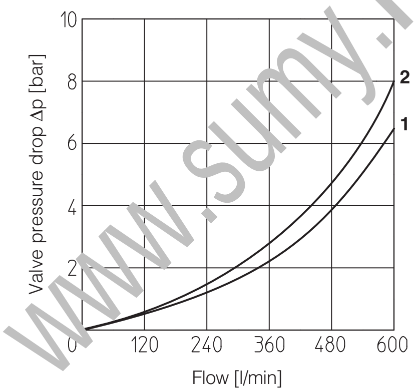
SC LI slip-in cartridges, poppet type 32, 33, 42, 43

1 = poppet type 32 and 33
2 = poppet type 42 and 43

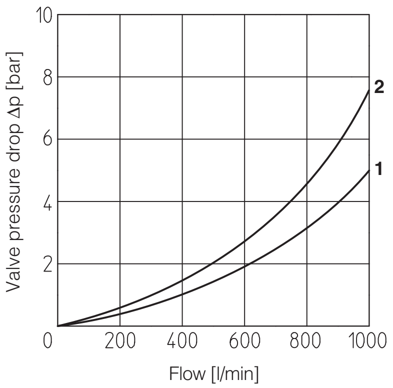
size 16



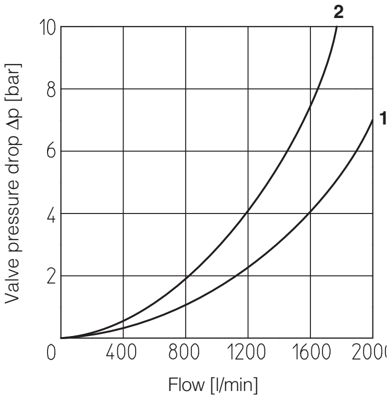
size 25



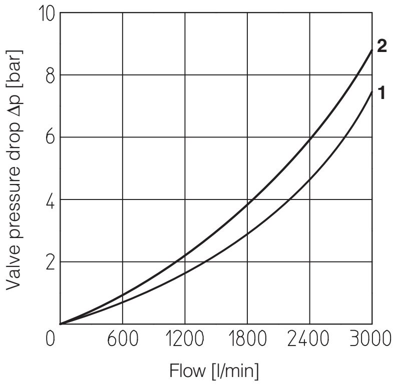
size 32



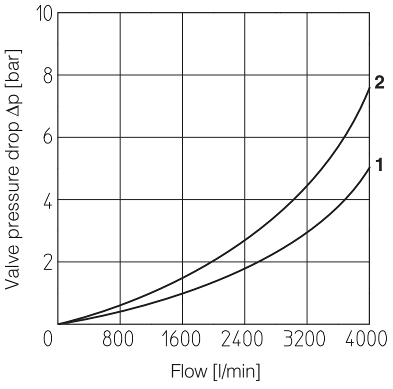
size 40



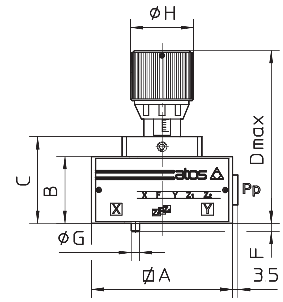
size 50



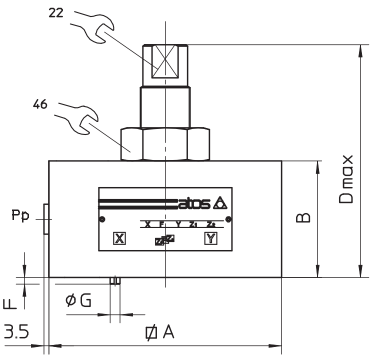
size 63



8 LIDD COVER DIMENSIONS [mm] - for mounting interface and cavity dimensions, see tech. table P006



LIDD (dim. 16...40)



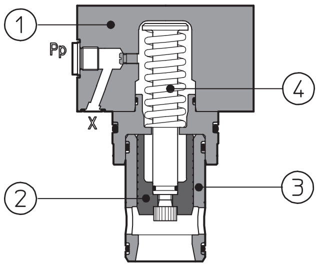
LIDD (size 50 ÷ 63)

Covers	A	B	C	D max	F	G	H	Port Pp	Seals	Fastening bolts (1)	Tightening torque [Nm]	Mass [Kg]
LIDD-1	65	40	52	104	4	3	38	G1/4	2 OR 108	Nr. 4 M8x45	35	2
LIDD-2	85	40	52	104	6	5	38	G1/4	2 OR 108	Nr. 4 M12x45	125	2,4
LIDD-3	100	50	75	156	6	5	50	G1/4	2 OR 2043	Nr. 4 M16x55	300	2,8
LIDD-4	125	60	85	166	6	5	50	G1/4	2 OR 3043	Nr. 4 M20x70	600	6,7
LIDD-5	140	70	-	140	4	6	-	G1/4	2 OR 3043	Nr. 4 M20x80	600	9,8
LIDD-6	180	80	-	151	4	6	-	G3/8	2 OR 3050	Nr. 4 M30x90	2100	17,5

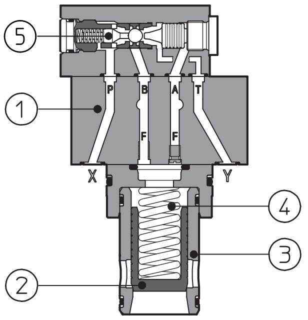
(1) Hexagon socket head screw according to DIN 912 class 12.9

ISO cartridge valves type LID*

Check function, high flow, **Pmax 420 bar**



LIDO-3



LIDR-3

① Functional cover
② Poppet
③ Sleeve
④ Spring
⑤ Pilot operated check valve

Directional control valves in ISO cartridge design, specific for check functions. They are made by a functional cover ① and a 2-way **SC LI** slip-in cartridge.

Covers are available with different check functions:
LIDA, normally closed
LIDO, normally open
LIDB, normally closed with shuttle valve for pilot pressure selection
LIDR, normally closed with pilot operated check valve

The SC LI slip-in cartridge is available with different poppet shape to optimize the check control, see section 6.

It is made by a poppet ② sliding into a sleeve ③ and kept in normally closed position (open position for type 62 and 63) by the spring ④ available with different cracking pressure values.

Size: **16 to 100** ISO 7368
Max flow up to **9000 l/min** at Δp = 5 bar
Max pressure up to **420 bar**

1 MODEL CODE OF FUNCTIONAL COVERS - for model code of slip-in cartridge see section 5, 7

LI	D	A	-	1	/	*	**	/	**	*

LI: Cover according to ISO 7368

D = directional function

Cover configuration see section 2:
A = normally closed;
O = normally open;
B = with shuttle valve for pilot selection;
R = with hydraulically operated pilot check valve;

Size:
1 = 16; **4** = 40; **8** = 80 (only for LIDA)
2 = 25; **5** = 50; **10** = 100 (only for LIDA)
3 = 32; **6** = 63 (not for LIDO)
LIDO is available only in sizes 16 to 50

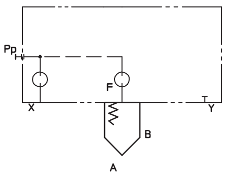
Options: see section 3

Series number

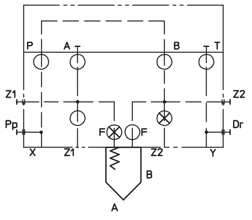
Seals material:
- = NBR
PE = FKM
BT = HNBR

Optional different setting of calibrated plugs in the pilot channels, see section 3, 4

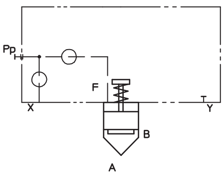
2 HYDRAULIC SYMBOLS (cover configuration)



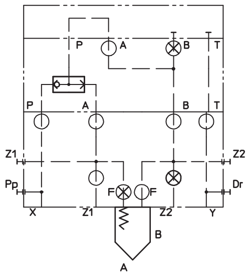
LIDA
size 16…25



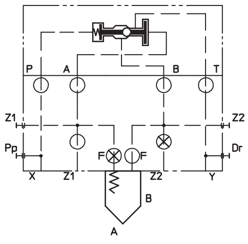
LIDA
size 32…100



LIDO
size 16…50



LIDB
size 16…63



LIDR
size 16…63

3 OPTIONS

For LIDA (sizes 16 and 25), for LIDO (all sizes) LIDB (sizes 40 ÷ 63), LIDR (sizes 40 ÷ 63):
/E = with external attachments Pp and underneath port X supplied plugged;
For LIDA, LIDB, LIDR:
/F = prearranged for coupling to an intermediate element with position detector for safety valves, see tab. EY120.
For all models:
******* = Calibrated plugs different from standard ones reported in section 4. The restrictors configuration (if different from the standard) it must be indicated at the end of the model code:

LIDB - **4** **/E** ****** **P** **06**

P – Channel where the restrictor has to be provided:
P = channel X, port P
F = channel F
Z1 = channel Z1
Z2 = channel Z2

06 – Size of the throttling hole in tenths of millimiters:
05 = 0,5 mm
06 = 0,6 mm
08 = 0,8 mm
10 =1 mm
12 =1,2 mm
15 =1,5 mm
17 = 1,7 mm
20 = 2 mm

4 STANDARD ORIFICES CONFIGURATION

Port \ Cover	LIDA-1	LIDO-1	LIDB-1	LIDR-1	LIDA-2	LIDO-2	LIDB-2	LIDR-2	LIDA-3	LIDO-3	LIDB-3	LIDR-3	LIDA-4	LIDO-4	LIDB-4	LIDR-4	LIDA-5	LIDO-5	LIDB-5	LIDR-5	LIDA-6	LIDB-6	LIDR-6	LIDA-8	LIDA-10
X	- -	v	- -	- -	- -	M4 10A	- -	- -	- -	M6 12A	- -	- -	- -	M6 15F	- -	- -	- -	M6 15F	- -	- -	- -	- -	- -	- -	- -
P	- -	- -	- -	M6 12A	- -	- -	- -	M6 12A	- -	- -	- -	M6 15A	- -	- -	- -	M6 17A	- -	- -	- -	M6 20A	- -	- -	M6 20A	- -	- -
Z2	- -	- -	- -	M4 100F	- -	- -	- -	M6 300F	- -	- -	- -	M6 300F	- -	- -	- -	M6 300F	- -	- -	- -	M6 300F	- -	- -	M6 300F	- -	- -

M4 ÷ M6 = screw size **10A ÷ 300F** = calibrated orifices diameters in tenths oh mm; **A** = short calibrated hole, **F** = long calibrated hole

5 MODEL CODE OF SLIP-IN CARTRIDGES

SC LI - **16** **43** **1** **40** / *****

SC LI – Cartridge according to ISO 7368

Size, the same of relevant cover:
16 **25** **32** **40** **50** **63** **80** **100**

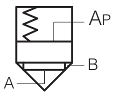
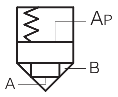
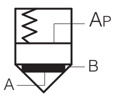
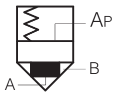
Type of poppet (not for LIDO)
32, 33 (size 16 to 100) = without damping nose
42 (size 16 to 80) = as 32 but with damping nose
43 (size 16 to 100) = as 33 but with damping nose

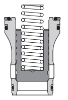
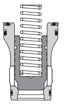
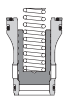
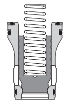
Spring cracking pressure:
1 = 0,3 bar for poppet 32, 42
1 = 0,6 bar for poppet 33, 43
2 = 1,5 bar for poppet 32, 42
3 = 3 bar for all poppets
6 = 5,5 bar for all poppets

40 – Series number

***** – Seals material:
- = NBR
PE = FKM
BT = HNBR

6 TYPE OF POPPET

Type of poppet	**32**	**33**	**42**	**43**
Functional sketch (Hydraulic symbol)				

Operating pressure		**420 bar max**			
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 10	Size **16**	270	270	240	240
	25	550	550	500	500
	32	1000	1000	800	800
	40	1700	1700	1400	1400
	50	2500	2500	2200	2200
	63	4000	4000	3300	3300
	80	5500	5500	4000	4000
	100	9000	9000	-	6300
Typical section					
Area ratio A:Ap		**1:1,1**	**1:1,5**	**1:1,1**	**1:1,5**
Cracking pressure A→B	Spring **1**	0,3 bar	0,6 bar	0,3 bar	0,6 bar
	2	1,5 bar	-	1,5 bar	-
	3	3 bar	2,5 bar	3 bar	2,5 bar
	6	5,5 bar	5,5 bar	5,5 bar	5,5 bar
Cracking pressure B→A	Spring **1**	3 bar	1,2 bar	3 bar	1,2 bar
	2	12,8 bar	-	12,8 bar	-
	3	32,5 bar	6 bar	32,5 bar	6 bar
	6	54,5 bar	11 bar	54,5 bar	11 bar

7 MODEL CODE OF SLIP-IN CARTRIDGES type 52, 62, 63 for LIDA and LIDO

SC LI	-	16	52	1	**	/*

Cartridge according to ISO 7368

Size, the same of relevant cover:
16 25 32 40 50

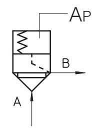
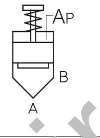
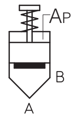
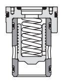
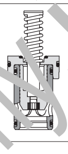
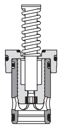
Type of poppet:
52 = normally closed, only for LIDA;
62 = normally open without damping nose, only for LIDO;
63 = normally open with damping nose, only for LIDO

Spring cracking pressure:
1 = 0,3 bar for poppet 52;
2 = 1,5 bar for poppet 52;
3 = 3 bar for all poppets
6 = 5,5 bar for all poppets

Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR

8 TYPICAL FUNCTIONS OF POPPETS

Type of poppet		**52**	**62**	**63**
Operating pressure		**420 bar**		
Nominal flow at Δp 5bar (l/min) see diagrams Q/Δp at section 10	Size **16**	160		
	25	400		
	32	600		
	40	1200		
	50	1800		
Functional sketch (Hydraulic symbol)				
Typical section				
Area ratio A:AP		**1 : 1,1**	**1 : 1,1**	**1 : 1,1**
Cracking pressure A→B (1)	Spring **1**	0,3 bar	-	-
	2	1,5 bar	-	-
	3	3 bar	-	-
	6	6 bar	-	-

(1) Depending on the spring cracking pressure and the area ratio of the poppet

9 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUID

Assembly position / location	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Ambient temperature	**Standard** execution = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog

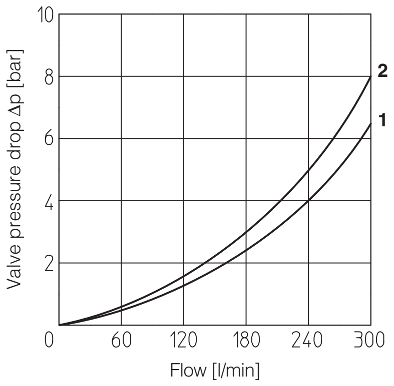
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

Flow direction	As shown in the symbols of table 2
Functional cover operating pressure	Ports P, A, B, X, Z1, Z2: **420** bar

10 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

10.1 SC LI slip-in cartridges, poppet type 32, 33, 42, 43

size 16



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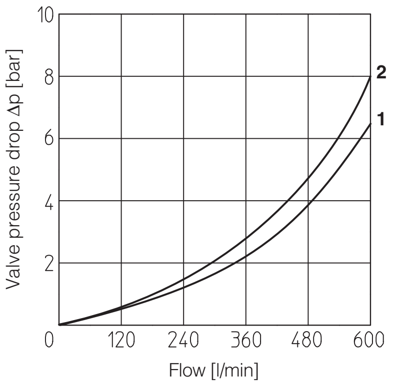
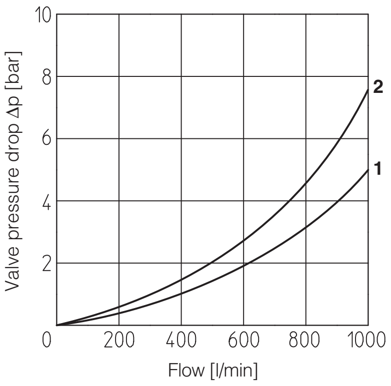
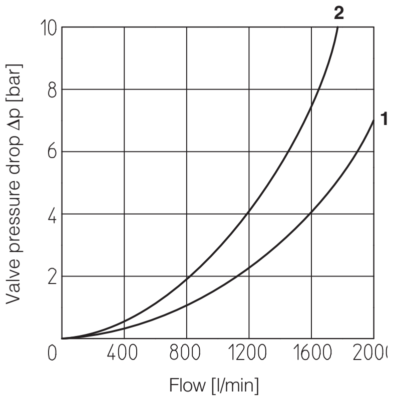


size 32



size 40



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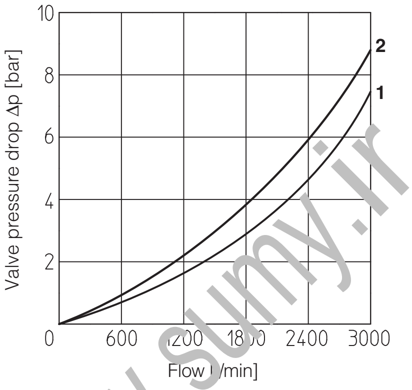
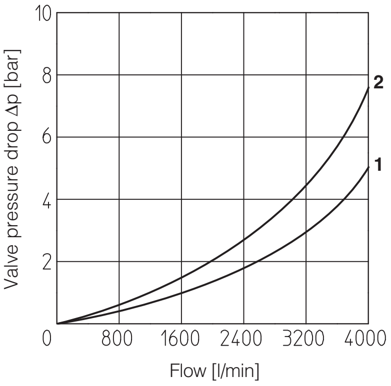


size 63



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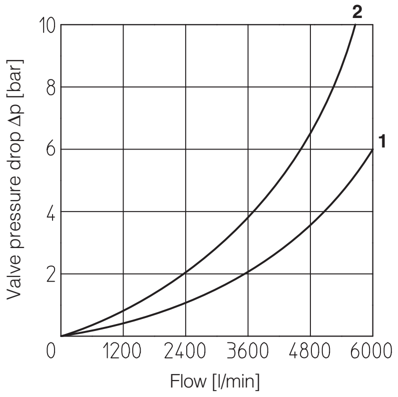
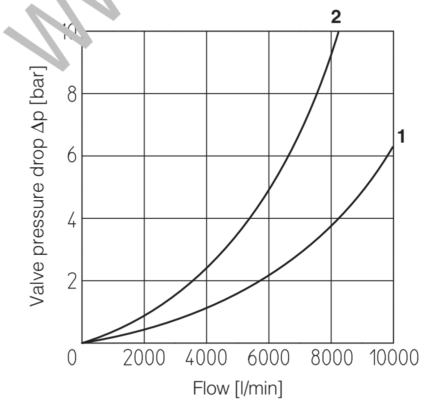


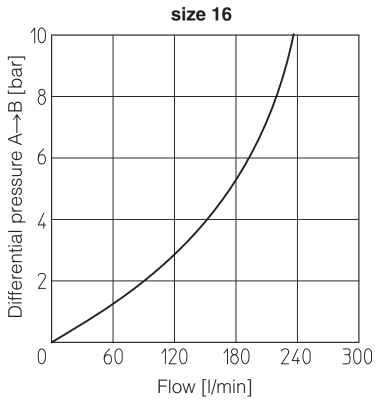
size 100



High flow - series 40

1 = poppet type 32 and 33
2 = poppet type 42 and 43

10.2 SC LI slip-in cartridges, poppet type 52, 62, 63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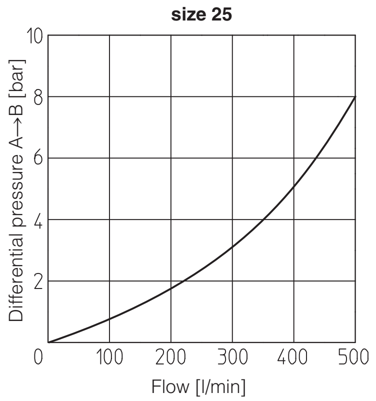
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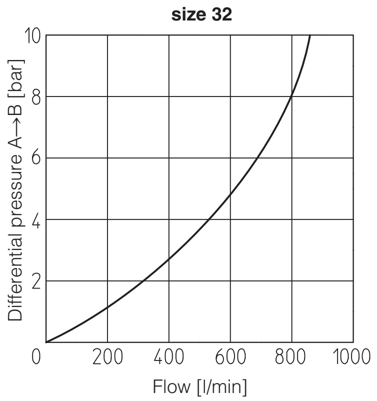
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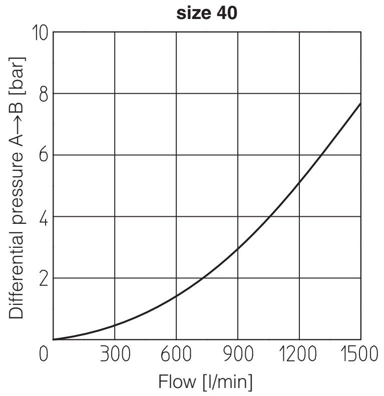
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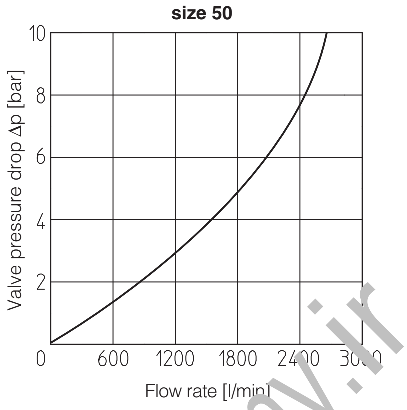
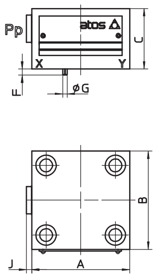
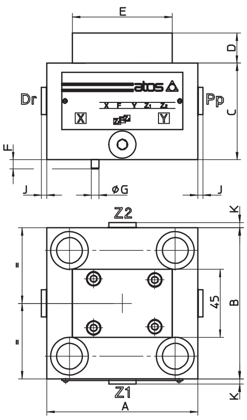

size 50

11 COVER DIMENSIONS [mm] - for mounting interface and cavity dimensions, see tech. table P006

LIDA



LIDA (size 16 ÷ 25)
LIDO (size 16…50)

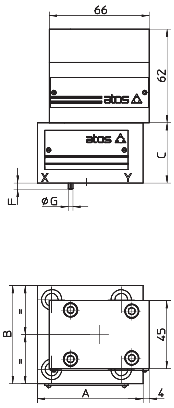


LIDA (size 32…100)
Note: for LIDA-80 and LIDA-100 the cover has round shape

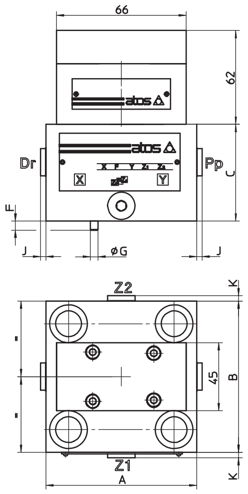
Covers (1)	A	B	C	D	E	F	G	K	J	Port Pp-Dr	Port Z1-Z2	Seals	Fastening bolts (3)	Tightening torque [Nm]	Mass [Kg]
LIDA-1 **LIDO-1**	65	65	40	-	-	4	3	-	3,5	G 1/4	-	2 OR-108 1 OR-108 (2)	Nr. 4 M8x45	35	1,4
LIDA-2 **LIDO-2**	85	85	40	-	-	6	5	-	3,5	G 1/4	-	2 OR-108 1 OR-108 (2)	Nr. 4 M12x45 (4)	125	1,8
LIDA-3 **LIDO-3**	100	100	50 60 (2)	20	66	6	5	-	- 3,5	G 1/4	-	4 OR-2043 1 OR-2043 (2)	Nr. 4 M16x55 (5)	300	2,3
LIDA-4 **LIDO-4**	125	125	60 100	20 -	66 -	6	5	-	3,5 3,5	G 1/4	-	4 OR-3043 1 OR-3043	Nr. 4 M20x70 (6)	600	6,2
LIDA-5 **LIDO-5**	140	140	70 110 (2)	20	66	4	6	3,5	3,5	G 1/4	G 1/4	4 OR-3043 1 OR-3043 (2)	Nr. 4 M20x80 (7)	600	9,3
LIDA-6	180	180	80	20	66	4	6	3,5	3,5	G 3/8	G 3/8	4 OR-3050	Nr. 4 M30x90	2100	17,1
LIDA-8	Ø 250	-	80	30	73	6	8	3,5	3,5	G 3/8	G 3/8	4 OR-4075	Nr. 8 M24x90	1000	27
LIDA-10	Ø 300	-	150	30	73	8	10	3,5	3,5	G 1/2	G 1/2	4 OR-4093	Nr. 8 M30x120	2100	54

(1) For LIDO-2: the external attachment Pp is located at Y port side of the cover;
(2) Only for LIDO;
(3) Hexagon socket head screw according to DIN 912 class 12.9
(4) M12x50 for LIDO-2;
(5) M16x60 for LIDO-3;
(6) M20x100 for LIDO-4;
(7) M20x110 for LIDO-5;

LIDB



LIDB (size 16)



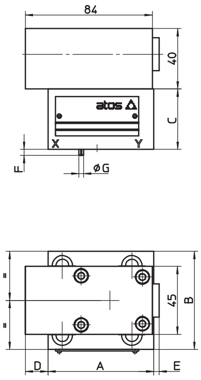
LIDB (size 25…63)

Covers	A	B	C	F	G	J	K	Port Pp-Dr	Port Z1-Z2	Seals	Fastening bolts (2)	Tightening torque [Nm]	Mass [Kg]
LIDB-1	70	65	40	4	3	-	-	-	-	4 OR-108	Nr. 4 M8x45	35	2,2
LIDB-2	85	85	40	6	5	-	-	-	-	4 OR-108	Nr. 4 M12x45	125	2,6
LIDB-3	100	100	50	6	5	-	-	-	-	4 OR-2043	Nr. 4 M16x55	300	3,1
LIDB-4	125	125	60	6	5	3,5	-	G 1/4	-	4 OR-3043	Nr. 4 M20x70	600	7
LIDB-5	140	140	70	4	6	3,5	3,5	G 1/4	G 1/4	4 OR-3043	Nr. 4 M20x80	600	10,1
LIDB-6 (1)	180	180	80	4	6	3,5	3,5	G 3/8	G 3/8	4 OR-3050	Nr. 4 M30x90	2100	17,9

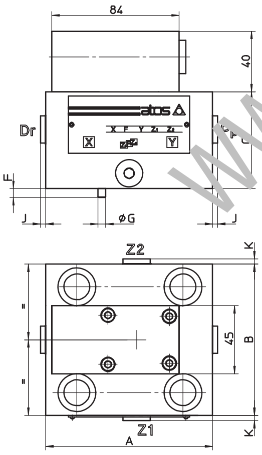
(1) The position of external attachments Pp, Dr, Z1 and Z2 are inverted each others respect to the showed sketch

(2) Hexagon socket head screw according to DIN 912 class 12.9

LIDR



LIDR (size 16…32)



LIDR (size 40…63)

Covers	A	B	C	D	E	F	G	J	K	Port Pp-Dr	Port Z1-Z2	Seals	Fastening bolts (2)	Tightening torque [Nm]	Mass [Kg]
LIDR-1	70	65	40	4	3,5	4	3	-	-	-	-	4 OR-108	Nr. 4 M8x45	35	2,5
LIDR-2	85	85	40	13,5	-	6	5	-	-	-	-	4 OR-108	Nr. 4 M12x45	125	2,9
LIDR-3	100	100	50	6	-	6	5	-	-	-	-	4 OR-2043	Nr. 4 M16x55	300	3,4
LIDR-4	125	125	60	-	-	6	5	3,5	-	G 1/4	-	4 OR-3043	Nr. 4 M20x70	600	7,3
LIDR-5	140	140	70	-	-	4	6	3,5	3,5	G 1/4	G 1/4	4 OR-3043	Nr. 4 M20x80	600	10,4
LIDR-6 (1)	180	180	80	-	-	4	6	3,5	3,5	G 3/8	G 3/8	4 OR-3050	Nr. 4 M30x90	2100	18,3

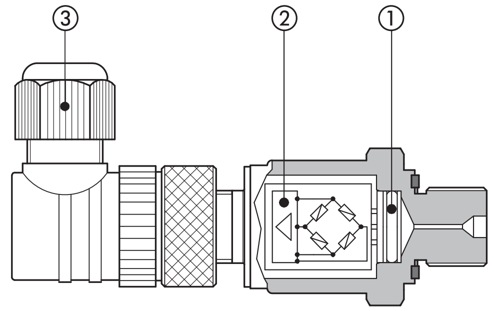
(1) The position of external attachments Pp, Dr, Z1 and Z2 are inverted each others respect to the showed sketch

(2) Hexagon socket head screw according to DIN 912 class 12.9

Pressure transducers type E-ATR-8

analog, for open and closed loop systems

CE



E-ATR-8 / 400

E-ATR-8

This pressure transducers measure the static and dynamic pressure of the hydraulic fluid, supplying a voltage or current output signal.

The sensor is composed by a thin-film circuit ①, with high resistance to overloads and pressure peaks.

The integrated electronic circuit ② supplies an amplified voltage or current output signal, proportional to the hydraulic pressure, with thermal drift compensation.

E-ATR-8 equip pressure control digital proportional valves with integral transducer and electronics, REB/RES execution.

They are also used in association with other Atos digital proportionals to perform closed loop pressure controls:

- variable displacement axial piston pumps, PE(R)S execution
  (see tech table AS170)
- directional control valves with additional closed loop pressure control, SP and SF options on TES/LES execution (see tech table FS500)

Features:

- Factory preset and calibrated
- Standard 5 pin M12 main connector ③
- IP67 protection degree
- CE mark according to EMC directive

1 MODEL CODE

E-ATR-8 / **400** / * *

Pressure transducer

Series number

Pressure measuring range:

60 = 0 ÷ 60 bar
100 = 0 ÷ 100 bar
160 = 0 ÷ 160 bar
250 = 0 ÷ 250 bar
400 = 0 ÷ 400 bar

Options:
- = voltage output signal 0 ÷ 10 V
I = current output signal 4 ÷ 20 mA

2 MAIN CHARACTERISTICS

Pressure measuring range	0 ÷ 60/100/160/250/400 bar; other values availables on request Note: negative pressure can damage the pressure transducer
Overload pressure	2 x FS without exceeding 600 bar
Burst pressure	5 x FS without exceeding 1700 bar
Response time	≤ 2 ms
Temperature range	Operating -40 ÷ +100 °C; Storage -40 ÷ +100 °C; Fluid: -40 ÷ +100 °C
Thermal drift	@ zero: ≤ ±0,025 % FS/°C max; @ FS: ≤ ±0,025 % FS/°C max
Accuracy	≤ ±1,2 % FS
Non-Linearity	≤ ±0,5 % of FS (BFSL) as per IEC 61298-2
Fluid Compatibility	Hydraulic oil as per DIN51524...535; for water-glycol, phosphate ester and skydrol® , please contact Atos technical department
Power supply	24 VDC nominal; 14 ÷ 30 VDC for standard (8 ÷ 30 VDC for /I option); Imax 25 mA
Output signal	Standard: voltage output signal 0 ÷ 10 V (3 pins); Min load > maximum output signal / 1 mA /I option: current output signal 4 ÷ 20 mA (2 pins); Max load ≤ (power supply - 8 V) / 0,02 mA
Wiring protections	Against reverse polarity on power supply and short-circuit on output signal
Materials	Wetted parts: stainless steel 316L (13-8 PH for sensor); seals: FPM/FKM
Mass	Approx. 57 g
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE EN 61326 emission (group 1, class B) and immunity (industrial application)
Service life	1x10^6 load cycles
MTTF	> 100 years
Compliance	RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006
Vibration resistance	20 g according to DIN EN 60068-2-6 from 20 to 2000 Hz
Shock resistance	40 g / 6 ms / half-sinusoid, according to DIN EN 60068-2-27
Protection class	IP67 with mating connector
Hydraulic connection	1/4" GAS - DIN 3852 (pressure port orifice Ø 0,6 mm)
Electrical connection	Type: plastic 5 pins M12 at 90° (DIN 43650-C) with cable gland type PG7 for cable max Ø 6 mm Protection: IP67 according to EN 60529; Insulation: according to VDE 0110-C

Notes: FS = Full Scale; **BFSL** = Best Fit Straight Line

3 INSTALLATION AND COMMISSIONING

3.1 Warning

E-ATR-8 transducers have to be installed as near as possible to the point where the pressure have to be measured, taking care that the oil flow is not turbulent.

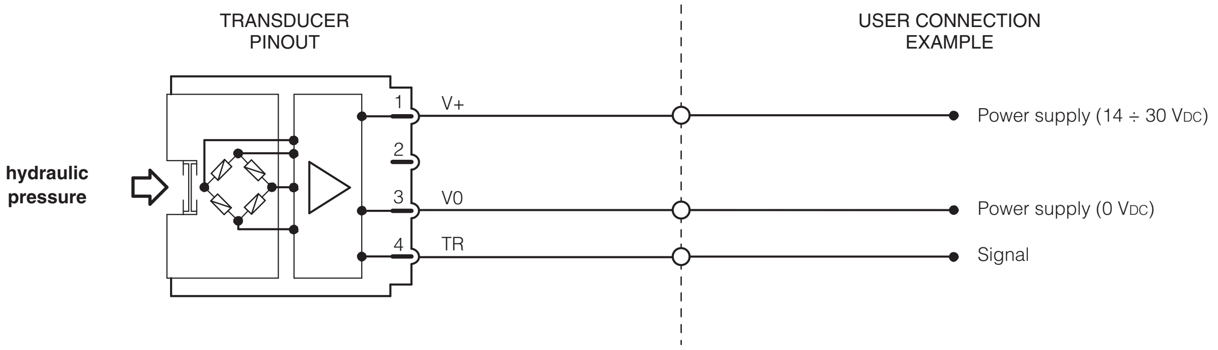
3.2 Commissioning

Install the transducer in the hydraulic circuit.
Switch-off the power supply before connecting and disconnecting the transducer connector as shown in scheme 4 .

4 ELECTRONIC CONNECTIONS

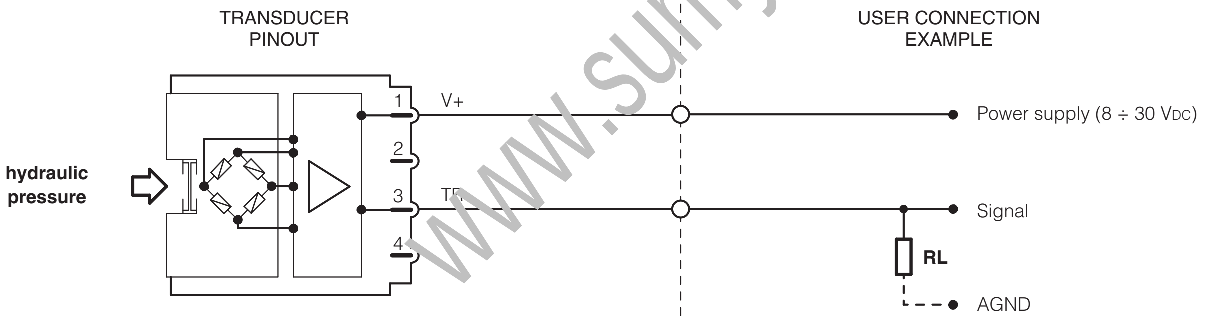
E-ATR-8 / *

voltage output signal 0 ÷ 10 V



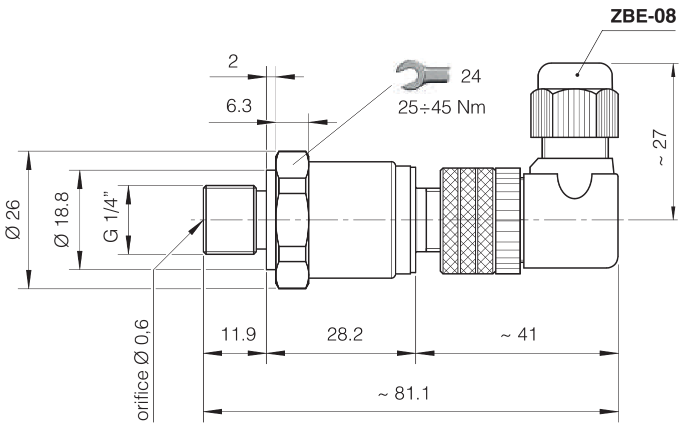
E-ATR-8 / * / I

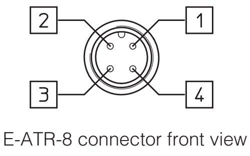
current output signal 4 ÷ 20 mA



The max resistance **RL** [Ω] is calculated: $\mathbf{RL} = \frac{\text{Vsupply} \ -10[V]}{0,02 \qquad [A]}$

5 OVERALL DIMENSIONS [mm]

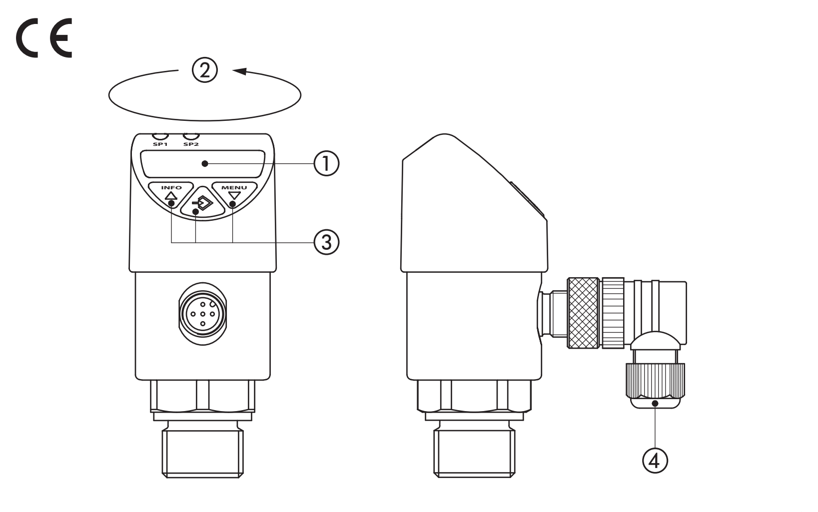




E-ATR-8 connector front view

Electronic pressure switches type E-DAP-2

digital, with integral digital display



1 MODEL CODE

E-DAP-2 - **250** / **2** *

Electronic pressure switch

Pressure range:
100 = 100 bar
250 = 250 bar
400 = 400 bar

2 = 2 switching outputs

Series number

E-DAP-2

Compact electronic pressure switch with integral digital display, available for 3 different pressure ranges.

The working pressure is real time measured and monitored on a 4 digits display ① in bar, Mpa, kPa, psi or kg/cm². The display can be mechanically rotated on 1 axis ② and turned electronically through 180°.

It provides two independent output with electronic contacts which are triggered when the pressure in the hydraulic circuit reaches the switch point or window (see section 4).

The functional parameters as the pressure switching point, hysteresis range, pressure measuring units and others additional functions can be easily set by the end user trough proper programming keys ③ .

For detailed instructions about the use of the electronic pressure switch refer to the operating manual supplied with the instrument.

Features:
- Standard 5 pin M12 main connector ④
- IP65 / IP67 protection degree
- CE mark according to EMC directive

2 MAIN CHARACTERISTICS

Model	**E-DAP-2-100**	**E-DAP-2-250**	**E-DAP-2-400**
Pressure measuring range [bar] (1)	0,5 ÷ 100	1,25 ÷ 250	2 ÷ 400
Overload pressure	2 x FS		
Response time	≤ 10 ms		
Temperature range	Operating -40 ÷ +80 °C; Storage -40 ÷ +80 °C; Fluid: -40 ÷ +85 °C		
Thermal drift	Zero ±0,02 % FS / °C (typ); span ±0,01 % FS / °C (typ)		
Accuracy display	≤ ±1,0 % of FS ±1 digit		
Non-Linearity	≤ ±0,5 % of span BFSL as per IEC 61298-2		
Fluid compatibility	Hydraulic oil as per DIN51524...535; for water-glycol, phosphate ester and skydrol® , please contact Atos technical department		
Power supply	15 ÷ 35 VDC; Imax 600 mA		
N° of outputs	2		
Output type	PNP transistor output (ON state ≅ power supply - 1 V)		
Switching current	250 mA max per output (resistive load)		
Wiring protections	Against reverse polarity on power supply and short-circuit on output signal		
Display	4 digit, 14 segment led, red, height 9 mm		
Materials	Wetted parts: stainless steel 316L (13-8 PH for sensor); seals: FPM/FKM		
Mass	174 g		
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE EN 61326 emission (group 1, class B) and immunity (industrial application)		
Service life	1x10^6 load cycles		
MTTF	> 100 years		
Compliance	RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Vibration resistance	10 g according to IEC 60068-2-6, under resonance		
Shock resistance	50 g according to IEC 60068-2-27		
Protection class	IP65 / IP67 with mating connector		
Hydraulic connection	1/4" GAS - DIN 3852 form E (pressure port orifice Ø 0,6 mm)		
Electrical connection	Type: plastic 5 pins M12 at 90° (DIN 43650-C) with cable gland type PG7 for cable max Ø 6 mm Protection: IP67 according to EN 60529; Insulation: according to VDE 0110-C		

Notes: FS = Full Scale; **BFSL** = Best Fit Straight Line; **(1)** negative pressure lower than -1 bar can damage the device

3 FEATURES

- Two independent PNP transistor switching outputs. Imax up to 250 mA per output
- 4 digit display, adjustable on one axes without tools for best visual position or visualized digits can be turned electronically of 180°
- Pressure reading selectable in: bar, Mpa, kPa, psi, kg/cm^2
- Selection of different display modes: unit switching, offset adjustment, actual pressure value, minimum or maximum pressure value, function switch points, function reset points, display updates/second.
- Hydraulic connection G1/4”
- Electric connector M12x1 supplied with the pressure switch

4 OUTPUTS SWITCHING FUNCTION

The independent outputs can be settable using two different functions: Hysteresis and Windows.

Hysteresis function - see 4.1

If the system pressure fluctuates around the set point, the hysteresis keeps the switching status of the outputs stable. With increasing system pressure, the output switches when reaching the switch point (SP).

- HNO - contact normally open: active
- HNC - contact normally closed: inactive

With system pressure falling again, the output will not switch back before the reset point (RP) is reached.

- HNO - contact normally open: inactive
- HNC - contact normally closed: active

Window function - see 4.2

The window function allows for the control of a defined range.
When the system pressure is between window High (FH) and window Low (FL), the output switches on.

- FNO - contact normally open: active
- FNC - contact normally closed: inactive

When the system pressure is outside window High (FH) and window Low (FL), the output does not switch on.

- FNO - contact normally open: inactive
- FNC - contact normally closed: active

Delay times (0 ... 50 s) - see 4.3

This makes it possible to filter out unwanted pressure peaks of a short duration or a high frequency (damping).

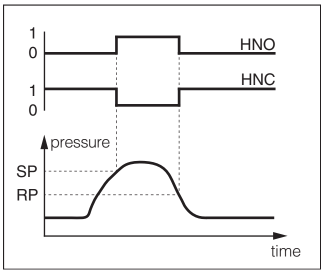
The pressure must be present for at least a certain pre-set time for the output to switch on. The output does not immediately change its status when it reaches the switching event (SP), but rather only after the pre-set delay time (DS).

If the switching event is no longer present after the delay time, the switch output does not change.
The output only switches back when the system pressure has fallen down to the reset point (RP) and stays at or below the reset point (RP) for at least the pre-set delay time (DR).

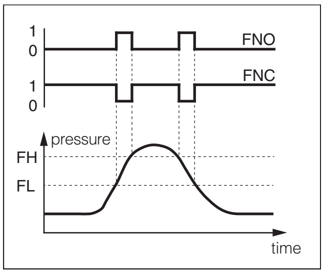
If the switching event is no longer present after the delay time, the switch output does not change.

Delay times is available for Hysteresis and Window functions.

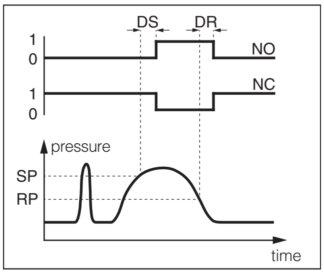
4.1 Hysteresis Function



4.2 Window Function



4.3 Delay times (0 ... 50 s)



5 INSTALLATION AND USE

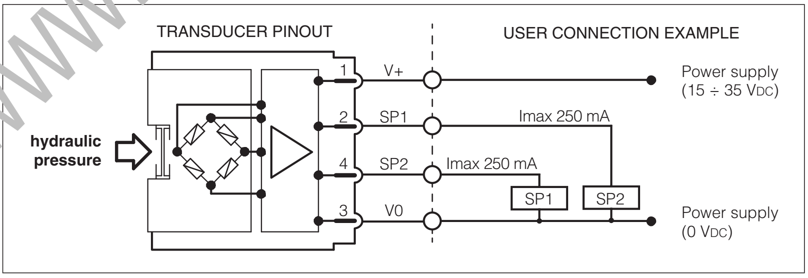
E-DAP-2 can be installed in any position.

Rotate the 4 digit display in order to provide the best visual orientation.

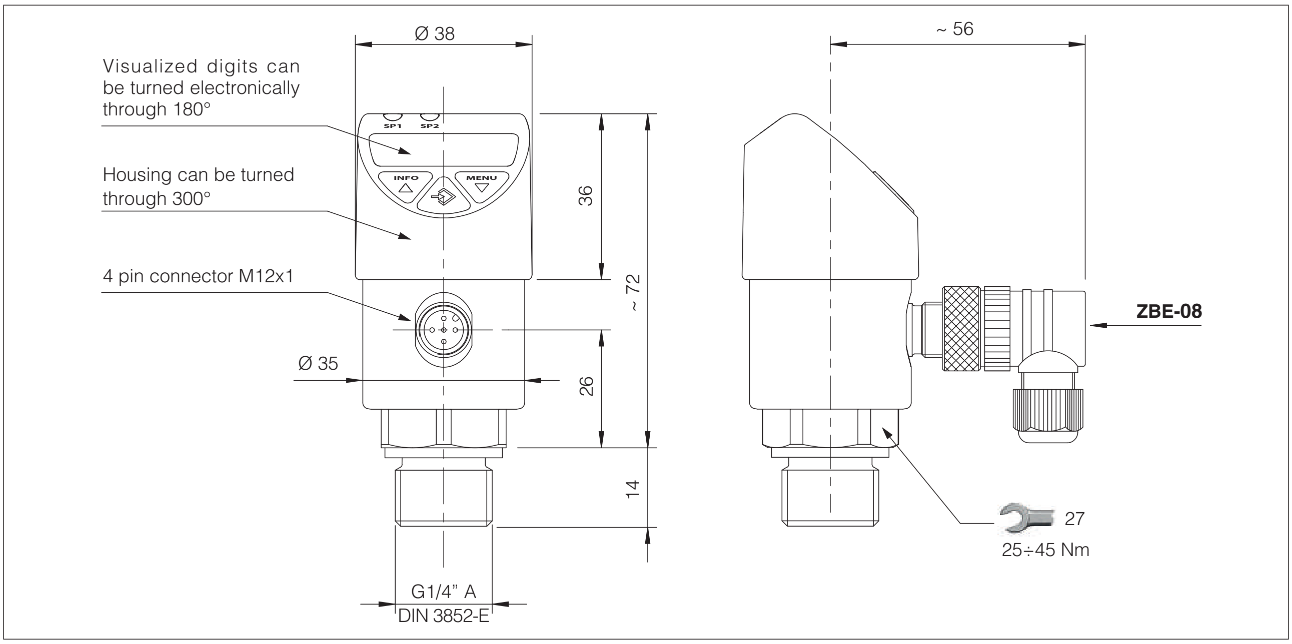
Connect M12 electric connector according the wiring diagram in section 6 .

Consult the operating manual, supplied with the electronic pressure switch, for the parameters setting.

6 ELECTRONIC CONNECTIONS

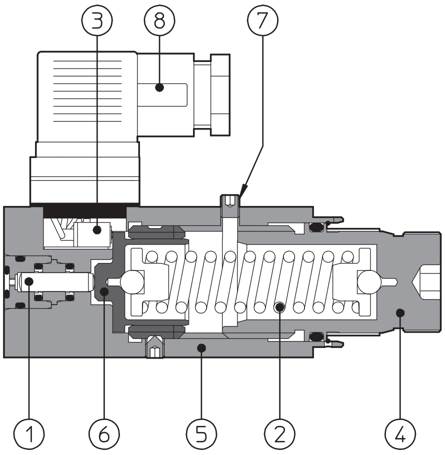


7 OVERALL DIMENSIONS [mm]



Pressure switches type MAP

with fixed switching pressure differential and microswitch with gold plated contacts



- ① Servo-piston
- ② Spring
- ③ Microswitch with gold plated contacts
- ④ Adjusting knob with graduated scale
- ⑤ Body
- ⑥ Switch actuator
- ⑦ Adjusting knob locking srew
- ⑧ Electric connector type 664 (included in the supply)

MAP are hydro-electric pressure switches with fixed switching pressure differential. The mechanical microswitch with gold plated contacts grants high reliability and long life service.

The microswitch changes its status when the pressure in the hydraulic circuit reaches the switching value set on the adjusting knob.The microswitch returns to the original rest position when the pressure in the hydraulic circuit drops below the nominal fixed switching pressure differential (hysteresis). The electric connector provides both NC or NO contacts.
The pressure in the circuit operates the piston ① acting against the adjustable spring ②; once the pressure setting is reached, the piston ⑥ actuates the microswitch ③.
The pressure switching value is selectable by a graduated adjusting knob ④.

Clockwise rotation increases the setting pressure.

Max pressure: **630 bar**

1 MODEL CODE

MAP - **160** / **E** ****** / *****

Fixed differential pressure switch

Pressure range:
40 = 5 ÷ 40 bar
80 = 7 ÷ 80 bar
160 = 10 ÷ 160 bar
320 = 30 ÷ 320 bar
630 = 50 ÷ 630 bar

Options:
E = Common electric contact connected to pin 1, see section 3

Series number

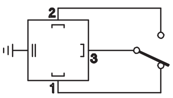
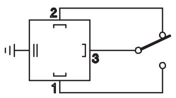
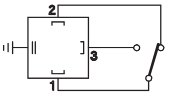
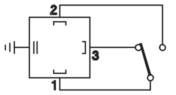
Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

2 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

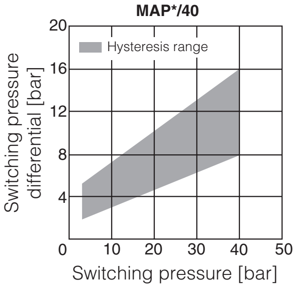
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
Compliance	CE to Low Voltage Directive 2014/35/EU RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		
Ambient temperature	**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option)= -20°C ÷ +80°C HNBR seals (/BT option)= -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Fluid contamination class	ISO 4406 class 21/19/16 NAS 1638 class 10, in line filters of 25 µm (β25 ≥75 recommended)		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

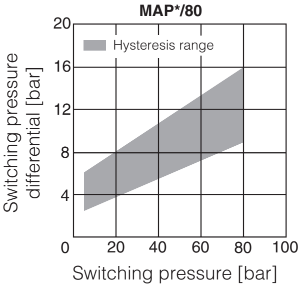
3 CHARACTERISTICS AND WIRING OF INTERNAL MICROSWITCH

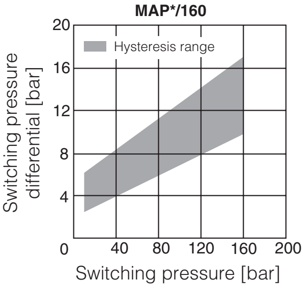
	Supply voltage [V]			
	125 AC	**250 AC**	**30 DC**	**250 DC**
Max current [A] resistive load	7	5	5	0,2
Max current [A] inductive load (Cos φ = 0,4)	4	2	3	0,02
Insulating resistance	≥100MΩ			
Contact resistance	15 mΩ			
Electrical life-expectancy	≥1.000.000 switchings			
Mechanical life-expectancy	≥10.000.000 switchings			

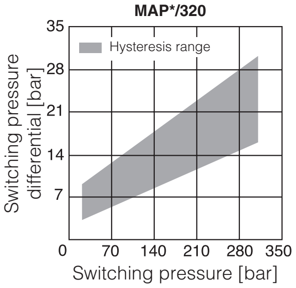
	Rest position	**Pressure operated position**
STD		
/E		

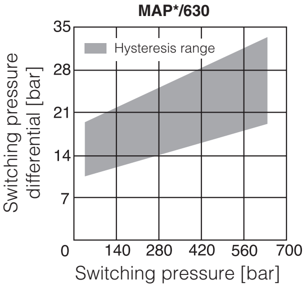
4 DIAGRAMS







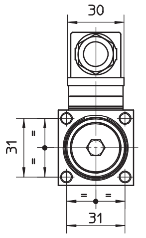


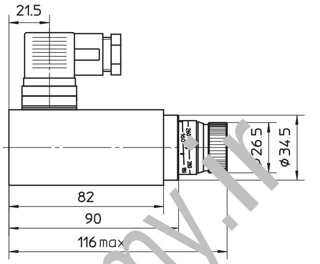


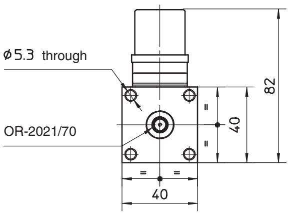
The diagrams show, the switching pressure difference (hysteresis) between the switching positions of the pressure switch electric contacts.

⚠ The switching pressure differential may increased depending to the deterioration of the fluid contamination class.

5 DIMENSIONS OF MAP WITHOUT ADAPTORS [mm]







Fastening bolts:
4 socket head screws M5X90 supplied with the pressure switch

6 MODEL CODE FOR ADAPTORS WHEN SUPPLIED SEPARATELY - BHM and BKM with option /PE or /BT are available on request

BHM – ******

Type of adaptor
BMM = male
BMF = female
BFM = in-line
BHM = ISO 4401 size 06
BKM = ISO 4401 size 10

Threated connections for BMM and BFM adaptors, see section 7

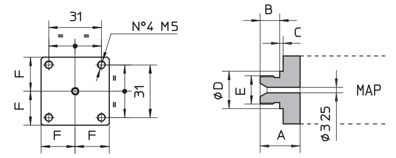
06 = G 1/4" (BMM, BMF, BFM)
10 = G 3/8" (BMM, BFM)
15 = G 1/2" (BMM, BFM)
20 = G 3/4" (BFM)
25 = G 1" (BFM)
32 = G 1 1/4"(BFM)

BHM and BKM adaptors, see section 7

11 = port P
12 = port A and B
13 = port A
14 = port B
17 = port P and A
18 = port P and B

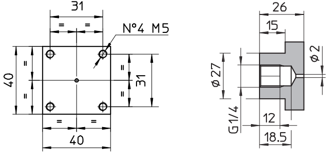
7 DIMENSIONS OF ADAPTORS [mm]

BMM - Male fittings:



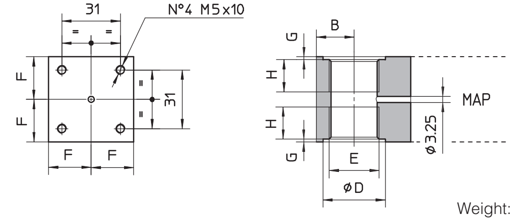
Weight: 0,3 Kg

BMF - Female fittings:



	A	B	C	Ø D	E	F
BMM-06	22,5	11	1,5	18	G 1/4"	20
BMM-10	23,5	11,5	2	22	G 3/8"	20
BMM-15	27,5	15	2,5	26	G 1/2"	20

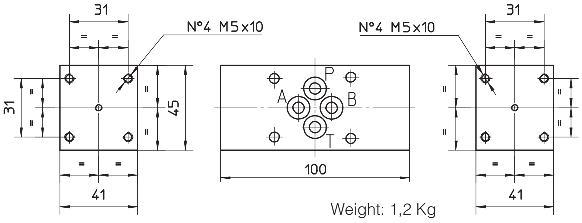
BFM - In-line mounting:



Weight: 0,8 Kg

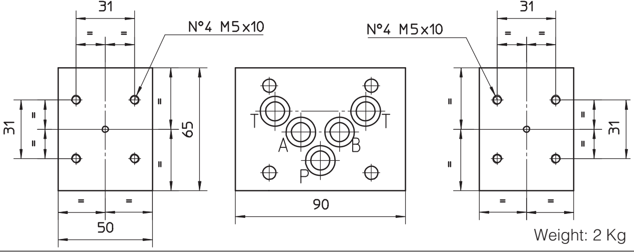
	A	B	Ø D	E	F	G	H
BFM-06	50	20	19	G 1/4"	22,5	1	12
BFM-10	50	20	23	G 3/8"	22,5	1	12
BFM-15	50	20	27	G 1/2"	22,5	1	15
BFM-20	50	20	33	G 3/4"	22,5	1,5	17
BFM-25	70	30	40	G 1"	30	1,5	19
BFM-32	70	30	50	G 1 1/4"	30	1,5	22

BHM - Modular mounting surface ISO 4401-03-02-0-05



Weight: 1,2 Kg

BKM - Modular mounting surface ISO 4401-05-03-0-05



Weight: 2 Kg

For versions 11 and 13 the pressure switch is mounted on side of port A. For version 14 the pressure switch is mounted on side of port B. For versions 12, 17, 18 the pressure switch is mounted on both sides.

Mounting subplates type BA

single, for ISO valves size 06 to 32

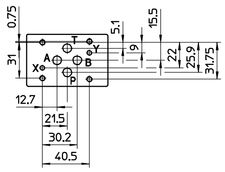
BA-* are single subplates with ISO mounting surface for installation of Atos valves and they are provided with threaded ports for connectios to pressure, tank and users lines. They are characterized by low pressure drops and they are specific for directional, flow and pressure control valves ISO size 06, 10, 16, 20, 25 and 32;
Special subplates or manifolds for customized applications are available upon request.
The set of screws for the valve installation on the BA subplate must be ordered separately, see the code SET SC-* specified in the following sections.

1 TECHNICAL CHARACTERISTICS

Installation position	Any position
Operating pressure	Ports P, T, A, B = 350 bar See technical table of the valves to be assembled
Ambient temperature range	-30°C ÷ +70°C
Fluid	Hydraulic oil as per DIN 51524...535, for other fluids contact our technical office
Recommended viscosity	15÷100 mm2/s - max allowed range: see the technical table of the valves to be assembled
Max fluid contamination level	See technical table of the valves to be assembled and filter section at www.atos.com or KTF catalog
Fluid temperature	See technical table of the valves to be assembled
Surface protection	zinc coating with black passivation
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

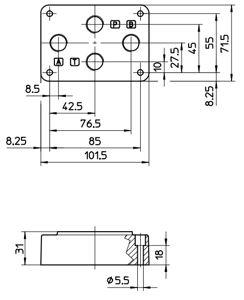
2 SINGLE STATION SUBPLATES FOR VALVES SIZE 06

ISO 4401:2005
Mounting surface: 4401-03-03-0-05

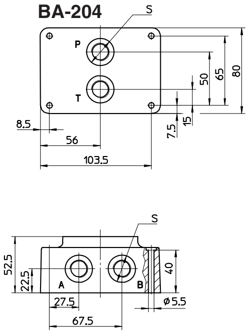


Matching valves	**Set of screw** (to be ordered separately)
DH-00, DH-01	SET SC-DHZ
DH-02, DH-04	SET SC-DHZ
DH-05, DH-08	SET SC-DHZ
DH-09	SET SC-DHZ
DHI, DHA, DHW	SET SC-DHZ
DHE, DHL	SET SC-DH
DHQ	SET SC-DHZ
DLEH, DLEHM	SET SC-DH
DLAH, DLAHM	SET SC-DHZ
DLWH	SET SC-DHZ
QV-06	SET SC-QV
RZMO, RZMA	SET SC-DHZ
RZME	SET SC-DH
RZGO, RZGA	SET SC-DHZ
RZGE	SET SC-DH
DHZO, DHZA	SET SC-DHZ
DHZE, DHRZE	SET SC-DH
DLHZO, DLHZA	SET SC-DHZ
QVHZO-*-06	SET SC-DHZ
QVHZA	SET SC-DHZ

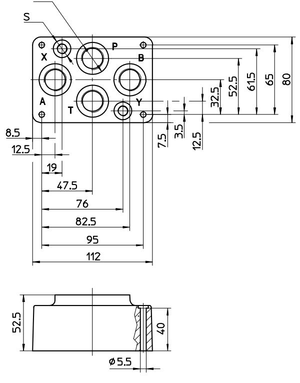
BA-202



BA-204



BA-302/Y



VERSIONS

BA-202: basic version without ports X and Y; ports P, A, B, T (3/8") on the base.

BA-204: basic version without ports X and Y; ports P and T (3/8") on the base; ports A and B (3/8") on the side.

BA-302: basic version without ports X and Y; ports P, A, B, T (1/2") on the base.

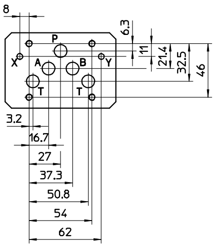
BA-302/Y: version dimensionally identical to the corresponding basic version with the addition of X and Y ports (1/8") on the base (see figure on the left).
The /Y version is always used for DHZO and DLHZO valves when drain from port Y is required.

X and Y ports are only present in the /Y versions.

Code	Ports (GAS)		Ø Counterbore		Mass
	A,B,P,T	(X-Y)	S [mm]	R [mm]	[Kg]
BA-202	3/8"	–	–	–	1,2
BA-204	3/8"	–	25,5	16,5	1,8
BA-302 (/Y)	1/2"	(1/8")	30	16,5	1,8

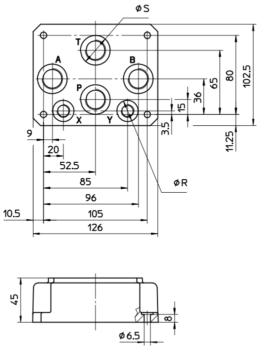
3 SINGLE STATION SUBPLATES FOR VALVES SIZE 10

ISO 4401:2005
Mounting surface: 4401-05-05-0-05

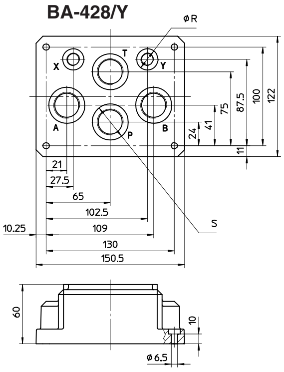


Matching valves	Set of screw (to be ordered separately)
DK-11	SET SC-DK/DP-1
DK-12	SET SC-DK/DP-1
DKE	SET SC-DK/DP-1
DKQ	SET SC-DK/DP-1
DKZOR	SET SC-DK/DP-1
DKZA	SET SC-DK/DP-1
DLKZOR	SET SC-DK/DP-1
DLKZA	SET SC-DK/DP-1

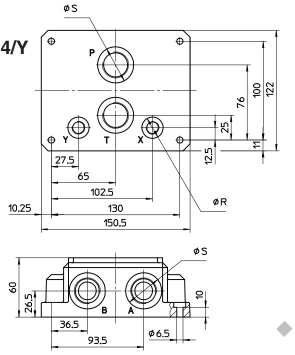
BA-308/Y



BA-428/Y



BA-434/Y



VERSIONS

BA-308: basic version without ports X and Y; ports P, A, B, T (1/2") on the base.

BA-428: basic version without ports X and Y; ports P, A, B, T (3/4") on the base.

BA-434: basic version without ports X and Y; ports P and T (3/4") on the base; ports A and B (3/4") on the side.

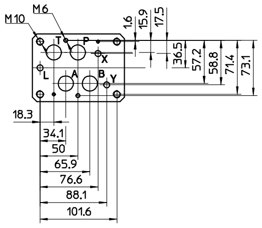
BA-*/Y**: versions dimensionally analogous to the corresponding basic versions with the addition of X and Y ports (1/4") on the base (see figure on the left).
The /Y versions are always used for valves type DKZOR, DLKZO, when drainage from port Y is required.

X and Y ports are only present in the /Y versions.

Code	Ports (GAS)		Ø Counterbore		Mass
	A,B,P,T	(X-Y)	S [mm]	R [mm]	[Kg]
BA- 308 (/Y)	1/2"	(1/4")	30	21,5	2,5
BA- 428 (/Y)	3/4"	(1/4")	36,5	21,5	5,5
BA- 434 (/Y)	3/4"	(1/4")	36,5	21,5	8,5

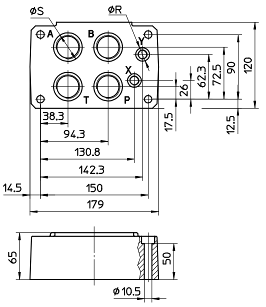
4 SINGLE STATION SUBPLATES FOR VALVES SIZE 16

ISO 4401:2005
Mounting surface: 4401-07-07-0-05

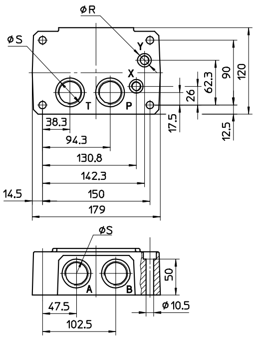


Matching valves	Set of screw (to be ordered separately)
DP-21	SET SC-DP2
DP-24	SET SC-DP2
DP-25	SET SC-DP2
DPH-28	SET SC-DP2
DPH-29	SET SC-DP2
DPHI-2	SET SC-DP2
DPHE-2	SET SC-DP2
DPHA-2	SET SC-DP2
DPHW-2	SET SC-DP2
DPZO-*-2	SET SC-DP2
DPZA-*-2	SET SC-DP2

BA-518



BA-519



VERSIONS

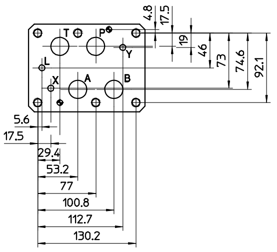
BA-518: basic version with ports P, A, B, T (1") and X, Y (1/4") on the base.

BA-519: basic version with ports P, T (1") and X, Y (1/4") on the base; ports A, B (1") on the side.

Code	Ports (GAS)		Ø Counterbore		Mass
	A,B,P,T	X-Y	S [mm]	R [mm]	[Kg]
BA-518	1"	1/4"	46	21,5	8
BA-519	1"	1/4"	46	21,5	8

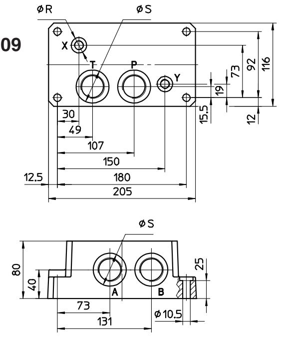
5 SINGLE STATION SUBPLATES FOR VALVES SIZE 25

ISO 4401:2005
Mounting surface: 4401-08-08-0-05

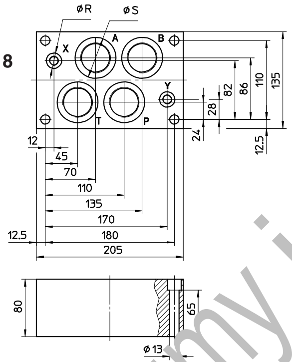


Matching valves	Set of screw (to be ordered separately)
DP-41	SET SC-DP4
DP-44	SET SC-DP4
DP-45	SET SC-DP4
DPH-48	SET SC-DP4
DPH-49	SET SC-DP4
DPHI-4	SET SC-DP4
DPHE-4	SET SC-DP4
DPHA-4	SET SC-DP4
DPHW-4	SET SC-DP4
DPZO-*-4	SET SC-DP4
DPZA-*-4	SET SC-DP4

BA-509



BA-618



VERSIONS

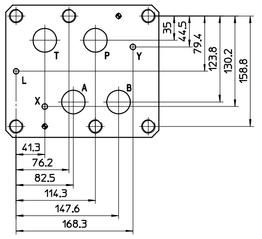
BA-509: basic version with ports P, T (1") and X, Y (1/4") on the base, ports A, B (1") on the side.

BA-618: basic version with ports P, A, B, T (1 1/4") and X, Y (1/4") on the base.

Code	Ports (GAS)		Ø Counterbore		Mass
	A,B,P,T	X-Y	S [mm]	R [mm]	[Kg]
BA-509	1"	1/4"	46	21,5	12,5
BA-618	1 1/4"	1/4"	57	21,5	13,5

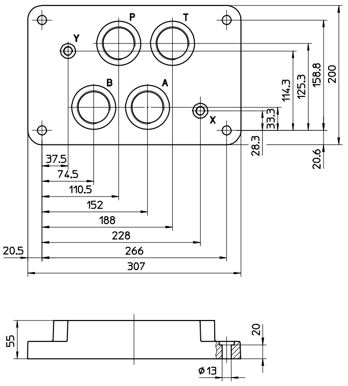
6 SINGLE STATION SUBPLATES FOR VALVES SIZE 32

ISO 4401:2005
Mounting surface: 4401-10-09-0-05



Matching valves	Set of screw (to be ordered separately)
DP-64	SET SC-DP6
DP-65	SET SC-DP6
DPH-68	SET SC-DP6
DPH-69	SET SC-DP6
DPHI-6	SET SC-DP6
DPHE-6	SET SC-DP6
DPHA-6	SET SC-DP6
DPZO-*-6	SET SC-DP6
DPZA-*-6	SET SC-DP6

BA-708



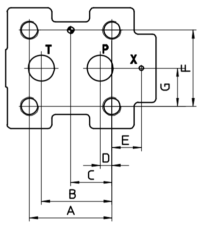
VERSIONS

BA-708: basic version with ports P, A, B, T
(1 1/2") and X, Y (1/4") on the base.

Code	Ports (GAS)		Ø Counterbore		Mass
	A,B,P,T	X-Y	S [mm]	R [mm]	[Kg]
BA-708	1 1/2"	1/4"	63,5	21,5	17

7 SINGLE STATION SUBPLATES FOR PRESSURE CONTROL VALVE SIZE 10, 20 AND 32

Mounting surface
ISO 6264: 1998



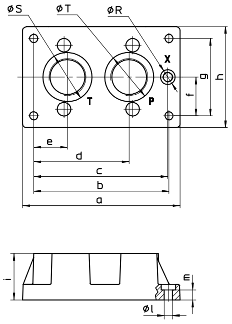
Matching valves	Set of screw to be ordered separately
AGAM-10	SET SC-AGA-10
AGMZO-10	SET SC-AGA-10
AGMZA-10	SET SC-AGA-10
AGAM-20	SET SC-AGA-20
AGMZO-20	SET SC-AGA-20
AGMZA-20	SET SC-AGA-20
AGAM-32	SET SC-AGA-32
AGMZO-32	SET SC-AGA-32
AGMZA-32	SET SC-AGA-32

size	A	B	C	D	E	F	G
10	53,8	47,5	22,1	22,1	-	53,8	26,9
20	66,7	55,6	33,4	11,1	23,8	70	35
32	88,9	76,2	44,5	12,7	31,8	82,6	41,3

BA-306
Mounting surface
ISO 6264-06-09-0-97
matching valves:
AGAM-10
AGMZO-*-10
AGMZA-*-10

BA-506
Mounting surface
ISO 6264-08-13-0-97
matching valves:
AGAM-20
AGMZO-*-20
AGMZA-*-20

BA-706
Mounting surface
ISO 6264-10-17-0-97
matching valves:
AGAM-32
AGMZO-*-32
AGMZA-*-32



BA-306
BA-506
BA-706

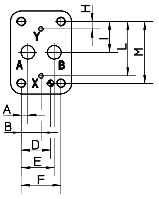
Code	a	b	c	d	e	f	g	h	i	l	m	Ø Blade S	Ø Blade R	Ø Blade T
BA - 306	130	104	97	64,5	19,5	27	54	80	40	8,4	15	36,5	21,5	30
BA - 506	180	150	133,25	92,25	37,25	37,5	75	105	50	10,5	13	46	21,5	46
BA - 706	204	175	173,5	123,5	43,5	50	100	130,5	60	10,5	13	63,5	21,5	63,5

VERSIONS

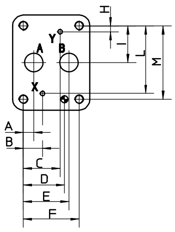
BA-306, BA-506, BA-706: basic version, see figure on left and dimensional tables.

Code	size	Ports (GAS)			Mass
		P	T	X	[Kg]
BA - 306	10	1/2"	3/4"	1/4"	1,5
BA - 506	20	1"	1"	1/4"	3,5
BA - 706	32	1 1/2"	1 1/2"	1/4"	6

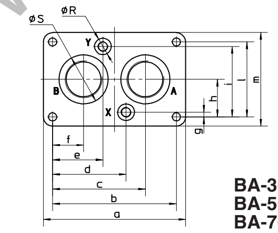
Mounting surface
ISO 5781: 2000



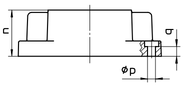
Mounting surface
ISO 5781-06-07-0-00
matching valves:
AGI*-10
AGRL-10
AGRLE-10
AGRZO-*-10

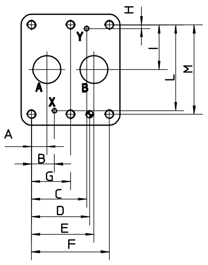


Mounting surface
ISO 5781-08-10-0-00
matching valves:
AGI*-20
AGRL-20
AGRLE-20
AGRZO-*-20



BA-305
BA-505
BA-705





Mounting surface
ISO 5781-10-13-0-00
matching valves:
AGI*-32
AGRL-32
AGRLE-32

VERSIONS

BA-305, BA-506 and **BA-705**:see figure on left and dimensional tables.

Matching valves	Set of screw to be ordered separately
AGI*-10(20)	SET SC-AGI
AGRL(E)-10(20)	SET SC-AGI
AGRCZO-10(20)	SET SC-AGI
AGRCZA-10(20)	SET SC-AGI
AGI*-32	SET SC-AGI-32
AGRL(E)-32	SET SC-AGRL-32

Code	a	b	c	d	e	f	g	h	i	l	m	n	p	q	Ø Blade S	Ø Blade R
BA - 305	113	90	67	45	45	23	8	33,3	58,7	66,7	90	30	10,5	10	30	21,5
BA - 505	133	110	82,5	64,5	45,5	27,5	6,4	39,7	73	79,4	102,5	42	10,5	10	46	21,5
BA - 705	184	160	120	95	65	40	6	48,5	91	97	121	60	10,5	13	63,5	21,5

Code	size	Ports (GAS)			Mass
		A	B	X-Y	[Kg]
BA - 305	10	1/2"	1/2"	1/4"	1
BA - 505	20	1"	1"	1/4"	2
BA - 705	32	1 1/2"	1 1/2"	1/4"	7,5

Table **K290-11/E**

Mounting subplates type BA-214 and 314

Multi-station, for valves ISO 4401 size 06 and 10

example of **BA-214/4**

BA-214 and **BA-314** are multistation subplates for assembling of directional and modular valves with mounting surface ISO 4401, size 06 and 10.
They are made in cast iron with high corrosion protection black zinc surface treatment, and they are provided with P, T passing through lines and A, B lateral user ports connections.

BA-214 are **multistaion subplates** with 1 to 7 stations for valves ISO size 06.

BA-314 are **multistaion subplates** with 1 to 5 stations for valves ISO size 10.

They are designed for installation on power units cover and they can be easily assembled together by means of n° 4 screws M6 class 12.9 (included in the supply), combining up to max 7 stations.

1 MODEL CODE OF SUBPLATES TYPE BA-214 and BA-314

BA-214 / **5** *

Series number

Number of stations, see section 3 4:

1 = one station
2 = two stations
3 = three stations
4 = four stations
5 = five stations
6 = six stations (only for BA-214)
7 = seven stations (only for BA-214)

Type of subplate:

BA-214 = for valves ISO size 06
BA-314 = for valves ISO size 10

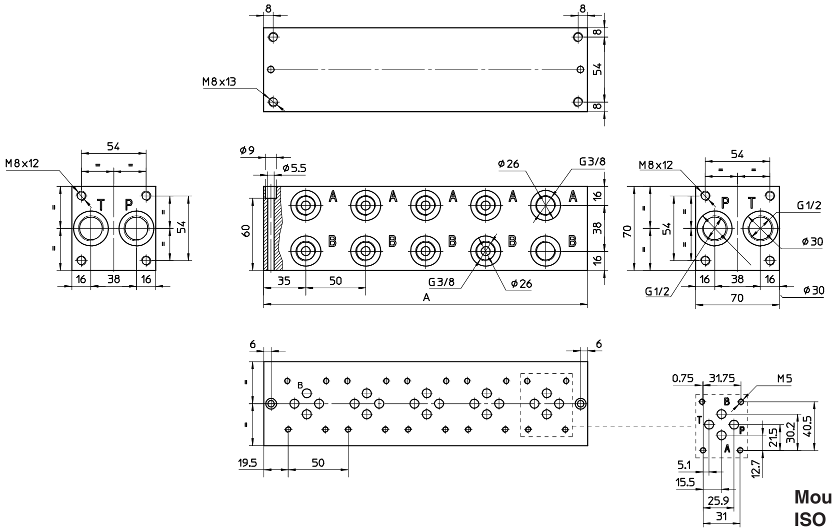
Model	Port P	Port T	Ports A, B	Qmax	Qmax ports A, B	Pmax
BA-214	G 1/2”	G 1/2”	G 3/8” lateral	80 l/min	60 l/min	350 bar
BA-314	G 3/4”	G 1”	G 3/4” lateral	150 l/min	100 l/min	300 bar

2 TECHNICAL CHARACTERISTICS

Installation position	Any position. In case of horizontal mounting proper brackets are recommended.
Operating pressure	Ports P, T, A, B = **350 bar** (BA-214), **300 bar** (BA-314) See technical table of the valves to be assembled
Ambient temperature range	-30°C ÷ +70°C
Fluid	Hydraulic oil as per DIN 51524...535, for other fluids contact our technical office
Recommended viscosity	15÷100 mm2/s - max allowed range: see the technical table of the valves to be assembled
Max fluid contamination level	See technical table of the valves to be assembled and filter section at www.atos.com or KTF catalog
Fluid temperature	See technical table of the valves to be assembled
Surface protection	zinc coating with black passivation
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

3 OVERALL DIMENSIONS OF SUBPLATES TYPE BA-214 [mm]

Ports P and T = G 1/2” (passing through)
Ports A and B = G 3/8”
Q_{max} = 80 l/min
Q_{max} A and B ports = 60 l/min
P_{max} = 350 bar



Mounting surface
ISO 4401-03-02-0-05

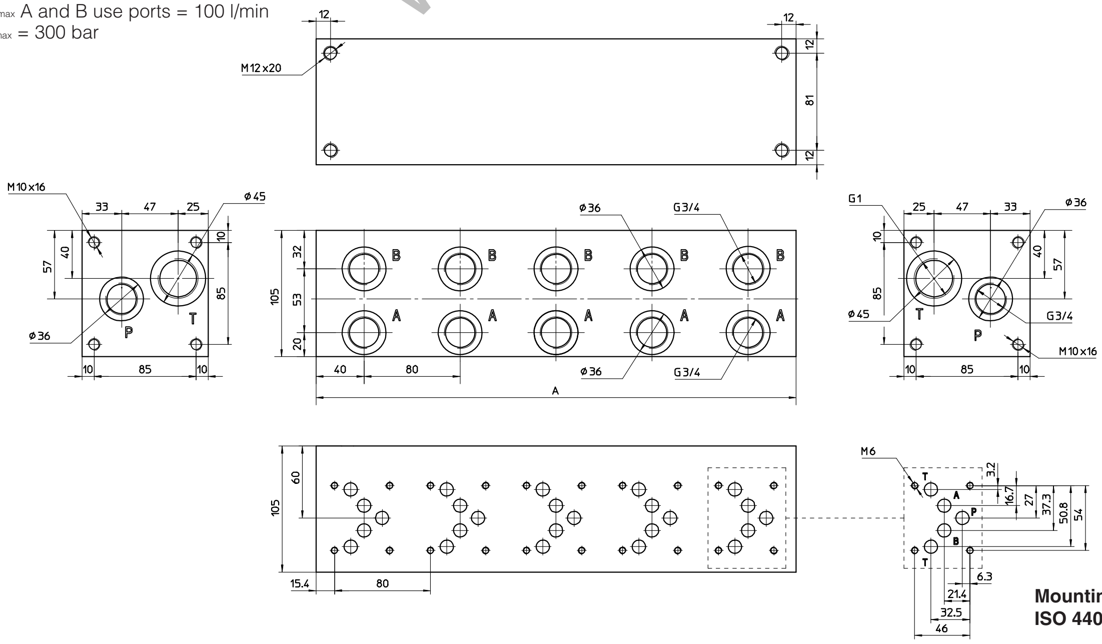
The lenght of the subplate depends to the number of stations as shown in the table below

Stations	1	2	3	4	5	6	7
Dimension A	70	120	170	220	270	320	370
Mass [Kg]	2	3,5	5	6,5	8	9,5	11

The 5-station version is shown in the drawing

4 OVERALL DIMENSIONS OF SUBPLATES TYPE BA-314 [mm]

Ports P = G 3/4” (passing through)
Ports T = G 1” (passing through)
Ports A and B = G 3/4”
Q_{max} = 150 l/min
Q_{max} A and B use ports = 100 l/min
P_{max} = 300 bar



Mounting surface
ISO 4401-05-04-0-05

The lenght of the subplate depends to the number of stations as shown in the table below

Stations	1	2	3	4	5
Dimension A	80	160	240	320	400
Mass [Kg]	4	8,5	13	17,5	22

The 5-station version is shown in the drawing

Mounting subplates type BA-214/*-AL

multi-station, for valves ISO 4401 size 06, in aluminium

The multi-stations subplates type BA-214/*-AL for directional control valves are in aluminium and their mounting surface are in accordance with the international standards ISO 4401.

They perform limited pressure drop and are made by a **single subplate** from 1 to 7 stations for directional valves and modular elements ISO 4401 size 06.

Main characteristics:
P and T ports = G 1/2; A and B lateral use ports G 3/8; M pressure gauge connection G1/4; Q_{max} = 80 l/min; Q_{max} use ports = 60 l/min; Pmax = 250 bar
Note: for versions /M and /MH Q_{max} = 35 l/min;

For other technical characteristics, see section 2 and 3.

1 MODEL CODE OF SUBPLATES TYPE BA-214/*-AL

BA-214	/	5	/	MH	/	210	-	AL	*	PE

Type of subplate:
BA-214 = for valves ISO size 06
On request, available with rear ports A and B

Number of stations:

1 = one station	**5** = five stations
2 = two stations	**6** = six stations
3 = three stations	**7** = seven stations
4 = four stations	

M = with direct operated pressure relief cartridge CART M-5/** - see tab. C010 (available also as spare part)
MH = with pressure relief valve type CART M-5, arranged with venting solenoid valve

Pressure range of pressure relief valve, for versions /M and /MH:
100 = 100 bar
210 = 210 bar
250 = 250 bar

AL = in aluminium
On request, available with anodizing

Series number

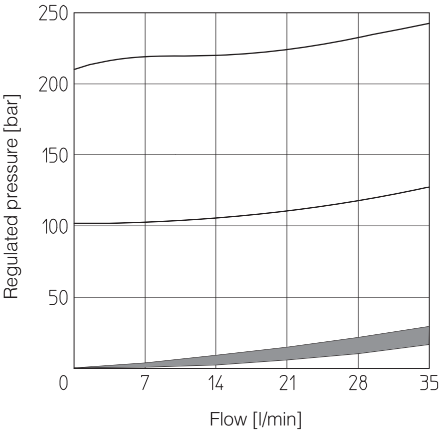
Seals material:
only for **M**, **MH**
- = HNBR
PE = HNBR

2 TECHNICAL CHARACTERISTICS

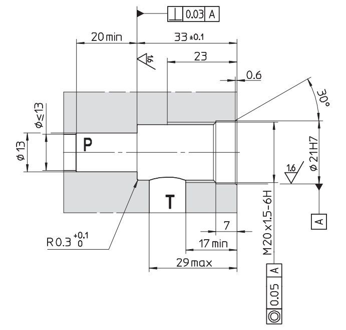
Installation position	Any position.
Operating pressure	Ports P, T, A, B = **250 bar** See technical table of the valves to be assembled
Ambient temperature range	-30°C ÷ +70°C
Fluid	Hydraulic oil as per DIN 51524...535, for other fluids contact our technical office
Recommended viscosity	15÷100 mm2/s - max allowed range: see the technical table of the valves to be assembled
Max fluid contamination level	See technical table of the valves to be assembled and filter section at www.atos.com or KTF catalog
Fluid temperature	See technical table of the valves to be assembled
Compliance	RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

3 REGULATED PRESSURE/FLOW DIAGRAM FOR VERSIONS /M and /MH

MAIN CHARACTERISTICS OF ENCLOSED PRESSURE RELIEF VALVE	
Model code	Regulation range
CART M-5/100	3 ÷ 100 bar
CART M-5/210	5 ÷ 210 bar
CART M-5/250	7 ÷ 250 bar
Q_{max} = 35 l/min	



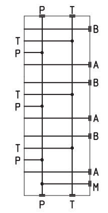
4 INSTALLATION DIMENSIONS OF CART M-5/***

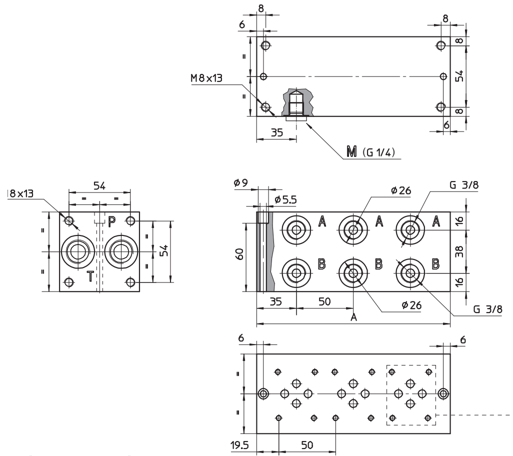


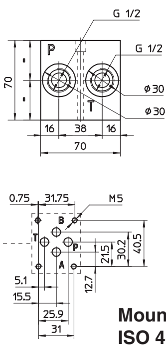
5 OVERALL DIMENSIONS OF SUBPLATES TYPE BA-214/*-AL [mm]

Ports P and T = G 1/2
Use ports A and B = G 3/8
Pressure gauge port M = G1/4 (plugged)
Q_{max} = 80 l/min
Q_{max} use ports = 60 l/min
P_{max} = 210 bar

Hydraulic scheme







The 3-stations subplate is shown in the drawing

The lenght of the subplate varies with the number of stations as shown in the table below

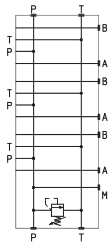
Stations	1	2	3	4	5	6	7
Dimension A	70	120	170	220	270	320	370
Mass [Kg]	1	1,4	2	2,6	3,2	3,8	4,4

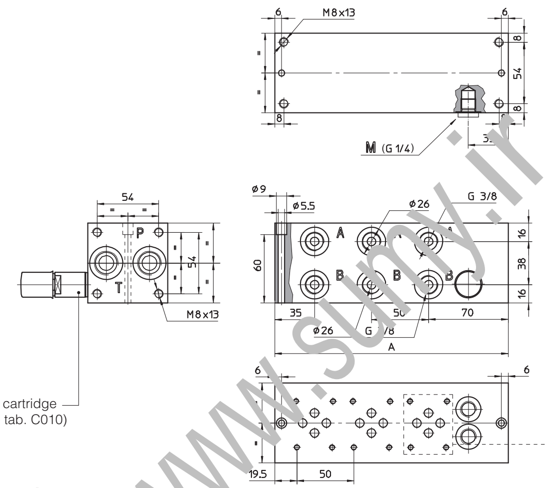
Mounting surface
ISO 4401-03-02-0-05

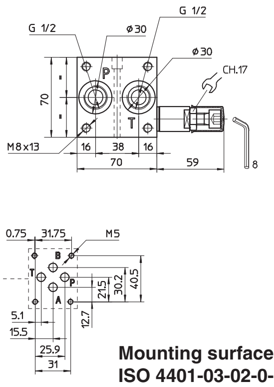
6 OVERALL DIMENSIONS OF SUBPLATES TYPE BA-214/*/M/*-AL [mm]

Ports P and T = G 1/2
Use ports A and B = G 3/8
Pressure gauge port M = G1/4 (plugged)
Q_{max} = 35 l/min
Q_{max} use ports = 35 l/min
P_{max} = 210 bar

Hydraulic scheme







The 3-stations subplate is shown in the drawing

The lenght of the subplate varies with the number of stations as shown in the table below

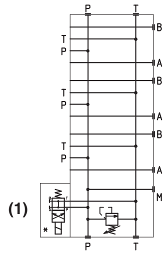
Stations	1	2	3	4	5	6	7
Dimension A	105	155	205	255	305	355	405
Mass [Kg]	1,1	1,5	2,1	2,7	3,3	3,9	4,5

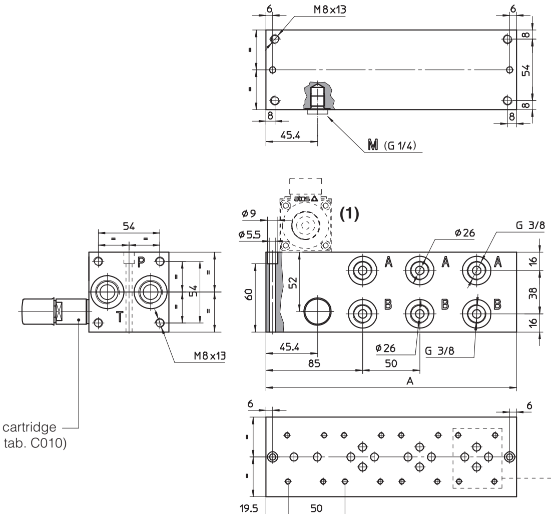
Mounting surface
ISO 4401-03-02-0-05

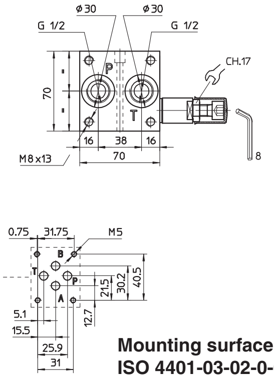
7 OVERALL DIMENSIONS OF SUBPLATES TYPE BA-214/*/MH/*-AL [mm]

Ports P and T = G 1/2
Use ports A and B = G 3/8
Pressure gauge port M = G1/4 (plugged)
Q_{max} = 35 l/min
Q_{max} use ports = 35 l/min
P_{max} = 210 bar

Hydraulic scheme







The 3-stations subplate is shown in the drawing

The lenght of the subplate varies with the number of stations as shown in the table below

Stations	1	2	3	4	5	6	7
Dimension A	120	170	220	270	320	370	420
Mass [Kg]	1,2	1,6	2,2	2,8	3,4	4	4,6

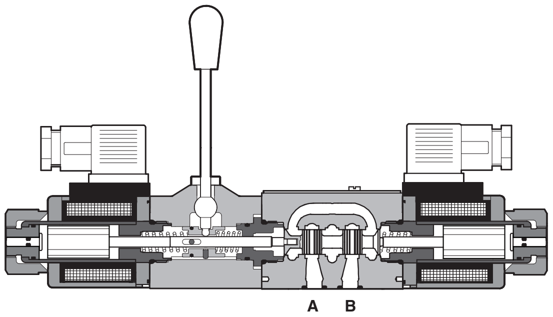
Mounting surface
ISO 4401-03-02-0-05

(1) The venting directional valve in the dashing line must be ordered separately

Auxiliary hand levers for solenoid valves

direct operated on-off and proportional, ISO 4401 size 06

CE



DHE-0711/MV

Auxiliary hand levers for direct operated on-off solenoid valves size 06, type DHE, DHL, DHA and proportional valves size 06, type DHZO, DHZE, DHZA and QVHZO.

This option allows to operate the valves in absence of electrical power supply, i.e. during commissioning, maintenance or in case of emergency.

It is available with two different configurations depending to the installation requirements:
MV = lever positioned vertically (perpendicular to the valve axis)
MO = lever positioned horizontally (parallel to the valve axis)

When the valve is electrically operated the hand lever remains stopped in its rest position

The hand lever execution does not affect the performances of the original valves.

1 MODEL CODE FOR ON-OFF DIRECTIONAL VALVES (for the details, see indicated tech. table)

DHE - 0		63		1/2	/	MV	-	X	24 DC	**	/*

Directional control valves size 06
DHE-0 = for AC and DC supply, high performances, with **cURus** certified solenoids - see table E015
DHL-0 = for AC and DC supply - see table E018
DHA-0 = ex-proof - see table EX010

Valve configuration: **61 - 63 - 71**

Available spools: **0 - 0/2 - 1 - 1P - 1/2 - 1/2P - 3 - 3P - 4 - 7**

Options, hand lever configuration:
MO = horizontal hand lever (not for DHA)
MV = vertical hand lever
AMO = horizontal hand lever installed at the side of port B (not for DHA)
AMV = vertical hand lever installed at the side of port B

Only for DHE and DHL:
00-AC = AC solenoids without coils
00-DC = DC solenoids without coils
X = without connector

Voltage code: see relevant tech. table

Series number

Seals material:
- = NBR
PE = FKM
BT = HNBR **(1)**

(1) Not available for DHL

2 MODEL CODE FOR PROPORTIONAL DIRECTIONAL VALVES AND FLOW CONTROL VALVES (for the details, see indicated tech.table)

DHZO	-	A	-	0		71	-	S5	/	MV	/*	**	/*

Directional proportional valves size 06
DHZO = see table F160
DHZE = see table F150
DHZA = ex-proof - see table FX010
Flow control valves size 06
QVHZO = see tab F410

A = without position transducer

Valve size
0 = ISO 4401 size 06 (for DHZ*)
06 = ISO 4401 size 06 (for QVHZO)

Valve configuration (only DHZ*): **51, 53, 71, 73**

Seals material:
- = NBR
PE = FKM
BT = HNBR

Series number

Coil option: see relevant tech. table

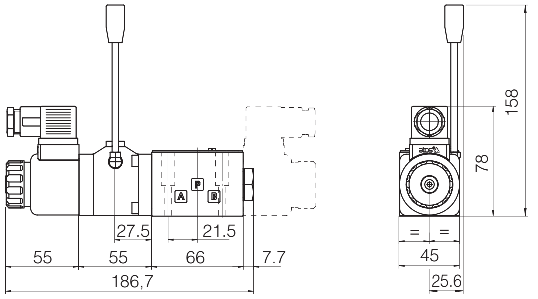
Options:
MO = horizontal hand lever (not for DHA, DHZA)
MV = vertical hand lever
BMO = horizontal hand lever installed at the side of port A (not for DHZA, QVHZO)
BMV = vertical hand lever installed at the side of port A (not for QVHZO)
O = Horizontal cable entrance (only for DHZA)
Y = External drain (only for DHZA, DHZO)

Spool size (for DHZ*): **S3 - S5 - D3 - D5 - L3 - L5**
Max regulated flow (for QVHZO): **3-12-18-36-45** l/min

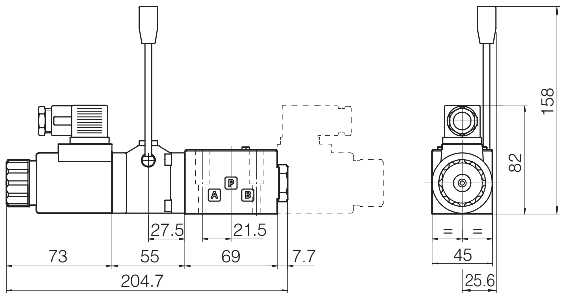
3 LEVER CHARACTERISTICS

Total angle stroke	[°deg]	± 28°	Lever actuating force	[N]	1 ÷ 8
Working angle stroke	[°deg]	± 15°	Lever device weight	[g]	880

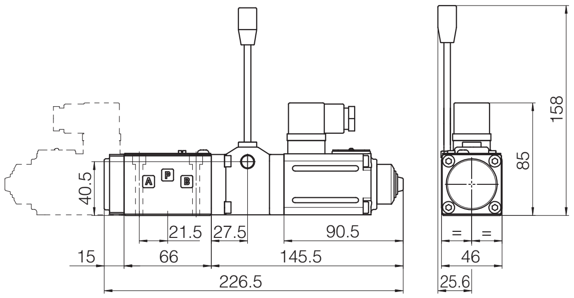
4 INSTALLATION DIMENSIONS [mm]



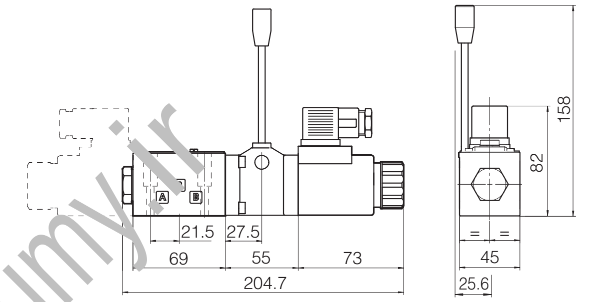
DHL-06*/MV Mass: 2,4 kg (single solenoid)
DHL-07*/MV (dotted line) Mass: 2,7 kg (double solenoid)



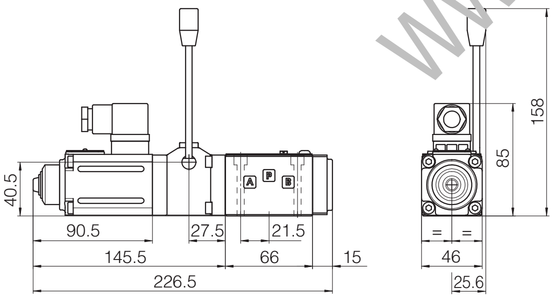
DHE-06*/MV Mass: 2,7 kg (single solenoid)
DHE-07*/MV (dotted line) Mass: 3,0 kg (double solenoid)



DHZO-A-05*/MV Mass: 2,8 kg (single solenoid)
DHZO-A-07*/MV (dotted line) Mass: 3,5 kg (double solenoid)

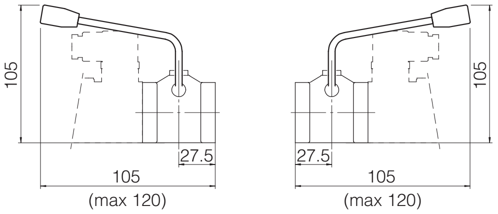


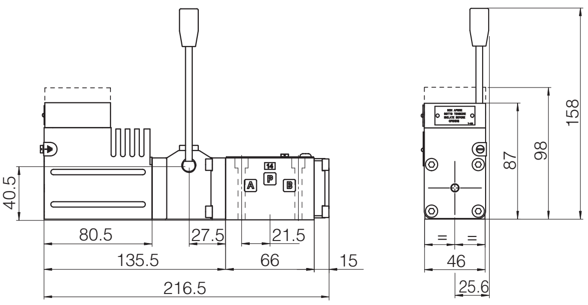
DHZE-05*/MV Mass: 2,7 kg (single solenoid)
DHZE-07*/MV (dotted line) Mass: 3,0 kg (double solenoid)



QVHZO-A-06*/MV Mass: 3,2 kg

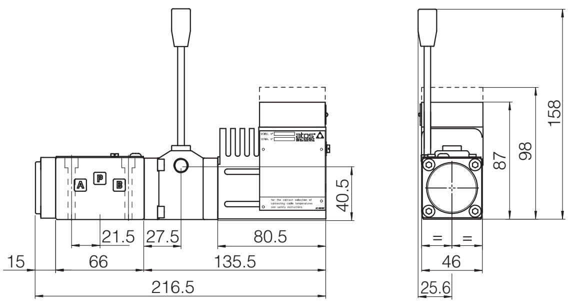
Horizontal hand lever device /MO, /AMO





DHA/*-06*/MV Mass: 3,4 kg
DHA/UL-*-06*/MV (dotted line)

Note: see tech. table FX010 for DHA/MV models

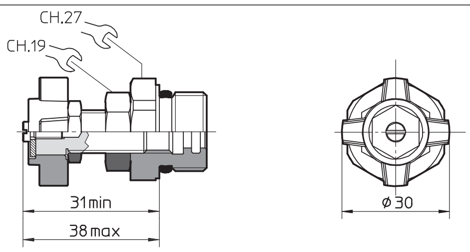
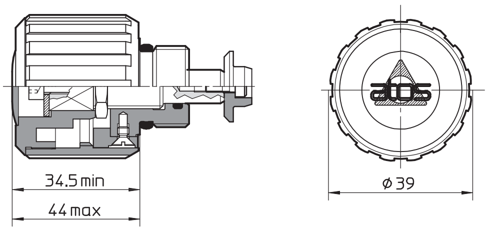
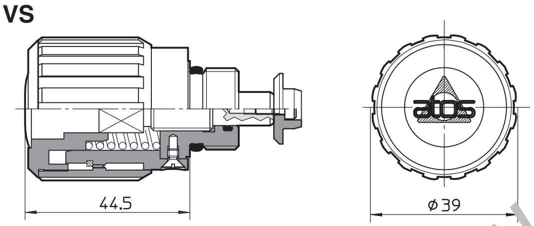
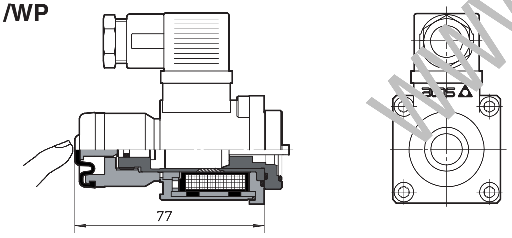
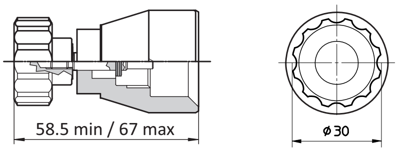
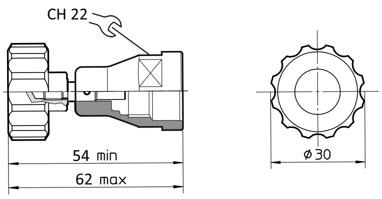
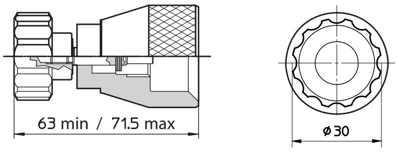


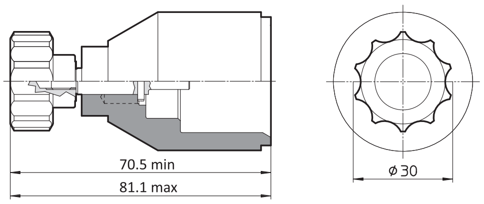
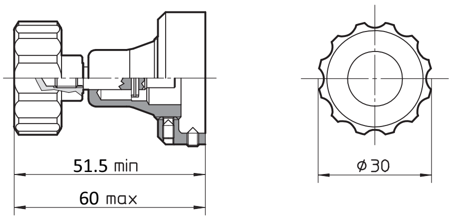
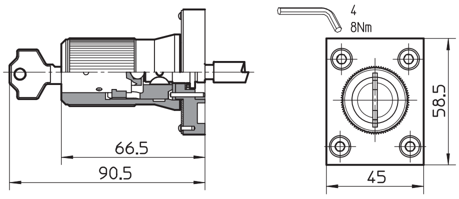
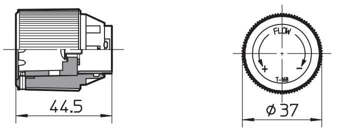
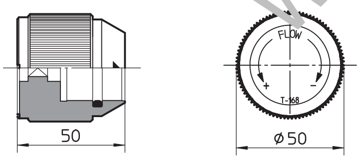
DHZA/*-06*/MV Mass: 3,4 kg
DHZA/UL-*-06*/MV (dotted line)

Note: see tech. table FX100 for DHZA/MV models

Handwheels for hydraulic controls

on-off and proportional valves

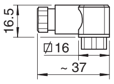
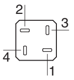
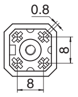
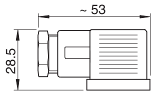
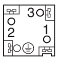
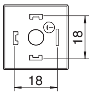
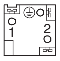
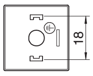
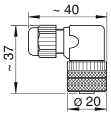
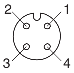
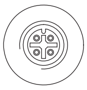
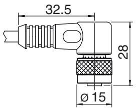
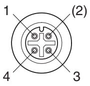
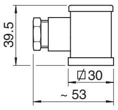
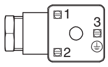
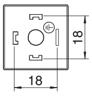
	OPTIONS CODES AND DIMENSIONS	FEATURES	VALVE TYPE
OPTION	**/V** 	Regulating handwheel	ARE, CART ARE, CART M-6, ARAM, AGAM, REM, AGIR, AGIS, AGIU, HMP, HM, KM, HS, KS, HG, KG, LIMM, LIRA, LICM
OPTION	**/VF** 	Regulating knob	ARE, CART ARE, CART M-6, AGIS, AGIU (as spare part, code VFG instead of VF and VSG instead of VS), HMP, HS, HG.
OPTION	**VS** 	Manual override with safety locking. Regulation possible only with pushed knob.	
OPTION	**/WP** 	Prolonged manual override protected by rubber cap	DHI, DHE DKE DLEH, DLEHM DPHI, DPHE LID*
SPARE PART	**WPD/HL** 	Manual override with detent, for mechanical operation and fixed actuation of spools	DHL (only DC version)
SPARE PART	**WPD/H** 		DHI
SPARE PART	**WPD/HE-DC** 		DHE (only DC version)

	OPTIONS CODES AND DIMENSIONS	FEATURES	VALVE TYPE
SPARE PART	**WPD/KE-DC**  	Manual override with detent, for mechanical operation and fixed actuation of spools	DKE-DC
SPARE PART	**WPD/Z**  	Manual override with detent, for mechanical operation and fixed actuation of spools. Only for open-loop valves.	DHZO, DKZOR, DPZO, QVHZO, QVKZOR
OPTION	**/K**  	Lock key for the setting knob	DHQ, DKQ QV-06,
OPTION	**/G**  	Adjustment by graduated micrometer	HQ, KQ, JPQ-2
OPTION	**/G**  		JPQ-3

Electric and electronic connectors

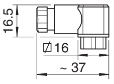
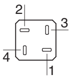
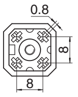
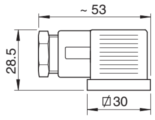
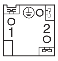
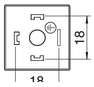
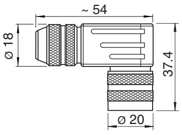
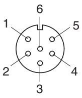
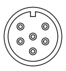
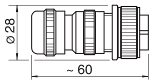
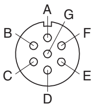
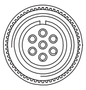
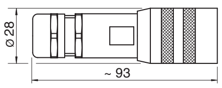
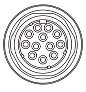
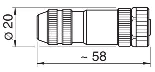
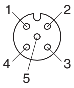
for transducers, on/off and proportional valves, pumps

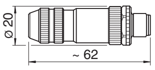
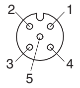
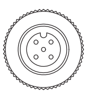
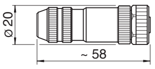
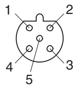
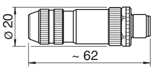
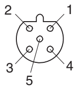
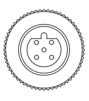
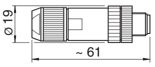
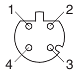
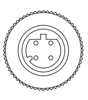
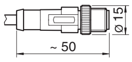
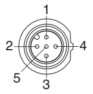
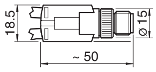
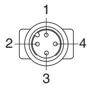
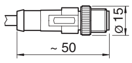
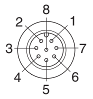
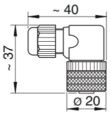
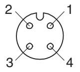
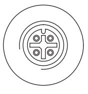
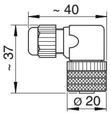
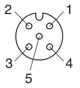
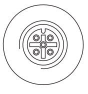
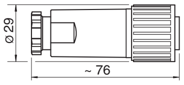
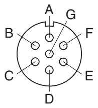
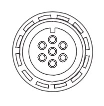
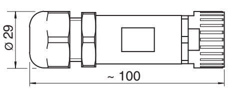
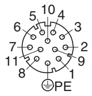
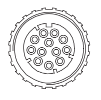
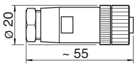
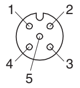
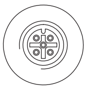
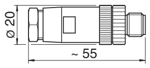
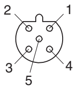
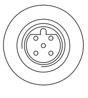
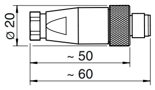
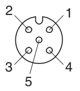
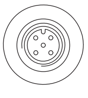
1 CONNECTORS FOR ON/OFF VALVES AND PUMPS

CODE AND DIMENSIONS		APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
345		Female plastic connector - 4 pin: - inductive proximity sensor, /FI option for DHI, DHE			PG7 ø 4 ÷ 6 mm	DIN EN 61984 (VDE 0627) Protection degree IP 65 EN 60529
664		Female plastic connector - 4 pin: - pressure switch type MAP - inductive proximity sensor, /FI option for DKE-17*	 **664**		PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529
666 (black) **666/A** (grey)		Female plastic connector - 3 pin: - standard coil connector for on/off valves - inductive proximity sensor, /FI option for DKE-16*	 **666** **667-***			
667-24 **667-110** **667-220**		Female plastic connector - 3 pin: - standard coil connector for on/off valves with built-in led				
ZBE-06		Female plastic connector - 4 pin: - inductive position switch, /FV option			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
BKS-B-20-4-03		Female plastic connector - 4 pin (3 wire): - inductive proximity sensor for LIFI Cable length: 3 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
669 (black) **669/A** (grey)		Female plastic connector - 3 pin: - optional electronic connector for on/off valves with built-in recti- fier bridge for supplying DC coils by AC current			PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529

(1) the wiring of electrical terminals has to be made according to specific technical table

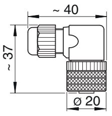
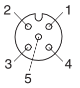
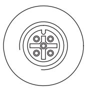
2 CONNECTORS FOR PROPORTIONAL VALVES AND PUMPS

CODE AND DIMENSIONS		APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
345		Female plastic connector - 4 pin: - position transducer for ZO(R)-T and ZO-L valves			PG7 ø 4 ÷ 6 mm	Protection degree IP 65 EN 60529
666 (black)		Female plastic connector - 3 pin: - standard coil connector for proportionals valves			PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529
STCO9131-6-PG9		Female metallic connector at 90° - 6 pin: - position transducer for LIQZP-L size 125 cartridges			PG9 ø 6 ÷ 8 mm	Protection degree IP 67 EN 60529
ZM-7P		Female metallic connector - 7 pin: - main connector for integral electronic driver			PG11 ø 7 ÷ 9 mm	According to MIL-C-5015 Protection degree IP 67 EN 60529
ZM-12P		Female metallic connector - 12 pin: - main connector for integral electronic driver			PG13,5 ø 8 ÷ 11 mm	DIN 43651 Protection degree IP 67 EN 60529
ZM-5PF		Female metallic connector - 5 pin: - CANbus for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding A IEC 60947-5-2 Protection degree IP 67 EN 60529

ZM-5PM 	Male metallic connector - 5 pin: - CANbus for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-5PF/BP 	Female metallic connector - 5 pin: - PROFIBUS DP for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding B IEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-5PM/BP 	Male metallic connector - 5 pin: - PROFIBUS DP for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding B IIEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-4PM/E 	Male metallic connector - 4 pin: - EtherCAT, POWERLINK, EtherNet/IP, PROFINET RT/IRT for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding D IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM/1.5 **ZH-5PM/5** 	Male plastic connector - 5 pin - single pressure/force transducer - analog position transducer Cable length: 1.5 m or 5 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM-2/2 	Male plastic connector - 4 pin: - double pressure/force transducers Splitting cable length: 2 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-8PM/5 **ZH-8PM/10** 	Male plastic connector - 8 pin: - digital position transducer Cable length: 5 m or 10 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZBE-06 	Female plastic connector - 4 pin: - position transducer (LIQZO-T* size 50) - integral pressure transducer (TERS)			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZBE-08 	Female plastic connector - 5 pin: - position transducer E-THT-15 (LIQZP)			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-7P 	Female plastic reinforced with fiber glass connector - 7 pin: - main connector for integral electronic driver			PG11 ø 8 ÷ 10 mm	According to MIL-C-5015 Protection degree IP 67 EN 60529
ZH-12P 	Female plastic reinforced with fiber glass connector - 12 pin: - main connector for integral electronic driver			PG16 ø 6 mm x 2 cable	DIN 43651 Protection degree IP 67 EN 60529
ZH-5P 	Female plastic connector - 5 pin: - RS232 Serial, CANbus - digital electronic driver E-MI-AS-IR, /M12 option			PG9 ø 6 ÷ 8 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5P/BP 	Male plastic connector - 5 pin: - PROFIBUS DP			PG9 ø 6 ÷ 8 mm	M12 - coding B IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM 	Male plastic connector - 5 pin: - pressure, force, position transducers (TEZ/LEZ series 10 or lower)			PG7 ø 4 ÷ 6 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529

(1) the wiring of electrical terminals has to be realized according to specific technical table

3 CONNECTOR FOR PRESSURE TRANSDUCERS AND PRESSURE SWITCHES

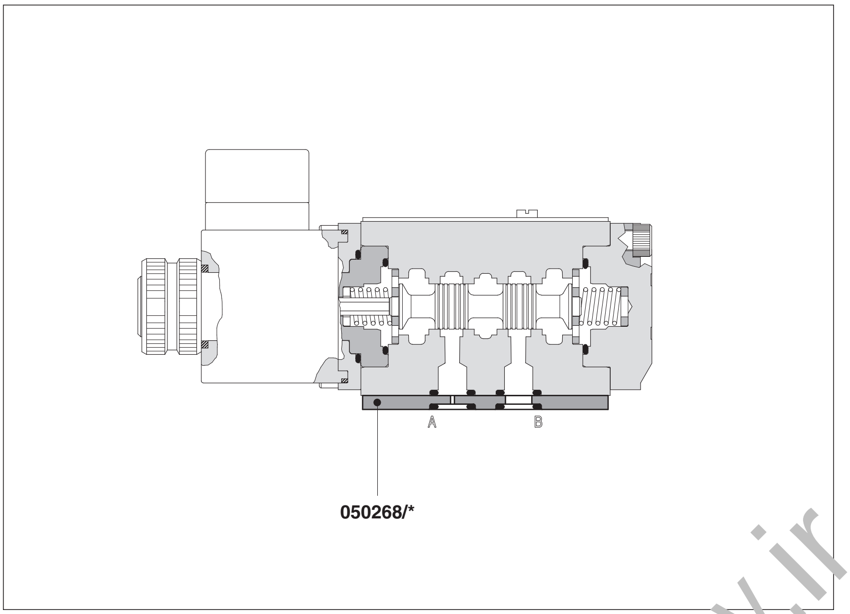
CODE AND DIMENSIONS	APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
ZBE-08 	Female plastic connector - 5 pin: - pressure transducer E-ATR8 - electronic pressure switch type E-DAP-2			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529

(1) the wiring of electrical terminals has to be made according to specific technical table

Modular plates with calibrated holes code SET-050268

ISO 4401 size 06

Available only on request



Modular plates with calibrated holes on ports A, B, P, T, for assembling under NG6 valves.
Up to 23 different calibrated holes are available from 0,4 mm to 5,0 mm, with several ports combination according the application requirements.

Application

To limit the flow to pilot valves or to actuators, instead of using PLUG or other type of restrictors.
The modular plates are supplied with 4 OR-108.

1 MODEL CODE

SET-050268 / **A*, B*, P*, T*** **/***

Modular plates with calibrated holes, supplied with 4 OR-108

A, B, P, T = port identification
***** = hole dimension, see section 2

Seals material
- = NBR
PE = FKM

EXAMPLE OF MODEL CODE

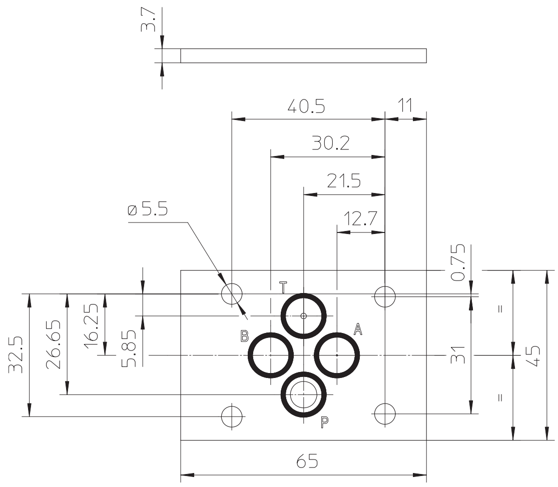
SET-050268/A04, B00, T15

A port with 0,4 mm hole
B port without hole
T port with 1,5 mm hole
P port with standard 7 mm hole

Note: in the code omit the port identification if the relevant hole is standard ø 7 mm

2 DIMENSIONS AND AVAILABLE HOLES

Code	ø hole [mm] A, B, P, T
/*04	0.4
/*05	0.5
/*06	0.6
/*07	0.7
/*08	0.8
/*09	0.9
/*10	1
/*12	1.25
/*15	1.5
/*17	1.75
/*20	2
/*22	2.25
/*25	2.5
/*27	2.75
/*30	3
/*32	3.25
/*35	3.5
/*37	3.75
/*40	4
/*42	4.25
/*45	4.5
/*47	4.75
/*50	5



ISO 4401: 2005
Mounting surface: ISO 4401-03-02-0-05

Table **TE080-1**

Din electric connectors with M12 interface

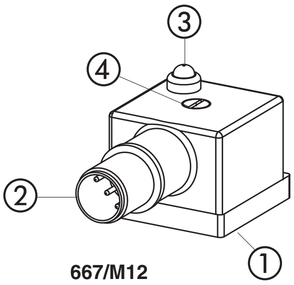
DIN 43650 standard coil connection and M12 user interface

Available only on request

Electric connectors with standard DIN 43650 solenoid interface and M12, 5 pin interface to the user side.

The connector includes integral signal led and suppressor diode.

Applications
Connector with M12 interface are particularly used in industrial sectors like machine tools and automotive.



667/M12

- ① DIN 43650 interface
- ② M12 - 5 pin user interface
- ③ Signal led
- ④ Fixing screw

1 MODEL CODE

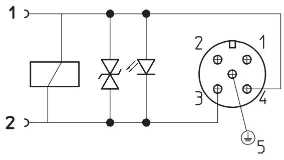
667	/	M12
Connector with coil electrical interface according to DIN43650 and built in signal led and suppressor diode		5 pin connector for electrical interface to the end user side

2 ELECTRIC CHARACTERISTICS

Connector model		**667/M12**
Normal voltage	[V]	24 DC
Max current	[A]	4
Protection degree		IP65

3 ELECTRIC CONNECTIONS

667/M12



4 DIMENSIONS

667/M12

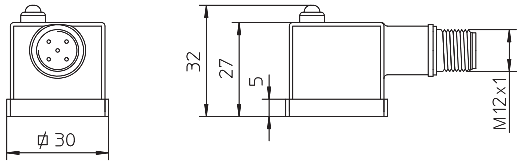
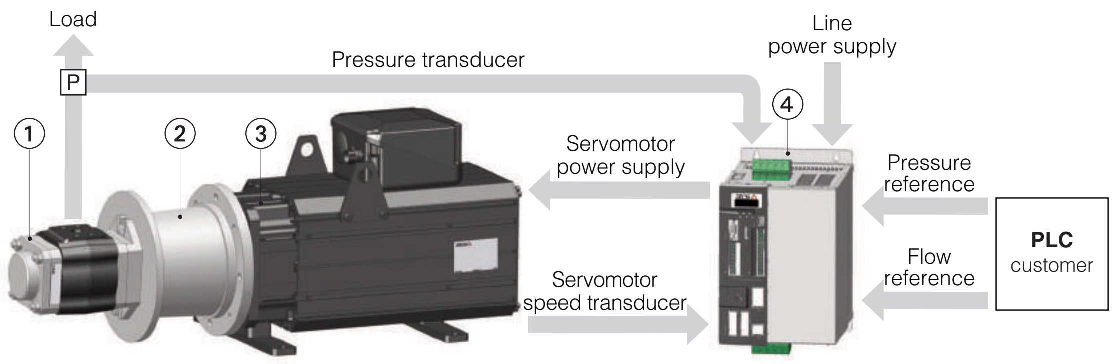


Table **AS050-0/E**

Basics for Smart Servopumps - SSP

The SSP servopumps represent a considerable step forward in the generation and control of hydraulic power, combining the typical advantages of fluid dynamics with the ease of control and adjustment of an electric drive.



① Internal gear pumps
② Bell with high precision joint
③ Permanent magnet servomotor
④ Vector control drive

1 GENERAL DESCRIPTION

The SSP servopumps are electro-hydraulic units designed to efficiently and accurately generate and regulate the flow rate and pressure through the continuous modulation of the pump rotational speed.
They guarantee high power density, high dynamics and precision, significant reduction in energy consumption and noise level, reliability and construction robustness.
The SSP servopumps are composed by a fixed displacement internal gear pump, driven by a permanent magnet synchronous servomotor, controlled by an electronic drive. The latter controls the speed of the servomotor and therefore of the pump, to adjust the flow rate or pressure of the system in closed loop based on the reference signals Q and P received from the machine PLC.

An angular position transducer, integrated in the servomotor, provides information on the instantaneous rotational speed of the pump and therefore the flow rate generated, while a pressure transducer, installed on the pump delivery, provides information about the actual pressure of the line. Atos has developed specific Smart Functions that offer flexibility of use and simplified commissioning, with significant advantages for the user.

Benefits of Smart Pumps - SSP

Energy savings up to 80%

Simplification of the hydraulic circuit and reduction of overall dimensions

Noise reduction up to 20 db less

Integrated P/Q control developed for hydraulics by industrial electrohydraulic specialists

Smart Start-up for quick and easy commissioning

Smart Tuning to select the optimal pressure control among the 3 dynamics levels available

Multiple axis for the optimization of the parameters for each axis of movement of the machine

S-SW-SETUP, dedicated software with a simple and easy to use graphic interface

S-SW-SIZING, for quick sizing of the SSP servopump

2 MAIN ADVANTAGES OF SERVOPUMPS

Servopumps offer general advantages over "traditional" systems equipped with fixed or variable displacement pump, operated by asynchronous motor:

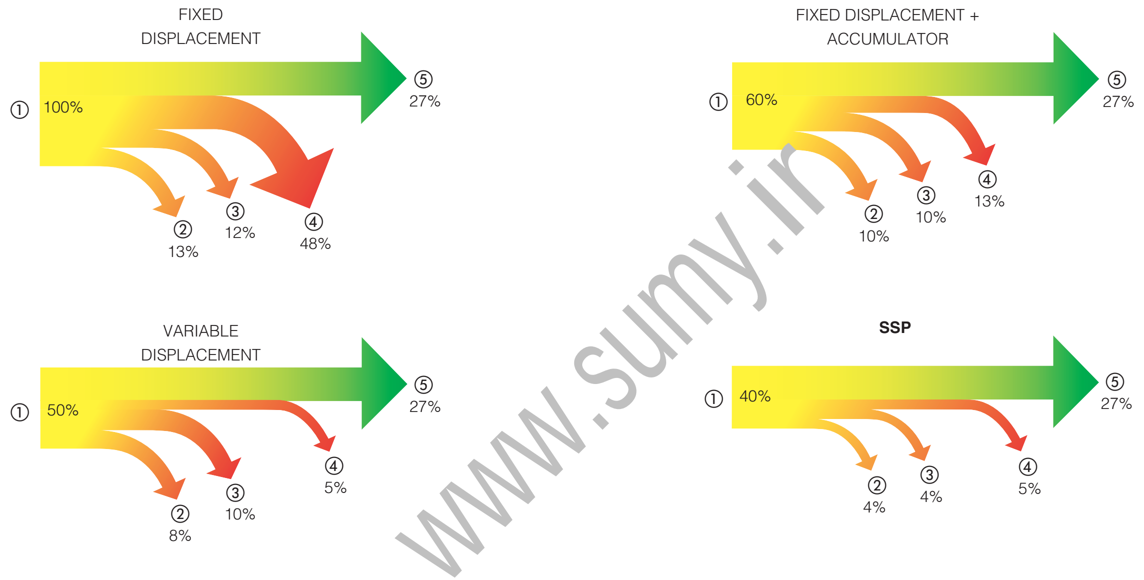
Efficiency

In traditional systems the pumps operate at constant speed regardless of the flow actually required at the different stages of the machine cycle, generating excessive power, which is then dissipated as heat.
In SSP servo pumps the flow rate is modulated through the change in the rotational speed, up to values close to zero when no flow is required, with a substantial advantage in terms of energy savings.

Compared to traditional systems, SSP is able to reduce energy consumption by up to 60/80%.

The lower figures represent a comparison between the consuption of a generic industria machine equipped with traditional systems and the same machine with an SSP servopump system.

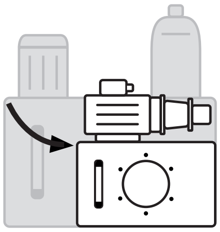
① Absorbed electrical power
② Energy losses due to electric motor performance (and drive)
③ Energy losses due to hydraulic pump efficiency
④ Energy losses by rolling through control valves
⑤ Useful hydraulic power



Smart ServoPump is in line with all climate protection initiatives and the European Green Deal, which invites machine manufacturers to use energy-efficient solutions.

Reduction of tank size and heat exchanger

The high efficiency of SSP results in less heating of the oil thanks to the reduction of the heat-dissipated power. This allows to contain the size of the tank and heat exchangers with the possibility, in some cases, even to avoid them.



Pump displacement reduction

The possibility of reaching maximum rotational speeds of up to 3000 rpm allows to reduce the displacement of the pump compared to traditional systems with asynchronous motor.

Simplification of the hydraulic circuit

Thanks to the high dynamic response and dedicated algorithms, SSP allows to directly control the speed of movement and the strength of hydraulic actuators with optimal levels of precision and repeatability allowing the use of simple ON/OFF directional valves.

Noise reduction

The internal gear pump that equips the SSP allows a general reduction of noise compared to other types of pumps. This, combined with the rotational speed modulation, especially in the static phases of the machine cycle, allows a reduction of up to 20 db compared to traditional systems and allows the user a lower investment to meet noise protection measures.

3 INTEGRATED P/Q CONTROL

Atos has exploited its unique know-how in electro-hydraulic systems to develop a specific P/Q control algorithm entirely dedicated to SSP servopumps and capable of satisfying the needs of any industrial machine.

SSP's P/Q control is specifically designed for hydraulic axes and is able to automatically manage the hydraulic properties of the working fluid.

The algorithm automatically selects which pressure-to-flow control is activated at each phase of the cycle according to the load conditions, always ensuring optimal management, free from sudden passages from P to Q and vice versa, pressure peaks and vibrations.

In this way the customer will be lightened by the construction of his own control algorithm and will only have to send to the D-MP drive the pressure and flow rate reference signals required at each phase of the machine cycle.

Q CONTROL PHASE

These phases are characterized by hydraulic axis translation with a normally low applied load, such as the translation of a mold before arriving in mechanical stop.

The SSP servopump will then follow the flow reference by adjusting the speed of the motor in such a way that the pump will deliver the required flow rate according to the below equation:

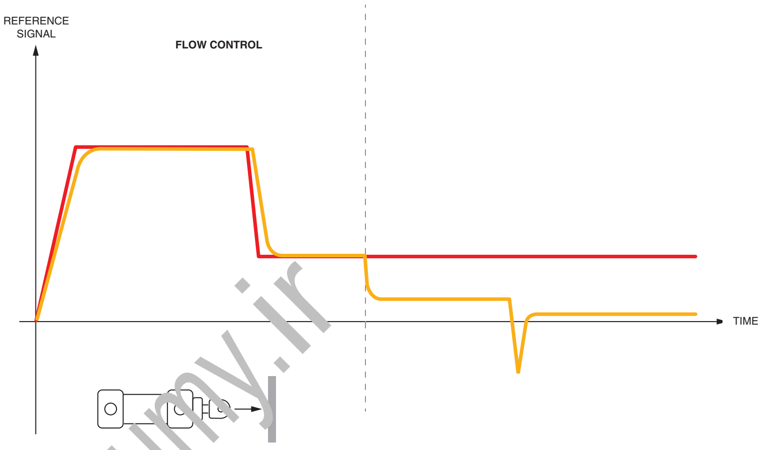
$$Q = \frac{CC_{pump}\, n_{engine}}{1000}$$

Where:

Q [l/min] = flow rate

cc_{pump} [cm³/rev] = pump displacement

n_{engine} [rpm] = servo motor rpm

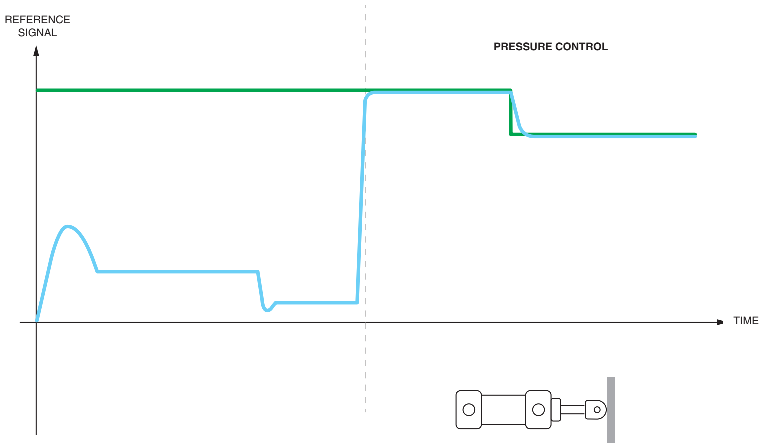


During the flow control phases the pressure reference signal is still present and has the function of limiting the maximum pressure of the system and therefore the force applied by the hydraulic actuator ensuring the safety of the machine.

P CONTROL PHASE

When, during translation, the axis encounters a strong load and the line pressure increases to a value close to the reference signal, pressure control is automatically activated. The D-MP drive controls the speed of the servo motor to limit and maintain the pressure exerted on the load to the value imposed by the reference signal.

These pressure stage can occur for example during the tonnage phase of a press or during the deformation of the metal material of a bending machine.



If, during the pressure control phases, a line depressurization is required, the PGI/PGIL pump is able to rotate in the opposite direction for a short period of time.

Simply reduce the pressure reference and D-MP drive will temporarily reverse the pump's rotation direction to discharge oil from the hydraulic circuit. During the pressure control phases, however, the flow rate reference signal is present and represents a limitation of the speed imposed on the load if the line pressure suddenly drops below the reference.

4 SSP SMART FUNCTIONS

Smart features allow to exploit the most of the potential of SSP, making the system simple to use and at the same time extremely flexible.

4.1 Smart Start-Up

The procedure supports the user during the commissioning phases of the SSP system, through a series of guided and intuitive procedures:

- **General settings**
It allows to choose the communication interface with the system (via Signals Analog or Fieldbus), configure analog signals (Voltage or Current) and set the protection features (see sect. 6).
- **Motor-check**
It performs an automatic control of the motor phases, verifying that they match the direction of rotation of the resolver and sending an alarm to the PLC if they are not. It also performs a self-calibration of resolver signals. The function is essential to allow the start-up of SSP, as it allows to verify the correctness of the electrical connections
- **Autotuning**
It automatically determines the optimal parameters of the pressure control, to adapt the dynamic response of the SSP and guarantee control precision and stability, regardless of the type of machine or the hydraulic circuit. Once the procedure is started, the servopump is subjected to an automatic cycle of a few seconds at the end of which the hydraulic parameters of the system will be estimated and the various control parameters set, based on the volume of oil controlled and the elasticity of the circuit. If the procedure is not carried out, the SSP servopump will use the factory parameters.
The S-SW-SETUP software can autonomously detect whether the Smart Start-Up procedure has been performed or not.
As any Atos products, through the S-SW-SETUP Software it is possible to save the system parameters on the PC and to load them again on the D-MP Drive if necessary.

4.2 Smart tuning

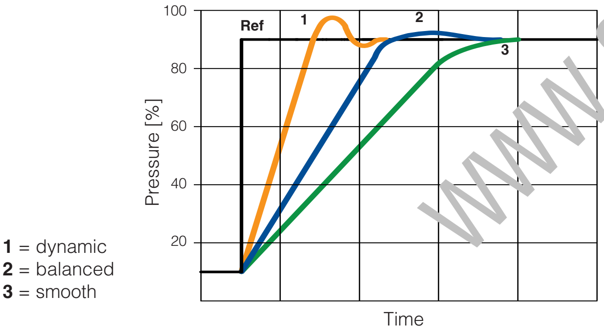
Once the Smart Start-Up procedure is complete, the Smart tuning feature allows to further refine the pressure control response by choosing from 3 different levels of performance:

- dynamic, high dynamic and minimized response time (factory setting)

- balanced, for fast response times with limited overshoot/undershoot

- smooth, attenuated response time, for soft adjustment that avoids undershoot/overshoot

The chosen setting can be changed at any time via the S-SW-SETUP Software, or via fieldbus or digital inputs of the D-MP Drive.



In case of necessity, performance can be further customized by directly modifying the individual control parameter via S-SW-SETUP.

4.3 Multiple axis

SSP servo pumps allow to create 4 possible sets of parameters, related to:

- Flow/pressure limits
- Flow/pressure ramps
- Parameters for pressure control and P/Q logics

Since most of industrial machines perform different movements, each driven by specific cylinders/motors of different sizes and with different pressure and flow requirements, the use of a single set of parameters could lead to inaccuracies in P/Q control with the possibility of unwanted vibrations or undesired response times.

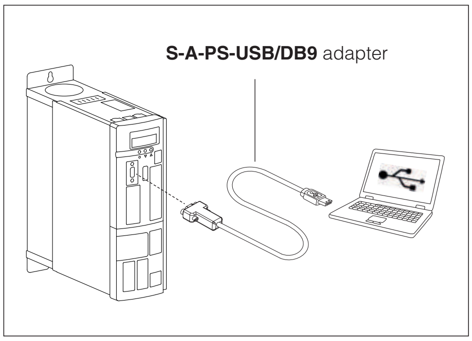
The multiple axis setting allows to optimize the different features for the different conditions of the machine cycle ensuring maximum performance at all stages of the cycle.

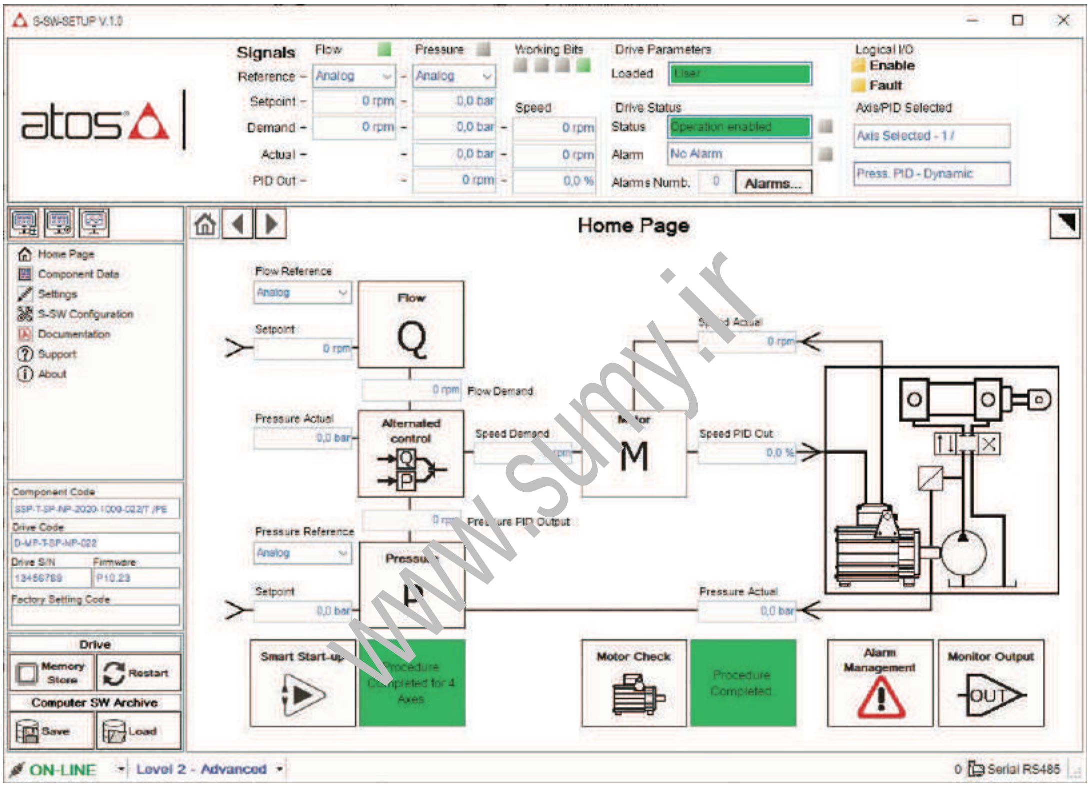
The active axis can be selected in real time via fieldbuses or digital inputs of the D-MP drive.

5 PROGRAMMING SOFTWARE

SSP systems can be configured using Atos S-SW-SETUP programming software.
This can be easily used by connecting PC to the D-MP drive via the RS485 port

S-SW-SETUP is specifically developed for servopump systems as opposed to competitive General Purpose Software, which must be customized by the user for the servopump application.
At the first start up, the software will invite the user to follow the Smart Start-Up guided procedure (see 4.1) for setting all the parameters needed for the correct start-up and operation of the system.
All the main functions can be reached and modified thanks to a simple and intuitive graphics.
Furthermore, the software allows to monitor in real-time the signals managed by the drive (References, Feedback, Temperatures, Currents, Voltages, etc.) and the status of each individual alarm.
S-SW-SETUP includes an internal oscilloscope to visualize the trend over time of the above signals.





Reference – Analog – Analog
Setpoint – 0 rpm – 0,0 bar
Demand – 0 rpm – 0,0 bar – 0 rpm
Actual – – 0,0 bar – 0 rpm
PID Out – – 0 rpm – 0,0 %
Loaded User
Status Operation enabled
Alarm No Alarm
Alarms Numb. 0
Axis Selected - 1 /
Press. PID - Dynamic
Flow Reference Analog
Setpoint 0 rpm
0 rpm Flow Demand
Pressure Actual 0,0 bar
Speed Demand rpm
0 rpm Pressure PID Output
Pressure Reference Analog
Setpoint 0,0 bar
Speed Actual 0 rpm
Speed PID Out 0,0 %
Pressure Actual 0,0 bar
Procedure Completed for 4 Axes
Procedure Completed
Component Code SSP-T-SP-NP-2020-1009-022/T /PE
Drive Code D-MP-T-SP-NP-022
Drive S/N 13456789
Firmware P10.23
Factory Setting Code
ON-LINE
Level 2 - Advanced
0 Serial RS485

All parameters available on the drive can be monitored with S-SW-SETUP or shared with the customer's PLC via fieldbus

6 SIZING SOFTWARE

It is a software developed by Atos to allow the customer to size the servopump that best suits the requirements of their machine cycle.

In the software S-SW-SIZING it is simply required to generate the machine cycle by entering the pressure, flow rate and cycle time data of each phase. It is possible to enter the data manually or load the acquired data recorder from the cycle of an existing machine.
The software shows the different parameters of the cycle and automatically selects the individual components for the SSP system, adapted to the machine cycle introduced.
The complete ordering code is automatically generated by the software.
It is also possible to navigate in detailed pages for each component to view the working conditions with respect to the maximum performance that the component can achieve.

The software also provides an estimate of energy saving compared to traditional systems such as variable displacement pump/fixed displacement pump.

S-SW-SIZING sizing tool software is available for free on the Atos website, you can download it from www.atos.com

7 PROTECTION FEATURES

SSP systems integrate logics specifically developed to prevent stressful working conditions of individual system components, thus avoiding sudden failures and consequent downtime.

7.1 Pump protection systems

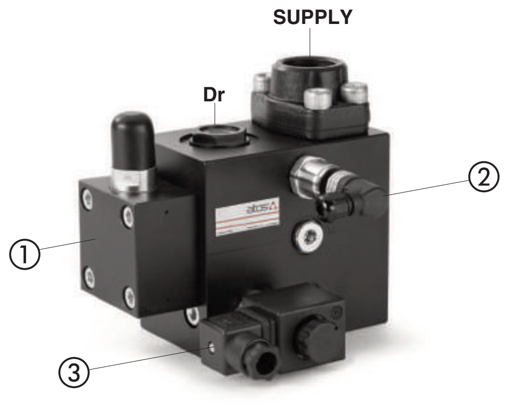
The pump is the most stressed element of the SSP system and requires special attention to prevent sudden failures and ensure longer durability. To do so, special safety features have been implemented on the D-MP drive.

Smart cooling

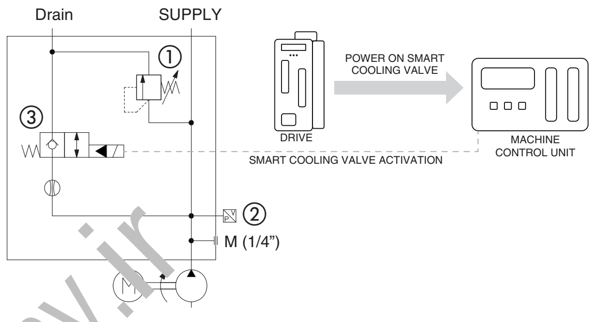
In prolonged pressure control phases, the pump tends to overheat due to internal leakages. An algorithm is implemented in the D-MP Drive to avoid this condition; the drive provides a digital output that indicates when to activate, via PLC of the machine, the dedicated valve that allows a small oil recirculation. This feature is provided in the built-in block available as an option - see tec. table AS300.

This block, flanged directly on the pump, offers a complete and ready-to-use solution. It includes:

① Relief valve, for system protection
② Pressure transducer, to be wired to drive, required for P/Q control
③ Smart Cooling valve, dedicated to pump cooling



Protection function hydraulic diagram (optional)



Depending on machine cycle, the Sizing Tool software (see sect. 9) will suggest whether or not the optional manifold is recommended.

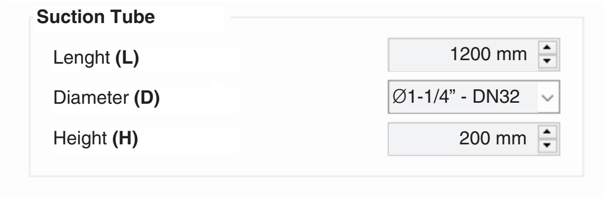
Protection from cavitation

One of the main causes of excessive wear of pumps is cavitation.
This function allows to set the angular acceleration limits of the servomotor, in accordance to the geometry of the pump intake line, to prevent this phenomenon from occurring.

To do this, simply enter the following parameters during the Smart Start-up procedure that will automatically define the servomotor acceleration limits:

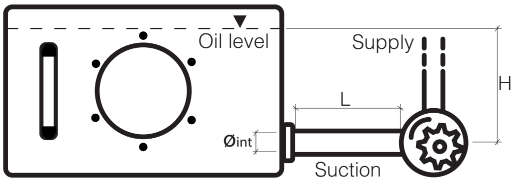
- Suction pipe length
- Diameter of the suction pipe
- Suction port height compared to the oil's free level

Suction pipe configuration



Suction Tube

Lenght **(L)** 1200 mm
Diameter **(D)** Ø1-1/4" - DN32
Height **(H)** 200 mm



Limiting minimum pressure

The drive always guarantees a minimum pressure in the pump supply line (10 bar) that allows to always work in the best conditions.

7.2 Servomotor and drive temperature control

Both the servomotor and D-MP drive temperatures are monitored with dedicated temperature probes in order to protect these components from overheating as a result of incorrect installations or excessively heavy working conditions.
In the event of overheating of the D-MP drive or servomotor, the drive sends an alarm to the central unit and blocks the SSP system to avoid sudden failures.
The servomotor is stopped by means of a deceleration ramp, so to obtain a soft slowdown of the load avoiding system ram blows and pump cavitation.
These features are an additional protection for SSP system although the correct sizing and use prescribed in the user manual allow to exclude problems of overheating of servo motor or drive.

8 COMPONENT DESCRIPTION

The SSP servopumps are composed by following components:

Fixed displacement Internal gears pump - PGI / PGIL

This type of pump is the ideal solution for servopump application as it guarantees reduced pressure pulses and a wide range of rotational speeds with the possibility of going down to a few revolutions per minute, essential characteristics to achieving accurate P/Q control.

The high efficiency allows to maximize the energy savings of the system, in addition the construction peculiarity allows a reduction in noise emissions up to 20 dB compared to traditional systems.

Two versions are available depending on the required operating pressures:

- **PGI**, cast iron body version, ideal for applications with maximum continuous pressures up to 330 bar – see tec. table **AS300**
- **PGIL**, aluminum body version, for applications with maximum continuous pressures up to 250 bar – see tec. table **AS350**

Both versions cover a wide range of displacements, from 10 cm3/rpm to 125 cm3/rpm, ensuring maximum flow rates up to 350 l/min.

Permanent magnet synchronous servomotor - PMM, tec. table **AS400**

It relies on the most performing technology available on the market for electric motors.

Synchronous servo motors exploits a surface permanent magnet rotor that allows high performance.

They differ from traditional asynchronous motors by:

- high electrical efficiency (up to 94% under nominal conditions)
- smaller footprints
- high control dynamics, due to low rotor inertia combined with a high overload

The servomotor is equipped with an integrated speed transducer (resolver), to control the rotational speed in closed loop.
A temperature transducer allows to monitor any overheating of the servomotor.
PMM servomotors are equipped with a cooling fan, which is activated automatically only under the most demanding conditions of use.
They are available in 8 sizes with rated power from 9 kW to 100 kW and with an overload capacity of 200%.

Servomotor - Pump Coupling

The coupling between servomotor and pump ensures maximum levels of precision in motion transmission, effective vibration damping and mechanical misalignment compensation.
The joint consists of a torsionally rigid lamellar package, which can compensate for axial, angular and radial misalignments.
The peculiar geometry and the materials chosen allow to withstand the torque generated by the servomotor.

Vector control Drive - D-MP, tec. table **AS500**

It represents the "brain" that manages and controls the entire SSP system, taking advantage of the most modern technology used in servo drives.
The Drive electrically powers and adjusts the servomotor speed to obtain flow and pressure values according to the reference signals received from the machine PLC.
It is interfaced with the servomotor angular transducer and the pressure transducer installed on the pump delivery for flow rate and pressure closed loop control.
A dedicated algorithm for P/Q control is implemented on the unit in order to optimally adjust the pressure and flow rate of the hydraulic system.
In accordance with industry 4.0, D-MP drive collects all the hydraulic and electrical parameters of the system in real time, allowing the user a simple monitoring of the status and performance of the machine.
In addition, any error is detected by the drive and returned to the central unit, protecting the system from incorrect conditions of use.

D-MP drives are available in 9 sizes with rated current from 22A to 210A and with 200% overload capacity.

9 FIELDBUS

The Fieldbus interface allows direct communication between the SSP and the machine control unit.
The bus allows the exchange of the following information:

- speed and pressure reference signals and logic inputs (example: enable signal)
- speed and pressure feedbacks
- diagnostic information
- all the configuration parameters of the SSP system

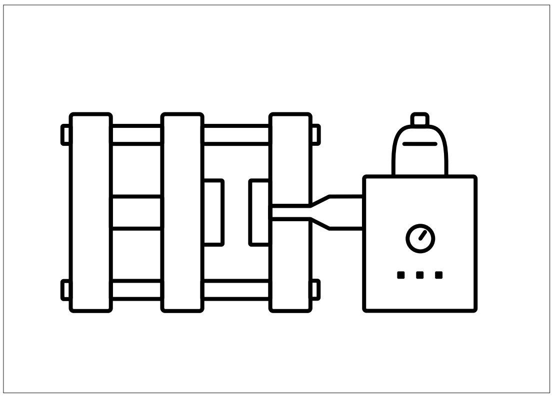
CANopen EtherCAT PROFIBUS PROFINET

10 APPLICATION EXAMPLES

The following paragraphs examine real machine cases highlighting the advantages that SSP servopumps offer over traditional systems.

10.1 Example of die casting machines: 65% more energy efficiency

The die casting machines were designed to guarantee extreme speed in the production process and extreme precision in the workpiece. For this reason, reliable and performing components are constantly being sought to increase productivity and reduce cycle times.



In this scenario, SSP systems are the optimal choice.

Hydraulic robustness, high power density and load sealing capacity are the strengths that make servopumps the ideal choice for the harsh environmental conditions of die casting machines.

The high acceleration/deceleration of the servo motor's permanent magnet technology, guarantees an absolute dynamic that allows the reduction of machine cycle times that resulting in a subsequent increase in productivity.

In addition, the use of SSP instead of traditional technologies with constant speed systems allows the simplification of the hydraulic circuit.

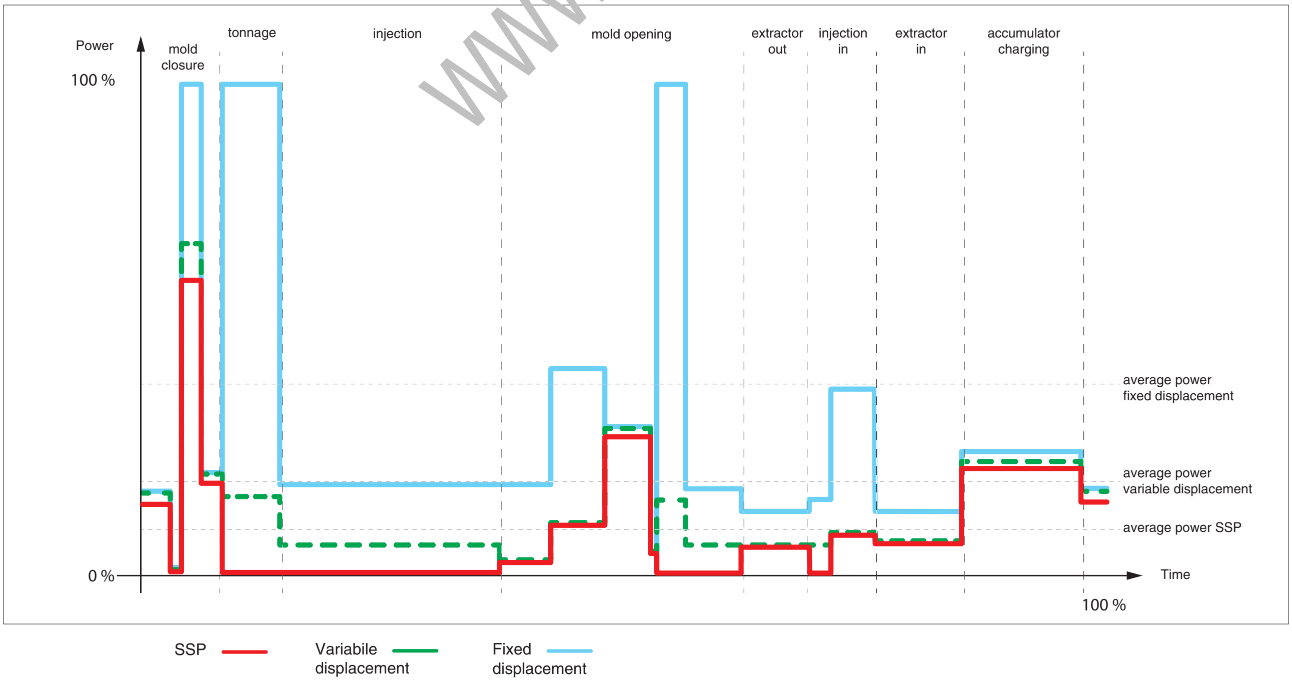
With traditional systems, in fact, it was necessary to have two pumps, one for rapid movements, characterized by very high flow rates, and a second for the slowest movements with high operating pressures.

Now, an SSP system is enough to handle both high-flow and low-flow phases. In addition, thanks to its high dynamics and control precision, it can also allow the replacement of some proportional valves with simple ON/OFF valves.

In die casting machines, the injection phase, which represents one of the most delicate movements, was previously made with accumulator and managed completely by proportional cartridges.

Now it is possible to manage the entire first part of the injection, which requires a very precise cylinder speed control and with very accentuated speed ramps, with the servopump, eliminating the huge energy losses generated by the use of high pressure oil of the accumulator throttled by proportional valves.

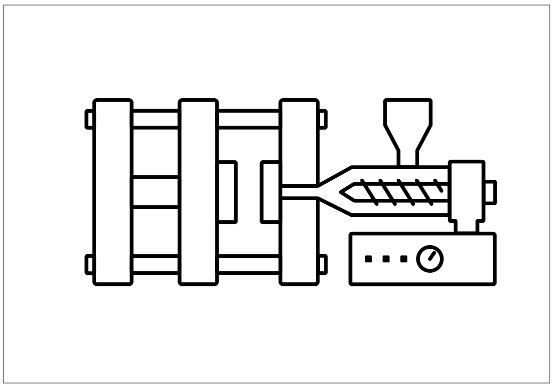
During the second part of the injection, which instead needs very high dynamics and for this reason must be carried out with accumulators, it is possible to stop the pump by bringing the speed reference to values close to 0% and reducing energy consumption and noise.



In the cycle shown in the graph, the SSP pump ensures energy savings of up to 65% compared to traditional systems.
The phases that benefit the most from an energy point of view are those characterized by low flow rate and high pressure, such as the tonnage phase and some phases of opening and closing molds, in which the servopump delivers exactly the required flow rate.

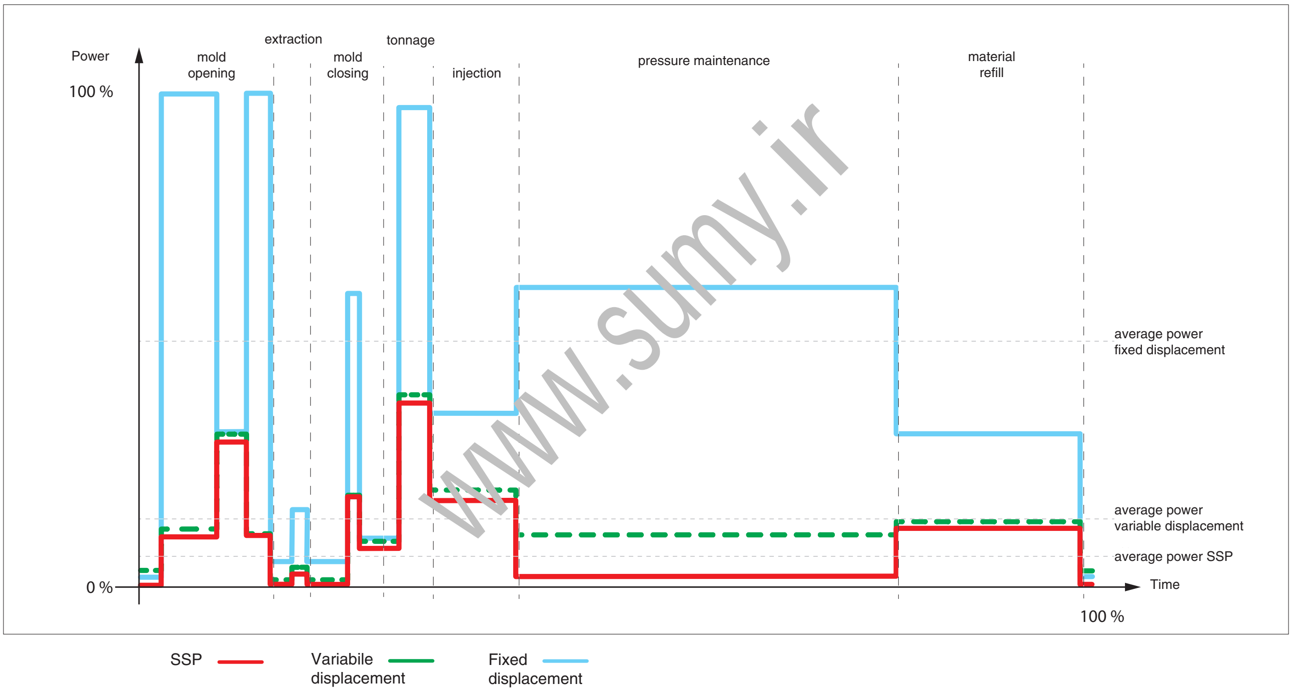
10.2 Example of plastic/rubber injection machines: 65% to 80% energy saving

Plastic/rubber injection presses require high dynamics, precision and maximum repeatability at every stage of the machine cycle together with the reliability of the entire system.



SSP servo pumps ensure high dynamics with engine speed step response times of 0-100% 50 ms for optimal control during all phases of the machine cycle.
The wide speed range allows to manage both the fast mold movement phase and the clamp saving phase, during which it is necessary to maintain a very low speed.

The various phases of the machine cycle usually rely on actuators with different areas and strokes with the consequence of having very different oil volumes to be controlled. With the multi-axis function it will be possible to use different set of parameters and always optimized for every movement, obtaining the optimal control for both larger cylinders that require high dynamics, as the injection cylinders, and with smaller actuators that need softer movements, as the extraction cylinders of the piece from the mold.



In the graph it is possible to detect in detail the great advantages of SSP in term of energy saving compared to other traditional systems.
It is especially during the holding pressure phase, that you have the greatest benefits in terms of energy saving are achieved.
During this phase the pump rotation speed is almost 0 as it has just to compensate for the oil leakage losses of the system (of the pump itself or of other hydraulic components), keeping the line pressure constant.
Depending on the duration of this phase, SSP can achieve energy savings of 65% to 80% per machine cycle.

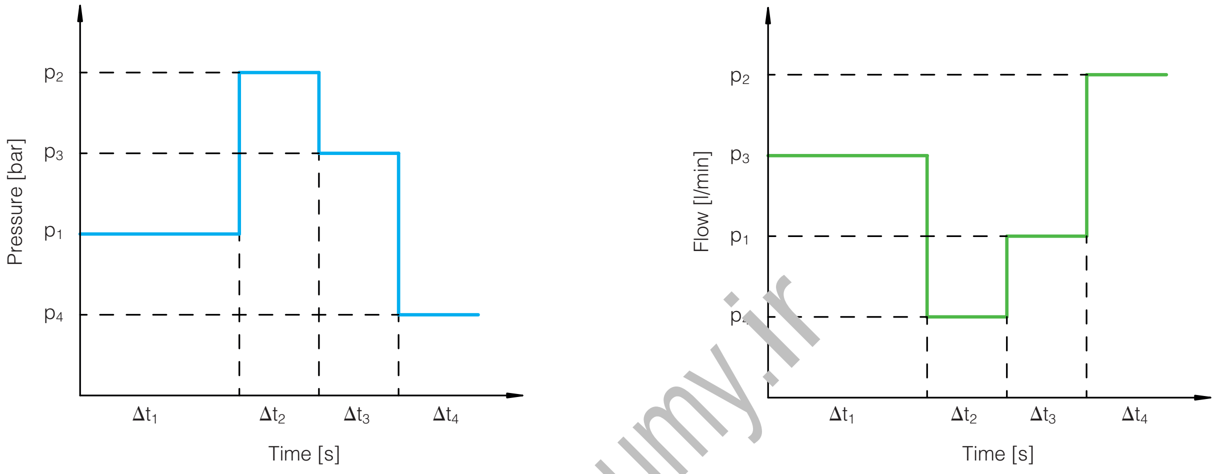
11 RELATED DOCUMENTATION

AS100	SSP Smart Servopumps	**AS800**	Programming tools for pumps & servopumps
AS200	Sizing criteria for servopumps	**AS810**	Accessories for servopumps
AS300	PGI cast iron internal gear pumps, high pressure	**AS910**	Operating and maintenance information for servopumps
AS350	PGIL aluminium internal gear pumps	**GS510**	Fieldbus
AS400	PMM high performance synchronous servomotors	**S-MAN-HW**	Servopumps installation manual
AS500	D-MP electronic drives	**S-MAN-SW**	Servopumps programming software manual
		S-MAN-STO	Servopumps Safe Torque Off manual

Sizing criteria for Servopumps - SSP

For the sizing must refer to the following Tab.1 and Tab.2 tables, respectively, for servopumps SSP equipped with PGI pumps with cast iron body and pressure up to 330 bar, or PGIL with aluminum body for pressure (up to 250 bar) - see sizing example in section 1.1

Example machine cycle



STEP 1 - Pump sizing

The pump must be selected to satisfy the following equation:

$$\begin{cases} Q_{max,pump} > Q_{max,cycle} \\ P_{peak,pump} > P_{max,cycle} \end{cases}$$

where:

Qmax,pump = *maximum flow rate of the pump*
Qmax,cycle = *maximum flow machine cycle*
Ppeak,pump = *maximum pump pressure*
Pmax,cycle = *maximum machine cycle pressure*

STEP 2 - Sizing of the electric servomotor and drive

The electric servomotor and the drive are selected according to the maximum average pressure *Pmed,SSP* that the servopump SSP can guarantee, according to the equation:

$$\begin{cases} P_{med,SSP} > P_{rms,\ cycle} \\ P_{med,SSP} > \dfrac{P_{max,cycle}}{2} \end{cases}$$

where:

Pmed,SSP = SSP maximum continuous mean pressure (see Tab.1 and Tab.2)

$$P_{rms,\ cycle} = \sqrt{\frac{p_1^2\ \Delta t_1 + p_2^2\ \Delta t_2 + ... + p_n^2\ \Delta t_n}{\Delta t_1 + \Delta t_2 + ... + \Delta t_n}}$$

p_1, p_2 ... p_n = pressures [bar] in each phase of the cycle

Δt_1, Δt_2 ... Δt_n = duration [s] of each phase of the cycle

⚠ **The procedure described must be considered only for a preliminary sizing of the servopump.**
For optimal sizing, use the S-SW-SIZING software. Download it from www.atos.com

1.1 Sizing example

Machine cycle data:

$Q_{max,cycle}$ = 140 l/min; $P_{max,cycle}$ = 290 bar; $P_{rms,cycle}$ = 200 bar;

STEP 1 - pump sizing

In the "Cycle data" column of the tables Tab.1 and Tab.2 identify the first row of Qmax, pump and Ppeak, pump values that are immediately higher than both machine cycle data:

$Q_{max,pump} > 140$ l/min; $P_{peak,pump} > 290$ bar;

In this case, the identified values that satisfy the machine cycle data are present only in Tab.1:

$Q_{max,pump} = 150$ l/min and $P_{peak,pump} = 300$ bar, corresponding to the **PGI-2050** pump

STEP 2 - PMM servomotor sizing and combination with D-MP drive

In the row corresponding to the identified pump (PGI-2050), move to the right in the table until you find the value of Pmed, SSP that meets the condition:

$P_{med,SSP} > 200;$

$$P_{med,SSP} > \frac{290}{2}$$

In this case, the Pmed, SSP identified value is = 227

Moving along the column corresponding to the value of Pmed, SSP identified, it is possible to select:

the electric servomotor: **PMM-2042**;

the drive: **D-MP-090**

The complete code of the SSP servopump is therefore: **SSP**-T-SP-**-**2050-2042-090-***-*

Tab.1 - Sizing of the SSP servopump equipped with PGI pump (cast iron body)

CODE	**CYCLE DATA**		**PGI** PUMP	**PMM** MOTOR								
	Qmax,pump (l/min)	*Ppeak,pump* (bar)	Code	**1009**	**1015**	**1024**	**1032**	**2042**	**2055**		**2080**	**2100**
				Pmed,SSP (bar)								
SSP-*	32	350	**1011**	223	330							
	60	350	**2020**	122	203	297	330					
	96	350	**2032**	76	126	185	252	330				
	120	300	**2040**		101	148	202	280				
	120	340	**4050**		81	119	162	227	270	297	330	
	150	300	**2050**		81	119	162	227	270	280		
	155	330	**4064**			93	127	177	211	232	330	
	175	330	**4080**			74	101	142	169	186	270	300
	195	290	**3064**			93	127	177	211	232	280	
	220	330	**4100**				81	113	135	149	216	270
	240	290	**3080**			74	101	142	169	186	270	280
	300	290	**3100**				81	113	135	149	216	270
				022	**032**	**046**	**060**	**090**	**100**	**140**	**165**	**210**
				DRIVE **D-MP**								

Tab. 2 - Sizing of the SSP servopump equipped with PGIL pump (aluminum body)

CODE	**CYCLE DATA**		**PGIL** PUMP	**PMM** MOTOR								
	Qmax,pump (l/min)	*Ppeak,pump* (bar)	Code	**1009**	**1015**	**1024**	**1032**	**2042**	**2055**		**2080**	**2100**
				Pmed,SSP (bar)								
SSP-*	60	320	**2020L**	122	203	250						
	96	320	**2032L**	76	126	185	250					
	120	300	**2040L**		101	148	202	250				
	150	280	**2050L**		81	118	161	225	250			
	195	270	**3064L**			91	124	174	207	227	250	
	240	270	**3080L**			74	101	141	168	185	250	
	300	270	**3100L**				74	113	134	148	215	250
	350	280	**4125L**					91	108	119	173	216
				022	**032**	**046**	**060**	**090**	**100**	**140**	**165**	**210**
				DRIVE **D-MP**								

Smart Servopump - SSP

high performance P/Q control and energy saving

SMART TUNING

P/Q CONTROL

SMART START-UP

MULTIPLE AXIS

SSP-T-SP-NP-2032L-1015-032-*/T **/PE

① Internal gear pump
② Bellhousing with zero backlash coupling
③ Permanent magnets Servomotor
④ Drive

SSP systems combine the typical advantages of hydraulic power transmission with the ease of control and adjustment of an electric drive while also ensuring maximum levels of energy efficiency.
They are used in high performance machines mainly for the plastic, die-casting and deformation sectors.

Maximum flow:	**350 l/min**
Maximum rated power:	**100 kW**
Maximum continuous pressure:	
cast iron pump	**330 bar**
aluminium pump	**250 bar**

They consist of a fixed displacement internal gear pump, driven by a permanent magnet synchronous servomotor controlled by an electronic drive. The latter controls the speed of the servomotor and therefore of the pump, to adjust the flow rate or pressure of the system based on the reference signals received from the PLC of the machine.
A dedicated algorithm optimizes the P/Q function by automatically selecting the activation of the flow or pressure control.

Compared to traditional systems, SSPs offer the following advantages:

- significant reduction in energy consumption, as the pump operates at the speed strictly necessary to generate the required flow rate / pressure
- high dynamics and precision of P/Q control thanks to a dedicated algorithm
- reduction of the noise level, thanks to the design of the pump and the variable speed
- maximum flexibility thanks to dedicated software
- simplified commisioning thanks to the Smart start-up and Smart tuning functions
- possibility of customization up to 4 axes with Multiple axis function

For more details see technical table AS050

1 MODEL CODE

SSP - **T-SP** - **NP** - **2020L** - **1024** - **046** / **C** / **T** * / **PE**

Smart servopump

Control logic:
T-SP = alternated P/Q control with resolver

Fieldbus interface, serial port always present:
NP = Not present
BC = CANopen
BP = PROFIBUS DP
EH = EtherCAT
EP = PROFINET RT/IRT

Pump

PGI, cast iron pump, Pmax 330 bar **(1)** - see table AS300:
1011 = 10,9 cm^3/rev
2020 = 20 cm^3/rev
2032 = 32,1 cm^3/rev
2040 = 40,1 cm^3/rev
2050 = 50 cm^3/rev
4050 = 50 cm^3/rev
3064 = 64 cm^3/rev
4064 = 64 cm^3/rev
3080 = 80 cm^3/rev
4080 = 80 cm^3/rev
3100 = 100 cm^3/rev
4100 = 100 cm^3/rev

PGIL, aluminium pump, Pmax 250 bar - see table AS350:
2020L = 20 cm^3/rev
2032L = 32,1 cm^3/rev
2040L = 40,1 cm^3/rev
2050L = 50 cm^3/rev
3064L = 64 cm^3/rev
3080L = 80 cm^3/rev
3100L = 100 cm^3/rev
4125L = 125 cm^3/rev

(1) Pmax depends on the pump displacement

Series number

Seals material
PE = FKM

Port orientation see section 10:
T = standard
U, **V** = optional

Hydraulic option see section 8:
C = integrated block with relief valve and pressure transducer
D = as option C plus Smart Cooling functionality

Electronic option see section 9:
K = Drive with Safe Torque Off

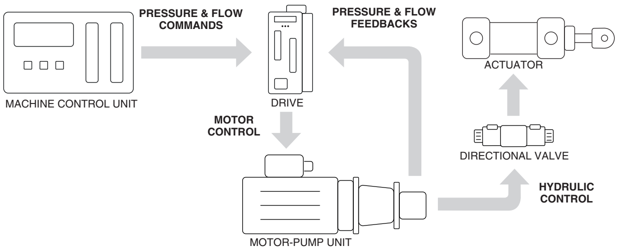
Drive D-MP - see table AS500:
022 = 22 A
032 = 32 A
046 = 46 A
060 = 57 A
090 = 87 A
100 = 100 A
140 = 140 A
165 = 165 A
210 = 210 A

Motor PMM - see table AS400:
1009 = 8,7 kW
1015 = 15 kW
1024 = 24 kW
1032 = 30 kW
2042 = 42 kW
2055 = 55 kW
2080 = 80 kW
2100 = 100 kW

⚠ **For optimal sizing, download the sizing software from www.atos.com**

2 FUNCTIONING DESCRIPTION

SSP servopumps are designed to efficiently and accurately generate and regulate hydraulic power at every stage of the machine cycle. The ability to modulate the required flow rate or pressure by varying the number of revolutions gives it a substantial advantage in terms of energy savings compared to traditional systems that operate at constant speed. Thanks to the high dynamics and dedicated algorithms, the SSP allow you to directly control the speed of movement and the force of the hydraulic actuators with optimal levels of precision and repeatability.
They consist of an internal gear pump, a permanent magnet servomotor and an electronic drive.
The drive is connected to an angular transducer which measures the rotation speed of the servomotor and to a pressure transducer. It manages the motor power supply, the operating logic and system diagnostics.



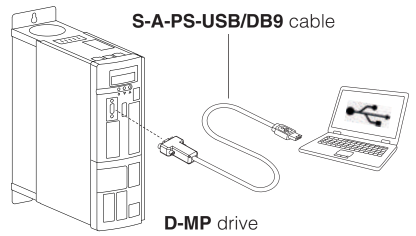
3 PROGRAMMING TOOLS

The functional parameters and configurations of the SSP servopumps can be easily set and optimized using the Atos S-SW-SETUP programming software by connecting the PC to the drive via the RS485 serial port.
The software allows the parameterization of the drive via the RS485 serial port even if the drive is connected to the machine central unit via fieldbus.

S-SW-SETUP support: NP (Serial) BC (CANopen) EH (EtherCAT)
BP (PROFIBUS DP) EP (PROFINET)

Note: For detailed descriptions of settings, wiring and installation procedures, refer to the user manual included in S-SW-SETUP

PC connection



4 FIELDBUS

Fieldbus allows direct communication between the Drive and the machine control unit for digital reference, extended diagnostics and servopump settings. However, the fieldbus versions allow the servopump to be controlled also through analog references.

5 GENERAL CHARACTERISTICS

Installation position	Motor and pump: horizontal position Drive: wall mounting, vertical position	
Ambient temperature range	Motor and pump: -20°C ÷ 40°C Drive: 0°C ÷ 40°C	motor and drive derate in power for higher temperature
Altitude	up to 1000 m, motor and drive derate in power for higher altitude	
Compliance	CE according to EMC directive 2014/30/EU and LVD 2014/35/EU Rohs directive 2011/65/EU as last update by 2015/863/EU	

6 HYDRAULIC CHARACTERISTICS

Hydraulic fluid		HL, HLP DIN 51524...535, for other fluids contact Atos technical office	
Fluid temperature range		-20°C ÷ 80°C	
Recommended viscosity		10 ÷ 300 mm²/s - cold start max 2000 mm²/s	
Max fluid contamination level	normal operation	ISO4406 class 20/18/15 NAS1638 class 9	see also fiter section at www.atos.com or KTF catalog
	longer life	ISO4406 class 18/16/13 NAS1638 class 7	
Min/max inlet pressure	(bar abs)	from 0.8 to 2 bar. Recommended ⩾ 1	

7 DRIVE ELECTRICAL CHARACTERISTICS

Rated IN voltage [V]	200 V -10% ÷ 460 V +10% @ 45 ÷ 65 Hz for drive 022 ÷ 060 380 V -15% ÷ 460 V +10% @ 45 ÷ 65 Hz for drive 090 ÷ 210			
DC Bus voltage [V]	280 V -10% ÷ 620 V +10% for drive 022 ÷ 060 530 V -15% ÷ 650 V +10% for drive 090 ÷ 210			
24VDC input power supply	24 VDC ±10% @ max 1,0 A for drives type 022, 032, 090, 100, 140, 165, 210 24 VDC ±10% @ max 1,6 A for drives type 046, 060			
24VDC output power supply	24 VDC ±10% @ max 500 mA - only for drives type 090, 100, 140, 165, 210			
Digital inputs	24 VDC ±10% @ max 10 mA			
Digital outputs	30 VDC @ max 60 mA			
Analog inputs	±10 V @ max 0,5 mA or 4 ÷ 20 mA (Dip-switch selectable - see user manual)			
Analog outputs	±10 V @ max 2 mA			
Protection degree to DIN EN60529	Motor: IP54 (IP65 on request); Drive: IP20 for sizes 022 ÷ 100, IP00 for sizes 140 ÷ 210			
Communication interface	Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, PROFINET IO RT / IRT EC 61158
Communication physical layer	insulated RS485	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insuated 100 Base TX

8 HYDRAULIC OPTION

C = This option provides a hydraulic block mounted directly on the pump outlet, which integrates a mechanical pressure relief valve with safety function on the maximum system pressure and a pressure transducer for the feedback of the actual pressure on the delivery line.

① Mechanical pressure relief valve; the valve is supplied with zero adjustment, and must be adjusted by the user at a pressure slightly higher than the maximum pressure required by the system.

② Pressure transducer E-ATR-8/400/I - see technical table GS465

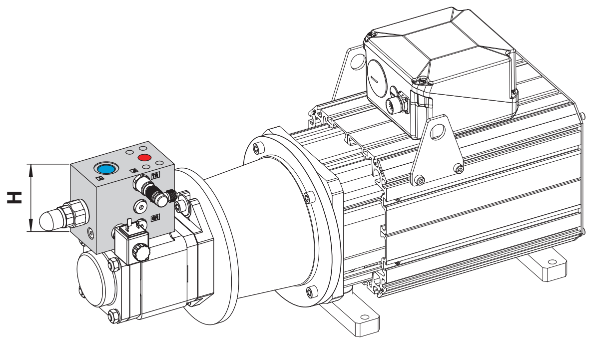
D = This option allows to protect the pump from overheating when it is subjected to particularly heavy duty cycles, in particular in the prolonged phases of static pressure control.
This option includes a hydraulic block with relief valve and pressure transducer, as for the /C option, with also integrated:

③ Smart Cooling cartridge valve JO-DL-4-2/NC-X 24DC - see technical table E105

When a temperature considered critical is reached, the Smart Cooling valve opens ③ as to cause a small recirculation of oil through the pump which protects it from dangerous overheating.

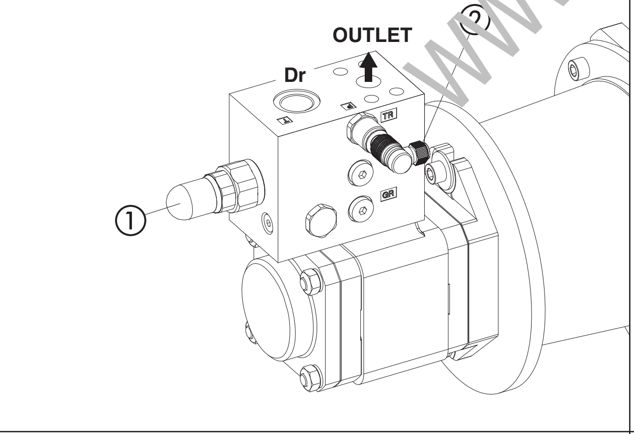
The sizing software for SSP suggests the need for the /D option based on the machine cycle.

Options **C** and **D** dimensions

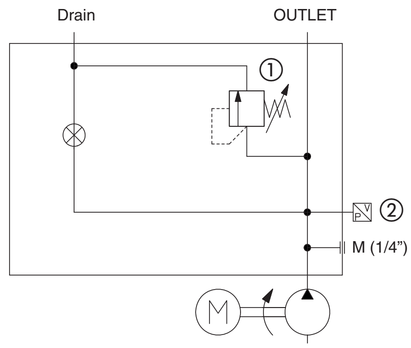


SSP CODE	OUTLET	**Dr** (drain)	**H** (mm)
SSP-T-SP-1011***	1/2" SAE3000	G1/2"	105
SSP-T-SP-2020***	3/4" SAE3000	G3/4"	110
SSP-T-SP-2032***			
SSP-T-SP-2040***	1" SAE3000	G1"	115
SSP-T-SP-2050***			
SSP-T-SP-4050**	1" SAE6000	G1"	115
SSP-T-SP-3064***	1" SAE6000	G1 1/4"	125
SSP-T-SP-4064**			
SSP-T-SP-3080***	1 1/4" SAE6000	G1 1/2"	140
SSP-T-SP-4080***			
SSP-T-SP-3100***			
SSP-T-SP-4100**			
SSP-T-SP-4125***	1 1/2" SAE6000	G 2"	140

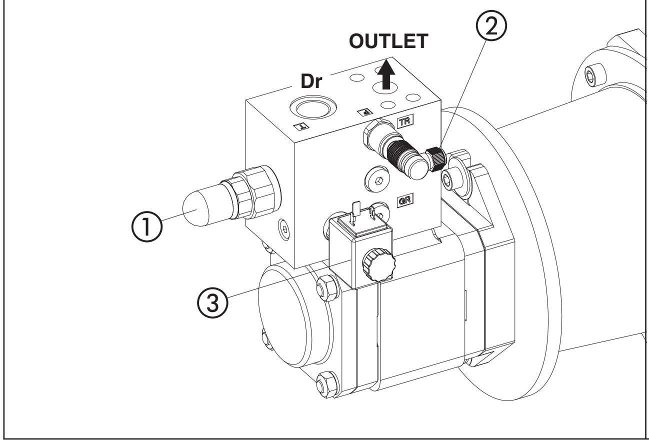
Detail option **C**



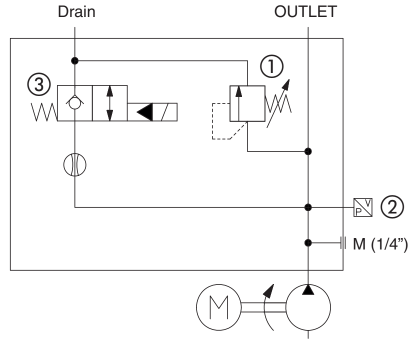
Hydraulic scheme option C



Detail option **D**



Hydraulic scheme option D



9 ELECTRONIC OPTION

K = Safe Torque Off (STO) safety function to prevent accidental starting of the servo pump, in accordance with the Machinery Directive 2006/42/EC (MD) - standard EN 61800-5-2

The STO function is implemented in the D-MP Drive and is activated by two digital signals sent by the control unit of the machine that allow to remove the power supply to the servomotor in order to prevent unwanted start-up.

At the same time, two digital signals are generated by the Drive to confirm that the power supply to the motor has been removed and the absence of other anomalies. These signals are read by the machine control unit for safety management.

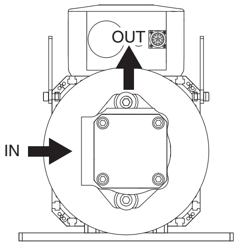
For more information see the S-MAN-STO manual.

Possible combined option:
/CK, /DK

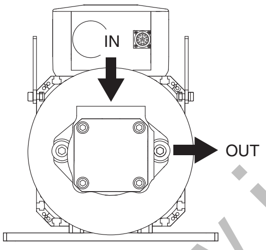
10 PORTS ORIENTATION

The pump can be supplied with inlet and outlet ports oriented in different configurations, as shown in the figure (seen from the bottom of the pump)

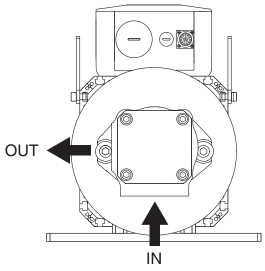
T
(standard)



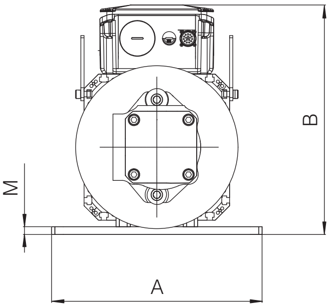
U
(optional)

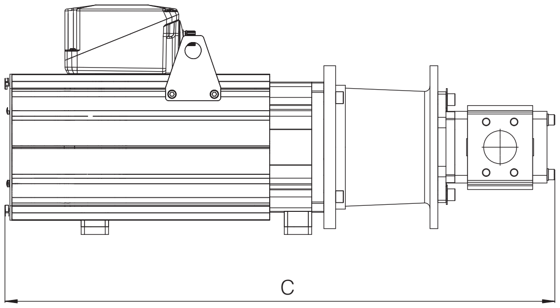


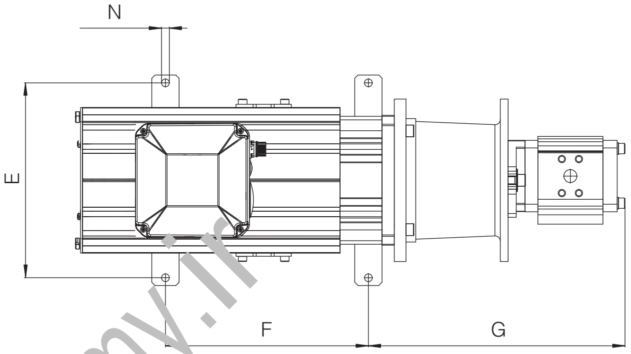
V
(optional)

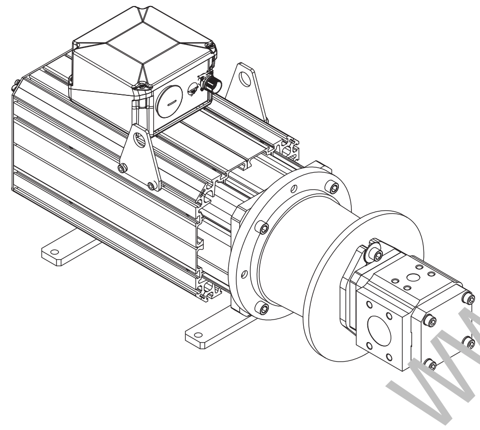


11 **INSTALLATION DIMENSIONS - motor pump unit [mm]** for drive dimensions see AS500

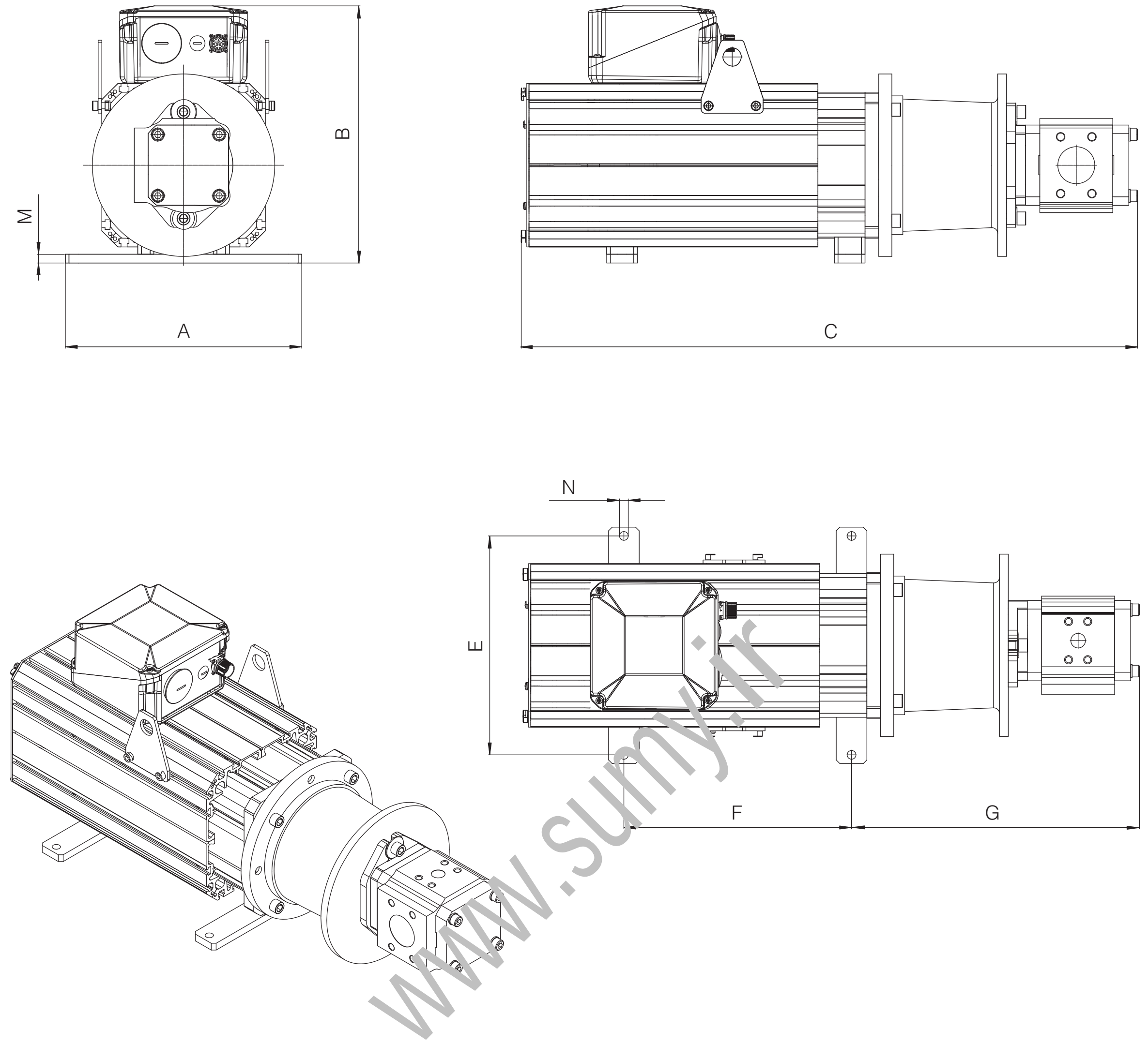




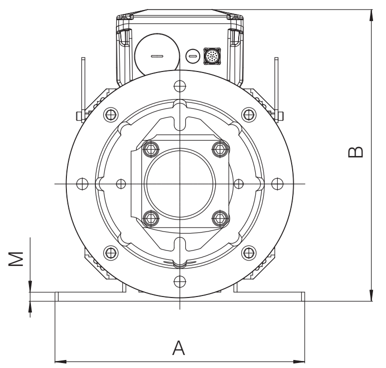


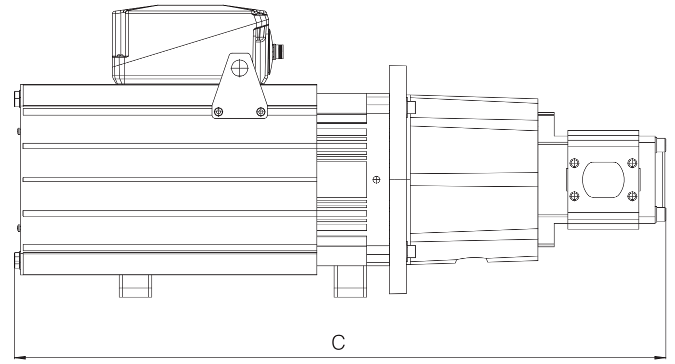


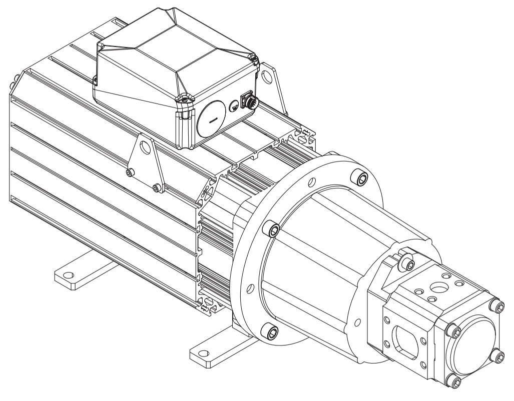
MODEL CODE	A	B	C	E	F	G	M	N	**Mass** [Kg]
SSP-*-**1011-1009**-*	324	335	630	300	168	324	12	12	56
SSP-*-**1011-1015**-*		355	700		240				68
SSP-*-**2020*-1009**-*	324	335	680	300	168	373	12	12	62
SSP-*-**2020*-1015**-*		355	750		240				74
SSP-*-**2020*-1024**-*			820		312				90
SSP-*-**2020-1032**-*			890		385				105
SSP-*-**2032*-1009**-*	324	335	670	300	168	368	12	12	63
SSP-*-**2032*-1015**-*		355	750		240				76
SSP-*-**2032*-1024**-*			820		312				91
SSP-*-**2032*-1032**-*			890		385				107
SSP-*-**2032-2042**-*	384	435	890	356	275	417	14	18	145
SSP-*-**2040*-1015**-*	278	355	760	300	240	381	12	12	79
SSP-*-**2040*-1024**-*			830		312				94
SSP-*-**2040*-1032**-*			900		385				110
SSP-*-**2040*-2042**-*	384	435	900	356	275	430	14	18	148
SSP-*-**2050*-1015**-*	324	355	770	300	240	395	12	12	81
SSP-*-**2050*-1024**-*			840		312				96
SSP-*-**2050*-1032**-*			910		385				112
SSP-*-**2050*-2042**-*	384	435	910	356	275	444	14	18	150
SSP-*-**2050*-2055**-*		450	970		330				172

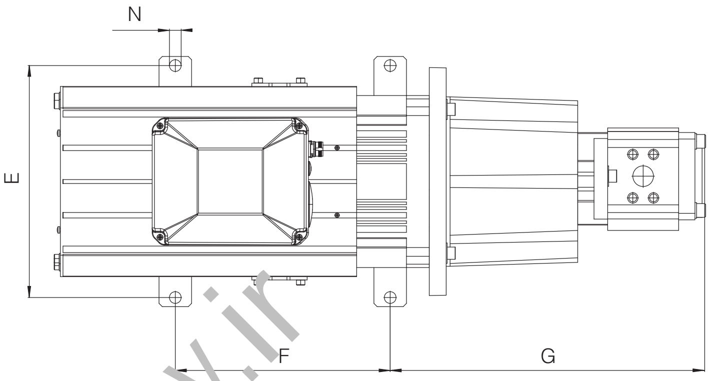


MODEL CODE	**A**	**B**	**C**	**E**	**F**	**G**	**M**	**N**	**Mass** [Kg]
SSP-*-**3064*-1024**-*	324	355	830	300	312	383.5	12	12	94
SSP-*-**3064*-1032**-*			900		385				111
SSP-*-**3064*-2042**-*	384	435	930	356	275	456.5	14	18	149
SSP-*-**3064*-2055**-*		450	980		330				170
SSP-*-**3064*-2080**-*			112		476				213
SSP-*-**3080*-1024**-*	324	355	840	300	312	395.5	12	12	97
SSP-*-**3080*-1032**-*			920		385				113
SSP-*-**3080*-2042**-*	384	435	940	356	275	468.5	14		151
SSP-*-**3080*-2055**-*		450	1000		330				172
SSP-*-**3080*-2080**-*			1123		476				216
SSP-*-**3080-2100**-*			1200		583				257
SSP-*-**3100*-1032**-*	324	355	930	300	385	411.5	12	12	115
SSP-*-**3100*-2042**-*	384	435	950	356	275	484.5	14	18	152
SSP-*-**3100*-2055**-*		450	1011		330				174
SSP-*-**3100*-2080**-*			1140		476				217
SSP-*-**3100*-2100**-*		490	1210		583				258
SSP-*-**4050-1015**-*	324	355	810	300	240	427	12	12	108
SSP-*-**4050-1024**-*			870		312				122
SSP-*-**4050-1032**-*			950		385				138
SSP-*-**4050-2042**-*	384	435	950	356	275	481	14	18	166
SSP-*-**4050-2055**-*		450	1011		330				187
SSP-*-**4050-2080**-*			1155		476	500			239









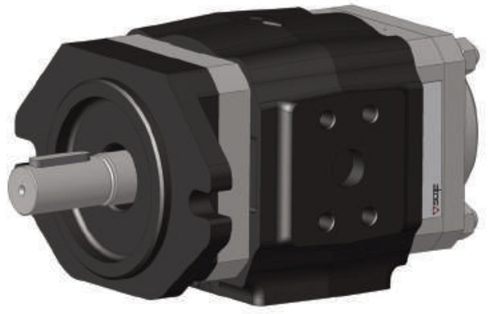
MODEL CODE	A	B	C	E	F	G	M	N	Mass [Kg]
SSP-*-**4064-1024**-*	324	355	860	300	312	438	12	12	124
SSP-*-**4064-1032**-*			960		385				140
SSP-*-**4064-2042**-*	384	445	48	356	275	492	14	18	168
SSP-*-**4064-2055**-*		450	1020		330				189
SSP-*-**4064-2080**-*			1166		476	511			241
SSP-*-**4080-1024**-*	324	355	890	300	312	447	12	12	126
SSP-*-**4080-1032**-*			970		385				142
SSP-*-**4080-2042**-*	384	435	970	356	275	501	14	18	170
SSP-*-**4080-2055**-*		450	1032		330				191
SSP-*-**4080-2080**-*			1175		476	520			243
SSP-*-**4080-2100**-*			1250		583				284
SSP-*-**4100-1032**-*	324	355	980	300	385	460	12	12	145
SSP-*-**4100-2042**-*	384	435	980	356	275	514	14	18	173
SSP-*-**4100-2055**-*		450	1040		330				194
SSP-*-**4100-2080**-*			1188		476	533			246
SSP-*-**4100-2100**-*			1260		583				287
SSP-*-**4125L-2042**-*	384	435	980	356	275	509	14	18	162
SSP-*-**4125L-2055**-*		450	1032		330				183
SSP-*-**4125L-2080**-*			1150		476	528			229
SSP-*-**4125L-2100**-*		490	1183		583				234

12 RELATED DOCUMENTATION

AS050	Basics for Smart Servopumps - SSP
AS200	Sizing criteria for servopumps
AS300	PGI cast iron internal gear pumps, high pressure
AS350	PGIL aluminium internal gear pumps
AS400	PMM high performance synchronous servomotors
AS500	D-MP electronic drives
AS800	Programming tools for pumps & servopumps
AS810	Accessories for servopumps
AS910	Operating and maintenance information for servopumps
GS510	Fieldbus
S-MAN-HW	Servopumps installation manual
S-MAN-SW	Servopumps programming software manual
S-MAN-STO	Servopumps Safe Torque Off manual

Cast iron internal gear pumps for SSP servopumps

fixed displacement, high pressure



PGI-2032/1D* /PE

PGI are fixed displacement cast iron internal gear pumps designed for high pressure application and are suitable for use in SSP system with variable speed drives to provide variable flow rate.

Their particular design allows outstanding efficiencies due to radial and axial gap compensation, low pressure pulsation and very low noise level.

The internal gear is supported by a hydrodynamic/hydrostatic lubrication film, which allows operation at low viscosities and low/high speeds.

Max displacement: up to **100 cm³/rev**

Max pressure: up to **330 bar**

1 MODEL CODE

PGI	-	2	020	/	1	D	*	/	PE

Internal gear pump

Size, see section 2 :
1, **2**, **3**, **4**

Displacement (cm³/rev), see section 2 :
011, **020**, **032**, **040**, **050**, **064**, **080**, **100**

Shaft, SAE Standard:
1 = keyed

Direction of rotation, viewed at the shaft end:
D = clockwise

Series number

Seals material:
PE = FKM

2 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Size code		**1**	**2**				**3**			**4**			
Displacement code		**011**	**020**	**032**	**040**	**050**	**064**	**080**	**100**	**050**	**064**	**080**	**100**
Displacement	(cm³/rev)	10,9	20	32,1	40,1	50,3	65,3	80,4	100,5	50,6	65,3	80	101,2
Continuous pressure	(bar)	330	330	330	280	280	280	280	280	330	315	300	300
Peak pressure **(1)**	(bar)	350	350	350	300	300	290	290	290	340	330	330	330
Recommended pressure on inlet port	(bar)	from 0,8 to 2 (absolute pressure)											
Max speed **(2)**	(rpm)	4000	3400	3000	3600	3600	3000	3000	3000	2400	2400	2200	2200
Volumetric efficiency **(3)**		93	93	94	95	95	94	95	95	93	94	94	95
Hydromechanical efficiency **(3)**		92	91	92	93	93	92	93	93	89	89	90	90
Noise **(3)**	(dBA)	58	62	64	65	66	69	70	71	73	74	75	76

(1) 15% duty cycle, max 10 sec continuously
(2) For SSP system max speed please consider table **AS200**;
(3) Measuring data with: n = 1450 rpm; Δp = 250 bar;

3 GENERAL CHARACTERISTICS

Assembly position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft
Ambient temperature range	-20°C ÷ +80°C
Compliance	REACH Regulation (EC) n°1907/2006

4 HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

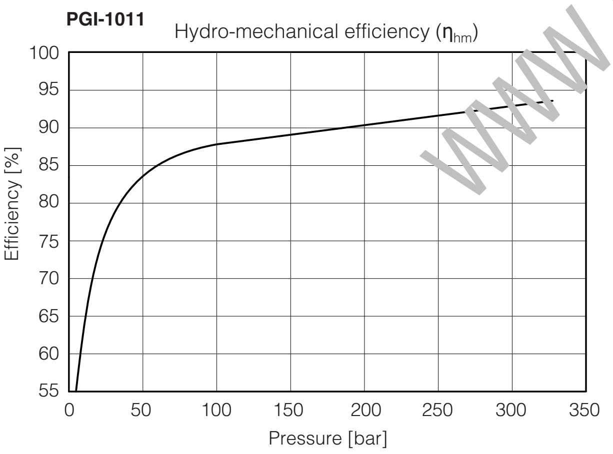
Fluid temperature		-20°C ÷ +80°C	
Recommended viscosity		10 ÷ 300 mm²/s - max at cold start 2000 mm²/s	
Max fluid contamination level	normal operation	ISO4406 class 20/18/13 NAS1638 class 9	see also filter section at www.atos.com or KTF catalog
	longer life	ISO4406 class 18/16/11 NAS1638 class 7	
Hydraulic fluid		**Classification**	**Ref. Standard**
Mineral oils		HL, HLP, HLPD, HVLP, HVLPD	DIN 51524

5 DIAGRAMS at 1450 rpm (based on mineral oil ISO VG 46 at 40°C)

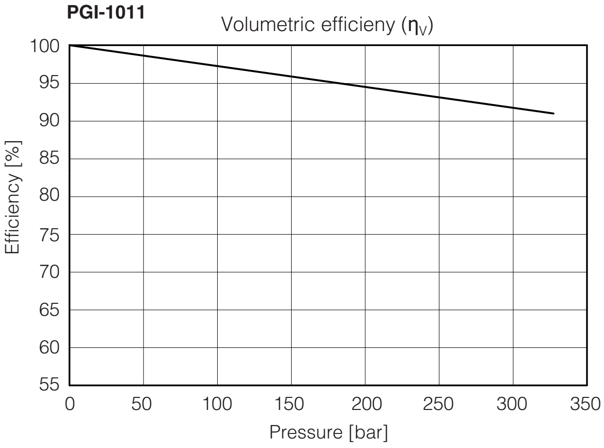
5.1 Efficiency

Efficiency is the ratio of useful output energy in relation to the input energy fed to a component.
In fluid power, pump efficiency can split in two different contributes:
- hydro-mechanical efficiency (η_{hm}), that describes the losses created by frictional forces (both mechanical and viscous)
- volumetric efficieny (η_V), that accounts for the flow leakages of a pump

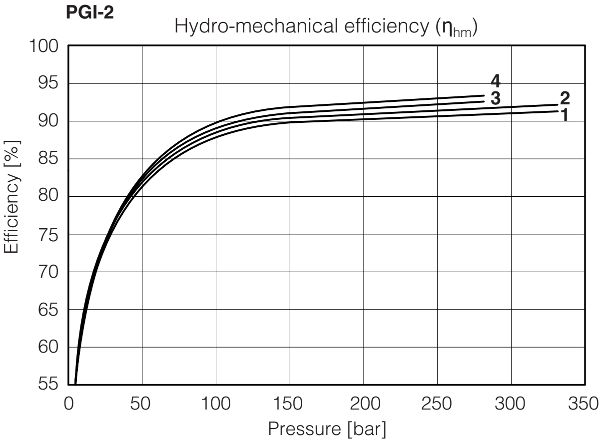
PGI-1011



PGI-1011

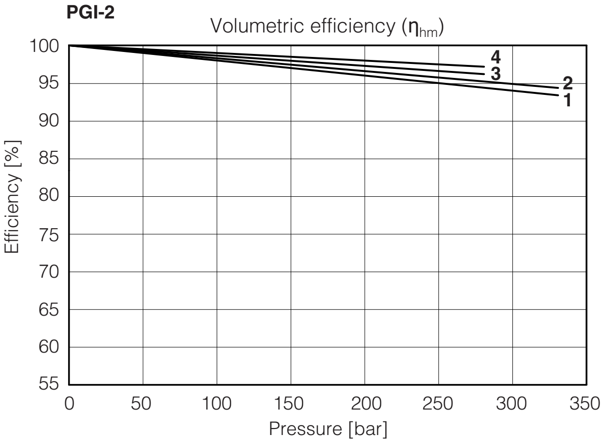


PGI-2



1 = PGI-2020 **2** = PGI-2032 **3** = PGI-2040 **4** = PGI-2050

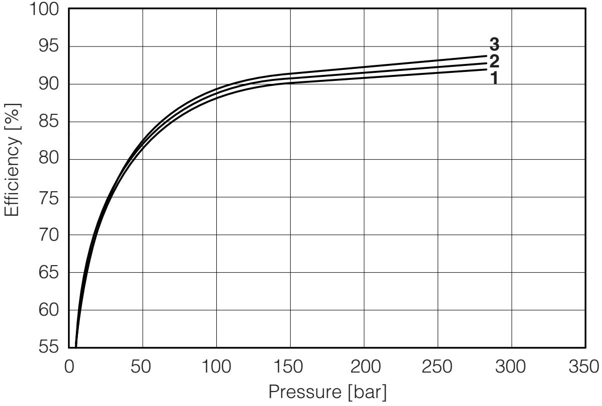
PGI-2



1 = PGI-2020 **2** = PGI-2032 **3** = PGI-2040 **4** = PGI-2050

PGI-3

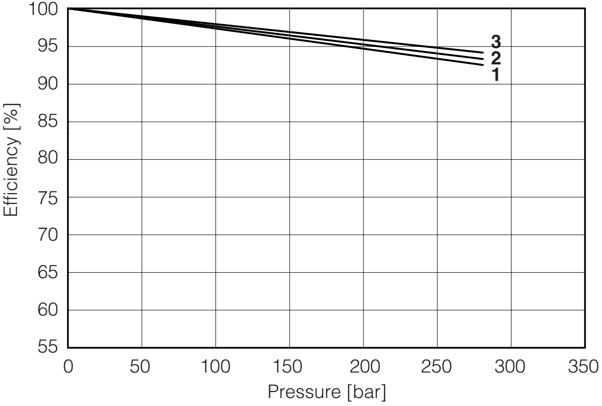
Hydro-mechanical efficiency (η_{hm})



1 = PGI-3064 **2** = PGI-3080 **3** = PGI-3100

PGI-3

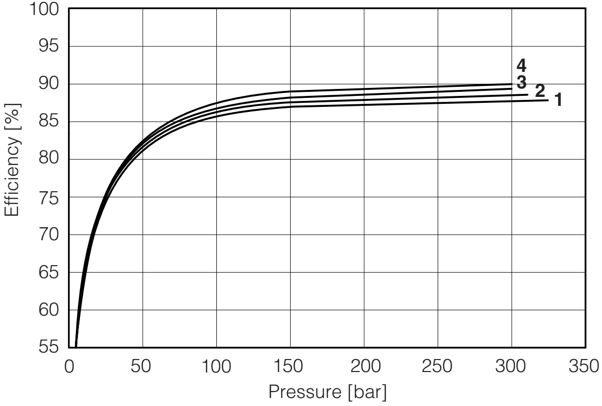
Volumetric efficiency (η_{hm})



1 = PGI-3064 **2** = PGI-3080 **3** = PGI-3100

PGI-4

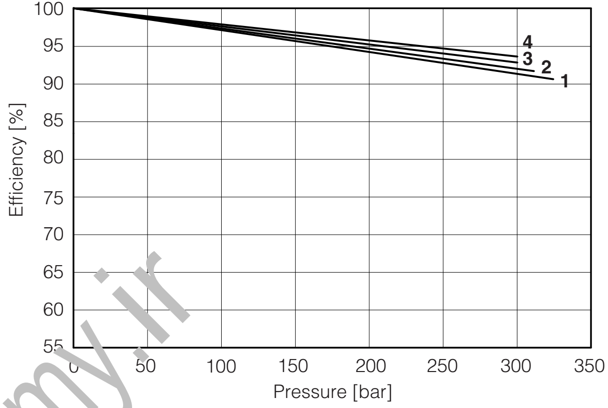
Hydro-mechanical efficiency (η_{hm})



1 = PGI-4050 **2** = PGI-4064 **3** = PGI-4080 **4** = PGI-4100

PGI-4

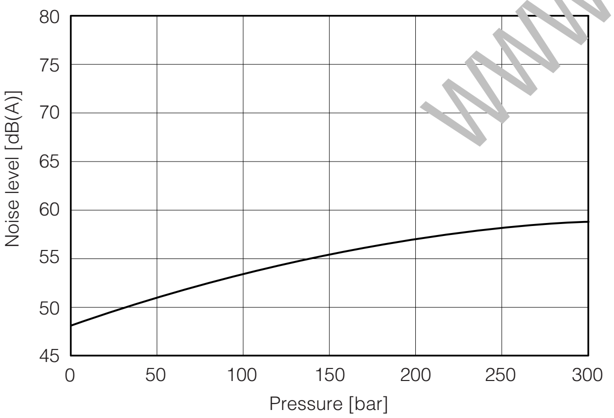
Volumetric efficiency (η_{hm})



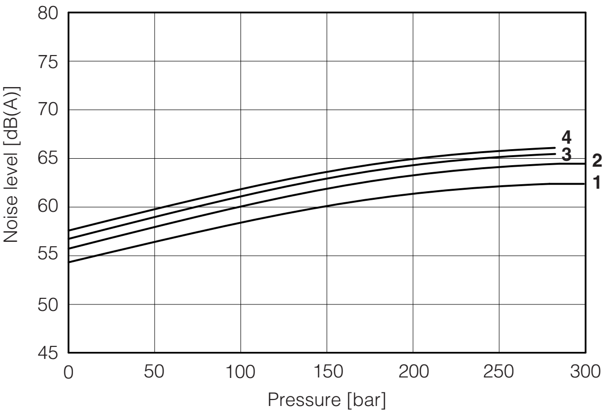
1 = PGI-4050 **2** = PGI-4064 **3** = PGI-4080 **4** = PGI-4100

5.2 Noise level

PGI-1011

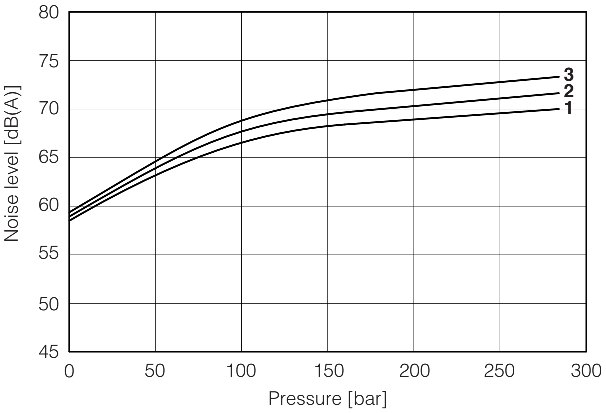


PGI-2



1 = PGI-2020 **2** = PGI-2032 **3** = PGI-2040 **4** = PGI-2050

PGI-3



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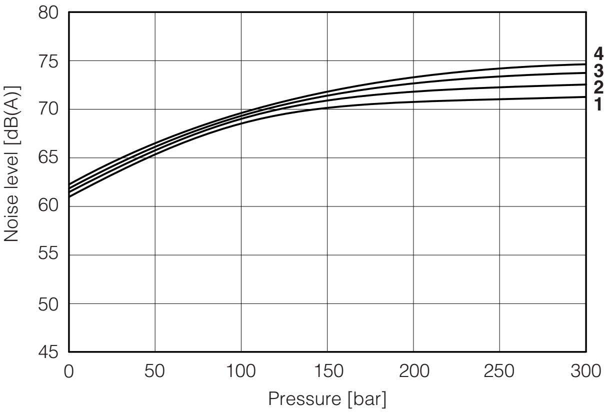
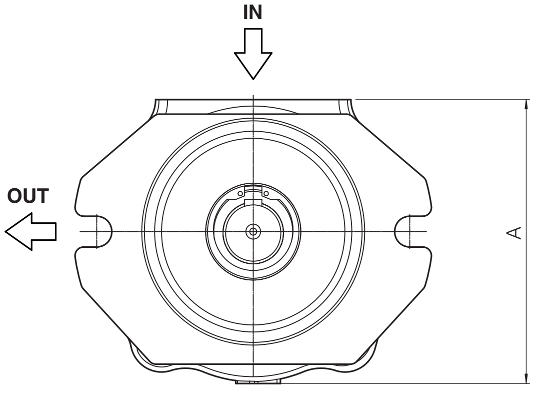
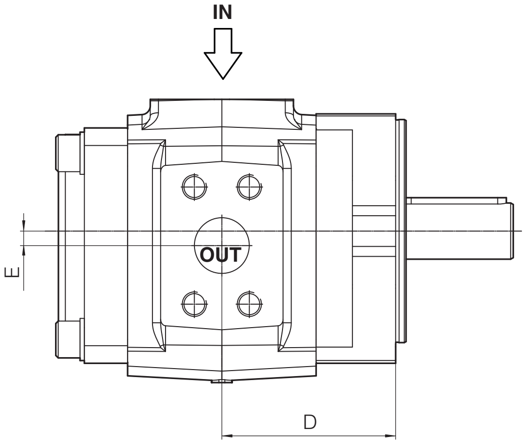
PGI-4

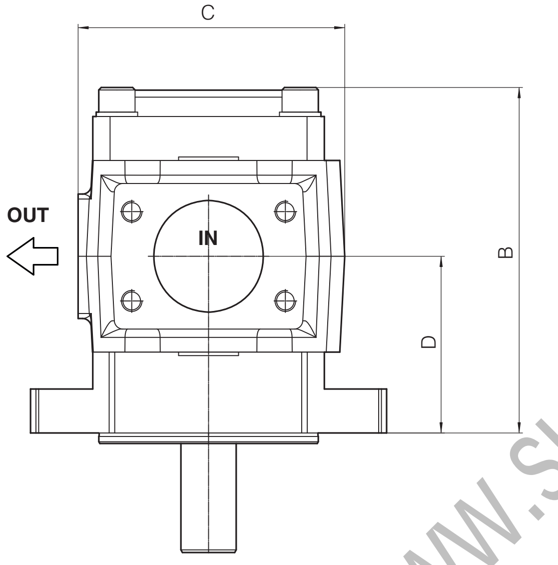


1 = PGI-4050 **2** = PGI-4064 **3** = PGI-4080 **4** = PGI-4100

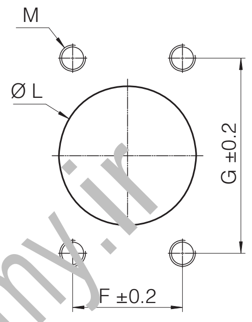
6 DIMENSIONS



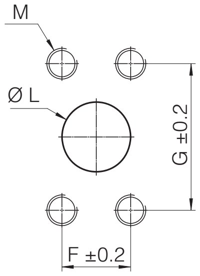




INLET



OUTLET



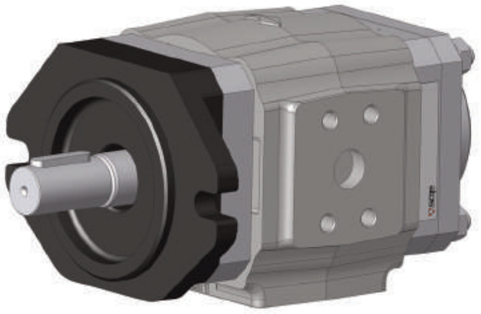
Pump code	Dimensions [mm]															Mass [kg]
						INLET port					OUTLET port					
	A	B	C	D	E	F	G	L	M	SAE Flange	F	G	L	M	SAE Flange	
PGI-1011	110	125	106	60.5	5.5	26.2	52.4	25	M10x15	1" SAE3000	17.5	38.1	14	M8x15	1/2" SAE3000	5.4
PGI-2020	126	158	129	75	6.5	30.2	58.7	32	M10x17	1 1/4" SAE3000	22	47.5	18	M10x17	3/4" SAE3000	10.5
PGI-2032	126	175	129	83.2	6.5	30.2	58.7	32	M10x17	1 1/4" SAE3000	22	47.5	18	M10x17	3/4" SAE3000	12
PGI-2040	135	186	138	88.7	6.5	42.9	77.8	51	M12x17	2" SAE3000	26.2	52.4	20	M10x17	1" SAE3000	15
PGI-2050	135	200	138	95.7	6.5	42.9	77.8	51	M12x17	2" SAE3000	26.2	52.4	20	M10x17	1" SAE3000	17
PGI-3064	160	168.5	155	86.5	8.3	42.9	77.8	51	M12x21	2" SAE3000	27.8	57.2	25.4	M12x22	1" SAE6000	15.3
PGI-3080	160	180.5	155	92.5	8.3	42.9	77.8	51	M12x21	2" SAE3000	31.8	66.7	31.75	M14x24	1 1/4" SAE6000	17.5
PGI-3100	160	196.5	155	100.5	8.3	50.8	88.9	63.5	M12x21	2 1/2" SAE3000	31.8	66.7	31.75	M14x24	1 1/4" SAE6000	18.7
PGI-4050	198	186	192.5	86.5	9.8	35.7	69.9	40	M12x25	1 1/2" SAE3000	27.8	57.2	20	M12x22	1" SAE6000	32
PGI-4064	198	195	192.5	91	9.8	35.7	69.9	40	M12x25	1 1/2" SAE3000	27.8	57.2	20	M12x22	1" SAE6000	34
PGI-4080	198	204	192.5	95.5	9.8	42.9	77.8	50	M12x25	2" SAE3000	31.8	66.7	30	M14x25	1 1/4" SAE6000	36
PGI-4100	198	217	192.5	102	9.8	42.9	77.8	50	M12x25	2" SAE3000	31.8	66.7	30	M14x25	1 1/4" SAE6000	39

7 RELATED DOCUMENTATION

AS050	Basics for Smart Servopumps - SSP
AS100	SSP Smart Servopumps
AS200	Sizing criteria for servopumps
AS350	PGIL aluminium internal gear pumps
AS400	PMM high performance synchronous servomotors
AS500	D-MP electronic drives
AS800	Programming tools for pumps & servopumps
AS810	Accessories for servopumps
AS910	Operating and maintenance information for servopumps
GS510	Fieldbus
S-MAN-HW	Servopumps installation manual
S-MAN-SW	Servopumps programming software manual
S-MAN-STO	Servopumps Safe Torque Off manual

Aluminium internal gear pumps for SSP servopumps

fixed displacement



PGIL-2032/1D* /PE

PGIL are fixed displacement internal gear pumps suitable for use in SSP system with variable speed drives to provide variable flow rate.

Their particular design allows outstanding efficiencies due to radial and axial gap compensation, low pressure pulsation and very low noise level.

The internal gear is supported by a hydrodynamic/hydrostatic lubrication film, which allows operation at low viscosities and low/high speeds.

Max displacement: up to **125 cm³/rev**

Max pressure: up to **250 bar**

1 MODEL CODE

PGIL	-	2	020	/	1	D	*	/	PE

PGIL: Internal gear pump

Size, see section 2 :
2, **3**, **4**

Displacement (cm³/rev), see section 2 :
020, **032**, **040**, **050**, **064**, **080**, **100**, **125**

Shaft, SAE Standard:
1 = keyed

Direction of rotation, viewed at the shaft end:
D = clockwise

*: Series number

Seals material:
PE = FKM

2 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Size code		2				3			4
Displacement code		**020**	**032**	**040**	**050**	**064**	**080**	**100**	**125**
Max displacement	(cm³/rev)	20	32,1	40,1	50,3	65,3	80,4	100,5	125,7
Continuous pressure	(bar)	250	250	250	250	250	250	250	250
Peak pressure **(1)**	(bar)	320	320	300	280	270	270	270	280
Recommended pressure on inlet port	(bar)	from 0,8 to 2 (absolute pressure)							
Max speed **(2)**	(rpm)	3900	3700	3600	3600	3000	3000	3000	2800
Volumetric efficiency **(3)**		93	94	95	95	94	95	95	94
Hydromechanical efficiency **(3)**		91	92	93	93	92	93	93	90
Noise **(3)**	(dBA)	62	64	65	66	69	70	71	76

(1) 15% duty cycle, max 10 sec continuously
(2) For SSP system max speed please consider table **AS100**;
(3) Measuring data with: n = 1450 rpm; Δp = 250 bar;

3 GENERAL CHARACTERISTICS

Assembly position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft
Ambient temperature range	-20°C ÷ +80°C
Compliance	REACH Regulation (EC) n°1907/2006

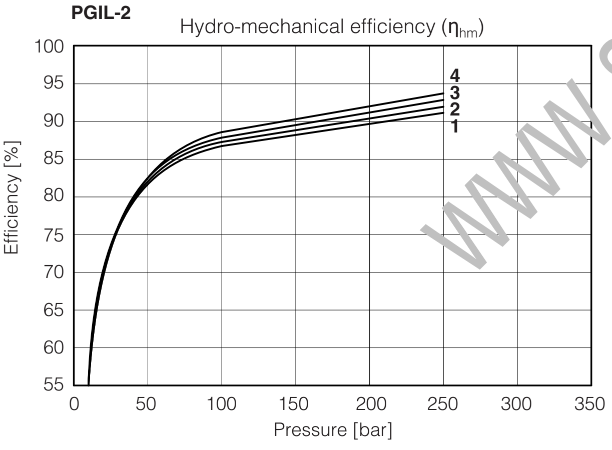
4 HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Fluid temperature	-20°C ÷ +80°C	
Recommended viscosity	10 ÷ 300 mm^2/s - max at cold start 2000 mm^2/s	
Max fluid contamination level — normal operation	ISO4406 class 20/18/13 NAS1638 class 9	see also filter section at www.atos.com or KTF catalog
Max fluid contamination level — longer life	ISO4406 class 18/16/11 NAS1638 class 7	
Hydraulic fluid	**Classification**	**Ref. Standard**
Mineral oils	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524

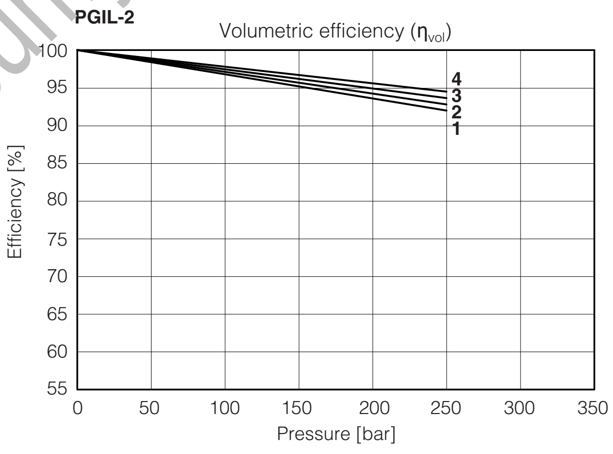
5 DIAGRAMS at 1450 rpm (based on mineral oil ISO VG 46 at 40°C)

5.1 Efficiency

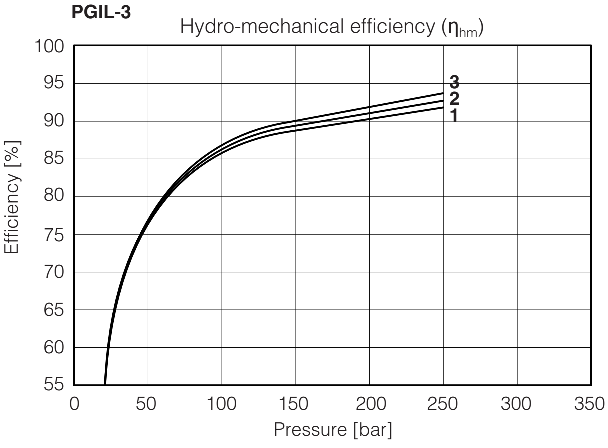
Efficiency is the ratio of useful output energy in relation to the input energy fed to a component.
In fluid power, pump efficiency can split in two different contributes:
- hydro-mechanical efficiency (η_{hm}), that describes the losses created by frictional forces (both mechanical and viscous)
- volumetric efficieny (η_V), that accounts for the flow leakages of a pump



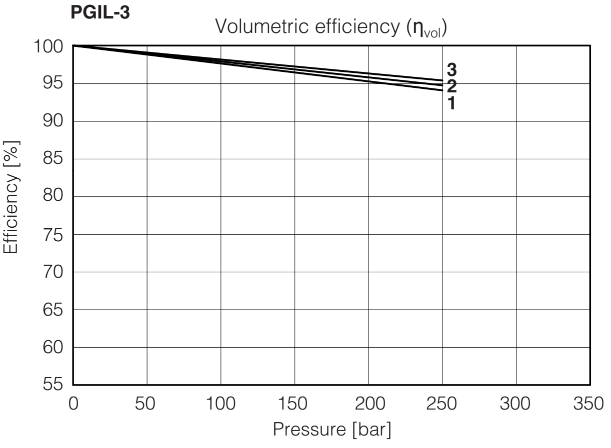
1 = PGIL-2020 **2** = PGIL-2032 **3** = PGIL-2040 **4** = PGIL-2050



1 = PGIL-2020 **2** = PGIL-2032 **3** = PGIL-2040 **4** = PGIL-2050

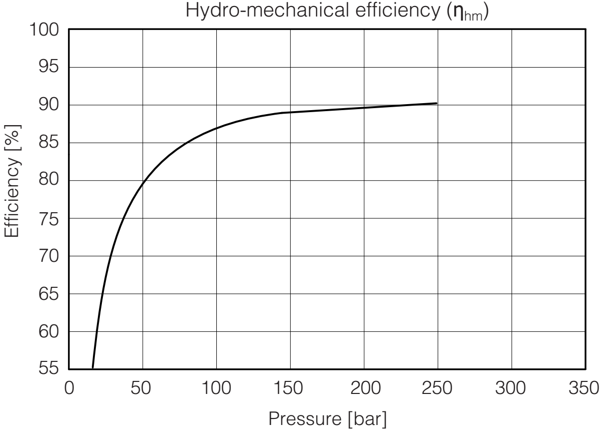


1 = PGIL-3064 **2** = PGIL-3080 **3** = PGIL-3100

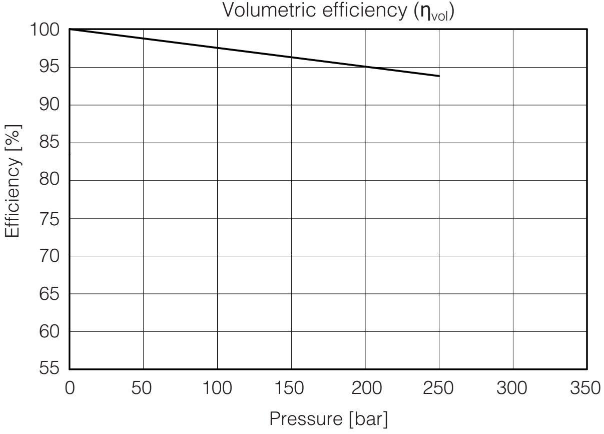


1 = PGIL-3064 **2** = PGIL-3080 **3** = PGIL-3100

PGIL-4125

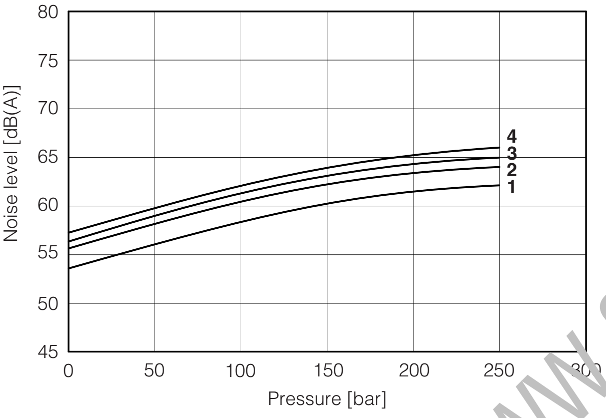


PGIL-4125



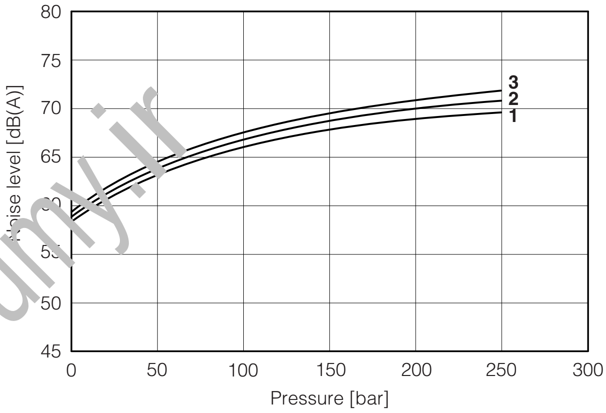
5.2 Noise level

PGIL-2



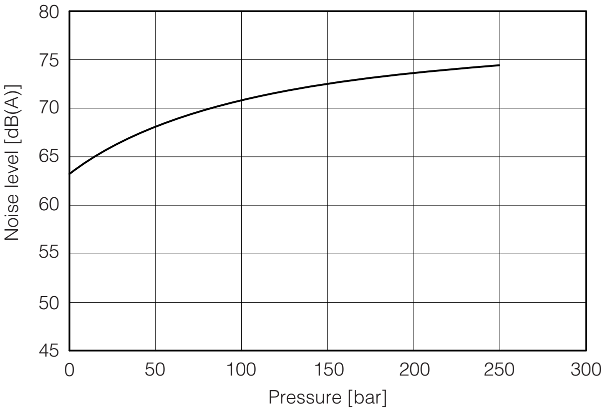
1 = PGIL-2020 **2** = PGIL-2032 **3** = PGIL-2040 **4** = PGIL-2050

PGIL-3

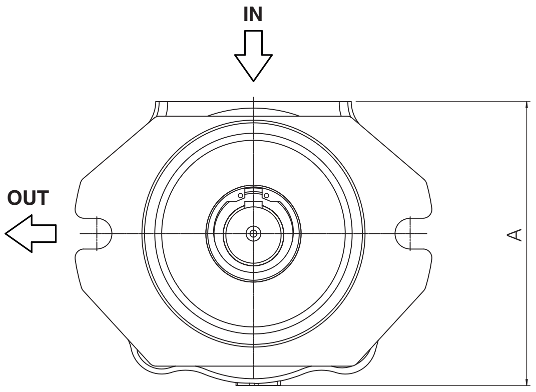


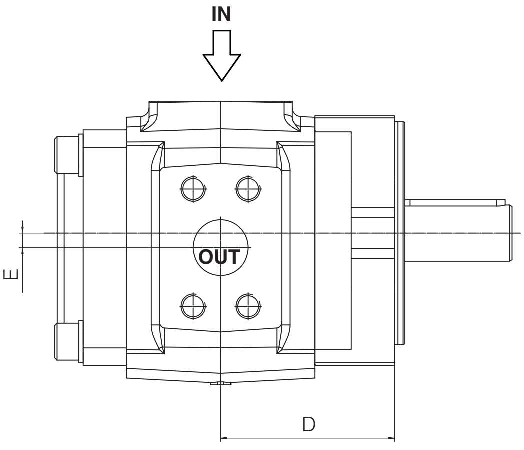
1 = PGIL-3064 **2** = PGIL-3080 **3** = PGIL-3100

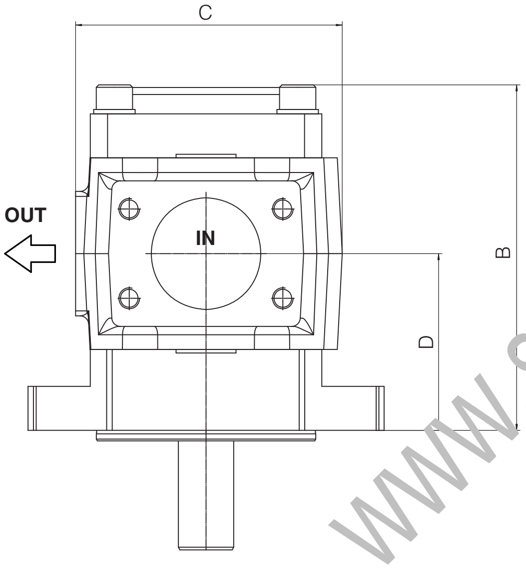
PGIL-4125

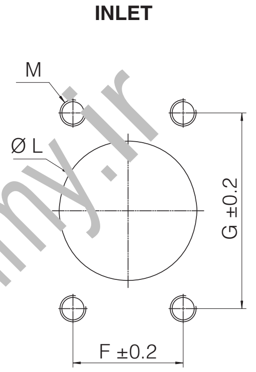


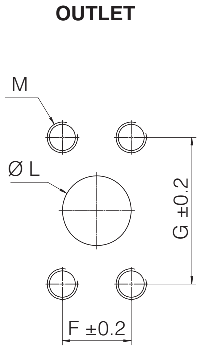
6 DIMENSIONS











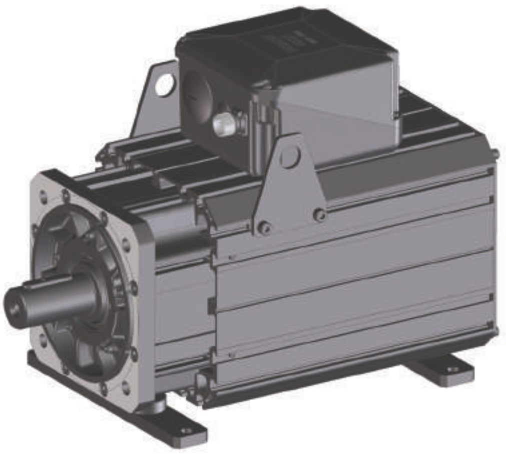
Pump code	Dimensions [mm]															Mass [kg]
						INLET port					OUTLET port					
	A	B	C	D	E	F	G	L	M	SAE flange	F	G	L	M	SAE flange	
PGIL-2020	126	158	129	75	6.5	30.2	58.7	32	M10x17	1 1/4” SAE3000	22	47.5	18	M10x17	3/4” SAE3000	8.3
PGIL-2032	126	153	129	83.2	6.5	30.2	58.7	32	M10x17	1 1/4” SAE3000	22	47.5	18	M10x17	3/4” SAE3000	9.2
PGIL-2040	135	166	138	88.7	6.5	42.9	77.8	51	M12x17	2” SAE3000	26.2	52.4	20	M10x17	1” SAE3000	9.8
PGIL-2050	135	180	138	95.7	6.5	42.9	77.8	51	M12x17	2” SAE3000	26.2	52.4	20	M10x17	1” SAE3000	10.5
PGIL-3064	160	168.5	155	86.5	8.3	42.9	77.8	51	M12x21	2” SAE3000	27.8	57.2	25.4	M12x22	1” SAE6000	11.5
PGIL-3080	160	180.5	155	92.5	8.3	42.9	77.8	51	M12x21	2” SAE3000	31.8	66.7	31.75	M14x24	1 1/4” SAE6000	13
PGIL-3100	160	196.5	155	100.5	8.3	50.8	88.9	63.5	M12x21	2 1/2” SAE3000	31.8	66.7	31.75	M14x24	1 1/4” SAE6000	13.5
PGIL-4125	189.6	212	185	109.5	9.8	50.8	88.9	63.5	M12x22	2 1/2” SAE3000	36.5	79.4	38.1	M16x27	1 1/2” SAE6000	27.5

7 RELATED DOCUMENTATION

AS050	Basics for Smart Servopumps - SSP
AS100	SSP Smart Servopumps
AS200	Sizing criteria for servopumps
AS300	PGI cast iron internal gear pumps, high pressure
AS400	PMM high performance synchronous servomotors
AS500	D-MP electronic drives
AS800	Programming tools for pumps & servopumps
AS810	Accessories for servopumps
AS910	Operating and maintenance information for servopumps
GS510	Fieldbus
S-MAN-HW	Servopumps installation manual
S-MAN-SW	Servopumps programming software manual
S-MAN-STO	Servopumps Safe Torque Off manual

Electric motors for SSP servopumps

high performance, synchronous, permanent magnets



PMM-T-1032-20-F

PMM are AC brushless servo motors. Based on rare earth Permanent Magnets, they provide the highest level of efficency and of dynamic performance, making them the best choice for SSP systems.

These motors, equipped with cooling fan, allow high power density for very compact solutions.

Atos PMM includes 8 different rated power from 9 kW to 100 kW, divided in 2 sizes front flange.

Power range: **9 kW** to **100 kW**

1 MODEL CODE

PMM - **T** - **1** **009** - **20** - **F** *****

Permanent Magnet Synchronous Motor

Cooling
F = Fan cooling

Series number

Speed sensor
T = Resolver

Rated speed [rpm], see section 2:
20 = 2000

Size, see section 2 :
1 = for rated power 009, 015, 024, 032
2 = for rated power 042, 055, 080, 100

Rated power [kW], see section 2 :
009 = 9 kW **015** = 15 kW **024** = 24 kW **032** = 32 kW
042 = 42 kW **055** = 55 kW **080** = 80 kW **100** = 100 kW

2 TECHNICAL CHARACTERISTICS

Code	Rated Power [kW]	Rated Torque [Nm]	Max Torque [Nm]	Rated Speed [rpm]	Max Speed [rpm]	Rated Current [A]	Max Current [A]	Torque constant [Nm/A]	Efficiency [%]	Inertia [kg cm^2]
PMM-*-1009-20	8,8	41,9	105	2000	3000	16,77	49	2,7	92	50
PMM-*-1015-20	16,5	78,7	210			29,68	92	2,86	94	90
PMM-*-1024-20	24,8	118,2	310			44,58	134	2,86	95	130
PMM-*-1032-20	31,4	145,2	410			61,34	199	2,54	95	170
PMM-*-2042-20	42,4	202,2	415			79,98	201	2,77	95	283
PMM-*-2055-20	55,6	265,2	550			110,87	264	2,6	97	390
PMM-*-2080-20	79,6	380,1	830			146,24	384	2,83	97	590
PMM-*-2100-20	100,7	480,9	1100			203,48	548	2,56	97	780

3 ELECTRIC CHARACTERISTICS

Type	Brushless Permanent Magnet 3 Phase AC servomotors
Insulation	Motor: class F according to DIN 0530; Winding: class H according to DIN 0530
Thermal protection	PT1000/PTC130 (except for motor 55 kW: KTY84/PTC130)
Protection	IP54
Cooling	Fan
Mounting	B35
Concentricity and sqaureness	Grade R according to IEC 72-DIN
Bearings	Heavy duty, life lubricated

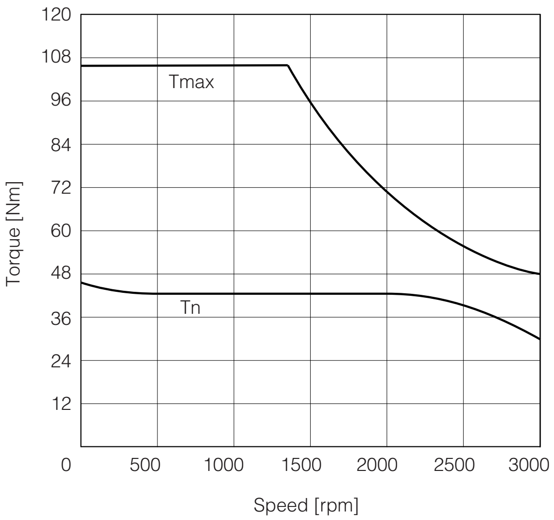
4 GENERAL CHARACTERISTICS

Assembly position	Any position
Ambient temperature	-20 ÷ +40°C de-rating for higher temperature
Altitude	up to 1000m, de-rating for higher altitude
Loads on the shaft	Axial and radial loads are not allowed on the shaft
Surface protection (motor body)	Black painting RAL9005
Compliance	CE according to EMC Directive 2014/30/EU and LVD Directive 2014/35/EU RoHs Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

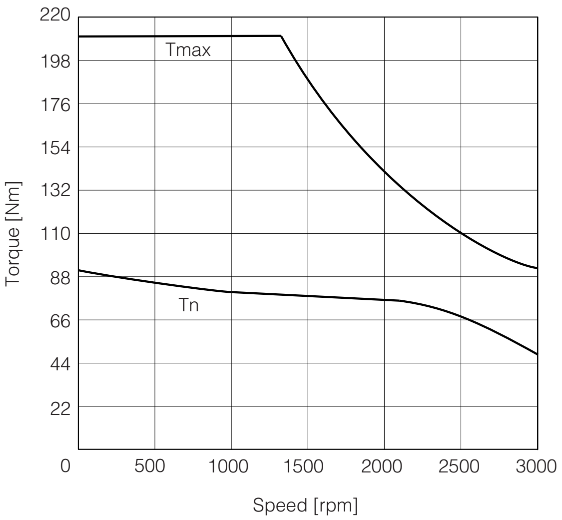
5 DIAGRAMS

Tn = Rated torque. It is the maximum torque admissible for a S1 operating conditions
Tmax = Maximum torque. It is the peak torque allowable for very short time, according to the specific working cycle.

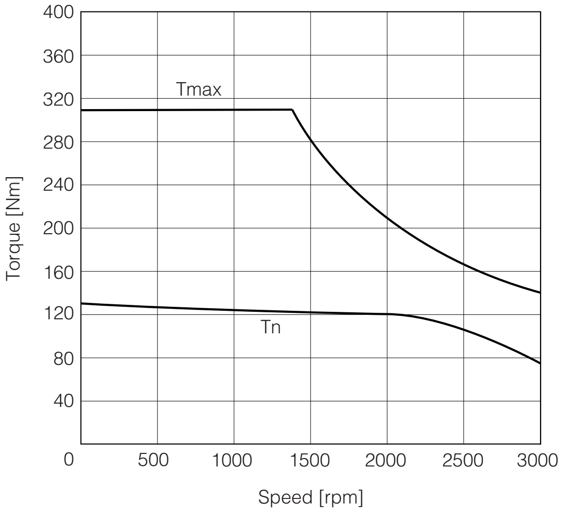
PMM-*-1009-20



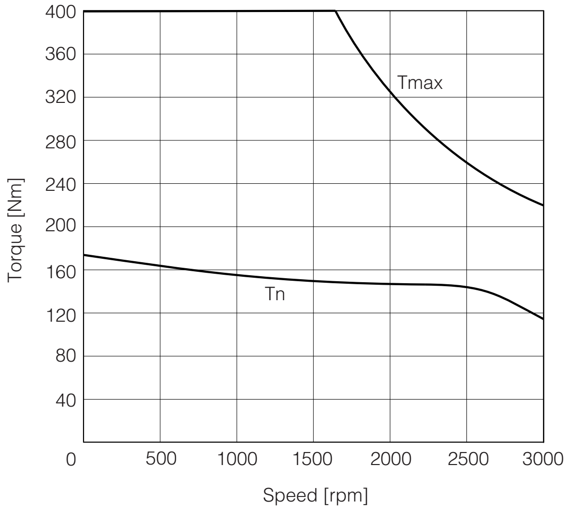
PMM-*-1015-20



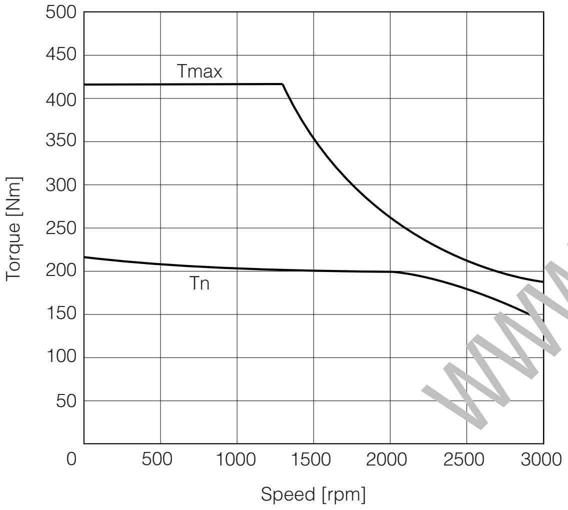
PMM-*-1024-20



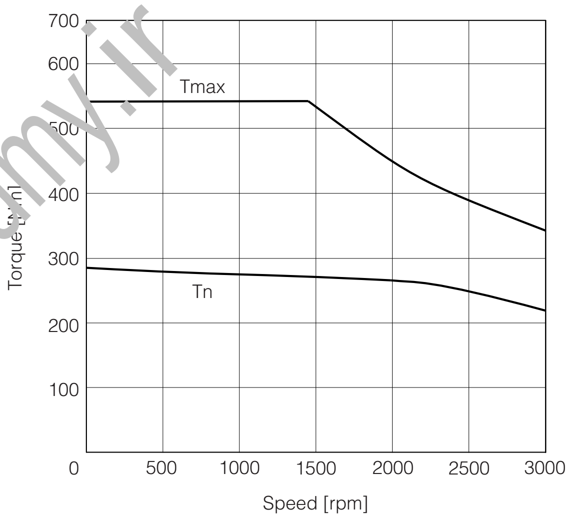
PMM-*-1032-20



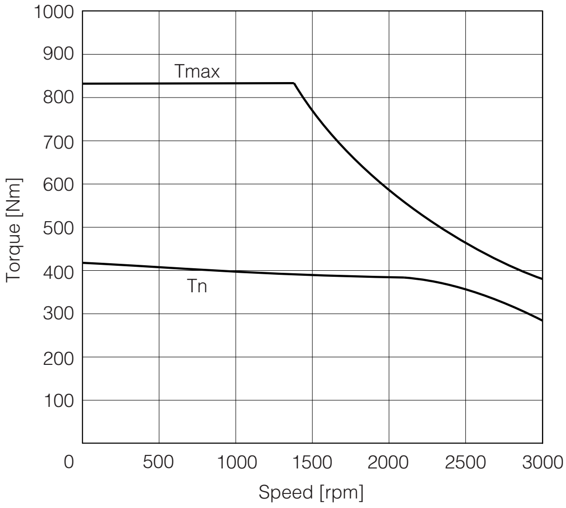
PMM-*-2042-20



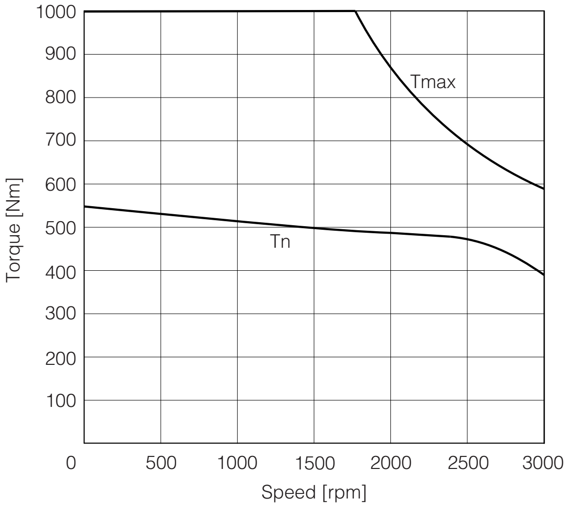
PMM-*-2055-20



PMM-*-2080-20



PMM-*-2100-20



6 ELECTRIC CONNECTIONS

6.1 Power connection - 4 phases C1

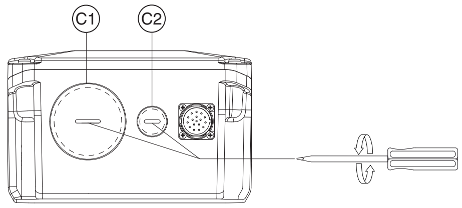
PIN	TECHNICAL SPECIFICATION	NOTES
1	Phase W	Input - power supply
2	Phase V	Input - power supply
3	Phase U	Input - power supply
6	GND	Gnd - power supply

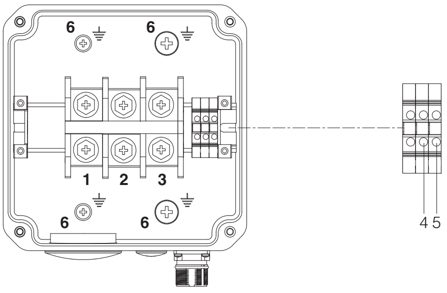
6.2 Fan power connection C2

PIN	TECHNICAL SPECIFICATION	NOTES
4	Fan	Input - power supply
5	Fan	Input - power supply

The fan automatically starts with motor temperature over 85°C

Power Input: 53W
Current draw: 0.33A
Power supply: 230 V @ 50 ÷ 60 Hz

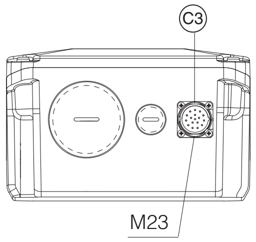


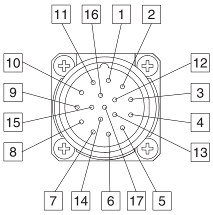


Connections	Motor size							
	1009	1015	1024	1032	2042	2055	2080	2100
C1	M40	M50	M50	M50	M50	M63	M63	M63
C2	M20	M20	M20	M20	M20	M20	M20	M50

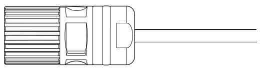
6.3 Signal connector - 17 pin C3

PIN	TECHNICAL SPECIFICATION
1	NC
2	NC
3	NC
4	SIN- , 1C/R
5	COS+ , 1C/R
6	COS- , 1C/R
7	RESEX+
8	Thermal sensor+
9	Thermal sensor-
10	RESEX-
11	NC
12	NC
13	NC
14	SIN+ , 1C/R
15	NC
16	NC
17	NC



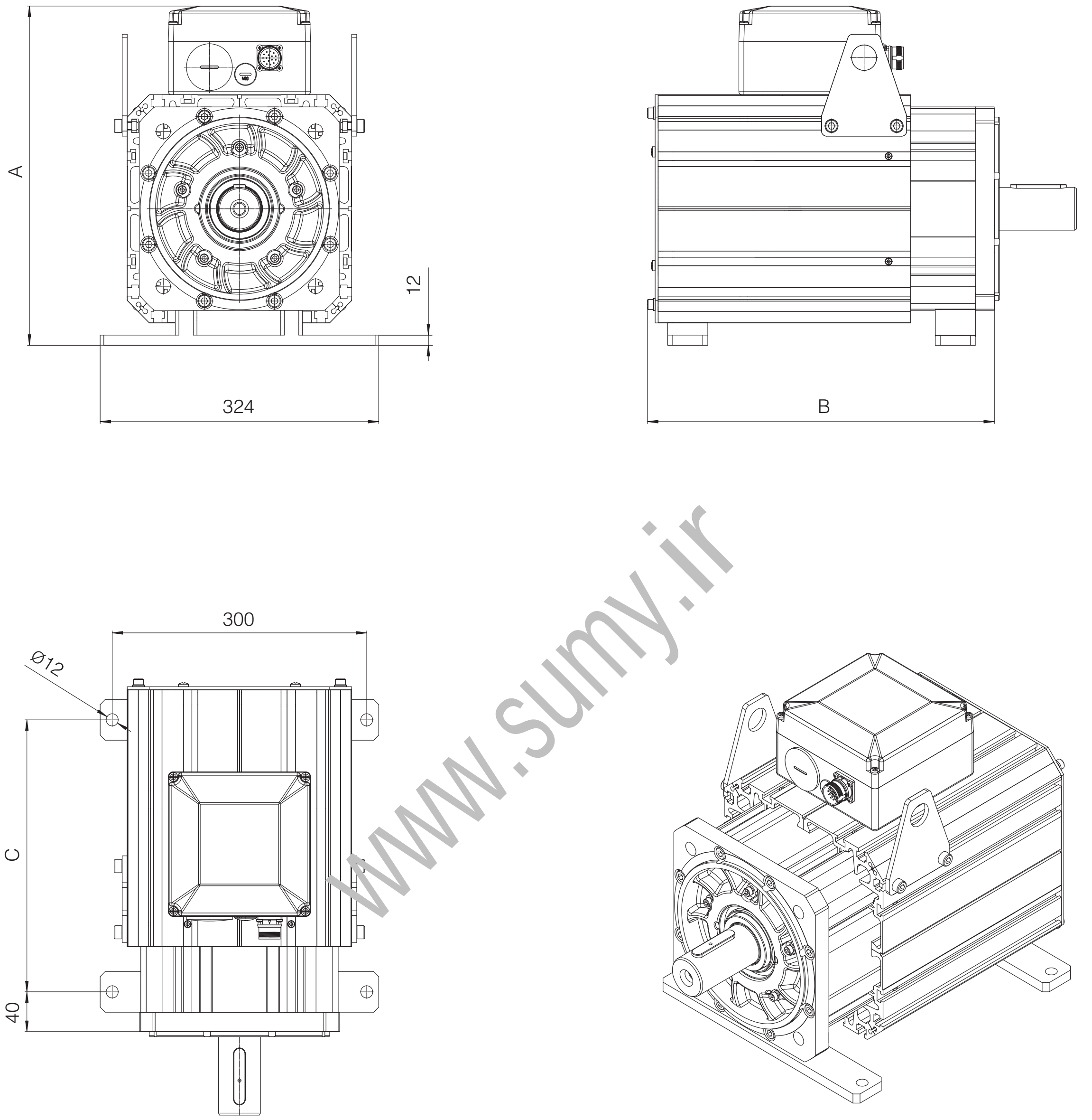


connector with cable
S-C-RSV-DB15/M23
see tech. table AS810



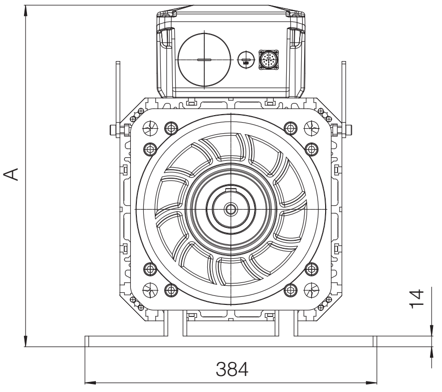
7 DIMENSIONS

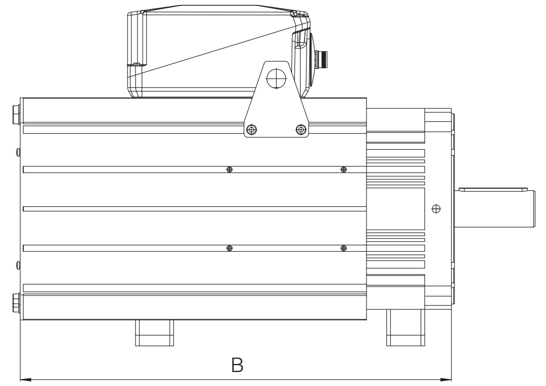
PMM-T-1*

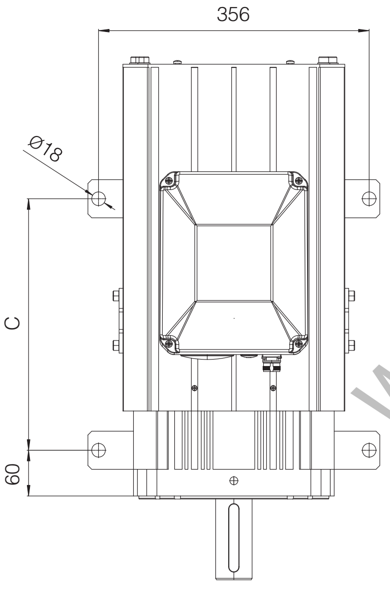


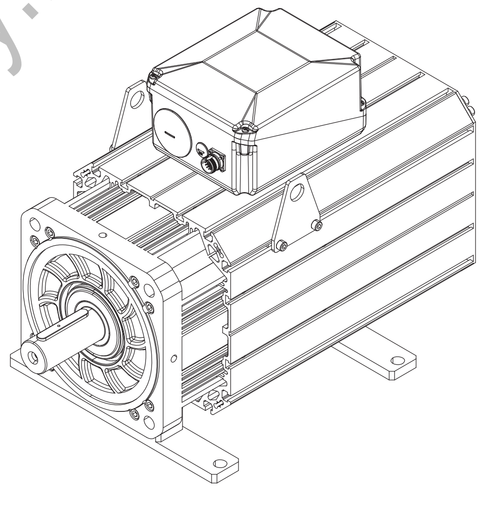
Motor code	Dimensions [mm]			Mass [kg]
	A	B	C	
1009	335	342	168	46
1015	355	414	240	59
1024	355	483	312	72
1032	355	555	385	87

PMM-T-2*









Motor code	Dimensions [mm]			Mass [kg]
	A	B	C	
2042	435	525	275	120
2055	450	580	330	141
2080	450	715	476	182
2100	490	785	583	223

15 RELATED DOCUMENTATION

AS050	Basics for Smart Servopumps - SSP
AS100	SSP Smart Servopumps
AS200	Sizing criteria for servopumps
AS300	PGI cast iron internal gear pumps, high pressure
AS350	PGIL aluminium internal gear pumps
AS500	D-MP electronic drives
AS800	Programming tools for pumps & servopumps
AS810	Accessories for servopumps
AS910	Operating and maintenance information for servopumps
GS510	Fieldbus
S-MAN-HW	Servopumps installation manual
S-MAN-SW	Servopumps programming software manual
S-MAN-STO	Servopumps Safe Torque Off manual

Digital electronic drives for SSP servopumps

fieldbus, smart start-up

SMART TUNING

P/Q CONTROL

SMART START-UP

MULTIPLE AXIS

D-MP-T-SP-NP-022/K

① Drive power supply - input
② Servomotor power supply - output
③ Serial RS485 communication port
④ IN/OUT signals
⑤ Fieldbus
⑥ Servomotor resolver

D-MP

Electronic drive exploits the modern technology of servo drives to accurately control pressure and flow in hydraulic systems through Smart Servopumps (SSP).
Atos PC software allows to customize the SSP configuration and via the Smart Start-up function guides the user step by step during the commissioning phases (see AS050).
Multiple axis function allows to manage customized settings for up to 4 axes (see AS050).

General Features:

- DB9 serial port RS485 always present
- Fieldbus communication connector for CANopen and PROFIBUS DP
- RJ45 ethernet communication connectors input/output for EtherCAT, PROFINET
- DB15 resolver connector always present
- Operating temperature range: 0 ÷ +40 °C
- IP20: for drives type 022 ÷ 100
- IP00: for drives type 140 ÷ 210
- CE mark according to LVD and EMC directive

Software Features:

- Intuitive graphic interface
- Smart Start-up
- Multiple axis
- Smart tuning
- Setting of SSP functional parameters
- Complete diagnostics
- Internal oscilloscope function

1 MODEL CODE

D-MP	-	T-SP	-	NP	-	022	/	*

Electronic drive
in wall mounting format

Control mode:
T-SP = high performances P/Q control

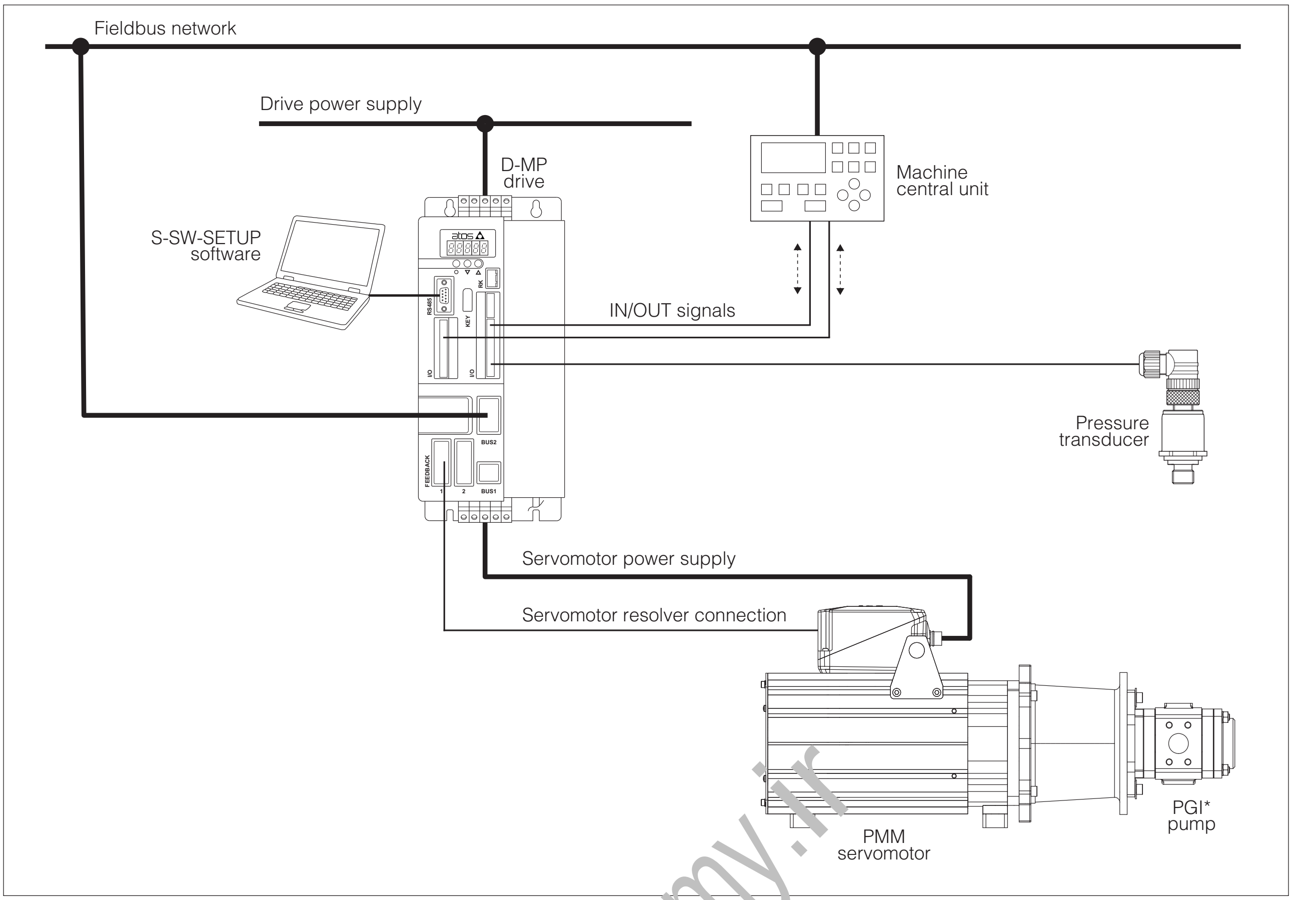
Fieldbus interface, serial port RS485 always present:
NP = Not Present
BC = CANopen
BP = PROFIBUS DP
EH = EtherCAT
EP = PROFINET RT/IRT

Rated current [Arms], see section 6 :

022 = 22 A	**060** = 57,5 A	**140** = 140 A
032 = 32 A	**090** = 87 A	**165** = 165 A
046 = 46 A	**100** = 100 A	**210** = 210 A

Option, see section 12 :
K = Safe Torque Off (STO)

2 BLOCK DIAGRAM EXAMPLE



3 DRIVE SETTINGS AND PROGRAMMING TOOLS - see tech. table **AS800**

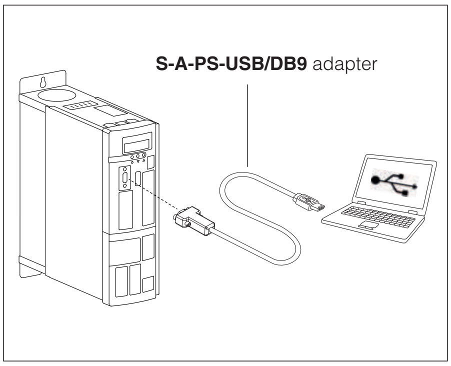
Drive functional parameters and configurations, can be easily set and optimized using Atos S-SW-SETUP programming software connected via serial port RS485 to the drive.
For fieldbus versions, the software permits drive parameterization through serial port RS485 also if the drive is connected to the central machine unit via fieldbus.

S-SW-SETUP permits to have many features so as Smart Start-up, Multiple axis and Smart tuning for an easy and rapid commissioning. For detailed info refer to **AS050**.

S-SW-SETUP support:	NP (Serial)	
	BC (CANopen)	EH (EtherCAT)
	BP (PROFIBUS DP)	EP (PROFINET)

Note: for detailed descriptions of settings, wirings and installation procedures, please refer to the user manual included in the S-SW-SETUP

Serial port RS485 connection



4 FIELDBUS - see tech. table **GS510**

Fieldbus allows drive direct communication with machine control unit for digital reference, drive diagnostics and settings. These execution allow to operate the drive through fieldbus or analog signals available on the connectors.

5 GENERAL CHARACTERISTICS

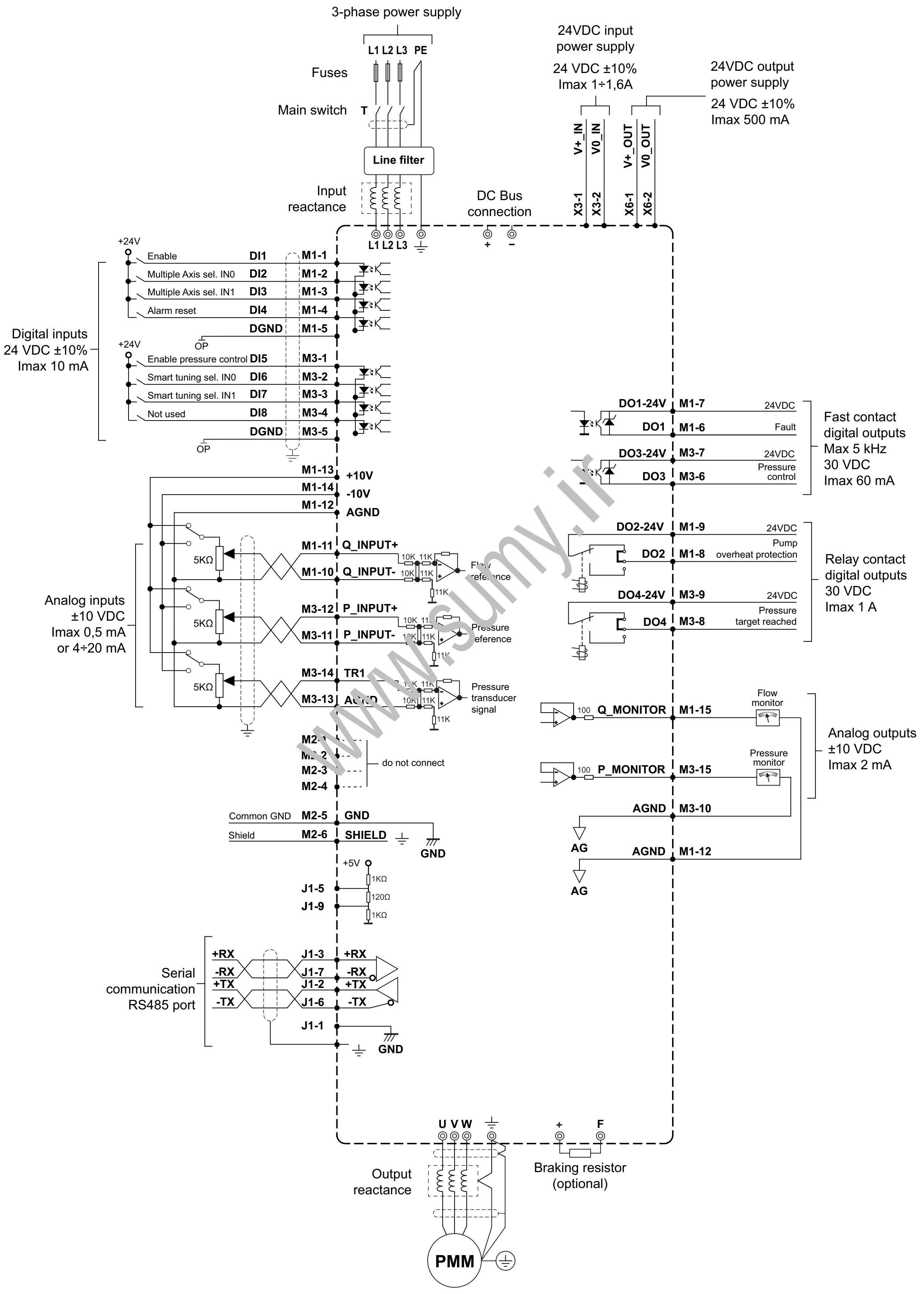
Assembly position	Wall mounting
Ambient temperature range	0 ÷ 40°C; up to 45°C with current derated to 88%
Storage temperature range	-10 ÷ 60°C
Altitude	Up to 1000 m; current derating for higher altitudes
Humidity	<90% - condensation not permitted
Vibration	0,2g
Cooling	Fan
Compliance	CE according to Low Voltage Directive (LVD) 2014/35/EU and to EMC directive 2014/30/EU RoHS Directive 2011/65/EU as last update by 2015/863/EU

6 ELECTRICAL CHARACTERISTICS

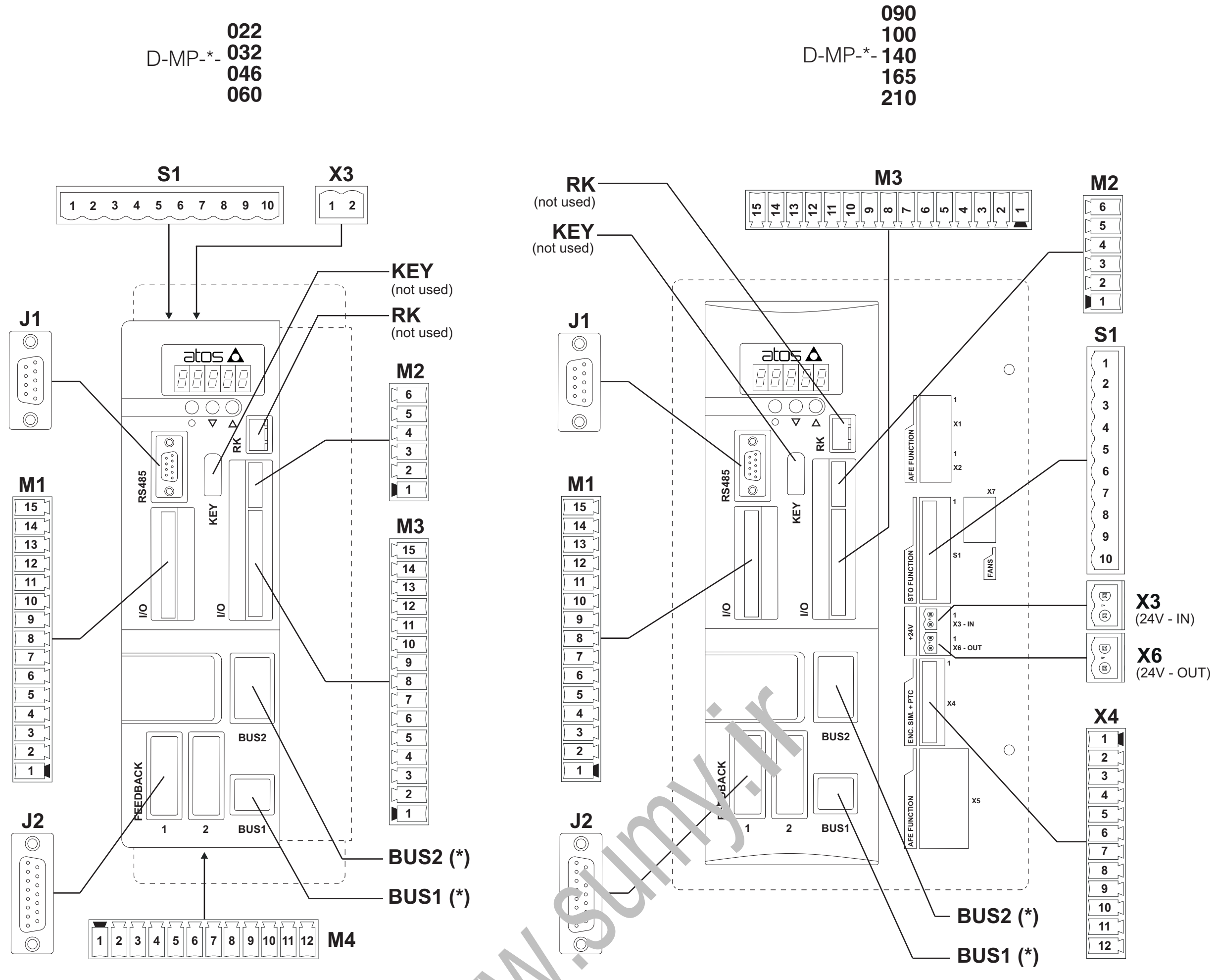
Drive type		**022**	**032**	**046**	**060**	**090**	**100**	**140**	**165**	**210**
Rated current	[A]	22	32	46	57.5	87	100	140	165	210
Overload current **(1)**	[A]	44	64	92	115	174	200	280	330	420
Rated power	[kW]	11	15	22	30	45	55	75	90	110
Rated IN voltage	[V]	200 V -10% ÷ 460 V +10% @ 45 ÷ 65 Hz				380 V -15% ÷ 460 V +10% @ 45 ÷ 65 Hz				
DC Bus voltage	[V]	280 V -10% ÷ 620 V +10%				530 V -15% ÷ 650 V +10%				
PWM frequency **(2)**	[kHz]	3 ÷ 14								
24VDC input power supply		24 V_{DC} ±10% @ max 1,0 A for drives type 022, 032, 090, 100, 140, 165, 210 24 V_{DC} ±10% @ max 1,6 A for drives type 046, 060								
24VDC output power supply		24 V_{DC} ±10% @ max 500 mA - only for drives type 090, 100, 140, 165, 210								
Digital inputs		24 V_{DC} ±10% @ max 10 mA								
Digital outputs - fast contact		30 V_{DC} @ max 60 mA (max 5 kHz)								
Digital outputs - relay contact		30 V_{DC} @ max 1 A								
Analog inputs		±10 V @ max 0,5 mA or 4 ÷ 20 mA (settable with specific dip-switch - see user manual)								
Analog outputs		±10 V @ max 2 mA								
Pressure transducer power supply		+24 V_{DC} @ max 100 mA (E-ATR-8 see tech table **GS465**)								
Protection degree to DIN EN60529		IP20 for drives type 022, 032, 046, 060, 090, 100 IP00 for drives type 140, 165, 210								
Analog reference resolution		16 bit								
Speed control mode		Field-Oriented Control								
Braking resistance		External (see tech table **AS810**)								
Filter		External (see tech table **AS810**)								
Reactance		External - recommended for high power (> 45kW); see section 14								
Communication interface		Serial Atos ASCII coding	CANopen EN50325-4 + DS408			PROFIBUS DP EN50170-2/IEC61158		EtherCAT, PROFINET IO RT / IRT EC 61158		
Communication physical layer		insulated RS485	optical insulated CAN ISO11898			optical insulated RS485		Fast Ethernet, insulated 100 Base TX		
Recommended wiring cable for logic and 24V_{DC} power supply		LiYCY shielded cables: 0,5 mm^2 max 30 m for logic - 1,5 mm^2 max 30 m for 24V_{DC} power supply Max conductor size: 1,5 mm^2 Notes: for pressure transducer wiring cable please consult the transducer datasheet								
Recommended wiring cable for drive and servomotor power supply		see section 13								

(1) 200% overload for maximum 3s and 155% for 30s
(2) Default is 5 kHz; only for drive type 140 default is 4 kHz

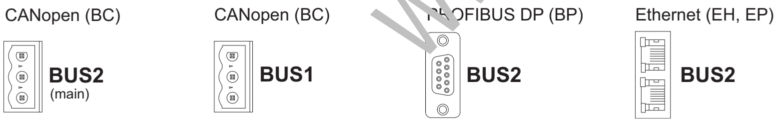
7 WIRING BLOCK DIAGRAM



8 ELECTRONIC CONNECTIONS

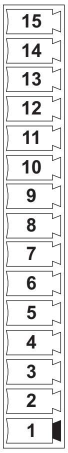


(*) type of BUS1 and BUS2 connectors change according to the fieldbus interface (BUS1 connector available only for CANopen)



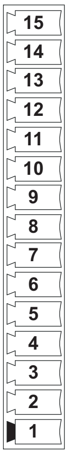
Connectors	**Description**	**See**
M1	IN/OUT analog and digital signals	8.1
M3	IN/OUT analog and digital signals - P/Q control	8.2
M2	Not used - available only for gnd and shield connections	8.3
X3	24VDC input power supply	8.4
X6	24VDC output power supply - only for 090, 100, 140, 165, 210	8.5
S1	Safe Torque Off (STO) - only for /K option	8.6
J2	Servomotor resolver	8.7
M4	Servomotor thermal sensor - for 022, 032, 046, 060	8.8
X4	Servomotor thermal sensor - for 090, 100, 140, 165, 210	
J1	Serial RS485 communication port	8.9
BUS1	Fieldbus optional boards - only for BC, BP, EH, EP	8.10 8.11 8.12
BUS2		
KEY	Not used	-
RK		

8.1 M1 connector - IN/OUT digital and analog signals

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
M1 	1	**DI1**	Enable (24 VDC) or disable (0 VDC) the servomotor control, referred to DGND	Input - on/off signal
	2	**DI2**	Multiple axis selection IN0, referred to DGND	Input - on/off signal
	3	**DI3**	Multiple axis selection IN1, referred to DGND	Input - on/off signal
	4	**DI4**	Alarm reset	Input - on/off signal
	5	**DGND**	Common gnd for digital input	Common gnd
	6	**DO1** (1)	Fault (0 VDC) or normal working (24 VDC), referred to DO1-24V	Output - on/off signal **Software selectable**
	7	**DO1-24V**	DO1 power supply 24 VDC	Input - power supply
	8	**DO2** (2)	Pump overheat protection active (24 VDC) or not active (0 VDC), referred to DO2-24V	Output - on/off signal **Software selectable**
	9	**DO2-24V**	DO2 power supply 24 VDC	Input - power supply
	10	**Q_INPUT-**	Negative flow reference input signal for Q_INPUT+	Input - analog signal
	11	**Q_INPUT+**	Flow reference input signal: ±10 VDC / 4 ÷ 20 mA maximum range Default is 0 ÷ 10 VDC	Input - analog signal **Dip-switch selectable**
	12	**AGND**	Common gnd for Q_MONITOR and stabilized power supply	Common gnd
	13	**+10V**	Stabilized power supply +10V - Current: max 10 mA	Output power supply
	14	**-10V**	Stabilized power supply -10V - Current: max 10 mA	Output power supply
	15	**Q_MONITOR**	Flow monitor output signal: ±10 VDC maximum range, referred to AGND	Output - analog signal **Software selectable**

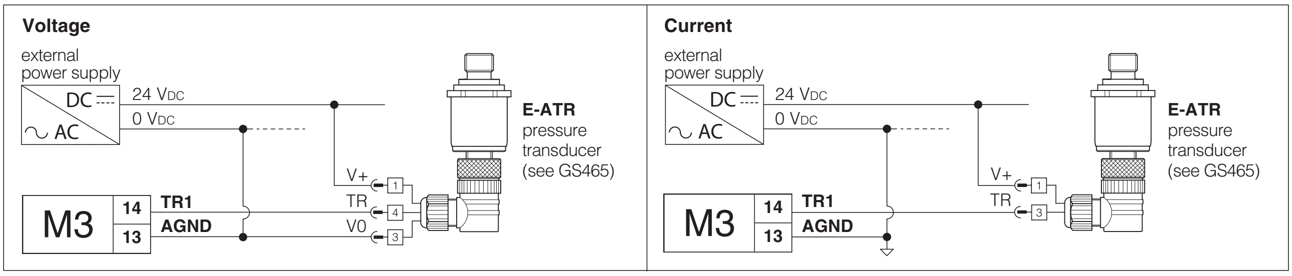
(1) Digital output with fast contact **(2)** Digital output with relay contact

8.2 M3 connector - IN/OUT digital and analog signals - P/Q control connections

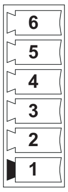
CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
M3 	1	**DI5**	Enable (24 VDC) or disable (0 VDC) the P/Q control, referred to DGND	Input - on/off signal
	2	**DI6**	Smart tuning setting selection IN0, referred to DGND	Input - on/off signal
	3	**DI7**	Smart tuning setting selection IN1, referred to DGND	Input - on/off signal
	4	**DI8**	(not used)	-
	5	**DGND**	Common gnd for digital input	Common gnd
	6	**DO3** (1)	Pressure control active (24 VDC) or not active (0 VDC), referred to DO3-24V	Output - on/off signal **Software selectable**
	7	**DO3-24V**	DO3 power supply 24 VDC	Input - power supply
	8	**DO4** (2)	Pressure target reached (24 VDC) or not reached (0 VDC), referred to DO4-24V	Output - on/off signal **Software selectable**
	9	**DO4-24V**	DO4 power supply 24 VDC	Input - power supply
	10	**AGND**	Common gnd for P_MONITOR	Common gnd
	11	**P_INPUT-**	Negative pressure reference input signal for P_INPUT+	Input - analog signal
	12	**P_INPUT+**	Pressure reference input signal: ±10 VDC / 4 ÷ 20 mA maximum range Default is 0 ÷ 10 VDC	Input - analog signal **Dip-switch selectable**
	13	**AGND**	Common gnd for transducer signal	Common gnd
	14	**TR1**	Signal pressure transducer: ±10 VDC / 4 ÷ 20 mA maximum range Default is 0 ÷ 10 VDC	Input - analog signal **Dip-switch selectable**
	15	**P_MONITOR**	Pressure monitor output signal: ±10 VDC maximum range, referred to AGND	Output - analog signal **Software selectable**

(1) Digital output with fast contact **(2)** Digital output with relay contact

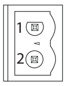
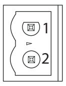
Remote pressure transducer connections - examples



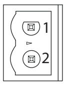
8.3 M2 connector - not used - available only for common GND and SHIELD connection

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
M2 	1	**NC**	-	Do not connect
	2	**NC**	-	Do not connect
	3	**NC**	-	Do not connect
	4	**NC**	-	Do not connect
	5	**GND**	Common gnd	
	6	**SHIELD**	Shield	

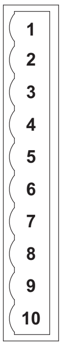
8.4 X3 connector - 24VDC input power supply

CONNECTORS		PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
X3  drives type **022 ÷ 060**	**X3**  drives type **090 ÷ 210**	1	**V+_IN**	Power supply 24 VDC	Input - power supply
		2	**V0_IN**	Power supply 0 VDC	Gnd - power supply

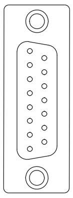
8.5 X6 connector - 24VDC output power supply - only for drives type **090 ÷ 210**

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
X6 	1	**V+_OUT**	Power supply 24 VDC	Output - power supply
	2	**V0_OUT**	Power supply 0 VDC	Gnd - power supply

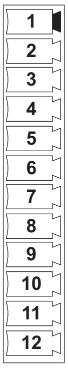
8.6 S1 connector - Safe Torque Off (STO) - only for **/K** option

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
S1 	1	**STO2_A**	Monitor for STO2 - second safety system channel When the terminal board is powered, the contact is open Voltage: max 60 VDC - Current: max 0,5 A	Output - on/off signal
	2	**STO2_B**		Output - on/off signal
	3	**NC**	-	Do not connect
	4	**+24V_STO2**	Power supply for STO2 - second safety system channel Voltage: +24 VDC ±10 % - Current: min 200 mA	Input - power supply
	5	**0V_STO2**		Gnd - power supply
	6	**NC**	-	Do not connect
	7	**STO1_A**	Monitor for STO1 - first safety system channel When the terminal board is powered, the contact is open Voltage: max 60 VDC - Current: max 0,5 A	Output - on/off signal
	8	**STO1_B**		Output - on/off signal
	9	**+24V_STO1**	Power supply for STO1 - first safety system channel Voltage: +24 VDC ±10 % - Current: min 200 mA	Input - power supply
	10	**0V_STO1**		Gnd - power supply

8.7 J2 connector - Servomotor resolver - DB15 - 15 pin

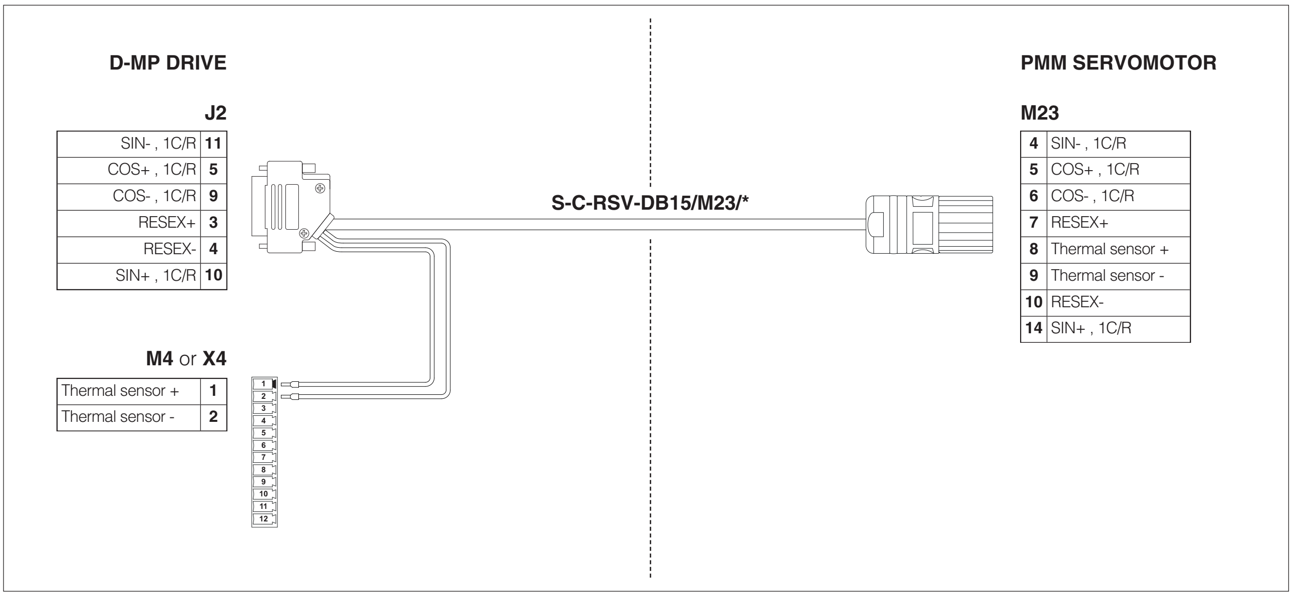
CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
J2  female (drive view)	1	**NC**	-	Do not connect
	2	**NC**	-	Do not connect
	3	**RESEX+**	Red	
	4	**RESEX-**	Blue	
	5	**COS+** , **1C/R**	Grey	
	6	**NC**	-	Do not connect
	7	**NC**	-	Do not connect
	8	**NC**	-	Do not connect
	9	**COS-** , **1C/R**	Pink	
	10	**SIN+** , **1C/R**	Yellow	
	11	**SIN-** , **1C/R**	Green	
	12	**NC**	-	Do not connect
	13	**NC**	-	Do not connect
	14	**NC**	-	Do not connect
	15	**NC**	-	Do not connect

8.8 M4 - X4 connector - Servomotor thermal sensor (1)

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
M4 - X4 	1	**Thermal sensor +**	Servomotor thermal sensor - positive input (KTY or PT)	Input - analog signal
	2	**Thermal sensor -**	Servomotor thermal sensor - negative input (KTY or PT)	Input - analog signal
	3	**GND**	Shield connection for PT or KTY cables	Common gnd
	4	**NC**	-	Do not connect
	5	**NC**	-	Do not connect
	6	**NC**	-	Do not connect
	7	**NC**	-	Do not connect
	8	**NC**	-	Do not connect
	9	**NC**	-	Do not connect
	10	**NC**	-	Do not connect
	11	**NC**	-	Do not connect
	12	**NC**	-	Do not connect

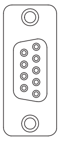
(1) M4 is for drives type 022 ÷ 060; X4 is for drives type 090 ÷ 210

Servomotor resolver cable connection - example - see tech table **AS810**

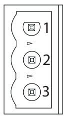
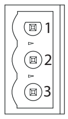


Note: for more information about PMM servomotor, please refer tech table **AS400**

8.9 J1 connector - Serial RS485 communication port - DB9 - 9 pin

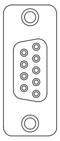
CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
J1  female (drive view)	1	**NC**	-	Do not connect
	2	**TX+**	Transmitter	
	3	**RX+**	Receiver	
	4	**NC**	-	Do not connect
	5	**NC**	-	Do not connect
	6	**TX-**	Transmitter	
	7	**RX-**	Receiver	
	8	**NC**	-	Do not connect
	9	**NC**	-	Do not connect

8.10 BUS2 and BUS1 connectors - CANopen (BC)

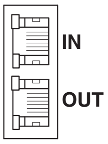
CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
BUS2  main	1	**CAN_H**	Bus line (high)	
	2	**CAN_L**	Bus line (low)	
	3	**CAN_GND**	Signal zero data line	
BUS1 	1	**CAN_H**	Bus line (high)	
	2	**CAN_L**	Bus line (low)	
	3	**CAN_GND**	Signal zero data line	

Note: on the board are present two dip-switch; one allows to terminate the fieldbus network while the other allows the simultaneous use of both connectors as input and output. For more information about setting dip-switch please refer user manual.

8.11 BUS2 connector - PROFIBUS DP (BP)

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
BUS2 	1	**SHIELD**	Shield	
	2	**NC**		Do not connect
	3	**LINE_B**	Bus line (B)	
	4	**DE**	Control's signal for repeater	
	5	**DGND**	Data line and termination signal zero	
	6	**+5V**	Termination supply signal	
	7	**NC**	-	Do not connect
	8	**LINE_A**	Bus line (A)	
	9	**NC**	-	Do not connect

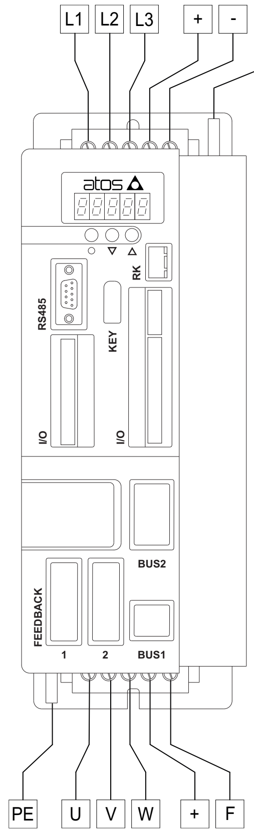
8.12 BUS2 connectors IN/OUT - Ethernet (EH, EP)

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
BUS2  	1	**TX+**	Transmitter (white/orange)	
	2	**RX+**	Receiver (orange)	
	3	**TX-**	Transmitter (white/green)	
	4	**NC**	-	Do not connect
	5	**NC**	-	Do not connect
	6	**RX-**	Receiver (green)	
	7	**NC**	-	Do not connect
	8	**NC**	-	Do not connect

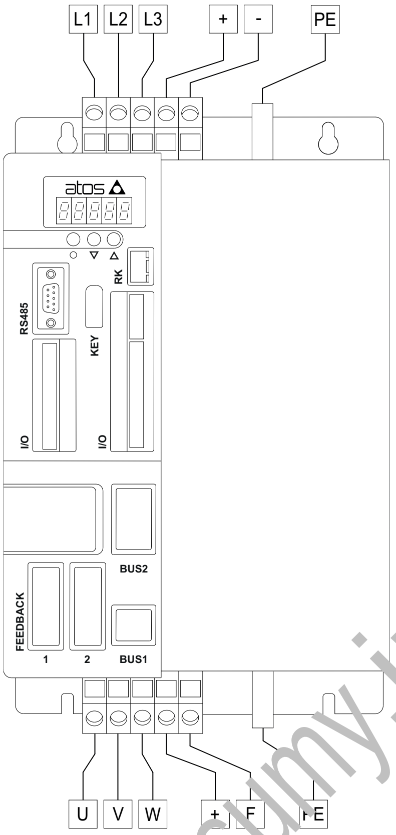
Note: perform the cables connection following the IN and OUT indications

9 DRIVE AND SERVOMOTOR POWER CONNECTIONS

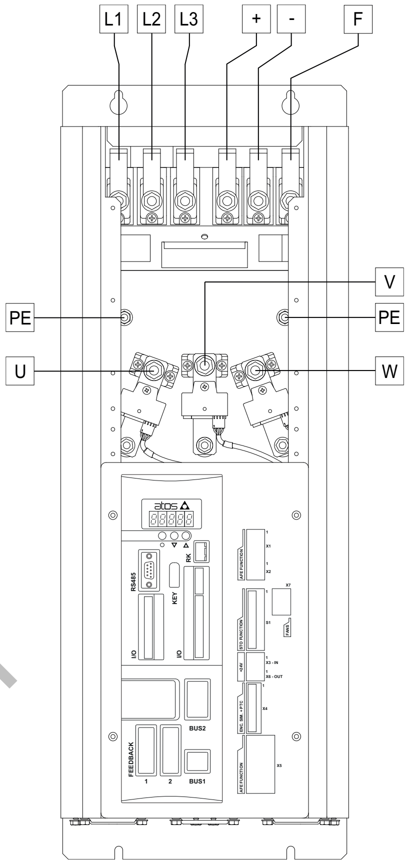
D-MP-*- **022**



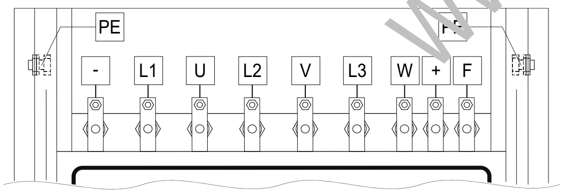
D-MP-*- **032**
D-MP-*- **046**
D-MP-*- **060**



D-MP-*- **090**
D-MP-*- **100**
D-MP-*- **140**



D-MP-*- **165**
D-MP-*- **210**

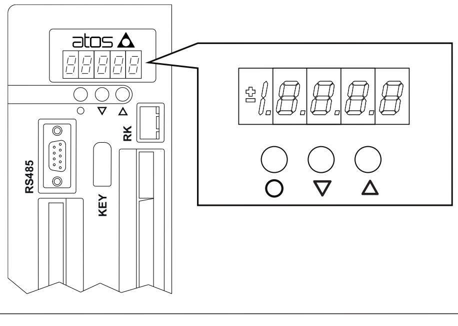


L1 **L2** **L3**	Drive power supply - input
U **V** **W**	Servomotor power supply - output (pass the cables through the toroid inside present, without the shield and ground)
+ **-**	DC Bus connection
+ **F**	Brake resistor connection
PE	Connection PE and shield

10 DISPLAY

On the drive front panel is available a numeric display to view the drive status: run or stop.

Note: the 3 keys, ● (S selection), ▼ (- decrease), ▲ (+ increase) are not used



11 POWER SUPPLY AND SIGNALS SPECIFICATIONS

Atos digital drives are CE marked according to the applicable directives (e.g. Immunity and Emission EMC Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in tech table **AS050** and in the user manuals included in the S-SW-SETUP programming software.
Generic electrical output signals of the drive (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).

11.1 Drive power supply (L1, L2, L3)

The drive must be connected to the main power supply trought terminals L1, L2, L3 and with the ground cable connected to the PE stud (see section 9).
When connecting drives type 022 ÷ 60A to 3-phase supply mains we recommend using a 3-phase reactance (see tech table **AS810**).
For drives type 060 ÷ 210 the 3-phase input reactance is **mandatory**. The 3-phase reactance is used to reduce the current peaks on the diode bridge DB and the effective value of the current through the capacitors. It is also used to reduce interference from the supply line to the drive and from the drive to the line.
The drive must be wired steadily through appropriately sized cables (see section 13).

Notes: drives type 022 ÷ 060 feature a soft-start function built in the drive;
the reactance can be omitted only for particular cases (in this case contact Atos technical office)

⚠ A correct installation to the main power supply is required according to IEC 61800-5-1

⚠ Ultra-fast fuses must be installed between the main power supply and the drive (see section 14)

11.2 Servomotor power supply (U, V, W)

The servomotor must be connected to terminals U, V, W and with the ground cable connected to the PE stud (see section 9).
For drives type 090 ÷ 140 pass the servomotor 3-phase through the present toroid inside, without shield and ground. Connect the servomotor by means of shielded or armored cables only and ground the shield on the converter side as well as on servomotor side. If shielded cables cannot be used, the servomotor cables should be placed in a metallic raceway connected to ground.
Atos recommends to use a 3-phase reactance between the drive and the servomotor (see tech table **AS810**).
With cables longer than 50 meters, the reactance is obligatory.
Any short circuit between U, V, W will cause the drive to shut down. If the interruption between the servomotor and the drive is obtained by means of electromagnetic switches (such as contactors, thermal relays and the like) ensure that the drive is disabled before cutting off the connection between the servomotor and the drive (in order not to damage the contactors).
The servomotor must be wired steadily through appropriately sized cables (see section 13).

11.3 24VDC input power supply (V+_IN and V0_IN)

Through the pins 1 and 2 of the X3 connector (see 8.4) is possible to power the drive logic and servomotor sensor (mandatory for drives type 022 ÷ 060 no self powered).
The drives type 090 ÷ 210 generates internally an 24 V_{DC} auxiliary supply through the main power supply; the drive logic can be supply through X3 connector with an external 24 V_{DC} without produce conflict between the internally generated voltage and the auxiliary power supplied externally (is used the source with higher voltage level). This feature allows to configure the drive without main power supply and keep the drive logic switched on even in the absence of the drive main power supply.

11.4 24VDC output power supply (V+_OUT and V0_OUT)

Only for drives type 090 ÷ 210 the 24V_{DC} output power supply is available on pins 1 and 2 of the X6 connector (see 8.5).
This voltage can be used only to provide an auxiliary supply for digital I/O to the drive and for /K option provides an auxiliary supply for STO channels function (the auxiliary supply must be interrupted by suitable safety contacts). The output current is internally limited to a 500mA; protection against external over-current and short-circuit.

11.5 Flow reference input signals (Q_INPUT+)

The drive is designed to receive an analog reference input signal (pin 11 on M1) for the servomotor rotation speed.
Flow reference input signal is factory preset, default is 0 ÷ 10 V_{DC}. Input signal can be reconfigured between voltage and current within a maximum range of ±10 V_{DC} or 4 ÷ 20 mA, using specific dip-switch present on the drive (see user manual).
Drive with fieldbus interface can be software set to receive reference signal directly from the machine control unit (fieldbus reference).

11.6 Pressure reference input signal (P_INPUT+)

The drive is designed to receive an analog reference input signal (pin 12 on M3) for the system pressure.
Pressure reference input signal is factory preset, default is 0 ÷ 10 V_{DC}. Input signal can be reconfigured between voltage and current within a maximum range of ±10 V_{DC} or 4 ÷ 20 mA, using specific dip-switch present on the drive (see user manual).
Drive with fieldbus interface can be software set to receive reference signal directly from the machine control unit (fieldbus reference).

11.7 Flow monitor output signal (Q_MONITOR)

The drive generates an analog output signal (pin 15 on M1) for servomotor actual rotation speed.
The monitor output signal can be software set to show other signals available in the drive (see user manual).

11.8 Pressure monitor output signal (P_MONITOR)

The drive generates an analog output signal (pin 15 on M3) to the system actual pressure.
The monitor output signal can be software set to show other signals available in the drive (see user manual).

11.9 Enable input signal (DI1)

To enable the servomotor control, supply a 24 V_{DC} on pin 1 of the M1: Enable input signal allows to enable/disable servomotor control, without removing the electrical power supply to the drive; it is used to keep active the communication and the other driver functions when the drive must be disabled for safety reasons. This condition **does not comply** with norms IEC 61508 and ISO 13849.
Enable input signal can be used as generic digital input by software selection.
Input is optoisolated from the internal regulation (24 V_{DC} ±10% @ Imax 10 mA).

11.10 Multiple axis selection input signal (DI2 and DI3)

Two on-off input signals are available on pin 2 and pin 3 of the M1 connector to select one of the four axis parameters setting, stored into the drive.
Switching the active setting of axis during the machine cycle allows to optimize the system dynamic response in different hydraulic working conditions (volume, flow, etc.).
Supply a 24 V_{DC} or a 0 V_{DC} on pin 2 and/or pin 3 of the M1, to select one of the PID settings as indicated by binary code table at side.
Input is optoisolated from the internal regulation (24 V_{DC} ±10% @ Imax 10 mA).

	AXIS SELECTION			
PIN	SET 1	SET 2	SET 3	SET 4
M1-2	0	24 V_{DC}	0	24 V_{DC}
M1-3	0	0	24 V_{DC}	24 V_{DC}

11.11 Alarm reset input signal (DI4)

Alarm reset input signal allows to clear all alarms present into the drive: to reset the drive alarms, supply 24 V_{DC} on pin 4 of the M1.
Input is optoisolated from the internal regulation (24 V_{DC} ±10% @ Imax 10 mA).

11.12 Fault output signal (DO1)

Fault output signal (pin 6 on M1) indicates fault conditions of the drive (reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC.
Fault status is not affected by the status of the Enable input signal.
This output signal can be used as digital output by software selection.
Note: digital output with fast contact (max 5 kHz)

11.13 Pump overheat protection output signal (DO2)

This output signal (pin 8 on M1) indicates the working conditions to which the internal gear pump (PGI*) is subject to rapid overheating.
In case of /D option (see **AS100**) this digital output condition can be used to manage (using an external relay) the JO-DL cartridge installed on the manifold block.
Pump overheat protection presence of the pump corresponds to 24 VDC, normal working corresponds to 0 VDC.
Pump overheat protection logical output signal is not intended as a fault condition.
This output signal can be used as digital output by software selection.
Note: digital output with relay contact

11.14 Enable pressure input signal (DI5)

By default, the P/Q control is always active.
Through S-SW-SETUP software, it's possible to modify the configuration of the drive so that the P/Q control can be enabled/disabled via this digital input:
- when digital input is set to 0VDC, P/Q control is disabled and the drive performs just flow control
- when digital input is set to 24VDC, P/Q control is enabled and the drive performs flow and pressure control

Input is optoisolated from the internal regulation (24 VDC ±10% @ Imax 10 mA).

11.15 Smart tuning selection input signals (DI6 and DI7)

Smart tuning setting can be switched from Dynamic (default) to Balanced or Smooth via software, fieldbus or using DI6 and DI7 digital inputs (pin 2 and 3 on M3), as shown at side; if requested, performances can be further customized directly tuning each single PID control parameter.

	SMART TUNING SELECTION		
PIN	**DYNAMIC**	**BALANCED**	**SMOOTH**
M3-2	0	24 VDC	0
M3-3	0	0	24 VDC

11.16 Pressure control active output signal (DO3)

Pressure control active output signal (pin 6 on M3) indicates the P/Q control status.
The pressure control active corresponds to 24 VDC, while not active corresponds to 0 VDC.
Pressure control status is not affected by the status of the Enable pressure input signal.
Pressure control output signal can be used as digital output by software selection.
Note: digital output with fast contact (max 5 kHz)

11.17 Pressure target reached output signal (DO4)

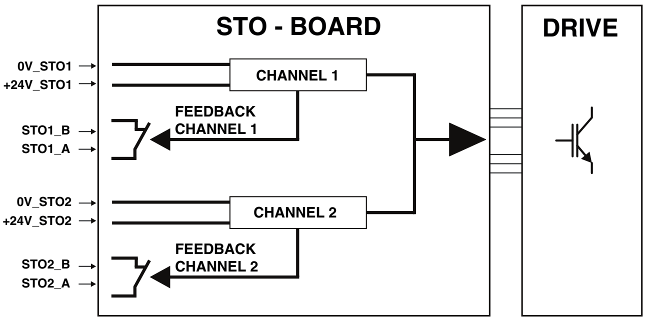
This output signal (pin 8 on M3) indicates if the pressure target has been reached.
The pressure target reached corresponds to 24 VDC, while not reached corresponds to 0 VDC.
Pressure target reached output signal can be used as digital output by software selection.
Note: digital output with relay contact

11.18 Remote pressure transducer input signals (TR1)

Analog remote pressure transducers can be directly connected to the drive.
Analog input signal (pin 14 on M3) is factory preset, default is 0 ÷ 10 VDC. Input signal can be reconfigured between voltage and current within a maximum range of ±10 VDC or 4 ÷ 20 mA, using specific dip-switch present on the drive (see user manual).
Refer to pressure transducer characteristics to select the transducer type according to specific application requirements.

12 OPTIONS

K = The drive implements the Safe Torque Off (STO) function as a prevention of unexpected starts according to 2006/42/EC Machinery Directive (MD) - standard EN 61800-5-2.
This function prevents the generation of a rotating magnetic field removing the power semiconductor control voltage allowing short-term operations (such as cleaning and / or maintenance work on parts of non-electrical devices of the machine) without disconnecting drive power supply or the connection between the drive and the servomotor.
The STO function is implemented using two redundant channels each having its own signal feedback accessible from the outside, available on the S1 connector (see 8.6).
For detailed descriptions, please refer to the user manual.



The following table resumes the STO enabling/disabling conditions according to the drives size:

	drive size 022 ÷ 140					drive size 165 ÷ 210				
	+24V_STO1	**STO1**	**+24V_STO2**	**STO2**	**STO Active**	**+24V_STO1**	**STO1**	**+24V_STO2**	**STO2**	**STO Active**
STO OFF	+24V	OPEN	+24V	OPEN	OFF	+24V	OPEN	+24V	OPEN	OFF
STO ON	+24V	OPEN	+24V	CLOSE	(*)	0V	CLOSE	0V	CLOSE	ON
	0V	CLOSE	0V	OPEN	ON					
	0V	CLOSE	0V	CLOSE	ON					

13 POWER AND PROTECTION CABLES SIZE

Drive type	Servomotor type (1)	Power Cables (mm^2)		Protection Cables (mm^2)		Max length [m]
		drive **L1 - L2 - L3**	servomotor **U - V - W**	drive **PE**	servomotor **PE**	drive and servomotor
D-MP-*-022	PMM-*009	6	6	6	6	20
D-MP-*-032	PMM-*015	10	10	10	10	
D-MP-*-046	PMM-*024	16	25	16	25	
D-MP-*-060	PMM-*032	25	25	25	25	
D-MP-*-090	PMM-*042	35	35	25	25	
D-MP-*-100	PMM-*055	50	70	35	35	
D-MP-*-140		70	70	50	35	
D-MP-*-165	PMM-*080	120	120	70	70	
D-MP-*-210	PMM-*100					

(1) For more information about PMM servomotor, please refer tech table **AS400**

14 FUSES

Drive type	Fuses - Min and Max value **(2)** [A]	Voltage [AC]	I2 T Maximum (A2s) for AC input
D-MP-*-022	25 - 40 (40 - 63)	480	1200
D-MP-*-032	40 - 63 (63 - 80)	480	1200
D-MP-*-046	50 - 80 (100 - 200)	480	3900
D-MP-*-060	80 - 100 (125 - 315)	480	3900
D-MP-*-090 **(1)**	100 - 140 (160 - 450)	480	9000
D-MP-*-100 **(1)**	125 - 160 (200 - 630)	480	40000
D-MP-*-140 **(1)**	160 - 200 (315 - 700)	480	62500
D-MP-*-165 **(1)**	200 - 250 (350 - 1000)	480	62500
D-MP-*-210 **(1)**	250 - 315 (400 - 1250)	480	160000

⚠ **WARNING:** the minimum values of the fuses are calculated for the drive that delivers the rated power

Notes:
- all fuses must be ultra-fast type
- the fuses are calculated for a minimum short-circuit current of 10 times the rated current; the maximum short-circuit current must not be greater than 20 times the rated current

(1) The fuse rated current must be greater than the rated input current
(2) In brackets input fuses with DC Bus connection

15 OVERALL DIMENSIONS [mm]

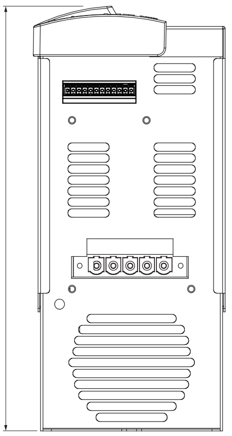
D-MP-*-022

Fixing screws = M4

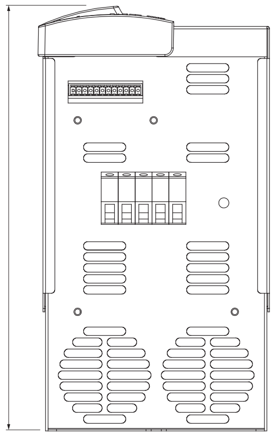
D-MP-*-032

Fixing screws = M4

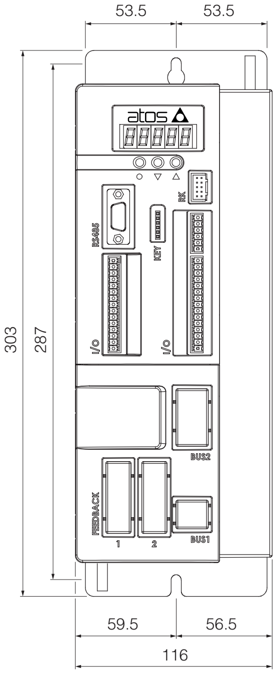
Mass [kg]	
D-MP-*-022	5.5
D-MP-*-032	6.4

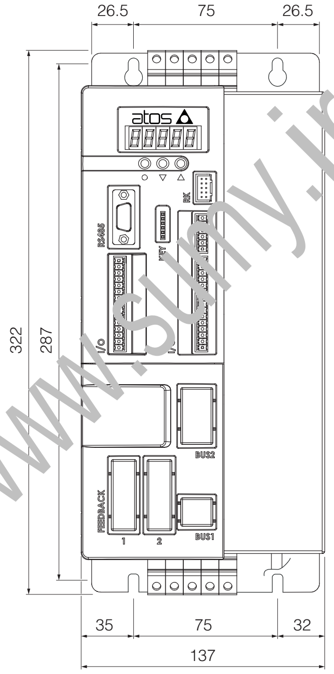


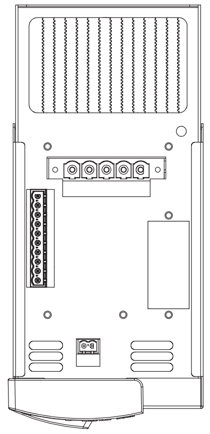
bottom view



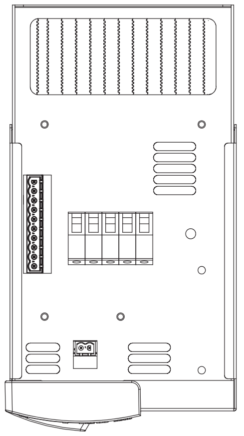
bottom view







top view

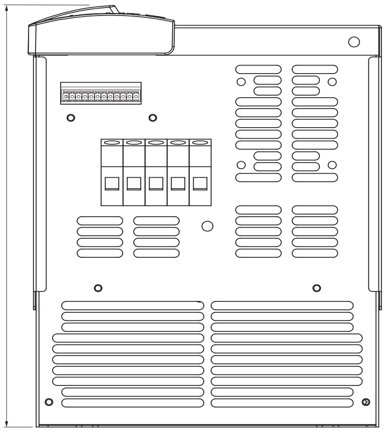


top view

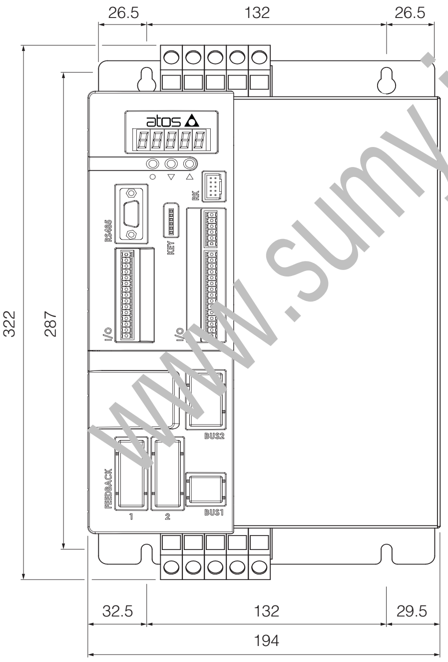
D-MP-*-046
D-MP-*-060

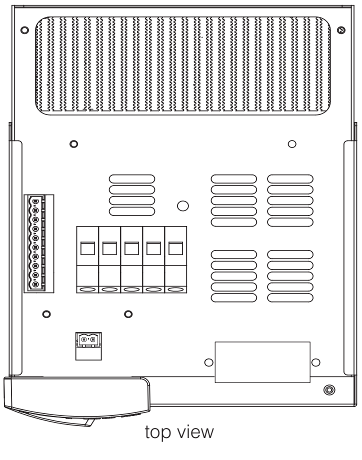
Fixing screws = M4

Mass [kg]	
D-MP-*-046	9.3
D-MP-*-060	10



bottom view



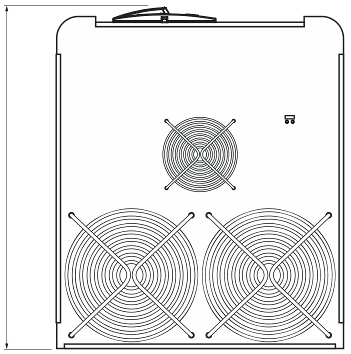


top view

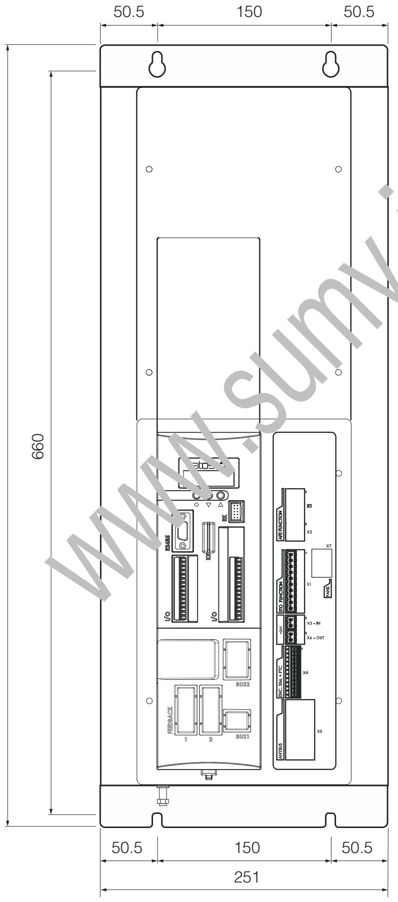
D-MP-*-090
D-MP-*-100
D-MP-*-140

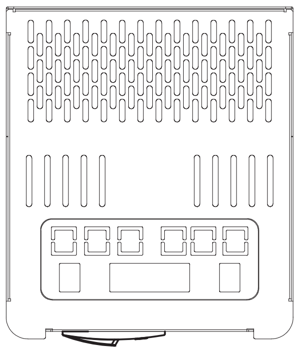
Fixing screws = M6

Mass [kg]	
D-MP-*-090	22
D-MP-*-100	
D-MP-*-140	



bottom view



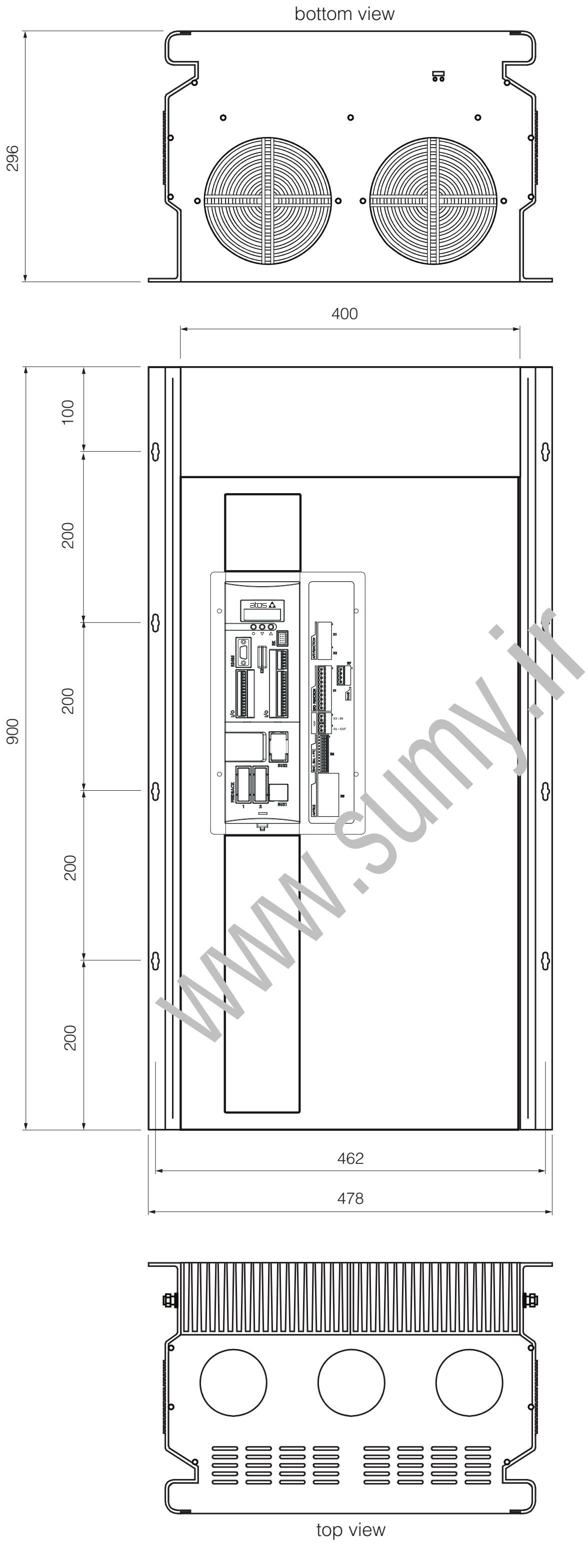


top view

D-MP-*-165
D-MP-*-210

Fixing screws = M4

Mass [kg]	
D-MP-*-165	65
D-MP-*-210	

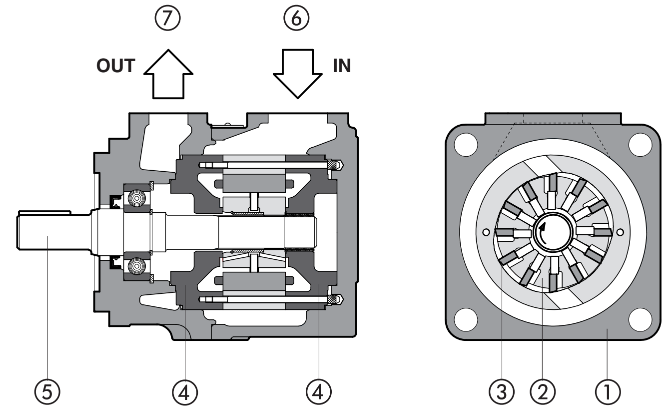


16 RELATED DOCUMENTATION

AS050	Basics for Smart Servopumps - SSP
AS100	SSP Smart Servopumps
AS200	Sizing criteria for servopumps
AS300	PGI cast iron internal gear pumps, high pressure
AS350	PGIL aluminium internal gear pumps
AS400	PMM high performance synchronous servomotors
AS800	Programming tools for pumps & servopumps
AS810	Accessories for servopumps
AS910	Operating and maintenance information for servopumps
GS510	Fieldbus
S-MAN-HW	Servopumps installation manual
S-MAN-SW	Servopumps programming software manual
S-MAN-STO	Servopumps Safe Torque Off manual

Vane pumps type PFE-31, PFE-41, PFE-51

fixed displacement - cartridge design



① Pump body
② ③ Rotor with vanes
④ Balanced plates
⑤ Shaft
⑥ IN port - SAE 3000 flange
⑦ OUT port - SAE 3000 flange

PFE-41

PFE-*1 are fixed displacement vane pumps, ② ③ cartridge design with integral hydraulic balancing ④ for high volumetric efficency, long service life and low noise level.

They are available in three different body sizes with max displacements up to 44, 85 and 150 cm^3/rev and single, multiple or with through-shaft configurations.

Mounting flange according to SAE J744 standard.

Inlet and outlet ports can be oriented in four different positions to match any installation requirement.

Simplified maintenance as the pumping cartridge can be easily replaced.

Max displacement: **up to 150 cm^3/rev**
Max pressure: **210 bar**

1 MODEL CODE OF SINGLE PUMPS

PFE	XA	-	31	036	/	1	D	T	*	/	*

PFE – Fixed displacement vane pump

Option for pumps with through shaft, see section 3:
XA, XA7, XB, XB7, XC = for coupling with other pumps type PFE
XO = with through shaft, without rear flange

Size, see section 2:
31, 41, 51

Displacement (cm^3/rev), see section 2

Drive shaft, see section 8 and 9:
cylindrical, keyed
1 = standard
2 = long version - only for PFE-41 and PFE-51
3 = for high torque applications
splined:
5 = for single and multiple pumps (any position)
6 = for single and multiple pumps (only first position) ⎤ only for PFE-31
7 = for second and third position in multiple pumps ⎦ and PFE-41

Direction of rotation, viewed from the shaft end:
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise

Port orientation, see section 6:
T = standard
U, V, W = on request

Series number

Seals material:
- = NBR
PE = FKM

Note: for multiple pumps factory assembled, see tech. table A190

2 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Size code	**31**						**41**						**51**			
Displacement code	**010**	**016**	**022**	**028**	**036**	**044**	**029**	**037**	**045**	**056**	**070**	**085**	**090**	**110**	**129**	**150**
Displacement (cm^3/rev)	10.5	16.5	21.6	28.1	35.6	43.7	29.3	36.6	45.0	55.8	69.9	85.3	90.0	109.6	129.2	150.2
Max working pressure (1) (bar)	160	210														
Recommended pressure on inlet port	from -0,15 to 1,5 bar for speed up to 1800 rpm; from 0 to +1,5 bar for speed over 1800 rpm															
Min speed (rpm)	800															
Max speed (2) (rpm)	2400	2800	2800	2800	2800	2500	2500	2500	2500	2500	2500	2000	2200	2200	2200	1800
Volumetric efficiency (3)	80	83	87	90	90	92	90	92	93	93	93	94	93	93	93	94
Noise level (3) (dBA)	62	62	63	63	63	64	67	67	68	68	69	69	72	72	73	74

(1) Max pressure is 160 bar for HFDU, HFDR and HFC fluids
(2) Max speed is 1800 rpm for /PE versions; 1500 rpm for HFDU, HFDR and HFC fluids
(3) Measuring data with: n = 1450 rpm; P = 140 bar;

3 OPTION FOR PUMPS WITH THROUGH SHAFT

Pump size	**PFE-31**	**PFE-41**				**PFE-51**				
Through shaft option type	**XA**	**XA**	**XB**	**XA7**	**XB7**	**XA**	**XB**	**XC**	**XA7**	**XB7**
Splined coupling characteristics	SAE 16/32-9T	SAE 16/32-9T	SAE 16/32-13T	SAE 16/32-13T	SAE 12/24-14T	SAE 16/32-14T	SAE 13/32-13T	SAE 12/24-14T	SAE 16/32-13T	SAE 12/24-14T
2nd pump	PFE-3* shaft type 5	PFE-3* shaft type 5	PFE-4* shaft type 5	PFE-3* shaft type 7	PFE-4* shaft type 7	PFE-3* shaft type 5	PFE-4* shaft type 5	PFE-5* shaft type 5	PFE-3* shaft type 7	PFE-4* shaft type 7

4 GENERAL CHARACTERISTICS

Assembly position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peak.
Ambient temperature range	-20°C ÷ +80°C
Compliance	REACH Regulation (EC) n°1907/2006 RoHS Directive 2011/65/EU as last update by 2015/863/EU

5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	10÷100 mm²/s - max at cold start 800 mm²/s		
Max fluid contamination level — normal operation	ISO4406 class 21/19/16 NAS1638 class 10		see also filter section at www.atos.com or KTF catalog
Max fluid contamination level — longer life	ISO4406 class 18/16/13 NAS1638 class 8		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR	HFC **(1)**	

(1) See performance restrictions at section 2

6 PORT ORIENTATION

Single pumps can be supplied with oil ports oriented in different configuration in relation to the drive shaft, as follows (wiewed from the shaft end);
Ports orientation can be easily changed by rotating the pump body that carries inlet port.

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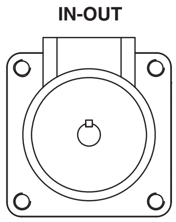

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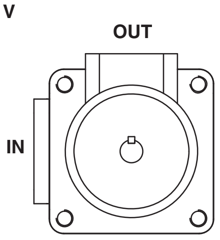

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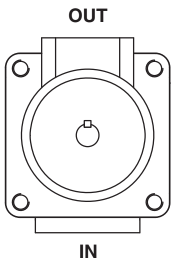

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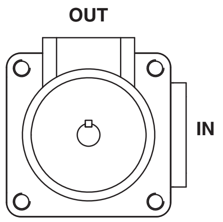
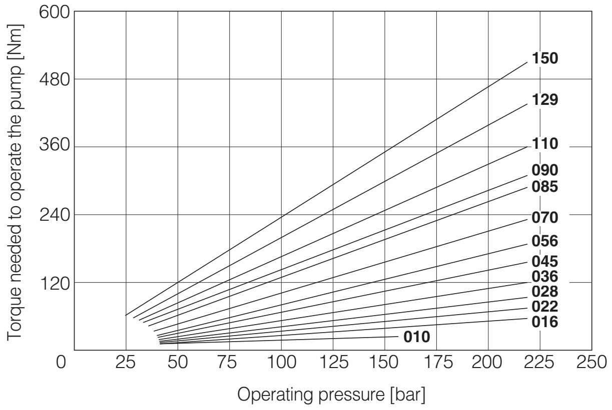


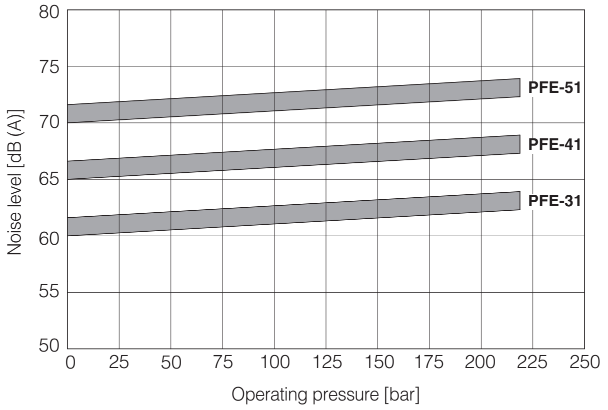
OUT = outlet port; **IN** = inlet port

7 **DIAGRAMS** (based on mineral oil ISO VG 46 at 50°C)

Torque versus pressure diagram

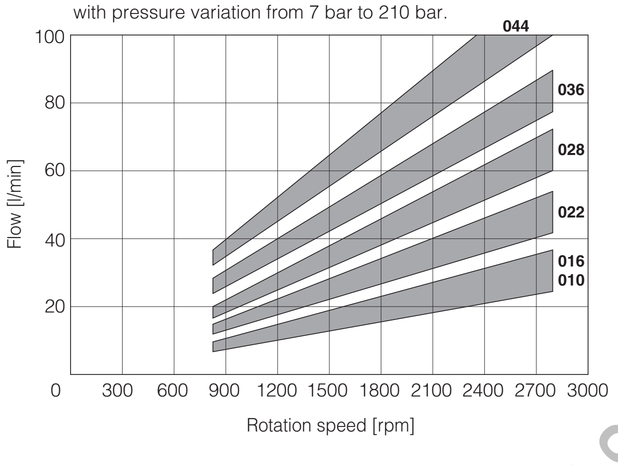


Noise levels

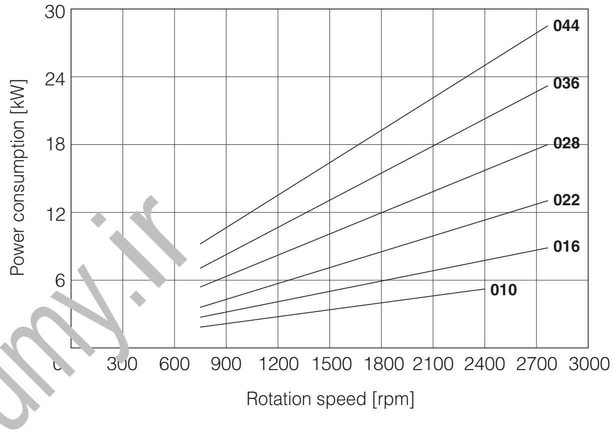


PFE-31:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

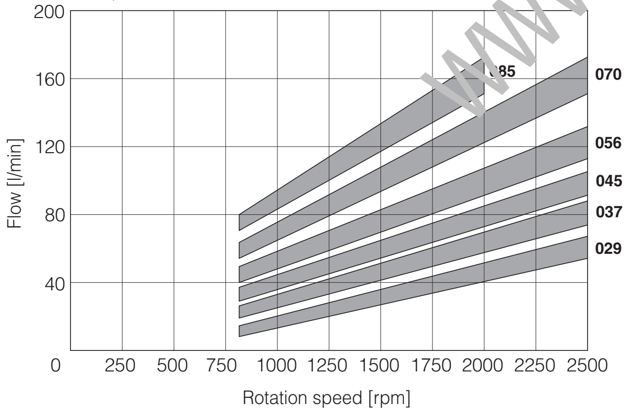


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

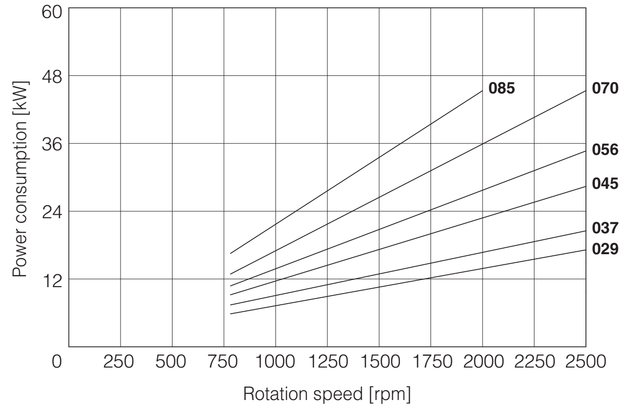


PFE-41:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

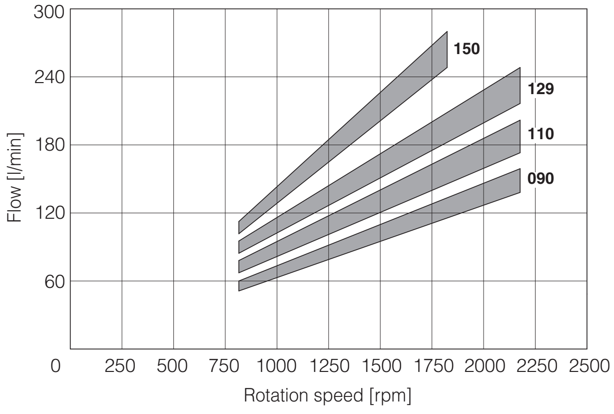


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

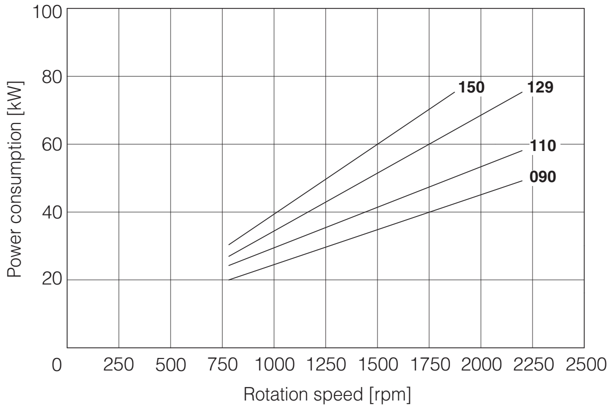


PFE-51:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.



Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.



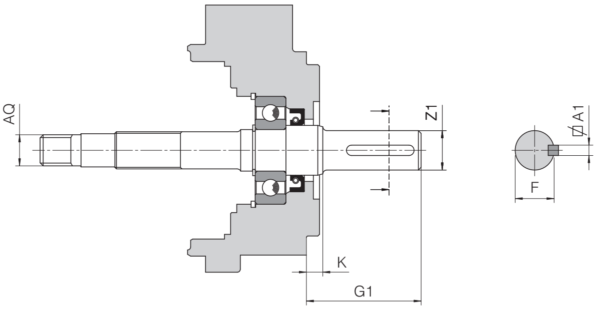
8 DRIVE SHAFT

CYLINDRICAL SHAFT KEYED

1 = for single and multiple pumps (only first position)

2 = for single and multiple pumps (only first position)
long version (only for PFE-41 and PFE-51)

3 = for single and multiple pumps (only first position)
for high torque applications



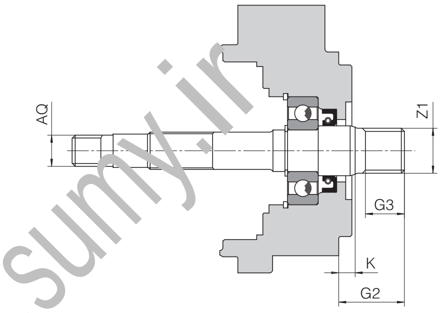
Pump size	Keyed shaft type 1 (standard)						Keyed shaft type 2						Keyed shaft type 3					
	A1	F	G1	K	ØZ1	Only for through shaft execution Ø AQ	A1	F	G1	K	ØZ1	Only for through shaft execution Ø AQ	A1	F	G1	K	ØZ1	Only for through shaft execution Ø AQ
PFE-31	4,78	21,11	56,00	8,00	19,05	SAE 16/32-9T	–	–	–	–	–	–	4,78	24,54	56,00	8,00	22,22	SAE 16/32-9T
	4,75	20,94			19,00								4,75	24,41			22,20	
PFE-41	4,78	24,54	59,00	11,40	22,22	SAE 32/64-24T	6,36	25,03	71,00	8,00	22,22	SAE 32/64-24T	6,38	28,30	78,00	11,40	25,38	SAE 32/64-24T
	4,75	24,41			22,20		6,35	24,77			22,20		6,35	28,10			25,36	
PFE-51	7,97	35,33	73,00	14	31,75	SAE 16/32-13T	7,95	35,33	84,00	8,10	31,75	SAE 16/32-13T	7,97	38,58	84,00	14	34,90	SAE 16/32-13T
	7,94	35,07			31,70		7,94	35,07			31,70		7,94	38,46			34,88	

SPLINED SHAFT

5 = for single and multiple pumps (any position)
for PFE-31 according to SAE A 16/32 DP, 9 teeth;
for PFE-41 according to SAE B 16/32 DP, 13 teeth;
for PFE-51 according to SAE C 12/24 DP, 14 teeth;

6 = for single and multiple pumps (only first position)
for PFE-31 and PFEX*-31 according to SAE B 16/32 DP, 13 teeth;
for PFE-41 and PFEX*-41 according to SAE C 12/24 DP, 14 teeth;

7 = for second and third position pump in multiple configuration:
for PFEX*-31 according to SAE B 16/32 DP, 13 teeth;
for PFEX*-41 according to SAE C 12/24 DP, 14 teeth;



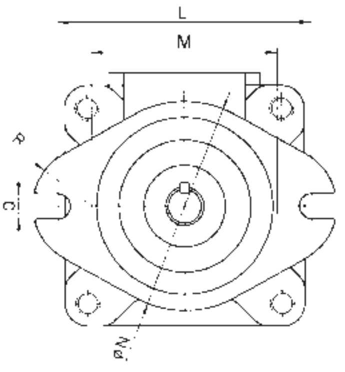
Pump size	Splined shaft type 5					Splined shaft type 6					Splined shaft type 7				
	G2	G3	K	Z1	Only for through shaft execution Ø AQ	G2	G3	K	Z1	Only for through shaft execution Ø AQ	G2	G3	K	Z1	Only for through shaft execution Ø AQ
PFE-31	32,00	19,50	6,50	SAE 16/32-9T	SAE 16/32-9T	41,00	28	8,00	SAE 16/32-13T	SAE 16/32-9T	32,00	19	8,00	SAE 16/32-13T	SAE 16/32-9T
PFE-41	41,25	28	8,00	SAE 16/32-13T	SAE 32/64-24T	55,60	42	8,00	SAE 12/24-14T	SAE 32/64-24T	41,60	28	8,00	SAE 12/24-14T	SAE 32/64-24T
PFE-51	56,00	42	8,10	SAE 12/24-14T	SAE 16/32-13T	–	–	–	–	–	–	–	–	–	–

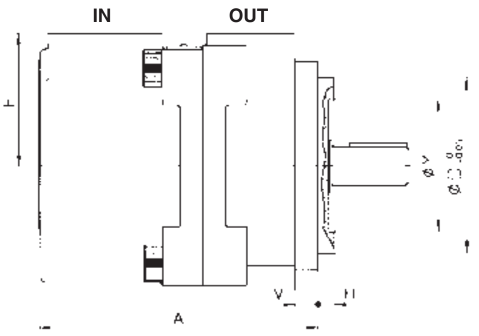
9 LIMITS OF SHAFT TORQUE

Pump size	Maximum driving torque [Nm]						Maximum torque available at the end of the through shaft [Nm]
	Shaft type 1	Shaft type 2	Shaft type 3	Shaft type 5	Shaft type 6	Shaft type 7	Any type of shaft
PFE-31	160	–	240	110	240	240	130
PFE-41	250	250	400	200	400	400	250
PFE-51	500	500	850	450	–	–	400

The values of torque required to operate the pumps are shown for each type on the “torque versus pressure” diagram at section 6.
In multiple pumps the total torque applied to the shaft of the first element (drive shaft) is the sum of the single torque needed for operating each single pump and it is necessary to verify that this total torque applied to the drive shaft is not higher than the values indicated in the table.

10 DIMENSIONS OF SINGLE PUMPS [mm]



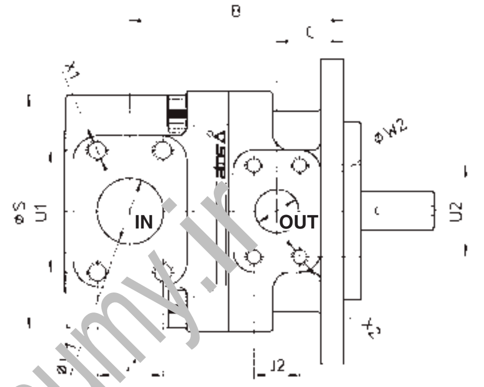


PORTS DIMENSION (SAE 3000)

PFE-31: IN = 1 1/4”; OUT = 3/4”
PFE-41: IN = 1 1/2”; OUT = 1”
PFE-51: IN = 2”; OUT = 1 1/4”

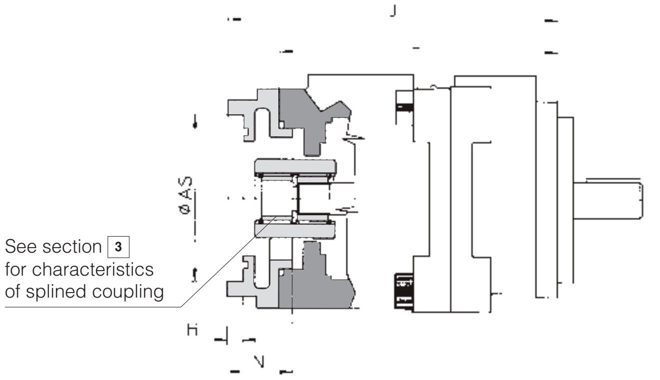
Mass:

PFE-31 = 9 kg
PFE-41 = 14 kg
PFE-51 = 25,5 kg



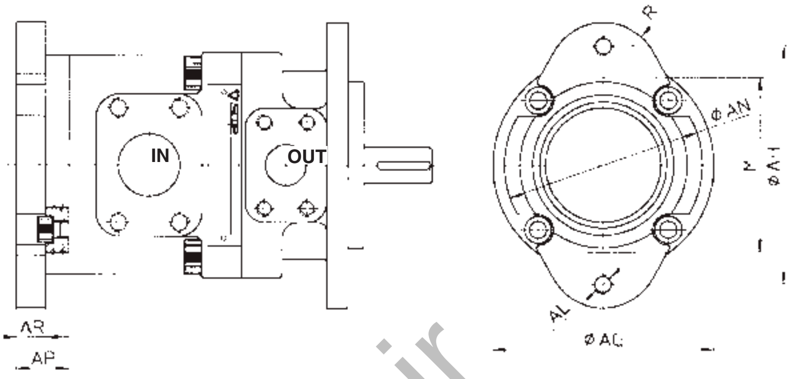
Pump size	A	B	C	ØD	E	H	L	M	ØN	Q	R
PFE-31	136	100	28	82,55	70	6,4	106	73	95	11,1	28,5
PFE-41	160	120	38	101,6	76,2	9,7	146	107	120	14,3	34
PFE-51	186,5	125	38	127	82,6	12,7	181	143,5	148	17,5	35
Pump size	**ØS**	**U1**	**U2**	**V**	**ØW1**	**ØW2**	**J1**	**J2**	**X1**	**X2**	**ØY**
PFE-31	114	58,7	47,6	10	32	19	30,2	22,2	M10X20	M10X17	47
PFE-41	134	70	52,4	13	38	25	35,7	26,2	M12X20	M10X17	76
PFE-51	160	77,8	58,7	15	51	32	42,9	30,2	M12X20	M10X20	76

11 DIMENSIONS OF PUMPS WITH THROUGH-SHAFT (XA*, XB*, XC options) [mm]



PORTS DIMENSION (SAE 3000)

PFE-31: IN = 1 1/4"; OUT = 3/4"
PFE-41: IN = 1 1/2"; OUT = 1"
PFE-51: IN = 2"; OUT = 1 1/4"

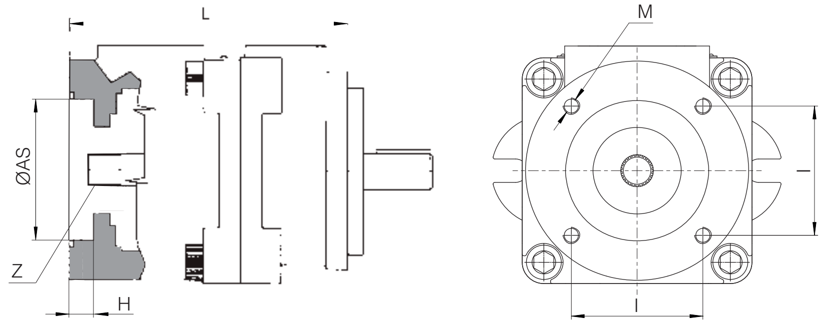


For other dimensions, see section 10

Pump size	Ø AG	Ø AH	AL	Tightening torque (Nm) (1)	Ø AN	AP	AR	Ø AS	H	J	L	M	N	R
PFEXA-31	114	106	M10X17	70	95	33	25	82,57 82,63	6,42 6,47	165,5	132,5	79	32	28,5
PFEXA-41	134	106	M10X17	70	95	23	11	82,57 82,63	6,42 6,47	194	171	73	32	28,5
PFEXB-41	134	146	M12	125	120	32	18	101,62 101,68	9,73 9,78	203	171	107	41	34
PFEXA-51	134	106	M10X17	70	95	22,7	11	82,57 82,63	6,42 6,47	206,2	183,5	73	32	28,5
PFEXB-51	134	146	M12	125	120	32	18	101,62 101,68	9,73 9,78	215,5	183,5	107	41	34
PFEXC-51	134	181	M16	300	148	46,5	30,7	127,02 127,02	12,73 12,78	230	183,5	143,5	56	35

(1) Tightening torque for screw class 12.9

12 DIMENSIONS OF PUMPS WITH THROUGH SHAFT, WITHOUT REAR FLANGE (XO option) [mm]



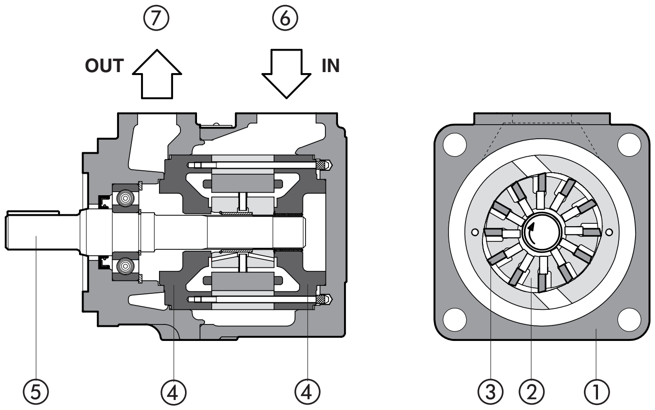
Pump size	L	Ø AS	H	M	I	Z
PFEXO-31	132.5	$60^{+0.03}_{0}$	6.5	n°4 M6x13(max)	70	SAE 16/32-9T x15mm
PFEXO-41	171	$86^{+0.035}_{0}$	15	n°4 M10x17(max)	79	SAE 32/64-24T x20mm
PFEXO-51	183.5	$86^{+0.035}_{0}$	15	n°4 M10x17(max)	79	SAE 16/32-13T x20mm

13 RELATED DOCUMENTATION

A900	Operating and maintenance information for pumps

Vane pumps type PFE-32, PFE-42, PFE-52

fixed displacement - cartridge design - high pressure



PFE-42

①	Pump body
② ③	Rotor with vanes
④	Balanced plates
⑤	Shaft
⑥	IN port - SAE 3000 flange
⑦	OUT port - SAE 3000 flange

PFE-*2 are high pressure fixed displacement vane pumps, ② ③ cartridge design with integral hydraulic balancing ④ for high volumetric efficency, long service life and low noise level.

They are available in three different body sizes with max displacements up to 44, 85 and 150 cm³/rev and single, multiple or with through-shaft configurations.

Mounting flange according to SAE J744 standard.

Inlet and outlet ports can be oriented in four different positions to match any installation requirement.

Simplified maintenance as the pumping cartridge can be easily replaced.

Max displacement: **up to 150 cm³/rev**
Max pressure: **300 bar**

1 MODEL CODE OF SINGLE PUMPS

PFE	**XA**	**-**	**32**	**036**	**/**	**1**	**D**	**T**	*****	**/**	*****

Fixed displacement vane pump

Option for pumps with through shaft, see section 3:
XA, XA7, XB, XB7, XC = for coupling with other pumps type PFE
XO = with through shaft, without rear flange

Size, see section 2:
32, 42, 52

Displacement (cm³/rev), see section 2

Drive shaft, see section 8 and 9:
cylindrical, keyed
3 = for high torque applications
splined:
5 = for single and multiple pumps (any position)
6 = for single and multiple pumps (only first position) ⎤ only for PFE-32
7 = for second and third position in multiple pumps ⎦ and PFE-42

Direction of rotation, viewed from the shaft end:
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise

Port orientation, see section 6:
T = standard
U, V, W = on request

Series number

Seals material:
- = NBR
PE = FKM

Note: for multiple pumps factory assembled, see tech. table A190

2 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Size code	**32**				**42**				**52**			
Displacement code	**016**	**022**	**028**	**036**	**045**	**056**	**070**	**085**	**090**	**110**	**129**	**150**
Displacement (cm³/rev)	16.5	21.6	28.1	35.6	45.0	55.8	69.9	85.3	90.0	109.6	129.2	150.2
Max working pressure (1) (bar)	210	300			280		250	210	250			210
Recommended pressure on inlet port	from -0,15 to 1,5 bar for speed up to 1800 rpm; from 0 to +1,5 bar for speed over 1800 rpm											
Min speed (rpm)	1000	1200			1000			800	1000			800
Max speed (2) (rpm)	2500	2500			2200			2000	2000			1800
Volumetric efficiency (3)	86	87	90	90	93	93	93	94	93	93	93	94
Noise level (3) (dBA)	62	63	63	63	66	66	67	67	71	71	72	72

(1) Max pressure is 160 bar for HFDU, HFDR and HFC fluids
(2) Max speed is 1800 rpm for /PE versions; 1500 rpm for HFDU, HFDR and HFC fluids
(3) Measuring data with: n = 1450 rpm; P = 140 bar;

3 OPTION FOR PUMPS WITH THROUGH SHAFT

Pump size	PFE-32	PFE-42				PFE-52				
Through shaft option type	**XA**	**XA**	**XB**	**XA7**	**XB7**	**XA**	**XB**	**XC**	**XA7**	**XB7**
Splined coupling characteristics	SAE 16/32-9T	SAE 16/32-9T	SAE 16/32-13T	SAE 16/32-13T	SAE 12/24-14T	SAE 16/32-14T	SAE 13/32-13T	SAE 12/24-14T	SAE 16/32-13T	SAE 12/24-14T
2nd pump	PFE-3* shaft type 5	PFE-3* shaft type 5	PFE-4* shaft type 5	PFE-3* shaft type 7	PFE-4* shaft type 7	PFE-3* shaft type 5	PFE-4* shaft type 5	PFE-5* shaft type 5	PFE-3* shaft type 7	PFE-4* shaft type 7

4 GENERAL CHARACTERISTICS

Assembly position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peak.
Ambient temperature range	-20°C ÷ +80°C
Compliance	REACH Regulation (EC) n°1907/2006 RoHS Directive 2011/65/EU as last update by 2015/863/EU

5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	10÷100 mm²/s - max at cold start 800 mm²/s		
Max fluid contamination level – normal operation	ISO4406 class 21/19/16 NAS1638 class 10		see also filter section at www.atos.com or KTF catalog
Max fluid contamination level – longer life	ISO4406 class 18/16/13 NAS1638 class 8		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR	HFC **(1)**	

(1) See performance restrictions at section 2

6 PORT ORIENTATION

Single pumps can be supplied with oil ports oriented in different configuration in relation to the drive shaft, as follows (wiewed from the shaft end);
Ports orientation can be easily changed by rotating the pump body that carries inlet port.

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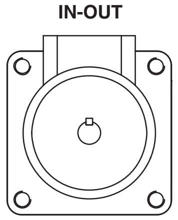

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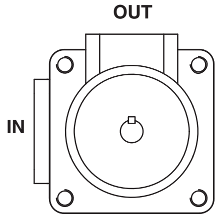

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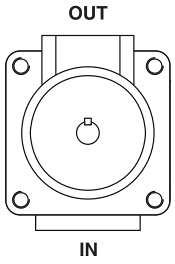

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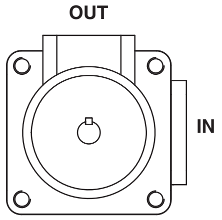
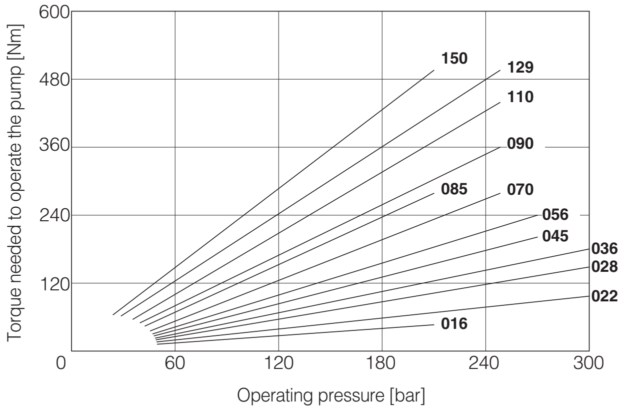


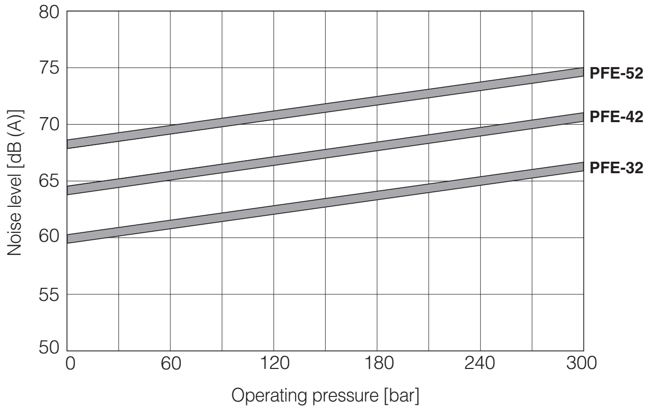
OUT = outlet port; **IN** = inlet port

7 DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

Torque versus pressure diagram

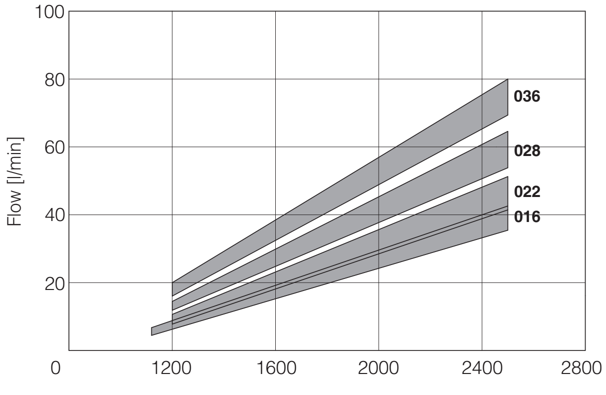


Noise levels

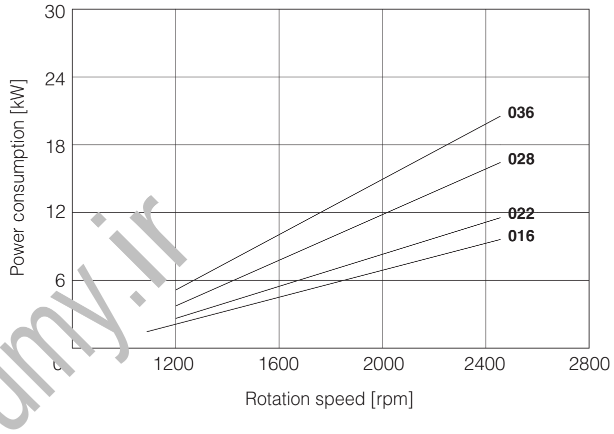


PFE-32:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

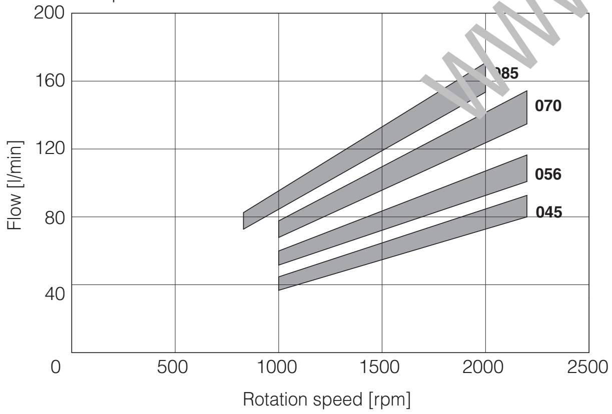


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

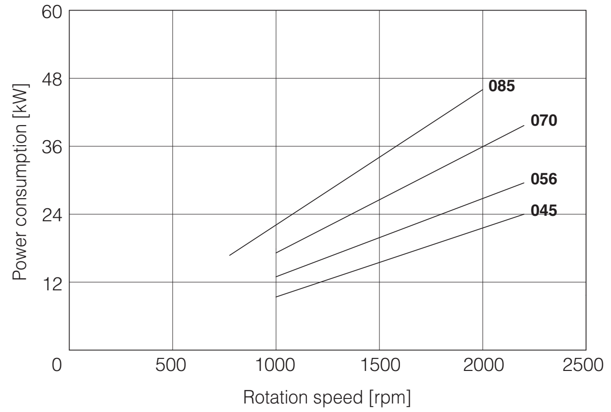


PFE-42:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

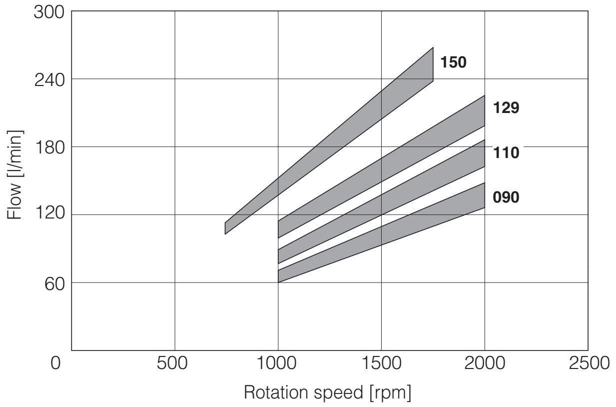


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

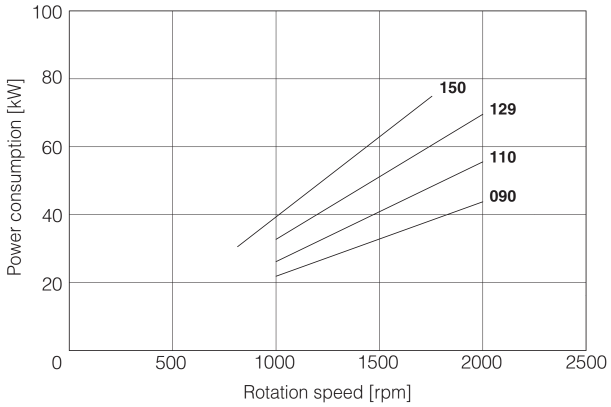


PFE-52:

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.



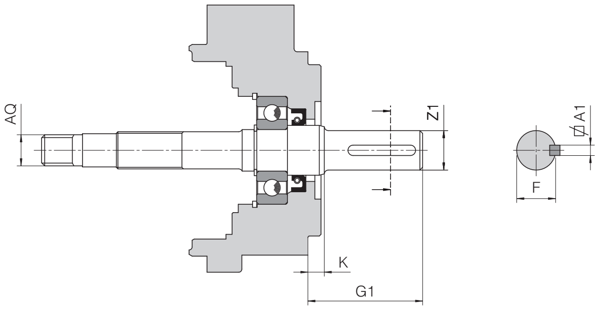
Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.



8 DRIVE SHAFT

CYLINDRICAL SHAFT KEYED

3 = for single and multiple pumps (only first position)
for high torque applications



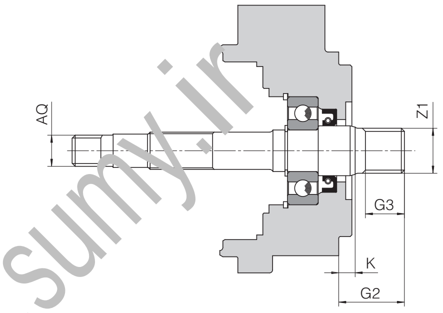
Pump size	Keyed shaft type 3					
	A1	F	G1	K	ØZ1	Only for through shaft execution Ø AQ
PFE-32	4,78 4,75	24,54 24,41	56,00	8,00	22,22 22,20	SAE 16/32-9T
PFE-42	6,38 6,35	28,30 28,10	78,00	11,40	25,38 25,36	SAE 32/64-24T
PFE-52	7,97 7,94	38,58 38,46	84,00	14	34,90 34,88	SAE 16/32-13T

SPLINED SHAFT

5 = for single and multiple pumps (any position)
for PFE-32 according to SAE A 16/32 DP, 9 teeth;
for PFE-42 according to SAE B 16/32 DP, 13 teeth;
for PFE-52 according to SAE C 12/24 DP, 14 teeth;

6 = for single and multiple pumps (only first position)
for PFE-32 and PFEX*-32 according to SAE B 16/32 DP, 13 teeth;
for PFE-42 and PFEX*-42 according to SAE C 12/24 DP, 14 teeth;

7 = for second and third position pump in multiple configuration:
for PFEX*-32 according to SAE B 16/32 DP, 13 teeth;
for PFEX*-42 according to SAE C 12/24 DP, 14 teeth;



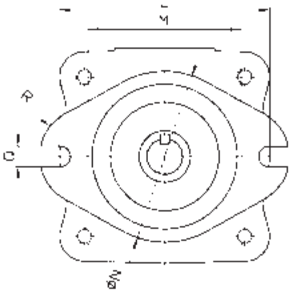
Pump size	Splined shaft type 5					Splined shaft type 6					Splined shaft type 7				
	G2	G3	K	Z1	Only for through shaft execution Ø AQ	G2	G3	K	Z1	Only for through shaft execution Ø AQ	G2	G3	K	Z1	Only for through shaft execution Ø AQ
PFE-32	32,00	19,50	6,50	SAE 16/32-9T	SAE 16/32-9T	41,00	28	8,00	SAE 16/32-13T	SAE 16/32-9T	32,00	19	8,00	SAE 16/32-13T	SAE 16/32-9T
PFE-42	41,25	28	8,00	SAE 16/32-13T	SAE 32/64-24T	55,60	42	8,00	SAE 12/24-14T	SAE 32/64-24T	41,60	28	8,00	SAE 12/24-14T	SAE 32/64-24T
PFE-52	56,00	42	8,10	SAE 12/24-14T	SAE 16/32-13T	–	–	–	–	–	–	–	–	–	–

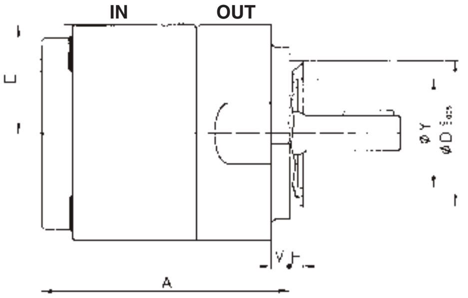
9 LIMITS OF SHAFT TORQUE

Pump size	Maximum driving torque [Nm]				Maximum torque available at the end of the through shaft [Nm]
	Shaft type 3	Shaft type 5	Shaft type 6	Shaft type 7	Any type of shaft
PFE-32	240	110	240	240	130
PFE-42	400	200	400	400	250
PFE-52	850	450	–	–	400

The values of torque required to operate the pumps are shown for each type on the “torque versus pressure” diagram at section 6.
In multiple pumps the total torque applied to the shaft of the first element (drive shaft) is the sum of the single torque needed for operating each single pump and it is necessary to verify that this total torque applied to the drive shaft is not higher than the values indicated in the table.

10 DIMENSIONS OF SINGLE PUMPS [mm]



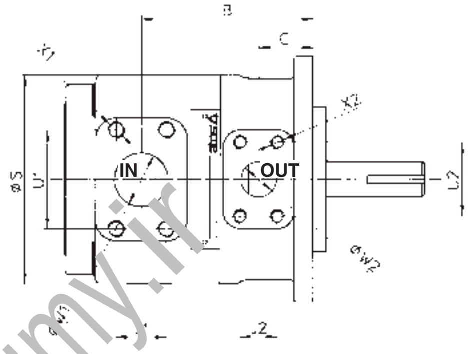


PORTS DIMENSION (SAE 3000)

PFE-32: IN = 1 1/4”; OUT = 3/4”
PFE-42: IN = 1 1/2”; OUT = 1”
PFE-52: IN = 2”; OUT = 1 1/4**”**

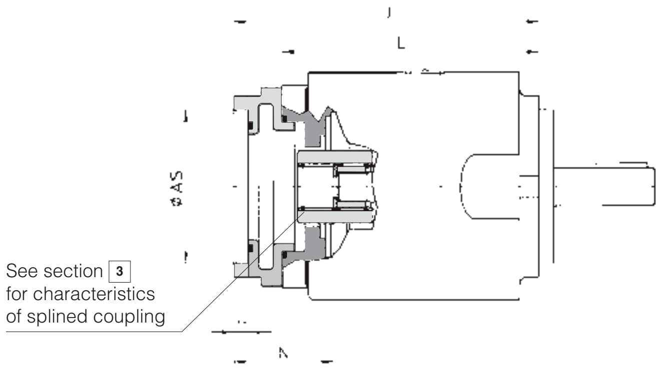
Mass:

PFE-32 = 9 kg
PFE-42 = 20,5 kg
PFE-52 = 32,1 kg



Pump size	A	B	C	ØD	E	H	L	M	ØN	Q	R
PFE-32	136	100	28	82,5	70	6,4	106	73	95	11	28,5
PFE-42	175,5	121	38	101,6	78	9,7	146	107	121	14,3	34
PFE-52	189	125	38	127	89	12,7	181	143,5	148	17,5	35
Pump size	**ØS**	**U1**	**U2**	**V**	**ØW1**	**ØW2**	**J1**	**J2**	**X1**	**X2**	**ØY**
PFE-32	114	58,7	47,6	10	32	19	30,2	22,2	M10X20	M10X17	47
PFE-42	148	70	52,4	13	38	25	35,7	26,2	M12X20	M10X17	76
PFE-52	174	77,8	58,7	16,3	50	50	42,9	30,2	M12X20	M10X20	76

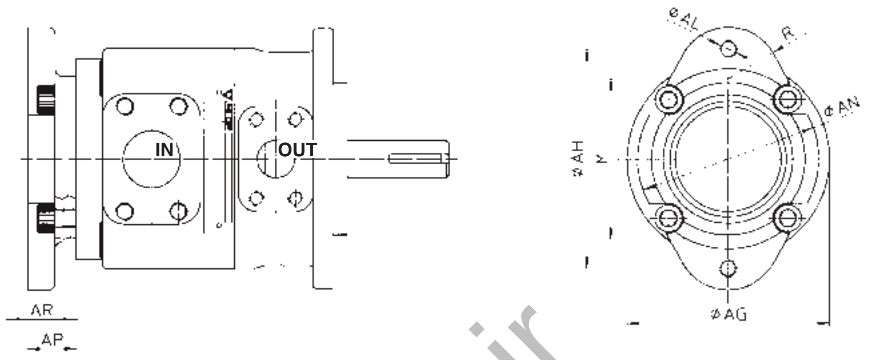
11 DIMENSIONS OF PUMPS WITH THROUGH-SHAFT (XA*, XB*, XC* options) [mm]



See section 3 for characteristics of splined coupling

PORTS DIMENSION (SAE 3000)

PFE-32: IN = 1 1/4”; OUT = 3/4”
PFE-42: IN = 1 1/2”; OUT = 1”
PFE-52: IN = 2”; OUT = 1 1/4”

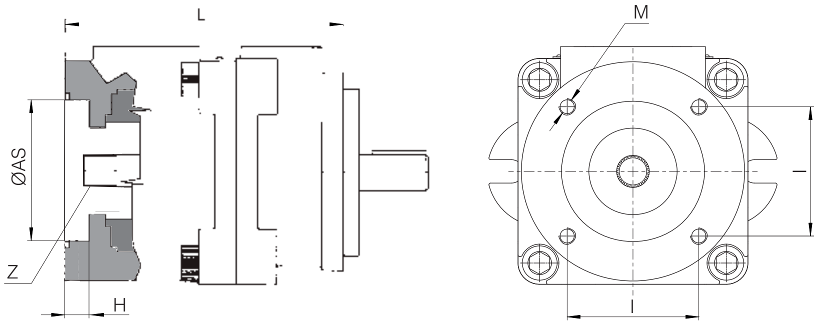


For other dimensions, see section 10

Pump size	Ø AG	Ø AH	AL	Tightening torque (Nm) (1)	Ø AN	AP	AR	Ø AS	H	J	L	M	N	R
PFEXA-32	114	106	M10X17	70	95	33	25	82,57 82,63	6,42 6,47	193,7	132,5	79	32	28,5
PFEXA-42	134	106	M10X17	70	95	22,7	11	82,57 82,63	6,42 6,47	194	171	73	34	28,5
PFEXB-42	134	146	M12	125	120	32	18	101,62 101,68	9,73 9,78	203	171	107	43	34
PFEXA-52	134	106	M10X17	70	95	22,7	11	82,57 82,63	6,42 6,47	206,2	183,5	73	34,5	28,5
PFEXB-52	134	146	M12	125	120	32	18	101,62 101,68	9,73 9,78	215,5	183,5	107	43,8	34
PFEXC-52	134	181	M16	300	148	46,7	30,7	127,02 127,02	12,73 12,78	230,2	183,5	143,5	58,5	35

(1) Tightening torque for screw class 12.9

12 DIMENSIONS OF PUMPS WITH THROUGH SHAFT, WITHOUT REAR FLANGE (XO option) [mm]



Pump size	L	Ø AS	H	M	I	Z
PFEXO-32	132.5	$60^{+0.03}_{0}$	6.5	n°4 M6x13(max)	70	SAE 16/32-9T x15mm
PFEXO-42	171	$86^{+0.035}_{0}$	15	n°4 M10x17(max)	79	SAE 32/64-24T x20mm
PFEXO-52	183.5	$86^{+0.035}_{0}$	15	n°4 M10x17(max)	79	SAE 16/32-13T x20mm

13 RELATED DOCUMENTATION

A900 Operating and maintenance information for pumps

Radial piston pumps type PFR

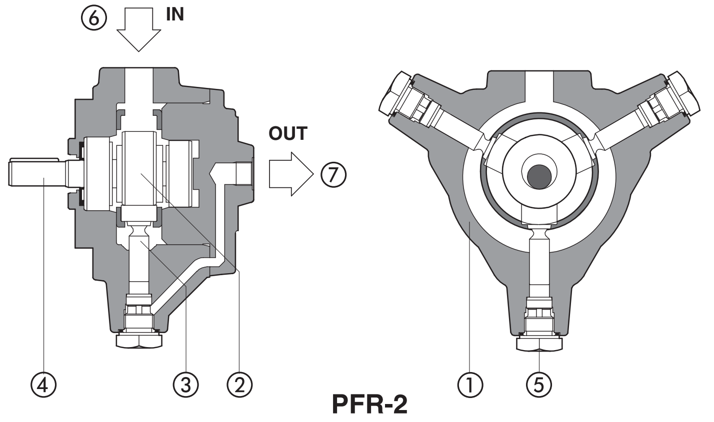
fixed displacement

PFR are fixed displacement radial piston pumps with positive drive construction of the pistons ③ (without return spring) for high performance and low noise level.

They are available in three different body size and single, multiple or with through-shaft configurations.

Max displacement **up to 25,4 cm³/rev.**

Max pressure **PFR-2 500 bar**
PFR-3, PFR-5 350 bar



① body
② central bearing and return plates
③ radial pistons
④ shaft
⑤ seat of delivery valve
⑥ IN port
⑦ OUT port

1 MODEL CODE

PFR	XA	-	3	08	**	-	*

PFR: Fixed displacement radial piston pump

XA: **Option for pumps with through shaft**, see section 3
Only for PFR-3:
XA, XA7, XB, XB7, XC = for coupling with pumps type PFE

3: **Size,** see section 2:
2, 3, 5

08: **Displacement [cm³/rev]**, see section 2
for PFR-2: **02, 03**
for PFR-3: **08, 11, 15**
for PFR-5: **18, 25**

******: Series number

*****: **Seals material**:
- = NBR
PE = FKM

Note: for multiple pumps factory assembled, see tech. table A190

2 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Size code	**2**		**3**			**5**	
Displacement code	**02**	**03**	**08**	**11**	**15**	**18**	**25**
Displacement (cm³/rev)	1,7	3,5	8,2	11,4	14,7	18,1	25,4
Max working pressure (1) (bar)	500		350				
Recommended pressure on inlet port	from -0,10 to 1,5 bar for speed up to 1800 rpm						
Min speed (rpm)	800						
Max speed (2) (rpm)	1800						
Volumetric efficiency (3)	98	97	97	98	98	97	96
Noise level (3) (dBA)	62	62	65	65	65	68	68

(1) Max pressure is 250 bar for HFDU, HFDR fluids - max pressure is 175 bar for HFC fluids
(2) Max speed is 1000 rpm for HFDU, HFDR and HFC fluids
(3) Measuring data with: n = 1450 rpm; P = 200 bar, see also diagram at section 6

3 OPTION FOR PUMPS WITH THROUGH SHAFT

Pump size	PFR-3				
Through shaft option type	**XA**	**XB**	**XA7**	**XB7**	**XC**
Splined coupling characteristics	SAE 16/32-9T	SAE 16/32-13T	SAE 16/32-13T	SAE 12/24-14T	SAE 12/24-14T
2nd pump PFE to be coupled	PFE-3* shaft type 5	PFE-4* shaft type 5	PFE-3* shaft type 7	PFE-4* shaft type 7	PFE-5* shaft type 5

4 MAIN CHARACTERISTICS

Installation position	Any position. It is advisable to install on the outlet pipe a proper valve for air bleeding. The installation under oil level is recommended. The installation above oil level should be avoided. The shaft of the pump has an eccentric cam which rotates with the shaft generating the stroke of the pistons and thus generating the flow rate. For best functioning a balanced coupling should be provided between the shaft of the motor and the shaft of the pump. See section 11
Commisioning	PFR pumps can be reversed without changing the flow direction. Therefore both directions of rotation are permitted. It is recommend to start the pump by short impulses, with pump case filled with working fluid and air bleed plugs unlocked. Pumps type PFR-3 and PFR-5 have 2 air bleeds ports, normally plugged, located near to the P ports. To help oil filling and air bleeding, it could be advisable to install a vertical pipe connected on the intake line, just before the IN port flange.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peak.
Compliance	EACH Regulation (EC) n°1907/2006 RoHS Directive 2011/65/EU as last update by 2015/863/EU

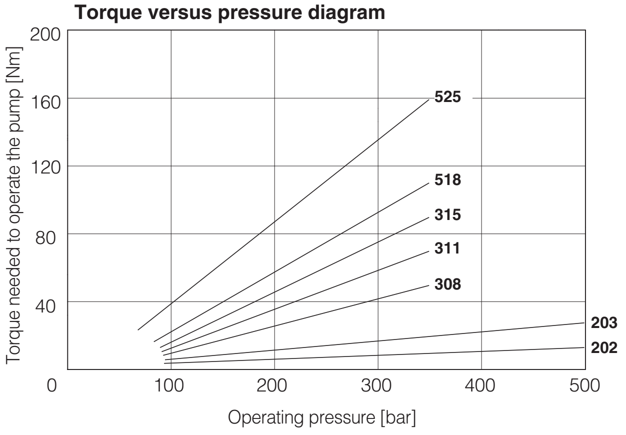
5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

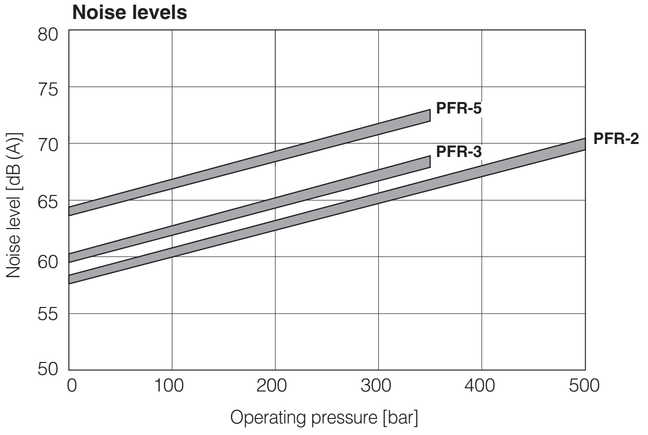
Seals, recommended fluid temperature		NBR seals (standard) = -25°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C	
Recommended viscosity		10÷100 mm²/s - max at cold start 800 mm²/s	
Max fluid contamination level	normal operation	ISO4406 class 21/19/16 NAS1638 class 10	see also filter section at www.atos.com or KTF catalog
	longer life	ISO4406 class 18/16/13 NAS1638 class 8	

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR	HFC **(1)**	

(1) See performance restrictions at section 2

6 DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)


Torque versus pressure diagram


Noise levels

7 LIMIT OF SHAFT TORQUE

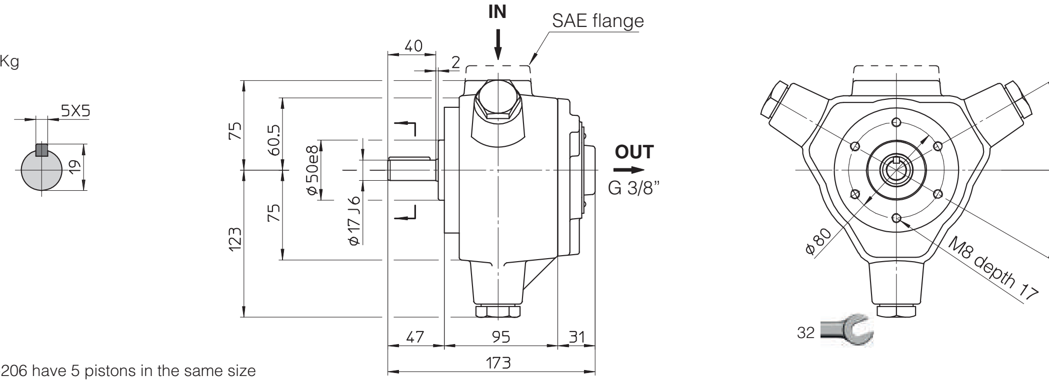
Pump size	Maximum driving torque [Nm]	Maximum torque available on the end of the through shaft [Nm]
PFR-2	200	=
PFR-3	600	320
PFR-5	800	320

The values of torque needed to operate the pumps are shown on the "torque versus pressure diagram" at section 6.
In multiple pumps the total torque applied to the shaft of the first element (drive shaft) is the sum of the single torque needed for operating each single pump and it is necessary to verify that this total torque applied to the drive shaft is not higher than the values indicated in the table.

8 DIMENSIONS OF SINGLE PUMPS [mm]

PFR-2

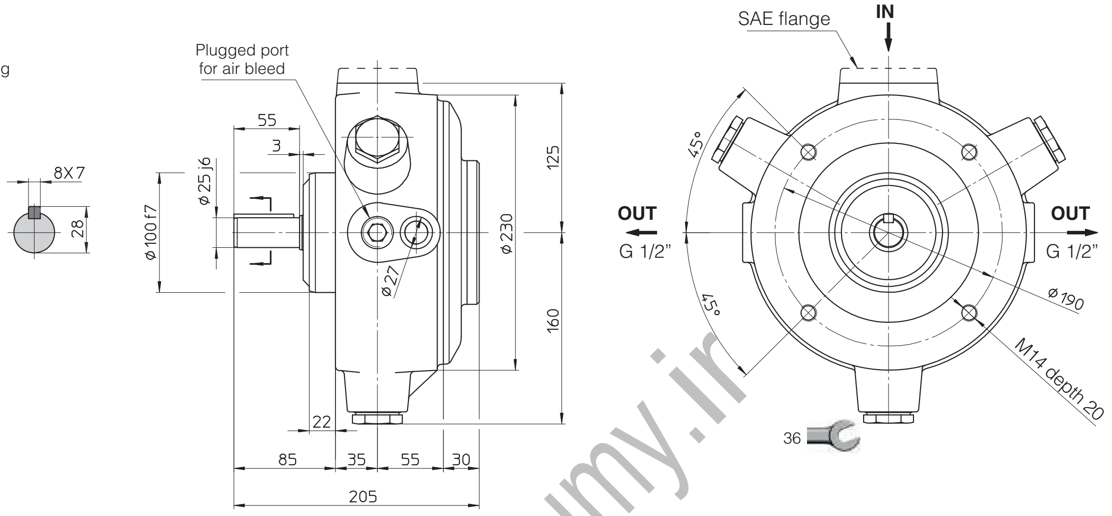
Mass: 12 Kg



Note: PFR-206 have 5 pistons in the same size

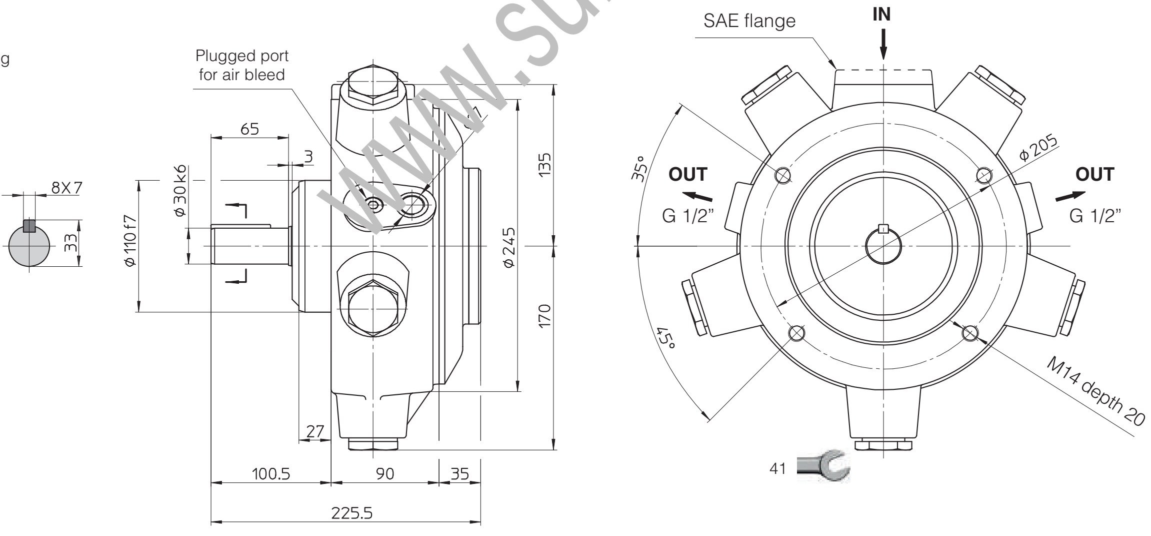
PFR-3

Mass: 31 Kg



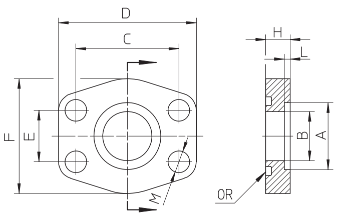
PFR-5

Mass: 38 Kg



SAE flanges are supplied with the pump

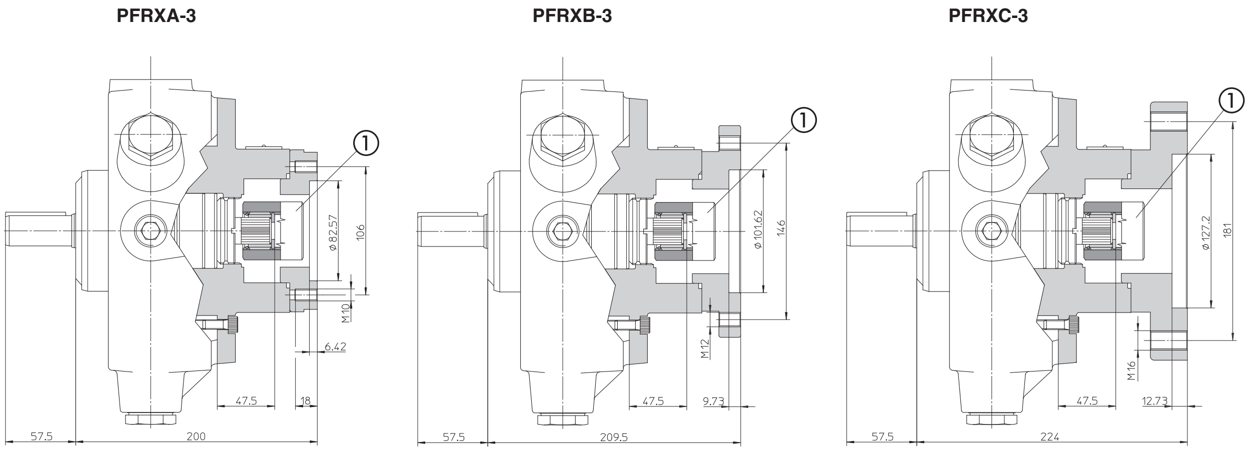
9 SAE-3000 FLANGES supplied with the pump [mm]



Flanges are supplied with seal and screws M10 class 12.9
Tightening torque = 70 Nm

Pump model	Flange code	A	B	C	D	E	F	H	L	M	OR	Screws
PFR - 2	WFA-25	35,5	29	52,37	70	26,19	55	12	4	ø 11	4131	M10x30
PFR - 3 PFR - 5	WFA-32	42,5	34	58,72	79	30,18	68	12	4	ø 11,5	4150	M10x35

10 DIMENSIONS OF PUMPS WITH THROUGH-SHAFT (XA*, XB*, XC options) [mm]



① See section 3 for characteristics of splined coupling

11 BALANCED COUPLING

The balanced couplings permit to minimize the vibrations caused by the unbalanced mass during the pump rotation.
The couplings listed in the table, supplied by Atos, must be used together with the relevant bell housing. The table lists the codes of the Atos balanced couplings and bell housing, available for the several pumps and for the standardized sizes of the electrical motors.

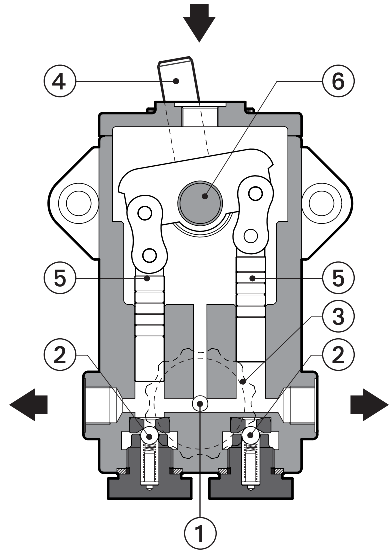
PUMP MODEL	ELECTRICAL MOTOR	BALANCED COUPLING	BELL HOUSING
PFR-202	UNEL-MEC 100-112	Y-GB-82/02	Y-LS4P2
	UNEL-MEC 132	Y-GB-122/02	Y-LS6P2
PFR-203	UNEL-MEC 100-112	Y-GB-82/03	Y-LS4P2
	UNEL-MEC 132	Y-GB-122/03	Y-LS6P2
PFR-308	UNEL-MEC 100-112	Y-GB-83/08	Y-LS4P3
	UNEL-MEC 132	Y-GB-123/08	Y-LS6P3
	UNEL-MEC 160	Y-GB-303/08	Y-LS7P3
PFR-311	UNEL-MEC 100-112	Y-GB-83/11	Y-LS4P3
	UNEL-MEC 132	Y-GB-123/11	Y-LS6P3
	UNEL-MEC 160	Y-GB-303/11	Y-LS7P3
PFR-315	UNEL-MEC 100-112	Y-GB-83/15	Y-LS4P3
	UNEL-MEC 132	Y-GB-123/15	Y-LS6P3
	UNEL-MEC 160	Y-GB-303/15	Y-LS7P3
PFR-518	UNEL-MEC 132	Y-GB-125/18	Y-LS6P5
	UNEL-MEC 160	Y-GB-305/18	Y-LS7P5
	UNEL-MEC 180	Y-GB-605/18	
PFR-525	UNEL-MEC 132	Y-GB-125/25	Y-LS6P5
	UNEL-MEC 160	Y-GB-305/25	Y-LS7P5
	UNEL-MEC 180	Y-GB-605/25	

12 RELATED DOCUMENTATION

A900	Operating and maintenance information for pumps

Hand pumps type PM

2-plunger



PM are double alternate-acting hand pumps with simple and rugged construction for minimum service and long operating life.

They are provided with one by-pass valve ① which connects directly the delivery ports with the inlet port through the delivery valves ②. The by-pass valve is operated by a handwheel ③.

Pumping operation is made by alternative movement of the lever ④ and consequently movement of plungers ⑤, after having locked the by-pass valve by means of the handwheel.

The splined shaft attachment ⑥ permits to turn the lever shaft in the best position.

On the pump body are available two outlet ports (one supplied plugged).

Displacements	**from 12 to 20 cm³** for double stroke.
Max pressure	**250 bar**

1 MODEL CODE

PM - **112** * / *

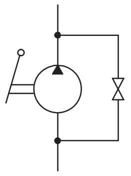
PM: 2-plunger hand pump

112: Displacement, see section 2
112= 12 cm³/double stroke
120= 20 cm³/double stroke

*: Series number

*: Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

2 OPERATING CHARACTERISTICS with hydraulic fluid having a viscosity of 24 mm²/s and 40°C

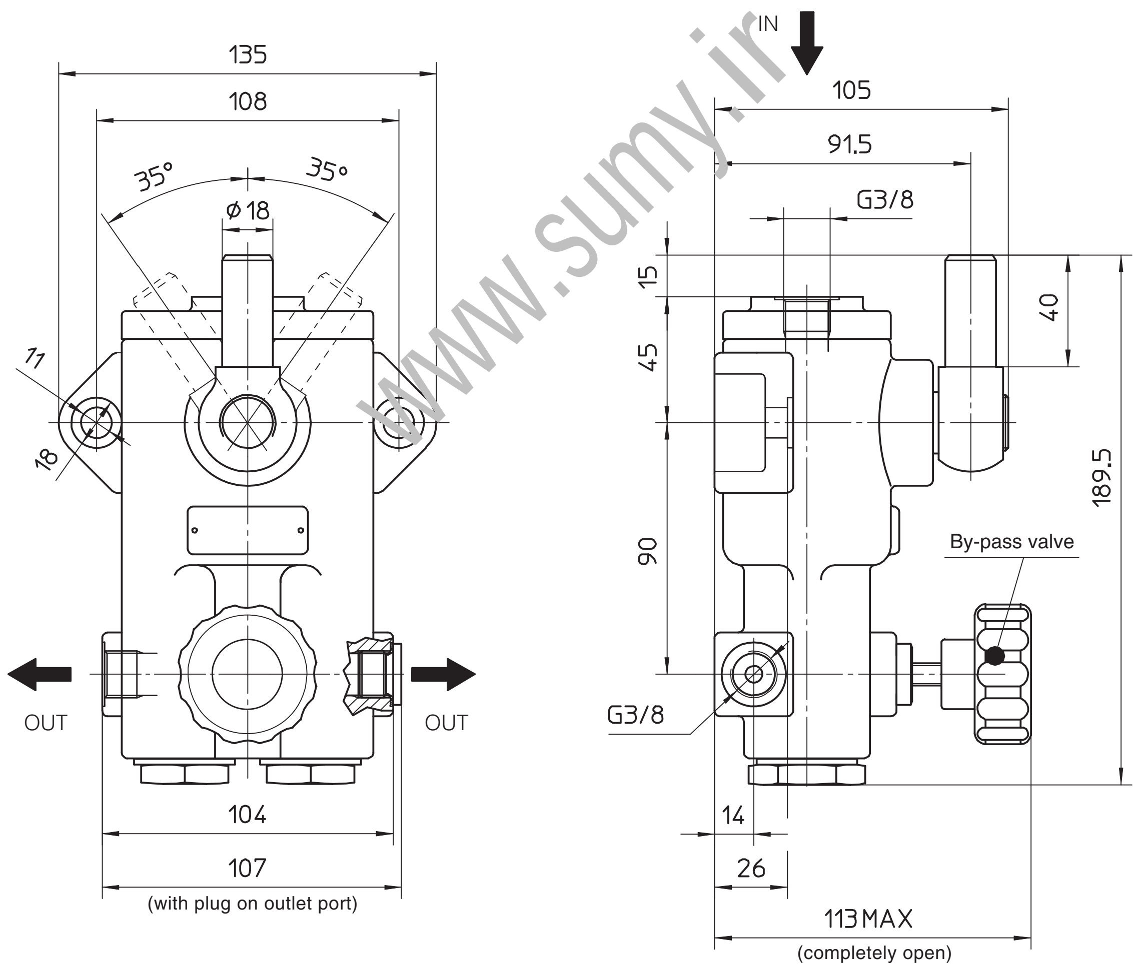


Model	Displacement for double stroke [cm³]	Max pressure [bar]	Shaft rotation angle [degree]	Maximum torque required [Nm]
PM-112	12	250	± 35°	133
PM-120	20	120	± 35°	116

3 MAIN CHARACTERISTICS OF HAND PUMP TYPE PM

Installation position	Vertical position, with inlet port facing upward to ensure complete case filling
Commissioning	Pumping operation is made by alternative movement of the lever after closing by-pass valve. **Note:** the by-pass valve connects the delivery ports with inlet port and when locked it could allow some leakage from outlet ports. Two opposite outlet ports are available for pump delivery: one of these is supplied plugged. The pumps are supplied without lever harm that could made by a simple tube with Ø 18 mm inside diameter. Usually a lenght of 500 to 600 mm is appropriate. Lever position can be selected by proper assembling of lever on splined shaft.
Ambient temperature	**Standard** = -25°C ÷ +80°C **/PE** option -15°C ÷ +80°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity	10 ÷ 100 mm^2/sec at 40°C (ISO VG 15 - 100)
Max fluid contamination level	normal operation: ISO4406 class 21/19/16 NAS1638 class 10 longer life: ISO4406 class 18/16/13 NAS1638 class 8 see also filter section at www.atos.com or KTF catalog
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (/PE seals)
Compliance	RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

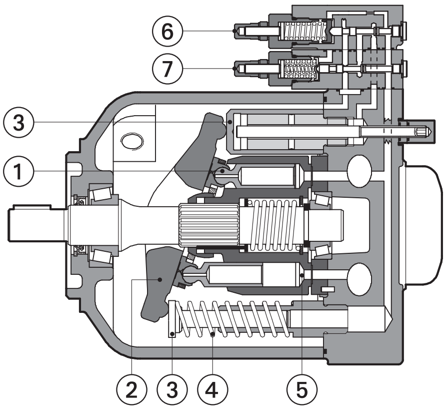
4 DIMENSIONS [mm]



Mass: 4,6 Kg

Axial piston pumps

variable displacement, mechanical controls



① Pistons
② Swash plate
③ Servo piston
④ Spring
⑤ Rotating barrel
⑥ Max pressure compensator
⑦ Load sensing compensator
⑧ Remote pressure transducer

PVPC-L-4046

PVPC

Variable displacement axial piston pumps with swash plate design suited for high pressure open circuits.

They are characterized by low noise emission, short response time and flexible operation thanks to the wilde range of mechanical controls, see section 12 and 13 .

For PVPC pumps with electrohydraulic proportional controls, see tech table AS170.

SAE J744 mounting flange and shaft.

Max displacement (cm³/rev)	**Max pressure working** (bar)	**Max pressure peak** (bar)
29, 46, 73, 140	280	350
88	250	315

1 MODEL CODE

PVPC **X2E** - **C** - **4046** / **1** **D** - **X** **24DC** ***** / *****

PVPC: Variable displacement axial piston pump

Option for pumps with through shaft (1):
XA = intermediate flange SAE A
XB = intermediate flange SAE B
XC = intermediate flange SAE C
(only for size 5073 and 5090)

Additional suffix for double pumps:
X2E = with a fixed displacement pump type PFE (see tech table A005)

Type of control, see sections 12 and 13 :
C = manual pressure compensator
CH = manual pressure compensator, with venting
R = remote pressure compensator **(1)**
L = load sensing (pressure & flow)
LW = constant power (combined pressure & flow) **(2)**

For electrohydraulic proportional controls, see tech table AS170

Size and max displacement (3):
3029 = size 3 - displacement 029 cm³/rev
4046 = size 4 - displacement 046 cm³/rev
5073 = size 5 - displacement 073 cm³/rev
5090 = size 5 - displacement 088 cm³/rev
6140 = size 6 - displacement 140 cm³/rev

Shaft, SAE Standard **(4)**:
1 = keyed
5 = splined

Direction of rotation, viewed at the shaft end:
D = clockwise
S = counterclockwise

X = without connector (only for CH version)
See section 4 for available connectors, to be ordered separately

Coil voltage, see section 4
(only for CH version)

Series number

Seals material, see section 5 :
- = NBR
PE = FKM

---

(1) Not available for PVPC-*-6140
(2) Please specify the requested value of torque setting or power and speed in the PVPC-LW pump order, e.g. 70 Nm or 10 kW at 1450 RPM
(3) Optional intermediate displacements 35 and 53 cm³/rev are available on request
(4) Pumps with ISO 3019/2 mounting flange and shaft (option /M) are available on request

2 GENERAL CHARACTERISTICS

Assembly position - see section 7	Any position. The drain port must be on the top of the pump. Drain line must be separated and unrestricted to the reservoir and extended below the oil level as far from the inlet as possible. Suggested maximum line lenght is 3 m.
Ambient temperature range	**Standard** = -25°C ÷ +80°C **/PE** option -15°C ÷ +80°C
Storage temperature	**Standard** = -40°C ÷ +70°C **/PE** option -20°C ÷ +70°C
Surface protection (pump body)	Black painting RAL9005
Compliance	RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

3 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

<table>
<tr><td>PVPC size</td><td colspan="2">3029</td><td colspan="2">4046</td><td colspan="2">5073</td><td colspan="2">5090</td><td colspan="2">6140</td></tr>
<tr><td>Max displacement (cm³/rev)</td><td colspan="2">29</td><td colspan="2">46</td><td colspan="2">73</td><td colspan="2">88</td><td colspan="2">140</td></tr>
<tr><td>Theoretical max flow at 1450 rpm (l/min)</td><td colspan="2">42</td><td colspan="2">66,7</td><td colspan="2">105,8</td><td colspan="2">127,6</td><td colspan="2">203</td></tr>
<tr><td>Max pressure working / peak (bar)</td><td colspan="2">280 / 350</td><td colspan="2">280 / 350</td><td colspan="2">280 / 350</td><td colspan="2">250 / 315</td><td colspan="2">280 / 350 (1)</td></tr>
<tr><td>Min/Max inlet pressure (bar abs.)</td><td colspan="2">0,8 / 25</td><td colspan="2">0,8 / 25</td><td colspan="2">0,8 / 25</td><td colspan="2">0,8 / 25</td><td colspan="2">0,8 / 25</td></tr>
<tr><td>Max pressure on drain port (bar abs.)</td><td colspan="2">1,5</td><td colspan="2">1,5</td><td colspan="2">1,5</td><td colspan="2">1,5</td><td colspan="2">1,5</td></tr>
<tr><td>Power consumption at 1450 rpm and at max pressure and displacement (Kw)</td><td colspan="2">19,9</td><td colspan="2">31,6</td><td colspan="2">50,1</td><td colspan="2">54,1</td><td colspan="2">122</td></tr>
<tr><td>Max torque on the shaft (shaft type) (Nm)</td><td>Type 1
210</td><td>Type 5
270</td><td>Type 1
350</td><td>Type 5
440</td><td>Type 1
670</td><td>Type 5
810</td><td>Type 1
670</td><td>Type 5
810</td><td>Type 1
1300</td><td>Type 5
1660</td></tr>
<tr><td>Max torque at max working pressure (Nm)</td><td colspan="2">128</td><td colspan="2">203</td><td colspan="2">328</td><td colspan="2">350</td><td colspan="2">780</td></tr>
<tr><td>Speed rating (rpm)</td><td colspan="2">500 ÷ 3000</td><td colspan="2">500 ÷ 2600</td><td colspan="2">500 ÷ 2600</td><td colspan="2">500 ÷ 2200</td><td colspan="2">500 ÷ 2200</td></tr>
<tr><td>Body volume (l)</td><td colspan="2">0,7</td><td colspan="2">0,9</td><td colspan="2">1,5</td><td colspan="2">1,5</td><td colspan="2">2,8</td></tr>
</table>

(1) The maximum pressure can be increased to 350 bar (working) and 420 bar (peak) after detailed analysis of the application and of the pump working cycle

4 ELECTRICAL CHARACTERISTICS - for PVPC-CH

Insulation class	H
Connector protection degree	IP 65
Relative duty factor	100 %
Supply voltage tolerance	± 10%

4.1 COIL VOLTAGE - only for CH version

Average values based ambient/coil temperature of 20°C.

External supply nominal voltage ±10%		**Voltage code**	Power consumption	Nominal courrent	Coil characteristics
DIRECT CURRENT	12 DC 24 DC	**12DC** **24DC**	19,2 W	1,61 A 0,80 A	Insulation Class: **H** Protection degree: **IP65**

4.2 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 - to be ordered separately

Code of connector	Function
SP-666	Connector IP-65
SP-667	Connector IP-65 but with built-in signal led

5 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷35 mm^2/s - max allowed range: min 10 cSt (at 80°C) - max 1500 cSt at cold startup (-25°C)		
Max fluid contamination level normal operation	ISO4406 class 20/18/13 NAS1638 class 9		see also filter section at www.atos.com or KTF catalog
longer life	ISO4406 class 18/16/11 NAS1638 class 7		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR	HFC **(1)**	

(1) See section 6

6 PERFORMACE RESTRICTIONS WITH FLAME RESISTANT FLUIDS

6.1 HFDU and HFDR - Phosphate ester

PVPC size	**3029**	**4046**	**5073**	**5090**	**6140**
Max pressure working / peak (bar)	200 / 240				**(2)**
Max speed **(1)** (rpm @ VMAX)	2050	1850	1700	1550	
Ambient temperature range (°C)	-10 ÷ +80				
Bearing life (% of bearing life with mineral oil) (%)	90				

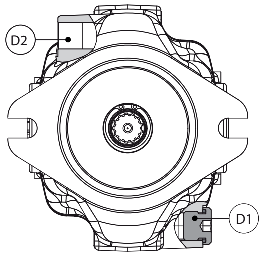
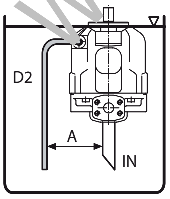
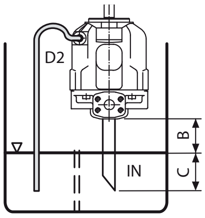
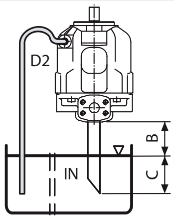
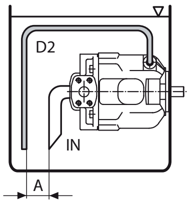
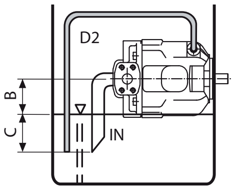
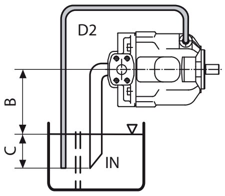
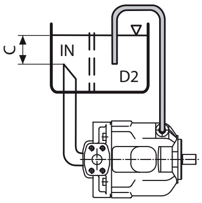
(1) With an inlet pressure of 1 bar abs
(2) For information about size 6140, contact Atos technical office

6.2 HFC - Water-glycol (35 ÷ 55 % of water)

PVPC size	**3029**	**4046**	**5073**	**5090**	**6140**
Max pressure working / peak (bar)	180 / 210				**(2)**
Max speed **(1)** (rpm @ VMAX)	2050	1850	1700	1550	
Ambient temperature range (°C)	[illegible]0 ÷ +60				
Bearing life (% of bearing life with mineral oil) (%)	40				

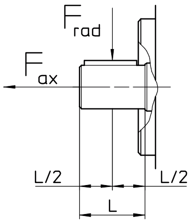
(1) With an inlet pressure of 1 bar abs
(2) For information about size 6140, contact Atos technical office

7 INSTALLATION POSITION

	VERTICAL INSTALLATION		
			
The pump is supplied with drain D2 open, and D1 plugged. Before installation fill the pump with hydraulic oil for at least 3/4 of its volume, keeping it in horizontal position. With exception of pump mounted below the oil level, we recomend to interpose a baffle plate between inlet and drain line.	**INSIDE THE TANK** Minimum oil level equal or above the pump mounting surface. A ≥ 200mm	**INSIDE THE TANK** Minimum oil level below the pump mounting surface. Minimum inlet pressure = 0,8 bar absolute B ≤ 800mm, C= 200mm	**OUTSIDE THE TANK, above oil level** Minimum inlet pressure = 0,8 bar absolute B ≤ 800mm, C= 200mm
HORIZONTAL INSTALLATION			
			
INSIDE THE TANK Minimum oil level equal or above the pump mounting surface. A ≥ 200mm	**INSIDE THE TANK** Minimum oil level below the pump mounting surface. Minimum inlet pressure = 0,8 bar (absolute) B ≤ 800mm, C= 200mm	**OUTSIDE THE TANK, above oil level** Minimum inlet pressure = 0,8 bar (absolute) B ≤ 800mm, C= 200mm	**OUTSIDE THE TANK, below oil level** C= 200mm

IN: inlet line - **D2:** drain line - **A:** minimum distance between inlet and drain line - **B+C:** permissible suction height - **C:** inlet line immersion dept

8 MAX PERMESSIBLE LOAD ON DRIVE SHAFT

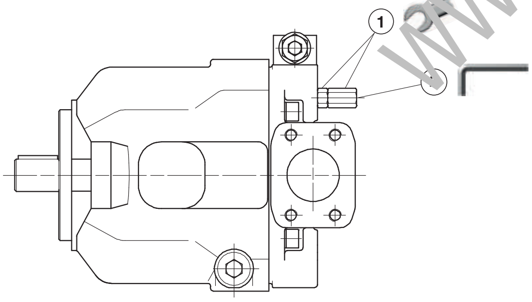
PVPC size			**3029**	**4046**	**5073**	**5090**	**6140**
F_{ax} = axial load		N	1000	1500	2000	2000	2000
F_{rad} = radial load		N	1500	1500	3000	3000	3000

9 VARIATION OF MAX SPEED VS INLET PRESSURE

Inlet pressure	**Displacement %**					
bar abs.	65	70	80	90	100	
0,8	120	115	105	97	90	**% variation of the max. speed**
0,9	120	120	110	103	95	
1,0	120	120	115	107	100	
1,2	120	120	120	113	106	
1,4	120	120	120	120	112	
1,6	120	120	120	120	117	
2,0	120	120	120	120	120	

Example
Displacement: 80% - Inlet pressure: 1,0 bar - Speed: 115%

10 MAX DISPLACEMENT SETTING



① Locking displacement limiter screw

② Displacement setting

PVPC size		**3029**	**4046**	**5073**	**5090**	**6140**
Max displacement setting range	from ÷ to	20,1 ÷ 28,7	31,8 ÷ 45,4	36,8 ÷ 73,6	44,0 ÷ 87,9	70 ÷ 140
One turn of screw changes pump displacement by approximately	cm³/rev	1,5	2,2	3,2	3,2	6,0
For locking displacement limiter screw	mm	14	14	17	17	19
For displacement setting	mm	4	4	5	5	6
Tightening torque	Nm	15 ± 1	15 ± 1	15 ± 1	15 ± 1	20 ± 1

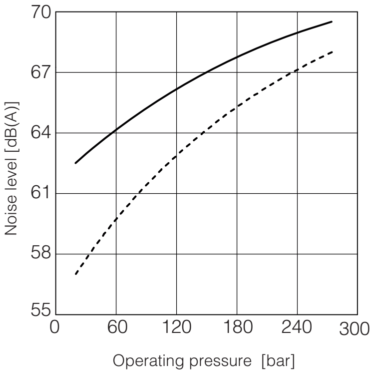
11 DIAGRAMS at 1450 rpm (based on mineral oil ISO VG 46 at 50°C)

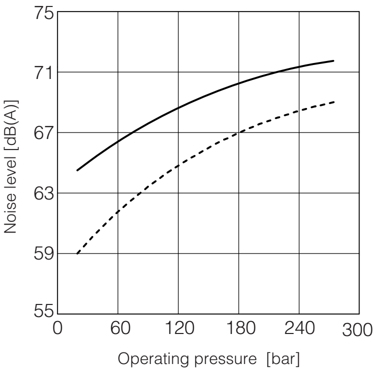
11.1 Noise level curves

Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics - Test procedure to define the ambient noise level - Pumps Shaft speed: 1450 rpm.

—— = Qmax

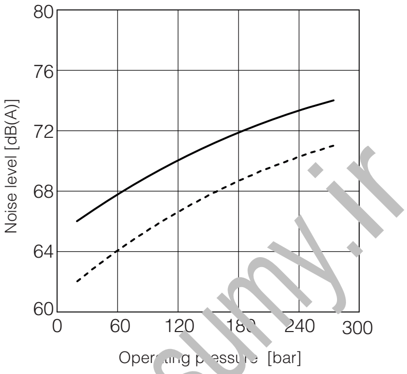
- - - - = Qmin

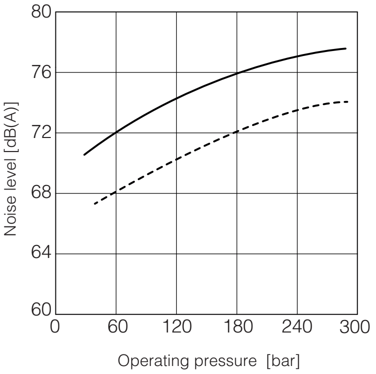

PVPC-*-3029


PVPC-*-4046

—— = Qmax

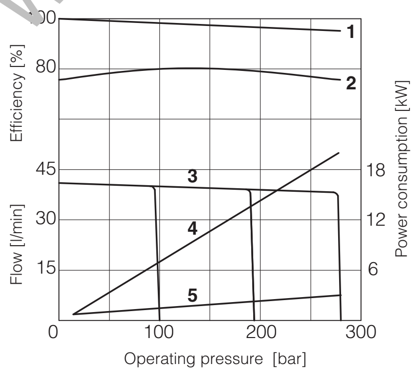
- - - - = Qmin

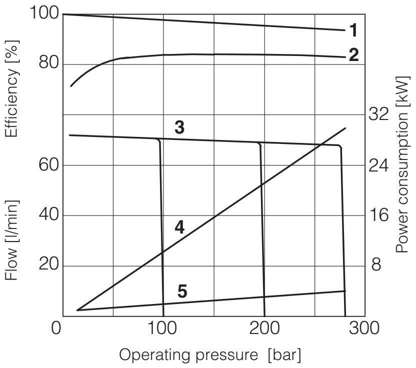

PVPC-*-5073 and PVPC-*-5090

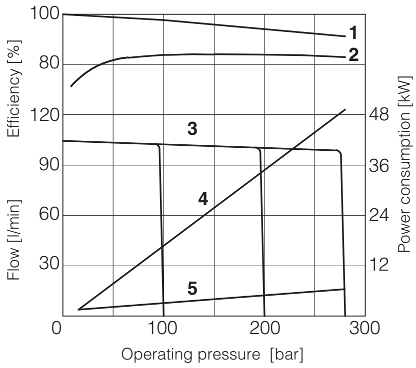

PVPC-*-6140

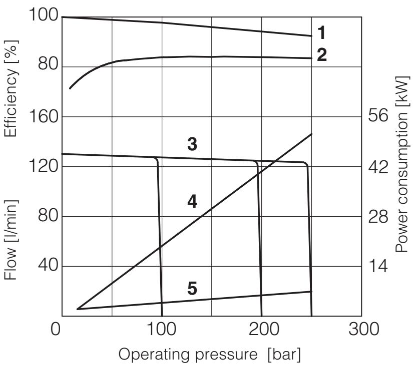
11.2 Operating limits

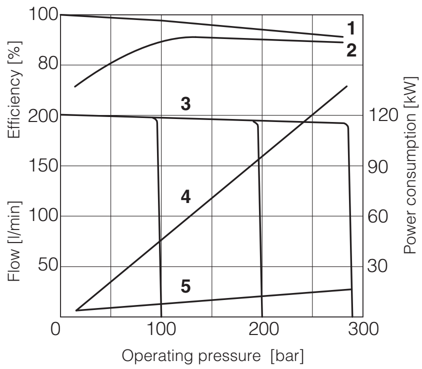
1 = Volumetric efficiency
2 = Overall efficiency
3 = Flow versus pressure curve
4 = Power consumption with full flow
5 = Power consumption at null flow


PVPC-*-3029


PVPC-*-4046


PVPC-*-5073

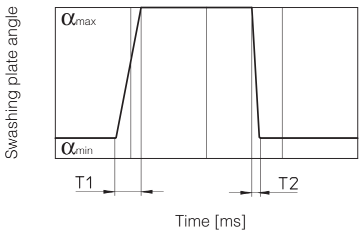

PVPC-*-5090


PVPC-*-6140

11.3 Response times

Response times and pressure peack due to variation 0% to 100% and 100% to 0% of the pump displacement, obtained with an istantaneously opening and shut-off of the delivery line.

Pump type	**T1** (ms)	**T2** (ms)
PVPC-*-3029	140	36
PVPC-*-4046	140	42
PVPC-*-5073	160	44
PVPC-*-5090	160	44
PVPC-*-6140	220	150



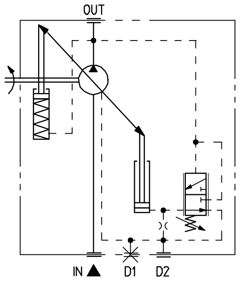
11.4 Minimum power/torque setting for PVPC-LW (constant power regulator)

For the pump correct operation, the power / torque factory setting hast to be higher than the values reported in the below table
In case of lower power/torque setting values, the regulator limits the maximum working pressure to a value lower than the standard setting.

Note: please specify the requested value of torque setting or power and speed in the PVPC-LW pump order, e.g. 70 Nm or 10 kW at 1450 RPM

Pump type	**Minimum torque** (Nm)	**Minimum power** (Kw)
PVPC-LW-3029	43	6,7
PVPC-LW-4046	68	10,7
PVPC-LW-5073	113	17,8
PVPC-LW-5090	132	20,7
PVPC-LW-6140	197	30

12 HYDRAULIC AND ELECTROHYDRAULIC CONTROLS for PVPC-3029 to PVPC-5090



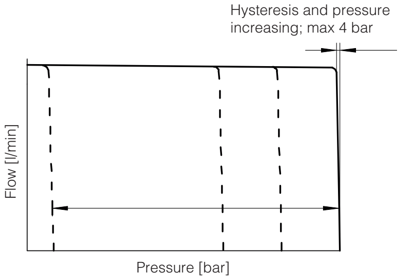
C

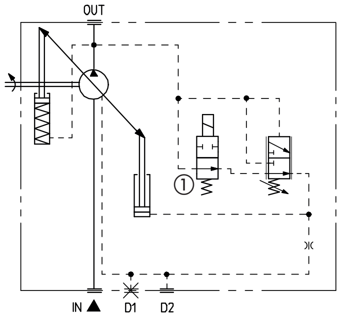
Manual pressure compensator

The pump displacement is zeroed when the line pressure approaches the setting pressure of the compensator.

Compensator setting range:
20 ÷ 280 bar for 3029, 4046, 5073
20 ÷ 250 bar for 5090

Compensator standard setting:
280 bar for 3029, 4046, 5073
250 bar for 5090





① solenoid venting valve

CH

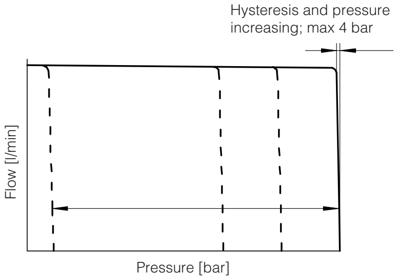
Manual pressure compensator with venting

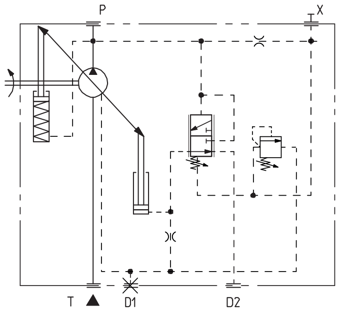
As C plus venting function, when a long unloading time is required and heat generation and noise have to be kept at lowest level.

Venting valve solenoid voltage, see section 4
Venting valve OFF = null displacement
Venting valve ON = max displacement

Compensator setting range:
20 ÷ 280 bar for 3029, 4046, 5073
20 ÷ 250 bar for 5090, 6140

Compensator standard setting:
280 bar for 3029, 4046, 5073
250 bar for 5090, 6140





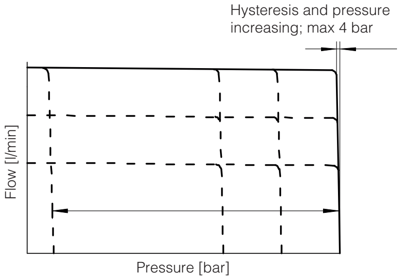
R

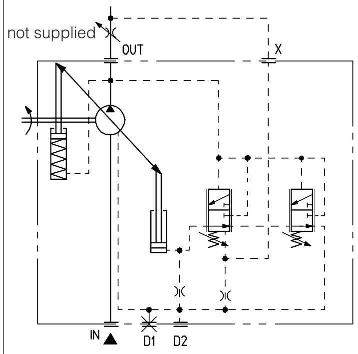
Remote pressure compensator

As C, but predisposed with X piloting port for connection of a remote pilot relief valve.

Compensator setting range:
20 ÷ 280 bar for 3029, 4046, 5073
20 ÷ 250 bar for 5090

Compensator standard setting:
280 bar for 3029, 4046, 5073
250 bar for 5090





L

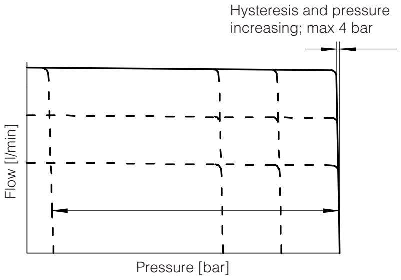
Load sensing

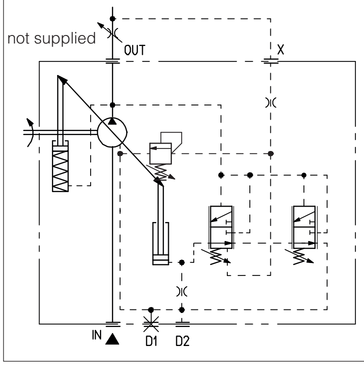
The pump displacement is automatically adjusted to maintain a constant (load indipendent) pressure drop across an external throttle. Changing the throttle regulation, the pump flow is consequently adjusted.
Load sensing control always incorporates an hydraulic compensator to limit the maximum pressure.

Compensator setting range:
20 ÷ 280 bar for 3029, 4046, 5073
20 ÷ 250 bar for 5090

Compensator standard setting:
280 bar for 3029, 4046, 5073
250 bar for 5090

Differential pressure setting range: 10 ÷ 40 bar
Differential pressure standard setting: 14 bar

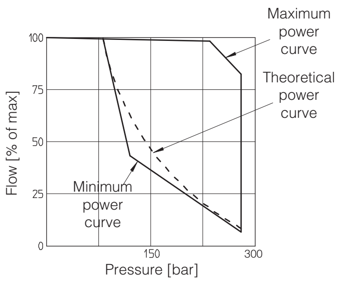




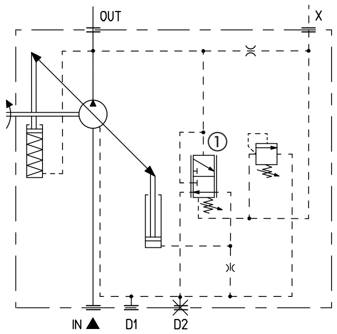
LW

Constant power

In order to achieve a constant drive torque with varying operating pressure. The swashing angle and therefore the outlet flow is varied so that the product of flow and pressure remains constant.
See section 11.4 for min power/torque setting



13 HYDRAULIC AND ELECTROHYDRAULIC CONTROLS for PVPC-6140



C

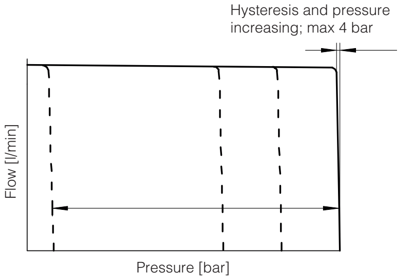
Manual pressure compensator

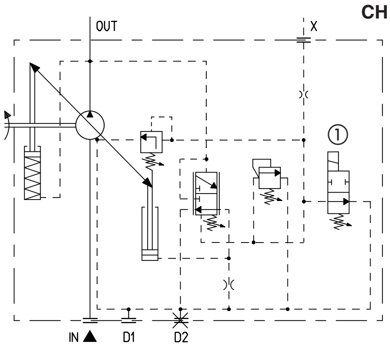
The pump displacement is zeroed when the line pressure approaches the setting pressure of the compensator.

Compensator setting range: 20 ÷ 280 bar

Compensator standard setting: 280 bar

Note: do not modify the setting of differential pressure compensator ①





① solenoid venting valve

CH

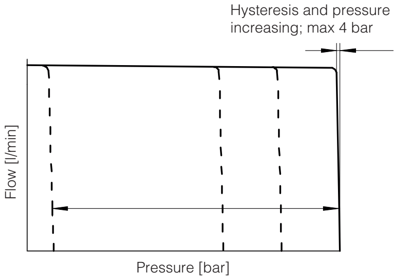
Manual pressure compensator with venting

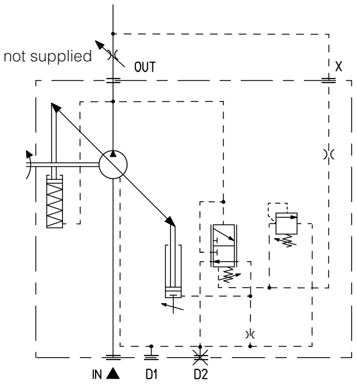
As C plus venting function, when a long unloading time is required and heat generation and noise have to be kept at lowest level.

Venting valve solenoid voltage, see section 4
Venting valve OFF = null displacement
Venting valve ON = max displacement

Compensator setting range: 20 ÷ 280 bar

Compensator standard setting: 280 bar





L

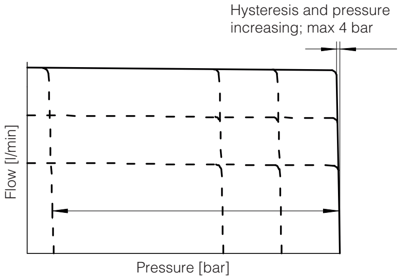
Load sensing

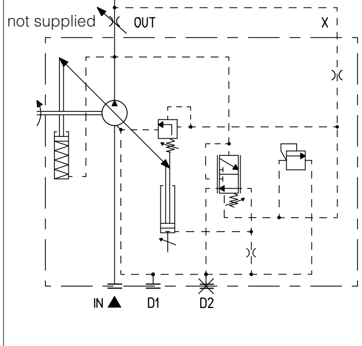
The pump displacement is automatically adjusted to maintain a constant (load indipendent) pressure drop across an external throttle. Changing the throttle regulation, the pump flow is consequently adjusted.
Load sensing control always incorporates an hydraulic compensator to limit the maximum pressure.

Compensator setting range: 20 ÷ 280 bar

Compensator standard setting: 280 bar

Differential pressure setting range: 10 ÷ 40 bar
Differential pressure standard setting: 14 bar

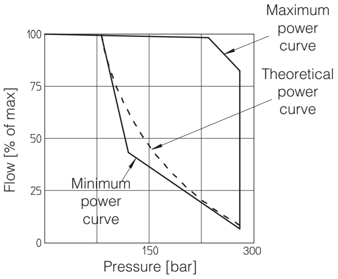




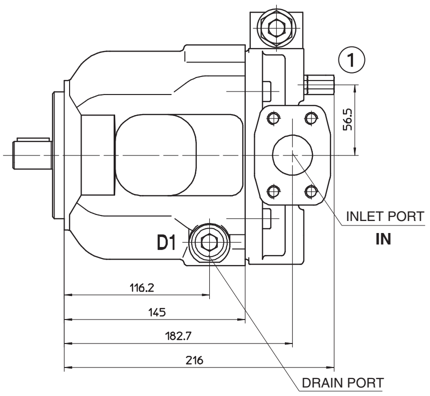
LW

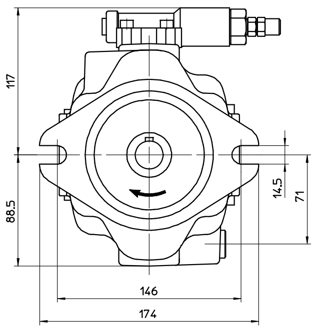
Constant power

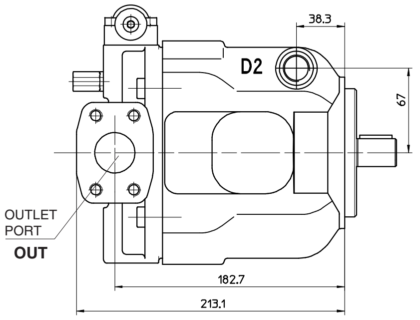
In order to achieve a constant drive torque with varying operating pressure. The swashing angle and therefore the outlet flow is varied so that the product of flow and pressure remains constant.
See section 11.4 for min power/torque setting



14 INSTALLATION DIMENSIONS OF PVPC-*-3029: BASIC VERSION “C” CONTROL







PORTS DIMENSION

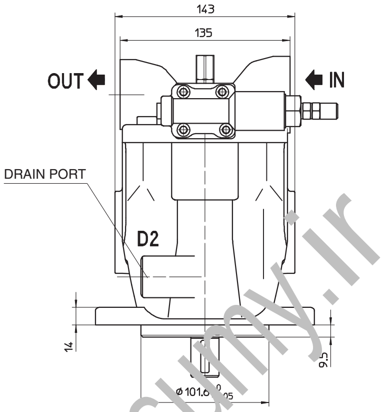
IN = Flange SAE 3000 1 1/4”

OUT = Flange SAE 6000 3/4”

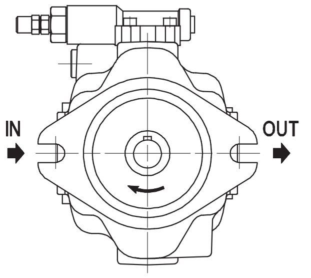
D1, D2 = 1/2” BSPP

① = Screw for max displacement setting. In case of double pumps, the screw is not available for version XB

Mass [kg]	
PVPC-*-3029	18

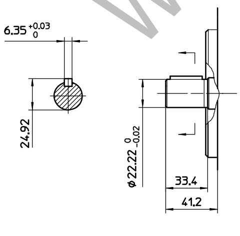


version S
counterclockwise rotation
viewed at the shaft end

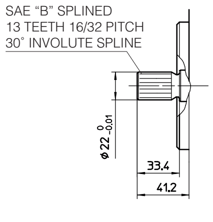


Pumps with counterclockwise rotation (**S**) have the IN and OUT inverted and consequently the position *of the compensators*

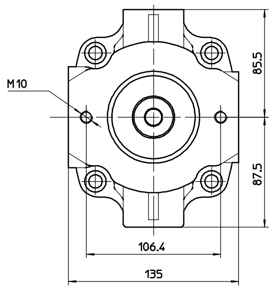
SHAFT TYPE “1”

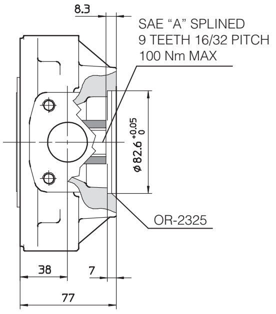


SHAFT TYPE “5”



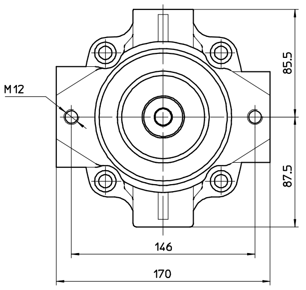
CODE XA - INTERMEDIATE FLANGE SAE “A” FOR PFE-31

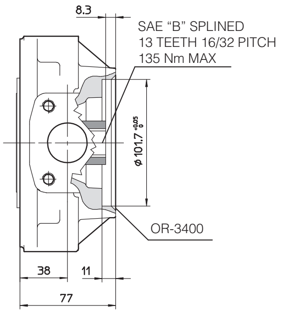




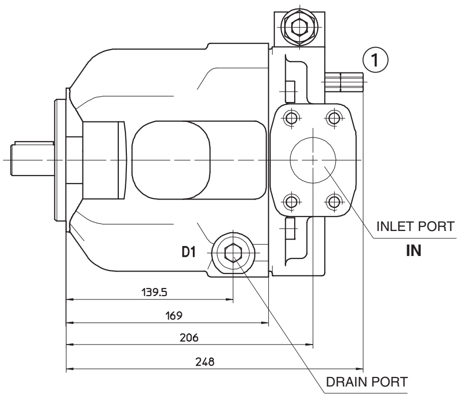
CODE XB - INTERMEDIATE FLANGE SAE “B” FOR PFE-41

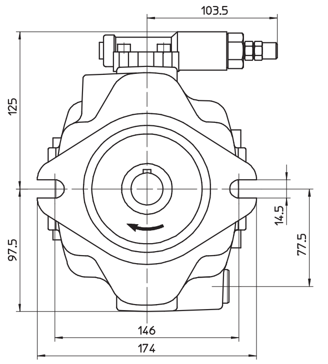
screw for max displacement setting not available

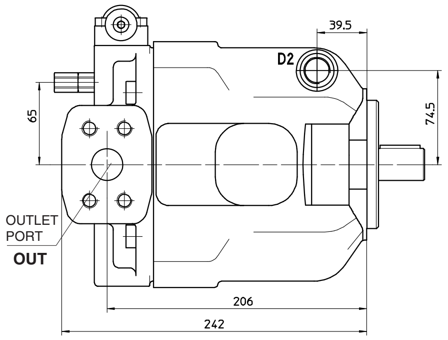


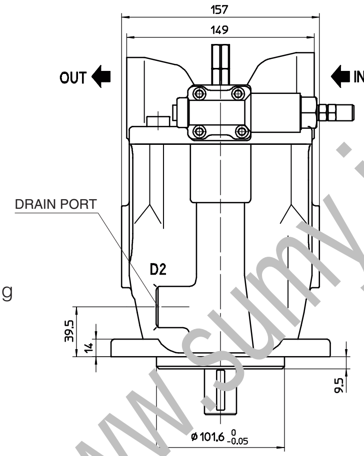


15 INSTALLATION DIMENSIONS OF PVPC-*-4046: BASIC VERSION “C” CONTROL

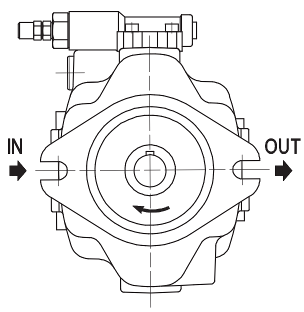








version S
counterclockwise rotation
viewed at the shaft end



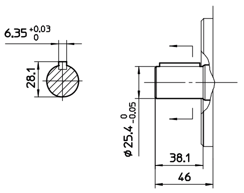
Pumps with counterclockwise rotation (**S**) have the IN and OUT inverted and consequently the position *of the compensators*

PORTS DIMENSION

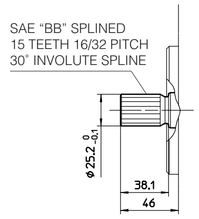
IN = Flange SAE 3000 1 1/2”
OUT = Flange SAE 6000 1”
D1, D2 = 1/2” BSPP
① = Screw for max displacement setting

Mass [kg]	
PVPC-*-4046	24

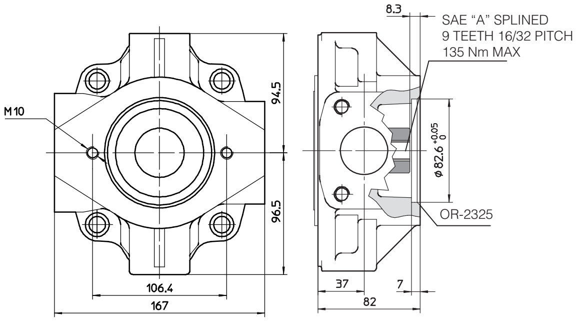
SHAFT TYPE “1”



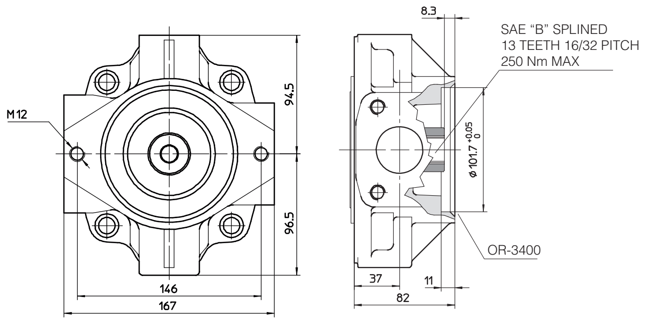
SHAFT TYPE “5”



CODE XA - INTERMEDIATE FLANGE SAE “A” FOR PFE-31

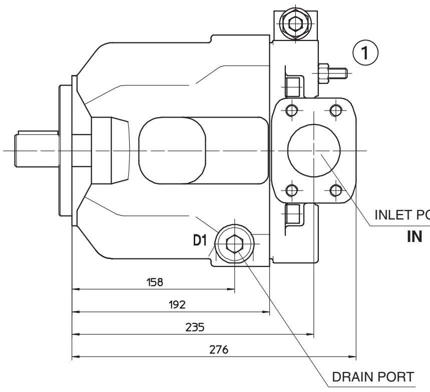


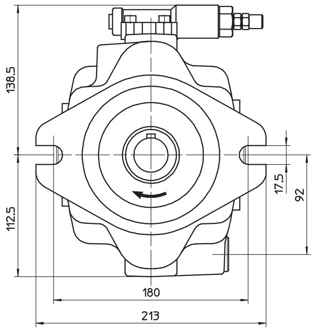
CODE XB - INTERMEDIATE FLANGE SAE “B” FOR PFE-41

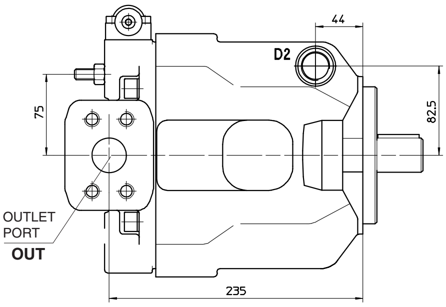


Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted

16 INSTALLATION DIMENSIONS OF PVPC-*-5073 and PVPC-*-5090: BASIC VERSION “C” CONTROL

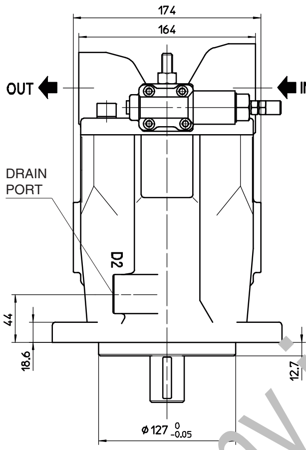






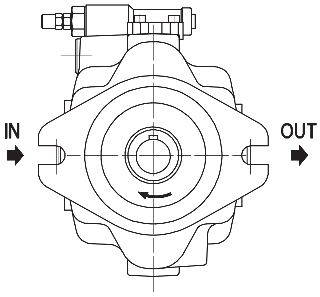
PORTS DIMENSION

IN = Flange SAE 3000 2”
OUT = Flange SAE 6000 1 1/4”
D1, D2 = 3/4” BSPP
① = Screw for max displacement setting.
In case of double pump the screw
is not available for version XC



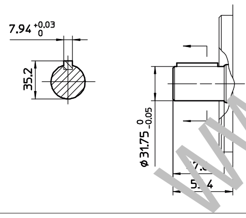
Mass [kg]	
PVPC-*-5073	33
PVPC-*-5090	

version S
counterclockwise rotation
viewed at the shaft end

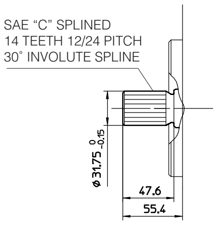


Pumps with counterclockwise rotation (**S**) have the IN and OUT inverted and consequently the position *of the compensators*

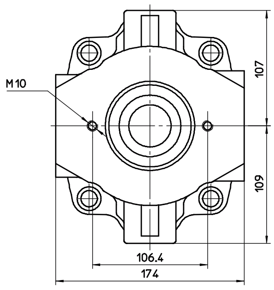
SHAFT TYPE “1”

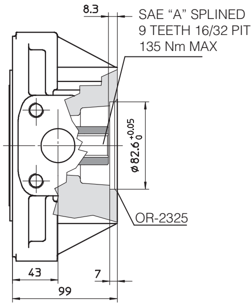


SHAFT TYPE “5”

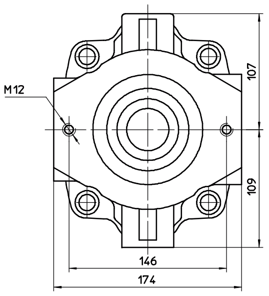


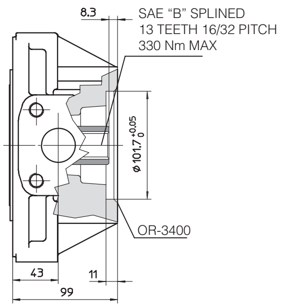
CODE XA - INTERMEDIATE FLANGE SAE “A” FOR PFE-31



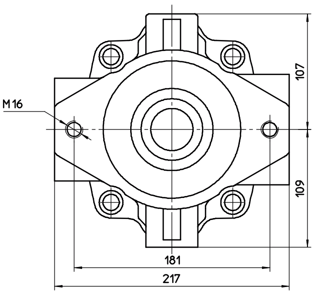


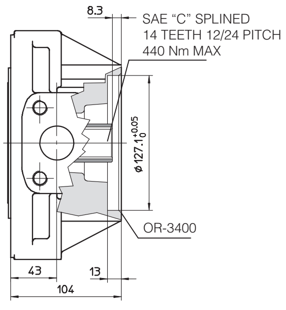
CODE XB - INTERMEDIATE FLANGE SAE “B” FOR PFE-41





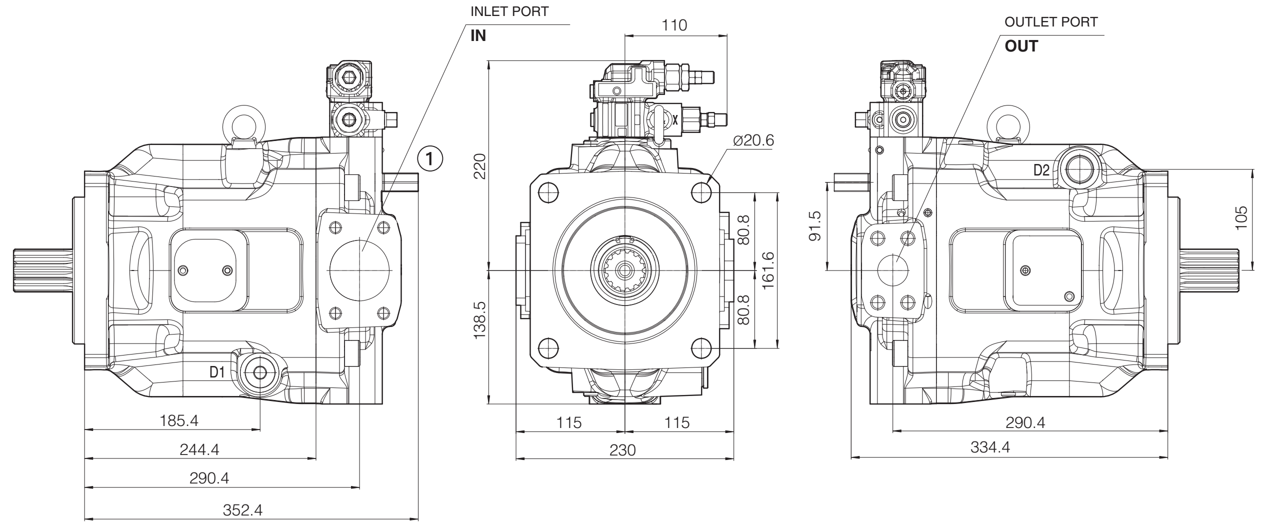
CODE XC - INTERMEDIATE FLANGE SAE “C” FOR PFE-51



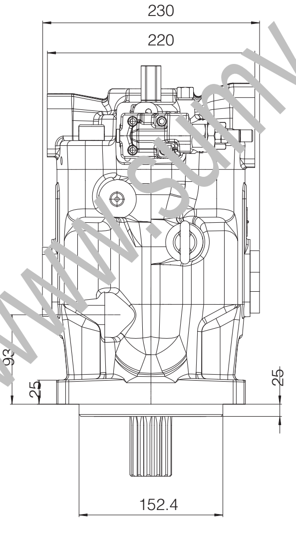


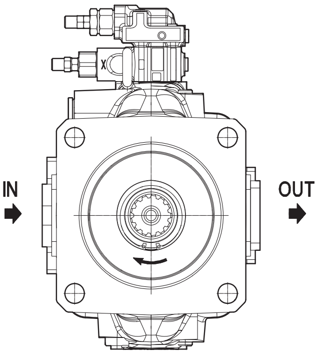
Drawing show pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted

17 INSTALLATION DIMENSIONS OF PVPC-*-6140: BASIC VERSION "C" CONTROL



version S
counterclockwise rotation
viewed at the shaft end





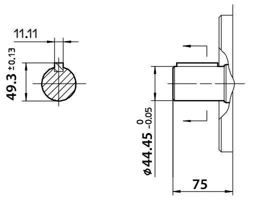
Pumps with counterclockwise rotation (**S**) have the IN and OUT inverted and consequently the position *of the compensators*

PORTS DIMENSION

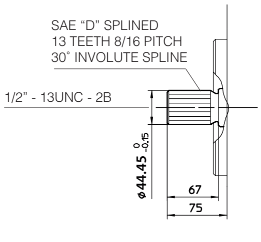
IN = Flange SAE 3000 2 1/2"
OUT = Flange SAE 6000 1 1/4"
D1, D2 = 1 1/16"-12UNF
① = Regulation screw for max displacement setting.

Mass [kg]	
PVPC-*-6140	69

SHAFT TYPE "1"



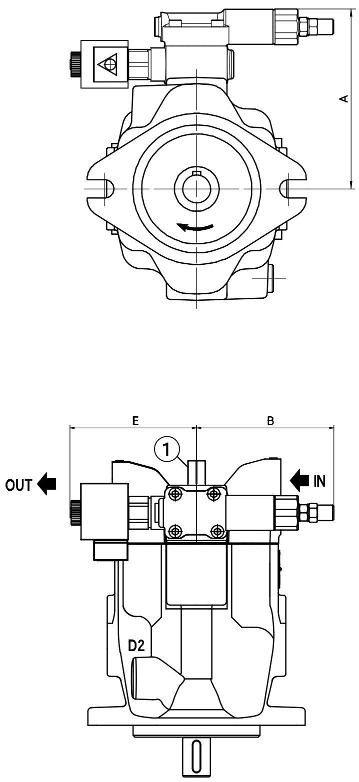
SHAFT TYPE "5"



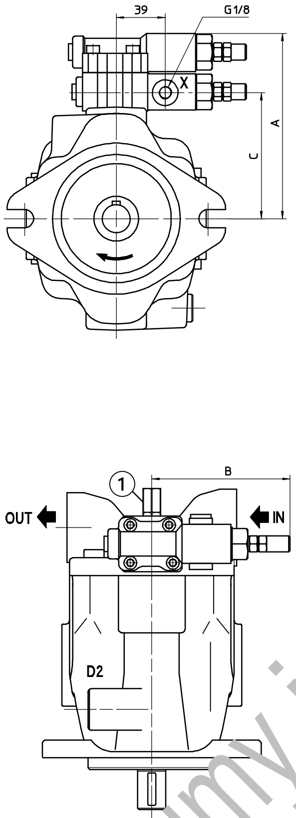
18 INSTALLATION DIMENSIONS OF OTHER CONTROLS

18.1 PVPC size 3, 4 and 5

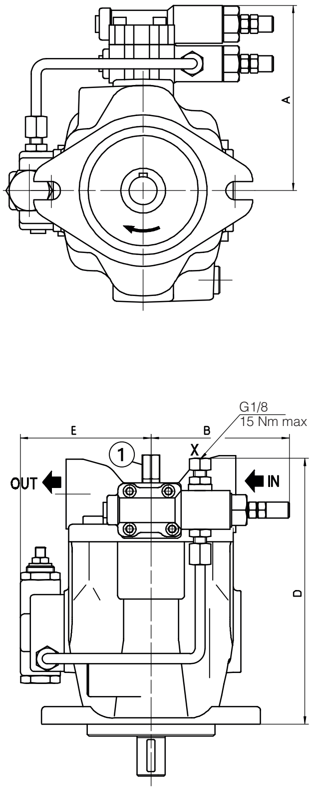
VERSION CH



VERSIONS L, R



VERSION LW



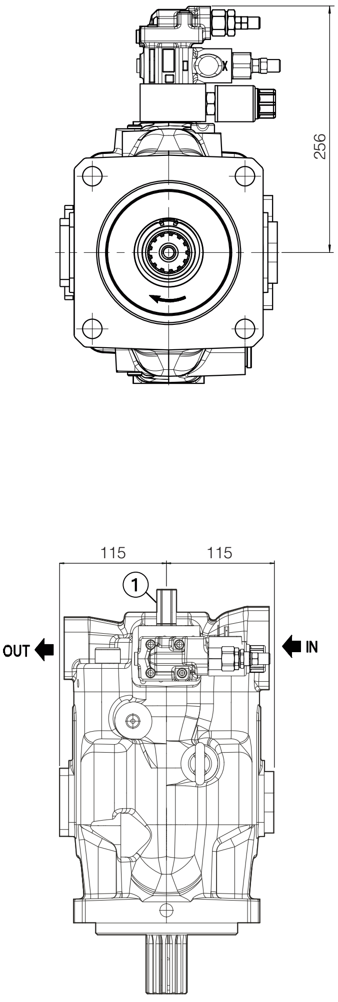
① = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement).
In case of double pump the regulation screw is not always available, please contact our technical office.

Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and also the consequently position of the control groups.

Pump type	Version	A	B	C	D	E	Mass (kg)
PVPC-*-3029	**CH**	144	111	-	-	102	22
	L -R	144	111	100	-	-	19,2
	LW	144	111	-	211	104	20
PVPC-*-4046	**CH**	153	111	-	-	102	28
	L -R	153	111	109	-	-	25,2
	LW	153	111	-	235	111	26
PVPC-*-5073 PVPC-*-5090	**CH**	166	111	-	-	102	36,9
	L -R	166	111	122	-	-	34,2
	LW	166	111	-	258	120	35

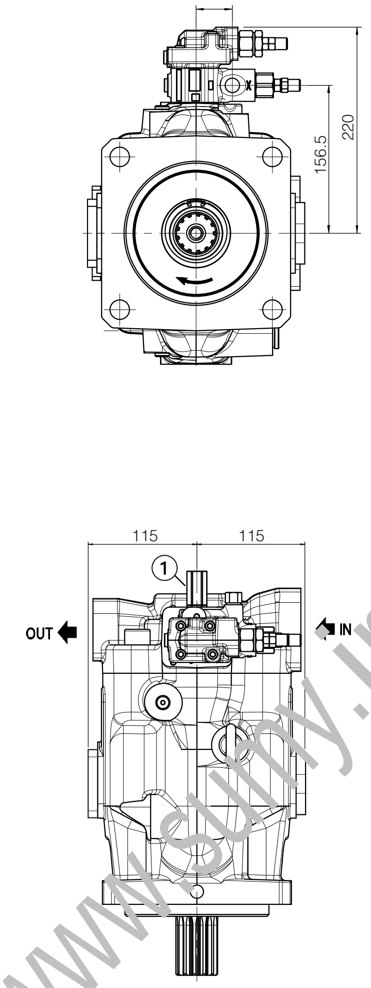
18.2 PVPC size 6

VERSION CH



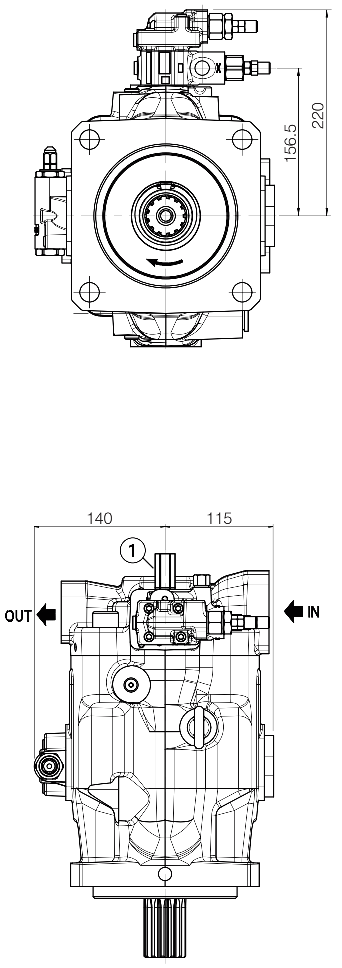
Mass [kg]	
PVPC-*-6140	74

VERSION L



Mass [kg]	
PVPC-*-6140	70.2

VERSION LW



Mass [kg]	
PVPC-*-6140	71

① = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement).
In case of double pump the regulation screw is not always available, please contact our technical office.

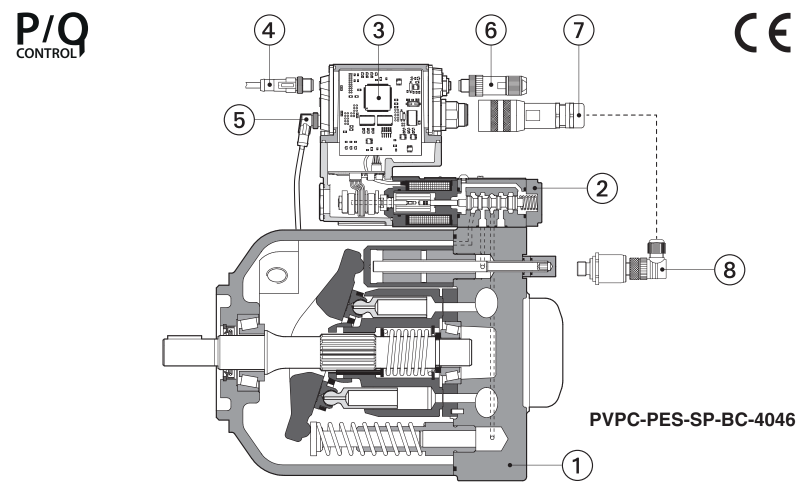
Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and also the consequently position of the control groups

19 RELATED DOCUMENTATION

A900 Operating and maintenance information for pumps
K800 Electric and electronic connectors

Proportional controls for axial piston pumps

pressure, flow or P/Q controls



① Pump body
② Proportional valve
③ On-board driver with P/Q control
④ USB connector
⑤ Swash plates transducer connection
⑥ Fieldbus connector
⑦ Main connector
⑧ Remote pressure transducer

PVPC

Variable displacement axial piston pumps with swash plate design suited for high pressure open circuits, they are provided with advanced electrohydraulic proportional controls:

- **CZ** open loop pressure control
- **LQZ** open loop flow control (load sensing)
- **PES** closed loop P/Q control

PES performs alternate closed loop controls of pressure, flow and max power limitation. It is also available with optional sequence module (PERS versions) that allows to reduce close to zero the pressure to the delivery line.

SAE J744 mounting flange and shaft.

Max displacement (cm³/rev)	**Max pressure working** (bar)	**Max pressure peak** (bar)
29, 46, 73, 140	280	350
88	250	315

For technical characteristics and features, see tech table A160.

1 MODEL CODE

PVPC **X2E** - **PERS-SP** - **BC** - **4046** / ***** / **1** **D** / ***** ***** / *****

PVPC
Variable displacement axial piston pump

Option for pumps with through shaft (1):
XA = intermediate flange SAE A
XB = intermediate flange SAE B
XC = intermediate flange SAE C
(only for size 5073 and 5090)

Additional suffix for double pumps:
X2E = with a fixed displacement pump type PFE (see tech table A005)

Type of control, see section 13 and 14:
CZ = proportional pressure control **(1)**
LQZ = proportional flow control (load sensing) **(1)**
PES-SP = closed loop integral digital P/Q driver
PERS-SP = as PES plus sequence module

Fieldbus interfaces, USB port always present **(2)**:
NP = Not present
BC = CANopen
BP = PROFIBUS DP
EH = EtherCAT
EW = POWERLINK
EI = EtherNet/IP
EP = PROFINET RT/IRT

Size and max displacement (3):
3029 = size 3 - displacement 029 cm³/rev
4046 = size 4 - displacement 046 cm³/rev
5073 = size 5 - displacement 073 cm³/rev
5090 = size 5 - displacement 090 cm³/rev
6140 = size 6 - displacement 140 cm³/rev

Pressure setting, only for PERS: **200** = 200 bar **250** = 250 bar **280** = 280 bar

Seals material, see section 9 :
- = NBR
PE = FKM

Series number

Coil voltage, for CZ, LQZ - see section 18:
18 = optional coil for low current drivers

Electronics options, for PES and PERS **(4):**
C = current feedback for pressure transducer 4÷20 mA (omit for std voltage ±10VDC)
I = current reference input and monitor 4÷20 mA (omit for std voltage ±10VDC)
X = on-board pressure transducer with pre-configured pressure settings (only for PERS)
S = with 2 on-off inputs for multiple pressure PID selection for NP execution or double power supply for fieldbus execution, plus dedicated connector for remote pressure transducer

Direction of rotation, viewed at the shaft end: see section 23:
D = clockwise **S** = counterclockwise

Shaft, SAE Standard **(5)**:
1 = keyed **5** = splined

(1) Not available for PVPC-*-6140
(2) Only for PES and PERS
(3) Optional intermediate displacements 35 and 53 cm³/rev are available on request
(4) For possible combined options, see section 17
(5) Pumps with ISO 3019/2 mounting flange and shaft (option /M) are available on request

2 OFF-BOARD ELECTRONIC DRIVERS - only for **CZ**, **LQZ**

Drivers model	E-MI-AC-01F		E-MI-AS-IR		E-BM-AS-PS		E-BM-AES
Type	Analog		Digital				
Voltage supply (VDC)	12	24	12	24	12	24	24
Valve coil option	/6	std	/6	std	/6	std	std
Format	plug-in to solenoid				DIN-rail panel		
Data sheet	G010		G020		G030		GS050

3 GENERAL NOTES

Atos digital proportionals pumps are CE marked according to the applicable directives (e.g. Immunity and Emission EMC Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in tech table **FS900** and in the user manuals included in the E-SW-* programming software.

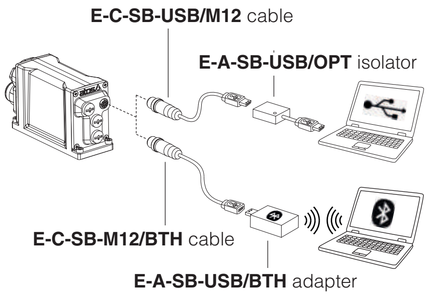
4 PUMP SETTINGS AND PROGRAMMING TOOLS

Pump's functional parameters and configurations, can be easily set and optimized using Atos E-SW programming software connected via USB port to the digital driver.
For fieldbus versions, the software permits pump's parameterization through USB port also if the driver is connected to the central machine unit via fieldbus.

The software is available in different versions according to the driver's options (see table **AS800**):

E-SW-BASIC/PQ	support:	NP (USB)	PS (Serial)	IR (Infrared)
E-SW-FIELDBUS/PQ	support:	BC (CANopen)	BP (PROFIBUS DP)	EH (EtherCAT)
		EW (POWERLINK)	EI (EtherNet/IP)	EP (PROFINET)

USB or Bluetooth connection



WARNING: drivers USB port is not isolated! For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection

WARNING: see tech table **AS800** for the list of countries where the Bluetooth adapter has been approved

5 FIELDBUS - see tech. table **GS510**

Fieldbus allows valve direct communication with machine control unit for digital reference, valve diagnostics and settings. These execution allow to operate the valves through fieldbus or analog signals available on the main connector.

6 GENERAL CHARACTERISTICS

Assembly position	Any position. The drain port must be on the top of the pump. Drain line must be separated and unrestricted to the reservoir and extended below the oil level as far from the inlet as possible. Suggested maximum line lenght is 3 m.
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤ 0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, for futher details see technical table P007
Ambient temperature range	**CZ,LQZ: Standard** = -25°C ÷ +60°C **/PE** option = -15°C ÷ +80°C **PES, PERS: Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C
Storage temperature range	**CZ,LQZ: Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **PES, PERS: Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Surface protection (pump body)	Black painting RAL 9005
Surface protection (pilot valve)	Zinc coating with black passivation, galvanic treatment (driver housing)
Corrosion resistance (pilot valve)	Salt spray test (EN ISO 9227) > 200 h
Vibration resistance	See technical table G004
Compliance (proportional pilot valve)	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006)

7 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

PVPC size		**3029**		**4046**		**5073**		**5090**		**6140**	
Max displacement	(cm³/rev)	29		46		73		88		140	
Theoretical max flow at 1450 rpm	(l/min)	42		66,7		105,8		127,6		203	
Max pressure working / peak	(bar)	280 / 350		280 / 350		280 / 350		250 / 315		280 / 350 **(1)**	
Min/Max inlet pressure	(bar abs.)	0,8 / 25		0,8 / 25		0,8 / 25		0,8 / 25		0,8 / 25	
Max pressure on drain port	(bar abs.)	1,5		1,5		1,5		1,5		1,5	
Power consumption at 1450 rpm and at max pressure and displacement	(Kw)	19,9		31,6		50,1		54,1		122	
Max torque on the first shaft	(Nm)	Type 1 210	Type 5 270	Type 1 350	Type 5 440	Type 1 670	Type 5 810	Type 1 670	Type 5 810	Type 1 1300	Type 5 1660
Max torque at max working pressure	(Nm)	128		203		328		350		780	
Speed rating	(rpm)	500 ÷ 3000		500 ÷ 2600		500 ÷ 2600		500 ÷ 2200		500 ÷ 2200	
Body volume	(l)	0,7		0,9		1,5		1,5		2,8	

(1) The maximum pressure can be increased to 350 bar (working) and 420 bar (peak) after detailed analysis of the application and of the pump working cycle

8 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption	**CZ**, **LQZ** = 35 Watt; **PES**, **PERS** = 50 Watt			
Max. solenoid current	2,6 A for standard **12 VDC** coil; 1,5 A for standard **18 VDC** coil (only for CZ, LQZ)			
Coil resistance R at 20°C	**Size 3**: 3 ÷ 3,3 Ω for standard **12 VDC** coil; 13 ÷ 13,4 Ω for **18 VDC** coil (only for version CZ, LQZ)			
	Size 4, 5: 3,8 ÷ 4,1 Ω for standard **12 VDC** coil; 12 ÷ 12,5 Ω for **18 VDC** coil (only for version CZ, LQZ)			
Analog input signals	Voltage: range ±10 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output	Output range: 0 ÷ 24 VDC (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)			
Pressure transducer power supply	+24VDC @ max 100 mA (E-ATR-8 see tech table **GS465**)			
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, valve spool transducer malfunctions, alarms history storage function			
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account			
Protection degree to DIN EN60529	**CZ, LQZ** = IP65; **PES, PERS** = IP66/67 with mating connector			
Duty factor	Continuous rating (ED=100%)			
Tropicalization	Tropical coating on electronics PCB			
Additional characteristics	Short circuit protection of solenoid's current supply; 3 leds for diagnostic; spool position control by P.I.D. with rapid solenoid switching; protection against reverse polarity of power supply			
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables, see section 22			

Note: a maximum time of 800 ms (depending on communication type) have be considered between the driver energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

9 **SEALS AND HYDRAULIC FLUIDS** - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature		NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C	
Recommended viscosity		20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s	
Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7	see also filter section at www.atos.com or KTF catalog
	longer life	ISO4406 class 16/14/11 NAS1638 class 5	

Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR, HNBR	HFC **(1)**	

(1) See section 10

10 PERFORMACE RESTRICTIONS WITH FLAME RESISTANT FLUIDS

10.1 HFDU and HFDR - Phosphate ester

PVPC size		**3029**	**4046**	**5073**	**5090**	**6140**
Max pressure working / peak	(bar)	200 / 240				**(2)**
Max speed	**(1)** (rpm @ VMAX)	2050	1850	1700	1550	
Ambient temperature range	(°C)	-10 ÷ +80				
Bearing life (% of bearing life with mineral oil)	(%)	90				

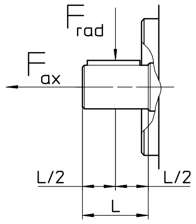
(1) With an inlet pressure of 1 bar abs
(2) For information about size 6140, contact Atos technical office

10.2 HFC - Water-glycol (35 ÷ 55 % of water)

PVPC size		**3029**	**4046**	**5073**	**5090**	**6140**
Max pressure working / peak	(bar)	180 / 210				**(2)**
Max speed	**(1)** (rpm @ VMAX)	2050	1850	1700	1550	
Ambient temperature range	(°C)	-10 ÷ +60				
Bearing life (% of bearing life with mineral oil)	(%)	40				

(1) With an inlet pressure of 1 bar abs
(2) For information about size 6140, contact Atos technical office

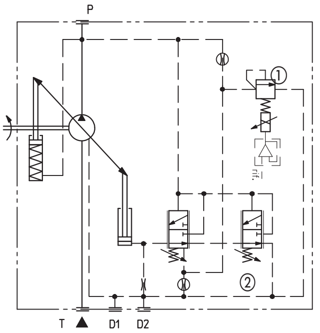
11 MAX PERMESSIBLE LOAD ON DRIVE SHAFT

PVPC size			**3029**	**4046**	**5073**	**5090**	**6140**
F_{ax} = axial load		N	1000	1500	2000	2000	2000
F_{rad} = radial load		N	1500	1500	3000	3000	3000

12 VARIATION OF MAX SPEED VS INLET PRESSURE

Inlet pressure	**Displacement %**					
bar abs.	65	70	80	90	100	
0,8	120	115	105	97	90	**% variation of the max. speed**
0,9	120	120	110	103	95	
1,0	120	120	115	107	100	
1,2	120	120	120	113	106	
1,4	120	120	120	120	112	
1,6	120	120	120	120	117	
2,0	120	120	120	120	120	

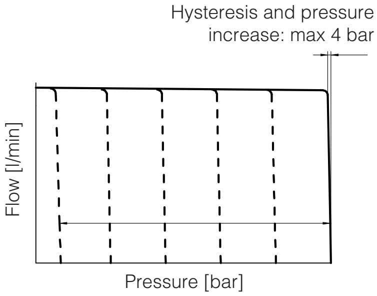
Example
Displacement: 80% - Inlet pressure: 1,0 bar - Speed: 115%

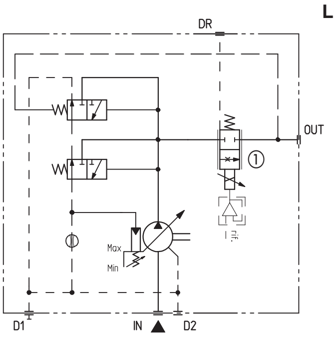


CZ

Proportional pressure control

Open loop control of the pump max pressure
The pumps displacement, and thus the flow, remains constant as far the pressure in the circuit reaches the value set on the proportional pilot valve ①, then the flow is reduced to maintain the circuit pressure to the value set by the electronic reference signal to the proportional valve. In this conditions the pressure in the circuit can be continuosly modulated by means of the reference signal.
Proportional pressure setting range: see below pressure control diagram.
Compensator setting range ②: 20÷350 bar (315 bar for 090)
Compensator factory setting ②: 280 bar (250 bar for 090)

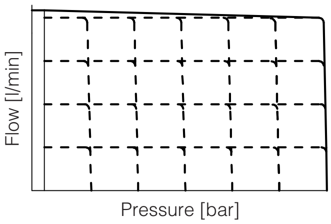




LQZ

Proportional flow (load-sensing)

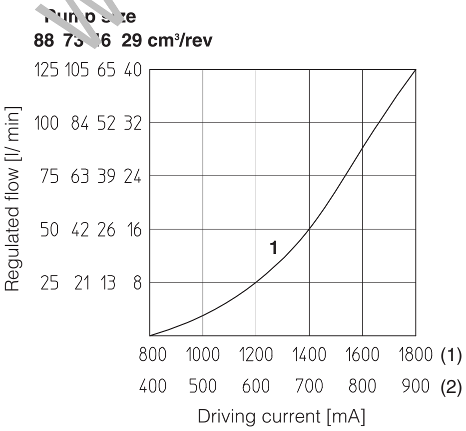
Open loop control of the pump flow independent to the cyrcuit load. The pump displacement is self adjusted to maintain a costant pressure drop across the proportional flow control valve ①.
The pump flow can be continuosly regulated by modulating the proportional valve ①.

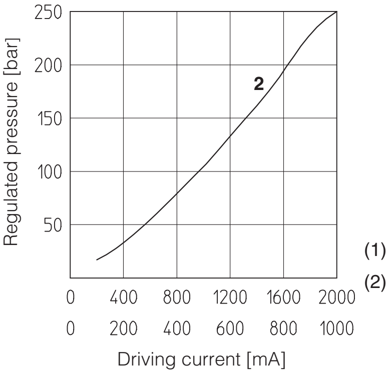


Diagrams for CZ, LQZ

Regulation diagrams
1 = Flow control
2 = Pressure control

(1) for standard 12 V_{DC} coil
(2) for 18 V_{DC} coil

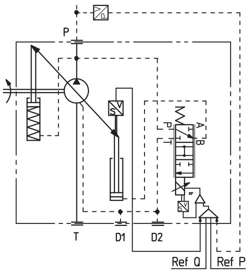




14 P/Q CONTROL

Pressure transducer not included

PES



P/Q control integrates the alternate pressure and flow regulation with the electronic max power limitation.
A remote pressure transducer must be installed on the system and its feedback has to be interfaced to the pump on-board digital driver.
Flow control is active when the actual system pressure is lower than the pressure reference input signal: the pump flow is regulated according to the flow reference input.
Pressure control is activated when the actual pressure grows up to the pressure reference input signal: the pump flow is then reduced in order to regulate and limit the max system pressure (if the pressure tends to decrease under its command value, the flow control returns active). This option allows to realize accurate dynamic pressure profiles.

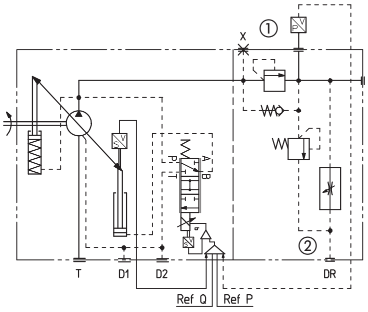
Following fieldbus interfaces are available:

- BC - CANopen interface
- BP - PROFIBUS DP interface
- EH - EtherCAT interface
- EW - POWRELINK interface
- EI - EtherNet/IP interface
- EP - PROFINET RT/IRT interface

The pumps with BC, BP, EH, EW, EI and EP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.
The digital control ensures high performances as flow and pressure linearity (see diagram 1), better flow knee (see diagram 2), internal leakage compensation (controlled flow independent to the load variations).

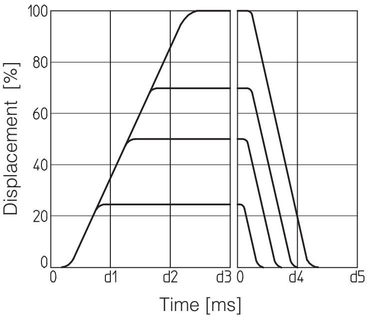
Pressure transducer included only for PERS/X

PERS
PERS/X

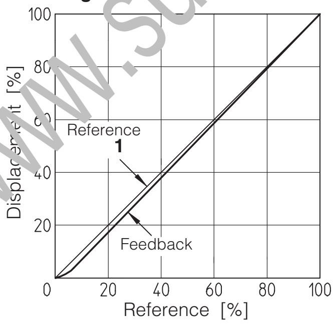


PVPC-PES	basic version, without sequence module and without pressure transducer, which has to be installed on the main line and wired to the 12 poles connector of the pump on-board digital driver.
PVPC-PERS	version with sequence module RESC ② which grant a minimum piloting pressure (18 bar) when the actual pressure falls below that value. Without pressure transducer.
PVPC-PERS/X	as PERS version plus integral pressure transducer, with output signal 4÷20 mA, factory wired to the pump on-board digital driver through a cable gland.

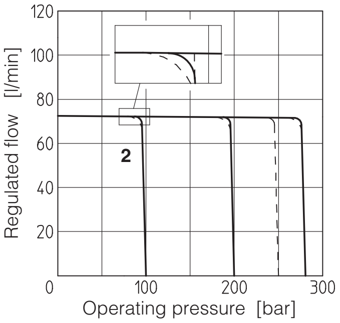
Response time



Regulated flow



P/Q control



Type pump	d1	d2	d3	d4	d5
	[ms]				
PVPC-PE(R)S-3029	30	60	90	30	60
PVPC-PE(R)S-4046	40	80	120	40	80
PVPC-PE(R)S-5073	50	100	150	50	100
PVPC-PE(R)S-5090	60	120	170	60	120
PVPC-PE(R)S-6140	90	180	200	90	180

Response time of displacement variation for a step change of the electronic reference signal.

15 PRESSURE TRANSDUCER SELECTION

The pressure transducer type E-ATR-8 must be ordered separately (see tech table **GS465**)
For /X option the pressure transducer with output signal 4 ÷ 20 mA is on-board to the pump.

Pump code:	**Pressure transducer code:**
PVPC-PE(R)S-*/200	E-ATR-8/250
PVPC-PE(R)S-*/250	E-ATR-8/400
PVPC-PE(R)S-*/280	E-ATR-8/400
PVPC-PE(R)S-*/200/*/C	E-ATR-8/250/I
PVPC-PE(R)S-*/250/*/C	E-ATR-8/400/I
PVPC-PE(R)S-*/280/*/C	E-ATR-8/400/I

16 ELECTRONICS OPTIONS - only for **PES** and **PERS**

I = This option provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.
It is normally used in case of long distance between the machine control unit and the valve or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

C = This option is available to connect pressure transducers with 4 ÷ 20 mA current output signal, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.

X = This option providing the presence of the pressure transducer, with output signal 4÷20 mA, integral to the pump and factory wired to the PES electronics through a cable gland (see 19.10).

S = Two on-off input signals are available on the main connector to select one of the four pressure PID parameters setting, stored into the driver (see 19.11).

17 POSSIBLE COMBINED OPTIONS

for **PES**:	for **PERS**:
/CI, /CS, /IS, /CIS	/CI, /CS, /IS, /IX, /SX, /CIS, /ISX

18 COIL VOLTAGE OPTION - only for **CZ** and **LQZ**

18 = Optional coil to be used with electronic drivers not supplied by Atos, with power supply 24 VDC and with max current limited to 1A.

19 POWER SUPPLY AND SIGNALS SPECIFICATIONS - only for **PES** and **PERS**

Generic electrical output signals of the pump (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).

19.1 Power supply (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers. In case of separate power supply see 19.2.

⚠ A safety fuse is required in series to each power supply: 2,5 A time lag fuse.

19.2 Power supply for driver's logic and communication (VL+ and VL0) - only for /S and /SX options for fieldbus executions

The power supply for driver's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.
The separate power supply for driver's logic on pin 9 and 10, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

⚠ A safety fuse is required in series to each driver's logic and communication power supply: 500 mA fast fuse.

19.3 Flow reference input signal (Q_INPUT+)

Functionality of Q_INPUT+ signal, is used as reference for the pump's flow.
Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Drivers with fieldbus interface can be software set to receive reference signal directly from the machine control unit (fieldbus reference). Analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

19.4 Pressure reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal, is used as reference for the driver pressure closed loop.
Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Drivers with fieldbus interface can be software set to receive reference signal directly by the machine control unit (fieldbus reference).
Analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

19.5 Flow monitor output signal (Q_MONITOR)

The driver generates an analog output signal proportional to the actual pump swashplate position; the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference, pilot spool position).
Monitor output signal is factory preset according to selected pump code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

19.6 Pressure monitor output signal (P_MONITOR)

The driver generates an analog output signal proportional to alternated pressure/force control; the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, force reference).
Monitor output signal is factory preset according to selected pump code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

19.7 Enable input signal (ENABLE) - only for /S and /SX options

To enable the driver, supply a 24 VDC on pin 3 (pin C): Enable input signal allows to enable/disable the current supply to the solenoid, without removing the electrical power supply to the driver; it is used to active the communication and the other driver functions when the valve must be disabled for safety reasons. This condition **does not comply** with norms IEC 61508 and ISO 13849.
Enable input signal can be used as generic digital input by software selection.

19.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 ÷ 20 mA input, spool position transducer cable broken, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC.
Fault status is not affected by the Enable input signal. Fault output signal can be used as digital output by software selection.

19.9 Pressure transducer input signal

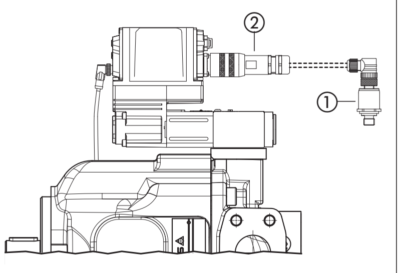
Analog pressure transducers can be directly connected to the driver.
Analog input signal is factory preset according to selected pump code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Refer to the pump technical table to transducer characteristics to select the transducer's maximum pressure.

Standard:
Remote pressure transducer can be directly connected to the main connector on the driver (see 20.1)

/S option
Remote pressure transducer can be directly connected to a dedicated M12 connector (see 20.4)

/X and /SX options
Integral-to-pump transducer is directly connected with a dedicated M12 connector and no remote transducer is required;
current input signal (4 ÷ 20 mA) of the integral transducer allows cable break detection functionality

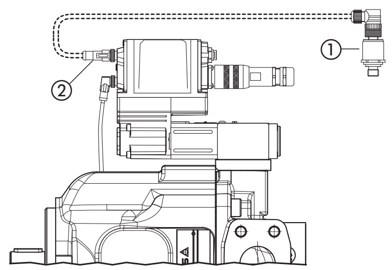
Standard



① = **remote transducer**
② = **main connector**

Note: ① and ② to be ordered separately

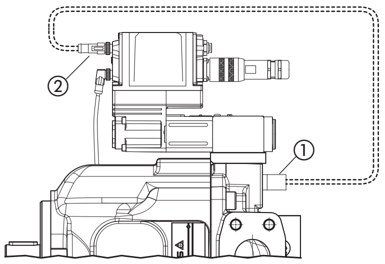
/S option



① = **remote transducer**
② = **M12 connector**

Note: ① and ② to be ordered separately

/X and /SX options



① = **integral transducer**
② = **M12 connector**

Note: ① and ② included

19.10 Logic Input Signal (D_IN) - only for **standard** and **standard** with **/X** option

D_IN on-off input signal can be software set to perform one of the following functions:
- enable and disable the driver functioning; apply 0 VDC to disable and 24 VDC to enable the driver - see 19.7
- switch between two pressure PID settings; apply 0 VDC to select SET1 pressure PID and 24 VDC to select SET2 - see 19.11
- enable and disable the power limitation function; default setting, apply 0V to disable and 24VDC to enable the power limitation - see 19.13

19.11 Multiple PID selection (D_IN0 and D_IN1) - only for **/S** and **/SX** options in **NP** execution

Two on-off input signals are available on the main connector to select one of the four pressure PID parameters setting, stored into the driver.
Switching the active setting of pressure PID during the machine cycle allows to optimize the system dynamic response in different hydraulic working conditions (volume, flow, etc.).
Supply a 24 VDC or a 0 VDC on pin 9 and/or pin 10, to select one of the PID settings as indicated by binary code table at side. Gray code can be selected by software.

	PID SET SELECTION			
PIN	**SET 1**	**SET 2**	**SET 3**	**SET 4**
9	0	24 VDC	0	24 VDC
10	0	0	24 VDC	24 VDC

19.12 Multiple pressure PID (1)

Four sets for pressure PID parameters are stored into the driver: switching in real-time the active pressure PID parameters during machine cycle allows to optimize the system dynamic response in different hydraulic working conditions (volume, flow, etc.).
The available commands to switch these PID pressure sets depend on the driver execution:

Fieldbus	Driver	Commands
NP	Standard and Standard with /X option	1 on-off input on main connector allow to switch the 2 PID parameters (SET1 and SET2, see 4.10)
	/S and /SX options	2 on-off inputs allow to switch the 4 PID parameters set (SET1.. SET4 - see 4.11)
BC, BP, EH, EW, EI, EP	All versions	real-time fieldbus communication can switch between the 4 PID parameters set (SET1 - SET4 - see driver manuals)

19.13 Hydraulic Power Limitation (1)

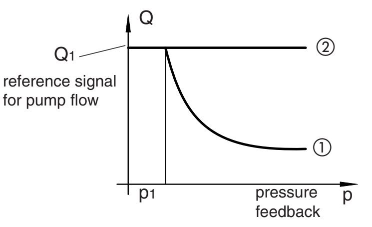
A limit to the maximum pump's hydraulic power can be software set into the driver thus limiting the electric power consumption of the motor coupled to the pump: when the actual requested hydraulic power **p**x**Q** (pressure transducer feeback x flow reference value) reaches the max power limit (p1xQ1), the driver automatically reduces the flow pump regulation.

The higher is the pressure feedback the lower is the pumps's regulated flow:

$$\text{Flow regulation} = \text{Min}\left(\frac{\text{Power Limit [kW]}}{\text{Pressure Feedback [bar]}} \text{ X } \frac{1}{\text{Flow Full Scale [l/min]}}\ ;\ \text{Flow Reference}\right)$$

The hydraulic power limitation, disabled as default, can be enabled using the Atos pc software or the fieldbus communication (fieldbus executions).
Standard and standard with /X option allow also to enable and disable this function during the machine cycle, using the D_IN on-off input available on the main connector (see 19.11).

19.13 - Hydraulic Power Limitation



regulation curve ① with and ② without power limitation.
p1 x Q1 = max power limit

(1) The sections 19.12 and 19.13 are a brief description of the settings and features of digital drivers with alternated P/Q control. For a detailed descriptions of available settings, wirings and installation procedures, please refer to the user manual included in the E-SW programming software:
E-MAN-RI-PES - user manual for **PES-S** digital drivers

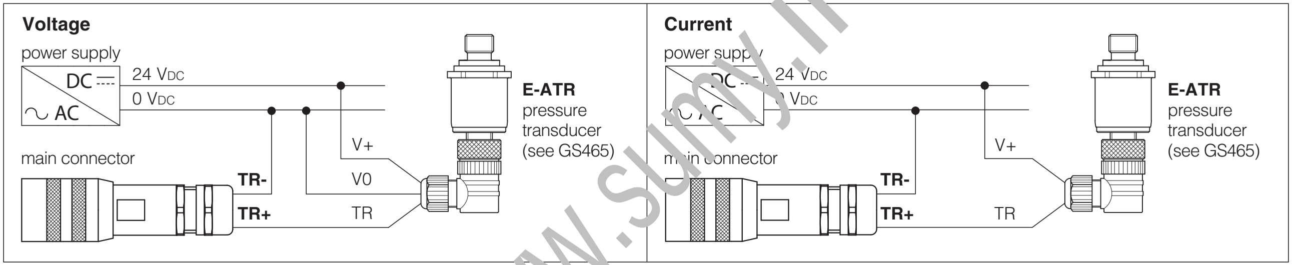
20 ELECTRONIC CONNECTIONS

20.1 Main connector signals - 12 pin Ⓐ **Standard** and **Standard** with **/X** option - for **PES** and **PERS**

PIN	Standard	/X	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**		Power supply 24 VDC	Input - power supply
2	**V0**		Power supply 0 VDC	Gnd - power supply
3	**FAULT**		Fault (0 VDC) or normal working (24 VDC), referred to V0	Output - on/off signal
4	**INPUT-**		Negative reference input signal for Q_INPUT+ and P_INPUT+	Gnd - analog signal
5	**Q_INPUT+**		Flow reference input signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
6	**Q_MONITOR**		Flow monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option. Referred to V0	Output - analog signal **Software selectable**
7	**P_INPUT+**		Pressure reference input signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
8	**P_MONITOR**		Pressure monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option. Referred to V0	Output - analog signal **Software selectable**
9	**D_IN**		Function software selectable between: power limitation enable (default), multiple pressure PID selection or pump enable (24 VDC) / disable (0 VDC). Referred to V0	Input - on/off signal
10	**TR+**		Remote pressure transducer input signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /C option	Input - analog signal **Software selectable**
		NC	Do not connect	
11	**TR-**		Negative pressure transducer input signal for TR+	Input - analog signal
		NC	Do not connect	
PE	**EARTH**		Internally connected to driver housing	

Note: these connections are the same of Rexroth A10VSO axial piston pumps, model SYDFEE and SYDFEC

Remote pressure transducer connections - only for **Standard**



20.2 Main connector signals - 12 pin Ⓐ **/S** and **/SX** option - for **PES** and **PERS**

PIN	/S and /SX		TECHNICAL SPECIFICATIONS	NOTES
	NP	Fieldbus		
1	**V+**		Power supply 24 VDC	Input - power supply
2	**V0**		Power supply 0 VDC	Gnd - power supply
3	**ENABLE** referred to: V0	VL0	Enable (24 VDC) or disable (0 VDC) the pump	Input - on/off signal
4	**Q_INPUT+**		Flow reference input signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
5	**INPUT-**		Negative reference input signal for Q_INPUT+ and P_INPUT+	Input - analog signal
6	**Q_MONITOR** referred to: V0	VL0	Flow monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
7	**P_INPUT+**		Pressure reference input signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
8	**P_MONITOR** referred to: V0	VL0	Pressure monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are 0÷+10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
9	**D_IN0**		Function software selectable between: multiple pressure PID 0 selection (default) or power limitation enable. Referred to V0	Input - on/off signal
		VL+	Power supply 24 VDC for driver's logic and communication	Input - power supply
10	**D_IN1**		Function software selectable between: multiple pressure PID 1 selection (default) or power limitation enable. Referred to V0	Input - on/off supply
		VL0	Power supply 0 VDC for driver's logic and communication	Gnd - power supply
11	**FAULT** referred to: V0	VL0	Fault (0 VDC) or normal working (24 VDC)	Output - on/off signal
PE	**EARTH**		Internally connected to driver housing	

Notes: these connections are the same of Moog radial piston pumps, model RKP-D;
do not disconnect VL0 before VL+ when the driver is connected to PC USB port

20.3 Communications connectors - for **PES** and **PERS** Ⓑ - Ⓒ

Ⓑ	**USB connector - M12 - 5 pin** always present	
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**+5V_USB**	Power supply
2	**ID**	Identification
3	**GND_USB**	Signal zero data line
4	**D-**	Data line -
5	**D+**	Data line +

C1 C2	**BC fieldbus execution, connector - M12 - 5 pin**	
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**CAN_SHLD**	Shield
2	**not used**	C1 - C2 pass-through connection (2)
3	**CAN_GND**	Signal zero data line
4	**CAN_H**	Bus line (high)
5	**CAN_L**	Bus line (low)

C1 C2	**BP fieldbus execution, connector - M12 - 5 pin**	
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**+5V**	Termination supply signal
2	**LINE-A**	Bus line (high)
3	**DGND**	Data line and termination signal zero
4	**LINE-B**	Bus line (low)
5	**SHIELD**	

C1 C2	**EH, EW, EI, EP fieldbus execution, connector - M12 - 4 pin**	
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**TX+**	Transmitter
2	**RX+**	Receiver
3	**TX-**	Transmitter
4	**RX-**	Receiver
Housing	**SHIELD**	

(1) Shield connection on connector's housing is recommended

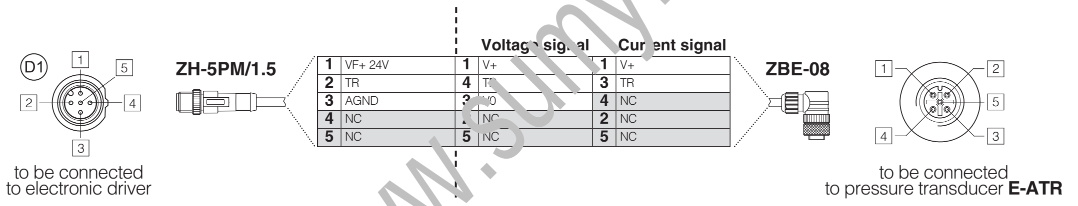
(2) Pin 2 can be fed with external +5V supply of CAN interface

20.4 Remote pressure/force transducer connector - M12 - 5 pin - for **PES** and **PERS** with for **/S, /X, /SX** options D1 - D2

PIN	**SIGNAL**	**TECHNICAL SPECIFICATION**	**NOTES**	**Voltage**	**Current**
1	**VF +24V**	Power supply +24VDC	Output - power supply	Connect	Connect
2	**TR1**	Signal transducer: ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect
3	**AGND**	Common gnd for transducer power and signals	Common gnd	Connect	/
4	**NC**	Not connect		/	/
5	**NC**	Not connect		/	/

Remote pressure transducer connection - example

for **/S** option



		Voltage signal		Current signal	
1	VF+ 24V	**1**	V+	**1**	V+
2	TR	**4**	TR	**3**	TR
3	AGND	**3**	V0	**4**	NC
4	NC	**2**	NC	**2**	NC
5	NC	**5**	NC	**5**	NC

to be connected
to electronic driver

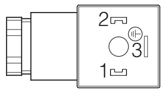
to be connected
to pressure transducer **E-ATR**

Note: connectors front view

20.5 Solenoid connection - for **CZ** and **LQZ**

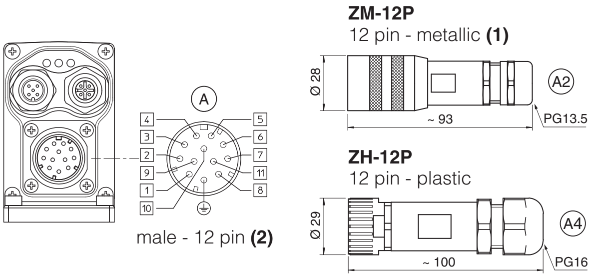
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION**
1	**COIL**	Power supply
2	**COIL**	Power supply
3	**GND**	Ground

Connector code 666

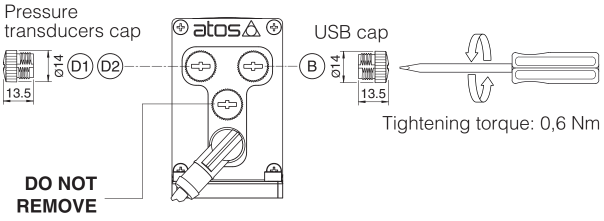


20.6 PES and PERS connections layout

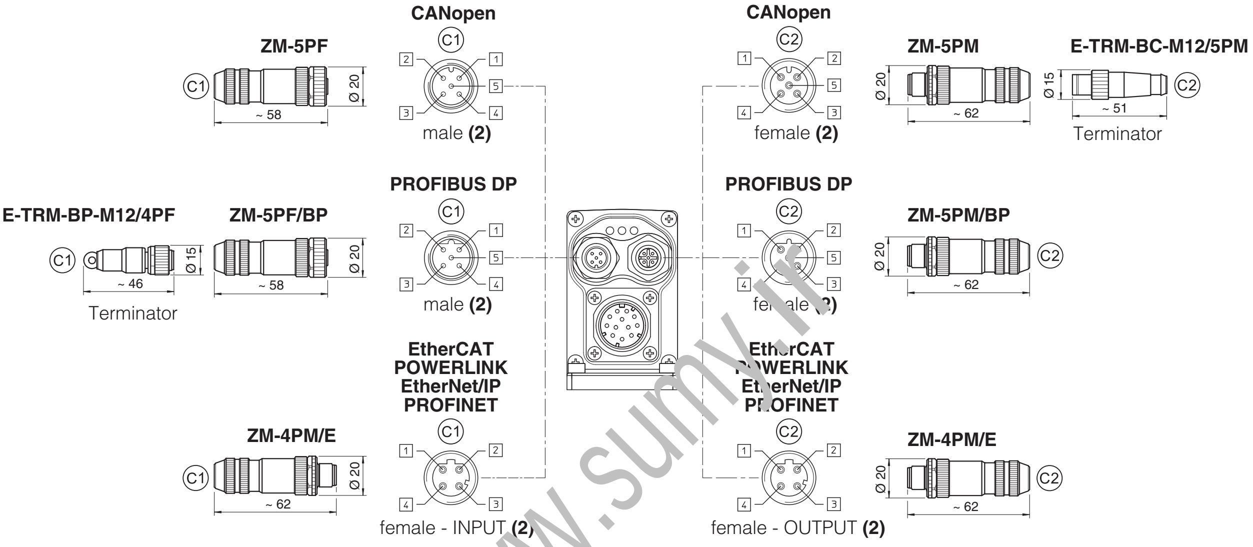
MAIN CONNECTORS



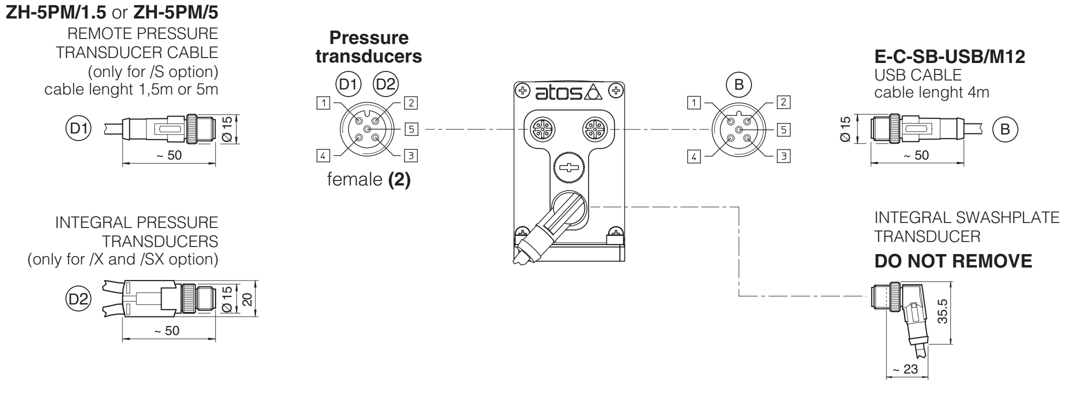
PLASTIC PROTECTION CAPS - supplied with the valves



FIELDBUS CONNECTORS



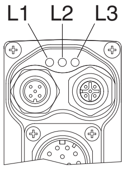
TRANSDUCERS AND USB CONNECTORS



(1) Use of metallic connectors is strongly recommended in order to fulfill EMC requirements **(2)** Pin layout always referred to driver's view

20.7 Diagnostic LEDs (L)

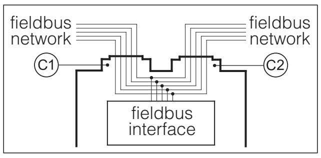
Three leds show driver operative conditions for immediate basic diagnostics. Please refer to the driver user manual for detailed information.

FIELDBUS **LEDS**	**NP** **Not Present**	**BC** **CANopen**	**BP** **PROFIBUS DP**	**EH** **EtherCAT**	**EW** **POWERLINK**	**EI** **EtherNet/IP**	**EP** **PROFINET**	
L1	VALVE STATUS			LINK/ACT				
L2	NETWORK STATUS			NETWORK STATUS				
L3	SOLENOID STATUS			LINK/ACT				

21 IN / OUT FIELDBUS COMMUNICATION CONNECTORS

Two fieldbus communication connectors are always available for digital driver executions BC, BP, EH, EW, EI, EP. This features allows considerable technical advantages in terms of installation simplicity, wirings reduction and also avoid the usage expensive T-connectors.
For BC and BP executions the fieldbus connectors have an internal pass-through connection and can be used like end point of the fieldbus network, using an external terminator (see tech table **AS800**).
For EH, EW, EI and EP execution the external terminators are not required: each connector is internally terminated.

BC and BP pass-through connection



22 CONNECTORS CHARACTERISTICS - to be ordered separately

22.1 Main connectors

CONNECTOR TYPE	POWER SUPPLY	POWER SUPPLY
CODE	(A1) **ZM-12P**	(A2) **ZH-12P**
Type	12pin female straight circular	12pin female straight circular
Standard	DIN 43651	DIN 43651
Material	Metallic	Plastic reinforced with fiber glass
Cable gland	PG13,5	PG16
Recommended cable	LiYCY 12 x 0,75 mm^2 max 20 m (logic and power supply)	LiYCY 10 x 0,14mm^2 max 40 m (logic) LiYY 3 x 1mm^2 max 40 m (power supply)
Conductor size	0,5 mm^2 to 1,5 mm^2 - available for 12 wires	0,14 mm^2 to 0,5 mm^2 - available for 9 wires 0,5 mm^2 to 1,5 mm^2 - available for 3 wires
Connection type	to crimp	to crimp
Protection (EN 60529)	IP 67	IP 67

22.2 Fieldbus communication connectors

CONNECTOR TYPE	**BC CANopen** (1)		**BP PROFIBUS DP** (1)		**EH EtherCAT, EW POWERLINK, EI EtherNet/IP, EP PROFINET** (2)
CODE	(C1) **ZM-5PF**	(C2) **ZM-5PM**	(C1) **ZM-5PF/BP**	(C2) **ZM-5PM/BP**	(C1) (C2) **ZM-4PM/E**
Type	5 pin female straight circular	5 pin male straight circular	5 pin female straight circular	5 pin male straight circular	4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding B – IEC 61076-2-101		M12 coding D – IEC 61076-2-101
Material	Metallic		Metallic		Metallic
Cable gland	Pressure nut - cable diameter 6÷8 mm		Pressure nut - cable diameter 6÷8 mm		Pressure nut - cable diameter 4÷8 mm
Cable	CANbus Standard (DR 303-1)		PROFIBUS DP Standard		Ethernet standard CAT-5
Connection type	screw terminal		screw terminal		terminal block
Protection (EN 60529)	IP67		IP 67		IP 67

(1) E-TRM-** terminators can be ordered separately, see tech table **AS800**

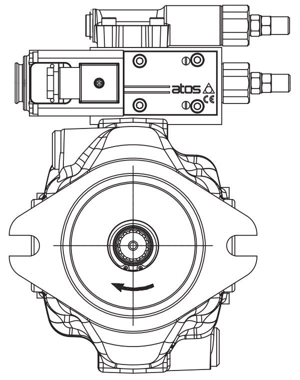
(2) Internally terminated

22.3 Remote pressure transducer connectors

CONNECTOR TYPE	PRESSURE TRANSDUCER		SF - Double transducers
CODE	(D1) (D2) **ZH-5PM/1.5**	(D1) (D2) **ZH-5PM/5**	(D2) **ZH-5PM-2/2**
Type	5 pin male straight circular		4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding A – IEC 61076-2-101
Material	Plastic		Plastic
Cable gland	Connector moulded on cables 1,5 m lenght	5 m lenght	Connector moulded on cables 2 m lenght
Cable	5 x 0,25 mm^2		3 x 0,25 mm^2 (both cables)
Connection type	molded cable		splitting cable
Protection (EN 60529)	IP 67		IP 67

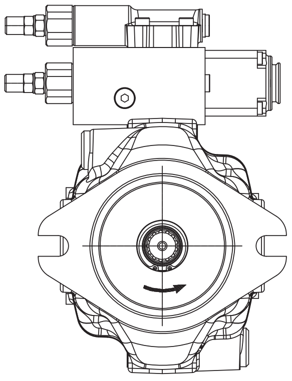
23 DIRECTION OF ROTATION

version D
clockwise rotation
viewed at the shaft end



Pumps with clockwise rotation (**D**)
have the IN and OUT as shown
in all representation of catalogue

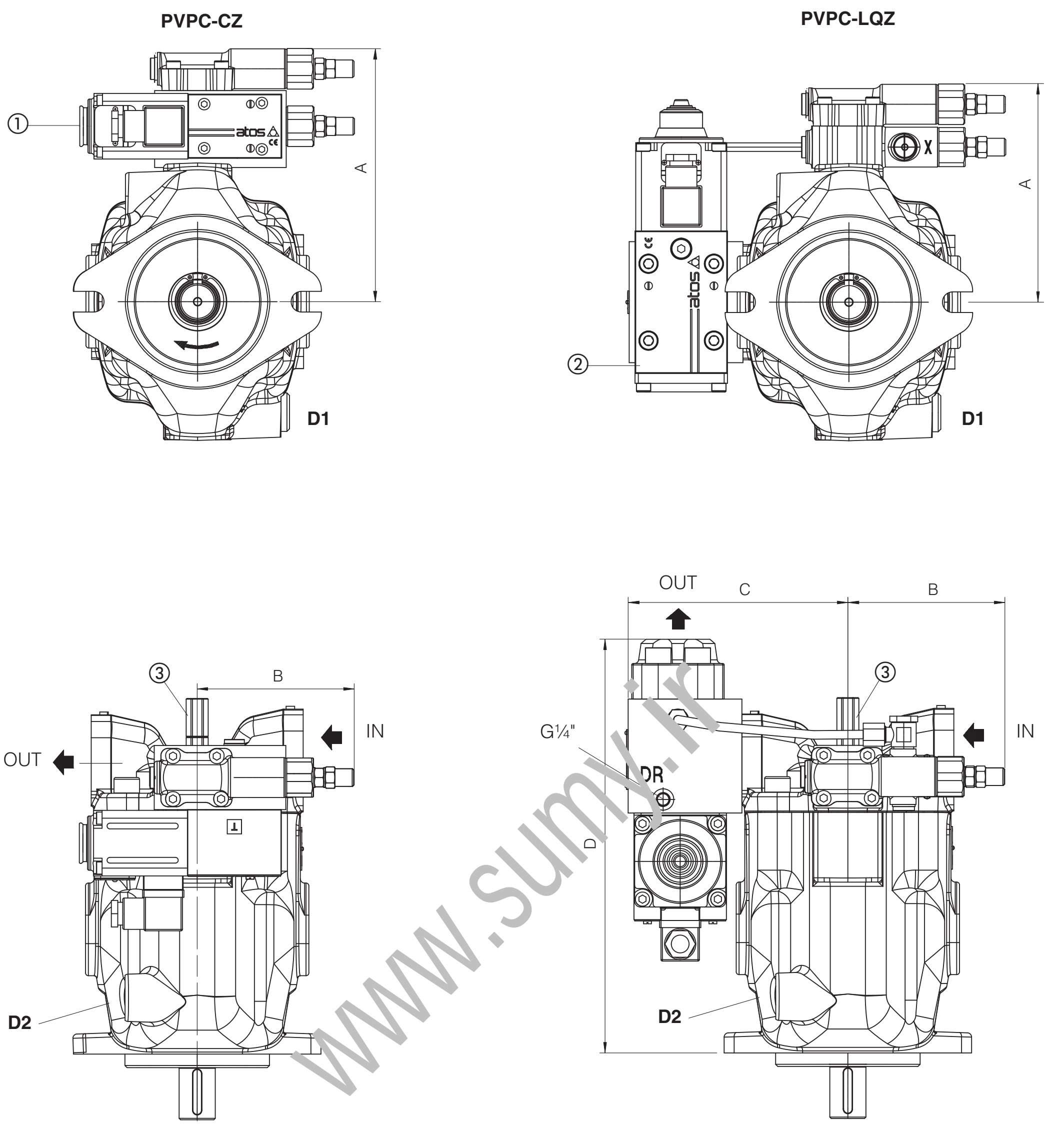
version S
counterclockwise rotation
viewed at the shaft end



Pumps with counterclockwise rotation (**S**)
have the IN and OUT inverted and
consequently the position of the
electrohydraulic proportional controls

24 INSTALLATION DIMENSION [mm]

DIMENSIONS OF PVPC size 3, 4 and 5



① = Proportional pressure control valve

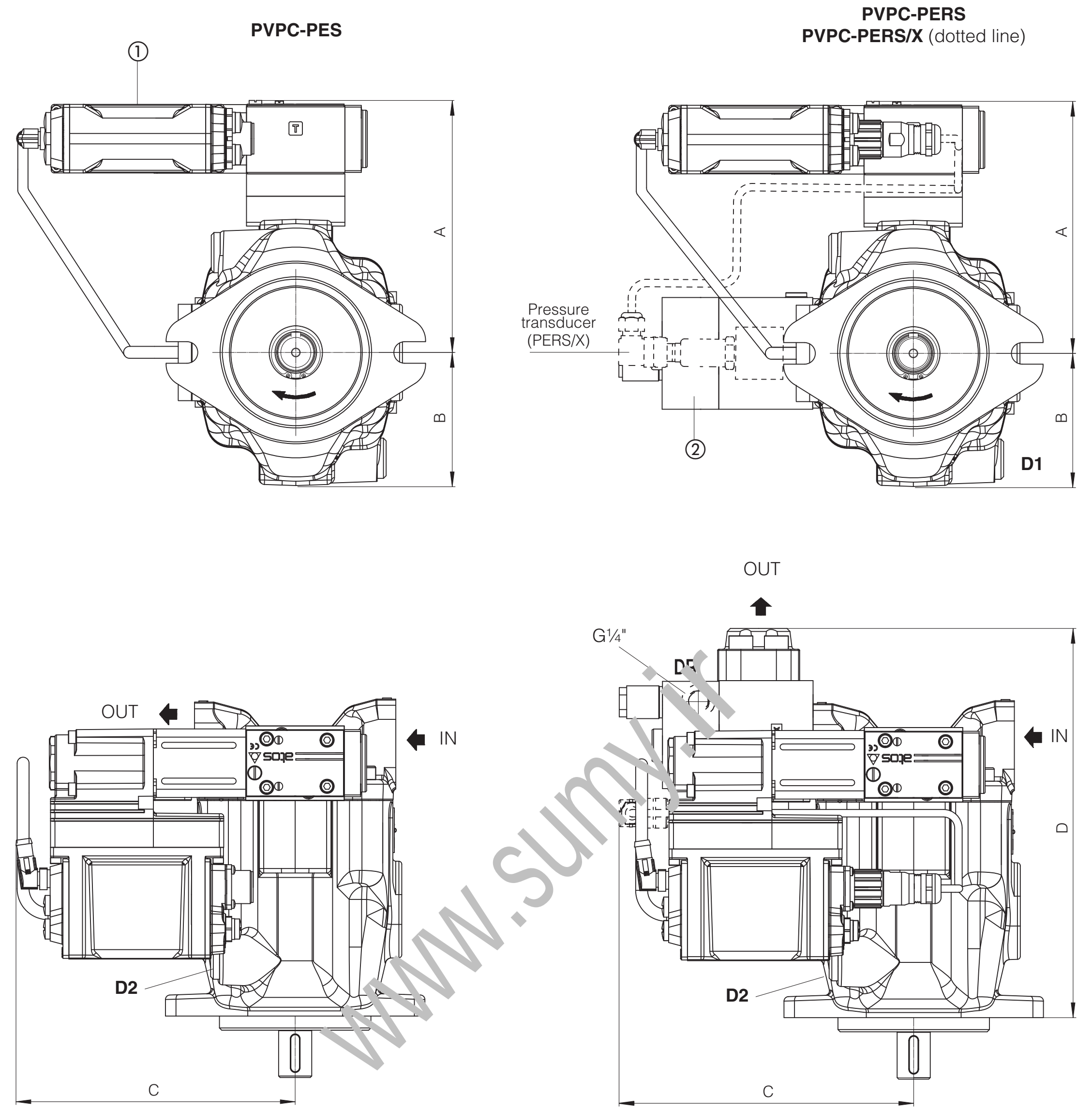
② = Proportional flow control valve

③ = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement (not available for versions PES, PERS and PERS/X). In case of double pump the regulation screw is not always available, please contact our technical office.

Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and consequently also the position of the control devices.

Pump type	Version	A	B	C	D	IN	OUT	D1, D2	Mass (kg)
PVPC-*-3029	**CZ**	168	111	-	-	Flange SAE 3000 1 1/4”	Flange SAE 6000 3/4”	1/2” BSPP	22
	LQZ	144	111	132	257				24
PVPC-*-4046	**CZ**	177	111	-	-	Flange SAE 3000 1 1/2”	Flange SAE 6000 1”	1/2” BSPP	28
	LQZ	153	111	156	293				33,6
PVPC-*-5073 PVPC-*-5090	**CZ**	190	111	-	-	Flange SAE 3000 2”	Flange SAE 6000 1 1/4”	3/4” BSPP	36,9
	LQZ	166	111	163	328				44

DIMENSIONS OF PVPC size 3, 4 and 5

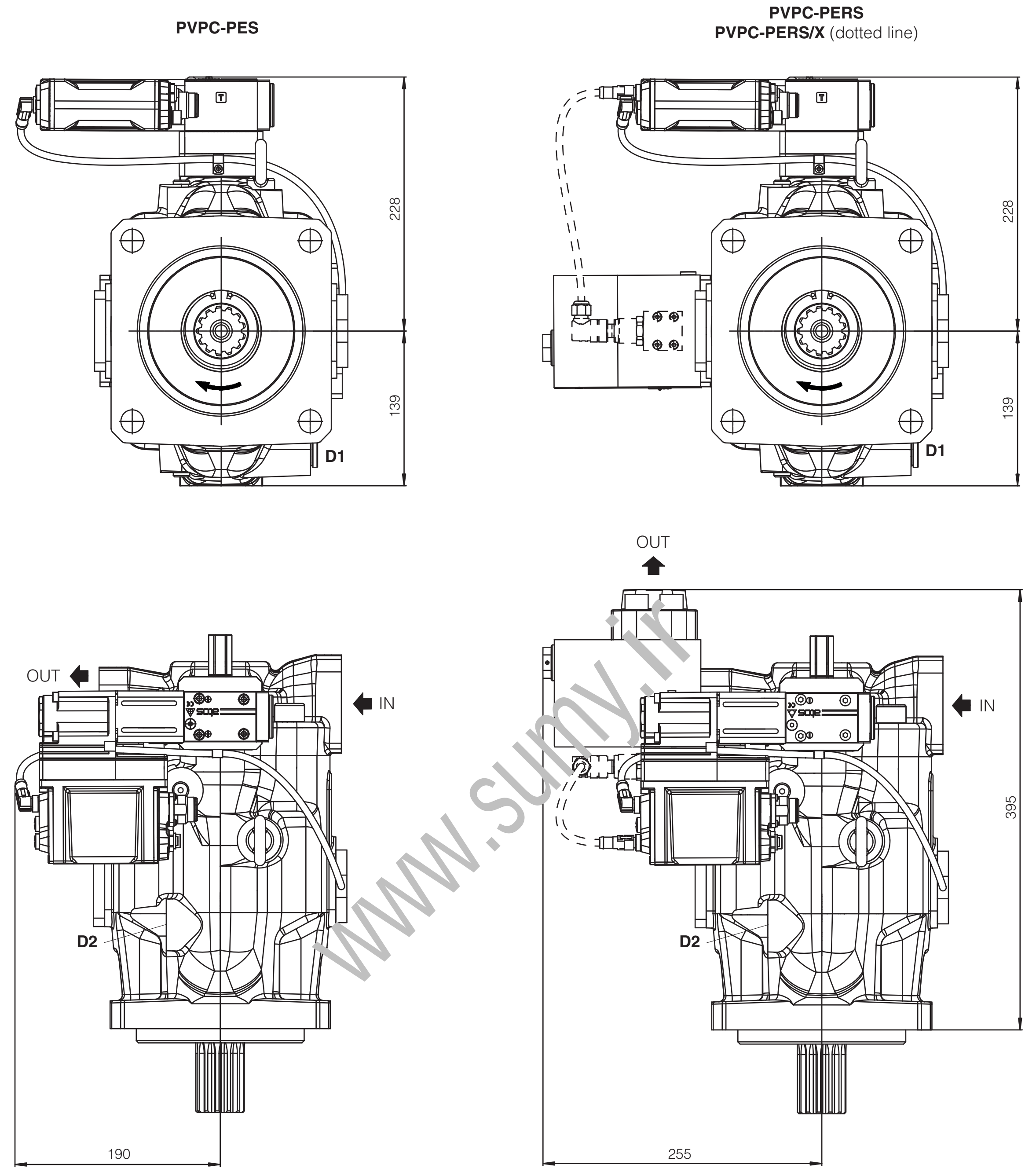


① = Proportional valve with on-board driver with P/Q control
② = Sequence module

Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and consequently also the position of the control devices.

Pump type	Version	A	B	C	D	IN	OUT	D1, D2	Mass (kg)
PVPC-*-3029	**PES**	170	103,5	190	-	Flange SAE 3000 1 1/4”	Flange SAE 6000 3/4”	1/2” BSPP	21,6
	PERS	170	103,5	200	262,5				26
	PERS/X	190	103,5	200	262,5				26,4
PVPC-*-4046	**PES**	178	103,5	190	-	Flange SAE 3000 1 1/2”	Flange SAE 6000 1”	1/2” BSPP	27,6
	PERS	178	103,5	220	299				33,7
	PERS/X	178	103,5	220	299				34,1
PVPC-*-5073 PVPC-*-5090	**PES**	190	103,5	190	-	Flange SAE 3000 2”	Flange SAE 6000 1 1/4”	3/4” BSPP	36,6
	PERS	190	103,5	230	337				46,7
	PERS/X	190	103,5	230	337				47,1

DIMENSIONS OF PVPC size 6



① = Proportional valve with on-board driver with P/Q control
② = Sequence module

Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and consequently also the position of the control devices.

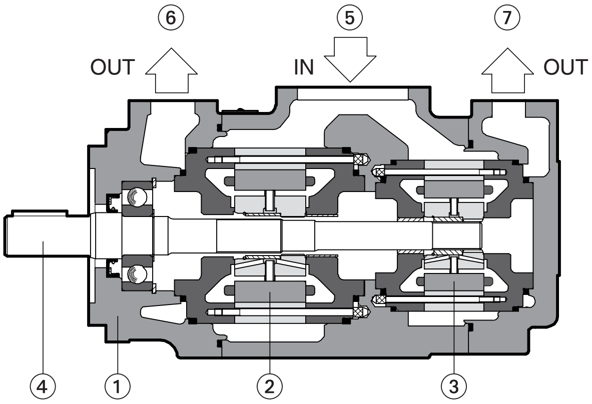
Pump type	Version	IN	OUT	D1, D2	Mass (kg)
PVPC-*-6140	**PES**	Flange SAE 3000 2 1/2”	Flange SAE 6000 1 1/4”	1 1/16”-12UNF	72,7
	PERS				82,8
	PERS/X				83,2

25 RELATED DOCUMENTATION

A900	Operating and maintenance information for pumps
AS800	Programming tools
FS001	Basics for digital electrohydraulics
FS500	Digital proportional valves with P/Q control
FS900	Operating and maintenance information for proportional valves
G010	E-MI-AC analog driver
G020	E-MI-AS-IR digital driver
G030	E-BM-AS digital driver
GS050	E-BM-AES digital driver
GS510	Fieldbus
K800	Electric and electronic connectors
P005	Mounting surfaces for electrohydraulic valves
E-MAN-RI-PES	PES user manual

Double vane pumps type PFED

fixed displacement



① Pump body
② First cartridge
③ Second cartridge
④ Shaft
⑤ IN port - SAE 3000 flange
⑥ First OUT port
⑦ Second OUT port

PFED-43

PFED are fixed displacement double vane pumps composed by two cartridges ②③ assembled into a main body having one IN port ⑤ and two indipendent OUT ports ⑥⑦.

Pumps are available with 2 body sizes:
PFED-43: SAE B mounting flange
fist element from 29 to 85 cc/rev
second element from 16 to 44 cc/rev
FPED-54: SAE C mounting flange
fist element from 90 to 150 cc/rev
second element from 29 to 85 cc/rev.

They can be assembled, with fixed vane pump type PFEX-4 and PFEX-5 to obtain triple pumps PFEXD, see table A190.

Easy installation as inlet and outlet ports can be assembled in any of four relative positions.

Simplified maintenance as pumping cartridge can be easily replaced.

Displacements: **from 29+16 up to 150+85 cm^3/rev.**
Max pressure **up to 210 bar.**

1 MODEL CODE

PFED	-	43	045	/	022	/	1	D	TA	*	/	*

Fixed displacement double vane pump

Ports orientation, see section 5

Series number

Seals material: see section 4
- = NBR
PE = FPM

Direction of rotation (as viewed at the shaft end):
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise

Note: PFED are not reversible

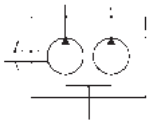
Size:
43 = displacement from 29+16 to 85+45 cm^3/rev
54 = displacement from 90+29 to 150+85 cm^3/rev

Drive shaft, see section 7 and 8:
cylindrical, keyed
1 = standard
2 = according to ISO/DIN 3019
3 = for high torque applications
splined
5 = for PFED-43: SAE B 13T 16/32 DP (13 teeth)
for PFED-54: SAE C 14T 12/24 DP (14 teeth)
6 = for PFED-43: SAE C 14T 12/24 DP (14 teeth)
7 = for PFED-43: SAE C 14T 12/24 DP (14 teeth) assembled in multiple pumps PFEXD and PFRXDE - see tech. table A190

Displacement of first element [cm^3/rev], see sec. 3

Displacement of second element [cm^3/rev], see sec. 3

1.1 HYDRAULIC SYMBOL



2 GENERAL CHARACTERISTICS

Assembly position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peak.
Ambient temperature range	-20°C ÷ +80°C
Compliance	REACH Regulation (EC) n°1907/2006 RoHS Directive 2011/65/EU as last update by 2015/863/EU

3 HYDRAULIC CHARACTERISTICS

Size code	**PFED-43**																										
First element displacement code	**029**			**037**				**045**					**056**					**070**					**085**				
First element displacement [cm³/rev]	29.3			36.6				45.0					55.8					69.9					85.3				
Second element displacement code	**016**	**022**	**028**	**016**	**022**	**028**	**036**	**016**	**022**	**028**	**036**	**044**	**016**	**022**	**028**	**036**	**044**	**016**	**022**	**028**	**036**	**044**	**016**	**022**	**028**	**036**	**044**
Second element displacement [cm³/rev]	16.5	21.5	28.1	16.5	21.5	28.1	35.6	16.5	21.5	28.1	35.6	43.7	16.5	21.5	28.1	35.6	43.7	16.5	21.5	28.1	35.6	43.7	16.5	21.5	28.1	35.6	43.7
Max working pressure (1) [bar]	210																										
Recommended pressure on inlet port	from -0,15 to +1,5 bar for speed up to 1800 rpm; from 0 to +1,5 bar for speed over to 1800 rpm;																										
Min speed [rpm]	800																										
Max speed (2) [rpm]	2500																						2000				

Size code	**PFED-54**																							
First element displacement code	**090**						**110**						**129**						**150**					
First element displacement [cm³/rev]	90.0						109.6						129.2						150.2					
Second element displacement code	**029**	**037**	**045**	**056**	**070**	**085**	**029**	**037**	**045**	**056**	**070**	**085**	**029**	**037**	**045**	**056**	**070**	**085**	**029**	**037**	**045**	**056**	**070**	**085**
Second element displacement [cm³/rev]	29.3	36.6	45.0	55.8	69.9	85.3	29.3	36.6	45.0	55.8	69.9	85.3	29.3	36.6	45.0	55.8	69.9	85.3	29.3	36.6	45.0	55.8	69.9	85.3
Max working pressure (1) [bar]	210																							
Recommended pressure on inlet port	from -0,15 to +1,5 bar for speed up to 1800 rpm; from 0 to +1,5 bar for speed over to 1800 rpm;																							
Min speed [rpm]	800																							
Max speed (2) [rpm]	2000						2200					2000	2200					2000	1800					

(1) Max pressure is 160 bar for HFDU, HFDR and HFC fluids

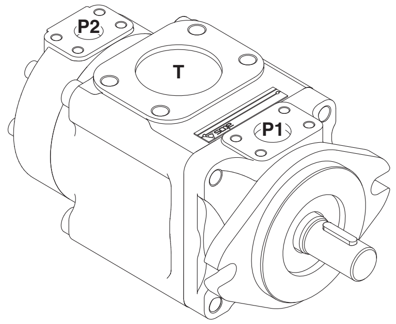
(2) Max speed is 1800 HFDU, HFDR fluids; 1500 rpm for HFC fluid

4 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	10÷100 mm^2/s - max at cold start 800 mm^2/s		
Max fluid contamination level normal operation	ISO4406 class 21/19/16 NAS1638 class 10		see also filter section at www.atos.com or KTF catalog
longer life	ISO4406 class 18/16/13 NAS1638 class 8		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR **(1)**	ISO 12922
Flame resistant with water	NBR	HFC **(1)**	

(1) See performance restrictions at section 2

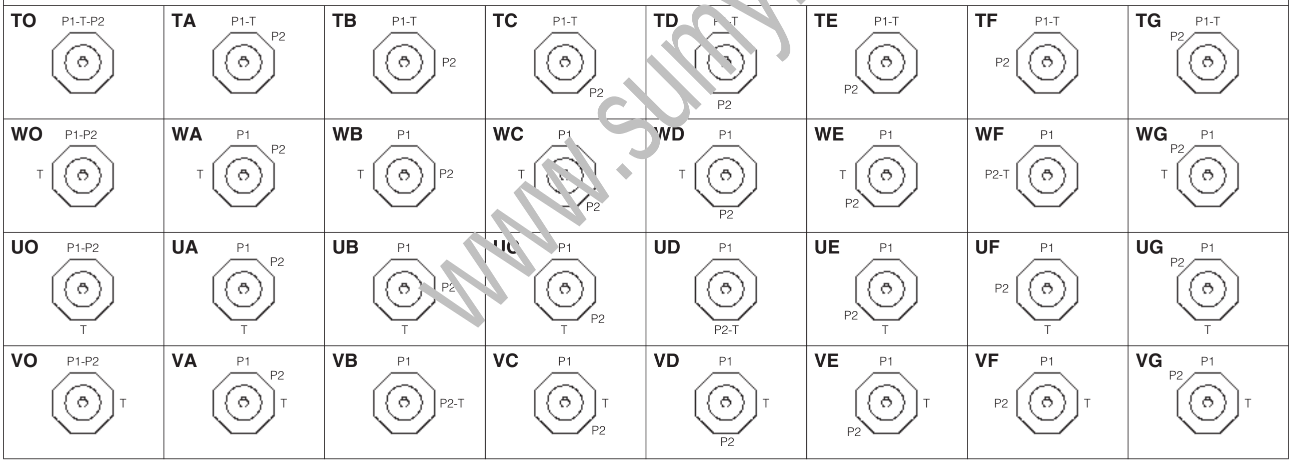
5 PORT ORIENTATION



Pumps can be supplied with the oil ports oriented in different configuration in relation to the drive shaft. Port orientation of the first elementis designated as follows (as wiewed at the shaft end);

T = inlet and outlet ports on the same axis (standard)
U = outlet orientated 180° with respect to the inlet
V = outlet oriented 90° with respect to the inlet
W = outlet oriented 270° with respect to the inlet

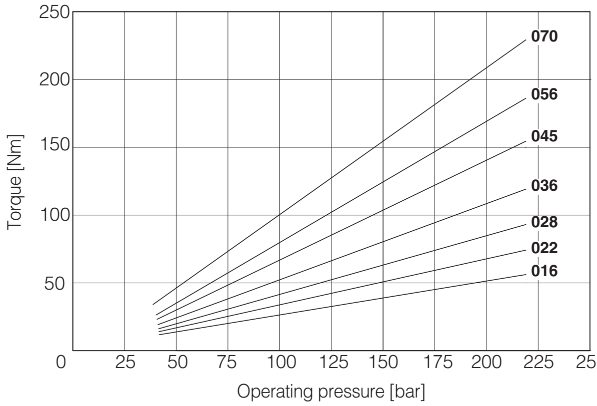
Outlet port of second element can be orientated, relative to the inlet port, in 8 positions at 45° **(O, A, B, C, D, E, F, G)**
Ports orientation can be easily changed by rotating the pump body that carries inlet port.

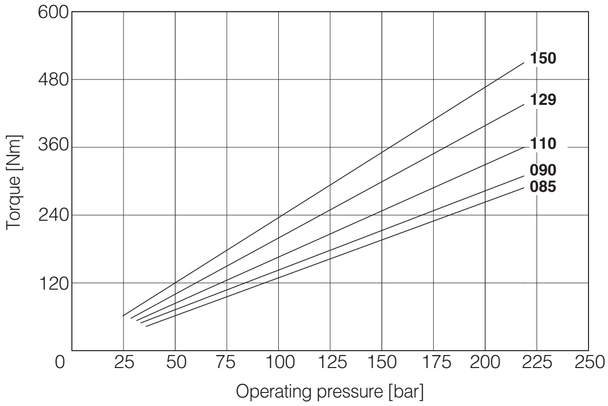


P1 = outlet port of first element; **P2** = outlet port of second element; **T** = inlet port

6 DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

6.1 Torque versus pressure diagram

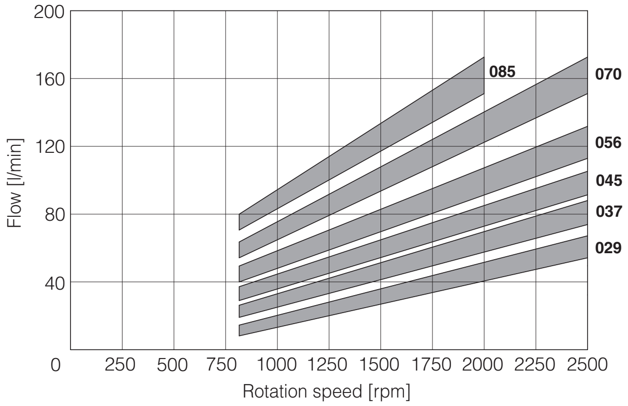




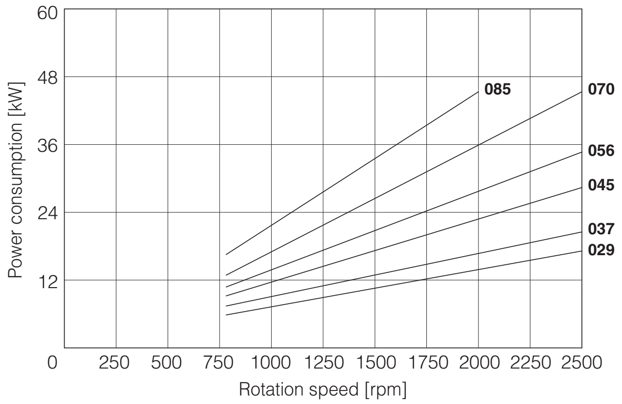
Note: values in above diagrams refer to the torque required to operate each single cartridge. The total torque applied to the pump shaft is given by the sum of the torque of each single cartridge (first element + second element)

6.2 PFED-43 FIRST ELEMENT

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

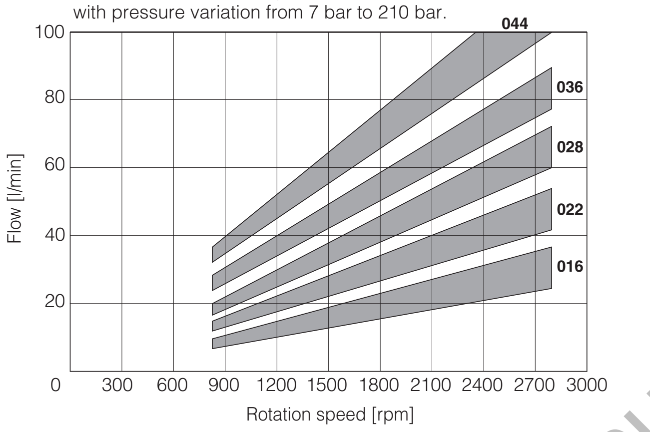


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

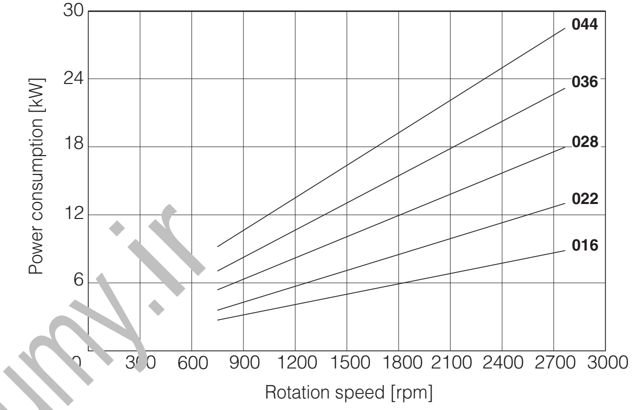


6.3 PFED-43 SECOND ELEMENT

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

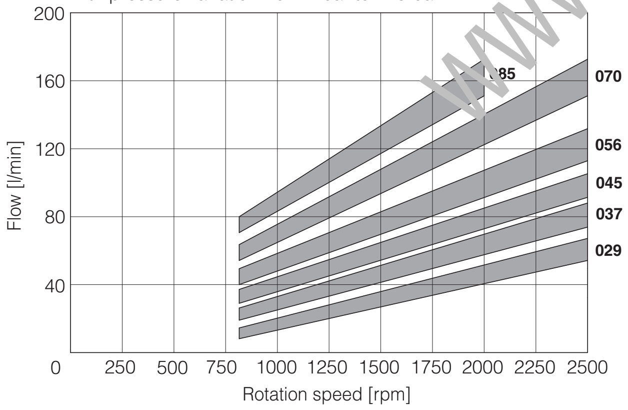


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

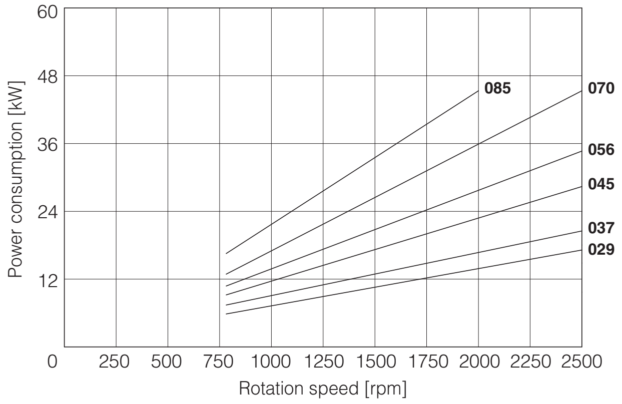


6.4 PFED-54 FIRST ELEMENT

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.

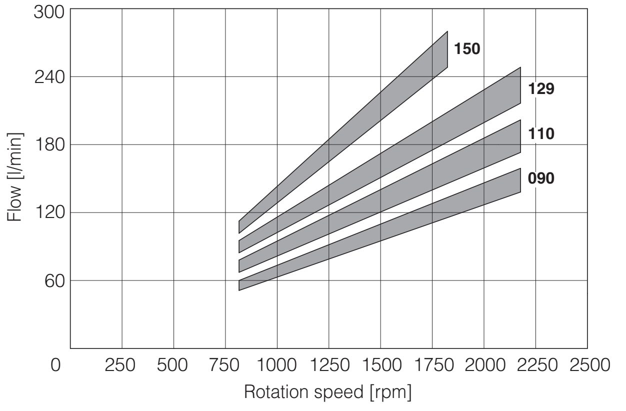


Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.

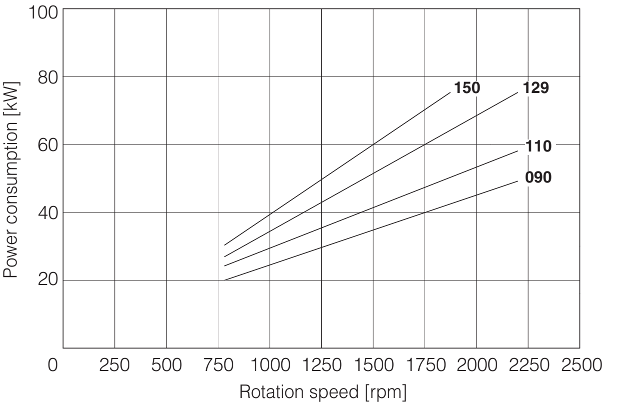


6.5 PFED-54 SECOND ELEMENT

Flow versus speed diagram
with pressure variation from 7 bar to 210 bar.



Power consumption versus speed diagram at 140 bar.
Power consumption is proportional to operating pressure.



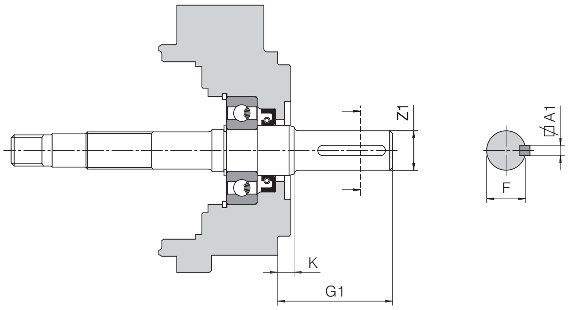
7 DRIVE SHAFT

CYLINDRICAL SHAFT KEYED

1 = supplied as standard if not specified in the model code

2 = according to ISO/DIN 3019 standards

3 = for high torque applications



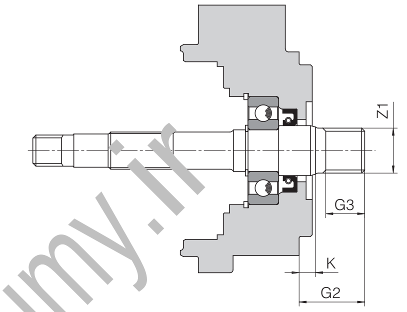
Model	Keyed shaft type 1 (standard)					Keyed shaft type 2					Keyed shaft type 3				
	A1	F	G1	K	ØZ1	A1	F	G1	K	ØZ1	A1	F	G1	K	ØZ1
PFED-43	4,78 4,75	24,54 24,41	59,00	11,40	22,22 22,20	6,38 6,35	25,03 24,77	71,00	8,00	22,22 22,20	6,38 6,35	28,30 28,10	78,00	11,40	25,38 25,35
PFED-54	7,97 7,94	35,33 35,07	74,25	14	31,75 31,70	7,97 7,94	35,33 35,07	84,25	8,1	31,75 31,70	7,97 7,94	38,58 38,46	84,25	14	34,90 34,88

SPLINED SHAFT

5 = for PFED-43 according to SAE B 16/32 DP, 13 teeth;
for PFED-54 according to SAE C 12/24 DP, 14 teeth;

6 = (only for PFED-43) according to SAE C 12/24 DP, 14 teeth;

7 = only for PFED-43 when used as the last element of a multiple pump: similar to shaft type 6.



Model	Splined shaft type 5				Splined shaft type 6				Splined shaft type 7			
	G2	G3	K	Z2	G2	G3	K	Z2	G2	G3	K	Z2
PFED-43	41,25	28	8,00	SAE 16/32-13T	55,60	42	8,00	SAE 12/24-14T	41,60	28	8,00	SAE 12/24-14T
PFED-54	55,7	42	8,1	SAE 12/24-14T	—	—	—	—	—	—	—	—

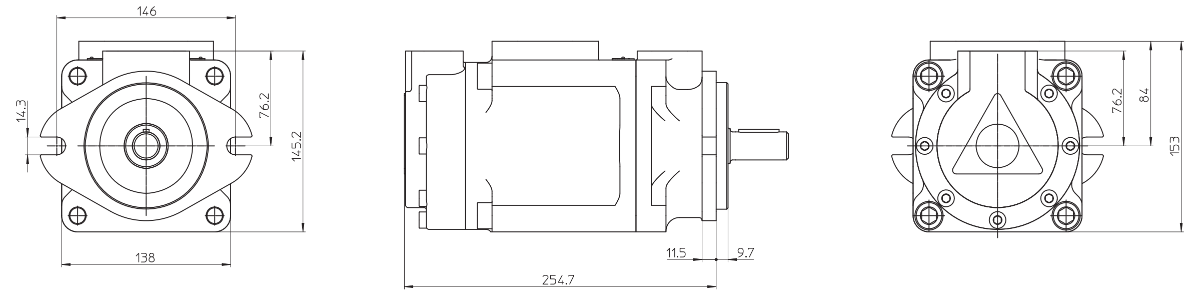
8 LIMITS OF SHAFT TORQUE

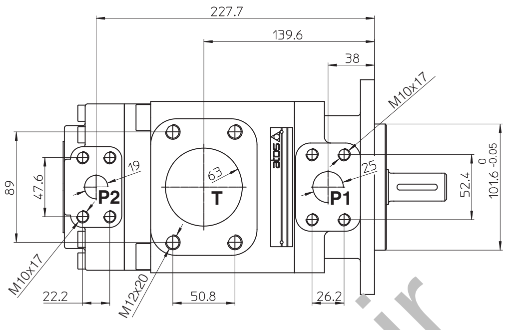
Pump size	Maximum driving torque [Nm]					
	Shaft type 1	Shaft type 2	Shaft type 3	Shaft type 5	Shaft type 6	Shaft type 7
PFED-43	250	250	400	200	400	400
PFED-54	500	500	850	450	–	–

The values of torque needed to operate each single cartridge are shown on the "torque versus pressure diagram" at section 6.
The total torque applied to the shaft of the pump is the sum of the single torque needed for operating each single cartridge and its valve must be lower than the vaues indicated in the table.

9 DIMENSIONS [mm]

PFED-43

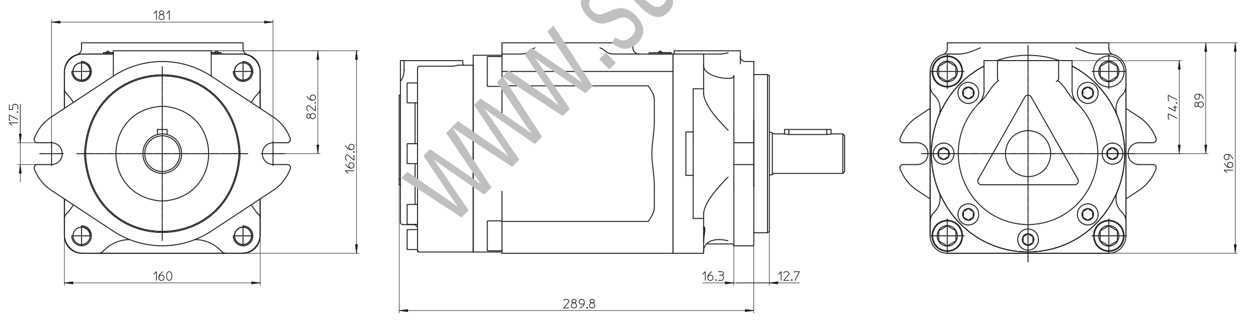


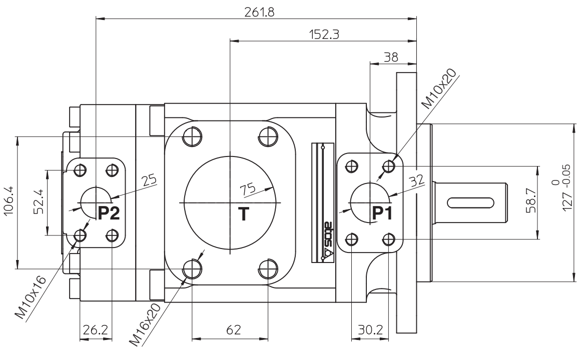


SAE FLANGES:
port P1 = 1"
port P2 = 3/4"
port T = 2 $^1/_2$"

Mass: 24,5 kg

PFED-54





SAE FLANGES:
port P1 = 1 $^1/_4$"
port P2 = 1"
port T = 3"

Mass: 36 kg

10 RELATED DOCUMENTATION

A900	Operating and maintenance information for pumps

Multiple pumps type PFEX, PFRX, PVPCX2E

vane, piston, fixed or variable displacement

Multiple pumps are compact groups made by single pumps factory assembled in modular execution, designed to be driven by a single motor. They are suitable to perform control logics such as high / low flow circuits or for applications where each individual stage of the pump feeds a specific line of the hydraulic circuit.

Multiple pumps are available in execution with double or triple fixed displacement vane pumps, or single vane pumps coupled to fixed displacement radial piston pumps or variable displacement axial piston pumps.

Multiple vane pumps, fixed displacement - see section $\boxed{1}$
PFEX2 double pump made by two vane pumps type **PFE**
PFEX3 triple pump made by three vane pumps type **PFE**
PFEXD triple pump made by one vane pump type **PFE** coupled with double vane pump type **PFED**

Multiple radial piston + vane pumps, fixed displacement - see section $\boxed{2}$
PFRX2E double pump made by radial piston pumps type **PFR** coupled with one vane pumps type **PFE**
PFRX3E triple pump made by radial piston pumps type **PFR** coupled with two vane pumps type **PFE**
PFRXE triple pump made by one vane pane type **PFR** coupled with double vane pump type **PFED**

Multiple axial piston, variable displacement + vane pump, fixed displacement - see section $\boxed{3}$
PVPCX2E double pump made by one axial piston pumps type **PVPC** coupled with one vane pump type **PFE**

Note: for tech. tables of single pumps see section $\boxed{4}$

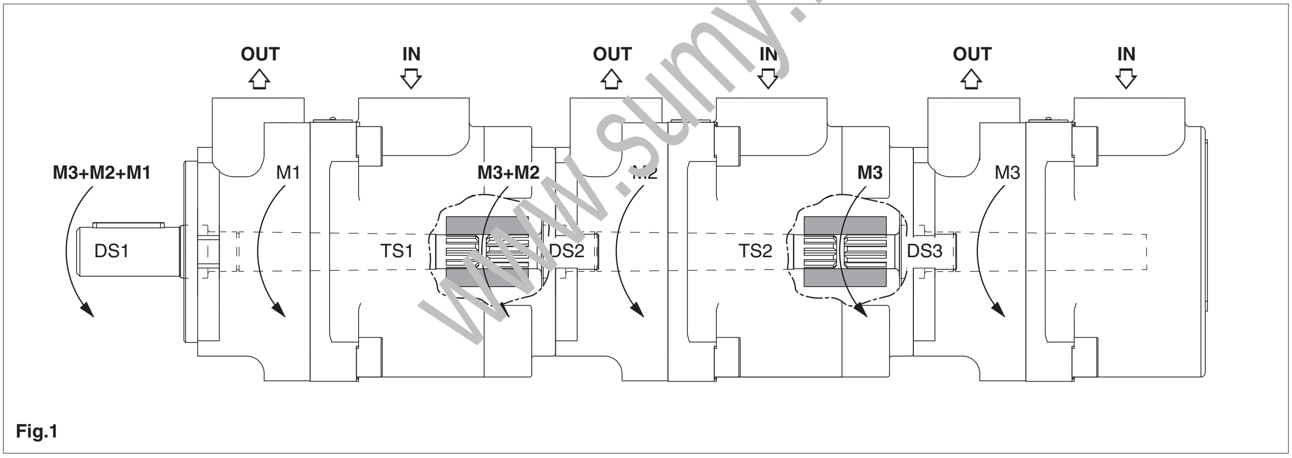


Fig.1

Sizing criteria

The total torque applied to the drive shaft of the first pumps is the sum of the single torque required to operate each single pump.

- It must be verified that the total torque applied to the drive shaft of the first pumps does not exceed the max allowed limit specified in the tech table of the specific pump
- It must be verified that the max torque applied on each single drive shaft and on each single through shaft are not higher than the max allowed limit specified in the tech table of each single pump

With reference to above Fig.1:
M1, M2, M3 = torque required to operate each single pump
DS1, DS2, DS3 = limits of torque for drive shafts
TS1, TS2 = limits of torque at the end of through shafts

The following conditions must be verified:
a) **M3** ≤ **TS2**
b) **M3** + **M2** ≤ **DS2**
c) **M3** + **M2** ≤ **TS1**
d) **M3** + **M2** + **M1** ≤ **DS1**

1 MODEL CODE OF PFEX*

1.1 MODEL CODE OF PFEX2, PFEX3

PFEX	**2**	**-**	**42**	**045**	**/**	**31028**	**/**	**31016**	**/**	**3**	**D**	**T**	*****	**/**	*****

Fixed displacement multiple vane pump

Execution
2 = double pump (two pumps type PFE)
3 = triple pump (three pumps type PFE)

Size of first pump:
31, **41**, **51**, **32**, **42**, **52**

Displacement of first pump
for PFE 31: **010, 016, 022, 028, 036, 044**
for PFE 41: **029, 037, 045, 056, 070,085**
for PFE 51: **090, 110, 129, 150**
for PFE 32: **016, 022, 028, 036**
for PFE 42: **045, 056, 070, 085**
for PFE 52: **090, 110, 129, 150**

Size and displacement of second pump - see first pump **(1)**

Size and displacement of third pump - see first pump **(1)**

Series number

Seals material:
- = NBR (mineral oil & water glycol)
PE = FPM

Port orientation, see section 1.4

Direction of rotation viewed at the shaft end:
D = clockwise (supplied standard)
S = counterclockwise
Note: PFE are not reversible

Drive shaft
cylindrical keyed:
1 = (only for PFE-31, 41, 51) standard
2 = (only for PFE-41 and PFE-51) according to ISO/DIN 3019
3 = for high torque applications

splined
5 = standard
6 = for high torque applications
for PFEX*-3 according to SAE B 16/32 DP, 13 teeth;
for PFEX*-4 according to SAE C 12/24 DP, 14 teeth;

(1) Second and third pumps must be selected with equal or smaller size than the first pump

1.2 MODEL CODE OF PFEXD

PFEX	**D**	**-**	**42**	**045**	**/**	**43037**	**/**	**022**	**/**	**3**	**D**	**T**	*****	**/**	*****

Fixed displacement multiple vane pump

Execution
D = triple pump (one pump type PFE and one pump type PFED)

Size of first pump:
41, **51**, **42**, **52**

Displacement of first pump
for PFE 41: 029, 037, 045, 056, 070,085
for PFE 51: 090, 110, 129, 150
for PFE 42: 045, 056, 070, 085
for PFE 52: 090, 110, 129, 150

Size and displacement of PFED first element
for PFED **43: 029, 037, 045, 056, 070, 085**
for PFED **54: 090, 110, 129, 150**

Displacement of PFED second element
for PFED 43: **016, 022, 028, 036, 044**
for PFED 54: **029, 037, 045, 056, 070, 085**

Series number

Seals material:
- = NBR (mineral oil & water glycol)
PE = FPM

Port orientation, see section 1.4

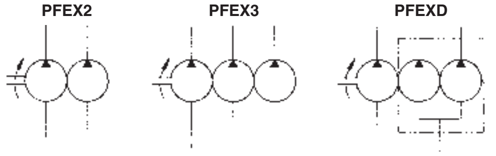
Direction of rotation viewed at the shaft end:
D = clockwise (supplied standard)
S = counterclockwise
Note: PFE are not reversible

Drive shaft
cylindrical keyed:
1 = (only for PFE-31, 41, 51) standard
2 = (only for PFE-41 and PFE-51) according to ISO/DIN 3019
3 = for high torque applications

splined
5 = standard
6 = for high torque applications
for PFEX*-3 according to SAE B 16/32 DP, 13 teeth;
for PFEX*-4 according to SAE C 12/24 DP, 14 teeth;

(1) PFEXD-41 and 42 can be coupled only with PFED-43

1.3 HYDRAULIC SYMBOL

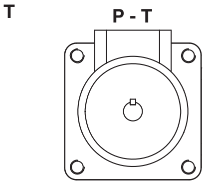


1.4 PORT ORIENTATION

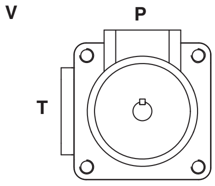
-PFEX2, PFEX3

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated.
The port orientation is defined by code **T, U, V, W** and it is the same for first, second (third) pumps.
Ports orientation can be easily changed by rotating the pump body that carries inlet port.

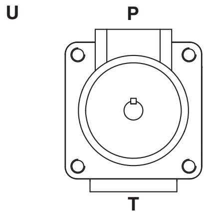
Model code example: PFEX2-42045/41037/5D**T**



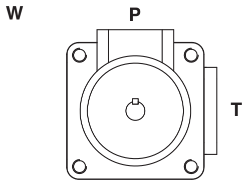
orientation of all pumps



orientation of all pumps



orientation of all pumps



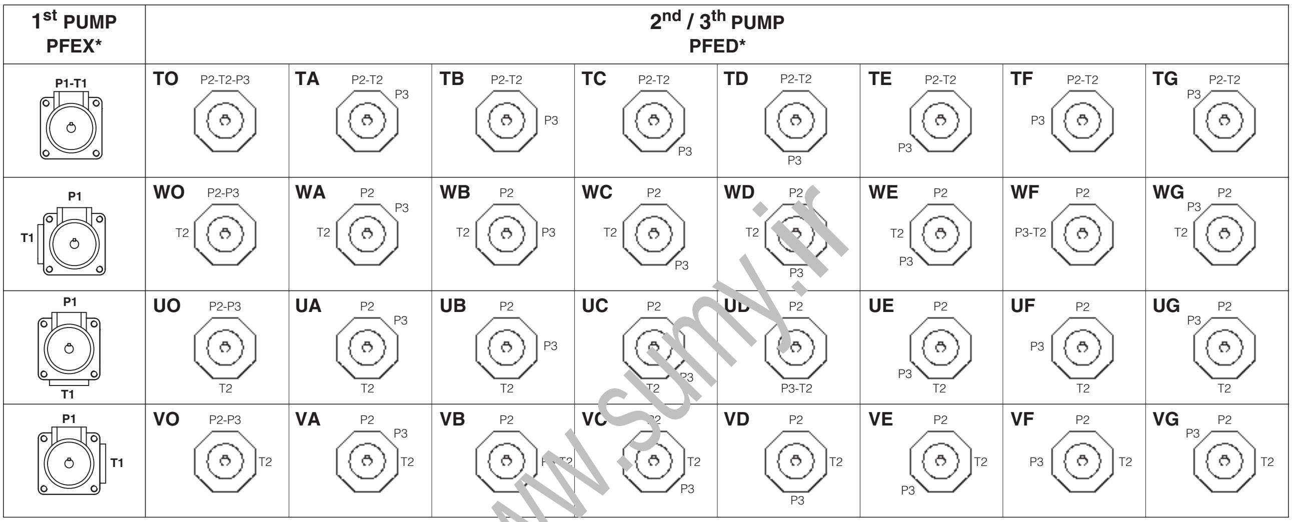
orientation of all pumps

P = outlet port; **T** = inlet port

-PFEXD

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated..
In PFEXD, the ports orientation of second / third pump (PFED), can be selected according following table.
The ports orientation of first pump depends to the selected orientation of second / third pumps.

Model code example: PFEXD-42045/43037/016/5D**TO**



1st PUMP PFEX*	2nd / 3th PUMP PFED*							
P1-T1	**TO** P2-T2-P3	**TA** P2-T2 P3	**TB** P2-T2 P3	**TC** P2-T2 P3	**TD** P2-T2 P3	**TE** P2-T2 P3	**TF** P2-T2 P3	**TG** P2-T2 P3
P1 T1	**WO** P2-P3 T2	**WA** P2 P3 T2	**WB** P2 T2 P3	**WC** P2 T2 P3	**WD** P2 T2 P3	**WE** P2 T2 P3	**WF** P2 P3-T2	**WG** P2 P3 T2
P1 T1	**UO** P2-P3 T2	**UA** P2 P3 T2	**UB** P2 P3 T2	**UC** P2 P3 T2	**UD** P2 P3-T2	**UE** P2 P3 T2	**UF** P2 P3 T2	**UG** P2 P3 T2
P1 T1	**VO** P2-P3 T2	**VA** P2 P3 T2	**VB** P2 P3-T2	**VC** P2 T2 P3	**VD** P2 T2 P3	**VE** P2 T2 P3	**VF** P2 P3 T2	**VG** P2 P3 T2

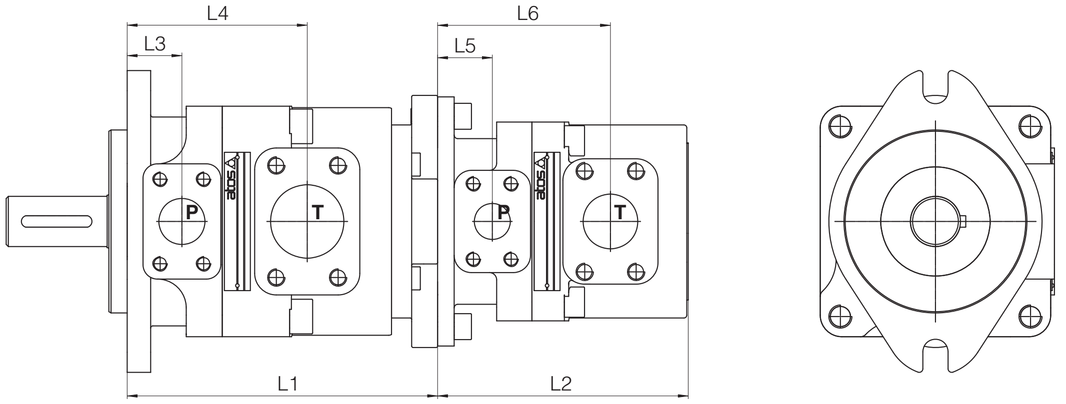
P1 outlet port of first element; **P2** outlet port of second element; **P3** outlet port of third element; **T1** inlet port of first element; **T2** inlet port of second element

1.5 OPERATING CHARACTERISTICS OF PFEX*

See technical table of single pumps:
A005 for PFE-31, 41, 51 **A007** for PFE-32, 42, 52

1.6 DIMENSIONS OF PFEX* [mm]

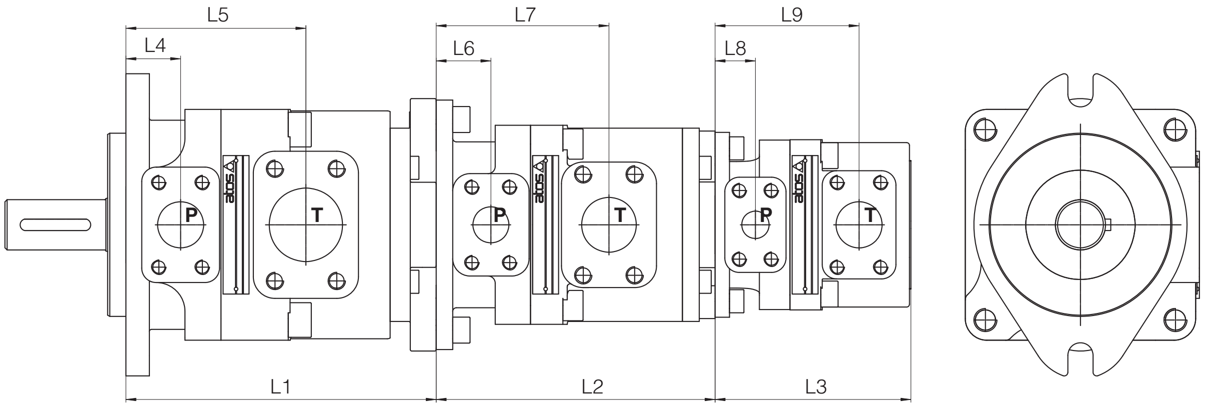
PFEX2



For missing details see tab. A005 and A007

Model code	First pump	Second pump	L1	L2	L3	L4	L5	L6
PFEX2-32***/31***/*	PFEXA-32***/*	PFE-31***/5	164	134,5	27,5	98,5	27,5	98,5
PFEX2-42***/31***/*	PFEXA7-42***/*	PFE-31***/7	194	134,5	38	120	27,5	98,5
PFEX2-42***/41***/*	PFEXB7-42***/*	PFE-41***/7	203	160	38	120	38	120
PFEX2-52***/31***/*	PFEXA7-52***/*	PFE-31***/7	206	134,5	38	125	27,5	98,5
PFEX2-52***/41***/*	PFEXB7-52***/*	PFE-41***/7	215,5	160	38	125	38	120
PFEX2-52***/51***/*	PFEXC-52***/*	PFE-51***/5	230	186,5	38	125	38	125

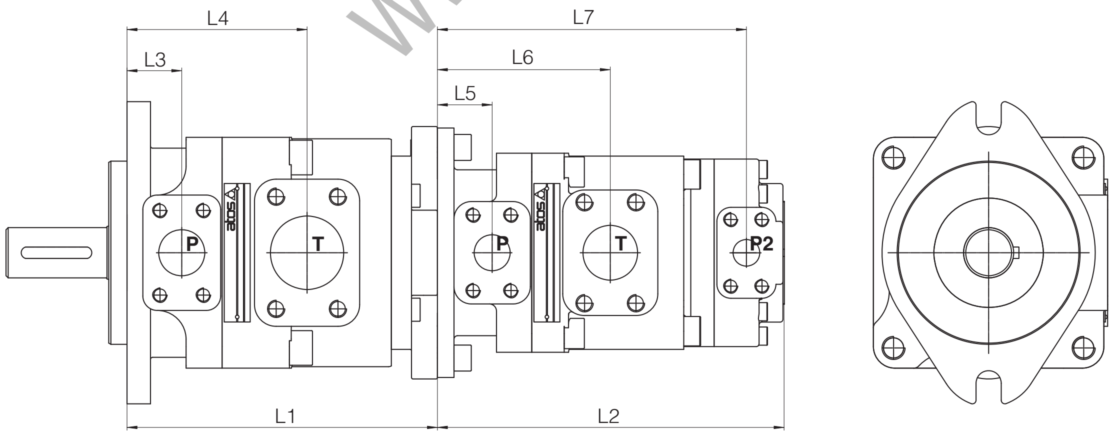
PFEX3



For missing details see tab. A005 and A007

Model code	First pump	Second pump	Third pump	L1	L2	L3	L4	L5	L6	L7	L8	L9
PFEX3-32***/31***/31***/*	PFEXA-32***/*	PFEXA-31***/5	PFE-31***/5	164	164	134,5	27,4	98,5	27,4	98,5	24,7	98,5
PFEX3-42***/31***/31***/*	PFEXA7-42***/*	PFEXA-31***/7	PFE-31***/5	203	164	134,5	38	120	27,4	98,5	24,7	98,5
PFEX3-42***/41***/31***/*	PFEXB7-42***/*	PFEXA7-41***/7	PFE-31***/7	203	194	134,5	38	120	38	120	24,7	98,5
PFEX3-42***/41***/41***/*	PFEXB7-42***/*	PFEXB7-41***/7	PFE-41***/7	203	203	160	38	120	38	120	38	120
PFEX3-52***/31***/31***/*	PFEXA7-52***/*	PFEXA-31***/7	PFE-31***/5	206	164	134,5	38	125	24,7	98,5	24,7	98,5
PFEX3-52***/41***/31***/*	PFEXB7-52***/*	PFEXA7-41***/7	PFE-31***/7	215,5	194	134,5	38	125	38	120	24,7	98,5
PFEX3-52***/41***/41***/*	PFEXB7-52***/*	PFEXB7-41***/7	PFE-41***/7	215,5	203	160	38	125	38	120	38	120
PFEX3-52***/51***/31***/*	PFEXC-52***/*	PFEXA7-51***/5	PFE-31***/7	230	206	134,5	38	125	38	125	24,7	98,5
PFEX3-52***/51***/41***/*	PFEXC-52***/*	PFEXB7-51***/5	PFE-41***/7	230	206	160	38	125	38	125	38	120
PFEX3-52***/51***/51***/*	PFEXC-52***/*	PFEXC-51***/5	PFE-51***/5	230	230	186,5	38	125	38	125	38	125

PFEXD



For missing details see tab. A005 and A007, A180

Model code	First pump	Second pump	L1	L2	L3	L4	L5	L6	L7
PFEXD-42***/43***/0**	PFEXB7-42***	PFED-43***/0**/7	203	256	38	120	38	139,6	227,7
PFEXD-52***/43***/0**	PFEXB7-52***	PFED-43***/0**/7	215,5	256	38	125	38	199,6	227,7
PFEXD-52***/54***/0**	PFEXC-52***	PFED-54***/0**/5	230	288	38	125	38	152,3	261,8

2 MODEL CODE OF PFRX*E

2.1 MODEL CODE OF PFRX2E, PFRX3E

PFRX	**2E**	**-**	**3**	**08**	**/**	**31044**	**/**	**31028**	**/**	**D**	*****	*****	**/**	*****

Multiple fixed displacement radial piston/vane pump

Execution
2E = double: PFR + PFE
3E = triple: PFR + PFEX2

Size of first pump type PFR
3

Displacement of first pump type PFR [cm³/rev]
for PFR-3: **08**, **11**, **15**

Size and displacement of PFE second (and third) pump
for PFE 31: 010, 016, 022, 028, 036, 044
for PFE 41: 029, 037, 045, 056, 070,085
for PFE 51: 090, 110, 129
for PFE 32: 016, 022, 028, 036
for PFE 42: 045, 056, 070, 085
for PFE 52: 090, 110, 129

Size and displacement of PFE third pump
for PFE 31: 010, 016, 022, 028, 036, 044
for PFE 41: 029, 037, 045, 056, 070,085
for PFE 51: 090, 110, 129
for PFE 32: 016, 022, 028, 036
for PFE 42: 045, 056, 070, 085
for PFE 52: 090, 110, 129

Direction of rotation viewed at the shaft end:
D = clockwise (supplied standard if not otherwise specified)
S = counter clockwise
Note: PFRX*E are not reversible

Port orientation, see section 2.4

Series number

Seals material:
- = NBR (mineral oil & water glycol)
PE = FPM

2.2 MODEL CODE OF PFRXDE

PFRX	**DE**	**-**	**3**	**08**	**/**	**43045**	**/**	**036**		**D**	*****	*****	**/**	*****

Multiple fixed displacement radial piston/vane pump

Execution
DE = triple: PFR + PFED

Size of first pump type PFR
3

Displacement of first pump type PFR [cm³/rev]
for PFR-3: **08**, **11**, **15**

Size and displacement of PFED first element [cm³/rev]
for PFED **43: 029, 037, 045, 056, 070, 085**
for PFED **54: 090, 110, 129**

Displacement of PFED second element [cm³/rev]
for PFED 43: **016, 022, 028, 036, 044**
for PFED 54: **029, 037, 045, 056, 070, 085**

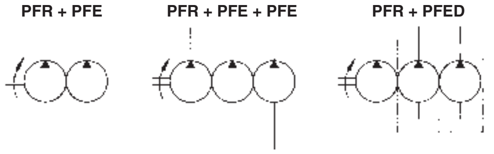
Direction of rotation viewed at the shaft end:
D = clockwise (supplied standard if not otherwise specified)
S = counter clockwise
Note: PFRX*E are not reversible

Port orientation, see section 2.4

Series number

Seals material:
- = NBR (mineral oil & water glycol)
PE = FPM

2.3 HYDRAULIC SYMBOL

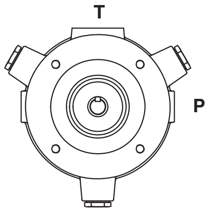
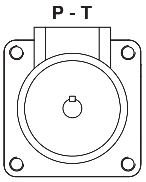
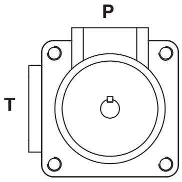
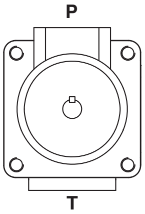
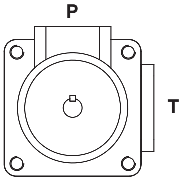


2.4 PORT ORIENTATION

-PFRX2E, PFRX3E

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated.
Referred to the first element (PFRX*), in second / third pumps the ports can be oriented as indicated in the picture. The third pump is always oriented as the second pump.

Model code example: PFRX2E-315/31044/D**T**

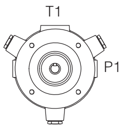
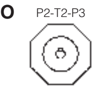
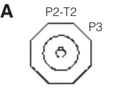
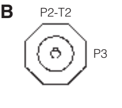
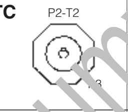
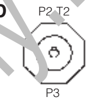
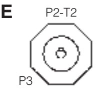
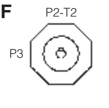
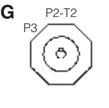
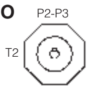
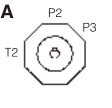
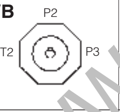
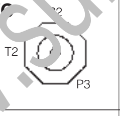
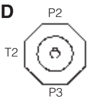
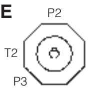
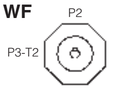
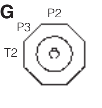
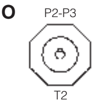
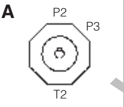
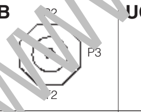
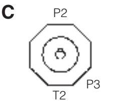
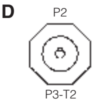
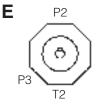
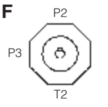
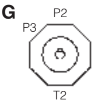
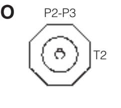
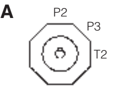
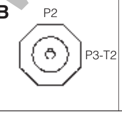
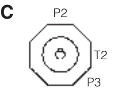
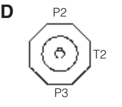
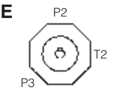
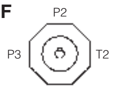
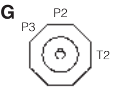
1st PUMP **PFRX***	**2nd / 3th PUMP** **PFE**			
	**T** 	**V** 	**U** 	**W** 

P = outlet port; **T** = inlet port

-PFRXDE

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated.
The port orientation of second and third pump (PFED) is defined by codes T*, W*, U*, V* as per below table

Model code example: PFRXDE-315/43045/022/D**TO**

1st PUMP **PFRX***	**2nd / 3th PUMP** **PFED***							
	**TO** 	**TA** 	**TB** 	**TC** 	**TD** 	**TE** 	**TF** 	**TG** 
	WO 	**WA** 	**WB** 	**WC** 	**WD** 	**WE** 	**WF** 	**WG** 
	UO 	**UA** 	**UB** 	**UC** 	**UD** 	**UE** 	**UF** 	**UG** 
	VO 	**VA** 	**VB** 	**VC** 	**VD** 	**VE** 	**VF** 	**VG** 

P1 outlet port of first element; **P2** outlet port of second element; **P3** outlet port of third element; **T1** inlet port of first element; **T2** inlet port of second element

2.5 OPERATING CHARACTERISTICS OF PFRX2E

(at 1450 rpm and based on mineral oil ISO VG46 at 50° C)

Model code (1)	Speed range [rpm] (2)	RADIAL PISTON PUMP			VANE PUMP			
		Displacement [cm^3/rev]	Flow [l/min] (3)	Max pressure [bar] (4)	Displacement [cm^3/rev]	Flow [l/min] (3)	Max pressure [bar] (5)	Total flow [l/min]
PFRX2E-308/31010	600-1800	8	12,6	350	10,5	15	160	27,6
PFRX2E-308/31016					16,5	23	210	35,6
PFRX2E-308/31022					21,6	30		42,6
PFRX2E-308/31028					28,1	40		52,6
PFRX2E-308/31036					36,5	51		63,6
PFRX2E-308/31044					43,7	63		75,6
PFRX2E-308/41029					29,3	41		53,6
PFRX2E-308/41037					36,6	52		64,6
PFRX2E-308/41045					45	64		76,6
PFRX2E-308/41056					55,8	80		92,6
PFRX2E-308/41070					69,9	101		113,6
PFRX2E-308/41085					85,3	124		136,6
PFRX2E-308/51090					90	128		140,6
PFRX2E-308/51110					109,6	157		169,6
PFRX2E-308/51129					129,2	186		198,6
PFRX2E-311/31044		11,4	16,5	350	43,7	63		79,5
PFRX2E-311/41070					69,9	101		117,5
PFRX2E-311/41085					85,3	124		140,5
PFRX2E-311/51110					109,6	157		173,5
PFRX2E-311/51129					129,2	186		202,5
PFRX2E-315/41056		14,7	21,5	350	55,8	80		101,5
PFRX2E-315/41070					69,9	101		122,5
PFRX2E-315/51110					109,6	157		178,5
PFRX2E-315/51129					129,2	186		207,5

(1) Further composition of PFR and PFE double pumps are available on request. Other composition of PFRX2E must subject to verification of max torque limits allowed by the drive shafts of PFR and PFE and by the through shaft of PFR (320 Nm).

(2) Max speed is 1800 rpm for HFDU, HFDR fluids; 1000 rpm for HFC fluids

(3) Flow rate and power consumption are proportional to revolution speed

(4) Max pressure is 250 bar for HFDU, HFDR fluids, 175 bar for HFC fluids

(5) Max pressure is 160 bar for HFDU, HFDR, HFC fluids

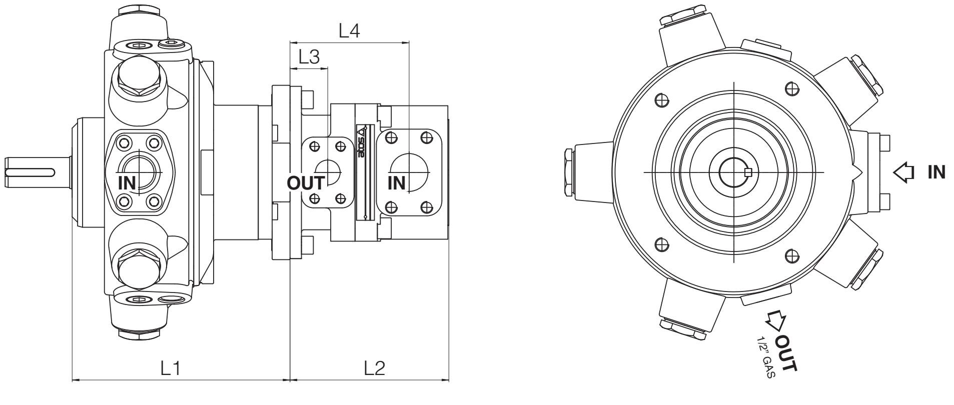
The shaft of the PFR pump has an eccentric cam which rotates with the shaft generating the stroke of the pistons and thus generating the flow rate.
For best functioning a balanced coupling should be provided between the shaft of the motor and the shaft of the pump.
See tab. A045

2.6 TRIPLE PUMPS TYPE PFRX3E AND PFRXDE

Many triple pump compositions PFRX3E = PFR + PFEX2 or PFRXDE = PFR + PFED can be realized but they must be subject to verification of max torque-limits allowed by drive shaft and through shaft of each individual basic pump according to description of first page.

2.7 DIMENSIONS OF PFRX* [mm]

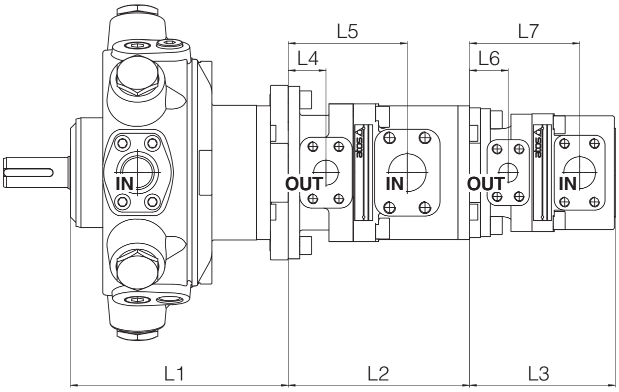
PFRX2E

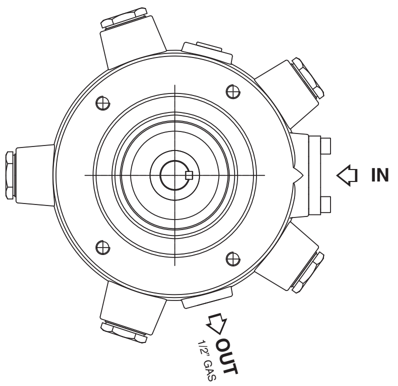


For missing details see tab. A045, A005 and A007

Model code	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4
PFRX2E-3**/31***	PFRXA-3**	PFE-31***	200	134,5	27,5	98,5
PFRX2E-3**/41***	PFRXB-3**	PFE-41***	209	160	38	120
PFRX2E-3**/51***	PFRXC-3**	PFE-51***	224	186,5	38	125

PFRX3E

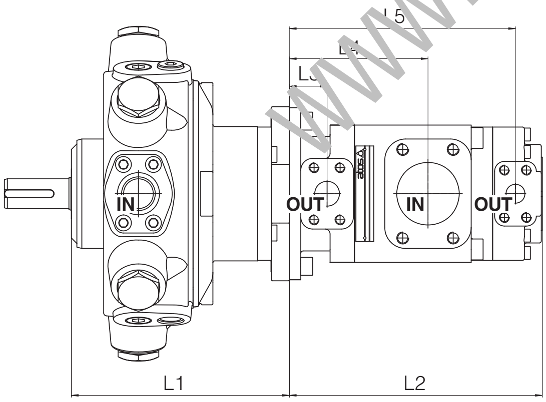


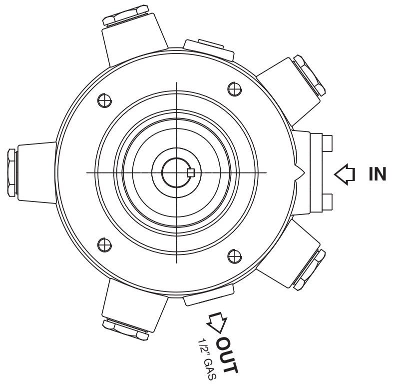


For missing details see tab. A045, A005 and A007

Model code	First element - piston pump -	Second element - vane pump -	Third element - vane pump -	L1	L2	L3	L4	L5	L6	L7
PFRX3E-3**/31**/31***	PFRXA-3**	PFEXA-31***	PFE-31***	200	164	134,5	27,5	98,5	27,5	98,5
PFRX3E-3**/41***/31***	PFRXB-3**	PFEXA-41***	PFE-31***	209	194	134,5	38	120	27,5	98,5
PFRX3E-3**/41***/41***	PFRXB-3**	PFEXB-41***	PFE-41***	209	203	160	38	120	38	120
PFRX3E-3**/51***/31***	PFRXC-3**	PFEXA-51***	PFE-31***	224	206	134,5	38	125	27,5	98,5
PFRX3E-3**/51***/41***	PFRXC-3**	PFEXB-51***	PFE-41***	224	215,5	160	38	125	38	120
PFRX3E-3**/51***/51***	PFRXC-3**	PFEXC-51***	PFE-51***	224	230	186,5	38	125	38	125

PFRXDE





For missing details see tab. A045 and A180

Model code	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4	L5
PFRXDE-3**/43***/0**	PFRXB-3**	PFED-43***/0**	209	256,5	38	139,6	227,7
PFRXDE-3**/54***/0**	PFRXC-3**	PFED-54***/0**	224	288	38	152,3	261,8

PFRX*E pumps are supplied with WFA-32 inlet flange for PFR, and set of inlet, outlet flanges for PFE or PFED;

3 MODEL CODE OF PVPCX2E

3.1 MODEL CODE FOR PVPCX2E with mechanical controls

PVPC	**X2E**	**-**	**C**	**-**	**4046**	**/**	**31044**	**/**	**1**	**D**	**X**	**24DC**	*****	**/**	*****

PVPC: Variable displacement axial piston pump

X2E = coupled with a fixed displacement pump type PFE (see tab. A005, A007)

Type of control:
C = manual pressure compensator
CH = manual pressure compensator, with venting
R = remote pressure compensator
L = load sensing (pressure & flow)
LW = constant power (combined pressure & flow)

Size and max displacement of axial piston pump:
3029 = 29 cm³/rev
4046 = 46 cm³/rev
5073 = 73 cm³/rev
5090 = 88 cm³/rev

Size and displacement of PFE second pump
for PFE 31: **010, 016, 022, 028, 036, 044**
for PFE 41: **029, 037, 045, 056, 070, 085**
for PFE 51: **090, 110, 129, 150**
for PFE 32: **016, 022, 028, 036**
for PFE 42: **045, 056, 070, 085**
for PFE 52: **090, 110, 129, 150**

Shaft (SAE Standard):
1 = keyed (7/8” for 029 - 1” for 046 - 1 1/4” for 073 and 090)
5 = splined (13 teeth for 029 - 15 for 046 - 14 for 073 and 090)

Direction of rotation viewed at the shaft end:
D = clockwise
S = counterclockwise

X = without connector

Coil voltage - only CH version:
12DC
24DC
24/50AC
110/50AC
220/50AC

Series number

Seals material:
– = NBR
PE = FKM
See notes under sect. 2

3.2 MODEL CODE FOR PVPCX2E with electrohydraulic proportional controls

PVPC	**X2E**	**-**	**PERS-SP**	**-**	**BC**	**-**	**4046**	**/**	**31044**	**/**	*****	**/**	**1**	**D**	**/**	**18**	*****	**/**	*****

PVPC: Variable displacement axial piston pump

X2E = coupled with a fixed displacement pump type PFE (see tab. A005, A007)

Type of control
CZ = proportional pressure control
LQZ = proportional flow control (load sensing)
PES-SP = closed loop integral digital P/Q driver
PERS-SP = as PES plus sequence module

Fieldbus interfaces, USB port always present (Only for PES and PERS):
NP = Not present
BC = CANopen
BP = PROFIBUS DP
EH = EtherCAT
EW = POWERLINK
EI = EtherNet/IP
EP = PROFINET RT/IRT

Size and max displacement of axial piston pump:
3029 = 29 cm³/rev
4046 = 46 cm³/rev
5073 = 73 cm³/rev
5090 = 88 cm³/rev

Size and displacement [cm³/rev] of PFE second pump
for PFE 31: **010, 016, 022, 028, 036, 044**
for PFE 41: **029, 037, 045, 056, 070, 085**
for PFE 51: **090, 110, 129, 150**
for PFE 32: **016, 022, 028, 036**
for PFE 42: **045, 056, 070, 085**
for PFE 52: **090, 110, 129, 150**

Pressure setting, only for PERS: **200** = 200 bar **250** = 250 bar **280** = 280 bar

Shaft (SAE Standard):
1 = keyed (7/8” for 029 - 1” for 046 - 1 1/4” for 073 and 090)
5 = splined (13 teeth for 029 - 15 for 046 - 14 for 073 and 090)

Direction of rotation viewed at the shaft end
D = clockwise **S** = counterclockwise

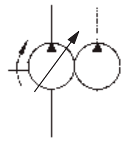
Electronics options, for PES and PERS **(4):**
C = current feedback for pressure transducer 4÷20 mA (omit for std voltage ±10VDC)
I = current reference input and monitor 4÷20 mA (omit for std voltage ±10VDC)
X = on-board pressure transducer with pre-configured pressure settings (only for PERS)
S = with 2 on-off inputs for multiple pressure PID selection for NP execution or double power supply for fieldbus execution, plus dedicated connector for remote pressure transducer

Coil voltage, for CZ, LQZ - see section 18:
18 = optional coil 18 VDC for low current drivers instead of standard 12 VDC

Series number

Seals material:
– = NBR
PE = FKM
See notes under sect. 2

3.3 HYDRAULIC SYMBOL



PVPCX2E are double pumps composed by one variable displacement axial piston pump type PVPC and one vane pump type PFE.
They have two separated inlet ports and two separated outlet ports.

For technical characteristics of PVPC pumps, see tab. A160;
for technical characteristics of PFE pumps see tab. A005 and A007.

3.4 OPERATING CHARACTERISTICS OF DOUBLE PUMPS TYPE PVPCX2E (with PFE-31, 41 and 51)

(at 1450 rpm and based on mineral oil ISO VG46 at 40° C)

Model code	Speed range [rpm] (1)	AXIAL PISTON PUMP			VANE PUMP			Total flow [l/min]
		Displacement [cm³/rev]	Flow [l/min] (2)	Max pressure [bar] (3)	Displacement [cm³/rev]	Flow [l/min] (2)	Max pressure [bar] (4)	
PVPCX2E-*-3029/31010	800-2400	29	42	280/350	10,5	15	160	57
PVPCX2E-*-3029/31016	800-2800				16,5	23	210	65
PVPCX2E-*-3029/31022					21,6	30		72
PVPCX2E-*-3029/31028					28,1	40		82
PVPCX2E-*-3029/31036					35,6	51		93
PVPCX2E-*-3029/31044	800-2500				43,7	63		105
PVPCX2E-*-3029/41029					29,3	41		83
PVPCX2E-*-3029/41037					36,6	52		94
PVPCX2E-*-3029/41045					45,0	64		106
PVPCX2E-*-3029/41056					55,8	80		122
PVPCX2E-*-3029/41070					69,9	101		143
PVPCX2E-*-3029/41085	800-2000				85,3	124		166
PVPCX2E-*-4046/31010	800-2400	46	66,7	280/350	10,5	15	160	81,7
PVPCX2E-*-4046/31016	800-2600				16,5	23	210	89,7
PVPCX2E-*-4046/31022					21,6	30		92,7
PVPCX2E-*-4046/31028					28,1	40		102,7
PVPCX2E-*-4046/31036					35,6	51		113,7
PVPCX2E-*-4046/31044	800-2500				43,7	63		129,7
PVPCX2E-*-4046/41029					29,3	41		107,7
PVPCX2E-*-4046/41037					36,6	52		118,7
PVPCX2E-*-4046/41045					45,0	64		130,7
PVPCX2E-*-4046/41056					55,8	80		146.7
PVPCX2E-*-4046/41070					69,9	101		167,7
PVPCX2E-*-4046/41085	800-2000				85,3	124		190,7
PVPCX2E-*-5073/31010	800-2400	73	105,8	280/350	10,5	15	160	120,8
PVPCX2E-*-5073/31016	800-2200				16,5	23	210	128,8
PVPCX2E-*-5073/31022					21,6	30		135,8
PVPCX2E-*-5073/31028					28,1	40		145,8
PVPCX2E-*-5073/31036					35,6	51		156,8
PVPCX2E-*-5073/31044					43,7	63		168,8
PVPCX2E-*-5073/41029					29,3	41		146,8
PVPCX2E-*-5073/41037					36,6	52		157,8
PVPCX2E-*-5073/41045					45,0	64		169,8
PVPCX2E-*-5073/41056					55,8	80		185,8
PVPCX2E-*-5073/41070					69,9	101		206,8
PVPCX2E-*-5073/41085	800-2000				85,3	124		229,8
PVPCX2E-*-5073/51090	800-2200				90,0	128		233,8
PVPCX2E-*-5073/51110					109,6	157		262,8
PVPCX2E-*-5073/51129					129,2	186		291,8
PVPCX2E-*-5073/51150	800-1800				150,2	215		320,8
PVPCX2E-*-5090/31010	800-2400	88	127,6	250/315	10,5	15	160	142,6
PVPCX2E-*-5090/31016	800-2200				16,5	23	210	150,6
PVPCX2E-*-5090/31022					21,6	30		157,6
PVPCX2E-*-5090/31028					28,1	40		167,6
PVPCX2E-*-5090/31036					35,6	51		178,6
PVPCX2E-*-5090/31044					43,7	63		190,6
PVPCX2E-*-5090/41029					29,3	41		168,6
PVPCX2E-*-5090/41037					36,6	52		179,6
PVPCX2E-*-5090/41045					45,0	64		191,6
PVPCX2E-*-5090/41056					55,8	80		207,6
PVPCX2E-*-5090/41070					69,9	101		228,6
PVPCX2E-*-5090/41085	800-2000				85,3	124		251,6
PVPCX2E-*-5090/51090	800-2200				90,0	128		255,6
PVPCX2E-*-5090/51110					109,6	157		284,6
PVPCX2E-*-5090/51129					129,2	186		313,6
PVPCX2E-*-5090/51150	800-1800				150,2	215		342,6

(1) Max speed is 1800 rpm for HFDU, HFDR fluids; 1000 rpm for HFC fluids
(2) Flow rate and power consumption are proportional to revolution speed
(3) Max pressure is 190 bar for HFDU, HFDR fluids, 160 bar for HFC fluids
(4) Max pressure is 160 bar for HFDU, HFDR, HFC fluids

3.5 OPERATING CHARACTERISTICS OF STANDARD DOUBLE PUMPS TYPE PVPCX2E (with PFE-32, 42 and 52)

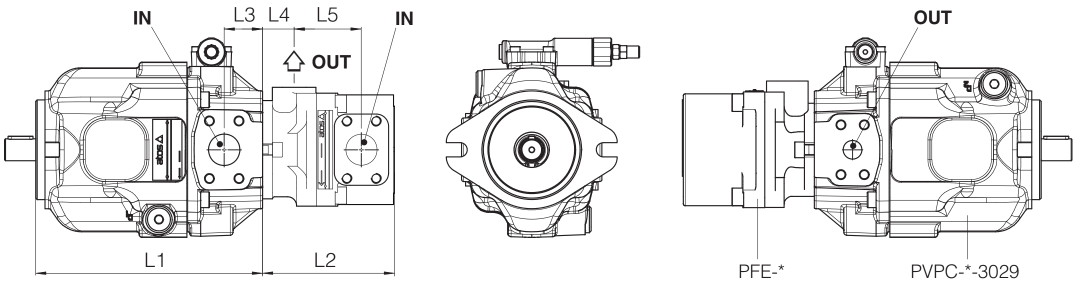
(at 1450 rpm and based on mineral oil ISO VG46 at 40° C)

Standard model	Speed range [rpm] (1)	AXIAL PISTON PUMP			VANE PUMP			
		Displacement [cm³/rev]	Flow [l/min] (2)	Max pressure [bar] (3)	Displacement [cm³/rev]	Flow [l/min] (2)	Max pressure [bar] (4)	Total flow [l/min]
PVPCX2E-*-3029/32016	1200-2500	29	42	280/350	16,5	23	210	65
PVPCX2E-*-3029/32022					21,6	30	300	72
PVPCX2E-*-3029/32028					28,1	40		82
PVPCX2E-*-3029/32036					35,6	51		93
PVPCX2E-*-3029/42045	1000-2200				45,0	64	280	106
PVPCX2E-*-3029/42056					55,8	80		122
PVPCX2E-*-3029/42070					69,9	101		143
PVPCX2E-*-3029/42085	800-2000				85,3	124		166
PVPCX2E-*-4046/32016	1200-2500	46	66,7	280/350	16,5	23	210	89,7
PVPCX2E-*-4046/32022					21,6	30	300	92,7
PVPCX2E-*-4046/32028					28,1	40		102,7
PVPCX2E-*-4046/32036					35,6	51		113,7
PVPCX2E-*-4046/42045	1000-2200				45,0	64	280	130,7
PVPCX2E-*-4046/42056					55,8	80		146,7
PVPCX2E-*-4046/42070					69,9	101		167,7
PVPCX2E-*-4046/42085	800-2000				85,3	124		190,7
PVPCX2E-*-5073/32016	1200-2500	73	105,8	280/350	16,5	23	210	128,8
PVPCX2E-*-5073/32022					21,6	30	300	135,8
PVPCX2E-*-5073/32028					28,1	40		145,8
PVPCX2E-*-5073/32036					35,6	51		156,8
PVPCX2E-*-5073/42045	1000-2200				45,0	64	280	169,8
PVPCX2E-*-5073/42056					55,8	80		185,8
PVPCX2E-*-5073/42070					69,9	101		206,8
PVPCX2E-*-5073/42085	800-2000				85,3	124		229,8
PVPCX2E-*-5073/52090	800-2000				90,0	128	250	233,8
PVPCX2E-*-5073/52110					109,6	157		262,8
PVPCX2E-*-5073/52129					129,2	186		291,8
PVPCX2E-*-5073/52150	800-1800				150,2	215	210	320,8
PVPCX2E-*-5090/32016	1200-1850	88	127,6	280/350	16,5	23	210	150,6
PVPCX2E-*-5090/32022					21,6	30	300	157,6
PVPCX2E-*-5090/32028					28,1	40		167,6
PVPCX2E-*-5090/32036					35,6	51		178,6
PVPCX2E-*-5090/42045	1000-1850				45,0	64	280	191,6
PVPCX2E-*-5090/42056					55,8	80		207,6
PVPCX2E-*-5090/42070					69,9	101		228,6
PVPCX2E-*-5090/42085	800-1850				85,3	124		251,6
PVPCX2E-*-5090/52090	1000-1850				90,0	128	250	255,6
PVPCX2E-*-5090/52110					109,6	157		284,6
PVPCX2E-*-5090/52129					129,2	186		313,6
PVPCX2E-*-5090/52150	800-1800				150,2	215	210	342,6

(1) Max speed is 1800 rpm for HFDU, HFDR versions; 1500 rpm for HFC fluids
(2) Flow rate and power consumption are proportional to revolution speed
(3) Max pressure is 190 bar for HFDU, HFDR fluids, 160 bar for HFC fluids
(4) Max pressure is 160 bar for HFDU, HFDR, HFC fluids

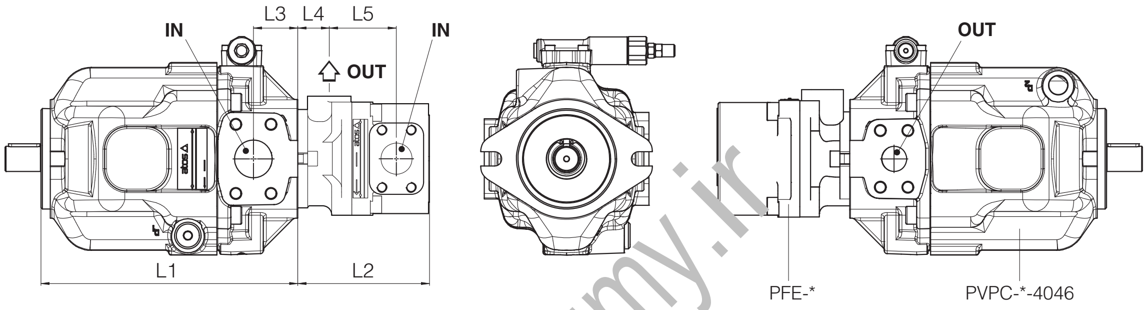
3.6 DIMENSIONS OF MULTIPLE PUMPS TYPE PVPCX2E [mm]

PVPCX2E-*-3029



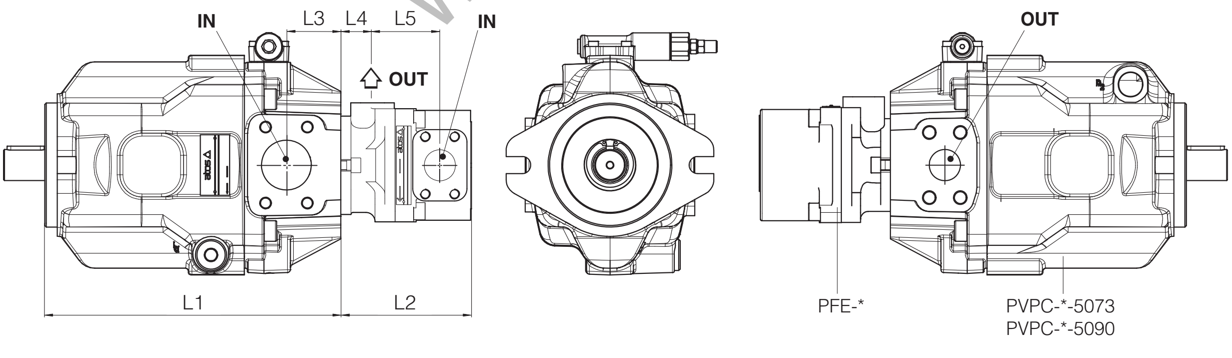
Model code	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4	L5
PVPCX2E-*-3029/3****	PVPCXA-*-3029	PFE-3****	231,2	134,5	39	27,5	71
PVPCX2E-*-3029/4****	PVPCXB-*-3029	PFE-4****	231,2	160	39	38	82

PVPCX2E-*-4046



Model code	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4	L5
PVPCX2E-*-4046/3****	PVPCXA-*-4046	PFE-3****	259	134,5	45	27,5	71
PVPCX2E-*-4046/4****	PVPCXB-*-4046	PFE-4****	259	160	45	38	82

PVPCX2E-*-5073
PVPCX2E-*-5090



Model code	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4	L5
PVPCX2E-*-5073/3****	PVPCXA-*-5073	PFE-3****	303,6	134,5	55,7	27,5	71
PVPCX2E-*-5073/4****	PVPCXB-*-5073	PFE-4****	303,6	160	55,7	38	82
PVPCX2E-*-5073/5****	PVPCXC-*-5073	PFE-5****	303,6	186,5	55,7	38	87
PVPCX2E-*-5090/3****	PVPCXA-*-5090	PFE-3****	303,6	134,5	55,7	27,5	71
PVPCX2E-*-5090/4****	PVPCXB-*-5090	PFE-4****	303,6	160	55,7	38	82
PVPCX2E-*-5090/5****	PVPCXC-*-5090	PFE-5****	303,6	186,5	55,7	38	87

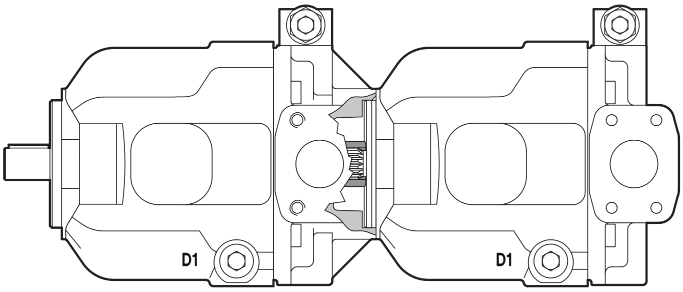
4 RELATED DOCUMENTATION

A005, A007	Vane pumps type PFE	**A160, AS170**	Axial piston pumps type PVPC
A180	Double vane pumps type PFED	**A900**	Operating and maintenance information for pumps
A045	Radial piston pumps type PFR		

Multiple axis piston pumps type PVPCX2C

variable displacement

Available only on request



PVPCX2C-C-4046/4046/1D

PVPCX2C are combined groups made by two variable displacement axial piston pumps type PVPC coupled together by means of a special intermediate flange and joint.

The pumps are available with standard max displacement 29, 46, 71 and 88 cc/rev and with standard mechanical controls (see KT catalog, tab. A160)

Other executions with proportional controls are available on request.

1 MODEL CODE

080***	PVPCX2C	-	CH	-	4	046	/	3	029	/	1	D	-I	X	24DC	*	/*

Special code

Axial piston pumps multiple execution

Type of control first / second pump (1):
C = manual pressure compensator
CH= manual pressure compensator, with venting
R = remote pressure compensator
L = load sensing (pressure & flow)
LW = constant power (combined pressure & flow)

Size of first pump see section 2:
3 = for displacement 029
4 = for displacement 046
5 = for displacement 073 and 090

Max displacement of first pump see section 2:
029 = 29 cm^3/rev **046** = 46 cm^3/rev
073 = 73 cm^3/rev **090** = 88 cm^3/rev

Size of second pump see section 2:
3 = for displacement 029
4 = for displacement 046
5 = for displacement 073 and 090

Max displacement of second pump see section 2:
029 = 29 cm^3/rev **046** = 46 cm^3/rev **073** = 73 cm^3/rev **090** = 88 cm^3/rev

Seals material:
- = NBR
PE = FKM

Series number

Supply voltage (only for control type CH):
see KT catalog, tab. A160, section 5:

X = without connector
(only for control type CH)

Solenoid of pilot valve (only for control type CH):
-I = solenoid OI (DHI) for AC and DC supply

Direction of rotation (viewed at the shaft end)
D = clockwise
S = counterclockwise

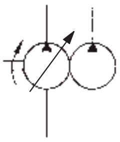
Shaft (SAE Standard):
1 = keyed (7/8" for 029 - 1" for 046 - 1 1/4" for 073 and 090)
5 = splined (13 teeth for 029 - 15 for 046 - 14 for 073 and 090)

(1) proportional controls available on request, consult our technical office

2 PUMPS SIZE AND DISPLACEMENT

size code	displacement code	max displacement [cm^3/rev]
3	029	29
4	046	46
5	073	73
	090	88

3 HYDRAULIC SYMBOL



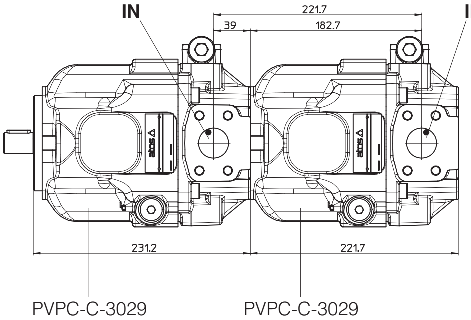
For other technical characteristics of PVPC pumps, see KT catalog, tab. A160

4 PUMPS COMBINATIONS AND SHAFT TORQUE

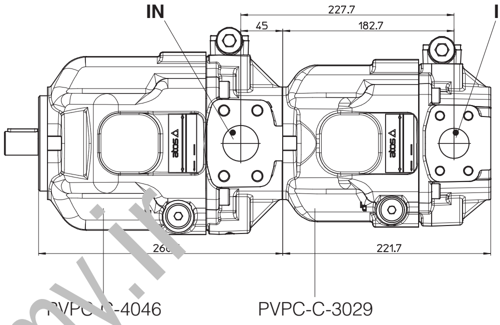
Multiple pump	First pump	1st shaft max torque [Nm] type **1**	1st shaft max torque [Nm] type **5**	Second pump	2nd shaft max torque [Nm] type **5**
080*** PVPCX2C-*/*-3029/3029	PVPCXB-*-3029/*	200	190	PVPC-X-3029/5*	135
080*** PVPCX2C-*/*-4046/3029	PVPCXB-*-4046/*	230	330	PVPC-X-3029/5*	250
080*** PVPCX2C-*/*-4046/4046	PVPCXB-*-4046/*	230	330	PVPC-X-4046/5*	250
080*** PVPCX2C-*/*-5073/3029	PVPCXB-*-5073/*	490	620	PVPC-X-3029/5*	330
080*** PVPCX2C-*/*-5073/4046	PVPCXB-*-5073/*	490	620	PVPC-X-4046/5*	330
080*** PVPCX2C-*/*-5073/5073	PVPCXC-*-5073/*	490	620	PVPC-X-5073/5*	440
080*** PVPCX2C-*/*-5090/3029	PVPCXB-*-5090/*	490	620	PVPC-X-3029/5*	330
080*** PVPCX2C-*/*-5090/4046	PVPCXB-*-5090/*	490	620	PVPC-X-4046/5*	330
080*** PVPCX2C-*/*-5090/5073	PVPCXC-*-5090/*	490	620	PVPC-X-5073/5*	440
080*** PVPCX2C-*/*-5090/5090	PVPCXC-*-5090/*	490	620	PVPC-X-5090/5*	440

5 DIMNESIONS [mm]

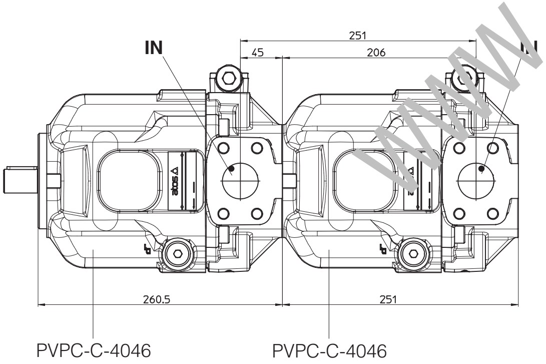
080* PVPCX2C-C/C-3029/3029**



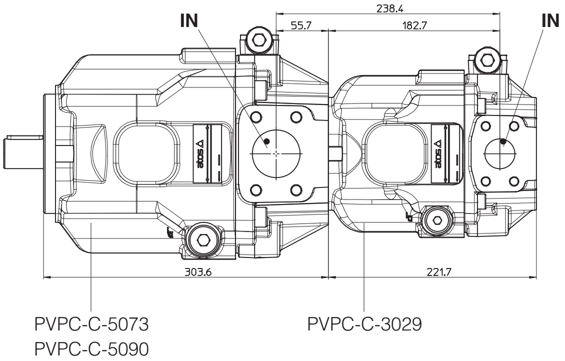
080* PVPCX2C-C/C-4046/3029**



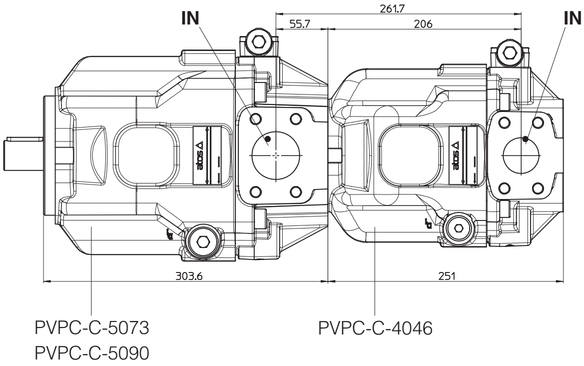
080* PVPCX2C-C/C-4046/4046**



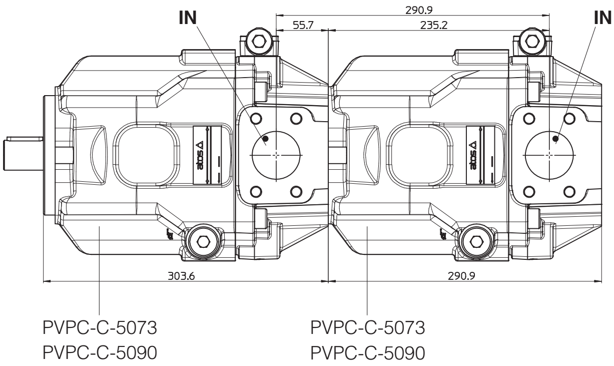
080* PVPCX2C-C/C-5073/3029**



080* PVPCX2C-C/C-5073/4046**



080* PVPCX2C-C/C-5073/5073**



Note:
The above dimensions are referred to the basic pumps with control type C.
For other type of controls (CH, R, L, LW) the reported dimensions remains uncharged

Accessories for SSP servopumps

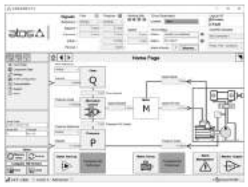
Software, cables, reactances, EMC filters and braking resistances

1 S-SW-SETUP PROGRAMMING SOFTWARE

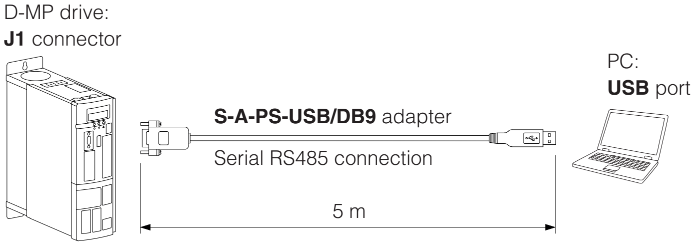
SSP system can be easily configured connecting D-MP drive to the PC and using Atos S-SW-SETUP programming software. At the system first start-up, the software will invite the user to follow the Smart Start-Up wizard for setting all the parameters necessary for the correct start-up and operation of the system. All the main functions can in any case, be reached and modified thanks to a simple and intuitive graphic interface.

Direct access to the latest releases of programming software, manuals and fieldbus configuration files in MyAtos area at www.atos.com .

For more information about S-SW-SETUP software, see techical table **AS800**.

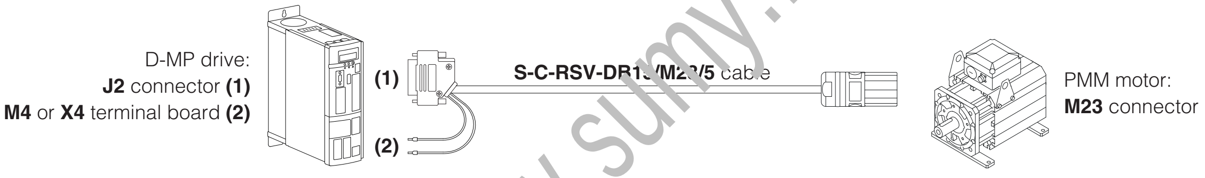


S-SW-SETUP programming software



2 RESOLVER CABLE

This cable allows to connect motor resolver to D-MP drive.



Model code

S-C-RSV	-	DB15	/	M23	/	5
Resolver cable						Length [m]: **5** , **10** , **15** , **20**

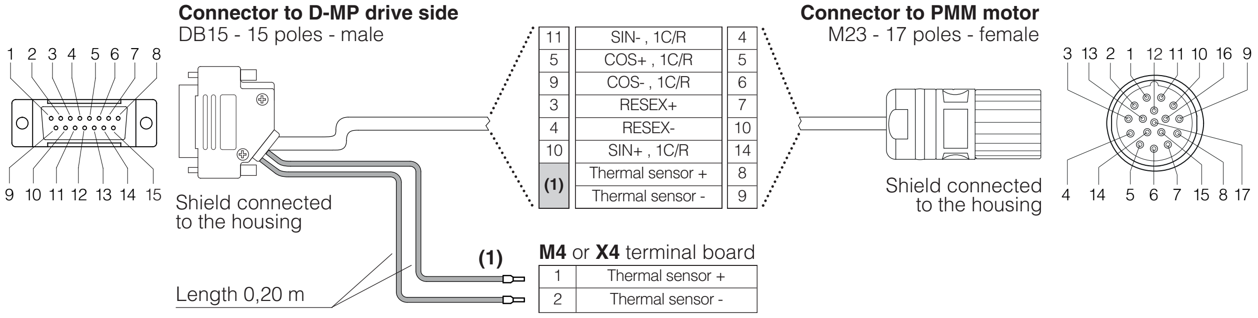
DB15 = from J2 DB15 connector, D-MP drive side

M23 = to M23 connector, PMM motor side

S-C-RSV-DB15/M23/* - technical specifications

- DB15 male 15 poles connector to D-MP drive
- M23 female 17 poles connector to motor
- two external wires for thermal sensor (KTY and PT)
- paired transmission cable with overall copper screen
- self extinguishing according to IEC 60332-1-2, EN 60332-1-2, UL CSA FT-1, FT-2
- oil resistant with outer green PUR stealth type TMPU
- halogen free according to DIN VDE 0472
- -40°C to +80°C installing temperature range
- 30 V max nominal voltage
- RoHS and CE compliant
- minimum bending radius: 5 x D (D = diameter)

Resolver cable wiring diagram



11	SIN- , 1C/R	4
5	COS+ , 1C/R	5
9	COS- , 1C/R	6
3	RESEX+	7
4	RESEX-	10
10	SIN+ , 1C/R	14
(1)	Thermal sensor +	8
	Thermal sensor -	9

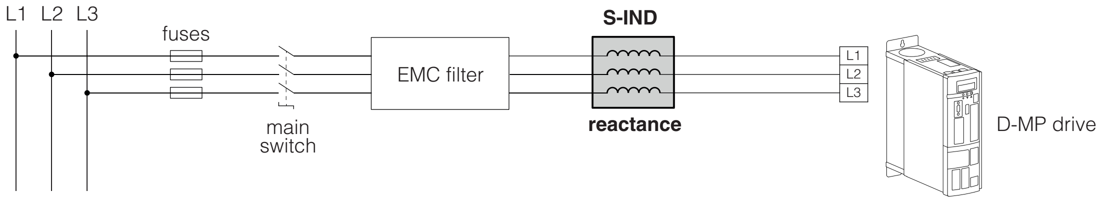
M4 or **X4** terminal board

1	Thermal sensor +
2	Thermal sensor -

(1) Thermal sensor external wires have to be connected to pin 1 and 2 of M4 or X4 D-MP drive terminal board (DB15 pass-through connection): **M4** available for D-MP drives size 022 ÷ 060 or **X4** available for D-MP drives size 090 ÷ 210

3 REACTANCES

The 3-phase reactance is used to reduce harmonics on the current drawn by D-MP drive.



Note: when connecting D-MP drives size 022 ÷ 060 to 3-phase power supply we recommend using a 3-phase reactance
For D-MP drives size 090 ÷ 210 the 3-phase input reactance is mandatory

Model code

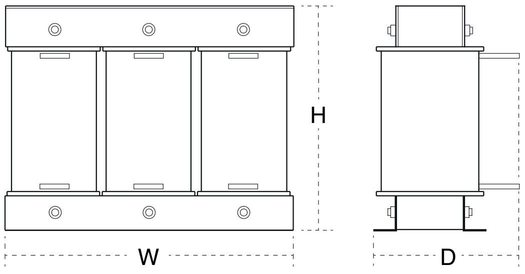
S-IND	-	022
Reactance on the line side - 3-phase input		Size: **022** = for D-MP-*-022 **032** = for D-MP-*-032 **046** = for D-MP-*-046 **060** = for D-MP-*-060 **090** = for D-MP-*-090 **100** = for D-MP-*-100 **140** = for D-MP-*-140 **165** = for D-MP-*-165 **210** = for D-MP-*-210

General characteristics

Reactance type	Reactance value [mH]	Nominal current [A]	Overload current [A]	Mass [Kg]	D-MP drive type	Supplier code
S-IND-022	0.470	23.4	46.9	6	D-MP-*-022 **(1)**	054R4900
S-IND-032	0.294	37.5	74.9	6	D-MP-*-032 **(1)**	054R49001
S-IND-046	0.235	46.9	93.7	6.5	D-MP-*-046 **(1)**	054R49003
S-IND-060	0.198	55.8	111.6	8	D-MP-*-060 **(1)**	054R49004
S-IND-090	0.132	83.7	167.4	9	D-MP-*-090 **(2)**	054R48005
S-IND-100	0.110	100.0	200.0	12	D-MP-*-100 **(2)**	054R48006
S-IND-140	0.080	137.9	275.7	14	D-MP-*-140 **(2)**	054R48007
S-IND-165	0.067	165.0	331.0	14	D-MP-*-165 **(2)**	054R48016
S-IND-210	0.055	202.0	404.0	20	D-MP-*-210 **(2)**	054R48017

(1) Reactance recommended
(2) Reactance mandatory
Note: voltage drop of 1,5% calculated for 3-phase power supply 400 Vrms, frequency 50 Hz and at nominal current

Installation dimension [mm]

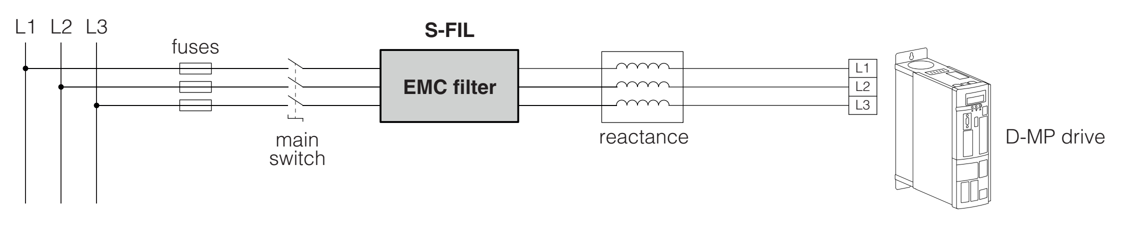


Reactance type	W	D	H
S-IND-022	180	115	200
S-IND-032	180	115	200
S-IND-046	180	120	200
S-IND-060	180	130	200
S-IND-090	180	160	165
S-IND-100	240	140	215
S-IND-140	240	150	215
S-IND-165	240	140	280
S-IND-210	240	170	280

Note: the image is intended for explanatory purposes only and may show differences in accordance to the type

4 EMC FILTERS

The EMC filters are used to improve the immunity and safety of electrical and electronic equipment from electromagnetic noise exchanged between D-MP drive and 3-phase power supply.

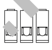
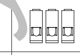
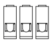


Note: when connecting D-MP drives to 3-phase power supply we recommend using a EMC filter

Model code

S-FIL	-	032
EMC filter - 3-phase		Size: **032** = for D-MP-*-022 and D-MP-*-032 **046** = for D-MP-*-046 **060** = for D-MP-*-060 **090** = for D-MP-*-090 **140** = for D-MP-*-100 and D-MP-*-140 **165** = for D-MP-*-165 **210** = for D-MP-*-210

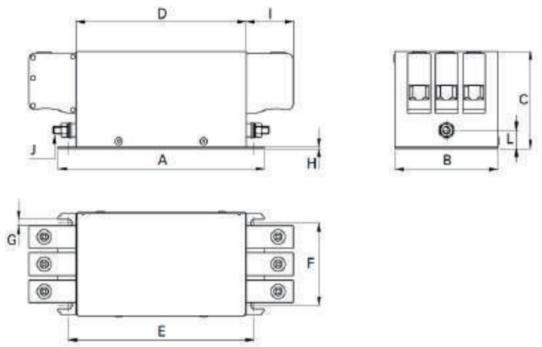
General characteristics

EMC filter type	Rated current @ 50°C (40°C) [A]	Typical drive power rating **(1)** [kW]	Leakage Current @ 480 VAC/50 Hz [mA]	Power loss @ 25°C/50 Hz [W]	Input-Output connections type		Mass [Kg]	D-MP drive type	Supplier code
S-FIL-032	35 (38)	22	29.4 **(2)**	6.8		-	0.7	D-MP-*-022 D-MP-*-032	FN3270H-35-33
S-FIL-046	50 (55)	30	29.4 **(2)**	12.8		-	1.2	D-MP-*-046	FN3270H-50-34
S-FIL-060	80 (88)	45	29.4 **(2)**	13.5		-	2.2	D-MP-*-060	FN3270H-80-35
S-FIL-090	100 (110)	55	29.4 **(2)**	17.1		-	2.6	D-MP-*-090	FN3270H-100-35
S-FIL-140	150 (164)	75	59.5 **(2)**	7.5	-		6.1	D-MP-*-100 D-MP-*-140	FN3270H-150-99
S-FIL-165	200 (219)	110	59.5 **(2)**	13.2	-		6.1	D-MP-*-165	FN3270H-200-99
S-FIL-210	250 (272)	130	10	80	-		9.0	D-MP-*-210	FIN538S1.250.BC

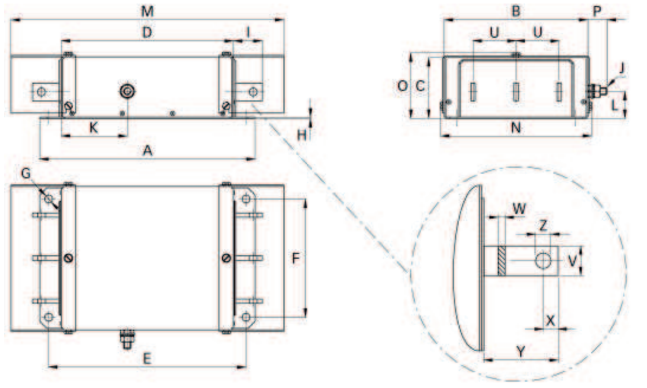
(1) Calculated at rated current, 480 VAC and cos phi = 0.8, the exact value depends upon the efficiency of the D-MP drive, motor and entire application
(2) Maximum leakage under normal operating conditions. Note: if two phases are interrupted, worst case leakage could reach 5.2 times higher levels

Installation dimensions [mm] - size 032 ÷ 165

size 032 ÷ 090

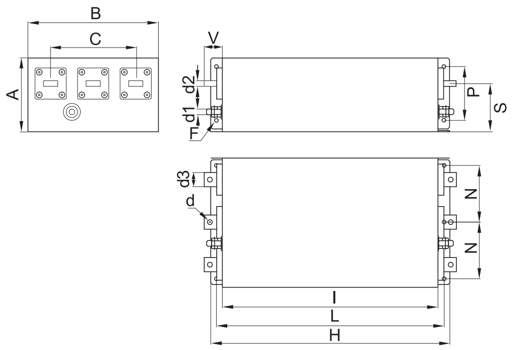


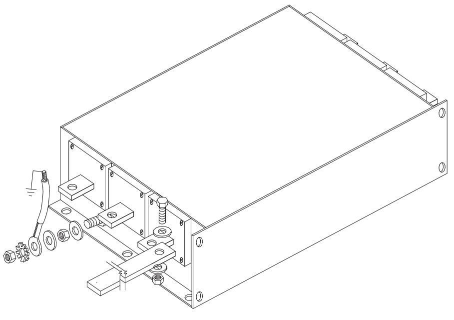
size 140 ÷ 165



EMC filter type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	U	V	W	X	Y	Z
S-FIL-032	160	70	68	130	142.5	50	5.5	1	25	M5		20										
S-FIL-046	170	85	80	140	152.5	65	5.5	1	39	M6		15										
S-FIL-060	200	95	90	170	182.5	75	5.5	1.5	45	M8		16										
S-FIL-090	230	95	90	200	212.5	75	5.5	1.5	45	M8		16										
S-FIL-140	300	200	86	240	275	165	Ø 11	2	40	M10	92	37	380	211	93	26.5	60	20	3	10	37	Ø 9
S-FIL-165	300	200	86	240	275	165	Ø 11	2	40	M10	92	37	380	211	93	26.5	60	20	3	10	37	Ø 9

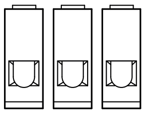
Installation dimension [mm] - size 210





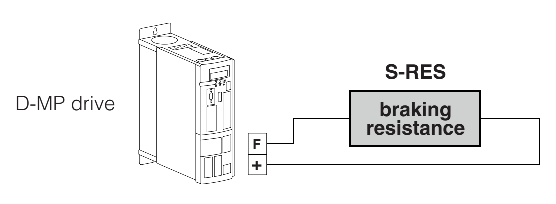
EMC filter type	A	B	C	d	d1	d2	d3	V	F	H	I	L	N	P	S
S-FIL-210	90	220	120	M8	M10	6	20	42	6.5	356	320	340	95	70	55

EMC filter input/output connector cross section - only for size 032 ÷ 090

EMC filter type	Solid wire [mm²]	Flex wire [mm²]	Recommended torque [Nm]	Connection type
S-FIL-032	16	10	1.5 - 1.8	
S-FIL-046	35	25	4.0 - 4.5	
S-FIL-060	50	50	7.0 - 8. 0	
S-FIL-090	50	50	7.0 - 8. 0	

5 BRAKING RESISTANCES

The braking resistances have the purpose of limiting the voltage of D-MP drive internal circuits (DC BUS) when the input stage of the line entrance is not able to recover the energy coming from the field into the network.
In these conditions, the energy supplied by D-MP drive internal circuits is transformed into heat dissipated on the external braking resistance.



Model code

S-RES	-	RFH-220	/	20R
Alluminium housing braking resistance				

Nominal power:

RFH-220 = 400 W
HPR-2000 = 1900 W
KHPR2-1200 = 2100 W
KHPR2-2000 = 3500 W

Ohmic value:

20R = 20 Ω (for **RFH-220**)
28R = 28 Ω (for **RFH-220**)
5R = 5 Ω (for **HPR-2000** and **KHPR2-1200**)
2R5 = 2,5 Ω (for **KHPR2-2000**)

Note: all braking resistances are available with an external IP20 protection grid and IP21 cable box with cable gland. Following related ordering codes: S-RES-RFH**G**-220/20R , S-RES-RFH**G**-220/28R , S-RES-HPR**G**-2000/5R , S-RES-KHPR2**G**-1200/5R , S-RES-KHPR2**G**-2000/2R5

Power rating and thermal characteristics

Braking resistance type	Nominal power **(1)** [W]	Nominal temperature rise [°C]	Single adiabatic load **(2)** [kJ]	Ciclic load at Pn Ton<2'' **(2)** [kJ]	Thermal time constant [s]	Thermal resistance [°C/W]
S-RES-RFH-220/20R	400	350	12	15	400	0.875
S-RES-RFH-220/28R						
S-RES-HPR-2000/5R	1900	400	100	120	900	0.21
S-RES-KHPR2-1200/5R	2100	400	100	120	800	0.22
S-RES-KHPR2-2000/2R5	3500	400	150	160	900	0.12

(1) Nominal power is intended as continuous and refers to lab conditions with the resistance suspended in air
(2) Maximum values: actual energy depends on ohmic value, mean power, load time

Electric characteristics

Braking resistance type	Ohmic value range [Ω]	Tollerance class	Thermal derivative [ppm/°C]	Max. working voltage (Vcc) [V]	Max. working voltage (Vac) **(1)** [V]
S-RES-RFH-220/20R	20	J	150	1500	1000
S-RES-RFH-220/28R	28				
S-RES-HPR-2000/5R	5	J	< 100	1500	1000
S-RES-KHPR2-1200/5R	5				
S-RES-KHPR2-2000/2R5	2,5				

(1) Maximum working voltage depends of the electric solicitation harmonic content; electric load with an important high frequency component have to be verified

Drive/resistance associations

D-MP drive type	Braking resistance type	Overall resistance [Ω]	Overall average power [W]
D-MP-*-022	1 x S-RES-RFH-220/28R	28	400
D-MP-*-032	1 x S-RES-RFH-220/20R	20	400
D-MP-*-046	2 x S-RES-RFH-220/20R **(1)**	10	800
D-MP-*-060	2 x S-RES-RFH-220/20R **(1)**	10	800
D-MP-*-090	3 x S-RES-RFH-220/20R **(1)**	6.7	1200
D-MP-*-100	1 x S-RES-HPR-2000/5R	5	1900
D-MP-*-140	1 x S-RES-KHPR2-1200/5R	5	2100
D-MP-*-165	1 x S-RES-KHPR2-1200/5R	5	2100
D-MP-*-210	1 x S-RES-KHPR2-2000/2R5	2.5	3500

(1) The resistance have to be connected in parallel

Note: the drive/resistance associations could change according to the average power (P average) and maximum energy value (E peak) indicated by the customer

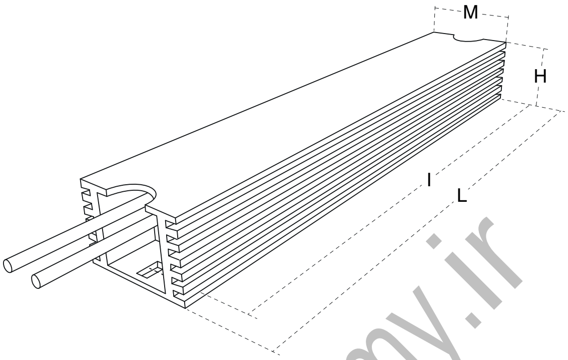
Standard

Standard		S-RES-RFH-*		S-RES-HPR-* S-RES-KHPR2-*	
		Limit	**Typical**	**Limit**	**Typical**
Dir. 2002/95/CE RoHS		compliant	compliant	compliant	compliant
IEC 60364	Component class	I	I	I	i
	Insulation resistance [MΩ] **(1)**	100	> 100	100	> 100
	Electric strength [mA] **(2)**	< 2	< 0.1	< 2	< 0.1
IEC 60529	Resistor body	IP64	IP64	IP55	IP55
	Terminals	IP00	IP00	IP00	IP00
IEC 60664	Overvoltage category	I	I	II	II
	Pollution degree	4	4	4	4

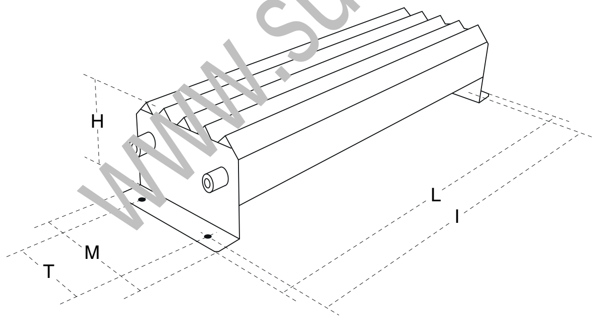
(1) Applied voltage 1000 Vcc
(2) Test voltage 3000 Vac 60''

Installation dimension [mm]

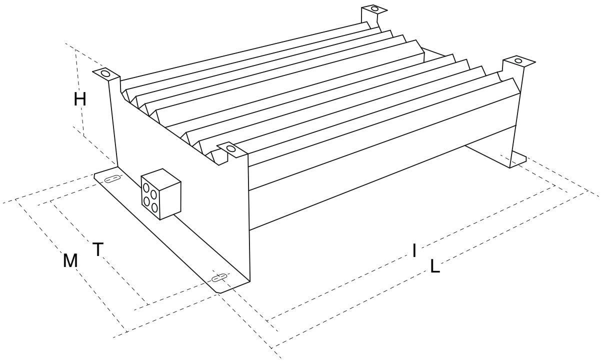
S-RES-RFH-*



S-RES-HPR-*



S-RES-KHPR2-*



Braking resistance type	L	H	M	I	T	Cables length	Average mass [kg]
S-RES-RFH-220/20R	200	27	36	189	-	300	0,333
S-RES-RFH-220/28R	200	27	36	189	-	300	0,333
S-RES-HPR-2000/5R	365	73	105	350	70	450	4
S-RES-KHPR2-1200/5R	310	115	230	295	170	-	7
S-RES-KHPR2-2000/2R5	365	115	230	350	170	-	8

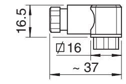
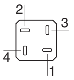
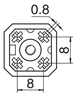
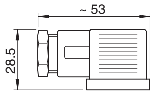
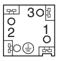
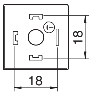
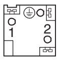
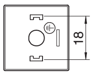
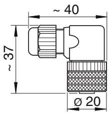
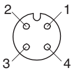
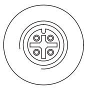
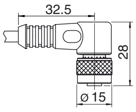
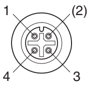
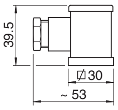
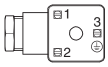
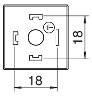
Note: tolerance of ± 2% on all nominal dimensions

Table **K800-2/E**

Electric and electronic connectors

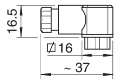
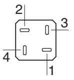
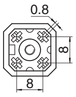
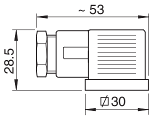
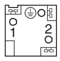
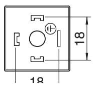
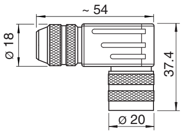
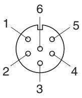
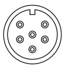
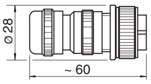
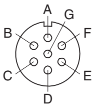
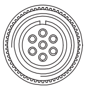
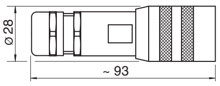
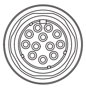
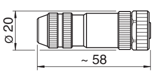
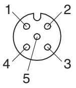
for transducers, on/off and proportional valves, pumps

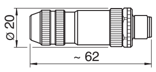
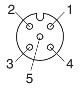
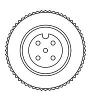
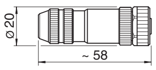
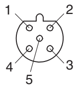
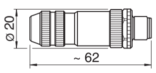
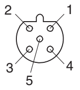
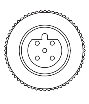
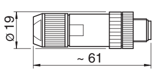
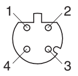
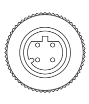
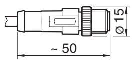
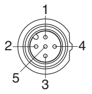
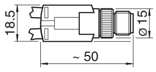
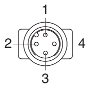
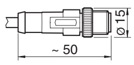
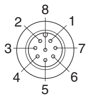
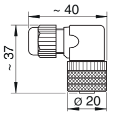
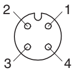
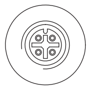
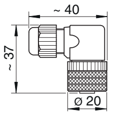
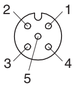
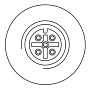
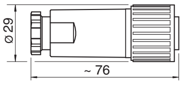
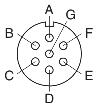
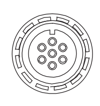
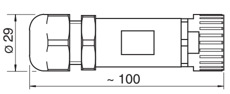
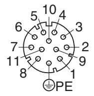
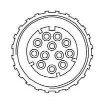
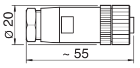
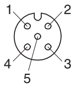
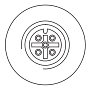
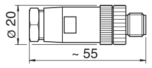
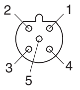
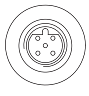
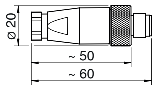
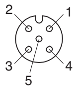
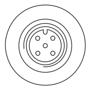
1 CONNECTORS FOR ON/OFF VALVES AND PUMPS

CODE AND DIMENSIONS		APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
345		Female plastic connector - 4 pin: - inductive proximity sensor, /FI option for DHI, DHE			PG7 ø 4 ÷ 6 mm	DIN EN 61984 (VDE 0627) Protection degree IP 65 EN 60529
664		Female plastic connector - 4 pin: - pressure switch type MAP - inductive proximity sensor, /FI option for DKE-17*	 **664**		PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529
666 (black) **666/A** (grey)		Female plastic connector - 3 pin: - standard coil connector for on/off valves - inductive proximity sensor, /FI option for DKE-16*	 **666** **667-***			
667-24 **667-110** **667-220**		Female plastic connector - 3 pin: - standard coil connector for on/off valves with built-in led				
ZBE-06		Female plastic connector - 4 pin: - inductive position switch, /FV option			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
BKS-B-20-4-03		Female plastic connector - 4 pin (3 wire): - inductive proximity sensor for LIFI Cable length: 3 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
669 (black) **669/A** (grey)		Female plastic connector - 3 pin: - optional electronic connector for on/off valves with built-in recti-fier bridge for supplying DC coils by AC current			PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529

(1) the wiring of electrical terminals has to be made according to specific technical table

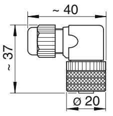
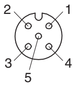
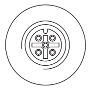
2 CONNECTORS FOR PROPORTIONAL VALVES AND PUMPS

CODE AND DIMENSIONS		APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
345		Female plastic connector - 4 pin: - position transducer for ZO(R)-T and ZO-L valves			PG7 ø 4 ÷ 6 mm	Protection degree IP 65 EN 60529
666 (black)		Female plastic connector - 3 pin: - standard coil connector for proportionals valves			PG11 ø 8 ÷ 10 mm	DIN 43650-A/ISO 4400 Protection degree IP 65 EN 60529
STCO9131-6-PG9		Female metallic connector at 90° - 6 pin: - position transducer for LIQZP-L size 125 cartridges			PG9 ø 6 ÷ 8 mm	Protection degree IP 67 EN 60529
ZM-7P		Female metallic connector - 7 pin: - main connector for integral electronic driver			PG11 ø 7 ÷ 9 mm	According to MIL-C-5015 Protection degree IP 67 EN 60529
ZM-12P		Female metallic connector - 12 pin: - main connector for integral electronic driver			PG13,5 ø 8 ÷ 11 mm	DIN 43651 Protection degree IP 67 EN 60529
ZM-5PF		Female metallic connector - 5 pin: - CANbus for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding A IEC 60947-5-2 Protection degree IP 67 EN 60529

ZM-5PM 	Male metallic connector - 5 pin: - CANbus for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-5PF/BP 	Female metallic connector - 5 pin: - PROFIBUS DP for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding B IEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-5PM/BP 	Male metallic connector - 5 pin: - PROFIBUS DP for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding B IIEC 61076-2-101 Protection degree IP 67 EN 60529
ZM-4PM/E 	Male metallic connector - 4 pin: - EtherCAT, POWERLINK, EtherNet/IP, PROFINET RT/IRT for integral electronic driver			Pressure nut ø 6 ÷ 8 mm	M12 - coding D IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM/1.5 **ZH-5PM/5** 	Male plastic connector - 5 pin - single pressure/force transducer - analog position transducer Cable length: 1.5 m or 5 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM-2/2 	Male plastic connector - 4 pin: - double pressure/force transducers Splitting cable length: 2 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-8PM/5 **ZH-8PM/10** 	Male plastic connector - 8 pin: - digital position transducer Cable length: 5 m or 10 m			Moulded on cable	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZBE-06 	Female plastic connector - 4 pin: - position transducer (LIQZO-T* size 50) - integral pressure transducer (TERS)			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZBE-08 	Female plastic connector - 5 pin: - position transducer E-THT-15 (LIQZP)			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-7P 	Female plastic reinforced with fiber glass connector - 7 pin: - main connector for integral electronic driver			PG11 ø 8 ÷ 10 mm	According to MIL-C-5015 Protection degree IP 67 EN 60529
ZH-12P 	Female plastic reinforced with fiber glass connector - 12 pin: - main connector for integral electronic driver			PG16 ø 6 mm x 2 cable	DIN 43651 Protection degree IP 67 EN 60529
ZH-5P 	Female plastic connector - 5 pin: - RS232 Serial, CANbus - digital electronic driver E-MI-AS-IR, /M12 option			PG9 ø 6 ÷ 8 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5P/BP 	Male plastic connector - 5 pin: - PROFIBUS DP			PG9 ø 6 ÷ 8 mm	M12 - coding B IEC 61076-2-101 Protection degree IP 67 EN 60529
ZH-5PM 	Male plastic connector - 5 pin: - pressure, force, position transducers (TEZ/LEZ series 10 or lower)			PG7 ø 4 ÷ 6 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529

(1) the wiring of electrical terminals has to be realized according to specific technical table

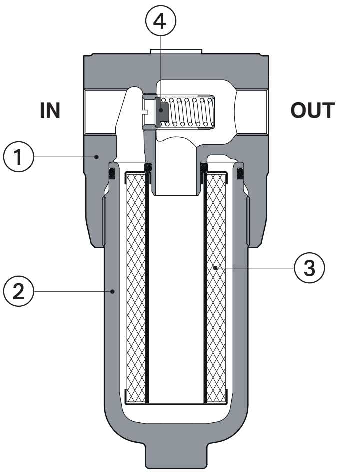
3 CONNECTOR FOR PRESSURE TRANSDUCERS AND PRESSURE SWITCHES

CODE AND DIMENSIONS	APPLICATION	INTERNAL VIEW PINOUT (1)	FRONT VIEW	CABLE GLAND Ø CABLE	REFERENCE RULES
ZBE-08 	Female plastic connector - 5 pin: - pressure transducer E-ATR8 - electronic pressure switch type E-DAP-2			PG7 ø 2,5 ÷ 6,5 mm	M12 - coding A IEC 61076-2-101 Protection degree IP 67 EN 60529

(1) the wiring of electrical terminals has to be made according to specific technical table

In line filters, high pressure type FPS

Threaded ports



① Filter head
② Filter bowl
③ Filter element
④ By-pass valve

FPS-10-*R-*

FPS

In line filters are designed for installation on the pressure line downstream the pump, to ensure a high cleanliness of the fluid circulating into the hydraulic system. They protect sensible components from contamination present in the working fluid and they are particularly recommended for systems with proportional valves.

- three head sizes
- port sizes: G1/2" to G1 1/2"
  SAE-16, SAE-20, SAE-24
- **Filtration Plus** microfiber elements ensure high efficiency, low pressure drop, high DHC and long lasting performance. Collapse pressure 21 bar for filters equipped with by-pass valve or 210 bar for filters without by-pass
- filtration rating 5 - 7 - 12 - 22 μm(c) (βx (c) >1000, ISO 16889).
- versions without or with by-pass valve with cracking pressure 6 bar.
- without or with differential clogging indicator

Max flow **450 l/min**
Max working pressure **420 bar**

1 MODEL CODE OF COMPLETE FILTERS

FPS	-	10	-	A	-	F10	-	01	-	R	-	*	-	W		*	/	*

FPS: In line filter, high pressure

Filter size (ports size):
10 = G1/2" ÷ G1" or SAE-16
20 = G1" ÷ G1 1/4" or SAE-20
30 = G1 1/4" ÷ G1 1/2" or SAE-24

Filter length:	Max flow [l/min] **(1)** FPS-10	FPS-20	FPS-30
A =	115	191	256
B =	137	205	361
C =	-	226	406
D =	-		450

Filter element:
SN = only body, without filter element
F+ microfibre filter element βx(c) >1000 - ISO 16889:
F03 = 5 μm (c) **F10** = 12 μm (c)
F06 = 7 μm (c) **F20** = 22 μm (c)
Filter element **F01** = 4 μm (c) available on request

Ports size:	FPS-10	FPS-20	FPS-30
BSPP threaded:	**00** = G 1/2" **01** = G 3/4" **02** = G 1"	**02** = G 1" **03** = G 1 1/4"	**03** = G 1 1/4" **04** = G 1 1/2"
SAE J1926-1	FPS-10	FPS-20	FPS-30
threaded:	**42** = SAE-16 (1")	**43** = SAE-20 (1 1/4")	**44** = SAE-24 (1 1/2")

Series number

Seals material:
- = NBR
PE = FKM

Differential clogging indicator see sect. 14 :
W = without, indicator port with plastic plug **(2)**
P = without, indicator port with steel plug
L = electrical indicator with LED **(3)**
M = electrical indicator without LED **(3)**
V = visual indicator **(3)**
see also note (4)

Options see sect. 10 :
- = none
AR = anti-back flow valve and reverse valve

By-pass valve see sect. 9:
R = by-pass valve with cracking pressure 6 bar (filter element PSH-*-R with collapse pressure 21 bar)
N = without by-pass (filter element PSH-*-N with collapse pressure 210 bar)

Note: filters for use in potentially explosive atmosphere are available on request, contact Atos Technical Office

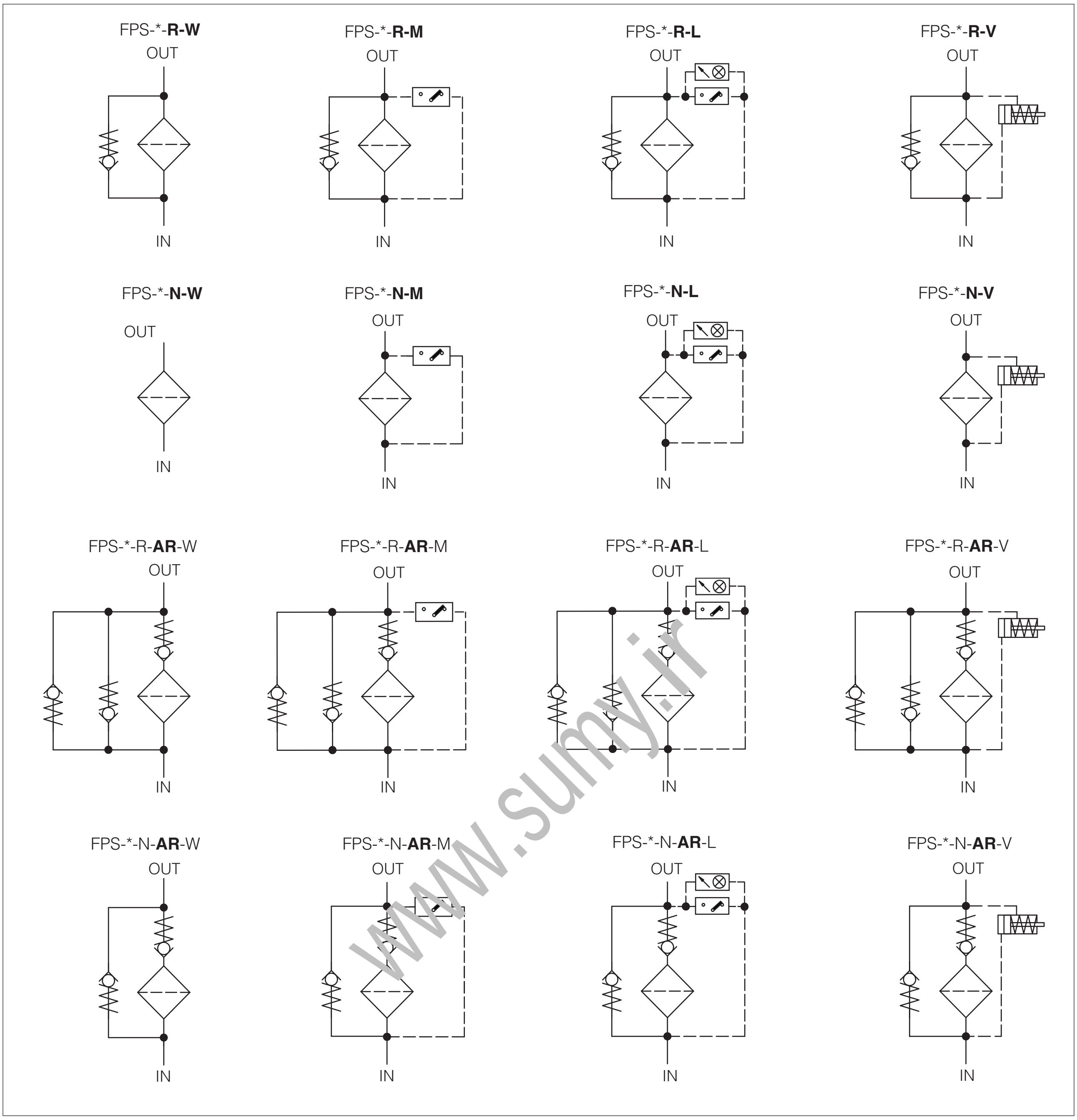
(1) Max flow rates are measured with: Δp 1 bar, filter element F20, largest port size, option -R, oil viscosity 32 mm^2/s - see also section 6
In case of different conditions see section 11 for filter sizing

(2) The plastic plug (option W) is factory assembled to prevent impurities from entering the filter through the clogging indicator port.
A clogging indicator must be fitted on the filter before commissioning. Do not install the filter with the plastic cap on the hydraulic system

(3) The clogging indicator is supplied disassembled from the filter. The indicator port on filter head is plugged with plastic plug

(4) Differential thermostated indicator CID-T and differential electronic transmitter with output signal 4÷20 mA CID-Z are available on request, see section 4

2 HYDRAULIC SYMBOLS (representation according to ISO 1219-1)



3 MODEL CODE OF FILTER ELEMENTS - only for spare **(1)**

PSH	-	**10**	-	**A**	-	**F10**	-	**R**	*	/	*

PSH: Spare filter element for in line filter type FPS

Filter element size:
10 = for FPS-10
20 = for FPS-20
30 = for FPS-30

Filter element length:

for FPS-10	for FPS-20	for FPS-30
A	**A**	**A**
B	**B**	**B**
	C	**C**
		D

Microfibre filter element, βx(c) >1000 - ISO 16889:
F03 = 5 μm (c)
F06 = 7 μm (c)
F10 = 12 μm (c)
F20 = 22 μm (c)
Filter element **F01** = 4 μm (c) available on request

R = filter element with collapse pressure 21 bar, for filter FPS-*-R with by-pass valve
N = filter element with collapse pressure 210 bar, for filter FPS-*-N without by-pass valve

*: Series number

Seals material:
- = NBR
PE = FKM

(1) Select the filter element according to the model code reported on the filter nameplate, see section 18

4 MODEL CODE OF DIFFERENTIAL CLOGGING INDICATORS - only for spare - see section 14 and 15

CID	-	E	05	-	M	*	/	*

CID: Spare differential clogging indicator for in line filter

Type of indicator:
E = electrical
V = visual
T = thermostated (available on request)
Z = electronic transmitter 4÷20 mA (available on request)

Differential switching pressure (only for CID-E and CID-V):
05 = 5 bar for filters with by-pass valve
08 = 8 bar for filters without by-pass valve

Optional LED - only for CID-E
L = with LED
M = without LED

Series number

Seals material:
\- = NBR
PE = FKM

5 GENERAL CHARACTERISTICS

Assembly position / location		Vertical position with the bowl downward
Ambient temperature range		**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range		**Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Materials	Filter head	Cast iron
	Filter bowl	Carbon steel
Surface protection		Zinc coating with black passivation
Corrosion resistance		Salt spray test (EN ISO 9227) > 600 h
Fatigue strength		min. 1 x 10^6 cycles at 420 bar
Compliance		RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

6 HYDRAULICS CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C (viscosity 32mm^2/s)

Filter size		**FPS-10**						**FPS-20**						**FPS-30**							
Ports size code		**00**		**01**		**02, 42**		**02**			**03, 43**			**03**				**04, 44**			
Ports dimension		G1/2"		G3/4		G1, SAE-16		G1"			G1"1/4, SAE-20			G1"1/4				G1/"1/2, SAE-24			
Filter length		**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Max flow (l/min) at Δp= 1 bar Filter with by-pass **-R** (see note)	**F03**	36	56	40	62	43	73	73	84	105	80	93	118	88	164	213	259	91	172	226	277
	F06	48	69	53	79	61	98	100	112	135	112	127	154	127	225	277	330	132	239	297	356
	F10	63	79	72	92	86	120	135	148	170	154	170	195	183	275	321	380	193	295	347	414
	F20	78	87	90	101	115	137	166	178	196	191	205	226	240	333	373	412	256	361	406	450
Max flow (l/min) at Δp= 1 bar Filter without by-pass **-N** (see note)	**F03**	31	43	34	48	36	53	60	70	88	65	76	98	71	120	191	215	74	125	202	228
	F06	47	55	52	61	58	71	83	94	116	91	105	131	93	187	228	290	97	197	242	311
	F10	54	75	60	87	70	111	117	130	153	133	149	176	158	245	298	343	166	260	321	372
	F20	72	85	82	99	103	131	154	166	187	177	192	215	210	315	367	380	223	340	400	414
Max operating pressure [bar]		**420**																			
Burst pressure [bar]		**> 1260**																			

Note: Max flow rates are measured with Δp= 1 bar and viscosity 32mm^2/s. In case of different conditions see section 11 for filter sizing

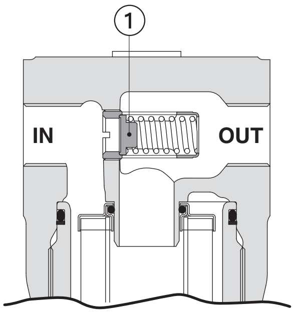
7 FILTER ELEMENTS F+ FILTRATION PLUS

Material		Inorganic microfibre
Filtration rating as per ISO16889	**F03**	$\beta_{4,5\mu m\ (c)} \geq 1000$
	F06	$\beta_{7\mu m\ (c)} \geq 1000$
	F10	$\beta_{12\mu m\ (c)} \geq 1000$
	F20	$\beta_{22\mu m\ (c)} \geq 1000$
Filter element collapse pressure	**R** = for filter with by-pass valve	21 bar
	N = for filter without by-pass valve	210 bar

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -30°C ÷ +100°C, with HFC hydraulic fluids = +10°C ÷ +50°C FKM seals (/PE option) = -25°C ÷ +120°C		
Recommended viscosity	15 ÷ 100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 BY-PASS VALVE



FPS-*-R

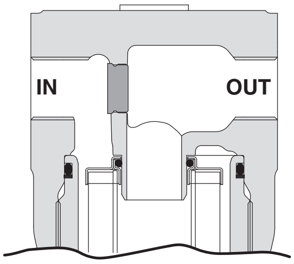
Filter with by-pass valve - version **-R**

The filter with by-pass valve ① is used in combination with filter elements PSH-*-R with collapse pressure 21 bar.
The by-pass valve allows the oil flow to by-pass the filter element in particular conditions:

- it protects the filter element from pressure peaks that could be generated, especially at the cold system start-up. In these cases the valve opens only for the instant necessary to discharge the pressure peak, limiting the quantity of oil that bypasses the filter.
- it allows the free passage of the oil flow in case of completely clogged filter element (Δp > 6 bar). This situation should be carefully avoided, by means of a scheduled maintenance, otherwise the contaminated oil will pass to the clean side of the filter and then it will circulate in the hydraulic system. The filter element must be replaced before the clogging condition, at this purpose the use of a differential clogging indicator CID-V (visual, option V) or CID-E (electrical, options L or M) is highly recommended.

Filter without by-pass valve - version **-N**

The filter version without by-pass is recommended when the hydraulic system must be absolutely protected by contamination, then avoiding the risk that the contaminant passes though the by-pass valve.
The filter without by pass must be used in combination with filter elements PSH-N with high collapse pressure 210 bar



FPS-*-N

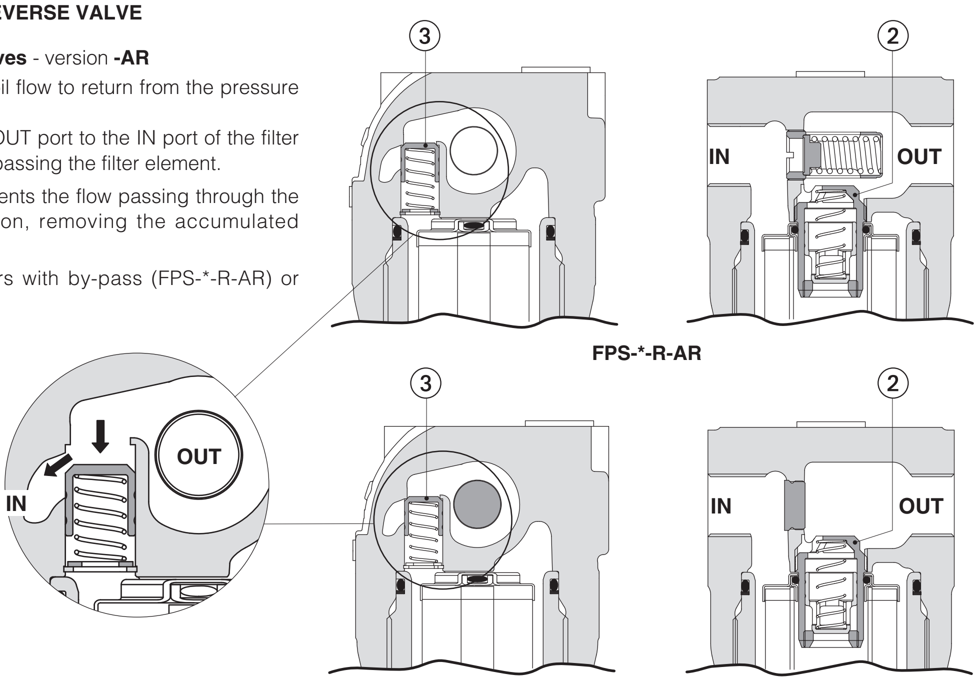
10 ANTI BACK-FLOW AND REVERSE VALVE

Anti-back flow and Reverse valves - version **-AR**

The filter version -AR allows the oil flow to return from the pressure line back to the pump.
The return flow passes from the OUT port to the IN port of the filter through the reverse valve ③, bypassing the filter element.

The anti-back flow valve ② prevents the flow passing through the filter element in reverse direction, removing the accumulated contaminant.

Version **AR** is available for filters with by-pass (FPS-*-R-AR) or without by-pass (FPS-*-N-AR)



FPS-*-N-AR

11 FILTERS SIZING

For the filter sizing it is necessary to consider the Total Δp at the maximum flow at which the filter must work.
The Total Δp is given by the sum of filter head Δp plus the filter element Δp:

Total Δp = filter head Δp + filter element Δp

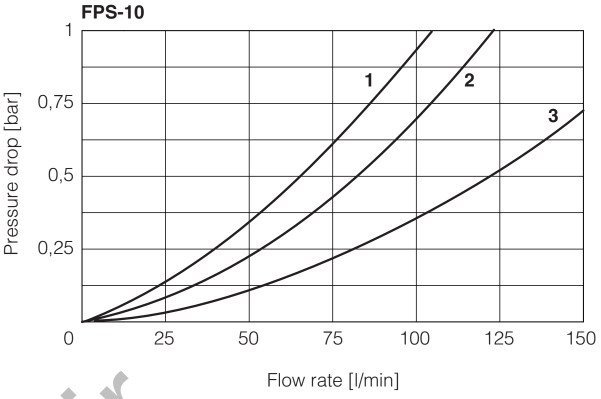
In the best conditions the total Δp should not exceed 1,0 bar
See below sections to calculate the Δp of filter head and Δp of the filter element

11.1 Q/Δp DIAGRAMS OF FILTER HEAD

The pressure drop of filter head mainly depends on the ports size and fluid density
In the following diagrams are reported the Δp characteristics of filter head based on mineral oil with density 0,86 kg/dm^3 and viscosity 30 mm^2/s

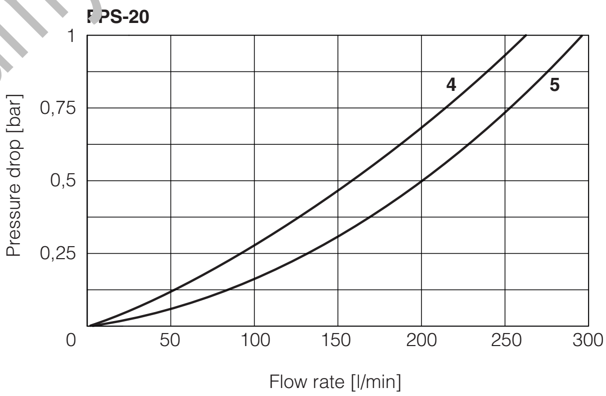
FPS-10

1 = FPS-10*** 00 (G 1/2")
2 = FPS-10*** 01 (G 3/4")
3 = FPS-10*** 02 (G 1")
FPS-10*** 42 (SAE-16)



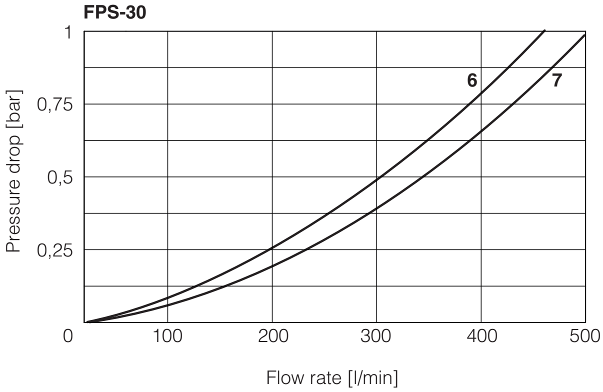
FPS-20

4 = FPS-20*** 02 (G 1")
5 = FPS-20*** 03 (G 1$^1/_4$")
FPS-20*** 43 (SAE-20)



FPS-30

6 = FPS-30*** 03 (G 1$^1/_4$")
7 = FPS-30*** 04 (G 1$^1/_2$")
FPS-30*** 44 (SAE-24)



11.2 FILTER ELEMENT Δp

The pressure drop through the filter depends to:
- size of filter element
- filtration rating
- fluid viscosity

The Δp of filter element is given by the formula:

$$\mathbf{\Delta p\ of\ filter\ element} = \mathbf{Q} \times \frac{\mathbf{Gc}}{\mathbf{1000}} \times \frac{\mathbf{Viscosity}}{\mathbf{32}}$$

Q = working flow (l/min)

Gc = Gradient coefficient (mbar/(l/min)).
The Gc values are reported in the following table

Viscosity = effective fluid viscosity in the working conditions (mm²/s)

Gradient coefficient Gc of PSH filter elements

Filter element size		**10**		**20**			**30**			
Filter element length		**A**	**B**	**A**	**B**	**C**	**A**	**B**	**C**	**D**
Filter element type	Filtration rating	**Gc** Gradient coefficient								
R for filter with bypass valve	**F03**	21.30	10.84	11.07	9.23	6.74	10.26	4.82	3.27	2.30
	F06	13.97	6.79	7.27	6.06	4.43	6.73	2.98	1.99	1.26
	F10	8.39	4.42	4.45	3.71	2.71	4.12	2.02	1.36	0.70
	F20	4.78	2.93	2.87	2.39	1.75	2.66	1.21	0.77	0.40
N for filter without bypass valve	**F03**	26.03	16.72	14.19	11.83	8.64	13.00	7.15	3.87	3.21
	F06	14.77	11.25	9.50	7.92	5.79	9.63	4.00	2.93	1.80
	F10	11.57	5.25	5.66	4.72	3.45	5.05	2.57	1.67	1.10
	F20	6.13	3.34	3.41	2.8[illegible]	2.07	3.33	1.44	0.83	0.70

Example:

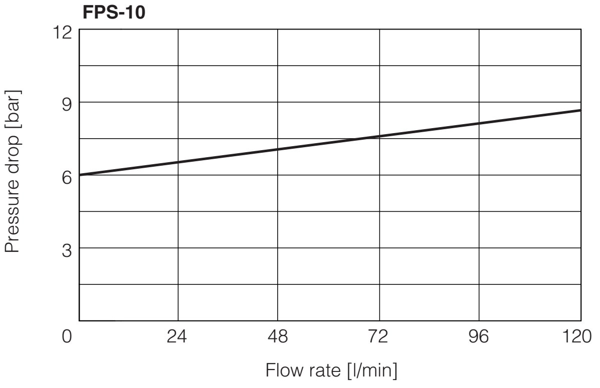
Calculation of Total Δp for filter type FPS-10-B-F10-02-R at Q = 80 l/min and viscosity 46 mm²/s (filter element PSH-10-B-F10-R)
Dp of filter head = 0,24 bar
Gr = 4,42 mbar/(l/min)

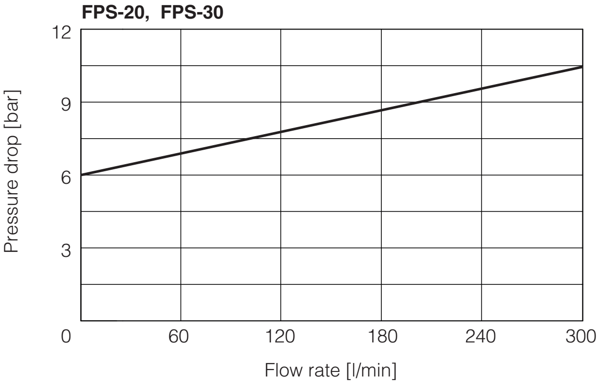
$$\mathbf{Filter\ element\ \Delta p} = 80 \times \frac{4{,}42}{1000} \times \frac{46}{32} = 0{,}51\ \text{bar}$$

Total Δp = 0,24 + 0,51 = **0,75 bar**

12 BY-PASS VALVE - based on mineral oil ISO VG46 at 50°C (viscosity = 32 mm²/s)

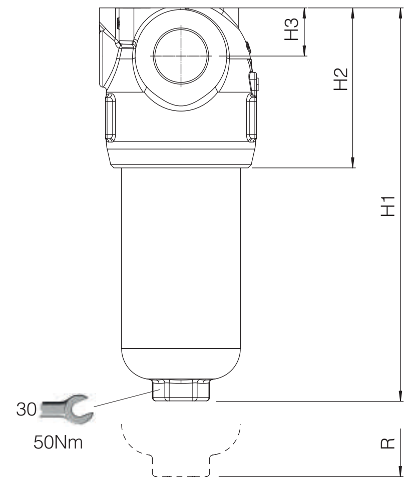
Q/Δp diagrams of flow through the by-pass valve

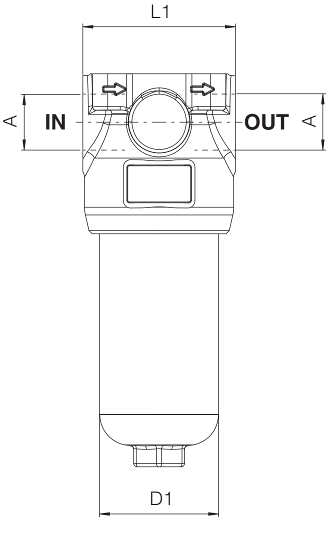


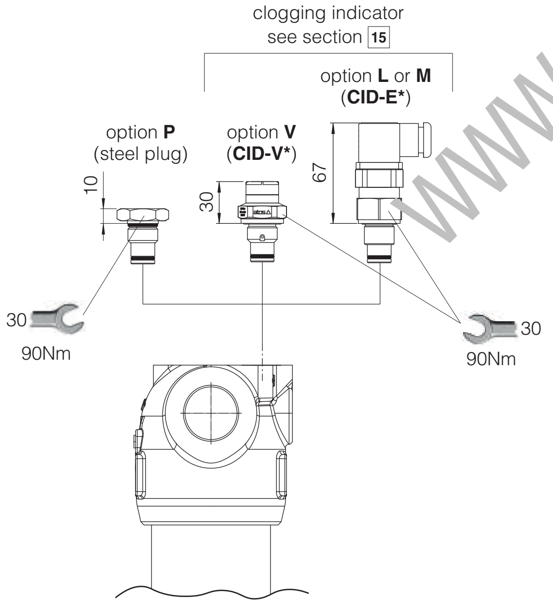


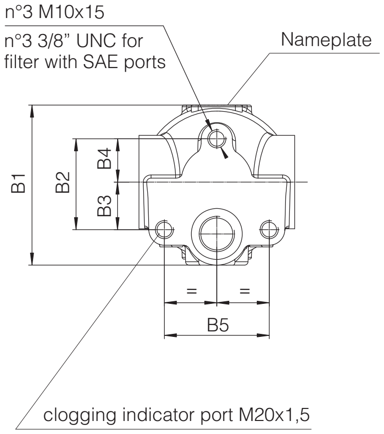
13 INSTALLATION DIMENSIONS OF FPS FILTERS [mm]

FPS -10



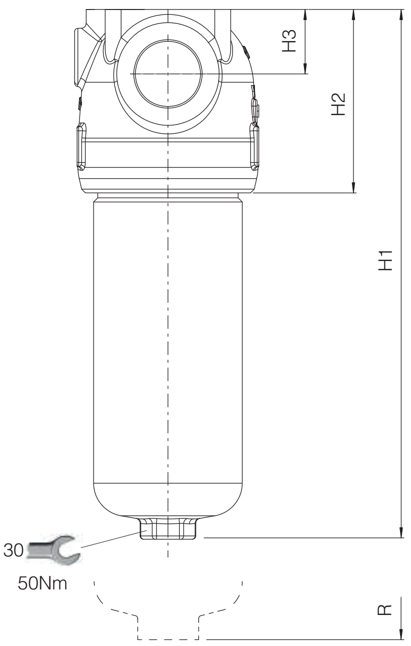


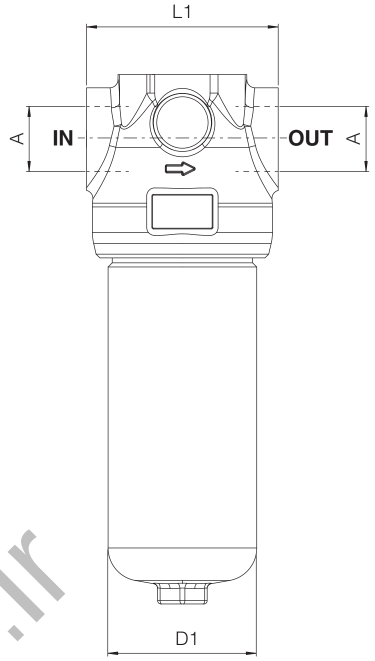


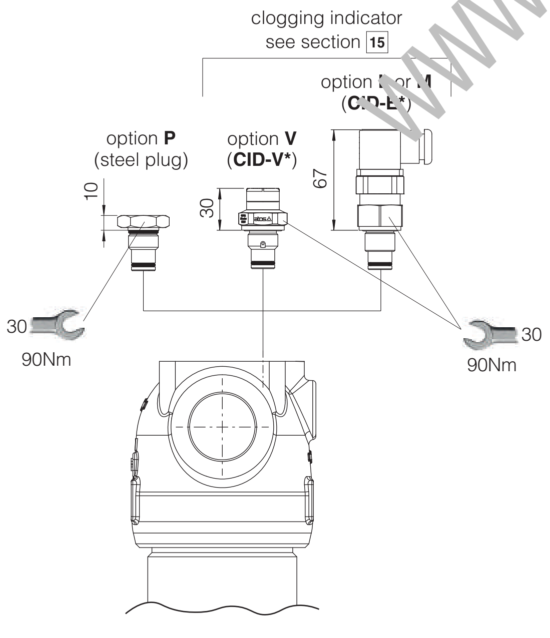


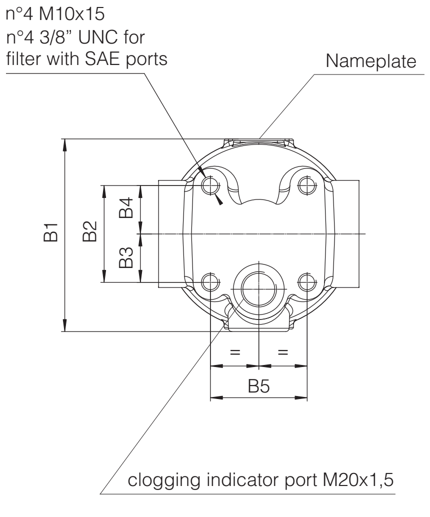
Code	A	B1	B2	B3	B4	B5	D1	H1	H2	H3	L1	R (element removal)	Mass (Kg)
FPS-10-A	1/2" BSPP 3/4" BSPP 1" BSPP SAE-16	93.5	52.5	27.5	25	60.6	70	203	93	28	90	110	4
FPS-10-B								296					5

FPS -20



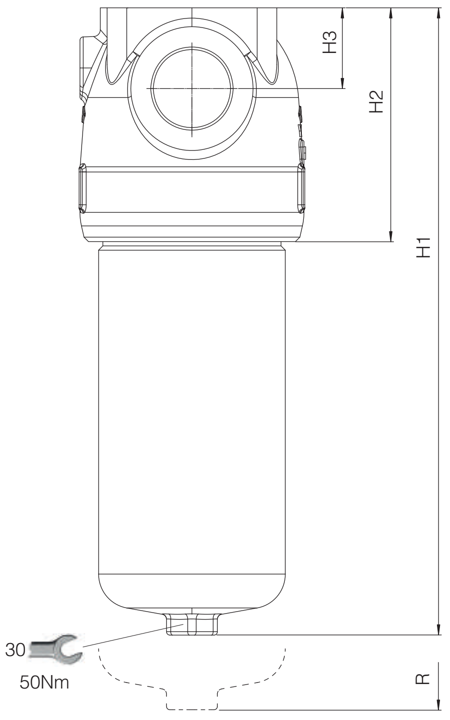


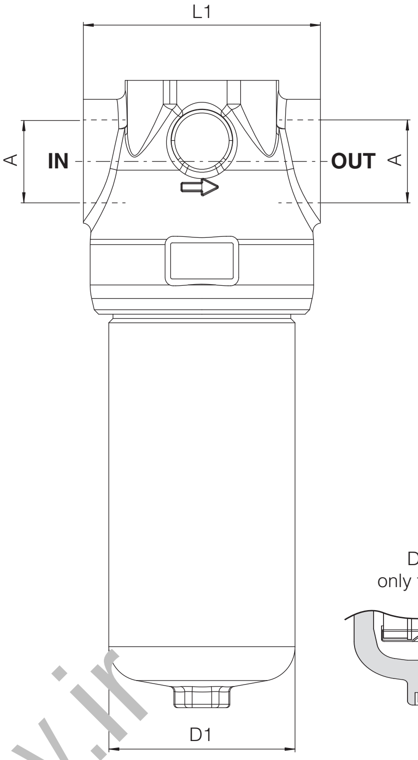


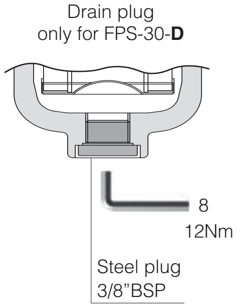


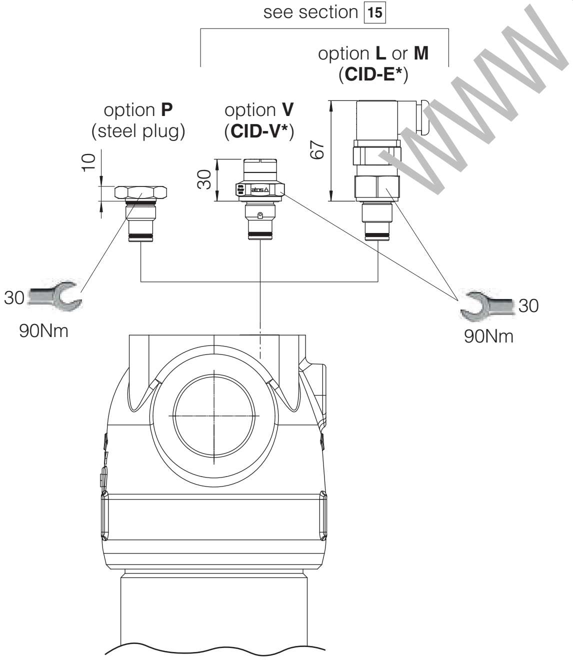
Code	A	B1	B2	B3	B4	B5	D1	H1	H2	H3	L1	R (element removal)	Mass (Kg)
FPS-20-A	1” BSPP 1 1/4” BSPP SAE-20	111.5	56	28	28	56	90	261	111	39	116	120	7.4
FPS-20-B								320					8.5
FPS-20-C								390					9.9

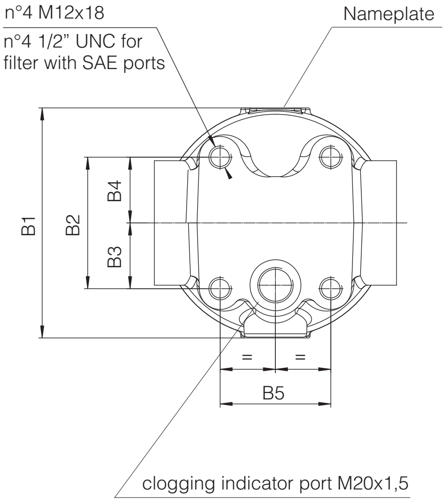
FPS -30





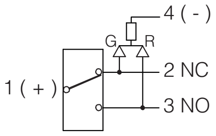
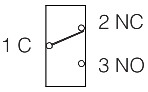
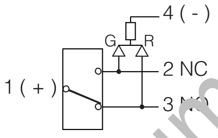
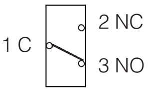






Code	A	B1	B2	B3	B4	B5	D1	H1	H2	H3	L1	R (element removal)	Mass (Kg)
FPS-30-A	1 1/4" BSPP 1 1/2 BSPP SAE-24	133.5	76	38	38	64	110	240.5	136	47	140	130	10.5
FPS-30-B								333.5					13
FPS-30-C								453.5					16.4
FPS-30-D								552.5					19

14 CHARACTERISTICS OF DIFFERENTIAL CLOGGING INDICATORS

Model code		**CID-E* ELECTRICAL**		**CID-V* VISUAL**
Differential switching pressure	CID-E05, CID-V05	5 bar ± 10%		5 bar ± 15%
	CID-E08, CID-V08	8 bar ± 10%		8 bar ± 10%
Max pressure		450 bar		420 bar
Max differential pressure		200 bar		
Ambient temperature		-25°C ÷ +100°C		-25°C ÷ +80°C
Hydraulic connection		M20x1,5		
Duty factor		100%		
Mechanical life		1 x 10^6 operations		
Mass (Kg)		0,16		0,11
Electric connection		Electric plug connection as per DIN 43650 with cable gland type PG7		-
Power supply	CID-E05-L, CID-E08-L	24 V_{DC} ± 10%		-
	CID-E05-M, CID-E08-M	14 V_{DC} ÷ 30 V_{DC}	125 V_{AC} ÷ 250 V_{AC}	-
Max current - resistive (inductive)		5 A (4 A) ÷ 4 A (3 A)	5 A (3 A) ÷ 3 A (2 A)	-
Protection degree to DIN EN 60529		IP65 with mating connector		-
Switching scheme		**CID-*-L**	**CID-*-M**	
	clean filter element			GREEN
	clogged filter element			RED

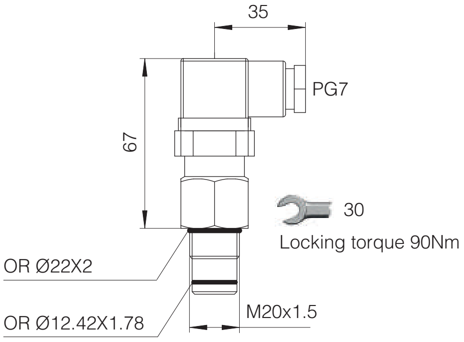
15 DIMENSIONS OF DIFFERENTIAL CLOGGING INDICATORS

ELECTRICAL INDICATOR

CID-E05-L
CID-E08-L
Electric connector
DIN 43650
Transparent
with internal Led

CID-E05-M
CID-E08-M
Electric connector
DIN 43650
Black colour

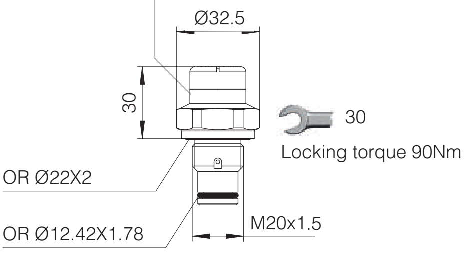
Led signal:
Green = clean filter element
Red = clogged filter element
(filter elements to be replaced)



VISUAL INDICATOR

CID-V05
CID-V08

Visual signal:
Green = clean filter element
Red = clogged filter element
(filter elements to be replaced)



Note: the electrical connector can be oriented at steps of 90°

NOTE: Differential thermostated indicator CID-T and differential electronic transmitter with output signal 4÷20 mA CID-Z are available on request

16 INSTALLATION AND COMMISSIONING

The max operating pressure of the system must not exceed the max working pressure of the filter (420 bar).
During the filter installation, pay attention to respect the flow direction, shown by the arrow on the filter head.
The filter should be preferably mounted with the bowl downward.
The filter should be properly secured using the threaded fixing holes on the filter head.
Make sure that there is enough space for the replacement of the filter element, see dimension "**R**" at section 13.
Never run the system without the filter element.

For filters ordered with clogging indicator:

- remove the plastic plug from the indicator port on the filter head
- install the clogging indicator and lock it at the specified torque

During the cold start up (fluid temperature lower than 30°C), a false clogging indicator signal can be given due to the high fluid viscosity.
To avoid false signal, a differential threaded clogging indicator CID-T can be used.

17 MAINTENANCE

The filter element must be replaced as soon as the clogging indicator switches to highlight the filter clogged condition.
For filters without clogging indicator, the filter element must be replaced according to the system manufacturer's recommendations.
Select the new filter element according to the model code reported on the filter nameplate, see section 18.

For the replacement of the filter element, proceed as follow:

- releases the system pressure; the filter has no pressure bleeding device
- pay attention to the fluid and filter surface temperature. Always use suitable gloves and protection glasses
- unscrew the bowl ② from the filter head ① by turning counterclockwise (view from bottom side)
- remove the dirty filter element ③ pulling it carefully
- lubricate the seal of new filter element and insert it over the spigot in the filter head
- clean the bowl internally, check the o-ring ⑥ and replace it if damaged
- lubricate the o-ring, the threads and screw by hand the bowl to the filter head by turning clockwise (view from bottom side). Tighten at the recommended torque.

WARNING: The dirty filter elements cannot be cleaned and re-used. They are classified as "dangerous waste material", then they must be disposed of by authorized Companies, according to the local laws.

17.1 SEALS KIT

Filter type	Seal kit code (NBR)	Seal kit code (FKM)	Seal kit composition
FPS-10	GUARN FPS-10	GUARN FPS-10 /PE	④+⑤+⑥+⑦
FPS-20	GUARN FPS-20	GUARN FPS-20 /PE	④+⑤+⑥+⑦
FPS-30	GUARN FPS-30	GUARN FPS-30 /PE	④+⑤+⑥+⑦+⑧

18 FILTER IDENTIFICATION NAMEPLATE

① Model code of complete filter
② Model code of filter element
③ Max working pressure
④ Filter matrix code

18.1 IDENTIFICATION OF FILTER ELEMENT

① Model code of filter element
② Filtration Plus identification

19 RELATED DOCUMENTATION

LF010	Fluid contamination
LF020	Filtration guidelines

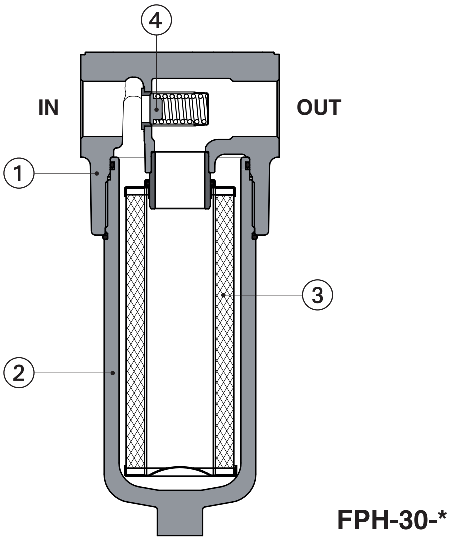
atos

Table **LF040-3/E**

In line filters, high pressure type FPH

SAE flanged ports

F+ FILTRATION PLUS



① Filter head
② Filter bowl
③ Filter element
④ By-pass valve

FPH

In line filters are designed for installation on the pressure line downstream the pump, to ensure a high cleanliness of the fluid circulating into the hydraulic system. They protect sensible components from contamination present in the working fluid and they are particularly recommended for systems with proportional valves.

- two head sizes
- SAE 6000 flanged ports, from 3/4" to 1 1/2"
- **Filtration Plus** microfiber filter elements ensure high efficiency, low pressure drop, high DHC and long lasting performance. Collapse pressure 21 bar for filters equipped with by-pass valve or 210 bar for filters without by-pass
- filtration rating 5 - 7 - 12 - 22 μm(c) (βx (c) >1000, ISO 16889).
- versions without or with by-pass valve with cracking pressure 6 bar.
- without or with differential clogging indicator

Max flow **410 l/min**
Max working pressure **420 bar**

1 MODEL CODE OF COMPLETE FILTERS

FPH	-	10	-	A	-	F10	-	21	-	R	-	W	**	/	*

In line filter, high pressure

Series number

Seals material:
- = NBR
PE = FKM

Filter size:
10 = ports size 3/4" ÷ 1" SAE6000 flange
30 = ports size 1 1/4" ÷ 1 1/2 SAE6000 flange

Filter length:		Max flow [l/min] **(1)**	
		FPH-10	FPH-30
A	=	100	242
B	=	120	334
C	=	-	371
D	=	-	410

Filter element:
SN = only body, without filter element
F+ microfibre filter element βx(c) >1000 - ISO 16889:
F03 = 5 μm (c) **F10** = 12 μm (c)
F06 = 7 μm (c) **F20** = 22 μm (c)
Filter element **F01** = 4 μm (c) available on request

Differential clogging indicator see sect. 9:
W = without, indicator port with plastic plug **(2)**
P = without, indicator port with steel plug
L = electrical indicator with LED **(3)**
M = electrical indicator without LED **(3)**
V = visual indicator **(3)**
See also note **(4)**

By-pass:
R = by-pass valve with cracking pressure 6 bar (filter element with collapse pressure 21 bar)
N = without by-pass (filter element with collapse pressure 210 bar)

Ports size:
SAE 6000 flange with metric bolts:

FPH-10	FPH-30
21 = 3/4"	**23** = 1 1/4"
22 = 1"	**24** = 1 1/2"

Note: filters for use in potentially explosive atmosphere are available on request, contact Atos Technical Office

(1) Max flow rates are measured with: Δp 1 bar, filter element F20, largest port size, option -R, oil viscosity 32 mm^2/s - see also section 6
In case of different conditions see section 11 for filter sizing

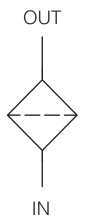
(2) The plastic plug (option W) is factory assembled to prevent impurities from entering the filter through the clogging indicator port.
A clogging indicator must be fitted on the filter before commissioning. Do not install the filter with the plastic cap on the hydraulic system

(3) The clogging indicator is supplied disassembled from the filter. The indicator port on filter head is plugged with plastic plug

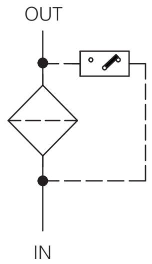
(4) Differential thermostated indicator CID-T and differential electronic transmitter with output signal 4÷20 mA CID-Z are available on request, see section 4

2 **HYDRAULIC SYMBOLS** (representation according to ISO 1219-1)

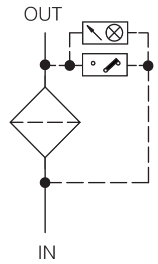
FPH-*-**N-W**



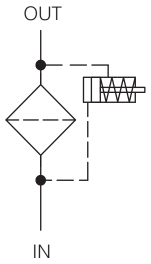
FPH-*-**N-M**



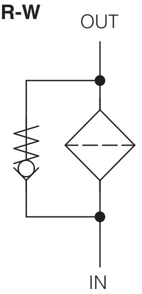
FPH-*-**N-L**



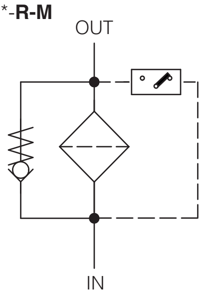
FPH-*-**N-V**



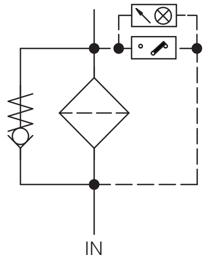
FPH-*-**R-W**



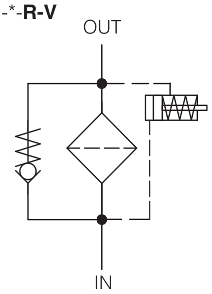
FPH-*-**R-M**



FPH-*-**R-L**



FPH-*-**R-V**



3 **MODEL CODE OF FILTER ELEMENTS** - only for spare **(1)**

PSH	-	**10**	-	**A**	-	**F10**	-	**R**	*****	**/**	*****

Spare filter element
for in line filter type FPH

Filter element size:

10 = for FPH-10
30 = for FPH-30

Filter element length:

for FPH-10	for FPH-30
A	**A**
B	**B**
	C
	D

Series number

Seals material:
- = NBR
PE = FKM

R = filter element with collapse pressure 21 bar, for filter FPH-*-R with by-pass valve

N = filter element with collapse pressure 210 bar, for filter FPH-*-N without by-pass valve

Microfibre filter element, βx(c) >1000 - ISO 16889:

F03 = 5 μm (c)
F06 = 7 μm (c)
F10 = 12 μm (c)
F20 = 22 μm (c)
Filter element **F01** = 4 μm (c) available on request

(1) Select the filter element according to the model code reported on the filter nameplate, see section 17

4 **MODEL CODE OF DIFFERENTIAL CLOGGING INDICATORS** - only for spare - see section 13 and 14

CID	-	**E**		**05**	-	**M**	*****	**/**	*****

Spare differential clogging indicator
for in line filter

Type of indicator:

E = electrical
V = visual
T = thermostated (available on request)
Z = electronic transmitter (available on request)

Differential switching pressure (only for CID-E and CID-V):

05 = 5 bar for filters with by-pass valve
08 = 8 bar for filters without by-pass valve

Series number

Seals material:
- = NBR
PE = FKM

Optional LED - only for CID-E

L = with LED
M = without LED

5 GENERAL CHARACTERISTICS

Assembly position / location		Vertical position with the bowl downward
Ambient temperature range		**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range		**Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Materials	Filter head	Cast iron
	Filter bowl	Carbon steel
Surface protection		Phosphatized
Fatigue strength		min. 1 x 10^6 cycles at 420 bar
Compliance		RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

6 HYDRAULICS CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C (viscosity 32mm^2/s)

Filter size		**FPH-10**				**FPH-30**							
Ports size code		**21**		**22**		**23**				**24**			
Ports dimension	SAE 6000 flange	3/4"		1"		1 1/4"				1 1/2"			
Filter length		**A**	**B**	**A**	**B**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Max flow (l/min) at Δp= 1 bar Filter with by-pass **-R** (see note)	**F03**	36	58	39	66	84	158	204	246	86	164	214	260
	F06	50	73	55	87	122	216	263	309	126	227	279	329
	F10	66	84	77	104	176	262	302	352	184	277	322	377
	F20	82	93	100	120	230	312	346	378	242	334	371	410
Max flow (l/min) at Δp= 1 bar Filter without by-pass **-N** (see note)	**F03**	31	44	33	48	68	11[illegible]	184	207	69	119	192	217
	F06	48	57	53	64	90	18[illegible]	218	274	92	188	230	291
	F10	56	80	63	98	153	234	282	320	158	246	300	342
	F20	75	90	91	114	202	297	341	352	212	316	365	380
Max operating pressure	[bar]	**420**											
Burst pressure	[bar]	**> 1260**											

Note: Max flow rates are measured with Δp= 1 bar and viscosity 32mm^2/s. In case of different conditions see section 11 for filter sizing

7 FILTER ELEMENTS

Material		Inorganic microfibre
Filtration rating as per ISO16889	**F03**	$\beta_{4,5\mu m\ (c)} \geq 1000$
	F06	$\beta_{7\mu m\ (c)} \geq 1000$
	F10	$\beta_{12\mu m\ (c)} \geq 1000$
	F20	$\beta_{22\mu m\ (c)} \geq 1000$
Filter element collapse pressure	**R** = for filter with by-pass valve	21 bar
	N = for filter without by-pass valve	210 bar

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

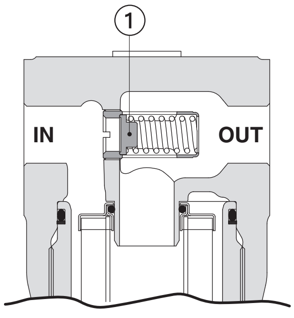
Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +100°C, with HFC hydraulic fluids = +10°C ÷ +50°C FKM seals (/PE option) = -25°C ÷ +100°C		
Recommended viscosity	15 ÷ 100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 BY-PASS VALVE

Filter with by-pass valve - version **-R**

The filter with by-pass valve ① is used in combination with filter elements PSH-*-R with collapse pressure 21 bar.
The by-pass valve allows the oil flow to by-pass the filter element in particular conditions:

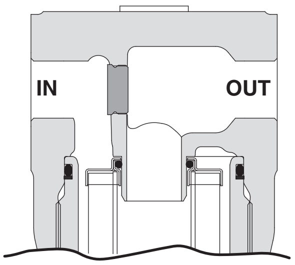
- it protects the filter element from pressure peaks that could be generated, especially at the cold system start-up. In these cases the valve opens only for the instant necessary to discharge the pressure peak, limiting the quantity of oil that bypasses the filter.
- it allows the free passage of the oil flow in case of completely clogged filter element ($\Delta p > 6$ bar). This situation should be carefully avoided, by means of a scheduled maintenance, otherwise the contaminated oil will pass to the clean side of the filter and then it will circulate in the hydraulic system. The filter element must be replaced before the clogging condition, at this purpose the use of a differential clogging indicator CID-V (visual, option V) or CID-E (electrical, options L or M) is highly recommended.



FPH-*-R

Filter without by-pass valve - version **-N**

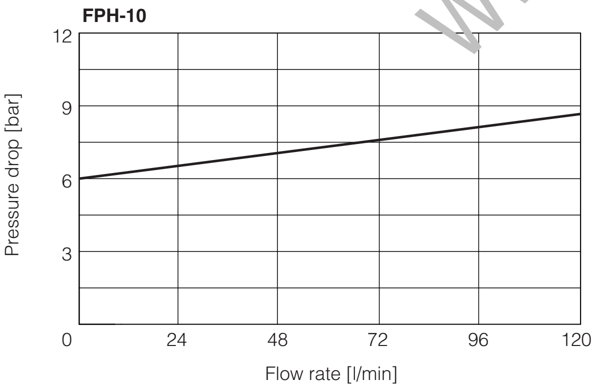
The filter version without by-pass is recommended when the hydraulic system must be absolutely protected by contamination, then avoiding the risk that the contaminant passes though the by-pass valve.
The filter without by pass must be used in combination with filter elements PSH-N with high collapse pressure 210 bar.

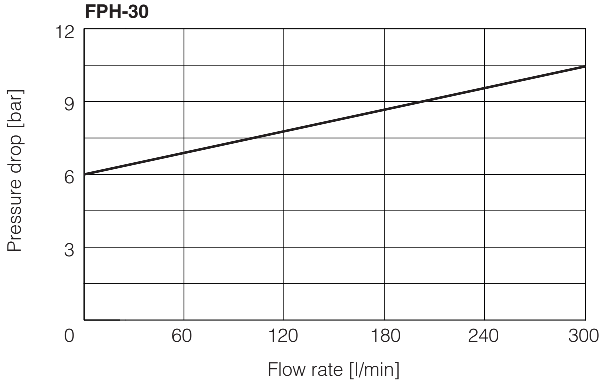


FPH-*-N

10 BY-PASS VALVE - based on mineral oil ISO VG46 at 50 °C (viscosity = 32 mm^2/s)

Q/Δp diagrams of flow through the by-pass valve





11 FILTERS SIZING

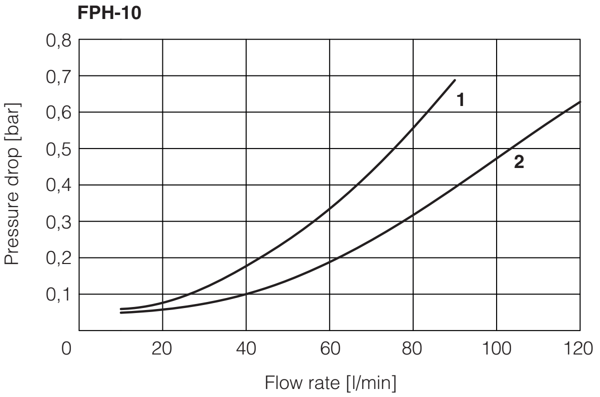
For the filter sizing it is necessary to consider the Total Δp at the maximum flow at which the filter must work.
The Total Δp is given by the sum of filter head Δp plus the filter element Δp:

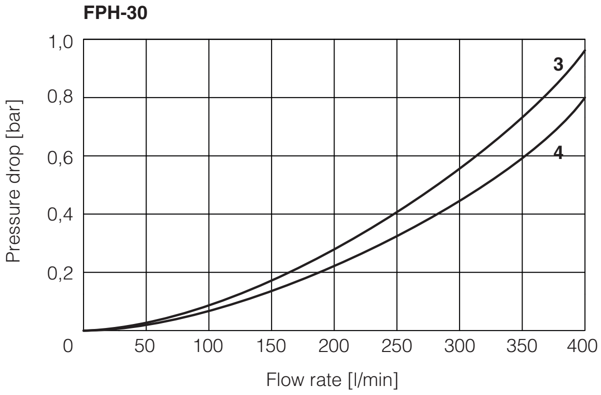
Total Δp = filter head Δp + filter element Δp

In the best conditions the total Δp should not exceed 1,0 bar
See below sections to calculate the Δp of filter head and Δp of the filter element

11.1 Q/Δp DIAGRAMS OF FILTER HEAD

The pressure drop of filter head mainly depends on the ports size and fluid density
In the following diagrams are reported the Δp characteristics of filter head based on mineral oil with density 0,86 kg/dm^3 and viscosity 30 mm^2/s





1 = FPH-10*** 21 (3/4" SAE 6000) **2** = FPH-10*** 22 (1" SAE 6000) **3** = FPH-30*** 23 (1 1/4"SAE 6000) **4** = FPH-30*** 24 (G 1 1/2"SAE 6000)

11.2 FILTER ELEMENT Δp

The pressure drop through the filter depends to:
- size of filter element
- filtration rating
- fluid viscosity

The Δp of filter element is given by the formula:

$$\textbf{Δp of filter element} = \textbf{Q} \times \frac{\textbf{Gc}}{\textbf{1000}} \times \frac{\textbf{Viscosity}}{\textbf{32}}$$

Q = working flow (l/min)

Gc = Gradient coefficient (mbar/(l/min)).
The Gc values are reported in the following table

Viscosity = effective fluid viscosity in the working conditions (mm^2/s)

Gradient coefficient Gc of PSH filter elements

Filter element size		**10**		**20**			**30**			
Filter element length		**A**	**B**	**A**	**B**	**C**	**A**	**B**	**C**	**D**
Filter element type	Filtration rating	**Gc** Gradient coefficient								
R for filter with bypass valve	**F03**	21.30	10.84	11.07	9.23	6.74	10.26	4.82	3.27	2.30
	F06	13.97	6.79	7.27	6.06	4.43	6.73	2.98	1.99	1.26
	F10	8.39	4.42	4.45	3.71	2.71	4.12	2.02	1.36	0.70
	F20	4.78	2.93	2.87	2.39	1.75	2.66	1.21	0.77	0.40
N for filter without bypass valve	**F03**	26.03	16.72	14.19	11.83	8.64	13.00	7.15	3.87	3.21
	F06	14.77	11.25	9.50	7.92	5.79	9.63	4.00	2.93	1.80
	F10	11.57	5.25	5.66	4.72	3.45	5.05	2.57	1.67	1.10
	F20	6.13	3.34	3.41	2.84	2.07	3.33	1.44	0.83	0.70

Example:

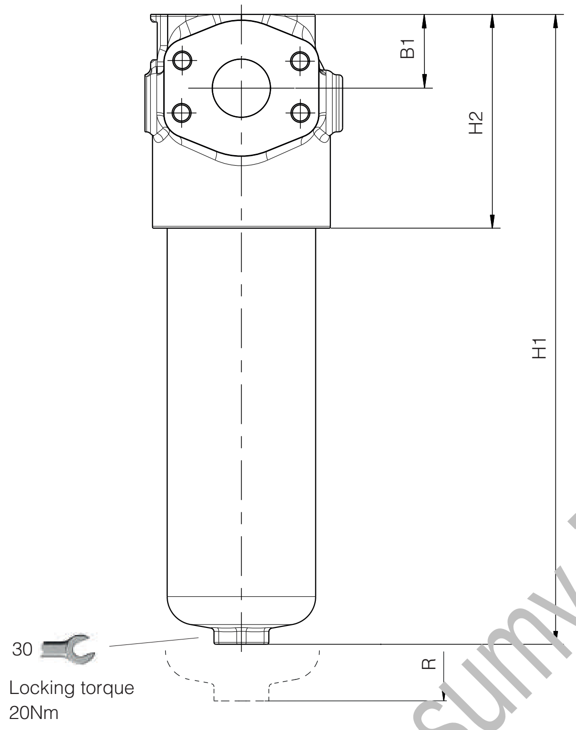
Calculation of Total Δp for filter type FPH-10-B-F10-22-R at Q = 80 l/min and viscosity 46 mm^2/s (filter element PSH-10-B-F10-R)
Dp of filter head = 0,32 bar
Gr = 4,42 mbar/(l/min)

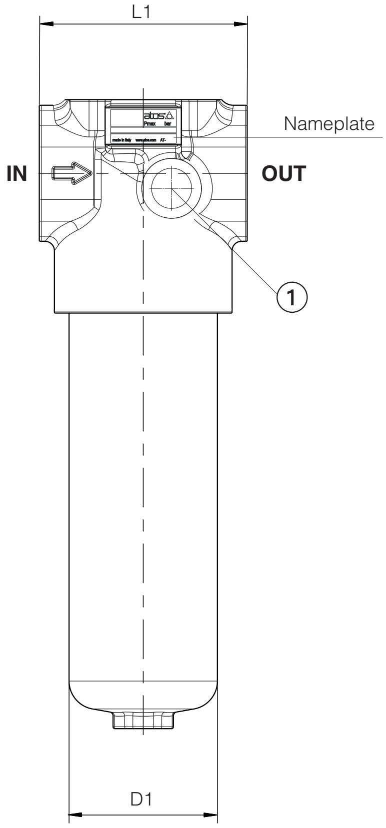
$$\textbf{Filter element Δp} = 80 \times \frac{4,42}{1000} \times \frac{46}{32} = 0,51 \text{ bar}$$

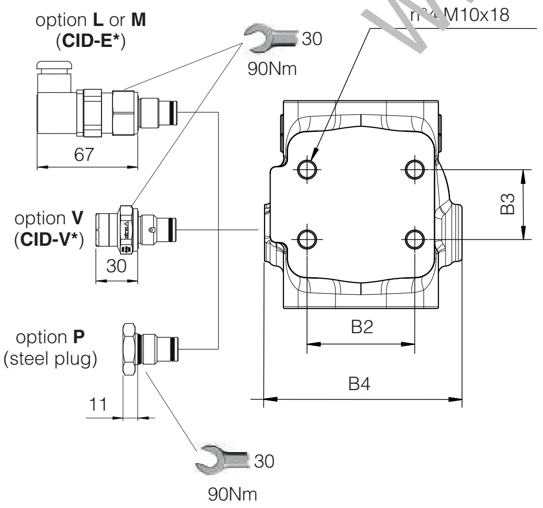
Total Δp = 0,32 + 0,51 = **0,83 bar**

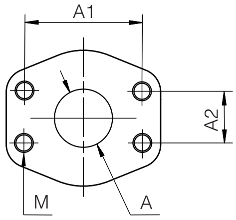
12 INSTALLATION DIMENSIONS OF FPH FILTERS [mm]

FPH -10







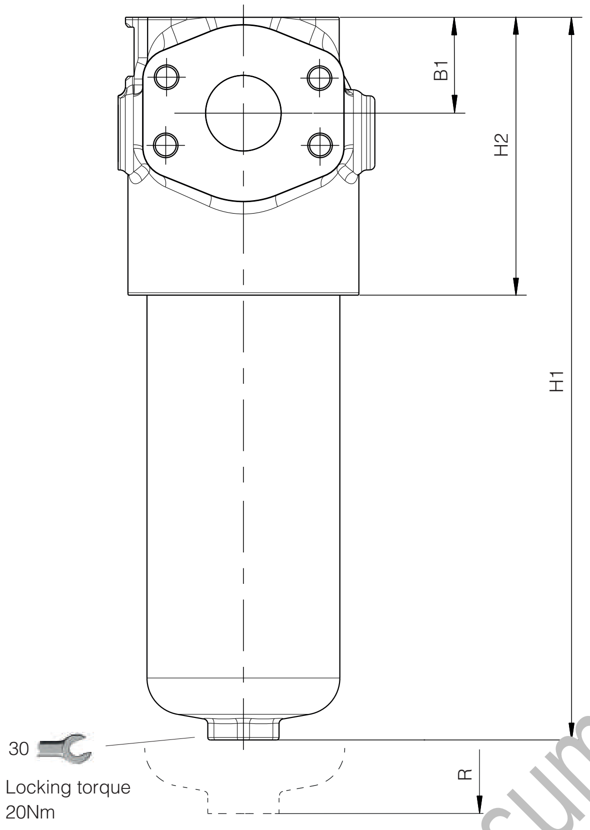


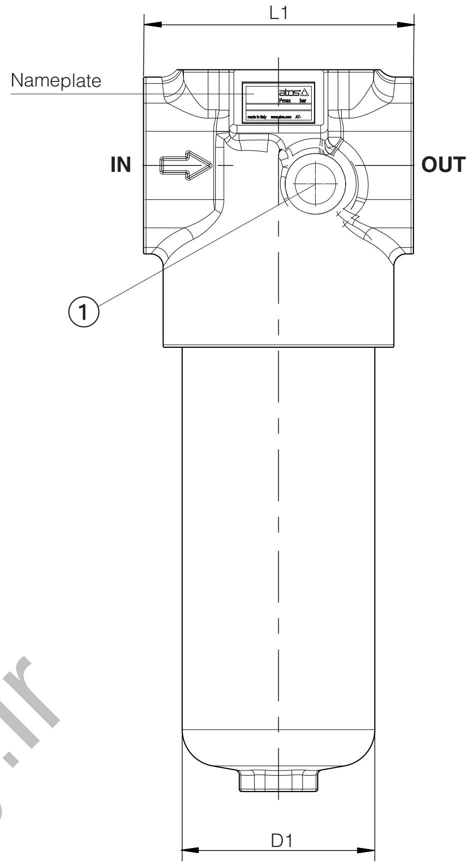
SAE J518-6000 FLANGE	A	A1	A2	M
3/4”	19	50.8	23.8	M10
1”	22	57.2	27.8	M12

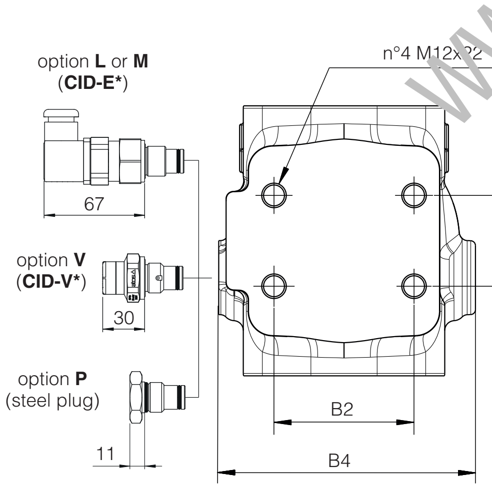
① Clogging indicator port M20x1.5

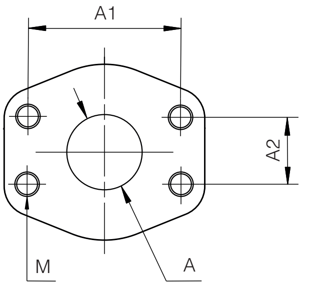
Code	B1	B2	B3	B4	D1	D2	F	H1	H2	L1	R (element removal)	Mass (Kg)
FPH-10-A	39	57	37	105	78,5	-	68	222	113	110	130	6,7
FPH-10-B								333				8,4

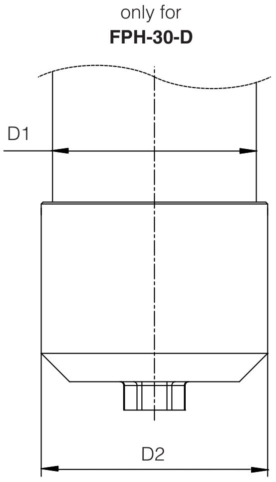
FPH -30









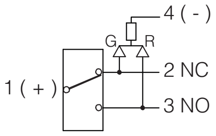
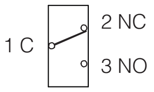
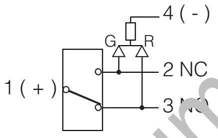
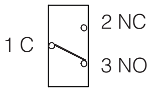


SAE J518-6000 FLANGE	A	A1	A2	M
1 1/4"	32	66.7	31.8	M14
1 1/2"	38	79.4	36.5	M16

① Clogging indicator port M20x1.5

Code	B1	B2	B3	B4	D1	D2	F	H1	H2	L1	R (element removal)	Mass (Kg)
FPH-30-A	47	76	64	140	107	-	68	262	145	140	140	13,2
FPH-30-B								355				15,5
FPH-30-C								475				18,4
FPH-30-D						120		568				22,8

13 CHARACTERISTICS OF DIFFERENTIAL CLOGGING INDICATORS

Model code		**CID-E* ELECTRICAL**		**CID-V* VISUAL**
Differential switching pressure	CID-E05, CID-V05	5 bar ± 10%		5 bar ± 15%
	CID-E08, CID-V08	8 bar ± 10%		8 bar ± 10%
Max pressure		450 bar		420 bar
Max differential pressure		200 bar		
Ambient temperature		-25°C ÷ +100°C		-25°C ÷ +80°C
Hydraulic connection		M20x1,5		
Duty factor		100%		
Mechanical life		1 x 10^6 operations		
Mass (Kg)		0,16		0,11
Electric connection		Electric plug connection as per DIN 43650 with cable gland type PG7		-
Power supply	CID-E05-L, CID-E08-L	24 V_{DC} ± 10%		-
	CID-E05-M, CID-E08-M	14 V_{DC} ÷ 30 V_{DC}	125 V_{AC} ÷ 250 V_{AC}	-
Max current - resistive (inductive)		5 A (4 A) ÷ 4 A (3 A)	5 A (3 A) ÷ 3 A (2 A)	-
Protection degree to DIN EN 60529		IP65 with mating connector		-
Switching scheme		**CID-*-L**	**CID-*-M**	
	clean filter element			GREEN
	clogged filter element			RED

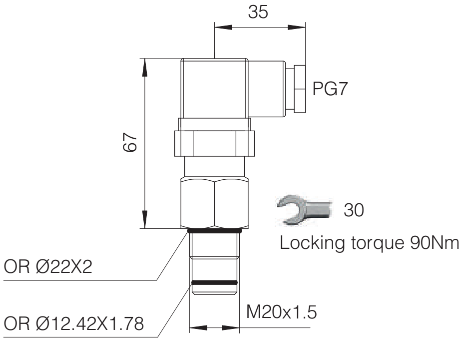
14 DIMENSIONS OF DIFFERENTIAL CLOGGING INDICATORS

ELECTRICAL INDICATOR

CID-E05-L
CID-E08-L
Electric connector
DIN 43650
Transparent
with internal Led

Led signal:
Green = clean filter element
Red = clogged filter element
(filter elements to be replaced)

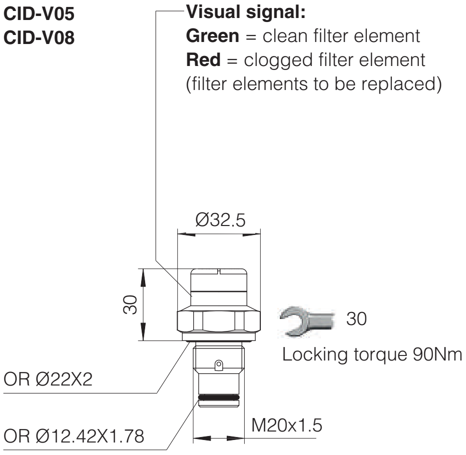
CID-E05-M
CID-E08-M
Electric connector
DIN 43650
Black colour



VISUAL INDICATOR

CID-V05
CID-V08

Visual signal:
Green = clean filter element
Red = clogged filter element
(filter elements to be replaced)



Note: the electrical connector can be oriented at steps of 90°

NOTE: Differential thermostated indicator CID-T and differential electronic transmitter with output signal 4÷20 mA CID-Z are available on request

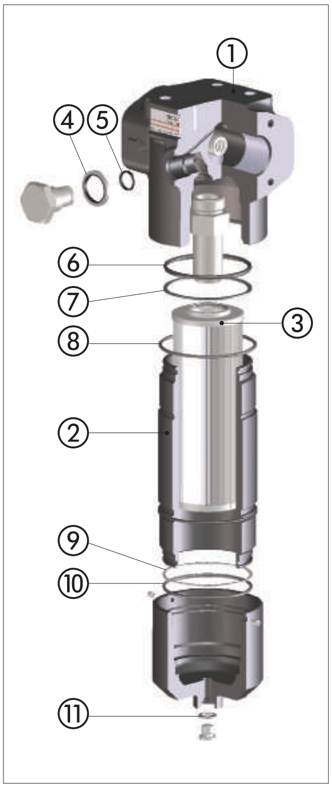
15 INSTALLATION AND COMMISSIONING

The max operating pressure of the system must not exceed the max working pressure of the filter (420 bar).
During the filter installation, pay attention to respect the flow direction, shown by the arrow on the filter head.
The filter should be preferably mounted with the housing downward.
The filter should be properly secured using the threaded fixing holes on the filter head.
Make sure that there is enough space for the replacement of the filter element, see dimension "**R**" at section 13.
Never run the system without the filter element.

For filters ordered with clogging indicator:
- remove the plastic plug from the indicator port on the filter head
- install the clogging indicator and lock it at the specified torque

During the cold start up (fluid temperature lower than 30°C), a false clogging indicator signal can be given due to the high fluid viscosity.
To avoid false signal, a differential threaded clogging indicator CID-T can be used.

16 MAINTENANCE



The filter element must be replaced as soon as the clogging indicator switches to highlight the filter clogged condition
For filters without clogging indicator, the filter element must be replaced according to the system manufacturer's recommendations.
Select the new filter element according to the model code reported on the filter nameplate, see section 17.

For the replacement of the filter element, proceed as follow:
- releases the system pressure; the filter has no pressure bleeding device
- pay attention to the fluid and filter surface temperature. Always use suitable gloves and protection glasses
- unscrew the bowl ② from the filter head ① by turning counterclockwise (view from bottom side)
- remove the dirty filter element ③ pulling it carefully
- lubricate the seal of new filter element and insert it over the spigot in the filter head
- clean the bowl internally, check the o-ring ⑥ ⑧ and replace them if damaged
- lubricate the o-ring and threads and screw by hand the bowl to the filter head by turning clockwise (view from bottom side). Tighten at the recommended torque.

⚠ **WARNING**: The dirty filter elements cannot be cleaned and re-used. They are classified as "dangerous waste material", then they must be disposed of by authorized Companies, according to the local laws.

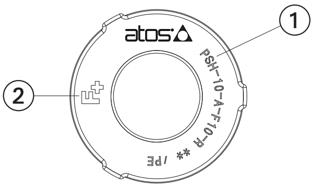
16.1 SEALS KIT

Filter type	Seal kit code (NBR)	Seal kit code (FKM)	Seal kit composition
FPH-10	GUARN FPH-10	GUARN FPH-10 /PE	④+⑤+⑥+⑦+⑧
FPH-30	GUARN FPH-30	GUARN FPH-30 /PE	④+⑤+⑥+⑦+⑧
FPH-30-D	GUARN FPH-30-D	GUARN FPH-30-D /PE	④+⑤+⑥+⑦+⑧+⑨+⑩+⑪

17 FILTER IDENTIFICATION NAMEPLATE

① Model code of complete filter
② Model code of filter element
③ Max working pressure
④ Filter matrix code

17.1 IDENTIFICATION OF FILTER ELEMENT



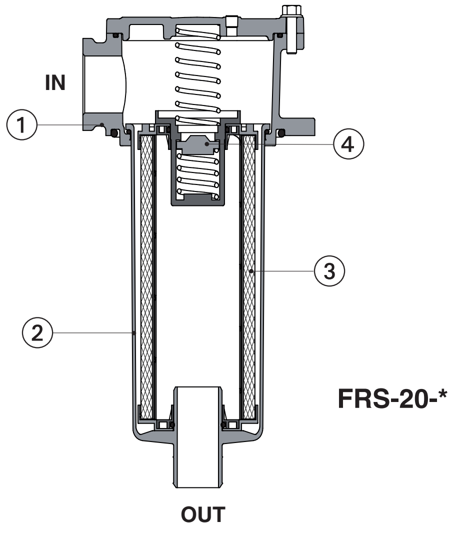
① Model code of filter element
② Filtration Plus identification

18 RELATED DOCUMENTATION

LF010	Fluid contamination
LF020	Filtration guidelines

Return line filters, tank-top type FRS

Threaded ports



① Filter head
② Filter bowl
③ Filter element
④ By-pass valve

FRS
Return filters are designed to ensure cleanliness of fluid back to the tank from contamination collected downstream of the hydraulic circuit.

They are specific for installation on the top of the hydraulic tank.

- four head sizes
- ports size: G1/2” to G2”
  SAE-12 to SAE-32
- by-pass valve with cracking pressure 3 bar
- **Filtration Plus** microfiber filter elements ensure low pressure drop, high DHC and long lasting performance,
- filtration rating 7 - 12 - 27 μm(c)
  (βx (c) >1000, ISO 16889)
- cellulose filter elements with filtration rating 10 or 25 μm (βx (c) >2, ISO 16889)
- without or with electrical or visual clogging indicators

Max flow **750 l/min**
Max working pressure **8 bar**

1 MODEL CODE OF COMPLETE FILTERS

FRS	-	10	-	A	-	F10	-	00	-	R	-	W	**	/	*

Return line filter

Series number

Seals material:
- = NBR
PE = FKM

Filter size (ports size):
10 = G1/2” ÷ G3/4” or SAE-12
20 = G1/2” ÷ G1^1/4” or SAE-16
30 = G1” ÷ G1^1/2” or SAE-24
40 = G1^1/4” ÷ G2” or SAE-32

Filter length:		Max flow [l/min] **(1)** FRS-10	FRS-20	FRS-30	FRS-40
A	=	50	75	290	370
B	=	80	125	310	600
C	=	-	200	-	650
D	=	-	260	-	430 **(2) (3)**
E	=	-	-	-	750 **(2)**

SN = only body, without filter element

F+ microfibre filter element, βx(c) >1000 - ISO 16889:
F06 = 7 μm (c)
F10 = 12 μm (c)
F25 = 27 μm (c)

Cellulose filter element, βx (c) >2 - ISO 16889:
C10 = 10 μm (c)
C25 = 25 μm (c)

Clogging indicator see sect. 12 :
W = without, indicator port plugged with steel plug
E = electrical indicator **(5)**
V = visual indicator **(5)**

By-pass:
R = by-pass valve with cracking pressure 3 bar

Ports size:
BSPP threaded:

FRS-10	FRS-20	FRS-30	FRS-40
00 = G 1/2”	**00** = G 1/2”	**02** = G 1”	**03** = G 1 1/4”
01 = G 3/4”	**01** = G 3/4”	**03** = G 1 1/4”	**04** = G 1 1/2”
	02 = G 1”	**04** = G 1 1/2”	**05** = G 2”
	03 = G 1 1/4”		

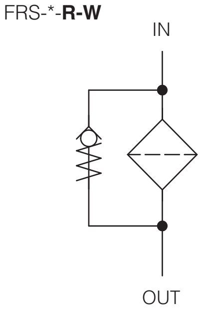
SAE J1926-1 threaded **(4)**:

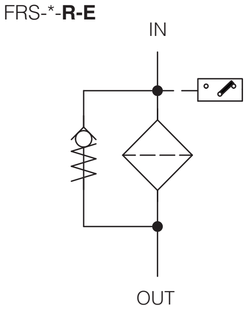
FRS-10	FRS-20	FRS-30	FRS-40
41 = SAE-12 (3/4”)	**42** = SAE-16 (1”)	**44** = SAE-24 (1 1/2”)	**45** = SAE-32 (2”)

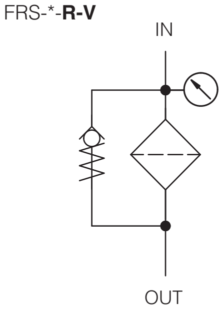
Note: filters for use in potentially explosive atmosphere are available on request, contact Atos Technical Office

(1) Max flow rates are measured with: Δp 0,5 bar, filter element F25, largest port size, oil viscosity 32 mm²/s - see also section 6
In case of different conditions see section 9 for filter sizing
(2) Available only for FRS-40 series 11, on request
(3) Filters type FRS-40-D has the same length to FRS-40-B but it uses filter elements with smaller internal diameter
(4) Filters with SAE threaded ports are available on request
(5) The clogging indicator is supplied disassembled from the filter. The indicator port on filter head is factory plugged with steel plug

2 HYDRAULIC SYMBOLS (representation according to ISO 1219-1)







3 MODEL CODE OF FILTER ELEMENTS - only for spare (1)

PRS - **10** - **A** - **F10** ** / *

Spare filter element for return line filter type FRS

Filter element size:
10 = for FRS-10
20 = for FRS-20
30 = for FRS-30
40 = for FRS-40

Filter element length:

for FRS-10	for FRS-20	for FRS-30	for FRS-40
A	**A**	**A**	**A**
B	**B**	**B**	**B**
	C		**C**
	D		**D**
			E

Microfibre filter element, βx(c) >1000 - ISO 16889:
F06 = 7 µm (c)
F10 = 12 µm (c)
F25 = 27 µm (c)

Cellulose filter element, βx(c) >2 - ISO 16889:
C10 = 10 µm
C25 = 25 µm

Series number

Seals material:
\- = NBR
PE = FKM **(2)**

(1) Select the filter element according to the model code reported on the filter nameplate, see section 17
(2) Filters with FKM seals are available on request
note: the spare filter element includes the by-pass valve

4 MODEL CODE OF CLOGGING INDICATORS - only for spare - see section 13 and 14

CIA - **V** **

Clogging indicator for return line filter type FRS

Type of indicator:
E = Electrical - pressure switch, switching pressure 2 bar
V = Visual - pressure gauge, range 0 ÷ 10 bar **(1)**

Series number

(1) Visual clogging indicator with rear side connection **CIA-V/P** available on request

5 GENERAL CHARACTERISTICS

Assembly position / location		Vertical position with the bowl downward
Ambient temperature range		**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Storage temperature range		**Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C
Materials	Filter head	Aluminium alloy
	Filter bowl	Nylon PA6 reinforced (FRS-10, FRS-20, FRS-30) Steel (FRS-40 series 10), nylon PA6 reinforced (FRS-40 series 11)
Compliance		RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

6 HYDRAULICS CHARACTERISTICS

FRS-10, FRS-20

Filter size		10				20															
Port size code		00		01, 41		00				01				02, 42				03			
Ports dimension		G1/2"		G3/4" SAE12		G1/2"				G3/4"				G1", SAE16				G1 1/4"			
Filter length		**A**	**B**	**A**	**B**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Max flow (l/min) at Δp 0,5 bar **-see note-**	**F06**	14	36	15	38	32	50	66	82	35	57	93	100	35	58	93	133	36	62	93	135
	F10	30	54	31	58	48	65	83	100	52	77	138	125	53	78	138	195	56	90	140	200
	F25	48	73	50	80	58	79	96	110	67	97	189	141	67	100	189	240	75	125	200	260
	C10	70	87	76	97	75	88	102	110	90	111	216	146	92	115	216	263	113	160	225	277
	C25	75	94	92	105	90	105	114	120	115	138	288	163	118	144	288	300	168	243	305	300
Max operating pressure		8 bar																			
Direction of filtration		See the arrow on the filter head																			

FRS-30, FRS-40

Filter size		30						40														
Port size code		02		03		04		03					04					05, 45				
Ports dimension		G1"		G1 1/4"		G1 1/2" SAE24		G1 1/4"					G1 1/2"					G2", SAE32				
Filter length		**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
Max flow (l/min) at Δp 0,5 bar **-see note-**	**F06**	180	190	175	185	180	190	203	286	310	233	430	210	300	330	240	460	210	310	338	245	500
	F10	250	260	250	270	270	280	314	429	492	353	540	340	478	565	374	607	340	500	594	387	640
	F25	265	275	280	293	290	310	340	495	525	386	590	370	570	611	412	708	370	600	650	430	750
	C10	280	290	311	315	326	330	365	515	546	401	606	400	597	642	430	732	400	630	679	446	780
	C25	330	355	380	390	400	409	473	594	640	495	648	536	714	782	540	790	536	750	800	564	800
Max operating pressure		8 bar																				
Direction of filtration		See the arrow on the filter head																				

Note: Max flow rates are measured with Δp= 0,5 bar and viscosity 32mm²/s. In case of different conditions see section 11
For a correct sizing of the filter, it is suggested not to exceed **750 l/min** to limit the maximum speed of the fluid in connecting pipes

7 FILTER ELEMENTS

Material		Inorganic microfibre F+ FILTRATION PLUS	Cellulose
Filtration rating as per ISO16889	**F06**	$\beta_{06\mu m\,(c)} \geq 1000$	-
	F10	$\beta_{12\mu m\,(c)} \geq 1000$	-
	F25	$\beta_{27\mu m\,(c)} \geq 1000$	-
	C10	-	$\beta_{10\mu m\,(c)} \geq 2$
	C25	-	$\beta_{25\mu m\,(c)} \geq 2$

8 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -25°C ÷ +100°C, with HFC hydraulic fluids = +10°C ÷ +50°C FKM seals (/PE option) = -25°C ÷ +100°C		
Recommended viscosity	15 ÷ 100 mm²/s - max allowed range 2.8 ÷ 500 mm²/s		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

9 FILTERS SIZING

For the filter sizing it is necessary to consider the Total Δp at the maximum flow at which the filter must work.
The Total Δp is given by the sum of filter head Δp plus filter bowl Δp plus the filter element Δp:

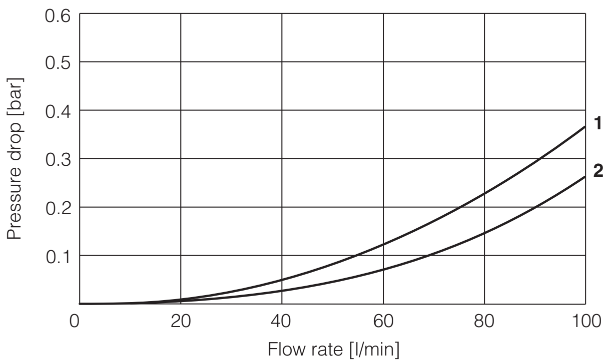
Total Δp = filter head Δp + filter bowl Δp + filter element Δp

In the best conditions the total Δp should not exceed 0,5 bar
See below sections to calculate the Δp of filter head and Δp of the filter element

9.1 Q/Δp DIAGRAMS OF FILTER HEAD + FILTER BOWL

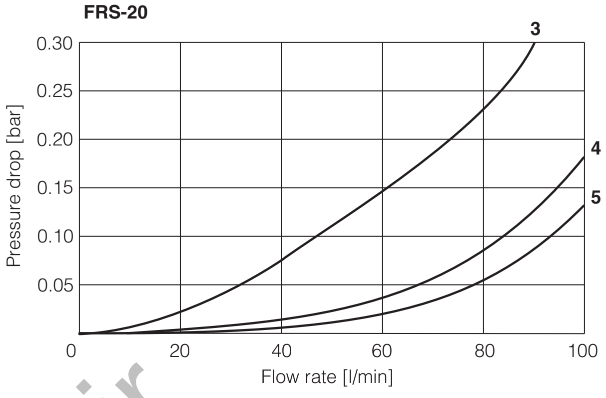
The pressure drop mainly depends on the ports size and fluid density
In the following diagrams are reported the Δp characteristics based on mineral oil with density 0,86 kg/dm^3 and viscosity 32 mm^2/s

FRS-10



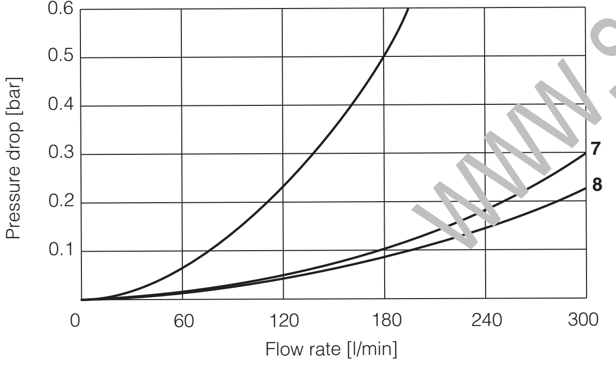
1 = FRS-10-*-00 (G 1/2")
2 = FRS-10-*-01 (G 3/4")
FRS-10-*-41 (SAE-12)

FRS-20



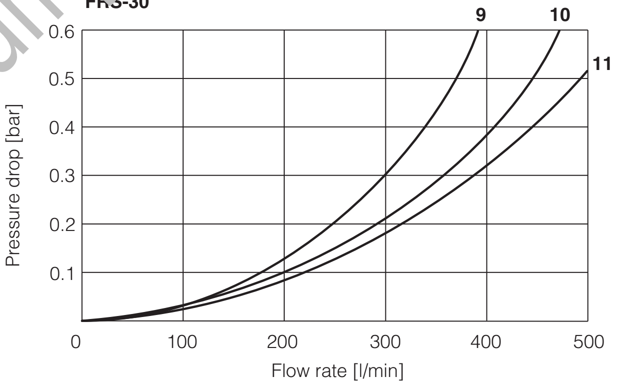
3 = FRS-20-*-00 (G 1/2")
4 = FRS-20-A-01 (G 3/4")
FRS-20-B-01 (G 3/4")
5 = FRS-20-A-02 (G 1")
FRS-20-B-02 (G 1")
FRS-20-A-42 (SAE-16)
FRS-20-B-42 (SAE-16)

FRS-20



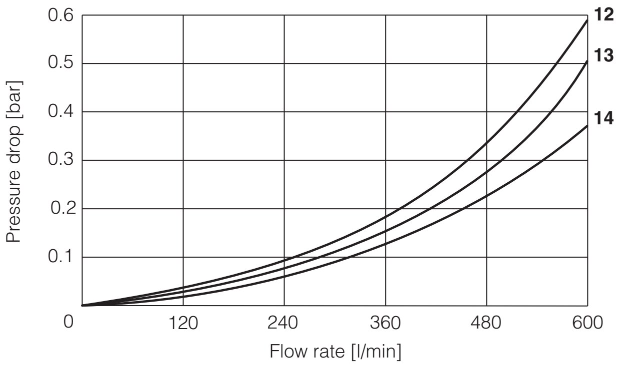
6 = FRS-20-C-01 (G 3/4")
FRS-20-D-01 (G 3/4")
8 = FRS-20-*-03 (G 1 1/4")
7 = FRS-20-C-02 (G 1")
FRS-20-D-02 (G 1")
FRS-20-C-42 (SAE-16)
FRS-20-D-42 (SAE-16)

FRS-30



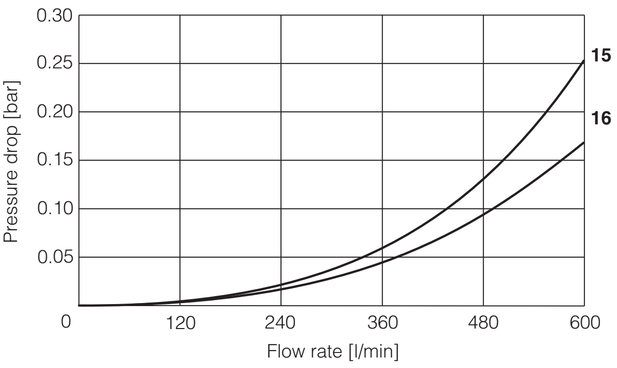
9 = FRS-30-*-02 (G 1")
10 = FRS-30-*-03 (G 1 1/4")
11 = FRS-30-*-04 (G 1 1/2")
FRS-30-*-44 (SAE-24)

FRS-40



12 = FRS-40-A-03 (G 1 1/4")
FRS-40-D-03 (G 1 1/4")
13 = FRS-40-A-04 (G 1 1/2")
FRS-40-D-04 (G 1 1/2")
14 = FRS-40-A-05 (G 2")
FRS-40-D-45 (G 2")
FRS-40-A-45 (SAE-32)
FRS-40-D-45 (SAE-32)

FRS-40



15 = FRS-40-B-04 (G 1 1/2")
FRS-40-C-04 (G 1 1/2")
FRS-40-E-04 (G 1 1/2")
16 = FRS-40-B-05 (G 2")
FRS-40-C-05 (G 2")
FRS-40-E-05 (G 2")
FRS-40-B-45 (SAE-32)
FRS-40-C-45 (SAE-32)
FRS-40-E-45 (SAE-32)

9.2 FILTER ELEMENT Δp

The pressure drop through the filter depends to:

- size of filter element
- filtration rating
- fluid viscosity

The Δp of filter element is given by the formula:

$$\Delta p \text{ of filter element} = Q \times \frac{Gc}{1000} \times \frac{\text{Viscosity}}{32}$$

Q = working flow (l/min)

Gc = Gradient coefficient (mbar/(l/min)).
The Gc values are reported in the following table

Viscosity = effective fluid viscosity in the working conditions (mm²/s)

Gradient coefficient Gc of FRS filter elements

Filter element size	10		20				30		40				
Filter element length	**A**	**B**	**A**	**B**	**C**	**D**	**A**	**B**	**A**	**B**	**C**	**D**	**E**
Filtration rating	**Gc** Gradient coefficient												
F06	33.84	12.28	13.85	7.80	5.09	3.34	2.43	2.25	2.40	1.49	1.32	1.80	0.80
F10	15.68	7.32	8.65	5.27	3.19	1.94	1.31	1.21	1.11	0.74	0.52	0.88	0.43
F25	8.81	4.28	6.32	3.60	2.06	1.26	1.10	1.00	0.96	0.51	0.42	0.71	0.24
C10	4.83	2.74	4.09	2.70	1.64	1.06	0.85	0.83	0.82	0.45	0.36	0.64	0.20
C25	4.13	2.06	2.52	1.41	0.82	0.42	0.39	0.35	0.34	0.23	0.12	0.26	0.10

Examples:

1) calculation of Total Δp for filter type FRS-20-B-F10-02-R at Q = 50 l/min and viscosity 46 mm²/s (filter element PRS-20-B-F10)

Δp of filter head + filter bowl = 0,03 bar

Gc = 5,27 mbar/(l/min)

Filter element Δp = $50 \times \frac{5{,}27}{1000} \times \frac{46}{32} = 0{,}379$ bar

Total Δp = 0,03 + 0,379 = **0,40 bar**

2) calculation of Total Δp of filter type FRS-40-C-F25-05-R at Q = 500 l/min and viscosity 46 mm²/s (filter element PRS-40-C-F25)

Δp of filter head + filter bowl = 0,13 bar

Gc = 0,42 mbar/(l/min)

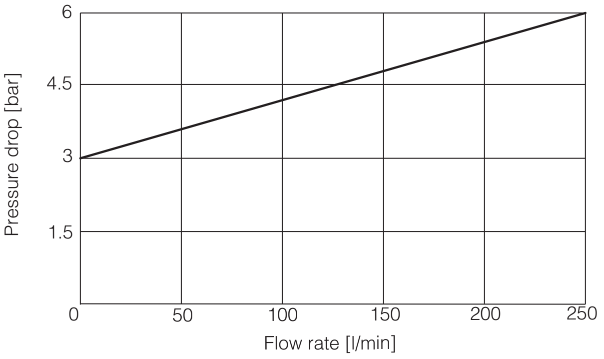
Filter element Δp = $500 \times \frac{0{,}42}{1000} \times \frac{46}{32} = 0{,}302$ bar

Total Δp = 0,13 + 0,302 = **0,43 bar**

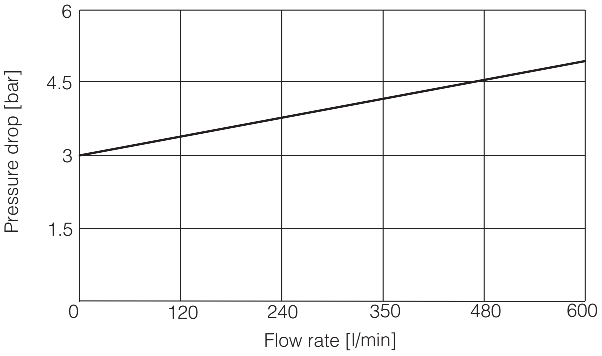
10 BY -PASS VALVE - based on mineral oil ISO VG46 at 50°C (viscosity = 32 mm²/s)

Q/Δp diagrams of flow trough the by pass valve

FRS-10
FRS-20

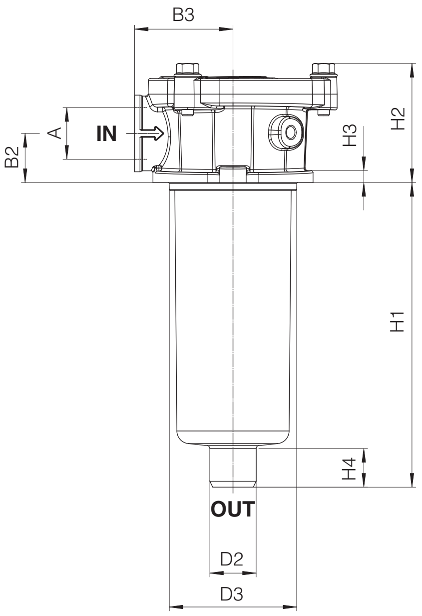


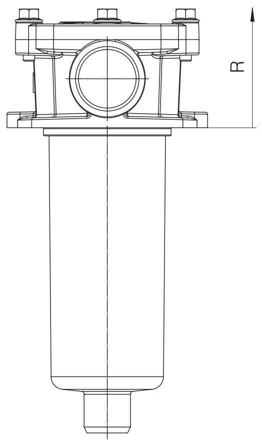
FRS-30
FRS-40

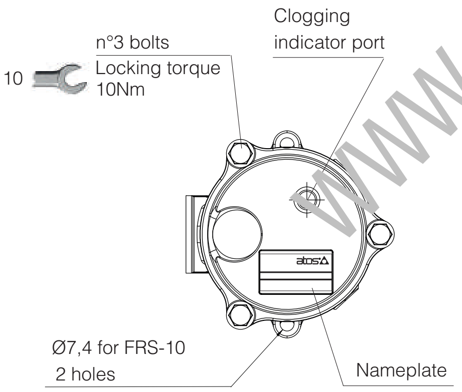


11 INSTALLATION DIMENSIONS OF FRS FILTERS [mm]

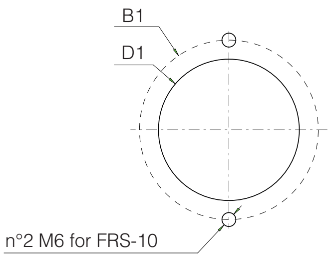
FRS-10





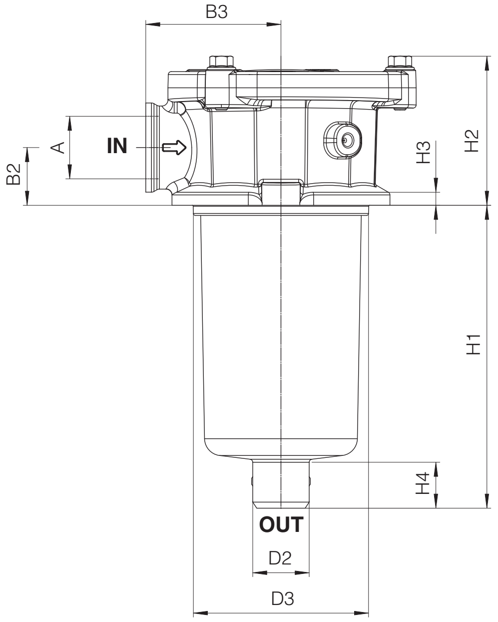


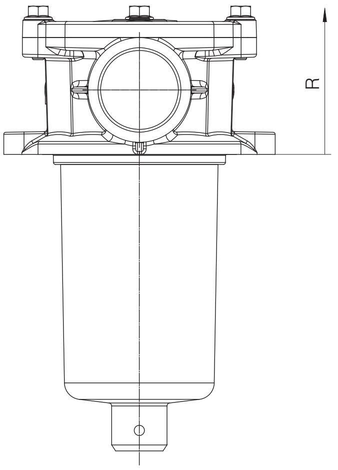
FILTER MOUNTING SURFACE

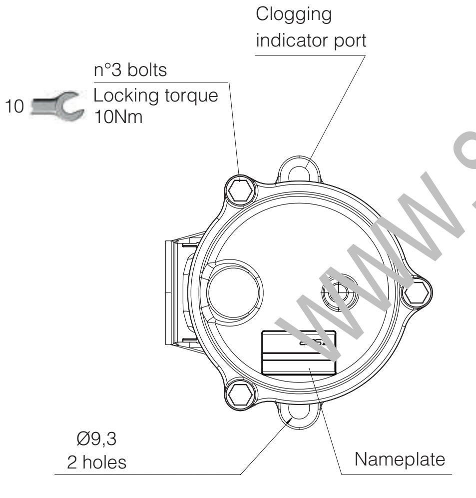


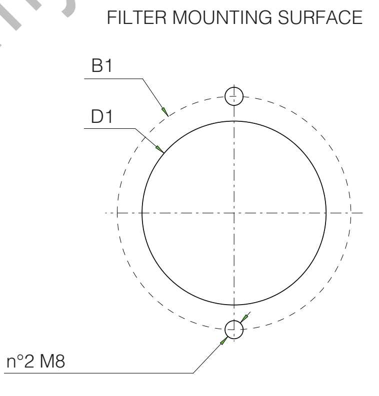
Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	**R** (element removal)	Mass (Kg)
FRS-10-A	1/2" BSPP 3/4" BSPP SAE-12	89	25	51	67,5	24	67	82	60	8	22	150	0,45
FRS-10-B								155				220	0,60

FRS-20







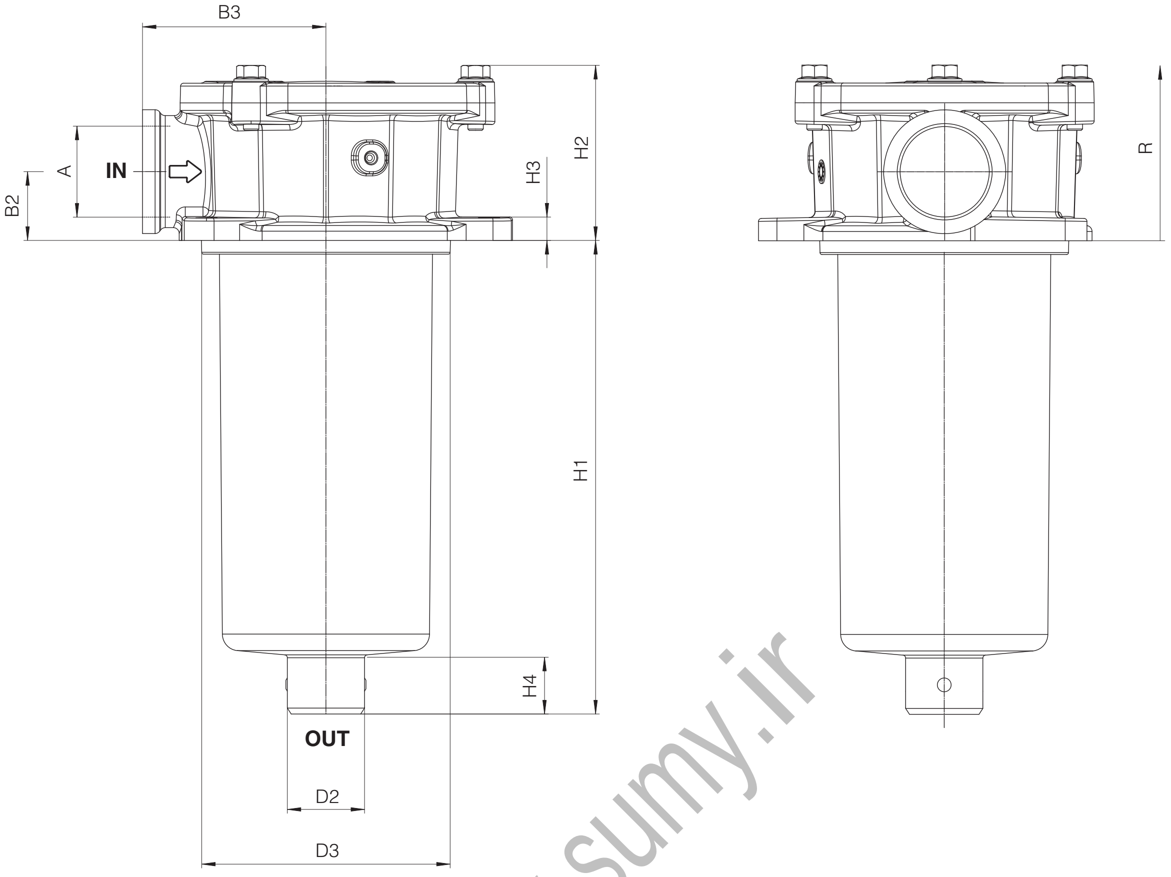


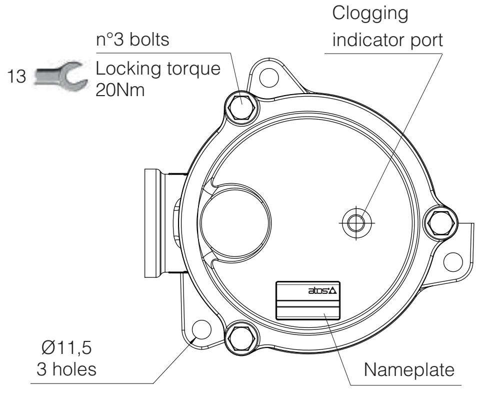
Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	R (element removal)	Mass (Kg)
FRS-20-A	1/2” BSPP 3/4” BSPP 1” BSPP 1 1/4” BSPP SAE-16	115	28,5 **(1)**	67	88,5	40	87	92	73	11	24	170	0,80
FRS-20-B								139				220	0,90
FRS-20-C			32 **(2)**					219				295	1,10
FRS-20-D								323				400	1,30

(1) For port size 3/4”, 1” and SAE-16

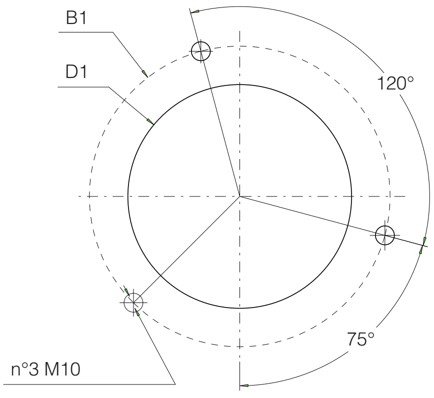
(2) For port size 1 1/4”

FRS-30



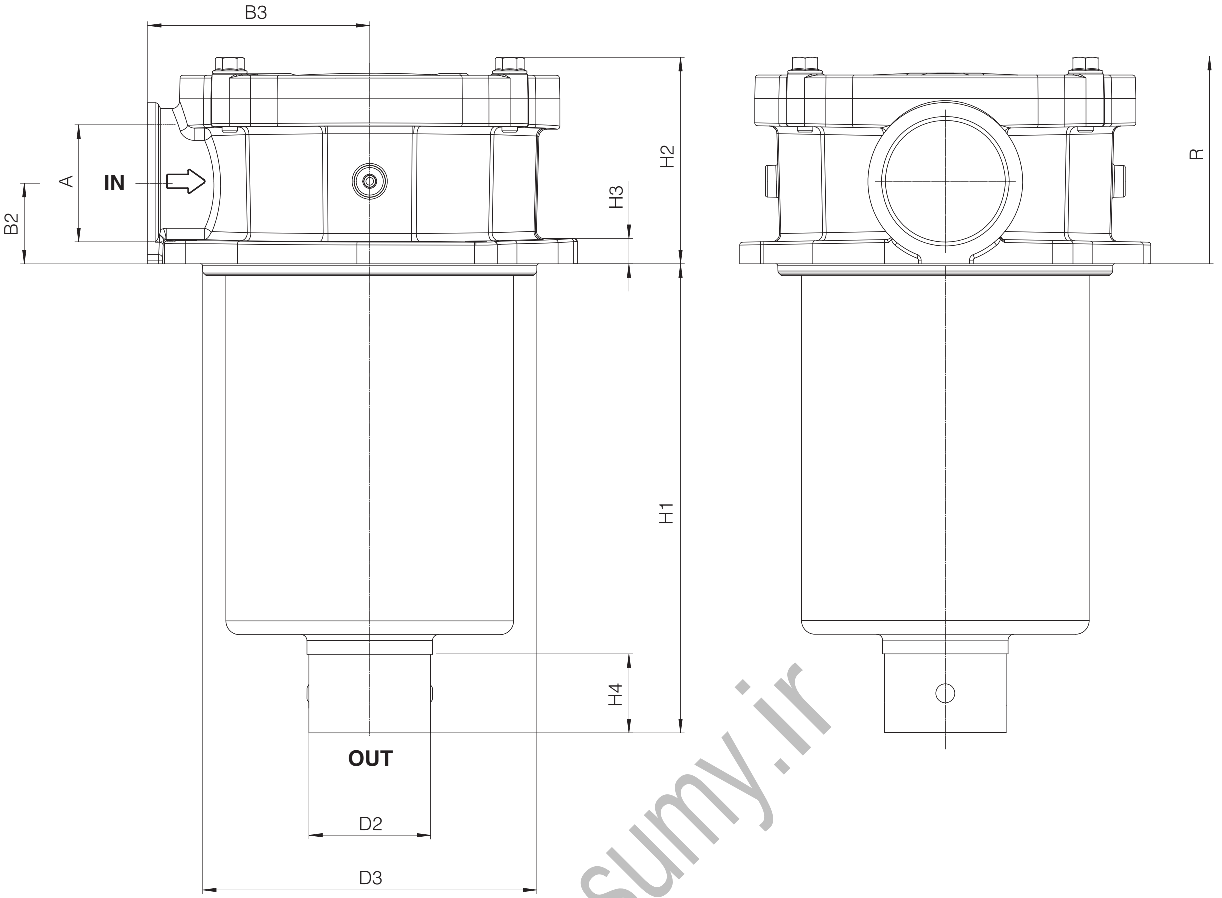


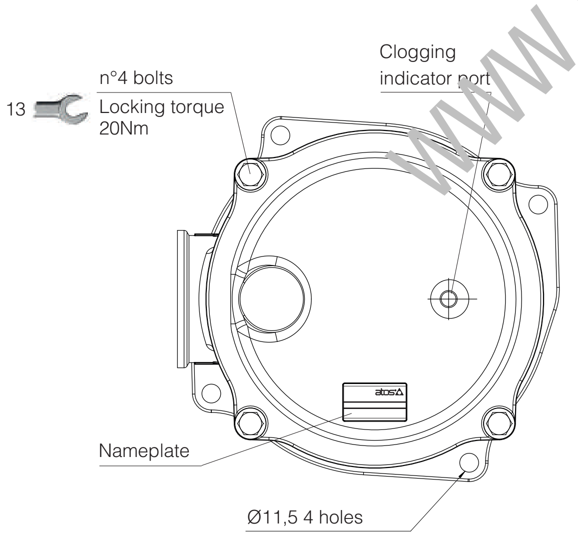
FILTER MOUNTING SURFACE

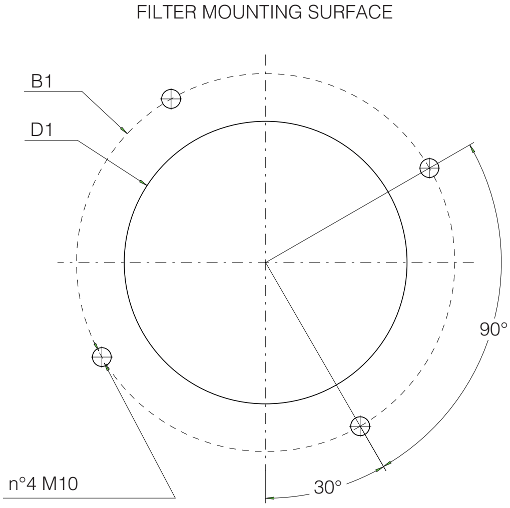


Code	A	B1	B2	B3	D1	D2	D3	H1	H2	H3	H4	R (element removal)	Mass (Kg)
FRS-30-A	1” BSPP 1 1/4” BSPP 1 1/2” BSPP SAE-24	175	35	95	130	40	129	234	90	11	30	320	2,10
FRS-30-B								263				360	2,40

FRS-40







Code	A	B1	B2	B3	D1	D2		D3	H1		H2	H3	H4		R (element removal)	Mass (Kg)
						series 10	series 11		series 10	series 11			series 10	series 11		
FRS-40-A	1 1/4" BSPP 1 1/2" BSPP 2" BSPP SAE-32	220	42	115	175	50	65	174	181	165	105	11	50	37	270	3,20
FRS-40-B						63			240	224					330	3,60
FRS-40-C									289	274					380	4,20
FRS-40-D **(1) (2)**									-	224					330	3,60
FRS-40-E **(1)**									-	424					530	4,00

(1) Available only for series 11, on request

(2) Filter type FRS-40-D has the same length of FRS-40-B but it uses filter elements with smaller internal diameter

12 **ACCESSORIES** - to be ordered separately

Following accessories can be assembled on return filters type FRS-20, FRS-30 and FRS-40 (not available for FRS-10) to avoid the foam or air/oil emulsion inside the tank caused by the return flow.

The discharge ending pipes **DSC-END-*** are used to extend the outlet port of the FRS filters below the oil level in the tank.
They are available with length 250 (200 mm for FRS-40) and 500 mm

The diffusers **DIFF-FRS** are used in case of high flow rates to evenly distribute the return flow inside the tank.
They can be mounted directly on the filter bowl or using the connecting pipes **CONN-END-***, available with lengths of 250 (200 for FRS-40) and 500 mm.

MODEL CODE OF DISCHARGE ENDING PIPES ①

DSC-END	-	250	FRS-20/30
Discharge ending pipe		**Pipe length** for **FRS-20** and **FRS-30**: 250 = 250 mm 500 = 500 mm **Pipe length** for **FRS-40**: 200 = 200 mm 500 = 500 mm	**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

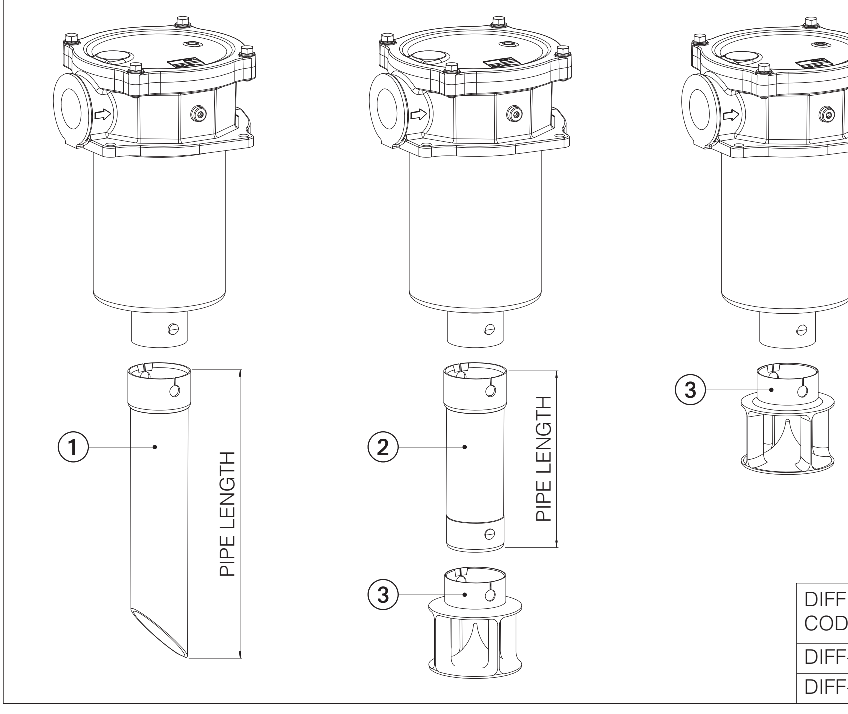
MODEL CODE OF CONNECTING ENDING PIPES ②

CONN-END	-	250	FRS-20/30
Connecting ending pipe		**Pipe length** for **FRS-20** and **FRS-30**: 250 = 250 mm **Pipe length** for **FRS-40**: 200 = 200 mm (for FRS-40) 500 = 500 mm (for FRS-40)	**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

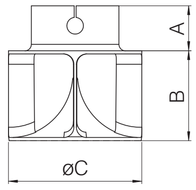
MODEL CODE OF DIFFUSERS ③

DIFF	-	FRS-20/30
Diffuser		**Filter type**: FRS-20/30 = for FRS-20 and FRS-30 FRS-40 = for FRS-40

DISCHARGE ENDING PIPE **CONNECTING ENDING PIPE** **DIFFUSER**

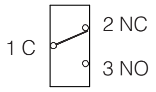
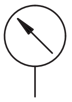


DIFFUSER DIMENSIONS



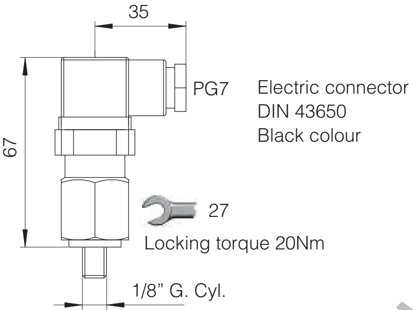
DIFFUSER CODE	DIMENSIONS		
	A	B	C
DIFF-FRS-20, DIFF-FRS-30	30	45	75
DIFF-FRS-40	35	70	105

13 CHARACTERISTICS OF CLOGGING INDICATORS

Model code	**CIA-E electrical**		**CIA-V visual**
Switching pressure	2 bar		green sector = 0 ÷ 3 bar red sector = 3 ÷ 10 bar
Switching tolerance at 20°C	± 10% of switching pressure		-
Electric connection	Electric plug connection as per DIN 43650 with cable gland type PG7		-
Power supply	14 V_{DC} ÷ 30 V_{DC}	125 V_{AC} ÷ 250 V_{AC}	
Max current - resistive (inductive)	4 A (3 A) ÷ 3 A (2 A)	5 A (3 A) ÷ 3 A (2 A)	
Fluid temperature	-25°C ÷ +100°C		-25°C ÷ +100°C
Protection degree according to DIN 40050	IP65 with mating connector		-
Hydraulic connection	G1/8" BSP		G1/8" BSP
Duty factor	100%		100%
Mass (Kg)	0,16		0,04
Electric scheme / Hydraulic symbol	 The electric scheme shows the switch position in case of clean filter element		

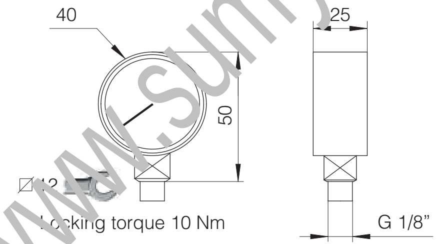
14 DIMENSIONS OF CLOGGING INDICATORS

CIA-E

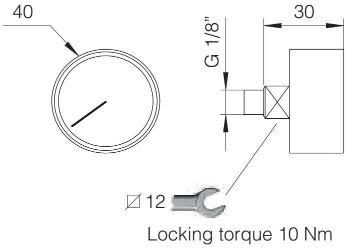


Note: add sealant on indicator threads

CIA-V



CIA-V/P
(available on request)



15 INSTALLATION AND COMMISSIONING

Verify that the tank flange with the filter mounting surface is clean and free of scratches.
Install the filter on the tank cover using the fixing holes on the filter head.
Connect the IN port of the filter to the system return pipe.
The OUT port of the filter must end under the oil level to avoid foam or air/oil emulsion inside the tank.
At this purpose specific accessories as connecting pipes, discharge ending pipes ad flow diffusers can be fit on the filter OUT port see section 12
Make sure that there is enough space above the filter, for the replacement of the filter element, see dimension "R" at section 11
Never run the system without the filter element.

For filters ordered with clogging indicator, code E or V:
- remove the steel plug from the indicator port on the filter head
- install the clogging indicator and lock it at the specified torque

During the cold start up (fluid temperature lower than 30°C), a false clogging indicator signal can be given due to the high fluid viscosity.

16 MAINTENANCE

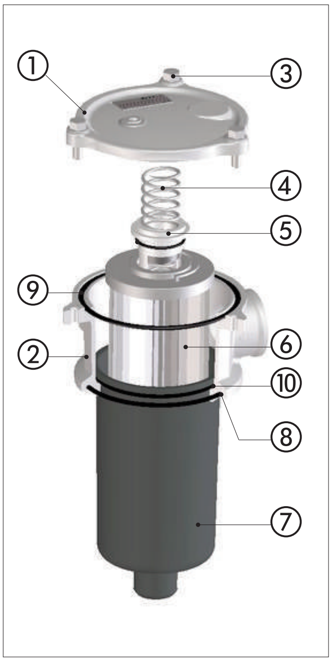
The filter element must be replaced as soon as the clogging indicator switches to highlight the filter clogged condition

For filters without clogging indicator, the filter element must be replaced according to the system manufacturer's recommendations.

Select the new filter element according to the model code reported on the filter nameplate, see section 17

For the replacement of the filter element, proceed as follow:

- switch-off the system and make sure that there is no residual pressure in the filter line (i.e. pressurized tank); the filter has no pressure bleeding device
- pay attention to the fluid and filter surface temperature. Always use suitable gloves an protection glasses
- remove the cover ① from the filter head ② by releasing the bolts ③
- remove the spring ④ and the bowl ⑦
- remove the dirty filter element ⑥ pulling it upward carefully
- clean the bowl ⑦
- install the bowl ⑦ after having checked the good condition of the seal ⑧
- insert the new filter element over the spigot in the filter bowl; the filter element includes the by-pass valve ⑤
- install the spring ④
- mount the cover and lock the relevant bolts ③ after having checked the good condition of the seal ⑨



WARNING: The dirty filter elements cannot be cleaned and re-used. They are classified as "dangerous waste material", then they must be disposed of by authorized Companies, according to the local laws.

16.1 SEALS KIT

Filter type	Seal kit code (NBR)	Seal kit code (FKM)	Seal kit composition
FRS-10	GUARN FRS-10	GUARN FRS-10 /PE	⑧+⑨+⑩
FRS-20	GUARN FRS-20	GUARN FRS-20 /PE	⑧+⑨+⑩
FRS-30	GUARN FRS-30	GUARN FRS-30 /PE	⑧+⑨+⑩
FRS-40	GUARN FRS-40	GUARN FRS-40 /PE	⑧+⑨+⑩

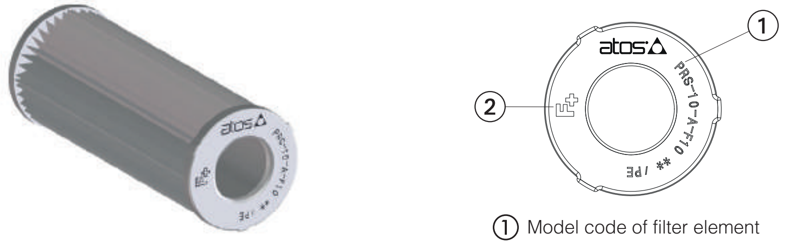
16.2 SPARE SPRING ④

Filter type	Seal kit code
FRS-10	MO-1246
FRS-20	MO-1247
FRS-30	MO-1248
FRS-40	MO-1249

17 FILTER IDENTIFICATION NAMEPLATE

① Model code of complete filter
② Model code of filter element
③ Filter matrix code

17.1 IDENTIFICATION OF FILTER ELEMENT



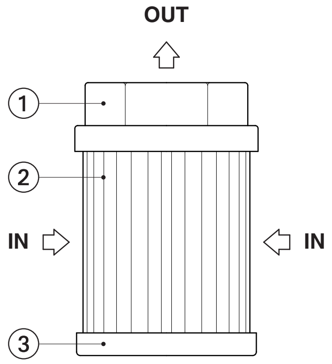
① Model code of filter element
② Filtration Plus identification

18 RELATED DOCUMENTATION

LF010	Fluid contamination
LF020	Filtration guidelines

Suction filters type FSS

Threaded ports



FSS-20-*

① Filter head
② Wire mesh
③ End cap

FSS

Suction filters are designed to protect pumps from ingestion of solid particles and coarse contamination present in the oil tank, which may cause heavy damage and seizures.

They are designed to be screwed onto the pumps suction line.

FSS filters are available with following features:

- four sizes with BSPP threaded ports, from 1/2" to 3 "
- wire mesh 125 µm (c)
- version without or with by-pass valve

Max flow **450 l/min**

1 MODEL CODE

FSS - **10** - **A** - **W125** - **00** - **N** **

Suction filter

Series number

Filter size:
10
20
30
40

By-pass:
N = without by-pass
R = by-pass valve, cracking pressure 0,35 bar

Filter length:		Max flow [l/min] **(1)**			
		FSS-10	FSS-20	FSS-30	FSS-40
A	=	20	38	85	330
B	=	-	60	125	450
C	=	-	-	200	-

Port size:
BSPP threaded:

FSS-10-A
00 = G 1/2"

FSS-20-A
01 = G 3/4"

FSS-20-B
02 = G 1"

FSS-30-A
03 = G 1 1/4"

FSS-30-B
04 = G 1 1/2"

FSS-30-C
05 = G 2"

FSS-40-A
06 = G 2 1/2"

FSS-40-B
07 = G 3"

Filtration rating:
W125 = wire mesh 125 µm

(1) Max flow rates are performed in following conditions:
- clean filter element
- Δp = 0,015 bar
- mineral oil with viscosity 32 mm^2/s

In case of different conditions see Q/Δp diagrams at section 6

2 HYDRAULIC SYMBOL (representation according to ISO 1219-1)

3 GENERAL CHARACTERISTICS

Assembly position / location		Any position
Differential collapse pressure	[bar]	1
Ambient temperature range		-20°C ÷ +70°C
Storage temperature range		-20°C ÷ +80°C
Materials	Filter head	Nylon
	Filter end cap	Carbon steel, zinc plated
	Filter Mesh	Stainless steel AISI 304

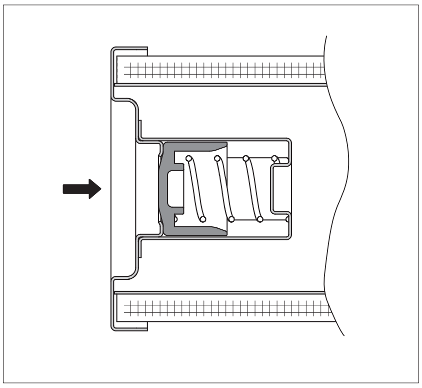
4 HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Recommended fluid temperature	-25°C ÷ +100°C, with HFC hydraulic fluids = +10°C ÷ +50°C	
Recommended viscosity	15 ÷ 100 mm^2/s - max allowed range 2.8 ÷ 500 mm^2/s	
Hydraulic fluid	**Classification**	**Ref. Standard**
Mineral oils	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	HFDU, HFDR	ISO 12922
Flame resistant with water	HFC	

5 BY-PASS VALVE - version **-R**

The by-pass valve allows the oil flow to by-pass the suction filter when the pressure drop across the element exceeds 0,35 bar, so that to avoid the pump cavitation.

This may happens in particular conditions as:
- instantaneous high flow peaks
- filter mesh clogged by contamination



6 FILTER SIZING

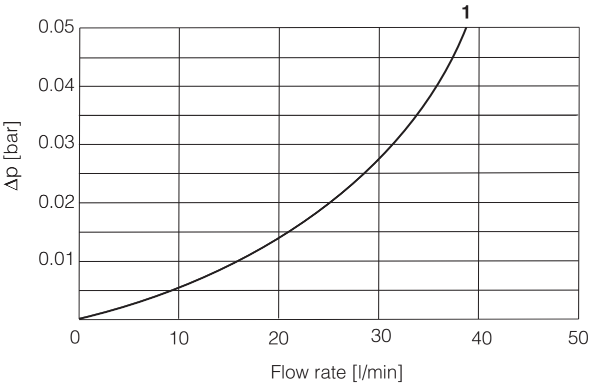
Suction filters must be largely sized to avoid the pumps cavitation. In the best conditions the Δp should not exceed 0.015 bar

6.1 Q/Δp DIAGRAMS

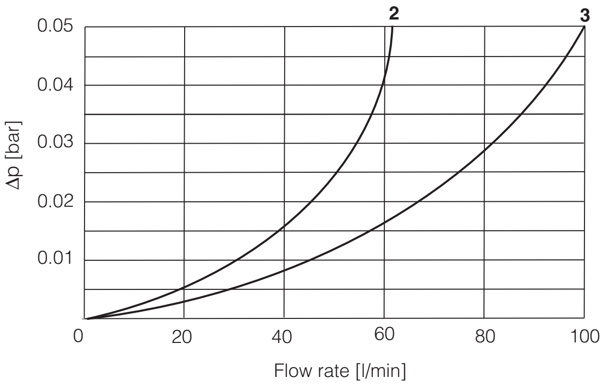
In following diagrams are reported the Δp characteristics of filter based on mineral oil with density 0,86 kg/dm^2 and viscosity 32 mm^2/s.
in case of different viscosity the effective Δp_E is given by the formula:

$$\Delta p_E = \Delta p \times \frac{\text{viscosity}}{32}$$

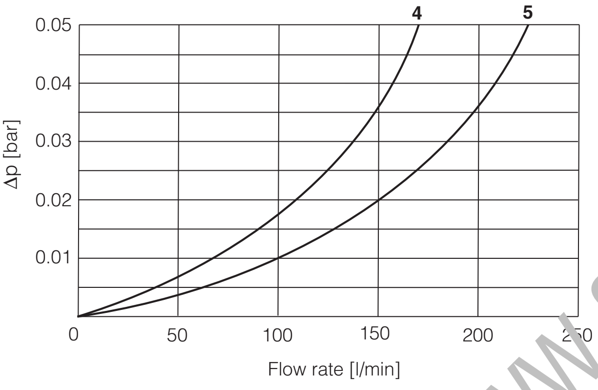
Δp_E = pressure drop calculated at the effective viscosity
Δp = pressure drop reported in the below diagrams
Viscosity = effective fluid viscosity in the working condition (mm^2/s)



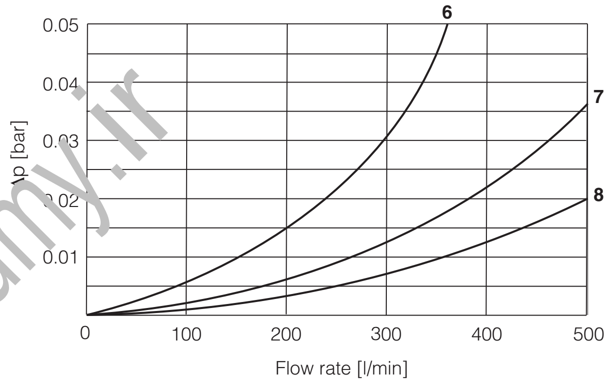
1 = FSS-10-A



2 = FSS-20-A
3 = FSS-20-B

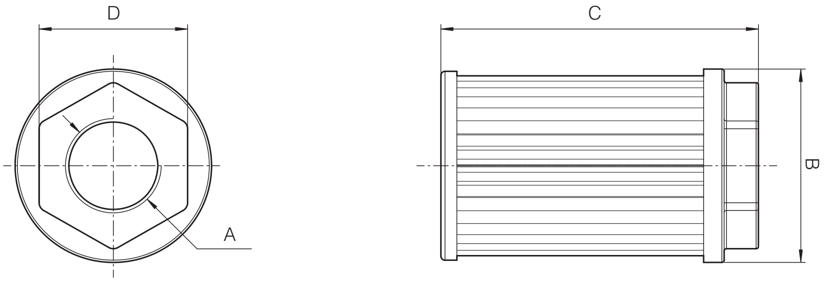


4 = FSS-30-A
5 = FSS-30-B



6 = FSS-30-C
7 = FSS-40-A
8 = FSS-40-B

7 INSTALLATION DIMENSIONS OF FSS FILTERS [mm]



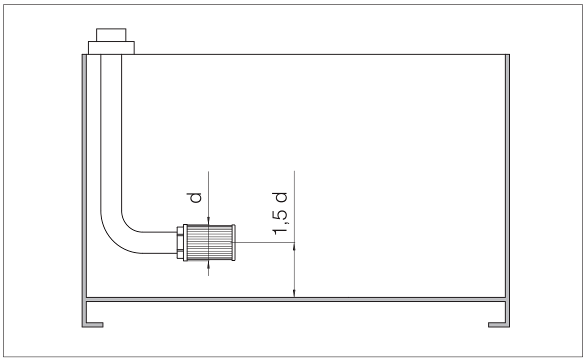
Code	A	B	C	D	Mass (Kg)
FSS-10-A	1/2" BSPP	46	106	36	0,10
FSS-20-A	3/4" BSPP	64	109	50	0,19
FSS-20-B	1" BSPP		139		0,21
FSS-30-A	1 1/4" BSPP	86		65	0,33
FSS-30-B	1 1/2" BSPP		200		0,24
FSS-30-C	2" BSPP		260	75	0,51
FSS-40-A	2 1/2" BSPP	150	212	110	1,07
FSS-40-B	3" BSPP		272		0,92

8 INSTALLATION AND COMMISSIONING

The suction filters FSS must be generously sized to avoid pump cavitation. The size of the OUT port of the FSS filter must be equal to or greater than the corresponding suction port of the pump.

The FSS filter must always remain below the oil level in the tank, in any operating condition.
During installation, a minimum distance must be observed between the filter and the bottom of the tank (see figure on the side) to avoid the possibility that the contaminant deposited on the bottom is sucked up.

The FSS filter should be installed as far as possible from the return pipe. It is advisable to use separators inside the tank to keep the suction area separate from the area affected by the return flow.



9 MAINTENANCE

The filter must be replaced according to the system manufacturer's recommendations

⚠ **WARNING**: The dirty filters cannot be cleaned and re-used. They are classified as "dangerous waste material", then they must be disposed of by authorized Companies, according to the local laws.

9.1 FILTER IDENTIFICATION

① Model code of filter

10 RELATED DOCUMENTATION

LF010	Fluid contamination
LF020	Filtration guidelines