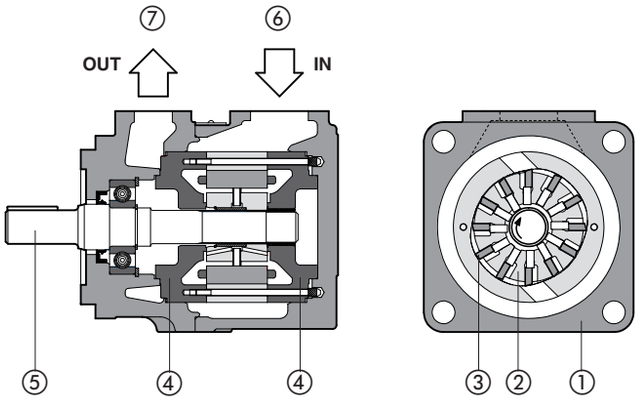
Vane pumps type PFE-31, PFE-41, PFE-51

fixed displacement - cartridge design



① body
②③ rotor with vanes
④ balanced plates
⑤ shaft
⑥ inlet port
⑦ outlet port

PFE-41

PFE-*1 are fixed displacement-twelve-vane pumps, ② ③ cartridge design with integral hydraulic balancing ④ for high pressure operation, long service life and low noise level.

They are available in three different 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 pressure 210 bar.

1 MODEL CODE

PFE **X2** – **31** **036** **/31028** / **1** **D** **T** ****** **/***

Fixed displacement vane pump

Additional suffix for multiple pumps:
X2 = double pump composed of single vane pumps
X3 = triple pump composed of single vane pumps

Eventual suffix for pumps with through shaft:
XA = for coupling one PFE-31
XB = for coupling one PFE-41 (only for PFE-41 and PFE-51)
XC = for coupling one PFE-51 (only for PFE-51)
XO = with through shaft, without rear flange
Note: mulitple pumps are assembled in decreasing order of size. See also tab. A190.

Size, see section 2:
31, 41, 51

Displacement [cm³/rev], see section 2
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**

Only for multiple pumps PFEX*: type of second (and third) pump

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

Series number

Port orientation, see section 5:
T = standard
U, V, W = on request

Direction of rotation (viewed from the shaft end):
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise
Note: PFE are not reversible

Drive shaft, see section 6 and 7:

cylindrical, keyed for single and multiple pump (only first position)
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)
7 = for second and third position in multiple pumps
} only for PFE-31 and PFE-41

2 OPERATING CHARACTERISTICS at 1450 rpm (based on mineral oil ISO VG 46 at 50°C)

Model	Displacement cm³/rev	Max pressure (1)	Speed range rpm (2)	7 bar (3) l/min	kW	70 bar (3) l/min	kW	140 bar (3) l/min	kW	210 bar (3) l/min	kW
PFE-31010	10,5	160	800-2400	15	0,2	13,5	2	12	5	-	-
PFE-31016	16,5	210 bar	800-2800	23	0,5	21	3	19	5	16	8,3
PFE-31022	21,6			30	0,6	28	4	26	7	23	10,8
PFE-31028	28,1			40	0,8	38	5,5	36	10	33	14
PFE-31036	35,6			51	1	49	7	46	12,5	43	17,8
PFE-31044	43,7		800-2500	63	1,3	61	8	58	15,5	55	22
PFE-41029	29,3			41	0,8	39	5,5	37	10	34	14,7
PFE-41037	36,6			52	1	50	7	48	12,5	45	18,3
PFE-41045	45,0			64	1,3	62	8,5	60	16	57	22,6
PFE-41056	55,8			80	1,6	78	11	75	21	72	28
PFE-41070	69,9			101	2	98	13,5	95	26	91	35
PFE-41085	85,3		800-2000	124	2,4	121	16	118	32	114	43
PFE-51090	90,0		800-2200	128	2,7	124	17	119	33	114	45
PFE-51110	109,6			157	3,2	152	21	147	40	141	55
PFE-51129	129,2			186	3,7	180	25	174	47	168	65
PFE-51150	150,2		800-1800	215	4,2	211	29	204	55	197	75

(1) Max pressure is 160 bar for /PE version and water glycol fluid
(2) Max speed is 1800 rpm for /PE versions; 1500 rpm for water glycol fluid
(3) Flow rate and power consumption are proportional to the rotation speed, see section 4

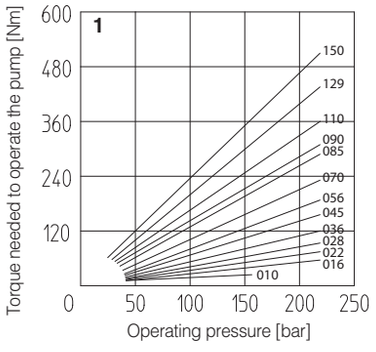
3 MAIN CHARACTERISTICS OF VANE PUMPS TYPE PFE-*1

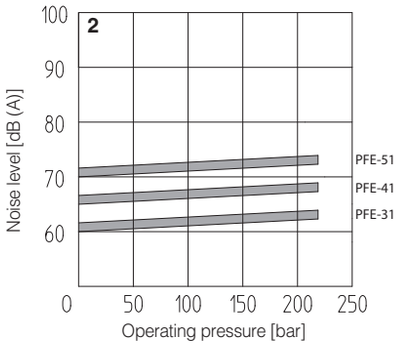
Installation position	Any position
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peak.
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity max at cold start max at full power during operation min at full power	 800 mm²/s 100 mm²/s 24 mm²/s 10 mm²/s
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 μm value with β_{25} 75 recommended)
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (/PE seals)
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

4 DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

1 = Torque versus pressure diagram

2 = Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics -Test procedure to define the ambient noise level - Pumps
Shaft speed: 1450 rpm.

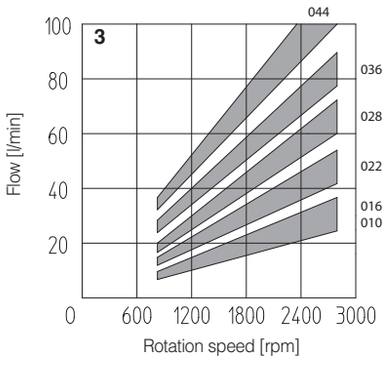


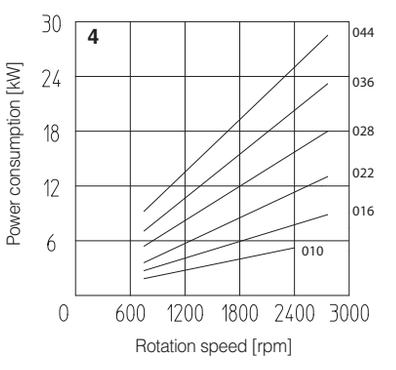


PFE-31:

3 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

4 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

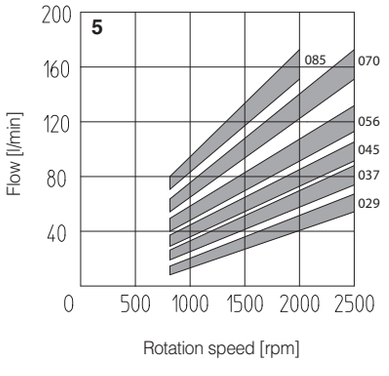


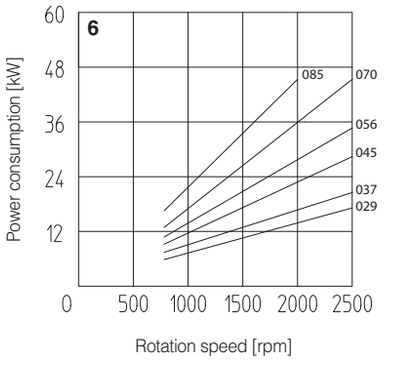


PFE-41:

5 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

6 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

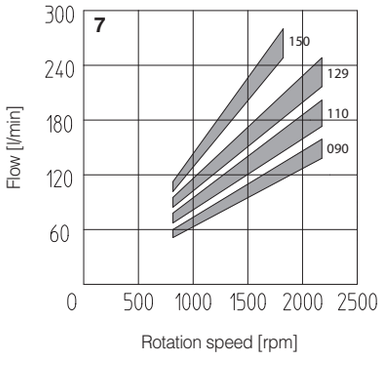


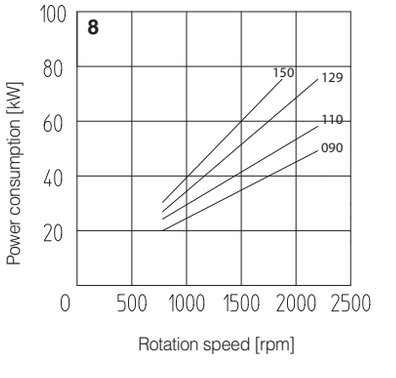


PFE-51:

7 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

8 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.



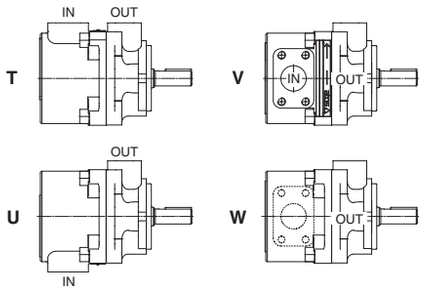


5 PORT ORIENTATION

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);

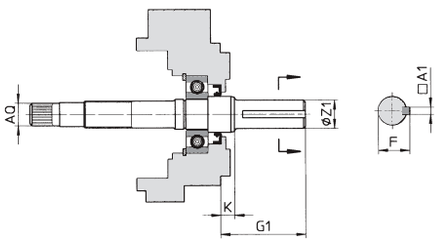
T = inlet and outlet ports on the same axis (standard)
U = outlet orientated 180° with respect to the inlet
V = outlet oriented 90° with respect to the inlet
W = outlet oriented 270° with respect to the inlet

In multiple pumps inlet ports and outlet ports are in line.
Ports orientation can be easily changed by rotating the pump body that carries inlet port.



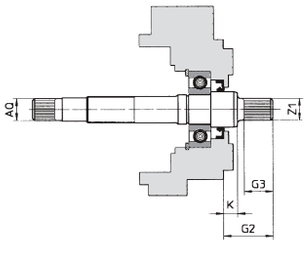
6 DRIVE SHAFT

CYLINDRICAL SHAFT KEYED
1 = for single and multiple pumps (only first position) supplied as standard if not specified in the model code
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



Model	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;



Model	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	–	–	–	–	–	–	–	–	–	–

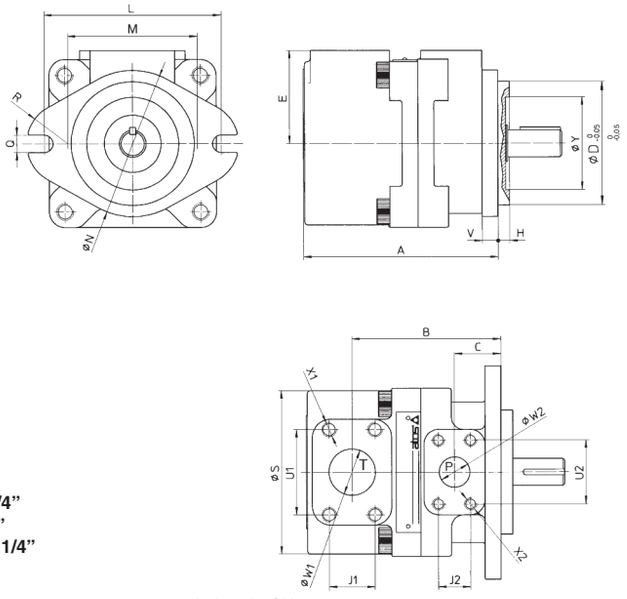
7 LIMITS OF SHAFT TORQUE

Pump model	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 4.
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]

T = inlet port
P = outlet port



SAE FLANGES
PFE-31: port **T = 1 1/4”**; port **P = 3/4”**
PFE-41: port **T = 1 1/2”**; port **P = 1”**
PFE-51: port **T = 2**; port **P = 1 1/4”**

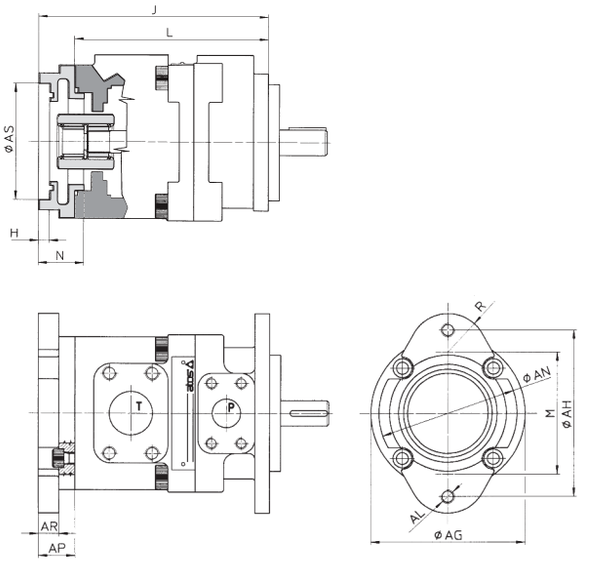
Mass:
PFE-31 = 9 kg
PFE-41 = 14 kg
PFE-51 = 25,5 kg

SAE flanges can be supplied with the pump, see www.scoda.it, tab. SK155

Model	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
Model	**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	15	51	32	42,9	30,2	M12X20	M10X20	76

9 DIMENSIONS OF PUMPS WITH THROUGH-SHAFT (FOR MULTIPLE PUMPS) [mm]

T = inlet port
P = outlet port



SAE FLANGES
PFEX-31: port **T = 1 1/4”**; port **P = 3/4”**
PFEX-41: port **T = 1 1/2”**; port **P = 1”**
PFEX-51: port **T = 2**; port **P = 1 1/4”**

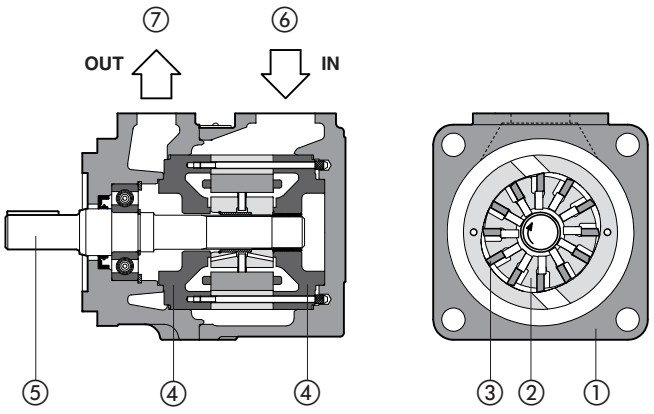
For other dimensions, see section 8

Model	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

Vane pumps type PFE-32, PFE-42, PFE-52

fixed displacement - cartridge design - high pressure and low noise level execution



① body
②③ rotor with vanes
④ balanced plates
⑤ shaft
⑥ inlet port
⑦ outlet port

PFE-42

New PFE-*2 are fixed displacement -twelve-vanes pumps ②③, cartridge design with integral hydraulic balancing ④ for high pressure operation and long service life with further reduction of noise level compared with PFE-*1.

These pumps are available as single, multiple or with through-shaft configuration.
Mounting flange according to SAE J744 standard.
Easy installation as inlet and outlet ports can be assembled in any of four relative positions.
Easy maintenance as the pumping cartridge can be replaced in a few minutes.

Three different sizes with max displacements up to 36, 85 and 150 cm³/rev.
Max pressures up to 300 bar.

1 MODEL CODE

PFE	X2	–	42	045	/31028	/	3	D	T	**	/*

Fixed displacement vane pump

Additional suffix for multiple pumps:
X2 = double pump composed of single vane pumps
X3 = triple pump composed of single vane pumps
Additional suffix for pumps with through shaft:
XA = for coupling one PFE-31
XB = for coupling one PFE-41 (only for PFE-42 and PFE-52)
XC = for coupling one PFE-51 (only for PFE-52)
XO = with through shaft, without rear flange
Note: mulitple pumps are assembled in decreasing order of size. See also tab. A190.

Size, see section 2:
32, 42, 52

Displacement [cm³/rev], see section 2
for PFE 32: **016, 022, 028, 036**
for PFE 42: **045, 056, 070, 085**
for PFE 52: **090, 110, 129, 150**

Only for multiple pumps PFEX*: type of second (and third) pump

Drive shaft, see section 6 and 7:
cylindrical, keyed for single and multiple pump (only first position)
3 = for high torque applications
splined
5 = for single and multiple pumps (any position)
6 = for single and multiple pumps (only first position)
7 = for second and third position in multiple pumps
} only for PFE-32 and PFE-42

Direction of rotation (viewed from the shaft end):
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise
Note: PFE are not reversible and it is therefore necessary to specify the desired direction of rotation

Port orientation, see section 5:
T = standard
U, V, W = on request

Series number

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

2 OPERATING CHARACTERISTICS at 1450 rpm (based on mineral oil ISO VG 46 at 50°C)

Model	Displacement cm³/rev	Max pressure (1)	Speed range rpm (2)	7 bar (3)		140 bar (3)		at max. pressure (3)	
				l/min	kW	l/min	kW	l/min	kW
PFE-32016	16,5	210 bar	1000-2500	23	0,35	20	6	16	10
PFE-32022	21,6	300 bar	1200-2500	30	0,6	26	7	20	16
PFE-32028	28,1			40	0,8	36	10	30	20
PFE-32036	35,6			51	1	46	12,5	40	26
PFE-42045	45	280 bar	1000-2200	64	1,3	60	16	56	31
PFE-42056	55,8			80	1,6	75	21	70	40
PFE-42070	69,9	250 bar		101	2	95	26	90	42
PFE-42085	85,3	210 bar	800-2000	124	2,4	118	32	114	43
PFE-52090	90	250 bar	1000-2000	128	2,7	119	33	111	54
PFE-52110	109,6			157	3,2	147	40	138	66
PFE-52129	129,2			186	3,7	174	47	163	78
PFE-52150	150,2	210 bar	800-1800	215	4,2	204	55	197	80

(1) Max pressure is 160 bar for /PE version and water glycol fluid
(2) Max speed is 1800 rpm for /PE versions; 1500 rpm for water glycol fluid
(3) Flow rate and power consumption are proportional to the rotation speed

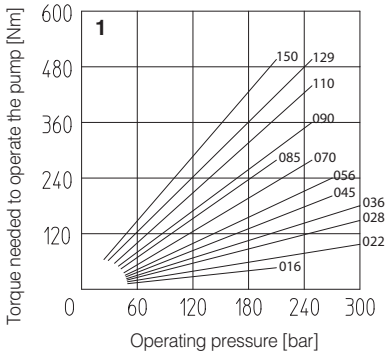
3 MAIN CHARACTERISTICS OF VANE PUMPS TYPE PFE-*2

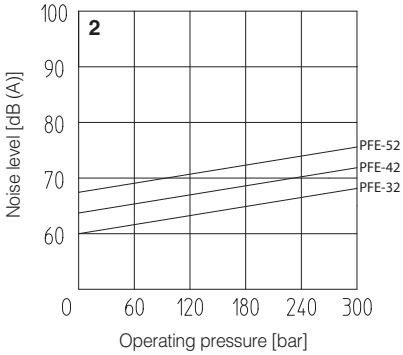
Installation position	Any position.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the power peaks.
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity max at cold start max at full power during operation min at full power	 800 mm²/s 100 mm²/s 24 mm²/s 10 mm²/s
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 -20°C +50°C (water glycol) -20°C +80°C (/PE seals)
Recommended pressure on inlet port	from 0 to 1,5 bar

4 DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

1 = Torque versus pressure diagram

2 = Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics -Test procedure to define the ambient noise level - Pumps
Shaft speed: 1450 rpm.

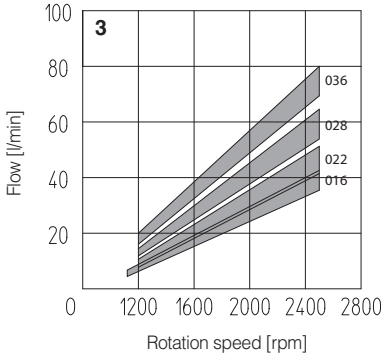


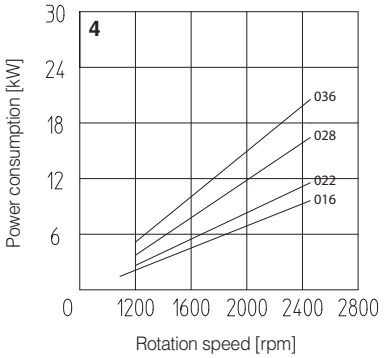


PFE-32:

3 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

4 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

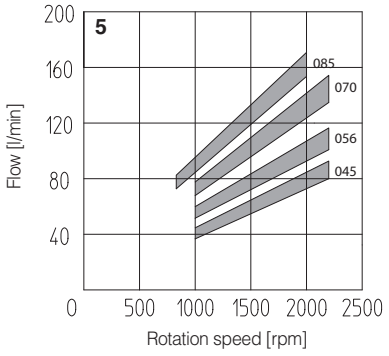


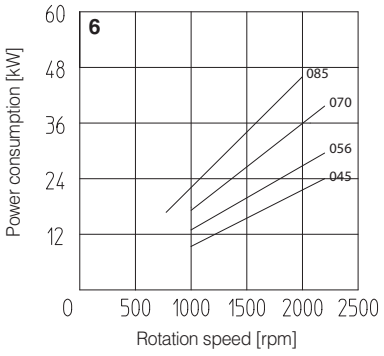


PFE-42:

5 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

6 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

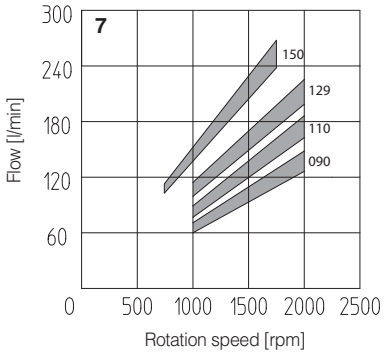


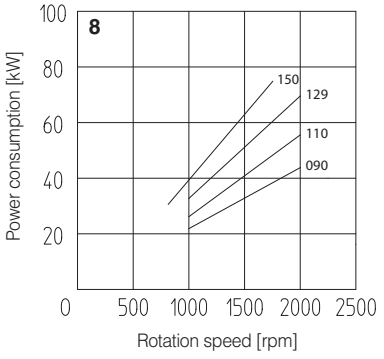


PFE-52:

7 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

8 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.



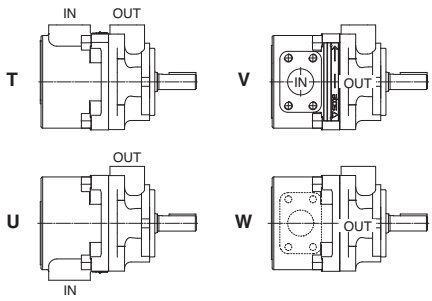


5 PORT ORIENTATION

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);

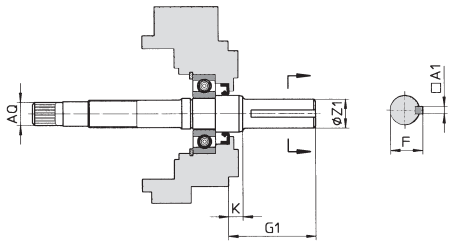
T = inlet and outlet ports on the same axis (standard)
U = outlet orientated 180° with respect to the inlet
V = outlet oriented 90° with respect to the inlet
W = outlet oriented 270° with respect to the inlet

In multiple pumps inlet ports and outlet ports are in line.
Ports orientation can be easily changed by rotating the pump body that carries inlet port.



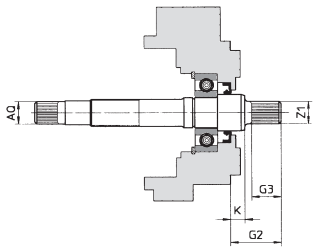
6 DRIVE SHAFT

CYLINDRICAL KEYED SHAFT
3 = for single and multiple pumps (only first position)
for high torque applications



Model	Keyed shaft type 3					
	A1	F	G1	K	ØZ1	Only for through shaft execution Ø AQ
PFE-32	4,78	24,54	56,00	8,00	22,22	SAE 16/32-9T
	4,75	24,41			22,20	
PFE-42	6,38	28,30	78,00	11,40	25,38	SAE 32/64-24T
	6,35	28,10			25,35	
PFE-52	7,97	38,58	84,00	14	34,90	SAE 16/32-13T
	7,94	38,46			34,88	

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;



Model	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	55,60	42	8,10	SAE 12/24-14T	SAE 16/32-13T	–	–	–	–	–	–	–	–	–	–

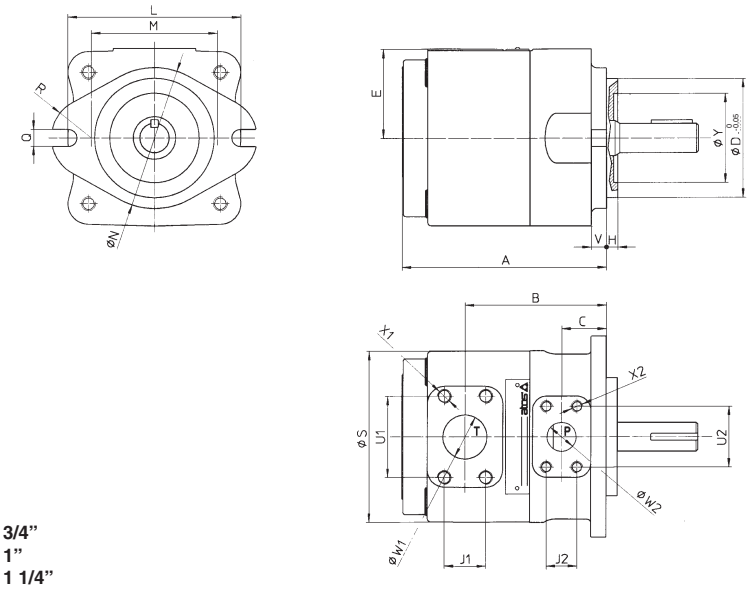
7 LIMITS OF SHAFT TORQUE

Pump model	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 4.
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]

T = inlet port
P = outlet port



SAE FLANGES
PFE-32: port **T = 1 1/4”**; port **P = 3/4”**
PFE-42: port **T = 1 1/2”**; port **P = 1”**
PFE-52: port **T = 2**; port **P = 1 1/4”**

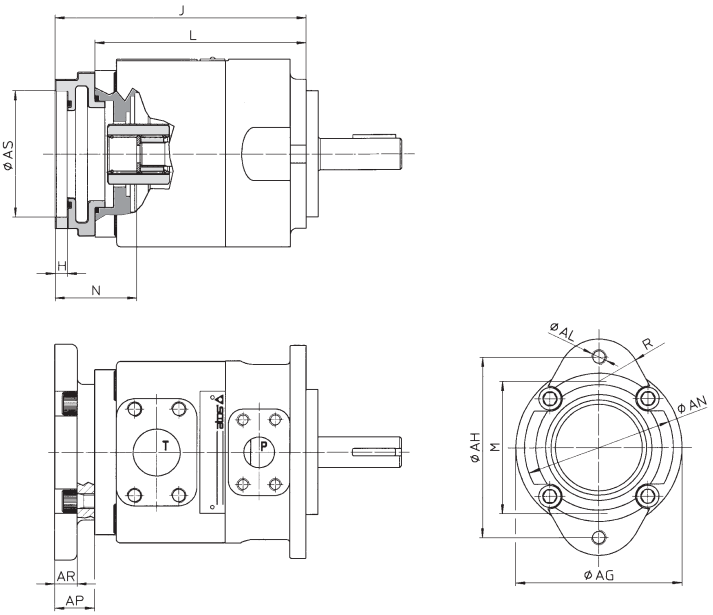
Mass:
PFE-32 = 9 kg
PFE-42 = 20,5 kg
PFE-52 = 32,1 kg

SAE flanges can be supplied with the pump, see www.scoda.it, tab. SK155

Model	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
Model	**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

9 DIMENSIONS OF PUMPS WITH THROUGH-SHAFT (FOR MULTIPLE PUMPS) [mm]

T = inlet port
P = outlet port



SAE FLANGES
PFEX-32: port **T = 1 1/4”**; port **P = 3/4”**
PFEX-42: port **T = 1 1/2”**; port **P = 1”**
PFEX-52: port **T = 2**; port **P = 1 1/4”**

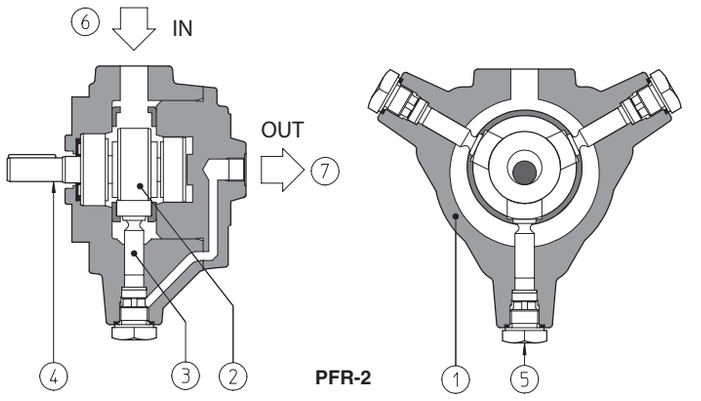
For other dimensions, see section 8

Model	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

Radial piston pumps type PFR

fixed displacement



① body
② central bearing and return plates
③ radial pistons
④ shaft
⑤ seat of delivery valve
⑥ inlet port
⑦ outlet port

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.
Suitable for hydraulic oils according to DIN 51524... 535 or synthetic fluids having similar lubricating characteristics.

These pumps are available as single or with through-shaft configuration in order to be coupled to PFE vane pumps, see table A190.

Wide range of displacements from 1,7 up to 25,4 cm³/rev.
Max pressure up to 350/500 bar.

1 MODEL CODE

PFR	XA	-	3	08	**	-	*

PFR: Fixed displacement radial piston pump

XA: Additional suffix for pumps provided to be coupled with vane pump type PFE (tab. A005), see section 9
Only for PFR-3:
XA = provided (throughgoing shaft, flange and joint) to be coupled with PFE-31
XB = provided (throughgoing shaft, flange and joint) to be coupled with PFE-41
XC = provided (throughgoing shaft, flange and joint) to be coupled with PFE-51
See table A190 for codes of complete multiple pumps:
PFR +PFE = PFRX*E

3: Conventional 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:
omit for NBR (mineral oil & water glycol)
PE = FPM

2 OPERATING CHARACTERISTICS at 1450 rpm (based on mineral oil ISO VG 46 at 50°C)

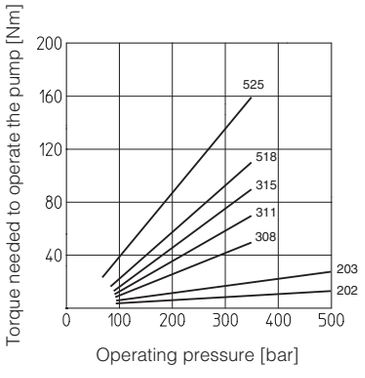
Model	Displacement cm³/rev	Max pressure bar	Speed range rpm	150 bar (3) l/min	150 bar (3) kW	250 bar (3) l/min	250 bar (3) kW	350 bar (3) l/min	350 bar (3) kW	500 bar (3) l/min	500 bar (3) kW
PFR-202	1,7	500 (1)	600-1800 (2)	2,4	0,7	2,4	1,1	2,4	1,6	2,4	2,1
PFR-203	3,5			5,0	1,4	5,0	2,2	4,9	3,0	4,9	4,2
PFR-308	8,2	350 (1)		11,8	3,2	11,5	5,6	11,5	7,5	-	-
PFR-311	11,4			16,5	4,5	16,4	7,8	16,2	10	-	-
PFR-315	14,7			21,3	6,3	21,3	10,0	20,9	12,5	-	-
PFR-518	18,1			26	7,7	25,8	12,3	25,6	15,2	-	-
PFR-525	25,4			36,5	11	36	17,3	35,5	21,6	-	-

(1) Max pressure is 250 bar for /PE versions; max pressure is 175 bar for water glycol fluid
(2) Max speed is 1000 rpm for /PE version and for water glycol fluid
(3) Flow rate and power consumption are proportional to rotation speed

3 MAIN CHARACTERISTICS OF FIXED DISPLACEMENT RADIAL PISTON PUMP TYPE PFR

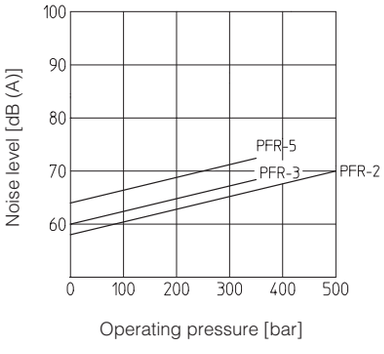
Installation position	Any position. If the pump is installed in vertical position, it is advisable to install on the outlet pipe a proper valve for air bleeding (consult our technical dept.). They are not self-priming therefore their installation under oil level is recommended. Installation above oil level requires foot valve on inlet line and pump central point located no more than 150 mm above minimum oil level. 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 10
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 and air bleed plugs unlocked. Pumps type PFR-3 and PFR-5 have 2 air bleeds, normally plugged, ports located near to the P ports. To help filling and air bleeding, it could be advisable to install a vertical pipe connected on the intake line, just before the inlet port flange.
Loads on the shaft	Axial and radial loads are not allowed on the shaft. The coupling should be sized to absorb the developed peak horsepower.
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity max at cold start max at full power during operation min at full power	 800 mm²/s 100 mm²/s 24 mm²/s 10 mm²/s
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 µm value with ß25 ≥ 75 recommended)
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (/PE seals)
Recommended pressure on inlet port	from -0,1 to 1,5 bar for speed up to 1800 rpm

4 TORQUE VERSUS PRESSURE DIAGRAM



5 NOISE LEVEL

Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics -Test procedure to define the ambient noise level - Pumps
Shaft speed: 1450 rpm. Mineral oil ISO VG 46 at 50°C.



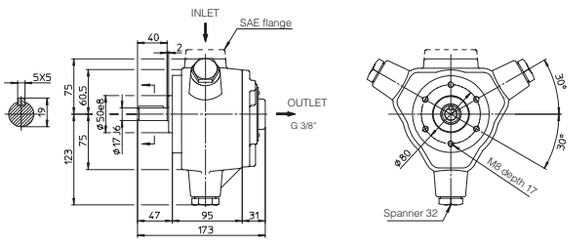
6 LIMIT OF SHAFT TORQUE

Pump model	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 for each type on the "torque versus pressure diagram" at section 4.
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.

7 DIMENSIONS OF SINGLE PUMPS [mm]

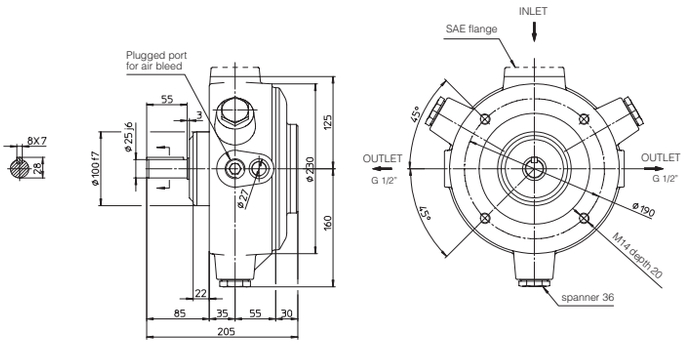
PFR-2



Note: PFR-206 have 5 pistons in the same size

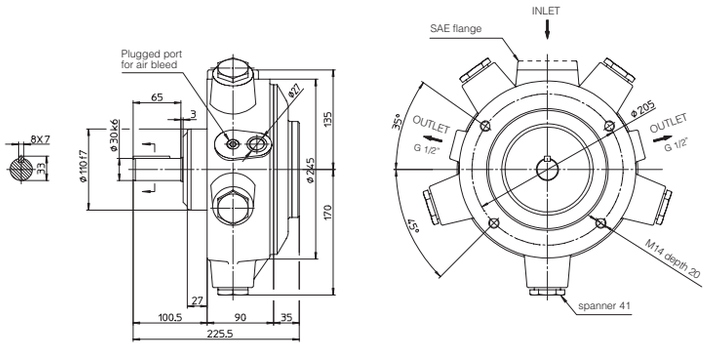
Mass: 12 Kg

PFR-3



Mass: 31 Kg

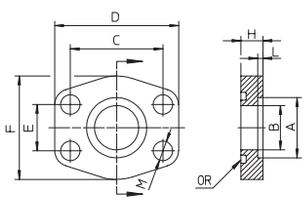
PFR-5



Model	Mass kg
PFR-518 PFR-525	38

(•) **SAE flanges are supplied with the pump**

8 SAE-3000 FLANGES supplied with the pump [mm]

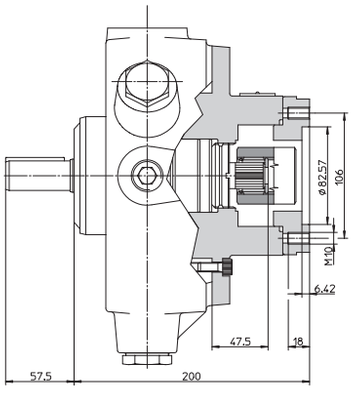


Flanges are supplied with seal and screws M10 class 12.9
Tightening torque = 70 Nm

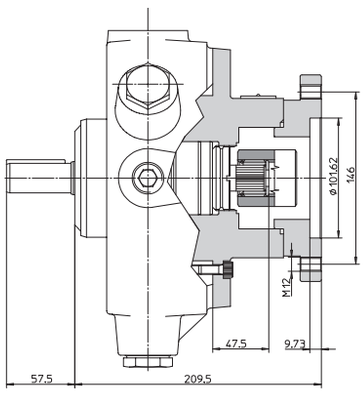
Pump model	Flange code	A	B	C	D	E	F	H	L	M	OR	Screws
PFR - 2	WFA-25	35,5	29	52,37	70	26,19	55	12	4	ø 11	4131	M10x30
PFR - 3 PFR - 5	WFA-32	42,5	34	58,72	79	30,18	68	12	4	ø 11,5	4150	M10x35

9 DIMENSIONS OF PUMPS PROVIDED TO BE COUPLED WITH VANE PUMPS [mm]

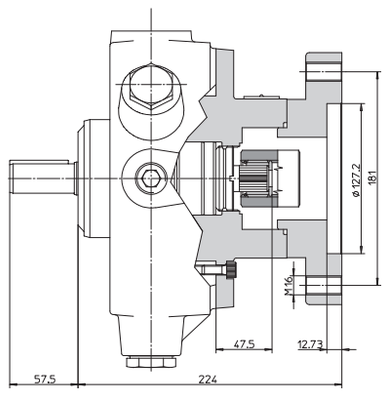
PFRXA-3



PFRXB-3



PFRXC-3



10 BALANCED COUPLING

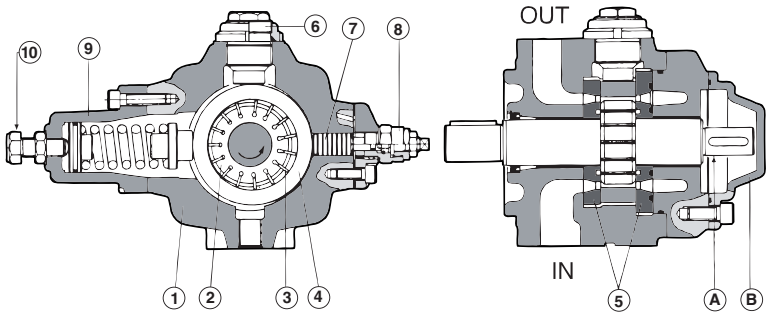
The balanced couplings permit to minimize the vibrations caused by the unbalanced mass during the pump rotation.
The couplings listed in the table, supplied by Atos, must be used together with the relevant bell housing (supplied by Scoda). The table lists the codes of the Atos balanced couplings and the Scoda 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	

Vane pumps type PVL

variable displacement with mechanical compensator

obsolete components - availability on request



PVL-4

① body
②③ rotor with vanes
④ swinging cam ring
⑤ lateral plates
⑥ sliding-shoe
⑦⑧ stroke limiter piston and screw for max displacement adjustment
⑨⑩ spring and screw for pressure compensator adjustment

PVL are variable displacement vane pumps equipped with mechanical compensator ⑩ for outlet pressure and max displacement adjustment ⑦, ⑧.
These low-noise pumps are available in 3 different size, have flange ports according to ISO 3019/2 and are designed to operate with anti-wear oil according to DIN 51524...535 and fire-resistant fluids with same lubricating characteristics.
Wide variety of displacements: from 6,8 up to 43 cm³/rev.
Max pressure up to 150 bar.

1 MODEL CODE

PVL	–	3	16	/	50	–	**

PVL: variable displacement vane pump

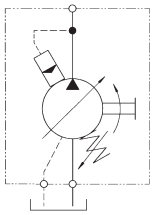
Conventional dimension:
2
3
4

Conventional displacement according to ISO 3662
06 (dimension **2**)
10 (dimension **2**)
16 (dimension **3**)
20 (dimension **3**)
40 (dimension **4**)

Pressure compensator calibration range:
– = 30 ÷ 100 bar
50 = 15 ÷ 50 bar
150 = 80 ÷ 150 bar (for PVL - 206 and PVL - 210 only)

******: Series number

Oleohydraulic symbol

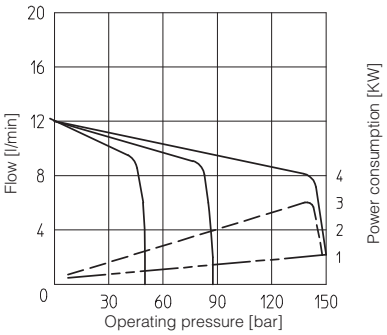


2 MAIN CHARACTERISTICS OF THE PVL VANE PUMP

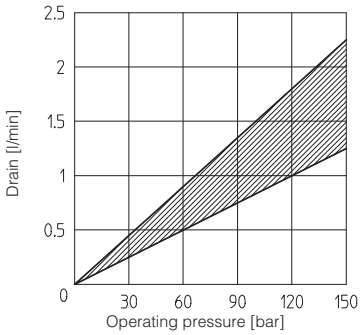
Modell		PVL-206	PVL-210	PVL-316	PVL-320	PVL-440
Max displacement	[cm³/rev]	6,8	11	18	22	43
Flow rate at 1450 rpm and 7 bar	[l/min]	9,6	15,4	25,2	31	60
Max operating pressure	[bar]	150	150	100	100	100
Max available torque on first shaft	[Nm]	110	110	197	197	400
Inlet port		G 3/4"	G 3/4"	G 1"	G 1"	flange 1"/2" SAE 3000
Outlet port		G 3/8"	G 3/8"	G 3/4"	G 3/4"	flange 1" SAE 3000
Drain port		G 1/4"	G 1/4"	G 3/8"	G 3/8"	1/2" GAS
Recommended pressure on inlet port	[bar]	-0,2 ÷ +0,5				
Max pressure at drain port	[bar]	1				
Min/max shaft speed	[rpm]	800/1800				
Direction of rotation		Clockwise rotation				
Loads on the shaft		Radial or axial loads on shaft not allowed				
Recommended viscosity		23÷45 mm²/s at 40°C (ISO VG22-46). For cold start-up and "0" pressure max: 400 mm²/s				
Fluid contamination class		ISO 19/16 (filters of 25 µm absolute and $\beta_{25} \geq 75$)				
Fluid temperature		+70°C				
Drain	[l/min]	from 1 to 4 - continuous -				
Installation position		Any				

3 DIAGRAMS

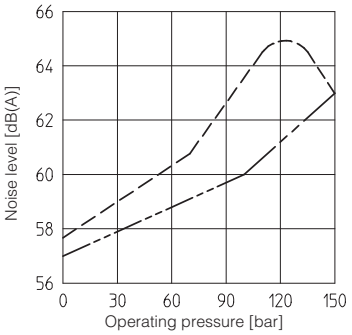
PVL - 206



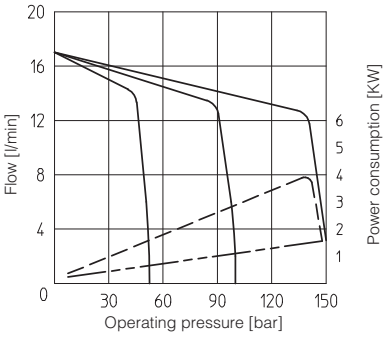
PVL - 206



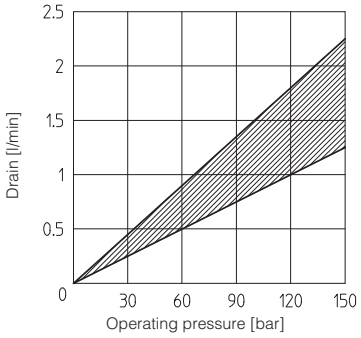
PVL - 206



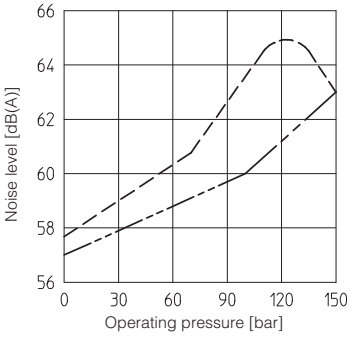
PVL - 210



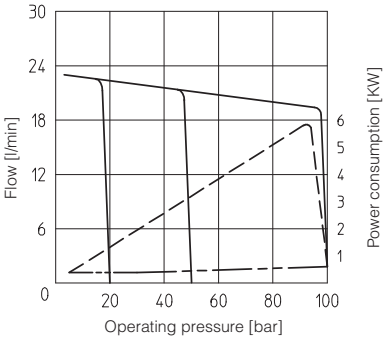
PVL - 210



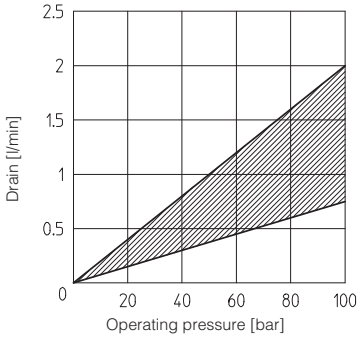
PVL - 210



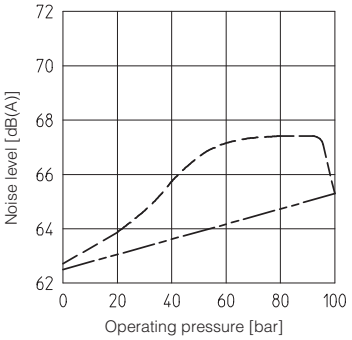
PVL - 316



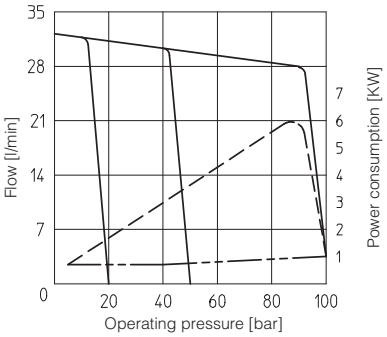
PVL - 316



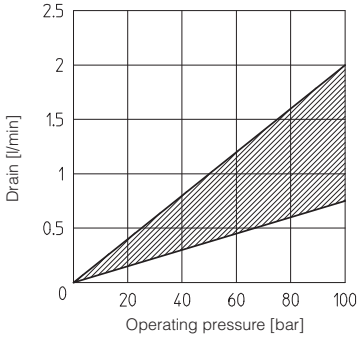
PVL - 316



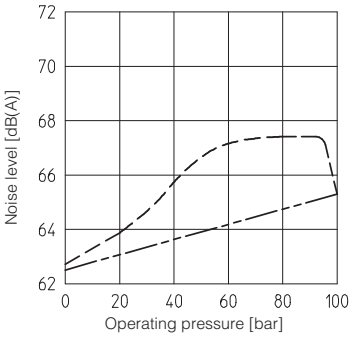
PVL - 320



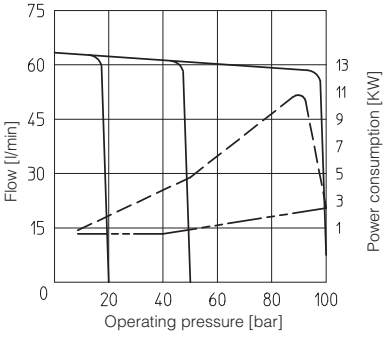
PVL - 320



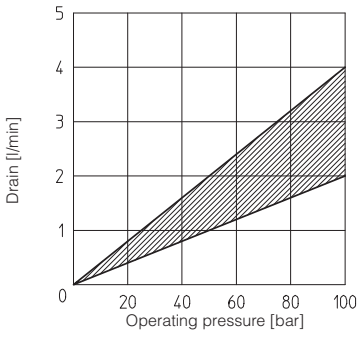
PVL - 320



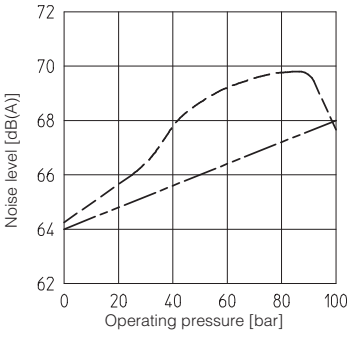
PVL - 440



PVL - 440



PVL - 440



Pressure versus flow diagram

Power consumption at max flow rate

Power consumption at null flow rate

Drain in pressure compensation

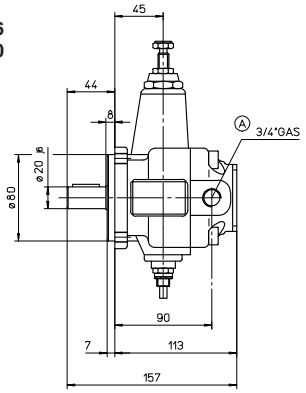
Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics -Test procedure to define the ambient noise level - Pumps

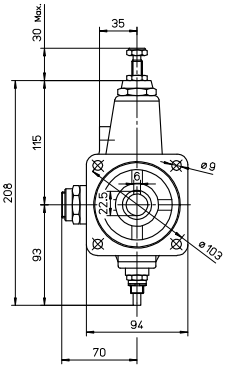
max. flow

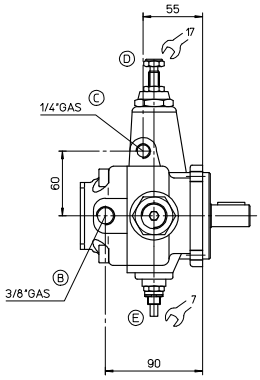
null flow

4 INSTALLATION DIMENSIONS [mm]

PVL-206
PVL-210

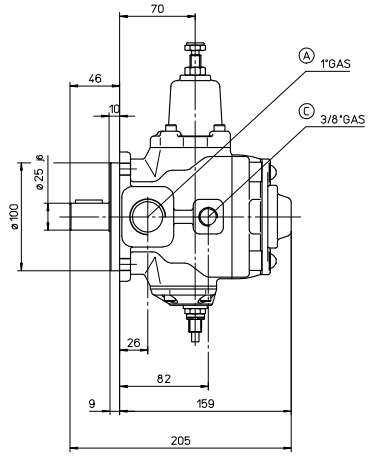


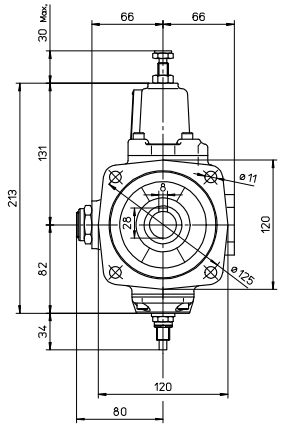


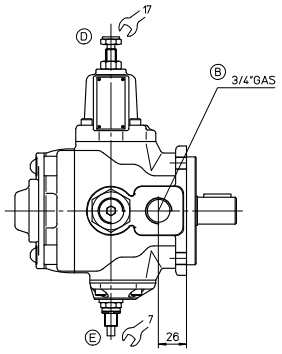


Mass: 6,5 kg

PVL-316
PVL-320

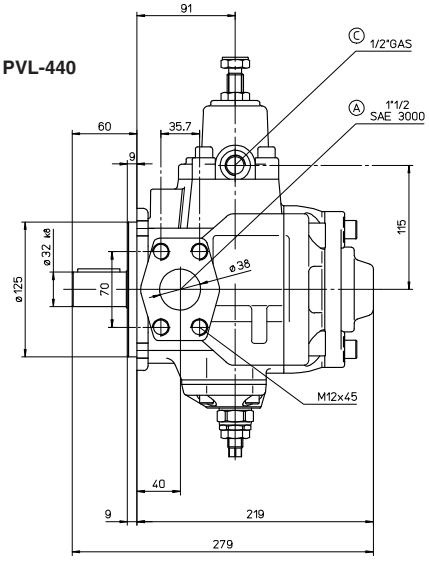


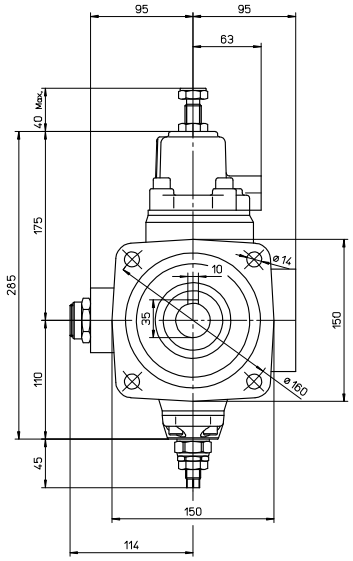


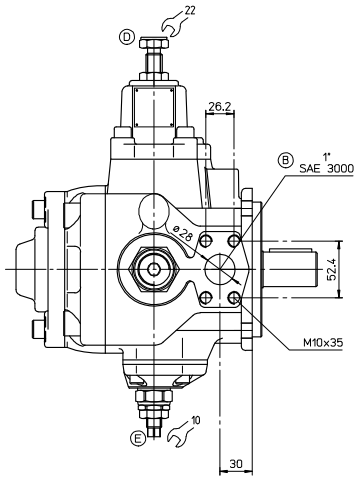


Mass: 12 kg

PVL-440







Mass: 32 kg

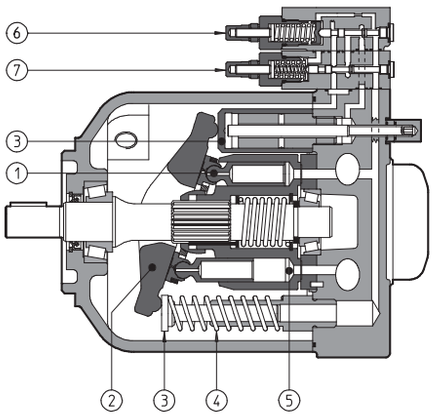
- (A) inlet port
- (B) outlet port
- (C) drain port
- (D) screw for pressure compensator adjustment
- (E) screw for max displacement adjustment

SAE flanges are available for inlet and outlet ports of pumps PVL-440, see www.scoda.it, tab. SK155.

bianca

Axial piston pumps type PVPC

variable displacement, by a full line of mechanical controls



PVPC-L-4046

PVPC are variable displacement axial piston pumps for high pressure operation, with low noise level, suitable for hydraulic oils or synthetic fluids having symilar lubricating characteristics.
The actual displacement is dependent on the lenght of stroke of the pumping pistons ①. This lenght of stroke is determined by the position of the swashing plate ② that is achieved by two servo pistons ③ with differential areas, against a spring ④.
The rotating barrel ⑤ forces the pistons in a circular path in and out of the barrel and fluid displacement takes place.
Typical section on side shows version L with manual pressure compensator ⑥ and flow regulation ⑦.
The available hydraulic controls are shown in sections [8]. The wide range of electrohydraulic proportional controls is shown in tab. A170.
SAE J744 mounting flange and shaft (see note 1).
Max displacement: 29-46-73-88 cm³/rev.
Max pressure: 280 bar working
350 bar peak.

1 MODEL CODE

PVPC X2E – C – 4 046 / 31044 / 1 D – X 24DC 10 /*

Variable displacement axial piston pump

Additional suffix for pumps with through shaft:
XA = intermediate flange SAE A
XB = intermediate flange SAE B
XC = intermediate flange SAE C (only for size 5)
Additional suffix for double pumps:
X2E = with a fixed displacement pump type PFE (see tab. A005)

Type of control (see section [8]):
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)
For electrohydraulic proportional controls, see table A170

Size:
3 = for displacement 029
4 = for displacement 046
5 = for displacement 073 and 090

Max displacement of axial piston pump **(1)**:
029 = 29 cm³/rev
046 = 46 cm³/rev
073 = 73 cm³/rev
090 = 88 cm³/rev

Type of PFE (for double pumps), see tab. A005

Shaft (SAE Standard) **(2)**:
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 (only for CH version)
See section [4] for available connectors, to be ordered separately

Supply voltage, see section [5] (only for CH version)

Series number

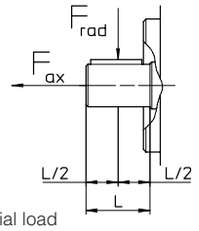
Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM
See notes in section [2]

1) optional intermediate displacements 35 and 53 cc/rev are available on request
2) pumps with ISO 3019/2 mounting flange and shaft (option /M) are available on request

2 OPERATING CHARACTERISTICS

Pump model		PVPC-*-3029	PVPC-*-4046	PVPC-*-5073	PVPC-*-5090
Displacement	[cm³/rev]	29	46	73	88
Theoretical max flow at 1450 rpm	[l/min]	42	66,7	105,8	127,6
Max working pressure / Peak pressure	[bar]	280/350	280/350	280/350	250/315
Min/Max inlet pressure	[bar abs.]	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
Power consumption at 1450 rpm and at maximum pressure and displacement	[kW]	19,9	31,6	50,1	54,1
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
Max permissible load on drive shaft	[N] F_{ax}	1000	1500	2000	2000
	F_{rad}	1500	1500	3000	3000
Speed rating	[rpm]	600 ÷ 3000	600 ÷ 2600	600 ÷ 2200	600 ÷ 1850

External load position



F_{ax} = axial load
F_{rad} = radial load

Notes: For speeds over 1800 rpm the inlet port must be under oil level with adequate pipes.
Maximum pressure for all models with water glycol fluid is 160 bar, with option /PE is 190 bar.
Max speed with options /PE and for water glycol fluid is 2000/1900/1600/1500 rpm respectively for the four sizes.

3 MAIN CHARACTERISTICS OF VARIABLE DISPLACEMENT AXIAL PISTON PUMP TYPE PVPC

Installation 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.
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/sec at 40°C (ISO VG 15÷100). Maximum start-up viscosity: 1000 mm²/sec
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 µm value with ß25 ≥ 75 recommended)
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (seals /PE)

3.1 Coils characteristics (for version CH)

Insulation class	H
Connector protection degree	IP 65
Relative duty factor	100%
Supply voltage and frequency	See electric feature 5
Supply voltage tolerance	± 10%

4 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 FOR VERSION CH

The connectors must be ordered separately

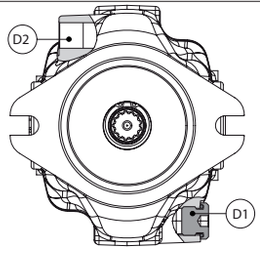
Code of connector	Function
SP-666	Connector IP-65, suitable for direct connection to electric supply source
SP-667	As SP-666 connector IP-65 but with built-in signal led, suitable for direct connection to electric supply source

5 ELECTRIC FEATURES FOR VERSION CH

External supply nominal voltage ±10%		Power consumption	Nominal courrent	Coil characteristics
DIRECT CURRENT	12 DC 24 DC	19,2 W	1,61 A 0,80 A	Insulation Class: **H** Protection degree: **IP65**
ALTERNATE CURRENT	24/50AC 110/50 AC 220/50 AC	19 W	0,89 A 0,19 A 0,09 A	

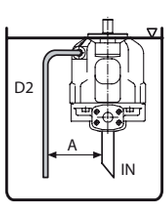
Average values based ambient/coil temperature of 20°C.

6 INSTALLATION POSITION



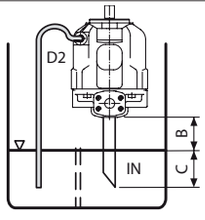
The pump is supplyed whit drain D2 open, and D1 plugged. Before installation fill the pump with hydraulic oil for at least 3/4 of its volume, keeping it in horizontal position. With exception of pump mounted below the oil level, we recomend to interpose a baffle plate between inlet and drain line.

VERTICAL INSTALLATION



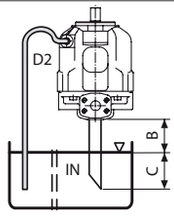
INSIDE THE TANK

Minimum oil level equal or above the pump mounting surface.
A ≥ 200mm



INSIDE THE TANK

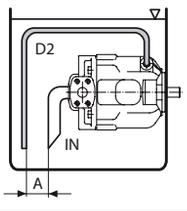
Minimum oil level below the pump mounting surface.
Minimum inlet pressure = 0,8 bar absolute
B ≤ 800mm, C= 200mm



OUTSIDE THE TANK, above oil level

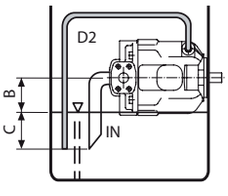
Minimum inlet pressure = 0,8 bar absolute
B ≤ 800mm, C= 200mm

HORIZONTAL INSTALLATION



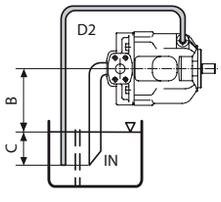
INSIDE THE TANK

Minimum oil level equal or above the pump mounting surface.
A ≥ 200mm



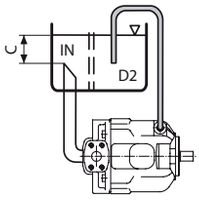
INSIDE THE TANK

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 - **D1:** drain line - **A:** minimum distance between inlet and drain line - **B+C:** permissible suction height - **C:** inlet line immersion dept

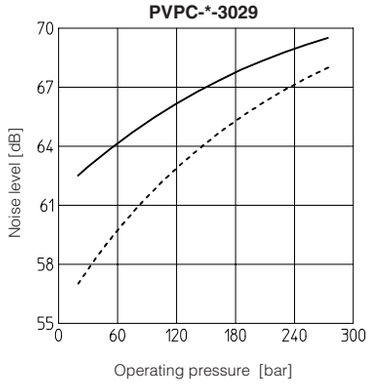
7 DIAGRAMS at 1450 rpm (based on mineral oil ISO VG 46 at 50°C)

7.1 Noise level curves

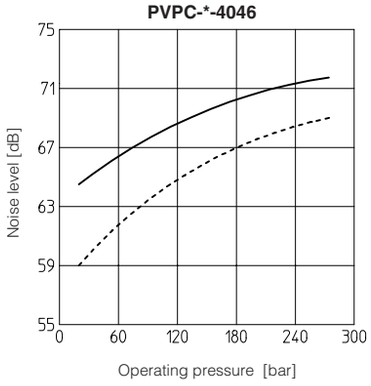
Ambient noise levels measured in compliance with ISO 4412-1 oleohydraulics -Test procedure to define the ambient noise level - Pumps
Shaft speed: 1450 rpm.

—— = Qmax ------ = Qmin

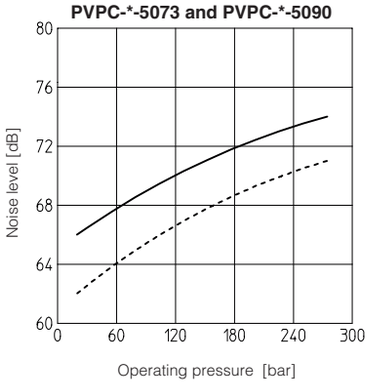
PVPC-*-3029



PVPC-*-4046



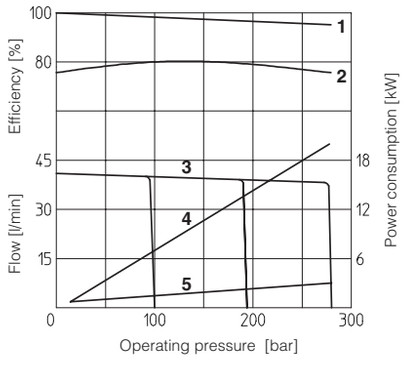
PVPC-*-5073 and PVPC-*-5090



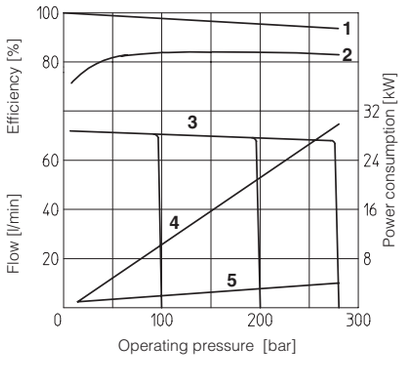
7.2 Operating limits

1 = Volumetric efficiency
2 = Overall efficiency
3 = Flow versus pressure curve
4 = Power consumption with full flow
5 = Power consumption at pressure compensation

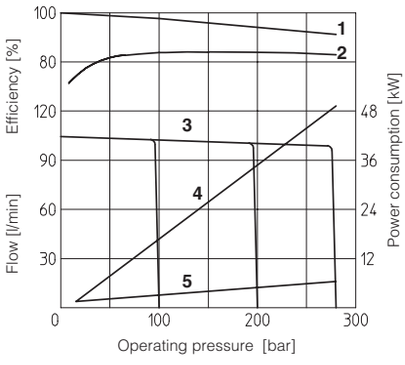
PVPC-*-3029



PVPC-*-4046



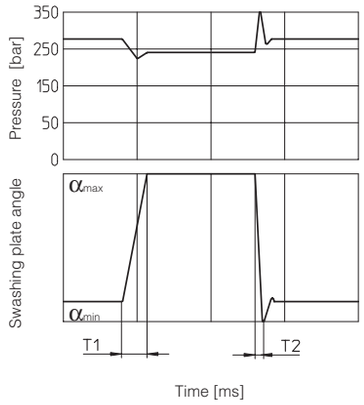
PVPC-*-5073



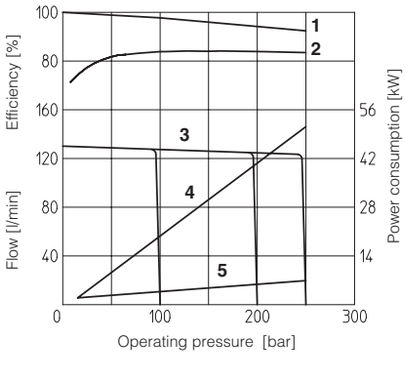
7.3 Response times

7.3.1 Response times and pressure peack due to variation 0% ∅ 100% ∅ 0% of the pump displacement, obtained with an istantaneously opening and shut-off of the delivery line.

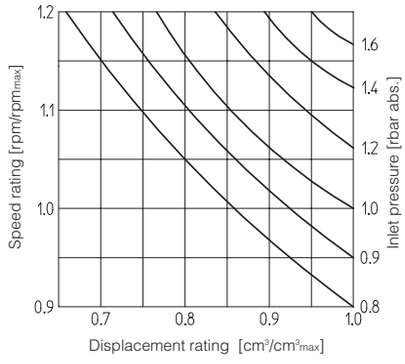
Pump type	**T1** (ms)	**T2** (ms)
PVPC-*-3029	31	19
PVPC-*-4046	44	20
PVPC-*-5073	50	25
PVPC-*-5090	53	28

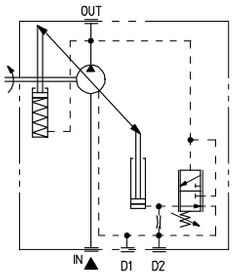


PVPC-*-5090



7.3.2 Variation of inlet pressure and reduction of displacement with increasing speed rating

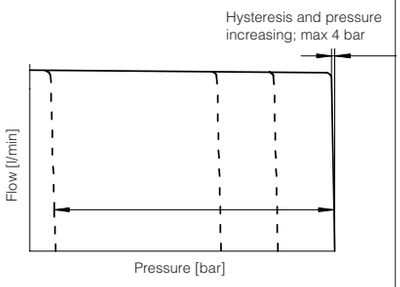


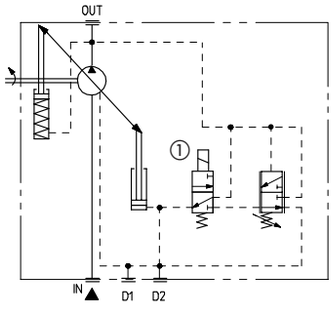


C

Manual pressure compensator

The pump displacement decreases when the line pressure approaches the setting pressure of the compensator. The pump supplies only the fluid required by the system. Pressure may be steplessly adjusted at the pilot valve.
Compensator setting range: 20 ÷ 350 bar (315 bar for 090)
Compensator standard setting: 280 bar (250 bar for 090)



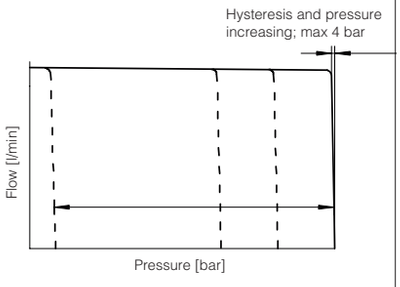


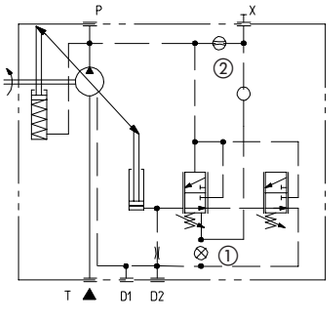
① solenoid venting valve

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 5
Venting valve OFF = null displacement
Venting valve ON = max displacement
Compensator setting range: 20 ÷ 350 bar (315 bar for 090)
Compensator standard setting: 280 bar (250 bar for 090)

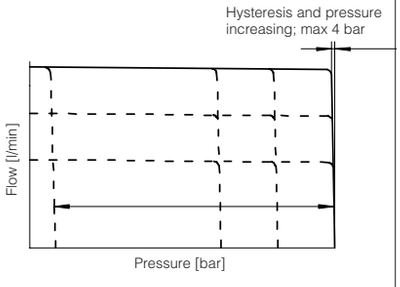


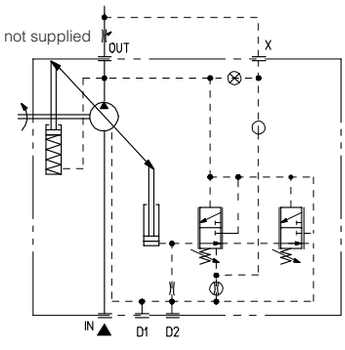


R

Remote pressure compensator

As C, but with remote setting of the compensator by means of a pressure relief valve on the piloting line X.
This version can be obtained from version L using a blind plug UNI 5923 M4x12 in pos. ① and a restrictor M4 drilled ø 0,75 mm in pos. ②.
Compensator setting range: 20 ÷ 350 bar (315 bar for 090)
Compensator standard setting: 280 bar (250 bar for 090)

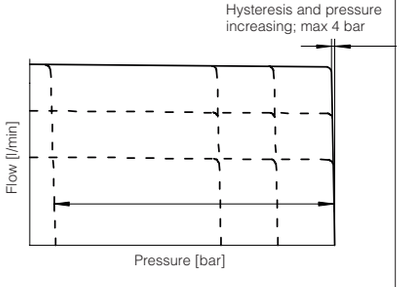


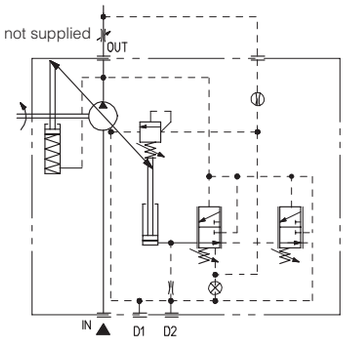


L

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 ÷ 350 bar (315 bar for 090)
Compensator standard setting: 280 bar (250 bar for 090)
Differential pressure setting range: 10 ÷ 40 bar
Differential pressure standard setting: 14 bar

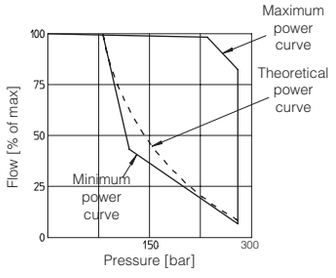




LW

Constant power

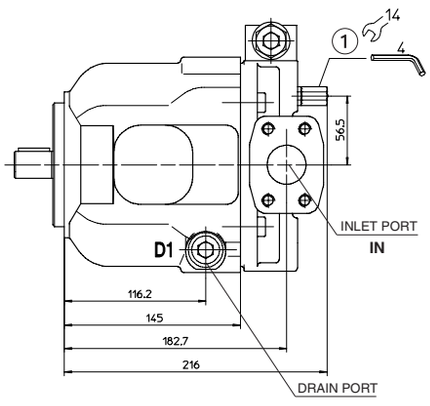
In order to achieve a constant drive torque with varying operating pressure. The swashing angle and therefore the outlet flow is varied so that the product of flow and pressure remains constant.
For the best regulation, minimum working pressure is 80 bar.
While selecting LW control, the required value of power must be communicated with the order (ex. 10 kW at 1450 rpm).

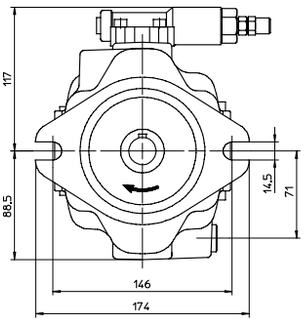


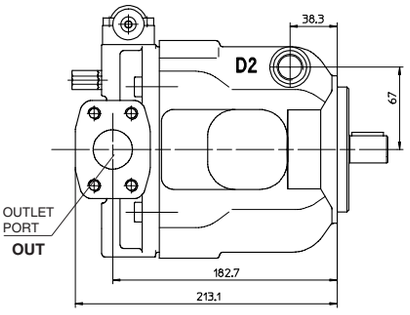
9 DIMENSIONS OF PVPC-*-3029: BASIC VERSION “C” CONTROL

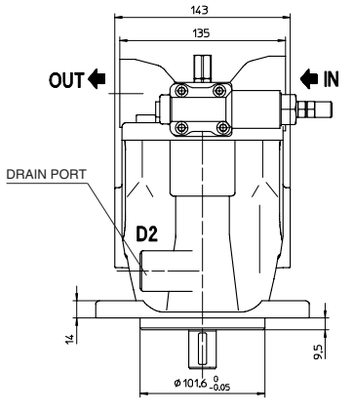
PORTS DIMENSION

IN = Flange SAE 3000 1 1/4”
OUT = Flange SAE 6000 3/4”
D1, D2 = 1/2” BSPP
① = Regulation screw for max displacement 1,5 cm³/rev per turn. 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.



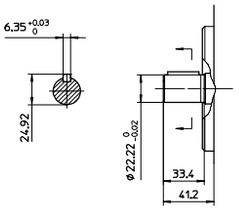




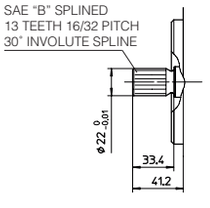


Mass: 18 kg

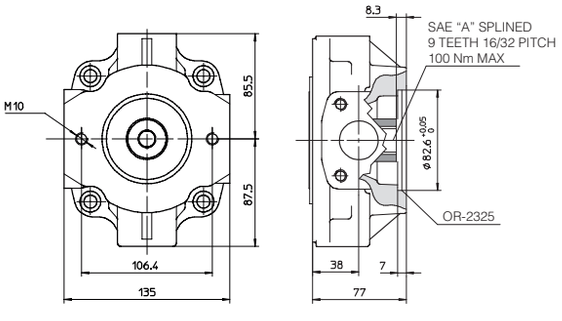
SHAFT TYPE “1”



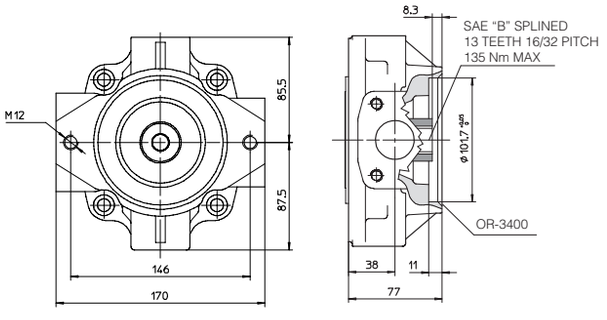
SHAFT TYPE “5”



INTERMEDIATE FLANGE SAE “A” FOR PFE-31



INTERMEDIATE FLANGE SAE “B” FOR PFE-41

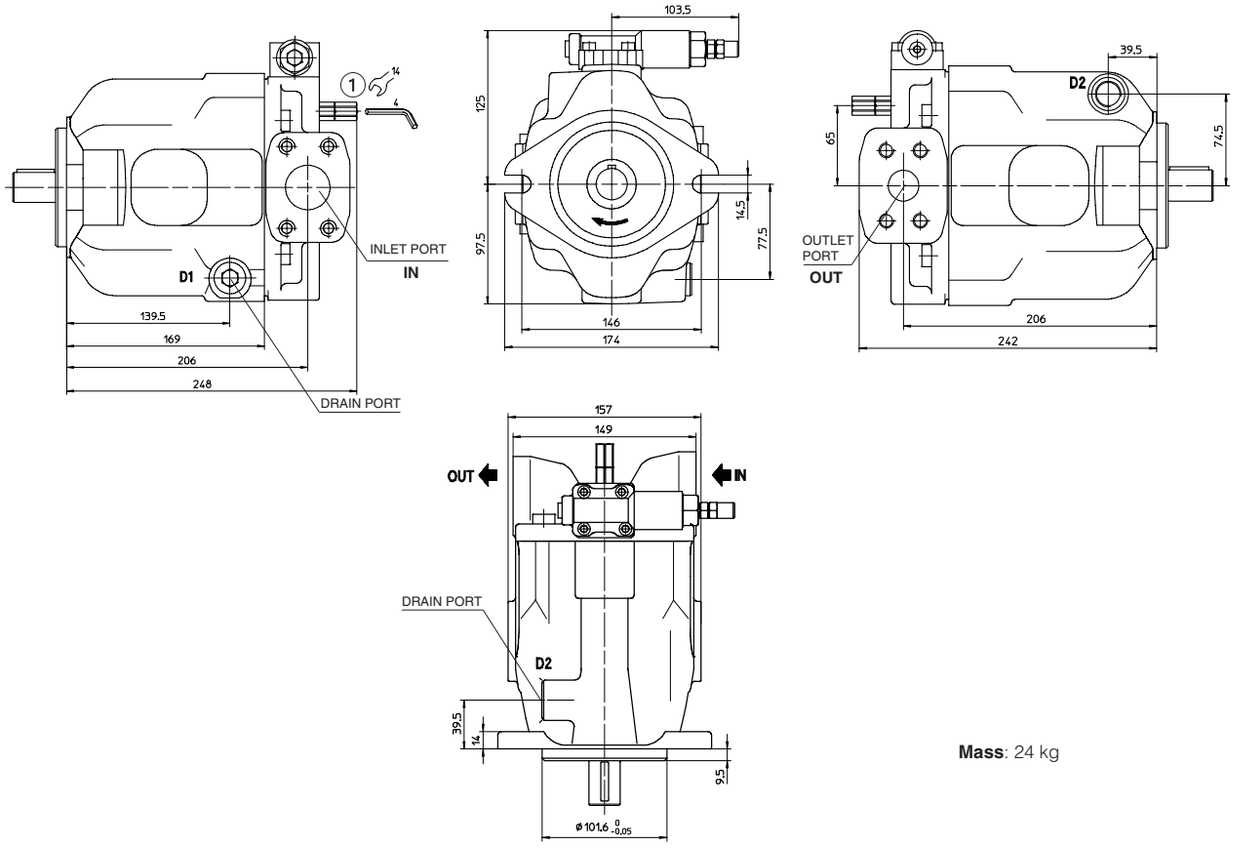


Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted

10 DIMENSIONS OF PVPC-*-4046: BASIC VERSION “C” CONTROL

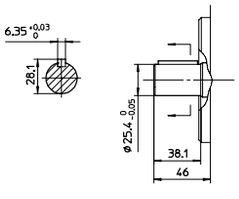
PORTS DIMENSION

IN = Flange SAE 3000 1 1/2”
OUT = Flange SAE 6000 1”
D1, D2 = 1/2” BSPP
① = Regulation screw for max displacement 2,2 cm³/rev per turn. 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.

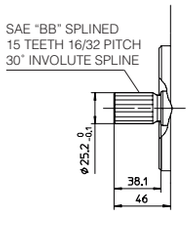


Mass: 24 kg

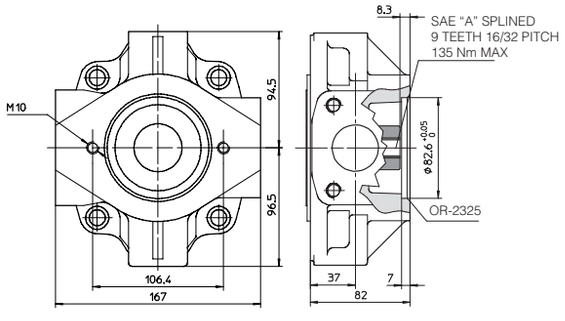
SHAFT TYPE “1”



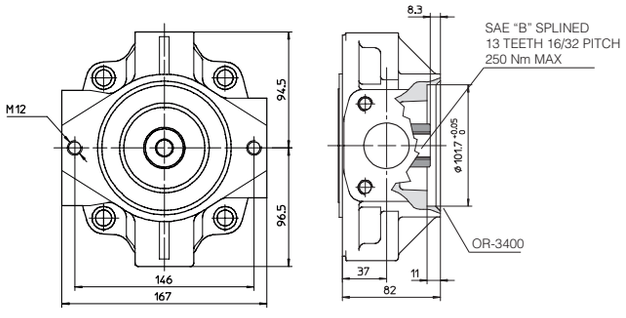
SHAFT TYPE “5”



INTERMEDIATE FLANGE SAE “A” FOR PFE-31

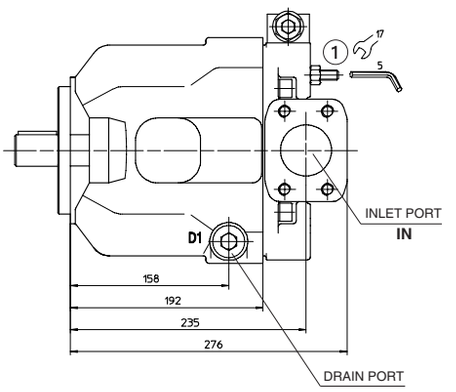


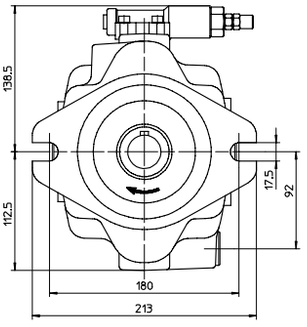
INTERMEDIATE FLANGE SAE “B” FOR PFE-41

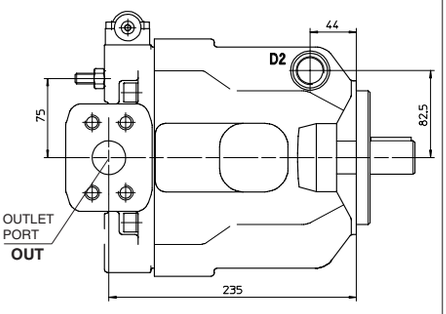


Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted

11 DIMENSIONS OF PVPC-*-5073 and PVPC-*-5090: BASIC VERSION "C" CONTROL

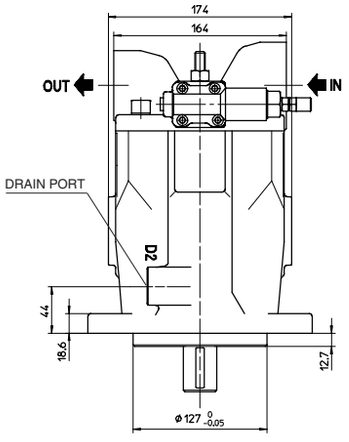






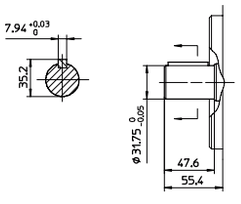
PORTS DIMENSION

IN = Flange SAE 3000 2"
OUT = Flange SAE 6000 1 1/4"
D1, D2 = 3/4" BSPP
① = Regulation screw for max displacement 3,2 cm³/rev per turn.
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.

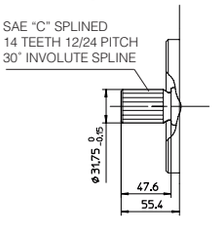


Mass: 33 kg

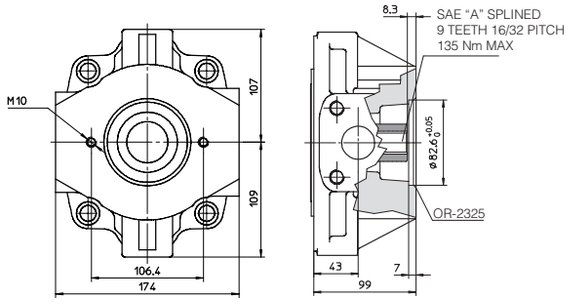
SHAFT TYPE "1"



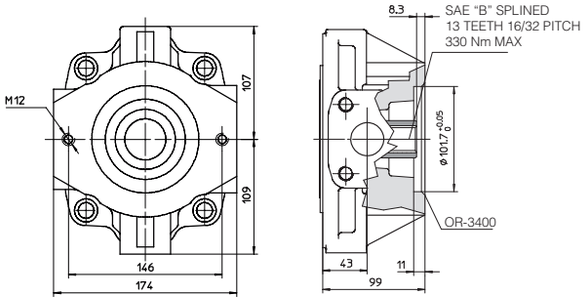
SHAFT TYPE "5"



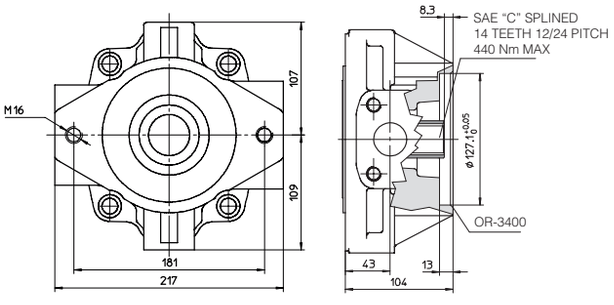
INTERMEDIATE FLANGE SAE "A" FOR PFE-31



INTERMEDIATE FLANGE SAE "B" FOR PFE-41



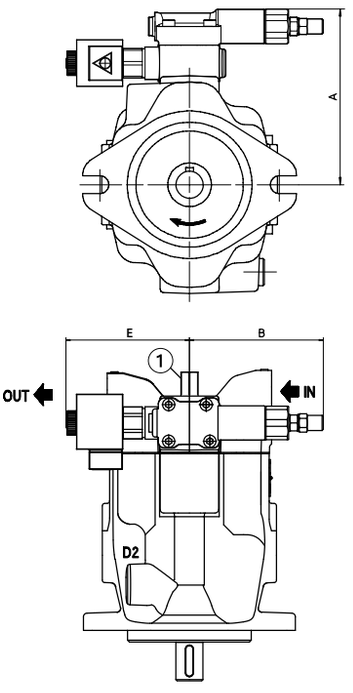
INTERMEDIATE FLANGE SAE "C" FOR PFE-51



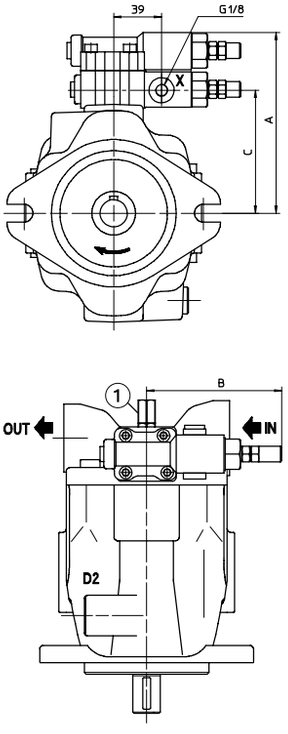
Drawing show pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted

12 DIMENSIONS OF PVPC: OTHER CONTROLS

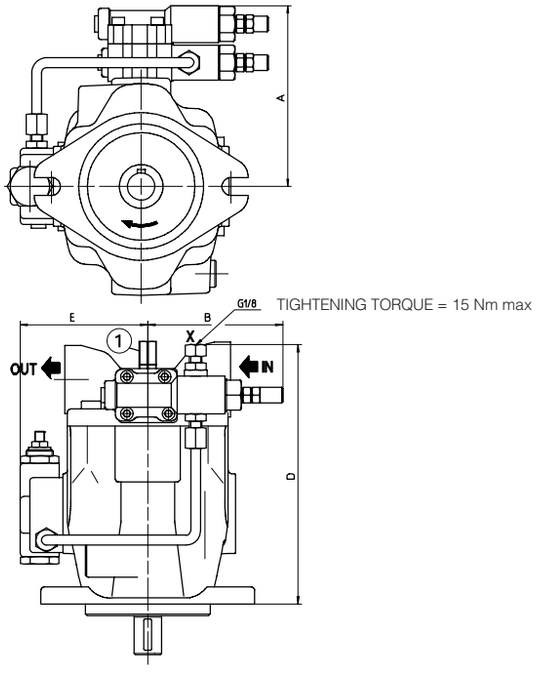
VERSION CH



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.

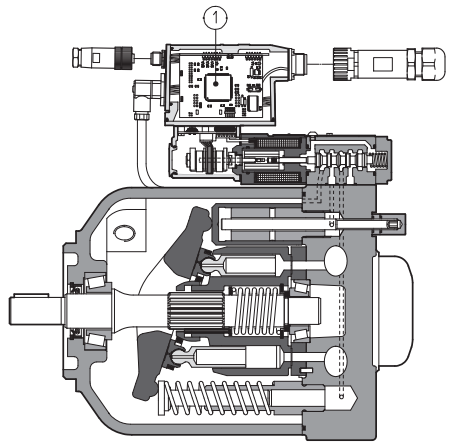
Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and also the consequently position of the control groups

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

Proportional electrohydraulic controls for PVPC pumps

pressure-flow alternate P/Q controls, analog or digital

obsolete components - availability on request



PVPC-PES-PS-4046

The variable displacement axial piston pumps type PVPC, can be supplied with advanced electrohydraulic proportional controls:

- open loop pressure control;
- load sensing flow control;
- Open and closed loop P/Q controls;

They allow to perform high dynamics and fine regulations, directly commanded from PLC or from the machine controller. They are available with separated driver or with integral electronics ①.

New PES digital controllers, integrated to the pump, realize alternate closed loop controls of pressure, flow and max power limitation. The P/Q controls are also available with optional sequence module (LZQZR or PERS versions) that allow to operate the pump with minimum pressure in the circuit close to zero. Following communication interfaces are available for the digital PE(R)S execution, see section [9]:

- **-PS**: Serial
- **-BC**: CANopen
- **-BP**: PROFIBUS DP

For technical characteristics and features of the PVPC pumps, see table A160.

1 MODEL CODE

PVPC X2E - PERS - BC - 4 046 /31044 / * /1 D / * 10 /*

Variable displacement axial piston pump

Additional suffix for double pumps
X2E = with a fixed displacement pump type PFE (see tab. A005)

Type of control (see section [7] and [8]):
CZ = proportional pressure compensator
LQZ = proportional flow control (load sensing)
LZQZ = proportional pressure & flow control (load sensing)
LZQZR = as LZQZ plus sequence module
PES = closed loop integral digital P/Q controller
PERS = as PES plus sequence module

Communication interface, only for PES and PERS versions
PS = Serial **BP** = PROFIBUS DP **BC** = CANopen

Size:
3 = for displacement 029 **4** = for displacement 046 **5** = for displacement 073 and 090

Max displacement:
029 = 29 cm³/rev **046** = 46 cm³/rev **073** = 73 cm³/rev **090** = 88 cm³/rev

Type of PFE (for double pumps), see tab. A005

Pressure setting (only for PERS): **200** = 200 bar **250** = 250 bar **280** = 280 bar

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM
See notes in section [2]

Series number

Options, for CZ, LQZ, LZQZ, LZQZR see sections [3]:
18 = optional coil for low current drivers
Electronics options for PES and PE(R)S see sections [4] and [7]:
I = current reference input and monitor output signals (4 ÷ 20 mA)
C = current feedback input signal (4÷20 mA) for remote pressure transducer
X = with integral pressure transducer (only for PERS)
S = with two on-off inputs for multiple pressure PID selection (PS execution) or double power supply (BC and BP execution)

Direction of rotation (viewed at the shaft end)
D = clockwise **S** = counterclockwise

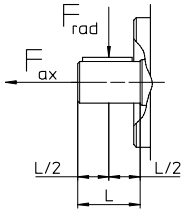
Shaft (SAE Standard):
1 = keyed (7/8" for 029 - 1" for 046 - 1 1/4" for 073 and 090)
5 = splined (13 teeth for 029 - 15 for 046 - 14 for 073 and 090)

1) pumps with ISO 3019/2 mounting flange and shaft (option /M) are available on request

2 OPERATING CHARACTERISTICS

Pump model		PVPC-*-3029	PVPC-*-4046	PVPC-*-5073	PVPC-*-5090
Displacement	[cm³/rev]	29	46	73	88
Theorical max flow at 1450 rpm	[l/min]	42	66,7	105,8	127,6
Max working pressure / Peak pressure	[bar]	280/350	280/350	280/350	250/315
Min/Max inlet pressure	[bar abs.]	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
Power consumption at 1450 rpm and at maximum pressure and displacement	[kW]	19,9	31,6	50,1	54,1
Max torque on the first shaft	[Nm]	Type 1 200 / Type 5 190	Type 1 230 / Type 5 330	Type 1 490 / Type 5 620	Type 1 490 / Type 5 620
Max permissible load on drive shaft	[N] F_{ax}	1000	1500	2000	2000
	[N] F_{rad}	1500	1500	3000	3000
Speed rating	[rpm]	600 ÷ 3000	600 ÷ 2600	600 ÷ 2200	600 ÷ 1850

External load position



F_{ax} = axial load
F_{rad} = radial load

Notes: For speeds over 1800 rpm the inlet port must be under oil level with adequate pipes.
Maximum pressure for all models with water glycol fluid is 160 bar, with option /PE is 190 bar.
Max speed with options /PE and water glycol fluid is 2000/1900/1600/1500 rpm respectively for the four sizes.

3 MAIN CHARACTERISTICS OF VARIABLE DISPLACEMENT AXIAL PISTON PUMP TYPE PVPC

Installation 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.
Ambient temperature	from -20°C to +70°C for versions with separated electronics / from -20°C to + 60°C for versions PES/PERS
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity	15÷100 mm²/sec at 40°C (ISO VG 15÷100). Maximum start-up viscosity: 1000 mm²/sec
Fluid contamination class	ISO 4401 class 20/18/15 NAS 1638 class 9 (filters at 10 µm value with $\beta_{10} \geq 75$ recommended)
Fluid temperature	-20°C +70°C -20°C +50°C (water glycol) -20°C +80°C (seals /PE)
Power supply for pressure transducer (PES, PERS)	24 VDC

3.1 Coils characteristics - only for CZ, LQZ, LZQZ(R) executions

Coil resistance R at 20°C	Pump size 3	**3 ÷ 3,3** Ω for standard **12 VDC** coil; **13 ÷ 13,4** Ω for **18 VDC** coil (only for version CZ, LQZ, LZQZ*)
	Pump sizes 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, LZQZ*)
Max solenoid current		**2,6 A** for standard **12** VDC coil; **1,5 A** for **18** VDC coil (available only for version CZ, LQZ, LZQZ*)
Max power		35 Watt
Protection degree (CEI EN-60529)		IP65 for -CZ, LQZ and LZQZ; IP65÷67 for versions with integral electronics (see section 17)
Duty factor		Continuous rating (ED = 100%)

4 ELECTRONIC DRIVERS

Pump model	CZ, LQZ, LZQZ(R)						PES, PERS
Drivers model	E-MI-AC-01F	E-MI-AS-IR	E-BM-AC	E-BM-AS-PS	E-ME-AC	E-RP-AC	E-RI-PES
Data sheet	G010	G020	G025	G030	G035	G100	G215

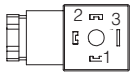
Note: for power supply and communication connector see section 11

5 GENERAL NOTES

Atos proportional pumps are CE marked according to the applicable directives (e.g. Immunity/Emission EMC Directive and Low Voltage Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in table F003 and in the user manuals included in the E-SW programming software.
The electrical signals of the pump (e.g. 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, EN-892)

6 CONNECTIONS FOR CZ, LQZ, AND LZQZ(R)

SOLENOID POWER SUPPLY CONNECTOR	
PIN	Signal description
1	SUPPLY
2	SUPPLY
3	GND



7 PRESSURE TRANSDUCER SELECTION (excluded option /X)

The pressure transducer type E-ATR-7 must be ordered separately (see table G465)
For option X the pressure transducer is integral to the pump.

Pump code:	Pressure transducer code:
PVPC-PER(S)-*/200	E-ATR-7/250
PVPC-PER(S)-*/250	E-ATR-7/400
PVPC-PER(S)-*/280	E-ATR-7/400
PVPC-PER(S)-*/200/*/C	E-ATR-7/250/I
PVPC-PER(S)-*/250/*/C	E-ATR-7/400/I
PVPC-PER(S)-*/280/*/C	E-ATR-7/400/I

8 ELECTRONICS OPTIONS FOR PES AND PERS

Standard execution provides on the 12 pin main connector:

Power supply -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.
A safety fuse is required in series to each driver power supply: 2,5 A fuse

Reference input signals -The driver controls in closed loop both the pump flow and pressure proportionally to the external reference input signals.
The driver is designed to receive two analog reference input signals both referred to the common mode signal zero (AGND).
The inputs range and polarity are software selectable within the ±10 VDC maximum range; default settings are 0 ÷ +10 VDC.
Driver with fieldbus interface (-BC or -BP) can be software set to receive reference values directly by the machine control unit (fieldbus master); in this case the analog reference input signals can be used for start-up and maintenance operations.

Monitor output signals -The driver generates an analog output signals proportional to the actual pump swashplate position and to the actual pressure on the pump outlet line; the monitor output signals can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference, pilot spool position).
The output polarity is software selectable within ±10 VDC maximum range; default settings are 0 ÷ +10 VDC.

Fault Output Signal -Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 ÷ 20mA input, pressure/swashplate/pilot transducer cable broken, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC (pin 11 referred to pin2). Fault status is not affected by the status of the Enable input signal

Enable Input Signal (only for /S and /SX options) -To enable the driver, supply a +24VDC on pin 3 referred to pin 2: when the Enable signal is set to zero the pump functioning is disabled but the driver current output stage is still active. This condition does not comply with European Norms EN954-1.

For other functions, see table G215.

Following options are available to standard execution to special application requirements.

8.1 Option /I

It provides 4÷20 mA current reference and monitor signals instead of the standard 0÷+10 VDC.
It is normally used in case of long distance between the machine control unit and the pump or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

8.2 Option /C

The pump electronics is set to receive 4÷20 mA feedback signal from the remote pressure transducer, instead of the standard 0÷10 V.

8.3 Option /X (only for -PERS)

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.

8.4 Option /S

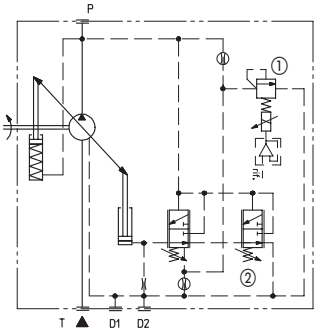
Multiple pressure PID selection (only for /S and /SX options in -PS execution)
Two on-off input signals are available on the main connector to switch the active pressure PID parameters among one of the four setting stored into the driver.
Supply a 24V or a 0V on pin 9 and/or 10, to select one of the PID settings as indicated in the table beside.

PID SET SELECTION				
PIN	SET 1	SET 2	SET 3	SET 4
9	0	0	24 VDC	24 VDC
10	0	24 VDC	24 VDC	0

Logic power supply (only for /S and /SX options in -BC or /BP execution)
Separate power supply for the solenoid (pin 1,2) and for the digital electronic circuits (pin 9,10).
Cutting solenoid power supply allows to interrupt the valve functioning but keeping energized the digital electronics thus avoiding fault conditions of the machine fieldbus controller (e.g. for emergency, as provided by the European Norms EN954-1 for components with safety class 2).
Note: pin 2 and 10 (zero Volt) are connected together inside the electronics;

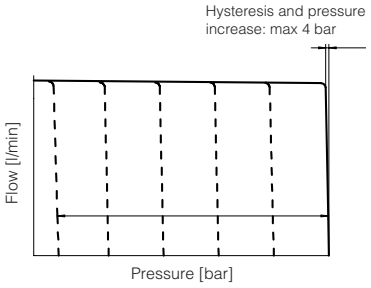
8.5 Possible combined options: /CS, /SX, /IC, /IS, /IX, /ICS and /ISX.

CZ

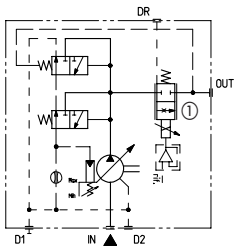


Proportional pressure compensator

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)

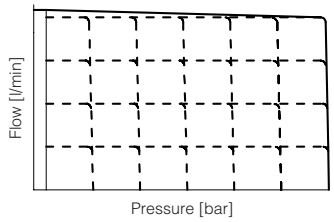


LQZ

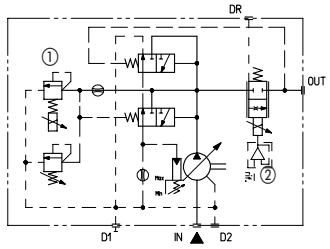


Proportional flow (load-sensing)

Open loop control of the flow rate via an reference signal to the electronic driver of the pilot proportional valve.
This energy saving control regulates the outlet pressure up to the minimum level required to operate the flow set by the reference signal to the proportional valve ①.

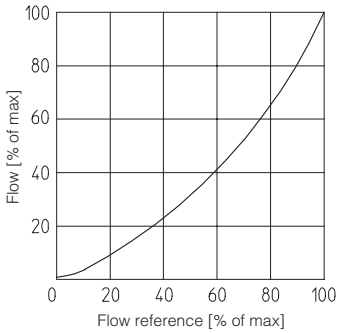


LZQZ

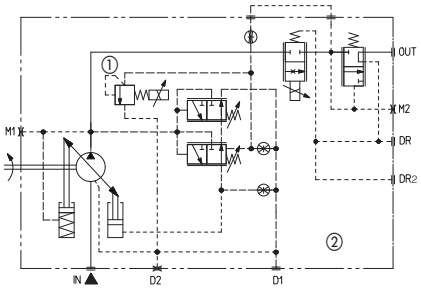


Proportional pressure & flow (load sensing)

Open loop control of pressure ① and flow ② via two reference signals to the electronic drivers of the two pilot proportional valves.
This energy saving control regulates the outlet pressure up to the minimum level required to operate the flow set by the reference signal.
In addition the proportional pressure control reduces the outlet flow, as per CZ control once max pressure is reached.
Minimum regulated pressure: 15 bar
For lower minimum regulated pressure, consult our technical office.
Maximum allowed pressure: 250 bar

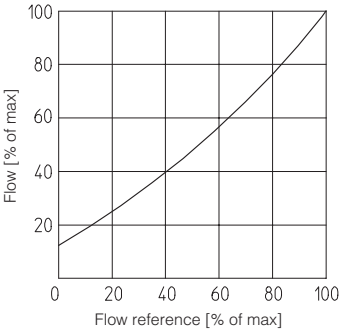


LZQZR



Flow and pressure proportional control with sequence module.
Same construction concept of LZQZ control, in addition it is equipped with RES ② sequence module which ensures the minimum pump piloting pressure in case the system pressure drops below the minimum value (18 bar).

Note: DR2 is available only for size 50.

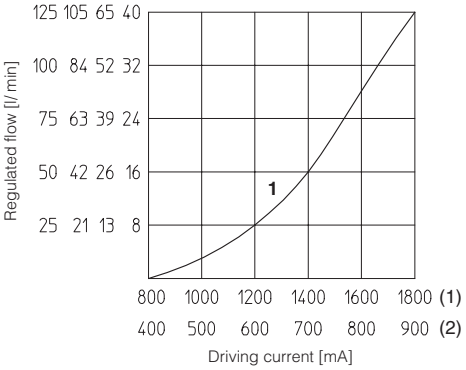


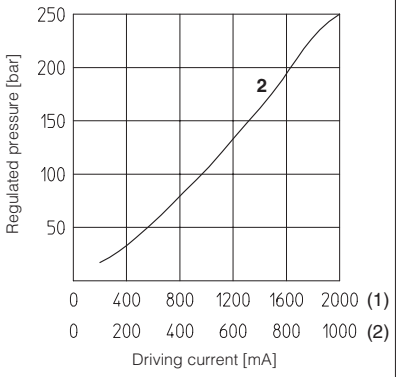
Diagrams for CZ, LQZ, LZQZ, LZQZR

Regulation diagrams
1 = Flow control
2 = Pressure control

(1) for standard 12 VDC coil
(2) for 18 VDC coil

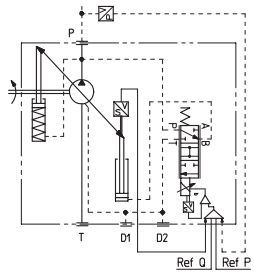
Pump size
88 73 46 29 cm³/rev



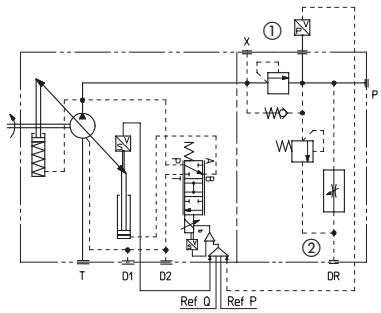


10 P/Q DIGITAL CONTROLLER

Pressure transducer not included



Pressure transducer included only for PERS/X



Digital P/Q controller 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 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 communication interfaces are available:

- -PS, Serial communication interface. The pump reference signals are provided with analog commands via the 12 pins connector
- -BC, CANopen interface
- -BP, PROFIBUS DP interface

The pumps with -BC or -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

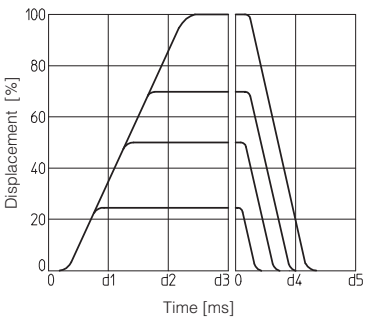
The digital control ensures high performances as flow and pressure linearity (see diagram 1), better flow knee (see diagram 2), internal leakage compensation (controlled flow independent to the load variations).

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 integral digital electronics.

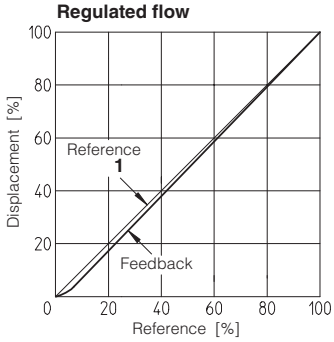
PVPC-PERS version with sequence module RES ② which grant a minimum piloting pressure (18 bar) when the actual pressure falls below that value. Without pressure transducer.

PVPC-PERSX as -PERS version plus integral pressure transducer, with output signal 4÷20 mA, factory wired to the pump digital electronics through a cable gland.

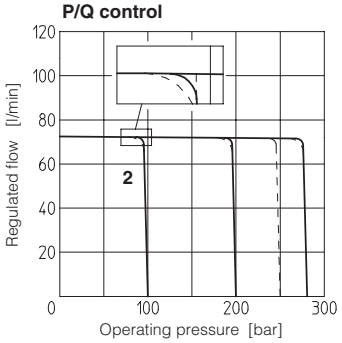
Response time



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

Response time of displacement variation for a step change of the electronic reference signal.

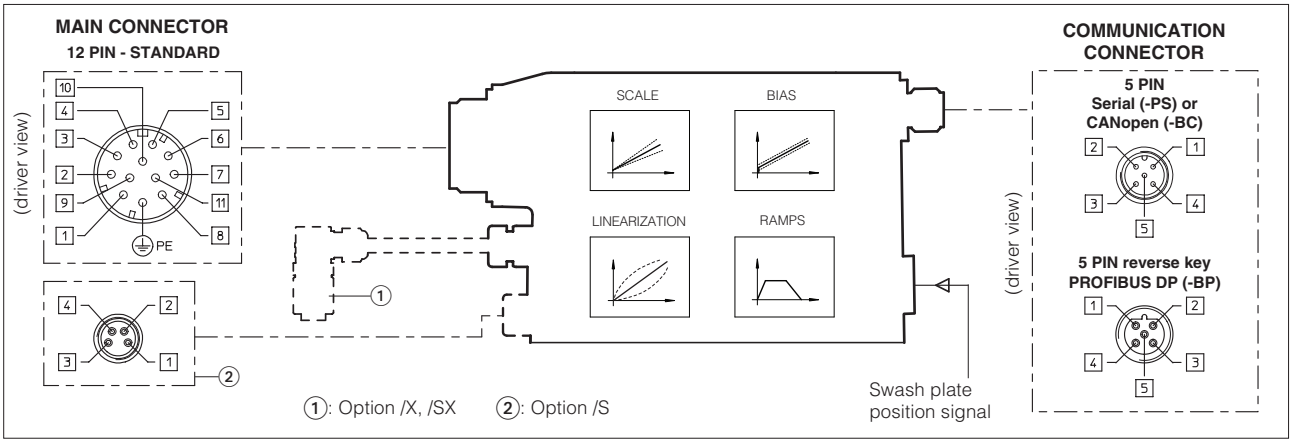
11 SOFTWARE TOOLS

The functional parameters of the digital valves, as the bias, scale, ramp and linearization of the regulation characteristic, can be easily set and optimized with graphic interface by using the Atos E-SW/S software and the relevant USB adapters, cable and terminators, **see tab. G500.**

Valves with fieldbus communication interface (-BC and -BP) can be completely managed by the machine control unit; it is required to implement in the machine control the standard communication as described in the user manuals supplied with the relevant programming software.

For detailed description of availabile fieldbus features, **see tab. G510**

12 DIGITAL INTEGRAL DRIVERS -PE(R)S MAIN FUNCTION AND ELECTRONICS CONNECTIONS



13 **ELECTRONIC CONNECTIONS - Standard, Standard with /X and /C options**

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	V+	Power supply 24 VDC for pilot valve's solenoid power stage	Input - power supply
2	V0	Power supply 0 VDC for pilot valve's solenoid power stage	Gnd - power supply
3	FAULT	Driver status: Fault (0VDC) or normal working (24 VDC)	Output - on/off signal
4	AGND	Ground: signal zero for MONITOR signals (pin 6,8) and INPUT+ signals (pin 5,7)	Gnd - analog signal
5	Q_INPUT+	Flow reference: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Input - analog signal
6	Q_MONITOR	Flow monitor: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Output - analog signal
7	P_INPUT+	Pressure reference: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Input - analog signal
8	P_MONITOR	Pressure monitor: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Output - analog signal
9	D_IN	Power limitation enable, multiple pressure PID selection or driver enable (software selectable)	Input - on/off signal
PE	EARTH	Internally connected to driver housing	
Standard with /X option			
10	NC	Do not connect for pumps with integral pressure transducer	
11	NC		
Standard and /C option			
10	TR+	Remote pressure transducer feedback: 0 ÷ 10 VDC maximum range (4 ÷ 20 mA) Input differential TR+ and TR-	Input - analog signal
11	TR-		

Note: A minimum time of 270 to 590 ms have be considered between the driver energizing with the 24 VDC power supply and when the pump is ready to operate; during this time the current to the valve coils is switched to zero.
These connections are the same of Rexroth A10VSO axial piston pumps, model SYDFEE and SYDFEC.

14 **ELECTRONIC CONNECTIONS - /S, /SX and /CS options**

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	V+	Power supply 24 VDC for pilot valve's solenoid power stage	Input - power supply
2	V0	Power supply 0 VDC for pilot valve's solenoid power stage	Gnd - power supply
3	ENABLE	Enable (24 VDC) or disable (0 VDC) the driver	Input - on/off signal
4	Q_INPUT+	Flow reference: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Input - analog signal
5	AGND	Ground: signal zero for MONITOR signals (pin 6,8) and INPUT+ signals (pin 5,7)	Gnd - analog signal
6	Q_MONITOR	Flow monitor: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Output - analog signal
7	P_INPUT+	Pressure reference: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Input - analog signal
8	P_MONITOR	Pressure monitor: ±10 VDC maximum range (4 ÷ 20 mA for /I option)	Output - analog signal
11	FAULT	Driver status: Fault (0VDC) or normal working (24 VDC)	Output - on/off signal
PE	EARTH	Internally connected to driver housing	
PS execution			
9	D_IN0	Multiple pressure PID selection	Input - on/off signal
10	D_IN1	Multiple pressure PID selection	Input - on/off signal
BC and BP execution			
9	VL+	Power supply 24 VDC for driver's logic	Input - power supply
10	VL0	Power supply 0 VDC for driver's logic	Gnd - power supply

Note: A minimum time of 270 to 590 ms have be considered between the driver energizing with the 24 VDC power supply and when the pump is ready to operate; during this time the current to the valve coils is switched to zero. These connections are the same of Moog radial piston pumps, model RKP-D.

15 **ELECTRONIC CONNECTIONS - 4 PIN REMOTE PRESSURE TRANSDUCER M8 CONNECTOR (only for /S and /CS options)**

PIN	/S option		/CS option (Ri = 316) /SX option (factory wired)	
1	TR	remote pressure trasducer feedback input (0÷+10 VDC)	TR	remote pressure trasducer feeback (4÷20 mA)
2	AGND	signal zero for remote transducer power supply and feedback	NC	reserved (do not connect)
3	VT	remote transducer power supply +24 VDC	VT	remote transducer power supply +24 VDC
4	NC	reserved (do not connect)	NC	reserved (do not connect)

See tab. G465 for the pressure transducer characteristics and connections.

16 **ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION M12 CONNECTOR**

	-PS Serial		-BC CANopen		-BP PROFIBUS DP	
PIN	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	data line and termination Signal zero
4	RS_RX	Valves receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)
5	RS_TX	Valves transmitting data line	CAN_L	Bus line (low)	SHIELD	

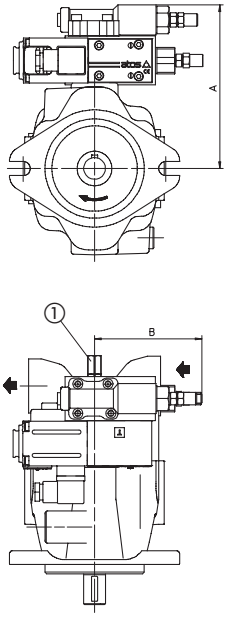
17 **MODEL CODE OF POWER SUPPLY AND COMMUNICATION CONNECTORS**

PUMP VERSION	CZ, LQZ, LZQZ	PES, PERS	-Serial (-PS) or CANopen (-BC) *only for PES and PERS*	PROFIBUS DP (-BP) *only for PES and PERS*	PRESSURE TRANSDUCER *only for /S*
CONNECTOR CODE	666	ZH-12P (1)	ZH-5P (1)	ZH-5P/BP (1)	ZH-4P-M8 /5 (1)(2)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP67

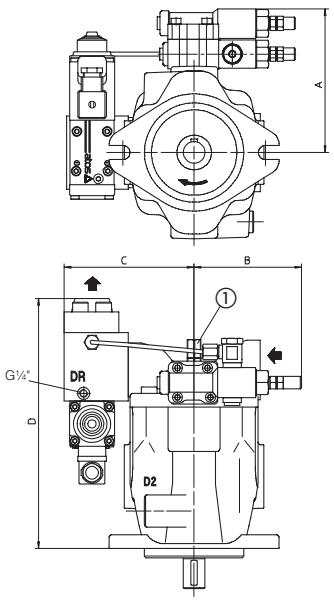
(1) to be ordered separately (2) M8 connector moulded on cable 5 mt lenght

18 DIMENSIONS OF PVPC PUMPS

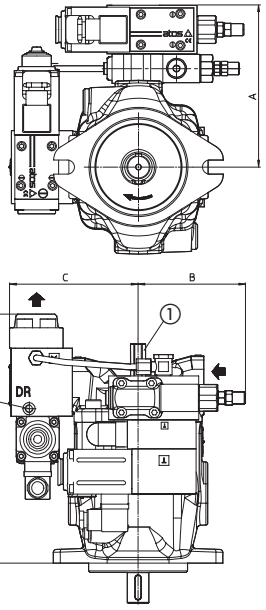
VERSION CZ



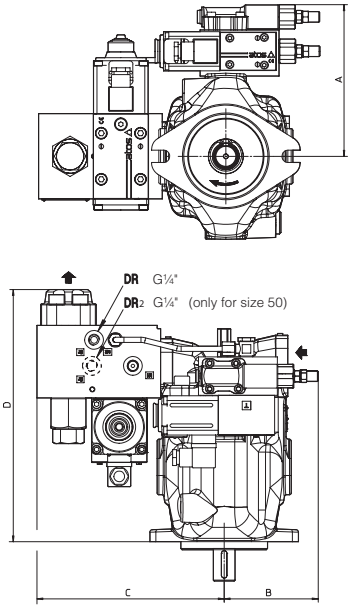
VERSION LQZ



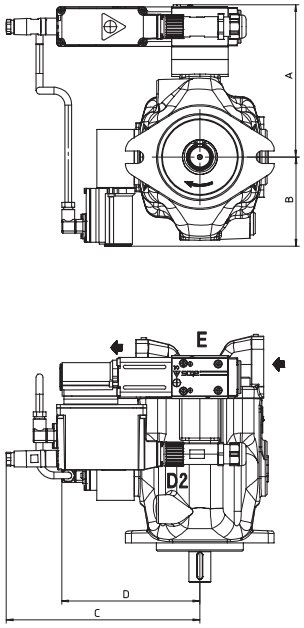
VERSION LZQZ



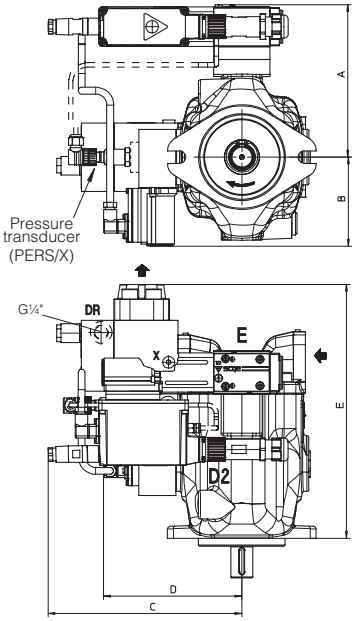
VERSION LZQZR



VERSION PES



VERSION PERS
VERSION PERS/X (dotted line)



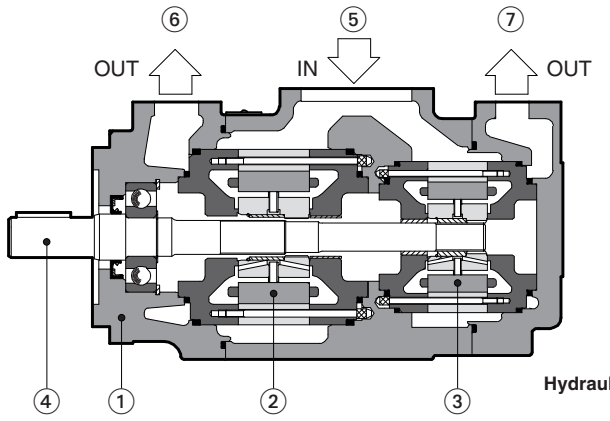
① = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement (not available for versions PES, PERS and PERS/X).
In case of double pump the regulation screw is not always available, please contact our technical office.

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	E	Mass
PVPC-*-3029	**CZ**	168	111	-	-		22
	LQZ	144	111	132	257		24
	LZQZ	168	111	132	257		27,5
	LZQZR	168	111	185	185		29
PVPC-*-4046	**CZ**	177	111	-	-		28
	LQZ	153	111	156	293		33,6
	LZQZ	178	111	156	293		37,4
	LZQZR	178	111	220	296		39,5
PVPC-*-5073	**CZ**	190	111	-	-		36,9
	LQZ	166	111	163	328		44
PVPC-*-5090	**LZQZ**	190	111	163	328		47,6
	LZQZR	190	111	226	328		49,6
PVPC-*-3029	**PES**	170	103,5	246	155	-	21,6
	PERS	170	103,5	246	155	262,5	26
	PERS/X	190	103,5	246	226	262,5	26,4
PVPC-*-4046	**PES**	178	103,5	246	162	-	27,6
	PERS	178	103,5	246	162	299	33,7
	PERS/X	178	103,5	246	162	299	34,1
PVPC-*-5073	**PES**	190	103,5	246	171	-	36,6
PVPC-*-5090	**PERS**	190	103,5	246	171	337	46,7
	PERS/X	190	103,5	246	171	337	47,1

Double vane pumps type PFED

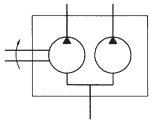
fixed displacement



① body
② first cartridge: stator, rotor, vanes, balanced plates
③ second cartridge: as above
④ shaft
⑤ inlet port
⑥ first outlet port
⑦ second outlet port

PFED-43

Hydraulic symbol



PFED are fixed displacement double vane pumps ②③ composed by two cartridges of pumps type PFE (see tab. A005) assembled in a main body having one inlet port ⑤ and two outlet ports ⑥⑦.

PFED-43 are composed by one cartridge of PFE-41 and one cartridge of PFE-31.
PFED-54 are composed by one cartridge of PFE-51 and one cartridge of PFE-41.

Suitable for hydraulic oils according to DIN 51524...535 or synthetic fluids having similar lubricating characteristics.

These pumps can be assembled, as second element, with PFE-4 and PFE-5 to obtain triple pumps, see tab A190.

Mounting according to SAE J744.
Easy installation as inlet and outlet ports can be assembled in any of four relative positions.
Easy maintenance as pumping cartridge can be replaced in a few minutes.

Wide variety of displacements: from 29+16 up to 150+85 cm³/rev.
Max pressure up to 210 bar.

1 MODEL CODE

PFED - 43 045 / 022 / 1 D TA ** / *

Fixed displacement double vane pump

Size of cartridges:
43 = composed by: one cartridge of PFE-41 + one cartridge of PFE-31
54 = composed by: one cartridge of PFE-51 + one cartridge of PFE-41

Displacement of first element [cm³/rev], see section 3

Displacement of second element [cm³/rev], see section 3

Drive shaft, see section 6 and 7:

cylindrical, keyed
1 = supplied standard if not otherwise specified
2 = according to ISO/DIN 3019
3 = for high torque applications

splined
5 = for PFED-43: according to SAE B 13T 16/32 DP (13 teeth)
for PFED-54: according to SAE C 14T 12/24 DP (14 teeth)
6 = (only for PFED-43) = according to SAE C 14T 12/24 DP (14 teeth)
7 = (only for PFED-43) = similar to shaft type 6. It is used when PFED-43 is the last element of a multiple pump

Direction of rotation (as viewed at the shaft end):
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise

Note: PFED are not reversible

Ports orientation, see section 4

Series number

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

2 MAIN CHARACTERISTICS OF DOUBLE VANE PUMPS TYPE PFED

Installation 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 peak horsepower developed.
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity max at cold start max at full power during operation min at full power	 800 mm²/s 100 mm²/s 24 mm²/s 10 mm²/s
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 µm value with ß25 ≥ 75 recommended)
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (/PE seals)
Recommended suction line pressure	from -0,5 to 1,5 bar for speed up to 1800 rpm; from 0 to +1,5 bar for speed over 1800 rpm

3 OPERATING CHARACTERISTICS at 1450 rpm with hydraulic oil having viscosity of 24 mm²/sec and 40°C

Model	7 bar				70 bar				140 bar				210 bar				Speed range min/max rpm
	1°flow		2°flow		1°flow		2°flow		1°flow		2°flow		1°flow		2°flow		
PFED-43	l/min	Kw	l/min	Kw	l/min	Kw	l/min	Kw	l/min	Kw	l/min	Kw	l/min	Kw	l/min	Kw	
PFED-43 029/016	41	0,8	23	0,5	39	5,5	21	3	37	10	19	5	34	14	16	6,5	800→2500
PFED-43 029/022	41	0,8	30	0,6	39	5,5	28	4	37	10	26	7	34	14	23	10	
PFED-43 029/028	41	0,8	40	0,8	39	5,5	38	5,5	37	10	36	10	34	14	33	14	
PFED-43 037/016	52	1	23	0,5	50	7	21	3	48	12,5	19	5	45	18	16	6,5	
PFED-43 037/022	52	1	30	0,6	50	7	28	4	48	12,5	26	7	45	18	23	10	
PFED-43 037/028	52	1	40	0,8	50	7	38	5,5	48	12,5	36	10	45	18	33	14	
PFED-43 037/036	52	1	51	1	50	7	49	7	48	12,5	46	12,5	45	18	43	18	
PFED-43 045/016	64	1,3	23	0,5	62	8,5	21	3	60	16	19	5	57	24	16	6,5	
PFED-43 045/022	64	1,3	30	0,6	62	8,5	28	4	60	16	26	7	57	24	23	10	
PFED-43 045/028	64	1,3	40	0,8	62	8,5	38	5,5	60	16	36	10	57	24	33	14	
PFED-43 045/036	64	1,3	51	1	62	8,5	49	7	60	16	46	12,5	57	24	43	18	
PFED-43 045/044	64	1,3	63	1,3	62	8,5	61	8	60	16	58	15,5	57	24	55	23	
PFED-43 056/016	80	1,6	23	0,5	78	11	21	3	75	21	19	5	72	30	16	6,5	
PFED-43 056/022	80	1,6	30	0,6	78	11	28	4	75	21	26	7	72	30	23	10	
PFED-43 056/028	80	1,6	40	0,8	78	11	38	5,5	75	21	36	10	72	30	33	14	
PFED-43 056/036	80	1,6	51	1	78	11	49	7	75	21	46	12,5	72	30	43	18	
PFED-43 056/044	80	1,7	63	1,3	78	11	61	8	75	21	58	15,5	72	30	55	23	
PFED-43 070/016	101	2	23	0,5	98	13,5	21	3	95	26	19	5	91	37	16	6,5	
PFED-43 070/022	101	2	30	0,6	98	13,5	28	4	95	26	26	7	91	37	25	10	
PFED-43 070/028	101	2	40	0,8	98	13,5	38	5,5	95	26	36	10	91	37	33	14	
PFED-43 070/036	101	2	51	1	98	13,5	49	7	95	26	46	12,5	91	37	43	18	
PFED-43 070/044	101	2	63	1,3	98	13,5	61	8	95	26	58	15,5	91	37	55	23	
PFED-43 085/016	124	2,4	23	0,5	121	16	21	3	118	32	19	5	114	46	16	6,5	800→2000
PFED-43 085/022	124	2,4	30	1,6	121	16	28	4	118	32	26	7	114	46	23	10	
PFED-43 085/028	124	2,4	40	0,8	121	16	38	5,5	118	32	36	10	114	46	33	14	
PFED-43 085/036	124	2,4	51	1	121	16	49	7	118	32	46	12,5	114	46	43	18	
PFED-43 085/044	124	2,4	63	1,3	121	16	61	8	118	32	58	15,5	114	46	55	23	
PFED-54																	
PFED-54 090/029	128	2,7	41	0,8	124	17	39	5,5	119	33	37	10	114	48	34	14	700→2200
PFED-54 090/037	128	2,7	52	1	124	17	50	7	119	33	48	12,5	114	48	45	18	
PFED-54 090/045	128	2,7	64	1,3	124	17	62	8,5	119	33	60	16	114	48	57	24	
PFED-54 090/056	128	2,7	80	1,6	124	17	78	11	119	33	75	21	114	48	72	30	
PFED-54 090/070	128	2,7	101	2	124	17	98	13,5	119	33	95	26	114	48	91	37	
PFED-54 090/085	128	2,7	124	2,4	124	17	121	16	119	33	118	32	114	48	114	46	700→2000
PFED-54 110/029	157	3,2	41	0,8	152	21	39	5,5	147	40	37	10	141	58	34	14	700→2200
PFED-54 110/037	157	3,2	52	1	152	21	50	7	147	40	48	12,5	141	58	45	18	
PFED-54 110/045	157	3,2	64	1,3	152	21	62	8,5	147	40	60	16	141	58	57	24	
PFED-54 110/056	157	3,2	80	1,6	152	21	78	11	147	40	75	21	141	58	72	30	
PFED-54 110/070	157	3,2	101	2	152	21	98	13,5	147	40	95	26	141	58	91	37	
PFED-54 110/085	157	3,2	124	2,4	152	21	121	16	147	40	118	32	141	58	114	46	700→2000
PFED-54 129/029	186	3,7	41	0,8	180	25	39	5,5	174	47	37	10	168	69	34	14	700→2200
PFED-54 129/037	186	3,7	52	1	180	25	50	7	174	47	48	12,5	168	69	45	18	
PFED-54 129/045	186	3,7	64	1,3	180	25	62	8,5	174	47	60	16	168	69	57	24	
PFED-54 129/056	186	3,7	80	1,6	180	25	78	11	174	47	75	21	168	69	72	30	
PFED-54 129/070	186	3,7	101	2	180	25	98	13,5	174	47	95	26	168	69	91	37	
PFED-54 129/085	186	3,7	124	2,4	180	25	121	16	174	47	118	32	168	69	114	46	700→2000
PFED-54 150/029	215	4,2	41	0,8	211	29	39	5,5	204	55	37	10	197	80	34	14	700→1800
PFED-54 150/037	215	4,2	52	1	211	29	50	7	204	55	48	12,5	197	80	45	18	
PFED-54 150/045	215	4,2	64	1,3	211	29	62	8,5	204	55	60	16	197	80	57	24	
PFED-54 150/056	215	4,2	80	1,6	211	29	78	11	204	55	75	21	197	80	72	30	
PFED-54 150/070	215	4,2	101	2	211	29	98	13,5	204	55	95	26	197	80	91	37	
PFED-54 150/085	215	4,2	124	2,4	211	29	121	16	204	55	118	32	197	80	114	46	

(1) Max pressure is 160 bar for /PE and /WG versions (2) Max speed is 1800 rpm for /PE versions; 1500 rpm for /WG versions

4 PORT ORIENTATION (pumps viewed from the shaf end)

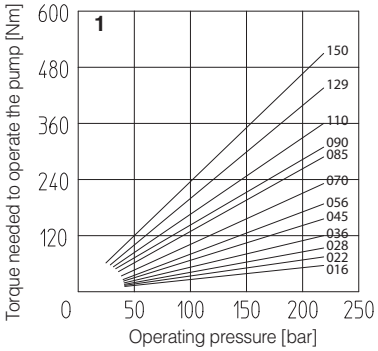
Pumps can be supplied with the oil ports oriented in different configuration in relation to the drive shaft. Port orientation of the first element is designated as follows (as wiewed at the shaft end);
T = inlet and outlet ports on the same axis (standard)
U = outlet orientated 180° with respect to the 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.

TO P1-T-P2	**TA** P1-T P2	**TB** P1-T P2	**TC** P1-T P2	**TD** P1-T P2	**TE** P1-T P2	**TF** P1-T P2	**TG** P1-T P2
WO P1-P2 T	**WA** P1 P2 T	**WB** P1 P2 T	**WC** P1 P2 T	**WD** P1 P2 T	**WE** P1 P2 T	**WF** P1 P2-T	**WG** P1 P2 T
UO P1-P2 T	**UA** P1 P2 T	**UB** P1 P2 T	**UC** P1 P2 T	**UD** P1 P2-T	**UE** P1 P2 T	**UF** P1 P2 T	**UG** P1 P2 T
VO P1-P2 T	**VA** P1 P2 T	**VB** P1 P2-T	**VC** P1 T P2	**VD** P1 T P2	**VE** P1 P2 T	**VF** P1 P2 T	**VG** P1 P2 T

P1 = outlet port of first element; P2 = outlet port of second element; T = inlet port

5 DIAGRAMS

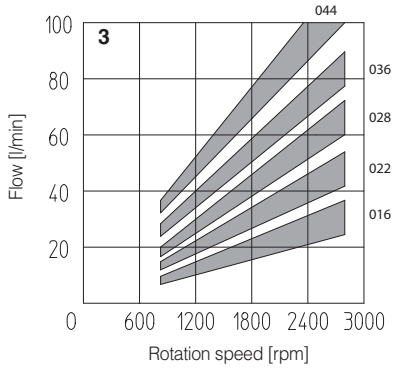
1 = Torque versus pressure diagram

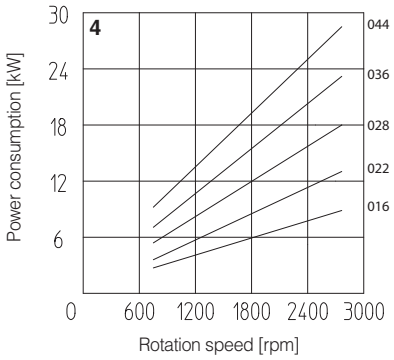


PFED-43: Second element (cartridge SC-PFED-31)**

2 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

3 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

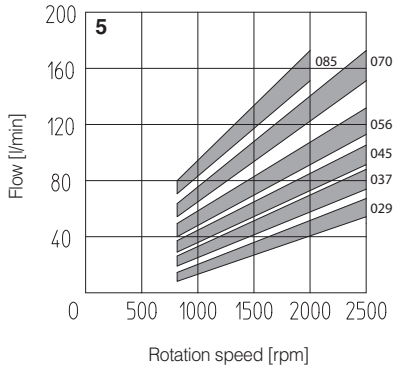


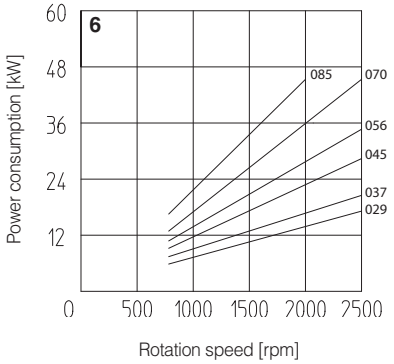


PFED-43: First element (cartridge SC-PFE-41)**
PFED-54: Second element (cartridge SC-PFED-41)**

4 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

5 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.

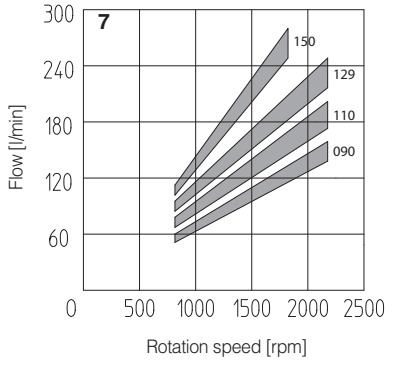


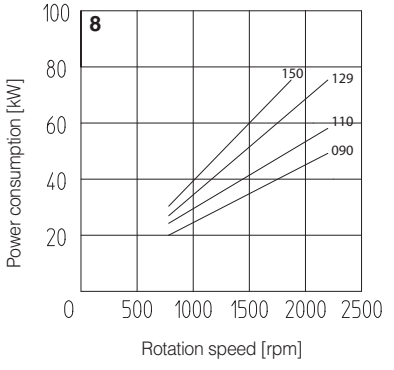


PFED-54: First element (cartridge SC-PFE-51)**

6 = Flow versus speed diagram with pressure variation from 7 bar to 210 bar.

7 = Power consumption versus speed diagram at 140 bar. Power consumption is proportional to operating pressure.





6 LIMITS OF SHAFT TORQUE

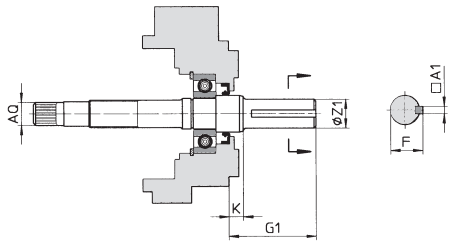
Pump model	Maximum driving torque [Nm]					
	Shaft type 1	Shaft type 2	Shaft type 3	Shaft type 5	Shaft type 6	Shaft type 7
PFED-43	250	250	400	200	400	400
PFED-54	500	500	850	450	–	–

The values of torque needed to operate each single cartridge are shown on the "torque versus pressure diagram" at section 5.
The total torque applied to the shaft of the pump is the sum of the single torque needed for operating each single cartridge 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.

7 DRIVE SHAFT

CYLINDRICAL SHAFT KEYED

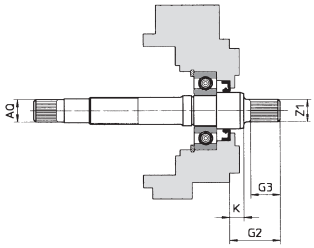
1 = supplied as standard if not specified in the model code
2 = according to ISO/DIN 3019 standards
3 = for high torque applications



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	24,54	59,00	11,40	22,22	6,38	25,03	71,00	8,00	22,22	6,38	28,30	78,00	11,40	25,38
	4,75	24,41			22,20	6,35	24,77			22,20	6,35	28,10			25,35
PFED-54	7,97	35,33	74,25	14	31,75	7,97	35,33	84,25	8,1	31,75	7,97	38,58	84,25	14	34,90
	7,94	35,07			31,70	7,94	35,07			31,70	7,94	38,46			34,88

SPLINED SHAFT

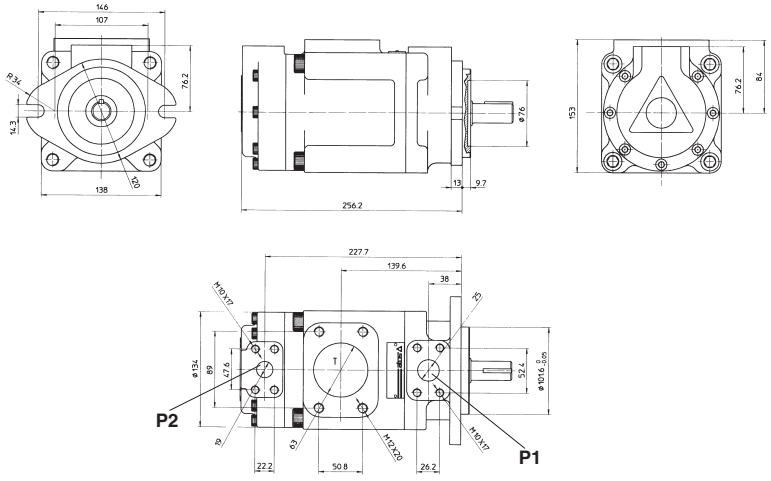
5 = for PFED-43 according to SAE B 16/32 DP, 13 teeth;
for PFED-54 according to SAE C 12/24 DP, 14 teeth;
6 = (only for PFED-43) according to SAE C 12/24 DP, 14 teeth;
7 = only for PFED-43 when used as the last element of a multiple pump: similar to shaft type 6.



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 DIMENSIONS [mm]

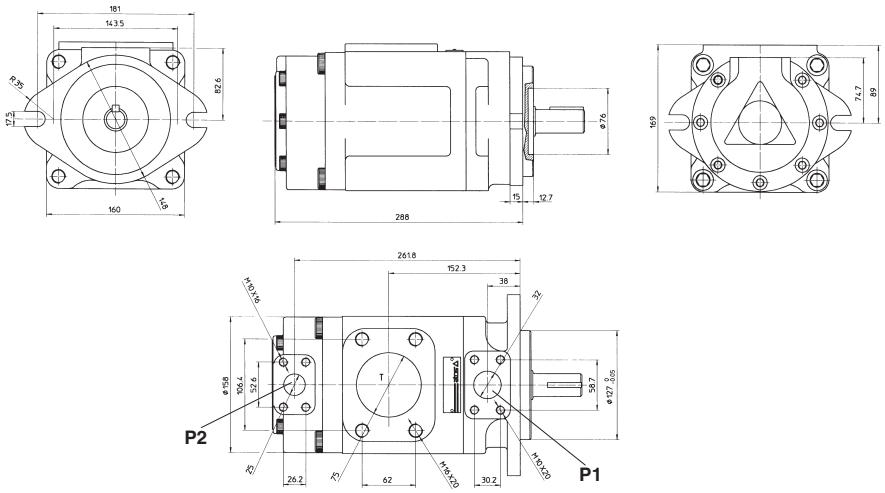
PFED-43



SAE FLANGES:
port P1 = 1";
port P2 = 3/4";
port T = 2 ½"

Weight: 24,5 kg

PFED-54



SAE FLANGES:
port P1 = 1 ¼";
port P2 = 1";
port T = 3"

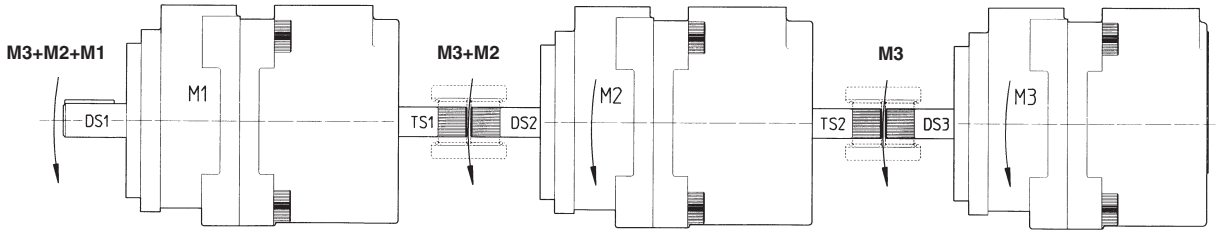
Weight: 36 kg

Multiple pumps type PFEX, PFRX, PVPCX2E

vane, piston, fixed or variable displacement

Multiple pumps are composed by various vane, radial piston or axial piston pumps modularly assembled:
PFEX, see section 1, are composed by vane pumps PFE (table A005 and A007) or PFED (table A180);
PFRX, see section 2, are composed by radial piston pumps PFR (table A045) and vane pumps PFE (table A005 and A007)
PVPCX2E, see section 3, are composed by axial piston pumps PVPC (table A160) and vane pumps PFE (table A005 and A007)

For multiple pumps must be verified that the max torques applied on each single drive shaft and on each single through shaft are not higher than the max allowed limits. In particular, must be considered that the total torque applied to the drive shaft of the first element is the sum of the single torque needed for operating each single pump.



In the figure are shown:

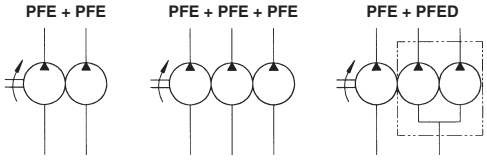
M1, M2, M3, = torque needed to operate each single pump (obtainable from “torque versus pressure diagram” of each single pump).
L_{DS1}, L_{DS2}, L_{DS3} = limits of torque for drive shafts;
L_{TS1}, L_{TS2} = limits of torque at the end of through shafts.

The values of torque needed to operate each single pump and the allowed limit torque values for drive shafts and through shafts are shown on technical tables of individual basic pumps.

For multiple pumps, the following verifications must be executed:
a) $M3 \le L_{TS2}$
b) $M3 + M2 \le L_{DS2}$
c) $M3 + M2 \le L_{TS1}$
d) $M3 + M2 + M1 \le L_{DS1}$

1 PFEX2, PFEX3, PFEXD MULTIPLE VANE PUMPS

PFEX* are fixed displacement multiple vane pumps. They can be double (composed by two pumps type PFE) or triple pumps (composed by three PFE or by one PFE and one PFED).



For technical characteristics of PFE-*1 pumps, see tab. A005; for technical characteristics of PFE-*2 see tab. A007; for technical characteristics of PFED pumps, see tab. A180.

1.1 MODEL CODE FOR PFEX*

PFEX	2	– 42	045	/31028	/	3	D	T	**	/*

Fixed displacement multiple vane pump

2 = double pump composed of two pumps type PFE
3 = triple pump composed of three pumps type PFE
D = triple pump composed of one pump type PFED and one pump type PFED
Pumps are assembled in decreasing order of size

Size of first pump:
31, **41**, **51**, **32**, **42**, **52**

Displacement of first pump [cm³/rev]
for PFE 31: 016, 022, 028, 036, 044
for PFE 41: 029, 037, 045, 056, 070,085
for PFE 51: 090, 110, 129, 150
for PFE 32: 022, 028, 036,
for PFE 42: 045, 056, 070, 085
for PFE 52: 090, 110, 129, 150

Size and displacement [cm³/rev] of second (and third) pump

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;

Direction of rotation (as viewed at the shaft end):
D = clockwise (supplied standard if not otherwise specified)
S = counterclockwise
Note: PFE are not reversible

Port orientation, see section 1.2

Series number

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

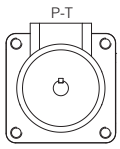
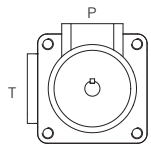
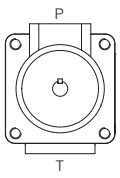
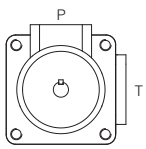
Note:
multiple pumps are supplied with inlet and outlet ports in line. Ports orientation can be easily changed by rotating the pump body that carries inlet port.

1.2 PORT ORIENTATION

-PFEX2, PFEX3

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated.
In PFEX2 and PFEX3 multiple pumps, the port orientation is the same for first, second (third) pumps.

Model code example: PFEX2-42045/41037/5D**T**

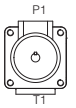
T	**V**	**U**	**W**
 orientation of all pumps	 orientation of all pumps	 orientation of all pumps	 orientation of all pumps

P1 outlet port ; **T1** 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***							
	**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

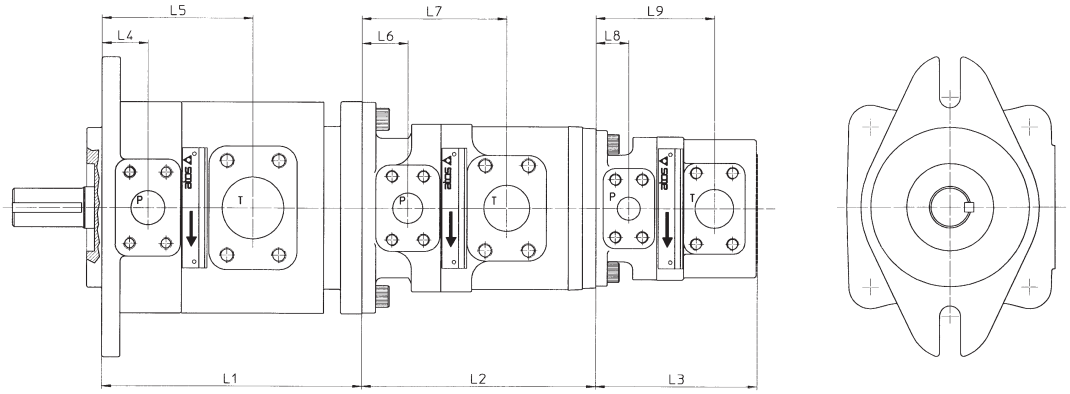
1.3 DIMENSIONS OF MULTIPLE PUMPS TYPE PFEX2, PFEX3, PFEXD [mm]

PFEX2

For missing details see tab. A005 and A007

Composed pump	First element	Second element	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

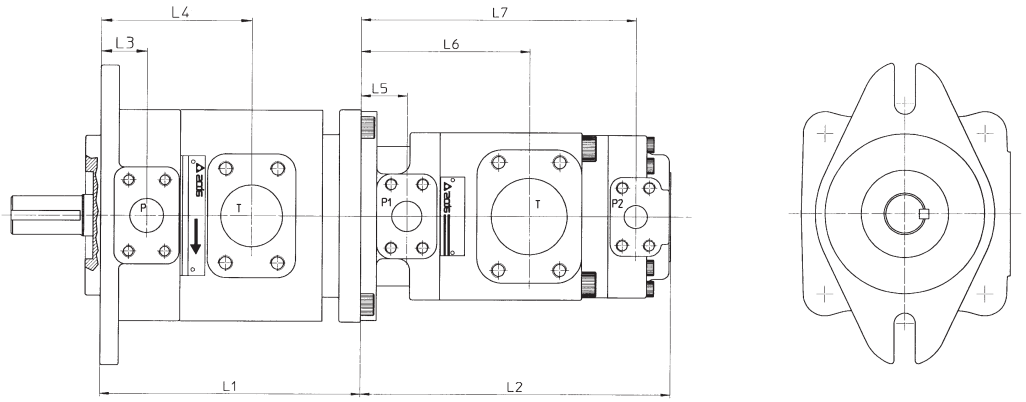
PFEX3



For missing details see tab. A005 and A007

Composed pump	First elem.	Second elem.	Third elem.	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

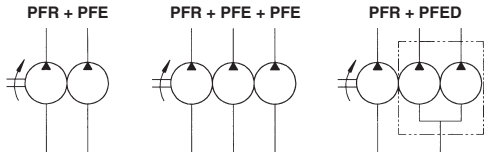


For missing details see tab. A005 and A007, A180

Composed pump	First element	Second element	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 PFRX2E, PFRX3E, PFRXDE MULTIPLE RADIAL PISTON/VANE PUMPS

PFRX*E are fixed displacement multiple piston/vane pumps. They can be double (composed by one pump type PFR and one pump type PFE) or triple pumps (composed by one pump type PFR and one pump type PFEX2 or by one PFR and one PFED).



For technical characteristics of PFR pumps see tab. A045, for technical characteristics of PFE-1* pumps see tab. A005; for technical characteristics of PFE-*2 see tab. A007, for technical characteristics of PFED pumps, see tab. A180.

2.1 MODEL CODE FOR PFRX*E

PFRX **2E** – **5** **22** / **31044** / **D** * / ** /*

Multiple fixed displacement piston/vane pump

Composition:
2E = double: PFR + PFE
3E = triple: PFR + PFEX2
DE = triple: PFR + PFED
The pumps are assembled in decreasing order of size.

Size of first pump type PFR:
3, **5**

Displacement of first pump type PFR [cm³/rev]
for **PFR-3** = 08, 11, 15
for **PFR-5** = 18, 22, 25

Size and displacement [cm³/rev] of PFE second (and third) pump
for PFE 31: 016, 022, 028, 036, 044
for PFE 41: 029, 037, 045, 056, 070,085
for PFE 51: 090, 110, 129, 150
for PFE 32: 022, 028, 036,
for PFE 42: 045, 056, 070, 085
for PFE 52: 090, 110, 129, 150

Direction of rotation (as 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 2.2

Series number

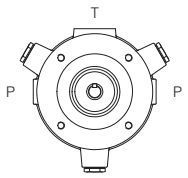
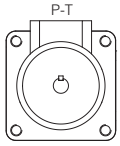
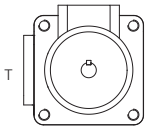
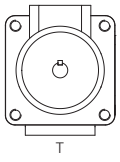
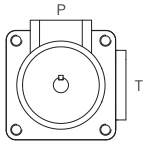
Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

2.2 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 element is always oriented as the second element.

Model code example: PFRX2E-522/31044/D**T**

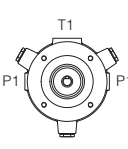
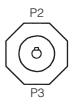
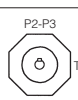
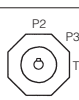
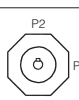
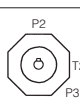
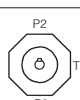
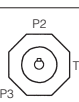
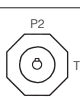
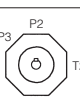
1st PUMP PFRX*	2nd / 3th PUMP PFE			
	**T** 	**V** 	**U** 	**W** 

P1 outlet port ; **T1** inlet port

-PFRXDE

Pumps can be supplied with oil ports oriented in different configurations viewed from shaft end, as below indicated.
In PFRXDE, can be select the orientation of second / third pump (PFED)

Model code example: PFRXDE-522/43045/022/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

2.3 OPERATING CHARACTERISTICS OF STANDARD DOUBLE PUMPS TYPE PFRX2E

(at 1450 rpm and based on mineral oil ISO VG46 at 50° C)

Standard model (1)	Speed range [rpm] (2)	RADIAL PISTON PUMP			VANE PUMP			
		Displacement [cm³/rev]	Flow [l/min] (3)	Max pressure [bar] (4)	Displacement [cm³/rev]	Flow [l/min] (3)	Max pressure [bar] (5)	Total flow [l/min]
PFRX2E-308/31016	600-1800	8	12,6	350	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
PFRX2E-518/31044		18,1	26	350	43,7	63		89
PFRX2E-518/41070					69,9	101		127
PFRX2E-518/41085					85,3	124		150
PFRX2E-518/51110					109,6	157		183
PFRX2E-518/51129					129,2	186		212
PFRX2E-522/41056		21,8	31,5	350	55,8	80		111,5
PFRX2E-522/41070					69,9	101		132,5
PFRX2E-522/51110					109,6	157		188,5
PFRX2E-522/51129					129,2	186		217,5
PFRX2E-525/41070		25,4	37	350	69,9	101		138
PFRX2E-525/51110					109,6	157		194
PFRX2E-525/51129					129,2	186		233

(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 /PE versions; 1000 rpm for water glycol fluid
(3) Flow rate and power consumption are proportional to revolution speed
(4) Max pressure is 250 bar for /PE versions, 175 bar for water glycol fluid
(5) Max pressure is 160 bar for /PE and water glycol fluid.

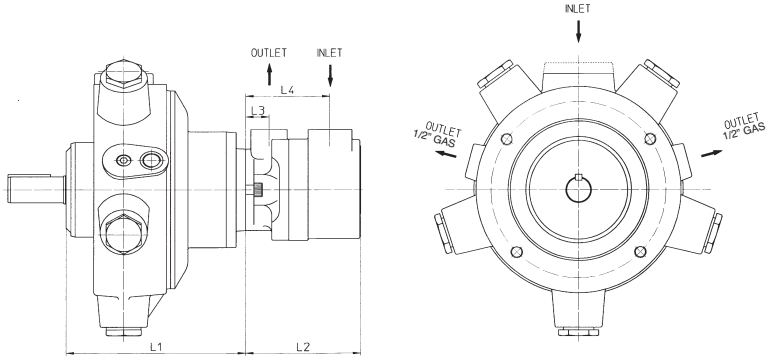
The shaft of the PFR pump has an eccentric cam which rotates with the shaft generating the stroke of the pistons and thus generating the flow rate.
For best functioning a balanced coupling should be provided between the shaft of the motor and the shaft of the pump.
See tab. A045

2.4 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.

2.5 DIMENSIONS OF MULTIPLE PUMPS TYPE PFRX2, PFRX3, PFRXD [mm]

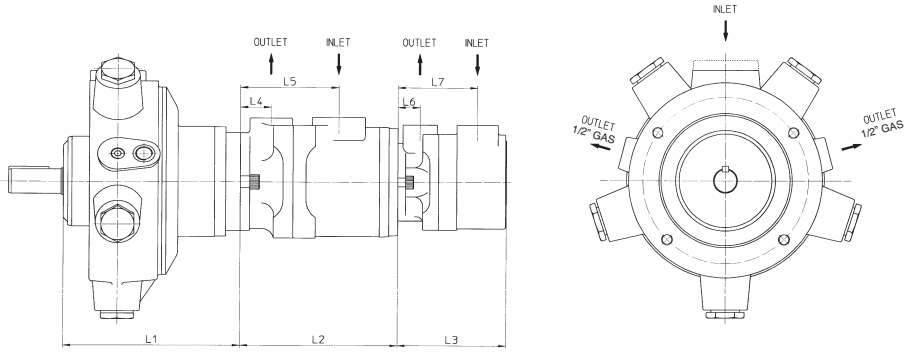
PFRX2E



For missing details see tab. A045, A005 and A007

Composed pump	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
PFRX2E-5**/31***	PFRXA-5**	PFE-31***	210	134,5	27,5	98,5
PFRX2E-5**/41***	PFRXB-5**	PFE-41***	219,5	160	38	120
PFRX2E-5**/51***	PFRXC-5**	PFE-51***	234	134,5	38	125

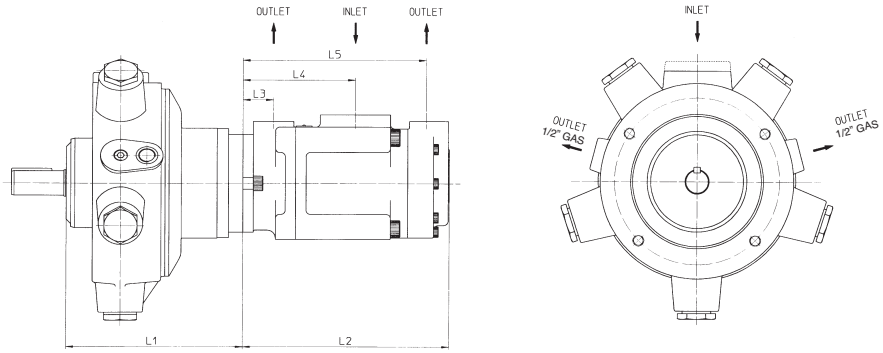
PFRX3E



For missing details see tab. A045, A005 and A007

Composed pump	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
PFRX3E-5**/31***/31***	PFRXA-5**	PFEXA-31***	PFE-31***	210	164	134,5	27,5	98,5	27,5	98,5
PFRX3E-5**/41***/31***	PFRXB-5**	PFEXA-41***	PFE-31***	219,5	194	134,5	38	120	27,5	98,5
PFRX3E-5**/41***/41***	PFRXB-5**	PFEXB-41***	PFE-41***	219,5	203	160	38	120	38	120
PFRX3E-5**/51***/31***	PFRXC-5**	PFEXA-51***	PFE-31***	234	206	134,5	38	125	27,5	98,5
PFRX3E-5**/51***/41***	PFRXC-5**	PFEXB-51***	PFE-41***	234	215,5	160	38	125	38	120
PFRX3E-5**/51***/51***	PFRXC-5**	PFEXC-51***	PFE-51***	234	230	186,5	38	125	38	125

PFRXDE



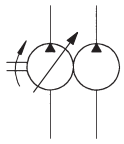
For missing details see tab. A045 and A180

Composed pump	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
PFRXDE-5**/43***/0**	PFRXB-5**	PFED-43***/0**	219,5	256,5	38	139,6	227,7
PFRXDE-5**/54***/0**	PFRXC-5**	PFED-54***/0**	234	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 PVPCX2E MULTIPLE AXIAL PISTON/VANE PUMPS

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.

3.1 MODEL CODE FOR PVPCX2E with standard hydraulic controls

PVPC | **X2E** - **C** - **4** | **046** / **31044** / **1** | **D** | **X** | **24DC** | **10** / | *****

Variable displacement axial piston pump

X2E = coupled with a fixed displacement pump type PFE (see tab. A005)

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: **3** = for displacement 029
4 = for displacement 046
5 = for displacement 073 and 090

Max displacement of axial piston pump:
029 = 29 cm³/rev **073** = 73 cm³/rev
046 = 46 cm³/rev **090** = 88 cm³/rev

Size and displacement [cm³/rev] of PFE second (and third) pump
for **PFE 31**: 016, 022, 028, 036, 044 for **PFE 32**: 022, 028, 036,
for **PFE 41**: 029, 037, 045, 056, 070,085 for **PFE 42**: 045, 056, 070, 085
for **PFE 51**: 090, 110, 129, 150 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

Supply voltage:
12 DC
24 DC
24/50 AC
110/50 AC
220/50 AC

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** - **4** | **046** / **31044** / ***** / **1** | **D** / **18** | **10** / | *****

Variable displacement axial piston pump

X2E = coupled with a fixed displacement pump type PFE (see tab. A005)

Type of control (see section 5, 6 and 7):
CZ = proportional pressure compensator
LQZ = proportional flow control (load sensing)
LZQZ = proportional pressure & flow control (load sensing)
LZQZR = as LZQZ plus sequence module
PES-SP = closed loop integral digital P/Q driver
PERS-SP = as PES plus sequence module

Fieldbus interfaces for PES and PERS:
USB interface always present
NP = Not present **BP** = PROFIBUS DP
BC = CANopen **EH** = EtherCAT

Size:
3 = for displacement 029 **4** = for displacement 046
5 = for displacement 073 and 090

Max displacement of axial piston pump:
029 = 29 cm³/rev **046** = 46 cm³/rev **073** = 73 cm³/rev **090** = 88 cm³/rev

Size and displacement [cm³/rev] of PFE second (and third) pump
for **PFE 31**: 016, 022, 028, 036, 044 for **PFE 32**: 022, 028, 036,
for **PFE 41**: 029, 037, 045, 056, 070,085 for **PFE 42**: 045, 056, 070, 085
for **PFE 51**: 090, 110, 129, 150 for **PFE 52**: 090, 110, 129, 150

Pressure setting (only for PERS): **200** = 200 bar **250** = 250 bar
280 = 280 bar (not available for 090)

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

Options, see sections 4 and 7:
18 = with 18 VDC coil instead of standard 12 VDC coil (only for CZ, LQZ, LZQZ)
for versions PES and PERS:
C = current feedback for pressure transducer 4÷20 mA
I = current reference input and monitor 4÷20 mA (omit for standard voltage reference input and monitor ±10 V)
X = with integral pressure transducer (only for PERS)
S = with two on-off inputs for multiple pressure PID selection (NP execution) or double power supply (BC, BP and EH execution).

Series number

Seals material:
– = NBR
PE = FKM
See notes under sect. 2

3.3 OPERATING CHARACTERISTICS OF STANDARD DOUBLE PUMPS TYPE PVPCX2E (with PFE-31, 41 and 51)

(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-*-3029/31016	800-2800	29	42	280/350	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-*-4046/31016	800-2600	46	66,7	280/350	16,5	23		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-*-5073/31016	800-2200	73	105,8	280/350	16,5	23		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-*-5090/31016	800-2200	88	127,6	280/350	16,5	23		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 /PE versions; 1000 rpm for water glycol fluid
(2) Flow rate and power consumption are proportional to revolution speed
(3) Max pressure is 190 bar for /PE versions, 160 bar for water glycol fluid
(4) Max pressure is 160 bar for /PE and water glycol fluid

3.4 OPERATING CHARACTERISTICS OF STANDARD DOUBLE PUMPS TYPE PVPCX2E (with PFE-32, 42 and 52)

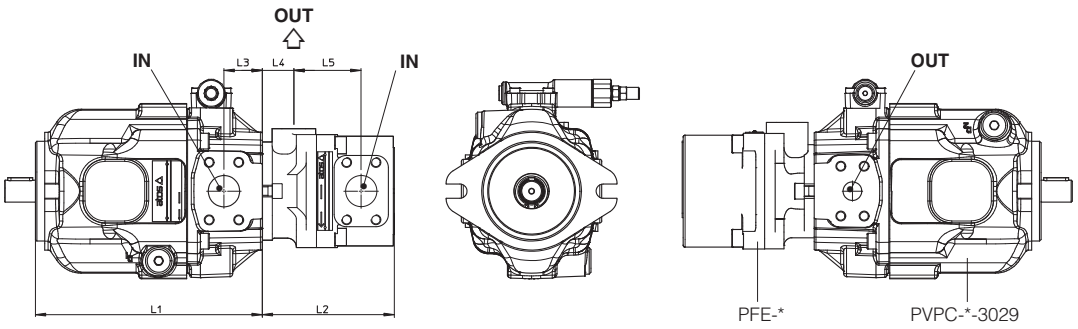
(at 1450 rpm and based on mineral oil ISO VG46 at 40° C)

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-*-3029/32022	1200-2500	29	42	280/350	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-*-4046/32022	1200-2500	46	66,7	280/350	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-*-5073/32022	1200-2500	73	105,8	280/350	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-*-5090/32022	1200-2500	88	127,6	280/350	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	1000-2000				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	800-2000				85,3	124		251,6
PVPCX2E-*-5090/52090	1000-2000				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	800-1500				150,2	215	210	342,6

(1) Max speed is 1800 rpm for /PE versions; 1500 rpm for water glycol fluid
(2) Flow rate and power consumption are proportional to revolution speed
(3) Max pressure is 190 bar for /PE versions, 160 bar for water glycol fluid
(4) Max pressure is 160 bar for /PE and water glycol fluid.

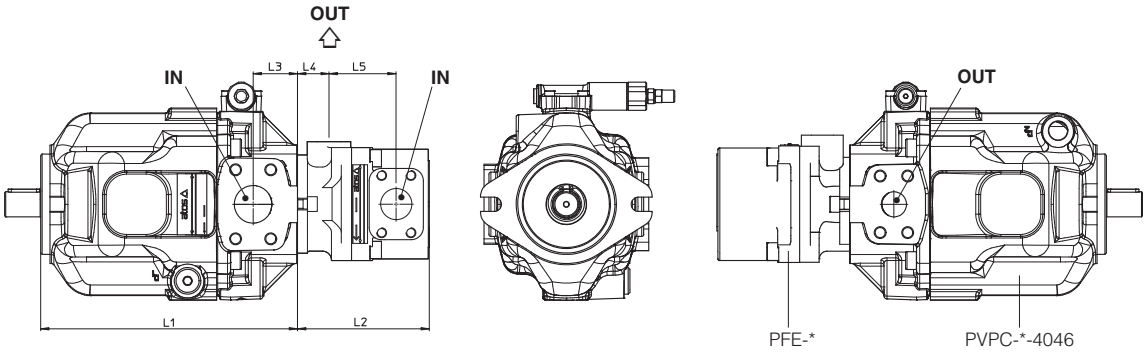
3.5 DIMENSIONS OF MULTIPLE PUMPS TYPE PVPCX2E [mm]

PVPCX2E-*-3029



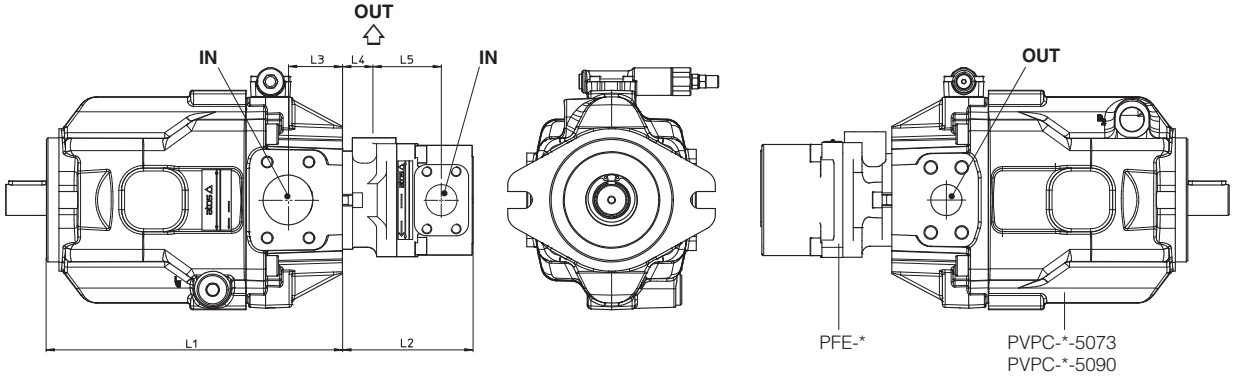
Composed pump	First element - piston pump -	Second element - vane pump -	L1	L2	L3	L4	L5
PVPCX2E-*-3029/3****	PVPCXA-*-3029	PFE-3****	231,2	134,5	39	27,5	71
PVPCX2E-*-3029/3****	PVPCXB-*-3029	PFE-4****	231,2	160	39	38	82

PVPCX2E-*-4046



Composed pump	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

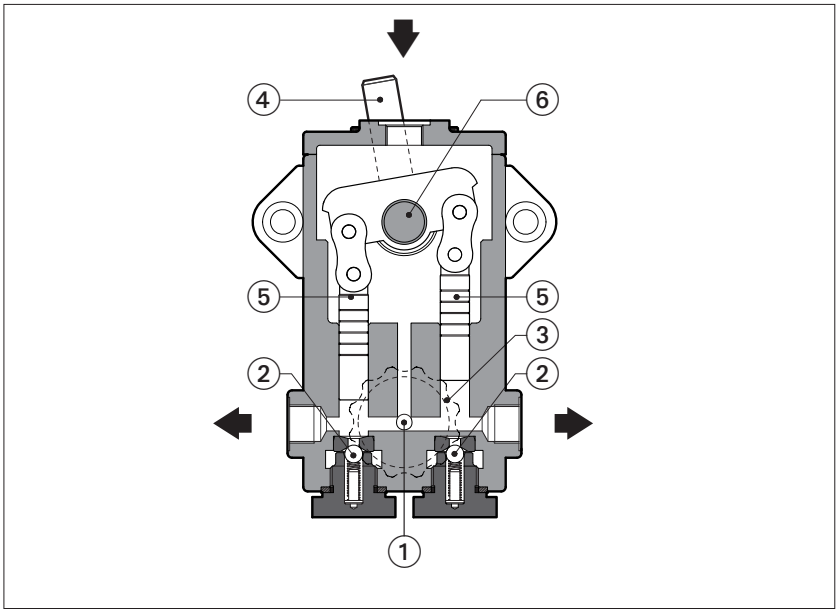
PVPCX2E-*-5073
PVPCX2E-*-5090



Composed pump	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

Hand pumps type PM

2-plunger

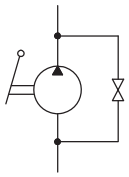


PM are double alternate-acting hand pumps with simple and rugged construction for minimum service and long operating life.
They are provided with one by-pass valve ① which connects directly the delivery ports with the inlet port through the delivery valves ②. The by-pass valve is operated by a handwheel 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).
Suitable for hydraulic oils according to DIN 51524...535 or synthetic fluids having similar lubricating characteristics.
Displacements: from 6 to 20 cm³ for double stroke.
Max pressure 500 bar

1 MODEL CODE

PM	–	106	**	/*
2-plunger hand pump		Displacement, see section 2 **106** = 6 cm³/double stroke **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

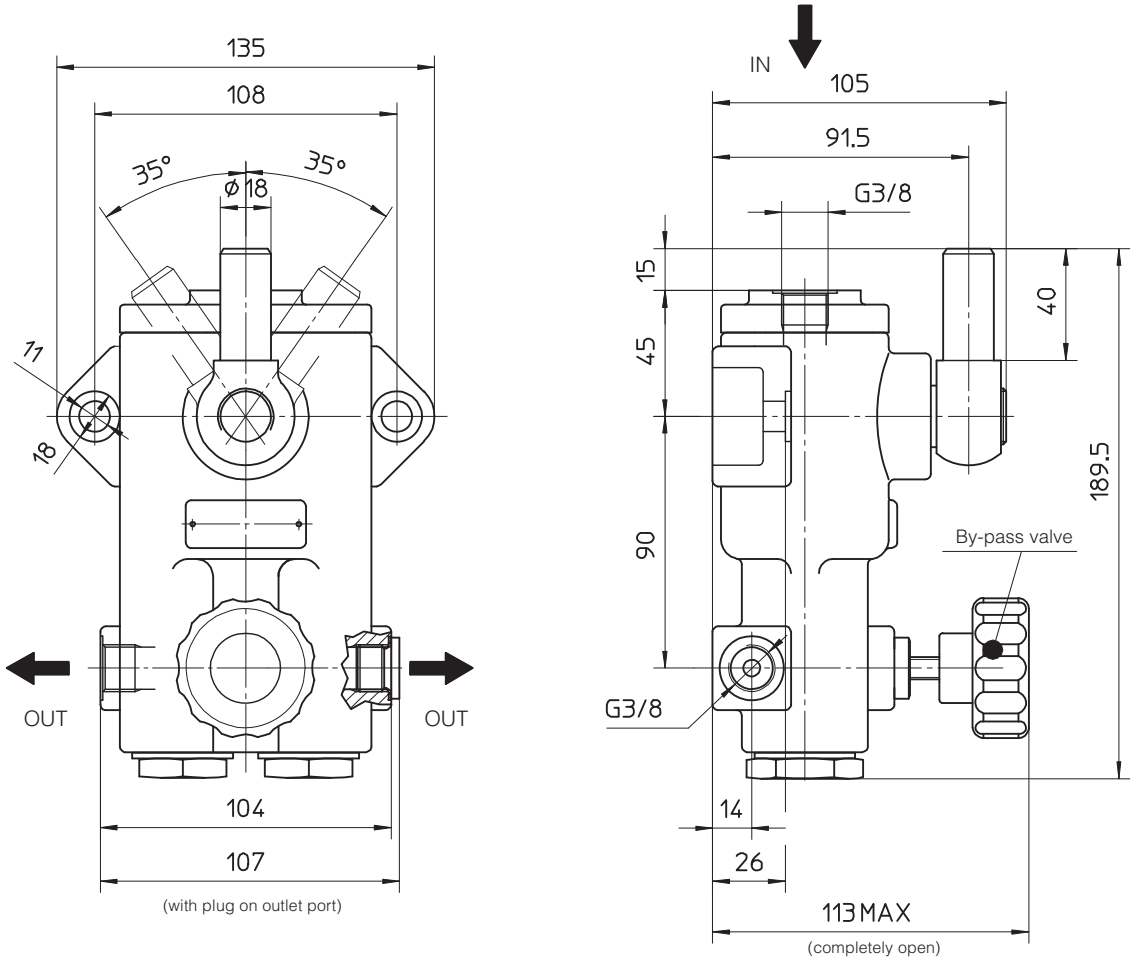


Model	Displacement for double stroke [cm³]	Max pressure [bar]	Shaft rotation angle [degree]	Maximum torque required [Nm]
PM-106	6	500	± 35°	139
PM-112	12	250	± 35°	133
PM-120	20	120	± 35°	116

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	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524...535; for other fluids see section 1
Recommended viscosity	10 ÷ 100 mm²/sec 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 ß25 ≥ 75 recommended)
Fluid temperature	-20°C +60°C -20°C +50°C (water glycol) -20°C +80°C (/PE seals)

4 DIMENSIONS [mm]



Mass: 4,6 Kg

Criteria for choice of cylinders and electrohydraulic servocylinders

General notes - construction series - options

The new Atos range of cylinders meets the most advanced requirements for control and operation of machines and plants both in on/off or proportional control systems and in closed-loop servosystems: high functional reliability, excellent repeatability, top static and dynamic characteristics.
For information on cylinder and servocylinder size about their employment, consult table B015.
For the definition of the construction series (see sect. 10) control not to exceed the nominal pressure values shown for the different series. Overpressures occurring inside the cylinders during their employment and due to different causes (throttling, cushioning, etc.) must not exceed the max. rated pressure value of the cylinder, which corresponds to its testing pressure. The general size of the cylinders allows, however, very generous safety margins.
The module construction allows a wide range of options and customization with fast delivery, thanks to full availability of components in stock.

1 OLEODYNAMIC CYLINDERS - GENERAL CONSTRUCTION NOTES

- Piston diameters up to 400 mm;
- Pressure up to 320 bar;
- Standard strokes up to 5000 mm;
- Mass-production according to the following standards:
  ISO 6020-1; DIN-ISO 6020-1; AFNOR NFE 48-015 (**CN** series);
  ISO 6020-2; DIN 24554; AFNOR NFE 48-016 (**CK** - **CH** series);
  ISO 6020-3 (**big size diameter** series **CH**);
  ISO 6022: DIN 24333; AFNOR NFE 48-025 (**CC** series);
- Construction solutions aimed to max. servicing simplification;
- High safety coefficients of size;
- Low-friction seals.

2 SERVOCYLINDERS AND LINEAR SERVOACTUATORS

These derive from the hydraulic cylinders of the standard series and build-in electronic stroke transducers, well-protected from shocks and/or difficult working environment. The following ranges of transducers are available: potentiometric, inductive or magnetosonic.
They are intelligent elements, electrohydraulic axis, which can be connected directly to the hydraulic source and to the electronic control system to get smooth, fast and precise movements.

3 OPTIONS AND CONSTRUCTION VARIANTS

Different construction options are available depending on the operations, protection and reliability requirements of the plant:
- Assembly of valves or hydraulic control units;
- Surface protections for bodies and rods for difficult environments;
- Adjustable stroke-end cushioning;
- Seals with mixes suitable for synthetic fluids, phosphate ester and water glycol base fluids;
- Air bleeds;
- Inductive stroke-end sensors.

4 MODEL CODE EXAMPLE

CK P /10 –80 / 56 ∗0500 – S 3 0 8 L **

Cylinder series
CK
CH
CC
CN
see sect. 10

Eventual:
servocylinder transducer

Eventual:
incorporated subplates: see 6.2

Bore diameter [mm]

Rod diameter [mm]

Stroke [mm]

Attachments, see proper technical tables

Cushioning: see 6.1

Spacers: see 5.4

Seals: see 5.5

Eventual:
Options: see 5.6, 6.3, 6.4

Series number

To complete the model code, consult the single product technical tables.

5 GENERAL CONSTRUCTION CHARACTERISTICS

5.1 Bodies

Depending on their bore, bodies are drawn from tubes obtained from different processes, as shown in the table below.
Internal surfaces are lapped.
Diameter tolerance: H8, roughness Ra ≤ 0,4 µm

CYLINDER SERIES	BORE	MATERIAL	Rs [N/mm²]
CK, CH	25÷200	drawn and stressed carbon-steel	≥ 450
	>200	rolled carbon-steel	≥ 360
CC, CN	50÷200	drawn and stressed carbon-steel	≥ 450
	>100	rolled carbon-steel	≥ 360

5.2 Rods

Rods are screwed to pistons and made in various materials, depending on their diameter and on the construction series, as shown in the table below. Surfaces are chrome-plated. Diameter tolerance f7; roughness: Ra ≤ 0,25 µm

CYLINDERS SERIES	Ø RODS [mm]	MATERIAL	Rs [N/mm²]	CHROME THICK [mm]
CK, CH	12÷90	Hardened and tempered alloy-steel	≥ 700	≥ 0,020
	≥ 110	Carbon-steel	≥ 360	≥ 0,045
CC, CN	36÷90	Hardened and tempered alloy-steel	≥ 700	≥ 0,020
	≥ 110	Carbon-steel	≥ 360	≥ 0,045

Options for rod surface processing
K = NIKROM processing: nickel and chrome-plating - resistance in saline mist 350 h, up to ISO 3768 and DIN 50021
T = induction surface hardening and plating
Versions of AISI 304, 316 and 420 or equivalent are available on request. Consult our technical office.
Tolerances on the thread of the rod: male thread 6g, female thread 6H.

5.3 Strokes

Maximum standard strokes are:
- 3000 mm for rods up to 18 mm and for bores up to 32 mm
- 5000 mm for other bores.

For longer strokes, consult our technical office.
Select strokes a few mm longer than the working stroke to prevent the contact surfaces inside the cylinder from being used as mechanical stops.
Stroke tolerance:
0+1.2 mm for strokes up to 1000 mm
0+2.5 mm for strokes over 1000 mm
Retractors for tie-rod cylinders
For strokes longer than 1000 mm or as shown in our technical tables, one or more retractors are mounted to maintain the radial tension on the tie-rods, keeping them rigidly integral with the cylinder body.

5.4 Spacers

For strokes longer than 1000 mm special spacers are inserted (on request also for shorter strokes) to increase the length of the bore and piston guide, to protect it form overloads and premature wear. Spacers can be omitted in cylinders working in traction mode.
The table below shows the recommendend dimensions depending on the stroke. For strokes longer than the ones shown in table, consult our technical office.

stroke [mm]	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 3000
spacer code	**2**	**4**	**6**	**8**
lenght [mm]	50	100	150	200

The additional spacers implies an increase in the overall length of the cylinder.

5.5 Seals

Choose seals up to the working conditions of the system: speed and operating frequency, type and temperature of the fluid, etc. according to technical tables of the product.
Low-friction seals are available with seat according to ISO standards, fully tested and reliable also in difficult operating conditions.

type **1** = (NITRILE+POLIURETHAN); low friction, **high static and dynamic seal.**
Speed: up to 0,5 m/s. Seats according to ISO 5597 and 6195 (rod seals) and ISO 7425 (piston seals).
Fluids compatibility: mineral oils.
Temperature range: -25°C ÷ +85°C.

type **2** = (VITON+PTFE); anti-friction, **for high fluid temperature.**
Speed: up to 1 m/s. Seats according to ISO 7425 (rod and piston seals).
Fluids compatibility: mineral oils and water-glycol with water percentage not higher than 45%, **phosphate ester based fluids.**
Temperature range: up to 120°C.

type **4** = (NITRILE+PTFE); anti-friction, **for high speed.**
Speed: up to 4 m/s. Seats according to ISO 7425 (rod and piston seals).
Fluids compatibility: mineral oils and water-glycol with water percentage not higher than 45% and usually synthetic organic esters based fluids.
Temperature range: -20°C ÷ +85°C.

type **6** = (NITRILE+PTFE); anti-friction, for **single effect - pushing** applications.
Speed: up to 1 m/s. Seats according to ISO 7425 (rod and pistons seals).
Fluids compatibility: mineral oils and water-glycol with water percentage not higher than 45% and usually synthetic organic esters based fluids.
Temperature range: -20°C ÷ +85°C.

type **7** = (NITRILE+PTFE); anti-friction, for **single effect - pulling** applications.
Speed: up to 1 m/s. Seats according to ISO 7425 (rod and pistons seals).
Fluids compatibility: mineral oils and water-glycol with water percentage not higher than 45% and usually
Temperature range: -20°C ÷ +85°C.

type **8** = (NITRILE+PTFE and POLIURETHAN); anti-friction.
Speed: up to 1 m/s. Seats according to ISO 7425 (rod and piston seals).
Fluids compatibility: mineral oils and usually synthetic organic esters based fluids.
Temperature range: -20°C ÷ +85°C (60°C for water-glycol).

When the simple effect seals are used, the chamber that is not under pressure must be connected to tank.
Please consult our technical office for the compatibility with other fluids not mentioned above and specify type and composition.
All the seals, static and dynamic, must be periodically replaced: proper spare kits are always available.

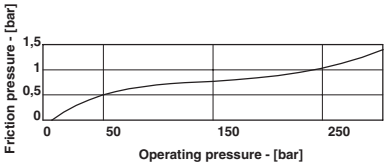
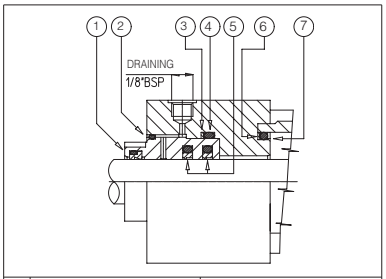


Diagram showing the pressure value equal to the friction strengths coming from the type 8 seals.



	Item	Material
1	Wiper	Nitrile rubber or Viton+ PTFE
2	O-Ring	Nitrile rubber or Viton
3	Anti-extrusion ring	PTFE
4	O-Ring	Nitrile rubber or Viton
5	Rod seal	Nitrile rubber or Viton + PTFE
6	Anti-extrusion ring	PTFE
7	O-Ring	Nitrile rubber or Viton

5.6 Draining - see figure on side

The rod-side seals drain provides:
- increased seal reliability especially in cylinders with strokes longer than 2000 mm and/or where the rod-side chamber is constantly pressurized.
- reduced friction and better repeatability for application in servosystems.

The device is standard in servocylinders and can be supplied as optional (**L**) for the cylinders of all the other construction series (CN series excluded).
The 1/8" GAS draining port is usually located on the same side as the oil supplying port; connect it directly to the tank without backpressure.

6 OPTIONS

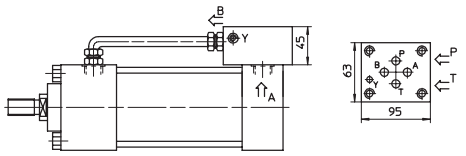
6.1 Stroke-end and cushioning

Stroke-end and cushioning systems are always recommended for application with vertical loads or with rod speed over 50 mm/s.
They can be supplied for all the cylinder typologies, without changing the overall dimensions.
They operate a progressive damping cushioning action which allows soft stops also in case of high speed, ensuring a longer life to the cylinder.

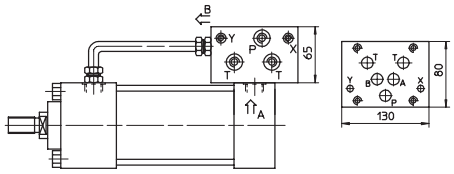
The adjustable versions are provided with regulating screws, supplied fully screwed-in (max cushioning effect).
In case of masses moved and/or very low operating speeds we recommend to back them off to damp the cushioning effect.
The cushioning effect is highly ensured even in case of variation of the fluid viscosity.
When stroke-end cushioning are foreseen only as safety when the control device is out of service (for example in case of servosystems),it is advisable to choose a cylinder with effective stroke longer than the operating one by the amount equal to the cushioning length. So the cushioning effect doesn't influence the movement during the operating stroke.
For cushioning length and maximum kinetic energy values that the cushioning system is able to damp, see table B015

6.2 Built-in subplates

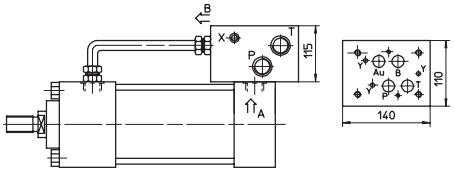
All the cylinder can be supplied with ISO (size 06, 10, 16 and 20) subplate for mounting of the valves directly on the cylinder board.



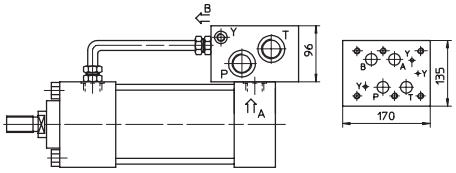
CK cylinder with ISO 4401 size 06 subplates (option /**10**)



CK cylinder with ISO 4401 size 10 subplates (option /**20**)



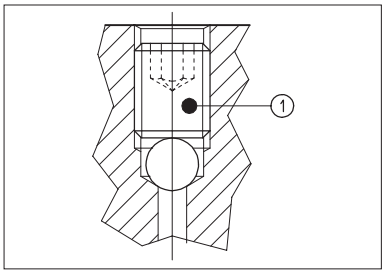
CK cylinder with ISO 4401 size 16 subplates (option /**30**)



CK cylinder with ISO 4401 size 25 subplates (option /**40**)

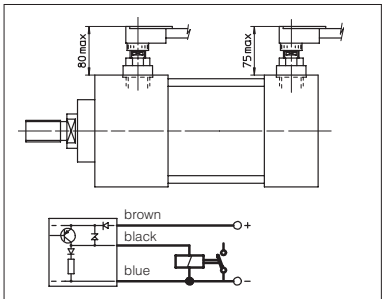
6.3 Air bleeds

They are mounted on the cylinder heads, on servocylinders and on servocylinders and all cylinders with proximity sensors and/or built-in subplates.
For CK, CH, CN and CC series cylinders air bleeds are available on request (consult the corresponding technical tables).
For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with wrench for hexagonal head screws, bleed-off the air and retighten carefully, proving the seal.



6.4 Proximity sensors

The inductive-type proximity sensors are available (on request) for the cylinder of CK and CH series and provide an electrical signal when the cylinder piston reaches the stroke-end. The inductive type proximities must always be coupled with the stroke-end cushioning.
Their functioning is based on the variation of the magnetic field (generated by the sensor itself) when a metallic detail enters its influence area, causing a change of state (on/off) of the sensor. The switching of the electrical contact is made by the cushioning piston when it reaches the sensor.
The distance from the mechanical stroke-end of the cylinder, at which the switching of the sensor electrical contact occurs, can be adjusted between 1-2 mm and 2-3 mm, changing the regulation of this last one. For the adjustment,it is necessary to locate the rod where it is desired to start the contact and rotate the sensor to obtain the LED switch-on (commutation occurred), supplied as equipment; do not force the sensor tightening to avoid damages.
The coupling of the proximity sensors with the stroke-end cushioning imposes particular executions with limitation of the damping masses and/or of the speed compared with the executions with standard cushioning.
Consult the technical table of the product for the model codes and for the construction limitations, depending on bores and attachments.



Sensor technical data:

Environment temperature	-20 +70°C
Operating voltage	10 . . . 30 VDC
Max load	200
Version	PNP
Output type	NA

7 CYLINDERS FOR SERVOSYSTEMS

Special executions for servosystems with or without incorporated position transducer (see table B137) are available with:
- seals, guides, low-friction sealing systems for operating speeds up to 4 m/s and for high dynamic performances;
- bore/piston realized in a unic block for max operating reliability in presence of pulsing stress and/or cycle operating with frequencies higher than 20 Hz;
- short tolerances on strokes compared with standard executions and general reduction of the coupling tolerances of the mechanical details;
- rods of stainless steel and/or with proper surface processing for any working environment;
- possibility to assemble directly on cylinder board the valves that realize the electrohydraulic driving circuits.

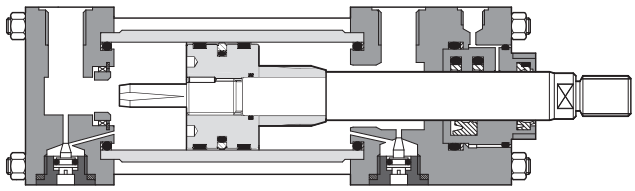
8 FLUID AND TEMPERATURE LIMITATIONS

Cylinders and servocylinders are suitable for operation with mineral oils or other synthetic or uninflammable fluids (organic esters, phosphate esters, glycol water, etc.). For possible limitations depending on compatibility of fluids with seals and transducers, consult our technical office.
The fluid must have a viscosity included between 15 and 100 mm²/s, a temperature included between 0 and 70°C and ISO19/16 contamination class, achievable with on-line filters of at least 25 µm.

9 CAD CATALOG

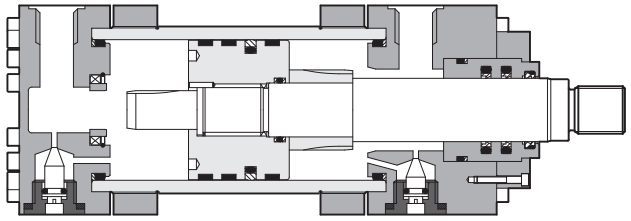
On request it is possible to supply a software aid for CAD filing.
For further information, consult our technical office.

SERIES CK/CH - Tab. B137 - B140



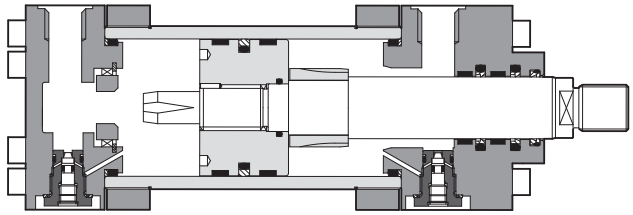
- ISO 6020-2, DIN 24554, AFNOR NFE 48-016 standards;
- nominal pressure 160 bar - max. pressure 250 bar;
- ten piston diameters, from 25 to 200 mm;
- construction typology: square head assembled with tie-rods (CK series) or counterflanges (CH series);
- different rod versions;
- typical application fields: injection and blow moulding machines, machine tools, steel plants, off-shore and on board installations;

SERIES CH BIG BORE SIZE - Tab. B160



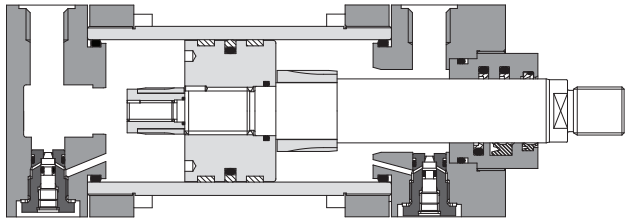
- ISO 6020-3 standard;
- nominal pressure 160 bar - max. pressure 250 bar;
- three piston diameters, from 250 to 400 mm;
- construction typology: round heads assembled with counterflages or tie-rods;
- typical application fields: great plants, sheet machines, steel plants;

SERIES CN - Tab. B180



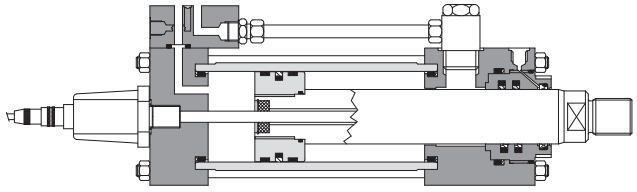
- ISO 6020-1; DIN-ISO 6020-1; AFNOR NFE 48-015;
- nominal pressure 160 bar - max. pressure 250 bar;
- seven piston diameters, from 50 to 200 mm;
- construction typology: round heads with counterflanges;
- typical application fields: steel plants, sheet steel processing, plastic injection machines;

SERIES CC - Tab. B241



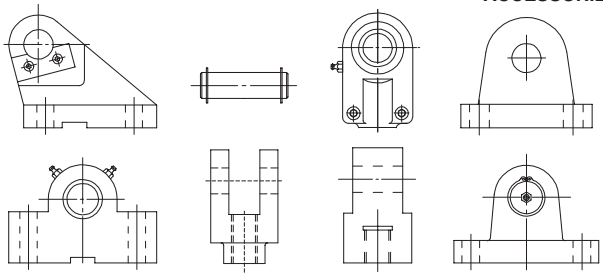
- ISO 6022; DIN 24333; AFNOR NFE 48-025 standards;
- nominal pressure 250 bar - max. pressure 320 bar;
- twelve piston diameters, from 50 to 400 mm;
- construction typology: round heads with counterflanges;
- typical application fields: automotive, steel plants and generally for heavy duty;

SERVOCYLINDERS - Tab. B310



- derived from cylinders of CK, CH, CC series, they maintain the same construction characteristics:
  - C*P = with potentiometric transducer
  - C*V = with VRVT inductive transducer
  - C*F = with magnetosonic transducer
  - C*M = with magnetosonic transducer

ACCESSORIES - Tab. B500



- C136 = swivel with eye, according to ISO 6982 ISO 8132
- C146 = swivel with eye, according to ISO 8133/DIN 24555
- C141 = female clevis, according to ISO 8133
- C151 = male clevis according to ISO 8133
- C124 = support 180° according to DIN 24556
- C134 = support according to ISO 8132
- C144 = male clevis support, according to ISO 8133 standard
- C154 = support trunnion according to ISO 8132
- C145 = axis

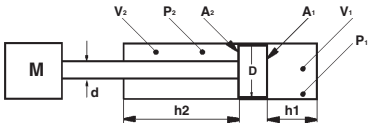
Criteria for sizing of cylinders and electrohydraulic servocylinders

1 STATIC AND DYNAMIC CONTROLS

For all working conditions, it is necessary to check the static and dynamic characteristics described in the following.
When determining the forces acting on the system, must be considered the forces of inertia, the external friction forces and the counterpressures generated by effect of cushioning and restrictor valves installed in the hydraulic circuit.
For an overall check of the system, an analysis performed by the Atos technical office is recommended, especially where high acceleration and/or short cycle times are requested.

2 SYMBOLS, DIAGRAMS AND BASIC FORMULA

Single rod cylinders



Cylinder speed during rod extension

$$V_1 = \frac{10 \cdot Q}{A_1 \cdot 60} \left[\frac{m}{sec}\right]$$

Cylinder speed during rod retraction

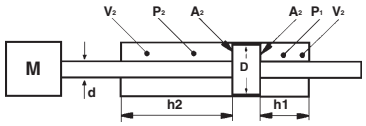
$$V_2 = \frac{10 \cdot Q}{A_2 \cdot 60} \left[\frac{m}{sec}\right]$$

Force applied during rod extension
$F = (p_1 \cdot A_1 - p_2 \cdot A_2) \cdot 10$ [N]

Force applied during rod retraction
$F = (p_2 \cdot A_2 - p_1 \cdot A_1) \cdot 10$ [N]

where: $A_1 = \frac{\pi \cdot D^2}{4 \cdot 100}$ [cm²] $A_2 = \frac{\pi \cdot (D^2 - d^2)}{4 \cdot 100}$ [cm²]

Double rod cylinders



Cylinder speed during rod

$$V = \frac{10 \cdot Q}{A_2 \cdot 60} \left[\frac{m}{sec}\right]$$

Force applied
$F = (p_2 - p_3) A_2 \cdot 10$ [N]

Quantity	Unit	Symbol
Total force (1)	N	F
Pressure	bar	p
Section	cm²	A
Bore diameter	mm	D
Rod diameter	mm	d
Cylinder stroke	mm	h
Flow rate	l/min	Q
Speed	m/sec	V
Acceleration	m/sec²	a
Load mass	Kg	M

(1) The total force is the algebraic sum of all the forces acting on the cylinder:
Forces of inertia = Fi = M•a
Working forces = Fl
Friction forces = Fa
Weight (only for vertical loads) = P

3 SIZING

The table below reports the thrust/retracting sections of the different size combinations rod/piston.

The rod/piston size, based on the system parameters (force, speed, flow) is determined with the formulae reported in section 2 and with the figures obtained from this table.
Calculation can be checked also graphically with the nomographs of table P003.
The rod dimension must be checked to the buckling load, according to what reported in section 4.

Piston [mm]	**25**		**32**		**40**			**50**			**63**			**80**			**100**		
Extention section A1-[cm²]	4,9		8,0		12,6			19,6			31,2			50,3			78,5		
Rod [mm]	**12**	**18**	**14**	**22**	**18**	**22**	**28**	**22**	**28**	**36**	**28**	**36**	**45**	**36**	**45**	**56**	**45**	**56**	**70**
Retraction section A2-[cm²]	3,8	2,4	6,5	4,2	10,0	8,8	6,4	15,8	13,5	9,5	25,0	21,0	15,3	40,1	34,4	25,6	62,6	53,9	40,1

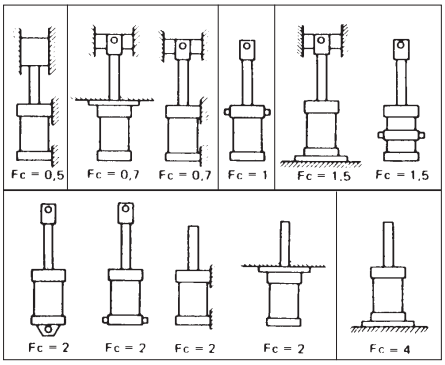
Piston [mm]	**125**			**140**		**160**			**180**		**200**			**250**		**320**		**400**	
Extention section A1-[cm²]	122,7			153,9		201,1			254,5		314,2			490,9		804,2		1256,6	
Rod [mm]	**56**	**70**	**90**	**90**		**70**	**90**	**110**	**110**		**90**	**110**	**140**	**140**	**180**	**180**	**220**	**220**	**280**
Retraction section A2-[cm²]	98,1	84,2	59,1	90,3		162,6	137,4	106,0	159,4		250,0	219,2	160,2	336,9	236,4	549,8	424,1	876,5	640,9

4 CHECK TO THE BUCKLING LOAD

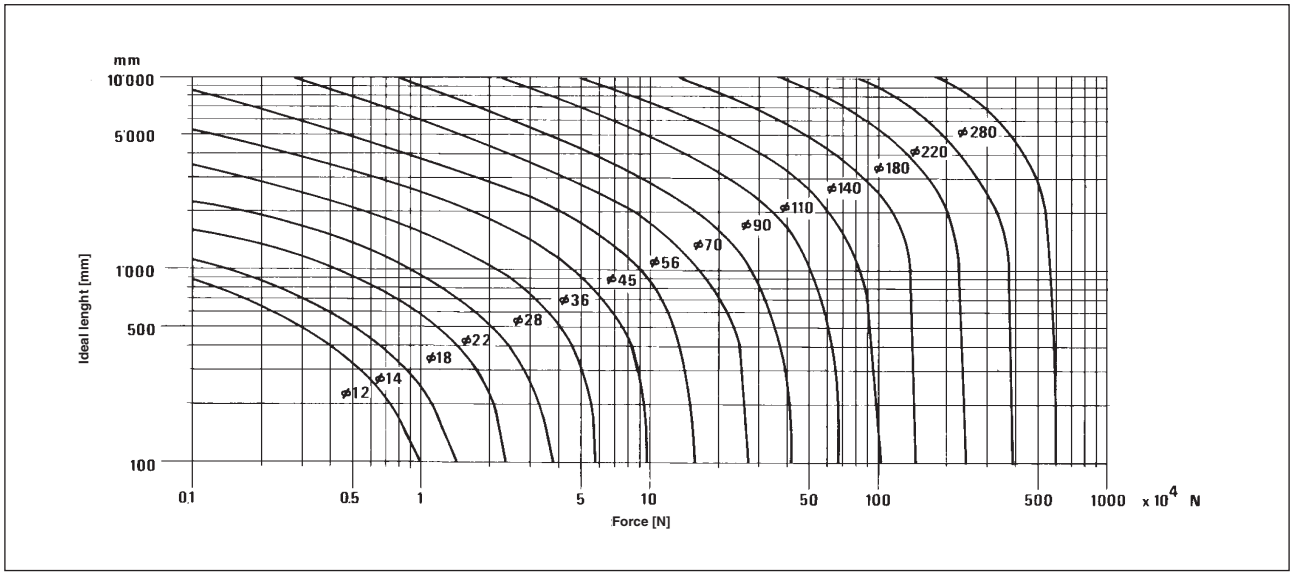
This check is performed considering the fully extended cylinder as a bar having the same diameter of the cylinder rod (safety criteria):

- Depending on the data for the mechanical connection of the cylinder to the structure, obtain the "**Fc** stroke factor" from table 4.1:
- Calcolate the "ideal length **Li**" multypling the factor Fc by the cylinder stroke L [mm]: **Li = L x Fc**
- Obtain on diagram 4.2 the point of intersection between the Li ideal length value and the max. force value (N) of the cylinder.
- The rod satisfying the verification at max. load conditions, is the one corresponding to the curve immediately above the intersection point found on diagram 4.2.

4.1 Fc stroke factor



4.2 Checking diagam



5 CHECK OF HYDRAULIC CUSHIONING

Introduction

Hydraulic cushions of cylinders are a kind of "dumpers" designed to dissipate the energy of a mass connected to the cylinder the rod and directed towards the cylinder stroke-end, reducing its velocity before the mechanical contact. This explains why cushions are advisable in case of rod translation speeds higher than 50 mm/sec, if no softening systems, external to the cylinder are used. Stroke-end cushionings greatly reduce mechanical shocks, increasing the average life of the cylinder and of the entire system.

The hydraulic cushion acts along a variable length, depending on cylinder bore, by isolating the oil volume contained in this section, identified as "Cushioning chamber".

The energy dissipation in the cylinder/mass system (cushioning) is obtained by causing the downflow of the oil volume inside the cylinder chamber by means of calibrated orifices.

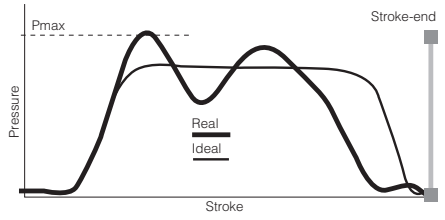
Functioning features

Cushioning proves to be most effective as the pressure inside the cushioning chamber gets close to the ideal behaviour described in the aside diagram.

Fig. 5.1 compares the ideal behaviour with Atos typical real pressure profile, achieved by optimizing the profile of the restricted orifices of the cushioning.

In this way high performances have been obtained in terms of dissipable energy and with great repeatability even with fluid viscosity variations due to temperature, or due to different types of fluids.

5.1 Pressure in the cushioning chamber



Another significant data to take into account is the maximum deceleration value produced by the cushioning (at the same quantity of energy dissipated), which can generate excessive inertia forces, which can be harmful to the cylinder.

Atos cushions profile is designed to exploit at the best the whole cushioning stroke and to perform a "soft" cushioning, where the maximum deceleration is limited and kept constant for its full length.

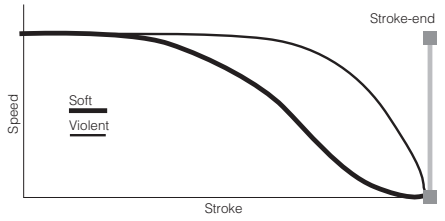
A "soft" cushioning reduces mechanical shocks which may damage mechanical parts inside or outside the cylinder, such as eyes, rod/piston, attachments, etc.

Fig. 5.2 compares the Atos "soft" cushioning with a typical "violent" cushioning.

The maximum pressure rate achieved in the cylinder chamber corresponds to the maximum cylinder deceleration and it directly depends to the speed at which the cylinder starts the cushioning phase.

Such pressure must never overcome the maximum value permitted.

5.2 Speed during cushioning



Application features

The guideline following reported referes to CK cylinders.
For cylinders CN, CC, CH big bore size, consult our technical office.

In order to allow the use of cushions in the various applications three different cushioning versions have been developed:

- Slow version, provided with adjustment, for speed V " 0,5 • Vmax;
- Fast version, without adjustment, for speed V > 0,5 • Vmax;
- Fast version, provided with adjustment, for speed V > 0,5 • Vmax;

The maximum permitted speed value Vmax depends to the cylinder bore and it is reported in tab. 5.5.

Cushions in “slow” version are always provided with adjustment, since used in slow speed conditions, this may result in excessive cushioning times increasing the machine cycle time. In fact it may happens that after a certain cushioning stroke, the cylinder speed is reduced at very low values and the time to approach the mechanical stroke-end could be excessive; the opening of the adjustment decreases the cushioning time, but it increases the speed in the remaining stroke of the cylinder before the stroke-end is reached, with a consequent decreasing of the cushioning effect.
On the opposit, the “fast” versions, suitable for high speeds, is less “flow restricted” and therefore has reduced cushioning times. They can be used in slow speeds as wel (V " 0,5 • Vmax); with the effect of having a very quick cushioning, perceivable only in last few millimetres before the stroke-end.
The “fast” version provided with adjustment allows to adapt with accuracy the cushioning effects and relevant times to the specific application requirements. Thanks to this characteristics it is advisable for cylinders with high speeds and low inertial loads.

Calculation procedures

Once the cushion is selected according to the cylinder translation time, will be necessary to check its compatibility with the specific application and particularly with the total energy to dissipated.

The total energy that the cushion must dissipate is given by the sum of the following three factors:
- Kinetic energy **Ec**, due to the mass speed;
- Hydraulic energy **Ei**, given by the pressure supplied to the cylinder;
- Potential energy **Ep**, due to the gravity and related to the cylinder inclination.

All the above factors are important and must be taken into consideration.

A summarizing scheme of the cylinder/mass system, as the same one reported in fig. 5.3 and 5.4, allows an easy and immediate dimensional check of the cushion. It is necessary to calculate the total energy to be dissipated **Etot** and compare it with the maximum permitted value **Emax** shown in table 5.5, according to the Bore/rod combination.
Parameters to be known are:

- Rod speed **V** [m/s], at which the cylinder begans the cushioning stroke;
- Supply pressure (actual value during cushioning stroke) **P** [bar];
- Inclination angle of the cylinder ;
- Mass connected to the rod **M** [Kg].

Proceed as follows:

To calculate the Kinetic Energy

Ec =1/2 • M • V^2 [Joule]

To calculate the Hydraulic Energy

For the verification of the rear cushion (fig. 5.3)

Ei =K • Lf • P • S1 [Joule]

For the verification of the front cushion (fig. 5.4)

Ei =K • Lf • P • S2 [Joule]

To calculate the Potential Energy

If the mass movement occurs as shown in fig. 5.3 and 5.4

$$Ep = +K \cdot Lf \cdot \left[\frac{M \cdot g \cdot \text{sen}(\alpha)}{10}\right] \quad \text{[Joule]}$$

If the mass movement occurs in the opposite direction compared to the ones of fig. 5.3 and 5.4.

$$Ep = -K \cdot Lf \cdot \left[\frac{M \cdot g \cdot \text{sen}(\alpha)}{10}\right] \quad \text{[Joule]}$$

Calculate the total energy to dissipate

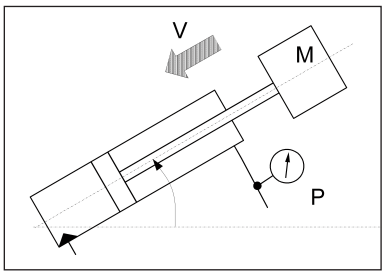
Etot = Ec + Ei + Ep [Joule]

Make sure that the obtained **Etot** value is lower or equal to the **Emax** value shown in tab. 5.5.

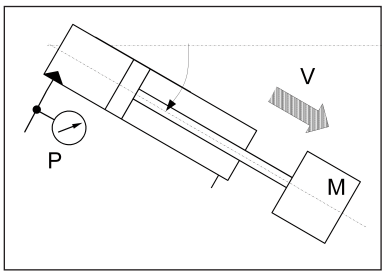
Notes: If a fast cushioning is selected for a slow moving cylinder, the verification related to the above mentioned criteria will have to be done by reducing by 30% the **Emax** value of tab. 5.5 (example: rear cushioning on a CK-50/28, use an **Emax** = 0,7 • 400 = 280 Joule).

If cushioning acts on the front cushion and the supply pressure P is higher than the **Pmax** shown in tab. 5.5, a deep analysis of the application is required, consult our technical department.

5.3 cushioning acting on the Rear Cushion



5.4 cushioning acting on the Front Cushion



K = Corrective coefficient (tab. 5.5)
S1 = Pull section in cm^2
S2 = Push section in cm^2
g = Gravity acceleration (9,81 m/s^2)
Lf = Cushion length in mm (tab. 5.5)

5.5 Calculation parameters

ø Piston [mm]	Vmax [m/s]	ø Rod [mm]	S1 Pull sect. [cm²]	S2 Push sect. [cm²]	Pmax [bar]	Front cushion				Rear cushion			
						K	Lf [mm]	Emax [Joule]	Cushioning Sect. [cm²]	K	Lf [mm]	Emax [Joule]	Cushioning Sect. [cm²]
25	1	12	3,8	4,9	180	0,0045	21	80	3,6	0,0035	12,5	80	4,5
		18	2,4		107	0,0057	17	60	2,1				
32	1	14	6,5	8,0	187	0,0033	23	140	6,0	0,0049	14,5	140	7,4
		22	4,2		122	0,0045	17	100	3,9				
40	1	18	10	12,6	173	0,0036	26	250	8,7	0,0027	27	300	11,9
		22	8,8		110	0,0044	25	150	5,5				
		28	6,4										
50	1	22	15,8	19,6	150	0,0035	28	350	13,5	0,0017	28	400	18,5
		28	13,5		106	0,0048	27	250	8,3				
		36	9,6										
63	0,8	28	25	31,2	160	0,0016	28	500	22,1	0,0016	27	600	29,1
		36	21		110	0,0040	27	350	13,8				
		45	15,3										
80	0,8	36	40,1	50,3	181	*	27	*	36,4	*	29	*	46,4
		45	34,4		118		29		23,8				
		56	25,6										
100	0,6	45	62,6	78,5	169	*	35	*	53	*	29	*	73,2
		56	53,9		120		27		37,8				
		70	40,1										
125	0,6	56	98,1	122,7	167	*	28	*	82	*	29,9	*	114
		70	84,2		105		25		51,8				
		90	59,1										
160	0,5	70	162,6	201,1	167	*	34	*	134,6	*	29,5	*	189
		90	137,4		127		31		102,5				
		110	106										
200	0,5	90	250,5	314,2	191	*	46	*	240,3	*	29,5	*	294
		110	219,2		168		33		215,6		30		
		140	160,2		120		46		151,3		29,5		

Pmax = maximum actual pressure allowable during the front cushioning stroke.
* consult our technical office.
For bore greater than Ø200 consult our technical office.

6 DYNAMIC LIMITS IN THE APPLICATION OF HYDRAULIC CYLINDERS

The calculation of pulsing value ωo of the cylinder-mass system, allows to define the minimum acceleration/deceleration time, the max. speed and the min. acceleration/deceleration space, wich do not affect the functional stability of the system.

System pulsation value ωo

$$\omega_o = \sqrt{\frac{40 \cdot E \cdot A_1}{c \cdot M}} \cdot \frac{1 + \sqrt{\alpha}}{2} \quad \left[\frac{rad}{sec}\right]$$

where:
E = oil modulus of elasticity ($1.4 \cdot 10^7$ kg/cm·s²)
c = stroke [mm]
M = mass [kg]
A_1 = piston section [cm²]
$\alpha = A_2/A_1$ annular/piston cross section ratio

Minimum acceleration time, see fig. 6.1

$$t_{min} = \frac{35}{\omega_o} \quad [s]$$

Maximum speed, see fig. 6.1

$$V_{max} = \frac{S_{tot}}{t_{tot} - t_{min}} \quad [mm/s]$$

where: S_{tot} = total space to run [mm]
t_{tot} = total time at disposal [s]

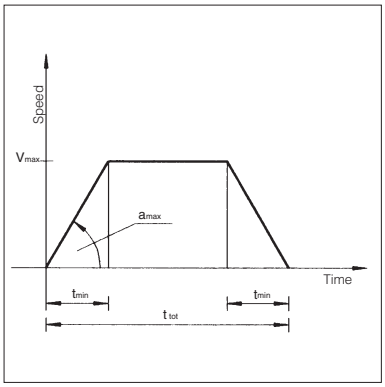
The formula is valid considering a constant acceleration value during t_{min}

Check that the maximum speed is according to the selected seals. See tab. B005.

Minimum acceleration/deceleration space

$$S_{min} = \frac{V_{max} \cdot t_{min}}{2} \quad [mm]$$

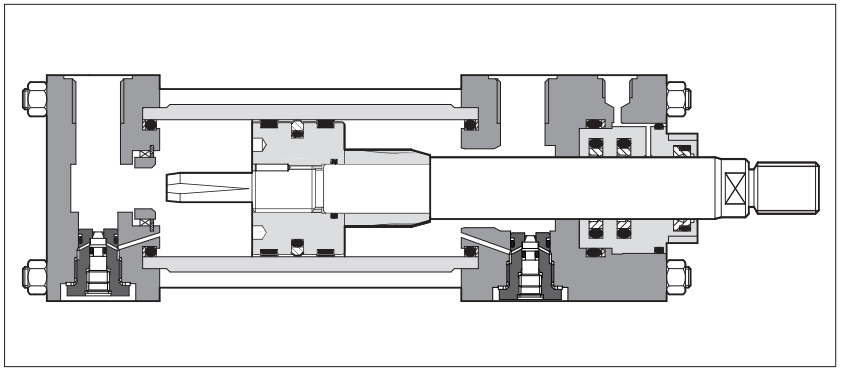
6.1 Positioning cycle



The ωo, and t_{min} values and so the V_{max} and S_{min} values are calculated in conservative way.
Check that the value S_{min} as above calculated is not higher than the length Lf indicated in tab. 5.5 for the selected cylinder bore.

Hydraulic cylinders type CK - square heads with tie rods

to ISO 6020-2 - nominal pressure 16 MPa (160 bar) - max 25 MPa (250 bar)



CK cylinders have engineered double acting construction, designed to suit the requirements of industrial applications: top reliability, high performances and long working life.

- Bore sizes from **25** to **200** mm
- Up to **3** rod diameters per bore
- Strokes up to **5000** mm
- Single or double rod
- Rods and tie rods with **rolled threads**
- **16** standard mounting styles
- **6** seals options
- Adjustable or fixed cushionings
- Optional built-in position transducer, **see tab. B310**
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

SWC Cylinders Designer
Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

1 MODEL CODE

CK	P	/	10	-	50	/	22	/	22	*	0500	-	S	3	0	1	-	A	-	B1E3X1Z3	**

Cylinder series
CK to ISO 6020 - 2

Rod position transducer
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive
Dimensions and performances see tab. B310

Incorporated subplate, see section 15
- = omit if subplate is not requested
10 = size 06
20 = size 10
30 = size 16
40 = size 25

Bore size, see section 3
from **25** to **200** mm

Rod diameter, see sections 6 and 9
from **12** to **140** mm

Second rod diameter for double rod, see section 10
from **12** to **140** mm, omit for single rod

Stroke, see section 4
up to **5000** mm
Quick deliveries available for selected strokes

Mounting style, see sections 2 and 3

		REF. ISO
C	fixed clevis	MP1 **(3)**
D	fixed eye	MP3 **(3)**
E	feet	MS2
G	front trunnion	MT1
H	rear trunnion	MT2 **(3)**
K	feet with key Ø 25÷63	-
L	intermediate trunnion	MT4 **(4)**
N	front flange	ME5
P	rear flange	ME6 **(3)**
S	fixed eye + spherical bearing	MP5 **(3)**
T	threaded hole+tie rods extended	MX7
V	rear tie rods extended	MX2
W	both end tie rods extended	MX1
X	basic execution	-
Y	front tie rods extended	MX3
Z	front threaded holes	MX5

Series number **(1)**

Heads' configuration (2), see section 13
Oil ports positions
B* = front head
X* = rear head
Cushioning adjustments positions, to be entered only if adjustable cushionings are selected
E* = front head
Z* = rear head
* = selected position (1, 2, 3 or 4)

Options (2):
Rod end, see section 6
F = female thread
G = light female thread
H = light male thread
Oversized oil ports, see section 11
D = front oversized oil port
Y = rear oversized oil port
Proximity sensors, see section 18
R = front sensor
S = rear sensor
Rod treatment, see section 9
K = nickel and chrome plating
T = induction surface hardening and chrome plating
Air bleeds, see section 16
A = front air bleed
W = rear air bleed
Draining, see section 17
L = rod side draining

Sealing system, see section 14
1 = (NBR + POLYURETHANE) high static and dynamic sealing
2 = (FKM + PTFE) very low friction and high temperatures
4 = (NBR + PTFE) very low friction and high speeds
6 = (NBR + PTFE) very low friction, single acting - pushing
7 = (NBR + PTFE) very low friction, single acting - pulling
8 = (NBR + PTFE and POLYURETHANE) low friction

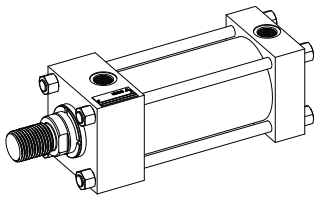
Spacer, see section 5
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

Cushionings, see section 12
0 = none

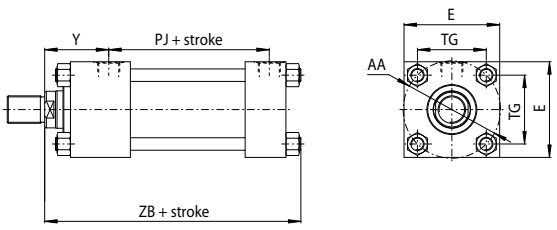
Fast adjustable	Slow adjustable	Fast fixed
1 = rear only	**4** = rear only	**7** = rear only
2 = front only	**5** = front only	**8** = front only
3 = front and rear	**6** = front and rear	**9** = front and rear

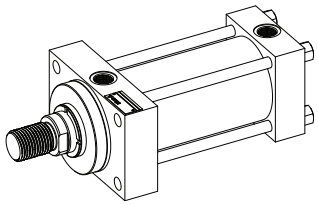
(1) For spare parts request indicate the series number printed on the nameplate only for series < 30
(2) To be entered in alphabetical order **(3)** Not available for double rod **(4)** XV dimension must be indicated in the model code, see section 3

2 MOUNTING STYLE - for dimensions see section 3

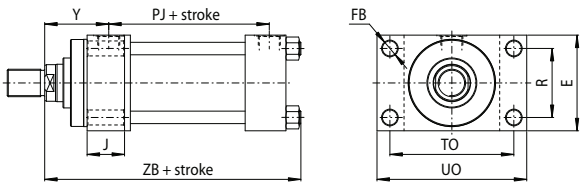


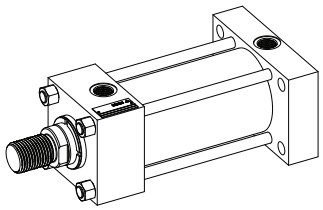
X = basic mounting



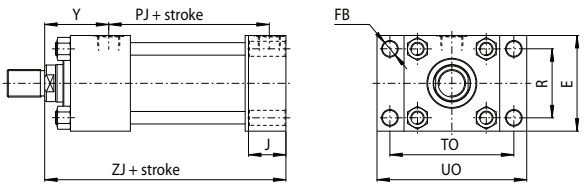


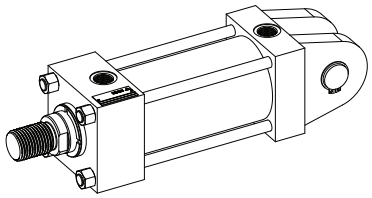
N (ISO ME5) = front flange mounting



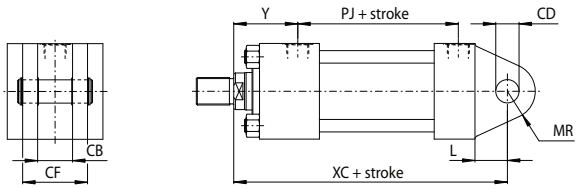


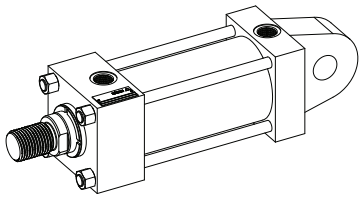
P (ISO ME6) = rear flange mounting



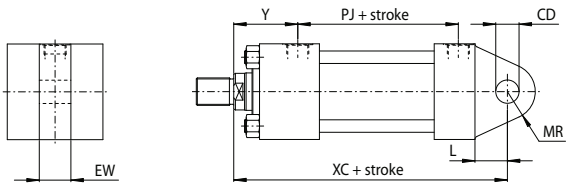


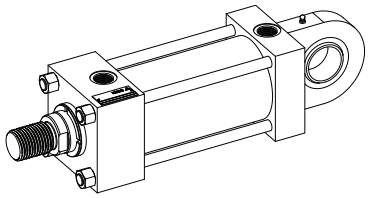
C (ISO MP1) = fixed clevis mounting - supplied with pivot pin C-145



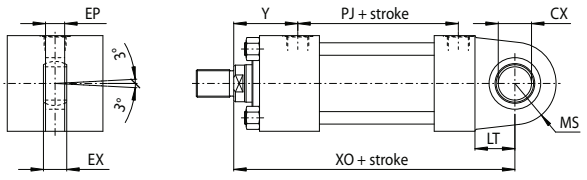


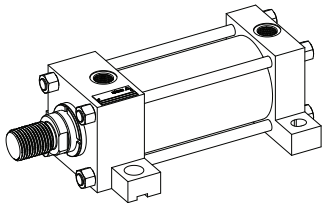
D (ISO MP3) = fixed eye mounting



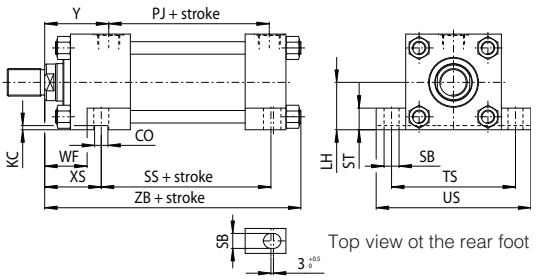


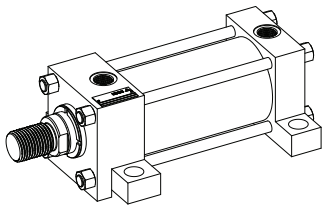
S (ISO MP5) = fixed eye with spherical bearing mounting



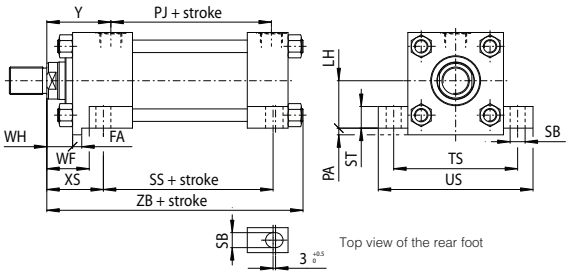


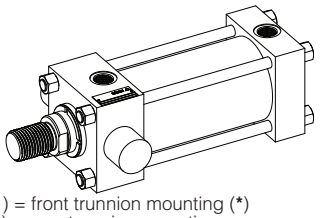
E (ISO MS2) = side feet mounting



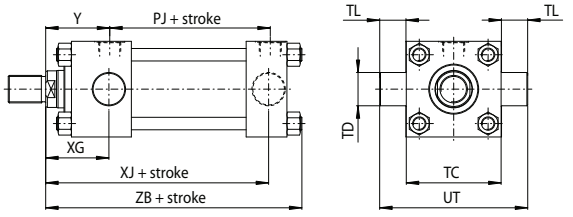


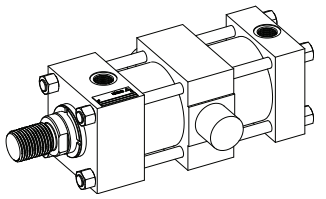
K = feet with key mounting (only for bores 25÷63)



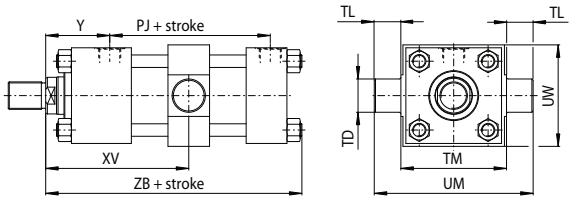


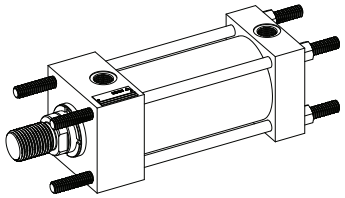
G (ISO MT1) = front trunnion mounting (*)
H (ISO MT2) = rear trunnion mounting
(*) see figure



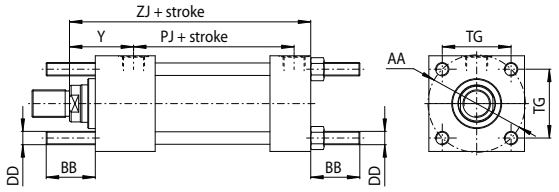


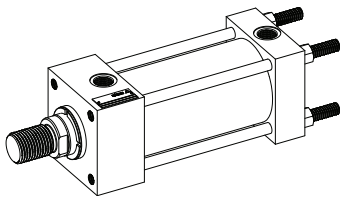
L (ISO MT4) = intermediate trunnion mounting



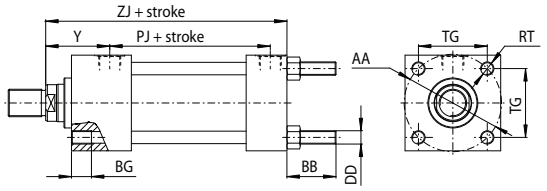


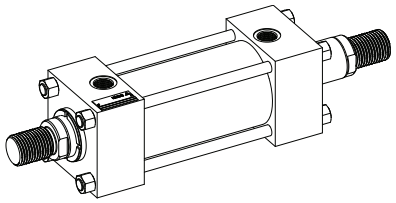
V (ISO MX2) = rear tie rods extended mounting
Y (ISO MX3) = front tie rods extended mounting
W (ISO MX1) = both end tie rods extended mounting (*)
(*) see figure



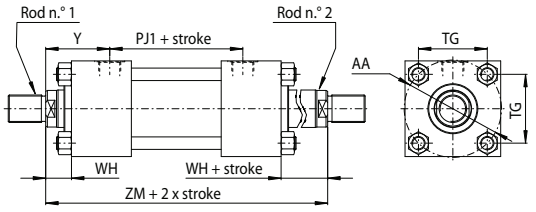


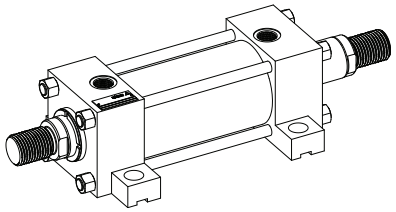
Z (ISO MX5) = front threaded holes mounting
T (ISO MX7) = threaded holes with tie rods extended mounting (*)
(*) see figure



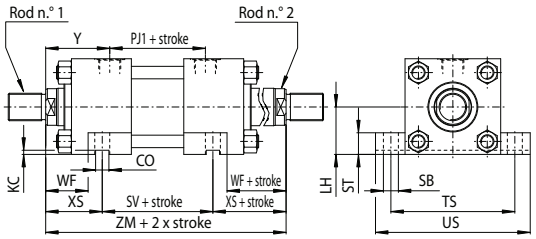


X = basic mounting for double rod





E = feet mounting for double rod



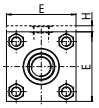
3 INSTALLATION DIMENSIONS [mm] - see figures in section 2

Ø Bore		25	32	40	50	63	80	100	125	160	200
Ø Rod	standard	12	14	18	22	28	36	45	56	70	90
	intermediate	NA	NA	22	28	36	45	56	70	90	110
	differential	18	22	28	36	45	56	70	90	110	140
AA		40	47	59	74	91	117	137	178	219	269
BB +3 / 0		19	24	35	46	46	59	59	81	92	115
BG min		8	9	12	18	18	24	24	27	32	40
CB A13		12	16	20	30	30	40	50	60	70	80
CD H9		10	12	14	20	20	28	36	45	56	70
CF max		25	34	42	62	62	83	103	123	143	163
CO N9		NA	NA	12	12	16	16	16	20	30	40
CX	value	12	16	20	25	30	40	50	60	80	100
	tolerance	0 -0,008		0 -0,012					0 -0,015		0 -0,02
DD 6g		M5x0,8	M6x1	M8x1	M12x1,25	M12x1,25	M16x1,5	M16x1,5	M22x1,5	M27x2	M30x2
E (1)		40±1,5	45±1,5	63±1,5	75±1,5	90±1,5	115±1,5	130±2	165±2	205±2	245±2
EP max		8	11	13	17	19	23	30	38	47	57
EW h14		12	16	20	30	30	40	50	60	70	80
EX		10 0/-0,12	14 0/-0,12	16 0/-0,12	20 0/-0,12	22 0/-0,12	28 0/-0,12	35 0/-0,12	44 0/-0,15	55 0/-0,15	70 0/-0,2
FA 0 / -0,075		8	8	8	14	14	NA	NA	NA	NA	NA
FB H13		5,5	6,6	11	14	14	18	18	22	26	33
H (2) max		5	5	NA	NA	NA	NA	NA	NA	NA	NA
J ref		25	25	38	38	38	45	45	58	58	76
L min		13	19	19	32	32	39	54	57	63	82
LH h10		19	22	31	37	44	57	63	82	101	122
LT min		16	20	25	31	38	48	58	72	92	116
KC min		NA	NA	4	4,5	4,5	5	6	6	8	8
M (3)		1000	1200	1500	1800	2300	3000	3500	3500	3500	3500
MR max		12	17	17	29	29	34	50	53	59	78
MS max		20	22,5	29	33	40	50	62	80	100	120
PA 0 / -0,2		5	5	5	8	8	NA	NA	NA	NA	NA
PJ (4) ±1,5 (6)		53	56	73	74	80	93	101	117	130	165
PJ1 ±1,5 (6)		54	58	71	73	81	92	101	117	130	160
PJ2 (4) ±1,5 (6)		53	57	73	76	80	93	99	121	143	167
R js13		27	33	41	52	65	83	97	126	155	190
RT		M5x0,8	M6x1	M8x1,25	M12x1,75	M12x1,75	M16x2	M16x2	M22x2,5	M27x3	M30x3,5
SB H13		6,6	9	11	14	18	18	26	26	33	39
SS ±1,25 (6)		72	72	97	91	85	104	101	130	129	171
ST js13		8,5	12,5	12,5	19	26	26	32	32	38	44
SV ±1,25 (6)		88	88	105	99	93	110	107	131	130	172
TC h14		38	44	63	76	89	114	127	165	203	241
TD f8		12	16	20	25	32	40	50	63	80	100
TG js13		28,3	33,2	41,7	52,3	64,3	82,7	96,9	125,9	154,9	190,2
TL js13		10	12	16	20	25	32	40	50	63	80
TM h14		48	55	76	89	100	127	140	178	215	279
TO js13		51	58	87	105	117	149	162	208	253	300
TS js13		54	63	83	102	124	149	172	210	260	311
UM ref		68	79	108	129	150	191	220	278	341	439
UO max		65	70	110	130	145	180	200	250	300	360
US max		72	84	103	127	161	186	216	254	318	381
UT ref		58	68	95	116	139	178	207	265	329	401
UW max		45	50	70	88	98	127	141	168	205	269
XC ±1,5 (6)		127	147	172	191	200	229	257	289	308	381
XG ±2 (6)		44	54	57	64	70	76	71	75	75	85
XJ ±1,5 (6)		101	115	134	140	149	168	187	209	230	276
XO ±1,5 (6)		130	148	178	190	206	238	261	304	337	415
XS ±2 (6)		33	45	45	54	65	68	79	79	86	92
XV (5) ±2 (6)	style L minimum stroke	5	5	5	15	20	20	35	35	35	35
	min	77	90	100	109	120	129	148	155	161	195
	max	75+stroke	86+stroke	99+stroke	98+stroke	100+stroke	115+stroke	117+stroke	134+stroke	141+stroke	166+stroke
Y (4) ±2 (6)		50	60	62	67	71	77	82	86	86	98
Y1 (4) ±2 (6)		49,5	59,5	63	65,5	70	75,5	83	84	79,5	97
ZB max		121	137	166	176	185	212	225	260	279	336
ZJ ±1 (6)		114	128	153	159	168	190	203	232	245	299
ZM ±2 (6)		154	178	195	207	223	246	265	289	302	356

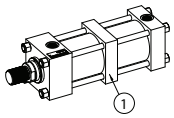
NOTES TO TABLE 3

(1) **E** - If not otherwise specified in the figures in section 2, this value is the front and rear square heads dimension for all the mounting styles (see figure below)

(2) **H** - This additional dimension has to be considered only for bores 25 and 32



(3) **M** - For strokes longer than M, one or more intermediate tie rods supports ① are fitted on the cylinder housing to maintain the radial tension on the tie rods, thus keeping them rigidly fixed to the cylinder housing. The support has the same overall dimensions of the square heads as indicated in note (1)



(4) When oversized oil ports are selected (see section 11 and 13 for dimensions and position) dimensions **PJ** and **Y** are respectively modified into **PJ2** and **Y1**

(5) **XV** - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table.
The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CK - 50 / 22 * 0500 - L301 - D - B1E3X1Z3
XV = 200

(6) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is given by the max stroke tolerance in section 4

4 STROKE SELECTION

Stroke has to be selected a few mm longer than the working stroke, to prevent to use the cylinder heads as mechanical stroke-end.

Standard strokes to ISO 4393

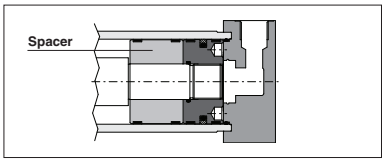
25	50	80	100	125	160	200	250
320	400	500	630	800	1000	1250	

Maximum stroke:
- 2600 mm for bores up to 40 mm
- 5000 mm for other bores

Stroke tolerances:
- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

5 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in section 3.



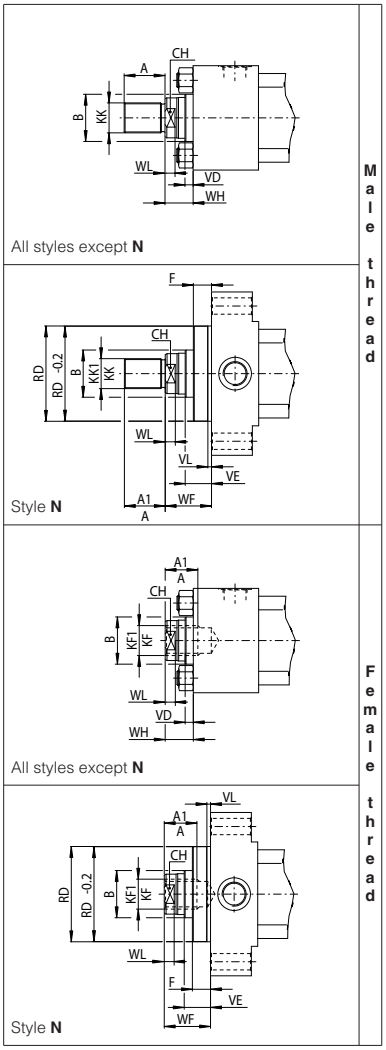
RECOMMENDED SPACERS [mm]

Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 5000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

6 ROD END DIMENSIONS [mm]

Ø Bore	Ø Rod	Male thread		Female thread		A	A1	B	CH	F	RD	VD	VE	VL	WF	WH	WL
		KK	KK1 (option **H**)	KF (option **F**)	KF1 (option **G**)	(KK or KF) **(1)**	(KK1 or KF1) **(1)**										
		6g	6g	6H	6H			f9	h14	max	f8		max	min	±2	±2	min
25	**12**	M10x1,25	NA	M8x1	NA	14	NA	24	10	10	38	6	16	3	25	15	5
	18	M14x1,5	M10x1,25	M12x1,25	M8x1	18	14	30	15	10	38	6	16	3	25	15	5
32	**14**	M12x1,25	NA	M10x1,25	NA	16	NA	26	12	10	42	12	22	3	35	25	5
	22	M16x1,5	M12x1,25	M16x1,5	M10x1,25	22	16	34	19	10	42	9	19	3	35	25	5
40	**18**	M14x1,5	NA	M12x1,25	NA	18	NA	30	15	10	62	6	16	3	35	25	5
	22(2)	M16x1,5	NA	M16x1,5	NA	22	NA	34	19	10	62	12	22	3	35	25	5
	28	M20x1,5	M14x1,5	M20x1,5	M12x1,25	28	18	42	22	10	62	12	22	3	35	25	7
50	**22**	M16x1,5	NA	M16x1,5	NA	22	NA	34	19	16	74	9	25	4	41	25	5
	28(2)	M20x1,5	NA	M20x1,5	NA	28	NA	42	22	16	74	9	25	4	41	25	7
	36	M27x2	M16x1,5	M27x2	M16x1,5	36	22	50	30	16	74	9	25	4	41	25	8
63	**28**	M20x1,5	NA	M20x1,5	NA	28	NA	42	22	16	75	13	29	4	48	32	7
	36(2)	M27x2	NA	M27x2	NA	36	NA	50	30	16	88	13	29	4	48	32	8
	45	M33x2	M20x1,5	M33x2	M20x1,5	45	28	60	39	16	88	13	29	4	48	32	10
80	**36**	M27x2	NA	M27x2	NA	36	NA	50	30	20	82	9	29	4	51	31	8
	45(2)	M33x2	NA	M33x2	NA	45	NA	60	39	20	105	9	29	4	51	31	10
	56	M42x2	M27x2	M42x2	M27x2	56	36	72	48	20	105	9	29	4	51	31	10
100	**45**	M33x2	NA	M33x2	NA	45	NA	60	39	22	92	10	32	5	57	35	10
	56(2)	M42x2	NA	M42x2	NA	56	NA	72	48	22	125	10	32	5	57	35	10
	70	M48x2	M33x2	M48x2	M33x2	63	45	88	62	22	125	10	32	5	57	35	10
125	**56**	M42x2	NA	M42x2	NA	56	NA	72	48	22	105	10	32	5	57	35	10
	70(2)	M48x2	NA	M48x2	NA	63	NA	88	62	22	150	7	29	5	57	35	10
	90	M64x3	M42x2	M64x3	M42x2	85	56	108	80	22	150	7	29	5	57	35	15
160	**70**	M48x2	NA	M48x2	NA	63	NA	88	62	25	125	7	32	5	57	32	10
	90(2)	M64x3	NA	M64x3	NA	85	NA	108	80	25	170	7	32	5	57	32	15
	110	M80x3	M48x2	M80x3	M48x2	95	63	133	100	25	170	7	32	5	57	32	15
200	**90**	M64x3	NA	M64x3	NA	85	NA	108	80	25	150	7	32	5	57	32	15
	110(2)	M80x3	NA	M80x3	NA	95	NA	133	100	25	210	7	32	5	57	32	15
	140	M100x3	M64x3	M100x3	M64x3	112	85	163	128	25	210	7	32	5	57	32	15

Notes: (1) Dimensions **A** and **A1** are according to ISO 4395 short type.
Tolerances: max for male thread; min for female thread
(2) Not included in ISO standard



7 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in "cold drawn and stressed steel" with Rs = 450 N/mm²; the internal surfaces are lapped: diameter tolerance H8, roughness Ra ≤ 0,25 µm.

8 TIE RODS FEATURES

The cylinder's tie rods are made in "normalized automatic steel" with Rs = 610 N/mm²; end-threads are rolled to improve the fatigue working life. They are screwed to the heads or mounted by means of nuts with a prefixed tightening torque MT, see the table at side.

TIE RODS TIGHTENING TORQUES

Ø Bore	**25**	**32**	**40**	**50**	**63**
MT [Nm]	5	9	20	70	70
Wrench	8	10	13	19	19
Ø Bore	**80**	**100**	**125**	**160**	**200**
MT [Nm]	160	160	460	820	1160
Wrench	24	24	32	41	46

9 RODS FEATURES and options

The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure. The rod surface is chrome plated: diameter tolerances f7; roughness Ra ≤ 0,25 µm. Corrosion resistance of 200 h in neutral spray to ISO 9227 NSS

ø Rod	Material	Rs min [N/mm²]	Chrome	
			min thickness [mm]	hardness [HV]
12÷90	hardened and tempered alloy-steel	700	0,020	850-1150
110÷140	alloy steel	450		

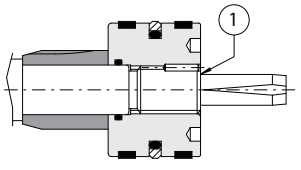
Rod diameters from 12 to 70 mm have rolled threads; in rolling process the component material is stressed beyond its yield point, being deformed plastically. This offers many technical advantages: higher profile accuracy, improved fatigue working life and high wear resistance. See **tab. B015** for the calculation of the expected rod fatigue life. The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the table 6. The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing. **Contact our technical office** in case of heavy duty applications.

Rod corrosion resistance and hardness can be improved selecting the options **K** and **T** (option K affects the strength of standard rod, see **tab. B015** for the calculation of the expected rod fatigue life):
K = Nickel and chrome-plating (for rods from 22 to 110 mm)
Corrosion resistance (rating 10 to ISO 10289):
- 350 h in acetic acid salt spray to ISO 9227 AASS
- 1000 h in neutral spray to ISO 9227 NSS

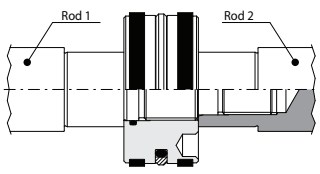
T = Induction surface hardening and chrome plating
- 56-60 HRC (613-697 HV) hardness

ROD-PISTON COUPLING

Single rod



Double rod



10 DOUBLE ROD

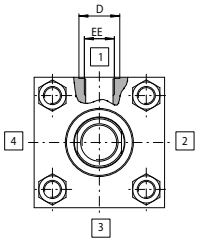
Double rod cylinders ensure the same pushing and pulling areas, thus the same speeds and forces. Rod2 (see figure at side) is screwed into the male thread of Rod1, consequently the Rod2 is weaker than the other and it is strongly recommended to use this one only to compensate the areas; the stronger rod is identified by the number '1' stamped on its end. For double rod cylinders, rod end dimensions indicated in section 6 are valid for both the rods.

11 OIL PORTS AND ROD SPEEDS

The fluid speed in pipings connected to the cylinder oil ports should not exceed 6 m/s in order to minimize the turbolence flow, the pressure drop and water hammer. The table below shows the max recommended rod speed relative to 6 m/s flow velocity.
In high dynamic systems the rod can reach even higher speeds (after a careful check of dampable masses, **see tab. B015**): in these cases it is recommended to use piping's diameters larger than the cylinder oil ports and to introduce proper reductions just near the cylinder oil ports.

Oil ports features are threaded according to ISO 1179-1 (GAS standards) with counterbore dimension D type N (narrow).
Oil ports with SAE 3000 flanges are available on request, **contact our technical office.**

Ø Bore	Standard oil ports				Oversized oil ports **D**, **Y** options			
	D [mm]	**EE** 6g	Internal pipe Ø[mm] min	Rod speed V [m/s]	**D** [mm]	**EE** 6g	Internal pipe Ø[mm] min	Rod speed V [m/s]
25	21	G 1/4	7,5	0,54	25	G 3/8	9	0,77
32	21	G 1/4	7,5	0,33	25	G 3/8	9	0,47
40	25	G 3/8	9	0,30	29	G 1/2	14	0,73
50	29	G 1/2	14	0,47	36	G 3/4	16	0,61
63	29	G 1/2	14	0,30	36	G 3/4	16	0,39
80	36	G 3/4	16	0,18	42	G 1	20	0,37
100	36	G 3/4	16	0,15	42	G 1	20	0,24
125	42	G 1	20	0,15	52	G 1 1/4	30	0,34
160	42	G 1	20	0,09	52 (1)	G 1 1/4 (1)	30	0,21
200	52	G 1 1/4	30	0,13	58	G 1 1/2	40	0,24



Note to table:
(1) For mounting styles C, D, E, N, P, S the dimension **PJ2** reported in section 3 is modified, contact our technical office.

12 CUSHIONINGS

Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is necessaty to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side). Two types of cushioning are available depending to the rod speed V:

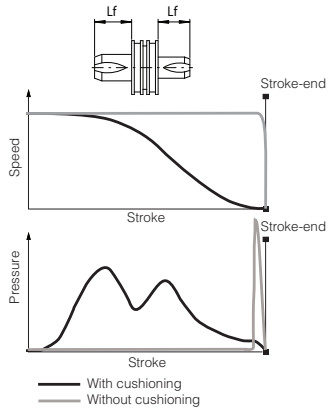
Slow version for $V \leq 0.5 \cdot V_{max}$

Fast version for $V > 0.5 \cdot V_{max}$

See the table below for V_{max} values and **tab. B015** for the max damping energy.
When fast or slow adjustable versions are selected, the cylinder is provided with needle valve to optimize cushioning performances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect).
In case of high masses and/or very high operating speeds it is recommended to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

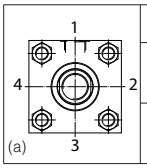
Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.

Ø Bore		**25**		**32**		**40**		**50**		**63**		**80**		**100**		**125**		**160**		**200**	
Ø Rod		**12**	**18**	**14**	**22**	**18**	**22 28**	**22**	**28 36**	**28**	**36 45**	**36**	**45 56**	**45**	**56 70**	**56**	**70 90**	**70**	**90 110**	**90 140**	**110**
Cushioning length [mm]	Lf front	21	17	23	17	26	25	28	27	28	27	27	29	35	27	28	25	34	34	49	34
	Lf rear	13		15		27		28		30		32		32		32		41		56	
V_{max} [m/s]		1		1		1		1		0,8		0,8		0,6		0,6		0,5		0,5	



13 POSITION COMBINATION FOR OIL PORTS AND CUSHIONING ADJUSTMENTS

FRONT HEAD: **B*** = oil port position; **E*** = cushioning adjustment position REAR HEAD: **X*** = oil port position; **Z*** = cushioning adjustment position
The table below shows all the available configurations for the oil port and cushioning adjustment positions. Bolt characters identify the standard positions. Each configuration for the front head can be variously combined with any one of the rear head. Cushioning adjustment positions **E***, **Z*** have to be entered only if adjustable cushionings are selected.
Example of model code: CK-50/22 *0100-S301 - A - **B2E3X1Z4**

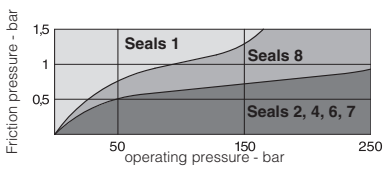


Mounting style			**C, D, S, L**							**E, K**		**G**		**H**		**N, P**			**T, V, W, X, Y, Z**			
FRONT HEAD	Oil port side	**B**	**1**	1	2	1	2	4	3	**1**	1	**1**		**1**	2	**1**	1	2●	**1**	1	2	3
	Cushioning adjustment side	**E**	**3**	2	3	4	4	3	1	**2**	4	**3**		**3**	4	**3**	2●	3	**3**	4	3	1
REAR HEAD	Oil port side	**X**	**1**	1	2	1	2	4	3	**1**	1	**1**	2	**1**		**1**	1	2●	**1**	1	2	3
	Cushioning adjustment side	**Z**	**3**	2	3	4	4	3	1	**2**	4	**3**	4	**3**		**3**	2●	3	**3**	4	3	1

● Not available for bores 25 and 32. Dimensions **PJ, PJ2, Y** and **Y1** change compared to the values in section 3, contact our technical office
(a) Front view rod side (rod n°1 for double rods)
Contact our technical office for combinations not included in the table.

14 SEALING SYSTEM FEATURES

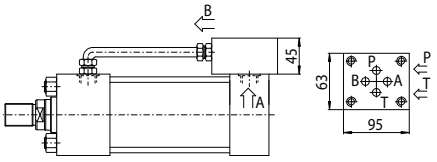
The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature. Additional verifications about minimum in/out rod speed ratio, static and dynamic sealing friction are warmly suggested, see **tab. B015**.
When single acting seals are selected (types **6** and **7**), the not pressurized cylinder's chamber must be connected to the tank. Special sealing system for low temperatures, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see section 22. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition. See section 19 for fluid requirements.



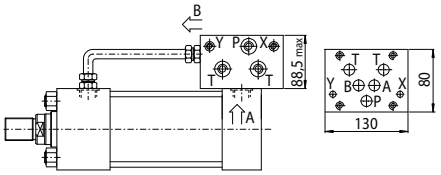
Sealing system	**Material**	**Features**	**Max speed [m/s]**	**Fluid temperature range**	**Fluids compatibility**	**ISO Standards for seals**	
						Piston	**Rod**
1	NBR + POLYURETHANE	**high static and dynamic sealing**	0.5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 5597/1
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%) , HFD-U,HFD-R	ISO 7425/1	ISO 7425/2
4	NBR + PTFE	**very low friction and high speeds**	4	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
6 - 7	NBR + PTFE	**very low friction single acting - pushing/pulling**	1	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
8	PTFE + NBR + POLYURETHANE	**low friction**	0,5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 7425/2

15 INCORPORATED SUBPLATE

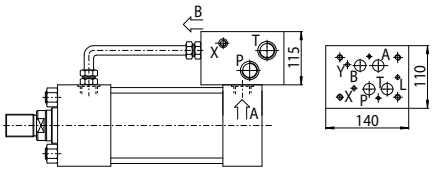
CK cylinders with oil ports positions 1 can be supplied with ISO (size 06, 10, 16 and 25) incorporated subplates for mounting of valves directly on the cylinder.



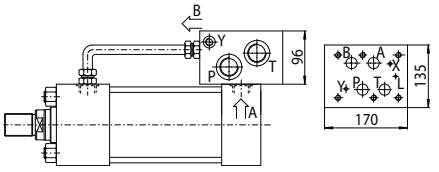
10 = subplate with mounting surface 4401-03-02-0-05 (size 06)
Oil ports P and T = G 3/8
For bores from 40 to 200 and strokes longer than 100 mm
For shorter strokes, the cylinder must be provided with suitable spacer



20 = subplate with mounting surface 4401-05-05-0-05 (size 10)
Oil ports P and T = G 3/4; X and Y = G 1/4
For bores from 40 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer



30 = subplate with mounting surface 4401-07-07-0-05 (size 16)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 80 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer

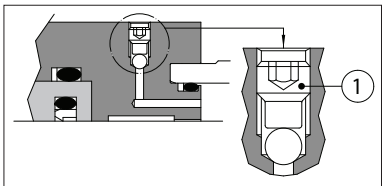


40 = subplate with mounting surface 4401-08-08-0-05 (size 25)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 125 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer

Note: for the choice of suitable spacer see section 5. The addition of spacer length and working stroke must be at least equal or upper than the minimum stroke indicated above, see the following example:
Subplate **20**; working stroke = **70** mm; min. stroke = **150** mm ⟶ select spacer **4** (lenght = **100**mm)

16 AIR BLEEDS

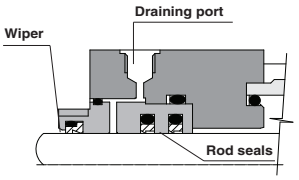
CODES: **A** = front air bleed; **W** = rear air bleed
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves are recommended to realize this operation easily and safely. Air bleeds are usually positioned on the opposite side of the oil port except for front heads of mounting styles **N**, **G** (on side 3), rear heads of mounting styles **C**, **D**, **S**, **H**, **P** (on side 3) and for heads of mounting style **E** (on side 2), see section 13. For cylinders with adjustable cushionings the air bleeds are positioned on the same side of the cushioning adjustment screw. For Servocylinders, cylinders with incorporated subplates or proximity sensors, air bleeds are supplied as standard and they must not be entered in the model code. For cylinders with proximity sensors, air bleeds A, W or AW are supplied respectively depending on the selected sensors R, S or RS. For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
25 - 40	M5 x 4	8 Nm
50 - 200	M8 x 10	20 Nm

17 DRAINING

CODE: **L** = rod side draining
The rod side draining reduces the seals friction and increases their reliability; it is mandatory for cylinders with strokes longer than 2000 mm, with rod side chamber constantly pressurized and for servocylinders.The draining is positioned on the same side of the oil port, between the wiper and the rod seals (see figure at side) and it can be supplied only with sealing system: **1**, **2**, **4**, **7** and **8**. It is recommended to connect the draining port to the tank without backpressure.
Draining port is G1/8.

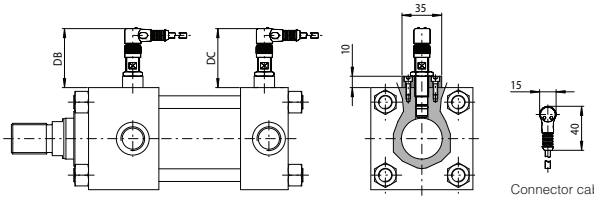


18 PROXIMITY SENSORS

CODES: **R** = front sensor; **S** = rear sensor
Proximity sensors functioning is based on the variation of the magnetic field, generated by the sensor itself, when the cushioning piston enters on its influence area, causing a change of state (on/off) of the sensors. The distance from the mechanical stroke-end of the cylinder, at which occurs the switching of the sensor's electrical contact, can be adjusted between 1 and 3 mm. For their regulation, it is necessary to position the rod where it is desired to obtain the contact switching and rotate the sensor until its LED switch-on (commutation occurred). The sensors tightening torque must be lower than 40 N/m to avoid damages. The sensors must always be coupled with fast adjustable cushioning, see section 12, to avoid pressure peaks on stroke-end. They are positioned on side 4 and they can be coupled with the standard oil ports and cushioning adjustments positions in bolt characters, see section 13. The coupling of the proximity sensors with the stroke-end cushioning imposes particular executions with limitation of the damping masses and/or speeds compared to the executions with standard cushioning.

Limitations
R, **S** options not available for cylinders with bores smaller then 40 mm.
R option not available for G and N mounting styles; **S** option not available for P and H mounting styles.

Ø Bore	40	50	63	80	100	125	160	200
DB max	77	75	72	74	73	71	71	67
DC	67	71	65	71	65	51	34	20

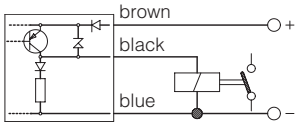


Connector cable lenght: 5m

SENSORS TECHNICAL DATA

The proximity sensors are inductive type, they supply a "NO" (Normally Open) output signal which status corresponds to the rod position:
- **R, S** = close contact = 24 Volt at output contacts = rod positioned at stroke ends
- **R**, **S** = open contact = 0 Volt at output contacts = rod not positioned at stroke ends

Ambient temperature	-20 +70°C
Nominal voltage	24 VDC
Operating voltage	10…30 VDC
Max load	200 mA
Version	PNP
Output type	NO
Repeatability	<5%
Hysteresis	<15%
Protection	IP68
Max pressure	25 MPa (250 bar)



19 FLUID REQUIREMENTS

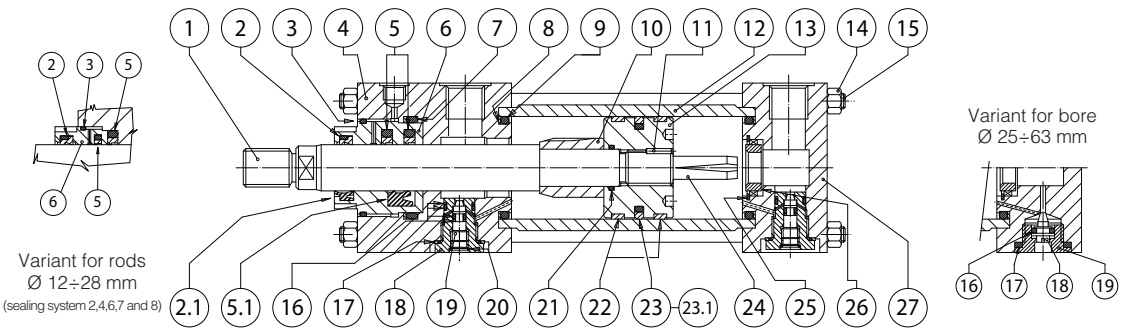
Cylinders and servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). The fluid must have a viscosity within 15 and 100 mm^2/s, a temperature within 0 and 70°C and fluid contamination class ISO 19/16 according to ISO 4406, achieved with in-line filters at 25 µm.

20 CYLINDERS MASSES [kg] (tolerance ± 5%)

		MASS FOR STYLES X, Z Single rod		MASS FOR STYLES X, Z Double rod		ADDITIONAL MASSES according to mounting styles and options											
Ø Bore [mm]	**Ø Rod** [mm]	Stroke 100 mm	Each added 100 mm	Stroke 100 mm	Each added 100 mm	Style **C**	Style **D**	Style **E**	Style **G**	Style **K**	Style **L**	Style **N**	Style **P**	Style **S**	Styles **V Y**	Style **W**	Each cush-ioning	Each 50 mm spacer
25	**12**	1,65	0,47	1,95	0,56	0,08	0,068	0,22	- 0,02	0,1	0,19	0,18	0,18	0,08	0,01	0,02	0,03	0,38
	18	1,80	0,58	2,40	0,78													
32	**14**	2,23	0,49	2,69	0,61	0,17	0,15	0,24	0,02	0,16	0,29	0,18	0,18	0,14	0,02	0,04	0,04	0,50
	22	2,51	0,67	3,21	0,97													
40	**18**	4,90	0,79	6,78	0,99	0,27	0,22	0,256	0,08	0,2	0,78	0,76	0,76	0,57	0,06	0,12	0,07	0,79
	22	5,15	0,89	7,19	1,19													
	28	5,40	1,07	7,60	1,55													
50	**22**	6,40	1,18	7,85	1,48	0,84	0,74	0,52	0,28	0,39	1,46	1,1	1,1	0,31	0,16	0,32	0,13	1,15
	28	6,59	1,37	8,23	1,85													
	36	7,20	1,68	9,45	2,48													
63	**28**	8,70	1,62	11,08	2,10	0,52	0,41	1,54	0,26	1,25	2,17	1,34	1,34	0,46	0,16	0,32	0,25	1,68
	36	9,13	1,93	11,94	2,73													
	45	9,80	2,39	13,64	3,64													
80	**36**	17,00	2,96	20,45	3,76	1,25	0,79	1,23	1,63	NA	3,67	2,39	2,39	0,86	0,34	0,68	0,40	2,85
	45	17,76	3,46	21,97	4,71													
	56	18,10	4,09	23,90	6,02													
100	**45**	23,80	3,90	29,85	5,15	3,05	2,31	1,63	1,00	NA	5,46	2,94	2,94	1,77	0,34	0,68	0,60	4,15
	56	24,70	4,6	32,01	6,53													
	70	26,00	5,68	35,20	8,70													
125	**56**	43,60	6,15	53,60	8,08	3,95	2,87	4,60	1,50	NA	8,60	5,65	5,65	4,65	0,90	1,80	1,15	6,61
	70	45,24	7,25	58,55	10,27													
	90	49,62	9,21	72,88	14,20													
160	**70**	74,55	8,75	85,96	11,77	8,33	7,63	7,56	4,66	NA	16,58	7,97	7,97	8,21	1,50	3,00	1,85	10,75
	90	79,31	10,72	96,08	15,71													
	110	83,90	13,18	106,20	20,64													
200	**90**	123,60	12,50	136,52	17,49	10,00	13,82	14,60	9,86	NA	37,00	16,78	16,82	14,80	2,50	5,00	2,50	15,86
	110	130,39	14,52	142,65	21,98													
	140	137,19	19,14	148,78	31,22													

Note: the masses related to the other options, not indicated in the table, don't have a relevant influence on the cylinder's mass

21 CYLINDER SECTION



POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL
1	Rod	Chrome plated steel	9	O-ring	NBR / FKM	19	Cushioning adjustment screw	Steel
2	Wiper	NBR / FKM and PTFE	10	Front cushioning piston	Steel	20	Seeger	Steel
2.1	Wiper (G1)	Polyurethane	11	Screw stop pin	Steel	21	O-ring	NBR / FKM
3	O-ring	NBR / FKM	12	Cylinder housing	Steel	22	Piston guide ring	PTFE or phenolic resin
4	Front head	Steel / cast iron	13	Piston	Steel	23	Piston seal	NBR / FKM and PTFE
5	Rod seal	NBR / FKM and PTFE	14	Nut	Steel	23.1	Piston seal (G1)	NBR and Polyurethane
5.1	Rod seal (type G1)	Polyurethane	15	Tie rod	Steel	24	Rear cushioning piston	Steel
6	Rod bearing	Bronze	16	O-ring and anti-extrusion ring	FKM and PTFE	25	Toroidal ring	Steel
7	O-ring and anti-extrusion ring	NBR / FKM and PTFE	17	Seal	FKM	26	Rear cushioning sleeve	Bronze
8	Anti-extrusion ring	PTFE	18	Cushioning adjustment plug	Steel	27	Rear head	Steel / cast iron

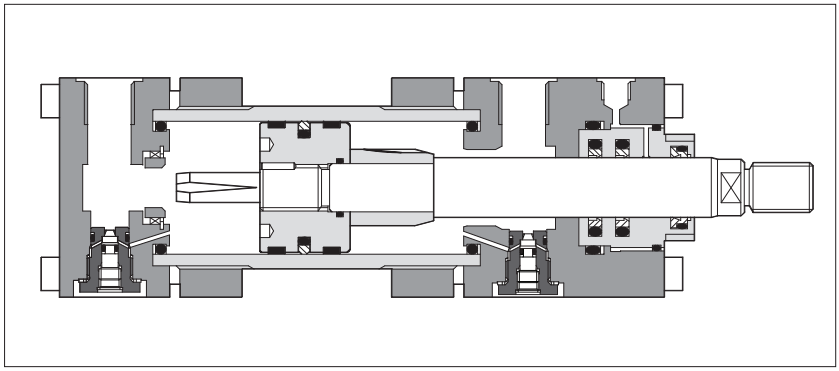
22 SPARE PARTS - SEE TABLE SP-B137

Example for seals spare parts code

G 8	-	C K	-	50	/	22	/	22	-	26
Sealing system								Second rod diameter for double rod [mm] Omit if not requested		Serial number (indicate only for series <30)
		Cylinder series								
				Bore size [mm]						
						Rod diameter [mm]				

Hydraulic cylinders type CH - square heads with counterflanges

to ISO 6020-2 - nominal pressure 16 MPa (160 bar) - max 25 MPa (250 bar)



SWC Cylinders Designer
Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

CH cylinders have engineered double acting construction, designed to suit the requirements of industrial applications: top reliability, high performances and long working life.

- Bore sizes from **63** to **200** mm
- **3** rod diameters per bore
- Strokes up to **5000** mm
- Single or double rod
- Rods with **rolled threads**
- **9** standard mounting styles
- **6** seals options
- Adjustable or fixed cushionings
- Optional built-in position transducer, **see tab. B310**
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

1 MODEL CODE

CH	P	/	10	-	63	/	28	/	28	*	0500	-	S	3	0	1	-	A	-	B1E3X1Z3	**

Cylinder series
CH to ISO 6020 - 2

Rod position transducer
- = omit if not requested
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive
Transducer available on request, contact our technical office

Incorporated subplate, see section 15
- = omit if subplate is not requested
10 = size 06
20 = size 10
30 = size 16
40 = size 25

Bore size, see section 3
from **63** to **200** mm

Rod diameter, see sections 7 and 9
from **28** to **140** mm

Second rod diameter for double rod, see section 10
from **28** to **140** mm, omit for single rod

Stroke, see section 5
up to **5000** mm

Mounting style, see sections 2 and 3

		REF. ISO
D	fixed eye	MP3 **(3)**
E	feet	MS2
G	front trunnion	MT1
H	rear trunnion	MT2 **(3)**
K	feet with key	-
N	front flange	ME5
P	rear flange	ME6 **(3)**
S	fixed eye + spherical bearing	MP5 **(3)**
X	basic execution	-

Series number **(1)**

Heads' configuration (2), see section 13
Oil ports positions
B* = front head
X* = rear head
Cushioning adjustments positions, to be entered only if adjustable cushionings are selected
E* = front head
Z* = rear head
* = selected position (1, 2, 3 or 4)

Options (2):
Rod end, see section 7
F = female thread
G = light female thread
H = light male thread
Oversized oil ports, see section 11
D = front oversized oil port
Y = rear oversized oil port
Proximity sensors, see section 18
R = front sensor
S = rear sensor
Rod treatment, see section 9
K = nickel and chrome plating
T = induction surface hardening and chrome plating
Air bleeds, see section 16
A = front air bleed
W = rear air bleed
Draining, see section 17
L = rod side draining

Sealing system, see section 14
1 = (NBR + POLYURETHANE) high static and dynamic sealing
2 = (FKM + PTFE) very low friction and high temperatures
4 = (NBR + PTFE) very low friction and high speeds
6 = (NBR + PTFE) very low friction, single acting - pushing
7 = (NBR + PTFE) very low friction, single acting - pulling
8 = (NBR + PTFE and POLYURETHANE) low friction

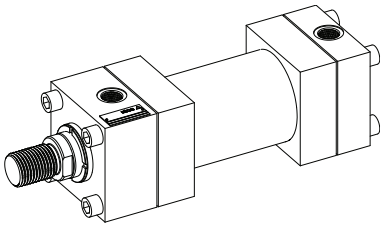
Spacer, see section 6
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

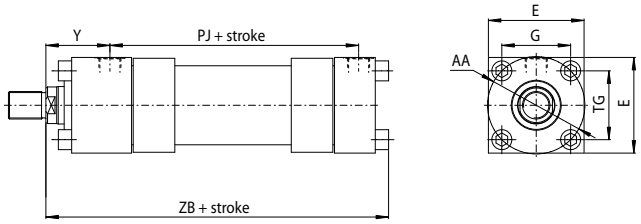
Cushionings, see section 12
0 = none

Fast adjustable	Slow adjustable	Fast fixed
1 = rear only	**4** = rear only	**7** = rear only
2 = front only	**5** = front only	**8** = front only
3 = front and rear	**6** = front and rear	**9** = front and rear

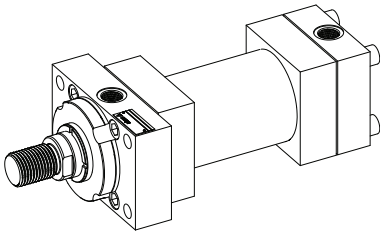
(1) For spare parts request indicate the series number printed on the nameplate only for series < 30
(2) To be entered in alphabetical order **(3)** Not available for double rod

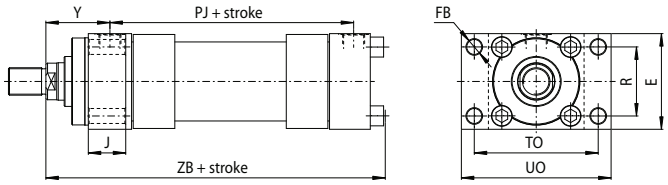
2 **MOUNTING STYLE** - for dimensions see section 3



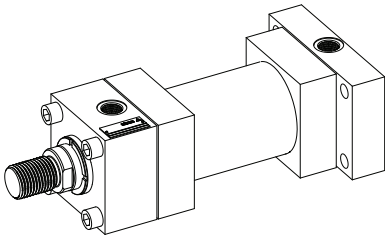


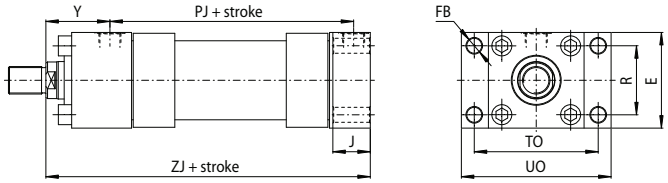
X = basic mounting



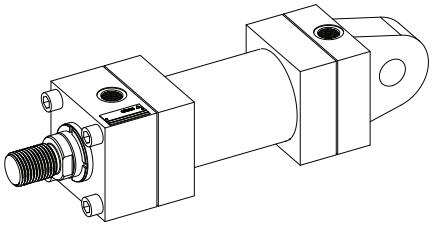


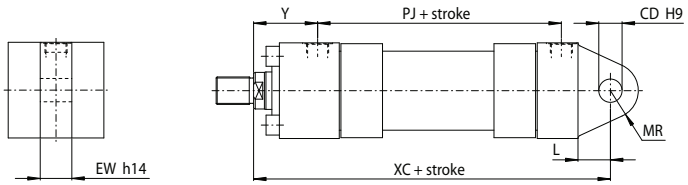
N (ISO ME5) = front flange mounting



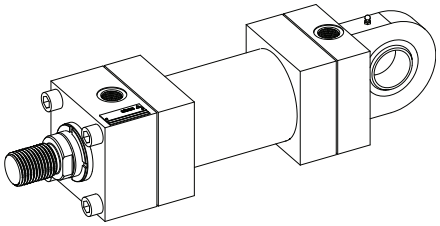


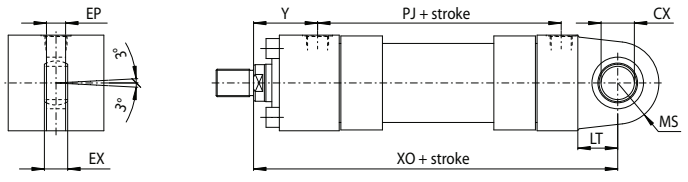
P (ISO ME6) = rear flange mounting



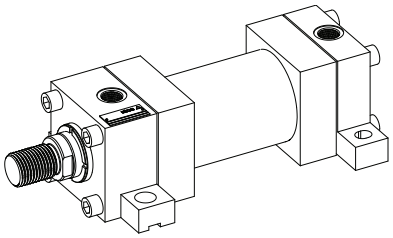


D (ISO MP3) = fixed eye mounting

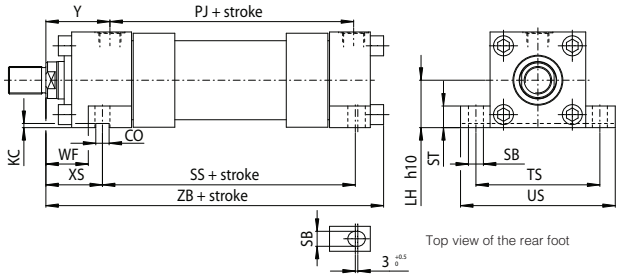


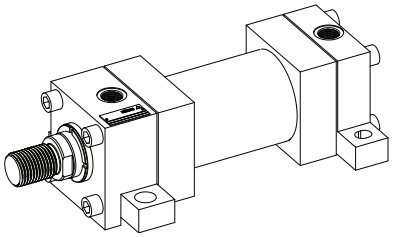


S (ISO MP5) = fixed eye with spherical bearing mounting

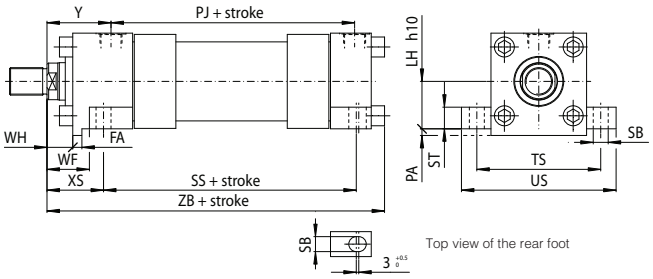


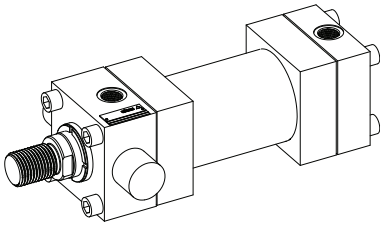
E (ISO MS2) = side feet mounting



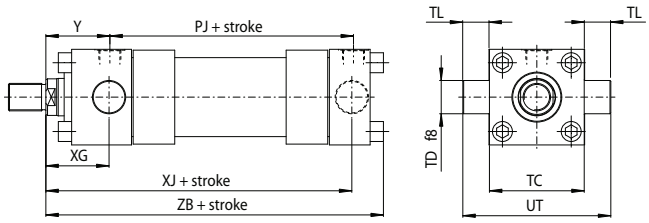


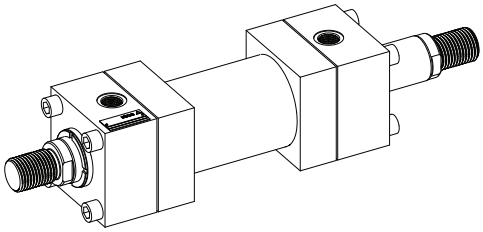
K = feet with key mounting (only for bore 63)



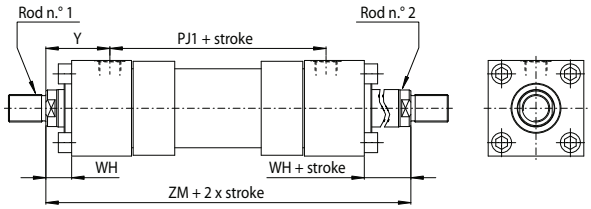


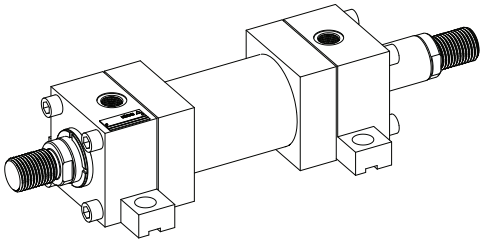
G (ISO MT1) = front trunnion mounting (*)
H (ISO MT2) = rear trunnion mounting
(*) see figure



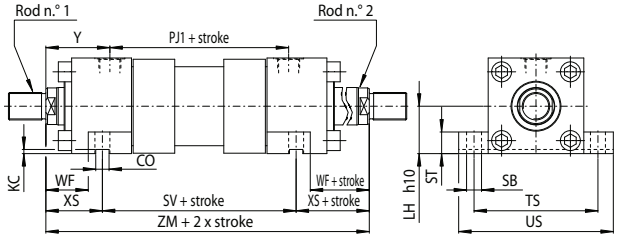


X = basic mounting for double rod





E = feet mounting for double rod

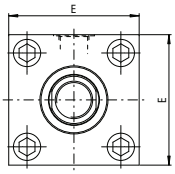


3 INSTALLATION DIMENSION [mm] - see figures in section 2

Ø Bore		63	80	100	125	160	200
Ø Rod	standard	28	36	45	56	70	90
	intermediate	36	45	56	70	90	110
	differential	45	56	70	90	110	140
AA		91	117	137	178	219	269
CD H9		20	28	36	45	56	70
CO N9		16	16	16	20	30	40
CX	value	30	40	50	60	80	100
	tolerance	0 -0,012			0 -0,015		0 -0,02
E (1)		90±1,5	115±1,5	130±2	165±2	205±2	245±2
EP max		19	23	30	38	47	57
EW h14		30	40	50	60	70	80
EX		22 0/-0,12	28 0/-0,12	35 0/-0,12	44 0/-0,15	55 0/-0,15	70 0/-0,2
FA 0 / -0,075		14	NA	NA	NA	NA	NA
FB H13		14	18	18	22	26	33
J ref		38	45	45	58	58	76
L min		32	39	54	57	63	82
LH h10		44	57	63	82	101	122
LT min		38	48	58	72	92	116
KC min		4,5	5	6	6	8	8
MR max		29	34	50	53	59	78
MS max		40	50	62	80	100	120
PA 0 / -0,2		8	NA	NA	NA	NA	NA
PJ (2)±1,5 (3)		80	93	101	117	130	165
PJ1±1,5 (3)		81	92	101	117	130	160
PJ2 (2) ±1,5 (3)		80	93	99	121	143	167
R js13		65	83	97	126	155	190
SB H13		18	18	26	26	33	39
SS ±1,25 (3)		85	104	101	130	129	171
ST js13		26	26	32	32	38	44
SV ±1,25 (3)		93	110	107	131	130	172
TC h14		89	114	127	165	203	241
TD f8		32	40	50	63	80	100
TG js13		64,3	82,7	96,9	125,9	154,9	190,2
TL js13		25	32	40	50	63	80
TO js13		117	149	162	208	253	300
TS js13		124	149	172	210	260	311
UO max		145	180	200	250	300	360
US max		161	186	216	254	318	381
UT ref		139	178	207	265	329	401
XC ±1,5 (3)		200	229	257	289	308	381
XG ±2 (3)		70	76	71	75	75	85
XJ ±1,5 (3)		149	168	187	209	230	276
XO±1,5 (3)		206	238	261	304	337	415
XS ±2 (3)		65	68	79	79	86	92
Y (2) ±2 (3)		71	77	82	86	86	98
Y1 (2) ±2 (3)		70	75,5	83	84	79,5	97
ZB max		185	212	225	260	279	336
ZJ ±1 (3)		168	190	203	232	245	299
ZM ±2 (3)		223	246	265	289	302	356

NOTES TO TABLE 3

(1) **E** - If not otherwise specified in the figures in section 2 this value is the front and rear square heads dimension for all the mounting styles (see figure below)



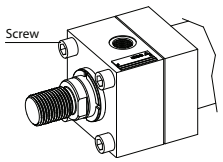
(2) When oversized oil ports are selected (see section 11 and 13 for dimensions and positions) dimensions **PJ** and **Y** are respectively modified into **PJ2** and **Y1**

(3) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is given by the max stroke tolerance in section 5

4 SCREWS TIGHTENING TORQUES

Mounting screws must be to a minimum strength of ISO 898/2 grade 12.9.

Ø Bore	63	80	100	125	160	200
MT [Nm]	70	160	160	460	820	1160
Screw	M12	M16	M16	M22	M27	M30



5 STROKE SELECTION

Stroke has to be selected a few mm longer than the working stroke, to prevent to use the cylinder heads as mechanical stroke-end.
The table below shows the minimum stroke depending to the bore.

Minimum stroke [mm]

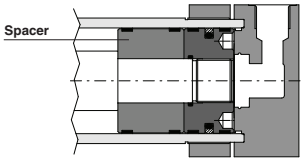
Ø Bore	63	80	100	125	160	200
Minimum stroke	55	70	70	75	70	85

Maximum stroke:
- 5000 mm

Stroke tolerances:
- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

6 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in section 3.



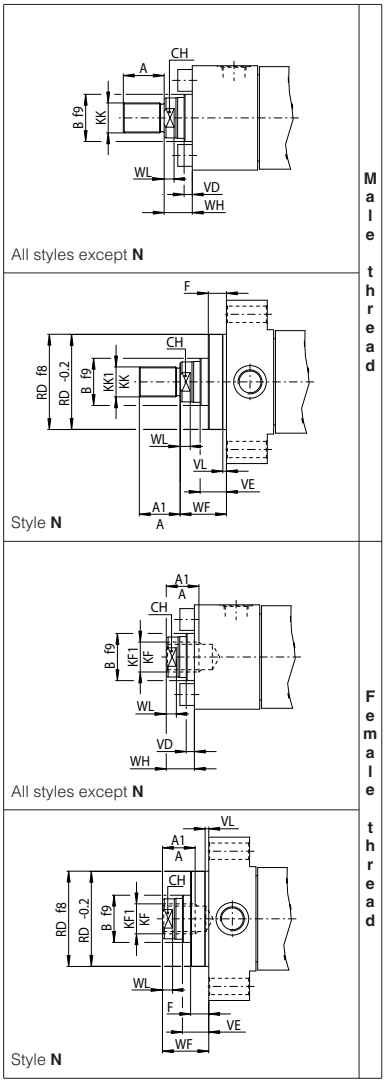
RECOMMENDED SPACERS [mm]

Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 5000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

7 ROD END DIMENSIONS [mm]

Ø Bore	Ø Rod	Male thread		Female thread		A (KK or KF) (1)	A1 (KK1 or KF1) (1)	B	CH	F	RD	VD	VE	VL	WF	WH	WL
		KK	KK1 (option H)	KF (option F)	KF1 (option G)												
		6g	6g	6H	6H			f9	h14	max	f8		max	min	±2	±2	min
	28	M20x1,5	NA	M20x1,5	NA	28	NA	42	22	16	75	13	29	4	48	32	7
63	36(*)	M27x2	NA	M27x2	NA	36	NA	50	30	16	88	13	29	4	48	32	8
	45	M33x2	M20x1,5	M33x2	M20x1,5	45	28	60	39	16	88	13	29	4	48	32	10
	36	M27x2	NA	M27x2	NA	36	NA	50	30	20	82	9	29	4	51	31	8
80	45 (2)	M33x2	NA	M33x2	NA	45	NA	60	39	20	105	9	29	4	51	31	10
	56	M42x2	M27x2	M42x2	M27x2	56	36	72	48	20	105	9	29	4	51	31	10
	45	M33x2	NA	M33x2	NA	45	NA	60	39	22	92	10	32	5	57	35	10
100	56 (2)	M42x2	NA	M42x2	NA	56	NA	72	48	22	125	10	32	5	57	35	10
	70	M48x2	M33x2	M48x2	M33x2	63	45	88	62	22	125	10	32	5	57	35	10
	56	M42x2	NA	M42x2	NA	56	NA	72	48	22	105	10	32	5	57	35	10
125	70 (2)	M48x2	NA	M48x2	NA	63	NA	88	62	22	150	7	29	5	57	35	10
	90	M64x3	M42x2	M64x3	M42x2	85	56	108	80	22	150	7	29	5	57	35	15
	70	M48x2	NA	M48x2	NA	63	NA	88	62	25	125	7	32	5	57	32	10
160	90 (2)	M64x3	NA	M64x3	NA	85	NA	108	80	25	170	7	32	5	57	32	15
	110	M80x3	M48x2	M80x3	M48x2	95	63	133	100	25	170	7	32	5	57	32	15
	90	M64x3	NA	M64x3	NA	85	NA	108	80	25	150	7	32	5	57	32	15
200	110 (2)	M80x3	NA	M80x3	NA	95	NA	133	100	25	210	7	32	5	57	32	15
	140	M100x3	M64x3	M100x3	M64x3	112	85	163	128	25	210	7	32	5	57	32	15

Notes: (1) Dimensions **A** and **A1** are according to ISO 4395 short type.
Tolerances: max for male thread; min for female thread
(2) Not included in ISO standard



8 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in "cold drawn and stressed steel" with Rs = 450 N/mm²; the internal surfaces are lapped; diameter tolerance H8, roughness Ra ≤ 0,25 µm.

9 RODS FEATURES and options

The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure. The rod surface is chrome plated: diameter tolerance f7, roughness Ra ≤ 0,25 µm. Corrosion resistance of 200h in neutral spray to ISO 9227 NSS.

ø Rod	Material	Rs min [N/mm²]	Chrome	
			min thickness [mm]	hardness [HV]
28÷90	hardened and tempered alloy-steel	700	0,020	850-1150
110÷140	alloy steel	450		

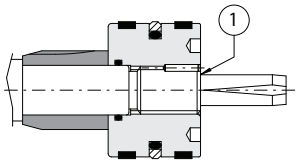
Rod diameters from 28 to 70 mm have rolled threads; in rolling process the component material is stressed beyond its yield point, being deformed plastically. This offers many technical advantages: higher profile accuracy, improved fatigue working life and high wear resistance. See **tab. B015** for the calculation of the expected rod fatigue life. The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the table 7. The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing. **Contact our technical office** in case of heavy duty applications.

Rod corrosion resistance and hardness can be improved selecting the options **K** and **T** (option K affects the strength of standard rod, see **tab. B015** for the calculation of the expected rod fatigue life):
K = Nickel and chrome-plating (for rods up to 110 mm)
Corrosion resistance (rating 10 to ISO 10289):
- 350 h in acetic acid salt spray to ISO 9227 AASS
- 1000 h in neutral spray to ISO 9227 NSS

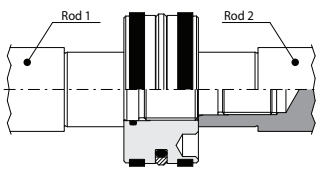
T = Induction surface hardening and chrome plating
- 56-60 HRC (613-697 HV) hardness

ROD-PISTON COUPLING

Single rod



Double rod



10 DOUBLE ROD

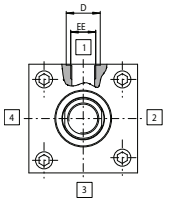
Double rod cylinders ensure the same pushing and pulling areas, thus the same speeds and forces. Rod2 (see figure at side) is screwed into the male thread of Rod1, consequently the Rod2 is weaker than the other and it is strongly recommended to use this one only to compensate the areas; the stronger rod is identified by the number '1' stamped on its end. For double rod cylinders, rod end dimensions indicated in section 7 are valid for both the rods.

11 OIL PORTS AND ROD SPEEDS

The fluid speed in pipings connected to the cylinder oil ports should not exceed 6 m/s in order to minimize the turbolence flow, the pressure drop and water hammer. The table below shows the max recommended rod speed relative to 6 m/s flow velocity.
In high dynamic systems the rod can reach even higher speeds (after a careful check of dampable masses, **see tab. B015**): in these cases it is recommended to use piping's diameters larger than the cylinder oil ports and to introduce proper reductions just near the cylinder oil ports.

Ø Bore	Standard oil ports				Oversized oil ports **D**, **Y** options			
	D [mm]	**EE** 6g	Internal pipe Ø[mm] min	Rod speed V [m/s]	**D** [mm]	**EE** 6g	Internal pipe Ø[mm] min	Rod speed V [m/s]
63	29	G 1/2	14	0,30	36	G 3/4	16	0,39
80	36	G 3/4	16	0,18	42	G 1	20	0,37
100	36	G 3/4	16	0,15	42	G 1	20	0,24
125	42	G 1	20	0,15	52	G 1 1/4	30	0,34
160	42	G 1	20	0,09	52 (1)	G 1 1/4	30	0,21
200	52	G 1 1/4	30	0,13	58	G 1 1/2	40	0,24

Oil ports features are threaded according to ISO 1179-1 (GAS standards) with counterbore dimension D type N (narrow).
Oil ports with SAE 3000 flanges are available on request, **contact our technical office.**



Note to table:
(1) For mounting styles D, E, N, P, S the dimension **PJ2** reported in section 3 is modified, contact our technical office.

12 CUSHIONINGS

Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is necessary to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side). Two types of cushioning are available depending to the rod speed V:

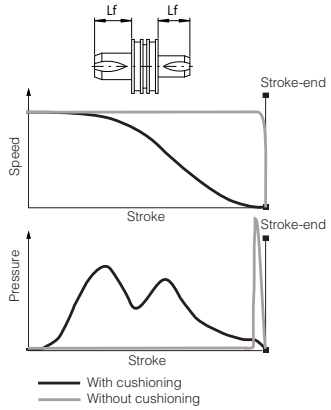
Slow version for $V \leq 0.5 \cdot V_{max}$

Fast version for $V > 0.5 \cdot V_{max}$

See the table below for V_{max} values and **tab. B015** for the max damping energy.
When fast or slow adjustable versions are selected, the cylinder is provided with needle valve to optimize cushioning performances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect).
In case of high masses and/or very high operating speeds it is recommended to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

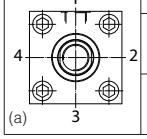
Ø Bore		**63**		**80**		**100**		**125**		**160**		**200**	
Ø Rod		**28**	**36 45**	**36**	**45 56**	**45**	**56 70**	**56**	**70 90**	**70**	**90 110**	**90 140**	**110**
Cushioning length [mm]	Lf front	28	27	27	29	35	27	28	25	34	34	49	34
	Lf rear	30		32		32		32		41		50	
Vmax [m/s]		0,8		0,8		0,6		0,6		0,5		0,5	

Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.



13 POSITION COMBINATION FOR OIL PORTS AND CUSHIONING ADJUSTMENTS

FRONT HEAD: **B*** = oil port position; **E*** = cushioning adjustment position REAR HEAD: **X*** = oil port position; **Z*** = cushioning adjustment position
The table below shows all the available configurations for the oil port and cushioning adjustment positions. Bolt characters identify the standard positions. Each configuration for the front head can be variously combined with any one of the rear head. Cushioning adjustment positions **E***, **Z*** have to be entered only if adjustable cushionings are selected.
Example of model code: CH-63/28 *0100-S301 - A - **B2E3X1Z4**

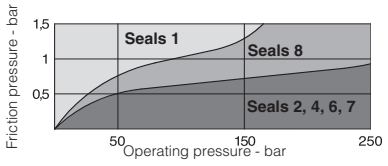


Mounting style			D, S							E, K		G		H		N, P			X			
FRONT HEAD	Oil port side	**B**	**1**	1	2	1	2	4	3	**1**	1	**1**		**1**	2	**1**	1	2●	**1**	1	2	3
	Cushioning adjustment side	**E**	**3**	2	3	4	4	3	1	**2**	4	**3**		**3**	4	**3**	2	3	**3**	4	3	1
REAR HEAD	Oil port side	**X**	**1**	1	2	1	2	4	3	**1**	1	**1**	2	**1**		**1**	1	2●	**1**	1	2	3
	Cushioning adjustment side	**Z**	**3**	2	3	4	4	3	1	**2**	4	**3**	4	**3**		**3**	2	3	**3**	4	3	1

● Dimensions **PJ, PJ2, Y** and **Y1** change compared to the values in section 3, contact our technical office
(a) Front view rod side (rod n°1 for double rods)
Contact our technical office for combinations not included in the table.

14 SEALING SYSTEM FEATURES

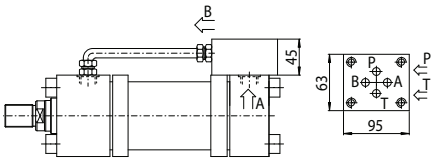
The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature.Additional verifications about minimum in/out rod speed ratio, static and dynamic sealing friction are warmly suggested, see **tab. B015**.
When single acting seals are selected (types **6** and **7**), the not pressurized cylinder's chamber must be connected to the tank. Special sealing system for low temperatures, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see section 22. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition. See section 19 for fluid requirements.



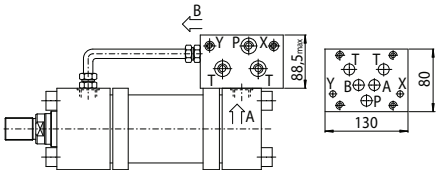
Sealing system	Material	Features	Max speed [m/s]	Fluid temperature range	Fluids compatibility	ISO Standards for seals	
						Piston	Rod
1	NBR + POLYURETHANE	**high static and dynamic sealing**	0.5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 5597/1
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%), HFD-U,HFD-R	ISO 7425/1	ISO 7425/2
4	NBR + PTFE	**very low friction and high speeds**	4	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
6 - 7	NBR + PTFE	**very low friction single acting - pushing/pulling**	1	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
8	PTFE + NBR + POLYURETHANE	**low friction**	0,5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 7425/2

15 INCORPORATED SUBPLATE

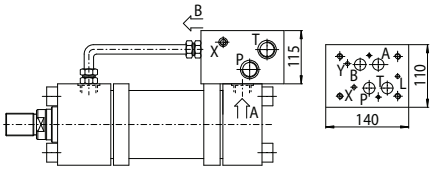
CH cylinders with oil ports positions 1 can be supplied with ISO (size 06, 10, 16 and 25) incorporated subplates for mounting of valves directly on the cylinder.



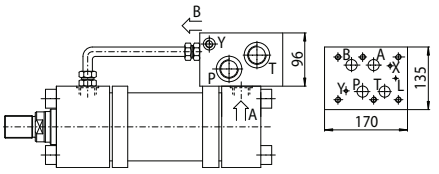
10 = subplate with mounting surface 4401-03-02-0-05 (size 06)
Oil ports P and T = G 3/8
For bores from 63 to 200 and strokes longer than 100 mm
For shorter strokes, the cylinder must be provided with suitable spacer



20 = subplate with mounting surface 4401-05-05-0-05 (size 10)
Oil ports P and T = G 3/4; X and Y = G 1/4
For bores from 63 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer



30 = subplate with mounting surface 4401-07-07-0-05 (size 16)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 80 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer

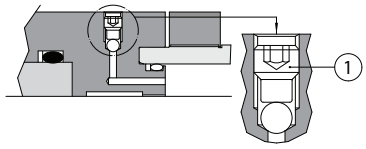


40 = subplate with mounting surface 4401-08-08-0-05 (size 25)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 125 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinder must be provided with suitable spacer

Note: for the choice of suitable spacer see section 6. The addition of spacer length and working stroke must be at least equal or upper than the minimum stroke indicated above, see the following example:
Subplate **20** ; working stroke = **70** mm; min. stroke = **150** mm ⟶ select spacer **4** (lenght = **100**mm)

16 AIR BLEEDS

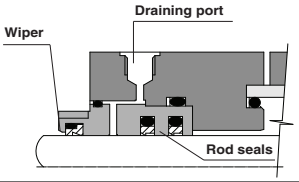
CODES: **A** = front air bleed; **W** = rear air bleed
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves are recommended to realize this operation easily and safely. Air bleeds are usually positioned on the opposite side of the oil port except for front heads of mounting styles **N**, **G** (on side 3), rear heads of mounting styles **D**, **S**, **H**, **P** (on side 3) and for heads of mounting style **E** (on side 2), see section 13. For cylinders with adjustable cushionings the air bleeds are positioned on the same side of the cushioning adjustment screw. For Servocylinders, cylinders with incorporated subplates or proximity sensors, air bleeds are supplied as standard and they must not be entered in the model code. For cylinders with proximity sensors, air bleeds A, W or AW are supplied respectively depending on the selected sensors R, S or RS. For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
63 - 200	M8 x 10	20 Nm

17 DRAINING

CODE: **L** = rod side draining
The rod side draining reduces the seals friction and increases their reliability; it is mandatory for cylinders with strokes longer than 2000 mm, with rod side chamber constantly pressurized and for servocylinder.
The draining is positioned on the same side of the oil port, between the wiper and the rod seals (see figure at side) and it can be supplied only with sealing system: **2**, **4**, **7** and **8**. It is recommended to connect the draining port to the tank without backpressure.
Draining port is G1/8.

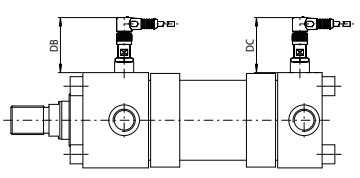


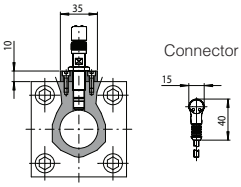
18 PROXIMITY SENSORS

CODES: **R** = front sensor; **S** = rear sensor
Proximity sensors functioning is based on the variation of the magnetic field, generated by the sensor itself, when the cushioning piston enters on its influence area, causing a change of state (on/off) of the sensors. The distance from the mechanical stroke-end of the cylinder, at which occurs the switching of the sensor's electrical contact, can be adjusted between 1 and 3 mm. For their regulation, it is necessary to position the rod where it is desired to obtain the contact switching and rotate the sensor until its LED switch-on (commutation occurred). The sensors tightening torque must be lower than 40 N/m to avoid damages. The sensors must always be coupled with fast adjustable cushioning, see section 12, to avoid pressure peaks on stroke-end. They are positioned on side 4 and they can be coupled with the standard oil ports and cushioning adjustaments positions in bolt characters, see section 13. The coupling of the proximity sensors with the stroke-end cushioning imposes particular executions with limitation of the damping masses and/or speeds compared to the executions with standard cushioning.

Limitations
R option not available for G and N mounting styles; **S** option not available for P and H mounting styles.

Ø Bore	63	80	100	125	160	200
DB max	72	74	73	71	71	67
DC	65	71	65	51	34	20





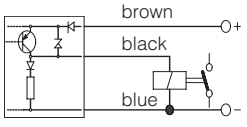
Connector cable lenght: 5m

SENSORS TECHNICAL DATA

The proximity sensors are inductive type, they supply a "NO" (Normally Open) output signal which status corresponds to the rod position:

- **R**, **S** = close contact = 24 Volt at output contacts = rod positioned at stroke ends
- **R**, **S** = open contact = 0 Volt at output contacts = rod not positioned at stroke ends

Ambient temperature	-20 +70°C
Nominal voltage	24 VDC
Operating voltage	10…30 VDC
Max load	200 mA
Version	PNP
Output type	NO
Repeatability	<5%
Hysteresis	<15%
Protection	IP68
Max pressure	25 MPa (250 bar)



19 FLUID REQUIREMENTS

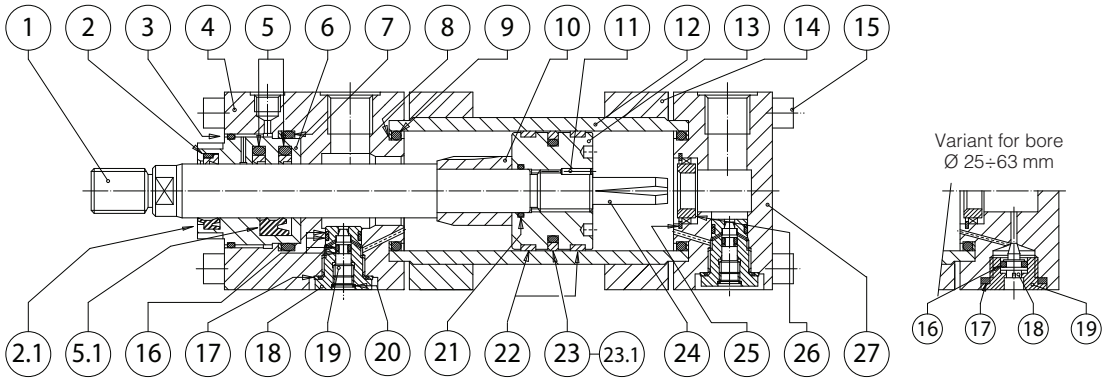
Cylinders and servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). The fluid must have a viscosity within 15 and 100 mm^2/s, a temperature within 0 and 70°C and fluid contamination class ISO 19/16 according to ISO 4406, achieved with in-line filters at 25 µm.

20 CYLINDERS MASSES [kg] (tolerance ± 5%)

		MASS FOR STYLES X, Z. Single rod		MASS FOR STYLES X, Z. Double rod		ADDITIONAL MASSES according to mounting styles and options								
Ø Bore [mm]	**Ø Rod** [mm]	Stroke 100 mm	Each added 100 mm	Stroke 100 mm	Each added 100 mm	Style **D**	Style **E**	Style **G**	Style **K**	Style **N**	Style **P**	Style **S**	Each Cushioning	Each 50 mm spacer
63	**28**	9,65	1,54	12,03	2,03	0,41	1,54	0,26	1,25	1,34	1,34	0,46	0,25	1,68
	36	10,17	1,85	12,98	2,65									
	45	10,84	2,31	14,68	3,56									
80	**36**	19,24	2,82	22,69	3,62	0,79	1,23	1,63	NA	2,39	2,39	0,86	0,40	2,85
	45	20,00	3,32	24,21	4,57									
	56	20,34	3,95	26,14	5,88									
100	**45**	25,89	3,76	31,94	5,01	2,31	1,63	1,00	NA	2,94	2,94	1,77	0,60	4,15
	56	26,79	4,46	34,10	6,39									
	70	28,09	5,54	37,29	8,56									
125	**56**	48,38	5,88	58,38	7,81	2,87	4,60	1,50	NA	5,65	5,65	4,65	1,15	6,61
	70	50,02	6,98	63,33	10,00									
	90	54,40	8,94	77,66	13,93									
160	**70**	80,74	8,34	92,15	11,36	7,63	7,56	4,66	NA	7,97	7,97	8,21	1,85	10,75
	90	85,50	10,31	102,27	15,31									
	110	90,09	12,77	112,39	20,23									
200	**90**	135,62	12,00	148,54	17,00	13,82	14,60	9,86	NA	16,78	16,82	14,80	2,50	15,86
	110	142,41	14,01	154,67	21,47									
	140	149,21	18,63	160,80	30,72									

Note: the masses related to the other options, not indicated in the table, don't have a relevant influence on the cylinder's mass

21 CYLINDER SECTION



PART	DESCRIPTION	MATERIAL	PART	DESCRIPTION	MATERIAL	PART	DESCRIPTION	MATERIAL
1	Rod	Chromeplated steel	9	O-ring	NBR / FKM	19	Cushioning adjustment screw	Steel
2	Wiper	NBR / FKM and PTFE	10	Front cushioning piston	Steel	20	Seeger	Steel
2.1	Wiper (G1)	Polyurethane	11	Screw stop pin	Steel	21	O-ring	NBR / FKM
3	O-ring	NBR / FKM	12	Cylinder housing	Steel	22	Piston guide ring	PTFE or phenolic resin
4	Front head	Steel / Cast iron	13	Piston	Steel	23	Piston seal	NBR / FKM and PTFE
5	Rod seal	NBR / FKM and PTFE	14	Counterflange	Steel	23.1	Piston seal (G1)	NBR and polyurethane
5.1	Rod seal (type G1)	Polyurethane	15	Screw	Steel (grade12.9)	24	Rear cushioning piston	Steel
6	Rod bearing	Bronze	16	O-ring and anti-extrusion ring	FKM and PTFE	25	Toroidal ring	Steel
7	O-ring and anti-extrusion ring	NBR / FKM and PTFE	17	Seal	FKM	26	Rear cushioning sleeve	Bronze
8	Anti-extrusion ring	PTFE	18	Cushioning adjustment plug	Steel	27	Rear head	Steel / Cast iron

22 SPARE PARTS - SEE TABLE SP-B140

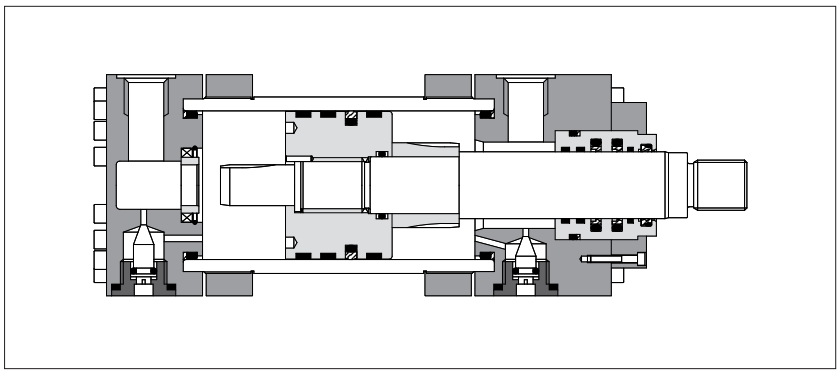
Example for seals spare parts code

G	**8**	-	**C**	**K**	-	**50**	/	**22**	/	**22**	-	**26**

- **G** — Sealing system
- **8** — Cylinder series
- **C K** — Bore size [mm]
- **50** — Rod diameter [mm]
- **22** — Second rod diameter for double rod [mm] Omit if not requested
- **26** — Serial number (indicate only for series <30)

Hydraulic cylinders type CH - big bore sizes

to ISO 6020-3 - nominal pressure 16 MPa (160 bar) - max 25 MPa (250 bar)



CH big bore cylinders have engineered double acting construction, designed to suit the requirements of industrial applications: top reliability, high performances and long working life.

- Bore sizes from **250** to **400** mm
- Strokes up to **5000** mm
- **7** standard mounting styles
- **2** seals options
- **3** piston guides for overload
- Adjustable cushionings
- Optional built-in position transducer, **see tab. B310**
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

SWC Cylinders Designer

Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

1 MODEL CODE

CH	F	-	250	/	140	*	0500	-	S	3	0	8	-	A	-	B1E3X1Z3	**

Cylinder series
CH to ISO 6020 - 3

Rod position transducer
- = omit if not requested
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive
Transducer available on request, contact our technical office

Bore size, see section 3
from **250** to **400** mm

Rod diameter, see sections 7
from **140** to **220** mm

Stroke, see section 4
up to **5000** mm

Mounting style, see sections 2 and 3

		REF. ISO
C	= fixed clevis	MP1
G	= front trunnion	MT1
L	= intermediate trunnion	MT4 **(3)**
N	= front flange	ME5
P	= rear flange	ME6
S	= fixed eye + spherical bearing	MX5
X	= basic execution	-

Cushionings, see section 10
0 = none
Slow adjustable
1 = rear only
2 = front only
3 = front and rear

Spacer, see section 5
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

Sealing system, see section 12
2 = (FKM + PTFE) very low friction and high temperatures
8 = (NBR + PTFE) low friction

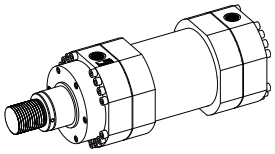
Options (2):
Rod treatment, see section 9
T = induction surface hardening and chrome plating
Air bleeds, see section 13
A = front air bleed
W = rear air bleed
Draining, see section 14
L = rod side draining
Flange oil ports, see section 6
M = front and rear SAE 6000 flange oil ports

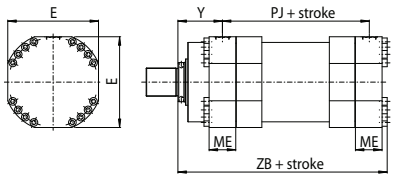
Heads' configuration (2), see section 11
Oil ports positions
B1 = front head
X1 = rear head
Cushioning adjustments positions
E3 = front head
Z3 = rear head

Series number **(1)**

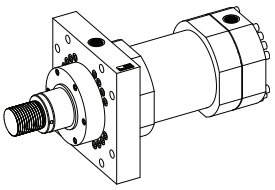
(1) For spare parts request indicate the series number printed on the nameplate only for series < 20
(2) To be entered in alphabetical order
(3) XV dimension must be indicated in the model code, see section 3

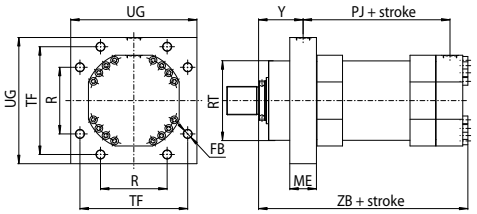
2 **MOUNTING STYLE** - for dimensions see section 3



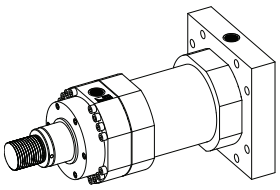


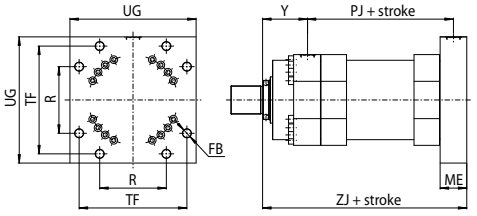
X = basic mounting



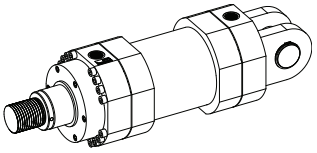


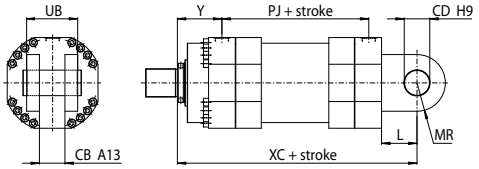
N (ISO MF5) = front flange mounting



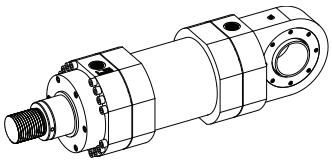


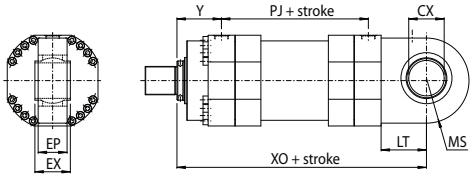
P (ISO MF6) = rear flange mounting



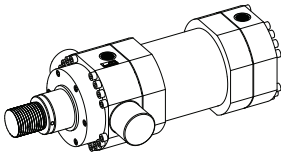


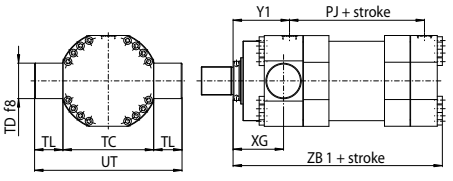
C (ISO MP1) = fixed clevis mounting - supplied with pivot pin C-145



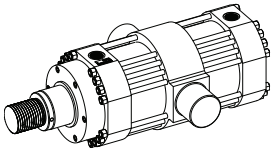


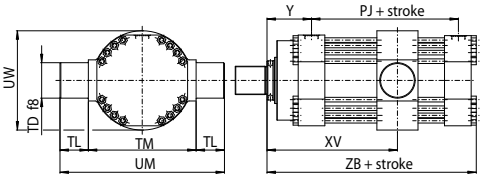
S (ISO MP5) = fixed eye with spherical bearing mounting





G (ISO MT1) = front trunnion mounting





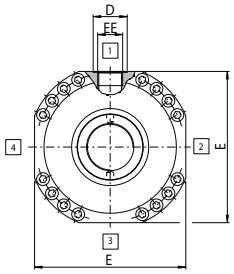
L (ISO MT4) = intermediate trunnion mounting

3 INSTALLATION DIMENSIONS [mm] - see figures in section 2

Ø Bore		250	320	400
Ø Rod		140	180	220
B f9 **(4)**		163	205	245
CB A13		90	110	140
CD H9		90	110	140
CX H7		125	160	200
D (1)		58	58	69
E (2) max		320	400	500
EE (1)		G 1 1/2	G 1 1/2	G 2
EP		102	130	162
EX		125	160	200
F max **(4)**		75	75	75
FB		30	36	45
L min		125	152	195
LT min		160	200	250
ME ref		94	114	140
MR max		100	120	160
MS max		160	200	250
MT (3) [Nm]		350	680	1060
PJ ±1,5 **(6)**		218	252	320
R js13		235	283	340
RD f8 **(4)**		280	325	380
TC h14		320	400	500
TD f8		125	160	200
TF		380	472	588
TL js13		100	125	160
TM h14		380	485	605
UB		180	220	280
UG max		445	549	683
UM ref		580	735	925
UT ref		520	650	820
UW max		480	600	750
VD (4)		8	8	8
VE max **(4)**		83	83	83
WF ±2		110	110	110
XC ±1,5 **(6)**		545	627	775
XG ±2 **(6)**		178	195	215
XO ±1,5 **(6)**		580	675	830
XV (5) ±2 **(6)**	**style L minimun stroke**	20	35	26
	min	275	312	358
	max	255+stroke	273+stroke	332+stroke
Y ±2 **(6)**		157	167	180
Y1 ±2 **(6)**		199	223	260
ZB max **(6)**		460	520	625
ZB1 max **(6)**		505	580	685
ZJ ±1 **(6)**		420	475	580

NOTES TO TABLE 3

(1) **D, EE** - Oil ports and drain are threaded according to GAS standard with counterbore dimension **D** according to ISO 1179-1 (see figure below)



(2) **E** - If not otherwise specified in the figures in section 2, this value is the front and rear round heads dimension for all the mounting styles (see figure above)

(3) **MT** - Screws tightening torque. Mounting screws must be to a minimum strength of ISO 898/2 grade 12.9

(4) See figures in section 7

(5) **XV** - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table.The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CH - 250 / 140 * 0500 - L308 - A - B1E3X1Z3
XV = 300

(6) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is given by the max stroke tolerance in section 4

4 STROKE SELECTION

Stroke has to be selected a few mm longer than the working stroke, to prevent to use the cylinder heads as mechanical stroke-end. The table below shows the minimum stroke depending to the bore.

Minimum stroke [mm]

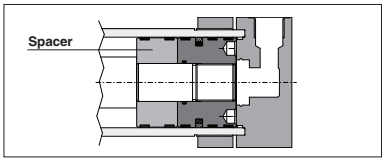
Ø Bore	250	320	400
Minimum stroke	65	70	40

Maximum stroke:
- 5000 mm

Stroke tolerances:
- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

5 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in section 3.

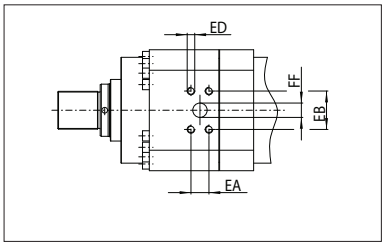


RECOMMENDED SPACERS [mm]

Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 5000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

6 SAE 6000 FLANGE OIL PORTS - DIMENSIONS TO ISO 6162-2 [mm]

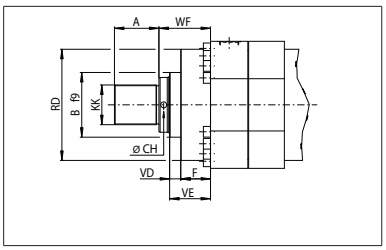
Ø Bore	DN	EA ±0,25	EB ±0,25	ED 6g	FF 0 / -1,5
250	38	36,5	79,3	M16	38
320					
400	51	44,5	96,8	M20	51



7 ROD END DIMENSIONS [mm]

Ø Bore	250	320	400
Ø Rod	140	180	220
A	112	125	160
CH (*)	15	15	15
KK	M100x3	M125x4	M160x4

(*) n°2 holes per key
Note: for B, F, RD, VD, VE and WF dimensions see section 3



8 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in "hot rolled steel" with Rs = 360 N/mm²; the internal surfaces are lapped: diameter tolerance H8, roughness Ra ≤ 0,25 µm.

9 RODS FEATURES and options

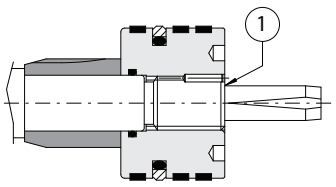
The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure. The rod surface is chrome plated: diameter tolerances f7; roughness Ra ≤ 0,25 µm. Corrosion resistance of 200h in neutral spray to ISO 9227 NSS.

ø Rod	Material	Rs min [N/mm²]	Chrome	
			min thickness [mm]	hardness [HV]
140	alloy-steel	450	0,020	850-1150
180÷220	carbon steel	360	0,045	

The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the table 7. See **tab. B015** for the calculation of the expected rod fatigue life. The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing. **Contact our technical office** in case of heavy duty applications.

Rod hardness can be improved selecting the option **T**:
T = Induction surface hardening and chrome plating (only for rod 140)
• 56-60 HRC (613-697 HV) hardness

ROD-PISTON COUPLING

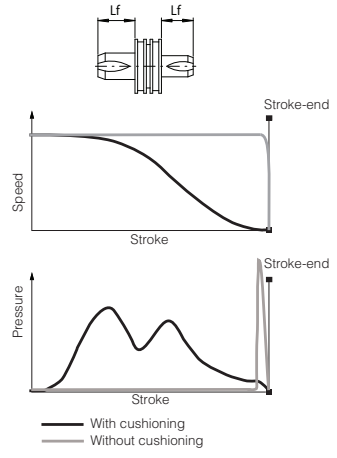


10 CUSHIONINGS

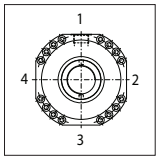
Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is necessary to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side).
The cylinder is provided with needle valve to optimize cushioning performances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect). In case of high masses and/or very high operating speeds it is recommended to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

Ø Bore		250	320	400
Ø Rod		140	180	220
Cushioning length [mm]	Lf front	50	60	70
	Lf rear	56	64	64

Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.



11 POSITION OF THE OIL PORTS AND CUSHIONING ADJUSTMENTS

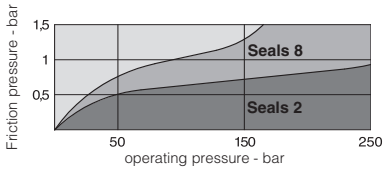


FRONT HEAD: **B1** = oil port position; **E3** = cushioning adjustment position
REAR HEAD: **X1** = oil port position; **Z3** = cushioning adjustment position.
The oil ports and cushioning adjustment positions are only available, respectively, on sides 1 and 3 (see the figure at side).

Example of model code: CH-250/140 *0100-S301 - A - **B1E3X1Z3**

12 SEALING SYSTEM FEATURES

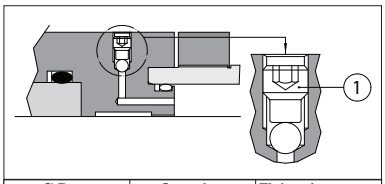
The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature. Additional verifications about minimum in/out rod speed is warmly suggested, see **tab. B015**.
Special sealing system for low temperatures, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see section 18. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition. See section 15 for fluid requirements.



Sealing system	Material	Features	Max speed [m/s]	Fluid temperature range	Fluids compatibility	ISO Standards for seals	
						Piston	Rod
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%), HFD-U,HFD-R	ISO 7425/1	ISO 7425/2
8	PTFE + NBR	**low friction**	1	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2

13 AIR BLEEDS

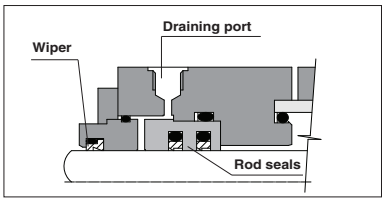
CODES: **A** = front air bleed; **W** = rear air bleed
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves are recommended to realize this operation easily and safely.
Air bleeds are positioned on side 3, see section 11.
For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
250	M8 x 10	20 Nm
320 - 400	M12 x 20	30 Nm

14 DRAINING

CODE: **L** = rod side draining
The rod side draining reduces the seals friction and increases their reliability; it is mandatory for cylinders with strokes longer than 2000 mm, with rod side chamber constantly pressurized and for servocylinders.
The draining is positioned on the same side of the oil port, between the wiper and the rod seals (see figure at side). It is recommended to connect the draining port to the tank without backpressure. Draining port is G1/8.



15 FLUID REQUIREMENTS

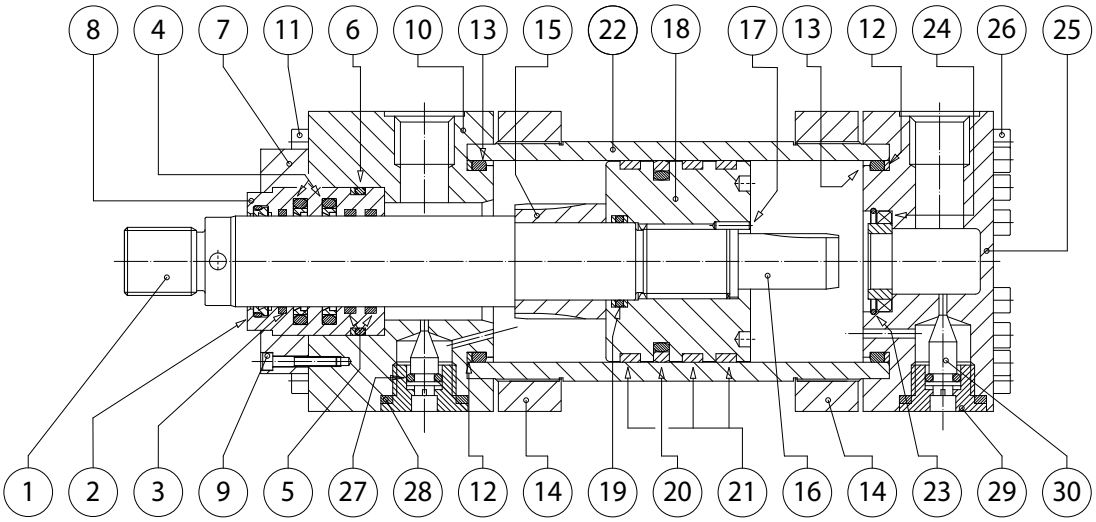
Cylinders and servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). The fluid must have a viscosity within 15 and 100 mm^2/s, a temperature within 0 and 70°C and fluid contamination class ISO 19/16 according to ISO 4406, achieved with in-line filters at 25 µm.

16 CYLINDERS MASSES [kg] (tolerance ± 5%)

		MASS FOR STYLE X single rod		ADDITIONAL MASSES according to mounting styles and options						
Ø Bore [mm]	**Ø Rod** [mm]	Stroke 100 mm	Each 100 mm more	Styles **C, S**	Style **G**	Style **L**	Styles **N, P**	Front cushioning	Rear cushioning	Each 50 mm spacer
250	**140**	324	27	55	9	110	83	8,5	19	28
320	**180**	485	41	82	16	160	142	11	27	44
400	**220**	902	71	155	34	360	275	17	45	72,4

Note: the masses related to the other options, not indicated in the table, don't have a relevant influence on the cylinder's mass

17 CYLINDER SECTION



POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL
1	Rod	Chrome plated steel	11	Screw	Steel (grade 12.9)	21	Piston guide ring	PTFE
2	Wiper	NBR / FKM + PTFE	12	Anti-extrusion ring	PTFE	22	Cylinder housing	Steel
3	Rod guide ring	PTFE	13	O-ring	NBR + PTFE	23	Toroidal ring	Steel
4	Rod seal	NBR + PTFE	14	Counterflange	Steel	24	Rear cushioning sleeve	Bronze
5	Rod guide ring	PTFE	15	Front cushioning piston	Steel	25	Rear head	Steel
6	O-Ring + Anti-extrusion ring	NBR / FKM + PTFE	16	Rear cushioning piston	Steel	26	Screw	Steel (grade 12.9)
7	Flange	Steel	17	Screw stop pin	Steel	27	O-Ring + Anti-extrusion ring	NBR / FKM + PTFE
8	Rod bearing	Steel	18	Piston	Steel	28	Seal	FKM
9	Screw	Steel (grade 12.9)	19	O-Ring + Anti-extrusion ring	NBR / FKM + PTFE	29	Cushioning adjustment plug	Steel
10	Front head	Steel	20	Piston seal	NBR / FKM + PTFE	30	Cushioning adjustment screw	Steel

18 SPARE PARTS - SEE TABLE SP-B160

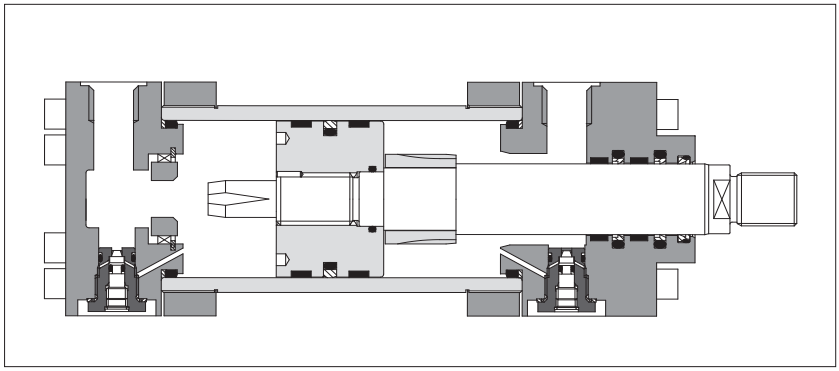
Example for seals spare parts code

G 8 - **C H** - **250** / **140** - **10**

- **G 8**: Sealing system
- **C H**: Cylinder series
- **250**: Bore size [mm]
- **140**: Rod diameter [mm]
- **10**: Serial number (indicate only for series <20)

Hydraulic cylinders type CN - round heads with counterflanges

to ISO 6020-1 - nominal pressure 16 MPa (160 bar) - max 25 MPa (250 bar)



SWC Cylinders Designer
Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

CN cylinders have engineered double acting construction, designed to suit the requirements of industrial applications: top reliability, high performances and long working life.

- Bore sizes from **40** to **200** mm
- **2** rod diameters per bore
- Strokes up to **5000** mm
- Rods with **rolled threads**
- **9** standard mounting styles
- **3** seals options
- Rod guide rings for low wear
- Adjustable or fixed cushionings
- Optional built-in position transducer, **see tab. B310**
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

1 MODEL CODE

CN	F	-	50	/	28	*	0500	-	S	3	0	8	-	A	-	B1E3X1Z3	**

Cylinder series
CN to ISO 6020 - 1

Rod position transducer
- = omit if not requested
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive
Transducer available on request, contact our technical office

Bore size, see section 4
from **40** to **200** mm

Rod diameter, see sections 7 and 9
from **22** to **140** mm

Stroke, see section 5
up to **5000** mm

Mounting style, see sections 2 and 4

	REF. ISO
A = front round flange	MF3
B = rear round flange	MF4
D = fixed eye	MP3
E = feet	MS2
L = intermediate trunnion	MT4 **(2)**
N = front square flange	MF1
P = rear square flange	MF2
S = fixed eye + spherical bearing	MP5
X = basic execution	-

Cushionings, see section 10
0 = none

Slow adjustable	Slow fixed
1 = rear only	**7** = rear only
2 = front only	**8** = front only
3 = front and rear	**9** = front and rear

Spacer, see section 6
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

Sealing system, see section 12
2 = (FKM + PTFE) very low friction and high temperatures
4 = (NBR + PTFE) very low friction and high speeds
8 = (NBR + PTFE and POLYURETHANE) low friction

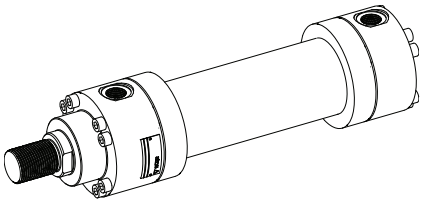
Options (1):
Oversized oil ports, see section 4
D = front oversized oil port
Y = rear oversized oil port
Rod treatment, see section 9
K = nickel and chrome plating
T = induction surface hardening and chrome plating
Air bleeds, see section 13
A = front air bleed
W = rear air bleed
Flange oil ports, see section 3
M = front and rear SAE 6000 flange oil ports

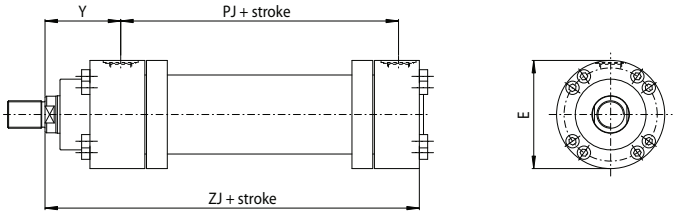
Heads' configuration (1), see section 11
Oil ports positions
B1 = front head
X1 = rear head
Cushioning adjustments positions, to be entered only if adjustable cushionings are selected
E3 = front head*
Z3 = rear head*
* = enter E2 and Z2 for mounting style E

Series number

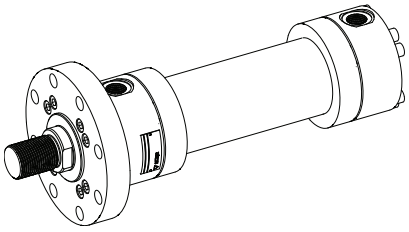
(1) To be entered in alphabetical order
(2) XV dimension must be indicated in the model code, see section 4

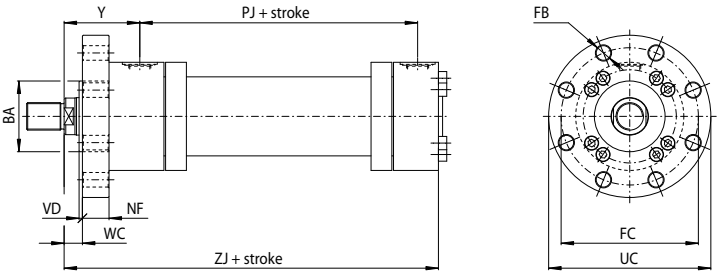
2 **MOUNTING STYLE** - for dimensions see section 4



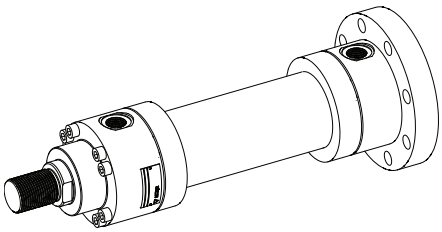


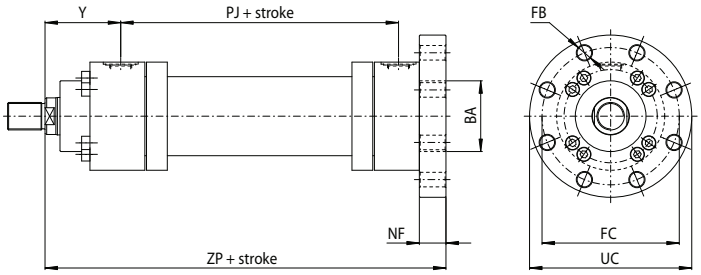
X = basic mounting



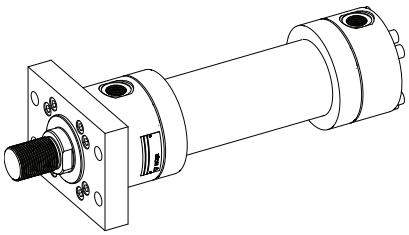


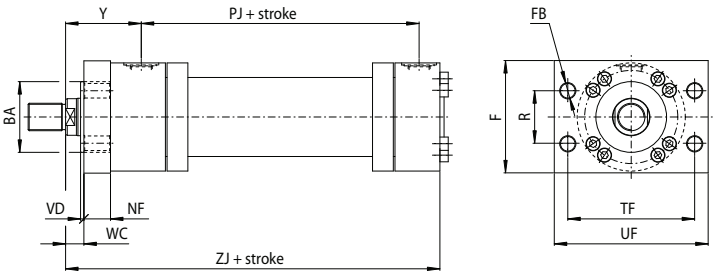
A (ISO MF3) = front round flange mounting



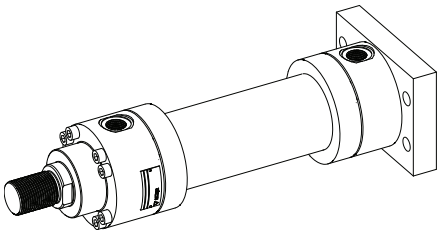


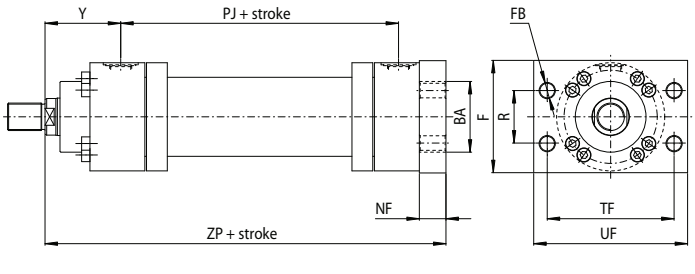
B (ISO MF4) = rear round flange mounting



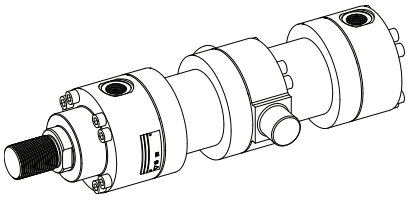


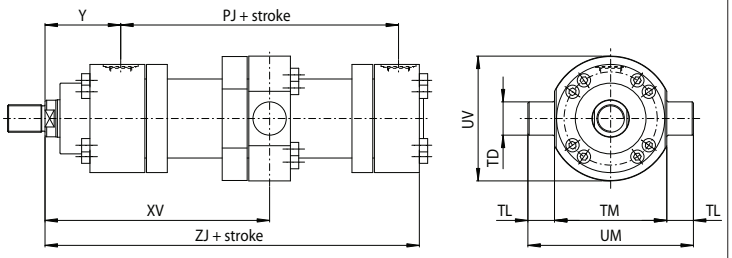
N (ISO MF1) = front square flange mounting (not for bores 160 - 200)



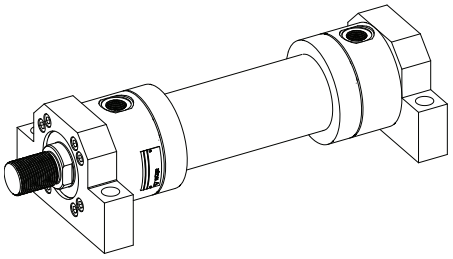


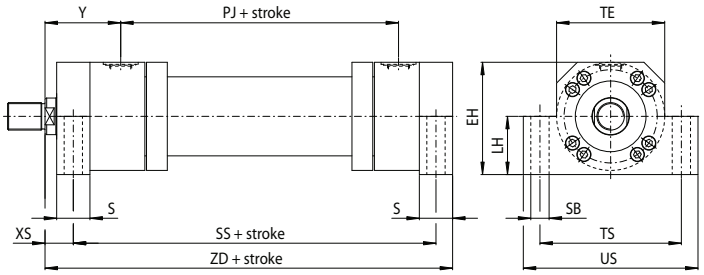
P (ISO MF2) = rear square flange mounting (not for bores 160 - 200)



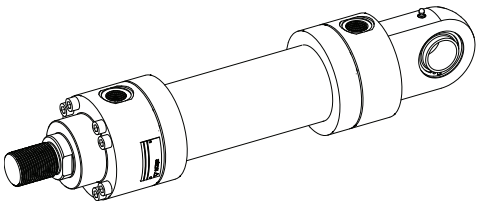


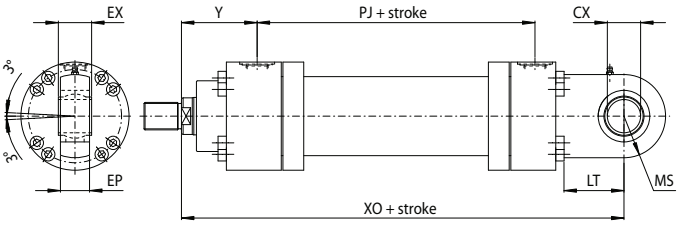
L (ISO MT4) = intermediate trunnion mounting



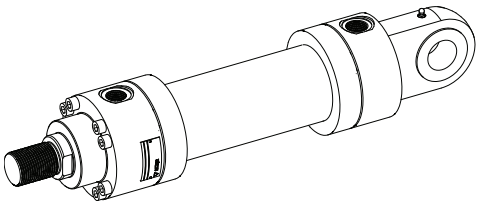


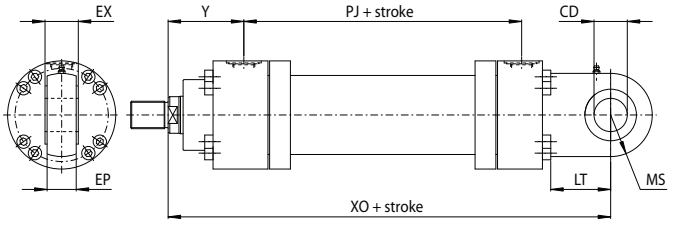
E (ISO MS2) = side feet mounting





S (ISO MP5) = fixed eye with spherical bearing mounting

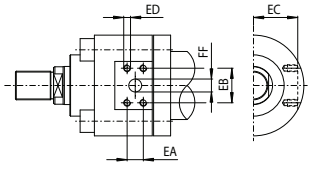




D (ISO MP3) = fixed eye mounting

3 **SAE 3000 FLANGE OIL PORTS - DIMENSIONS TO ISO 6162-1 [mm]**

Ø Bore	DN	EC	EA ±0,25	EB ±0,25	ED 6g	FF 0 / -1,5
63	13	50	17.5	38.1	M8x1.25	13
80		58				
100	19	71	22.3	47.6	M10x1.5	19
125		89				
160	25	113	26.2	52.4	M10x1.5	25
200		137				



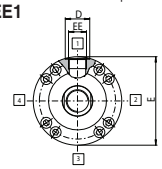
SAE 3000 flange not available for bores 40 and 50

4 INSTALLATION DIMENSIONS [mm] - see figures in section 2

Ø Bore		40	50	63	80	100	125	160	200
Ø Rod	Standard	22	28	36	45	56	70	90	110
	Differential	28	36	45	56	70	90	110	140
B / BA f8/H8		50	60	70	85	106	132	160	200
CD / CX H9/H7		20	25	32	40	50	63	80	100
D (1) min		29	29	36	36	42	42	52	52
D1 (1) min		36	36	42	42	52	52	58	58
E (2) max		78	95	116	130	158	192	238	285
EE (1)		G 1/2	G 1/2	G 3/4	G 3/4	G 1	G 1	G 1 1/4	G 1 1/4
EE1 (1)		G 3/4	G 3/4	G 1	G 1	G 1 1/4	G 1 1/4	G 1 1/2	G 1 1/2
EH max		82	100	120	135	161	196	238	288
EP		18	22	27	35	40	52	66	84
EX h12		20	25	32	40	50	63	80	100
F max		80	100	120	135	160	195	NA	NA
FB H13		9	11	13.5	17.5	22	22	22	26
FC js13		106	126	145	165	200	235	280	340
LH h10		43	52	62	70	82	100	119	145
LT min		25	32	40	50	63	71	90	112
MS max		25	32	40	50	63	71	90	112
MT [Nm] (3)		40	78	137	78	137	226	471	471
NF js13		16	20	25	32	32	32	36	40
PJ (5)		97	111	117	134	162	174	191	224
R js13		40.6	48.2	55.5	63.1	76.5	90.2	NA	NA
S js13		25	32	32	40	50	56	60	72
SB H13		11	14	18	22	26	33	33	39
SS (5)		183	199	211	236	293	321	364	447
TD f8		20	25	32	40	50	63	80	100
TE js13		78	95	116	130	158	192	238	285
TF js13		98	116.4	134	152.5	184.8	217.1	NA	NA
TL js13		16	20	25	32	40	50	63	80
TM h12		90	105	120	135	160	195	240	295
TS js13		100	120	150	170	205	245	295	350
UC max		125	148	170	195	238	272	316	385
UF max		115	140	160	185	225	255	NA	NA
UM		122	145	170	199	240	295	366	455
US max		120	145	180	210	250	300	350	415
UV		90	108	124	150	180	219	280	333
VD		3	4	4	4	5	5	5	5
WC (5)		16	18	20	22	25	28	30	35
XO (5)		231	257	289	332	395	428	505	615
XS (5)		19.5	22	29	34	32	32	36	39
XV (4) (5)	minimum stroke for style L	55	55	85	90	110	135	170	190
	min	155	160	190	215	255	290	340	420
	max	100+stroke	105+stroke	105+stroke	125+stroke	145+stroke	155+stroke	170+stroke	230+stroke
Y (5)		71	72	82	91	108	121	143	190
ZD		215	237	256	290	350	381	430	522
ZP (5)		206	225	249	282	332	357	406	490
ZJ (5)		190	205	224	250	300	325	370	450

NOTES TO TABLE 4

(1) **D, EE** - Oil ports are threaded according to GAS standard with counterbore dimension **D** according to ISO 1179-1 (see figure below). When oversized oil ports are selected (**D** = front oversized oil ports, **Y** = rear oversized oil ports) dimensions **D** and **EE** are respectively modified into **D1** and **EE1**



(2) **E** - If not otherwise specified in the figures in section 2, this value is the front and rear round heads dimension for all the mounting styles (see figure above)

(3) **MT** - Screws tightening torque. Mounting screws must be to a minimum strength of ISO 898/2 grade 12.9

(4) **XV** - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table. The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CN - 50 / 28 * 0500 - L308 - A - B1E3X1Z3
XV = 200

(5) The tolerance is according to the table below

Mounting dimensions	ZJ, ZP, XO, SS, PJ	WF, WC, XV, XS, Y
stroke < 1250	±1,5	±2
1250 > stroke < 3150	±3	±4
stroke > 3150	±5	±8

5 STROKE SELECTION

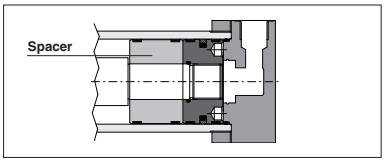
Stroke has to be selected a few mm longer than the working stroke, to prevent to use the cylinder heads as mechanical stroke-end.

Maximum stroke:
- 5000 mm

Stroke tolerances:
- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

6 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in section 4.

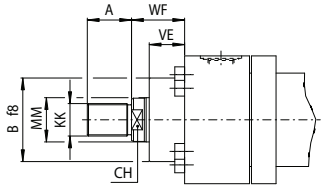


RECOMMENDED SPACERS [mm]

Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 5000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

7 ROD END DIMENSIONS [mm]

Ø Bore	40	50	63	80	100	125	160	200
VE max	19	24	29	36	37	37	41	45
WF	32	38	45	54	57	60	66	75
Ø Rod Standard	**22**	**28**	**36**	**45**	**56**	**70**	**90**	**110**
A max	22	28	36	45	56	63	85	95
CH	19	22	30	39	48	62	80	100
KK 6g	M16x1,5	M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x3	M80x3
Ø Rod Differential	**28**	**36**	**45**	**56**	**70**	**90**	**110**	**140**
A max	28	36	45	56	63	85	95	112
CH	22	30	39	48	62	80	100	128
KK 6g	M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x3	M80x3	M100x3



8 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in "cold drawn and stressed steel" with Rs = 450 N/mm²; the internal surfaces are lapped: diameter tolerance H8, roughness Ra ≤ 0,25 µm.

9 RODS FEATURES and options

The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure.
The rod surface is chrome plated: diameter tolerances f7, roughness Ra ≤ 0,25 µm. Corrosion resistance of 200 h in neutral spray to ISO 9227 NSS.

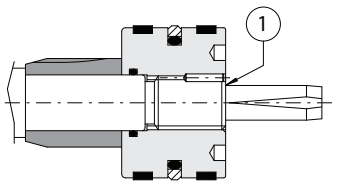
ø Rod	Material	Rs min [N/mm²]	Chrome	
			min thickness [mm]	hardness [HV]
22÷90	hardened and tempered alloy-steel	700	0,020	850-1150
110÷140	alloy steel	450		

Rod diameters from 22 to 70 mm have rolled threads; in rolling process the component material is stressed beyond its yield point, being deformed plastically. This offers many technical advantages: higher profile accuracy, improved fatigue working life and high wear resistance. See **tab. B015** for the calculation of the expected rod fatigue life. **Contact our technical office** in case of heavy duty applications.

Rod corrosion resistance and hardness can be improved selecting the options **K** and **T** (option K affects the strength of standard rod, see **tab. B015** for the calculation of the expected rod fatigue life):
K = Nickel and chrome-plating (for rods from 22 to 110 mm)
Corrosion resistance (rating 10 to ISO 10289):
- 350 h in acetic acid salt spray to ISO 9227 AASS
- 1000 h in neutral spray to ISO 9227 NSS

T = Induction surface hardening and chrome plating
- 56-60 HRC (613-697 HV) hardness

ROD-PISTON COUPLING



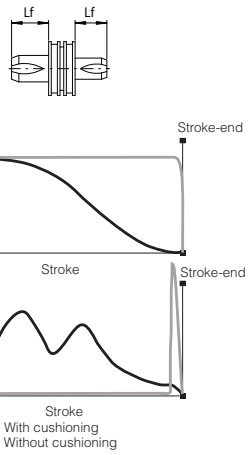
The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the table 7. The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing.

10 CUSHIONINGS

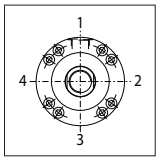
Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is necessary to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side). See the **tab. B015** for the max damping energy.
When fast adjustable versions are selected, the cylinder is provided with needle valve to optimize cushioning peformances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect).
In case of high masses and/or very high operating speeds it is recommended to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

Ø Bore		40		50		63		80		100		125		160		200	
Ø Rod		22	28	28	36	36	45	45	56	56	70	70	90	90	110	110	140
Cushioning length [mm]	Lf front	25	25	29	29	29	29	27	27	26	26	27	27	34	34	34	49
	Lf rear	30		30		32		32		32		41		56		56	

Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.



11 POSITION OF THE OIL PORTS AND CUSHIONING ADJUSTMENTS



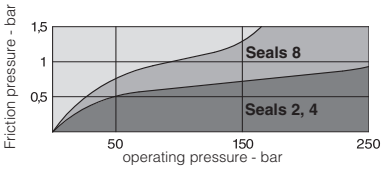
FRONT HEAD: **B1** = oil port position; **E*** = cushioning adjustment position
REAR HEAD: **X1** = oil port position; **Z*** = cushioning adjustment position.
The oil ports and cushioning adjustments positions are available , respectively, on sides 1 and 3 for all styles except E (see the figure at side): the style E has the cushioning adjustments on side 2. Cushioning adjustment positions **E***, **Z*** have to be entered only if adjustable cushionings are selected.

Example of model code: CN-50/28 *0500-S308 - A - **B1E3X1Z3**

12 SEALING SYSTEM FEATURES

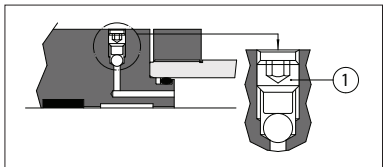
Sealing system	Material	Features	Max speed [m/s]	Fluid temperature range	Fluids compatibility	ISO Standards for seals	
						Piston	Rod
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%) HFD-U, HFD-R	ISO 7425/1	ISO 7425/2
4	NBR + PTFE	**very low friction and high speeds**	4	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
8	NBR + PTFE + POLYURETHANE	**low friction**	1	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 7425/2

The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature. Additional verifications about minimum in/out rod speed is warmly suggested, see **tab. B015**.
Special sealing system for low temperature, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see section 17. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition.
See section 14 for fluid requirements.



13 AIR BLEEDS

CODES: **A** = front air bleed; **W** = rear air bleed
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves are recommended to realize this operation easily and safely.
Air bleeds are positioned on side 3 for all styles except E: the style E has the air bleeds on side 2, see section 11.
For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
40 - 200	M8 x 10	20 Nm

14 FLUID REQUIREMENTS

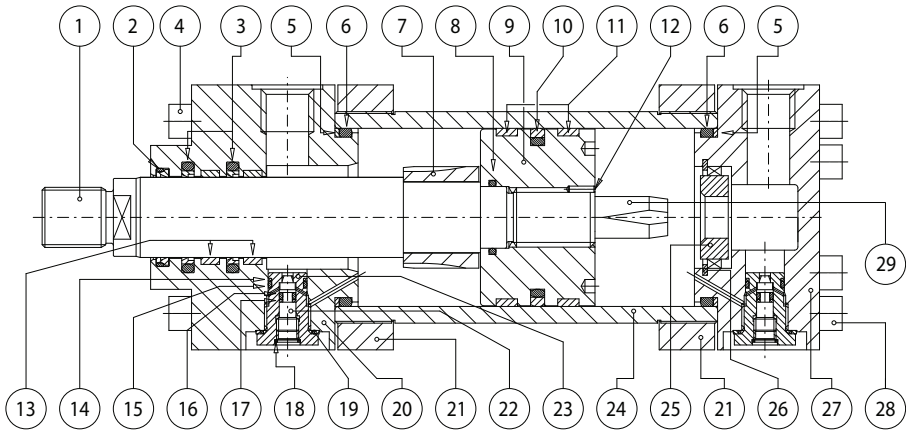
Cylinders and servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). The fluid must have a viscosity within 15 and 100 mm²/s, a temperature within 0 and 70°C and fluid contamination class ISO 19/16 according to ISO 4406, achieved with in-line filters at 25 µm.

15 CYLINDERS MASSES [kg] (tolerance ± 5%)

		MASS FOR STYLE X		ADDITIONAL MASSES according to mounting styles and options							
Ø Bore [mm]	**Ø Rod** [mm]	Stroke 100 mm	Each 100 mm more	Styles **A, B**	Style **E**	Style **L**	Styles **N, P**	Styles **D, S**	Front cushioning	Rear cushioning	Each 50 mm spacer
40	**22**	7,36	1,18	1,16	1,16	1,58	0,82	0,29	0,09	0,50	0,93
	28	7,60	1,36								
50	**28**	12	1,55	2	3,80	2,87	1,54	0,64	0,20	0,80	1,30
	36	12,50	1,86								
63	**36**	19,50	2,30	3,28	5,80	4,54	2,70	1,32	0,30	1	1,97
	45	20	2,75								
80	**45**	28	2,87	5,26	9,04	6,79	4,30	2,36	0,50	1	2,78
	56	28,50	3,55								
100	**56**	48,50	4,65	7,76	15,72	10,36	5,96	4,76	0,80	1,50	4,43
	70	49,50	5,73								
125	**70**	76,50	7,26	9,76	24,68	18,14	8,08	7,28	1,20	2	6,93
	90	78,50	9,23								
160	**90**	126	11,47	14,54	38,16	35	NA	15,64	1,70	3	11,13
	110	128,50	13,93								
200	**110**	233,50	18,31	22,66	63,36	58,88	NA	32,20	2,50	5	17,75
	140	238	22,94								

Note: the masses related to the other options, not indicated in the table, don't have a relevant influence on the cylinder's mass

16 CYLINDER SECTION



POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL
1	Rod	Chrome plated steel	11	Piston guide rings	PTFE	21	Counterflange	Steel
2	Wiper	NBR / FKM and PTFE	12	Screw stop pin	Steel	22	Cushioning adjustment screw	Steel
3	Rod seal	NBR / FKM and PTFE	13	Rod guide rings	Phenolic resin	23	Cushioning adjustment plug	Steel
4	Screw	Steel class 12.9	14	Anti-extrusion ring	PTFE	24	Cylinder housing	Steel
5	Anti-extrusion ring	PTFE	15	O-ring	FKM	25	Rear cushioning sleeve	Bronze
6	O-ring	NBR / FKM	16	O-ring	FKM	26	Toroidal ring	Steel
7	Front cushioning piston	Steel	17	Anti-extrusion ring	PTFE	27	Rear head	Steel / Cast iron
8	O-ring	NBR / FKM	18	Seeger	Steel	28	Screw	Steel class 12.9
9	Piston	Steel	19	Seal	FKM	29	Rear cushioning piston	Steel
10	Piston seal	NBR / FKM and PTFE	20	Front head	Steel / Cast iron			

17 SPARE PARTS - SEE TABLE SP-B180

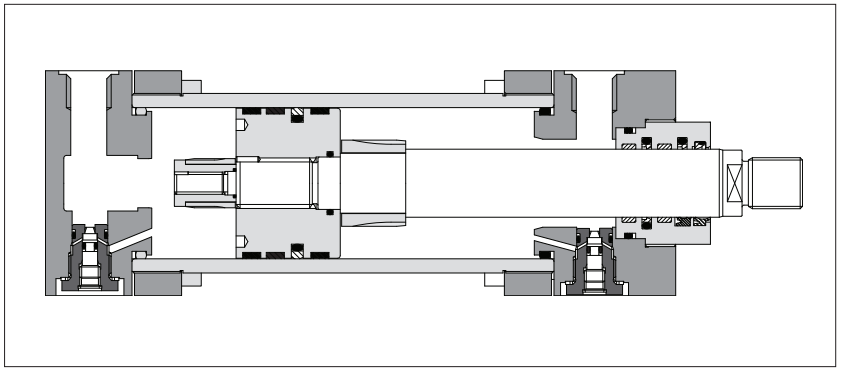
Example for seals spare parts code

G 8 - **C N** - **50** / **28**

- **G 8** — Sealing system
- **C N** — Cylinder series
- **50** — Bore size [mm]
- **28** — Rod diameter [mm]

Hydraulic cylinders type CC - round heads with counterflanges

to ISO 6022 - nominal pressure 25 MPa (250 bar) - max 32 MPa (320 bar)



CC cylinders have engineered double acting construction, designed to suit the requirements of industrial heavy duty applications: top reliability, high performances and long working life.

- Bore sizes from **50** to **320** mm
- Rods with **rolled threads**
- **6** standard mounting styles
- **3** seals options
- Adjustable cushioning
- Rod guide rings for low wear
- Optional built-in position transducer, **see tab. B310**
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

SWC Cylinders Designer

Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

1 MODEL CODE

CC	P	-	50	/	36	*	0500	-	S	3	0	1	-	A	-	B1E3X1Z3	**

Cylinder series
CC to ISO 6022

Rod position transducer
- = omit if not requested
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive
Transducer available on request, contact our technical office

Bore size, see section 3
from **50** to **320** mm

Rod diameter, see sections 7 and 9
from **36** to **220** mm

Stroke, see section 4
up to **5000** mm

Mounting style, see sections 2 and 3

		REF. ISO
A	=front flange	MF3
B	=rear flange	MF4
L	=intermediate trunnion	MT4 **(3)**
S	=fixed eye with spherical bearing	MP5
X	=basic execution	-
Z	=front threaded holes	MX5

Cushionings, see section 10
0 = none
Slow adjustable
1 = rear only
2 = front only
3 = front and rear

Spacer, see section 5
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

Sealing system, see section 12
1 = (NBR + PTFE + POLYURETHANE) high static and dynamic sealing
2 = (FKM + PTFE) very low friction and high temperatures
4 = (NBR + PTFE) very low friction and high speeds

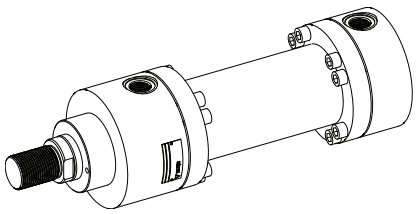
Options (2):
Oversized oil ports, see section 3
D = front oversized oil port
Y = rear oversized oil port
Flange oil ports, see section 6
M = front and rear SAE 6000 flange oil ports
Rod treatment, see section 9
K = nickel and chrome plating
T = induction surface hardening and chrome plating
Air bleeds, see section 13
A = front air bleed
W = rear air bleed
Draining, see section 14
L= rod side draining

Heads' configuration (2), see section 11
Oil ports positions
B1 = front head
X1 = rear head
Cushioning adjustments positions
E3 = front head
Z3 = rear head

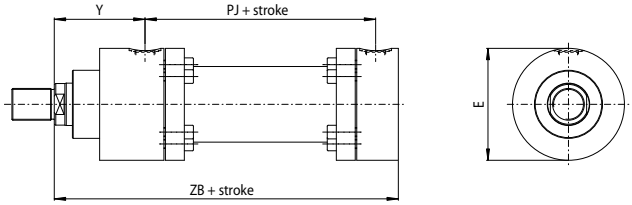
Series number **(1)**

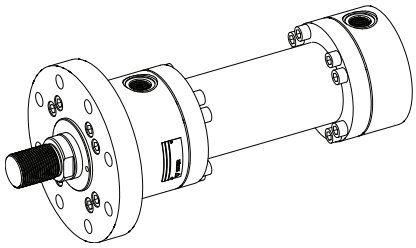
(1) For spare parts request indicate the series number printed on the nameplate only for series < 20
(2) To be entered in alphabetical order
(3) XV dimension must be indicated in the model code, see section 3

2 **MOUNTING STYLE** - for dimensions see section 3

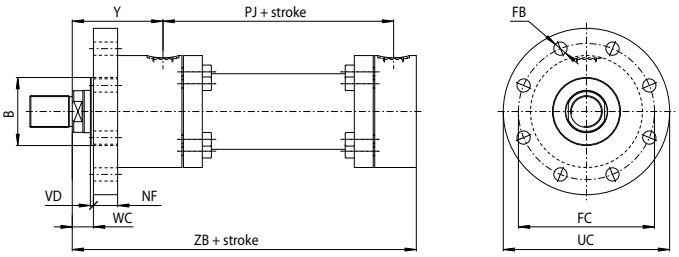


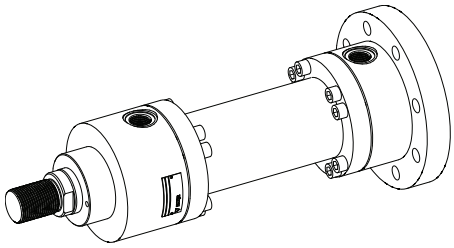
X = basic mounting



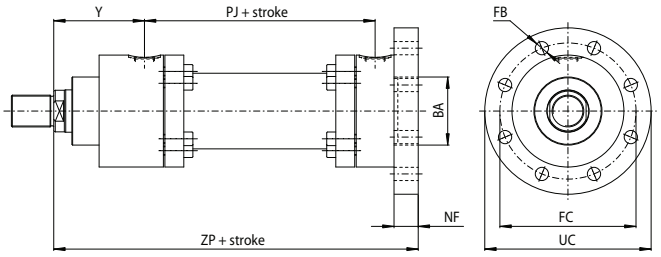


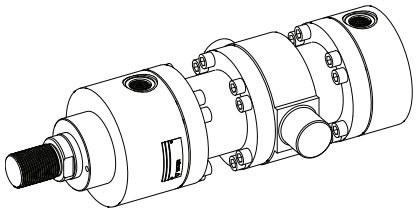
A (ISO MF3) = front flange mounting



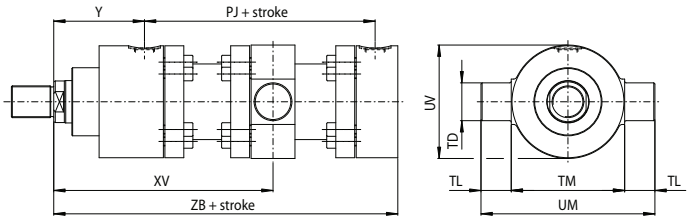


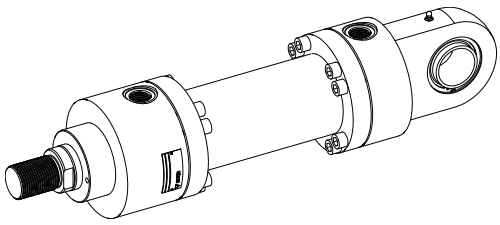
B (ISO MF4) = rear flange mounting



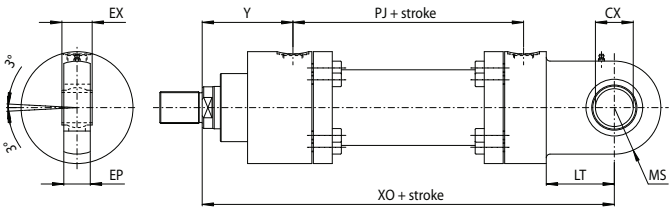


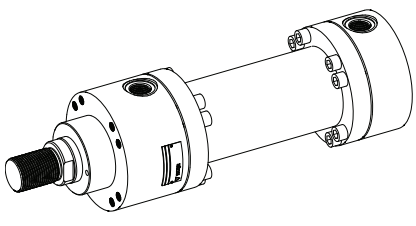
L (ISO MT4) = intermediate trunnion mounting



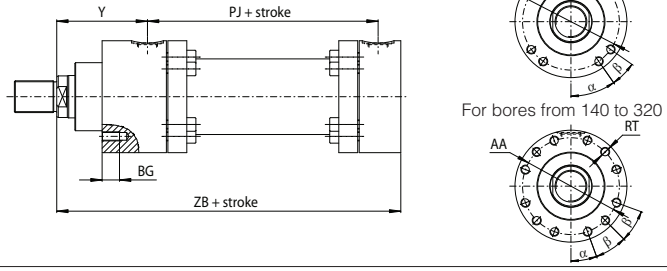


S (ISO MP5) = fixed eye with spherical bearing mounting





Z = front threaded holes mounting

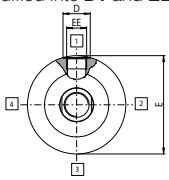


3 INSTALLATION DIMENSIONS [mm] - see figures in section 2

Ø Bore	50	63	80	100	125	140	160	180	200	250	320
Ø Rod	**36**	**45**	**56**	**70**	**90**	**90**	**110**	**110**	**140**	**180**	**220**
α, β	32,5°, 25°	32°, 26°	35°, 20°	35°, 20°	35°, 20°	27,5°, 17,5°	25°, 20°	25°, 20°	25°, 20°	27°, 18°	25°, 20°
AA	90	105	128	152	188	215	241	275	295	365	458
B / BA f8/H8 **(4)**	63	75	90	110	132	145	160	185	200	250	320
BG min	20	23	23	30	33	33	43	40	40	58	70
CX H7	32	40	50	63	80	90	100	110	125	160	200
D (1)	29	36	36	42	42	52	52	52	52	58	58
D1 (1)	36	42	42	52	52	58	58	58	58	69	69
E max **(2)**	108	124	148	175	214	255	270	315	330	412	510
EE (1) 6g	G 1/2	G 3/4	G 3/4	G 1	G 1	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/2	G 1 1/2
EE1 (1) 6g	G 3/4	G1	G 1	G 1 1/4	G 1 1/4	G 1 1/2	G 1 1/2	G 1 1/2	G 1 1/2	G 2	G 2
EP	27	35	40	52	66	65	84	88	102	130	162
EX h12	32	40	50	63	80	90	100	110	125	160	200
FB H13	13,5	13,5	17,5	22	22	26	26	33	33	39	45
FC js13	132	150	180	212	250	300 **(7)**	315	365 **(7)**	385	475	600
LT min	40	50	63	71	90	113	112	135	160	200	250
MS max	40	50	63	71	90	113	112	118	160	200	250
MT [Nm] **(3)**	30	50	85	152	255	255	304	370	490	950	1750
NF js13	25	28	32	36	40	40	45	50	56	63	80
PJ (6)	120	133	155	171	205	208	235	250	278	325	350
RT	n°8 holes M8	n°8 holes M10	n°8 holes M12	n°8 holes M14	n°8 holes M16	n°12 holes M16	n°12 holes M18	n°12 holes M20	n°12 holes M22	n°12 holes M27	n°12 holes M33
TD f8	32	40	50	63	80	90	100	110	125	160	200
TL js13	25	32	40	50	63	70	80	90	100	125	160
TM h12	112	125	150	180	224	265	280	320	335	425	530
UC max	160	180	215	260	300	340	370	425	455	545	680
UM	162	189	230	280	350	405	440	500	535	675	850
UV max	108	124	150	180	219	260	280	315	333	412	510
VD	4	4	4	5	5	5	5	5	5	8	8
VE max **(4)**	29	32	36	41	45	45	50	55	61	71	88
WC (6)	22	25	28	32	36	36	40	45	45	50	56
WF (4) (6)	47	53	60	68	76	76	85	95	101	113	136
XO (6)	305	348	395	442	520	580	617	690	756	903	1080
XV (5) (6) **minimum stroke for style L**	175	185	150	160	245	250	260	350	390	460	560
XV (5) (6) **min**	260	285	290	320	410	440	465	540	590	690	820
XV (5) (6) **max**	85 + stroke	100 + stroke	140 + stroke	160 + stroke	165 + stroke	190 + stroke	205 + stroke	190 + stroke	200 + stroke	230 + stroke	260 + stroke
Y ±2	98	112	120	134	153	181	185	205	220	260	310
ZB max	244	274	305	340	396	430	467	505	550	652	764
ZP (6)	265	298	332	371	430	465	505	550	596	703	830

NOTES TO TABLE 3

(1) D, EE - Oil ports and drain are threaded according to GAS standard with counterbore dimension **D** according to ISO 1179-1 (see figure below).
When oversized oil ports are selected (**D** = front oversized oil ports, **Y** = rear oversized oil ports) dimensions **D** and **EE** are respectively modified into **D1** and **EE1**



(2) E - If not otherwise specified in the figures in section 2 this value is the front and rear round heads dimension for all the mounting styles (see figure above)

(3) MT - Screws tightening torque. Mounting screws must be to a minimum strength of ISO 898/2 grade 12.9

(4) B, VE, WF - See figure in section 7

(5) XV - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table.
The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CC - 50 / 36 * 0500 - L308 - A -B1E3X1Z3
XV = 300

(6) The tolerance is according to the table below

Mounting dimensions	PJ, ZP, XO	WF, WC, XV
stroke < 1250	±1,5	±2
1250 > stroke < 3150	±3	±4
stroke > 3150	±5	±8

(7) The dimension is not according to ISO 6022

4 STROKE SELECTION

Stroke has to be selected a few mm longer than the working stroke, to prevent to use the cylinder heads as mechanical stroke-end. The table below shows the minimum stroke depending to the bore.

Minimum stroke [mm]

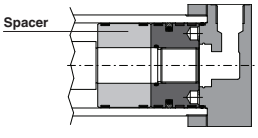
Ø Bore	50	63	80	100	125	140
Minimum stroke	70	70	20	25	50	50
Ø Bore	**160**	**180**	**200**	**250**	**320**	
Minimum stroke	50	70	70	80	120	

Maximum stroke:
- 5000 mm

Stroke tolerances:
- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

5 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in section 3.



RECOMMENDED SPACERS [mm]

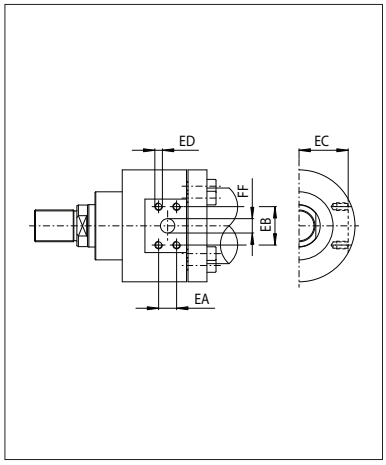
Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 5000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

6 SAE 6000 FLANGE OIL PORTS - DIMENSIONS TO ISO 6162-2 [mm]

Ø Bore	DN	EC	EA ±0,25	EB ±0,25	ED 6g	FF 0 / -1,5
50 (*)	13	46	18,2	40,5	M8x1,25	13
63 (*)	19	51	23,8	50,8	M10x1,5	19
80		65				
100	25	77	27,8	57,2	M12x1,75	25
125		99				
140	32	118	31,6	66,6	M14x2 (**)	32
160		126				
180		150				
200		158				
250	38	195	36,7	79,3	M16x2	38
320	51	245	44,5	96,8	M20x2,5	51

(*) SAE flange not available for style B (ISO MF4)
(**) Not compliance to ISO 6162-2

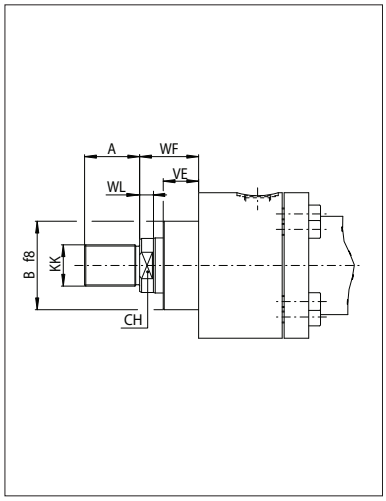
CODE: **M** = Front and rear SAE 6000 flange oil ports
Flange oil port allows an easy cylinder's connection to the piping system and it can work up to the maximum pressure 32 MPa (320 bar).



7 ROD END DIMENSIONS [mm]

Ø Bore	50	63	80	100	125	140	160	180	200	250	320
Ø Rod	**36**	**45**	**56**	**70**	**90**	**90**	**110**	**110**	**140**	**180**	**220**
A max	36	45	56	63	85	90	95	105	112	125	160
CH	30	39	48	62	80	75	100	100	128	15 (*)	20 (*)
KK 6g	M27x2	M33x2	M42x2	M48x2	M64x3	M72x3	M80x3	M90x3	M100x3	M125x4	M160x4
WL min	8	10	10	10	15	15	15	15	15	-	-

(*) n° 2 holes per key



8 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in different materials depending to the bore; the internal surfaces are lapped: diameter tolerance H8, roughness Ra ≤ 0,25 µm.

ø Bore	Material	Rs min [N/mm²]
50÷200	Cold drawn and stressed steel	450
250-320	Hot rolled steel	355

9 RODS FEATURES and options

The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure.
The rod surface is chrome plated: diameter tolerances f7, roughness Ra ≤ 0,25 µm. Corrosion resistance of 200h in neutral spray to ISO 9227 NSS.

ø Rod	Material	Rs min [N/mm²]	Chrome	
			min thickness [mm]	hardness [HV]
36÷110	Hardened and tempered alloy-steel	700	0,020	850-1150
140	Alloy steel	450		
180÷220	Carbon steel	360	0,045	850-1150

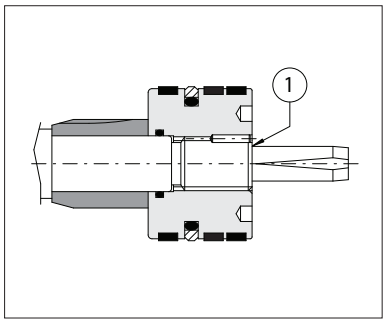
Rod diameters from 36 to 70 mm have rolled threads; in rolling process the component material is stressed beyond its yield point, being deformed plastically. This offers many technical advantages: higher profile accuracy, improved fatigue working life and high wear resistance. See **tab. B015** for the calculation of the expected rod fatigue life.
Contact our technical office in case of heavy duty applications.

Rod corrosion resistance and hardness can be improved selecting the options **K** and **T** (option K affects the strength of standard rod, see **tab. B015** for the calculation of the expected rod fatigue life):

K = Nickel and chrome-plating (for rods from 36 to 110 mm)
Corrosion resistance (rating 10 to ISO 10289):
- 350 h in acetic acid salt spray to ISO 9227 AASS
- 1000 h in neutral spray to ISO 9227 NSS

T = Induction surface hardening and chrome plating (for rods up to 140 mm)
- 56-60 HRC (613-697 HV) hardness

ROD-PISTON COUPLING



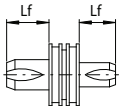
The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the table 7. The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing.

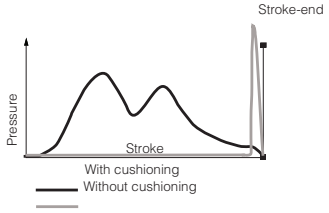
10 CUSHIONINGS

Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is necessary to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side). See the **tab. B015** for the max damping energy.
The cylinder is provided with needle valve to optimize cushioning performances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect).
In case of high masses and/or very high operating speeds it is recommended to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

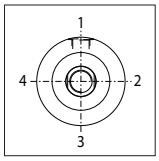
Ø Bore		**50**	**63**	**80**	**100**	**125**	**140**	**160**	**180**	**200**	**250**	**320**
Ø Rod		**36**	**45**	**56**	**70**	**90**	**90**	**110**	**110**	**140**	**180**	**220**
Cushioning length [mm]	Lf front	29	40	45	50	60	60	64	64	64	80	100
	Lf rear	35	38	45	50	60	60	64	64	64	64	64

Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.





11 POSITION OF THE OIL PORTS AND CUSHIONING ADJUSTMENTS

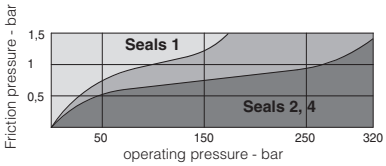


FRONT HEAD: **B1** = oil port position; **E3** = cushioning adjustment position
REAR HEAD: **X1** = oil port position; **Z3** = cushioning adjustment position.
The oil ports and cushioning adjustment positions are only available, respectively, on sides 1 and 3 (see figure at side).

Example of model code: CC-200/140 *0100-S301 - A - **B1E3X1Z3**

12 SEALING SYSTEM FEATURES

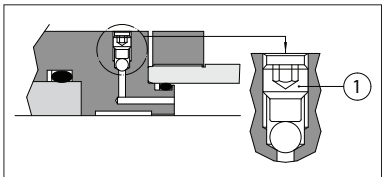
The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature. Additional verifications about minimum in/out rod speed is warmly suggested, see **tab. B015**.
Special sealing system for low temperature, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see section 18. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition. See section 15 for fluid requirements.



Sealing system	Material	Features	Max speed [m/s]	Fluid temperature range	Fluids compatibility	ISO Standards for seals	
						Piston	Rod
1	NBR + PTFE + POLYURETHANE	**high static and dynamic sealing**	0,5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 5597/1
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%), HFD-U, HFD-R	ISO 7425/1	ISO 7425/2
4	NBR + PTFE	**very low friction and high speeds**	4	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2

13 AIR BLEEDS

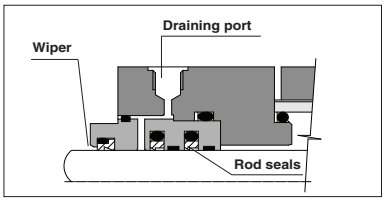
CODES: **A** = front air bleed; **W** = rear air bleed
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves are recommended to realize this operation easily and safely.
Air bleeds are positioned on side 3, see section 11.
For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
50÷200	M8 x 10	20 Nm
250÷320	M12 x 20	30 Nm

14 DRAINING

CODE: **L** = rod side draining
The rod side draining reduces the seals friction and increases their reliability; it is mandatory for cylinders with strokes longer than 2000 mm, with rod side chamber constantly pressurized and for servocylinders.
The draining is positioned on the same side of the oil port, between the wiper and the rod seals (see figure at side). It is recommended to connect the draining port to the tank without backpressure.
Draining port is G1/8.



15 FLUID REQUIREMENTS

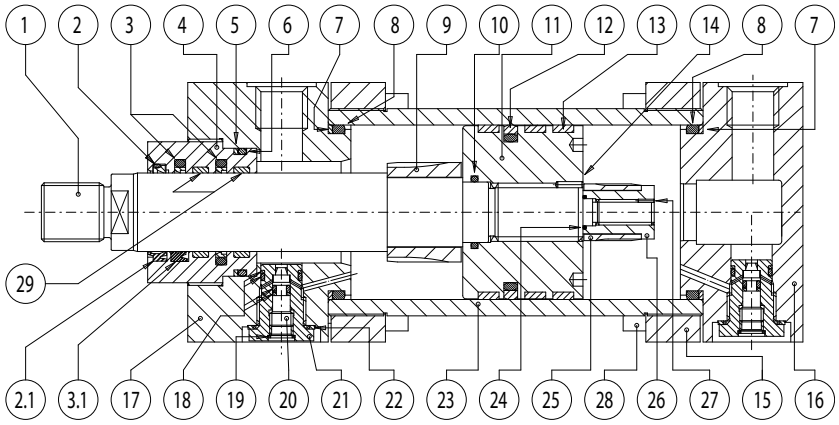
Cylinders and servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). The fluid must have a viscosity within 15 and 100 mm²/s, a temperature within 0 and 70°C and fluid contamination class ISO 19/16 according to ISO 4406, achieved with in-line filters at 25 µm.

16 CYLINDERS MASSES [kg] (tolerance ± 5%)

		MASS FOR STYLE X for single rod		ADDITIONAL MASSES depending on mounting styles and options					
Ø Bore [mm]	**Ø Rod** [mm]	for 100 mm stroke	each 100 mm more	Styles **A, B**	Style **L**	Style **S**	front cushioning	rear cushioning	each 50 mm spacer
50	**36**	18	1,9	2,77	3,15	1	0,2	1	1,3
63	**45**	20,1	2,75	3,96	4,64	2,58	0,3	1	2
80	**56**	35,5	4,15	7,17	7,81	4,54	0,5	1	3,08
100	**70**	58	6,5	11,14	13,38	7,18	0,8	1,5	4,81
125	**90**	100	10,17	16	23,68	14,02	1,2	2	7,40
140	**90**	144	10,73	22,5	41,09	23	1,2	2	8,90
160	**110**	189	15,12	29,92	47,92	27,5	1,7	5	11,72
180	**110**	262	17,32	41,66	70,16	45,9	2,5	5	14,92
200	**140**	335	22,94	54,22	81,12	69	2,5	5	17,75
250	**180**	660	42,62	86,01	167	116	2,5	5	30,58
320	**220**	1230	65,35	166	304	250	2,8	5	49,32

Note: the masses related to the other options, not indicated in the table, don't have a relevant influence on the cylinder's mass

17 CYLINDER SECTION



POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL	POS.	DESCRIPTION	MATERIAL
1	Rod	Chrome plated steel	10	O-ring	NBR / FKM	21	Cushioning adjustment plug	Steel
2	Wiper	NBR / FKM and PTFE	11	Piston	Steel	22	Seal	FKM
2.1	Wiper	Polyurethane	12	Piston seal	NBR / FKM and PTFE	23	Cylinder housing	Steel
3	Rod seal	NBR / FKM and PTFE	13	Piston guide ring	PTFE	24	O-ring	NBR / FKM
3.1	Rod seal	Polyurethane	14	Screw stop pin	Steel	25	Rear cushioning piston	Steel
4	Rod bearing	Bronze / Steel	15	Counterflange	Steel	26	Cushioning piston locking	Steel
5	Anti-extrusion ring	PTFE	16	Rear head	Steel / Cast iron	27	Screw stop pin	Steel
6	O-ring	NBR / FKM	17	Front head	Steel / Cast iron	28	Screw	Steel class 12.9
7	Anti-extrusion ring	PTFE	18	O-ring and anti-extrusion ring	FKM and PTFE	29	Rod guide	PTFE
8	O-ring	NBR /FKM	19	Seeger	Steel			
9	Front cushioning piston	Steel	20	Cushioning adjustment screw	Steel			

18 SPARE PARTS - SEE TABLE SP-B241

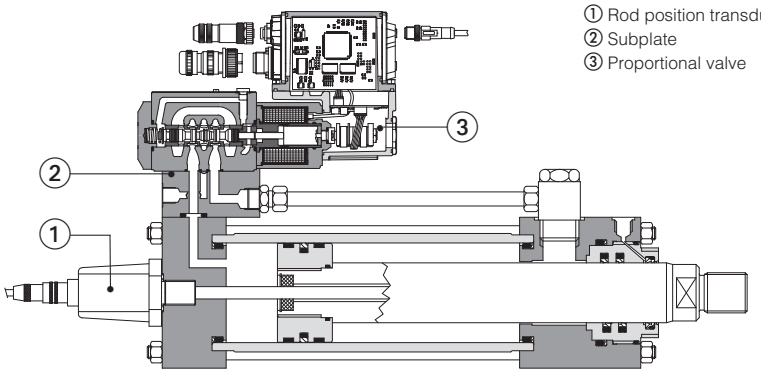
Example for seals spare parts code

G 1	-	C C	-	50	/	36	-	10

- Sealing system
- Cylinder series
- Bore size [mm]
- Rod diameter [mm]
- Serial number (indicate only for series <20)

Servocylinders type CK* with built-in position transducer

to ISO 6020-2 - nominal pressure 16 MPa (160 bar) - max 25 MPa (250 bar)



CKM/10-50/36*0500-X008 -Q-B1X1

SWC Cylinders Designer

Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

CK* electrohydraulic servocylinders have engineered double acting construction, designed to suit the requirements of industrial applications: top reliability, high performances and long working life.
Their compact construction allows high flexibility for use in all applications. The rod position transducer ① is well protected against shocks or external dirt, and maintenance is reduced to a minimum.

- Derived from cylinders series CK according to ISO 6020-2, **see tab. B137**
- Integral position transducers: Magnetosonic analog or digital, Magnetostrictive, Potentiometric and Inductive
- Bore sizes from **40** to **200** mm
- Rod draining and air bleeds supplied as standard
- Available with incorporated subplates ② for on-board on/off or proportional valves ③ to achieve the max hydraulic strenght, fast response time and repeatability
- Attachments for rods and mounting styles, **see tab. B500**

For cylinder's choice and sizing criteria **see tab. B015**

1 MODEL CODE

CK	P	/	10	-	63	/	45	*	0500	-	S	2	0	8	-	K	-	B1E3X1	**

Cylinder series
CK to ISO 6020 - 2, see **tab. B137**
See section 29 for other cylinder series

Rod position transducer, see section 2
F = magnetosonic
M = magnetosonic programmable
N = magnetostrictive
P = potentiometric
V = inductive

Incorporated subplate, see section 26
- = omit if subplate is not requested
10 = size 06
20 = size 10
30 = size 16
40 = size 25

Bore size, see section 6, 10 and 15
from **40** to **200** mm

Rod diameter, see sections 6, 10 and 15
from **28** to **140** mm

Stroke, see section 2 and 18
up to **4000** mm

Mounting style, see sections 6, 8, 10, 12, 15 and 17

		REF. ISO
C	fixed clevis	MP1 **(4)**
D	fixed eye	MP3 **(4)**
E	feet	MS2
G	front trunnion	MT1
L	intermediate trunnion	MT4
N	front flange	ME5
P	rear flange	ME6 **(4)**
S	fixed eye + spherical bearing	MP5 **(4)**
X	basic execution	-
Y	front tie rods extended	MX3
Z	front threaded holes	MX5

Cushionings, see section 23 option **2** is only available for bores from 63 to 200
0 = without cushioning **2** = front adjustable cushioning

Spacer, see section 19
0 = none **2** = 50 mm **4** = 100 mm **6** = 150 mm **8** = 200 mm

Sealing system, see section 25
2 = (FKM + PTFE) very low friction and high temperatures
4 = (NBR + PTFE) very low friction and high speeds
8 = (NBR + PTFE and POLYURETHANE) low friction

Heads' configuration (2), see section 24
Oil ports positions
B1 = front head
X1 = rear head
Cushioning adjustments positions, to be entered only if adjustable cushionings are selected
E3 = front head *
* enter E2 only for mounting style E

Options (2) (3):
Rod end, see section 7, 11 and 16
H = light male thread
Rod treatment, see section 22
K = nickel and chrome plating
T = induction surface hardening and chrome plating
Oversized oil ports, see section 6 and 7
D = front oversized oil port
Y = rear oversized oil port
Output for CKF, CKM, CKN, CKV, see sections 3, 4, 9 and 14
A = current output (4÷20 mA)
V = voltage output (0÷10V)
N = electronic conditioning card for CKN
Digital SSI output for CKM, see section 4
Q = binary 24 bit **R** = binary 25 bit
S = gray 24 bit **U** = gray 25 bit
Fieldbus output, see section 5
C = CANopen
P = PROFIBUS DP
Fieldbus output, see section 3, 4, 5, 9, 13 and 14
M = 90° female connector

Series number **(1)**

(1) For spare parts request indicate the series number printed on the nameplate only for series < 40
(2) To be entered in alphabetical order
(3) Rod draining and air bleeds supplied as standard, see sections 27 and 28
(4) Not available for CKF and CKM

2 MAIN CHARACTERISTICS OF TRANSDUCERS

Code	**CKF** section 3	**CKM** section 4	**CKN** section 9	**CKP** section 13	**CKV** section 14
Transducer type	Magnetosonic, analog	Magnetosonic, programmable	Magnetostrictive	Potentiometric	Inductive
Linearity error **(1)**	< ± 0,02%	< ± 0,01%	< ± 0,02%	± 0,1%	± 0,2%
Repeatability	< ± 0,001% **(1)**	< ± 0,001% **(1)**	< ± 0,005% **(1)**	0,01 mm	± 0,05% **(1)**
Strokes	50 to 2500	25 to 3000	100 to 3000	100 to 900	30 to 1000
Interface	Voltage: 0 ÷ 10 V Current: 4 ÷ 20 mA	Analog: 0 ÷ 10 V, 4 ÷ 20 mA Digital: SSI, CANopen, PROFIBUS DP	Voltage: 0,1 ÷ 10,1 V Current: 4 ÷ 20 mA	Voltage 0 ÷ 10 V	Voltage: 0 ÷ 10 V Current: 4 ÷ 20 mA
Typical applications	Sawing or bending machines	Steel plants, plastic and rubber	Foundry and energy	Various	Simulators and energy
Temperature limits	-20°C to +75°C	-20°C to +75°C	-20°C to +90°C	-20°C to +100°C	-20°C to +120°C

(1) Percentage of the total stroke

3 SERVOCYLINDERS TYPE CKF

3.1 Magnetosonic transducers - basic working principles

The magnetosonic transducer is composed by: a waveguide element ① fixed to the cylinder's body, a permanent magnet ② rigidly connected to the cylinder's rod and an integral electronics signal conditioning ③ located on the rear head.
The position measurement is based upon the magnetostriction phenomenon: the electronics signal conditioning ③ generates a short current pulse that travels through the waveguide ①. When this pulse meets the magnetic field of the permanent magnet ②, a torsional wave is generated and it travels back to the electronics signal conditioning.
The position of the moving magnet is thus accurately determined by measuring the elapsed time between the application of the current pulse and the arrival of the torsional wave, thanks to their constant ultrasonic speed. Sensor electronics signal conditioning transforms this measurement into the analogic output feedback signal.
The contactless construction of the position transducer ensures a long working life and allows its use even in hard environmental conditions (shocks, vibrations etc.) or high working frequencies.
The transducer can be replaced without disassembling the cylinder, providing a great advantage of easy and quick maintenance.
Magnetosonic transducers, particularly simple and cost-effective, makes the CKF servocylinders commonly used as alternatives to external absolute encoders or to potentiometric transducers.

3.2 Output signal

The transducer integral electronics is available with the following configurations:

Analog

A = 4 - 20 mA
V = 0 - 10 V

Example of model code: CKF-63/45*0500-X008 -**A**-B1X1

3.3 Transducer features

CKF are equipped with "MTS"'s magnetosonic transducers, whose main features are shown in the table at side.

3.4 Electronic connections

The 5 pin male connector M12 is located on the transducer rear head.
The straight female cable connector ④ **CON031** is included in the supply. The 90° female connector **CON041** can be supplied selecting option **M**. See the table at side for electronic connections.

3.5 Strokes

From 50 to 2500 mm by increments of 5 mm.
If a not standard stroke is required, contact our technical office.

3.6 Cylinder features

See sections 6, 7 and 8 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

3.7 Fluid requirements

CKF servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). **For the proper choice of the sealing system, in relation to the fluid characteristics, see section** 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm^2/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achievable with in-line filters at 25 µm

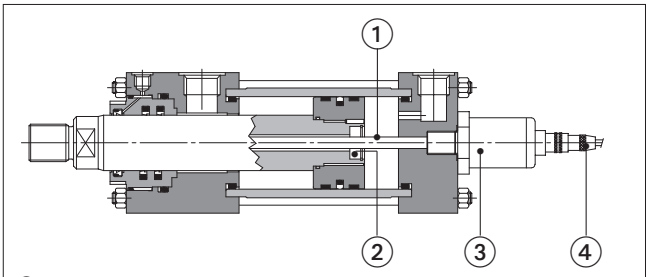
3.8 Start-up notes

During the start-up it is necessary to bleed off the air from the servocylinder as indicated in section 27.
For other details refer to the start-up instructions included in the supply.

3.9 Warnings

Ensure that the servocylinder and wirings are kept away from strong magnetic field and electrical noise to prevent noises on the feedback signal. Check the electronic connections and switch-off the power supply before connecting or disconnecting the position transducer to avoid electronic damages.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKF

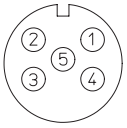


① Waveguide
② Permanent magnet
③ Integral electronics signal conditioning
④ Connector

TRANSDUCER FEATURES

Power supply	24 VDC (±15%)
Output signal	0÷10 VDC / 4÷20 mA
Resolution	infinite, restricted by the output ripple
Linearity	< ± 0,02% F.S (min ± 60 µm)
Repeatability	< ± 0,001 % F.S.
Output update frequency	< 3 kHz
Temperature coefficient	< 50 ppm/°C
Operating temperature	-20 ÷ +75 °C
Connection type	5 pin connector M12
Protection degree	IP67 to DIN 40050
Shock resistance	100g (single shock) / IEC Standard 68-2-27
Vibration resistance	15g/10÷2000 Hz / IEC Standard 68-2-6
Measuring range	50 to 2500 mm (increments of 5 mm)
Maximum speed	1m/s

ELECTRONIC CONNECTIONS

5 PIN female connector (to solder)	PIN	SIGNAL	NOTES
	1	V+	Input - power supply 24 VDC (±15%)
	2	OUTPUT	Output - analog signal
	3	V0	Gnd - power supply 0 VDC
	4	NC	Do not connect
CON031 (Transducer view)	5	AGND	Gnd - analog signal

4 SERVOCYLINDERS TYPE CKM - PROGRAMMABLES

4.1 Magnetosonic transducers - basic working principles

The magnetosonic transducer is composed by: a waveguide element ① fixed to the cylinder's body, a permanent magnet ② rigidly connected to the cylinder's rod and an integral electronics signal conditioning ③ located on the rear head.
The position measurement is based upon the magnetostriction phenomenon: the electronics signal conditioning ③ generates a short current pulse that travels through the waveguide ①. When this pulse meets the magnetic field of the permanent magnet ②, a torsional wave is generated and it travels back to the electronics signal conditioning.
The position of the moving magnet is thus accurately determined by measuring the elapsed time between the application of the current pulse and the arrival of the torsional wave, thanks to their constant ultrasonic speed. Sensor electronics signal conditioning transforms this measurement into the output feedback signal.
The contactless construction of the position transducer ensures a long working life and allows its use even in hard environmental conditions (shocks, vibrations etc.) or high working frequencies.
The transducer can be replaced without disassembling the cylinder, providing a great advantage of easy and quick maintenance.
Additionally, the only electronics signal conditioning can be easily removed and replaced without removing its case; in this way the cylinder could keep on working avoiding any production-stop time.
CKM servocylinders are characterized by high performances and they are availables in several versions.

4.2 Output signal

The transducer integral electronics is available with the following configurations:

Analog	**Digital SSI**
A = 4-20 mA	**Q** = Binary 24 bit
V = 0-10 V	**R** = Binary 25 bit
	S = Gray 24 bit
	U = Gray 25 bit

Example of model code: CKM-63/45*0500-X008 -**A**D-B1X1

ETHERNET output is available on request, for other output signal contact our technical office.

4.3 Transducer features

CKM are equipped with "MTS"'s magnetosonic transducers, whose main features are shown in the table at side. The integral position tranducer is also available with an explosion-proof housing, ATEX certified, for use in explosion-hazardous environments.
Other integral position transducers brands are available on request, contact our technical office.

4.4 Electronic connections

The 6 or 7 pin male connector M16 is located on the transducer rear head. The straight female cable connector ④ is included in the supply:

STCO9131-D06-PG7 6 pin female connector for analog version
STCO9131-D07-PG9 7 pin female connector for digital SSI version

The 90° female connector can be supplied selecting option **M**:
STCO9131-6-PG7 6 pin 90° female connector for analog version
STCO9131-7-PG9 7 pin 90° female connector for digital SSI version

See the tables at side for electronic connections.
For other connector types or cable outputs, contact our technical office.

4.5 Strokes

From 25 to 3000 mm by increments of 5 mm.
If a not standard stroke is required, contact our technical office.

4.6 Cylinder features

See sections 6, 7 and 8 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

4.7 Fluid requirements

For the suitable fluids and the proper choice of the sealing system, in relation to the fluid characteristics, see sections 3 and 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm²/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achievable with in-line filters at 25 µm

4.8 Start-up notes

The output signal of the CKM analog or digital SSI versions is programmable by using proper programming tools to be ordered separately:

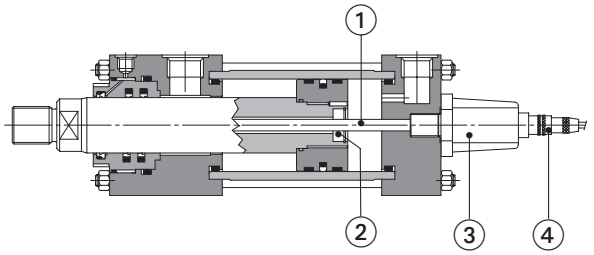
253-124 for zero/span setting of analog version
253-135 for complete re-programming of the transducers parameters (resolution, output format, length etc.) of digital SSI version

The sensor electronics case is equipped with two LED that indicate the transducer status, allowing a quick recognition of main possible faults (magnet not detected or out of set-up range).
During the start-up it is necessary to bleed off the air from the servocylinder as indicated in section 27.
For other details refer to the start-up instructions included in the supply.

4.9 Warnings

Ensure that the servocylinder and wirings are kept away from strong magnetic field and electrical noise to prevent noises on the feedback signal. Check the electronic connections and switch-off the power supply before connecting or disconnecting the position transducer to avoid electronic damages.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKM



① Waveguide
② Permanent magnet
③ Integral electronics signal conditioning
④ Connector

TRANSDUCER FEATURES

	Analog	**Digital SSI**
Power supply	24 VDC (±15%)	
Outputs signal	0÷10 VDC/ 4÷20 mA	SSI RS 422/485 Standard
Data format (SSI)	NA	Binary / Gray
Data lenght (SSI)	NA	24 / 25 bit
Resolution	16 bit; 0,0015% (min. 1 µm)	5 µm
Linearity	<±0,01% F.S. (min ±50 µm)	<±0,01% F.S. (min ±40 µm)
Repeatability	<±0,001% F.S. (min ±1 µm)	
Hysteresis	< 4 µm	
Data speed (only for digital)	70 kBd÷1MBd (depending to cables lenght)	
Update frequency	0,5÷2kHz (depending to the stroke)	0,5÷3,7kHz (depenging to the stroke)
Temperature coefficient	< 30 ppm/°C	< 15 ppm/°C
Connection type	6 pin connector M16 to DIN45322	7 pin connector M16 to DIN45329
Protection degree	IP67 to DIN 40050	
Shock resistance	100g (single hit) / IEC Standard 68-2-27	
Vibration resistance	15g/10÷2000 Hz / IEC Standard 68-2-6	
Polarity protection	up to -30 VDC	
Operating temperature	-20 ÷ +75 °C	
Measuring range	25 to 3000 mm (increments of 5 mm)	
Maximum speed	2m/s	

ELECTRONIC CONNECTIONS - ANALOG

6 PIN female connector (to solder)	**PIN**	**SIGNAL**	**NOTES**
	1	OUTPUT	Output - analog signal
	2	AGND	Gnd - analog signal
	3	NC	Do not connect
	4	NC	Do not connect
	5	V+	Input - power supply 24 VDC (±15%)
STCO9131-D06-PG7 (Transducer view)	6	V0	Gnd - power supply 0 VDC

ELECTRONIC CONNECTIONS - DIGITAL SSI

7 PIN female connector (to solder)	**PIN**	**SIGNAL**	**NOTES**
	1	DATA -	Input - serial position data (-)
	2	DATA +	Output - serial position data (+)
	3	CLOCK +	Output -serial syncronous clock (+)
	4	CLOCK -	Input - serial syncronous clock (-)
	5	V+	Input - power supply 24 VDC (±15%)
	6	V0	Gnd - power supply 0 VDC
STCO9131-D07-PG9 (Transducer view)	7	NC	Do not connect

5 SERVOCYLINDERS TYPE CKM - PROGRAMMABLES with fieldbus interface PROFIBUS DP or CANopen

5.1 Working basic principles

CKM servocylinders (see section 4 for magnetosonic working principle) are also available with fieldbus communication interface. Field communication networks allow to exchange a great amount of data among all the devices installed on the machines and industrial plants (servocylinders, valves, pumps, motors, etc.) by means of just one cable. It is so possible to connect all the devices of the system to the machine control unit (fieldbus master) avoiding expensive wirings and start-up costs.
Fieldbus provides also a more efficient connection that can speed up the installation task as well as prevent wiring errors.
The possibility to perform system level diagnostics on each node or device in the system represents an optimum maintenance tool and it has a positive impact on the system performances.
The remarkable aspect of these communication networks is the common standardized language ("protocol") of all the connected devices, making the control and monitoring of the whole machine very easy.

5.2 Output signal

The available feedback protocols are:

P = **PROFIBUS DP** according to EN 50 170 (ISO 74498)
C = **CANopen** according to CiA standard DS-301 V4.02 (ISO-DIS11898)

Example of model code: CKM-63/45*0500-X008 -D**P**-B1X1

Other feedback protocols are available on request, contact our technical office.

5.3 Transducer features

CKM are equipped with "MTS"'s magnetosonic transducers whose features are shown in the table at side. Other integral position transducers brands are available on request, contact our technical office.

5.4 Electronic connections

Male and female connectors are located on the transducer rear head.
The cable connectors are included in the supply:

CANopen - 2 connectors

STCO9131-D06-PG9 6 pin female M16 connector for bus input
STCO9131-D06-PG9 6 pin female M16 connector for bus output

The 90° female connector can be supplied selecting option **M**:
STCO9131-6-PG9 6 pin 90° female connector for bus input
STCO9131-6-PG9 6 pin 90° female connector for bus output

PROFIBUS DP- 4 connectors

560884 5 pin male M12 connector for bus input
560885 5 pin female M12 connector for bus output
560888 5 pin female M12 for bus terminator
560886 4 pin female M8 connector for power supply

See the table at side for electronic connections..
For other connector types, contact our technical office.

5.5 Strokes

From 25 to 3000 mm by increments of 5 mm.
If a not standard stroke is required, contact our technical office.

5.6 Cylinder features

See sections 6, 7 and 8 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

5.7 Fluid requirements

For the suitable fluids and the proper choice of the sealing system, in relation to the fluid characteristics, see sections 3 and 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm²/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achievable with in-line filters at 25 µm

5.8 Start-up notes

The transducer's fieldbus configuration files and the manual for start-up are included in the supply.
The setup of the transducer's slave address is usually done by the bus standard service of the system: if the fieldbus master does not support this service, the setting can be done by a proper programmer tool to be separately ordered:

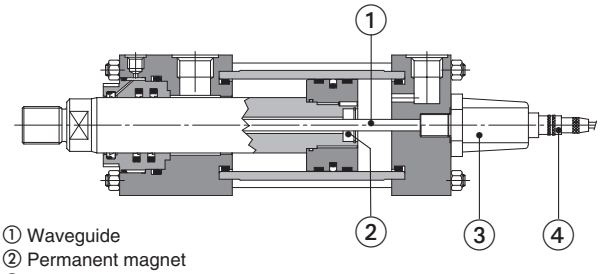
252-382-D62 for CANopen protocol
252-173-D52 for PROFIBUS DP protocol

The sensor electronics case is equipped with two LED that indicate the transducer status, allowing a quick recognition of main possible faults (magnet not detected or out of set-up range).
During the start-up it is necessary to bleed off the air from the servocylinder as indicated in section 27.
For other details refer to the start-up instructions included in the supply.

5.9 Warnings

Ensure that the servocylinder and wirings are kept away from strong magnetic field and electrical noise to prevent noises on the feedback signal. Check the electronic connections and switch-off the power supply before connecting or disconnecting the position transducer to avoid electronic damages.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKM

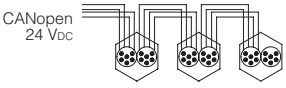


① Waveguide
② Permanent magnet
③ Integral electronics signal conditioning
④ Connector

TRANSDUCER FEATURES

Power supply	24 VDC (±15%)
Data transmission rate (with cable L < 25 m and 1 node)	**PROFIBUS DP:** max. 12 MBit/s **CAN open:** max. 1000 KBit/s
Cycle time	1 ms with stroke up to 2000 mm
Resolution (selectable by Bus)	5 µm for **CANopen** ; 1 µm for **PROFIBUS DP**
Linearity	<±0,01% F.S. (min ±50 µm)
Repeatability	<±0,001% F.S. (min ±2,5 µm)
Hysteresis	< 4 µm
Temperature coefficient	< 15 ppm/°C
Shock resistance	100g (single hit) / IEC Standard 68-2-27
Vibration resistance	15g/10÷2000 Hz / IEC Standard 68-2-6
Overvoltage protection	Up to 36 VDC
Protection degree	IP67 to DIN 40050
Operating temperature	-20 ÷ +75 °C
Measuring range	25 to 3000 mm (increments of 5 mm)
Maximum speed	2m/s

ELECTRONIC CONNECTIONS - CANopen

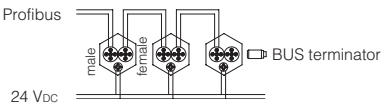


6 PIN female connector (to solder)

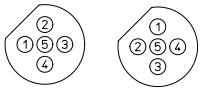
STCO9131-D06-PG9
(Transducer view)

PIN	SIGNAL	NOTES
1	CAN_L	Bus line (low)
2	CAN_H	Bus line (high)
3	NC	Do not connect
4	NC	Do not connect
5	V+	Power supply 24 VDC (±15%)
6	CAN_GND	Signal zero data line (0V)

ELECTRONIC CONNECTIONS - PROFIBUS DP



5 PIN connectors (to screw)



560884 male **560885** female
(Transducer view)

4 PIN female connector (to solder)

560886
(Transducer view)

PIN	SIGNAL	NOTES
1	+ 5V	for bus termination *
2	LINE-B	RxD/TxD-N (BUS)
3	DGND	data line and termination signal zero *
4	LINE-A	RxD/TxD-P (BUS)
5	SCHIELD	
1	V+	Input - power supply 24 VDC (±15%)
2	NC	Do not connect
3	V0	Gnd - power supply 0 VDC
4	NC	Do not connect

* Female only

6 INSTALLATION DIMENSIONS [mm] FOR SERVOCYLINDERS TYPE CKF, CKM

Ø Bore	40	50	63	80	100	125	160	200
Ø Rod	**28**	**36**	**45**	**56**	**70**	**90**	**110**	**140**
A max	28	36	45	56	63	85	95	112
A1 (option **H)** max	18	22	28	36	45	56	63	85
AA	59	74	91	117	137	178	219	269
B f9	42	50	60	72	88	108	133	163
BB +3 / 0	35	46	46	59	59	81	92	115
BG min	12	18	18	24	24	27	32	40
CH h14	22	30	39	48	62	80	100	128
CO N9	12	12	16	16	16	20	30	40
DD 6g	M8x1	M12x1,25	M12x1,25	M16x1,25	M16x1,25	M22x1,5	M27x2	M30x2
D (1)	25	29	29	36	36	42	42	52
D1 (1)	29	NA	NA	42	42	52	52	58
E	63±1,5	75±1,5	90±1,5	115±1,5	130±2	165±2	205±2	245±2
EE (1) 6g	G 3/8	G 1/2	G 1/2	G 3/4	G 3/4	G 1	G 1	G 1 1/4
EE1(1) 6g	G 1/2	NA	NA	G 1	G 1	G1 1/4	G1 1/4	G 1 1/2
F max	10	16	16	20	22	22	25	25
FB H13	11	14	14	18	18	22	26	33
J	38	38	38	45	45	58	58	76
KC min	4	4,5	4,5	5	6	6	8	8
KK standard 6g	M20 x 1,5	M27 x 2	M33 x 2	M42 x 2	M48 x 2	M64 x 3	M80 x 3	M100 x 3
KK1 option **H** 6g	M14 x 1,5	M16 x 1,5	M20 x 1,5	M27 x 2	M33 x2	M42 x 2	M48 x 2	M64 x 3
LH h10	31	37	44	57	63	82	101	122
PJ ±1,5 **(3)**	85	74	80	93	101	117	130	165
PJ1 ±1,5 **(1) (3)**	87,5	NA	NA	93	99	121	143	167
R js13	41	52	65	83	97	126	155	190
RD f8	62	74	88	105	125	150	170	210
RT	M8x1,25	M12x1,75	M12x1,75	M16x2	M16x2	M22x2,5	M27x3	M30x3,5
SB H13	11	14	18	18	26	26	33	39
SS ±1,25 **(3)**	109	91	85	104	101	130	129	171
ST js13	12,5	19	26	26	32	32	38	44
TC h14	63	76	89	114	127	165	203	241
TD f8	20	25	32	40	50	63	80	100
TG js13	41,7	52,3	64,3	82,7	96,9	125,9	154,9	190,2
TL js13	16	20	25	32	40	50	63	80
TM h14	76	89	100	127	140	178	215	279
TO js13	87	105	117	149	162	208	253	300
TS js13	83	102	124	149	172	210	260	311
UM	108	129	150	191	220	278	341	439
UO max	110	130	145	180	200	250	300	360
US max	103	127	161	186	216	254	318	381
UT	95	116	139	178	207	265	329	401
UW max	70	88	98	127	141	168	205	269
VD	12	9	13	9	10	7	7	7
VE max	22	25	29	29	32	29	32	32
VL min	3	4	4	4	5	5	5	5
WF ±2	35	41	48	51	57	57	57	57
WH ±2	25	25	32	31	35	35	32	32
XG ±2 **(3)**	57	64	70	76	71	75	75	85
XS ±2 **(3)**	45	54	65	68	79	79	86	92
Minimum stroke	5	15	20	20	35	35	35	35
XV (2) min	100	109	120	129	148	155	161	195
±2 **(3)** max	99+stroke	98+stroke	100+stroke	115+stroke	117+stroke	134+stroke	141+stroke	166+stroke
Y ±2	62	67	71	77	82	86	86	98
Y1 ±2 **(1)**	61,5	NA	NA	75,5	83	84	79,5	97
ZB max	178	184	192	212	225	260	279	336

NOTES TO TABLE

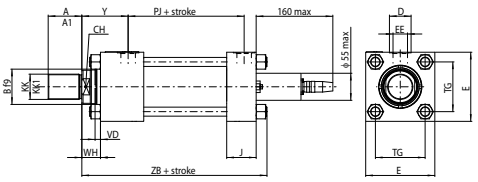
(1) Oil ports are threaded according to ISO 1179-1 (GAS standards) with counterbore dimension D. When oversized oil ports are selected, dimensions **D**, **EE**, **PJ** and **Y** are respectively modified into **D1**, **EE1**, **PJ1** and **Y1**. For bore 160 with mounting styles E, N the dimension **PJ1** reported in the table is modified, contact our technical office.

(2) XV - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table. The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CKM-50/36*0500-L208 - D - B1E3X1 **XV = 200**

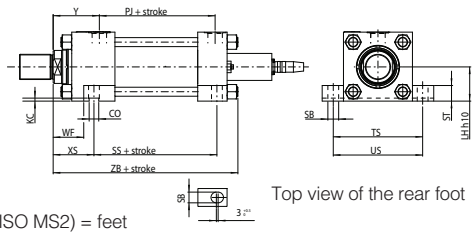
(3) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is the max stroke tolerance reported in section 18.

7 BASIC CONFIGURATION



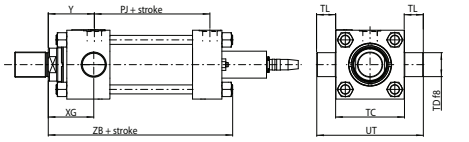
Basic configuration: X - see section 6 for dimensions

8 MOUNTING STYLE FOR SERVOCYLINDERS TYPE CKF, CKM

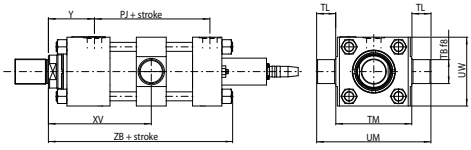


Top view of the rear foot

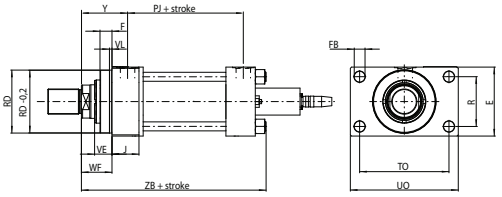
E (ISO MS2) = feet



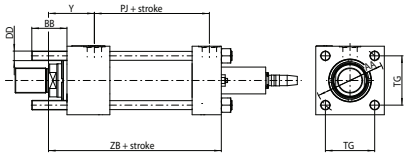
G (ISO MT1) = front trunnion



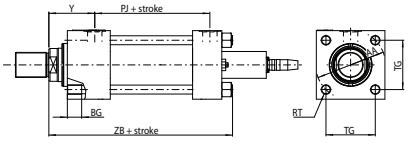
L (ISO MT4) = intermediate trunnion



N (ISO ME5) = front flange



Y (ISO MX3) = front tie rods extended



Z (ISO MX5) = front threaded holes

9 SERVOCYLINDERS TYPE CKN

9.1 Magnetostrictive transducers - basic working principles

The magnetostrictive transducer is composed by: a waveguide element ① fixed to the cylinder's body, a permanent magnet ② rigidly connected to the cylinder's rod and an integral electronics signal conditioning ③ located inside the rear head.
The position measurement is based upon the magnetostriction phenomenon: the electronics signal conditioning ③ generates a short current pulse that travels through the waveguide ①. When this pulse meets the magnetic field of the permanent magnet ②, a torsional wave is generated and it travels back to the electronics signal conditioning.
The position of the moving magnet is thus accurately determined by measuring the elapsed time between the application of the current pulse and the arrival of the torsional wave, thanks to their constant ultrasonic speed. Sensor electronics signal conditioning transforms this measurement into the analogic output feedback signal.
The contactless construction of the position transducer ensures a long working life and allows its use even in hard environmental conditions (shocks, vibrations etc.) or high working frequencies.
The small size of this magnetostrictive transducer allows the installation completely inside the cylinder, providing a very compact construction and a reduction of the overall dimensions respect to CKF and CKM servocylinders. These features make CKN servocylinders the best alternative to external absolute encoders, potentiometric and inductive transducers.

9.2 Output signal

The transducer integral electronics is available with the following configurations:

Analog

A = 4 - 20 mA
V = 0,1 - 10,1 V (0 - 10 V with electronic conditioning card)

The option **A** or **V** for the output signal has to be always entered in the cylinder code.
Transducer's performance can be enhanced with the optional electronic conditioning card, option **N**, which allows to adjust zero and gain references by a "magnetic pen" included in the supply.
CANopen output is available on request, contact our technical office.

Example of model code for CKN with electronic conditioning card and current output:
CKN-63/45*0500-X008 -**AN**-B1X1

9.3 Transducer features

CKN are equipped with "GEFRAN"'s magnetostrictive transducers whose features are shown in the tables at side.

9.4 Electronic connections

The 6 pin male connector M16 is mounted on side 4 of the cylinder rear head. The electronic conditioning card (option **N**) has to be connected to the transducer by wire clamp IP67 and screw terminals.
The straight female cable connector ④ **STCO9131-D06-PG7** is included in the supply, for option N the connector is supplied with a cable 3 m long connected to the electonic conditioning card. The 90° female connector **STCO9131-6-PG7** can be supplied selecting option **M**. See the table at side for electronic connections. The 5 pin male connector M12 allows the connection of the electronic conditioning card to the control system, the straight female connector M12 5 pin **CON031** is included in the supply.

9.5 Strokes

From 100 to 3000 mm by increments of 100 mm.
If a not standard stroke is required, contact our technical office.

9.6 Cylinder features

See sections 10, 11 and 12 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

9.7 Fluid requirements

CKN servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters). **For the proper choice of the sealing system, in relation to the fluid characteristics, see section** 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm^2/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achievable with in-line filters at 25 µm

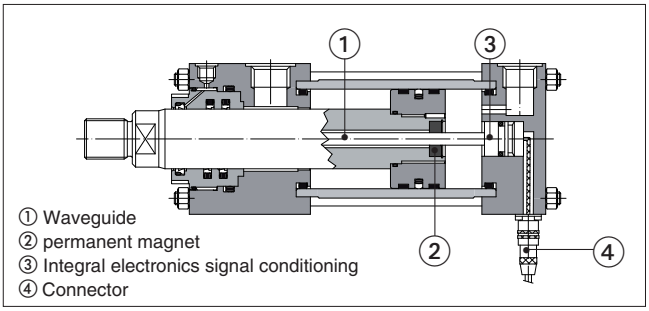
9.8 Start-up notes

CKN servocylinders are supplied with the zero/span values adjusted to the cylinder's mechanical stroke ends.
During the start-up it is necessary to bleed off the air from the servocylinder as indicated in section 27.
For other details refer to the start-up instructions included in the supply.

9.9 Warnings

Ensure that the servocylinder and wirings are kept away from strong magnetic field and electrical noise to prevent noises on the feedback signal. Check the electronic connections and switch-off the power supply before wiring, connecting or disconnecting the position transducer to avoid electronic damages. Ensure that the maximum distance between the servocylinder and the electronic conditioning card is lower than the recommended one: 50 m.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKN



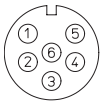
① Waveguide
② permanent magnet
③ Integral electronics signal conditioning
④ Connector

TRANSDUCER FEATURES

Power supply	18 - 30 VDC (±15%)
Output signal	0,1 ÷10,1 VDC / 4 ÷20 mA
Resolution	infinite, restricted by the output ripple
Linearity	< ± 0,02% F.S (min ± 60 µm)
Repeatability	< ± 0,01 mm (hysteresis< ± 0,005 % F.S.)
Cycle time	1 ms (1,5 for 1100 < strokes < 2000 ; 2 for strokes > 2000 mm)
Temperature coefficient	50 ppm/°C
Operating temperature	-20 ÷ +90°C (+70°C for strokes > 2500 mm)
Connection type	6 pin connector M16 to DIN 45322
Protection degree	IP67 to DIN 40050
Shock resistance	100g (single hit) / IEC Standard 68-2-27
Vibration resistance	20g / 10÷2000 Hz / IEC Standard 68-2-6
Measuring range	100 to 3000 mm (increments of 100 mm)
Maximum speed	1m/s

ELECTRONIC CONNECTIONS - OPTION A,V

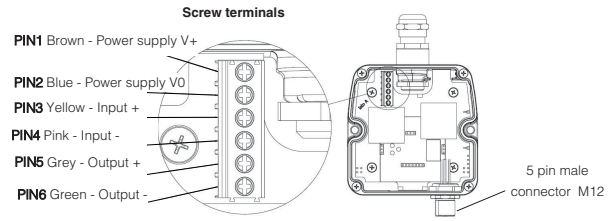
6 PIN female connector (to solder)



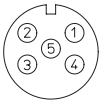
STCO9131-D06-PG7
(Transducer view)

PIN	SIGNAL	NOTES
1	V+	Input - power supply 24 VDC (±15%)
2	V0	Gnd - power supply 0 VDC
3	OUTPUT	Output - analog signal
4	AGND	Gnd - analog signal
5	NC	Not connect
6	NC	Not connect

ELECTRONIC CONDITIONING CARD - OPTION N



5 PIN female connector (to solder)



CON031
(Transducer view)

PIN	SIGNAL	NOTES
1	OUTPUT1	Output - analog signal
2	AGND	Gnd - analog signal
3	OUTPUT2	Output2 - analog signal
4	V0	Gnd - power supply 0 VDC
5	V+	Input - power supply 24 VDC (±15%)

ELECTRONIC CONDITIONING CARD FEATURES

	Current output A	Voltage output V
Output	4÷20 mA	0÷10 VDC
Output load	< 500 Ω	2 kΩ
Max output value	25 mA	10,6 V
Output ripple	< 5 mV pp	
Supply voltage	from 10 to 30 VDC	
Resolution	16 bit	
Speed calculation time	sampling time +500 µ s	
Operating temperature	0 ÷ +70°C (storage -40 ÷ +85°C)	

10 INSTALLATION DIMENSIONS [mm] FOR SERVOCYLINDERS TYPE CKN

Ø Bore		40	50	63	80	100	125	160	200
Ø Rod		28	36	45	56	70	90	110	140
A max		28	36	45	56	63	85	95	112
A1 option **H** max		NA	NA	NA	36	45	56	63	85
AA ref		59	74	91	117	137	178	219	269
B f9		42	50	60	72	88	108	133	163
BB +3 / 0		35	46	46	59	59	81	92	115
BG min		12	18	18	24	24	27	32	40
CB A16		20	30	30	40	50	60	70	80
CD H9		14	20	20	28	36	45	56	70
CF max		42	62	62	83	103	123	143	163
CH h14		22	30	39	48	62	80	100	128
CO N9		12	12	16	16	16	20	30	40
CX	value	20	25	30	40	50	60	80	100
	tolerance	0 -0,012					0 -0,015		0 -0,02
D (1)		25	29	29	36	36	42	42	52
DD		M8x1	M12x1,25	M12x1,25	M16x1,25	M16x1,25	M22x1,5	M27x2	M30x2
E		63±1,5	75±1,5	90±1,5	115±1,5	130±2	165±2	205±2	245±2
EE (1) 6g		G 3/8	G 1/2	G 1/2	G 3/4	G 3/4	G 1	G 1	G 1 1/4
EP max		13	17	19	23	30	38	47	57
EW h14		20	30	30	40	50	60	70	80
EX		16 0/-0,12	20 0/-0,12	22 0/-0,12	28 0/-0,12	35 0/-0,12	44 0/-0,15	55 0/-0,15	70 0/-0,2
F max		10	16	16	20	22	22	25	25
FB H13		11	14	14	18	18	22	26	33
J ref		38	38	38	45	45	58	58	76
KC min		4	4,5	4,5	5	6	6	8	8
KK 6g		M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x3	M80x3	M100x3
KK1 option **H** 6g		M14x1,5	M16x1,5	M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x2
L min		19	32	32	39	54	57	63	82
LH h10		31	37	44	57	63	82	101	122
LT min		25	31	38	48	58	72	92	116
MR max		17	29	29	34	50	53	59	78
MS max		29	33	40	50	62	80	100	120
PJ ±1,5 **(3)**		85	74	80	143	151	167	180	190
R js13		41	52	65	83	97	126	155	190
RD f8		62	74	88	105	125	150	170	210
RT		M8x1,25	M12x1,75	M12x1,75	M16x2	M16x2	M22x2,5	M27x3	M30x3,5
SB H13		11	14	18	18	26	26	33	39
SS ±1,25 **(3)**		109	91	85	154	151	180	179	196
ST js13		12,5	19	26	26	32	32	38	44
TC h14		63	76	89	114	127	165	203	241
TD f8		20	25	32	40	50	63	80	100
TG js13		41,7	52,3	64,3	82,7	96,9	125,9	154,9	190,2
TL js13		16	20	25	32	40	50	63	80
TM h14		76	89	100	127	140	178	215	279
TO js13		87	105	117	149	162	208	253	300
TS js13		83	102	124	149	172	210	260	311
UM ref		108	129	150	191	220	278	341	439
UO max		110	130	145	180	200	250	300	360
US max		103	127	161	186	216	254	318	381
UT ref		95	116	139	178	207	265	329	401
UW max		70	88	98	127	141	168	205	269
VD		12	9	13	9	10	7	7	7
VE max		22	25	29	29	32	29	32	32
VL min		3	4	4	4	5	5	5	5
WF ±2		35	41	48	51	57	57	57	57
WH ±2		25	25	32	31	35	35	32	32
XC ±1,5 **(3)**		237	256	265	279	307	339	358	406
XG ±2 **(3)**		57	64	70	76	71	75	75	85
XO ±1,5 **(3)**		243	255	271	288	311	354	387	440
XS ±2 **(3)**		45	54	65	68	79	79	86	92
XV (2) ±2 **(3)**	**Minimum stroke**	5	15	20	20	35	35	35	35
	min	100	109	120	129	148	155	161	195
	max	99+stroke	98+stroke	100+stroke	115+stroke	117+stroke	134+stroke	141+stroke	166+stroke
Y ±2		62	67	71	77	82	86	86	98
ZB max		231	241	250	262	275	310	329	361
ZJ ±1 **(3)**		218	224	233	240	253	282	295	324

NOTES TO TABLE

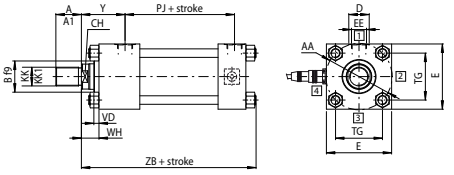
(1) Oil ports with dimension EE are threaded according to ISO 1179-1 (GAS standards) with counterbore dimension D.

(2) XV - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table.The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CKN-50/36*0500-L208 - AK - B1E3X1 **XV = 200**

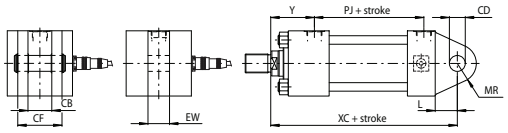
(3) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is the max stroke tolerance reported in section 18.

11 BASIC CONFIGURATION

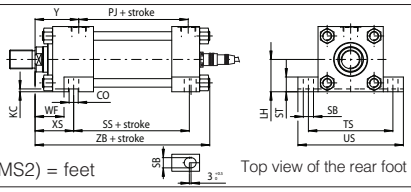


Basic configuration: X - see section 10 for dimensions
Electrical connector on side 4

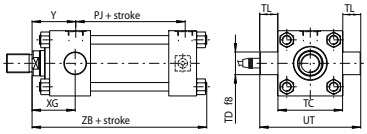
12 MOUNTING STYLES FOR SERVOCYLINDERS TYPE CKN



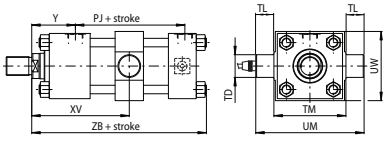
C (ISO MP1) = fixed clevis
D (ISO MP3) = fixed eye



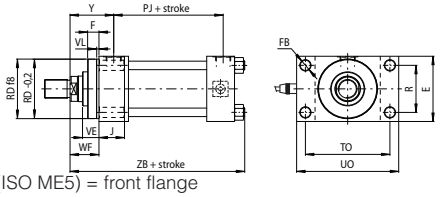
E (ISO MS2) = feet Top view of the rear foot



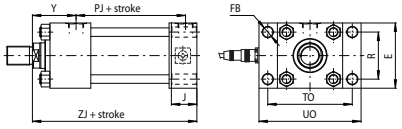
G (ISO MT1) = front trunnion



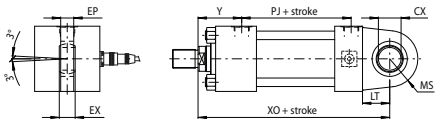
L (ISO MT4) = intermediate trunnion



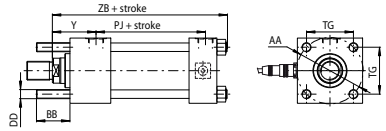
N (ISO ME5) = front flange



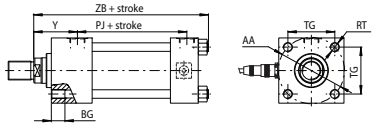
P (ISO ME6) = rear flange



S (ISO MP5) = fixed eye with spherical bearing



Y (ISO MX3) = front tie rods extended



Z (ISO MX5) = front threaded holes

13 SERVOCYLINDERS TYPE CKP

13.1 Potentiometric transducers - basic working principles

The potentiometric transducer is composed by two resistive tracks ① and a wiper ② which realizes the sliding contact through two metallic brushes. The resistive track is an aluminium element with a conductive plastic coating fixed to the cylinder's rear head. The wiper is mounted on the piston rod and moves together with it.
The tracks of the potentiometer have to be connected to a stabilized DC voltage to allow a small current flow. The two brushes of the wiper close the electronic circuit with the tracks (see figure at side), changing the resistance value and thus the voltage output proportionally to the rod position (principle of potential divider).
CKP servocylinders present the best price/performance ratio. Their compact construction allows the easy application of servocylinders in place of a standard cylinders without transducer.

13.2 Transducer features

For all the transducer features see the table at side.

13.3 Electronic connections

The 4 pin male connector is mounted on side 4 of the cylinder rear head for all mounting styles except style E (ISO MS2), where it is mounted along the cylinder axis, see section 17.
The straight female cable connector ③ **STCO9131-D04-PG7** is included in the supply. The 90° female connector **STCO9131-4-PG7** can be supplied selecting option **M**.
See the table at side for electronic connections.

13.4 Strokes

From 100 to 900 mm by increments of 100 mm.
If a not standard stroke is required, contact our technical office.

13.5 Cylinder features

See sections 15, 16 and 17 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

13.6 Fluids requirements

CKP servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**) **not compatible with glycol water and water based fluids.**

For the proper choice of the sealing system, in relation to the fluid characteristics, see section 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm^2/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achieved with in-line filters at 25 µm

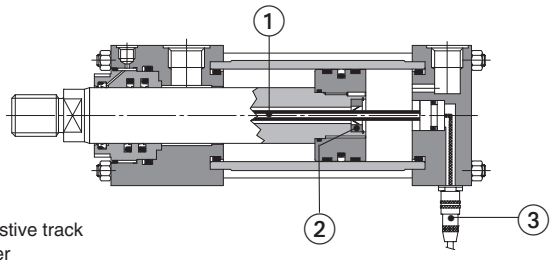
13.7 Start-up notes

During the start-up it is necessary to bleed off the air from the servocylinder. The air bleed is located on the rod end, see figure at side.
For a proper use of the air-bleed unlock the grub screw ④ M8 x 10 with a wrench for hexagonal head screws, moves the cylinder for the necessary cycles to bleed-off the air and retighten by a torque of 20 Nm.
Take care to completely bleed off the air from the inside because the compressibility effects of the air trapped-in may compromise the contact between the brushes and the resistive tracks.
Ensure to bleed off the air after every long time stop of the servocylinder.
For other details refer to the start-up instructions included in the supply.

13.8 Warnings

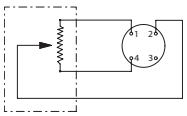
For a correct functioning, the transducer must be exclusively used as a potential divider.
Ensure to observe the maximum rating power indicated in the table "transducer features" to avoid any component damage.
The power supply must be stabilized: variations on the voltage provided have direct influence on the output values.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKP



① Resistive track
② Wiper
③ Straight connector

ELECTRONIC CIRCUIT



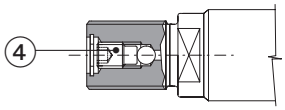
TRANSDUCER FEATURES

Supply reference	10 VDC recommended (max 30 VDC)
Dissipation	3 W at 40°C, 0 W at 120°C
Linearity	±0,1% F.S.
Repeatability	0,01 mm
Total resistance	10 kΩ at full stroke
Insulation resistance	> 100 MΩ to 500 VDC
Wiper current	Recommended: a few µA (10mA max)
Temperature limits	-20 ÷ + 100°C
Connection type	4 pin connector to Mil-C-26482
Protection degree	IP67 to DIN 40050
Measuring range	100 to 900 mm (increments of 100 mm)
Maximum speed	0,5 m/s

ELECTRONIC CONNECTIONS

4 PIN female connector (to solder)	PIN	SIGNAL	NOTES
	1	V0	Gnd - power supply 0 VDC
	2	OUTPUT	Output - 0 - 10 V
	3	NC	Do not connect
STCO9131-D04-PG7 (Transducer view)	4	Vref	Input - power supply 10 VDC

ROD AIR BLEED



14 SERVOCYLINDERS TYPE CKV

14.1 Inductive transducers - basic working principles

The transducer is composed by a single coil-winding ① and a ferromagnetic core ②. The coil-winding is integrated into a tube fixed to the cylinder's rear head, the core is fixed to the piston rod and moves together with it.
When the core moves together with the piston, the inductance of the coil-winding changes proportionally to the core position. The separate electronic conditioning card sends a sinusoidal signal to the primary coil-winding, it reads the corresponding signal of the secondary coil-winding and, from their difference, it calculates the inductance and computes the analog output feedback signal.
The contactless principle of the transducer ensures a long working life and its ruggedness construction allows to withstand high frequencies or dynamical stresses (i.e. simulators, vibropresses etc.).
The compact construction of CKV allows the easy application of the servocylinders in place of cylinders without transducer.
The separate conditioning card makes the inductive transducer ideal for all applications with high temperatures: in this case the max temperature is limited by the sealing system.

14.2 Transducer features

CKV are equipped with "Penny & Giles"'s ICT inductive transducers whose features are shown in the table at side.
The performances of the transducer indicated in the table at side refer exclusively to the use with its proper conditioning card.

14.3 Electronic conditioning card

In order to grant the performance in the table at side, it is mandatory to purchase the electronic conditioning card with one of the two following configurations:

A = 4 - 20 mA
V = 0 - 10 V

Other output ranges are available on request, contact our technical office.

The electronic conditioning card allows to adjust the zero and gain references by a screwdriver.
The card format fits to DIN EN50022 or EN50035 rails or allows a wall mounting by 4 screws M5x30.

14.4 Electronic connections

The 4 pin male connector is mounted on side 4 of the cylinder rear head for all mounting styles except style E (ISO MS2), where it is mounted along the cylinder's axis, see section 17.
The straight female cable connector ③ **STCO9131-D04-PG7** is supplied with a cable 3 m long connectedto the electronic conditioning card by wire clamp IP66 and screw terminals. The 90° female connector **STCO9131-4-PG7** can be supplied selecting option **M**.
See the table at side for electronic connections.

14.5 Strokes

From 30 to 1000 mm by increments of 10 mm.
If a not standard stroke is required, contact our technical office.

14.6 Cylinder features

See sections 15, 16 and 17 for sizes, mounting style and dimensions.
See sections from 18 to 26 for materials and options.

14.7 Fluid requirements

CKV servocylinders are suitable for operation with mineral oils with or without additives (**HH, HL, HLP, HLP-D, HM, HV**), fire resistant fluids (**HFA** oil in water emulsion - 90-95% water and 5-10% oil, **HFB** water in oil emulsion - 40% water, **HFC** water glycol - max 45% water) and synthetic fluids (**HFD-U** organic esters, **HFD-R** phosphate esters).
For the proper choice of the sealing system, in relation to the fluid characteristics, see section 25.
Recommended fluid characteristics:
- Viscosity: 15 ÷ 100 mm²/s
- Temperature range: 0 ÷ 70°C
- Fluid contamination class: ISO 19/16 achieved with in-line filters at 25 µm

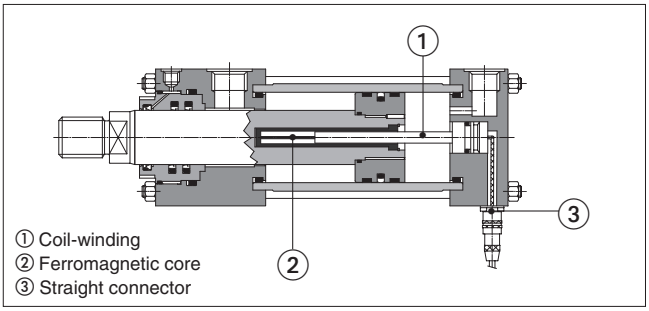
14.8 Start-up notes

CKV servocylinders are supplied with zero/span values adjusted to the cylinder's mechanical stroke ends. During the start-up it is necessary to bleed off the air from the servocylinder as indicated in section 27.
For other details refer to the start-up instructions included in the supply.

14.9 Warnings

Ensure that the maximum distance between the servocylinder and the conditioning card is lower than the recommended one: 10 m.
It is recommended to connect the draining port, supplied as standard, to the tank without back pressure, see section 28 for details.

SERVOCYLINDER TYPE CKV



① Coil-winding
② Ferromagnetic core
③ Straight connector

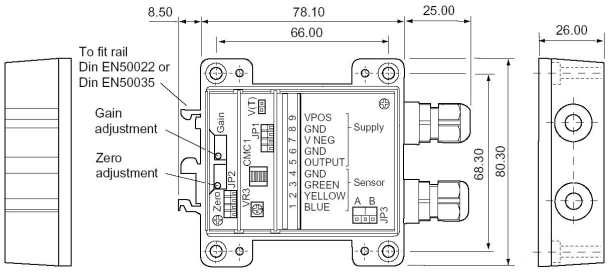
TRANSDUCER FEATURES

Linearity	±0,2%
Repeatability	±0,05 %
Insulation resistance	>50 MΩ to 50 VDC
Temperature coefficient	±200 ppm/°C from -20 to +100°C
Operating temperature	-20 ÷ +120°C
Connection type	4 pin connector to Mil-C-26482
Protection degree	IP67 to DIN 40050
Measuring range	30 to 1000 mm (increments of 10 mm)
Maximum speed	1 m/s

ELECTRONIC CONNECTIONS

4 PIN female connector (to solder)	PIN	SIGNAL	NOTES
	1	Ve+	Coil V+
	2	Ve-	Coil V-
	3	NC	Do not connect
STCO9131-D04-PG7 (Transducer view)	4	V0	Sensor ground

ELECTRONIC CONDITIONING CARD



	Analog output A	Voltage output V
Supply voltage	from 10 to 30 VDC	from 13,5 to 30 VDC
Supply current	12,6 mA max	19 mA max
Output	4÷20 mA	0÷10 VDC
Zero adjustment range	-10% to +60% of span	
Gain adjustment range	+40% to +110% of span	
Output ripple	< 5 mV rms	
Output load	10 kΩ min.	
Operating temperature	0 ÷ +70°C (storage -40 ÷ +85°C)	
Temperature coefficient	300 ppm/°C	
Protection degree	IP66 to DIN 40050	

15 INSTALLATION DIMENSIONS [mm] FOR SERVOCYLINDERS TYPE CKP, CKV

Ø Bore		40	50	63	80	100	125	160	200
Ø Rod		28	36	45	56	70	90	110	140
A max		28	36	45	56	63	85	95	112
A1 option **H** max		NA	NA	NA	36	45	56	63	85
AA ref		59	74	91	117	137	178	219	269
B f9		42	50	60	72	88	108	133	163
BB +3 / 0		35	46	46	59	59	81	92	115
BG min		12	18	18	24	24	27	32	40
CB A16		20	30	30	40	50	60	70	80
CD H9		14	20	20	28	36	45	56	70
CF max		42	62	62	83	103	123	143	163
CH h14		22	30	39	48	62	80	100	128
CO N9		12	12	16	16	16	20	30	40
CX	value	20	25	30	40	50	60	80	100
	tolerance	0 -0,012					0 -0,015		0 -0,02
D (1)		25	29	29	36	36	42	42	52
DD 6g		M8x1	M12x1,25	M12x1,25	M16x1,25	M16x1,25	M22x1,5	M27x2	M30x2
E		63±1,5	75±1,5	90±1,5	115±1,5	130±2	165±2	205±2	245±2
EE (1) 6g		G 3/8	G 1/2	G 1/2	G 3/4	G 3/4	G 1	G 1	G 1 1/4
EP max		13	17	19	23	30	38	47	57
EW h14		20	30	30	40	50	60	70	80
EX		16 0/-0,12	20 0/-0,12	22 0/-0,12	28 0/-0,12	35 0/-0,12	44 0/-0,15	55 0/-0,15	70 0/-0,2
F max		10	16	16	20	22	22	25	25
FB H13		11	14	14	18	18	22	26	33
J ref		38	38	38	45	45	58	58	76
KC min		4	4,5	4,5	5	6	6	8	8
KK 6g		M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x3	M80x3	M100x3
KK1 option **H** 6g		M14x1,5	M16x1,5	M20x1,5	M27x2	M33x2	M42x2	M48x2	M64x2
L min		19	32	32	39	54	57	63	82
LH h10		31	37	44	57	63	82	101	122
LT min		25	31	38	48	58	72	92	116
MR max		17	29	29	34	50	53	59	78
MS max		29	33	40	50	62	80	100	120
PJ ±1,5 **(3)**		85	74	80	93	101	117	130	165
R js13		41	52	65	83	97	126	155	190
RD f8		62	74	88	105	125	150	170	210
RT		M8x1,25	M12x1,75	M12x1,75	M16x2	M16x2	M22x2,5	M27x3	M30x3,5
SB H13		11	14	18	18	26	26	33	39
SS ±1,25 **(3)**		109	91	85	104	101	130	129	171
ST js13		12,5	19	26	26	32	32	38	44
TC h14		63	76	89	114	127	165	203	241
TD f8		20	25	32	40	50	63	80	100
TG js13		41,7	52,3	64,3	82,7	96,9	125,9	154,9	190,2
TL js13		16	20	25	32	40	50	63	80
TM h14		76	89	100	127	140	178	215	279
TO js13		87	105	117	149	162	208	253	300
TS js13		83	102	124	149	172	210	260	311
UM ref		108	129	150	191	220	278	341	439
UO max		110	130	145	180	200	250	300	360
US max		103	127	161	186	216	254	318	381
UT ref		95	116	139	178	207	265	329	401
UW max		70	88	98	127	141	168	205	269
VD		12	9	13	9	10	7	7	7
VE max		22	25	29	29	32	29	32	32
VL min		3	4	4	4	5	5	5	5
WF ±2		35	41	48	51	57	57	57	57
WH ±2		25	25	32	31	35	35	32	32
XC ±1,5 **(3)**		184	191	200	229	257	289	308	381
XG ±2 **(3)**		57	64	70	76	71	75	75	85
XO ±1,5 **(3)**		190	190	206	238	261	304	337	415
XS ±2 **(3)**		45	54	65	68	79	79	86	92
XV (2) ±2 **(3)**	**Minimum stroke**	5	15	20	20	35	35	35	35
	min	100	109	120	129	148	155	161	195
	max	99+stroke	98+stroke	100+stroke	115+stroke	117+stroke	134+stroke	141+stroke	166+stroke
Y ±2		62	67	71	77	82	86	86	98
ZB max		178	176	185	212	225	260	279	336
ZJ		165	159	168	190	203	232	245	299

NOTES TO TABLE

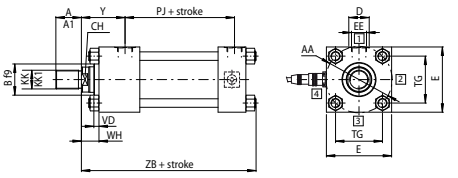
(1) Oil ports with dimension EE are threaded according to ISO 1179-1 (GAS standards) with counterbore dimension D.

(2) XV - For cylinders with mounting style **L** the stroke must always exceed the minimum values reported in the table.The requested XV value must be included between **XV min** and **XV max** and it must be always indicated, with dimension in millimeters, together with the cylinder code. See the following example:

CKP-50/36*0500-L208 - K - B1E3X1 **XV = 200**

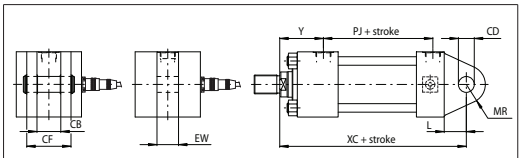
(3) The tolerance is valid for strokes up to 1250 mm, for longer strokes the upper tolerance is the max stroke tolerance reported in section 18.

16 BASIC CONFIGURATION

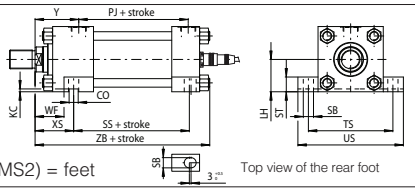


Basic configuration: X - see section 15 for dimensions
Electrical connector on side 4

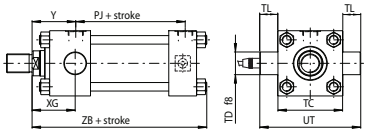
17 MOUNTING STYLES FOR SERVOCYLINDERS TYPE CKP, CKV



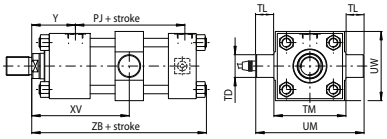
C (ISO MP1) = fixed clevis
D (ISO MP3) = fixed eye



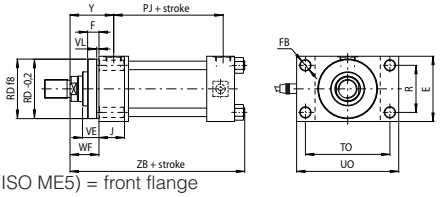
E (ISO MS2) = feet Top view of the rear foot



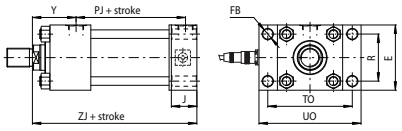
G (ISO MT1) = front trunnion



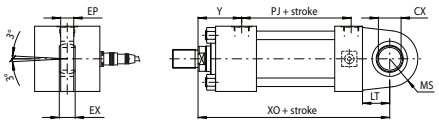
L (ISO MT4) = intermediate trunnion



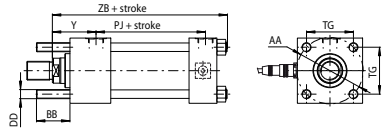
N (ISO ME5) = front flange



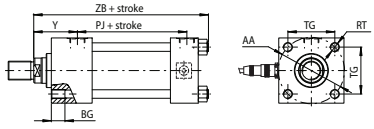
P (ISO ME6) = rear flange



S (ISO MP5) = fixed eye with spherical bearing



Y (ISO MX3) = front tie rods extended



Z (ISO MX5) = front threaded holes

18 STROKE SELECTION

Stroke has to be selected a few mm longer than the working stroke to prevent the use of the cylinder heads as mechanical stroke-end. The stroke tolerances are reported in the table at side.

19 SPACER

For strokes longer than 1000 mm, proper spacers have to be introduced in the cylinder's construction to increase the rod and piston guide and to protect them from overloads and premature wear. Spacers can be omitted for cylinders working in traction mode. The introduction of spacers increases the overall cylinder's dimensions: spacers' lenght has to be added to all stroke dependent dimensions in sections 6 , 10 and 15.

20 CYLINDER'S HOUSING FEATURES

The cylinder's housings are made in "cold drawn and stressed steel" with Rs = 450 N/mm²; the internal surfaces are lapped: diameter tolerance H8, roughness Ra ≤ 0,25 µm.

21 TIE RODS FEATURES

The cylinder's tie rods are made in "normalized automatic steel" with Rs = 610 N/mm²; end-threads are rolled to improve the fatigue working life. They are screwed to the heads or mounted by means of nuts with a prefixed tightening torque MT, see the table at side.

22 RODS FEATURES and options

The rods materials have high strength, which provide safety coefficients higher than 4 in static stress conditions, at maximum working pressure. The rod surface is chrome plated: diameter tolerances f7; roughness Ra ≤ 0,25 µm. Corrosion resistance of 100 h in neutral spray to ISO 9227 NSS

ø Rod	Material	Rs min [N/mm²]	Chrome	
			min. thickness [mm]	hardness [HV]
28÷90	hardened and tempered alloy-steel	700	0,020	850-1150
110÷140	alloy steel	450		

Rod diameters from 28 to 70 mm have rolled threads; in rolling process the component material is stressed beyond its yield point, being deformed plastically. This offers many technical advantages: higher profile accuracy, improved fatigue working life and high wear resistance. See **tab. B015** for the calculation of the expected rod fatigue life. The rod and piston are mechanically coupled by a threaded connection in which the thread on the rod is at least equal to the external thread KK, indicated in the tables 6 , 10 and 15.The piston is screwed to the rod by a prefixed tightening torque in order to improve the fatigue resistance. The stop pin ① avoids the piston unscrewing. **Contact our technical office** in case of heavy duty applications.

Rod corrosion resistance and hardness can be improved selecting the options **K** and **T** (option K affects the strength of standard rod, see **tab. B015** for the calculation of the expected rod fatigue life):
K = Nickel and chrome-plating (for rods from 28 to 110 mm)
Corrosion resistance (rating 10 to ISO 10289):
- 350 h in acetic acid salt spray to ISO 9227 AASS
- 1000 h in neutral spray to ISO 9227 NSS

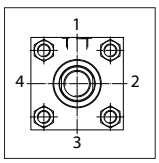
T = Induction surface hardening and chrome plating:
- 56-60 HRC (613-697 HV) hardness

23 CUSHIONINGS

Cushionings are recommended for applications where: • the piston makes a full stroke with speed over than 0,05 m/s; • it is required to reduce undesirable noise and mechanical shocks; • vertical application with heavy loads. The stroke-end cushionings are hydraulic dampers specifically designed to dissipate the energy of the mass connected to the cylinder rod, by progressively increasing the pressure in the cushioning chamber and thus reducing the rod speed before the cylinder's mechanical stroke-end (see the graphics at side). See **tab. B015** for the max damping energy.
The cylinder is provided with needle valve to optimize cushioning performances in different applications. The regulating screws are supplied fully screwed in (max cushioning effect).
In case of high masses and/or very high operating speeds we recommend to back them off to optimize the cushioning effect. The adjustment screw has a special design to prevent unlocking and expulsion. The cushioning effect is highly ensured even in case of variation of the fluid viscosity.

Ø Bore		63	80	100	125	160	200
Ø Rod		45	56	70	90	110	140
Cushioning length [mm]	Lf	27	29	27	25	34	34

24 POSITION OF THE OIL PORTS AND CUSHIONING ADJUSTMENTS



FRONT HEAD: **B1** = oil port position; **E* =** cushioning adjustment position
REAR HEAD: **X1** = oil port position.
The oil ports and cushioning adjustment positions are available, respectively, on sides 1 and 3 for all styles except E (see the figure at side): the style E has the cushioning adjustment on side 2.

Example of model code: CKM/00-50/22 *0500-S201 - D - **B1E3X1**

25 SEALING SYSTEM FEATURES

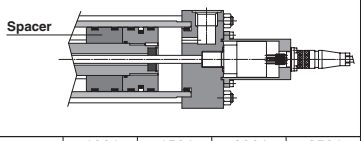
The sealing system must be choosen according to the working conditions of the system: speed, operating frequencies, fluid type and temperature. Additional verifications about minimum in/out rod speed ratio, static and dynamic sealing friction are warmly suggested, see **tab. B015**.
Seals **2** and **4** not available for CKP since they are not compatible with glycol water and water based fluids.
Special sealing system for low temperature, high frequencies (up to 20 Hz), long working life and heavy duty are available, see **tab. TB020**. All the seals, static and dynamic, must be periodically replaced: proper spare kits are available, see **tab. B137**. Contact our technical office for the compatibility with other fluids not mentioned below and specify type and composition.

Sealing system	Material	Features	Max speed [m/s]	Fluid temperature range	Fluids compatibility	ISO Standards for seals	
						Piston	Rod
2	FKM + PTFE	**very low friction and high temperatures**	4	-20°C to 120°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFB, HFC (water max 45%), HFD-U, HFD-R	ISO 7425/1	ISO 7425/2
4	NBR + PTFE	**very low friction and high speeds**	4	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606 fire resistance fluids HFA, HFC (water max 45%), HFD-U	ISO 7425/1	ISO 7425/2
8	NBR + PTFE + POLYURETHANE	**low friction**	0,5	-20°C to 85°C	Mineral oils HH, HL, HLP, HLP-D, HM, HV, MIL-H-5606	ISO 7425/1	ISO 7425/2

STROKE TOLERANCES

- 0 +2 mm for strokes up to 1250 mm
- 0 +5 mm for strokes from 1250 to 3150 mm
- 0 +8 mm for strokes over 3150 mm

RECOMMENDED SPACERS [mm]

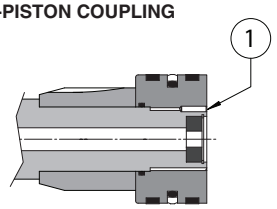


Stroke	1001 ÷ 1500	1501 ÷ 2000	2001 ÷ 2500	2501 ÷ 3000
Spacer code	**2**	**4**	**6**	**8**
Length	50	100	150	200

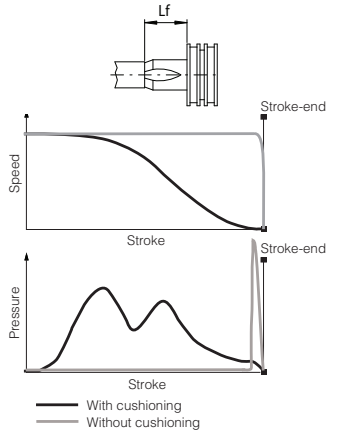
TIE RODS TIGHTENING TORQUES

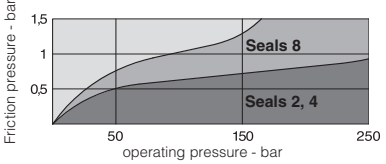
Ø Bore	**40**	**50**	**63**	**80**
MT [Nm]	20	70	70	160
Wrench	13	19	19	24
Ø Bore	**100**	**125**	**160**	**200**
MT [Nm]	160	460	820	1160
Wrench	24	32	41	46

ROD-PISTON COUPLING



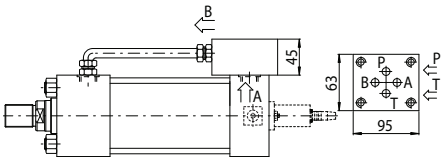
Lf is the total cushioning lenght. When the stroke-end cushionings are used as safety devices, to mechanically preserve the cylinder and the system, it is advisable to select the cylinder's stroke longer than the operating one by an amount equal to the cushioning lenght Lf; in this way the cushioning effect does not influence the movement during the operating stroke.



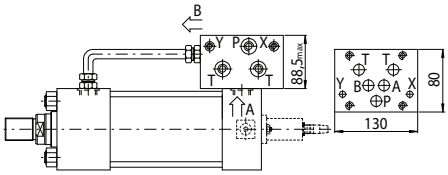


26 INCORPORATED SUBPLATE

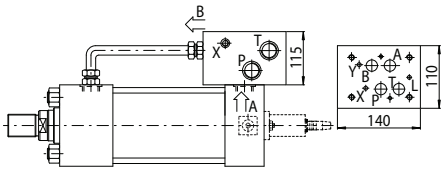
CK* cylinders with oil ports positions 1 can be supplied with ISO (size 06, 10, 16 and 25) incorporated subplates for mounting of valves directly on the cylinder.



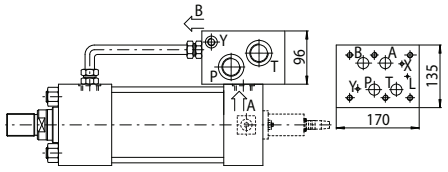
10 = subplate with mounting surface 4401-03-02-0-05 (size 06)
Oil ports P and T = G 3/8
For bores from 40 to 200 and strokes longer than 100 mm
For shorter strokes, the cylinder must be provided with suitable spacer



20 = subplate with mounting surface 4401-05-05-0-05 (size 10)
Oil ports P and T = G 3/4; X and Y = G 1/4
For bores from 40 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinders must be provided with suitable spacer



30 = subplate with mounting surface 4401-07-07-0-05 (size 16)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 80 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinders must be provided with suitable spacer

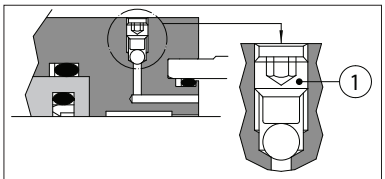


40 = subplate with mounting surface 4401-08-08-0-05 (size 25)
Oil ports P and T = G 1; L, X and Y = G 1/4
For bores from 125 to 200 and strokes longer than 150 mm
For shorter strokes, the cylinders must be provided with suitable spacer

Note: for the choice of suitable spacer see section 19. The addition of spacer length and working stroke must be at least equal or upper than the minimum stroke indicated above, see the following example:
Subplate **20**; working stroke = **70** mm; min. stroke = **150** mm → select spacer **4** (lenght = **100**mm)

27 AIR BLEEDS

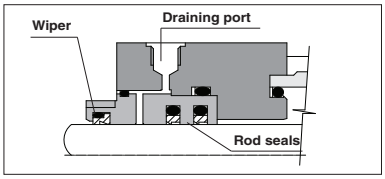
The air in the hydraulic circuit must be removed to avoid noise, vibrations and irregular cylinder's motion: air bleed valves realize this operation easily and safely.
Air bleeds are positioned on side 3 except for rear heads of CKV, CKP cylinders with bores from 80 to 200 mm (on side 2) and for heads of mounting style **E** (on side 2), see section 24.
For a proper use of the air-bleed (see figure on side) unlock the grub screw ① with a wrench for hexagonal head screws, moves the cylinder for the necessary cycles to bleed-off the air and retighten as indicated in table at side.



Ø Bore	Screwing	Tightening torque
40	M5 x 4	8 Nm
50 - 200	M8 x 10	20 Nm

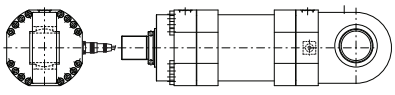
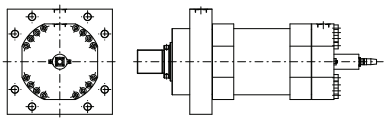
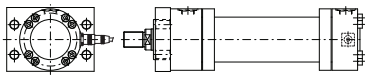
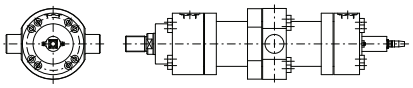
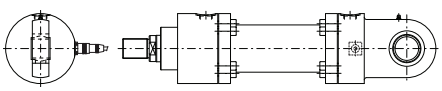
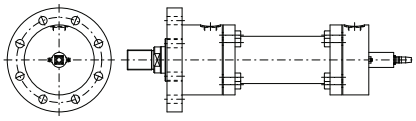
28 DRAINING

The rod side draining reduces the seals friction and increases their reliability.
The draining is positioned on the same side of the oil port, between the wiper and the rod seals (see figure at side).
It is recommended to connect the draining port to the tank without backpressure.
Draining port is G1/8.



29 SERVOCYLINDERS DERIVED FROM SERIES CH, CN, CC

Servocylinders derived from CH (ISO 6020-2 P = 160 bar; **tab. B140**), CH big bores (ISO 6020-3 P = 160 bar; **tab. B160**), CN (ISO 6020-1 P = 160 bar; **tab. B180**) and CC series (ISO 6022 P = 250 bar; **tab. B241**) are available on request. Contact our technical office for details.

BASIC CYLINDER	DERIVED SERVOCYLINDERS	
CH big bore (tab. B160) **ISO 6020-3** Pnom 160 bar Pmax 250 bar Ø bore 250÷400 mm Ø rod 140÷220 mm	**CHP, CHV -** example of style "S" 	**CHF, CHM -** example of style "N" 
CN (tab. B180) **ISO 6020-1** Pnom 160 bar Pmax 250 bar Ø bore 40÷200 mm Ø rod 22÷140 mm	**CNP, CNV -** example of style "N" 	**CNF, CNM -** example of style "L" 
CC (tab. B241) **ISO 6022** Pnom 250 bar Pmax 320 bar Ø bore 50÷320 mm Ø rod 36÷220 mm	**CCP, CCV -** example of style "S" 	**CCF, CCM -** example of style "A" 

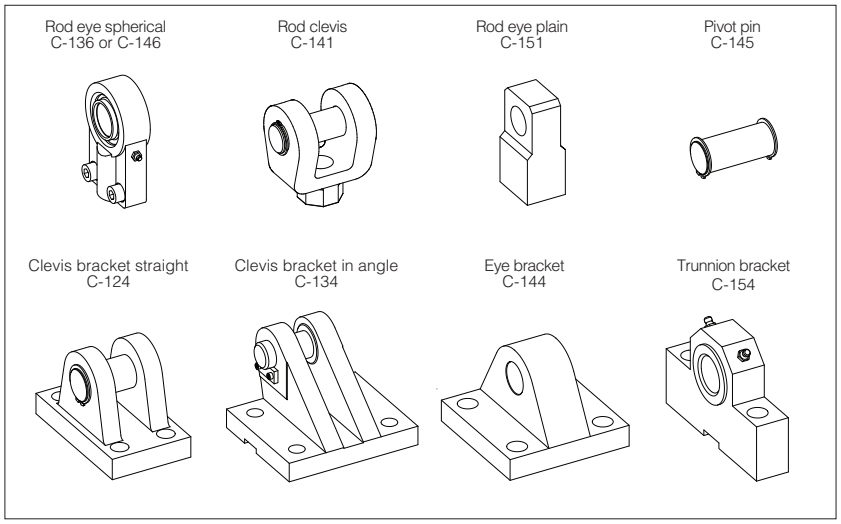
30 SPARE PARTS - SEE TABLE SP-B310

Example for seals spare parts code

G 8	-	CKF	-	125	/	90	-	30
Sealing system								
Cylinder series								
Bore size [mm]						Rod diameter [mm]		Serial number (indicate only for series <40)

Attachments for hydraulic cylinders

to ISO 6982, ISO 8132 and ISO 8133



SWC Cylinders Designer
Software for assisted selection of Atos cylinders & servocylinders codes, including cylinder's sizing, full technical information, 2D & 3D drawings in several CAD formats.

Available for download at www.atos.com

The table at side shows the Atos range of standard rod attachments and brackets: they are available for each cylinder bore. See section 2 for possible combinations. Stainless steel attachments are available on request.

1 MODEL CODE

C	-	141	12	-	V
Standard attachment		**Rod attachments**: **136**= Rod eye spherical **146**= Rod eye spherical **141**= Rod clevis **151**= Rod eye plain **145**= Pivot pin **Brackets:** **124** = Clevis bracket straight **134** = Clevis bracket in angle **144**= Eye bracket **154**= Trunnion bracket	**Bore** size/rod diameter [mm]		**Painting** see sect. 5

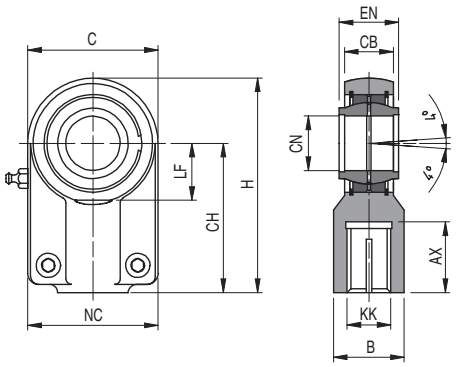
2 POSSIBLE COMBINATIONS

Ø Rod	Rod attachments codes					Ø Bore	Brackets codes			
	(a)									
12 **18** opt.**H**(b)	NA	C-14612	C-14112	C-15112	C-14512	**25**	NA	C-13425	C-14425	C-15425
14 **22** opt.**H**(b)	C-13616	C-14614	C-14114	C-15114	C-14514	**32**	NA	C-13432	C-14432	C-15432
18 **28** opt.**H**(b)	C-13618	C-14618	C-14118	C-15118	C-14518	**40**	C-12422 (c)	C-13440	C-14440	C-15440
22 **36** opt.**H**(b)	C-13622	C-14622	C-14122	C-15122	C-14522	**50**	C-12428 (c) C-12436 (d)	C-13450	C-14450	C-15450
28 **45** opt.**H**(b)	C-13628	C-14628	C-14128	C-15128	C-14528	**63**	C-12436 (c) C-12445 (d)	C-13463	C-14463	C-15463
36 **56** opt.**H**(b)	C-13636	C-14636	C-14136	C-15136	C-14536	**80**	C-12445 (c) C-12456 (d)	C-13480	C-14480	C-15480
45 **70** opt.**H**(b)	C-13645	C-14645	C-14145	C-15145	C-14545	**100**	C-12456 (c) C-12470 (d)	C-134100	C-144100	C-154100
56 **90** opt.**H**(b)	C-13656	C-14656	C-14156	C-15156	C-14556	**125**	C-12470 (c) C-12490 (d)	C-134125	C-144125	C-154125
70 **110** opt.**H**(b)	C-13670	C-14670	C-14170	C-15170	C-14570	**160**	C-12490 (c) C-124100 (d)	C-134160	C-144160	C-154160
90 **140** opt.**H**(b)	C-13690	C-14690	C-14190	C-15190	C-14590	**200**	C-124100 (c)	C-134200	C-144200	C-154200

Notes:
(**a**) Option **H** : light male thread, for details see table B137 or B140
(**b**) C-136 is also available for rods 110, 140, 180 and 220. See section 3
(**c**) For S mounting styles in CN cylinder
(**d**) For S mounting styles in CC cylinder

3 DIMENSIONS [mm]

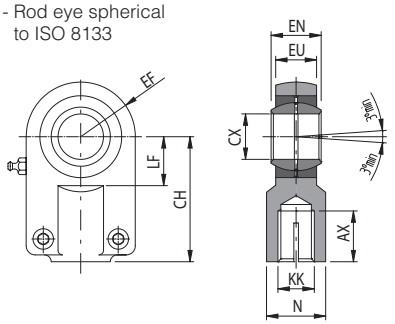
C-136 - Rod eye spherical
to ISO 6982 and 8132



Notes:
(1) This attachment does not include the greaser because it is selflubricated
(2) Dynamic loads has to be considered when the cylinders work with oscillatory motions or push-pull loads in high frequencies
(3) Without standards

Code	KK	AX min	B max	C max	CB max	CH js13	CN H7	EN h12	H	LF min	NC	Mass [kg]	Max load [kN] (2) Dynamic	Max load [kN] (2) Static	Screws torque
C-13616 (1)	M12x1,25	17	19	33	11	38	12	12	54	13	32	0,11	10,8	24,5	6 Nm
C-13618	M14x1,5	19	22	41	14	44	16	16	64	16,5	40	0,2	17,6	36,5	10 Nm
C-13622	M16x1,5	23	28	50	17,5	52	20	20	75	20,5	47	0,35	30	48	25 Nm
C-13628	M20x1,5	29	31	64	22	65	25	25	96	25,5	54	0,62	48	78	25 Nm
C-13636	M27x2	37	38	80	28	80	32	32	118	30	66	1,15	67	114	49 Nm
C-13645	M33x2	46	47	100	34	97	40	40	146	39	80	2,18	100	204	49 Nm
C-13656	M42x2	57	58	126	42	120	50	50	179	47	96	3,96	156	310	86 Nm
C-13670	M48x2	64	70	145	53,5	140	63	63	211	58	114	6,8	255	430	210 Nm
C-13690	M64x3	86	91	184	68	180	80	80	270	74	148	13	400	695	410 Nm
C-13690A (3)	M72x3	91	100	185	72	195	90	90	296	91	160	19,1	490	750	410 Nm
C-136110	M80x3	96	110	228	85,5	210	100	100	322	94	178	25	610	1.060	710 Nm
C-136110A (3)	M90x3	106	125	235	88	235	110	110	364	106	190	32	655	1.200	710 Nm
C-136140	M100x3	113	135	320	105	260	125	125	405	116	200	46	950	1.430	710 Nm
C-136180	M125x4	126	165	400	133	310	160	160	488	145	250	82,5	1.370	2.200	710 Nm
C-136220	M160x4	161	215	500	165	390	200	200	620	190	320	168	2.120	3.650	1500Nm

C-146 - Rod eye spherical
to ISO 8133

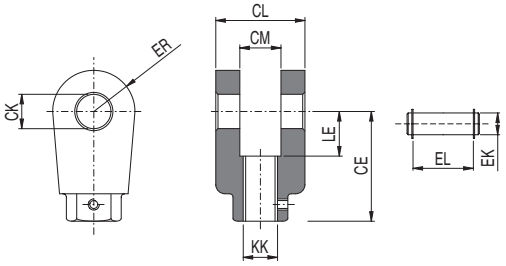


Notes:
(1) This attachment does not include the greaser because it is selflubricated
(2) Dynamic loads has to be considered when the cylinders work with oscillatory motions or push-pull loads in high frequencies

Code	KK	AX min	CH js13	CX	EF max	EN	EU max	LF min	N max	Mass [kg]	Max load [kN] (2) Dynamic	Max load [kN] (2) Static	Screws torque
C-14612 (1)	M10x1,25	15	42	$12^{0}_{-0,008}$	18	$10^{0}_{-0,12}$	8,5	16	19	0,12	10,8	17	10 Nm
C-14614 (1)	M12x1,25	17	48	$16^{0}_{-0,008}$	23	$14^{0}_{-0,12}$	11,5	20	22	0,22	21,1	28,5	10 Nm
C-14618 (1)	M14x1,5	19	58	$20^{0}_{-0,01}$	28	$16^{0}_{-0,12}$	13,5	25	28	0,43	30	42,5	25 Nm
C-14622	M16x1,5	23	68	$25^{0}_{-0,01}$	33	$20^{0}_{-0,12}$	18	30	31	0,67	48	67	25 Nm
C-14628	M20x1,5	29	85	$30^{0}_{-0,01}$	41	$22^{0}_{-0,12}$	20	35	37	1,25	62	108	49 Nm
C-14636	M27x2	37	105	$40^{0}_{-0,012}$	51	$28^{0}_{-0,12}$	24	45	47	2,16	100	156	49 Nm
C-14645	M33x2	46	130	$50^{0}_{-0,012}$	61	$35^{0}_{-0,12}$	31	58	57	3,9	156	245	86 Nm
C-14656	M42x2	57	150	$60^{0}_{-0,015}$	80	$44^{0}_{-0,15}$	39	68	69	7,15	245	380	210 Nm
C-14670	M48x2	64	185	$80^{0}_{-0,015}$	102,5	$55^{0}_{-0,15}$	48	92	91	15	400	585	410 Nm
C-14690	M64x3	86	240	$100^{0}_{-0,02}$	120	$70^{0}_{-0,20}$	57	116	110	27,3	610	865	710 Nm

C-141 - Rod clevis
to ISO 8133

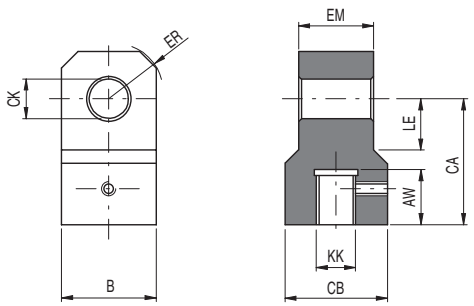
C-145 - Pivot pin



Note: Pivot pin C-145* is included in the supply

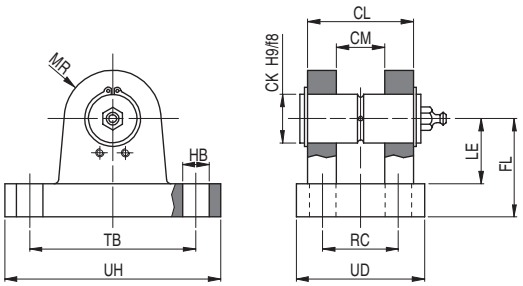
Code	KK	CE JS13	CK H9	CL max	CM A13	EK f8	EL min	ER max	LE min	Mass [kg]	Max load **static** [kN]
C-14112 C-14512	M10x1,25	32	10	26	12	10	29	12	13	0,1	8
C-14112 C-14512	M12x1,25	36	12	34	16	12	37	17	19	0,18	12,5
C-14118 C-14518	M14x1,5	38	14	42	20	14	45	17	19	0,23	20
C-14122 C-14522	M16x1,5	54	20	62	30	20	66	29	32	0,9	32
C-14128 C-14528	M20x1,5	60	20	62	30	20	66	29	32	0,91	50
C-14136 C-14536	M27x2	75	28	83	40	28	87	34	39	1,92	80
C-14145 C-14545	M33x2	99	36	103	50	36	107	50	54	4,92	125
C-14156 C-14556	M42x2	113	45	123	60	45	129	53	57	6,53	200
C-14170 C-14570	M48x2	126	56	143	70	56	149	59	63	10,11	320
C-14190 C-14590	M64x3	168	70	163	80	70	169	78	83	19,2	500

C-151 - Rod eye plain
to ISO 8133



Code	KK	AW min	B	CA JS13	CB max	CK H9	EM h13	ER max	LE min	Mass [kg]	Max load **static** [kN]
C-15112	M10x1,25	14	18	32	18	10	12	12	13	0,08	8
C-15114	M12x1,25	16	22	36	22	12	16	17	19	0,15	12,5
C-15118	M14x1,5	18	25	38	20	14	20	17	19	0,22	20
C-15122	M16x1,5	22	35	54	30	20	30	29	32	0,5	32
C-15128	M20x1,5	28	40	60	30	20	30	29	32	1,1	50
C-15136	M27x2	36	50	75	40	28	40	34	39	1,5	80
C-15145	M33x2	45	70	99	50	36	50	50	54	2,5	125
C-15156	M42x2	56	100	113	65	45	60	53	57	4,2	200
C-15170	M48x2	63	116	126	90	56	70	59	63	11,8	320
C-15190	M64x3	85	160	168	110	70	80	78	83	17	500

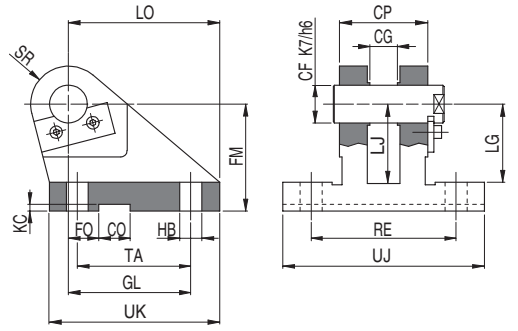
C-124 - Clevis bracket straight
to ISO 8132



Note: Pivot pin and seeger are included in the supply
Supplied with threaded holes for pivot pin locking plate (not included)

Code	CK H9	CL h16	CM A13	FL JS12	HB H13	LE min	MR max	RC JS14	TB JS14	UD max	UH max	Mass [kg]	Max load static [kN]
C-12414	12	28	12	34	9	22	12	20	50	40	70	0,31	8
C-12418	16	36	16	40	11	27	16	26	65	50	90	0,59	12,5
C-12422	20	45	20	45	11	30	20	32	75	58	98	0,9	20
C-12428	25	56	25	55	13,5	37	25	40	85	70	113	1,6	32
C-12436	32	70	32	65	17,5	43	32	50	110	85	143	2,8	50
C-12445	40	90	40	76	22	52	40	65	130	108	170	5	80
C-12456	50	110	50	95	26	65	50	80	170	130	220	10,1	125
C-12470	63	140	63	112	33	75	63	100	210	160	270	15,4	200
C-12490	80	170	80	140	39	95	80	125	250	210	320	30	320
C-124100	100	210	100	180	45	120	100	160	315	260	400	60,2	500

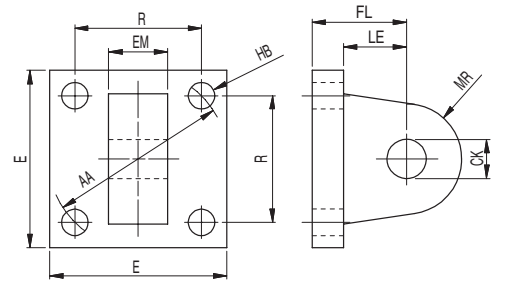
C-134 - Clevis bracket in angle
to DIN 24556 or ISO 8133 with additional machining for dimension CO



Note: Pivot pin with locking plate is included in the supply

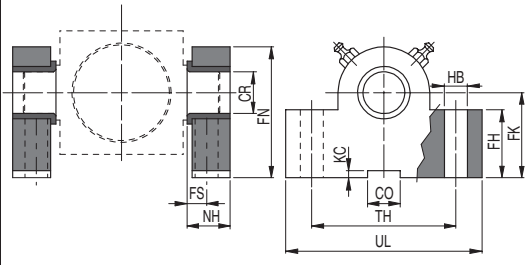
Code	CF K7	CG +0,1/+0,3	CO H9	CP h14	FM js13	FO	GL JS13	HB H13	KC	LG	LJ min	LO max	RE js13	SR max	TA js13	UJ max	UK max	Mass [kg]	Max load static [kN]
C-13425	12	10	10	30	40	16	46	9	3,3	28	29	56	55	12	40	75	60	0,52	8
C-13432	16	14	16	40	50	18	61	11	4,3	37	38	74	70	16	55	95	80	1,05	12,5
C-13440	20	16	16	50	55	20	64	13,5	4,3	39	40	80	85	20	58	120	90	1,72	20
C-13450	25	20	25	60	65	22	78	15,5	5,4	48	49	98	100	25	70	140	110	2,72	32
C-13463	30	22	25	70	85	24	97	17,5	5,4	62	63	120	115	30	90	160	135	5,15	50
C-13480	40	28	36	80	100	24	123	22	8,4	72	73	148	135	40	120	190	170	9,3	80
C-134100	50	35	36	100	125	35	155	30	8,4	90	92	190	170	50	145	240	215	18,3	125
C-134125	60	44	50	120	150	35	187	39	11,4	108	110	225	200	60	185	270	260	35	200
C-134160	80	55	50	160	190	35	255	45	11,4	140	142	295	240	80	260	320	340	63	320
C-134200	100	70	63	200	210	35	285	48	12,4	150	152	335	300	100	300	400	400	109	500

C-144 - Eye bracket
to ISO 8133



Code	CK H9	AA	E max	EM h13	FL js13	HB H13	LE min	MR max	R js13	Mass [kg]	Max load static [kN]
C-14425	10	40	40	12	23	5,5	13	12	28,3	0,3	8
C-14432	12	47	46	16	29	6,6	19	17	33,2	0,45	12
C-14440	14	59	65	20	29	9	19	17	41,7	0,9	20
C-14450	20	74	79	30	48	13,5	32	29	52,3	1,3	32
C-14463	20	91	91	30	48	13,5	32	29	64,3	1,9	50
C-14480	28	117	118	40	59	17,5	39	34	82,7	4	80
C-144100	36	137	132	50	79	17,5	54	50	96,9	6,25	125
C-144125	45	178	174	60	87	24	57	53	125,9	11,4	200
C-144160	56	219	215	70	103	30	63	59	154,9	20,8	320
C-144200	70	269	256	80	132	33	82	78	190,2	38,8	500

C-154 - Trunnion bracket
(for cylinders whit mounting styles G,H and L)
to ISO 8132

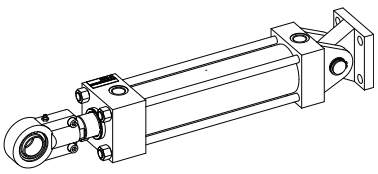


Note: The code includes two trunnion brackets
(1) To ISO 8133

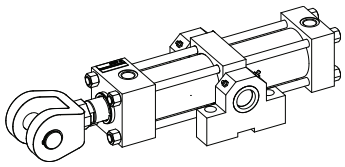
Code	CR H7	CO N9	FH max	FK JS12	FN max	FS js13	HB H13	KC 0/+0,3	NH max	TH js13	UL max	Mass [kg]	Max load static [kN]
C-15425	12	10	25	34	50	8	9	3,3	17	40	63	0,46	8
C-15432	16	16	30	40	60	10	11	4,3	21	50	80	0,83	12,5
C-15440	20	16	38	45	70	10	11	4,3	21	60	90	1,21	20
C-15450	25	25	45	55	80	12	13,5	5,4	26	80	110	2,15	32
C-15463	32	25	52	65	100	15	17,5	5,4	33	110	150	4,63	50
C-15480	40	36	60	76	120	16	22	8,4	41	125	170	7,78	80
C-154100	50	36	75	95	140	20	26	8,4	51	160	210	14,3	125
C-154125	63	50	85	112	180	25	33	11,4	61	200	265	23,4	200
C-154160	80	50	112	140	220	31	39	11,4	81	250	325	53,1	320
C-154200 (1)	100	63	150	200	300	42	52	12,4	101	320	410	112	500

4 EXAMPLES OF ATTACHMENTS

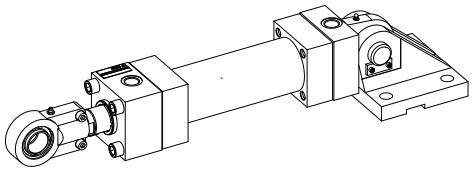
CK - mounting style **C** with rod eye **C-136** and bracket **C-144**



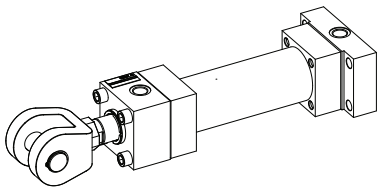
CK - mounting style **L** with rod clevis **C-141** and bracket **C-154**



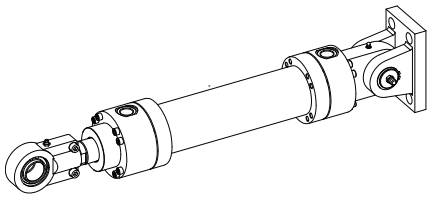
CH - mounting style **S** with rod eye **C-136** and bracket **C-134**



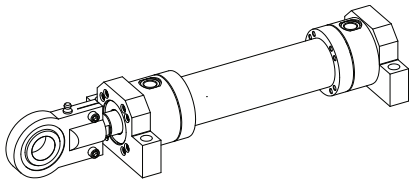
CH - mounting style **P** with rod clevis **C-141**



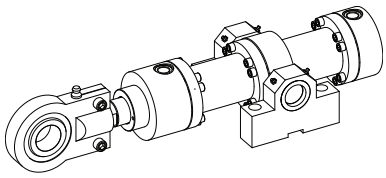
CN - mounting style **S** with rod eye **C-136** and bracket **C-124**



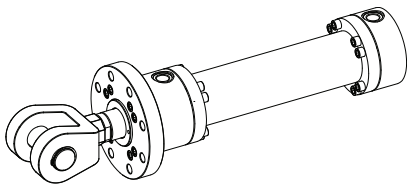
CN - mounting style **E** with rod eye **C-146**



CC - mounting style **L** with rod eye **C-146** and bracket **C-154**



CC - mounting style **A** with rod clevis **C-141**



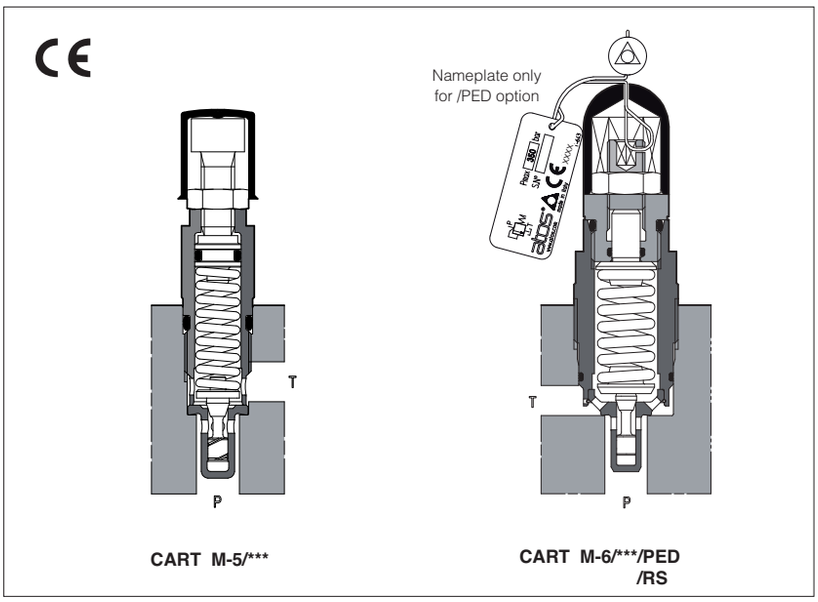
5 SURFACE TREATMENT

Some attachments are provided with additional surface treatment to increase the corrosion resistance (24h in neutral salt spray), see table below for details. All the attachments, except pivot pin C-145, can be supplied with standard painting RAL 9007 (200h in neutral salt spray) selecting option **-V**, special painting are available on request.

Code	Surface treatment	Code	Surface treatment
 C-136 or C-146	No treatment	 C-124	No treatment
 C-141	No treatment	 C-134	No treatment
 C-151	Black phosphate	 C-144	Black phosphate
 C-145	Black phosphate	 C-154	No treatment

Cartridge pressure relief valves type CART

screw-in mounting



CART M-5/***

CART M-6/*/PED**
/RS

CART are direct operated pressure relief valves for screw-in mounting.
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 range.
The cartridge execution is specifically designed to reduce the dimension of blocks and manifolds, without penalizing the functional characteristics.

The following safety options are available with factory preset regulation, not adjustable (lead sealed regulation):

/RS conforming to the Machine Directive (2006/42/CE). The factory preset regulation required by the costumer corresponds to the valve's cracking pressure.

/PED certified by ConCert according to PED Directive (2014/68/UE). The valves are factory set at the pressure level required by the costumer with a flow trough the valve as shown in section 6. For this version, the P/Q limits are shown in section 9.

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

1 MODEL CODE

CART	M-6	/	350	/	PED	/	*	**	/	*

CART — Screw-in relief cartridges

M-6 — 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)**

350 — Max pressure setting:
see section 3 for available setting

PED — Options:
see section 5 for options availability and combination:
- **R** = reduced leakage for special application **(standard code for CART M-4 and CART ARE-20) (2)**
- **RS** = as /R, plus conforming to 2006/42/CE
- **PED** = as /R, plus certified by ConCert according to 2014/68/CE

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

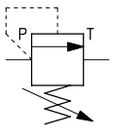
***** — Only for RS, PED options:
280 = factory pressure setting to be defined depending to the customer requirement
min step: 1 bar - min pressure setting: 25 bar
(example 280 = 280 bar)

****** — Series number

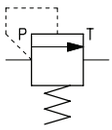
***** — Seals material, see section 4:
- **-** = NBR
- **PE** = FKM
- **BT** = HNBR **(4)**

(1) Available also in stainless steel execution, see technical table E135
(2) Standard execution of CART M-4 and CART ARE-20 provides the reduced leakage feature, then the /R is always present in the valve model code
(3) For handwheel and knob features, see sections 10, 11. For their availability, see section 5
(4) Not available for PED certified valves

2 HYDRAULIC SYMBOLS



CART
CART **/R



CART **/RS
CART **/PED

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	
	/PED	/50 /100 /210 /350	/100 /210 /350	/100 /210 /350	/100 /210 /350	/75 /150 /250 /350	/100 /210 /315 /400
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	
	/PED	25÷50 50÷100 100÷210 210÷350	25÷100 100÷210 210÷350	25÷100 100÷210 210÷350	25÷100 100÷210 210÷350	25÷75 75÷150 150÷250 250÷350	25÷100 100÷210 210÷315 315÷400
Max pressure on port T [bar]		50	50	50	50	50	50
Max flow [l/min]							
	STANDARD	2,5	15	35	40	75	120
	/RS, /PED	2,5	15	50	60	100	150

(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
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 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		●		●	●	
	/PED	●	●	●	●	●	●
	/V	●			●	●	●
	/VF				●	●	
	/VS				●	●	
Combinated option (1)	**/RV**				●	●	●
	/RVF				●	●	
	/RVS				●	●	

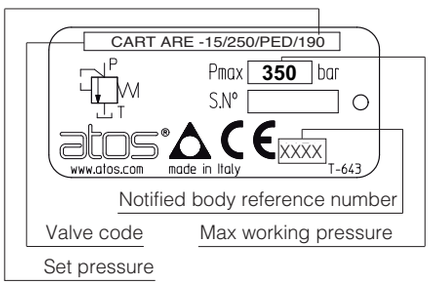
(1) RV = reduced leakage and regulating handwheel
RVF = reduced leakage and regulating knob
RVS = reduced leakage and regulating knob with safety lock

6 SETTING OF VALVES WITH /PED OPTION

The /PED valves are factory set at the pressure level required by the costumer (min step: 1bar - min pressure setting: 25 bar) at the following flow shown in the table.
The set pressure is marked on the valve nameplate, see section 6.1

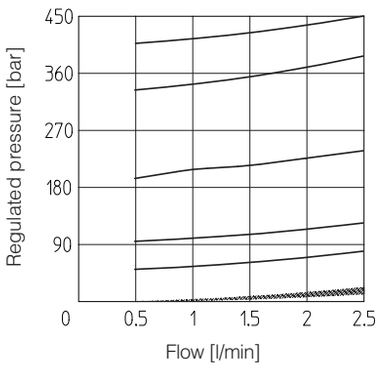
VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
CART M-3	1
CART M-4	1
CART M-5	12
CART M-6	12
CART ARE-15	12
CART ARE-20	23

6.1 EXAMPLE OF NAMEPLATE FOR /PED OPTION

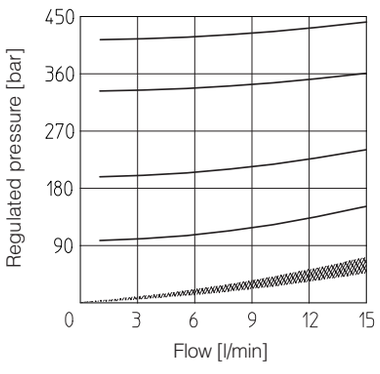


7 REGULATED PRESSURE VERSUS FLOW DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

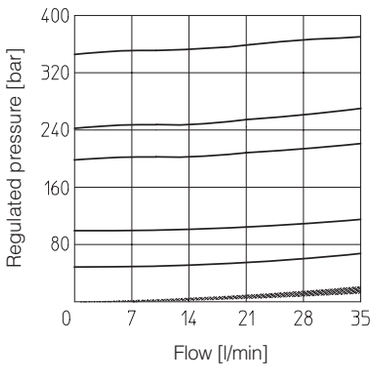
CART M-3
Min. regulated pressure



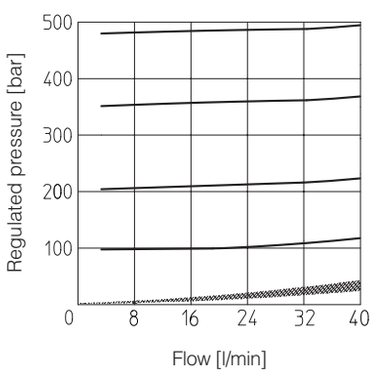
CART M-4 **/R
Min. regulated pressure



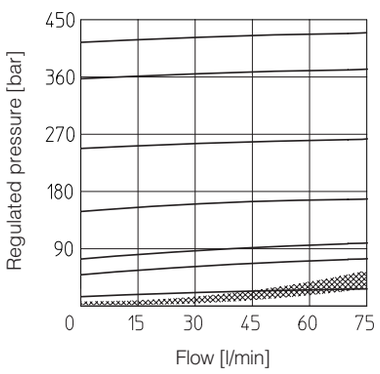
CART M-5
Min. regulated pressure



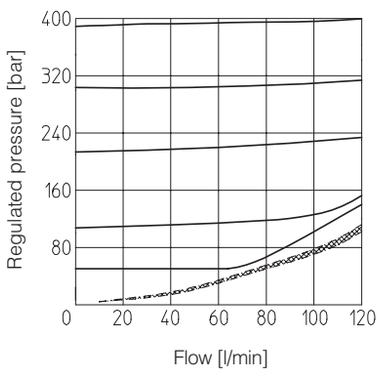
CART M-6
Min. regulated pressure



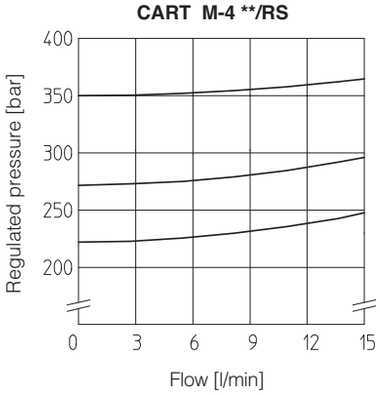
CART ARE-15
Min. regulated pressure



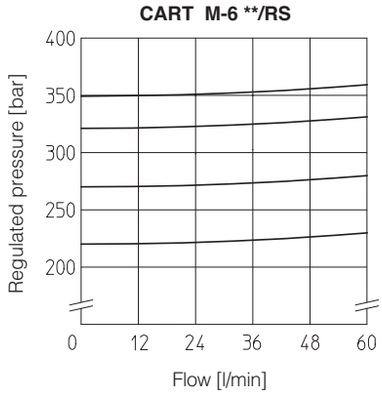
CART ARE-20 **/R
Min. regulated pressure



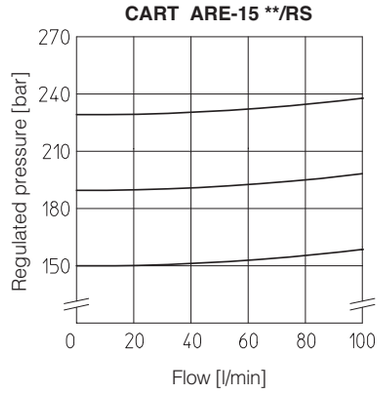
CART M-4 **/RS



CART M-6 **/RS

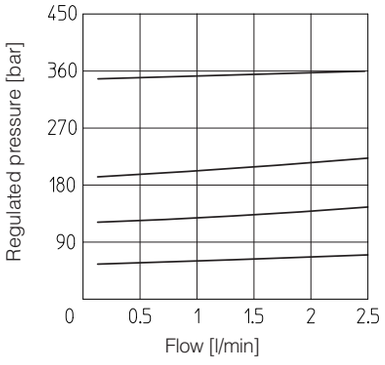


CART ARE-15 **/RS

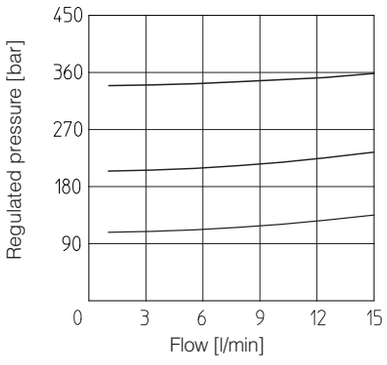


8 **REGULATED PRESSURE VERSUS FLOW DIAGRAMS** (based on mineral oil ISO VG 46 at 50°C)

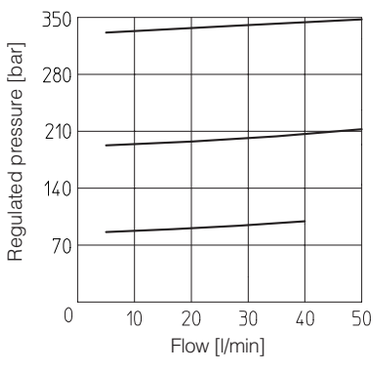
CART M-3 **/PED



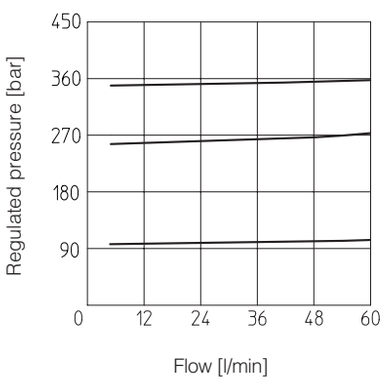
CART M-4 **/PED



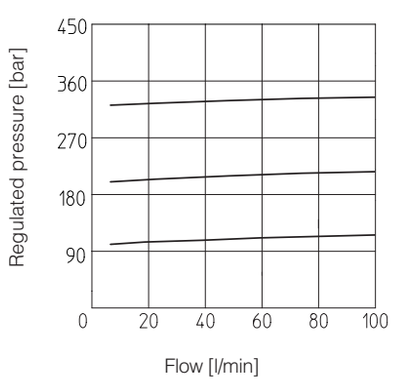
CART M-5 **/PED



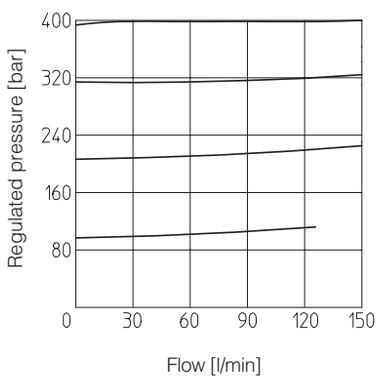
CART M-6 **/PED



CART ARE-15 **/PED

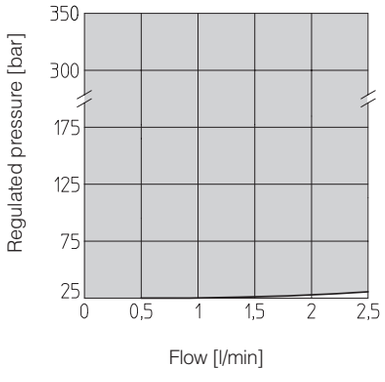


CART ARE-20 **/PED

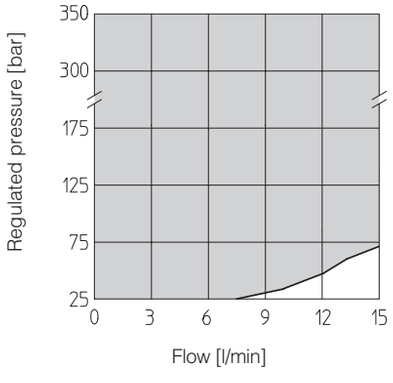


9 **PERMITTED WORKING RANGES** shaded area (based on mineral oil ISO VG 46 at 50°C)

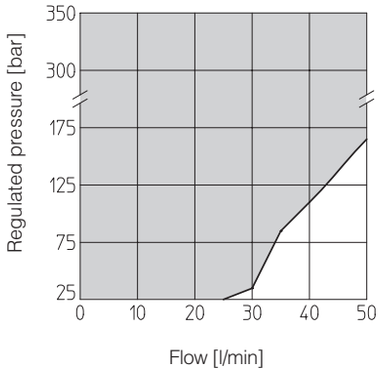
CART M-3 **/PED



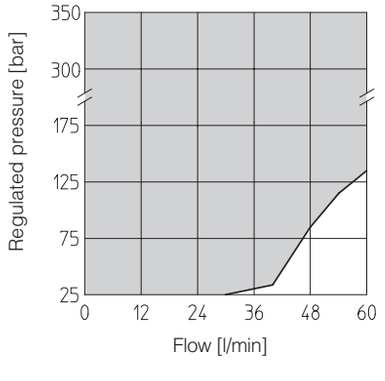
CART M-4 **/PED



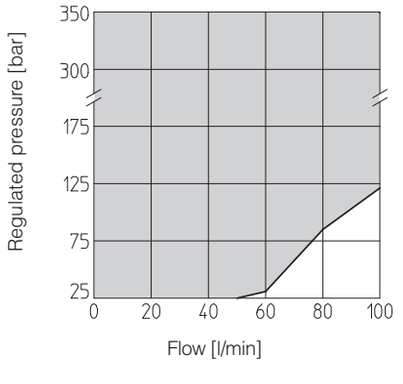
CART M-5 **/PED



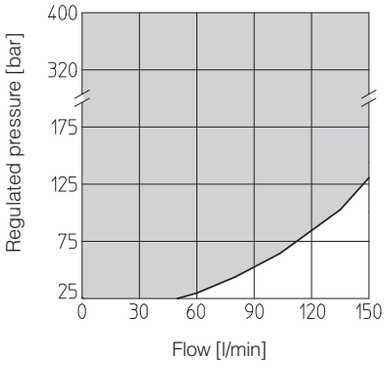
CART M-6 **/PED



CART ARE-15 **/PED

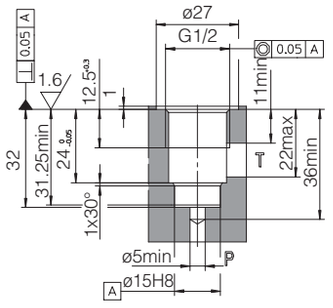


CART ARE-20 **/PED

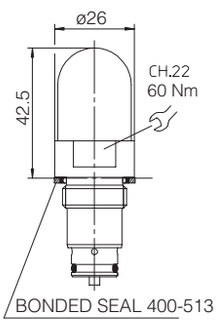


10 CAVITY AND DIMENSIONS FOR CART M-3, M-4 AND M-5 [mm]

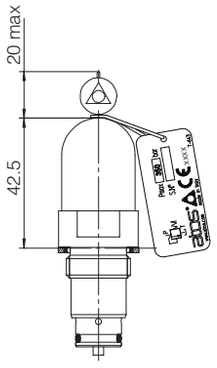
CART M-3



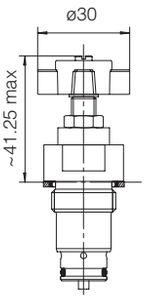
Standard



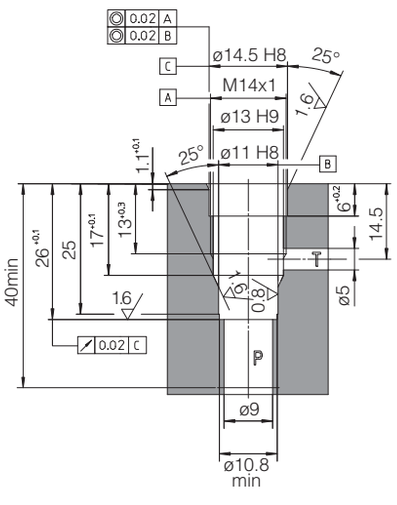
Option /PED



Option /V

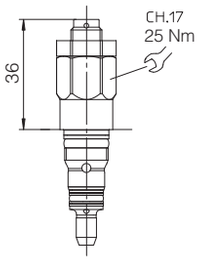


CART M-4

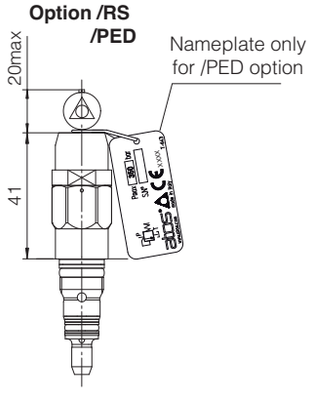


Cavity drawing not in scale
with the cartridge

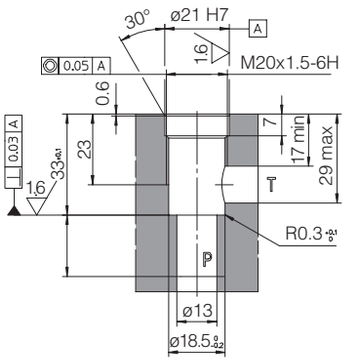
Standard



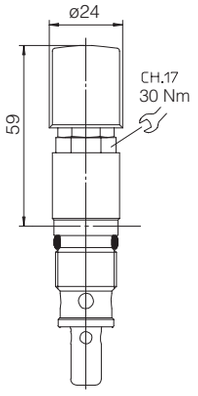
Option /RS
/PED



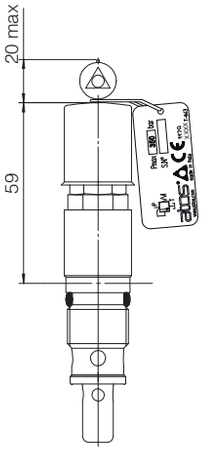
CART M-5



Standard

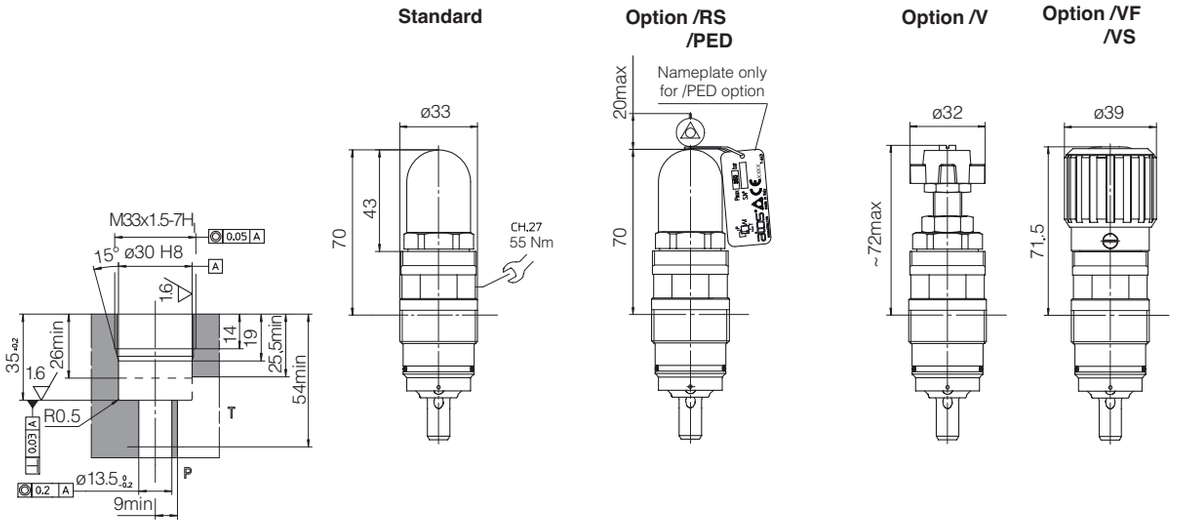


Option /PED

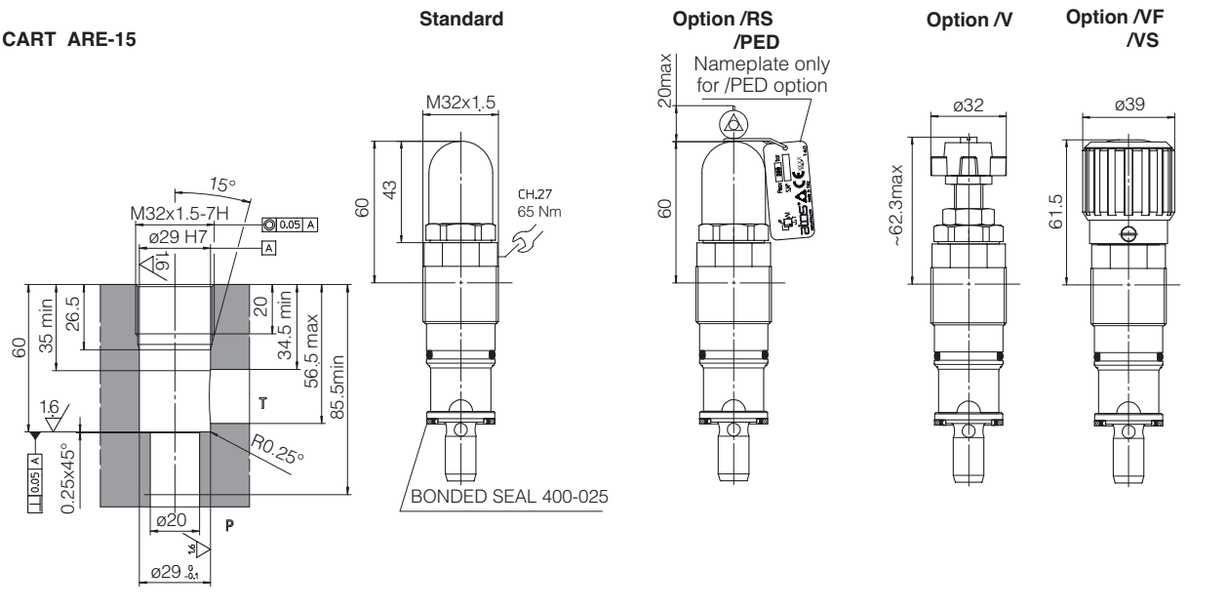


11 CAVITY AND DIMENSIONS FOR CART M-6, CART ARE-15 AND ARE-20 [mm]

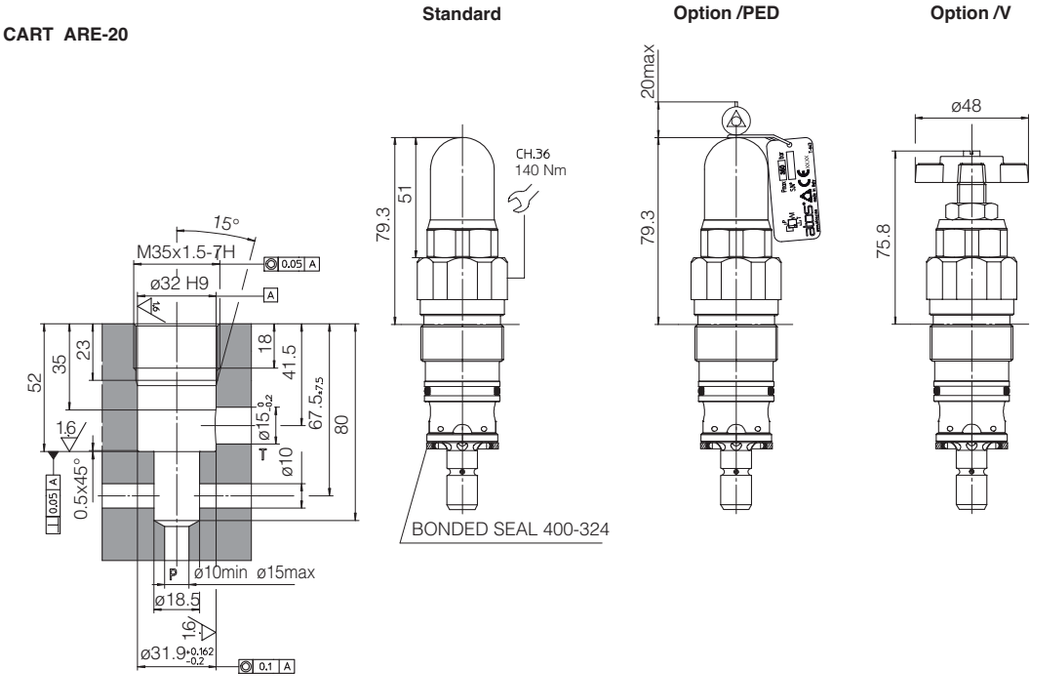
CART M-6



CART ARE-15

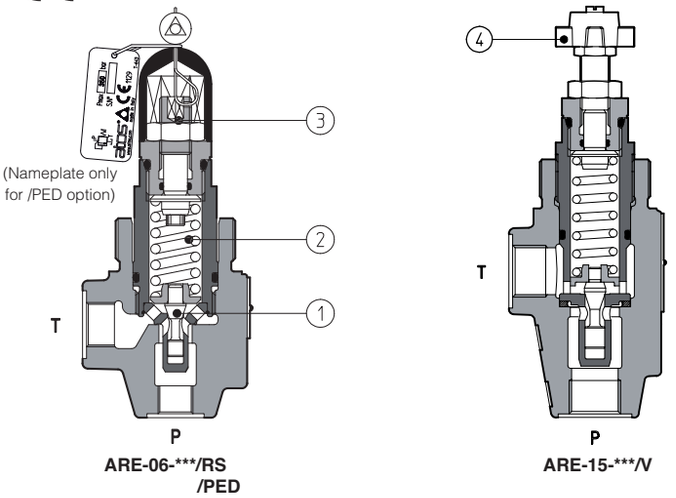


CART ARE-20



Pressure relief valves type ARE

direct operated, in line mounting - G 1/4" and G 1/2" threaded ports



ARE-06-*/RS /PED** **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".

Also available in safety options with sealed regulation:

/RS conforming to Machine Directive (2006/42/CE). The factory preset regulation required by the costumer corresponds to the valve's cracking pressure.

/PED conforming to PED Directive (2014/68/UE). The valves are factory set at the pressure level required by the costumer with a flow through the valve as shown in section 5.

For this version, the P, Q limits are shown in section 7.

Max flow: up to **100 l/min**:

Max pressure: ARE-06 up to **500 bar**
ARE-15 up to **420 bar**

1 MODEL CODE

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

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"

Setting:

for size 06:
50 = 2 → 50 bar
100 = 3 → 100 bar
210 = 10 → 210 bar
350 = 15 → 350 bar
500 = 30 → 500 bar

for size 15:
15 = 2 → 15 bar
50 = 3 → 50 bar
75 = 4 → 75 bar
150 = 8 → 150 bar
250 = 8 → 250 bar
350 = 30 → 350 bar
420 = 30 → 420 bar

Options **(1)(2)**:
R = reduced leakage for special applications
RS = as /R, plus conforming to 2006/42/CE
PED = as /R, plus conforming to 2014/68/UE

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

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

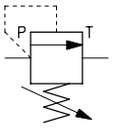
Series number

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR **(3)**

(1) For handwheel and knob features and avaibility, see section 7 and technical table K150
(2) Possible combined options:
RV = reduced leakages and regulating handweel
RVF = reduced leakages and regulating knob
RVS = reduced leakages and regulating knob with safety locking
(3) Not available for PED certified valves

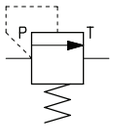
2 HYDRAULIC SYMBOLS

Hydraulic symbol



ARE-06

ARE-15



ARE-06 **/RS /PED

ARE-15 **/RS /PED

3 HYDRAULIC CHARACTERISTICS

Valve model		ARE-06					ARE-15						
Setting	**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				
	/PED	/100	/210	/350			/75	/150	/250				
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	2÷50	3÷100	10÷210	15÷350	30÷500	2÷15	3÷50	4÷75	8÷150	8÷250	30÷420	
	/RS	200÷250	250÷290	290÷350	310÷370		130÷170	170÷210	210÷250				
	/PED	25÷100	100÷210	210÷350			25÷75	75÷150	150÷250				
Max pressure port T [bar]		50					50						
Max flow [l/min]	**Standard, /R**	40					75						
	/RS, **/PED**	60					100						

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

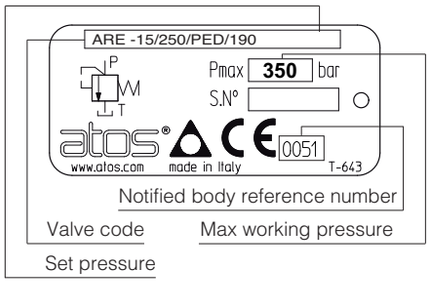
Assembly position	Any position		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR 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 SETTING OF VALVES WITH /PED OPTION

The /PED valves are factory set at the pressure level required by the costumer (every 1 bar) at the following flow shown in the table.
The set pressure is marked on the valve nameplate, see section 5.1

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
ARE-06	12
ARE-15	12

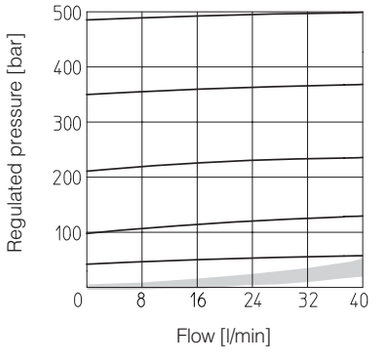
5.1 EXAMPLE OF NAMEPLATE FOR /PED OPTION



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

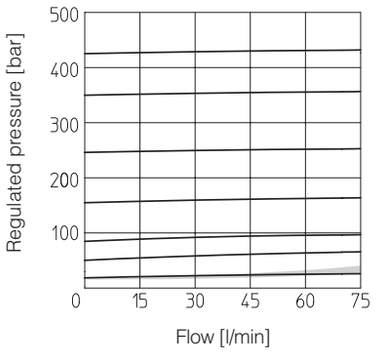
ARE-06 and ARE-06/R

Min. regulated pressure

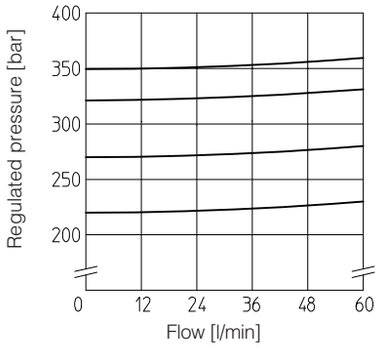


ARE-15 and ARE-15/R

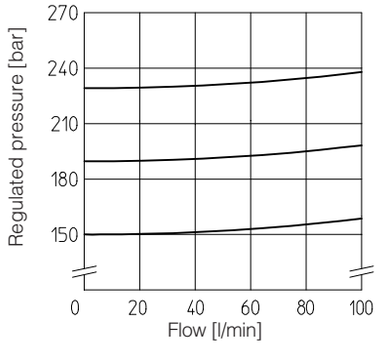
Min. regulated pressure



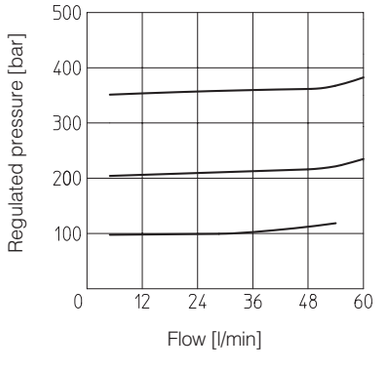
ARE-06 /RS



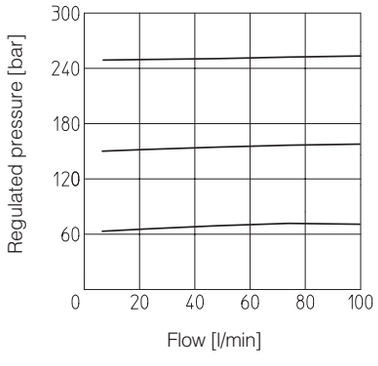
ARE-15 /RS



ARE-6 /PED

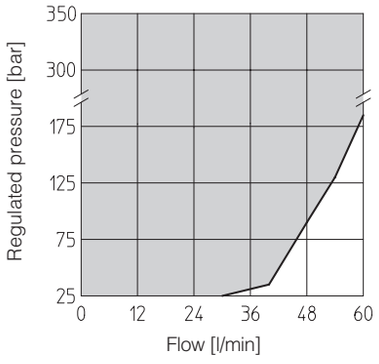


ARE-15 /PED

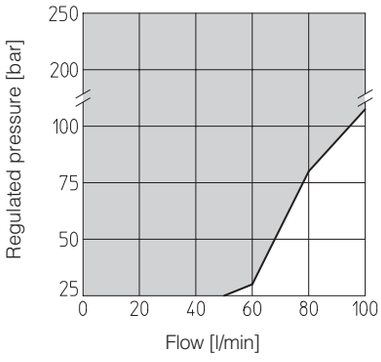


7 **PERMISSIBLE RANGES** (shaded area)
based on mineral oil ISO VG 46 at 50°C

ARE-6 /PED



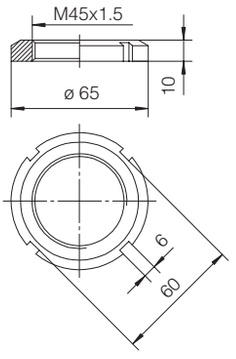
ARE-15 /PED

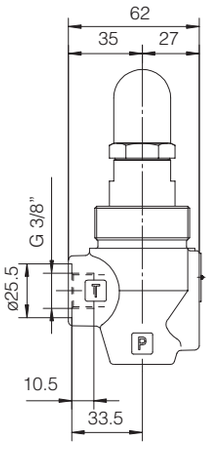


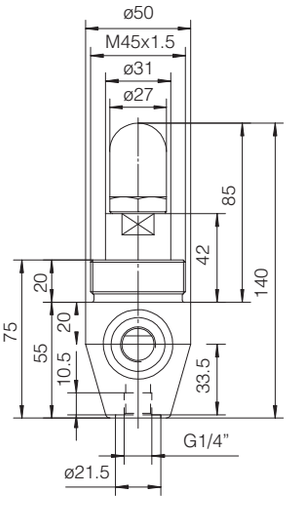
8 DIMENSIONS [mm]

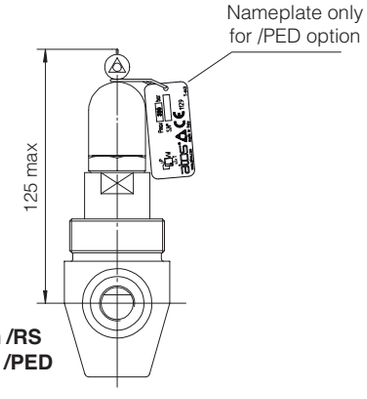
ARE-06

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

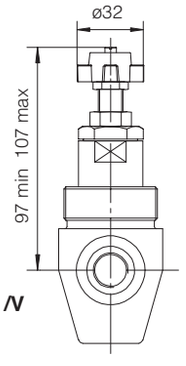




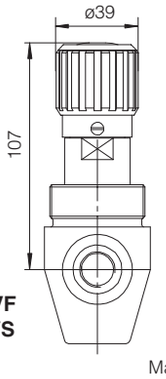




Option /RS /PED



Option /V

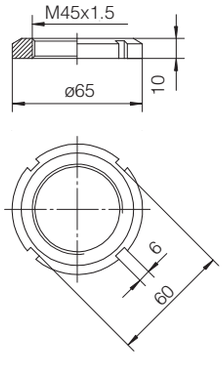


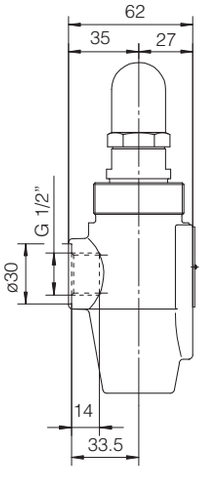
Option /VF /VS

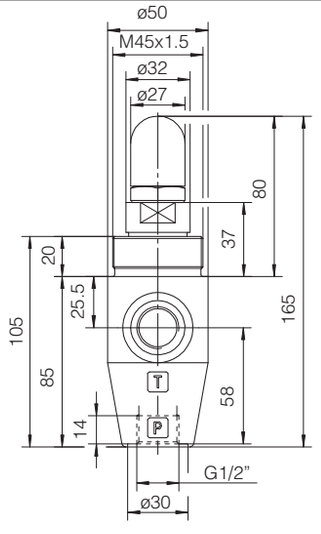
Mass: 1 Kg

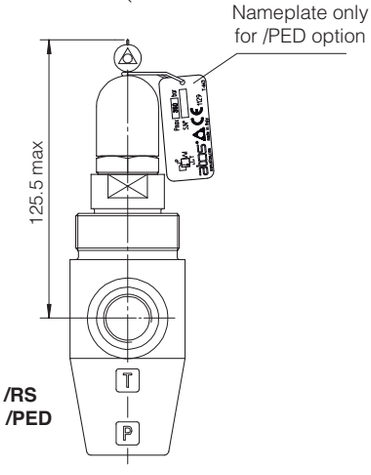
ARE-15

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

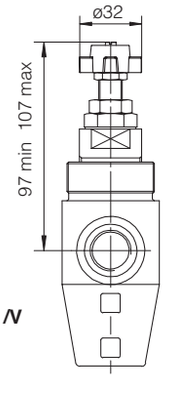




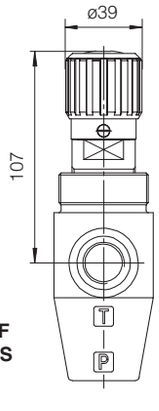




Option /RS /PED



Option /V



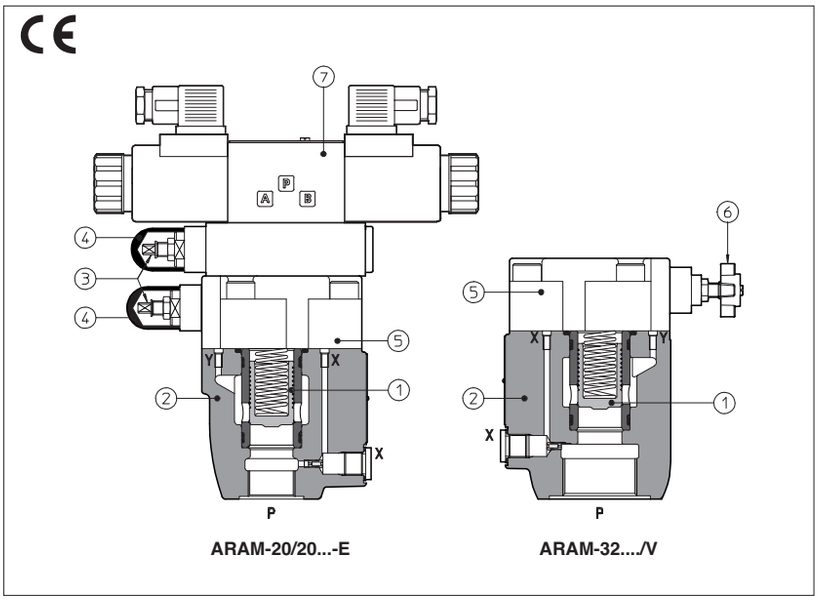
Option /VF /VS

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 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.

Also available in safety option with sealed regulation:
/PED conforming to PED Directive (2014/68/UE). The valves are factory set at the pressure level required by the costumer with a flow through the valve as shown in section 6. For this version the P, Q limits are shown in section 10.

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

- DHI for AC and DC supply, with **cURus** certified solenoids
- DHE for AC and DC supply, high performances with **cURus** certified solenoids

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	/	*	-	I	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 3 for available setting

Pressure range of second/third setting **(1)(2)**:
50 = 4÷50 bar
100 = 6÷100 bar
210 = 7÷210 bar
350 = 8÷350 bar

Options, see section 5
E PED V WP Y

Only for /PED options:
190 = factory pressure setting to be defined depending to the customer requirement (example 190 = 190 bar)

Pilot valve **(1)**:
I = DHI for AC and DC supply, with **cURus** certified solenoids
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

X = without connector **(1):**
See section 7 for available connectors, to be ordered separately
-00 = solenoid valve without coils (for -I)
-00-AC = AC solenoid valve without coils (for -E)
-00-DC = DC solenoid valve without coils (for -E)

Voltage code, see section 8 **(1)**:

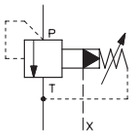
Series number

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR **(3)**

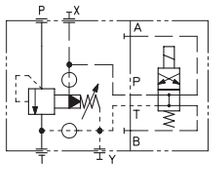
(1) Only for ARAM with solenoid valve for venting and/or for the selection of the setting pressure.
(2) For valves with multiple pressure settings, the eventual /PED option is relevant only to the first main setting. The second (and third) pressure setting are not sealed and their regulation must be lower than the /PED one.
(3) Not available for PED certified valves

2 HYDRAULIC SYMBOL

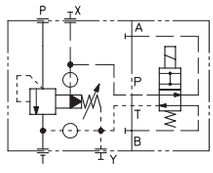
ARAM



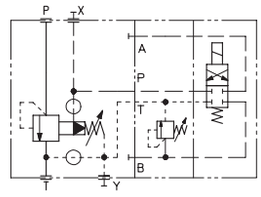
ARAM-/10**

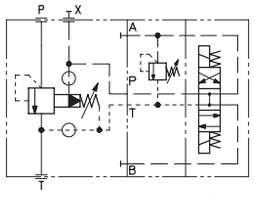


ARAM-/11**

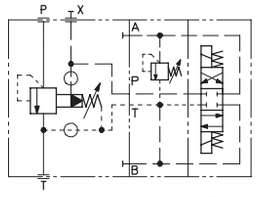


ARAM-/22**

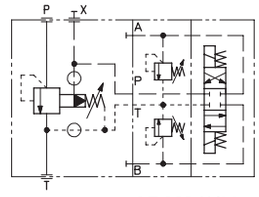




ARAM-/20**



ARAM-/21**



ARAM-/32**

3 HYDRAULIC CHARACTERISTICS

Valve model		**ARAM-20**	**ARAM-32**
Setting [bar]	standard	50; 100; 210; 350	
	/PED		
Pressure range [bar]	standard	4÷50; 6÷100; 7÷210; 8÷350	
	/PED	10÷50; 10÷100; 10÷210; 10÷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 E010 and E015	
Max flow [l/min]	standard	350	500
	/PED		

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

Assembly position	Any position		
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	

4.1 Coils characteristics (for ARAM with pilot solenoid valve)

Insulation class	DHI pilot	**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
	DHE pilot	**H** (180°C) for DC coils **F** (155°C) for AC coils	
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 electric feature 8	
Supply voltage tolerance		± 10%	
Certification		**cURus** North American standard	

5 OPTIONS

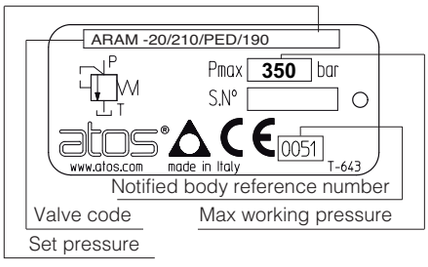
/E = external pilot
/PED = conforming to Directive 97/23/CE (not available with option /V)
/V = regulating handwheel instead of grub screw protected by cap (for handwheel features, see table K150), (not available with option /PED)
/WP = prolunged manual override protected by rubber cap (only for ARAM with pilot solenoid valve)
/Y = external drain (only for ARAM with pilot solenoid valve)

6 SETTING OF VALVES WITH /PED OPTION

The /PED valves are factory set at the pressure level required by the costumer (every 1 bar) at the following flow shown in the table.
The set pressure is marked on the valve nameplate, see section 6.1

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
ARAM-20	25
ARAM-32	25

6.1 EXAMPLE OF NAMEPLATE FOR /PED OPTION



7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 FOR ARAM WITH 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 tab. E010 and K500

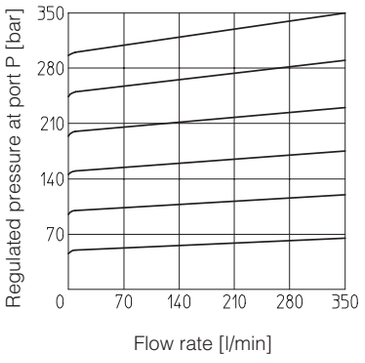
8 ELECTRIC FEATURES FOR AGAM WITH SOLENOID VALVE

Solenoid valve type	External supply nominal voltage ± 10% (1)		**Voltage code**	Type of connector	Power consumption **(3)** DHI	DHE	Code of spare coil DHI	Colour of coil label DHI	Code of spare coil DHE
DHI DHE	DC	12 DC 24 DC 110 DC 220 DC	**12 DC** **24 DC** **110 DC** **220 DC**	666 or 667	33 W	30 W	COU-12DC COU-24DC COU-110DC COU-220DC	green red black black	COE-12DC COE-24DC COE-110DC COE-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 (5)** **120/60 AC (6)** **230/50/60 AC** **230/60 AC**	666 or 667	60 VA - 60 VA 60 VA 60 VA	58 VA 80 VA - 58 VA 80 VA	COI-110/50/60AC - COI-120/60AC COI-230/50/60AC COI-230/60AC	yellow - white light blue silver	COE-110/50/60AC COE-115/60AC - COE-230/50/60AC COE-230/60AC

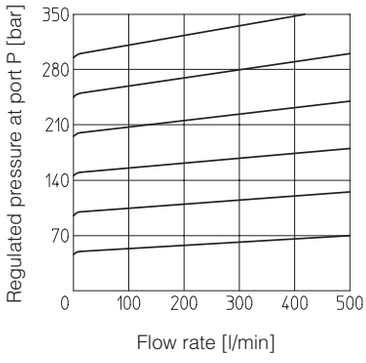
(1) For other supply voltages available on request see technical tables E010, E015.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHI) and 58 VA
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current.
(5) Only for DHE
(6) Only for DHI

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

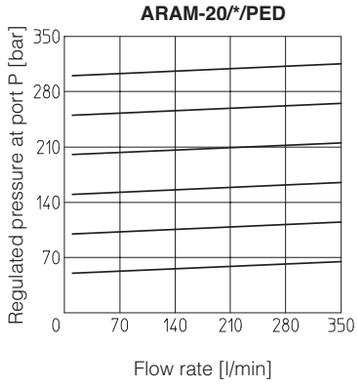
ARAM-20



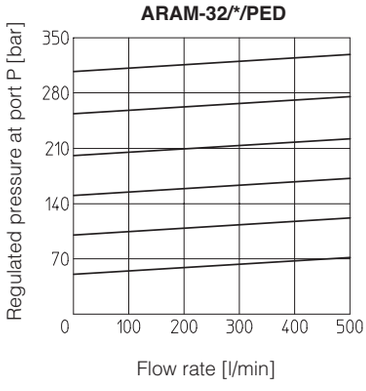
ARAM-32



ARAM-20/*/PED

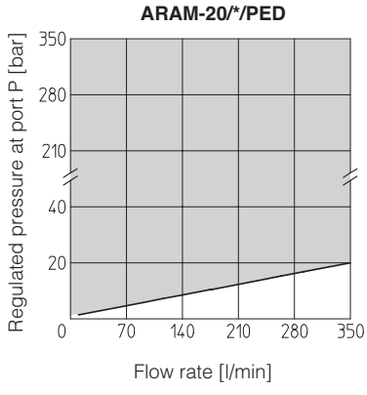


ARAM-32/*/PED

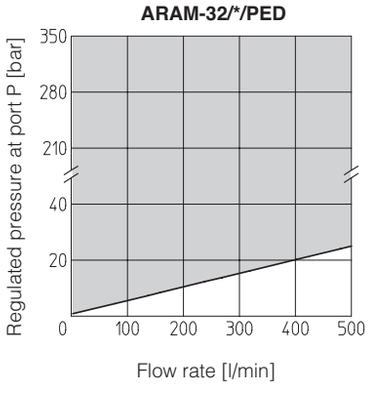


10 **PERMISSIBLE RANGE (shared area)** based on mineral oil ISO VG 46 at 50°C

ARAM-20/*/PED

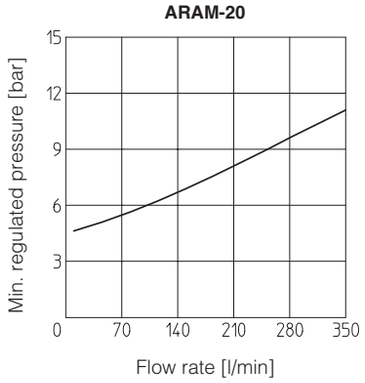


ARAM-32/*/PED

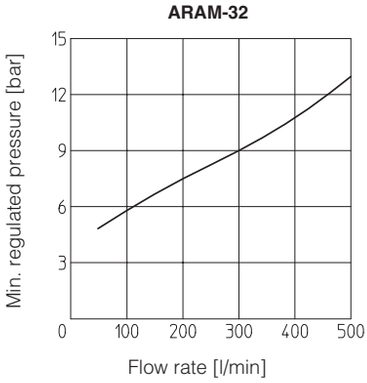


11 **MINIMUM PRESSURE VERSUS FLOW DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

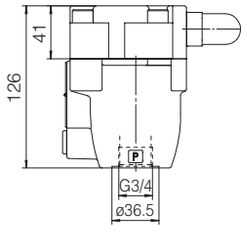
ARAM-20

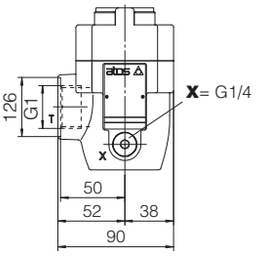


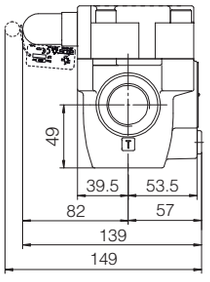
ARAM-32



ARAM-20



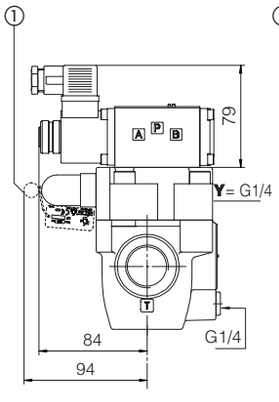




X = port connection for external pilot
Y = port connection for external drain

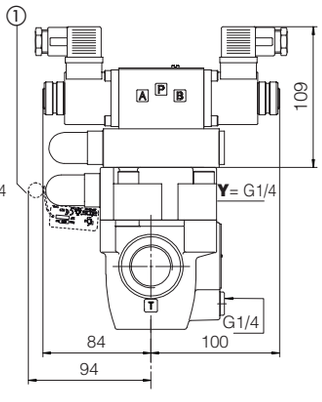
Mass: 3,9 Kg

OPTION /PED



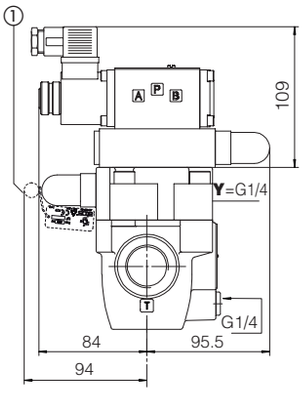
ARAM-20/10/-IX**
ARAM-20/11/-IX**

Mass: 5,4 Kg



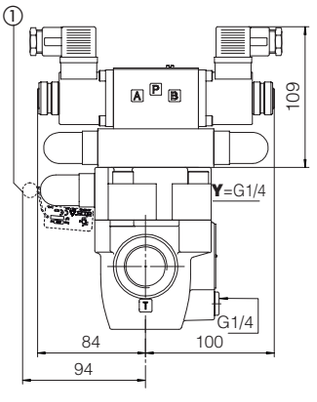
ARAM-20/20/-IX**
ARAM-20/21/-IX**

Mass: 7,1 Kg



ARAM-20/22/-IX**

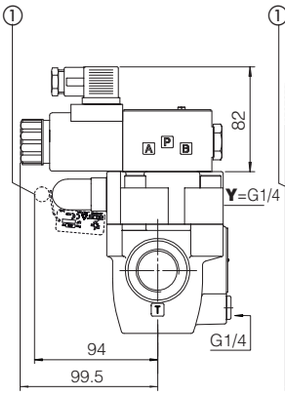
Mass: 6,8 Kg



ARAM-20/32/-IX**

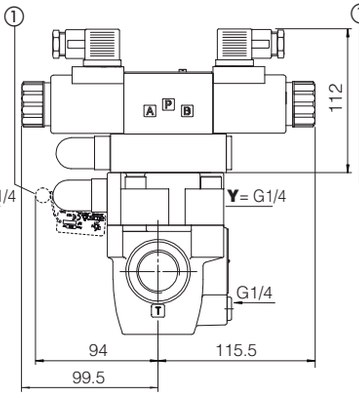
Mass: 7,4 Kg

① = sealed adjustment and nameplate only for /PED option



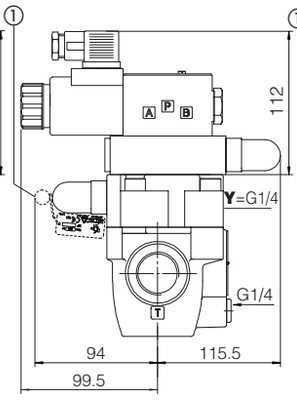
ARAM-20/10/-EX**
ARAM-20/11/-EX**

Mass: 5,7 Kg



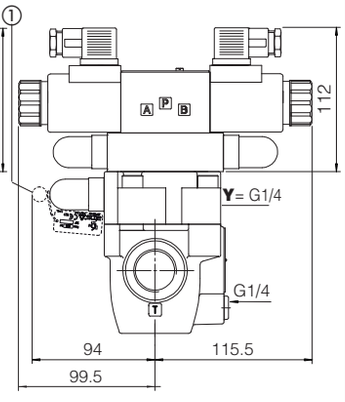
ARAM-20/20/-EX**
ARAM-20/21/-EX**

Mass: 7,7 Kg



ARAM-20/22/-EX**

Mass: 7,2 Kg



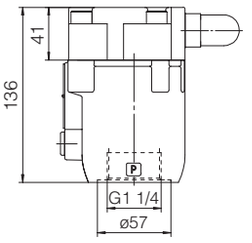
ARAM-20/32/-EX**

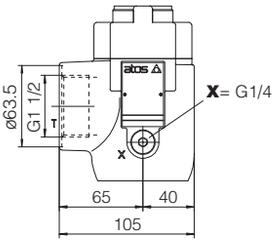
Mass: 8 Kg

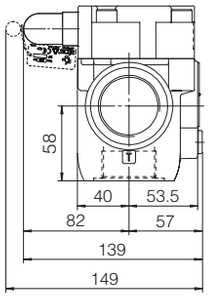
① = sealed adjustment and nameplate only for /PED option

Overall dimensions refer to valves with connectors type 666

ARAM-32



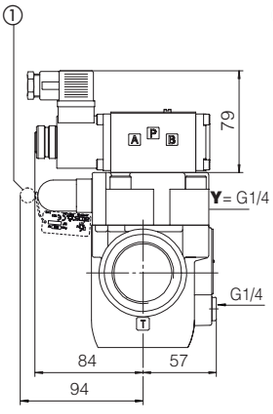




X = port connection for external pilot
Y = port connection for external drain

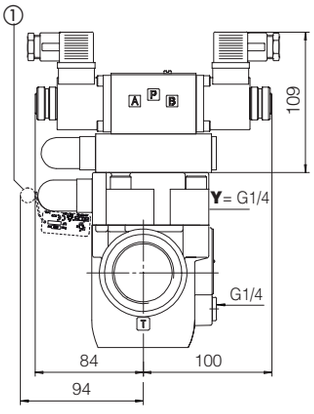
Mass: 4,7 Kg

OPTION /PED



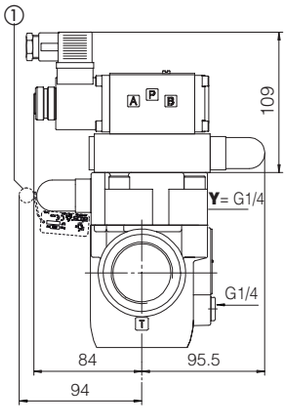
ARAM-32/10/-IX**
ARAM-32/11/-IX**

Mass: 6,2 Kg



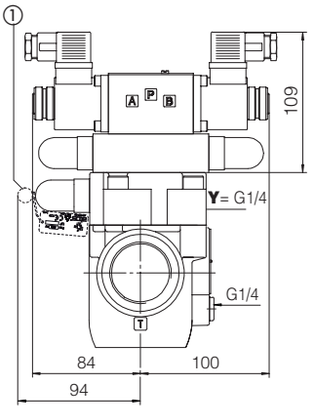
ARAM-32/20/-IX**
ARAM-32/21/-IX**

Mass: 7,9 Kg



ARAM-32/22/-IX**

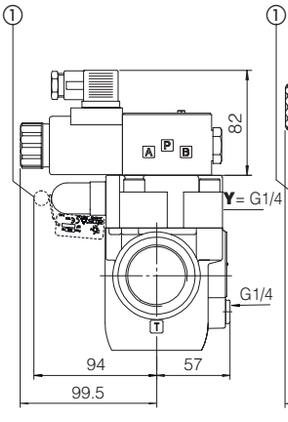
Mass: 7,6 Kg



ARAM-32/32/-IX**

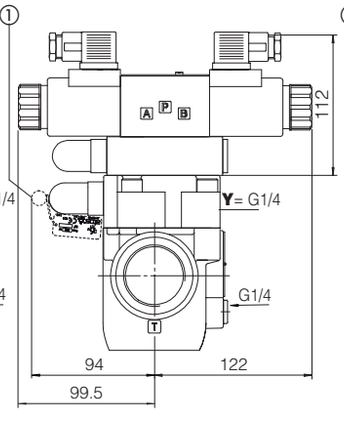
Mass: 8,2 Kg

① = sealed adjustment and nameplate only for /PED option



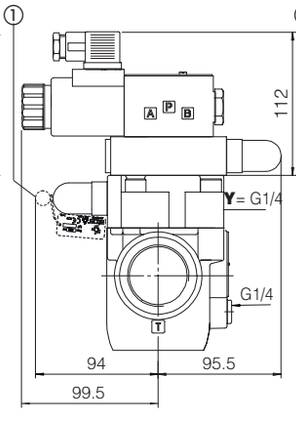
ARAM-32/10/-EX**
ARAM-32/11/-EX**

Mass: 6,5 Kg



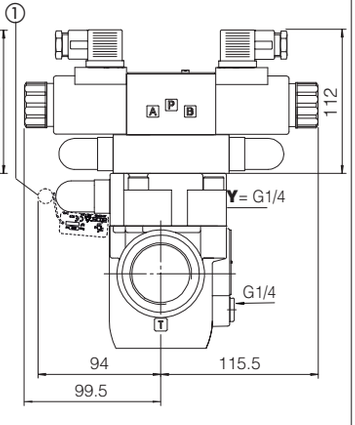
ARAM-32/20/-EX**
ARAM-32/21/-EX**

Mass: 8,5 Kg



ARAM-32/22/-EX**

Mass: 7,9 Kg



ARAM-32/32/-EX**

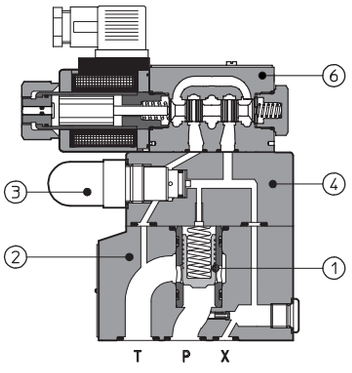
Mass: 8,8 Kg

① = sealed adjustment and nameplate only for /PED option

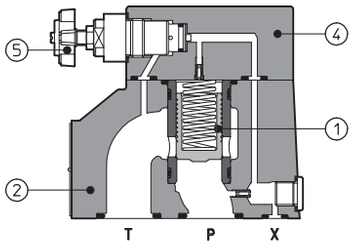
Overall dimensions refer to valves with connectors type 666

Pressure relief valves type AGAM

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



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.

Also available in safety option with sealed regulation:
/PED conforming to PED Directive (2014/68/UE). The valves are factory set at the pressure level required by the costumer with a flow through the valve as shown in section 6.
For this version the P, Q limits are shown in section 10.

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

- DHI for AC and DC supply, with **cURus** certified solenoids
- DHE for AC and DC supply,high performances with **cURus** certified solenoids

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	/	*	-	I	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)(2)**:
50 = 4÷50 bar
100 = 6÷100 bar
210 = 7÷210 bar
350 = 8÷350 bar

Options, see section 5
E PED V WP Y

Only for /PED options:
190 = factory pressure setting to be defined depending to the customer requirement (example 190 = 190 bar)

Pilot valve **(1)**:
I = DHI for AC and DC supply, with **cURus** certified solenoids
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

X = without connector **(1):**
See section 7 for available connectors, to be ordered separately
-00 = solenoid valve without coils (for -I)
-00-AC = AC solenoid valve without coils (for -E)
-00-DC = DC solenoid valve without coils (for -E)

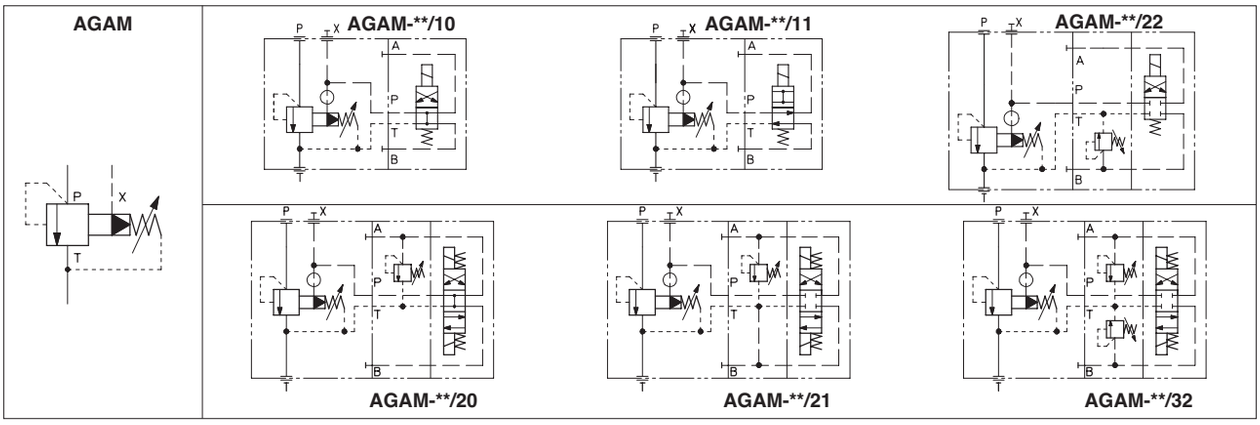
Voltage code, see section 8 **(1)**:

Series number

Seals material, see section 4:
- = NBR
PE = FKM
BT = HNBR **(3)**

(1) Only for AGAM with solenoid valve for venting and/or for the selection of the setting pressure
(2) For valves with multiple pressure settings, the eventual /PED option is relevant only to the first main setting
The second (and third) pressure setting are not sealed and their regulation must be lower than the /PED one
(3) FNot available for PED certified valves

2 HYDRAULIC SYMBOLS



3 HYDRAULIC CHARACTERISTICS

Valve model		AGAM-10	AGAM-20	AGAM-32
Setting [bar]	standard /PED	50; 100; 210; 350		
Pressure range [bar]	standard	4÷50;	6÷100;	7÷210; 8÷350
	/PED	10÷50;	10÷100;	10÷210; 10÷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 E010 and E015		
Max flow [l/min]	standard /PED	200	400	600

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

Assembly position	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 /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	

4.1 Coils characteristics (for AGAM with pilot solenoid valve)

Insulation class	DHI pilot	**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
	DHE pilot	**H** (180°C) for DC coils **F** (155°C) for AC coils	
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 electric feature 8	
Supply voltage tolerance		± 10%	
Certification		**cURus** North American standard	

5 OPTIONS

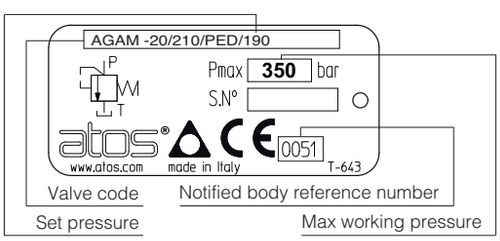
/E = external pilot
/PED = conforming to Directive 2014/68/UE (not available with option /V)
/V = regulating handwheel instead of grub screw protected by cap (for handwheel features, see table K150), (not available with option /PED)
/WP = prolunged manual override protected by rubber cap (only for AGAM with pilot solenoid valve)
/Y = external drain (only for AGAM with pilot solenoid valve)

6 SETTING OF VALVES WITH /PED OPTION

The /PED valves are factory set at the pressure level required by the costumer (every 1 bar) at the following flow shown in the table.
The set pressure is marked on the valve nameplate, see section 6.1

VALVE MODEL	FLOW FOR FACTORY PRESSURE SETTING (l/min)
AGAM-10	25
AGAM-20	25
AGAM-32	25

6.1 EXAMPLE OF NAMEPLATE FOR /PED OPTION



7 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 FOR AGAM WITH 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 tab. E010 and K500

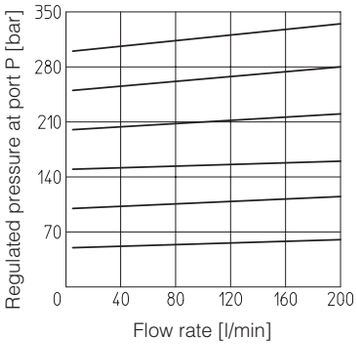
8 ELECTRIC FEATURES FOR AGAM WITH SOLENOID VALVE

Solenoid valve type	External supply nominal voltage ± 10% (1)		**Voltage code**	Type of connector	Power consumption **(3)** DHI	DHE	Code of spare coil DHI	Colour of coil label DHI	Code of spare coil DHE
DHI DHE	DC	12 DC 24 DC 110 DC 220 DC	**12 DC** **24 DC** **110 DC** **220 DC**	666 or 667	33 W	30 W	COU-12DC COU-24DC COU-110DC COU-220DC	green red black black	COE-12DC COE-24DC COE-110DC COE-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 (5)** **120/60 AC (6)** **230/50/60 AC** **230/60 AC**	666 or 667	60 VA - 60 VA 60 VA 60 VA	58 VA 80 VA - 58 VA 80 VA	COI-110/50/60AC - COI-120/60AC COI-230/50/60AC COI-230/60AC	yellow - white light blue silver	COE-110/50/60AC COE-115/60AC - COE-230/50/60AC COE-230/60AC

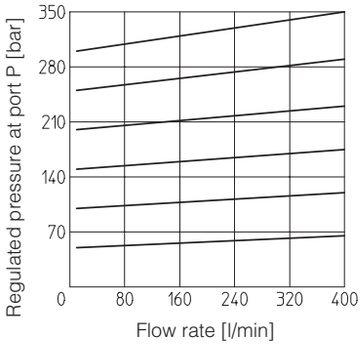
(1) For other supply voltages available on request see technical tables E010, E015.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHI) and 58 VA
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When AC solenoid is energized, the inrush current is approx 3 times the holding current.
(5) Only for DHE
(6) Only for DHI

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

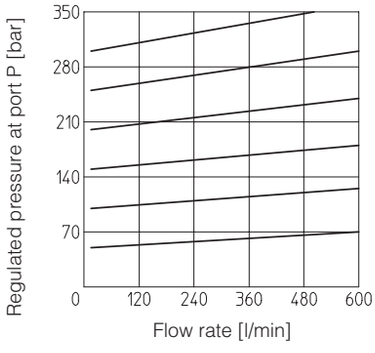
AGAM-10



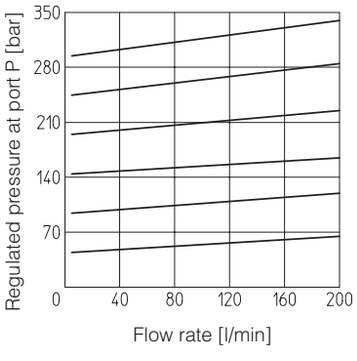
AGAM-20



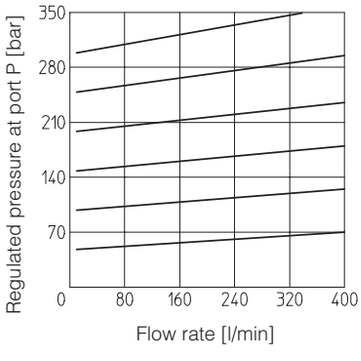
AGAM-32



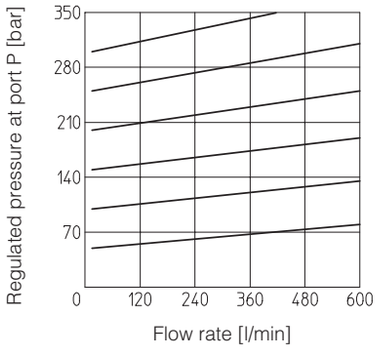
AGAM-10/*/PED



AGAM-20/*/PED

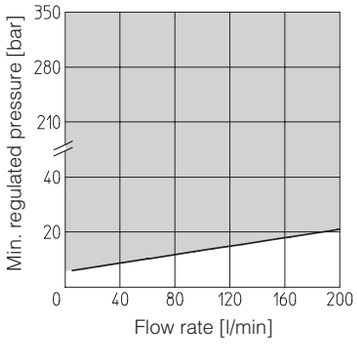


AGAM-32/*/PED

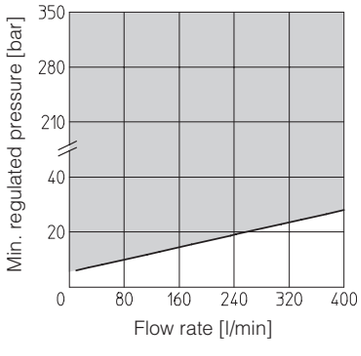


10 PERMISSIBLE RANGE (shared area) based on mineral oil ISO VG 46 at 50°C

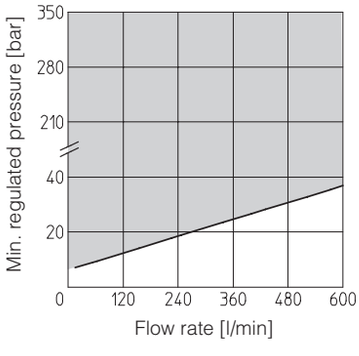
AGAM-10



AGAM-20

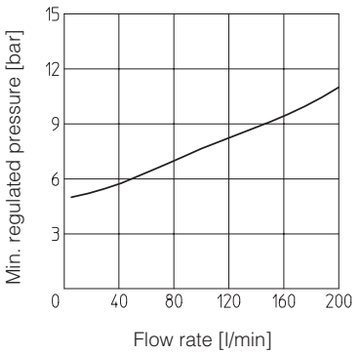


AGAM-32

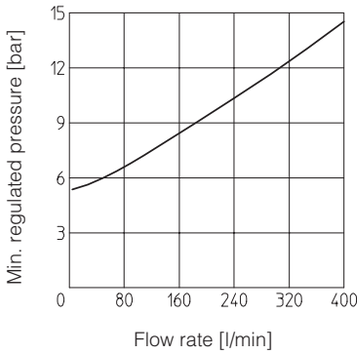


11 **MINIMUM PRESSURE VERSUS FLOW DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

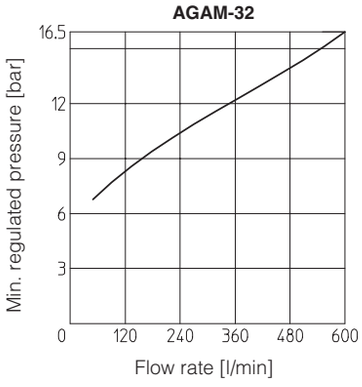
AGAM-10



AGAM-20

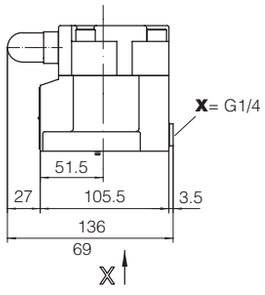


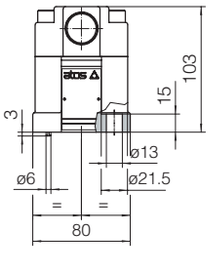
AGAM-32

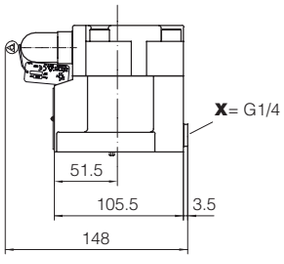


12 **DIMENSIONS [mm]**

AGAM-10

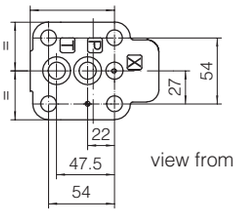






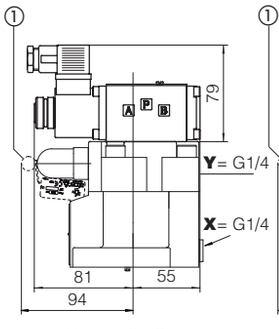
Mass: 3,6 Kg

OPTION /PED

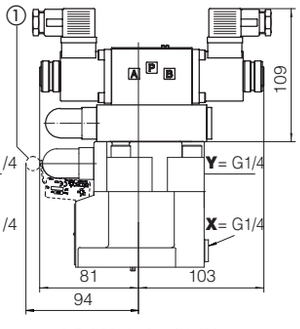


view from X

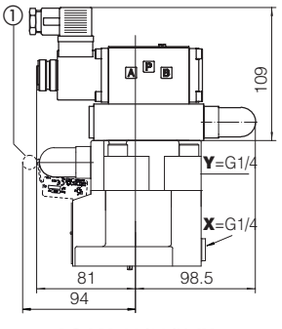
ISO 6264: 2007
Mounting surface: 6264-06-09-1-97
Fastening bolts:
4 socket head screws M12x35 class 12.9
Tightening torque = 125 Nm
Seals: 2 OR 123; 1 OR 109/70
Ports P, T: Ø = 14,5 mm
Ports X: Ø = 3,2 mm



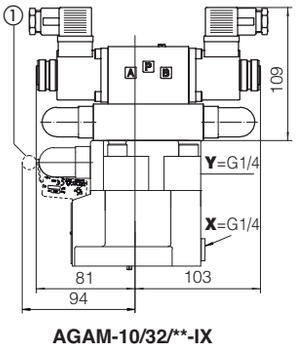
AGAM-10/10/-IX**
AGAM-10/11/-IX**
Mass: 5,1 Kg



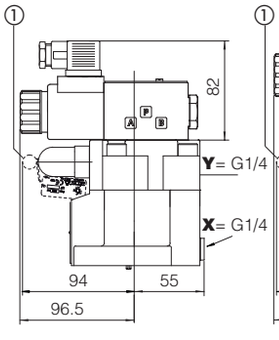
AGAM-10/20/-IX**
AGAM-10/21/-IX**
Mass: 6,2 Kg



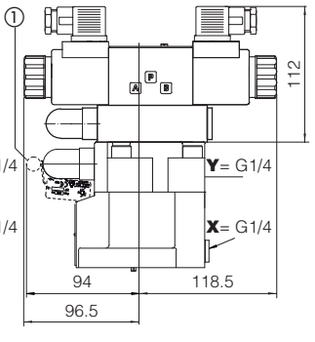
AGAM-10/22/-IX**
Mass: 5,9 Kg



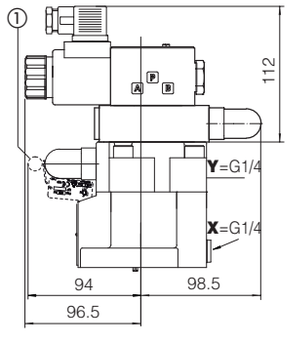
AGAM-10/32/-IX**
Mass: 6,3 Kg



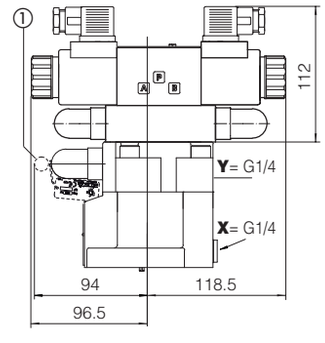
AGAM-10/10/-EX**
AGAM-10/11/-EX**
Mass: 5,1 Kg



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



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

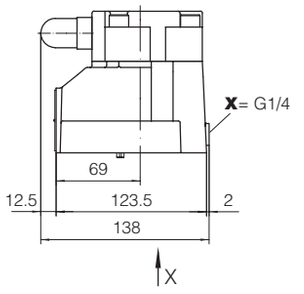


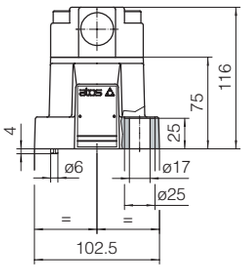
AGAM-10/32/-EX**
Mass: 6,3 Kg

① = sealed adjustment and nameplate only for /PED option

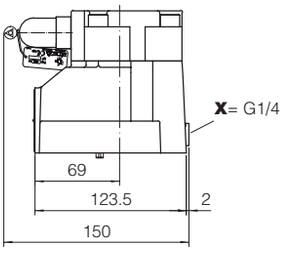
Overall dimensions refer to valves with connectors type 666

AGAM-20

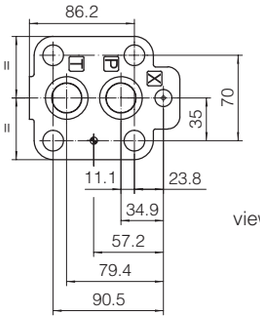




Mass: 4,8Kg

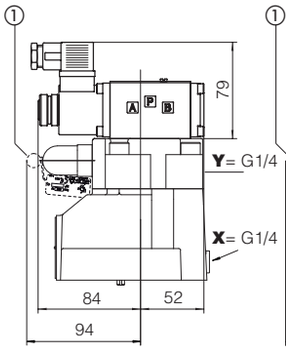


OPTION /PED



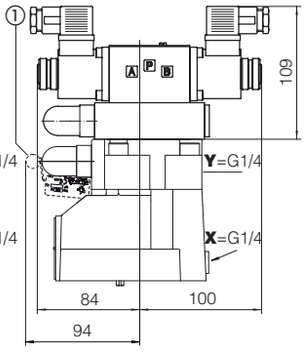
view from X

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



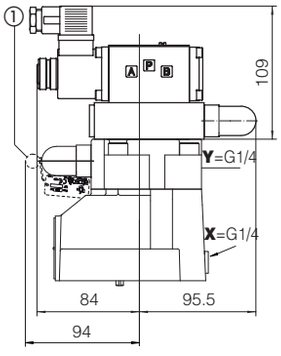
AGAM-20/10/-IX**
AGAM-20/11/-IX**

Mass: 6,3 Kg



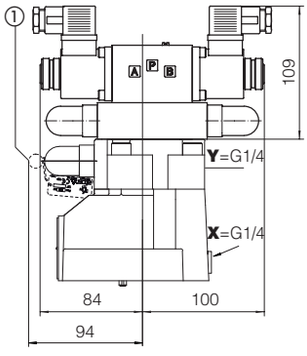
AGAM-20/20/-IX**
AGAM-20/21/-IX**

Mass: 7,4Kg



AGAM-20/22/-IX**

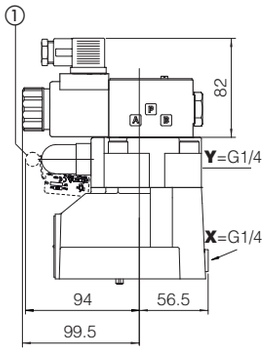
Mass: 7,1 Kg



AGAM-20/32/-IX**

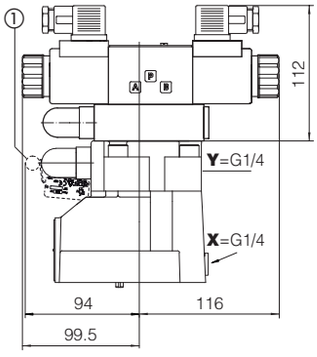
Mass: 7,5 Kg

① = sealed adjustment and nameplate only for /PED option



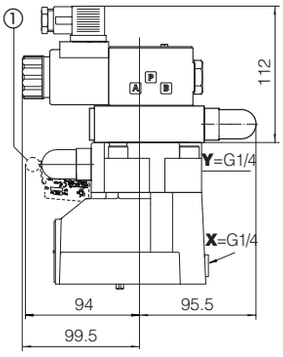
AGAM-20/10/-EX**
AGAM-20/11/-EX**

Mass: 6,3 Kg



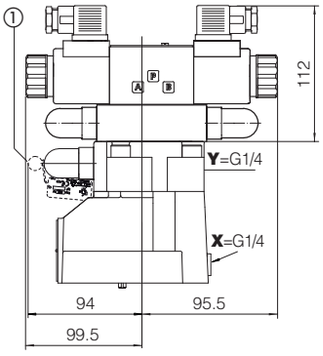
AGAM-20/20/-EX**
AGAM-20/21/-EX**

Mass: 7,4 Kg



AGAM-20/22/-EX**

Mass: 7,1 Kg



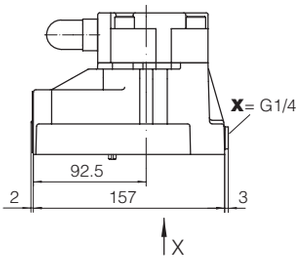
AGAM-20/32/-EX**

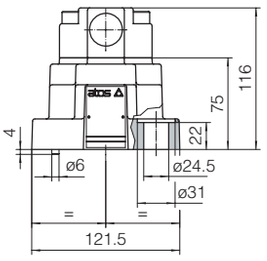
Mass: 7,5 Kg

① = sealed adjustment and nameplate only for /PED option

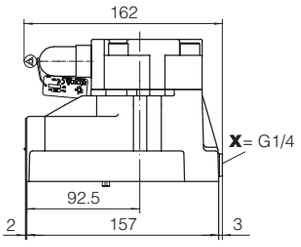
Overall dimensions refer to valves with connectors type 666

AGAM-32

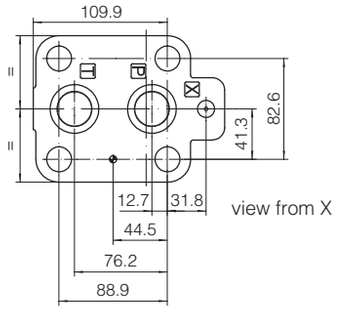




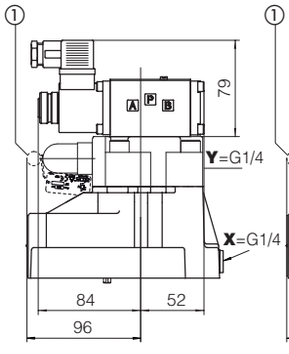
Mass: 6,2 Kg



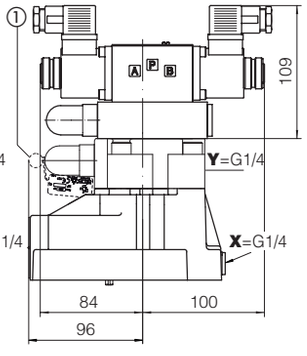
OPTION /PED



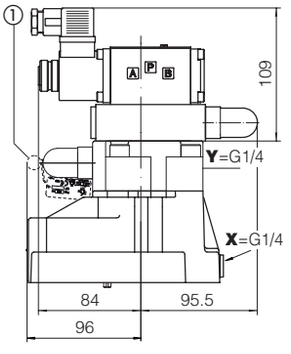
ISO 6264: 2007
Mounting surface: 6264-10-17-1-97
(with M20 fixing holes instead of standard M18)
Fastening bolts:
4 socket head screws M20x60 class 12.9
Tightening torque = 600 Nm
Seals: 2 OR 4131; 1 OR 109/70
Ports P, T: Ø = 28,5 mm
Ports X: Ø = 3,2 mm



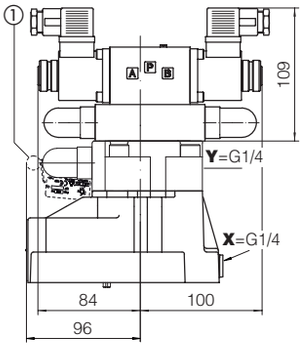
AGAM-32/10/-IX**
AGAM-32/11/-IX**
Mass: 7,7 Kg



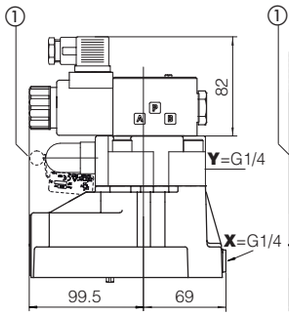
AGAM-32/20/-IX**
AGAM-32/21/-IX**
Mass: 8,8 Kg



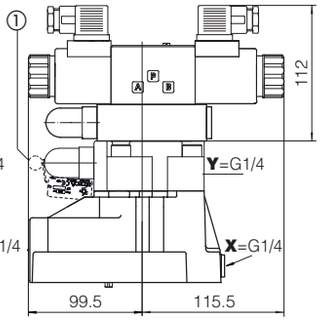
AGAM-32/22/-IX**
Mass: 8,5 Kg



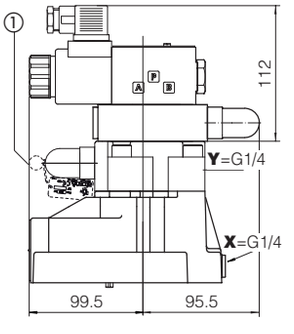
AGAM-32/32/-IX**
Mass: 8,9 Kg



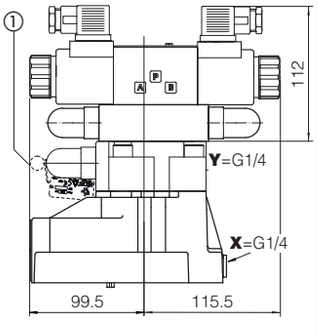
AGAM-32/10/-EX**
AGAM-32/11/-EX**
Mass: 7,7 Kg



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

① = sealed adjustment and nameplate only for /PED option

Overall dimensions refer to valves with connectors type 666

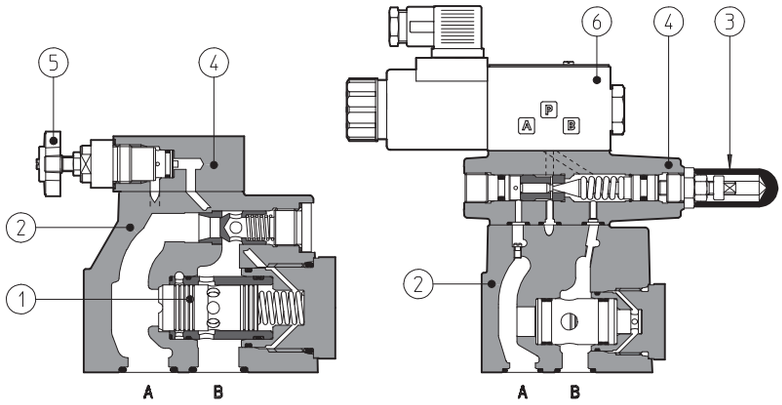
13 MOUNTING SUBPLATES

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 control valves type AGIR, AGIS, AGIU

two stage, subplate mounting, ISO 5781 sizes 10, 20 and 32



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:
- DHI for AC and DC supply, with **cURus** certified solenoids
- DHE for AC and DC supply, high performances with **cURus** certified solenoids

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	-	I	X	24DC	**	/	*

AGIU
Pressure control valves subplate mounting
AGIR = pressure reducing
AGIS = sequence
AGIU = unloading

*
Only for AGIR and AGIS:
R = with check valve
- = without check valve

20
Size: **10** **20** **32**

10
Optional solenoid valve for venting **(1)**
10 = venting with de-energized solenoid
11 = venting with energized solenoid

210
Pressure range:
50 = 4÷50 bar (AGIR*); **100** = 6÷100 bar;
210 = 7÷210 bar; **350** = 8÷350 bar

V
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 (1)
- = standard unloading characteristics
5, 6, 7 = other unloading characteristics, see section 5

I
Pilot valve **(1)**:
I = DHI for AC and DC supply, with **cURus** certified solenoids
E = DHE for AC and DC supply, high performances with **cURus** certified solenoids

X
X = without connector **(1):**
See section 7 for available connectors, to be ordered separately
-00 = solenoid valve without coils (for -I)
-00-AC = AC solenoid valve without coils (for -E)
-00-DC = DC solenoid valve without coils (for -E)

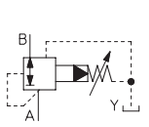
24DC
Voltage code, see section 7 **(1)**

**
Series number

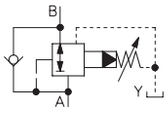
*
Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

(1) Only for AGIU with solenoid valve for venting **(2)** For handwheel features, see technical table K150

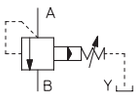
2 HYDRAULIC CHARACTERISTICS



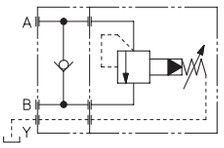
AGIR



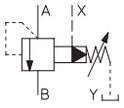
AGIRR



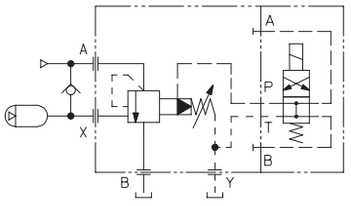
AGIS



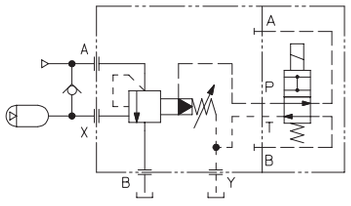
AGISR



AGIU



AGIU-/10**



AGIU-/11**

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								

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

Assembly position	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 /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)

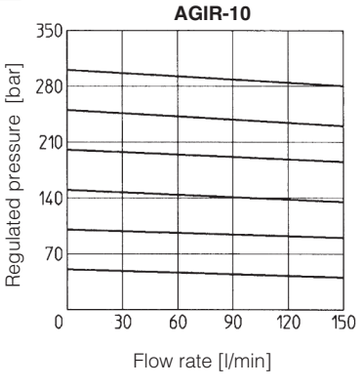
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

3.1 Coils characteristics

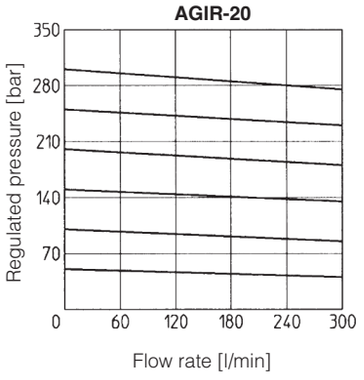
Insulation class	DHI pilot	**H** (180°C)
	DHE pilot	**H** (180°C) for DC coils **F** (155°C) for AC coils
		Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529		**IP 65** (with connectors 666, 667, 669 or E-SD correctly assembled)
Relative duty factor		100%
Supply voltage and frequency		See electric feature 8
Supply voltage tolerance		± 10%
Certification		**cURus** North American standard

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

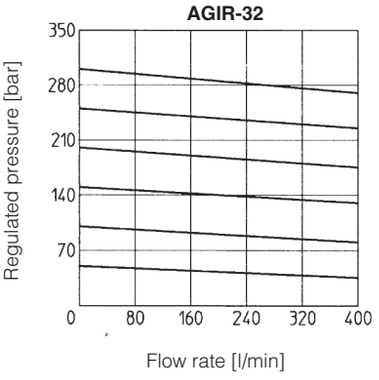
AGIR-10



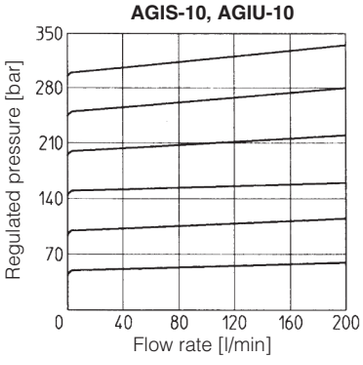
AGIR-20



AGIR-32

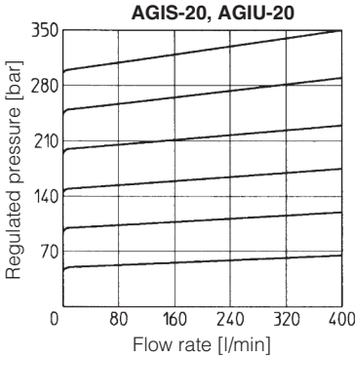


AGIS-10, AGIU-10



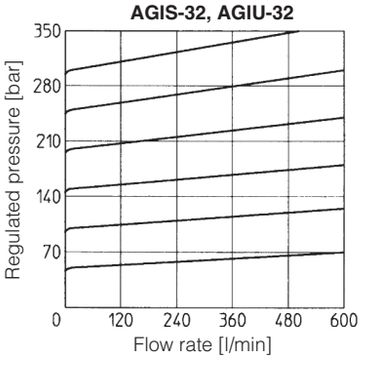
Note: for AGIU-10, the max flow rate is 100 l/min

AGIS-20, AGIU-20



Note: for AGIU-20, the max flow rate is 200 l/min

AGIS-32, AGIU-32

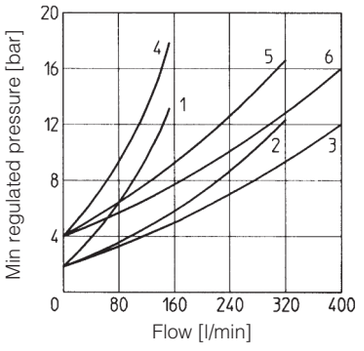


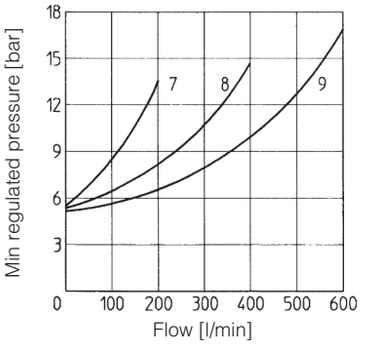
Note: for AGIU-32, the max flow rate is 300 l/min

5 **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

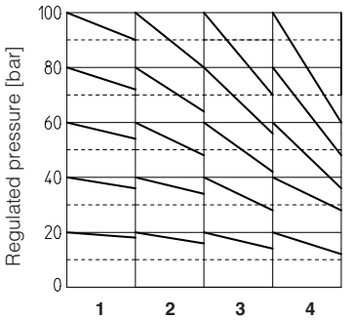
7 = AGIS-10
8 = AGIS-20
9 = AGIS-32

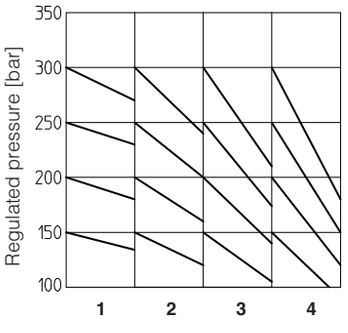




Opening/closing diagram for AGIU

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 unadvisable 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);

6 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 FOR AGIU WITH 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 tab. E010 and K500

7 ELECTRIC FEATURES FOR AGAM WITH SOLENOID VALVE

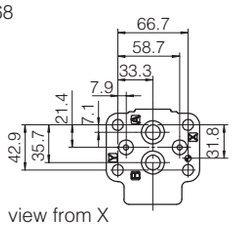
Solenoid valve type	External supply nominal voltage ± 10% (1)		**Voltage code**	Type of connector	Power consumption **(3)** DHI	DHE	Code of spare coil DHI	Colour of coil label DHI	Code of spare coil DHE
DHI DHE	DC	12 DC 24 DC 110 DC 220 DC	**12 DC** **24 DC** **110 DC** **220 DC**	666 or 667	33 W	30 W	COU-12DC COU-24DC COU-110DC COU-220DC	green red black black	COE-12DC COE-24DC COE-110DC COE-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 (5)** **120/60 AC (6)** **230/50/60 AC** **230/60 AC**	666 or 667	60 VA - 60 VA 60 VA 60 VA	58 VA 80 VA - 58 VA 80 VA	COI-110/50/60AC - COI-120/60AC COI-230/50/60AC COI-230/60AC	yellow - white light blue silver	COE-110/50/60AC COE-115/60AC - COE-230/50/60AC COE-230/60AC

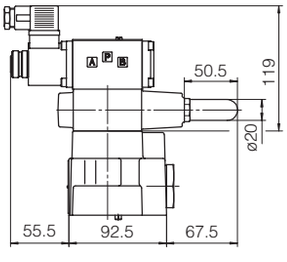
(1) For other supply voltages available on request see technical tables E010, E015.
(2) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA (DHI) and 58 VA
(3) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(4) When solenoid is energized, the inrush current is approx 3 times the holding current.
(5) Only for DHE
(6) Only for DHI

8 DIMENSIONS [mm]

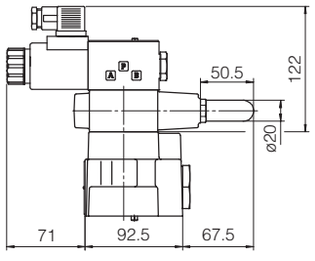
AGIR, AGIS, AGIU size 10

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

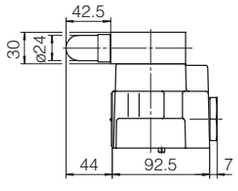


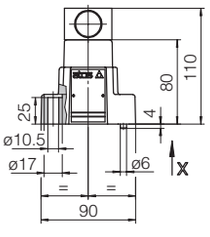


AGIU-10/10/-IX**
Mass = 5,3 Kg

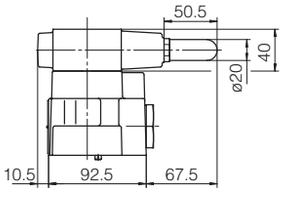


AGIU-10/10/-EX**
Mass = 5,6 Kg

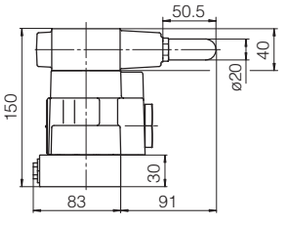




AGIR-10; Mass= 3,3 Kg
AGIRR-10; Mass= 3,5 Kg



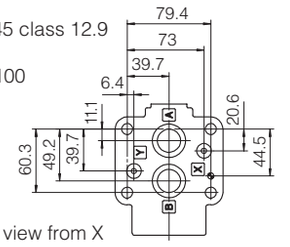
AGIS-10; Mass= 3,8 Kg
AGIU-10; Mass= 3,8 Kg

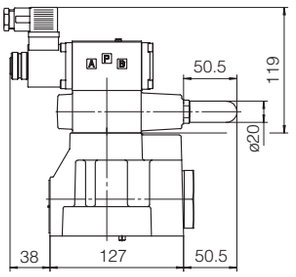


AGISR-10; Mass= 5,3 Kg

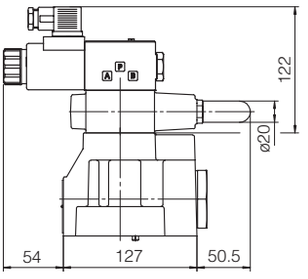
AGIR, AGIS, AGIU size 20

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

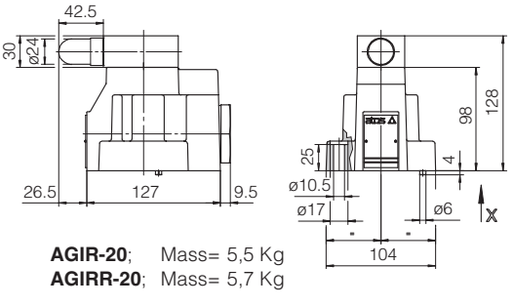




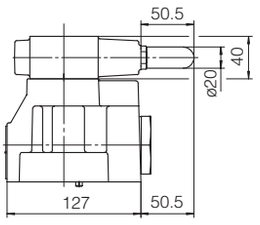
AGIU-20/10/-IX**
Mass = 7,5 Kg



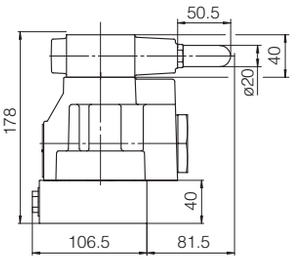
AGIU-20/10/-EX**
Mass = 7,8 Kg



AGIR-20; Mass= 5,5 Kg
AGIRR-20; Mass= 5,7 Kg



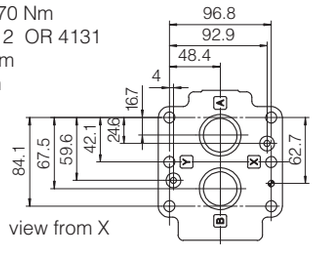
AGIS-20; Mass= 6 Kg
AGIU-20; Mass= 6 Kg

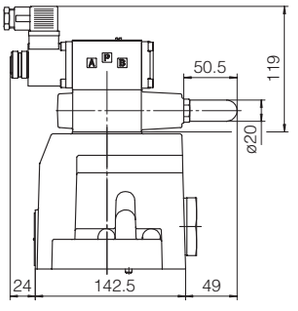


AGISR-20; Mass= 9 Kg

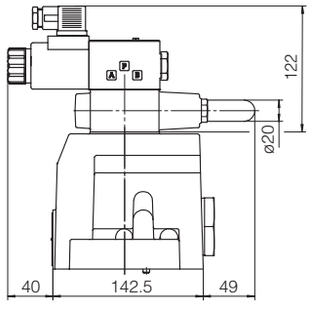
AGIR, AGIS, AGIU size 32

ISO 5781: 2000
Mounting surface: 5781-08-13-0-00
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

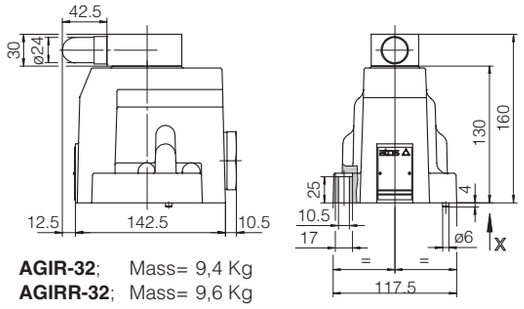




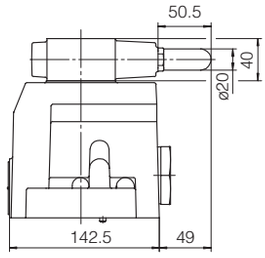
AGIU-32/10/-IX**
Mass = 11,4 Kg



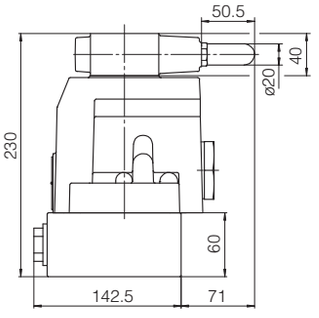
AGIU-32/10/-EX**
Mass = 11,7 Kg



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 with connectors type 666

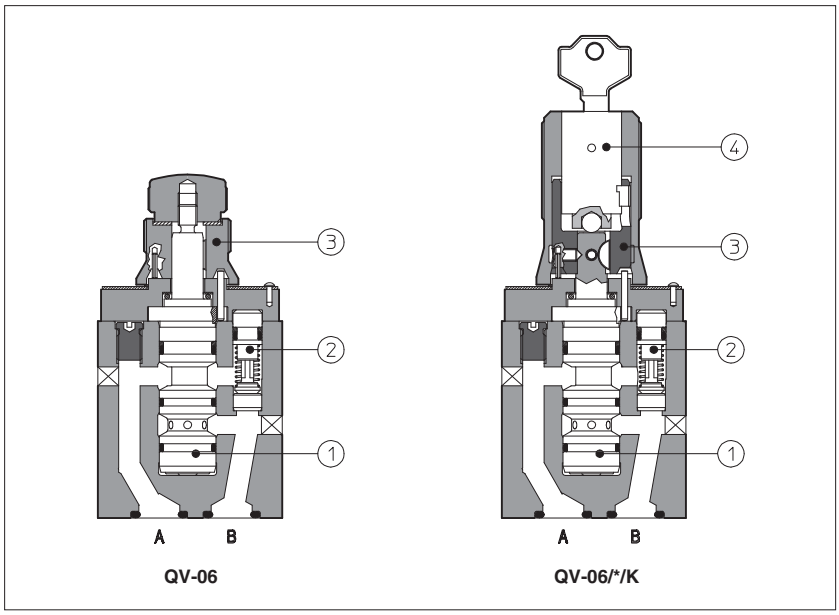
9 MOUNTING SUBPLATES

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
AGIU-10	BA-325 (with incorporated check valve)	G 1/2"	G 3/4"	G 1/4"	G 1/2"	30	36,5	21,5	30	5	
AGIU-20	BA-425 (with incorporated check valve)	Ports A, B, Y underneath;	G 1"	G 1"	G 1/4"	G 1"	46	46	21,5	46	6,5
AGIU-32	BA-625 (with incorporated check valve)		G 1 1/2"	G 1 1/2"	G 1/4"	G 1 1/2"	63,5	63,5	21,5	63,5	13

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 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.

ISO 4401 size 06.

Flow up to 1,5; 6; 11; 16; 24 l/min (depending on models).
Pressure up to 250 bar.

Valves designed to operate in hydraulic systems with hydraulic mineral oil or synthetic fluid having similar lubricating characteristics.

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

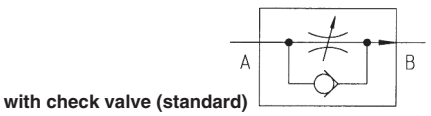
Options:
K = with lock key for the setting knob
V = without by-pass check valve

Series number

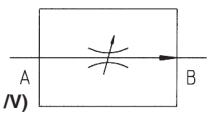
Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

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

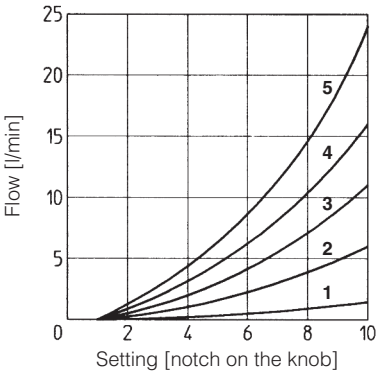
Assembly position	Any position
Ambient temperature	Standard = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT 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	

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

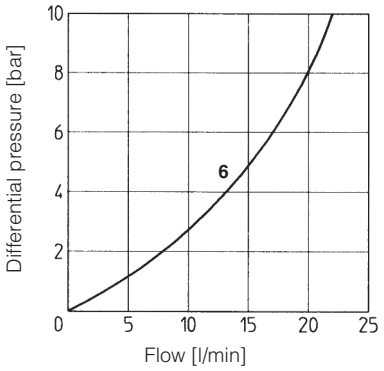
4.1 Regulation diagram

1 = QV-06/1
2 = QV-06/6
3 = QV-06/11
4 = QV-06/16
5 = QV-06/24

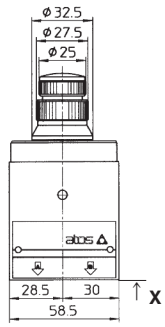


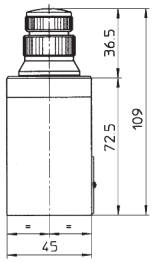
4.2 Q/Δp diagram through the check valve for free flow B→A

6 = QV-06/*

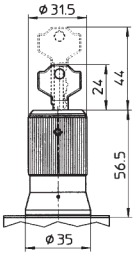


5 DIMENSIONS [mm]

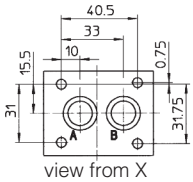




Mass: 1,2 Kg



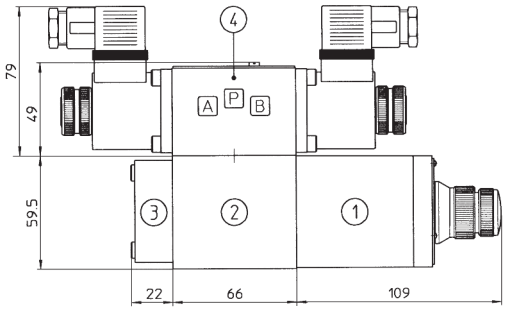
Option /K



view from X

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
(see note 1)
Fastening bolts:
4 socket head screws M5x60 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



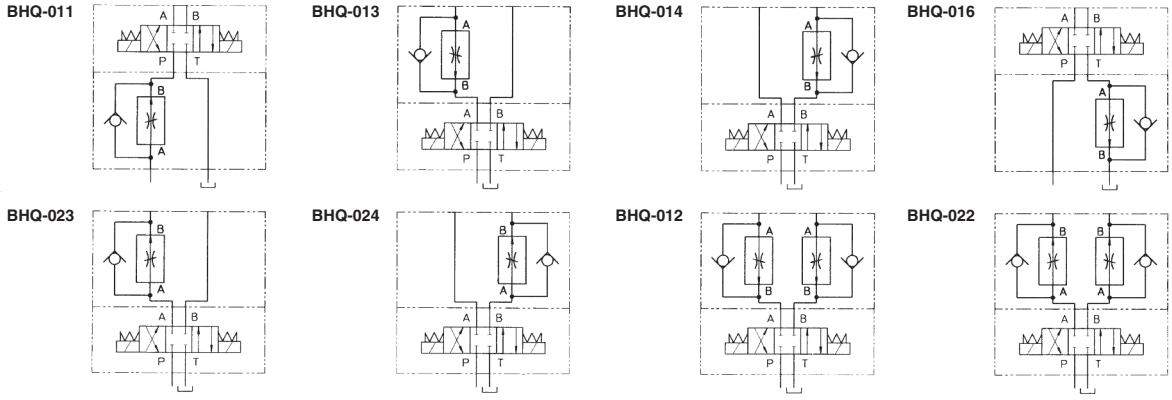
① = Flow control valve type QV-06
Note that the valve(s) is (are) mounted:
- on side port A for BHQ-011, BHQ-013, BHQ-016 and BHQ-023
- on side port B for BHQ-014 and BHQ-024
- on both sides for BHQ-012 and BHQ-022

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.



Available also version for phosphate ester (add /PE at the end of the model code).

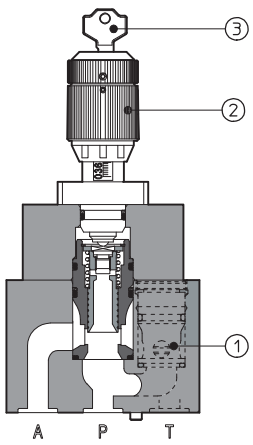
7 MOUNTING PLATES TYPE BA

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

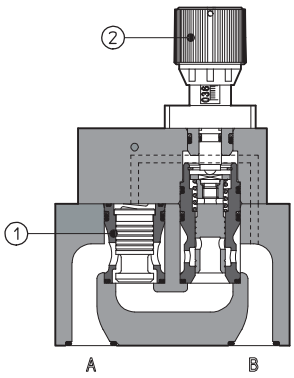
Flow control valves type QV-10, QV-20

pressure compensated, two or three way, ISO 6263 sizes 10 and 20

obsolete components - availability on request



QV-10/3/K



QV-20/2

QV are flow control valves with pressure compensator ① (the controlled flow rate is indipendent of pressure variations), designed to operate in oil hydraulic systems.

The two-way type are available with a built-in check valve to allow the free flow in the opposite direction.

The flow adjustment is done by turning a graduate micrometer knob ②.
Clockwise rotation increases the flow regulation.
Optional versions with locking key ③ on the adjustment knob are available on request.

QV-10 = ISO 6263 size 10 interface: max flow 60 l/min, max pressure 250 bar.

QV-20 = ISO 6263 size 20 interface: flow up to 180 l/min (three-way version), max pressure 250 bar.

1 MODEL CODE

QV	-	10	/	3	/K	**	/*

Pressure compensated flow control valve

Size:
10
20

2 = two-way valve
3 = three-way valve

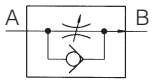
Options:
/K = with lock key for the setting knob only for two-way valves
/V = without by-pass check valve

Series number

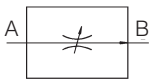
Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM

2 HYDRAULIC CHARACTERISTICS

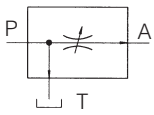
Hydraulic symbols



TWO-WAY VERSION



TWO-WAY VERSION WITHOUT CHECK VALVE



THREE-WAY VERSION

Valve model		QV-10/2	QV-10/2/V	QV-10/3	QV-20/2	QV-20/2/V	QV-20/3
Max regulated flow	[l/min]	65	60		130	160	180
Min regulated flow	[cm³/min]	120			120		
Max flow B → A through check valve (2-way versions)	[l/min]	80	–	–	160	–	–
Regulating Δp	[bar]	≥ 6		6	≥ 7		8
Max flow on port P (only 3-way versions)	[l/min]	–	–	60	–	–	180
Max pressure	[bar]	250			250		

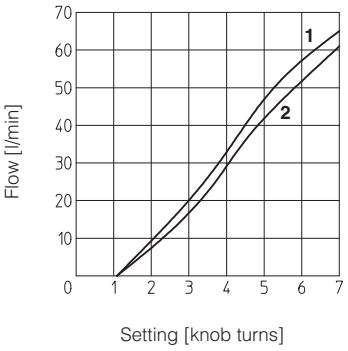
3 MAIN CHARACTERISTICS OF FLOW CONTROL VALVES TYPE QV-10 AND QV-20

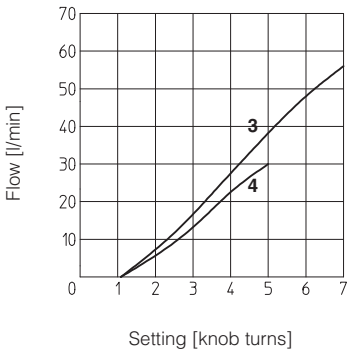
Assembly position	Any position
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	-20°C to + 70°
Fluid	Hydraulic oil as per DIN 51524...535, for other fluids see section 1
Recommended viscosity	15 ÷ 100 mm²/s at 40°C (ISO VG 15 ÷ 100)
Fluid contamination class	ISO 4401 class 21/19/16 NAS 1638 class 10 (filters at 25 μm value with $\beta_{25} \geq 75$ recommended)
Fluid temperature	-20°C +60°C (standard seals and water glycol) -20°C +80°C (/PE seals)

4 DIAGRAMS OF QV-10 based on mineral oil ISO VG 46 at 50°C

4.1 Regulation diagram

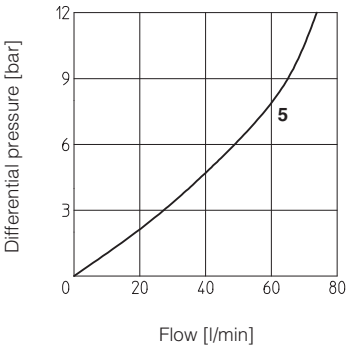
1 = QV-10/2
2 = QV-10/2/V
3 = QV-10/3 with 60 l/min of inlet flow
4 = QV-10/3 with 30 l/min of inlet flow





4.2 Q/Δp diagram through the check valve for free flow B → A (two-way valve)

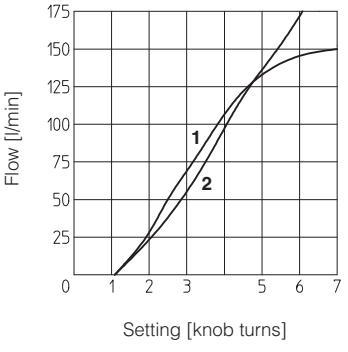
5 = QV-10/2

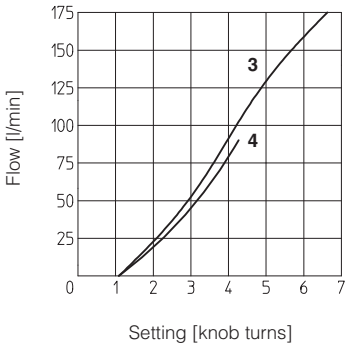


5 DIAGRAMS OF QV-20 based on mineral oil ISO VG 46 at 50°C

5.1 Regulation diagram

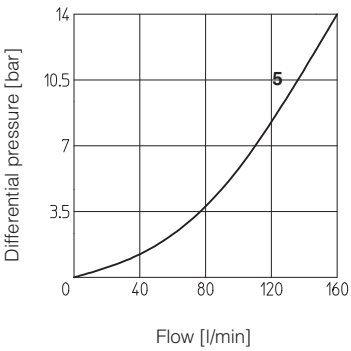
1 = QV-20/2
2 = QV-20/2/V
3 = QV-20/3 with 180 l/min of inlet flow
4 = QV-20/3 with 90 l/min of inlet flow



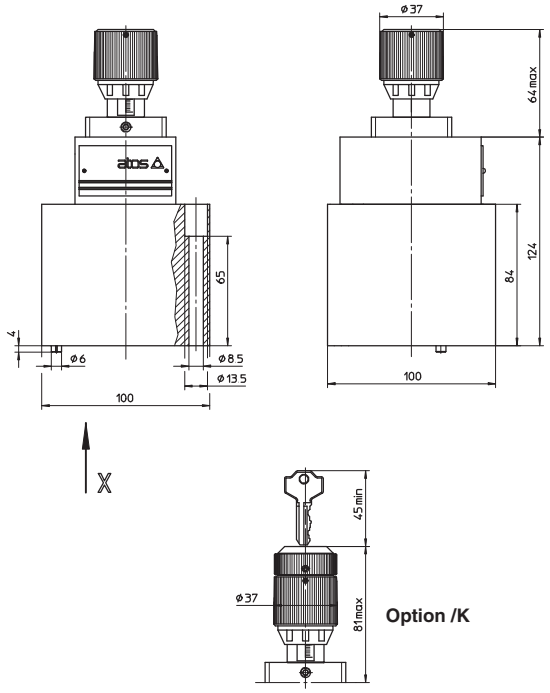


5.2 Q/Δp diagram through the check valve for free flow B → A (two-way valve)

5 = QV-20/2

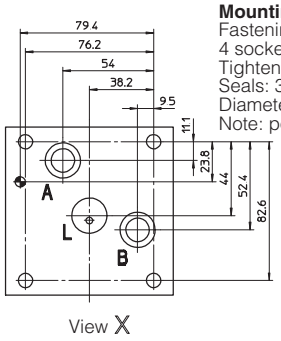


6 DIMENSIONS OF QV-10 [mm]



Option /K

2-WAY VERSION

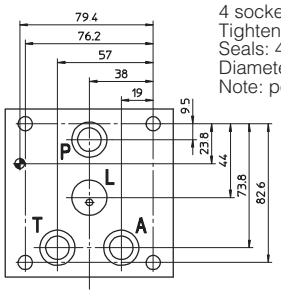


View X

ISO 6263: 1997
Mounting surface: 6263-06-05-0-97
Fastening bolts:
4 socket headscrews M8x80 class 12.9
Tightening torque = 35 Nm
Seals: 3 OR 121
Diameter of ports A, B : Ø = 14 mm
Note: port L is not used

Mass: 7,3 Kg

3-WAY VERSION

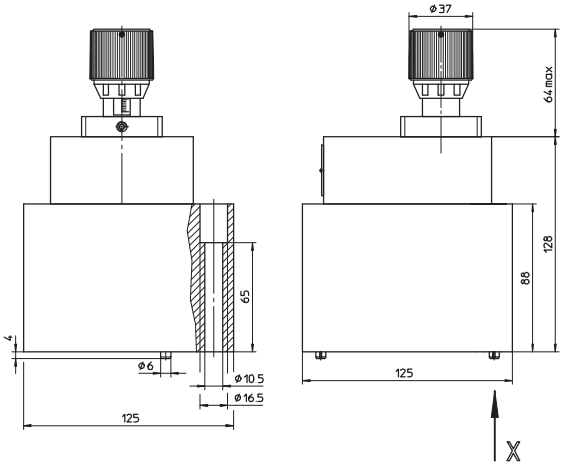


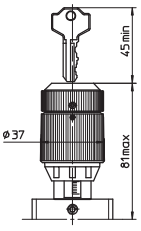
View X

ISO 6263: 1997
Mounting surface: 6263-06-07-0-97
Fastening bolts:
4 socket head screws M8x80 class 12.9
Tightening torque = 35 Nm
Seals: 4 OR 121
Diameter of ports A, P, T: Ø = 14 mm
Note: port L is not used

Mass: 7,3 Kg

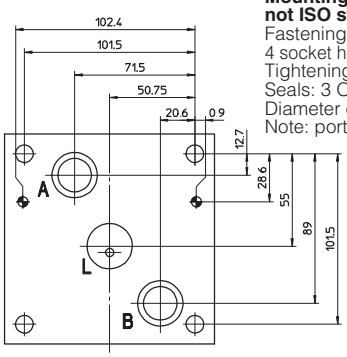
7 DIMENSIONS OF QV-20 [mm]





Option /K

2-WAY VERSION

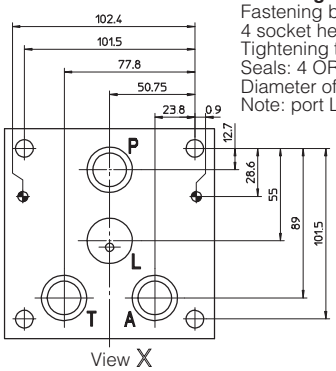


View X

Mounting surface
not ISO standard
Fastening bolts:
4 socket head screws M10x80 class 12.9
Tightening torque = 70 Nm
Seals: 3 OR 130
Diameter of ports A, B: Ø = 20 mm
Note: port L is not used

Mass: 11,9 Kg

3-WAY VERSION



View X

ISO 6263: 1997
Mounting surface: 6263-07-11-0-97
Fastening bolts:
4 socket head screws M10x80 class 12.9
Tightening torque = 70 Nm
Seals: 4 OR 130
Diameter of ports A, P, T: Ø = 20 mm
Note: port L is not used

Mass: 11,9 Kg

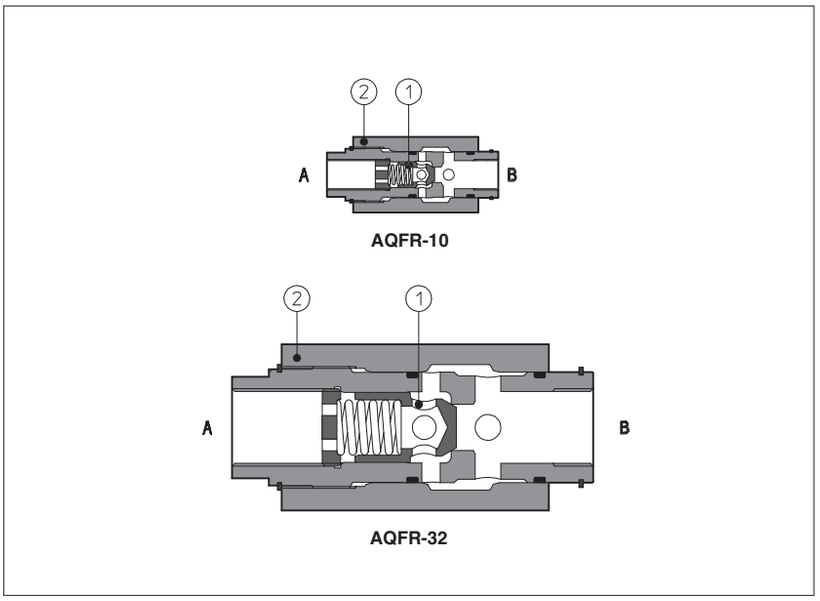
8 MOUNTING SUBPLATES

Valve	Subplate model	Port location	Ports A, B, P, T	Ø Counterbore [mm] A, B, P, T	Mass [Kg]
QV-10/2	BA-320	Ports A, B, underneath;	G 1/2"	30	4,2
QV-10/3	BA-322	Ports A, P, T, underneath;	G 1/2"	30	3,9
QV-20/2	BA-520	Ports A,B, underneath;	G 1"	46	5,5
QV-20/3	BA-522	Ports A, P, T, underneath;	G 1"	46	5,2

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

Flow restrictor valves type AQFR

in-line mounting - from G 3/8" to G 1¹/₄" threaded ports



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 throtting (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 pressure: **350 bar**

1 MODEL CODE

AQF	R	-	10	**	/	*

Throtting valve in-line mounting

R = with check valve for free reverse flow

Size and ports dimensions:

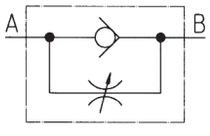
10 = G 3/8" **15** = G 1/2" **20** = G 3/4" **25** = G 1" **32** = G 1 ¹/4"

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

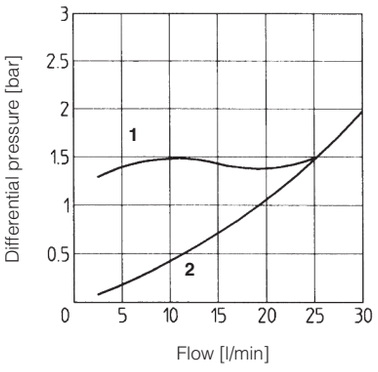
Assembly position	Any position
Ambient temperature	Standard execution = -30°C ÷ +70°C; /PE option = -20°C ÷ +70°C; /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR 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)

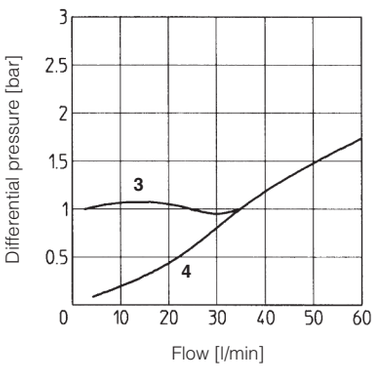
Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

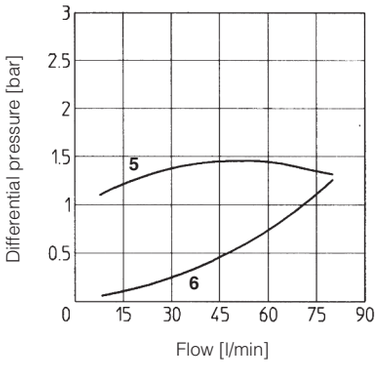
4 DIAGRAMS based on mineral oil ISO VG 46 at 50°C

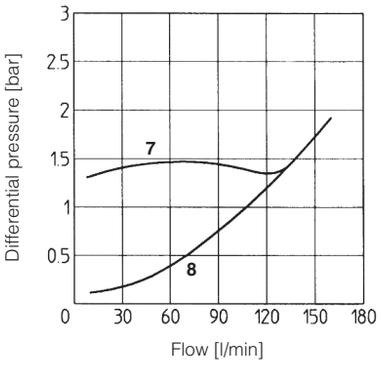
4.1 Q/Δp diagram through the chec valve for free flow B→A with the throttle valve fully open and fully closed

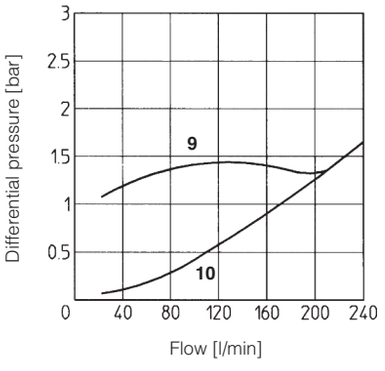
1 = AQFR-10 fully closed
2 = AQFR-10 fully open
3 = AQFR-15 fully closed
4 = AQFR-15 fully open
5 = AQFR-20 fully closed
6 = AQFR-20 fully open
7 = AQFR-25 fully closed
8 = AQFR-25 fully open
9 = AQFR-32 fully closed
10 = AQFR-32 fully open



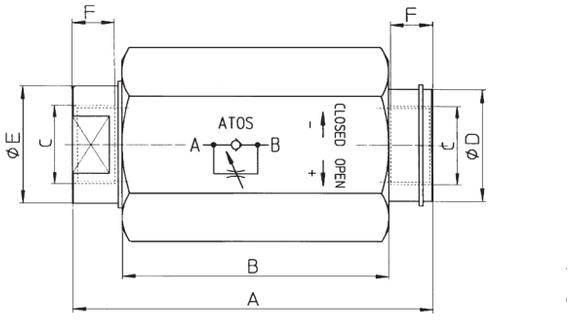


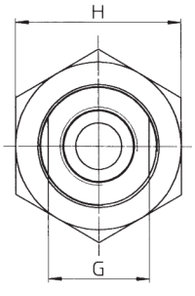






5 DIMENSIONS [mm]

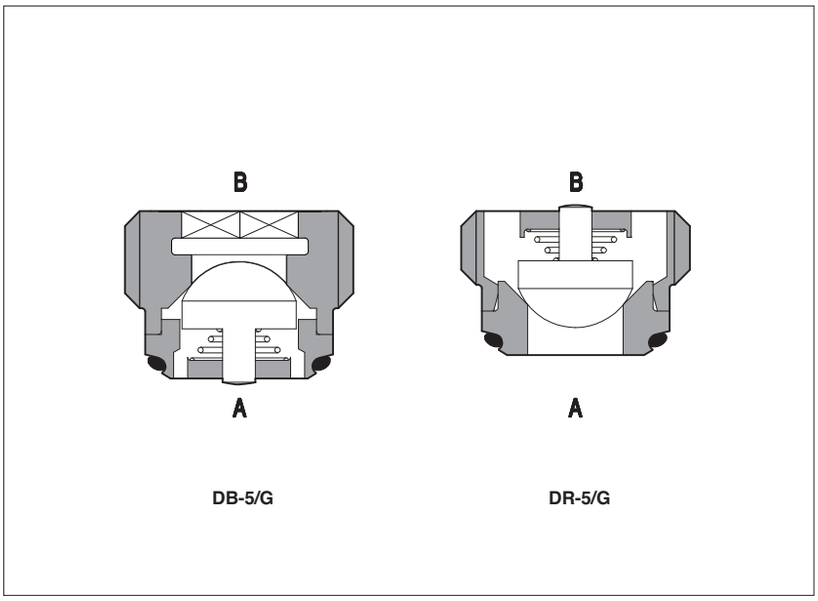




Valve model	A	B	C	ØD	ØE	F	G	H	Mass [Kg]
AQFR-10	93	68	G 3/8"	28	25	13	24	41	0,7
AQFR-15	105	78	G 1/2"	32	30	15	27	46	1
AQFR-20	127	95,5	G 3/4"	36	34	17	32	55	1,6
AQFR-25	153	112	G 1"	48	45	19	42	75	3,5
AQFR-32	196	145	G 1 1/4"	63	60	21	55	90	6,5

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

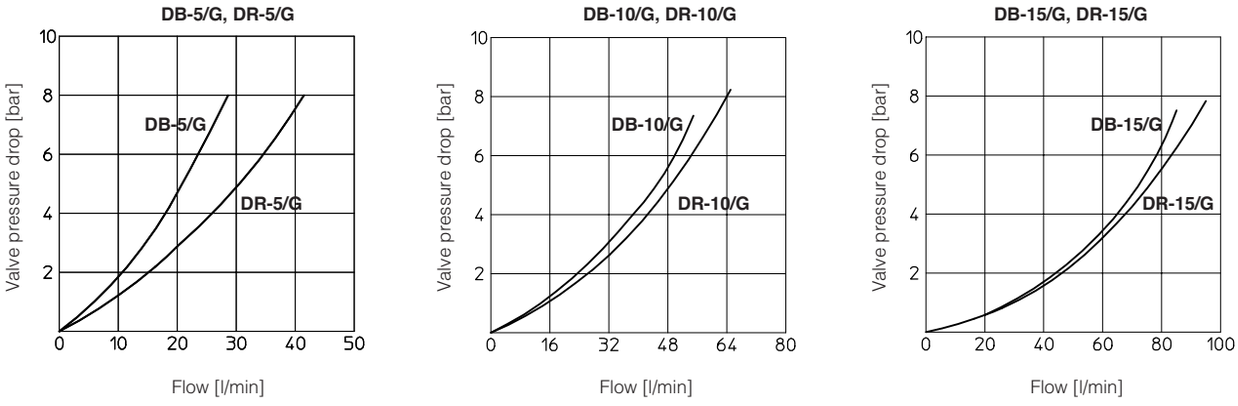
Hydraulic symbol		**DB-*/G** 			**DR-*/G** 		
Valve model		**DB-5/G**	**DR-5/G**	**DB-10/G**	**DR-10/G**	**DB-15/G**	**DR-15/G**
Nominal flow (at Δp = 8 bar)	[l/min]	25	35	55	65	85	95
Max pressure	[bar]	350					
Cracking pressure	[bar]	0,3					

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

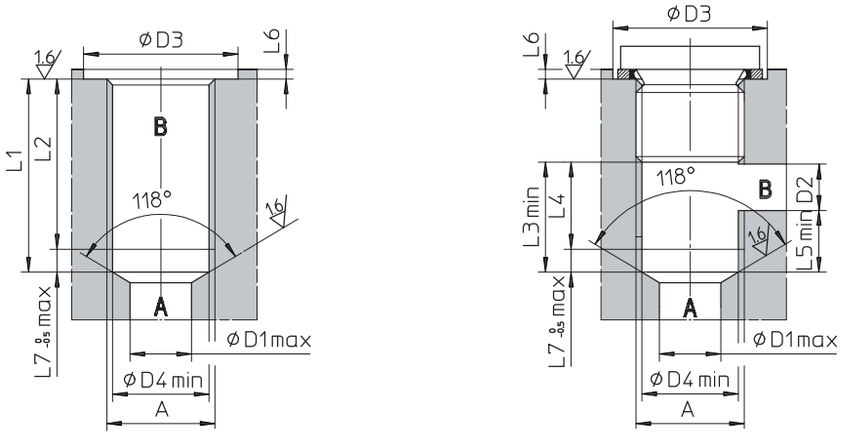
Assembly position	Any position
Ambient temperature	Standard execution = -30°C ÷ +70°C; /PE option = -20°C ÷ +70°C ; /BT option = -40°C ÷ +70°C
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR 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)
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

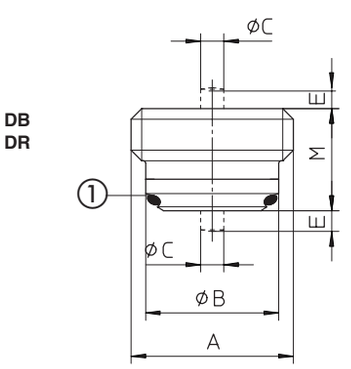


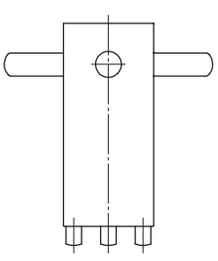
5 RECESS DIMENSIONS [mm]



	A	D1	D2	D3	D4	L1	L2	L3	L4	L5	L6	L7
DB-5/G	G 1/4”	8	6	22	11,6	22	19	14	11	8	1,5	3
DR-5/G												
DB-10/G	G 3/8”	9	8	26	15	24	21	17	14	9	1,5	3
DR-10/G												
DB-15/G	G 1/2”	12	12	30	18,75	28	24,5	22	18,5	10	1,5	3,5
DR-15/G												

6 VALVE DIMENSIONS [mm]





***-DRG-205000**

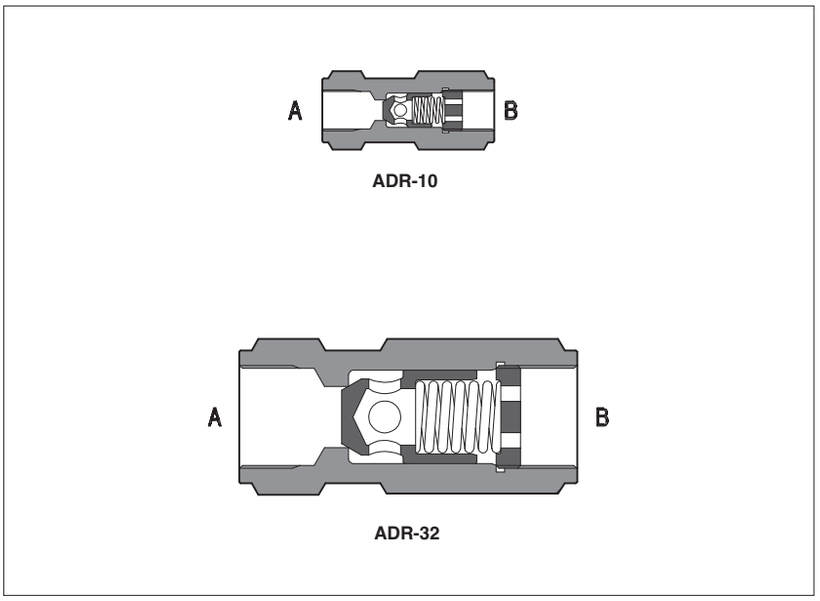
Note: this special key is required for assembling the valve in the cavity

	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 are direct operated check valves for in-line mounting available with port size from 1/4" to 1¼" 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**		******
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

2 HYDRAULIC CHARACTERISTICS

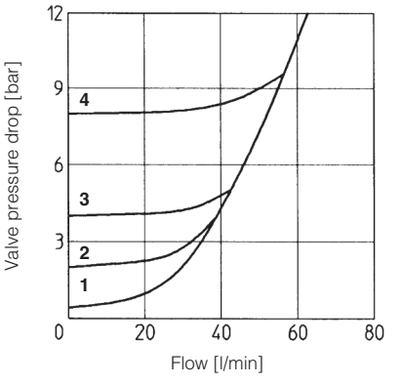
Hydraulic symbol						
Valve model	**ADR-06**	**ADR-10**	**ADR-15**	**ADR-20**	**ADR-25**	**ADR-32**
Max recommended flow [l/min]	40	80	150	300	360	500
Max pressure [bar]	400		350			

3 MAIN CHARACTERISTICS OF CHECK VALVES TYPE ADR

Assembly position / location	Any position
Fluid	Hydraulic oil as per DIN 51524 ... 535;
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)
Fluid temperature	T ≤ 80°C
Flow direction	As shown in the symbol at section 2
Rated flow	See diagrams Q/Δp at section 4

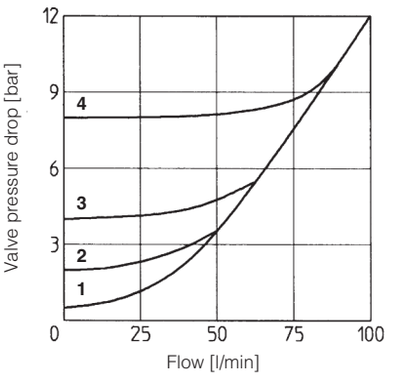
4 FLOW VERSUS PRESSURE DROP DIAGRAMS Based on based on mineral oil ISO VG 46 at 50°C

ADR-06



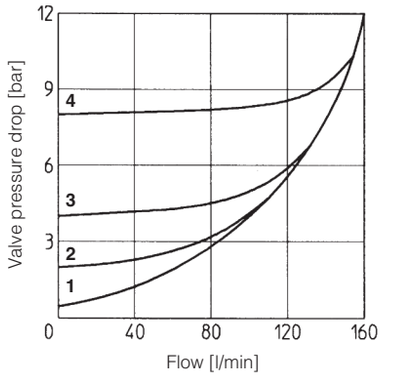
1 = ADR-06
2 = ADR-06/2
3 = ADR-06/4
4 = ADR-06/8

ADR-10



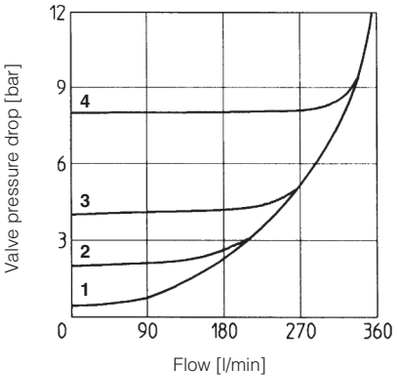
1 = ADR-10
2 = ADR-10/2
3 = ADR-10/4
4 = ADR-10/8

ADR-15



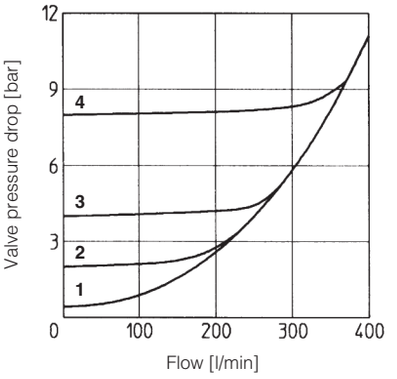
1 = ADR-15
2 = ADR-15/2
3 = ADR-15/4
4 = ADR-15/8

ADR-20



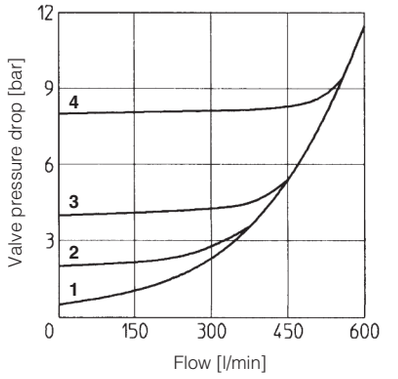
1 = ADR-20
2 = ADR-20/2
3 = ADR-20/4
4 = ADR-20/8

ADR-25



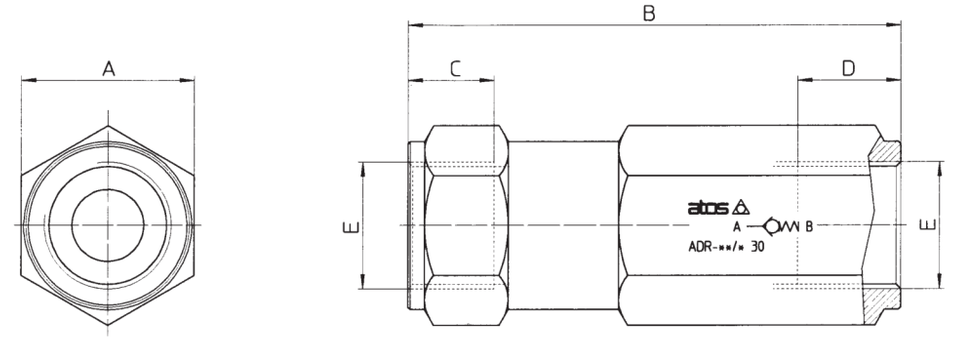
1 = ADR-25
2 = ADR-25/2
3 = ADR-25/4
4 = ADR-25/8

ADR-32



1 = ADR-32
2 = ADR-32/2
3 = ADR-32/4
4 = ADR-32/8

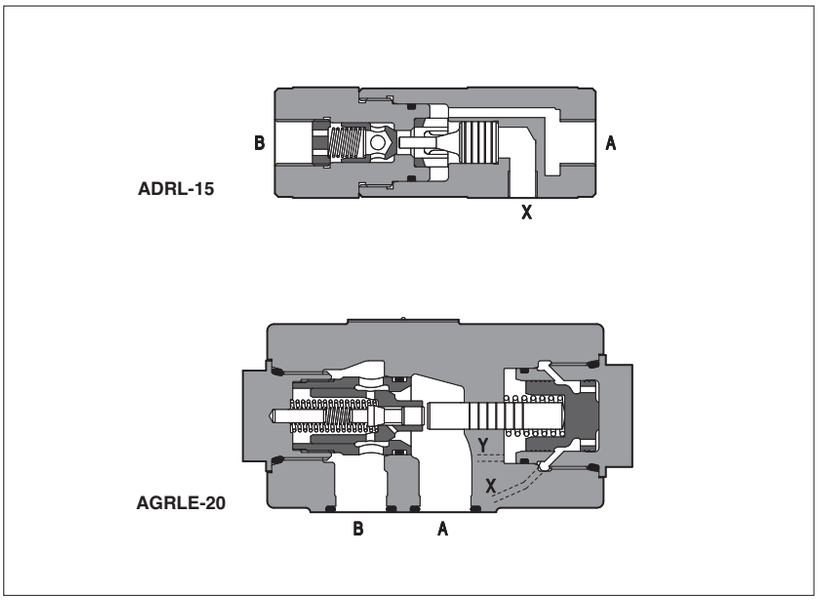
5 DIMENSIONS [mm]



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 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

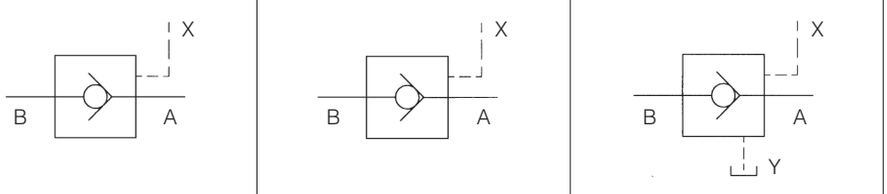
for ADRL	for AGRL
- = 0,5 bar	**-** = 0,5 bar
2 = 2 bar	
4 = 4 bar	
8 = 8 bar	

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					

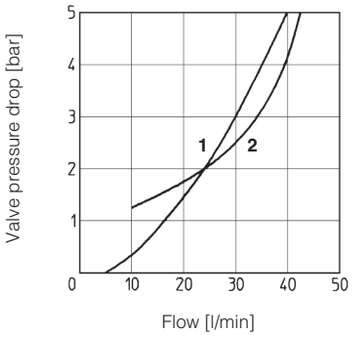
(1) Applying the pilot pressure through the pilot port X, the pilot spool opens the check valve, allowing free flow B→A.
The minimum pilot pressure for correct operation depends on the pilot ratio indicated in the table and on the pressure closing the check. i.e.: the pilot pressure for ADRL-20 is the pressure on the check divided by 2,5. The valves AGRL-* and AGRLE-*, are equipped with a decompression system.

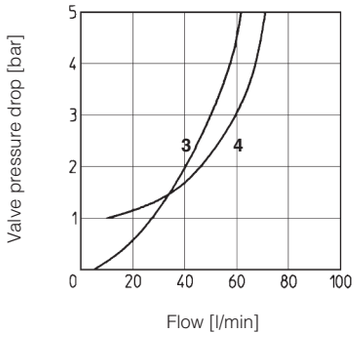
3 MAIN CHARACTERISTICS, SEALS AND FLUIDS - for other fluids not included in below table, consult our technical office

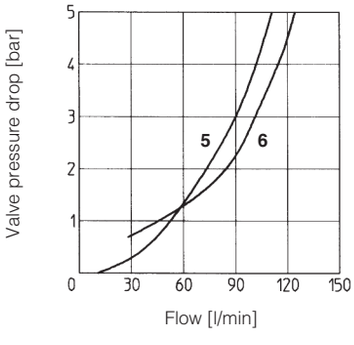
Assembly position	Any position. For AGRLE valves, the drain port Y has to be connected directly to the tank without counter pressure		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -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)		
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	

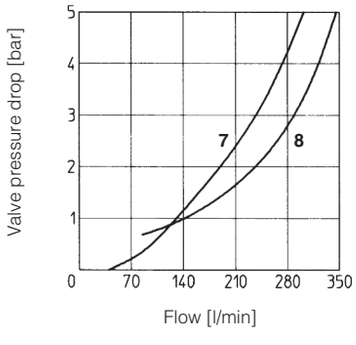
4 FLOW VERSUS PRESSURE DROP DIAGRAMS FOR ADRL based on mineral oil ISO VG 46 at 50°C

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



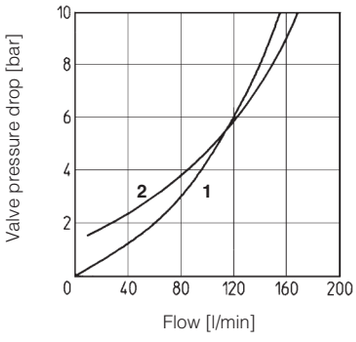


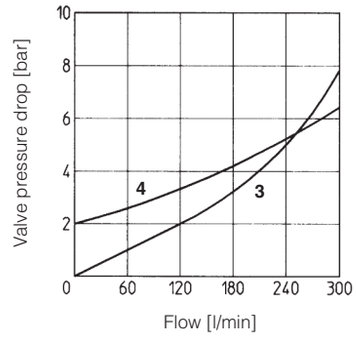


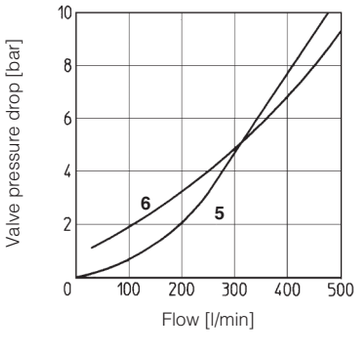


5 FLOW VERSUS PRESSURE DROP DIAGRAMS FOR AGRL AND AGRLE based on mineral oil ISO VG 46 at 50°C

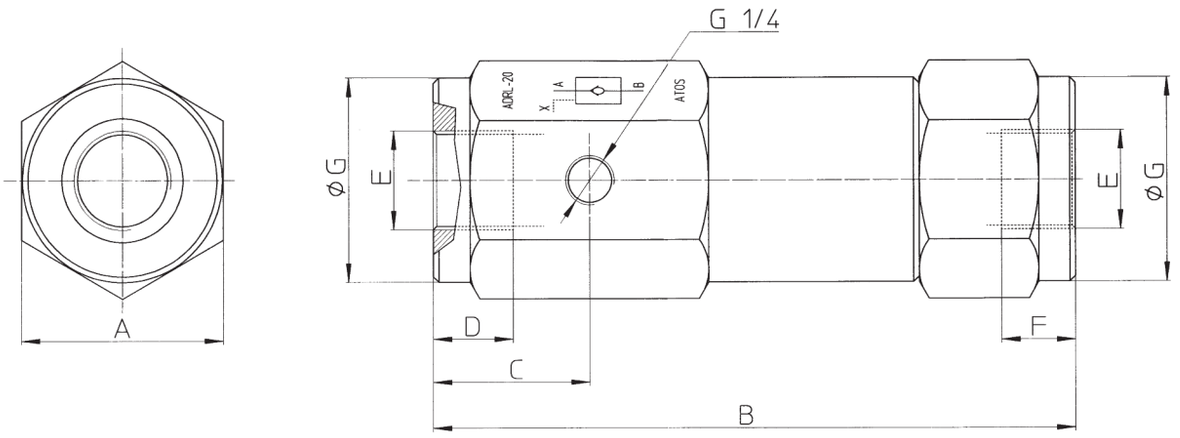
1 = **AGRL-10, AGRLE-10** B→A
2 = **AGRL-10, AGRLE-10** A→B
3 = **AGRL-20, AGRLE-20** B→A
4 = **AGRL-20, AGRLE-20** A→B
5 = **AGRL-32, AGRLE-32** B→A
6 = **AGRL-32, AGRLE-32** A→B







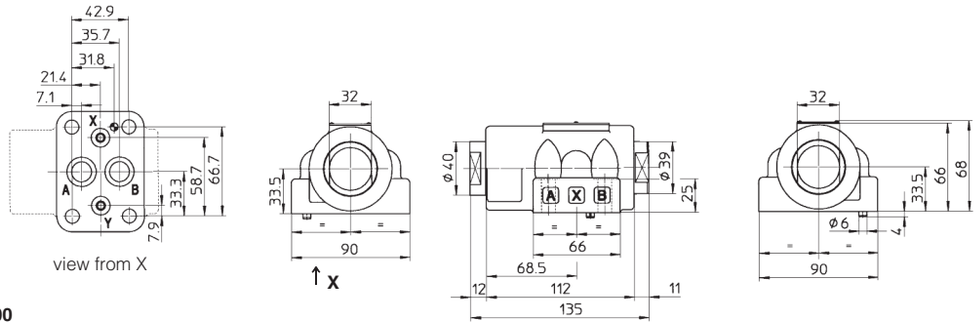
6 DIMENSIONS FOR ADRL VALVES [mm]



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]

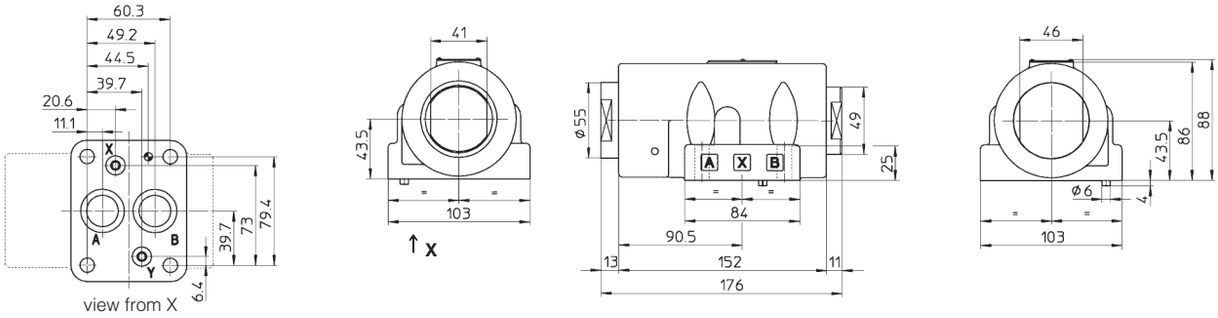
AGRL-10
AGRLE-10



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

Mass: 4 Kg

AGRL-20
AGRLE-20

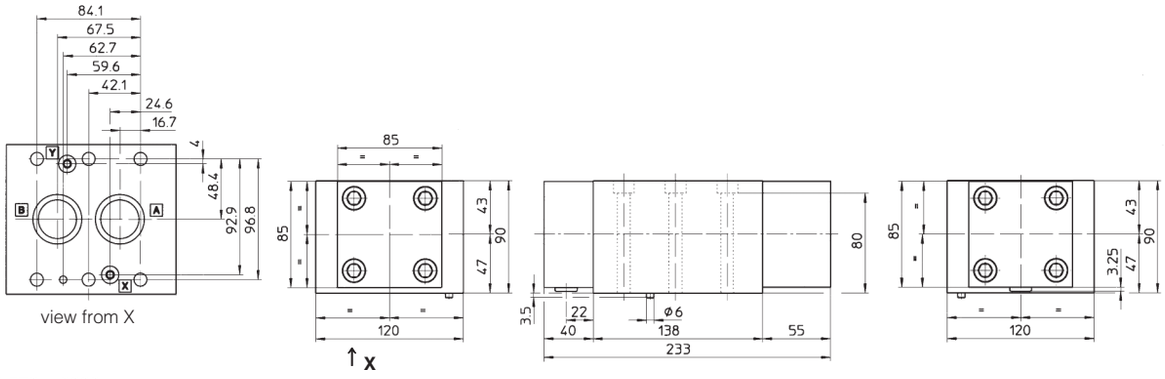


ISO 5781: 2000
Mounting surface: 5781-08-10-0-00
Fastening bolts: 4 socket head screws M10x45 class 12.9
Tightening torque = 70 Nm
Seals: 2 OR 4100; 2 OR 109/70
Ports A, B: Ø = 23 mm
Ports X, Y: Ø = 5 mm

Mass: 7 Kg

7 DIMENSIONS FOR AGRL AND AGRLE VALVES [mm]

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 4131; 2 OR 109/70
Ports A, B: Ø = 30 mm
Ports X, Y: Ø = 5 mm

Mass: 14,8 Kg

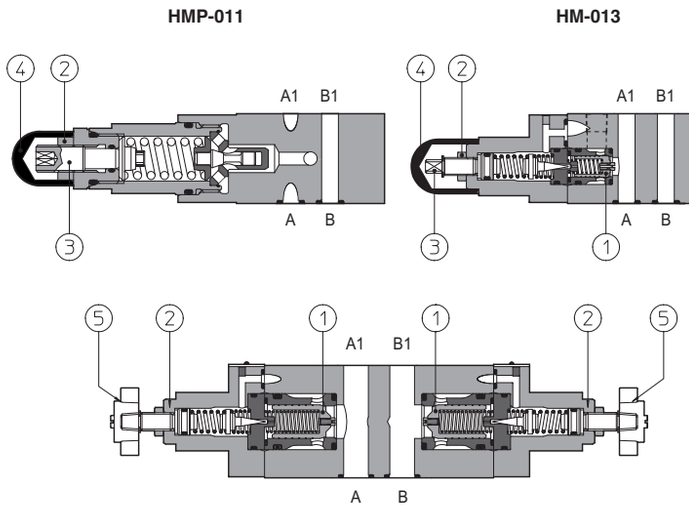
8 MOUNTING SUBPLATES FOR AGRL AND AGRLE VALVES

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 A		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.

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:	HM and KM:
50 = 2÷ 50 bar	**50** = 4÷ 50 bar
100 = 3÷100 bar	**100** = 5÷100 bar
210 = 10÷210 bar	**210** = 5÷210 bar
350 = 15÷350 bar	**350** = 5÷350 bar

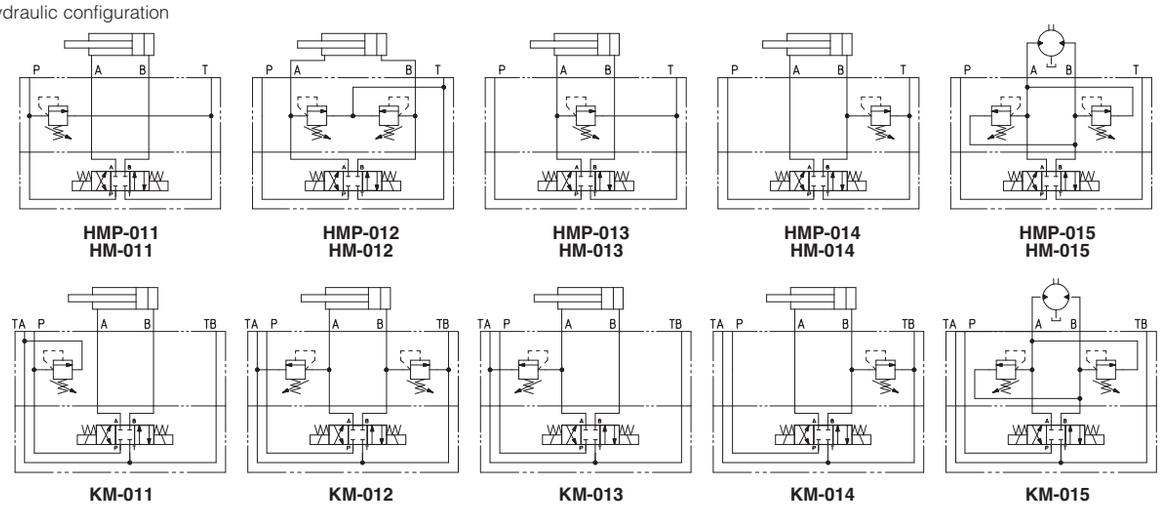
Options:
V = setting adjustment by handwheel instead of a grub screw protected by cap
Only for HMP:
R = reduced leakage for special applications
VF = regulating knob
VS = regulating knob with safety locking

Series number

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

2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration



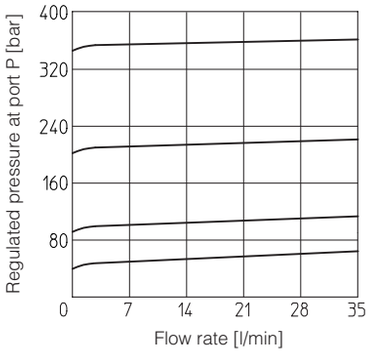
Valve model		HMP	HM	KM
Max flow	[l/min]	35	60	120
Pressure range	[bar]	2÷50; 3÷100; 10÷210; 15÷350	4÷50; 5÷100; 5÷210; 5÷350	

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

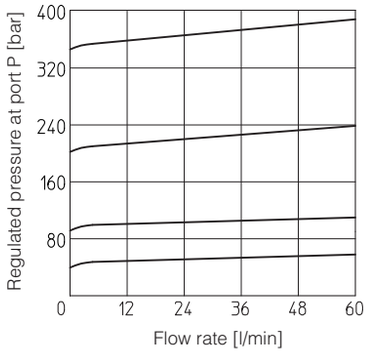
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +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	

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

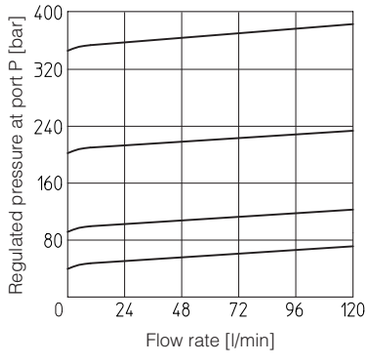
HMP



HM

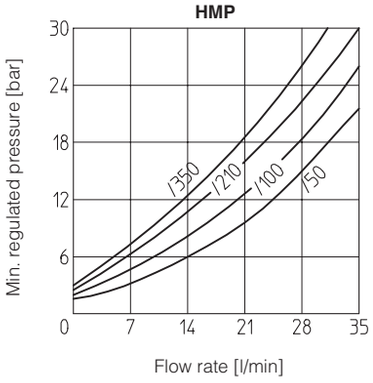


KM

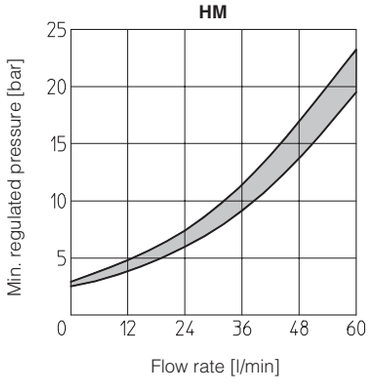


5 MINIMUM PRESSURE VERSUS FLOW DIAGRAMS (Based on fluid viscosity of 25 mm²/s at 40°C)

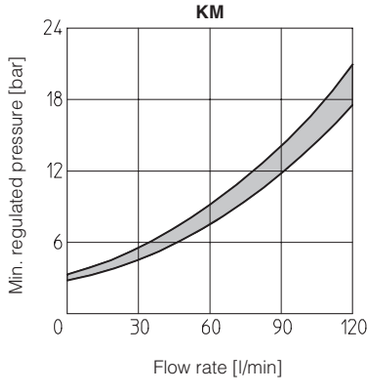
HMP



HM

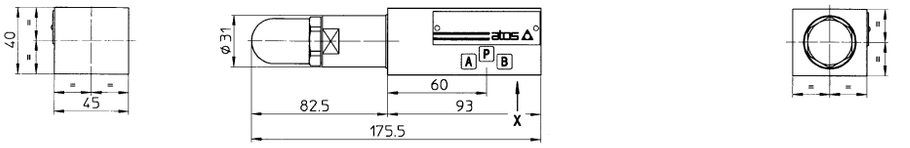


KM



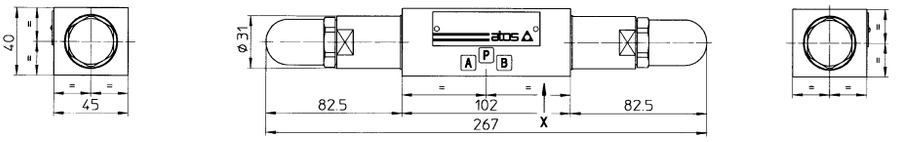
6 INSTALLATION DIMENSIONS OF HMP VALVES [mm]

HMP-011



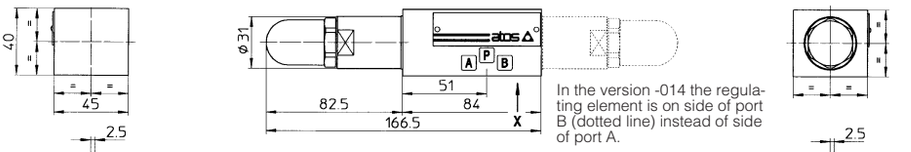
Mass: 1,4 Kg

HMP-012



Mass: 1,7 Kg

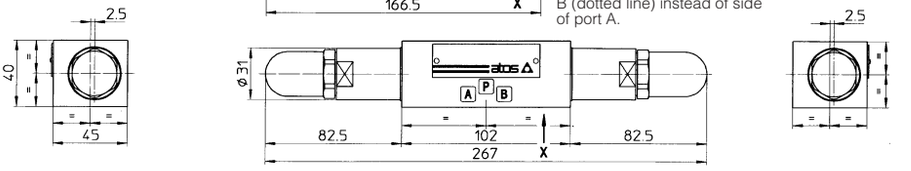
HMP-013
HMP-014



In the version -014 the regulating element is on side of port B (dotted line) instead of side of port A.

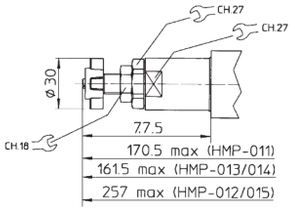
Mass: 1,2 Kg

HMP-015

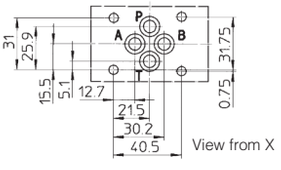


Mass: 1,7 Kg

Adjustment device for option /V

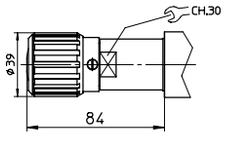


ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108



View from X

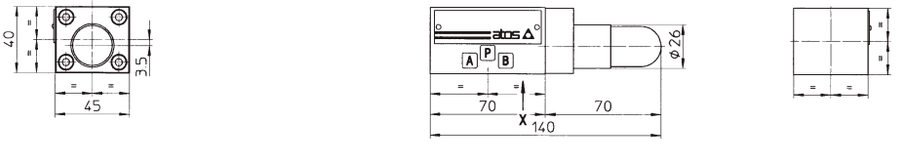
Adjustment device for option /VF and /VS



Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

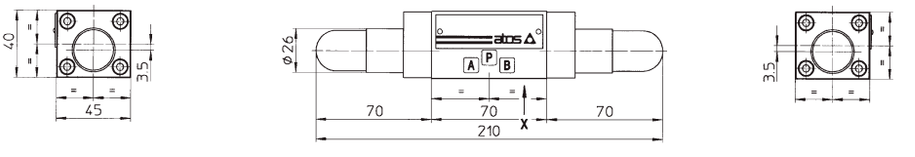
7 INSTALLATION DIMENSIONS OF HM VALVES [mm]

HM-011
HM-014



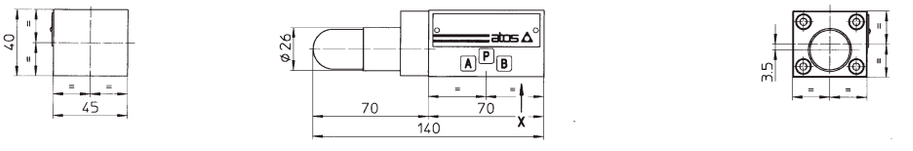
Mass: 1,1 Kg

HM-012
HM-015



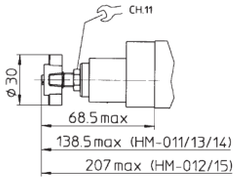
Mass: 1,3 Kg

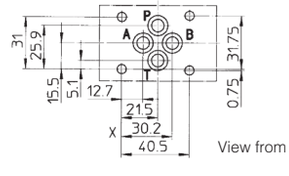
HM-013



Mass: 1,1 Kg

Adjustment device for option /V





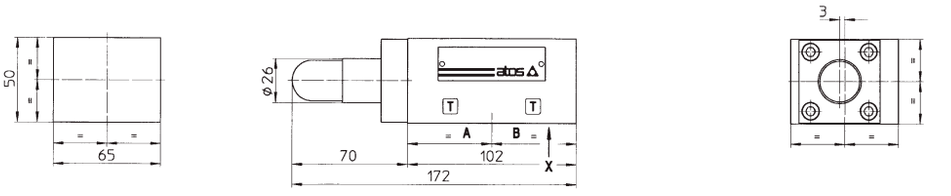
View from X

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.

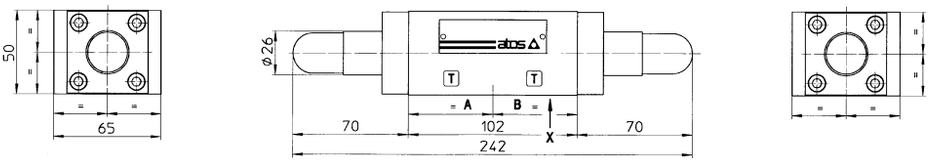
8 INSTALLATION DIMENSIONS OF KM VALVES [mm]

KM-011



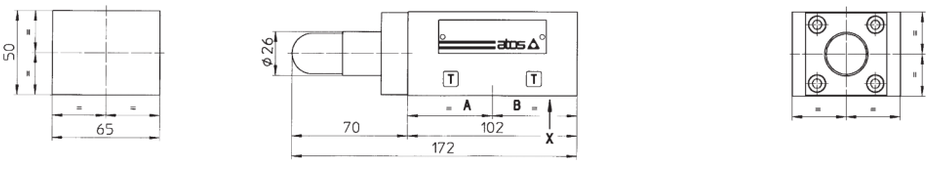
Mass: 2,5 Kg

KM-012



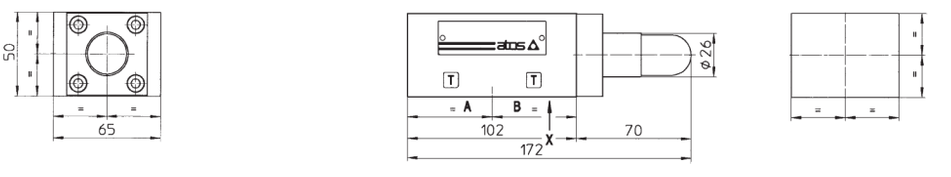
Mass: 2,8 Kg

KM-013



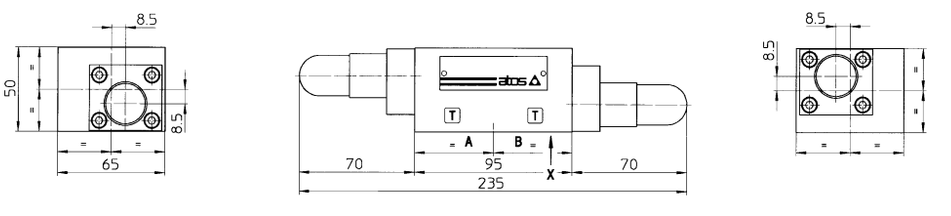
Mass: 2,5 Kg

KM-014



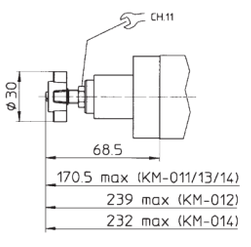
Mass: 2,5 Kg

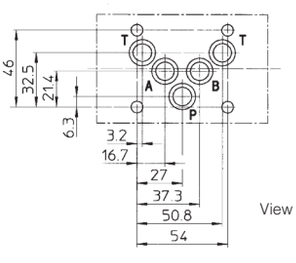
KM-015



Mass: 2,5 Kg

Adjustement device for option /V





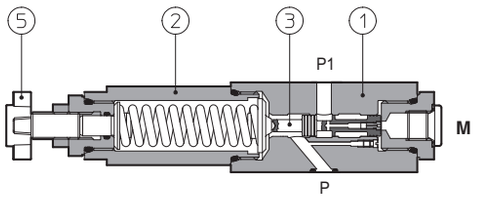
View from X

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

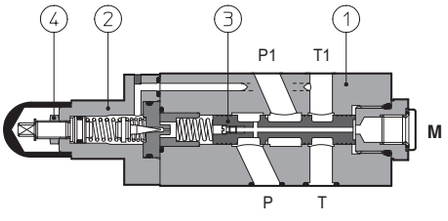
Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

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	**	/	*

HS Modular sequence valve, size:
HS = 06
KS = 10

011 Configuration, see section 2
011 = single, acting on port P, drain to port T

210 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

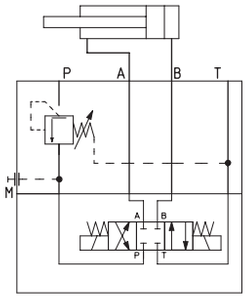
V Options:
V = setting adjustment by handwheel instead of a grub screw protected by cap
Only for HS:
VF = regulating knob
VS = regulating knob with safety locking

****** Series number

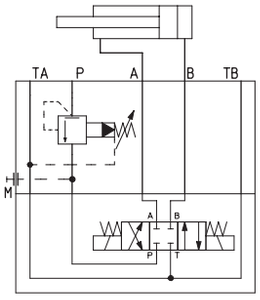
***** Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration



HS-011



KS-011

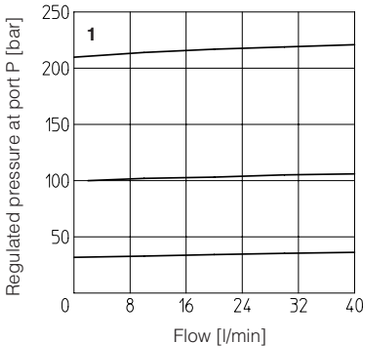
Valve model		HS-011/32	HS-011/100	HS-011/210	KS-011/100	KS-011/210
Max flow	[l/min]	40			80	
Max drain	[cm³/min]	50			50	
Pressure range	[bar]	3 - 32	20 - 100	50 - 210	7 - 100	8 - 210
Max inlet pressure	[bar]	350			315	
Max pressure on port T	[bar]	160			160	

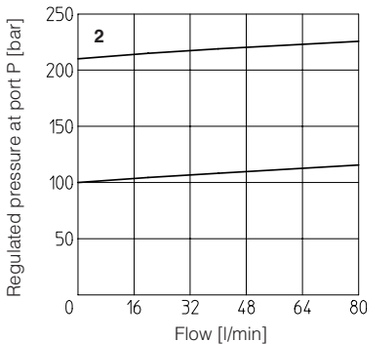
3 MAIN CHARACTERISTICS SEALS and HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
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	

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

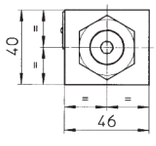
1 = HS
2 = KS

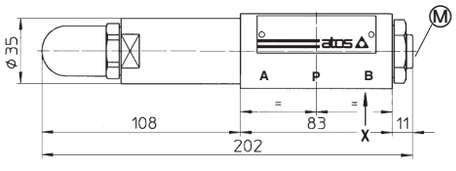


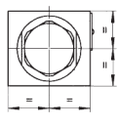


5 INSTALLATION DIMENSIONS [mm]

HS-011

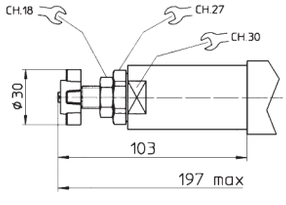




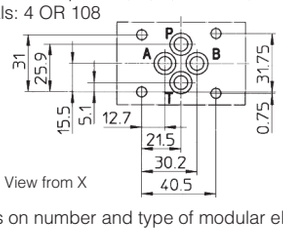


Ⓜ = Pressure gauge port = G 1/4"

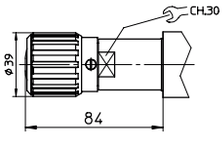
Adjustment device for option/V



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



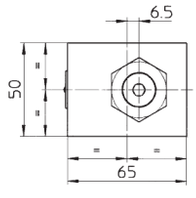
Adjustment device for option /VF and /VS

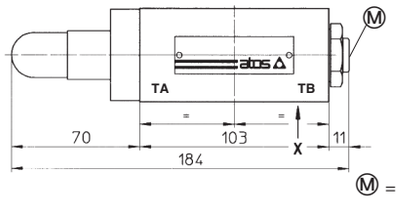


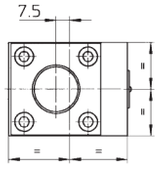
Fastening bolts: n°4 socket head screws M5. The lenght depends on number and type of modular elements associated.

Mass: 2 Kg

KS-011

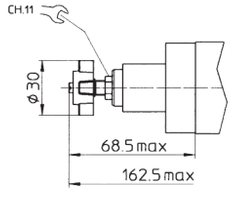


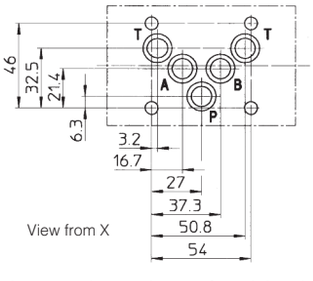




Ⓜ = Pressure gauge port = G 1/4"

Adjustment device for option/V





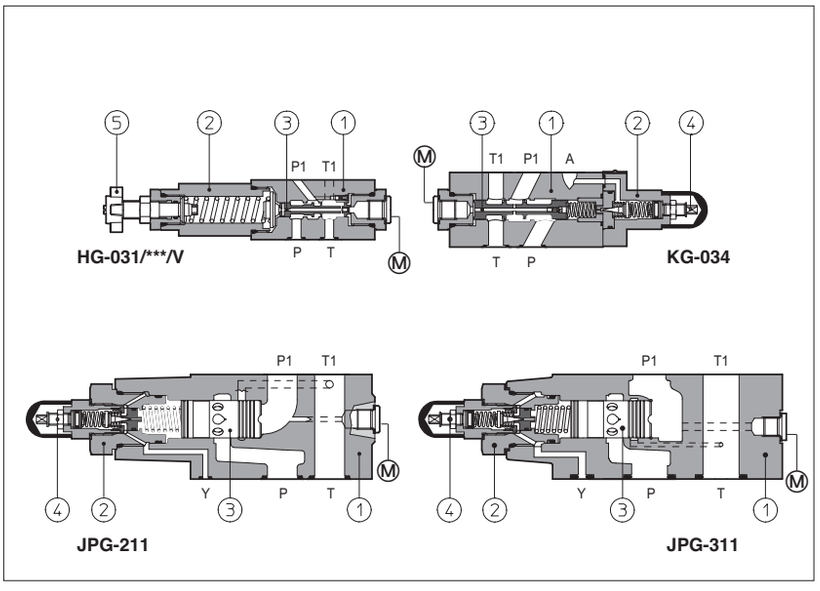
ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports A, B, P, T: Ø = 11,2 mm
Seals: 5 OR 2050

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	**	/	*

HG-0
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	**100** = 20 - 100 bar	**100** = 7 - 100 bar	**100** = 6 - 100 bar
50 = 2 - 50 bar	**210** = 50 - 210 bar	**210** = 8 - 210 bar	**210** = 70 - 210 bar
75 = 10 - 75 bar			

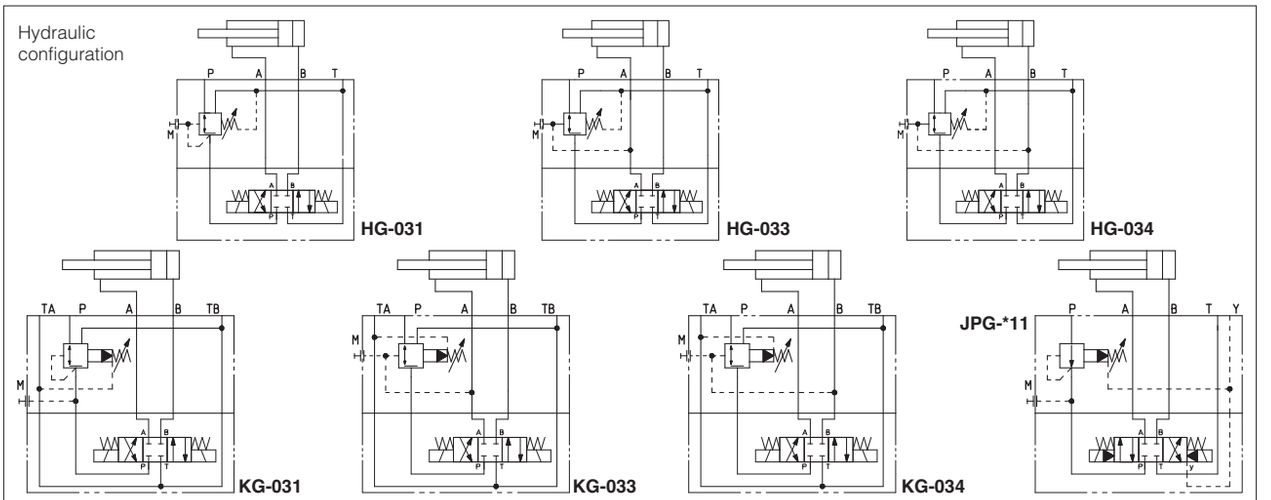
Series number

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

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

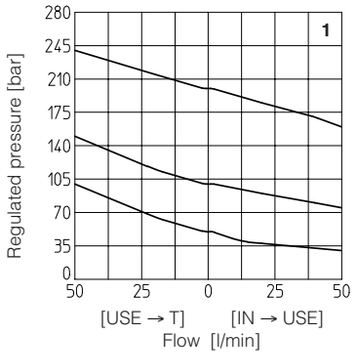
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +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	

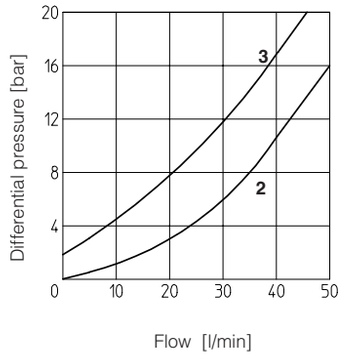
4 DIAGRAMS OF HG-03* based on mineral oil ISO VG 46 at 50°C

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



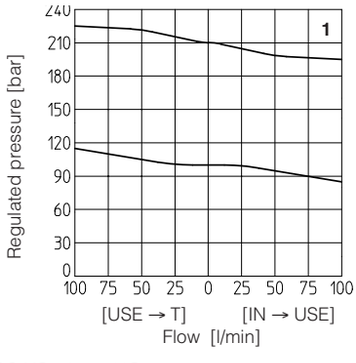


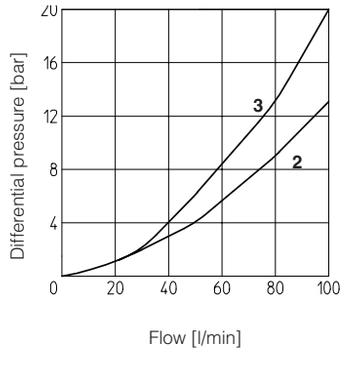
5 DIAGRAMS OF KG-03* based on mineral oil ISO VG 46 at 50°C

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

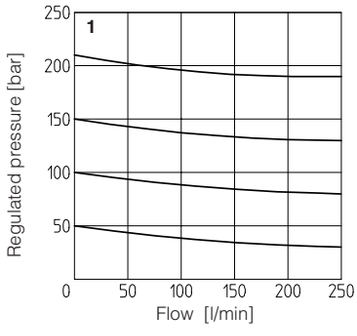


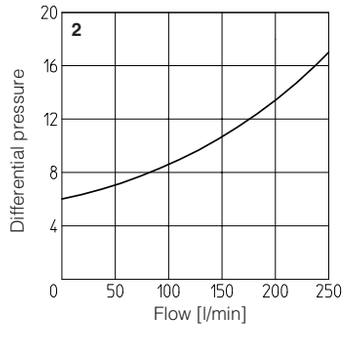


6 DIAGRAMS OF JPG-211 based on mineral oil ISO VG 46 at 50°C

1 = regulated pressure variation versus flow between inlet port and use port

2 = differential pressure variation versus flow between use port and discharge port

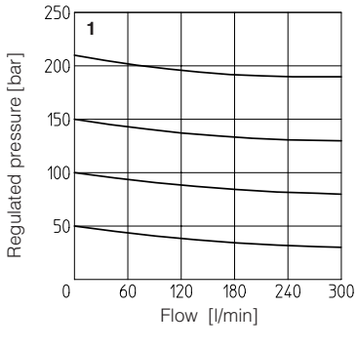


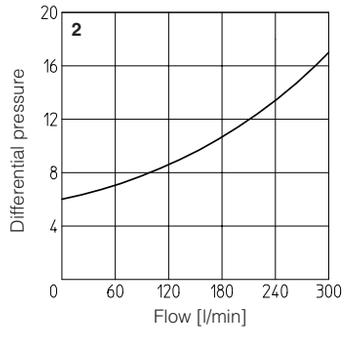


7 DIAGRAMS OF JPG-311 based on mineral oil ISO VG 46 at 50°C

1 = regulated pressure variation versus flow between inlet port and use port

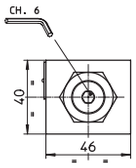
2 = differential pressure variation versus flow between use port and discharge port

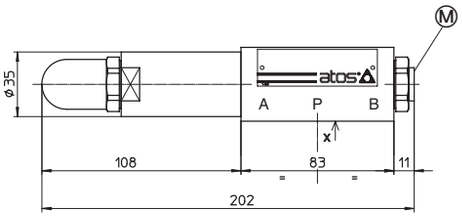


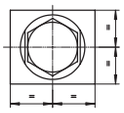


8 INSTALLATION DIMENSIONS OF HG-0 VALVES [mm]

HG-03*



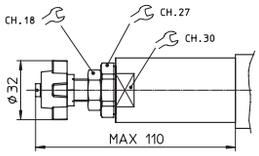




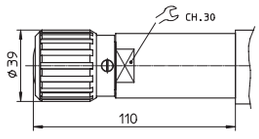
Ⓜ = Pressure gauge port = G 1/4"

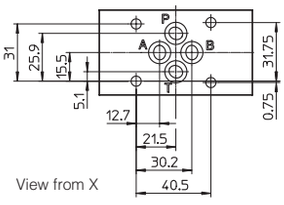
Mass: 2,3 Kg

Adjustment device for option /V



Adjustment device for option /VF and /VS



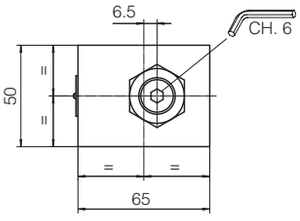


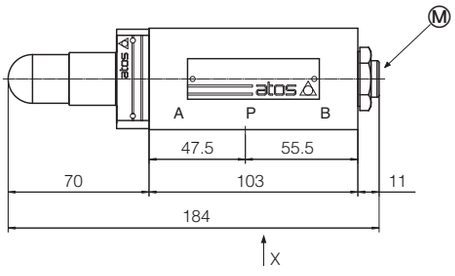
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm
Seals: 4 OR 108

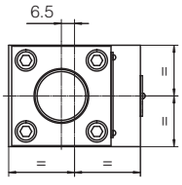
Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

9 INSTALLATION DIMENSIONS OF KG-0 VALVES [mm]

KG-03*



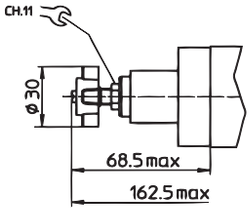


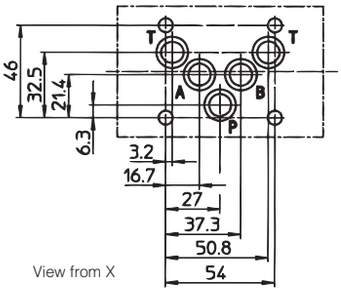


Ⓜ = Pressure gauge port = G 1/4"

Mass: 3,8 Kg

Adjustment device for option /V



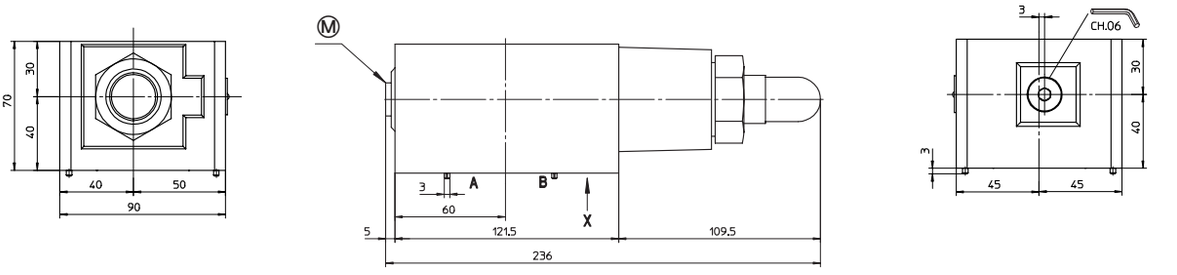


ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports A, B, P, T: Ø = 11,2 mm
Seals: 5 OR 2050

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]

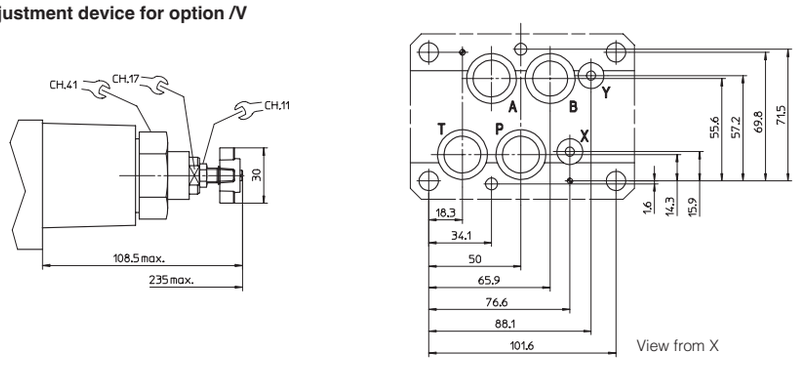
JPG-211



Ⓜ = Pressure gauge port = G 1/4"

Mass: 9 Kg

Adjustment device for option /V

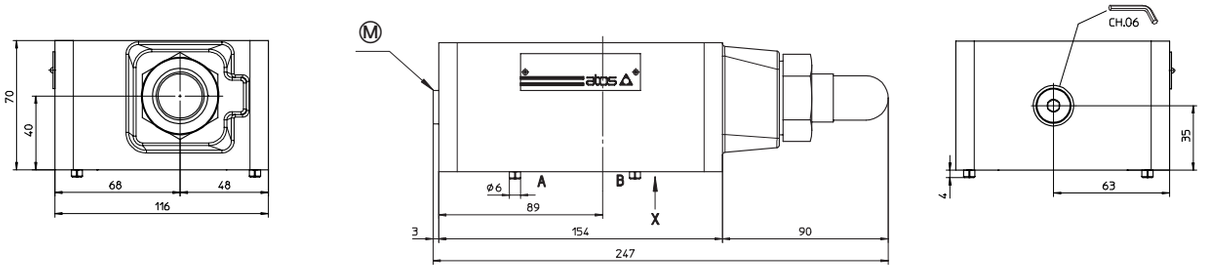


ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Diameter of ports A, B, P, T: Ø = 20 mm
Diameter of ports X, Y: Ø 7 mm
Seals: 4 OR 130: 2 OR 109

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]

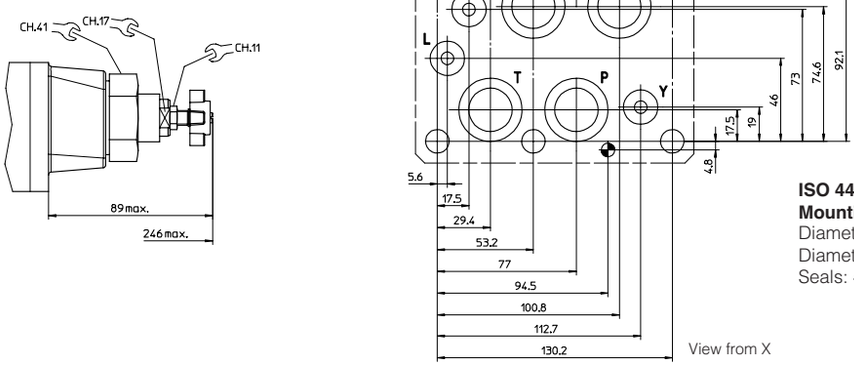
JPG-311



Ⓜ = Pressure gauge port = G 1/4"

Mass: 9 Kg

Adjustment device for option /V

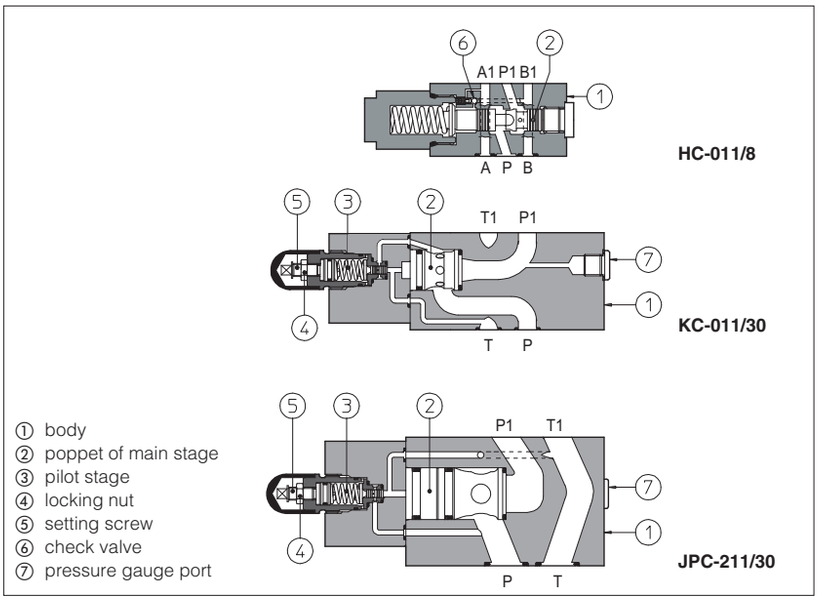


ISO 4401: 2005
Mounting surface: 4401-08-08-0-05
Diameter of ports A, B, P, T: Ø = 24 mm
Diameter of ports X, Y: Ø 7 mm
Seals: 4 OR 130: 2 OR 109

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	**	/	*

HC-0: Modular pressure compensator, size:
HC-0 = 06
KC-0 = 10
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

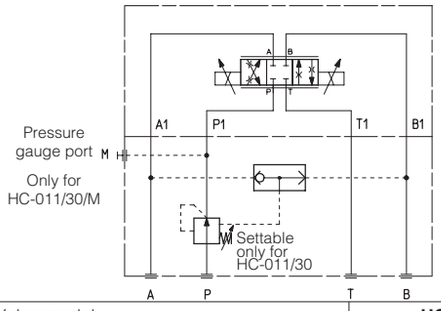
Series number

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

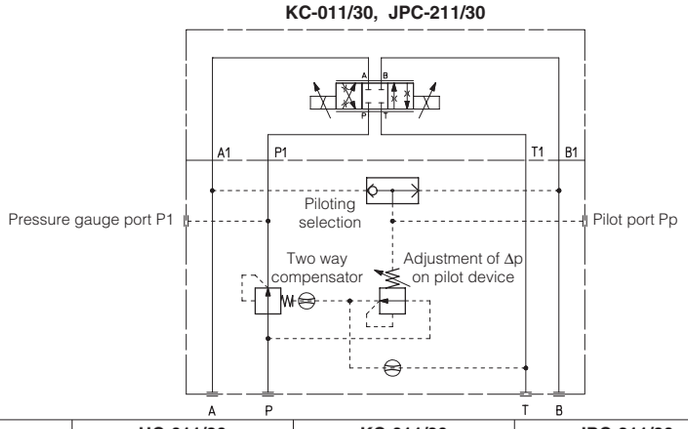
2 HYDRAULIC CHARACTERISTICS

Hydraulic configuration

HC-011/8, HC-011/30



KC-011/30, JPC-211/30



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	

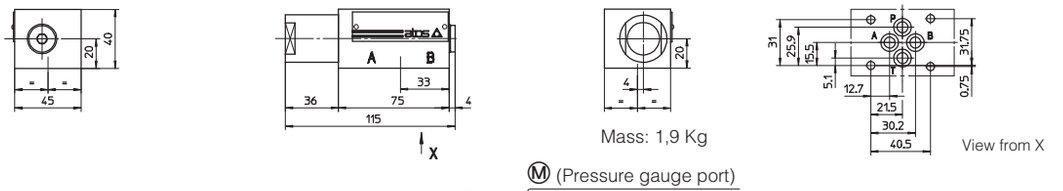
(1) The Δp for single flow path is fixed at 8 bar or is adjustable between 5 and 35 bar; it corresponds to values of total Δp across the valve of 16 bar or between 10 and 70 bar. Threaded plugged ports Pp and P1 are suitable for pressure adjustment or check of Δp value for single flow path (reading difference between Pp and P1 values).

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

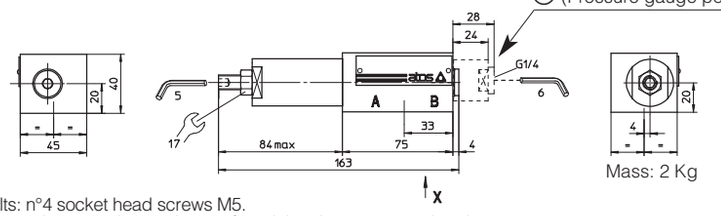
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -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	

4 INSTALLATION DIMENSIONS [mm]

HC-011/8



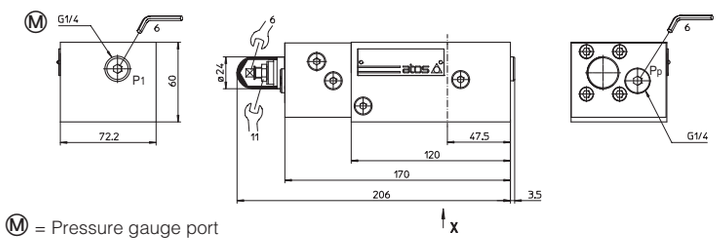
HC-011/30

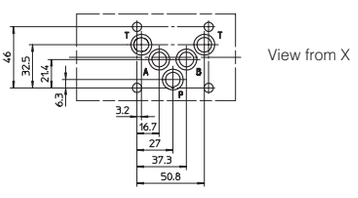


Fastening bolts: n°4 socket head screws M5.
The lenght depends on number and type of modular elements associated.

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

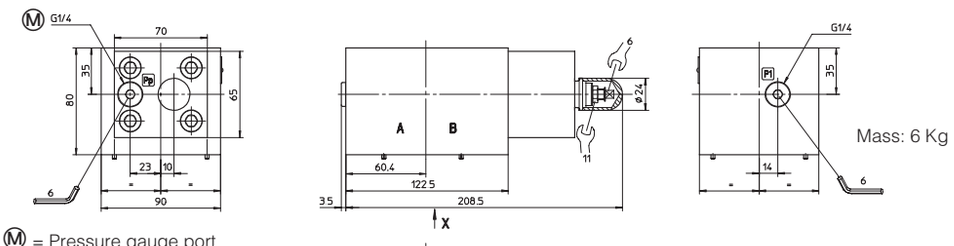


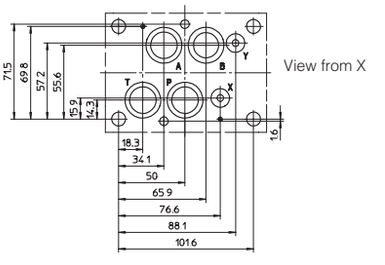


Fastening bolts: n°4 socket head screws M6.
The lenght depends on number and type of modular elements associated.

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



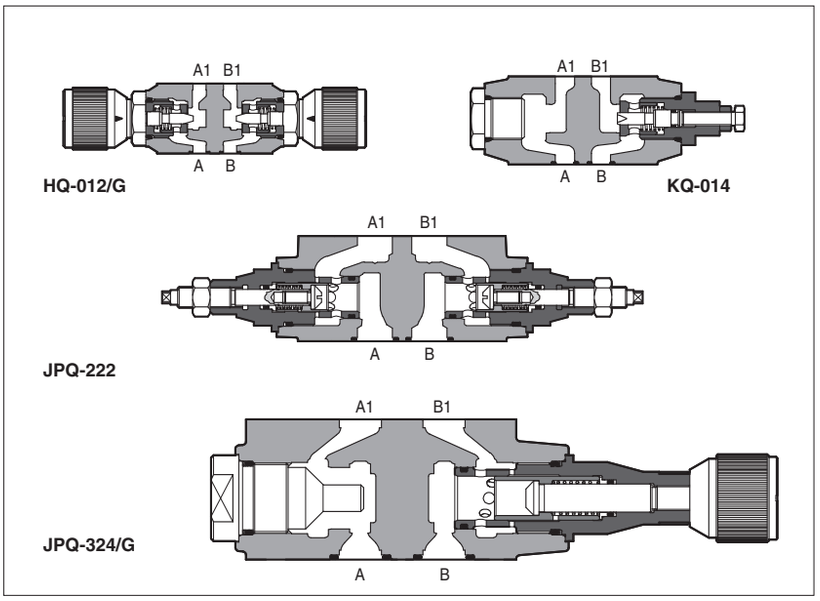


Fastening bolts: n°4 socket head screws M10 and n°2 M6.
The lenght depends on number and type of modular elements associated.

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 throttle valves type HQ, KQ, JPQ

flow control, ISO 4401 sizes 06, 10, 16 and 25



HQ, **KQ** and **JPQ** are flow throttling valves, not compensated, and with check valve to allow free flow in the opposite direction.
The flow adjustement is done by turning the setting screw in the normal model.
Optional versions with a graduate micrometer knob are available on request.
Clockwise rotation increases the throttling (passage reduced).

Valve size and max flow:
HQ-0 = size 06, flow up to 25 l/min for /U option, up to 80 l/min for standard
KQ-0 = size 10, flow up to 160 l/min
JPQ-2 = size 16, flow up to 200 l/min
JPQ-3 = size 25, flow up to 300 l/min

Mounting surface:
ISO 4401 size 06, 10, 16 and **25**
Max pressure: **350 bar** (HQ, JPQ)
315 bar (KQ)

1 MODEL CODE

HQ-0	13	/	G	**	/	*

HQ-0
Modular flow control valve, size:
HQ-0 = 06
KQ-0 = 10
JPQ-2 = 16
JPQ-3 = 25

13
Configuration, see section 2
meter OUT control:
12 = double, acting on port A and B
13 = single, acting on port A
14 = single, acting on port B
meter IN control:
22 = double, acting on port A and B
23 = single, acting on port A
24 = single, acting on port B

G
Options:
U = better accuracy for reduced flow (only for HQ-0)
G = adjustment by graduated micrometer

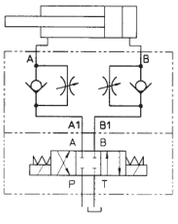
******
Series number

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

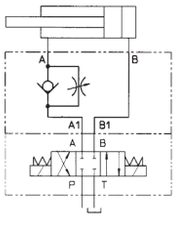
2 VALVE CONFIGURATION

Meter OUT control

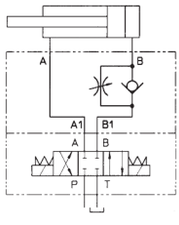
HQ-012
KQ-012
JPQ-212
JPQ-312



HQ-013
KQ-013
JPQ-213
JPQ-313

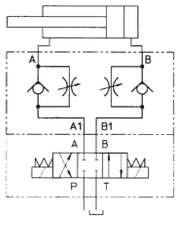


HQ-014
KQ-014
JPQ-214
JPQ-314

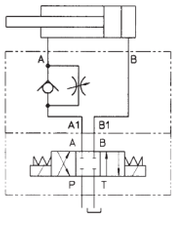


Meter IN control

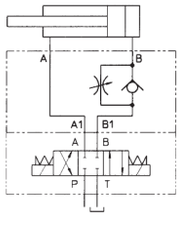
HQ-022
KQ-022
JPQ-222
JPQ-322



HQ-023
KQ-023
JPQ-223
JPQ-323



HQ-024
KQ-024
JPQ-224
JPQ-324

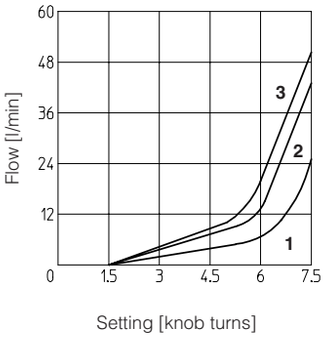


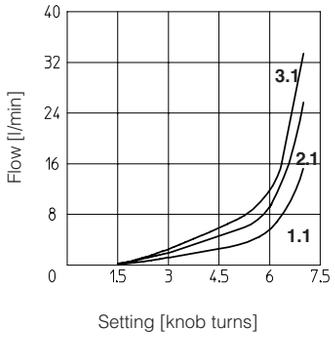
3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

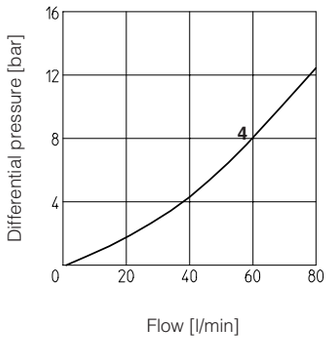
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +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	

4 DIAGRAMS OF HQ-0 based on mineral oil ISO VG 46 at 50°C

1 = Regulation diagram at Δp 10 bar (1.1 = option /U)
2 = Regulation diagram at Δp 30 bar (2.1 = option /U)
3 = Regulation diagram at Δp 50 bar (3.1 = option /U)
4 = Q/Δp diagram for free flow through the non-return valve

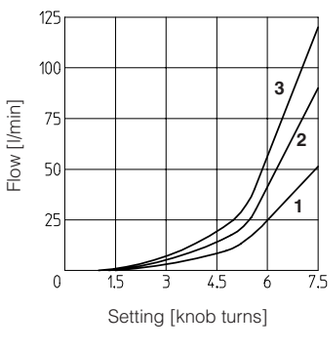


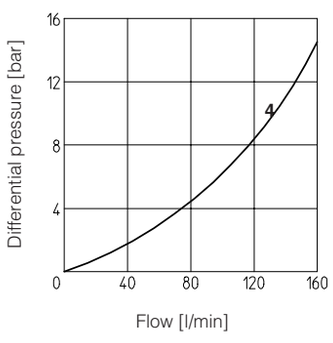




5 DIAGRAMS OF KQ-0 based on mineral oil ISO VG 46 at 50°C

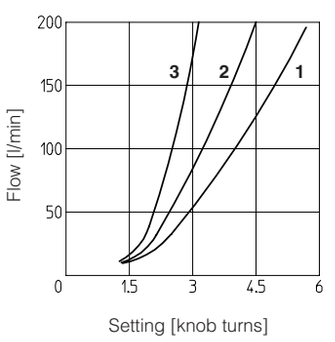
1 = Regulation diagram at Δp 10 bar
2 = Regulation diagram at Δp 30 bar
3 = Regulation diagram at Δp 50 bar
4 = Q/Δp diagram for free flow through the non-return valve

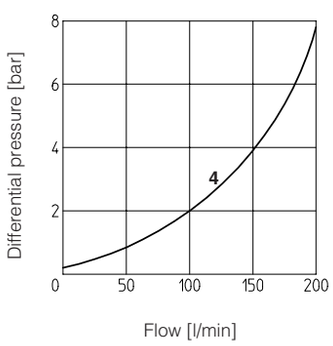




6 DIAGRAMS OF JPQ-2 based on mineral oil ISO VG 46 at 50°C

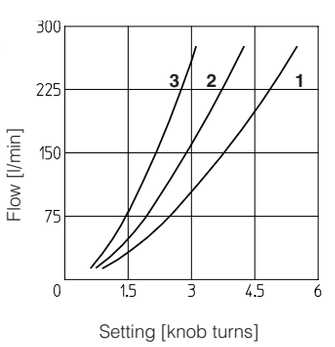
1 = Regulation diagram at Δp 10 bar
2 = Regulation diagram at Δp 30 bar
3 = Regulation diagram at Δp 50 bar
4 = Q/Δp diagram for free flow through the non-return valve

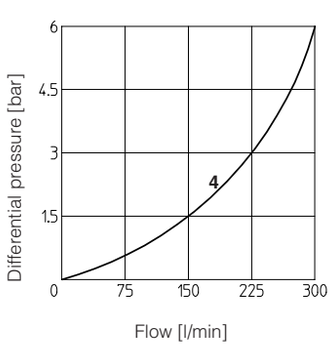




7 DIAGRAMS OF JPQ-3 based on mineral oil ISO VG 46 at 50°C

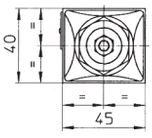
1 = Regulation diagram at Δp 10 bar
2 = Regulation diagram at Δp 30 bar
3 = Regulation diagram at Δp 50 bar
4 = Q/Δp diagram for free flow through the non-return valve

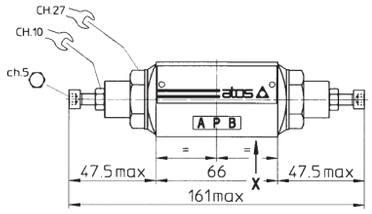




8 INSTALLATION DIMENSIONS OF HQ-0 VALVES [mm]

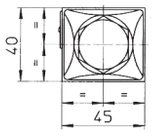
HQ-012
HQ-022

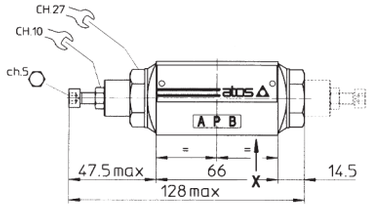




Mass: 1,1 Kg

HQ-013
HQ-014
HQ-023
HQ-024

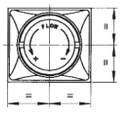


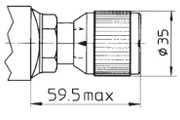


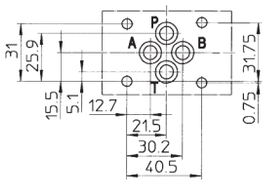
In version -014 and -024 the regulating element is on side of port B (dotted line) instead of side of port A.

Mass: 1,2 Kg

/G OPTION





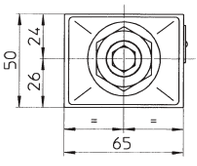


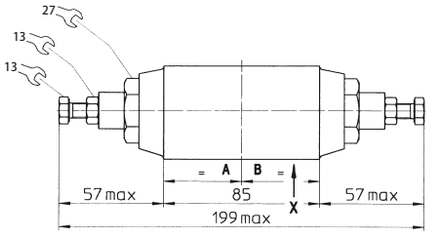
ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Diameter of ports A, B, P, T: Ø = 7,5 mm (max)
Seals: 4 OR 108

Fastening bolts: n° 4 socket head screws M5. The lenght depends on number and type of modular elements associated.

9 INSTALLATION DIMENSIONS OF KQ-0 VALVES [mm]

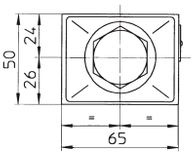
KQ-012
KQ-022

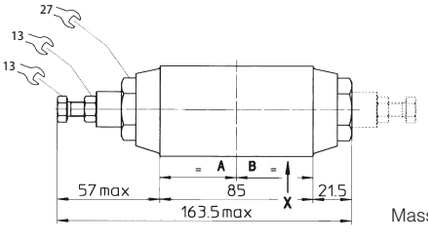




Mass: 2 Kg

KQ-013
KQ-014
KQ-023
KQ-024

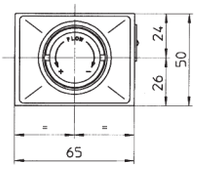


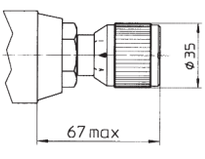


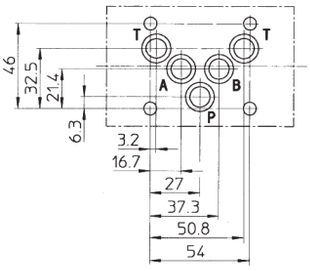
In version -014 and -024 the regulating element is on side of port B (dotted line) instead of side of port A.

Mass: 2,2 Kg

/G OPTION





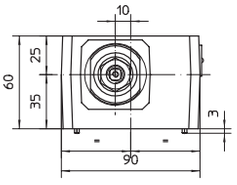


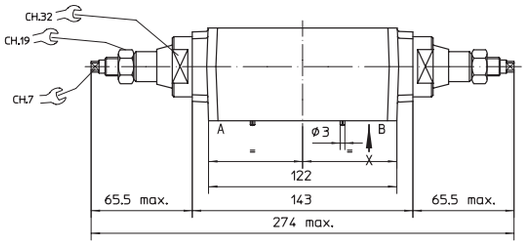
ISO 4401: 2005
Mounting surface: 4401-05-04-0-05
Diameter of ports, A, B, P, T: Ø = 11,2 mm (max)
Seals: 5 OR 2050

Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

10 INSTALLATION DIMENSIONS OF JPQ-2 VALVES [mm]

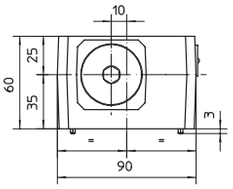
JPQ-212
JPQ-222

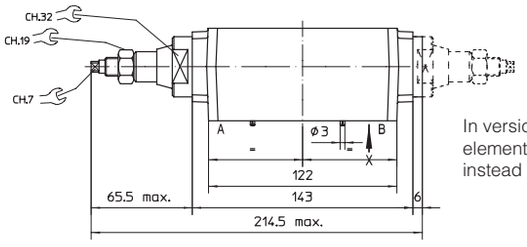




Mass: 4,6 Kg

JPQ-213
JPQ-214
JPQ-223
JPQ-224

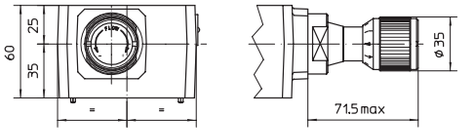


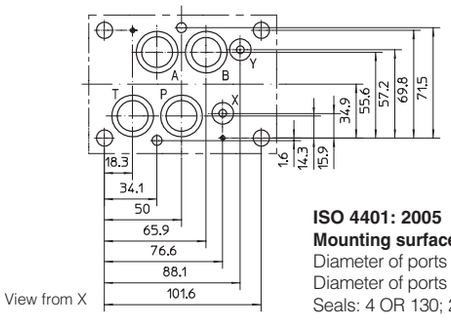


In version -214 and -224 the regulating element is on side of port B (dotted line) instead of side of port A.

Mass: 4,3 Kg

/G OPTION



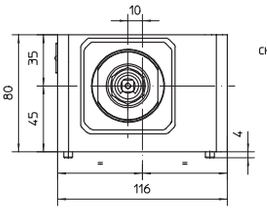


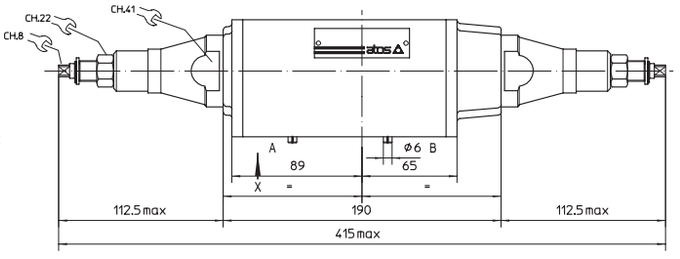
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Diameter of ports A, B, P, T: Ø = 20 mm
Diameter of ports X, Y: Ø = 7 mm
Seals: 4 OR 130; 2 OR 109

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 JPQ-3 VALVES [mm]

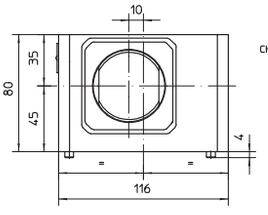
JPQ-312
JPQ-322

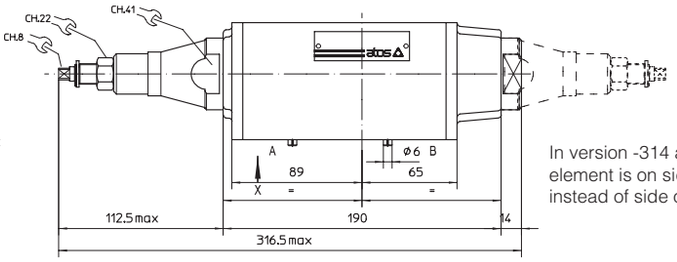




Mass: 10,7 Kg

JPQ-313
JPQ-314
JPQ-323
JPQ-324

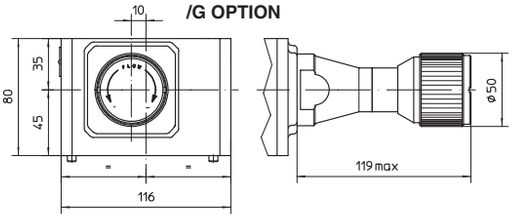


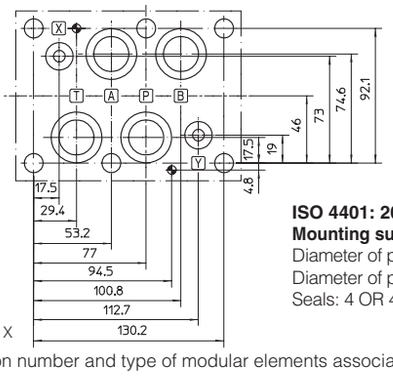


In version -314 and -324 the regulating element is on side of port B (dotted line) instead of side of port A.

Mass: 9,5 Kg

/G OPTION



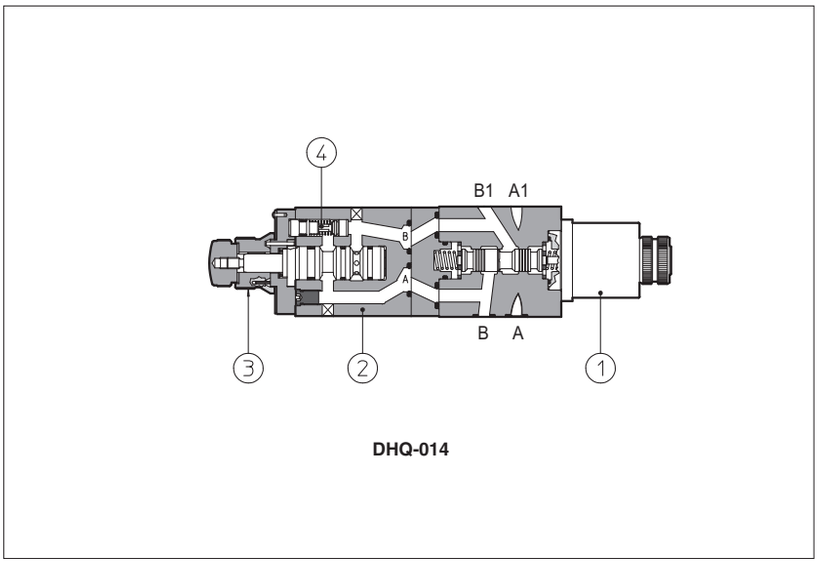


ISO 4401: 2005
Mounting surface: 4401-08-08-0-05
Diameter of ports A, B, P, T: Ø = 24 mm
Diameter of ports X, Y: Ø = 7 mm
Seals: 4 OR 4112; 2 OR 3056

Fastening bolts: n° 6 socket head screws M12. The lenght depends on number and type of modular elements associated.

Modular fast/slow valves type DHQ

compensated flow control and by-pass solenoid valve, ISO 4401 size 06



DHQ-014

DHQ are modular units composed by one by-pass solenoid valve ① and one 2-way pressure compensated flow control valve ② type QV-06 (tab. C210).

The flow control valve is provided with a built-in check valve ④ to allow the free flow in the opposite direction.

The flow adjustment is obtained by turning the graduated micrometer knob ③. Clockwise rotation decreases the throttling (passage reduced).
Optional versions with locking key on the adjustment knob are available on request.

Mounting surface:
ISO 4401 size 06

Max controlled flow: up to 1,5-6-11-16-24 l/min (depending on models);

Free flow up to 36 l/min.

Max pressure: up to **250 bar**

1 MODEL CODE

DHQ-0	13	/	C	/	6	/	K	-	I	X	24DC	**	/	*

DHQ-0: Modular flow control unit, pressure compensated, size: **DHQ-0** = 06

13 / C / 6: Configuration, see section 2
control of flow discharged from the actuator
13 = on port A
14 = on port B
16 = on port T
control of flow entering the actuator:
11 = on port P
23 = on port A
24 = on port B

C = flow controlled when solenoid is de-energized
O = flow controlled when solenoid is energized

K: Options:
K = with lock key for the setting knob **V** = without by-pass check valve

Maximum adjustable controlled flow:
1 = 1,5 l/min; **6** = 6 l/min; **11** = 11 l/min; **16** = 16 l/min; **24** = 24 l/min
00 = whitout flow control valve

I: Type of solenoid:
I = solenoid OI for AC and DC supply with **cURus** certification

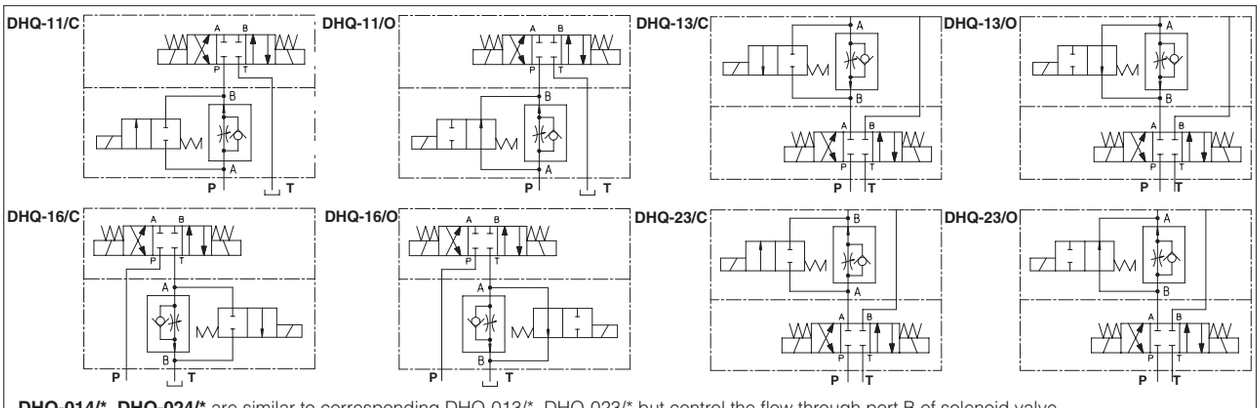
X: **X** = without connector **(1):**
See section 7 for available connectors, to be ordered separately
-00 = solenoid valve without coils

24DC: Supply voltage, see section 4

******: Series number

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

2 HYDRAULIC CHARACTERISTICS



DHQ-014/*, DHQ-024/* are similar to corresponding DHQ-013/*, DHQ-023/* but control the flow through port B of solenoid valve

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 flow through check valve	[l/min]	24				
Max free flow		36 l/min				
Max flow on port A	[l/min]	24				
Max pressure	[bar]	250				

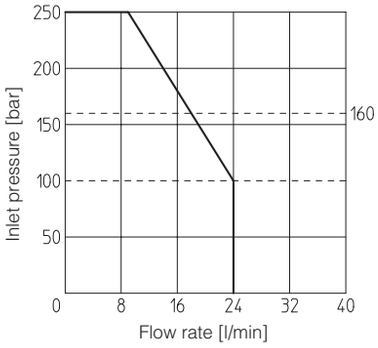
3 MAIN CHARACTERISTICS, SEALS and HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
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 (β10 ≥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	

4 ELECTRIC/ELECTRONIC CONNECTORS AND ELECTRIC FEATURES

For electric/electronic connectors (to be ordered separately) and electric features of DHQ units, see tab. E010.

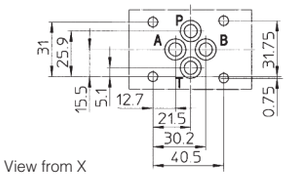
5 OPERATING LIMITS



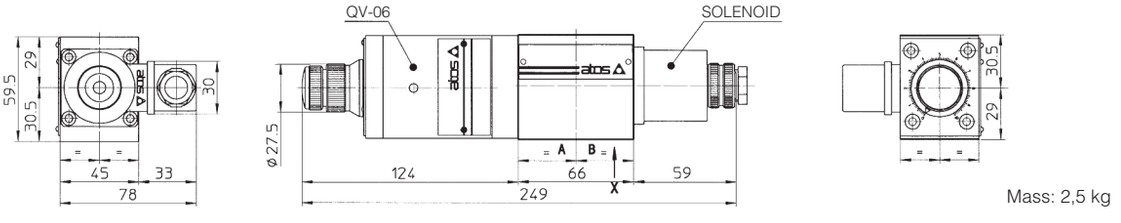
6 INSTALLATION DIMENSIONS [mm]

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 lenght depends on number and type
of modular elements associated



View from X



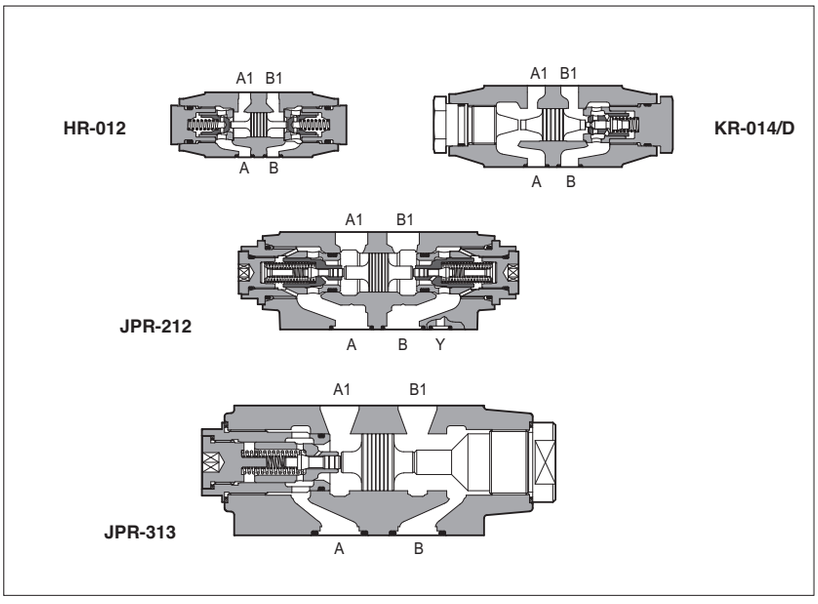
Mass: 2,5 kg

In versions -014 and -024 the position of valve QV-06 and of solenoid are inverted.

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, 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	/	*	**	/	*

HR-0

Modular check valve, size:

HR-0 = 06 **JPR-2** = 16
KR-0 = 10 **JPR-3** = 25

12

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

4

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)

*****

Options (only for KR-012, -013, -014):
D = with decompression (only with cracking pressure standard = 1 bar)

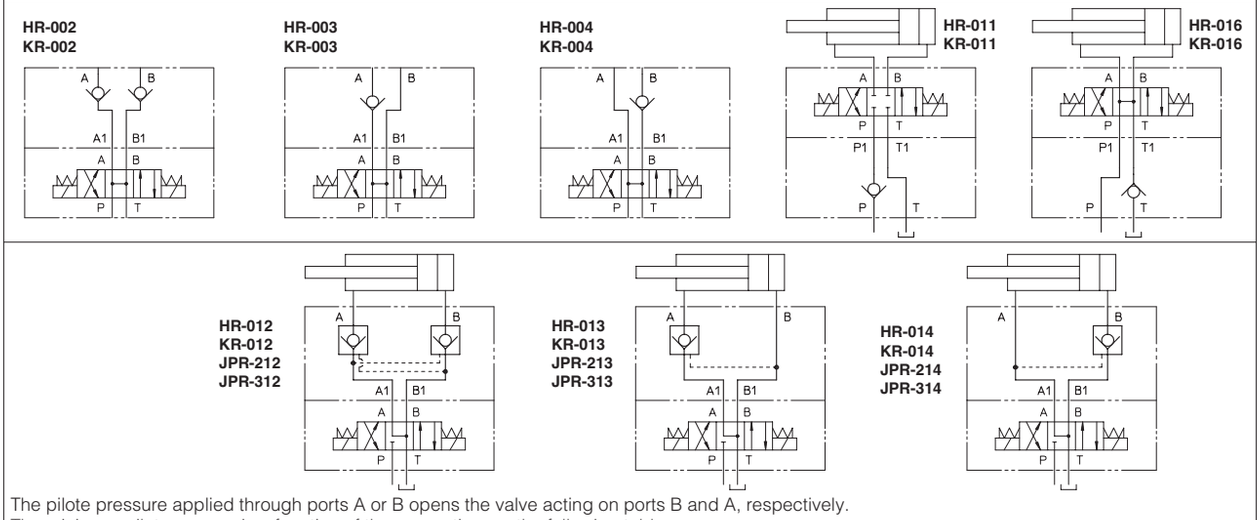
******

Series number

*****

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

2 VALVE CONFIGURATION



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		
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	

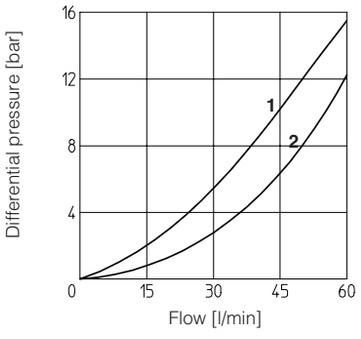
4 **DIAGRAMS OF HR-0** based on mineral oil ISO VG 46 at 50°C

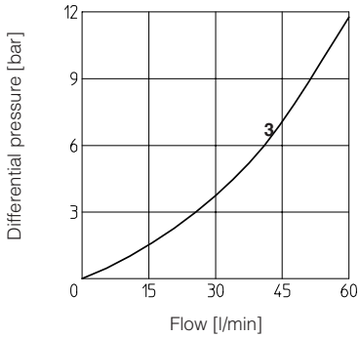
Flow through check valve:

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





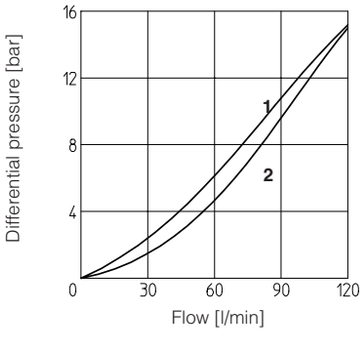
5 **DIAGRAMS OF KR-0** based on mineral oil ISO VG 46 at 50°C

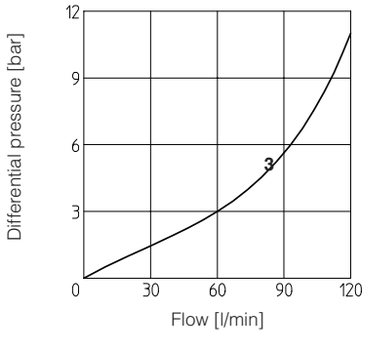
Flow through check valve:

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



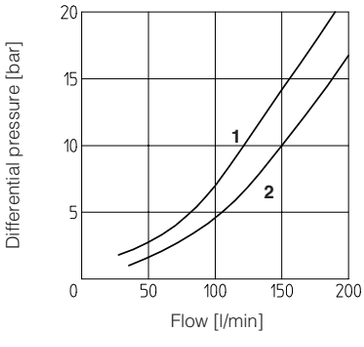


6 **DIAGRAMS OF JPR-2** based on mineral oil ISO VG 46 at 50°C

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

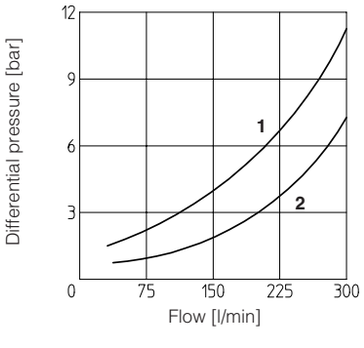


7 **DIAGRAMS OF JPR-3** based on mineral oil ISO VG 46 at 50°C

Flow through check valve:

1 = A→A1; B→B1 of JPR-312, JPR-313, JPR-314

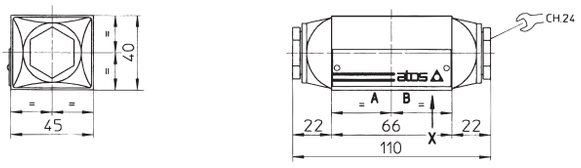
2 = A1→A; B1→B of JPR-312, JPR-313, JPR-314



8 INSTALLATION DIMENSIONS OF HR-0 VALVES [mm]

HR-002
HR-003
HR-004
HR-012
HR-013
HR-014

LATERAL VIEW



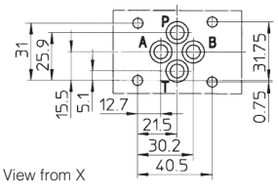
Mass: 1 Kg

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



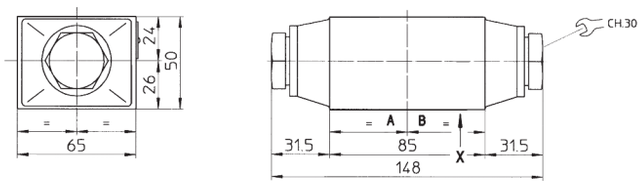
View from X

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]

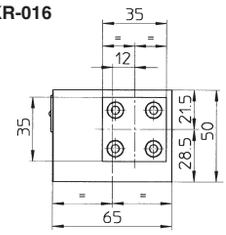
KR-012
KR-002
KR-003
KR-004
KR-013
KR-014

LATERAL VIEW

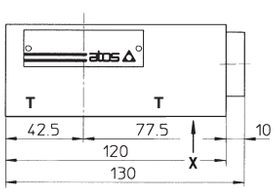


Massa: 2,3 Kg

KR-016



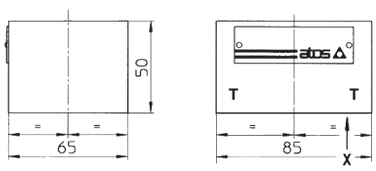
LATERAL VIEW



Mass: 2,5 Kg

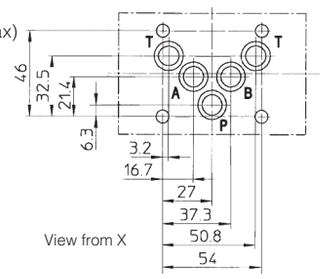
KR-011

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



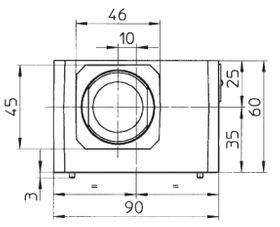
View from X

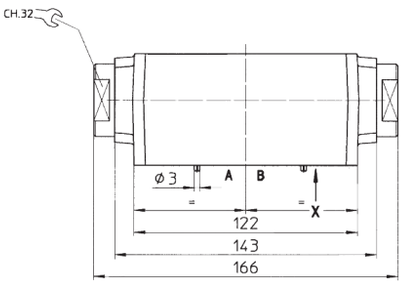
Fastening bolts: n° 4 socket head screws M6. The lenght depends on number and type of modular elements associated.

10 INSTALLATION DIMENSIONS OF JPR-2 VALVES [mm]

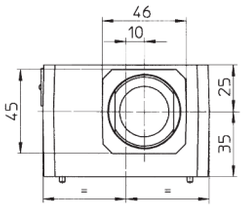
JPR-212
JPR-213
JPR-214

LATERAL VIEW



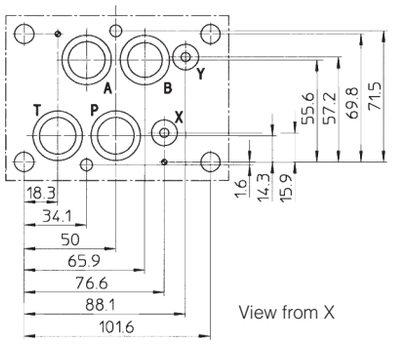


LATERAL VIEW



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



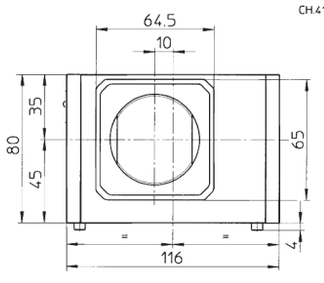
View from X

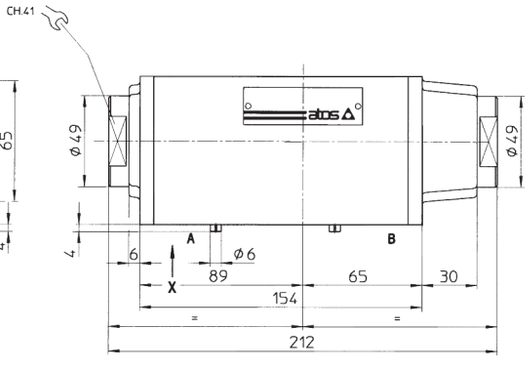
Fastening bolts: n° 4 socket head screws M10 and n° 2 M6. The lenght depends on number and type of modular elements associated.

11 INSTALLATION DIMENSIONS OF JPR-3 VALVES [mm]

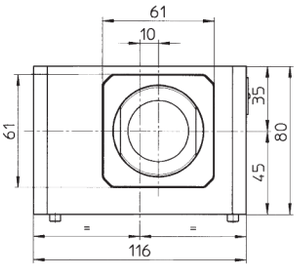
JPR-312
JPR-313
JPR-314

LATERAL VIEW B



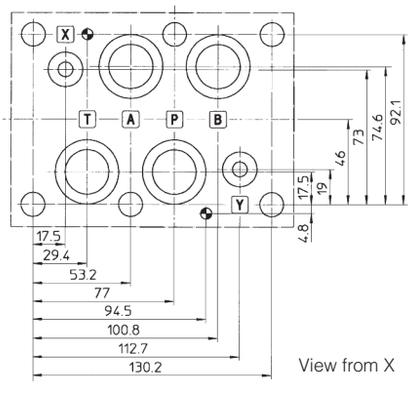


LATERAL VIEW A



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

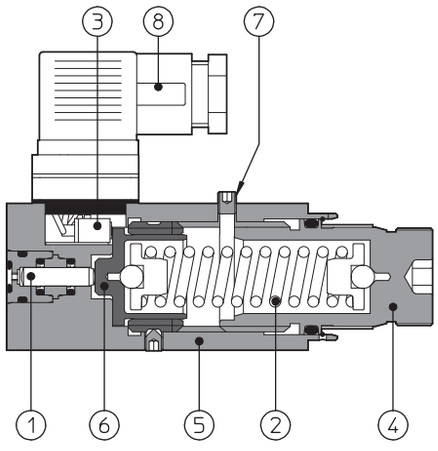


View from X

Fastening bolts: n° 6 socket head screws M12. The lenght depends on number and type of modular elements associated.

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: **650 bar**

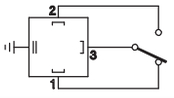
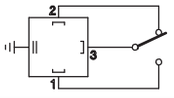
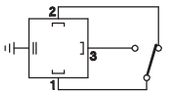
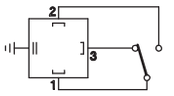
1 MODEL CODE

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

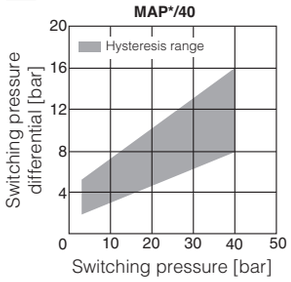
2 MAIN CHARACTERISTICS, SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

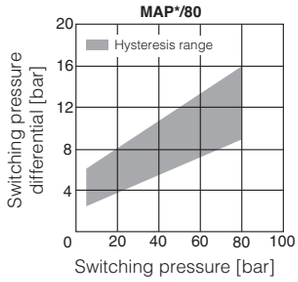
Assembly position / location	Any position		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
Ambient temperature	Standard execution = -30°C ÷ +70°C /PE option = -20°C ÷ +70°C /BT option = -40°C ÷ +70°C		
Seals, recommended fluid temperature	NBR seals (standard) = -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	

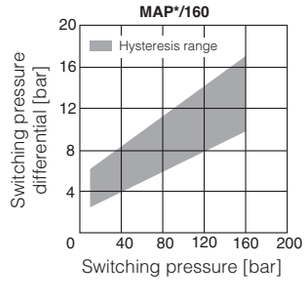
3 CHARACTERISTICS AND WIRING OF INTERNAL MICROSWITCH

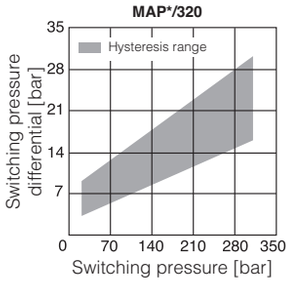
	Supply voltage [V]					Rest position	Pressure operated position
	125 AC	**250 AC**	**30 DC**	**250 DC**			
Max current resistive load [A]	7	5	5	0,2	**STD**		
Max current inductive load (Cos φ = 0,4) [A]	4	2	3	0,02			
Insulating resistance	≥100MΩ				**/E**		
Contact resistance	15 mΩ						
Electrical life-expectancy	≥1.000.000 switchings						
Mechanical life-expectancy	≥10.000.000 switchings						

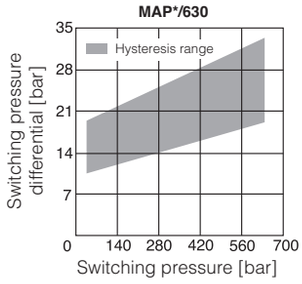
4 DIAGRAMS







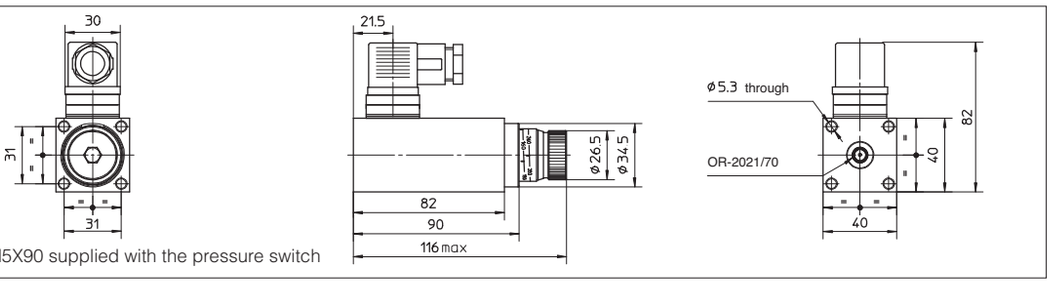




The diagrams show, the switching pressure difference (hysteresis) between the switching positions of the pressure switch electric contacts.

⚠ 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

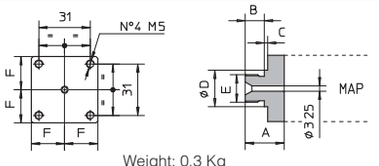
06 = G 1/4" (BMM, BMF, BFM)
10 = G 3/8" (BMM, BFM)
15 = G 1/2" (BMM, BFM)
20 = G 3/4" (BFM)
25 = G 1" (BFM)
32 = G 1 ¹/4"(BFM)

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

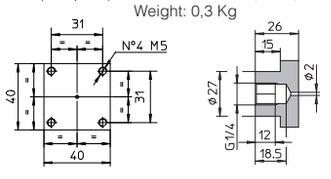
7 DIMENSIONS OF ADAPTORS [mm]

BMM - Male fittings:



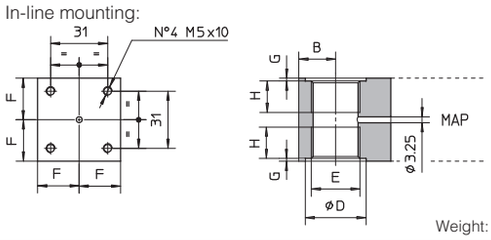
Weight: 0,3 Kg

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

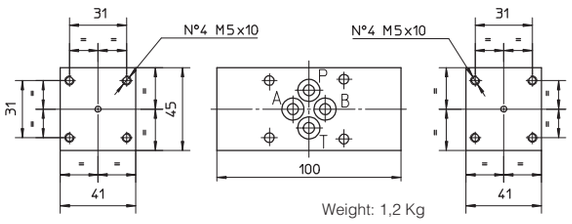
BFM - In-line mounting:



Weight: 0,8 Kg

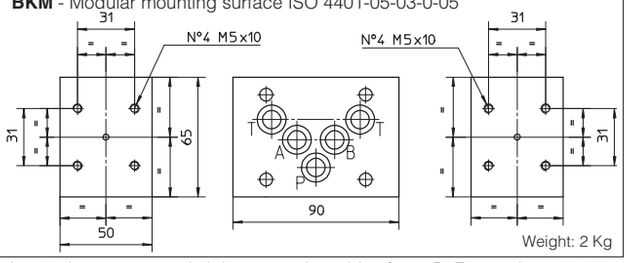
	A	B	Ø D	E	F	G	H
BFM-06	50	20	19	G 1/4"	22,5	1	12
BFM-10	50	20	23	G 3/8"	22,5	1	12
BFM-15	50	20	27	G 1/2"	22,5	1	15
BFM-20	50	20	33	G 3/4"	22,5	1,5	17
BFM-25	70	30	40	G 1"	30	1,5	19
BFM-32	70	30	50	G 1 ¹/4"	30	1,5	22

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.

Solenoid directional valves: user's guidelines

Atos solenoid valves have been designed and tested with innovative concepts to satisfy the advanced needs of modern machines: rapid or damped switching, quiet operation, reduced power absorbed, versatility, reliability and safety of use.
This table gives engineers, in condensed form, a series of useful information for the choice and the use of modern solenoid valves.

1 DESCRIPTION OF FUNCTION

Solenoid directional valves are used for changing flow direction in hydraulic systems.
Main features are:

1.1 New integrated design between hydraulic and electrical parts with more compact construction and better efficiencies.
1.2 Wet solenoids for maximum reliability, also available in flame-proof, intrinsically safe and stainless steel execution.
1.3 All seals are static and all the moving parts are protected and lubricated by the fluid.
1.4 Smoother switching with effective regulation thanks to optional switching control devices.
1.5 Plastic encapsulated coils easily interchangeable and UL certified.
1.6 Electric or electronic connectors, depending on the application and on electric control board interface.
1.7 Cored oil passages with low pressure drops.
1.8 Interchangeable spools for various directional functions.

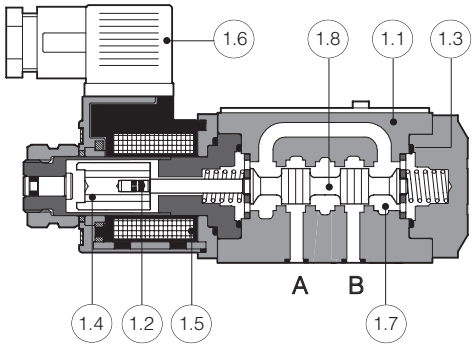


Fig. 1 Cross-section of direct operated solenoid valve

2 SOLENOID IDENTITY

According to European Convention solenoid "A" is close to "A" port and solenoid "B" is close to "B" port of the direct operated valves.
When pilot operated, the solenoids are identified according to following practice: solenoid "A" is at port A end of pilot valve and solenoid "B" at port B end, independent of main stage valve port location or spool type.

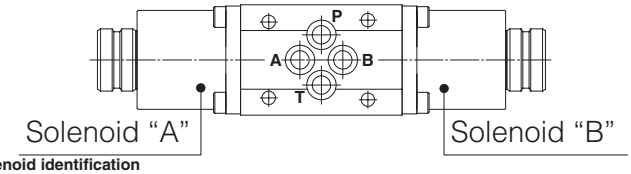


Fig. 2 Solenoid identification

3 SPOOLS CHARACTERISTICS

Standard interchangeable spools are available in a wide range of configurations, as indicated in table 3.

Specific spools to reduce water hammer-shocks during switching: variants 1/1, 4/8 and 5/1. Their special shape reduces water hammer-shocks during switching. Use of these spools is not recommended with maximum flow greater than 80% of the nominal values, because of higher pressure drops generated in the valve.

Response times and control of switching time: direct operated solenoid valves.
The solenoid valve response times can be controlled by the use of specific devices (option L); associated with the spools */1 and */8 it is possible to control smooth acceleration/deceleration of the connected actuator. The L* devices allow an effective control of the solenoid valve switching time, slowing down the spool speed without reducing the solenoid force.
They are available in different configurations. For correct use a slight backpressure (2 bar) on solenoid valve T port is recommended. Valve response time is also influenced by operating conditions (oil characteristics and temperature), elasticity of the hydraulic circuit and by use of electronic connectors.

Response time and control of switching time: pilot operated solenoid valves.
The response time of the piloted valves can be adjusted by means of the options /H (meter-out control) or /H9 (meter-in control). This options provide the installation between the main stage and the pilot valve of a modular throttle valve, type HQ-*/U specific for fine pilot flow control.
Associated with */1 and */8 spools, smooth acceleration/deceleration can be controlled on loads.

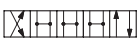
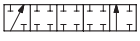
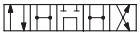
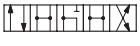
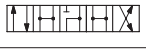
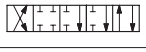
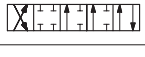
Type	Scheme	Intermediate passages
0		
1		
2		
3		
4		
5		
58		
6		
7		
8		
0/2		
1/2		
2/2		
16		
17		

Table 3 Basic spools, schemes and intermediate passages between central and external positions. **The spools are not available for all the directional valves. For their availability see the relevant valve table.**

***P spools for direct operated solenoid valves to reduce leakage.**
They are normally used on pilot valve for pressure and directional control valves, for cartridge valves and systems with specific requirements.
Use of these spools is not recommended with maximum flow greater than 70% of the nominal values, because of the higher pressure drops generated in the valve.
Following types available: 1P, 3P, 1/2 P, 8P (for ISO size 06 valves).

4 COIL CHARACTERISTICS

Solenoid valves are available both with DC and AC coils. Three main solenoids for use with following supply for DH* valves:
- OI solenoid for AC and DC supply (only replacing coil);
- OU and OO solenoid for DC supply only;

The solenoid OO can be used also with AC supply: in this case it must be coupled with the connector SP-669 having the rectifier bridge.
Coils are fully encapsulated; they are easily replaceable without aid of tools in DHI and DHU valves. AC and DC solenoids are available for DKE* valves. The DC solenoids can be also fed with AC supply, by using SP-669 connector. The coils with different nominal voltages can be interchanged on the same solenoid type.

5 ELECTRICAL CONNECTORS TO ISO 4400 (DIN 43650)

The cable entry on electrical plugs can be fitted at 90° intervals by reassembling the contact holder relative to the plug housing.
The cable entry is Pg. 11 suitable for cable Ø 6-10 mm.
Following types are available:
Standard connectors, IP65 protection degree (SP-666);
Connectors with built in LED (SP-667);
Connectors with built in rectifier bridge (SP-669) to supply DC coils by alternating current AC.
In addition to the above DIN connectors, other type of electrical interfaces are available on request:
- Lead Wire connection
- Deutsch connector DT-04-2P (IP67)
- AMP Junior Timer connector (IP67)

6 ELECTRONIC CONNECTORS

Operational principle
E-SE for direct current power supply on DC coils with reduction of power consumption and increase of performance;
E-SD to eliminate electric disturbances when solenoids are deenergized;
E-SR to pilot the solenoid valves with a low power signal (20 mA max);

E-SE main characteristics
They allow a modulation of the power supply voltage and thus an effective control of the solenoid force to obtain increased performance and reduction of power consumption.
The use of electronic E-SE connector allows a considerable increase in solenoid valve performance.

7 OPERATING NOTES

Tightening of the fixing screws to the subplates and of the plastic coil ring-nut.
It is particularly important to check that the tightening of the fixing screws respects the torque limits indicated in table 5.
Higher values may cause anomalous deformations of the body and prevent sliding of the spool. 12.9 class fixing screws are recommended. The plastic coil ring-nuts will be fixed on the solenoid with a torque 3Nm: this deforms properly the seals and protects against external particles and water.

Operation in circuits with flow exceeding the nominal valve flow
In circuits with flow rates greater than the nominal values and in circuits with accumulators, where the instantaneous flow can exceed nominal values, is recommended a throttle valve on P port of solenoid valve to limit the maximum flow on the valve.
Dilatation and contraction of flexible hoses subjected to variations of system pressure can generate high instantaneous flow rates.
The version indicated in fig. 6 can be directly inserted into P port of the valve but also in other valve ports.
Where throttle valve may be required they can be supplied with following codes:
SP-PLUG H-** (for DH* valves)
SP-PLUG K-** (for DKE* valves)
** the double asterisk identifies the dimension in tenths of a millimeter.
Example: SP-PLUG H-05 = 0,5 mm diameter

Limits on two-way and three-way operation for direct operated solenoid valves.
When used as two-way and three-way valves with P, A or B ports blocked or not subject to flow, or with flow much lower than flow on other ports, maximum catalogue performance cannot be assured.

Minimum pilot pressure for pilot operated solenoid valves.
A minimum pressure value must be guaranteed for piloting the valve. This value is 8 bar (or 10 bar in the case of valves with hydraulic centering). In case of circuits with lower pilot pressure on P port, the option /R should be used.

Operation combined with hydraulic cylinders with high section ratios.
Operational limits may occur with cylinders with section ratios (piston/rod) greater than 1.25. In these cases multiplications or demultiplications of flow and pressure may disturb the correct operation of the solenoid valve.

8 SPECIAL VERSION SOLENOID VALVES

- for explosion-proof environments
- for intrinsically safe operation
- stainless steel execution for marine or aggressive environments
- for operation beyond the allowed temperature limits.

Table 3.2 Spools to reduce water hammer shocks associated with switching

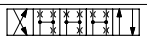
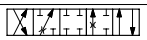
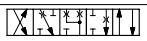
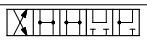
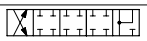
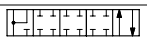
Type	Scheme	Intermediate passages
0/1		
1/1		
3/1		
4/8		

Table 3.3 Specific spools for special uses or in regenerative circuits

Type	Scheme	Intermediate passages
09		
90		
19		
91		
39		
93		
49		
94		

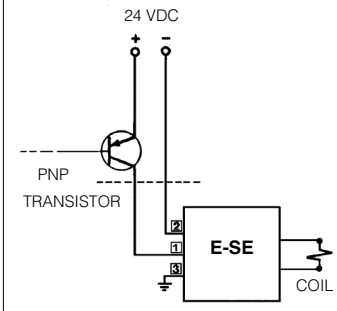


Fig. 4 E-SE electrical connection

Table 5
Recommended torque for the fixing screws

Valve type	Fixing screws	Torque
DH*	M5	8 Nm
DKE*	M6	13 Nm
DP**-2	M10 and M6	60 Nm and 13 Nm
DP**-3	M12	100 Nm
DP**-6	M20	600 Nm

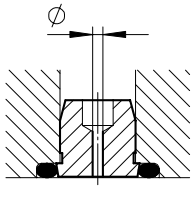
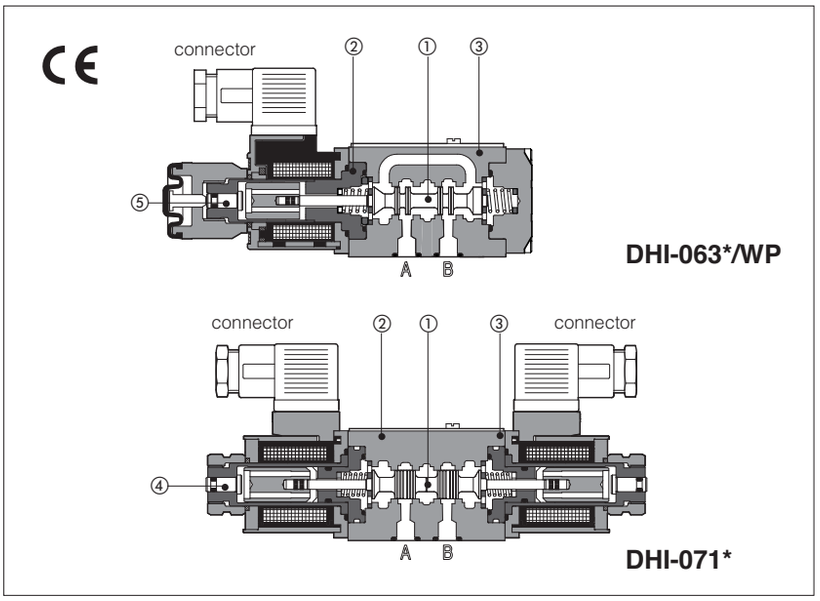


Fig. 6 Throttle valve which can be inserted in port P (or A and B) of the solenoid valve to limit the flow.

Solenoid directional valves type DHI

direct operated, ISO 4401 size 06



Spool type, two or three position, direct operated valves with solenoids certified according the North American standard **cURus**.
Solenoids ② are made by:
- wet type flanged tube, same 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

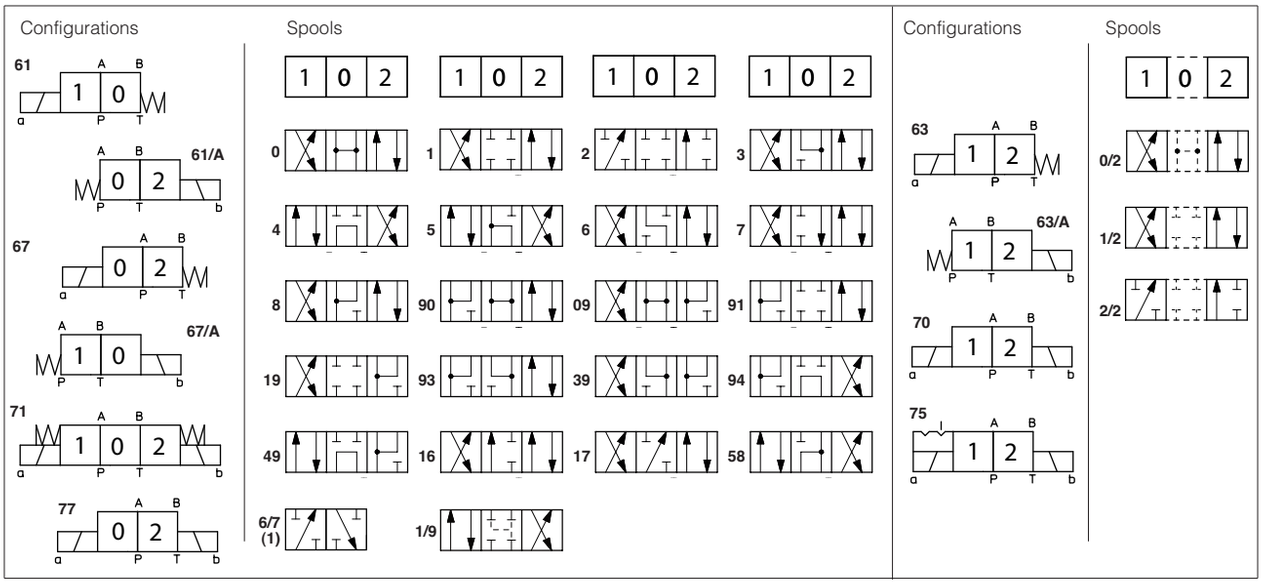
Standard coils protection **IP65**, optional coils with IP67 AMP Junior Timer, XK Deutsch or Lead Wire connections.
Wide range of interchangeable spools ①, see section 2
The valve body ③ is 3 chamber type made by shell-moulding casting with wide internal passages.

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

1 MODEL CODE

DHI - 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 springs **71** = double solenoid, 3 positions, spring centered **75** = double solenoid, 2 external positions, with detent **77** = double solenoid, center plus external position, without springs	Spool type, see section 2	Options, see note 1 at section 4		**00** = valve without coils **X** = without connector See section 13 for available connectors, to be ordered separately Coils with special connectors, see section 10 **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)



Note: see also section 4, note 3, for special shaped spools
(1): spool type 6/7 available only for configuration 61, not available for version /A

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

Assembly position / location	Any position for all valves except for type - 70 and 77 (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; /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	
Flow direction	As shown in the symbols of table 2		
Operating pressure	Ports P,A,B: **350** bar; Port T **120** bar		
Rated flow	See diagrams Q/Δp at section 6		
Maximum flow	**60 l/min**, see operating limits at section 7		

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 DIN EN 60529	IP 65 (with connectors 666, 667, 669 or E-SD correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric feature 6
Supply voltage tolerance	± 10%
Certification	**cURus**

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 11.

⚠ The manual override operation can be possible only if the pressure at T port is lower than 50 bar - see section 11.

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

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, 3, 8** and 1/2 are available as **1P, 3P, 8P** and **1/2P** 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

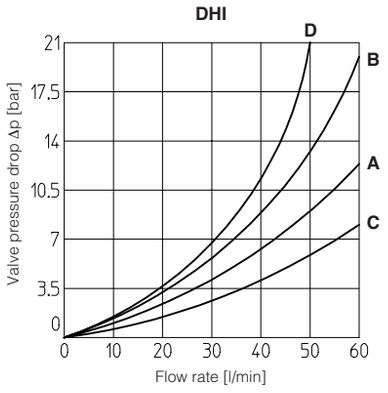
External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil DHI	Colour of coil label
6 DC	**6 DC**	666 or 667	33 W	COU-6DC/ 80	brown
9 DC	**9 DC**			COU-9DC /80	light blue
12 DC	**12 DC**			COU-12DC /80	green
14 DC	**14 DC**			COU-14DC /80	brown
18 DC	**18 DC**			COU-18DC /80	blue
24 DC	**24 DC**			COU-24DC /80	red
28 DC	**28 DC**			COU-28DC /80	silver
48 DC	**48 DC**			COU-48DC /80	silver
110 DC	**110 DC**			COU-110DC /80	black
125 DC	**125 DC**			COU-125DC /80	silver
220 DC	**220 DC**			COU-220DC /80	black
24/50 AC 24/60 AC	**24/50/60 AC**		60 VA (3)	COI-24/50/60AC /80 (1)	pink
48/50 AC 48/60 AC	**48/50/60 AC**			COI-48/50/60AC /80 (1)	white
110/50 AC 120/60 AC	**110/50/60 AC** **120/60 AC**			COI-110/50/60AC /80 (1) COI-120/60AC /80	yellow white
230/50 AC 230/60 AC	**230/50/60 AC** **230/60 AC**			COI-230/50/60AC /80 (1) COI-230/60AC /80	light blue silver
110/50 AC 120/60 AC	**110RC**	669	33 W	COU-110RC /80	gold
230/50 AC 230/60 AC	**230RC**			COU-230RC /80	blue

(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.

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
0, 0/1	C	C	C	C	
0/2, 1, 1/1, 1/2, 1/9	A	A	A	A	
2, 3, 3/1	A	A	C	C	
2/2, 4, 4/8, 5, 5/1, 58, 58/1, 94	D	D	D	D	A
6, 7, 16, 17	A	A	C	A	
8	C	C	B	B	
9, 19, 90, 91	B	B	A	A	
39, 93	D	D	D	D	

DHI



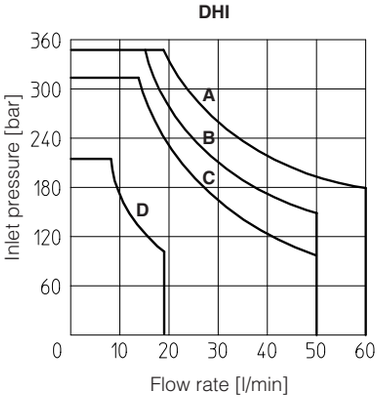
7 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

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.

DHI

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

DHI



8 SWITCHING TIMES (average values in msec)

Valve	Switch-on AC	Switch-on DC	Switch-off
DHI + 666 / 667	30	45	20
DHI + 669	45	—	80
DHI + E-SD	30	45	50

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.

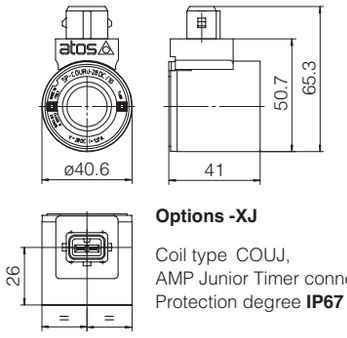
The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

9 SWITCHING FREQUENCY

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

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

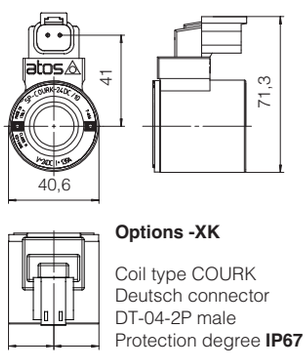
AMP Junior timer connector



Options -XJ

Coil type COUJ,
AMP Junior Timer connector
Protection degree **IP67**

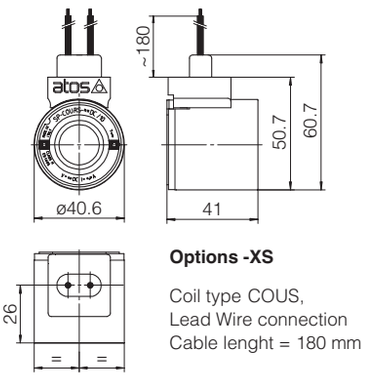
Deutsch connector DT-04-2P



Options -XK

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

Lead Wire connection



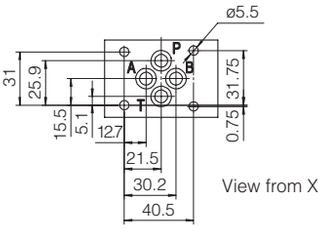
Options -XS

Coil type COUS,
Lead Wire connection
Cable lenght = 180 mm

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

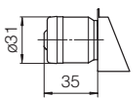
11 DIMENSIONS [mm]

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

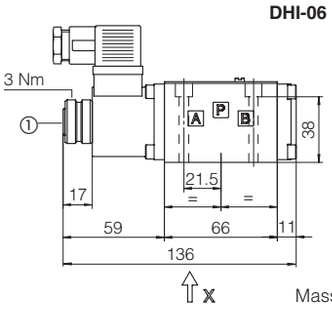


P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

OPTION /WP

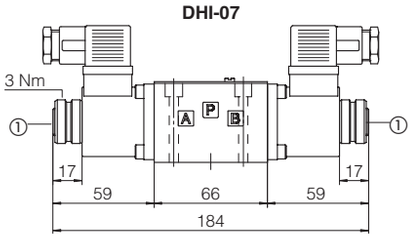


DHI-06



Mass: 1,3 kg

DHI-07



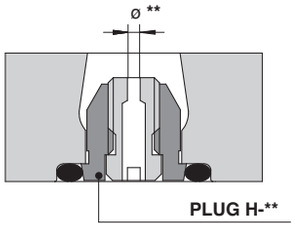
Mass: 1,6 kg

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 connectors type 666

12 PLUG-IN RESTRICTOR (to be ordered separately)

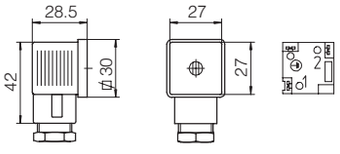
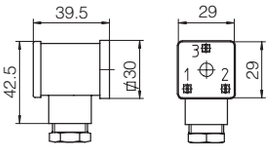
The use of plug-in restrictors in valve's ports P or A or B may be necessary is case of particular conditions as long flexible hoses or the presence of accumulators which could cause at the valve switching instantaneous high flow peaks over the max valve's operating limits.



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

13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (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

Note: for electronic connectors type **E-SD**, see tab. K500

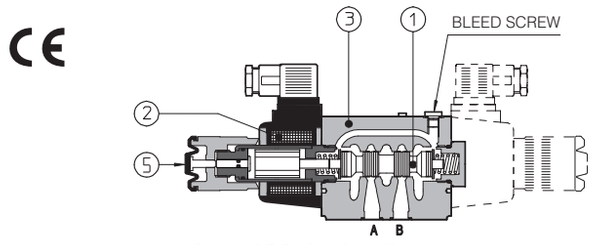
14 MOUNTING SUBPLATES

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

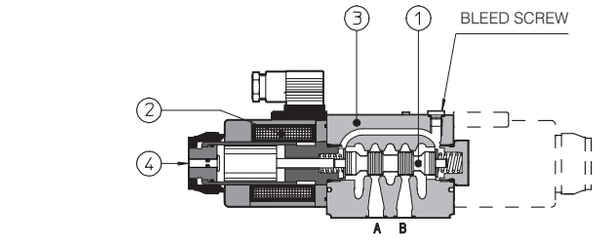
The subplates are supplied with 4 fastening bolts M5x50. Also available are multi-station subplates and modular subplates. For further details see table K280.

Solenoid directional valves type DKE

direct operated, ISO 4401 size 10



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



DKE-17*-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

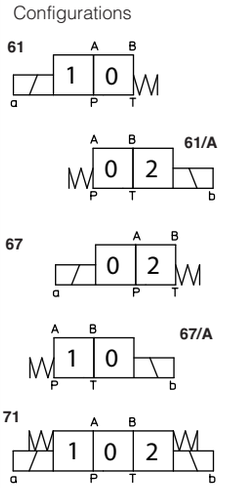
Mounting surface: **ISO 4401 size 10**
Max flow: **150 l/min**
Max pressure: **350 bar**

1 MODEL CODE

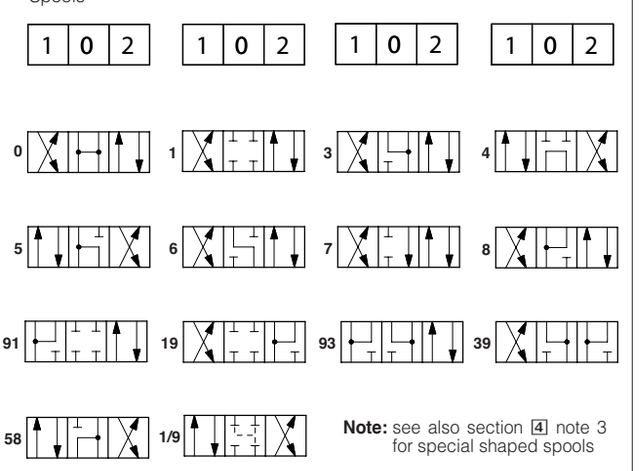
DKE - 1	61	1	/A	-	X	24 DC	**	/*
Directional control valves size 10	Valve configuration, see section 2 **61** = single solenoid, center plus external position, spring centered **63** = single solenoid, 2 external positions, spring offset **67** = single solenoid, center plus external position, spring 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)

Configurations

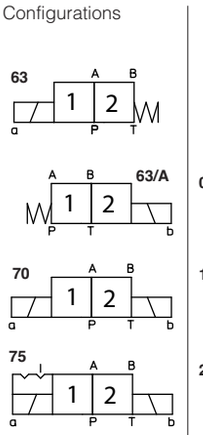


Spools

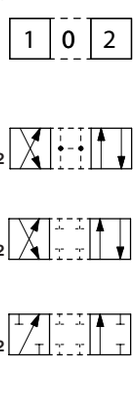


Note: see also section 4 note 3 for special shaped spools

Configurations



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 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	
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 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 - see section 12.
WPD/KE-DC = (only for DC supply) manual override with detent, to be ordered separately, see tab. K150
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 = 5 chambers body for DC and AC versions with proximity switch for spool position monitoring: see tab. E110.
Y = external drain, only for DC version, to be selected if the pressure at T port is higher than the max allowed limits.

2 Type of electric connectors DIN 43650, to be ordered separately - see section 13.
666 = standard connector IP-65 for direct connection to electric supply source.
667 = as 666, but with built-in signal led.
669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - Imax 1A).

3 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

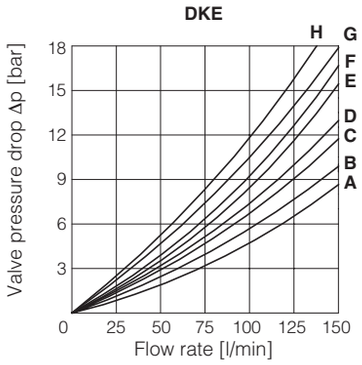
(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 90 VA

(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.

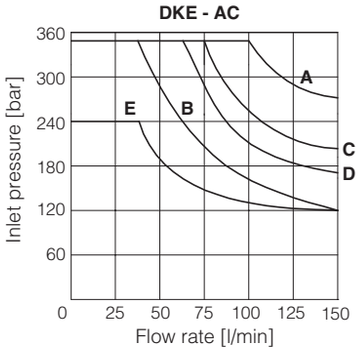
6 Q/ΔP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

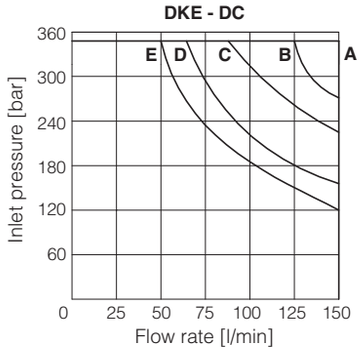
Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T	B→A
0, 0/1, 0/2, 2/2	A	A	B	B		
1, 1/1, 1/9, 6, 8	A	A	D	C		
3, 3/1, 7	A	A	C	D		
4	B	B	B	B	F	
5, 58	A	B	C	C	G	
1/2	B	C	C	B		
19, 91	F	F	G	G		H
39, 93	F	F	G	G		H

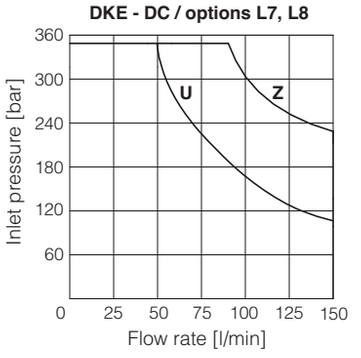


7 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

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

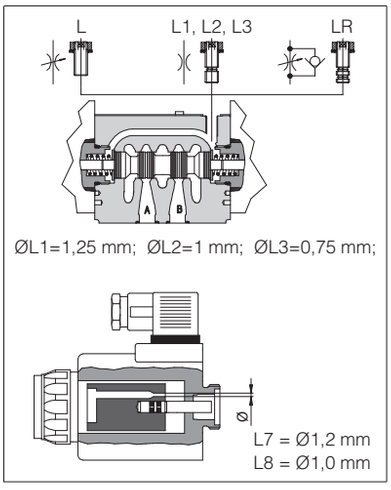
Valve	AC (cycles/h)	DC (cycles/h)
DKE + 666 / 667	7200	15000

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.

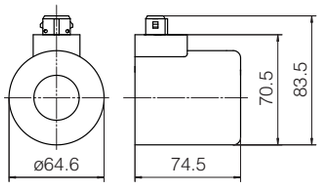
- **L**: controls and regulates the switching time in both moving directions of the spool: regulation is carried out by screwing/unscrewing the element itself (regulating choke);
- **L1/L2/L3**: controls the switching time in both moving directions of the spool by means of fixed calibrated restrictor (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.

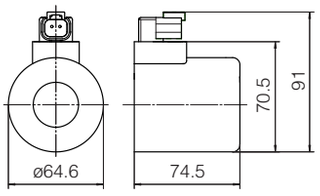


11 COILS TYPE CAE WITH SPECIAL CONNECTORS (only for 12DC, 14DC, 24DC and 28DC)

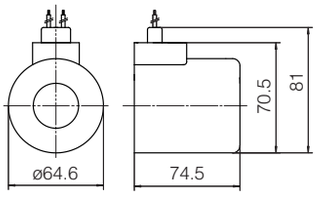
Options -XJ
Coil type CAEJ
AMP Junior Timer connector
Protection degree IP67



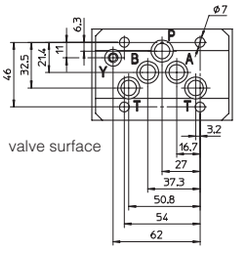
Options -XK
Coil type CAEK
Deutsch connector, DT-04-2P male
Protection degree IP67



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



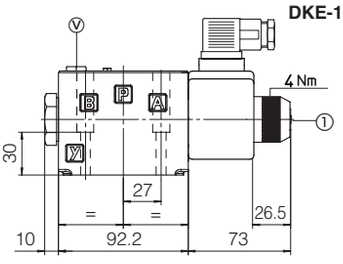
12 INSTALLATION DIMENSIONS [mm]

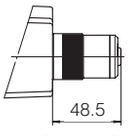


ISO 4401: 2005
Mounting surface according to 4401-05-05-0-05 (without X port, Y port optional)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050 and 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

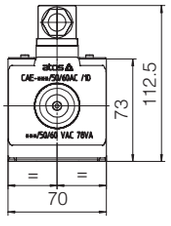
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT (only for option /Y)
For the max pressures on ports, see section 3

DKE-16*-AC



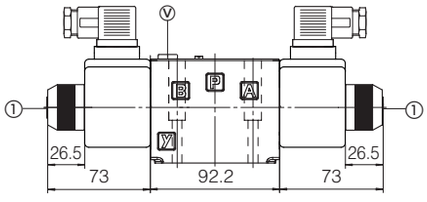


Option /WP



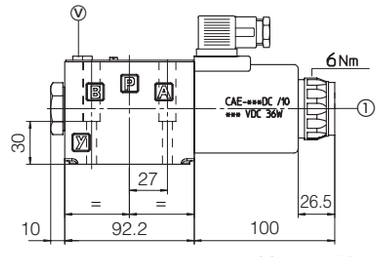
Mass: 3,9 kg

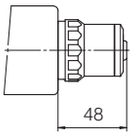
DKE-17*-AC



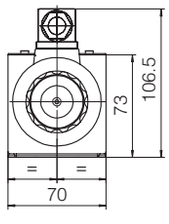
Mass: 4,7 kg

DKE-16*-DC



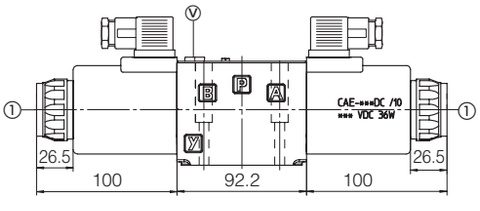


Option /WP



Mass: 4,5 kg

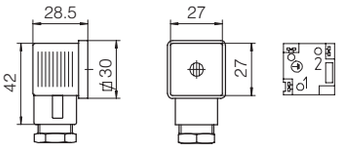
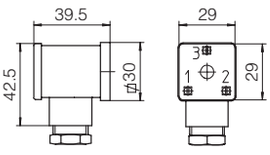
DKE-17*-DC



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
Ⓥ Bleed screw

13 ELECTRIC CONNECTORS ACCORDING TO DIN 43650 (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 All voltages	**667** 24 AC or DC 110 AC or DC 220 AC or DC **669** 110/50 AC 110/60 AC 230/50 AC 230/60 AC

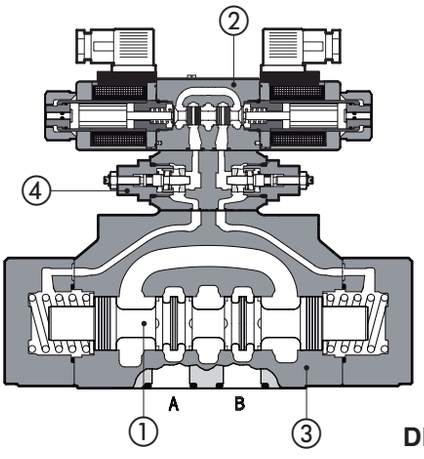
14 MOUNTING SUBPLATES

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 type DPHI and DPHE

two stage, ISO 4401 size 10, 16, 25 and 32



DPHE-471*/H

Spool type, two stage directional valves with solenoids certified according to North American standard **cURus**, available in two different executions:

- DPHI for AC and DC supply, solenoid pilot ② type DHI, see tech. table E010
- DPHE high performances, for AC and DC supply, solenoid pilot ② type DHE see tech. table E015

Single and double solenoids versions are available in two or three position configurations and with a wide range of interchangeable spools ①, see section 2.
Standard coils protection **IP65**.
The valve body is made by shell-moulding casting ③ with wide internal passages.
The valves can be supplied with optional devices, see section 4 for available options.

Mounting surface: **ISO 4401, size 10, 16, 25 and 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	**	/	*

DPH — Two stage directional control valve

Solenoid pilot valve:
I = DHI for AC and DC supply with **cURus** certified solenoids
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 4

X = without connector
See section 14 for available connectors, to be ordered separately
00 = solenoid valve without coils (for DPHI)
00-AC = AC solenoid valve without coils (for DPHE)
00-DC = DC solenoid valve without coils (for DPHE)

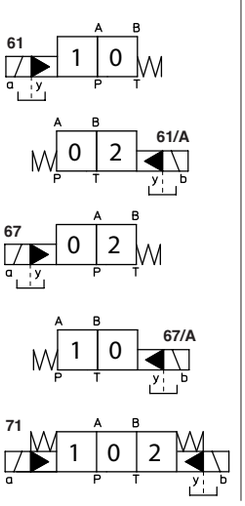
Voltage code, see section 5

Series number

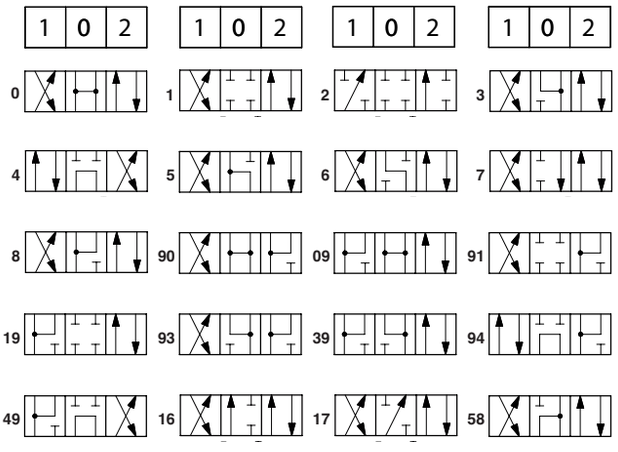
Seals material, see section 3:
- = NBR
PE = FKM
BT = HNBR

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1, for functional scheme, see section 4)

Configurations

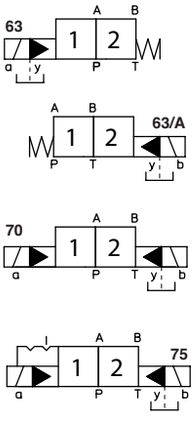


Spools

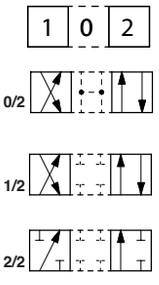


NOTES (see also section 4,2 for special shaped spools):
- For **DP*-1** are available only spools: **0, 0/2, 1, 1/2, 3, 4, 5, 58, 6, 7**
- For **DP*-6** are available only spools: **0, 1, 1/2, 2, 3, 4, 5, 58, 6, 7, 8, 19, 91**

Configurations



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 for all valves except for type -*70 (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	75 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		
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	
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 4) T = **250 bar** for external drain (standard) T and Y with internal drain (option /D) = **120 bar** DPHI; **210 bar** DPHE (DC); **160 bar** DPHE (AC) Ports Y and L (if required): 0 bar Minimum pilot pressure for correct operation is 8 bar		
Rated flow	See diagrams Q/Δp at section 6		
Maximum flow	DPH*-1: **160 l/min;** DPH*-2: **300 l/min;** DPH*-4: **700 l/min;** DPH*-6: **1000 l/min** (see rated flow at section 6 and operating limits at section 7)		

3.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils (all versions) and AC coils (only DPHI) **F** (155°C) for AC coils (only DPHE) 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 electric feature 5
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

4 NOTES

4.1 Options

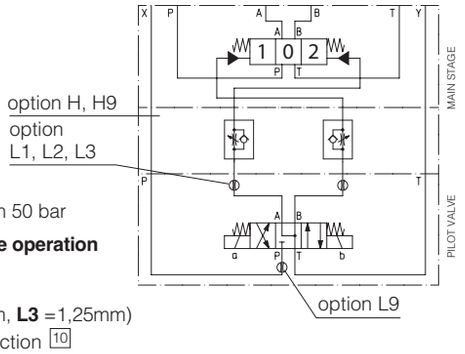
/A = Solenoid mounted at side of port A of main body (only for single solenoid valves).
In standard version, solenoid is mounted at side of port B.
/D = Internal drain (standard configuration is external drain)
/E = External pilot pressure (standard configuration is internal pilot pressure).
/FV = With proximity switch for spool position monitoring: see tab. E110.
/R = Pilot pressure generator (4 bar on port P - not for DPH*-1, see section 9.
/S = Main spool stroke adjustment (not for DPH*-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

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 DP-2 and DP-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

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



4.2 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	0/1	3/1	1/1	4/8	5/1	58/1	6/1	7/1
DPH*-1	•	•		•				
DPH*-2, DPH*-4	•	•	•	•	•	•	•	•
DPH*-6		•	•	•				

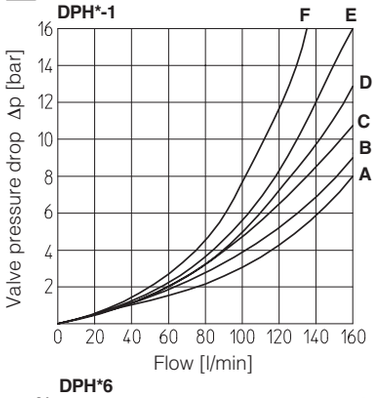
5 ELECTRIC FEATURES

Valve	External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption **(3)** DHI	DHE	Code of spare coil DPHI	Colour of coil label DPHI	DPHE
DPHI DPHE	6 DC	**6 DC** (4)	666 or 667	33 W	30 W	COU-6DC	brown	-
	12 DC	**12 DC**				COU-12DC	green	COE-12DC
	14 DC	**14 DC**				COU-14DC	brown	COE-14DC
	24 DC	**24 DC**				COU-24DC	red	COE-24DC
	28 DC	**28 DC**				COU-28DC	silver	COE-28DC
	48 DC	**48 DC**				COU-48DC	silver	COE-48DC
	110 DC	**110 DC**				COU-110DC	gold	COE-110DC
	125 DC	**125 DC**				COU-125DC	blue	COE-125DC
	220 DC	**220 DC**				COU-220DC	black	COE-220DC
	24/50 AC 24/60 AC	**24/50/60 AC** (4)		60 VA	-	COI-24/50/60AC (1)	pink	-
	48/50 AC 48/60 AC	**48/50/60 AC** (4)				COI-48/50/60AC (1)	white	-
	110/50 AC	**110/50/60 AC**			58 VA	COI-110/50/60AC (1)	yellow	COE-110/50/60AC
	115/60 AC (5)	**115/60 AC**		-	80 VA	-		COE-115/60AC
	120/60 AC (4)	**120/60 AC**		60 VA	-	COI-120/60AC	white	-
	230/50 AC	**230/50/60 AC**			58 VA	COI-230/50/60AC (1)	light blue	COE-230/50/60AC
	230/60 AC	**230/60 AC**			80 VA	COI-230/60AC	silver	COE-230/60AC
	110/50 AC 120/60 AC	**110RC**	669	33 W	30 W	COU-110RC	gold	COE-110RC
	230/50 AC 230/60 AC	**230RC**				COU-230RC	blue	COE-230RC

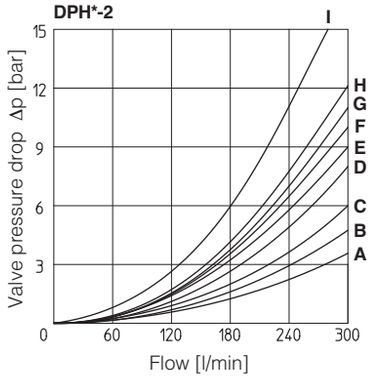
(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 55 VA (DPHI) and 58 VA (DPHE)
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.
(4) Only for DPHI
(5) Only for DPHE

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

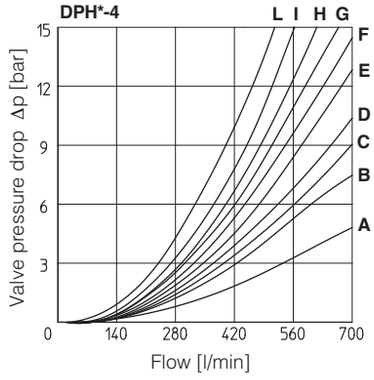
DPH*-1



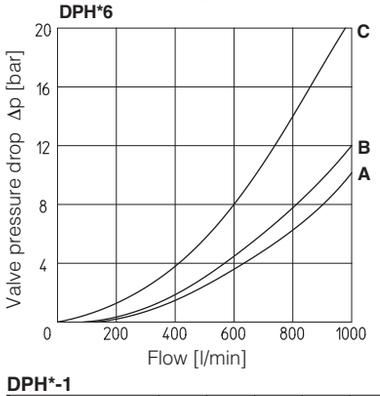
DPH*-2



DPH*-4



DPH*6



DPH*-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

DPH*-6

Spool type \ Flow direction	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

DPH*-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	-	-	-	-

DPH*-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	-	-

7 OPERATING LIMITS

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

DPH*-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

DPH*-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

DPH*-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

DPH*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

8 SWITCHING TIMES (average values in m sec)

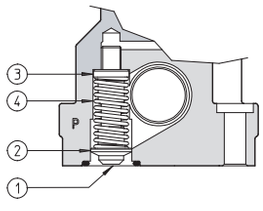
Valve model	Configuration		Piloting pressure 70 bar		140 bar		250 bar	
			Alternating current	Direct current	Alternating current	Direct current	Alternating current	Direct current
DPH*-1	71, 61, 67, 61*/A, 67*/A	Switch ON	35	50	30	45	20	35
		Switch OFF	50					
	63, 63*/A	Switch ON	50	75	40	65	30	50
		Switch OFF	80					
DPH*-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					
DPH*-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					
DPH*-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.

9 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

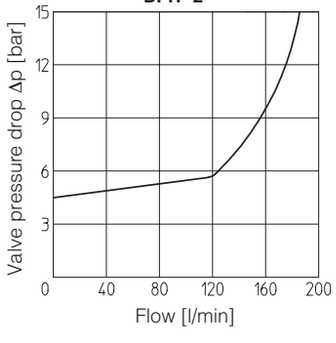
Ordering code of spare pilot pressure generator

R/DP - *****

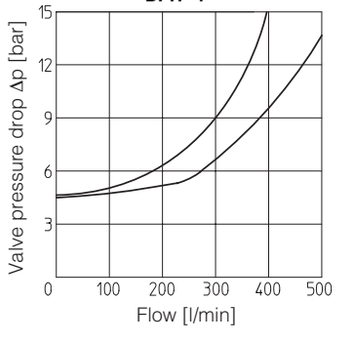
Pilot pressure generator

Size:
2 for DP-2
4 for DP-4
6 for DP-6

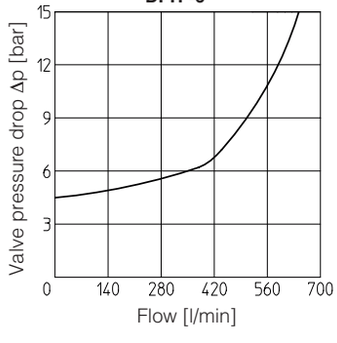
DPH*-2



DPH*-4



DPH*-6

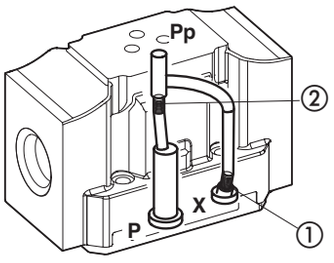


10 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

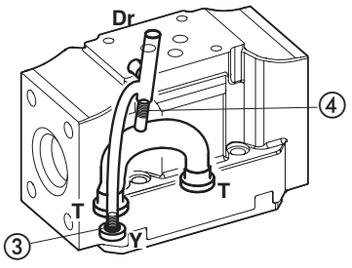
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external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

DPH*-1

Pilot channels



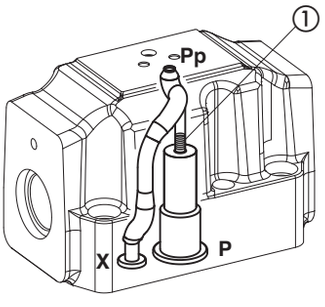
Drain channels



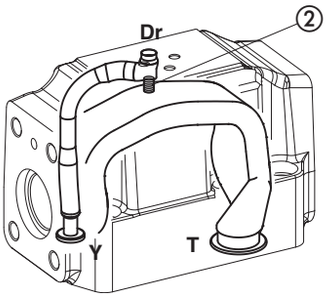
Internal piloting: blinded plug SP-X300F ① in X;
plug SP-X310F ② in Pp;
External piloting: blinded plug SP-X300F ② in Pp;
plug SP-X310F ① in X;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPH*-2

Pilot channels



Drain channels



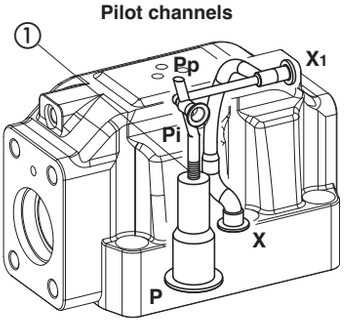
Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

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

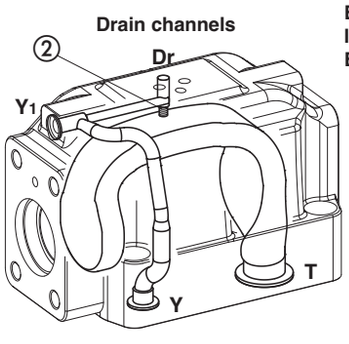
PLUG-12A

DPH*-4

Pilot channels

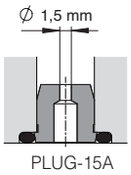


Drain channels



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.

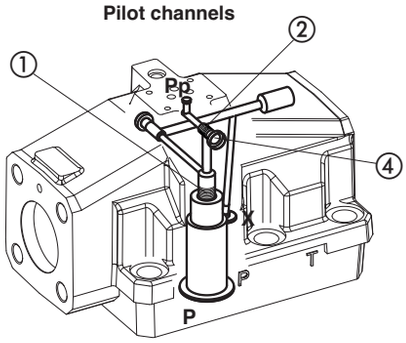
Option L9
This option provides a a calibrated restrictor PLUG-H-15A (Ø 1,5 mm) in the P port of the pilot valve



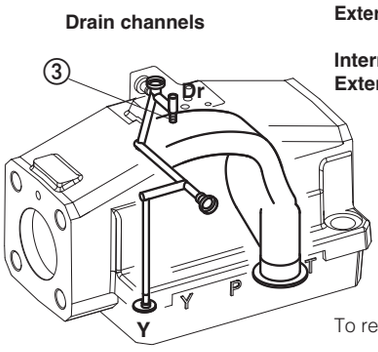
PLUG-15A

DPH*-6

Pilot channels



Drain channels



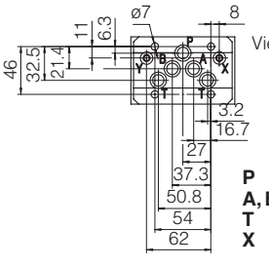
Internal piloting: Without plug ①;
plug SP-X325A in pos ②;
External piloting: Add DIN-908 M16x1,5 in pos ①;
plug SP-X325A in pos ②;
Internal drain: Without blinded plug SP-X300F ③;
External drain: Add blinded plug SP-X300F ③.

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

11 DIMENSIONS FOR DPH*-1 AND DPH*-2 [mm]

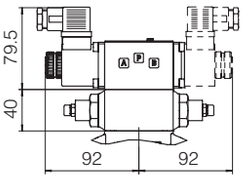
DPH*-1*

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

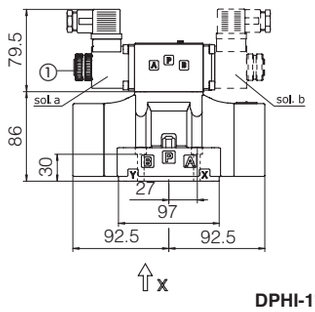


P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

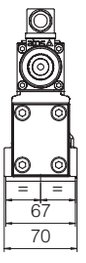
DPHI-1*/H /H9

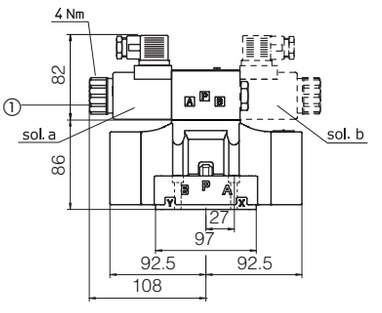


Mass (Kg)	
DPHI-16	6,8
DPHI-17	7,1
DPHE-16	6,9
DPHE-17	7,3
Option H, H9	+1,0



DPHI-1*



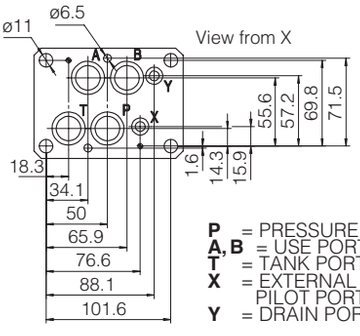


DPHE-1*

① Standard manual override PIN

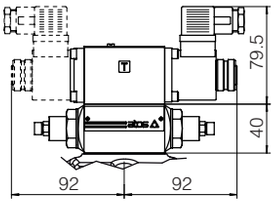
DPH*-2*

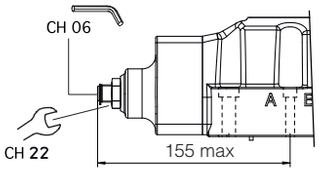
ISO 4401: 2005
Mounting surface: 4401-07-07-0-05
Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 20 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 130, 2 OR 2043



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

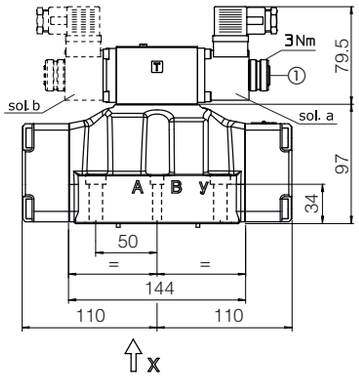
DPHI-2*/H /H9



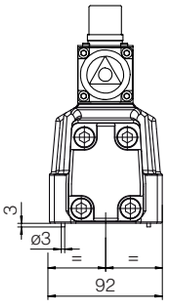


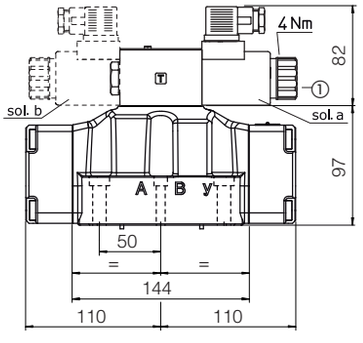
Stroke adjustment device for option /S

Mass (Kg)	
DPHI-26	9,8
DPHI-27	10,1
DPHE-26	9,9
DPHE-27	10,3
Option /S	+1,0
Option H, H9	+1,0



DPHI-2*





DPHE-2*

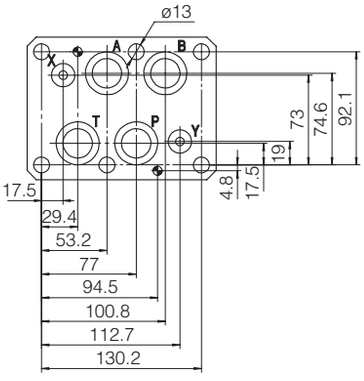
① Standard manual override PIN

Overall dimensions refer to valves with connectors type 666

12 DIMENSIONS FOR DPH*-4 [mm]

DPH*-4*

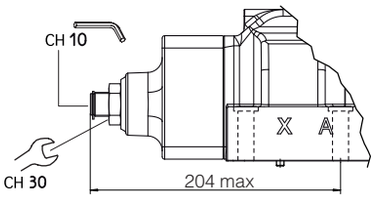
ISO 4401: 2005
Mounting surface: 4401-08-08-0-05 (see table P005)
Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Seals: 4 OR 4112; 2 OR 3056
Diameter of ports A, B, P, T: Ø = 24 mm;
Diameter of ports X, Y: Ø = 7 mm;



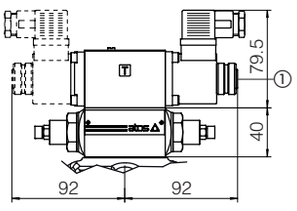
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT
For the max pressures on ports, see section

Mass (Kg)	
DPHI-46	17,3
DPHI-47	17,6
DPHE-46	17,4
DPHE-47	17,8
Option /S	+1,5
Option H, H9	+1,0

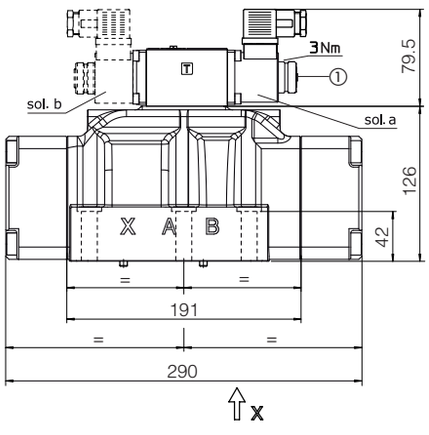
DPHI-4*
Stroke adjustment device for option /S

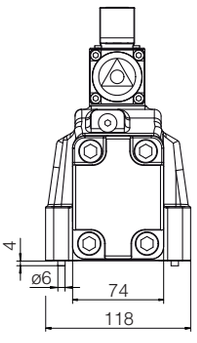


DPHI-4*/H /H9

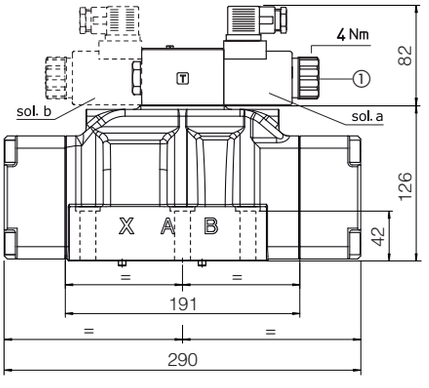


DPHI-4*





DPHE-4*



① Standard manual override PIN

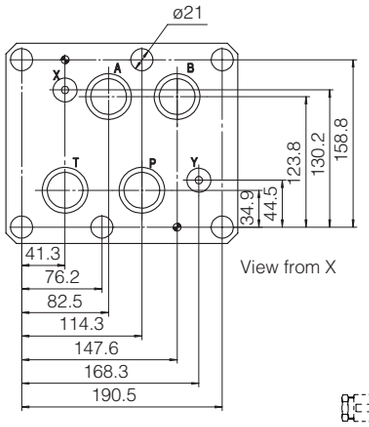
Overall dimensions refer to valves with connectors type 666

13 DIMENSIONS FOR DPH*-6 [mm]

DPH*-6*

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

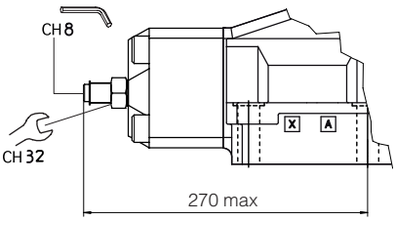
Fastening bolts:
6 socket head screws M20x80 class 12.9
Tightening torque = 600 Nm
Diameter of ports A, B, P, T: Ø = 34 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 144, 2 OR 3056



View from X

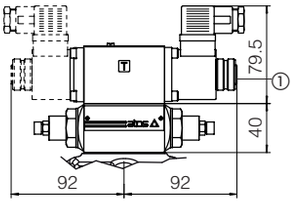
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL OIL PILOT PORT
Y = DRAIN PORT

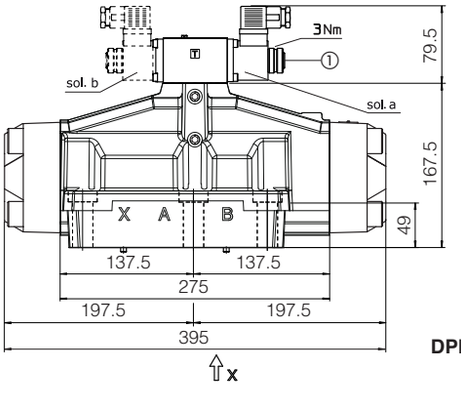
Stroke adjustment device for option/S



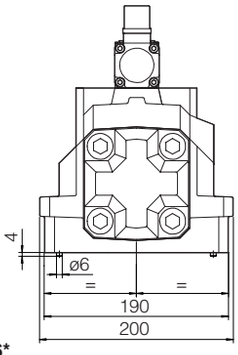
Mass (Kg)	
DPHI-66	43,8
DPHI-67	44,1
DPHE-66	44
DPHE-67	44,5
Option /S	+3,5
Option H, H9	+1,0

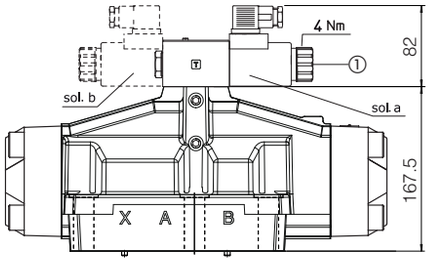
DPHI-6*/H /H9





DPHI-6*





DPHE-6*

① Standard manual override PIN

Overall dimensions refer to valves with connectors type 666

14 ELECTRONIC CONNECTORS ACCORDING TO DIN 43650 - the connectors must be ordered separately

Connector code	Function
666	Connector IP65, suitable for direct connection to electric supply source
667	As 666 connector IP65 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)

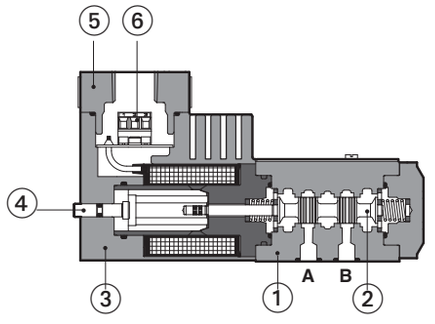
For other available connectors, see tab. E010, E015 and K500

15 MOUNTING SUBPLATES FOR DPH*-1, DPH*-2, DPH*-4 AND DPH*-6

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y	A, B, P, T	X, Y	
DPH*-1	BA-428	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	5,6
DPH*-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
DPH*-2	BA-418	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	3,5
DPH*-2	BA-518	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	8
DPH*-2	BA-519	Ports P, T, X, Y underneath; ports A, B on lateral side	G 1"	G 1/4"	46	21,5	8
DPH*-4	BA-508	Ports A, B, P, T, X, Y underneath;	G 1"	G 1/4"	46	21,5	7
DPH*-4	BA-509	Ports P, T, X, Y underneath; ports A, B on lateral	G 1"	G 1/4"	46	21,5	12,5
DPH*-6	BA-708	Ports A, B, P, T, X, Y underneath;	G 11/2"	G 1/4"	63,5	21,5	17

On-off ex-proof solenoid valves

multicertification ATEX, IECEx, EAC



DHA-06*

① valve body
② spool
③ ex-proof solenoid
④ manual override
⑤ threaded connections for cable gland or conduit pipe
⑥ internal terminal board for cable connection

On/off valves equipped with explosion-proof solenoids available with following multicertifications:

Multicertification for solenoids group II for surface plants with gas, vapours and dust environment

- ATEX 2014/34/UE
  Ex II 2G Ex d IIC T6/T4 Gb
  Ex II 2D Ex tb IIIC T85°C/T135°C Db
- IECEx worldwide recognized certification
  Ex d IIC T6/T4 Gb
  Ex tb IIIC T85°C/T135°C Db
- EAC EurAsian Certification
  Ex II 2G Exd IIC T6/T4

Multicertification for solenoids group I for surface, tunnels or mining plants

- ATEX 2014/34/UE: Ex I M2 Ex db I Mb
- IECEx: Ex db I Mb

DHA and DLAH are **SIL** compliance with IEC 61508 (TÜV certified) - see section 3.6

The solenoid case is designed to contain the possible explosion which could be caused by the presence of the gas mixture inside the housing, thus avoiding dangerous propagation in the external environment. They are also designed to limit the external temperature according to the certified class to avoid the self ignition of the explosive mixture present in the environment.

1 EX-PROOF SOLENOIDS: MAIN DATA

SOLENOID TYPE			
Solenoid code	Multicertification for Group II		OA
	Multicertification for Group I (mining)		OAM
Voltage code	VDC	±10%	**12DC, 24DC, 28DC, 48DC, 110DC, 125DC, 220DC**
	VAC 50/60 Hz	±10%	**12AC, 24AC, 110-120AC, 230-240AC (1)**
Power consumption			8W
Coil insulation			Class H
Protection degree			IP 66/67 According to IEC 144 when correctly coupled with the relevant cable gland PA*, see section 16
Duty factor			100%
Mechanical construction			Flame proof housing classified Ex d, according to EN 60079-0: 2006, EN 60079-1: 2007
Cable entrance and electrical wiring			Internal terminal board for cable connection. Threaded connection for cable entrance, vertical (standard) or horizontal (option /O). See section 16 for cable gland and wiring
Method of protection			Ex d
Temperature class (only for Group II)			**T6** / **T4**
Surface temperature	Multicertification for Group II		≤ 85 °C / ≤135 °C
	Multicertification for Group I (mining)		150 °C
Ambient temperature	Multicertification for Group II		-40 ÷ +45 °C **(2)** / -40 ÷ +70 °C **(2)**
	Multicertification for Group I (mining)		-20 ÷ +70

(1) For alternating current supply a rectifier bridge is provided built-in the solenoid
(2) The Group II solenoids are certified according to ATEX and IECEx for minimum ambient temperature -40°C.
In case the complete valve must withstand with minimum ambient temperature of -40°C, select **/BT** in the model code

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

Assembly position / location	Any position for all valves		
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)		
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 (β10 ≥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 MULTICERTIFICATIONS

In the following are resumed the valves marking according to multicertifications for Group II and Group I (mining)

3.1 GROUP II, ATEX marking

II 2 G = Solenoid for surface plants with gas and vapors environment, category 2, suitable for zone 1 and zone 2
Ex d = Explosion-proof equipment
II C = Equipment of group IIC suitable for substances (gas) of group IIC
T6/T4 = Solenoid temperature class (maximum surface temperature)
Gb = Equipment protection level, high level protection for explosive Gas atmospheres
CE = Mark of conformity to the applicable European directives
II 2 D = Solenoid for surface plants with dust environment, category 2, suitable for zone 21 and zone 22
Ex d = Explosion-proof equipment
III C = Suitable for conductive dust (applicable also IIIB and/or IIIA)
IP66/67 = Protection degree
T85/T135 = Maximum surface temperature (Dust)
Db = Equipment protection level, high level protection for explosive Dust atmospheres
Ex = Mark of conformity to the 94/9/CE directive and to the technical norms

3.2 GROUP II, IECEx marking

Ex d = Explosion-proof equipment
IIC = Equipment of group IIC suitable for substances (gas) of group IIC
T6/T4 = Solenoid temperature classes (Gas)
Gb = Equipment protection level, high level protection for explosive Gas atmospheres
Ex tb = Equipment protection by enclosure"tb"
IIIC = Suitable for conductive dust (applicable also IIIB and/or IIIA)
T85°C/T135°C = Maximum surface temperature (Dust)
Db = Equipment protection level, high level protection for explosive Dust atmospheres
IP66/67 = Protection degree

3.3 EAC marking

EAC (EurAsian certification) acknowledges the whole ATEX Directive 2014/34/EU.
This certification is available only for gas environment (not for dust).

II 2 G = Solenoid for surface plants with gas and vapors environment, category 2, suitable for zone 1 and zone 2
Ex d = Explosion-proof equipment
II C = Equipment of group IIC suitable for substances (gas) of group IIC
T6/T4 = Solenoid temperature class (maximum surface temperature)
Ex = Mark of conformity to the 94/9/CE directive and to the technical norms

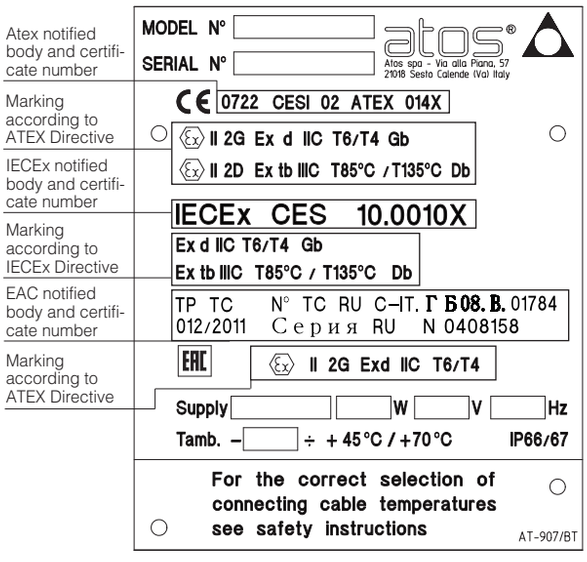
3.4 GROUP I, ATEX (mining)

Ex = ATEX identification for explosive atmospheres equipments
I = Group I for mines and surface plants
M2 = High protection (equipment category)
Ex db = Explosion-proof equipment
I = Gas group (Methane)
Mb = Equipment protection level, high level protection for explosive atmospheres
IP66/67 = Protection degree

3.5 GROUP I, IECEx (mining)

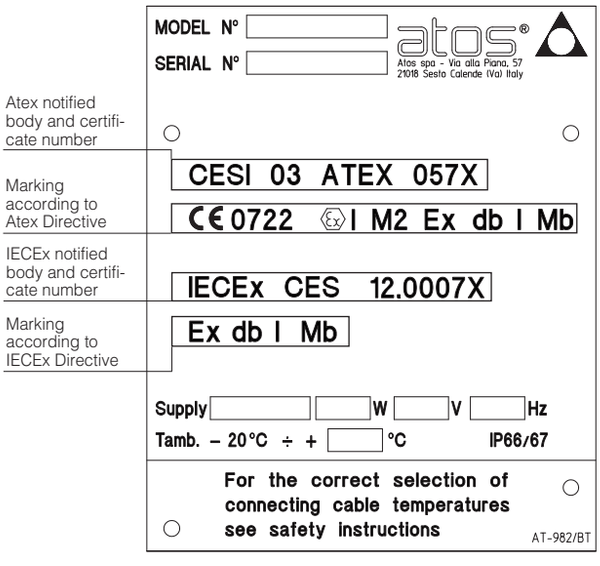
Ex db = Explosion-proof equipment
I = Gas group (Methane)
Mb = Equipment protection level, high level protection for explosive atmospheres
IP66/67 = Protection degree

EXAMPLE OF NAMEPLATE MARKING



Note:
According to EN60079-0 the valves with Atex certification can be coated with a non-metallic material (for ex. paintened), observing the maximum thickness:
Group IIC = 0,2 mm max

EXAMPLE OF NAMEPLATE MARKING



3.6 SIL compliance with IEC 61508: 2010

DHA and DLAH (multicertified for surface and mining) meets the requirements of:
- **SC3** (systematic capability)
- max **SIL 2** (HFT = 0 if the hydraulic system does not provide the redundancy for the specific safety function where the component is applied)
- max **SIL 3** (HFT = 1 if the hydraulic system provides the redundancy for the specific safety function where the component is applied)

WARNING: service work provided on the valve by the end users or not qualified personnel invalidates the certification

4 MODEL CODE OF SPOOL TYPE, DIRECT SOLENOID VALVES

DHA	/	*	-	0	63	1/2	/	GK	/	*	24DC	**	/	*

DHA = spool type - direct

Optional multicertifications
- = omit for Group II
M = Group I (mining)

Valve size (ISO 4401)
for DHA **0** = 06

Valve configuration, see section 5

Spool type, see section 5

Solenoid threaded connection for cable gland:
GK = GK-1/2" ISO/UNI-6125 (tapered)
NPT = 1/2" NPT ANSI B2.1 (tapered)
M = M20x1,5 UNI-4535 (6H/6g)

Options:
A = solenoid at side of port B (for single solenoid valves)
MV = vertical hand lever **(2)**
O = horizontal cable entrance **(1)**
WP = prolongued manual override protected by metallic cap

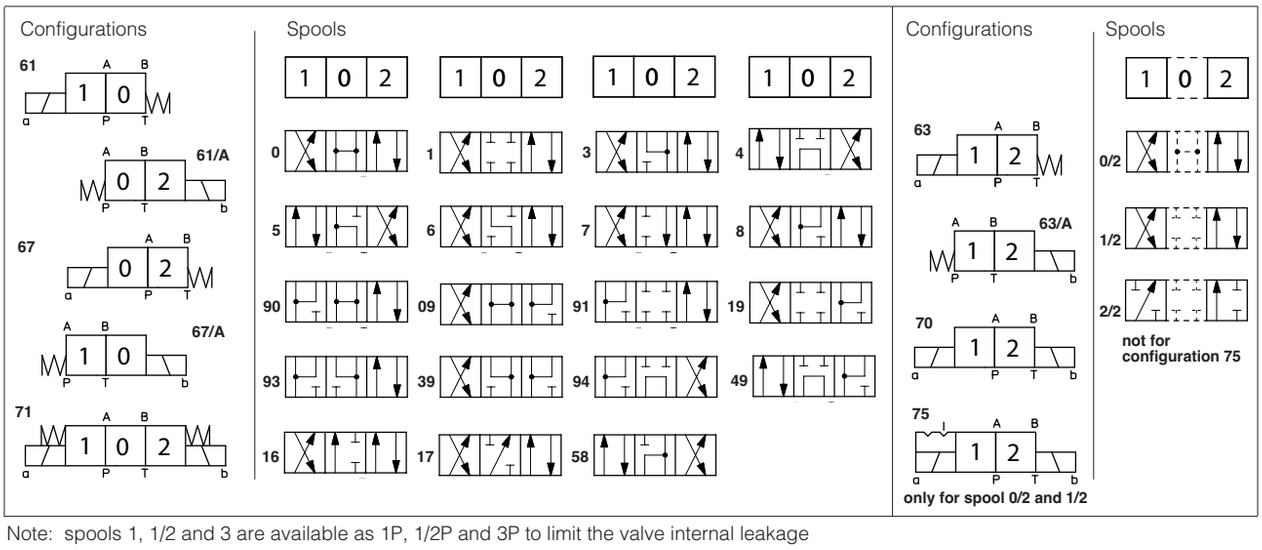
Voltage code - see section 1

Series number

Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

(1) Not for multicertification **M** group I (mining)
(2) Available only for DHA, configuration 61, 63, 71 and spool type 0, 0/2, 1, 1P, 1/2, 1/2P, 3, 3P, 4, 7

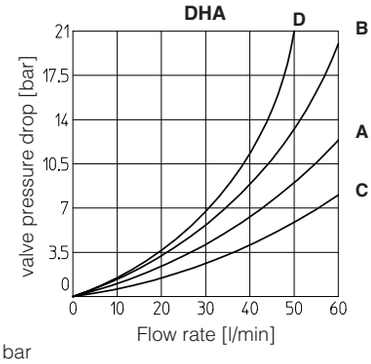
5 CONFIGURATIONS and SPOOLS for DHA valves

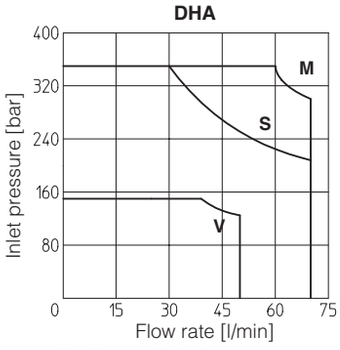


Note: spools 1, 1/2 and 3 are available as 1P, 1/2P and 3P to limit the valve internal leakage

6 Q/Δp DIAGRAMS AND OPERATING LIMITS OF DHA (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	C	C	C	C	
0/2, 1, 1/2	A	A	A	A	
3	A	A	C	C	
4, 5	D	D	D	D	A
6	A	A	C	A	
7	A	A	A	C	
8	C	C	B	B	





PRESSURE LIMITS: P, A, B = 350 bar; T = 210 bar

M = Spools 0, 1, 8;
S = Spools 0/2,1/2, 3, 6, 7;
V = Spools 4, 5

7 MODEL CODE OF SPOOL TYPE, PILOTED SOLENOID VALVES

DPHA	/	*	-	2	63	1/2	/	GK	/	*	24DC	**	/	*

DPHA = spool type - piloted

Optional multicertifications
- = omit for Group II
M = Group I (mining)

Valve size (ISO 4401)
for DPHA **1** = 10 **2** = 16
4 = 25 **6** = 32

Valve configuration, see section 8

Spool type, see section 8

Solenoid threaded connection for cable gland:
GK = GK-1/2" ISO/UNI-6125 (tapered)
NPT = 1/2" NPT ANSI B2.1 (tapered)
M = M20x1,5 UNI-4535 (6H/6g)

Options:
A = solenoid at side of port B (for single solenoid valves)
O = horizontal cable entrance **(1)**
WP = prolongued manual override protected by metallic cap
/D = Internal drain
/E = external pilot pressure
/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)
/L9 = (only for DPHA-2 and DPHA-4) plug with calibrated restrictor on port P of pilot valve
/R = pilot pressure generator (not for DPHA-1)
/S = main spool stroke adjustment (not for DPHA-1)

Voltage code - see section 1

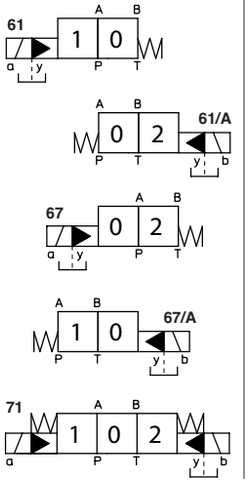
Series number

Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

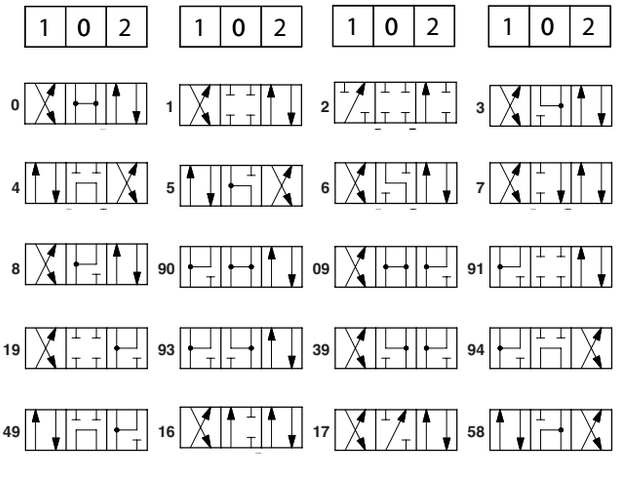
(1) Not for multicertification **M** group I (mining)

8 CONFIGURATIONS and SPOOLS for DPHA valves

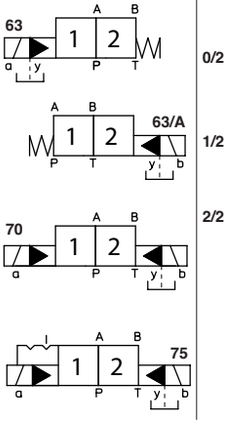
Configurations



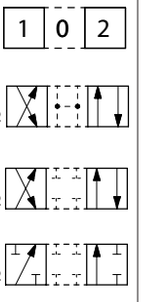
Spools



Configurations



Spools



NOTES: - 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, 2, 3, 4, 5, 58, 6, 7, 8, 19, 91**

9 MODEL CODE OF POPPET TYPE LEAK FREE DIRECTIONAL SOLENOID VALVES

DLAH / * - **2** **A** / **GK** / * **24DC** / ** / *

Directional control valve poppet type, size 06
DLAH = max flow 12 l/min
DLAHM = max flow 30 l/min

Optional multicertifications
- = omit for Group II
M = Group I (mining)

2 = two way (only for DLAH)
3 = three way

Valve configuration, see section 10
A = open in rest position
C = closed in rest position

Solenoid threaded connection for cable gland:
GK = GK-1/2" ISO/UNI-6125 (tapered)
NPT = 1/2" NPT ANSI B2.1 (tapered)
M = M20x1,5 UNI-4535 (6H/6g)

Options:
O = horizontal cable entrance **(1)**
R = with check valve on port P (only for DLAH)
WP = prolongued manual override protected by metallic cap

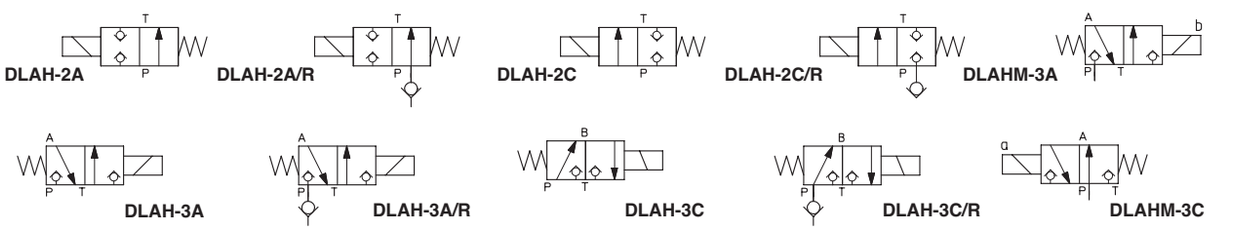
Voltage code - see section 1

Series number

Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

(1) Not for multicertification **M** group I (mining)

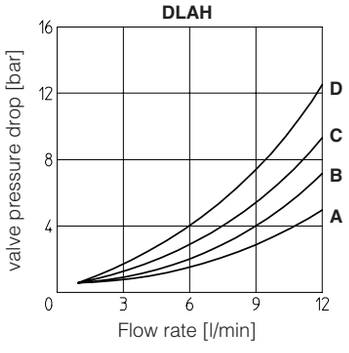
10 CONFIGURATION OF DLAH AND DLAHM

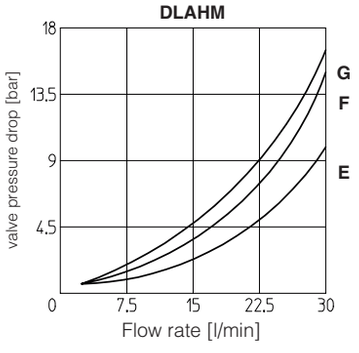


11 Q/Δp DIAGRAMS AND OPERATING LIMITS OF DLAH AND DLAHM (based on mineral oil ISO VG 46 at 50°C)

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

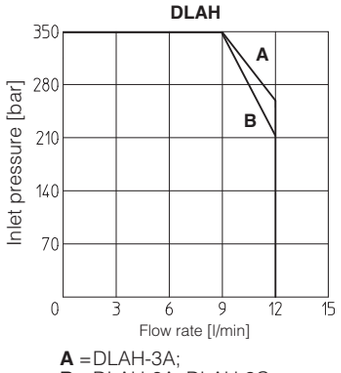
(1) For two-way valves pressure drop refers to P→T



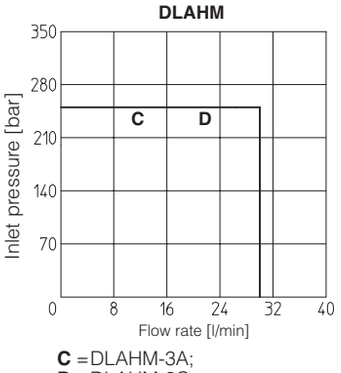


INTERNAL LEAKAGE of DLAH and DLAHM less than 5 drops/min (0,36 cm³/min) at max pressure

PRESSURE LIMITS:
P, A, B = 350 bar; T = 210 bar



A = DLAH-3A;
B = DLAH-2A, DLAH-3C



C = DLAHM-3A;
D = DLAHM-3C

12 MODEL CODE OF PRESSURE RELIEF VALVES

AGAM	-	20	/	2	0	/	210/100/100	/	NPT	-	AO	/	*	24DC	**	/	*

AGAM = pressure relief valve: subplate mounting, see tab. C066
ARAM = pressure relief valve: threated connections, see tab. C045

Valve size
for AGAM: **10** (ISO 6264)
20 (ISO 6264)
32 (ISO 6264)
for ARAM: **20** = G 3/4”
32 = G 1 1/4”

Number of the different setting pressure values:
1 = one setting pressure
2 = two setting pressure
3 = three setting pressure

Valve configuration
0 = venting with de-energized solenoid
1 = venting with energized solenoid
2 = without venting

Max regulated pressure of first (second / third) setting see sect. 13

Solenoid threated connection for cable gland:
GK = GK-1/2” ISO/UNI-6125 (tapered)
NPT = 1/2” NPT ANSI B2.1 (tapered)
M = M20x1,5 UNI-4535 (6H/6g)

Certification type
AO = Multicertification for Group II
AO/M = Multicertification for Group I (mining)

Options:
E = external pilot
O = horizontal cable entrance **(1)**
V = regulating handweel
WP = prolongued manual override protected by metallic cap
Y = external drain

Voltage code - see section 1

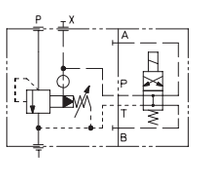
Series number

Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

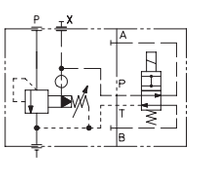
(1) Not for multicertification **M** group I (mining)

13 HYDRAULIC CHARACTERISTICS

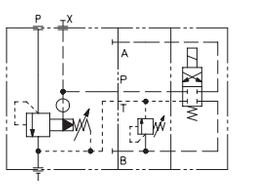
AGAM-/10**
ARAM-/10**



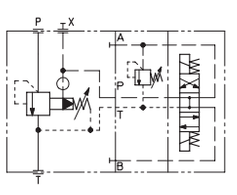
ARAM-/10**
AGAM-/11**



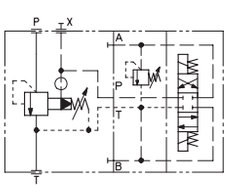
AGAM-/22**
ARAM-/22**



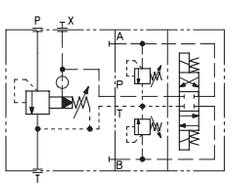
AGAM-/20**
ARAM-/20**



AGAM-/21**
ARAM-/21**



AGAM-/32**
ARAM-/32**



Valve model		**Size 10**	**Size 20**	**Size 32**
Setting		**50; 100; 210; 350**		
Max pressure port P	[bar]	350		
Pressure range	[bar]	4÷50; 6÷100; 7÷210; 8÷350		
Max flow **AGAM**	[l/min]	200	400	600
Max flow **ARAM**	[l/min]	-	350	500

14 MODEL CODE OF COVERS FOR CARTRIDGE VALVES

LIDEW	-	1	/	GK	-	AO	/	*	24DC	**	/	*	*

Cover type:
LIDBH* = with solenoid valve and shuttle valve for pilot selection
LIDEW* = with solenoid valve for pilot selection
* = valve configuration (see H030 section 2)

Size (ISO 7368)
1 = 16; **4** = 40;
2 = 25; **5** = 50;
3 = 32; **6** = 63;

Solenoid threaded connection for cable gland:
GK = GK-1/2" ISO/UNI-6125 (tapered)
NPT = 1/2" NPT ANSI B2.1 (tapered)
M = M20x1,5 UNI-4535 (6H/6g)

Certification type
AO = Multicertifications for Group II,
AO/M = Multicertifications for Group I, ATEX (mining)

Options:
B = cartridge piloted via port "B" of solenoid pilot valve
E = external attachments X (1/4" GAS) and underneath port X supplied plugged (only for sizes 40...63)
O = horizontal cable entrance **(1)**
WP = prolongued manual override protected by metallic cap

Voltage code - see section 1

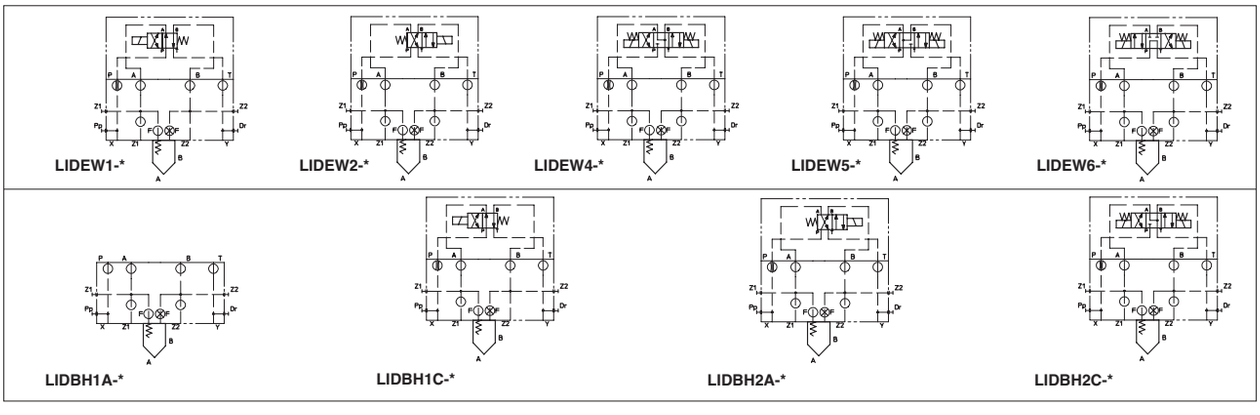
Series number

Seals material, see section 2:
- = NBR
PE = FKM
BT = HNBR

Optional different provision or setting of the calibrated plugs in the pilot channels see table H030 sect. 6

Note: for the code of the ISO cartridge to use with the above covers see tab. H003, section 2 and tab. H030, section 3
(1) Not for multicertification **M** group I (mining)

15 HYDRAULIC SYMBOLS



16 CABLE GLANDS AND WIRING

16.1 Cable glands

Cable glands with threaded connections GK-1/2", 1/2"NPT or M20x1,5 for standard or armoured cables have to be ordered separately, see tech. table **K600**

16.2 Terminal board for cable connection

PCB 3 poles terminal board suitable for wires cross sections up to 2,5 mm² (max AWG14)

1 = Coil
2 = GND
3 = Coil

16.3 Wiring specifications

Power supply: section of coil connection wires = 2,5 mm²

Grounding: section of internal ground wire = 2,5 mm²

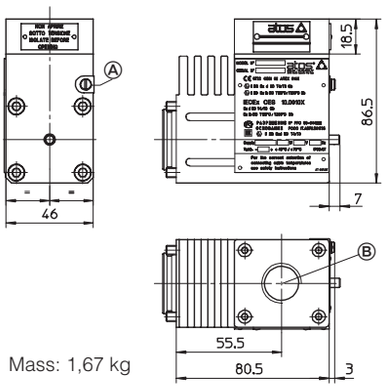
additional equipotential grounding can be also performed by the user on the external facility provided on the solenoid case. section of external ground wire = 4 mm²

The cable must be suitable for the working temperature as specified in the "safety instructions" delivered with the first supply of the products.

Max ambient temperature [°C]	Temperature class	Surface temperature [°C]	Cable temperature
45 °C	T6	85 °C	not prescribed
70 °C	T4	135 °C	90 °C

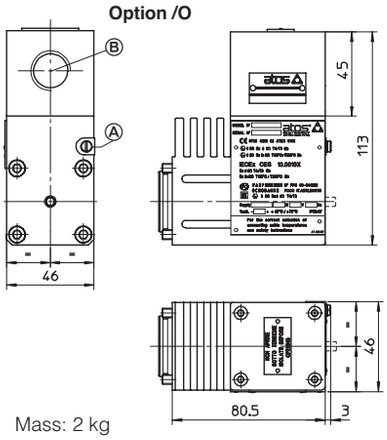
17 SOLENOIDS DIMENSIONS AND WIRING

OA; **OA/M**



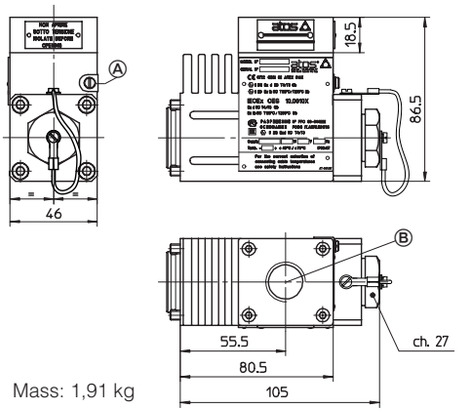
Mass: 1,67 kg

Option /O



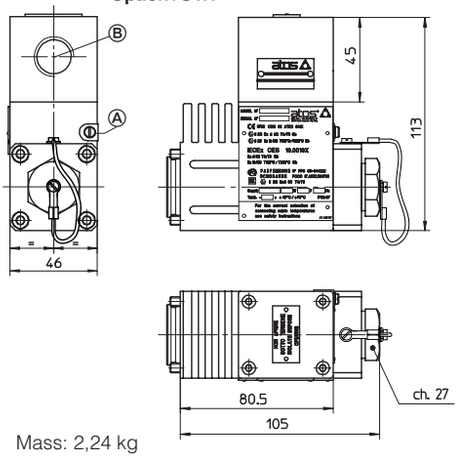
Mass: 2 kg

Option /WP



Mass: 1,91 kg

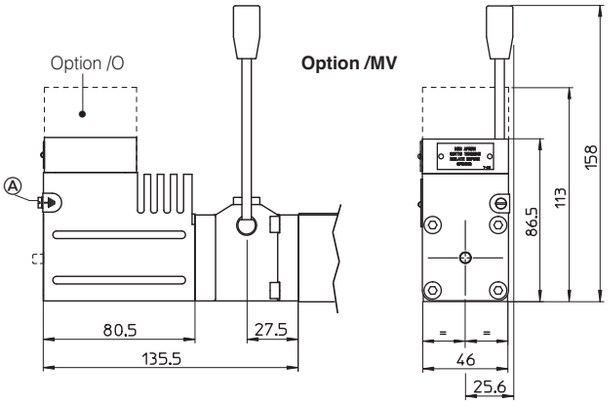
Option /OWP



Mass: 2,24 kg

Option /O

Option /MV

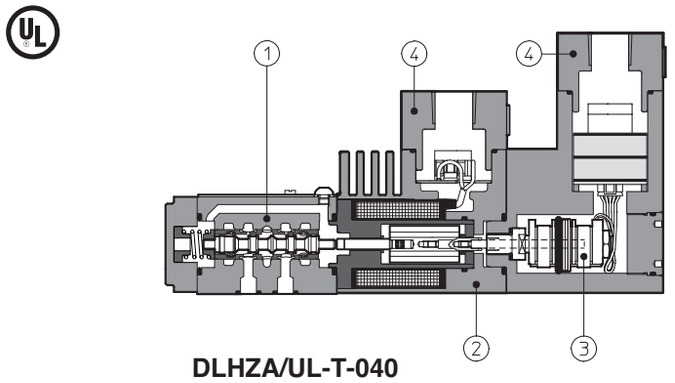


Ⓐ = screw terminal for additional equipotential grounding

Ⓑ = Cable entrance for solenoid wiring

Explosion-proof solenoid valves

on/off and proportional controls - cULus certification



DLHZA/UL-T-040

① valve body
② ex-proof solenoid
③ ex-proof transducer (only for proportional -T valves)
④ threaded connections for conduit pipe

Explosion-proof on/off and proportional solenoids certified **cULus** according to UL 1203 and UL429, CSA 22.2 n°30-1986 and CSA 22.2 n°139-13.

These solenoids are applied to hydraulic valves for application in explosion-hazardous environments.

The solenoid case is designed to contain the possible explosion which could be caused by the presence of the gas mixture inside the housing, thus avoiding dangerous propagation in the external environment.

They are also designed to limit the external temperature according to the certified class to avoid the self ignition of the explosive mixture present in the environment.

DHA and DLAH valves are **SIL** compliance with IEC 61508 (TÜV certified) - see section 3.2

1 EXPLOSION PROOF SOLENOIDS: MAIN DATA

SOLENOID TYPE			PROPORTIONAL without transducer	PROPORTIONAL with transducer	ON-OFF
Solenoid code			OZAUL-A	OZAUL-T	OAUL
Voltage code	VDC	±10%	**12 DC, 24 DC**	**12 DC**	**12DC, 24DC, 110DC, 125DC, 220DC**
	VAC 50/60 Hz	±10%	–		**12AC, 24AC, 110-120AC, 230-240AC (1)**
Power consumption			35W		12W
Coil insulation			Class H		
Protection degree			IP 67 According to IEC 144 when correctly coupled with the relevant conduit pipe		
Duty factor			100%		
Mechanical construction			Flame proof housing classified, according to UL 1203 and UL429, CSA 22.2 n°30-1986 and CSA 22.2 n°139-13		
Cable entrance and electrical wiring			Connection 1/2" NPT (ANSI/ASME B46.1) for cable gland internal terminal board for cable connection		

(1) For alternating current supply a rectifier bridge is provided built-in the solenoid

2 EXPLOSION PROOF SOLENOIDS: TEMPERATURE DATA

SOLENOID TYPE	PROPORTIONAL		ON/OFF	
Method of protection	Ex d			
Temperature class	T4 (≤ 135°C)	T3 (≤ 200°C)	T6 (≤ 85°C)	T5 (≤ 100°C)
Ambient temperature	-40 ÷ +55	-40 ÷ +70	-40 ÷ +55	-40 ÷ +70
Surface temperature	≤135 °C		≤ 85 °C	

3 CERTIFICATIONS

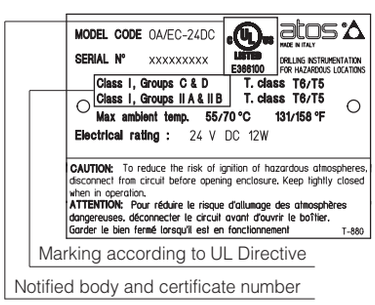
In the following is resumed the valves marking according to UL certification

Class I = Equipment for famable gas and vapours
Division 1 = Possibility of explosive atmosphere during normal functioning
Groups C&D = Atmosphere containing flamable gas
Groups IIA&IIB = Gas group
T6/T5 = Temperature class of solenoid surface referred to +55°C / +70°C ambient temperature

3.2 SIL compliance with IEC 61508: 2010

DHA/UL and DLAH/UL meets the requirements of:
- **SC3** (systematic capability)
- max **SIL 2** (HFT = 0 if the hydraulic system does not provide the redundancy for the specific safety function where the component is applied)
- max **SIL 3** (HFT = 1 if the hydraulic system provides the redundancy for the specific safety function where the component is applied)

3.1 EXAMPLE OF NAMEPLATE MARKING



4 MODEL CODE OF SPOOL TYPE ON-OFF DIRECTIONAL SOLENOID VALVES

DHA / UL – 0 63 1/2 / NPT / * 24DC ** /*

DHA = spool type - direct
DPHA = spool type - piloted

UL = C UL US certification

Valve size (ISO 4401)
for DHA **0** = 06
for DPHA **1** = 10 **2** = 16 **4** = 25 **6** = 32

Valve configuration, DHA see section 5 and DPHA see section 6

Spool type, DHA see section 5 and DPHA see section 6

Solenoid threated connection:
NPT = 1/2" NPT ANSI/ASME B46.1 (tapered)

Voltage code - see section 1

Series number

Seals material:
omit for NBR (mineral oil & water glycol)
PE = FPM
Low temperature execution:
BT = low temperature -40°C

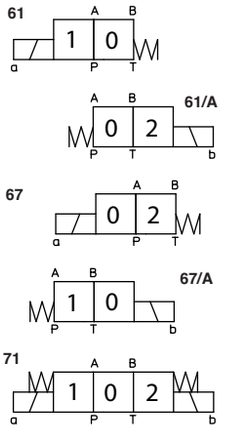
Options:
A = solenoid at side of port B (for single solenoid valves)
O = horizontal cable entrance
MV = vertical hand lever (1)
WP = prolongued manual override protected by metallic cap

Only for DPHA:
/D = Internal drain
/E = External pilot pressure
/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)
/L9 = (only for DPHA-2 and DPHA-4) plug with calibrated restrictor on port P of pilot valve
/S = Main spool stroke adjustment (only for DPHA-2, -4)

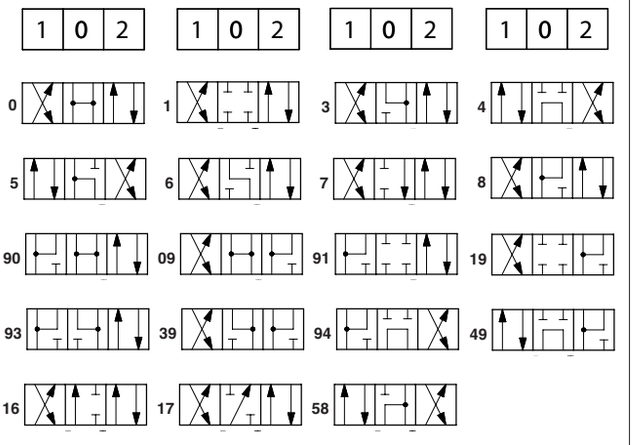
(1) Option **/MV** available only for DHA, configuration 61, 63, 71 and spool type 0, 0/2, 1, 1P, 1/2, 1/2P, 3, 3P, 4, 7

5 CONFIGURATIONS and SPOOLS for DHA valves

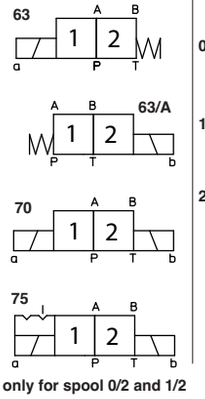
Configurations



Spools

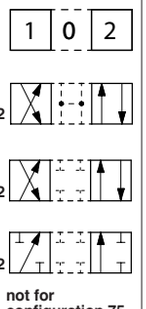


Configurations



only for spool 0/2 and 1/2

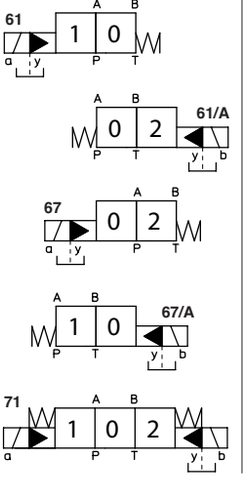
Spools



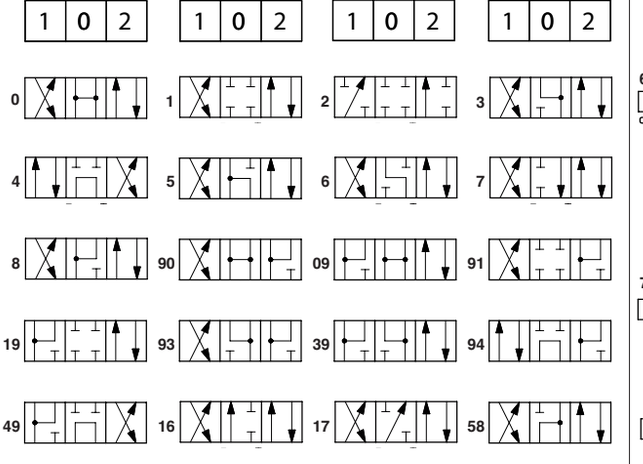
not for configuration 75

6 CONFIGURATIONS and SPOOLS for DPHA valves

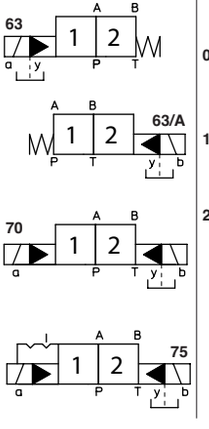
Configurations



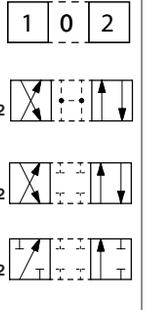
Spools



Configurations



Spools



NOTES:
- 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, 2, 3, 4, 5, 58, 6, 7, 8, 19, 91**

7 MODEL CODE OF POPPET TYPE, LEAK FREE, DIRECTIONAL SOLENOID VALVES

DLAH /UL – 2 A / NPT / * 24DC ** /*

Directional control valve poppet type, size 06
DLAH = max flow 12 l/min
DLAHM = max flow 30 l/min

UL = C UL US certification

2 = two way (only for DLAH)
3 = three way

Valve configuration, see section 8
A = open in rest position
C = closed in rest position

Solenoid threated connection:
NPT = 1/2" NPT ANSI/ASME B46.1 (tapered)

Options:
O = horizontal cable entrance
R = with check valve on port P (only for DLAH)
WP = prolongued manual override protected by metallic cap

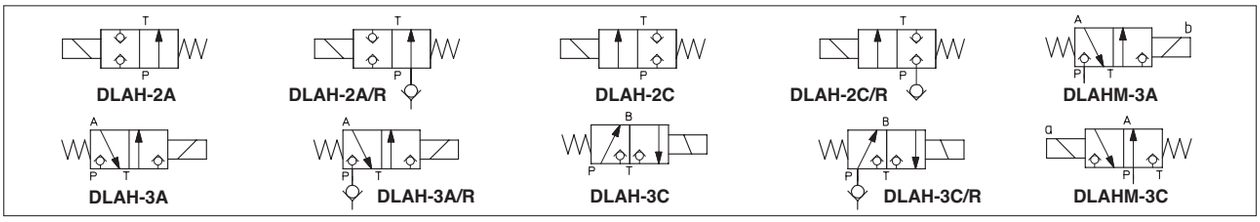
Voltage code - see section 1

Series number

Seals material (1):
omit for NBR (mineral oil & water glycol)
PE = FPM

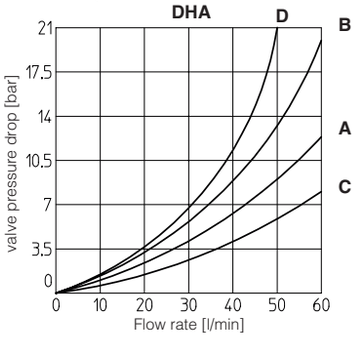
(1) Option **/BT** = low temperature -40°C also available on request

8 CONFIGURATION OF DLAH AND DLAHM



9 Q/Δp DIAGRAMS OF ON/OFF DIRECTIONAL CONTROLS (based on mineral oil ISO VG 46 at 50°C)

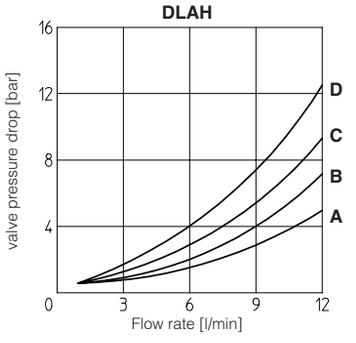
Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T
0	C	C	C	C	
0/2, 1, 1/2	A	A	A	A	
3	A	A	C	C	
4, 5	D	D	D	D	A
6	A	A	C	A	
7	A	A	A	C	
8	C	C	B	B	

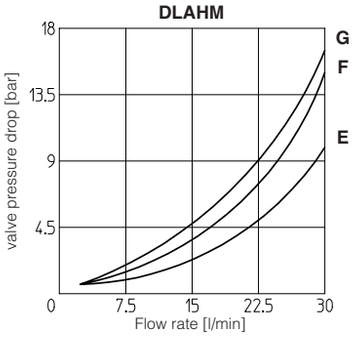


INTERNAL LEAKAGE of DLAH and DLAHM less than 5 drops/min (0,36 cm³/min) at max pressure.

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

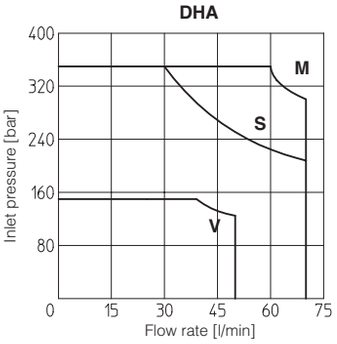
(1) For two-way valves pressure drop refers to P→T



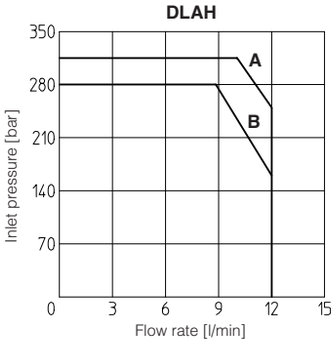


10 OPERATING LIMITS OF ON/OFF DIRECTIONAL CONTROLS (based on mineral oil ISO VG 46 at 50°C)

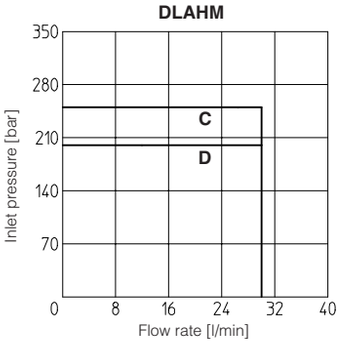
The diagram have been obtained with warm solenoids and power supply at lowest value (V_{nom}-10%). For DHA valves the curves refer to application with symmetrical flow through the valve (i.e. P → A and B → T). In case of asymmetric flow the operating limits must be reduced.



M = Spools 0, 1, 8; **V** = Spools 4, 5
S = Spools 0/2,1/2, 3, 6, 7;



A = DLAH-3A;
B = DLAH-2A, DLAH-3C



C = DLOK-3A;
D = DLAHM-3C

10.1 Max pressure in port T = 210 bar

11 MODEL CODE OF PRESSURE RELIEF VALVES

AGAM - 20 / 2 0 /210/100/100 / NPT - AO/UL / * 24 DC ** /*

AGAM = pressure relief valve: subplate mounting, see tab. C066
ARAM = pressure relief valve: threated connections, see tab. C045

Valve size
for AGAM: **10** (ISO 6264), **20** (ISO 6264), **32** (ISO 6264)
for ARAM: **20** = G 3/4", **32** = G 1 1/4"

Number of the different setting pressure values:
1 = one setting pressure
2 = two setting pressure
3 = three setting pressure

Valve configuration
0 = venting with de-energized solenoid
1 = venting with energized solenoid
2 = without venting

Max regulated pressure of first (second / third) setting
see section 12

Solenoid threated connection:
NPT = 1/2" NPT ANSI/ASME B46.1 (tapered)

AO/UL = C UL US certification

Options:
E = external pilot
O = horizontal cable entrance
V = regulating handweel
WP = prolongued manual override protected by metallic cap
Y = external drain

Voltage Code, see section 1

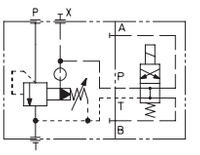
Series number

Seals material (1):
omit for NBR (mineral oil & water glycol)
PE = FPM

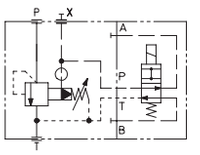
(1) Option **/BT** = low temperature -40°C also available on request

12 HYDRAULIC CHARACTERISTICS

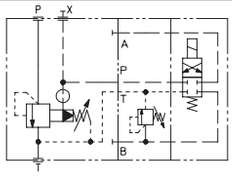
AGAM-/10**
ARAM-/10**



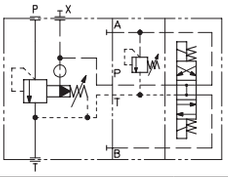
ARAM-/10**
AGAM-/11**



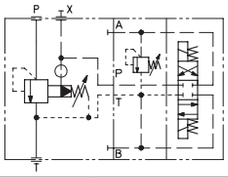
AGAM-/22**
ARAM-/22**



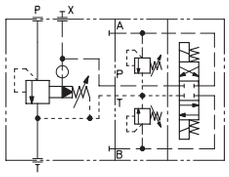
AGAM-/20**
ARAM-/20**



AGAM-/21**
ARAM-/21**



AGAM-/32**
ARAM-/32**



Valve model		**Size 10**	**Size 20**	**Size 32**
Setting			**50; 100; 210; 350**	
Max pressure port P	[bar]		350	
Pressure range	[bar]		4÷50; 6÷100; 7÷210; 8÷350	
Max flow **AGAM**	[l/min]	200	400	600
Max flow **ARAM**	[l/min]	-	350	500

13 MODEL CODE OF COVERS FOR CARTRIDGE VALVES

LIDEW - 1 / NPT - AO/UL - * 24DC ** /* *

Cover type:
LIDBH* = with solenoid valve and shuttle valve for pilot selection
LIDEW* = with solenoid valve for pilot selection
* = valve configuration (see H030 section 2))

Size (ISO 7368)
1 = 16; **2** = 25; **3** = 32; **4** = 40; **5** = 50; **6** = 63; **8** = 80 (only for LIDEW);

Solenoid threated connection:
NPT = 1/2" NPT ANSI/ASME B46.1 (tapered)

Certification type
AO/UL = C UL US certification

Options:
B = cartridge piloted via port "B" of solenoid pilot valve
E = external attachments X (1/4" GAS) and underneath port X supplied plugged (only forsizes 40...80)
O = horizontal cable entrance
WP = prolongued manual override protected by metallic cap

Voltage code - see section 1

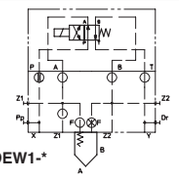
Series number

Seals material (1):
omit for NBR (mineral oil & water glycol)
PE = FPM

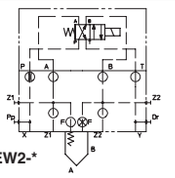
Optional different provision or setting of the calibrated plugs in the pilot channels see table H030 sect. 6

Note: for the code of the ISO cartridge to use with the above covers see tab. H003, section 2 and tab. H030, section 3.
(1) Option **/BT** = low temperature -40°C also available on request

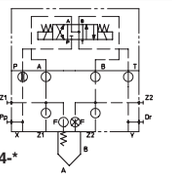
14 HYDRAULIC SYMBOLS



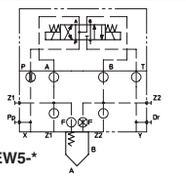
LIDEW1-*



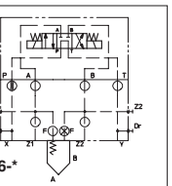
LIDEW2-*



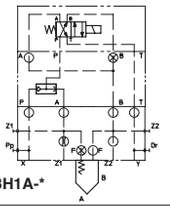
LIDEW4-*



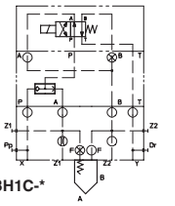
LIDEW5-*



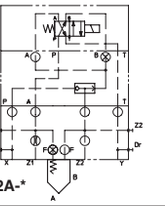
LIDEW6-*



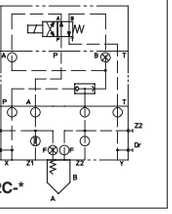
LIDBH1A-*



LIDBH1C-*



LIDBH2A-*



LIDBH2C-*