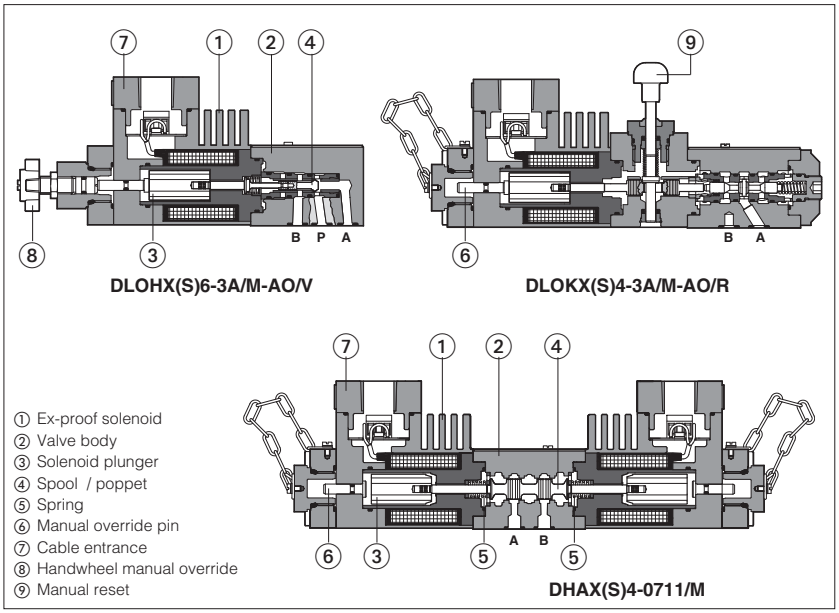
Stainless steel valves for corrosive environments & water base fluids

explosion-proof solenoid valves, with Atex, IECEx or C UL US certification and pressure relief valves



New line of directional solenoid valves and pressure relief valves in stainless steel execution for corrosive environments.
Stainless steel solenoids ①, ex-proof Atex, IECEx or C UL US, for hazardous areas -see section 3.

Two executions are available:
- **•X** stainless steel for external and internal parts, to withstand extreme and corrosive environmental conditions, and to ensure full compatibility also with water base and special fluids.
- **•XS** stainless steel for external parts to withstand extreme and corrosive environmental conditions. Internal components are derived from standard valves.

Directional valves are available in two basic versions: poppet type, 3-way leak free (suitable for accumulator systems) or spool type, 4-way on-off valves.

Explosion proof solenoids ① with:
- **ATEX** 94/9/CE certification, protection mode Ex II 2GD, Ex d IIC T6/T4/T3, Ex tD A21 IP67
- **IECEx** worldwide recognized safety certification, Ex d IIC T6/T4/T3, Ex tD A21 IP67
- **C UL US** certification, according to UL 1002 and CSA 22.2 n°139-1982 class I Group C & D (Group IIA & IIB to NEC 505-7)

DHAX and DLOHX valves conform to **SIL 3** safety level (TÜV approved).

1 STAINLESS STEEL VALVES: MAIN DATA

Valve execution (1)		Description	ISO size	Voltages		ATEX, IECEx			C UL US		Max flow l/min	Δp (at max flow) bar	Max pressure bar (3)
				DC	AC	T class (1)		Input Power	T class (1)	Input Power			
X	XS				50/60Hz	Standard	Option /7						
DHAX4	DHAXS6 DHAXS4	4 way, spool type direct solenoid valves	06 (ISO 4401)	12	12	T6 T4	T4 T3	8 W 25 W	(2) T4	12 W 33 W	60 70	see diagram at section 8	350
DLOHX6-AO DLOHX4-AO	DLOHXS6-AO DLOHXS4-AO	3 way, poppet type, direct solenoid valves	06 (ISO 4401)	24	24	T6 T4	T4 T3	8 W 25 W	(2) T4	12 W 33 W	10 12		315 350
DLOKX4-AO	DLOKXS6-AO DLOKXS4-AO	3 way, poppet type, direct solenoid valves	06 (ISO 4401)	48 110	110	T6 T4	T4 T3	8 W 25 W	(2) T4	12 W 33 W	25 30		250 315
DLOPX6-AO	DLOPXS6-AO	3 way, poppet type, piloted solenoid valve	no	220	230	T6	T4	8 W	(2)	12 W	220		315
DLPX	DLPXS	3 way, poppet type, hydraulic operated valve	no	–	–	–	–	–	–	–	220		315
SP-CART-MX-3 SP-CART-MX-6 SP-CART AREX-20	SP-CART-MXS-3 SP-CART-MXS-6 SP-CART AREXS-20	relief valve direct screw-in	no no no	– – –	– – –	– – –	– – –	– – –	– – –	– – –	2,5 40 (60 PED) 120 (150 PED)	30	350 350 400
HMPX-*	HMPXS-*	relief valve direct modular	06 (ISO 4401)	–	–	–	–	–	–	–	40	35	350
SC LIX-2531* LIMMX-2/*	LIMMXS-2/*	relief valve DIN cartridge **(4)**	25 (ISO 7368)	–	–	–	–	–	–	–	400	6	350

Notes:

(1) XS6 and XS4 versions differ only for the coil power (see Input Power) - For ATEX, IECEx certification the certified temperature class T6, T4, T3 is related to the max ambient temperature, from which results the max solenoid surface temperature allowed in the application (see section 3). The reference ambient temperature is -40÷+40°C (+45°C for X*6), for higher ambient temperature (-40÷+70 °C) the temperature class has to be degraded (option /7). For C UL US certification the temperature class is related to the coil power 12W or 33 W

(2) For C UL US certification the temperature class corresponding to the coil power 12W is not reported in the nameplate marking. For coil power 33W the temperature class is T4.

(3) Max pressure on T port = 110 bar

(4) Optional electrohydraulic venting available on request.

Valves are provided by HNBR seals, which allow min ambient temperature down to -40 °C (max oil viscosity = 380 cSt). The min ambient temperature for valves with /PE option (FPM seals) is -20°C
Max ambient temperature for valves without solenoids is 70°C.

2 MATERIALS SPECIFICATION

Valve type	solenoid housing ①	valve body ②	internal parts for **X** execution ③ + ④	internal parts for **XS** execution ③ + ④	spring ⑤	seals	
						std	/PE
DHAX(S)	AISI 630	AISI 316L	AISI 316L, 420B, 440C, 430F	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
DLOHX(S) DLOKX(S)	AISI 630	AISI 316L	AISI 316L, 420B, 440C, 430F	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
DLOPX(S)	AISI 630	AISI 630	AISI 316L, 420B, 440C, 430F	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
DLPX(S)	–	AISI 630	AISI 420B	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
SP-CART-*X(S)	–	AISI 316L	AISI 316L, 420B, 630	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
HMPX(S)	–	AISI 316L	AISI 316L, 420B, 630	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
LIMMX(S)	–	AISI 316L	AISI 316L, 420B, 630	Carbon steel	AISI 302	HNBR (buna)	FPM (viton)
SC LIX	–	AISI 316L	AISI 630, AISI 420B	-	AISI 302	HNBR (buna)	FPM (viton)

3 EXPLOSION PROOF SOLENOIDS: MAIN DATA

VALVE TYPE			DHAXS6 DLOHX(S)6 DLOKXS6 DLOPX(S)6		DHAX(S)4 DLOHX(S)4 DLOKX(S)4	
Solenoid code		**ATEX**	OAX/WP		OAKX/WP	
		IECEx	OAIX/WP		OAIKX/WP	
		C UL US	OAXUL/WP		OAKXUL/WP	
Voltage code	VDC	±10%	**12DC, 24DC, 48DC (1), 110DC, 220DC**			
	VAC 50/60 Hz	±10%	**12AC, 24AC, 110AC, 230AC**			
Power consumption		**ATEX, IECEx**	8W		25W	
		C UL US	12W		33W	
Coil insulation			Class H			
Protection degree			IP 67 According to IEC 144 when correctly coupled with the relevant cable gland SP-PAX19*, see section 17			
Duty factor			100%			
Mechanical construction			Flame proof housing classified Ex d, according to EN 60079-0: 2006, EN 6079-1: 2007			
Cable entrance and electrical wiring			Internal terminal board for cable connection threaded connection M20x1,5 for cable entrance, vertical (standard) or Horizontal (option /O) See section 17 for cable gland			
Metod of protection			Ex d			
Temperature class (surface temperature)		**ATEX, IECEx**	T6 (≤ 85°C)	T4 (≤ 135°C) option /7	T4 (≤ 135°C)	T3 (≤ 200°C) option /7
		C UL US	Not applicable		T4 (≤ 135°C)	
Ambient temperature		**ATEX, IECEx**	-40 ÷ +45 °C	-40 ÷ +70 °C	-40 ÷ +40 °C	-40 ÷ +70 °C
		C UL US	-40 ÷ +70 °C			

Notes: (1) 48DC only for ATEX, IECEx
For alternating current supply a rectifier bridge is integrated in the solenoid

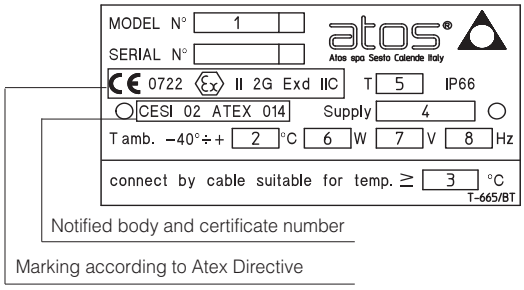
3.1 CERTIFICATIONS

In the following are resumed the valves marking according to ATEX Group II, IECEx Group II and C UL US certifications.

ATEX, Group II

Ex = ATEX identification for explosive atmospheres equipments
II = Group II for surfaces plants
2 = High protection (equipment category)
GD = For gas, vapours and dust
d = Flame proof housing
IIC = Gas group
T6/T4/T3 = Temperature class of solenoid surface
tD = Dust ignition protection
A21 = Housing protection practice (for dust)
IP67 = Protection degree
Zone 1 (gas) and 21 (dust) = Possibility of explosive atmosphere during normal functioning
Zone 2 (gas) and 22 (dust) = Low probability of explosive atmosphere

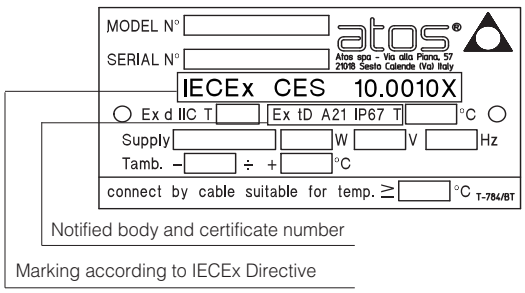
EXAMPLE OF NAMEPLATE MARKING



IECEx, Group II

Ex = Equipment for explosive atmospheres
d = Flame proof housing
IIC = Gas group
T6/T4/T3 = Temperature class of solenoid surface
tD = Dust ignition protection
A21 = Housing protection practice (for dust)
IP67 = Protection degree

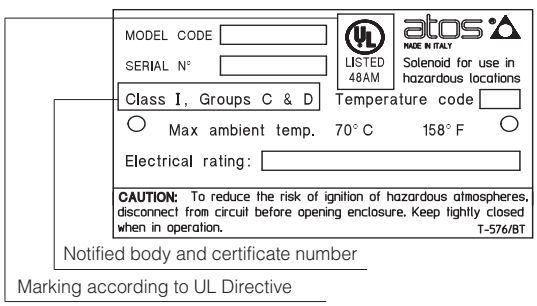
EXAMPLE OF NAMEPLATE MARKING



C UL US certification

Class I = Equipment for famable gas and vapours
Division 1 = Possibility of explosive atmosphere during normal functioning
Groups C&D = Gas group (according to UL 1002)
Groups IIA&IIB = Gas group (according to NEC 505-7)
T4 = Temperature class of solenoid surface referred to +70°C ambient temperature

EXAMPLE OF NAMEPLATE MARKING



4 SPOOL TYPE DIRECTIONAL SOLENOID VALVES: MODEL CODE

DHA X 4 * - 0 63 1/2 / PA - M / V 24DC ** /*

Spool type, direct

X = Stainless steel execution for all parts
XS = Stainless steel execution for external parts

Temperature class, see section 1
4 = T4
6 = T6 (only for XS execution)

Certification type
- (omit for ATEX)
/IE = Group II IECEx
/UL = C UL US

Size:
0 = 06

Valve configuration, see section 4.1
61, 63, 71, 75
(configurations 63 and 75 are available only with spool type 1/2)

Spool type, see section 4.2

Optional cable gland:
PA = with threaded cable gland, see section 17

Solenoid threaded connection:
M = M20x1,5 UNI-4535 (6H/6g)
NPT = 1/2" NPT ANSI B2.1 (tapered) only for /UL

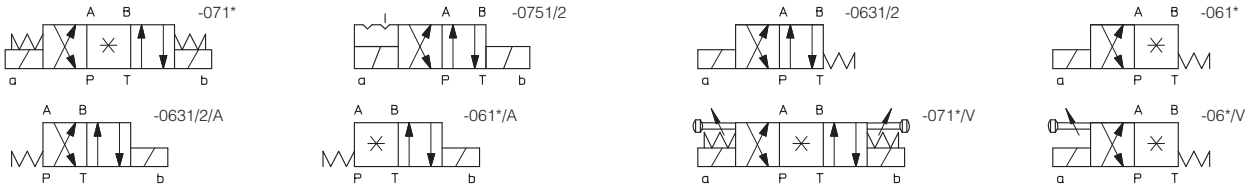
Options:
A = solenoid at side of port B
V = with handweel manual override
7 = for ambient temperature up to 70°C (only for Atex and IECEx)
O = horizontal cable entrance

Voltage code - see section 3

Series number

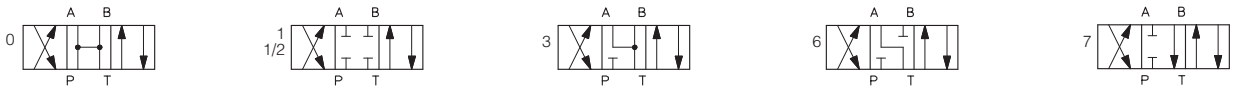
Synthetic fluids:
WG = water-glycol
PE = phosphate ester

4.1 Hydraulic configuration



Where the symbol doesn't show the hydraulic connection (*), it depends on the central configuration of the spool; see section 4.2.

4.2 Spools - for intermediate passages, see tab. E001.



5 POPPET TYPE LEAK FREE DIRECTIONAL SOLENOID VALVES: MODEL CODE

DLOH X 6 - 3 A / PA - M – AO / V 24DC ** /*

DLOH - DLOK = poppet type, direct
DLOP = poppet type, electro-hydraulic piloted
DLP = as DLOP but hydraulically piloted

X = Stainless steel execution for all parts
XS = Stainless steel execution for external parts

Temperature class (not for DLP*), see section 1
4 = T4 (only for DLOH* and DLOK*)
6 = T6 (not for DLOKX)

3 = three way

Valve configuration, see section 5.1
A = A to T in rest position
C = P to A in rest position

Optional cable gland:
PA = with threaded cable gland, see section 17

Solenoid threaded connection:
M = M20x1,5 UNI-4535 (6H/6g) - **NPT** = 1/2" NPT ANSI B2.1 (tapered) only for /UL

Certification type:
AO = Group II, Atex
AO/IE = Group II, IECEx
AO/UL = C UL US

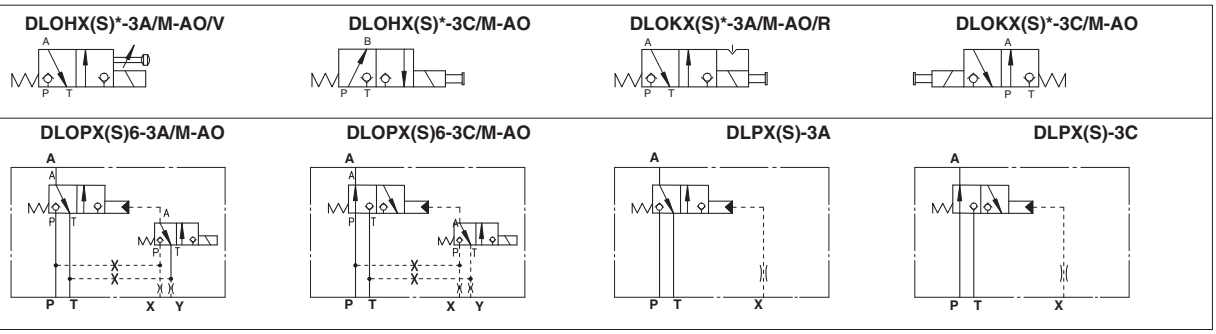
Options: (not for DLPX)
R = with solenoid manual reset
V = with handweel manual override
7 = for ambient temperature up to 70°C (only for Atex and IECEx)
O = Horizontal cable entrance
Only for DLOPXS
D = internal drain
E = external pilot pressure

Voltage code - see section 3

Series number

Synthetic fluids:
WG = water-glycol
PE = phosphate ester

5.1 Hydraulic configuration



6 PRESSURE CONTROL VALVES: MODEL CODE

6.1 Screw-in type

SP-CART | **MX** | / **350** | / * | / * | ** | / *

- **SP-CART**: Screw-in relief cartridge
- **MX**: See note (1):
  MX(S)-3 = G1/2
  MX(S)-6 = M33x1,5
  AREX(S)-20 =M35x1,5
- **350**: Pressure range
  50 = 50 bar (not for AREX(S)-20 PED)
  100 = 100 bar
  210 = 210 bar
  315 = 315 bar (only for AREX(S)-20)
  350 = 350 bar (not for AREX(S)-20)
  400 = 400 bar (only for AREX(S)-20)
- First *: Options
  PED = reduced leakages and certified according to 97/23/CE
- Second *: Only for PED
  * = factory preset regulation to be defined depending to the customer requirements (example 280 = 280 bar)
- **: Series number
- Last *: Synthetic fluids:
  WG = water glycol
  PE = phosphate ester

(1): **X**= Stainless steel execution for all parts
XS= Stainless steel execution for external parts

6.2 Modular type

HMP | **X** | - **011** | / **350** | ** | / *

- **HMP**: Modular pressure relief valve ISO 4401 size 06
- **X**: **X**= Stainless steel execution for all parts
  XS= Stainless steel execution for external parts
- **011**: Configuration, see section 6.5
  011, 013, 014
- **350**: Pressure rangefor HMP:
  50 = 50 bar
  100 = 100 bar
  210 = 210 bar
  350 = 350 bar
- **: Series number
- Last *: Synthetic fluids:
  WG = water glycol
  PE = phosphate ester

6.3 Control cover

LIMM | **X** | - **2** | / **350** | ** | / *

- **LIMM**: Cover according to ISO 7368
- **X**: **X**= Stainless steel execution for all parts
  XS= Stainless steel execution for external parts
- **2**: Size: **2** = 25
- **350**: Pressure range
  50 = 6 ÷ 50 bar
  100 = 8 ÷ 100 bar
  210 = 10 ÷ 210 bar
  350 = 15 ÷ 350 bar
- **: Series number
- Last *: Synthetic fluids:
  WG = water glycol
  PE = phosphate ester

6.4 Standard cartridge valve to be coupled with LIMMX(S) cover

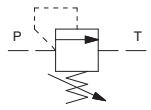
SC LI | **X** | - **25** | **31** | / **2** | ** | / *

- **SC LI**: Cartridge according to ISO 7368
- **X**: **X**= Stainless steel execution for all parts
- **25**: Size 25
- **31**: Area ratio 1÷1
- **2**: Spring cracking pressure
  1 = 0,3 bar
  2 = 1,2 bar
  3 = 3 bar
  6 = 6 bar
- **: Series number
- Last *: Synthetic fluids:
  WG = water glycol
  PE = phosphate ester

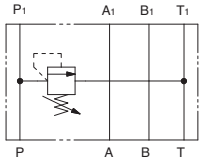
Note: for LIMMXS cover, the standard SCLI-25* cartridge can be used

6.5 Hydraulic configuration

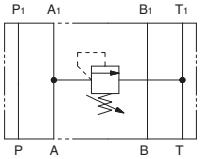
SP-CART-*X(S)



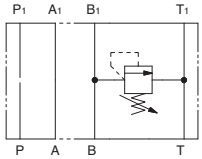
HMPX(S)-011/*



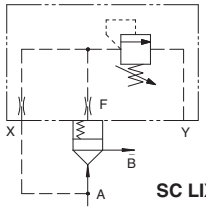
HMPX(S)-013/*



HMPX(S)-014/*



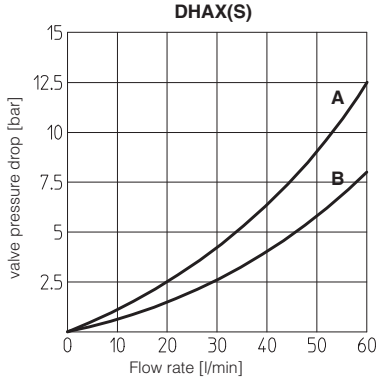
LIMMX(S)-2/*



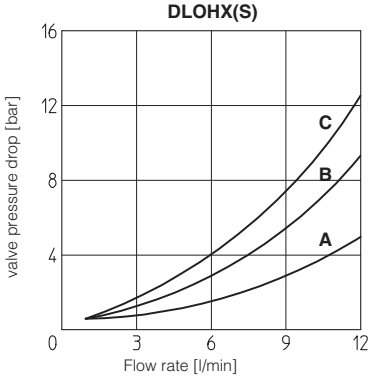
SC LIX-2531*

7 Q/Δp DIAGRAMS (based on mineral oil ISO VG 46 at 50°C)

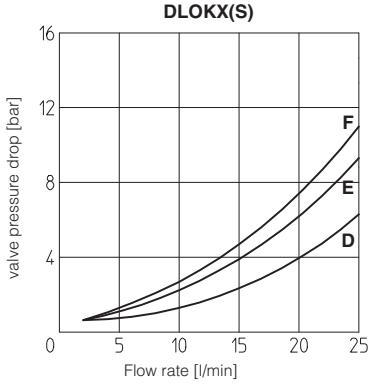
DHAX(S)



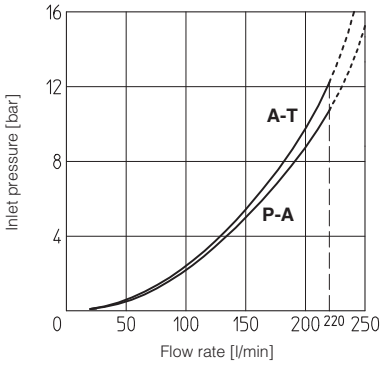
DLOHX(S)



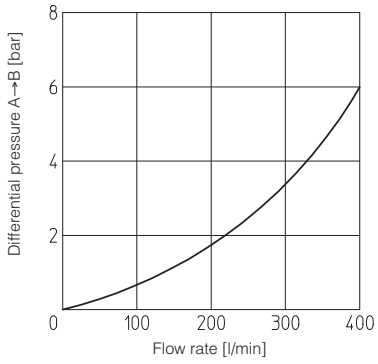
DLOKX(S)



DLOPX(S)



SCLIX-2531*



DHAX(S)

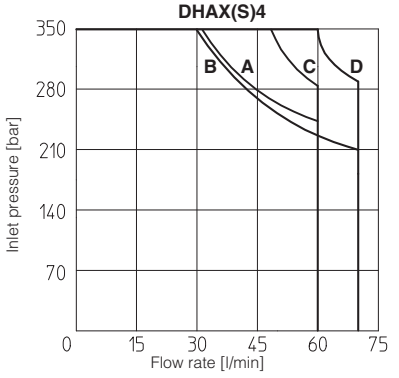
Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0	B	B	B	B	A
1, 1/2	A	A	A	A	
3	A	A	B	B	
6	A	A	B	A	
7	A	A	A	B	

Valve type \ Flow direction	P → A (P → B)	A → T (B → T)
DLOHX(S)-3A	C	B
DLOHX(S)-3C	B	A
DLOKX(S)-3A	F	E
DLOKX(S)-3C	E	D

8 OPERATING LIMITS OF ON/OFF DIRECTIONAL CONTROLS (based on mineral oil ISO VG 46 at 50°C)

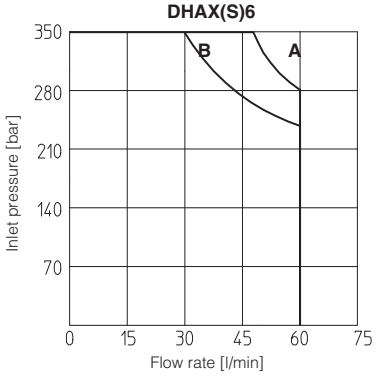
The diagram have been obtained with warm solenoids and power supply at lowest value (V_{nom}-10%). For DHAX(S) valves the curves refer to application with symmetrical flow through the valve (i.e. P → A and B → T). In case of asymmetric flow the operating limits must be reduced.

DHAX(S)4



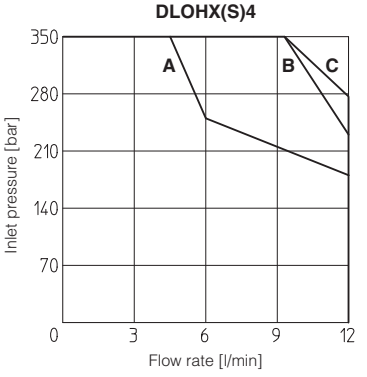
DHAX4 **A =** Spools 0,1 **B =** Spools 1/2, 3, 6, 7
DHAXS4 **C =** Spools 0,1 **D =** Spools 1/2, 3, 6, 7

DHAX(S)6



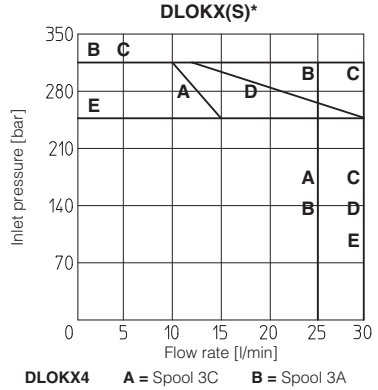
A = Spools 0,1 **B =** Spools 1/2, 3, 6, 7

DLOHX(S)4



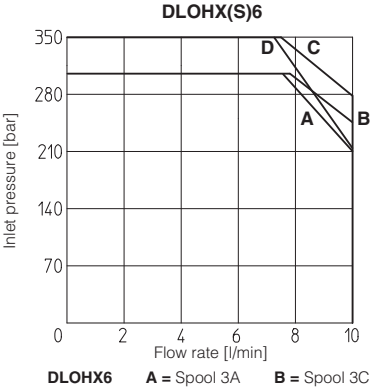
DLOHX4 **A =** Spool 3C **B =** Spool 3A
DLOHXS4 **C =** Spools 3C, 3A

DLOKX(S)*



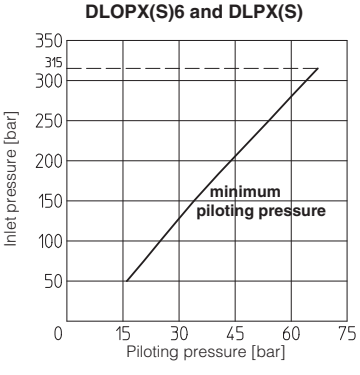
DLOKX4 **A =** Spool 3C **B =** Spool 3A
DLOKXS4 **C =** Spool 3A **D =** Spool 3C
DLOKXS6 **E =** Spool 3A, 3C

DLOHX(S)6



DLOHX6 **A =** Spool 3A **B =** Spool 3C
DLOHXS6 **C =** Spool 3A **D =** Spool 3C

DLOPX(S)6 and DLPX(S)

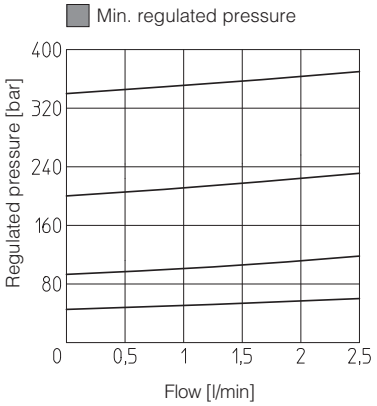


8.1 Internal leakages internal leakage of DLOHX(S), DLOKX(S), DLOPX(S) and DLPX(S): less than 5 drops/min (0,36 cm³/min) at max pressure.

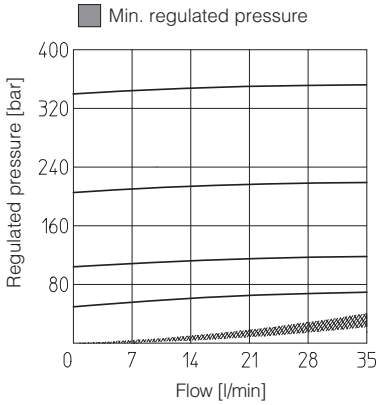
8.2 Piloting pressure for DLOPX(S) and DLPX(S)) max piloting pressure = 315 bar; min piloting pressure = see diagram

9 **REGULATED PRESSURE VERSUS FLOW DIAGRAM** of screw-in cartridge valves (based on mineral oil ISO VG 46 at 50°C)

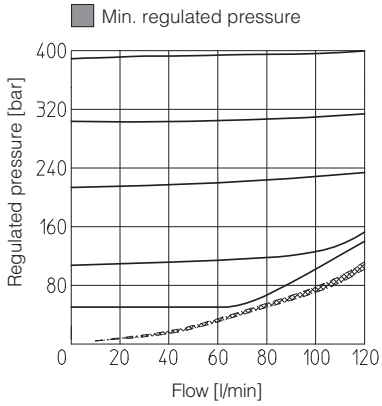
SP-CART MX(S)-3



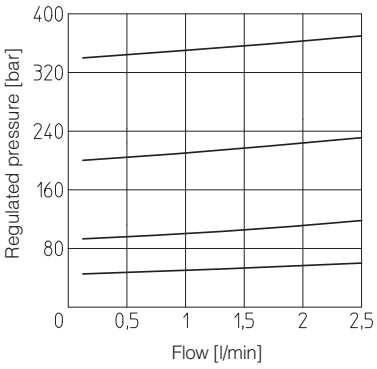
SP-CART MX(S)-6



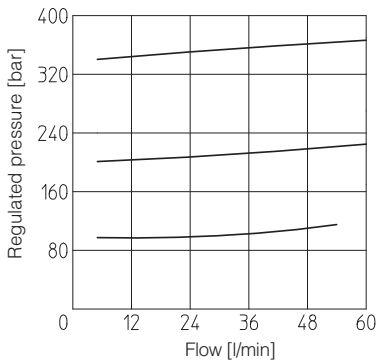
SP-CART AREX(S)-20



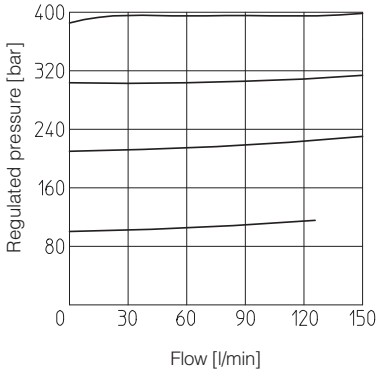
SP-CART MX(S)-3 **/PED



SP-CART MX(S)-6 **/PED

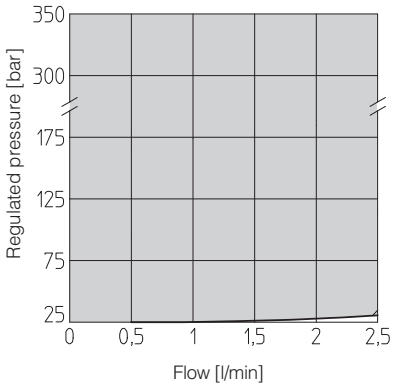


SP-CART AREX(S)-20 **/PED

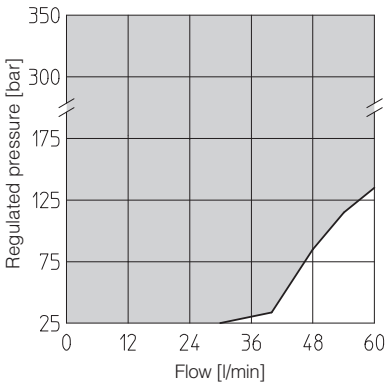


10 **PERMITTED WORKING RANGES** of screw-in cartridge valves with PED option (shared area)

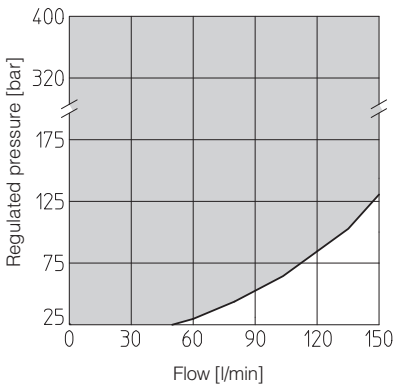
SP-CART MX(S)-3 **/PED



SP-CART MX(S)-6 **/PED

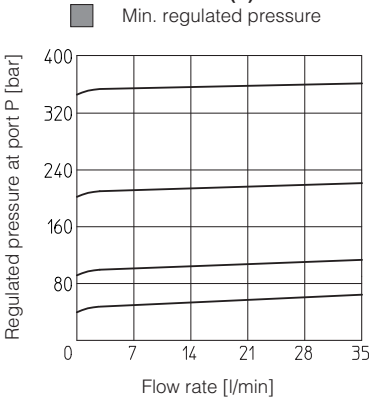


SP-CART AREX(S)-20 **/PED



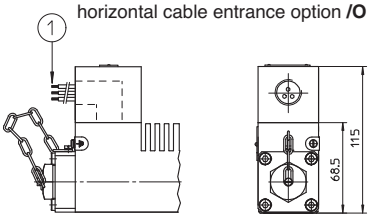
10.1 Regulated pressure for modular valves

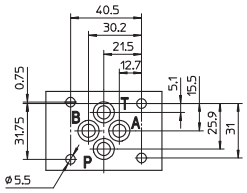
HMPX(S)-*



11 INSTALLATION DIMENSIONS OF DHAX(S) [mm]

horizontal cable entrance option **/O**

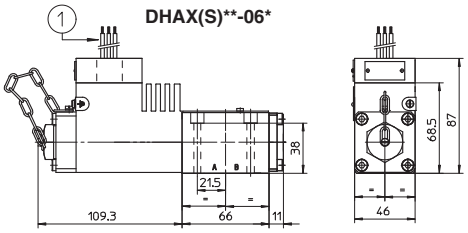




ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws M5x50-A4-70
Tightening torque = 5,5 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max).

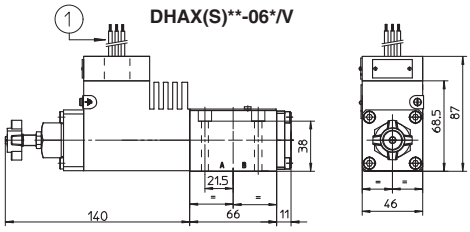
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

DHAX(S)-06***



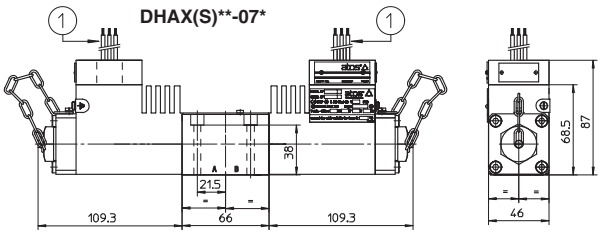
Mass: 2,9 kg

DHAX(S)-06*/V**



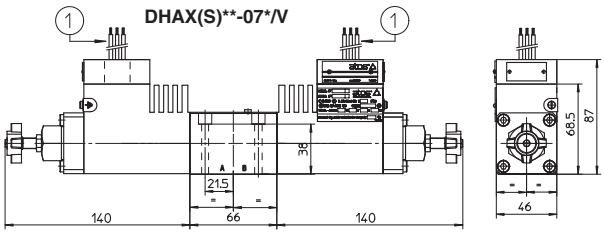
Mass: 3 kg

DHAX(S)-07***



Mass: 4,6 kg

DHAX(S)-07*/V**

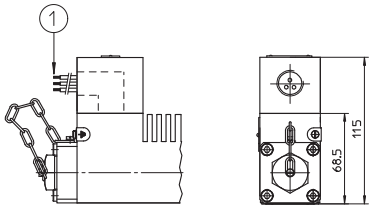


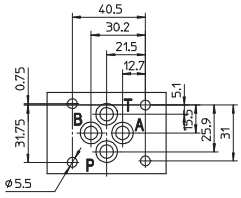
Mass: 4,8 kg

① Factory wired cables only for /UL

12 INSTALLATION DIMENSIONS OF DLOHX(S) AND DLOKX(S) [mm]

horizontal cable entrance option **/O**

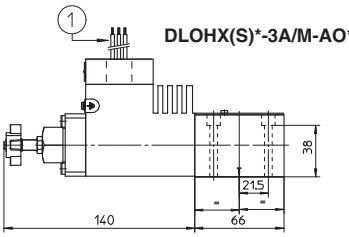




ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws M5x50-A4-70
Tightening torque = 5,5 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max).

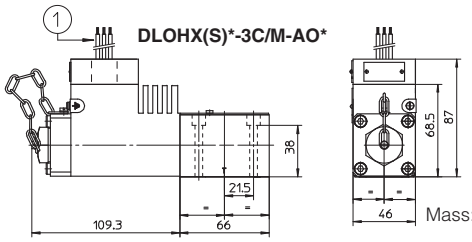
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

DLOHX(S)*-3A/M-AO*/V



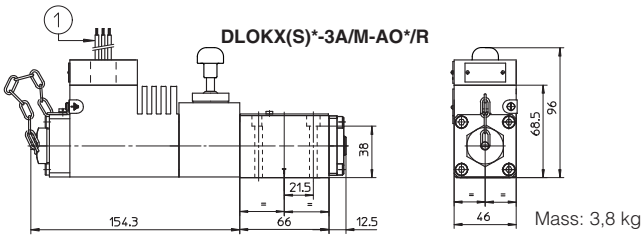
Mass: 3 kg

DLOHX(S)*-3C/M-AO*



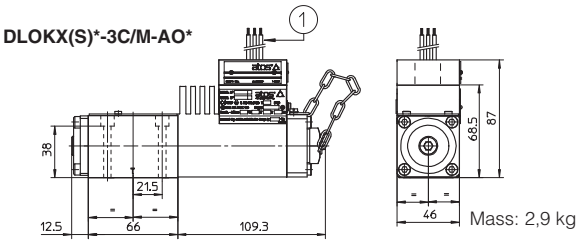
Mass: 2,9 kg

DLOKX(S)*-3A/M-AO*/R



Mass: 3,8 kg

DLOKX(S)*-3C/M-AO*

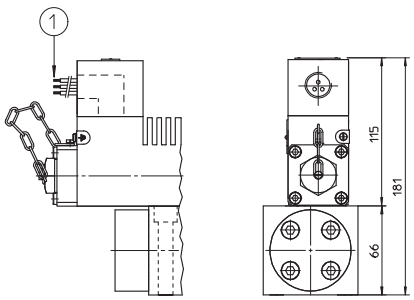


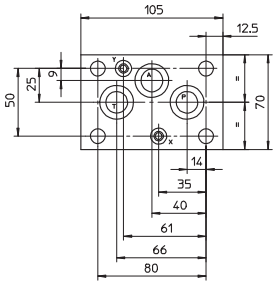
Mass: 2,9 kg

① Factory wired cables only for /UL

13 INSTALLATION DIMENSIONS OF DLOPX(S) AND DLPX(S) [mm]

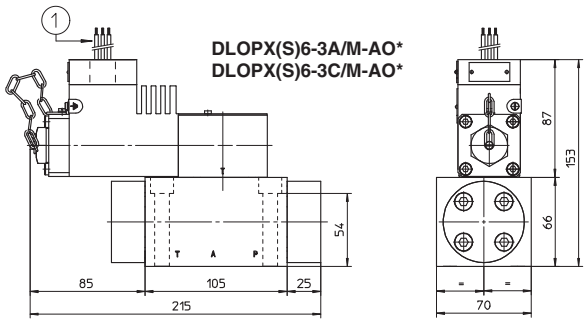
horizontal cable entrance option **/O**





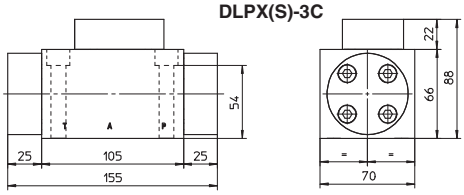
Mounting surface of DLOPX(S)6 and DLPX(S) is not ISO standard
Fastening bolts:
4 socket head screws M10x70-A4-70
Tightening torque = 40 Nm
Seals: 3 OR 3081; 2 OR 108
Ports P,A,T: Ø = 16 mm (max)
Ports X, Y: Ø = 7 mm (max)

DLOPX(S)6-3A/M-AO*
DLOPX(S)6-3C/M-AO*



Mass: 7 kg

DLPX(S)-3A
DLPX(S)-3C

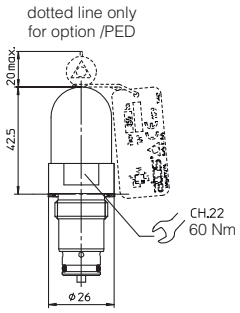


Mass: 4,5 kg

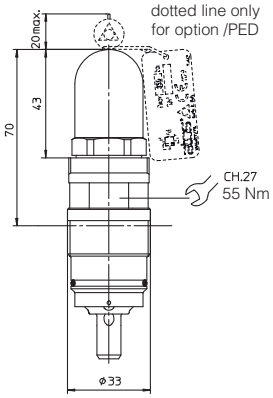
Factory wired cables only for /UL

14 INSTALLATION DIMENSIONS OF SCREW IN PRESSURE RELIEF VALVES [mm]

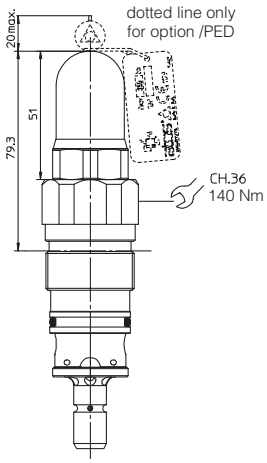
SP-CART MX(S)-3/*



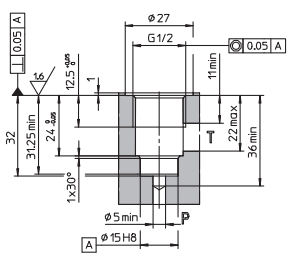
SP-CART MX(S)-6/*



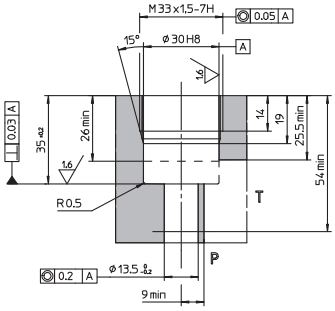
SP-CART AREX(S)-20



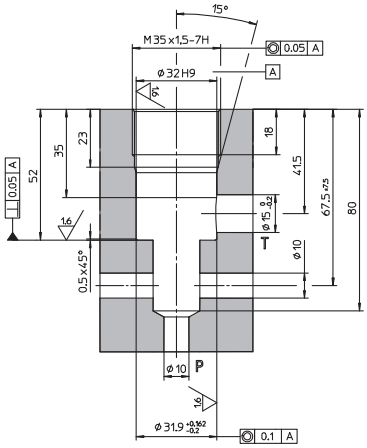
Recess dimensions for SP-CART MX(S)-3



Recess dimensions for SP-CART MX(S)-6

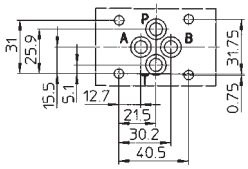


Recess dimensions for SP-CART AREX(S)-20

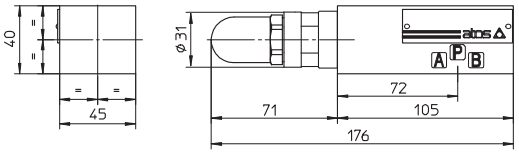


15 INSTALLATION DIMENSIONS OF MODULAR AND CARTRIDGE VALVES

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts: M5x**-A4-70
Tightening torque = 5,5 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)

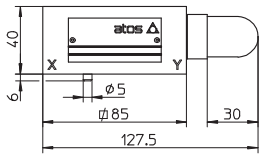


HMPX(S)-011/*



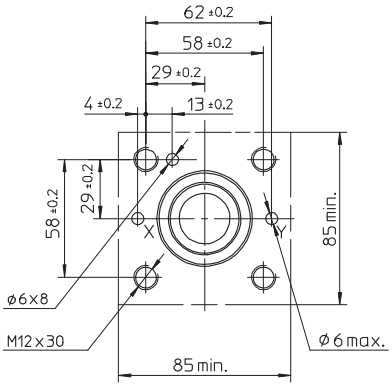
Mass: 1,4 kg

LIMMX(S)-2/*

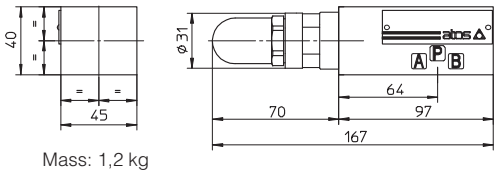


Mass: 2,2 kg

Cover interface dimensions for LIMMX(S)-2

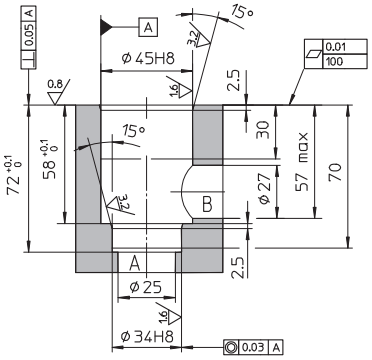


HMPX(S)-013/*

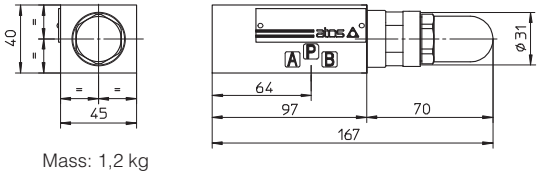


Mass: 1,2 kg

Recess dimensions for SC LIX-25



HMPX(S)-014/*



Mass: 1,2 kg

16 SOLENOID WIRING

Solenoid wiring (ATEX, IECEx)

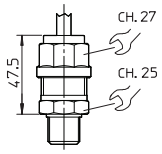
1 = Coil
2 = GND
3 = Coil

Solenoid wiring (UL)

		AC	DC
1	= Coil	white	red
2	= GND	green	green
3	= Coil	black	black

17 CABLE GLAND

STAINLESS STEEL CABLE GLAND SP-PAX19/* (PG9 - IP67)



Stainless steel cable glands - available on request - are certified ATEX according to EN60079-0 and EN60079-1.

Following codes have to be specified for spare cable glands:
SP-PAX19/M = with threated connection M20x1,5 UNI-4535 (6H/6g).
This cable gland must be blocked with loctite or similar or with a lock nut.
The valves must be connected to the power supply using the terminal board inside the solenoid.

The cable must be suitable for the working temperature as specified in the "safety instructions" delivered with the first supply of the products.
Additional equipotential grounding can be also performed by the user on the external facility provided on the solenoid case.
Minimum section of external ground wire = 4 mm².
Minimum section of internal ground wire = the same of supply wire.
In order to reach the terminal board inside the solenoid, the top plate of the solenoid must be removed.
Solenoids are provided with threated connection for cable entrance:
M20x1,5 (UNI-4535)