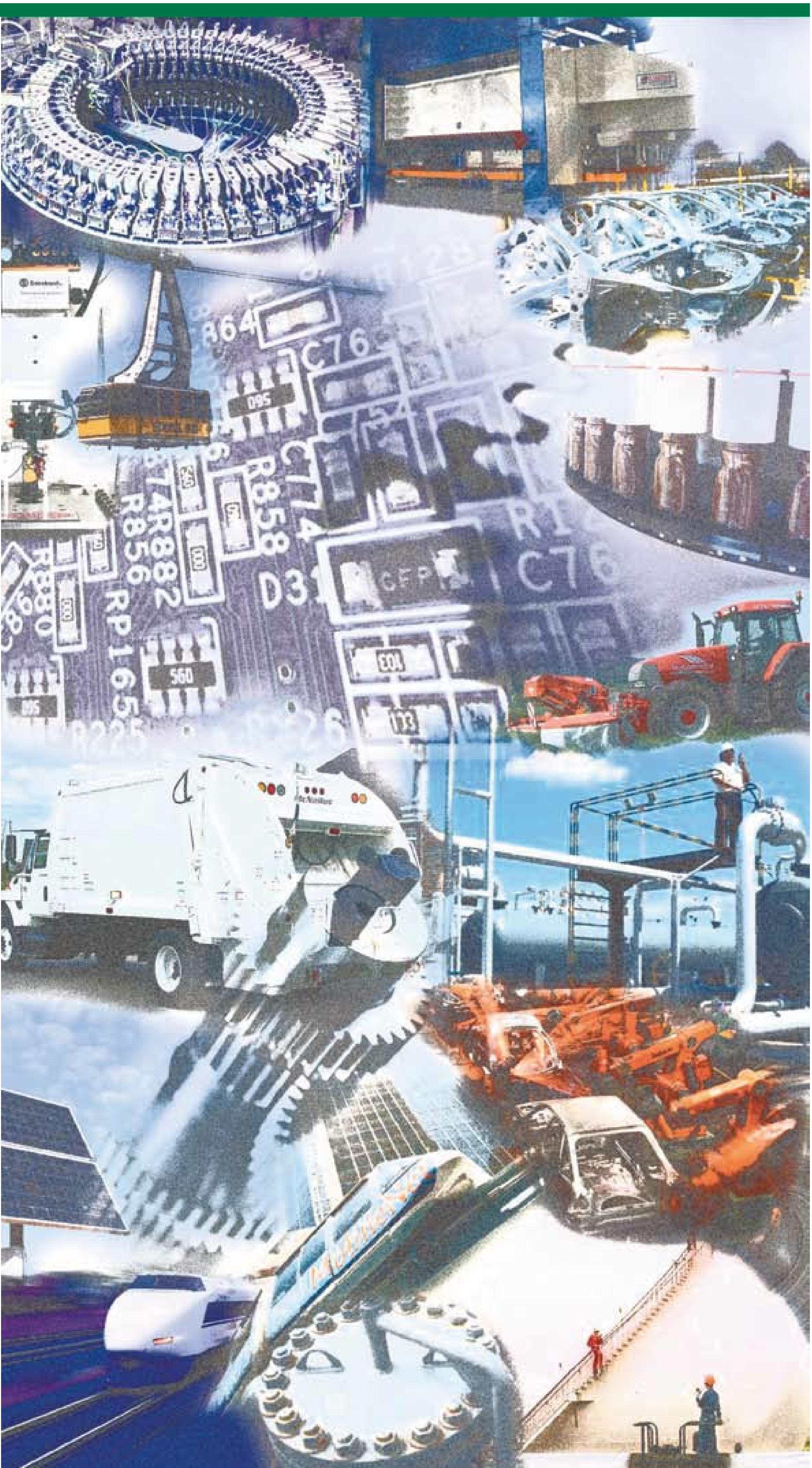
上海文胜机械设备有限公司



General Catalogue 2011

ACL

This general catalogue has been committed to :

Mrs/Mr ______________________________

Company ______________________________

address : ______________________________

on date ______________________________

by our ______________________________

EDITION EN 01/11

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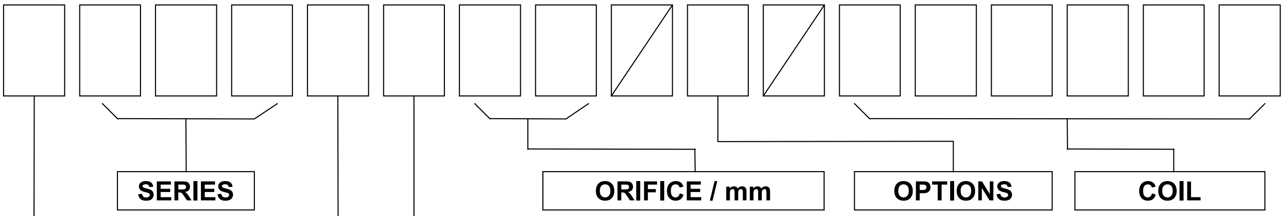
1.1 Introduction

The solenoid valves illustrated in this catalogue have applications in all industrial sectors, being compatible with a vast range of fluids.
The quality of the materials used and the precise engineering of the parts, coupled with rigorous testing of the large production guarantees their service capability.
In addition to the standard versions illustrated here, we are able to offer alternative designs to resolve specific problems.

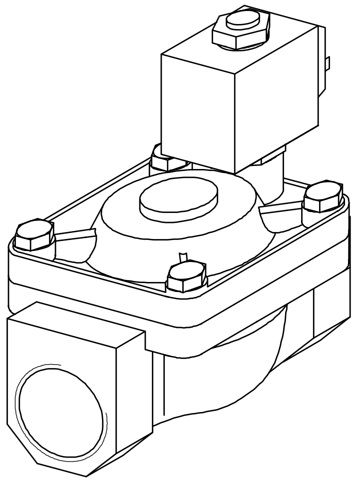
1.2 Type number composition for servo-assisted versions



CURRENT	
E	**D**
AC/DC CURRENT	**DC CURRENT ONLY**

CONNECTION	
A=G1/8”	**G**=G1” 1/4
B=G1/4”	**H**=G1” 1/2
C=G3/8”	**I**=G2”
D=G1/2”	**M**=G2” 1/2
E=G3/4”	**R**=G3”
F=G1”	

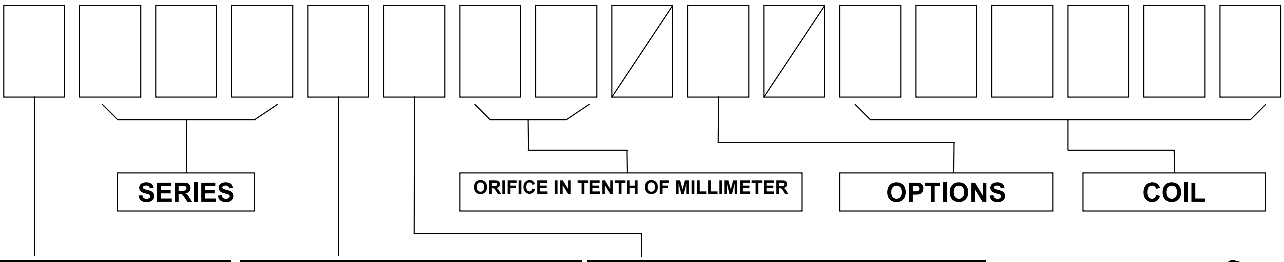
SEAL	
A=NBR DVGW	**S**=SILICONE
B=NBR	**V**=FPM
E=EPDM	**W**=PTFE
F=EPDM WRC	
H=HNBR	
N=CHLOROPRENE	



Example :
E207IV50///20E

Solenoid valve suited to work in alternative or direct current 2/2 normally open, 2”BSP connections, FPM seal, orifice 50 mm, coil width 30mm, class F insulation, power consumption 15VA, voltage 220-230V 50/60Hz.

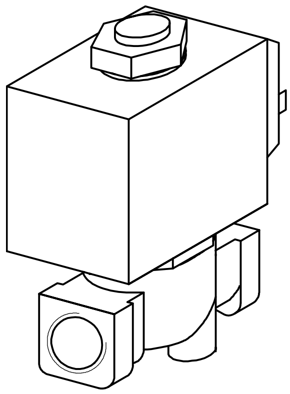
1.2 Type number composition for direct-acting versions



CURRENT	
E	**D**
AC/DC CURRENT	**DC CURRENT ONLY**

CONNECTION	
A=G1/8”	**X**=FLANGE
B=G1/4”	**K**=SPIGGOT
C=G3/8”	**N**=1/8" MALE
D=G1/2”	**P**=HOSETAIL
E=G3/4”	**W**=COMPRESSION
L=M5	**Z**=PUSH-IN
	Y= PUSH-IN

SEAL	
A=NBR DVGW	**W**=PTFE
B=NBR	**S**=SILICONE
E=EPDM	**N**=CHLOROPRENE
F=EPDM WRC	**H**=HNBR
V=FPM	



Example :
E105AB15///301

Solenoid valve suited to work in alternative or direct current 2/2 normally closed, 1/8”BSP connections, NBR seal, orifice 1,5mm, coil width 22mm, class F insulation, power consumption 6,5W, voltage 24V DC.

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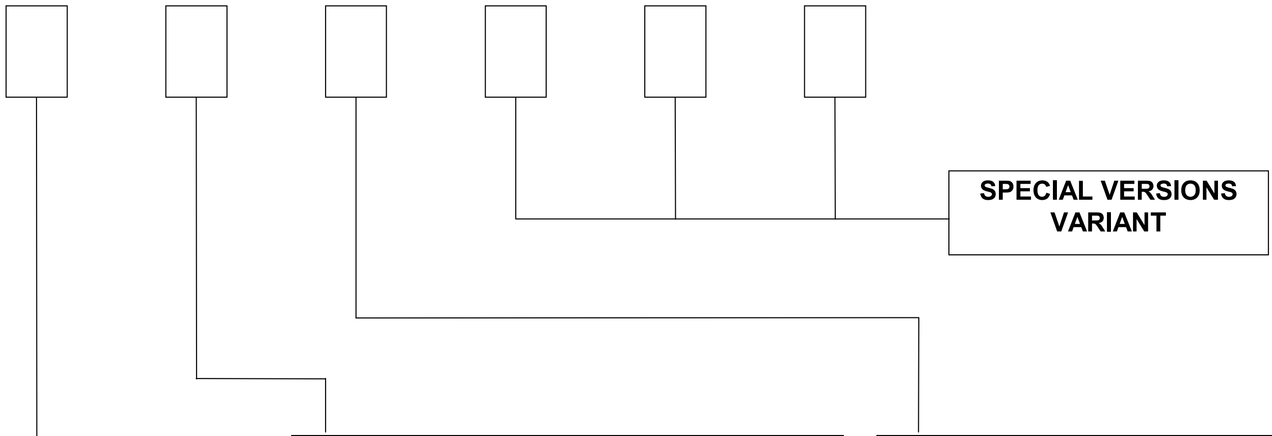
1.2 Type number composition for coils



SERIES	WIDTH
2	30
3	22
4	30
5	36
6	16
7	30

MATERIAL		Insulation Class
0	Nylon 6+18%FV	F
1	PBT+30%FV	F
2	Polyarylamide	H
3	Epoxy	H
5	Nylon Self-extinguish	F

VOLTAGE			
AC 50/60 Hz		DC	
A	12V	**0**	12V
B	24V	**1**	24V
C	48V	**2**	48V
D	110V	**3**	110V
E	220-230V	**4**	220V
F	240V	**5**	6V
G	380V	**6**	205V
		7	9V
		8	3V

Example : 30B
Coil width 22 mm in Nylon 6+18% Fibre Glass
Insulation class F Voltage 24V 50/60Hz power 8VA

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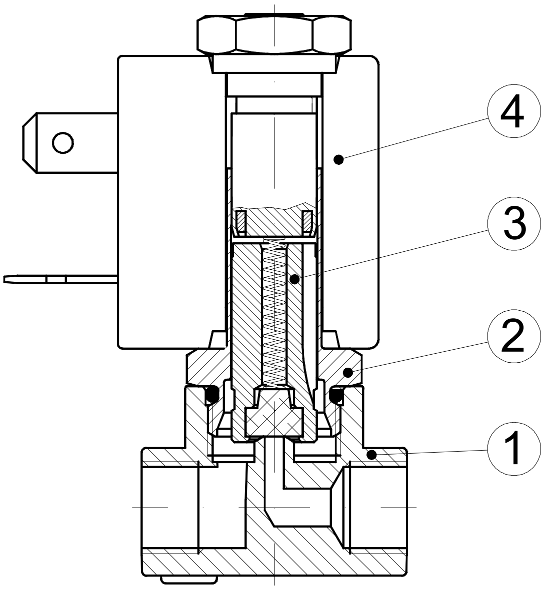
1.3 Construction details

Solenoid valves are equipments to control media in pressure. Their action is to either open or close the interception device, directly or indirectly, when the coil is energised.

1

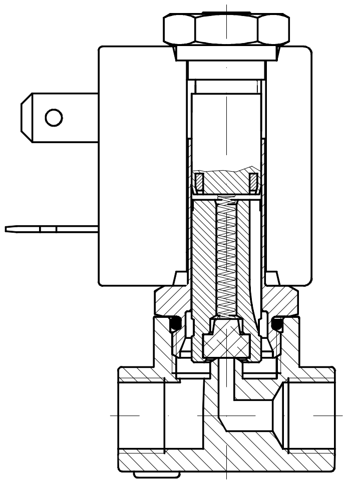
The most important components of the solenoid valve are :

1. The **body valve**, which has an inlet and an outlet connection and an orifice for media flowing.
2. The **armature tube**, with the core, where the coil is fitted.
3. The **plunger**, which in some cases serves like a seal, sliding in the armature tube.
4. The **coil**, which produces the magnetic field required to move the plunger.

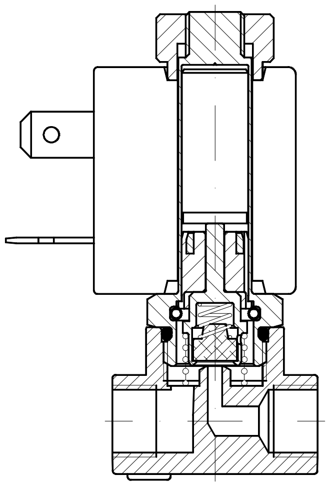


1.3.1 Methods of operation

2 way direct-acting
The 2 way solenoid valve has an inlet and an outlet connection within the valve body.
It can be **normally closed** (2/2 NC). In this case the media is prevented from flowing through the orifice by the plunger seal. When connected to an electrical supply, the orifice opens allowing the inlet to feed the outlet port.



It can be **normally open** (2/2 NO). In this case the orifice is open, the inlet feeds through the outlet. When connected to an electrical supply the orifice is closed. The operation, in both cases depends only on the magnetic field produced by the coil. These solenoid valves are able to work at **zero pressure**.



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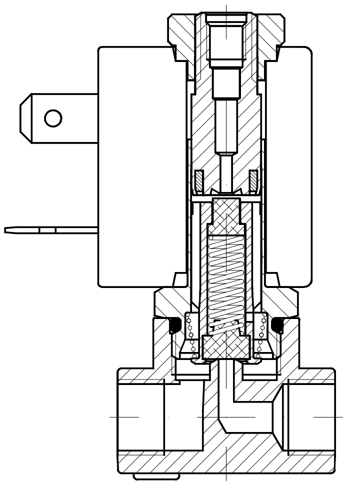
3 way direct-acting

The 3 way solenoid valve has inlet and outlet connections in the body and an exhaust connection above the core.

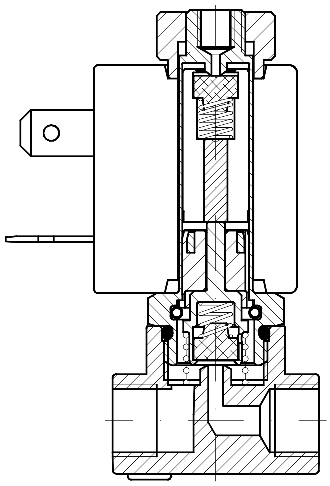
It can be **normally closed** (3/2 NC). In this case the media is prevented from flowing through the inlet orifice by the plunger seal. The inlet and exhaust orifices are at each end of the plunger. When connected to an electrical supply, the inlet orifice opens feeding the user port. The exhaust is closed.



It can be **normally open** (3/2 NO). In this case when the coil isn't energised the inlet orifice is open to the user port. Exhaust port is closed. When connected to an electrical supply, the inlet orifice closes, at the same time the exhaust port is opened and connected with the user port.

In both cases, the operation depends only on the magnetic field produced by the coil.

These solenoid valves are able to work at **zero pressure**



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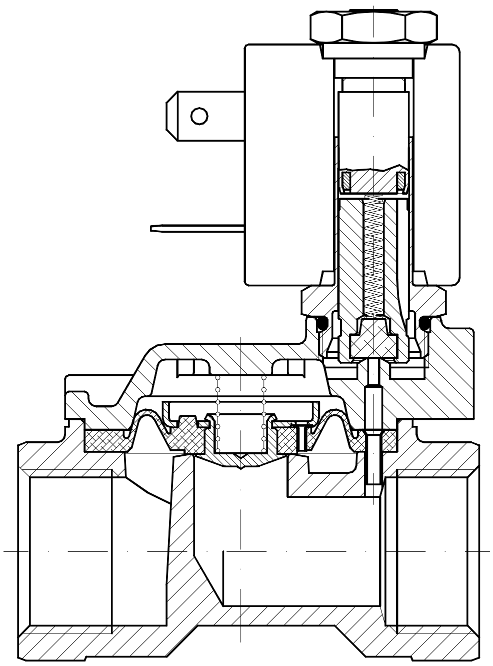
Servo-assisted action

With larger orifices, static pressures increase, and it's still necessary that the magnetic field produced by the coil is able to control these forces. This is achieved by using servo-assisted action in the solenoid valve.

In this design the media pressure helps to keep the main valve seal closed.

The normally closed design (2/2 NC) has an inlet and outlet connection in the valve body. When the coil is not energised, the flow is blocked by the main seal, which could be either a diaphragm or a piston design. In this mode the media flows through a small hole in the diaphragm or piston and helps close the valve. When the coil is energised the pilot orifice opens, allowing the media above the main seal to exhaust and the main valve seal to open.

This type of solenoid valve needs a minimum differential pressure to work.



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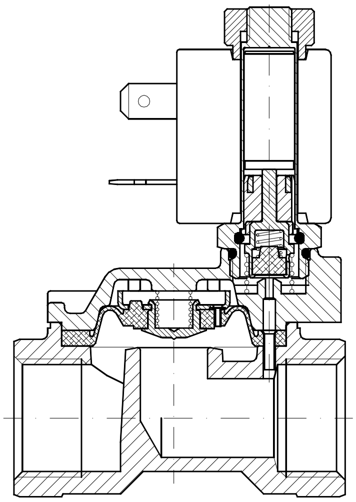
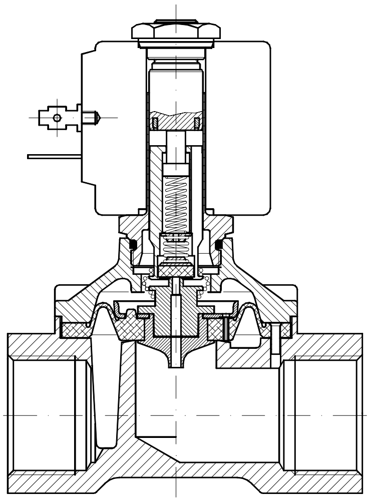
The **normally open** (2/2 NO) version has an inlet and outlet connection in the valve body. With larger orifices, static pressures increase, and it's still necessary that the magnetic field produced by the coil is able to control these forces. This is achieved by using servo-assisted action in the solenoid valve. In this design the media pressure helps to keep the main valve seal open. When the coil isn't energised, the flow is not interrupted by the main seal, which could be either a diaphragm or a piston design. In this mode the media flows through a small hole in the diaphragm or piston and helps the valve to open. When the coil is energised the pilot orifice closes, allowing the media above the main seal to pressurise and the main valve seal to close.
This type of solenoid valve needs a minimum differential pressure to work.



They are available with an **assisted lift** design pilot operated by diaphragm and **normally closed** (2/2 NC). In these models the plunger is mechanically attached to the diaphragm and controls the central pilot orifice and the stroke of the main seal.
This design allows the valve to work at zero differential pressure.



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1.4 Seal materials

Designation	Commercial denomination	General characteristics	Typical application
NBR (Acrylic-nitrile butadylene)	BUNA -N PERBUNAN ELAPRIM JSR-N	A synthetic elastomer with good mechanical and thermal properties. Good resistance to oils. Poor resistance to ozone and atmospheric derivatives.	Water with a max. temperature 70°C, air with a max. temp.90°C. Mineral oils and their derivatives, hydrocarbons, methane, ethane, propane, butane, kerosene oil, fuel oil.
EPDM (Ethylene-propylene-dylene)	BUNA- AP DUTRAL NORDEL	A synthetic elastomer derived from the co-polymerization of ethylene and propylene. Suitable for use with non-phosphoric based hydraulic fluids(hold). Water and steam to a max. temp of 140°C. Not suitable for use with mineral based products. (oil, grease , fuel oils and petrol)	Hot water and steam. Detergents. Potassium and sodium solutions. Hydraulic fluids. Polarised solvents. Skydrol 500 and 700 *
FPM (Fluorocarbon)	VITON TECNOFLON FLUOREL	A synthetic elastomer derived from flour-propylene. Excellent resistance to the high temp. Excellent resistance to ozone, oxygen, mineral oils, synthetic hydraulic oil, petrol, hydro-carbons and many other chemicals. Not suitable for use with superheated steam.	For general use up to 130°C
PTFE (Polytetra-fluorethylene)	TEFLON	Thermoplastic material used also filled with a mineral resin. Excellent resistance to many chemicals. Optimum high temp. resistance. Poor resilience, improved by adding the mineral filling.	For general use up to 160°C

*Warning: not to be used with mineral oils and grease

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1.5 Media compatibility

The following table has the scope to provide an indication of the general characteristics with regard to the compatibility with the different materials and media.

To determine the compatibility with corrosive fluids it is important to know all the data relative to :
temperature, concentration and media composition.

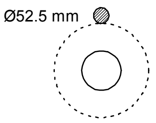
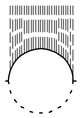
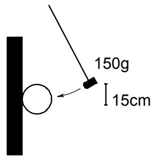
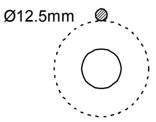
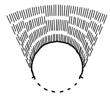
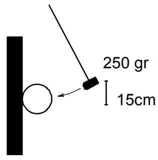
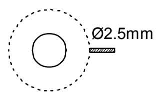
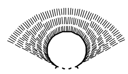
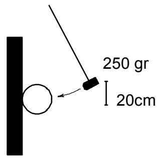
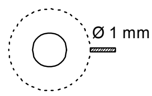
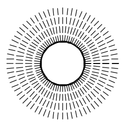
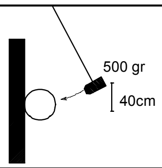
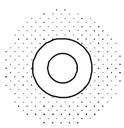
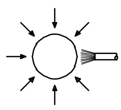
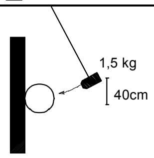
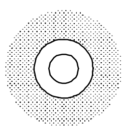
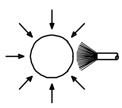
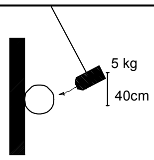
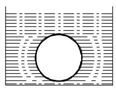
1

MEDIA	Brass	Stainless Steel	NBR	EPDM	FPM	PTFE
Acetone	•	•	-	•	-	•
Acetylene	•	•	-	•	•	•
Argon hold	•	•	-	•	•	•
Benzol	•	•	-	-	-	•
Butane	•	•	-	-	•	•
Calcium monoxide	•	•	•	•	•	•
Carbon dioxide (liquid)	-	•	-	-	-	•
Carbon disulphide	•	•	-	-	-	•
Chloroform	•	•	-	-	-	•
De-ionised water	-	•	•	•	•	•
De-mineralised water	-	•	•	•	•	•
Dry carbon dioxide (gas)	•	•	•	•	•	•
Ethane	•	•	•	-	•	•
Ethanol	•	•	-	-	-	•
Ethyl acetate	•	•	-	-	-	•
Ethyl cloride	•	•	•	•	•	•
Ethylene glycol	•	•	•	•	•	•
Formaldehyde	•	•	•	•	•	•
Freon	•	•	-	-	-	•
Fuel oil	•	•	•	-	•	•
Glycerine	•	•	•	-	•	•
Hard water	•	•	•	•	•	•
Helium	•	•	•	-	•	•
Heptane	•	•	•	-	•	•
Hexane	•	•	•	-	•	•
Hot water <75°C	•	•	•	•	•	•
Hot water and steam <140°C	•	•	-	•	-	•
Hydrogen	•	•	-	-	•	•
Hydrogen dioxide	-	•	-	-	•	•
Isobutane	•	•	•	-	•	•
Isopentane	•	•	•	-	•	•
Methane	•	•	•	-	•	•
Methanol	•	•	-	•	-	•
Methyl cloride	•	•	-	-	-	•
Mineral oil	•	•	•	-	•	•
Natural gas	•	•	•	-	•	•
Neon	•	•	•	-	•	•
Nitrobenzene	•	•	-	-	-	•
Nitrogen	•	•	•	•	•	•
Oxygen	•	•	•	-	•	•
Pentane	•	•	•	•	•	•
Petrol	•	•	-	-	•	•
Propane-n	•	•	•	-	•	•
Soapy water	•	•	•	-	•	•
Toluene	•	•	-	-	•	•
Trichlorethylene dry	•	•	-	-	•	•
Vinegar	•	•	-	•	-	•
Water with glycol	•	•	-	-	•	•
Xilol	-	•	-	-	•	•

• Compatible - Not compatible

1.6.1 Protection class IP......

Compliance with the standard DIN 40050 for the electrical protection at 1000 Volt AC and 1500 Volt DC.

1st number : protection against solid bodies			2nd number : protection against liquids			3rd number : mechanical protection		
IP	**Testes**	**Description**	**IP**	**Testes**	**Description**	**IP**	**Testes**	**Description**
0		No protection	**0**		No protection	**0**		No protection
1		Protection against solid bodies larger than d.50 mm (ex. involuntary contact by hand)	**1**		Protection against the vertical fall of water drops (condensation)	**1**		Impact energy 0.225 joules
2		Protection against solid bodies larger than d.12mm (ex. finger contact)	**2**		Protection against the fall of water drops up to 15° from the vertical	**2**		Impact energy 0.375 joules
3		Protection against solid bodies larger than d. 2,5mm (ends of tools, wires)	**3**		Protection against the fall of water drops and rain up to 60° from the vertical	**3**		Impact energy 0.500 joules
4		Protection against solid bodies larger than d. 1 mm (ends of tools, thin wires)	**4**		Protection against water jets from all directions	**4**		Impact energy 2.00 joules
5		Protection against dust (no harmful deposits)	**5**		Protection against forced water jets from all directions	**7**		Impact energy 6.00 joules
6		Total protection against dust	**6**		Protection against water similar to waves	**9**		Impact energy 20.000 joules
			7		Protection against water immersion			
In the case of the solenoid valve, use only the first two numbers								

1.6.2 Insulation class (or temperature class) according to CEI 15-26

Insulation class	Temperature °C
Y	90
A	105
E	120
B	130
F	155
H	180
200	200
220	220
250	250

The indicated temperature is the effective temperature of the insulation and not the over temperature.

1.6.3 Service

The coils are normally expected to be used in continuous service (ED100%).
Definition of "Continuous service": when the electrical connection time exceed the thermal constant of the coil by approx.1/4 .
As a general rule, the continuous service corresponds to an electrical connection time that is equal or higher than 15 minutes.
It's possible, for non-continuous service (e.g. ED50%), either to have coils at powers that are higher than the standard ones, or to use the coils with an ambient temperature higher than the ones indicated.

$$ED = \frac{\text{connection time}}{(\text{connection time} + \text{disconnection time})} \times 100$$

EXAMPLE : $\frac{5'(\text{connection time})}{5'(\text{connection time}) + 5'(\text{disconnection time})} \times 100 = ED50\%$

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1.6.4 Coils power

The power (P) indicated is referred to a temperature of 20°C.
For DC current it is as follows:

$$P(watt) = V(Volt) \times I(Ampere); \quad P = \frac{v^2 \,(Volt)}{R\,(Ohm)}$$

In the case of AC current, the value is referred to the apparent power during inrush (connection moment) and during holding.

P(VA)= V(Volt) x I(Ampere)

In the case of AC current, voltage and current are not in phase with each other. Phase angle between current and voltage is shown by the angle φ of the resistance triangle (the three sides represent: resistance, reactance and impedance of the circuit).
In the case of AC current the power showed in Watt become:

P(watt) = V(Volt) x I(Ampere) x power factor φ

power factor φ = power factor is always less than 1

The power, or electric input, in a AC current solenoid valve, is higher during inrush while it decreases when the plunger's stroke is complete.
In the DC current solenoid valve, as the power depends from the coil's Ohmic resistance, the power is the same during inrush and also when the plunger's stroke is complete too.

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1.7 Units of measure

In the international system (SI) the physical and technical units are validated as follows :

Unit of length	:	Meter	(symbol m)
Unit of mass	:	Kilogram	(symbol Kg)
Unit of time	:	Second	(symbol s)
Unit of electrical current	:	Ampére	(symbol A)
Unit of temperature	:	Kelvin	(symbol K)
Unit of luminosity	:	Candle	(symbol cd)

Pressure

Old measuring units :

Kilopond per cm ²	Kp/cm²
Meter of water column	mH_20
Millimeter of mercury column	mmHg
Metric Atmosphere	at
Atmosphere	atm

They were replaced in the SI from Pascal.

One Pascal corresponds to the pressure of 1 Newton, which is acting on the area of 1 m².

$$1\,\text{Pascal} = \frac{1\,\text{N}}{1\,\text{m}^2} \quad (\text{symbol Pa})$$

Unit Pa is a very low value and for standard industrial applications, the Bar (symbol bar) is used.

1 bar = 0.1 MegaPascal (symbol Mpa=1.000.000 Pa).

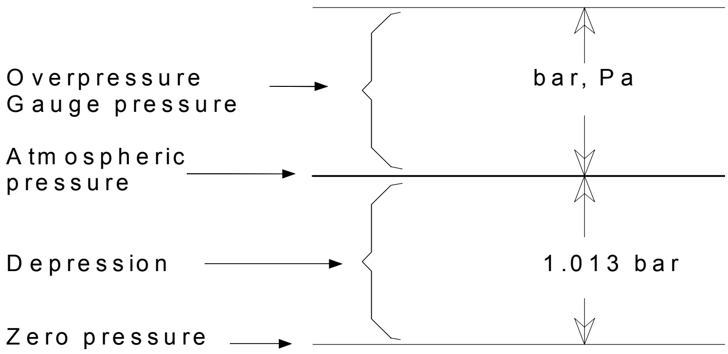
The conversion from the old unit of measure to the new one (SI) is the following :

1 Kp/cm² = 0.981 bar

1 bar = 1.02 Kp/cm²

The conversion in the SI unit is also possible where the metric system is not yet used.

Conversion	:	1 bar	=	14.50 psi		
		1 psi	=	0.07 bar	=	7.000 Pa

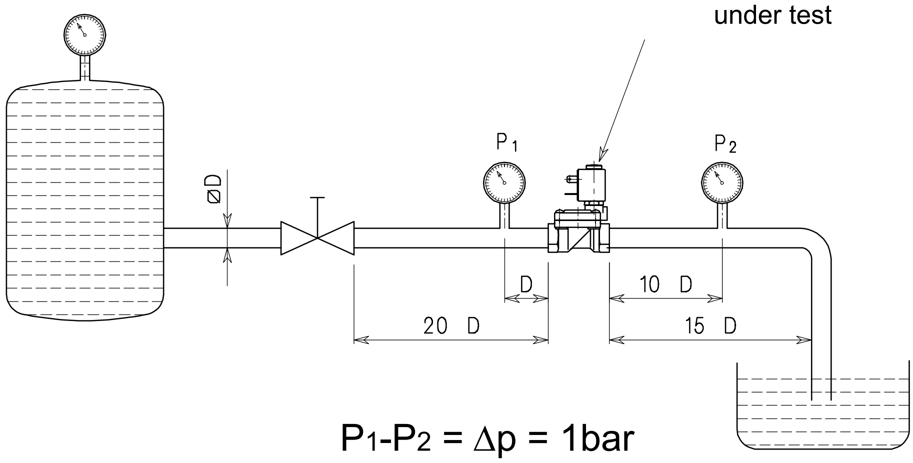


Pressure values, except specific references, are referred to the atmospheric pressure.

1.8 Flow calculation

Each solenoid valve has a flow coefficient (Kv).
It is possible, with this data, to calculate the flow. Given the loss of flowing pressure (pressure drop),the media type and the working pressure it's possible to calculate the flow rate.
This flow coefficient is determined by way of experimentation according to the standard VDE 2173 and it represents the quantity of water discharged from the solenoid valve with a pressure difference of 1 bar at a temperature between 5°C and 40°C.

Kv coefficient measuring system



$P_1 - P_2 = \Delta p = 1\text{bar}$

Kv	=	m^3/h	Flow coefficient
Q	=	m^3/h	Flow
Q_n	=	$m^3{}_n/h$	Normal flow (20°C 760mm Hg)
P_1	=	bar	Inlet pressure (Gauge pressure + 1)
P_2	=	bar	Outlet pressure (Gauge pressure + 1)
Δp	=	bar	Pressure drop (differential pressure between inlet & outlet)
ρ	=	Kg/dm^3	Relative density referred to water (Water at 4°C = 1)

ρ_n	=	Kg/dm³	Normal relative density referred to air
G	=	Kg/h	Mass
t	=	°C	Inlet media temperature
V_1	=	m³/Kg	Inlet specific volume
V_2	=	m³/Kg	Outlet specific volume referred to "P2" pressure and "t" temperature

Liquids : $Q = Kv \sqrt{\frac{\Delta p}{\rho}}$

Gas : $\Delta p = \quad \Delta p < P_1/2 \qquad Q_n = 514 \times Kv \sqrt{\frac{\Delta p \times P_2}{\rho_n \times (273 + t)}}$

$\Delta p = \quad \Delta p > P_1/2 \qquad Q_n = 257 \times Kv \frac{P_1}{\sqrt{\rho_n (273 + t)}}$

Air : $\Delta p = \quad \Delta p < P_1/2 \qquad Q_n = 26 \times Kv \sqrt{\Delta p \times P_2}$

$\Delta p = \quad \Delta p > P_1/2 \qquad Q_n = Kv \times P_1 \times 13$

Steam : $\Delta p = \quad \Delta p < P_1/2 \qquad G = 31.6 \times Kv \sqrt{\frac{\Delta p}{V_2}}$

$\Delta p = \quad \Delta p > P_1/2 \qquad G = 31.6 \times Kv \sqrt{\frac{P_1}{v_1}}$

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1.9 Technical tables

1.9.1 Pressure

bar	N/cm²	MPa	Psi	bar	N/cm²	MPa	Psi
0.1	1	0.01	1.45	14	140	1.4	203.00
0.2	2	0.02	2.90	15	150	1.5	217.50
0.3	3	0.03	4.35	16	160	1.6	232.00
0.4	4	0.04	5.80	17	170	1.7	246.50
0.5	5	0.05	7.25	18	180	1.8	261.00
0.6	6	0.06	8.70	19	190	1.9	275.50
0.7	7	0.07	10.15	20	200	2.0	390.00
0.8	8	0.08	11.60	21	210	2.1	304.50
0.9	9	0.09	13.05	22	220	2.2	316.00
1.0	10	0.10	14.50	23	230	2.3	333.50
1.5	15	0.15	21.75	24	240	2.4	348.00
2.0	20	0.20	29.00	25	250	2.5	362.50
2.5	25	0.25	36.25	26	260	2.6	377.00
3.0	30	0.30	43.50	27	270	2.7	391.50
3.5	35	0.35	50.75	28	280	2.8	406.00
4.0	40	0.40	58.00	29	290	2.9	420.50
4.5	45	0.45	65.25	30	300	3.0	435.00
5.0	50	0.50	72.50	35	350	3.5	507.50
5.5	55	0.55	79.75	40	400	4.0	580.00
6.0	60	0.60	87.00	45	450	4.5	652.50
6.5	65	0.65	94.25	50	500	5.0	725.00
7.0	70	0.70	101.50	55	550	5.5	797.50
7.5	75	0.75	108.75	60	600	6.0	870.00
8.0	80	0.80	116.00	65	650	6.5	942.50
8.5	85	0.85	123.25	70	700	7.0	1015.00
9.0	90	0.90	130.50	75	750	7.5	1087.50
9.5	95	0.95	137.75	80	800	8.0	1160.00
10.0	100	1.00	145.00	85	850	8.5	1232.50
11.0	110	1.10	159.50	90	900	9.0	1305.00
12.0	120	1.20	174.00	95	950	9.5	1377.50
13.0	130	1.30	188.50	100	1000	10.0	1450.00

1.9.2 Viscosity

Kinematic viscosity centistokes cSt (mm²/s)	°Engler °E	Saybolt Universal Ssu	Redwood Seconds n°1 SRW n°1
1	1	---	---
2	1.1	32.7	31
3	1.2	36	33.5
4	1.3	39	36
5	1.4	42.5	38.5
7	1.5	49	44
10	1.8	59	52
15	2.3	77.5	68
20	2.9	98	86
25	3.4	119	105
30	4	140	120
35	4.7	164	145
40	5.3	186	165
50	6.6	232	205
60	8	278	245
70	9.2	324	286
80	10.5	370	327
90	12	415	370
100	13	465	410

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1.9.3 Temperatures

°C	K	°F	°C	K	°F	°C	K	°F	°C	K	°F
-50	223	-58.0	1	274	33.8	51	324	123.8	105	378	221.0
-49	224	-56.2	2	275	35.6	52	325	125.6	110	383	230.0
-48	225	-54.4	3	276	37.4	53	326	127.4	115	388	239.0
-47	226	-52.6	4	277	39.2	54	327	129.2	120	393	248.0
-46	227	-50.8	5	278	41.0	55	328	131.9	125	398	257.0
-45	228	-49.0	6	279	42.8	56	329	132.8	130	403	266.0
-44	229	-47.2	7	280	44.6	57	330	134.6	135	408	275.0
-43	230	-45.4	8	281	46.4	58	331	136.4	140	413	284.0
-42	231	-43.6	9	282	48.2	59	332	138.2	145	418	293.0
-41	232	-41.8	10	283	50.0	60	333	140.0	150	423	303.0
-40	233	-40.0	11	284	51.8	61	334	141.8	155	428	311.0
-39	234	-38.2	12	285	53.6	62	335	143.6	160	433	320.0
-38	235	-36.4	13	286	55.4	63	336	145.4	165	438	329.0
-37	236	-34.6	14	287	57.2	64	337	147.2	170	443	338.0
-36	237	-32.8	15	288	59.0	65	338	149.0	175	448	347.0
-35	238	-31.0	16	289	60.8	66	339	150.8	180	453	356.0
-34	239	-29.2	17	290	62.6	67	340	152.6	185	458	365.0
-33	240	-27.4	18	291	64.4	68	341	154.4	190	463	374.0
-32	241	-25.6	19	292	66.2	69	342	156.2	195	468	383.0
-31	242	-23.8	20	293	68.0	70	343	158.0	200	473	392.0
-30	243	-22.0	21	294	69.8	71	344	159.8	205	478	401.0
-29	244	-20.2	22	295	71.6	72	345	161.6	210	483	410.0
-28	245	-18.4	23	296	73.4	73	346	163.4	215	488	419.0
-27	246	-16.6	24	297	75.2	74	347	165.2	220	493	428.0
-26	247	-14.8	25	298	77.0	75	348	167.0	225	498	437.0
-25	248	-13.0	26	299	78.8	76	349	168.8	230	503	446.0
-24	249	-11.2	27	300	80.6	77	350	170.6	235	508	455.0
-23	250	-9.4	28	301	82.4	78	351	172.4	240	513	464.0
-22	251	-7.6	29	302	84.2	79	352	174.2	245	518	473.0
-21	252	-5.8	30	303	86.0	80	353	176.0	250	523	482.0
-20	253	-4.0	31	304	87.8	81	354	177.8	255	528	491.0
-19	254	-2.2	32	305	89.6	82	355	179.6	260	533	500.0
-18	255	-0.4	33	306	91.4	83	356	181.4	265	538	509.0
-17	256	1.4	34	307	93.2	84	357	183.2	270	543	518.0
-16	257	3.2	35	308	95.0	85	358	185.0	275	548	527.0
-15	258	5.0	36	309	96.8	86	359	186.8	280	553	536.0
-14	259	6.8	37	310	98.6	87	360	188.6	285	558	545.0
-13	260	8.6	38	311	100.4	88	361	190.4	290	563	554.0
-12	261	10.4	39	312	102.2	89	362	192.2	295	568	563.0
-11	262	12.2	40	313	104.0	90	363	194.0	300	573	572.0
-10	263	14.0	41	314	105.8	91	364	195.8	310	583	590.0
-9	264	15.8	42	315	107.6	92	365	197.6	320	593	608.0
-8	265	17.6	43	316	109.4	93	366	199.4	330	603	626.0
-7	266	19.4	44	317	111.2	94	367	201.2	340	613	644.0
-6	267	21.2	45	318	113.0	95	368	203.0	350	623	662.0
-5	268	23.0	46	319	114.8	96	369	204.8	360	633	680.0
-4	269	24.8	47	320	116.6	97	370	206.6	370	643	698.0
-3	270	26.6	48	321	118.4	98	371	208.4	380	653	716.0
-2	271	28.4	49	322	120.2	99	372	210.2	390	663	734.0
-1	272	30.2	50	323	122.0	100	373	212.0	400	673	752.0
0	273	32.0									

1.9.4 Steam

Relative pressure (bar)	Absolute pressure (bar)	Temperature (°C)	Steam specific volume (m³/kg)
---	0.050	32.88	28.192
---	0.500	81.33	3.240
0.00	1.013	100.00	1.673
0.10	1.113	102.66	1.533
0.20	1.213	105.10	1.414
0.35	1.363	108.50	1.268
0.50	1.513	111.61	1.149
0.70	1.713	115.40	1.024
1.00	2.013	120.42	0.881
1.50	2.513	127.62	0.714
2.00	3.013	133.69	0.603
2.50	3.513	139.02	0.522
3.00	4.013	143.75	0.461
3.50	4.513	148.02	0.413
4.00	5.013	151.96	0.374
4.50	5.513	155.55	0.342
5.00	6.013	158.92	0.315
6.00	7.013	165.04	0.272
7.00	8.013	170.50	0.240
8.00	9.013	175.43	0.215
9.00	10.013	179.97	0.194
10.00	11.013	184.13	0.177

1.9.5 Specific gravity

Liquid substances		
Liquid	°C	specific gravity Kg/dm^3
Absolute Alcohol	15	0.79
Acetone	20	0.79
Alcohol	15	0.81
Aniline	0	1.04
Benzol	0	0.90
Bromine	0	3.19
Carbonic acid	0	0.94
Caustic Soda 9%NaOH	15	1.10
Caustic Soda 18%NaOH	15	1.20
Caustic Soda 27%NaOH	15	1.30
Caustic Soda 37%NaOH	15	1.40
Caustic Soda 47%NaOH	15	1.50
Coal tar	15	1.1÷1.26
Colza oil	15	0.97
Distilled water	0	0.99987
Distilled water	4	1.0000
Distilled water	15	0.99913
Distilled water	25	0.99707
Ether	15	0.79
Fuming sulphuric acid	15	1.89
Glycerine with water 50%	0	1.13
Glycerine without water	0	1.26
Hydrochloric acid 10%	15	1.05
Hydrochloric acid 20%	15	1.10
Hydrochloric acid 30%	15	1.15
Hydrochloric acid 40%	15	1.20
Lube oil	20	0.90÷0.93
Milk	15	1.030
Mineral oil	20	0.91
Naphta	20	0.76
Nitric acid 17%	15	1.10
Nitric acid 25%	15	1.15
Nitric acid 47%	15	1.3
Nitric acid 94%	15	1.5
Oil	15	0.79÷0.82
Olive oil	15	0.92
Petrol	15	0.68÷0.72
Potassium Hydrox. 11% KOH	15	1.10
Potassium Hydrox. 21% KOH	15	1.20
Potassium Hydrox. 31% KOH	15	1.30
Potassium Hydrox. 49% KOH	15	1.50
Salt solution 14%NaCl	15	1.10
Salt solution 26% NaCl	15	1.20
Sea water	4	1.026
Stand oil	15	0.94
Sulphuric acid 27%	15	1.20
Sulphuric acid 50%	15	1.40
Sulphuric acid 75%	15	1.50
Sulphuric acid 87%	15	1.80
Turpentine oil	15	0.87

Gases and vapours at 0°C	
Gases or vapour	Specific gravity gr/m^3
Acetylene	0,91
Carbon dioxide	1,52
Sulphur dioxide	2,15
Alcohol	1,60
Ammonia	0,59
Air	1,00
Nitrogen	0,97
Benzol	2,69
Bromine	5,39
Cyanide	1,81
Hydrogen cyanide	0,95
Chlorine	2,45
Chloroform	4,21
Ether	2,56
Illuminating gas	0,38÷0,45
Hydrogen	0,07
Hydrogen sulphide	1,19
Methane	0,55
Nitric oxide	1,04
Carbon monoxide	0,97
Oxygen	1,10
Steam	0,62

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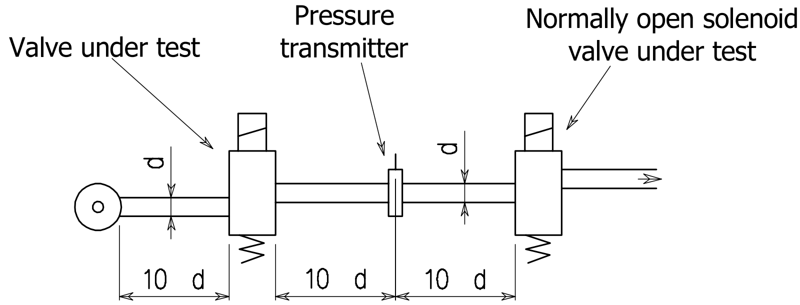
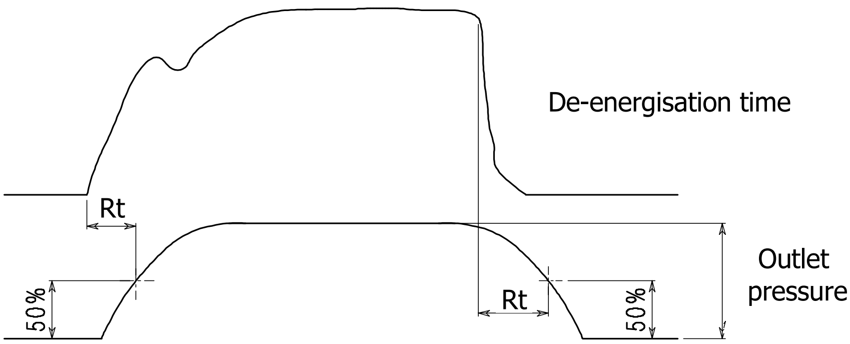
1.10 Response time

The Response time (Rt) of a solenoid valve is the period passing between the energisation (or de-energisation) of the coil and the moment when the outlet pressure reaches the 50% of its peak.
Example of a circuit test :





The response time depends from the type of valve, the nature of the medium, the pressure and the current (AC or DC), if these value are measured at the moment of electrical connection or disconnection.

SERIES	Tr (ms) Air P=6 bar		NOTES
	Opening	Closing	
2 & 3 ways direct acting NC	8	25	With liquids +50% ÷150% depending on the viscosity
2 & 3 ways direct acting NO	25	8	
Servoassisted NC G3/8 & G1/2 G3/4 & G1	30 50	50 70	
Servoassisted NO G3/8 & G1/2 G3/4 & G1	50 70	30 50	
Servoassisted G1”1/4 -G1”1/2 - G2” G2”1/2 - G3”	Adjustable time		

1.11 P.E.D. Directive (97/23/EC)

P.E.D. DECLARATION OF CONFORMITY

ACL S.r.l.
Via Giovanni Falcone, 6
20040 Cavenago di Brianza (MB)

Declares that the solenoid valves listed in the present catalogue are in conformity with the following EU directive

97/23/EC (Pressure Equipment Directive)

We also declare that they are not allowed to carry the CE mark in conformity to the article 3, paragraph 3.

Remark:
In case that on our goods you will find the CE sticker, means that the product meets the EC 89/336, EC 92/31, EC 93/68, EC 72/23.
Limitedly to the rules apply by EN 55014, EN 61000-3-2, EN 61000-3-3, EN 60335-1 (CEI 61-150 volume N 2616E).

1.12 Operating instructions and installation

1.PRECAUTIONS DURING THE HYDRAULIC CONNECTION

Check that the valve series meets the application. Don't exceed the specification shown on the valve label.
Check that the fluid is in the same direction as the arrow stamped on the valve body and that the pipes are compatible with the flow rate of the valve.
Check that the pipes are clean and, if possible, fit a filter before the valve.
When connecting the valve , make sure that no foreign matter and sealing materials such as tape and jointing paste get inside the valve, as this could obstruct the internal pilot holes. (pilot operated valves)
When making connections using a wrench, apply force only the body of the valve. Avoid the coil area.
The solenoid valve can work in any position but to avoid the eventual precipitation of impurities inside the guide tube it's recommended that the coil is positioned above a horizontal pipe run.
When connecting with flexible tubes, it's recommended to use the provided fixing holes.
(types with 1/8" and ¼" threads)

2.PRECAUTIONS DURING THE ELECTRICAL CONNECTION

Check if the electrical data on the coil are compatible with the electrical supply.
The direct current valves don't require a fixed polarity with the exception of bi-stable valves.
To help heat dissipation of the coil, put the valve in a ventilated environment away from any other heat source.
It's possible that the coil working temperature could, in conjunction with ambient and fluid temperatures, cause scorching.
It's recommended an appropriate protection of the coil from water and humidity.
The coil fixing nut should not be over tightened. Don't exceed a torque more than 1.5Nm

3. MAINTENANCE

Coils can be changed without removing the valve from the system.
Spare parts are available for all wearing valve components.
When replacing the guide tube do not exceed the following tightening torque :

Normally Open valves	Normally Closed valves
16mm wrench=10Nm	11mm wrench=5Nm
22mm wrench=20Nm	16mm wrench=15Nm
	22mm wrench=50Nm

Before removing the valve, check that the power supply has been switched off and that no pressure is present in the pipeline.
If the valve needs cleaning, pay special attention to the seat area to avoid any damage.
The plunger must move freely inside the guide tube. If this isn't achievable due to incrustations, scale deposits or worn surfaces, then replacement parts must be fitted.
Seals must be replaced if swollen or damaged with incisions etc.
The diaphragm pilot holes must not be blocked to guarantee the correct operation of servo-assisted valves. Check that both holes are clear. Check also that the diaphragm has not hardened, swollen or it shows wear in the seat/seal area. Replace if necessary

4. GENERAL PRECAUTIONS

When the solenoid valve is used on machines or equipment with high mechanical stress (for example, vibrating stress), contact the manufacturer or verify life and functionality testes with appropriate tests.

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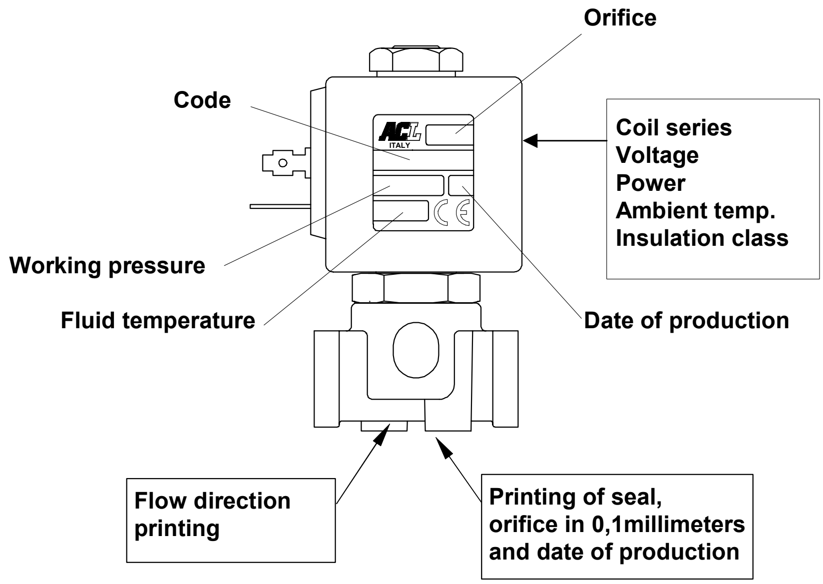
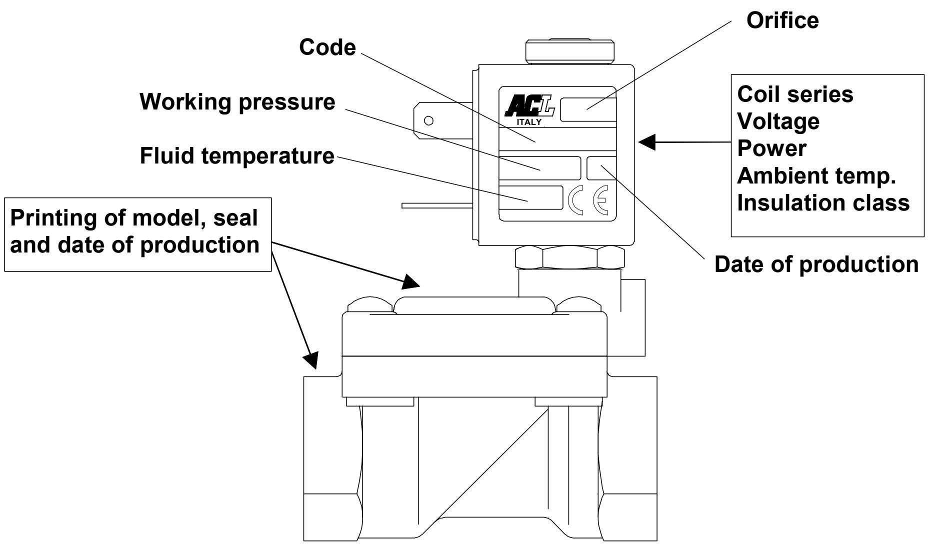
1.13 Model identification

Solenoid valves are identified as follow :

1.13.1 DIRECT ACTING



1.13.2 SERVO-ASSISTED



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