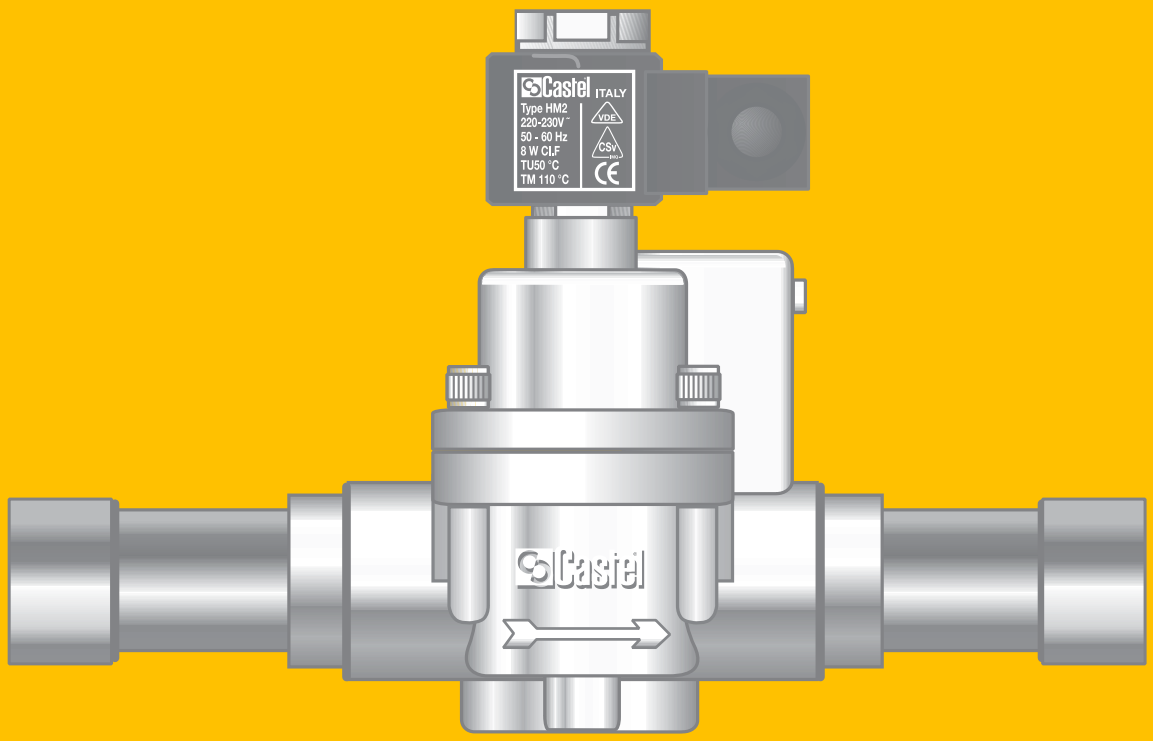
SOLENOID VALVES



Castel®

SOLENOID VALVES FOR REFRIGERATING SYSTEMS

APPLICATIONS

The solenoid valves, shown in this chapter, are classified “Pressure accessories” in the sense of the Pressure Equipment Directive 97/23/EC, Article 1, Section 2.1.4 and are subject of Article 3, Section 1.3 of the same Directive.
They are designed for installation on commercial refrigerating systems and on civil and industrial conditioning plants, which use refrigerant fluids proper to the Group II (as defined in Article 9, Section 2.2 of Directive 97/23/EC and referred to in Directive 67/548/EEC).

OPERATION

The valves series 1020; 1028; 1050; 1058; 1059; 1064; 1068; 1070; 1078; 1079; 1090; 1098; 1099 are normally closed.
NC = when the coil is de-energised the plunger stops the refrigerant flow.
The valves series 1150; 1158; 1164; 1168; 1170; 1178;1190; 1198 are normally open.
NO = when the coil is energised the plunger stops the refrigerant flow.
The valves series 1020 and 1028 are direct acting, while the valves of all the other series are pilot operated, with diaphragm or piston.
The NC valves are supplied either without coil (S type) or with coil (example: A6 type with coil HM2–220 Vac).
The NO valves are supplied only without coil (S type).
N.B.: the NO valve visually differs from the corresponding NC model by means of the red ring installed below the yellow nut that fastens the coil.

CONSTRUCTION

The main parts of the valves are made with the following materials:
- hot forged brass EN 12420 – CW 617N for body and cover;
- copper tube EN 12735-1 – Cu-DHP for solder connections;
- austenitic stainless steel EN 10088-2 – 1.4303 for enclosure where the plunger moves;
- ferritic stainless steel EN 10088-3 – 1.4105 for plunger:
- austenitic stainless steel EN ISO 3506 – A2-70 for tightening screws between body and cover;
- chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for seat gaskets.

INSTALLATION

The valves can be installed in all sections of a refrigerating system, in compliance with the limits and capacities indicated in Tables 3 and 6.
Tables 1 and 4 show the following functional characteristics of a solenoid valve:
- PS;
- TS;
- Kv factor;
- minimum Opening Pressure Differential (minOPD), that is the minimum pressure differential between inlet and outlet at which a solenoid valve, pilot operated, can open and stay opened;
- maximum Opening Pressure Differential (MOPD according to ARI STANDARD 760: 2001), that is the maximum pressure differential between inlet and outlet at which a solenoid valve, pilot operated, can open.

Before connecting the valve to the pipe it is advisable to make sure that the refrigerating system is clean. In fact the valves with P.T.F.E. gaskets are particularly sensitive to dirt and debris.
Furthermore check that the flow direction in the pipe corresponds to the arrow stamped on the body of the valve.
All valves can be mounted in whatever position except with the coil pointing downwards.
The brazing of valves with solder connections should be carried out with care, using a low melting point filler material. It is not necessary to disassemble the valves before brazing but it’s important to avoid direct contact between the torch flame and the valve body, which could be damaged and compromise the proper functioning of the valve.
Before connecting a valve to the electrical system, be sure that the line voltage and frequency correspond to the values marked on the coil.

The NO valves have been designed to work only with direct current coils.
To use them with an alternate current supply it's necessary to mate the NO valve with the following components:

- voltage 24 Vac:
  Coil 9120/RD2 + Connector 9150/R44;
- voltage 220 Vac:
  Coil 9120/RD6 + Connector 9150/R45.

TABLE 1: General Characteristics of NC valves (normally closed)

Catalogue Number	Connections			Seat size nominal Ø [mm]	Kv Factor [m³/h]	Operating Principles	Opening Pressure Differential [bar]				TS [°C]		PS [bar]	Risk Category according to PED
	SAE Flare	ODS					min OPD	MOPD Coil type			min.	max.		
		Ø [in.]	Ø [mm]					HM2 CM2 (AC)	HM4 (AC)	HM3 (DC)				
1020/2	1/4"	–	–	2,5	0,175	Ditect Acting	0	21	25 (3)	19	– 35	+105 (1)	45	Art. 3.3
1020/3	3/8"	–	–	3	0,23									
1028/2	–	1/4"	–	2,2	0,15									
1028/2E	–	1/4"	–	3	0,23									
1028/3	–	3/8"	–											
1028/M10	–	–	10											
1064/3	3/8"	–	–	7	0,80	Diaphragm Pilot Operated	0,05							
1064/4	1/2"	–	–											
1068/3	–	3/8"	–											
1068/M10	–	–	10											
1068/M12	–	–	12											
1068/4	–	1/2"	–											
1070/4	1/2"	–	–	12,5	2,20					18				
1070/5	5/8"	–	–		2,61									
1078/M12	–	–	12		2,20									
1078/4	–	1/2"	–											
1078/5	–	5/8"	16		2,61									
1079/7	–	7/8"	22											
1050/5	5/8"	–	–	16,5	3,80	Piston Pilot Operated	0,07			13		+110 (2)		
1050/6	3/4"	–	–		4,80									
1058/5	–	5/8"	16		3,80									
1058/6	–	3/4"	–		4,80									
1058/7	–	7/8"	22		5,70									
1059/9	–	1.1/8"	–											
1090/5	5/8"	–	–		3,80	Diaphragm Pilot Operated	0,05		21			+105 (1)		
1090/6	3/4"	–	–		4,80									
1098/5	–	5/8"	16		3,80									
1098/6	–	3/4"	–		4,80									
1098/7	–	7/8"	22		5,70									
1099/9	–	1.1/8"	–											
1078/9	–	1.1/8"	–	25,5	10					19				
1079/11	–	1.3/8"	35											
1098/9	–	1.1/8"	–	25	10	Piston Pilot Operated	0,07		25 (3)			+110 (2)		
1099/11	–	1.3/8"	35											
1078/11	–	1.3/8"	35	27	16									
1079/13	–	1.5/8"	–											
1079/M42	–	–	42											

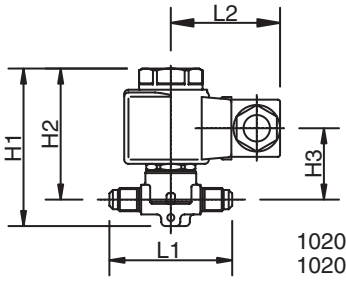
(1) Temperature peaks of 120 °C are allowed during defrosting.
(2) Temperature peaks of 130 °C are allowed during defrosting.
(3) For information about higher MOPD, please contact Castel Technical Department.

SOLENOID VALVES FOR REFRIGERATING SYSTEMS

TABLE 2: Dimensions and Weights of NC valves with 9100 coil (1)

Catalogue Number	Dimensions [mm]						Weight [g]
	H_1	H_2	H_3	L_1	L_2	Q	
1020/2	75	62,5	34	58	50	–	340
1020/3				65			355
1028/2				125			350
1028/2E				125			350
1028/3				125			365
1028/M10				125			365
1064/3	82	69,5	40	68		–	400
1064/4				72			415
1068/3				111			400
1068/M10				111			395
1068/M12				127			420
1068/4				127			420
1070/4	91	75	47	100		45	710
1070/5				106			755
1078/M12				127			690
1078/4				127			680
1078/5				175			775
1079/7				190			765
1050/5	121	93	65	120		57	1157
1050/6				124			1487
1058/5				175			1117
1058/6				175			1307
1058/7				180			1292
1059/9				216			1347
1090/5	106	78	50	120			1035
1090/6				124			1365
1098/5				175			995
1098/6				175			1185
1098/7				180			1170
1099/9				216			1225
1078/9	115	96	72	250		80	2565
1079/11				292			2620
1098/9	157	127	99	235		68	2050
1099/11				277			2130
1078/11	172	138	110	278		68	2710
1079/13							2750
1079/M42							2750

(1) With coil type 9120 the dimension L_2 is equal to 64 mm and the valves weights must be increased of 305 g.



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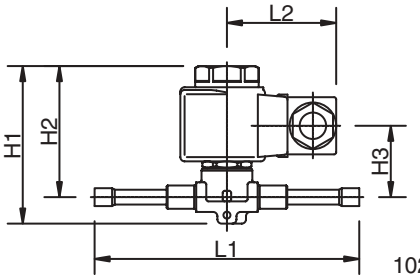

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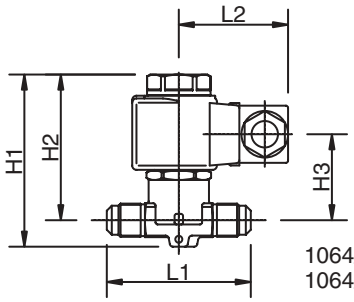
1028/2E
1028/3
1028/M10



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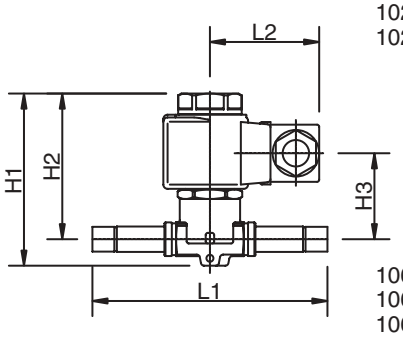

1068/3
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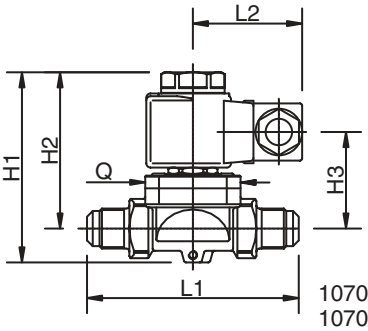
1068/M12



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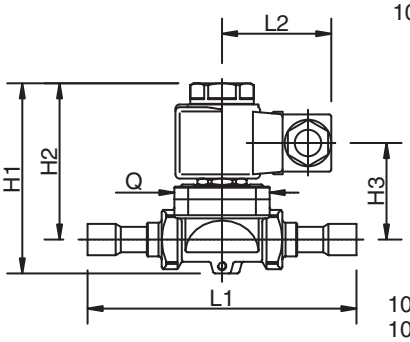
1070/5



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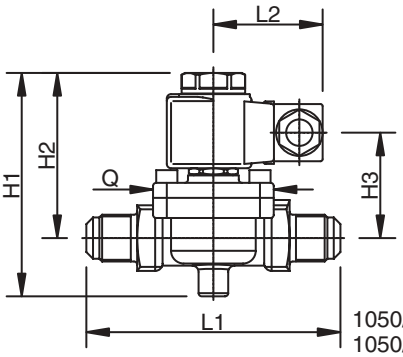
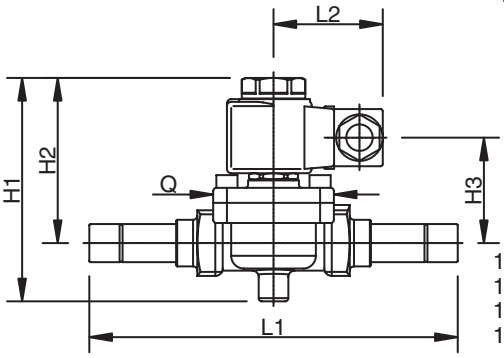
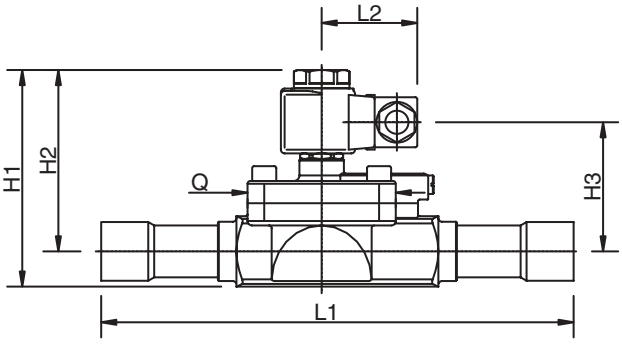
1079/7



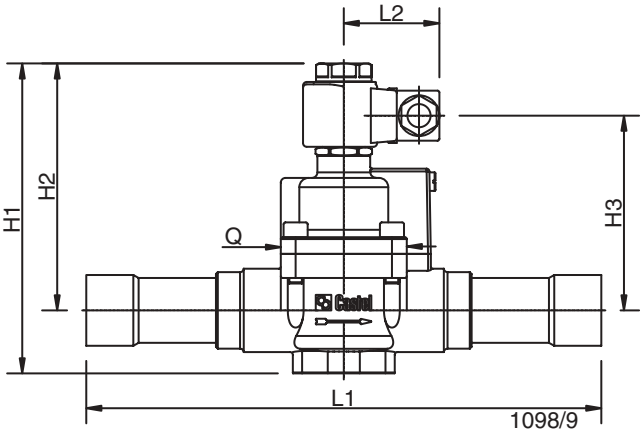
1050/5
1050/6
1090/5
1090/6



1058/5 1098/5
1058/6 1098/6
1058/7 1098/7
1059/9 1099/9



1078/9
1079/11



1098/9
1099/11
1078/11
1079/13
1079/M42

Connectors are not included in the boxes and have to be ordered separately.

SOLENOID VALVES FOR REFRIGERATING SYSTEMS

TABLE 3: Refrigerant Flow Capacity of NC valves

Catalogue Number	Resa frigorifera [kW]														
	Liquid					Vapour					Hot Gas				
	R134a	R22	R407C	R404A	R410A	R134a	R22	R407C	R404A	R410A	R134a	R22	R407C	R404A	R410A
1020/2	2,95	3,15	3,28	2,08	3,33	–	–	–	–	–	1,49	2,05	2,03	1,75	2,28
1020/3	3,88	4,14	4,31	2,74	4,38						1,96	2,69	2,67	2,30	2,99
1028/2	2,53	2,70	2,81	1,79	2,86						1,28	1,76	1,74	1,50	1,95
1028/2E	3,88	4,14	4,31	2,74	4,38						1,96	2,69	2,67	2,30	2,99
1028/3															
1028/M10															
1064/3	13,5	14,4	15,0	9,5	15,2	1,73	2,16	2,14	1,81	2,88	6,8	9,4	9,3	8,0	10,4
1064/4															
1068/3															
1068/M10															
1068/M12															
1068/4															
1070/4	37,1	39,6	41,2	26,2	41,9	4,75	5,94	5,90	4,97	7,92	18,7	25,7	25,6	22,0	28,6
1070/5	44,0	47,0	48,9	31,1	49,7	5,64	7,05	6,99	5,90	9,40	22,2	30,5	30,3	26,1	33,9
1078/M12	37,1	39,6	41,2	26,2	41,9	4,75	5,94	5,90	4,97	7,92	18,7	25,7	25,6	22,0	28,6
1078/4															
1078/5	44,0	47,0	48,9	31,1	49,7	5,64	7,05	6,99	5,90	9,40	22,2	30,5	30,3	26,1	33,9
1079/7															
1050/5	64,0	68,4	71,2	45,2	72,4	8,2	10,3	10,2	8,6	13,7	32,3	44,5	44,2	38,0	49,4
1050/6	80,9	86,4	90,0	57,1	91,4	10,4	13,0	12,9	10,8	17,3	40,8	56,2	55,8	48,0	62,4
1058/5	64,0	68,4	71,2	45,2	7,4	8,2	10,3	10,2	8,6	13,7	32,3	44,5	44,2	38,0	49,4
1058/6	80,9	86,4	90,0	57,1	91,4	10,4	13,0	12,9	10,8	17,3	40,8	56,2	55,8	48,0	62,4
1058/7	96,0	102,6	106,8	67,8	108,5	12,3	15,4	15,3	12,9	20,5	48,5	66,7	66,2	57,0	74,1
1059/9															
1090/5	64,0	68,4	71,2	45,2	72,4	8,2	10,3	10,2	8,6	13,7	32,3	44,5	44,2	38,0	49,9
1090/6	80,9	86,4	90,0	57,1	91,4	10,4	13,0	12,9	10,8	17,3	40,8	56,2	55,8	48,0	62,4
1098/5	64,0	68,4	71,2	45,2	72,4	8,2	10,3	10,2	8,6	13,7	32,3	44,5	44,2	38,0	49,4
1098/6	80,9	86,4	90,0	57,1	91,4	10,4	13,0	12,9	10,8	17,3	40,8	56,2	55,8	48,0	62,4
1098/7	96,0	102,6	106,8	67,8	108,5	12,3	15,4	15,3	12,9	20,5	48,5	66,7	66,2	57,0	74,1
1099/9															
1078/9	168,5	180,0	187,4	119,0	190,4	21,6	27,0	26,8	22,6	36,0	85,0	117,0	116,2	100,0	130,0
1079/11															
1098/9	168,5	180,0	187,4	119,0	190,4	21,6	27,0	26,8	22,6	36,0	85,0	117,0	116,2	100,0	130,0
1099/11															
1078/11	269,6	288,0	299,8	190,4	304,6	34,6	43,2	42,9	36,2	57,6	136,0	187,2	185,9	160,0	208,0
1079/13															
1079/M42															

Refrigerant flow capacity referred to the following operating conditions:
- *Evaporating temperature: + 4 °C*
- *Condensing temperature: + 38 °C*
- *Pressure drop: 0,15 bar*

Particularly for hot gas:
- *Suction temperature: + 18 °C*
- *Pressure drop: 1 bar*

TABLE 4: General Characteristics of NO valves (normally open)

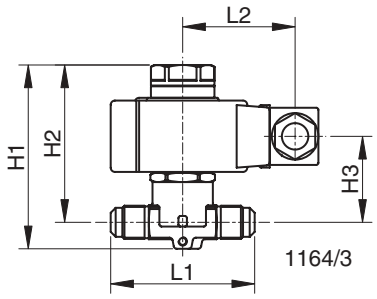
Catalogue Number	Coil Type	Connections			Seat size nominal Ø [mm]	Kv Factor [m³/h]	Operating Principles	Opening Pressure Differential [bar]		TS [°C]		PS [bar]	Risk Category according to PED
		SAE Flare	ODS Ø [in.]	ODS Ø [mm]				min OPD	MOPD	min.	max.		
1164/3 R	HM3 (D.C.)	3/8"	–	–	7	0,80	Diaphragm Pilot operated	0,05	21	– 35	+105 (1)	32	Art. 3.3
1168/3 R		–	3/8"	–									
1168/M10 R		–	–	10									
1170/4 R		1/2"	–	–	12,5	2,20							
1170/5 R		5/8"	–	–		2,61							
1178/M12 R		–	–	12		2,20							
1178/4 R		–	1/2"	–									
1178/5 R		–	5/8"	16		2,61							
1150/5 R		5/8"	–	–	16,5	3,80	Piston Pilot Operated	0,07	19		+110 (2)		
1150/6 R		3/4"	–	–		4,80							
1158/5 R		–	5/8"	16		3,80							
1158/6 R		–	3/4"	–		4,80							
1158/7 R		–	7/8"	22		5,70							
1190/5 R		5/8"	–	–		3,80	Diaphragm Pilot operated	0,05			+105 (1)		
1190/6 R		3/4"	–	–		4,80							
1198/5 R		–	5/8"	16		3,80							
1198/6 R		–	3/4"	–		4,80							
1198/7 R		–	7/8"	22		5,70							
1178/9 R		–	1.1/8"	–	25,5	10							
1198/9 R		–	1.1/8"	–	25	10	Piston Pilot Operated	0,07			+110 (2)		
1178/11 R		–	1.3/8"	35	27	16							

(1) Temperature peaks of 120 °C are allowed during defrosting.

(2) Temperature peaks of 130 °C are allowed during defrosting.

R *Available on request.*

SOLENOID VALVES FOR REFRIGERATING SYSTEMS



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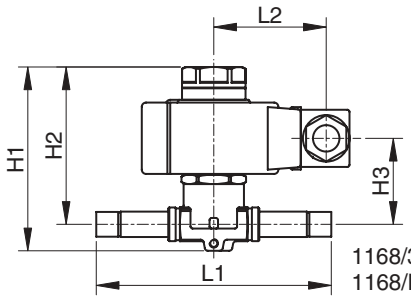

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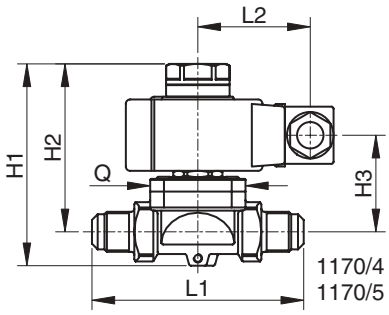
1168/M10



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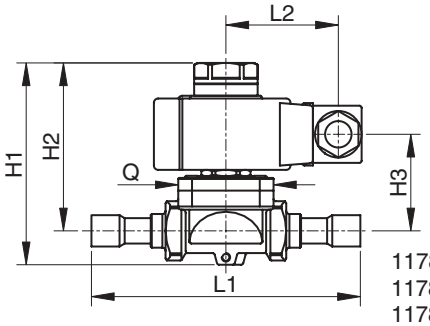
1170/5



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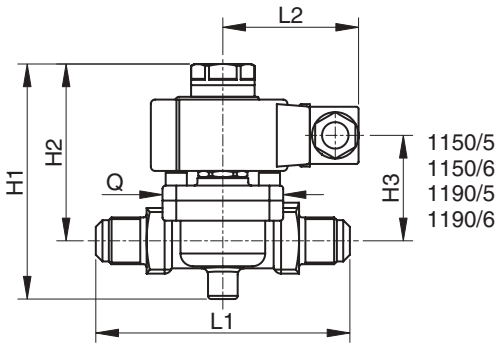
1178/5



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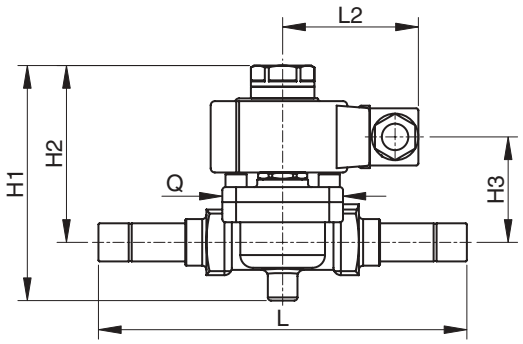
1190/5
1190/6



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1158/6
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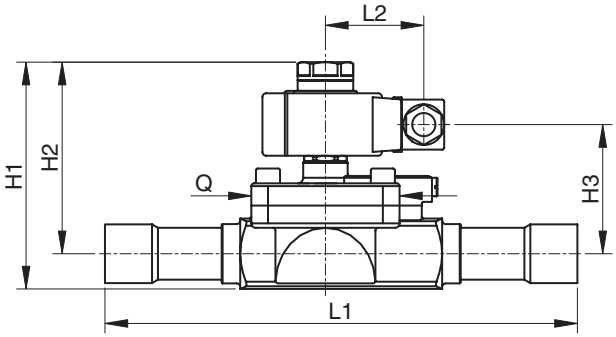
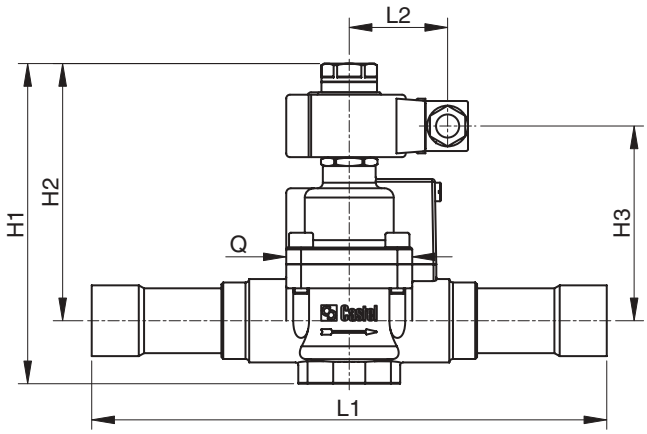
1198/5
1198/6
1198/7



1178/9



1198/9
1178/11

Connectors and coils are not included in the boxes and have to be ordered separately.

TABLE 5: Dimensions and Weights of NO valves with 9120 coil

Catalogue Number	Dimensions [mm]						Weight [g]
	H_1	H_2	H_3	L_1	L_2	Q	
1164/3	87	74,5	40	68	64	–	705
1168/3				111			705
1168/M10				111			700
1170/4	96	80	47	100		45	1015
1170/5				106			1060
1178/M12				127			995
1178/4				127			985
1178/5				175			1080
1150/5	126	98	70	120		57	1462
1150/6				124			1792
1158/5				175			1422
1158/6				175			1612
1158/7				180			1597
1190/5	111	83	50	120			1340
1190/6				124			1670
1198/5				175			1300
1198/6				175			1490
1198/7				180			1475
1178/9	120	101	72	250		80	2870
1198/9	162	132	99	235		68	2355
1178/11	177	143	110	278		68	3015

TABLE 6: Refrigerant Flow Capacity of NO valves

Catalogue Number	Refrigerant Flow Capacity [kW]											
	Liquid				Vapour				Hot Gas			
	R134a	R22	R407C	R404A	R134a	R22	R407C	R404A	R134a	R22	R407C	R404A
1164/3	13,5	14,4	15,0	9,5	1,73	2,16	2,14	1,81	6,8	9,4	9,3	8,0
1168/3												
1168/M10												
1170/4	37,1	39,6	41,2	26,2	4,75	5,94	5,90	4,97	18,7	25,7	25,6	22,0
1170/5	44,0	47,0	48,9	31,1	5,64	7,05	6,99	5,90	22,2	30,5	30,3	26,1
1178/M12	37,1	39,6	41,2	26,2	4,75	5,94	5,90	4,97	18,7	25,7	25,6	22,0
1178/4												
1178/5	44,0	47,0	48,9	31,1	5,64	7,05	6,99	5,90	22,2	30,5	30,3	26,1
1150/5	64,0	68,4	71,2	45,2	8,2	10,3	10,2	8,6	32,3	44,5	44,2	38,0
1150/6	80,9	86,4	90,0	57,1	10,4	13,0	12,9	10,8	40,8	56,2	55,8	48,0
1158/5	64,0	68,4	71,2	45,2	8,2	10,3	10,2	8,6	32,3	44,5	44,2	38,0
1158/6	80,9	86,4	90,0	57,1	10,4	13,0	12,9	10,8	40,8	56,2	55,8	48,0
1158/7	96,0	102,6	106,8	67,8	12,3	15,4	15,3	12,9	48,5	66,7	66,2	57,0
1190/5	64,0	68,4	71,2	45,2	8,2	10,3	10,2	8,6	32,3	44,5	44,2	38,0
1190/6	80,9	86,4	90,0	57,1	10,4	13,0	12,9	10,8	40,8	56,2	55,8	48,0
1198/5	64,0	68,4	71,2	45,2	8,2	10,3	10,2	8,6	32,3	44,5	44,2	38,0
1198/6	80,9	86,4	90,0	57,1	10,4	13,0	12,9	10,8	40,8	56,2	55,8	48,0
1198/7	96,0	102,6	106,8	67,8	12,3	15,4	15,3	12,9	48,5	66,7	66,2	57,0
1178/9	168,5	180,0	187,4	119,0	21,6	27,0	26,8	22,6	85,0	117,0	116,2	100,0
1198/9	168,5	180,0	187,4	119,0	21,6	27,0	26,8	22,6	85,0	117,0	116,2	100,0
1178/11	269,6	288,0	299,8	190,4	34,6	43,2	42,9	36,2	136,0	187,2	185,9	160,0

Refrigerant flow capacity referred to the following operating conditions:
- *Evaporating temperature: + 4 °C*
- *Condensing temperature: + 38 °C*
- *Pressure drop: 0,15 bar*

Particularly for hot gas:
- *Suction temperature: + 18 °C*
- *Pressure drop: 1 bar*

COILS

APPLICATION

For the normally closed solenoid valves, previously shown in this Handbook, Castel puts the following types of coils at disposal of its own customers:

- coils series HM2, only for A.C. (catalogue numbers 9100 - 9105).
- coils series CM2, only for A.C. (catalogue number 9110);
- coils series HM3,either for A.C. or for D.C. (catalogue number 9120).
- coils series HM4, only for A.C. (catalogue number 9160).

For the normally open solenoid valves, always shown in this Handbook, the customer's selection must compulsorily apply to the coils series HM3 – D.C.
For applications of the NO solenoid valves with a voltage supply of 220 VAC, Castel has designed a specific coil at 220 V RAC (code 9120/RD6) that must be used solely with the 220 VAC connector/rectifier circuit (code 9150/R45).
For applications of the same NO valves with a voltage supply of 24 VAC, Castel suggests to the user the 24 VDC coil (code 9120/RD2) with the 24 VAC connector/rectifier circuit (code 9150/R44).

CONSTRUCTION

Coils HM2 (9100), CM2, HM3 and HM4 are class F in compliance with IEC 85 standard and their construction is in compliance with EN 60730-1 and EN 60730-2-8 standards. The windings are made with copper wire, insulation class H 180 °C, in compliance with IEC 85 standard. The outer casing is provided with dielectric and waterproof resins that assure a reinforced insulation making the coils suitable for all assemblies. Coils HM2 (9105) are class F, with UL approved EIS (Electrical Insulation System), and their construction is in compliance with UL 429 Standards.
Protection against electric contacts is class I for all the coils. Therefore, for safety purposes, coils must be effectively connected to an earthing system. Rubber gaskets on the upper and lower ends of coil ensure moisture protection of winding. Coils HM2 and HM3 may be joined to all connectors produced by Castel except type 9155/R01; protection degree guaranteed by this system, coil (HM2, HM3) + connector, is IP65 according to EN 60529. Coils HM4 must be preferably used with connector type 9155/R01; protection degree guaranteed by this other system, coil HM4 + connector 9155/R01, is IP65/IP68 according to EN 60529. Coils HM4 can be used with connectors series 9150 and 9900 too; protection degree guaranteed by this system is IP65.
Either the terminals of coils series HM2 and HM3 or the ones of coils series HM4 consist of two Faston line connections plus one Faston earthing connection. Coil type CM2 has a pre-assembled cable (length 1 meter).
The coils are designed for continuous use.
The solid construction of these coils is suitable for heavy-duty applications in refrigerant systems. The maximum ambient temperature for all coils is 50 °C.

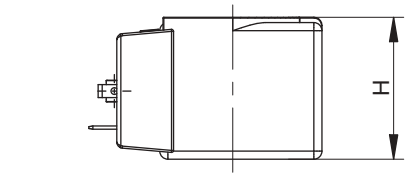
ELECTRIC TYPE APPROVAL

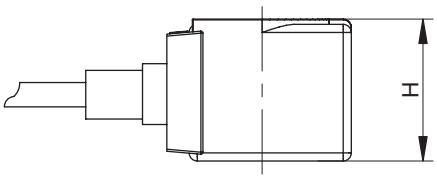
All HM2 coils series 9105 are approved by Underwriters Laboratories Inc of the United States.
Moreover either coils types HM2, CM2 and HM4 (110 VAC, 220/230 VAC and 240 VAC) or coils type HM3 (220/230 VAC) are manufactured according to Low Voltage Directives EC 73/23, EC 93/68 and to EMC Directives EC 89/336, EC 92/31, EC 93/68.

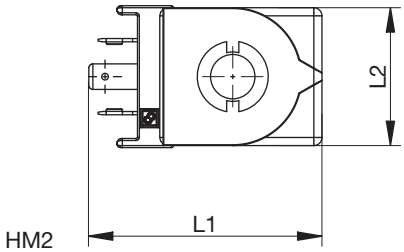
TABLE 1: General Characteristics of coils

Coil Type	Catalogue Number	Voltage [V]	Voltage tollerance [%]	Frequecy [Hz]	Connections	Degree of protection
HM2	9100/RA2	24 A.C.	+10 / -10	50 / 60	Junction box DIN 43650	IP65 EN 60529 (with junction box)
	9100/RA4	110 A.C.				
	9100/RA6	220/230 A.C.	+6 / -10			
	9100/RA7	240 A.C.	+10 / -10			
	9100/RA8	380 A.C.				
HM2 (UL) Recognized File number E243604	9105/RA2	24 A.C.	+10 / -10	60	Junction box DIN 43650	IP65 EN 60529 (with junction box)
	9105/RA4	110/120 A.C.	+6 / -10			
	9105/RA6	220/230 A.C.				
	9105/RA7	240 A.C.	+10 / -10			
CM2	9110/RA2	24 A.C.	+10 / -10	50 / 60	Three wire cable	IP65 EN 60529
	9110/RA4	110 A.C.				
	9110/RA6	220/230 A.C.	+6 / -10			
	9110/RA7	240 A.C.	+10 / -10			
HM3	9120/RA6	220/230 A.C.	+6 / -10	50 / 60	Junction box DIN 43650	IP65 EN 60529 (with junction box)
	9120/RD1	12 D.C.	+10 / -5	–		
	9120/RD2	24 D.C.				
	9120/RD4	48 D.C.				
	9120/RD6	220 RAC				
HM4	9160/RA2	24 A.C.	+10 / -10	50 / 60	Junction box DIN 43650 or Connector 9155/R01 (1)	IP65 EN 60529 (with junction box) IP65/IP68 EN 60529 (with connector)
	9160/RA4	110 A.C.				
	9160/RA6	220/230 A.C.	+6 / -10			
	9160/RA7	240 A.C.	+10 / -10			

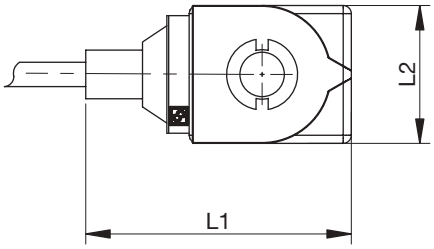
(1) Coil HM4 can also be coupled to connectors series 9150 and 990, achieving a degree of protection IP65, the "versatile" degree of protection (IP65/IP68) is achieved coupling coil H4 with four screws connector 9155/RO1.







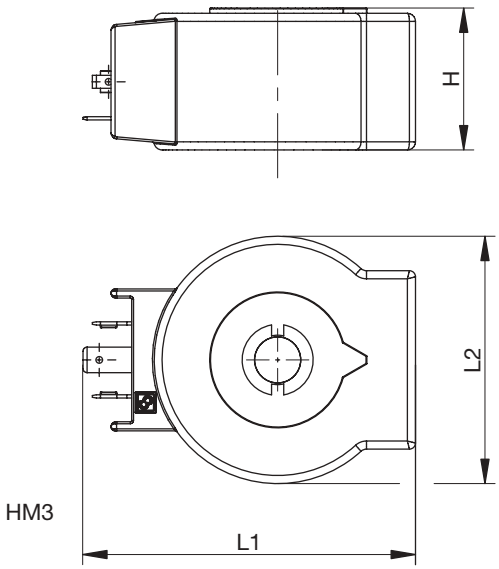
HM2



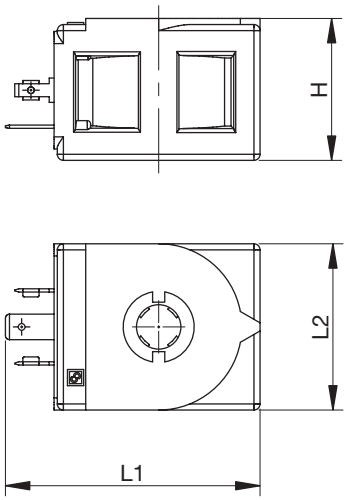
CM2

TABLE 2: Coils Consumptions

Coil Type	Catalogue Number	Consumptions at 20 °C [mA]						Dimensions [mm]			Weight [g]
		Start			Working						
		50 [Hz]	60 [Hz]	D.C.	50 [Hz]	60 [Hz]	D.C.	L_1	L_2	H	
HM2	9100/RA2	920	825	–	527	420	–	57,5	34	35	165
	9100/RA4	230	205		128	114					
	9100/RA6	120	105		68	58					
	9100/RA7	100	87		54	43					
	9100/RA8	58	51		32	23					
HM2 (UL Recognized)	9105/RA2	–	825	–	–	420	–	57,5	34	35	165
	9105/RA4		205			114					
	9105/RA6		105			58					
	9105/RA7		87			43					
CM2	9110/RA2	920	825	–	527	420	–	66,5	34	35	230
	9110/RA4	230	205		128	114					
	9110/RA6	120	105		68	58					
	9110/RA7	100	87		54	43					
HM3	9120/RA6	190	160	–	110	80	–	82	61	35	470
	9120/RD1	–	–	1720	–	–	1720				
	9120/RD2			900			900				
	9120/RD4			460			460				
	9120/RD6			93			93				
HM4	9160/RA2	1490	1320	–	700	530	–	63	41	35	220
	9160/RA4	330	300		156	118					
	9160/RA6	162	142		76	57					
	9160/RA7	147	130		70	53					



HM3



HM4

CONNECTORS

The junction boxes 9150, DIN 43650 standardized, represent an effective system for the connection of the coil to the supply circuit, thus ensuring safety also in the presence of moisture.
These junction boxes, according to assembly requirements, allow choosing the position of outer casing compared to inner terminal block. The clamping screw of casing may be PG9 or PG11, which are respectively suitable for cables with an external diameter of 6 ÷ 8 or 8 ÷ 10 mm. Cables sized 3 x 0,75 mm^2 are to be preferred.
The junction box type 9900 is available with cabled core of different length. In this case, it is not possible to change the position of casing compared to terminal block.
Both the two types offer a protection degree IP65 against dust and water, according to EN 60529, when correctly installed with the proper gaskets, which are supplied as standard.
Castel has developed a specific junction box, type 9155/R01, suitable for use on those refrigerating systems working in heavy duty environments, for example:
– exposition to the atmospheric conditions;
– rooms with high moisture degree;
– cyclic condensing / evaporating on the valve;
– cyclic icing / defrosting on the valve.

This junction box, according to assembly requirements, allows choosing the side position of outer casing compared to inner terminal block; but it is not possible to point the cable upwards. The gland nut of casing is suitable to receive cables with an external diameter of 6 ÷ 9 mm and is provided with a self-locking device. Cables sized 3 x 0,75 mm^2 are to be preferred for this junction box too.
The junction box type 9155/R01 offers a protection degree IP65/IP68 against dust and water, according to EN 60529, when correctly installed with the proper gaskets, which are supplied as standard.
The junction box 9150/R44 and 9150/R45 are equipped with a full-wave bridge rectifier plus VDR for protection. The VDR device, Voltage e-Dependent-Resistor, is a special type of resistor, placed in parallel to the coil; its purpose is to protect the diodes and the coil from any excessive voltage generated within the ac supply circuit.

WARNING: the junction box 9150/R44 and 9150/R45 must be solely used with the respective coils 9120/RD2 (24 VDC) and 9120/RD6 (220 VRAC). The wrong use of these junction boxes with other types of Castel coils takes quickly to the destruction of the coil.

TABLE 3: General Characteristics of connectors

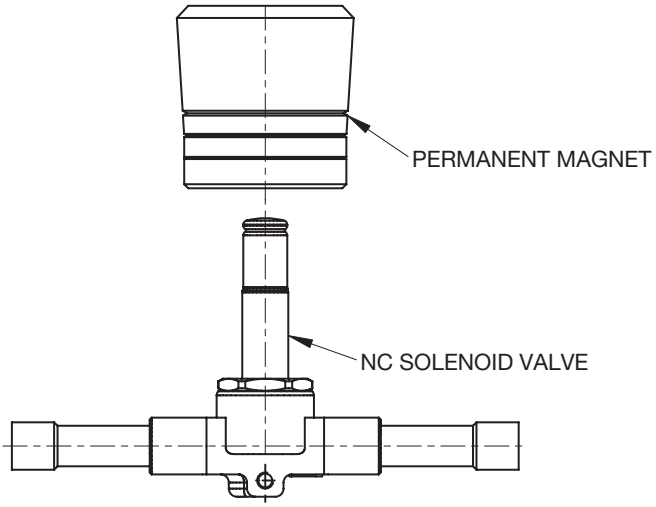
Catalogue Number	Supply Voltage [V]		Pg	Cable length [m]	Cable thickness [mm^2]	Standard	Degree of protection	Class of insulation
	Nominal	Maximum						
9150/R01	–	–	9	–	–	DIN 43650	IP65 EN 60529	Group C VDE 0110-1 / 89
9150/R02								
9150/R44	24 A.C.	30 A.C.	11					
9150/R45	220 A.C.	250 A.C.						
9155/R01	–	–	–			–	IP65/IP68 EN 60529	
9900/X66	–	–	–	1	3 x 0,75	DIN 43650	IP65 EN 60529	
9900/X84 R				1,5				
9900/X73				2				
9900/X55				3				
9900/X54				5				

R *Available on request.*

PERMANET MAGNET

APPLICATION

Castel supplies to its customers the permanent magnet code 9900/X91 for the normally closed solenoid valves, shown in this chapter.
This product can be used during brazing of the valve copper connections to the plant pipes; slipping it on the armature, instead of the coil, it allows the protective gas (nitrogen) flowing and avoids any damage to the plunger gasket and to the diaphragm.



CONSTRUCTION

The main parts of the permanent magnet code 9900/X91 are made with the following materials:
– three rings of anisotropic ferrite;
– anodized aluminum for the body.

SOLENOID VALVES FOR DIFFERENT FLUIDS

Connectors are not included in the boxes and have to be ordered separately.

APPLICATIONS

The solenoid valves, shown in this chapter, are classified “Pressure accessories” in the sense of the Pressure Equipment Directive 97/23/EC, Article 1, Section 2.1.4 and are subject of Article 3, Section 1.3 of the same Directive.
They are designed for the applications specified in Table 1 where the different fluids are indicated with the following symbols, according to an already established code:
– W = Water;
– L = Air;
– B = Secondary coolants (solutions of glycol and water);
– O = Light oils (gas oil).

In short these valves may be used:
– with fluids in the gaseous state proper to the Group II (as defined in Article 9, Section 2.2 of Directive 97/23/EC and referred to in Directive 67/548/EEC);
– with fluids in the liquid state proper to the Group I (as defined in Article 9, Section 2.1 of Directive 97/23/EC and referred to in Directive 67/548/EEC).

TABELLA 1: General Characteristics

Catalogue Number	Coil Type	Main Use	FPT Connections	Seat Size nominal Ø [mm]	Kv Factor [m³/h]	Operating Principles	Opening Pressure Differential [bar]		TS [°C]		PS [bar]	Risk Category according to PED
							min OPD	MOPD	min.	max.		
1512/01	HM2 (A.C.) - CM2 (A.C.) - HM3 (A.C.; D.C.) - HM4 (A.C.)	W.L.O.	G 1/8"	1,5	0,070	Direct Acting	0	30	-15	+105	30	Art. 3.3
1522/02		W.O.	G 1/4"	4,5	0,40			4				
1522/03			G 3/8"									
1522/04			G 1/2"									
1132/03		W.L.O.B.	G 3/8"	12,5	2,10	Diaphragm Pilot Operated	0,1	17				
1132/04			G 1/2"		2,20							
1132/06			G 3/4"	20	5,50		0,15	12			15	
1132/08			G 1"		6,00							
1142/010			G 1.1/4"	38	19,00		0,3	11		+90		
1142/012			G 1.1/2"		21,00							

OPERATION

All the valves for different fluids are normally closed. NC = when the coil is de-energised the plunger stops the refrigerant flow.
The valves series 1512 and 1522 are direct acting, while the valves series 1132 and 1142 are pilot operated with diaphragm.

CONSTRUCTION

The main parts of the valves are made with the following materials:
- hot forged brass EN 12420 – CW 617N for body and cover;
- austenitic stainless steel EN 10088-2 – 1.4303 for enclosure where the plunger moves;
- ferritic stainless steel EN 10088-3 – 1.4105 for plunger;
- austenitic stainless steel EN ISO 3506 – A2-70 for tightening screws between body and cover;
- fluorocarbon rubber (FPM) for outlet seal gaskets;
- fluorocarbon rubber (FPM) for seat gaskets;
- fluorocarbon rubber (FPM) for diaphragms. Nitril rubber (NBR) for the valves series 1142.

INSTALLATION

Table 1 shows the following functional characteristics of a solenoid valve:
- PS;
- TS;
- Kv factor;
- minimum Opening Pressure Differential (minOPD), that is the minimum pressure differential between inlet and outlet at which a solenoid valve, pilot operated, can open and stay opened;
- maximum Opening Pressure Differential (MOPD according to ARI STANDARD 760: 2001), that is the maximum pressure differential between inlet and outlet at which a solenoid valve, pilot operated, can open.

Before connecting the valve it is advisable to make sure that the piping are clean and that the flow direction in the pipe corresponds to the arrow stamped on the body of the valve.
All valves can be mounted in whatever position except with the coil pointing downwards.
Before connecting a valve to the electrical system, be sure that the line voltage and frequency correspond to the values marked on the coil.

VISCOSITY

The values of maximum differential pressure specified in Table 1 are suitable for fluids with maximum cinematic viscosity of 12 cSt where:

$1cSt = 10^{-6}\ m^2/sec.$

If the cinematic viscosity of the fluid under consideration is more than 12 cSt it is necessary to multiply the value of the maximum differential pressure by the following reducing factors:

Viscosity cSt	Reducing Factor
12	1
12 ÷ 30	0,8
30 ÷ 45	0,7

When the viscosity of the liquid is expressed as dynamic viscosity, i.e. cP, where:

$1cP = 10^{-3}\ N\ sec/m^2$

the corresponding value of cinematic viscosity in cSt is obtained by the following relation:

$$\nu = \frac{\mu}{\rho}$$

where:
ν = cinematic viscosity [cSt];
μ = dynamic viscosity [cP];
ρ = volumic mass of the fluid at the considered temperature [kg/dm^3].

Moreover, the fluid viscosity may remarkably vary according to changes in temperature. Therefore, if the temperature of the fluid does not ensure viscosity values compatible with the correct operation of the valve, the valve may not open.

LIQUIDS CAPACITY

The following ratio applies:

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

where:
Kv = Kv factor of the valve [m^3/h];
Q = capacity [m^3/h];
Δp = pressure drop through the valve [bar];
ρ = volumic mass of the liquid [kg/dm^3].

AIR CAPACITY

Table 2 provides the values of air capacity under the following conditions:

- temperature at valve inlet = 20 °C;
- discharge pressure (absolute) = 1 bar;
- Kv of the valve under consideration = 1 m^3/h.

The pressures upstream the valve specified in the table are absolute values.

EXAMPLE

Select the valve suitable for use with approximately 200 m^3/h of air, assuming an absolute pressure of 8 bars at valve inlet (= 7 bars of relative pressure + 1 bar) and an acceptable pressure drop across the valve of 1,5 bars.
In the column of pressures upstream the valve, the value 8 is shown; where this column intersects the horizontal column relating to the pressure drop of 1,5, the value of 87 m^3/h is shown. This is the capacity value of a hypothetical valve with Kv = 1 working under the above mentioned conditions.

$$200 / 87 = 2,29$$

This is the Kv value required in the case under consideration.
In Table 1, select the valve with the Kv value nearest to 2,29, rounding off the value and subsequently checking that all the characteristics of the selected valve (max. opening pressure differential, temperature, connections, etc.) are suitable.

TABLE 2 - Air Capacity (Kv = 1)

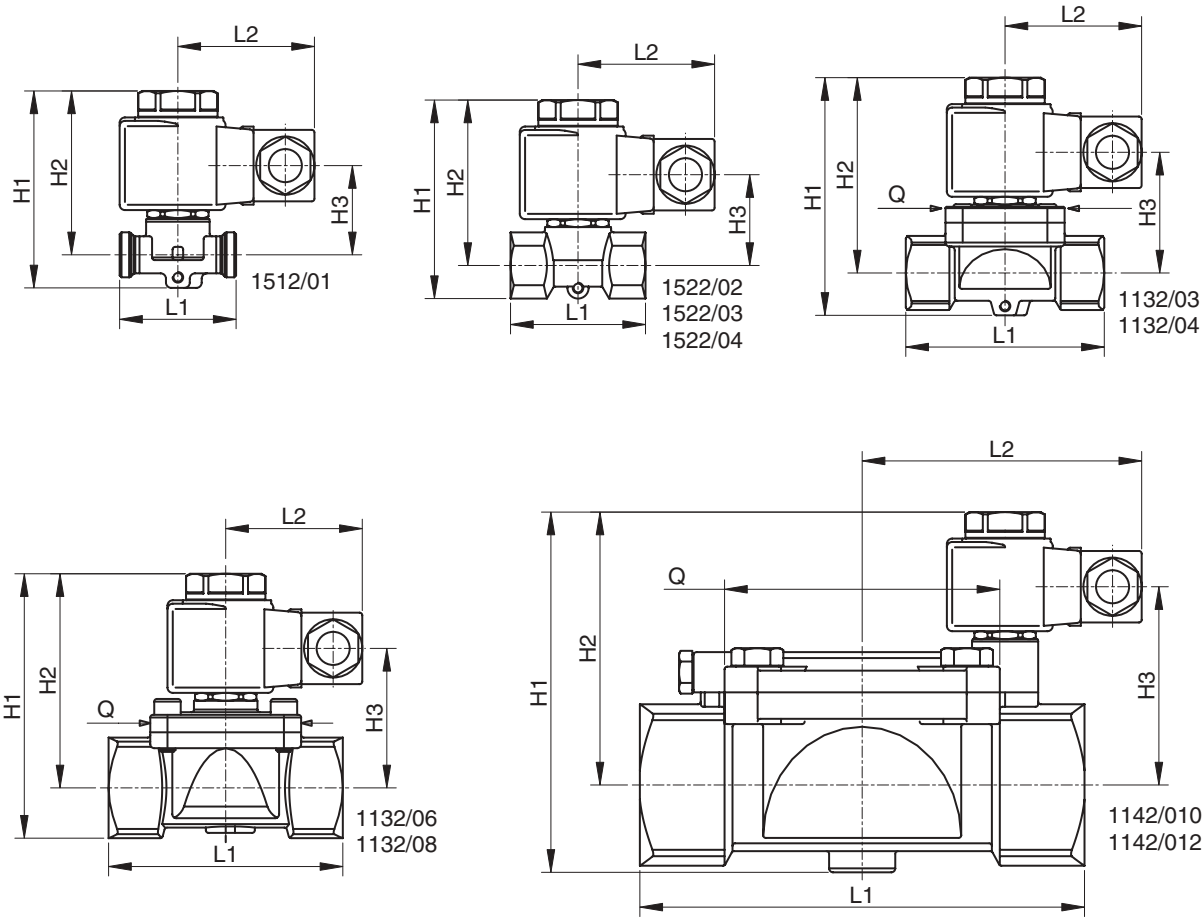
Pressure drop [bar]	Capacity [m³/h] (1) — INLET PRESSURE (absolute) [bar]																							
	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1,5	1,3	1,2	1,1	1,05	1,03	1,015
0,0025																					1,46	1,42	1,40	1,35
0,005																				2,2	2,10	2,00	1,95	1,90
0,010																			3,0	3,0	3,00	2,85	2,80	2,75
0,015																		4,2	3,9	3,7	3,55	3,45	3,40	3,35
0,025																	6,2	5,4	5,0	4,8	4,56	4,45	4,40	
0,05																10,7	8,7	7,5	6,9	6,6	6,40	6,20		
0,10															17,4	15,0	12,2	10,2	9,6	9,2	8,80			
0,15														23,8	21,2	18,3	14,6	12,5	11,5	11,0				
0,25													33,4	30,4	27,0	23,2	18,5	15,6	13,9					
0,5	82,0	80,0	77,0	74,0	72,0	69,5	66,6	63,7	60,6	57,3	54,0	50,0	46,0	41,7	36,8	31,0	24,3	19,6						
1	115,0	111,0	108,0	104,0	100,0	96,0	92,0	88,0	83,0	78,6	73,5	68,0	62,0	55,6	48,0	39,3	27,8							
1,5	138,0	134,0	130,0	125,0	120,0	115,5	110,3	105,0	99,3	93,0	87,0	80,0	72,0	63,7	53,8	41,7								
2	157,0	152,0	147,0	142,0	136,0	130,0	124,0	118,0	111,0	96,0	96,0	88,0	78,0	68,0	55,6									
2,5	173,0	167,5	161,5	155,5	149,0	142,5	135,5	128,0	120,4	112,0	103,0	89,5	82,0	69,5										
3	186,0	180,0	174,0	167,0	160,0	152,0	144,5	136,0	127,0	118,0	108,0	96,0	83,0											
3,5	198,0	191,0	184,0	176,5	168,6	160,3	151,7	142,5	132,6	122,0	110,0	97,0												
4	208,0	200,0	193,0	184,0	176,0	167,0	157,0	147,0	136,0	124,0	111,0													
4,5	216,0	208,6	200,0	191,0	182,0	172,0	161,5	150,4	138,0	125,0														
5	224,0	215,0	206,0	195,5	186,0	176,0	164,5	152,3	139,0															
5,5	230,0	221,0	211,0	201,0	190,0	178,6	166,3	152,9																
6	236,0	226,0	215,0	204,0	192,7	180,0	166,8																	
6,5	240,0	230,0	218,0	206,7	194,0	180,7																		
7	244,0	233,0	220,0	208,0	194,7																			
7,5	246,0	234,0	222,0	208,5																				
8	249,0	236,0	222,5																					
8,5	250,0	236,5																						
9	250,5																							

(1) The table provides air capacity values in m³/h under the following conditions:
- *– temperature at value inlet: + 20°C*
- *– pressure at outlet (absolute): 1 bar*
- *– Kv of the solenoid valve: 1 m³/h*

TABLE 3 - Dimensions and Weight (Valves with coils 9100)

Catalogue Number	Dimensions [mm]						Weight [g]
	H_1	H_2	H_3	L_1	L_2	Q	
1132/03	91	75	47	75	50	45	670
1132/04							635
1132/06	101	81	52	88		57	960
1132/08							670
1142/010	136	103	82	168	104	104	4100
1142/012							4000
1512/01	69	57	34	44	50	–	310
1522/02	71	59	36	51		–	385
1522/03							370
1522/04							355

With coils 9120 the dimension L_2 is equal to 64 mm and the weight must be increased of 305 g.



Connectors are not included in the boxes and have to be ordered separately.