VALVES

FOR INDUSTRIAL APPLICATIONS

HANDBOOK

GP SOLENOID VALVES

APPLICATION

The general purpose solenoid valves are considered “Pressure Accessories” according to the definition provided in Article 2, Point 5 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.c and 3 of the same Directive.

These valves 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 (diesel fuel)

In conclusion, these valves can be used:

- with fluids in the gaseous state belonging to Group 2, as defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
- with fluids in the liquid state belonging to Group 1, as defined in Article 13, Chapter 1, Point (a) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

OPERATION

These valves are normally closed valves (NC). This means that when the coil is not energised, the plunger closes the fluid flow. When the coil is energised, the plunger opens the valve seat connecting the inlet to the outlet.

All the above indicated valves are sold in the version without coil (with the S suffix), and in the version with series 9300, type HF2 - “FAST LOCK” coils (A6 suffix with coil 9300/RA6- 220/230 VAC).

The valves in series 1512 and 1522 are direct acting valves. Their operation depends only on the magnetic field produced by the current flow into the coil. Opening/closing of main valve seat, the only seat, is directly controlled by the mobile plunger.

These valves can work with zero pressure differential.

The valves in series 1132 e 1142 are pilot operated diaphragm solenoid valves. Their operation depends not only on the magnetic field produced by the current flow into the coil, but also on a minimum inlet pressure, which is necessary to:

- open the diaphragm and keep it lifted off the main opening
- close the diaphragm and ensure the tightness on the main opening

Opening/closing of main valve seat is controlled by the diaphragm while opening/closing of pilot seat is controlled by the mobile plunger of the coil.

These valves cannot work with zero differential pressure.

CONSTRUCTION

The main parts of the solenoid valves described in this chapter are constructed 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 the plunger
- Austenitic stainless steel EN ISO 3506 – A2-70 for tightening screws between body and cover.
- Fluorocarbon rubber (FPM) for outlet seal gaskets, seat gasket and diaphragm

VALVE SELECTION AND FLOW RATE CALCULATION

TABLE 1 shows the following functional characteristics for the selection of a solenoid valve for industrial applications:

- Connection dimensions
- PS: maximum allowable pressure of the fluid
- TS: maximum / minimum allowable temperature of the fluid
- TA: maximum / minimum allowable ambient temperature
- Kv: discharge factor
- minOPD: minimum Opening Pressure Differential. This is the minimum pressure differential between inlet and outlet at which a pilot-operated solenoid valve can open and stay opened or close and maintain the seal.
- MOPD: maximum Opening Pressure Differential according to ARI STANDARD 760 : 2001. This is the maximum pressure differential between inlet and outlet at which a solenoid valve can open.

With the Kv factor listed in TABLE 1 it is possible to calculate the flow rate through the valve, if you know the acceptable pressure drop, the type of fluid and the operating pressure; in addition, it is also possible to check the pressure drop through the valve, if you know the flow rate.

With the following formula it’s possible to calculate the volumetric flow rate of a liquid:

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

For water with a temperature between 5 and 30 °C and density (ρ) equal to 1 kg/dm^3 the formula is:

$$Q = Kv \times \sqrt{\Delta p}$$

With the following formula, it is possible to calculate the volumetric flow rate of a gas:

$$\text{if } \Delta p < \frac{p_1}{2} \qquad Q_n = 514 \times Kv \times \sqrt{\frac{\Delta \times p_2}{\rho_n \times (273 + t_1)}}$$

$$\text{if } \Delta p > \frac{p_1}{2} \qquad Q_n = 257 \times Kv \times \frac{p_1}{\sqrt{\rho_n \times (273 + t_1)}}$$

For air at 20 °C and density (ρ) equal to 1.29 kg/dm^3 the formulas are:

$$\text{if } \Delta p < \frac{p_1}{2} \qquad Q_n = 26\,4 \times Kv \times \sqrt{\Delta \times p_2}$$

$$\text{if } \Delta p > \frac{p_1}{2} \qquad Q_n = 13\,2 \times Kv \times p_1$$

where:

POLYHEDRA HANDBOOK - 2020

Kv = Kv factor of the valve [m^3/h]
Q = volumetric flow rate for a liquid [m^3/h]
Q_n = volumetric flow rate for a gas at "normal" reference conditions, 0 °C and 760 mm Hg [m_n^3/h]
p_1 = absolute pressure upstream from the valve [bar abs]
p_2 = absolute pressure downstream from the valve [bar abs]
t_1 = temperature upstream from the valve [°C]
Δ_p = pressure drop through the valve [bar]
ρ = density of a liquid [kg/dm^3]
ρ_n = volumetric mass for a gas at "normal" reference conditions, 0 °C and 760 mm Hg [kg/m_n^3]

Entering the following data in TABLE 2:
- p_1 = absolute pressure upstream from the valve [bar abs]
- Δ_p = pressure drop through the valve [bar]

It is possible to identify the corresponding airflow rate value under the following reference conditions:
- Temperature at the valve inlet = 20 °C
- Pressure at the outlet (absolute) = 1 bar
- Kv factor of the valve considered = 1 m^3/h

Example of the use of TABLE 2: Select the valve suitable for use with a flow rate of 200 m^3/h of air, assuming an absolute pressure of 8 bars at the valve inlet (= 7 bars of relative pressure + 1 bar) and an acceptable pressure drop across the valve of 1.5 bar. Intersecting the column p_1 = 8 bar abs with the line Δ_p = 1.5 bar, the flow rate value is equal to 87 m^3/h. This is the flow rate value of a hypothetical valve with Kv = 1 m^3/h working under the above-mentioned conditions. Dividing 200 by 87 equals 2.29 m^3/h. 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 up, and subsequently checking that all the characteristics of the selected valve (max. opening pressure differential, connections, etc.) are suitable.

VISCOSITY

The values of MOPD (maximum opening pressure differential) specified in TABLE 1, are suitable for fluids with maximum kinematic viscosity of 12 cSt, where:

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

For kinematic viscosity values greater than 12 cSt, it is necessary to multiply the maximum differential pressure by the following reducing factors:

kinematic viscosity, cSt	Reducing factors
12	1
12 / 30	0.8
30 / 45	0.7

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

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

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

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

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

TABLE 3 shows the approximate equivalences among the most common units of measure of viscosity at the same temperature. Moreover, remember that the viscosity of a fluid may change, even significantly, as the temperature varies. Therefore, if the temperature of the fluid does not ensure viscosity values compatible with the correct operation of the valve, the valve might not open.

INSTALLATION

Before installation, check that the valve model meets the application requirements and check that the flow direction in the pipe corresponds to the arrow stamped on the body of the valve.
Make sure that the pipes are clean. If possible, fit an inspectable filter before the valve, avoid that foreign matter enter the valve.
Make sure that the sealing materials (tape, jointing paste, etc.) do not obstruct the valve supply holes or exiting pilot holes (pilot-operated versions).
Connect the valve to the pipes or fittings, using the wrench only on the dedicated body surfaces. Do not use the coil or the plunger enclosure as a lever arm.
The valves can be mounted in any position as long as the coil does not point downwards. An assembly that keeps the coil upwards is recommended to avoid any accumulation of impurities inside the guide pipe. When using hoses, fix the valve using the dedicated fixing holes in the body. Before connecting a valve to the electrical system, make sure that the line voltage and frequency correspond to the values marked on the coil. Direct current valves do not require a fixed polarity. To promote heat dissipation from the coil, position the valve in a ventilated environment, far from any other heat sources. The increase in the coil temperature, added to the environment and fluid temperatures, may lead to a temperature that can cause burns. It is recommended to suitably protect the coil from water and humidity.

TRACEABILITY

Direct action valves in series 1512 are identified by laser marking on the valve enclosure of the mobile plunger. This marking includes the following data: valve code, fluids, PS, TS, and production lot.

The direct action valves in series 1522 and the pilot-operated diaphragm solenoid valves in series 1132 and 1142 are identified by a plastic label fit on the valve enclosure of the mobile plunger (below the coil when present). This label includes the following data: valve code, fluids, PS, TS, and production lot.

TABLE 1: GENERAL CHARACTERISTICS OF GENERAL PURPOSE VALVES

Catalogue Number	Seal	Media	FPT Connections	Seat size nominal Ø [mm]	Kv Factor [m3/h]	Operating Principles	Opening Pressure Differential [bar]					PS [bar]	TS [°C]		Risk Category according to PED Recast
							min OPD	MOPD coil series					min.	max.	
								9100 9110 9300 (AC)	9160 9360 (AC)	9120 9320 (AC)	9120 9320 (DC)				
1512/01#	FPM	W.L.O.	G 1/8"	1,5	0,07	Direct Acting	0	30	30	30	30	30	-15	+130	Art. 4.3
1522/02#		W.O.	G 1/4"	4,5	0,40			10	10	12	8				
1522/03#			G 3/8"												
1522/04#			G 1/2"												
1132/03#		W.L.O..B.	G 3/8"	12,5	2,1	Diaphragm Pilot Operated	0,1	25	25	30	15				
1132/04#			G 1/2"		2,2										
1132/06#			G 3/4"	20	5,5		0,15	12	12	15	12	15			
1132/08#			G 1"		6,0										
1142/010#			G 1.1/4"	38	22		0,3	12	12	15	12				
1142/012#			G 1.1/2"		24										

= S , A6

TABLE 2 - AIR CAPACITY [mn^3/h] (1)

Pressure Drop [bar]	Inlet pressure [bar abs]																							
	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1,500	1,300	1,200	1,100	1,050	1,030	1,015
0,003																					1,38	1,35	1,33	1,33
0,005																				2,00	1,95	1,91	1,89	1,88
0,010																			2,94	2,82	2,76	2,69	2,66	2,65
0,015																		3,94	3,59	3,44	3,37	3,29	3,25	3,23
0,025																	5,9	5,07	4,62	4,43	4,33	4,23	4,17	
0,05																10,1	8,2	7,11	6,47	6,19	6,05	5,90		
0,1	35,3	34,3	33,3	32,2	31,1	30,0	28,8	27,6	26,3	24,9	23,5	21,9	20,3	18,5	16,5	14,2	11,5	9,88	8,95	8,55	8,35			
0,15	43,2	42,0	40,7	39,4	38,1	36,7	35,2	33,7	32,1	30,4	28,6	26,8	24,7	22,5	20,1	17,3	13,9	11,88	10,72	10,22				
0,25	55,6	54,0	52,4	50,7	48,9	47,1	45,2	43,3	41,2	39,0	36,7	34,3	31,7	28,8	25,6	21,9	17,5	14,76	13,20					
0,5	78,1	75,8	73,5	71,1	68,6	66,0	63,3	60,5	57,5	54,4	51,1	47,6	43,8	39,6	34,9	29,5	22,9	18,67						
1	108,8	105,6	102,2	98,8	95,2	91,5	87,6	83,5	79,2	74,7	69,8	64,7	59,0	52,8	45,7	37,3	26,4							
1,5	131,3	127,3	123,1	118,8	114,3	109,6	104,8	99,7	94,3	88,5	82,4	75,8	68,6	60,5	51,1	39,6								
2	149,3	144,6	139,7	134,6	129,3	123,8	118,1	112,0	105,6	98,8	91,5	83,5	74,7	64,7	52,8									
2,5	164,3	158,9	153,4	147,6	141,6	135,3	128,7	121,7	114,3	106,4	97,9	88,5	78,1	66,0										
3	177,1	171,1	164,9	158,4	151,7	144,6	137,2	129,3	121,0	112,0	102,2	91,5	79,2											
3,5	188,1	181,5	174,6	167,5	160,0	152,2	144,0	135,3	125,9	115,8	104,8	92,4												
4	197,6	190,4	182,9	175,1	167,0	158,4	149,3	139,7	129,3	118,1	105,6													
4,5	205,8	198,0	189,9	181,5	172,6	163,3	153,4	142,8	131,3	118,8														
5	212,8	204,5	195,8	186,7	177,1	167,0	156,2	144,6	132,0															
5,5	218,9	210,0	200,6	190,8	180,5	169,6	157,8	145,2																
6	224,0	214,5	204,5	194,0	182,9	171,1	158,4																	
6,5	228,2	218,1	207,5	196,2	184,3	171,6																		
7	231,7	220,9	209,5	197,6	184,8																			
7,5	234,3	222,8	210,8	198,0																				
8	236,1	224,0	211,2																					
8,5	237,2	224,4																						
9	237,6																							

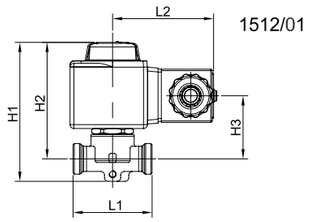
(1) The table provides air capacity values in m^3/h under the following conditions:
- temperature at valve inlet: + 20°C
- pressure at outlet (absolute): 1 bar
- Kv of the solenoid valve: 1 m^3/h

TABLE 3: VISCOSITY EQUIVALENCE

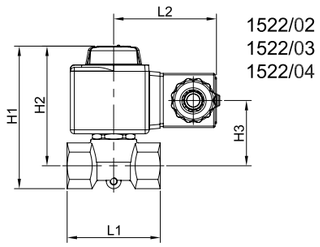
Cinematic Viscosity [cSt] o [mm²/s]	Engler Degree [°E]	Saybolt Universal Seconds [Ssu]	Seconds Redwood N.1 [SRW N.1]
1	1	---	---
2	1,1	32,7	31
3	1,2	36	33,5
4	1,3	39	36
5	1,4	42,5	38,5
7	1,5	49	44
10	1,8	59	52
15	2,3	77,5	68
20	2,9	98	86
25	3,4	119	105
30	4	140	120
35	4,7	164	145
40	5,3	186	165
50	6,6	232	205
60	8	278	245
70	9,2	324	286
80	10,5	370	327
90	12	415	370
100	13	465	410

TABLE 4: DIMENSIONS AND WEIGHTS OF GP VALVES (VALVES WITH 9300 COILS)

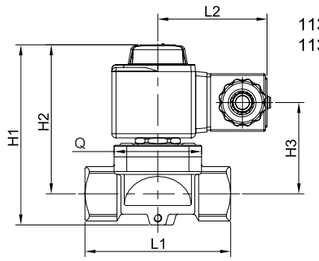
Catalogue Number	Dimensions [mm]						Weight [g]
	H1	H2	H3	L1	L2	Q	
1512/01#	69	57	34	44	52	–	310
1522/02#	71	59	36	51		–	385
1522/03#							370
1522/04#							355
1132/03#	91	75	47	75	52	45	670
1132/04#							635
1132/06#	101	81	52	88		57	960
1132/08#							670
1142/010#	131	104	76	168	104	104	3850
1142/012#							4000



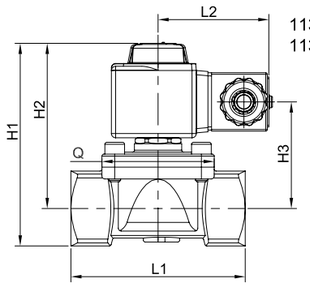
1512/01



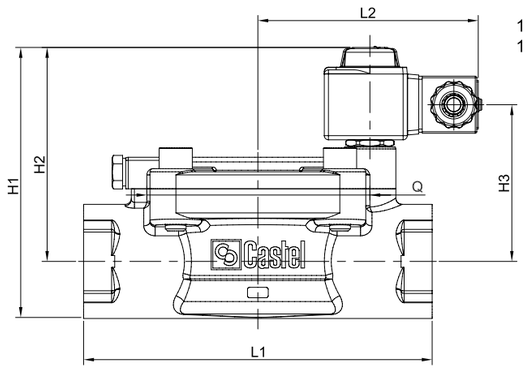
1522/02
1522/03
1522/04



1132/03
1132/04



1132/06
1132/08



1142/010
1142/012

POLYHEDRA HANDBOOK - 2020

COILS AND CONNECTORS

APPLICATION

For NC solenoid valves, Castel provides its customers with the following new series of coils that use the “FAST LOCK” system:
– **Series 9300** (coil type HF2), interchangeable with coils in series 9100 (coils type HM2) that are out of production. The coils in series 9300 can be used on all the valves produced by Castel that used the coils in series 9100.

– **Series 9320** (coils type HF3) are interchangeable with coils in series 9120 (coils type HM3), that are still in production in direct current and rectified versions. The coils in series 9320 can be used on all the valves produced by Castel that used the coils in series 9120.

– **Series 9360** (coils type HF4) are interchangeable with coils in series 9160 (coils type HM4), that are still in production in direct current version. The coils in series 9360 can be used on all the valves produced by Castel that used the coils in series 9160.

The “FAST LOCK” system (protected by law) guarantees secure fixing, without errors or carelessness, of the coil on the valve, making assembly and disassembly easy and quick. Coils using the “FAST LOCK” system can be assembled on valves, and later disassembled, without the need of additional equipment.

Furthermore, the following types of coils are still available:
– **Series 9110** (coils type CM2)
– **Series 9120** (coils type HM3)
– **Series 9160** (coils type HM4)

Coils in series 9110, 9120, 9300, and 9320 can be coupled with all connectors in series 9150 and 9900 manufactured by Castel. With the exception of connector 9155/R01, the protection rating guaranteed by the coil + connector system is IP65 according to the EN 60529 standard.

Coils in series 9160, 9360 must be used preferably with connector type 9155/R01. The protection rating of the coil + connector 9155/R01 system is IP65/IP68 according to the EN 60529 standard. Alternatively, these coils can be coupled with connectors in series 9150 or 9900. In this case, the protection rating of these systems is IP65.

CONSTRUCTION

In compliance with IEC standard 85, the coils in series 9110, 9120, 9160, 9320 and 9360 have Class F encapsulation, while the coils in series 9300 have Class H encapsulation, while the coils in series 9300 and 9360 have Class H encapsulation, and their production is compliant with standards EN 60730-1 and EN 60730-2-8.

The windings are made of copper wire, with insulation class H (180 °C), in compliance with IEC standard 85. The outer casing is made of waterproof, dielectric resins that guarantee reinforced insulation and allow any type of assembly.
All coils have Class I protection ratings against electric contacts. Consequently, their safety requires an efficient ground system. Rubber gaskets assembled on the upper and lower ends of the coils (only on the lower end for coils in series 9300, 9320 and 9360) complete the protection of the windings from humidity.

The terminals of the coils in series 9120, 9160, 9300, 9320 and 9360 consist of two Faston connectors plus a Faston ground connector. Coils in series 9110 are equipped with an encapsulated co-moulded cable 1 m long. All coils in this chapter are designed for continuous use. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments

APPROVALS

Coils in series 9300 with 110 VAC, 220/230 VAC and 240 VAC power supply are approved by the German registration body, VDE. Coils in series 9110, 9160, 9300 and 9360 with 110 VAC, 220/230 VAC and 240 VAC power supply, and coils in series 9120 and 9320 with 220/230 VAC power supply are manufactured according to the Low Voltage (LV) Directive (2006/95/EC). All coils in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).

CONNECTORS

DIN 43650 standardized connectors 9150 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture. Based on the assembly requirements, these connectors allow you to choose the orientation of the outer casing with respect to the inner terminal block. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. Three-pole cables with a cross-section greater than or equal to 0.75 mm2 are recommended.

The connectors in series 9900 are available with co-moulded cables of different lengths. In these versions, the orientation of the casing cannot be changed with respect to the terminal block. As long as they are used with the gaskets provided, both types ensure IP65 protection rating according to EN 60529.

Castel developed specific connectors, series 9155, suitable for use in refrigeration systems operating in heavy-duty environments, for example:
– exposure to the atmospheric conditions
– rooms with high degree of moisture
– cyclic condensing / evaporation on the valve
– cyclic icing / defrosting on the valve

POLYHEDRA HANDBOOK - 2020

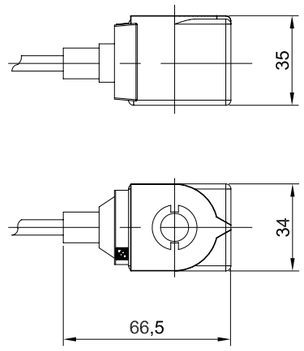
Based on the assembly requirements, these connectors allow you to choose the side orientation of the outer casing with respect to the inner terminal block. It is not possible to point the exit of the cable upwards. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. It is again recommended that three-pole cables with a cross-section greater than or equal to 0.75 mm2 be used. As long as they are used with the gaskets provided, the connectors in series 9155 ensure IP65/IP68 protection rating according to the EN 60529 standard.

Connectors 9150/R45 and 9150/R90 are equipped with a full-wave bridge rectifier plus VDR for protection. Connector 9150/R90 is the version with a 2 m long, co-moulded cable, with remote rectified circuit (with respect to the connector). The VDR (Voltage e-Dependent-Resistor) device is a special type of resistor, mounted in parallel to the windings. Its purpose is to protect the diodes and the coil from any voltage surges generated within the alternating current supply circuit.

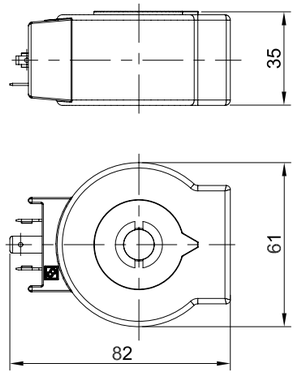
TABLE 1: GENERAL CHARACTERISTICS OF COILS

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Insulation class EN 60730	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9110/RA2	CM2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Three wires cable	-	IP 66
9110/RA4		110 A.C.								
9110/RA6		220/230 A.C.	+6 / -10							
9110/RA7		240 A.C.	+10 / -10							
9120/RD1	HM3	12 D.C.	+10 / -5	_	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)
9120/RD2		24 D.C.								
9120/RD3		27 D.C.								
9120/RD4		48 D.C.								
9160/RA2	HM4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150 , 9900) IP 65 / IP 68 (with connector 9155)
9160/RA4		110 A.C.								
9160/RA6		220/230 A.C.	+6 / -10							
9160/RA7		240 A.C.	+10 / -10							
9160/RD1		12 D.C.	+10 / -5	_						
9160/RD2		24 D.C.								
9300/RA2	HF2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Terminal block for DIN 43650/A	9150/R## 9900/X##	IP 65 (with connector)
9300/RA4		110/120 A.C.	+6 / -10							
9300/RA6		220/230 A.C.	+6 / -10							
9300/RA7		240 A.C.	+10 / -10							
9300/RA8		380 A.C.								
9320/RA6	HF3	220/230 A.C.	+6 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)
9320/RD1		12 D.C.	+10 / -5	_						
9320/RD2		24 D.C.								
9320/RD3		27 D.C.								
9320/RD4		48 D.C.								
9360/RA2	HF4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150 , 9900) IP 65 / IP 68 (with connector 9155)
9360/RA4		110 A.C.								
9360/RA6		220/230 A.C.	+6 / -10							
9360/RA7		240 A.C.	+10 / -10							
9360/RD1		12 D.C.	+10 / -5	_						
9360/RD2		24 D.C.								

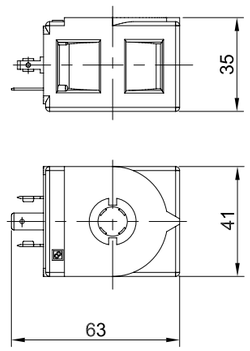
9110 (Type CM2)



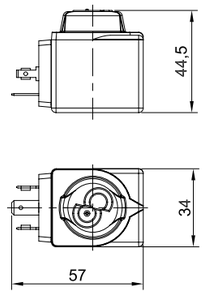
9120 (Type HM3)



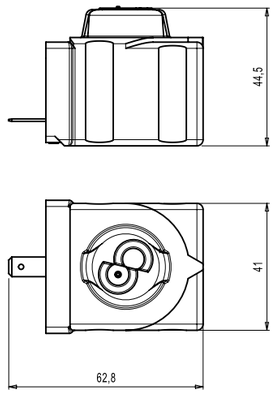
9160 (Type HM4)



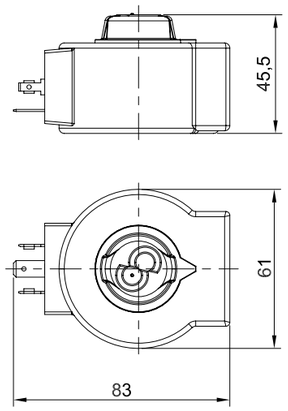
9300 (Type HF2)



9360 (Type HF4)



9320 (Type HF3)



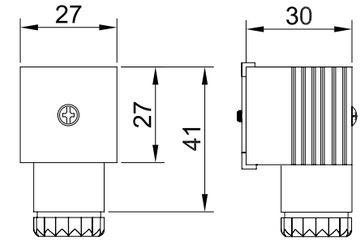
POLYHEDRA HANDBOOK - 2020

TABLE 2: CONSUMPTIONS AND WEIGHTS OF COILS

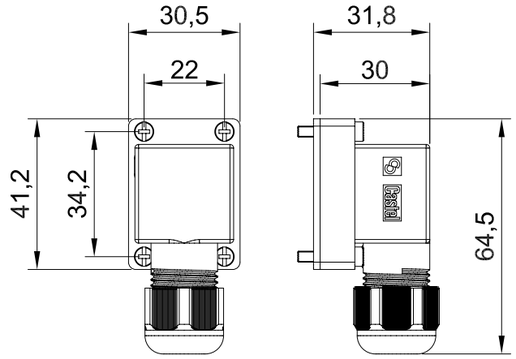
Catalogue Number	Coil type	Voltage [V]	Power [W]	Consumption at 20 °C [mA]						Weight [g]
				Start			Working			
				50 [Hz]	60 [Hz]	D.C.	50 [Hz]	60 [Hz]	D.C.	
9110/RA2	CM2	24 A.C.	8	920	825	–	527	420	–	230
9110/RA4		110 A.C.		230	205		128	114		
9110/RA6		220/230 A.C.		120	105		68	58		
9110/RA7		240 A.C.		100	87		54	43		
9120/RD1	HM3	12 D.C.	20	–	–	1720	–	–	1720	470
9120/RD2		24 D.C.	20			895			895	
9120/RD3		27 D.C.	20			800			800	
9120/RD4		48 D.C.	22			460			460	
9160/RA2	HM4	24 A.C.	8	1490	1320	–	700	530	–	220
9160/RA4		110 A.C.		330	300		156	118		
9160/RA6		220/230 A.C.		162	142		76	57		
9160/RA7		240 A.C.		147	130		70	53		
9160/RD1		12 D.C.	17	–	–	1300	–	–	1300	
9160/RD2		24 D.C.	15,5			650			650	
9300/RA2	HF2	24 A.C.	8	920	825	–	527	420	–	180
9300/RA4		110/120 A.C.		230	205		128	114		
9300/RA6		220/230 A.C.		140	128		68	58		
9300/RA7		240 A.C.		100	87		54	43		
9300/RA8		380 A.C.		58	51		32	23		
9320/RA6	HF3	220/230 A.C.	12	190	160	–	110	80	–	500
9320/RD1		12 D.C.	20	–	–	1720	–	–	1720	
9320/RD2		24 D.C.	20			895			895	
9320/RD3		27 D.C.	20			800			800	
9320/RD4		48 D.C.	22			460			460	
9360/RA2	HF4	24 A.C.	8	1490	1320	–	700	530	–	240
9360/RA4		110 A.C.		330	300		156	118		
9360/RA6		220/230 A.C.		162	142		76	57		
9360/RA7		240 A.C.		147	130		70	53		
9360/RD1		12 D.C.	17	–	–	1300	–	–	1300	
9360/RD2		24 D.C.	15,5			650			650	

TABLE 3: GENERAL CHARACTERISTICS OF CONNECTORS

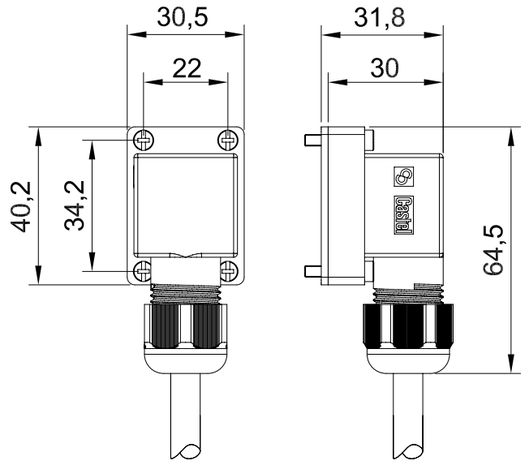
Catalogue Number	Supply Voltage [V]		Cable length [m]	Cable thickness [mm2]	Standard	Degree of protection	Class of insulation
	Nominal	Maximum					
9150/R02	–	–	–	–	DIN 43650	IP65 EN 60529	Gruppo C VDE 0110-1 / 89
9900/X66	–	–	1	3 x 0,75			
9900/X84			1,5				
9900/X73			2				
9900/X55			3				
9900/X54			5				
9900/X93			10				
9901/X41			15				
9155/R01	–	–	–	–	–	IP65/IP68 EN 60529	
9155/R02			1	3 x 0,75			



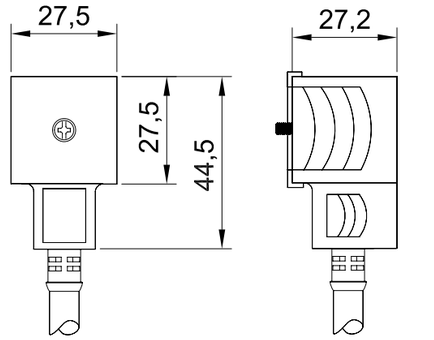
9150/R02



9155/R01



9155/R02



9900/X66
9900/X84
9900/X73
9900/X55
9900/X54
9900/X93
9900/X41

POLYHEDRA HANDBOOK - 2020