GO GREEN

R744 • NATURAL REFRIGERANT

TECHNICAL HANDBOOK

Castel
Italian technology

CASTEL
THE COMPANY AND THE PRODUCTS

Castel, a leading supplier of refrigeration and air conditioning components, is a 100% Italian-owned family-run company which has grown and established a name for itself since 1961, thanks to its outstanding pursuit of innovation and unwavering desire to conquer markets not only in Italy, but also abroad.

Mission

Supporting an increase in our customer base with reliable, durable, high quality and technologically advanced products, manufactured with respect for the environment, and supported and improved upon by levels of service that exceed industry standards, in order to consolidate the Castel brand's presence in its existing markets, and make the brand known in emerging ones.

Castel is now present in more than 90 countries on 5 continents. In 2010, Castel opened an associated company in China, "Castel Refrigeration (Shanghai) Co., Ltd", to support development in these countries, creating a logistics and commercial development platform for the entire Asian continent and the Pacific. Recently, an associated company in the United States, "Castel USA, Inc.", was established to support commercial and logistic development in the Americas.

Castel was one of the first Italian companies in the sector to obtain Business Quality System Certification issued by TÜV SÜD according to EN ISO 9001:2015 standard before subsequently receiving certification also for its Environmental Management System from TÜV SÜD according to EN ISO 14001:2015 standard. The company has also obtained several product certifications in conformity with European Directives and Certification Marks (e.g. VDE) and extra-European (e.g "UL", "EAC") Quality Approvals.

Castel has dedicated constant attention for years to the evolution of the refrigerant market in adapting to international protocols aimed at reducing harmful emissions and global warming. The implementation in the European Union of the so-called F-Gas Regulation and similar legislation in important extra-European nations is leading to a progressive reduction and abandonment of many traditional refrigerants in favor of alternative synthetic or natural refrigerants.

In response to these developments in the market, in recent years Castel has progressively restructured its offer and is now proud to offer to its customers this 2023 Handbook about the line of products:

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Products developed specifically for refrigerant R744 within the A1 security group according to ASHRAE STANDARD,34-2019

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REFERENCE STANDARDS

EXTERNAL LEAKAGE

All the products are submitted, one by one, to tightness tests as well as specific functional tests. The allowable external leakage, measurable during the test, complies with the requirements of standards:
- EN 12178:2003 – Refrigerating systems and heat pumps
Liquid-level indicators - Requirements, testing and marking
- EN 21922: 2021 – Refrigerating systems and heat pumps.
Valves - Requirements, testing and marking
- EN 14276-1:2020 – Pressure equipment for refrigerating systems and heat pumps.
Part 1: Vessels - General requirements
- EN ISO 14903:2017 – Refrigerating systems and heat pumps
Qualification of tightness of components and joints

PRESSURE CONTAINMENT

All the products, if submitted to hydrostatic testing, guarantee a pressure strength at least equal to 1.43 x PS in compliance with Directive 2014/68/EU.
All the products, if submitted to burst testing, guarantee a pressure strength at least equal to 3 x PS in compliance with standard EN 378-2:2016.
All the UL-certified products, if submitted to burst testing, guarantee a pressure strength at least equal to 3 x MWP in compliance with standard UL 207.

WEIGHT

The weight of the items listed in this Handbook includes packaging and is not binding.

EXPANSION VALVES

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EXPANSION VALVES

1.1 – SOLENOID EXPANSION VALVES

APPLICATIONS

The solenoid expansion valves in series 2028E can be used in a wide range of applications as listed below:
- Refrigeration systems (display cases in supermarkets, freezers, ice cream and icemaker machines, refrigerated shipping, etc.).
- Air conditioning systems
- Heat pump systems

These 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.
They can be installed on systems that use the R744 refrigerant fluid 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.
CAUTION!: these solenoid valves cannot be used with other refrigerant fluids.

OPERATION

The valve in series 2028E is a throttling device that receives liquid from the condenser and injects it into the evaporator, creating the necessary pressure drop across the expansion orifice. It regulates the refrigerant flow into the evaporator by modulating the opening time phase of the shutter, allowing for a wide power range. It is an ON/OFF valve that must be regulated with the Pulse **Width Modulation** (PWM) principle and it can be actuated by a very simple electronic controller. According to the PWM principle, the evaporator refrigerant flow rate, QT, required in a fixed period “T”, is delivered by the valve in a time interval “t”, shorter than “T”, during which the maximum flow rate is allowed (ON step). In time period that remains, T - t, the valve stays closed (OFF phase).
For an effective regulation, the PWM valve must be sized in such a way that, under the most severe operating load conditions, the orifice of the valve is large enough to deliver the refrigerant required. In these extreme conditions, the valve will stay open for the entire period “T”.
The use of an electronic regulator allows a more accurate metering of the refrigerant, obtaining a greater efficiency in time (and a sensible decrease in machinery management costs) and a faster response to the variations of the evaporator load.

CONSTRUCTION

The valves in series 2028E are supplied complete with orifice. Ten different orifices with ten different maximum capacities that range from orifice 00 to orifice 09 can be assembled. The last two numbers in the part number identify the type of orifice that has been mounted on the valve at the factory. For example, part number 2028E/3S02 identifies a 3/8” valve with solder connections and size 02 orifice. The orifices are interchangeable and can be mounted even after the valve is soldered on the system. If you wish to change orifice, purchase the corresponding spare parts kit, according to the part number indicated in Table 3. Inside the valve body is a ring mesh filter that traps dirt and contaminants at the valve inlet.

Valves in series 2028E are sold exclusively without coil (suffix S). For these valves are available:
- Coils in series 9120 (coils type HM3)
- Coils in series 9121 (coils type CM3)
- Coils in series 9160 (coils type HM4)
- Coils, UL Recognized, in series 9125 (coils type HM3)
- Coils, UL Recognized, in series 9185 (coils type CM3-N2)
- Coils, UL Recognized, in series 9186 (coils type CM3-N4)

The main parts of the valves in series 2028E are manufactured with the following materials:
- Hot forged brass EN 12420 – CW617N for the body
- Ferritic stainless steel EN 10088-3 – 1.4105 for the fixed and mobile plungers
- Austenitic stainless steel EN 10088-3 – 1.4305 for mobile plunger valve sleeve and orifice
- Austenitic stainless steel EN 10088-3 – 1.4301 for the mesh filter
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- P.T.F.E. for seat gaskets
- Ethylene propylene rubber (EPDM) for outlet seal gaskets

SELECTION

To dimension correctly a valve 2028E for a refrigerating system, the following design parameters must be available:
- Type of refrigerant
- Evaporator capacity, Q_e
- Evaporating temperature/pressure, T_e / p_e
- Minimum condensing temperature/pressure, T_c / p_c
- Liquid refrigerant temperature at valve inlet, T_l
- Pressure drop in the liquid line, distributor and evaporator, Δp

The following procedure helps the correct dimensioning of an expansion valve for a refrigeration plant.

Step 1
Determine the pressure drop across the valve. The pressure drop is calculated using the equation:


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ITALY
Type HM4
220-230 V~
50 - 60 Hz
8 W Cl. F
TU50 °C
TM110 °C
41 21
UK
CA
CE

$$\Delta p_{tot} = p_c - (p_e + \Delta p)$$

where:
- P_c = condensing pressure
- P_e = evaporating pressure
- Δp = sum of pressure drops in the liquid line, distributor, and evaporator at the maximum flow rate, that is with the valve always open

Step 2
Evaporator capacity correction with subcooling. The evaporator capacity Q_e must be suitably sized based on the subcooling value. The subcooling is calculated using the equation:

$$\Delta T_{sub} = T_c - T_l$$

In the subcooling correction factor table, find the appropriate correction factor, F_{sub}, corresponding to the calculated ΔT_{sub} value and determine the required valve capacity using the equation:

$$Q_{sub} = {}^{Q_e}/_{F_{sub}}$$

Step 3
Capacity correction based on the application. To obtain a correct regulation with this valve, it is necessary it be oversized so that its closing period is 25% to 50% of the regulator's total period, T. The correct choice of this potential margin depends on the application, which can have variable flow rate peaks, and on the control algorithm used by the electronic control unit.
Generally, however, this correction factor, F_{ev}, is highly dependent by the evaporation temperature, T_e, so it be assumed equal to 125% for T_e >= -15 °C and 150% for T_e <-15 °C. These generic values must be verified based on the specific application.
The capacity of the valve must be at least equal to:

$$Q_{ev} = F_{ev} \cdot Q_{sub}$$

Step 4
Determine required orifice size. Use the pressure drop across the valve, the evaporating temperature and the correct evaporator capacity, Q_e, calculated above, to select the corresponding orifice size from the capacity table corresponding to the chosen refrigerant fluid.

Step 5
Liquid line sizing. Since the valve operates under ON/OFF criteria, during the opening phase, the flow rate can be much higher than the average flow rate in the time period. For this reason, the designer must size the diameter of the pipes of the liquid line according to the maximum flow rate across the orifice in the real conditions of Δp_{tot} and to avoid that a drop-in load cause a reduction in the maximum valve power.

DIMENSIONING EXAMPLE

- Type of refrigerant R744
- Evaporator capacity, Q_e 2.8 kW
- Evaporating temperature, T_e -30°C
- Minimum condensing temperature, T_c -5°C
- Liquid refrigerant temperature, T_l -15°C
- Pressure drop in the liquid line, distributor and evaporator, Δ_p 2bar

Step 1 - *Determine the pressure drop across the valve.*

- Condensing pressure at - 5 °C - P_c = 30.4 bar
- Evaporating pressure at – 30 °C - P_e = 14.3 bar

$$\Delta p_{tot} = 30{,}4 - (14{,}3 + 2) = 14{,}1 \cdot bar$$

Step 2 - *Determine required valve capacity*

$$\Delta T_{sub} = -5 - (-15) = 10 \cdot °K$$

From the subcooling correction factor Table 4B, we find the appropriate correction factor, F_{sub}, equal to 1.05 for ΔT_{sub} = 10 °K. The required valve capacity is

$$Q_{sub} = {}^{2{,}8}/_{1{,}05} = 2{,}67 \cdot kW$$

Step 3 - *Capacity correction based on the application*
According to the above sizing criterion, a correction of + 25% is applied to the calculated capacity:

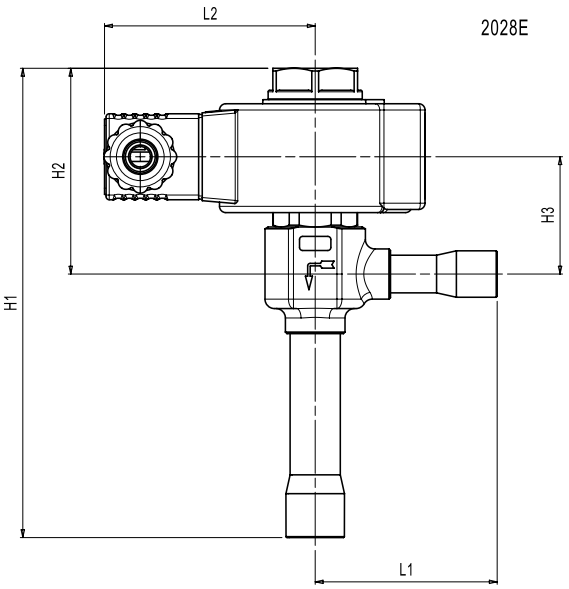
$$Q_{ev} = 1{,}25 \cdot 2{,}67 = 3{,}33 \cdot kW$$

Step 4 - *Determine the orifice size*.
Using the capacity Table 4A enter the data:
- Pressure drop across the valve = 14.1 bar
- Evaporating temperature = - 30 °C
- Calculated evaporator capacity = 3.33 kW

Select the corresponding orifice, 02 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity).

CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the expansion valves in series 2028E with file MH50005. These valves are certified UL-CSA Recognized for the USA and Canada with a Design Pressure of 1305 PSI, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.



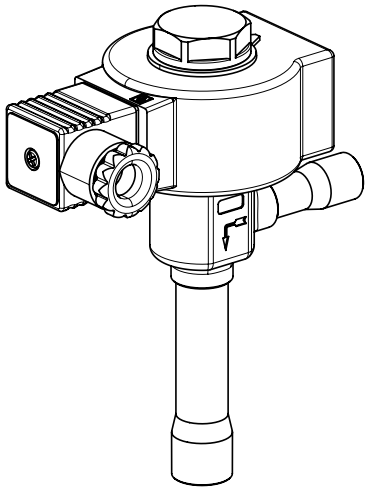


TABLE 1: GENERAL CARACTERISTICS OF PWM EXPANSION VALVES

Catalogue number	Orifice Type	ODS Connections				Kv Factor [m3/h]	Opening Pressure Differential [bar]				Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		Risk Category according to PED Recast
		[in]		[mm]			MinOPD	MOPD						min.	max.	
		IN	OUT	IN	OUT			9120 9121 (AC)	9120 (DC)	9160 (DC)						
2028E/3S00	00	3/8"	1/2"	-	-	0,003	0	50	50	35	PWM (Pulse Width Modulating)	1	90	-50	+100	Art.4.3
2028E/M10S00		-	-	10	12											
2028E/3S01	01	3/8"	1/2"	-	-	0,010										
2028E/M10S01		-	-	10	12											
2028E/3S02	02	3/8"	1/2"	-	-	0,017										
2028E/M10S02		-	-	10	12											
2028E/3S03	03	3/8"	1/2"	-	-	0,023										
2028E/M10S03		-	-	10	12											
2028E/3S04	04	3/8"	1/2"	-	-	0,043										
2028E/M10S04		-	-	10	12											
2028E/3S05	05	3/8"	1/2"	-	-	0,065										
2028E/M10S05		-	-	10	12											
2028E/3S06	06	3/8"	1/2"	-	-	0,113										
2028E/M10S06		-	-	10	12											
2028E/4S07	07	1/2"	5/8"	-	-	0,200			32	23						
2028E/M12S07		-	-	12	16											
2028E/4S08	08	1/2"	5/8"	-	-	0,230		27	26	20						
2028E/M12S08		-	-	12	16											
2028E/4S09	09	1/2"	5/8"	-	-	0,250		19	17	16						
2028E/M12S09		-	-	12	16											

TABLE 2: DIMENSIONS AND WEIGHTS OF PWM EXPANSION VALVES WITH 9120 COILS

Catalogue number	H1	H2	H3	L1	L2	Weight [g]
2028E/3S00	119	66	38	58	47	675
2028E/M10S00						
2028E/3S01						
2028E/M10S01						
2028E/3S02						
2028E/M10S02						
2028E/3S03						
2028E/M10S03						
2028E/3S04						
2028E/M10S04						
2028E/3S05						
2028E/M10S05						
2028E/3S06						
2028E/M10S06						
2028E/4S07	150					700
2028E/M12S07						
2028E/4S08						
2028E/M12S08						
2028E/4S09						
2028E/M12S09						

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

TABLE 3: ORIFICES - RATED CAPACITIES IN KW

Catalogue number	Orifice Type	Orifice Size [mm]	R744
9151E/R61	00	0,3	0,58
9150E/R63	01	0,5	2,09
9150E/R64	02	0,7	4,16
9150E/R65	03	0,8	4,93
9150E/R66	04	1,1	7,98
9150E/R67	05	1,3	13,65
9150E/R68	06	1,7	18,93
9150E/R69	07	2,3	29,85
9150E/R78	08	2,5	35,98
9150E/R79	09	2,7	39,90

Rated capacities are based on:
- Evaporating temperature Tevap = -25 °C
- Condensing temperature Tcond = 0 °C
- Refrigerant liquid temperature ahead of valve Tliq = -4 °C

Table 4A - Evaporating Temperature 5 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,16	0,23	0,27	0,30	0,32	0,34	0,36	0,37	0,38	0,38	0,38	0,37	0,36	0,33
01	0,59	0,81	0,97	1,08	1,17	1,24	1,29	1,33	1,35	1,37	1,37	1,35	1,31	1,18
02	1,18	1,62	1,92	2,15	2,32	2,46	2,56	2,64	2,69	2,72	2,72	2,68	2,62	2,34
03	1,40	1,92	2,28	2,55	2,75	2,92	3,04	3,13	3,19	3,23	3,22	3,18	3,10	2,77
04	2,27	3,11	3,69	4,12	4,46	4,72	4,92	5,06	5,17	5,22	5,21	5,14	5,02	4,49
05	3,88	5,32	6,31	7,05	7,63	8,07	8,41	8,66	8,84	8,93	8,92	8,80	8,58	7,68
06	5,38	7,38	8,75	9,78	10,58	11,19	11,67	12,01	12,25	12,39	12,37	12,20	11,90	10,65
07	8,49	11,63	13,80	15,42	16,68	17,65	18,39	18,94	19,32	19,54	19,51	19,24	18,77	16,80
08	10,23	14,02	16,63	18,59	20,10	21,27	22,17	22,83	23,29	23,55	23,51	23,19	22,62	20,25
09	11,35	15,55	18,45	20,62	22,29	23,59	24,59	25,32	25,83	26,12	26,07	25,72	25,09	22,46

Table 4A - Evaporating Temperature 0 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,18	0,25	0,29	0,33	0,36	0,38	0,40	0,41	0,42	0,43	0,43	0,43	0,43	0,41
01	0,65	0,89	1,06	1,19	1,29	1,36	1,43	1,47	1,51	1,54	1,56	1,55	1,54	1,48
02	1,29	1,78	2,11	2,36	2,56	2,72	2,84	2,93	3,01	3,06	3,10	3,09	3,06	2,94
03	1,53	2,10	2,50	2,80	3,03	3,22	3,36	3,48	3,56	3,62	3,67	3,66	3,63	3,49
04	2,48	3,41	4,05	4,53	4,91	5,21	5,45	5,63	5,77	5,86	5,94	5,93	5,88	5,64
05	4,25	5,83	6,92	7,75	8,40	8,91	9,32	9,63	9,86	10,03	10,17	10,14	10,05	9,65
06	5,89	8,08	9,60	10,75	11,65	12,36	12,92	13,35	13,68	13,91	14,10	14,06	13,94	13,38
07	9,28	12,74	15,13	16,95	18,36	19,49	20,37	21,06	21,57	21,93	22,23	22,18	21,98	21,10
08	11,19	15,36	18,24	20,43	22,14	23,49	24,55	25,38	26,00	26,44	26,80	26,73	26,50	25,44
09	12,41	17,03	20,23	22,65	24,55	26,05	27,23	28,15	28,84	29,32	29,72	29,64	29,38	28,21

Table 4A - Evaporating Temperature -10 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,21	0,29	0,34	0,38	0,41	0,44	0,46	0,48	0,49	0,50	0,52	0,52	0,52	0,51
01	0,75	1,03	1,22	1,37	1,49	1,58	1,66	1,72	1,77	1,81	1,86	1,87	1,87	1,86
02	1,49	2,05	2,43	2,73	2,96	3,15	3,30	3,43	3,52	3,60	3,70	3,72	3,73	3,69
03	1,77	2,43	2,89	3,24	3,51	3,73	3,91	4,06	4,18	4,27	4,38	4,41	4,42	4,38
04	2,86	3,93	4,67	5,24	5,68	6,04	6,34	6,57	6,76	6,91	7,09	7,13	7,15	7,08
05	4,89	6,72	7,99	8,96	9,72	10,34	10,84	11,24	11,56	11,81	12,13	12,20	12,23	12,12
06	6,79	9,32	11,08	12,42	13,48	14,34	15,03	15,59	16,04	16,38	16,82	16,92	16,95	16,81
07	10,70	14,69	17,47	19,59	21,26	22,61	23,70	24,59	25,29	25,84	26,52	26,69	26,74	26,50
08	12,90	17,71	21,06	23,61	25,63	27,26	28,57	29,63	30,48	31,14	31,97	32,17	32,23	31,94
09	14,31	19,64	23,35	26,18	28,42	30,22	31,68	32,86	33,80	34,53	35,46	35,67	35,74	35,42

Table 4A - Evaporating Temperature -20 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,23	0,32	0,38	0,42	0,46	0,49	0,51	0,53	0,55	0,56	0,58	0,58	0,59	0,59
01	0,84	1,15	1,36	1,53	1,66	1,76	1,85	1,92	1,98	2,02	2,09	2,11	2,12	2,12
02	1,67	2,28	2,71	3,04	3,30	3,51	3,68	3,82	3,94	4,03	4,15	4,19	4,22	4,22
03	1,97	2,71	3,21	3,60	3,91	4,16	4,36	4,53	4,66	4,77	4,92	4,97	5,00	5,00
04	3,20	4,38	5,20	5,83	6,33	6,73	7,06	7,33	7,55	7,72	7,97	8,04	8,09	8,10
05	5,47	7,49	8,90	9,97	10,83	11,51	12,08	12,54	12,91	13,21	13,63	13,75	13,83	13,85
06	7,58	10,39	12,34	13,83	15,01	15,97	16,75	17,39	17,91	18,32	18,90	19,07	19,18	19,20
07	11,95	16,39	19,47	21,81	23,67	25,18	26,41	27,42	28,24	28,90	29,80	30,08	30,25	30,28
08	14,41	19,75	23,46	26,29	28,53	30,35	31,83	33,05	34,04	34,83	35,92	36,26	36,46	36,50
09	15,98	21,90	26,02	29,16	31,64	33,66	35,30	36,65	37,74	38,62	39,84	40,20	40,43	40,48

continue ⟶

Table 4A - Evaporating Temperature -30 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,25	0,35	0,41	0,46	0,50	0,53	0,56	0,58	0,59	0,61	0,63	0,63	0,64	0,64
01	0,91	1,25	1,48	1,66	1,80	1,91	2,00	2,08	2,14	2,19	2,26	2,29	2,30	2,31
02	1,82	2,49	2,95	3,30	3,58	3,80	3,99	4,14	4,26	4,36	4,50	4,55	4,58	4,61
03	2,16	2,95	3,50	3,91	4,24	4,51	4,72	4,90	5,05	5,17	5,34	5,39	5,43	5,46
04	3,49	4,77	5,66	6,33	6,86	7,29	7,65	7,93	8,17	8,36	8,64	8,73	8,79	8,84
05	5,98	8,17	9,68	10,83	11,74	12,48	13,08	13,57	13,98	14,31	14,78	14,93	15,04	15,12
06	8,29	11,33	13,43	15,02	16,28	17,30	18,14	18,82	19,39	19,84	20,49	20,71	20,85	20,96
07	13,07	17,86	21,17	23,68	25,67	27,28	28,60	29,68	30,57	31,29	32,32	32,65	32,88	33,06
08	15,75	21,53	25,52	28,55	30,94	32,88	34,47	35,78	36,84	37,71	38,95	39,36	39,63	39,84
09	17,47	23,87	28,30	31,66	34,31	36,47	38,23	39,67	40,86	41,82	43,20	43,64	43,95	44,19
Table 4A - Evaporating Temperature -40 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,27	0,37	0,44	0,49	0,53	0,56	0,59	0,61	0,63	0,64	0,66	0,67	0,68	0,68
01	0,98	1,34	1,58	1,77	1,91	2,03	2,12	2,20	2,26	2,32	2,39	2,42	2,44	2,45
02	1,96	2,67	3,15	3,52	3,80	4,03	4,22	4,38	4,51	4,61	4,76	4,81	4,85	4,88
03	2,32	3,16	3,73	4,17	4,51	4,78	5,01	5,19	5,34	5,47	5,64	5,70	5,75	5,79
04	3,76	5,12	6,04	6,74	7,30	7,74	8,10	8,40	8,65	8,85	9,14	9,23	9,30	9,37
05	6,43	8,75	10,34	11,54	12,48	13,24	13,86	14,37	14,79	15,14	15,63	15,79	15,91	16,02
06	8,92	12,14	14,34	16,00	17,31	18,36	19,22	19,93	20,51	20,99	21,67	21,90	22,07	22,22
07	14,06	19,14	22,61	25,23	27,29	28,95	30,31	31,43	32,35	33,10	34,18	34,54	34,80	35,03
08	16,95	23,07	27,25	30,41	32,89	34,90	36,54	37,89	38,99	39,89	41,20	41,63	41,94	42,23
09	18,80	25,58	30,22	33,72	36,48	38,70	40,52	42,01	43,24	44,24	45,68	46,17	46,51	46,83
Table 4A - Evaporating Temperature -50 °C														
Orifice Type	Pressure drop across valve [bar]													
	2	4	6	8	10	12	14	16	18	20	24	26	28	32
00	0,29	0,39	0,46	0,51	0,55	0,59	0,61	0,64	0,65	0,67	0,69	0,70	0,70	0,71
01	1,05	1,42	1,67	1,85	2,00	2,12	2,21	2,29	2,35	2,41	2,48	2,51	2,53	2,54
02	2,08	2,82	3,31	3,69	3,98	4,21	4,40	4,56	4,69	4,79	4,94	4,99	5,03	5,06
03	2,47	3,34	3,93	4,37	4,71	4,99	5,22	5,40	5,55	5,68	5,86	5,92	5,96	6,00
04	3,99	5,40	6,36	7,07	7,63	8,08	8,44	8,74	8,99	9,19	9,48	9,58	9,65	9,71
05	6,83	9,24	10,87	12,09	13,05	13,82	14,44	14,95	15,38	15,72	16,21	16,38	16,50	16,62
06	9,48	12,82	15,08	16,77	18,10	19,16	20,03	20,74	21,32	21,80	22,49	22,72	22,88	23,04
07	14,94	20,22	23,78	26,45	28,53	30,21	31,58	32,70	33,62	34,37	35,46	35,82	36,08	36,34
08	18,01	24,37	28,66	31,88	34,39	36,42	38,07	39,42	40,53	41,43	42,74	43,18	43,49	43,80
09	19,97	27,02	31,79	35,35	38,14	40,39	42,21	43,71	44,94	45,95	47,39	47,88	48,23	48,57
TABLE 4B - Correction factors for subcoolingΔtsub ± 4°K														
Δtsub [°K]	1	4	10	15	20	25	30	35	40	45				
Fsub	0,96	1,00	1,05	1,10	1,15	1,20	1,25	1,29	1,39	1,43				

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporatore capacity by dividing by the appropriate correction factor found in Table 4B

SOLENOID VALVES

GOGREEN

R744 • NATURAL REFRIGERANT

SOLENOID VALVES

2.1 – NORMALLY CLOSED SOLENOID VALVES

APPLICATION

The normally closed 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 have been developed by Castel for all those applications that use the sub critical R744 refrigerant fluid 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.
CAUTION!: these solenoid valves cannot be used with other refrigerant fluids.

OPERATION

A normally closed valves (NC) 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.

NC solenoid valves for R744 are sold without coil (with the S suffix). For these solenoid valves are available:
• Coils in series 9121 (coils type CM3)
• Coils in series 9320 (coils type HF3)
• Coils in series 9360 (coils type HF4)

The valves in series 1028EL 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.

All the other NC valves are pilot-operated solenoid valves (piston operated). 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 piston and keep it lifted off the main opening
- close the piston and ensure the tightness on the main opening
Opening/closing of main valve seat is controlled by the piston while opening/closing of pilot seat is controlled by the mobile plunger of the coil.
These valves cannot work with zero pressure differential.

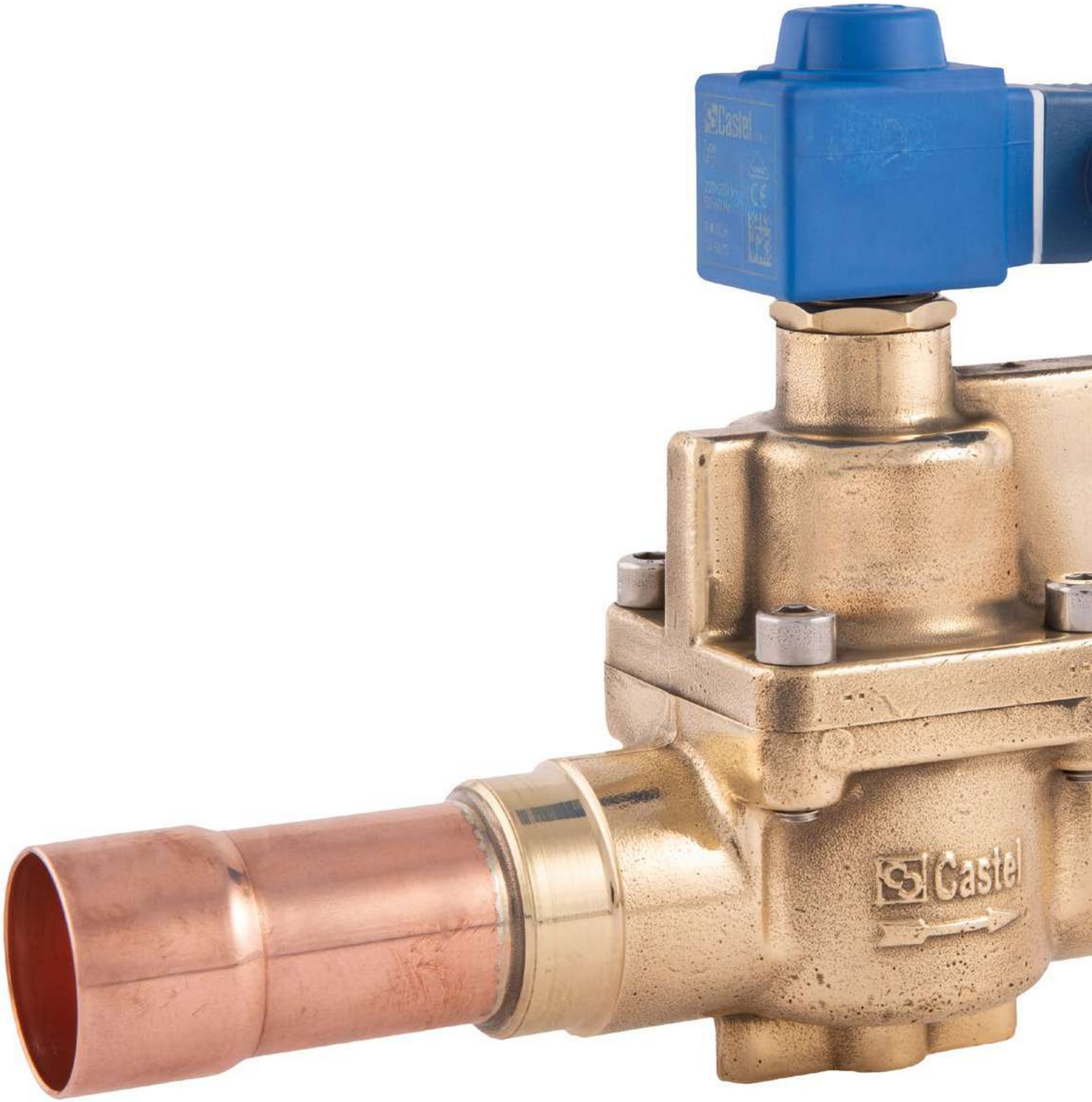
CONSTRUCTION

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
- 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 the plunger
- Austenitic stainless steel EN ISO 3506 – A2-70 for tightening screws between body and cover.
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- P.T.F.E. for seat gaskets

INSTALLATION

All the valves in this chapter can be installed on the three main branches of a plant (hot gas line, liquid line, and suction line), while respecting the limits of use and the capacities indicated in TABLE 1.
TABLE 1 shows the following functional characteristics of a solenoid valve:
- Connection dimensions
- PS: maximum allowable pressure of the refrigerant
- TS: maximum / minimum allowable temperature of the refrigerant
- 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 AHRI STANDARD 760 : 2014. This is the maximum pressure differential between inlet and outlet at which a solenoid valve can open.

Before connecting the valve to the pipe, it is advisable to make sure that the refrigerating system is clean. In fact, valves with P.T.F.E. gaskets, and particularly piston valves, are sensitive to dirt and debris. Furthermore, check that the flow direction in the pipe corresponds to the arrow stamped on the valve body. All the valves can be mounted in any position so long as the coil does not point 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 is 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.


Castel
Castel

TRACEABILITY

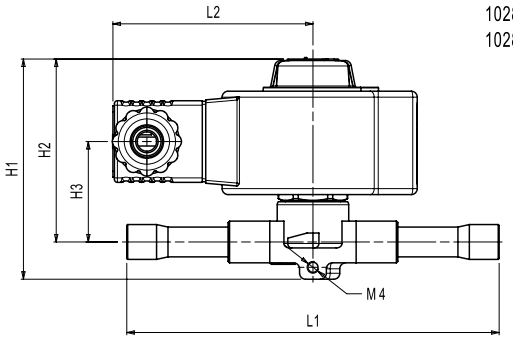
A laser marking on the valve enclosure of the mobile plunger identifies:

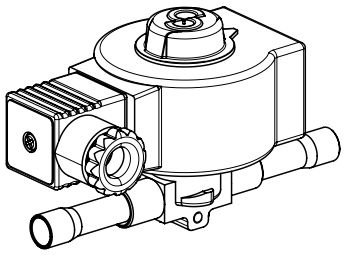
- Direct action valves in series 1028EL
- Pilot-operated piston valves in series 1038EL, 1048EL

This laser marking includes the following data: valve code, refrigerants, PS, TS and batch number.

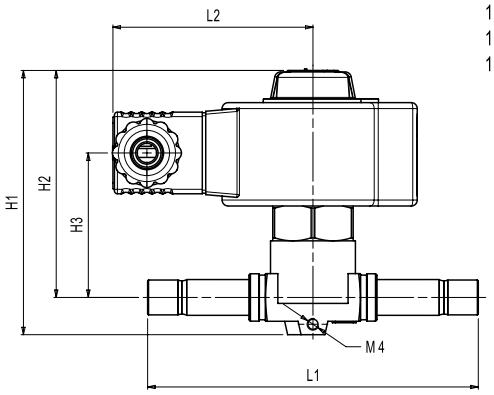
All the other pilot-operated valves are identified by a plastic label fit on the valve enclosure of the mobile plunger (under the coil when indicated). This label includes the following data: valve code, refrigerants, PS, TS and batch number.

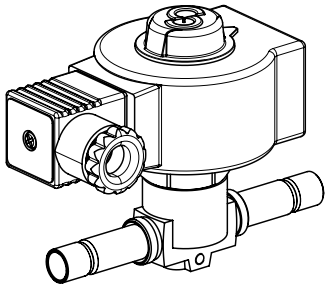
1028EL/2
1028EL/3
1028EL/M10



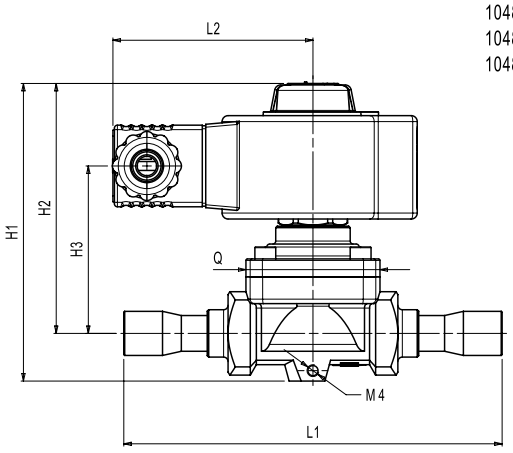


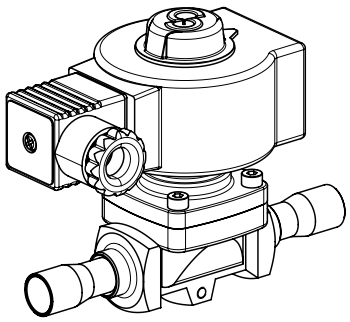
1038EL/3
1038EL/4
1038EL/M10
1038EL/M12

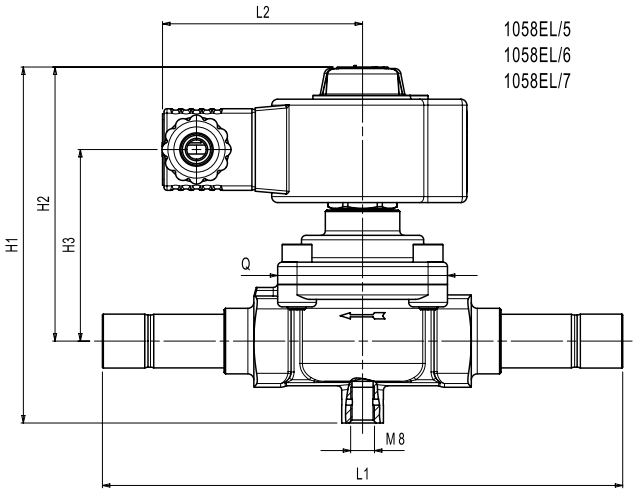




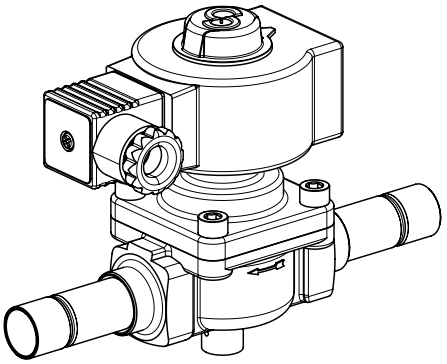
1048EL/M12
1048EL/4
1048EL/5

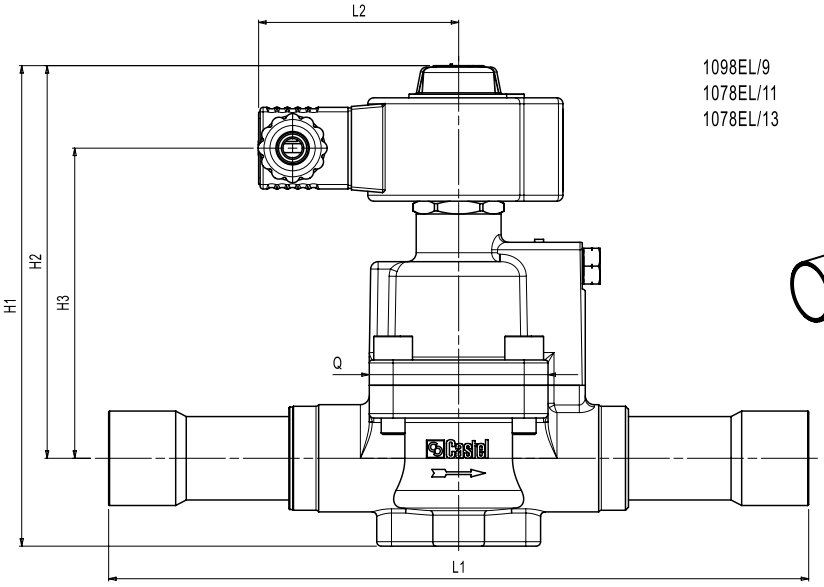






1058EL/5
1058EL/6
1058EL/7





1098EL/9
1078EL/11
1078EL/13

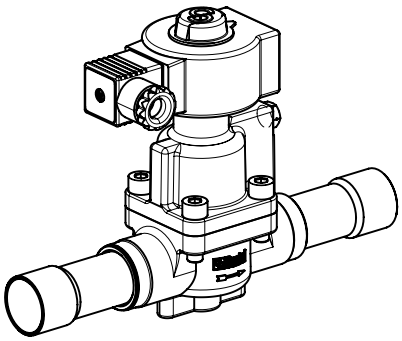


TABLE 1: GENERAL CHARACTERISTICS OF NC VALVES WITH ODS CONNECTIONS

Operating Principles	Catalogue Number	Copper connections ODS		Seat size nominal Ø [mm]	Kv Factor [m3/h]	Opening Pressure Differential [bar]				PS [bar]	TS [°C]		Risk Category according to PED Recast
		Ø [in.]	Ø [mm]			min OPD	MOPD Coil series 9360 (AC)	MOPD Coil series 9121 9320 (AC)	MOPD Coil series 9320 (DC)		min.	max.	
Direct Acting	1028EL/2S	1/4"	–	2,2	0,15	0	28	35	21	60	-40	+130	Art. 4.3
	1028EL/2S.E	1/4"	–	3	0,23								
	1028EL/3S	3/8"	–										
	1028EL/M10S	–	10										
Piston Pilot Operated	1038EL/3S	3/8"	–	6,5	1,0	0,05	28	35	18	60	-40	+130	Art. 4.3
	1038EL/M10S	–	10										
	1038EL/M12S	–	12										
	1038EL/4S	1/2"	–										
	1048EL/M12S	–	12	12,5	2,4	0,07							
	1048EL/4S	1/2"	–										
	1048EL/5S	5/8"	16		3,0								
	1058EL/5S	5/8"	16	16,5	3,8				16				
	1058EL/6S	3/4"	–		4,8								
	1058EL/7S	7/8"	22		5,7								
	1098EL/9S	1.1/8"	–	25	10	0,1			18				
	1078EL/11S	1.3/8"	35	27	16								
	1078EL/13S	1.5/8"	–	34	25	0,15							I

TABLE 2: DIMENSIONS AND WEIGHTS OF NC VALVES WITH 9320 COILS

Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]
		H1	H2	H3	L1	L2	Q	
Direct Acting	1028EL/2S	75	62,5	34	125	67	–	677
	1028EL/2S.E				125			677
	1028EL/3S				125			691
	1028EL/M10S				125			691
Piston Pilot Operated	1038EL/3S	92,5	80,0	50,5	111	67	–	765
	1038EL/M10S				111			765
	1038EL/M12S				127			786
	1038EL/4S				127			786
	1048EL/M12S	100,5	84,5	56,5	127		45	1074
	1048EL/4S				127			1074
	1048EL/5S				175			1138
	1058EL/5S	121	93	65	175		57	1574
	1058EL/6S				175			1616
	1058EL/7S				180			1470
	1098EL/9S	157	127	99	235		60	2550
	1078EL/11S	175	141	113	278		68	3210
	1078EL/13S	190	153	125	280		88	4310

Connectors are not included in the boxes and have to be ordered separately
With coil 9360 the dimension L2 is equal to 57 and the weight must be decreased of 250 g

TABLE 3: REFRIGERANT FLOW CAPACITY [KW]

Operating Principles	Catalogue Number	Liquid line	Suction line	Hot Gas line
Direct Acting	1028EL/2S	4,0		3,0
	1028EL/2S.E	6,2		4,6
	1028EL/3S			
	1028EL/M10S			
Piston Pilot Operated	1038EL/3S	27	5	20
	1038EL/M10S			
	1038EL/M12S			
	1038EL/4S			
	1048EL/M12S	64	13	48
	1048EL/4S			
	1048EL/5S	80	16	61
	1058EL/5S	102	20	77
	1058EL/6S	129	25	97
	1058EL/7S	153	30	115
	1098EL/9S	268	53	202
	1078EL/11S	429	85	323
	1078EL/13S	670	133	505

Standard rating conditions according to AHRI Standard 760-2014		
Condensing temperature	30 °F	(-1,2 °C)
Liquid temperature	20 °F	(-6,7 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	-20 °F	(-28,9°C)
Temperature leaving evaporator	-10 °F	(-23,4°C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	-5 °F	(-15 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	80 °F	(26,6°C)

SOLENOID VALVES

2.2 – HIGH PRESSURE NORMALLY CLOSED SOLENOID VALVES

APPLICATION

The high-pressure normally closed 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 have been developed by Castel for all those applications that use the trans-critical R744 refrigerant fluid 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.
CAUTION!: these solenoid valves cannot be used with other refrigerant fluids.

OPERATION

A normally closed valves (NC) 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.

High pressure NC solenoid valves for R744 are sold without coil (with the S suffix). For these solenoid valves are available:
• Coils in series 9121 (coils type CM3)
• Coils in series 9320 (coils type HF3)

The valves in series 1417E and 1418E 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. Inside the valve body there is a ring mesh filter that traps dirt and contaminants at the valve inlet.
These valves can work with zero pressure differential.

All the other high pressure NC valves are pilot-operated solenoid valves (piston operated). 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 piston and keep it lifted off the main opening
- close the piston and ensure the tightness on the main opening
Opening/closing of main valve seat is controlled by the piston while opening/closing of pilot seat is controlled by the mobile plunger of the coil.
These valves cannot work with zero differential pressure.

CONSTRUCTION

- Hot forged brass EN 12420 – CW 617N for body and cover
- Copper tube EN 12735-1 – CuFe2P (k65) for solder connections of 1437E valves
- Stainless steel tube AISI 304 for solder connections of 1438E valves
- Austenitic stainless steel EN 10088-3 – 1.4305 for enclosure where the plunger moves
- Ferritic stainless steel EN 10088-3 – 1.4105 for the plunger
- Austenitic stainless steel EN 10088-3 – 1.4301 for the mesh filter
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- PTFE, bronze filled, for seat

INSTALLATION

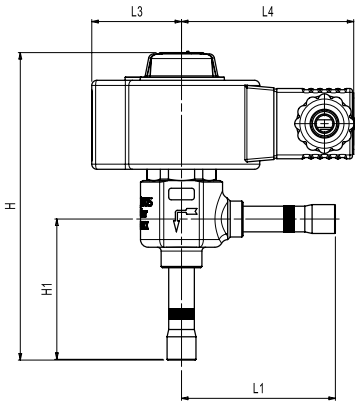
All the valves in this chapter can be installed on the three main branches of a plant (hot gas line, liquid line, and suction line), while respecting the limits of use and the capacities indicated in TABLE 4.
The valves in series 1417, 1418, 1427 and 1428 can also be used on the oil lines of R744 systems.
TABLE 4 shows the following functional characteristics of a solenoid valve:
- Connection dimensions
- PS: maximum allowable pressure of the refrigerant
- TS: maximum / minimum allowable temperature of the refrigerant
- 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 AHRI STANDARD 760: 2014. This is the maximum pressure differential between inlet and outlet at which a solenoid valve can open.

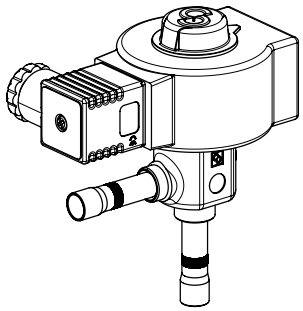
Before connecting the valve to the pipe, it is advisable to make sure that the refrigerating system is clean. In fact, valves with PTFE, bronze filled, gaskets are sensitive to dirt and debris. Furthermore, check that the flow direction in the pipe corresponds to the arrow stamped on the valve body. All the valves can be mounted in any position so long as the coil does not point downwards.
The brazing of connections of 1417E, 1427E and 1437E valves should be carried out with care, using a low melting point filler material (min 5% Ag). It is not necessary to disassemble the valves before brazing, but it is 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.


Castel ITALY
Type
HF3
220-230 V~
50-60 Hz
12W CL. F
TA 50 °C
Castel

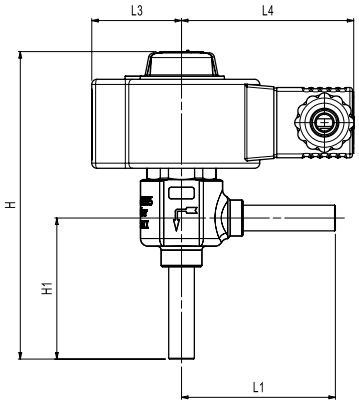
We recommend TIG welding for steel connectors of 1418E, 1428E and 1438E valves, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.
Before connecting a valve to the electrical system, be sure that the line voltage and frequency correspond to the values marked on the coil.

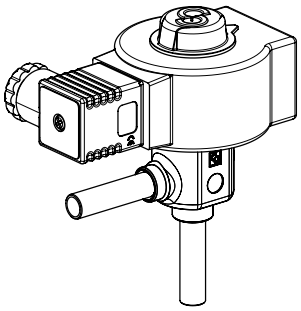
1417E



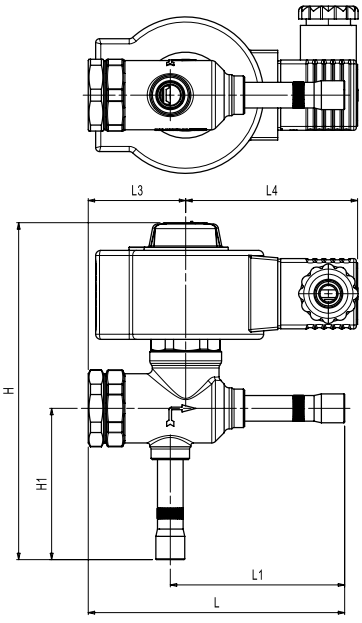


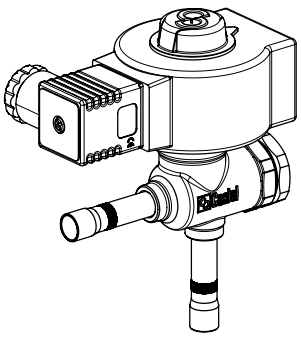
1418E



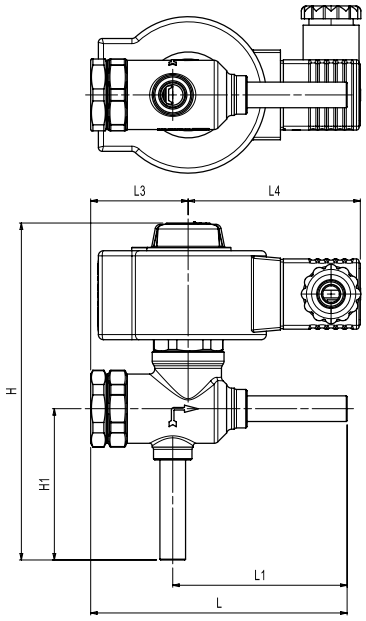


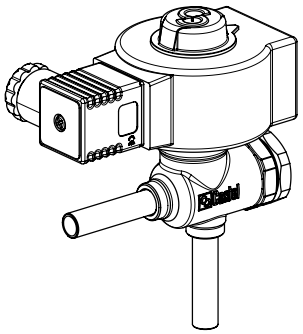
1427E



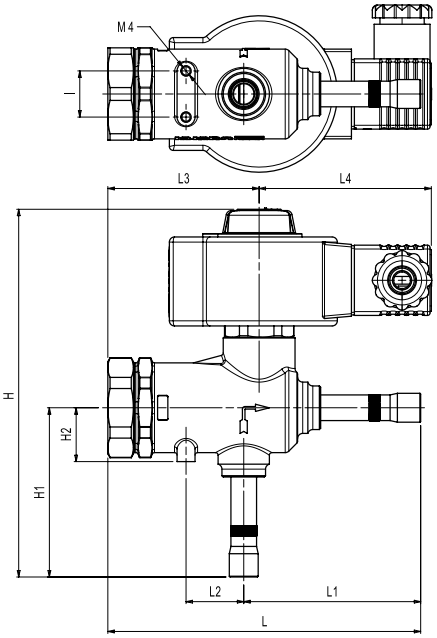


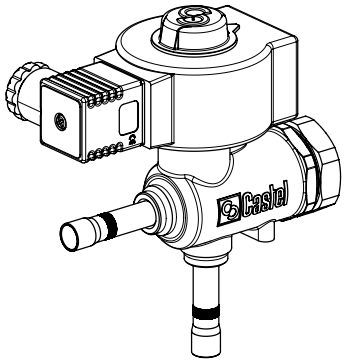
1428E



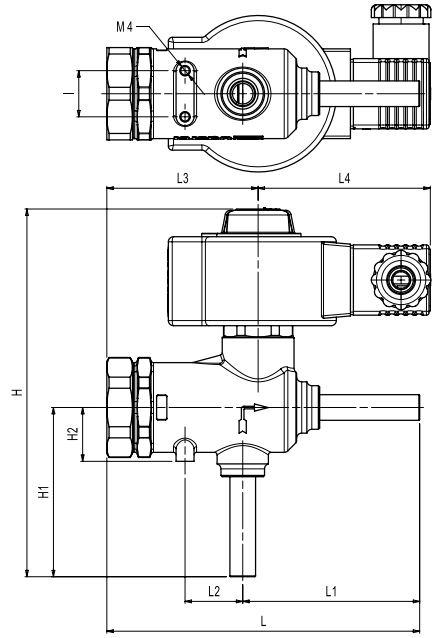


1437E





1438E



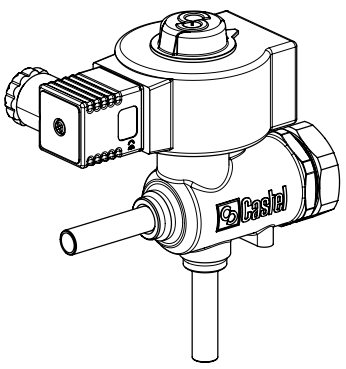


TABLE 4: GENERAL CHARACTERISTICS OF HP-NC VALVES WITH ODS CONNECTIONS

Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m3/h]	Opening Pressure Differential [bar]					PS [bar]	R744 TS [°C]		Oil TS [°C]		Risk Category according to PED Recast
		Ø [in.]	Ø [mm]			min OPD	R744 MOPD		Oil MOPD			min.	max.	min.	max.	
							9121 9320 (AC)	9320 (DC)	9121 9320 (AC)	9320 (DC)						
with reinforced copper connections (K65)																
Direct Acting	1417E/2S05	1/4"	–	1,3	0,065	0	80	80	20	20	130	-40	+ 150	-10	+70	Art. 4.3
	1417E/3S05	3/8"	–													
Piston Pilot Operated	1427E/2S020	1/4"	–	2	0,150	0,4	80	80	20	20						
	1427E/3S020	3/8"	–													
	1427E/2S030	1/4"	–	3	0,320											
	1427E/3S030	3/8"	–													
	1437E/3S050	3/8"	–	5	0,800				NA	NA				NA	NA	
	1437E/4S050	1/2"	–													
	1437E/3S070	3/8"	–	7	1,100											
	1437E/4S070	1/2"	–													
with stainless steel connections																
Direct Acting	1418E/M6S05	–	6	1,3	0,065	0	80	80	20	20	140	-40	+150	-10	+70	Art. 4.3
	1418E/M10S05	–	10													
Piston Pilot Operated	1428E/M6S020	–	6	2	0,150	0,4	80	80	20	20						
	1428E/M10S020	–	10													
	1428E/M6S030	–	6	3	0,320											
	1428E/M10S030	–	10													
	1438E/M10S050	–	10	5	0,800				NA	NA				NA	NA	
	1438E/M12S050	–	12													
	1438E/M10S070	–	10	7	1,100											
	1438E/M12S070	–	12													

TABLE 5: DIMENSIONS AND WEIGHTS

Operating Principles	Catalogue Number	Dimensions [mm]									Weight [g]
		H	H1	H2	L	L1	L2	L3	L4	I	
Direct Acting	1417E/2S05	117	51	NA	NA	56	NA	35	67	NA	270
	1417E/3S05	121	55			60					
Piston Pilot Operated	1427E/2S020	127	55		96	64	NA	38	67	NA	398
	1427E/2S030										
	1427E/3S020	131	59		100	68					
	1427E/3S030										
	1437E/3S050	143	66	21	122	69	22,5	59	67	18	710
	1437E/3S070										
	1437E/4S050	141	64		120	67					
	1437E/4S070										
Direct Acting	1418E/M6S05	119	53	NA	NA	58	NA	35	67	NA	250
	1418E/M10S05	121	55			60					
Piston Pilot Operated	1428E/M6S020	127	55		96	64	NA	38	67	NA	390
	1428E/M6S030										
	1428E/M10S020	131	59		100	68					
	1428E/M10S030										
	1438E/M10S050	143	66	21	122	69	22,5	59	67	18	700
	1438E/M10S070										
	1438E/M12S050	141	64		120	67					
	1438E/M12S070										

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

TABLE 6: REFRIGERANT FLOW CAPACITY [KW]

Operating Principles	Catalogue Number	gas cooler line	Suction line	Hot Gas line
Direct Acting	1417E/2S05	1,7	0,30	1,2
	1417E/3S05			
Piston Pilot Operated	1427E/2S020	3,9	0,69	2,8
	1427E/3S020			
	1427E/2S030	8,4	1,48	6,0
	1427E/3S030			
	1437E/3S050	21,0	3,70	15,0
	1437E/4S050			
	1437E/3S070	28,9	5,09	20,6
	1437E/4S070			
Direct Acting	1418E/M6S05	1,7	0,30	1,2
	1418E/M10S05			
Piston Pilot Operated	1428E/M6S020	3,9	0,69	2,8
	1428E/M10S020			
	1428E/M6S030	8,4	1,48	6,0
	1428E/M10S030			
	1438E/M10S050	21,0	3,70	15,0
	1438E/M12S050			
	1438E/M10S070	28,9	5,09	20,6
	1438E/M12S050			

Standard rating conditions according to AHRI Standard 760-2014		
Gas-cooler outlet temperature	95 °F	(35 °C)
Evaporating temperature	14 °F	(- 10 °C)
Evaporator outlet temperature	23 °F	(- 5 °C)
Evaporator superheating	9 °R	(5 °K)
Suction line temperature	32 °F	(0 °C)
Suction line superheating	9 °R	(5 °K)
Discharge temperature	212 °F	(110 °C)

SOLENOID VALVES

2.3 – MAGNETIC TOOL

APPLICATION

Castel supplies to its customers the permanent magnet tool code 9900/X91 for the normally closed solenoid valves illustrated in the previous chapters. This tool can be used when brazing the copper connections to the plant pipes: once fit on the valve stem of the mobile plunger, instead of the coil, it allows the protective gas (nitrogen) flow and avoids any damage to the plunger gasket and to the diaphragm.

CONSTRUCTION

The permanent magnet tool code 9900/X91 consists of three anisotropic ferrite rings in an anodized aluminium body.

COILS

GOGREEN

R744 • NATURAL REFRIGERANT

COILS

3.1 – COILS AND CONNECTORS

APPLICATION

For NC solenoid valves (Chapter 2), Castel provides its customers with the following series of coils that use the "FAST LOCK" system:
- **Series 9320** (coils type HF3) are interchangeable with coils in series 9120 (coils type HM3). 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). 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.

For solenoid expansion valve (Chapter 1) the following type of coils are available:
- **Series 9120** (coils type HM3) equipped with DIN connection
- **Series 9160** (coils type HM4) equipped with DIN connection
- **Series 9121** (coils type CM3) equipped with an encapsulated co-moulded cable 7 m long.

PS: these coils can be used also with NC solenoid valves in Chapter 2

Coils in series 9120, 9320 can be coupled with all connectors in series 9150 and 9900 manufactured by Castel. 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 9120, 9121, 9160, 9320 and 9360 have Class F 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 9320 and 9360) complete the protection of the windings from humidity.
The terminals of the coils in series 9120, 9160, 9320 and 9360 consist of two Faston connectors plus a Faston ground connector.
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

CERTIFICATIONS

Coils in series 9160, 9360 with 110 VAC, 220/230 VAC and 240 VAC power supply, and coils in series 9120, 9121 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.

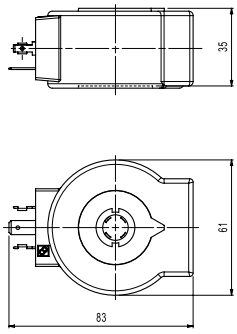
Castel developed specific connectors, series 9155, suitable for use in refrigeration systems operating in heavy-duty environments, for example:
- exposure to the atmospheric conditions
- rooms with high degree of moisture
- cyclic condensing / evaporation on the valve
- cyclic icing / defrosting on the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

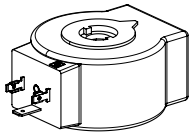
Based on the assembly requirements, these connectors allow you to choose the side orientation of the outer casing with respect to the inner terminal block. It is not possible to point the exit of the cable upwards. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. It is again recommended that


Castel
ITALY
Type
HF3
24 VDC
20W CL.F
TA 50 °C

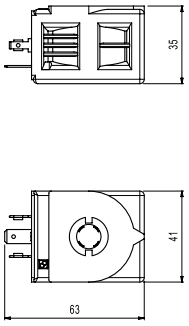
three-pole cables with a cross-section greater than or equal to 0.75 mm2 be used. As long as they are used with the gaskets provided, the connectors in series 9155 ensure IP65/IP68 protection rating according to the EN 60529 standard.

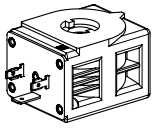
9120 (Type HM3)



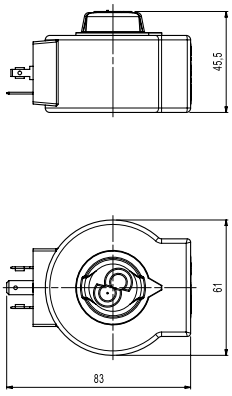


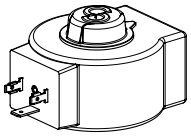
9160 (Type HM4)



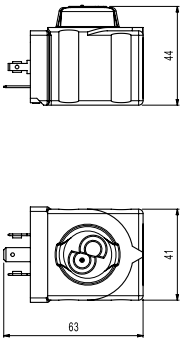


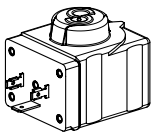
9320 (Type HF3)



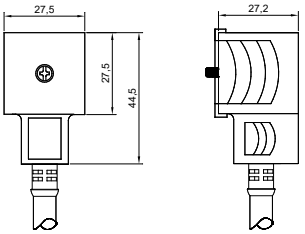


9360 (Type HF4)

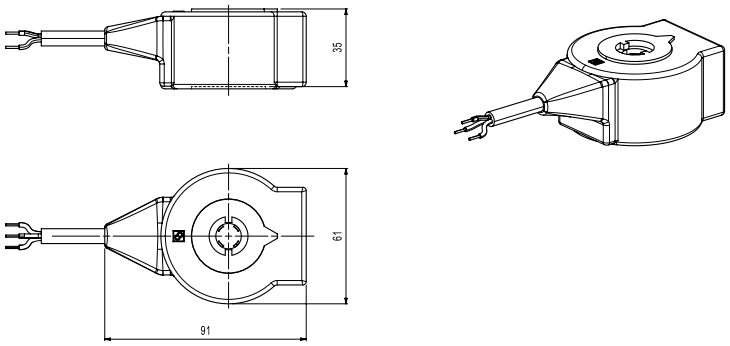




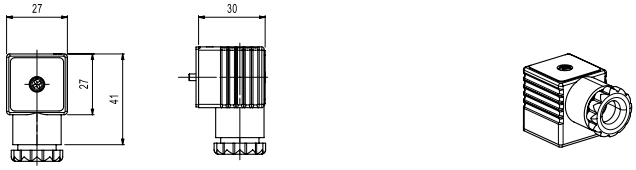
9900/X66



9121 (Type CM3)



9150/R02



9155/R01

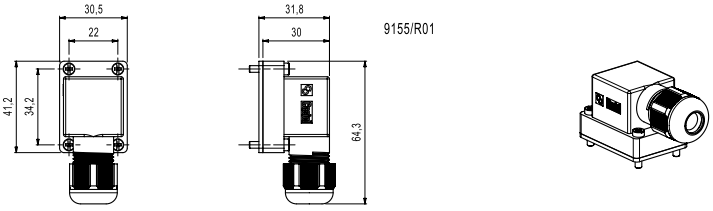


TABLE 1: GENERAL CHARACTERISTICS OF COILS

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Insulation class EN 60730	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9120/RA6	HM3	220/230 A.C.	+6 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X66	IP 65 (with connector)
9121/RA6	CM3	220/230 A.C.	+6 / -10	50 / 60	F	-20	+50	Three wires cable	_	IP 66
9320/RA6	HF3	220/230 A.C.	+6 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X66	IP 65 (with connector)
9320/RD1		12 D.C.	+10 / -5	_						
9320/RD2		24 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/X66	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							
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/X66	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							

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.	
9120/RA6	HM3	220/230 A.C.	12	190	160	–	110	80	–	470
9121/RA6	CM3	220/230 A.C.	12	190	160	–	110	80	–	860
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	
9160/RA2	HM4	24 A.C.	8	1490	1320	–	700	530	–	230
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		
9360/RA2	HF4	24 A.C.	8	1490	1320	–	700	530	–	230
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		

TABLE 3: GENERAL CHARACTERISTICS OF CONNECTORS

Catalogue Number	Cable length [m]	Cable thickness [mm2]	Standard	Degree of protection	Class of insulation
9150/R02	_	_	DIN 43650	IP65 EN 60529	Gruppo C VDE 0110-1 / 89
9900/X66	1	3 x 0,75			
9155/R01	_	_	_	IP65/IP68 EN 60529	

COILS

3.2 – COILS AND CONNECTORS, UL APPROVED

APPLICATION

For solenoid expansion valve (Chapter 1) approved by the American certification authority Underwriters Laboratories Inc., Castel provides its customers with the following types of coils:
- **Series 9125** (coil type HM3), with connection type DIN 43650
- **Series 9185** (coil type CM3-N2), with connection type "Junction Box NEMA 2".
- **Series 9186** (coil type CM3-N4), with connection type "Conduit Hub NEMA 4".

Coils in series 9125 must be coupled with connector type 9150UL/R02. The protection rating of the coil + connector system is IP65 according to the EN 60529 standard.
The coils in series 9185 are complete with a connection system and a metal sheath. The protection rating guaranteed by the "Junction Box" connection system is similar to IP12-32 according to the EN 60529 standard.
The coils in series 9186 are complete with a connection system and a metal sheath. The protection rating guaranteed by the "Conduit Hub" connection system is similar to IP54 according to the EN 60529 standard.

CONSTRUCTION

In compliance with IEC standard 85, the coils in series 9125, 9185 and 9186 have Class F 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 (155°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 complete the protection of the windings from humidity.
The coils in series 9125 are equipped with three flat terminals, two Faston connections in line plus a Faston ground connection.
The coils in series 9185 are equipped with two cables, at least 153 mm long, and ground screws incorporated in the body of the metal casing. The body of the casing is screwed onto the metal reinforcement of the coil and there are two semi-sheared slots to screw on a metal sheath. A metal cover screwed on the body closes the casing and encloses the joints between the power cable and the coil wires.
Coils in series 9186 are equipped with two wires, at least 457 mm long. The flange of the inlet plug is screwed to the metal reinforcement of the coil. The inlet plug is threaded in order to screw on a metal sheath.

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

CERTIFICATIONS

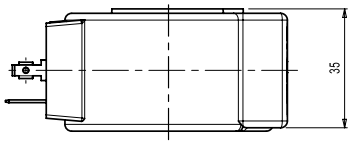
The American certification authority Underwriters Laboratories Inc. has approved coils in series 9125, 9185, and 9186 with file E243604. These coils are certified UL-CSA Recognized for the USA and Canada with file E243604, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.
The coils in series 9125, 9185, and 9186 with voltages of 120 VAC, 208 VAC, 220/230 VAC, 240 VAC comply with the Low Voltage Directive (2006/95/EC). All coils in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).

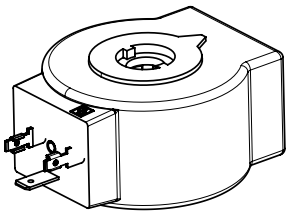
CONNECTORS

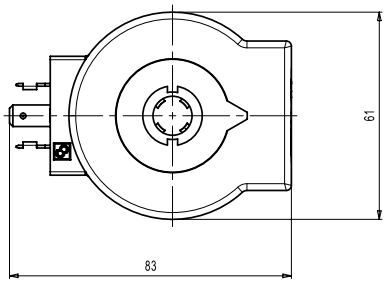
Connector 9150UL/R02 has been approved by the American certification authority Underwriters Laboratories Inc. This connector is certified **UL-CSA Recognized** for the USA and Canada with file E333724, in compliance with American standard UL 1977 and Canadian standard C22.2 No. 182.3.
The DIN 43650 standardized connector 9150UL/R02 represents 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, this connector allows 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.
As long as it is used with the gaskets provided, connector 9150UL/R02 ensures IP65 protection rating according to the EN 60529 standard.


Castel ITALY
Model
9185/RD2
24 VDC
20 W CL.F
TA 50 °C
Raintight
Enclosure
Castel ITALY
Model
9186/RD2
24 VDC
20 W CL.F
TA 50 °C
Watertight
Enclosure

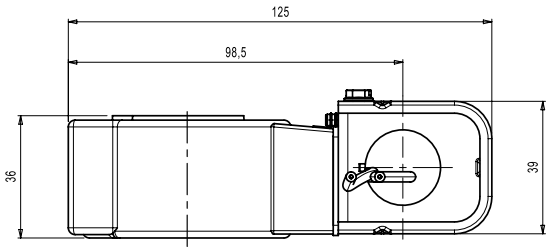
9125

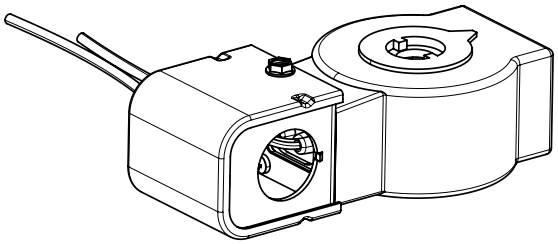


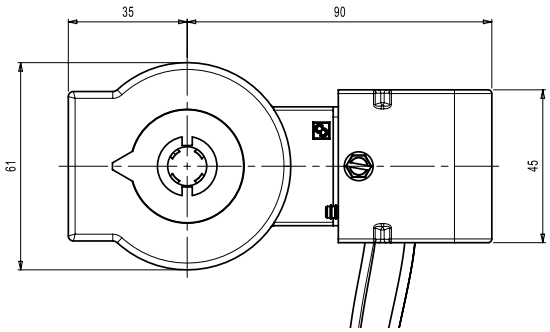




9185







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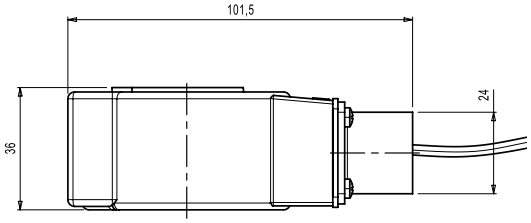

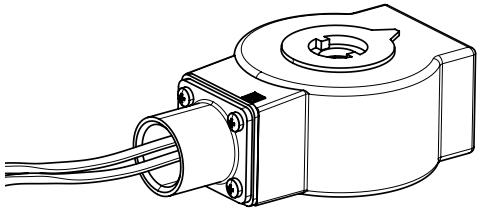

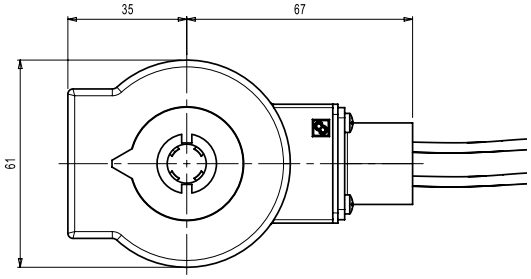

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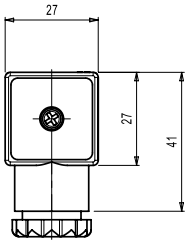
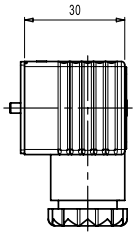




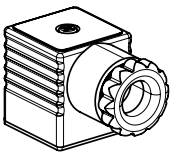


TABLE 4: GENERAL CHARACTERISTICS OF COILS, UL RECOGNIZED APPROVED

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Insulation class IEC 85	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9125/RD1	HM3	12 D.C.	+10 / -5	-	F	-20	+50	Terminal block for DIN 43650/A	9150UL/R02	IP 65 (with connector)
9125/RD2		24 D.C.								
9125/RA2		24 A.C.	+10 / -10	60						
9125/RA4		120 A.C.								
9125/RA5		208 A.C.								
9125/RA6		220/230 A.C.	+6 / -10							
9125/RA7		240 A.C.	+10 / -10							
9185/RD1	CM3-N2	12 D.C.	+10 / -5	-	F	-20	+50	Junction box NEMA 2	-	~ IP 12-32
9185/RD2		24 D.C.								
9185/RA2		24 A.C.	+10 / -10	60						
9185/RA4		120 A.C.								
9185/RA5		208 A.C.								
9185/RA6		220/230 A.C.	+6 / -10							
9185/RA7		240 A.C.	+10 / -10							
9186/RD1	CM3-N4	12 D.C.	+10 / -5	-	F	-20	+50	Conduit hub NEMA 4	-	~ IP 54
9186/RD2		24 D.C.								
9186/RA2		24 A.C.	+10 / -10	60						
9186/RA4		120 A.C.								
9186/RA5		208 A.C.								
9186/RA6		220/230 A.C.	+6 / -10							
9186/RA7		240 A.C.	+10 / -10							

TABLE 5: CONSUMPTIONS AND WEIGHTS OF COILS

Catalogue Number	Coil type	Voltage [V]	Power [W]	Consumption at 20 °C [mA]				Weight [g]
				Start		Working		
				60 [Hz]	D.C.	60 [Hz]	D.C.	
9125/RD1	HM3	12 D.C.	24	-	1720	-	1720	470
9125/RD2		24 D.C.		-	895	-	895	
9125/RA2		24 A.C.	20	2060	-	1015	-	
9125/RA4		120 A.C.		506		261		
9125/RA5		208 A.C.		286		152		
9125/RA6		220/230 A.C.		260		133		
9125/RA7		240 A.C.		235		122		
9185/RD1	CM3-N2	12 D.C.	24	-	1720	-	1720	590
9185/RD2		24 D.C.		-	895	-	895	
9185/RA2		24 A.C.	20	2060	-	1015	-	
9185/RA4		120 A.C.		506		261		
9185/RA5		208 A.C.		286		152		
9185/RA6		220/230 A.C.		260		133		
9185/RA7		240 A.C.		235		122		
9186/RD1	CM3-N4	12 D.C.	24	-	1720	-	1720	530
9186/RD2		24 D.C.		-	895	-	895	
9186/RA2		24 A.C.	20	2060	-	1015	-	
9186/RA4		120 A.C.		506		261		
9186/RA5		208 A.C.		286		152		
9186/RA6		220/230 A.C.		260		133		
9186/RA7		240 A.C.		235		122		

TABLE 6: GENERAL CHARACTERISTICS OF CONNECTORS, UL RECOGNIZED APPROVED

Catalogue Number	Standard	Degree of protection	Class of insulation	Approval
9150UL/R02	DIN 43650	IP65 EN 60529	Gruppo C VDE 0110-1 / 89	UL Recognized

COILS

3.3 – “SMART CONNECTOR” SYSTEM

APPLICATION

The “SMART CONNECTOR” systems series 9910 are formed by coupling a connector in series 9152, equipped with an integrated electronic circuit in the connector, with a specific series 9300 coil designed for the connector. These systems have been designed by Castel to be installed on:
- Normally-closed solenoid valves
- PWM expansion valves

and allow:
- a reduction in energy consumption when fully operational
- a consequent reduction in the operating temperature
- an extension of the coil life
- an increase in the MOPD value

N.B.: Castel does not sell the two parts (coil and connector) that make up a “SMART CONNECTOR” system separately.

CONNECTION CONSTRUCTION

EN 175301-803 (former DIN 43650) standardized connectors 9152 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture.
Connectors 9152 are available in both the direct current version (with 12 VDC and 24 VDC voltages) and in the alternating current version (with 24 VAC or 220/240 VAC voltages).
The direct current versions are equipped with polarity inversion protection.
The alternating current versions are equipped with a bridge rectifier circuit integrated on the circuit.
All versions, both direct current and alternating current, are equipped with a diode device that guarantees surge protection. All versions have the voltage for use and the wiring diagram printed on the casing. 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 recommended that three-pole cables with a cross-section greater than or equal to 0.75 mm2 be used. There are no versions with co-moulded cables.
Each connector in a “SMART CONNECTOR” system must be used only for the type of coil with which it is coupled in the system. Incorrect use of the connector with other types of coils produced by Castel will quickly damage the coil and the connector.

COIL CONSTRUCTION

Coils in series HF2 (9300) used in the “SMART CONNECTOR” systems are special coils available in both the direct current version (with 12 VDC and 24 VDC voltages) and rectified current version (with 24 VRAC, 220 VRAC, or 240 VRAC).
These coils are in Class H, in accordance with IEC standard 85 and their production is compliant with standards EN 60730-1 and EN 60730-2-8. The windings are made of enamelled copper wire, with insulation class H (180 °C), in compliance with IEC standard 85.
The terminals of the coils consist of two Faston connectors plus a Faston ground connector. The outer casing is made of waterproof, dielectric resins that guarantee reinforced insulation and allow any type of assembly.
They have Class I protection ratings against electric contacts. Consequently, their safety requires an efficient ground system. A rubber gasket assembled on the lower end of the coil completes the protection of the windings from humidity. When coupled with connectors 9152, these coils guarantee an IP65 protection rating according to standard EN 60529.
The coils are designed for continuous use. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments The maximum ambient temperature for all coils is 50 °C.
Each coil in a “SMART CONNECTOR” system must be used only in combination with the type of connector with which it is coupled in the system. Incorrect use of the coil with other types of connectors produced by Castel will quickly damage the coil and the connector.

OPERATION

Through the integrated circuit in the connector, and coupling with the specific coil, connectors 9152 are capable of improving the MOPD characteristics of Castel solenoid valves, reducing the power consumption by up to 50% over time, extending the coil life, and decreasing the noise.
The integrated circuit located inside the connector works in different modes based on the power supply voltage. Specifically, there are two main families with different operating logics.

Connectors 9152/RD (direct current) supercharge the dedicated coil 9300 to its maximum allowed power for a short, pre-set interval. This is called the “Boost” time. It generates a greater attraction force on the valve’s magnetic unit, and consequently increases the MOPD value. At the end of the “Boost” phase, during normal operation, connectors 9152/RD maintain the electric consumption of the dedicated coil 9300 at a lower value, from 45% to 55% lower than the power absorbed by the coil. The power reduction occurs by powering the coil with a high-frequency pulsed current (ON/OFF cycles), from 15 to 30 kHz. This frequency is aimed at guaranteeing the minimum magnetic force to keep the valve open during operation.

Connectors 9152/RA (alternating current) supercharge the coils 9300 for a pre-set interval. This is called the “Boost” time. It generates a greater attraction force on the valve’s magnetic unit, and consequently increases the MOPD value. Once this period is over, the electronics remove one phase wave every second one, with an effect comparable to powering the coil with pulsed/rectified current with a frequency half of that of the network. By using this system, you obtain an electric power consumption reduction of the unit to a value from 35% to 45%, while maintaining the minimum magnetic force that allows the valve to be opened. This operating logic makes the “Smart Connector” system powered in alternating current very quiet, reducing the normal noise level, which can be up to 13 dB, to values less than 4 dB based on the valve installation.

Using the afore-mentioned logic, it is possible to significantly reduce the electricity consumption (which can be important considering the system of refrigerator aisles in a supermarket). Also, it leads to a lower operating temperature of the coil and therefore, in conclusion, less wear on the electromechanical drive system. Obviously, these reductions in consumption are strictly related to the use of the coils.

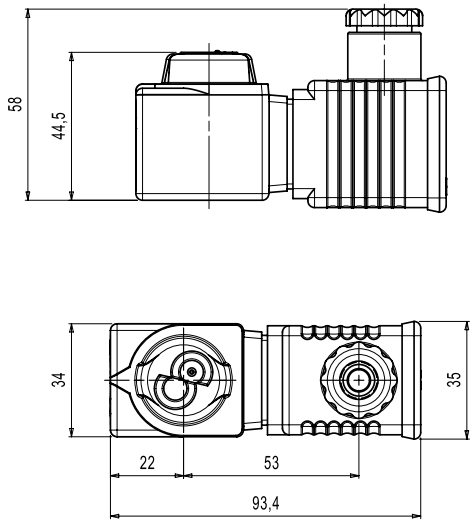
For proper evaluation of the real energy savings, it is necessary to consider the number of coil interventions with respect to the normal power supply time of the valve. If the number of interventions is reduced, the consumption is reduced; if the number of interventions increases, the consumption grows.

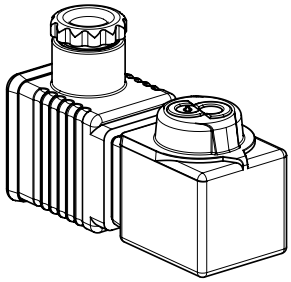
As indicated in the paragraph APPLICATION, the “SMART CONNECTOR” systems can also be used with the series of valves PWM 2028 manufactured by Castel, if suitably sized to have opening / closing cycles with a frequency greater than 0.6 seconds.

CERTIFICATIONS

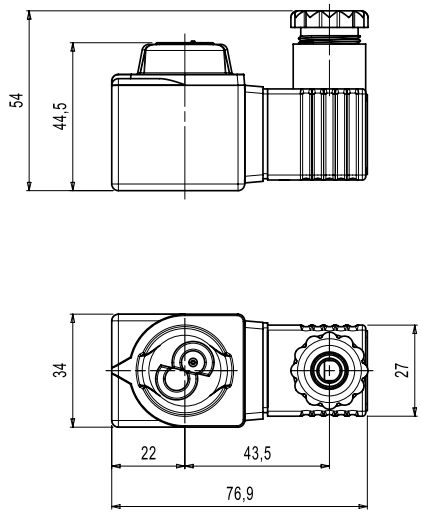
All connectors and coils in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC). The connectors with 220/240 VAC voltage and the coils with 220 VRAC and 240 VRAC voltage comply with the Low Voltage Directive (2006/95/EC).

9910/RA





9910/RD



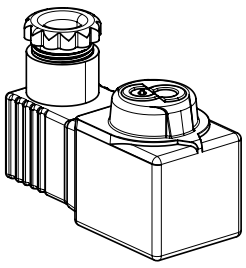


TABELLA 7: GENERAL CHARACTERISTICS OF SYSTEMS SMART CONNECTOR

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Working nominal power [W]	Nominal power tolerance [%]	Insulation class IEC 85	TA [°C]		Boost Time [msec]	Protection degree
							min	max		
9910/RD1 (1)	12 VDC	+/-10	-	3	+/-10	H	-20	+50	130	IP65
9910/RD2 (1)	24 VDC			5						
9910/RA2	24 VAC	+/-10	50/60	7	+/-10	H	-20	+50	200	IP65
9910/RA6	220 VAC									
9910/RA7	240 VAC									

(1): Warning if these connectors are supplied via unidirectional direct current or rectified by means of the Graetz bridge, they could not perform a correct cycle of operation but always remain in Boost conditions, leading to fast damage of the coil. For correct operation the kits series 9910/RD MUST be powered by direct current stabilized or rectified.

SAFETY DEVICES

GOGREEN

R744 • NATURAL REFRIGERANT

SAFETY DEVICES

4.1 – SAFETY VALVES IN SERIES 3030

GENERAL DESCRIPTION

Safety valves in series 3030 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3030/44)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 250)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the atmosphere. For this reason, during relief, there is a gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from PTFE (Polytetrafluorethylene), a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the head and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.
Material used: DIN 17223-1 steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent unauthorized interventions by means of a threaded cap nut, screwed on outside the head and sealed with a Castel lead seal.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.

(reference standard: EN 378-2:2016)
Fluids: the valves in series 3030 can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is reported on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- CE marking
- Identification number of the notified body involved in the production control phase
- Valve model
- Serial number
- Set pressure
- Temperature range allowed
- Kd discharge coefficient
- Flow section
- Production date

DOCUMENTATION

The safety valves in series 3030 are supplied with the following documentation provided in the packaging:


Caster
PESSANO MI
MADE IN
ITALY
PS55
Caster
PESSANO-MI
MADE IN
ITALY
PS55

- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.
N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page “PRODUCT CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3030 with a specific setting, for ex. 3030/44C250 or 3030/88C420. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

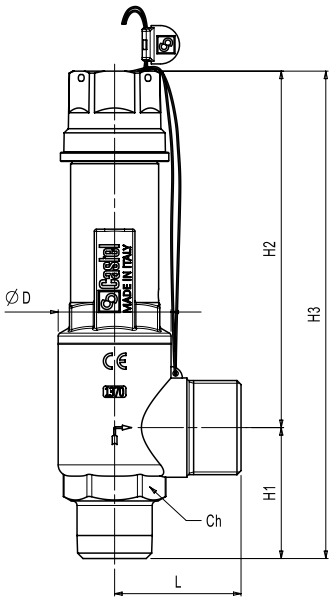
- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016: “Refrigerating systems and heat pumps – safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

To select the safety valves in series 3030, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3030 guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained. Nevertheless, it is advisable to replace a 3030 valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.
To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

3030/44C
3030/66C
3030/88C



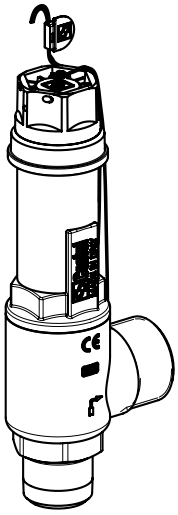


TABLE 1: GENERAL CHARACTERISTICS OF VALVES 3030

Catalogue Number		3030/44C	3030/44G	3030/66C	3030/88C
Connections	Inlet male	1/2" NPT	1/2" G	3/4" NPT	1" NPT
	Outlet male	3/4" G	3/4" G	3/4" G	1.1/4" G
Inlet connection wrench torque (min/max) [Nm]		25/35	25/35	30/40	60/80
Flow Diameter [mm]		12	12	12	19,5
Flow Section [mm2]		113	113	113	298
Lift [mm]		4,1	4,1	4,1	6,8
Discharge Coefficient "Kd"		0,90	0,90	0,90	0,83
PS [bar]		55			
TS [°C]		- 50 / + 150			
Set Pressure Range at atmospheric back pressure Pset [bar]		9 / 50			
Overpressure		+ 5 % of Pset			
Blowdown		- 15 % of Pset			
Helium tightness		-15 % di Pset (9 bar < Pset < 31 bar)			
		-10 % di Pset (31,1 bar < Pset < 50 bar)			
Estimated service life		9 years			
Risk Category according to PED Recast		IV			

TABLE 2: DIMENSIONS AND WEIGHTS OF VALVES 3030

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3030/44C	38	38	28	44	115	159	780
3030/44G	38	38	28	44	115	159	780
3030/66C	38	38	28	44	115	159	780
3030/88C	50	56	40	58	158	216	1960

SAFETY DEVICES

4.2 – SAFETY VALVES IN SERIES 3060

GENERAL DESCRIPTION

Safety valves in series 3060 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3060/45)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 300)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from PTFE (Polytetrafluorethylene), a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the body and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief.
Material used: DIN 17223-1 steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the body, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The calibration system is protected against subsequent unauthorized interventions by means of a cap nut that is housed into the brass body and is fixed in this seat with an edge calking operation.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.

(reference standard: EN 378-2:2016)
Fluids: the valves in series 3060 can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is reported on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- CE marking
- Identification number of the notified body involved in the production control phase
- Valve model
- Serial number
- Set pressure
- Temperature range allowed
- Kd discharge coefficient
- Flow section
- Production date

DOCUMENTATION

The safety valves in series 3060 are supplied with the following documentation provided in the packaging:
- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with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PESSANO-MI
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Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.
N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page “PRODUCT CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3060 with a specific setting, for ex. 3060/24C250 or 3060/45C420. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

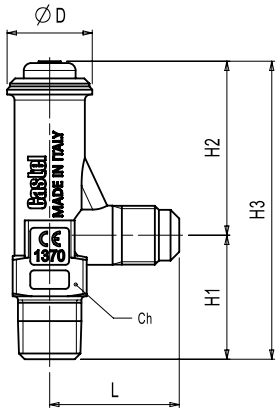
- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016: “Refrigerating systems and heat pumps – safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

To select the safety valves in series 3060, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3060 do NOT guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are NOT maintained.
To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

3060/23C
3060/24C
3060/33C
3060/34C
3060/45C
3060/36C
3060/46C



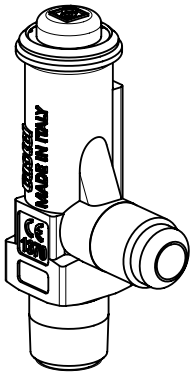


TABLE 3: GENERAL CHARACTERISTICS OF VALVES 3060

Catalogue Number		3060/23C	3060/24C	3060/33C	3060/34C	3060/45C	3060/36C	3060/46C
Connections	Inlet male	1/4" NPT	1/4" NPT	3/8" NPT	3/8" NPT	1/2" NPT	3/8" NPT	1/2" NPT
	Outlet male	3/8" SAE	1/2" SAE	3/8" SAE	1/2" SAE	5/8" SAE	3/4" G	3/4" G
Inlet connection wrench torque (min/max) [Nm]		15/20	15/20	17/22	17/22	25/35	17/22	25/35
Flow Diameter [mm]		7,0				9,5	10,0	
Flow Section [mm2]		38,5				70,9	78,5	
Discharge Coefficient "Kd"		0,63	0,69	0,63	0,69	0,45	0,92	0,93
PS [bar]		55						
TS [°C]		- 50 / + 120						
Set Pressure Range at atmospheric back pressure Pset [bar]		9 / 50						
Overpressure		+ 10 % of Pset						
Blowdown		- 50 % of Pset				- 40 % of Pset		
Helium tightness		-20 % di Pset (9 bar < Pset < 31 bar)						
		-10 % di Pset (31,1 bar < Pset < 50 bar)						
Estimated service life		5 years						
Risk Category according to PED Recast		IV						

TABLE 4: DIMENSIONS AND WEIGHTS OF VALVES 3060

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3060/23C	21,5	35	20	33,5	46,5	80	180
3060/24C	21,5	35	20	33,5	46,5	80	195
3060/33C	21,5	35	20	33,5	46,5	80	195
3060/34C	21,5	35	20	33,5	46,5	80	195
3060/45C	24,5	39,0	23	37	52,5	89	240
3060/36C	30	40	27	37	59,5	96,5	360
3060/46C	30	40	27	40	59,5	99,5	380

SAFETY DEVICES

4.3 – SAFETY VALVES IN SERIES 3061

GENERAL DESCRIPTION

Safety valves in series 3061 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3061/3)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 200)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from modified PTFE (Polytetrafluorethylene), a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the body and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.
Material used: EN 10270-2 - FD steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent unauthorized interventions by means of a cap nut that is housed into the brass body and is fixed in this seat with an edge calking operation.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.
(reference standard: EN 378-2:2016)
Fluids: the valves in series 3061 can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is cast on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- Valve model
- Serial number
- Set pressure
- Allowable temperature range
- Kd discharge coefficient
- Flow section
- Production date
- CE marking
- Identification number of the notified body involved in the production control phase

DOCUMENTATION

The safety valves in series 3061 are supplied with the following documentation provided in the packaging: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- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.

N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page “PRODUCT CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3061 with a specific setting, for ex. 3061/2C250 or 3061/4C420. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

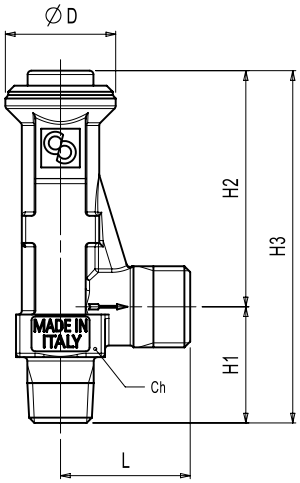
Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016 “Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

To select the safety valves in series 3061, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3061 guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained. Nevertheless, it is advisable to replace a 3061 valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.
To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.



3061/2C
3061/3C
3061/4C

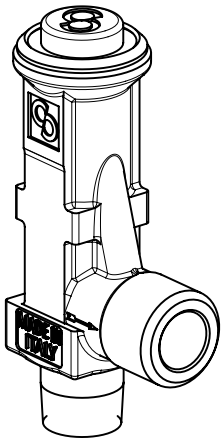


TABLE 5 : GENERAL CHARACTERISTICS OF VALVES 3061

Catalogue Number		3061/2C	3061/3C	3061/4C
Connections	Inlet male	1/4" NPT	3/8" NPT	1/2" NPT
	Outlet male	3/8" G	1/2" G	1/2" G
Inlet connection wrench torque (min/max) [Nm]		15/20	17/22	25/35
Flow Diameter [mm]		7,5	7,5	7,5
Flow Section [mm2]		44,2	44,2	44,2
Lift [mm]		-	-	-
Discharge Coefficient "Kd"		0,89	0,89	0,89
PS [bar]		70		
TS [°C]		- 50 / + 150		
Set Pressure Range at atmospheric back pressure Pset [bar]		11 / 60		
Overpressure		+ 10 % of Pset		
Blowdown		- 15 % of Pset		
Helium tightness		- 20 % of Pset (11 bar < Pset < 14 bar)		
		- 15 % of Pset (14,1 bar < Pset < 24 bar)		
		- 10 % of Pset (24,1 bar < Pset < 60 bar)		
Estimated service life		9 years		
Risk Category according to PED Recast		IV		

TABLE 6: DIMENSIONS AND WEIGHTS OF VALVES 3061

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3061/2C	28,5	33,5	23	30	61	91	200
3061/3C	28,5	33,5	23	30	61	91	230
3061/4C	28,5	33,5	23	35	61	96	260

SAFETY DEVICES

4.4 – SAFETY VALVES IN SERIES 3065

GENERAL DESCRIPTION

Safety valves in series 3065 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3065/4)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 140)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from modified PTFE (Polytetrafluorethylene), a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the body and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.
Material used: EN 10270-2 - FD steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent unauthorized interventions by means of a cap nut that is housed into the brass body and is fixed in this seat with an edge calking operation.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.
(reference standard: EN 378-2:2016)
Fluids: the valves in series 3065 can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is cast on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- Valve model
- Serial number
- Set pressure
- Allowable temperature range
- Kd discharge coefficient
- Flow section
- Production date
- CE marking
- Identification number of the notified body involved in the production control phase

DOCUMENTATION

The safety valves in series 3065 are supplied with the following documentation provided in the packaging: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PS 70

- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.

N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page “PRODUCT CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3061 with a specific setting, for ex. 3065/4C250 or 3065/6C420. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

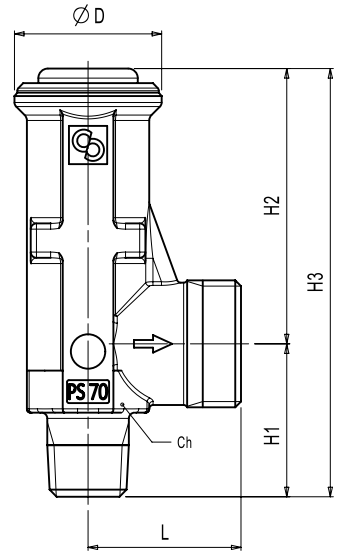
- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016 “Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

For sizing of the safety valves in series 3065, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3065 guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained. Nevertheless, it is advisable to replace a 3065 valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.

To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.



3065/4C
3065/6C

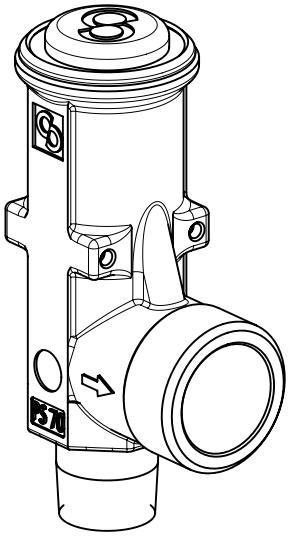


TABLE 7 : GENERAL CHARACTERISTICS OF VALVES 3065

Catalogue Number		3065/4C	3065/6C
Connections	Inlet male	1/2" NPT	3/4" NPT
	Outlet male	1" G	1" G
Inlet connection wrench torque (min/max) [Nm]		25/35	30/40
Flow Diameter [mm]		13,0	13,0
Flow Section [mm2]		132,7	132,7
Lift [mm]		6,3	6,3
Discharge Coefficient "Kd"		0,87	0,87
PS [bar]		70	
TS [°C]		- 50 / + 150	
Set Pressure Range at atmospheric back pressure Pset [bar]		11 / 60	
Overpressure		+ 10 % of Pset	
Blowdown		- 15 % of Pset	
Helium tightness		- 20 % of Pset (11 bar < Pset < 18,5 bar)	
		- 15 % of Pset (18,6 bar < Pset < 31 bar)	
		- 10 % of Pset (31,1 bar < Pset < 60 bar)	
Estimated service life		9 years	
Risk Category according to PED Recast		IV	

TABLE 8: DIMENSIONS AND WEIGHTS OF VALVES 3065

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3065/4C	38,5	40	32	40	72	112	520
3065/6C	38,5	40	32	40	72	112	520

SAFETY DEVICES

4.5 – HIGH PRESSURE SAFETY VALVES IN SERIES 3030E

GENERAL DESCRIPTION

Safety valves in series 3030E are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3030E/46)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 1250)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the atmosphere. For this reason, during relief, there is a gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from PTFE 50% stainless steel filled, a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the head and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.
Material used: DIN 17223-1 steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent unauthorized interventions by means of a threaded cap nut, screwed on outside the head and sealed with a Castel lead seal.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.

(reference standard: EN 378-2:2016)
Fluids: the valves in series 3030E can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is reported on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- CE marking
- Identification number of the notified body involved in the production control phase
- Valve model
- Serial number
- Set pressure
- Temperature range allowed
- Kd discharge coefficient
- Flow section
- Production date

DOCUMENTATION

The safety valves in series 3030E are supplied with the following documentation provided in the packaging: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Castel
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- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.
N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page “PRODUCT CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3030E with a specific setting, for ex. 3030E/46C1250 or 3030E/610C800. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

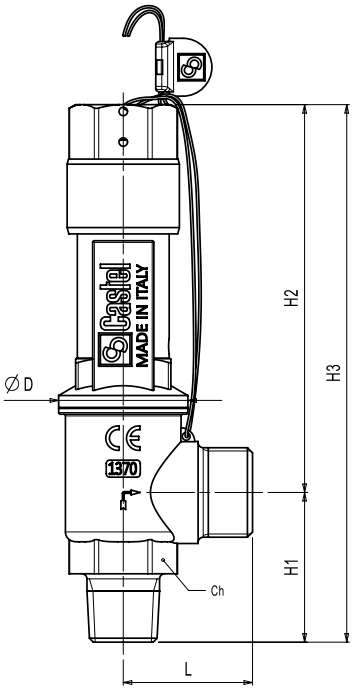
- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016: “Refrigerating systems and heat pumps – safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

To select the safety valves in series 3030E, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3030E guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained. Nevertheless, it is advisable to replace a 3030E valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.
To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

3030E/34C
3030E/46C
3030E/410C
3030E/610C



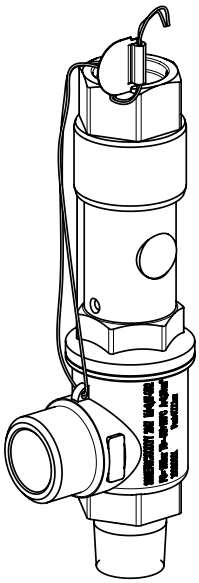


TABLE 9: GENERAL CHARACTERISTICS OF VALVES 3030E

Catalogue Number		3030E/36C	3030E/46C	3030E/410C	3030E/610C
Connections	Inlet male	3/8" NPT	1/2" NPT	1/2" NPT	3/4" NPT
	Outlet male	3/4" G	3/4" G	1.1/4" G	1.1/4" G
Inlet connection wrench torque (min/max) [Nm]		17/22	25/35	25/35	30/40
Flow Diameter [mm]		7	7	11	11
Flow Section [mm2]		38,5	38,5	95,0	95,0
Lift [mm]		4,2	4,2	4,7	4,7
Discharge Coefficient "Kd"		0,97	0,97	0,91	0,91
PS [bar]		165			
TS [°C]		- 50 / + 150			
Set Pressure Range at atmospheric back pressure Pset [bar]		60 / 150			
Overpressure		+ 10 % of Pset			
Blowdown		- 15 % of Pset			
Helium tightness		-10 % di Pset			
Estimated service life		9 years			
Risk Category according to PED Recast		IV			

TABLE 10: DIMENSIONS AND WEIGHTS OF VALVES 3030E

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3030E/36C	38	38	28	41	114	155	730
3030E/46C	38	38	28	41	114	155	750
3030E410C	50	56	40	55	155	210	1830
3030E/610C	50	56	40	55	155	210	1860

SAFETY DEVICES

4.6 – HIGH PRESSURE SAFETY VALVES IN SERIES 3061E

GENERAL DESCRIPTION

Safety valves in series 3061E are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.
Valves are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3061E/3)
- the type of inlet connection (for ex. C = NPT)
- the set pressure, expressed in bar, multiplied by 10 (for ex. 900)
- an alphanumerical serial number

CONSTRUCTION

Body: squared, obtained through hot moulding and subsequent machining. It houses the following elements:
- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.
Material used: EN 12420-CW617N brass
Shutter: obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from PTFE 50% stainless steel filled, a material that, during the valve's estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the body and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.
Material used: EN 12164-CW614N brass
Spring: it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.
Material used: EN 10270-2 - FD steel for springs.
Calibration system: hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent unauthorized interventions by means of a cap nut that is housed into the brass body and is fixed in this seat with an edge calking operation.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.
(reference standard: EN 378-2:2016)
Fluids: the valves in series 3061E can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is cast on the valve body:
- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure
- Valve model
- Serial number
- Set pressure
- Allowable temperature range
- Kd discharge coefficient
- Flow section
- Production date
- CE marking
- Identification number of the notified body involved in the production control phase

DOCUMENTATION

The safety valves in series 3061E are supplied with the following documentation provided in the packaging:


MADE IN
ITALY

- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.
- Calibration certificate for the safety valve, printed on the reverse side of the Declaration of Conformity.

N.B.: on the website: www.castel.it use the “DOWNLOAD” pull-down menu to access the web-page PRODUCT “CERTIFICATION” in the “DOWNLOAD CENTER”. On this page, you can download:
- the Declaration of Conformity / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Declaration of Conformity referring to a specific model of valve 3061E with a specific setting, for ex. 3061E/2C1100 or 3061E/4C950. (SEARCH BY PRODUCT CODE)

VALVE SELECTION

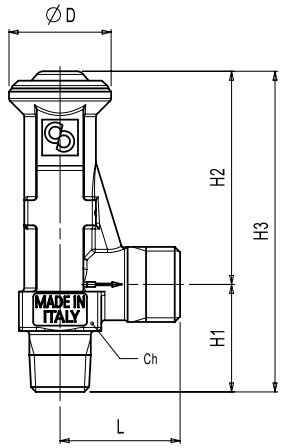
Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

- EN ISO 4126-1: 2013: “Safety devices for protection against excessive pressure – Part 1: Safety valves” indicates the general requirements for safety valves regardless of the fluid for which they were designed.
- EN 378-2:2016 “Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation” provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).
- EN 13136:2013+A1: “Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation” highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

To select the safety valves in series 3061E, please see Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

VALVE INSTALLATION

Safety valves type 3061E guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained. Nevertheless, it is advisable to replace a 3061E valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.
To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.



3061E/2C
3061E/3C
3061E/4C

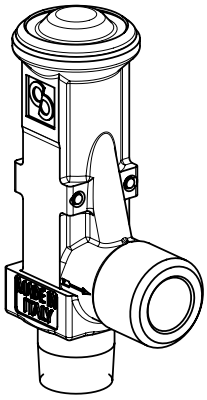


TABLE 11 : GENERAL CHARACTERISTICS OF VALVES 3061E

Catalogue Number		3061E/2C	3061E/3C	3061E/4C
Connections	Inlet male	1/4" NPT	3/8" NPT	1/2" NPT
	Outlet male	3/8" G	1/2" G	1/2" G
Inlet connection wrench torque (min/max) [Nm]		15/20	17/22	25/35
Flow Diameter [mm]		4,5	4,5	4,5
Flow Section [mm2]		15,9	15,9	15,9
Lift [mm]		-	-	-
Discharge Coefficient "Kd"		0,90	0,90	0,90
PS [bar]		165		
TS [°C]		- 50 / + 150		
Set Pressure Range at atmospheric back pressure Pset [bar]		60 / 150		
Overpressure		+ 10 % of Pset		
Blowdown		- 30 % of Pset		
Helium tightness		- 20 % of Pset (60 bar < Pset < 90 bar)		
		- 15 % of Pset (91 bar < Pset < 120 bar)		
		- 10 % of Pset (121 bar < Pset < 150 bar)		
Estimated service life		9 years		
Risk Category according to PED Recast		IV		

TABLE 12: DIMENSIONS AND WEIGHTS OF VALVES 3061E

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H1	H2	H3	
3061E/3C	28,5	33,5	23	30	61	91	200
3061E/3C	28,5	33,5	23	30	61	91	230
3061E/4C	28,5	33,5	23	35	61	96	260

SAFETY DEVICES

4.7 – SELECTION CRITERIA FOR SAFETY VALVES

CALCULATION OF THE DISCHARGE CAPACITY (REF. EN 13136:2013+A1)

The calculation of the minimum discharge capacity is linked to the system configuration on which the safety valve is installed, and to the cause of the safety valve opening, i.e.:

– **External heat sources** (Para. 6.2.1 - EN 13136:2013+A1). The minimum required discharge capacity is determined by the following formula:

$$\mathbf{Q_{md}} = {}^{(3600 \times \phi \times A_{surf})}/_{\mathbf{h_{vap}}} \quad [kg/h]$$

where:
- φ = density of heat flow rate, assumed to be 10 [kW/m^2]
- A_{surf} = external surface area of the vessel [m^2]
- h_{vap} = latent heat of vaporization of liquid at p_o = 1,1 x p_{set} [kJ/kg]
  - If p_o is higher that the saturated pressure of the refrigerant at critical temperature minus 5 °K, then h_{vap} shall be taken at critical temperature minus 5 °K
  - If the temperature at p_o is higher than the saturated temperature (superheated gas), then h_{vap} shall be taken at saturated condition

Note: vessels only containing refrigerant in the gas phase do not produce a continuous mass flow under an external hear impact.

– **Internal heat sources** (Para. 6.2.2 - EN 13136:2013 + A1). The minimum required discharge capacity is determined by the following formula:

$$\mathbf{Q_{md}} = {}^{(3600 \times Q_h)}/_{\mathbf{h_{vap}}} \quad [kg/h]$$

where Q_h = rate of heat production [kW]

– **Increased pressure caused by a positive displacement compressor** (Para. 6.3 - EN 13136:2013+A1). The minimum required discharge capacity is determined by the following formula:

$$\mathbf{Q_{md}} = 60 \times V \times n \times \rho_0 \times \eta_v \quad [kg/h]$$

where:
– V = theoretical displacement of compressor [m^3]
– n = rotational frequency of compressor [min^{-1}]
– ρ_0 = 97,6 [kg/m3]. Vapour density of R744, from the saturation curve at a temperature of 0 °C [kg/m^3].
– η_v = volumetric efficiency of the compressor, estimated at suction pressure and discharge pressure equivalent to the safety valve setting.

– **Excessive pressure caused by expansion of trapped liquid** (Para. 6.4 - EN 13136:2013+A1).
For protection against pressure caused expansion of trapped liquid, the effective area of the pressure valve shall be calculated based on volume of the trapped liquid:

$$\mathbf{A_{effective}} = \mathbf{K_{volume}} \times \mathbf{V_{trapped}} \quad [mm^2]$$

where:
- K_{volume} = 0,04 [mm^2/l]
- $A_{effective}$ = if calculating this area the flow diameter is less than 1 mm, then the diameter must be selected to 1 mm

and the effective area of the pressure valve is defined as:

$$\mathbf{A_{effective}} = \mathbf{A_{actual}} \times \mathbf{K_{dr}} \quad [mm^2]$$

SIZING OF SAFETY VALVES DESIGNED TO DISCHARGE GAS OR VAPOUR AT CRITICAL FLOW (REF. EN ISO 4126-1: 2013 AND EN 13136 :2013+A1)

Critical flow occurs when the back-pressure p_b (the pressure existing immediately at the outlet of the valve) is lower than or equal to the critical pressure:

$$\mathbf{p_b} \leq \mathbf{p_o} \times \left|\frac{2}{k+1}\right|^{\left(\frac{k}{k-1}\right)} \quad [bar\ abs]$$

where:
– p_o = actual relieving pressure, upstream the valve. It's equal to the set pressure plus overpressure; that is, the pressure increase over the set pressure at which the shutter has its total lift [bar abs]
– k = isentropic exponent of gas or vapour, based on the actual temperature and pressure conditions upstream of the valve during the discharge phase under full glow.

If k is unknown or difficult to determine, it is possible to assume:

$$\mathbf{p_{critical}} = 0,5 \times \mathbf{p_o} \quad [bar\ abs]$$

A valve that discharges to the atmosphere, is under in critical flow conditions.


3061/4C100 PSet=10,0 bar
1234567
A=0.441 cm2
12/15
PS 70
3065/4C100 PSet=10,0 bar
1234567
A=1.326 cm2
12/15
PG 15
PS 70

To calculate the flow rate of a safety valve designed to discharge gas or vapour at critical flow, under specific operating conditions, use the following formulas, provided in Para. 7.2.5.2 of EN 13136:2013+A1.

$$\mathbf{Q_m = 0,2883 \times C \times A \times 0,9 \times K_d \times \sqrt{\frac{p_o}{v_o}}} \quad \text{[kg/h]}$$

where:
– Q_m = calculated mass flow rate of safety valve [kg/h]
– A = calculated flow area of the safety valve [mm^2]
– K_d = certified discharge ratio of safety valve
– p_o = actual pressure upstream of the safety valve during discharge of the entire flow, see definition above. [bar abs]
– v_o = specific volume of gas or vapour at discharge conditions p_o and T_o, where T_o is the fluid temperature at valve inlet, defined by the user or by the designer [m^3/kg]
– C = expansion rate as a function of the k coefficient in the isentropic equation calculated with the following formula:

$$\mathbf{C = 3,948 \times \sqrt{k \times \left|\frac{2}{k+1}\right|^{\frac{(k+1)}{(k-1)}}}}$$

for this calculation, the value of k_{R744} = 1,3 and C = 2,63 referring to a temperature of 25 °C. (Para. 7.2.3, EN 13136:2013+A1 standard).

If $\mathbf{Q_{md} < Q_m < 1,25 \times Q_{md}} \quad \rightarrow \quad \mathbf{Q_{md'} = Q_{md}}$

If $\mathbf{Q_m > 1,25 \times Q_{md}} \quad \rightarrow \quad \mathbf{Q_{md'} = {Q_m}/{1,25}}$

where:
– $Q_{md'}$ = adjusted discharge capacity of safety valve, used for pressure drop calculation [kg/h]

The flow area A_c is calculated from the adjusted discharge capacity $Q_{md'}$ as follows:

$$\mathbf{A_c = 3,469 \times {Q_{md'}}/{(C \times 0,9 \times K_d)} \times \sqrt{\frac{v_o}{p_o}}} \quad [mm^2]$$

INSTALLATION OF A SAFETY VALVE (REF. EN 13136:2013+A1)

As far as the installation of safety valves is concerned, remember these basic points:

– Safety valves must be installed near an area of the system where vapours or gases are present and where there is no fluid turbulence. They must be placed in as close to an upright position as possible, with the inlet connector turned downwards.

– Vessels joined by piping, of a diameter deemed by the manufacturer and the user to be adequate, without any stop valves between them, may be considered as a single vessel for the installation of a safety valve.

– The fitting between the valve and the equipment to be protected must be as short as possible. Furthermore, the cross-section of the piping must not be smaller than the valve inlet. In any case, EN 13136:2013+A1 states that the pressure drop between the protected vessel and the safety valve, at discharge capacity, shall not exceed 3% of the setting value, po, including any accessory on the line.

– The location selected for installation of the safety valve must consider that valve operation involves the discharge of the refrigerant fluid under pressure, sometimes at high temperature. Where there is the risk of causing injuries to people nearby, exhaust piping must be provided, sized so as to not compromise valve operation. EN 13136:2013+A1 states that this piping must not generate, at discharge capacity, a back-pressure exceeding 10% of pressure po , for unbalanced, conventional valves. **NB: If exhaust piping is indispensable, minimize both the length and the number of elbows; the discharge of carbon dioxide at temperatures below the triple point may result in the formation of solid carbon dioxide (carbonic snow) that could block exhaust pipes that are too long or too curvy.** In the event of multiple valves installed in parallel, it is highly recommended that each valve be fit with a dedicated exhaust line rather than a single manifold for all of the valves. The risk of the latter solution is to create an overpressure in the manifold determined when a valve discharges. This overpressure can modify the operating characteristics of all the other valves installed in parallel.

Pressure losses in the upstream line

To calculate the pressure losses in the upstream line (between vessel and safety valve) refer to Section 7.4 of EN 13136:2013+A1. The upstream pressure loss is given by:

$$\mathbf{\Delta p_{in} = 0,032 \times \left[\frac{A_c}{A_{in}} \times C \times K_{dr}\right]^2 \times \zeta \times p_0} \quad \text{[bar]}$$

where:
– A_c = calculated flow area from the minimum required discharge capacity $Q_{md'}$ [mm^2]
– A_{in} = cross-section area of inlet tube to valve [mm^2]
– K_{dr} = K_d x 0.9 , reduced discharge coefficient
– C = expansion rate as a function of the k coefficient in the isentropic equation for the refrigerant fluid
– ξ = sum of the of pressure loss coefficients ξ_n of the individual components and piping
The coefficients ξ_n refer to:
– pipe element losses, such as fittings and elbows
– valve losses
– losses along the piping
and are listed in standard EN 13136:2013+A1, Table A.4.

To ensure correct operation of safety valve

$$\Delta p_{in} \leq 0{,}03 \times p_0 \quad \text{[bar]}$$

Pressure losses in the downstream line

To calculate the pressure losses in the downstream line (between safety valve and atmosphere) refer to Section 7.4 of EN 13136:2013+A1.
The downstream pressure loss is given by:

$$\Delta p_{out} = p_1 - p_0 \quad \text{[bar]}$$

$$p_1 = \sqrt{0,064 \times \zeta \times \left(\frac{A_c}{A_{out}} \times C \times K_{dr} \times p_o\right)^2 + p_2^2}$$

[bar abs]

where:
- P_1 = inlet pressure to discharge line [bar abs]
- P_2 = outlet pressure to discharge line, equal to atmospheric pressure [bar abs]
- A_c = calculated flow area from the minimum required discharge capacity $Q_{md'}$ [mm^2]
- A_{out} = cross-section area of valve outlet pipe [mm^2]
- $K_{dr} = K_d$ x 0.9 , reduced discharge coefficient
- C = expansion rate as a function of the k coefficient in the isentropic equation for the refrigerant fluid
- p_o = actual pressure downstream of the safety valve during discharge of the entire flow [bar abs].
- ξ = sum of the of pressure loss coefficients ξ_n of the piping

The coefficients ξ_n refer to:
- pipe element losses, bends
- losses along the piping

and are listed in standard EN 13136:2013+A1, Table A.4..

To ensure correct operation of safety valve

$$\Delta p_{out} \leq 0{,}10 \times p_0 \quad \text{[bar]}$$

EXAMPLE: Calculation of the flow rate ($Q_{md'}$) and selection of the safety valve (Increased pressure caused by a positive displacement compressor)

Compressor data

- Refrigerant fluid	R744
- Discharge pressure	98,6 bar
- Discharge temperature	89,1 °C
- Number of compressors	5
- Required discharge capacity	2713 kg/h

The safety valve is installed on the discharge manifold of the compressors.
The PS of this manifold is 120 bar; then the set pressure of the safety valve must be: p_{set} = 120 bar

$$p_0 = p_{set} \times \left(1 + \frac{10}{100}\right) + 1 = 133 \quad \text{[bar abs]}$$

Choosing a safety valve in series 3030E/46 its mass flow rate is:

$$Q_m = 0,2883 \times C \times A \times 0,9 \times K_d \times \sqrt{\frac{p_o}{v_o}} =$$

$$0,2883 \times 2,63 \times 38,5 \times 0,9 \times 0,97 \times \sqrt{\frac{133}{0,00323}} =$$

$$= 5171 \quad \text{[kg/h]}$$

where:
- K_d = 0,97 , certified discharge ratio of safety valve 3030E/46
- A = 38,5 [mm^2] , flow area of the safety valve 3030E/46
- v_o = 0,00323 [m^3/kg] , specific volume of the superheated vapour upstream of the safety valve during operation. This value refers to the following operating conditions upstream of the valve:
  - Pressure, p_o = 133 [bar abs]
  - Temperature, T_o = 89,1 [°C]

The adjusted discharge capacity of the safety valve, used for pressure drop calculation is:

$$Q_m > 1,25 \times Q_{md} = 5171 > 1,25 \times 2713 \rightarrow$$

$$\rightarrow Q_{md'} = {}^{5171}/_{1,25} = 4137 \quad \text{[kg/h]}$$

The flow area A_c calculated with the adjusted discharge capacity $Q_{md'}$ is:

$$A_c = 3,469 \times \frac{Q_{md'}}{(C \times 0,9 \times K_d)} \times \sqrt{\frac{v_o}{p_o}} =$$

$$3,469 \times \frac{4137}{(2,63 \times 0,9 \times 0,97)} \times \sqrt{\frac{0,00323}{133}} =$$

$$= 30,8$$

Verification of the system upstream the safety valve

Assuming the valve installed is 3061/4C280, using a steel fitting with the following characteristics:
- d_{in} = 17 [mm] , fitting inside diameter
- A_{in} = 227 [mm^2] fitting inside cross-section area
- L = 60 [mm] , fitting length
- Manifold connection: Flush with the housing and with a sharp edge

The following data is taken from Table A.4 in standard EN 13136:2013+A1:
- $\xi_{1\ (inlet)}$ = 0,25
- $\xi_{2\ (length)} = \lambda$ x L/ d_{in} = 0,02 x 60/17 = 0,07

with λ = 0.02 for steel pipe
- $\xi_T = \xi_1 + \xi_2$ = 0,25 + 0,07 = 0,32

Between the safety valve and the steel fitting, a shut-off valve type 3064E/44 is installed.
The main characteristics of this valve are:

– d_R = 13 [mm] , inside valve diameter
– A_R = 132.7 [mm^2], inside valve cross-section area
– kv = 10 [m^3/h] , valve kv coefficient

The pressure loss coefficient ξ_R of the shut-off valve is given by:

$$\zeta_R = 2,592 \times \left[\frac{132,7}{10}\right]^2 \times 10^{-3} = 0,45$$

Total loss coefficient: $\xi_T + \xi_R = 0,77$

Recalling the previously calculated flow area Ac , the characteristics of safety valve 3030E/46 and refrigerant fluid R744:
– A_c = 30,8 [mm^2]
– K_{dr} = 0,97 x 0,9 =0,873
– C = 2,63

The pressure loss is given by:

$$\frac{\Delta p_{in}}{p_o} = 0,032 \times \left[\frac{30,8}{227} \times 2,63 \times 0,873\right]^2 \times 0,77 =$$

$$= 0,0024$$

The pressure loss value obtained is admissible because it is lower than the value of 0.03 indicated in standard EN 13136:2013+A1.

Verification of system downstream the safety valve

Suppose it is necessary to construct a discharge pipe on safety valve 3030E/46C120, using 1" gas pipe with the following characteristics:
– d_{out} = 30 [mm] , inside pipe diameter
– A_{out} = 707 [mm^2] , inside pipe cross-section area
– L = 3000 [mm] , pipe length
– 90° elbow with bending radius, R, equal to three times external diameter of pipe

The following information is taken from Table A.4 in standard EN 13136:2013+A1:
– $\xi_{1\ (elbow)}$ = 0.25
– $\xi_{2\ (length)} = \lambda$ x L/ dout = 0.02 x 3000/30 = 2 where λ = 0.02 for steel pipe
– $\xi_T = \xi_1 + \xi_2$ = 0,25 + 2 = 2,25

The pressure loss is given by:

$$p_1 = \sqrt{0,064 \times 2,25 \times \left(\left(\frac{30,8}{707}\right) \times 2,63 \times 0,873 \times 133\right)^2 + 1^2} =$$

$$= 5,14 = \frac{\Delta p_{out}}{p_o} = \frac{5,14 - 1}{133} = 0,031$$

The pressure loss value obtained is admissible because it is lower than the value of 0.10 indicated in standard EN 13136:2013+A1.

TABLE 13: MAXIMUM DISCHARGE CAPACITY OF VALVES

R744 subcritical				Safety valves								
Pset [bar]	Po [barsass]	Tosat [°C]	Vosat [mc/kg]	3030/44-66	3030/88	3060/23-33	3060/24-34	3060/45	3060/36	3060/46	3061/2-/3-/4	3065/4-/6
11,0	13,1	-32,5	0,029	1465	3563	349	383	459	1040	1052	567	1663
12,0	14,2	-30,2	0,027	1588	3863	379	415	498	1128	1140	614	1803
13,0	15,3	-27,9	0,025	1713	4165	408	447	537	1216	1229	662	1944
14,0	16,4	-25,8	0,023	1837	4468	438	480	576	1305	1319	711	2086
15,0	17,5	-23,8	0,022	1962	4773	468	513	616	1394	1409	759	2228
16,0	18,6	-21,8	0,021	2088	5079	498	545	655	1483	1499	808	2371
17,0	19,7	-20,0	0,019	2215	5387	528	578	695	1573	1590	857	2514
18,0	20,8	-18,2	0,018	2342	5697	559	612	735	1663	1681	906	2659
19,0	21,9	-16,5	0,017	2470	6008	589	645	775	1754	1773	956	2804
20,0	23,0	-14,9	0,016	2599	6322	620	679	815	1846	1866	1005	2951
21,0	24,1	-13,3	0,016	2729	6637	651	713	856	1938	1959	1056	3098
22,0	25,2	-11,7	0,015	2860	6955	682	747	897	2031	2053	1106	3246
23,0	26,3	-10,2	0,014	2991	7274	713	781	938	2124	2147	1157	3395
24,0	27,4	-8,8	0,014	3123	7596	745	816	980	2218	2242	1208	3546
25,0	28,5	-7,4	0,013	3257	7921	777	851	1022	2313	2338	1260	3697
26,0	29,6	-6,0	0,012	3391	8248	809	886	1064	2408	2434	1312	3850
27,0	30,7	-4,7	0,012	3527	8577	841	921	1106	2504	2531	1364	4004
28,0	31,8	-3,4	0,011	3663	8909	874	957	1149	2601	2630	1417	4159
29,0	32,9	-2,2	0,011	3801	9245	906	993	1192	2699	2728	1470	4315
30,0	34,0	-0,9	0,011	3940	9583	940	1029	1236	2798	2828	1524	4473
31,0	35,1	0,3	0,010	4080	9924	973	1066	1280	2898	2929	1578	4632
32,0	36,2	1,4	0,010	4222	10268	1007	1103	1324	2998	3030	1633	4793
33,0	37,3	2,6	0,009	4365	10616	1041	1140	1369	3100	3133	1688	4955
34,0	38,4	3,7	0,009	4509	10967	1075	1178	1414	3202	3237	1744	5119
35,0	39,5	4,8	0,009	4655	11322	1110	1216	1460	3306	3342	1801	5285
36,0	40,6	5,9	0,008	4803	11681	1145	1254	1506	3411	3447	1858	5452
37,0	41,7	6,9	0,008	4952	12043	1181	1293	1553	3517	3554	1916	5621
38,0	42,8	8,0	0,008	5103	12411	1217	1333	1601	3624	3663	1974	5793
39,0	43,9	9,0	0,008	5256	12782	1253	1373	1649	3732	3773	2033	5966
40,0	45,0	10,0	0,007	5411	13159	1290	1413	1697	3842	3884	2093	6142
41,0	46,1	11,0	0,007	5567	13540	1328	1454	1746	3954	3996	2154	6320
42,0	47,2	11,9	0,007	5727	13927	1365	1496	1796	4067	4110	2215	6501
43,0	48,3	12,9	0,007	5888	14320	1404	1538	1847	4181	4226	2278	6684
44,0	49,4	13,8	0,006	6052	14719	1443	1581	1898	4298	4344	2341	6870
45,0	50,5	14,7	0,006	6219	15124	1483	1624	1951	4416	4464	2405	7059
46,0	51,6	15,6	0,006	6388	15536	1523	1668	2004	4536	4585	2471	7252
47,0	52,7	16,5	0,006	6561	15956	1564	1713	2058	4659	4709	2538	7448
48,0	53,8	17,3	0,006	6737	16384	1606	1759	2113	4784	4835	2606	7647
49,0	54,9	18,2	0,006	6916	16820	1649	1806	2169	4911	4964	2675	7851
50,0	56,0	19,0	0,005	7100	17266	1693	1854	2227	5042	5096	2746	8059
51,0	57,1	19,9	0,005	7287	17723	1738	1903	2286	5175	5231	2819	8273
52,0	58,2	20,7	0,005	7480	18191	1784	1953	2346	5312	5369	2893	8491
53,0	59,3	21,5	0,005	7678	18672	1831	2005	2408	5452	5511	2970	8716
54,0	60,4	22,3	0,005	7881	19168	1879	2058	2472	5597	5657	3049	8947
55,0	61,5	23,0	0,005	8092	19679	1929	2113	2538	5746	5808	3130	9186
56,0	62,6	23,8	0,004	8310	20209	1981	2170	2606	5901	5965	3214	9433
57,0	63,7	24,6	0,004	8536	20760	2035	2229	2677	6062	6127	3302	9690
58,0	64,8	25,3	0,004	8773	21336	2092	2291	2752	6230	6297	3394	9959
59,0	65,9	26,0	0,004	9022	21942	2151	2356	2830	6407	6476	3490	10242
60,0	67,0	26,8	0,004	9286	22585	2214	2425	2913	6594	6666	3592	10542

TABLE 14: MAXIMUM DISCHARGE CAPACITY OF VALVES 3030E/36 AND 3030E/46 [KG/H]

Pset [bar]	Po [barsass]	Gas-cooler outlet temperatures							Compressor discharge temperatures												
		T= 20 °C	T= 25 °C	T= 30 °C	T= 31 °C	T= 35 °C	T= 40 °C	T= 45 °C	T= 80 °C	T= 85 °C	T= 90 °C	T= 95 °C	T= 100 °C	T= 105 °C	T= 110 °C	T= 115 °C	T= 120 °C	T= 125 °C	T= 130 °C	T= 135 °C	T= 140 °C
60,0	67,0					2935	2810	2715	2347	2313	2281	2251	2223	2197	2172	2148	2125	2104	2083	2063	2045
65,0	72,5					3382	3171	3035	2571	2530	2493	2459	2426	2396	2367	2340	2314	2290	2267	2244	2223
70,0	78,0	6461	6249	5906	5790	4097	3609	3394	2801	2753	2710	2670	2633	2598	2566	2535	2506	2478	2452	2427	2403
75,0	83,5	6722	6526	6247	6170	5635	4204	3814	3037	2982	2932	2886	2843	2804	2767	2732	2700	2669	2639	2612	2585
80,0	89,0	6975	6789	6544	6482	6150	5145	4332	3281	3217	3159	3106	3058	3013	2971	2932	2896	2861	2829	2798	2768
85,0	94,5	7219	7042	6818	6765	6502	5932	4991	3533	3459	3392	3331	3276	3226	3179	3135	3095	3056	3020	2986	2954
90,0	100,0	7457	7286	7078	7030	6803	6389	5688	3793	3707	3630	3561	3499	3442	3390	3341	3296	3254	3214	3176	3140
95,0	105,5	7688	7523	7326	7281	7078	6738	6225	4062	3961	3874	3796	3726	3662	3604	3550	3500	3453	3409	3368	3329
100,0	111,0	7914	7753	7564	7522	7335	7040	6631	4338	4223	4123	4035	3957	3886	3821	3761	3706	3654	3606	3561	3519
105,0	116,5	8134	7977	7795	7756	7580	7314	6967	4623	4492	4379	4280	4192	4112	4041	3975	3914	3858	3806	3756	3710
110,0	122,0	8349	8195	8020	7982	7815	7570	7263	4916	4766	4639	4528	4430	4343	4263	4191	4125	4063	4006	3953	3903
115,0	127,5	8561	8409	8239	8202	8043	7813	7535	5214	5046	4904	4781	4672	4576	4489	4410	4338	4271	4209	4151	4097
120,0	133,0	8767	8618	8452	8416	8263	8045	7789	5516	5330	5173	5037	4918	4812	4717	4631	4552	4480	4413	4351	4293
125,0	138,5	8970	8823	8660	8626	8478	8270	8029	5820	5617	5445	5296	5165	5050	4947	4854	4769	4691	4618	4552	4489
130,0	144,0	9170	9024	8864	8830	8687	8487	8259	6124	5905	5718	5557	5415	5290	5179	5078	4986	4903	4825	4753	4687
135,0	149,5	9366	9222	9065	9031	8891	8698	8481	6423	6192	5992	5818	5667	5532	5412	5304	5206	5116	5033	4956	4885
140,0	155,0	9558	9416	9261	9228	9092	8905	8696	6716	6476	6265	6080	5918	5775	5646	5531	5426	5330	5241	5160	5084
145,0	160,5	9748	9606	9454	9422	9288	9106	8904	7002	6755	6535	6341	6170	6017	5881	5758	5646	5544	5451	5364	5284
150,0	166,0	9934	9794	9644	9612	9480	9303	9108	7278	7027	6801	6600	6420	6259	6115	5985	5867	5759	5660	5569	5484

R744 critical point: Pc = 73,8 bara ; Tc = 31,06 °C

TABLE 15: MAXIMUM DISCHARGE CAPACITY OF VALVES 3030E/410 AND 3030E/610 [KG/H]

Pset [bar]	Po [barsass]	Gas-cooler outlet temperatures							Compressor discharge temperatures												
		T = 20 °C	T = 25 °C	T = 30 °C	T = 31 °C	T = 35 °C	T = 40 °C	T = 45 °C	T = 80 °C	T = 85 °C	T = 90 °C	T = 95 °C	T = 100 °C	T = 105 °C	T = 110 °C	T = 115 °C	T = 120 °C	T = 125 °C	T = 130 °C	T = 135 °C	T = 140 °C
60,0	67,0					6794	6504	6286	5434	5354	5281	5211	5147	5085	5028	4973	4920	4870	4823	4777	4733
65,0	72,5					7829	7342	7026	5951	5858	5771	5691	5616	5546	5480	5417	5358	5301	5247	5195	5146
70,0	78,0	14957	14466	13671	13403	9485	8354	7858	6483	6374	6274	6181	6095	6014	5939	5868	5801	5737	5676	5618	5563
75,0	83,5	15561	15107	14460	14284	13045	9733	8830	7031	6903	6787	6681	6582	6491	6405	6325	6249	6178	6110	6045	5984
80,0	89,0	16145	15717	15148	15006	14238	11910	10029	7596	7447	7313	7191	7079	6975	6879	6788	6704	6624	6548	6477	6409
85,0	94,5	16711	16302	15784	15660	15052	13731	11554	8179	8006	7852	7712	7585	7468	7359	7258	7164	7075	6992	6912	6837
90,0	100,0	17261	16867	16384	16273	15749	14789	13167	8781	8580	8403	8244	8100	7968	7847	7735	7630	7532	7439	7352	7270
95,0	105,5	17797	17415	16958	16855	16384	15598	14411	9402	9170	8968	8787	8625	8478	8342	8217	8101	7993	7892	7796	7706
100,0	111,0	18319	17947	17511	17414	16980	16296	15349	10043	9776	9545	9342	9159	8995	8845	8706	8579	8460	8348	8244	8146
105,0	116,5	18829	18465	18046	17954	17547	16930	16127	10702	10398	10136	9907	9703	9520	9354	9201	9061	8931	8809	8696	8589
110,0	122,0	19328	18971	18565	18477	18092	17524	16814	11379	11033	10738	10482	10256	10053	9870	9702	9549	9407	9274	9151	9035
115,0	127,5	19817	19466	19072	18986	18618	18086	17442	12069	11681	11352	11067	10816	10593	10391	10209	10041	9887	9743	9610	9484
120,0	133,0	20295	19950	19565	19483	19129	18624	18030	12770	12339	11974	11660	11384	11139	10919	10720	10538	10371	10216	10071	9937
125,0	138,5	20765	20425	20048	19968	19625	19143	18586	13474	13003	12604	12259	11958	11691	11452	11236	11039	10858	10691	10536	10392
130,0	144,0	21227	20890	20520	20441	20110	19647	19119	14176	13670	13237	12863	12536	12247	11988	11755	11543	11349	11170	11004	10849
135,0	149,5	21680	21347	20984	20907	20582	20136	19633	14869	14333	13871	13469	13118	12806	12528	12278	12050	11842	11651	11473	11308
140,0	155,0	22126	21797	21438	21363	21046	20613	20130	15548	14990	14502	14076	13700	13368	13070	12803	12560	12338	12133	11945	11769
145,0	160,5	22565	22238	21885	21810	21500	21079	20613	16208	15636	15128	14679	14282	13929	13613	13329	13070	12834	12618	12417	12231
150,0	166,0	22997	22672	22324	22250	21946	21535	21083	16847	16268	15745	15277	14861	14490	14156	13855	13582	13332	13103	12891	12695

R744 critical point: Pc = 73,8 bara ; Tc = 31,06 °C

TABLE 16: MAXIMUM DISCHARGE CAPACITY OF VALVES 3061E/2 , 3061E/3 AND 3061E/4 [KG/H]

Pset [bar]	Po [barsass]	Gas-cooler outlet temperatures							Compressor discharge temperatures												
		T = 20 °C	T = 25 °C	T = 30 °C	T = 31 °C	T = 35 °C	T = 40 °C	T = 45 °C	T = 80 °C	T = 85 °C	T = 90 °C	T = 95 °C	T = 100 °C	T = 105 °C	T = 110 °C	T = 115 °C	T = 120 °C	T = 125 °C	T = 130 °C	T = 135 °C	T = 140 °C
60,0	67,0					891	853	825	713	702	693	684	675	667	659	652	645	639	633	627	621
65,0	72,5					1027	963	922	781	768	757	747	737	727	719	711	703	695	688	682	675
70,0	78,0	1962	1898	1793	1758	1244	1096	1031	850	836	823	811	799	789	779	770	761	753	745	737	730
75,0	83,5	2041	1982	1897	1874	1711	1277	1158	922	906	890	876	863	851	840	830	820	810	801	793	785
80,0	89,0	2118	2062	1987	1968	1868	1562	1316	996	977	959	943	929	915	902	890	879	869	859	850	841
85,0	94,5	2192	2138	2070	2054	1974	1801	1516	1073	1050	1030	1012	995	980	965	952	940	928	917	907	897
90,0	100,0	2264	2212	2149	2135	2066	1940	1727	1152	1126	1102	1081	1063	1045	1029	1015	1001	988	976	964	954
95,0	105,5	2334	2284	2224	2211	2149	2046	1890	1233	1203	1176	1153	1131	1112	1094	1078	1063	1049	1035	1023	1011
100,0	111,0	2403	2354	2297	2284	2227	2138	2013	1317	1282	1252	1225	1201	1180	1160	1142	1125	1110	1095	1081	1068
105,0	116,5	2470	2422	2367	2355	2302	2221	2115	1404	1364	1330	1299	1273	1249	1227	1207	1189	1171	1156	1141	1127
110,0	122,0	2535	2489	2435	2424	2373	2299	2206	1493	1447	1409	1375	1345	1319	1295	1273	1253	1234	1217	1200	1185
115,0	127,5	2599	2553	2502	2490	2442	2372	2288	1583	1532	1489	1452	1419	1389	1363	1339	1317	1297	1278	1261	1244
120,0	133,0	2662	2617	2566	2556	2509	2443	2365	1675	1619	1571	1529	1493	1461	1432	1406	1382	1360	1340	1321	1303
125,0	138,5	2724	2679	2630	2619	2574	2511	2438	1767	1706	1653	1608	1569	1534	1502	1474	1448	1424	1402	1382	1363
130,0	144,0	2784	2740	2692	2681	2638	2577	2508	1859	1793	1736	1687	1644	1606	1573	1542	1514	1489	1465	1443	1423
135,0	149,5	2844	2800	2753	2742	2700	2641	2575	1950	1880	1820	1767	1721	1680	1643	1611	1581	1553	1528	1505	1483
140,0	155,0	2902	2859	2812	2802	2761	2704	2640	2039	1966	1902	1846	1797	1753	1714	1679	1647	1618	1592	1567	1544
145,0	160,5	2960	2917	2871	2861	2820	2765	2704	2126	2051	1984	1926	1873	1827	1786	1748	1714	1684	1655	1629	1604
150,0	166,0	3017	2974	2928	2919	2879	2825	2766	2210	2134	2065	2004	1949	1901	1857	1817	1782	1749	1719	1691	1665

R744 critical point: Pc = 73,8 bara ; Tc = 31,06 °C

SAFETY DEVICES

4.8 – BURSTING DISC DEVICES

GENERAL DESCRIPTION

Bursting disc in series 3070 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. This device is a pressure relief device that cannot be closed again, in which a bursting disc is sensitive to a positive differential pressure between the upstream and downstream sections. It is designed to burst at a specified pressure.
Bursting discs in series 3070 are identified by means of:
- a model number formed of an alphanumerical code that includes:
- the family identity (for ex. 3070/44C)
- the type of connection (C = NPT)
- the burst pressure, expressed in bar, multiplied by 10 (for ex. 140)
- a serial number for the lot production.

CONSTRUCTION

Bursting disc holder: this is the body of the device; it is manufactured in two halves, screwed together, that hold the burst disc in position. The two body halves are obtained through bar machining. The lower half of the body houses the inlet connection, while the upper half houses the outlet connection and two 1/8" NPT female service ports for installing a gauge or a pressure transducer. If you don't use these ports pay attention to close them with two NPT plugs code 7520/1.
Material used: EN 12164-CW614N brass
Bursting discs: the discs are designed and tested, according to the requirements of EN ISO 4126-2:2003, to burst at a pre-defined pressure. This pressure is called specified burst pressure, and is related to an associated temperature and a burst tolerance. The disc is manufactured from a calibrated gauge of nickel sheet, contained by a copper ring case.

SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:
- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.
(reference standard: EN 378-2:2016)
Fluids: bursting disc in series 3070 can be used with refrigerant fluid R744 in vapour or gaseous state, belonging to Group 2 with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU, the following information is reported on the bursting disc holder:
- Manufacturer's mark
- CE marking
- Identification number of the notified body involved in the production control phase
- device model
- Flow section
- Indication of flow direction
- Bursting pressure
- Performance tolerances
- Temperature associated with bursting pressure
- Production date
- Lot number

DOCUMENTATION

The bursting disc devices in series 3070 are supplied with the following documents, provided in the packaging:
- operating instructions for the user, containing all information useful for safety in terms of assembly, commissioning, use, and maintenance.
- Declaration of Conformity for the equipment according to Directive 2014/68/EU, required in Article 17 and issued in compliance with Annex IV of the same directive.

BURSTING DISC DEVICES SELECTION

Directive 2014/68/EU requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as bursting disc devices. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.
The bursting disc safety device 3070 may be used either as sole pressure relief device or in conjunction with a Castel safety valve. The disc and valve combination prevent refrigerant leakage through the safety valve and the total loss of refrigerant after bursting. The disc and valve combination can be also equipped with a suitable


3270/4C280
Pb=28.0 bar
t=22°C

pressure switch to detect if the valve has discharged.
The bursting pressure of a bursting disc is affected by the operating temperature of fluid contained in the equipment to be protected. The specified bursting pressure (Pb), stamped on the body of the bursting disc, is the nominal bursting pressure at the associated temperature of 22 °C. At higher operating temperatures, the nominal bursting pressure is reduced while at lower operating temperatures, the nominal bursting pressure is increased. Refer to table 6 for temperature adjustment factors for Pb.
As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

- Standard EN ISO 4126-2: 2003: "Safety devices for protection against excessive pressure – Part 2: Bursting disc safety devices" specifies the design, manufacturing, inspection, testing, certification, marking and packaging requirements for bursting disc safety devices.

- EN ISO 4126-3:2006 Safety devices for protection against excessive pressure – Part 3: Safety valves and bursting disc safety devices in combination" specifies the general requirements for design, application and marking for a product assembled from the in-series combination of a safety valve and bursting disc safety device.

- EN ISO 4126-6: 2003: "Safety devices for protection against excessive pressure – Part 6: Application, selection and installation of bursting disc safety devices" gives guidance on the application, selection and installation of bursting disc safety devices used to protect against overpressure.

- EN 378-2:2016: "Refrigerating systems and heat pumps – safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation" provides a general outline of the protection devices to be used in refrigerating systems and their characteristics (Para. 6.2.5) and the criteria for the selection of the device suitable for the type and size of the system component to be protected (Para. 6.2.6).

- EN 13136:2013+A1: "Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation" highlights the possible causes of overpressure in a system and provides users with the tools for sizing pressure relief devices, among which safety valves.

SIZING OF BURSTING DISC DEVICES DESIGNED TO DISCHARGE GAS OR VAPOUR AT CRITICAL FLOW (Ref. EN ISO 4126-6:2003)

A bursting disc safety device which discharges to atmosphere works at critical flow. For the definition of critical flow, please see Chapter 4.3.
To calculate the discharge capacity of a bursting disc designed to discharge gas or vapour at critical flow, under specific operating conditions, use the following formulas, provided in Para. 7.2.5.2 of EN 13136:2013+A1.

$$\mathbf{Q_m = 0,2883 \times C \times A \times K_{dr} \times \sqrt{\frac{p_o}{v_o}}}$$

where:
- A = calculated flow area of the bursting disc [mm^2]
- K_{dr} = bursting disc de-rated coefficient of discharge.

The following values shall be the maximum used depending on how the pipe between the vessel and the bursting disc is mounted on the vessel (see tab A.4 of EN 13136:2013+A1):
- Flush or flare connection: $K_{dr} = 0.70$
- Inserted connection: $K_{dr} = 0.55$

The evaluation of the minimum required discharge capacity of the bursting disc device is closely linked to the type of system where the equipment it protects is installed, with the causes that may cause it to burst, i.e.:
- external heat sources
- internal heat sources
- increased pressure caused by a positive displacement compressor

For the calculation of minimum required discharge capacity in these three cases see Chapter 4.7 "Selection Criteria for Safety Valves" in this technical handbook.

SIZING OF COMBINED SAFETY DEVICES DESIGNED TO DISCHARGE GAS OR VAPOUR AT CRITICAL FLOW (Ref. EN ISO 4126-3:2006)

A **combination** is an installation which includes a bursting disc safety device installed at most five pipe diameters before the inlet of a safety valve. The combination of a specific safety valve with a bursting disc device is characterized by a combination discharge capacity coefficient "Fd". According to EN ISO 4126-3: 2006, this coefficient is the ratio of the average of the discharge coefficients ("Kd") of the combination, measured in test bench flow rate tests, to the certified discharge coefficient ("Kd)" of the safety valve alone. The same standard also permits, as an alternative to the tests to determine "Kd" of the group, the use of a predefined discharge coefficient ("Fd"), equal to 0.9, a slightly lower value than that which could be obtained from testing. Therefore, to size the combination of a safety valve with a bursting disc safety device (3070), please follow the procedure provided in Chapter 4.3, but multiply the certified coefficient of discharge ("Kd") by 0.9.

INSTALLATION OF BURSTING DISC DEVICES AND COMBINATIONS

Bursting disc safety device 3070 must never be subjected to a negative pressure differential upstream and downstream of the disc (for example: discharge to the atmosphere and pressure inside the equipment to be protected lower than that

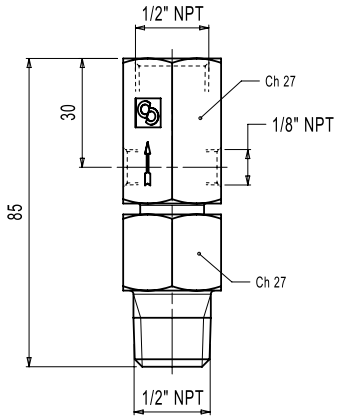
of the atmospheric pressure) to avoid damaging or breaking the disk. For this reason, safety device 3070 must always be used along with a cut-off device (such as valve 3064N/44) which can exclude device 3070 any time there is a vacuum in the equipment to be protected.

When the bursting disc discharges it is necessary to replace the entire unit, as safety devices 3070 are sealed components and the bursting disc cannot be replaced.
The maximum operating pressure of the equipment to be protected must not be greater than 75 % of the burst pressure of device 3070 to avoid damages to the disc or leakage. If the operating pressure exceeds 85 % of the burst pressure, safety device 3070 must be replaced immediately.

As far as the installation of bursting disc safety devices and combined devices is concerned, remember these basic points:
- Safety devices must be installed in an area of the system where vapours or gases are present and there is no fluid turbulence.
- Vessels joined by piping, of a diameter deemed by the manufacturer and the user to be adequate, without any stop valves between them, may be considered as a single vessel for the installation of a safety device.
- The fitting between the combined device and the equipment to be protected must be as short as possible. Furthermore, the cross-section of the piping must not be smaller than the valve inlet. In any case, EN 13136:2013+A1 states that the pressure drop between the protected vessel and the combined device, at discharge capacity, shall not exceed 3% of the pressure setting value, including any accessories in the line.
- The location selected for installation of the safety device must consider that its operation involves the discharge of the refrigerant fluid under pressure, sometimes at high temperature. Where there is the risk of causing injuries to people nearby, exhaust piping must be provided, sized so as to not compromise the operation of the device. When installing combined devices, EN 13136:2013+A1 requires that this piping must not generate, at discharge capacity, a back-pressure exceeding 10% of the valve setting pressure. In the event of multiple valves installed in parallel, it is highly recommended that each valve be fit with a dedicated exhaust line rather than a single manifold for all of the valves. The risk of the latter solution is to create an overpressure in the manifold determined when a valve discharges. This overpressure can modify the operating characteristics of all the other valves installed in parallel.

To calculate the pressure loss in either the upstream line (between vessel and safety device) or the downstream line (between safety device and atmosphere) refer to Chapter 4.7 “Selection Criteria for Safety Valves” in this technical handbook.

3070/44C



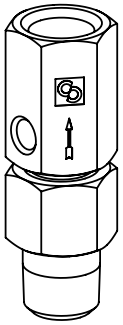


TABLE 17: GENERAL CHARACTERISTICS OF RUPTURE DISCS 3070

Catalogue Number		3070/44	
Connections	Inlet male	1/2" NPT	
	Outlet female	1/2" NPT	
	Service	2 x 1/8" NPT	
Inlet connection wrench torque (min/max) [Nm]		21/30	
Flow Diameter [mm]		12	
Flow Section [mm2]		113	
TS [°C]		- 50 / + 150	
Bursting Pressure Pb [bar]		14,0	
		15,0	
		16,0	
		19,0	
		21,0	
		23,0	
		24,0	
		24,8	
		25,0	
		27,0	
		27,5	
		28,0	
		37,0	
		44,0	
		47,0	
		52,0	
Pb tolerance	from 14 up to 19 bar	+/- 15 %	
	from 21 up to 44 bar	+/- 10%	
Coincident temperature Ta [°C]		22	
Correction factor of Pb for Ta ≠ 22 °C		-50 °C	1,13
		-35 °C	1,12
		-25 °C	1,10
		-10 °C	1,03
		-0 °C	1,03
		22°C	1,00
		40°C	0,99
		60 °C	0,97
		80 °C	0,95
		100 °C	0,94
		150 °C	0,93
Max operating pressure		75 % Pb	
Risk Category according to PED Recast		IV	

SAFETY DEVICES

4.9 – CHANGEOVER VALVES

APPLICATIONS

Changeover valves in series 3032E perform the role of a service valve for a pair of safety valves, allowing the use of one and the exclusion of the other. This device allows the user to work on the isolated valve, for periodic inspection or replacement, while the line is completely operative and the system safety is integral.
N.B.: each safety valve located on the changeover valve must have sufficient capacity to protect the vessel alone.
These valves are considered "Pressure Accessories" according to the definition provided in Article 2, Point 5 of said Directive and are subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

Valves models 3032E/33 are supplied with:
- Two female 3/8" NPT threaded connections with swivel nut, Castel code 3039/3
- Two O-Rings for these connections

These components ensure perfect alignment of a pair of safety valves.

Valves models 3032E/44 are supplied with:
- Two female 1/2" NPT threaded connections with swivel nut, Castel code 3039/4
- Two O-Rings for these connections

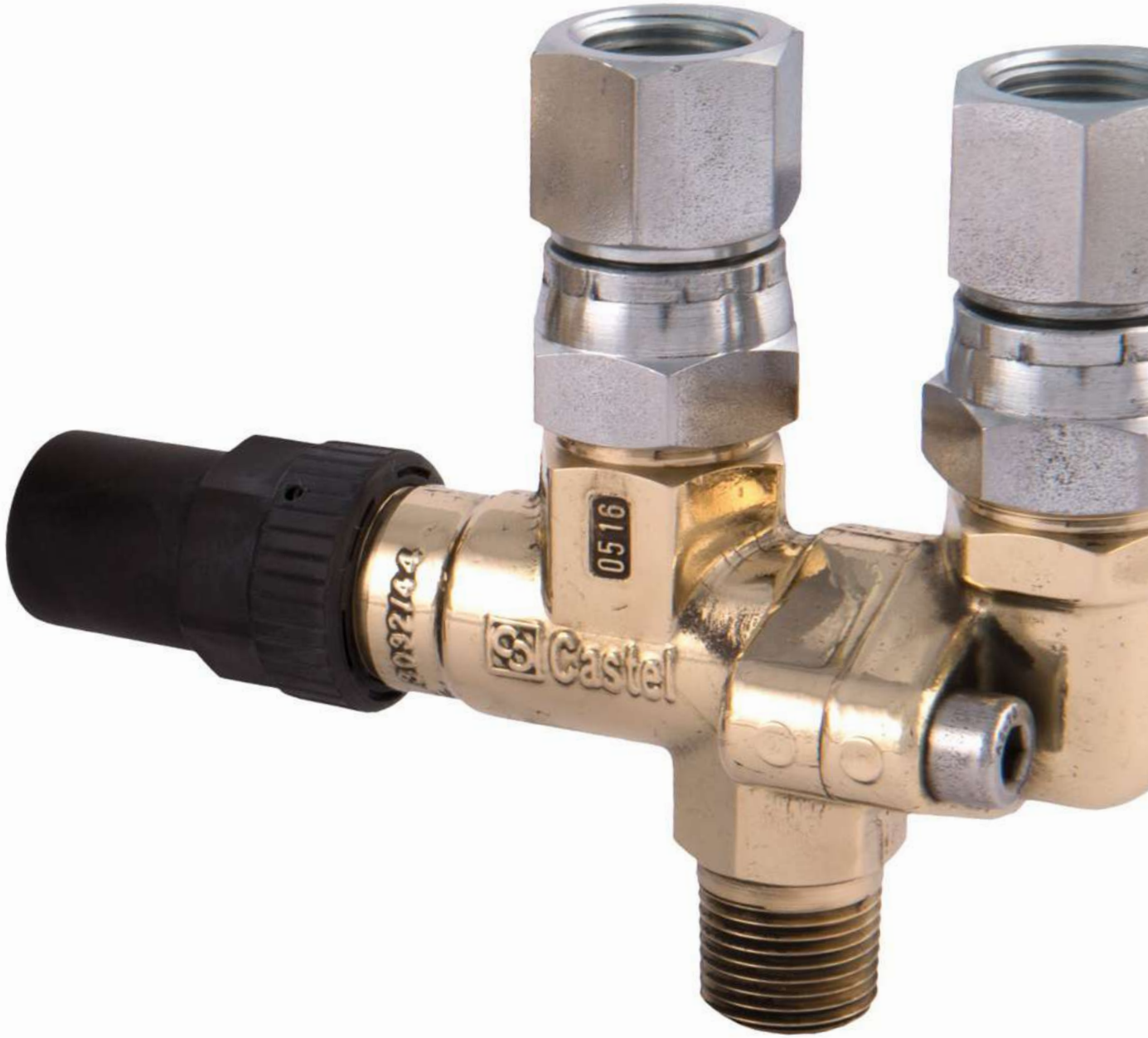
These components ensure perfect alignment of a pair of safety valves.

Valves models: 3032E/64, 3032E/64L, 3032E/66, 3032E/66L, 3032E/88, 3032E/108 have not threaded connections with swivel nuts on the outlet connection. Therefore, safety valves are screwed directly onto the changeover valve.
NB: the safety valves 3030E/410C must be mounted on the changeover valve 3032/64L and the safety valves 3030E/610C must be mounted on the changeover valve 3032/66L.

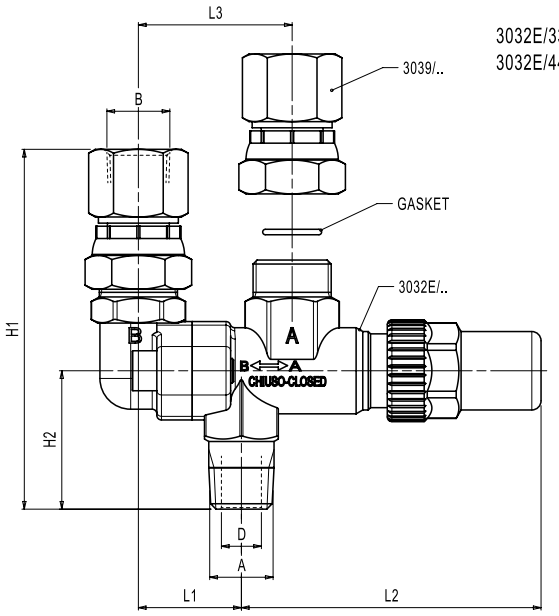
The valves in series 3032E can be used only with refrigerant fluid R744.

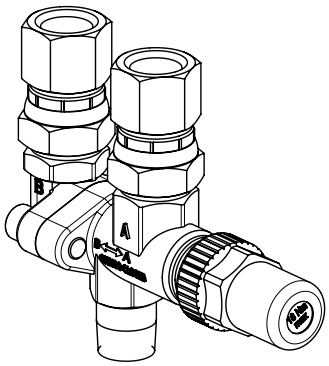
CONSTRUCTION

Valves in series 3032E are designed so that it is never possible to exclude both safety valves simultaneously. Under working conditions, the shutter must be clamped against one of the two seats of the valve, front port or back port, in order to ensure always full discharge to the corresponding safety valve. Intermediate shutter positions must be avoided in order not to affect the operation of both safety valves. The valve ensures a pressure drop perfectly compatible with the safety valve operation under saturated vapour and superheated vapour discharge conditions.
The main parts of the valves in series 3032E are made from the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Steel, with proper surface protection, for the spindle.
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- Glass reinforced PBT for the protective cap that covers the spindle.
- Hot forged steel EN 12420 – CW 617N for the protective cap of the spindle for models from 1" to 1-1/4" NPT.

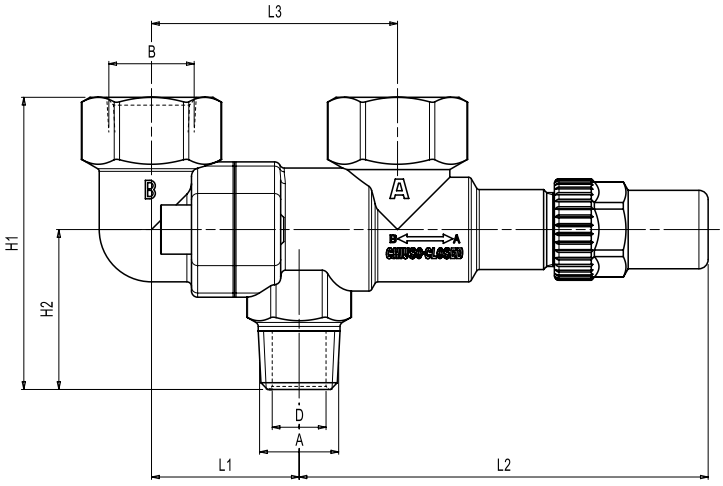

0516
Castel

3032E/33
3032E/44





3032E/64
3032E/66
3032E/88
3032E/108



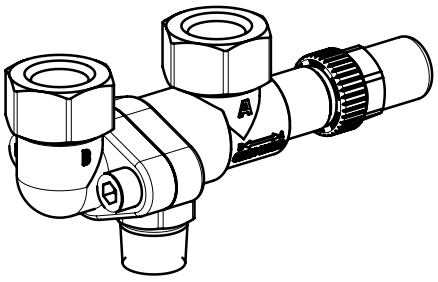


TABLE 18: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF VALVES 3032E

Catalogue Number	Kv Factor [m3/h]	PS [bar]	TS [°C]		Dimensions [mm]								Inlet connection wrench torque (min/max) [Nm]	Weight [g]	Risk Category according to PED Recast
			min	max	D	A	B	H1	H2	L1	L2	L3			
3032E/33	2,5	150	-40	150	13	3/8" NPT	3/8" NPT	114	42	33	91	50	17/22	775	Art. 4.3
3032E/44	3,3				13	1/2" NPT	1/2" NPT	114	42	33	91	50	25/35	775	
3032E/64	9,0				17,5	3/4" NPT	1/2" NPT	95	52	48	133	80	32/45	1750	
3032E/64L					17,5	3/4" NPT	1/2" NPT	95	52	78	133	110	32/45	1770	
3032E/66	9,0				17,5	3/4" NPT	3/4" NPT	95	52	48	133	80	32/45	1730	
3032E/66L					17,5	3/4" NPT	3/4" NPT	95	52	78	133	110	32/45	1750	
3032E/88	14,5	120			22,0	1" NPT	1" NPT	120	71	66	185	110	50/65	3200	
3032E/108	20,0				31,0	1.1/4" NPT	1" NPT	123	74	66	185	110	60/80	3200	

SAFETY DEVICES

4.10 – SHUT-OFF VALVES

APPLICATIONS

Please remember that the operation of pressure equipment and pressure assemblies is not covered by Directive 2014/68/EU ; rather, it is regulated by the national legislation of the Member States of the European Union. Therefore, the various Member States have issued laws that call for periodic inspection of pressure equipment and pressure assemblies. Italy issued Ministerial Decree 329 dated 01/12/2004 regarding the provisions for the installation and use of pressure equipment and pressure assemblies that comply with Directive 97/23/EC. Any intervention for periodic inspection or replacement of an installed safety device becomes very difficult if the protected vessel is not equipped with a shut-off valve.

Shut-off valves in series 3064E installed between the protected vessel and the safety valve, allow the device to be disassembled for inspection or replacement without blowing off all the refrigerant fluid from an entire section of the system.

These valves are considered “Pressure Accessories” according to the definition provided in Article 2, Point 5 of said Directive and are subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

The valves in series 3032E can be used only with refrigerant fluid R744.

CONSTRUCTION

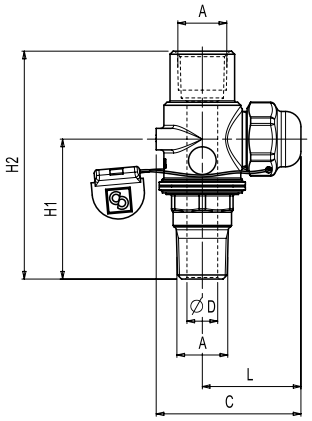
Valves in series 3064E are supplied by Castel in the open position and the spindle cap protection is sealed with a Castel lead seal. Any operation to close the valve requires causes the tampering with the seal and must be performed exclusively by:

- staff authorized to work on the system
- an operator of a competent inspection body

These persons will be responsible for the subsequent re-opening of the valve and the application of a new cap seal with their own lead seal.

The main parts of the valves in series 3064E are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball
- Steel, with proper surface protection, for the spindle.
- P.T.F.E. for the ball seat gaskets
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- Hot forged brass EN 12420 – CW 617N for the protective cap of the spindle



3064E

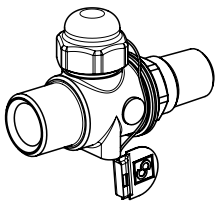


TABLE 19: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF VALVES SERIES 3064E

Catalogue Number	Kv Factor [m3/h]	PS [bar]	TS [°C]		Dimensions [mm]							Inlet connection wrench torque (min/max) [Nm]	Weight [g]	Risk Category according to PED Recast
			min	max	Ø D	A	C	L	H1	H2	H3			
3064E/22	2,5	150	-40	+150	7	1/4" NPT	47	32	45	74	147	15/20	216	Art. 4.3
3064E/33	5				10	3/8" NPT	47	32	45	74	147	17/22	208	
3064E/44	10				13	1/2" NPT	54	35	51	86	165	25/35	334	
3064E/88	20	80			20	1" NPT	78	52	70	119	323	50/65	871	


Castel

SAFETY DEVICES

4.11 – FITTING

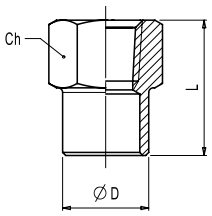
The fittings in series 3035 allow for the installation of:
- safety valves in series 3030, 3060, 3061, 3065, 3030E and 3061E
- bursting disc devices in series 3070
- shut-off valves in series 3064E
- changeover valves in series 3032E

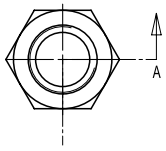
near pressure equipment to be protected in the system.
These fittings are designed to be installed in two ways:
- Construct a copper pipe by-pass that connects the pressure equipment to the fitting. Insert the end of the by-pass in the solder connection of the fitting and then perform capillary brazing.
- Drill the inner/outer pipe near the pressure equipment (if possible, it is best to build a collar on the pipe). Put the end of the fitting into this hole and proceed to braze weld.

The fittings in series 3035 are produced by machining brass bars EN 12164-CW614N.

Note: The fitting in series 3035 are excluded from the scope of application of Directive 2014/68/EU as they are piping components.

3035/2
3035/3
3035/4
3035/6
3035/8
3035/10





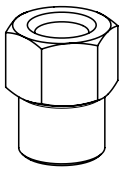
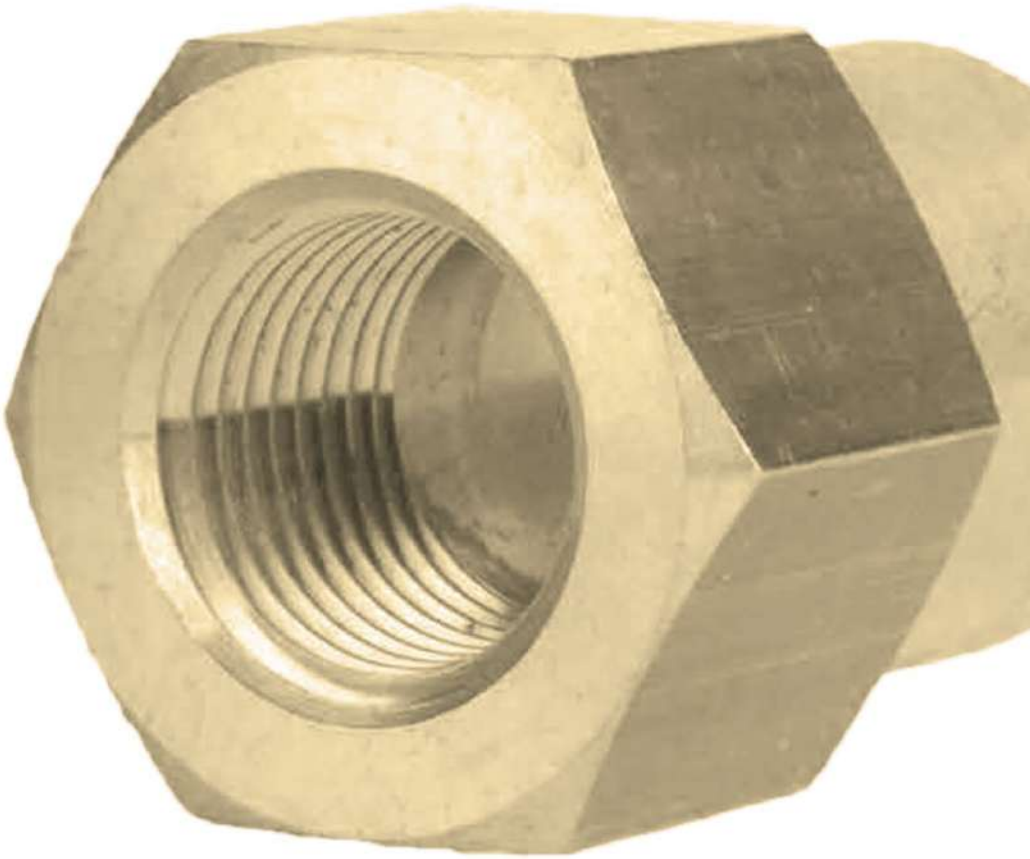


TABLE 20: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF UNIONS 3035

Catalogue Number	Connections		PS [bar]	Dimensions			Weight [g]
	NPT	ODS Ø [mm]		D	L	Ch	
3035/2	1/4"	12	150	18	33	21	58
3035/3	3/8"	18		22	36,5	26	90,5
3035/4	1/2"	22		28	44	32	165
3035/6	3/4"	28		35	51	40	255
3035/8	1"	35	120	42	72	45	364
3035/10	1.1/4"	42		54	67	55	613



CHECK VALVES

GOGREEN

R744 • NATURAL REFRIGERANT

CHECK VALVES

5.1 – HERMETIC CHECK VALVES

APPLICATIONS

The hermetic check 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 have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The check valves for plants that operate using refrigerant fluid R744 are the following:
- Valves in series 3132EW, 3133EW, 3145EW and 3185EW, PS = 80 bar for trans-critical plants low and medium pressure sides.
- Valves in series 3137EW, 3147EW and 3187EW, PS = 130 bar for trans-critical plants high-pressure side.
- Valves in series 3138EW, 3148EW and 3188EW, PS = 140 bar for trans-critical plants high-pressure side.

CAUTION! The check valves in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

Only straight check valves in series 3132EW (standard spring) ensure a low opening differential; $\Delta p = 0.04$ bar. All the other check valves for R744 (reinforced spring) ensure a high opening differential; $\Delta p = 0.3$ bar.
To guarantee tightness between body the cover, the valves in series 3132EW, 3133EW, 3137EW, 3138EW, are equipped with laser welds. To guarantee tightness between body the cover, the valves in series 3145EW, 3147EW, 3148EW, 3185EW, 3187EW, 3188EW are equipped with TIG welds.
The main parts of the check valves are made with the following materials:
- Brass bar EN 12164 - CW 614N for body and cover of the valves in series 3132EW, 3133EW, 3137EW, 3138EW.
- Hot forged brass EN 12420 - CW 617N for body and cover of the valves in series: 3145EW, 3147EW, 3148EW, 3185EW, 3187EW, 3188EW.
- Austenitic stainless steel AISI 302 for the spring
- Laminated glass fibre fabric and PTFE for seat gaskets of valves in series 3132EW, 3133EW, 3137EW, 3138EW.
- PTFE for seat gaskets of valves in series 3145EW, 3147EW, 3148EW, 3185EW, 3187EW, 3188EW.
- Copper pipe EN 12735-1 – Cu-DHP for welded connections in series 3132EW, 3133EW, 3145EW, 3185EW.
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 3137EW, 3147EW, 3187EW
- Stainless steel pipe AISI 304 for welded connections in series 3138EW, 3148EW 3188EW.

INSTALLATION

The valves can be installed in any section of a refrigeration system where it is necessary to avoid the consequences from undesirable flow inversion, with respect for the operating limits and the capacities indicated in Table 1. Table 1 shows the following functional characteristics of a check valve:
- PS and TS
- Kv factor
- Minimum opening differential pressure at which the valve can open and remain opened.

Before connecting the valve to the pipe, it is advisable to make sure that the refrigerating system is clean. Valves with laminated fibreglass and PTFE gaskets are particularly sensitive to dirt and debris. Furthermore, check that the flow direction in the pipe corresponds to the arrow stamped on the valve body.

Copper connections: The brazing of valves with copper connections should be carried out with care, using a low melting point filler material (min. 5% Ag). It is not necessary to disassemble the valves, but it is 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.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.
The allowed operating positions are the following:

- 3145EW, 3147EW, 3148EW:
- with the piping axis horizontal and valve cover facing upward or to the side, horizontal.
- with the piping axis vertical and arrow facing either upward or downward.

Note: valves 3145EW, 3147EW, 3148EW cannot be installed with the valve cover facing downward.

- 3185EW, 3187EW, 3188EW:
- with inlet pipe facing downward and valve cover facing upward.
- with inlet pipe horizontal and outlet pipe vertical or horizontal.

Note: valves 3185EW, 3187EW, 3188EW cannot be installed with the valve input facing upward and the valve cover facing downward.

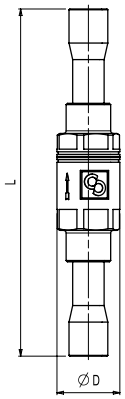

3138EW/M16
19016687
TS=-40+150 °C
PS=140bar

- Valves 3132EW, 3133EW, 3137EW, 3138EW can be installed in any working position.

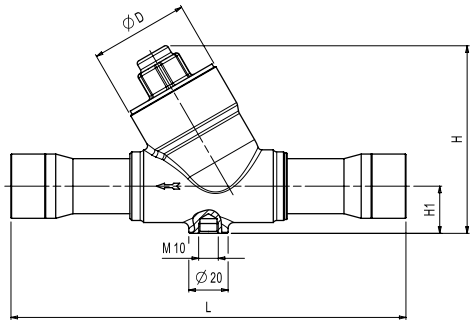
CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved Castel check valves with file SA33319. These valves are certified **UL Listed** for the USA, in compliance with American standard UL 207 with a Design Pressure of:

- 1160 PSI for valves in series 3132EW, 3133EW, 3145EW and 3185EW
- 1740 PSI for valves in series 3137EW, 3147EW and 3187EW
- 2030 PSI for valves in series 3138EW, 3148EW and 3188EW



3132EW/2 3133EW/2
3132EW/3 3133EW/3
3132EW/M10 3133EW/M10
3132EW/M12 3133EW/M12
3132EW/4 3133EW/4
3132EW/5 3133EW/5
3132EW/M18 3133EW/M18
3132EW/6 3133EW/6
3132EW/7 3133EW/7



3145EW/7
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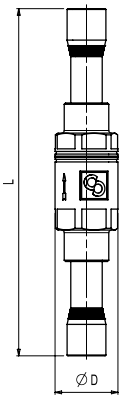
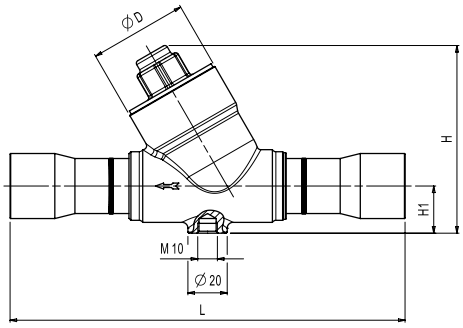
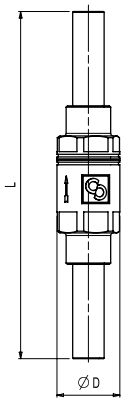
3145EW/9
3145EW/11
3145EW/13
3145EW/M42
3145EW/17



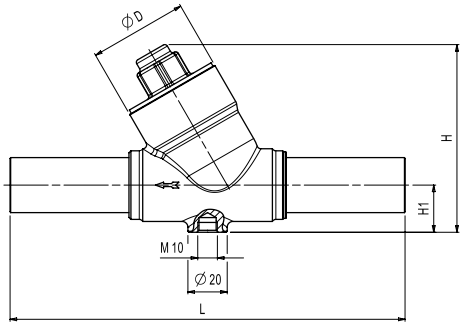
3137EW/2
3137EW/3
3137EW/4
3137EW/5
3137EW/6



3147EW/7
3147EW/9
3147EW/11
3147EW/13
3147EW/17



3138EW/M10
3138EW/M12
3138EW/M16



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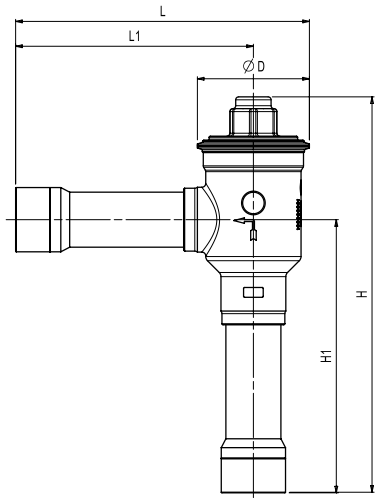
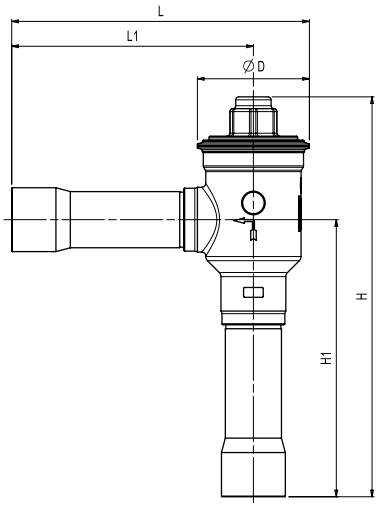
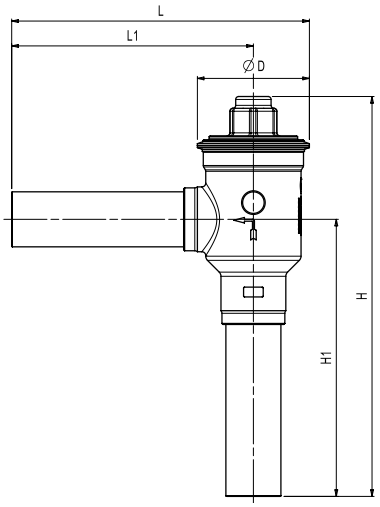
3148EW/M28
3148EW/M35
3148EW/M42



3185EW/7
3185EW/M28
3185EW/9
3185EW/11



3187EW/7
3187EW/9
3187EW/11



3188EW/M22
3188EW/M28
3188EW/M35

TABLE 1: GENERAL CHARACTERISTICS OF HERMETIC CHECK VALVES

Catalogue Number	Connections		Kv Factor [m3/h]	Minimum Opening Pressure Differential [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS							
	Ø [in.]	Ø [mm]				min.	max.	
with reinforced copper connections								
3132EW/2	1/4”	–	0,5	0,04	80	– 40	+150	Art. 4.3
3132EW/3	3/8”	–	1,5					
3132EW/M10	–	10						
3132EW/M12	–	12	1,8					
3132EW/4	1/2”	–						
3132EW/5	5/8”	16	3,3					
3132EW/M18	–	18	5,0					
3132EW/6	3/4”	–						
3132EW/7	7/8”	22						
with reinforced copper connections								
3133EW/2	1/4”	–	0,5	0,3	80	– 40	+150	Art. 4.3
3133EW/3	3/8”	–	1,5					
3133EW/M10	–	10						
3133EW/M12	–	12	1,8					
3133EW/4	1/2”	–						
3133EW/5	5/8”	16	3,3					
3133EW/M18	–	18	5,0					
3133EW/6	3/4”	–						
3133EW/7	7/8”	22						
with K65 copper alloy connections (K65)								
3137EW/2	1/4”	–	0,5	0,3	130	-40	150	Art. 4.3
3137EW/3	3/8”	–	1,5					
3137EW/4	1/2”	–						
3137EW/5	5/8”	16	3,3					
3137EW/6	3/4”	–	5,0					
with stainless steel connections								
3138EW/M10	–	10	1,5	0,3	140	-40	150	Art. 4.3
3138EW/M12	–	12						
3138EW/M16	–	16	3,3					
with reinforced copper connections								
3145EW/7	7/8”	22	8,1	0,3	80	– 40	+150	Art. 4.3
3145EW/M28	–	28	10,4					
3145EW/9	1.1/8”	–						
3145EW/11	1.3/8”	35	15,6					
3145EW/13	1.5/8”	–	27,0					I
3145EW/M42	–	42						
3145EW/17	2.1/8”	54	39,0					
with K65 copper alloy connections (K65)								
3147EW/7	7/8”	22	8,1	0,3	130	– 40	+150	Art. 4.3
3147EW/9	1.1/8”	–	10,4					
3147EW/11	1.3/8”	35	15,6					
3147EW/13	1.5/8”	–	27,0					I
3147EW/17	2.1/8”	54	39,0					
with stainless steel connections								
3148EW/M22	–	22	8,1	0,3	140	– 40	+150	Art. 4.3
3148EW/M28	–	28	10,4					
3148EW/M35	–	33,4	15,6					
3148EW/M42	–	42,2	27,0					I
with reinforced copper connections								
3185EW/7	7/8”	22	9,0	0,3	80	– 40	+150	Art. 4.3
3185EW/M28	–	28	19,0					
3185EW/9	1.1/8”	–						
3185EW/11	1.3/8”	35	29,0					
with K65 copper alloy connections (K65)								
3187EW/7	7/8”	22	9,0	0,3	130	– 40	+150	Art. 4.3
3187EW/9	1.1/8”	–	19,0					
3187EW/11	1.3/8”	35	29,0					
with stainless steel connections								
3188EW/M22	–	22	9,0	0,3	140	– 40	+150	Art. 4.3
3188EW/M28	–	28	19,0					
3188EW/M35	–	33,4	29,0					

TABLE 2: REFRIGERANT FLOW CAPACITY OF CHECK VALVES [KW]

Catalogue Number		subcritical system			transcritical system		
		Liquid line	Suction line	Hot gas line	Gas cooler line	Suction line	Hot gas line
3132EW/2	3133EW/2	13,4	2,7	10,1		2,3	
3132EW/3	3133EW/3	40,2	8,0	30,3		6,9	
3132EW/M10	3133EW/M10						
3132EW/M12	3133EW/M12	48,2	9,5	36,3		8,3	
3132EW/4	3133EW/4						
3132EW/5	3133EW/5	88	17	67		15	
3132EW/M18	3133EW/M18	134	27	101		23	
3132EW/6	3133EW/6						
3132EW/7	3133EW/7						
3137EW/2	–				13,1	2,3	9,3
3137EW/3	3138EW/M10				39,4	6,9	28,0
3137EW/4	3138EW/M12						
3137EW/5	3138EW/M16				87	15	62
3137EW/6	–				131	23	93
–	3145EW/7	217	43	163		38	
	3145EW/M28	279	55	210		48	
	3145EW/9						
	3145EW/11	418	83	315		72	
	3145EW/13	724	143	545		125	
	3145EW/M42						
	3145EW/17	1045	207	787		181	
3147EW/7	3148EW/M22				213	38	151
3147EW/9	3148EW/M28				273	48	194
3147EW/11	3148EW/M35				410	72	292
3147EW/13	–				709	125	505
–	3148EW/M42						
3147EW/17	–				1025	181	729
–	3185EW/7	241	48	182		42	
	3185EW/M28	509	101	383		88	
	3185EW/9						
	3185EW/11	777	154	585		134	
3187EW/7	3188EW/M22				236	42	168
3187EW/9	3188EW/M28				499	88	355
3187EW/11	3188EW/M35				762	134	542

Standard rating conditions according to AHRI Standard 760-2014 for subcritical system		
Condensing temperature	30 °F	(- 1,2 °C)
Liquid temperature	20 °F	(- 6,7 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	- 20 °F	(- 28,9 °C)
Evaporator outlet temperature	- 10 °F	(- 23,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	- 5 °F	(-15 °C)
Suction line superheating	15 °R	(8,4 °K)
Discharge temperature	80 °F	(26,6 °C)

Standard rating conditions according to AHRI Standard 760-2014 for transcritical system		
Gas-cooler outlet temperature	95 °F	(35 °C)
Evaporating temperature	14 °F	(- 10 °C)
Evaporator outlet temperature	23 °F	(- 5 °C)
Evaporator superheating	9 °R	(5 °K)
Suction line temperature	32 °F	(0°C)
Suction line superheating	9°R	(5 °K)
Discharge temperature	212 °F	(110 °C)

TABLE 3: DIMENSIONS AND WEIGHTS OF CHECK VALVES

Catalogue Number		Dimensions [mm]						Weight [g]
		H	H1	L	L1	Q	Ø D	
3132EW/2	3133EW/2	93					18	65
3132EW/3	3133EW/3	108					22	120
3132EW/M10	3133EW/M10							
3132EW/M12	3133EW/M12	133					24	157
3132EW/4	3133EW/4							
3132EW/5	3133EW/5	146					29	220
3132EW/M18	3133EW/M18	165					35	304
3132EW/6	3133EW/6							
3132EW/7	3133EW/7		–	–	–	–		
3137EW/2		122					22	65
3137EW/3		126					22	120
3137EW/4		132					24	157
3137EW/5		146					29	220
3137EW/6		165					35	370
3138EW/M10		126					22	130
3138EW/M12		132					24	155
3138EW/M16		146					29	242
3145EW/7		96	24	170		50		1055
3145EW/M28				201				1062
3145EW/9								
3145EW/11		115	29	232		56		1300
3145EW/13		148	36	255		67		3300
3145EW/M42								
3145EW/17		167	44	285		79		5500
3147EW/7		96	24	170		50		1055
3147EW/9				201				1062
3147EW/11	–	115	29	232	–	56	–	1300
3147EW/13		148	36	255		67		3330
3147EW/17		167	44	285		79		5830
3148EW/M22		96	24	170		50		1055
3148EW/M28				201				1085
3148EW/M35		115	29	232		56		1610
3148EW/M42		148	36	255		67		3500
3185EW/7		146	94	111	88	45		600
3185EW/M28		196	141	149	123	51		1010
3185EW/9								
3185EW/11		204		151		56		1300
3187EW/7		146	94	111	88	45		600
3187EW/9		196	141	149	123	51		1010
3187EW/11		204		151		56		1300
3188EW/M22		146	94	111	88	45		600
3188EW/M28		196	141	149	123	51		1000
3188EW/M35		204		151		56		1740

PRESSURE REGULATORS

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PRESSURE REGULATORS

6.1 – EVAPORATING PRESSURE REGULATORS

APPLICATIONS

Evaporating pressure regulators are an accessory designed to maintain a constant evaporating pressure and thereby a constant surface temperature on the evaporator under varying evaporator loads. This valve prevents too low evaporating pressure and therefore protects against freezing in water chiller or against coil icing in air evaporators. These regulators allow multiple evaporators to operate at different temperatures in a system with only one compressor.
The evaporating pressure regulators 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 have been developed by Castel for all applications that use subcritical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
CAUTION!: the evaporating pressure regulators in this chapter cannot be used with other refrigerant fluids.

OPERATION

Evaporating pressure regulators adjust the flow of hot gas according to changes of suction pressure, upstream the regulator. When the evaporating pressure is less than the regulator calibration pressure, the shutter remains closed. As the suction pressure rises above the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in evaporating pressure. As the evaporating pressure continues to rise, the shutter continues to open, until the stroke limit is reached and the regulator is open completely. When the shutter is fully open, a further increase in the valve capacity can be obtained only by increasing the load loss across the valve.
Evaporating pressure regulators only modulate based on the inlet pressure change, pressure changes on the outlet side do not affect their opening as the valve is equipped with an equalizer bellow with an area equal to that of the valve seat

The factory pressure settings for regulators in series 3335EL is 12 bar. This means that until the condensation (discharge) pressure is below 12 bar, the regulator remains closed. When it rises above 12 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2,5 bar in calibration pressure. The calibration range varies from 12 to 35 bar.

CONSTRUCTION

The main parts of the evaporating pressure regulators are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Austenitic stainless steel AISI 303 for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Ethylene propylene rubber (EPDM) for outlet seal gaskets

INSTALLATION

Evaporating pressure regulators in series 3335EL are installed in the suction line between the evaporator and the compressor.
Refrigerating system with one compressor serving two or more evaporators in parallel, where different evaporating temperature are required. In this case the evaporating pressure regulator is installed downstream the evaporator with the highest temperature. Downstream of the evaporators with lower temperatures, it is necessary to install a check valve to avoid refrigerant condensing during compressor stops.

SELECTION

To correctly select evaporating pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:
1. Type of refrigerant = R744
2. Designed evaporator capacity.
3. Designed evaporating temperature.
4. Minimum evaporating temperature. This data identifies the valve calibration pressure.
5. Allowable pressure drop across the valves at design load condition.
6. Liquid temperature
The refrigerating capacities indicated in Table 3A are based on:
• A liquid reference temperature of -6.7 °C.
• An allowable variation in evaporating pressure of 1.12 bar.
With liquid temperatures other than -6.7 °C and for variations in evaporating pressure other than 1.12 bar, the required cooling


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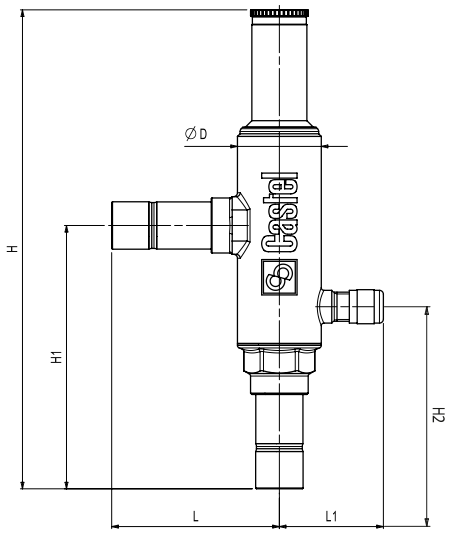
capacity of regulator is:

$$\frac{\mathbf{Q_{evap}}}{\mathbf{K_{T\ liquid}} \times \mathbf{K_{\Delta P\ evap}}} = \mathbf{Q_{Valve}}$$

where:

Q_{evap} = Evaporator capacity [kW]
$K_{T\ liquid}$ = Correction factor for $T_{liquid} \neq$ -6.7 °C. (Table 3B)
$K_{\Delta P\ evap}$ = Correction factor for $\Delta P_{valve} \neq$ 1.12 bar. (Table 3C)
Q_{valve} = Refrigerating capacity requested at regulator. [kW]



3335EL/M12S
3335EL/4S
3335EL/5S
3335EL/7S

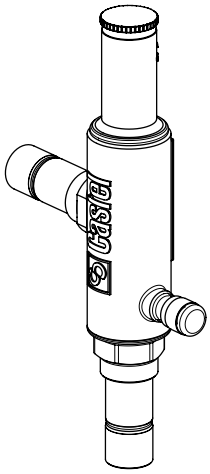


TABLE 1: GENERAL CHARACTERISTICS OF EVAPORATOR PRESSURE REGULATORS

Catalogue Number	Connections			Kv Factor [m3/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS											
		Ø [in.]	Ø [mm]		min.	max.			min.	max.	min.	max.	
3335EL/M12S	–	–	12	2,7	12	36	12	60	-40	+120	-40	+50	Art. 4.3
3335EL/4S	–	1/2"	–										
3335EL/5S	–	5/8"	16										
3335EL/7S	–	7/8"	22										

TABLE 2. DIMENSIONS AND WEIGHTS OF EVAPORATOR PRESSURE REGULATORS

Catalogue Number	Dimensions [mm]						Weight [g]
	H	H1	H2	L	L1	D	
3335EL/M12S	183	100,5	69,5	64	37	32	510
3335EL/4S	183	100,5	69,5	64			480
3335EL/5S	183	100,5	69,5	64			500
3335EL/7S	194	112	81	75,5			560

TABLE 3A : REFRIGERANT FLOW CAPACITY OF EVAPORATOR PRESSURE REGULATORS 3335EL [KW]

Catalogue Number	Pressure drop across regulator [bar]	Design evaporator temperature [°C]									
		5	0	-5	-10	-15	-20	-25	-30	-35	-40
3335EL/4S 3335EL/M12S	0,07	3,9	3,5	3,1	2,8	2,5	2,1	1,9	1,8	1,6	1,4
	0,14	7,8	7,1	6,3	5,5	4,9	4,2	3,9	3,5	3,1	2,8
	0,21	12,8	11,5	10,2	9,0	7,8	6,6	6,0	5,4	4,7	4,1
	0,35	19,4	17,4	15,4	13,5	11,6	9,8	8,8	7,7	6,7	5,7
	0,42	26,6	23,7	20,7	17,8	15,1	12,4	11,0	9,5	8,1	6,6
	0,56	40,0	35,3	30,6	25,9	21,7	17,5	15,2	13,0	10,7	8,5
	0,81	49,2	43,3	37,4	31,5	26,2	20,9	18,1	15,3	12,5	9,7
	1,12	59,5	52,3	45,0	37,8	31,3	24,8	21,4	17,9	14,5	11,1
3335EL/5S	0,07	4,8	4,4	4,0	3,5	3,1	2,6	2,5	2,3	2,1	1,9
	0,14	9,9	9,0	8,1	7,1	6,2	5,4	5,0	4,6	4,2	3,9
	0,21	14,9	13,5	12,1	10,8	9,4	8,0	7,5	6,9	6,3	5,8
	0,35	20,8	18,9	16,9	15,0	13,1	11,1	10,3	9,6	8,8	8,0
	0,42	27,6	25,0	22,4	19,8	17,2	14,6	13,6	12,5	11,4	10,3
	0,56	37,3	33,8	30,2	26,7	23,1	19,6	18,1	16,7	15,2	13,7
	0,81	43,7	39,5	35,4	31,2	27,0	22,9	21,2	19,5	17,7	16,0
	1,12	51,1	46,2	41,3	36,4	31,6	26,7	24,7	22,7	20,7	18,7
3335EL/7S	0,07	5,4	4,9	4,4	3,9	3,4	3,0	2,7	2,5	2,2	2,0
	0,14	11,1	10,0	9,0	7,9	7,0	6,0	5,5	5,0	4,5	3,9
	0,21	18,2	16,4	14,5	12,7	11,1	9,4	8,5	7,6	6,7	5,8
	0,35	27,3	24,5	21,7	18,9	16,4	13,8	12,3	10,9	9,5	8,0
	0,42	36,7	32,7	28,6	24,5	20,8	17,1	15,1	13,1	11,1	9,1
	0,56	55,1	48,7	42,2	35,8	29,9	24,1	21,0	17,9	14,8	11,7
	0,81	64,4	56,8	49,2	41,7	34,8	28,0	24,3	20,7	17,0	13,4
	1,12	76,4	67,3	58,2	49,1	40,9	32,7	28,3	24,0	19,6	15,2

Standard rating conditions according to AHRI Standard 770-2014		
Condensing temperature	30°F	-1,2°C
Liquid temperature	20°F	-6,7°C
Subcooling	10° R	5,5°K
Evaporating temperature	-20°F	-28,9°C
Suction temperature	-5°F	-15°C
Superheating	15°R	8,4°K
Discharge temperature	80°F	26,6°C

Nominal evaporator pressure change ($T_{design\ evap}$ -$T_{min\ evap}$) : 16 psi (1,12 bar)

TABLE 3B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
-25	-20	-15	-10	-5	0	5	10	15
1,21	1,15	1,1	1,04	0,98	0,92	0,86	0,8	0,73

TABLE 3C : CORRECTION FACTOR FOR EVAPORATOR PRESSURE CHANGE DIFFERENT FROM NOMINAL VALUE

Evaporator pressure change [bar]								
0,35	0,42	0,56	0,81	1,12	1,39	1,67	1,84	2,05
0,35	0,48	0,72	0,84	1	1,2	1,3	1,4	1,5

REFRIGERATING SYSTEM PROTECTORS

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REFRIGERATING SYSTEM PROTECTORS

7.1 – MOISTURE/LIQUID INDICATORS

APPLICATIONS

The moisture/liquid indicators 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 indicators have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The moisture/liquid indicators for plants that operate using refrigerant fluid R744 are the following:
- Indicators in series 3940EL, PS = 60 bar for sub-critical plants.
- Indicators in series 3740E, PS = 80 bar for trans-critical plants low and medium pressure sides.
- Indicators in series 3747E, PS = 130 bar for trans-critical plants high-pressure side.
- Indicators in series 3748E, PS = 140 bar for trans-critical plants high-pressure side.

CAUTION! The indicators in this chapter cannot be used with other refrigerant fluids.

OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.
The moisture content values that correspond to the "green" colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, "Chartreuse green", the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes "yellow", it's time to replace the filter dryer.
If the charge and operating conditions of the plant are normal, the refrigerant fluid appears perfectly liquid underneath the "lens" of the indicator. The presence of bubbles indicates that the refrigerant fluid is partially evaporating along the liquid line.

CONSTRUCTION

Liquid indicators in series 3940EL are manufactured in a total hermetic construction to avoid any possible leaks. The glass "lens", with suitable gasket, is housed inside the brass body and is fixed in its seat with an edge calking operation. The main parts of these indicators are made from the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Copper tube EN 12735-1 – Cu-DHP for solder connections
- Glass for lens
- PTFE for outlet gaskets

Indicators in series 3740E, 3747E, and 3748E are manufactured with the glass "lens" directly fused onto a steel metallic ring, with proper surface protection. This metallic ring, screwed on the indicator body, is equipped with an EPDM (ethylene-propylene) gasket. The main parts of these three series of indicators are manufactured with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu-DHP for welded connections in series 3740EL
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 3747E
- Stainless steel pipe AISI 304 for welded connections in series 3748E

INSTALLATION

At start-up, the colour of the sensitive element may be yellow, due to exposure to air humidity or due to moisture in the circuit. When the moisture of the refrigerant is returned to acceptable levels by the filter drier, the indicator colour turns green again. This is evidence that equilibrium has been re-established. If the yellow colour persists, measures must be taken to eliminate moisture. Only when the sensitive element turns green again, is there evidence that measures adopted were effective.
About 12 hours of system operation are required to achieve equilibrium. In any case, the moisture indication is usually read when the plant is in function and the fluid is flowing

Copper connections: The brazing of indicators with copper connections should be carried out with care, using a low melting point filler material (min. 5% Ag). It is important to avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning of the indicator.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.

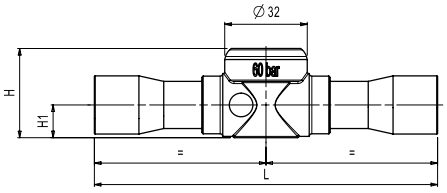
With indicators series 3740EL, 3747E and 3748E, it is necessary to disassemble the ring before starting to braze/weld.


Castel
UL

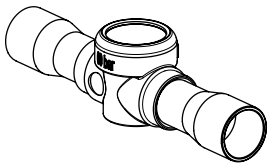
CERTIFICATIONS

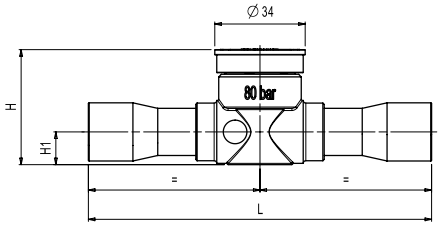
The American certification authority Underwriters Laboratories Inc. has approved Castel indicators with file SA33318. These indicators are certified **UL Listed** for the USA, in compliance with American standard UL 207 with a Design Pressure of:

- 600 PSI for indicators in series 3940EL
- 1160 PSI for indicators in series 3740E
- 1885 PSI for indicators in series 3747E and 3748E

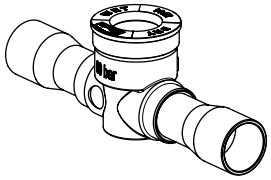


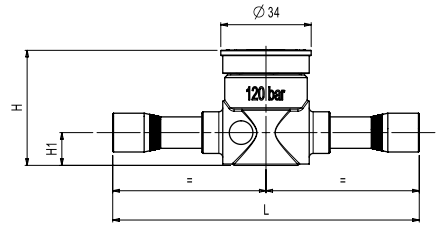
3940EL/..



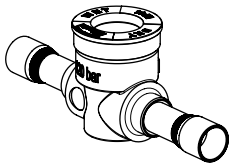


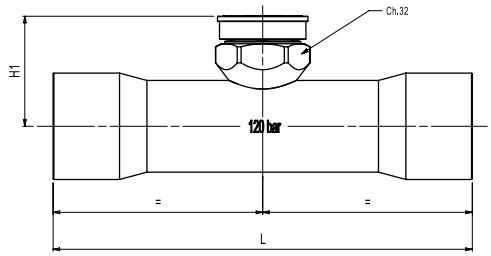
3740E/..



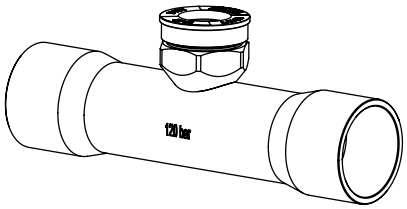


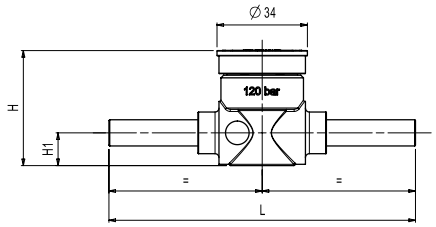
3747E/..





3777E/..





3748E/..

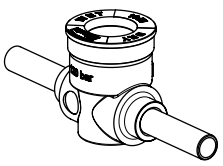


TABLE 1: GENERAL CHARACTERISTICS OF LIQUID / MOISTURE INDICATORS

Catalogue Number	Type	Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast
		ODS		ODM				
		Ø [in.]	Ø [mm]	Ø [in.]		min.	max.	
with copper connections								
3940EL/M6	brazing	–	6	–	60	–40	+120	Art. 4.3
3940EL/2		1/4"	–	–				
3940EL/3		3/8"	–	–				
3940EL/M10		–	10	–				
3940EL/M12		–	12	–				
3940EL/4		1/2"	–	–				
3940EL/5		5/8"	16	–				
3940EL/M18		–	18	–				
3940EL/6		3/4"	–	–				
3940EL/7		7/8"	22	–				
3940EL/9		1.1/8"	–	–				
with reinforced copper connections								
3740E/M6	brazing	–	6	–	80	–40	+120	Art. 4.3
3740E/2		1/4"	–	–				
3740E/3		3/8"	–	–				
3740E/M10		–	10	–				
3740E/M12		–	12	–				
3740E/4		1/2"	–	–				
3740E/5		5/8"	16	–				
3740E/M18		–	18	–				
3740E/6		3/4"	–	–				
3740E/7		7/8"	22	–				
3740E/9		1.1/8"	–	–				
with K65 copper alloy connections								
3747E/2	brazing	1/4"	–	–	120	–40	+120	Art. 4.3
3747E/3		3/8"	–	–				
3747E/4		1/2"	–	–				
3747E/5		5/8"	16	–				
3747E/6		3/4"	–	–				
3747E/7		7/8"	22	–				
3747E/9		1.1/8"	–	–				
3777E/11		1.3/8"	35	–				
with stainless steel connections								
3748E/M6	welding	–	–	6	120	–40	+120	Art. 4.3
3748E/M10		–	–	10				
3748E/M12		–	–	12				
3748E/M16		–	–	16				
3748E/M18		–	–	18				
3748E/M22		–	–	22				
3748E/M28		–	–	28				

TABLE 2: DIMENSIONS AND WEIGHTS

Catalogue Number	Dimensions [mm]			Weight [g]
	H	H1	L	
with copper connections				
3940EL/M6	22	15,5	113	120
3940EL/2				
3940EL/3	34	21,5	117	185
3940EL/M10				
3940EL/M12				
3940EL/4				
3940EL/5	34	21,5	131	195
3940EL/M18				
3940EL/6				
3940EL/7	37,5	23,5	151	306
3940EL/9	43,5	26	186	500
with reinforced copper connections				
3740E/M6	43,5	31	117	140
3740E/2				
3740E/3				200
3740E/M10				
3740E/M12				
3740E/4				
3740E/5	43,5	31	131	215
3740E/M18				
3740E/6				
3740E/7	42,5	28,5	151	325
3740E/9	48,5	31	186	518
with K65 copper alloy connections				
3747E/2	43,5	31	117	200
3747E/3				
3747E/4				
3747E/5	43,5	31	131	215
3747E/6				
3747E/7	42,5	28,5	151	325
3747E/9	48,5	31	186	575
3777E/11	-	41,5	160	378
with stainless steel connections				
3748E/M6	43,5	31	113	200
3748E/M10			117	
3748E/M12				
3748E/M16	43,5	31	131	234
3748E/M18				
3748E/M22	42,5	28,5	151	304
3748E/M28	48,5	31	186	530

REFRIGERATING SYSTEM PROTECTORS

7.2 – HERMETIC FILTER DRIERS

APPLICATIONS

The hermetic filters driers in series DFxxxE are considered "Pressure Vessels" according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These filters have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

CONSTRUCTION

The filter body is made completely from steel with copper connections, EN 12735-1 – Cu-DHP, offering the possibility to solder the copper pipe inside the connections (ODS).
The cartridges are made from moulding a dehydrating filler made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable deacidifying characteristics.

FILTER SELECTION BASED ON REFRIGERANT FLOW CAPACITY

Refrigerant flow capacities shown in Table 4 refer to the following operating conditions according to ARI STANDARD 710-2009:
- Liquid temperature - 5 °C
- Evaporating temperature - 40 °C

Total pressure drop, including inlet and outlet connections, 0.07 bar / 0.14 bar
For different operating conditions apply the following formula:

$$Q = Q_{ref} \times L_1$$

where:
Q = required refrigeration flow capacity [kW]
Q_{ref} = reference refrigeration flow capacity [kW]
L_1= flow capacity correction factor in presence of operative temperatures different from reference conditions. (See Table 5)

EXAMPLE

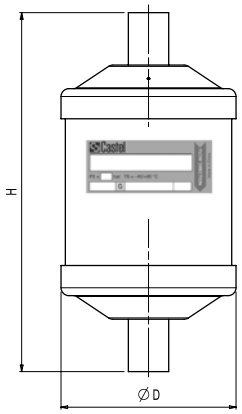
Refrigerant: R744
Required refrigeration flow capacity: 15 [kW]
Liquid temperature: - 10 [°C]
Evaporating temperature: - 45 [°C}
Set pressure drop: 0.14 [bar]

$$Q = Q_{ref} \times L_1$$
$$15 = Q_{ref} \times 1{,}05$$
$$Q_{ref} = 15/1{,}05 = 14{,}3 \quad [kW]$$

Comparing the reference flow capacity obtained with the values indicated in Table 4, the choice falls on filter model DF308E/3S with a flow capacity of 16,3 kW, with a pressure drop of 0.14 bar.

CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved hermetic filter driers in series DFxxxE with file SA7054. These filters are certified **UL-CSA Listed** for the USA and Canada with a Design Pressure of 1160 PSI, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15.



DF3XXE/..


Castel
SOLID CORE FILTER DRIER for R744
Type DF316E/4S
164S
PS = 80 bar
TS = -40/+80 °C
V
Lot N. 0816
Made in China
FLOW DIRECTION
Castel
SOLID CORE FILTER DRIER for R744
PS = 80 bar
TS = -40/+80 °C
084S
0817
DF308E/4S
FLOW DIRECTION
Castel
SOLID CORE FILTER DRIER for R744
032S
DF303E/2S
FLOW DIRECTION
Castel
SOLID CORE FILTER DRIER for R744
053S
DF305E/3S
0817

TABLE 3: GENERAL CHARACTERISTICS OF HERMETIC FILTER DRIERS

Catalogue Number	International Reference	Block Filtering Surface [cm2]	Nominal Volume [cm3]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
DF303E/2S	032S	58	50	1/4"	–	80	–40	+80	Art. 4.3
DF303E/3S	033S			3/8"	–				
DF305E/2S	052S	104	80	1/4"	–				
DF305E/3S	053S			3/8"	–				
DF305E/M10S	–			–	10				
DF308E/2S	082S	141	130	1/4"	–				
DF308E/3S	083S			3/8"	–				
DF308E/M10S	–			–	10				
DF308E/M12S	–			–	12				
DF308E/4S	084S			1/2"	–				
DF316E/3S	163S	183	250	3/8"	–				
DF316E/M10S	–			–	10				
DF316E/M12S	–			–	12				
DF316E/4S	164S			1/2"	–				
DF316E/5S	165S			5/8"	16				
DF330E/3S	303S	345	500	3/8"	–				
DF330E/4S	304S			1/2"	–				
DF330E/5S	305S			5/8"	16				
DF341E/4S	414S	384	670	1/2"	–				
DF341E/5S	415S			5/8"	16				

TABLE 4: REFRIGERANT FLOW CAPACITY , WATER CAPACITY AND DEHYDRATABLE CHARGE OF HERMETIC FILTER DRIERS

Catalogue Number	Flow capacity at pressure drop 0,07 bar (1) [kW]	Flow capacity at pressure drop 0,14 bar (1) [kW]	Water Capacity at + 24 °C (2) [g H2O]	Dehydratable Charge at + 24 °C [kg R744]	Water Capacity at -6,6 °C (2) [g H2O]	Dehydratable Charge at -6,6 °C [kg R744]
DF303E/2S	5,8	7,0	4,2	4,4	5,1	5,4
DF303E/3S	10,8	12,9				
DF305E/2S	7,3	9,5	9,5	9,9	11,5	12,0
DF305E/3S	11,4	14,9				
DF305E/M10S	11,4	14,9				
DF308E/2S	7,0	9,2	14,2	14,8	17,2	17,9
DF308E/3S	12,5	16,3				
DF308E/M10S	12,5	16,3				
DF308E/M12S	15,7	20,4				
DF308E/4S	15,7	20,4				
DF316E/3S	13,5	18,2	22,4	23,3	27,1	28,2
DF316E/M10S	13,5	18,2				
DF316E/M12S	18,7	25,2				
DF316E/4S	18,7	25,2				
DF316E/5S	22,2	30,0				
DF330E/3S	14,0	18,9	48,9	51,0	59,2	61,7
DF330E/4S	23,4	31,5				
DF330E/5S	27,4	37,0				
DF341E/4S	23,9	35,9	71,9	74,9	87,0	90,7
DF341E/5S	30,9	46,3				

(1) : Maximum values of the refrigerant flow capacity at which the drier can be used when fluid dehydration is not the a major problem, provided that the original moisture is limited before the installation of the drier.
The maximum refrigerant flow capacities are referred to a total pressure drop of 0,07 bar / 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at -5 °C and evaporating temperature at - 40 °C)

(2) Drying capacity is based on the following moisture content test standards before and after drying:
EPD ; from 1110 ppm W to 50 ppm W at 24 °C
EPD ; from 445 ppm W to 50 ppm W at - 6,6 °C

TABLE 5- CORRECTION FACTORS OF THE REFRIGERATION CAPACITY FOR TEMPERATURES DIFFERENT FROM STANDARD VALUES

Refrigerant	Liquid temperature [°C]	Evaporating temperature [°C]										
		-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70
R744	-25	1,23	1,24	1,23	1,23	1,23	1,22	1,22	1,21			
	-20	1,18	1,18	1,18	1,17	1,17	1,17	1,16	1,15			
	-15	1,12	1,12	1,12	1,12	1,11	1,11	1,10	1,10			
	-10	1,06	1,06	1,06	1,06	1,05	1,05	1,04	1,04			
	-5	1,00	1,00	1,00	1,00	0,99	0,99	0,98	0,98			
	0	0,94	0,94	0,94	0,94	0,93	0,93	0,92	0,92			
	5	0,88	0,88	0,88	0,87	0,87	0,87	0,86	0,85			
	10	0,81	0,81	0,81	0,81	0,81	0,80	0,80	0,79			
	15	0,75	0,75	0,75	0,74	0,74	0,74	0,73	0,72			

TABLE 6: DIMENSIONS AND WEIGHTS OF HERMETIC FILTERS

Catalogue Number	Connections		Dimensions [mm]		Weight [g]
	ODS				
	Ø [in.]	Ø [mm]	Ø D	L	
DF303E/2S	1/4"	–	42	101	152
DF303E/3S	3/8"	–		105	186
DF305E/2S	1/4"	–	64	112	406
DF305E/3S	3/8"	–		116	414
DF305E/M10S	–	10		120	414
DF308E/2S	1/4"	–	64	133	502
DF308E/3S	3/8"	–		137	514
DF308E/M10S	–	10		141	520
DF308E/M12S	–	12		141	520
DF308E/4S	1/2"	–		137	514
DF316E/3S	3/8"	–	64	157	616
DF316E/M10S	–	10		161	616
DF316E/M12S	–	12		161	616
DF316E/4S	1/2"	–		157	626
DF316E/5S	5/8"	16		163	628
DF330E/3S	3/8"	–	76	230	1450
DF330E/4S	1/2"	–		230	1450
DF330E/5S	5/8"	16		236	1500
DF341E/4S	1/2"	–	89	235	1775
DF341E/5S	5/8"	16		241	1886

REFRIGERATING SYSTEM PROTECTORS

7.3 – HERMETIC FILTER DRIERS WITH MOISTURE INDICATOR

APPLICATIONS

The hermetic filters driers with moisture indicators in series DIxxxE are considered “Pressure Vessels” according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These filters have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
For refrigerant flow capacity, water capacity and dehydratable charge of the filters in this paragraph see tab 4 of paragraph 7.2.

CONSTRUCTION

The driers with moisture indicators are drying filters for the liquid line with a moisture/liquid indicator brazed directly onto the outlet of the filter. This unit reduces the amount of field brazing required and the potential risk for refrigerant fluid leaks. The indicators ensure fast safe inspection of the conditions of the refrigerant fluid in the circuit regarding regular flow and the presence of moisture.
The filter is completely manufactured in steel, with ODS soldered connections in copper. The indicator is manufactured with the glass “lens” directly fused onto a steel metallic ring, with proper surface protection.
The cartridges are made from moulding a dehydrating filler made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable deacidifying characteristics.

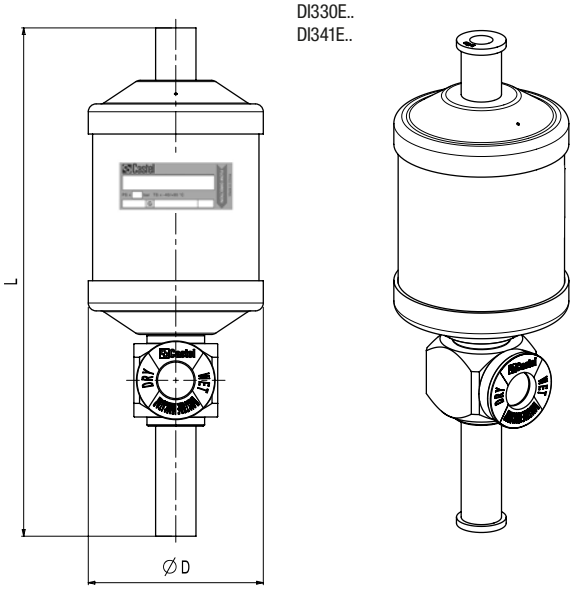
OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.
The moisture content values that correspond to the “green” colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, “Chartreuse green”, the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes “yellow”, it’s time to replace the filter dryer.
If the charge and operating conditions of the plant are normal, the refrigerant fluid appears perfectly liquid underneath the “lens” of the indicator. The presence of bubbles indicates that the refrigerant fluid is partially evaporating along the liquid line.

INSTALLATION

At start-up, the colour of the sensitive element may be yellow, due to exposure to air humidity or due to moisture in the circuit. When the moisture of the refrigerant is returned to acceptable levels by the filter drier, the indicator colour turns green again. This is evidence that equilibrium has been re-established. If the yellow colour persists, measures must be taken to eliminate moisture. Only when the sensitive element turns green again, is there evidence that measures adopted were effective. About 12 hours of system operation are required to achieve equilibrium. In any case, the moisture indication is usually read when the plant is in function and the fluid is flowing
Brazing of the filter/indicator with solder connections should be carried out with care, using a low melting point filler material (min. 5% Ag). Avoid direct contact between the torch flame and the indicator body or glass, which could be damaged and compromise the proper functioning of the indicator.

DI305E..
DI308E..
DI316E..
DI330E..
DI341E..




Castel
FILTER/DRYERS
LISTED SQUS
MWP = 680 PSIG
T. RANGE = -40/+176°F
SOLID CORE FILTER DRIER
R744
PS = 80 bar TS = -40/+80 °C
3020
DI308E/3S
083
FLOW DIRECTION
Made in China
Castel
DRY
WET
MOISTURE INDICATOR

TABLE 7 GENERAL CHARACTERISTICS OF FILTER DRIERS WITH MOISTURE INDICATOR

Catalogue Number	International Reference	Block Filtering Surface [cm2]	Nominal Volume [cm3]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
DI305E/2S	052S	104	80	1/4”	–	80	– 40	+ 80	Art. 4.3
DI305E/3S	053S			3/8”	–				
DI305E/M10S	–			–	10				
DI308E/2S	082S	141	130	1/4”	–				
DI308E/3S	083S			3/8”	–				
DI308E/M10S	–			–	10				
DI308E/M12S	–			–	12				
DI308E/4S	084S			1/2”	–				
DI316E/3S	163S	183	250	3/8”	–				
DI316E/M10S	–			–	10				
DI316E/M12S	–			–	12				
DI316E/4S	164S			1/2”	–				
DI316E/5S	165S			5/8”	16				
DI330E/3S	303S	345	500	3/8”	–				
DI330E/4S	304S			1/2”	–				
DI330E/5S	305S			5/8”	16				
DI341E/4S	414S	384	670	1/2”	–				
DI341E/5S	415S			5/8”	16				

TABLE 8: REFRIGERANT FLOW CAPACITY , WATER CAPACITY AND DEHYDRATABLE CHARGE OF FILTER DRIERS WITH MOISTURE INDICATOR

Catalogue Number	Flow capacity at pressure drop 0,07 bar (1) [kW]	Flow capacity at pressure drop 0,14 bar (1) [kW]	Water Capacity at + 24 °C (2) [g H2O]	Dehydratable Charge at + 24 °C [kg R744]	Water Capacity at -6,6 °C (2) [g H2O]	Dehydratable Charge at -6,6 °C [kg R744]
DI305E/2S	7,3	9,5	9,5	9,9	11,5	12,0
DI305E/3S	11,4	14,9				
DI305E/M10S	11,4	14,9				
DI308E/2S	7,0	9,2	14,2	14,8	17,2	17,9
DI308E/3S	12,5	16,3				
DI308E/M10S	12,5	16,3				
DI308E/M12S	15,7	20,4				
DI308E/4S	15,7	20,4				
DI316E/3S	13,5	18,2	22,4	23,3	27,1	28,2
DI316E/M10S	13,5	18,2				
DI316E/M12S	18,7	25,2				
DI316E/4S	18,7	25,2				
DI316E/5S	22,2	30,0				
DI330E/3S	14,0	18,9	48,9	51,0	59,2	61,7
DI330E/4S	23,4	31,5				
DI330E/5S	27,4	37,0				
DI341E/4S	23,9	35,9	71,9	74,9	87,0	90,7
DI341E/5S	30,9	46,3				

(1) : Maximum values of the refrigerant flow capacity at which the drier can be used when fluid dehydration is not the a major problem, provided that the original moisture is limited before the installation of the drier.
The maximum refrigerant flow capacities are referred to a total pressure drop of 0,07 bar / 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at -5 °C and evaporating temperature at - 40 °C)

(2) Drying capacity is based on the following moisture content test standards before and after drying:
EPD ; from 1110 ppm W to 50 ppm W at 24 °C
EPD ; from 445 ppm W to 50 ppm W at - 6,6 °C

TABLE 9: DIMENSIONS AND WEIGHTS OF FILTERS WITH MOISTURE INDICATOR

Catalogue Number	Connections			Dimensions [mm]		Weight [g]
	SAE Flare	ODS				
		Ø [in.]	Ø [mm]	Ø D	L	
DI305E/2S	–	1/4"	–	64	166	650
DI305E/3S	–	3/8"	–		169	655
DI305E/M10S	–	–	10		171	655
DI308E/2S	–	1/4"	–	64	187	750
DI308E/3S	–	3/8"	–		190	765
DI308E/M10S	–	–	10		192	750
DI308E/M12S	–	–	12		196	765
DI308E/4S	–	1/2"	–		191	770
DI316E/3S	–	3/8"	–	64	210	860
DI316E/M10S	–	–	10		212	860
DI316E/M12S	–	–	12		216	870
DI316E/4S	–	1/2"	–		221	870
DI316E/5S	–	5/8"	16		250	870
DI330E/3S	–	3/8"	–	76	282	1730
DI330E/4S	–	1/2"	–		286	1750
DI330E/5S	–	5/8"	16		293	1820
DI341E/4S	–	1/2"	–	89	290	2204
DI341E/5S	–	5/8"	16		297	2274

REFRIGERATING SYSTEM PROTECTORS

7.4 – REPLACEABLE SOLID CORE FILTER DRIERS

APPLICATIONS

The replaceable filter driers in series 4411E and 4412E are considered "Pressure Vessels" according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These filters have been developed by Castel for all the applications that use the sub-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

OPERATION

In the case of filters with two cartridges, the fluid passage takes place in parallel. As a result, the pressure drop does not increase in proportion with the number of cartridges. A large ring area between the cartridge and the inner surface of the filter allows for the accumulation of solid particles and prevents clogging. Before leaving the filter, the refrigerant fluid must pass through the mesh sieve in which cartridges are mounted. This eliminates the danger that small particles of drying material be dragged into circulation. Furthermore, at the filter outlet, a plastic cup, the edge of which closely adheres to the inner surface of the filter, prevents dirt from reaching the outlet connection during normal operation and cartridge change.

CONSTRUCTION

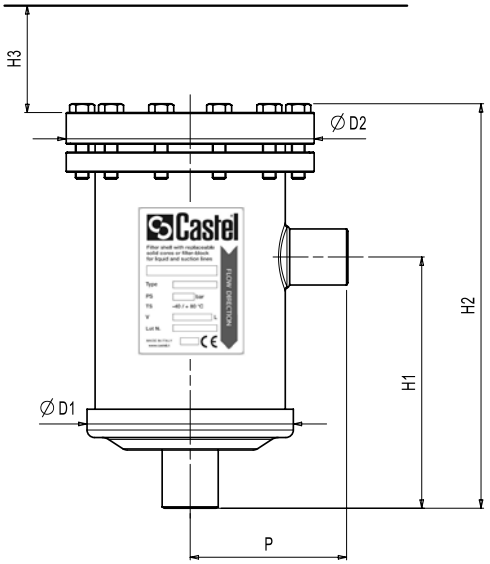
Filter shells: these are built with an aluminium cover, stainless steel screws, and the steel body is equipped with brazing connections machined from a steel bar EN 10025 S355JR.
They are sold in the following two configurations:
- Codes with an "A" suffix, equipped with 1/4" NPT threaded cover for mounting an access fitting with valve core (for example G9150/R05)
- Codes with a "B" suffix, equipped with blind cover

Cartridges 4490/B: are made from moulding a dehydrating filler, made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable de-acidifying characteristics. These cartridges are supplied without cover gasket as spare parts,
Cartridges 4490/AB: are made from moulding a dehydrating filler, made from 80% 3 Å molecular sieves and 20% activated alumina, with a suitable binder. The use of a blend of molecular sieves – activated alumina, grant the cartridges a high deacidifying capacity maintaining very good moisture adsorption characteristics. These cartridges are supplied without cover gasket as spare parts
Cartridges 4490/BB: are made from moulding a dehydrating filler, made from 25% 3 Å molecular sieves and 75% activated alumina, with a suitable binder. The use of a blend of molecular sieves and a big quantity of activated alumina, grant the cartridges a very high deacidifying capacity. These cartridges can be used as a compressor motor burn-out core. They are supplied without cover gasket as spare part.s
Cartridges 4490/E: are made from moulding a dehydrating filler, made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable de-acidifying characteristics. These cartridges are supplied with cover gasket as spare parts,

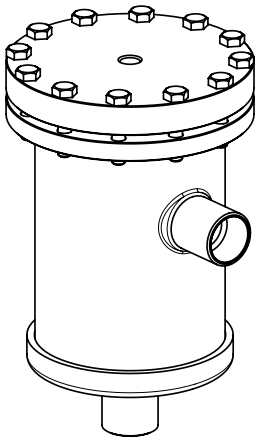
All the cartridges listed above have volume of 48 cubic inches (equivalent to about 800 cm3), have a hollow cylinder shape and are of the same size as the corresponding products of the main international brands. Consequently they are interchangeable. The hollow cylinder shape provides a large surface area to the fluid which to cross it in a radial direction. As a result, drying is highly efficient with a minimum loss of charge.

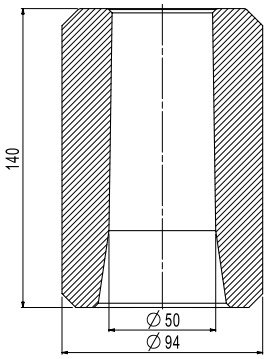
Cartridge 4495: characterized by a large filter surface, these consist of metal mesh fabric with a controlled porosity filter sieve insert, which can retain solid particles to 20 microns. At both ends, soft felt gaskets ensure perfect seal with the plastic cups. These cartridges can be used in the 4411E and 4412E filter shell by replacing the internal components with spare 9151/R02. If the 4412E filter shell is used, the 9900/X74 centering disc is also required.


Castel
Filter shell with replaceable solid cores or filter-block for liquid and suction lines
Media: R22 - R134a - R404A R407C - R410A - R507
Type 4411E/5AF
PS 62 bar
TS -40 / + 80 °C
V 2,02 L
Lot N. 0717
MADE IN ITALY - www.castel.it
FLOW DIRECTION
Castel
Filter shell with replaceable solid cores or filter-block for liquid and suction lines
Media: R22 - R134a - R404A R407C - R410A - R507
Type 4412E/11AF
PS 62 bar
TS -40 / + 80 °C
V 3,00 L
Lot N. 0617
II
MADE IN ITALY - www.castel.it
FLOW DIRECTION
The component is for use with R744 system components where the design pressure of the component is not less than the design pressure of the associated components.

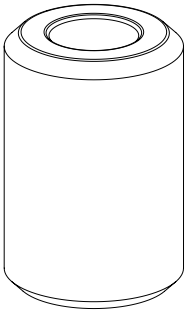


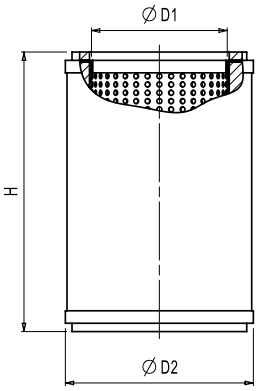
4411E
4412E





4490/..





4491
4496

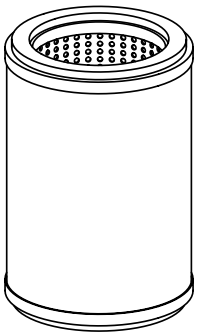


TABLE 10: GENERAL CHARACTERISTICS OF FILTER DRIERS WITH REPLACEABLE SOLID CORE

Catalogue Number		Number of Cores	Core Filtering Surface [cm2]	Nominal Volume		Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast
						ODS		W				
Theaded cover	Blind cover			[cu.in]	[cm3]	Ø [in.]	Ø [mm]	Ø [mm]		min.	max.	
Subcritical												
4411E/5AF	4411E/5BF	1	420	48	800	5/8"	16	21,3	62	–40	+80	I
4411E/7AF	4411E/7BF					7/8"	22	26,9				
4411E/9AF	4411E/9BF					1.1/8"	–	33,7				
4411E/11AF	4411E/11BF					1.3/8"	35	42,4				
4411E/13AF	4411E/13BF					1.5/8"	–	48,3				
4411E/M42AF	4411E/M42BF					–	42	48,3				
4411E/17AF	4411E/17BF					2.1/8"	54	60,3				
4412E/7AF	4412E/7BF	2	840	96	1600	7/8"	22	26,9				
4412E/9AF	4412E/9BF					1.1/8"	–	33,7				
4412E/11AF	4412E/11BF					1.3/8"	35	42,4				
4412E/13AF	4412E/13BF					1.3/8"	35	42,4				
4412E/M42AF	4412E/M42BF					–	42	48,3				
4412E/17AF	4412E/17BF					2.1/8"	54	60,3				

TABLE 11: REFRIGERANT FLOW CAPACITY OF FILTERS WITH REPLACEABLE CORE

Catalogue Number		Flow capacity at pressure drop 0,07 bar (1)) [kW]	Flow capacity at pressure drop 0,14 bar (1)) [kW]
Theaded cover	Blind cover		
4411E/5AF	4411E/5BF	52	62
4411E/7AF	4411E/7BF	91	119
4411E/9AF	4411E/9BF	125	162
4411E/11AF	4411E/11BF	145	189
4411E/13AF	4411E/13BF	156	203
4411E/M42AF	4411E/M42BF	156	203
4411E/17AF	4411E/17BF	156	203
4412E/7AF	4412E/7BF	91	119
4412E/9AF	4412E/9BF	141	183
4412E/11AF	4412E/11BF	191	248
4412E/13AF	4412E/13BF	208	281
4412E/M42AF	4412E/M42BF	208	281
4412E/17AF	4412E/17BF	208	281

(1) : Maximum values of the refrigerant flow capacity at which the drier can be used when fluid dehydration is not the a major problem, provided that the original moisture is limited before the installation of the drier.
The maximum refrigerant flow capacities are referred to a total pressure drop of 0,07 bar / 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at -5 °C and evaporating temperature at - 40 °C)

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 5

TABLE 12: DIMENSIONS AND WEIGHTS OF FILTERS

Catalogue Number		Connections			Dimensions [mm]						Weight [g]
		ODS		W	Ø D1	Ø D2	H1	H2	H3	P	
Theaded cover	Blind cover	Ø [in.]	Ø [mm]	Ø [mm]							
4411E/5AF	4411E/5BF	5/8"	16	21,3	121	149	144	231	185	90	5158
4411E/7AF	4411E/7BF	7/8"	22	26,9			150	237		95	5300
4411E/9AF	4411E/9BF	1.1/8"	–	33,7							
4411E/11AF	4411E/11BF	1.3/8"	35	42,4			155	242		100	5400
4411E/13AF	4411E/13BF	1.5/8"	–	48,3			167	254		112	5450
4411E/M42AF	4411E/M42BF	–	42	48,3							
4411E/17AF	4411E/17BF	2.1/8"	54	60,3			158	245		103	5500
4412E/7AF	4412E/7BF	7/8"	22	26,9			292	379	324	95	6600
4412E/9AF	4412E/9BF	1.1/8"	–	33,7							
4412E/11AF	4412E/11BF	1.3/8"	35	42,4			297	384		100	6800
4412E/13AF	4412E/13BF	1.5/8"	–	48,3			309	396		112	6950
4412E/M42AF	4412E/M42BF	–	42	48,3							
4412E/17AF	4412E/17BF	2.1/8"	54	60,3			300	387		103	7000

TABLE 13: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF SOLID CORES

Catalogue Number	Batch characteristic	Filtering Surface [cm2]	Nominal Volume		Dimensions [mm]			Weight [g]
			[cu.in]	[cm3]	Ø D1	Ø D2	H	
4490/E (1)	High moisture adsorption (100% molecular sieve)	420	48	800	47	96	140	730
4490/B (2)								
4490/AB (2)	Moisture and acid adsorption (80% molecular sieve + 20% activated alumina)							
4490/BB (2)	High acid adsorption, motor burn-out core (25% molecular sieve + 75% activated alumina)							

(1): Supplied with cover gaskets as spare part
(2): Supplied without cover gasket as part part

TAB 14: WATER CAPACITY / DEHYDRATABLE CHARGE AND ACID CAPACITY OF SOLID CORES

Part number	Dehydrating charge	Water Capacity at + 24 °C (1) [g H2O]	Dehydratable Charge at + 24 °C [kg R744]	Water Capacity at -6,6 °C (1) [g H2O]	Dehydratable Charge at -6,6 °C [kg R744]	Acid Capacity (2) [g]
4490/B 4490/E	100% Molecular sieve	75,7	78,8	91,6	95,4	
4490/AB	80% Molecular sieve + 20% activated alumina	64,1	66,8	77,6	80,8	
4490/BB	25% Molecular sieve + 75% activated alumina					62

(1) Drying capacity is based on the following moisture content test standards before and after drying:
EPD ; from 1110 ppm W to 50 ppm W at 24 °C
EPD ; from 445 ppm W to 50 ppm W at - 6,6 °C

(2) : Neutralized oleic acid

TABLE 15: GENERAL CHARACTERISTIC, DIMENSIONS AND WEIGHTS OF MECHANICAL BLOCK

Catalogue Number	Filtering Surface		Dimensions [mm]			Weight [g]
	[sq.in]	[cm2]	Ø D1	Ø D2	H	
4495/C	127	820	60	87	138	480

REFRIGERATING SYSTEM PROTECTORS

7.5 – HIGH PRESSURE REPLACEABLE SOLID CORE FILTER DRIERS

APPLICATIONS

The high pressure replaceable filter driers in series 4431E and 4432E are considered "Pressure Vessels" according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These filters have been developed by Castel for all the applications that use the trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

OPERATION

In the case of filters with two cartridges, the fluid passage takes place in parallel. As a result, the pressure drop does not increase in proportion with the number of cartridges. A large ring area between the cartridge and the inner surface of the filter allows for the accumulation of solid particles and prevents clogging. Before leaving the filter, the refrigerant fluid must pass through the mesh sieve in which cartridges are mounted. This eliminates the danger that small particles of drying material be dragged into circulation. Furthermore, at the filter outlet, a plastic cup, the edge of which closely adheres to the inner surface of the filter, prevents dirt from reaching the outlet connection during normal operation and cartridge change.

CONSTRUCTION

Filter shells: these are built with a thick aluminium cover, stainless steel screws, and the reinforced steel body is equipped with brazing connections machined from a steel bar EN 10025 S355JR.
They are sold in the following two configurations:
- Codes with an "A" suffix, equipped with 1/4" NPT threaded cover for mounting an access fitting with valve core (for example G9150/R05)
- Codes with a "B" suffix, equipped with blind cover

Cartridges 4490/B: are made from moulding a dehydrating filler, made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable de-acidifying characteristics. These cartridges are supplied without cover gasket as spare parts,
Cartridges 4490/AB: are made from moulding a dehydrating filler, made from 80% 3 Å molecular sieves and 20% activated alumina, with a suitable binder. The use of a blend of molecular sieves – activated alumina, grant the cartridges a high deacidifying capacity maintaining very good moisture adsorption characteristics. These cartridges are supplied without cover gasket as spare parts
Cartridges 4490/BB: are made from moulding a dehydrating filler, made from 25% 3 Å molecular sieves and 75% activated alumina, with a suitable binder. The use of a blend of molecular sieves and a big quantity of activated alumina, grant the cartridges a very high deacidifying capacity. These cartridges can be used as a compressor motor burn-out core. They are supplied without cover gasket as spare part.s
Cartridges 4490/E: are made from moulding a dehydrating filler, made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable de-acidifying characteristics. These cartridges are supplied with cover gasket as spare parts,

All the cartridges listed above have volume of 48 cubic inches (equivalent to about 800 cm3), have a hollow cylinder shape and are of the same size as the corresponding products of the main international brands. Consequently they are interchangeable. The hollow cylinder shape provides a large surface area to the fluid which to cross it in a radial direction. As a result, drying is highly efficient with a minimum loss of charge.

Cartridge 4495: characterized by a large filter surface, these consist of metal mesh fabric with a controlled porosity filter sieve insert, which can retain solid particles to 20 microns. At both ends, soft felt gaskets ensure perfect seal with the plastic cups. These cartridges can be used in the 4411E and 4412E filter shell by replacing the internal components with spare 9151/R02. If the 4412E filter shell is used, the 9900/X74 centering disc is also required.

CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved filter driers in series 4431E and 4432E with file SA7054. These filters are certified **UL-CSA Listed** for the USA and Canada with a Design Pressure of 1300 PSI, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15.


Castel
FILTER/DRYERS MWP = 1305 PSIG
LISTED 81D4
T. RANGE = -40/+176°F
Filter shell with replaceable solid cores or filter-block for liquid and suction lines
R744
Type 4431E/7AF
PS 90 bar
TS -40 / + 80 °C
V 1,6 L
Lot N. 2022001234
MADE IN ITALY
FLOW DIRECTION

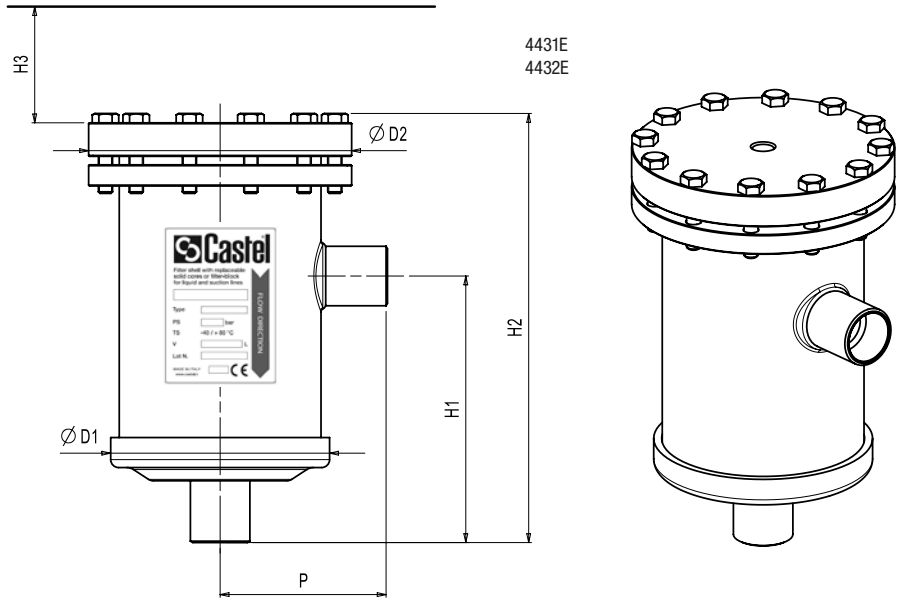


TABLE 16: GENERAL CHARACTERISTICS OF HIGH PRESSURE FILTER DRIERS WITH REPLACEABLE SOLID CORE

Catalogue Number		Number of Cores	Core Filtering Surface [cm2]	Nominal Volume		Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast
						ODS		W		min.	max.	
Theaded cover	Blind cover			[cu.in]	[cm3]	Ø [in.]	Ø [mm]	Ø [mm]				
4431E/5AF	4431E/5BF	1	420	48	800	5/8"	16	21,3	90	– 40	+ 80	II
4431E/7AF	4431E/7BF					7/8"	22	26,9				
4431E/9AF	4431E/9BF					1.1/8"	–	33,7				
4431E/11AF	4431E/11BF					1.3/8"	35	42,4				
4431E/13AF	4431E/13BF					1.5/8"	–	48,3				
4431E/M42AF	4431E/M42BF					–	42	48,3				
4431E/17AF	4431E/17BF					2.1/8"	54	60,3				
4432E/7AF	4432E/7BF	2	840	96	1600	7/8"	22	26,9				
4432E/9AF	4432E/9BF					1.1/8"	–	33,7				
4432E/11AF	4432E/11BF					1.3/8"	35	42,4				
4432E/13AF	4432E/13BF					1.3/8"	35	42,4				
4432E/M42AF	4432E/M42BF					–	42	48,3				
4432E/17AF	4432E/17BF					2.1/8"	54	60,3				

TABLE 17: REFRIGERANT FLOW CAPACITY OF FILTERS WITH REPLACEABLE CORE

Catalogue Number		Flow capacity at pressure drop 0,07 bar (1)) [kW]	Flow capacity at pressure drop 0,14 bar (1)) [kW]
Theaded cover	Blind cover		
4431E/5AF	4431E/5BF	52	62
4431E/7AF	4431E/7BF	91	119
4431E/9AF	4431E/9BF	125	162
4431E/11AF	4431E/11BF	145	189
4431E/13AF	4431E/13BF	156	203
4431E/M42AF	4431E/M42BF	156	203
4431E/17AF	4431E/17BF	156	203
4432E/7AF	4432E/7BF	91	119
4432E/9AF	4432E/9BF	141	183
4432E/11AF	4432E/11BF	191	248
4432E/13AF	4432E/13BF	208	281
4432E/M42AF	4432E/M42BF	208	281
4432E/17AF	4432E/17BF	208	281

(1) : Maximum values of the refrigerant flow capacity at which the drier can be used when fluid dehydration is not the a major problem, provided that the original moisture is limited before the installation of the drier.
The maximum refrigerant flow capacities are referred to a total pressure drop of 0,07 bar / 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at -5 °C and evaporating temperature at - 40 °C)

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 5

TABLE 18: DIMENSIONS AND WEIGHTS OF FILTERS

Catalogue Number		Connections			Dimensions [mm]						Weight [g]
		ODS		W	Ø D1	Ø D2	H1	H2	H3	P	
Theaded cover	Blind cover	Ø [in.]	Ø [mm]	Ø [mm]							
4431E/5AF	4431E/5BF	5/8"	16	21,3	124	149	145	238	185	89	4210
4431E/7AF	4431E/7BF	7/8"	22	26,9			151	244		95	4240
4431E/9AF	4431E/9BF	1.1/8"	–	33,7							4290
4431E/11AF	4431E/11BF	1.3/8"	35	42,4			156	249		100	4430
4431E/13AF	4431E/13BF	1.5/8"	–	48,3			168	261		112	4570
4431E/M42AF	4431E/M42BF	–	42	48,3							4550
4431E/17AF	4431E/17BF	2.1/8"	54	60,3			159	252		103	4480
4432E/7AF	4432E/7BF	7/8"	22	26,9			293	385	324	95	5780
4432E/9AF	4432E/9BF	1.1/8"	–	33,7							5830
4432E/11AF	4432E/11BF	1.3/8"	35	42,4			298	390		100	5970
4432E/13AF	4432E/13BF	1.5/8"	–	48,3			310	402		112	6110
4432E/M42AF	4432E/M42BF	–	42	48,3							6090
4432E/17AF	4432E/17BF	2.1/8"	54	60,3			301	393		103	6020

REFRIGERATING SYSTEM PROTECTORS

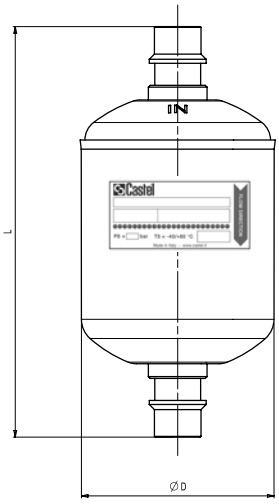
7.6 – HERMETIC STRAINERS

APPLICATIONS

The hermetic strainers in series 45xxxE are considered “Pressure Vessels” according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These strainers have been developed by Castel for all the applications that use the sub-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

CONSTRUCTION

The strainers is completely manufactured in steel, with copper plated solder connections, offering the possibility to solder the copper pipe inside the connections (ODS).
Inside the strainers there is a screen basket, with large filter surface, made of austenitic stainless steel AISI 304. The mesh filters are not inspectable and therefore cannot be cleaned.



4520E


Castel
HP
R22 - R134a - R404A
R407C - R410A - R507
0517
G
4520E/M12
PS = 60 bar
TS = -40/+80 °C
STRAINER (RETE)
Made in Italy - www.castel.it
FLOW DIRECTION

TABLE 19: GENERAL CHARACTERISTICS OF STRAINERS

Catalogue Number	Filtering Surface [cm2]	Useful Passage Surface [%]	Mesh Opening [mm]	Connections				Kv Factor [m3/h]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
				ODS		ODM				min.	max.	min.	max.	
				Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]							
4520E/M10	58	36,6	0,166	–	10	–	12	2,4	60	–40	+80	–20	+50	Art. 4.3
4520E/M12				–	12	–	14	3,4						
4520E/4				1/2"	–	5/8"	16							
4520E/5				5/8"	16	3/4"	–							

TABLE 20: DIMENSIONS AND WEIGHTS OF STRAINERS

Catalogue Number	Dimensions [mm]		Weight [g]
	Ø D	L	
4520E/M10	52	109	195
4520E/M12		113	205
4520E/4		113	205
4520E/5		126	245

REFRIGERATING SYSTEM PROTECTORS

7.7 – INSPECTABLE STRAINERS

APPLICATIONS

The inspectable strainers in series 4727E and 4728E 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 strainers have been developed by Castel for all applications that use trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
CAUTION!: the filters in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

The main parts of the inspectable strainers are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for body and cover
- Austenitic stainless steel AISI 304 for the mesh filter
- Un-sintered PTFE for the sealing gasket of the mesh filter
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 4274E
- Stainless steel pipe AISI 304 for welded connections in series 4278E

INSTALLATION

The inspectable strainers can be installed on all branches of a refrigeration plant where it is necessary to avoid the accumulation of dirt and sludge inside a highly delicate component. These strainers can be disassembled to clean or replace the filter cartridge housed inside. Table 24 lists the codes of the spare part filter cartridges for replacement.
Table 21 shows the following operational characteristics of an inspectable strainer:
- PS
- TS
- Kv factor

Copper connections: The brazing of filters with solder connections should be carried out with care, using a low melting point filler material (min.5 Ag). It is not necessary to disassemble the filters. However, avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning of the filter.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.

The allowed operating positions are the following:
- With horizontal piping axis, removable cover facing downward.
- With vertical piping axis, arrow and removable cover facing downward.

NOTE: Filters 4727E and 4728E cannot be installed with the cover facing upward, in order to avoid that the dirt accumulated return into the plant when the filter is inspected/ cleaned.

CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved inspectable filters with file SA7054. These filters are certified **UL-CSA Listed** for the USA and Canada, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15 with a Design Pressure of:
- 1740 PSI for filters in series 4727E and 4728E, from 4728E/M18
- 2030 PSI for filters in series 4728E, up to 4728E/M16


031
Sirai

TABLE 21 GENERAL CHARACTERISTICS OF INSPECTABLE STRAINER

Catalogue Number	Filtering Surface [cm2]	Useful Passage Surface [%]	Mesh Opening [mm]	Connections		Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS				min.	max.	
				Ø [in.]	Ø [mm]					
with K65 copper alloy connections										
4727E/3	13	26	0,1	3/8"	–	2,0	130	–40	+140	Art. 4.3
4727E/4				1/2"	–	2,5				
4727E/5				5/8"	16	3,0				
4727E/6	18		0,2	3/4"	–	6,0				
4727E/7				7/8"	22	6,0				
4727E/9				1.1/8"	–	6,0				
4727E/11	31			1.3/8"	35	7,0				
4727E/13	46			1.5/8"	–	10,0				I
4727E/17	60			2.1/8"	54	15,0				
with stainless steel connections										
4728E/M10	13	26	0,1	–	10	2,0	140	–40	+140	Art. 4.3
4728E/M12				–	12	2,5				
4728E/M16				–	16	3,0				
4728E/M18	18		0,2	–	18	6,0				
4728E/M22				–	22	6,0				
4728E/M28				–	28	6,0				
4728E/M35	31			–	35	7,0				
4728E/M42	46			–	42	10,0				I

TABLE 22: REFRIGERANT FLOW CAPACITY OF INSPECTABLE STRAINER

Catalogue Number	Transcritical system		
	Gas-cooling line	Suction line	Hot gas line
with K65 copper alloy connections			
4727E/3	52,5	9,3	37,4
4727E/4	65,7	11,6	46,7
4727E/5	78,8	13,9	56,1
4727E/6	157,6	27,8	112,1
4727E/7	157,6	27,8	112,1
4727E/9	157,6	27,8	112,1
4727E/11	183,9	32,4	130,8
4727E/13	262,7	46,3	186,9
4727E/17	394,1	69,5	280,4
with stainless steel connections			
4728E/M10	52,5	9,3	37,4
4728E/M12	65,7	11,6	46,7
4728E/M16	78,8	13,9	56,1
4728E/M18	157,6	27,8	112,1
4728E/M22	157,6	27,8	112,1
4728E/M28	157,6	27,8	112,1
4728E/M35	183,9	32,4	130,8
4728E/M42	262,7	46,3	186,9

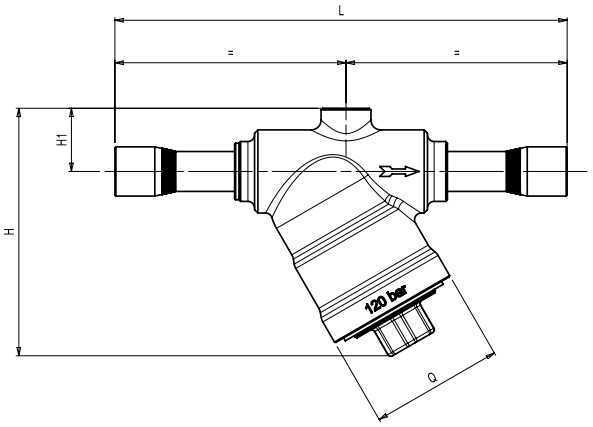
Standard rating conditions according to AHRI Standard 760-2014 for transcritical system		
Gas-cooler outlet temperature	95 °F	(35 °C)
Evaporating temperature	14 °F	(- 10 °C)
Evaporator outlet temperature	23 °F	(- 5 °C)
Evaporator superheating	9 °R	(5 °K)
Suction line temperature	32 °F	(0 °C)
Suction line superheating	9 °R	(5 °K)
Discharge temperature	212 °F	(110 °C)

TABLE 23: DIMENSIONS AND WEIGHTS OF INSPECTABLE STRAINERS

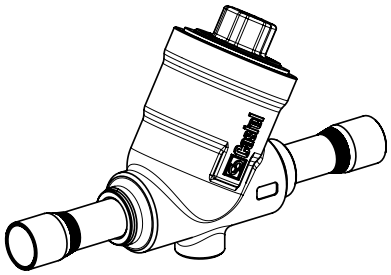
Catalogue Number	Dimensions [mm]				Weight [g]
	H	H1	L	Q	
with K65 copper alloy connections					
4727E/3	74	19	140	40	505
4727E/4			136		510
4727E/5			148		520
4727E/6	96	24	164	50	1005
4727E/7			170		1024
4727E/9			201		1084
4727E/11	115	29	208	56	1480
4727E/13	148	36	242	67	3490
4727E/17	167	44	285	79	5500
with stainless steel connections					
4728E/M10	74	19	146	40	500
4728E/M12			142		500
4728E/M16			156		510
4728E/M18	96	24	164	50	1005
4728E/M22			170		1020
4728E/M28			201		1080
4728E/M35	115	29	206	56	1510
4728E/M42	148	36	240	67	3380

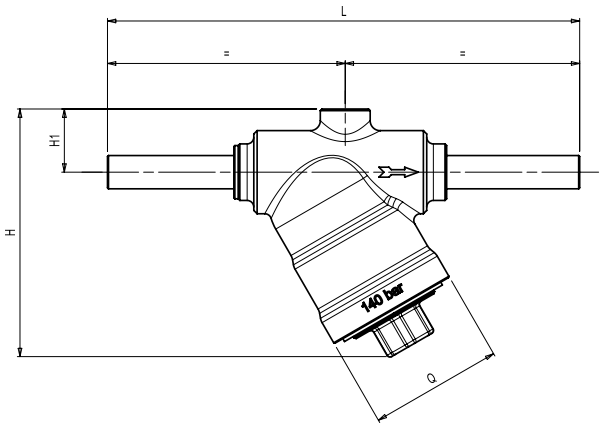
TABLE 24: GENERAL CHARACTERISTICS OF STRAINER BLOCKS

Catalogue Number	Filtering Surface [cm2]	Useful Passage Surface [%]	Mesh Opening [mm]	Suitable for strainer	
9151/R15	13	32	0,1	4727E/3	4728E/M10
				4727E/4	4728E/M12
9151/R16				4727E/5	4728E/M16
9151/R17	18	26	0,2	4727E/6	4728E/M18
				4727E/7	4728E/M22
9151/R18				4727E/9	4728E/M28
9151/R19	31			4727E/11	4728E/M35
9151/R24	46			4727E/13	4728E/M42
9151/R25	60			4727E/17	-
9151E/R54	13	16	0,05	4727E/3	4728E/M10
				4727E/4	4728E/M12
9151E/R55				4727E/5	4728E/M16
9151E/R50	18			4727E/6	4728E/M18
				4727E/7	4728E/M22
9151E/R51				4727E/9	4728E/M28
9151E/R52	31			4727E/11	4728E/M35
9151E/R53	46			4727E/13	4728E/M42



4727E..





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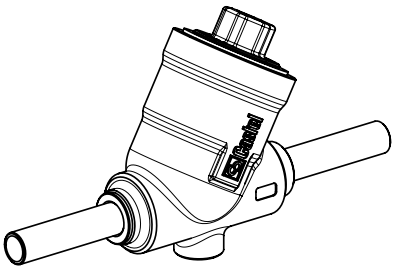
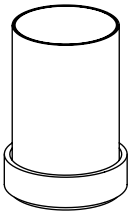


9151E..



OIL CONTROL SYSTEMS

GOGREEN

R744 • NATURAL REFRIGERANT

OIL CONTROL SYSTEMS

8.1 – ELECTRONIC OIL LEVEL REGULATORS

APPLICATIONS

The electronic oil level regulators are considered “Pressure Vessels” according to the definition provided in Article 2, Point 2 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.a) and 3 of the same Directive.
These regulators have been developed by Castel for all the applications that use the trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The regulators for plants that operate using refrigerant fluid R744 are the following:
- regulators in series 5650E with PS = 90 bar.
- regulators in series 5658E with PS = 140 bar.

CAUTION! The regulators in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

The regulator 5650E and 5658E is made up of an anodized aluminium machined body in which several holes and the injection seat allow the oil proper flow. The oil supply connection and the integrated solenoid valve armature are made from stainless steel.
In the body of the regulator there are:
- The electronic control unit board protected by a plastic cover that guarantees a degree of protection IP65. This board is connected to the outside of the body by two EN 175301-803 industrial standard Form C micro-connectors.
- The sight glass for visual control of the oil level

There are two symmetric versions of the electronic regulator:
- Version 5650E/11R and 5658E/07R with oil supply on the left side and sight glass on the right.
- Version 5650E/11L and 5658E/07L with the oil supply on the right side and the sight glass on the left.

Regulators 5650E and 5658E are sold with coil 24 VAC (A2 suffix) or with coil 220 VAC (A6 suffix).
On both sides of the regulator two membranes, related to four LED indicator lights, show the operation condition of the regulator.
The specific construction of the regulator makes it capable of minimizing emulsion and foaming phenomena of the refrigerant. Thus, during the oil injection phase, the correct level detection is always guaranteed.

OPERATION

The electronic regulators check the compressor oil level by using a combination of opto-electronic sensors. The level optical detection is based on light refraction phenomena since the light refraction is different if the glass prism is immersed in a liquid or in a gas.
The oil level control and relative alarm condition is governed by electronic control unit that can maintain the desired level by managing the number of “injection” and “waiting” cycles by operating the solenoid valve.
When a low level is detected, the electronic control unit commands the integrated solenoid valve. Incremental cycles inject oil into the compressor crankcase. Furthermore, the electronic control unit is equipped with an alarm relay capable of generating a cut-off signal for the compressor. Under normal operating conditions, this relay is energized. Otherwise, if the level remains low even after a specific number of injection cycles, an alarm signal is generated by switching OFF the relay.

PLEASE NOTE:
Under alarm condition, the injection cycles continue: the electronic control unit continues to command the integrated solenoid valve. If the opto-electric sensors detect that a correct oil level is again reached, the alarm is automatically reset and the regulator returns under normal operating conditions.

On both side of the regulator there are four LEDs that provide information about the operating conditions of the regulator. Specifically:
- “POWER” LED - GREEN

Remains always on when the regulator is correctly powered.
- “OIL GOOD” LED - GREEN

Remains on and steady when the oil level is correct.
Blinks when the level is low, but the injection cycles are not still active.
Off during active injection cycles.
- “OIL FILLING” LED - YELLOW

Off when the level measured is correct.
Blinks during the injection cycles with the solenoid valve open.
Remains on and steady during the injection cycles with the solenoid valve closed.
- “ALARM” LED - RED

Remains on and steady when the electronic controller triggers the alarm signal.
Off during the normal operating condition.

INSTALLATION

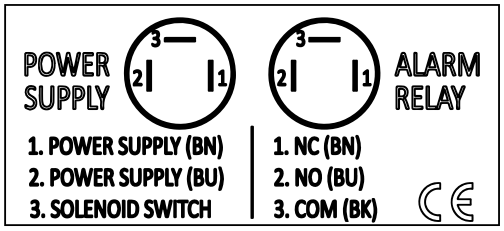
The electronic regulator must be horizontally assembled in order to guarantee a correct level detection. The coil, supplied in the regulator packaging, must be upwards oriented with a tolerance of +/- 1 degree from the vertical axis.
The regulator 5650E and 5658E cannot be directly coupled


Castel ITALY
Type
HF2
220-230 V~
50-60 Hz
8 W CL H
TA 50 °C
B
POWER
SUPPLY
C
Part Nr.
5650E/11RA6
Supply:
220 Vac-50/60 Hz
Serial Nr.
2021 03 0001
Relay: 3A - 250
Ts:
Ps: 90 bar
MADE IN ITALY
POWER
OIL GOOD
FILLING
ALARM

(without an adapter) to the compressor crankcase. This connection must always be performed using one of the following adapters, sold separately:
- 5690/X11: two-flange adapter with length of 83 mm; fixed one with 3 holes, mobile one with 4 holes.
- 5690/X12: adapter with mobile flange and 1.1/8" – 12 UNF threaded end.
- 5690/X13: adapter with mobile flange and 1.1/8" – 18 UNEF threaded end.
- 5690/X14: adapter mobile flange and 3/4" NPT threaded end.
- 5690/X15: two-flange adapter with length of 53 mm; fixed one with 3 holes, mobile one with 4 holes.
- 5690/X17: adapter, with mobile flange and 1.1/4" – 12 UNF swivel threaded end (rotalock).
- 5650E/X01: two-flange adapter with length of 53 mm; fixed one with 6 holes, mobile one with 4 holes.

During installation of the electronic regulator, make sure of:
- The gasket is fit between the adapter and the regulator and that it is well lubricated.
- The adapter fixing screws are tightened to the torque indicated in the instructions.
- The gaskets under the micro-connectors (power supply and alarms relay) are correctly positioned.
- The screw of the micro-connectors are tightened to the torque indicated in the instructions.
- The gaskets under the coil connector is correctly positioned and the coil connector is tightened to the torque indicated on the instructions.
- The electric connections are performed according to the wiring diagram on the instructions and on the front of the regulator.
- Upstream of the oil supply connection a strainer should be installed.

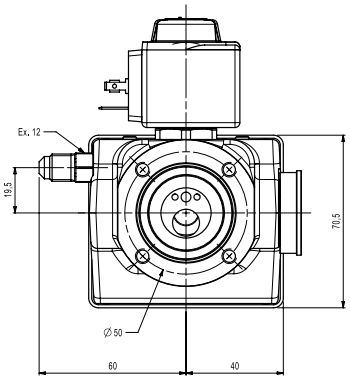
After the installation of the electronic regulator, make sure that the system has been correctly installed by performing a tightness test. Before powering the system, check the oil level in the regulator and in the compressor crankcase: it should be slightly above the sight-glass centre line.

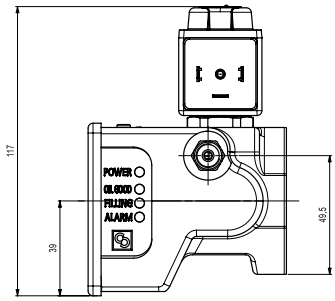


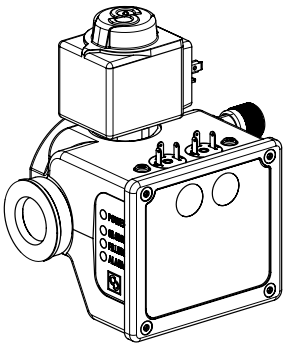
WIRING AND ELECTRIC CONNECTIONS

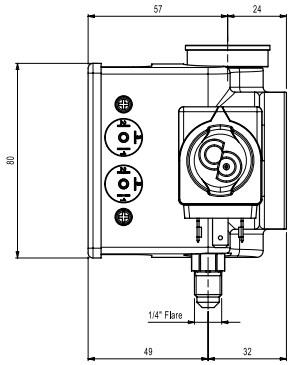
Wiring is performed using two co-moulded cables with DIN connectors to guarantee IP65 protection degree. One cable is used for power supply and the other cable is used for the alarm cut-off signals.
The cables length is 3 meters and the kit must be purchased separately (part. number 9901/X26). The kit is supplied with gaskets and fixing screws.
Electronic oil level regulator has two EN175301-803-C (9.4mm pitch) connectors on top.
During the alarm condition, the relay is switched OFF and the circuit is closed between contacts 1 (NC) and 3 (COM). During normal operation, the relay is switched ON and therefore the circuit is closed between contacts 2 (NO) and 3 (COM) (see the diagram).

5650E/R
5658E/R

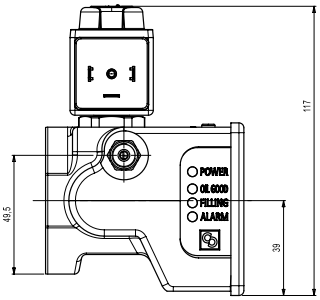


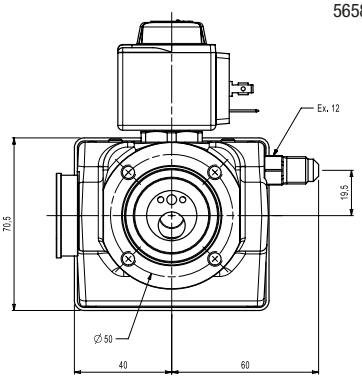


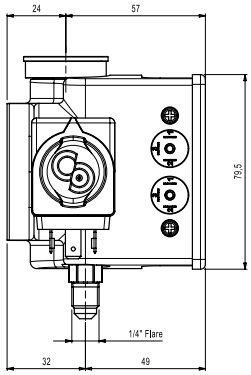


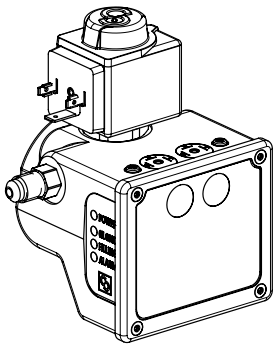


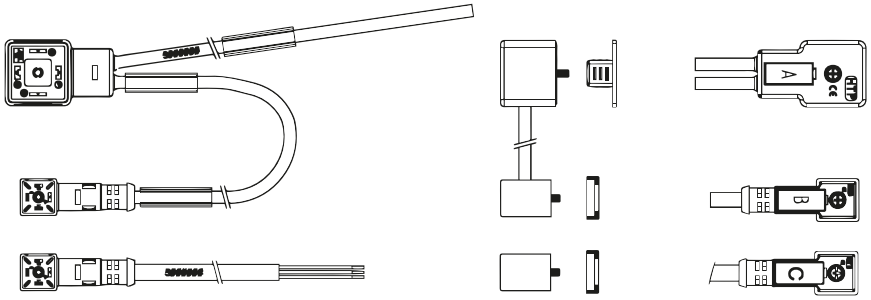
5650E/L
5658E/L

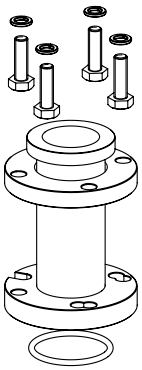




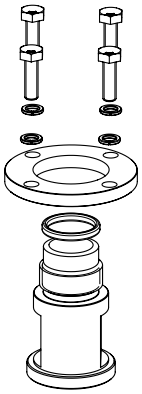




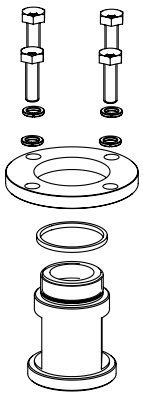




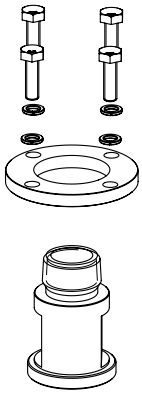
5690/X11
5690/x15



5690/X12



5690/X13



5690/X14

5690/X17

TABLE 1: GENERAL CHARACTERISTICS OF ELECTRONIC OIL LEVEL REGULATORS

Part number	Version	Connections		Cables kit (1)	Opening Pressure Differential [bar]		PS [bar]	TS [°C]		Weight [g]	Risk Category according to PED Recast
		Adapters	Oil inlet		Min	Max		Min	Max		
		(1)	SAE FLARE								
5650E/11RA2	Right	5690/X11 5690/X12 5690/X13 5690/X14 5690/X15 5690/X17 5690E/X01	3/8"	9901/X26	2	60	90	-30	+130	990	Art. 4.3
5650E/11RA6											
5650E/11LA2	Left										
5650E/11LA6											
5658E/07RA2	Right	5690/X11 5690/X12 5690/X13 5690/X14 5690/X15 5690/X17 5690E/X01	3/8"	9901/X26	2	100	140	-30	+130	990	Art. 4.3
5658E/07RA6											
5658E/07LA2	Left										
5658E/07LA6											

Note: (1) To be ordered separately

TABLE 2: ELECTRICAL CHARACTERISTICS

Part number	Voltage [V]	Voltage Tolerance [%]	Frequency [Hz]	Coil (1)					Degree of protection	Alarm contact	
				Tipo	Insulation class EN 60730	Power [W]	Coil consumption at 20 °C [mA]			Admissible load	Max voltage
							Start	Working			
5650E/11RA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527	IP 65	3A	250 V
5650E/11RA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			
5650E/11LA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527			
5650E/11LA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			
5658E/07RA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527	IP 65	3A	250 V
5658E/07RA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			
5658E/07LA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527			
5658E/07LA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			

Note: (1) Enclosed into the package

TABLE 3: CABLES KIT CHARACTERISTICS

Part number	Use		Degree of protection	Cable length [m]
9901/X26	A	Power supply cable	IP 65	3
	B	Coil cable		
	C	Alarms cable		

TABLE 4: ADAPTERS CHARACTERISTICS

Catalogue Number	Connections	PS [bar]	TS [°C]		weight [g]
			min	max	
5690/X11	Flanged with: 3 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 83 mm	140	-30	+130	506
5690/X12	Threaded 1-1,8" - 12 UNF				254
5690/X13	Threaded 1 - 1,8" - 18 UNEF				346
5690/X14	Threaded 3/4" - 14 NPT				246
5690/X15	Flanged with: 3 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 53 mm				405
5690/X17	Rotalock 1.1/4" - 12 UNF				390
5690E/X01	Flanged with: 6 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 53 mm				405

Based on the compressor make and model number, it's possible that an adapter may be required.
Please check the OEM compressor literature for specific requirements regard the need for an adapter

OIL CONTROL SYSTEMS

8.2 – OIL RESERVOIR PRESSURE VALVES

APPLICATIONS

The oil reservoir pressure valves in series 3150W 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 have been developed by Castel for all the applications that use trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
CAUTION! The check valves in this chapter cannot be used with other refrigerant fluids.

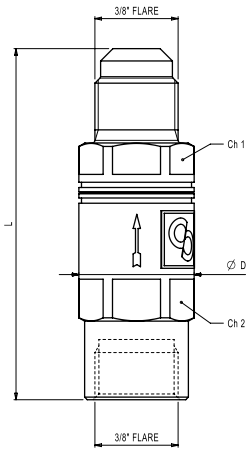
CONSTRUCTION

Castel manufactures three oil reservoirs pressure relief valves with different pressures. A higher-pressure differential will increase the oil flow rate from the oil reservoir back to the compressor crankcase. The selection of the model must consider both the individual compressor crankcase pressures as well as the differential pressure range of the oil regulators.
The main components of the valves are made with the following materials:
- Hot forged brass EN 12164 – CW 614N for body and cover valves series 3150W are equipped with laser welds between the body and the cover to ensure that the product is hermetically sealed.
- Austenitic stainless steel AISI 302 for the spring
- Laminated glass fibre fabric and PTFE for gasket seat seals

INSTALLATION

These valves are used to relieve pressure in the oil reservoir while maintaining a positive pressure differential between the reservoir and the compressor crankcase. This positive pressure ensures adequate oil supply to the oil level regulator. The calibrated pressure relief valve is mounted directly on the 3/8" SAE Flare connection of the reservoir and is piped to the suction line.

3150W/X04
3150W/X05
3150W/X06



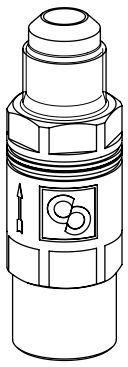


TABLE 5: GENERAL CHARACTERISTICS OF OIL RESERVOIR PRESSURE VALVES

Catalogue Number	SAE Flare Connections		Kv Factor [m3/h]	Pressure Differential [bar]	PS [bar]	TS [°C]		Dimensions and weights					Risk Category according to PED Recast
	IN	OUT				min.	max.	D	L	Ch1	Ch2	[g]	
3150W/X04	3/8"- F	3/8"- M	1,6	7	140	– 40	+150	35	96	32	32	395	Art. 4.3
3150W/X05				9									
3150W/X06				12									


3150/XO-F
140 bar

CHAPTER 8

OIL CONTROL SYSTEMS

8.3 – OIL INDICATORS

See: Chapter 7 - Paragraph 7.1

8.4 – STRAINERS

See: Chapter 7 - Paragraph 7.6 and 7.7

8.5 – NORMALLY CLOSED SOLENOID VALVES

See: Chapter 2 - Paragraph 2.1

VALVES

GOGREEN

R744 • NATURAL REFRIGERANT

VALVES

9.1 – VALVES WITH SCREW SHUTTER

APPLICATIONS

The valves with screw shutter 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 have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
CAUTION! The valves in this chapter cannot be used with other refrigerant fluids.

HERMETIC VALVES

The hermetic valves are two-way shut-off valves with SAE flare connections for types 6010E.
The main parts of these valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body.
- Steel, with proper surface protection, or brass for the spindle
- Ethylene propylene rubber (EPDM) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

RECEIVER VALVES

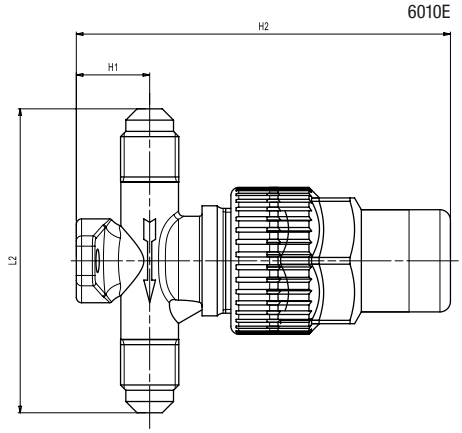
The receiver valves are two-way valves with square connections, SAE flare / ODS, types 6110E and 6120E.
The main parts of these valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body.
- Steel, with proper surface protection, for the spindle.
- Ethylene propylene rubber (EPDM) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

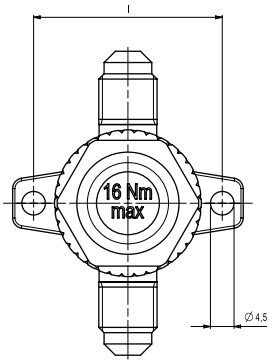
CAPPED VALVES

The capped valves are two-way shut-off valves with ODS connections, types 6420E.
The main parts of these valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Steel, with proper surface protection, for the spindle.
- Ethylene propylene rubber (EPDM) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

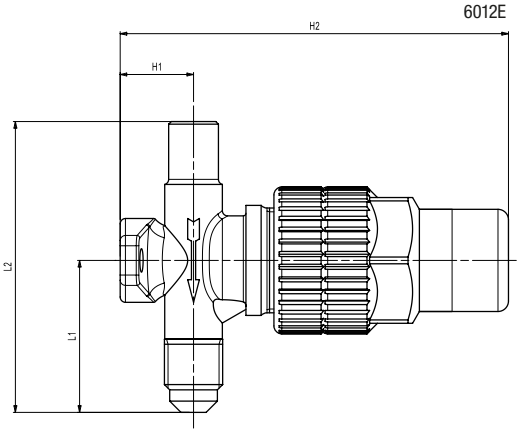
The brazing of capped valves should be carried out with care, using a low melting point filler material. It is necessary to remove the spindle assembly, including the packing gland before brazing the body. It is important to avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning of the valves.

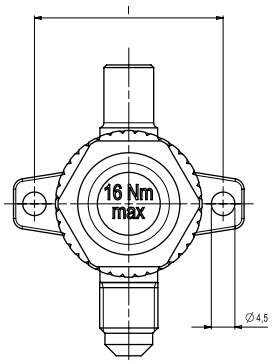
6010E





6012E





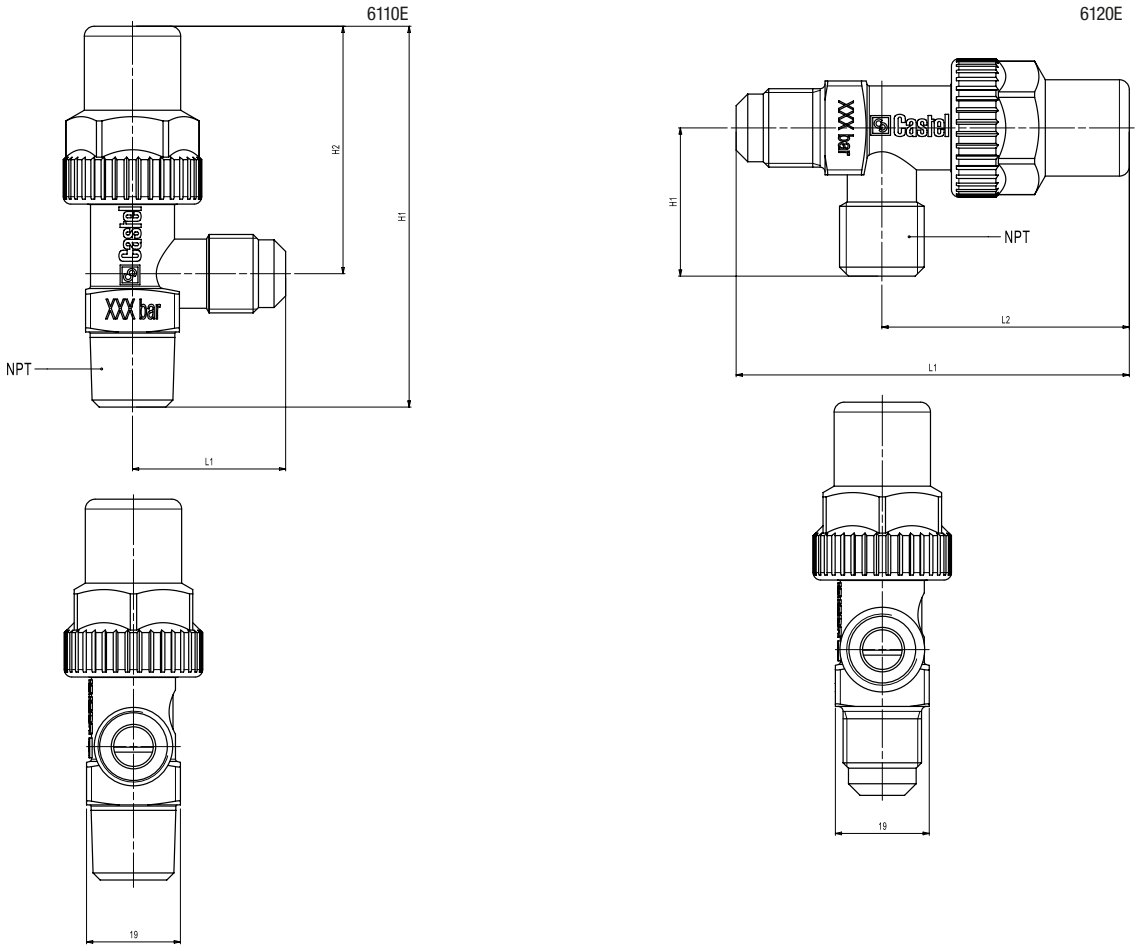


TABLE 1: GENERAL CHARACTERISTICS OF VALVES FOR HERMETIC SYSTEMS

Catalogue Number	Connections			Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare		ODS					
			Ø [in.]			min.	max.	
6010E/2	1/4"	1/4"	–	,27	140	-40	+130	Art. 4.3
6012E/22	1/4"	–	1/4"					

TABLE 2: DIMENSIONS AND WEIGHTS OF VALVES FOR HERMETIC SYSTEMS

Catalogue Number	Dimensions [mm]					Weight [g]
	H1	H2	I	L1	L2	
6010E/2	14	66	36	–	58	160
6012E/22				29	55,5	145

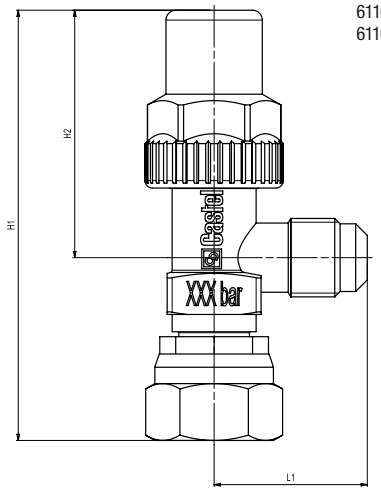
TABLE 3: GENERAL CHARACTERISTICS OF RECEIVER VALVES

Catalogue Number	Connections				Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare		NPT				min.	max.	
6110E/22	_	1/4"	1/4"	_	0,44	140	-40	+130	Art. 4.3
6110E/X02	_	_	1/4"	1/4" F					
6110E/X11	1/4"	1/4"	_	_					
6110E/X15	1/4" F	1/4"	_	_					
6110E/33	_	3/8"	3/8"	_	1,35				
6110E/X13	3/8" F	3/8"	_	_					
6110E/44	_	1/2"	1/2"	_	3,40				
6120E/22	_	1/4"	1/4"	_	0,44				
6120E/33	_	3/8"	3/8"	_	1,35				
6120E/44	_	1/2"	1/2"	_	3,40				

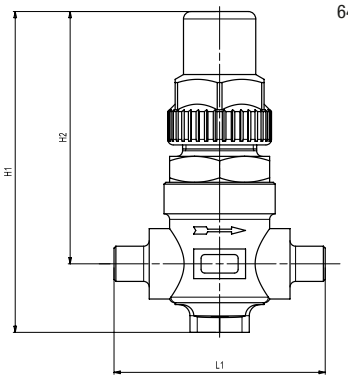
TABLE 4: DIMENSIONS AND WEIGHTS OF RECEIVER VALVES

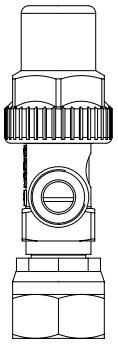
Catalogue Number	Dimensions [mm]				Weight [g]
	H1	H2	L1	L2	
6110E/22	72	48	27,5	–	110
6110E/X02					100
6110E/X11	90,5	58	28,5		230
6110E/X15	83	48	27,5		130
6110E/33	77	50	31		140
6110E/X13	87				175
6110E/44	92	55,5	34,5		235
6120E/22	27,5	–	72	48	110
6120E/33	30		80	50	140
6120E/44	33		93	55,5	305

6110E/X13
6110E/X15



6420E





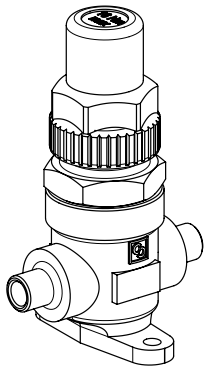


TABLE 5: GENERAL CHARACTERISTICS OF CAPPED VALVES

Catalogue Number	Connections		Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS Ø [in.]			min.	max.	
6420E/2	–	1/4"	0,40	120	-40	+130	Art. 4.3
6420E/3		3/8"	1,00				
6420E/3S3	3/8" - OUT	3/8" - IN					
6420E/4	–	1/2"	1,45				

TABLE 6: DIMENSIONS AND WEIGHTS OF CAPPED VALVES

Catalogue Number	Dimensions [mm]					Weight [g]
	H1	H2	L1	d	l	
6420E/2	85,5	67	57	4,5	38	300
6420E/3			61			305
6420E/3S3			67,5			
6420E/4			70			

VALVES

9.2 – TWO-WAYS VALVES WITH BALL SHUTTER

APPLICATIONS

The 2-ways valves with ball shutter in series 6570EL, 6570E, 6577E, 6578E and 6588E 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 have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The ball valves for plants that operate using refrigerant fluid R744 are the following:
- Valves in series 6570EL, PS = 60 bar for sub-critical plants.
- Valves in series 6570E, PS = 80 bar for trans-critical plants low and medium pressure sides.
- Valves in series 6577E, PS = 130 bar for trans-critical plants high-pressure side.
- Valves in series 6578E, PS = 140 bar for trans-critical plants high-pressure side.
- Valves in series 6588E, PS = 150 bar for trans-critical plants high-pressure side.

CAUTION! The ball valves in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

The specific design of 2-ways valves with ball shutter:
- ensures the internal pressure equilibrium when the valve is closed,
- permits the two-directional flow of the refrigerant
- prevents any risk of ejection or explosion of the spindle.

The electric welding of the body and the spindle gaskets ensure perfect hermetic seal of the valve.

The valves in series 6570EL, 6577E and 6578E are available without access fitting.
The valves in series 6570E and 6588E are available in two series:
- 6570E/XX and 6588E/XX without access fitting.
- 6570E/XXA and 6588E/XXA with access fitting. These valves are equipped with mechanism 8395/A4.

The main parts of 6570EL , 6570E, 6577E and 6578E are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body and the protective cap of the spindle
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball
- Copper pipe EN 12735-1 – Cu-DHP for welded connections in series 6570EL and 6570E.
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 6577E
- Stainless steel pipe AISI 304 for welded connections in series 6578E.
- Steel, with proper surface protection, for the spindle.
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- P.T.F.E. for the ball seat gaskets

The main parts of 6588E are made with the following materials:
- Cast stainless steel AISI 304 for the body, connections and the protective cap of the spindle.
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball.
- Steel, with proper surface protection, for the spindle.
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- P.T.F.E. for the ball seat gaskets

INSTALLATION

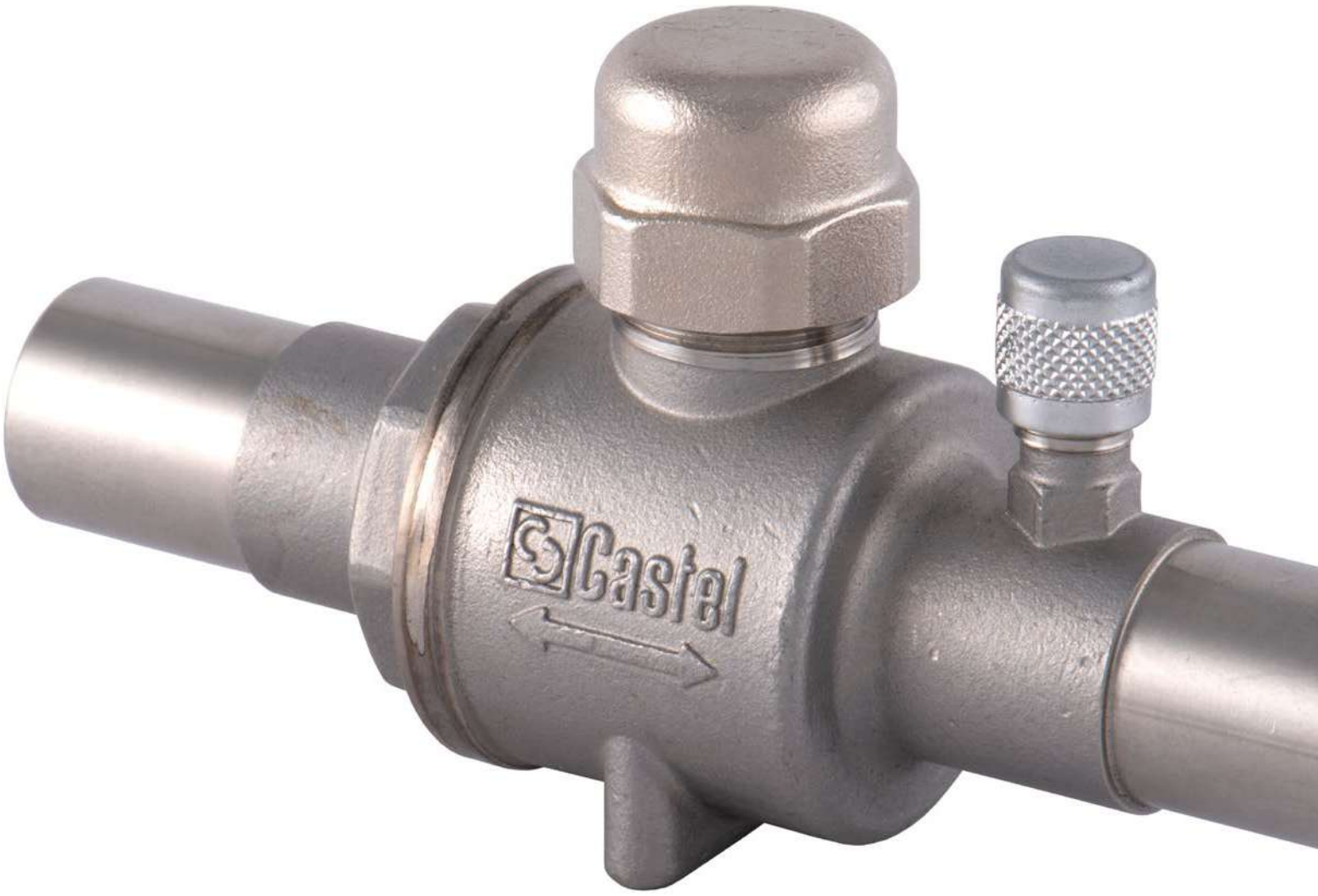
The 2-ways valves with ball shutter can be installed in all sections of a refrigerating system, in compliance with the limits and capacities indicated in Tables from 7 up to 12. These tables show the following functional characteristics of a valve with ball shutter.
- PS
- TS
- Kv factor

Copper connections: The brazing of valves with copper connections should be carried out with care, using a low melting point filler material (min. 5% Ag). It is not necessary to disassemble the valves, but it is 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.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.

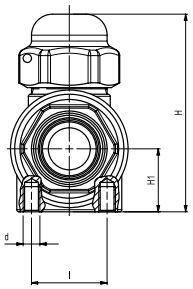
CERTIFICATIONS

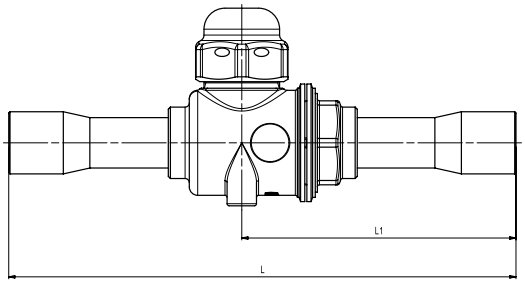
The American certification authority Underwriters Laboratories Inc. has approved valves with ball shutter with file SA33319. These valves are certified **UL Listed** for the USA, in compliance with American standard UL 207 with a Design Pressure of:
- 1160 PSI for valves in series 6570E
- 1740 PSI for valves in series 6577E/13 and 6578E/M48
- 1885 PSI for valves in series 6577E
- 2030 PSI for valves in series 6578E
- 2176 PSI for valves in series 6588E

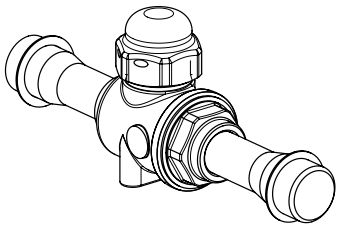
NB: valves 6577E/17, 6578E/M60 and 6578E/M73 are not UL approved.


Castel

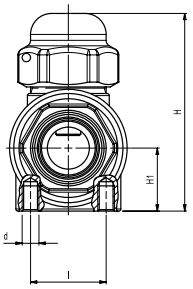
6570EL
6577E

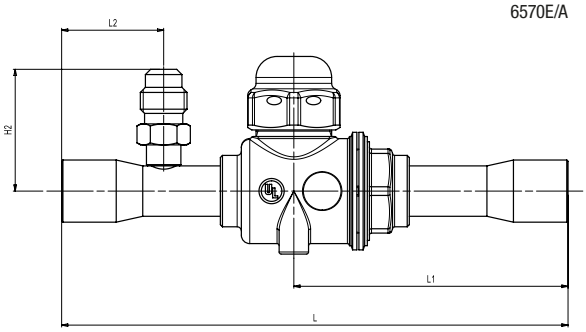


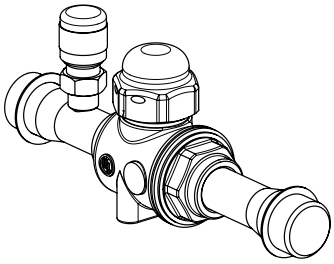




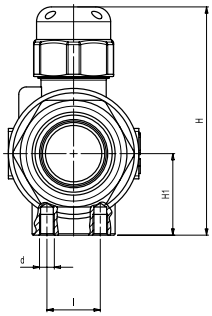
6570E/A

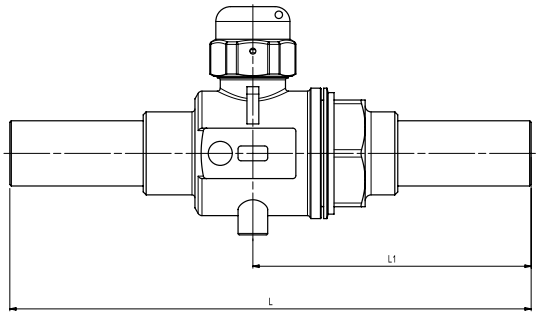


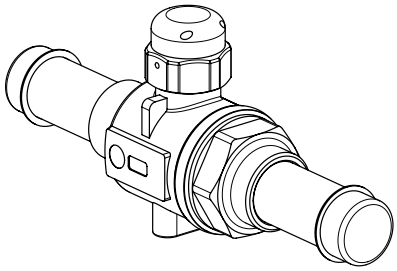




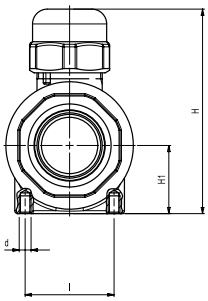
6588E

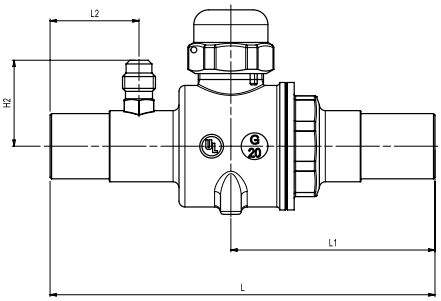






6588E/A





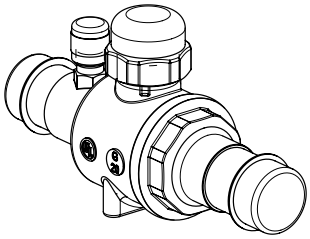


TABLE 7 GENERAL CHARACTERISTICS OF BALL VALVES WITH COPPER ODS CONNECTIONS

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS							
	Ø [in.]	Ø [mm]				min.	max.	
6570EL/M6	–	6	10	0,8	60	-40	+150	Art. 4.3
6570EL/2	1/4"	–						
6570EL/3	3/8"	–		3				
6570EL/M10	–	10						
6570EL/M12	–	12		5				
6570EL/4	1/2"	–						
6570EL/5	5/8"	16	15	17				
6570EL/M18	–	18						
6570EL/6	3/4"	–						
6570EL/7	7/8"	22	19	29				
6570EL/M28	–	28	25	51				
6570EL/9	1.1/8"	–						
6570EL/11	1.3/8"	35	32	86				
6570EL/13	1.5/8"	–	40	117				I
6570EL/M42	–	42						
6570EL/17	2.1/8"	54	50	214				

TABLE 8: GENERAL CHARACTERISTICS OF BALL VALVES WITH REINFORCED COPPER ODS CONNECTIONS

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS							
	Ø [in.]	Ø [mm]				min.	max.	
6570E/M6	–	6	10	0,8	80	-40	+150	Art. 4.3
6570E/2	1/4"	–						
6570E/3	3/8"	–		3				
6570E/M10	–	10						
6570E/M12	–	12		5				
6570E/4	1/2"	–						
6570E/5	5/8"	16	15	17				
6570E/M18	–	18						
6570E/6	3/4"	–						
6570E/7	7/8"	22	19	29				
6570E/M28	–	28	25	51				
6570E/9	1.1/8"	–						
6570E/11	1.3/8"	35	32	86				
6570E/13	1.5/8"	–	40	117				I
6570E/M42	–	42						
6570E/17	2.1/8"	54	50	214				

TABLE 9: GENERAL CHARACTERISTICS OF BALL VALVES WITH REINFORCED COPPER ODS CONNECTIONS, ACCESS FITTING

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS							
	Ø [in.]	Ø [mm]				min.	max.	
6570E/M6A	–	6	10	0,8	80	-40	+150	Art. 4.3
6570E/2A	1/4"	–						
6570E/3A	3/8"	–		3				
6570E/M10A	–	10						
6570E/M12A	–	12		5				
6570E/4A	1/2"	–						
6570E/5A	5/8"	16	15	17				
6570E/M18A	–	18						
6570E/6A	3/4"	–						
6570E/7A	7/8"	22	19	29				
6570E/M28A	–	28	25	51				
6570E/9A	1.1/8"	–						
6570E/11A	1.3/8"	35	32	86				
6570E/13A	1.5/8"	–	40	117				I
6570E/M42A	–	42						
6570E/17A	2.1/8"	54	50	214				

TABLE 10: GENERAL CHARACTERISTICS OF BALL VALVES WITH K65 COPPER ALLOY ODS CONNECTIONS

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS							
	Ø [in.]	Ø [mm]				min.	max.	
6577E/2	1/4"	–	10	0,8	130	-40	+150	Art. 4.3
6577E/3	3/8"	–		3				
6577E/4	1/2"	–		5				
6577E/5	5/8"	16	15	17				
6577E/6	3/4"	–						
6577E/7	7/8"	22	19	29				
6577E/9	1.1/8"	–	25	51				
6577E/11	1.3/8"	35	32	86				
6577E/13	1.5/8"	–	40	117				I
6577E/17	2.1/8"	54	50	214	120			

TABLE 11: GENERAL CHARACTERISTICS OF BALL VALVES WITH STAINLESS STEEL CONNECTIONS

Catalogue Number	Connections W Ø [mm]	Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C] min.	TS [°C] max.	Risk Category according to PED Recast
6578E/M6	6	10	0,8	140	-40	+150	Art. 4.3
6578E/M10	10		3				
6578E/M12	12		5				
6578E/M16	16	15	17				
6578E/M18	18						
6578E/M22	22	19	29				
6578E/M28	28	25	51				
6578E/M35	35	32	86				
6578E/M42	42	40	117				I
6578E/M48	48,3						
6578E/M60	60,3	50	214	120			
6578E/M73	73	60	380				

TABLE 12: GENERAL CHARACTERISTICS OF STAINLESS STEEL BALL VALVES

Catalogue Number	Connections W Ø [mm]	Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C] min.	TS [°C] max.	Risk Category according to PED Recast
6588E/M10	10	10	3	150	-40	+150	Art. 4.3
6588E/M12	12		5				
6588E/M16	16	15	17				
6588E/M18	18						
6588E/M22	22	19	29				
6588E/M28	28	25	51				
6588E/M35	35	32	86				
6588E/M42	42	40	117				I
6588E/M48	48,3						
6588E/M60	60,3	50	214				

TABLE 13: GENERAL CHARACTERISTICS OF STAINLESS STEEL BALL VALVES, ACCESS FITTING

Catalogue Number	Connections W Ø [mm]	Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C] min.	TS [°C] max.	Risk Category according to PED Recast
6588E/M10A	10	10	3	150	-40	+150	Art. 4.3
6588E/M12A	12		5				
6588E/M16A	16	15	17				
6588E/M18A	18						
6588E/M22A	22	19	29				
6588E/M28A	28	25	51				
6588E/M35A	35	32	86				
6588E/M42A	42	40	117				I
6588E/M48A	48,3						
6588E/M60A	60,3	50	214				

TABLE 14: REFRIGERANT FLOW CAPACITY OF BALL VALVES [KW]

Catalogue Number		Subcritical system			Transcritical system		
w/o access fitting	with access fitting	liquid line	suction line	hot gas line	gas cooler line	suction line	hot gas line
with copper connections							
6570EL/M6	-	21	4,2	16			
6570EL/2							
6570EL/3		80	16	61			
6570EL/M10							
6570EL/M12		134	27	101			
6570EL/4							
6570EL/5		456	90	343			
6570EL/M18							
6570EL/6							
6570EL/7		777	154	585			
6570EL/M28		1367	270	1029			
6570EL/9							
6570EL/11		2305	456	1735			
6570EL/13		3136	620	2361			
6570EL/M42							
6570EL/17		5735	1134	4319			
with reinforced copper connections							
6570E/M6	6570E/M6A	21	4,2	16		3,7	
6570E/2	6570E/2A						
6570E/3	6570E/3A	80	16	61		14	
6570E/M10	6570E/M10A						
6570E/M12	6570E/M12A	134	27	101		23	
6570E/4	6570E/4A						
6570E/5	6570E/5A	456	90	343		79	
6570E/M18	6570E/M18A						
6570E/6	6570E/6A						
6570E/7	6570E/7A	777	154	585		134	
6570E/M28	6570E/M28A	1367	270	1029		236	
6570E/9	6570E/9A						
6570E/11	6570E/11A	2305	456	1735		398	
6570E/13	6570E/13A	3136	620	2361		542	
6570E/M42	6570E/M42A						
6570E/17	6570E/17A	5735	1134	4319		991	

continue ⟶

TABLE 14: REFRIGERANT FLOW CAPACITY OF BALL VALVES [KW]

Catalogue Number		Subcritical system			Transcritical system		
w/o access fitting	with access fitting	liquid line	suction line	hot gas line	gas cooler line	suction line	hot gas line
with K65 copper alloy connections							
6577E/2					21	3,7	15
6577E/3					79	14	56
6577E/4					131	23	93
6577E/5					447	79	318
6577E/6							
6577E/7					762	134	542
6577E/9					1340	236	953
6577E/11					2259	398	1607
6577E/13					3074	542	2187
6577E/17					5622	991	4000
with stainless steel connections							
6578E/M6					21	3,7	15
6578E/M10					79	14	56
6578E/M12					131	23	93
6578E/M16					447	79	318
6578E/M18							
6578E/M22					762	134	542
6578E/M28					1340	236	953
6578E/M35					2259	398	1607
6578E/M42					3074	542	2187
6578E/M48							
6578E/M60					5622	991	4000
6578E/M73					9983	1759	7102
with stainless steel body / connections							
6588E/M10	6588E/M10A				79	14	56
6588E/M12	6588E/M12A				131	23	93
6588E/M16	6588E/M16A				447	79	318
6588E/M18	6588E/M18A						
6588E/M22	6588E/M22A				762	134	542
6588E/M28	6588E/M28A				1340	236	953
6588E/M35	6588E/M35A				2259	398	1607
6588E/M42	6588E/M42A				3074	542	2187
6588E/M48	6588E/M48A						
6588E/M60	6588E/M60A				5622	991	4000

Standard rating conditions according to AHRI Standard 760-2007 for subcritical systems		
Condensing temperature	30 °F	(- 1,2 °C)
Liquid temperature	20 °F	(- 6,7 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	- 20 °F	(- 28,9 °C)
Evaporator outlet temperature	- 10 °F	(- 23,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	- 5 °F	(-15 °C)
Suction line superheating	15 °R	(8,4 °K)
Discharge temperature	80 °F	(26,6 °C)

Standard rating conditions according to AHRI Standard 760-2007 for transcritical systems		
Gas-cooler outlet temperature	95 °F	(35 °C)
Evaporating temperature	14 °F	(- 10 °C)
Evaporator outlet temperature	23 °F	(- 5 °C)
Evaporator superheating	9 °R	(5 °K)
Suction line temperature	32 °F	(0 °C)
Suction line superheating	9 °R	(5 °K)
Discharge temperature	212 °F	(110 °C)

TABLE 15: DIMENSIONS AND WEIGHTS OF BALL VALVES

Catalogue Number		Dimensions [mm]								Weight [g]
w/o access fitting	with access fitting	H	H1	H2	L	L1	L2	l	d	
with copper connections										
6570EL/M6	-	47	15	-	121	65	-	18	M4	216
6570EL/2										
6570EL/3										
6570EL/M10										
6570EL/M12										
6570EL/4										
6570EL/5		54	19		139	73		25,5		333
6570EL/M18										
6570EL/6										
6570EL/7		70	23		175	94		30		610
6570EL/M28		78	27		203	109				834
6570EL/9										
6570EL/11		100	32		213	115		42	M6	1500
6570EL/13		114	39		242	130				2396
6570EL/M42										
6570EL/17		137	49		282	154		55		4260
with reinforced copper connections										
6570E/M6	6570E/M6A	47	15	29	121	65	24,5	18	M4	216
6570E/2	6570E/2A									
6570E/3	6570E/3A									
6570E/M10	6570E/M10A									
6570E/M12	6570E/M12A									
6570E/4	6570E/4A									
6570E/5	6570E/5A	55	19	32	139	73	30	25,5		333
6570E/M18	6570E/M18A									
6570E/6	6570E/6A									
6570E/7	6570E/7A	70	23	34	175	94	39,5	30		610
6570E/M28	6570E/M28A	78	27	37	203	109	45			834
6570E/9	6570E/9A									
6570E/11	6570E/11A	100	32	40,5	213	115	43,5	42	M6	1600
6570E/13	6570E/13A	114	39	44	242	130	48			2570
6570E/M42	6570E/M42A									
6570E/17	6570E/17A	137	49	50	282	154	61	55		4660
with K65 copper alloy connections										
6577E/2	-	47	15	-	115	62	-	18	M4	213
6577E/3					123	66				
6577E/4					121					
6577E/5		54	19		139	70		25,5		333
6577E/6										337
6577E/7		76	26		175	93		18	M5	754
6577E/9		82	28		208	111		30	M6	1104
6577E/11		100	32		213	115		42		1670
6577E/13		114	39		242	130				2614
6577E/17		137	49		282	154		55		4942

continue ⟶

TABLE 15: DIMENSIONS AND WEIGHTS OF BALL VALVES

Catalogue Number		Dimensions [mm]								Weight [g]
w/o access fitting	with access fitting	H	H1	H2	L	L1	L2	l	d	
with stainless steel connections										
6578E/M6	-	47	15	-	119	64	-	18	M4	210
6578E/M10					123	66				
6578E/M12										
6578E/M16		54	19		142	74		25,5		333
6578E/M18										
6578E/M22		76	26		176	94		18	M5	722
6578E/M28		82	28		208	111		30	M6	1035
6578E/M35		100	32		213	115		42		1610
6578E/M42		114	39		240	129				2442
6578E/M48					242	130				2650
6578E/M60		137	49		282	154		55		4800
6578E/M73		186	70		312	164		89	M8	12424
with stainless steel body / connections										
6588E/M10	6588E/M10A	48	15	24	108	50	28	18	M4	210
6588E/M12	6588E/M12A									
6588E/M16	6588E/M16A	55	19	27	126	66	30	25,5		322
6588E/M18	6588E/M18A									350
6588E/M22	6588E/M22A	69	23	29	130	69		30		600
6588E/M28	6588E/M28A	77,5	27	32	144	79				780
6588E/M35	6588E/M35A	100	32	35,5	160	85		42	M6	774
6588E/M42	6588E/M42A	114	39	39	185	100	35			
6588E/M48	6588E/M48A			42						
6588E/M60	6588E/M60A	138	49	49	214	119	30	55		

VALVES

9.3 – THREE-WAYS MANUAL VALVES WITH BALL SHUTTER

APPLICATIONS

The 3-ways manual 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 have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The 3-way valves for plants that operate using refrigerant fluid R744 are the following:
- valves in series 6690E and 6690/EB, PS = 80 bar for trans-critical plants low and medium pressure sides.
- valves in series 6697E and 6697EB, PS = 120 bar for trans-critical plants high-pressure side.
- valves in series 6698E and 6698EB, PS = 140 bar trans-critical plants high-pressure side.

CAUTION! The 3-way valves with ball shutter in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

The specific design of 3-ways valves with ball shutter prevents any risk of ejection or explosion of the spindle. The electric welding of the body and the spindle gaskets ensure perfect hermetic seal of the valve.
The main parts of these valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball
- Stainless steel EN 10088-3 – 1.4305 for spindles
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- PTFE for the ball seat gaskets
- Hot forged brass EN 12420 – CW 617N for the protective cap of the spindle
- Copper pipe EN 12735-1 – Cu-DHP for solder connections in series 6690E, 6690/EB
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 6697E, 6697/EB
- Stainless steel pipe AISI 304 for welded connections in series 6698E, 6698/EB

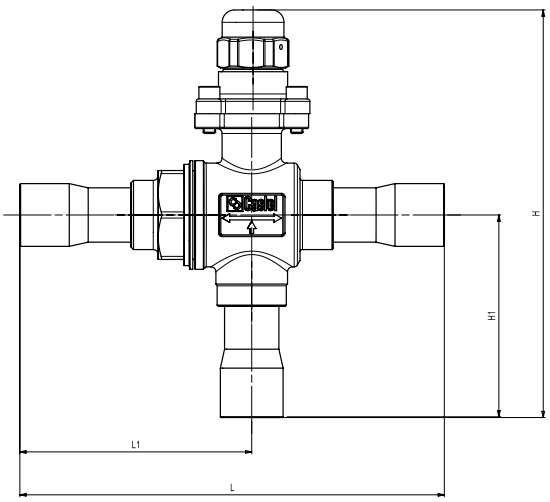
INSTALLATION

The 3-way valves with ball shutter act as changeover valves, not allowing for bi-direction flow of the refrigerant fluid. The input is always in the centre position, and the two outputs in the lateral positions.
These valves can be coupled with:
- Castel actuators in series 9700, 9720 and 9730
- actuators of other brands at disposal on the market

using specific flanged adapters between the two parts. To find the adapter to be used with Castel or other brands actuators, refer to the specific Castel brochure.
The actuator can be mounted on the valve in four different positions, oriented at 90° to each other. The 3-way ball valves can be mounted in any orientation and any limitations on their mounting must be found on the instructions of the actuator itself.
Copper connections: The brazing of valves with solder connections should be carried out with care, using a low melting point filler material (min.5 Ag). It is important to avoid direct contact between the torch flame and the valve body, which could be damaged and compromise the proper functioning of the entire valve.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.


Castel
Castel

FIG. 1



6690E
6697E
6698E

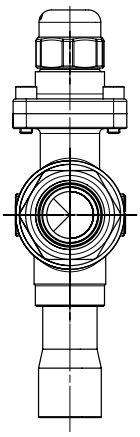
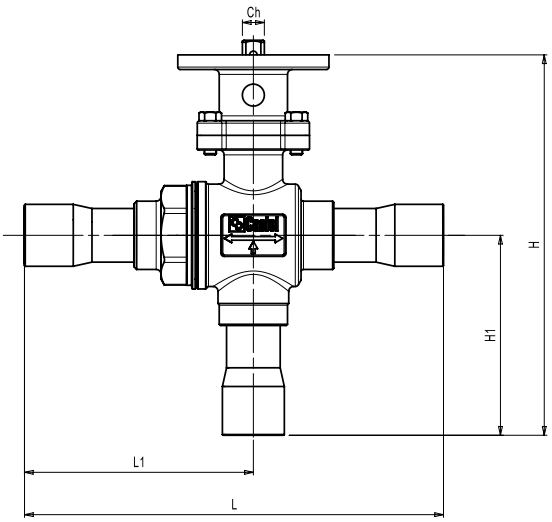


FIG. 2



6690EB
6697EB
6698EB

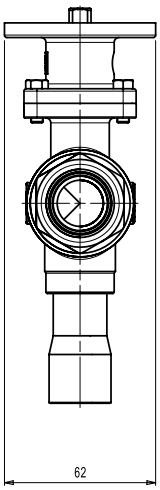


TABLE 16: GENERAL CHARACTERISTICS OF 3-WAYS MANUAL VALVES

Catalogue Number	Connections			Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS		W [mm]				min.	max.	
	Ø [in.]	Ø [mm]							
with reinforced copper ODS connections									
6690E/3	3/8"	-	–	13,5	4,6	80	-40	+150	Art. 4.3
6690E/M10	-	10							
6690E/M12	-	12							
6690E/4	1/2"	-							
6690E/5	5/8"	16							
6690E/M18	-	18							
6690E/6	3/4"	-							
6690E/7	7/8"	22		19	11				
6690E/M28	–	28		24	16				
6690E/9	1.1/8"	–		24	16				
6690E/11	1.3/8"	35		28	20,5				
6690E/13	1.5/8"	–		37	39				I
6690E/M42	–	42							
with K65 copper alloy ODS connections									
6697E/3	3/8"	-	–	13,5	4,6	130	-40	+150	Art. 4.3
6697E/4	1/2"	-							
6697E/5	5/8"	16							
6697E/6	3/4"	-							
6697E/7	7/8"	22		19	11				
6697E/9	1.1/8"	–		24	16				
6697E/11	1.3/8"	35		28	20,5				
6697E/13	1.5/8"	–		37	39				I
with stainless steel connections									
6698E/M10	–	–	10	13,5	4,6	140	-40	+150	Art. 4.3
6698E/M12			12						
6698E/M16			16						
6698E/M18			18						
6698E/M22			22	19	11				
6698E/M28			28	24	16				
6698E/M35			35	28	20,5				
6698E/M42			42	37	39				I

TABLE 17: DIMENSIONS AND WEIGHTS OF 3-WAYS MANUAL VALVE

Catalogue Number	Figure	Dimensions [mm]				Weight [g]
		H	H1	L	L1	
with reinforced copper ODS connections						
6690E/3	1	142	62	144	85	894
6690E/M10						
6690E/M12						899
6690E/4						
6690E/5		150	68	158	92	904
6690E/M18						909
6690E/6						
6690E/7		165	82	172	94	1210
6690E/M28		186	100	208	111	1540
6690E/9						
6690E/11		203	103	211	113	2117
6690E/13		226	121	240	127	3447
6690E/M42						
with K65 copper alloy ODS connections						
6697E/3	1	146	66	152	89	894
6697E/4		142	62	144	85	
6697E/5		150	68	158	92	949
6697E/6						959
6697E/7		165	82	172	94	1210
6697E/9		186	100	208	111	1610
6697E/11		204	101	211	113	2449
6697E/13		226	121	240	127	3660
with stainless steel connections						
6698E/M10	1	146	66	152	86	899
6698E/M12		142	62	144	85	909
6698E/M16		154	72	166	96	949
6698E/M18		154	72	166	96	959
6698E/M22		165	82	172	94	1180
6698E/M28		186	100	208	111	1600
6698E/M35		202	101	209	112	2250
6698E/M42		225	120	238	126	3290

TABLE 18: GENERAL CHARACTERISTICS OF 3-WAYS VALVES TO BE MOTORIZED

Catalogue Number	Connections			Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS		W [mm]				min.	max.	
	Ø [in.]	Ø [mm]							
with reinforced copper ODS connections									
6690EB/3	3/8"	-	–	13,5	4,6	80	-40	+150	Art. 4.3
6690EB/M10	-	10							
6690EB/M12	-	12							
6690EB/4	1/2"	-							
6690EB/5	5/8"	16							
6690EB/M18	-	18							
6690EB/6	3/4"	-							
6690EB/7	7/8"	22		19	11				
6690EB/M28	–	28		24	16				
6690EB/9	1.1/8"	–		24	16				
6690EB/11	1.3/8"	35		28	20,5				
6690EB/13	1.5/8"	–		37	39				I
6690EB/M42	–	42							
with K65 copper alloy ODS connections									
6697EB/3	3/8"	-	–	13,5	4,6	130	-40	+150	Art. 4.3
6697EB/4	1/2"	-							
6697EB/5	5/8"	16							
6697EB/6	3/4"	-							
6697EB/7	7/8"	22		19	11				
6697EB/9	1.1/8"	–		24	16				
6697EB/11	1.3/8"	35		28	20,5				
6697EB/13	1.5/8"	–		37	39				I
with stainless steel connections									
6698EB/M10	–	–	10	13,5	4,6	140	-40	+150	Art. 4.3
6698EB/M12			12						
6698EB/M16			16						
6698EB/M18			18						
6698EB/M22			22	19	11				
6698EB/M28			28	24	16				
6698EB/M35			35	28	20,5				
6698EB/M42			42	37	39				I

TABLE 19: DIMENSIONS AND WEIGHTS OF 3-WAYS VALVES TO BE MOTORIZED

Catalogue Number	Figure	Dimensions [mm]					Weight [g]
		H	H1	L	L1	Ch	
with reinforced copper ODS connections							
6690EB/3	2	92	62	144	85	9	575
6690EB/M10							575
6690EB/M12							580
6690EB/4							580
6690EB/5		100	68	158	92		585
6690EB/M18							590
6690EB/6							590
6690EB/7		156	82	172	94		1210
6690EB/M28		177	100	208	111		1540
6690EB/9							1540
6690EB/11		186	103	211	113	11	2117
6690EB/13		209	121	240	127		3447
6690EB/M42							
with K65 copper alloy ODS connections							
6697EB/3	2	96	68	152	89	9	575
6697EB/4		92	62	144	85		575
6697EB/5		100	68	158	92		630
6697EB/6							640
6697EB/7		156	82	172	94		1300
6697EB/9		177	100	208	111		1600
6697EB/11		186	103	211	113	11	2130
6697EB/13		209	121	240	127		3500
with stainless steel connections							
6698EB/M10	2	96	68	152	89	9	580
6698EB/M12		101	62	144	85		590
6698EB/M16		104	73	166	96		630
6698EB/M18		112	72				640
6698EB/M22		156	82	172	94		1400
6698EB/M28		177	100	208	111		1700
6698EB/M35		186	102	209	112	11	2230
6698EB/M42		209	120	238	126		3550

VALVES

9.4 – THREE-WAYS MOTORIZED VALVES WITH BALL SHUTTER

APPLICATIONS

The 3-ways motorized 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 have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.
The 3-way valves for plants that operate using refrigerant fluid R744 are the following:
- valves in series 6690EM, PS = 80 bar for trans-critical plants low and medium pressure sides.
- valves in series 6697EM, PS = 120 bar for trans-critical plants high-pressure side.
- valves in series 6698EM, PS = 140 bar trans-critical plants high-pressure side.

CAUTION! The 3-way valves with ball shutter in this chapter cannot be used with other refrigerant fluids.

CONSTRUCTION

The specific design of the 3-way valves with ball shutter in series 6690EM, 6697EM, 6698EM:
- Fixing flange with 4 holes
- Extended spindle
- No mechanical stops on the spindle rotation (OPEN and CLOSED positions)

makes them suitable for operating only when coupled with actuators in series 9700, 9720 and 9730. For this reason, these valves are always sold including the actuators and relative fixing plate in versions with suffix A2 (24 VAC) or suffix A6 (230 VAC).

3-ways valves in series 6690EM, 6697EM, and 6698EM cannot be used without an actuators.

The electric welding of the body and the seal gaskets, assembled on the spindle, ensure perfect hermetic seal of the valve. The spindle construction eliminates the danger of explosion/expulsion.
The main parts of these valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for the body
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball
- Stainless steel EN 10088-3 – 1.4305 for spindles
- Ethylene propylene rubber (EPDM) for outlet seal gaskets
- PTFE for the ball seat gaskets
- Hot forged brass EN 12420 – CW 617N for the protective cap of the spindle
- Copper pipe EN 12735-1 – Cu-DHP for solder connections in series 6690EM
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 6697EM
- Stainless steel pipe AISI 304 for welded connections in series 6698EM

INSTALLATION

The 3-way valves with ball shutter act as changeover valves, not allowing for bi-direction flow of the refrigerant fluid. The input is always in the centre position, and the two outputs in the lateral positions. These valves are coupled directly to actuators and do not require a flanged adapter between the two parts. The actuator can be mounted on the valve in four different positions, oriented at 90° to each other.
The 3-way valves in series: 6690EM, 6697EM, and 6698EM can be mounted:
- With horizontal output connections and vertical input connection, facing downward.
- With vertical output connections and horizontal input connection.

The actuator for the 3-way valves can never be mounted:
- Upside-down, oriented facing downward
- Vertically, with the cable oriented upwards

Once the valve / actuator has been coupled, remote movement of the valve is possible. In the event power is cut-off, the valve can be operated manually, excluding the actuator with a release clutch.
The actuators 9700 and 9720 can be equipped with auxiliary contacts in series 9750, sold separately. For more information on the actuators , please see Chapter 8.5.

Copper connections: The brazing of valves with solder connections should be carried out with care, using a low melting point filler material (min.5 Ag). It is important to avoid direct contact between the torch flame and the valve body, which could be damaged and compromise the proper functioning of the entire valve.
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.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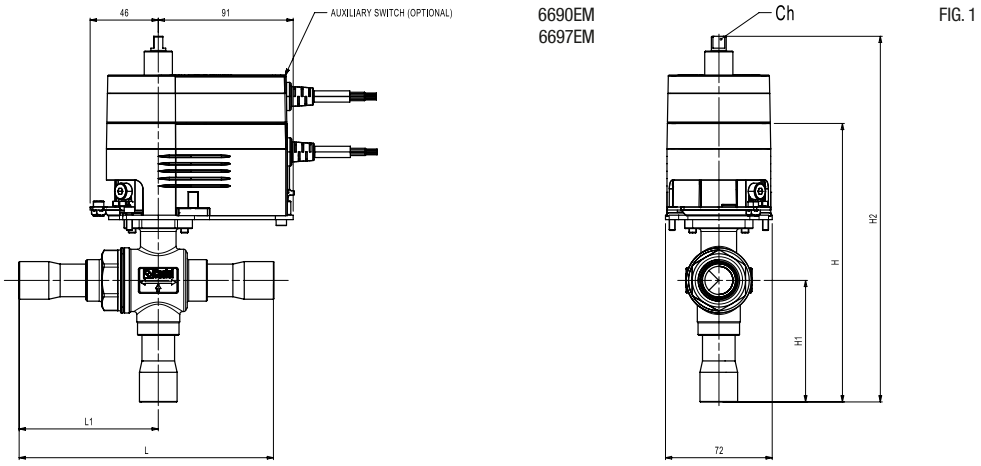


FIG. 1

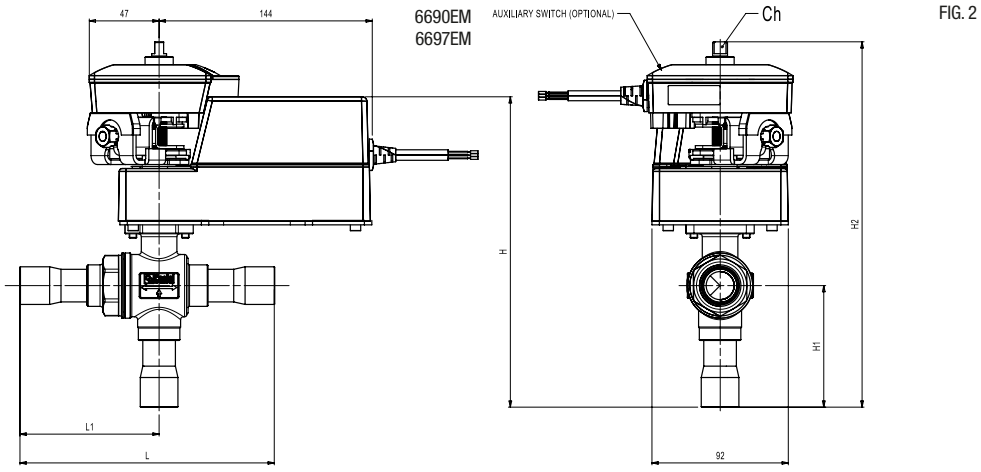


FIG. 2

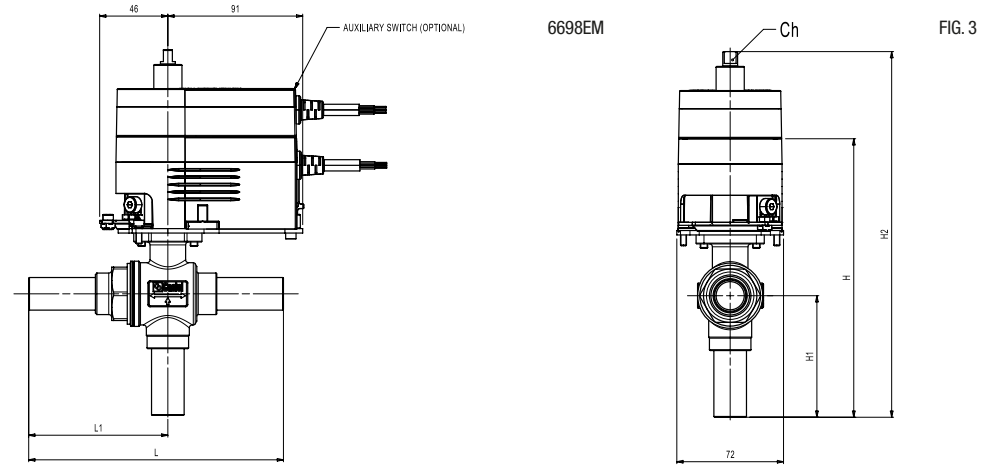


FIG. 3

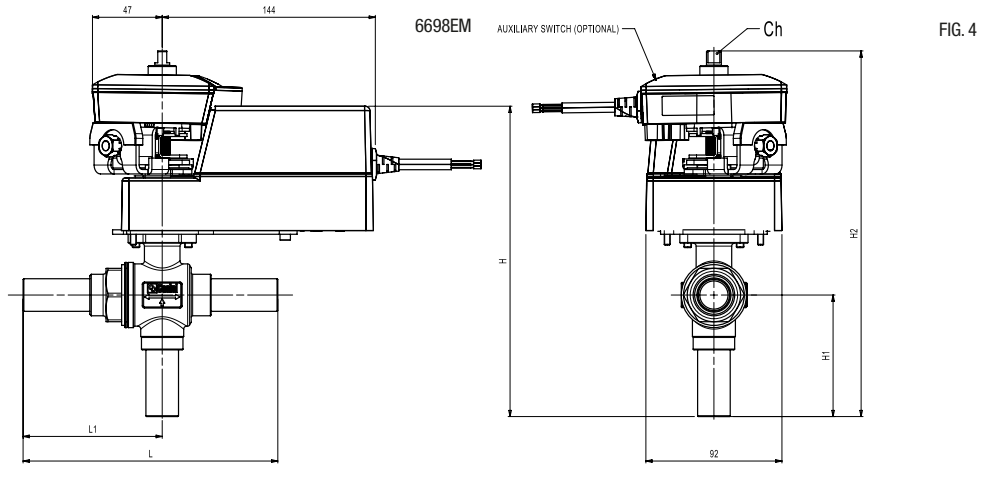


FIG. 4

TABLE 20: ELECTRICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Active Power {W}		Apparent Power [VA]		Cable 1 m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/ Close)	Continuos output (0 - 10V)	
with reinforced copper ODS connections											
6690EM/3A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/3A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M10A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M10A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M12A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M12A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/4A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/4A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/5A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/5A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M18A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M18A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/6A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/6A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/7A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M28A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M28A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/9A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/9A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/11A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/11A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6690EM/13A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/13A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M42A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M42A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43

continue ⟶

TABLE 20: ELECTRICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Active Power {W]		Apparent Power [VA]		Cable 1 m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/ Close)	Continuos output (0 - 10V)	
with K65 copper alloy ODS connections											
6697EM/3A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/3A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/4A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/4A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/5A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/5A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/6A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/6A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/7A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/9A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/9A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/11A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/11A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6697EM/13A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/13A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
with stainless steel connections											
6698EM/M10A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M10A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M12A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M12A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M16A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M16A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M18A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M18A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M22A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M22A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M28A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M28A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M35A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M35A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M42A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M42A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43

TABLE 21: ELECTRICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Active Power (W]		Apparent Power [VA]		Cable 1 m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/Close)	Continuos output (0 - 10V)	
with reinforced copper ODS connections											
6690EM/3A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/3A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M10A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M10A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M12A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M12A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/4A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/4A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/5A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/5A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M18A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M18A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/6A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/6A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/7A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M28A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M28A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/9A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/9A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6690EM/11A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/11A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6690EM/13A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/13A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6690EM/M42A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6690EM/M42A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43

continue ⟶

TABLE 21: ELECTRICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Active Power [W]		Apparent Power [VA]		Cable 1 m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/Close)	Continuos output (0 - 10V)	
with K65 copper alloy ODS connections											
6697EM/3A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/3A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/4A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/4A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/5A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/5A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/6A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/6A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/7A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/9A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/9A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6697EM/11A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/11A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6697EM/13A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6697EM/13A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
with stainless steel connections											
6698EM/M10A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M10A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M12A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M12A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M16A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M16A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M18A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M18A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M22A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M22A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M28A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M28A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M35A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M35A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43
6698EM/M42A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm2	YES	YES	IP 54
	24 D.C.	+20 / -20	_								
6698EM/M42A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75 mm2	YES	NO	IP 43

TABLE 22: REFRIGERANT FLOW CAPACITY OF 3-WAYS VALVES [KW]

Catalogue Number			Kv	Subcritical system			Transcritical system		
manual	to be motorized	motorized		liquid line	suction line	hot gas line	gas cooler line	suction line	hot gas line
Rese unitarie				26,80	5,30	20,18	26,27	4,63	18,69
with reinforced copper ODS connections									
6690E/3	6690EB/3	6690EM/3	4,6	123	24,4	93		21,3	
6690E/M10	6690EB/M10	6690EM/M10	4,6	123	24,4	93		21,3	
6690E/M12	6690EB/M12	6690EM/M12	4,6	123	24,4	93		21,3	
6690E/4	6690EB/4	6690EM/4	4,6	123	24,4	93		21,3	
6690E/5	6690EB/5	6690EM/5	4,6	123	24,4	93		21,3	
6690E/M18	6690EB/M18	6690EM/M18	4,6	123	24,4	93		21,3	
6690E/6	6690EB/6	6690EM/6	4,6	123	24,4	93		21,3	
6690E/7	6690EB/7	6690EM/7	11	295	58,3	222		50,9	
6690E/M28	6690EB/M28	6690EM/M28	16	429	84,8	323		74,1	
6690E/9	6690EB/9	6690EM/9	16	429	84,8	323		74,1	
6690E/11	6690EB/11	6690EM/11	20,5	549	108,7	414		94,9	
6690E/13	6690EB/13	6690EM/13	39	1045	206,7	787		180,6	
6690E/M42	6690EB/M42	6690EM/M42	39	1045	206,7	787		180,6	
with K65 copper alloy ODS connections									
6697E/3	6697EB/3	6697EM/3	4,6				121	21,3	86
6697E/4	6697EB/4	6697EM/4	4,6				121	21,3	86
6697E/5	6697EB/5	6697EM/5	4,6				121	21,3	86
6697E/6	6697EB/6	6697EM/6	4,6				121	21,3	86
6697E/7	6697EB/7	6697EM/7	11				289	50,9	206
6697E/9	6697EB/9	6697EM/9	16				420	74,1	299
6697E/11	6697EB/11	6697EM/11	20,5				539	94,9	383
6697E/13	6697EB/13	6697EM/13	39				1025	180,6	729
with stainless steel connections									
6698E/M10	6698EB/M10	6698EM/M10	4,6				121	21,3	86
6698E/M12	6698EB/M12	6698EM/M12	4,6				121	21,3	86
6698E/M16	6698EB/5	6698EM/5	4,6				121	21,3	86
6698E/M18	6698EB/M18	6698EM/M18	4,6				121	21,3	86
6698E/M22	6698EB/M22	6698EM/M22	11				289	50,9	206
6698E/M28	6698EB/M28	6698EM/M28	16				420	74,1	299
6698E/M35	6698EB/M35	6698EM/M35	20,5				539	94,9	383
6698E/M42	6698EB/M42	6698EM/M42	39				1025	180,6	729

Standard rating conditions according to AHRI Standard 760-2007 for subcritical system		
Condensing temperature	30 °F	(- 1,2 °C)
Liquid temperature	20 °F	(- 6,7 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	- 20 °F	(- 28,9 °C)
Evaporator outlet temperature	- 10 °F	(- 23,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	- 5 °F	(-15 °C)
Suction line superheating	15 °R	(8,4 °K)
Discharge temperature	80 °F	(26,6 °C)

Standard rating conditions according to AHRI Standard 760-2007 for transcritical system		
Gas-cooler outlet temperature	95 °F	(35 °C)
Evaporating temperature	14 °F	(- 10 °C)
Evaporator outlet temperature	23 °F	(- 5 °C)
Evaporator superheating	9 °R	(5 °K)
Suction line temperature	32 °F	(0 °C)
Suction line superheating	9 °R	(5 °K)
Discharge temperature	212 °F	(110 °C)

TABLE 23: DIMENSIONS AND WEIGHTS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Figure	Dimensions [mm]						Weight [g]
		H	H1	H2 (1)	L	L1	Ch	
with reinforced copper ODS connections								
6690EM/3A2	1	158	62	190	144	85	-	1,4
6690EM/3A6	2	179		201				2,3
6690EM/M10A2	1	158		190				1,4
6690EM/M10A6	2	179		201				2,3
6690EM/M12A2	1	158		190				1,4
6690EM/M12A6	2	179		201				2,3
6690EM/4A2	1	158		190				1,4
6690EM/4A6	2	179		201				2,3
6690EM/5A2	1	165	68	197	158	92		1,4
6690EM/5A6	2	186		208				2,3
6690EM/M18A2	1	165		197				1,4
6690EM/M18A6	2	186		208				2,3
6690EM/6A2	1	165		197				1,4
6690EM/6A6	2	186		208				2,3
6690EM/7A2	1	188	82	246	172	94	6	2,6
6690EM/7A6	2	210		246				2,7
6690EM/M28A2	1	210	100	268	208	111		3,5
6690EM/M28A6	2	231		268				3,6
6690EM/9A2	1	210	100	268	208	111		3,5
6690EM/9A6	2	231		268				3,6
6690EM/11A2	2	240	103	273	211	113	10	4,2
6690EM/11A6	2							4,3
6690EM/13A2	2	263	121	296	240	127		5,2
6690EM/13A6	2							5,3
6690EM/M42A2	2	263	121	296	240	127		5,2
6690EM/M42A6	2							5,3
with K65 copper alloy ODS connections								
6697EM/3A2	1	162	66	194	152	89	-	1,4
6697EM/3A6	2	183		205				2,3
6697EM/4A2	1	158	62	190	144			1,4
6697EM/4A6	2	179		201				2,3
6697EM/5A2	1	165	68	197	158	92		1,4
6697EM/5A6	2	186		208				2,4
6697EM/6A2	1	165		197				1,4
6697EM/6A6	2	186		208				2,4
6697EM/7A2	1	188	82	246	172	94	6	2,8
6697EM/7A6	2	210		246				3,0
6697EM/9A2	1	210	100	268	208	111		3,7
6697EM/9A6	2	231		268				3,9
6697EM/11A2	1	240	103	273	211	113	10	4,5
6697EM/11A6	2							4,6
6697EM/13A2	1	263	121	296	240	127		5,5
6697EM/13A6	2							5,6

(1): total height with optional auxiliary contact

continue ⟶

TABLE 23: DIMENSIONS AND WEIGHTS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Figure	Dimensions [mm]						Weight [g]
		H	H1	H2 (1)	L	L1	Ch	
with stainless steel connections								
6690EM/M10A2	3	162	66	194	152	89	-	1,4
6690EM/M10A6	4	183		205				2,3
6690EM/M12A2	3	158	62	190	144	85		1,4
6690EM/M12A6	4	179		201				2,3
6690EM/M16A2	3	169	72	201	166	96		1,4
6690EM/M16A6	4	190		212				2,4
6690EM/M18A2	3	169		201				1,4
6690EM/M18A6	4	190		212				2,4
6698EM/M22A2	3	188	82	246	172	94	6	2,8
6698EM/M22A6	4	210		246				3,0
6698EM/M28A2	3	210	100	268	208	111		3,7
6698EM/M28A6	4	231		268				3,9
6698EM/M35A2	4	240	103	273	211	113	10	4,5
6698EM/M35A6	4							4,6
6698EM/M42A2	4	263	121	296	240	127		5,5
6698EM/M42A6	4							5,6

(1): total height with optional auxiliary contact

APPLICATIONS

The actuators in series 9700, 9720, 9730 and 9740 can be assembled using suitable flanged connections (to be purchased separately) to:
- 2-way valves with ball shutter in series 6570EL, 6570E, 6577E, 6578E and 6588E.
- 3-way manual valves with ball shutter in series 6690E, 6690EB, 6697E, 6697EB, 6598E and 669EB.

Once this coupling has been performed, the valves can be opened or closed remotely. Alternatively, the actuator can be excluded and the valve operated manually.
The actuators in series 9700 and 9720 are also included in the package of 3-way motorized valve with ball shutter in series 6690EM, 6697EM and 6698E.

CONSTRUCTION

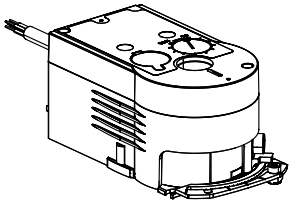
Actuators in series 9700 and 9720: Casing in two parts of self-extinguishing synthetic material, lower part black, upper part blue. The upper part of the casing holds the actual motor (step or synchronous) and all control and cut-out electronics based on the torque. The lower part of the casing holds the gear reducer, which requires no maintenance, and the self-centring fixing system for the spindle.
Note: If the casing is opened and tampered with, any and all the guarantees by Castel will be null and void. In the event of a power outage to the actuator, the gear reducer can be disengaged using the specific lever or a button to permit manual use of the valve.
Actuators in series 9730: Casing in two parts of self-extinguishing synthetic black material with light gray cover. Inside the enclosure is contained the actual motor (step-by-step), the gear reducer, which requires no maintenance, and all control and cut-out electronics based on the torque.
Note: If the casing is opened and tampered with, any and all the guarantees by Castel will be null and void. In the event of a power outage to the actuator, the gear reducer can be disengaged using the specific lever to permit manual use of the valve.
Actuators in series 9740: Casing in two parts of self-extinguishing synthetic material, lower part black, upper part red. The upper part of the casing holds the actual motor (step or synchronous) and all control and cut-out electronics based on the torque. The lower part of the casing holds the gear reducer, which requires no maintenance, and the star fixing system for the spindle.
Note: If the casing is opened and tampered with, any and all the guarantees by Castel will be null and void. In the event of a power outage to the actuator, the gear reducer can be disengaged using the emergency manual override, under the position round indicator.
The actuators in series 9700, 9720 and 9730 have a maximum rotational angle of 95°, allowed by the mechanical construction. Models 9700/RA6, 9720/RA2, 9720/RA6, 9730RA2, and 9730/RA6 are factory set for a maximum stroke of 90°. In model 9700/RA2, the maximum stroke of 90° must be set by the customer, following the instructions.
The actuators in series 9740 have a maximum rotational angle of 90°, allowed by the mechanical construction and the maximum stroke must be set by the customer, following the instructions.
The housings of actuators 9700/RA6 and 9720/RA6 have an IP43 protection rating according to EN 60529, and a Class II electric shock protection rating according to EN 60730-1. In the event of outdoor installation, it is recommended that the actuators be protected from the weather.
The housings of actuators 9700/RA2, 9720/RA2, 9730/RA2 and 9730/RA6 have an IP54 protection rating according to EN 60529, and a Class III electric shock protection rating according to EN 60730-1.In the event of outdoor installation, it is recommended that the actuators be protected from the weather.
The housings of actuators 9740 have an IP66 protection rating according to EN 60529, and a Class II electric shock protection rating according to EN 60730-1.
To install the actuators on the valves and cable them, follow the instructions provided in the package.

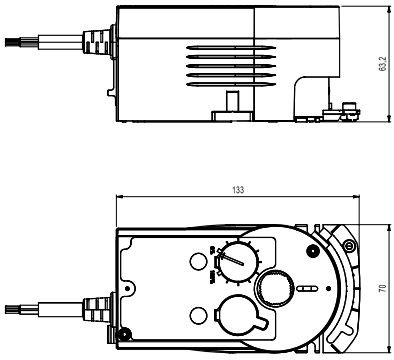
CERTIFICATIONS

Actuator powered with 230 VAC are compliant with the Low Voltage Directive, 2006/95/EC.
All actuators in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).
The American certification authority Underwriters Laboratories Inc. has approved the actuators in series 9740.

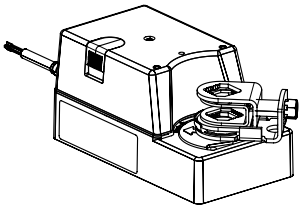

Castel
Manufactured by
SAUTER
9720/RA2
SWISS MADE
24V~ 50...60Hz 5VA
90° 120(240)V 30Nm
-20T55 IP54
A1446
1 2a 2b Y U
blue brown black red 3 44
in Y 0...10V = / out U 0...10V =

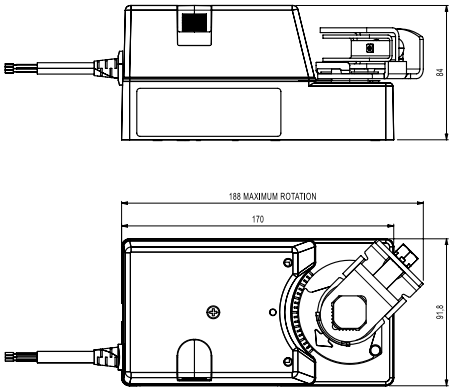
9700/RA2



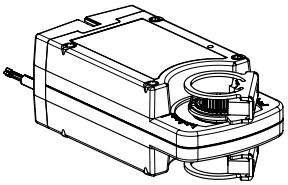


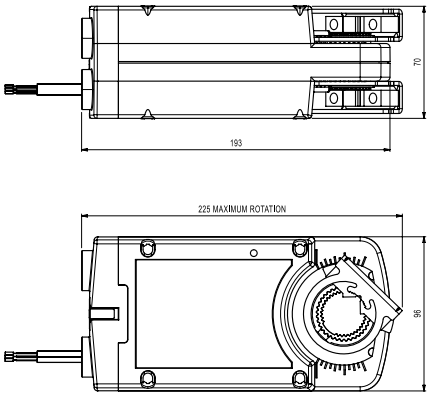
9700/RA6
9720/RA2
9720/RA6



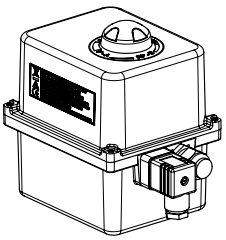


9730/RA2
9730/RA6





9740/RA2
9740/RA6



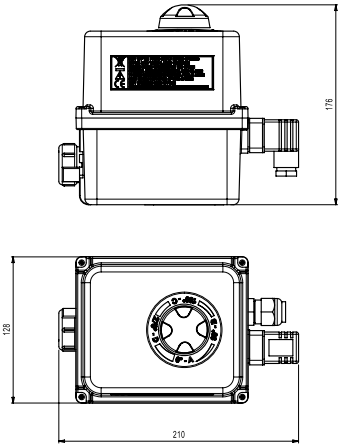


TABLE 24: GENERAL CHARACTERISTICS OF ACTUATORS

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequecy [Hz]	Active Power {W}		Apparent Power [VA]		Torque [Nm]	Running Time [sec]	Rotation Angle	Wiring Connections		Auxiliary switches	Protection Degree	TA [°C]	
				Operation	Standstill	Operation	Standstill				Switching output 2 point (Open/ Close)	Continuos output (0 - 10V)			min.	max.
9700/RA2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	10	60	90	YES	YES	external see tab. 22	IP 54	-20	+50
	24 D.C.	+20 / -20	_													
9700/RA6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1				YES	NO		IP 43		
9720/RA2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	30	120		YES	YES	external see tab. 22	IP 54		
	24 D.C.	+20 / -20	_													
9720/RA6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7				YES	NO		IP 43		
9730/RA2	24 A.C.	+20 / -20	50 / 60	13,5	1,5	16,5	ND	60	150		NO	YES	internal	IP 54	-30	+50
	24 D.C.	+20 / -20	_													
9730/RA6	230 A.C.	+15 / -15	50 / 60	13	2,0	20	ND				YES	NO		IP 54		
9740/RA2	24 A.C.	+20 / -20	50 / 60	45	ND	60	ND	100	120		NO	YES	internal	IP 66	-10	55
	24 D.C.	+20 / -20	_													
9740/RA6	230 A.C.	+10 / -10	50 / 60	45	ND	60	ND	100	120		YES	NO		IP 66		
	230 D.C.	+10 / -10	_													

APPLICATIONS

Auxiliary contacts in series 9750 are accessories to be used with actuators in series 9700 and 9720. They are double switching contacts and can be set to any position between 0° and 90°. No auxiliary contacts are at disposal for actuators in series 9730.

CONSTRUCTION

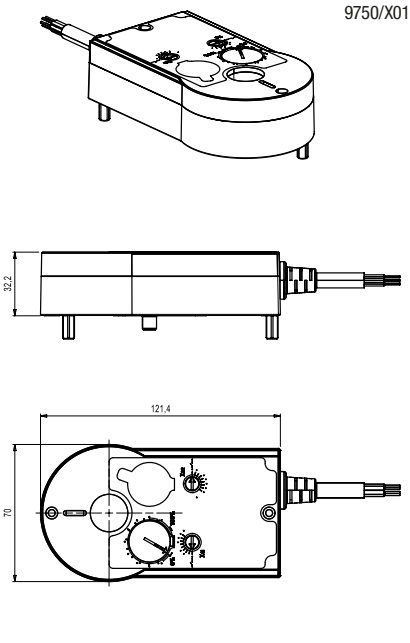
Casing in two parts of self-extinguishing synthetic material, lower part black, upper part yellow.
Note: If the casing is opened and tampered with, any and all the guarantees by Castel will be null and void.
Functional limits of the contacts: admissible load 5A, voltage 250 VAC.

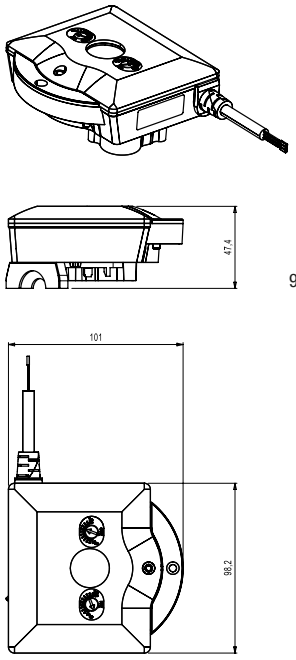
Contact 9750/X01 has an IP54 protection rating according to EN 60529, and a Type 1C classification for automatic operation according to EN 60730-1.
Contact 9750/X02 has an IP40 protection rating according to EN 60529, and a Type 1C classification for automatic operation according to EN 60730-1.
In the event of outdoor installation, it is recommended that the contacts be protected from the weather.

OPERATION

To install the contacts on the actuators and cable them, follow the instructions provided in the package carefully. The settings for the switching positions must be performed using the two trimmers present on the yellow cover (see the instructions).

9750/X01





9750/X02

TABLE 25: GENERAL CHARACTERISTICS OF AUXILIARY SWITCHS

Catalogue Number	Designed for actuator	Contact type	Admissible load	Voltage Range	Cable	Protection Degree	TA [°C]	
							min.	max.
9750/X01	9700/RA2	double	5(2) A	24 ÷ 230 V	6 x 0,5 mm² 1 m	IP 54	-20	+50
9750/X02	9700/RA6 9720/RA2 9720/RA6					IP 40		


Castel by SAUTER
9750/X02
10(3)A 250V~ (2x)
A1446
SWISS MADE

VALVES

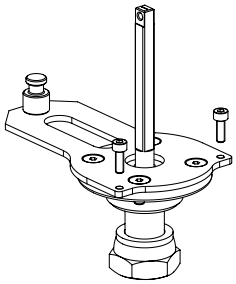
9.7 – ADAPTERS FOR ACTUATORS

APPLICATIONS

Castel has developed two series of flange adapters to be able to connect the series ball valves: 6570EL, 6570E, 6577E, 6578E and 6588E with:
• Castel servomotors (by SAUTER) series 9700, 9720, 9730 and 9740.
• BELIMO and WATERGATES servomotors.
All these adapters allow the transformation from a manual to a motorized ball valves.

CONSTRUCTION

The main parts of the adapters are manufactured with the following materials:
- Hot forged brass EN 12420 – CW 617N for lug and round flange
- Stainless steel AISI 303 for the swivel ring
- Stainless steel AISI 303 for the spindle
- Stainless steel AISI 304 for the motor plate
- Stainless steel for all screws



9901/X58
9901/X60
9901/X73

OPERATION

To assemble the adapter on the valve and then the actuator to the adapter, carefully follow:
- the instruction sheet in the adapter packaging
- the instruction sheet in the actuator packaging

Table 25 indicate for each ball valve and for the main two voltages (24V or 230 VAC):
- the Castel actuator (or the BELIMO-WATERGATES actuator) that must be assembled
- the auxiliary switches, if necessary, that must be chosen
- the Castel adapter that must be selected to mate the valve with the above actuator

Then the customers can use this table as a guidebook when choosing components (actuator, auxiliary contacts, and adapter) when they need to motorize a ball valve.

FIG. 1

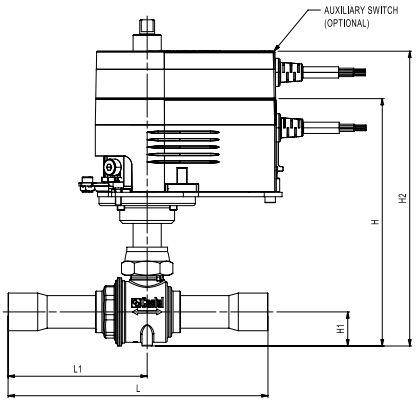
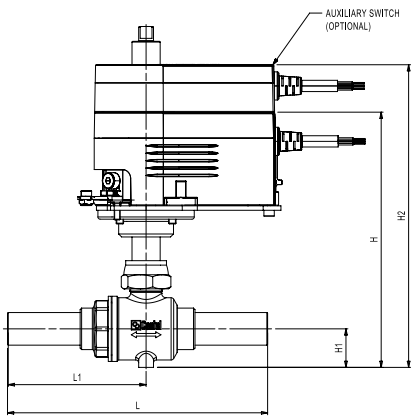


FIG. 2



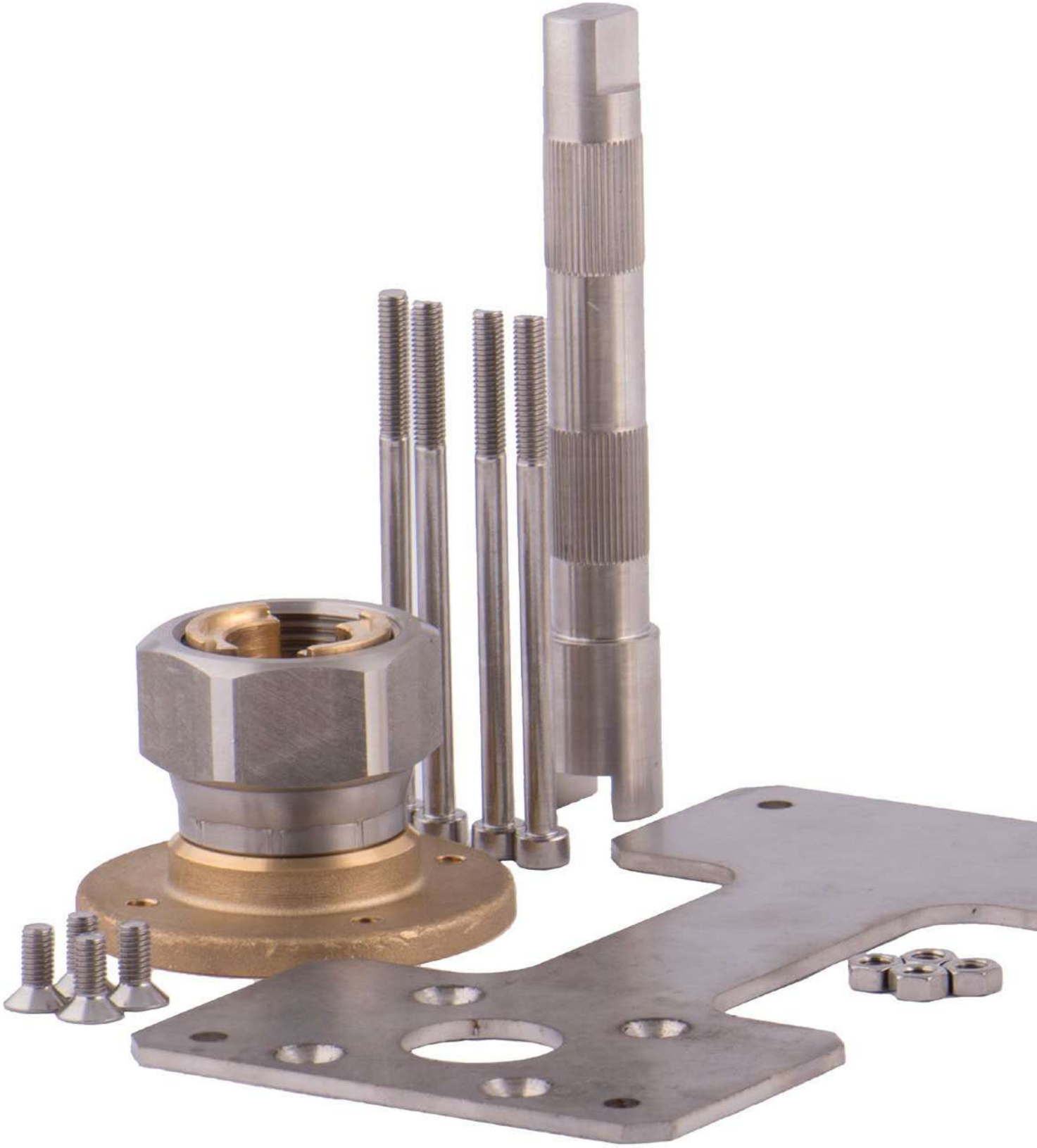
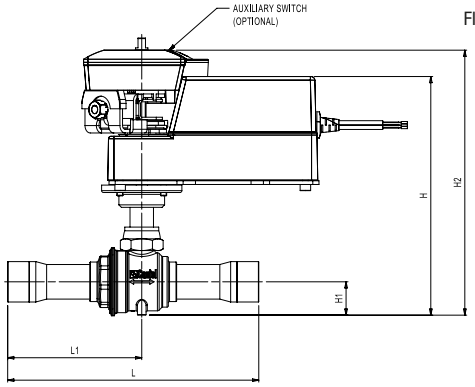


FIG. 3



9901/X57
9901/X74
9901/X75

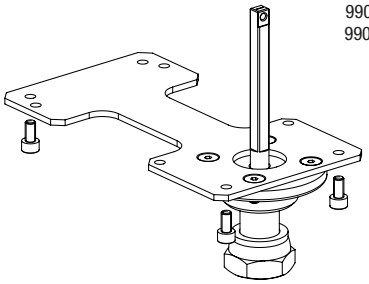
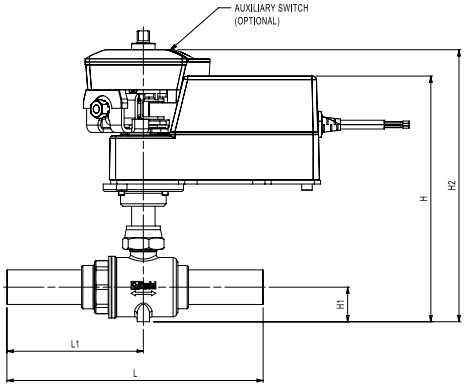
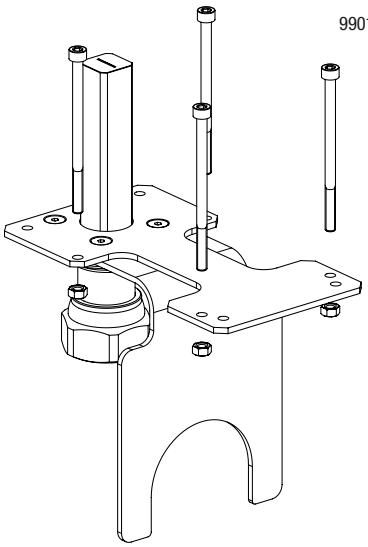


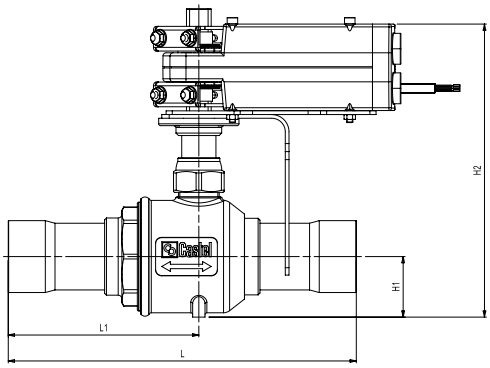
FIG. 4



9901/X76



9901/X76



9901/X95

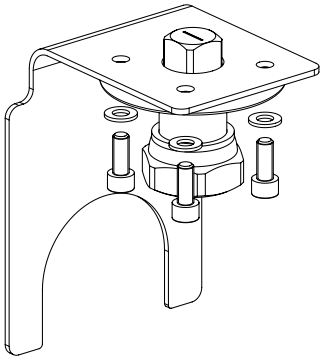
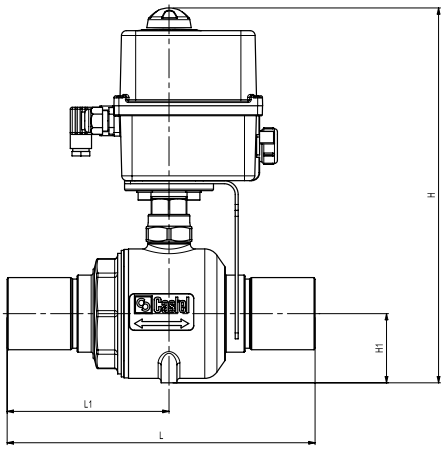


FIG. 6



MOTORIZATION COUPLING SCHEME: VALVE + SERVOMOTOR + ADAPTER + AUXILIARY SWITCH

Part number	CASTEL			BELIMO			CASTEL	WATERGATES		CASTEL
	Part number			Part number			Part number	Part number		Part number
	servomotor	Adapter	switch	servomotor	Shaped handle	switch	Adapter	servomotor	switch	Adapter
BALL VALVES WITH COPPER ODS CONNECTIONS W/O ACCESS FITTING										
6570EL/M6	9700/RA2	9901/X58	9750/X01	SR24A-R SR230A-R	ZSV-11	S1A S2A	9901/X45	NA032100 NA034100	(1)	9901/X45
6570EL/2										
6570EL/3										
6570EL/M10										
6570EL/M12										
6570EL/4										
6570EL/5										
6570EL/M18										
6570EL/6										
6570EL/7	9700/RA2 --- 9700/RA6	9901/X60 --- 9901/X57	9750/X01 --- 9750/X02				9901/X46			9901/X46
6570EL/M28										
6570EL/9										
6570EL/11	9720/RA2 9720/RA6	9901/X75	9901/X02				9901/X68			9901/X68
6570EL/13										
6570EL/M42										
6570EL/17	9730/RA2 9730/RA6	9901/X76	(1)	GR24A-R GR230A-R	ZGV-14		9901/X69	NA0052100 NA0054100		9901/X69
BALL VALVES WITH REINFORCED COPPER ODS CONNECTIONS W/O ACCESS FITTING										
6570E/M6	9700/RA2	9901/X58	9750/X01	SR24A-R SR230A-R	ZSV-11	S1A S2A	9901/X45	NA032100 NA034100	(1)	9901/X45
6570E/2										
6570E/3										
6570E/M10										
6570E/M12										
6570E/4										
6570E/5										
6570E/M18										
6570E/6										
6570E/7	9700/RA2 --- 9700/RA6	9901/X60 --- 9901/X57	9750/X01 --- 9750/X02				9901/X46			9901/X46
6570E/M28										
6570E/9										
6570E/11	9720/RA2 9720/RA6	9901/X75	9750/X02				9901/X68			9901/X68
6570E/13										
6570E/M42										
6570E/17	9730/RA2 9730/RA6	9901/X76	(1)	GR24A-R GR230A-R	ZGV-14		9901/X69	NA0052100 NA0054100		9901/X69

(1) internal
(2) coupling scheme valid also for ball valves with access fitting, where available

continue ⟶

MOTORIZATION COUPLING SCHEME: VALVE + SERVOMOTOR + ADAPTER + AUXILIARY SWITCH

Part number	CASTEL			BELIMO			CASTEL	WATERGATES		CASTEL
	Part number			Part number			Part number	Part number		Part number
	servomotor	Adapter	switch	servomotor	Shaped handle	switch	Adapter	servomotor	switch	Adapter
BALL VALVES WITH K65 ODS CONNECTIONS W/O ACCESS FITTING										
6577E/2	9700/RA2	9901/X58	9750/X01	SR24A-R SR230A-R	ZSV-11	S1A S2A	9901/X45	NA032100 NA034100	(1)	9901/X45
6577E/3										
6577E/4										
6577E/5										
6577E/6										
6577E/7	9700/RA2 --- 9700/RA6	9901/X73 --- 9901/X74	9750/X01 --- 9750/X02				9901/X80			9901/X80
6577E/9	9720/RA2 9720/RA6	9901/X74	9750/X02							
6577E/11		9901/X75					9901/X68			9901/X68
6577E/13										
6577E/17	9730/RA2 9730/RA6	9901/X76	(1)	GR24A-R GR230A-R	ZGV-14		9901/X69	NA0052100 NA0054100		9901/X69
BALL VALVES WITH STAINLESS STEEL CONNECTIONS W/O ACCESS FITTING										
6578E/M6	9700/RA2	9901/X58	9750/X01	SR24A-R SR230A-R	ZSV-11	S1A S2A	9901/X45	NA032100 NA034100	(1)	9901/X45
6578E/M10										
6578E/M12										
6578E/M16										
6578E/M18										
6578E/M22	9700/RA2 --- 9700/RA6	9901/X73 --- 9901/X74	9750/X01 --- 9750/X02				9901/X80			9901/X80
6578E/M28	9720/RA2 9720/RA6	9901/X74	9750/X02							
6578E/M35		9901/X75					9901/X68			9901/X68
6578E/M42										
6578E/M48										
6578E/M60	9730/RA2 9730/RA6	9901/X76	(1)	GR24A-R GR230A-R	ZGV-14		9901/X69	NA0052100 NA0054100		9901/X69
6578E/M73	9740/RA2 9740/RA6	9901/X95		-	-	-	-	-	-	-

(1) internal
(2) coupling scheme valid also for ball valves with access fitting, where available

continue ⟶

MOTORIZATION COUPLING SCHEME: VALVE + SERVOMOTOR + ADAPTER + AUXILIARY SWITCH

Part number (2)	CASTEL			BELIMO			CASTEL	WATERGATES		CASTEL
	Part number			Part number			Part number	Part number		Part number
	servomotor	Adapter	switch	servomotor	Shaped handle	switch	Adapter	servomotor	switch	Adapter
STAINLESS STEEL BALL VALVES W/O ACCESS FITTING										
6588E/M10	9700/RA2	9901/X58	9750/X01	SR24A-R SR230A-R	ZSV-11	S1A S2A	9901/X45	NA032100 NA034100	(1)	9901/X45
6588E/M12										
6588E/M16										
6588E/M18										
6588E/M22	9700/RA2 --- 9700/RA6	9901/X73 --- 9901/X74	9750/X01 --- 9750/X02				9901/X46			9901/X46
6588E/M28	9720/RA2 9720/RA6	9901/X74	9750/X02							
6588E/M35		9901/X75					9901/X68			9901/X68
6588E/M42										
6588E/M48										
6588E/M60	9730/RA2 9730/RA6	9901/X76	(1)	GR24A-R GR230A-R	ZGV-14		9901/X69	NA0052100 NA0054100		9901/X69

(1) internal
(2) coupling scheme valid also for ball valves with access fitting, where available

TABLE 27: BALL VALVES MOTORIZATION, COUPLING SCHEME: DIMENSIONS

Part numbers				Dimensions [mm]								
Ball valve	servomotor	Adapter	switch	Figure	H	H1	H2 (1)	L	L1	l	d	Ch
BALL VALVES WITH COPPER ODS CONNECTIONS												
6570EL/M6	9700/RA2	9901/X58	9750/X01	1	147	15	179	121	65	18	M4	6
6570EL/2												
6570EL/3	9700/RA2	9901/X58	9750/X01									
6570EL/M10												
6570EL/M12	9700/RA2	9901/X58	9750/X01									
6570EL/4												
6570EL/5	9700/RA2	9901/X58	9750/X01		154,3	19	186,3	139	73	25,5		
6570EL/M18	9700/RA2	9901/X58	9750/X01									
6570EL/6												
6570EL/7	9700/RA2	9901/X60	9750/X01		167	23	199	175	94	30		
	9700/RA6	9901/X57	9750/X02	3	188,6		210,2					
6570EL/M28	9700/RA2	9901/X60	9750/X01	1	175,2	27	207,2	203	109			
	9700/RA6	9901/X57	9750/X02	3	197		218,5					
6570EL/9	9700/RA2	9901/X60	9750/X01	1	175,2		207,2					
	9700/RA6	9901/X57	9750/X02	3	197		218,5					
6570EL/11	9720/RA2	9901/X75	9750/X02	3	211,9	32	237,5	213	115	42	M6	
	9720/RA6											
6570EL/13	9720/RA2	9901/X75	9750/X02	3	225,4	39	251	242	130			
	9720/RA6											
6570EL/M42	9720/RA2	9901/X75	9750/X02									
	9720/RA6											
6570EL/17	9730/RA2	9901/X76	-	5	237,8	49	-	282	154	55		20
	9730/RA6											

continue ⟶

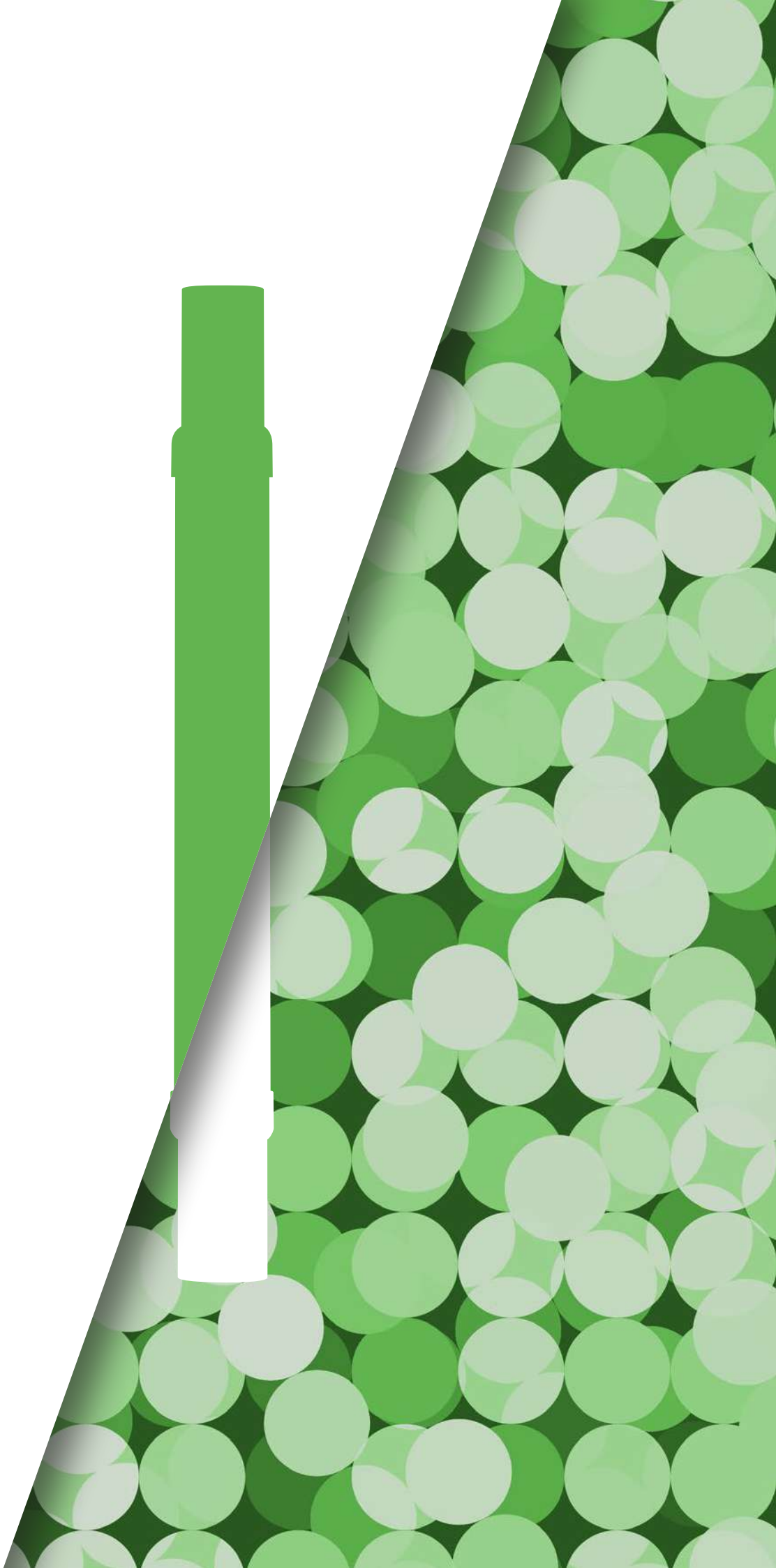
TABLE 27: BALL VALVES MOTORIZATION, COUPLING SCHEME: DIMENSIONS

Part numbers				Dimensions [mm]								
Ball valve	servomotor	Adapter	switch	Figure	H	H1	H2 (1)	L	L1	I	d	Ch
BALL VALVES WITH REINFORCED COPPER ODS CONNECTIONS												
6570E/M6	9700/RA2	9901/X58	9750/X01	1	147	15	179	121	65	18	M4	6
6570E/2												
6570E/3	9700/RA2	9901/X58	9750/X01									
6570E/M10												
6570E/M12	9700/RA2	9901/X58	9750/X01									
6570E/4												
6570E/5	9700/RA2	9901/X58	9750/X01		154,3	19	186,3	139	73	25,5		
6570E/M18	9700/RA2	9901/X58	9750/X01									
6570E/6												
6570E/7	9700/RA2	9901/X60	9750/X01		167	23	199	175	94	30		
	9700/RA6	9901/X57	9750/X02	3	188,6		210,2					
6570E/M28	9700/RA2	9901/X60	9750/X01	1	175,2	27	207,2	203	109			
	9700/RA6	9901/X57	9750/X02	3	197		218,5					
6570E/9	9700/RA2	9901/X60	9750/X01	1	175,2		207,2					
	9700/RA6	9901/X57	9750/X02	3	197		218,5					
6570E/11	9720/RA2	9901/X75	9750/X02		211,9	32	237,5	213	115	42	M6	
	9720/RA6											
6570E/13	9720/RA2	9901/X75	9750/X02		225,4	39	251	242	130			
	9720/RA6											
6570E/M42	9720/RA2	9901/X75	9750/X02									
	9720/RA6											
6570E/17	9730/RA2	9901/X76	-	5	237,8	49	-	282	154	55		20
	9730/RA6											
BALL VALVES WITH K65 COPPER ALLOY ODS CONNECTIONS												
6577E/2	9700/RA2	9901/X58	9750/X01	1	147	15	179	115	62	18	M4	6
6577E/3	9700/RA2	9901/X58	9750/X01					123	66			
6577E/4	9700/RA2	9901/X58	9750/X01					121				
6577E/5	9700/RA2	9901/X58	9750/X01		154,3	19	186,3	139	70	25,5		
6577E/6	9700/RA2	9901/X58	9750/X01									
6577E/7	9700/RA2	9901/X73	9750/X01		172,7	26	205,2	175	93	18	M5	
6577E/7	9700/RA6	9901/X74	9750/X02	3	194,4		216					
6577E/9	9720/RA2	9901/X74	9750/X02		200	28	221,5	208	111	30	M6	
	9720/RA6											
6577E/11	9720/RA2	9901/X75	9750/X02		211,9	32	237,5	213	115	42		
	9720/RA6											
6577E/13	9720/RA2	9901/X75	9750/X02		225,4	39	251	242	130			
	9720/RA6											
6577E/17	9730/RA2	9901/X76	-	5	237,8	49	-	282	154	55		20
	9730/RA6											

continue ⟶

TABLE 27: BALL VALVES MOTORIZATION, COUPLING SCHEME: DIMENSIONS

Part numbers				Dimensions [mm]								
Ball valve	servomotor	Adapter	switch	Figure	H	H1	H2 (1)	L	L1	I	d	Ch
BALL VALVES WITH STAINLESS STEEL CONNECTIONS												
6578E/M6	9700/RA2	9901/X58	9750/X01	1	147	15	179	119	64	18	M4	6
6578E/M10	9700/RA2	9901/X58	9750/X01	1				123	66			
6578E/M12	9700/RA2	9901/X58	9750/X01	1								
6578E/M16	9700/RA2	9901/X58	9750/X01	1	154,3	19	186,3	142	74	25,5		
6578E/M18	9700/RA2	9901/X58	9750/X01	1								
6578E/M22	9720/RA2	9901/X73	9750/X01	2	172,7	26	205,2	176	94	18	M5	
	9700/RA6	9901/X74	9750/X02	4	194,4	26	216					
6578E/M28	9720/RA2	9901/X74	9750/X02	4	200	28	221,5	208	111	30	M6	
	9720/RA6											
6578E/M35	9720/RA2	9901/X75	9750/X02	4	211,9	32	237,5	213	115	42		
	9720/RA6											
6578E/M42	9720/RA2	9901/X75	9750/X02	4	225,4	39	251	240	129			
	9720/RA6											
6578E/M48	9720/RA2	9901/X75	9750/X02	4				242	130			
	9720/RA6											
6578E/M60	9730/RA2	9901/X76	-	5	237,8	49	-	282	154	55		20
	9730/RA6											
6578E/M73	9740/RA2	9901/X95	-	6	370,4	70	-	312	164	89	M8	-
	9740/RA6											
STAINLESS STEEL BALL VALVES												
6588E/M10	9700/RA2	9901/X58	9750/X01	2	147	15	179	108	50	18	M4	6
6588E/M12	9700/RA2	9901/X58	9750/X01									
6588E/M16	9700/RA2	9901/X58	9750/X01		154,3	19	186,3	126	66	25,5		
6588E/M18	9700/RA2	9901/X58	9750/X01									
6588E/M22	9720/RA2	9901/X73	9750/X01		166,4	23	199	130	69	30		
	9700/RA6	9901/X74	9750/X02	4	188,1	23	213,7					
6588E/M28	9720/RA2	9901/X74	9750/X02		196,6	27	222,2	144	79			
	9720/RA6											
6588E/M35	9720/RA2	9901/X75	9750/X02		211,9	32	237,5	160	85	42		
	9720/RA6											
6588E/M42	9720/RA2	9901/X75	9750/X02		225,6	39	251,2	185	100		M6	
	9720/RA6											
6588E/M48	9720/RA2	9901/X75	9750/X02									
	9720/RA6											
6588E/M60	9730/RA2	9901/X76	-	5	237,8	49	-	214	119	55		20
	9730/RA6											



PIPING ACCESSORIES

GO GREEN

R744 • NATURAL REFRIGERANT

PIPING ACCESSORIES

10.1 – VIBRATION ABSORBERS

APPLICATIONS

The vibration absorbers in series 7690N 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.
The function of this item is to avoid the transmission of compressor's vibrations to the refrigerating system pipes. They can also compensate small thermal expansion of the piping.
These products have been developed by Castel for all the applications that use the sub-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

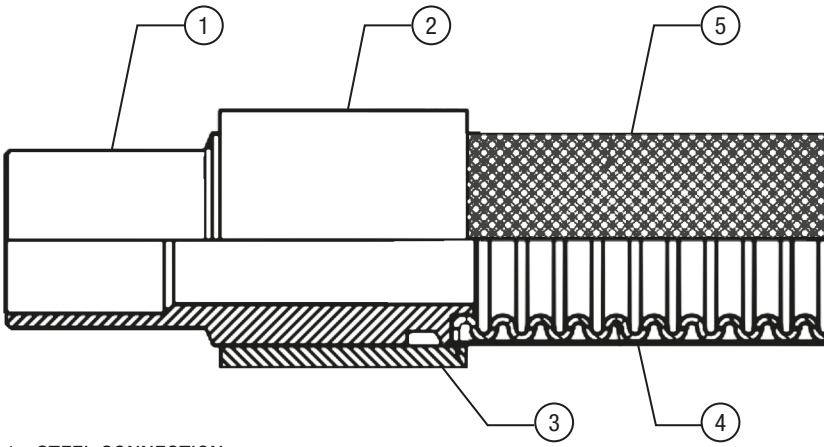
CONSTRUCTION

The main union between various parts are TIG welded (figure 1). This solution makes the vibration absorbers particularly resistant to the overheating during connection to the piping.
The main parts of vibration absorbers are manufactured with the following materials:

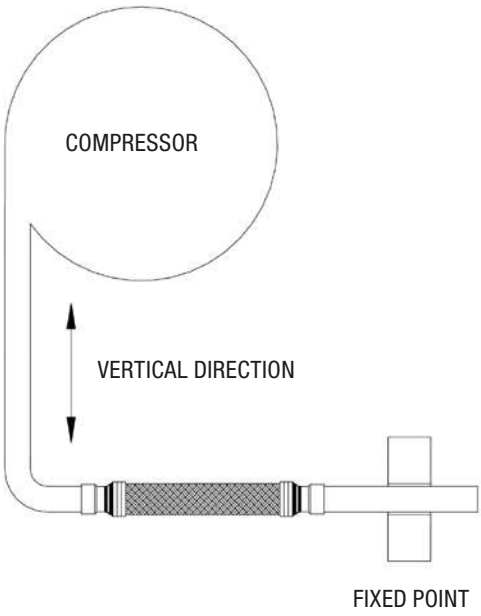
- Stainless steel EN 10088-1 – 1.4305/1.4301 for connections
- Stainless steel EN 10028-7 – 1.4541/1.4404 for corrugate flexible
- Stainless steel EN 10028-7 – 1.4301 for net holder
- Stainless steel EN 10088-3 – 1.4301/1.406 for wire "braid"

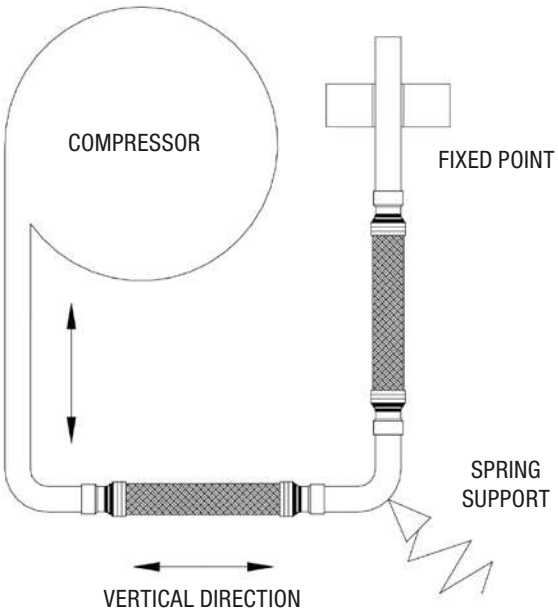
INSTALLATION

The vibration absorbers can be installed both on suction and discharge lines, as close as possible to the compressor. They are not designed to compensate possible piping misalignment.
Vibration absorbers should be installed perpendicularly to the direction of vibration. In the case of vertical and horizontal vibrations, two vibrations absorbers should be used perpendicular to each other, as shown in Fig. 2 and 3. For the maximum absorption of vibrations, the refrigerant line should be anchored at the vibration absorber end, as shown in Fig. 2 and 3.
Castel vibration absorbers can be installed vertically too, because they are designed to avoid the retention of condensation in the wavy area near to the connections. There are no issues when employing them at temperatures below 0°C.
Vibration absorbers are not designed to absorb axial or torsional stress. Care should be taken to allow sufficient space to avoid compression or tension, after installation.
High-speed refrigerant fluid can produce vibrations and noise phenomena. In this case, it is recommended that a larger size vibration absorber be installed
The connection of the vibration absorbers to the piping is normally performed by brazing. The specific design and construction of vibration absorbers allows the installer to perform this operation without special protection to prevent overheating, generated in this phase.
It is given that best installation calls for the vibration absorber to be linear. A misalignment from the axis of no more than 3% of the length of the corrugated hose is allowed.
WARNING! Ensure a gap corresponding to the 2% of the total length of the vibration absorber to compensate any extensions due to possible thermal expansion.



1 - STEEL CONNECTION
2 - NET HOLDER
3 - CORRUGATED FLEXIBLE WELDING
4 - CORRUGATED FLEXIBLE
5 - STAINLESS STEEL WIRE BRAID





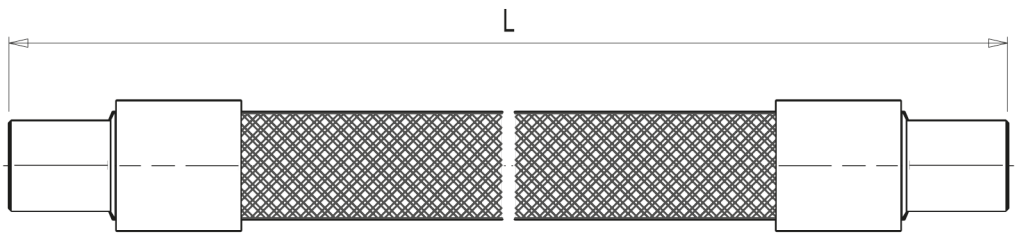


TABLE 1: GENERAL CHARACTERISTICS OF VIBRATION ABSORBERS

Catalogue Nr.	Connections		Length	Weight [g]	Working pressure (PS), depending on fluid temperature [bar]			Risk Category according to PED Recast
	ODS							
	[mm]	[inch]	[mm]		-80 / +100 °C	+ 120 °C	+140 °C	
7690N/3	-	3/8	230	91	50	49	48	Art. 4.3
7690N/M10	10	-		98				
7690N/M12	12	-		122				
7690N/4	-	1/2		120				
7690N/M15	15	-	255	190				
7690N/5	16	5/8		200				
7690N/M18	18	-		180				
7690N/6	-	3/4		180				
7690N/7	22	7/8	290	317				
7690N/M28	28	-	330	380				
7690N/9	-	1.1/8		416				
7690N/11	35	1.3/8	375	846				II
7690N/13	-	1.5/8	430	1088				
7690N/M42	42	-		1200				
7690N/17	54	2.1/8	510	2060				

PIPING ACCESSORIES

10.2 – THREADED BRASS FITTINGS

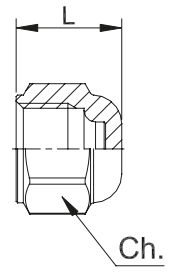
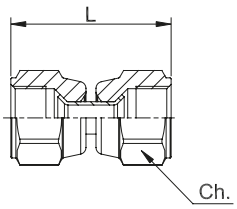
APPLICATIONS

The threaded brass fittings are excluded from the scope of application of Directive 2014/68/EU, as specified in Guidelines 1/8 and 1/9, because they are piping components.
These fittings have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

CONSTRUCTION

All nuts series 7020, all plugs series 7521 and all the elbows, T and cross fittings, from series 7210 to series 7410, are manufactured with hot forged brass EN 12420 – CW 617N.
All straight fittings, from series 7110 to series 7170, and all plugs series 7510 are machined from brass bars EN 12164 – CW 614N.
Tapered gaskets in series 7580 are from copper Cu – ETP UNI 5649.

TABLE 2: GENERAL CHARACTERISTICS OF UNIONS

	Catalogue Number	International Reference	SAE Flare	PS [bar]	Dimensions [mm]		Wrench torque min / max [Nm]	Weight [g]
					L	Ch		
SAE-Flare cap nuts								
	7020/20 (1)	N5–4	1/4"	140	15	16	8,5 / 11,5	16
	7020/30	N5–6	3/8"		19,5	22	20 / 25	41
	7020/40	N5–8	1/2"		22,5	25	34 / 47	60
SAE-Flare twin nuts								
	7050/2	US4–4	1/4"	140	32	17	11 / 14	39
	7050/3	US4–6	3/8"		40	22	20 / 25	75
	7050/4	US4–8	1/2"		46	25	34 / 47	105
	7050/5	US4–10	5/8"		51	28	54 / 75	140

(1): copper gasket doesn't need

TABLE 3: GENERAL CHARACTERISTICS OF UNIONS

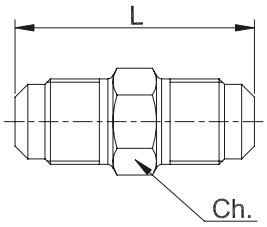
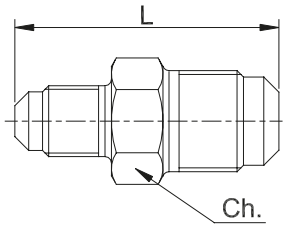
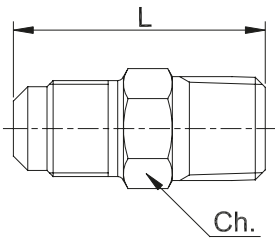
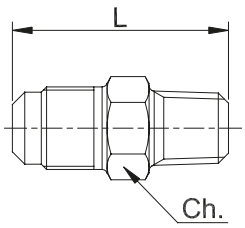
	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare	NPT		L	Ch	
SAE-Flare unions								
	7110/2	U2–4	1/4”	–	140	38	12	23
	7110/3	U2–6	3/8”			44	17	46
	7110/4	U2–8	1/2”			50	20	73
	7110/5	U2–10	5/8”			58	23	113
	7110/6	U2–12	3/4”			63	27	164
	7110/8	U2–16	1”			72	36	304
Reducing SAE-Flare unions								
	7120/23	UR2–64	1/4” x 3/8”	–	140	42	17	38
	7120/24	UR2–84	1/4” x 1/2”			45	20	58
	7120/34	UR2–86	3/8” x 1/2”			48		66
	7120/35	UR2–106	3/8” x 5/8”			52	23	89
	7120/45	UR2–108	1/2” x 5/8”			54	23	98
	7120/46	UR2–128	1/2” x 3/4”			57,5	27	136
	7120/56	UR2–1210	5/8” x 3/4”			61,5	27	150
SAE Flare / NPT unions								
	7130/2	U1–4B	1/4”	1/4”	140	38,1	14	32
	7130/3	U1–6C	3/8”	3/8”		41,2	17	48
	7130/4	U1–8D	1/2”	1/2”		49,8	22	92
	7130/6	U1–12F	3/4”	3/4”		57,6	27	152
	7130/8	U1–16H	1”	1”		68	36	277
SAE Flare / NPT reducing unions								
	7140/21	U1–4A	1/4”	1/8”	140	32,9	12	20
	7140/32	U1–6B	3/8”	1/4”		41,1	17	39
	7140/34	U1–6D	3/8”	1/2”		45,8	22	77
	7140/43	U1–8C	1/2”	3/8”		45,2	20	63
	7140/54	U1–10D	5/8”	1/2”		53,8	23	102

TABLE 4: GENERAL CHARACTERISTICS OF UNIONS

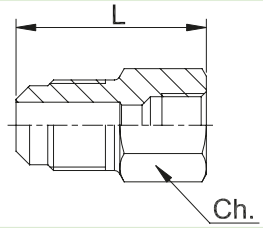
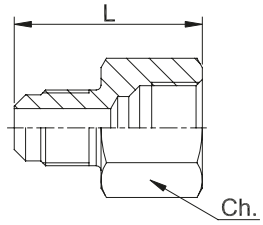
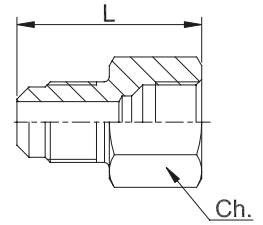
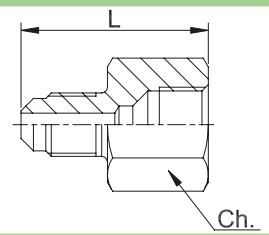
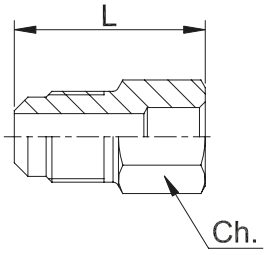
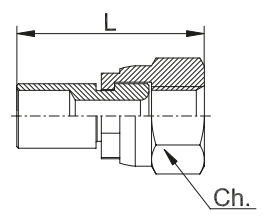
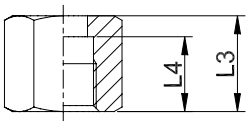
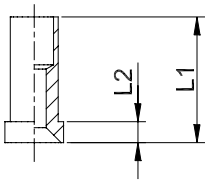
	Catalogue Number	International Reference	Connections						PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT	GAS	ODS					
			m	f			Ø [in.]	Ø [mm]		L	Ch	
Male/female reducing unions (reduced female)												
	7150/21	U3–4A	1/4"	–	1/8" f	–	–	–	140	29	14	21
	7150/32	UR3–46	3/8"	1/4"	–					33	17	38
	7150/42	UR3–48	1/2"	1/4"						35	22	75
	7150/43	UR3–68	1/2"	3/8"						38	22	66
	7150/54	UR3–810	5/8"	1/2"						45	25	99
	7150/64	UR3–812	3/4"	1/2"						46,5	27	132
	7150/65	UR3–1012	3/4"	5/8"						49,5	30	157
Male/female reducing unions (reduced male)												
	7150/X29	–	–	1/4"	1/8"	–	–	–	140	24	17	24
	7150/X27	–	–	1/4"	1/4"					30	17	35
	7150/23	UR3–64	1/4"	3/8"	–					33	22	49
	7150/24	UR3–84	1/4"	1/2"						36	25	66
	7150/34	UR3–86	3/8"	1/2"						39		74
	7150/45	UR3–108	1/2"	5/8"						44	30	125
	7150/46	UR3–128	1/2"	3/4"						45	34	142
	7150/56	UR3–1210	5/8"	3/4"						49	34	157
Male/female unions												
	7160/2	–	1/4"	1/4"	–	–	–	–	140	30,5	17	31
	7160/3		3/8"	3/8"						36	22	57
	7160/4		1/2"	1/2"						41	25	84
Unions SAE-Flare to BSP												
	7164/2	–	1/4"	–	–	G1/4" f	–	–	140	32,5	20	45
	7166/2		–	1/4"		G1/4" m				32	17	25
Male SAE-Flare/solder unions												
	7170/22	US3–44	1/4"	–	–	–	1/4"	–	140	26,5	12	17
	7170/2M8	–					–	8				
	7170/33	US3–66	3/8"				3/8"	–		33	17	39
	7170/3M8	–					–	8				
	7170/3M10	–					–	10				
	7170/34	US3–68					1/2"	–				
	7170/44	US3–88	1/2"				1/2"	–		35	20	53
	7170/4M12	–					–	12				
	7170/55	US3–1010	5/8"				5/8"	16		42	23	82
	7170/6M18	–	3/4"				–	18		45,5	27	123
	7170/65	US3–1210					5/8"	16				
	7170/67	US3–1214					7/8"	22		45,5	30	124
	7170/87	US3–1614	1"				7/8"	22		50	36	241
Female swivel SAE-Flare/solder unions												
	9901/X88	–	–	1/4"	–	–	3/8"	–	140	35,5	19	70
	9901/X89		–	3/8"	–	–	3/8"	–		32	22	70

TABLE 5: GENERAL CHARACTERISTICS OF UNIONS

	Catalogue Number	Item Position	Connections			PS [bar]	Dimensions [mm]					Wrench torque min / max [Nm]	Weight [g]
			SAE Flare	ODS			L1	L2	L3	L4	Ch		
				Ø [in.]	Ø [mm]								
Flare / ODS adapters													
POS.1  POS.2  POS.3 	9901/X11	1	1/4"	–	6	140	–	–	16	12,5	17	11 / 14	274
		2					21	3,5	–	–	–	–	
		3					–						
	9901/X12	1	3/8"	–	10		–	–	18,5	14,7	22	20 / 25	393
		2					23,5	4	–	–	–	–	
		3					–						
	9901/X13	1	1/2"	–	12		–	–	21	17	27	34 / 47	672
		2					26	4,5	–	–	–	–	
		3					–						
	9901/X14	1	5/8"	5/8"	16		–	–	22,5	18	30	54 / 75	511
		2					27,5	5	–	–	–	–	
		3					–						
	9901/X15	1	3/4"	–	18		–	–	25	20	36	68 / 71	806
		2					30	5	–	–	–	–	
		3					–						
	9901/X16	1	1/4"	1/4"	–		–	–	16	12,5	17	11 / 14	274
		2					21	3,5	–	–	–	–	
		3					–						
	9901/X17	1	3/8"	3/8"	–		–	–	18,5	14,7	22	20 / 25	383
		2					23,5	4	–	–	–	–	
		3					–						
	9901/X18	1	1/2"	1/2"	–		–	–	21	17	27	34 / 47	672
		2					26	4,5	–	–	–	–	
		3					–						
	9901/X19	1	3/4"	3/4"	–		–	–	25	20	36	68 / 71	806
		2					30	5	–	–	–	–	
		3					–						
	9901/X58	1	1/4"	–	–		–	–	16	12,5	17	11 / 14	23
	9901/X59	1	3/8"	–	–		–	–	18,5	14,7	22	20 / 25	39
	9901/X60	1	1/2"	–	–		–	–	21	17	27	34 / 47	67
	9901/X61	1	5/8"	–	–		–	–	22,5	18	30	54 / 75	83
	9901/X68	1	3/4"	–	–		–	–	25	20	36	68 / 71	129

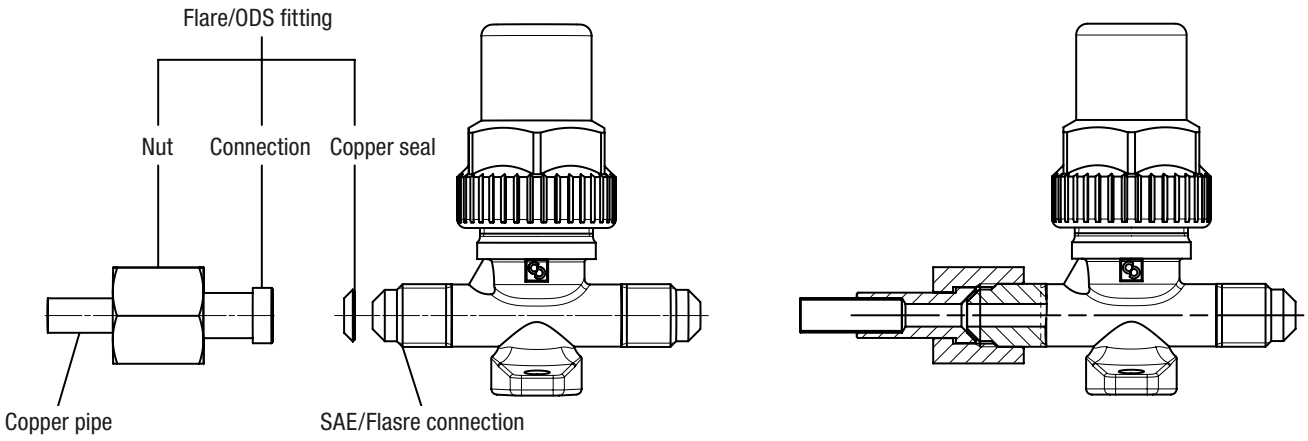


TABLE 6: GENERAL CHARACTERISTICS OF UNIONS

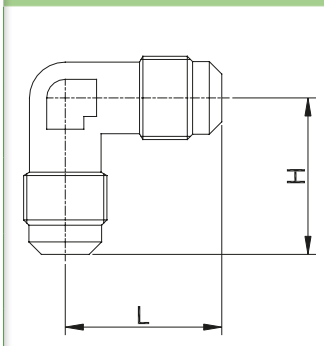
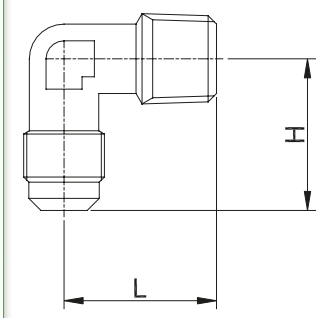
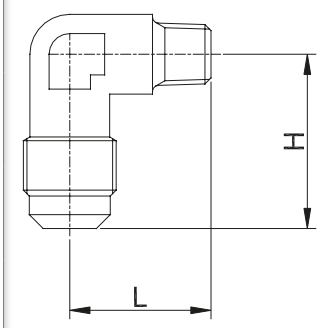
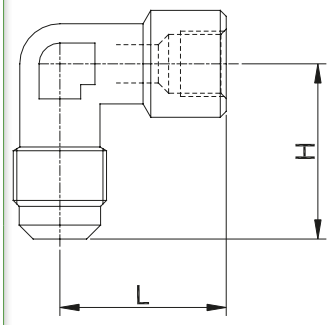
	Catalogue Number	International Reference	Connections			PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT		H	L	
			m	f					
SAE-Flare elbows									
	7210/2	E2–4	1/4"	–	–	140	24,5	24,5	24
	7210/3	E2–6	3/8"				29,5	29,5	60
	7210/4	E2–8	1/2"				32,5	32,5	80
	7210/5	E2–10	5/8"				36	36	116
	7210/6	E2–12	3/4"				42,5	42,5	192
SAE-Flare / NPT elbows									
	7220/2	E1–4B	1/4"	–	1/4"	140	26	24	33
	7220/3	E1–6C	3/8"		3/8"		29,5	28,5	54
	7220/4	E1–8D	1/2"		1/2"		32,5	32	91
	7220/6	E1–12F	3/4"		3/4"		42,5	39,5	183
SAE-Flare / reduced NPT elbows									
	7230/21	E1–4A	1/4"	–	1/8"	140	24,5	23,5	25
	7230/32	E1–6B	3/8"		1/4"		29,5	29,5	46
	7230/43	E1–8C	1/2"		3/8"		32,5	31	97
	7230/54	E1–10D	5/8"		1/2"		36	35	112
Male/female SAE-Flare elbows									
	7240/2	–	1/4"	1/4"	–	140	28,5	28	56
	7240/3		3/8"	3/8"			32	31	80
	7240/4		1/2"	1/2"			39,5	38	200

TABLE 7: GENERAL CHARACTERISTICS OF UNIONS

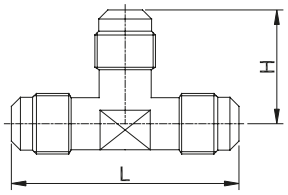
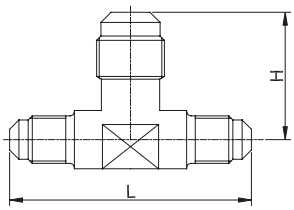
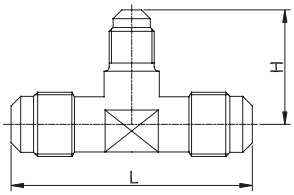
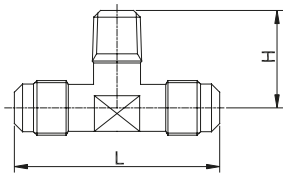
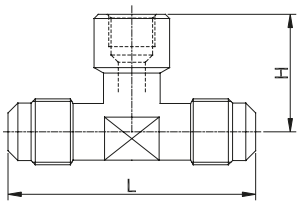
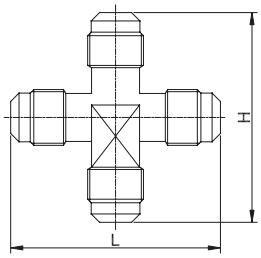
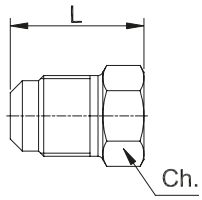
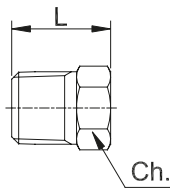
	Catalogue Number	International Reference	Connections					PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare				NPT (3)		H	L	
			(1)	(2)	(3)	(4)					
SAE-Flare TEE											
	7310/2	T2–4	1/4"	1/4"	1/4"	–	–	140	23,5	47	35
	7310/3	T2–6	3/8"	3/8"	3/8"				29	58	70
	7310/4	T2–8	1/2"	1/2"	1/2"				31,5	63	98
	7310/5	T2–10	5/8"	5/8"	5/8"				36	72	150
	7310/6	T2–12	3/4"	3/4"	3/4"				41,5	83	235
SAE-Flare reducing TEE (reduced side connections)											
	7320/223	TR2–46	1/4"	1/4"	3/8"	–	–	140	29	56	77
	7320/334	TR2–68	3/8"	3/8"	1/2"				32,5	63	95
	7320/445	TR2–810	1/2"	1/2"	5/8"				38	72	153
	7320/556	TR2–1012	5/8"	5/8"	3/4"				41,5	83	228
SAE-Flare reducing TEE (reduced central connection)											
	7320/332	TR2–64	3/8"	3/8"	1/4"	–	–	140	28	58	77
	7320/443	TR2–86	1/2"	1/2"	3/8"				32,5	63	101
	7320/554	TR2–108	5/8"	5/8"	1/2"				38	72	149
	7320/665	TR2–1210	3/4"	3/4"	5/8"				41,5	83	232
SAE-Flare / NPT TEE (taper central connection)											
	7330/221	T1–4A	1/4"	1/4"	–	–	1/8"	140	21	47	33
	7330/222	T1–4B	1/4"	1/4"			1/4"		24	51	45
	7330/332	T1–6B	3/8"	3/8"			1/4"		28	58	65
Male/female SAE-Flare TEE (female central connection)											
	7340/222	T6–4	1/4"	1/4"	1/4"	–	–	140	27,5	56	73
SAE-Flare cross											
	7410/2	C1–4	1/4"	1/4"	1/4"	1/4"	–	140	52	52	72

TABLE 8: GENERAL CHARACTERISTICS OF UNIONS

	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Wrench torque min/ max [Nm]	Weight [g]
			SAE Flare	NPT		L	Ch		
SAE-Flare plugs									
	7510/2	P2–4	1/4”	–	140	23	12	11 / 14	19
	7510/3	P2–6	3/8”			26	17	20 / 25	40
	7510/4	P2–8	1/2”			30	20	34 / 47	67
NPT plugs									
	7521/1	121–B–02	–	1/8”	140	15,9	12	10 / 13	17
	7521/2	121–B–04		1/4”		23,1	14	15 / 20	26
	7521/3	121–B–06		3/8”		23,2	17	17 / 22	36
	7521/4	121–B–08		1/2”		29,8	22	25 / 35	112
	7521/6	121–B–12		3/4”		32,1	27	30 / 40	160
	7521/8	121–B–16		1”		39	34	60 / 80	247
Copper gaskets									
	7580/2 (1)	B2–4	1/4”	–	140	–	–	–	0,2
	7580/3 (1)	B2–6	3/8”						0,5
	7580/4 (1)	B2–8	1/2”						0,7
	7580/5 (1)	B2–10	5/8”						1,1
	7580/6 (1)	B2–12	3/4”						1,2
	7581/2 (2)	B2–4	1/4”						0,2
	7581/3 (2)	B2–6	3/8”						0,4
	7581/4 (2)	B2–8	1/2”						0,6
	7581/5 (2)	B2–10	5/8”						0,9
	7581/6 (2)	B2–12	3/4”						1,1

(1) Nominal thickness 1 mm
(2) Nominal thickness 0,5 mm

PIPING ACCESSORIES

10.3 – ACCESS FITTINGS AND VALVE CORE

APPLICATIONS

The access fittings are excluded from the scope of application of Directive 2014/68/EU, as specified in Guidelines 1/8 and 1/9, because they are piping components.
The valve core is considered “Pressure Accessory” according to the definition provided in Article 2, Point 5 of said Directive and is subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.
The access fittings and the valve core have been developed by Castel for all the applications that use the sub-critical or trans-critical R744 refrigerant fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

OPERATION

The access fittings allow creating a loading or draining point rapidly and with a minimum expense. After completion of the filling or draining operations, use of the cap and gasket (p/n 8392/A or 8391/A) prevents any refrigerant leakage.
For special customer requirements, the cap 8392/A can be replaced by a blind union p/n 7020/20. The latter solution requires that the union be tightened using a torque wrench to 8.5 / 11.5 Nm. **Note: it is not necessary to use a copper gasket between union 7020/20 and the filling connector chosen.**
If a component other than the two blind unions in series 7020 must be tightened on the access fittings (for example a pressure gauge), a tapered gasket with tang (p/n 8580/2) must be positioned between the component and the chosen access fitting.
The access fittings have different shapes and sizes, according to varying customer requirements. For all access fittings, the valve core seat is manufactured according to the ARI STANDARD 720:1997.
After tightening the valve core inside the access fitting with the dedicated wrench, p/n 8390/A, to the indicated torque, the refrigerant passage, filling or draining is obtained simply by activating the needle on the valve core.

CONSTRUCTION

The straight fittings are machined by hexagonal brass bar EN 12164 – CW 614N.
The T and cross fittings are hot forged in brass EN 12420 – CW 617N.
Caps 8392/A and 8392/B are machined from hexagonal brass bar EN 12164 – CW 614N, with chloroprene rubber (CR) gasket.
Valve core 8395/A4 is equipped with ethylene propylene rubber (EPDM) gaskets
The tapered gasket with tang, 8580/2, is manufactured from copper Cu - ETP UNI 5649.

TABLE 9: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

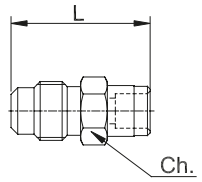
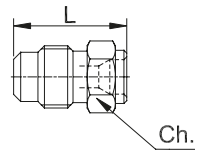
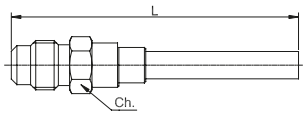
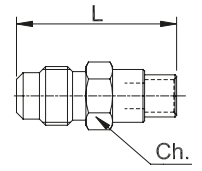
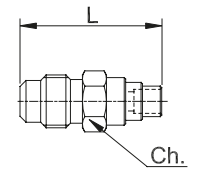
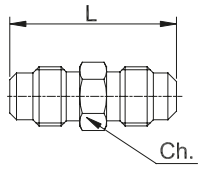
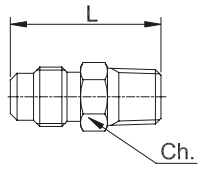
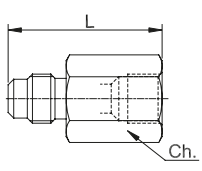
Drawing	Part number	Connections								PS [bar]	Dimensions [mm]		Weight [g]
		SAE Flare			NPT	ODS		IDS			L	Ch	
		Valve core	m	f		Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
Straight access fittings													
	8350/22	1/4”	–	–	–	1/4”	–	3/8”	–	140	26	11	12
	8350/X10	1/4”	–	–	–	1/4”	–	–	10		26	11	12
	8350/X01	1/4”	–	–	–	–	6	–	–		20	11	10
	8350/X03	1/4”	–	–	–	–	–	–	6	120	90	11	23
	8350/X06	1/4”	–	–	–	–	–	1/4”	–		126	11	28
	8350/X07	1/4”	–	–	–	–	–	1/4”	–		326	11	58
	8350/X12	1/4”	–	–	–	–	–	–	6		180	11	36
	8351/2	1/4”	–	–	–	–	6	–	8 - 10	140	30	11	13
	8351/X04	1/4”	–	–	–	–	–		6		26	11	11
	8351/X01	1/4”	–	–	–	–	1/8”	–	6		36	11	13
	8351/X02	1/4”	–	–	–	–	5	1/4” 5/16” 3/8”	–		26	11	11
	8351/X06	1/4”	–	–	–	–	–	–	6 8 10		28	11	13
	8352/22	1/4”	1/4”	–	–	–	–	–	–		31	11	15
	8354/21	1/4”	–	–	1/8”	–	–	–	–		28	11	13
	8354/22	1/4”	–	–	1/4”	–	–	–	–		33	14	25
	8354/23	1/4”	–	–	3/8”	–	–	–	–		38	17	41
	8362/22	1/4”	–	1/4”	–	–	–	–	–		35	17	42

TABLE 10: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

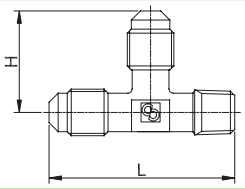
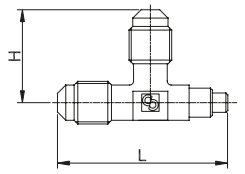
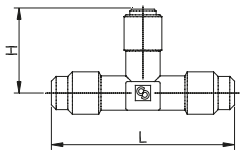
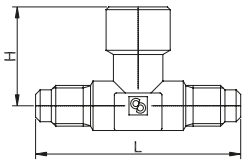
Drawing	Part number	Connections				PS [bar]	Dimensions [mm]		Weight [g]	Note
		SAE Flare		NPT	IDS		L	H		
		m	f		Ø [mm]					
TEE access fittings										
	8380/122	1/4"	–	1/8"	–	140	45	24	31	The valve core may be installed on each of the two 1/4" SAE Flare male connections
	8380/222	1/4"	–	1/4"	–		49,5	25,5	44	
	8380/X01	1/4"	–	–	6	140	43	24	28	
	8380/X02	1/4"	–	–	7		48	22	33	
	8380/X09	1/4"	1/4"	–	–		56	27	70	

TABLE 11: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

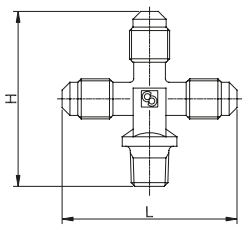
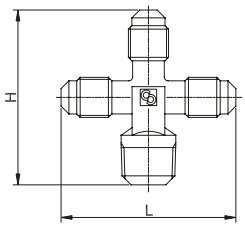
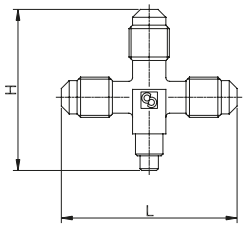
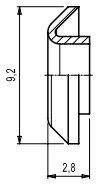
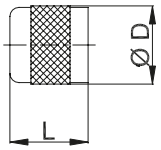
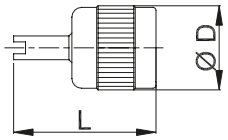
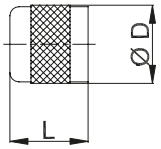
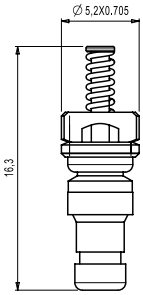
Drawing	Part number	Connections				PS [bar]	Dimensions [mm]		Weight [g]	Note
		SAE Flare		NPT	IDS		L	H		
		m	f		Ø [mm]					
Cross access fittings										
	8382/1222	1/4"	–	1/8"	–	140	48	50	49	The valve core may be installed on each of the three 1/4" SAE Flare male connections
	8382/X02	1/4"	–	1/4"	–	140	48	50	53	
	8382/X01	1/4"	–	–	7-10	140	48	47	47	
	8382/X03	1/4"	–	–	6		48	44	42	
Copper gaskets with neck										
	8580/2	1/4"	–	–	–	140	–	–	0,3	

TABLE 12: GENERAL CHARACTERISTICS OF CAPS WITH GASKET

Drawing	Part number	Connections		PS [bar]	TS [°C]		Dimensions [mm]		Weight [g]
		SAE Flare			min	max	L	D	
	8392/A	-	1/4"	80	-20	+100	13	13	7
	8392/B (1)	-	1/4"	80	-20	+100	22	13	7
	8393/A	-	5/16"	80	-20	+100	22	13	7

Note:
(1) The key needs to remove the valve core

TABLE 13: GENERAL CHARACTERISTICS OF VALVE CORES

Drawing	Part number	Spring	Gaskets		Refrigerant Fluids	Max Static Pressure [bar]	Operating Pressure [bar]	Operating Temperature [°C]		Peak Temperature (1) [°C]	Dimensions [mm]		Wrench torque min / max (2) [Nm]	Weight [g]
			body	seat				min	max		L	D		
	8395/A4	outside	EPDM	EPDM	R744	140	80	-35	+120	150	16,3	5,2 x 0,705 V0.07.1	0,4/0,5 Nm	0,7

Note:
(1) permitted value for shot period
(2) To remove the valve core use the key code 8390/A

TABLE 14: GENERAL CHARACTERISTICS OF MANIFOLDS WITH ACCESS FITTINGS

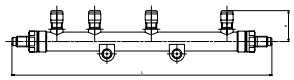
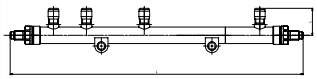
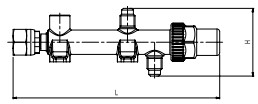
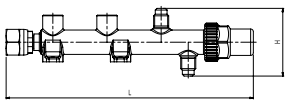
Drawing	Part number	Connections	PS [bar]	Dimensions [mm]		Weight [g]	Note
		SAE Flare		L	H		
	9901/X43	1/4"	140	275	49	650	N° 6 access fittings
	9901/X44	1/4"	140	335	49	851	N° 6 access fittings

TABLE 15: GENERAL CHARACTERISTICS OF MANIFOLDS WITH ACCESS FITTINGS AND VALVE

Drawing	Part number	SAE Flare Connections		PS [bar]	Dimensions [mm]			Weight [g]	Note
		female	swivel female		L	H1	H2		
	9901/X90	1/4"	1/4"	140	152,5	14,5	20	368	N° 2 access fittings
	9901/X94	2 x 1/4"	1/4"	140	182,5	14,5	20	769	N° 2 access fittings

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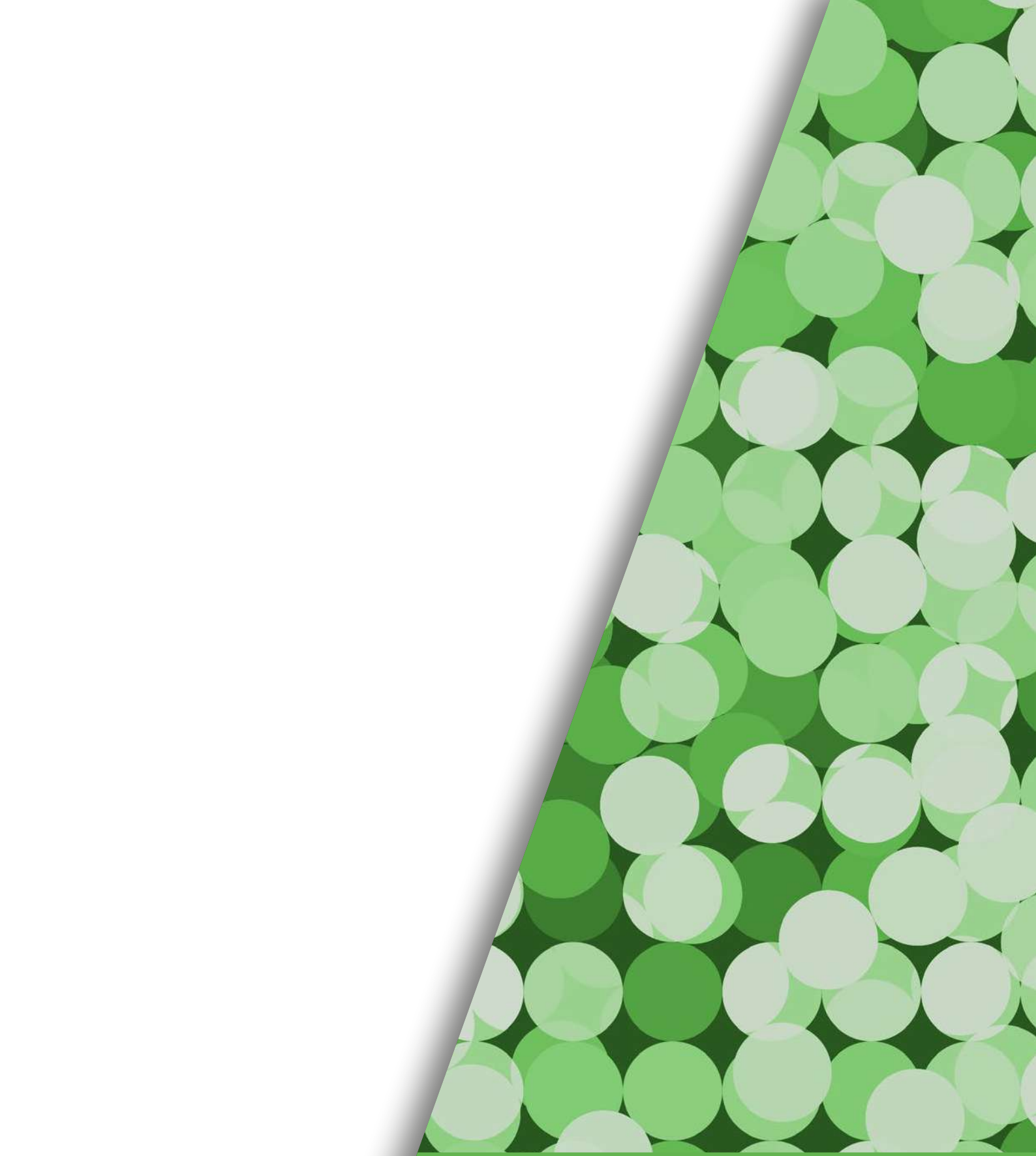

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Via Provinciale, 2-4
20042 Pessano con Bornago (MI)

Tel. +39 02.957021
Fax +39 02.95741317

info@castel.it
castel.it