

CLASSIC

TECHNICAL HANDBOOK



# 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 2025 Handbook about the line of products:**

## CLASSIC

**Products compatible with the following range of refrigerants, classified A1 according to ASHRAE STANDARD 34-2024 # :**

- HCFC (R22)
- HFC (R134a, R404A, R407C, R410A, R507)
- HFO (R1234ze)
- HFO + HFC (R448A, R449A, R450A, R452A, R513A, R515A, R515B)

**These refrigerants belong 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.**

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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

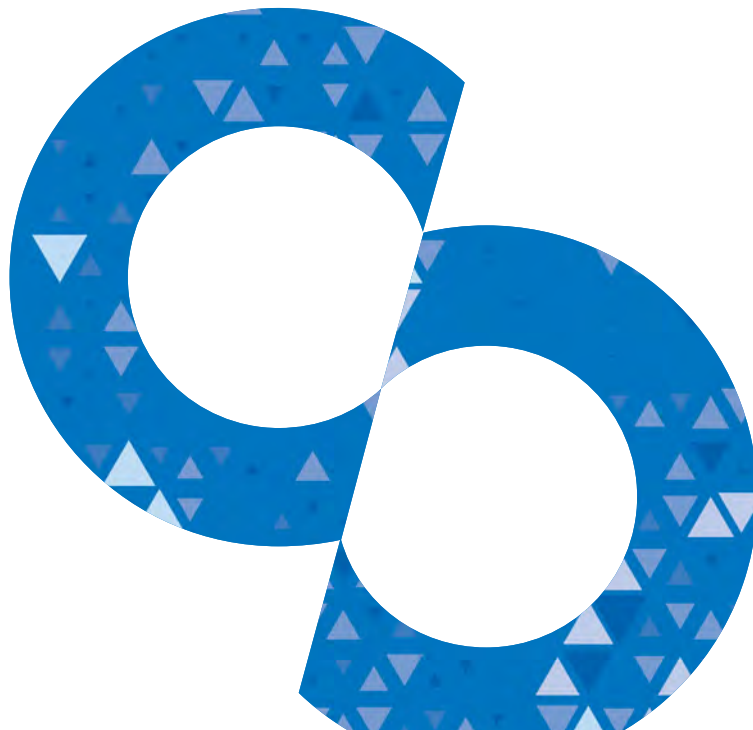
According to Directive 2014/68/EU and to the EN 378-2: 2016 Standard (Par. 5.3.2.2.2), all Castel products subjected to hydrostatic test guarantee a pressure strength at least equal to  $1.43 \times PS$ .

According to the EN 378-2: 2016 Standard, Castel products are designed to guarantee a pressure strength in compliance with either the burst test (Par. 5.3.2.2.3) or the fatigue test (Par. 5.3.2.2.4).

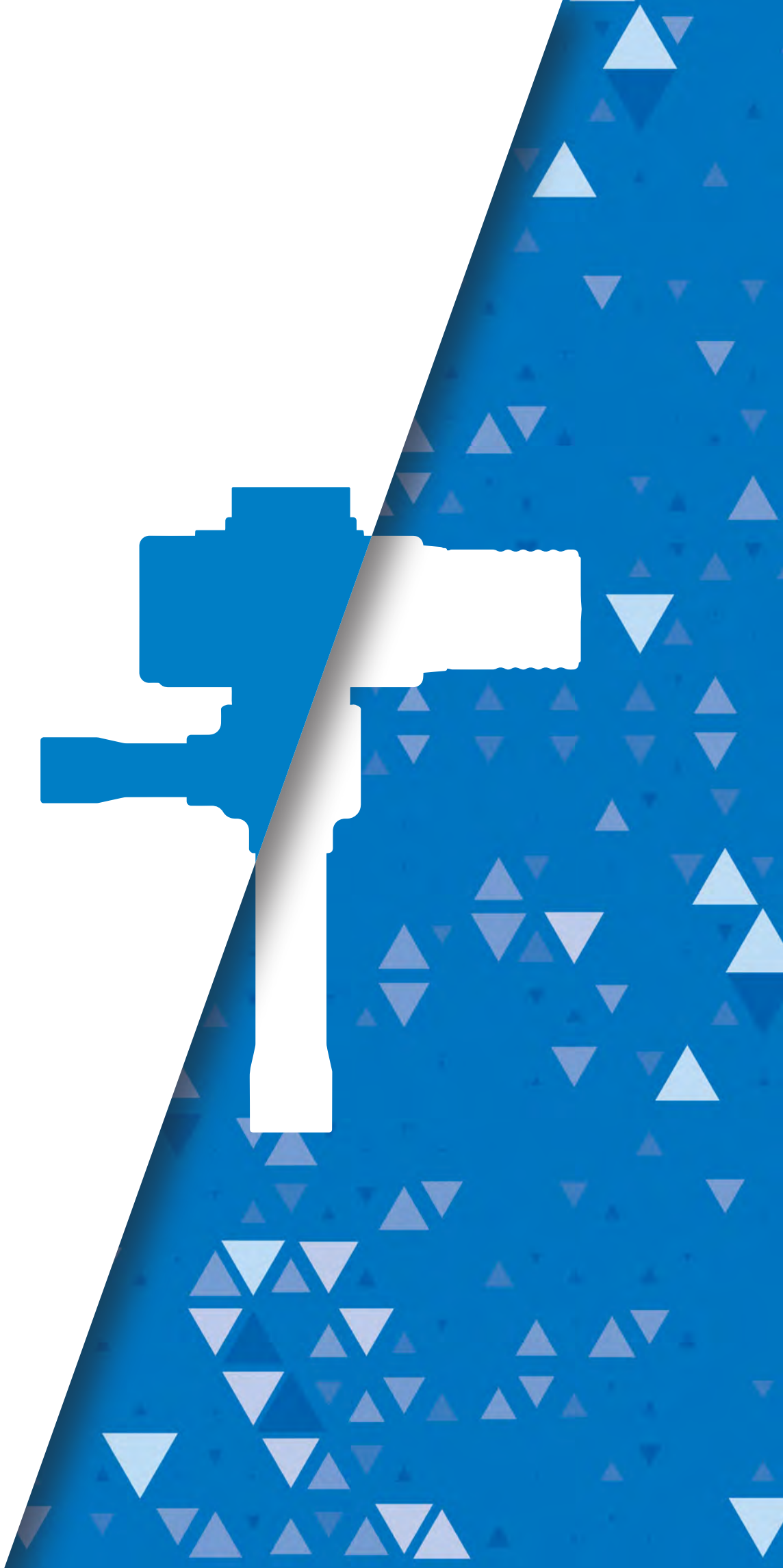
According to the UL 207: 2022 Standard, UL-approved Castel products are designed to guarantee a pressure strength in compliance with either the burst test (Chap. 19) or the fatigue test (Chap. 20).

### 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 2028C 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;
- Liquid chillers.

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.

These valves have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. (plus R23).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

The valve in series 2028C 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,  $Q_T$ , 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 2028C 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 2028C/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.

The main parts of the valves in series 2028C 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 – 1.4301 for the mesh filter;
- Austenitic stainless steel EN 10088-3 – 1.4305 for mobile plunger valve sleeve and orifice;
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- P.T.F.E. for seat gaskets;
- Copper EN 1625 – Cu-DHP for the outlet gaskets.

Valves in series 2028C are sold exclusively without coil (suffix S).

For these valves are available:

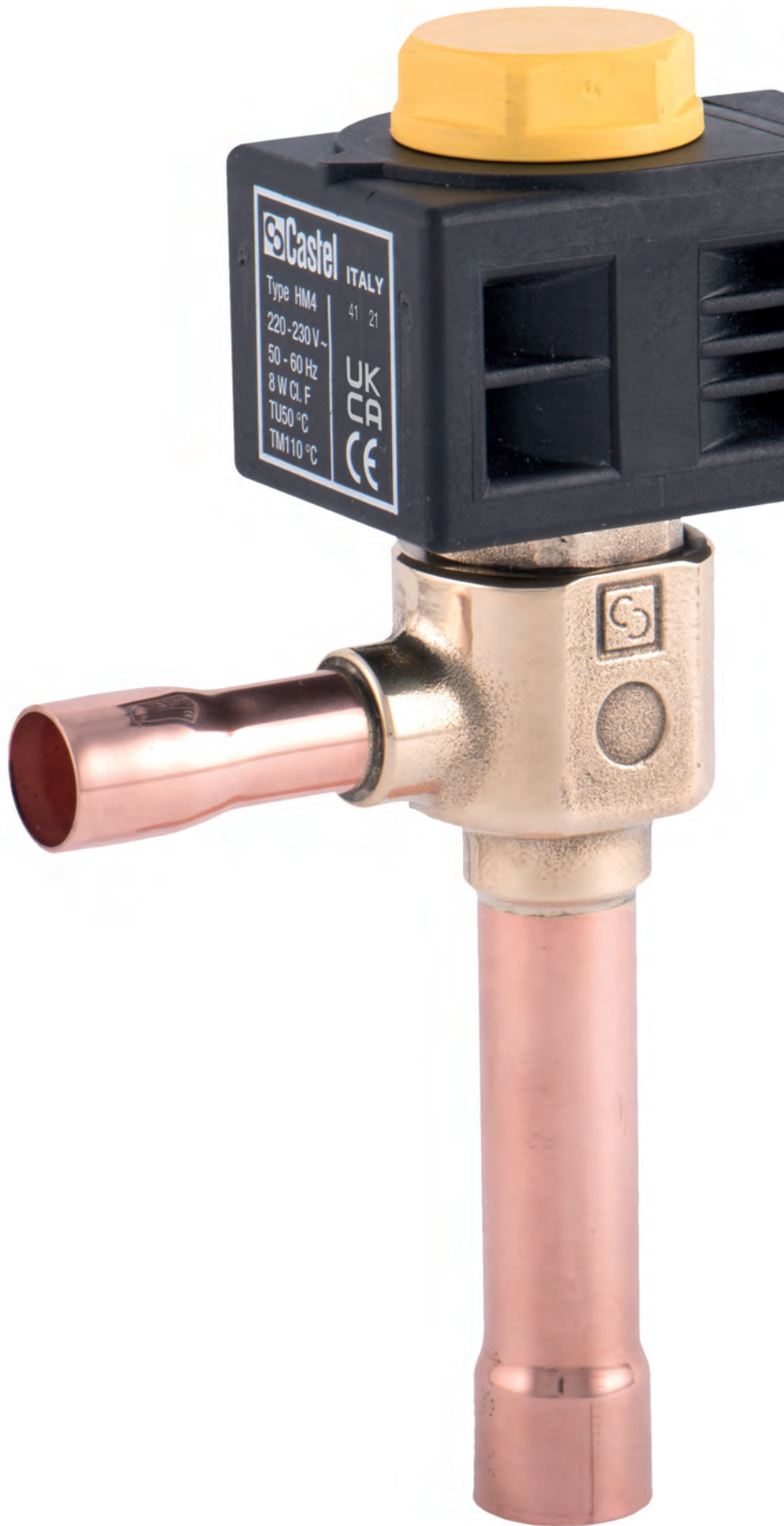
- Coils in series 9110 (coils type CM2);
- Coils in series 9120 (coils type HM3);
- Coils in series 9121 (coils type CM3);
- Coils in series 9160 (coils type HM4);
- Coils, UL Recognized, in series 9105 (coils type HM2);
- Coils, UL Recognized, in series 9115 (coils type CM2-N2);
- Coils, UL Recognized, in series 9116 (coils type CM2-N4);
- 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).

### SELECTION

To dimension a valve in series 2028C for a refrigerating system correctly, 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,  $\Delta p$

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:

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

where:

- $P_c$  = condensing pressure;
- $P_e$  = evaporating pressure;
- $\Delta p$  = 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:

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

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

$$Q_{\text{sub}} = Q_e / F_{\text{sub}}$$

### 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,  $F_{\text{ev}}$ , is highly dependent by the evaporation temperature,  $T_e$ , so it be assumed equal to 125% for  $T_e \geq -15$  °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:

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

### 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  $\Delta p_{\text{tot}}$  and to avoid that a drop-in load cause a reduction in the maximum valve power.

## DIMENSIONING EXAMPLE 1

- Type of refrigerant: R404A
- Evaporator capacity,  $Q_e$ : 2.8 kW
- Evaporating temperature,  $T_e$ : -10 °C
- Minimum condensing temperature,  $T_c$ : +35 °C
- Liquid refrigerant temperature,  $T_l$ : +20 °C
- Pressure drop in the liquid line, distributor and evaporator,  $\Delta p$ : 2 bar

### Step 1

Determine the pressure drop across the valve.

- Condensing pressure at +35 °C -  $P_c = 16.9$  bar
- Evaporating pressure at -10 °C -  $P_e = 4.4$  bar

$$\Delta p_{\text{tot}} = 16.9 - (4.4 + 2) = 10.5 \text{ bar}$$

### Step 2

Determine required valve capacity.

$$\Delta T_{\text{sub}} = 35 - 20 = 15 \text{ °K}$$

From the subcooling correction factor Table 5B, we find the appropriate correction factor,  $F_{\text{sub}}$ , equal to 1.17 for  $\Delta T_{\text{sub}} = 15$  °K. The required valve capacity is:

$$Q_{\text{sub}} = 2.8 / 1.17 = 2.39 \text{ kW}$$

### Step 3

Capacity correction based on the application.

According to the above criterion, a correction of +25% is applied to the calculated capacity:

$$Q_{\text{ev}} = 1.25 \cdot 2.39 = 3 \text{ kW}$$

### Step 4

Determine required orifice dimension.

Using Table 5A for the capacity for refrigerant fluid R404A, enter the data:

- Pressure drop across the valve = 10.5 bar;
- Evaporating temperature = -10 °C;
- Calculated evaporator capacity = 3 kW.

Select the corresponding orifice, 04 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity).

## DIMENSIONING EXAMPLE 2

- Type of refrigerant: R23
- Evaporator capacity,  $Q_e$ : 2.8 kW
- Evaporating temperature,  $T_e$ : -40°C
- Minimum condensing temperature,  $T_c$ : +5°C
- Liquid refrigerant temperature,  $T_l$ : +15°C
- Pressure drop in the liquid line, distributor and evaporator,  $\Delta p$ : 2 bar

### Step 1

Determine the pressure drop across the valve.

- Condensing pressure at -5 °C -  $P_c = 21.7$  bar
- Evaporating pressure at -40 °C -  $P_e = 7.06$  bar

$$\Delta p_{\text{tot}} = 21.7 - (7.06 + 2) = 12.6 \text{ bar}$$

### Step 2

Determine required valve capacity.

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

From the subcooling correction factor Table 17B, we find the appropriate correction factor,  $F_{\text{sub}}$ , equal to 1.05 for  $\Delta T_{\text{sub}} = 10 \text{ °K}$ . The required valve capacity is:

$$Q_{\text{sub}} = 2.8 / 1.05 = 2.67 \text{ kW}$$

### Step 3

Capacity correction based on the application.

According to the above criterion, a correction of +25% is applied to the calculated capacity:

$$Q_{\text{ev}} = 1.25 \cdot 2.67 = 3.34 \text{ kW}$$

### Step 4

Determine the orifice size.

Using the capacity Table 17A for R23 refrigerant, enter the data:

- Pressure drop across the valve = 12.6 bar;
- Evaporating temperature = -40 °C;
- Calculated evaporator capacity = 3.34 kW.

Select the corresponding orifice, O3 (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 solenoid expansion valves in series 2028C with file MH50005. These valves are certified **UL-CSA Recognized** for the USA and Canada with a Design Pressure of 1035 PSI, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13,

TABLE 1: GENERAL CHARACTERISTICS OF PWM EXPANSION VALVES

Catalogue Number	Orifice Type	ODS Connections				Kv Factor [m <sup>3</sup> /h]	Opening Pressure Differential [bar]					Operating principles	Min. Working Time [s]	PS [bar]	TS [°C]		Risk Category according to PED Recast																																																																																									
		[in]		[mm]			MinOPD	MOPD																																																																																																		
		IN	OUT	IN	OUT			AC coils series			DC coils series																																																																																															
								9100 9110	9160	9120	9160				9120																																																																																											
2028C/3S00	00	3/8"	1/2"	-	-	0																																																																																																				
2028C/M10S00		-	-	10	12																																																																																																					
2028C/3S01	01	3/8"	1/2"	-	-												37	37	37	37	37	1	90	-80	+60	Art.4.3																																																																																
2028C/M10S01		-	-	10	12																																																																																																					
2028C/3S02	02	3/8"	1/2"	-	-																						27																																																																															
2028C/M10S02		-	-	10	12																																																																																																					
2028C/3S03	03	3/8"	1/2"	-	-																																15	23	32	23	32																																																																	
2028C/M10S03		-	-	10	12																																																																																																					
2028C/3S04	04	3/8"	1/2"	-	-																																										12	20	27	20	27																																																							
2028C/M10S04		-	-	10	12																																																																																																					
2028C/3S05	05	3/8"	1/2"	-	-																																																				10	16	22	16	22																																													
2028C/M10S05		-	-	10	12																																																																																																					
2028C/3S06	06	3/8"	1/2"	-	-																																																																																																					
2028C/M10S06		-	-	10	12																																																																																																					
2028C/4S07	07	1/2"	5/8"	-	-																																																																																																					
2028C/M12S07		-	-	12	16																																																																																																					
2028C/4S08	08	1/2"	5/8"	-	-																																																																																																					
2028C/M12S08		-	-	12	16																																																																																																					
2028C/4S09	09	1/2"	5/8"	-	-																																																																																																					
2028C/M12S09		-	-	12	16																																																																																																					

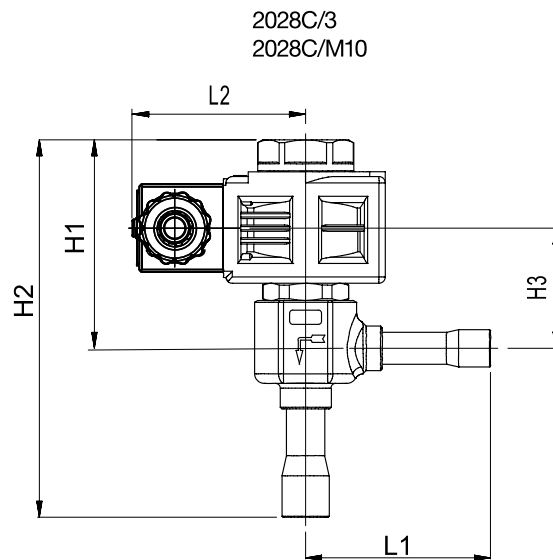


TABLE 2: DIMENSIONS AND WEIGHTS OF PWM EXPANSION VALVES WITH 9160 COILS (1)

Catalogue Number	Dimensions [mm]					Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	
2028C/3S00	66	119	38	58	35,5	430
2028C/M10S00						
2028C/3S01						
2028C/M10S01						
2028C/3S02						
2028C/M10S02						
2028C/3S03						
2028C/M10S03						
2028C/3S04						
2028C/M10S04						
2028C/3S05						
2028C/M10S05						
2028C/3S06						
2028C/M10S06						
2028C/4S07	150					450
2028C/M12S07						
2028C/4S08						
2028C/M12S08						
2028C/4S09						
2028C/M12S09						

(1) : with coil 9120 the dimension L<sub>2</sub> is equal to 47 and the weight must be increased of 245 g  
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]	Refrigerants														
			R134a	R404A	R407C	R410A	R507A	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B	R22	R23*
9151C/R61	00	0,3	0,22	0,21	0,29	0,34	0,20	0,17	0,27	0,27	0,19	0,21	0,19	0,17	0,17	0,29	0,32
9150C/R63	01	0,5	0,79	0,74	1,03	1,21	0,72	0,62	0,98	0,97	0,69	0,76	0,67	0,6	0,59	1,01	1,15
9150C/R64	02	0,7	1,57	1,47	2,04	2,40	1,44	1,23	1,96	1,92	1,38	1,52	1,33	1,19	1,18	2,00	2,28
9150C/R65	03	0,8	1,86	1,75	2,42	2,84	1,70	1,46	2,32	2,27	1,63	1,80	1,58	1,41	1,40	2,37	2,70
9150C/R66	04	1,1	3,01	2,83	3,92	4,60	2,76	2,36	3,75	3,68	2,64	2,91	2,55	2,27	2,26	3,83	4,37
9150C/R67	05	1,3	5,15	4,84	6,71	7,88	4,72	4,05	6,42	6,30	4,52	4,98	4,37	3,89	3,88	6,56	7,48
9150C/R68	06	1,7	7,14	6,71	9,30	10,92	6,54	5,61	8,90	8,73	6,27	6,90	6,06	5,39	5,37	9,10	10,37
9150C/R69	07	2,3	11,26	10,58	14,66	17,22	10,32	8,84	14,03	13,77	9,88	10,88	9,55	8,51	8,47	14,35	16,35
9150C/R78	08	2,5	13,57	12,75	17,67	20,75	12,44	10,66	16,91	16,60	11,91	13,11	11,51	10,25	10,21	17,29	19,70
9150C/R79	09	2,7	15,05	14,14	19,60	23,02	13,79	11,82	18,76	18,40	13,21	14,54	12,76	11,37	11,32	19,17	21,85

Rated capacities are based on:  
 - Evaporating temperature T<sub>evap</sub> = + 5 °C  
 - Condensing temperature T<sub>cond</sub> = + 32 °C  
 - Refrigerant liquid temperature ahead of valve T<sub>liq</sub> = + 28 °C

\* R23 Rated capacities are based on:  
 - Evaporating temperature T<sub>evap</sub> = - 30 °C  
 - Condensing temperature T<sub>cond</sub> = - 4 °C  
 - Refrigerant liquid temperature ahead of valve T<sub>liq</sub> = - 8 °C

TABLE 4A: REFRIGERANT R134A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,17	0,21	0,23	0,24	0,24	0,24	0,23	0,23	0,22
01	0,62	0,76	0,83	0,86	0,87	0,86	0,84	0,81	0,78
02	1,24	1,52	1,65	1,70	1,72	1,70	1,67	1,61	1,55
03	1,47	1,80	1,95	2,02	2,04	2,02	1,98	1,91	1,83
04	2,38	2,91	3,16	3,27	3,30	3,27	3,20	3,09	2,96
05	4,07	4,97	5,40	5,59	5,64	5,59	5,47	5,29	5,07
06	5,64	6,89	7,49	7,75	7,82	7,75	7,59	7,34	7,03
07	8,89	10,87	11,80	12,23	12,33	12,23	11,96	11,57	11,08
08	10,71	13,10	14,23	14,73	14,86	14,74	14,42	13,95	13,36
09	11,88	14,53	15,78	16,34	16,49	16,34	15,99	15,47	14,81

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,17	0,21	0,22	0,23	0,23	0,23	0,22	0,21	0,20
01	0,62	0,75	0,81	0,83	0,83	0,82	0,80	0,77	0,73
02	1,23	1,49	1,61	1,65	1,66	1,64	1,59	1,53	1,46
03	1,46	1,76	1,90	1,96	1,96	1,94	1,89	1,81	1,73
04	2,36	2,86	3,08	3,17	3,18	3,14	3,05	2,93	2,79
05	4,04	4,89	5,27	5,42	5,44	5,36	5,22	5,02	4,78
06	5,60	6,77	7,30	7,52	7,54	7,44	7,24	6,96	6,63
07	8,84	10,68	11,51	11,85	11,89	11,73	11,41	10,98	10,45
08	10,65	12,87	13,87	14,28	14,33	14,13	13,75	13,23	12,59
09	11,81	14,28	15,39	15,84	15,90	15,68	15,25	14,67	13,97

**TABLE 4B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,12	1,17	1,23	1,29	1,35	1,44	1,49

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

TABLE 5A: REFRIGERANT R404A - CAPACITIES IN KW

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



Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,19	0,21	0,22	0,22	0,22	0,22	0,21	0,20
01	0,55	0,69	0,75	0,79	0,80	0,79	0,78	0,76	0,73
02	1,09	1,36	1,50	1,56	1,59	1,58	1,55	1,50	1,44
03	1,29	1,61	1,77	1,85	1,88	1,87	1,84	1,78	1,71
04	2,09	2,61	2,87	3,00	3,04	3,03	2,97	2,88	2,76
05	3,57	4,47	4,91	5,13	5,20	5,18	5,09	4,93	4,73
06	4,95	6,19	6,81	7,11	7,21	7,18	7,05	6,84	6,56
07	7,81	9,76	10,73	11,21	11,37	11,33	11,12	10,78	10,34
08	9,41	11,77	12,93	13,51	13,71	13,65	13,40	13,00	12,47
09	10,43	13,05	14,34	14,98	15,20	15,14	14,86	14,41	13,82

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,19	0,21	0,22	0,22	0,22	0,21	0,20	0,19
01	0,56	0,69	0,75	0,78	0,79	0,78	0,76	0,73	0,70
02	1,11	1,37	1,49	1,55	1,56	1,55	1,51	1,46	1,39
03	1,31	1,62	1,76	1,83	1,85	1,83	1,79	1,73	1,65
04	2,12	2,62	2,86	2,96	2,99	2,96	2,90	2,80	2,67
05	3,63	4,48	4,89	5,07	5,12	5,07	4,96	4,79	4,57
06	5,03	6,21	6,77	7,03	7,10	7,03	6,87	6,64	6,33
07	7,94	9,80	10,68	11,08	11,19	11,09	10,84	10,46	9,99
08	9,56	11,81	12,87	13,36	13,49	13,37	13,06	12,61	12,04
09	10,61	13,10	14,28	14,82	14,96	14,82	14,49	13,99	13,35

TABLE 5B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,09	1,17	1,26	1,34	1,42	1,50	1,56	1,63

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 5B

TABLE 6A: REFRIGERANT R407C - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,18	0,24	0,26	0,28	0,29	0,30	0,30	0,30	0,30
01	0,66	0,85	0,95	1,01	1,05	1,07	1,08	1,08	1,07
02	1,32	1,68	1,89	2,01	2,09	2,13	2,15	2,14	2,12
03	1,56	1,99	2,24	2,39	2,48	2,52	2,54	2,54	2,52
04	2,53	3,23	3,62	3,86	4,01	4,09	4,12	4,11	4,07
05	4,33	5,52	6,19	6,60	6,85	6,99	7,04	7,03	6,96
06	6,00	7,65	8,59	9,16	9,50	9,69	9,77	9,75	9,66
07	9,46	12,07	13,54	14,44	14,99	15,29	15,40	15,37	15,23
08	11,40	14,55	16,32	17,40	18,06	18,42	18,56	18,53	18,35
09	12,65	16,13	18,10	19,30	20,03	20,43	20,59	20,55	20,35

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,19	0,24	0,26	0,28	0,29	0,29	0,30	0,29	0,29
01	0,67	0,85	0,95	1,00	1,04	1,06	1,06	1,06	1,04
02	1,34	1,69	1,88	2,00	2,06	2,10	2,11	2,10	2,07
03	1,58	2,00	2,23	2,36	2,45	2,49	2,50	2,49	2,46
04	2,56	3,23	3,61	3,83	3,96	4,02	4,04	4,02	3,97
05	4,39	5,53	6,17	6,55	6,77	6,88	6,92	6,88	6,80
06	6,08	7,67	8,55	9,08	9,39	9,54	9,59	9,54	9,43
07	9,59	12,10	13,49	14,32	14,80	15,05	15,12	15,05	14,87
08	11,56	14,58	16,25	17,25	17,84	18,14	18,22	18,14	17,92
09	12,82	16,17	18,03	19,13	19,78	20,12	20,21	20,12	19,87

TABLE 6B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,12	1,19	1,25	1,31	1,37	1,44	1,49

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 6B

TABLE 7A: REFRIGERANT R410C - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,22	0,28	0,32	0,35	0,37	0,38	0,39	0,39	0,39
01	0,78	1,01	1,16	1,25	1,32	1,36	1,39	1,41	1,41
02	1,55	2,02	2,30	2,49	2,62	2,70	2,76	2,79	2,80
03	1,83	2,39	2,72	2,95	3,10	3,20	3,27	3,31	3,32
04	2,97	3,86	4,41	4,77	5,01	5,18	5,29	5,35	5,38
05	5,08	6,61	7,54	8,16	8,58	8,87	9,05	9,16	9,20
06	7,04	9,17	10,45	11,31	11,90	12,30	12,55	12,70	12,75
07	11,10	14,46	16,48	17,83	18,76	19,39	19,80	20,03	20,11
08	13,38	17,42	19,86	21,49	22,61	23,37	23,86	24,14	24,24
09	14,84	19,32	22,03	23,84	25,07	25,92	26,46	26,77	26,88

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,22	0,29	0,33	0,35	0,37	0,38	0,39	0,39	0,39
01	0,80	1,03	1,17	1,26	1,32	1,36	1,39	1,40	1,41
02	1,59	2,05	2,32	2,50	2,62	2,71	2,76	2,78	2,79
03	1,88	2,43	2,75	2,96	3,11	3,21	3,27	3,30	3,31
04	3,05	3,93	4,45	4,80	5,03	5,19	5,29	5,34	5,35
05	5,21	6,72	7,62	8,21	8,61	8,88	9,04	9,13	9,16
06	7,22	9,32	10,56	11,38	11,94	12,31	12,54	12,66	12,70
07	11,39	14,69	16,65	17,95	18,82	19,41	19,78	19,97	20,03
08	13,73	17,70	20,07	21,63	22,69	23,39	23,83	24,07	24,13
09	15,23	19,63	22,26	23,99	25,16	25,94	26,43	26,69	26,77

TABLE 7B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,14	1,21	1,28	1,34	1,41	1,48	1,54

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 7B

TABLE 8A: REFRIGERANT R507A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,19	0,20	0,21	0,22	0,22	0,21	0,20	0,20
01	0,54	0,67	0,74	0,77	0,78	0,78	0,77	0,74	0,71
02	1,07	1,34	1,47	1,54	1,56	1,55	1,52	1,47	1,41
03	1,27	1,59	1,74	1,82	1,85	1,84	1,80	1,75	1,67
04	2,05	2,57	2,82	2,94	2,99	2,97	2,92	2,83	2,71
05	3,51	4,39	4,83	5,04	5,11	5,09	4,99	4,83	4,63
06	4,87	6,09	6,69	6,98	7,08	7,05	6,92	6,70	6,42
07	7,68	9,60	10,55	11,01	11,17	11,12	10,91	10,57	10,13
08	9,25	11,57	12,72	13,27	13,46	13,40	13,14	12,74	12,20
09	10,26	12,84	14,11	14,72	14,93	14,86	14,58	14,13	13,53

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,19	0,20	0,21	0,21	0,21	0,21	0,20	0,19
01	0,55	0,68	0,74	0,76	0,77	0,76	0,75	0,72	0,69
02	1,09	1,34	1,47	1,52	1,53	1,52	1,48	1,43	1,36
03	1,29	1,59	1,74	1,80	1,82	1,80	1,76	1,69	1,62
04	2,09	2,58	2,81	2,91	2,94	2,91	2,84	2,74	2,61
05	3,57	4,41	4,81	4,99	5,03	4,98	4,86	4,69	4,47
06	4,95	6,11	6,66	6,91	6,97	6,91	6,74	6,50	6,20
07	7,81	9,64	10,51	10,90	11,00	10,89	10,64	10,26	9,78
08	9,41	11,62	12,67	13,14	13,25	13,13	12,82	12,36	11,79
09	10,44	12,89	14,05	14,57	14,70	14,56	14,22	13,71	13,07

TABLE 8B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,14	1,21	1,28	1,34	1,41	1,48	1,54

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 8B



TABLE 9A: REFRIGERANT R1234ZE - CAPACITIES IN KW

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

Evaporating Temperature -20 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,19	0,19	0,18	0,18	0,17	0,15	0,14
01	0,53	0,63	0,67	0,67	0,66	0,63	0,60	0,56	0,51
02	1,05	1,25	1,32	1,34	1,31	1,26	1,19	1,10	1,01
03	1,24	1,48	1,57	1,58	1,55	1,49	1,41	1,31	1,19
04	2,01	2,40	2,54	2,56	2,51	2,41	2,28	2,12	1,93
05	3,43	4,10	4,34	4,38	4,30	4,13	3,90	3,62	3,30
06	4,76	5,68	6,02	6,07	5,96	5,72	5,40	5,02	4,58
07	7,51	8,96	9,49	9,58	9,39	9,03	8,52	7,92	7,22
08	9,05	10,80	11,44	11,54	11,32	10,88	10,27	9,54	8,71
09	10,03	11,98	12,69	12,80	12,55	12,06	11,39	10,58	9,65

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,17	0,18	0,18	0,17	0,17	0,15	0,14	0,13
01	0,52	0,61	0,64	0,64	0,63	0,59	0,56	0,51	0,46
02	1,04	1,22	1,28	1,28	1,24	1,18	1,10	1,01	0,91
03	1,23	1,44	1,51	1,51	1,47	1,40	1,31	1,20	1,08
04	1,99	2,34	2,45	2,45	2,38	2,27	2,12	1,94	1,75
05	3,40	4,00	4,19	4,19	4,07	3,88	3,62	3,32	2,99
06	4,72	5,55	5,81	5,81	5,65	5,38	5,02	4,61	4,14
07	7,44	8,75	9,17	9,17	8,91	8,48	7,92	7,26	6,53
08	8,96	10,54	11,05	11,05	10,74	10,22	9,55	8,76	7,87
09	9,94	11,69	12,25	12,25	11,91	11,33	10,59	9,71	8,73

TABLE 9B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,12	1,18	1,24	1,30	1,36	1,44	1,49

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 9B

TABLE 10A: REFRIGERANT R448A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,18	0,23	0,25	0,27	0,28	0,29	0,29	0,29	0,28
01	0,64	0,81	0,91	0,97	1,00	1,02	1,03	1,03	1,01
02	1,26	1,61	1,81	1,93	2,00	2,03	2,05	2,04	2,01
03	1,50	1,91	2,14	2,28	2,37	2,41	2,42	2,41	2,39
04	2,42	3,09	3,47	3,69	3,83	3,90	3,92	3,91	3,86
05	4,14	5,29	5,93	6,32	6,55	6,67	6,71	6,68	6,60
06	5,75	7,34	8,22	8,76	9,08	9,25	9,30	9,27	9,16
07	9,06	11,57	12,97	13,82	14,32	14,59	14,67	14,61	14,44
08	10,92	13,94	15,63	16,65	17,26	17,58	17,68	17,61	17,40
09	12,11	15,46	17,34	18,47	19,14	19,50	19,61	19,53	19,30

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,18	0,23	0,25	0,27	0,28	0,28	0,28	0,28	0,28
01	0,65	0,82	0,91	0,96	0,99	1,01	1,01	1,01	0,99
02	1,28	1,62	1,80	1,91	1,98	2,01	2,01	2,00	1,97
03	1,52	1,92	2,14	2,27	2,34	2,38	2,38	2,37	2,33
04	2,46	3,11	3,46	3,67	3,79	3,84	3,86	3,83	3,77
05	4,21	5,32	5,92	6,28	6,48	6,58	6,60	6,55	6,46
06	5,84	7,37	8,21	8,70	8,99	9,12	9,15	9,08	8,95
07	9,21	11,62	12,95	13,73	14,17	14,38	14,42	14,33	14,12
08	11,10	14,01	15,60	16,54	17,08	17,33	17,38	17,26	17,01
09	12,31	15,53	17,30	18,35	18,94	19,22	19,28	19,15	18,87

**TABLE 10B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,14	1,20	1,27	1,33	1,40	1,48	1,54

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 10B

TABLE 11A: REFRIGERANT R449A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,18	0,22	0,25	0,27	0,28	0,28	0,28	0,28	0,28
01	0,63	0,80	0,90	0,96	0,99	1,01	1,01	1,01	0,99
02	1,25	1,60	1,79	1,90	1,97	2,00	2,01	2,00	1,97
03	1,49	1,89	2,12	2,25	2,33	2,37	2,38	2,37	2,34
04	2,40	3,06	3,43	3,65	3,78	3,84	3,86	3,84	3,78
05	4,11	5,24	5,87	6,24	6,46	6,57	6,60	6,56	6,48
06	5,70	7,27	8,14	8,66	8,96	9,11	9,15	9,10	8,98
07	8,99	11,46	12,83	13,65	14,13	14,37	14,43	14,35	14,16
08	10,84	13,81	15,46	16,45	17,03	17,32	17,39	17,29	17,06
09	12,02	15,32	17,15	18,24	18,88	19,20	19,29	19,18	18,92

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,18	0,22	0,25	0,26	0,27	0,28	0,28	0,27	0,27
01	0,64	0,81	0,90	0,95	0,98	0,99	0,99	0,99	0,97
02	1,27	1,60	1,78	1,89	1,95	1,97	1,98	1,96	1,93
03	1,51	1,90	2,11	2,24	2,31	2,34	2,34	2,32	2,28
04	2,44	3,08	3,42	3,62	3,73	3,78	3,79	3,76	3,70
05	4,18	5,26	5,85	6,20	6,39	6,48	6,48	6,43	6,32
06	5,79	7,30	8,12	8,59	8,86	8,98	8,99	8,91	8,77
07	9,13	11,51	12,80	13,55	13,97	14,16	14,17	14,06	13,83
08	11,01	13,87	15,42	16,33	16,84	17,06	17,08	16,94	16,66
09	12,21	15,38	17,11	18,11	18,67	18,92	18,95	18,79	18,48

TABLE 11B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,14	1,21	1,27	1,34	1,40	1,48	1,54

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 11B

TABLE 12A: REFRIGERANT R450A - CAPACITIES IN KW

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



Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,19	0,20	0,20	0,20	0,20	0,19	0,18	0,17
01	0,56	0,67	0,72	0,73	0,72	0,70	0,67	0,64	0,59
02	1,11	1,33	1,42	1,45	1,44	1,40	1,34	1,27	1,18
03	1,32	1,58	1,69	1,72	1,70	1,66	1,59	1,50	1,40
04	2,13	2,56	2,73	2,78	2,76	2,68	2,57	2,43	2,26
05	3,65	4,38	4,67	4,76	4,72	4,59	4,40	4,16	3,87
06	5,06	6,07	6,48	6,60	6,54	6,36	6,10	5,76	5,37
07	7,97	9,57	10,22	10,41	10,32	10,04	9,62	9,09	8,47
08	9,61	11,53	12,31	12,54	12,43	12,10	11,59	10,95	10,21
09	10,66	12,79	13,66	13,91	13,79	13,42	12,85	12,15	11,32

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,19	0,19	0,19	0,18	0,18	0,16	0,15
01	0,55	0,65	0,69	0,70	0,69	0,67	0,63	0,59	0,55
02	1,10	1,30	1,38	1,39	1,37	1,32	1,26	1,18	1,08
03	1,30	1,54	1,63	1,65	1,62	1,57	1,49	1,39	1,28
04	2,11	2,49	2,64	2,67	2,63	2,53	2,41	2,25	2,08
05	3,60	4,27	4,52	4,56	4,49	4,34	4,12	3,86	3,56
06	4,99	5,92	6,26	6,33	6,23	6,01	5,71	5,35	4,93
07	7,88	9,33	9,87	9,98	9,82	9,48	9,01	8,43	7,77
08	9,49	11,25	11,90	12,03	11,83	11,42	10,86	10,16	9,37
09	10,53	12,47	13,20	13,34	13,13	12,67	12,04	11,27	10,39

**TABLE 12B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,12	1,18	1,24	1,30	1,36	1,40	1,45

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 12B

TABLE 13A: REFRIGERANT R452A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,20	0,21	0,22	0,22	0,21	0,21	0,20
01	0,53	0,66	0,73	0,77	0,78	0,78	0,77	0,75	0,73
02	1,04	1,31	1,45	1,52	1,55	1,55	1,54	1,50	1,45
03	1,24	1,56	1,72	1,80	1,84	1,84	1,82	1,78	1,72
04	2,00	2,52	2,78	2,92	2,98	2,98	2,94	2,87	2,78
05	3,43	4,31	4,76	4,99	5,09	5,10	5,04	4,92	4,75
06	4,75	5,98	6,60	6,92	7,06	7,07	6,98	6,82	6,59
07	7,49	9,42	10,41	10,92	11,14	11,15	11,01	10,75	10,39
08	9,03	11,36	12,54	13,16	13,42	13,44	13,27	12,95	12,52
09	10,02	12,60	13,91	14,60	14,89	14,90	14,71	14,37	13,88

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,20	0,21	0,21	0,21	0,21	0,20	0,19
01	0,53	0,66	0,73	0,76	0,77	0,77	0,75	0,73	0,70
02	1,06	1,32	1,44	1,51	1,53	1,52	1,50	1,45	1,40
03	1,26	1,56	1,71	1,78	1,81	1,80	1,77	1,72	1,66
04	2,04	2,53	2,77	2,89	2,93	2,92	2,87	2,79	2,68
05	3,48	4,32	4,74	4,94	5,01	4,99	4,91	4,77	4,59
06	4,83	5,99	6,57	6,85	6,95	6,92	6,80	6,61	6,36
07	7,61	9,45	10,36	10,80	10,96	10,92	10,73	10,43	10,03
08	9,17	11,39	12,48	13,01	13,20	13,16	12,93	12,57	12,09
09	10,18	12,63	13,84	14,43	14,64	14,59	14,34	13,94	13,41

TABLE 13B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,14	1,15	1,23	1,30	1,37	1,45	1,49	1,56

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 13B

TABLE 14A: REFRIGERANT R513A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,19	0,20	0,19	0,19	0,18	0,17	0,16
01	0,54	0,65	0,69	0,70	0,70	0,68	0,65	0,61	0,56
02	1,06	1,28	1,37	1,40	1,38	1,34	1,28	1,21	1,12
03	1,26	1,52	1,62	1,65	1,64	1,59	1,52	1,43	1,33
04	2,04	2,46	2,63	2,68	2,65	2,57	2,46	2,32	2,15
05	3,49	4,21	4,50	4,58	4,54	4,41	4,21	3,97	3,68
06	4,84	5,83	6,24	6,35	6,29	6,11	5,84	5,50	5,10
07	7,63	9,20	9,84	10,01	9,92	9,63	9,21	8,67	8,05
08	9,19	11,09	11,85	12,07	11,95	11,61	11,09	10,45	9,70
09	10,20	12,30	13,15	13,39	13,26	12,87	12,30	11,59	10,76

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,15	0,18	0,19	0,19	0,19	0,18	0,17	0,16	0,14
01	0,53	0,63	0,67	0,68	0,67	0,64	0,61	0,57	0,52
02	1,06	1,26	1,33	1,35	1,32	1,28	1,21	1,13	1,04
03	1,25	1,49	1,58	1,60	1,57	1,51	1,43	1,34	1,23
04	2,03	2,41	2,56	2,58	2,54	2,45	2,32	2,16	1,99
05	3,47	4,13	4,37	4,42	4,34	4,19	3,97	3,70	3,40
06	4,81	5,72	6,06	6,12	6,02	5,80	5,50	5,13	4,71
07	7,59	9,03	9,56	9,66	9,49	9,15	8,67	8,10	7,43
08	9,14	10,88	11,52	11,64	11,44	11,03	10,45	9,76	8,96
09	10,14	12,06	12,78	12,91	12,69	12,23	11,59	10,82	9,94

**TABLE 14B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,13	1,20	1,27	1,33	1,40	1,48	1,54

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 14B

TABLE 15A: REFRIGERANT R515A - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,14	0,16	0,17	0,17	0,16	0,15	0,14	0,13	0,11
01	0,50	0,59	0,61	0,61	0,59	0,56	0,51	0,47	0,41
02	1,00	1,17	1,22	1,21	1,17	1,10	1,02	0,93	0,82
03	1,18	1,38	1,44	1,43	1,38	1,31	1,21	1,10	0,97
04	1,91	2,24	2,33	2,32	2,24	2,12	1,96	1,78	1,57
05	3,28	3,83	3,99	3,97	3,83	3,62	3,35	3,04	2,69
06	4,54	5,31	5,54	5,50	5,31	5,02	4,64	4,21	3,73
07	7,16	8,38	8,73	8,68	8,38	7,91	7,32	6,64	5,88
08	8,63	10,10	10,53	10,46	10,10	9,54	8,83	8,00	7,09
09	9,57	11,20	11,67	11,60	11,20	10,58	9,79	8,88	7,86

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,14	0,16	0,16	0,16	0,15	0,14	0,13	0,12	0,10
01	0,49	0,57	0,58	0,57	0,55	0,51	0,47	0,42	0,36
02	0,98	1,13	1,16	1,14	1,09	1,02	0,93	0,83	0,71
03	1,16	1,34	1,38	1,35	1,29	1,20	1,10	0,98	0,85
04	1,88	2,16	2,23	2,19	2,09	1,95	1,78	1,58	1,37
05	3,21	3,70	3,81	3,75	3,58	3,34	3,04	2,71	2,34
06	4,45	5,13	5,29	5,20	4,96	4,63	4,22	3,76	3,25
07	7,02	8,09	8,33	8,20	7,82	7,29	6,65	5,92	5,12
08	8,46	9,74	10,04	9,88	9,43	8,79	8,02	7,14	6,17
09	9,38	10,81	11,14	10,95	10,46	9,75	8,89	7,92	6,85

TABLE 15B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,12	1,14	1,20	1,26	1,31	1,39	1,44

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 15B

TABLE 16A: REFRIGERANT R515B - CAPACITIES IN KW

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



Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,14	0,17	0,17	0,17	0,17	0,16	0,14	0,13	0,12
01	0,51	0,59	0,62	0,62	0,59	0,56	0,52	0,47	0,42
02	1,01	1,18	1,23	1,22	1,18	1,11	1,03	0,94	0,83
03	1,19	1,40	1,46	1,45	1,40	1,32	1,22	1,11	0,98
04	1,93	2,26	2,36	2,34	2,26	2,14	1,98	1,79	1,59
05	3,31	3,87	4,03	4,01	3,87	3,66	3,38	3,07	2,72
06	4,59	5,37	5,59	5,56	5,37	5,07	4,69	4,25	3,77
07	7,23	8,46	8,82	8,77	8,46	7,99	7,40	6,71	5,94
08	8,72	10,20	10,63	10,57	10,20	9,63	8,91	8,08	7,16
09	9,67	11,31	11,79	11,72	11,31	10,68	9,89	8,96	7,94

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,14	0,16	0,16	0,16	0,15	0,14	0,13	0,12	0,10
01	0,50	0,57	0,59	0,58	0,55	0,52	0,47	0,42	0,36
02	0,99	1,14	1,17	1,15	1,10	1,03	0,94	0,83	0,72
03	1,17	1,35	1,39	1,37	1,31	1,22	1,11	0,99	0,85
04	1,90	2,18	2,25	2,21	2,11	1,97	1,80	1,60	1,38
05	3,24	3,74	3,85	3,79	3,61	3,37	3,07	2,74	2,37
06	4,50	5,18	5,34	5,25	5,01	4,67	4,26	3,79	3,28
07	7,09	8,17	8,42	8,28	7,90	7,37	6,72	5,98	5,17
08	8,54	9,84	10,15	9,98	9,52	8,88	8,10	7,21	6,23
09	9,48	10,92	11,25	11,06	10,56	9,85	8,98	7,99	6,91

**TABLE 16B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,05	1,11	1,13	1,20	1,25	1,30	1,38	1,44

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 16B

TABLE 17A: REFRIGERANT R22 - CAPACITIES IN KW

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

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,20	0,26	0,29	0,32	0,33	0,34	0,35	0,35	0,35
01	0,71	0,91	1,03	1,10	1,15	1,19	1,21	1,22	1,22
02	1,40	1,80	2,03	2,18	2,29	2,35	2,39	2,41	2,41
03	1,66	2,13	2,41	2,59	2,71	2,79	2,83	2,85	2,85
04	2,68	3,44	3,89	4,18	4,38	4,50	4,58	4,61	4,61
05	4,59	5,89	6,66	7,16	7,50	7,71	7,84	7,90	7,90
06	6,36	8,18	9,24	9,94	10,40	10,70	10,87	10,95	10,96
07	10,03	12,89	14,58	15,67	16,40	16,87	17,15	17,27	17,28
08	12,09	15,54	17,56	18,88	19,76	20,32	20,66	20,81	20,82
09	13,40	17,22	19,47	20,93	21,90	22,53	22,91	23,08	23,08

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,20	0,26	0,29	0,31	0,33	0,34	0,34	0,34	0,34
01	0,71	0,91	1,02	1,10	1,14	1,17	1,19	1,20	1,19
02	1,41	1,80	2,02	2,17	2,26	2,32	2,36	2,37	2,36
03	1,68	2,13	2,40	2,57	2,68	2,75	2,79	2,81	2,80
04	2,71	3,45	3,88	4,15	4,33	4,45	4,51	4,53	4,53
05	4,64	5,91	6,64	7,11	7,42	7,62	7,72	7,77	7,76
06	6,43	8,19	9,21	9,87	10,29	10,56	10,72	10,77	10,76
07	10,14	12,92	14,53	15,56	16,23	16,66	16,90	16,99	16,96
08	12,22	15,56	17,50	18,75	19,56	20,07	20,36	20,47	20,44
09	13,55	17,26	19,41	20,79	21,69	22,25	22,57	22,70	22,66

**TABLE 17B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^{\circ}K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,05	1,10	1,15	1,20	1,25	1,29	1,35	1,41

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 17B

TABLE 18A: REFRIGERANT R23 - CAPACITIES IN KW

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

Evaporating Temperature -70 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,20	0,27	0,30	0,33	0,35	0,36	0,37	0,37	0,38
01	0,73	0,95	1,09	1,18	1,24	1,29	1,32	1,34	1,35
02	1,45	1,89	2,16	2,34	2,47	2,56	2,62	2,66	2,68
03	1,72	2,24	2,55	2,77	2,92	3,03	3,10	3,15	3,17
04	2,78	3,62	4,14	4,48	4,73	4,90	5,02	5,10	5,14
05	4,76	6,20	7,08	7,68	8,10	8,39	8,60	8,73	8,79
06	6,61	8,59	9,81	10,64	11,22	11,64	11,92	12,10	12,19
07	10,41	13,55	15,47	16,78	17,70	18,35	18,79	19,07	19,22
08	12,55	16,33	18,64	20,21	21,32	22,10	22,64	22,98	23,16
09	13,92	18,11	20,68	22,42	23,65	24,52	25,11	25,49	25,69

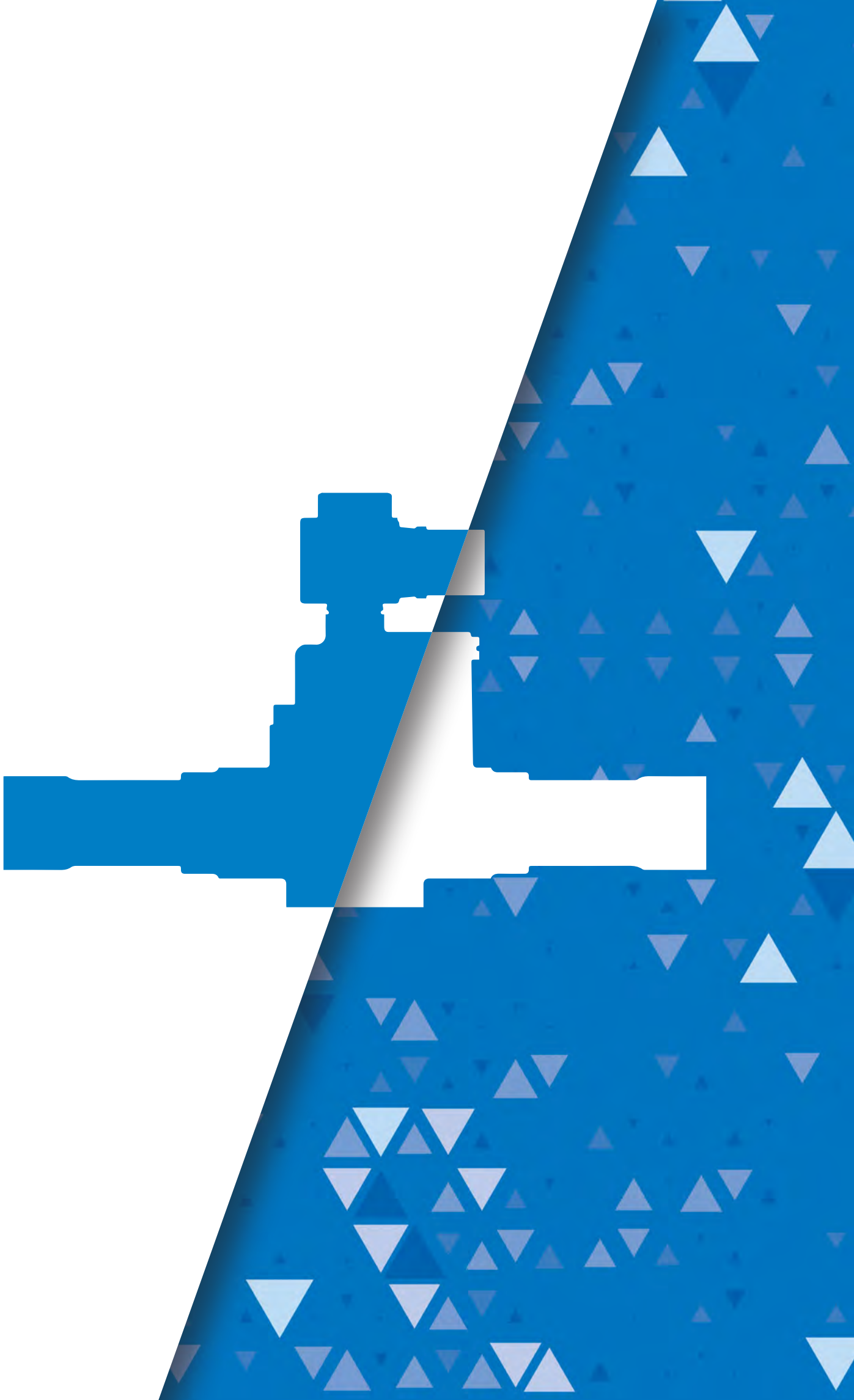
  

Evaporating Temperature -80 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
00	0,21	0,27	0,30	0,33	0,35	0,36	0,37	0,37	0,37
01	0,75	0,96	1,09	1,18	1,24	1,29	1,32	1,33	1,34
02	1,48	1,91	2,17	2,34	2,47	2,55	2,61	2,64	2,66
03	1,76	2,26	2,57	2,78	2,92	3,02	3,09	3,13	3,15
04	2,84	3,66	4,16	4,49	4,73	4,89	5,00	5,07	5,10
05	4,87	6,27	7,12	7,69	8,09	8,37	8,56	8,67	8,73
06	6,75	8,69	9,87	10,66	11,22	11,60	11,86	12,02	12,10
07	10,64	13,70	15,56	16,81	17,68	18,29	18,70	18,95	19,08
08	12,82	16,51	18,75	20,26	21,31	22,04	22,54	22,84	22,98
09	14,22	18,31	20,79	22,47	23,63	24,45	24,99	25,33	25,49

**TABLE 18B - CORRECTION FACTORS FOR SUBCOOLING  $\Delta T_{SUB} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,07	1,14	1,20	1,27	1,33	1,39	1,41	1,48

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 18B





# SOLENOID VALVES

CLASSIC



# SOLENOID VALVES

## 2.1 – NORMALLY CLOSED SOLENOID VALVES

### APPLICATIONS

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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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 are sold without coil (with the S suffix) or with coil (for example A6 suffix with coil 9300/RA6-220/230 VAC). For these solenoid valves are available:

- Coils in series 9110 (coils type CM2);
- Coils in series 9120 (coils type HM3);
- Coils in series 9160 (coils type HM4);
- Coils in series 9300 (coils type HF2);
- Coils in series 9320 (coils type HF3);
- Coils in series 9360 (coils type HF4).

NC solenoid valves, UL Certified, are sold without coil (with the S suffix) For these solenoid valves are available:

- Coils, UL Recognized, in series 9105 (coils type HM2);
- Coils, UL Recognized, in series 9115 (coils type CM2-N2);
- Coils, UL Recognized, in series 9116 (coils type CM2-N4);
- 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 valves in series 1020/1020UL and 1028/1028UL 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 (diaphragm or 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 diaphragm/piston and keep it lifted off the main opening;
- Close the diaphragm/piston and ensure the tightness on the main opening.

Opening/closing of main valve seat is controlled by the diaphragm/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;
- Chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for seat gaskets.

### INSTALLATION

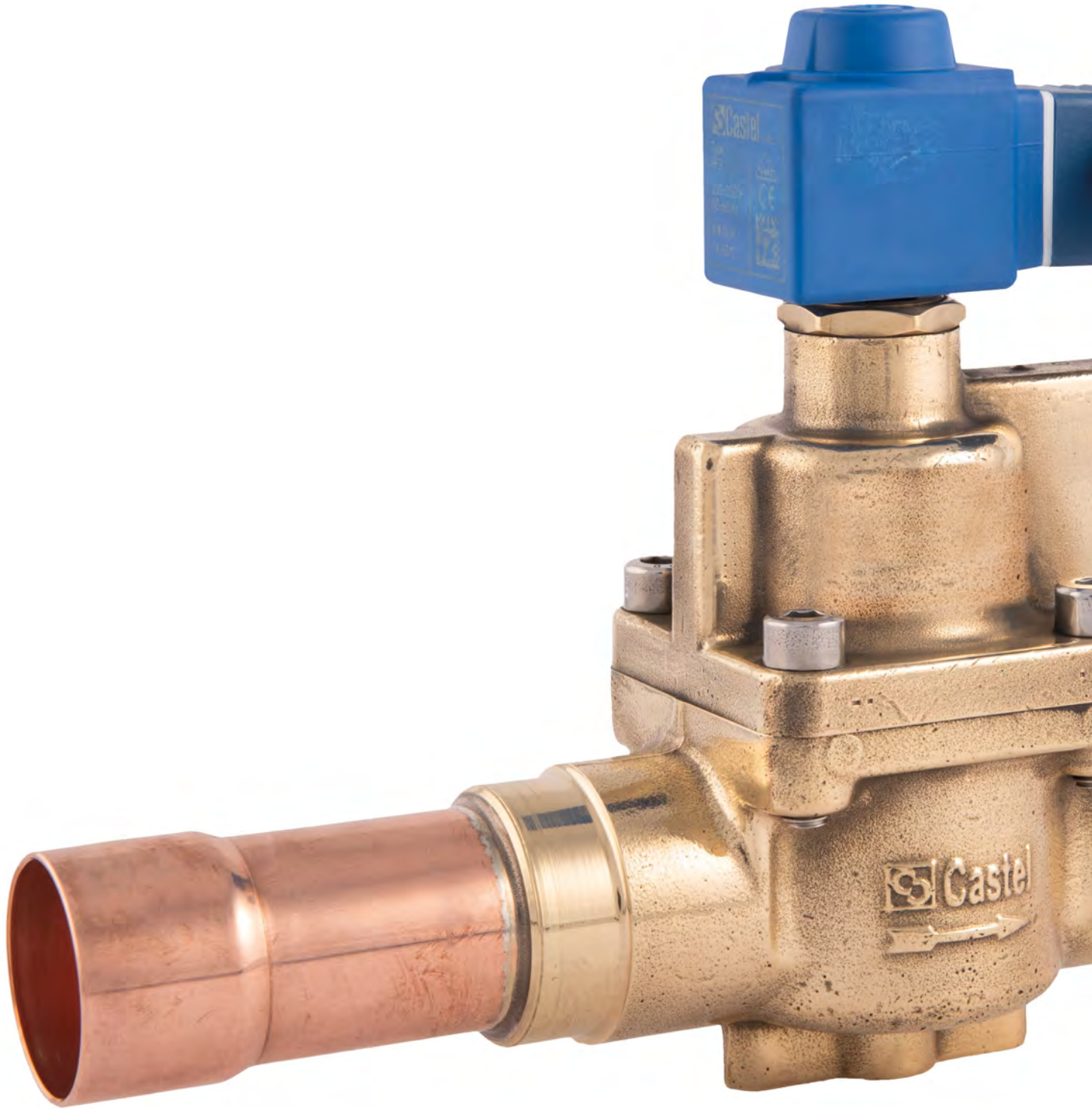
All the valves in this chapter can be installed on the three main branches of a plant (hot gas line, liquid line, and suction line), while respecting the limits of use indicated in Tables 1, 2, 3 and 4 and the capacities indicated in Tables 6, 7 and 8. Castel recommends using piston pilot-operated solenoid valves for applications with the hot gas supply line in particularly harsh (temperature/pressure) operating conditions.


Tables 1, 2, 3 and 4 show 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.

## TRACEABILITY

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

- Direct action valves in series 1020/1020UL and 1028/1028UL;
- Pilot-operated piston valves in series 1034/1034UL, 1038/1038UL, 1040/1040UL, 1048/1048UL, 1049/1049UL;
- Pilot-operated diaphragm valves in series 1064/1064UL, 1068/1068UL, 1070/1070UL, 1078/1078UL up to 1078/5-1078UL/5, 1079/1079UL up to 1079/7-1079UL/7;

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

All the other pilot-operated valves (diaphragm and piston) 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.

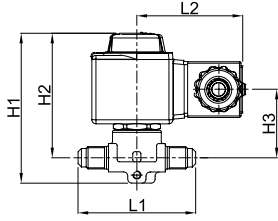
## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the solenoid valves in series: 1020UL, 1028UL, 1034UL, 1038UL, 1040UL, 1048UL, 1049UL, 1064UL, 1068UL, 1070UL, 1078UL, 1079UL, 1090UL, 1098UL, 1099UL with file MH50005.

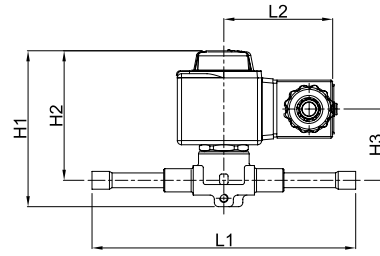
These valves are certified **UL-CSA Listed** for the USA and Canada, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13, with a Design Pressure of:

- 650 PSI for valves in series 1020UL, 1028UL, 1034UL, 1038UL, 1064UL, 1068UL;
- 600 PSI for valves in series 1040UL, 1048UL, 1050UL, 1058UL, 1070UL, 1078UL;
- 500 PSI for valves in series 1090UL, 1098UL;
- 580 PSI for valves in series 1098/9;
- 435 PSI for valves in series 1078UL/11, 1078UL/13.

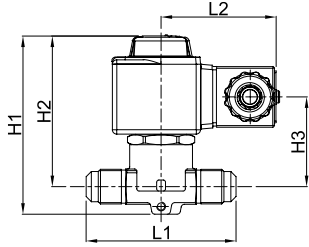
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1020/3



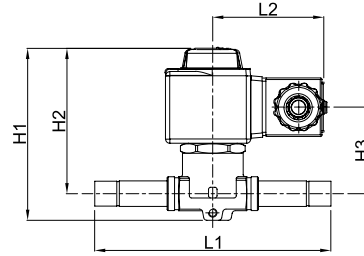
1028/2  
1028/3  
1028/M10



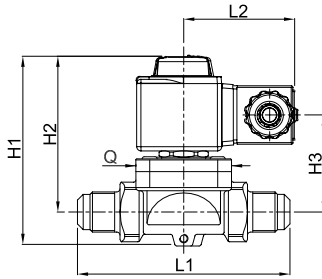
1034/3 1064/3  
1034/4 1064/4



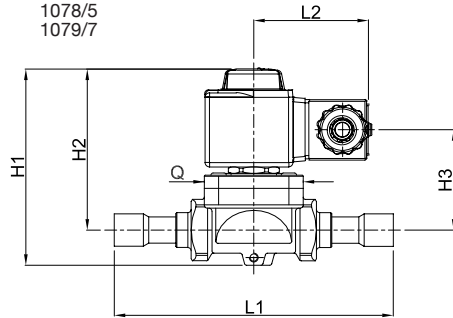
1038/3 1068/3  
1038/4 1068/4  
1038/M10 1068/M10  
1038/M12 1068/M12



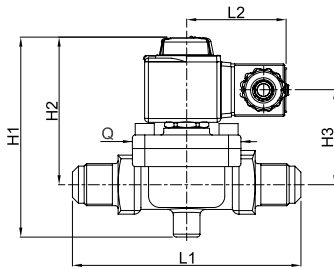
1040/4 1070/4  
1040/5 1070/5



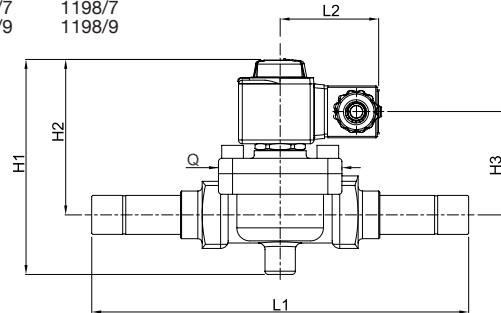
1048/M12 1078/M12  
1048/4 1078/4  
1048/5 1078/5  
1049/7 1079/7



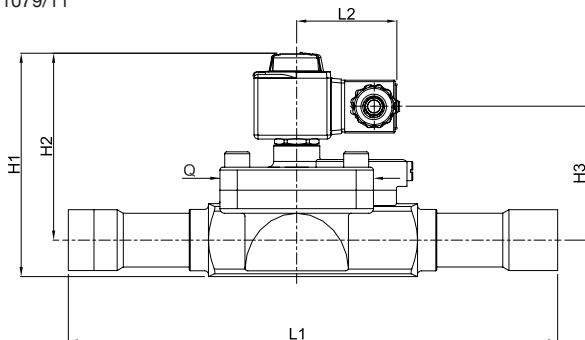
1150/5 1190/5  
1150/6 1190/6



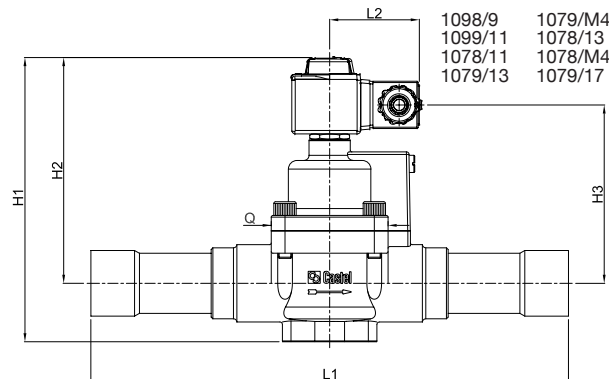
1158/5 1198/5  
1158/6 1198/6  
1158/7 1198/7  
1158/9 1198/9



1078/9  
1079/11



1098/9 1079/M42  
1099/11 1078/13  
1078/11 1078/M42  
1079/13 1079/17



**TABLE 1: GENERAL CHARACTERISTICS OF NC VALVES WITH SAE FLARE CONNECTIONS**

Operating Principles	Catalogue Number	SAE Flare Connections	Seat size nominal Ø [mm]	Kv Factor [m³/h]	Opening Pressure Differential [bar]					PS [bar]	TS [°C]		Risk Category according to PED Recast	
					min OPD	MOPD					min.	max.		
						AC coils series			DC coils series					
						9110 9300	9160 9360	9120 9320	9160 9360					9120 9320
Direct Acting	1020/2#	1/4"	2,5	0,175	0	21	28	35	20	21	45	-35	+110	Art. 4.3
	1020/3#	3/8"	3	0,23										
Diaphragm Pilot Operated	1064/3#	3/8"	6,5	0,8	0,05	21	28	35	17	18	45	-35	+105	Art. 4.3
	1064/4#	1/2"												
	1070/4#	1/2"	12,5	2,2					10	13				
	1070/5#	5/8"	2,61											
	1090/5#	5/8"	16,5	3,8					8	10				
	1090/6#	3/4"		4,8										
Piston Pilot Operated	1034/3#	3/8"	6,5	1,0	0,05	21	28	35	10	18	45	-35	+110	Art. 4.3
	1034/4#	1/2"												
	1040/4#	1/2"	12,5	2,4					14	18				
	1040/5#	5/8"	3,0											
	1050/5#	5/8"	16,5	3,8					8	16				
	1050/6#	3/4"		4,8										

# = S, A6

**TABLE 2: GENERAL CHARACTERISTICS OF NC VALVES, UL APPROVED, WITH SAE FLARE CONNECTIONS**

Operating Principles	Catalogue Number	SAE Flare Connections	Seat size nominal Ø [mm]	Kv Factor [m³/h]	Opening Pressure Differential [bar]			Design Pressure		Design Temperature [°C]		Risk Category according to PED Recast	
					min OPD	MOPD			bar	PSI	min.		max.
						AC coils series		DC coils s.					
						9105 9115 9116	9125 9185 9186	9125 9185 9186					
Direct Acting	1020UL/2S	1/4"	2,5	0,175	0	21	35	19	45	650	-35	+110	Art. 4.3
	1020UL/3S	3/8"	3	0,23									
Diaphragm Pilot Operated	1064UL/3S	3/8"	6,5	0,8	0,05	21	35	19	45	650	-35	+105	Art. 4.3
	1064UL/4S	1/2"											
	1070UL/4S	1/2"	12,5	2,2				18	41,5	600			
	1070UL/5S	5/8"	2,61										
	1090UL/5S	5/8"	16,5	3,8				13	34,5	500			
	1090UL/6S	3/4"		4,8									
Piston Pilot Operated	1034UL/3S	3/8"	6,5	1,0	0,05	21	35	19	45	650	-35	+110	Art. 4.3
	1034UL/4S	1/2"											
	1040UL/4S	1/2"	12,5	2,4				18	41,5	600			
	1040UL/5S	5/8"	3,0										
	1050UL/5S	5/8"	16,5	3,8				13	41,5	600			
	1050UL/6S	3/4"		4,8									

TABLE 3: GENERAL CHARACTERISTICS OF 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]	TS [°C]		Risk Category according to PED Recast	
		Ø [in.]	Ø [mm]			min OPD	MOPD					min.	max.		
							AC coils series			DC coils series					
							9110 9300	9160 9360	9120 9320	9160 9360					9120 9320
Direct Acting	1028/2#	1/4"	–	2,2	0,15	0	21	28	35	20	21	45	–35	+110	Art. 4.3
	1028/2#.E	1/4"	–	3	0,23										
	1028/3#	3/8"	–												
	1028/M10#	–	10												
Diaphragm Pilot Operated	1068/3#	3/8"	–	6,5	0,8	0,05	21	28	35	17	18	45	–35	+105	Art. 4.3
	1068/M10#	–	10												
	1068/M12#	–	12												
	1068/4#	1/2"	–												
	1078/M12#	–	12	12,5	2,2										
	1078/4#	1/2"	–												
	1078/5#	5/8"	16												
	1079/7#	7/8"	22	16,5	2,61										
	1098/5#	5/8"	16												
	1098/6#	3/4"	–												
	1098/7#	7/8"	22												
	1099/9#	1.1/8"	–	25,5	10										
	1078/9#	1.1/8"	–												
	1079/11#	1.3/8"	35												
Piston Pilot Operated	1038/3#	3/8"	–	6,5	1,0	0,05	21	28	35	10	18	45	–35	+110	Art. 4.3
	1038/M10#	–	10												
	1038/M12#	–	12												
	1038/4#	1/2"	–												
	1048/M12#	–	12	12,5	2,4										
	1048/4#	1/2"	–												
	1048/5#	5/8"	16												
	1049/7#	7/8"	22												
	1058/5#	5/8"	16	16,5	3,0										
	1058/6#	3/4"	–												
	1058/7#	7/8"	22												
	1059/9#	1.1/8"	–												
	1098/9#	1.1/8"	–	25	10										
	1099/11#	1.3/8"	35												
	1078/11#	1.3/8"	35												
	1079/13#	1.5/8"	–	27	16										
	1079/M42#	–	42												
	1078/13#	1.5/8"	–	34	25										
1078/M42#	–	42													
1079/17#	2.1/8"	54													

# = S, A6

TABLE 4: GENERAL CHARACTERISTICS OF NC VALVES, UL APPROVED, WITH ODS CONNECTIONS

Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m³/h]	Opening Pressure Differential [bar]				Design Pressure		Design Temperature [°C]		Risk Category according to PED Recast
		Ø [in.]	Ø [mm]			min OPD	MOPD			bar	PSI	min.	max.	
							AC coils series		DC coils s.					
							9105 9115 9116	9125 9185 9186						
Direct Acting	1028UL/2S	1/4"	–	2,2	0,15	0	21	35	19	45	650	–35	+110	Art. 4.3
	1028UL/2S.E	1/4"	–	3	0,23									
	1028UL/3S	3/8"	–											
	1028UL/M10S	–	10											
Diaphragm Pilot Operated	1068UL/3S	3/8"	–	6,5	0,8	0,05	21	35	19	45	650	–35	+105	Art. 4.3
	1068UL/M10S	–	10											
	1068UL/M12S	–	12											
	1068UL/4S	1/2"	–											
	1078UL/M12S	–	12	12,5	2,2									
	1078UL/4S	1/2"	–											
	1078UL/5S	5/8"	16	16,5	2,61									
	1079UL/7S	7/8"	22											
	1098UL/5S	5/8"	16											
	1098UL/6S	3/4"	–	16,5	4,8									
	1098UL/7S	7/8"	22											
	1099UL/9S	1.1/8"	–											
	1078UL/9S	1.1/8"	–	25,5	10									
	1079UL/11S	1.3/8"	35											
Piston Pilot Operated	1038UL/3S	3/8"	–	6,5	1,0	0,05	21	35	19	45	650	–35	+110	Art. 4.3
	1038UL/M10S	–	10											
	1038UL/M12S	–	12											
	1038UL/4S	1/2"	–											
	1048UL/M12S	–	12	12,5	2,4									
	1048UL/4S	1/2"	–											
	1048UL/5S	5/8"	16											
	1049UL/7S	7/8"	22											
	1058UL/5S	5/8"	16	16,5	3,8									
	1058UL/6S	3/4"	–											
	1058UL/7S	7/8"	22											
	1059UL/9S	1.1/8"	–	16,5	4,8									
	1098UL/9S	1.1/8"	–											
	1099UL/11S	1.3/8"	35											
	1078UL/11S	1.3/8"	35	27	16									
	1079UL/13S	1.5/8"	–											
	1079UL/M42S	–	42											
	1078UL/13S	1.5/8"	–	34	25									
1078UL/M42S	–	42												
1079UL/17S	2.1/8"	54												

TABLE 5: DIMENSIONS AND WEIGHTS OF NC VALVES WITH 9300 COILS (1)

Operating Principles	Catalogue Number		Dimensions [mm]					Weight [g]		
			H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>		Q	
Direct Acting	1020/2#	1020UL/2S	75	62,5	34	58	52	-	340	
	1020/3#	1020UL/3S				65			355	
	1028/2#	1028UL/2S				125			350	
	1028/2#.E	1028UL/2S.E				125			350	
	1028/3#	1028UL/3S				125			365	
	1028/M10#	1028UL/M10S				125			365	
Diaphragm Pilot Operated	1064/3#	1064UL/3S	82	69,5	40	68	52	-	400	
	1064/4#	1064UL/4S				72			415	
	1068/3#	1068UL/3S				111			400	
	1068/M10#	1068UL/M10S				111			395	
	1068/M12#	1068UL/M12S				127			420	
	1068/4#	1068UL/4S				127			420	
	1070/4#	1070UL/4S	91	75	47	100		45	710	
	1070/5#	1070UL/5S				106			755	
	1078/M12#	1078UL/M12S				127			690	
	1078/4#	1078UL/4S				127			680	
	1078/5#	1078UL/5S				175			775	
	1079/7#	1079UL/7S				190			765	
	1090/5#	1090UL/5S	106	78	50	120			57	1035
	1090/6#	1090UL/6S				124				1365
	1098/5#	1098UL/5S				175				995
	1098/6#	1098UL/6S				175				1185
	1098/7#	1098UL/7S				180				1170
	1099/9#	1099UL/9S				216				1225
	1078/9#	1078UL/9S	115	96	72	250		80		2565
	1079/11#	1079UL/11S				292				2620
Piston Pilot Operated	1034/3#	1034UL/3S	92,5	80	50,5	68	52	-		440
	1034/4#	1034UL/4S				72				457
	1038/3#	1038UL/3S				111				440
	1038/M10#	1038UL/M10S				111				435
	1038/M12#	1038UL/M12S				127			462	
	1038/4#	1038UL/4S				127			462	
	1040/4#	1040UL/4S	100,5	84,5	56,5	100		45	781	
	1040/5#	1040UL/5S				106			831	
	1048/M12#	1048UL/M12S				127			759	
	1048/4#	1048UL/4S				127			748	
	1048/5#	1048UL/5S				175			853	
	1049/7#	1049UL/7S				190			842	
	1050/5#	1050UL/5S	121	93	65	120			57	1157
	1050/6#	1050UL/6S				124				1487
	1058/5#	1058UL/5S				175				1117
	1058/6#	1058UL/6S				175				1307
	1058/7#	1058UL/7S				180				1292
	1059/9#	1059UL/9S				216				1347
	1098/9#	1098UL/9S	157	127	99	235		60		2050
	1099/11#	1099UL/11S				277				2130
	1078/11#	1078UL/11S	171	137	110	254		68		2710
	1079/13#	1079UL/13S				278				2750
	1079/M42#	1079UL/M42S				278				2750
	1078/13#	1078UL/13S	192	155	128	265		88		3810
	1078/M42#	1078UL/M42S				280			3880	
	1079/17#	1079UL/17S				280			3880	

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(1) : With coil 9360 the dimension L2 is equal to 57 mm and the weights must be increased of 240 g.

(1) : With coil 9320 the dimension L2 is equal to 65 mm and the weights must be increased of 500 g.

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

TABLE 6: REFRIGERANT FLOW CAPACITY OF NC VALVES IN LIQUID LINE [KW]

Operating Principles	Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B	
	Direct Acting	1020/2#	1020UL/2S	2,98	3,20	2,08	3,02	3,00	2,01	2,63	2,74	2,75	2,78	2,12	2,55	2,53	2,58
1020/3#		1020UL/3S	3,91	4,21	2,74	3,96	3,95	2,65	3,46	3,60	3,62	3,66	2,79	3,35	3,33	3,40	
1028/2#		1028UL/2S	2,55	2,75	1,79	2,58	2,58	1,73	2,26	2,35	2,36	2,39	1,82	2,18	2,17	2,22	
1028/2#.E		1028UL/2S.E	3,91	4,21	2,74	3,96	3,95	2,65	3,46	3,60	3,62	3,66	2,79	3,35	3,33	3,40	
1028/3#		1028UL/3S															
	1028/M10#	1028UL/M10S															
Diaphragm Pilot Operated	1064/3#	1064UL/3S	13,6	14,6	9,5	13,8	13,7	9,2	12,0	12,5	12,6	12,7	9,7	11,6	11,58	11,82	
	1064/4#	1064UL/4S															
	1068/3#	1068UL/3S															
	1068/M10#	1068UL/M10S															
	1068/M12#	1068UL/M12S															
	1068/4#	1068UL/4S															
	1070/4#	1070UL/4S	37,4	40,3	26,2	37,9	37,8	25,3	33,1	34,4	34,6	35,0	26,7	32,0	31,83	32,49	
	1070/5#	1070UL/5S	44,4	47,8	31,1	45,0	44,8	30,0	39,3	40,8	41,0	41,5	31,7	38,0	37,77	38,55	
	1078/M12#	1078UL/M12S	37,4	40,3	26,2	37,9	37,8	25,3	33,1	34,4	34,6	35,0	26,7	32,0	31,83	32,49	
	1078/4#	1078UL/4S	44,4	47,8	31,1	45,0	44,8	30,0	39,3	40,8	41,0	41,5	31,7	38,0	37,77	38,55	
	1078/5#	1078UL/5S															
	1079/7#	1079UL/7S															
	1090/5#	1090UL/5S	64,6	69,5	45,2	65,5	65,2	43,7	57,2	59,5	59,7	60,5	46,1	55,3	54,99	56,13	
	1090/6#	1090UL/6S	81,6	87,8	57,1	82,7	82,4	55,2	72,2	75,1	75,5	76,4	58,2	69,9	69,46	70,90	
	1098/5#	1098UL/5S	64,6	69,5	45,2	65,5	65,2	43,7	57,2	59,5	59,7	60,5	46,1	55,3	54,99	56,13	
	1098/6#	1098UL/6S	81,6	87,8	57,1	82,7	82,4	55,2	72,2	75,1	75,5	76,4	58,2	69,9	69,46	70,90	
	1098/7#	1098UL/7S	96,9	104,3	67,8	98,2	97,9	65,6	85,7	89,2	89,6	90,7	69,1	83,0	82,48	84,19	
	1099/9#	1099UL/9S															
	1078/9#	1078UL/9S	170,0	183,0	119,0	172,3	171,7	115,0	150,4	156,5	157,2	159,1	121,3	145,6	144,70	147,70	
	1079/11#	1079UL/11S															
Piston Pilot Operated	1034/3#	1034UL/3S	17,0	18,3	11,9	17,2	17,2	11,5	15,0	15,7	15,7	15,9	12,1	14,6	14,47	14,77	
	1034/4#	1034UL/4S															
	1038/3#	1038UL/3S															
	1038/M10#	1038UL/M10S															
	1038/M12#	1038UL/M12S															
	1038/4#	1038UL/4S															
	1040/4#	1040UL/4S	40,8	43,9	28,6	41,4	41,2	27,6	36,1	37,6	37,7	38,2	29,1	34,9	34,73	35,45	
	1040/5#	1040UL/5S	51,0	54,9	35,7	51,7	51,5	34,5	45,1	47,0	47,2	47,7	36,4	43,7	43,41	44,31	
	1048/M12#	1048UL/M12S	40,8	43,9	28,6	41,4	41,2	27,6	36,1	37,6	37,7	38,2	29,1	34,9	34,73	35,45	
	1048/4#	1048UL/4S															
	1048/5#	1048UL/5S	51,0	54,9	35,7	51,7	51,5	34,5	45,1	47,0	47,2	47,7	36,4	43,7	43,41	44,31	
	1049/7#	1049UL/7S															
	1050/5#	1050UL/5S	64,6	69,5	45,2	65,5	65,2	43,7	57,2	59,5	59,7	60,5	46,1	55,3	54,99	56,13	
	1050/6#	1050UL/6S	81,6	87,8	57,1	82,7	82,4	55,2	72,2	75,1	75,5	76,4	58,2	69,9	69,46	70,90	
	1058/5#	1058UL/5S	64,6	69,5	45,2	65,5	65,2	43,7	57,2	59,5	59,7	60,5	46,1	55,3	54,99	56,13	
	1058/6#	1058UL/6S	81,6	87,8	57,1	82,7	82,4	55,2	72,2	75,1	75,5	76,4	58,2	69,9	69,46	70,90	
	1058/7#	1058UL/7S	96,9	104,3	67,8	98,2	97,9	65,6	85,7	89,2	89,6	90,7	69,1	83,0	82,48	84,19	
	1059/9#	1059UL/9S															
	1098/9#	1098UL/9S	170,0	183,0	119,0	172,3	171,7	115,0	150,4	156,5	157,2	159,1	121,3	145,6	144,70	147,70	
	1099/11#	1099UL/11S															
1078/11#	1078UL/11S	272,0	292,8	190,4	275,7	274,7	184,0	240,6	250,4	251,5	254,6	194,1	233,0	231,52	236,32		
1079/13#	1079UL/13S																
1079/M42#	1079UL/M42S	425,0	457,5	297,5	430,8	429,3	287,5	376,0	391,3	393,0	397,8	303,3	364,0	361,75	369,25		
1078/13#	1078UL/13S																
1078/M42#	1078UL/M42S																
1079/17#	1079UL/17S																

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Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)
Temperature leaving evaporator	50 °F	(9,9 °C)			



TABLE 7: REFRIGERANT FLOW CAPACITY OF NC VALVES IN SUCTION LINE [KW]

Operating Principles	Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
Direct Acting	1020/2#	1020UL/2S	0,32	0,45	0,39	0,40	0,58	0,39	0,25	0,42	0,39	0,28	0,37	0,31	0,24	0,27
	1020/3#	1020UL/3S	0,42	0,59	0,51	0,52	0,76	0,51	0,33	0,55	0,51	0,37	0,49	0,41	0,32	0,36
	1028/2#	1028UL/2S	0,27	0,38	0,33	0,34	0,50	0,33	0,21	0,36	0,33	0,24	0,32	0,27	0,21	0,24
	1028/2#.E	1028UL/2S.E														
	1028/3#	1028UL/3S	0,42	0,59	0,51	0,52	0,76	0,51	0,33	0,55	0,51	0,37	0,49	0,41	0,32	0,36
	1028/M10#	1028UL/M10S														
Diaphragm Pilot Operated	1064/3#	1064UL/3S														
	1064/4#	1064UL/4S														
	1068/3#	1068UL/3S	1,46	2,04	1,76	1,82	2,64	1,78	1,14	1,92	1,76	1,27	1,69	1,43	1,10	1,26
	1068/M10#	1068UL/M10S														
	1068/M12#	1068UL/M12S														
	1068/4#	1068UL/4S														
	1070/4#	1070UL/4S	4,00	5,61	4,84	4,99	7,26	4,91	3,12	5,28	4,84	3,50	4,64	3,94	3,04	3,45
	1070/5#	1070UL/5S	4,75	6,66	5,74	5,92	8,61	5,82	3,71	6,26	5,74	4,15	5,51	4,67	3,60	4,10
	1078/M12#	1078UL/M12S	4,00	5,61	4,84	4,99	7,26	4,91	3,12	5,28	4,84	3,50	4,64	3,94	3,04	3,45
	1078/4#	1078UL/4S														
	1078/5#	1078UL/5S	4,75	6,66	5,74	5,92	8,61	5,82	3,71	6,26	5,74	4,15	5,51	4,67	3,60	4,10
	1079/7#	1079UL/7S														
	1090/5#	1090UL/5S	6,9	9,7	8,4	8,6	12,5	8,5	5,4	9,1	8,4	6,0	8,0	6,8	5,24	5,97
	1090/6#	1090UL/6S	8,7	12,2	10,6	10,9	15,8	10,7	6,8	11,5	10,6	7,6	10,1	8,6	6,62	7,54
	1098/5#	1098UL/5S	6,9	9,7	8,4	8,6	12,5	8,5	5,4	9,1	8,4	6,0	8,0	6,8	5,24	5,97
	1098/6#	1098UL/6S	8,7	12,2	10,6	10,9	15,8	10,7	6,8	11,5	10,6	7,6	10,1	8,6	6,62	7,54
	1098/7#	1098UL/7S														
1099/9#	1099UL/9S	10,4	14,5	12,5	12,9	18,8	12,7	8,1	13,7	12,5	9,1	12,0	10,2	7,87	8,95	
1078/9#	1078UL/9S															
1079/11#	1079UL/11S	18,2	25,5	22,0	22,7	33,0	22,3	14,2	24,0	22,0	15,9	21,1	17,9	13,80	15,70	
Piston Pilot Operated	1034/3#	1034UL/3S														
	1034/4#	1034UL/4S														
	1038/3#	1038UL/3S	1,82	2,55	2,20	2,27	3,30	2,23	1,42	2,40	2,20	1,59	2,11	1,79	1,38	1,57
	1038/M10#	1038UL/M10S														
	1038/M12#	1038UL/M12S														
	1038/4#	1038UL/4S														
	1040/4#	1040UL/4S	4,37	6,12	5,28	5,45	7,92	5,35	3,41	5,76	5,28	3,82	5,06	4,30	3,31	3,77
	1040/5#	1040UL/5S	5,46	7,65	6,60	6,81	9,90	6,69	4,26	7,20	6,60	4,77	6,33	5,37	4,14	4,71
	1048/M12#	1048UL/M12S	4,37	6,12	5,28	5,45	7,92	5,35	3,41	5,76	5,28	3,82	5,06	4,30	3,31	3,77
	1048/4#	1048UL/4S														
	1048/5#	1048UL/5S	5,46	7,65	6,60	6,81	9,90	6,69	4,26	7,20	6,60	4,77	6,33	5,37	4,14	4,71
	1049/7#	1049UL/7S														
	1050/5#	1050UL/5S	6,9	9,7	8,4	8,6	12,5	8,5	5,4	9,1	8,4	6,0	8,0	6,8	5,24	5,97
	1050/6#	1050UL/6S	8,7	12,2	10,6	10,9	15,8	10,7	6,8	11,5	10,6	7,6	10,1	8,6	6,62	7,54
	1058/5#	1058UL/5S	6,9	9,7	8,4	8,6	12,5	8,5	5,4	9,1	8,4	6,0	8,0	6,8	5,24	5,97
	1058/6#	1058UL/6S	8,7	12,2	10,6	10,9	15,8	10,7	6,8	11,5	10,6	7,6	10,1	8,6	6,62	7,54
	1058/7#	1058UL/7S														
	1059/9#	1059UL/9S	10,4	14,5	12,5	12,9	18,8	12,7	8,1	13,7	12,5	9,1	12,0	10,2	7,87	8,95
	1098/9#	1098UL/9S														
	1099/11#	1099UL/11S	18,2	25,5	22,0	22,7	33,0	22,3	14,2	24,0	22,0	15,9	21,1	17,9	13,80	15,70
1078/11#	1078UL/11S															
1079/13#	1079UL/13S	29,1	40,8	35,2	36,3	52,8	35,7	22,7	38,4	35,2	25,4	33,8	28,6	22,08	25,12	
1079/M42#	1079UL/M42S															
1078/13#	1078UL/13S															
1078/M42#	1078UL/M42S	45,5	63,8	55,0	56,8	82,5	55,8	35,5	60,0	55,0	39,8	52,8	44,8	34,50	39,25	
1079/17#	1079UL/17S															

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Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)
Temperature leaving evaporator	50 °F	(9,9 °C)			

TABLE 8: REFRIGERANT FLOW CAPACITY OF NC VALVES IN HOT GAS LINE LINE [KW]

Operating Principles	Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B	
Direct Acting	1020/2#	1020UL/2S	1,49	1,96	1,68	2,08	2,38	1,67	1,20	2,07	1,89	1,34	1,75	1,42	1,16	1,29	
	1020/3#	1020UL/3S	1,96	2,58	2,21	2,74	3,13	2,19	1,58	2,71	2,48	1,76	2,30	1,87	1,52	1,69	
	1028/2#	1028UL/2S	1,28	1,68	1,44	1,79	2,04	1,43	1,03	1,77	1,62	1,15	1,50	1,22	0,99	1,10	
	1028/2#.E	1028UL/2S.E	1,96	2,58	2,21	2,74	3,13	2,19	1,58	2,71	2,48	1,76	2,30	1,87	1,52	1,69	
	1028/3#	1028UL/3S															
	1028/M10#	1028UL/M10S															
Diaphragm Pilot Operated	1064/3#	1064UL/3S	6,8	9,0	7,7	9,5	10,9	7,6	5,5	9,4	8,6	6,1	8,0	6,5	5,28	5,88	
	1064/4#	1064UL/4S															
	1068/3#	1068UL/3S															
	1068/M10#	1068UL/M10S															
	1068/M12#	1068UL/M12S															
		1068/4#	1068UL/4S														
		1070/4#	1070UL/4S	18,7	24,6	21,1	26,2	29,9	21,0	15,1	26,0	23,7	16,8	22,0	17,9	14,52	16,17
		1070/5#	1070UL/5S	22,2	29,2	25,1	31,1	35,5	24,9	17,9	30,8	28,1	20,0	26,0	21,2	17,23	19,18
		1078/M12#	1078UL/M12S	18,7	24,6	21,1	26,2	29,9	21,0	15,1	26,0	23,7	16,8	22,0	17,9	14,52	16,17
		1078/4#	1078UL/4S	22,2	29,2	25,1	31,1	35,5	24,9	17,9	30,8	28,1	20,0	26,0	21,2	17,23	19,18
		1078/5#	1078UL/5S														
		1079/7#	1079UL/7S														
		1090/5#	1090UL/5S	32,3	42,6	36,5	45,2	51,7	36,3	26,0	44,8	41,0	29,1	37,9	30,9	25,08	27,93
		1090/6#	1090UL/6S	40,8	53,8	46,1	57,1	65,3	45,8	32,9	56,6	51,7	36,7	47,9	39,1	31,68	35,28
		1098/5#	1098UL/5S	32,3	42,6	36,5	45,2	51,7	36,3	26,0	44,8	41,0	29,1	37,9	30,9	25,08	27,93
		1098/6#	1098UL/6S	40,8	53,8	46,1	57,1	65,3	45,8	32,9	56,6	51,7	36,7	47,9	39,1	31,68	35,28
		1098/7#	1098UL/7S	48,5	63,8	54,7	67,8	77,5	54,4	39,0	67,3	61,4	43,6	56,9	46,4	37,62	41,90
		1099/9#	1099UL/9S														
		1078/9#	1078UL/9S	85,0	112,0	96,0	119,0	136,0	95,4	68,5	118,0	107,8	76,5	99,8	81,4	66,00	73,50
		1079/11#	1079UL/11S														
Piston Pilot Operated	1034/3#	1034UL/3S	8,5	11,2	9,6	11,9	13,6	9,5	6,9	11,8	10,8	7,7	10,0	8,1	6,60	7,35	
	1034/4#	1034UL/4S															
	1038/3#	1038UL/3S															
	1038/M10#	1038UL/M10S															
	1038/M12#	1038UL/M12S															
		1038/4#	1038UL/4S														
		1040/4#	1040UL/4S	20,4	26,9	23,0	28,6	32,6	22,9	16,4	28,3	25,9	18,4	24,0	19,5	15,84	17,64
		1040/5#	1040UL/5S	25,5	33,6	28,8	35,7	40,8	28,6	20,6	35,4	32,3	23,0	29,9	24,4	19,80	22,05
		1048/M12#	1048UL/M12S	20,4	26,9	23,0	28,6	32,6	22,9	16,4	28,3	25,9	18,4	24,0	19,5	15,84	17,64
		1048/4#	1048UL/4S	25,5	33,6	28,8	35,7	40,8	28,6	20,6	35,4	32,3	23,0	29,9	24,4	19,80	22,05
		1048/5#	1048UL/5S														
		1049/7#	1049UL/7S														
		1050/5#	1050UL/5S	32,3	42,6	36,5	45,2	51,7	36,3	26,0	44,8	41,0	29,1	37,9	30,9	25,08	27,93
		1050/6#	1050UL/6S	40,8	53,8	46,1	57,1	65,3	45,8	32,9	56,6	51,7	36,7	47,9	39,1	31,68	35,28
		1058/5#	1058UL/5S	32,3	42,6	36,5	45,2	51,7	36,3	26,0	44,8	41,0	29,1	37,9	30,9	25,08	27,93
		1058/6#	1058UL/6S	40,8	53,8	46,1	57,1	65,3	45,8	32,9	56,6	51,7	36,7	47,9	39,1	31,68	35,28
		1058/7#	1058UL/7S	48,5	63,8	54,7	67,8	77,5	54,4	39,0	67,3	61,4	43,6	56,9	46,4	37,62	41,90
		1059/9#	1059UL/9S														
		1098/9#	1098UL/9S	85,0	112,0	96,0	119,0	136,0	95,4	68,5	118,0	107,8	76,5	99,8	81,4	66,00	73,50
		1099/11#	1099UL/11S														
	1078/11#	1078UL/11S	136,0	179,2	153,6	190,4	217,6	152,6	109,6	188,8	172,5	122,4	159,7	130,2	105,60	117,60	
	1079/13#	1079UL/13S															
	1079/M42#	1079UL/M42S															
	1078/13#	1078UL/13S	212,5	280,0	240,0	297,5	340,0	238,5	171,3	295,0	269,5	191,3	249,5	203,5	165,00	183,75	
	1078/M42#	1078UL/M42S															
	1079/17#	1079UL/17S															

# = S, A6

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)
Temperature leaving evaporator	50 °F	(9,9 °C)			



# SOLENOID VALVES

## 2.2 – NORMALLY OPEN SOLENOID VALVES

### APPLICATIONS

The normally open 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

A normally open valves (NO) means that:

- When the coil is not energised, the plunger opens the fluid flow;
- When the coil is energized, the plunger closes the fluid flow.

The NO solenoid valves are exclusively sold without coil (with the S suffix).

**N.B. The NO valves have been designed to work only with direct current coils; therefore, they can be used solely with coils 9120/RD1 (HM3 type – 12 VDC) , 9120/RD2 (HM3 type – 24 VDC) , 9120/RD4 (HM3 type – 48 VDC). For applications with 220/230 VAC power supply, it is mandatory to couple the NO valves with the following components: Coil 9120/RD6 (HM3 types - 220 VRAC) + Connector/Rectifier 9150/R45 or 9150/R90.**

**NO solenoid valves cannot be coupled with coils series 9110, 9120/RA6, 9160, 9300, 9320 and 9360.**

N.B.: the NO valve visually differs from the corresponding NC model by means of a red ring installed below the yellow nut that fastens the coil.

The NO valves are pilot-operated valves (diaphragm or pilot 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 diaphragm/piston and keep it lifted off the main opening;
- Close the diaphragm/piston and ensure the tightness on the main opening.

Opening/closing of main valve seat is controlled by the diaphragm/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;
- Chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for seat gaskets.

### INSTALLATION

The valves 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 indicated in Tables 9 and 10.

Tables 9 and 10 show 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.



## TRACEABILITY

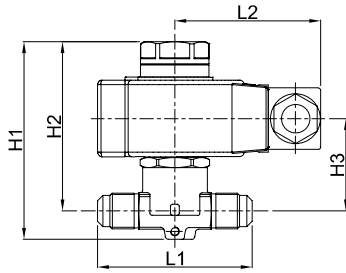
A laser marking on the valve enclosure of the mobile plunger identifies:

- Pilot-operated piston valves in series 1134, 1138, 1140, 1148;
- Pilot-operated diaphragm valves in series 1164, 1168, 1170, 1178, up to 1078/5.

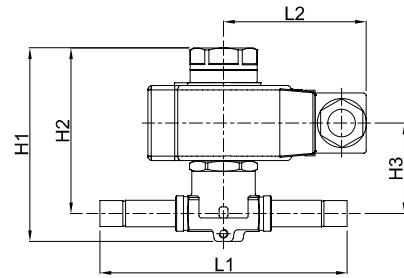
This laser marking includes the following data: valve code, refrigerants, PS, TS and batch number.

All the other pilot-operated valves (diaphragm and piston) 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.

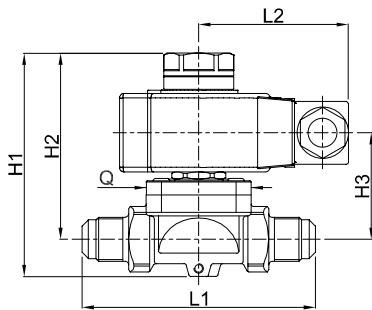
1134/3  
1164/3



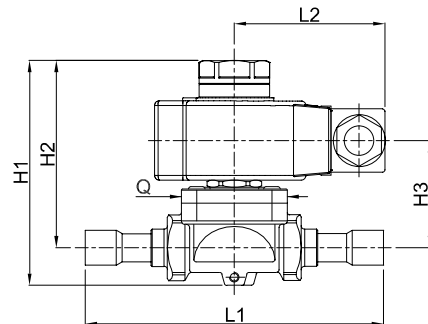
1138/3 1168/3  
1138/M10 1168/M10



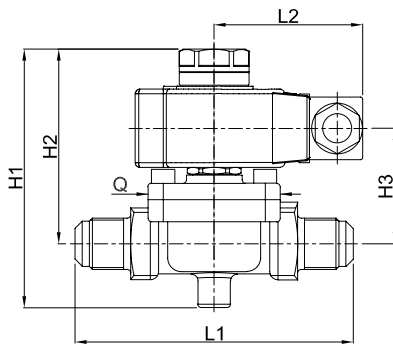
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1140/5 1170/5



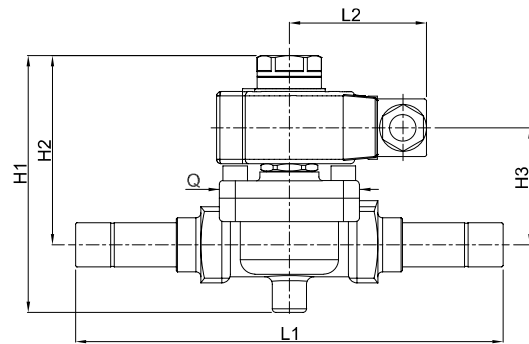
1148/M12 1178/M12  
1148/4 1178/4  
1148/5 1178/5



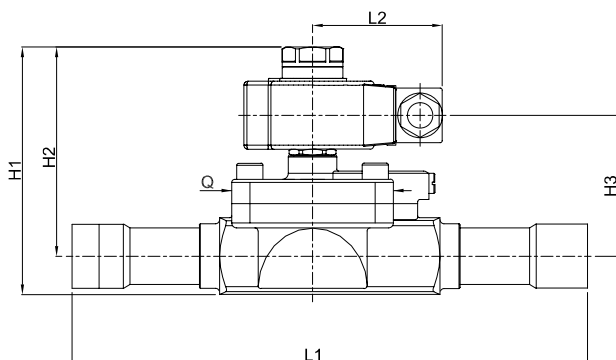
1150/5 1190/5  
1150/6 1190/6



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



1178/9



1198/9  
1178/11  
1178/13  
1178/M42

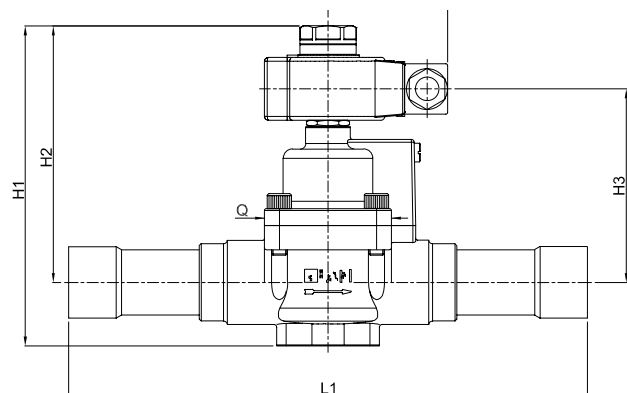


TABLE 9: GENERAL CHARACTERISTICS OF NO VALVES WITH SAE FLARE CONNECTIONS

Operating Principles	Catalogue Number	SAE Flare Connections	Seat size nominal Ø [mm]	Kv Factor [m³/h]	Opening Pressure Differential [bar]			PS [bar]	TS [°C]		Risk Category according to PED Recast
					min OPD	MOPD coils series 9320/9120			min.	max.	
						RD6	RD1 RD2				
Diaphragm Pilot Operated	1164/3S	3/8"	6,5	0,8	0,05	21	15	45	-35	+105	Art. 4.3
	1170/4S	1/2"	12,5	2,2		30	30				
	1170/5S	5/8"		2,61							
	1190/5S	5/8"	16,5	3,8							
	1190/6S	3/4"		4,8							
Piston Pilot Operated	1134/3S	3/8"	6,5	1,0	0,07	30	30	45	-35	+110	Art. 4.3
	1140/4S	1/2"	12,5	2,4							
	1140/5S	5/8"		3,0							
	1150/5S	5/8"	16,5	3,8							
	1150/6S	3/4"		4,8							

TABLE 10: GENERAL CHARACTERISTICS OF NO VALVES WITH ODS CONNECTIONS

Operating Principles	Catalogue Number	SAE Flare Connections		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 coils series 9320/9120			min.	max.			
							RD6	RD1 RD2						
Diaphragm Pilot Operated	1168/3S	3/8"	-	6,5	0,8	0,05	21	15	45	-35	+105	Art. 4.3		
	1168/M10S	-	10											
	1178/M12S	-	12	12,5	2,2									
	1178/4S	1/2"	-											
	1178/5S	5/8"	16	16,5	3,8		30	30						
	1198/5S	5/8"	16											
	1198/6S	3/4"	-	25,5	5,7									
	1198/7S	7/8"	22											
1178/9S	1.1/8"	-	10	8	8									
Piston Pilot Operated	1138/3S	3/8"	-	6,5	1,0	0,07	30	30	45	-35	+110	Art. 4.3		
	1138/M10S	-	10											
	1148/M12S	-	12	12,5	2,4									
	1148/4S	1/2"	-											
	1148/5S	5/8"	16	16,5	3,8									
	1158/5S	5/8"	16											
	1158/6S	3/4"	-	25	5,7									
	1158/7S	7/8"	22											
	1198/9S	1.1/8"	-	10	0,1								16	16
	1178/11S	1.3/8"	35	16										
	1178/13S	1.5/8"	-	34	25								0,15	
	1178/M42S	-	42											



TABLE 11: DIMENSIONS AND WEIGHTS OF NO VALVES WITH 9120 COILS

Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]	
		H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	L <sub>1</sub>	L <sub>2</sub>	Q		
Diaphragm Pilot Operated	1164/3S	87	74,5	40	68	65	-	705	
	1168/3S				111			705	
	1168/M10S				111			700	
	1170/4S	96	80	47	100		45	45	1015
	1170/5S				106				1060
	1178/M12S				127				995
	1178/4S				127				985
	1178/5S				175				1080
	1190/5S	111	83	50	120		57	57	1340
	1190/6S				124				1670
	1198/5S				175				1300
	1198/6S				175				1490
	1198/7S				180				1475
	1178/9S	120	101	72	250		80	80	2870
	Piston Pilot Operated	1134/3S	97,5	85	50,5		68	65	-
1138/3S		111				775			
1138/M11S		111				770			
1140/4S		105,5	89,5	56,5	100	45	45		1117
1140/5S					106				1166
1148/M12S					127				1095
1148/4S					127				1084
1148/5S					175				1188
1150/5S		126	98	70	120	57	57		1462
1150/6S				124	1792				
1158/5S				175	1422				
1158/6S				175	1612				
1158/7S				180	1597				
1198/9S		162	132	99	235	60	60		2355
1178/11S		176	142	110	254	68	68		3015
1178/13S		197	160	128	265	88	88		3820
1178/M42S									3820

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

# SOLENOID VALVES

## 2.3 – NORMALLY CLOSED SOLENOID VALVES. GENERAL PURPOSE

### APPLICATIONS

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

These valves are designed for the applications specified in Table 12, where the different fluids are indicated with the following symbols, according to an already established code:

- W = Water;
- L = Air;
- B = Secondary coolants (solutions of glycol and water);
- O = Light oils (diesel fuel).

In conclusion, these valves can be used:

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

### OPERATION

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.

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

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

**These valves can work with zero pressure differential.**

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

- Open the diaphragm and keep it lifted off the main opening;
- Close the diaphragm and ensure the tightness on the main opening.

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

**These valves cannot work with zero 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;
- Austenitic stainless steel EN 10088-2 – 1.4303 for enclosure where the plunger moves;
- Ferritic stainless steel EN 10088-3 – 1.4105 for the plunger;
- Austenitic stainless steel EN ISO 3506 – A2-70 for tightening screws between body and cover;
- Fluorocarbon rubber (FPM) for outlet seal gaskets, seat gasket and diaphragm.

### VALVE SELECTION AND FLOW RATE CALCULATION

Table 12 shows the following functional characteristics for the selection of a solenoid valve for industrial applications:

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

With the Kv factor listed in Table 12 it is possible to calculate the flow rate through the valve, if you know the acceptable pressure drop, the type of fluid and the operating pressure; in addition, it is also possible to check the pressure drop through the valve, if you know the flow rate.

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

$$Q = K_v \cdot \sqrt{\frac{\Delta p}{\rho}}$$

For water with a temperature between 5 and 30 °C and density ( $\rho$ ) equal to 1 kg/dm<sup>3</sup> the formula is:

$$Q = K_v \cdot \sqrt{\Delta p}$$

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

$$\text{if } \Delta p < \frac{p_1}{2} \quad Q_n = 514 \cdot K_v \cdot \sqrt{\frac{\Delta p \cdot p_2}{\rho_n (273 + t_1)}}$$



$$\text{if } \Delta p > \frac{p_1}{2} \quad Q_n = 257 \cdot K_v \cdot \frac{p_1}{\sqrt{\rho_n (273 + t_1)}}$$

For air at 20 °C and density ( $\rho$ ) equal to 1.29 kg/dm<sup>3</sup> the formulas are:

$$\text{if } \Delta p < \frac{p_1}{2} \quad Q_n = 26.4 \cdot K_v \cdot \sqrt{\Delta p \cdot p_2}$$

$$\text{if } \Delta p > \frac{p_1}{2} \quad Q_n = 13.2 \cdot K_v \cdot p_1$$

where:

- $K_v$  =  $K_v$  factor of the valve [m<sup>3</sup>/h];
- $Q$  = volumetric flow rate for a liquid [m<sup>3</sup>/h];
- $Q_n$  = volumetric flow rate for a gas at “normal” reference conditions, 0°C and 760 mm Hg [mn<sup>3</sup>/h];
- $p_1$  = absolute pressure upstream from the valve [bar abs];
- $p_2$  = absolute pressure downstream from the valve [bar abs];
- $t_1$  = temperature upstream from the valve [°C];
- $\Delta p$  = pressure drop through the valve [bar];
- $\rho$  = density of a liquid [kg/dm<sup>3</sup>];
- $\rho_n$  = volumetric mass for a gas at “normal” reference conditions, 0 °C and 760 mm Hg [kg/mn<sup>3</sup>].

Entering the following data in Table 13:

- $p_1$  = absolute pressure upstream from the valve [bar abs];
- $\Delta p$  = pressure drop through the valve [bar].

It is possible to identify the corresponding airflow rate value under the following reference conditions:

- Temperature at the valve inlet = 20 °C;
- Pressure at the outlet (absolute) = 1 bar;
- $K_v$  factor of the valve considered = 1 m<sup>3</sup>/h.

Example of the use of Table 13: Select the valve suitable for use with a flow rate of 200 m<sup>3</sup>/h of air, assuming an absolute pressure of 8 bars at the valve inlet (= 7 bars of relative pressure + 1 bar) and an acceptable pressure drop across the valve of 1.5 bar.

Intersecting the column  $p_1 = 8$  bar abs with the line  $\Delta p = 1.5$  bar, the flow rate value is equal to 87 m<sup>3</sup>/h. This is the flow rate value of a hypothetical valve with  $K_v = 1$  m<sup>3</sup>/h working under the above-mentioned conditions. Dividing 200 by 87 equals 2.29 m<sup>3</sup>/h. This is the  $K_v$  value required in the case under consideration.

In Table 12, select the valve with the  $K_v$  value nearest to 2,29, rounding up, and subsequently checking that all the characteristics of the selected valve (max. opening pressure differential, connections, etc.) are suitable.

## VISCOSITY

The values of MOPD (maximum opening pressure differential) specified in Table 12, are suitable for fluids with maximum kinematic viscosity of 12 cSt, where: **1 cSt = 10<sup>-6</sup> m<sup>2</sup>/sec.**

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

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

When the viscosity of the fluid is expressed as dynamic viscosity, i.e. in cP, where: **1 cP = 10<sup>-3</sup> N sec/m<sup>2</sup>.**

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

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

where:

- $v$  = Kinematic viscosity [cSt];
- $\mu$  = dynamic viscosity [cP];
- $\rho$  = volumetric mass of the fluid at the temperature considered [kg/dm<sup>3</sup>].

Table 14 shows the approximate equivalences among the most common units of measure of viscosity at the same temperature. Moreover, remember that the viscosity of a fluid may change, even significantly, as the temperature varies. Therefore, if the temperature of the fluid does not ensure viscosity values compatible with the correct operation of the valve, the valve might not open.

## INSTALLATION

Before installation, check that the valve model meets the application requirements and check that the flow direction in the pipe corresponds to the arrow stamped on the body of the valve.

Make sure that the pipes are clean. If possible, fit an inspectable filter before the valve, avoid that foreign matter enter the valve. Make sure that the sealing materials (tape, jointing paste, etc.) do not obstruct the valve supply holes or exiting pilot holes (pilot-operated versions). Connect the valve to the pipes or fittings, using the wrench only on the dedicated body surfaces. Do not use the coil or the plunger enclosure as a lever arm.

The valves can be mounted in any position as long as the coil does not point downwards. An assembly that keeps the coil upwards is recommended to avoid any accumulation of impurities inside the guide pipe. When using hoses, fix the valve using the dedicated fixing holes in the body.

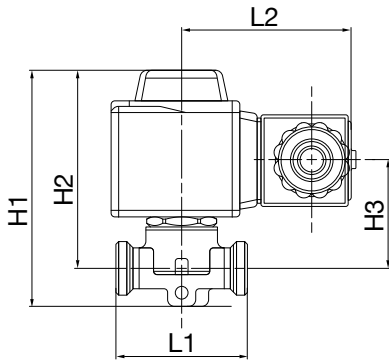
Before connecting a valve to the electrical system, make sure that the line voltage and frequency correspond to the values marked on the coil. Direct current valves do not require a fixed polarity. To promote heat dissipation from the coil, position the valve in a ventilated environment, far from any other heat sources. The increase in the coil temperature, added to the environment and fluid temperatures, may lead to a temperature that can cause burns. It is recommended to suitably protect the coil from water and humidity.

## TRACEABILITY

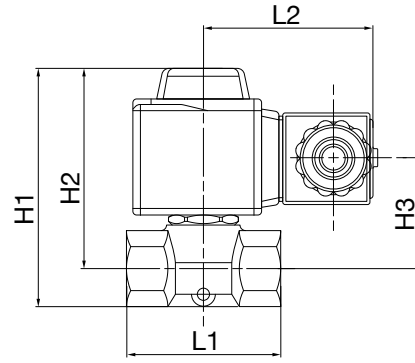
Direct action valves in series 1512 are identified by laser marking on the valve enclosure of the mobile plunger. This marking includes the following data: valve code, PS, TS, and production lot.

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

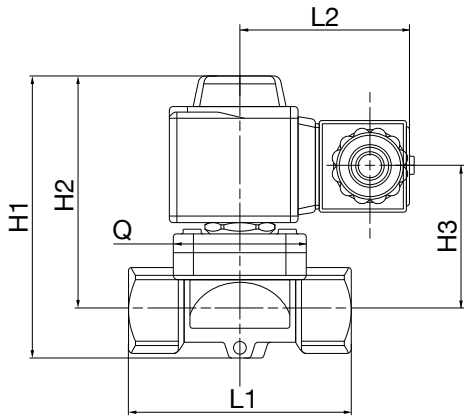
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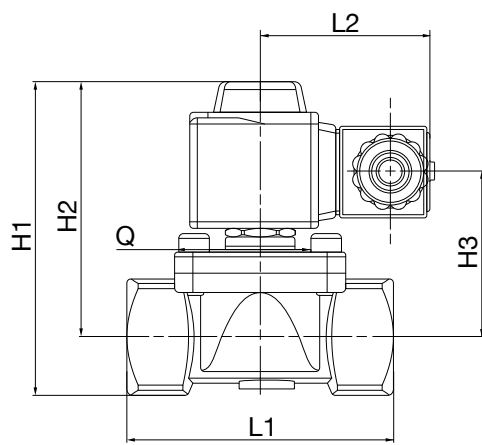
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1522/04



1132/03  
1132/04



1132/06  
1132/08



1142/010  
1142/012

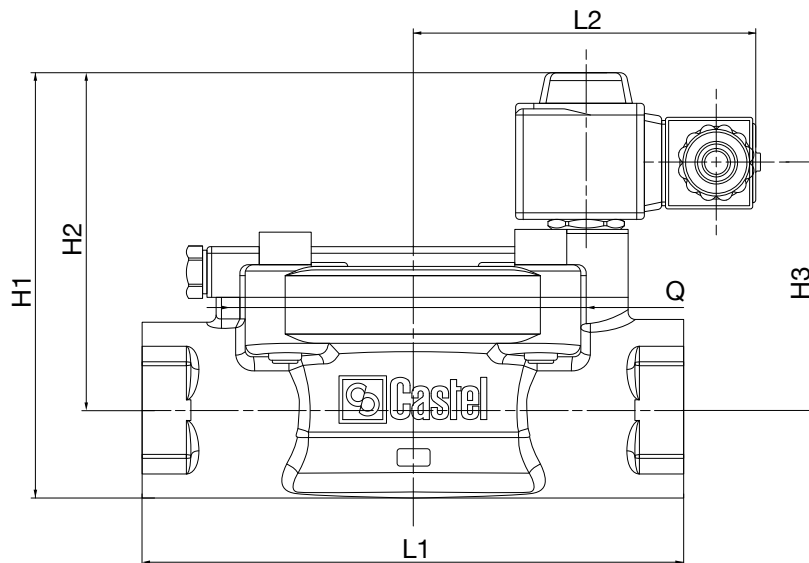


TABLE 12: GENERAL CHARACTERISTICS OF GENERAL PURPOSE VALVES

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

TABLE 13 - AIR CAPACITY [M<sub>N</sub>³/H] (1)

Pressure Drop [bar]	Inlet pressure [bar abs]																																	
	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1,500	1,250	1,150	1,100	1,050	1,025	1,015										
0,0025																									1,38	1,35	1,33	1,33						
0,005																										2,00	1,95	1,91	1,89	1,88				
0,010																										2,94	2,82	2,76	2,69	2,66	2,65			
0,015																										3,94	3,59	3,44	3,37	3,29	3,25	3,23		
0,025																										5,9	5,07	4,62	4,43	4,33	4,23	4,17		
0,05																										10,1	8,2	7,11	6,47	6,19	6,05	5,90		
0,1	35,3	34,3	33,3	32,2	31,1	30,0	28,8	27,6	26,3	24,9	23,5	21,9	20,3	18,5	16,5	14,2	11,5	9,88	8,95	8,55	8,35													
0,15	43,2	42,0	40,7	39,4	38,1	36,7	35,2	33,7	32,1	30,4	28,6	26,8	24,7	22,5	20,1	17,3	13,9	11,88	10,72	10,22														
0,25	55,6	54,0	52,4	50,7	48,9	47,1	45,2	43,3	41,2	39,0	36,7	34,3	31,7	28,8	25,6	21,9	17,5	14,76	13,20															
0,5	78,1	75,8	73,5	71,1	68,6	66,0	63,3	60,5	57,5	54,4	51,1	47,6	43,8	39,6	34,9	29,5	22,9	18,67																
1	108,8	105,6	102,2	98,8	95,2	91,5	87,6	83,5	79,2	74,7	69,8	64,7	59,0	52,8	45,7	37,3	26,4																	
1,5	131,3	127,3	123,1	118,8	114,3	109,6	104,8	99,7	94,3	88,5	82,4	75,8	68,6	60,5	51,1	39,6																		
2	149,3	144,6	139,7	134,6	129,3	123,8	118,1	112,0	105,6	98,8	91,5	83,5	74,7	64,7	52,8																			
2,5	164,3	158,9	153,4	147,6	141,6	135,3	128,7	121,7	114,3	106,4	97,9	88,5	78,1	66,0																				
3	177,1	171,1	164,9	158,4	151,7	144,6	137,2	129,3	121,0	112,0	102,2	91,5	79,2																					
3,5	188,1	181,5	174,6	167,5	160,0	152,2	144,0	135,3	125,9	115,8	104,8	92,4																						
4	197,6	190,4	182,9	175,1	167,0	158,4	149,3	139,7	129,3	118,1	105,6																							
4,5	205,8	198,0	189,9	181,5	172,6	163,3	153,4	142,8	131,3	118,8																								
5	212,8	204,5	195,8	186,7	177,1	167,0	156,2	144,6	132,0																									
5,5	218,9	210,0	200,6	190,8	180,5	169,6	157,8	145,2																										
6	224,0	214,5	204,5	194,0	182,9	171,1	158,4																											
6,5	228,2	218,1	207,5	196,2	184,3	171,6																												
7	231,7	220,9	209,5	197,6	184,8																													
7,5	234,3	222,8	210,8	198,0																														
8	236,1	224,0	211,2																															
8,5	237,2	224,4																																
9	237,6																																	

(1) The table provides air capacity values in m³/h under the following conditions:

- Temperature at valve inlet: + 20°C;
- Pressure at outlet (absolute): 1 bar;
- Kv of the solenoid valve: 1 m³/h.

TABLE 14: VISCOSITY EQUIVALENCE

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

# SOLENOID VALVES

## 2.4 – MAGNETIC TOOL

### APPLICATIONS

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

CLASSIC



# COILS

## 3.1 – COILS AND CONNECTORS

### APPLICATIONS

For NC solenoid valves (Chapter 2), Castel provides its customers with the following new series of coils that use the “FAST LOCK” system:

- **Series 9300** (coil type HF2), interchangeable with coils in series 9100 (coils type HM2) that are out of production. The coils in series 9300 can be used on all the valves produced by Castel that used the coils in series 9100;
- **Series 9320** (coils type HF3) are interchangeable with coils in series 9120 (coils type HM3), that are still in production in direct current and rectified versions. The coils in series 9320 can be used on all the valves produced by Castel that used the coils in series 9120;
- **Series 9360** (coils type HF4) are interchangeable with coils in series 9160 (coils type HM4), that are still in production in direct current version. The coils in series 9360 can be used on all the valves produced by Castel that used the coils in series 9160.

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

**N.B.: the coils equipped with the “FAST LOCK” system cannot be assembled on the normally-open valves produced by Castel.**

For solenoid expansion valve (Chapter 1) and NC solenoid valves (Chapter 2), the following types of coils are still available:

- **Series 9110** (coils type CM2);
- **Series 9120** (coils type HM3);
- **Series 9160** (coils type HM4).

**For NO solenoid valves (Chapter 2), the choice must fall on the direct current coils in series 9120. For NO solenoid valves with a power supply of 220 VAC, Castel has developed a dedicated 220 V rectified coil (part number 9120/RD6).**

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

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

**The coil code 9120/RD6 must be coupled only with connectors/**

**rectifiers codes 9150/R45 or 9150/R90. The protection rating guaranteed by the coil + connector system is IP65 according to the EN 60529 standard.**

### CONSTRUCTION

In compliance with IEC standard 85, the coils in series 9110, 9120, 9160, 9320 and 9360 have Class F encapsulation, while the coils in series 9300 have Class H encapsulation, and their production is compliant with standards EN 60730-1 and EN 60730-2-8. The windings are made of copper wire, with insulation class H (180 °C), in compliance with IEC standard 85. The outer casing is made of waterproof, dielectric resins that guarantee reinforced insulation and allow any type of assembly.

All coils have Class I protection ratings against electric contacts. Consequently, their safety requires an efficient ground system. Rubber gaskets assembled on the upper and lower ends of the coils (only on the lower end for coils in series 9300, 9320 and 9360) complete the protection of the windings from humidity.

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

### CERTIFICATIONS

Coils in series 9300 with 110/120 VAC, 220/230 VAC and 240 VAC power supply are approved by the German registration body, VDE. Coils in series 9110, 9160, 9300 and 9360 with 110 VAC, 220/230 VAC and 240 VAC power supply, and coils in series 9120 and 9320 with 220/230 VAC power supply are manufactured according to the Low Voltage (LV) Directive (2006/95/EC). All coils in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).

### CONNECTORS

DIN 43650 standardized connectors 9150 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture. Based on the assembly requirements, these connectors allow you to choose the orientation of the outer casing with respect to the inner terminal block. The gland nut of the outer casing is suitable for receiving



cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. Three-pole cables with a cross-section greater than or equal to 0.75 mm<sup>2</sup> 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:

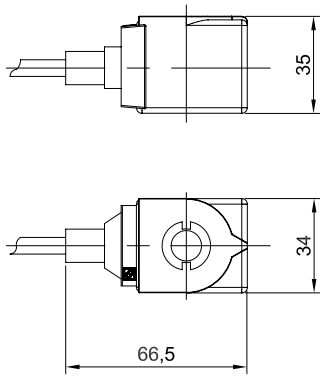
- Exposure to the atmospheric conditions;
- Rooms with high degree of moisture;
- Cyclic condensing / evaporation on the valve;
- Cyclic icing / defrosting on the valve.

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 three-pole cables with a cross-section greater than or equal to 0.75 mm<sup>2</sup> be used. As long as they are used with the gaskets provided, the connectors in series 9155 ensure IP65/IP68 protection rating according to the EN 60529 standard.

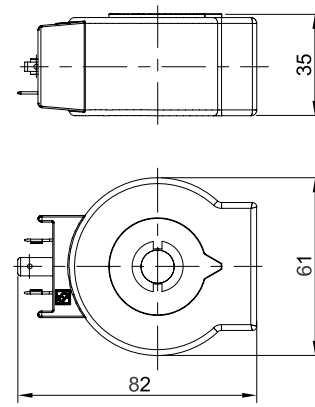
Connectors 9150/R45 and 9150/R90 are equipped with a full-wave bridge rectifier plus VDR for protection. Connector 9150/R90 is the version with a 2 m long, co-moulded cable, with remote rectified circuit (with respect to the connector). The VDR (Voltage e-Dependent-Resistor) device is a special type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

**WARNING: connectors 9150/R45 and 9150/R90 must be used only with coil 9120/RD6 (220 V RAC). Incorrect use of these connectors with other types of Castel coils leads to the rapid destruction of the coil.**

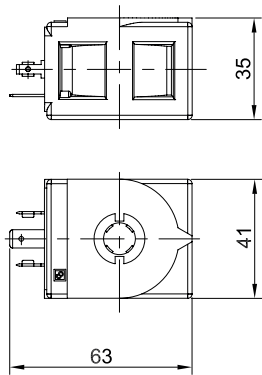
9110 (Type CM2)



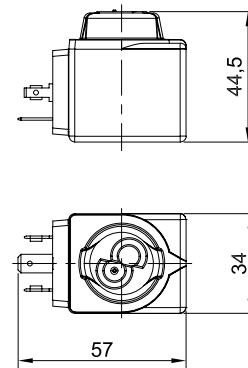
9120 (Type HM3)



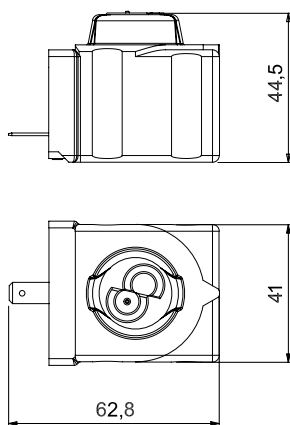
9160 (Type HM4)



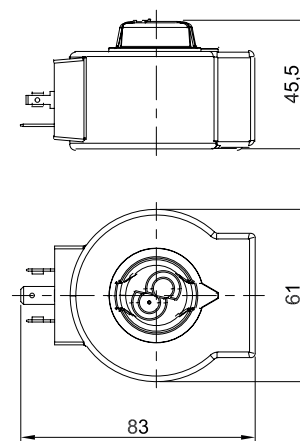
9300 (Type HF2)



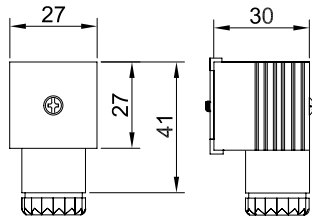
9360 (Type HF4)



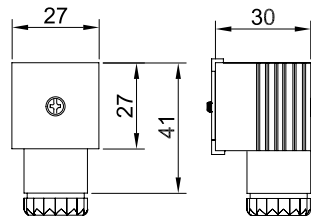
9320 (Type HF3)



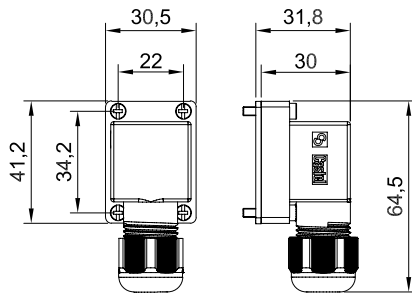
9150/R02



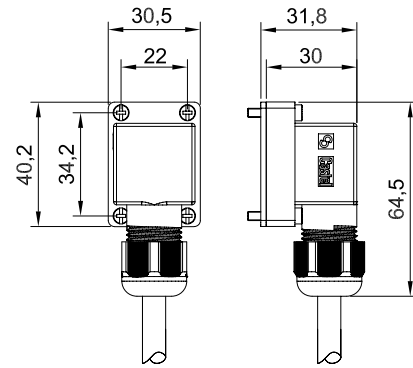
9150/R45



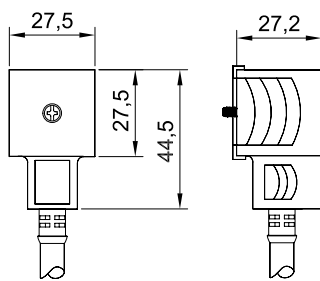
9155/R01



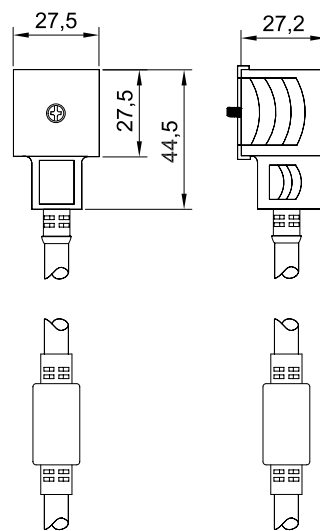
9155/R02



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



9150/R90





**TABLE 1: GENERAL CHARACTERISTICS OF COILS**

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Insulation class EN 60730	TA [°C]		Connection	Connectors	Protection Degree	
						min.	max.				
9110/RA2	CM2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Three wires cable	-	IP 66	
9110/RA4		110 A.C.									
9110/RA6		220/230 A.C.	+6 / -10								
9110/RA7		240 A.C.									
9120/RD1	HM3	12 D.C.	+10 / -5	-	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)	
9120/RD2		24 D.C.									
9120/RD3		27 D.C.									
9120/RD4		48 D.C.									
9120/RD6		220 RAC							9150/R45 9150/R90		
9160/RA2	HM4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150, 9900)	
9160/RA4		110/120 A.C.									
9160/RA6		220/230 A.C.	+6 / -10								
9160/RA7		240 A.C.		+10 / -10							
9160/RD1		12 D.C.	+10 / -5							-	IP 65 / IP 68 (with connector 9155)
9160/RD2		24 D.C.									
9300/RA2	HF2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Terminal block for DIN 43650/A	9150/R## 9900/X##	IP 65 (with connector)	
9300/RA4		110/120 A.C.									
9300/RA6		220/230 A.C.	+6 / -10								
9300/RA7		240 A.C.									
9300/RA8		380 A.C.	+10 / -10								
9320/RA6	HF3	220/230 A.C.		+6 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)
9320/RD1		12 D.C.									
9320/RD2		24 D.C.	+10 / -5								
9320/RD3		27 D.C.									
9320/RD4		48 D.C.									
9360/RA2	HF4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150, 9900)	
9360/RA4		110/120 A.C.									
9360/RA6		220/230 A.C.	+6 / -10								
9360/RA7		240 A.C.		+10 / -10							
9360/RD1		12 D.C.	+10 / -5							-	IP 65 / IP 68 (with connector 9155)
9360/RD2		24 D.C.									

TABLE 2: CONSUMPTIONS AND WEIGHTS OF COILS

Catalogue Number	Coil Type	Voltage [V]	Power [W]	Consumption at 20 °C [mA]						Connection			
				Start			Working						
				50 [Hz]	60 [Hz]	D.C.	50 [Hz]	60 [Hz]	D.C.				
9110/RA2	CM2	24 A.C.	8	920	825	-	527	420	-	230			
9110/RA4		110 A.C.		230	205		128	114					
9110/RA6		220/230 A.C.		120	105		68	58					
9110/RA7		240 A.C.		100	87		54	43					
9120/RD1	HM3	12 D.C.	20	-	-	1720	-	-	1720	470			
9120/RD2		24 D.C.				20			895		895		
9120/RD3		27 D.C.				20			800		800		
9120/RD4		48 D.C.				22			460		460		
9120/RD6		220 RAC				18			93		93		
9160/RA2	HM4	24 A.C.	8	1490	1320	-	700	530	-	220			
9160/RA4		110/120 A.C.		330	300		156	118					
9160/RA6		220/230 A.C.		162	142		76	57					
9160/RA7		240 A.C.		147	130		70	53					
9160/RD1		12 D.C.	17	1300	1300								
9160/RD2		24 D.C.	15,5	650	650								
9300/RA2	HF2	24 A.C.	8	920	825	-	527	420	-	180			
9300/RA4		110/120 A.C.		230	205		128	114					
9300/RA6		220/230 A.C.		140	128		68	58					
9300/RA7		240 A.C.		100	87		54	43					
9300/RA8		380 A.C.		58	51		32	23					
9320/RA6	HF3	220/230 A.C.	12	190	160	-	110	80	-	500			
9320/RD1		12 D.C.									20	1720	1720
9320/RD2		24 D.C.									20	895	895
9320/RD3		27 D.C.									20	800	800
9320/RD4		48 D.C.									22	460	460
9360/RA2	HF4	24 A.C.	8	1490	1320	-	700	530	-	240			
9360/RA4		110/120 A.C.		330	300		156	118					
9360/RA6		220/230 A.C.		162	142		76	57					
9360/RA7		240 A.C.		147	130		70	53					
9360/RD1		12 D.C.	17	1300	1300								
9360/RD2		24 D.C.	15,5	650	650								

TABLE 3: GENERAL CHARACTERISTICS OF CONNECTORS

Catalogue Number	Supply Voltage [V]		Cable length [m]	Cable thickness [mm <sup>2</sup> ]	Standard	Degree of protection	Class of insulation
	Nominal	Maximum					
9150/R02	-	-	-	-	DIN 43650	IP65	C Group VDE 0110-1 / 89
9150/R45	220 A.C.	250 A.C.					
9150/R90	220 A.C.	250 A.C.	2	3 x 0,75			
9900/X66	-	-	1	3 x 0,75			
9900/X84			1,5				
9900/X73			2				
9900/X55			3				
9900/X54			5				
9900/X93			10				
9901/X41			15				
9155/R01			-		-	-	-
9155/R02	-	-	1	3 x 0,75			

## COILS

## 3.2 – COILS AND CONNECTORS, UL APPROVED

## APPLICATIONS

For solenoid expansion valve (Ch.1) and NC solenoid valves (Ch.2), Castel provides its customers with the following types of coils:

- **Series 9105** (coil type HM2), with connection type DIN 43650
- **Series 9115** (coil type CM2-N2), with connection type “Junction Box NEMA 2”.
- **Series 9116** (coil type CM2-N4), with connection type “Conduit Hub NEMA 4”.
- **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 9105 and 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 9115 and 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 9116 and 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 9105, 9115, 9116, 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 9115 and 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 9116 and 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 9105, 9115, 9116, 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 9105, 9115, 9116, 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

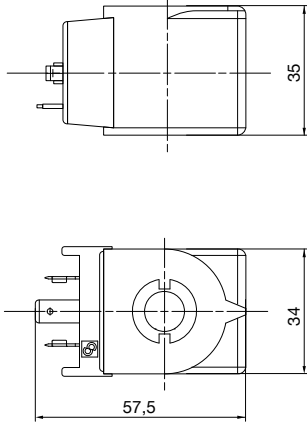
Connector 9150UL/R02 has been approved by the American certification authority Underwriters Laboratories Inc. This connector is certified **UL-CSA Recognized** for the USA and Canada with file E333724, in compliance with American standard UL 1977 and Canadian standard C22.2 No. 182.3.

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 mm<sup>2</sup> are recommended.

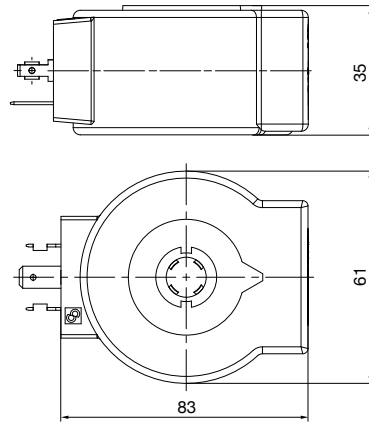
As long as it is used with the gaskets provided, connector 9150UL/R02 ensures IP65 protection rating according to the EN 60529 standard.



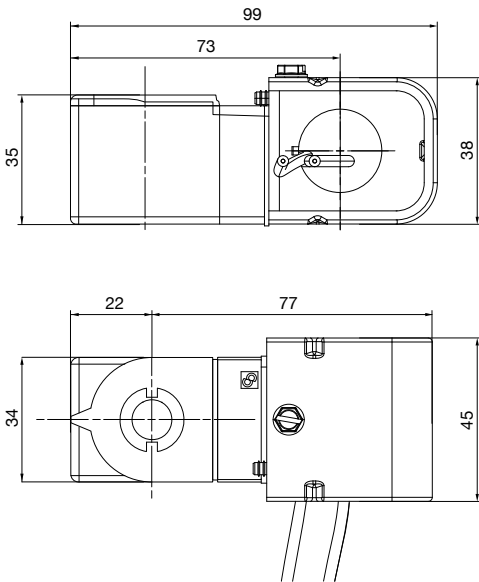
9105 (Type HM2)



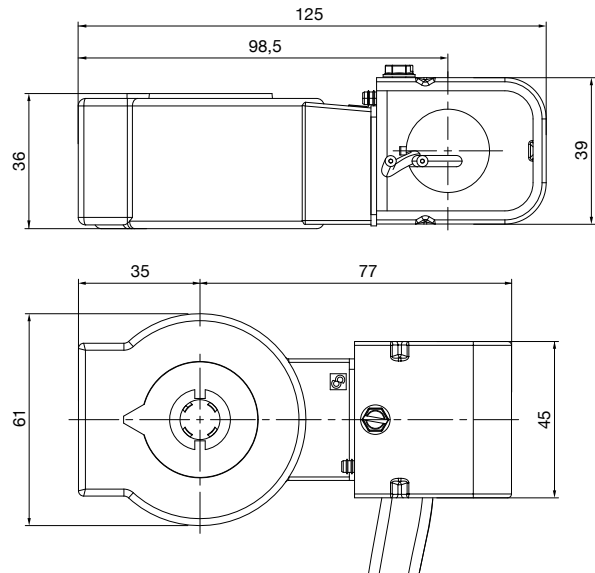
9125 (Type HM3)



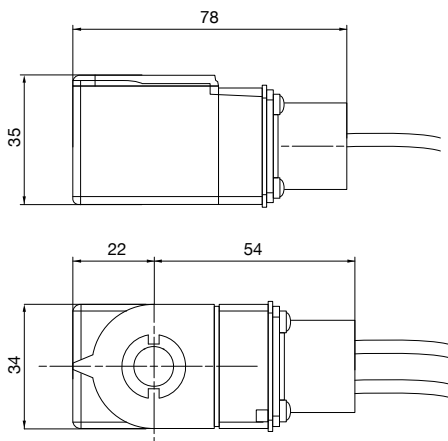
9115 (Type CM2-N2)



9185 (Type CM3-N2)



9116 (Type CM2-N4)



9186 (Type CM3-N4)

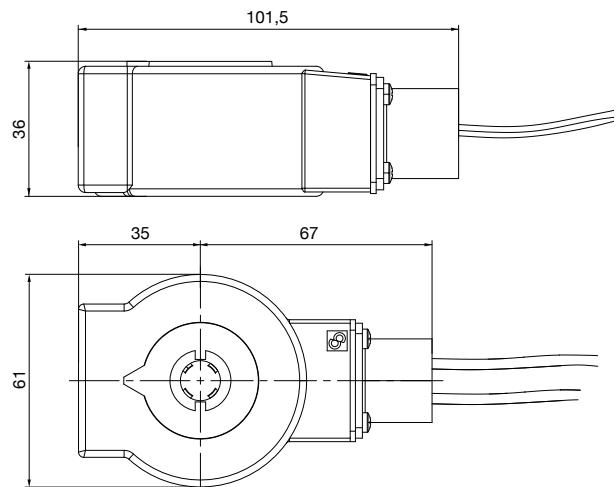


TABLE 4: GENERAL CHARACTERISTICS OF COILS, UL APPROVED

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Insulation class IEC 85	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9105/RA2	HM2	24 A.C.	+10 / -10	60	F	-20	+50	Terminal block for DIN 43650/A	9150UL/R02	IP 65 (with connector)
9105/RA4		120 A.C.								
9105/RA5		208 A.C.								
9105/RA6		220/230 A.C.								
9105/RA7		240 A.C.								
9115/RA2	CM2-N2	24 A.C.	+10 / -10	60	F	-20	+50	Junction box NEMA 2	-	~ IP 12-32
9115/RA4		120 A.C.								
9115/RA5		208 A.C.								
9115/RA6		220/230 A.C.								
9115/RA7		240 A.C.								
9116/RA2	CM2-N4	24 A.C.	+10 / -10	60	F	-20	+50	Conduit hub NEMA 4	-	~ IP 54
9116/RA4		120 A.C.								
9116/RA5		208 A.C.								
9116/RA6		220/230 A.C.								
9116/RA7		240 A.C.								
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.								
9125/RA4		120 A.C.								
9125/RA5		208 A.C.								
9125/RA6		220/230 A.C.								
9125/RA7		240 A.C.								
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.								
9185/RA4		120 A.C.								
9185/RA5		208 A.C.								
9185/RA6		220/230 A.C.								
9185/RA7		240 A.C.								
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.								
9186/RA4		120 A.C.								
9186/RA5		208 A.C.								
9186/RA6		220/230 A.C.								
9186/RA7		240 A.C.								

**TABLE 5: CONSUMPTIONS AND WEIGHTS OF COILS**

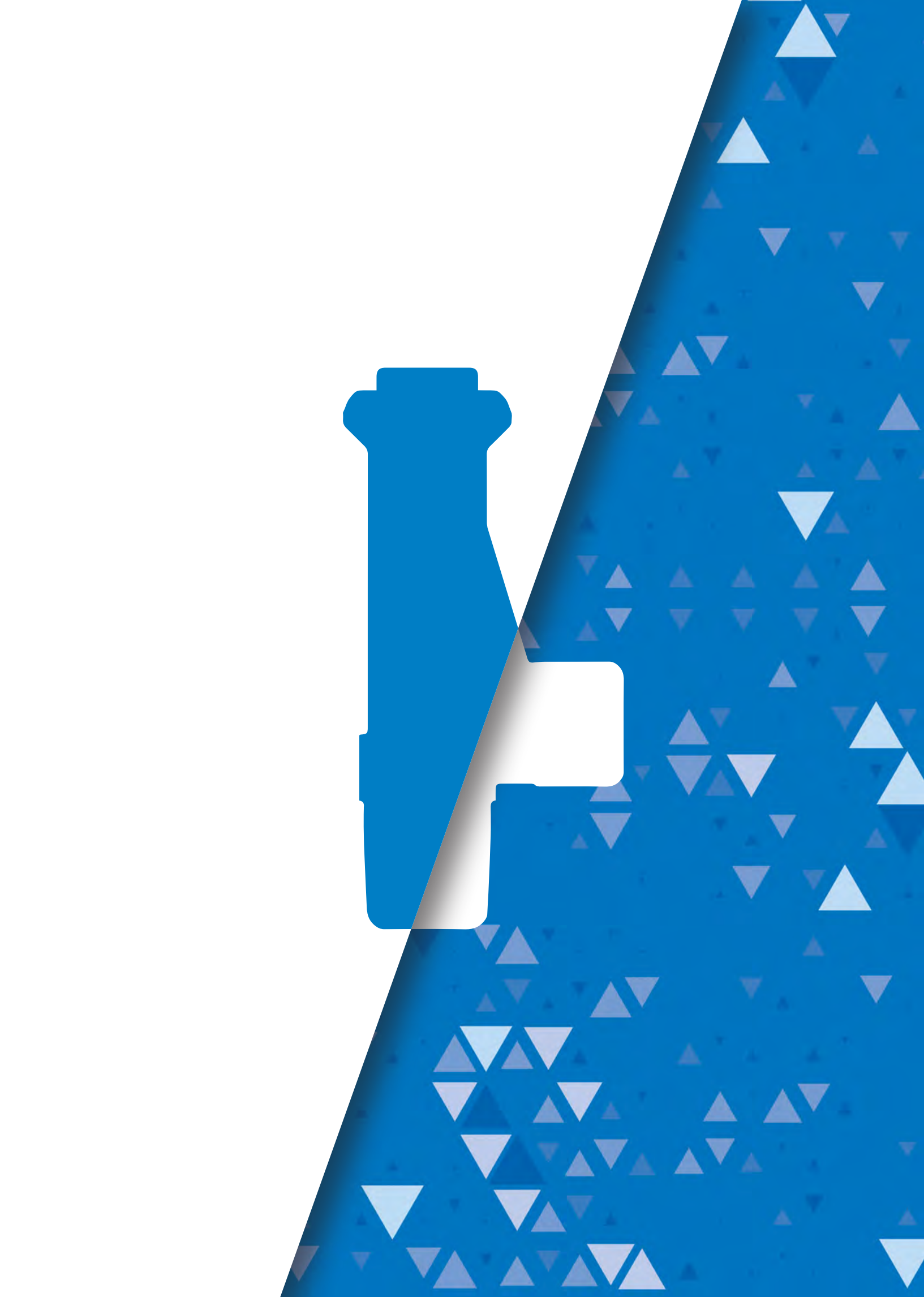
Catalogue Number	Coil Type	Voltage [V]	Power [W]	Consumption at 20 °C [mA]				Weight [g]
				Start		Working		
				60 [Hz]	D.C.	60 [Hz]	D.C.	
9105/RA2	HM2	24 A.C.	11	1746	-	725	-	170
9105/RA4		120 A.C.		353		154		
9105/RA5		208 A.C.		195		84		
9105/RA6		220/230 A.C.		140		63		
9105/RA7		240 A.C.		140		63		
9115/RA2	CM2-N2	24 A.C.	11	1746	-	725	-	310
9115/RA4		120 A.C.		353		154		
9115/RA5		208 A.C.		195		84		
9115/RA6		220/230 A.C.		140		63		
9115/RA7		240 A.C.		140		63		
9116/RA2	CM2-N4	24 A.C.	11	1746	-	725	-	240
9116/RA4		120 A.C.		353		154		
9116/RA5		208 A.C.		195		84		
9116/RA6		220/230 A.C.		140		63		
9116/RA7		240 A.C.		140		63		
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 APPROVED**

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









# **SAFETY DEVICES**

**CL▲SSIC**

# 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 plastic 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:

- a. Refrigerant fluids in vapour or gaseous state belonging to Group 2:
  - HCFC (R22);
  - HFC (R134a, R404A, R407C, R410A, R507);
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B), with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).
- b. Air and nitrogen (reference Directive: 2009/105/EC).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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:

- 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](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access to the web-page and then click on the "START HERE" button. Now you are in the "CASTEL DOWNLOAD CENTER" and here 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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook

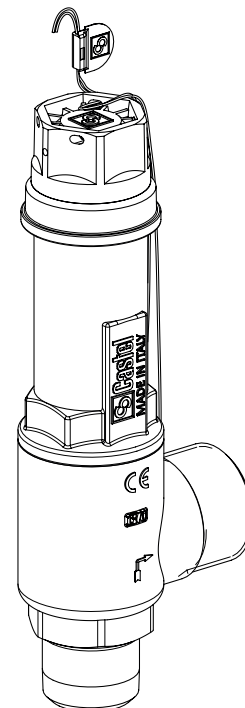
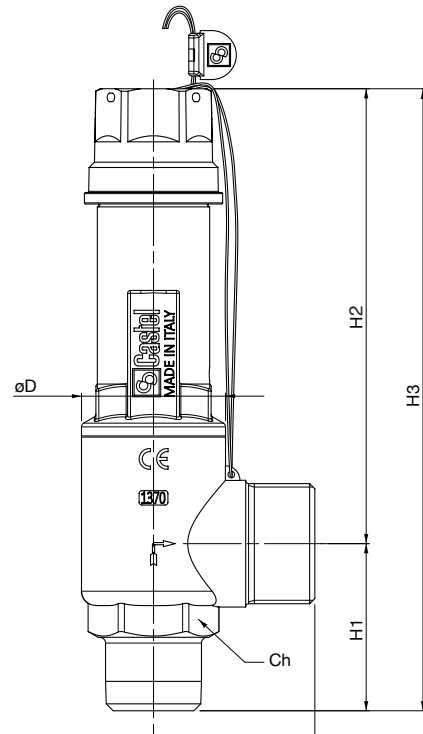
## VALVE INSTALLATION

**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 Paragraph 4.5 "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 [mm <sup>2</sup> ]		113	113	113	298
Lift [mm]		4,1	4,1	4,1	6,8
Discharge Coefficient $K_d$		0,90	0,90	0,90	0,83
PS [bar]		55			
TS [°C]		- 50 / + 150			
Set Pressure Range at atmospheric back pressure $P_{set}$ [bar]		9 / 50			
Overpressure		+ 5 % of $P_{set}$			
Blowdown		- 15 % of $P_{set}$			
Helium tightness		-15 % di $P_{set}$ (9 bar < $P_{set}$ < 31 bar)			
		-10 % di $P_{set}$ (31,1 bar < $P_{set}$ < 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	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	
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

TABLE 3: MAXIMUM DISCHARGE CAPACITY OF VALVES 3030/44 ; 3030/66

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	1937	33,7	0,0179	1815	27,0	0,0144	1988	33,9	0,0175	1811	16,5	0,0195	1735	31,1	0,0172	1828	31,0	0,0170
12,0	14,2	53,0	0,0139	2109	36,9	0,0164	1972	30,2	0,0132	2166	36,9	0,0161	1969	19,4	0,0179	1887	34,1	0,0158	1986	34,0	0,0156
13,0	15,3	56,0	0,0128	2284	39,9	0,0151	2130	33,1	0,0121	2348	39,7	0,0148	2130	22,1	0,0165	2041	36,9	0,0145	2152	36,9	0,0143
14,0	16,4	58,9	0,0118	2461	42,8	0,0140	2290	35,9	0,0111	2532	42,4	0,0137	2292	24,7	0,0153	2196	39,6	0,0134	2317	39,5	0,0133
15,0	17,5	61,7	0,0109	2641	45,5	0,0131	2452	38,5	0,0103	2720	44,9	0,0127	2457	27,2	0,0142	2352	42,1	0,0125	2478	42,1	0,0123
16,0	18,6	64,3	0,0102	2823	48,1	0,0122	2615	41,0	0,0095	2912	47,3	0,0119	2623	29,5	0,0133	2511	44,6	0,0116	2652	44,5	0,0115
17,0	19,7	66,8	0,0095	3009	50,6	0,0115	2780	43,4	0,0089	3107	49,6	0,0111	2792	31,8	0,0124	2672	46,9	0,0108	2829	46,8	0,0107
18,0	20,8	69,2	0,0088	3199	53,0	0,0108	2947	45,7	0,0083	3307	51,8	0,0104	2963	33,9	0,0116	2834	49,1	0,0102	2991	49,1	0,0100
19,0	21,9	71,5	0,0083	3392	55,3	0,0101	3116	48,0	0,0077	3512	54,0	0,0098	3137	36,0	0,0109	2999	51,2	0,0095	3180	51,2	0,0094
20,0	23,0	73,7	0,0078	3589	57,5	0,0096	3287	50,1	0,0072	3722	56,0	0,0092	3313	37,9	0,0103	3167	53,3	0,0090	3348	53,2	0,0089
21,0	24,1	75,9	0,0073	3791	59,7	0,0090	3461	52,1	0,0068	3938	58,0	0,0087	3493	39,9	0,0097	3336	55,2	0,0085	3527	55,2	0,0083
22,0	25,2	77,9	0,0069	3997	61,7	0,0086	3637	54,1	0,0063	4161	59,9	0,0082	3675	41,7	0,0092	3509	57,1	0,0080	3717	57,1	0,0079
23,0	26,3	79,9	0,0065	4209	63,7	0,0081	3815	56,0	0,0059	4392	61,7	0,0077	3861	43,5	0,0087	3684	58,9	0,0075	3922	58,9	0,0074
24,0	27,4	81,9	0,0061	4428	65,7	0,0077	3997	57,9	0,0056	4631	63,4	0,0073	4051	45,2	0,0082	3863	60,7	0,0071	4115	60,7	0,0070
25,0	28,5	83,7	0,0057	4652	67,6	0,0073	4181	59,7	0,0052	4881	65,2	0,0069	4244	46,9	0,0078	4045	62,4	0,0067	4320	62,4	0,0066
26,0	29,6	85,6	0,0054	4885	69,4	0,0070	4369	61,4	0,0049	5144	66,8	0,0066	4442	48,5	0,0074	4230	64,1	0,0064	4504	64,1	0,0063
27,0	30,7	87,3	0,0051	5127	71,2	0,0066	4561	63,1	0,0045	5422	68,4	0,0062	4645	50,1	0,0071	4419	65,7	0,0060	4738	65,7	0,0060
28,0	31,8	89,0	0,0048	5379	72,9	0,0063	4756	64,7	0,0042	5719	70,0	0,0059	4853	51,6	0,0067	4613	67,2	0,0057	4947	67,2	0,0056
29,0	32,9	90,7	0,0045	5644	74,6	0,0060	4955	66,3	0,0039	6043	71,5	0,0056	5067	53,1	0,0064	4811	68,7	0,0054	5170	68,7	0,0053
30,0	34,0	92,3	0,0042	5924	76,2	0,0057	5159	67,8	0,0036	6403	72,9	0,0053	5288	54,6	0,0061	5014	70,2	0,0051	5408	70,2	0,0051
31,0	35,1	93,9	0,0039	6224	77,8	0,0055	5369	69,3	0,0033	6823	74,4	0,0051	5516	56,0	0,0058	5224	71,6	0,0049	5606	71,6	0,0048
32,0	36,2	95,4	0,0037	6550	79,4	0,0052	5584	70,7	0,0029	7361	75,7	0,0048	5753	57,4	0,0055	5439	73,0	0,0046	5876	73,0	0,0045
33,0	37,3	96,9	0,0034	6913	80,9	0,0050	5805	72,1	0,0022	8520	77,1	0,0045	6000	58,7	0,0052	5662	74,3	0,0043	6169	74,3	0,0043
34,0	38,4	98,3	0,0031	7336	82,4	0,0047	6034				78,4	0,0043	6259	60,1	0,0050	5893	75,6	0,0041	6410	75,6	0,0040
35,0	39,5	99,2	0,0029	7702	83,9	0,0045	6271				79,7	0,0041	6533	61,4	0,0047	6134	76,9	0,0038	6753	76,9	0,0037
36,0	40,6	99,5	0,0028	7897	85,3	0,0043	6518				80,9	0,0038	6826	62,6	0,0045	6386	78,1	0,0036	7034	78,1	0,0035
37,0	41,7	99,7	0,0028	8102	86,7	0,0041	6776				82,1	0,0036	7142	63,8	0,0042	6652	79,2	0,0033	7445	79,2	0,0032
38,0	42,8				88,0	0,0039	7048				83,2	0,0033	7493	65,0	0,0040	6935	80,3	0,0030	7911	80,3	0,0029
39,0	43,9				89,4	0,0037	7338				84,3	0,0031	7896	66,2	0,0038	7240				80,7	0,0019
40,0	45,0				90,7	0,0035	7651				85,3	0,0028	8399	67,4	0,0035	7574					
41,0	46,1				92,0	0,0032	7995				86,1	0,0024	9227	68,5	0,0033	7952					
42,0	47,2				93,2	0,0030	8387							69,6	0,0030	8404					
43,0	48,3				94,4	0,0028	8866							70,7	0,0027	9024					
44,0	49,4				95,6	0,0024	9584														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				



R450A				R452A				R507				R513A				R515A				R515B				R1234ze			
k		1,1		k		1,11		k		1,10		k		1,11		k		1,10		k		1,07					
C		2,49		C		2,49		C		2,48		C		2,49		C		2,48		C		2,45					
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]			
1838	55,2	0,0144	1982	28,7	0,0140	2007	25,8	0,0142	1990	47,9	0,0139	2017	61,4	0,0133	2056	61,18	0,0134	2046	61,1	0,0139	1987						
2000	58,5	0,0131	2163	31,8	0,0128	2186	28,9	0,0129	2169	51,3	0,0127	2199	64,9	0,0121	2241	64,6	0,0122	2233	64,5	0,0127	2166						
2164	61,7	0,0121	2336	34,6	0,0118	2366	31,9	0,0119	2351	54,4	0,0116	2383	68,1	0,0111	2430	67,83	0,0112	2419	67,7	0,0116	2347						
2330	64,6	0,0111	2526	37,4	0,0109	2550	34,7	0,0109	2536	57,4	0,0107	2570	71,1	0,0102	2621	70,89	0,0103	2611	70,8	0,0107	2532						
2498	67,5	0,0103	2708	39,9	0,0101	2736	37,3	0,0101	2724	60,2	0,0099	2762	74,1	0,0094	2817	73,8	0,0096	2794	73,7	0,0099	2720						
2668	70,1	0,0096	2892	42,4	0,0094	2925	39,8	0,0094	2916	62,9	0,0092	2957	76,8	0,0088	3016	76,57	0,0089	2992	76,5	0,0092	2912						
2841	72,7	0,0089	3091	44,7	0,0087	3118	42,2	0,0087	3112	65,4	0,0085	3156	79,5	0,0081	3220	79,22	0,0082	3208	79,1	0,0085	3108						
3016	75,2	0,0083	3289	47,0	0,0082	3314	44,5	0,0081	3313	67,9	0,0080	3360	82,0	0,0076	3429	81,76	0,0077	3401	81,7	0,0079	3309						
3195	77,5	0,0078	3482	49,1	0,0077	3514	46,8	0,0076	3518	70,3	0,0074	3569	84,5	0,0071	3644	84,19	0,0071	3635	84,1	0,0074	3514						
3376	79,8	0,0073	3688	51,2	0,0072	3718	48,9	0,0071	3729	72,5	0,0069	3783	86,8	0,0066	3865	86,54	0,0067	3834	86,4	0,0069	3726						
3561	82,0	0,0068	3912	53,2	0,0067	3928	50,9	0,0066	3946	74,7	0,0065	4005	89,1	0,0062	4092	88,79	0,0062	4080	88,7	0,0065	3943						
3749	84,1	0,0064	4123	55,1	0,0063	4142	52,9	0,0062	4171	76,8	0,0061	4233	91,2	0,0058	4328	90,97	0,0058	4314	90,9	0,0061	4168						
3941	86,2	0,0060	4350	57,0	0,0060	4362	54,8	0,0058	4403	78,9	0,0057	4470	93,3	0,0054	4573	93,07	0,0055	4525	93,0	0,0057	4401						
4137	88,1	0,0056	4596	58,7	0,0056	4588	56,7	0,0054	4644	80,8	0,0053	4717	95,4	0,0050	4829	95,11	0,0051	4797	95,0	0,0053	4644						
4338	90,1	0,0053	4818	60,5	0,0053	4822	58,5	0,0051	4896	82,7	0,0050	4975	97,3	0,0047	5098	97,07	0,0048	5043	97,0	0,0050	4898						
4544	91,9	0,0050	5056	62,1	0,0050	5065	60,2	0,0048	5162	84,6	0,0046	5247	99,2	0,0044	5384	98,98	0,0044	5368	98,9	0,0046	5166						
4756	93,7	0,0046	5368	63,7	0,0047	5317	61,9	0,0044	5443	86,4	0,0043	5537	101,1	0,0041	5690	100,83	0,0041	5663	100,7	0,0043	5451						
4974	95,4	0,0043	5650	65,3	0,0044	5581	63,5	0,0041	5746	88,1	0,0040	5851	102,9	0,0038	6025	102,61	0,0038	5987	102,5	0,0040	5760						
5199	97,1	0,0040	5959	66,8	0,0041	5859	65,1	0,0038	6076	89,8	0,0037	6196	104,6	0,0034	6402	104,35	0,0035	6345	104,3	0,0037	6100						
5430	98,8	0,0038	6215	68,3	0,0039	6155	66,6	0,0035	6448	91,4	0,0034	6592	106,3	0,0031	6852	106,03	0,0032	6746	106,0	0,0034	6489						
5672	100,3	0,0035	6580	69,7	0,0036	6483	68,1	0,0032	6889	93,0	0,0030	7083	107,9	0,0027	7488	107,65	0,0028	7327	107,6	0,0030	6972						
5930	101,9	0,0031	7100	68,3	0,0005	16968	69,6	0,0028	7484	94,5	0,0025	7898							109,2	0,0025	7821						
6182				72,3	0,0031	7225																					
6490				73,5	0,0028	7708																					
6801																											
7140																											
7526																											
7994																											
10047																											

TABLE 4: MAXIMUM DISCHARGE CAPACITY OF VALVES 3030/88

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	4712	33,7	0,0179	4414	27,0	0,0144	768	33,9	0,0175	4404	16,5	0,0195	4221	31,1	0,0172	4446	31,0	0,0170
12,0	14,2	53,0	0,0139	5131	36,9	0,0164	4796	30,2	0,0132	837	36,9	0,0161	4790	19,4	0,0179	4590	34,1	0,0158	4829	34,0	0,0156
13,0	15,3	56,0	0,0128	5555	39,9	0,0151	5181	33,1	0,0121	908	39,7	0,0148	5181	22,1	0,0165	4963	36,9	0,0145	5233	36,9	0,0143
14,0	16,4	58,9	0,0118	5985	42,8	0,0140	5570	35,9	0,0111	979	42,4	0,0137	5575	24,7	0,0153	5340	39,6	0,0134	5636	39,5	0,0133
15,0	17,5	61,7	0,0109	6423	45,5	0,0131	5963	38,5	0,0103	1051	44,9	0,0127	5975	27,2	0,0142	5721	42,1	0,0125	6028	42,1	0,0123
16,0	18,6	64,3	0,0102	6867	48,1	0,0122	6360	41,0	0,0095	1125	47,3	0,0119	6380	29,5	0,0133	6107	44,6	0,0116	6451	44,5	0,0115
17,0	19,7	66,8	0,0095	7319	50,6	0,0115	6762	43,4	0,0089	1201	49,6	0,0111	6791	31,8	0,0124	6498	46,9	0,0108	6880	46,8	0,0107
18,0	20,8	69,2	0,0088	7780	53,0	0,0108	7167	45,7	0,0083	1278	51,8	0,0104	7207	33,9	0,0116	6893	49,1	0,0102	7275	49,1	0,0100
19,0	21,9	71,5	0,0083	8250	55,3	0,0101	7579	48,0	0,0077	1357	54,0	0,0098	7630	36,0	0,0109	7294	51,2	0,0095	7735	51,2	0,0094
20,0	23,0	73,7	0,0078	8729	57,5	0,0096	7995	50,1	0,0072	1439	56,0	0,0092	8059	37,9	0,0103	7701	53,3	0,0090	8144	53,2	0,0089
21,0	24,1	75,9	0,0073	9220	59,7	0,0090	8417	52,1	0,0068	1522	58,0	0,0087	8495	39,9	0,0097	8114	55,2	0,0085	8578	55,2	0,0083
22,0	25,2	77,9	0,0069	9722	61,7	0,0086	8845	54,1	0,0063	1608	59,9	0,0082	8939	41,7	0,0092	8534	57,1	0,0080	9041	57,1	0,0079
23,0	26,3	79,9	0,0065	10238	63,7	0,0081	9279	56,0	0,0059	1698	61,7	0,0077	9391	43,5	0,0087	8961	58,9	0,0075	9539	58,9	0,0074
24,0	27,4	81,9	0,0061	10768	65,7	0,0077	9721	57,9	0,0056	1790	63,4	0,0073	9852	45,2	0,0082	9395	60,7	0,0071	10007	60,7	0,0070
25,0	28,5	83,7	0,0057	11316	67,6	0,0073	10170	59,7	0,0052	1887	65,2	0,0069	10323	46,9	0,0078	9837	62,4	0,0067	10507	62,4	0,0066
26,0	29,6	85,6	0,0054	11882	69,4	0,0070	10627	61,4	0,0049	1988	66,8	0,0066	10804	48,5	0,0074	10288	64,1	0,0064	10955	64,1	0,0063
27,0	30,7	87,3	0,0051	12470	71,2	0,0066	11092	63,1	0,0045	2096	68,4	0,0062	11298	50,1	0,0071	10748	65,7	0,0060	11523	65,7	0,0060
28,0	31,8	89,0	0,0048	13083	72,9	0,0063	11567	64,7	0,0042	2211	70,0	0,0059	11804	51,6	0,0067	11219	67,2	0,0057	12032	67,2	0,0056
29,0	32,9	90,7	0,0045	13727	74,6	0,0060	12052	66,3	0,0039	2336	71,5	0,0056	12324	53,1	0,0064	11702	68,7	0,0054	12574	68,7	0,0053
30,0	34,0	92,3	0,0042	14409	76,2	0,0057	12549	67,8	0,0036	2475	72,9	0,0053	12861	54,6	0,0061	12196	70,2	0,0051	13153	70,2	0,0051
31,0	35,1	93,9	0,0039	15138	77,8	0,0055	13058	69,3	0,0033	2637	74,4	0,0051	13416	56,0	0,0058	12705	71,6	0,0049	13634	71,6	0,0048
32,0	36,2	95,4	0,0037	15930	79,4	0,0052	13581	70,7	0,0029	2845	75,7	0,0048	13993	57,4	0,0055	13229	73,0	0,0046	14291	73,0	0,0045
33,0	37,3	96,9	0,0034	16813	80,9	0,0050	14119	72,1	0,0022	3294	77,1	0,0045	14594	58,7	0,0052	13771	74,3	0,0043	15004	74,3	0,0043
34,0	38,4	98,3	0,0031	17843	82,4	0,0047	14675				78,4	0,0043	15224	60,1	0,0050	14333	75,6	0,0041	15590	75,6	0,0040
35,0	39,5	99,2	0,0029	18732	83,9	0,0045	15252				79,7	0,0041	15890	61,4	0,0047	14919	76,9	0,0038	16424	76,9	0,0037
36,0	40,6	99,5	0,0028	19207	85,3	0,0043	15852				80,9	0,0038	16601	62,6	0,0045	15532	78,1	0,0036	17107	78,1	0,0035
37,0	41,7	99,7	0,0028	19706	86,7	0,0041	16481				82,1	0,0036	17371	63,8	0,0042	16179	79,2	0,0033	18109	79,2	0,0032
38,0	42,8				88,0	0,0039	17143				83,2	0,0033	18224	65,0	0,0040	16867	80,3	0,0030	19241	80,3	0,0029
39,0	43,9				89,4	0,0037	17847				84,3	0,0031	19205	66,2	0,0038	17608				80,7	0,0019
40,0	45,0				90,7	0,0035	18608				85,3	0,0028	20427	67,4	0,0035	18422					
41,0	46,1				92,0	0,0032	19445				86,1	0,0024	22443	68,5	0,0033	19341					
42,0	47,2				93,2	0,0030	20399							69,6	0,0030	20439					
43,0	48,3				94,4	0,0028	21562							70,7	0,0027	21949					
44,0	49,4				95,6	0,0024	23310														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
4471	55,2	0,0144	4820	28,7	0,0140	4883	25,8	0,0142	4841	47,9	0,0139	4906	61,4	0,0133	5001	61,18	0,0134	4977	61,1	0,0139	4834			
4865	58,5	0,0131	5261	31,8	0,0128	5316	28,9	0,0129	5275	51,3	0,0127	5347	64,9	0,0121	5451	64,6	0,0122	5430	64,5	0,0127	5268			
5263	61,7	0,0121	5683	34,6	0,0118	5756	31,9	0,0119	5718	54,4	0,0116	5796	68,1	0,0111	5909	67,83	0,0112	5883	67,7	0,0116	5709			
5667	64,6	0,0111	6143	37,4	0,0109	6201	34,7	0,0109	6167	57,4	0,0107	6252	71,1	0,0102	6376	70,89	0,0103	6351	70,8	0,0107	6158			
6075	67,5	0,0103	6587	39,9	0,0101	6654	37,3	0,0101	6625	60,2	0,0099	6717	74,1	0,0094	6851	73,8	0,0096	6796	73,7	0,0099	6616			
6489	70,1	0,0096	7034	42,4	0,0094	7115	39,8	0,0094	7092	62,9	0,0092	7191	76,8	0,0088	7336	76,57	0,0089	7276	76,5	0,0092	7083			
6910	72,7	0,0089	7519	44,7	0,0087	7583	42,2	0,0087	7569	65,4	0,0085	7676	79,5	0,0081	7833	79,22	0,0082	7801	79,1	0,0085	7559			
7336	75,2	0,0083	8000	47,0	0,0082	8060	44,5	0,0081	8057	67,9	0,0080	8171	82,0	0,0076	8341	81,76	0,0077	8273	81,7	0,0079	8047			
7770	77,5	0,0078	8468	49,1	0,0077	8547	46,8	0,0076	8557	70,3	0,0074	8680	84,5	0,0071	8863	84,19	0,0071	8840	84,1	0,0074	8547			
8211	79,8	0,0073	8970	51,2	0,0072	9044	48,9	0,0071	9070	72,5	0,0069	9202	86,8	0,0066	9400	86,54	0,0067	9326	86,4	0,0069	9061			
8660	82,0	0,0068	9514	53,2	0,0067	9552	50,9	0,0066	9598	74,7	0,0065	9740	89,1	0,0062	9954	88,79	0,0062	9923	88,7	0,0065	9590			
9118	84,1	0,0064	10028	55,1	0,0063	10074	52,9	0,0062	10143	76,8	0,0061	10296	91,2	0,0058	10527	90,97	0,0058	10492	90,9	0,0061	10137			
9585	86,2	0,0060	10580	57,0	0,0060	10609	54,8	0,0058	10708	78,9	0,0057	10872	93,3	0,0054	11123	93,07	0,0055	11006	93,0	0,0057	10704			
10063	88,1	0,0056	11178	58,7	0,0056	11160	56,7	0,0054	11295	80,8	0,0053	11472	95,4	0,0050	11745	95,11	0,0051	11667	95,0	0,0053	11294			
10551	90,1	0,0053	11719	60,5	0,0053	11729	58,5	0,0051	11908	82,7	0,0050	12100	97,3	0,0047	12400	97,07	0,0048	12265	97,0	0,0050	11912			
11052	91,9	0,0050	12296	62,1	0,0050	12318	60,2	0,0048	12554	84,6	0,0046	12762	99,2	0,0044	13094	98,98	0,0044	13055	98,9	0,0046	12564			
11567	93,7	0,0046	13055	63,7	0,0047	12931	61,9	0,0044	13239	86,4	0,0043	13468	101,1	0,0041	13839	100,83	0,0041	13773	100,7	0,0043	13258			
12098	95,4	0,0043	13743	65,3	0,0044	13573	63,5	0,0041	13974	88,1	0,0040	14230	102,9	0,0038	14654	102,61	0,0038	14560	102,5	0,0040	14008			
12644	97,1	0,0040	14493	66,8	0,0041	14250	65,1	0,0038	14778	89,8	0,0037	15071	104,6	0,0034	15571	104,35	0,0035	15432	104,3	0,0037	14836			
13207	98,8	0,0038	15116	68,3	0,0039	14970	66,6	0,0035	15682	91,4	0,0034	16034	106,3	0,0031	16665	106,03	0,0032	16406	106,0	0,0034	15783			
13795	100,3	0,0035	16004	69,7	0,0036	15767	68,1	0,0032	16755	93,0	0,0030	17227	107,9	0,0027	18212	107,65	0,0028	17821	107,6	0,0030	16957			
14423	101,9	0,0031	17269	68,3	0,0005	41269	69,6	0,0028	18203	94,5	0,0025	19209							109,2	0,0025	19023			
15037				72,3	0,0031	17572																		
15784				73,5	0,0028	18748																		
16541																								
17367																								
18305																								
19443																								
24436																								

# 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 alphanumeric 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 alphanumeric 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 fluids in vapour or gaseous state belonging to Group 2:
  - HCFC (R22);
  - HFC (R134a, R404A, R407C, R410A, R507);
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B) with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).
- Air and nitrogen (reference Directive: 2009/105/EC).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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 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](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access to the web-page and then click on the "START HERE" button. Now you are in the "CASTEL DOWNLOAD CENTER" and here 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:

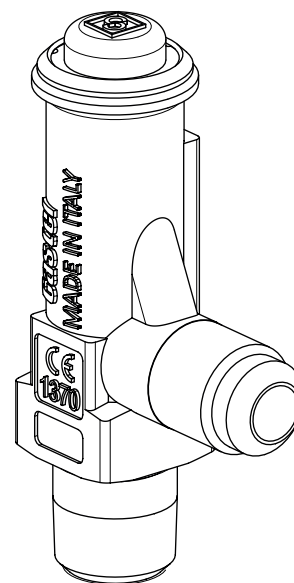
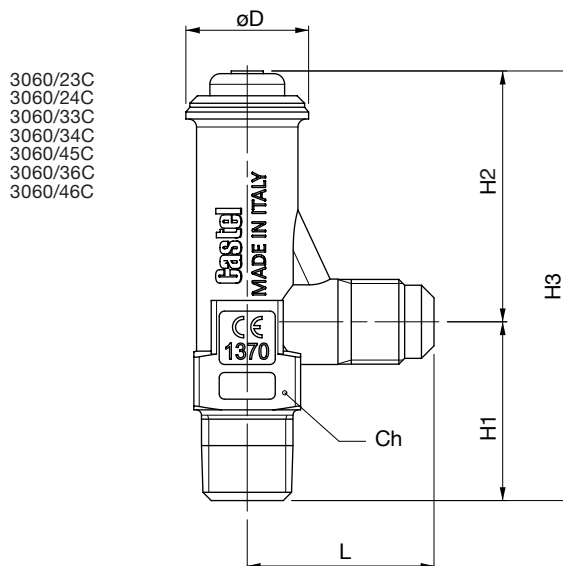
- **EN ISO 4126-1:2013:** "Safety devices for protection against excessive pressure – Part 1: Safety valves" indicates the general requirements for safety valves regardless of the fluid for which they were designed;
- **EN 378-2:2016:** "Refrigerating systems and heat pumps – safety and environmental 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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

## VALVE SELECTION

**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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.





**TABLE 5: 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	1/2" NPT
	Outlet male	3/8" SAE	1/2" SAE	3/8" SAE	1/2" SAE	5/8" SAE	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 [mm <sup>2</sup> ]	38,5				70,9	78,5	
Discharge Coefficient $K_d$	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 $P_{set}$ [bar]	9 / 50						
Overpressure	+ 10 % of $P_{set}$						
Blowdown	- 50 % of $P_{set}$				- 40 % of $P_{set}$		
Helium tightness	-20 % di $P_{set}$ (9 bar < $P_{set}$ < 31 bar)						
	-10 % di $P_{set}$ (31,1 bar < $P_{set}$ < 50 bar)						
Estimated service life	5 years						
Risk Category according to PED Recast	IV						

**TABLE 6: DIMENSIONS AND WEIGHTS OF VALVES 3060**

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	
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

TABLE 7: MAXIMUM DISCHARGE CAPACITY OF VALVES 3060/23 ; 3060/33

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	462	33,7	0,0179	433	27,0	0,0144	768	33,9	0,0175	432	16,5	0,0195	414	31,1	0,0172	436	31,0	0,0170
12,0	14,2	53,0	0,0139	503	36,9	0,0164	470	30,2	0,0132	837	36,9	0,0161	470	19,4	0,0179	450	34,1	0,0158	474	34,0	0,0156
13,0	15,3	56,0	0,0128	545	39,9	0,0151	508	33,1	0,0121	908	39,7	0,0148	508	22,1	0,0165	487	36,9	0,0145	513	36,9	0,0143
14,0	16,4	58,9	0,0118	587	42,8	0,0140	546	35,9	0,0111	979	42,4	0,0137	547	24,7	0,0153	524	39,6	0,0134	553	39,5	0,0133
15,0	17,5	61,7	0,0109	630	45,5	0,0131	585	38,5	0,0103	1051	44,9	0,0127	586	27,2	0,0142	561	42,1	0,0125	591	42,1	0,0123
16,0	18,6	64,3	0,0102	673	48,1	0,0122	624	41,0	0,0095	1125	47,3	0,0119	626	29,5	0,0133	599	44,6	0,0116	632	44,5	0,0115
17,0	19,7	66,8	0,0095	718	50,6	0,0115	663	43,4	0,0089	1201	49,6	0,0111	666	31,8	0,0124	637	46,9	0,0108	675	46,8	0,0107
18,0	20,8	69,2	0,0088	763	53,0	0,0108	703	45,7	0,0083	1278	51,8	0,0104	707	33,9	0,0116	676	49,1	0,0102	713	49,1	0,0100
19,0	21,9	71,5	0,0083	809	55,3	0,0101	743	48,0	0,0077	1357	54,0	0,0098	748	36,0	0,0109	715	51,2	0,0095	758	51,2	0,0094
20,0	23,0	73,7	0,0078	856	57,5	0,0096	784	50,1	0,0072	1439	56,0	0,0092	790	37,9	0,0103	755	53,3	0,0090	798	53,2	0,0089
21,0	24,1	75,9	0,0073	904	59,7	0,0090	825	52,1	0,0068	1522	58,0	0,0087	833	39,9	0,0097	796	55,2	0,0085	841	55,2	0,0083
22,0	25,2	77,9	0,0069	953	61,7	0,0086	867	54,1	0,0063	1608	59,9	0,0082	876	41,7	0,0092	837	57,1	0,0080	887	57,1	0,0079
23,0	26,3	79,9	0,0065	1004	63,7	0,0081	910	56,0	0,0059	1698	61,7	0,0077	921	43,5	0,0087	879	58,9	0,0075	935	58,9	0,0074
24,0	27,4	81,9	0,0061	1056	65,7	0,0077	953	57,9	0,0056	1790	63,4	0,0073	966	45,2	0,0082	921	60,7	0,0071	981	60,7	0,0070
25,0	28,5	83,7	0,0057	1110	67,6	0,0073	997	59,7	0,0052	1887	65,2	0,0069	1012	46,9	0,0078	965	62,4	0,0067	1030	62,4	0,0066
26,0	29,6	85,6	0,0054	1165	69,4	0,0070	1042	61,4	0,0049	1988	66,8	0,0066	1059	48,5	0,0074	1009	64,1	0,0064	1074	64,1	0,0063
27,0	30,7	87,3	0,0051	1223	71,2	0,0066	1088	63,1	0,0045	2096	68,4	0,0062	1108	50,1	0,0071	1054	65,7	0,0060	1130	65,7	0,0060
28,0	31,8	89,0	0,0048	1283	72,9	0,0063	1134	64,7	0,0042	2211	70,0	0,0059	1157	51,6	0,0067	1100	67,2	0,0057	1180	67,2	0,0056
29,0	32,9	90,7	0,0045	1346	74,6	0,0060	1182	66,3	0,0039	2336	71,5	0,0056	1208	53,1	0,0064	1147	68,7	0,0054	1233	68,7	0,0053
30,0	34,0	92,3	0,0042	1413	76,2	0,0057	1230	67,8	0,0036	2475	72,9	0,0053	1261	54,6	0,0061	1196	70,2	0,0051	1290	70,2	0,0051
31,0	35,1	93,9	0,0039	1484	77,8	0,0055	1280	69,3	0,0033	2637	74,4	0,0051	1315	56,0	0,0058	1246	71,6	0,0049	1337	71,6	0,0048
32,0	36,2	95,4	0,0037	1562	79,4	0,0052	1332	70,7	0,0029	2845	75,7	0,0048	1372	57,4	0,0055	1297	73,0	0,0046	1401	73,0	0,0045
33,0	37,3	96,9	0,0034	1649	80,9	0,0050	1384	72,1	0,0022	3294	77,1	0,0045	1431	58,7	0,0052	1350	74,3	0,0043	1471	74,3	0,0043
34,0	38,4	98,3	0,0031	1750	82,4	0,0047	1439				78,4	0,0043	1493	60,1	0,0050	1405	75,6	0,0041	1529	75,6	0,0040
35,0	39,5	99,2	0,0029	1837	83,9	0,0045	1495				79,7	0,0041	1558	61,4	0,0047	1463	76,9	0,0038	1610	76,9	0,0037
36,0	40,6	99,5	0,0028	1883	85,3	0,0043	1554				80,9	0,0038	1628	62,6	0,0045	1523	78,1	0,0036	1677	78,1	0,0035
37,0	41,7	99,7	0,0028	1932	86,7	0,0041	1616				82,1	0,0036	1703	63,8	0,0042	1586	79,2	0,0033	1776	79,2	0,0032
38,0	42,8				88,0	0,0039	1681				83,2	0,0033	1787	65,0	0,0040	1654	80,3	0,0030	1887	80,3	0,0029
39,0	43,9				89,4	0,0037	1750				84,3	0,0031	1883	66,2	0,0038	1727				80,7	0,0019
40,0	45,0				90,7	0,0035	1825				85,3	0,0028	2003	67,4	0,0035	1806					
41,0	46,1				92,0	0,0032	1907				86,1	0,0024	2201	68,5	0,0033	1896					
42,0	47,2				93,2	0,0030	2000							69,6	0,0030	2004					
43,0	48,3				94,4	0,0028	2114							70,7	0,0027	2152					
44,0	49,4				95,6	0,0024	2286														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				



		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,11		k	1,11		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0,sat</sub> [mc/kg]	Q <sub>m</sub> [kg/h]
438	55,2	0,0144	473	28,7	0,0140	479	25,8	0,0142	475	47,9	0,0139	481	61,4	0,0133	490	61,18	0,0134	488	61,1	0,0139	474			
477	58,5	0,0131	516	31,8	0,0128	521	28,9	0,0129	517	51,3	0,0127	524	64,9	0,0121	535	64,6	0,0122	532	64,5	0,0127	517			
516	61,7	0,0121	557	34,6	0,0118	564	31,9	0,0119	561	54,4	0,0116	568	68,1	0,0111	579	67,83	0,0112	577	67,7	0,0116	560			
556	64,6	0,0111	602	37,4	0,0109	608	34,7	0,0109	605	57,4	0,0107	613	71,1	0,0102	625	70,89	0,0103	623	70,8	0,0107	604			
596	67,5	0,0103	646	39,9	0,0101	652	37,3	0,0101	650	60,2	0,0099	659	74,1	0,0094	672	73,8	0,0096	666	73,7	0,0099	649			
636	70,1	0,0096	690	42,4	0,0094	698	39,8	0,0094	695	62,9	0,0092	705	76,8	0,0088	719	76,57	0,0089	713	76,5	0,0092	694			
678	72,7	0,0089	737	44,7	0,0087	744	42,2	0,0087	742	65,4	0,0085	753	79,5	0,0081	768	79,22	0,0082	765	79,1	0,0085	741			
719	75,2	0,0083	784	47,0	0,0082	790	44,5	0,0081	790	67,9	0,0080	801	82,0	0,0076	818	81,76	0,0077	811	81,7	0,0079	789			
762	77,5	0,0078	830	49,1	0,0077	838	46,8	0,0076	839	70,3	0,0074	851	84,5	0,0071	869	84,19	0,0071	867	84,1	0,0074	838			
805	79,8	0,0073	880	51,2	0,0072	887	48,9	0,0071	889	72,5	0,0069	902	86,8	0,0066	922	86,54	0,0067	914	86,4	0,0069	888			
849	82,0	0,0068	933	53,2	0,0067	937	50,9	0,0066	941	74,7	0,0065	955	89,1	0,0062	976	88,79	0,0062	973	88,7	0,0065	940			
894	84,1	0,0064	983	55,1	0,0063	988	52,9	0,0062	995	76,8	0,0061	1010	91,2	0,0058	1032	90,97	0,0058	1029	90,9	0,0061	994			
940	86,2	0,0060	1037	57,0	0,0060	1040	54,8	0,0058	1050	78,9	0,0057	1066	93,3	0,0054	1091	93,07	0,0055	1079	93,0	0,0057	1050			
987	88,1	0,0056	1096	58,7	0,0056	1094	56,7	0,0054	1108	80,8	0,0053	1125	95,4	0,0050	1152	95,11	0,0051	1144	95,0	0,0053	1107			
1035	90,1	0,0053	1149	60,5	0,0053	1150	58,5	0,0051	1168	82,7	0,0050	1186	97,3	0,0047	1216	97,07	0,0048	1203	97,0	0,0050	1168			
1084	91,9	0,0050	1206	62,1	0,0050	1208	60,2	0,0048	1231	84,6	0,0046	1251	99,2	0,0044	1284	98,98	0,0044	1280	98,9	0,0046	1232			
1134	93,7	0,0046	1280	63,7	0,0047	1268	61,9	0,0044	1298	86,4	0,0043	1321	101,1	0,0041	1357	100,83	0,0041	1350	100,7	0,0043	1300			
1186	95,4	0,0043	1348	65,3	0,0044	1331	63,5	0,0041	1370	88,1	0,0040	1395	102,9	0,0038	1437	102,61	0,0038	1428	102,5	0,0040	1374			
1240	97,1	0,0040	1421	66,8	0,0041	1397	65,1	0,0038	1449	89,8	0,0037	1478	104,6	0,0034	1527	104,35	0,0035	1513	104,3	0,0037	1455			
1295	98,8	0,0038	1482	68,3	0,0039	1468	66,6	0,0035	1538	91,4	0,0034	1572	106,3	0,0031	1634	106,03	0,0032	1609	106,0	0,0034	1548			
1353	100,3	0,0035	1569	69,7	0,0036	1546	68,1	0,0032	1643	93,0	0,0030	1689	107,9	0,0027	1786	107,65	0,0028	1747	107,6	0,0030	1663			
1414	101,9	0,0031	1693	68,3	0,0005	4047	69,6	0,0028	1785	94,5	0,0025	1884							109,2	0,0025	1865			
1474				72,3	0,0031	1723																		
1548				73,5	0,0028	1838																		
1622																								
1703																								
1795																								
1906																								
2396																								

TABLE 8: MAXIMUM DISCHARGE CAPACITY OF VALVES 3060/24 ; 3060/34

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	506	33,7	0,0179	474	27,0	0,0144	768	33,9	0,0175	473	16,5	0,0195	453	31,1	0,0172	477	31,0	0,0170
12,0	14,2	53,0	0,0139	551	36,9	0,0164	515	30,2	0,0132	837	36,9	0,0161	514	19,4	0,0179	493	34,1	0,0158	519	34,0	0,0156
13,0	15,3	56,0	0,0128	597	39,9	0,0151	556	33,1	0,0121	908	39,7	0,0148	556	22,1	0,0165	533	36,9	0,0145	562	36,9	0,0143
14,0	16,4	58,9	0,0118	643	42,8	0,0140	598	35,9	0,0111	979	42,4	0,0137	599	24,7	0,0153	573	39,6	0,0134	605	39,5	0,0133
15,0	17,5	61,7	0,0109	690	45,5	0,0131	640	38,5	0,0103	1051	44,9	0,0127	642	27,2	0,0142	614	42,1	0,0125	647	42,1	0,0123
16,0	18,6	64,3	0,0102	737	48,1	0,0122	683	41,0	0,0095	1125	47,3	0,0119	685	29,5	0,0133	656	44,6	0,0116	693	44,5	0,0115
17,0	19,7	66,8	0,0095	786	50,6	0,0115	726	43,4	0,0089	1201	49,6	0,0111	729	31,8	0,0124	698	46,9	0,0108	739	46,8	0,0107
18,0	20,8	69,2	0,0088	835	53,0	0,0108	770	45,7	0,0083	1278	51,8	0,0104	774	33,9	0,0116	740	49,1	0,0102	781	49,1	0,0100
19,0	21,9	71,5	0,0083	886	55,3	0,0101	814	48,0	0,0077	1357	54,0	0,0098	819	36,0	0,0109	783	51,2	0,0095	831	51,2	0,0094
20,0	23,0	73,7	0,0078	937	57,5	0,0096	859	50,1	0,0072	1439	56,0	0,0092	865	37,9	0,0103	827	53,3	0,0090	875	53,2	0,0089
21,0	24,1	75,9	0,0073	990	59,7	0,0090	904	52,1	0,0068	1522	58,0	0,0087	912	39,9	0,0097	871	55,2	0,0085	921	55,2	0,0083
22,0	25,2	77,9	0,0069	1044	61,7	0,0086	950	54,1	0,0063	1608	59,9	0,0082	960	41,7	0,0092	916	57,1	0,0080	971	57,1	0,0079
23,0	26,3	79,9	0,0065	1099	63,7	0,0081	996	56,0	0,0059	1698	61,7	0,0077	1008	43,5	0,0087	962	58,9	0,0075	1024	58,9	0,0074
24,0	27,4	81,9	0,0061	1156	65,7	0,0077	1044	57,9	0,0056	1790	63,4	0,0073	1058	45,2	0,0082	1009	60,7	0,0071	1075	60,7	0,0070
25,0	28,5	83,7	0,0057	1215	67,6	0,0073	1092	59,7	0,0052	1887	65,2	0,0069	1109	46,9	0,0078	1056	62,4	0,0067	1128	62,4	0,0066
26,0	29,6	85,6	0,0054	1276	69,4	0,0070	1141	61,4	0,0049	1988	66,8	0,0066	1160	48,5	0,0074	1105	64,1	0,0064	1176	64,1	0,0063
27,0	30,7	87,3	0,0051	1339	71,2	0,0066	1191	63,1	0,0045	2096	68,4	0,0062	1213	50,1	0,0071	1154	65,7	0,0060	1237	65,7	0,0060
28,0	31,8	89,0	0,0048	1405	72,9	0,0063	1242	64,7	0,0042	2211	70,0	0,0059	1268	51,6	0,0067	1205	67,2	0,0057	1292	67,2	0,0056
29,0	32,9	90,7	0,0045	1474	74,6	0,0060	1294	66,3	0,0039	2336	71,5	0,0056	1323	53,1	0,0064	1257	68,7	0,0054	1350	68,7	0,0053
30,0	34,0	92,3	0,0042	1547	76,2	0,0057	1348	67,8	0,0036	2475	72,9	0,0053	1381	54,6	0,0061	1310	70,2	0,0051	1412	70,2	0,0051
31,0	35,1	93,9	0,0039	1626	77,8	0,0055	1402	69,3	0,0033	2637	74,4	0,0051	1441	56,0	0,0058	1364	71,6	0,0049	1464	71,6	0,0048
32,0	36,2	95,4	0,0037	1711	79,4	0,0052	1458	70,7	0,0029	2845	75,7	0,0048	1503	57,4	0,0055	1421	73,0	0,0046	1535	73,0	0,0045
33,0	37,3	96,9	0,0034	1806	80,9	0,0050	1516	72,1	0,0022	3294	77,1	0,0045	1567	58,7	0,0052	1479	74,3	0,0043	1611	74,3	0,0043
34,0	38,4	98,3	0,0031	1916	82,4	0,0047	1576				78,4	0,0043	1635	60,1	0,0050	1539	75,6	0,0041	1674	75,6	0,0040
35,0	39,5	99,2	0,0029	2011	83,9	0,0045	1638				79,7	0,0041	1706	61,4	0,0047	1602	76,9	0,0038	1764	76,9	0,0037
36,0	40,6	99,5	0,0028	2063	85,3	0,0043	1702				80,9	0,0038	1783	62,6	0,0045	1668	78,1	0,0036	1837	78,1	0,0035
37,0	41,7	99,7	0,0028	2116	86,7	0,0041	1770				82,1	0,0036	1865	63,8	0,0042	1737	79,2	0,0033	1945	79,2	0,0032
38,0	42,8				88,0	0,0039	1841				83,2	0,0033	1957	65,0	0,0040	1811	80,3	0,0030	2066	80,3	0,0029
39,0	43,9				89,4	0,0037	1917				84,3	0,0031	2062	66,2	0,0038	1891				80,7	0,0019
40,0	45,0				90,7	0,0035	1998				85,3	0,0028	2194	67,4	0,0035	1978					
41,0	46,1				92,0	0,0032	2088				86,1	0,0024	2410	68,5	0,0033	2077					
42,0	47,2				93,2	0,0030	2191							69,6	0,0030	2195					
43,0	48,3				94,4	0,0028	2315							70,7	0,0027	2357					
44,0	49,4				95,6	0,0024	2503														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
480	55,2	0,0144	518	28,7	0,0140	524	25,8	0,0142	520	47,9	0,0139	527	61,4	0,0133	537	61,18	0,0134	534	61,1	0,0139	519			
522	58,5	0,0131	565	31,8	0,0128	571	28,9	0,0129	567	51,3	0,0127	574	64,9	0,0121	585	64,6	0,0122	583	64,5	0,0127	566			
565	61,7	0,0121	610	34,6	0,0118	618	31,9	0,0119	614	54,4	0,0116	622	68,1	0,0111	635	67,83	0,0112	632	67,7	0,0116	613			
609	64,6	0,0111	660	37,4	0,0109	666	34,7	0,0109	662	57,4	0,0107	671	71,1	0,0102	685	70,89	0,0103	682	70,8	0,0107	661			
652	67,5	0,0103	707	39,9	0,0101	715	37,3	0,0101	711	60,2	0,0099	721	74,1	0,0094	736	73,8	0,0096	730	73,7	0,0099	710			
697	70,1	0,0096	755	42,4	0,0094	764	39,8	0,0094	762	62,9	0,0092	772	76,8	0,0088	788	76,57	0,0089	781	76,5	0,0092	761			
742	72,7	0,0089	807	44,7	0,0087	814	42,2	0,0087	813	65,4	0,0085	824	79,5	0,0081	841	79,22	0,0082	838	79,1	0,0085	812			
788	75,2	0,0083	859	47,0	0,0082	866	44,5	0,0081	865	67,9	0,0080	877	82,0	0,0076	896	81,76	0,0077	888	81,7	0,0079	864			
834	77,5	0,0078	909	49,1	0,0077	918	46,8	0,0076	919	70,3	0,0074	932	84,5	0,0071	952	84,19	0,0071	949	84,1	0,0074	918			
882	79,8	0,0073	963	51,2	0,0072	971	48,9	0,0071	974	72,5	0,0069	988	86,8	0,0066	1009	86,54	0,0067	1001	86,4	0,0069	973			
930	82,0	0,0068	1022	53,2	0,0067	1026	50,9	0,0066	1031	74,7	0,0065	1046	89,1	0,0062	1069	88,79	0,0062	1066	88,7	0,0065	1030			
979	84,1	0,0064	1077	55,1	0,0063	1082	52,9	0,0062	1089	76,8	0,0061	1106	91,2	0,0058	1130	90,97	0,0058	1127	90,9	0,0061	1089			
1029	86,2	0,0060	1136	57,0	0,0060	1139	54,8	0,0058	1150	78,9	0,0057	1167	93,3	0,0054	1194	93,07	0,0055	1182	93,0	0,0057	1149			
1081	88,1	0,0056	1200	58,7	0,0056	1198	56,7	0,0054	1213	80,8	0,0053	1232	95,4	0,0050	1261	95,11	0,0051	1253	95,0	0,0053	1213			
1133	90,1	0,0053	1258	60,5	0,0053	1259	58,5	0,0051	1279	82,7	0,0050	1299	97,3	0,0047	1332	97,07	0,0048	1317	97,0	0,0050	1279			
1187	91,9	0,0050	1320	62,1	0,0050	1323	60,2	0,0048	1348	84,6	0,0046	1370	99,2	0,0044	1406	98,98	0,0044	1402	98,9	0,0046	1349			
1242	93,7	0,0046	1402	63,7	0,0047	1389	61,9	0,0044	1422	86,4	0,0043	1446	101,1	0,0041	1486	100,83	0,0041	1479	100,7	0,0043	1424			
1299	95,4	0,0043	1476	65,3	0,0044	1458	63,5	0,0041	1501	88,1	0,0040	1528	102,9	0,0038	1574	102,61	0,0038	1564	102,5	0,0040	1504			
1358	97,1	0,0040	1556	66,8	0,0041	1530	65,1	0,0038	1587	89,8	0,0037	1618	104,6	0,0034	1672	104,35	0,0035	1657	104,3	0,0037	1593			
1418	98,8	0,0038	1623	68,3	0,0039	1608	66,6	0,0035	1684	91,4	0,0034	1722	106,3	0,0031	1790	106,03	0,0032	1762	106,0	0,0034	1695			
1481	100,3	0,0035	1719	69,7	0,0036	1693	68,1	0,0032	1799	93,0	0,0030	1850	107,9	0,0027	1956	107,65	0,0028	1914	107,6	0,0030	1821			
1549	101,9	0,0031	1854	68,3	0,0005	4432	69,6	0,0028	1955	94,5	0,0025	2063							109,2	0,0025	2043			
1615				72,3	0,0031	1887																		
1695				73,5	0,0028	2013																		
1776																								
1865																								
1966																								
2088																								
2624																								

TABLE 9: MAXIMUM DISCHARGE CAPACITY OF VALVES 3060/45

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	607	33,7	0,0179	569	27,0	0,0144	768	33,9	0,0175	567	16,5	0,0195	544	31,1	0,0172	573	31,0	0,0170
12,0	14,2	53,0	0,0139	661	36,9	0,0164	618	30,2	0,0132	837	36,9	0,0161	617	19,4	0,0179	591	34,1	0,0158	622	34,0	0,0156
13,0	15,3	56,0	0,0128	716	39,9	0,0151	667	33,1	0,0121	908	39,7	0,0148	667	22,1	0,0165	639	36,9	0,0145	674	36,9	0,0143
14,0	16,4	58,9	0,0118	771	42,8	0,0140	718	35,9	0,0111	979	42,4	0,0137	718	24,7	0,0153	688	39,6	0,0134	726	39,5	0,0133
15,0	17,5	61,7	0,0109	827	45,5	0,0131	768	38,5	0,0103	1051	44,9	0,0127	770	27,2	0,0142	737	42,1	0,0125	776	42,1	0,0123
16,0	18,6	64,3	0,0102	885	48,1	0,0122	819	41,0	0,0095	1125	47,3	0,0119	822	29,5	0,0133	787	44,6	0,0116	831	44,5	0,0115
17,0	19,7	66,8	0,0095	943	50,6	0,0115	871	43,4	0,0089	1201	49,6	0,0111	875	31,8	0,0124	837	46,9	0,0108	886	46,8	0,0107
18,0	20,8	69,2	0,0088	1002	53,0	0,0108	923	45,7	0,0083	1278	51,8	0,0104	928	33,9	0,0116	888	49,1	0,0102	937	49,1	0,0100
19,0	21,9	71,5	0,0083	1063	55,3	0,0101	976	48,0	0,0077	1357	54,0	0,0098	983	36,0	0,0109	940	51,2	0,0095	996	51,2	0,0094
20,0	23,0	73,7	0,0078	1124	57,5	0,0096	1030	50,1	0,0072	1439	56,0	0,0092	1038	37,9	0,0103	992	53,3	0,0090	1049	53,2	0,0089
21,0	24,1	75,9	0,0073	1188	59,7	0,0090	1084	52,1	0,0068	1522	58,0	0,0087	1094	39,9	0,0097	1045	55,2	0,0085	1105	55,2	0,0083
22,0	25,2	77,9	0,0069	1252	61,7	0,0086	1139	54,1	0,0063	1608	59,9	0,0082	1151	41,7	0,0092	1099	57,1	0,0080	1165	57,1	0,0079
23,0	26,3	79,9	0,0065	1319	63,7	0,0081	1195	56,0	0,0059	1698	61,7	0,0077	1210	43,5	0,0087	1154	58,9	0,0075	1229	58,9	0,0074
24,0	27,4	81,9	0,0061	1387	65,7	0,0077	1252	57,9	0,0056	1790	63,4	0,0073	1269	45,2	0,0082	1210	60,7	0,0071	1289	60,7	0,0070
25,0	28,5	83,7	0,0057	1458	67,6	0,0073	1310	59,7	0,0052	1887	65,2	0,0069	1330	46,9	0,0078	1267	62,4	0,0067	1353	62,4	0,0066
26,0	29,6	85,6	0,0054	1530	69,4	0,0070	1369	61,4	0,0049	1988	66,8	0,0066	1392	48,5	0,0074	1325	64,1	0,0064	1411	64,1	0,0063
27,0	30,7	87,3	0,0051	1606	71,2	0,0066	1429	63,1	0,0045	2096	68,4	0,0062	1455	50,1	0,0071	1384	65,7	0,0060	1484	65,7	0,0060
28,0	31,8	89,0	0,0048	1685	72,9	0,0063	1490	64,7	0,0042	2211	70,0	0,0059	1520	51,6	0,0067	1445	67,2	0,0057	1550	67,2	0,0056
29,0	32,9	90,7	0,0045	1768	74,6	0,0060	1552	66,3	0,0039	2336	71,5	0,0056	1587	53,1	0,0064	1507	68,7	0,0054	1620	68,7	0,0053
30,0	34,0	92,3	0,0042	1856	76,2	0,0057	1616	67,8	0,0036	2475	72,9	0,0053	1657	54,6	0,0061	1571	70,2	0,0051	1694	70,2	0,0051
31,0	35,1	93,9	0,0039	1950	77,8	0,0055	1682	69,3	0,0033	2637	74,4	0,0051	1728	56,0	0,0058	1636	71,6	0,0049	1756	71,6	0,0048
32,0	36,2	95,4	0,0037	2052	79,4	0,0052	1749	70,7	0,0029	2845	75,7	0,0048	1802	57,4	0,0055	1704	73,0	0,0046	1841	73,0	0,0045
33,0	37,3	96,9	0,0034	2166	80,9	0,0050	1819	72,1	0,0022	3294	77,1	0,0045	1880	58,7	0,0052	1774	74,3	0,0043	1933	74,3	0,0043
34,0	38,4	98,3	0,0031	2298	82,4	0,0047	1890				78,4	0,0043	1961	60,1	0,0050	1846	75,6	0,0041	2008	75,6	0,0040
35,0	39,5	99,2	0,0029	2413	83,9	0,0045	1965				79,7	0,0041	2047	61,4	0,0047	1922	76,9	0,0038	2116	76,9	0,0037
36,0	40,6	99,5	0,0028	2474	85,3	0,0043	2042				80,9	0,0038	2138	62,6	0,0045	2001	78,1	0,0036	2204	78,1	0,0035
37,0	41,7	99,7	0,0028	2538	86,7	0,0041	2123				82,1	0,0036	2238	63,8	0,0042	2084	79,2	0,0033	2333	79,2	0,0032
38,0	42,8				88,0	0,0039	2208				83,2	0,0033	2347	65,0	0,0040	2173	80,3	0,0030	2478	80,3	0,0029
39,0	43,9				89,4	0,0037	2299				84,3	0,0031	2474	66,2	0,0038	2268				80,7	0,0019
40,0	45,0				90,7	0,0035	2397				85,3	0,0028	2631	67,4	0,0035	2373					
41,0	46,1				92,0	0,0032	2505				86,1	0,0024	2891	68,5	0,0033	2491					
42,0	47,2				93,2	0,0030	2628							69,6	0,0030	2633					
43,0	48,3				94,4	0,0028	2777							70,7	0,0027	2827					
44,0	49,4				95,6	0,0024	3003														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
576	55,2	0,0144	621	28,7	0,0140	629	25,8	0,0142	624	47,9	0,0139	632	61,4	0,0133	644	61,18	0,0134	641	61,1	0,0139	623			
627	58,5	0,0131	678	31,8	0,0128	685	28,9	0,0129	680	51,3	0,0127	689	64,9	0,0121	702	64,6	0,0122	699	64,5	0,0127	679			
678	61,7	0,0121	732	34,6	0,0118	741	31,9	0,0119	736	54,4	0,0116	747	68,1	0,0111	761	67,83	0,0112	758	67,7	0,0116	735			
730	64,6	0,0111	791	37,4	0,0109	799	34,7	0,0109	794	57,4	0,0107	805	71,1	0,0102	821	70,89	0,0103	818	70,8	0,0107	793			
783	67,5	0,0103	848	39,9	0,0101	857	37,3	0,0101	853	60,2	0,0099	865	74,1	0,0094	882	73,8	0,0096	875	73,7	0,0099	852			
836	70,1	0,0096	906	42,4	0,0094	916	39,8	0,0094	914	62,9	0,0092	926	76,8	0,0088	945	76,57	0,0089	937	76,5	0,0092	912			
890	72,7	0,0089	968	44,7	0,0087	977	42,2	0,0087	975	65,4	0,0085	989	79,5	0,0081	1009	79,22	0,0082	1005	79,1	0,0085	974			
945	75,2	0,0083	1030	47,0	0,0082	1038	44,5	0,0081	1038	67,9	0,0080	1053	82,0	0,0076	1074	81,76	0,0077	1066	81,7	0,0079	1037			
1001	77,5	0,0078	1091	49,1	0,0077	1101	46,8	0,0076	1102	70,3	0,0074	1118	84,5	0,0071	1142	84,19	0,0071	1139	84,1	0,0074	1101			
1058	79,8	0,0073	1155	51,2	0,0072	1165	48,9	0,0071	1168	72,5	0,0069	1185	86,8	0,0066	1211	86,54	0,0067	1201	86,4	0,0069	1167			
1116	82,0	0,0068	1225	53,2	0,0067	1230	50,9	0,0066	1236	74,7	0,0065	1255	89,1	0,0062	1282	88,79	0,0062	1278	88,7	0,0065	1235			
1174	84,1	0,0064	1292	55,1	0,0063	1298	52,9	0,0062	1307	76,8	0,0061	1326	91,2	0,0058	1356	90,97	0,0058	1351	90,9	0,0061	1306			
1235	86,2	0,0060	1363	57,0	0,0060	1367	54,8	0,0058	1379	78,9	0,0057	1400	93,3	0,0054	1433	93,07	0,0055	1418	93,0	0,0057	1379			
1296	88,1	0,0056	1440	58,7	0,0056	1437	56,7	0,0054	1455	80,8	0,0053	1478	95,4	0,0050	1513	95,11	0,0051	1503	95,0	0,0053	1455			
1359	90,1	0,0053	1509	60,5	0,0053	1511	58,5	0,0051	1534	82,7	0,0050	1559	97,3	0,0047	1597	97,07	0,0048	1580	97,0	0,0050	1534			
1424	91,9	0,0050	1584	62,1	0,0050	1587	60,2	0,0048	1617	84,6	0,0046	1644	99,2	0,0044	1687	98,98	0,0044	1682	98,9	0,0046	1618			
1490	93,7	0,0046	1682	63,7	0,0047	1666	61,9	0,0044	1705	86,4	0,0043	1735	101,1	0,0041	1783	100,83	0,0041	1774	100,7	0,0043	1708			
1558	95,4	0,0043	1770	65,3	0,0044	1748	63,5	0,0041	1800	88,1	0,0040	1833	102,9	0,0038	1888	102,61	0,0038	1876	102,5	0,0040	1804			
1629	97,1	0,0040	1867	66,8	0,0041	1835	65,1	0,0038	1904	89,8	0,0037	1941	104,6	0,0034	2006	104,35	0,0035	1988	104,3	0,0037	1911			
1701	98,8	0,0038	1947	68,3	0,0039	1928	66,6	0,0035	2020	91,4	0,0034	2065	106,3	0,0031	2147	106,03	0,0032	2113	106,0	0,0034	2033			
1777	100,3	0,0035	2061	69,7	0,0036	2031	68,1	0,0032	2158	93,0	0,0030	2219	107,9	0,0027	2346	107,65	0,0028	2295	107,6	0,0030	2184			
1858	101,9	0,0031	2224	68,3	0,0005	5316	69,6	0,0028	2345	94,5	0,0025	2474							109,2	0,0025	2450			
1937				72,3	0,0031	2263																		
2033				73,5	0,0028	2415																		
2131																								
2237																								
2358																								
2504																								
3148																								

TABLE 10: MAXIMUM DISCHARGE CAPACITY OF VALVES 3060/36

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	1376	33,7	0,0179	1289	27,0	0,0144	768	33,9	0,0175	1286	16,5	0,0195	1232	31,1	0,0172	1298	31,0	0,0170
12,0	14,2	53,0	0,0139	1498	36,9	0,0164	1400	30,2	0,0132	837	36,9	0,0161	1398	19,4	0,0179	1340	34,1	0,0158	1410	34,0	0,0156
13,0	15,3	56,0	0,0128	1622	39,9	0,0151	1513	33,1	0,0121	908	39,7	0,0148	1513	22,1	0,0165	1449	36,9	0,0145	1528	36,9	0,0143
14,0	16,4	58,9	0,0118	1748	42,8	0,0140	1626	35,9	0,0111	979	42,4	0,0137	1628	24,7	0,0153	1559	39,6	0,0134	1645	39,5	0,0133
15,0	17,5	61,7	0,0109	1875	45,5	0,0131	1741	38,5	0,0103	1051	44,9	0,0127	1745	27,2	0,0142	1670	42,1	0,0125	1760	42,1	0,0123
16,0	18,6	64,3	0,0102	2005	48,1	0,0122	1857	41,0	0,0095	1125	47,3	0,0119	1863	29,5	0,0133	1783	44,6	0,0116	1883	44,5	0,0115
17,0	19,7	66,8	0,0095	2137	50,6	0,0115	1974	43,4	0,0089	1201	49,6	0,0111	1983	31,8	0,0124	1897	46,9	0,0108	2009	46,8	0,0107
18,0	20,8	69,2	0,0088	2271	53,0	0,0108	2093	45,7	0,0083	1278	51,8	0,0104	2104	33,9	0,0116	2013	49,1	0,0102	2124	49,1	0,0100
19,0	21,9	71,5	0,0083	2409	55,3	0,0101	2213	48,0	0,0077	1357	54,0	0,0098	2228	36,0	0,0109	2130	51,2	0,0095	2258	51,2	0,0094
20,0	23,0	73,7	0,0078	2549	57,5	0,0096	2334	50,1	0,0072	1439	56,0	0,0092	2353	37,9	0,0103	2249	53,3	0,0090	2378	53,2	0,0089
21,0	24,1	75,9	0,0073	2692	59,7	0,0090	2457	52,1	0,0068	1522	58,0	0,0087	2480	39,9	0,0097	2369	55,2	0,0085	2504	55,2	0,0083
22,0	25,2	77,9	0,0069	2838	61,7	0,0086	2582	54,1	0,0063	1608	59,9	0,0082	2610	41,7	0,0092	2492	57,1	0,0080	2640	57,1	0,0079
23,0	26,3	79,9	0,0065	2989	63,7	0,0081	2709	56,0	0,0059	1698	61,7	0,0077	2742	43,5	0,0087	2616	58,9	0,0075	2785	58,9	0,0074
24,0	27,4	81,9	0,0061	3144	65,7	0,0077	2838	57,9	0,0056	1790	63,4	0,0073	2876	45,2	0,0082	2743	60,7	0,0071	2922	60,7	0,0070
25,0	28,5	83,7	0,0057	3304	67,6	0,0073	2969	59,7	0,0052	1887	65,2	0,0069	3014	46,9	0,0078	2872	62,4	0,0067	3067	62,4	0,0066
26,0	29,6	85,6	0,0054	3469	69,4	0,0070	3103	61,4	0,0049	1988	66,8	0,0066	3154	48,5	0,0074	3004	64,1	0,0064	3199	64,1	0,0063
27,0	30,7	87,3	0,0051	3641	71,2	0,0066	3238	63,1	0,0045	2096	68,4	0,0062	3298	50,1	0,0071	3138	65,7	0,0060	3364	65,7	0,0060
28,0	31,8	89,0	0,0048	3820	72,9	0,0063	3377	64,7	0,0042	2211	70,0	0,0059	3446	51,6	0,0067	3276	67,2	0,0057	3513	67,2	0,0056
29,0	32,9	90,7	0,0045	4008	74,6	0,0060	3519	66,3	0,0039	2336	71,5	0,0056	3598	53,1	0,0064	3417	68,7	0,0054	3671	68,7	0,0053
30,0	34,0	92,3	0,0042	4207	76,2	0,0057	3664	67,8	0,0036	2475	72,9	0,0053	3755	54,6	0,0061	3561	70,2	0,0051	3840	70,2	0,0051
31,0	35,1	93,9	0,0039	4420	77,8	0,0055	3812	69,3	0,0033	2637	74,4	0,0051	3917	56,0	0,0058	3709	71,6	0,0049	3981	71,6	0,0048
32,0	36,2	95,4	0,0037	4651	79,4	0,0052	3965	70,7	0,0029	2845	75,7	0,0048	4085	57,4	0,0055	3862	73,0	0,0046	4172	73,0	0,0045
33,0	37,3	96,9	0,0034	4909	80,9	0,0050	4122	72,1	0,0022	3294	77,1	0,0045	4261	58,7	0,0052	4021	74,3	0,0043	4380	74,3	0,0043
34,0	38,4	98,3	0,0031	5210	82,4	0,0047	4285				78,4	0,0043	4445	60,1	0,0050	4185	75,6	0,0041	4552	75,6	0,0040
35,0	39,5	99,2	0,0029	5469	83,9	0,0045	4453				79,7	0,0041	4639	61,4	0,0047	4356	76,9	0,0038	4795	76,9	0,0037
36,0	40,6	99,5	0,0028	5608	85,3	0,0043	4628				80,9	0,0038	4847	62,6	0,0045	4535	78,1	0,0036	4995	78,1	0,0035
37,0	41,7	99,7	0,0028	5753	86,7	0,0041	4812				82,1	0,0036	5072	63,8	0,0042	4724	79,2	0,0033	5287	79,2	0,0032
38,0	42,8				88,0	0,0039	5005				83,2	0,0033	5321	65,0	0,0040	4925	80,3	0,0030	5618	80,3	0,0029
39,0	43,9				89,4	0,0037	5211				84,3	0,0031	5607	66,2	0,0038	5141				80,7	0,0019
40,0	45,0				90,7	0,0035	5433				85,3	0,0028	5964	67,4	0,0035	5378					
41,0	46,1				92,0	0,0032	5677				86,1	0,0024	6552	68,5	0,0033	5647					
42,0	47,2				93,2	0,0030	5956							69,6	0,0030	5967					
43,0	48,3				94,4	0,0028	6295							70,7	0,0027	6408					
44,0	49,4				95,6	0,0024	6806														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
576	55,2	0,0144	1407	28,7	0,0140	1426	25,8	0,0142	1413	47,9	0,0139	1432	61,4	0,0133	1460	61,18	0,0134	1453	61,1	0,0139	1411			
627	58,5	0,0131	1536	31,8	0,0128	1552	28,9	0,0129	1540	51,3	0,0127	1561	64,9	0,0121	1592	64,6	0,0122	1585	64,5	0,0127	1538			
678	61,7	0,0121	1659	34,6	0,0118	1680	31,9	0,0119	1669	54,4	0,0116	1692	68,1	0,0111	1725	67,83	0,0112	1718	67,7	0,0116	1667			
730	64,6	0,0111	1793	37,4	0,0109	1811	34,7	0,0109	1801	57,4	0,0107	1825	71,1	0,0102	1861	70,89	0,0103	1854	70,8	0,0107	1798			
783	67,5	0,0103	1923	39,9	0,0101	1943	37,3	0,0101	1934	60,2	0,0099	1961	74,1	0,0094	2000	73,8	0,0096	1984	73,7	0,0099	1932			
836	70,1	0,0096	2054	42,4	0,0094	2077	39,8	0,0094	2071	62,9	0,0092	2099	76,8	0,0088	2142	76,57	0,0089	2124	76,5	0,0092	2068			
890	72,7	0,0089	2195	44,7	0,0087	2214	42,2	0,0087	2210	65,4	0,0085	2241	79,5	0,0081	2287	79,22	0,0082	2278	79,1	0,0085	2207			
945	75,2	0,0083	2336	47,0	0,0082	2353	44,5	0,0081	2352	67,9	0,0080	2386	82,0	0,0076	2435	81,76	0,0077	2415	81,7	0,0079	2349			
1001	77,5	0,0078	2472	49,1	0,0077	2495	46,8	0,0076	2498	70,3	0,0074	2534	84,5	0,0071	2588	84,19	0,0071	2581	84,1	0,0074	2495			
1058	79,8	0,0073	2619	51,2	0,0072	2640	48,9	0,0071	2648	72,5	0,0069	2687	86,8	0,0066	2744	86,54	0,0067	2723	86,4	0,0069	2645			
1116	82,0	0,0068	2778	53,2	0,0067	2789	50,9	0,0066	2802	74,7	0,0065	2844	89,1	0,0062	2906	88,79	0,0062	2897	88,7	0,0065	2800			
1174	84,1	0,0064	2928	55,1	0,0063	2941	52,9	0,0062	2961	76,8	0,0061	3006	91,2	0,0058	3073	90,97	0,0058	3063	90,9	0,0061	2960			
1235	86,2	0,0060	3089	57,0	0,0060	3097	54,8	0,0058	3126	78,9	0,0057	3174	93,3	0,0054	3247	93,07	0,0055	3213	93,0	0,0057	3125			
1296	88,1	0,0056	3264	58,7	0,0056	3258	56,7	0,0054	3298	80,8	0,0053	3349	95,4	0,0050	3429	95,11	0,0051	3406	95,0	0,0053	3297			
1359	90,1	0,0053	3421	60,5	0,0053	3424	58,5	0,0051	3477	82,7	0,0050	3533	97,3	0,0047	3620	97,07	0,0048	3581	97,0	0,0050	3478			
1424	91,9	0,0050	3590	62,1	0,0050	3596	60,2	0,0048	3665	84,6	0,0046	3726	99,2	0,0044	3823	98,98	0,0044	3811	98,9	0,0046	3668			
1490	93,7	0,0046	3812	63,7	0,0047	3775	61,9	0,0044	3865	86,4	0,0043	3932	101,1	0,0041	4041	100,83	0,0041	4021	100,7	0,0043	3871			
1558	95,4	0,0043	4012	65,3	0,0044	3963	63,5	0,0041	4080	88,1	0,0040	4155	102,9	0,0038	4278	102,61	0,0038	4251	102,5	0,0040	4090			
1629	97,1	0,0040	4231	66,8	0,0041	4160	65,1	0,0038	4315	89,8	0,0037	4400	104,6	0,0034	4546	104,35	0,0035	4505	104,3	0,0037	4331			
1701	98,8	0,0038	4413	68,3	0,0039	4371	66,6	0,0035	4579	91,4	0,0034	4681	106,3	0,0031	4866	106,03	0,0032	4790	106,0	0,0034	4608			
1777	100,3	0,0035	4672	69,7	0,0036	4603	68,1	0,0032	4892	93,0	0,0030	5030	107,9	0,0027	5317	107,65	0,0028	5203	107,6	0,0030	4951			
1858	101,9	0,0031	5042	68,3	0,0005	12049	69,6	0,0028	5315	94,5	0,0025	5608							109,2	0,0025	5554			
1937				72,3	0,0031	5130																		
2033				73,5	0,0028	5474																		
2131																								
2237																								
2358																								
2504																								
3148																								

TABLE 11: MAXIMUM DISCHARGE CAPACITY OF VALVES 3060/46

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	1391	33,7	0,0179	1303	27,0	0,0144	768	33,9	0,0175	1300	16,5	0,0195	1246	31,1	0,0172	1312	31,0	0,0170
12,0	14,2	53,0	0,0139	1514	36,9	0,0164	1415	30,2	0,0132	837	36,9	0,0161	1414	19,4	0,0179	1355	34,1	0,0158	1425	34,0	0,0156
13,0	15,3	56,0	0,0128	1639	39,9	0,0151	1529	33,1	0,0121	908	39,7	0,0148	1529	22,1	0,0165	1465	36,9	0,0145	1544	36,9	0,0143
14,0	16,4	58,9	0,0118	1767	42,8	0,0140	1644	35,9	0,0111	979	42,4	0,0137	1646	24,7	0,0153	1576	39,6	0,0134	1663	39,5	0,0133
15,0	17,5	61,7	0,0109	1896	45,5	0,0131	1760	38,5	0,0103	1051	44,9	0,0127	1764	27,2	0,0142	1689	42,1	0,0125	1779	42,1	0,0123
16,0	18,6	64,3	0,0102	2027	48,1	0,0122	1877	41,0	0,0095	1125	47,3	0,0119	1883	29,5	0,0133	1802	44,6	0,0116	1904	44,5	0,0115
17,0	19,7	66,8	0,0095	2160	50,6	0,0115	1996	43,4	0,0089	1201	49,6	0,0111	2004	31,8	0,0124	1918	46,9	0,0108	2031	46,8	0,0107
18,0	20,8	69,2	0,0088	2296	53,0	0,0108	2115	45,7	0,0083	1278	51,8	0,0104	2127	33,9	0,0116	2035	49,1	0,0102	2147	49,1	0,0100
19,0	21,9	71,5	0,0083	2435	55,3	0,0101	2237	48,0	0,0077	1357	54,0	0,0098	2252	36,0	0,0109	2153	51,2	0,0095	2283	51,2	0,0094
20,0	23,0	73,7	0,0078	2576	57,5	0,0096	2360	50,1	0,0072	1439	56,0	0,0092	2378	37,9	0,0103	2273	53,3	0,0090	2403	53,2	0,0089
21,0	24,1	75,9	0,0073	2721	59,7	0,0090	2484	52,1	0,0068	1522	58,0	0,0087	2507	39,9	0,0097	2395	55,2	0,0085	2532	55,2	0,0083
22,0	25,2	77,9	0,0069	2869	61,7	0,0086	2610	54,1	0,0063	1608	59,9	0,0082	2638	41,7	0,0092	2519	57,1	0,0080	2668	57,1	0,0079
23,0	26,3	79,9	0,0065	3022	63,7	0,0081	2739	56,0	0,0059	1698	61,7	0,0077	2772	43,5	0,0087	2645	58,9	0,0075	2815	58,9	0,0074
24,0	27,4	81,9	0,0061	3178	65,7	0,0077	2869	57,9	0,0056	1790	63,4	0,0073	2908	45,2	0,0082	2773	60,7	0,0071	2954	60,7	0,0070
25,0	28,5	83,7	0,0057	3340	67,6	0,0073	3001	59,7	0,0052	1887	65,2	0,0069	3047	46,9	0,0078	2903	62,4	0,0067	3101	62,4	0,0066
26,0	29,6	85,6	0,0054	3507	69,4	0,0070	3136	61,4	0,0049	1988	66,8	0,0066	3189	48,5	0,0074	3036	64,1	0,0064	3233	64,1	0,0063
27,0	30,7	87,3	0,0051	3680	71,2	0,0066	3274	63,1	0,0045	2096	68,4	0,0062	3334	50,1	0,0071	3172	65,7	0,0060	3401	65,7	0,0060
28,0	31,8	89,0	0,0048	3861	72,9	0,0063	3414	64,7	0,0042	2211	70,0	0,0059	3484	51,6	0,0067	3311	67,2	0,0057	3551	67,2	0,0056
29,0	32,9	90,7	0,0045	4051	74,6	0,0060	3557	66,3	0,0039	2336	71,5	0,0056	3637	53,1	0,0064	3454	68,7	0,0054	3711	68,7	0,0053
30,0	34,0	92,3	0,0042	4253	76,2	0,0057	3704	67,8	0,0036	2475	72,9	0,0053	3796	54,6	0,0061	3599	70,2	0,0051	3882	70,2	0,0051
31,0	35,1	93,9	0,0039	4468	77,8	0,0055	3854	69,3	0,0033	2637	74,4	0,0051	3960	56,0	0,0058	3750	71,6	0,0049	4024	71,6	0,0048
32,0	36,2	95,4	0,0037	4702	79,4	0,0052	4008	70,7	0,0029	2845	75,7	0,0048	4130	57,4	0,0055	3904	73,0	0,0046	4218	73,0	0,0045
33,0	37,3	96,9	0,0034	4962	80,9	0,0050	4167	72,1	0,0022	3294	77,1	0,0045	4307	58,7	0,0052	4064	74,3	0,0043	4428	74,3	0,0043
34,0	38,4	98,3	0,0031	5266	82,4	0,0047	4331				78,4	0,0043	4493	60,1	0,0050	4230	75,6	0,0041	4601	75,6	0,0040
35,0	39,5	99,2	0,0029	5528	83,9	0,0045	4501				79,7	0,0041	4690	61,4	0,0047	4403	76,9	0,0038	4847	76,9	0,0037
36,0	40,6	99,5	0,0028	5669	85,3	0,0043	4679				80,9	0,0038	4900	62,6	0,0045	4584	78,1	0,0036	5049	78,1	0,0035
37,0	41,7	99,7	0,0028	5816	86,7	0,0041	4864				82,1	0,0036	5127	63,8	0,0042	4775	79,2	0,0033	5345	79,2	0,0032
38,0	42,8				88,0	0,0039	5059				83,2	0,0033	5379	65,0	0,0040	4978	80,3	0,0030	5679	80,3	0,0029
39,0	43,9				89,4	0,0037	5267				84,3	0,0031	5668	66,2	0,0038	5197				80,7	0,0019
40,0	45,0				90,7	0,0035	5492				85,3	0,0028	6029	67,4	0,0035	5437					
41,0	46,1				92,0	0,0032	5739				86,1	0,0024	6624	68,5	0,0033	5708					
42,0	47,2				93,2	0,0030	6020							69,6	0,0030	6032					
43,0	48,3				94,4	0,0028	6364							70,7	0,0027	6478					
44,0	49,4				95,6	0,0024	6880														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				



		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
1320	55,2	0,0144	1423	28,7	0,0140	1441	25,8	0,0142	1429	47,9	0,0139	1448	61,4	0,0133	1476	61,18	0,0134	1469	61,1	0,0139	1427			
1436	58,5	0,0131	1553	31,8	0,0128	1569	28,9	0,0129	1557	51,3	0,0127	1578	64,9	0,0121	1609	64,6	0,0122	1603	64,5	0,0127	1555			
1553	61,7	0,0121	1677	34,6	0,0118	1699	31,9	0,0119	1687	54,4	0,0116	1711	68,1	0,0111	1744	67,83	0,0112	1736	67,7	0,0116	1685			
1672	64,6	0,0111	1813	37,4	0,0109	1830	34,7	0,0109	1820	57,4	0,0107	1845	71,1	0,0102	1882	70,89	0,0103	1874	70,8	0,0107	1818			
1793	67,5	0,0103	1944	39,9	0,0101	1964	37,3	0,0101	1955	60,2	0,0099	1982	74,1	0,0094	2022	73,8	0,0096	2006	73,7	0,0099	1953			
1915	70,1	0,0096	2076	42,4	0,0094	2100	39,8	0,0094	2093	62,9	0,0092	2122	76,8	0,0088	2165	76,57	0,0089	2148	76,5	0,0092	2090			
2039	72,7	0,0089	2219	44,7	0,0087	2238	42,2	0,0087	2234	65,4	0,0085	2265	79,5	0,0081	2312	79,22	0,0082	2303	79,1	0,0085	2231			
2165	75,2	0,0083	2361	47,0	0,0082	2379	44,5	0,0081	2378	67,9	0,0080	2412	82,0	0,0076	2462	81,76	0,0077	2442	81,7	0,0079	2375			
2293	77,5	0,0078	2499	49,1	0,0077	2523	46,8	0,0076	2525	70,3	0,0074	2562	84,5	0,0071	2616	84,19	0,0071	2609	84,1	0,0074	2523			
2423	79,8	0,0073	2647	51,2	0,0072	2669	48,9	0,0071	2677	72,5	0,0069	2716	86,8	0,0066	2774	86,54	0,0067	2752	86,4	0,0069	2674			
2556	82,0	0,0068	2808	53,2	0,0067	2819	50,9	0,0066	2833	74,7	0,0065	2875	89,1	0,0062	2938	88,79	0,0062	2929	88,7	0,0065	2830			
2691	84,1	0,0064	2960	55,1	0,0063	2973	52,9	0,0062	2994	76,8	0,0061	3039	91,2	0,0058	3107	90,97	0,0058	3096	90,9	0,0061	2992			
2829	86,2	0,0060	3123	57,0	0,0060	3131	54,8	0,0058	3160	78,9	0,0057	3209	93,3	0,0054	3283	93,07	0,0055	3248	93,0	0,0057	3159			
2970	88,1	0,0056	3299	58,7	0,0056	3294	56,7	0,0054	3334	80,8	0,0053	3386	95,4	0,0050	3467	95,11	0,0051	3443	95,0	0,0053	3333			
3114	90,1	0,0053	3459	60,5	0,0053	3462	58,5	0,0051	3515	82,7	0,0050	3571	97,3	0,0047	3660	97,07	0,0048	3620	97,0	0,0050	3516			
3262	91,9	0,0050	3629	62,1	0,0050	3636	60,2	0,0048	3705	84,6	0,0046	3767	99,2	0,0044	3865	98,98	0,0044	3853	98,9	0,0046	3708			
3414	93,7	0,0046	3853	63,7	0,0047	3817	61,9	0,0044	3907	86,4	0,0043	3975	101,1	0,0041	4085	100,83	0,0041	4065	100,7	0,0043	3913			
3570	95,4	0,0043	4056	65,3	0,0044	4006	63,5	0,0041	4124	88,1	0,0040	4200	102,9	0,0038	4325	102,61	0,0038	4297	102,5	0,0040	4134			
3732	97,1	0,0040	4278	66,8	0,0041	4206	65,1	0,0038	4362	89,8	0,0037	4448	104,6	0,0034	4596	104,35	0,0035	4555	104,3	0,0037	4379			
3898	98,8	0,0038	4461	68,3	0,0039	4418	66,6	0,0035	4629	91,4	0,0034	4732	106,3	0,0031	4919	106,03	0,0032	4842	106,0	0,0034	4658			
4072	100,3	0,0035	4723	69,7	0,0036	4654	68,1	0,0032	4945	93,0	0,0030	5084	107,9	0,0027	5375	107,65	0,0028	5260	107,6	0,0030	5005			
4257	101,9	0,0031	5097	68,3	0,0005	12180	69,6	0,0028	5373	94,5	0,0025	5669							109,2	0,0025	5614			
4438				72,3	0,0031	5186																		
4658				73,5	0,0028	5533																		
4882																								
5126																								
5403																								
5738																								
7212																								

# 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 alphanumeric 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 alphanumeric 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:

- a. Refrigerant fluids in vapour or gaseous state belonging to Group 2:
  - HCFC (R22);
  - HFC (R134a, R404A, R407C, R410A, R507);
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B) with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008);
- b. Air and nitrogen (reference Directive: 2009/105/EC).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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;
- 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:

- 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](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access to the web-page and then click on the "START HERE" button. Now you are in the "CASTEL DOWNLOAD CENTER" and here 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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

## VALVE SELECTION

**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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

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

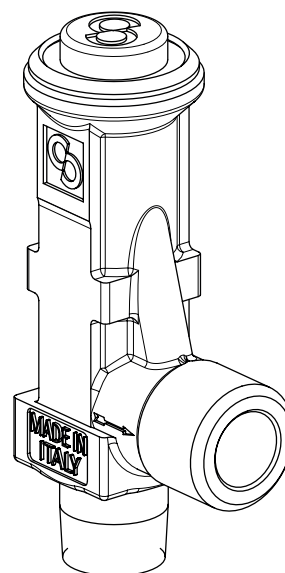
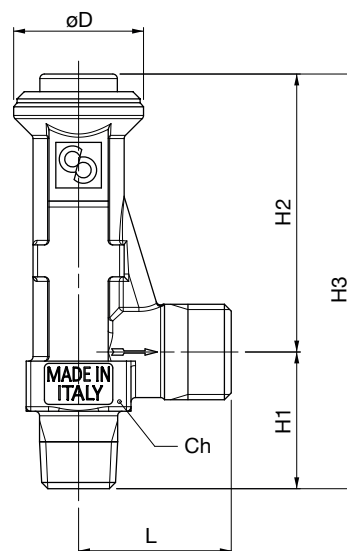


TABLE 12 : GENERAL CHARACTERISTICS OF VALVES 3061

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 [mm <sup>2</sup> ]		44,2	44,2	44,2
Lift [mm]		-	-	-
Discharge Coefficient K <sub>d</sub>		0,89	0,89	0,89
PS [bar]		70		
TS [°C]		- 50 / + 150		
Set Pressure Range at atmospheric back pressure P <sub>set</sub> [bar]		11 / 60		
Overpressure		+ 10 % of P <sub>set</sub>		
Blowdown		- 15 % of P <sub>set</sub>		
Helium tightness		- 20 % of P <sub>set</sub> (11 bar < Pset < 14 bar)		
		- 15 % of P <sub>set</sub> (14,1 bar < Pset < 24 bar)		
		- 10 % of P <sub>set</sub> (24,1 bar < Pset < 60 bar)		
Estimated service life		9 years		
Risk Category according to PED Recast		IV		

TABLE 13: DIMENSIONS AND WEIGHTS OF VALVES 3061

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	
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

TABLE 14: MAXIMUM DISCHARGE CAPACITY OF VALVES 3061

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	749	33,7	0,0179	702	27,0	0,0144	768	33,9	0,0175	700	16,5	0,0195	671	31,1	0,0172	707	31,0	0,0170
12,0	14,2	53,0	0,0139	815	36,9	0,0164	762	30,2	0,0132	837	36,9	0,0161	761	19,4	0,0179	729	34,1	0,0158	768	34,0	0,0156
13,0	15,3	56,0	0,0128	883	39,9	0,0151	823	33,1	0,0121	908	39,7	0,0148	823	22,1	0,0165	789	36,9	0,0145	832	36,9	0,0143
14,0	16,4	58,9	0,0118	951	42,8	0,0140	885	35,9	0,0111	979	42,4	0,0137	886	24,7	0,0153	849	39,6	0,0134	896	39,5	0,0133
15,0	17,5	61,7	0,0109	1021	45,5	0,0131	948	38,5	0,0103	1051	44,9	0,0127	950	27,2	0,0142	909	42,1	0,0125	958	42,1	0,0123
16,0	18,6	64,3	0,0102	1091	48,1	0,0122	1011	41,0	0,0095	1125	47,3	0,0119	1014	29,5	0,0133	971	44,6	0,0116	1025	44,5	0,0115
17,0	19,7	66,8	0,0095	1163	50,6	0,0115	1075	43,4	0,0089	1201	49,6	0,0111	1079	31,8	0,0124	1033	46,9	0,0108	1093	46,8	0,0107
18,0	20,8	69,2	0,0088	1236	53,0	0,0108	1139	45,7	0,0083	1278	51,8	0,0104	1145	33,9	0,0116	1096	49,1	0,0102	1156	49,1	0,0100
19,0	21,9	71,5	0,0083	1311	55,3	0,0101	1204	48,0	0,0077	1357	54,0	0,0098	1213	36,0	0,0109	1159	51,2	0,0095	1229	51,2	0,0094
20,0	23,0	73,7	0,0078	1387	57,5	0,0096	1271	50,1	0,0072	1439	56,0	0,0092	1281	37,9	0,0103	1224	53,3	0,0090	1294	53,2	0,0089
21,0	24,1	75,9	0,0073	1465	59,7	0,0090	1338	52,1	0,0068	1522	58,0	0,0087	1350	39,9	0,0097	1290	55,2	0,0085	1363	55,2	0,0083
22,0	25,2	77,9	0,0069	1545	61,7	0,0086	1406	54,1	0,0063	1608	59,9	0,0082	1421	41,7	0,0092	1356	57,1	0,0080	1437	57,1	0,0079
23,0	26,3	79,9	0,0065	1627	63,7	0,0081	1475	56,0	0,0059	1698	61,7	0,0077	1492	43,5	0,0087	1424	58,9	0,0075	1516	58,9	0,0074
24,0	27,4	81,9	0,0061	1711	65,7	0,0077	1545	57,9	0,0056	1790	63,4	0,0073	1566	45,2	0,0082	1493	60,7	0,0071	1590	60,7	0,0070
25,0	28,5	83,7	0,0057	1798	67,6	0,0073	1616	59,7	0,0052	1887	65,2	0,0069	1641	46,9	0,0078	1563	62,4	0,0067	1670	62,4	0,0066
26,0	29,6	85,6	0,0054	1888	69,4	0,0070	1689	61,4	0,0049	1988	66,8	0,0066	1717	48,5	0,0074	1635	64,1	0,0064	1741	64,1	0,0063
27,0	30,7	87,3	0,0051	1982	71,2	0,0066	1763	63,1	0,0045	2096	68,4	0,0062	1796	50,1	0,0071	1708	65,7	0,0060	1831	65,7	0,0060
28,0	31,8	89,0	0,0048	2079	72,9	0,0063	1838	64,7	0,0042	2211	70,0	0,0059	1876	51,6	0,0067	1783	67,2	0,0057	1912	67,2	0,0056
29,0	32,9	90,7	0,0045	2182	74,6	0,0060	1915	66,3	0,0039	2336	71,5	0,0056	1959	53,1	0,0064	1860	68,7	0,0054	1998	68,7	0,0053
30,0	34,0	92,3	0,0042	2290	76,2	0,0057	1994	67,8	0,0036	2475	72,9	0,0053	2044	54,6	0,0061	1938	70,2	0,0051	2090	70,2	0,0051
31,0	35,1	93,9	0,0039	2406	77,8	0,0055	2075	69,3	0,0033	2637	74,4	0,0051	2132	56,0	0,0058	2019	71,6	0,0049	2167	71,6	0,0048
32,0	36,2	95,4	0,0037	2532	79,4	0,0052	2158	70,7	0,0029	2845	75,7	0,0048	2224	57,4	0,0055	2102	73,0	0,0046	2271	73,0	0,0045
33,0	37,3	96,9	0,0034	2672	80,9	0,0050	2244	72,1	0,0022	3294	77,1	0,0045	2319	58,7	0,0052	2189	74,3	0,0043	2384	74,3	0,0043
34,0	38,4	98,3	0,0031	2836	82,4	0,0047	2332				78,4	0,0043	2419	60,1	0,0050	2278	75,6	0,0041	2478	75,6	0,0040
35,0	39,5	99,2	0,0029	2977	83,9	0,0045	2424				79,7	0,0041	2525	61,4	0,0047	2371	76,9	0,0038	2610	76,9	0,0037
36,0	40,6	99,5	0,0028	3052	85,3	0,0043	2519				80,9	0,0038	2638	62,6	0,0045	2468	78,1	0,0036	2719	78,1	0,0035
37,0	41,7	99,7	0,0028	3132	86,7	0,0041	2619				82,1	0,0036	2761	63,8	0,0042	2571	79,2	0,0033	2878	79,2	0,0032
38,0	42,8				88,0	0,0039	2724				83,2	0,0033	2896	65,0	0,0040	2681	80,3	0,0030	3058	80,3	0,0029
39,0	43,9				89,4	0,0037	2836				84,3	0,0031	3052	66,2	0,0038	2798				80,7	0,0019
40,0	45,0				90,7	0,0035	2957				85,3	0,0028	3246	67,4	0,0035	2928					
41,0	46,1				92,0	0,0032	3090				86,1	0,0024	3567	68,5	0,0033	3074					
42,0	47,2				93,2	0,0030	3242							69,6	0,0030	3248					
43,0	48,3				94,4	0,0028	3427							70,7	0,0027	3488					
44,0	49,4				95,6	0,0024	3705														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
711	55,2	0,0144	766	28,7	0,0140	776	25,8	0,0142	769	47,9	0,0139	780	61,4	0,0133	795	61,18	0,0134	791	61,1	0,0139	768			
773	58,5	0,0131	836	31,8	0,0128	845	28,9	0,0129	838	51,3	0,0127	850	64,9	0,0121	866	64,6	0,0122	863	64,5	0,0127	837			
836	61,7	0,0121	903	34,6	0,0118	915	31,9	0,0119	909	54,4	0,0116	921	68,1	0,0111	939	67,83	0,0112	935	67,7	0,0116	907			
901	64,6	0,0111	976	37,4	0,0109	986	34,7	0,0109	980	57,4	0,0107	994	71,1	0,0102	1013	70,89	0,0103	1009	70,8	0,0107	979			
966	67,5	0,0103	1047	39,9	0,0101	1058	37,3	0,0101	1053	60,2	0,0099	1067	74,1	0,0094	1089	73,8	0,0096	1080	73,7	0,0099	1051			
1031	70,1	0,0096	1118	42,4	0,0094	1131	39,8	0,0094	1127	62,9	0,0092	1143	76,8	0,0088	1166	76,57	0,0089	1156	76,5	0,0092	1126			
1098	72,7	0,0089	1195	44,7	0,0087	1205	42,2	0,0087	1203	65,4	0,0085	1220	79,5	0,0081	1245	79,22	0,0082	1240	79,1	0,0085	1201			
1166	75,2	0,0083	1271	47,0	0,0082	1281	44,5	0,0081	1280	67,9	0,0080	1299	82,0	0,0076	1326	81,76	0,0077	1315	81,7	0,0079	1279			
1235	77,5	0,0078	1346	49,1	0,0077	1358	46,8	0,0076	1360	70,3	0,0074	1379	84,5	0,0071	1409	84,19	0,0071	1405	84,1	0,0074	1358			
1305	79,8	0,0073	1426	51,2	0,0072	1437	48,9	0,0071	1441	72,5	0,0069	1462	86,8	0,0066	1494	86,54	0,0067	1482	86,4	0,0069	1440			
1376	82,0	0,0068	1512	53,2	0,0067	1518	50,9	0,0066	1525	74,7	0,0065	1548	89,1	0,0062	1582	88,79	0,0062	1577	88,7	0,0065	1524			
1449	84,1	0,0064	1594	55,1	0,0063	1601	52,9	0,0062	1612	76,8	0,0061	1636	91,2	0,0058	1673	90,97	0,0058	1667	90,9	0,0061	1611			
1523	86,2	0,0060	1682	57,0	0,0060	1686	54,8	0,0058	1702	78,9	0,0057	1728	93,3	0,0054	1768	93,07	0,0055	1749	93,0	0,0057	1701			
1599	88,1	0,0056	1777	58,7	0,0056	1774	56,7	0,0054	1795	80,8	0,0053	1823	95,4	0,0050	1867	95,11	0,0051	1854	95,0	0,0053	1795			
1677	90,1	0,0053	1862	60,5	0,0053	1864	58,5	0,0051	1893	82,7	0,0050	1923	97,3	0,0047	1971	97,07	0,0048	1949	97,0	0,0050	1893			
1757	91,9	0,0050	1954	62,1	0,0050	1958	60,2	0,0048	1995	84,6	0,0046	2028	99,2	0,0044	2081	98,98	0,0044	2075	98,9	0,0046	1997			
1838	93,7	0,0046	2075	63,7	0,0047	2055	61,9	0,0044	2104	86,4	0,0043	2140	101,1	0,0041	2199	100,83	0,0041	2189	100,7	0,0043	2107			
1923	95,4	0,0043	2184	65,3	0,0044	2157	63,5	0,0041	2221	88,1	0,0040	2262	102,9	0,0038	2329	102,61	0,0038	2314	102,5	0,0040	2226			
2009	97,1	0,0040	2303	66,8	0,0041	2265	65,1	0,0038	2349	89,8	0,0037	2395	104,6	0,0034	2475	104,35	0,0035	2453	104,3	0,0037	2358			
2099	98,8	0,0038	2402	68,3	0,0039	2379	66,6	0,0035	2492	91,4	0,0034	2548	106,3	0,0031	2649	106,03	0,0032	2607	106,0	0,0034	2508			
2192	100,3	0,0035	2543	69,7	0,0036	2506	68,1	0,0032	2663	93,0	0,0030	2738	107,9	0,0027	2894	107,65	0,0028	2832	107,6	0,0030	2695			
2292	101,9	0,0031	2745	68,3	0,0005	6559	69,6	0,0028	2893	94,5	0,0025	3053							109,2	0,0025	3023			
2390				72,3	0,0031	2793																		
2508				73,5	0,0028	2980																		
2629																								
2760																								
2909																								
3090																								
3884																								



# 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 alphanumeric 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 alphanumeric 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:

- a. Refrigerant fluids in vapour or gaseous state belonging to Group 2:
  - HCFC (R22);
  - HFC (R134a, R404A, R407C, R410A, R507);
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B) with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008);
- b. Air and nitrogen (reference Directive: 2009/105/EC).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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;
- 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:

- 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](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access to the web-page and then click on the "START HERE" button. Now you are in the "CASTEL DOWNLOAD CENTER" and here 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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

## VALVE SELECTION

**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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

3065/4C  
3065/6C

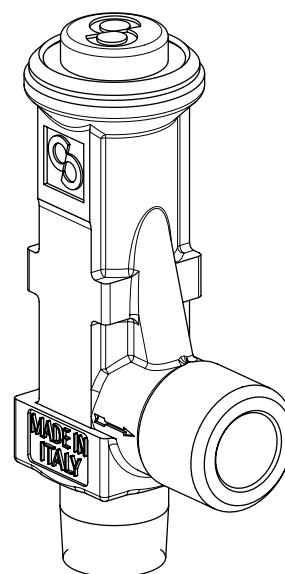
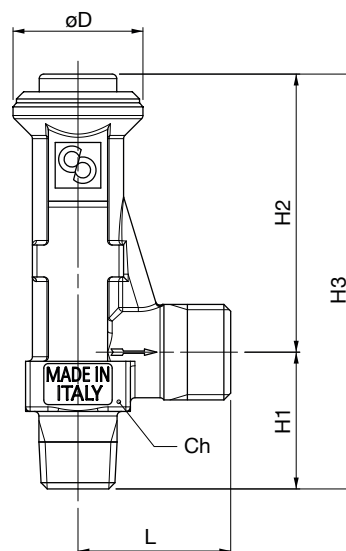


TABLE 15 : GENERAL CHARACTERISTICS OF VALVES 3065

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 [mm <sup>2</sup> ]		132,7	132,7
Lift [mm]		6,3	6,3
Discharge Coefficient $K_d$		0,87	0,87
PS [bar]		70	
TS [°C]		- 50 / + 150	
Set Pressure Range at atmospheric back pressure $P_{set}$ [bar]		11 / 60	
Overpressure		+ 10 % of $P_{set}$	
Blowdown		- 15 % of $P_{set}$	
Helium tightness		- 20 % of $P_{set}$ (11 bar < $P_{set}$ < 18,5 bar)	
		- 15 % of $P_{set}$ (18,6 bar < $P_{set}$ < 31 bar)	
		- 10 % of $P_{set}$ (31,1 bar < $P_{set}$ < 60 bar)	
Estimated service life		9 years	
Risk Category according to PED Recast		IV	

TABLE 16: DIMENSIONS AND WEIGHTS OF VALVES 3065

Catalogue Number	Dimensions [mm]						Weight [g]
	Ø D	L	Ch	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	
3065/4C	38,5	40	32	40	72	112	520
3065/6C	38,5	40	32	40	72	112	520

TABLE 17: MAXIMUM DISCHARGE CAPACITY OF VALVES 3065

P <sub>set</sub> [bar]	P <sub>0</sub> [barsass]	R134a			R22			R404A			R407C			R410A			R448A			R449A	
		k	1,12		k	1,17		k	1,12		k	1,14		k	1,17		k	1,14		k	1,14
		C	2,50		C	2,54		C	2,50		C	2,51		C	2,54		C	2,51		C	2,51
		T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>0</sub> [°C]	V <sub>0</sub> sat [mc/kg]
11,0	13,1	49,8	0,0152	2200	33,7	0,0179	2061	27,0	0,0144	2257	33,9	0,0175	2056	16,5	0,0195	1970	31,1	0,0172	2075	31,0	0,0170
12,0	14,2	53,0	0,0139	2395	36,9	0,0164	2239	30,2	0,0132	2460	36,9	0,0161	2236	19,4	0,0179	2143	34,1	0,0158	2254	34,0	0,0156
13,0	15,3	56,0	0,0128	2593	39,9	0,0151	2419	33,1	0,0121	2666	39,7	0,0148	2418	22,1	0,0165	2317	36,9	0,0145	2443	36,9	0,0143
14,0	16,4	58,9	0,0118	2794	42,8	0,0140	2600	35,9	0,0111	2875	42,4	0,0137	2603	24,7	0,0153	2493	39,6	0,0134	2631	39,5	0,0133
15,0	17,5	61,7	0,0109	2998	45,5	0,0131	2784	38,5	0,0103	3088	44,9	0,0127	2789	27,2	0,0142	2671	42,1	0,0125	2814	42,1	0,0123
16,0	18,6	64,3	0,0102	3206	48,1	0,0122	2969	41,0	0,0095	3306	47,3	0,0119	2978	29,5	0,0133	2851	44,6	0,0116	3011	44,5	0,0115
17,0	19,7	66,8	0,0095	3417	50,6	0,0115	3156	43,4	0,0089	3528	49,6	0,0111	3170	31,8	0,0124	3033	46,9	0,0108	3212	46,8	0,0107
18,0	20,8	69,2	0,0088	3632	53,0	0,0108	3346	45,7	0,0083	3755	51,8	0,0104	3364	33,9	0,0116	3218	49,1	0,0102	3396	49,1	0,0100
19,0	21,9	71,5	0,0083	3851	55,3	0,0101	3538	48,0	0,0077	3987	54,0	0,0098	3562	36,0	0,0109	3405	51,2	0,0095	3611	51,2	0,0094
20,0	23,0	73,7	0,0078	4075	57,5	0,0096	3732	50,1	0,0072	4226	56,0	0,0092	3762	37,9	0,0103	3595	53,3	0,0090	3802	53,2	0,0089
21,0	24,1	75,9	0,0073	4304	59,7	0,0090	3929	52,1	0,0068	4471	58,0	0,0087	3966	39,9	0,0097	3788	55,2	0,0085	4004	55,2	0,0083
22,0	25,2	77,9	0,0069	4538	61,7	0,0086	4129	54,1	0,0063	4724	59,9	0,0082	4173	41,7	0,0092	3984	57,1	0,0080	4221	57,1	0,0079
23,0	26,3	79,9	0,0065	4779	63,7	0,0081	4332	56,0	0,0059	4986	61,7	0,0077	4384	43,5	0,0087	4183	58,9	0,0075	4453	58,9	0,0074
24,0	27,4	81,9	0,0061	5027	65,7	0,0077	4538	57,9	0,0056	5258	63,4	0,0073	4599	45,2	0,0082	4386	60,7	0,0071	4672	60,7	0,0070
25,0	28,5	83,7	0,0057	5282	67,6	0,0073	4747	59,7	0,0052	5542	65,2	0,0069	4819	46,9	0,0078	4592	62,4	0,0067	4905	62,4	0,0066
26,0	29,6	85,6	0,0054	5547	69,4	0,0070	4961	61,4	0,0049	5840	66,8	0,0066	5044	48,5	0,0074	4803	64,1	0,0064	5114	64,1	0,0063
27,0	30,7	87,3	0,0051	5821	71,2	0,0066	5178	63,1	0,0045	6156	68,4	0,0062	5274	50,1	0,0071	5017	65,7	0,0060	5379	65,7	0,0060
28,0	31,8	89,0	0,0048	6107	72,9	0,0063	5400	64,7	0,0042	6494	70,0	0,0059	5510	51,6	0,0067	5237	67,2	0,0057	5617	67,2	0,0056
29,0	32,9	90,7	0,0045	6408	74,6	0,0060	5626	66,3	0,0039	6861	71,5	0,0056	5753	53,1	0,0064	5463	68,7	0,0054	5870	68,7	0,0053
30,0	34,0	92,3	0,0042	6726	76,2	0,0057	5858	67,8	0,0036	7270	72,9	0,0053	6004	54,6	0,0061	5693	70,2	0,0051	6140	70,2	0,0051
31,0	35,1	93,9	0,0039	7067	77,8	0,0055	6096	69,3	0,0033	7747	74,4	0,0051	6263	56,0	0,0058	5931	71,6	0,0049	6365	71,6	0,0048
32,0	36,2	95,4	0,0037	7436	79,4	0,0052	6340	70,7	0,0029	8358	75,7	0,0048	6532	57,4	0,0055	6175	73,0	0,0046	6671	73,0	0,0045
33,0	37,3	96,9	0,0034	7849	80,9	0,0050	6591	72,1	0,0022	9674	77,1	0,0045	6812	58,7	0,0052	6428	74,3	0,0043	7004	74,3	0,0043
34,0	38,4	98,3	0,0031	8329	82,4	0,0047	6851				78,4	0,0043	7107	60,1	0,0050	6691	75,6	0,0041	7278	75,6	0,0040
35,0	39,5	99,2	0,0029	8744	83,9	0,0045	7120				79,7	0,0041	7418	61,4	0,0047	6964	76,9	0,0038	7667	76,9	0,0037
36,0	40,6	99,5	0,0028	8966	85,3	0,0043	7400				80,9	0,0038	7749	62,6	0,0045	7251	78,1	0,0036	7986	78,1	0,0035
37,0	41,7	99,7	0,0028	9199	86,7	0,0041	7693				82,1	0,0036	8109	63,8	0,0042	7552	79,2	0,0033	8453	79,2	0,0032
38,0	42,8				88,0	0,0039	8002				83,2	0,0033	8507	65,0	0,0040	7874	80,3	0,0030	8982	80,3	0,0029
39,0	43,9				89,4	0,0037	8331				84,3	0,0031	8965	66,2	0,0038	8220				80,7	0,0019
40,0	45,0				90,7	0,0035	8686				85,3	0,0028	9536	67,4	0,0035	8600					
41,0	46,1				92,0	0,0032	9077				86,1	0,0024	10476	68,5	0,0033	9029					
42,0	47,2				93,2	0,0030	9522							69,6	0,0030	9541					
43,0	48,3				94,4	0,0028	10066							70,7	0,0027	10246					
44,0	49,4				95,6	0,0024	10882														
45,0	50,5																				
46,0	51,6																				
47,0	52,7																				
48,0	53,8																				
49,0	54,9																				
50,0	56,0																				
51,0	57,1																				
52,0	58,2																				
53,0	59,3																				
54,0	60,4																				
55,0	61,5																				
56,0	62,6																				
57,0	63,7																				
58,0	64,8																				
59,0	65,9																				
60,0	67,0																				

		R450A			R452A			R507			R513A			R515A			R515B			R1234ze				
		k	1,1		k	1,1		k	1,10		k	1,11		k	1,10		k	1,10		k	1,07			
		C	2,49		C	2,49		C	2,48		C	2,49		C	2,48		C	2,48		C	2,45			
Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]	T <sub>o</sub> [°C]	V <sub>o</sub> sat [mc/kg]	Q <sub>m</sub> [kg/h]
2087	55,2	0,0144	2250	28,7	0,0140	2279	25,8	0,0142	2260	47,9	0,0139	2290	61,4	0,0133	2334	61,18	0,0134	2323	61,1	0,0139	2256			
2271	58,5	0,0131	2456	31,8	0,0128	2482	28,9	0,0129	2463	51,3	0,0127	2496	64,9	0,0121	2545	64,6	0,0122	2535	64,5	0,0127	2459			
2457	61,7	0,0121	2653	34,6	0,0118	2687	31,9	0,0119	2669	54,4	0,0116	2705	68,1	0,0111	2759	67,83	0,0112	2746	67,7	0,0116	2665			
2645	64,6	0,0111	2867	37,4	0,0109	2895	34,7	0,0109	2879	57,4	0,0107	2918	71,1	0,0102	2976	70,89	0,0103	2965	70,8	0,0107	2875			
2836	67,5	0,0103	3075	39,9	0,0101	3106	37,3	0,0101	3093	60,2	0,0099	3135	74,1	0,0094	3198	73,8	0,0096	3172	73,7	0,0099	3088			
3029	70,1	0,0096	3284	42,4	0,0094	3321	39,8	0,0094	3311	62,9	0,0092	3357	76,8	0,0088	3425	76,57	0,0089	3397	76,5	0,0092	3306			
3226	72,7	0,0089	3510	44,7	0,0087	3540	42,2	0,0087	3533	65,4	0,0085	3583	79,5	0,0081	3656	79,22	0,0082	3642	79,1	0,0085	3529			
3425	75,2	0,0083	3735	47,0	0,0082	3763	44,5	0,0081	3761	67,9	0,0080	3815	82,0	0,0076	3894	81,76	0,0077	3862	81,7	0,0079	3757			
3627	77,5	0,0078	3953	49,1	0,0077	3990	46,8	0,0076	3994	70,3	0,0074	4052	84,5	0,0071	4137	84,19	0,0071	4127	84,1	0,0074	3990			
3833	79,8	0,0073	4187	51,2	0,0072	4222	48,9	0,0071	4234	72,5	0,0069	4296	86,8	0,0066	4388	86,54	0,0067	4353	86,4	0,0069	4230			
4043	82,0	0,0068	4441	53,2	0,0067	4459	50,9	0,0066	4481	74,7	0,0065	4547	89,1	0,0062	4646	88,79	0,0062	4632	88,7	0,0065	4477			
4256	84,1	0,0064	4681	55,1	0,0063	4702	52,9	0,0062	4735	76,8	0,0061	4806	91,2	0,0058	4914	90,97	0,0058	4898	90,9	0,0061	4732			
4474	86,2	0,0060	4939	57,0	0,0060	4952	54,8	0,0058	4999	78,9	0,0057	5075	93,3	0,0054	5192	93,07	0,0055	5138	93,0	0,0057	4997			
4697	88,1	0,0056	5218	58,7	0,0056	5210	56,7	0,0054	5273	80,8	0,0053	5355	95,4	0,0050	5483	95,11	0,0051	5446	95,0	0,0053	5272			
4925	90,1	0,0053	5470	60,5	0,0053	5475	58,5	0,0051	5559	82,7	0,0050	5648	97,3	0,0047	5788	97,07	0,0048	5725	97,0	0,0050	5561			
5159	91,9	0,0050	5740	62,1	0,0050	5750	60,2	0,0048	5860	84,6	0,0046	5958	99,2	0,0044	6113	98,98	0,0044	6094	98,9	0,0046	5865			
5400	93,7	0,0046	6094	63,7	0,0047	6037	61,9	0,0044	6180	86,4	0,0043	6287	101,1	0,0041	6460	100,83	0,0041	6429	100,7	0,0043	6189			
5647	95,4	0,0043	6415	65,3	0,0044	6336	63,5	0,0041	6523	88,1	0,0040	6643	102,9	0,0038	6841	102,61	0,0038	6797	102,5	0,0040	6539			
5902	97,1	0,0040	6766	66,8	0,0041	6652	65,1	0,0038	6899	89,8	0,0037	7035	104,6	0,0034	7269	104,35	0,0035	7204	104,3	0,0037	6926			
6165	98,8	0,0038	7056	68,3	0,0039	6988	66,6	0,0035	7321	91,4	0,0034	7485	106,3	0,0031	7780	106,03	0,0032	7659	106,0	0,0034	7368			
6440	100,3	0,0035	7471	69,7	0,0036	7360	68,1	0,0032	7821	93,0	0,0030	8042	107,9	0,0027	8502	107,65	0,0028	8319	107,6	0,0030	7916			
6733	101,9	0,0031	8061	68,3	0,0005	19265	69,6	0,0028	8498	94,5	0,0025	8967							109,2	0,0025	8880			
7019				72,3	0,0031	8203																		
7368				73,5	0,0028	8752																		
7721																								
8107																								
8545																								
9076																								
11407																								

# SAFETY DEVICES

## 4.5 – 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:

$$Q_{md} = (3600 \cdot \phi \cdot A_{surf}) / h_{vap} \quad [\text{kg/h}]$$

where:

- $\phi$  = density of heat flow rate, assumed to be 10 [kW/m<sup>2</sup>];
- $A_{surf}$  = external surface area of the vessel [m<sup>2</sup>];
- $h_{vap}$  = latent heat of vaporization of liquid at  $p_o = 1,1 \times p_{set}$  [kJ/kg]:
  - If  $p_o$  is higher than 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 heat impact.

- **Internal heat sources** (Para. 6.2.2 - EN 13136:2013+A1). The minimum required discharge capacity is determined by the following formula:  $Q_{md} = (3600 \cdot Q_h) / h_{vap}$  [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:  $Q_{md} = 60 \cdot V \cdot n \cdot \rho_{10} \cdot \eta_v$  [kg/h]

where:

- $V$  = theoretical displacement of compressor [m<sup>3</sup>]
- $n$  = rotational frequency of compressor [min<sup>-1</sup>]
- $\rho_{10}$  = vapour density of refrigerant, from the saturation curve at a temperature of 10 °C [kg/m<sup>3</sup>].

Table 18 provides the values of  $\rho_{10}$  for:

- Traditional HCFC and HFC refrigerants most commonly used;
- New HFO and HFC/HFO blend refrigerants;
- $\eta_v$  = volumetric efficiency of the compressor, estimated at suction pressure and discharge pressure equivalent to the safety valve setting.

### 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:

$$p_b \leq p_o \cdot \left| \frac{2}{k+1} \right|^{\frac{k}{k-1}} \quad [\text{bar abs}]$$

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:

$p_{critical} = 0.5 \cdot p_o$  [bar abs]. A valve that discharges to the atmosphere, is under in critical flow conditions.

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.

$$Q_m = 0.2883 \cdot C \cdot A \cdot 0.9 \cdot K_d \cdot \sqrt{\frac{p_o}{V_o}} \quad [\text{kg/h}]$$

where:

- $Q_m$  = calculated mass flow rate of safety valve [kg/h]
- $A$  = calculated flow area of the safety valve [mm<sup>2</sup>]

This formula was used to calculate the maximum discharge flow of the safety valves shown in:

- Table 3-4 for valves in series 3030;
- Tables 7-11 for valves series 3060;
- Table 14 for valves in series 3061;
- Table 17 for valves in series 3065.

If  $Q_{md} < Q_m < 1.25 \cdot Q_{md} \rightarrow Q_{md}' = Q_{md}$

If  $Q_m > 1.25 \cdot Q_{md} \rightarrow Q_{md}' = Q_m / 1.25$

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:

$$A_c = 3.469 \cdot \frac{Q_{md}'}{C \cdot 0.9 \cdot K_d} \cdot \sqrt{\frac{V_o}{p_o}} \quad [\text{mm}^2]$$





3061/4C100 PSet=10,0 bar  
1234567  
A=0,441 cm<sup>2</sup> 12/15

PS 70

3065/4C100 PSet=10,0 bar  
1234567  
A=1,326 cm<sup>2</sup> 12/15

PG 15

PS 70

where:

- $K_d$  = 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:

$$A_c = 3.948 \cdot \sqrt{k \cdot \left| \frac{2}{k+1} \right|^{\frac{(k+1)}{(k-1)}}} \quad [\text{bar abs}]$$

For this calculation, the value of  $k$  refers to a temperature of 25°C. (Para. 7.2.3, EN 13136:2013+A1 standard).

Table 18 provides the  $k$  and  $C$  values for:

- Traditional HCFC and HFC refrigerants most commonly used;
- New HFO and HFC/HFO blend refrigerants.

## 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,  $p_o$ , 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  $p_o$ , for unbalanced, conventional valves. 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:

$$\Delta p_{in} = 0.032 \cdot \left[ \frac{A_c}{A_{in}} \cdot C \cdot K_{dr} \right]^2 \cdot \zeta \cdot p_o \quad [\text{bar}]$$

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 [ $mm^2$ ];
- $K_{dr} = K_d \times 0.9$ , reduced discharge coefficient;
- $C$  = expansion rate as a function of the  $k$  coefficient in the isentropic equation for the refrigerant fluid;
- $\zeta$  = sum of the of pressure loss coefficients  $\xi_n$  of the individual components and piping. The coefficients  $\xi_n$  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:**

$$\Delta p_{in} \leq 0.03 \cdot p_o \dots \quad [\text{bar}]$$

### 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:

$$\Delta p_{out} \leq p_1 - p_o \dots \quad [\text{bar}]$$

$$p_1 = \sqrt{0.064 \cdot \zeta \cdot \left( \frac{A_c}{A_{out}} \cdot C \cdot K_{dr} \cdot p_o \right)^2 + p_2^2} \quad [\text{bar abs}]$$

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 [ $mm^2$ ];
- $K_{dr} = K_d \times 0.9$ , 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];
- $\zeta$  = sum of the of pressure loss coefficients  $\zeta_n$  of the piping
  - The coefficients  $\zeta_n$  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:**

$$\Delta p_{in} \leq 0.10 \cdot p_o \dots \quad [\text{bar}]$$

## EXAMPLE 1

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

### Compressor data

• Bore:	82.5 mm
• Stroke:	69.8 mm
• Number of cylinders:	4
• Rotational frequency:	1450 rpm
• Clearance:	4%
• Refrigerant fluid:	R407C

The theoretical displacement of the compressor is:

$$V = \frac{\pi}{4} \cdot 0.0825^2 \cdot 0.0698 \cdot 4 = 0.00149 \quad [m^3]$$



Maximum allowable pressure of the liquid condenser/receiver: PS = 25 bar

Set pressure of the safety valve installed on the upper crown of the condenser housing:  $p_{set} = 25$  bar

$$p_0 = p_{set} \cdot \left(1 + \frac{10}{100}\right) + 1 = 28,5 \quad [\text{bar abs}]$$

Operating conditions of compressor at the safety valve discharge:

- Condensation temperature: +65.2 °C (28.5 bar abs);
- Evaporation temperature: +10 °C (6.33 bar abs).

These conditions, defined by the designer, are assumed to be the most unfavourable for the safety valve due to operating faults such as:

- Movement errors;
- Non-operation of automatic safety devices that should have been triggered prior to the safety valve due to failures or other reasons.

For cautionary reasons, ignoring the vapour overheating at the outlet of the evaporator, the volumetric efficiency of compressor is:

$$\eta_v = 1 - 0.04 \cdot \frac{p_{discharge}}{p_{suction}} = 1 - 0.04 \cdot \frac{28.5}{6.33} = 0.82$$

and the minimum required discharge capacity is:

$$Q_{md} = 60 \cdot V \cdot n \cdot \rho_{10} \cdot \eta_v = 60 \cdot 0.00149 \cdot 1450 \cdot 27.45 \cdot 0.82 = 2918 \quad [\text{kg/h}]$$

where  $\rho_{10} = 27.45$  [kg/m<sup>3</sup>], saturated vapour density of R407C at a temperature of 10 °C.

Choosing a safety valve in series 3065 its mass flow rate:

$$Q_m = 0.2883 \cdot C \cdot A \cdot 0.9 \cdot K_d \cdot \sqrt{\frac{p_0}{v_0}} = 0.2883 \cdot 2.51 \cdot 132.7 \cdot 0.9 \cdot 0.87 \cdot \sqrt{\frac{28.5}{0.0069}} = 4832 \quad [\text{kg/h}]$$

where:

- C = 2.51, corresponding to k exponent for R407C, equal to 1.14, according to Table 18;
- K<sub>d</sub> = 0.87, certified discharge ratio of safety valve 3065/4;
- v<sub>0</sub> = 0.0069 [m<sup>3</sup>/kg], specific volume of the saturated vapour upstream of the safety valve during operation.

This value refers to the following operating conditions upstream of the valve:

- Pressure, p<sub>0</sub> = 28.5 [bar abs];
- Temperature, T<sub>0</sub> = 65.2 [°C].

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

$$Q_m > 1.25 \cdot Q_{md} = 4832 > 1.25 \cdot 2918 \rightarrow Q_{md'} = \frac{4832}{1.25} = 3865 \quad [\text{kg/h}]$$

The flow area A<sub>c</sub> calculated with the adjusted discharge capacity Q<sub>md'</sub> is:

$$A_c = 3.469 \cdot \frac{Q_{md'}}{C \cdot 0.9 \cdot K_d} \cdot \sqrt{\frac{v_0}{p_0}} = 3.469 \cdot \frac{3865}{2.51 \cdot 0.9 \cdot 0.87} \cdot \sqrt{\frac{0.0069}{28.5}} = 106 \quad [\text{mm}^2]$$

### Verification of the system upstream the safety valve

Assuming the valve installed is 3065/4C250, using a steel fitting with the following characteristics:

- d<sub>in</sub> = 17 [mm], fitting inside diameter;
- A<sub>in</sub> = 227 [mm<sup>2</sup>] fitting inside cross-section area;
- L = 60 [mm], fitting length;
- Condenser connection: Flush with the housing and with a sharp edge.

The following information is taken from Table A.4 in standard EN 13136:2013+A1:

- ξ<sub>1</sub> (inlet) = 0.25;
- ξ<sub>2</sub> (length) = λ x L/ d<sub>in</sub> = 0.02 x 60/17 = 0.07;
- with λ = 0.02 for steel pipe;
- ξ<sub>T</sub> = ξ<sub>1</sub> + ξ<sub>2</sub> = 0.25 + 0.07 = 0.32.

Between the safety valve and the steel fitting, a shut-off valve type 3064N/44 is installed.

The main characteristics of this valve are:

- d<sub>R</sub> = 13 [mm], inside valve diameter;
- A<sub>R</sub> = 132.7 [mm<sup>2</sup>], inside valve cross-section area;
- K<sub>v</sub> = 10 [m<sup>3</sup>/h], valve kv coefficient.

The pressure loss coefficient ξ<sub>R</sub> of the shut-off valve is given by:

$$\zeta_R = 2.592 \cdot \left[\frac{132.7}{10}\right]^2 \cdot 10^{-3} = 0.45$$

Total loss coefficient: ξ<sub>T</sub> + ξ<sub>R</sub> = 0.77

Recalling the previously calculated flow area A<sub>c</sub>, the characteristics of safety valve 3065/4 and refrigerant fluid R407C:

- A<sub>c</sub> = 106 [mm<sup>2</sup>];
- K<sub>dr</sub> = 0.89 x 0.9 = 0.801;
- C = 2.51.

The pressure loss is given by:

$$\frac{\Delta p_{in}}{p_0} = 0.032 \cdot \left[\frac{106}{227} \cdot 2.51 \cdot 0.801\right]^2 \cdot 0.77 = 0.022$$

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 3065/4C250, using 1" gas pipe with the following characteristics:

- d<sub>out</sub> = 30 [mm], inside pipe diameter;
- A<sub>out</sub> = 707 [mm<sup>2</sup>], 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:

- ξ<sub>1</sub> (elbow) = 0.25
- ξ<sub>2</sub> (length) = λ x L/ d<sub>out</sub> = 0.02 x 3000/30 = 2, where λ = 0.02 for steel pipe
- ξ<sub>T</sub> = ξ<sub>1</sub> + ξ<sub>2</sub> = 0.25 + 2 = 2.25

The pressure loss is given by:

$$p_1 = \sqrt{0.064 \cdot 2.25 \cdot \left[\left(\frac{106}{707}\right) 2.51 \cdot 0.801 \cdot 28.5\right]^2 + 1^2} = 3.41 [\text{bar}]$$

$$= \frac{\Delta p_{out}}{p_0} = \frac{3.41-1}{28.5} = 0.086 \quad [\text{mm}^2]$$

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

## EXAMPLE 2

### Calculation of the flow rate ( $Q_{md}$ ) and selection of the safety valve (Increased pressure caused by internal heat source).

#### Data for the liquid receiver

- Refrigerant fluid R404A
- Pressure equipment 300 l liquid receiver
- External surface area of the vessel 3.2 m<sup>2</sup>
- PS of the vessel 28 bar

Calculation of the valve discharge pressure is:

$$p_0 = (p_{set} \cdot 1.1) + 1 = (28 \cdot 1.1) + 1 = 31.8 \text{ [bar abs]}$$

Calculation of the minimum required discharge capacity for the external heat source considering that there are flammable substances in such quantities as to feed a fire near the vessel to be protected.

$$Q_{md} = \frac{3600 \cdot \phi \cdot A_{surf}}{h_{vap}} = \frac{3600 \cdot 10 \cdot 3.2}{67.28} = 1712 \text{ [kg/h]}$$

where:

- $\phi$  = density of heat flow rate, assumed to be 10 [kW/m<sup>2</sup>];
- $A_{surf}$  = external surface area of the vessel [m<sup>2</sup>];
- $h_{vap}$  = latent heat of vaporization of R404A at pressure,  $p_0$  [kJ/kg];

Choosing a safety valve in series 3061 its mass flow rate:

$$Q_m = 0.2883 \cdot C \cdot A \cdot 0.9 \cdot K_d \cdot \sqrt{\frac{p_0}{v_0}} =$$

$$= 0.2883 \cdot 2.5 \cdot 44.2 \cdot 0.9 \cdot 0.89 \cdot \sqrt{\frac{31.8}{0.0042}} = 2220 \text{ [kg/h]}$$

where:

- $C = 2.5$ , corresponding to  $k$  exponent for R404A, equal to 1.12, according to Table 18;
- $K_d = 0.89$ , certified discharge ratio of safety valve 3061/4;
- $v_0 = 0.0042$  [m<sup>3</sup>/kg], specific volume of the saturated vapour upstream of the safety valve during operation. This value refers to the following operating conditions upstream of the valve:
  - Pressure,  $p_0 = 31.8$  [bar abs];
  - Temperature,  $T_0 = 64.7$  [°C].

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

$$Q_m > 1.25 \cdot Q_{md} =$$

$$= 2220 > 1.25 \cdot 1712 \rightarrow Q_{md}' = \frac{2220}{1.25} = 1776 \text{ [kg/h]}$$

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

$$A_c = 3.469 \cdot \frac{Q_{md}'}{C \cdot 0.9 \cdot K_d} \cdot \sqrt{\frac{v_0}{p_0}} =$$

$$= 3.469 \cdot \frac{1776}{2.5 \cdot 0.9 \cdot 0.89} \cdot \sqrt{\frac{0.0042}{31.8}} = 35.4 \text{ [mm}^2\text{]}$$

#### 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<sup>2</sup>] fitting inside cross-section area;
- $L = 60$  [mm], fitting length;
- Receiver connection: Flush with the housing and with a sharp edge.

The following information is taken from Table A.4 in standard EN 13136:2013+A1:

- $\xi_1$  (inlet) = 0,25;
- $\xi_2$  (length) =  $\lambda \times L / d_{in} = 0,02 \times 60 / 17 = 0,07$ ;
- with  $\lambda = 0,02$  for steel pipe;
- $\xi_T = \xi_1 + \xi_2 = 0,25 + 0,07 = 0.32$ .

Between the valve and the fitting, an exchange valve (type 3032N/44) has been installed.

The main characteristics of this valve are:

- $d_R = 13$  [mm], inside valve diameter;
- $A_R = 132.7$  [mm<sup>2</sup>], inside valve cross-section area;
- $K_V = 3.3$  [m<sup>3</sup>/h], valve kv coefficient.

The pressure loss coefficient  $\xi_R$  of the shut-off valve is given by:

$$\xi_R = 2.592 \cdot \left[ \frac{132.7}{3.3} \right]^2 \cdot 10^{-3} = 4.19$$

Total loss coefficient:  $\xi_T + \xi_R = 4.51$

Recalling the previously calculated cross-section, the characteristics of safety valve 3061/4 and refrigerant fluid R404A:

- $A_c = 35,4$  [mm<sup>2</sup>];
- $K_{dr} = 0.89 \times 0.9 = 0.801$ ;
- $C = 2.50$ .

The pressure loss is given by:

$$\frac{\Delta p_{in}}{p_0} = 0.032 \cdot \left[ \frac{35.4}{227} \cdot 2.50 \cdot 0.801 \right]^2 \cdot 4.51 = 0.014$$

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

TABLE 18: EXPONENT K OF THE ISOENTROPIC EQUATION. EXPANSION COEFFICIENT C. VAPOUR DENSITY  $\rho$

Refrigerants	R134a	R22	R404A	R407C	R410A	R448A	R449A	R450A	R452A	R507	R513A	R515A	R515B	R1234ze
k	1,12	1,17	1,12	1,14	1,17	1,14	1,14	1,11	1,11	1,10	1,11	1,10	1,10	1,07
C	2,50	2,54	2,50	2,51	2,54	2,51	2,51	2,49	2,49	2,48	2,49	2,48	2,48	2,45
$\rho$ [kg/m <sup>3</sup> ]	20,23	28,82	41,66	27,45	41,92	30,63	31,11	18,49	40,62	44,03	23,86	17,09	16,92	16,45



# SAFETY DEVICES

## 4.6 – BURSTING DISC DEVICES

### GENERAL DESCRIPTION

The devices 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

**Device piping:** it is manufactured in two halves, screwed together, that contain the bursting disc assembly. 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 disc assembly:** it is 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 assembly is manufactured from a calibrated gauge of nickel sheet (the disc) and a copper ring case (the holder).

### 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 devices in series 3070 can be used with:

- a. Refrigerant fluids in vapour or gaseous state belonging to Group 2:
  - HCFC (R22);
  - HFC (R134a, R404A, R407C, R410A, R507)
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B) with reference to

Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008);

- b. Air and nitrogen (reference Directive: 2009/105/EC).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EC, 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;
- Compliance Statement 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 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 ( $P_b$ ), 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 19 for temperature adjustment factors for  $P_b$ .

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 4.5.

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.

$$Q_m = 0.2883 \cdot C \cdot A \cdot 0.9 \cdot K_{dr} \cdot \sqrt{\frac{p_0}{V_0}} =$$

where:

- $A$  = calculated flow area of the bursting disc [ $\text{mm}^2$ ];
- $K_{dr}$  = 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:  $K_{dr} = 0.55$ .

- 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 4.5 "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 " $F_d$ ". According to EN ISO 4126-3: 2006, this coefficient is the ratio of the average of the discharge coefficients (" $K_d$ ") of the combination, measured in test bench flow rate tests, to the certified discharge coefficient (" $K_d$ ") of the safety valve alone. The same standard also permits, as an alternative to the tests to determine " $K_d$ " of the group, the use of a predefined discharge coefficient (" $F_d$ "), 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 4.5, but multiply the certified coefficient of discharge (" $K_d$ ") 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 Paragraph 4.5 "Selection Criteria for Safety Valves" in this technical handbook.

307044/C

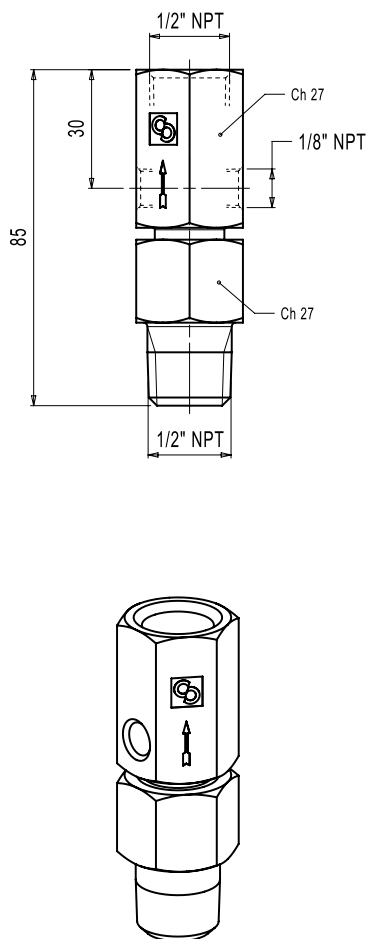


TABLE 19: GENERAL CHARACTERISTICS OF RUPTURE DISCS 3070

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 [mm <sup>2</sup> ]		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
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

## 4.7 – CHANGEOVER VALVES

### APPLICATIONS

Changeover valves in series 3032 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 3032/33 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 3032/44 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: 3032/64, 3032/66, 3032/88, 3032/108 have not threaded connections with swivel nuts on the outlet connection. Therefore, safety valves are screwed directly onto the changeover valve.

The valves in series 3032 can be used with the same fluids foreseen for the safety valves, specifically:

- HCFC (R22);

- HFC (R134a, R404A, R407C, R410A, R507);
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B).

### CONSTRUCTION

Valves in series 3032 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 3032 are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body;
- Steel, with proper surface protection, for the spindle;
- Chloroprene rubber (CR) for outlet seal gaskets in valves series 3032N;
- 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.

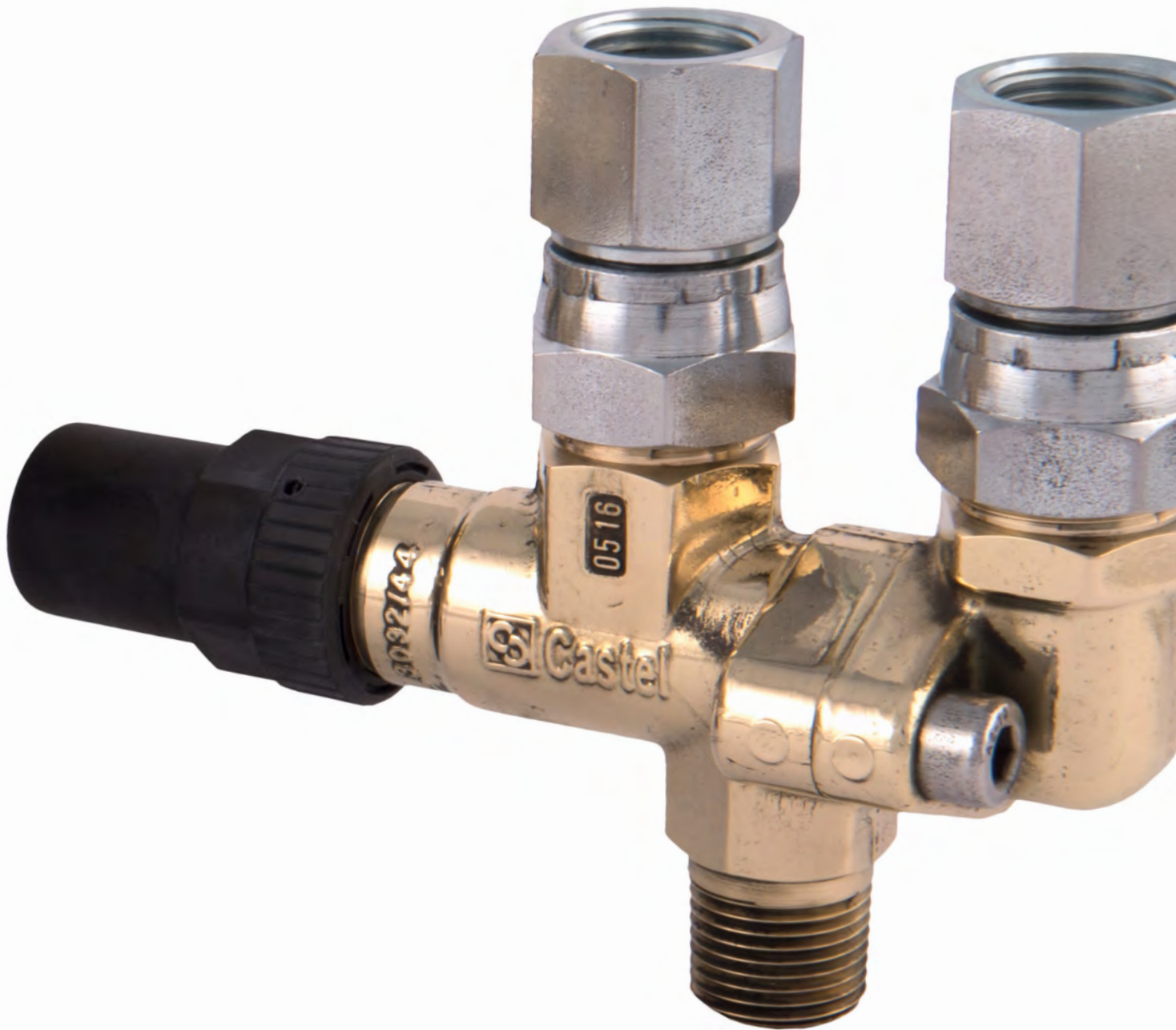
### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the changeover valves in series 3032 with file SA33319. These valves are certified UL-CSA Recognized for the USA and Canada with a Design Pressure of 1015 PSI, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.

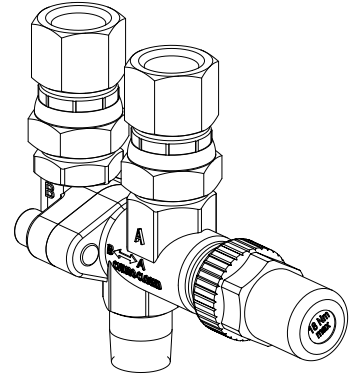
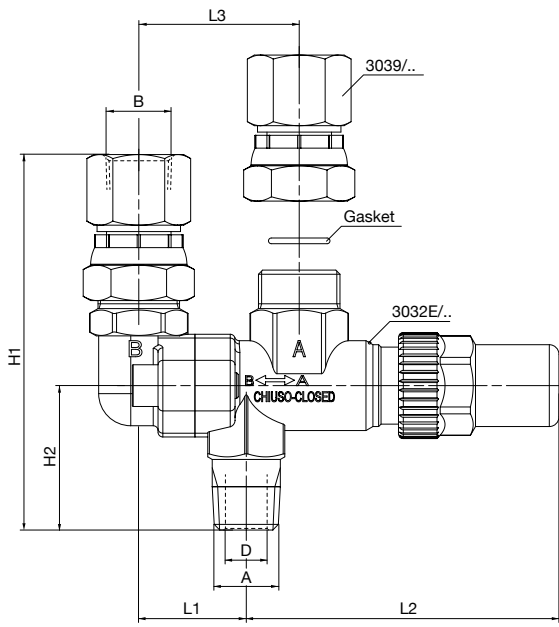
TABLE 20: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF VALVES 3032

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	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>				
3032/33	2,5	80	-40	+120	13	3/8" NPT	3/8" NPT	114	42	33	91	50	17/22	775	Art. 4.3	
3032/44	3,3				13	1/2" NPT	1/2" NPT	114	42	33	91	50	25/35	775		
3032/64	9,0				17,5	3/4" NPT	1/2" NPT	95	52	48	133	80	32/45	1750		
3032/66	9,0				17,5	3/4" NPT	3/4" NPT	95	52	48	133	80	32/45	1730		
3032/88	14,5				22,0	1" NPT	1" NPT	120	71	66	185	110	50/65	3200		
3032/108	20,0				31,0	1.1/4" NPT	1" NPT	123	74	66	185	110	60/80	3200		

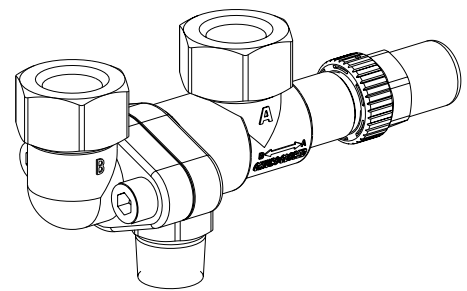
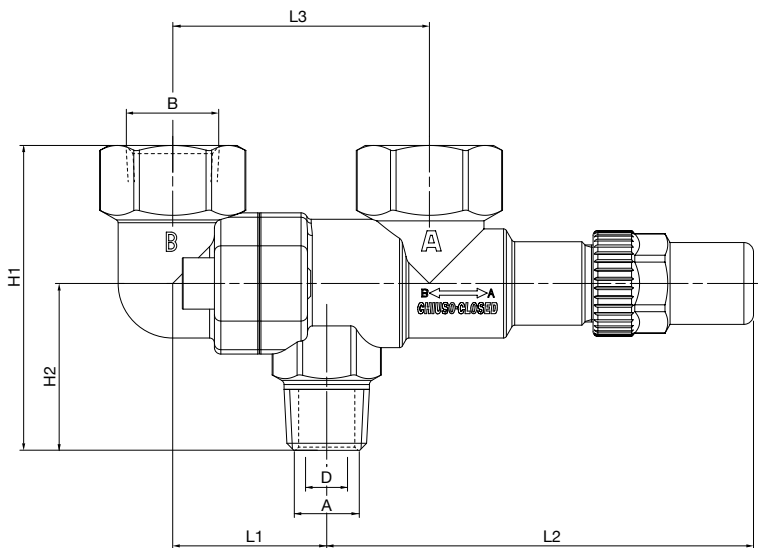




3032/33  
3032/44



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





# SAFETY DEVICES

## 4.8 – SHUT-OFF VALVES

### APPLICATIONS

Please remember that the operation of pressure equipment and pressure assemblies is not covered by Directive 2014/68/EC; 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 3064 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 3064 can be used with the same fluids foreseen for the safety valves, specifically:

- HCFC (R22);
- HFC (R134a, R404A, R407C, R410A, R507);
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B).

### CONSTRUCTION

Valves in series 3064 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 3064 are made from the following materials:

- Hot forged brass EN 12420 - CW 617N for the body;
- Hot forged brass EN 12420 - CW617N, chromium plated, for the ball;
- Steel, with proper surface protection, for the spindle;
- P.T.F.E. for the ball seat gaskets;
- Chloroprene rubber (CR) for outlet seal gaskets in valves series 3032N;
- Hot forged brass EN 12420 - CW617N for the protective cap of the spindle.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the shut-off valves in series 3064 with file SA33319. These valves are certified UL-CSA Recognized for the USA and Canada, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13, with a Design Pressure of:

- 1160 PSI for valves 3064/22, /33, /44;
- 798 PSI for valves 3064/88.

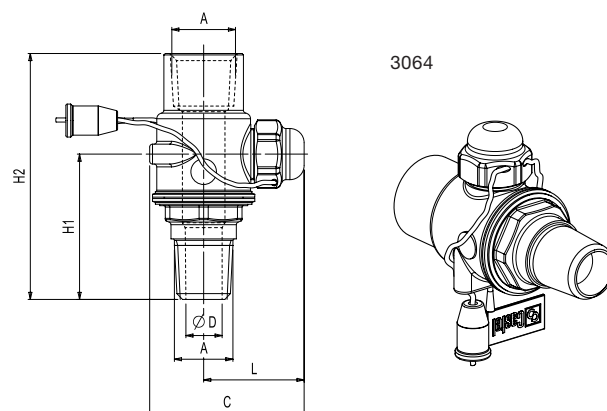
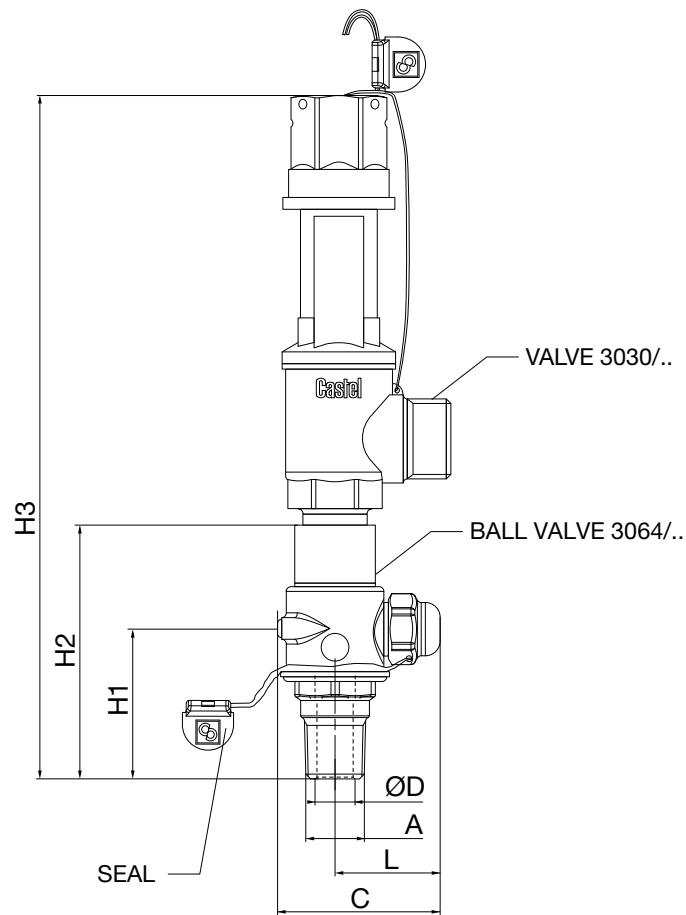


TABLE 21: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF VALVES SERIES 3064

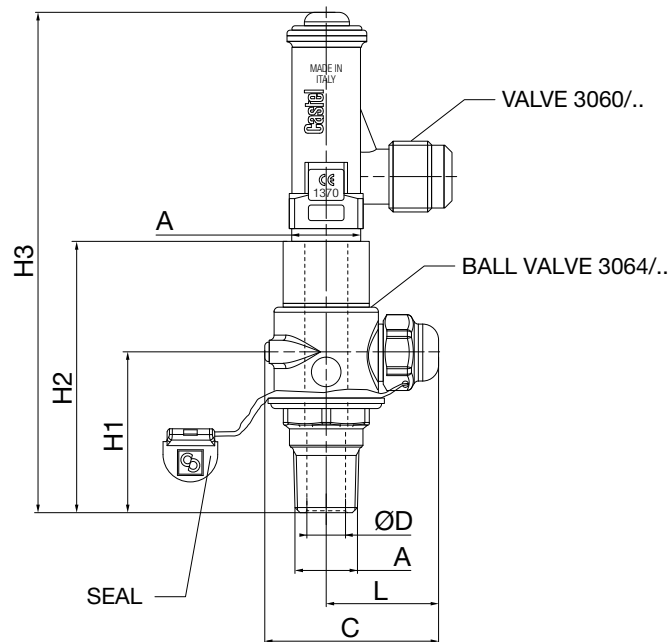
Catalogue Number	Kv Factor [m³/h]	PS [bar]	TS [°C]		Dimensions [mm]							Inlet connection wrench torque (min/max) [Nm]	Weight [g]	Risk Category according to PED Recast
			min	max	Ø D	A	C	L	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>			
3064/22	2,5	80	-40	+150	7	1/4" NPT	47	32	45	74	147	15/20	216	Art. 4.3
3064/33	5				10	3/8" NPT	47	32	45	74	147	17/22	208	
3064/44	10				13	1/2" NPT	54	35	51	86	165	25/35	334	
3064/66	12,7				13	3/4" NPT	78	52	66	109	190	32/45	890	
3064/88	20				20	1" NPT	78	52	70	119	323	50/65	923	



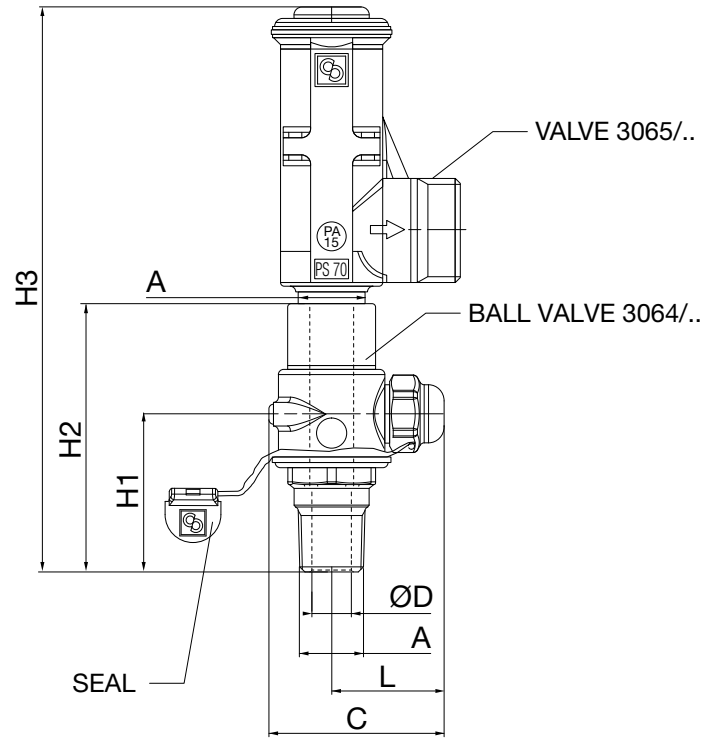
3064/44 → 3030/44C  
 3064/66 → 3030/66C  
 3064/88 → 3030/88C



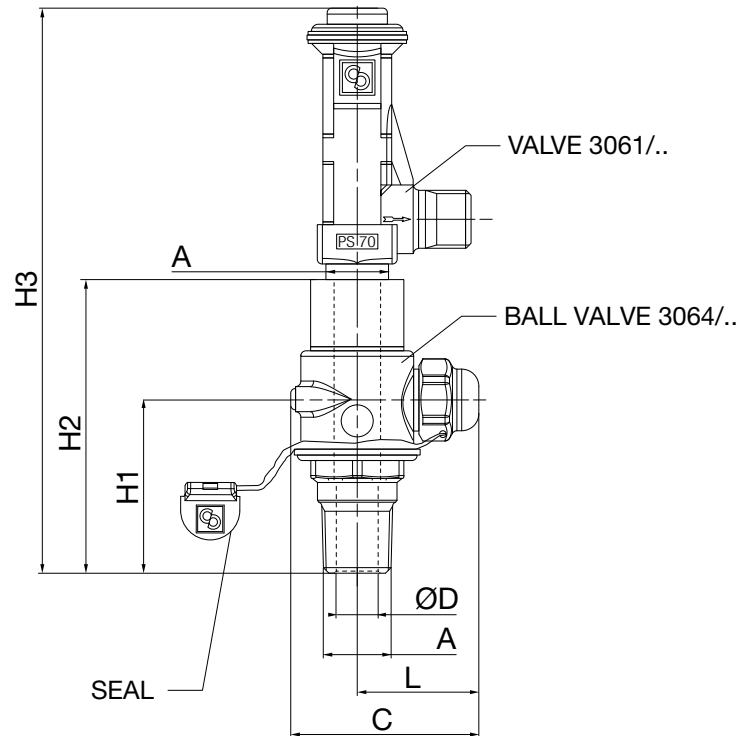
3064/22 → 3060/..C  
 3064/33 → 3060/..C  
 3064/44 → 3060/..C



3064/44 → 3065/4C



3064/22 → 3061/2C  
3064/33 → 3061/3C  
3064/44 → 3061/3C





# SAFETY DEVICES

## 4.9 – FITTINGS

The fittings in series 3035 allow for the installation of:

- Safety valves in series 3030, 3060, 3061 and 3065;
- Bursting disc devices in series 3070;
- Shut-off valves in series 3064;
- Changeover valves in series 3032;

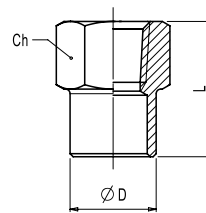
near pressure equipment to be protected in the system.

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

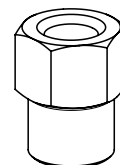
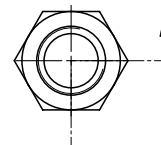
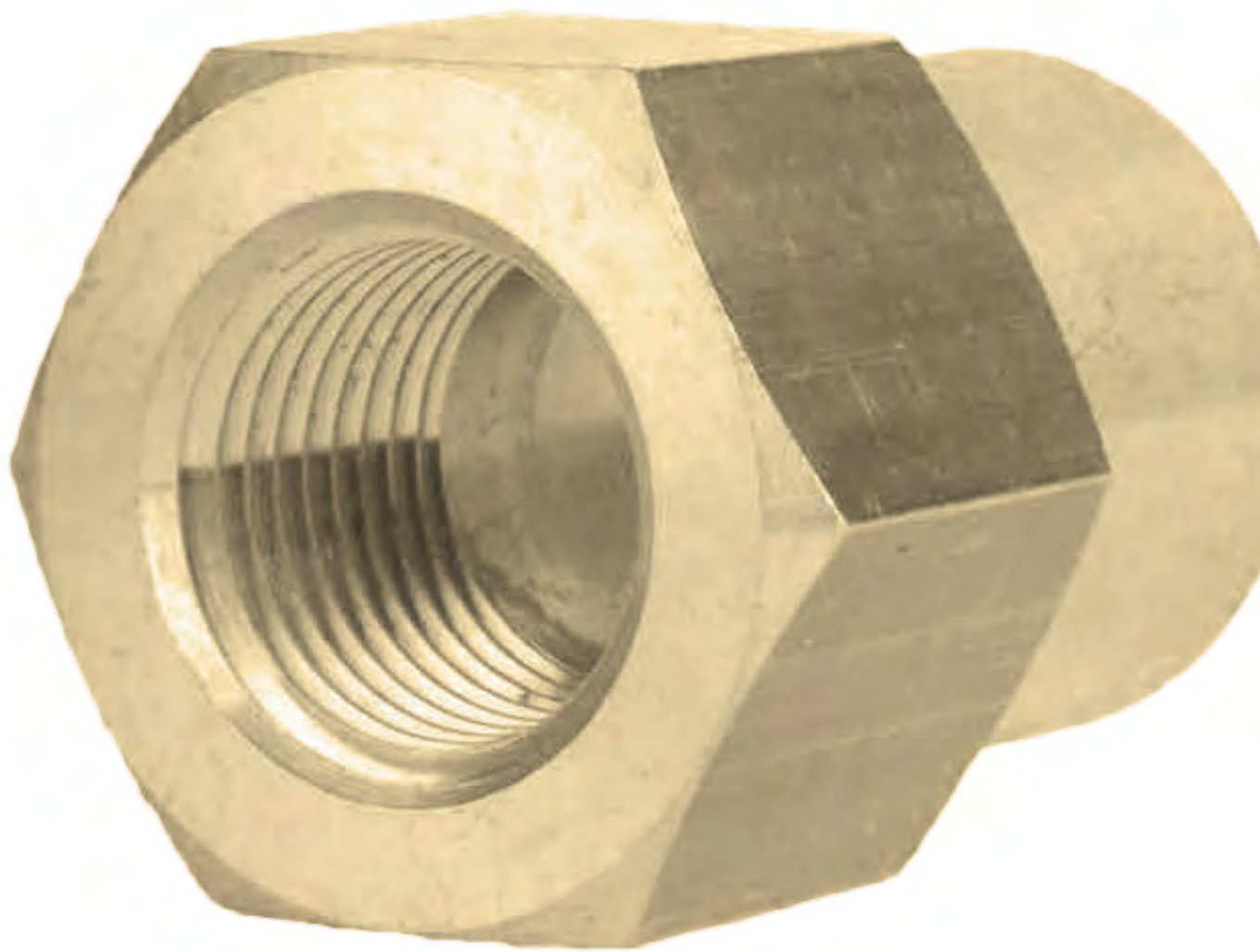


TABLE 22: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF UNIONS 3035

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	120	42	72	364
3035/10	1.1/4"	42		54	67	55	613



# SAFETY DEVICES

## 4.10 – FUSIBLE PLUGS

### GENERAL DESCRIPTION

According to the definition given in Para. 3.6.4 of EN 378-1:2016, a fusible plug is a device containing material that melts at a predetermined temperature, thereby relieving the pressure.

Castel has decided to classify the fusible plugs in series 3080/C and 3082/C in the Risk Category I. This determines their use, as protection devices, on specific pressure equipment, in the same Risk Category I, in compliance with Annex II, Point 2, of Directive 2014/68/EU. Consequently, fusible plugs in series 3080/C and 3082/C **cannot be used**, as sole protection devices, on pressure equipment in Risk Categories greater than I.

### CONSTRUCTION

The body of the fusible plug is an NPT threaded plug drilled with a through hole, with the taper opposite that of the thread. This hole is filled with a specific amount of fusible alloy, with known melting point. Materials used:

- EN 12164 – CW 614N lead-free hot tinned brass for the plug;
- Cadmium-free eutectic alloy with several components for the fusible material.

### SCOPE

**Use:** fusible plugs are basically used to protect a specific components in a refrigerating system or heat pump against possible overpressure, based on the operating conditions for which they have been designed, caused by an excessive external heat source, such as fire. Fusible plugs in series 3080/C and 3082/C **cannot be used**, as sole protection devices, on pressure equipment.

**Fluids:** fusible plugs in series 3080 and 3082 can be used with Group 2 refrigerant fluids in either the gaseous or vapour state:

- HCFC (R22);
- HFC (R134a, R404A, R407C, R410A, R507);
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B) with reference to Article 13, Para. 1(b) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### MARKING

In compliance with the provisions of Article 19 of Directive 2014/68/EU and of Para. 7.3.3 of EN 378-2:2008, the following data are reported on the hex nut of fusible plug:

- CE marking;

- Castel logo;
- Maximum allowable pressure, PS;
- Melting point.

### INSTALLATION

**If a fusible plug is mounted on a pressure vessel, it must be installed in a position in which the refrigerant in the superheated gaseous state does not compromise proper operation.** Fusible plugs must never be covered by thermal insulation.

Discharge from fusible plugs shall take place so that persons and property are not endangered by the released refrigerant.

### FUSIBLE PLUG SELECTION

Directive 2014/68/EU requires that pressure equipment, in which it is reasonably possible to forecast that the admissible limits will be exceeded, shall be fit with suitable protection devices, for instance safety devices such as fusible plugs. 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.

- **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 fusible plugs.

### SIZING OF FUSIBLE PLUGS (Ref. EN 13136:2013+A1)

As fusible plugs discharge to the atmosphere, they always work in critical flow.

Fusible plugs must be sized as follows:

$$A_c = 3.469 \cdot \frac{Q_{md}}{C \cdot K_{dr}} \cdot \sqrt{\frac{v_0}{p_0}} \quad [\text{mm}^2]$$

where:

- $A_c$  = minimum net cross-section area of the fusible plug orifice [mm<sup>2</sup>];
- $Q_{md}$  = minimum required discharge flow rate of fusible plug [kg/h];
- $K_{dr}$  = derated coefficient of discharge of fusible plug, equal to 0.9xK<sub>d</sub>;
- $p_0$  = pressure upstream of the fusible plug, inside the equipment to be protected [bar abs];



- $v_0$  = specific volume of gas or vapour at discharge conditions,  $p_0$  and  $T_0$ , where  $T_0$  is the fluid temperature at plug inlet during discharge, defined by the user or by the designer [ $m^3/kg$ ];
- $C$  = expansion coefficient as a function of the  $k$  coefficient (as measured at 25 °C, see Para. 7.2.3 of EN 13136:2013+A1) in the isentropic equation calculated with the following formula:

$$C = 3.948 \cdot \sqrt{k \cdot \left| \frac{2}{k+1} \right|^{\frac{(k+1)}{(k-1)}}$$

To find the values of  $k$  and  $C$  for the more common refrigerants, see Paragraph 4.5.

The evaluation of the minimum required discharge capacity of a fusible plug is closely linked to the main cause that can cause its opening, which is an external heat source.

The minimum required discharge capacity is determined by the following formula:  $Q_{md} = (3600 \cdot \phi \cdot A_{surf}) / h_{vap}$  [kg/h]

where:

- $\phi$  = Density of heat flow rate, assumed to be 10 [kW/m<sup>2</sup>];
- $A_{surf}$  = external surface area of the vessel [m<sup>2</sup>];
- $h_{vap}$  = latent heat of vaporization of liquid at  $p_0$  [kJ/kg].

EN 13136:2013+A1 also establishes the following maximum limits for the value of  $K_{dr}$ , based on the type of connection between the fusible plug and the equipment to be protected:

- Flush or flared fitting to the housing of the vessel:  $K_{dr} = 0.70$ ;
- Internally protruding fitting to the housing of the vessel:  $K_{dr} = 0.55$ .

TABLE 23: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF FUSIBLE PLUGS 3080 AND 3082

Catalogue Number	NPT Connections	Flow Diameter [mm]	Flow Section [mm <sup>2</sup> ]	$K_d$	Melting Point [°C]	Maximum working temperature [°C]	PS [bar] (1)	Hexagonal Key	Wrench Torque min/max [Nm]	Weight [g]	Risk Category according to PED Recast
3080/1C	1/8"	4,9	18,8	0,91	79	68	42	12	7 / 10	11	I
3080/2C	1/4"	5,7	25,5					17	10 / 15	23	
3080/3C	3/8"	8,5	56,7					14 / 20	39		
3080/4C	1/2"	9,3	67,9					22	21 / 30	76	
3082/1C	1/8"	4,9	18,8		138	127	30	12	7 / 10	11	
3082/2C	1/4"	5,7	25,5					17	10 / 15	23	
3082/3C	3/8"	8,5	56,7					14 / 20	39		
3082/4C	1/2"	9,3	67,9					22	21 / 30	76	

(1) at maximum working temperature









# CHECK VALVES

CLASSIC

# 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2022 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### CONSTRUCTION

These check valves are available in the following two types:

- Valve types 3112W, 3132W, 3144W, 3184W (standard spring) with a low opening differential;  $\Delta p = 0.04$  bar;
- Valve types 3113W, 3133W, 3145W, 3185W (reinforced spring) with a high opening differential;  $\Delta p = 0.3$  bar. To be used, for example, with compressors in parallel.

To guarantee the tightness between body and cover, the valves in series:

- 3112W, 3113W, 3132W, 3133W are equipped with laser welds;
- 3144W, 3145W, 3184W, 3185W 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 valves in series 3112W, 3113W, 3132W, and 3133W;
- Hot forged brass EN 12420 – CW 617N for body and cover of valves in series 3144W, 3145W, 3184W, and 3185W;
- Copper pipe EN 12735-1 – Cu--DHP for solder connections;
- Austenitic stainless steel AISI 302 for the spring;
- Laminated glass fibre fabric and PTFE for gasket seals of valves in series 3112W, 3113W, 3132W, and 3133W;
- PTFE for gasket seals of valves in series 3144W, 3145W, 3184W, and 3185W.

### 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.

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 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.

The allowed operating positions are the following:

- 3144W, 3145W:
  - 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 3144W, 3145W cannot be installed with the valve cover facing downward.**

- 3184W, 3185W:
  - With inlet pipe facing downward and valve cover facing upward;
  - With inlet pipe horizontal and outlet pipe vertical or horizontal.

**Note: valves 3184W, and 3185W cannot be installed with the valve input facing upward and the valve cover facing downward.**

- Valves 3112W, 3113W, 3132W, 3133W can be installed in any working position.

### CERTIFICATIONS

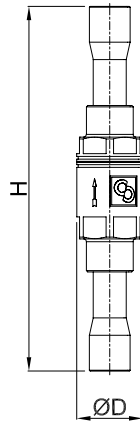
The American certification authority Underwriters Laboratories Inc. has approved hermetic check valves in series: 3112W, 3113W, 3132W, 3133W, 3144W, 3145W, 3184W, 3185W with file SA33319.

These valves 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:

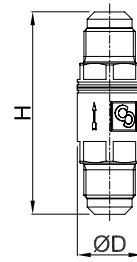
- 600 PSI for valves in series 3112W, 3113W, 3132W, 3133W, 3184W and 3185W;
- 653 PSI for valves in series 3144W, 3145W.



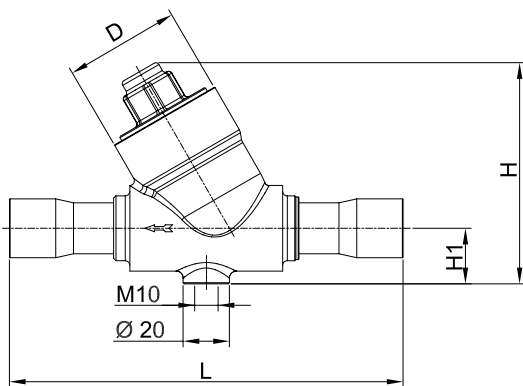
3132W  
3133W



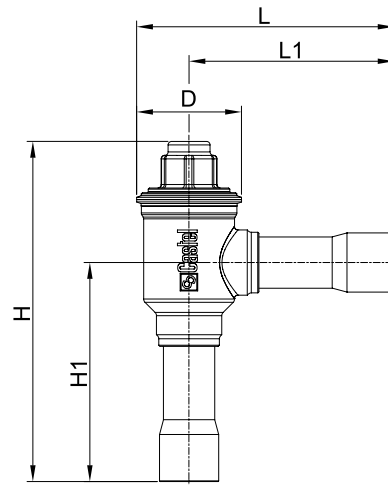
3112W  
3113W



3144W  
3145W



3184W  
3185W



**TABLE 1: GENERAL CHARACTERISTICS OF HERMETIC CHECK VALVES, UL APPROVED**

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	Minimum Opening Pressure Differential [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast					
	SAE Flare	ODS					max.	min.						
		Ø [in.]	Ø [mm]											
3112W/2	1/4"			0,5	0,04	50	-40	+150	Art. 4.3					
3112W/3	3/8"			1,5										
3112W/4	1/2"			1,8										
3112W/5	5/8"			3,3										
3112W/6	3/4"			5,0										
3113W/2	1/4"	-	-	0,5						0,30	50	-40	+150	Art. 4.3
3113W/3	3/8"			1,5										
3113W/4	1/2"			1,8										
3113W/5	5/8"			3,3										
3113W/6	3/4"			5,0										
3132W/2		1/4"	-	0,5	0,04	50	-40	+150	Art. 4.3					
3132W/3		3/8"	-	1,5										
3132W/M10		-	10	1,8										
3132W/M12		-	12	3,3										
3132W/4		1/2"	-	5,0										
3132W/5		5/8"	16	5,0										
3132W/M18		-	18	8,1										
3132W/6		3/4"	-	10,4										
3132W/7		7/8"	22	15,6										
3133W/2		1/4"	-	0,5						0,30	50	-40	+150	Art. 4.3
3133W/3		3/8"	-	1,5										
3133W/M10		-	10	1,8										
3133W/M12		-	12	3,3										
3133W/4		1/2"	-	5,0										
3133W/5		5/8"	16	5,0										
3133W/M18		-	18	8,1										
3133W/6		3/4"	-	10,4										
3133W/7		7/8"	22	15,6										
3144W/7		7/8"	22	8,1	0,04	50	-40	+150	Art. 4.3					
3144W/M28		-	28	10,4										
3144W/9		1.1/8"	-	15,6										
3144NW/11		1.3/8"	35	27,0										
3144NW/13		1.5/8"	-	39,0										
3144NW/M42		-	42	8,1		45			-40	+150	I			
3144NW/17		2.1/8"	54	10,4										
3144W/21		2.5/8"	-	15,6										
3144W/25		3.1/8"	-	27,0										
3145W/7		7/8"	22	8,1								0,3	50	-40
3145W/M28		-	28	10,4										
3145W/9		1.1/8"	-	15,6										
3145W/11		1.3/8"	35	27,0										
3145W/13		1.5/8"	-	39,0	45	-40	+150	I						
3145W/M42		-	42	8,1										
3145W/17		2.1/8"	54	10,4										
3145W/21		2.5/8"	-	15,6										
3145W/25		3.1/8"	-	27,0										
3184W/7		7/8"	22	9,0	0,04			50	-40	+150	Art. 4.3			
3184W/M28		-	28	19,0										
3184W/9		1.1/8"	-	29,0										
3184W/11		1.3/8"	35	29,0				45				-40	+150	Art. 4.3
3185W/7		7/8"	22	9,0	0,3						50			
3185W/M28		-	28	19,0										
3185W/9		1.1/8"	-	29,0										
3185W/11		1.3/8"	35	29,0										
						45								

TABLE 2: DIMENSIONS AND WEIGHTS OF HERMETIC CHECK VALVES

Catalogue Number		Dimensions [mm]						Weight [g]													
		L	L <sub>1</sub>	D	H	H <sub>1</sub>	Ch														
3112W/2	3113W/2	58	-	18	-	-	16	60													
3112W/3	3113W/3	70		22			20	100													
3112W/4	3113W/4	75		24			22	132													
3112W/5	3113W/5	87		29			26	204													
3112W/6	3113W/6	100		35			32	330													
3132W/2	3133W/2	93	-	18	-	-	-	65													
3132W/3	3133W/3	108		22				120													
3132W/M10	3133W/M10			133				24	157												
3132W/M12	3133W/M12	29						220													
3132W/4	3133W/4	140						35	304												
3132W/5	3133W/5	165																			
3132W/M18	3133W/M18																				
3132W/6	3133W/6																				
3132W/7	3133W/7	170		-				50	96	24	-	1055									
3144W/7	3145W/7	201										56	115	29	-	1062					
3144W/M28	3145W/M28		255		67	148	36									-	1558				
3144W/9	3145W/9	232															79	167	44	-	3570
3144W/11	3145W/11																				285
3144W/13	3145W/13	329															79	167	44	-	
3144W/M42	3145W/M42																				255
3144W/17	3145W/17	285															79	167	44	-	
3144W/21	3145W/21																				329
3144W/25	3145W/25	329															79	167	44	-	
3184W/7	3185W/7		111	88	45	146	94	-	760												
3184W/M28	3185W/M28	149	123	51	196	141	-	-	1250												
3184W/9	3185W/9																				
3184W/11	3185W/11								151	56	204	141	-	1580							



**TABLE 3: REFRIGERANT FLOW CAPACITY OF HERMETIC CHECK VALVES IN LIQUID LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3112W/2	3113W/2	8,5	9,2	6,0	8,6	8,6	5,8	7,5	7,8	7,9	8,0	6,1	7,3	7,2	7,4
3112W/3	3113W/3	25,5	27,5	17,9	25,8	25,8	17,3	22,6	23,5	23,6	23,9	18,2	21,8	21,7	22,2
3112W/4	3113W/4	30,6	32,9	21,4	31,0	30,9	20,7	27,1	28,2	28,3	28,6	21,8	26,2	26,0	26,6
3112W/5	3113W/5	56,1	60,4	39,3	56,9	56,7	38,0	49,6	51,6	51,9	52,5	40,0	48,0	47,8	48,7
3112W/6	3113W/6	85,0	91,5	59,5	86,2	85,9	57,5	75,2	78,3	78,6	79,6	60,7	72,8	72,4	73,9
3132W/2	3133W/2	8,5	9,2	6,0	8,6	8,6	5,8	7,5	7,8	7,9	8,0	6,1	7,3	7,2	7,4
3132W/3	3133W/3	25,5	27,5	17,9	25,8	25,8	17,3	22,6	23,5	23,6	23,9	18,2	21,8	21,7	22,2
3132W/M10	3133W/M10														
3132W/M12	3133W/M12	30,6	32,9	21,4	31,0	30,9	20,7	27,1	28,2	28,3	28,6	21,8	26,2	26,0	26,6
3132W/4	3133W/4														
3132W/5	3133W/5														
3132W/M18	3133W/M18	85,0	91,5	59,5	86,2	85,9	57,5	75,2	78,3	78,6	79,6	60,7	72,8	72,4	73,9
3132W/6	3133W/6														
3132W/7	3133W/7														
3144W/7	3145W/7	138	148	96	140	139	93	122	127	127	129	98	118	117	120
3144W/M28	3145W/M28	177	190	124	179	179	120	156	163	163	165	126	151	150	154
3144W/9	3145W/9														
3144W/11	3145W/11	265	285	186	269	268	179	235	244	245	248	189	227	226	230
3144W/13	3145W/13	459	494	321	465	464	311	406	423	424	430	328	393	391	399
3144W/M42	3145W/M42														
3144W/17	3145W/17	663	714	464	672	670	449	587	610	613	620	473	568	564	576
3144W/21	3145W/21														
3144W/25	3145W/25														
3184W/7	3185W/7	153	165	107	155	155	104	135	141	141	143	109	131	130	133
3184W/M28	3185W/M28	323	348	226	327	326	219	286	297	299	302	230	277	275	281
3184W/9	3185W/9														
3184W/11	3185W/11	493	531	345	500	498	334	436	454	456	461	352	422	420	428

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)



**TABLE 4: REFRIGERANT FLOW CAPACITY OF HERMETIC CHECK VALVES IN SUCTION LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3112W/2	3113W/2	0,9	1,3	1,1	1,1	1,7	1,1	0,7	1,2	1,1	0,8	1,1	0,9	0,7	0,8
3112W/3	3113W/3	2,7	3,8	3,3	3,4	5,0	3,3	2,1	3,6	3,3	2,4	3,2	2,7	2,1	2,4
3112W/4	3113W/4	3,3	4,6	4,0	4,1	5,9	4,0	2,6	4,3	4,0	2,9	3,8	3,2	2,5	2,8
3112W/5	3113W/5	6,0	8,4	7,3	7,5	10,9	7,4	4,7	7,9	7,3	5,2	7,0	5,9	4,6	5,2
3112W/6	3113W/6	9,1	12,8	11,0	11,4	16,5	11,2	7,1	12,0	11,0	8,0	10,6	9,0	6,9	7,9
3132W/2	3133W/2	0,9	1,3	1,1	1,1	1,7	1,1	0,7	1,2	1,1	0,8	1,1	0,9	0,7	0,8
3132W/3	3133W/3	2,7	3,8	3,3	3,4	5,0	3,3	2,1	3,6	3,3	2,4	3,2	2,7	2,1	2,4
3132W/M10	3133W/M10														
3132W/M12	3133W/M12	3,3	4,6	4,0	4,1	5,9	4,0	2,6	4,3	4,0	2,9	3,8	3,2	2,5	2,8
3132W/4	3133W/4														
3132W/5	3133W/5	6,0	8,4	7,3	7,5	10,9	7,4	4,7	7,9	7,3	5,2	7,0	5,9	4,6	5,2
3132W/M18	3133W/M18	9,1	12,8	11,0	11,4	16,5	11,2	7,1	12,0	11,0	8,0	10,6	9,0	6,9	7,9
3132W/6	3133W/6														
3132W/7	3133W/7														
3144W/7	3145W/7	15	21	18	18	27	18	12	19	18	13	17	14	11	13
3144W/M28	3145W/M28	19	27	23	24	34	23	15	25	23	17	22	19	14	16
3144W/9	3145W/9														
3144W/11	3145W/11	28	40	34	35	51	35	22	37	34	25	33	28	22	24
3144W/13	3145W/13	49	69	59	61	89	60	38	65	59	43	57	48	37	42
3144W/M42	3145W/M42														
3144W/17	3145W/17	71	99	86	89	129	87	55	94	86	62	82	70	54	61
3144W/21	3145W/21														
3144W/25	3145W/25														
3184W/7	3185W/7	16	23	20	20	30	20	13	22	20	14	19	16	12	14
3184W/M28	3185W/M28	35	48	42	43	63	42	27	46	42	30	40	34	26	30
3184W/9	3185W/9														
3184W/11	3185W/11	53	74	64	66	96	65	41	70	64	46	61	52	40	46

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

**TABLE 5: REFRIGERANT FLOW CAPACITY OF HERMETIC CHECK VALVES IN HOT GAS LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3112W/2	3113W/2	4,3	5,6	4,8	6,0	6,8	4,8	3,4	5,9	5,4	3,8	5,0	4,1	3,3	3,7
3112W/3	3113W/3	12,8	16,8	14,4	17,9	20,4	14,3	10,3	17,7	16,2	11,5	15,0	12,2	9,9	11,0
3112W/4	3113W/4	15,3	20,2	17,3	21,4	24,5	17,2	12,3	21,2	19,4	13,8	18,0	14,7	11,9	13,2
3112W/5	3113W/5	28,1	37,0	31,7	39,3	44,9	31,5	22,6	38,9	35,6	25,2	32,9	26,9	21,8	24,3
3112W/6	3113W/6	42,5	56,0	48,0	59,5	68,0	47,7	34,3	59,0	53,9	38,3	49,9	40,7	33,0	36,8
3132W/2	3133W/2	4,3	5,6	4,8	6,0	6,8	4,8	3,4	5,9	5,4	3,8	5,0	4,1	3,3	3,7
3132W/3	3133W/3	12,8	16,8	14,4	17,9	20,4	14,3	10,3	17,7	16,2	11,5	15,0	12,2	9,9	11,0
3132W/M10	3133W/M10														
3132W/M12	3133W/M12	15,3	20,2	17,3	21,4	24,5	17,2	12,3	21,2	19,4	13,8	18,0	14,7	11,9	13,2
3132W/4	3133W/4														
3132W/5	3133W/5	28,1	37,0	31,7	39,3	44,9	31,5	22,6	38,9	35,6	25,2	32,9	26,9	21,8	24,3
3132W/M18	3133W/M18	42,5	56,0	48,0	59,5	68,0	47,7	34,3	59,0	53,9	38,3	49,9	40,7	33,0	36,8
3132W/6	3133W/6														
3132W/7	3133W/7														
3144W/7	3145W/7	69	91	78	96	110	77	55	96	87	62	81	66	53	60
3144W/M28	3145W/M28	88	116	100	124	141	99	71	123	112	80	104	85	69	76
3144W/9	3145W/9														
3144W/11	3145W/11	133	175	150	186	212	149	107	184	168	119	156	127	103	115
3144W/13	3145W/13	230	302	259	321	367	258	185	319	291	207	269	220	178	198
3144W/M42	3145W/M42														
3144W/17	3145W/17	332	437	374	464	530	372	267	460	420	298	389	317	257	287
3144W/21	3145W/21														
3144W/25	3145W/25														
3184W/7	3185W/7	77	101	86	107	122	86	62	106	97	69	90	73	59	66
3184W/M28	3185W/M28	162	213	182	226	258	181	130	224	205	145	190	155	125	140
3184W/9	3185W/9														
3184W/11	3185W/11	247	325	278	345	394	277	199	342	313	222	289	236	191	213

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

# CHECK VALVES

## 5.2 – DEMOUNTABLE CHECK VALVES

### APPLICATIONS

The demountable 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning of the entire valve.

The allowed operating positions are the following:

- 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 3124, 3125 cannot be installed with the valve cover facing downward.**

### CONSTRUCTION

These check valves are available in the following two types:

- Valve types 3124 (standard spring) with a low opening differential;  $\Delta p = 0.04$ ;
- Valve types 3125 (reinforced spring) with a high opening differential;  $\Delta p = 0.3$  bar. To be used, for example, with compressors in parallel.

The main parts of the check valves are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover;
- Copper pipe EN 12735-1 – Cu--DHP for solder connections;
- Austenitic stainless steel AISI 302 for the spring;
- Chloroprene (CR) for outlet seal gaskets;
- PTFE for seat gaskets.

### 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 yields indicated in Table 6. Table 6 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 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.

The brazing of valves with solder connections should be carried out with care, using a low melting point filler material (min. 5% Ag). **Before starting to braze the body, it is necessary to disassemble the valves in series 3124, 3125.** It is important to



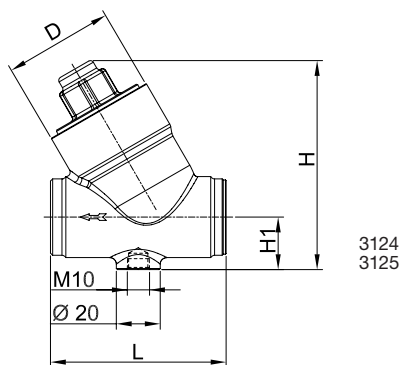


TABLE 6: GENERAL CHARACTERISTICS OF DEMOUNTABLE CHECK VALVES

Catalogue Number	Connections		Kv Factor [m <sup>3</sup> /h]	Minimum Opening Pressure Differential [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast				
	ODS					min.	max.					
	Ø [in.]	Ø [mm]										
3124/M22	–	22	8,1	0,04	45	-40	+120	Art. 4.3				
3124/7	7/8"	–										
3124/M28	–	28										
3124/9	1.1/8"	–										
3124/11	1.3/8"	35										
3124/13	1.5/8"	–										
3124/M42	–	42	27,0					I				
3124/17	2.1/8"	54										
3125/M22	–	22	8,1					0,3	45	-40	+120	Art. 4.3
3125/7	7/8"	–										
3125/M28	–	28										
3125/9	1.1/8"	–										
3125/11	1.3/8"	35										
3125/13	1.5/8"	–										
3125/M42	–	42	27,0	I								
3125/17	2.1/8"	54										

TABLE 7: DIMENSIONS AND WEIGHTS OF DEMOUNTABLE CHECK VALVES

Catalogue number		Dimensions [mm]				Weight [g]
		H	H <sub>1</sub>	L	Q	
3124/M22	3125/M22	96	24	80	50	855
3124/7	3125/7					
3124/M28	3125/M28					
3124/9	3125/9	115	29	92	56	1130
3124/11	3125/11					
3124/13	3125/13					
3124/M42	3125/M42	149	36	121	67	3000
3124/17	3125/17					
		167	44	157	79	4300

**TABLE 8: REFRIGERANT FLOW CAPACITY OF DEMOUNTABLE CHECK VALVES IN LIQUID LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3124/M22	3125/M22	138	148	96	140	139	93	122	127	127	129	98	118	117	120
3124/7	3125/7														
3124/M28	3125/M28	177	190	124	179	179	120	156	163	163	165	126	151	150	154
3124/9	3125/9														
3124/11	3125/11	265	285	186	269	268	179	235	244	245	248	189	227	226	230
3124/13	3125/13	459	494	321	465	464	311	406	423	424	430	328	393	391	399
3124/M42	3125/M42														
3124/17	3125/17	663	714	464	672	670	449	587	610	613	620	473	568	564	576
Standard rating conditions according to AHRI Standard 760-2014															
Condensing temperature		110 °F		(43,3 °C)				Evaporator superheating				10 °R		(5,5 °K)	
Liquid temperature		100 °F		(37,8 °C)				Suction line temperature				65 °F		(18,3 °C)	
Subcooling		10 °R		(5,5 °K)				Suction superheating				15 °R		(8,4 °K)	
Evaporating temperature		40 °F		(4,4 °C)				Discharge temperature				160 °F		(71,1 °C)	

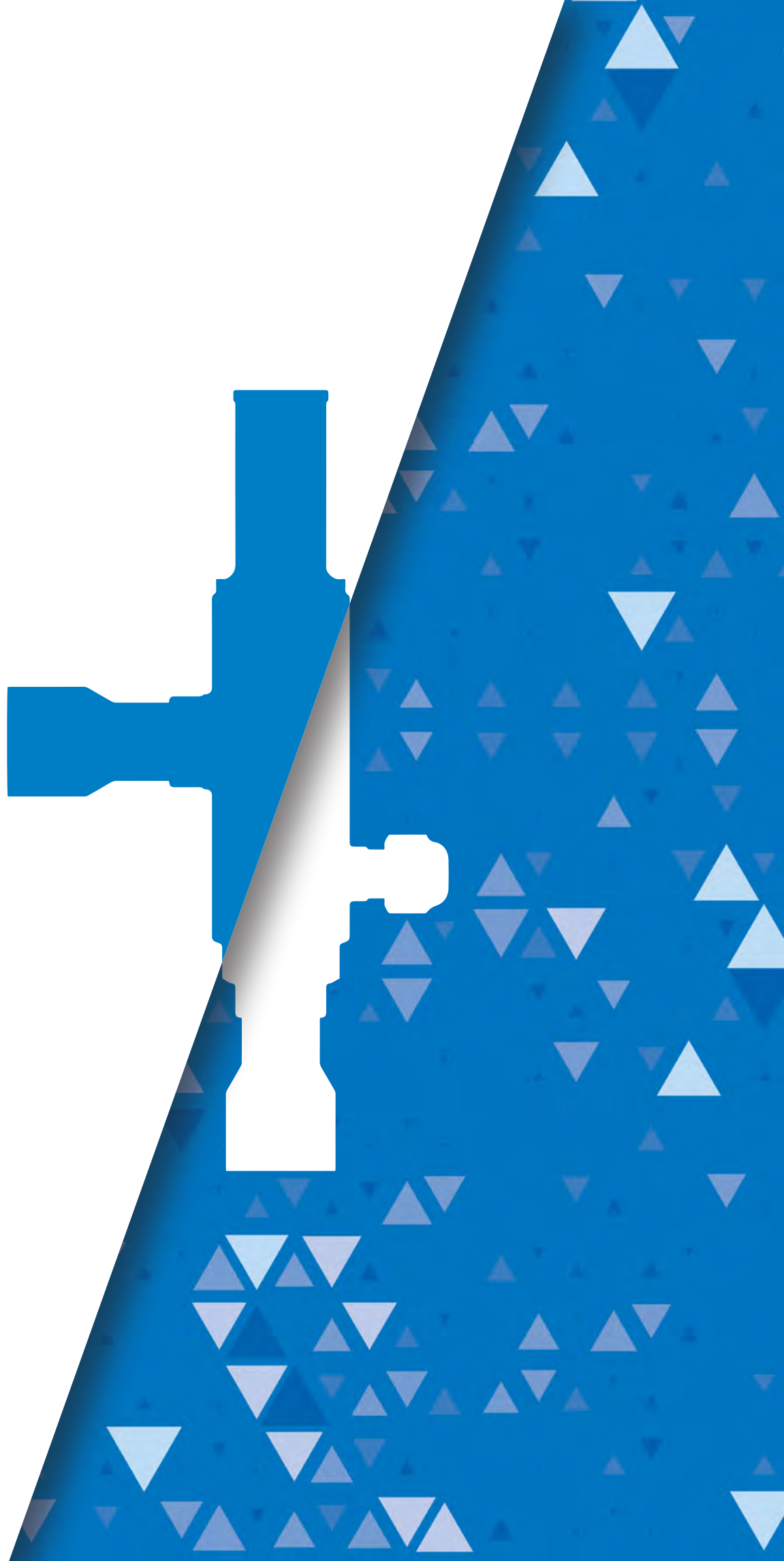
**TABLE 9: REFRIGERANT FLOW CAPACITY OF DEMOUNTABLE CHECK VALVES IN SUCTION LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3124/M22	3125/M22	15	21	18	18	27	18	12	19	18	13	17	14	11	13
3124/7	3125/7														
3124/M28	3125/M28	19	27	23	24	34	23	15	25	23	17	22	19	14	16
3124/9	3125/9														
3124/11	3125/11	28	40	34	35	51	35	22	37	34	25	33	28	22	24
3124/13	3125/13	49	69	59	61	89	60	38	65	59	43	57	48	37	42
3124/M42	3125/M42														
3124/17	3125/17	71	99	86	89	129	87	55	94	86	62	82	70	54	61
Standard rating conditions according to AHRI Standard 760-2014															
Condensing temperature		110 °F		(43,3 °C)				Evaporator superheating				10 °R		(5,5 °K)	
Liquid temperature		100 °F		(37,8 °C)				Suction line temperature				65 °F		(18,3 °C)	
Subcooling		10 °R		(5,5 °K)				Suction superheating				15 °R		(8,4 °K)	
Evaporating temperature		40 °F		(4,4 °C)				Discharge temperature				160 °F		(71,1 °C)	

**TABLE 10: REFRIGERANT FLOW CAPACITY OF DEMOUNTABLE CHECK VALVES IN HOT GAS LINE [KW]**

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
3124/M22	3125/M22	69	91	78	96	110	77	55	96	87	62	81	66	53	60
3124/7	3125/7														
3124/M28	3125/M28	88	116	100	124	141	99	71	123	112	80	104	85	69	76
3124/9	3125/9														
3124/11	3125/11	133	175	150	186	212	149	107	184	168	119	156	127	103	115
3124/13	3125/13	230	302	259	321	367	258	185	319	291	207	269	220	178	198
3124/M42	3125/M42														
3124/17	3125/17	332	437	374	464	530	372	267	460	420	298	389	317	257	287
Standard rating conditions according to AHRI Standard 760-2014															
Condensing temperature		110 °F		(43,3 °C)				Evaporator superheating				10 °R		(5,5 °K)	
Liquid temperature		100 °F		(37,8 °C)				Suction line temperature				65 °F		(18,3 °C)	
Subcooling		10 °R		(5,5 °K)				Suction superheating				15 °R		(8,4 °K)	
Evaporating temperature		40 °F		(4,4 °C)				Discharge temperature				160 °F		(71,1 °C)	









# **PRESSURE REGULATORS**

**CLASSIC**

# PRESSURE REGULATORS

## 6.1 – CAPACITY REGULATORS

### APPLICATIONS

In air conditioning systems, it is desirable to limit the minimum evaporating pressure during periods of low load to prevent coil icing. In refrigerating systems, it is desirable to limit the minimum evaporating pressure during periods of low load to avoid operating the compressor at a lower suction pressure than it was designed to operate. Capacity regulators in series 3310 are practical and economical solutions to these problems as they allow a portion of the hot discharge gas in the high pressure line to bypass directly to the low pressure line, returning the evaporation temperature/pressure to the desired value.

The capacity regulators in series 3310 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

Capacity regulators adjust the flow of hot gas according to changes of suction pressure, downstream the regulator. When the evaporating pressure is greater than the regulator calibration pressure, the shutter remains closed. As the suction pressure drops below the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in suction pressure. As the suction pressure continues to drop, the shutter continues to open, until the stroke limit is reached and the regulator is open completely. Under normal conditions, there should be insufficient pressure change to cause open these valves to open completely; rather, they should modulate inside its stroke. Capacity regulators only modulate based on the outlet pressure change, pressure changes on the inlet side do not affect their opening as the valve is equipped with an equalizer bellows with an area equal to that of the valve seat.

The factory pressure settings for capacity regulators in series 3310 is 2 bar. This means that until the suction pressure is above 2 bar the regulator remains closed. When the suction pressure drops below 2 bar, it 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 0.6 bar in calibration pressure.

The calibration range varies from 0.2 to 6 bar.

### CONSTRUCTION

The main parts of the capacity 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;
- Brass bar EN 12164 – CW 614N for the shutter;
- Brass bar EN 12164 – CW 614N for regulator ring;
- Spring steel DIN 17223/84 Class C/D for setting spring;
- Chloroprene rubber (CR) for outlet seal gaskets.

### INSTALLATION

Capacity regulators are installed on a branch off the discharge line. The by-passed hot gas can enter in the low pressure side at one of the following locations:

- Compressor inlet (see installation example 1);
- Evaporator inlet, with or without distributor (see installation example 2).

In the first installation example, to avoid the danger of overheating the compressor, it is good practice to install a liquid injection valve that brings liquid refrigerant to the suction line, cooling the hot gas recirculated by the regulator.

### SELECTION

To correctly select a capacity regulator, all information on the system where it will be installed must be available. Selection is based on the following data:

1. **Type of refrigerant;**
2. **Minimum allowable evaporating temperature at reduced load condition.** This data depends on the system. In air conditioning systems, this value must be set to prevent coil icing. In refrigerating systems, this value must be set to avoid that the suction temperature is lower than minimum values recommended by compressor manufacturers;
3. **Minimum required operating evaporating temperature.** This is the temperature when the valve begins to open;
4. **Compressor capacity at minimum allowable evaporating temperature.** Consult the compressor manufacturer for this value;
5. **Minimum evaporator load at which the system is to be operated.** This depends on the type of system. It can be a percentage of maximum load (15-25%) or it can be zero;
6. **Liquid temperature at minimum evaporator cooling load.**

The capacity regulator must be selected based on the difference between the compressor capacity (item 4) and the minimum evaporator cooling load (item 5). The refrigerating capacities indicated on Tables 3A, 4A, 5A, 6A are the regulator capacities,



not the system capacities on which the valves are installed. These capacities are based on a reference liquid temperature of 36.7 °C. The data listed on these tables are based on:

- Refrigerant used (item 1);
- Minimum allowable evaporating temperature at reduced load condition (item 2);
- Allowed evaporating temperature (pressure) change downstream the regulator, this is the temperature (pressure) change necessary to move the valve shutter from the initial starting position to the nominal rating capacity position (temperature in item 3 – temperature in item 2).

With liquid temperatures other than 36.7 °C the required cooling capacity of regulator is:

$$(Q_{\text{compr}} - Q_{\text{evap}}) \cdot K_{T \text{ liquid}} = Q_{\text{valve}}$$

where:

- $Q_{\text{compr}}$  = Compressor capacity at minimum allowable evaporating temperature [kW];
- $Q_{\text{evap}}$  = Minimum evaporator load at which the system is to be operated [kW];
- $K_{T \text{ liquid}}$  = Correction factor for  $T_{\text{liquid}} \neq 36.7$  °C. (See Tables 3B, 4B, 5B, 6B);
- $Q_{\text{valve}}$  = Refrigerating capacity requested at regulator [kW].

### Example

- Refrigerant R404A
- Minimum required operating evaporating temperature -15 [°C]
- Min. allowable evaporating temp. at reduced load condition -19 [°C]
- Compressor capacity at min. allowable evaporating temp. 10 [kW]
- Min. evaporator load at which the system can be operated 5 [kW]

- Liquid temperature at min. evaporating cooling load - 10 [°C]
- Solder connections 35 [°C]

1. Use Table 5B to determine the correction factor for the liquid temperature  $T_{\text{Liquid}} = 35$  °C.

$$K_{T \text{ liquid}} = 1.03$$

2. Calculate the refrigerating capacity requested at regulator.

$$Q_{\text{valve}} = (Q_{\text{compr}} - Q_{\text{evap}}) \cdot K_{T \text{ liquid}} = (10 - 5) \cdot 1.03 = 5.15 \text{ kW}$$

3. Calculate the evaporating temperature change.

$$T_{\text{ev}} - T_{\text{ev min}} = -15 - (-19) = 4 \text{ °C}$$

4. With the following parameters:

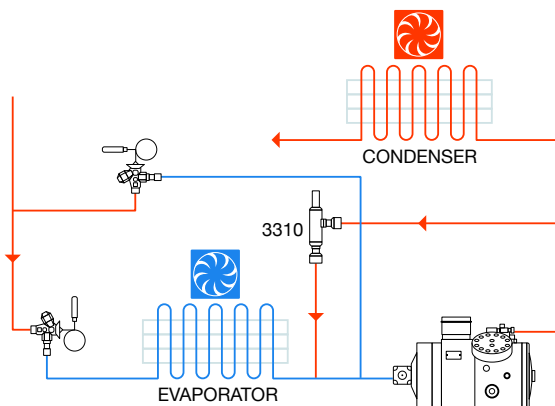
- Minimum cooling capacity = 5.15 kW;
- Evaporating temperature change = 4 °C;
- Minimum allowable evaporating temperature = -19 °C;

Choose the proper valve in Table 5A. The selected valves are:

- 3310/M12 with 12 mm diameter solder connections;
- 3310/4 with 1/2" diameter solder connections.

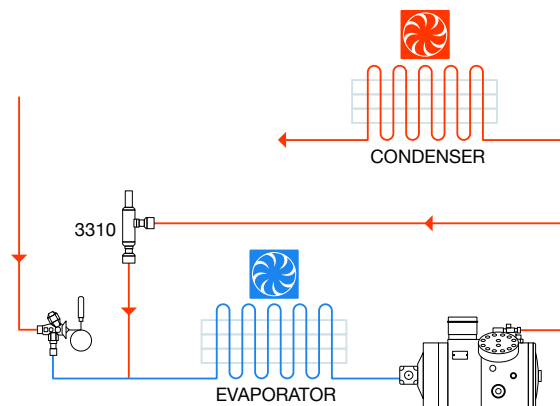
## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the capacity regulators in series 3310 with file SA33319. These regulators 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 405 PSI.



### Installation (1)

The regulator is installed as a bypass between compressor discharge and suction line. The regulator opens as evaporation pressure decreases. Note: there must be a liquid injection valve for desuperheating suction line gas.



### Installation (2)

The regulator may also be installed as a bypass between compressor discharge and the expansion valve outlet.

TABLE 1: GENERAL CHARACTERISTICS OF CAPACITY REGULATORS

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	
		Ø [in.]	Ø [mm]								
3310/4	1/2"	-	-	0,70	0,2	6	2	28	-40	+110	Art. 4.3
3310/M12S	-	-	12								
3310/4S	-	1/2"	-								
3310/5	5/8"	-	-	1,26	0,2	6	2	28	-40	+110	Art. 4.3
3310/5S	-	5/8"	16								
3310/7S	-	7/8"	22								

TABLE 2: DIMENSIONS AND WEIGHTS OF CAPACITY REGULATORS

Catalogue Number	Dimensions [mm]						Weight [g]
	H	H <sub>1</sub>	L	D	Ch <sub>1</sub>	Ch <sub>2</sub>	
3310/4	159	76,5	48	32	22	24	490
3310/M12S	183	100,5	64		-	-	490
3310/4S	183	100,5	64		-	-	490
3310/5	163	80,5	52		22	24	550
3310/5S	183	100,5	64		-	-	480
3310/7S	194	112	75,5		-	-	560

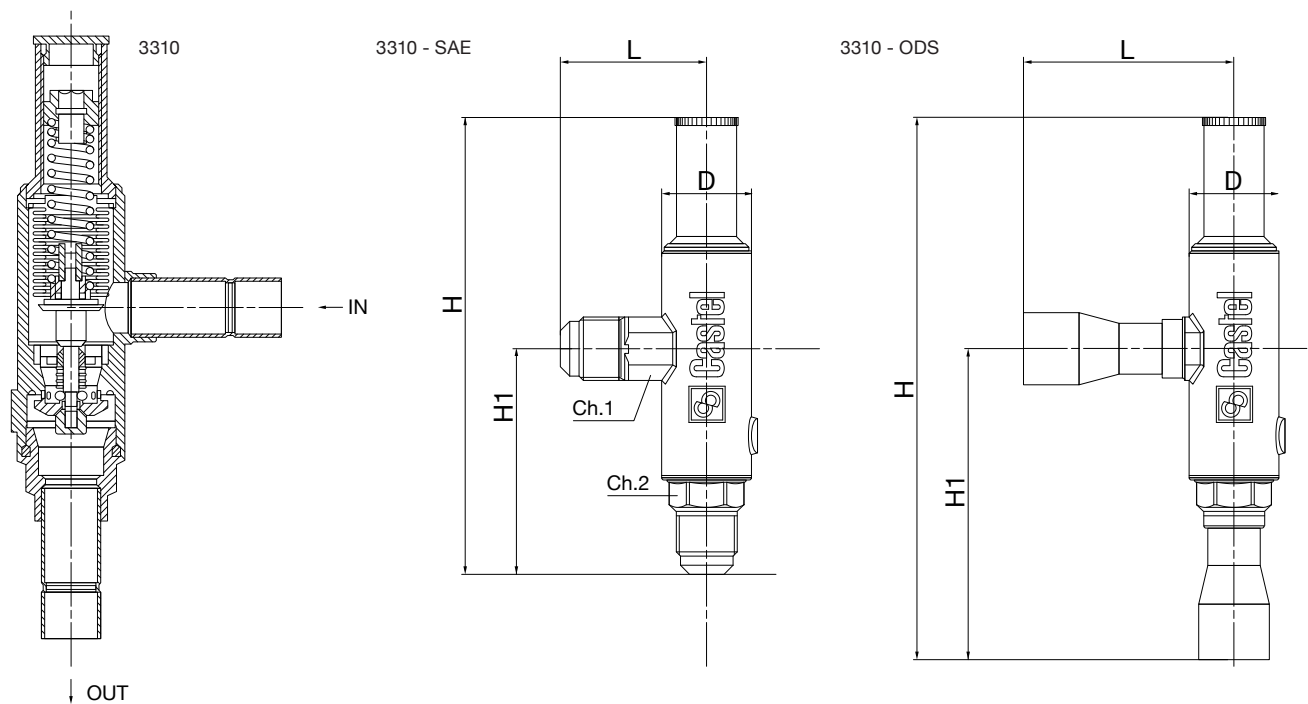




TABLE 3A : REFRIGERANT FLOW CAPACITY OF CAPACITY REGULATORS 3310 [KW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		10	4,4	0	-5	-10	-15	-20	-25	-30	-35
3310/4 3310/4S 3310/M12S	1	1,70	1,70	1,67	1,63	1,60	1,57	1,53	1,50	1,46	1,43
	2	3,30	3,30	3,23	3,17	3,10	3,04	2,97	2,91	2,84	2,78
	3	4,41	4,41	4,32	4,24	4,15	4,06	3,97	3,89	3,80	3,71
	4	4,95	4,95	4,85	4,75	4,66	4,56	4,46	4,36	4,27	4,17
	5	5,21	5,21	5,10	5,00	4,90	4,79	4,69	4,59	4,49	4,38
	6	6,08	6,08	5,96	5,84	5,72	5,60	5,48	5,36	5,24	5,12
3310/5 3310/5S	1	2,49	2,49	2,44	2,38	2,33	2,27	2,22	2,16	2,11	2,05
	2	4,27	4,27	4,17	4,07	3,97	3,87	3,77	3,67	3,56	3,46
	3	5,92	5,92	5,80	5,68	5,56	5,43	5,31	5,19	5,07	4,95
	4	8,48	8,48	8,31	8,13	7,96	7,79	7,61	7,44	7,27	7,09
	5	10,05	10,05	9,84	9,64	9,43	9,23	9,02	8,81	8,61	8,40
	6	11,43	11,43	11,19	10,96	10,72	10,49	10,25	10,02	9,79	9,55
3310/7S	1	2,46	2,46	2,42	2,39	2,35	2,31	2,28	2,24	2,20	2,17
	2	4,39	4,39	4,32	4,26	4,19	4,13	4,06	4,00	3,93	3,87
	3	5,62	5,62	5,54	5,45	5,37	5,29	5,20	5,12	5,03	4,95
	4	8,32	8,32	8,20	8,07	7,95	7,82	7,70	7,58	7,45	7,33
	5	11,02	11,02	10,86	10,69	10,53	10,36	10,20	10,04	9,87	9,71
	6	14,60	14,60	14,38	14,16	13,94	13,73	13,51	13,29	13,08	12,86

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : temperature change required to move the valve shutter from "start to open" position to rated opening position

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

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,28	1,23	1,18	1,13	1,08	1,03	0,97	0,92	0,86

TABLE 4A : REFRIGERANT FLOW CAPACITY OF CAPACITY REGULATORS 3310 [KW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		10	4,4	0	-5	-10	-15	-20	-25	-30	-35
3310/4 3310/4S 3310/M12S	1	1,70	1,70	1,67	1,63	1,60	1,57	1,53	1,50	1,46	1,43
	2	3,30	3,30	3,23	3,17	3,10	3,04	2,97	2,91	2,84	2,78
	3	4,41	4,41	4,32	4,24	4,15	4,06	3,97	3,89	3,80	3,71
	4	4,95	4,95	4,85	4,75	4,66	4,56	4,46	4,36	4,27	4,17
	5	5,21	5,21	5,10	5,00	4,90	4,79	4,69	4,59	4,49	4,38
	6	6,08	6,08	5,96	5,84	5,72	5,60	5,48	5,36	5,24	5,12
3310/5 3310/5S	1	2,49	2,49	2,44	2,38	2,33	2,27	2,22	2,16	2,11	2,05
	2	4,27	4,27	4,17	4,07	3,97	3,87	3,77	3,67	3,56	3,46
	3	5,92	5,92	5,80	5,68	5,56	5,43	5,31	5,19	5,07	4,95
	4	8,48	8,48	8,31	8,13	7,96	7,79	7,61	7,44	7,27	7,09
	5	10,05	10,05	9,84	9,64	9,43	9,23	9,02	8,81	8,61	8,40
	6	11,43	11,43	11,19	10,96	10,72	10,49	10,25	10,02	9,79	9,55
3310/7S	1	2,46	2,46	2,42	2,39	2,35	2,31	2,28	2,24	2,20	2,17
	2	4,39	4,39	4,32	4,26	4,19	4,13	4,06	4,00	3,93	3,87
	3	5,62	5,62	5,54	5,45	5,37	5,29	5,20	5,12	5,03	4,95
	4	8,32	8,32	8,20	8,07	7,95	7,82	7,70	7,58	7,45	7,33
	5	11,02	11,02	10,86	10,69	10,53	10,36	10,20	10,04	9,87	9,71
	6	14,60	14,60	14,38	14,16	13,94	13,73	13,51	13,29	13,08	12,86

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : temperature change required to move the valve shutter from "start to open" position to rated opening position

TABLE 4B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,23	1,19	1,16	1,11	1,06	1,01	0,98	0,94	0,9



# R404A / R507

TABLE 5A : REFRIGERANT FLOW CAPACITY OF CAPACITY REGULATORS 3310 [KW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		4,4	0	-5	-10	-15	-20	-25	-30	-35	-40
3310/4 3310/4S 3310/M12S	1	2,46	2,38	2,34	2,30	2,26	2,21	2,17	2,13	2,09	2,05
	2	4,75	4,59	4,51	4,43	4,35	4,27	4,19	4,11	4,03	3,95
	3	6,49	6,27	6,16	6,05	5,94	5,83	5,72	5,61	5,50	5,39
	4	7,08	6,84	6,72	6,60	6,48	6,36	6,24	6,12	6,00	5,88
	5	7,42	7,17	7,04	6,91	6,79	6,66	6,54	6,41	6,29	6,16
	6	8,63	8,34	8,19	8,05	7,90	7,75	7,61	7,46	7,32	7,17
3310/5 3310/5S	1	3,67	3,52	3,44	3,37	3,29	3,22	3,15	3,07	3,00	2,92
	2	6,30	6,04	5,91	5,78	5,65	5,53	5,40	5,27	5,14	5,01
	3	8,72	8,36	8,19	8,01	7,83	7,65	7,48	7,30	7,12	6,94
	4	12,49	11,98	11,73	11,47	11,22	10,96	10,71	10,45	10,20	9,94
	5	14,80	14,19	13,89	13,59	13,29	12,99	12,69	12,38	12,08	11,78
	6	16,82	16,13	15,79	15,45	15,10	14,76	14,42	14,08	13,73	13,39
3310/7S	1	3,70	3,49	3,38	3,27	3,16	3,05	2,94	2,83	2,72	2,61
	2	6,59	6,21	6,01	5,82	5,62	5,43	5,24	5,04	4,85	4,65
	3	8,44	7,94	7,69	7,44	7,19	6,95	6,70	6,45	6,20	5,95
	4	14,98	14,10	13,66	13,22	12,77	12,33	11,89	11,45	11,01	10,57
	5	18,18	17,11	16,58	16,04	15,51	14,97	14,44	13,90	13,37	12,83
	6	24,07	22,66	21,95	21,24	20,53	19,83	19,12	18,41	17,70	16,99

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : temperature change required to move the valve shutter from "start to open" position to rated opening position

TABLE 5B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,43	1,35	1,28	1,2	1,12	1,03	0,95	0,86	0,76

TABLE 6A : REFRIGERANT FLOW CAPACITY OF CAPACITY REGULATORS 3310 [KW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		8	4,4	0	-5	-10	-15	-30	-35	-30	-35
3310/4 3310/4S 3310/M12S	1	2,88	2,88	2,81	2,74	2,66	2,59	2,52	2,45	2,38	2,30
	2	5,58	5,58	5,44	5,30	5,16	5,02	4,88	4,74	4,60	4,46
	3	7,61	7,61	7,42	7,23	7,04	6,85	6,66	6,47	6,28	6,09
	4	8,53	8,53	8,31	8,10	7,89	7,67	7,46	7,25	7,04	6,82
	5	8,96	8,96	8,74	8,52	8,29	8,07	7,84	7,62	7,40	7,17
	6	10,47	10,47	10,21	9,95	9,68	9,42	9,16	8,90	8,64	8,38
3310/5 3310/5S	1	4,27	4,27	4,16	4,05	3,95	3,84	3,73	3,63	3,52	3,41
	2	7,36	7,36	7,18	6,99	6,81	6,62	6,44	6,26	6,07	5,89
	3	10,22	10,22	9,97	9,71	9,46	9,20	8,95	8,69	8,43	8,18
	4	14,62	14,62	14,25	13,89	13,52	13,15	12,79	12,42	12,06	11,69
	5	17,31	17,31	16,87	16,44	16,01	15,57	15,14	14,71	14,28	13,84
	6	19,66	19,66	19,17	18,67	18,18	17,69	17,20	16,71	16,22	15,73
3310/7S	1	4,25	4,25	4,14	4,04	3,93	3,82	3,72	3,61	3,50	3,40
	2	7,56	7,56	7,37	7,18	6,99	6,80	6,62	6,43	6,24	6,05
	3	9,68	9,68	9,44	9,20	8,96	8,72	8,47	8,23	7,99	7,75
	4	17,20	17,20	16,77	16,34	15,91	15,48	15,05	14,62	14,19	13,76
	5	20,89	20,89	20,37	19,84	19,32	18,80	18,28	17,76	17,23	16,71
	6	27,67	27,67	26,98	26,28	25,59	24,90	24,21	23,52	22,83	22,13

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : temperature change required to move the valve shutter from "start to open" position to rated opening position

TABLE 6B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,3	1,25	1,2	1,14	1,09	1,03	0,97	0,9	0,84

# PRESSURE REGULATORS

## 6.2 – CRANKCASE PRESSURE REGULATORS

### APPLICATIONS

Crankcase pressure regulator in series 3320 is an accessory often used in low temperature cooling systems. It is designed to prevent the compressor motor from overloading when the intake pressure exceeds the manufacturer's recommended operating pressure. This can occur in many low temperature refrigeration systems during or after a defrosting cycle, or after an extended shut-down period. The crankcase pressure regulators in series 3320 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

Crankcase pressure regulators adjust the flow of hot gas according to changes of suction pressure, downstream the regulator. When the suction pressure is greater than the regulator calibration pressure, the shutter remains closed. As the suction pressure drops below the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in suction pressure. As the suction pressure continues to drop, 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. Crankcase pressure regulators only modulate based on the outlet pressure change, pressure changes on the inlet 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 crankcase pressure regulators in series 3320 is 2 bar. This means that until the suction pressure is above 2 bar the regulator remains closed. When the suction pressure drops below 2 bar 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 0.6 bar in calibration pressure. The calibration range varies from 0.2 to 6 bar.

### CONSTRUCTION

The main parts of the crankcase 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;
- Chloroprene rubber (CR) for outlet seal gaskets.

### INSTALLATION

Crankcase pressure regulators in series 3320 are installed in the suction line between the evaporator and the compressor. Normally there are no other components installed downstream of regulator 3320, between the valve outlet and the compressor. This is to ensure that the outlet of regulator senses the true crankcase pressure of the compressor.

### SELECTION

To correctly select crankcase 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;**
2. **Evaporator capacity**, at system working conditions;
3. **Designed evaporating temperature (saturated pressure) at design load condition;**
4. **Maximum allowable suction pressure.** Consult the compressor manufacturer for this value. This data identifies the valve calibration pressure;
5. **Allowable pressure drop across the valves at design load condition.**

The pressure difference between items 3 and 4 determines how much of the valve stroke is utilized. The valve calibration should be as high as possible without exceeding the compressor manufacturer's recommendation. When the full shutter stroke is used, the only way to increase the valve capacity is to accept an increase in the load loss across the valve. Since excessive suction line pressure losses penalize the system capacity, the pressure drop across regulator 3320 should be minimized. The lower the evaporator temperature, the lower the pressure drop allowed. The refrigeration capacities indicated in Tables 9A, 10A, 11A, 12A are based on a reference liquid temperature of 36.7 °C. With liquid temperatures other than 36.7 °C the required cooling capacity of regulator is:

$$\frac{Q_{\text{evap}}}{K_{T \text{ liquid}}} = Q_{\text{valve}}$$



where:

- $Q_{\text{evap}}$  = Evaporator capacity [kW]
- $K_{T \text{ liquid}}$  = Correction factor for  $T_{\text{liquid}} \neq 36.7 \text{ }^\circ\text{C}$ . (See Tables 9B, 10B, 11B, 12B.)
- $Q_{\text{valve}}$  = Refrigerating capacity requested at regulator. [kW]

### Example

- Refrigerant R404A
- Refrigeration yield of evaporator 4.5 [kW]
- Designed evaporating temperature -25 [°C]
- Max allowable suction pressure (regulator calibration) 3.5 [bar]
- Pressure drop across the regulator 0.07 [bar]
- Liquid temperature 35 [°C]
- Solder connections

1. Use Table 5B to determine the correction factor for the liquid temperature  $T_{\text{Liquid}} = 35 \text{ }^\circ\text{C}$ .

$$K_{T \text{ liquid}} = 1.03$$

2. Calculate the refrigerating capacity requested at regulator.

$$Q_{\text{valve}} = \frac{Q_{\text{evap}}}{K_{T \text{ liquid}}} = \frac{4.5}{1.03} = 4.36 \text{ kW}$$

3. With the following parameters:

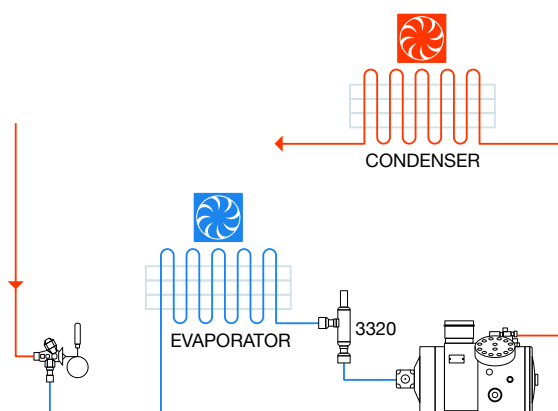
- Minimum cooling capacity = 4.36 kW;
- Evaporating temperature = -25 °C;
- Maximum allowable suction pressure = 3.5 bar;
- Pressure drop across the valve = 0.07 bar;

Select the right valve from Table 11A. The selected valves are:

- 3320/M12 with 12 mm diameter solder connections;
- 3320/4 with 1/2" diameter solder connections.

## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the capacity regulators in series 3320 with file SA33319. These regulators 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 405 PSI.



### Installation

Refrigerating system for applications with low evaporation temperatures. The regulator is installed on the suction pipe upstream of the compressor. The regulator opens when suction pressure drops below the calibrated value.

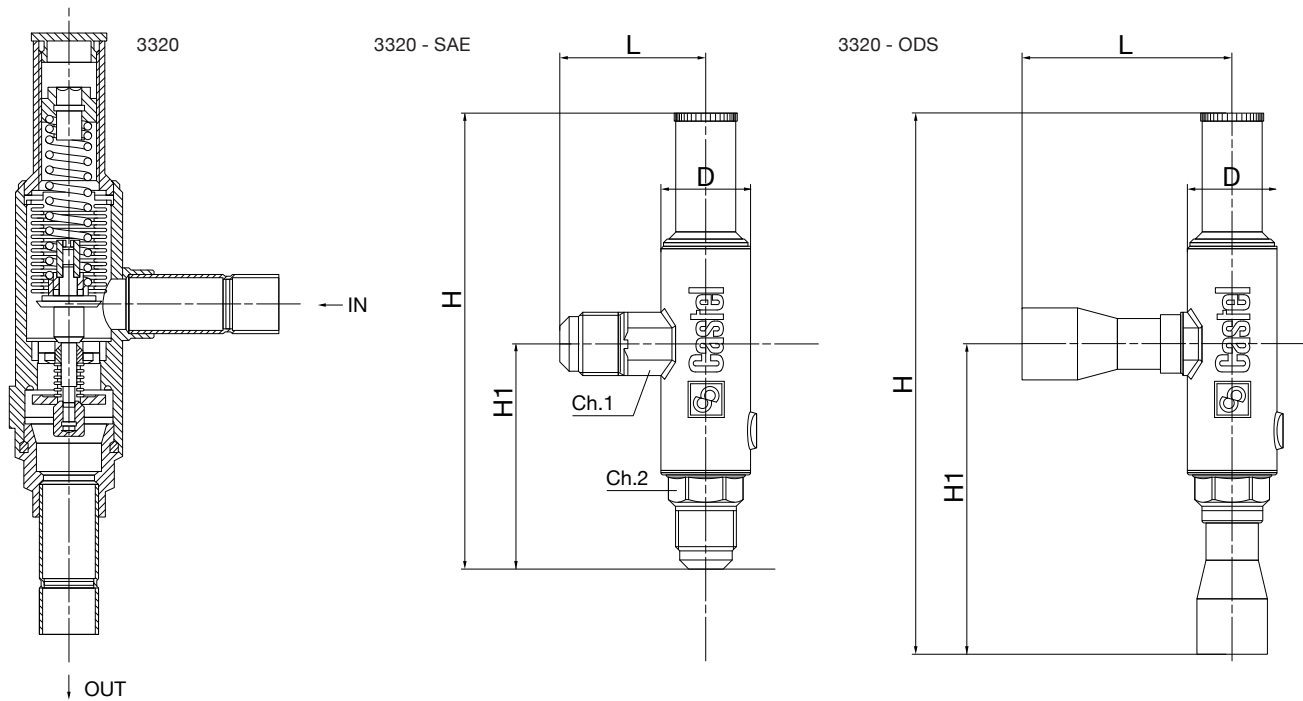


TABLE 7: GENERAL CHARACTERISTICS OF CRANCKCASE PRESSURE REGULATORS

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	
		Ø [in.]	Ø [mm]								
3320/4	1/2"	-	-	3,30	0,2	6	2	28	-40	+110	Art. 4.3
3320/M12S	-	-	12								
3320/4S	-	1/2"	-								
3320/5	5/8"	-	-								
3320/5S	-	5/8"	16								
3320/7S	-	7/8"	22								
3320/9S	-	1.1/8"	-	8							
3320/M28S	-	-	28								
3320/11S	-	1.3/8"	35								

TABLE 8: DIMENSIONS AND WEIGHTS OF CRANCKCASE PRESSURE REGULATORS

Catalogue Number	Dimensions [mm]						Weight [g]
	H	H <sub>1</sub>	L	D	Ch <sub>1</sub>	Ch <sub>2</sub>	
3320/4	159	76,5	48	32	22	24	470
3320/M12S	183	100,5	64		-	-	490
3320/4S	183	100,5	64		-	-	490
3320/5	163	80,5	52		22	24	550
3320/5S	183	100,5	64		-	-	480
3320/7S	194	112	75,5		-	-	550
3320/9S	263	151	105	46	-	-	1480
3320/M28S	263	151	105				1460
3320/11S	263	151	105				1490

TABLE 9A : REFRIGERANT FLOW CAPACITY OF CRANCKCASE PRESSURE REGULATORS 3320 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (1)	Design evaporator temperature [°C]										
			20	15	10	5	0	-5	-10	-15	-20	-25	
3320/4 3320/4S 3320/M12S	0,07	0,7	-	-	-	-	-	-	-	-	2,71	3,06	2,76
		1,4	-	-	-	-	4,38	4,34	3,90	3,51	3,98	3,58	
		2,1	-	-	-	6,96	6,26	5,63	5,07	4,56	5,17	4,65	
		3,5	-	-	6,89	8,63	7,77	6,99	6,45	5,81	5,23	4,70	
		4,2	-	5,57	8,56	9,47	8,52	7,67	6,90	6,21	5,59	5,03	
		5,5	-	6,92	8,61	9,49	8,54	7,69	6,92	6,23	5,60	5,04	
	0,14	0,7	-	-	-	-	-	-	-	3,87	4,38	3,94	
		1,4	-	-	-	-	6,26	6,20	5,58	5,02	5,68	5,11	
		2,1	-	-	-	9,94	8,94	8,05	7,24	6,52	7,38	6,64	
		3,5	-	-	9,85	12,33	11,10	9,99	9,22	8,30	7,47	6,72	
		4,2	-	7,95	12,23	13,53	12,17	10,96	9,86	8,87	7,99	7,19	
		5,5	-	9,88	12,29	13,56	12,20	10,98	9,89	8,90	8,01	7,21	
	0,21	0,7	-	-	-	-	-	-	-	3,91	4,43	3,99	
		1,4	-	-	-	-	6,34	6,27	5,65	5,08	5,75	5,18	
		2,1	-	-	-	10,06	9,05	8,15	7,33	6,60	7,47	6,72	
		3,5	-	-	9,97	12,48	11,23	10,11	9,33	8,40	7,56	6,80	
		4,2	-	8,07	12,38	13,69	12,32	11,09	9,98	8,98	8,08	7,28	
		5,5	-	10,03	12,44	13,72	12,35	11,12	10,01	9,00	8,10	7,29	
3320/5 3320/5S	0,07	0,7	-	-	-	-	-	-	-	3,37	3,82	3,44	
		1,4	-	-	-	-	5,46	5,41	4,87	4,38	4,96	4,46	
		2,1	-	-	-	8,67	7,80	7,02	6,32	5,69	6,44	5,80	
		3,5	-	-	8,58	10,76	9,68	8,71	8,05	7,24	6,52	5,86	
		4,2	-	6,56	10,65	11,80	10,62	9,56	8,60	7,74	6,97	6,27	
		5,5	-	8,15	10,71	11,83	10,65	9,58	8,63	7,76	6,99	6,29	
	0,14	0,7	-	-	-	-	-	-	-	4,73	5,36	4,82	
		1,4	-	-	-	-	8,67	7,59	6,83	6,15	6,96	6,26	
		2,1	-	-	-	12,17	10,95	9,86	8,87	7,99	9,04	8,13	
		3,5	-	-	12,03	15,10	13,59	12,23	11,29	10,16	9,15	8,23	
		4,2	-	9,15	14,95	16,56	14,91	13,42	12,08	10,87	9,78	8,80	
		5,5	-	11,37	15,03	16,61	14,95	13,45	12,11	10,90	9,81	8,83	
	0,21	0,7	-	-	-	-	-	-	-	4,82	5,45	4,91	
		1,4	-	-	-	-	7,80	7,73	6,95	6,26	7,08	6,38	
		2,1	-	-	-	12,39	11,15	10,03	9,03	8,13	9,20	8,28	
		3,5	-	-	12,25	15,37	13,83	12,45	11,49	10,34	9,31	8,38	
		4,2	-	9,37	15,22	16,86	15,17	13,66	12,29	11,06	9,96	8,96	
		5,5	-	11,64	15,30	16,90	15,21	13,69	12,32	11,09	9,98	8,98	
3320/7S	0,07	0,7	-	-	-	-	-	-	-	5,01	5,67	5,10	
		1,4	-	-	-	-	9,18	8,03	7,23	6,51	7,37	6,63	
		2,1	-	-	-	12,88	11,59	10,43	9,39	8,45	9,57	8,61	
		3,5	-	-	12,84	15,98	14,38	12,94	11,95	10,76	9,68	8,71	
		4,2	-	10,04	15,95	17,53	15,78	14,20	12,78	11,50	10,35	9,32	
		5,5	-	12,47	16,04	17,57	15,82	14,24	12,81	11,53	10,38	9,34	
	0,14	0,7	-	-	-	-	-	-	-	7,08	8,01	7,21	
		1,4	-	-	-	-	14,57	11,35	10,22	9,19	10,41	9,37	
		2,1	-	-	-	18,20	16,38	14,74	13,27	11,94	13,52	12,16	
		3,5	-	-	18,14	22,58	20,32	18,29	16,88	15,20	13,68	12,31	
		4,2	-	14,30	22,54	24,77	22,29	20,06	18,06	16,25	14,63	13,16	
		5,5	-	17,77	22,66	24,83	22,35	20,11	18,10	16,29	14,66	13,20	
	0,21	0,7	-	-	-	-	-	-	-	7,16	8,10	7,29	
		1,4	-	-	-	-	13,11	11,48	10,33	9,30	10,52	9,47	
		2,1	-	-	-	18,40	16,56	14,90	13,41	12,07	13,66	12,30	
		3,5	-	-	18,35	22,83	20,55	18,49	17,07	15,36	13,83	12,45	
		4,2	-	14,34	22,79	25,04	22,54	20,29	18,26	16,43	14,79	13,31	
		5,5	-	17,81	22,91	25,11	22,60	20,34	18,30	16,47	14,83	13,34	



Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (1)	Design evaporator temperature [°C]										
			20	15	10	5	0	-5	-10	-15	-20	-25	
3320/9S 3320/M28S	0,07	0,7	-	-	-	-	-	-	-	-	8,01	9,07	8,16
		1,4	-	-	-	-	12,98	12,85	11,56	10,41	11,78	10,60	
		2,1	-	-	-	20,60	18,54	16,69	15,02	13,52	15,30	13,77	
		3,5	-	-	20,38	25,56	23,00	20,70	19,11	17,20	15,48	13,93	
		4,2	-	15,58	25,31	28,04	25,24	22,71	20,44	18,40	16,56	14,90	
		5,5	-	19,36	25,44	28,11	25,30	22,77	20,49	18,44	16,60	14,94	
	0,14	0,7	-	-	-	-	-	-	-	11,25	12,73	11,46	
		1,4	-	-	-	-	20,60	18,03	16,23	14,61	16,53	14,88	
		2,1	-	-	-	28,91	26,02	23,42	21,08	18,97	21,47	19,32	
		3,5	-	-	28,59	35,87	32,29	29,06	26,83	24,14	21,73	19,56	
		4,2	-	21,74	35,52	39,35	35,42	31,88	28,69	25,82	23,24	20,91	
		5,5	-	27,01	35,70	39,45	35,51	31,96	28,76	25,88	23,30	20,97	
	0,21	0,7	-	-	-	-	-	-	-	11,45	12,96	11,66	
		1,4	-	-	-	-	18,54	18,36	16,52	14,87	16,83	15,15	
		2,1	-	-	-	29,43	26,49	23,84	21,46	19,31	21,86	19,67	
		3,5	-	-	29,11	36,52	32,86	29,58	27,31	24,57	22,12	19,91	
		4,2	-	22,26	36,16	40,06	36,05	32,45	29,20	26,28	23,65	21,29	
		5,5	-	27,65	36,35	40,16	36,14	32,53	29,27	26,35	23,71	21,34	
3320/11S	0,07	0,7	-	-	-	-	-	-	-	11,90	13,47	12,13	
		1,4	-	-	-	-	21,80	19,09	17,18	15,46	17,50	15,75	
		2,1	-	-	-	30,60	27,54	24,79	22,31	20,08	22,72	20,45	
		3,5	-	-	30,51	37,97	34,17	30,75	28,39	25,55	23,00	20,70	
		4,2	-	23,84	37,90	41,65	37,48	33,74	30,36	27,33	24,59	22,13	
		5,5	-	29,62	38,10	41,75	37,58	33,82	30,44	27,39	24,66	22,19	
	0,14	0,7	-	-	-	-	-	-	-	16,82	19,04	17,13	
		1,4	-	-	-	-	34,61	26,97	24,27	21,84	24,72	22,25	
		2,1	-	-	-	43,24	38,91	35,02	31,52	28,37	32,11	28,90	
		3,5	-	-	43,11	53,64	48,28	43,45	40,11	36,10	32,49	29,24	
		4,2	-	33,98	53,55	58,85	52,96	47,67	42,90	38,61	34,75	31,27	
		5,5	-	42,22	53,83	59,00	53,10	47,79	43,01	38,71	34,84	31,35	
	0,21	0,7	-	-	-	-	-	-	-	17,01	19,25	17,32	
		1,4	-	-	-	-	31,15	27,27	24,54	22,09	25,00	22,50	
		2,1	-	-	-	43,72	39,34	35,41	31,87	28,68	32,46	29,22	
		3,5	-	-	43,59	54,24	48,81	43,93	40,56	36,50	32,85	29,57	
		4,2	-	34,06	54,14	59,50	53,55	48,19	43,38	39,04	35,13	31,62	
		5,5	-	42,31	54,43	59,65	53,68	48,32	43,48	39,14	35,22	31,70	

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : This value is the valve pressure setting

TABLE 9B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,28	1,23	1,18	1,13	1,08	1,03	0,97	0,92	0,86

TABLE 10A : REFRIGERANT FLOW CAPACITY OF CRANCKCASE PRESSURE REGULATORS 3320 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (t)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/4 3320/4S 3320/M12S	0,07	0,7	-	-	-	-	-	-	-	-	-	3,06	2,76
		1,4	-	-	-	-	-	4,09	3,68	3,31	3,98	3,58	
		2,1	-	-	5,19	6,55	5,90	5,31	4,78	4,30	5,17	4,65	
		3,5	-	5,15	6,44	8,13	7,31	6,58	6,45	5,81	5,23	4,70	
		4,2	-	6,38	7,99	8,91	8,02	7,22	6,50	5,85	5,26	4,74	
		5,5	-	6,44	8,04	8,93	8,03	7,23	6,51	5,86	5,27	4,74	
	0,14	0,7	-	-	-	-	-	-	-	-	-	4,38	3,94
		1,4	-	-	-	-	-	5,84	5,25	4,73	5,68	5,11	
		2,1	-	-	7,42	9,36	8,42	7,58	6,82	6,14	7,38	6,64	
		3,5	-	7,35	9,20	11,61	10,45	9,40	9,22	8,30	7,47	6,72	
		4,2	-	9,11	11,42	12,73	11,46	10,31	9,28	8,35	7,52	6,77	
		5,5	-	9,20	11,48	12,75	11,48	10,33	9,29	8,37	7,53	6,78	
	0,21	0,7	-	-	-	-	-	-	-	-	-	4,41	3,97
		1,4	-	-	-	-	-	5,89	5,30	4,77	5,73	5,16	
		2,1	-	-	7,37	9,44	8,50	7,65	6,88	6,19	7,44	6,70	
		3,5	-	7,24	9,14	11,71	10,54	9,49	9,30	8,37	7,53	6,78	
		4,2	-	8,97	11,35	12,84	11,56	10,40	9,36	8,42	7,58	6,82	
		5,5	-	9,06	11,41	12,86	11,57	10,42	9,37	8,44	7,59	6,83	
3320/5 3320/5S	0,07	0,7	-	-	-	-	-	-	-	-	3,80	3,42	
		1,4	-	-	-	-	-	5,06	4,56	4,10	4,93	4,44	
		2,1	-	-	6,44	8,12	7,31	6,58	5,92	5,33	6,40	5,76	
		3,5	-	6,16	7,99	10,07	9,07	8,16	8,00	7,20	6,48	5,83	
		4,2	-	7,63	9,91	11,04	9,94	8,95	8,05	7,25	6,52	5,87	
		5,5	-	7,71	9,96	11,06	9,96	8,96	8,06	7,26	6,53	5,88	
	0,14	0,7	-	-	-	-	-	-	-	-	-	5,34	4,81
		1,4	-	-	-	-	-	7,13	6,41	5,77	6,94	6,24	
		2,1	-	-	9,06	11,42	10,28	9,25	8,33	7,50	9,01	8,11	
		3,5	-	8,63	11,24	14,17	12,75	11,48	11,25	10,13	9,11	8,20	
		4,2	-	10,69	13,95	15,54	13,98	12,58	11,33	10,19	9,17	8,26	
		5,5	-	10,80	14,02	15,56	14,01	12,60	11,34	10,21	9,19	8,27	
	0,21	0,7	-	-	-	-	-	-	-	-	-	5,42	4,88
		1,4	-	-	-	-	-	7,24	6,51	5,86	7,04	6,34	
		2,1	-	-	9,20	11,60	10,44	9,40	8,46	7,61	9,15	8,23	
		3,5	-	8,80	11,41	14,39	12,95	11,66	11,43	10,28	9,26	8,33	
		4,2	-	10,90	14,16	15,78	14,20	12,78	11,50	10,35	9,32	8,39	
		5,5	-	11,01	14,23	15,80	14,22	12,80	11,52	10,37	9,33	8,40	
3320/7S	0,07	0,7	-	-	-	-	-	-	-	-	5,68	5,11	
		1,4	-	-	-	-	-	7,58	6,82	6,14	7,38	6,64	
		2,1	-	-	9,70	12,15	10,94	9,84	8,86	7,97	9,58	8,62	
		3,5	-	8,71	12,02	15,07	13,56	12,21	11,97	10,77	9,69	8,73	
		4,2	-	10,79	14,92	16,52	14,87	13,39	12,05	10,84	9,76	8,78	
		5,5	-	10,90	15,00	16,55	14,90	13,41	12,07	10,86	9,77	8,80	
	0,14	0,7	-	-	-	-	-	-	-	-	-	7,99	7,19
		1,4	-	-	-	-	-	10,65	9,59	8,63	10,37	9,33	
		2,1	-	-	13,63	17,08	15,38	13,84	12,45	11,21	13,47	12,12	
		3,5	-	12,17	16,90	21,19	19,07	17,16	16,83	15,15	13,63	12,27	
		4,2	-	15,08	20,98	23,23	20,91	18,82	16,94	15,24	13,72	12,35	
		5,5	-	15,23	21,09	23,27	20,94	18,85	16,96	15,27	13,74	12,37	
	0,21	0,7	-	-	-	-	-	-	-	-	-	8,11	7,30
		1,4	-	-	-	-	-	10,83	9,74	8,77	10,54	9,48	
		2,1	-	-	13,85	17,36	15,62	14,06	12,65	11,39	13,69	12,32	
		3,5	-	12,44	17,18	21,53	19,38	17,44	17,10	15,39	13,85	12,46	
		4,2	-	15,42	21,32	23,61	21,25	19,12	17,21	15,49	13,94	12,55	

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (1)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/9S 3320/M28S	0,07	5,5	–	15,57	21,43	23,64	21,28	19,15	17,24	15,51	13,96	12,57	
		0,7	–	–	–	–	–	–	–	–	9,02	8,12	
		1,4	–	–	–	–	–	12,03	10,83	9,75	11,71	10,54	
		2,1	–	–	15,30	19,29	17,36	15,63	14,06	12,66	15,21	13,69	
		3,5	–	14,63	18,97	23,93	21,54	19,38	19,00	17,10	15,39	13,85	
		4,2	–	18,13	23,55	26,24	23,62	21,25	19,13	17,22	15,49	13,94	
		5,5	–	18,31	23,67	26,28	23,65	21,29	19,16	17,24	15,52	13,97	
	0,14	0,7	–	–	–	–	–	–	–	–	12,69	11,42	
		1,4	–	–	–	–	–	16,93	15,23	13,71	16,48	14,83	
		2,1	–	–	21,53	27,14	24,43	21,98	19,79	17,81	21,40	19,26	
		3,5	–	20,50	26,70	33,66	30,30	27,27	26,73	24,06	21,65	19,49	
		4,2	–	25,41	33,14	36,91	33,22	29,90	26,91	24,22	21,80	19,62	
		5,5	–	25,66	33,32	36,97	33,27	29,95	26,95	24,26	21,83	19,65	
	0,21	0,7	–	–	–	–	–	–	–	–	12,88	11,60	
		1,4	–	–	–	–	–	17,19	15,47	13,92	16,73	15,06	
		2,1	–	–	21,86	27,56	24,81	22,33	20,09	18,08	21,73	19,56	
		3,5	–	20,90	27,10	34,19	30,77	27,69	27,15	24,43	21,99	19,79	
		4,2	–	25,90	33,64	37,49	33,74	30,36	27,33	24,59	22,13	19,92	
		5,5	–	26,16	33,82	37,54	33,79	30,41	27,37	24,63	22,17	19,95	
	3320/11S	0,07	0,7	–	–	–	–	–	–	–	–	13,49	12,14
			1,4	–	–	–	–	–	18,00	16,20	14,58	17,53	15,77
2,1			–	–	23,04	28,87	25,98	23,38	21,04	18,94	22,76	20,48	
3,5			–	20,69	28,56	35,81	32,22	29,00	28,43	25,59	23,03	20,73	
4,2			–	25,64	35,46	39,26	35,33	31,80	28,62	25,76	23,18	20,86	
5,5			–	25,89	35,64	39,32	35,39	31,85	28,66	25,80	23,22	20,90	
0,14		0,7	–	–	–	–	–	–	–	–	18,97	17,08	
		1,4	–	–	–	–	–	25,31	22,78	20,50	24,64	22,18	
		2,1	–	–	32,39	40,59	36,53	32,87	29,59	26,63	32,00	28,80	
		3,5	–	28,91	40,15	50,34	45,31	40,78	39,98	35,98	32,38	29,14	
		4,2	–	35,83	49,84	55,20	49,68	44,71	40,24	36,22	32,59	29,33	
		5,5	–	36,18	50,11	55,29	49,76	44,78	40,30	36,27	32,65	29,38	
0,21		0,7	–	–	–	–	–	–	–	–	19,28	17,35	
		1,4	–	–	–	–	–	25,72	23,15	20,83	25,04	22,53	
		2,1	–	–	32,91	41,24	37,11	33,40	30,06	27,06	32,51	29,26	
		3,5	–	29,55	40,80	51,15	46,04	41,43	40,62	36,56	32,90	29,61	
		4,2	–	36,63	50,65	56,08	50,48	45,43	40,89	36,80	33,12	29,81	
		5,5	–	36,99	50,92	56,17	50,56	45,50	40,95	36,85	33,17	29,85	

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : This value is the valve pressure setting

TABLE 10B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,23	1,19	1,16	1,11	1,06	1,01	0,98	0,94	0,9

TABLE 11A : REFRIGERANT FLOW CAPACITY OF CRANCKCASE PRESSURE REGULATORS 3320 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (t)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/4 3320/4S 3320/M12S	0,07	0,7	-	-	-	-	-	-	-	-	-	3,06	2,76
		1,4	-	-	-	-	-	3,62	3,26	2,93	3,98	3,58	
		2,1	-	-	-	5,81	5,23	4,70	4,23	3,81	5,17	4,65	
		3,5	-	3,65	5,72	7,20	6,48	5,83	6,45	5,81	5,23	4,70	
		4,2	-	4,53	7,11	7,90	7,11	6,40	5,76	5,18	4,67	4,20	
		5,5	-	5,63	7,14	7,92	7,13	6,42	5,77	5,20	4,68	4,21	
	0,14	0,7	-	-	-	-	-	-	-	-	-	4,38	3,94
		1,4	-	-	-	-	-	5,17	4,66	4,19	5,68	5,11	
		2,1	-	-	-	8,29	7,46	6,72	6,05	5,44	7,38	6,64	
		3,5	-	5,21	8,17	10,29	9,26	8,33	9,22	8,30	7,47	6,72	
		4,2	-	6,47	10,15	11,29	10,16	9,14	8,23	7,41	6,67	6,00	
		5,5	-	8,04	10,20	11,32	10,18	9,17	8,25	7,42	6,68	6,01	
	0,21	0,7	-	-	-	-	-	-	-	-	-	4,40	3,96
		1,4	-	-	-	-	-	5,20	4,68	4,21	5,72	5,14	
		2,1	-	-	-	8,34	7,51	6,76	6,08	5,47	7,42	6,68	
		3,5	-	5,16	8,12	10,35	9,32	8,38	9,27	8,35	7,51	6,76	
		4,2	-	6,42	10,09	11,35	10,22	9,20	8,28	7,45	6,70	6,03	
		5,5	-	7,97	10,14	11,38	10,24	9,22	8,30	7,47	6,72	6,05	
3320/5 3320/5S	0,07	0,7	-	-	-	-	-	-	-	-	-	3,80	3,42
		1,4	-	-	-	-	-	4,49	4,04	3,63	4,93	4,44	
		2,1	-	-	-	7,19	6,47	5,83	5,24	4,72	6,40	5,76	
		3,5	-	4,39	7,05	8,93	8,03	7,23	8,00	7,20	6,48	5,83	
		4,2	-	5,45	8,76	9,79	8,81	7,93	7,14	6,42	5,78	5,20	
		5,5	-	6,77	8,80	9,82	8,83	7,95	7,16	6,44	5,80	5,22	
	0,14	0,7	-	-	-	-	-	-	-	-	-	5,32	4,79
		1,4	-	-	-	-	-	6,29	5,66	5,10	6,91	6,22	
		2,1	-	-	-	10,09	9,08	8,17	7,36	6,62	8,98	8,08	
		3,5	-	6,10	9,87	12,52	11,27	10,14	11,22	10,10	9,09	8,18	
		4,2	-	7,58	12,26	13,73	12,36	11,12	10,01	9,01	8,11	7,30	
		5,5	-	9,42	12,32	13,77	12,39	11,15	10,04	9,03	8,13	7,32	
	0,21	0,7	-	-	-	-	-	-	-	-	-	5,42	4,88
		1,4	-	-	-	-	-	6,41	5,77	5,19	7,04	6,34	
		2,1	-	-	-	10,28	9,25	8,32	7,49	6,74	9,14	8,23	
		3,5	-	6,27	10,07	12,75	11,48	10,33	11,42	10,28	9,25	8,33	
		4,2	-	7,78	12,51	13,99	12,59	11,33	10,20	9,18	8,26	7,43	
		5,5	-	9,67	12,58	14,02	12,62	11,36	10,22	9,20	8,28	7,45	
3320/7S	0,07	0,7	-	-	-	-	-	-	-	-	-	5,68	5,11
		1,4	-	-	-	-	-	6,71	6,04	5,44	7,38	6,64	
		2,1	-	-	-	10,76	9,69	8,72	7,85	7,06	9,58	8,62	
		3,5	-	6,71	10,66	13,36	12,02	10,82	11,97	10,77	9,69	8,72	
		4,2	-	8,33	13,24	14,65	13,19	11,87	10,68	9,61	8,65	7,79	
		5,5	-	10,35	13,31	14,69	13,22	11,90	10,71	9,64	8,67	7,81	
	0,14	0,7	-	-	-	-	-	-	-	-	-	7,96	7,16
		1,4	-	-	-	-	-	9,41	8,47	7,62	10,34	9,30	
		2,1	-	-	-	15,09	13,58	12,22	11,00	9,90	13,43	12,08	
		3,5	-	9,35	14,92	18,72	16,85	15,16	16,77	15,10	13,59	12,23	
		4,2	-	11,62	18,54	20,54	18,48	16,63	14,97	13,47	12,13	10,91	
		5,5	-	14,43	18,64	20,59	18,53	16,68	15,01	13,51	12,16	10,94	
	0,21	0,7	-	-	-	-	-	-	-	-	-	8,11	7,30
		1,4	-	-	-	-	-	9,59	8,63	7,77	10,54	9,48	
		2,1	-	-	-	15,38	13,84	12,46	11,21	10,09	13,68	12,32	
		3,5	-	9,58	15,23	19,08	17,17	15,45	17,10	15,39	13,85	12,46	
		4,2	-	11,91	18,92	20,93	18,84	16,95	15,26	13,73	12,36	11,12	
		5,5	-	14,79	19,02	20,98	18,88	17,00	15,30	13,77	12,39	11,15	

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (1)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/9S 3320/M28S	0,07	0,7	-	-	-	-	-	-	-	-	-	9,02	8,11
		1,4	-	-	-	-	-	10,66	9,59	8,63	11,71	10,54	
		2,1	-	-	-	17,09	15,38	13,84	12,46	11,21	15,21	13,69	
		3,5	-	10,42	16,75	21,20	19,08	17,17	19,00	17,10	15,39	13,85	
		4,2	-	12,95	20,80	23,26	20,93	18,84	16,96	15,26	13,74	12,36	
		5,5	-	16,08	20,91	23,32	20,99	18,89	17,00	15,30	13,77	12,39	
	0,14	0,7	-	-	-	-	-	-	-	-	-	12,65	11,38
		1,4	-	-	-	-	-	14,95	13,46	12,11	16,43	14,78	
		2,1	-	-	-	23,97	21,58	19,42	17,48	15,73	21,33	19,20	
		3,5	-	14,50	23,45	29,74	26,77	24,09	26,65	23,99	21,59	19,43	
		4,2	-	18,02	29,13	32,63	29,37	26,43	23,79	21,41	19,27	17,34	
		5,5	-	22,38	29,28	32,71	29,44	26,50	23,85	21,46	19,32	17,38	
	0,21	0,7	-	-	-	-	-	-	-	-	-	12,88	11,59
		1,4	-	-	-	-	-	15,23	13,70	12,33	16,73	15,06	
		2,1	-	-	-	24,41	21,97	19,78	17,80	16,02	21,72	19,55	
		3,5	-	14,89	23,93	30,29	27,26	24,54	27,14	24,43	21,98	19,79	
		4,2	-	18,49	29,72	33,23	29,91	26,92	24,22	21,80	19,62	17,66	
		5,5	-	22,97	29,88	33,31	29,98	26,98	24,28	21,86	19,67	17,70	
3320/11S	0,07	0,7	-	-	-	-	-	-	-	-	-	13,49	12,14
		1,4	-	-	-	-	-	15,95	14,36	12,92	17,52	15,77	
		2,1	-	-	-	25,57	23,02	20,72	18,64	16,78	22,76	20,48	
		3,5	-	15,94	25,33	31,73	28,56	25,70	28,43	25,59	23,03	20,73	
		4,2	-	19,80	31,46	34,81	31,33	28,19	25,38	22,84	20,55	18,50	
		5,5	-	24,60	31,63	34,90	31,41	28,27	25,44	22,89	20,61	18,54	
	0,14	0,7	-	-	-	-	-	-	-	-	-	18,91	17,02
		1,4	-	-	-	-	-	22,36	20,12	18,11	24,56	22,10	
		2,1	-	-	-	35,85	32,26	29,04	26,13	23,52	31,90	28,71	
		3,5	-	22,22	35,46	44,47	40,03	36,02	39,85	35,86	32,28	29,05	
		4,2	-	27,60	44,05	48,79	43,91	39,52	35,57	32,01	28,81	25,93	
		5,5	-	34,28	44,28	48,91	44,02	39,62	35,66	32,09	28,88	25,99	
	0,21	0,7	-	-	-	-	-	-	-	-	-	19,28	17,35
		1,4	-	-	-	-	-	22,79	20,51	18,46	25,03	22,53	
		2,1	-	-	-	36,54	32,88	29,59	26,63	23,97	32,51	29,26	
		3,5	-	22,77	36,18	45,33	40,80	36,72	40,62	36,55	32,90	29,61	
		4,2	-	28,29	44,95	49,73	44,75	40,28	36,25	32,63	29,36	26,43	
		5,5	-	35,14	45,18	49,85	44,87	40,38	36,34	32,71	29,44	26,49	

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : This value is the valve pressure setting

TABLE 11B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,43	1,35	1,28	1,2	1,12	1,03	0,95	0,86	0,76

# R407C

TABLE 12A : REFRIGERANT FLOW CAPACITY OF CRANCKCASE PRESSURE REGULATORS 3320 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (t)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/4 3320/4S 3320/M12S	0,07	0,7	-	-	-	-	-	-	-	-	-	3,06	2,76
		1,4	-	-	-	-	-	4,18	3,77	3,39	3,98	3,58	
		2,1	-	-	5,20	6,71	6,04	5,43	4,89	4,40	5,17	4,65	
		3,5	-	4,71	6,45	8,32	7,49	6,74	6,45	5,81	5,23	4,70	
		4,2	5,22	5,85	8,01	9,13	8,22	7,40	6,66	5,99	5,39	4,85	
		5,5	6,49	7,27	8,05	9,15	8,24	7,41	6,67	6,01	5,40	4,86	
	0,14	0,7	-	-	-	-	-	-	-	-	-	4,38	3,94
		1,4	-	-	-	-	-	5,98	5,38	4,84	5,68	5,11	
		2,1	-	-	7,42	9,58	8,63	7,76	6,99	6,29	7,38	6,64	
		3,5	-	6,73	9,21	11,89	10,70	9,63	9,22	8,30	7,47	6,72	
		4,2	7,46	8,36	11,44	13,04	11,74	10,57	9,51	8,56	7,70	6,93	
		5,5	9,27	10,38	11,50	13,08	11,77	10,59	9,53	8,58	7,72	6,95	
	0,21	0,7	-	-	-	-	-	-	-	-	-	4,41	3,96
		1,4	-	-	-	-	-	6,02	5,42	4,87	5,72	5,15	
		2,1	-	-	7,34	9,65	8,68	7,81	7,03	6,33	7,43	6,69	
		3,5	-	6,65	9,11	11,97	10,77	9,70	9,28	8,35	7,52	6,77	
		4,2	7,37	8,26	11,32	13,13	11,82	10,64	9,57	8,62	7,75	6,98	
		5,5	9,15	10,26	11,38	13,16	11,85	10,66	9,60	8,64	7,77	7,00	
3320/5 3320/5S	0,07	0,7	-	-	-	-	-	-	-	-	3,80	3,42	
		1,4	-	-	-	-	-	5,19	4,67	4,20	4,93	4,44	
		2,1	-	-	6,62	8,32	7,48	6,74	6,06	5,46	6,40	5,76	
		3,5	-	5,85	8,22	10,32	9,29	8,36	8,00	7,20	6,48	5,83	
		4,2	6,27	7,27	10,21	11,32	10,19	9,17	8,25	7,43	6,68	6,02	
		5,5	7,79	9,03	10,26	11,35	10,21	9,19	8,27	7,44	6,70	6,03	
	0,14	0,7	-	-	-	-	-	-	-	-	-	5,33	4,80
		1,4	-	-	-	-	-	7,28	6,56	5,90	6,93	6,23	
		2,1	-	-	9,30	11,68	10,51	9,46	8,51	7,66	8,99	8,09	
		3,5	-	8,19	11,54	14,49	13,04	11,74	11,24	10,11	9,10	8,19	
		4,2	8,76	10,18	14,33	15,90	14,31	12,88	11,59	10,43	9,39	8,45	
		5,5	10,88	12,64	14,40	15,94	14,34	12,91	11,62	10,46	9,41	8,47	
	0,21	0,7	-	-	-	-	-	-	-	-	-	5,42	4,88
		1,4	-	-	-	-	-	7,41	6,67	6,00	7,04	6,34	
		2,1	-	-	9,46	11,88	10,69	9,62	8,66	7,79	9,15	8,23	
		3,5	-	8,35	11,74	14,74	13,27	11,94	11,43	10,29	9,26	8,33	
		4,2	8,96	10,38	14,58	16,17	14,55	13,10	11,79	10,61	9,55	8,59	
		5,5	11,13	12,89	14,66	16,21	14,59	13,13	11,82	10,64	9,57	8,61	
3320/7S	0,07	0,7	-	-	-	-	-	-	-	-	5,68	5,11	
		1,4	-	-	-	-	-	7,76	6,98	6,28	7,38	6,64	
		2,1	-	-	9,94	12,44	11,20	10,08	9,07	8,16	9,58	8,62	
		3,5	-	8,86	12,33	15,44	13,89	12,50	11,97	10,77	9,69	8,73	
		4,2	9,61	11,00	15,32	16,93	15,24	13,72	12,34	11,11	10,00	9,00	
		5,5	11,94	13,67	15,40	16,97	15,28	13,75	12,37	11,14	10,02	9,02	
	0,14	0,7	-	-	-	-	-	-	-	-	-	7,97	7,17
		1,4	-	-	-	-	-	10,89	9,80	8,82	10,35	9,32	
		2,1	-	-	14,09	17,46	15,71	14,14	12,73	11,45	13,44	12,10	
		3,5	-	12,54	17,48	21,66	19,49	17,54	16,80	15,12	13,60	12,24	
		4,2	13,59	15,58	21,71	23,76	21,38	19,25	17,32	15,59	14,03	12,63	
		5,5	16,88	19,35	21,82	23,82	21,44	19,29	17,37	15,63	14,07	12,66	
	0,21	0,7	-	-	-	-	-	-	-	-	-	8,11	7,30
		1,4	-	-	-	-	-	11,08	9,98	8,98	10,54	9,48	
		2,1	-	-	14,20	17,77	16,00	14,40	12,96	11,66	13,69	12,32	
		3,5	-	12,65	17,61	22,05	19,85	17,86	17,10	15,39	13,85	12,46	
		4,2	13,73	15,72	21,88	24,19	21,77	19,59	17,63	15,87	14,28	12,85	
		5,5	17,05	19,52	21,99	24,25	21,82	19,64	17,68	15,91	14,32	12,89	

Catalogue Number	Pressure drop across regulator [bar]	Max allowable suction pressure [bar] (1)	Design evaporator temperature [°C]										
			4,4	0	-5	-10	-15	-20	-25	-30	-35	-40	
3320/9S 3320/M28S	0,07	0,7	-	-	-	-	-	-	-	-	-	9,02	8,12
		1,4	-	-	-	-	-	12,32	11,09	9,98	11,72	10,54	
		2,1	-	-	15,73	19,76	17,78	16,00	14,40	12,96	15,22	13,69	
		3,5	-	13,89	19,52	24,51	22,06	19,86	19,01	17,11	15,40	13,86	
		4,2	14,90	17,26	24,25	26,89	24,20	21,78	19,60	17,64	15,88	14,29	
		5,5	18,51	21,44	24,37	26,96	24,26	21,84	19,65	17,69	15,92	14,33	
	0,14	0,7	-	-	-	-	-	-	-	-	-	12,67	11,40
		1,4	-	-	-	-	-	17,31	15,57	14,02	16,45	14,81	
		2,1	-	-	22,09	27,75	24,97	22,47	20,23	18,20	21,37	19,23	
		3,5	-	19,46	27,41	34,42	30,98	27,88	26,69	24,02	21,62	19,46	
		4,2	20,81	24,18	34,04	37,76	33,99	30,59	27,53	24,78	22,30	20,07	
		5,5	25,85	30,03	34,22	37,86	34,07	30,67	27,60	24,84	22,35	20,12	
	0,21	0,7	-	-	-	-	-	-	-	-	-	12,89	11,60
		1,4	-	-	-	-	-	17,60	15,84	14,26	16,74	15,06	
		2,1	-	-	22,47	28,23	25,40	22,86	20,58	18,52	21,74	19,56	
		3,5	-	19,85	27,88	35,02	31,52	28,37	27,15	24,44	22,00	19,80	
		4,2	21,29	24,66	34,64	38,42	34,57	31,12	28,00	25,20	22,68	20,42	
		5,5	26,44	30,63	34,82	38,51	34,66	31,19	28,07	25,27	22,74	20,47	
3320/11S	0,07	0,7	-	-	-	-	-	-	-	-	-	13,49	12,15
		1,4	-	-	-	-	-	18,43	16,59	14,93	17,53	15,77	
		2,1	-	-	23,61	29,56	26,60	23,94	21,55	19,39	22,76	20,48	
		3,5	-	21,04	29,29	36,67	33,00	29,70	28,44	25,59	23,03	20,73	
		4,2	22,83	26,13	36,39	40,23	36,20	32,58	29,33	26,39	23,75	21,38	
		5,5	28,35	32,47	36,58	40,33	36,29	32,67	29,40	26,46	23,81	21,43	
	0,14	0,7	-	-	-	-	-	-	-	-	-	18,94	17,04
		1,4	-	-	-	-	-	25,87	23,28	20,95	24,59	22,13	
		2,1	-	-	33,47	41,48	37,33	33,60	30,24	27,21	31,94	28,75	
		3,5	-	29,79	41,52	51,46	46,31	41,68	39,90	35,91	32,32	29,09	
		4,2	32,28	37,01	51,58	56,45	50,81	45,72	41,15	37,04	33,33	30,00	
		5,5	40,10	45,97	51,85	56,59	50,93	45,84	41,26	37,13	33,42	30,08	
	0,21	0,7	-	-	-	-	-	-	-	-	-	19,28	17,35
		1,4	-	-	-	-	-	26,33	23,70	21,33	25,04	22,53	
		2,1	-	-	33,73	42,22	38,00	34,20	30,78	27,70	32,52	29,26	
		3,5	-	30,05	41,85	52,39	47,15	42,43	40,62	36,56	32,90	29,61	
		4,2	32,61	37,34	51,98	57,47	51,72	46,55	41,89	37,70	33,93	30,54	
		5,5	40,51	46,38	52,25	57,61	51,85	46,66	42,00	37,80	34,02	30,62	

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : This value is the valve pressure setting

TABLE 12B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,3	1,25	1,2	1,14	1,09	1,03	0,97	0,9	0,84



# PRESSURE REGULATORS

## 6.3 – EVAPORATING PRESSURE REGULATORS

### APPLICATIONS

Evaporating pressure regulator in series 3330 is an accessory designed to maintain a constant evaporating pressure and thereby a constant surface temperature on the evaporator under varying evaporator loads. This regulator prevents too low evaporating pressure and therefore protects the water chiller from freezing or the formation of ice in air evaporators. These regulators allow multiple evaporators to operate at different temperatures in a system with only one compressor.

The evaporating pressure regulators in series 3330 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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 3330 is 2 bar. This means that until the evaporating pressure is less than 2 bar the regulator remains closed. When it rises above 2 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 0.5 bar in calibration pressure (0.3 bar for models 3330/9S, 3330/M28S, and 3330/11S). The calibration range varies from 0.2 to 5.5 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;
- Chloroprene rubber (CR) for outlet seal gaskets.

### INSTALLATION

Evaporating pressure regulators in series 3330 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 the same evaporating temperature is required**. In this case the evaporating pressure regulator is installed on the common suction line (installation example 1).

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 (installation example 2).

### 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;**
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 on Tables 15A, 16A, 17A, 18A are calculated as a function of:

- A liquid reference temperature of 36.7 °C;
- An allowable variation in evaporating pressure of 0.56 bar.

With liquid temperatures other than 36.7 °C and for variations in evaporating pressure other than 0.56 bar, the required cooling capacity of regulator is:



$$\frac{Q_{\text{evap}}}{K_{T \text{ liquid}} \cdot K_{\Delta P \text{ evap}}} = Q_{\text{valve}}$$

where:

- $Q_{\text{evap}}$  = Evaporator capacity [kW];
- $K_{T \text{ liquid}}$  = Correction factor for  $T_{\text{liquid}} \neq 36.7 \text{ }^\circ\text{C}$  (See Tables 15B, 16B, 17B, 18B.);
- $K_{\Delta P \text{ evap}}$  = Correction factor for  $\Delta P \text{ valve} \neq 0.56 \text{ bar}$  (See Tables 15C, 16C, 17C, 18C);
- $Q_{\text{valve}}$  = Refrigerating capacity requested at regulator [kW].

### Example

- Refrigerant R404A
- Refrigeration yield of evaporator 4 [kW]
- Designed evaporating temperature 0 [°C] (corresponding to 5 [bar])
- Min. allowable suction temperature (regulator calibration) - 5 [°C] (corresponding to 4.2 [bar])
- Pressure drop across the regulator 0.42 [bar]
- Liquid temperature 40 [°C]
- Solder connections

1. Use Table 17B to determine the correction factor for the liquid temperature  $T_{\text{Liquid}} = 40 \text{ }^\circ\text{C}$ .

$$K_{T \text{ liquid}} = 0.95$$

2. Using Table 17C, determine the correction factor for the variation in the evaporating pressure.

$$\Delta P = P_{T \text{ progetto}} - P_{T \text{ min asp}} = 5 - 4.2 = 0.8 \text{ bar}$$

$$K_{DP \text{ evap}} = 1.3$$

3. Calculate the evaporating temperature change.

$$Q_{\text{valve}} = \frac{Q_{\text{evap}}}{K_{T \text{ liquid}} \cdot K_{\Delta P \text{ evap}}} = \frac{4}{0.95 \cdot 1.3} = 3.23 \text{ kW}$$

4. With the following parameters:

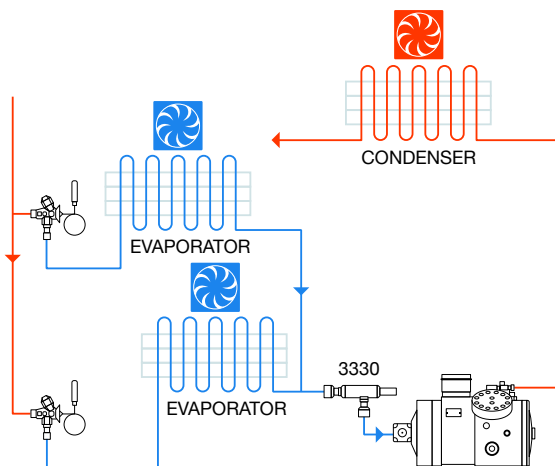
- Minimum cooling capacity = 3.23 kW;
- Evaporating temperature = 0 °C;
- Pressure drop across the valve = 0.42 bar;

Select the right valve from Table 17A. The selected valves are:

- 3330/M12 with 12 mm diameter solder connections;
- 3330/4 with 1/2" diameter solder connections.

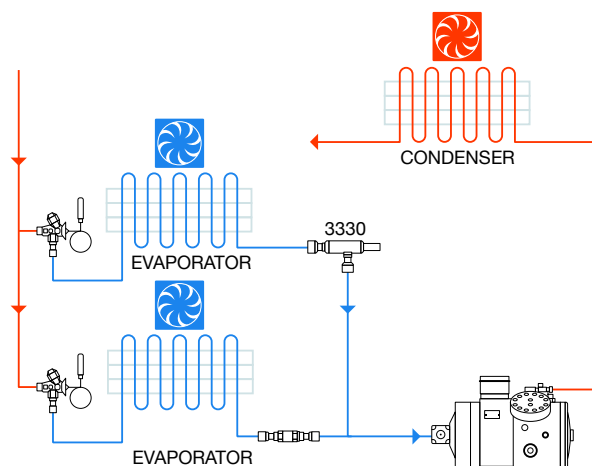
## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the capacity regulators in series 3330 with file SA33319. These regulators 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 405 PSI.



### Installation (1)

Refrigerating system with a single compressor serving multiple evaporators in parallel, where the same evaporation pressure is required. The valve is installed on the common suction pipe.



### Installation (2)

Refrigerating system with multiple evaporators which work with different evaporation pressures. The regulator is installed downstream of the evaporator with the highest pressure.

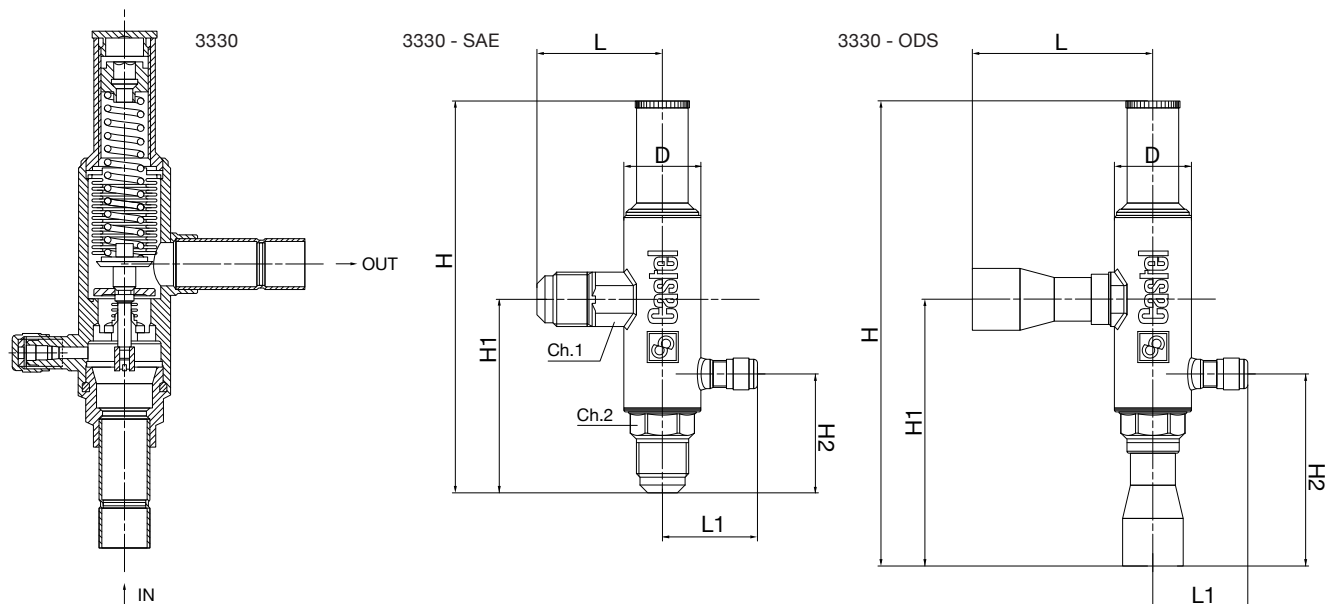


TABLE 13: GENERAL CHARACTERISTICS OF EVAPORATOR PRESSURE REGULATORS

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	
		Ø [in.]	Ø [mm]								
3330/4	1/2"	-	-	2,7	0,2	5,5	2	28	-40	+110	Art. 4.3
3330/M12S	-	-	12								
3330/4S	-	1/2"	-								
3330/5	5/8"	-	-								
3330/5S	-	5/8"	16								
3330/7S	-	7/8"	22								
3330/9S	-	1.1/8"	-	8,4							
3330/M28S	-	-	28								
3330/11S	-	1.3/8"	35								

TABLE 14: DIMENSIONS AND WEIGHTS OF EVAPORATOR PRESSURE REGULATORS

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H <sub>1</sub>	H <sub>2</sub>	L	L <sub>1</sub>	D	Ch <sub>1</sub>	Ch <sub>2</sub>	
3330/4	159	76,5	45,5	48	37	32	22	24	530
3330/M12S	183	100,5	69,5	64			-	-	510
3330/4S	183	100,5	69,5	64			-	-	480
3330/5	163	80,5	49,5	52			22	24	500
3330/5S	183	100,5	69,5	64			-	-	500
3330/7S	194	112	81	75,5			-	-	560
3330/9S	263	151	111	105	44	46	-	-	1470
3330/M28S	263	151	111	105					1470
3330/11S	263	151	111	105					1480

# R134A

TABLE 15A : REFRIGERANT FLOW CAPACITY OF EVAPORATOR PRESSURE REGULATORS 3330 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		20	15	10	5	0	-5	-10	-15	-20	-25
3330/4 3330/4S 3330/M12S	0,07	–	–	1,10	0,99	0,88	0,77	0,67	0,57	–	–
	0,14	–	–	2,27	2,03	1,79	1,55	1,34	1,13	–	–
	0,21	–	–	3,70	3,26	2,83	2,39	2,01	1,63	–	–
	0,35	–	–	5,62	4,91	4,21	3,50	2,88	2,26	–	–
	0,42	–	–	7,17	6,18	5,18	4,18	3,44	–	–	–
	0,56	–	–	10,16	8,63	7,10	5,58	4,59	–	–	–
3330/5 3330/5S	0,07	–	–	1,42	1,28	1,15	1,01	0,89	0,77	–	–
	0,14	–	–	2,89	2,60	2,32	2,04	1,80	1,56	–	–
	0,21	–	–	4,37	3,93	3,50	3,07	2,70	2,33	–	–
	0,35	–	–	6,08	5,47	4,87	4,27	3,74	3,21	–	–
	0,42	–	–	8,02	7,20	6,38	5,56	4,87	–	–	–
	0,56	–	–	10,80	9,67	8,54	7,41	6,50	–	–	–
3330/7S	0,07	–	–	1,42	1,27	1,13	0,99	0,86	0,73	–	–
	0,14	–	–	2,92	2,61	2,30	1,99	1,72	1,45	–	–
	0,21	–	–	5,27	4,64	4,00	3,37	2,59	2,26	–	–
	0,35	–	–	7,63	6,67	5,71	4,75	3,91	3,07	–	–
	0,42	–	–	10,81	9,28	7,74	6,21	4,74	–	–	–
	0,56	–	–	13,99	11,88	9,78	7,68	6,32	–	–	–
3330/9S 3330/M28S	0,07	–	–	4,47	4,03	3,60	3,16	2,80	2,43	–	–
	0,14	–	–	9,07	8,18	7,29	6,40	5,65	4,91	–	–
	0,21	–	–	13,71	12,35	11,00	9,64	8,48	7,32	–	–
	0,35	–	–	19,09	17,20	15,30	13,40	11,75	10,09	–	–
	0,42	–	–	25,18	22,60	20,03	17,45	15,30	–	–	–
	0,56	–	–	33,93	30,38	26,83	23,29	20,41	–	–	–

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)	Nominal evaporator pressure change <small>(T<sub>design evap</sub> - T<sub>min evap</sub>)</small>	8 psi	(0,56 bar)

TABLE 15B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,28	1,23	1,18	1,13	1,08	1,03	0,97	0,92	0,86

TABLE 15C : CORRECTION FACTOR FOR EVAPORATOR PRESSURE CHANGE DIFFERENT FROM NOMINAL VALUE

Evaporator pressure change [bar]							
0,14	0,28	0,42	0,56	0,7	0,84	0,98	1,12
0,3	0,6	0,8	1	1,2	1,3	1,4	1,5

TABLE 16A : REFRIGERANT FLOW CAPACITY OF EVAPORATOR PRESSURE REGULATORS 3330 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		4,4	0	-5	-10	-15	-20	-25	-30	-35	-40
3330/4 3330/4S 3330/M12S	0,07	1,29	1,18	1,06	0,95	0,83	0,77	0,70	0,64	0,58	–
	0,14	2,66	2,41	2,15	1,90	1,65	1,52	1,39	1,26	1,13	–
	0,21	4,68	4,20	3,71	3,26	2,80	2,50	2,20	1,90	1,60	–
	0,35	7,51	6,70	5,88	5,13	4,37	3,82	3,26	2,71	2,16	–
	0,42	9,72	8,56	7,40	6,30	5,21	4,55	3,90	3,24	2,58	–
	0,56	13,85	12,07	10,30	8,61	6,92	6,06	5,19	4,32	3,45	–
3330/5 3330/5S	0,07	1,64	1,49	1,34	1,21	1,07	1,00	0,92	0,85	0,78	–
	0,14	3,30	2,99	2,69	2,42	2,15	2,00	1,85	1,70	1,55	–
	0,21	5,01	4,55	4,08	3,67	3,26	3,02	2,79	2,55	2,31	–
	0,35	7,00	6,35	5,69	5,11	4,53	4,20	3,86	3,53	3,20	–
	0,42	9,30	8,41	7,53	6,75	5,96	5,50	5,05	4,59	4,13	–
	0,56	12,58	11,38	10,17	9,09	8,01	7,38	6,75	6,12	5,49	–
3330/7S	0,07	1,62	1,47	1,32	1,18	1,04	0,96	0,88	0,80	0,72	–
	0,14	3,45	3,11	2,78	2,46	2,14	1,97	1,80	1,63	1,46	–
	0,21	6,04	5,41	4,79	4,20	3,61	3,22	2,84	2,45	2,06	–
	0,35	10,09	9,00	7,90	6,89	5,88	5,13	4,39	3,64	2,89	–
	0,42	13,41	11,81	10,21	8,70	7,19	6,28	5,38	4,47	3,56	–
	0,56	19,44	16,95	14,47	12,09	9,72	8,50	7,28	6,07	4,85	–
3330/9S 3330/M28S	0,07	5,14	4,67	4,21	3,79	3,37	3,14	2,90	2,67	2,44	–
	0,14	10,35	9,40	8,45	7,60	6,76	6,29	5,81	5,34	4,86	–
	0,21	15,75	14,28	12,82	11,52	10,23	9,49	8,75	8,01	7,27	–
	0,35	22,00	19,94	17,88	16,06	14,24	13,19	12,14	11,09	10,04	–
	0,42	29,20	26,43	23,65	21,19	18,72	17,28	15,85	14,42	12,98	–
	0,56	39,52	35,73	31,94	28,55	25,16	23,18	21,20	19,22	17,24	–
3330/11S	0,07	4,96	4,51	4,05	3,63	3,20	2,95	2,70	2,45	2,20	–
	0,14	10,57	9,55	8,52	7,54	6,56	6,04	5,52	5,00	4,48	–
	0,21	18,53	16,60	14,68	12,88	11,07	9,88	8,70	7,51	6,33	–
	0,35	30,94	27,59	24,24	21,13	18,02	15,73	13,45	11,16	8,88	–
	0,42	41,12	36,22	31,31	26,68	22,04	19,27	16,49	13,71	10,93	–
	0,56	59,63	51,99	44,36	37,09	29,81	26,08	22,34	18,60	14,87	–

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)	Nominal evaporator pressure change <small>(T<sub>design evap</sub> - T<sub>min evap</sub>)</small>	8 psi	(0,56 bar)

TABLE 16B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,23	1,19	1,16	1,11	1,06	1,01	0,98	0,94	0,9

TABLE 16C : CORRECTION FACTOR FOR EVAPORATOR PRESSURE CHANGE DIFFERENT FROM NOMINAL VALUE

Evaporator pressure change [bar]							
0,14	0,28	0,42	0,56	0,7	0,84	0,98	1,12
0,3	0,6	0,8	1	1,2	1,3	1,4	1,5

# R404A / R507

TABLE 17A : REFRIGERANT FLOW CAPACITY OF EVAPORATOR PRESSURE REGULATORS 3330 [KW]

Catalogue Number	Pressure drop across regulator [bar]	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		4,4	0	-5	-10	-15	-20	-25	-30	-35	-40
3330/4 3330/4S 3330/M12S	0,07	1,24	1,11	0,99	0,87	0,75	0,69	0,62	0,56	0,50	–
	0,14	2,50	2,23	1,96	1,73	1,49	1,37	1,24	1,11	0,98	–
	0,21	4,08	3,63	3,17	2,76	2,35	2,12	1,90	1,67	1,44	–
	0,35	6,16	5,46	4,76	4,11	3,47	3,10	2,74	2,38	2,02	–
	0,42	8,38	7,34	6,30	5,35	4,40	3,88	3,37	2,85	2,33	–
	0,56	12,49	10,83	9,17	7,68	6,19	5,39	4,60	3,80	3,00	–
3330/5 3330/5S	0,07	1,56	1,40	1,24	1,09	0,93	0,87	0,80	0,74	0,68	–
	0,14	3,18	2,85	2,53	2,21	1,90	1,76	1,63	1,50	1,37	–
	0,21	4,79	4,30	3,81	3,32	2,84	2,64	2,44	2,24	2,04	–
	0,35	6,67	5,99	5,30	4,62	3,94	3,66	3,38	3,10	2,82	–
	0,42	8,86	7,93	7,01	6,09	5,18	4,80	4,42	4,04	3,66	–
	0,56	11,95	10,69	9,43	8,18	6,93	6,42	5,90	5,38	4,86	–
3330/7S	0,07	1,72	1,55	1,38	1,21	1,05	0,96	0,87	0,78	0,69	–
	0,14	3,56	3,18	2,80	2,46	2,13	1,94	1,76	1,58	1,40	–
	0,21	5,79	5,14	4,50	3,92	3,34	3,02	2,69	2,37	2,05	–
	0,35	8,67	7,69	6,70	5,79	4,88	4,37	3,86	3,35	2,84	–
	0,42	11,56	10,12	8,69	7,38	6,07	5,35	4,64	3,93	3,22	–
	0,56	17,22	14,93	12,65	10,59	8,53	7,44	6,34	5,24	4,14	–
3330/9S 3330/M28S	0,07	4,89	4,40	3,91	3,41	2,92	2,72	2,52	2,32	2,12	–
	0,14	9,98	8,95	7,93	6,95	5,96	5,54	5,13	4,71	4,30	–
	0,21	15,05	13,50	11,96	10,44	8,93	8,30	7,67	7,04	6,40	–
	0,35	20,96	18,80	16,64	14,51	12,38	11,50	10,62	9,74	8,86	–
	0,42	27,82	24,91	22,01	19,14	16,26	15,07	13,88	12,69	11,50	–
	0,56	37,54	33,59	29,63	25,70	21,78	20,15	18,52	16,90	15,27	–
3330/11S	0,07	5,29	4,75	4,22	3,71	3,21	2,94	2,66	2,39	2,12	–
	0,14	10,90	9,74	8,57	7,55	6,52	5,96	5,40	4,85	4,29	–
	0,21	17,75	15,78	13,81	12,02	10,24	9,25	8,26	7,27	6,28	–
	0,35	26,59	23,57	20,55	17,75	14,96	13,40	11,83	10,27	8,71	–
	0,42	35,46	31,05	26,64	22,62	18,60	16,42	14,24	12,05	9,87	–
	0,56	52,80	45,80	38,80	32,48	26,17	22,80	19,44	16,07	12,70	–

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)	Nominal evaporator pressure change <small>(T<sub>design evap</sub> - T<sub>min evap</sub>)</small>	8 psi	(0,56 bar)

TABLE 17B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,43	1,35	1,28	1,2	1,12	1,03	0,95	0,86	0,76

TABLE 17C : CORRECTION FACTOR FOR EVAPORATOR PRESSURE CHANGE DIFFERENT FROM NOMINAL VALUE

Evaporator pressure change [bar]							
0,14	0,28	0,42	0,56	0,7	0,84	0,98	1,12
0,3	0,6	0,8	1	1,2	1,3	1,4	1,5



**TABLE 18A : REFRIGERANT FLOW CAPACITY OF EVAPORATOR PRESSURE REGULATORS 3330 [KW]**

Catalogue Number	Pressure drop across regulator [bar]	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		15	10	4,4	0	-5	-10	-15	-20	-25	-30
3330/4 3330/4S 3330/M12S	0,07	–	1,07	0,96	0,91	0,85	0,81	0,76	0,65	–	–
	0,14	–	2,19	1,96	1,84	1,72	1,63	1,53	1,29	–	–
	0,21	–	3,55	3,13	2,92	2,71	2,55	2,38	1,93	–	–
	0,35	–	5,27	4,60	4,27	3,94	3,69	3,44	2,70	–	–
	0,42	–	6,88	5,92	5,45	4,97	4,58	4,20	3,30	–	–
	0,56	–	9,74	8,27	7,54	6,81	6,21	5,60	4,40	–	–
3330/5 3330/5S	0,07	–	1,37	1,24	1,17	1,11	1,05	0,99	0,86	–	–
	0,14	–	2,77	2,50	2,37	2,23	2,11	1,99	1,73	–	–
	0,21	–	4,19	3,77	3,57	3,36	3,18	3,00	2,59	–	–
	0,35	–	5,71	5,14	4,85	4,57	4,33	4,08	3,51	–	–
	0,42	–	7,71	6,92	6,52	6,13	5,79	5,45	4,68	–	–
	0,56	–	10,37	9,29	8,74	8,20	7,73	7,26	6,24	–	–
3330/7S	0,07	–	1,37	1,23	1,16	1,09	1,03	0,97	0,83	–	–
	0,14	–	2,80	2,50	2,35	2,20	2,08	1,96	1,65	–	–
	0,21	–	5,00	4,40	4,10	3,80	3,33	2,87	2,48	–	–
	0,35	–	7,24	6,33	5,87	5,42	5,07	4,72	3,71	–	–
	0,42	–	10,35	8,88	8,15	7,42	6,61	5,81	4,56	–	–
	0,56	–	13,46	11,43	10,42	9,41	8,58	7,74	6,08	–	–
3330/9S 3330/M28S	0,07	–	4,32	3,90	3,69	3,48	3,29	3,11	2,70	–	–
	0,14	–	8,71	7,86	7,43	7,00	6,63	6,25	5,43	–	–
	0,21	–	13,15	11,85	11,20	10,55	9,99	9,43	8,13	–	–
	0,35	–	17,92	16,14	15,25	14,36	13,59	12,83	11,02	–	–
	0,42	–	24,20	21,72	20,48	19,24	18,17	17,11	14,70	–	–
	0,56	–	32,57	29,17	27,46	25,76	24,28	22,81	19,60	–	–
3330/11S	0,07	–	4,19	3,76	3,55	3,34	3,16	2,98	2,55	–	–
	0,14	–	8,58	7,67	7,21	6,76	6,38	6,00	5,06	–	–
	0,21	–	15,34	13,49	12,57	11,65	10,22	8,79	7,61	–	–
	0,35	–	22,20	19,40	18,01	16,61	15,55	14,49	11,38	–	–
	0,42	–	31,74	27,24	24,99	22,74	20,27	17,81	13,98	–	–
	0,56	–	41,27	35,06	31,96	28,86	26,30	23,74	18,65	–	–

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)	Nominal evaporator pressure change <small>(T<sub>design evap</sub> - T<sub>min evap</sub>)</small>	8 psi	(0,56 bar)

**TABLE 18B : CORRECTION FACTOR FOR LIQUID TEMPERATURE DIFFERENT FROM NOMINAL VALUE**

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,3	1,25	1,2	1,14	1,09	1,03	0,97	0,9	0,84

**TABLE 18C : CORRECTION FACTOR FOR EVAPORATOR PRESSURE CHANGE DIFFERENT FROM NOMINAL VALUE**

Evaporator pressure change [bar]							
0,14	0,28	0,42	0,56	0,7	0,84	0,98	1,12
0,3	0,6	0,8	1	1,2	1,3	1,4	1,5

# PRESSURE REGULATORS

## 6.4 – CONDENSING PRESSURE REGULATORS

### APPLICATIONS

When designing air conditioning and refrigerating systems that use air cooled condensing units, subject to wide range of ambient temperatures, it is very important to provide accurate condenser capacity control. Since a properly sized condensing unit operates satisfactorily at high ambient temperature, capacity control is needed at low ambient temperatures. Good condensing pressure control during low ambient temperature avoids problems during system operation and facilitates start-up. Specifically, this control maintains a sufficient pressure differential across the thermostatic expansion valve ensuring correct refrigerant feed to the evaporator.

Condensing pressure regulators, together with the differential valves, are the solution to this control need. The regulators in series 3340 restrict the liquid flow from the condenser to the receiver, reducing the active condenser surface and raising the condensing pressure. The differential valve 3136W by-passes hot gas from the compressor discharge to the receiver, raising the liquid pressure in the receiver. The condensing pressure regulators in series 3340 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

Condensing pressure regulators adjust the flow of the liquid (hot gas) according to changes of condensation pressure (compressor discharge), upstream of the regulator. When the condensation pressure (discharge) is less than the regulator calibration pressure, the shutter remains closed. As the condensation pressure (discharge) rises above the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in condensation pressure (discharge). As the condensing pressure (discharge) 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. Condensing 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 3340 is 8 bar. This means that until the condensation (discharge) pressure is below

8 bar, the regulator remains closed. When it rises above 8 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 2.3 bar in calibration pressure (1.5 bar for models 3340/9S, 3340/M28S, and 3340/11S). The calibration range varies from 3 to 20 bar.

The differential valves adjust the flow of hot gas to the liquid receiver according to the differential pressure between compressor discharge and liquid receiver. The valves 3136W begin to open when the differential pressure reaches 1.4 bar and are fully open when differential pressure is 3 bar.

### CONSTRUCTION

The main parts of regulators in series 3340 are manufactured 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;
- Chloroprene rubber (CR) for outlet seal gaskets.

The main parts of the differential valves 3136W are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover;
- Copper pipe EN 12735-1 – Cu-DHP for solder connections;
- Austenitic stainless steel AISI 302 for the spring;
- PTFE for seat gaskets.

### INSTALLATION

Condensing pressure regulators can be mounted in two locations of the refrigerating system:

- In the liquid line between the condenser and the liquid receiver (for regulator selection see Tables 22A, 23A, 24A and 25A related to liquid line). Valve 3136W is mounted between the compressor discharge and the inlet of liquid receiver. This choice requires a smaller sized regulator as it is controlling liquid refrigerant. It is most suitable for installations in temperate climates (see installation example 1);
- In the discharge line between the compressor and the condenser (for regulator selection see Tables 22B, 23B, 24B and 25B related to hot gas line). Valve 3136W is mounted between the



compressor discharge and the inlet of liquid receiver. A check valve 3132W must be installed between the condenser discharge and receiver inlet to prevent liquid migration during an off cycle. This choice requires a larger sized regulator as it is controlling gaseous refrigerant. It is most suitable for installations in cold climates (see installation example 2).

## SELECTION

To correctly select condensing 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;**
2. **Designed evaporator (system) capacity;**
3. **Evaporating temperature;**
4. **Condensing temperature;**
5. **Allowable condensing pressure change;**
6. **Allowable pressure drop across the regulator.**

The refrigerating capacities indicated on Tables 22A - 22B, 23A - 23B, 24A - 24B, 25A - 25B are calculated as a function of a reference evaporating temperature of 4.4 °C.

With liquid temperatures other than 4.4 °C, the required cooling capacity of regulator is:

$$\frac{Q_{\text{evap}}}{K_{T \text{ evap}}} = Q_{\text{valve}}$$

where:

- $Q_{\text{evap}}$  = Evaporator capacity [kW];
- $K_{T \text{ evap}}$  = Correction factor for  $T_{\text{evap}} \neq 4.4$  °C. (See Tables 22C, 23C, 24C, 25C);
- $Q_{\text{valve}}$  = Refrigerating capacity requested at regulator [kW].

### Example

- Refrigerant R404A
- Refrigeration yield of evaporator 20 [kW]

- Designed evaporating temperature 0 [°C]
- Condensing temperature 40 [°C]
- Allowed condensing pressure change 1.5 [bar]
- Pressure drop across the regulator 0.31 [bar]
- Solder connections

1. Use Table 24C to determine the correction factor for the liquid temperature  $T_{\text{Liquid}} = 0$  °C.

$$K_{T \text{ evap}} = 1.02$$

2. Calculate the refrigerating capacity requested at regulator.

$$Q_{\text{valve}} = \frac{Q_{\text{evap}}}{K_{T \text{ evap}}} = \frac{20}{1.02} = 19.60 \text{ kW}$$

3. With the following parameters:

- Minimum cooling capacity = 19.60 kW
- Condensing temperature = 40 °C
- Condensing pressure change = 1.5 bar
- Pressure drop across the valve = 0.31 bar

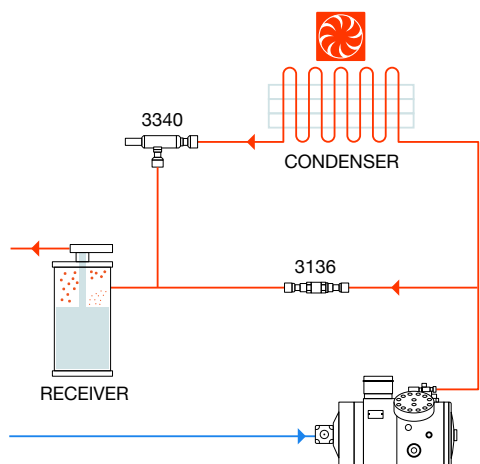
Select the right valve from Table 24A. The valve selected is 3340/5S.

## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the capacity regulators in series 3340 and the differential valves in series 3136W with file SA33319.

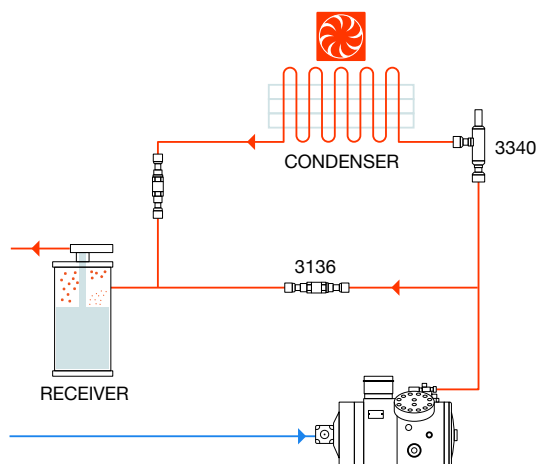
The regulators 3340 are certified **UL-CSA Listed** for the USA and Canada, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15, with a Design Pressure of 405 PSI.

The valves 3136W 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 600 PSI.



### Installation (1)

Refrigerating system with air condenser. The regulator is installed at a condenser outlet on the liquid line, before the liquid receiver. Injection valve 3136 guarantees sufficiently high pressure under variable conditions (min. diff. 1.4 bar / max 3 bar).



### Installation (2)

Refrigerating system with air condenser and receiver installed in very cold environments. The regulator is installed upstream of the condenser. Injection valve 3136 ensures that the receiver has sufficiently high pressure.

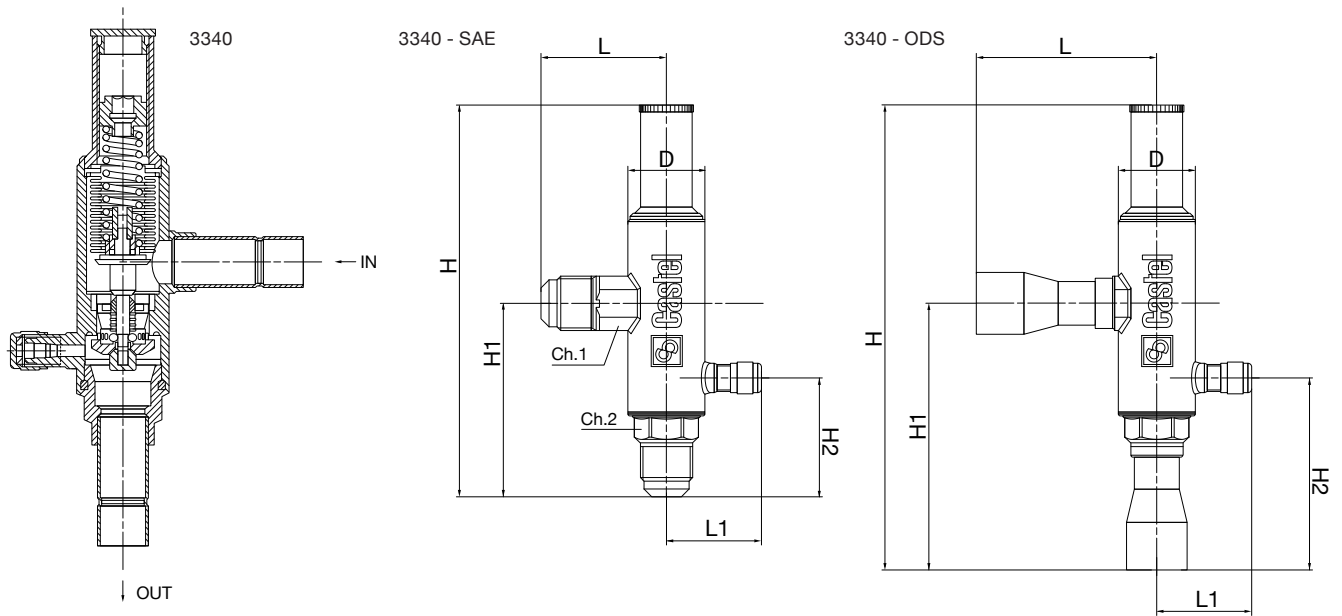


TABLE 19: GENERAL CHARACTERISTICS OF CONDENSING PRESSURE REGULATORS

Catalogue Number	Connections		Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS		min.	max.			min.	max.	
3340/4	1/2"	-	2,70	3	20	8	28	-40	+110	Art. 4.3
3340/M12S	-	12								
3340/4S	-	1/2"								
3340/5	5/8"	-								
3340/5S	-	5/8"								
3340/7S	-	7/8"								
3340/9S	-	1.1/8"	8,4							
3340/M28S	-	28								
3340/11S	-	1.3/8"								

TABLE 20: DIMENSIONS AND WEIGHTS OF CONDENSING PRESSURE REGULATORS

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H <sub>1</sub>	H <sub>2</sub>	L	L <sub>1</sub>	D	Ch <sub>1</sub>	Ch <sub>2</sub>	
3340/4	159	76,5	45,5	48	37	32	22	24	490
3340/M12S	183	100,5	69,5	64			-	-	506
3340/4S	183	100,5	69,5	64			-	-	506
3340/5	163	80,5	49,5	52			22	24	550
3340/5S	183	100,5	69,5	64			-	-	506
3340/7S	194	112	81	75,5			-	-	570
3340/9S	263	151	111	105	44	46	-	-	1520
3340/M28S	263	151	111	105					1520
3340/11S	263	151	111	105					1530

TABLE 21: GENERAL CHARACTERISTICS OF DIFFERENTIAL VALVES

Catalogue Number	Connections		Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS		min.	max.			min.	max.	
3136W/M12	-	12	1,80	1,4	3	45	-40	+110	Art. 4.3	Art. 4.3
3136W/4	-	1/2"								

**TABLE 22A : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. LIQUID LINE**

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	17,93	17,05	16,07	15,19	14,30	13,15	12,00	11,30	10,59
		0,14	26,22	24,80	23,24	21,81	20,38	18,75	17,10	16,06	15,02
		0,31	45,70	43,03	40,12	37,44	34,75	32,22	29,67	27,59	25,49
		0,65	61,82	57,92	53,71	49,82	45,90	42,56	39,19	36,35	33,50
		1,03	77,67	72,46	66,84	61,63	56,38	52,27	48,14	44,55	40,94
		1,68	106,45	99,02	91,04	83,60	76,12	69,90	63,65	58,62	53,55
	3	0,07	32,36	31,29	28,60	27,53	26,36	25,12	23,78	22,70	21,55
		0,14	46,39	44,80	40,90	39,31	37,57	35,86	34,01	32,41	30,71
		0,31	73,39	70,82	64,60	62,03	59,22	56,43	53,41	51,00	48,43
		0,65	104,52	100,74	91,77	87,99	83,86	80,04	75,91	72,36	68,57
		1,03	128,57	123,78	112,61	107,82	102,58	98,07	93,18	88,67	83,87
		1,68	174,27	167,14	151,46	144,34	136,59	129,93	122,73	116,69	110,26
3340/5 3340/5S	1,5	0,07	29,89	28,42	26,79	25,32	23,84	21,92	20,00	18,83	17,66
		0,14	43,71	41,33	38,73	36,36	33,97	31,24	28,50	26,77	25,03
		0,31	76,17	71,72	66,86	62,40	57,92	53,70	49,46	45,98	42,49
		0,65	103,03	96,54	89,51	83,03	76,50	70,93	65,32	60,59	55,83
		1,03	129,46	120,76	111,40	102,71	93,96	87,12	80,23	74,25	68,23
		1,68	177,42	165,03	151,73	139,34	126,87	116,51	106,08	97,70	89,26
	3	0,07	53,93	52,15	47,67	45,89	43,94	41,87	39,63	37,83	35,91
		0,14	77,32	74,67	68,17	65,52	62,62	59,77	56,69	54,02	51,18
		0,31	122,31	118,03	107,66	103,38	98,70	94,05	89,02	85,00	80,71
		0,65	174,21	167,90	152,96	146,65	139,77	133,41	126,52	120,59	114,29
		1,03	214,29	206,29	187,69	179,69	170,97	163,45	155,30	147,78	139,78
		1,68	290,44	278,57	252,43	240,56	227,64	216,55	204,55	194,48	183,76
3340/7S	1,5	0,07	38,91	38,73	34,68	34,50	34,10	32,83	31,29	30,71	30,02
		0,14	56,59	55,99	49,84	49,25	48,29	46,51	44,32	43,39	42,29
		0,31	89,88	88,50	78,39	77,00	75,01	72,82	70,06	67,90	65,40
		0,65	128,43	125,80	110,83	108,19	104,63	101,57	97,71	94,48	90,75
		1,03	158,18	154,18	135,14	131,13	125,92	122,23	117,59	113,44	108,67
		1,68	209,46	203,51	177,77	171,83	164,21	157,88	150,17	144,17	137,31
	3	0,07	60,79	60,70	53,51	53,42	52,88	51,95	50,58	49,56	48,29
		0,14	86,43	86,19	75,87	75,63	74,72	73,54	71,74	70,17	68,23
		0,31	134,24	133,75	117,64	117,15	115,63	113,60	110,60	108,39	105,65
		0,65	187,42	186,50	163,82	162,90	160,50	157,95	154,08	150,74	146,63
		1,03	226,69	225,29	197,64	196,24	193,03	190,27	185,95	181,62	176,32
		1,68	293,29	290,33	253,67	250,71	245,28	240,57	233,74	228,10	221,22
3340/9S 3340/M28S	1,5	0,07	93,88	89,26	84,14	79,52	74,87	68,86	62,81	59,15	55,46
		0,14	137,28	129,82	121,64	114,18	106,68	98,13	89,52	84,08	78,61
		0,31	239,25	225,25	209,99	195,99	181,91	168,66	155,34	144,42	133,44
		0,65	323,58	303,20	281,14	260,76	240,26	222,76	205,15	190,29	175,34
		1,03	406,59	379,28	349,89	322,59	295,11	273,62	251,99	233,19	214,29
		1,68	557,24	518,31	476,54	437,62	398,45	365,91	333,18	306,84	280,34
	3	0,07	169,38	163,78	149,72	144,13	137,99	131,50	124,48	118,82	112,80
		0,14	242,83	234,51	214,09	205,77	196,66	187,72	178,05	169,66	160,73
		0,31	384,15	370,71	338,14	324,69	309,98	295,38	279,59	266,96	253,50
		0,65	547,14	527,34	480,40	460,60	438,97	418,99	397,36	378,75	358,94
		1,03	673,03	647,92	589,49	564,37	536,97	513,36	487,77	464,15	439,01
		1,68	912,20	874,92	792,82	755,53	714,97	680,12	642,45	610,81	577,15
3340/11S	1,5	0,07	119,33	118,77	106,36	105,80	104,56	100,69	95,94	94,18	92,06
		0,14	173,53	171,70	152,85	151,02	148,10	142,62	135,92	133,08	129,70
		0,31	275,63	271,39	240,38	236,14	230,04	223,31	214,85	208,23	200,56
		0,65	393,87	385,79	339,87	331,79	320,86	311,47	299,65	289,74	278,31
		1,03	485,10	472,83	414,42	402,15	386,15	374,84	360,61	347,88	333,25
		1,68	642,33	624,10	545,17	526,93	503,57	484,18	460,53	442,12	421,09
	3	0,07	186,43	186,16	164,09	163,82	162,15	159,32	155,12	151,98	148,09
		0,14	265,06	264,31	232,67	231,92	229,15	225,53	220,02	215,19	209,25
		0,31	411,67	410,17	360,76	359,26	354,59	348,38	339,18	332,40	323,99
		0,65	574,77	571,94	502,38	499,55	492,21	484,39	472,50	462,27	449,67
		1,03	695,17	690,88	606,09	601,79	591,95	583,49	570,25	556,96	540,71
		1,68	899,42	890,34	777,94	768,85	752,20	737,74	716,80	699,49	678,40

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : pressure change required to move the valve shutter from "start to open" position to rated opening position

TABLE 22B : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. HOT GAS LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	2,47	2,46	2,47	2,47	2,48	2,49	2,49	2,50	2,51
		0,14	3,47	3,46	3,47	3,48	3,49	3,50	3,51	3,53	3,54
		0,31	5,88	5,87	5,88	5,90	5,92	5,93	5,95	5,97	5,99
		0,65	7,68	7,66	7,68	7,71	7,73	7,75	7,78	7,80	7,82
		1,03	9,34	9,31	9,34	9,37	9,39	9,42	9,45	9,48	9,50
		1,68	11,86	11,82	11,86	11,89	11,93	11,96	12,00	12,03	12,07
	3	0,07	4,50	4,37	4,50	4,62	4,74	4,87	4,99	5,12	5,25
		0,14	6,35	6,17	6,35	6,52	6,70	6,87	7,05	7,22	7,41
		0,31	9,99	9,71	9,99	10,26	10,54	10,81	11,09	11,37	11,66
		0,65	14,01	13,63	14,01	14,40	14,78	15,17	15,55	15,95	16,35
		1,03	16,98	16,51	16,98	17,45	17,91	18,38	18,85	19,32	19,81
		1,68	21,72	21,12	21,72	22,32	22,91	23,51	24,11	24,72	25,35
3340/5 3340/5S	1,5	0,07	4,11	4,10	4,11	4,12	4,13	4,15	4,16	4,17	4,18
		0,14	5,79	5,77	5,79	5,81	5,82	5,84	5,86	5,88	5,89
		0,31	9,80	9,78	9,80	9,83	9,86	9,89	9,92	9,95	9,98
		0,65	12,81	12,77	12,81	12,85	12,88	12,92	12,96	13,00	13,04
		1,03	15,56	15,52	15,56	15,61	15,65	15,70	15,75	15,79	15,84
		1,68	19,76	19,71	19,76	19,82	19,88	19,94	20,00	20,06	20,12
	3	0,07	7,50	7,29	7,50	7,70	7,91	8,11	8,32	8,53	8,75
		0,14	10,58	10,29	10,58	10,87	11,16	11,45	11,74	12,04	12,35
		0,31	16,65	16,19	16,65	17,11	17,56	18,02	18,48	18,95	19,43
		0,65	23,35	22,71	23,35	23,99	24,64	25,28	25,92	26,58	27,25
		1,03	28,30	27,52	28,30	29,08	29,85	30,63	31,41	32,21	33,02
		1,68	36,20	35,21	36,20	37,20	38,19	39,19	40,18	41,20	42,25
3340/7S	1,5	0,07	5,60	5,30	5,60	5,89	6,19	6,48	6,8	7,09	7,41
		0,14	7,84	7,43	7,84	8,26	8,67	9,08	9,5	9,93	10,38
		0,31	12,10	11,46	12,10	12,74	13,37	14,01	14,6	15,32	16,01
		0,65	16,69	15,81	16,69	17,57	18,45	19,33	20,2	21,13	22,09
		1,03	19,87	18,82	19,87	20,92	21,96	23,01	24,1	25,15	26,30
		1,68	24,37	23,09	24,37	25,66	26,94	28,23	29,5	30,86	32,26
	3	0,07	8,72	8,18	8,72	9,27	9,81	10,35	10,9	11,47	12,07
		0,14	12,21	11,45	12,21	12,97	13,73	14,49	15,3	16,05	16,90
		0,31	18,86	17,69	18,86	20,04	21,21	22,39	23,6	24,80	26,10
		0,65	25,94	24,32	25,94	27,55	29,17	30,78	32,4	34,10	35,89
		1,03	30,90	28,98	30,90	32,83	34,75	36,68	38,6	40,63	42,76
		1,68	37,73	35,38	37,73	40,08	42,43	44,78	47,1	49,60	52,20
3340/9S 3340/M28S	1,5	0,07	12,90	12,87	12,90	12,94	12,98	13,02	13,1	13,10	13,13
		0,14	18,18	18,13	18,18	18,24	18,29	18,34	18,4	18,45	18,51
		0,31	30,79	30,70	30,79	30,88	30,98	31,07	31,2	31,25	31,34
		0,65	40,23	40,11	40,23	40,35	40,46	40,58	40,7	40,82	40,94
		1,03	48,88	48,73	48,88	49,02	49,17	49,31	49,5	49,60	49,75
		1,68	62,07	61,89	62,07	62,26	62,44	62,63	62,8	63,00	63,18
	3	0,07	23,54	22,89	23,54	24,19	24,83	25,48	26,1	26,79	27,47
		0,14	33,23	32,32	33,23	34,14	35,06	35,97	36,9	37,82	38,78
		0,31	52,29	50,85	52,29	53,72	55,16	56,60	58,0	59,51	61,02
		0,65	73,34	71,33	73,34	75,36	77,38	79,39	81,4	83,48	85,59
		1,03	88,88	86,43	88,88	91,32	93,76	96,21	98,6	101,15	103,72
		1,68	113,70	110,57	113,70	116,82	119,95	123,07	126,2	129,40	132,69
3340/11S	1,5	0,07	17,17	16,26	17,17	18,07	18,98	19,88	20,8	21,74	22,73
		0,14	24,05	22,78	24,05	25,32	26,58	27,85	29,1	30,45	31,83
		0,31	37,10	35,14	37,10	39,06	41,01	42,97	44,9	46,97	49,11
		0,65	51,18	48,48	51,18	53,88	56,58	59,28	62,0	64,80	67,75
		1,03	60,93	57,72	60,93	64,14	67,36	70,57	73,8	77,14	80,65
		1,68	74,74	70,80	74,74	78,68	82,62	86,57	90,5	94,63	98,94
	3	0,07	26,76	25,09	26,76	28,42	30,09	31,75	33,4	35,17	37,02
		0,14	37,45	35,12	37,45	39,78	42,12	44,45	46,8	49,23	51,82
		0,31	57,85	54,25	57,85	61,45	65,06	68,66	72,3	76,05	80,04
		0,65	79,55	74,59	79,55	84,50	89,45	94,41	99,4	104,57	110,06
		1,03	94,77	88,87	94,77	100,67	106,57	112,47	118,4	124,59	131,12
		1,68	115,70	108,50	115,70	122,91	130,11	137,32	144,5	152,11	160,09

TABLE 22C : CORRECTION FACTOR FOR EVAPORATOR TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Evaporator temperature [°C]								
-40	-30	-20	-15	-10	-5	0	4,4	10
1,2	1,15	1,1	1,08	1,06	1,04	1,02	1	0,98



TABLE 23A : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. LIQUID LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	12,67	12,16	11,66	11,16	10,66	9,94	9,23	8,51	7,78
		0,14	18,42	17,63	16,84	16,05	15,26	14,18	13,08	12,06	11,03
		0,31	31,25	29,40	27,57	25,72	23,86	22,30	20,74	19,24	17,74
		0,65	45,19	42,42	39,65	36,88	34,08	31,71	29,33	27,21	25,08
		1,03	56,48	52,88	49,30	45,70	42,08	38,99	35,87	33,27	30,66
		1,68	77,58	71,84	66,13	60,39	54,62	50,99	47,34	43,76	40,16
	3	0,07	25,93	24,97	24,10	23,14	22,09	21,04	19,91	19,02	18,06
		0,14	37,08	35,69	34,43	33,04	31,53	30,02	28,38	27,06	25,65
		0,31	58,80	56,44	54,28	51,92	49,35	47,05	44,56	42,46	40,23
		0,65	84,03	80,62	77,51	74,11	70,41	67,08	63,49	60,39	57,09
		1,03	103,26	99,04	95,19	90,98	86,39	82,26	77,79	73,86	69,67
		1,68	137,60	131,78	126,46	120,64	114,32	108,65	102,55	98,47	94,12
3340/5 3340/5S	1,5	0,07	21,17	20,33	19,38	18,55	17,71	16,53	15,34	14,13	12,93
		0,14	30,78	29,47	27,99	26,68	25,36	23,56	21,74	20,04	18,32
		0,31	52,22	49,15	45,81	42,74	39,65	37,06	34,46	31,98	29,48
		0,65	75,52	70,90	65,89	61,28	56,63	52,70	48,74	45,22	41,68
		1,03	94,37	88,39	81,93	75,95	69,93	64,78	59,61	55,29	50,96
		1,68	129,63	120,09	109,90	100,36	90,76	84,73	78,67	72,72	66,74
	3	0,07	44,32	42,79	39,06	37,53	35,86	34,18	32,37	30,91	29,36
		0,14	63,37	61,16	55,80	53,60	51,19	48,76	46,14	43,98	41,68
		0,31	100,49	96,73	87,99	84,22	80,11	76,42	72,43	69,02	65,39
		0,65	143,60	138,17	125,64	120,21	114,29	108,96	103,19	98,15	92,79
		1,03	176,46	169,74	154,29	147,57	140,24	133,61	126,44	120,05	113,25
		1,68	235,12	225,84	204,97	195,68	185,57	176,49	166,68	160,05	152,98
3340/7S	1,5	0,07	29,23	29,42	26,65	26,84	26,90	26,28	25,47	24,47	23,33
		0,14	42,10	42,22	38,10	38,22	38,14	37,09	35,76	34,36	32,75
		0,31	70,67	69,56	61,59	60,48	58,89	57,64	55,99	54,16	52,05
		0,65	100,94	99,08	87,48	85,63	83,06	80,92	78,19	75,62	72,66
		1,03	125,22	122,60	107,96	105,34	101,80	98,74	94,90	91,78	88,17
		1,68	167,69	162,21	141,04	135,56	128,68	125,78	121,98	117,54	112,45
	3	0,07	50,98	50,83	44,73	44,58	44,04	43,28	42,15	41,32	40,29
		0,14	72,37	72,12	63,45	63,20	62,40	61,29	59,64	58,36	56,77
		0,31	113,17	112,45	98,63	97,91	96,28	94,70	92,32	90,30	87,81
		0,65	158,86	157,79	138,35	137,28	134,94	132,64	129,20	126,14	122,40
		1,03	194,11	192,75	168,94	167,57	164,64	161,73	157,43	153,41	148,54
		1,68	251,39	249,24	218,11	215,96	211,73	207,62	201,68	198,77	195,01
3340/9S 3340/M28S	1,5	0,07	66,48	63,86	60,88	58,26	55,62	51,90	48,16	44,39	40,60
		0,14	96,67	92,55	87,91	83,79	79,65	73,99	68,29	62,93	57,55
		0,31	164,01	154,37	143,86	134,22	124,52	116,40	108,24	100,44	92,60
		0,65	237,19	222,69	206,95	192,45	177,86	165,51	153,08	142,03	130,91
		1,03	296,40	277,62	257,31	238,53	219,63	203,47	187,20	173,66	160,04
		1,68	407,13	377,17	345,16	315,20	285,06	266,12	247,07	228,39	209,60
	3	0,07	139,19	134,39	122,67	117,87	112,62	107,35	101,65	97,08	92,22
		0,14	199,03	192,10	175,27	168,34	160,76	153,14	144,90	138,13	130,92
		0,31	315,63	303,79	276,34	264,51	251,59	240,01	227,47	216,77	205,37
		0,65	451,00	433,96	394,60	377,56	358,96	342,21	324,09	308,26	291,42
		1,03	554,21	533,10	484,59	463,48	440,45	419,64	397,13	377,04	355,67
		1,68	738,46	709,30	643,75	614,60	582,83	554,31	523,49	502,68	480,47
3340/11S	1,5	0,07	89,64	90,23	81,72	82,31	82,48	80,59	78,12	75,06	71,55
		0,14	129,09	129,47	116,84	117,22	116,95	113,74	109,67	105,36	100,43
		0,31	216,72	213,31	188,88	185,47	180,60	176,77	171,70	166,09	159,62
		0,65	309,54	303,85	268,28	262,59	254,72	248,17	239,77	231,91	222,83
		1,03	384,02	375,98	331,08	323,03	312,20	302,81	291,04	281,45	270,38
		1,68	514,24	497,45	432,51	415,72	394,62	385,71	374,07	360,47	344,86
	3	0,07	156,34	155,87	137,18	136,71	135,04	132,72	129,26	126,71	123,54
		0,14	221,93	221,17	194,57	193,82	191,36	187,94	182,91	178,97	174,10
		0,31	347,07	344,86	302,47	300,26	295,27	290,42	283,11	276,91	269,29
		0,65	487,16	483,89	424,27	421,00	413,81	406,75	396,22	386,82	375,35
		1,03	595,28	591,09	518,09	513,90	504,90	495,97	482,77	470,46	455,52
		1,68	770,93	764,32	668,88	662,27	649,30	636,70	618,48	609,57	598,03

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : pressure change required to move the valve shutter from "start to open" position to rated opening position

TABLE 23B : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. HOT GAS LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	2,23	2,23	2,23	2,24	2,25	2,25	2,26	2,27	2,27
		0,14	3,15	3,14	3,15	3,16	3,17	3,18	3,19	3,20	3,21
		0,31	4,97	4,96	4,97	4,99	5,00	5,02	5,03	5,05	5,06
		0,65	7,00	6,98	7,00	7,02	7,04	7,06	7,08	7,10	7,12
		1,03	8,52	8,49	8,52	8,54	8,57	8,60	8,62	8,65	8,67
		1,68	10,94	10,91	10,94	10,98	11,01	11,04	11,07	11,11	11,14
	3	0,07	4,36	4,24	4,36	4,48	4,60	4,72	4,84	4,96	5,08
		0,14	6,15	5,98	6,15	6,32	6,49	6,66	6,83	7,00	7,18
		0,31	9,70	9,43	9,70	9,96	10,23	10,50	10,76	11,04	11,32
		0,65	13,68	13,31	13,68	14,06	14,43	14,81	15,19	15,57	15,97
		1,03	16,60	16,15	16,60	17,06	17,52	17,97	18,43	18,90	19,38
		1,68	21,39	20,80	21,39	21,97	22,56	23,15	23,74	24,34	24,96
3340/5 3340/5S	1,5	0,07	3,72	3,71	3,72	3,73	3,74	3,75	3,77	3,78	3,79
		0,14	5,25	5,24	5,25	5,27	5,28	5,30	5,31	5,33	5,35
		0,31	8,29	8,26	8,29	8,31	8,34	8,36	8,39	8,41	8,43
		0,65	11,67	11,63	11,67	11,70	11,73	11,77	11,80	11,84	11,87
		1,03	14,20	14,16	14,20	14,24	14,28	14,33	14,37	14,41	14,45
		1,68	18,24	18,18	18,24	18,29	18,35	18,40	18,46	18,51	18,56
	3	0,07	7,26	7,06	7,26	7,46	7,66	7,86	8,06	8,26	8,47
		0,14	10,25	9,97	10,25	10,53	10,81	11,10	11,38	11,67	11,96
		0,31	16,16	15,72	16,16	16,61	17,05	17,49	17,94	18,39	18,86
		0,65	22,80	22,18	22,80	23,43	24,06	24,68	25,31	25,95	26,61
		1,03	27,67	26,91	27,67	28,43	29,20	29,96	30,72	31,50	32,30
		1,68	35,64	34,66	35,64	36,62	37,60	38,58	39,56	40,57	41,60
3340/7S	1,5	0,07	5,70	5,40	5,70	6,00	6,30	6,60	6,90	7,22	7,55
		0,14	7,97	7,55	7,97	8,39	8,81	9,23	9,65	10,09	10,54
		0,31	12,42	11,76	12,42	13,07	13,73	14,38	15,04	15,72	16,44
		0,65	17,26	16,35	17,26	18,17	19,08	19,99	20,90	21,85	22,85
		1,03	20,85	19,75	20,85	21,95	23,05	24,15	25,25	26,40	27,60
		1,68	26,09	24,71	26,09	27,46	28,84	30,21	31,59	33,02	34,53
	3	0,07	9,13	8,56	9,13	9,70	10,27	10,84	11,41	12,01	12,64
		0,14	12,80	12,00	12,80	13,59	14,39	15,19	15,99	16,82	17,71
		0,31	19,89	18,66	19,89	21,13	22,37	23,61	24,85	26,15	27,53
		0,65	27,57	25,86	27,57	29,29	31,01	32,72	34,44	36,25	38,15
		1,03	33,27	31,20	33,27	35,35	37,42	39,49	41,56	43,74	46,04
		1,68	41,65	39,06	41,65	44,24	46,84	49,43	52,02	54,75	57,63
3340/9S 3340/M28S	1,5	0,07	11,69	11,65	11,69	11,72	11,76	11,79	11,8	11,86	11,90
		0,14	16,49	16,44	16,49	16,54	16,59	16,64	16,7	16,74	16,79
		0,31	26,03	25,95	26,03	26,10	26,18	26,26	26,3	26,41	26,49
		0,65	36,64	36,53	36,64	36,75	36,86	36,96	37,1	37,18	37,29
		1,03	44,60	44,46	44,60	44,73	44,86	44,99	45,1	45,26	45,39
		1,68	57,28	57,11	57,28	57,45	57,62	57,79	58,0	58,13	58,31
	3	0,07	22,81	22,18	22,81	23,43	24,06	24,69	25,3	25,96	26,62
		0,14	32,19	31,31	32,19	33,08	33,96	34,85	35,7	36,64	37,57
		0,31	50,76	49,36	50,76	52,15	53,55	54,94	56,3	57,77	59,24
		0,65	71,62	69,65	71,62	73,59	75,56	77,52	79,5	81,51	83,58
		1,03	86,92	84,53	86,92	89,31	91,69	94,08	96,5	98,92	101,43
		1,68	111,95	108,87	111,95	115,03	118,10	121,18	124,3	127,41	130,65
3340/11S	1,5	0,07	17,48	16,56	17,48	18,41	19,33	20,25	21,2	22,14	23,14
		0,14	24,43	23,14	24,43	25,72	27,01	28,29	29,6	30,93	32,34
		0,31	38,08	36,07	38,08	40,09	42,10	44,11	46,1	48,21	50,41
		0,65	52,93	50,14	52,93	55,72	58,51	61,30	64,1	67,01	70,06
		1,03	63,95	60,58	63,95	67,32	70,69	74,06	77,4	80,96	84,65
		1,68	79,99	75,78	79,99	84,21	88,43	92,65	96,9	101,28	105,89
	3	0,07	28,01	26,26	28,01	29,75	31,50	33,24	35,0	36,82	38,75
		0,14	39,25	36,80	39,25	41,69	44,13	46,58	49,0	51,59	54,30
		0,31	61,01	57,21	61,01	64,81	68,61	72,41	76,2	80,20	84,41
		0,65	84,56	79,29	84,56	89,82	95,09	100,35	105,6	111,16	116,99
		1,03	102,04	95,69	102,04	108,39	114,75	121,10	127,5	134,14	141,18
		1,68	127,73	119,77	127,73	135,68	143,64	151,59	159,5	167,91	176,72

TABLE 23C : CORRECTION FACTOR FOR EVAPORATOR TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Evaporator temperature [°C]								
-40	-30	-20	-15	-10	-5	0	4,4	10
1,12	1,08	1,05	1,04	1,03	1,02	1,01	1	0,99

# R404A / R507

TABLE 24A : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. LIQUID LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	11,30	10,61	9,87	9,19	8,50	8,06	7,62	6,95	6,27
		0,14	16,16	15,20	14,15	13,19	12,23	11,59	10,94	9,95	8,96
		0,31	26,31	24,64	22,83	21,16	19,48	18,14	16,79	15,55	14,30
		0,65	37,42	35,08	32,55	30,21	27,86	25,94	24,00	22,17	20,33
		1,03	46,04	43,21	40,14	37,31	34,46	32,08	29,68	27,35	25,00
		1,68	62,48	58,40	53,99	49,90	45,79	42,63	39,45	36,42	33,38
	3	0,07	22,15	21,52	19,77	19,14	18,45	17,64	16,76	15,81	14,80
		0,14	31,76	30,83	28,30	27,36	26,33	25,21	24,00	22,63	21,17
		0,31	52,00	50,22	45,85	44,07	42,12	40,07	37,86	35,75	33,51
		0,65	74,00	71,40	65,12	62,52	59,68	56,86	53,81	50,79	47,58
		1,03	91,29	88,00	80,19	76,90	73,31	69,94	66,29	62,55	58,57
		1,68	120,77	116,30	105,84	101,36	96,47	92,37	87,92	82,97	77,71
3340/5 3340/5S	1,5	0,07	18,83	17,69	16,45	15,32	14,17	13,44	12,70	11,58	10,45
		0,14	26,93	25,33	23,59	21,99	20,38	19,31	18,24	16,59	14,93
		0,31	43,85	41,07	38,05	35,27	32,47	30,23	27,99	25,92	23,84
		0,65	62,36	58,46	54,25	50,35	46,43	43,23	40,00	36,95	33,88
		1,03	76,73	72,02	66,90	62,19	57,44	53,47	49,47	45,58	41,67
		1,68	104,14	97,33	89,98	83,17	76,32	71,05	65,75	60,71	55,63
	3	0,07	36,91	35,86	32,95	31,91	30,75	29,40	27,94	26,35	24,67
		0,14	52,94	51,38	47,16	45,60	43,89	42,02	40,00	37,71	35,29
		0,31	86,67	83,70	76,41	73,45	70,20	66,79	63,10	59,59	55,86
		0,65	123,33	119,00	108,53	104,20	99,46	94,76	89,68	84,65	79,31
		1,03	152,15	146,67	133,64	128,17	122,18	116,57	110,49	104,25	97,62
		1,68	201,29	193,83	176,39	168,93	160,78	153,95	146,53	138,28	129,52
3340/7S	1,5	0,07	28,72	28,08	27,66	27,02	26,18	25,92	25,54	24,27	22,84
		0,14	40,68	39,83	39,28	38,43	37,29	36,92	36,35	34,47	32,34
		0,31	65,85	64,14	62,93	61,22	59,00	57,39	55,38	53,46	51,26
		0,65	91,91	89,64	88,06	85,79	82,83	80,55	77,71	74,83	71,53
		1,03	111,82	109,20	107,41	104,79	101,34	98,54	95,04	91,29	87,00
		1,68	149,30	145,06	142,00	137,76	132,34	128,71	124,17	119,50	114,16
	3	0,07	45,07	45,08	45,42	45,43	45,11	44,34	43,22	41,84	40,20
		0,14	64,02	63,96	64,37	64,31	63,77	62,76	61,27	59,30	56,95
		0,31	104,06	103,33	103,44	102,71	101,15	98,91	95,86	92,91	89,39
		0,65	145,90	144,72	144,73	143,55	141,17	138,25	134,20	130,02	125,03
		1,03	177,91	176,28	176,13	174,50	171,39	168,07	163,40	158,25	152,10
		1,68	230,21	227,79	227,32	224,90	220,54	217,05	211,92	205,27	197,33
3340/9S 3340/M28S	1,5	0,07	59,14	55,56	51,68	48,10	44,51	42,20	39,88	36,36	32,82
		0,14	84,57	79,54	74,08	69,05	64,00	60,65	57,28	52,11	46,90
		0,31	137,72	128,98	119,52	110,78	101,98	94,96	87,89	81,40	74,87
		0,65	195,86	183,62	170,37	158,14	145,83	135,76	125,64	116,05	106,41
		1,03	241,00	226,19	210,12	195,31	180,40	167,92	155,37	143,16	130,87
		1,68	327,08	305,69	282,61	261,21	239,69	223,15	206,51	190,66	174,72
	3	0,07	115,93	112,64	103,50	100,21	96,57	92,34	87,75	82,77	77,49
		0,14	166,26	161,37	148,12	143,23	137,85	131,99	125,62	118,45	110,83
		0,31	272,20	262,88	240,00	230,68	220,48	209,77	198,19	187,15	175,43
		0,65	387,36	373,75	340,88	327,28	312,39	297,63	281,66	265,86	249,08
		1,03	477,86	460,66	419,74	402,54	383,74	366,10	347,01	327,41	306,60
		1,68	632,19	608,76	554,00	530,56	504,98	483,51	460,21	434,30	406,78
3340/11S	1,5	0,07	88,08	86,12	84,82	82,87	80,27	79,50	78,32	74,44	70,05
		0,14	124,76	122,15	120,45	117,85	114,35	113,21	111,46	105,70	99,17
		0,31	201,93	196,69	192,98	187,74	180,95	176,00	169,83	163,96	157,20
		0,65	281,85	274,89	270,05	263,09	254,00	247,02	238,30	229,47	219,34
		1,03	342,92	334,88	329,39	321,35	310,77	302,17	291,45	279,94	266,79
		1,68	457,86	444,86	435,46	422,46	405,85	394,70	380,77	366,48	350,09
	3	0,07	138,21	138,24	139,29	139,32	138,34	135,96	132,53	128,31	123,29
		0,14	196,34	196,15	197,41	197,22	195,56	192,46	187,89	181,84	174,64
		0,31	319,11	316,88	317,22	314,99	310,18	303,34	293,98	284,94	274,14
		0,65	447,42	443,80	443,84	440,22	432,94	423,97	411,55	398,73	383,43
		1,03	545,59	540,59	540,12	535,12	525,59	515,41	501,11	485,29	466,44
		1,68	705,98	698,57	697,12	689,70	676,33	665,63	649,87	629,48	605,16

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : pressure change required to move the valve shutter from "start to open" position to rated opening position

TABLE 24B : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. HOT GAS LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	2,08	2,07	2,08	2,08	2,09	2,10	2,10	2,11	2,11
		0,14	2,94	2,93	2,94	2,95	2,96	2,97	2,98	2,99	3,00
		0,31	4,64	4,62	4,64	4,65	4,66	4,68	4,69	4,70	4,72
		0,65	6,54	6,52	6,54	6,55	6,57	6,59	6,61	6,63	6,65
		1,03	7,97	7,95	7,97	8,00	8,02	8,04	8,07	8,09	8,11
		1,68	10,24	10,21	10,24	10,27	10,30	10,33	10,36	10,39	10,42
	3	0,07	4,26	4,14	4,26	4,38	4,49	4,61	4,73	4,85	4,97
		0,14	6,04	5,87	6,04	6,20	6,37	6,54	6,70	6,87	7,05
		0,31	9,52	9,26	9,52	9,78	10,04	10,31	10,57	10,84	11,11
		0,65	13,40	13,03	13,40	13,77	14,14	14,51	14,87	15,25	15,64
		1,03	16,35	15,90	16,35	16,80	17,25	17,70	18,15	18,61	19,08
		1,68	21,01	20,43	21,01	21,59	22,16	22,74	23,32	23,91	24,52
3340/5 3340/5S	1,5	0,07	3,46	3,45	3,46	3,47	3,48	3,49	3,50	3,51	3,52
		0,14	4,90	4,89	4,90	4,92	4,93	4,95	4,96	4,98	4,99
		0,31	7,73	7,70	7,73	7,75	7,77	7,80	7,82	7,84	7,86
		0,65	10,89	10,86	10,89	10,92	10,96	10,99	11,02	11,05	11,09
		1,03	13,29	13,25	13,29	13,33	13,37	13,41	13,45	13,49	13,52
		1,68	17,06	17,01	17,06	17,11	17,16	17,21	17,26	17,31	17,37
	3	0,07	7,10	6,90	7,10	7,29	7,49	7,68	7,88	8,08	8,28
		0,14	10,06	9,79	10,06	10,34	10,62	10,89	11,17	11,45	11,74
		0,31	15,87	15,43	15,87	16,30	16,74	17,18	17,61	18,06	18,52
		0,65	22,33	21,72	22,33	22,95	23,56	24,18	24,79	25,42	26,06
		1,03	27,25	26,51	27,25	28,00	28,75	29,50	30,25	31,02	31,81
		1,68	35,01	34,05	35,01	35,98	36,94	37,90	38,86	39,85	40,86
3340/7S	1,5	0,07	5,80	5,49	5,80	6,11	6,41	6,72	7,02	7,34	7,68
		0,14	8,14	7,71	8,14	8,57	9,00	9,43	9,86	10,31	10,78
		0,31	12,74	12,07	12,74	13,41	14,08	14,75	15,43	16,13	16,86
		0,65	17,63	16,70	17,63	18,56	19,49	20,42	21,35	22,32	23,34
		1,03	21,27	20,15	21,27	22,39	23,51	24,63	25,76	26,93	28,15
		1,68	26,84	25,43	26,84	28,26	29,67	31,09	32,50	33,98	35,53
	3	0,07	9,51	8,92	9,51	10,11	10,70	11,29	11,88	12,51	13,16
		0,14	13,36	12,53	13,36	14,19	15,02	15,85	16,69	17,56	18,48
		0,31	20,89	19,59	20,89	22,19	23,49	24,79	26,09	27,46	28,90
		0,65	28,96	27,16	28,96	30,77	32,57	34,37	36,18	38,08	40,07
		1,03	34,93	32,76	34,93	37,11	39,28	41,46	43,63	45,92	48,33
		1,68	43,88	41,15	43,88	46,62	49,35	52,08	54,82	57,69	60,72
3340/9S 3340/M28S	1,5	0,07	10,87	10,84	10,87	10,90	10,94	10,97	11,0	11,03	11,07
		0,14	15,40	15,36	15,40	15,45	15,50	15,54	15,6	15,63	15,68
		0,31	24,27	24,19	24,27	24,34	24,41	24,48	24,6	24,63	24,70
		0,65	34,21	34,11	34,21	34,31	34,41	34,52	34,6	34,72	34,82
		1,03	41,73	41,61	41,73	41,86	41,98	42,10	42,2	42,35	42,48
		1,68	53,58	53,42	53,58	53,74	53,90	54,06	54,2	54,38	54,54
	3	0,07	22,29	21,68	22,29	22,90	23,52	24,13	24,7	25,37	26,02
		0,14	31,60	30,74	31,60	32,47	33,34	34,21	35,1	35,97	36,88
		0,31	49,83	48,46	49,83	51,20	52,57	53,94	55,3	56,72	58,16
		0,65	70,14	68,22	70,14	72,07	74,00	75,93	77,9	79,83	81,86
		1,03	85,60	83,25	85,60	87,95	90,31	92,66	95,0	97,42	99,90
		1,68	109,97	106,95	109,97	113,00	116,02	119,04	122,1	125,16	128,34
3340/11S	1,5	0,07	17,79	16,85	17,79	18,73	19,66	20,60	21,5	22,52	23,55
		0,14	24,97	23,66	24,97	26,29	27,61	28,92	30,2	31,62	33,06
		0,31	39,07	37,01	39,07	41,13	43,19	45,25	47,3	49,46	51,71
		0,65	54,06	51,21	54,06	56,91	59,77	62,62	65,5	68,45	71,56
		1,03	65,23	61,79	65,23	68,67	72,10	75,54	79,0	82,58	86,34
		1,68	82,32	77,98	82,32	86,66	91,00	95,34	99,7	104,22	108,96
	3	0,07	29,18	27,36	29,18	30,99	32,81	34,63	36,4	38,36	40,37
		0,14	40,97	38,41	40,97	43,52	46,07	48,62	51,2	53,85	56,68
		0,31	64,06	60,07	64,06	68,05	72,04	76,03	80,0	84,21	88,63
		0,65	88,82	83,29	88,82	94,35	99,88	105,41	110,9	116,77	122,89
		1,03	107,12	100,45	107,12	113,80	120,47	127,14	133,8	140,83	148,22
		1,68	134,58	126,20	134,58	142,96	151,34	159,72	168,1	176,92	186,20

TABLE 24C : CORRECTION FACTOR FOR EVAPORATOR TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Evaporator temperature [°C]								
-40	-30	-20	-15	-10	-5	0	4,4	10
1,26	1,19	1,13	1,1	1,07	1,05	1,02	1	0,98

TABLE 25A : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. LIQUID LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	16,01	15,08	14,08	13,15	12,22	11,52	10,82	9,92	9,02
		0,14	23,06	21,75	20,31	19,00	17,68	16,52	15,35	14,11	12,85
		0,31	36,67	34,37	31,87	29,56	27,24	25,65	24,04	22,24	20,44
		0,65	52,65	49,38	45,84	42,58	39,29	36,67	34,03	31,54	29,04
		1,03	65,41	61,41	57,07	53,06	49,04	45,37	41,69	38,71	35,71
		1,68	90,55	83,88	76,76	70,09	63,38	59,02	54,62	50,52	46,40
	3	0,07	30,94	29,86	27,24	26,16	24,97	23,90	22,73	21,65	20,50
		0,14	44,23	42,71	38,99	37,48	35,82	34,21	32,47	30,86	29,16
		0,31	70,70	67,89	61,59	58,78	55,71	53,36	50,81	48,36	45,75
		0,65	100,68	96,74	87,84	83,90	79,62	76,11	72,32	68,70	64,85
		1,03	124,02	119,26	108,37	103,61	98,41	93,92	89,05	84,43	79,51
		1,68	164,06	157,56	142,98	136,49	129,42	123,12	116,32	110,26	103,82
3340/5 3340/5S	1,5	0,07	26,61	25,07	23,53	21,98	20,43	19,26	18,08	16,58	15,08
		0,14	38,33	36,14	33,95	31,76	29,55	27,61	25,66	23,58	21,48
		0,31	60,96	57,11	53,27	49,42	45,54	42,87	40,19	37,18	34,16
		0,65	87,52	82,06	76,63	71,18	65,68	61,29	56,88	52,72	48,54
		1,03	108,73	102,04	95,39	88,70	81,97	75,85	69,69	64,71	59,70
		1,68	150,53	139,38	128,31	117,16	105,95	98,65	91,31	84,45	77,56
	3	0,07	50,28	48,39	46,68	44,79	42,74	40,86	38,84	36,99	35,03
		0,14	71,87	69,23	66,82	64,18	61,29	58,50	55,49	52,74	49,83
		0,31	114,93	110,04	105,55	100,66	95,34	91,25	86,84	82,65	78,19
		0,65	163,66	156,81	150,54	143,69	136,24	130,16	123,59	117,41	110,83
		1,03	201,60	193,30	185,72	177,42	168,41	160,60	152,18	144,28	135,89
		1,68	266,69	255,38	245,04	233,74	221,47	210,55	198,78	188,43	177,42
3340/7S	1,5	0,07	36,90	36,21	35,78	35,08	34,13	33,61	32,90	31,45	29,81
		0,14	52,80	51,86	51,29	50,36	49,06	47,88	46,39	44,44	42,20
		0,31	83,13	81,03	79,57	77,47	74,74	73,50	71,82	69,28	66,35
		0,65	117,75	114,91	112,95	110,10	106,38	103,70	100,31	96,93	93,03
		1,03	144,15	140,83	138,57	135,24	130,85	126,48	121,13	117,25	112,77
		1,68	197,40	189,76	183,85	176,21	166,83	162,27	156,57	150,96	144,52
	3	0,07	59,19	58,72	58,74	58,27	57,33	56,38	55,00	53,77	52,26
		0,14	83,85	83,26	83,35	82,76	81,49	80,00	77,88	75,98	73,68
		0,31	132,79	130,95	130,28	128,44	125,43	123,49	120,61	117,83	114,42
		0,65	185,23	182,82	182,03	179,62	175,60	172,56	168,18	163,98	158,87
		1,03	226,03	223,29	222,49	219,75	215,06	210,95	205,16	199,66	193,00
		1,68	294,35	290,35	288,93	284,93	278,35	272,19	263,77	256,63	248,02
3340/9S 3340/M28S	1,5	0,07	83,58	78,73	73,90	69,05	64,16	60,49	56,79	52,08	47,35
		0,14	120,39	113,49	106,64	99,74	92,81	86,72	80,60	74,06	67,47
		0,31	191,47	179,36	167,32	155,21	143,02	134,64	126,21	116,78	107,29
		0,65	274,88	257,73	240,69	223,54	206,29	192,50	178,63	165,58	152,44
		1,03	341,50	320,49	299,61	278,60	257,46	238,22	218,86	203,23	187,49
		1,68	472,78	437,77	402,98	367,97	332,75	309,83	286,77	265,24	243,59
	3	0,07	157,91	151,99	146,60	140,68	134,22	128,34	121,99	116,18	110,01
		0,14	225,74	217,43	209,88	201,57	192,51	183,74	174,27	165,65	156,49
		0,31	360,98	345,59	331,52	316,13	299,43	286,61	272,73	259,58	245,59
		0,65	514,01	492,49	472,81	451,28	427,90	408,81	388,18	368,75	348,07
		1,03	633,16	607,11	583,30	557,24	528,93	504,42	477,95	453,16	426,79
		1,68	837,61	802,10	769,62	734,11	695,57	661,28	624,33	591,81	557,24
3340/11S	1,5	0,07	113,17	111,05	109,71	107,59	104,68	103,08	100,89	96,46	91,41
		0,14	161,92	159,05	157,30	154,43	150,44	146,84	142,27	136,27	129,43
		0,31	254,94	248,51	244,00	237,57	229,20	225,40	220,25	212,44	203,47
		0,65	361,10	352,38	346,37	337,65	326,23	318,01	307,62	297,25	285,28
		1,03	442,07	431,88	424,95	414,75	401,29	387,87	371,48	359,58	345,83
		1,68	605,37	581,93	563,82	540,38	511,62	497,63	480,15	462,95	443,20
	3	0,07	181,50	180,08	180,14	178,71	175,80	172,90	168,68	164,90	160,26
		0,14	257,13	255,32	255,60	253,79	249,90	245,33	238,83	233,02	225,94
		0,31	407,23	401,59	399,52	393,88	384,65	378,69	369,88	361,34	350,89
		0,65	568,04	560,66	558,22	550,84	538,52	529,19	515,75	502,87	487,22
		1,03	693,17	684,76	682,31	673,90	659,52	646,92	629,17	612,28	591,88
		1,68	902,68	890,41	886,05	873,78	853,60	834,71	808,89	787,00	760,59

Standard rating conditions according to AHRI Standard 770-2014					
Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

(1) : pressure change required to move the valve shutter from "start to open" position to rated opening position

TABLE 25B : REFRIGERANT FLOW CAPACITY OF CONDENSING PRESSURE REGULATORS 3340 [KW]. HOT GAS LINE

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	2,33	2,32	2,33	2,34	2,34	2,35	2,36	2,37	2,37
		0,14	3,29	3,28	3,29	3,30	3,31	3,32	3,33	3,34	3,35
		0,31	5,20	5,18	5,20	5,21	5,23	5,25	5,26	5,28	5,29
		0,65	7,33	7,31	7,33	7,35	7,37	7,39	7,42	7,44	7,46
		1,03	8,94	8,92	8,94	8,97	8,99	9,02	9,05	9,07	9,10
		1,68	11,43	11,40	11,43	11,46	11,50	11,53	11,57	11,60	11,63
	3	0,07	4,55	4,43	4,55	4,68	4,81	4,93	5,06	5,18	5,32
		0,14	6,45	6,27	6,45	6,62	6,80	6,98	7,15	7,34	7,52
		0,31	10,17	9,89	10,17	10,45	10,73	11,01	11,29	11,57	11,87
		0,65	14,34	13,94	14,34	14,73	15,12	15,52	15,91	16,32	16,73
		1,03	17,49	17,01	17,49	17,97	18,45	18,93	19,41	19,90	20,41
		1,68	22,37	21,75	22,37	22,98	23,60	24,21	24,83	25,46	26,10
3340/5 3340/5S	1,5	0,07	3,88	3,87	3,88	3,90	3,91	3,92	3,93	3,94	3,95
		0,14	5,49	5,47	5,49	5,51	5,52	5,54	5,56	5,57	5,59
		0,31	8,67	8,64	8,67	8,69	8,72	8,74	8,77	8,79	8,82
		0,65	12,21	12,18	12,21	12,25	12,29	12,32	12,36	12,40	12,43
		1,03	14,90	14,86	14,90	14,95	14,99	15,04	15,08	15,12	15,17
		1,68	19,05	18,99	19,05	19,11	19,16	19,22	19,28	19,33	19,39
	3	0,07	7,59	7,38	7,59	7,80	8,01	8,22	8,43	8,64	8,86
		0,14	10,74	10,45	10,74	11,04	11,33	11,63	11,92	12,23	12,54
		0,31	16,95	16,48	16,95	17,41	17,88	18,34	18,81	19,29	19,78
		0,65	23,89	23,24	23,89	24,55	25,21	25,86	26,52	27,19	27,88
		1,03	29,15	28,35	29,15	29,95	30,75	31,55	32,35	33,17	34,01
		1,68	37,28	36,26	37,28	38,30	39,33	40,35	41,38	42,43	43,51
3340/7S	1,5	0,07	5,91	5,59	5,91	6,22	6,53	6,84	7,15	7,48	7,82
		0,14	8,29	7,86	8,29	8,73	9,17	9,61	10,04	10,50	10,98
		0,31	12,94	12,26	12,94	13,62	14,31	14,99	15,67	16,38	17,13
		0,65	18,00	17,05	18,00	18,95	19,90	20,85	21,80	22,79	23,83
		1,03	21,65	20,51	21,65	22,79	23,93	25,07	26,21	27,41	28,66
		1,68	27,30	25,86	27,30	28,73	30,17	31,61	33,05	34,56	36,13
	3	0,07	9,55	8,96	9,55	10,15	10,74	11,34	11,93	12,56	13,22
		0,14	13,40	12,57	13,40	14,23	15,07	15,90	16,74	17,62	18,54
		0,31	20,91	19,61	20,91	22,22	23,52	24,82	26,12	27,50	28,94
		0,65	28,89	27,09	28,89	30,69	32,49	34,29	36,09	37,98	39,97
		1,03	34,92	32,74	34,92	37,09	39,27	41,44	43,61	45,90	48,31
		1,68	43,96	41,22	43,96	46,69	49,43	52,17	54,91	57,79	60,82
3340/9S 3340/M28S	1,5	0,07	12,20	12,16	12,20	12,24	12,27	12,31	12,3	12,38	12,42
		0,14	17,24	17,19	17,24	17,30	17,35	17,40	17,4	17,50	17,55
		0,31	27,22	27,13	27,22	27,30	27,38	27,46	27,5	27,62	27,70
		0,65	38,36	38,25	38,36	38,47	38,59	38,70	38,8	38,93	39,05
		1,03	46,81	46,67	46,81	46,95	47,08	47,22	47,4	47,50	47,64
		1,68	59,83	59,65	59,83	60,01	60,18	60,36	60,5	60,72	60,90
	3	0,07	23,84	23,19	23,84	24,50	25,15	25,81	26,5	27,14	27,83
		0,14	33,74	32,82	33,74	34,67	35,60	36,52	37,5	38,40	39,38
		0,31	53,22	51,76	53,22	54,68	56,15	57,61	59,1	60,57	62,11
		0,65	75,04	72,98	75,04	77,11	79,17	81,23	83,3	85,41	87,58
		1,03	91,54	89,03	91,54	94,06	96,57	99,09	101,6	104,19	106,83
		1,68	117,09	113,87	117,09	120,31	123,52	126,74	130,0	133,26	136,64
3340/11S	1,5	0,07	18,11	17,16	18,11	19,07	20,02	20,98	21,9	22,93	23,97
		0,14	25,44	24,10	25,44	26,78	28,12	29,46	30,8	32,20	33,67
		0,31	39,69	37,60	39,69	41,78	43,87	45,97	48,1	50,25	52,53
		0,65	55,20	52,29	55,20	58,11	61,02	63,93	66,8	69,89	73,07
		1,03	66,39	62,89	66,39	69,89	73,39	76,89	80,4	84,05	87,88
		1,68	83,71	79,29	83,71	88,12	92,53	96,95	101,4	105,98	110,80
	3	0,07	29,30	27,47	29,30	31,12	32,95	34,77	36,6	38,52	40,54
		0,14	41,09	38,53	41,09	43,65	46,21	48,77	51,3	54,02	56,86
		0,31	64,14	60,15	64,14	68,13	72,13	76,12	80,1	84,32	88,74
		0,65	88,60	83,08	88,60	94,12	99,63	105,15	110,7	116,47	122,59
		1,03	107,08	100,41	107,08	113,75	120,42	127,08	133,8	140,77	148,16
		1,68	134,80	126,41	134,80	143,19	151,59	159,98	168,4	177,21	186,51

TABLE 25C : CORRECTION FACTOR FOR EVAPORATOR TEMPERATURE DIFFERENT FROM NOMINAL VALUE

Evaporator temperature [°C]								
-40	-30	-20	-15	-10	-5	0	4,4	10
1,18	1,13	1,09	1,07	1,05	1,03	1,02	1	0,98

# PRESSURE REGULATORS

## 6.5 – LIQUID RECEIVER PRESSURE REGULATORS

### APPLICATIONS

Regulator 3350 is used coupled with the regulator 3340, or alternately to the differential valve 3136W. Together, these valves form a regulating system that maintains constant condenser and receiver pressure in plants with heat recovery and air and water condensation. The regulators in series 3340 restrict the liquid flow from the condenser to the receiver, reducing the active condenser surface and raising the condensing pressure. The regulator 3350 by-passes hot gas from the compressor discharge to the receiver, raising the liquid pressure in the receiver.

The receiver pressure regulators in series 3350 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

Receiver pressure regulators adjust the flow of the hot gas according to changes of liquid receiver pressure, downstream stream of the regulator. When the receiver pressure is greater than the regulator calibration pressure, the shutter remains closed. As the receiver pressure drops below the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in the receiver pressure. As the receiver pressure continues to drop, the shutter continues to open, until the stroke limit is reached and the regulator is open completely. Liquid receiver pressure regulators only modulate based on the outlet pressure change, pressure changes on the inlet 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 3350 is 8 bar. This means that until the receiver pressure is less than 8 bar, the regulator remains closed. When it drops under 8 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 2.3 bar in calibration pressure. The calibration range varies from 3 to 20 bar.

### CONSTRUCTION

The main parts of regulators in series 3350 are manufactured 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;
- Brass bar EN 12164 – CW 614N for the shutter;
- Brass bar EN 12164 – CW 614N for regulator ring;
- Spring steel DIN 17223/84 Class C/D for setting spring;
- Chloroprene rubber (CR) for outlet seal gaskets.

### INSTALLATION

Condensing pressure regulators 3340 are assembled on the liquid line between the condenser and the liquid receiver. On the other hand, receiver pressure regulator 3350 is assembled in by-pass between the compressor discharge and the liquid receiver inlet.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the capacity regulators in series 3350 with file SA33319. These regulators 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 405 PSI.





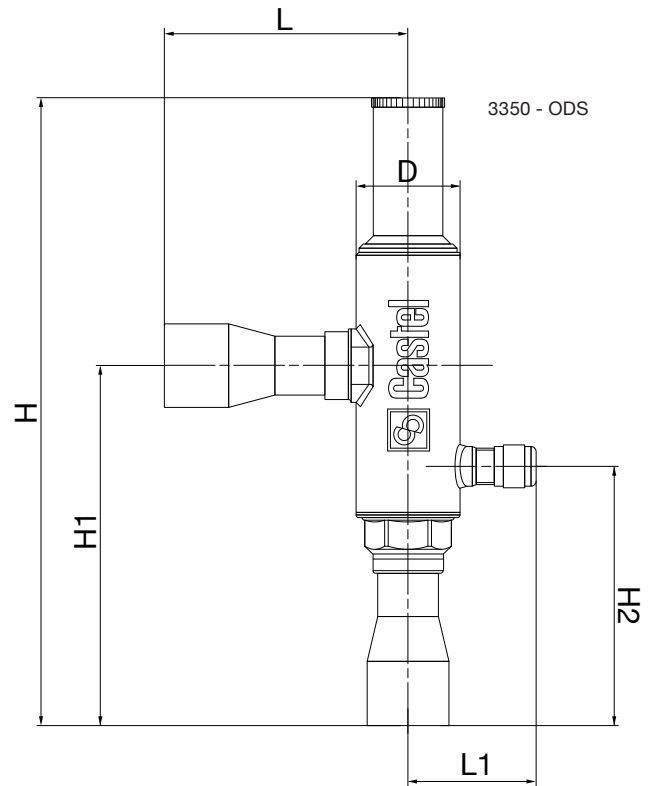
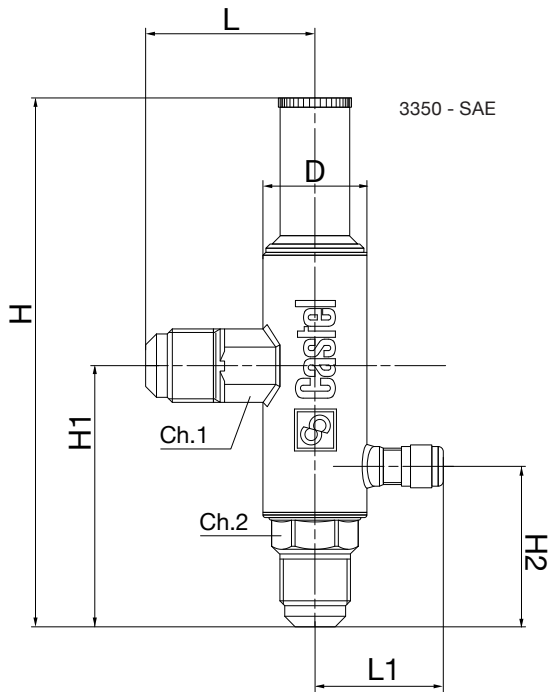
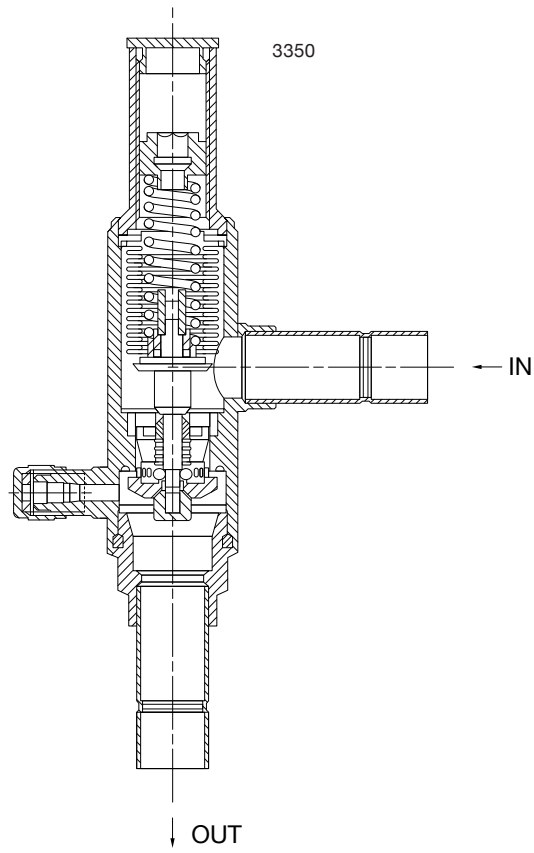


TABLE 26: GENERAL CHARACTERISTICS OF RECEIVER PRESSURE REGULATORS

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	
		∅ [in.]	∅ [mm]								
3350/4	1/2"	–	–	1,80	3	20	8	28	–40	+110	Art. 43.3
3350/M12S	–	–	12								
3350/4S	–	1/2"	–								
3350/5	5/8"	–	–								
3350/5S	–	5/8"	16								
3350/7S	–	7/8"	22								

TABLE 27: DIMENSIONS AND WEIGHTS OF RECEIVER PRESSURE REGULATORS

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H <sub>1</sub>	H <sub>2</sub>	L	L <sub>1</sub>	D	Ch <sub>1</sub>	Ch <sub>2</sub>	
3340/4	159	76,5	45,5	48	37	32	22	24	4902
3340/M12S	183	100,5	69,5	64			-	-	506
3340/4S	183	100,5	69,5	64			-	-	506
3340/5	163	80,5	49,5	52			22	24	550
3340/5S	183	100,5	69,5	64			-	-	506
3340/7S	194	112	81	75,5			-	-	570

# PRESSURE REGULATORS

## 6.6 – WATER REGULATING VALVES

### APPLICATIONS

Water regulating valves, usually used with condensers fed with either mains or well water, keep the condensation pressure constant at a pre-set value by adjusting the water flow so as to ensure balanced heat exchange under all conditions.

At plant start-up, this adjustment is designed to allow the thermostatic valve to rapidly reach normal operating conditions and subsequently, during operations, to avoid excessive pressure increases or decreases under different load conditions.

An excessive rise of high pressure affects the refrigerating capacity of the system. On the other hand, lowering the high pressure leads to insufficient refrigerant feed to the evaporator with consequent increased overheating of the gas and a parallel reduction in the gas pressure at the compressor suction.

Water regulating valves in series 3210 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. (excluded R410A)

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

The moving elements of the valve are a metal bellows and a shutter. The thrust of the refrigerant condensation pressure outside the bellows favours the opening of the valve and the thrust of the adjustment spring on the shutter acts to close it.

Given a specific spring setting, the valve progressively opens as the condensation pressure increase, and closes when this pressure decreases. When the compressor stops, the valve closes: water is no longer fed into the condenser, providing significant operating economy.

Valves are calibrated to a pressure of 7.5 bar. This calibration setting can be modified by turning the regulating screw.

There are three reference notches on the spring cover marked with letters A, B and C. Each notch is equivalent to a different spring setting.

- Letter A is equivalent to about 7.5 bar (valid for R134a at a condensation temperature of 30°C);
- Letter B is equivalent to about 14 bar (valid for R404A, R407C and R507 at a condensing temperature of 30°C);
- Letter C is equivalent to about 18 bar (maximum working pressure).

### CONSTRUCTION

The main parts of the check valves are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover;
- Austenitic stainless steel AISI 303 for the seat;
- Nitrile rubber (NBR) for the seat gaskets;
- Rubber coated fabric (NBR) for the membranes.

### INSTALLATION

The valve must be assembled on the water side of the condenser inlet, preferably vertically, with the bellows downward. The high-pressure connection to the bellows must show no deflection. The arrow on the valve body indicates the water flow direction.

### SELECTION

Refrigerating systems with a hermetic compressor and a condenser fed with mains water.

- Mains water pressure: 3 bar;
- Water temperature at the condenser inlet: 14 °C;
- Expected thermal difference:  $D_t = 10$  °C;
- Condensation temperature expected based of the water/refrigerant heat exchange in the condenser: approximately 6 °C above the outlet water temperature, equivalent to 30 °C (with a corresponding saturation pressure) (Fig. 1);
- Refrigeration yield at the evaporator: 18.6 kW under the following conditions: condensation temperature: +30 °C; evaporation temperature: -15 °C.

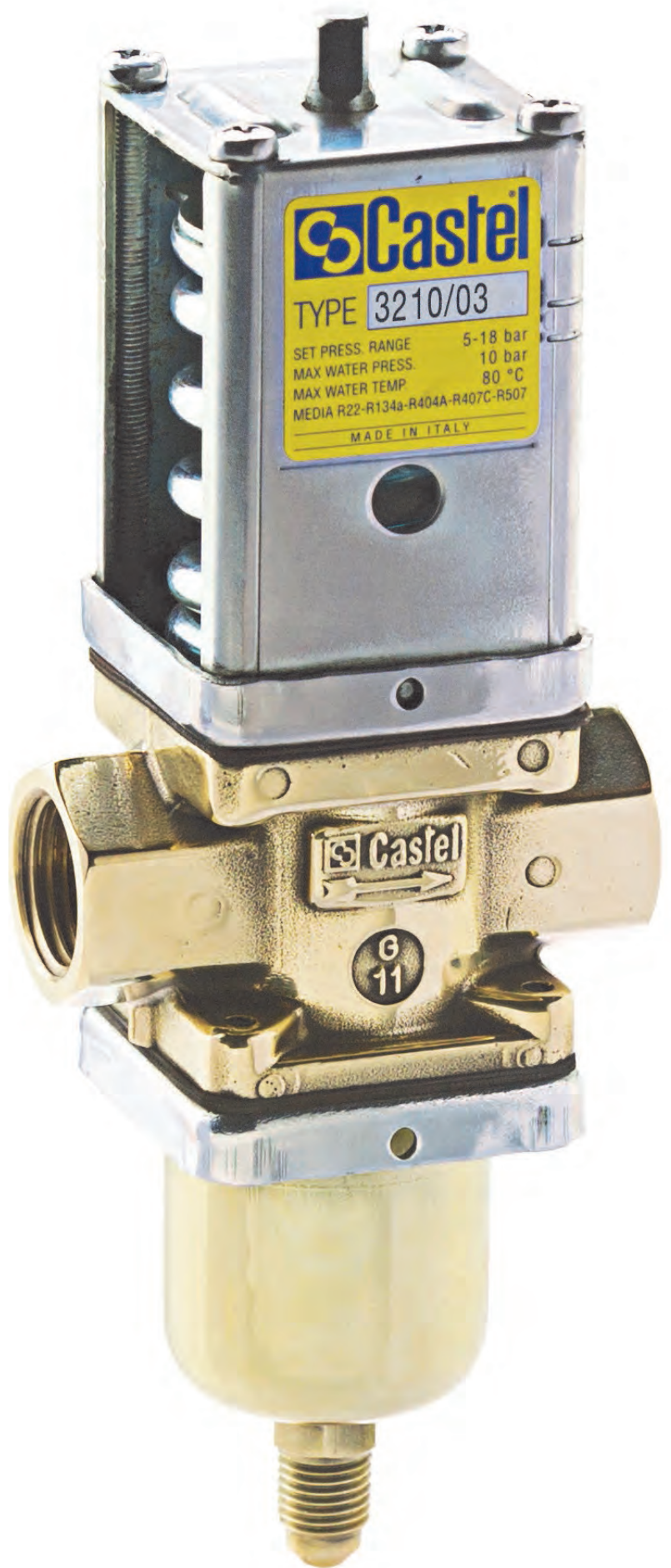
Thermal power to be dispersed at the condenser (see Table 29 for the thermal factor):  $18.6 \cdot 1.325 = 24.65$  [kW]

$$\text{Water flow rate: } \frac{24.65 \cdot 860}{10} = 2120 \text{ l/h} = 2.12 \text{ [m}^3\text{/h]}$$

The pressure drop corresponding to the water flow rate specified above in the condenser/piping circuit, with the exclusion of the water regulating valve, is about 2,5 bar. The pressure differential available across the water regulating valve is therefore:

$$\Delta p = 3 - 2.5 = 0.5 \text{ bar}$$

At  $\Delta p = 0.5$  bar, when pressure valve 3210/04 is fully opened, it ensures the required flow rate (Fig. 2). When the intersection point of the pressure differential across the valve and flow rate falls within the area defined by the curves of two valves, select the valve with larger diameter. The fully closed pressure of the valve must be equal to the refrigerant saturation pressure at the ambient air temperature at which the condenser is installed. When the valve begins to open, the pressure is about 0,2 bar greater than the fully closed pressure.



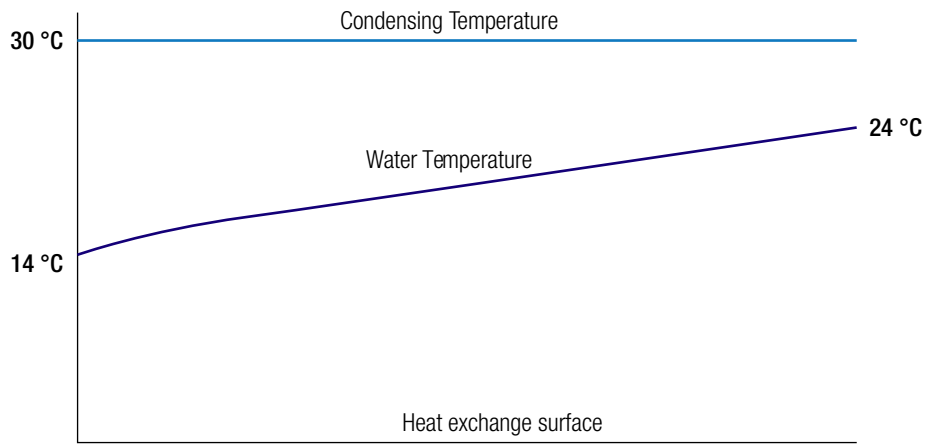


Fig.1 - Heat exchange pattern in the condenser

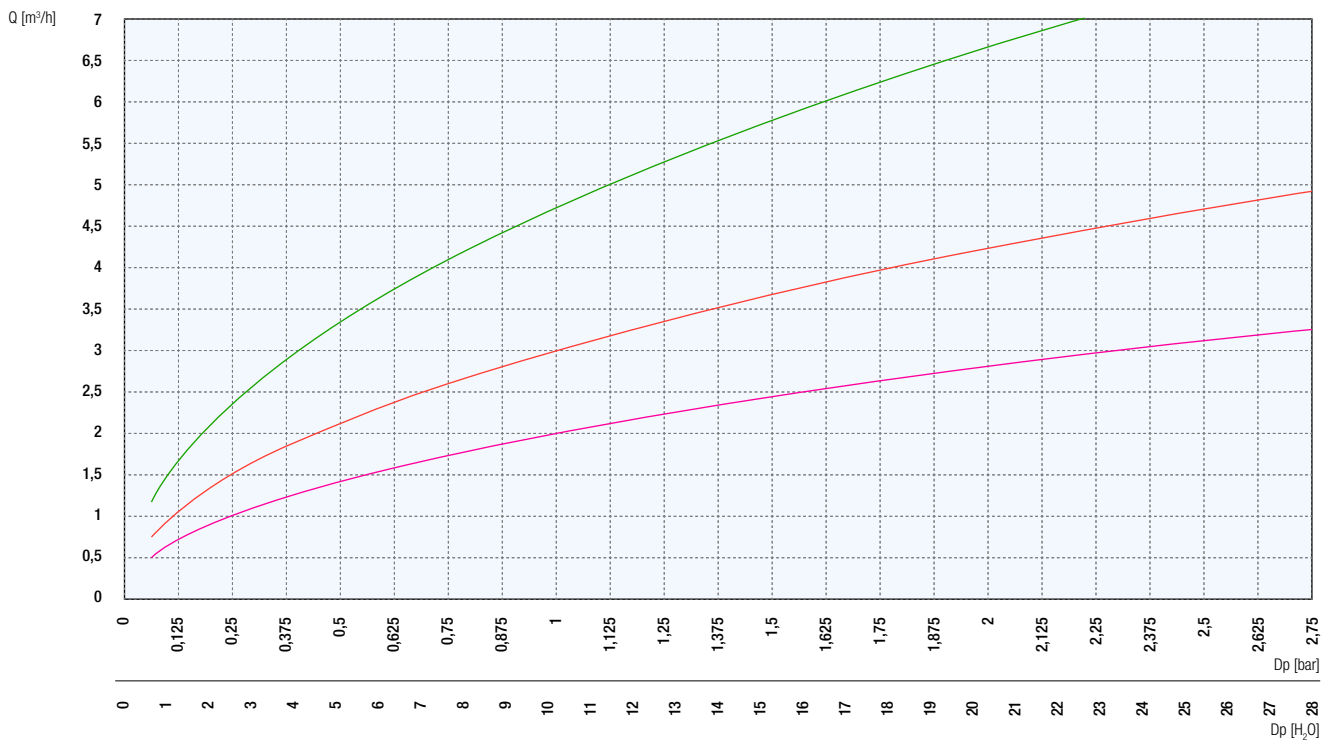


Fig.2 - Characteristics curves when the valves are completely open.

TABLE 28: GENERAL CHARACTERISTIC OF WATER REGULATING VALVES

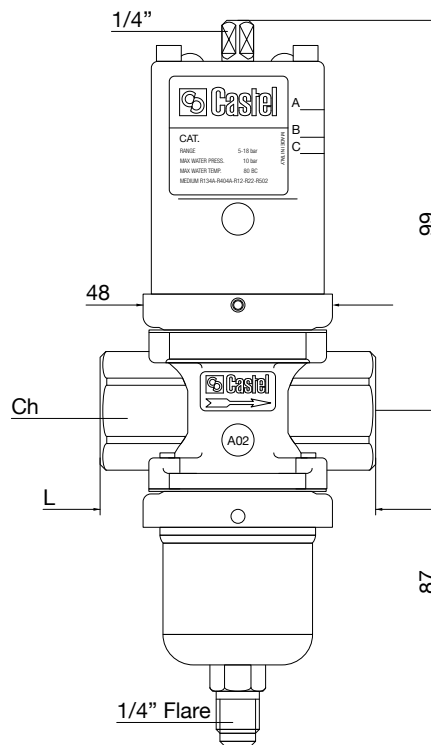
Catalogue Number	Connections UNI ISO 228/1	Working pressure [bar]	Maximum water pressure [bar]	Max. water temperature [°C]	Kv Factor [m³/h]	Refrigerant max working pressure [bar]	Ch	L	Weight [g]
3210/03	G 3/8"	5 - 20	10	80	2	22	27	70	1015
3210/04	G1/2"				3				985
3210/06	G 3/4"				4,7				1010

TABLE 29: THERMAL FACTOR FOR HERMETIC REFRIGERATION COMPRESSOR. RELATIONSHIP BETWEEN THE TOTAL HEAT TO BE DISPOSED OF AT THE LEVEL OF THE CONDENSER AND REFRIGERATION CAPACITY AT THE LEVEL OF THE EVAPORATOR

Condensing Temperature [°C]	Evaporating Temperature [°C]									
	-35	-30	-25	-20	-15	-10	-5	0	+5	+10
+30	1,524	1,473	1,421	1,371	1,325	1,281	1,238	1,200	1,163	1,133
+35	1,553	1,503	1,453	1,403	1,355	1,310	1,268	1,228	1,188	1,155
+40	1,578	1,531	1,484	1,435	1,387	1,340	1,295	1,254	1,210	1,175
+45	-	-	1,521	1,475	1,425	1,377	1,330	1,285	1,240	1,200
+50	-	-	-	-	1,468	1,420	1,369	1,320	1,270	1,227
+55	-	-	-	-	1,520	1,465	1,412	1,363	1,304	1,255
+60	-	-	-	-	-	1,526	1,457	1,398	1,338	1,285

TABLE 30: THERMAL FACTOR FOR OPEN COMPRESSOR(DIRECT OR BELT DRIVEN). RELATIONSHIP BETWEEN THE TOTAL HEAT TO BE DISPOSED OF AT THE LEVEL OF THE CONDENSER AND REFRIGERATION CAPACITY AT THE LEVEL OF THE EVAPORATOR

Condensing Temperature [°C]	Evaporating Temperature [°C]									
	-35	-30	-25	-20	-15	-10	-5	0	+5	+10
+30	1,460	1,417	1,371	1,330	1,291	1,243	1,213	1,178	1,143	1,114
+35	1,495	1,450	1,405	1,367	1,320	1,279	1,240	1,202	1,168	1,133
+40	1,537	1,530	1,441	1,396	1,350	1,306	1,265	1,224	1,185	1,152
+45	-	-	1,485	1,437	1,390	1,342	1,295	1,252	1,211	1,175
+50	-	-	-	1,482	1,431	1,381	1,334	1,288	1,241	1,120
+55	-	-	-	-	-	1,426	1,369	1,320	1,274	1,228
+60	-	-	-	-	-	1,474	1,410	1,355	1,330	1,255









# REFRIGERATING SYSTEM PROTECTORS

CLASSIC

# REFRIGERATING SYSTEM PROTECTORS

## DRYING REFRIGERANT FLUIDS

Among contaminating agents that can cause serious damages to refrigerating systems, moisture plays a major role.

Its presence, always a possibility in refrigerating systems, is due to many factors:

- Inadequate or insufficient vacuum before refrigerant charging;
- Topping up using oil that has been exposed to the humidity in the air;
- Refrigerant used for subsequent additions stored in vessels that have not been dried;
- Sealing defects, especially in systems not designed for operation at low temperatures.

High temperatures combined with humidity give rise to complex phenomena that promote acid formation both in the lubricating oil and the refrigerant. Organic acids of the oils react with metals, promoting the formation of sludge, which are viscous clots consisting of insoluble metal salts and large molecules of polymerized oil. In the long term, in addition to reducing lubrication of the moving parts of the compressor, sludge can clog valves and filters, causing serious damage.

Acids produced by the hydrolysis of the refrigerant (in compressors iron and aluminium act as catalysts) are particularly corrosive, especially hydrofluoric acid. Acids attack metal surfaces with the consequent formation of crystal salts, penalizing the total heat exchange coefficient in the condenser and in the evaporator. In particular, in hermetic and semi-hermetic units, these salts damage the windings of electric motors, cooled by direct contact with the cold gas.

Water solubility in refrigerants in the liquid phase is quite low, especially at low temperatures. Consequently, when water in the system exceeds the very low limits of solubility allowed at low temperature, the excess water turns into ice, and partially or totally blocks expansion valves and capillaries.

Therefore, it is absolutely necessary to equip refrigeration systems with effective filters for drying the fluid.

In terms of concept and construction, the filter driers available on the market consist of two types: loose molecular sieve and solid core.

In the loose molecular sieve type, consisting of non-agglomerating product, the dehydrating mass is pressed using a spring between two metal fine-mesh wires, or two filter separators that can be constructed from various materials.

In solid core driers, the core is made from specifically dosed dehydrating and deacidifying products with binders. Water adsorption combines with the neutralization of acids that may be present in the refrigerant, and with a strong filtering action.

Castel has set up both its hermetic filter product lines based on the latter construction, which eliminates the danger of abrasion during loading and consequent formation of dust, and it allows the filter to be positioned at any location in the system.

It is always advisable to install a humidity indicator downstream

from the filter. It will show the refrigerant's moisture content and the degree of efficiency of the filter. Remember, the drying capacity of Castel filters refers to the refrigerant charge and not the refrigeration potential of the system. As a matter of fact, with the same refrigerant potential and the same type of refrigerant fluid, there may be different refrigerant charges based on the type, design and partialization range of the plant, as well as to the operating conditions.

The data shown in the following tables are deduced from the test results of the present Castel production.

It is important to note that, in the event of a high oil level in the circuit (> 5%), the data shown in the tables will be reduced considerably.



**Castrol**  UL FILTER/DRYERS  
LISTED EQUIPMENT  
MWP = 680 PSIG  
T. RANGE = -40/+176°F

SOLID CORE  
FILTER DRIER  
R22 - R134a - R404A  
R407C - R410A - R507

Type **SF411/5A**

PS = 47 bar  
TS = -40/+80 °C

V **1,91**

Lot N. **2718**

CE  Made in China

**FLOW DIRECTION**



# REFRIGERATING SYSTEM PROTECTORS

## 7.1 – LIQUID INDICATORS & MOISTURE/LIQUID INDICATORS

### APPLICATIONS

The liquid indicators and moisture/liquid indicators ensure fast, safe inspection of the refrigerant fluid conditions in the liquid circuit in terms of its regular flow and the presence of moisture. They are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants.

These 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

**Note: The indicator in series 3780 are excluded from the scope of application of Directive 2014/68/EU as they are piping components.**

### 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 drier.

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

The liquid indicators in series 38 and moisture/liquid indicators in series 39 are manufactured in a sealed hermetic unit to avoid any possible refrigerant 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.

Liquid/moisture indicators in series 3770, 3771 and 3780 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 a gasket of chloroprene butadiene (CR).

### 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 indicators 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.

For indicators in series 3780 the ring must be disassembled before brazing. Note: the PS declared in Table 1 for saddle-type indicators in series 3780, refers only to the body plus the ring (with its o-ring), which the customer must tighten to the torque indicated on the product instruction handbook. The aforesaid declaration doesn't cover any possible leakage or malfunctions due to brazing the body on the copper pipe. The customer is totally responsible for the success of this operation.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the liquid indicators in series 3810, 3840, 3850 and the moisture/liquid indicators in series 3910, 3940, 3950 with file SA33318.

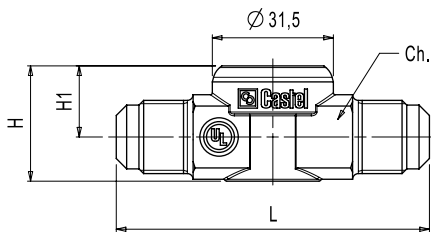
These valves are certified **UL-CSA Listed** for the USA and Canada, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15, with a Design Pressure of 500 PSI.



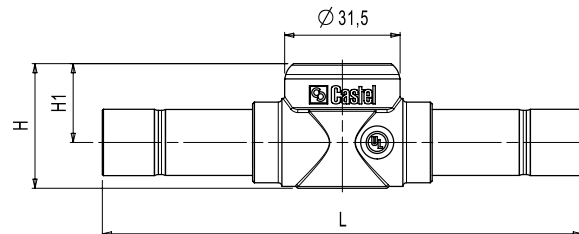
TABLE 1: GENERAL CHARACTERISTICS OF LIQUID INDICATORS

Catalogue Number	Type	Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast
		SAE Flare	ODS			min.	max.	
			Ø [in.]	Ø [mm]				
3810/22	male - male	1/4"	-	-	50	-40	+120	Art. 4.3
3810/33		3/8"	-	-				
3810/44		1/2"	-	-				
3810/55		5/8"	-	-				
3810/66		3/4"	-	-				
3850/22		male - female	1/4"	-				
3850/33	3/8"		-	-				
3850/44	1/2"		-	-				
3850/55	5/8"		-	-				
3850/66	3/4"		-	-				
3840/2	brazing	-	1/4"	-	50	-40	+120	Art. 4.3
3840/3		-	3/8"	-				
3840/M10		-	-	10				
3840/M12		-	-	12				
3840/4		-	1/2"	-				
3840/5		-	5/8"	16				
3840/M18		-	-	18				
3840/6		-	3/4"	-				
3840/7		-	7/8"	22				
3840/9		-	1.1/8"	-				

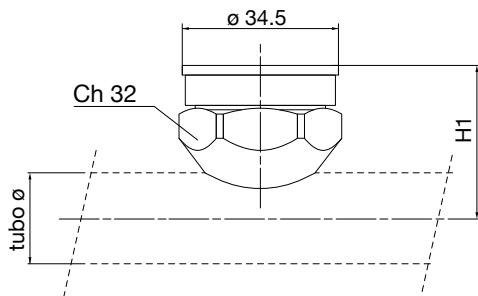
3810  
3910



3840  
3940



3680  
3780



3850  
3950

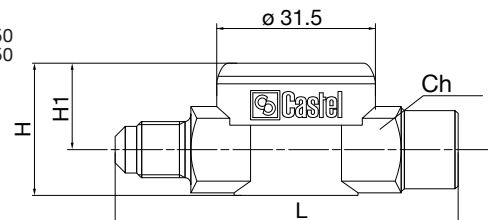




TABLE 2: GENERAL CHARACTERISTICS OF LIQUID / MOISTURE INDICATORS

Catalogue Number	Type	Connections								PS [bar]	TS [°C]		Risk Category according to PED Recast
		SAE Flare	ODS		ODM		for pipe				min.	max.	
			Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]	Hole Ø [mm]				
3910/22	male - male	1/4"	w	-	-	-	-	-	-	50	-40	+120	Art. 4.3
3910/33		3/8"											
3910/44		1/2"											
3910/55		5/8"											
3910/66		3/4"											
3950/22	male - female	1/4"	-	-	-	-	-	-	50	-40	+120	Art. 4.3	
3950/33		3/8"											
3950/44		1/2"											
3950/55		5/8"											
3950/66		3/4"											
3940/2	brazing	1/4"	-	10	-	-	-	-	50	-40	+120	Art. 4.3	
3940/3		3/8"											
3940/M10		12											
3940/M12		12											
3940/4		1/2"											
3940/5		5/8"											
3940/M18		18											
3940/6		3/4"											
3940/7		7/8"											
3940/9		1.1/8"											
3770/M28	brazing	-	-	-	-	-	-	-	45	-30	+110	Art. 4.3	
3770/11													28
3770/13													35
3770/M42													42
3771/11													35
3771/M42													42
3770/17													42
3780/5	saddle type	-	-	-	-	-	-	-	45	-30	+110	excluded	
3780/M18													16
3780/7													18
3780/9													22
3780/11													28
3781/M28	level glass	-	-	-	-	-	-	28	-	-	-	-	

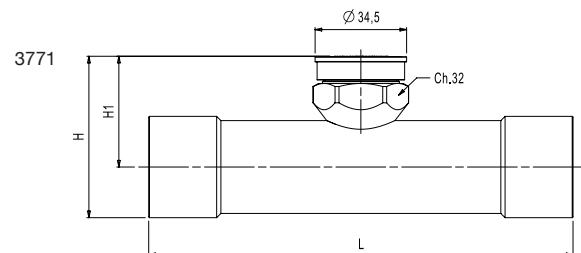
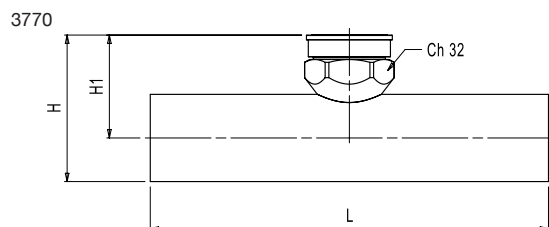
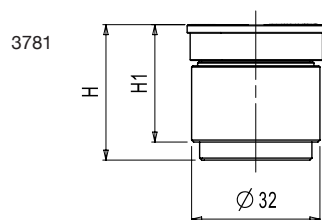


TABLE 3: DIMENSIONS AND WEIGHTS

Catalogue Number		Dimensions [mm]				Weight [g]									
Liquid Indicators	Moisture Liquid Indicators	H	H <sub>1</sub>	L	Ch										
3810/22	3910/22	22	16,5	71,5	12	110									
3810/33	3910/33	26,5	17,5	77,5	17	150									
3810/44	3910/44	30	18,5	81,5	22	196									
3810/55	3910/55	34	21,5	89,5	24	238									
3810/66	3910/66	37,5	23,5	90	28	298									
3850/22	3950/22	26,5	17,5	68	17	140									
3850/33	3950/33	30	18,5	74	22	185									
3850/44	3950/44	34	21,5	77	24	231									
3850/55	3950/55	37,5	23,5	82	28	288									
3850/66	3950/66	43,5	26	92	35	517									
3840/2	3940/2	22	15,5	113	-	116									
3840/3	3940/3	34	21,5	117		-	185								
3840/M10	3940/M10														
3840/M12	3940/M12														
3840/4	3940/4														
3840/5	3940/5	34	21,5	131			-	195							
3840/M18	3940/M18														
3840/6	3940/6														
3840/7	3940/7	37,5	23,5	151				-	306						
3840/9	3940/9	43,5	26	186					-	501					
-	3770/M28	52	38	150						-	300				
	3770/11	59	41,5	160							-	349			
	3770/13	66	45	170								-	516		
	3770/M42														
	3771/11	61	41,5	160	-								378		
	3771/M42	68	45	170		-							516		
	3771/17	80											-	550	
	3780/5	-	30	-										-	90
	3780/M18		31												
	3780/7		33												
3780/9	36														
3780/11	39,5														
3781/M28	34	29	-	-			-	107							





# REFRIGERATING SYSTEM PROTECTORS

## 7.2 – HERMETIC FILTER DRIERS

### APPLICATIONS

The hermetic filter driers in series 42-43, DF2-DF3 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### CONSTRUCTION

**Filters in series 42-43:** The filter is completely manufactured in steel, with threaded connections, SAE FLARE, in copper-plated steel. The product range also includes types with copper plated solder connections, offering the possibility to solder the copper pipe inside the connections (ODS).

On specific customer request, Castel is also able to supply filters in series 42-43 with connections:

- ORS (O-Ring Seal) according to SAE Standard J 1453;
- ORP (O-Ring Pilot) according to IMACA Standard 305.

**Filters in series DF2-DF3:** the filter body is made completely from steel with threaded connections, SAE FLARE, made from nickel plated steel. The product range also includes types with copper connections, EN 12735-1 - Cu-DHP, offering the possibility to solder the copper pipe inside the connections (ODS). On specific customer request, Castel can supply filters in series DF2-DF3 with ORS (O-Ring Seal) connections according to SAE Standard J 1453.

**Filters in series 42 and DF2:** The cartridges 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 very high deacidifying capacity maintaining very good moisture adsorption characteristics. The presence of a controlled and defined percentage of activated alumina, lower than the maximum value recommended by ASERCOM, maintains the original concentration of additives in the polyester oil.

**Filters in series 43 and DF3:** 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.

The manufacturing process allows both products to be compact and strong, making them resistant to impact and abrasion. The cartridge is shaped to offer the incoming fluid maximum possible surface area. The internal cavity is positioned in such a way as to ensure a uniform wall thickness. As a result, the fluid encounters constant resistance, flows linearly, ensuring efficient dehydration and minimum charge loss. The cartridge is chemically inert, not deliquescent, does not react with refrigerating fluids, and is capable of capturing all oil by-products in the circuit. Impurities accumulate in the ring between the metal shell and the cartridge. This prevents the filter from clogging.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the hermetic filters in series 42-43 and DF2-DF3 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:

- 435 PSI for filters in series 4203-4303, 4205-4305, 4216-4316;
- 400 PSI for filters in series 4208-4308, 4230-4330, 4241-4341;
- 680 PSI for filters in series DF2-DF3.



## FILTER SELECTION BASED ON REFRIGERANT FLOW CAPACITY

Refrigerant flow capacities shown in Tables 6-7 and Tables 14-15 refer to the following operating conditions according to ARI STANDARD 710-2009:

- Liquid temperature + 30 °C;
- Evaporating temperature - 15 °C.

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

$$Q = Q_{\text{ref}} \cdot L_1$$

where:

- Q = required refrigeration flow capacity [kW];
- $Q_{\text{ref}}$  = reference refrigeration flow capacity [kW] (see Tables 6-7 and Tables 14-15);
- $L_1$  = flow capacity correction factor in presence of operative temperatures different from reference conditions. (See Table 8).

### Example

- |  |            |
|--|------------|
| • Refrigerant:                         | R404A      |
| • Required refrigeration flow capacity | 15 [kW]    |
| • Liquid temperature                   | + 40 [°C]  |
| • Evaporating temperature              | - 10 [°C]  |
| • Set pressure drop                    | 0.14 [bar] |

Filter with 100% molecular sieve cartridge and ODF solder connections.

$$Q = Q_{\text{ref}} \cdot L_1$$

$$15 = Q_{\text{ref}} \cdot 0.86$$

$$Q_{\text{ref}} = 15 / 0.86 = 17.44 \text{ [kW]}$$

Comparing the reference flow capacity obtained with the values indicated in Table 7, the choice falls on filter model 4305/3S with a flow capacity of 17,9 kW, with a pressure drop of 0.14 bar.

## FILTER SELECTION BASED ON DEHYDRATION CAPACITY

### System Data:

- |                      |         |
|----------------------|---------|
| • Refrigerant fluid  | R407C   |
| • Liquid temperature | + 50 °C |
| • Refrigerant charge | 34 kg   |

According to ARI STANDARD 710-2009 and DIN 8949:2000, the adsorption capacity of the filter drier is given by:

$$(1,050 - 50) \cdot 34 / 1,000 = 34 \text{ g of H}_2\text{O}$$

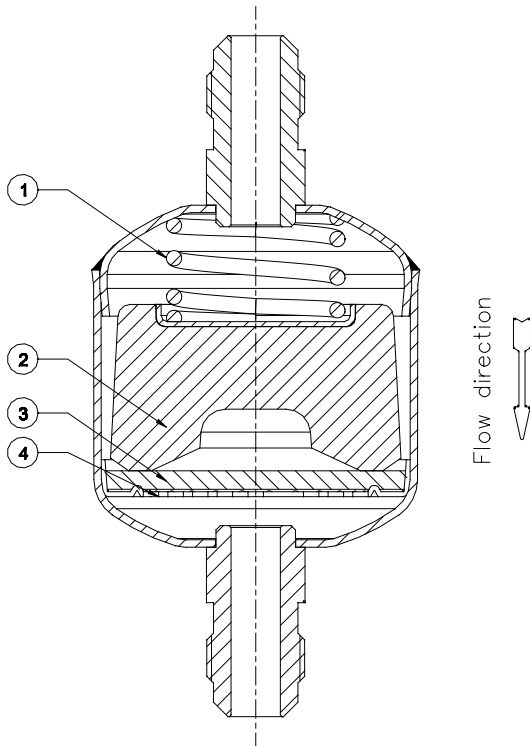
where:

- 1,050 ppm. = moisture in the refrigerant entering the filter according to ARI STANDARD 710-2004 and DIN 8949:2000;
- 50 ppm. = moisture in the refrigerant flowing out the filter according to ARI STANDARD 710-2004 and DIN 8949:2000.

Comparing the adsorption capacity required with the values shown in table 9, filter 4341 should be selected, which has an adsorption capacity at 50 °C of 41,7 g of H<sub>2</sub>O.

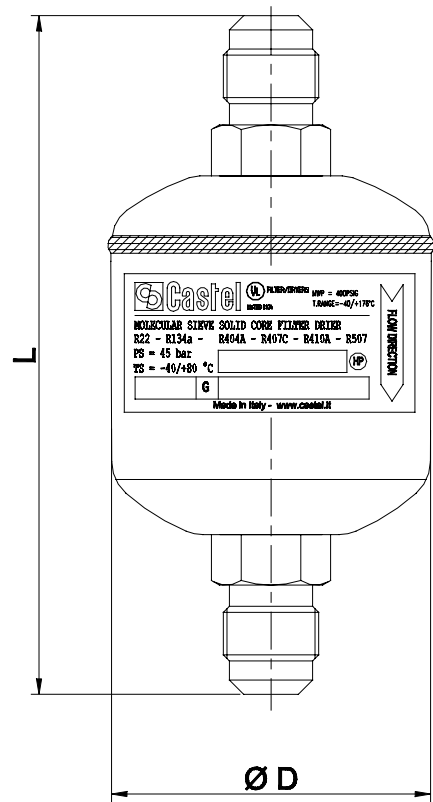
If the manufacturer indicates the drying capacity of their products in water drops, remembered that: **1g H<sub>2</sub>O = 20 water drops**. In this case, and when a molecular sieve filter dryer is selected, the following result is obtained: 34 x 20 = 680 water drops.

If moisture exceeds the values specified in ARI STANDARD 710-2009 and DIN 8949:2000, a filter with a greater adsorption capacity must be selected.

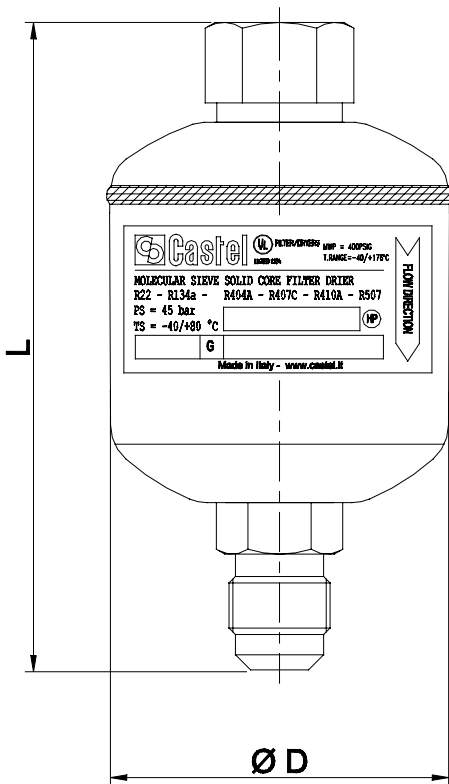


**Solid core dehydrator**

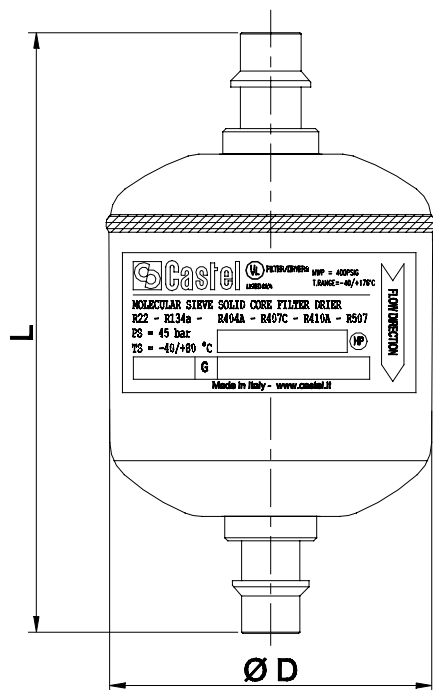
- 1 - Spring
- 2 - Bock
- 3 - Felt
- 4 - Stainless steel mesh



Male connections

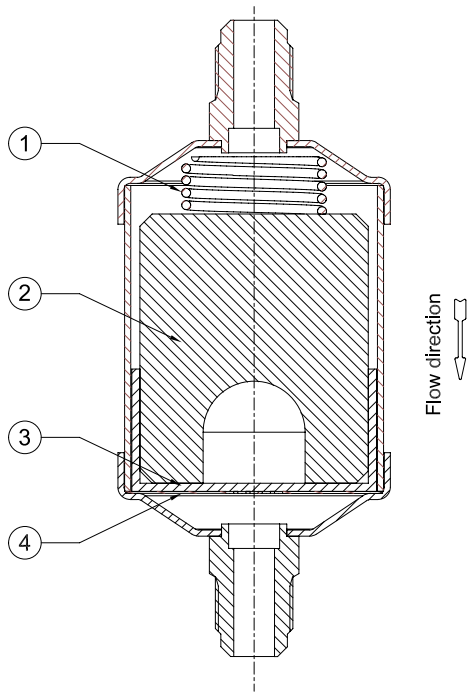


Male-Female connections  
(female in)



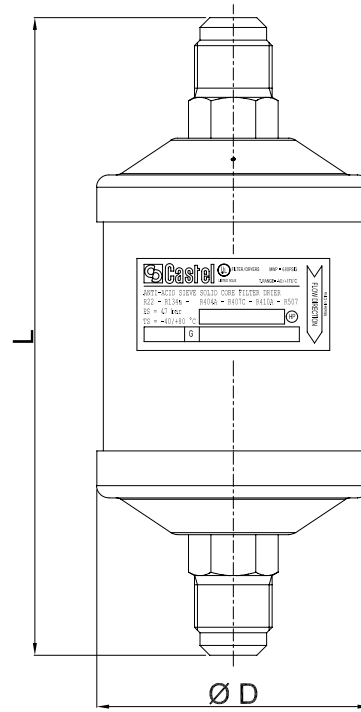
Solder connections



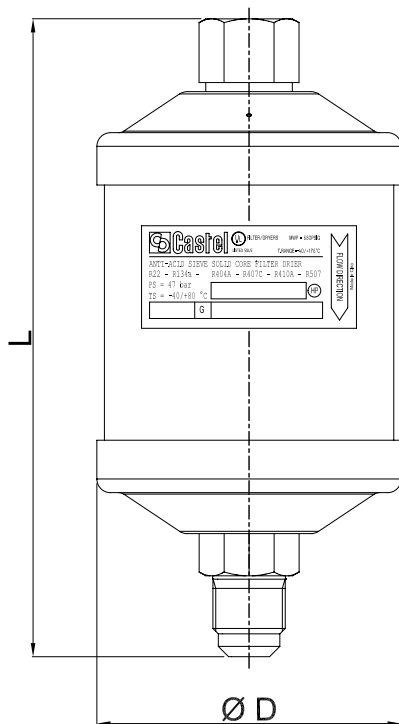


**Solid core dehydrator**

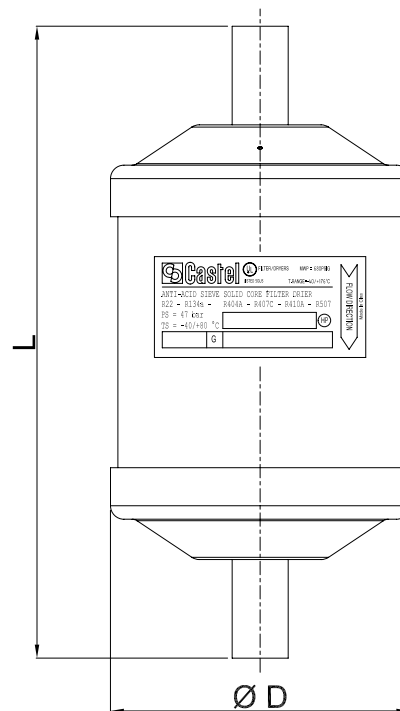
- 1 - Spring
- 2 - Bock
- 3 - Felt
- 4 - Stainless steel mesh



**Male connections**



**Male-Female connections  
(female in)**



**Solder connections**

TABLE 4: GENERAL CHARACTERISTICS OF HERMETIC FILTER DRIERS. SAE FLARE CONNECTIONS

Catalogue Number		International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections	PS [bar]	TS [°C]		Risk Category according to PED Recast
100% molecular sieves	80% molecular sieves + 20% activated alumina						min.	max.	
4303/2	4203/2	032	47	50	1/4"	45	- 40	+ 80	Art. 4.3
4303/3	4203/3	033			3/8"				
4305/2	4205/2	052	70	80	1/4"				
4305/3	4205/3	053			3/8"				
4308/2	4208/2	082	103	130	1/4"				
4308/3	4208/3	083			3/8"				
4308/4	4208/4	084			1/2"				
4316/2	4216/2	162			1/4"				
4316/3	4216/3	163	155	250	3/8"				
4316/4	4216/4	164			1/2"				
4316/5	4216/5	165			5/8"				
4330/3	4230/3	303			3/8"				
4330/4	4230/4	304	310	500	1/2"				
4330/5	4230/5	305			5/8"				
4341/4	-	414			1/2"				
4341/5	4241/5	415	330	670	5/8"				
4341/6	4241/6	416			3/4"				
4303/2F (1)	-	-	47	50	1/4"				
4305/2F (1)	-	-	70	80	1/4"				
4308/2F (1)	-	-	103	130	1/4"				
4308/3F (1)	-	-			3/8"				
4316/3F (1)	-	-	155	250	3/8"				

(1) : Male-female connections (Inlet female)

TABLE 5: GENERAL CHARACTERISTICS OF HERMETIC FILTER DRIERS. ODS CONNECTIONS

Catalogue Number		Inter. Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections				PS [bar]	TS [°C]		Risk Category according to PED Recast
100% molecular sieves	80% molecular sieves + 20% activated alumina				ODS		ODM			min.	max.	
					Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
4303/2S	4203/2S	032S	47	50	1/4"	-	3/8"	-	45	- 40	+ 80	Art. 4.3
4303/2.5S	-	-			5/16"	-	3/8"	-				
4303/3S	-	033S			3/8"	-	1/2"	-				
4305/2S	4205/2S	052S	70	80	1/4"	-	3/8"	-				
4305/3S	4205/3S	053S			3/8"	-	1/2"	-				
4305/M10S	4205/M10S	-			-	10	-	12				
4308/2S	4208/2S	082S	103	130	1/4"	-	3/8"	-				
4308/3S	4208/3S	083S			3/8"	-	1/2"	-				
4308/M10S	4208/M10S	-			-	10	-	12				
4308/M12S	4208/M12S	-			-	12	-	14				
4308/4S	4208/4S	084S	155	250	1/2"	-	5/8"	16				
4316/3S	4216/3S	163S			3/8"	-	1/2"	-				
4316/M10S	4216/M10S	-			-	10	-	12				
4316/M12S	4216/M12S	-			-	12	-	14				
4316/4S	4216/4S	164S			1/2"	-	5/8"	16				
4316/5S	4216/5S	165S			5/8"	16	3/4"	-				
4316/7S	-	167S			7/8"	-	1.1/8"	-				
4330/3S	4230/3S	303S	310	500	3/8"	-	1/2"	-				
4330/4S	4230/4S	304S			1/2"	-	5/8"	16				
4330/5S	4230/5S	305S			5/8"	16	3/4"	-				
4330/7S	-	307S			7/8"	-	1.1/8"	-				
4330/9S	-	309S			1.1/8"	-	1.3/8"	35				
4341/4S	-	414S	330	670	1/2"	-	5/8"	16				
4341/5S	4241/5S	415S			5/8"	16	3/4"	-				
4341/6S	4241/6S	416S			3/4"	-	7/8"	-				
4341/7S	4241/7S	417S			7/8"	-	1.1/8"	-				
4375/4S	4275/4S	754S	768	1340	1/2"	-	5/8"	16				
4375/5S	4275/5S	755S			5/8"	16	3/4"	-				
4375/6S	4275/6S	756S			3/4"	-	7/8"	-				
4375/7S	4275/7S	757S			7/8"	-	1.1/8"	-				
4375/9S	4275/9S	759S			1.1/8"	-	1.3/8"	35				

TABLE 6: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,07 BAR (1) [KW]

Catalogue Number		Refrigerants													
100% molecular sieves	80% molecular sieves + 20% activated alumina	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
4303/2	4203/2	6,4	7,0	4,6	6,6	6,8	4,4	5,7	6,2	6,0	5,1	4,6	5,4	5,5	6,4
4303/2F	–	6,4	7,0	4,6	6,6	6,8	4,4	5,7	6,2	6,0	5,1	4,6	5,4	5,5	6,4
4303/2S	4203/2S	7,9	8,6	5,6	8,1	8,3	5,5	7,0	7,6	7,4	6,3	5,7	6,6	6,7	7,9
4303/3	4203/3	14,8	16,1	10,5	15,2	15,6	10,2	13,0	14,2	13,8	11,7	10,7	12,4	12,5	14,7
4303/3S	–	18,6	20,3	13,3	19,2	19,7	12,9	16,4	17,9	17,5	14,8	13,4	15,7	15,8	18,6
4305/2	4205/2	6,6	7,2	4,7	6,8	7,0	4,6	5,8	6,4	6,2	5,2	4,8	5,6	5,6	6,6
4305/2F	–	6,6	7,2	4,7	6,8	7,0	4,6	5,8	6,4	6,2	5,2	4,8	5,6	5,6	6,6
4305/2S	4205/2S	8,2	8,9	5,8	8,4	8,6	5,7	7,2	7,8	7,7	6,5	5,9	6,9	6,9	8,2
4305/3	4205/3	15,2	16,6	10,9	15,7	16,1	10,5	13,4	14,6	14,3	12,1	11,0	12,8	12,9	15,2
4305/3S	4205/3S	19,3	21,0	13,7	19,8	20,3	13,3	17,0	18,5	18,1	15,3	13,9	16,2	16,4	19,2
4305/M10S	–	19,3	21,0	13,7	19,8	20,3	13,3	17,0	18,5	18,1	15,3	13,9	16,2	16,4	19,2
4308/2	4208/2	6,9	7,5	4,9	7,1	7,3	4,8	6,1	6,6	6,5	5,5	5,0	5,8	5,8	6,9
4308/2F	–	6,9	7,5	4,9	7,1	7,3	4,8	6,1	6,6	6,5	5,5	5,0	5,8	5,8	6,9
4308/2S	4208/2S	8,4	9,2	6,0	8,7	8,9	5,8	7,5	8,1	7,9	6,7	6,1	7,1	7,2	8,4
4308/3	4208/3	17,9	19,5	12,8	18,4	18,9	12,4	15,8	17,2	16,8	14,2	12,9	15,0	15,2	17,9
4308/3F	–	17,9	19,5	12,8	18,4	18,9	12,4	15,8	17,2	16,8	14,2	12,9	15,0	15,2	17,9
4308/3S	4208/3S	22,6	24,7	16,2	23,3	23,9	15,7	20,0	21,8	21,2	18,0	16,4	19,0	19,2	22,6
4308/M10S	–	22,6	24,7	16,2	23,3	23,9	15,7	20,0	21,8	21,2	18,0	16,4	19,0	19,2	22,6
4308/M12S	–	28,7	31,3	20,5	29,6	30,3	19,9	25,4	27,6	26,9	22,8	20,7	24,1	24,4	28,7
4308/4	4208/4	23,8	25,9	16,9	24,5	25,1	16,4	21,0	22,8	22,3	18,9	17,1	20,0	20,2	23,7
4308/4S	4208/4S	28,7	31,3	20,5	29,6	30,3	19,9	25,4	27,6	26,9	22,8	20,7	24,1	24,4	28,7
4316/2	4216/2	6,9	7,5	4,9	7,1	7,3	4,8	6,1	6,6	6,5	5,5	5,0	5,8	5,8	6,9
4316/3	4216/3	19,5	21,3	13,9	20,1	20,6	13,5	17,3	18,8	18,3	15,5	14,1	16,4	16,6	19,5
4316/3F	–	19,5	21,3	13,9	20,1	20,6	13,5	17,3	18,8	18,3	15,5	14,1	16,4	16,6	19,5
4316/3S	4216/3S	24,4	26,6	17,4	25,1	25,8	16,9	21,5	23,5	22,9	19,4	17,6	20,5	20,7	24,4
4316/M10S	–	24,4	26,6	17,4	25,1	25,8	16,9	21,5	23,5	22,9	19,4	17,6	20,5	20,7	24,4
4316/M12S	–	33,8	36,9	24,1	34,9	35,8	23,4	29,9	32,5	31,7	26,9	24,4	28,4	28,7	33,8
4316/4	4216/4	28,0	30,5	19,9	28,8	29,6	19,4	24,7	26,9	26,2	22,2	20,2	23,5	23,8	27,9
4316/4S	4216/4S	33,8	36,9	24,1	34,9	35,8	23,4	29,9	32,5	31,7	26,9	24,4	28,4	28,7	33,8
4316/5	4216/5	37,2	40,6	26,6	38,4	39,3	25,8	32,9	35,8	34,9	29,6	26,9	31,3	31,6	37,2
4316/5S	4216/5S	44,7	48,7	31,8	46,0	47,2	30,9	39,4	43,0	41,9	35,5	32,2	37,5	37,9	44,6
4316/7S	–	47,3	51,6	33,7	48,8	50,0	32,8	41,8	45,5	44,4	37,6	34,2	39,8	40,2	47,3
4330/3	4230/3	21,5	23,4	15,3	22,1	22,7	14,9	19,0	20,6	20,1	17,0	15,5	18,0	18,2	21,4
4330/3S	4230/3S	26,9	29,3	19,2	27,7	28,4	18,6	23,7	25,8	25,2	21,3	19,4	22,6	22,8	26,8
4330/4	4230/4	30,6	33,4	21,8	31,6	32,4	21,2	27,1	29,5	28,7	24,3	22,1	25,8	26,0	30,6
4330/4S	4230/4S	37,0	40,4	26,4	38,2	39,1	25,7	32,7	35,6	34,7	29,4	26,7	31,1	31,5	37,0
4330/5	4230/5	38,4	41,9	27,4	39,6	40,6	26,6	33,9	37,0	36,0	30,5	27,7	32,3	32,6	38,4
4330/5S	4230/5S	46,2	50,4	33,0	47,6	48,8	32,0	40,8	44,5	43,3	36,7	33,4	38,9	39,3	46,2
4330/7S	–	48,8	53,2	34,8	50,3	51,6	33,8	43,1	46,9	45,8	38,7	35,2	41,0	41,4	48,7
4330/9S	–	48,8	53,2	34,8	50,3	51,6	33,8	43,1	46,9	45,8	38,7	35,2	41,0	41,4	48,7
4341/4	–	34,3	37,4	24,5	35,3	36,2	23,7	30,3	33,0	32,2	27,2	24,8	28,8	29,1	34,3
4341/4S	–	40,9	44,6	29,2	42,1	43,2	28,3	36,1	39,3	38,4	32,5	29,5	34,4	34,7	40,9
4341/5	4241/5	40,5	44,2	28,9	41,8	42,8	28,1	35,8	39,0	38,0	32,2	29,3	34,1	34,4	40,5
4341/5S	4241/5S	49,1	53,5	35,0	50,6	51,8	34,0	43,3	47,2	46,0	38,9	35,4	41,2	41,7	49,0
4341/6	4241/6	66,6	72,6	47,5	68,6	70,3	46,1	58,8	64,0	62,4	52,9	48,1	56,0	56,6	66,5
4341/6S	4241/6S	66,6	72,6	47,5	68,6	70,3	46,1	58,8	64,0	62,4	52,9	48,1	56,0	56,6	66,5
4341/7S	4241/7S	73,5	80,2	52,5	75,8	77,7	50,9	65,0	70,7	69,0	58,4	53,1	61,8	62,5	73,5
4375/4S	4275/4S	52,9	57,7	37,7	54,5	55,9	36,6	46,7	50,9	49,6	42,0	38,2	44,5	44,9	52,9
4375/5S	4275/5S	54,0	58,9	38,5	55,7	57,1	37,4	47,7	51,9	50,7	42,9	39,0	45,4	45,9	54,0
4375/6S	4275/6S	79,9	87,1	57,0	82,3	84,4	55,3	70,6	76,8	74,9	63,4	57,7	67,2	67,9	79,8
4375/7S	4275/7S	92,0	100,3	65,6	94,8	97,2	63,7	81,2	88,5	86,3	73,0	66,4	77,3	78,1	91,9
4375/9S	4275/9S	95,6	104,3	68,2	98,6	101,1	66,2	84,5	92,0	89,7	75,9	69,0	80,4	81,2	95,5

(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, inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at + 30 °C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

TABLE 7: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,14 BAR (1) [KW]

Catalogue Number		Refrigerants													
100% molecular sieves	80% molecular sieves + 20% activated alumina	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
4303/2	4203/2	7,7	8,4	5,5	7,9	8,1	5,3	6,8	7,3	7,2	6,1	5,6	6,5	6,5	7,7
4303/2F	-	7,7	8,4	5,5	7,9	8,1	5,3	6,8	7,3	7,2	6,1	5,6	6,5	6,5	7,7
4303/2S	4203/2S	9,5	10,3	6,7	9,8	10,0	6,6	8,4	9,0	8,9	7,6	6,8	8,0	8,0	9,5
4303/3	4203/3	17,7	19,3	12,6	18,3	18,7	12,3	15,6	16,8	16,6	14,1	12,8	14,9	15,1	17,7
4303/3S	-	22,3	24,4	15,9	23,0	23,6	15,5	19,7	21,2	20,9	17,8	16,1	18,8	19,0	22,3
4305/2	4205/2	7,9	8,6	5,7	8,2	8,4	5,5	7,0	7,5	7,4	6,3	5,7	6,7	6,7	7,9
4305/2F	-	7,9	8,6	5,7	8,2	8,4	5,5	7,0	7,5	7,4	6,3	5,7	6,7	6,7	7,9
4305/2S	4205/2S	10,6	11,6	7,6	10,9	11,2	7,3	9,4	10,1	10,0	8,5	7,7	8,9	9,0	10,6
4305/3	4205/3	19,8	21,6	14,1	20,4	20,9	13,7	17,5	18,8	18,6	15,8	14,3	16,6	16,8	19,8
4305/3S	4205/3S	25,0	27,3	17,9	25,8	26,5	17,3	22,1	23,8	23,5	20,0	18,1	21,0	21,3	25,0
4305/M10S	-	25,0	27,3	17,9	25,8	26,5	17,3	22,1	23,8	23,5	20,0	18,1	21,0	21,3	25,0
4308/2	4208/2	8,9	9,8	6,4	9,2	9,4	6,2	7,9	8,5	8,4	7,1	6,5	7,5	7,6	8,9
4308/2F	-	8,9	9,8	6,4	9,2	9,4	6,2	7,9	8,5	8,4	7,1	6,5	7,5	7,6	8,9
4308/2S	4208/2S	11,0	12,0	7,8	11,3	11,6	7,6	9,7	10,4	10,3	8,8	7,9	9,2	9,3	11,0
4308/3	4208/3	23,2	25,4	16,6	24,0	24,6	16,1	20,5	22,1	21,8	18,6	16,8	19,5	19,7	23,2
4308/3F	-	23,2	25,4	16,6	24,0	24,6	16,1	20,5	22,1	21,8	18,6	16,8	19,5	19,7	23,2
4308/3S	4208/3S	29,4	32,1	21,0	30,3	31,1	20,4	26,0	28,0	27,6	23,5	21,3	24,8	25,0	29,4
4308/M10S	-	29,4	32,1	21,0	30,3	31,1	20,4	26,0	28,0	27,6	23,5	21,3	24,8	25,0	29,4
4308/M12S	-	37,3	40,7	26,6	38,5	39,4	25,8	33,0	35,5	35,0	29,8	26,9	31,4	31,7	37,3
4308/4	4208/4	30,9	33,7	22,0	31,8	32,6	21,4	27,3	29,4	29,0	24,6	22,3	26,0	26,2	30,8
4308/4S	4208/4S	37,3	40,7	26,6	38,5	39,4	25,8	33,0	35,5	35,0	29,8	26,9	31,4	31,7	37,3
4316/2	4216/2	9,3	10,1	6,6	9,6	9,8	6,4	8,2	8,8	8,7	7,4	6,7	7,8	7,9	9,3
4316/3	4216/3	26,4	28,8	18,8	27,2	27,9	18,3	23,3	25,1	24,7	21,0	19,0	22,2	22,4	26,3
4316/3F	-	26,4	28,8	18,8	27,2	27,9	18,3	23,3	25,1	24,7	21,0	19,0	22,2	22,4	26,3
4316/3S	4216/3S	32,9	35,9	23,5	33,9	34,8	22,8	29,1	31,3	30,9	26,3	23,8	27,7	28,0	32,9
4316/M10S	-	32,9	35,9	23,5	33,9	34,8	22,8	29,1	31,3	30,9	26,3	23,8	27,7	28,0	32,9
4316/M12S	-	45,7	49,8	32,6	47,1	48,3	31,6	40,4	43,4	42,8	36,5	33,0	38,4	38,8	45,6
4316/4	4216/4	37,8	41,2	26,9	38,9	39,9	26,1	33,4	35,9	35,4	30,1	27,3	31,7	32,1	37,7
4316/4S	4216/4S	45,7	49,8	32,6	47,1	48,3	31,6	40,4	43,4	42,8	36,5	33,0	38,4	38,8	45,6
4316/5	4216/5	50,3	54,8	35,8	51,8	53,1	34,8	44,4	47,8	47,1	40,1	36,3	42,3	42,7	50,2
4316/5S	4216/5S	60,3	65,7	43,0	62,1	63,7	41,7	53,3	57,3	56,5	48,1	43,5	50,7	51,2	60,2
4316/7S	-	63,9	69,7	45,6	65,8	67,5	44,2	56,4	60,7	59,9	51,0	46,1	53,7	54,3	63,8
4330/3	4230/3	29,0	31,6	20,7	29,9	30,6	20,1	25,6	27,5	27,2	23,1	20,9	24,4	24,6	28,9
4330/3S	4230/3S	36,3	39,6	25,9	37,4	38,3	25,1	32,0	34,5	34,0	29,0	26,2	30,5	30,8	36,2
4330/4	4230/4	41,3	45,1	29,5	42,6	43,7	28,6	36,5	39,3	38,8	33,0	29,8	34,8	35,1	41,3
4330/4S	4230/4S	50,0	54,5	35,7	51,5	52,8	34,6	44,2	47,6	46,9	39,9	36,1	42,1	42,5	50,0
4330/5	4230/5	51,9	56,6	37,0	53,5	54,8	35,9	45,8	49,3	48,6	41,4	37,4	43,6	44,1	51,8
4330/5S	4230/5S	62,4	68,0	44,5	64,3	65,9	43,2	55,1	59,3	58,5	49,8	45,0	52,5	53,0	62,3
4330/7S	-	65,9	71,8	47,0	67,9	69,6	45,6	58,2	62,6	61,8	52,6	47,5	55,4	55,9	65,8
4330/9S	-	65,9	71,8	47,0	67,9	69,6	45,6	58,2	62,6	61,8	52,6	47,5	55,4	55,9	65,8
4341/4	-	51,4	56,1	36,7	53,0	54,4	35,6	45,4	48,9	48,2	41,1	37,1	43,3	43,7	51,4
4341/4S	-	61,3	66,9	43,8	63,2	64,8	42,5	54,2	58,3	57,5	49,0	44,3	51,6	52,1	61,3
4341/5	4241/5	60,8	66,3	43,4	62,7	64,2	42,1	53,7	57,8	57,0	48,5	43,9	51,1	51,6	60,7
4341/5S	4241/5S	73,6	80,3	52,5	75,8	77,8	51,0	65,0	70,0	69,0	58,7	53,1	61,9	62,5	73,5
4341/6	4241/6	99,9	108,9	71,2	102,9	105,5	69,2	88,2	95,0	93,7	79,7	72,1	84,0	84,8	99,8
4341/6S	4241/6S	99,9	108,9	71,2	102,9	105,5	69,2	88,2	95,0	93,7	79,7	72,1	84,0	84,8	99,8
4341/7S	4241/7S	110,3	120,3	78,7	113,7	116,6	76,4	97,4	104,9	103,5	88,1	79,6	92,8	93,7	110,2
4375/4S	4275/4S	79,4	86,6	56,6	81,8	83,9	55,0	70,1	75,5	74,4	63,4	57,3	66,7	67,4	79,3
4375/5S	4275/5S	81,0	88,4	57,8	83,5	85,6	56,1	71,6	77,0	76,0	64,7	58,5	68,1	68,8	80,9
4375/6S	4275/6S	119,8	130,7	85,4	123,5	126,6	83,0	105,8	113,9	112,4	95,6	86,5	100,7	101,8	119,7
4375/7S	4275/7S	138,0	150,5	98,4	142,2	145,8	95,5	121,9	131,2	129,4	110,1	99,6	116,0	117,2	137,8
4375/9S	4275/9S	143,5	156,5	102,3	147,8	151,6	99,3	126,7	136,4	134,5	114,5	103,6	120,6	121,9	143,3

(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 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at + 30 °C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

TABLE 8- CORRECTION FACTORS OF THE REFRIGERATION CAPACITY FOR TEMPERATURES DIFFERENT FROM STANDARD VALUES

Refrigerant	Liquid temperature [°C]	Evaporating temperature [°C]										
		+ 10	+ 5	0	- 5	- 10	- 15	- 20	- 25	- 30	-35	- 40
R134a	15	1,27	1,25	1,23	1,21	1,19	1,17	1,15	1,13	1,11	1,08	1,06
	20	1,21	1,19	1,18	1,15	1,13	1,11	1,09	1,07	1,05	1,03	1,01
	25	1,16	1,14	1,12	1,10	1,08	1,06	1,04	1,01	0,99	0,97	0,95
	30	1,10	1,08	1,06	1,04	1,02	1,00	0,98	0,96	0,94	0,92	0,89
	35	1,04	1,02	1,00	0,98	0,96	0,94	0,92	0,90	0,88	0,86	0,84
	40	0,98	0,96	0,95	0,93	0,91	0,89	0,87	0,84	0,82	0,80	0,78
	45	0,92	0,91	0,89	0,87	0,85	0,83	0,81	0,79	0,77	0,75	0,72
	50	0,87	0,85	0,83	0,81	0,79	0,77	0,75	0,73	0,71	0,69	0,67
55	0,81	0,79	0,77	0,75	0,73	0,71	0,69	0,67	0,65	0,63	0,61	
R22	15	1,20	1,19	1,18	1,17	1,15	1,14	1,13	1,12	1,10	1,09	1,07
	20	1,15	1,14	1,13	1,12	1,11	1,09	1,08	1,07	1,05	1,04	1,03
	25	1,11	1,10	1,08	1,07	1,06	1,05	1,03	1,02	1,01	0,99	0,98
	30	1,06	1,05	1,04	1,02	1,01	1,00	0,99	0,97	0,96	0,95	0,93
	35	1,01	1,00	0,99	0,98	0,96	0,95	0,94	0,93	0,91	0,90	0,88
	40	0,96	0,95	0,94	0,93	0,92	0,90	0,89	0,88	0,86	0,85	0,84
	45	0,91	0,90	0,89	0,88	0,87	0,85	0,84	0,83	0,82	0,80	0,79
	50	0,86	0,85	0,84	0,83	0,82	0,81	0,79	0,78	0,77	0,75	0,74
55	0,81	0,80	0,79	0,78	0,77	0,76	0,74	0,73	0,72	0,70	0,69	
R404A	15	1,35	1,33	1,31	1,29	1,26	1,24	1,21	1,19	1,16	1,13	1,11
	20	1,27	1,25	1,23	1,21	1,18	1,16	1,13	1,11	1,08	1,06	1,03
	25	1,19	1,17	1,15	1,13	1,10	1,08	1,06	1,03	1,00	0,98	0,95
	30	1,11	1,09	1,07	1,05	1,02	1,00	0,98	0,95	0,93	0,90	0,87
	35	1,03	1,01	0,99	0,97	0,94	0,92	0,90	0,87	0,85	0,82	0,79
	40	0,95	0,93	0,90	0,88	0,86	0,84	0,81	0,79	0,76	0,74	0,71
	45	0,86	0,84	0,82	0,80	0,78	0,75	0,73	0,71	0,68	0,66	0,63
	50	0,77	0,76	0,74	0,71	0,69	0,67	0,65	0,62	0,60	0,58	0,55
55	0,69	0,67	0,65	0,63	0,61	0,58	0,56	0,54	0,52	0,49	0,47	
R407C	15	1,26	1,24	1,23	1,21	1,19	1,18	1,16	1,14	1,12	1,10	1,08
	20	1,20	1,18	1,17	1,15	1,13	1,12	1,10	1,08	1,06	1,04	1,03
	25	1,14	1,12	1,11	1,09	1,08	1,06	1,04	1,02	1,01	0,99	0,97
	30	1,08	1,06	1,05	1,03	1,02	1,00	0,98	0,97	0,95	0,93	0,91
	35	1,02	1,00	0,99	0,97	0,96	0,94	0,92	0,91	0,89	0,87	0,85
	40	0,96	0,94	0,93	0,91	0,90	0,88	0,86	0,85	0,83	0,81	0,79
	45	0,89	0,88	0,87	0,85	0,84	0,82	0,80	0,79	0,77	0,75	0,73
	50	0,83	0,82	0,80	0,79	0,77	0,76	0,74	0,72	0,71	0,69	0,67
55	0,77	0,76	0,74	0,73	0,71	0,70	0,68	0,66	0,65	0,63	0,61	
R410A	15	1,24	1,23	1,22	1,21	1,20	1,19	1,17	1,16	1,15	1,13	1,12
	20	1,17	1,17	1,16	1,15	1,14	1,13	1,11	1,10	1,09	1,07	1,06
	25	1,11	1,10	1,09	1,08	1,07	1,06	1,05	1,04	1,02	1,01	1,00
	30	1,05	1,04	1,03	1,02	1,01	1,00	0,99	0,98	0,96	0,95	0,93
	35	0,98	0,97	0,97	0,96	0,95	0,94	0,92	0,91	0,90	0,89	0,87
	40	0,92	0,91	0,90	0,89	0,88	0,87	0,86	0,85	0,83	0,82	0,81
	45	0,85	0,84	0,83	0,82	0,81	0,80	0,79	0,78	0,77	0,75	0,74
	50	0,78	0,77	0,77	0,76	0,75	0,74	0,72	0,71	0,70	0,69	0,67
55	0,71	0,70	0,69	0,69	0,68	0,67	0,65	0,64	0,63	0,62	0,61	
R507	15	1,36	1,34	1,32	1,29	1,27	1,24	1,22	1,19	1,17	1,14	1,11
	20	1,28	1,26	1,24	1,21	1,19	1,16	1,14	1,11	1,09	1,06	1,03
	25	1,20	1,18	1,15	1,13	1,11	1,08	1,06	1,03	1,00	0,98	0,95
	30	1,11	1,09	1,07	1,05	1,02	1,00	0,98	0,95	0,92	0,90	0,87
	35	1,03	1,01	0,99	0,96	0,94	0,92	0,89	0,87	0,84	0,82	0,79
	40	0,94	0,92	0,90	0,88	0,86	0,83	0,81	0,78	0,76	0,73	0,71
	45	0,86	0,84	0,82	0,79	0,77	0,75	0,72	0,70	0,67	0,65	0,62
	50	0,77	0,75	0,73	0,71	0,68	0,66	0,64	0,61	0,59	0,56	0,54
55	0,68	0,66	0,64	0,62	0,59	0,57	0,55	0,53	0,50	0,48	0,45	
R1234ze	15	1,31	1,29	1,26	1,23	1,21	1,18	1,15	1,13	1,10	1,07	1,04
	20	1,25	1,23	1,20	1,17	1,15	1,12	1,09	1,07	1,04	1,01	0,98
	25	1,19	1,16	1,14	1,11	1,09	1,06	1,03	1,01	0,98	0,95	0,93
	30	1,13	1,10	1,08	1,05	1,03	1,00	0,97	0,95	0,92	0,89	0,87
	35	1,07	1,04	1,02	0,99	0,97	0,94	0,91	0,89	0,86	0,83	0,81
	40	1,01	0,98	0,96	0,93	0,91	0,88	0,85	0,83	0,80	0,77	0,75
	45	0,95	0,92	0,90	0,87	0,84	0,82	0,79	0,77	0,74	0,71	0,69
	50	0,88	0,86	0,83	0,81	0,78	0,76	0,73	0,71	0,68	0,65	0,63
55	0,82	0,80	0,77	0,75	0,72	0,70	0,67	0,65	0,62	0,59	0,57	

Refrigerant	Liquid temperature [°C]	Evaporating temperature [°C]										
		+ 10	+ 5	0	- 5	- 10	- 15	- 20	- 25	- 30	-35	- 40
R448A	15	1,27	1,26	1,24	1,22	1,21	1,19	1,17	1,15	1,13	1,11	1,09
	20	1,21	1,19	1,18	1,16	1,14	1,13	1,11	1,09	1,07	1,05	1,03
	25	1,15	1,13	1,12	1,10	1,08	1,06	1,04	1,03	1,01	0,99	0,97
	30	1,08	1,07	1,05	1,03	1,02	1,00	0,98	0,96	0,94	0,92	0,91
	35	1,02	1,00	0,99	0,97	0,95	0,94	0,92	0,90	0,88	0,86	0,84
	40	0,95	0,94	0,92	0,91	0,89	0,87	0,85	0,84	0,82	0,80	0,78
	45	0,89	0,87	0,86	0,84	0,82	0,81	0,79	0,77	0,75	0,73	0,71
	50	0,82	0,80	0,79	0,77	0,76	0,74	0,72	0,71	0,69	0,67	0,65
55	0,75	0,74	0,72	0,71	0,69	0,67	0,66	0,64	0,62	0,60	0,58	
R449A	15	1,28	1,26	1,24	1,23	1,21	1,19	1,17	1,15	1,13	1,11	1,09
	20	1,21	1,20	1,18	1,16	1,15	1,13	1,11	1,09	1,07	1,05	1,03
	25	1,15	1,13	1,12	1,10	1,08	1,06	1,05	1,03	1,01	0,99	0,97
	30	1,08	1,07	1,05	1,04	1,02	1,00	0,98	0,96	0,94	0,92	0,90
	35	1,02	1,00	0,99	0,97	0,95	0,94	0,92	0,90	0,88	0,86	0,84
	40	0,95	0,94	0,92	0,90	0,89	0,87	0,85	0,83	0,81	0,80	0,78
	45	0,89	0,87	0,85	0,84	0,82	0,80	0,79	0,77	0,75	0,73	0,71
	50	0,82	0,80	0,79	0,77	0,75	0,74	0,72	0,70	0,68	0,66	0,65
55	0,75	0,73	0,72	0,70	0,69	0,67	0,65	0,63	0,62	0,60	0,58	
R450A	15	1,30	1,27	1,25	1,23	1,20	1,18	1,15	1,13	1,10	1,08	1,05
	20	1,24	1,21	1,19	1,17	1,14	1,12	1,09	1,07	1,04	1,02	0,99
	25	1,18	1,15	1,13	1,11	1,08	1,06	1,03	1,01	0,99	0,96	0,94
	30	1,12	1,09	1,07	1,05	1,02	1,00	0,98	0,95	0,93	0,90	0,88
	35	1,06	1,03	1,01	0,99	0,96	0,94	0,92	0,89	0,87	0,84	0,82
	40	1,00	0,97	0,95	0,93	0,90	0,88	0,86	0,83	0,81	0,78	0,76
	45	0,93	0,91	0,89	0,87	0,84	0,82	0,80	0,77	0,75	0,73	0,70
	50	0,87	0,85	0,83	0,81	0,78	0,76	0,74	0,71	0,69	0,67	0,64
55	0,81	0,79	0,77	0,75	0,72	0,70	0,68	0,65	0,63	0,61	0,58	
R452A	15	1,33	1,31	1,29	1,27	1,24	1,22	1,19	1,17	1,14	1,11	1,09
	20	1,26	1,24	1,22	1,19	1,17	1,14	1,12	1,09	1,07	1,04	1,01
	25	1,19	1,17	1,14	1,12	1,10	1,07	1,05	1,02	1,00	0,97	0,94
	30	1,11	1,09	1,07	1,05	1,02	1,00	0,98	0,95	0,92	0,90	0,87
	35	1,04	1,02	1,00	0,98	0,95	0,93	0,90	0,88	0,85	0,83	0,80
	40	0,97	0,95	0,93	0,90	0,88	0,86	0,83	0,81	0,78	0,76	0,73
	45	0,90	0,87	0,85	0,83	0,81	0,78	0,76	0,73	0,71	0,68	0,66
	50	0,82	0,80	0,78	0,76	0,73	0,71	0,69	0,66	0,64	0,61	0,59
55	0,75	0,73	0,71	0,69	0,66	0,64	0,62	0,59	0,57	0,54	0,52	
R513A	15	1,32	1,29	1,27	1,24	1,22	1,19	1,17	1,14	1,12	1,09	1,06
	20	1,25	1,23	1,20	1,18	1,15	1,13	1,10	1,08	1,05	1,03	1,00
	25	1,19	1,16	1,14	1,12	1,09	1,07	1,04	1,01	0,99	0,96	0,94
	30	1,12	1,10	1,07	1,05	1,03	1,00	0,97	0,95	0,92	0,90	0,87
	35	1,06	1,03	1,01	0,98	0,96	0,94	0,91	0,89	0,86	0,83	0,81
	40	0,99	0,97	0,94	0,92	0,89	0,87	0,85	0,82	0,79	0,77	0,74
	45	0,92	0,90	0,88	0,85	0,83	0,80	0,78	0,75	0,73	0,71	0,68
	50	0,86	0,83	0,81	0,79	0,76	0,74	0,71	0,69	0,66	0,64	0,62
55	0,79	0,77	0,74	0,72	0,70	0,67	0,65	0,62	0,60	0,57	0,55	
R515A	15	1,32	1,29	1,27	1,24	1,22	1,19	1,17	1,14	1,12	1,09	1,06
	20	1,25	1,23	1,20	1,18	1,15	1,13	1,10	1,08	1,05	1,03	1,00
	25	1,19	1,16	1,14	1,12	1,09	1,07	1,04	1,01	0,99	0,96	0,94
	30	1,12	1,10	1,07	1,05	1,03	1,00	0,97	0,95	0,92	0,90	0,87
	35	1,06	1,03	1,01	0,98	0,96	0,94	0,91	0,89	0,86	0,83	0,81
	40	0,99	0,97	0,94	0,92	0,89	0,87	0,85	0,82	0,79	0,77	0,74
	45	0,92	0,90	0,88	0,85	0,83	0,80	0,78	0,75	0,73	0,71	0,68
	50	0,86	0,83	0,81	0,79	0,76	0,74	0,71	0,69	0,66	0,64	0,62
55	0,79	0,77	0,74	0,72	0,70	0,67	0,65	0,62	0,60	0,57	0,55	
R515B	15	1,33	1,30	1,27	1,24	1,21	1,19	1,16	1,13	1,10	1,07	1,04
	20	1,26	1,24	1,21	1,18	1,15	1,12	1,10	1,07	1,04	1,01	0,98
	25	1,20	1,17	1,15	1,12	1,09	1,06	1,03	1,01	0,98	0,95	0,92
	30	1,14	1,11	1,08	1,06	1,03	1,00	0,97	0,94	0,92	0,89	0,86
	35	1,07	1,05	1,02	0,99	0,96	0,94	0,91	0,88	0,85	0,83	0,80
	40	1,01	0,98	0,96	0,93	0,90	0,87	0,85	0,82	0,79	0,76	0,74
	45	0,94	0,92	0,89	0,87	0,84	0,81	0,78	0,76	0,73	0,70	0,68
	50	0,88	0,85	0,83	0,80	0,78	0,75	0,72	0,70	0,67	0,64	0,61
55	0,82	0,79	0,76	0,74	0,71	0,69	0,66	0,63	0,61	0,58	0,55	

TABLE 9: WATER CAPACITY AND DEHYDRATABLE CHARGE OF FILTERS WITH CORE 100% MOLECULAR SIEVES

Catalogue Number	Water Capacity at + 24 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
4303/2																
4303/2F																
4303/2S	4,9	5,0	4,0	4,3	5,3	5,4	4,3	4,6	4,2	4,6	3,2	3,5	4,5	4,9	3,4	3,8
4303/3																
4303/3S																
4305/2																
4305/2F																
4305/2S	7,7	7,9	6,3	6,9	8,3	8,5	6,8	7,4	6,7	7,3	5,1	5,6	7,2	7,8	5,5	6,0
4305/3																
4305/3S																
4305/M10S																
4308/2																
4308/2F																
4308/2S																
4308/3																
4308/3F	12,9	13,2	10,6	11,5	13,9	14,2	11,4	12,4	11,1	12,2	8,5	9,3	11,9	13,1	9,1	10,0
4308/3S																
4308/M10S																
4308/M12S																
4308/4																
4308/4S																
4316/2																
4316/3																
4316/3F																
4316/3S																
4316/M10S																
4316/M12S	25,2	25,7	20,6	22,5	27,1	27,6	22,2	24,2	21,7	23,9	16,6	18,1	23,3	25,7	17,8	19,5
4316/4																
4316/4S																
4316/5																
4316/5S																
4316/7S																
4330/3																
4330/3S																
4330/4																
4330/4S	50,4	51,5	41,3	44,9	54,2	55,3	44,3	48,4	43,5	47,8	33,2	36,2	46,7	51,4	35,7	38,9
4330/5																
4330/5S																
4330/7S																
4330/9S																
4341/4																
4341/4S																
4341/5																
4341/5S	63,3	64,7	51,8	56,4	68,1	69,6	55,7	60,6	54,6	60,1	41,7	45,4	58,7	64,6	44,8	48,8
4341/6																
4341/6S																
4341/7S																
4375/4S																
4375/5S																
4375/6S	126,6	129,4	103,7	112,8	136,1	139,1	111,5	121,3	109,2	120,2	83,5	90,8	117,4	129,2	89,8	97,6
4375/7S																
4375/9S																

(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

- Liquid temperatures: 24 °C and 52 °C;
- Equilibrium point dryness, EPD: 60 ppm for R22;
- Equilibrium point dryness, EPD: 50 ppm for R134a , R404A , R407C , R410A e R507.



**TABLE 10: WATER CAPACITY AND DEHYDRATABLE CHARGE OF FILTERS WITH CORE 80% MOLECULAR SIEVES + 20% ACTIVATED ALUMINA**

Catalogue Number	Water Capacity at + 24 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
4203/2																
4203/2S	4,2	4,3	3,4	3,7	4,5	4,6	3,7	3,9	3,6	3,9	2,7	3,0	3,8	4,2	2,9	3,2
4203/3																
4205/2																
4205/2S	6,5	6,7	5,4	5,9	7,0	7,2	5,8	6,3	5,7	6,2	4,3	4,8	6,1	6,7	4,7	5,1
4205/3																
4205/3S																
4208/2																
4208/2S																
4208/3	11,0	11,2	9,0	9,8	11,8	12,1	9,7	10,5	9,4	10,4	7,2	7,9	10,1	11,2	7,8	8,5
4208/3S																
4208/4																
4208/4S																
4216/2																
4216/3																
4216/3S																
4216/4	21,4	21,8	17,5	19,1	23,0	23,5	18,8	20,6	18,4	20,3	14,1	15,4	19,8	21,8	15,2	16,5
4216/4S																
4216/5																
4216/5S																
4230/3																
4230/3S																
4230/4	42,8	43,8	35,1	38,2	46,1	47,0	37,7	41,1	37,0	40,6	28,2	30,8	39,7	43,7	30,3	33,1
4230/4S																
4230/5																
4230/5S																
4241/5																
4241/5S																
4241/6	53,8	55,0	44,0	47,9	57,9	59,1	47,3	51,5	46,4	51,1	35,4	38,6	49,9	54,9	38,1	41,5
4241/6S																
4241/7S																
4275/4S																
4275/5S																
4275/6S	107,6	110,0	88,1	95,9	115,7	118,3	94,7	103,1	92,8	102,2	71,0	77,2	99,8	109,9	76,3	83,0
4275/7S																
4275/9S																

(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

- Liquid temperatures: 24 °C and 52 °C;
- Equilibrium point dryness, EPD: 60 ppm for R22;
- Equilibrium point dryness, EPD: 50 ppm for R134a , R404A , R407C , R410A e R507.

TABLE 11: DIMENSIONS AND WEIGHTS OF HERMETIC FILTERS

Catalogue Number		Connections			Dimensions [mm]		Weight [g]
		SAE Flare	ODS		Ø D	L	
			Ø [in.]	Ø [mm]			
4303/2	4203/2	1/4"	-	-	52	103	240
4303/2F	-	1/4"	-	-		92	230
4303/2S	4203/2S	-	1/4"	-		94	220
4303/3	4203/3	3/8"	-	-		111	235
4303/3S	-	-	3/8"	-		96	220
4305/2	4205/2	1/4"	-	-		119	275
4305/2F	-	1/4"	-	-		109	
4305/2S	4205/2S	-	1/4"	-		110	260
4305/3	4205/3	3/8"	-	-		127	295
4305/3S	4205/3S	-	3/8"	-		112	260
4305/M10S	-	-	-	10			
4308/2	4208/2	1/4"	-	-		146	380
4308/2F	-	1/4"	-	-		135	
4308/2S	4208/2S	-	1/4"	-		137	345
4308/3	4208/3	3/8"	-	-		154	395
4308/3F	-	3/8"	-	-		142	380
4308/3S	4208/3S	-	3/8"	-		139	345
4308/M10S	-	-	-	10			
4308/M12S	-	-	-	12		146	380
4308/4	4208/4	1/2"	-	-		162	430
4308/4S	4208/4S	-	1/2"	-	146	380	
4316/2	4216/2	1/4"	-	-	73	158	635
4316/3	4216/3	3/8"	-	-		166	690
4316/3F	-	3/8"	-	-		154	680
4316/3S	4216/3S	-	3/8"	-		151	620
4316/M10S	-	-	-	10			630
4316/M12S	-	-	-	12		158	640
4316/4	4216/4	1/2"	-	-		174	680
4316/4S	4216/4S	-	1/2"	-		158	640
4316/5	4216/5	5/8"	-	-		183	740
4316/5S	4216/5S	-	5/8"	16		166	640
4316/7S	-	-	7/8"	-		171	650
4330/3	4230/3	3/8"	-	-		245	1380
4330/3S	4230/3S	-	3/8"	-		230	1240
4330/4	4230/4	1/2"	-	-		253	1360
4330/4S	4230/4S	-	1/2"	-		237	1280
4330/5	4230/5	5/8"	-	-		262	1480
4330/5S	4230/5S	-	5/8"	16		245	1370
4330/7S	-	-	7/8"	-		250	1420
4330/9S	-	-	1.1/8"	-		250	1450
4341/4	-	1/2"	-	-		222	1560
4341/4S	-	-	1/2"	-	208	1450	
4341/5	4241/5	5/8"	-	-	231	1580	
4341/5S	4241/5S	-	5/8"	16	214	1470	
4341/6	4241/6	3/4"	-	-	232	1640	
4341/6S	4241/6S	-	3/4"	-	219	1560	
4341/7S	4241/7S	-	7/8"	-		1600	
4375/4S	4275/4S	-	1/2"	-	387	2540	
4375/5S	4275/5S	-	5/8"	16	393	2640	
4375/6S	4275/6S	-	3/4"	-	398	2820	
4375/7S	4275/7S	-	7/8"	-		2900	
4375/9S	4275/9S	-	1.1/8"	-		3050	

TABLE 12: GENERAL CHARACTERISTICS OF HERMETIC FILTER DRIERS. SAE FLARE CONNECTIONS

Catalogue Number		International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections	PS [bar]	TS [°C]		Risk Category according to PED Recast
100% molecular sieves	80% molecular sieves + 20% activated alumina						min.	max.	
DF303/2	DF203/2	032	58	50	1/4"	50	- 40	+ 80	Art. 4.3
DF303/3	DF203/3	033			3/8"				
DF305/2	DF205/2	052	104	80	1/4"				
DF305/3	DF205/3	053			3/8"				
DF308/2	DF208/2	082	141	130	1/4"				
DF308/3	DF208/3	083			3/8"				
DF308/4	DF208/4	084			1/2"				
DF316/2	DF216/2	162			183				
DF316/3	DF216/3	163	3/8"						
DF316/4	DF216/4	164	1/2"						
DF316/5	DF216/5	165	5/8"						
DF330/3	DF230/3	303	345	500	3/8"				
DF330/4	DF230/4	304			1/2"				
DF330/5	DF230/5	305			5/8"				
DF330/6	-	306			3/4"				
DF341/4	-	414	384	670	1/2"				
DF341/5	DF241/5	415			5/8"				
DF341/6	DF241/6	416			3/4"				
DF303/2F (1)	-	-	58	50	1/4"				
DF305/2F (1)	-	-	104	80	1/4"				
DF308/2F (1)	-	-	141	130	1/4"				
DF308/3F (1)	-	-			3/8"				
DF316/3F (1)	-	-	183	250	3/8"				

(1) : Male-female connections (Inlet female)

TABLE 13: GENERAL CHARACTERISTICS OF HERMETIC FILTER DRIERS. ODS CONNECTIONS

Catalogue Number		International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
100% molecular sieves	80% molecular sieves + 20% activated alumina				ODS			min.	max.	
					Ø [in.]	Ø [mm]				
DF303/2S	DF203/2S	032S	58	50	1/4"	–	50	–40	+80	Art. 4.3
DF303/3S	DF203/3S	033S			3/8"	–				
DF305/2S	DF205/2S	052S	104	80	1/4"	–				
DF305/3S	DF205/3S	053S			3/8"	–				
DF305/M10S	DF205/M10S	–			–	10				
DF308/2S	DF208/2S	082S	141	130	1/4"	–				
DF308/3S	DF208/3S	083S			3/8"	–				
DF308/M10S	DF208/M10S	–			–	10				
DF308/M12S	DF208/M12S	–			–	12				
DF308/4S	DF208/4S	084S			1/2"	–				
DF316/3S	DF216/3S	163S	183	250	3/8"	–				
DF316/M10S	DF216/M10S	–			–	10				
DF316/M12S	DF216/M12S	–			–	12				
DF316/4S	DF216/4S	164S			1/2"	–				
DF316/5S	DF216/5S	165S			5/8"	16				
DF316/7S	DF216/7S	167S			7/8"	–				
DF330/3S	DF230/3S	303S	345	500	3/8"	–				
DF330/4S	DF230/4S	304S			1/2"	–				
DF330/5S	DF230/5S	305S			5/8"	16				
DF330/6S	–	306S			3/4"	–				
DF330/7S	DF230/7S	307S			7/8"	–				
DF330/9S	DF230/9S	309S			1.1/8"	–				
DF341/4S	–	414S	384	670	1/2"	–				
DF341/5S	DF241/5S	415S			5/8"	16				
DF341/6S	DF241/6S	416S			3/4"	–				
DF341/7S	DF241/7S	417S			7/8"	–				
DF375/4S	DF275/4S	754S	768	1340	1/2"	–				
DF375/5S	DF275/5S	755S			5/8"	16				
DF375/6S	DF275/6S	756S			3/4"	–				
DF375/7S	DF275/7S	757S			7/8"	–				
DF375/9S	DF275/9S	759S					–			

**TABLE 14: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,07 BAR (1) [KW]**

Catalogue Number		Refrigerants													
100% molecular sieves	80% molecular sieves + 20% activated alumina	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
DF316/M10S	–	21,5	23,4	15,3	22,1	22,7	14,9	19,0	20,4	20,1	17,1	15,5	18,0	18,2	21,4
DF316/M12S	–	29,7	32,4	21,2	30,6	31,4	20,6	26,2	28,3	27,9	23,7	21,4	25,0	25,2	29,7
DF316/4	DF216/4	25,2	27,5	18,0	26,0	26,6	17,5	22,3	24,0	23,7	20,1	18,2	21,2	21,4	25,2
DF316/4S	DF216/4S	29,7	32,4	21,2	30,6	31,4	20,6	26,2	28,3	27,9	23,7	21,4	25,0	25,2	29,7
DF316/5	DF216/5	33,7	36,7	24,0	34,7	35,6	23,3	29,7	32,0	31,6	26,9	24,3	28,3	28,6	33,6
DF316/5S	DF216/5S	35,3	38,5	25,2	36,4	37,3	24,4	31,2	33,6	33,1	28,2	25,5	29,7	30,0	35,3
DF316/7S	–	45,4	49,5	32,4	46,8	48,0	31,4	40,1	43,2	42,6	36,2	32,8	38,2	38,6	45,3
DF330/3	DF230/3	20,4	22,3	14,6	21,1	21,6	14,2	18,1	19,4	19,2	16,3	14,8	17,2	17,4	20,4
DF330/3S	DF230/3S	22,2	24,2	15,8	22,9	23,4	15,4	19,6	21,1	20,8	17,7	16,0	18,7	18,9	22,2
DF330/4	DF230/4	28,7	31,3	20,5	29,6	30,3	19,9	25,4	27,3	26,9	22,9	20,7	24,1	24,4	28,7
DF330/4S	DF230/4S	37,1	40,5	26,5	38,3	39,2	25,7	32,8	35,3	34,8	29,6	26,8	31,2	31,5	37,1
DF330/5	DF230/5	37,2	40,6	26,6	38,4	39,3	25,8	32,9	35,4	34,9	29,7	26,9	31,3	31,6	37,2
DF330/5S	DF230/5S	43,6	47,5	31,1	44,9	46,0	30,2	38,5	41,4	40,9	34,8	31,4	36,6	37,0	43,5
DF330/6	–	40,5	44,2	28,9	41,8	42,8	28,1	35,8	38,5	38,0	32,4	29,3	34,1	34,4	40,5
DF330/6S	–	46,4	50,6	33,1	47,8	49,0	32,1	41,0	44,1	43,5	37,0	33,5	39,0	39,4	46,3
DF330/7S	–	50,1	54,6	35,7	51,6	52,9	34,7	44,2	47,6	47,0	40,0	36,1	42,1	42,5	50,0
DF330/9S	–	50,1	54,6	35,7	51,6	52,9	34,7	44,2	47,6	47,0	40,0	36,1	42,1	42,5	50,0
DF341/4	–	36,5	39,8	26,0	37,6	38,6	25,3	32,2	34,7	34,2	29,1	26,3	30,7	31,0	36,5
DF341/4S	–	38,1	41,5	27,1	39,2	40,2	26,4	33,6	36,2	35,7	30,4	27,5	32,0	32,3	38,0
DF341/5	DF241/5	42,2	46,0	30,1	43,5	44,6	29,2	37,3	40,1	39,6	33,7	30,5	35,5	35,8	42,1
DF341/5S	DF241/5S	49,1	53,5	35,0	50,6	51,8	34,0	43,3	46,7	46,0	39,2	35,4	41,2	41,7	49,0
DF341/6	DF241/6	66,6	72,6	47,5	68,6	70,3	46,1	58,8	63,3	62,4	53,1	48,1	56,0	56,6	66,5
DF341/6S	DF241/6S	66,6	72,6	47,5	68,6	70,3	46,1	58,8	63,3	62,4	53,1	48,1	56,0	56,6	66,5
DF341/7S	DF241/7S	71,1	77,5	50,7	73,2	75,1	49,2	62,8	67,6	66,7	56,7	51,3	59,8	60,4	71,0
DF375/4S	DF275/4S	52,9	57,7	37,7	54,5	55,9	36,6	46,7	50,3	49,6	42,2	38,2	44,5	44,9	52,9
DF375/5S	DF275/5S	88,7	96,7	63,2	91,4	93,7	61,4	78,3	84,3	83,2	70,8	64,0	74,6	75,3	88,6
DF375/6S	DF275/6S	99,0	108,0	70,6	102,1	104,7	68,6	87,5	94,2	92,9	79,1	71,5	83,3	84,1	98,9
DF375/7S	DF275/7S	103,6	113,0	73,9	106,8	109,5	71,8	91,5	98,5	97,2	82,7	74,8	87,1	88,0	103,5
DF375/9S	DF275/9S	105,5	115,0	75,2	108,7	111,4	73,0	93,2	100,3	98,9	84,2	76,1	88,7	89,6	105,3

(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, inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at +30°C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

TABLE 15: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,14 BAR (1) [KW]

Catalogue Number		Refrigerants													
100% molecular sieves	80% molecular sieves + 20% activated alumina	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
DF303/2	DF203/2	8,6	9,4	6,1	8,8	9,1	5,9	7,6	8,2	8,0	6,9	6,2	7,2	7,3	8,6
DF303/2F	–	8,6	9,4	6,1	8,8	9,1	5,9	7,6	8,2	8,0	6,9	6,2	7,2	7,3	8,6
DF303/2S	DF203/2S	11,1	12,1	7,9	11,5	11,7	7,7	9,8	10,6	10,4	8,9	8,0	9,3	9,4	11,1
DF303/3	DF203/3	20,1	22,0	14,4	20,8	21,3	13,9	17,8	19,1	18,9	16,1	14,5	16,9	17,1	20,1
DF303/3S	–	20,6	22,4	14,7	21,2	21,7	14,2	18,2	19,6	19,3	16,4	14,9	17,3	17,5	20,6
DF305/2	DF205/2	9,0	9,8	6,4	9,3	9,5	6,2	8,0	8,6	8,5	7,2	6,5	7,6	7,7	9,0
DF305/2F	–	9,0	9,8	6,4	9,3	9,5	6,2	8,0	8,6	8,5	7,2	6,5	7,6	7,7	9,0
DF305/2S	DF205/2S	15,1	16,5	10,8	15,6	16,0	10,5	13,4	14,4	14,2	12,1	10,9	12,7	12,9	15,1
DF305/3	DF205/3	22,8	24,8	16,2	23,5	24,1	15,8	20,1	21,7	21,4	18,2	16,4	19,1	19,3	22,7
DF305/3S	DF205/3S	23,6	25,7	16,8	24,3	24,9	16,3	20,8	22,4	22,1	18,8	17,0	19,8	20,1	23,6
DF305/M10S	–	23,6	25,7	16,8	24,3	24,9	16,3	20,8	22,4	22,1	18,8	17,0	19,8	20,1	23,6
DF308/2	DF208/2	9,5	10,4	6,8	9,8	10,1	6,6	8,4	9,1	8,9	7,6	6,9	8,0	8,1	9,5
DF308/2F	–	9,5	10,4	6,8	9,8	10,1	6,6	8,4	9,1	8,9	7,6	6,9	8,0	8,1	9,5
DF308/2S	DF208/2S	14,5	15,9	10,4	15,0	15,4	10,1	12,8	13,8	13,6	11,6	10,5	12,2	12,4	14,5
DF308/3	DF208/3	25,3	27,6	18,0	26,0	26,7	17,5	22,3	24,0	23,7	20,2	18,2	21,2	21,5	25,2
DF308/3F	–	25,3	27,6	18,0	26,0	26,7	17,5	22,3	24,0	23,7	20,2	18,2	21,2	21,5	25,2
DF308/3S	DF208/3S	25,9	28,2	18,4	26,7	27,3	17,9	22,9	24,6	24,3	20,6	18,7	21,7	22,0	25,8
DF308/M10S	–	25,9	28,2	18,4	26,7	27,3	17,9	22,9	24,6	24,3	20,6	18,7	21,7	22,0	25,8
DF308/M12S	–	32,4	35,4	23,1	33,4	34,3	22,5	28,6	30,8	30,4	25,9	23,4	27,3	27,5	32,4
DF308/4	DF208/4	30,6	33,4	21,9	31,6	32,4	21,2	27,1	29,1	28,7	24,5	22,1	25,8	26,0	30,6
DF308/4S	DF208/4S	32,4	35,4	23,1	33,4	34,3	22,5	28,6	30,8	30,4	25,9	23,4	27,3	27,5	32,4
DF316/2	DF216/2	11,1	12,2	7,9	11,5	11,8	7,7	9,8	10,6	10,4	8,9	8,0	9,4	9,5	11,1
DF316/3	DF216/3	26,4	28,8	18,8	27,2	27,9	18,3	23,3	25,1	24,7	21,0	19,0	22,2	22,4	26,3
DF316/3F	–	26,4	28,8	18,8	27,2	27,9	18,3	23,3	25,1	24,7	21,0	19,0	22,2	22,4	26,3
DF316/3S	DF216/3S	29,0	31,6	20,7	29,9	30,6	20,1	25,6	27,5	27,2	23,1	20,9	24,4	24,6	28,9
DF316/M10S	–	29,0	31,6	20,7	29,9	30,6	20,1	25,6	27,5	27,2	23,1	20,9	24,4	24,6	28,9
DF316/M12S	–	40,1	43,7	28,6	41,3	42,4	27,8	35,4	38,1	37,6	32,0	29,0	33,7	34,1	40,1
DF316/4	DF216/4	34,0	37,1	24,3	35,1	36,0	23,6	30,1	32,4	31,9	27,2	24,6	28,6	28,9	34,0
DF316/4S	DF216/4S	40,1	43,7	28,6	41,3	42,4	27,8	35,4	38,1	37,6	32,0	29,0	33,7	34,1	40,1
DF316/5	DF216/5	45,4	49,5	32,4	46,8	48,0	31,5	40,1	43,2	42,6	36,3	32,8	38,2	38,6	45,4
DF316/5S	DF216/5S	47,7	52,0	34,0	49,1	50,4	33,0	42,1	45,3	44,7	38,0	34,4	40,1	40,5	47,6
DF316/7S	–	61,3	66,8	43,7	63,1	64,8	42,4	54,1	58,3	57,5	48,9	44,2	51,5	52,1	61,2
DF330/3	DF230/3	27,6	30,1	19,7	28,4	29,2	19,1	24,4	26,3	25,9	22,0	19,9	23,2	23,5	27,6
DF330/3S	DF230/3S	30,0	32,7	21,4	30,9	31,7	20,7	26,5	28,5	28,1	23,9	21,6	25,2	25,4	29,9
DF330/4	DF230/4	38,7	42,3	27,6	39,9	40,9	26,8	34,2	36,8	36,3	30,9	28,0	32,6	32,9	38,7
DF330/4S	DF230/4S	50,1	54,7	35,8	51,7	53,0	34,7	44,3	47,7	47,0	40,0	36,2	42,2	42,6	50,1
DF330/5	DF230/5	50,3	54,8	35,8	51,8	53,1	34,8	44,4	47,8	47,1	40,1	36,3	42,3	42,7	50,2
DF330/5S	DF230/5S	58,8	64,1	41,9	60,6	62,1	40,7	51,9	55,9	55,1	46,9	42,5	49,4	50,0	58,7
DF330/6	–	54,7	59,7	39,0	56,4	57,8	37,9	48,3	52,0	51,3	43,7	39,5	46,0	46,5	54,7
DF330/6S	–	62,6	68,3	44,7	64,6	66,2	43,4	55,3	59,6	58,7	50,0	45,2	52,7	53,2	62,6
DF330/7S	–	67,6	73,7	48,2	69,7	71,4	46,8	59,7	64,3	63,4	54,0	48,8	56,8	57,4	67,5
DF330/9S	–	67,6	73,7	48,2	69,7	71,4	46,8	59,7	64,3	63,4	54,0	48,8	56,8	57,4	67,5
DF341/4	–	54,7	59,7	39,0	56,4	57,8	37,9	48,4	52,1	51,3	43,7	39,5	46,0	46,5	54,7
DF341/4S	–	57,1	62,3	40,7	58,8	60,3	39,5	50,4	54,3	53,5	45,6	41,2	48,0	48,5	57,0
DF341/5	DF241/5	63,3	69,0	45,1	65,2	66,9	43,8	55,9	60,2	59,3	50,5	45,7	53,2	53,8	63,2
DF341/5S	DF241/5S	73,6	80,3	52,5	75,8	77,8	51,0	65,0	70,0	69,0	58,7	53,1	61,9	62,5	73,5
DF341/6	DF241/6	99,9	108,9	71,2	102,9	105,5	69,2	88,2	95,0	93,7	79,7	72,1	84,0	84,8	99,8
DF341/6S	DF241/6S	99,9	108,9	71,2	102,9	105,5	69,2	88,2	95,0	93,7	79,7	72,1	84,0	84,8	99,8
DF341/7S	DF241/7S	106,6	116,3	76,0	109,9	112,6	73,8	94,2	101,4	100,0	85,1	77,0	89,6	90,6	106,5
DF375/4S	DF275/4S	79,4	86,6	56,6	81,8	83,9	55,0	70,1	75,5	74,4	63,4	57,3	66,7	67,4	79,3
DF375/5S	DF275/5S	133,0	145,1	94,9	137,1	140,6	92,1	117,5	126,5	124,7	106,2	96,0	111,8	113,0	132,9
DF375/6S	DF275/6S	148,6	162,0	105,9	153,1	157,0	102,9	131,2	141,3	139,3	118,6	107,2	124,9	126,2	148,4
DF375/7S	DF275/7S	155,4	169,5	110,9	160,2	164,2	107,6	137,3	147,8	145,8	124,1	112,2	130,7	132,0	155,3
DF375/9S	DF275/9S	158,2	172,5	112,8	163,0	167,2	109,5	139,7	150,4	148,4	126,3	114,2	133,0	134,4	158,0

(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 0,14 bar , inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at +30°C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

**TABLE 16: WATER CAPACITY AND DEHYDRATABLE CHARGE OF FILTERS WITH CORE 100% MOLECULAR SIEVES**

Catalogue Number	Water Capacity at + 24 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
DF303/2																
DF303/2F																
DF303/2S	5,6	5,7	4,6	5,0	6,0	6,1	4,9	5,4	4,8	5,3	3,7	4,0	5,2	5,7	4,0	4,3
DF303/3																
DF303/3S																
DF305/2																
DF305/2F																
DF305/2S	15,8	16,1	12,9	14,1	17,0	17,3	13,9	15,2	13,6	15,0	10,4	11,3	14,6	16,1	11,2	12,2
DF305/3																
DF305/3S																
DF305/M10S																
DF308/2																
DF308/2F																
DF308/2S																
DF308/3																
DF308/3F	22,8	23,3	18,6	20,3	24,5	25,1	20,0	21,8	19,6	21,6	15,0	16,3	21,1	23,2	16,1	17,5
DF308/3S																
DF308/M10S																
DF308/M12S																
DF308/4																
DF308/4S																
DF316/2																
DF316/3																
DF316/3F																
DF316/3S																
DF316/M10S																
DF316/M12S																
DF316/4	30,4	31,0	24,9	27,1	32,7	33,3	26,8	29,1	26,2	28,8	20,0	21,8	28,2	31,0	21,5	23,4
DF316/4S																
DF316/5																
DF316/5S																
DF316/7S																
DF316/9S																
DF330/3																
DF330/3S																
DF330/4																
DF330/4S																
DF330/5	72,1	73,7	59,0	64,3	77,5	79,2	63,4	69,1	62,2	68,4	47,5	51,7	66,9	73,5	51,1	55,6
DF330/5S																
DF330/6																
DF330/6S																
DF330/7S																
DF330/9S																
DF341/4																
DF341/4S																
DF341/5																
DF341/5S	103,2	105,5	84,5	92,0	111,0	113,4	90,9	98,9	89,0	98,0	68,1	74,1	95,7	105,4	73,2	79,7
DF341/6																
DF341/6S																
DF341/7S																
DF375/4S																
DF375/5S																
DF375/6S	192,8	197,0	157,9	171,8	221,9	226,9	181,7	197,8	166,2	183,0	127,1	138,3	141,6	210,8	146,5	159,4
DF375/7S																
DF375/9S																

(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

- Liquid temperatures: 24 °C and 52 °C;
- Equilibrium point dryness, EPD: 60 ppm for R22;
- Equilibrium point dryness, EPD: 50 ppm for R134a , R404A , R407C , R410A e R507.



TABLE 17: WATER CAPACITY AND DEHYDRATABLE CHARGE OF FILTERS WITH CORE 80% MOLECULAR SIEVES + 20% ACTIVATED ALUMINA

Catalogue Number	Water Capacity at + 24 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
DF203/2	4,8	4,9	3,9	4,3	5,2	5,3	4,2	4,6	4,1	4,5	3,1	3,4	4,4	4,8	3,3	3,7
DF203/2S																
DF203/3																
DF203/3S																
DF205/2	13,4	13,7	11,0	12,0	14,4	14,7	11,8	12,9	11,6	12,7	8,8	9,6	12,5	13,7	9,5	10,3
DF205/2S																
DF205/3																
DF205/3S																
DF205/M10S	19,4	19,8	15,8	17,3	20,9	21,3	17,0	18,6	16,7	18,4	12,8	13,9	18,0	19,8	13,8	14,9
DF208/2																
DF208/2S																
DF208/3																
DF208/3S	25,8	26,4	21,1	23,0	27,7	28,4	22,7	24,7	22,3	24,5	17,0	18,5	24,0	26,3	18,3	19,9
DF208/M10S																
DF208/M12S																
DF208/4																
DF208/4S	61,3	62,6	50,2	54,6	65,9	67,3	54,0	58,7	52,9	58,2	40,4	44,0	56,9	62,6	43,4	47,3
DF216/2																
DF216/3																
DF216/3S																
DF216/M10S	87,7	89,6	71,8	78,2	94,3	96,3	77,2	84,1	75,7	83,3	57,9	62,9	81,4	89,6	62,3	67,6
DF216/M12S																
DF216/4																
DF216/4S																
DF216/5	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF216/5S																
DF216/7S																
DF216/9S																
DF230/3	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF230/3S																
DF230/4																
DF230/4S																
DF230/5	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF230/5S																
DF230/7S																
DF230/9S																
DF241/5	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF241/5S																
DF241/6																
DF241/6S																
DF241/7S	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF275/4S																
DF275/5S																
DF275/6S																
DF275/7S	163,9	167,4	134,2	146,1	188,6	192,7	154,4	168,2	141,3	155,6	108,1	117,6	141,6	179,1	124,5	135,3
DF275/9S																

(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

- Liquid temperatures: 24 °C and 52 °C;
- Equilibrium point dryness, EPD: 60 ppm for R22;
- Equilibrium point dryness, EPD: 50 ppm for R134a , R404A , R407C , R410A e R507.

TABLE 18: DIMENSIONS AND WEIGHTS OF HERMETIC FILTERS

Catalogue Number		Connections			Dimensions [mm]		Weight [g]
		SAE Flare	ODS		Ø D	L	
			Ø [in.]	Ø [mm]			
DF303/2	DF203/2	1/4"	-	-	42	109	168
DF303/2F	-	1/4"	-	-		101	168
DF303/2S	DF203/2S	-	1/4"	-		101	152
DF303/3	DF203/3	3/8"	-	-		119	202
DF303/3S	-	-	3/8"	-		105	186
DF305/2	DF205/2	1/4"	-	-		64	120
DF305/2F	-	1/4"	-	-	112		420
DF305/2S	DF205/2S	-	1/4"	-	112		406
DF305/3	DF205/3	3/8"	-	-	130		450
DF305/3S	DF205/3S	-	3/8"	-	116		414
DF305/M10S	DF205/M10S	-	-	10	120		414
DF308/2	DF208/2	1/4"	-	-	64	141	526
DF308/2F	-	1/4"	-	-		133	526
DF308/2S	DF208/2S	-	1/4"	-		133	502
DF308/3	DF208/3	3/8"	-	-		151	556
DF308/3F	-	3/8"	-	-		140	556
DF308/3S	DF208/3S	-	3/8"	-		137	514
DF308/M10S	DF208/M10S	-	-	10		141	520
DF308/M12S	DF208/M12S	-	-	12		141	520
DF308/4	DF208/4	1/2"	-	-		156	578
DF308/4S	DF208/4S	-	1/2"	-		137	514
DF316/2	DF216/2	1/4"	-	-	64	161	635
DF316/3	DF216/3	3/8"	-	-		171	648
DF316/3F	-	3/8"	-	-		160	648
DF316/3S	DF216/3S	-	3/8"	-		157	616
DF316/M10S	DF216/M10S	-	-	10		161	616
DF316/M12S	DF216/M12S	-	-	12		161	616
DF316/4	DF216/4	1/2"	-	-		176	684
DF316/4S	DF216/4S	-	1/2"	-		157	626
DF316/5	DF216/5	5/8"	-	-		186	748
DF316/5S	DF216/5S	-	5/8"	16		163	628
DF316/7S	-	-	7/8"	-	177	650	
DF316/9S	-	-	1.1/8"	-	177	650	
DF330/3	DF230/3	3/8"	-	-	76	244	1490
DF330/3S	DF230/3S	-	3/8"	-		230	1450
DF330/4	DF230/4	1/2"	-	-		249	1504
DF330/4S	DF230/4S	-	1/2"	-		230	1450
DF330/5	DF230/5	5/8"	-	-		259	1568
DF330/5S	DF230/5S	-	5/8"	16		236	1500
DF330/7S	-	-	7/8"	-		250	1482
DF330/9S	-	-	1.1/8"	-		258	1366
DF341/4	-	1/2"	-	-	89	254	1850
DF341/4S	-	-	1/2"	-		235	1775
DF341/5	DF241/5	5/8"	-	-		264	1976
DF341/5S	DF241/5S	-	5/8"	16		241	1886
DF341/6	DF241/6	3/4"	-	-		273	2076
DF341/6S	DF241/6S	-	3/4"	-		247	1914
DF341/7S	DF241/7S	-	7/8"	-		255	1890
DF375/4S	DF275/4S	-	1/2"	-	89	373	2920
DF375/5S	DF275/5S	-	5/8"	16		379	2930
DF375/6S	DF275/6S	-	3/4"	-		385	2950
DF375/7S	DF275/7S	-	7/8"	-			2950
DF375/9S	DF275/9S	-	1.1/8"	-		401	2990

# REFRIGERATING SYSTEM PROTECTORS

## 7.3 – BI-FLOW HERMETIC FILTER DRIERS

### APPLICATIONS

The hermetic filter driers in series DB3 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### CONSTRUCTION

The filter body is made completely from steel with threaded connections, SAE FLARE, made from nickel plated steel. The product range also includes types with copper connections, EN 12735-1 - Cu-DHP; offering the possibility to solder the copper pipe inside the connections (ODS). Bi-flow filters have two built-in check valves, inserted inside on both sides of the filter, which ensure that the refrigerant liquid always flows correctly from the outside of the cartridge to its core, regardless of the flow direction. Thus, all dirt particles in the circuit are trapped by the filter, regardless of the flow direction.

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. The manufacturing process allows both products to be compact and strong, making them resistant to impact and abrasion. The cartridges are symmetrical and are designed to offer the maximum possible surface area to the incoming fluid, while the core hole guarantees a uniform wall thickness. As a result, the fluid encounters constant resistance, flows linearly, ensuring efficient dehydration and minimum charge loss. The cartridge is chemically inert, not deliquescent, does not react with refrigerating fluids, and is capable of capturing all oil by-products in the circuit.

When building heat pump systems or air conditioning systems with reverse-cycle, the use of bi-flow filter driers eliminates the need for external check valves and reduces external piping and brazing.

### FILTER SELECTION BASED ON REFRIGERANT FLOW CAPACITY

Refrigerant flow capacities shown in Tables 21-22 refer to the following operating conditions according to ARI STANDARD 710-2009:

- Liquid temperature + 30 °C;
- Evaporating temperature - 15 °C.

Total pressure drop, including inlet and outlet connections, 0.07 bar / 0.14 bar.

For different operating conditions apply the following formula:

$$Q = Q_{\text{ref}} \cdot L_1$$

where:

- Q = required refrigeration flow capacity [kW];
- $Q_{\text{ref}}$  = reference refrigeration flow capacity [kW] (see Tab. 21-22);
- $L_1$  = flow capacity correction factor in presence of operative temperatures different from reference conditions. (See Table 8).

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved filters in series DB3 with file SA7054.

Filters in series DB3 are certified **UL-CSA Listed** for the USA and Canada with a Design Pressure of 680 PSI, in compliance with American standard UL 207 and Canadian standard CSA C22.2 No. 140.3-15.



TABLE 12: GENERAL CHARACTERISTICS OF BI-FLOW HERMETIC FILTER DRIERS. SAE FLARE CONNECTIONS

Catalogue Number 100% molecular sieves	International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections	PS [bar]	TS [°C]		Risk Category according to PED Recast
						min.	max.	
DB305/2	052	47	80	1/4"	50	-40	+80	Art. 4.3
DB308/3	083	78	130	3/8"				
DB308/4	084			1/2"				
DB316/3	163			3/8"				
DB316/4	164	134	250	1/2"				
DB316/5	165			5/8"				
DB330/5	305	274	500	5/8"				

TABLE 20: GENERAL CHARACTERISTICS OF HERMETIC BI-FLOW FILTER DRIERS. ODS CONNECTIONS

Catalogue Number 100% molecular sieves	International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
DB305/2S	052S	47	80	1/4"	-	50	-40	+80	Art. 4.3
DB308/3S	083S	78	130	3/8"	-				
DB308/4S	084S			1/2"	-				
DB316/3S	163S			3/8"	-				
DB316/4S	164S	134	250	1/2"	-				
DB316/5S	165S			5/8"	16				
DB316/7S	167S			7/8"	-				
DB330/5S	305S			5/8"	16				
DB330/7S	307S	274	500	7/8"	-				
DB330/9S	309S			1.1/8"	-				

TABLE 21: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,07 BAR (1) [KW]

Catalogue Number	Refrigerants													
	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
DB305/2	5,3	5,8	3,8	5,5	5,6	3,7	4,7	5,1	5,0	4,2	3,8	4,5	4,5	5,3
DB305/2S	8,3	9,1	6,0	8,6	8,8	5,8	7,4	7,9	7,8	6,7	6,0	7,0	7,1	8,3
DB308/3	11,3	12,3	8,0	11,6	11,9	7,8	10,0	10,7	10,6	9,0	8,1	9,5	9,6	11,3
DB308/3S	12,6	13,7	9,0	12,9	13,3	8,7	11,1	11,9	11,8	10,0	9,1	10,6	10,7	12,5
DB308/4	15,2	16,6	10,9	15,7	16,1	10,5	13,4	14,5	14,3	12,2	11,0	12,8	12,9	15,2
DB308/4S	17,0	18,5	12,1	17,5	17,9	11,7	15,0	16,1	15,9	13,5	12,2	14,3	14,4	16,9
DB316/3	15,7	17,1	11,2	16,2	16,6	10,9	13,9	14,9	14,7	12,5	11,3	13,2	13,3	15,7
DB316/3S	17,6	19,2	12,6	18,1	18,6	12,2	15,6	16,7	16,5	14,1	12,7	14,8	15,0	17,6
DB316/4	26,0	28,3	18,5	26,7	27,4	18,0	22,9	24,7	24,3	20,7	18,7	21,8	22,0	25,9
DB316/4S	27,9	30,4	19,9	28,7	29,5	19,3	24,6	26,5	26,1	22,3	20,1	23,4	23,7	27,8
DB316/5	31,9	34,8	22,8	32,9	33,7	22,1	28,2	30,3	29,9	25,5	23,0	26,8	27,1	31,9
DB316/5S	34,3	37,4	24,5	35,3	36,2	23,7	30,3	32,6	32,2	27,4	24,8	28,8	29,1	34,3
DB316/7S	37,7	41,1	26,9	38,8	39,8	26,1	33,3	35,8	35,3	30,1	27,2	31,7	32,0	37,6
DB330/5	34,0	37,1	24,3	35,1	35,9	23,6	30,1	32,4	31,9	27,2	24,6	28,6	28,9	34,0
DB330/5S	36,7	40,0	26,2	37,8	38,8	25,4	32,4	34,9	34,4	29,3	26,5	30,8	31,2	36,6
DB330/7S	40,3	44,0	28,8	41,6	42,6	27,9	35,6	38,4	37,8	32,2	29,1	33,9	34,3	40,3
DB330/9S	43,1	47,0	30,7	44,4	45,5	29,8	38,1	41,0	40,4	34,4	31,1	36,2	36,6	43,1

(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, inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at +30°C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

**TABLE 22: REFRIGERANT FLOW CAPACITY WITH PRESSURE DROP 0,14 BAR (1) [KW]**

Catalogue Number	Refrigerants													
	R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
DB305/2	6,6	7,3	4,7	6,9	7,0	4,6	5,9	6,3	6,2	5,3	4,8	5,6	5,6	6,6
DB305/2S	10,4	11,4	7,4	10,7	11,0	7,2	9,2	9,9	9,8	8,3	7,5	8,8	8,9	10,4
DB308/3	14,1	15,4	10,1	14,5	14,9	9,8	12,5	13,4	13,2	11,3	10,2	11,9	12,0	14,1
DB308/3S	15,7	17,1	11,2	16,2	16,6	10,9	13,9	14,9	14,7	12,5	11,3	13,2	13,3	15,7
DB308/4	19,0	20,8	13,6	19,6	20,1	13,2	16,8	18,1	17,8	15,2	13,7	16,0	16,2	19,0
DB308/4S	21,2	23,1	15,1	21,9	22,4	14,7	18,7	20,2	19,9	16,9	15,3	17,8	18,0	21,2
DB316/3	19,6	21,4	14,0	20,2	20,7	13,6	17,3	18,7	18,4	15,7	14,2	16,5	16,7	19,6
DB316/3S	22,0	24,0	15,7	22,7	23,3	15,2	19,4	20,9	20,6	17,6	15,9	18,5	18,7	22,0
DB316/4	32,4	35,4	23,1	33,4	34,3	22,5	28,7	30,8	30,4	25,9	23,4	27,3	27,6	32,4
DB316/4S	34,8	38,0	24,9	35,9	36,8	24,1	30,8	33,1	32,7	27,8	25,2	29,3	29,6	34,8
DB316/5	39,9	43,5	28,4	41,1	42,2	27,6	35,2	37,9	37,4	31,8	28,8	33,5	33,9	39,8
DB316/5S	42,9	46,8	30,6	44,2	45,3	29,7	37,9	40,8	40,2	34,2	30,9	36,0	36,4	42,8
DB316/7S	47,1	51,4	33,6	48,5	49,8	32,6	41,6	44,8	44,2	37,6	34,0	39,6	40,0	47,1
DB330/5	42,5	46,4	30,3	43,8	44,9	29,4	37,6	40,4	39,9	33,9	30,7	35,8	36,1	42,5
DB330/5S	45,9	50,0	32,7	47,3	48,5	31,8	40,5	43,6	43,0	36,6	33,1	38,6	39,0	45,8
DB330/7S	50,4	55,0	36,0	52,0	53,3	34,9	44,6	48,0	47,3	40,3	36,4	42,4	42,8	50,4
DB330/9S	53,9	58,8	38,4	55,5	56,9	37,3	47,6	51,2	50,5	43,0	38,9	45,3	45,8	53,8

(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, inlet and outlet connections included, (according to ARI STANDARD 710-2009 - with liquid temperature at +30°C and evaporating temperature at -15°C).

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8.

**TABLE 23: WATER CAPACITY AND DEHYDRATABLE CHARGE OF HERMETIC BI-FLOW FILTER DRIERS**

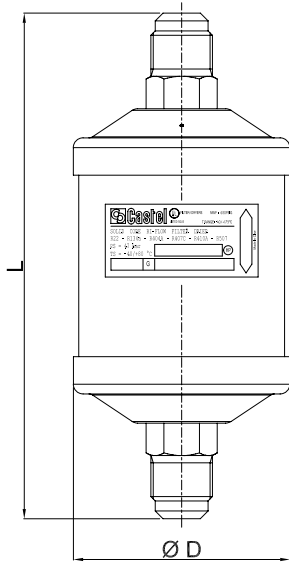
Catalogue Number	Water Capacity at + 24 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H <sub>2</sub> O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
DB305/2	6,4	6,5	5,2	5,7	6,9	7,0	5,6	6,1	5,5	6,1	4,2	4,6	5,9	6,6	4,5	4,9
DB305/2S																
DB308/3	11,4	11,6	9,3	10,1	12,3	12,5	10,0	10,9	9,8	10,8	7,5	8,2	10,5	11,6	8,1	8,8
DB308/3S																
DB308/4																
DB308/4S																
DB316/3	24,7	25,3	20,3	22,1	26,6	27,2	21,8	23,8	21,3	23,5	16,3	17,8	22,9	25,3	17,5	19,1
DB316/3S																
DB316/4																
DB316/4S																
DB316/5																
DB316/5S																
DB316/7S																
DB330/5	51,3	52,4	42,0	45,7	55,2	56,3	45,2	49,1	44,2	48,7	33,8	36,8	47,5	52,4	36,3	39,6
DB330/5S																
DB330/7S																
DB330/9S																

(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

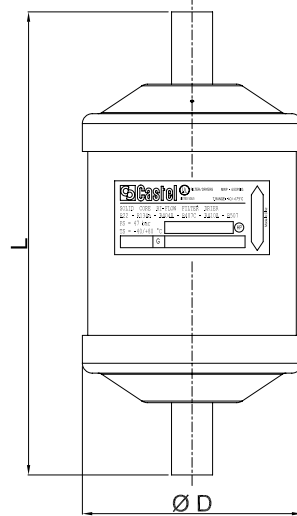
- Liquid temperatures: 24 °C and 52 °C
- Equilibrium point dryness, EPD: 60 ppm for R22
- Equilibrium point dryness, EPD: 50 ppm for R134a , R404A , R407C , R410A e R507

TABLE 24: DIMENSIONS AND WEIGHTS OF BI-FLOW FILTERS

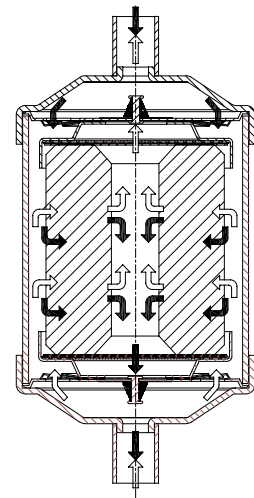
Catalogue Number	Connections			Dimensions [mm]		Weight [g]
	SAE Flare	ODS		Ø D	L	
		Ø [in.]	Ø [mm]			
DB305/2	1/4"	-	-	64	121	480
DB305/2S	-	1/4"	-		113	460
DB308/3	3/8"	-	-	64	152	600
DB308/3S	-	3/8"	-		138	560
DB308/4	1/2"	-	-		157	630
DB308/4S	-	1/2"	-		138	570
DB316/3	3/8"	-	-	76	171	1000
DB316/3S	-	3/8"	-		157	970
DB316/4	1/2"	-	-		176	1050
DB316/4S	-	1/2"	-		157	990
DB316/5	5/8"	-	-		186	1100
DB316/5S	-	5/8"	16		163	1000
DB316/7S	-	7/8"	-		177	1030
DB330/5	5/8"	-	-	76	260	1600
DB330/5S	-	5/8"	16		237	1500
DB330/7S	-	7/8"	-			1550
DB330/9S	-	1.1/8"	-		259	1590



Male connections



Solder connections







# REFRIGERATING SYSTEM PROTECTORS

## 7.4 – REPLACEABLE SOLID CORE FILTER DRIERS

### APPLICATIONS

The replaceable filter driers in series:

- SF411, SF412, SF413 and SF414;
- 4411, 4412, 4413 and 4414;
- 4421, 4423 and 4424.

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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

In the case of filters with more than one cartridge, 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

**Filters in series SF41X** are manufactured with: a zinc plated steel cover, zinc plated screws, and the steel body is equipped with brazing connections made from copper pipe EN 12735-1 – Cu-DHP. 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 an "B" suffix, equipped with blind cover.

**Filters in series 441X** are manufactured with: an aluminium cover, zinc plated screws, and the steel body is equipped with brazing connections:

- Made from copper pipe EN 12735-1 – Cu-DHP. (No suffix after the connection code);
- Machined from a steel bar EN 10025 S355JR. ("F" suffix after connection code).

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.

**Filters in series 442X** are manufactured with: a zinc plated steel cover, stainless steel screws, steel body equipped with brazing connections machined from steel bar EN 10025 S355JR.

Sold only in the configuration of codes with an "A" suffix, equipped with 1/4" NPT threaded cover for mounting an access fitting with valve core (for example kit G9150/R05).

**Cartridges in series 4490 (type A, type B and Type D) and 4491 (type A)** 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.

**Cartridges in series 4490 (type AA and type AB) and 4491 (type AA)** 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 very high deacidifying capacity maintaining very good moisture adsorption characteristics.

The presence of a controlled and defined percentage of activated alumina, lower than the maximum value recommended by ASERCOM, maintains the original concentration of additives in the polyester oil.

**Cartridges in series 4490 (type BA and type 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.

The cartridges in series 4490 have volume of 48 cubic inches, equivalent to about 800 cm<sup>3</sup>, and are suitable for being used with filters in series:

- SF411, SF412, SF413 and SF414
- 4411, 4412, 4413 and 4414.

The cartridges in series 4491 have volume of 96 cubic inches, equivalent to about 1600 cm<sup>3</sup>, and are suitable for being used with filters in series 4421, 4423, and 4424.

Both 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 REPLACEMENT

Cartridges must be ordered separately from the filter. They are supplied in individual packages, which are hermetically sealed in metal containers. This type of packaging is suitable for long-term storage of the cartridge.

Each cartridge is supplied with two synthetic gaskets to be used as a seal between the two cartridges and between the cartridge and its covers.

If the filter is installed in a system without a by-pass, the cartridge replacement must be done following these instructions:

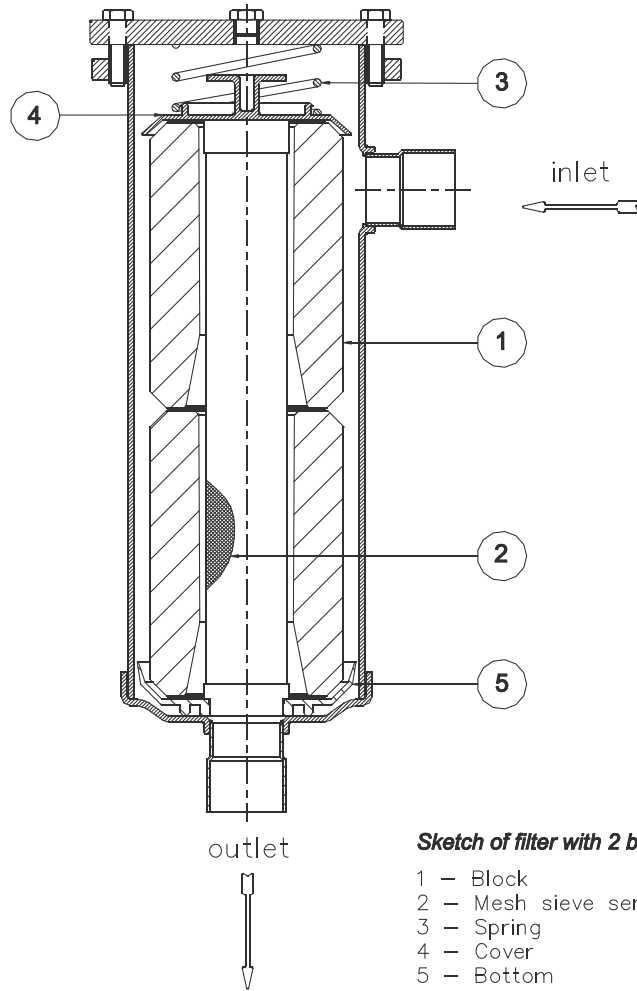
1. Close the valve on the liquid outlet line.
2. Start the compressor and its auxiliaries in order to transfer the refrigerant charge to the high pressure side of the plant (liquid vessel);
3. Stop the compressor at a sufficiently high suction pressure above atmospheric pressure;
4. Close the service valve on the suction side of the compressor.  
NOTE: if during the transfer of the refrigerant to the high-pressure side of the plant, the discharge pressures reach values that are too high (the condenser is flooded due to insufficient capacity of the liquid vessel), shut off the valve on the suction side of the compressor and immediately stop the compressor.
5. Quickly replace the filter cartridge. During preparation for installation of the new cartridge, wrap the filter in a clean rag. The slight over-pressure in the filter and the technician's skill will prevent air from getting into the plant.
6. The cleanliness of the inside of the body is guaranteed by the scraping effect of the cup, which is characteristic of Castel filters.
7. If it is assumed that air has entered the plant during filter cartridge replacement, put the low-pressure side of the plant under vacuum. Always do this to the circuit involved in the operation.
8. Open the valve on the liquid outlet line.
9. Slowly open the compressor's suction valve and start the compressor and its auxiliaries.
10. Top the charge up, if necessary.

## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved filters in series SF41X, 441X and 442X 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 CSA C22.2 No. 140.3-15, with a Design Pressure of:

- 470 PSI for filters in series 441X and 442X;
- 600 PSI for filters in series SF411, SF412 and SF413;
- 450 PSI for filters in series SF414.



**Sketch of filter with 2 blocks**

- 1 - Block
- 2 - Mesh sieve serving as block support
- 3 - Spring
- 4 - Cover
- 5 - Bottom

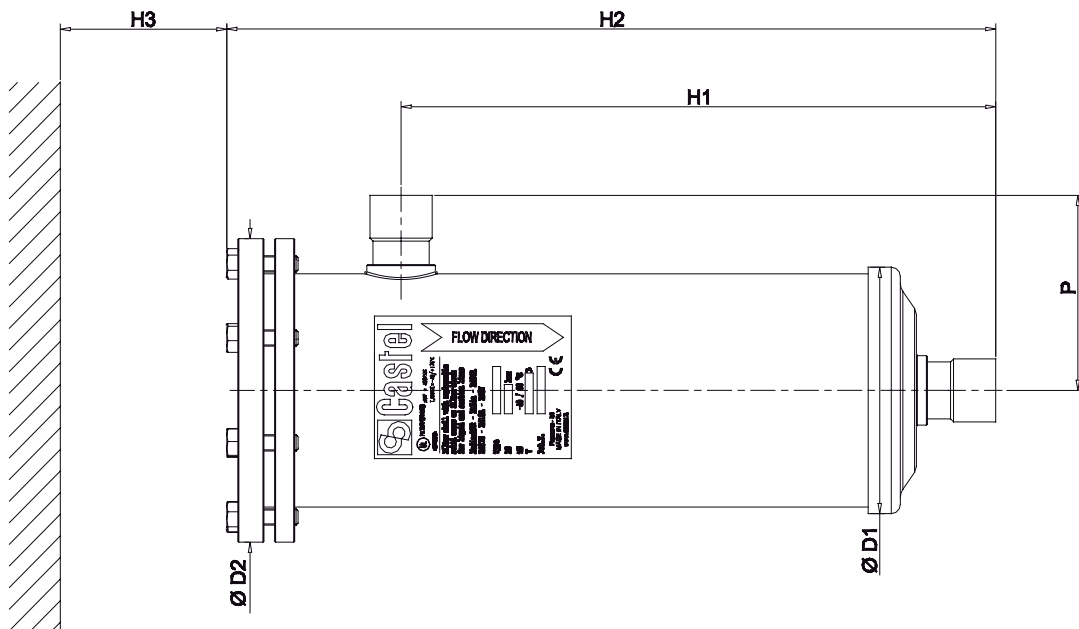


TABLE 25: GENERAL CHARACTERISTICS OF FILTER DRIERS WITH REPLACEABLE SOLID CORE, COPPER CONNECTIONS

Catalogue Number		Core Cat. Number	Number of Cores	Core Filtering Surface [cm <sup>2</sup> ]	Nominal Volume		Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast	
Threaded cover	Blind cover				[cu.in.]	[cm <sup>3</sup> ]	ODS						
							Ø [in.]	Ø [mm]		min.	max.		
SF411/5A	SF411/5B	4490/A 4490/B 4490/AA 4490/AB 4490/BA 4490/BB	1	420	48	800	5/8"	16	47	-40	+80	I	
SF411/7A	SF411/7B						7/8"	22					
SF411/M28A	SF411/M28B						-	28					
SF411/9A	SF411/9B						1.1/8"	-					
SF411/11A	SF411/11B						1.3/8"	35					
SF411/13A	SF411/13B						1.5/8"	-					
SF411/M42A	SF411/M42B						-	42					
SF411/17A	SF411/17B						2.1/8"	54					
SF411/21A	SF411/21B						2.5/8"	-					
SF412/5A	SF412/5B						5/8"	16					
SF412/7A	SF412/7B		7/8"	22									
SF412/M28A	SF412/M28B		-	28									
SF412/9A	SF412/9B		1.1/8"	-									
SF412/11A	SF412/11B		1.3/8"	35									
SF412/13A	SF412/13B		1.5/8"	-									
SF412/M42A	SF412/M42B		-	42									
SF412/17A	SF412/17B		2.1/8"	54									
SF412/21A	SF412/21B		2.5/8"	-									
SF413/7A	SF413/7B		7/8"	22	3	1260	144	2400					41
SF413/M28A	SF413/M28B		-	28									
SF413/9A	SF413/9B		1.1/8"	-									
SF413/11A	SF413/11B		1.3/8"	35									
SF413/13A	SF413/13B		1.5/8"	-									
SF413/M42A	SF413/M42B		-	42									
SF413/17A	SF413/17B	2.1/8"	54										
SF414/11A	SF414/11B	1.3/8"	35	4	1680	192	3200	31					
SF414/13A	SF414/13B	1.5/8"	-										
SF414/M42A	SF414/M42B	-	42										
SF414/17A	SF414/17B		54										

TABLE 26: GENERAL CHARACTERISTICS OF FILTER DRIERS WITH REPLACEABLE SOLID CORE, COPPER CONNECTIONS

Catalogue Number		Core Cat. Number	Number of Cores	Core Filtering Surface [cm <sup>2</sup> ]	Nominal Volume		Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
Theaded cover	Blind cover				[cu.in]	[cm <sup>3</sup> ]	ODS			min.	max.	
							Ø [in.]	Ø [mm]				
4411/5A	4411/5B	4490/A 4490/B 4490/AA 4490/AB 4490/BA 4490/BB	1	420	48	800	5/8"	16	45	- 40	+ 80	I
4411/7A	4411/7B						7/8"	22				
4411/M28A	4411/M28B						-	28				
4411/9A	4411/9B						1.1/8"	-				
4411/11A	4411/11B						1.3/8"	35				
4411/13A	4411/13B						1.5/8"	-				
4411/M42A	4411/M42B						-	42				
4411/17A	4411/17B						2.1/8"	54				
4411/21A	4411/21B		2.5/8"	-								
4412/7A	4412/7B		2	840	96	1600	7/8"	22				
4412/M28A	4412/M28B						-	28				
4412/9A	4412/9B						1.1/8"	-				
4412/11A	4412/11B						1.3/8"	35				
4412/13A	4412/13B						1.5/8"	-				
4412/M42A	4412/M42B						-	42				
4412/17A	4412/17B		2.1/8"	54								
4413/7A	4413/7B	3	1260	144	2400	7/8"	22					
4413/9A	4413/9B					1.1/8"	-					
4413/11A	4413/11B					1.3/8"	35					
4413/13A	4413/13B					1.5/8"	-					
4413/M42A	4413/M42B	-	42									
4414/11A	4414/11B	4	1680	192	3200	1.3/8"	35					
4414/13A	4414/13B					1.5/8"	-					
4414/M42A	4414/M42B					-	42					
4414/17A	4414/17B					5/8"	16					



TABLE 27: GENERAL CHARACTERISTICS OF FILTER DRIERS WITH REPLACEABLE SOLID CORE, STEEL CONNECTIONS

Catalogue Number Theaded cover	Core Cat. Number	Number of Cores	Core Filtering Surface [cm <sup>2</sup> ]	Nominal Volume		Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast				
				[cu.in]	[cm <sup>3</sup> ]	ODS		W		min.	max.					
						Ø [in.]	Ø [mm]						Ø [mm]			
4411/5AF	4490/A 4490/B 4490/AA 4490/AB 4490/BA 4490/BB	1	420	48	800	5/8"	16	21,3	50	- 40	+ 80	II				
4411/7AF						7/8"	22	26,9								
4411/9AF						1.1/8"	-	33,7								
4411/11AF						1.3/8"	35	42,4								
4411/13AF						1.5/8"	-	48,3								
4411/M42AF						-	42	48,3								
4411/17AF						2.1/8"	54	60,3								
4411/21AF						2.5/8"	-	76,1								
4412/7AF						2	840	96					1600	7/8"	22	26,9
4412/9AF														1.1/8"	-	33,7
4412/11AF		1.3/8"	35	42,4												
4412/M42AF		-	42	48,3												
4412/17AF		2.1/8"	54	60,3												
4413/7AF		3	1260	144	2400	7/8"	22	26,9	45							
4413/9AF						1.1/8"	-	33,7								
4413/11AF						1.3/8"	35	42,4								
4413/13AF						1.5/8"	-	48,3								
4413/M42AF						-	42	48,3								
4414/11AF		4	1680	192	3200	1.3/8"	35	42,4	35							
4414/13AF						1.5/8"	-	48,3								
4414/M42AF	-					42	48,3									
4414/17AF	2.1/8"					54	60,3									
4423/17A	4491/A 4491/AA	3	1890	300	4800	2.1/8"	54	60,3	32							
4423/21A						2.5/8"	67	76,1								
4423/25A						3.1/8"	80	88,9								
4424/25A		4	2520	400	6400	3.1/8"	80	88,9								
4424/34A						-	108	114,3								

TABLE 28: REFRIGERANT FLOW CAPACITY OF FILTER DRIERS WITH REPLACEABLE SOLID CORE

Catalogue Number			Pressure drop 0,07 bar (1) [kW]													
			R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
SF411/5A-B	4411/5A-A-B	4411/5AF	83	90	59	85	87	57	73	78	77	66	60	69	70	82
SF411/7A-B	4411/7A-B	4411/7AF	145	158	103	149	153	100	128	138	136	116	105	122	123	145
SF411/M28A-B	4411/M28A-B	-	198	216	141	204	209	137	175	188	186	158	143	167	168	198
SF411/9A-B	4411/9A-B	4411/9AF	198	216	141	204	209	137	175	188	186	158	143	167	168	198
SF411/11A-B	4411/11A-B	4411/11AF	231	252	165	238	244	160	204	220	217	184	167	194	196	231
SF411/13A-B	4411/13A-B	4411/13AF	248	270	177	255	262	171	219	235	232	198	179	208	210	247
SF411/M42A-B	4411/M42A-B	4411/M42AF	248	270	177	255	262	171	219	235	232	198	179	208	210	247
SF411/17A-B	4411/17A-B	4411/17AF	248	270	177	255	262	171	219	235	232	198	179	208	210	247
SF411/21A-B	4411/21A-B	4411/21AF	248	270	177	255	262	171	219	235	232	198	179	208	210	247
SF412/5A-B	-	-	83	90	59	85	87	57	73	78	77	66	60	69	70	82
SF412/7A-B	4412/7A-B	4412/7AF	145	158	103	149	153	100	128	138	136	116	105	122	123	145
SF412/M28A-B	4412/M28A-B	-	224	244	160	231	236	155	198	213	210	179	162	188	190	224
SF412/9A-B	4412/9A-B	4412/9AF	224	244	160	231	236	155	198	213	210	179	162	188	190	224
SF412/11A-B	4412/11A-B	4412/11AF	304	331	216	313	321	210	268	289	285	242	219	255	258	303
SF412/13A-B	4412/13A-B	-	331	361	236	341	350	229	292	315	310	264	239	278	281	331
SF412/M42A-B	4412/M42A-B	4412/M42AF	331	361	236	341	350	229	292	315	310	264	239	278	281	331
SF412/17A-B	4412/17A-B	4412/17AF	331	361	236	341	350	229	292	315	310	264	239	278	281	331
SF412/21A-B	-	-	331	361	236	341	350	229	292	315	310	264	239	278	281	331
SF413/7A-B	4413/7A-B	4413/7AF	145	158	103	149	153	100	128	138	136	116	105	122	123	145
SF413/M28A-B	4413/M28A-B	-	224	244	160	231	236	155	198	213	210	179	162	188	190	224
SF413/9A-B	4413/9A-B	4413/9AF	224	244	160	231	236	155	198	213	210	179	162	188	190	224
SF413/11A-B	4413/11A-B	4413/11AF	325	354	232	335	343	225	287	309	304	259	234	273	276	324
SF413/13A-B	4413/13A-B	4413/13AF	359	391	256	369	379	248	317	341	336	286	259	301	305	358
SF413/M42A-B	4413/M42A-B	4413/M42AF	359	391	256	369	379	248	317	341	336	286	259	301	305	358
SF413/17A-B	-	-	359	391	256	369	379	248	317	341	336	286	259	301	305	358
SF414/11A-B	4414/11A-B	4414/11AF	376	410	268	387	397	260	332	358	353	300	271	316	319	376
SF414/13A-B	4414/13A-B	4414/13AF	422	460	301	435	446	292	373	401	396	337	305	355	358	421
SF414/M42A-B	4414/M42A-B	4414/M42AF	422	460	301	435	446	292	373	401	396	337	305	355	358	421
SF414/17A-B	4414/17A-B	4414/17AF	422	460	301	435	446	292	373	401	396	337	305	355	358	421
-	-	4423/17A	266	290	190	274	281	184	235	253	249	212	192	223	226	265
-	-	4423/21A	293	319	209	302	309	203	259	278	275	234	211	246	249	292
-	-	4423/25A	399	435	284	411	422	276	352	379	374	318	288	335	339	398
-	-	4424/25A	439	478	313	452	463	304	387	417	411	350	317	369	373	438
-	-	4424/34A	702	766	501	723	742	486	620	668	658	560	507	590	596	701

(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 +30°C and evaporating temperature at -15°C).

TABLE 29: REFRIGERANT FLOW CAPACITY OF FILTER DRIERS WITH REPLACEABLE SOLID CORE

Catalogue Number			Pressure drop 0,14 bar (1) [kW]													
			R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
SF411/5A-B	4411/5A-A-B	4411/5AF	99	108	71	102	105	69	87	94	93	79	71	83	84	99
SF411/7A-B	4411/7A-B	4411/7AF	188	205	134	194	199	130	166	179	177	150	136	158	160	188
SF411/M28A-B	4411/M28A-B	-	257	281	184	265	272	178	227	245	241	206	186	216	219	257
SF411/9A-B	4411/9A-B	4411/9AF	257	281	184	265	272	178	227	245	241	206	186	216	219	257
SF411/11A-B	4411/11A-B	4411/11AF	300	328	214	310	317	208	265	286	282	240	217	253	255	300
SF411/13A-B	4411/13A-B	4411/13AF	322	351	230	332	340	223	284	306	302	257	232	271	273	322
SF411/M42A-B	4411/M42A-B	4411/M42AF	322	351	230	332	340	223	284	306	302	257	232	271	273	322
SF411/17A-B	4411/17A-B	4411/17AF	322	351	230	332	340	223	284	306	302	257	232	271	273	322
SF411/21A-B	4411/21A-B	4411/21AF	322	351	230	332	340	223	284	306	302	257	232	271	273	322
SF412/5A-B	-	-	99	108	71	102	105	69	87	94	93	79	71	83	84	99
SF412/7A-B	4412/7A-B	4412/7AF	188	205	134	194	199	130	166	179	177	150	136	158	160	188
SF412/M28A-B	4412/M28A-B	-	291	317	207	300	307	201	257	277	273	232	210	245	247	291
SF412/9A-B	4412/9A-B	4412/9AF	291	317	207	300	307	201	257	277	273	232	210	245	247	291
SF412/11A-B	4412/11A-B	4412/11AF	395	430	281	407	417	273	349	375	370	315	285	332	335	394
SF412/13A-B	4412/13A-B	-	447	487	319	461	472	309	395	425	419	357	323	376	380	446
SF412/M42A-B	4412/M42A-B	4412/M42AF	447	487	319	461	472	309	395	425	419	357	323	376	380	446
SF412/17A-B	4412/17A-B	4412/17AF	447	487	319	461	472	309	395	425	419	357	323	376	380	446
SF412/21A-B	-	-	447	487	319	461	472	309	395	425	419	357	323	376	380	446
SF413/7A-B	4413/7A-B	4413/7AF	196	213	139	202	207	135	173	186	183	156	141	164	166	195
SF413/M28A-B	4413/M28A-B	-	302	329	215	311	319	209	267	287	283	241	218	254	257	302
SF413/9A-B	4413/9A-B	4413/9AF	302	329	215	311	319	209	267	287	283	241	218	254	257	302
SF413/11A-B	4413/11A-B	4413/11AF	438	478	313	452	463	303	387	417	411	350	316	368	372	438
SF413/13A-B	4413/13A-B	4413/13AF	484	528	345	499	511	335	428	460	454	386	349	407	411	484
SF413/M42A-B	4413/M42A-B	4413/M42AF	484	528	345	499	511	335	428	460	454	386	349	407	411	484
SF413/17A-B	-	-	484	528	345	499	511	335	428	460	454	386	349	407	411	484
SF414/11A-B	4414/11A-B	4414/11AF	526	574	375	542	556	364	465	501	494	420	380	443	447	526
SF414/13A-B	4414/13A-B	4414/13AF	591	644	421	609	624	409	522	562	554	471	426	497	502	590
SF414/M42A-B	4414/M42A-B	4414/M42AF	591	644	421	609	624	409	522	562	554	471	426	497	502	590
SF414/17A-B	4414/17A-B	4414/17AF	591	644	421	609	624	409	522	562	554	471	426	497	502	590
-	-	4423/17A	372	406	265	383	393	258	329	354	349	297	269	313	316	372
-	-	4423/21A	410	447	292	422	433	284	362	390	384	327	296	345	348	409
-	-	4423/25A	558	609	398	576	590	387	493	531	524	446	403	470	474	558
-	-	4424/25A	614	669	438	633	649	425	542	584	576	490	443	516	522	613
-	-	4424/34A	983	1072	701	1013	1039	681	868	935	922	785	710	826	835	982

(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 +30°C and evaporating temperature at -15°C).

TABLE 30: GENERAL CHARACTERISTICS, DIMENSIONS AND WEIGHTS OF SOLID CORES

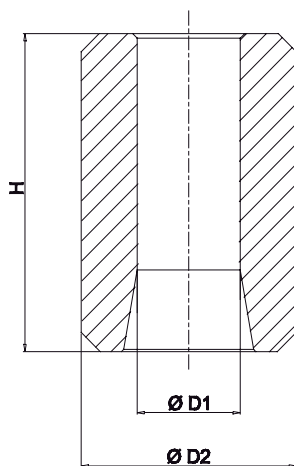
Catalogue Number	Batch characteristic	Filtering Surface [cm <sup>2</sup> ]	Nominal Volume		Suitable for filters	Dimensions [mm]			Weight [g]
			[cu.in]	[cm <sup>3</sup> ]		Ø D1	Ø D2	H	
4490/A (1)	High moisture adsorption (100% molecular sieve)	420	48	800	4411 4412 4413 4414 SF411 SF412 SF413 SF414	47	96	140	730
4490/B (2)									
4490/D (3)									
4490/AA (1)	Moisture and acid adsorption (80% molecular sieve + 20% activated alumina)	420	48	800	4411 4412 4413 4414 SF411 SF412 SF413 SF414	47	96	140	730
4490/AB (2)									
4490/BA (1)	High acid adsorption, motor burn-out core (25% molecular sieve + 75% activated alumina)	420	48	800	4411 4412 4413 4414 SF411 SF412 SF413 SF414	47	96	140	730
4490/BB (2)									
4491/A (4)	High moisture adsorption (100% molecular sieve)	630	100	1600	4423 4424	53	122	165	1560
4491/AA (4)	Moisture and acid adsorption (80% molecular sieve + 20% activated alumina)								

- (1): Supplied with cover gaskets as spare part, either for Castel filters or for competitors ones.
- (2): Supplied without cover gasket as part part.
- (3): Supplied with high performance cover gaskets as spare part, either for Castel filters or for competitors ones.
- (4): Supplied with cover gasket as spare part for Castel filters.

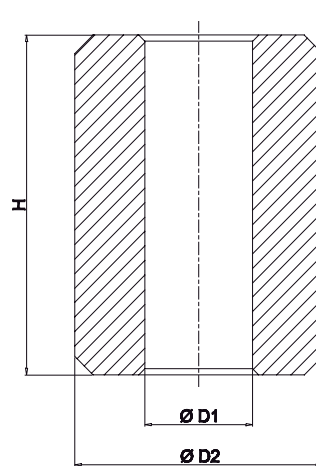
TABLE 31: WATER CAPACITY / DEHYDRATABLE CHARGE AND ACID CAPACITY OF ONE SOLID CORE

Catalogue Number	Nominal Volume		Water Capacity at + 24 °C (1) [g H2O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H2O]				Dehydratable Charge at + 52 °C [kg refrigerant]				Acid Capacity (2) [g]
	[cu.in]	[cm <sup>3</sup> ]	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	
4490/A 4490/B 4490/D	48	800	82	84	67	73	88	90	72	79	71	78	54	59	76	84	58	63	
4490/AA 4490/AB			70	71	57	62	75	77	61	67	60	66	46	50	65	71	50	54	
4490/BA 4490/BB																			
4491/A	100	1600	216	220	177	192	232	237	190	207	186	205	142	155	200	220	153	166	
4491/AA			183	187	150	163	197	201	161	176	158	174	121	131	170	187	130	141	

- (1): Supplied with cover gaskets as spare part, either for Castel filters or for competitors ones.
- (2): Supplied without cover gasket as part part.
- (3): Supplied with high performance cover gaskets as spare part, either for Castel filters or for competitors ones.
- (4): Supplied with cover gasket as spare part for Castel filters.



4490



4491

TABLE 32: DIMENSIONS AND WEIGHTS OF FILTER, COPPER CONNECTIONS

Catalogue Number	Connections		Dimensions [mm]					Weight [g]	
	ODS		Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>		P
	Ø [in.]	Ø [mm]							
SF411/5A-B	5/8"	16	129	157	153	240	185	93	5570
SF411/7A-B	7/8"	22			99	5370			
SF411/M28A-B	-	28			159	246		99	5400
SF411/9A-B	1.1/8"	-			164	251		104	5450
SF411/11A-B	1.3/8"	35			176	263		116	5700
SF411/13A-B	1.5/8"	-			166	253		106	5700
SF411/M42A-B	-	42			190	277		130	6000
SF411/17A-B	2.1/8"	54			294	381		93	6950
SF411/21A-B	2.5/8"	-			300	387		99	6900
SF412/5A-B	5/8"	16			305	392		104	6880
SF412/7A-B	7/8"	22			317	404	116	7180	
SF412/M28A-B	-	28			307	394	106	7320	
SF412/9A-B	1.1/8"	-			331	418	130	7380	
SF412/11A-B	1.3/8"	35			442	529	99	8240	
SF412/13A-B	1.5/8"	-			447	534	104	8400	
SF412/M42A-B	-	42			459	546	116	8320	
SF412/17A-B	2.1/8"	54			449	536	106	8620	
SF412/21A-B	2.5/8"	-			588	675	104	9690	
SF413/7A-B	7/8"	22			600	687	116	9700	
SF413/M28A-B	-	28			590	677	106	9950	
SF413/9A-B	1.1/8"	-							
SF413/11A-B	1.3/8"	35							
SF413/13A-B	1.5/8"	-							
SF413/M42A-B	-	42							
SF413/17A-B	2.1/8"	54							
SF413/21A-B	2.5/8"	-							
SF414/11A-B	1.3/8"	35							
SF414/13A-B	1.5/8"	-							
SF414/M42A-B	-	42							
SF414/17A-B	2.1/8"	54							

TABLE 33: DIMENSIONS AND WEIGHTS OF FILTER, COPPER CONNECTIONS

Catalogue Number	Connections		Dimensions [mm]					Weight [g]			
	ODS		Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>		P		
	Ø [in.]	Ø [mm]									
4411/5A-B	5/8"	16	121	149	144	231	185	89	3800		
4411/7A-B	7/8"	22									3800
4411/M28A-B	-	28			150	237				95	3850
4411/9A-B	1.1/8"										
4411/11A-B	1.3/8"	35						155	242	100	3900
4411/13A-B	1.5/8"	-						167	254	112	3990
4411/M42A-B	-	42									
4411/17A-B	2.1/8"	54					158	245	103	4130	
4411/21A-B	2.5/8"	-					182	269	127	4430	
4412/7A-B	7/8"	22									
4412/M28A-B	-	28					292	379		95	5050
4412/9A-B	1.1/8"	-									
4412/11A-B	1.3/8"	35					297	384	100	5150	
4412/M42A-B	-	42					309	396	112	5270	
4412/17A-B	2.1/8"	54					300	387	103	5400	
4413/7A-B	7/8"	22									
4413/9A-B	1.1/8"	-					433	520		95	6350
4413/11A-B	1.3/8"	35					438	525	100	6480	
4413/13A-B	1.5/8"	-									
4413/M42A-B	-	42					450	537	112	6520	
4414/11A-B	1.3/8"	35			580	667	100	7780			
4414/13A-B	1.5/8"	-									
4414/M42A-B	-	42			592	679	112	7960			
4414/17A-B	2.1/8"	54			583	670	103	7900			

TABLE 34: DIMENSIONS AND WEIGHTS OF FILTERS, STEEL CONNECTIONS

Catalogue Number	Connections			Dimensions [mm]						Weight [g]
	ODS		W	Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	P	
	Ø [in.]	Ø [mm]	Ø [mm]							
4411/5AF	5/8"	16	21,3	121	149	144	231	185	90	3810
4411/7AF	7/8"	22	26,9			150	237		95	3860
4411/9AF	1.1/8"	–	33,7			155	242		100	4050
4411/11AF	1.3/8"	35	42,4			167	254		112	4190
4411/13AF	1.5/8"	–	48,3			158	245		103	4150
4411/M42AF	–	42	48,3			152	239		95	4350
4411/17AF	2.1/8"	54	60,3			292	379	95	5280	
4412/7AF	7/8"	22	26,9			297	384	100	5320	
4412/9AF	1.1/8"	–	33,7			309	396	112	5380	
4412/11AF	1.3/8"	35	42,4			300	387	103	5400	
4412/M42AF	–	42	48,3			433	520	95	6400	
4412/17AF	2.1/8"	54	60,3			438	525	100	6600	
4413/7AF	7/8"	22	26,9			450	537	112	6770	
4413/9AF	1.1/8"	–	33,7			580	667	100	7700	
4413/11AF	1.3/8"	35	42,4			592	679	112	7900	
4413/13AF	1.5/8"	–	48,3			583	670	103	8000	
4413/M42AF	–	42	48,3	163	200	518	641	600	142	18450
4414/17AF	2.1/8"	54	60,3			538	661		17370	
4423/17A	2.1/8"	54	60,3			705	829	760	162	18720
4423/21A	2.5/8"	67	76,1			715	839		21600	
4423/25A	3.1/8"	80	88,9						172	24300
4424/25A	3.1/8"	80	88,9							
4424/34A	4.1/4"	108	114,3							





# REFRIGERATING SYSTEM PROTECTORS

## 7.5 – REPLACEABLE MECHANICAL CARTRIDGE FILTERS

### APPLICATIONS

The replaceable mechanical filter in series SF411, 4411 and 4421 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

Good filtering of the refrigerant on the low-pressure side of the system is an absolute guarantee of protection for the compressor. System cleanliness is ensured by micro filtering cores, which filter out every kind of impurities derived from manufacture and assembly of the refrigerating system.

### CONSTRUCTION

**Filters in series SF411** are manufactured with: a zinc plated steel cover, zinc plated screws, and the steel body is equipped with brazing connections made from copper pipe EN 12735-1 – Cu-DHP. Sold only in the configuration of codes with an "C" suffix, equipped with 1/4" NPT threaded cover and an access fitting with valve core

**Filters in series 4411** are manufactured with: an aluminium cover, zinc plated screws, and the steel body is equipped with brazing connections:

- Made from copper pipe EN 12735-1 – Cu-DHP. (No suffix after the connection code);
- Machined from a steel bar EN 10025 S355JR. ("F" suffix after connection code).

Sold only in the configuration of codes with an "C" suffix, equipped with 1/4" NPT threaded cover and an access fitting with valve core

**Filters in series 4421** are manufactured with: a zinc plated steel cover, stainless steel screws, steel body equipped with brazing connections machined from steel bar EN 10025 S355JR.

Sold only in the configuration of codes with an "C" suffix, equipped with 1/4" NPT threaded cover and an access fitting with valve core

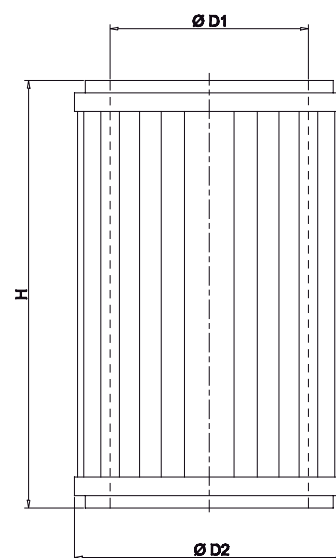
**Cartridge 4495 and 4496:** characterized by a large filter surface, these consist of metal mesh fabric with a controlled porosity filter sieve insert, which can retain solid particles to 20 microns. At both ends, soft felt gaskets ensure perfect seal with the plastic cups.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved filters in series SF41X, 441X and 442X 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 CSA C22.2 No. 140.3-15, with a Design Pressure of:

- 470 PSI for filters in series 441X and 442X;
- 600 PSI for filters in series SF411, SF412 and SF413;
- 450 PSI for filters in series SF414.



4491  
4496



**Castel**

FILTER/DRYERS MWP = 470 PSIG  
 LISTED 81D4 T. RANGE = -40/+176°F

Filter shell with replaceable  
 solid cores or filter-block  
 for liquid and suction lines

R22 - HFC - HFO - HC

Type 4411/11CF  
 PS 50 bar  
 TS -40 / + 80 °C  
 V 2.02 L  
 Lot N. 2019-015198

MADE IN ITALY  
 www.castel.it 1370 CE

FLOW DIRECTION

**Castel**

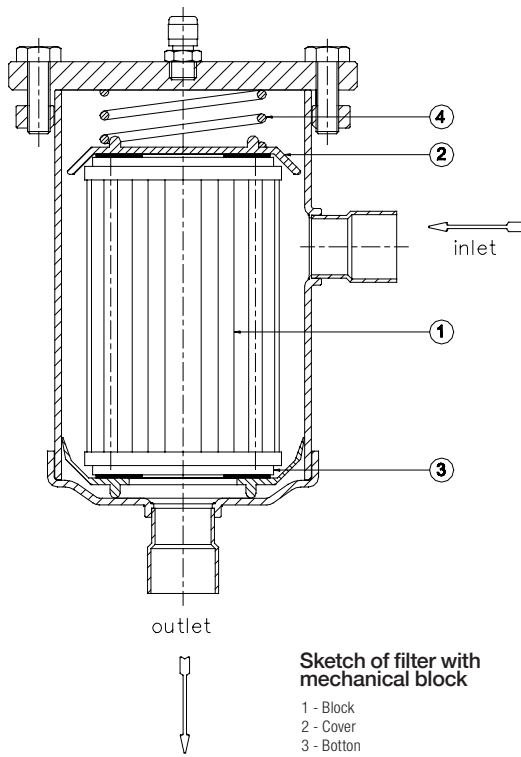
FILTER/DRYERS MWP = 470 PSIG  
 LISTED 81D4 T. RANGE = -40/+176°F

Filter shell with replaceable  
 solid cores or filter-block  
 for liquid and suction lines

R22 - HFC - HFO - HC

Type 4411/17CF  
 PS 50 bar  
 TS -40 / + 80 °C  
 V 2.02 L  
 Lot N. 2019-015746

MADE IN ITALY  
 www.castel.it 1370 CE



Sketch of filter with mechanical block

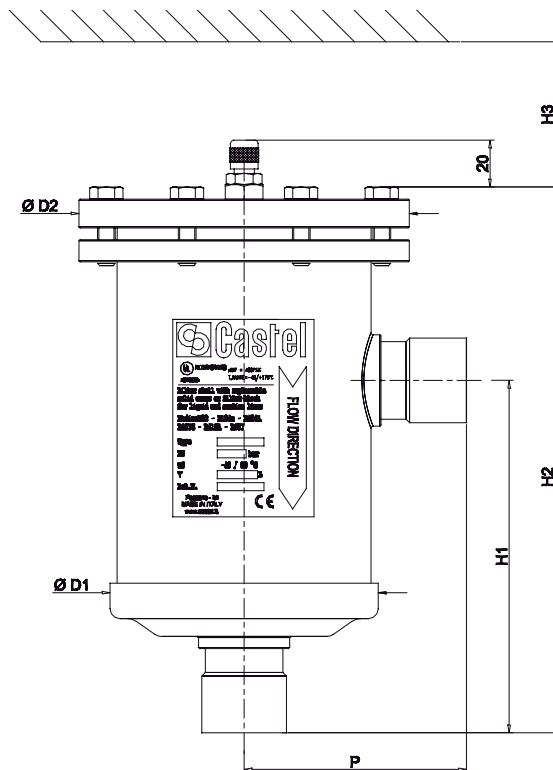


TABLE 35: GENERAL CHARACTERISTICS OF MECHANICAL BLOCK FILTERS

Catalogue Number	Core Cat. Number	Number of Cores	Filtering Surface [cm <sup>2</sup> ]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
SF411/5C	4495/C	1	820	5/8"	16	47	- 40	+ 80	I
SF411/7C				7/8"	22				
SF411/M28C				-	28				
SF411/9C				1.1/8"	-				
SF411/11C				1.3/8"	35				
SF411/13C				1.5/8"	-				
SF411/M42C				-	42				
SF411/17C				2.1/8"	54				
SF411/21C				2.5/8"	-				

TABLE 36: GENERAL CHARACTERISTICS OF MECHANICAL BLOCK FILTERS

Catalogue Number	Core Cat. Number	Number of Cores	Filtering Surface [cm <sup>2</sup> ]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
4411/5C	4495/C	1	820	5/8"	16	45	- 40	+ 80	I
4411/7C				7/8"	22				
4411/M28C				-	28				
4411/9C				1.1/8"	-				
4411/11C				1.3/8"	35				
4411/13C				1.5/8"	-				
4411/M42C				-	42				
4411/17C				2.1/8"	54				
4411/21C				2.5/8"	-				

TABLE 37: GENERAL CHARACTERISTICS OF MECHANICAL BLOCK FILTERS

Catalogue Number	Number of Cores	Filtering block		Connections			PS [bar]	TS [°C]		Risk Category according to PED Recast
		Cat. Number	Filtering Surface [cm <sup>2</sup> ]	ODS		W		max.	min.	
				Ø [in.]	Ø [mm]	Ø [mm]				
4411/5CF	1	4495/C	820	5/8"	16	21,3	50	- 40	+ 80	I
4411/7CF				7/8"	22	26,9				
4411/9CF				1.1/8"	-	33,7				
4411/11CF				1.3/8"	35	42,4				
4411/13CF				1.5/8"	-	48,3				
4411/M42CF				-	42	48,3				
4411/17CF				2.1/8"	54	60,3				
4411/21CF				2.5/8"	-	76,1				
4411/25CF				3.1/8"	80	88,9				
4421/21C		4496/C	1850	2.5/8"	67	76,1	45	- 40	+ 80	I
4421/25C				3.1/8"	80	88,9				
4421/34C				4.1/4"	108	114,3				

TABLE 38: REFRIGERANT FLOW CAPACITY OF FILTERING BLOCK (4495/C - 4496/C) [KW]

Refrigerant	Evaporating Temperature [°C]	Pressure drop [bar]	Catalogue Number														Copper connections
			SF411/5C	SF411/7C	SF411/M28C	SF411/9C	SF411/11C	SF411/13C	SF411/M42C	SF411/17C	SF411/21C						
			4411/5C	4411/7C	4411/M28C	4411/9C	4411/11C	4411/13C	4411/M42C	4411/17C	4411/21C						
			4411/5CF	4411/7CF		4411/9CF	4411/11CF	4411/13CF	4411/M42CF	4411/17CF	4411/21CF	4411/25CF	4421/21C	4421/25C	4421/34C	Steel connections	
R134a	4,4	0,14	9,9	22,8	40,6	40,6	54,2	61,6	61,6	83,3	83,3	83,3	155,5	202,1	202,1		
	-6,7	0,10	6,6	15,2	26,7	26,7	35,7	41,1	41,1	54,8	54,8	54,8	98,6	128,2	128,2		
	-18	0,07	4,3	9,8	16,9	16,9	22,6	26,5	26,5	34,7	34,7	34,7	60,2	78,2	78,2		
	-29	0,03	2,2	4,8	8,1	8,1	10,9	13,0	13,0	16,7	16,7	16,7	27,0	35,1	35,1		
R22	4,4	0,21	15,5	36,1	65,1	65,1	87,0	97,3	97,3	133,5	133,5	133,5	259,1	336,9	336,9		
	-6,7	0,14	10,4	24,1	42,9	42,9	57,3	65,0	65,0	88,0	88,0	88,0	164,4	213,7	213,7		
	-18	0,10	7,1	16,3	28,6	28,6	38,2	44,1	44,1	58,7	58,7	58,7	105,9	137,6	137,6		
	-29	0,07	4,7	10,8	18,6	18,6	24,9	29,1	29,1	38,2	38,2	38,2	66,2	86,1	86,1		
-40	0,03	2,4	5,4	9,1	9,1	12,2	14,7	14,7	18,8	18,8	18,8	24,4	24,4	24,4			
R404A	4,4	0,21	13,8	32,3	58,9	58,9	78,7	87,2	87,2	120,8	120,8	120,8	239,6	311,5	311,5		
	-6,7	0,14	9,1	21,1	37,8	37,8	50,4	56,8	56,8	77,4	77,4	77,4	147,9	192,2	192,2		
	-18	0,10	6,1	14,1	25,0	25,0	33,4	38,1	38,1	51,3	51,3	51,3	94,6	123,0	123,0		
	-29	0,07	3,9	9,0	15,7	15,7	20,9	24,3	24,3	32,2	32,2	32,2	57,1	74,2	74,2		
-40	0,03	1,9	4,4	7,4	7,4	9,9	11,8	11,8	15,2	15,2	15,2	19,7	19,7	19,7			
R407C	4,4	0,21	14,7	34,2	61,6	61,6	82,2	92,1	92,1	126,3	126,3	126,3	244,3	317,6	317,6		
	-6,7	0,14	9,7	22,3	39,6	39,6	52,9	60,2	60,2	81,2	81,2	81,2	151,0	196,3	196,3		
	-18	0,10	6,4	14,7	25,7	25,7	34,3	39,7	39,7	52,7	52,7	52,7	94,4	122,7	122,7		
	-29	0,07	4,1	9,4	16,2	16,2	21,7	25,4	25,4	33,3	33,3	33,3	57,2	74,4	74,4		
-40	0,03	2,1	4,6	7,7	7,7	10,3	12,5	12,5	15,9	15,9	15,9	20,6	20,6	20,6			
R410A	4,4	0,21	18,7	43,8	79,5	79,5	106,2	118,0	118,0	163,1	163,1	163,1	322,1	418,7	418,7		
	-6,7	0,14	12,7	29,4	52,6	52,6	70,2	79,2	79,2	107,8	107,8	107,8	204,9	266,4	266,4		
	-18	0,10	8,6	19,9	35,2	35,2	47,0	53,7	53,7	72,1	72,1	72,1	132,2	171,9	171,9		
	-29	0,07	5,8	13,2	23,0	23,0	30,7	35,6	35,6	47,1	47,1	47,1	83,1	108,0	108,0		
-40	0,03	3,0	6,7	11,3	11,3	15,1	18,0	18,0	23,2	23,2	23,2	23,2	30,2	30,2			
R507	4,4	0,21	13,2	30,9	56,2	56,2	75,1	83,3	83,3	115,3	115,3	115,3	228,3	296,8	296,8		
	-6,7	0,14	8,7	20,2	36,2	36,2	48,3	54,5	54,5	74,2	74,2	74,2	141,5	184,0	184,0		
	-18	0,10	5,8	13,3	23,6	23,6	31,5	36,0	36,0	48,4	48,4	48,4	89,0	115,7	115,7		
	-29	0,07	3,8	8,6	14,9	14,9	20,0	23,2	23,2	30,6	30,6	30,6	54,3	70,6	70,6		
-40	0,03	1,9	4,2	7,1	7,1	9,5	11,4	11,4	14,7	14,7	14,7	19,0	19,0	19,0			
R448A	4,4	0,21	14,6	34,1	61,6	61,6	82,3	92,0	92,0	126,4	126,4	126,4	245,8	319,5	319,5		
	-6,7	0,14	9,7	22,3	39,7	39,7	53,0	60,2	60,2	81,5	81,5	81,5	152,4	198,1	198,1		
	-18	0,10	6,4	14,8	25,9	25,9	34,6	39,9	39,9	53,1	53,1	53,1	95,8	124,5	124,5		
	-29	0,07	4,2	9,5	16,4	16,4	22,0	25,7	25,7	33,7	33,7	33,7	58,4	75,9	75,9		
-40	0,03	2,1	4,7	7,8	7,8	10,5	12,6	12,6	16,1	16,1	16,1	20,9	20,9	20,9			
R449A	4,4	0,21	14,5	33,8	61,2	61,2	81,7	91,3	91,3	125,4	125,4	125,4	244,2	317,4	317,4		
	-6,7	0,14	9,6	22,2	39,4	39,4	52,7	59,8	59,8	80,9	80,9	80,9	151,4	196,8	196,8		
	-18	0,10	6,4	14,6	25,7	25,7	34,3	39,5	39,5	52,7	52,7	52,7	95,0	123,5	123,5		
	-29	0,07	4,1	9,4	16,3	16,3	21,8	25,5	25,5	33,4	33,4	33,4	58,0	75,4	75,4		
-40	0,03	2,1	4,6	7,8	7,8	10,4	12,5	12,5	16,0	16,0	16,0	20,8	20,8	20,8			
R450A	4,4	0,21	10,9	25,3	45,3	45,3	60,4	68,2	68,2	92,8	92,8	92,8	176,1	228,9	228,9		
	-6,7	0,14	7,0	16,2	28,5	28,5	38,0	43,6	43,6	58,3	58,3	58,3	106,4	138,3	138,3		
	-18	0,10	4,6	10,4	18,1	18,1	24,1	28,1	28,1	37,1	37,1	37,1	65,1	84,6	84,6		
	-29	0,07	2,9	6,5	11,1	11,1	14,8	17,6	17,6	22,8	22,8	22,8	38,4	49,9	49,9		
-40	0,03	1,4	3,1	5,2	5,2	6,9	8,4	8,4	10,6	10,6	10,6	13,7	13,7	13,7			
R452A	4,4	0,21	12,8	29,9	54,4	54,4	72,6	80,7	80,7	111,5	111,5	111,5	220,0	286,0	286,0		
	-6,7	0,14	8,4	19,4	34,8	34,8	46,5	52,4	52,4	71,4	71,4	71,4	135,5	176,1	176,1		
	-18	0,10	5,5	12,8	22,5	22,5	30,1	34,5	34,5	46,2	46,2	46,2	84,6	110,0	110,0		
	-29	0,07	3,6	8,2	14,2	14,2	18,9	22,0	22,0	29,1	29,1	29,1	51,2	66,6	66,6		
-40	0,03	1,8	4,0	6,7	6,7	9,0	10,7	10,7	13,8	13,8	13,8	17,9	17,9	17,9			
R513A	4,4	0,21	11,4	26,4	47,5	47,5	63,4	71,2	71,2	97,3	97,3	97,3	186,9	243,0	243,0		
	-6,7	0,14	7,4	17,0	30,0	30,0	40,1	45,8	45,8	61,6	61,6	61,6	113,7	147,8	147,8		
	-18	0,10	4,8	11,0	19,2	19,2	25,6	29,6	29,6	39,3	39,3	39,3	69,9	90,9	90,9		
	-29	0,07	3,1	6,9	11,9	11,9	15,9	18,7	18,7	24,4	24,4	24,4	41,7	54,2	54,2		
-40	0,03	1,5	3,3	5,5	5,5	7,4	8,9	8,9	11,4	11,4	11,4	14,8	14,8	14,8			
R1234ze	4,4	0,21	10,0	23,2	41,5	41,5	55,4	62,7	62,7	85,1	85,1	85,1	160,5	208,6	208,6		
	-6,7	0,14	6,4	14,8	25,9	25,9	34,6	39,8	39,8	53,2	53,2	53,2	96,4	125,3	125,3		
	-18	0,10	4,1	9,5	16,4	16,4	21,8	25,5	25,5	33,5	33,5	33,5	58,5	76,0	76,0		
	-29	0,07	2,6	5,9	10,0	10,0	13,3	15,8	15,8	20,4	20,4	20,4	34,2	44,5	44,5		
-40	0,03	1,2	2,8	4,6	4,6	6,1	7,5	7,5	9,4	9,4	9,4	12,2	12,2	12,2			
Correction factor x condensing temperature = T rif. 37,8 °C																	
Condensing temperature			20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C	55 °C	60 °C						
Correction factor			0,84	0,87	0,92	0,97	1,02	1,07	1,13	1,19	1,25						
Standard rating conditions according to AHRI Standard 760-2014																	
Condensing temperature			100 °F	(37,8 °C)	Evaporating temperature			40 °F	(4,4 °C)	Temperature entering filter			65 °F	(18,3 °C)			
Liquid temperature			90 °F	(32,3 °C)	Temperature leaving evaporator			50 °F	(9,9 °C)	Suction superheating			15 °R	(8,4 °K)			
Subcooling			10 °R	(5,5 °K)	Evaporator superheating			10 °R	(5,5 °K)	Discharge temperature			150 °F	(65,5 °C)			

**TABLE 39: DIMENSIONS AND WEIGHTS**

Catalogue Number	Connections		Dimensions [mm]					Weight [g]	
	ODS		Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>		P
	Ø [in.]	Ø [mm]							
SF411/5C	5/8"	16	128,5	157	152,5	239,5	185	93,0	5320
SF411/7C	7/8"	22			158,5	245,5		99,0	5420
SF411/M28C	–	28			163,5	250,5		104,0	5330
SF411/9C	1.1/8"	–			175,5	262,5		116,0	5600
SF411/11C	1.3/8"	35			165,5	252,5		106,0	5490
SF411/13C	1.5/8"	–			189,5	276,5		116,0	5560
SF411/M42C	–	42			106,0	5740			
SF411/17C	2.1/8"	54			130,0	5740			
SF411/21C	2.5/8"	–			130,0	6020			

**TABLE 40: DIMENSIONS AND WEIGHTS**

Catalogue Number	Connections		Dimensions [mm]					Weight [g]	
	ODS		Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>		P
	Ø [in.]	Ø [mm]							
4411/5C	5/8"	16	121	149	150	237	185	95	3780
4411/7C	7/8"	22							3810
4411/M28C	–	28							3850
4411/9C	1.1/8"	–			155	242		100	3950
4411/11C	1.3/8"	35						112	4000
4411/13C	1.5/8"	–						103	4140
4411/M42C	–	42			158	245		103	4140
4411/17C	2.1/8"	54						127	4500
4411/21C	2.5/8"	–						182	269

**TABLE 41: DIMENSIONS AND WEIGHTS**

Catalogue Number	Connections			Dimensions [mm]					Weight [g]	
	ODS		W Ø [mm]	Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>		P
	Ø [in.]	Ø [mm]								
4411/5CF	5/8"	16	21,3	121	149	150	237	185	95	3810
4411/7CF	7/8"	22	26,9							3860
4411/9CF	1.1/8"	–	33,7							3920
4411/11CF	1.3/8"	35	42,4			155	242		100	4050
4411/13CF	1.5/8"	–	48,3						112	4190
4411/M42CF	–	42	48,3						103	4150
4411/17CF	2.1/8"	54	60,3			152	239		95	4350
4411/21CF	2.5/8"	–	76,1						103	4540
4411/25CF	3.1/8"	80	88,9						172	259
4421/21C	2.5/8"	67	76,1	163	200	187	308	200	142	12450
4421/25C	3.1/8"	80	88,9			205	328		162	13100
4421/34C	4.1/4"	108	114,3			215	338		172	13100

**TABLE 42: GENERAL CHARACTERISTIC OF MECHANICAL BLOCK**

Catalogue Number	Filtering Surface		Dimensions [mm]			Weight [g]
	[sq.in]	[cm <sup>2</sup> ]	Ø D <sub>1</sub>	Ø D <sub>2</sub>	H	
4495/C	127	820	60	87	138	480
4496/C	287	1850	80	113	168	750



# REFRIGERATING SYSTEM PROTECTORS

## 7.6 – HERMETIC STRAINERS

### APPLICATIONS

The hermetic strainers in series 45 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.

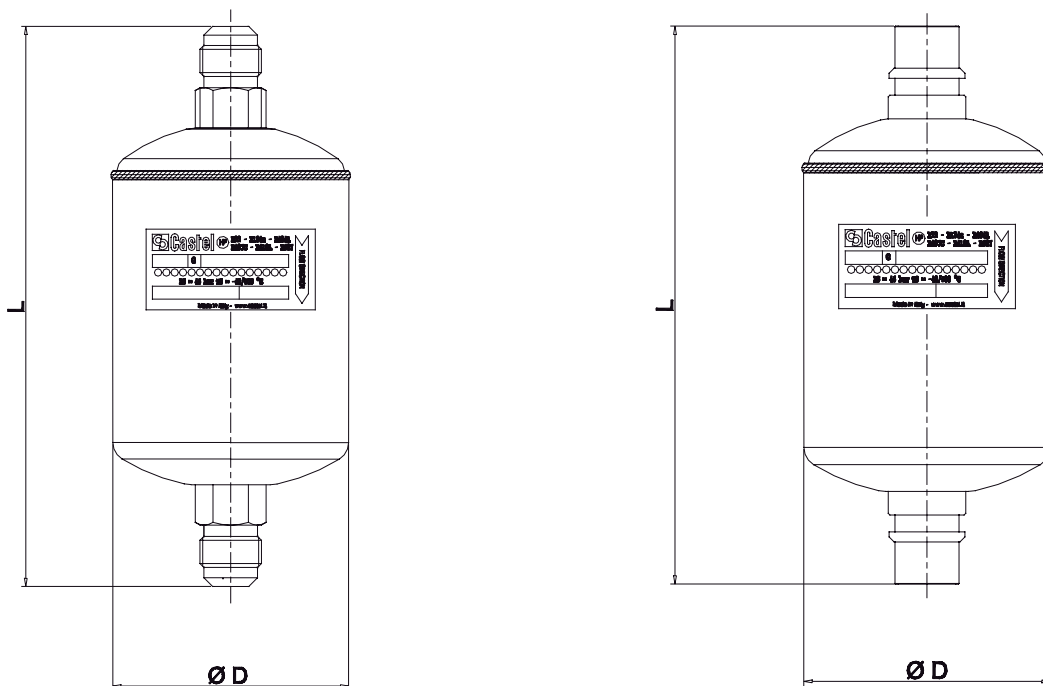
These strainers have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

The strainers is completely manufactured in steel, with threaded connections, SAE FLARE, in copper-plated steel. The product range also includes types 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.





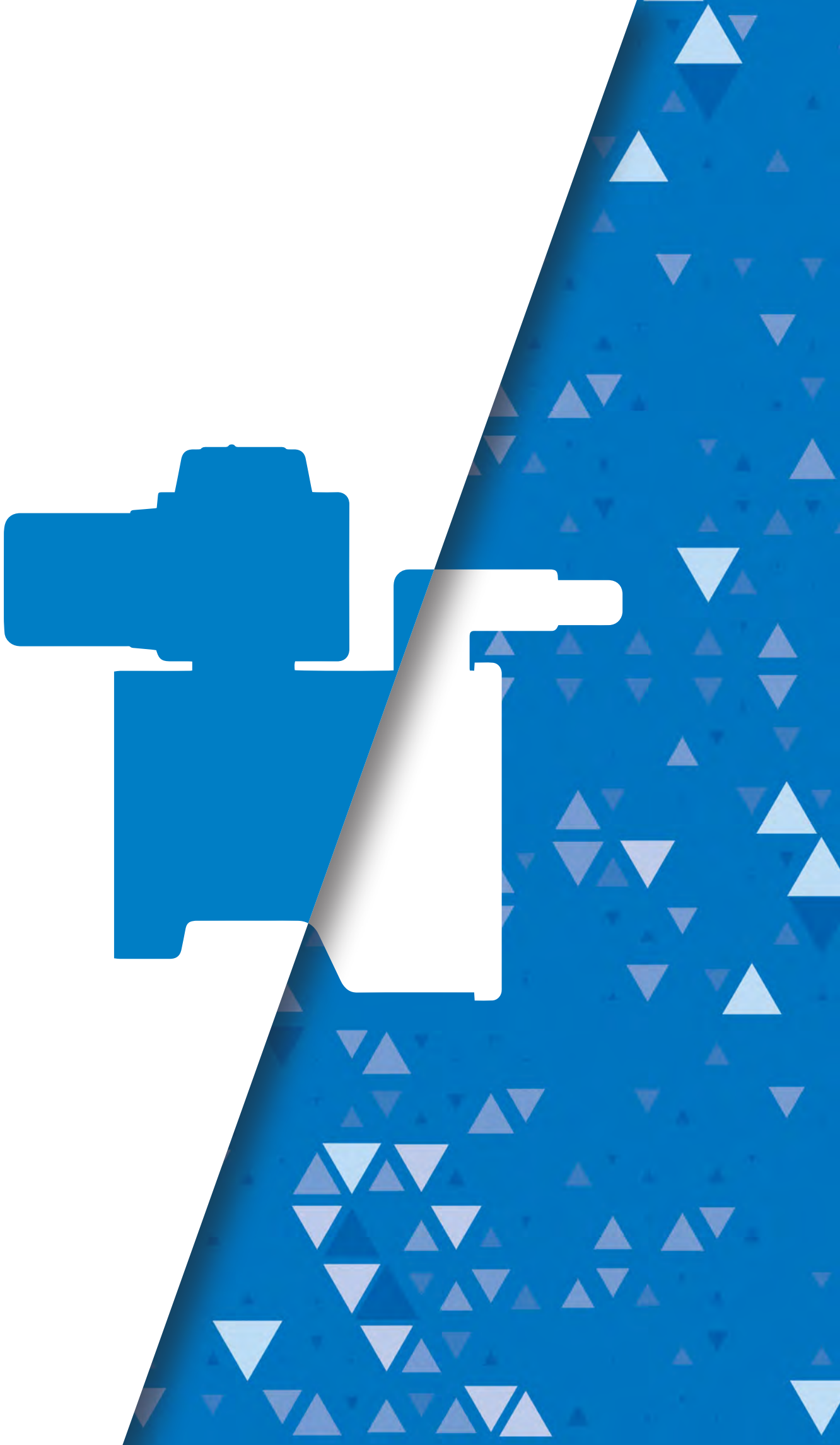
**TABLE 43: GENERAL CHARACTERISTICS OF STRAINERS**

Catalogue Number	Filtering Surface [cm <sup>2</sup> ]	Useful Passage Surface [%]	Mesh Opening [mm]	Connections					Kv Factor [m <sup>2</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
				SAE Flare	ODS		ODM				min.	max.	
					Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]					
4510/3	58	36,6	0,166	3/8"	–	–	–	–	2,4	45	–40	+80	Art. 4.3
4510/4	142			1/2"	–	–	–	–	3,2				
4520/2	58			–	1/4"	–	3/8"	–	2,4				
4520/3				–	3/8"	–	1/2"	–					
4520/M10				–	–	10	–	12					
4520/M12				–	–	12	–	14					
4520/4				–	1/2"	–	5/8"	16					
4520/5				–	5/8"	16	3/4"	–					
4520/M18				142	–	–	18	–	22				

**TABLE 44: DIMENSIONS AND WEIGHTS OF STRAINERS**

Catalogue Number	Dimensions [mm]		Weight [g]
	Ø D	L	
4510/3	52	110	195
4510/4	76	174	515
4520/2	52	109	195
4520/3			
4520/M10			
4520/M12		113	205
4520/4		122	215
4520/5		126	245
4520/M18		76	170







# OIL CONTROL SYSTEM

CLASSIC

# OIL CONTROL SYSTEMS

## OIL CONTROL SYSTEMS

A proper oil control system is essential to ensure compressor lubrication and energy efficient cooling. If accurately selected and installed, an oil control system protects the compressors both from low and high oil levels and avoids expensive replacements of compressors. An excessive amount of oil in a refrigerating system could lead to oil slugging to the compressor. This could damage the compressor as a liquid refrigerant slugging. Removing or reducing the amount of oil entering the discharge line increases the yield of the refrigeration plant.

Large quantities of oil in a refrigeration or air conditioning system reduce the efficiency of the system.

For instance:

- Oil coating on the condenser and evaporator walls reduces the heat transfer;
- Slugged oil volume displaces refrigerant fluid in the system mass flow. Since oil has no refrigerating power, it does not contribute to the system yield.

The products shown in this handbook can be used in two control systems:

- Single compressor system;
- Low pressure oil control system.

The single compressor system has a simple oil control system. The compressor discharge is piped to the inlet of the oil separator and the outlet of the oil separator is piped to the condenser. A check valve is normally fitted between the oil separator and the condenser. An oil return line is connected from the oil separator to the compressor crankcase through an oil strainer. When the oil level in the separator increases, a float valve opens and feeds to the crankcase a small amount of oil at the discharge pressure. When the oil level in the separator drops, the float valve closes avoiding the hot gas to by pass to the crankcase.

To ensure the proper operation of the separator and the oil supply to the crankcase, it's a good practise to install a liquid indicator between the separator and the crankcase.

The low-pressure oil control system is normally used for a parallel multi- compressor system. The common discharge header is piped to the inlet of the oil separator and the outlet of the oil separator is piped to the condenser. A check valve is generally fitted between the oil separator and condenser. An oil return line is connected from the oil separator to the top valve of the oil reservoir. A vent line connects the suction line to the oil reservoir by using a calibrated pressure relief valve in order to reduce the pressure in the reservoir. This calibrated pressure relief valve, mounted on the top header of the reservoir, keeps the reservoir at a set pressure (above the suction line). The valve housed at the bottom of the oil reservoir is piped to the electronic oil level regulator mounted on the compressor crankcases.

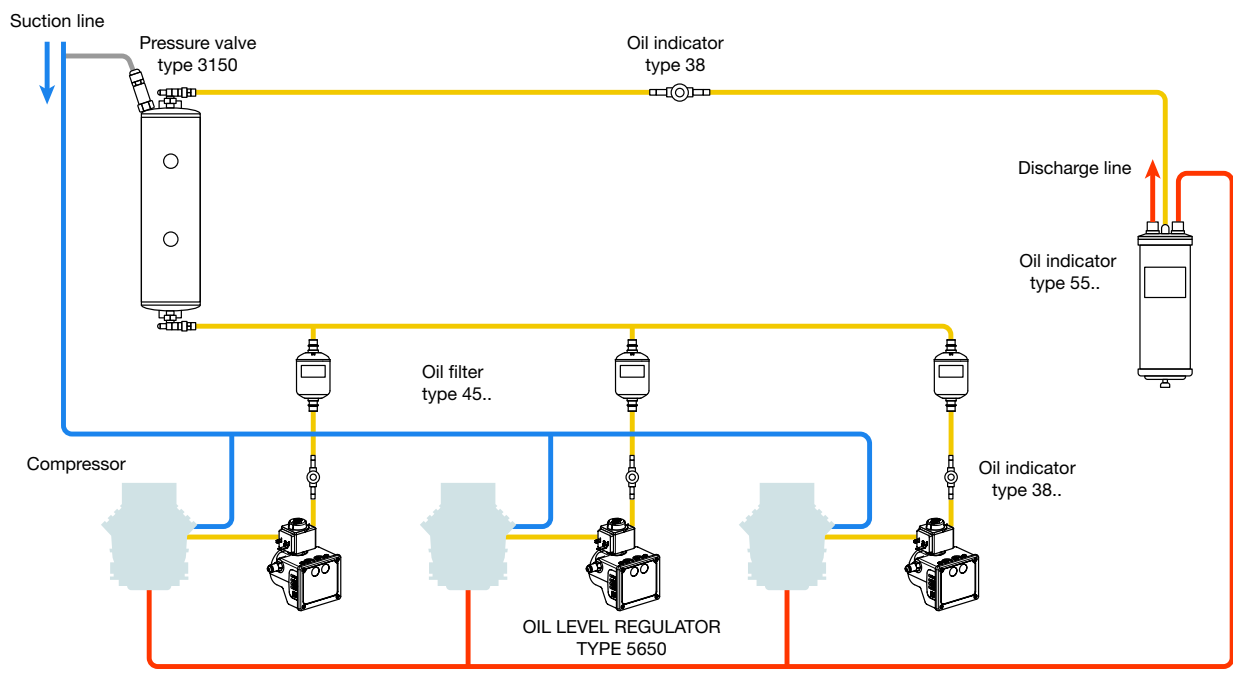
A strainer should be fitted upstream of each oil level regulator in order to remove oil impurities.

These regulators open to feed oil as the oil level drops and close as the oil level rises to the set level, by checking the oil level in the compressor crankcases.

It is recognized as best practice to fit:

- A liquid indicator between separator and reservoir to check the correct operation of the separator;
- A liquid indicator before each level regulator to check the oil feed to the regulator.





# OIL CONTROL SYSTEMS

## 8.1 – OIL SEPARATORS

### APPLICATIONS

The oil separators series 5520 and OS540 / 5540 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 oil separators have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

The advantages of the oil separator on the discharge line of a compressor in a refrigeration system are confirmed by many years of experience. The oil separator intercepts the oil mixed with compressed gas and returns it to the oil reservoir or to the compressor crankcase, ensuring efficient lubrication of its moving parts. Furthermore, by eliminating or reducing the oil film on the condenser and evaporator heat exchange surfaces, it maintains a high heat exchange coefficient in this equipment. When a very high temperature at the end of the compression stage leads to the formation of oil vapours, a separator with a capacity exceeding the values shown in the table should be used. Moreover, the oil separator, damping the pulsing from the valves, reduces the system noise in open or semi-hermetic compressors.

Finally, the use of an oil separator leads to:

- Longer compressor life;
- Better performance of the whole system with consequent energy savings;
- Quieter operation by reducing pulsing.

Tables 1 and 3 show the data relating to the operating conditions of oil separators.

### CONSTRUCTION

Castel manufactures two types of oil separators:

- Separators in series 5520 can be inspected for maintenance and can be removed from the system. They are equipped with threaded connections, which can mate to the connections type 5590 (to be ordered separately);
- Separators in series OS540 / 5540 are hermetically closed and cannot be disassembled from the system, except by cutting the piping.

The separator body is composed by a steel pipe of adequate thickness. The flanges and cover are also made of steel. Both the threaded connections of separators in series 5520 or the solder connections of separators in series OS540 / 5540 are machined from steel bar EN 10277-3 11S Mn Pb 37 + C. The internal device

is simple to ensure a trouble-free long-term operation.

Appropriate metal screens, placed on the inlet and outlet, along with the rapid reduction in gas speed create ideal conditions for separating the oil from the refrigerant.

A float mechanism, located on the bottom of the vessel, returns the oil to the compressor.

The bottom of the separator also includes a chamber for collecting any iron debris. A permanent magnet holds these impurities to avoid they clog or damage the operation of the float-controlled needle.

### HOW TO CHOOSE AN OIL SEPARATOR

An oil separator must be sized based on the characteristics of the compressor installed, once the following have been defined:

- Inlet connection corresponding to the discharge diameter of the compressor;
- Refrigerant fluid power for the established operating conditions (discharge saturation temperature, suction saturation temperature, any liquid subcooling, overheating of suction vapour).

This is necessary to define, for an end compression temperature assigned, the gas speed in reference to the gross section of the oil separator. It is advisable that the above-mentioned speed does not exceed 0.4 m/s, to avoid excessive turbulence.

Generally, once the refrigerating potential of the compressor has been assigned, based on the type of refrigerant and operating conditions, the volumetric flow rate,  $Q$ , of the compressed gas, is given by:

$$Q = \frac{P}{\Delta H} \cdot v_g \quad [\text{m}^3/\text{s}]$$

where:

- $P$  = refrigerant potential [kW];
- $\Delta H$  = enthalpy of superheated vapour, taken from the cycle diagram (Fig. 1) [kJ/kg];
- $v_g$  = specific volume of the compressed gas at the separator inlet (Fig. 1) [m<sup>3</sup>/kg].

Checking the gas speed, with reference to the cross section of oil separator, the following is obtained:

$$v = \frac{Q}{S} \quad [\text{m/s}]$$

with  $S$  = gross section of separator body [m<sup>2</sup>].



## INSTALLATION

The oil separators 5520 and OS540 / 5540 should be installed on the discharge line between the compressor and the condenser, mounted exclusively in a vertical position and as close to the compressor as possible.

To prevent the return of the refrigerant liquid from condenser to the oil separator, it's advisable to install a check valve between the condenser and oil separator during a shut-down period.

The oil separator performs best when operating at or near the compressor discharge temperature. If possible, avoid installation in locations that could cause the body of the separator to be cooled, causing condensation of the refrigerant. If this is not possible, it is advisable to equip the separator with appropriate solutions (insulation, strap heater, or other) to prevent the refrigerant in the system from condensing.

Before the oil separator is installed, be it a 5520 or a OS540 / 5540, add the amount of lubricant specified in the table as an initial oil charge. It is very important to carry out this oil pre-charge correctly for a good operation of the separator and to avoid damaging the float mechanism. Always use the same type of lubricant that is in the compressor crankcase.

Based on the layout of refrigerating system, connect the oil return line to one of the following positions:

- Directly to the compressor crankcase;
- To the suction line upstream of the compressor or upstream of the receiver, if present;
- To the oil reservoir if the system has a centralised oil control system and an oil distribution system to compressors.

It is recommended that a liquid indicator be installed in the oil return line, in order to check the correct working of the oil separator.

## CERTIFICATION

The American certification authority Underwriters Laboratories Inc. has approved the oil separators in series OS540 with file SA45832. These valves 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 600 PSI.

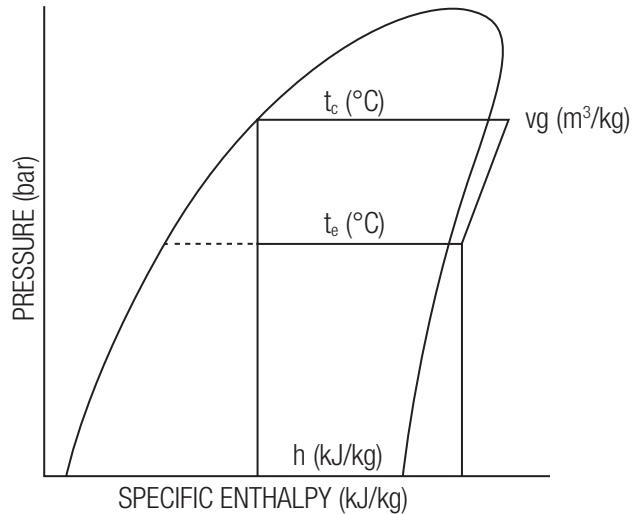


TABLE 1: GENERAL CHARACTERISTICS OF OIL SEPARATORS

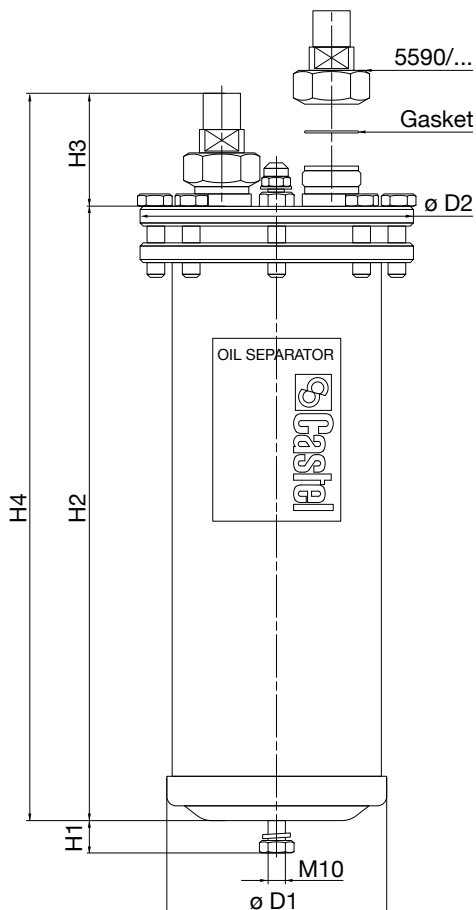
Catalogue Number	Solder Connections				Couple of solder connections IN / OUT			Oil connection [SAE Flare]	Oil addition [kg]	Max. differential pressure [bar]	PS [bar]	TS [°C]		Volume [l]	Risk Category according to PED Recast					
	ODS		ODM		Cat. Number	ODS (1)						ø [in.]	ø [mm]							
	ø [in.]	ø [mm]	ø [in.]	ø [mm]		ø [in.]	ø [mm]													
OS540/4R	1/2"	-	5/8"	16	-	-	-	1/4"	0,4 / 0,5	30	45	-10	+130	2,00	I					
OS540/4														2,40						
OS540/5	5/8"	16	3/4"	-										3,03						
OS540/6	3/4"	-	7/8"	-										3,52						
OS540/7	7/8"	-	1"	-										7,00		II				
OS540/9	1.1/8"	-	1.3/8"	35										2,95						
OS540/11	1.3/8"	35	1.5/8"	-				3,45												
5540/13	1.5/8"	-	-	-				3,45												
5540/M42	-	42	-	-				5590/5	5/8"	16	1/4"			0,4 / 0,5		30	45	-10	+130	I
5540/17	2.1/8"	54	-	-				5590/7	7/8"	-										
5520/C	-							5590/9	1.1/8"	-										
5520/D	-							5590/11	1.3/8"	35										
5520/E	-							5590/13	1.5/8"	-										
					5590/M42	-	42													

(1) : The dimensions of the separator's connections must agree with the discharge diameter of the compressor

TABLE 2: DIMENSIONS AND WEIGHTS OF OIL SEPARATORS

Catalogue Number		Solder Connections		Dimensions [mm]						Weight [g]											
Separator	Connections	ODS		Ø D <sub>1</sub>	Ø D <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	H <sub>4</sub>												
		Ø [in.]	Ø [mm]																		
OS540/4R	-	1/2"	-	123	-	-	-	-	250	3610											
OS540/4														280	3830						
OS540/5		5/8"	16												4560						
OS540/6		3/4"	-											367	4580						
OS540/7		7/8"	-												4580						
OS540/9		1.1/8"	-											428	5340						
OS540/11		1.3/8"	35												5340						
5540/13		1.5/8"	-						163,5	-	17,5	-	-	-	471	10000					
5540/M42		-	42																	481	10460
5540/17		2.1/8"	54																		
5520/C	5590/5	5/8"	16	121	149	-	-	-	336	61	397	6980									
	5590/7	7/8"	-																		
5520/D	5590/9	1.1/8"	-			391	-	-	67	458		7760									
	5590/11	1.3/8"	35																		
5520/E	5590/13	1.5/8"	-						92	483		7680									
	5590/M42	-	42																		

5520/C  
5520/D  
5520/E



OS540/4R  
OS540/4  
OS540/5  
OS540/7  
OS540/9  
OS540/11  
5540/13  
5540/4M42  
5540/17

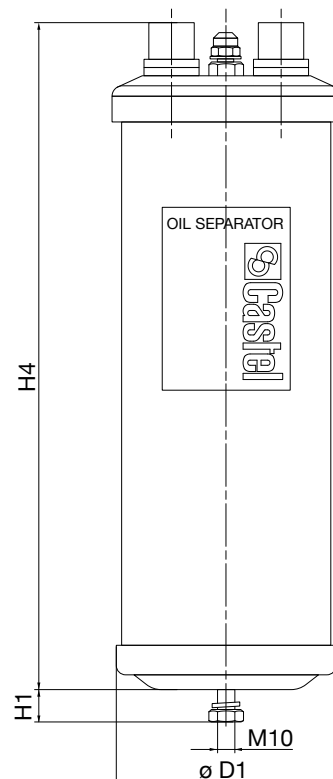


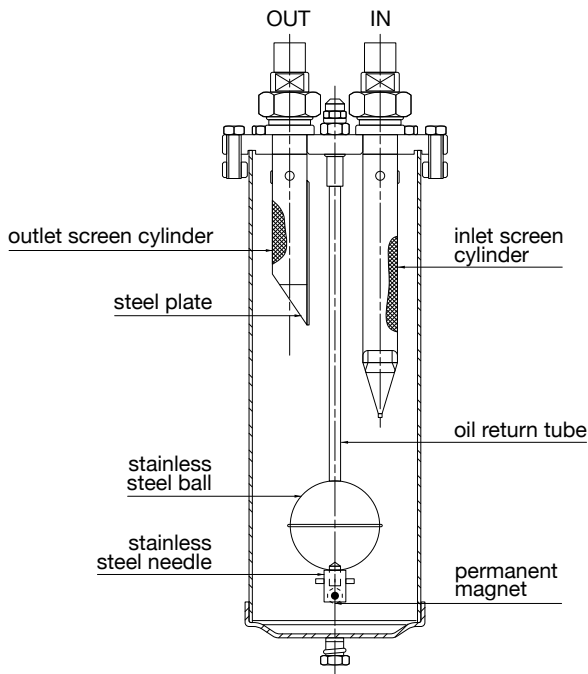
TABLE 3: REFRIGERANT FLOW CAPACITY [KW]

Catalogue Number	Catalogue Number of solder connections	R134a						R22									
		Condensing temperature [°C]						Condensing temperature [°C]									
		+40			+50			+40					+50				
		Evaporating temperature [°C]			Evaporating temperature [°C]			Evaporating temperature [°C]					Evaporating temperature [°C]				
		-20	-10	+5	-20	-10	+5	-40	-30	-20	-10	+5	-40	-30	-20	-10	+5
OS540/4R	-	5,4	5,7	6,3	6,2	6,7	7,3	6,0	6,5	7,0	7,5	8,2	6,7	7,3	7,9	8,5	9,3
OS540/4																	
OS540/5		10,7	11,5	12,6	12,4	13,3	14,7	12,0	13,0	13,9	14,9	16,4	13,4	14,6	15,8	16,9	18,6
OS540/6																	
OS540/7		13,4	14,4	15,7	15,5	16,6	18,4	15,0	16,2	17,4	18,6	20,5	16,8	18,2	19,7	21,2	23,3
OS540/9		16,1	17,2	18,8	18,6	20,0	22,0	18,0	19,5	20,9	22,4	14,6	20,2	21,9	23,7	25,4	28,0
OS540/11		18,8	20,1	22,0	21,7	23,3	15,7	21,0	22,7	24,4	26,1	28,7	23,5	25,5	27,6	29,6	32,6
5540/13		30,6	32,7	35,8	35,3	37,9	41,9	34,2	37,0	39,7	42,5	46,8	38,3	41,6	45,0	48,3	53,1
5540/M42																	
5540/17		38,3	40,9	44,8	44,1	47,4	52,4	42,8	46,2	49,6	53,1	58,5	47,9	52,0	56,2	60,4	66,4
5520/C	5590/5	10,7	11,5	12,6	12,4	13,3	14,7	12,0	13,0	13,9	14,9	16,4	13,4	14,6	15,8	16,9	18,6
	5590/7	13,4	14,4	15,7	15,5	16,6	18,4	15,0	16,2	17,4	18,6	20,5	16,8	18,2	19,7	21,2	23,3
5520/D	5590/9	16,1	17,2	18,8	18,6	20,0	22,0	18,0	19,5	20,9	22,4	14,6	20,2	21,9	23,7	25,4	28,0
	5590/11	18,8	20,1	22,0	21,7	23,3	15,7	21,0	22,7	24,4	26,1	28,7	23,5	25,5	27,6	29,6	32,6
5520/E	5590/13	21,5	23,0	25,1	24,7	26,6	29,4	24,0	25,9	27,9	29,8	32,8	26,9	29,2	31,5	33,9	37,3
	5590/M42																

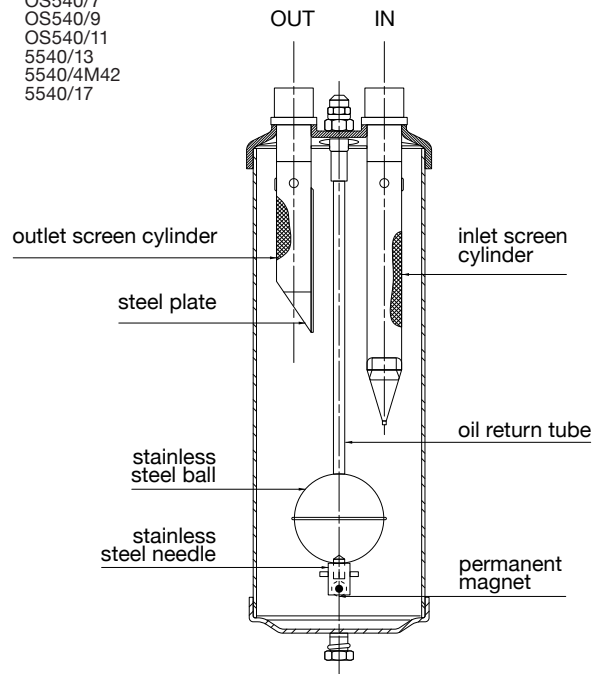
(1) : Refrigerant flow capacity with overheating values of vapour sucked by compressor of 10 °C. No liquid subcooling.  
Maximum pressure drop of 0,15 bar

R404A										R407C										R410A					
Condensing temperature [°C]										Condensing temperature [°C]										Condensing temperature [°C]					
+40					+50					+40					+50					+40			+50		
Evaporating temperature [°C]					Evaporating temperature [°C]					Evaporating temperature [°C]					Evaporating temperature [°C]					Evaporating temperature [°C]			Evaporating temperature [°C]		
-40	-30	-20	-10	+5	-40	-30	-20	-10	+5	-40	-30	-20	-10	+5	-40	-30	-20	-10	+5	-20	-10	+5	-20	-10	+5
6,6	7,2	7,9	8,5	9,4	6,8	7,6	8,3	9,1	10,2	7,0	7,6	8,2	8,8	9,7	7,6	8,4	9,1	9,8	10,9	10,1	10,9	12,0	11,0	11,8	13,2
13,2	14,5	15,8	17,1	18,8	13,6	15,1	16,7	18,2	20,4	14,0	15,2	16,4	17,6	19,4	15,3	16,7	18,2	19,6	21,8	20,2	21,7	23,9	22,0	23,6	26,4
16,5	18,1	19,7	21,3	23,5	17,0	18,9	20,8	22,8	25,5	17,5	19,0	20,5	22,0	24,3	19,1	20,9	22,7	24,5	27,3	25,3	27,1	29,9	27,5	29,5	32,9
19,8	21,7	23,7	25,6	28,2	20,3	22,7	25,0	27,3	30,6	21,0	22,8	24,6	26,4	29,1	22,9	25,1	27,3	29,4	32,7	30,3	32,6	35,9	33,0	35,4	39,5
23,1	25,3	27,6	29,9	32,9	23,7	26,5	29,1	31,9	35,7	24,4	26,6	28,7	30,8	34,0	26,7	29,3	31,8	34,3	38,2	35,4	38,0	41,9	38,5	41,3	46,1
37,6	41,2	45,0	48,6	53,6	38,7	43,1	47,5	52,0	58,2	39,8	43,4	46,8	50,2	55,3	43,5	47,7	51,8	55,9	62,2	-	-	-	-	-	-
47,0	51,5	56,3	60,8	67,0	48,3	53,9	59,4	65,0	72,7	49,8	54,2	58,5	62,7	69,1	54,4	59,7	64,8	69,9	77,7	-	-	-	-	-	-
13,2	14,5	15,8	17,1	18,8	13,6	15,1	16,7	18,2	20,4	14,0	15,2	16,4	17,6	19,4	15,3	16,7	18,2	19,6	21,8	20,2	21,7	23,9	22,0	23,6	26,4
16,5	18,1	19,7	21,3	23,5	17,0	18,9	20,8	22,8	25,5	17,5	19,0	20,5	22,0	24,3	19,1	20,9	22,7	24,5	27,3	25,3	27,1	29,9	27,5	29,5	32,9
19,8	21,7	23,7	25,6	28,2	20,3	22,7	25,0	27,3	30,6	21,0	22,8	24,6	26,4	29,1	22,9	25,1	27,3	29,4	32,7	30,3	32,6	35,9	33,0	35,4	39,5
23,1	25,3	27,6	29,9	32,9	23,7	26,5	29,1	31,9	35,7	24,4	26,6	28,7	30,8	34,0	26,7	29,3	31,8	34,3	38,2	35,4	38,0	41,9	38,5	41,3	46,1
26,4	28,9	31,6	34,1	37,6	27,1	30,3	33,3	36,5	40,8	27,9	30,4	32,8	35,2	38,8	30,5	33,5	36,4	39,2	43,6	40,4	43,4	47,9	4,0	47,2	52,7

5520/C  
5520/D  
5520/E



OS540/4R  
OS540/4  
OS540/5  
OS540/7  
OS540/9  
OS540/11  
5540/13  
5540/4M42  
5540/17





# OIL CONTROL SYSTEMS

## 8.2 – ELECTRONIC OIL LEVEL REGULATORS

### APPLICATIONS

The electronic oil level regulators series 5650 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

The oil regulators ensure monitoring and control of the oil level in the crankcases of both alternative reciprocating and scroll compressors. Specifically, these regulators are employed to resolve the problem of incorrect oil distribution in multiple compressor plants.

### CONSTRUCTION

The regulator 5650 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 5650/R with oil supply on the left side and sight glass on the right;
- Version 5650/L with the oil supply on the right side and the sight glass on the left.

On both sides of the regulator two membranes, related to four LED indicator lights, show the operation condition of the regulator. The regulator aluminium body, thanks to its geometry, is able to minimize refrigerant emulsion and foaming phenomena, so, during the oil injection phase, the correct level detection is always guaranteed.

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 series 5650 checks 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 series 5650 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 5650 cannot be directly coupled (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; the first flange is fixed and the second is mobile;
- 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; the first flange is fixed and the second is mobile;
- 5690/X17: adapter, with mobile flange and 1.1/4" – 12 UNF swivel threaded end (rotalock).

During installation of the electronic regulator series 5650, 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 and 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 filter series 45 or 47 should be installed.

After the installation of the electronic regulator series 5650, 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).

TABLE 4: GENERAL CHARACTERISTICS OF ELECTRONIC OIL LEVEL REGULATORS

Part number	Version	Connections		Cable 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								
5650/RA2	Right	5690/X11 5690/X12 5690/X13 5690/X14 5690/X15 5690/X17	3/8"	9901/X26	2	30	50	-30	+130	990	Art. 4.3
5650/RA6											
5650/LA2	Left										
5650/LA6											

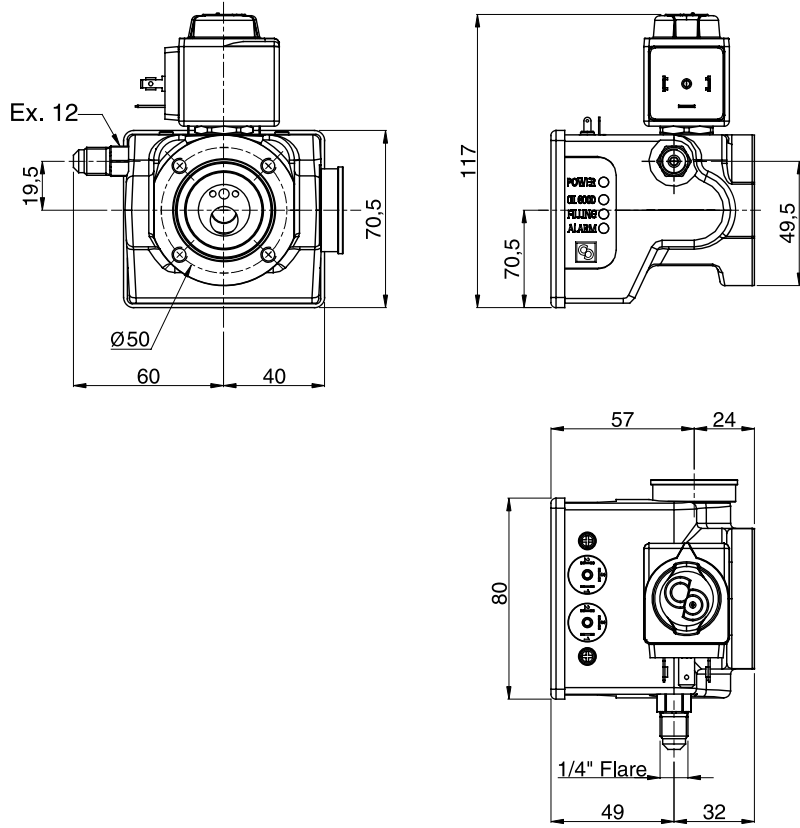
Note: (1) To be ordered separately

TABLE 5: 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			
5650/RA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527	IP 65	3A	250 V
5650/RA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			
5650/LA2	24 A.C.	+10 / -10	50 / 60	9300/RA2	H	8	920	527			
5650/LA6	220 A.C.	+10 / -10	50 / 60	9300/RA6	H	8	120	68			

Note: (1) To be ordered separately

5650/R



5650/R

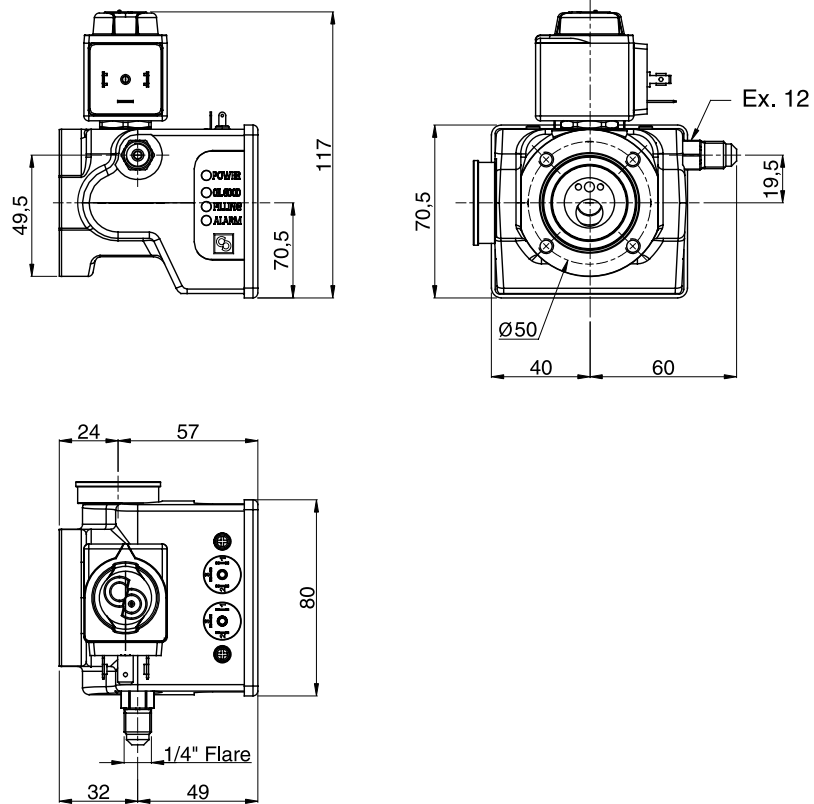


TABLE 6: CABLES KIT CHARACTERISTICS

Part number	Use		Degree of protection	Cable length [m]
9901/X26	A	Power supply cable	IP 67	3
	B	Coil cable		
	C	Alarms cable		

9901/X26

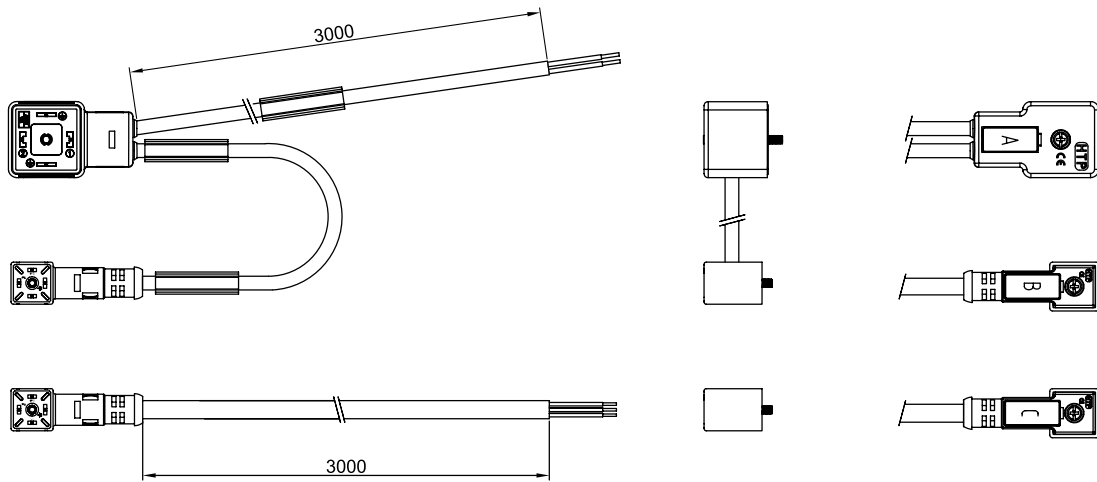
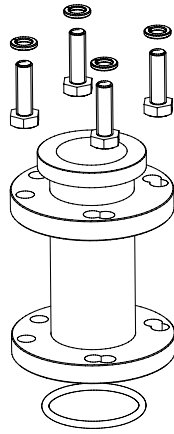


TABLE 7: ADAPTERS CHARACTERISTICS

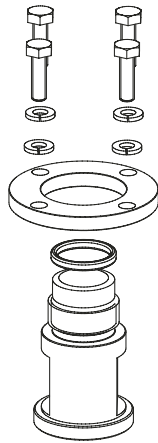
Catalogue Number	Connections	PS [bar]	TS [°C]		weight [g]
			min	max	
5690/X11	Flanged with: 3 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 83 mm"	50	-30	+130	506
5690/X12	Threaded 1-1,8" - 12 UNF				254
5690/X13	Threaded 1 - 1,8" - 18 UNEF				346
5690/X14	Threaded 3/4"- 14 NPT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

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.

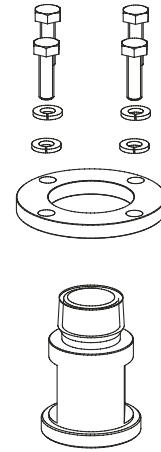
5690/X11



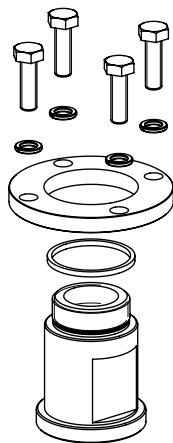
5690/X12



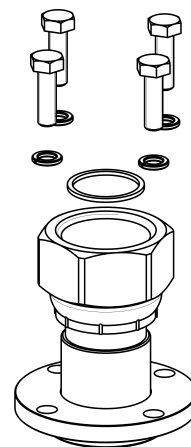
5690/X14



5690/X13



5690/X17



# OIL CONTROL SYSTEMS

## 8.3 – 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### CONSTRUCTION

Castel manufactures four 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/X01  
3150W/X02  
3150W/X03

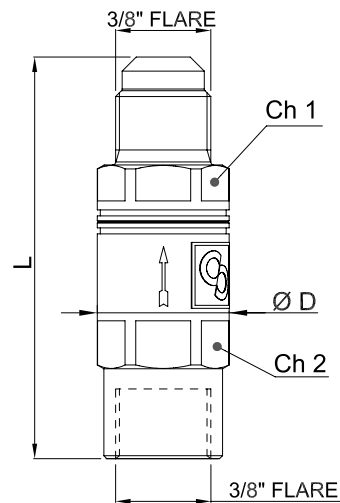


TABLE 8: GENERAL CHARACTERISTICS OF OIL RESERVOIR PRESSURE VALVES

Catalogue Number	SAE Flare Connections		Kv Factor [m <sup>3</sup> /h]	Pressure Differential [bar]	PS [bar]	TS [°C]		Dimensions and weights					Risk Category according to PED Recast
	IN	OUT				min.	max.	D	L	Ch <sub>1</sub>	Ch <sub>2</sub>	[g]	
3150W/X01	3/8"- F	3/8"- M	1,6	0,35	50	- 40	+150	22	67	20	20	152	Art. 4.3
3150W/X02				1,4	80								
3150W/X03				3									





# OIL CONTROL SYSTEMS

## 8.4 – OIL INDICATORS

### APPLICATIONS

The oil 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.

The indicators in series 3810, 3840 provide control of the regular return of oil to the compressor crankcase.

These indicators have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### CONSTRUCTION

Indicators series 3810, 3840 are manufactured in a total hermetic construction to avoid any possible oil leak. The glass “lens”, with suitable gasket, is housed inside the brass body and is fixed in its seat with a reflagging 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.

### INSTALLATION

The brazing of indicators with solder connections in series 3810, 3840 should be carried out with care, using a low melting point filler material. 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.

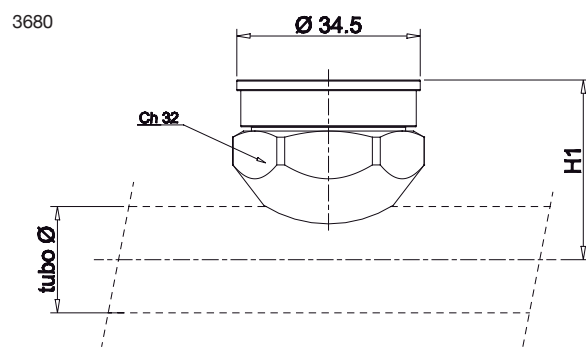
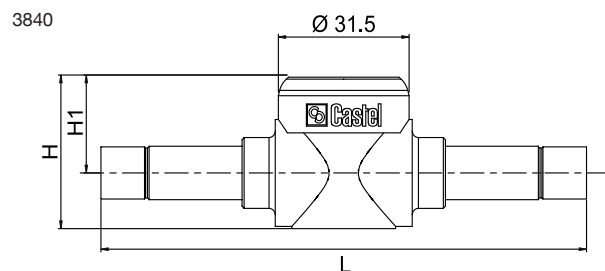
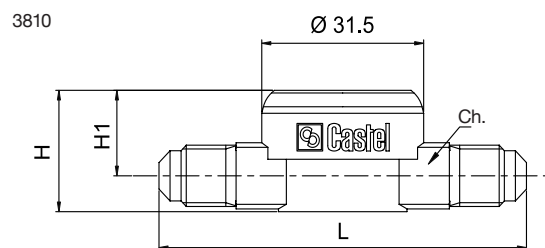




TABLE 9: GENERAL CHARACTERISTICS OF LIQUID INDICATORS

Catalogue Number	Type	Connections					PS [bar]	TS [°C]		Risk Category according to PED Recast
		SAE Flare	ODS		for pipe			min.	max.	
			Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
3810/22	male male	1/4"	–	–	–	–	50	–40	+120	Art. 4.3
3810/33		3/8"	–	–						
3810/44		1/2"	–	–						
3840/2	brazing	–	1/4"	–	–	–	50	–40	+120	Art. 4.3
3840/3		–	3/8"	–						
3840/M10		–	–	10						
3840/M12		–	–	12						
3840/4		–	1/2"	–						

TABLE 10: DIMENSIONS AND WEIGHTS

Catalogue Number	Dimensions [mm]				Weight [g]
	H	H <sub>i</sub>	L	Ch (Pipe DIA)	
3810/22	22	16,5	71,5	12	110
3810/33	26,5	17,5	77,5	17	150
3810/44	30	18,5	81,5	22	196
3840/2	22	15,5	113	–	116
3840/3	34	21,5	117		185
3840/M10					
3840/M12					
3840/4					

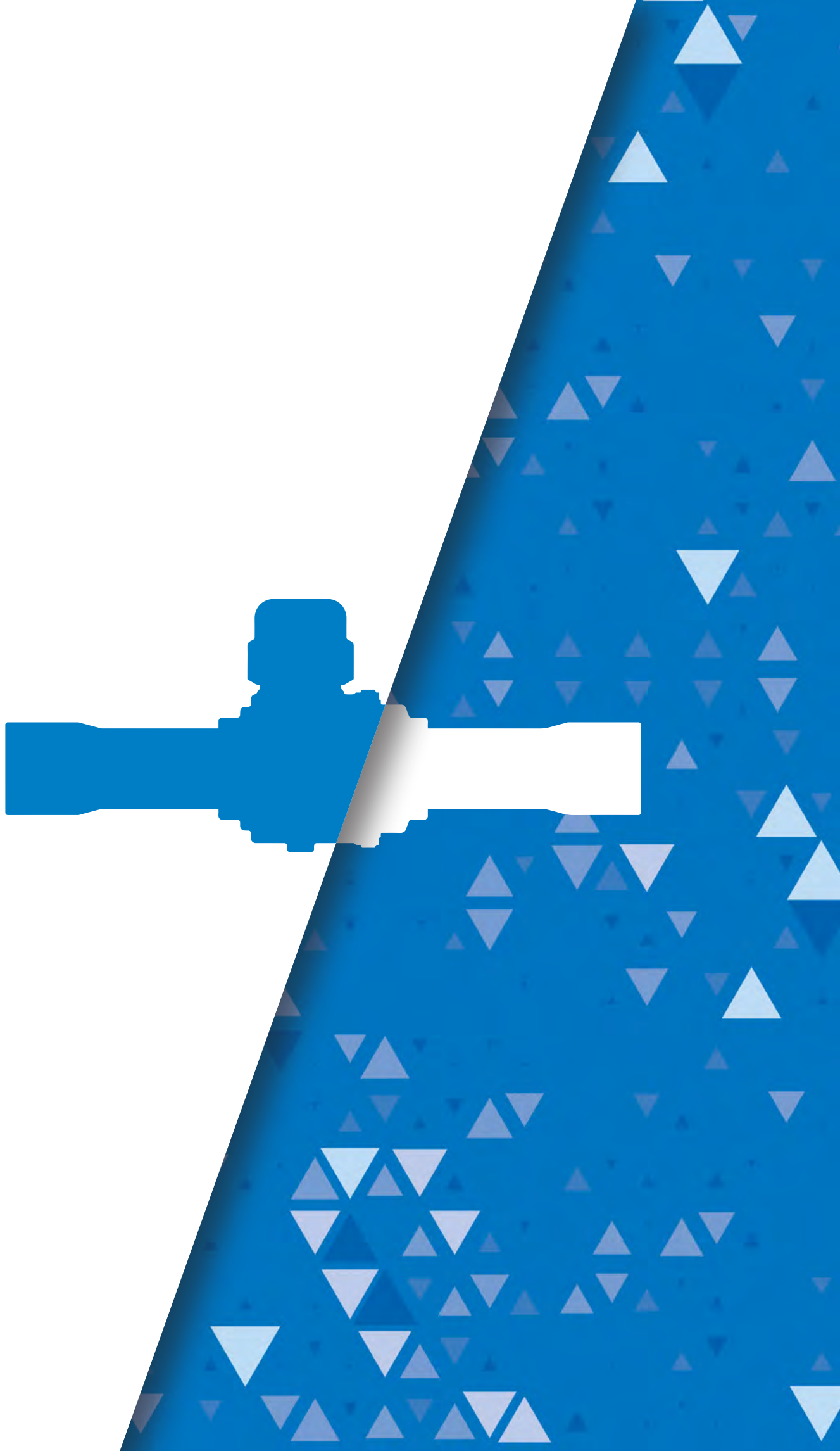
# OIL CONTROL SYSTEMS

## 8.5 – STRAINERS

*See Chapter 7 - Paragraphs 7.8 and 7.9*

## 8.6 – NORMALLY CLOSER SOLENOID VALVES

*See Chapter 2 - Paragraphs 2.2*







# VALVES

CLASSIC



# 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 those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### HERMETIC VALVES

The hermetic valves can be divided into two categories:

- Two-way shut-off valves, types 6010/2 and 6012/22;
- Three -way shut-off valves, types 6020, two main connections plus a third one for charging;
- Three-way valves; two main connections plus a third one for charging, types:
  - 6062, with right charge connection;
  - 6072, with left charge connection.

Note: the third way must be equipped with a mechanism (for example type 8394/A or other similar ones) to be ordered separately.

The main parts of the hermetic 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;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Glass-reinforced PBT for the protective cap that covers the spindle.

TABLE 1: GENERAL CHARACTERISTICS OF VALVES FOR HERMETIC SYSTEMS

Catalogue Number	Acces fitting	Connections			Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast	
	SAE Flare	SAE Flare		ODS			min.	max.		
				Ø [mm]						Ø [in.]
6010/2	-	1/4"	1/4"	-	0,27	45	-40	+130	Art. 4.3	
6012/22		1/4"	-	1/4"						
6020/222	1/4"	1/4"	1/4"	-	0,39	-40	+110			
6020/233		3/8"	3/8"		1,20					
6020/244		1/2"	1/2"		2,20					
6020/255		5/8"	5/8"		2,80					
6062/22M6		1/4"	-		-			6		0,46
6062/23M10		3/8"						10		1,38
6072/22M6		1/4"						6		0,46
6072/23M8		3/8"						8		1,29
6072/23M10		3/8"						10		1,38
6072/24M12		1/2"						12		2,55
6072/25M16	5/8"	16		3,40						

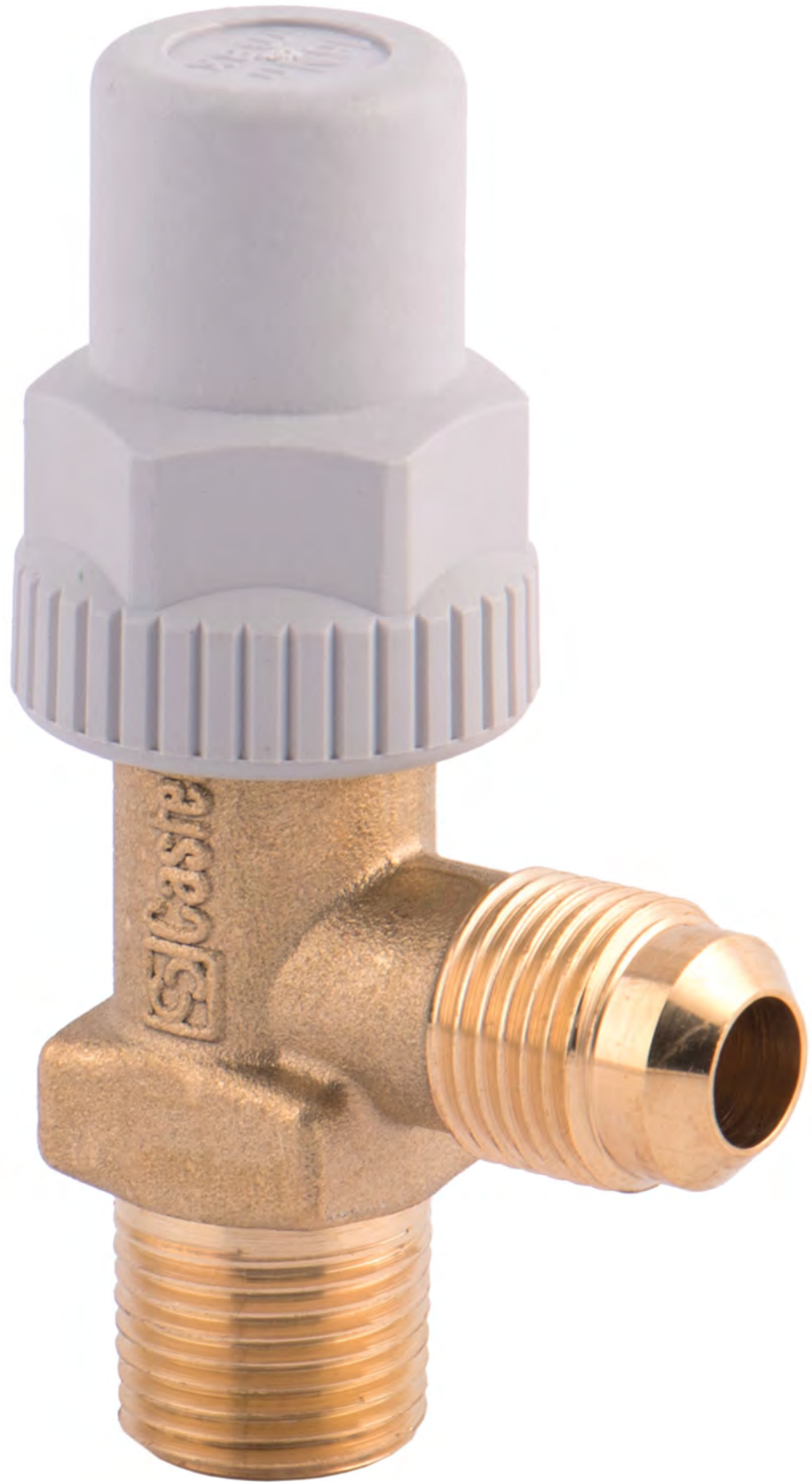
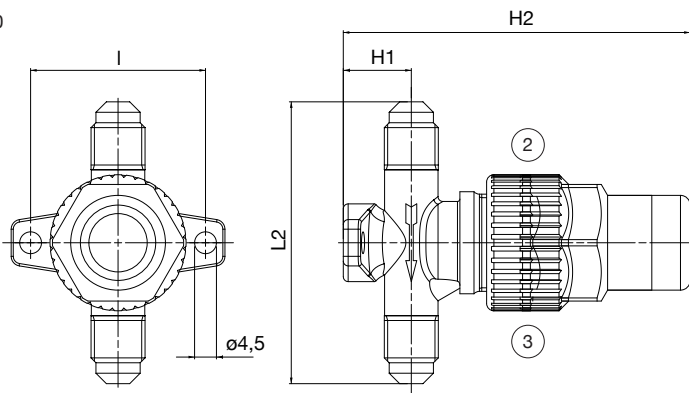


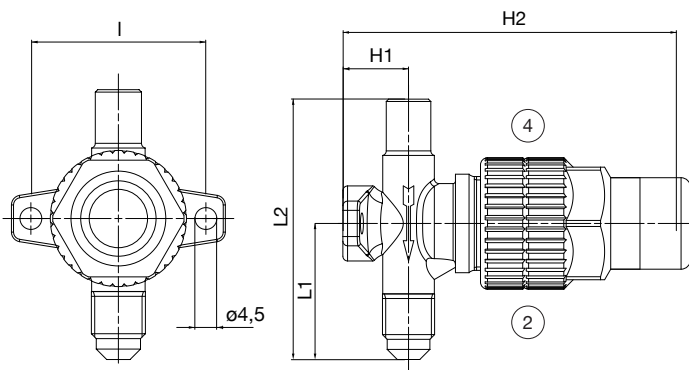
TABLE 2: DIMENSIONS AND WEIGHTS OF VALVES FOR HERMETIC SYSTEMS

Catalogue Number	Dimensions [mm]									Weight [g]	
	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	H <sub>4</sub>	H <sub>5</sub>	l	L <sub>1</sub>	L <sub>2</sub>	P <sub>1</sub>		
6010/2	14	66	-	-	-	36	-	58	-	-	160
6012/22			29	55,5			145				
6020/222	25	51	61	115	-	-	62	-	-	-	360
6020/233			60				67				370
6020/244			67,5				77				520
6020/255	26,5	52	67,5	127	-	-	79	-	-	-	530
6062/22M6	25,5	31	31	56,5	-	1	-	25	72	30,5	205
6062/23M10			33	58,5							200
6072/22M6			31	56,5							205
6072/23M8			33	58,5							210
6072/23M10			33	58,5							220
6072/24M12	29,5	38,5	68	-	-	-	-	-	-	-	310
6072/25M16			39,5								69

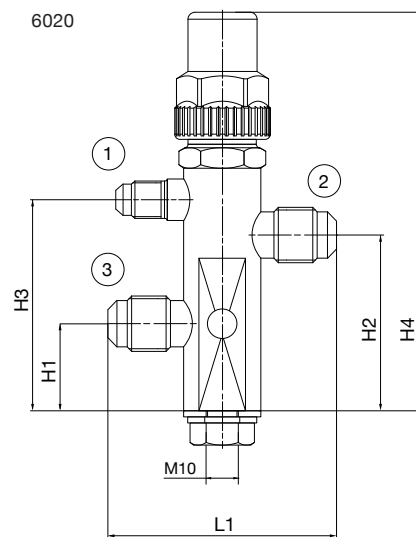
6010



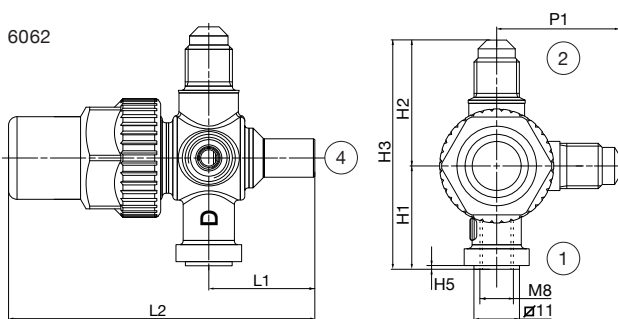
6012



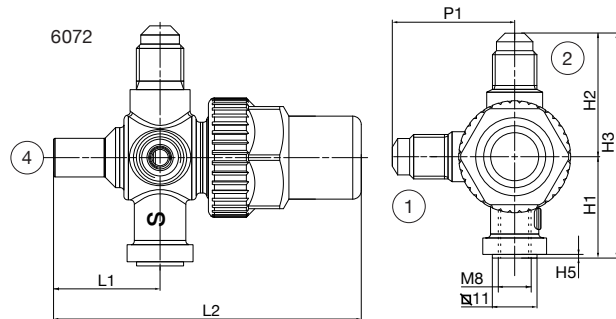
6020



6062



6072



## RECEIVER VALVES

The receiver valves can be divided into three categories:

- Two-way valves, 90° angle connections, types 6110 and 6120;
- Three-way valves; two main connections (90° angle) plus a third one for charging, type 6132. The access connection may be shut off by the back-sealing of the spindle;
- Two-way valves, 120° angle connections, type 6140.

The main parts of the receiver 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;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Glass-reinforced PBT for the protective cap that covers the spindle.

TABLE 3: GENERAL CHARACTERISTICS OF RECEIVER VALVES

Catalogue Number	Access fitting		Connections		Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	SAE Flare	NPT	min.			max.		
6110/21	-		1/4"	1/8"	0,44	45	-40	+130	Art. 4.3
6110/22			1/4"	1/4"					
6110/X11			-	1/4" x 1/4" F					
6110/X15			1/4" x 1/4" F	-					
6110/X21 (1)			1/4"	3/8"	0,45				
6110/23			3/8"	1/4"	1,35				
6110/32			3/8"	3/8"					
6110/33			3/8" x 3/8" F	-					
6110/X13			1/2"	3/8"	2,40				
6110/43			1/2"	1/2"	3,40				
6110/44			5/8"	1/2"					
6110/54			3/4"	3/4"	6,00				
6120/22			1/4"	1/4"	0,44				
6120/23			1/4"	3/8"	0,45				
6120/32			3/8"	1/4"	1,35				
6120/33			3/8"	3/8"	1,35				
6120/43			1/2"	3/8"	2,40				
6120/44			1/2"	1/2"	3,40				
6120/54	5/8"	1/2"							
6120/66	3/4"	3/4"	6,00						
6132/22	1/4"	1/4"	1/4"	0,45			+110		
6132/33		3/8"	3/8"	1,20					
6132/44		1/2"	1/2"	2,20					
6132/54		5/8"	1/2"	3,85					
6140/22	-	1/4"	1/4"	0,36			+130		
6140/23		1/4"	3/8"						

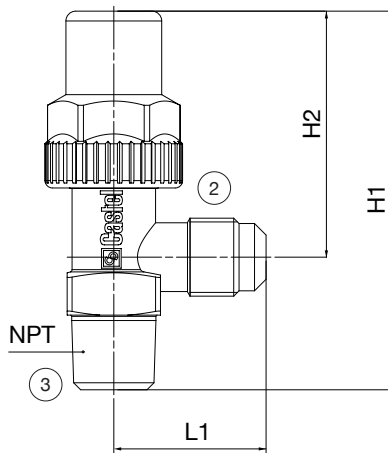
(1) can be used without copper gasket

TABLE 4: DIMENSIONS AND WEIGHTS OF RECEIVER VALVES

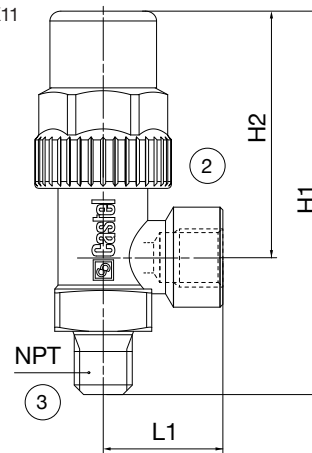
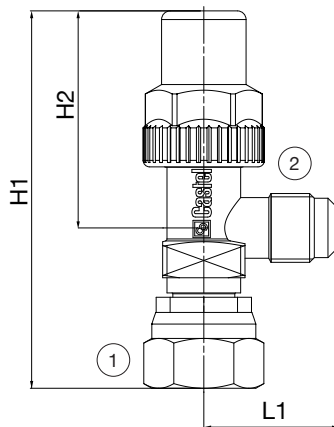
Catalogue Number	Dimensions [mm]				Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	
6110/21	70,5	48	27,5		100
6110/22	72				110
6110/X15	83				130
6110/X21					
6110/X11	88	55,5	28,5		230
6110/23	77	50	31	-	135
6110/32					130
6110/33					140
6110/X13					175
6110/43	88	55,5	34,5		220
6110/44	92				235
6110/54					245
6110/66	128	88	42,5		675
6120/22	27,5	-	72	48	110

Catalogue Number	Dimensions [mm]				Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	
6120/23	30		77	50	130
6120/32			80		135
6120/33			80	140	
6120/43				93	55,5
6120/44	33		94		305
6120/54	40		129,5	88	245
6120/66					670
6132/22	56	29	94	64	240
6132/33			97	250	
6132/44	65,5	36	112	75	350
6132/54			115		365
6140/22	57	-	69	46	115
6140/23					125

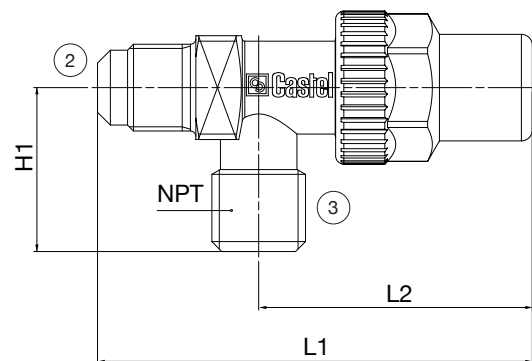
6110



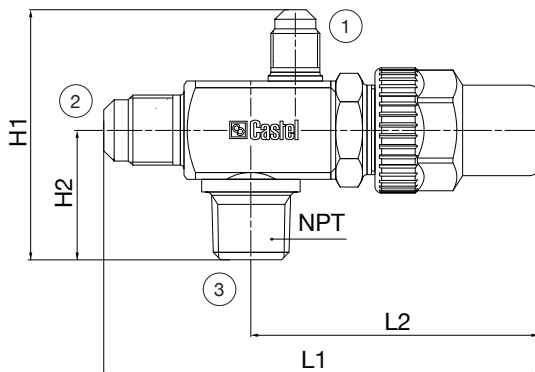
6110/X11

6110/X13  
6110/X15  
6110/X21

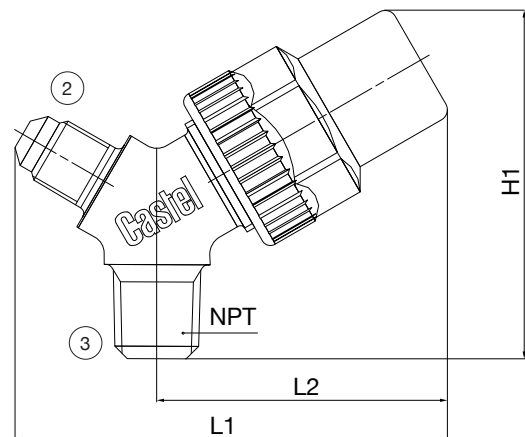
6120



6132



6140



## STOP VALVES

Stop valves have a very compact design and a fixing flange that is dimensioned to meet the current market requirements.

Valves 6170 and 6175 must be completed with the following components, which must be ordered separately:

- Internal spring mechanism, part no. 8394/B or external spring mechanism, part nos. 8395/A1;
- Cap with gasket code 8392/A or 1/4" SAE FLARE blind union part no. 7020/20.

Valves 6176 have been specifically designed to be installed on air conditioning systems that use R410A refrigerant fluid. They must be completed with the following components, to be ordered separately:

- External spring mechanisms, part no. 8395/A1 and 8395/A3;
- 5/16" SAE FLARE blind union, part no. 7020/X02.

The main parts of the stop valves are made with the following materials:

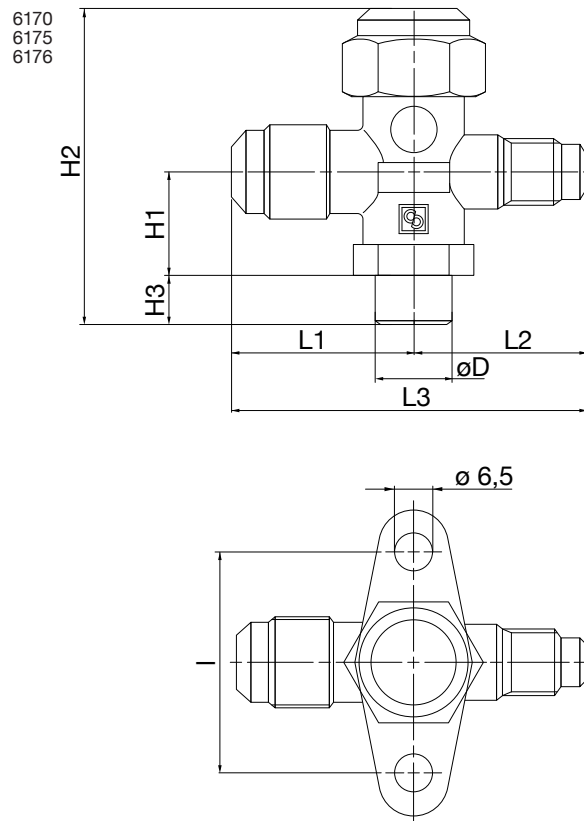
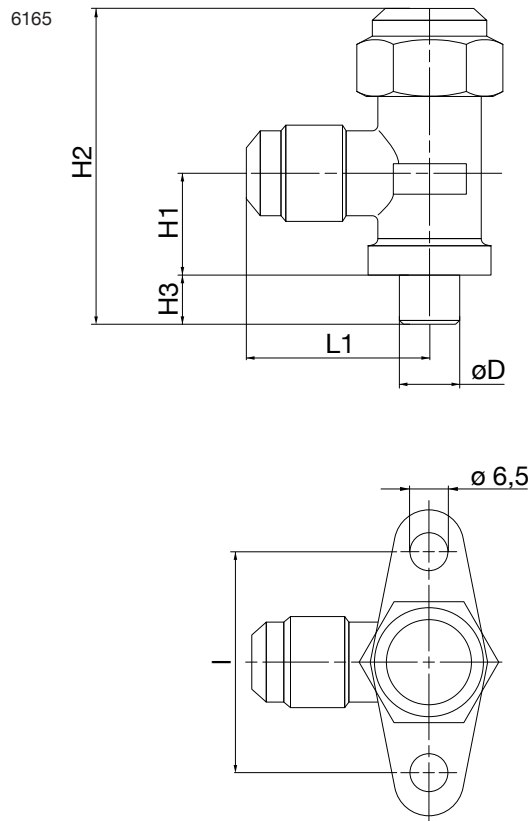
- Hot forged brass EN 12420 – CW 617N for the body;
- Brass EN 12164 – CW 614N for spindle and protection cap;
- Chloroprene rubber (CR) for outlet seal gaskets for series 6165, 6175 and 6176;
- Chloroprene rubber (CR) and aramid fibres for gland seal, only for series 6170.

TABLE 5: GENERAL CHARACTERISTICS OF VALVES FOR SPLIT SYSTEMS

Catalogue Number	Access fitting		Connections		Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast	
	SAE Flare	SAE Flare	ODS				min.	max.		
			Ø [mm]	Ø [in.]						
6165/22	-	1/4"	1/4"	-	0,68	45	-20	+110	Art. 4.3	
6165/33		3/8"	3/8"		1,70					
6175/33		3/8"	3/8"		1,70					
6175/44		1/2"	1/2"		3,40					
6175/55		5/8"	5/8"		16					4,60
6170/66		3/4"	3/4"		-					9,00
6170/77		7/8"	7/8"							10,80
6176/44	5/16"	1/2"	1/2"	16	3,40					
6176/55		5/8"	5/8"		4,60					
6176/66		3/4"	3/4"		7,50					

TABLE 6: DIMENSIONS AND WEIGHTS OF VALVES FOR SPLIT SYSTEMS

Catalogue Number	Dimensions [mm]								Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	D	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	l	
6165/22	17	52	8	9,5	29	-	-	38	113
6165/33				12,7	30,5				120
6175/33				29	59,5				135
6175/44	20	65	8	15,9	36	31	67	38	225
6175/55				19,0					235
6170/66	28,5	104	12	22,2	47	36	83	50	655
6170/77				28,6					670
6176/44	20	65	8	15,9	36	31	67	38	225
6176/55				19,0					235
6176/66				24					70



## DIAPHRAGM VALVES

Diaphragm valves do not have a gland seal. Thin metal discs (diaphragms), which hermetically isolate the spindle chamber from the fluid flow area, ensure the external sealing.

The main parts of the diaphragm valves are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body;
- Brass EN 12164 – CW 614N for spindle;
- Harmonic steel for spring;
- Nylon for seat sealing gaskets.

TABLE 7: GENERAL CHARACTERISTICS OF DIAPHRAGM VALVES

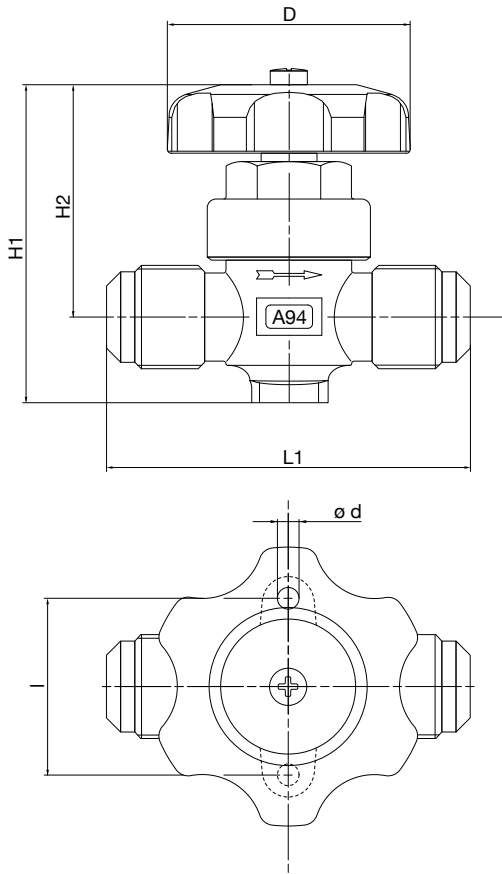
Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	ODS				min.	max.	
		Ø [in.]	Ø [mm]					
6210/2	1/4"	-	-	0,28	28	-35	+90	Art. 4.3
6210/3	3/8"			1,00				
6210/4	1/2"			1,30				
6210/5	5/8"			1,80				
6210/6	3/4"			3,65				
6220/M6	-	-	6	0,28				
6220/2	1/4"	-	-	1,00				
6220/3	3/8"	-	-					
6220/M10	-	-	10	1,30				
6220/4	1/2"	-	-	1,80				
6220/5	5/8"	-	16	3,65				
6220/6	3/4"	-	-					
6220/7	7/8"	-	-					

TABLE 8: DIMENSIONS AND WEIGHTS OF DIAPHRAGM VALVES

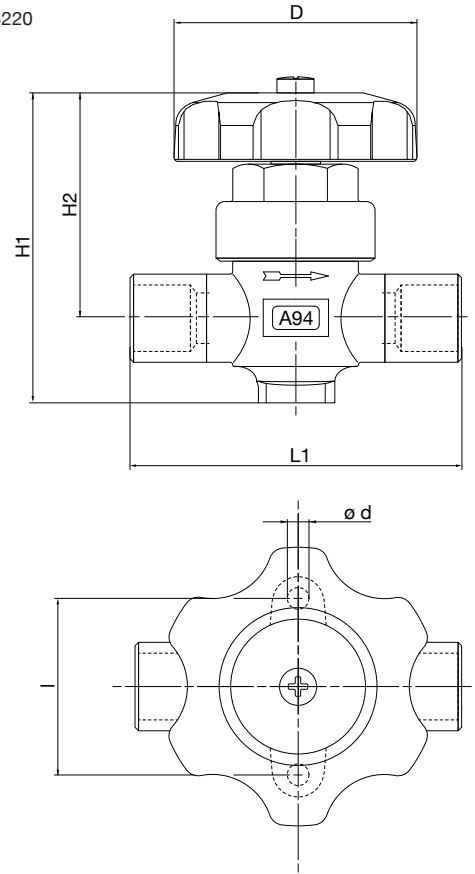
Catalogue Number	Dimensions [mm]						Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	d	l	D	
6210/2	68	53,5	58	4,5	36	52	200
6210/3	72		74		38		325
6210/4			78		340		
6210/5	86	62,5	98	6,2	50	60	655
6220/M6	68	53,5	53	4,5	36	52	195
6220/2	72		61		38		300
6220/3			70				305
6220/M10			71				
6220/4	92		6,2		50		60
6220/5	86	62,5	94		645		



6210



6220



## ROTALOCK VALVES

Rotalock valves mounted with 7910 fittings and 7990 gaskets, guarantee quick installation and safe sealing. They can be assembled in any direction before tightening the ring. Furthermore, they have an additional charging connection, which can be excluded by the back sealing of the spindle.

Fittings 7910 and gaskets 7990 must be ordered separately.

The main parts of the rotalock valves and their accessories are

made with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body;
- Steel, with proper surface protection, for the spindle and ring;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Glass-reinforced PBT for the protective cap that covers the spindle;
- Steel bar EN 10277-3 11S Mn Pb 37 + C for 7910 fittings;
- PTFE for 7990 gaskets.

TABLE 9: GENERAL CHARACTERISTICS OF ROTALOCK VALVES

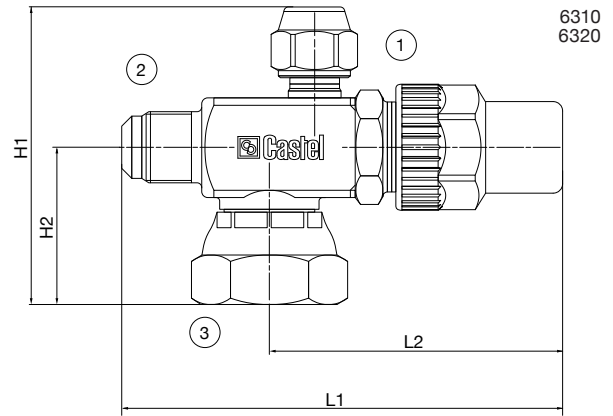
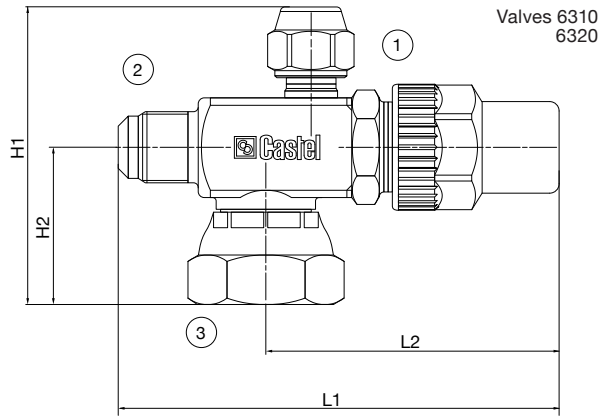
Catalogue Number	Access fitting	Connections		Union code	Gasket code	PS [bar]	Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	SAE Flare	Swivel nut						min.	max.	
6310/2	1/4"	1/4"	3/4" UNF	7910/6	7990/6	45	0,46	45	-40	+110	Art. 4.3
6310/3		3/8"									
6310/4		1/2"									
6320/3		3/8"	1" UNS	7910/8	7990/8		1,40				
6320/4		1/2"					3,10				
6320/5		5/8"					3,4				
6320/6	3/4"										

TABLE 10: DIMENSIONS AND WEIGHTS OF ROTALOCK VALVES

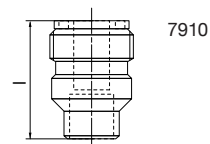
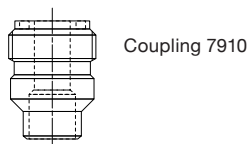
Catalogue Number	Dimensions [mm]				Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	
6310/2	68,5	33,5	94	64	290
6310/3			97		300
6310/4					330
6320/3	69,5	34,5	114,5	77,5	400
6320/4	72	36,5	117,5		415
6320/5					425
6320/6					

TABLE 11: DIMENSIONS AND WEIGHTS OF UNIONS

Catalogue number	Connections		L	Weight [g]	Gasket code	
	Threaded	Solder [mm]				
		ODF				ODM
7910/6	3/4" UNF	10	13	26	28	7990/6
7910/8	1" UNS	-	19		47	7990/8



 Gasket 7990



## CAPPED VALVES

The main parts of the capped 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;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Glass-reinforced PBT for the protective cap that covers the spindle.

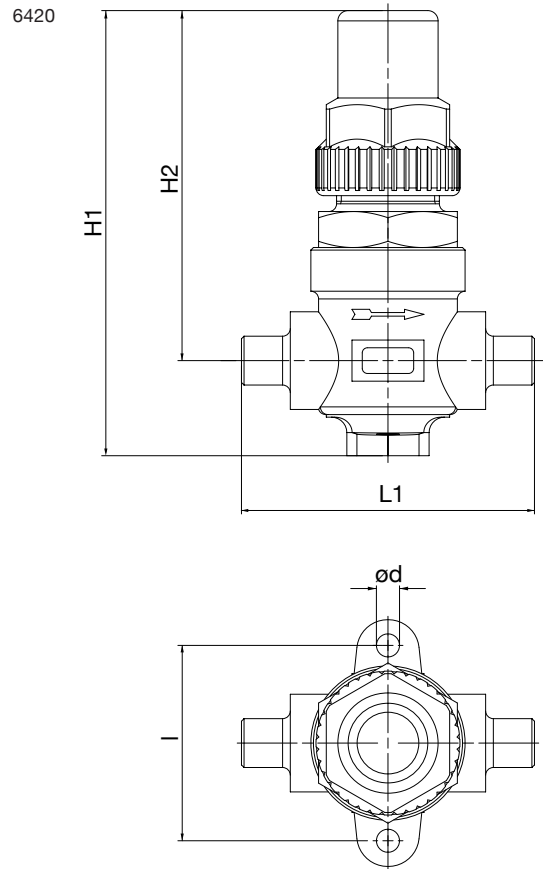
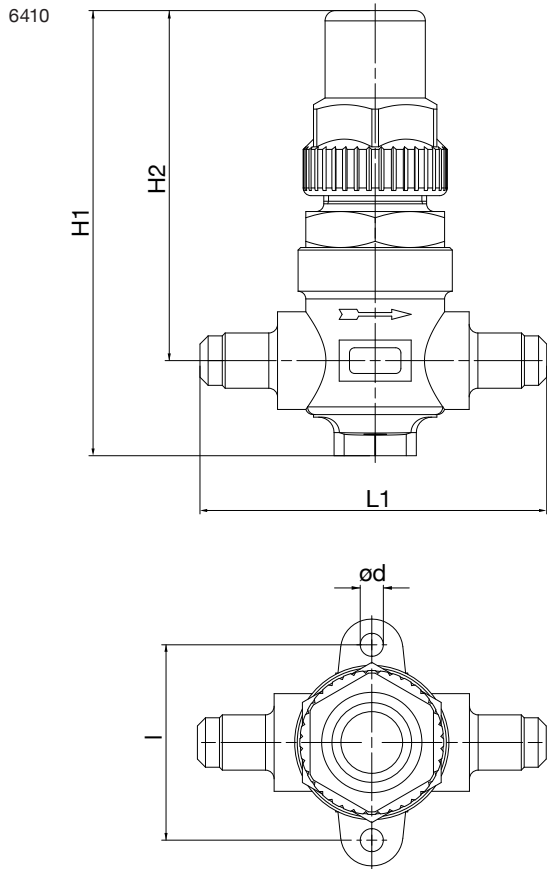
The brazing of capped valves with solder connections, type 6420, should be carried out with care, using a low melting point filler material. It is necessary to remove the spindle assembly, including the packing gland before brazing the body. It is important to avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning of the valves.

TABLE 12: 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			min.	max.		
		Ø [in.]						Ø [mm]
6410/2	1/4"	-	0,40	45	-40	+110	Art. 4.3	
6410/3	3/8"		1,00					
6410/4	1/2"		1,45					
6410/5	5/8"		1,70					
6410/6	3/4"		3,50					
6420/2	-		1/4"					0,40
6420/3	-	3/8"	1,00					
6420/3S3	3/8" - OUT	3/8" - IN						
6420/M10	-	-	10					
6420/M12		-	12					1,45
6420/4		1/2"	-					
6420/5		5/8"	16					1,70
6420/M18		-	18	3,50				
6420/6		3/4"	-					
6420/M22		-	22					
6420/7		7/8"	-					

TABLE 13: DIMENSIONS AND WEIGHTS OF CAPPED VALVES

Catalogue Number	Dimensions [mm]					Weight [g]
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	d	l	
6410/2	85,5	67	68	4,5	38	305
6410/3			74			325
6410/4			78			330
6410/5						
6410/6	113	89,5	98	6,2	50	695
6420/2	85,5	67	57	4,5	38	300
6420/3			61			305
6420/3S3			67,5			
6420/M10			61			
6420/M12			70			
6420/4			71			
6420/5						
6420/M18	113	89,5	92	6,2	50	700
6420/6			94			685
6420/M22						690
6420/7						



## GLOBE VALVES

These valves are available in the following two types:

- 6512 with straight solder connections;
- 6532 with right-angle solder connections.

The main parts of the globe valves are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for body, cover and cap

that covers the spindle;

- Steel, with proper surface protection, for the spindle;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Metal-rubber laminate for outlet seal gaskets;
- PTFE for seat gaskets.

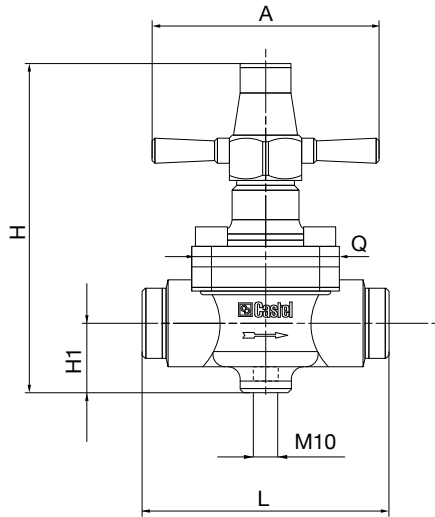
TABLE 14: GENERAL CHARACTERISTICS OF GLOBE VALVES

Catalogue Number	Connections				Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS		ODM				min.	max.	
	Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]					
6512/M22	–	22	–	28	7,1	45	-35	+160	Art. 4.3
6512/7	7/8"	–	1.1/8"	–					
6512/M28	–	28	1.3/8"	35	8,4				
6512/9	1.1/8"	–	1.3/8"	35					
6512/11	1.3/8"	35	1.5/8"	–	15,0				
6512/13	1.5/8"	–	2"	–	25,0				
6512/M42	–	42	2"	–					
6512/17	2.1/8"	54	–	–	40,0				I
6532/M22	–	22	–	28	8,2				
6532/7	7/8"	–	1.1/8"	–					
6532/M28	–	28	1.3/8"	35	9,1				Art. 4.3
6532/9	1.1/8"	–	1.3/8"	35					
6532/11	1.3/8"	35	1.5/8"	–	18,7				
6532/13	1.5/8"	–	2"	–	38,0				
6532/M42	–	42	2"	–					
6532/17	2.1/8"	54	–	–	48,5				

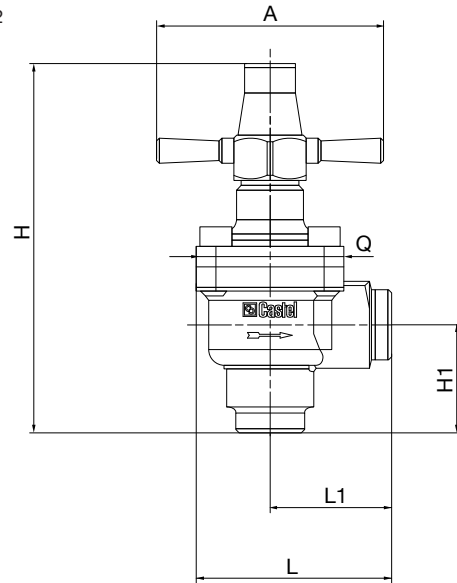
TABLE 15: DIMENSIONS AND WEIGHTS OF GLOBE VALVES

Catalogue Number	Dimensions [mm]						Weight [g]						
	H	H <sub>1</sub>	L	L <sub>1</sub>	Q	A							
6512/M22	136	28,5	100	–	60	94	1415						
6512/7													
6512/M28							1310						
6512/9													
6512/11							166	34	118	68	126	2020	
6512/13							199	37	141	88	138	3500	
6512/M42													
6512/17	215	42,5	173	104	5050								
6532/M22	147	44,5	80	50	60	94	1350						
6532/7													
6532/M28							1290						
6532/9													
6532/11							165	52,5	93	59	68	126	1910
6532/13							238	65	139	86,5	104	138	4920
6532/M42													
6532/17	4765												

6512



6532



## GAUGE MOUNTING VALVES

The valves are equipped with:

- A small flange for fixing the tap to the control panel;
- A threaded SAE Flare connection for joining it to the copper pipe with a union;
- A threaded NPT (type 8320) or a swivel union SAE Flare (8321) connection for mounting the gauge.

The main parts of the gauge mounting 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;
- Chloroprene rubber (CR) and aramid fibres for gland seal;
- Glass-reinforced PBT for the protective cap that covers the spindle.

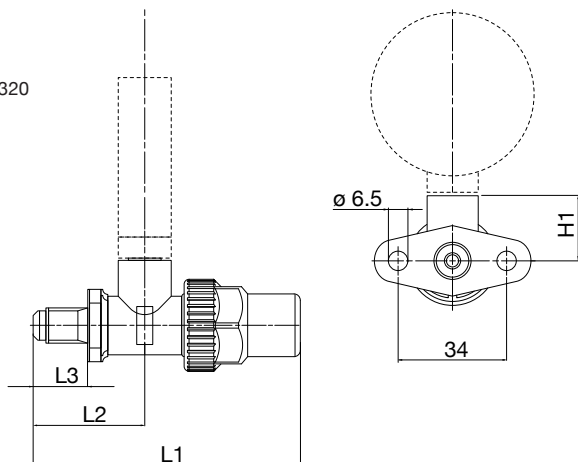
TABLE 16: GENERAL CHARACTERISTICS OF GAUGE MOUNTING VALVES

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	SAE Flare	NPT	SAE Flare			min.	max.	
8320/21	1/4"	1/8"	–	0,44	45	-40	+130	Art. 4.3
8320/22	1/4"	1/4"	–					
8321/22	1/4"	–	1/4" f					

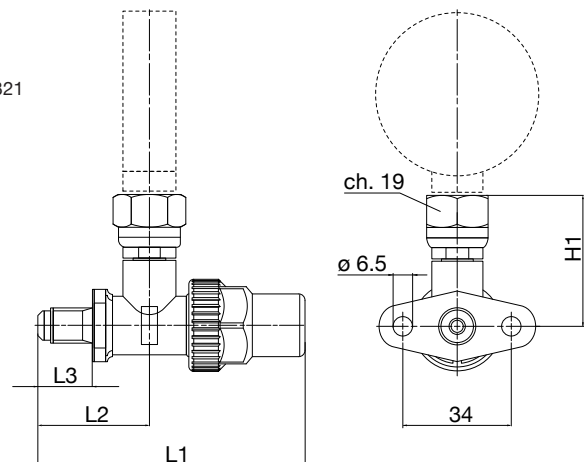
TABLE 17: DIMENSIONS AND WEIGHT OF GAUGE MOUNTING VALVES

Catalogue Number	Dimensions [mm]				Weight [g]
	H <sub>1</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	
8320/21	19	83	35	17	140
8320/22	37				186
8321/22	40				

8320



8321



## LINE PIERCING VALVE

The piercing valve is a fast, economic means of providing a charging, purging or gauge inlet point in the refrigeration system. It can be applied on copper pipes with a 6 mm to 10 mm diameter, and can be installed in any position on the system.

The main parts of the piercing valve are made with the following materials:

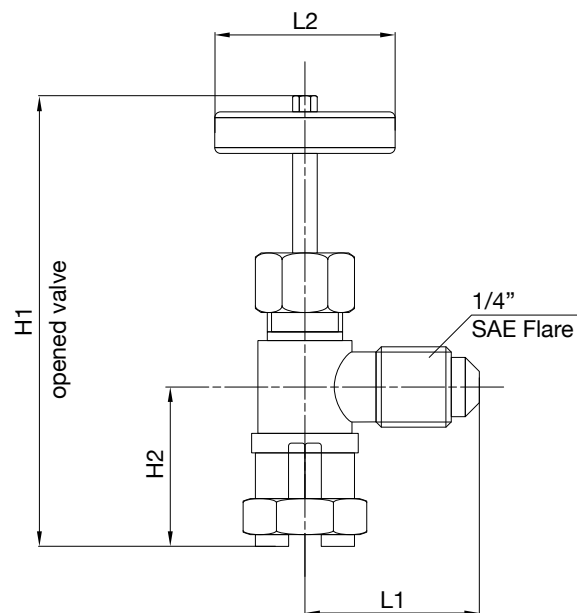
- Hot forged brass EN 12420 – CW 617N for the body;

- Hardened steel for the needle;
- Chloroprene rubber (CR) for the outlet seal gaskets.

Install the threaded fork astride of the copper pipe, fix the valve to the pipe, tightening the lower nut. Then, as the needle advances, it pierces the pipe. The hole connects the inside of the pipe with the 1/4" SAE Flare connection of the valve as shown in Figures 1 and 2.

TABLE 18: GENERAL CHARACTERISTICS AND DIMENSIONS OF LINE PIERCING VALVE

Catalogue Number	Connections		PS [bar]	TS [°C]		Dimensions [mm]				Weight [g]	Risk Category according to PED Recast
	SAE Flare	Pipe Diameter [mm]		min.	max.	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>		
8330/A	1/4"	6 - 10	25	-10	+70	72	25,5	29	36	104	Art. 4.3



## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved valves with screw shutter in series: 6010, 6012, 6110, 6120, 6410, 6420 with file SA33319.

These valves are certified **UL-CSA Recognized** 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 650 PSI.





# VALVES

## 9.2 – TWO-WAYS VALVES WITH BALL SHUTTER

### APPLICATIONS

The 2-ways valves with ball shutter in series 6570, 6571 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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.

These valves are available in the following two series:

- 6570/xx (full port) and 6571/xx (reduced port) without access fitting;
- 6570/xxA (full port) and 6571/xxA (reduced port) with access fitting.

The valves are equipped with mechanism 8395/A1 and cap 8392/A.

The main parts 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 solder connections;
- Steel, with proper surface protection, for the spindle;
- Chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for the ball seat gaskets.

### INSTALLATION

The valves with ball shutter can be installed in all sections of a refrigerating system, in compliance with the limits and capacities indicated in Tables 21, 22 and 23. Tables 19 and 20 shows the following functional characteristics of a valve with ball shutter.

- PS;
- TS;
- Kv factor.

Brazing of the valves with ball shutter 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.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved valves with ball shutter in series: 6570, 6571 with file SA33319.

These valves are certified UL-CSA Recognized 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:

- 600 PSI for valves in series 6570;
- 435 PSI for valves in series 6571;
- 362 PSI for valves in series 6571/M64.



TABLE 19: GENERAL CHARACTERISTICS OF FULL BORE BALL VALVES

Catalogue Number		Connections		Ball Port Ø [mm]	Kv Factor [m³/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
Without access fitting	With access fitting	ODS					min.	max.	
		Ø [in.]	Ø [mm]						
6570/M6	6570/M6A	–	6	10	0,8	45	-40	+150	Art. 4.3
6570/2	6570/2A	1/4"	–						
6570/3	6570/3A	3/8"	–						
6570/M10	6570/M10A	–	10		3				
6570/M12	6570/M12A	–	12		5				
6570/4	6570/4A	1/2"	–	15	17				
6570/M15	6570/M15A	–	15						
6570/5	6570/5A	5/8"	16						
6570/M18	6570/M18A	–	18						
6570/6	6570/6A	3/4"	–						
6570/7	6570/7A	7/8"	22	19	29				
6570/M28	6570/M28A	–	28	25	51				
6570/9	6570/9A	1.1/8"	–						
6590/11	6590/11A	1.3/8"	35	32	86				
6590/13	6590/13A	1.5/8"	–	38	117				
6590/M42	6590/M42A	–	42						
6590/17	6590/17A	2.1/8"	54	50	214				
6570/M64	6570/M64A	–	64	60	380				
–	6570/21A	2.5/8"	–						
	6570/24A	3"	76	73	550				
	6570/25A	3.1/8"	80						
	6570/28A	3.1/2"	89	82	710				
	6570/29A	3.5/8"	92						

TABLE 20: GENERAL CHARACTERISTICS OF REDUCED BORE BALL VALVES

Catalogue Number		Connections		Ball Port Ø [mm]	Kv Factor [m³/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast	
Without access fitting	With access fitting	ODS					min.	max.		
		Ø [in.]	Ø [mm]							
6571/5	–	5/8"	16	10	5	45	-40	+150	Art. 4.3	
6571/7		7/8"	22	15	17					
6571/M28		–	28	19	29					
6571/9		1.1/8"	–							
6571/11		1.3/8"	35	25	51					
6571/13		1.5/8"	–	32	86					
6571/M42		–	42							
6571/17		2.1/8"	54	38	117					
6571/M64		6571/M64A	–	64	50					214
6571/21		6571/21A	2.5/8"	–						
–	6571/24A	3"	76	60	380					
	6571/25A	3.1/8"	80							
	6571/28A	3.1/2"	89	73	550					
	6571/29A	3.5/8"	92							
	6571/33A	4.1/8"	105	82	660					
6571/34A	4.1/4"	108								

TABLE 21: REFRIGERANT FLOW CAPACITY OF BALL VALVES IN LIQUID LINE [KW]

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
Without access fitting	With access fitting														
6570/M6	6570/M6A	13,6	14,6	9,5	13,8	13,7	9,2	12,0	12,5	12,6	12,7	9,7	11,6	11,6	11,8
6570/2	6570/2A														
6570/3	6570/3A	51	55	36	52	52	35	45	47	47	48	36	44	43	44
6570/M10	6570/M10A														
6570/M12	6570/M12A	85	92	60	86	86	58	75	78	79	80	61	73	72	74
6570/4	6570/4A														
6571/5	–	289	311	202	293	292	196	256	266	267	270	206	248	246	251
6570/M15	6570/M15A														
6570/5	6570/5A	493	531	345	500	498	334	436	454	456	461	352	422	420	428
6570/M18	6570/M18A														
6570/6	6570/6A	867	933	607	879	876	587	767	798	802	811	619	743	738	753
6571/7	–														
6570/7	6570/7A	1462	1574	1023	1482	1477	989	1293	1346	1352	1368	1043	1252	1244	1270
6571/M28	–														
6571/9	–	1989	2141	1392	2016	2009	1346	1760	1831	1839	1861	1419	1704	1693	1728
6570/M28	6570/M28A														
6570/9	6570/9A	3638	3916	2547	3687	3674	2461	3219	3349	3364	3405	2596	3116	3097	3161
6571/11	–														
6590/11	6590/11A	6460	6954	4522	6547	6525	4370	5715	5947	5974	6046	4609	5533	5499	5613
6591/13	–														
6591/M42	–	9350	10065	6545	9477	9444	6325	8272	8608	8646	8751	6672	8008	7959	8124
6590/13	6590/13A														
6590/M42	6590/M42A	12070	12993	8449	12233	12191	8165	10678	11112	11161	11296	8612	10338	10274	10487
6591/17	–														
6590/17	6590/17A	11220	12078	7854	11372	11332	7590	9926	10329	10375	10501	8006	9610	9550	9748
6591/M64	6591/M64A														
6591/21	6591/21A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6570/M64	6570/M64A														
–	6570/21A	6460	6954	4522	6547	6525	4370	5715	5947	5974	6046	4609	5533	5499	5613
–	6571/24A														
–	6571/25A	9350	10065	6545	9477	9444	6325	8272	8608	8646	8751	6672	8008	7959	8124
–	6570/24A														
–	6570/25A	12070	12993	8449	12233	12191	8165	10678	11112	11161	11296	8612	10338	10274	10487
–	6571/28A														
–	6571/29A	11220	12078	7854	11372	11332	7590	9926	10329	10375	10501	8006	9610	9550	9748
–	6570/28A														
–	6570/29A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/33A														
–	6571/34A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–														

Standard rating conditions according to AHRI Standard 760-2007

Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 22: REFRIGERANT FLOW CAPACITY OF BALL VALVES IN SUCTION LINE [KW]

Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
Without access fitting	With access fitting														
6570/M6	6570/M6A	1,5	2,0	1,8	1,8	2,6		1,1	1,9	1,8	1,3	1,7	1,4	1,1	1,3
6570/2	6570/2A														
6570/3	6570/3A	5,5	7,7	6,6	6,8	9,9	6,7	4,3	7,2	6,6	4,8	6,3	5,4	4,1	4,7
6570/M10	6570/M10A														
6570/M12	6570/M12A	9,1	12,8	11,0	11,4	16,5	11,2	7,1	12,0	11,0	8,0	10,6	9,0	6,9	7,9
6570/4	6570/4A														
6571/5	–	31	43	37	39	56	38	24	41	37	27	36	30	23	27
6570/M15	6570/M15A														
6570/5	6570/5A	53	74	64	66	96	65	41	70	64	46	61	52	40	46
6570/M18	6570/M18A														
6570/6	6570/6A	93	130	112	116	168	114	72	122	112	81	108	91	70	80
6571/7	–														
6570/7	6570/7A	157	219	189	195	284	192	122	206	189	137	181	154	119	135
6571/M28	–														
6571/9	–	213	298	257	266	386	261	166	281	257	186	247	209	161	184
6570/M28	6570/M28A														
6570/9	6570/9A	389	546	471	486	706	477	304	514	471	340	452	383	295	336
6571/11	–														
6590/11	6590/11A	692	969	836	863	1254	847	540	912	836	604	802	680	524	597
6591/13	–														
6591/M42	–	1001	1403	1210	1249	1815	1227	781	1320	1210	875	1161	985	759	864
6590/13	6590/13A														
6590/M42	6590/M42A	1292	1811	1562	1612	2343	1583	1008	1704	1562	1129	1498	1271	980	1115
6591/17	–														
6590/17	6590/17A	1201	1683	1452	1498	2178	1472	937	1584	1452	1049	1393	1181	911	1036
6591/M64	6591/M64A														
6591/21	6591/21A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6570/M64	6570/M64A														
–	6570/21A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/24A														
–	6571/25A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6570/24A														
–	6570/25A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/28A														
–	6571/29A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6570/28A														
–	6570/29A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/33A														
–	6571/34A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–														

Standard rating conditions according to AHRI Standard 760-2007

Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 23: REFRIGERANT FLOW CAPACITY OF BALL VALVES IN HOT GAS LINE [KW]

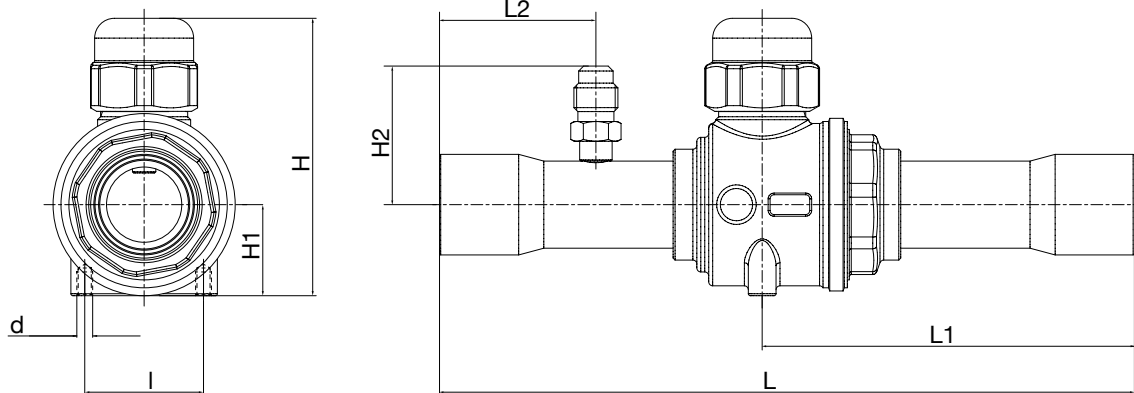
Catalogue Number		R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
Without access fitting	With access fitting														
6570/M6	6570/M6A	6,8	9,0	7,7	9,5	10,9	7,6	5,5	9,4	8,6	6,1	8,0	6,5	5,3	5,9
6570/2	6570/2A														
6570/3	6570/3A	26	34	29	36	41	29	21	35	32	23	30	24	20	22
6570/M10	6570/M10A														
6570/M12	6570/M12A	43	56	48	60	68	48	34	59	54	38	50	41	33	37
6570/4	6570/4A														
6571/5	–	145	190	163	202	231	162	116	201	183	130	170	138	112	125
6570/M15	6570/M15A														
6570/5	6570/5A	247	325	278	345	394	277	199	342	313	222	289	236	191	213
6570/M18	6570/M18A														
6570/6	6570/6A	434	571	490	607	694	487	349	602	550	390	509	415	337	375
6571/7	–														
6570/7	6570/7A	731	963	826	1023	1170	820	589	1015	927	658	858	700	568	632
6571/M28	–														
6571/9	–	995	1310	1123	1392	1591	1116	801	1381	1261	895	1168	952	772	860
6570/M28	6570/M28A														
6570/9	6570/9A	1819	2397	2054	2547	2910	2042	1466	2525	2307	1637	2136	1742	1412	1573
6571/11	–														
6590/11	6590/11A	3230	4256	3648	4522	5168	3625	2603	4484	4096	2907	3792	3093	2508	2793
6591/13	–														
6591/M42	–	4675	6160	5280	6545	7480	5247	3768	6490	5929	4208	5489	4477	3630	4043
6590/13	6590/13A														
6590/M42	6590/M42A	6035	7952	6816	8449	9656	6773	4864	8378	7654	5432	7086	5779	4686	5219
6591/17	–														
6590/17	6590/17A	5610	7392	6336	7854	8976	6296	4521	7788	7115	5049	6587	5372	4356	4851
6591/M64	6591/M64A														
6591/21	6591/21A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6570/M64	6570/M64A														
–	6570/21A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/24A														
–	6571/25A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6570/24A														
–	6570/25A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/28A														
–	6571/29A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6570/28A														
–	6570/29A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	6571/33A														
–	6571/34A	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–														

Standard rating conditions according to AHRI Standard 760-2007					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 24: DIMENSIONS AND WEIGHTS OF BALL VALVES

Catalogue Number		Dimensions [mm]							Weight [g]	
		H	H <sub>1</sub>	H <sub>2</sub>	L	L <sub>1</sub>	L <sub>2</sub>	l		d
6570/M6	6570/M6A	48	15	29	121	65	25	18	M4	198
6570/2	6570/2A									201
6570/3	6570/3A									
6570/M10	6570/M10A			208						
6570/M12	6570/M12A									
6570/4	6570/4A			55	19	–	138			73,5
6571/5	–	360								
6570/M15	6570/M15A		70	23	32	139	73	30	30	M4
6570/5	6570/5A	570								
6570/M18	6570/M18A				79	27	–	175		
6570/6	6570/6A	708								
6571/7	–		70	23	34	175	94	40	30	M4
6571/9	–	601								
6570/M28	6570/M28A	79	27	37	204	109	45	30	M6	708
6570/9	6570/9A									840
6571/11	–	117	37	–	245	130	–	30	M6	
6570/11	6570/11A			45	210	112	43			
6571/13	–									–
6571/M42		127	44	45	239	126	48	30	M6	2470
6570/13	6570/13A									2520
6570/M42	6570/M42A	148	54	53	275	149	58	30	M6	
6571/17	–									4400
6570/17	6570/17A	150	55	57	343	186	68	75	M8	
6571/M64	6571/M64A									6240
6571/21	6571/21A	186,5	70	64	363	196	78	89	M8	
6570/M64	6570/M64A									6580
–	6570/21A	186,5	70	64	365,5	196,5	69	89	M8	
–	6571/24A									10790
–	6571/25A	195	75	68	381,5	204,5	77	75	M8	
–	6570/24A									12789
–	6570/25A	373	197,5	70,5	405	213,5	86,5	75	M8	
–	6571/28A									13223
–	6571/29A	13257								
–	6570/28A									
–	6570/29A									
–	6571/33A									
–	6571/34A									

6570  
6571







# VALVES

## 9.3 – THREE-WAYS MANUAL VALVES WITH BALL SHUTTER

### APPLICATIONS

The 3-ways manual valves in series 6690 and 6690B 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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 are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for all the parts of 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 solder connections;
- Stainless steel EN 10088-3 – 1.4305 for spindles;
- Chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for the ball seat gaskets.

### INSTALLATION

**The 3-way ball valves in series 6690 and 6690B 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.

The brazing of 3-way valves 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.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the valves with ball shutter in series 6690 and 6690B (up to 6690/9 and 6690B/9) with file SA33319.

These valves are certified **UL-CSA Recognized** for the USA and Canada with a Design Pressure of 650 PSI, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15.

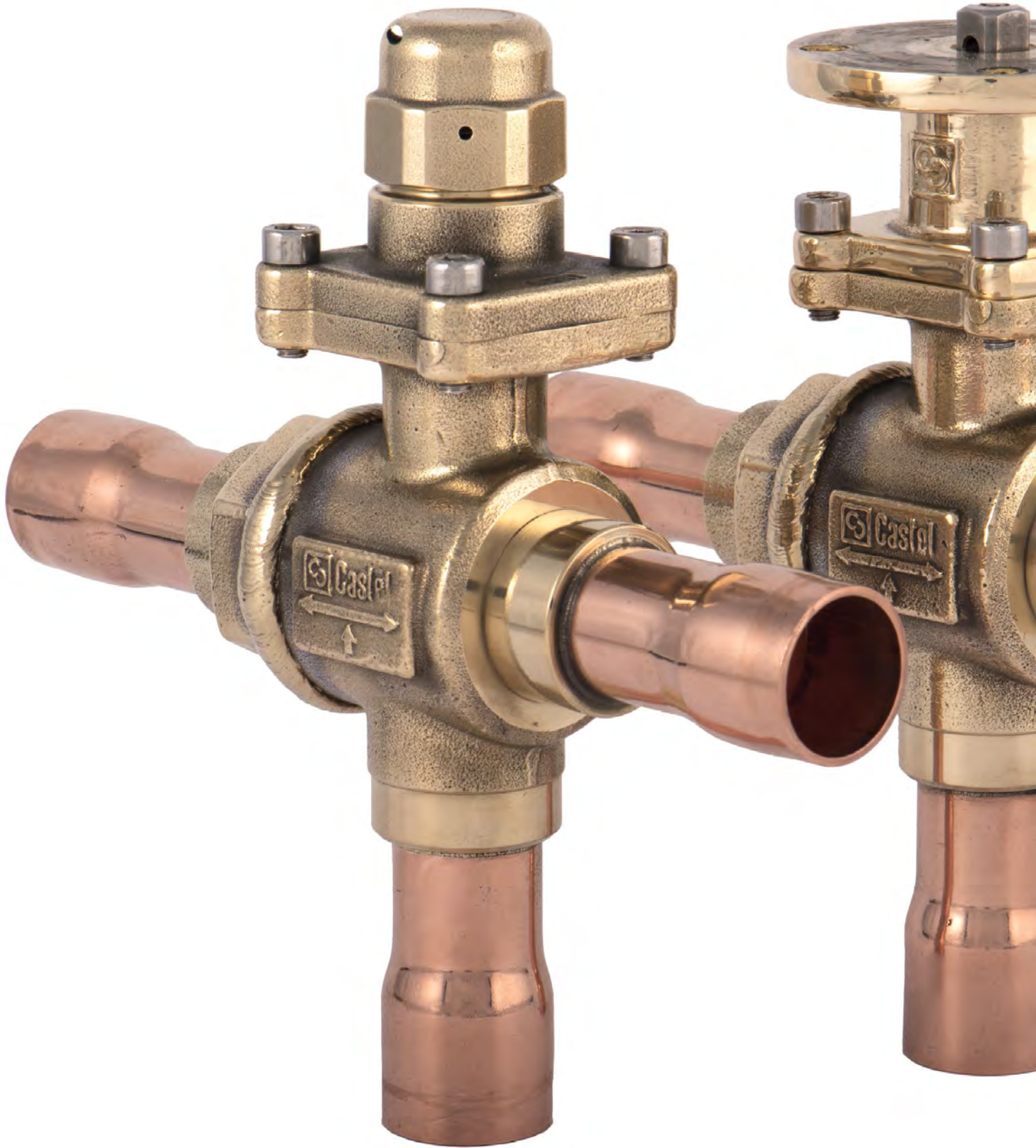
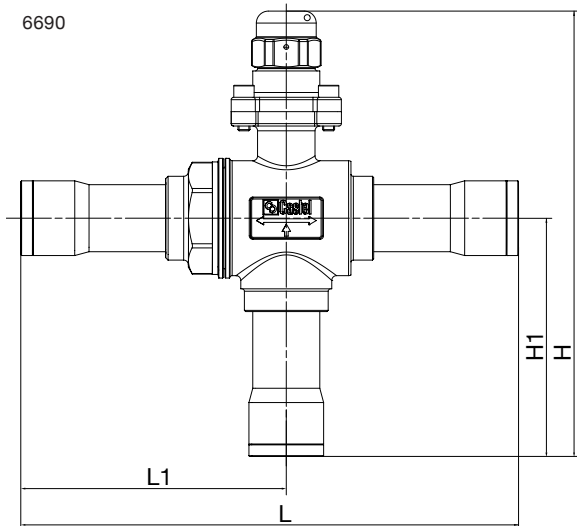


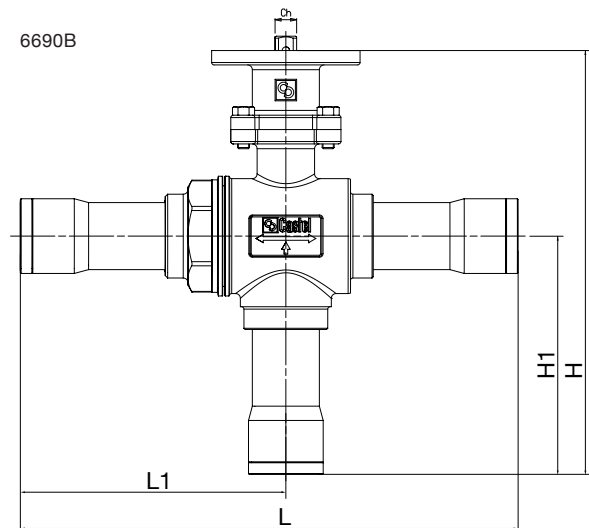
TABLE 25: GENERAL CHARACTERISTICS OF 3-WAY VALVES

Catalogue Number		Connections		Ball Port Ø [mm]	Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
Manual valves	Valves to be motorized	ODS					min.	max.	
		Ø [in.]	Ø [mm]						
6690/3	6690B/3	3/8"	–	13,5	4,6	45	-40	+150	Art. 4.3
6690/M10	6690B/M10	–	10						
6690/M12	6690B/M12	–	12						
6690/4	6690B/4	1/2"	–						
6690/5	6690B/5	5/8"	16						
6690/M18	6690B/M18	–	18						
6690/6	6690B/6	3/4"	–	19	10,7				
6690/7	6690B/7	7/8"	22	24	15,9				
6690/M28	6690B/M28	–	28	28	20,3				
6690/9	6690B/9	1.1/8"	–	37	38,5				
6690/11	6690B/11	1.3/8"	35						
6690/13	6690B/13	1.5/8"	–	48	63				
6690/M42	6690B/M42	–	42	55	83				
6690/17	6690B/17	2.1/8"	54						
6690/M64	6690B/M64	–	64						
6690/21	6690B/21	2.5/8"	–						

6690



6690B



**TABLE 26: DIMENSIONS AND WEIGHTS OF 3-WAYS VALVES**

Catalogue Number	Figure	Dimensions [mm]					Weight [g]
		H	H <sub>1</sub>	L	L <sub>1</sub>	Ch	
6690/3	1	142	62	144	85	11	840
6690/M10							
6690/M12							
6690/4							
6690/5		150	68	158	92	11	890
6690/M18							
6690/6							
6690/7							
6690/M28		186	100	208	111	9	1540
6690/9							
6690/11							
6690/13							
6690/M42		203	103	211	113	11	2117
6690/17							
6690/M64							
6690/21							
6690/13	226	121	240	127	11	3447	
6690/M42							
6690/17							
6690/M64							
6690/21	309	164	391	207	14	13100	
6690/17							
6690/M64							
6690/21							
6690/3	2	92	62	144	85	11	590
6690B/M10							
6690B/M12							
6690B/4							
6690B/5		100	68	158	92	11	640
6690B/M18							
6690B/6							
6690B/7							
6690B/M28		156	82	172	94	9	1210
6690B/9							
6690B/11							
6690B/13							
6690B/M42		177	100	208	111	9	1540
6690B/17							
6690B/M64							
6690B/21							
6690B/13	186	103	211	113	11	2117	
6690B/M42							
6690B/17							
6690B/M64							
6690B/21	209	121	240	127	11	3447	
6690B/M42							
6690B/17							
6690B/M64							
6690B/17	3	226	148	301	164	14	6800
6690B/M64							
6690B/21							
6690B/M64	250	164	391	207	14	12400	
6690B/21							
6690B/21							

# VALVES

## 9.4 – THREE-WAYS MOTORIZED VALVES WITH BALL SHUTTER

### APPLICATIONS

The 3-ways motorized valves in series 6690M 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 commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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. These valves are sold including the actuator and the relative adapter, in versions with suffix A2 (24 VAC) or suffix A6 (230 VAC). The main parts are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for all the parts of 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 solder connections;
- Stainless steel EN 10088-3 – 1.4305 for spindles;
- Chloroprene rubber (CR) for outlet seal gaskets;
- P.T.F.E. for the ball seat gaskets.

### INSTALLATION

**The 3-way ball valves in series 6690M 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 with the Castel actuators in series 9700, 9720 and 9730 using proper flanged adapters between the two parts.

The actuator can be mounted on the valve:

- In four different positions, oriented at 90° to each other;
- With horizontal output connections and vertical input connection, facing downward;
- With vertical output connections and horizontal input connection.

The actuator can never be mounted on the valve:

- 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. **All**

**of the actuators can be equipped with auxiliary contacts in series 9750, sold separately.**

The brazing of 3-way valves 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.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the valves with ball shutter in series 6690M (up to 6690/6M) with file SA33319. These valves are certified **UL Recognized** for the USA with a Design Pressure of 650 PSI, in compliance with American standard UL 207.







TABLE 27: MECHANICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Connections		Ball Port Ø [mm]	Kv Factor [m <sup>3</sup> /h]	Torque [Nm]	Running Time [sec]	Rotation Angle	PS [bar]	TS [°C]		Risk Category according to PED Recast
		ODS								min.	max.	
		Ø [in.]	Ø [mm]									
6690M/3A2	24 V	3/8"	-	13,5	4,6	10	60	90°	45	-40	+150	Art. 4.3
6690M/3A6	230V											
6690M/M10A2	24 V	-	10									
6690M/M10A6	230V											
6690M/M12A2	24 V	-	12									
6690M/M12A6	230V											
6690M/4A2	24 V	1/2"	-									
6690M/4A6	230V											
6690M/5A2	24 V	5/8"	16									
6690M/5A6	230V											
6690M/M18A2	24 V	-	18									
6690M/M18A6	230V											
6690M/6A2	24 V	3/4"	-									
6690M/6A6	230V											
6690M/7A2	24 V	7/8"	22	19	10,7							
6690M/7A6	230V											
6690M/M28A2	24 V	-	28	24	15,9							
6690M/M28A6	230V											
6690M/9A2	24 V	1.1/8"	-									
6690M/9A6	230V											
6690M/11A2	24 V	1.3/8"	35			28	20,3					
6690M/11A6	230V											
6690M/13A2	24 V	1.5/8"	-	37	38,5							
6690M/13A6	230V											
6690M/M42A2	24 V	-	42									
6690M/M42A6	230V											
6690M/17A2	24 V	2.1/8"	54	48	63,0							
6690M/17A6	230V											
6690M/M64A2	24 V	-	64	55	83,0							
6690M/M64A6	230V											
6690M/21A2	24 V	2.5/8"	-									
6690M/21A6	230V											

TABLE 28: ELECTRICAL CHARACTERISTICS OF 3-WAYS MOTORIZED VALVES

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Active Power [W]		Apparent Power [VA]		Cable 1m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/Close)	Continuous output (0 - 10V)	
6690M/3A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/3A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/M10A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M10A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/M12A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M12A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/4A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/4A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/5A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/5A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/M18A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M18A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/6A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/6A6	230V	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/7A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/M28A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M28A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/9A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/9A6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/11A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5 mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/11A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/13A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/13A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/M42A2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48	5 x 0,5mm <sup>2</sup>	YES	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M42A6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7	3 x 0,75mm <sup>2</sup>	YES	NO	IP 43
6690M/17A2	24 A.C.	+20 / -20	50 / 60	13,5	1,5	16,5	ND	4 x 0,5mm <sup>2</sup>	NO	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/17A6	230 A.C.	+15 / -15	50 / 60	13	2	20	ND	3 x 0,75mm <sup>2</sup>	YES	NO	IP54
6690M/M64A2	24 A.C.	+20 / -20	50 / 60	13,5	1,5	16,5	ND	4 x 0,5mm <sup>2</sup>	NO	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/M64A6	230 A.C.	+15 / -15	50 / 60	13	2	20	ND	3 x 0,75mm <sup>2</sup>	YES	NO	IP54
6690M/21A2	24 A.C.	+20 / -20	50 / 60	13,5	1,5	16,5	ND	4 x 0,5mm <sup>2</sup>	NO	YES	IP 54
	24 D.C.	+20 / -20	–								
6690M/21A6	230 A.C.	+15 / -15	50 / 60	13	2	20	ND	3 x 0,75mm <sup>2</sup>	YES	NO	IP54

TABLE 29: REFRIGERANT FLOW CAPACITY OF 3-WAY VALVES IN LIQUID LINE [KW]

Catalogue Number			Refrigerants													
			R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
6690/3	6690B/3	6690M/3#	78	84	55	79	79	53	69	72	72	73	56	67	67	68
6690/M10	6690B/M10	6690M/M10#														
6690/M12	6690B/M12	6690M/M12#														
6690/4	6690B/4	6690M/4#														
6690/5	6690B/5	6690M/5#														
6690/M18	6690B/M18	6690M/M18#														
6690/6	6690B/6	6690M/6#	182	196	127	184	184	123	161	167	168	170	130	156	155	158
6690/7	6690B/7	6690M/7A#														
6690/M28	6690B/M28	6690M/M28A#	270	291	189	274	273	183	239	249	250	253	193	232	230	235
6690/9	6690B/9	6690M/9A#														
6690/11	6690B/11	6690M/11A#	345	371	242	350	349	233	305	318	319	323	246	296	294	300
6690/13	6690B/13	6690M/13A#	655	705	458	663	661	443	579	603	605	613	467	561	557	569
6690/M42	6690B/M42	6690M/M42A#														
6690/17	6690B/17	6690M/17#	1071	1153	750	1085	1082	725	948	986	990	1002	764	917	912	931
6690/M64	6690B/M64	6690M/M64A#	1411	1519	988	1430	1425	955	1248	1299	1305	1321	1007	1208	1201	1226
6690/21	6690B/21	6690M/21#														

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 30: REFRIGERANT FLOW CAPACITY OF 3-WAY VALVES IN SUCTION LINE [KW]

Catalogue Number			Refrigerants													
			R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
6690N/3	6690NB/3	6690NM/3	8	12	10	10	15	10	7	11	10	7	10	8	6	7
6690N/M10	6690NB/M10	6690NM/M10														
6690N/M12	6690NB/M12	6690NM/M12														
6690N/4	6690NB/4	6690NM/4														
6690N/5	6690NB/5	6690NM/5														
6690N/M18	6690NB/M18	6690NM/M18														
6690N/6	6690NB/6	6690NM/6	19	27	24	24	35	24	15	26	24	17	23	19	15	17
6690N/7	6690NB/7	6690NM/7A#														
6690N/M28	6690NB/M28	6690NM/M28A#	29	41	35	36	52	35	23	38	35	25	34	28	22	25
6690N/9	6690NB/9	6690NM/9A#														
6690N/11	6690NB/11	6690NM/11A#	37	52	45	46	67	45	29	49	45	32	43	36	28	32
6690N/13	6690NB/13	6690NM/13A#	70	98	85	87	127	86	55	92	85	61	81	69	53	60
6690N/M42	6690NB/M42	6690NM/M42A#														
6690/17	6690B/17	6690M/17#	115	161	139	143	208	140	89	151	139	100	133	113	87	99
6690/M64	6690B/M64	6690M/M64A#	151	212	183	188	274	185	118	199	183	132	175	149	115	130
6690/21	6690B/21	6690M/21#														

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 31: REFRIGERANT FLOW CAPACITY OF 3-WAY VALVES IN HOT GAS LINE [KW]

Catalogue Number			Refrigerants													
			R134a	R22	R404A	R407C	R410A	R507	R1234ze	R448A	R449A	R450A	R452A	R513A	R515A	R515B
6690N/3	6690NB/3	6690NM/3	39	52	44	55	63	44	32	54	50	35	46	37	30	34
6690N/M10	6690NB/M10	6690NM/M10														
6690N/M12	6690NB/M12	6690NM/M12														
6690N/4	6690NB/4	6690NM/4														
6690N/5	6690NB/5	6690NM/5														
6690N/M18	6690NB/M18	6690NM/M18														
6690N/6	6690NB/6	6690NM/6														
6690N/7	6690NB/7	6690NM/7A#	91	120	103	127	146	102	73	126	115	82	107	87	71	79
6690N/M28	6690NB/M28	6690NM/M28A#	135	178	153	189	216	152	109	188	171	122	159	129	105	117
6690N/9	6690NB/9	6690NM/9A#														
6690N/11	6690NB/11	6690NM/11A#	173	227	195	242	276	194	139	240	219	155	203	165	134	149
6690N/13	6690NB/13	6690NM/13A#	327	431	370	458	524	367	264	454	415	295	384	313	254	283
6690N/M42	6690NB/M42	6690NM/M42A#														
6690/17	6690B/17	6690M/17#	536	706	605	750	857	601	432	743	679	482	629	513	416	463
6690/M64	6690B/M64	6690M/M64A#	706	930	797	988	1129	792	569	979	895	635	828	676	548	610
6690/21	6690B/21	6690M/21#														

Standard rating conditions according to AHRI Standard 760-2014					
Condensing temperature	110 °F	(43,3 °C)	Evaporator superheating	10 °R	(5,5 °K)
Liquid temperature	100 °F	(37,8 °C)	Suction line temperature	65 °F	(18,3 °C)
Subcooling	10 °R	(5,5 °K)	Suction superheating	15 °R	(8,4 °K)
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	160 °F	(71,1 °C)

TABLE 32: DIMENSIONS AND WEIGHTS OF 3-WAYS VALVES

Catalogue Number	Figure	Dimensions [mm]						Weight [g]
		H	H <sub>1</sub>	H <sub>2</sub> (1)	L	L <sub>1</sub>	Ch	
6690M/3A2	1	158	62	190	144	85	6	1390
6690M/3A6	2	178		201				2250
6690M/M10A2	1	158	62	190	144	85		1390
6690M/M10A6	2	178		201				2250
6690M/M12A2	1	158	62	190	144	85		1390
6690M/M12A6	2	178		201				2250
6690M/4A2	1	158	62	190	144	85		1390
6690M/4A6	2	178		201				2250
6690M/5A2	1	165	68	208	158	92		1390
6690M/5A6	2	186		197				2250
6690M/M18A2	1	165	68	208	158	92		1440
6690M/M18A6	2	186		197				2300
6690M/6A2	1	165	68	208	158	92		1440
6690M/6A6	2	186		197				2300
6690M/7A2	1	188	82	246	172	94		2570
6690M/7A6	2	210		246				3510
6690M/M28A2	1	210	100	268	208	111		2860
6690M/M28A6	2	231		268				3800
6690M/9A2	1	210	100	268	208	111	2860	
6690M/9A6	2	231		268			3800	
6690M/11A2	2	240	103	273	211	113	10	4200
6690M/11A6								
6690M/13A2		263	121	293	240	127		5250
6690M/13A6								
6690M/M42A2		263	121	296	240	127		5250
6690M/M42A6								
6690M/17A2	3	226	148	306	301	164	-	8800
6690M/17A6								
6690M/M64A2		250	164	330	391	207		14400
6690M/M64A6								
6690M/21A2		250	164	330	391	207		14400
6690M/21A6								

(1): total height with optional auxiliary contact

Fig.1

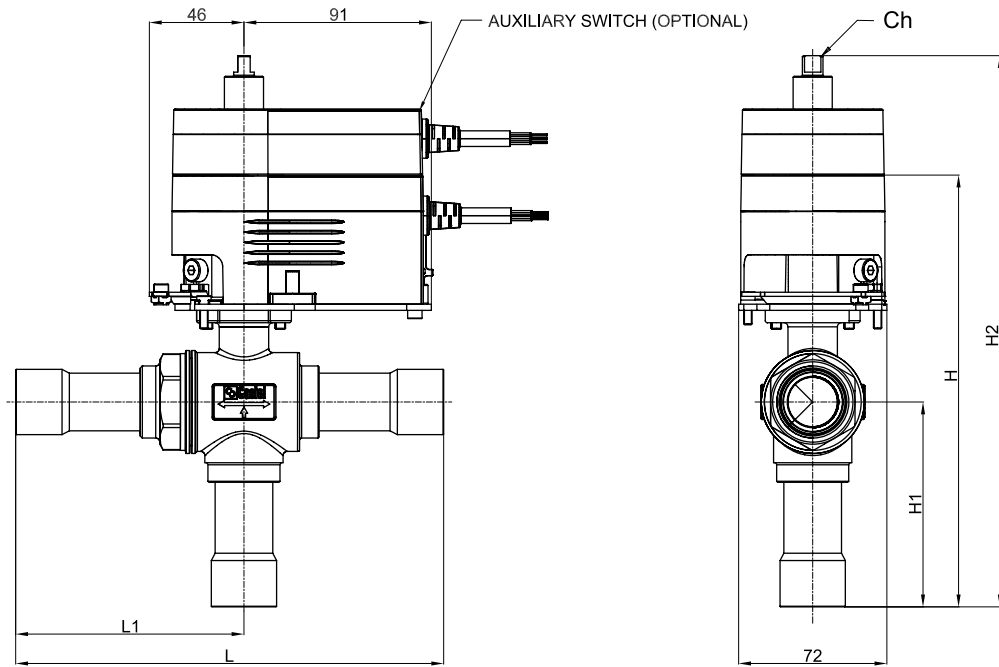
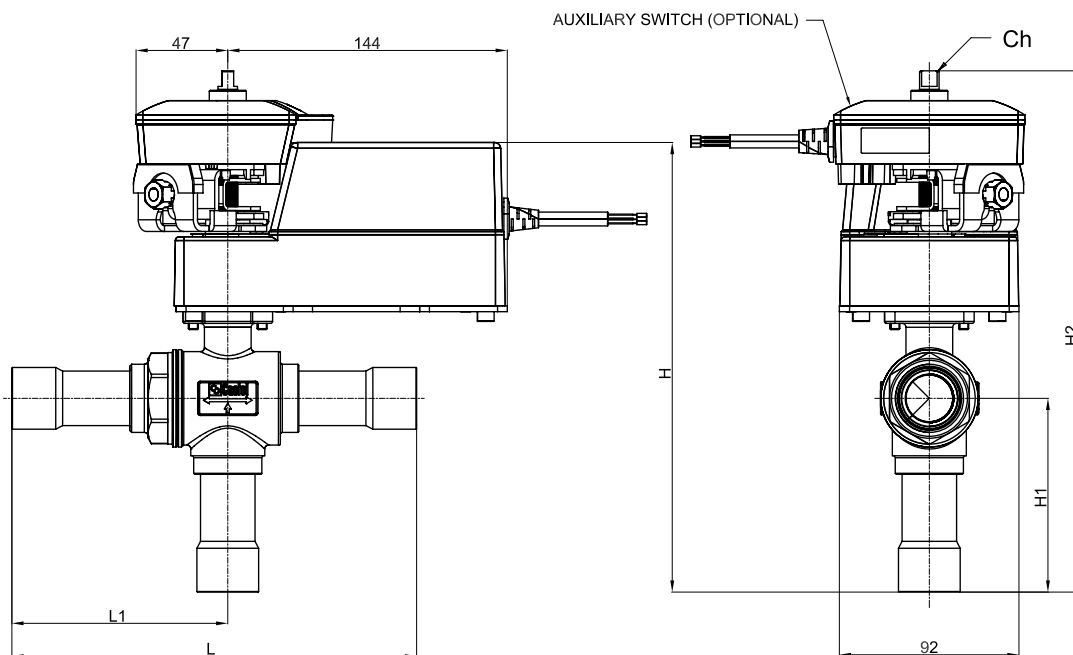


Fig.2



## VALVES

## 9.5 – ACTUATORS

## 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 6570 and 6571;
- 3-way manual valves with ball shutter in series 6690 and 6690B.

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 6690M.

## 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.

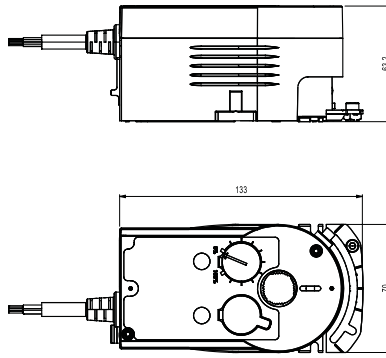
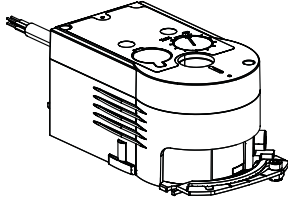




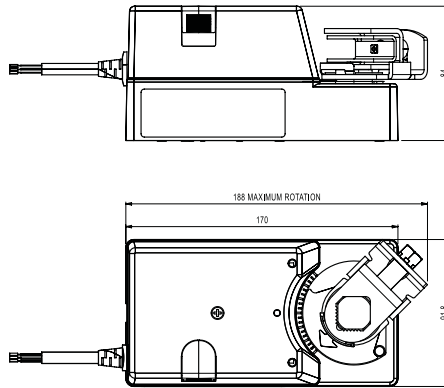
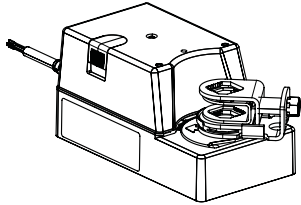
TABLE 33: GENERAL CHARACTERISTICS OF ACTUATORS

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequency [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)	Continuous 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	_								YES	NO		IP 43						
9700/RA6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1	30	120		YES	YES	external see tab. 22	IP 54						
	24 D.C.	+20 / -20	_	2,4	0,26	4,3	0,48				YES	NO		IP 43						
9720/RA2	24 A.C.	+20 / -20	50 / 60	3,7	1,1	4,7	2,7				60	150	NO	YES			internal	IP 54	-30	+50
	24 D.C.	+20 / -20	_										13,5	1,5				16,5		
9720/RA6	230 A.C.	+15 / -15	50 / 60	13	2,0	20	ND				100	120	NO	YES	internal	IP 66	-10	55		
	24 D.C.	+20 / -20	_	45	ND	60	ND						YES	NO		IP 66				
9730/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	_										45	ND		60			ND	YES
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	_										45	ND		60			ND	YES
9740/RA6	230 A.C.	+10 / -10	50 / 60	45	ND	60	ND	100	120	NO	YES	internal	IP 66	-10	55					
	230 D.C.	+10 / -10	_							45	ND		60			ND	YES	NO	IP 66	

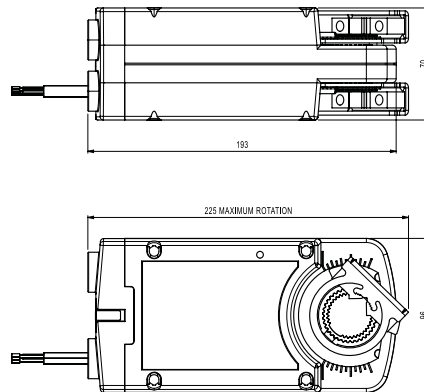
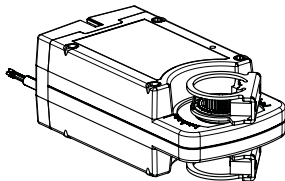
9700/RA2



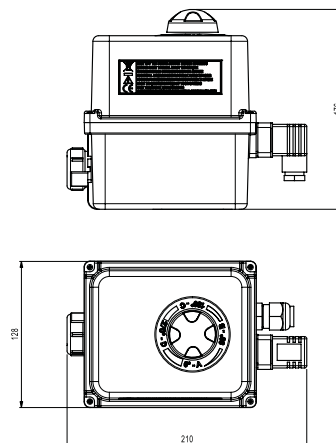
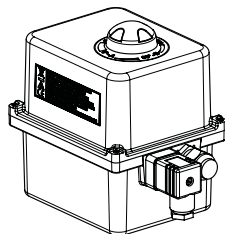
9700/RA6  
9720/RA2  
9720/RA6



9730/RA2  
9730/RA6



9740/RA2  
9740/RA6



# VALVES

## 9.6 – AUXILIARY CONTACTS

### 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. Actuators in series 9740 have internal contacts.

### 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.

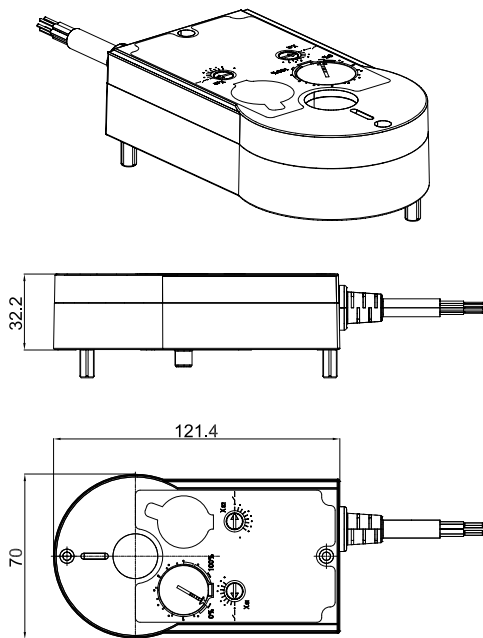
Contact 9750/X02 has an IP40 protection rating according to EN 60529, and a Type 1C classification for automatic operation according to EN 60730-1.

In the event of outdoor installation, it is recommended that the contacts be protected from the weather.

### CERTIFICATIONS

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

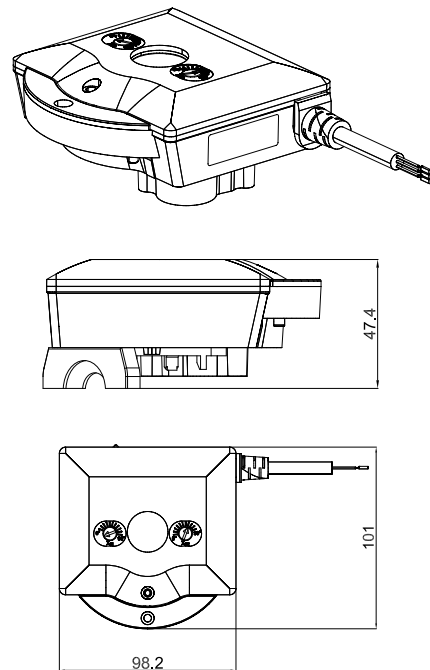


TABLE 34: GENERAL CHARACTERISTICS OF AUXILIARY SWITCHES

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



# VALVES

## 9.7 – ADAPTERS FOR ACTUATORS

### APPLICATIONS

Castel has constructed the flange adapters in series 9901 for coupling the actuators CASTEL (by SAUTER) in series 9700, 9720, 9730 and 9740 to the ball valves in series 6570, 6571. All these actuators 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.

### CERTIFICATIONS

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 23 indicate for each ball valve and for the main two voltages (24V or 230 VAC):

- The 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 or a 2-way valve with ball shutter.

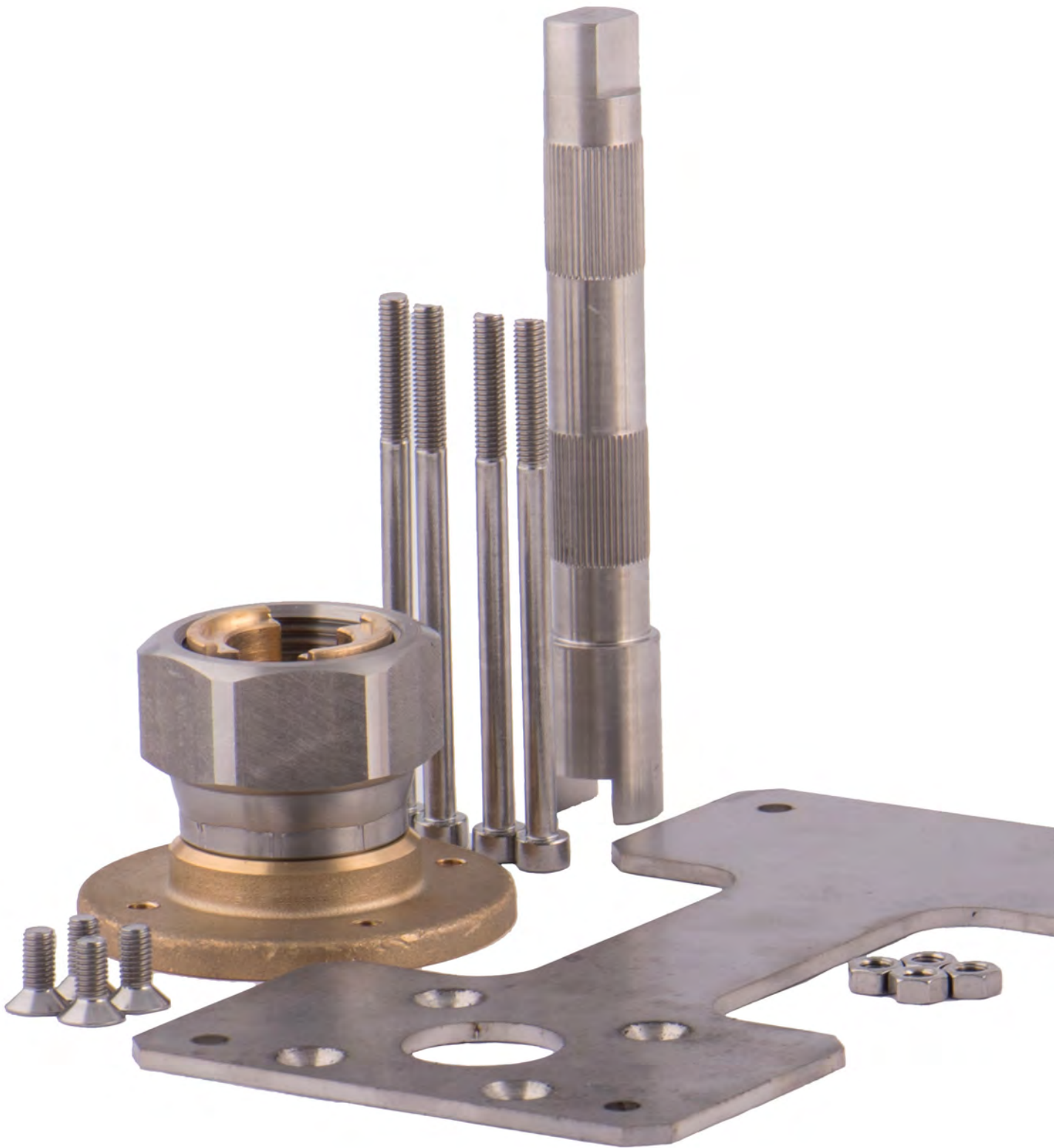




TABLE 35: COUPLING SCHEMES: VALVE + SERVOMOTOR + ADAPTER + SWITCHES

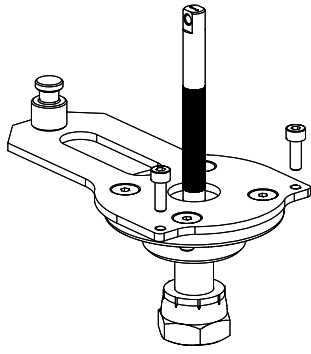
Ball valve part number		CASTEL part number			BELIMO part number			CASTEL part number	WATERGATES part number		CASTEL part number			
W/o access fitting	With access fitting	servomotor	adapter	switch	servomotor	shaped handle	switch	adapter	servomotor	switch	adapter			
6570/M6	6570/M6A	9700/RA2	9901/X58	9750/X01	SR24A-R	ZSV-11	S1A S2A	9901/X45	NA032100	INTERNAL	9901/X45			
6570/2	6570/2A													
6570/3	6570/3A													
6570/M10	6570/M10A													
6570/M12	6570/M12A													
6570/4	6570/4A				SR230A-R	ZSV-11	S1A S2A	9901/X45	NA034100	INTERNAL	9901/X45			
6571/5	-													
6570/M15	6570/M15A													
6570/5	6570/5A													
6570/M18	6570/M18A													
6570/6	6570/6A	9700/RA2	9901/X60	9750/X01	SR24A-R	ZSV-11	S1A S2A	9901/X46	NA032100	INTERNAL	9901/X46			
6571/7	-													
6570/7	6570/7A													
6571/M28	-	9700/RA6	9901/X57	9750/X02	SR230A-R	ZSV-11	S1A S2A	9901/X46	NA034100	INTERNAL	9901/X46			
6571/9	-													
6570/M28	6570/M28A	9720/RA2	9901/X75	9750/X02	SR24A-R	ZSV-11	S1A S2A	9901/X68	NA032100	INTERNAL	9901/X68			
6571/11	-													
6570/11	6570/11A													
6571/13	-	9720/RA6	9901/X75	9750/X02	SR230A-R	ZSV-11	S1A S2A	9901/X68	NA042100	INTERNAL	9901/X68			
6571/M42	-													
6570/13	6570/13A	9730/RA2	9901/X76	INTERNAL	GR24A-R	ZGV-14	S1A S2A	9901/X69	NA0052100	INTERNAL	9901/X69			
6570/M42	6570/M42A													
6571/17	-	9730/RA6	9901/X76	INTERNAL	GR230A-R	ZGV-14	S1A S2A	9901/X69	NA0054100	INTERNAL	9901/X69			
6570/17	6570/17A													
6571/M64	6571/M64A	9740/RA2	9901/X70	INTERNAL										
6571/21	6571/21A													
6570/M64	6570/M64A													
	6570/21A													
	6571/24A											9740/RA6	9901/X70	INTERNAL
	6571/25A													
	6570/24A											9740/RA2	9901/X71	INTERNAL
	6570/25A													
	6571/28A											9740/RA6	9901/X71	INTERNAL
	6571/29A													
	6570/28A	9740/RA2	9901/X72	INTERNAL										
	6570/29A													
	6571/33A	9740/RA6	9901/X72	INTERNAL										
	6571/34A													

TABLE 36: DIMENSIONS OF BALL VALVES WITH ACTUATOR

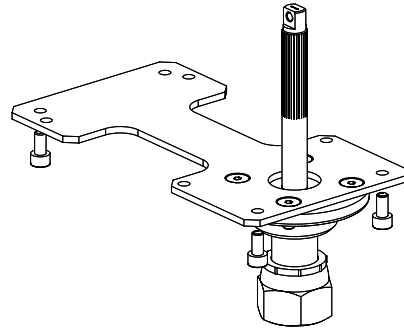
Ball Valve Catalogue No	Actuator Catalogue No	H	H <sub>1</sub>	H <sub>2</sub> (1)	L	L <sub>1</sub>	I	d	Ch	Figure
6570/M6	6570/M6A						18	M4	6	1
6570/2	6570/2A									
6570/3	6570/3A									
6570/M10	6570/M10A	147	15	179	121	65	25,5	M4	6	1
6570/M12	6570/M12A									
6570/4	6570/4A				138	73,5				
6571/5	-	154	19	186	139	73	30	M4	6	1
6570/M15	6570/M15A									
6570/5	6570/5A									
6570/M18	6570/M18A	167	23	199	175	94	30	M4	6	1
6570/6	6570/6A									
6571/7	-				175	94				
6570/7	6570/7A	176	27	207	206	109	30	M4	6	1
6571/M28	-									
6571/9	-				204	109				
6570/M28	6570/M28A	176	27	207	24	130	30	M4	6	1
6570/9	6570/9A									
6571/11	-				175	94				
6570/7	6570/7A	188	23	210	206	109	30	M4	6	2
6571/M28	-									
6571/9	-				204	109				
6570/M28	6570/M28A	197	27	218	24	130	30	M4	6	2
6570/9	6570/9A									
6571/11	-				213	114				
6570/11	6570/11A	212	32	233	213	114	42	M6	6	2
6571/13	-									
6571/M42	-				242	129				
6570/13	6570/13A	225	39	247	242	129	55	M6	20	3
6570/M42	6570/M42A									
6571/17	-				281	153				
6570/17	6570/17A	238	49	-	281	153	75	M8	-	4
6571/M64	6571/M64A									
6571/21	6571/21A				343	186				
6570/M64	6570/M64A	330	55	-	343	186	89	M8	-	4
	6570/21A									
	6571/24A				365	197				
	6571/25A	357	70	-	365	197	75	M8	-	4
	6570/24A									
	6570/25A				373	198				
	6571/28A	366	75	-	373	198	75	M8	-	4
	6571/29A									
	6570/28A									
	6570/29A									
	6571/33A									
	6571/34A									

(1): total height with optional auxiliary contact

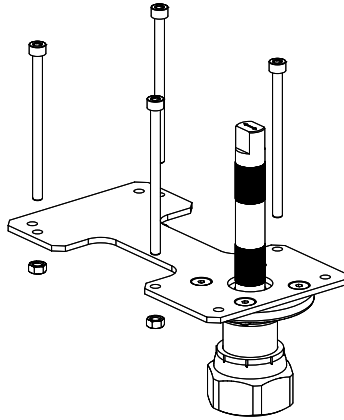
9901/X21  
9901/X27  
9901/X30



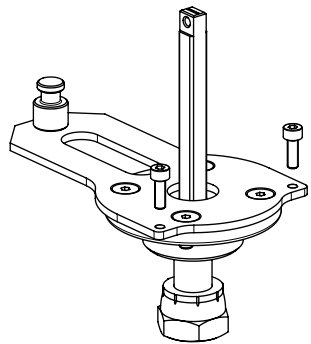
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9901/X23  
9901/X28  
9901/X38



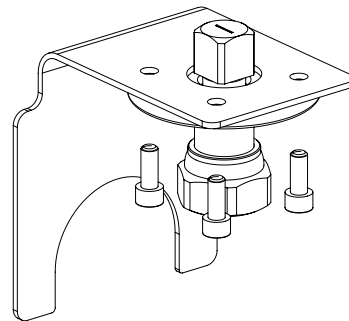
9901/X37  
9901/X39  
9901/X40



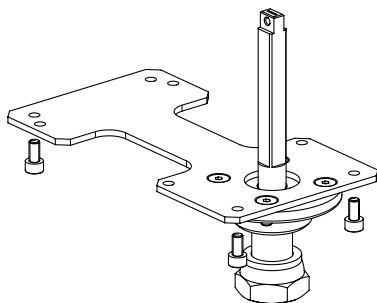
9901/X58  
9901/X60  
9901/X73



9901/X70  
9901/X71  
9901/X72



9901/X57  
9901/X74  
9901/X75



9901/X76

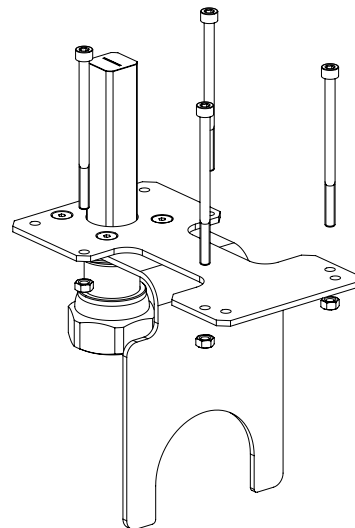


Fig.1

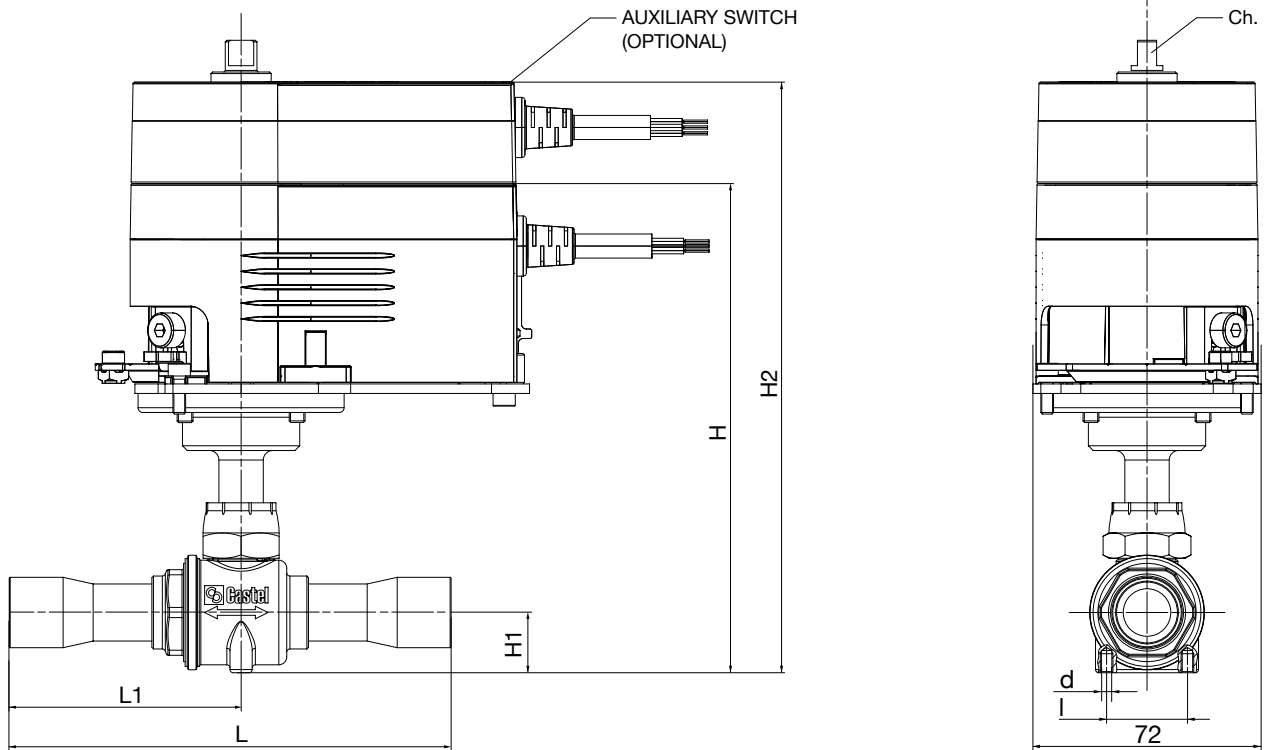


Fig.2

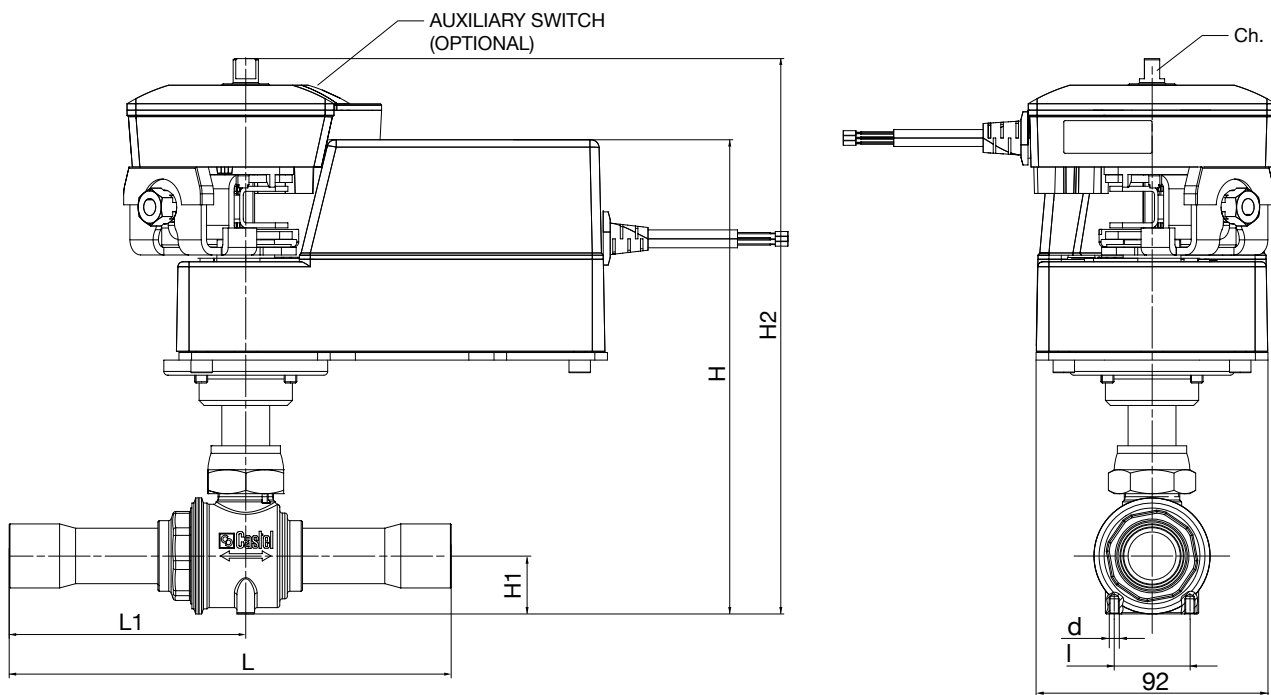


Fig.3

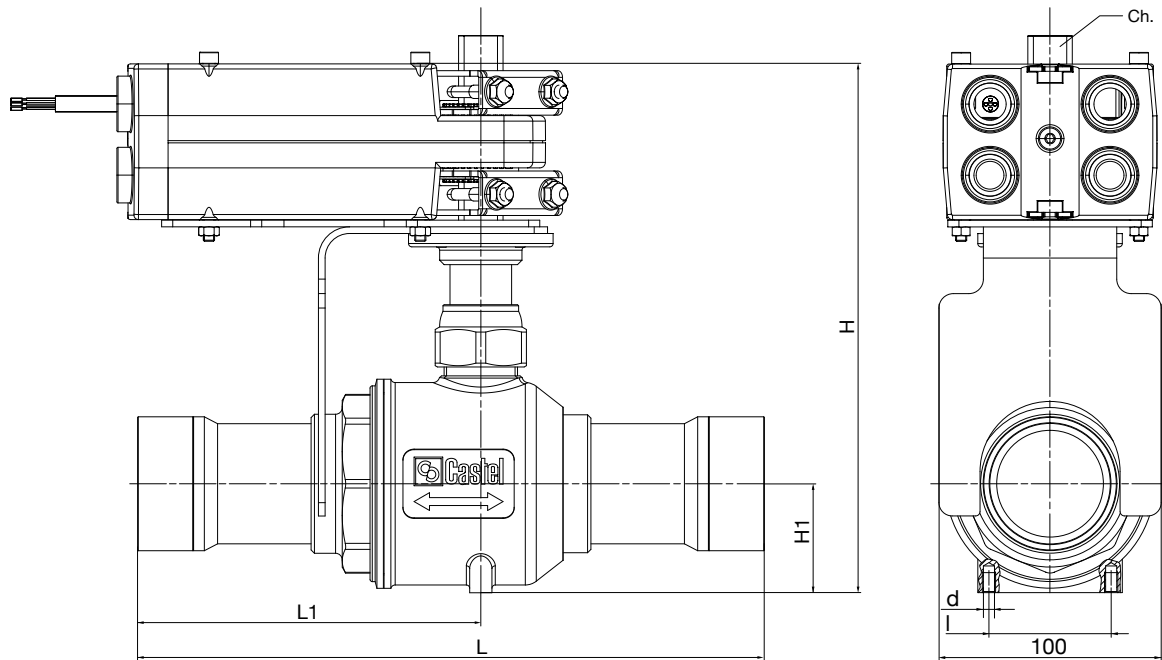
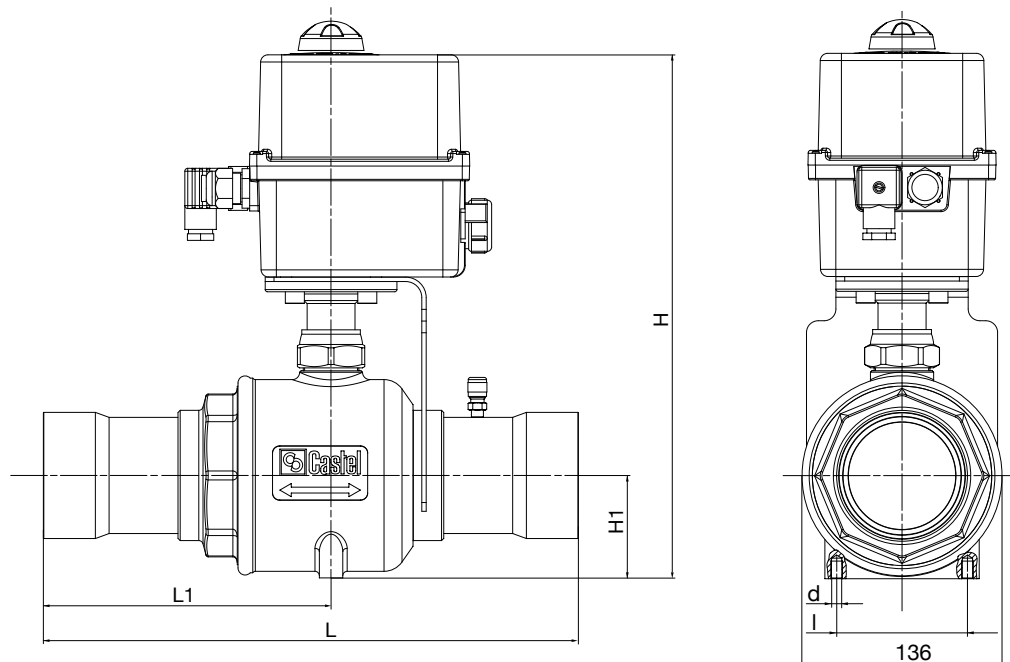
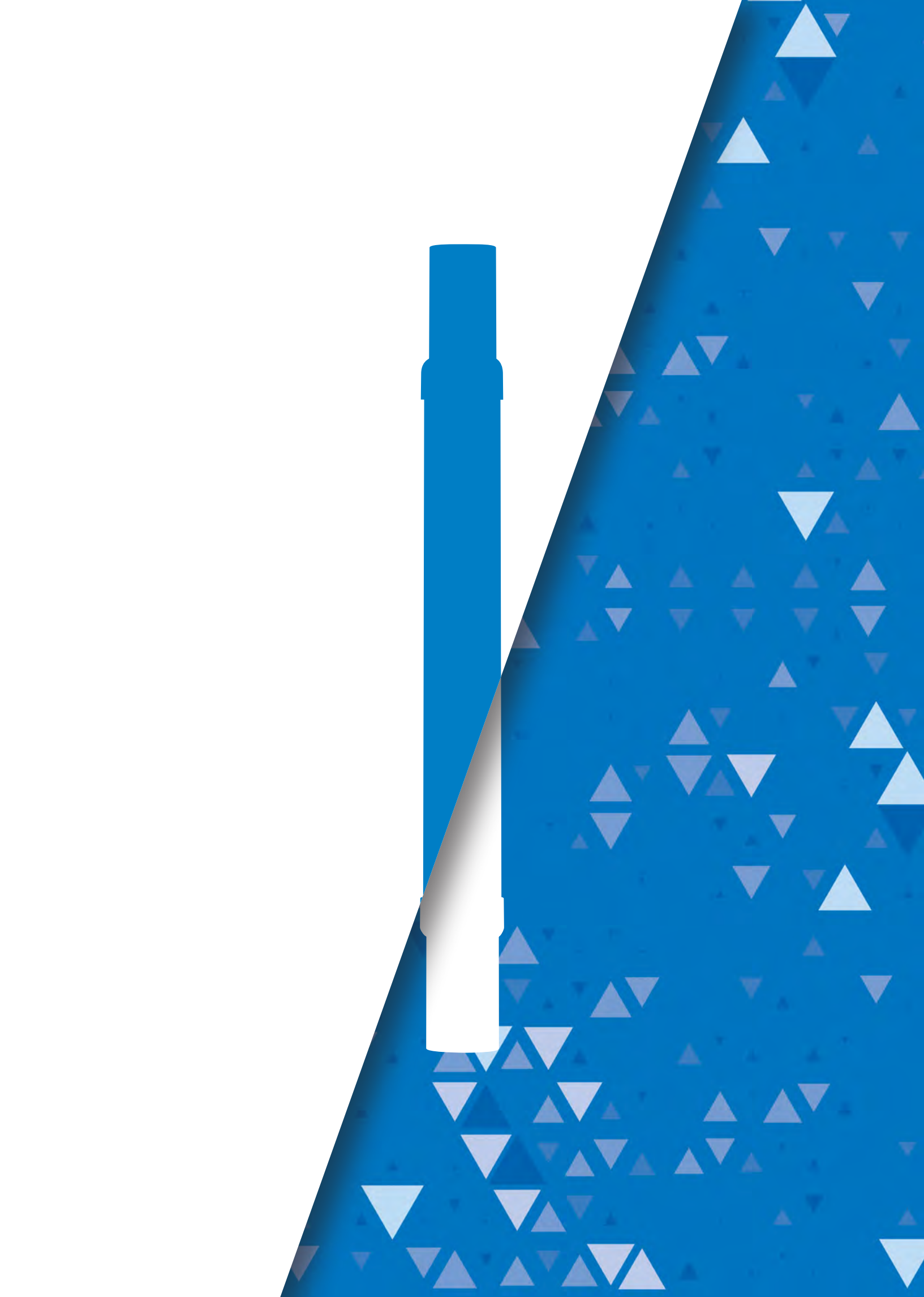


Fig.4











# PIPING ACCESSORIES

CLASSIC

# PIPING ACCESSORIES

## 10.1 – VIBRATION ABSORBERS

### APPLICATIONS

The vibration absorbers in series 7690 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 products are designed for installation on commercial refrigerating systems and on civil and industrial air conditioning plants. 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.

The vibration absorbers can be installed on systems that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

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.**

### CONSTRUCTION

The main union between various parts, including the copper/ stainless steel connections are TIG welded (Fig. 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:

- Copper pipe EN 12735-1 – Cu-DHP for connections;
- Stainless steel EN 10088-1 – 1.4305/1.4301 for fittings;
- 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.

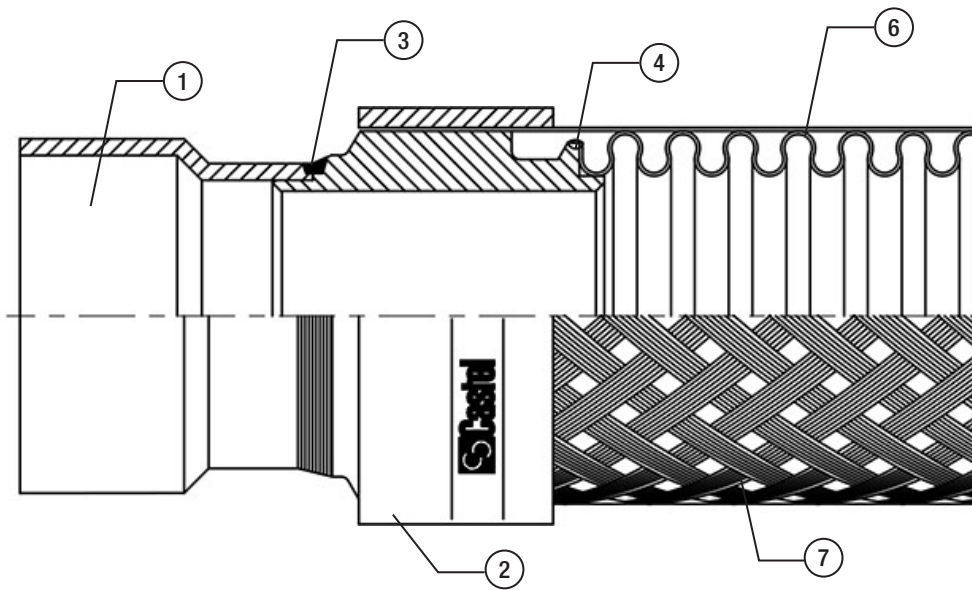
Vibration absorbers should be installed perpendicularly to the direction of vibration. In the case of vertical and horizontal vibrations, two vibrations absorbers should be used perpendicular to each other, as shown in Fig. 2 and 3. For the maximum absorption of vibrations, the refrigerant line should 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.







- 1 - Steel connection
- 2 - Net holder
- 3 - Copper ends welding
- 4 - Corrugated flexible welding
- 5 - Fitting
- 6 - Corrugated flexible
- 7 - Stainless steel wire braid

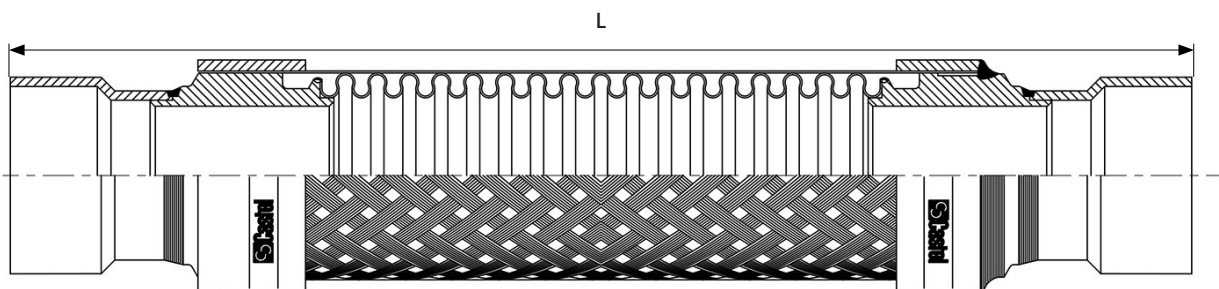
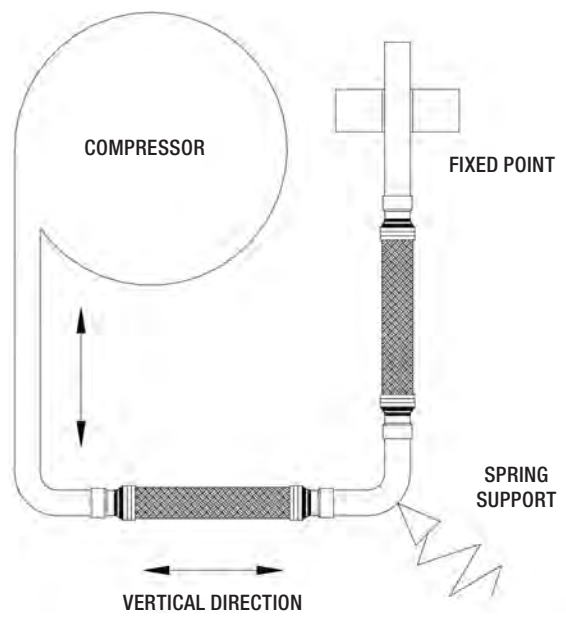
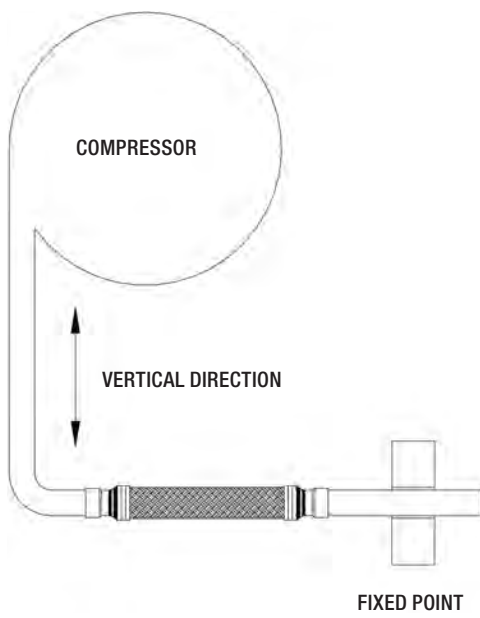


TABLE 1: GENERAL CHARACTERISTICS OF VIBRATION ABSORBERS

Catalogue Number	Connections		Length	Weight [g]	Working pressure (PS), depending on fluid temperature [bar]			Risk Category according to PED Recast
	ODS				[mm]	-80 / +100 °C	+ 120 °C	
	[mm]	[inch]						
7690/3	-	3/8	230	91	45	44	43,5	Art. 4.3
7690/M10	10	-		98				
7690/M12	12	-		122				
7690/4	-	1/2		120				
7690/M15	15	-	255	190				
7690/5	16	5/8		200				
7690/M18	18	-		180				
7690/6	-	3/4		180				
7690/7	22	7/8	290	317				
7690/M28	28	-	330	380				
7690/9	-	1.1/8		416				
7690/11	35	1.3/8	375	846				
7690/13	-	1.5/8	430	1088				
7690/M42	42	-		1200				
7690/17	54	2.1/8	510	2060				
7690/M64	64	-	690	3312	35	34,5	34	1
7690/21	67	2.5/8		3500				
7690/24	76	3		3610				
7690/25	80	3.1/8		3660				
7690/28	89	3.1/2	710	4550	25	24,5	24	
7690/34	108	4.1/4		4770				

# 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 A/8 and A/9, because they are piping components.

These fittings have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook. For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### OPERATION

The sealing system between the end of a male connection and a union in series 7010, 7020 and 7030 requires a special flaring of the end of copper pipe, the so-called flared connection.

The sealing system between the end of a male connection and a Flare-ODS adapter allows avoiding flaring the end of the copper pipe (national laws of some European countries do not accept this operation) as the end of the copper pipe is brazed into the adapter joint. We wish to remind our customers that perfect seal of the male connector / Flare-ODS adapter can only be ensured using the appropriate tapered gasket, 7580, supplied with the adapter.

The flange joints in series 7630 consist of two brass bushes for brazing to the copper pipes. Once this connection has been made, the joint seal is ensured by the compression of a gasket between the bushes. This compression occurs when the four flange screws are tightened.

### CONSTRUCTION

All nuts from series 7010 to series 7050, all plugs series 7521 and all 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. Caps in series 7560 and tapered gaskets in series 7580 are from copper Cu – ETP UNI 5649.

The main parts of the flanged joints in series 7630 are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for bushes and flanges;
- Aramid fibres for flange gaskets.



TABLE 2: GENERAL CHARACTERISTICS OF FLANGE JOINTS

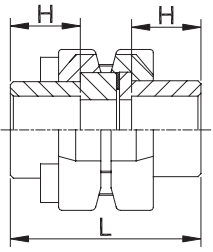
Drawing	Catalogue Number	Connections		PS [bar]	TS [°C]		Dimensions [mm]		Wrench torque min/max [Nm]	Weight [g]	
		ODS			min	max	H	L			
		Ø [in.]	Ø [mm]								
	7630/7	7/8"	–	45	-40	+130	22	63	20 / 24	612	
	7630/9	1.1/8"	–				23			490	
	7630/11	1.3/8"	35				42 / 50	1100			
	7630/13	1.5/8"	–					24	67	1412	
	7630/M42	–	42					25	71	68 / 80	2020
	7630/17	2.1/8"	54								



TABLE 3: GENERAL CHARACTERISTICS OF UNIONS

Drawing	Catalogue Number	International Reference	SAE Flare	Copper pipe		PS [bar]	Dimensions [mm]			Wrench torque min/max [Nm]	Weight [g]
				Ø [in.]	Ø [mm]		Ø D	L	Ch		
<b>SAE-Flare nuts (inch tubing)</b>											
	7010/22	NS4-4	1/4"	1/4"	6	50	6,5	15,5	17	11 / 14	19
	7010/33	NS4-6	3/8"	3/8"	-		9,7	19,5	22	20 / 25	36
	7010/44	NS4-8	1/2"	1/2"	-		13	22,5	25	34 / 47	50
	7010/55	NS4-10	5/8"	5/8"	16		16,2	25	28	54 / 75	66
	7010/66	NS4-12	3/4"	3/4"	-		19,4	29,5	33	68 / 71	99
	7010/77	NS4-14	7/8"	7/8"	22		22,5	36,5	41	90 / 120	194
	7010/88	NS4-16	1"	1"	-		25,6			120 / 150	150
<b>SAE-Flare cap nuts</b>											
	7020/20 (1)	N5-4 CAP NUT	1/4"	blind	blind	140	-	15	16	8,5 / 11,5	16
	7020/X02 (1)	N5-5 CAP NUT	5/16"	blind	blind	140	-	19,5	22	20 / 25	41
	7020/30	N5-6 CAP NUT	3/8"	blind	blind	140	-	22,5	25	34 / 47	60
	7020/40	N5-8 CAP NUT	1/2"	blind	blind	140	-	22,5	25	34 / 47	60
<b>SAE-Flare reducing nuts (inch tubing)</b>											
	7020/32	NRS4-64	3/8"	1/4"	6	50	6,5	19,5	22	20 / 25	38
	7020/43	NRS4-86	1/2"	3/8"	-		9,7	22,5	25	34 / 47	52
	7020/54	NRS4-108	5/8"	1/2"	-		13	25	28	54 / 75	71
	7020/65	NRS4-1210	3/4"	5/8"	16		16,2	29,5	33	68 / 71	104
	7020/87	NRS4-1614	1"	7/8"	22		22,5	36,5	41	120 / 150	160
<b>SAE-Flare nuts (metric tubing)</b>											
	7030/2M5	-	1/4"	-	5	50	5,2	15,5	17	11 / 14	19
	7030/3M8		3/8"		8		8,2	19,5	22	20 / 25	35
	7030/3M10		10		10,2		22,5	25	34 / 47	36	
	7030/4M10		10		10,2					52	
	7030/4M12		12		12,2		25	28	54 / 75	51	
	7030/X04 (2)		12		12,5					46	
	7030/4M14		14		14,2		22,5	48			
	7030/5M12		12		12,2		25	28	54 / 75	71	
	7030/5M14		14		14,2					69	
	7030/6M14		14		14,2		29,5	33	68 / 71	107	
	7030/6M18		18		18,2					102	
	<b>SAE-Flare twin nuts</b>										
	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): must be used without copper gasket  
 (2) shortened

TABLE 4: GENERAL CHARACTERISTICS OF UNIONS

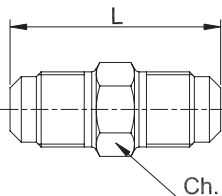
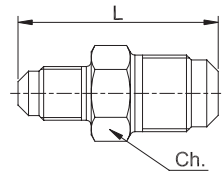
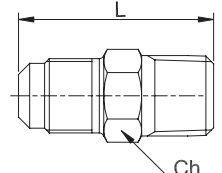
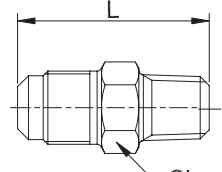
Drawing	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare	NPT		L	Ch	
<b>SAE-Flare unions</b>								
	7110/2	U2-4	1/4"	-	140	38	12	23
	7110/3	U2-6	3/8"			44	17	46
	7110/4	U2-8	1/2"			50	20	73
	7110/5	U2-10	5/8"			58	23	113
	7110/6	U2-12	3/4"			63	27	164
	7110/8	U2-16	1"			72	36	304
<b>Reducing SAE-Flare unions</b>								
	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
<b>SAE Flare / NPT unions</b>								
	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
<b>SAE Flare / NPT reducing unions</b>								
	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 5: GENERAL CHARACTERISTICS OF UNIONS

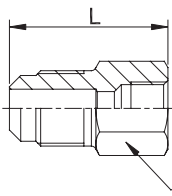
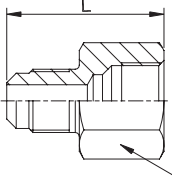
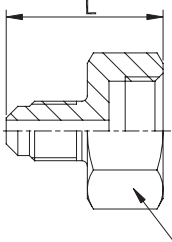
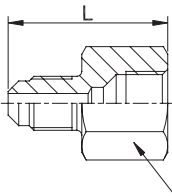
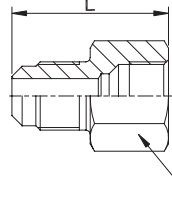
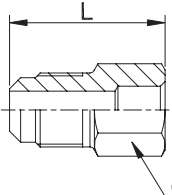
Drawing	Catalogue Number	International Reference	Connections						PS [bar]	Dimensions [mm]		Weight [g]				
			SAE Flare		NPT	GAS	ODS			L	Ch					
			m	f			Ø [in.]	Ø [mm]								
<b>Male/female reducing unions (reduced female)</b>																
	7150/21	U3-4A	1/4"	-	1/8" f	-	-	-	-	140	29	14	21			
	7150/32	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			
<b>Male/female reducing unions (reduced male)</b>																
	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	25	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			
<b>Cylinder adaptors</b>																
	7154/2	-	1/4"	20 - 14 left thread, female		-	-	-	-	45	29	25	46			
	7156/2	-	1/4"	W 21,8 - 14 right thread, female		-	-	-	-	-	29	27	52			
<b>Male/female unions</b>																
	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			
<b>Unions SAE-Flare to BSP</b>																
	7164/2	-	1/4"	-	-	G1/4" f	-	-	-	140	32,5	20	45			
	7166/2	-	-	1/4"	-	G1/4" m	-	-	-	-	32	17	25			
<b>Male SAE-Flare/solder unions</b>																
	7170/22	US3-44	1/4"	-	-	-	-	1/4"	-	140	26,5	12	17			
	7170/2M8	-						-	8							
	7170/33	US3-66						3/8"	-							
	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"	16							
	7170/6M18	-	-					18								
	7170/65	US3-1210	3/4"					5/8"	16					45,5	27	123
	7170/67	US3-1214						7/8"	22							
7170/87	US3-1614	1"		22	50	36	241									

TABLE 6: GENERAL CHARACTERISTICS OF UNIONS

Drawing	Catalogue Number	Item Position	Connections			PS [bar]	Dimensions [mm]					Wrench torque min/max [Nm]	Weight [g]
			SAE Flare	ODS			L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	Ch		
				Ø [in.]	Ø [mm]								
Flare / ODS adapters													
	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				-	-	-	-	-	-			
9900/X58	1	1/4"	-	-	-	-	16	12,5	17	11 / 14	23		
9900/X59	1	3/8"	-	-	-	-	18,5	14,7	22	20 / 25	39		
9900/X60	1	1/2"	-	-	-	-	21	17	27	34 / 47	67		
9900/X61	1	5/8"	-	-	-	-	22,5	18	30	54 / 75	83		
9900/X68	1	3/4"	-	-	-	-	25	20	36	68 / 71	129		

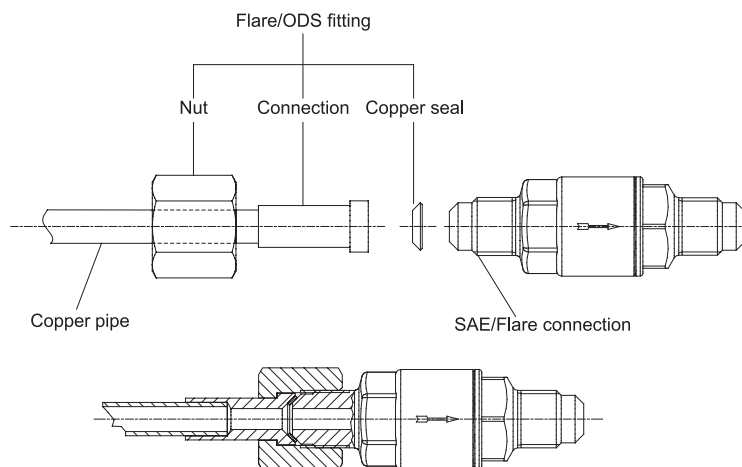


TABLE 7: GENERAL CHARACTERISTICS OF UNIONS

Drawing	Catalogue Number	International Reference	Connections			PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT		H	L	
			m	f					
<b>SAE-Flare elbows</b>									
	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
<b>SAE-Flare / NPT elbows</b>									
	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
<b>SAE-Flare / reduced NPT elbows</b>									
	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
<b>Male/female SAE-Flare elbows</b>									
	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 8: GENERAL CHARACTERISTICS OF UNIONS

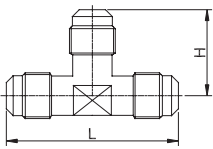
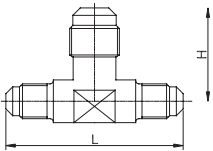
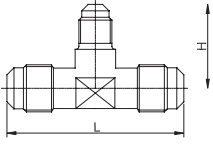
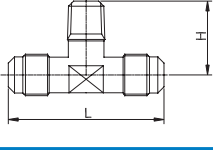
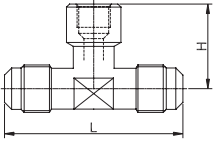
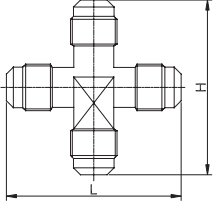
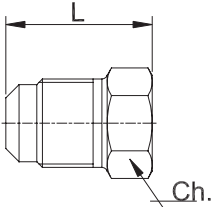
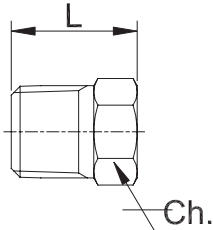
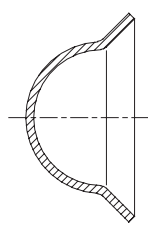

Drawing	Catalogue Number	International Reference	Connections					PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare				NPT (3)		H	L	
			(1)	(2)	(3)	(4)					
<b>SAE-Flare TEE</b>											
	7310/2	T2-4	1/4"	1/4"	1/4"	-	-	140	23,5	47	35
	7310/3	T2-6	3/8"	3/8"	3/8"				29	58	70
	7310/4	T2-8	1/2"	1/2"	1/2"				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
<b>SAE-Flare reducing TEE ( reduced side connections)</b>											
	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
<b>SAE-Flare reducing TEE ( reduced central connection)</b>											
	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
<b>SAE-Flare / NPT TEE ( taper central connection)</b>											
	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
<b>Male/female SAE-Flare TEE (female central connection)</b>											
	7340/222	T6-4	1/4"	1/4"	1/4"	-	-	140	27,5	56	73
<b>SAE-Flare cross</b>											
	7410/2	C1-4	1/4"	1/4"	1/4"	1/4"	-	140	52	52	72

TABLE 9: GENERAL CHARACTERISTICS OF UNIONS

Drawing	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Wrench torque min/max [Nm]	Weight [g]
			SAE Flare	NPT		L	Ch		
<b>SAE-Flare plugs</b>									
	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
<b>NPT plugs</b>									
	7521/1	121-B-02	-	1/8"	140	15,9	12	10 / 13	12
	7521/2	121-B-04		1/4"		23,1	14	15 / 20	27
	7521/3	121-B-06		3/8"		23,2	17	17 / 22	43
	7521/4	121-B-08		1/2"		29,8	22	25 / 35	87
	7521/6	121-B-12		3/4"		32,1	27	30 / 40	149
	7521/8	121-B-16		1"		39	34	60 / 80	279
	<b>Copper seal caps</b>								
	7560/2	B1-4	1/4"	-	50	-	-	-	0,5
	7560/3	B1-6	3/8"						1,1
	7560/4	B1-8	1/2"						2,5
	7560/5	B1-10	5/8"						2,6
	7560/6	B1-12	3/4"						3,7
	<b>Copper gaskets</b>								
	7580/2 (1)	B2-4	1/4"	-	140	-	-	-	0,3
	7580/3 (1)	B2-6	3/8"						0,6
	7580/4 (1)	B2-8	1/2"						0,8
	7580/5 (1)	B2-10	5/8"						1,2
	7580/6 (1)	B2-12	3/4"						1,4
	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"						1,0
	7581/6 (2)	B2-12	3/4"						1,2

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



# PIPING ACCESSORIES

## 10.3 – ACCESS FITTINGS AND VALVE CORES

### 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.

These fittings and valve cores have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the refrigerant fluids classified A1 according to ASHRAE STANDARD 34-2024 and listed on the first page of this Handbook.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

### 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  $8.5 \div 11.5$  Nm.

**Note: it is not necessary to use a copper gasket between union 7020/20 and the access fitting chosen.**

For systems using refrigerant fluid R410A, Castel has developed three specific filling connectors with 5/16” SAE-Flare connection (p/n 8350/X09, 8351/X05 and 8351/X07) that must be used with the following parts:

- Valve core, p/n 8395/A3;
- Blind union, p/n 7020/X02.

This solution for R410A requires to the union to be tightened with a torque wrench to  $8.5 \div 11.5$  Nm.

**Note: also in this case, it is not necessary to use a copper gasket between union 7020/X02 and the access fitting 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.

Cap 8391/A is moulded Nylon.

Caps 8392/A and 8392/B are machined from hexagonal brass bar EN 12164 – CW 614N, with chloroprene rubber (CR) gasket.

The tapered gasket with tang, 8580/2, is manufactured from copper Cu - ETP UNI 5649



TABLE 10: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

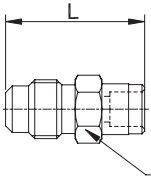
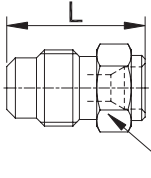
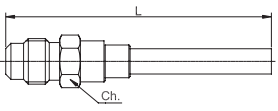
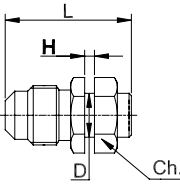
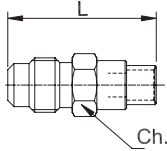
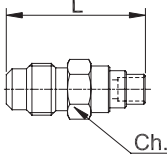
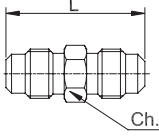
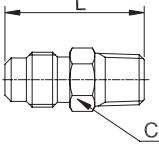
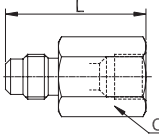
Drawing	Part number	Connections								PS [bar]	Dimensions [mm]				Weight [g]
		SAE Flare			NPT	ODS		IDS			L	Ch	D	H	
		Valve core	m	f		Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]						
<b>Straight access fittings</b>															
	8350/22	1/4"	-	-	-	1/4"	-	3/8"	-	140	26	11	-	-	12
	8350/X10	1/4"	-	-	-	1/4"	-	-	10		26	11	-	-	12
	8350/X01	1/4"	-	-	-	-	6	-	-	140	20	11	-	-	10
	8350/X03	1/4"	-	-	-	-	-	-	6	140	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	-	-	
	8350/X09	5/16"	-	-	-	1/4"	-	-	-	50	27	14	9,4	2,1	19
	8351/2	1/4"	-	-	-	-	6	-	8 - 10	140	30	11	-	-	13
	8351/X04	1/4"	-	-	-	-	-	-	6		26	11	-	-	11
	8351/X05	5/16"	-	-	-	-	-	3/8"	7		27	14	-	-	18
	8351/X07	5/16"	-	-	-	-	-	3/8"	6		27	14	-	-	19
	8351/X01	1/4"	-	-	-	-	1/8"	-	6	140	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"	-	-	-	-	-	-	140	31	11	-	-	15
	8354/21	1/4"	-	-	1/8"	-	-	-	-	140	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"	-	-	-	-	-	140	35	17	-	-	42

TABLE 11: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

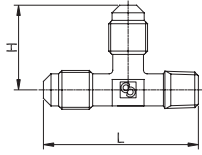
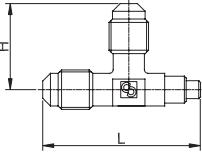
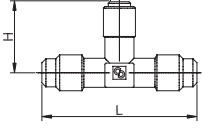
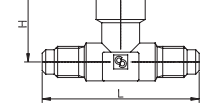
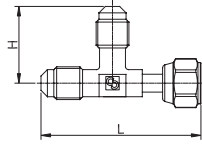
Drawing	Part number	Connections					PS [bar]	Dimensions [mm]			Wrench torque min / max [Nm]	Weight [g]	Note
		SAE Flare		NPT	IDS			L	Ch	H			
		m	f		Ø [in.]	Ø [mm]							
<b>TEE access fittings</b>													
	8380/122	1/4"	-	1/8"	-	-	140	45	-	24	-	31	The valve core may be installed on each of the two 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	140	48	-	22	-	33	
	8380/X09	1/4"	1/4"	-	-	-	140	56	-	27	-	70	
<b>TEE access fittings with swivel nuts</b>													
	8380/X06	1/4"	1/4"	-	-	-	140	50	-	24	11/14	47	With valve-core opening device on female connection. The valve core may be installed on each of the two 1/4" SAE Flare connections
	8380/X08	1/4"	1/4"	-	-	-	140	49	17	24	11/14	49	The valve core may be installed on each of the two 1/4" SAE Flare male connections

TABLE 12: GENERAL CHARACTERISTICS OF ACCESS FITTINGS

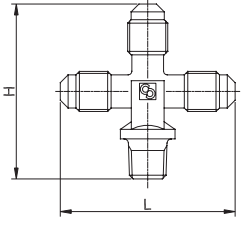
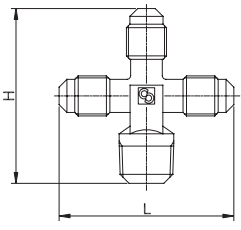
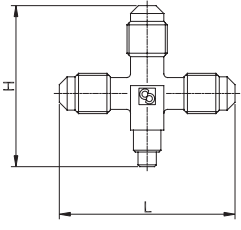
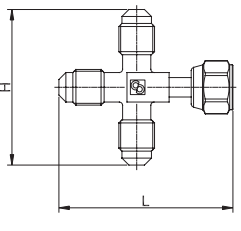
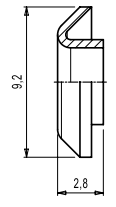
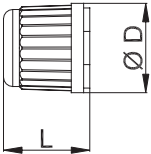
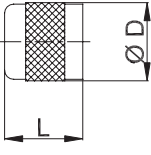
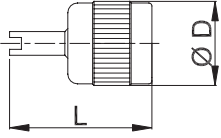
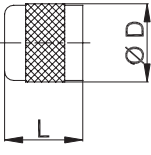
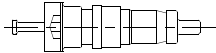
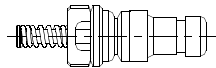
Drawing	Part number	Connections					PS [bar]	Dimensions [mm]			Wrench torque min / max [Nm]	Weight [g]	Note
		SAE Flare		NPT	IDS			L	Ch	H			
		m	f		∅ [in.]	∅ [mm]							
<b>Cross access fittings</b>													
	8382/1222	1/4"	-	1/8"	-	-	140	48	-	50	-	49	The valve core may be installed on each of the 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	
<b>Cross access fittings with swivel nut</b>													
	8382/X04	1/4"	1/4"	-	-	-	140	50	17	46	11/14	35	With valve-core opening device on female connection. The valve core may be installed on each of the three 1/4" SAE Flare connections
<b>Copper gaskets with neck</b>													
	8580/2	1/4"	-	-	-	-	140	-	-	-	-	0,3	

TABLE 13: GENERAL CHARACTERISTICS OF CAPS WITH GASKET

Drawing	Part number	Connections		PS [bar]	TS [°C]		Dimensions [mm]		Weight [g]
		SAE Flare			min	max	L	D	
	8391/A	-	1/4"	35	-20	+100	14	14	1
	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 14: GENERAL CHARACTERISTICS OF VALVE CORES

Drawing	Part number	Spring	Gaskets		Refrig. Fluids	Max Static Pressure [bar]	Operating Pressure [bar]	Operating Temperature [°C]		Dimensions [mm]		Wrench torque min / max (2) [Nm]	Weight [g]
			Body	Seat				min	max	L	D		
	8394/B	inside	PTFE	CR	R22 HFC (3)	35	30	-35	+100	19,5	5,2 x 0,705 V0.07.1	0,30/0,35	1
	8395/A1	outside	CR	CR	R22 HFC (3) HFO (4)	90	50	-32	+100	16,3		0,4/0,5	0,7

Note:

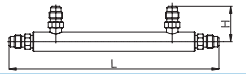
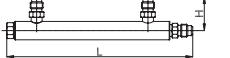
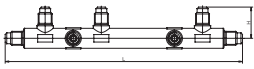
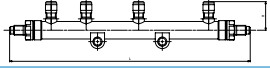

(1) Permitted value for short periods

(2) To remove the valve core use the key code 8390/A

(3) R134a, R404A, R407C, R410A, R507

(4) R1234ze, R448A, R449A, R450A, R452A, R513A, R515A, R515B

TABLE 15: GENERAL CHARACTERISTICS OF MANIFOLDS WITH ACCESS FITTINGS

Drawing	Part number	Connections			PS [bar]	TS [°C]		Dimensions [mm]		Weight [g]
		Input	Output			min	max	L	H	
			SAE Flare	SAE Flare						
	9900/X47	1/4"	2 x 1/4"	1/4"	45	-40	+150	162	30	36
	9900/X87	1/4"	2 x 1/4"	-				175		
	9900/X81	2 x 1/4"	5 x 1/4"	-				190	25	343
	9901/X43	1/4"	4 x 1/4"	1/4"	140	-50	+140	275	49	650
	9901/X44	1/4"	4 x 1/4"	1/4"				335		











Handwritten notes on lined paper. The text is extremely faint and illegible.



A series of horizontal blue lines for writing notes, spanning the width of the page.















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