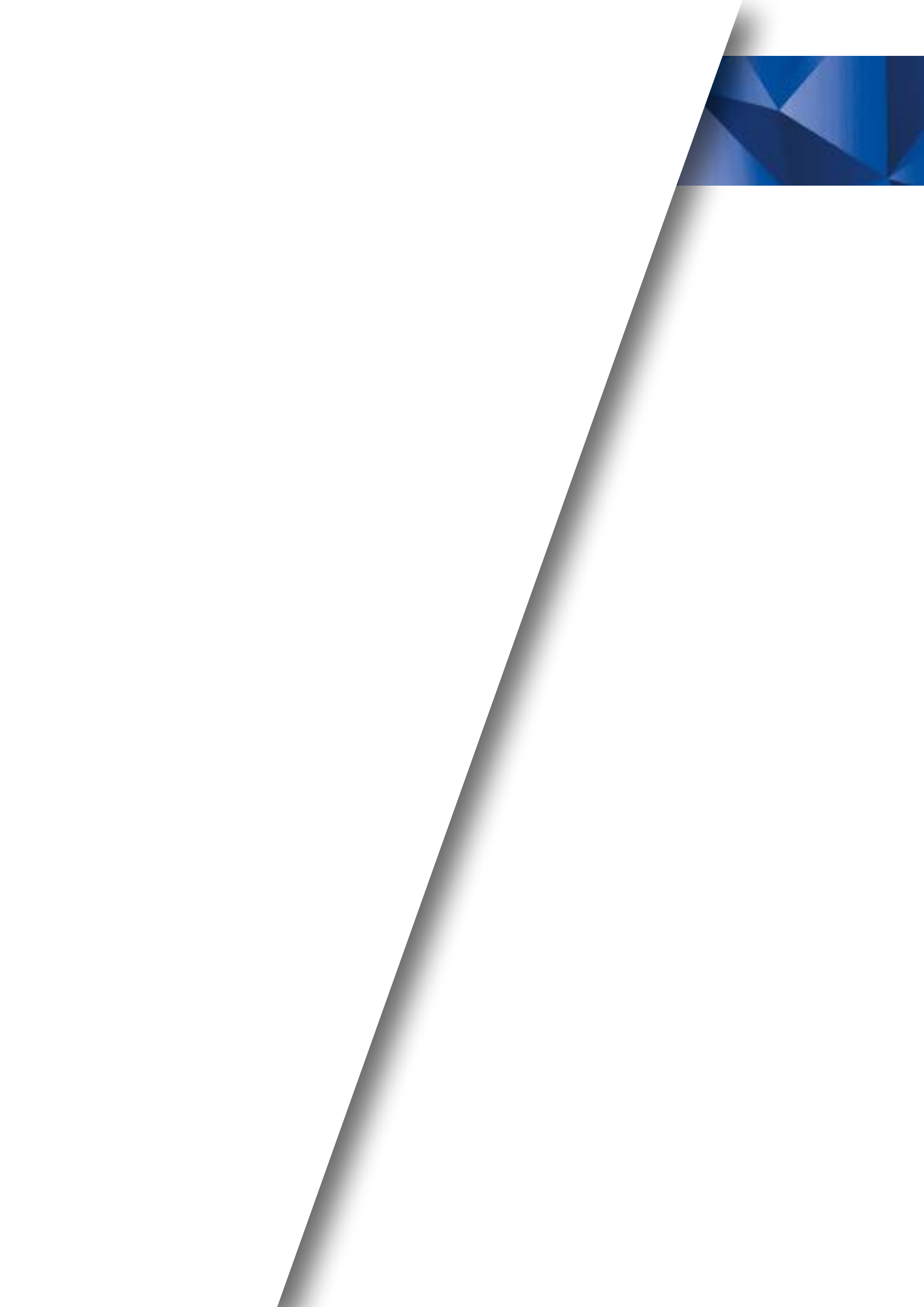


P  LYHEDRA

— 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 2020 Handbook about the line of products:**

## POLYHEDRA

**New products compatible with the widest possible range of refrigerants classified A1, A2L and A3 according to ASHRAE STANDARD 34-2019 # :**

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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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 12284:2003 – Refrigerating systems and heat pumps  
Valves - Requirements, testing and marking
- EN 14276-1:2011 – Pressure equipment for refrigerating systems and heat pumps.  
Part 1: Vessels - General requirements
- EN ISO 14903:2017 – Refrigerating systems and heat pumps  
Qualification of tightness of components and joints

### PRESSURE CONTAINMENT

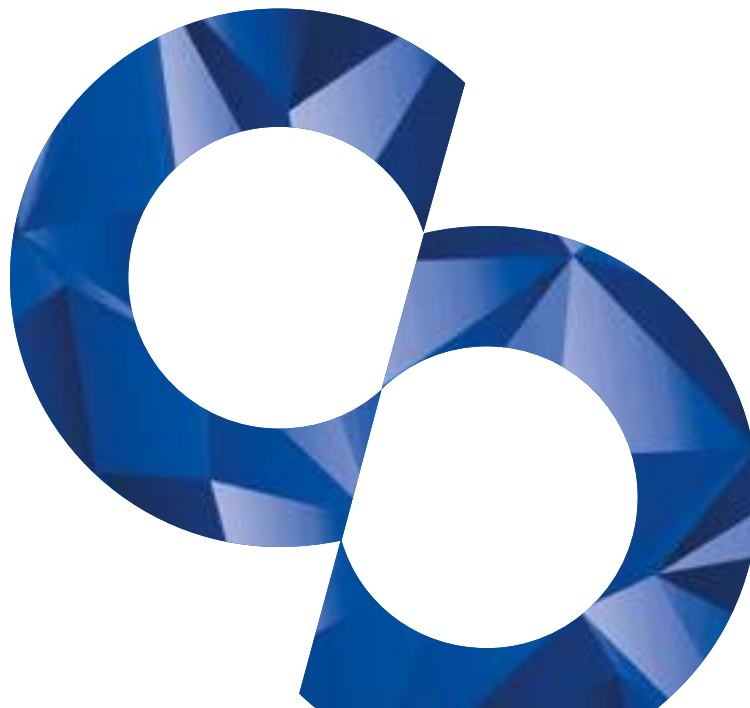
All the products, if submitted to hydrostatic testing, guarantee a pressure strength at least equal to 1.43 x PS in compliance with Directive 2014/68/EU.

All the products, if submitted to burst testing, guarantee a pressure strength at least equal to 3 x PS in compliance with standard EN 378-2:2016.

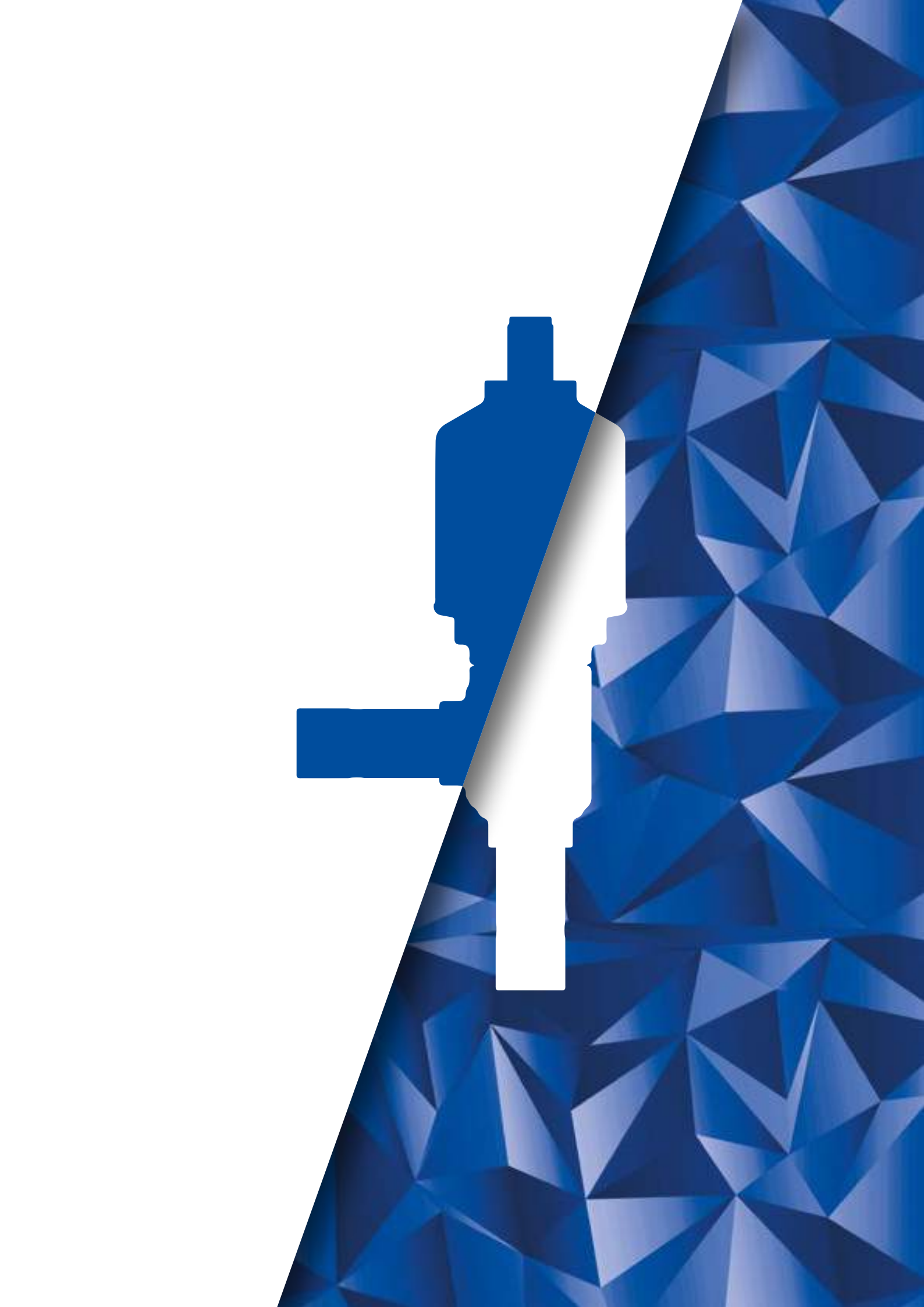
All the UL-certified products, if submitted to burst testing, guarantee a pressure strength at least equal to 5 x MWP in compliance with standard UL 207 or UL 429.

### WEIGHT

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









The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a 3D effect of depth and shadow. The colors range from light sky blue to deep navy blue.

# EXPANSION VALVES

P  LYHEDRA

# EXPANSION VALVES

## 1.1 – SOLENOID EXPANSION VALVES

### APPLICATIONS

The solenoid expansion valves in series 2028N 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.

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

### OPERATION

The valve in series 2028N 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 2028N are supplied complete with orifice. Nine different orifices with nine different maximum capacities that range from orifice 01 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 2028N/3S02 identifies a 3/8” valve with solder connections and size 02 orifice. The orifices are interchangeable and can be mounted even after the valve is soldered on the system. If you wish to change orifice, purchase the corresponding spare parts kit, according to the part number indicated in Table 3. Inside the valve body is a ring mesh filter that traps dirt and contaminants at the valve inlet.

Valves in series 2028N are sold exclusively without coil (suffix S). For these valves are available:

- Coils in series 9300 (coils type HF2)
- Coils in series 9320 (coils type HF3)
- Coils in series 9360 (coils type HF4)

The main parts of the valves in series 2028N are manufactured with the following materials:

- Hot forged brass EN 12420 – CW617N for the body
- Ferritic stainless steel EN 10088-3 – 1.4105 for the fixed and mobile plungers
- Austenitic stainless steel EN 10088-3 – 1.4305 for mobile plunger valve sleeve and orifice
- Austenitic stainless steel EN 10088-3 – 1.4301 for the mesh filter
- Copper pipe EN 12735-1 – Cu -DHP for solder connections
- P.T.F.E. for seat gaskets
- Hydrogenate nitrile rubber (HNBR) for outlet seal gaskets

### SELECTION

To dimension correctly a valve 2028N for a refrigerating system, the following design parameters must be available:

- Type of refrigerant
- Evaporator capacity,  $Q_e$
- Evaporating temperature/pressure,  $T_e / p_e$
- Minimum condensing temperature/pressure,  $T_c / p_c$
- Liquid refrigerant temperature at valve inlet,  $T_l$
- Pressure drop in the liquid line, distributor and evaporator,  $\Delta p$

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:

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

### 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

- 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

$$\Delta p_{\text{tot}} = 16,9 - (4,4 + 2) = 10,5 \cdot \text{bar}$$

Step 2 - Determine required valve capacity

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

From the subcooling correction factor Table 6B, 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

$$Q_{\text{sub}} = \frac{2,8}{1,17} = 2,39 \cdot \text{kW}$$

Step 3 - Capacity correction based on the application

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

$$Q_{\text{ev}} = 1,25 \cdot 2,39 = 3 \cdot \text{kW}$$

Step 4 - Determine required orifice dimension.

Using the capacity Table 6A for refrigerant fluid R404A, enter the data:

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

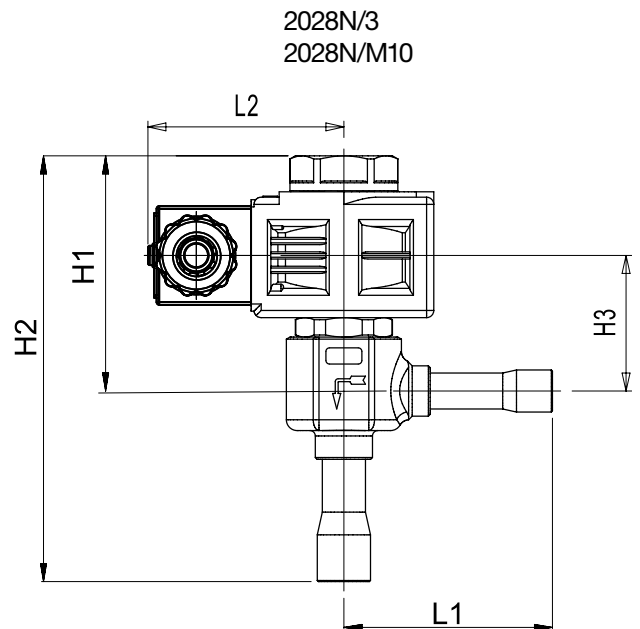
Select the corresponding orifice, 04 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity)

Table 1: General characteristics of PWM expansion valves

Catalogue number	Orifice Type	ODS Connections				Kv Factor [m³/h]	Opening Pressure Differential [bar]					Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		Risk Category according to PED Recast																	
		[in]		[mm]			MinOPD	MOPD																										
		IN	OUT	IN	OUT			AC coils series			DC coils series																							
								9110 9300	9160 9360	9120 9320	9160 9360				9120 9320																			
2028N/3S01	01	3/8"	1/2"	-	-	0																												
2028N/M10S01		-	-	10	12																													
2028N/3S02	02	3/8"	1/2"	-	-																													
2028N/M10S02		-	-	10	12																													
2028N/3S03	03	3/8"	1/2"	-	-													37	37	37	37													
2028N/M10S03		-	-	10	12																													
2028N/3S04	04	3/8"	1/2"	-	-																													
2028N/M10S04		-	-	10	12																													
2028N/3S05	05	3/8"	1/2"	-	-																													
2028N/M10S05		-	-	10	12																													
2028N/3S06	06	3/8"	1/2"	-	-																									27	27	18		
2028N/M10S06		-	-	10	12																													
2028N/4S07	07	1/2"	5/8"	-	-																									15	18	32	14	32
2028N/M12S07		-	-	12	16																													
2028N/4S08	08	1/2"	5/8"	-	-																									12	18	27	27	
2028N/M12S08		-	-	12	16																													
2028N/4S09	09	1/2"	5/8"	-	-																									10	22	10	22	
2028N/M12S09		-	-	12	16																													

Table 2: Dimensions and weights of PWM expansion valves with 9360 coils (1)

Catalogue number	Dimensions [mm]					Weight [g]				
	H1	H2	H3	L1	L2					
2028N/3S01	66	119	38	58	35,5	430				
2028N/M10S01										
2028N/3S02										
2028N/M10S02										
2028N/3S03										
2028N/M10S03										
2028N/3S04		150				450				
2028N/M10S04										
2028N/3S05										
2028N/M10S05										
2028N/3S06										
2028N/M10S06										
2028N/4S07		66				119	38	58	35,5	430
2028N/M12S07										
2028N/4S08										
2028N/M12S08										
2028N/4S09										
2028N/M12S09										



(1) : with coil 9300 the dimension L2 is equal to 34 and the weight must be decreased of 45 g  
 (1) : with coil 9320 the dimension L2 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]	Refrigerant																		
			R134a	R32	R404A	R407C	R410A	R507	R1234ze	R1234yf	R448A	R449A	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
9150N/R63	01	0,5	0,79	1,75	0,74	1,03	1,21	0,72	0,62	0,58	0,98	0,97	0,69	0,76	1,36	1,38	0,67	1,06	0,68	0,70	1,19
9150N/R64	02	0,7	1,57	3,48	1,47	2,04	2,40	1,44	1,23	1,16	1,96	1,92	1,38	1,52	2,71	2,73	1,33	2,11	1,34	1,39	2,37
9150N/R65	03	0,8	1,86	4,13	1,75	2,42	2,84	1,70	1,46	1,37	2,32	2,27	1,63	1,80	3,21	3,24	1,58	2,51	1,59	1,64	2,80
9150N/R66	04	1,1	3,01	6,68	2,83	3,92	4,60	2,76	2,36	2,22	3,75	3,68	2,64	2,91	5,19	5,24	2,55	4,05	2,57	2,66	4,54
9150N/R67	05	1,3	5,15	11,43	4,84	6,71	7,88	4,72	4,05	3,80	6,42	6,30	4,52	4,98	8,88	8,97	4,37	6,94	4,40	4,55	7,76
9150N/R68	06	1,7	7,14	15,84	6,71	9,30	10,92	6,54	5,61	5,26	8,90	8,73	6,27	6,90	12,31	12,44	6,06	9,62	6,11	6,31	10,76
9150N/R69	07	2,3	11,26	24,98	10,58	14,66	17,22	10,32	8,84	8,30	14,03	13,77	9,88	10,88	19,42	19,61	9,55	15,17	9,63	9,95	16,98
9150N/R78	08	2,5	13,57	30,11	12,75	17,67	20,75	12,44	10,66	10,00	16,91	16,60	11,91	13,11	23,40	23,64	11,51	18,28	11,60	12,00	20,46
9150N/R79	09	2,7	15,05	33,39	14,14	19,60	23,02	13,79	11,82	11,09	18,76	18,40	13,21	14,54	25,95	26,21	12,76	20,27	12,87	13,31	22,69

Rated capacities are based on:

- Evaporating temperature  $T_{evap} = + 5 \text{ }^\circ\text{C}$
- Condensing temperature  $T_{cond} = + 32 \text{ }^\circ\text{C}$
- Refrigerant liquid temperature ahead of valve  $T_{liq} = + 28 \text{ }^\circ\text{C}$

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
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
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

**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
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
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
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
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 Δtsub ≠ 4°K									
Δtsub [°K]	4	10	15	20	25	30	35	40	45
Fsub	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 R32 - Capacities in kW

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



**Table 5A: Refrigerant R32 - Capacities in kW**

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

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 5B

**Table 6A: 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
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
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
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
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

**Table 6A: Refrigerant R404A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 6B - Correction factors for subcooling $\Delta t_{sub} = 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 6B

Table 7A: 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
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
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
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
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

**Table 7A: Refrigerant R407C - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 7B - Correction factors for subcooling $\Delta t_{sub} = 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 7B

**Table 8A: Refrigerant R410A - Capacities in kW**

Evaporating Temperature 10 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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
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
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

**Table 8A: Refrigerant R410A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 8B - Correction factors for subcooling $\Delta t_{sub} = 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 8B

Table 9A: 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
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
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
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
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



**Table 9A: Refrigerant R507A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 9B - Correction factors for subcooling $\Delta t_{sub} = 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,09	1,18	1,26	1,35	1,44	1,52	1,60	1,67

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 9B

Table 10A: 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
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
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
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
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

**Table 10A: 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
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
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 10B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 10B

Table 11A: Refrigerant R1234yf - Capacities in kW

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

**Table 11A: Refrigerant R1234yf - Capacities in kW**

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

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 R448A - Capacities in kW

Evaporating Temperature 10 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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
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
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

**Table 12A: Refrigerant R448A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 12B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 12B

Table 13A: 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
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
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
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
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



**Table 13A: Refrigerant R449A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 13B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 13B

Table 14A: 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
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
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
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
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

**Table 14A: Refrigerant R450A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 14B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 14B

Table 15A: 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
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
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
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
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

**Table 15A: Refrigerant R452A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 15B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 15B

Table 16A: Refrigerant R452B - Capacities in kW

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

**Table 16A: Refrigerant R452B - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,85	1,12	1,28	1,39	1,46	1,52	1,56	1,58	1,60
02	1,70	2,22	2,54	2,76	2,91	3,02	3,10	3,15	3,17
03	2,01	2,63	3,01	3,27	3,45	3,58	3,67	3,73	3,76
04	3,25	4,25	4,87	5,28	5,58	5,79	5,94	6,03	6,08
05	5,57	7,28	8,33	9,04	9,55	9,91	10,16	10,32	10,41
06	7,72	10,09	11,54	12,53	13,24	13,73	14,08	14,30	14,43
07	12,17	15,91	18,20	19,77	20,87	21,66	22,20	22,56	22,76
08	14,67	19,17	21,94	23,82	25,16	26,10	26,76	27,19	27,42
09	16,27	21,26	24,33	26,42	27,90	28,95	29,68	30,15	30,41

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,87	1,13	1,29	1,40	1,47	1,52	1,56	1,58	1,59
02	1,74	2,25	2,56	2,77	2,92	3,02	3,09	3,14	3,16
03	2,06	2,67	3,04	3,28	3,46	3,58	3,66	3,72	3,74
04	3,33	4,32	4,91	5,32	5,60	5,80	5,93	6,02	6,06
05	5,70	7,38	8,41	9,09	9,58	9,92	10,15	10,29	10,37
06	7,91	10,24	11,65	12,61	13,28	13,75	14,07	14,27	14,37
07	12,47	16,15	18,38	19,88	20,94	21,68	22,18	22,50	22,67
08	15,03	19,46	22,15	23,96	25,23	26,13	26,73	27,12	27,32
09	16,67	21,58	24,56	26,58	27,99	28,98	29,65	30,08	30,30

TABLE 16B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,11	1,16	1,22	1,27	1,32	1,43	1,48

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 16B

Table 17A: Refrigerant R454B - Capacities in kW

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



**Table 17A: Refrigerant R454B - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,86	1,13	1,29	1,40	1,48	1,53	1,57	1,60	1,61
02	1,71	2,24	2,56	2,78	2,94	3,05	3,12	3,17	3,20
03	2,03	2,65	3,03	3,29	3,48	3,61	3,70	3,76	3,80
04	3,28	4,29	4,91	5,33	5,63	5,84	5,99	6,09	6,14
05	5,61	7,33	8,39	9,12	9,63	9,99	10,25	10,41	10,51
06	7,78	10,17	11,64	12,64	13,35	13,86	14,21	14,44	14,57
07	12,27	16,04	18,35	19,93	21,05	21,85	22,41	22,77	22,97
08	14,79	19,33	22,12	24,02	25,37	26,33	27,00	27,44	27,69
09	16,40	21,43	24,53	26,64	28,14	29,21	29,95	30,43	30,71

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,88	1,14	1,30	1,41	1,48	1,53	1,57	1,59	1,61
02	1,75	2,27	2,58	2,80	2,94	3,05	3,12	3,17	3,19
03	2,08	2,69	3,06	3,31	3,49	3,61	3,70	3,75	3,78
04	3,36	4,35	4,95	5,36	5,64	5,85	5,98	6,07	6,12
05	5,75	7,44	8,47	9,17	9,66	10,00	10,24	10,39	10,47
06	7,97	10,32	11,75	12,71	13,39	13,87	14,19	14,40	14,51
07	12,57	16,27	18,52	20,05	21,12	21,87	22,38	22,71	22,88
08	15,14	19,61	22,32	24,16	25,45	26,35	26,97	27,37	27,58
09	16,79	21,75	24,76	26,79	28,22	29,23	29,91	30,35	30,58

TABLE 17B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,11	1,16	1,22	1,27	1,32	1,43	1,48

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 17B

Table 18A: 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
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
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
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
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

**Table 18A: Refrigerant R513A - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
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
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 18B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	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 18B

Table 19A: Refrigerant R290 - Capacities in kW

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

**Table 19A: Refrigerant R290 - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,80	1,00	1,10	1,16	1,18	1,18	1,16	1,14	1,10
02	1,59	1,99	2,19	2,30	2,34	2,34	2,31	2,26	2,18
03	1,88	2,36	2,60	2,73	2,78	2,78	2,74	2,67	2,58
04	3,04	3,82	4,21	4,41	4,49	4,50	4,44	4,33	4,18
05	5,21	6,53	7,20	7,55	7,69	7,69	7,59	7,40	7,15
06	7,22	9,05	9,98	10,46	10,66	10,66	10,52	10,26	9,91
07	11,38	14,27	15,74	16,50	16,81	16,82	16,59	16,19	15,63
08	13,72	17,20	18,97	19,88	20,26	20,27	20,00	19,51	18,84
09	15,22	19,08	21,04	22,05	22,47	22,48	22,18	21,63	20,89

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,80	1,00	1,09	1,14	1,15	1,15	1,13	1,10	1,06
02	1,60	1,98	2,17	2,26	2,29	2,29	2,25	2,18	2,10
03	1,89	2,35	2,57	2,68	2,72	2,71	2,66	2,58	2,48
04	3,06	3,80	4,16	4,34	4,40	4,38	4,31	4,18	4,02
05	5,24	6,50	7,12	7,42	7,53	7,50	7,37	7,15	6,88
06	7,27	9,01	9,87	10,29	10,44	10,40	10,21	9,92	9,54
07	11,46	14,21	15,57	16,23	16,46	16,39	16,11	15,64	15,04
08	13,81	17,13	18,76	19,56	19,84	19,76	19,41	18,85	18,12
09	15,32	19,00	20,80	21,69	22,00	21,91	21,53	20,91	20,10

TABLE 19B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,12	1,18	1,24	1,30	1,35	1,40	1,45

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 19B

Table 20A: Refrigerant R600 - Capacities in kW

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

Table 20A: Refrigerant R600 - Capacities in kW									
Evaporating Temperature -20 °C									
Orifice Type	Pressure drop across valve [bar]								
	1	2	4	6	8	10	12	14	16
01	0,55	0,68	0,77	0,79	0,76	0,71	0,64	0,56	0,47
02	1,09	1,35	1,54	1,56	1,51	1,41	1,27	1,12	0,94
03	1,29	1,60	1,82	1,85	1,79	1,67	1,51	1,32	1,12
04	2,09	2,58	2,95	3,00	2,89	2,70	2,44	2,14	1,81
05	3,58	4,42	5,04	5,13	4,95	4,61	4,18	3,66	3,09
06	4,97	6,13	6,99	7,11	6,86	6,40	5,79	5,08	4,29
07	7,83	9,67	11,03	11,21	10,82	10,09	9,13	8,01	6,76
08	9,44	11,65	13,29	13,51	13,04	12,16	11,00	9,65	8,15
09	10,47	12,92	14,74	14,98	14,46	13,49	12,20	10,70	9,03

TABLE 20B - Correction factors for subcooling $\Delta t_{sub} \neq 4 \text{ °K}$									
$\Delta t_{sub} \text{ [°K]}$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,09	1,14	1,19	1,23	1,28	1,38	1,43

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporatore capacity by dividing by the appropriate correction factor found in Table 20B

Table 21A: Refrigerant R600a - Capacities in kW

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



**Table 21A: Refrigerant R600a - Capacities in kW**

Evaporating Temperature -20 °C									
Orifice Type	Pressure drop across valve [bar]								
	1	2	4	6	8	10	12	14	16
01	0,52	0,65	0,76	0,78	0,76	0,72	0,66	0,59	0,52
02	1,04	1,30	1,51	1,55	1,52	1,44	1,32	1,18	1,03
03	1,23	1,54	1,79	1,84	1,80	1,70	1,57	1,40	1,21
04	1,99	2,49	2,89	2,98	2,91	2,75	2,53	2,27	1,97
05	3,40	4,26	4,94	5,09	4,98	4,71	4,33	3,88	3,36
06	4,71	5,90	6,85	7,06	6,90	6,53	6,01	5,38	4,66
07	7,43	9,31	10,81	11,13	10,89	10,30	9,47	8,48	7,35
08	8,96	11,22	13,03	13,42	13,12	12,41	11,42	10,22	8,86
09	9,93	12,44	14,45	14,88	14,55	13,76	12,66	11,33	9,83

**TABLE 21B - Correction factors for subcooling  $\Delta t_{sub} \neq 4 \text{ °K}$**

$\Delta t_{sub} \text{ [°K]}$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,11	1,16	1,21	1,26	1,31	1,40	1,45

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 21B

Table 22A: Refrigerant R1270 - Capacities in kW

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

**Table 22A: Refrigerant R1270 - Capacities in kW**

Evaporating Temperature -30 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,85	1,08	1,21	1,29	1,33	1,36	1,36	1,35	1,33
02	1,69	2,15	2,41	2,56	2,65	2,69	2,70	2,68	2,64
03	2,00	2,55	2,86	3,04	3,14	3,19	3,20	3,18	3,13
04	3,23	4,13	4,62	4,92	5,08	5,17	5,18	5,14	5,06
05	5,53	7,06	7,91	8,41	8,70	8,84	8,86	8,80	8,66
06	7,67	9,79	10,96	11,66	12,06	12,25	12,29	12,20	12,01
07	12,09	15,43	17,29	18,39	19,02	19,32	19,38	19,24	18,94
08	14,57	18,60	20,83	22,16	22,92	23,29	23,35	23,19	22,82
09	16,16	20,63	23,11	24,58	25,42	25,83	25,90	25,71	25,31

Evaporating Temperature -40 °C									
Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,86	1,09	1,21	1,28	1,32	1,34	1,34	1,32	1,30
02	1,71	2,16	2,40	2,55	2,62	2,66	2,66	2,63	2,58
03	2,02	2,56	2,85	3,02	3,11	3,15	3,15	3,12	3,06
04	3,28	4,14	4,61	4,88	5,03	5,09	5,09	5,04	4,95
05	5,61	7,08	7,89	8,35	8,61	8,71	8,71	8,63	8,47
06	7,77	9,82	10,93	11,58	11,93	12,08	12,08	11,96	11,74
07	12,26	15,49	17,24	18,26	18,82	19,05	19,05	18,86	18,51
08	14,77	18,67	20,78	22,00	22,68	22,96	22,96	22,73	22,31
09	16,38	20,70	23,05	24,40	25,15	25,46	25,46	25,21	24,74

TABLE 22B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$									
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,12	1,18	1,24	1,30	1,35	1,40	1,45

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 22B

# EXPANSION VALVES

## 1.2 – SOLENOID EXPANSION VALVES, ATEX - CERTIFIED

### APPLICATIONS

The solenoid expansion valves in series 2028EX comply with the European standard EN 80079-36:2016, EN 80079-37:2016 and, therefore, comply with the ESR of Directive 2014/34/EU – ATEX. This equipment is suitable for use on refrigeration systems located in areas classified as “Zone 2” risk of explosion, according to the definition in Annex I of Directive 1999/92/EC.

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

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These solenoid expansion valves cannot be installed on systems that use HCFC (R22) refrigerant.**

### OPERATION

Please refer to Chapter 1.1, second paragraph, for the description of the operation of the valves in series 2028EX, as it is identical to that of valves in series 2028N.

### CONSTRUCTION

The valves in series 2028EX are supplied complete with orifice. Nine different orifices with nine different maximum capacities that range from orifice 01 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 2028EX/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.

Valves in series 2028EX are sold only in the version with coil series 9100EX (A6 suffix with coil, 9100EX-220/230 VAC, ATEX certified).

For these solenoid expansion valves are available:

- Coils in series 9100EX (coils type HM2)
- Coils in series 9110EX (coils type CM2)

The coils in series 9100EX and 9110EX must be coupled only with connectors 9150EX/R02. The protection rating guaranteed by the

coil + connector system is IP65 according to the EN 60529 standard.

The main parts of the valves in series 22028EX are made from the same materials as the valves in series 2028N.

### SELECTION

Please refer to Chapter 1.1, paragraph 4, for the description of the selection of the valves in series 2028EX, as it is identical to that of valves in series 2028N.

### DIMENSIONING EXAMPLE

- Type of refrigerant: R290
- Evaporator capacity,  $Q_e$  2.8 kW
- Evaporating temperature,  $T_e$ : 0 °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 -  $P_c = 12.2$  bar
- Evaporating pressure at 0 °C -  $P_e = 4.7$  bar

$$\Delta p_{\text{tot}} = 12,2 - (4,7 + 2) = 5,5 \cdot \text{bar}$$

*Step 2 - Determine required valve capacity*

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

From the subcooling correction factor Table 19B, par. 1.1, we find the appropriate correction factor,  $F_{\text{sub}}$ , equal to 1.12 for  $\Delta T_{\text{sub}} = 15$  °K. The required valve capacity is

$$Q_{\text{sub}} = \frac{2,8}{1,12} = 2,5 \cdot \text{kW}$$

*Step 3 - Capacity correction based on the application*

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

$$Q_{\text{ev}} = 1,25 \cdot 2,5 = 3,1 \cdot \text{kW}$$

*Step 4 - Determine the orifice size.*

Using the capacity Table 19A, par. 1.1 for R290 refrigerant, enter the data:

- Pressure drop across the valve = 5.5 bar
- Evaporating temperature = 0 °C
- Calculated evaporator capacity = 3.1 kW

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



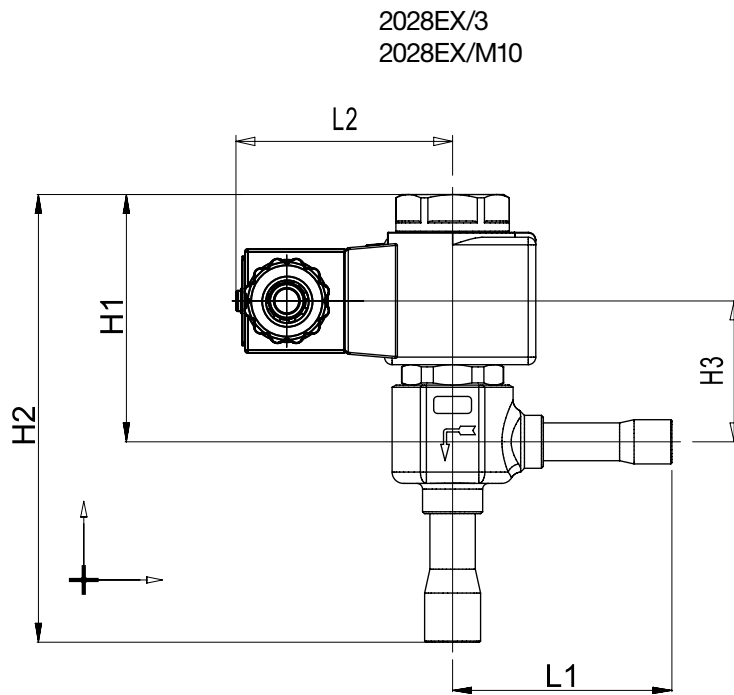
Table 23: General characteristics of PWM expansion valves - ATEX conformity for use in EX Zone 2

Catalogue number	Orifice Type	ODS Connections				Kv Factor [m3/h]	Opening Pressure Differential [bar]		Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		Risk Category according to PED Recast
		[in]		[mm]			MinOPD	MOPD 9100EX 9110EX (AC)				min.	max.	
		IN	OUT	IN	OUT									
2028EX/3A601	01	3/8"	1/2"	-	-	0,010								
2028EX/M10A601		-	-	10	12									
2028EX/3A602	02	3/8"	1/2"	-	-	0,017								
2028EX/M10A602		-	-	10	12									
2028EX/3A603	03	3/8"	1/2"	-	-	0,023	37							
2028EX/M10A603		-	-	10	12									
2028EX/3A604	04	3/8"	1/2"	-	-	0,043								
2028EX/M10A604		-	-	10	12									
2028EX/3A605	05	3/8"	1/2"	-	-	0,065	0	PWM (Pulse Width Modulating)	1	50	-40	+100	Art.4.3	
2028EX/M10A605		-	-	10	12									
2028EX/3A606	06	3/8"	1/2"	-	-	0,113								
2028EX/M10A606		-	-	10	12									
2028EX/4A607	07	1/2"	5/8"	-	-	0,200								
2028EX/M12A607		-	-	12	16									
2028EX/4A608	08	1/2"	5/8"	-	-	0,230								
2028EX/M12A608		-	-	12	16									
2028EX/4A609	09	1/2"	5/8"	-	-	0,250								
2028EX/M12A609		-	-	12	16									

Table 24: Dimensions and weights of PWM expansion valves with 9100EX coils

Catalogue number	Dimensions [mm]					Weight [g]	
	H1	H2	H3	L1	L2		
2028EX/3A601	66	119	37	58	35	370	
2028EX/M10A601							
2028EX/3A602							
2028EX/M10A602							
2028EX/3A603							
2028EX/M10A603							
2028EX/3A604		150	37	58	35		390
2028EX/M10A604							
2028EX/3A605							
2028EX/M10A605							
2028EX/3A606							
2028EX/M10A606							
2028EX/4A607	66	150	37	58	35	390	
2028EX/M12A607							
2028EX/4A608							
2028EX/M12A608							
2028EX/4A609							
2028EX/M12A609							

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



# EXPANSION VALVES

## 1.3 – MOTORIZED EXPANSION VALVES

### APPLICATIONS

Castel step-motor expansion valves series 271, 272, 273 regulate the flow of the liquid refrigerant into evaporators by modulating the valve shutter position in a calibrated orifice, allowing a wide capacity regulation range.

These right-angle valves permit bi-directional flow (the side connection is the liquid preferential inlet) and ensure a high precision and reliable control in both directions and contributing to increasing the efficiency of the entire refrigerating system.

Step-motor expansion valves can be used in a wide range of applications as listed below:

- Refrigeration systems
- Air conditioning systems
- Heat pump systems

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

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixture (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

### OPERATION

Step-motor expansion valves in series 271, 272, 273 is a lamination device that receives liquid from the condenser and injects it into the evaporator, creating the necessary pressure drop across the expansion orifice.

This valve finds applications in air conditioning systems and refrigeration plants that have a significant variation in thermal load during the entire period of operation.

This device can very quickly and efficiently vary its throttling capacity, even under significant variations in the potential demand, continuously modulating the refrigerant flow to the evaporator by opening and closing the shutter.

These valves are equipped with a linear stepper motor. The positioning of the valve shutter is controlled by an external electronic device called “driver” or “controller”. This device calculates the superheating by data acquired from the pressure transmitter and the temperature probe immediately mounted downstream of the evaporator and generate the positioning signal for the stepper motor.

In this way, the step-motor expansion valve can provide very accurate regulation of the refrigerant flow and, therefore, is able to control the superheating value, even under significant changes in thermal load, or under large power variations of the refrigeration cycle.

These valves have been developed with high linearity of the stroke/flow rate characteristic, this means that these valves can be used in operating range between 10% and 95% (maximum value to be used under transitory conditions) of declared nominal capacity. This allows the system to maintain maximum performance efficiency under any condition of thermal load and preventing the superheating value swings across the entire range of adjustment.

#### Tips and tricks:

**1.The performance and lifetime of the step-motor expansion valves in series 271, 272, 273 are guaranteed only if in the circuit lubricant oil is mixed with the refrigerant.**

**In oil-free systems, the performance, nominal capacity and the lifetime cannot be guaranteed.**

**2.The stepper motor is sensitive to the dirt/residue presence in the system, carried by the refrigerant. So, It is very important to protect the valve by installing a mechanical filter upstream of the inlet connection.**

**3.Step-motor expansion valves are not equipped with position control. Therefore, in order to operate, the linear stepper motor uses the seat valve as mechanical zero position. In this way, the initial position can be successfully detected.**

**4.The design of the linear stepper motor guarantees the irreversible motion. This means that when the valve is not powered, the valve shaft maintains the last reached position.**

**5.During continuous operation, due to their construction, a stepper motor is subject to step losses. In order to guarantee correct operation over the lifetime of the valve, the driver or controller must include in the algorithm a special feature that adjust and recover any lost steps.**





## CONSTRUCTION

Expansion valves series 271 are manufactured in a total hermetic construction making the two main components inseparable:

- Valve body: where are located the copper connections and the machined calibrated orifice
- Motor unit: where the stepper motor and all the electrical connections are located

Expansion valves series 272 and 273 are manufactured in a semi-hermetical construction. The two main components are:

- Valve body: where are located the copper connections and the machined calibrated orifice
- Motor unit: where the stepper motor and all the electrical connections are located

These components are separate, but they are supplied assembled by Castel to the correct torque. It is strongly recommended to not disassemble the motor unit from the valve body during brazing operation, to avoid damages to the motor shutter.

For all expansion valve series 271, 272, 273 brazing must be performed with care, using a low melting point filler material. During brazing operation, it is mandatory to avoid direct contact between the torch flame and the valve body and cover the motor unit with a wet cloth.

The main parts of valves in series 271, 272, 273 are made with the following materials:

- Hot forged brass EN 12240 – CW 617N for the valve body
- Austenitic stainless steel EN 10088-3 – 1.4301 for the motor unit
- Brass bar EN 12164 – CW 614N for the shutter
- Austenitic stainless steel EN 10088-3 – 1.4301 for the hermetic connector
- Copper pipe EN 12735-1 – Cu DHP for solder connections
- Bronze filled P.T.F.E. for seat gaskets
- Hydrogenate nitrile rubber (HNBR) for outlet seal gaskets

## SELECTION

To correctly select a step-motor expansion valve series 271, 272, 273 on a refrigerating system, the following design parameters must be available:

- Type of refrigerant
- Evaporator capacity,  $Q_e$
- Evaporating temperature/pressure,  $T_e / p_e$
- Minimum condensing temperature/pressure,  $T_c / p_c$
- Liquid refrigerant temperature at valve inlet,  $T_l$
- Pressure drop in the liquid line, distributor and evaporator,  $\Delta p$

The following procedure helps to select the correct expansion valve for the refrigeration system.

### 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 with the valve open

### Step 2

*Subcooling correction.* Use the evaporating capacity  $Q_e$  to select the required valve size at a given evaporating temperature. If necessary, correct the evaporator capacity by the actual subcooling value. The subcooling is calculated by the equation:

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

From the subcooling corrector factor table find the appropriate corrector factor  $F_{\text{sub}}$  corresponding to the  $\Delta T_{\text{sub}}$  calculated and determine the required valve capacity by the formula:

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

### Step 3

*Capacity correction based on the application.* To obtain a correct regulation, both in transitory period and in stable running condition, it is necessary to oversize the valve.

In this way the valve correctly works over the entire range of the system's capacity.

Generally, this correction factor,  $F_{\text{ev}}$ , can be assumed equal to 125% of the maximum evaporator's capacity. This allows the valve to modulate from about 75% during full running operation.

The capacity of the valve must be at least equal to:

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

### Step 4

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

## DIMENSIONING EXAMPLE

- Type of refrigerant: R410A
- Evaporator capacity,  $Q_e$ : 70 kW
- Evaporating temperature,  $T_e$ : 0°C
- Minimum condensing temperature,  $T_c$ : +40°C
- Liquid refrigerant temperature,  $T_l$ : +30°C
- Pressure drop in the liquid line, distributor and evaporator,  $\Delta p$ : 1 bar

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

- Condensing pressure at + 40 °C -  $P_c = 24,2$  bar
- Evaporating pressure at 0 °C -  $P_e = 8$  bar

$$\Delta p_{\text{tot}} = 24,2 - (8 + 1) = 15,2 \text{ bar}$$

Step 2 - Determine required valve capacity

$$\Delta T_{\text{sub}} = 40 - 30 = 10 \text{ }^{\circ}\text{C}$$

From the subcooling correction factor Table 33B, we find the appropriate correction factor,  $F_{\text{sub}}$ , equal to 1,07 for  $\Delta T_{\text{sub}} = 10 \text{ }^{\circ}\text{C}$ . The required valve capacity is

$$Q_{\text{sub}} = 70 / 1,07 = 65,4 \text{ kW}$$

Step 3 - Potential correction based on the application

According to the above sizing criterion,  $F_{\text{ev}} = 1,25$ :

$$Q_{\text{ev}} = 1,25 \cdot 65,4 = 81,2 \text{ kW}$$

Step 4 - Determine the valve size.

Using the capacity Table 33A for refrigerant R410A, with:

- Pressure drop across the valve = 15,2 bar
- Evaporating temperature = 0  $^{\circ}\text{C}$
- Calculated evaporator capacity = 81,8 kW

Select the corresponding step valve code: 27340

Please Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity

## ELECTRICAL CONNECTIONS

All the expansion valves series 271, 272, 273 are equipped with an M12 male connector with 4 pins.

The connection cable to the driver / controller must be order separately.

The cable with 4 pins M12 female connector can be supplied in two different lengths:

- Part no. 9901/X08: cable length: 3 m
- Part no. 9901/X20: cable length: 15 m

N.B.: It is important to control the overall resistance of the connection, cables and joints, between the driver and the valve. A significant increase of the resistance could lead to a drop in performance of the valve or in the driven proper shutter positioning. In case of greater overall resistances or longer cables, please contact the Castel Technical Department.

TABLE 25: General characteristics of stepper-motor expansion valves

Body Size	Catalogue number	ODS Connections				Equivalent port Ø [mm]	MOPD [bar]	Operating principles	PS [bar]	TS [°C]		Risk Category according to PED Recast
		[in]		[mm]						min.	max.	
		IN	OUT	IN	OUT							
271	27115/3	3/8"	3/8"	-	-	1,5	45	Stepper motor without gearbox	50	-40	+60	Art. 4.3
	27115/M10	-	-	10	10							
	27115/M12	-	-	12	12							
	27115/4	1/2"	1/2"	-	-							
	27120/3	3/8"	3/8"	-	-	2,0	45					
	27120/M10	-	-	10	10							
	27120/M12	-	-	12	12							
	27120/4	1/2"	1/2"	-	-							
	27127/3	3/8"	3/8"	-	-	2,7	45					
	27127/M10	-	-	10	10							
27127/M12	-	-	12	12								
27127/4	1/2"	1/2"	-	-								
272	27232/M12	-	-	12	12	3,2	30					
	27232/4	1/2"	1/2"	-	-							
	27232/5	5/8"	5/8"	16	16							
	27232/7	7/8"	7/8"	22	22							
	27236/M12	-	-	12	12	3,6	30					
	27236/4	1/2"	1/2"	-	-							
	27236/5	5/8"	5/8"	16	16							
27236/7	7/8"	7/8"	22	22								
273	27340/7	7/8"	7/8"	22	22	4,0	30					
	27340/9	1.1/8"	1.1/8"	-	-							
	27344/7	7/8"	7/8"	22	22	4,4	30					
	27344/9	1.1/8"	1.1/8"	-	-							

TABLE 26. General characteristics of electric motor

BODY SIZE	271	272	273
Stepper motor type	bi-polar - permanent magnet	bi-polar - permanent magnet	bi-polar - permanent magnet
Step mode	full step drive	full step drive	full step drive
Duty cycle [%]	100	100	100
Nominal voltage [V]	6	9	9
Max phase current [mA]	200	300	300
Holding current [mA]	50	50	50
Nominal power [W]	2,4	5,4	5,4
Phase resistance [ohm]	30 (at 23 °C)	30 (at 23 °C)	30 (at 23 °C)
Resistance tolerances [%]	+/- 10	+/- 10	+/- 10
Phase inductance [mH]	20	20	20
Step travel [mm]	0,025	0,025	0,025
Speed rotation [steps/sec]	35	35	35
Minimum speed rotation [steps/sec]	10	10	10
Acceleration/deceleration	50	50	50
Acceleration/deceleration [ms x 10/step]	10,5	10,5	10,5
N° steps x nominal stroke	415	415	415
N° steps of extra-travel	100	100	100
N° cycles x nominal stroke	500.000 min	500.000 min	500.000 min
Electrical connection	Circular connector M12	Circular connector M12	Circular connector M12
Protection degree	IP 65 according to EN 60529	IP 65 according to EN 60529	IP 65 according to EN 60529

TABLE 27: Dimensions and weights of stepper-motor expansion valves

Body Size	Catalogue number	H	L1	L2	D	Ch	Weight [g]
271 (Fig.1)	27115/--	160	54	52	40	-	530
	27120/--						
	27127/--						
272 (Fig.2)	27232/4-M12S	176	62	59	50	36	820
	27236/4-M12S						
	27232/5	179	65,5	62			850
	27236/5						
	27232/7						
27236/7	190,5	77	73,5				
273 (Fig.2)	27340/--	190	76,5	73	50	36	900
	27344/--						

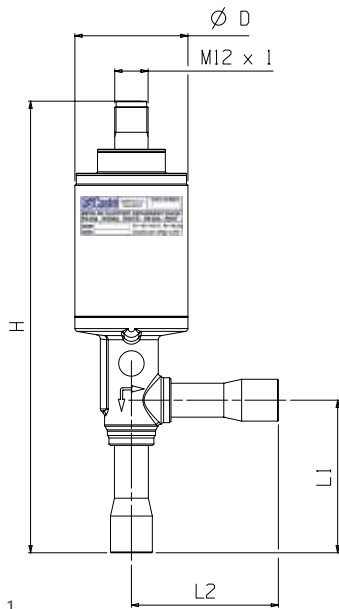


Fig. 1

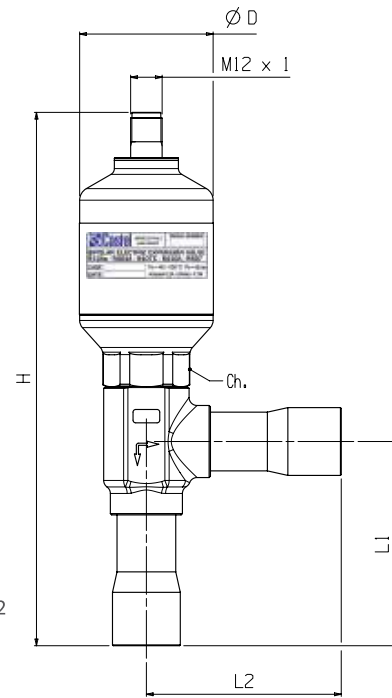
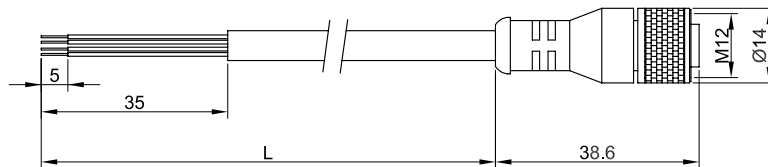


Fig. 2



9901/X28 L=3m

9901/X20 L=15m

TABLE 28: Rated capacities in kW of stepper-motor expansion valves (1)

Body Size	Catalogue number	Equivalent port Ø [mm]	Refrigerant									
			R134a	R32	R404A	R407C	R410A	R507A	R1234yf	R1234ze	R448A	R449A
271	27115/--	1,5	15,30	33,94	14,37	19,92	23,40	14,02	11,28	12,02	19,07	18,71
	27120/--	2,0	20,40	45,26	19,16	26,56	31,20	18,70	15,04	16,02	25,42	24,95
	27127/--	2,7	25,20	55,91	23,67	32,81	38,54	23,09	18,57	19,79	31,41	30,82
272	27232/--	3,2	32,20	71,44	30,24	41,92	49,24	29,51	23,73	25,29	40,13	39,38
	27236/--	3,6	44,10	97,84	41,42	57,42	67,44	40,42	32,51	34,64	54,96	53,93
273	27340/--	4,0	51,00	113,15	47,90	66,40	78,00	46,74	37,59	40,00	63,56	62,37
	27344/--	4,4	59,32	131,60	55,71	77,24	90,72	54,36	43,72	46,59	73,93	72,54

Body Size	Catalogue number	Equivalent port Ø [mm]	Refrigerant								
			R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
271	27115/--	1,5	13,43	14,78	26,38	26,65	12,98	20,61	13,08	13,53	23,07
	27120/--	2,0	17,90	19,71	35,18	35,53	17,30	27,48	17,44	18,03	30,75
	27127/--	2,7	22,11	24,35	43,45	43,89	21,37	33,94	21,55	22,28	38,00
272	27232/--	3,2	28,26	31,11	55,52	56,09	27,31	43,37	27,53	28,47	48,54
	27236/--	3,6	38,70	42,61	76,04	76,81	37,40	59,40	37,71	39,00	66,48
273	27340/--	4,0	44,75	49,28	87,94	88,83	43,25	68,69	43,61	45,09	76,89
	27344/--	4,4	52,05	57,32	102,29	103,32	50,31	79,89	50,72	52,44	89,43

(1): Rated capacity with fully open valve and liquid flow from radial to axial connection

Rated capacities are based on:

- Evaporating temperature  $T_{evap} = + 5 \text{ }^\circ\text{C}$
- Condensing temperature  $T_{cond} = + 32 \text{ }^\circ\text{C}$
- Refrigerant liquid temperature ahead of valve  $T_{liq} = + 28 \text{ }^\circ\text{C}$

**Valves operating range from 10% up to 95% of declared nominal capacities**

**Table 29A: Refrigerant R134a - Capacities in kW (1)**

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,19	14,34	16,05	17,01	17,49	17,65	17,55	17,25	16,78	16,18	15,44
27120/--	2,0	14,92	19,13	21,40	22,68	23,33	23,53	23,40	23,00	22,38	21,57	20,59
27127/--	2,7	18,43	23,63	26,44	28,02	28,81	29,06	28,90	28,41	27,64	26,64	25,44
27232/--	3,2	23,55	30,19	33,78	35,80	36,82	37,14	36,93	36,30	35,32	34,04	32,50
27236/--	3,6	32,25	41,35	46,27	49,03	50,43	50,86	50,57	49,71	48,37	46,63	44,51
27340/--	4,0	37,30	47,82	53,51	56,70	58,32	58,82	58,49	57,49	55,94	53,92	51,48
27344/--	4,4	43,38	55,62	62,23	65,95	67,83	68,42	68,03	66,87	65,07	62,72	59,88
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,58	14,69	16,32	17,20	17,62	17,71	17,55	17,20	16,69	16,05	15,29
27120/--	2,0	15,44	19,59	21,76	22,94	23,49	23,61	23,40	22,93	22,25	21,40	20,38
27127/--	2,7	19,07	24,20	26,88	28,34	29,02	29,16	28,90	28,33	27,49	26,43	25,18
27232/--	3,2	24,37	30,92	34,35	36,21	37,08	37,26	36,93	36,20	35,13	33,77	32,17
27236/--	3,6	33,38	42,34	47,05	49,59	50,78	51,03	50,58	49,57	48,11	46,26	44,06
27340/--	4,0	38,60	48,97	54,41	57,35	58,73	59,02	58,49	57,33	55,64	53,49	50,95
27344/--	4,4	44,90	56,96	63,28	66,70	68,31	68,65	68,04	66,68	64,71	62,22	59,26
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,87	14,88	16,40	17,19	17,52	17,53	17,31	16,90	16,35	15,66	14,86
27120/--	2,0	15,82	19,83	21,87	22,92	23,36	23,38	23,08	22,54	21,80	20,88	19,82
27127/--	2,7	19,54	24,50	27,01	28,31	28,85	28,88	28,51	27,84	26,92	25,79	24,48
27232/--	3,2	24,97	31,31	34,52	36,17	36,87	36,90	36,43	35,58	34,40	32,96	31,28
27236/--	3,6	34,20	42,88	47,27	49,54	50,50	50,54	49,90	48,73	47,12	45,14	42,84
27340/--	4,0	39,55	49,58	54,67	57,30	58,40	58,44	57,70	56,35	54,49	52,20	49,54
27344/--	4,4	46,00	57,67	63,59	66,64	67,92	67,98	67,12	65,54	63,38	60,72	57,62
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,03	14,90	16,30	16,98	17,22	17,16	16,87	16,40	15,79	15,06	14,22
27120/--	2,0	16,04	19,87	21,73	22,64	22,96	22,88	22,49	21,87	21,05	20,08	18,96
27127/--	2,7	19,82	24,54	26,85	27,97	28,37	28,26	27,78	27,01	26,01	24,80	23,42
27232/--	3,2	25,32	31,36	34,31	35,74	36,25	36,11	35,50	34,52	33,23	31,69	29,92
27236/--	3,6	34,68	42,95	46,98	48,95	49,64	49,46	48,62	47,28	45,51	43,40	40,98
27340/--	4,0	40,11	49,66	54,34	56,61	57,41	57,20	56,23	54,67	52,64	50,19	47,40
27344/--	4,4	46,65	57,77	63,20	65,84	66,78	66,53	65,40	63,59	61,22	58,38	55,13

**Table 29A: Refrigerant R134a - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,08	14,77	16,04	16,61	16,76	16,62	16,26	15,73	15,06	14,28	13,40
27120/--	2,0	16,11	19,70	21,39	22,15	22,35	22,15	21,67	20,97	20,08	19,04	17,86
27127/--	2,7	19,89	24,33	26,42	27,36	27,60	27,37	26,77	25,90	24,81	23,52	22,07
27232/--	3,2	25,42	31,09	33,76	34,96	35,27	34,97	34,21	33,10	31,70	30,05	28,20
27236/--	3,6	34,82	42,58	46,23	47,88	48,31	47,89	46,85	45,33	43,41	41,16	38,62
27340/--	4,0	40,26	49,24	53,47	55,37	55,86	55,38	54,18	52,42	50,20	47,60	44,66
27344/--	4,4	46,83	57,28	62,19	64,41	64,98	64,42	63,02	60,97	58,39	55,36	51,95

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,01	14,51	15,64	16,11	16,16	15,94	15,51	14,92	14,20	13,37	12,44
27120/--	2,0	16,01	19,35	20,86	21,47	21,55	21,25	20,68	19,89	18,93	17,82	16,59
27127/--	2,7	19,78	23,91	25,77	26,53	26,62	26,25	25,54	24,57	23,38	22,02	20,49
27232/--	3,2	25,27	30,55	32,92	33,89	34,01	33,54	32,64	31,39	29,88	28,13	26,19
27236/--	3,6	34,61	41,84	45,09	46,42	46,58	45,94	44,70	43,00	40,92	38,53	35,86
27340/--	4,0	40,02	48,38	52,14	53,68	53,87	53,12	51,69	49,72	47,32	44,56	41,48
27344/--	4,4	46,55	56,28	60,65	62,44	62,66	61,79	60,12	57,84	55,04	51,83	48,24

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 29B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 29B

Table 30A: Refrigerant R32 - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,85	22,82	26,81	29,74	31,97	33,70	35,04	36,06	36,82	37,36	37,70
27120/--	2,0	22,47	30,43	35,75	39,65	42,63	44,94	46,72	48,09	49,11	49,82	50,27
27127/--	2,7	27,76	37,59	44,16	48,99	52,66	55,51	57,72	59,41	60,66	61,54	62,10
27232/--	3,2	35,47	48,03	56,43	62,59	67,29	70,93	73,75	75,91	77,51	78,64	79,35
27236/--	3,6	48,57	65,77	77,28	85,72	92,16	97,14	101,00	103,96	106,16	107,70	108,67
27340/--	4,0	56,17	76,07	89,37	99,14	106,58	112,34	116,81	120,23	122,77	124,55	125,67
27344/--	4,4	65,33	88,47	103,94	115,30	123,96	130,66	135,86	139,83	142,79	144,86	146,16
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	17,97	24,23	28,37	31,40	33,70	35,48	36,86	37,92	38,71	39,28	39,65
27120/--	2,0	23,96	32,31	37,84	41,87	44,94	47,31	49,15	50,56	51,62	52,38	52,88
27127/--	2,7	29,60	39,91	46,74	51,73	55,52	58,44	60,72	62,46	63,77	64,71	65,32
27232/--	3,2	37,82	50,99	59,73	66,10	70,94	74,68	77,58	79,81	81,49	82,68	83,46
27236/--	3,6	51,80	69,84	81,80	90,52	97,15	102,28	106,25	109,31	111,60	113,24	114,30
27340/--	4,0	59,91	80,77	94,60	104,68	112,35	118,28	122,88	126,41	129,06	130,96	132,19
27344/--	4,4	69,67	93,94	110,02	121,75	130,67	137,57	142,91	147,02	150,10	152,31	153,75
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	18,96	25,42	29,65	32,72	35,04	36,83	38,21	39,27	40,07	40,65	41,03
27120/--	2,0	25,28	33,89	39,54	43,63	46,72	49,11	50,96	52,37	53,44	54,20	54,71
27127/--	2,7	31,23	41,87	48,84	53,90	57,72	60,66	62,95	64,70	66,01	66,96	67,58
27232/--	3,2	39,90	53,50	62,41	68,87	73,75	77,51	80,43	82,67	84,35	85,56	86,36
27236/--	3,6	54,65	73,27	85,47	94,32	101,00	106,16	110,15	113,22	115,52	117,18	118,27
27340/--	4,0	63,20	84,73	98,85	109,07	116,81	122,77	127,39	130,93	133,60	135,51	136,78
27344/--	4,4	73,50	98,55	114,96	126,86	135,86	142,79	148,16	152,28	155,38	157,61	159,08
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	19,81	26,38	30,63	33,69	36,00	37,77	39,13	40,18	40,96	41,52	41,89
27120/--	2,0	26,41	35,17	40,85	44,93	48,00	50,36	52,18	53,58	54,62	55,37	55,86
27127/--	2,7	32,63	43,45	50,46	55,51	59,30	62,21	64,46	66,18	67,47	68,40	69,00
27232/--	3,2	41,69	55,52	64,48	70,92	75,77	79,49	82,37	84,57	86,21	87,39	88,17
27236/--	3,6	57,10	76,04	88,31	97,13	103,77	108,87	112,80	115,82	118,07	119,69	120,75
27340/--	4,0	66,03	87,93	102,13	112,33	120,01	125,91	130,46	133,94	136,55	138,42	139,65
27344/--	4,4	76,80	102,27	118,78	130,65	139,58	146,44	151,73	155,78	158,81	160,99	162,42



**Table 30A: Refrigerant R32 - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	20,51	27,10	31,33	34,34	36,60	38,33	39,65	40,67	41,42	41,95	42,30
27120/--	2,0	27,35	36,14	41,77	45,80	48,81	51,11	52,88	54,23	55,23	55,95	56,41
27127/--	2,7	33,78	44,65	51,60	56,57	60,29	63,14	65,32	66,99	68,23	69,11	69,68
27232/--	3,2	43,17	57,05	65,94	72,29	77,04	80,68	83,47	85,60	87,18	88,31	89,03
27236/--	3,6	59,12	78,13	90,30	99,00	105,51	110,49	114,31	117,23	119,40	120,94	121,94
27340/--	4,0	68,37	90,35	104,43	114,49	122,02	127,78	132,20	135,57	138,08	139,86	141,02
27344/--	4,4	79,52	105,09	121,46	133,16	141,92	148,62	153,76	157,68	160,60	162,67	164,01

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	21,05	27,59	31,74	34,68	36,88	38,55	39,83	40,79	41,51	42,01	42,32
27120/--	2,0	28,07	36,79	42,32	46,25	49,18	51,41	53,11	54,40	55,35	56,02	56,44
27127/--	2,7	34,67	45,44	52,28	57,13	60,75	63,50	65,61	67,20	68,37	69,20	69,72
27232/--	3,2	44,30	58,07	66,80	73,00	77,62	81,14	83,83	85,86	87,37	88,42	89,08
27236/--	3,6	60,67	79,52	91,48	99,98	106,31	111,12	114,81	117,59	119,65	121,09	122,00
27340/--	4,0	70,16	91,97	105,80	115,62	122,94	128,51	132,77	135,99	138,37	140,04	141,10
27344/--	4,4	81,60	106,96	123,05	134,48	142,99	149,47	154,42	158,17	160,94	162,88	164,10

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 30B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,06	1,11	1,16	1,22	1,27	1,32	1,43	1,48

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 30B

Table 31A: Refrigerant R404A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,82	11,47	12,94	13,78	14,19	14,29	14,16	13,82	13,31	12,63	11,79
27120/--	2,0	11,77	15,30	17,26	18,37	18,92	19,06	18,88	18,43	17,75	16,84	15,72
27127/--	2,7	14,54	18,90	21,32	22,69	23,37	23,54	23,32	22,77	21,92	20,81	19,42
27232/--	3,2	18,57	24,14	27,24	28,99	29,85	30,08	29,79	29,08	28,01	26,59	24,81
27236/--	3,6	25,43	33,07	37,31	39,71	40,89	41,20	40,80	39,84	38,36	36,42	33,98
27340/--	4,0	29,41	38,24	43,14	45,92	47,29	47,64	47,19	46,07	44,37	42,11	39,30
27344/--	4,4	34,21	44,48	50,18	53,40	55,00	55,41	54,88	53,58	51,60	48,98	45,71
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,42	12,16	13,66	14,49	14,89	14,98	14,84	14,50	13,99	13,34	12,54
27120/--	2,0	12,56	16,22	18,21	19,32	19,85	19,98	19,78	19,33	18,66	17,78	16,72
27127/--	2,7	15,52	20,03	22,50	23,86	24,52	24,68	24,44	23,88	23,05	21,97	20,65
27232/--	3,2	19,82	25,59	28,74	30,49	31,33	31,53	31,22	30,51	29,44	28,07	26,38
27236/--	3,6	27,15	35,06	39,36	41,76	42,92	43,18	42,76	41,79	40,33	38,44	36,14
27340/--	4,0	31,40	40,54	45,52	48,29	49,63	49,94	49,46	48,32	46,64	44,46	41,79
27344/--	4,4	36,52	47,15	52,94	56,17	57,72	58,08	57,52	56,20	54,25	51,70	48,61
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,92	12,69	14,16	14,96	15,32	15,38	15,20	14,83	14,31	13,65	12,85
27120/--	2,0	13,22	16,92	18,89	19,94	20,43	20,50	20,26	19,78	19,08	18,19	17,14
27127/--	2,7	16,34	20,91	23,33	24,64	25,23	25,33	25,03	24,43	23,57	22,48	21,17
27232/--	3,2	20,87	26,71	29,81	31,48	32,24	32,36	31,98	31,21	30,11	28,71	27,04
27236/--	3,6	28,59	36,58	40,83	43,11	44,16	44,32	43,81	42,75	41,24	39,33	37,04
27340/--	4,0	33,06	42,31	47,21	49,86	51,06	51,25	50,66	49,44	47,70	45,48	42,84
27344/--	4,4	38,45	49,21	54,91	57,99	59,39	59,61	58,92	57,50	55,47	52,90	49,82
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,32	13,06	14,47	15,20	15,50	15,50	15,28	14,87	14,31	13,63	12,82
27120/--	2,0	13,76	17,41	19,29	20,27	20,67	20,67	20,37	19,83	19,09	18,17	17,09
27127/--	2,7	16,99	21,51	23,84	25,04	25,53	25,53	25,16	24,49	23,58	22,44	21,11
27232/--	3,2	21,71	27,49	30,45	31,98	32,62	32,62	32,15	31,29	30,12	28,67	26,97
27236/--	3,6	29,74	37,65	41,71	43,81	44,68	44,68	44,03	42,86	41,26	39,28	36,95
27340/--	4,0	34,39	43,54	48,23	50,66	51,67	51,67	50,92	49,57	47,71	45,42	42,73
27344/--	4,4	40,00	50,64	56,10	58,92	60,09	60,10	59,22	57,65	55,49	52,83	49,69

**Table 31A: Refrigerant R404A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,61	13,27	14,58	15,23	15,45	15,39	15,11	14,65	14,05	13,33	12,50
27120/--	2,0	14,14	17,69	19,44	20,30	20,61	20,52	20,14	19,54	18,74	17,78	16,66
27127/--	2,7	17,47	21,85	24,02	25,08	25,46	25,35	24,89	24,14	23,15	21,96	20,59
27232/--	3,2	22,32	27,92	30,69	32,04	32,52	32,39	31,79	30,84	29,58	28,06	26,30
27236/--	3,6	30,58	38,24	42,03	43,89	44,54	44,36	43,55	42,24	40,51	38,43	36,03
27340/--	4,0	35,36	44,22	48,61	50,76	51,51	51,30	50,36	48,84	46,85	44,44	41,66
27344/--	4,4	41,12	51,43	56,54	59,03	59,91	59,66	58,57	56,81	54,49	51,69	48,45

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,78	13,31	14,51	15,06	15,21	15,07	14,73	14,22	13,57	12,81	11,95
27120/--	2,0	14,38	17,75	19,35	20,08	20,27	20,09	19,64	18,96	18,10	17,08	15,93
27127/--	2,7	17,76	21,93	23,91	24,81	25,05	24,82	24,26	23,42	22,36	21,10	19,68
27232/--	3,2	22,69	28,02	30,54	31,70	32,00	31,71	30,99	29,92	28,56	26,96	25,14
27236/--	3,6	31,08	38,37	41,84	43,41	43,83	43,44	42,45	40,98	39,13	36,93	34,43
27340/--	4,0	35,94	44,38	48,38	50,21	50,69	50,24	49,09	47,39	45,25	42,71	39,82
27344/--	4,4	41,80	51,61	56,27	58,39	58,95	58,43	57,09	55,12	52,62	49,67	46,31

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 31B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 31B

Table 32A: Refrigerant R407C - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,06	14,62	16,79	18,21	19,16	19,75	20,08	20,19	20,13	19,91	19,54
27120/--	2,0	14,74	19,49	22,38	24,28	25,54	26,34	26,77	26,93	26,84	26,54	26,06
27127/--	2,7	18,21	24,07	27,65	30,00	31,55	32,53	33,07	33,26	33,15	32,79	32,19
27232/--	3,2	23,27	30,76	35,32	38,33	40,31	41,57	42,26	42,50	42,36	41,89	41,13
27236/--	3,6	31,88	42,13	48,39	52,50	55,22	56,93	57,88	58,21	58,02	57,38	56,33
27340/--	4,0	36,86	48,72	55,95	60,71	63,85	65,84	66,93	67,32	67,09	66,35	65,14
27344/--	4,4	42,88	56,68	65,09	70,62	74,28	76,59	77,86	78,30	78,05	77,19	75,78
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,66	15,30	17,49	18,90	19,83	20,40	20,71	20,80	20,72	20,49	20,12
27120/--	2,0	15,54	20,40	23,31	25,20	26,44	27,20	27,61	27,74	27,63	27,32	26,83
27127/--	2,7	19,20	25,20	28,80	31,14	32,66	33,60	34,11	34,26	34,13	33,75	33,14
27232/--	3,2	24,53	32,20	36,80	39,78	41,73	42,93	43,58	43,78	43,61	43,12	42,34
27236/--	3,6	33,60	44,11	50,40	54,49	57,15	58,81	59,69	59,97	59,73	59,06	58,00
27340/--	4,0	38,85	51,00	58,29	63,01	66,09	68,00	69,03	69,34	69,07	68,29	67,07
27344/--	4,4	45,20	59,33	67,80	73,30	76,88	79,11	80,30	80,67	80,35	79,44	78,02
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,16	15,83	17,99	19,36	20,24	20,77	21,04	21,10	20,99	20,73	20,34
27120/--	2,0	16,21	21,11	23,98	25,82	26,99	27,70	28,05	28,13	27,98	27,64	27,12
27127/--	2,7	20,03	26,07	29,63	31,89	33,34	34,22	34,66	34,75	34,57	34,14	33,50
27232/--	3,2	25,59	33,31	37,85	40,75	42,60	43,72	44,28	44,40	44,17	43,62	42,81
27236/--	3,6	35,05	45,63	51,85	55,81	58,35	59,88	60,65	60,82	60,50	59,75	58,63
27340/--	4,0	40,54	52,77	59,95	64,54	67,47	69,24	70,14	70,33	69,96	69,10	67,80
27344/--	4,4	47,15	61,38	69,74	75,08	78,49	80,55	81,59	81,82	81,38	80,38	78,87
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,56	16,20	18,29	19,60	20,41	20,89	21,10	21,12	20,96	20,67	20,25
27120/--	2,0	16,75	21,60	24,38	26,13	27,22	27,85	28,14	28,16	27,95	27,56	27,00
27127/--	2,7	20,69	26,68	30,12	32,28	33,62	34,40	34,76	34,78	34,53	34,05	33,36
27232/--	3,2	26,44	34,09	38,49	41,24	42,96	43,96	44,41	44,44	44,12	43,50	42,62
27236/--	3,6	36,22	46,69	52,72	56,49	58,84	60,21	60,83	60,87	60,43	59,58	58,38
27340/--	4,0	41,88	53,99	60,96	65,32	68,04	69,62	70,35	70,39	69,88	68,90	67,51
27344/--	4,4	48,72	62,81	70,91	75,98	79,15	80,99	81,83	81,88	81,29	80,15	78,53

**Table 32A: Refrigerant R407C - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,86	16,40	18,40	19,62	20,36	20,77	20,93	20,89	20,69	20,35	19,90
27120/--	2,0	17,14	21,87	24,53	26,16	27,15	27,69	27,90	27,85	27,59	27,14	26,54
27127/--	2,7	21,18	27,01	30,30	32,31	33,54	34,21	34,47	34,41	34,08	33,53	32,78
27232/--	3,2	27,06	34,51	38,71	41,29	42,85	43,71	44,04	43,96	43,54	42,84	41,88
27236/--	3,6	37,06	47,28	53,03	56,55	58,69	59,87	60,32	60,21	59,64	58,67	57,37
27340/--	4,0	42,86	54,67	61,32	65,40	67,87	69,23	69,76	69,63	68,97	67,85	66,34
27344/--	4,4	49,86	63,59	71,33	76,07	78,95	80,53	81,15	81,00	80,22	78,93	77,17

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,03	16,44	18,32	19,45	20,11	20,45	20,55	20,45	20,20	19,82	19,33
27120/--	2,0	17,38	21,92	24,43	25,94	26,82	27,27	27,39	27,27	26,94	26,43	25,78
27127/--	2,7	21,46	27,08	30,18	32,04	33,13	33,68	33,84	33,69	33,28	32,65	31,84
27232/--	3,2	27,42	34,60	38,56	40,93	42,32	43,03	43,24	43,04	42,52	41,72	40,69
27236/--	3,6	37,56	47,39	52,82	56,07	57,97	58,95	59,22	58,95	58,24	57,15	55,73
27340/--	4,0	43,44	54,81	61,08	64,84	67,04	68,16	68,48	68,17	67,34	66,08	64,44
27344/--	4,4	50,53	63,75	71,05	75,42	77,98	79,29	79,66	79,30	78,34	76,87	74,96

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 32B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 32B

Table 33A: Refrigerant R410A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,21	16,35	19,00	20,83	22,14	23,05	23,66	24,03	24,19	24,16	23,97
27120/--	2,0	16,28	21,80	25,33	27,78	29,52	30,73	31,55	32,04	32,25	32,22	31,96
27127/--	2,7	20,11	26,93	31,29	34,31	36,46	37,96	38,97	39,57	39,84	39,79	39,48
27232/--	3,2	25,69	34,41	39,98	43,84	46,58	48,50	49,79	50,56	50,90	50,84	50,44
27236/--	3,6	35,19	47,13	54,75	60,05	63,80	66,43	68,19	69,25	69,71	69,64	69,08
27340/--	4,0	40,70	54,51	63,33	69,45	73,79	76,83	78,87	80,09	80,62	80,54	79,90
27344/--	4,4	47,34	63,40	73,66	80,77	85,82	89,36	91,74	93,16	93,77	93,67	92,93
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,11	17,47	20,23	22,13	23,47	24,41	25,05	25,43	25,61	25,62	25,46
27120/--	2,0	17,48	23,29	26,97	29,50	31,29	32,55	33,40	33,91	34,15	34,15	33,94
27127/--	2,7	21,59	28,77	33,31	36,44	38,65	40,21	41,25	41,89	42,19	42,19	41,93
27232/--	3,2	27,58	36,76	42,56	46,56	49,39	51,37	52,70	53,52	53,90	53,90	53,57
27236/--	3,6	37,77	50,35	58,29	63,77	67,64	70,36	72,19	73,30	73,82	73,83	73,37
27340/--	4,0	43,69	58,23	67,42	73,76	78,23	81,37	83,49	84,78	85,38	85,39	84,86
27344/--	4,4	50,81	67,72	78,42	85,78	90,99	94,64	97,10	98,60	99,30	99,31	98,70
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,89	18,39	21,20	23,12	24,46	25,40	26,02	26,40	26,58	26,58	26,43
27120/--	2,0	18,52	24,52	28,27	30,82	32,61	33,86	34,70	35,21	35,44	35,44	35,24
27127/--	2,7	22,87	30,29	34,92	38,07	40,29	41,83	42,86	43,49	43,78	43,78	43,53
27232/--	3,2	29,22	38,70	44,61	48,64	51,47	53,44	54,76	55,56	55,93	55,93	55,61
27236/--	3,6	40,02	53,00	61,10	66,62	70,50	73,20	75,00	76,10	76,60	76,61	76,16
27340/--	4,0	46,29	61,30	70,67	77,06	81,54	84,66	86,75	88,01	88,60	88,60	88,09
27344/--	4,4	53,84	71,30	82,19	89,62	94,83	98,47	100,90	102,37	103,05	103,05	102,46
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,55	19,12	21,92	23,82	25,13	26,03	26,63	26,98	27,14	27,12	26,95
27120/--	2,0	19,40	25,49	29,23	31,75	33,51	34,71	35,51	35,98	36,18	36,16	35,93
27127/--	2,7	23,96	31,49	36,11	39,22	41,39	42,88	43,86	44,44	44,69	44,66	44,39
27232/--	3,2	30,62	40,23	46,13	50,11	52,88	54,78	56,04	56,78	57,10	57,06	56,71
27236/--	3,6	41,93	55,10	63,18	68,64	72,42	75,03	76,75	77,77	78,21	78,15	77,67
27340/--	4,0	48,50	63,73	73,08	79,38	83,76	86,78	88,77	89,95	90,45	90,39	89,83
27344/--	4,4	56,41	74,12	84,99	92,33	97,42	100,93	103,25	104,62	105,21	105,13	104,48

**Table 33A: Refrigerant R410A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,08	19,64	22,40	24,23	25,49	26,35	26,90	27,21	27,33	27,28	27,09
27120/--	2,0	20,11	26,19	29,86	32,31	33,99	35,13	35,87	36,29	36,44	36,38	36,12
27127/--	2,7	24,84	32,35	36,89	39,91	41,99	43,40	44,31	44,82	45,01	44,93	44,62
27232/--	3,2	31,74	41,33	47,13	50,99	53,64	55,44	56,61	57,27	57,51	57,41	57,00
27236/--	3,6	43,47	56,61	64,55	69,84	73,47	75,94	77,53	78,43	78,77	78,63	78,07
27340/--	4,0	50,28	65,48	74,65	80,78	84,98	87,83	89,67	90,71	91,10	90,94	90,30
27344/--	4,4	58,48	76,15	86,83	93,95	98,83	102,15	104,29	105,51	105,96	105,77	105,02

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,48	19,96	22,63	24,39	25,58	26,37	26,87	27,14	27,21	27,13	26,90
27120/--	2,0	20,64	26,62	30,17	32,52	34,10	35,17	35,83	36,18	36,28	36,17	35,87
27127/--	2,7	25,50	32,88	37,27	40,17	42,13	43,44	44,26	44,70	44,82	44,68	44,30
27232/--	3,2	32,57	42,01	47,62	51,32	53,82	55,50	56,55	57,11	57,26	57,08	56,60
27236/--	3,6	44,61	57,53	65,22	70,29	73,72	76,01	77,45	78,21	78,43	78,18	77,53
27340/--	4,0	51,60	66,54	75,43	81,29	85,26	87,91	89,58	90,46	90,71	90,42	89,67
27344/--	4,4	60,01	77,39	87,73	94,55	99,17	102,25	104,18	105,21	105,50	105,16	104,29

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 33B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 33B

Table 34A: Refrigerant R507A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,63	11,22	12,65	13,46	13,85	13,94	13,79	13,44	12,92	12,23	11,38
27120/--	2,0	11,51	14,96	16,87	17,95	18,47	18,59	18,39	17,93	17,24	16,32	15,17
27127/--	2,7	14,21	18,48	20,84	22,16	22,81	22,96	22,71	22,14	21,28	20,15	18,73
27232/--	3,2	18,17	23,61	26,63	28,32	29,15	29,34	29,03	28,30	27,20	25,75	23,94
27236/--	3,6	24,88	32,34	36,47	38,80	39,93	40,19	39,76	38,76	37,26	35,27	32,79
27340/--	4,0	28,77	37,40	42,18	44,86	46,17	46,47	45,98	44,82	43,08	40,79	37,92
27344/--	4,4	33,46	43,50	49,05	52,18	53,70	54,05	53,47	52,13	50,10	47,44	44,11
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,23	11,92	13,38	14,19	14,57	14,65	14,49	14,15	13,63	12,97	12,17
27120/--	2,0	12,31	15,89	17,84	18,92	19,43	19,54	19,33	18,87	18,19	17,30	16,23
27127/--	2,7	15,20	19,63	22,03	23,36	23,99	24,13	23,87	23,30	22,46	21,36	20,04
27232/--	3,2	19,43	25,08	28,16	29,86	30,67	30,83	30,51	29,78	28,70	27,30	25,61
27236/--	3,6	26,61	34,36	38,57	40,90	42,00	42,23	41,79	40,79	39,31	37,40	35,07
27340/--	4,0	30,77	39,73	44,60	47,29	48,57	48,84	48,32	47,16	45,45	43,25	40,56
27344/--	4,4	35,79	46,21	51,87	55,00	56,49	56,80	56,20	54,85	52,87	50,30	47,17
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,73	12,46	13,90	14,67	15,02	15,06	14,88	14,50	13,97	13,31	12,51
27120/--	2,0	12,98	16,61	18,53	19,57	20,03	20,09	19,84	19,34	18,64	17,75	16,68
27127/--	2,7	16,03	20,51	22,89	24,16	24,73	24,80	24,50	23,89	23,02	21,92	20,60
27232/--	3,2	20,49	26,22	29,25	30,88	31,61	31,70	31,31	30,53	29,41	28,01	26,33
27236/--	3,6	28,06	35,91	40,06	42,29	43,29	43,42	42,89	41,81	40,29	38,36	36,06
27340/--	4,0	32,45	41,52	46,33	48,90	50,06	50,21	49,59	48,35	46,59	44,36	41,70
27344/--	4,4	37,74	48,29	53,88	56,88	58,22	58,40	57,68	56,23	54,18	51,59	48,50
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,14	12,83	14,21	14,92	15,21	15,20	14,97	14,56	14,00	13,31	12,50
27120/--	2,0	13,52	17,12	18,96	19,91	20,29	20,28	19,97	19,42	18,67	17,75	16,67
27127/--	2,7	16,69	21,13	23,41	24,58	25,05	25,04	24,66	23,98	23,06	21,92	20,58
27232/--	3,2	21,33	27,01	29,92	31,41	32,02	32,00	31,51	30,65	29,47	28,01	26,31
27236/--	3,6	29,22	37,00	40,98	43,03	43,86	43,83	43,16	41,98	40,36	38,37	36,03
27340/--	4,0	33,79	42,78	47,39	49,75	50,71	50,69	49,91	48,54	46,67	44,37	41,66
27344/--	4,4	39,30	49,76	55,11	57,86	58,98	58,95	58,05	56,45	54,28	51,60	48,46



**Table 34A: Refrigerant R507A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,43	13,05	14,34	14,96	15,18	15,11	14,82	14,36	13,76	13,03	12,20
27120/--	2,0	13,91	17,40	19,12	19,96	20,25	20,15	19,76	19,15	18,35	17,38	16,27
27127/--	2,7	17,18	21,49	23,61	24,64	25,00	24,88	24,40	23,65	22,66	21,46	20,09
27232/--	3,2	21,96	27,46	30,18	31,50	31,95	31,80	31,19	30,22	28,96	27,43	25,67
27236/--	3,6	30,07	37,62	41,34	43,14	43,76	43,55	42,72	41,39	39,66	37,57	35,16
27340/--	4,0	34,78	43,50	47,80	49,89	50,60	50,36	49,40	47,87	45,86	43,45	40,66
27344/--	4,4	40,45	50,59	55,59	58,02	58,85	58,57	57,45	55,67	53,34	50,53	47,29

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,61	13,10	14,28	14,81	14,94	14,80	14,45	13,94	13,29	12,53	11,66
27120/--	2,0	14,16	17,47	19,05	19,75	19,93	19,74	19,27	18,59	17,73	16,71	15,55
27127/--	2,7	17,48	21,58	23,52	24,39	24,61	24,37	23,80	22,95	21,89	20,63	19,20
27232/--	3,2	22,34	27,58	30,05	31,17	31,45	31,15	30,41	29,34	27,97	26,37	24,54
27236/--	3,6	30,60	37,77	41,17	42,70	43,08	42,67	41,66	40,18	38,32	36,12	33,62
27340/--	4,0	35,38	43,68	47,60	49,37	49,82	49,34	48,17	46,46	44,31	41,76	38,87
27344/--	4,4	41,15	50,80	55,36	57,42	57,94	57,38	56,02	54,04	51,53	48,57	45,21

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 34B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,09	1,18	1,26	1,35	1,44	1,52	1,60	1,67

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 34B

Table 35A: Refrigerant R1234yf - Capacities in kW (1)

Evaporating Temperature 20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,16	10,32	11,34	11,76	11,79	11,53	11,07	10,42	9,62	8,68	7,59
27120/--	2,0	10,88	13,76	15,12	15,68	15,72	15,38	14,75	13,89	12,83	11,57	10,13
27127/--	2,7	13,44	16,99	18,67	19,36	19,40	18,99	18,22	17,15	15,84	14,29	12,50
27232/--	3,2	17,17	21,71	23,86	24,74	24,80	24,26	23,28	21,92	20,24	18,26	15,98
27236/--	3,6	23,52	29,75	32,69	33,89	33,97	33,24	31,89	30,03	27,73	25,02	21,89
27340/--	4,0	27,20	34,40	37,80	39,19	39,28	38,44	36,87	34,72	32,06	28,93	25,31
27344/--	4,4	31,64	40,01	43,96	45,58	45,69	44,71	42,89	40,38	37,29	33,64	29,43
Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,56	10,72	11,69	12,06	12,03	11,73	11,22	10,54	9,72	8,77	7,69
27120/--	2,0	11,41	14,29	15,59	16,07	16,04	15,64	14,96	14,05	12,95	11,69	10,26
27127/--	2,7	14,09	17,64	19,25	19,85	19,80	19,31	18,47	17,35	16,00	14,43	12,66
27232/--	3,2	18,01	22,55	24,60	25,36	25,31	24,67	23,60	22,17	20,44	18,44	16,18
27236/--	3,6	24,67	30,89	33,70	34,74	34,67	33,80	32,33	30,37	28,00	25,27	22,17
27340/--	4,0	28,53	35,72	38,97	40,17	40,09	39,08	37,38	35,12	32,38	29,21	25,63
27344/--	4,4	33,18	41,54	45,32	46,72	46,62	45,46	43,48	40,84	37,66	33,98	29,82
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,87	10,98	11,87	12,16	12,06	11,70	11,13	10,41	9,55	8,57	7,48
27120/--	2,0	11,83	14,64	15,83	16,21	16,08	15,59	14,84	13,87	12,73	11,43	9,98
27127/--	2,7	14,61	18,07	19,55	20,01	19,85	19,25	18,32	17,13	15,72	14,11	12,32
27232/--	3,2	18,67	23,09	24,98	25,58	25,37	24,60	23,42	21,89	20,08	18,03	15,74
27236/--	3,6	25,57	31,64	34,22	35,04	34,76	33,71	32,08	29,99	27,51	24,70	21,57
27340/--	4,0	29,57	36,58	39,57	40,51	40,19	38,97	37,09	34,67	31,81	28,56	24,94
27344/--	4,4	34,39	42,55	46,02	47,12	46,74	45,33	43,14	40,33	37,00	33,21	29,00
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,09	11,10	11,89	12,08	11,90	11,46	10,83	10,06	9,15	8,14	7,03
27120/--	2,0	12,13	14,80	15,86	16,11	15,87	15,28	14,45	13,41	12,20	10,85	9,37
27127/--	2,7	14,97	18,27	19,58	19,89	19,59	18,87	17,84	16,55	15,07	13,40	11,57
27232/--	3,2	19,13	23,35	25,02	25,41	25,03	24,11	22,79	21,15	19,25	17,12	14,78
27236/--	3,6	26,21	31,99	34,27	34,82	34,29	33,04	31,23	28,98	26,37	23,46	20,25
27340/--	4,0	30,31	36,99	39,63	40,26	39,65	38,20	36,11	33,51	30,50	27,12	23,42
27344/--	4,4	35,25	43,02	46,09	46,82	46,12	44,43	41,99	38,97	35,47	31,54	27,24

**Table 35A: Refrigerant R1234yf - Capacities in kW (1)**

Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,22	11,09	11,76	11,84	11,57	11,05	10,36	9,52	8,57	7,52	6,37
27120/--	2,0	12,29	14,78	15,67	15,79	15,42	14,74	13,81	12,70	11,43	10,02	8,49
27127/--	2,7	15,17	18,25	19,35	19,49	19,04	18,20	17,05	15,68	14,11	12,37	10,49
27232/--	3,2	19,39	23,32	24,73	24,91	24,34	23,25	21,79	20,03	18,03	15,81	13,40
27236/--	3,6	26,57	31,95	33,88	34,12	33,34	31,86	29,86	27,44	24,70	21,66	18,36
27340/--	4,0	30,72	36,95	39,17	39,45	38,55	36,84	34,52	31,73	28,56	25,04	21,23
27344/--	4,4	35,73	42,97	45,56	45,89	44,84	42,84	40,15	36,91	33,21	29,13	24,69

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,24	10,94	11,48	11,45	11,09	10,50	9,73	8,84	7,83	6,74	5,56
27120/--	2,0	12,32	14,59	15,31	15,27	14,79	14,00	12,98	11,78	10,45	8,98	7,41
27127/--	2,7	15,21	18,02	18,90	18,86	18,26	17,28	16,03	14,55	12,90	11,09	9,15
27232/--	3,2	19,44	23,02	24,15	24,10	23,33	22,08	20,48	18,59	16,48	14,17	11,69
27236/--	3,6	26,63	31,54	33,09	33,01	31,97	30,26	28,06	25,47	22,58	19,42	16,02
27340/--	4,0	30,79	36,47	38,26	38,17	36,96	34,98	32,44	29,45	26,11	22,45	18,52
27344/--	4,4	35,81	42,42	44,50	44,40	42,99	40,69	37,73	34,26	30,36	26,11	21,54

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 35B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,07	1,15	1,22	1,29	1,36	1,43	1,49	1,55

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 35B

Table 36A: Refrigerant R1234ze - Capacities in kW (1)

Evaporating Temperature 20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,52	12,01	13,21	13,74	13,86	13,67	13,27	12,69	11,96	11,10	10,12
27120/--	2,0	12,69	16,01	17,61	18,32	18,47	18,22	17,69	16,91	15,94	14,79	13,49
27127/--	2,7	15,68	19,77	21,75	22,63	22,81	22,51	21,85	20,89	19,69	18,27	16,66
27232/--	3,2	20,04	25,27	27,79	28,91	29,15	28,77	27,92	26,70	25,16	23,35	21,29
27236/--	3,6	27,45	34,61	38,07	39,60	39,93	39,41	38,24	36,57	34,47	31,99	29,16
27340/--	4,0	31,70	39,97	43,96	45,73	46,11	45,51	44,16	42,23	39,80	36,94	33,67
27344/--	4,4	36,92	46,55	51,20	53,27	53,71	53,00	51,44	49,18	46,36	43,02	39,22
Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,84	12,27	13,38	13,83	13,86	13,61	13,15	12,51	11,74	10,84	9,84
27120/--	2,0	13,12	16,35	17,83	18,43	18,48	18,14	17,52	16,68	15,64	14,45	13,11
27127/--	2,7	16,21	20,20	22,03	22,77	22,83	22,41	21,64	20,60	19,32	17,85	16,19
27232/--	3,2	20,71	25,81	28,15	29,09	29,17	28,64	27,66	26,32	24,69	22,81	20,69
27236/--	3,6	28,37	35,35	38,56	39,85	39,95	39,23	37,89	36,06	33,82	31,24	28,34
27340/--	4,0	32,76	40,83	44,53	46,02	46,14	45,30	43,75	41,64	39,06	36,08	32,73
27344/--	4,4	38,16	47,55	51,86	53,60	53,74	52,76	50,96	48,50	45,49	42,02	38,12
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,07	12,38	13,38	13,72	13,67	13,34	12,80	12,11	11,28	10,34	9,30
27120/--	2,0	13,42	16,50	17,83	18,29	18,22	17,78	17,07	16,14	15,04	13,78	12,40
27127/--	2,7	16,58	20,38	22,03	22,60	22,51	21,96	21,08	19,94	18,58	17,03	15,32
27232/--	3,2	21,18	26,05	28,15	28,88	28,76	28,07	26,94	25,48	23,74	21,76	19,57
27236/--	3,6	29,02	35,68	38,55	39,55	39,40	38,44	36,90	34,90	32,51	29,81	26,81
27340/--	4,0	33,51	41,20	44,52	45,67	45,49	44,39	42,61	40,30	37,55	34,42	30,96
27344/--	4,4	39,03	47,99	51,85	53,20	52,99	51,70	49,63	46,94	43,73	40,09	36,06
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,19	12,35	13,21	13,45	13,30	12,88	12,27	11,51	10,63	9,64	8,56
27120/--	2,0	13,58	16,46	17,61	17,92	17,72	17,17	16,36	15,34	14,17	12,85	11,41
27127/--	2,7	16,78	20,33	21,76	22,14	21,89	21,21	20,21	18,96	17,50	15,88	14,10
27232/--	3,2	21,44	25,98	27,80	28,29	27,97	27,10	25,82	24,22	22,37	20,29	18,02
27236/--	3,6	29,36	35,59	38,08	38,75	38,32	37,12	35,37	33,18	30,64	27,79	24,68
27340/--	4,0	33,91	41,09	43,97	44,75	44,25	42,87	40,84	38,31	35,38	32,09	28,50
27344/--	4,4	39,49	47,86	51,22	52,12	51,54	49,93	47,57	44,63	41,21	37,38	33,19

**Table 36A: Refrigerant R1234ze - Capacities in kW (1)**

Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,20	12,18	12,90	13,02	12,77	12,27	11,58	10,76	9,82	8,78	7,66
27120/--	2,0	13,60	16,23	17,19	17,35	17,01	16,35	15,44	14,34	13,08	11,70	10,21
27127/--	2,7	16,80	20,05	21,24	21,43	21,02	20,19	19,07	17,71	16,16	14,46	12,61
27232/--	3,2	21,47	25,63	27,14	27,39	26,86	25,81	24,37	22,63	20,66	18,47	16,11
27236/--	3,6	29,40	35,10	37,18	37,51	36,79	35,35	33,38	31,00	28,29	25,30	22,07
27340/--	4,0	33,95	40,53	42,93	43,32	42,48	40,82	38,54	35,80	32,67	29,22	25,48
27344/--	4,4	39,54	47,21	50,00	50,45	49,48	47,54	44,89	41,70	38,05	34,03	29,68

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,11	11,89	12,46	12,46	12,11	11,52	10,76	9,87	8,88	7,79	6,62
27120/--	2,0	13,47	15,84	16,61	16,60	16,14	15,36	14,35	13,16	11,83	10,38	8,82
27127/--	2,7	16,64	19,57	20,52	20,51	19,93	18,97	17,72	16,26	14,61	12,82	10,90
27232/--	3,2	21,27	25,01	26,22	26,21	25,48	24,24	22,65	20,77	18,67	16,39	13,93
27236/--	3,6	29,13	34,26	35,91	35,90	34,89	33,21	31,02	28,45	25,58	22,44	19,08
27340/--	4,0	33,64	39,56	41,47	41,46	40,29	38,34	35,82	32,86	29,54	25,92	22,03
27344/--	4,4	39,18	46,08	48,30	48,29	46,93	44,66	41,72	38,27	34,40	30,19	25,66

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 36B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 36B

Table 37A: Refrigerant R448A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,45	13,81	15,86	17,18	18,05	18,58	18,85	18,91	18,79	18,51	18,10
27120/--	2,0	13,93	18,42	21,13	22,91	24,06	24,76	25,12	25,20	25,05	24,68	24,13
27127/--	2,7	17,22	22,75	26,12	28,30	29,73	30,60	31,04	31,14	30,95	30,50	29,81
27232/--	3,2	22,00	29,07	33,37	36,16	37,98	39,10	39,66	39,79	39,54	38,96	38,09
27236/--	3,6	30,13	39,81	45,70	49,53	52,02	53,54	54,32	54,49	54,15	53,36	52,16
27340/--	4,0	34,84	46,04	52,85	57,28	60,16	61,92	62,82	63,02	62,62	61,71	60,32
27344/--	4,4	40,52	53,56	61,47	66,62	69,97	72,02	73,07	73,30	72,84	71,78	70,17
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,06	14,53	16,59	17,92	18,78	19,29	19,55	19,59	19,47	19,19	18,78
27120/--	2,0	14,75	19,36	22,12	23,89	25,03	25,72	26,05	26,12	25,95	25,58	25,03
27127/--	2,7	18,22	23,93	27,33	29,52	30,93	31,78	32,19	32,27	32,06	31,60	30,93
27232/--	3,2	23,28	30,57	34,92	37,72	39,52	40,60	41,13	41,23	40,96	40,38	39,51
27236/--	3,6	31,88	41,87	47,83	51,66	54,12	55,60	56,33	56,47	56,10	55,30	54,11
27340/--	4,0	36,87	48,42	55,31	59,74	62,59	64,30	65,15	65,30	64,88	63,95	62,58
27344/--	4,4	42,89	56,32	64,33	69,49	72,80	74,79	75,78	75,96	75,46	74,39	72,79
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,58	15,08	17,14	18,43	19,25	19,72	19,94	19,96	19,80	19,51	19,08
27120/--	2,0	15,44	20,11	22,84	24,57	25,66	26,29	26,58	26,60	26,40	26,00	25,43
27127/--	2,7	19,08	24,85	28,22	30,36	31,70	32,49	32,85	32,87	32,62	32,13	31,43
27232/--	3,2	24,37	31,74	36,06	38,79	40,50	41,50	41,97	42,00	41,68	41,05	40,15
27236/--	3,6	33,38	43,47	49,38	53,12	55,47	56,84	57,47	57,52	57,08	56,22	54,99
27340/--	4,0	38,60	50,28	57,11	61,43	64,15	65,74	66,47	66,52	66,01	65,01	63,59
27344/--	4,4	44,90	58,48	66,43	71,45	74,61	76,46	77,31	77,37	76,78	75,62	73,97
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,00	15,48	17,48	18,71	19,47	19,89	20,06	20,04	19,84	19,51	19,06
27120/--	2,0	16,00	20,64	23,30	24,94	25,95	26,52	26,74	26,71	26,45	26,01	25,41
27127/--	2,7	19,77	25,50	28,79	30,82	32,07	32,76	33,05	33,00	32,69	32,14	31,40
27232/--	3,2	25,26	32,58	36,78	39,38	40,97	41,86	42,22	42,16	41,76	41,06	40,11
27236/--	3,6	34,59	44,62	50,37	53,93	56,11	57,33	57,82	57,74	57,19	56,24	54,94
27340/--	4,0	40,00	51,61	58,25	62,37	64,89	66,30	66,87	66,78	66,14	65,04	63,53
27344/--	4,4	46,53	60,03	67,76	72,54	75,48	77,12	77,78	77,67	76,93	75,65	73,90

**Table 37A: Refrigerant R448A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,32	15,72	17,63	18,78	19,47	19,82	19,94	19,86	19,62	19,26	18,77
27120/--	2,0	16,42	20,96	23,50	25,03	25,95	26,42	26,58	26,47	26,16	25,67	25,02
27127/--	2,7	20,28	25,89	29,03	30,93	32,06	32,65	32,84	32,71	32,32	31,71	30,91
27232/--	3,2	25,92	33,08	37,09	39,52	40,96	41,72	41,96	41,79	41,30	40,52	39,50
27236/--	3,6	35,49	45,31	50,80	54,12	56,10	57,13	57,46	57,24	56,56	55,49	54,09
27340/--	4,0	41,05	52,40	58,75	62,59	64,88	66,07	66,45	66,19	65,41	64,18	62,56
27344/--	4,4	47,74	60,94	68,33	72,81	75,46	76,85	77,29	76,99	76,08	74,65	72,76

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,51	15,79	17,59	18,65	19,26	19,55	19,60	19,47	19,18	18,77	18,25
27120/--	2,0	16,68	21,05	23,45	24,86	25,67	26,05	26,13	25,95	25,57	25,02	24,32
27127/--	2,7	20,61	26,02	28,98	30,72	31,72	32,19	32,28	32,06	31,60	30,92	30,06
27232/--	3,2	26,33	33,24	37,02	39,25	40,52	41,13	41,24	40,97	40,37	39,50	38,40
27236/--	3,6	36,06	45,52	50,70	53,76	55,50	56,33	56,49	56,10	55,29	54,10	52,59
27340/--	4,0	41,70	52,64	58,63	62,17	64,18	65,15	65,32	64,88	63,94	62,57	60,82
27344/--	4,4	48,50	61,23	68,20	72,31	74,66	75,78	75,98	75,47	74,37	72,77	70,74

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 37B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 37B

Table 38A: Refrigerant R449A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,37	13,69	15,70	16,99	17,82	18,32	18,56	18,60	18,45	18,15	17,71
27120/--	2,0	13,83	18,26	20,93	22,66	23,77	24,43	24,75	24,80	24,60	24,20	23,61
27127/--	2,7	17,09	22,56	25,85	27,99	29,36	30,18	30,58	30,63	30,39	29,89	29,16
27232/--	3,2	21,83	28,82	33,04	35,76	37,51	38,56	39,07	39,14	38,83	38,20	37,26
27236/--	3,6	29,90	39,47	45,24	48,97	51,38	52,81	53,51	53,60	53,18	52,31	51,03
27340/--	4,0	34,58	45,64	52,32	56,64	59,42	61,08	61,88	61,99	61,50	60,50	59,02
27344/--	4,4	40,22	53,09	60,85	65,87	69,10	71,04	71,97	72,09	71,53	70,36	68,64
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,98	14,40	16,43	17,72	18,54	19,02	19,25	19,27	19,11	18,81	18,37
27120/--	2,0	14,64	19,20	21,90	23,63	24,72	25,37	25,67	25,69	25,49	25,08	24,49
27127/--	2,7	18,09	23,72	27,06	29,19	30,54	31,34	31,71	31,74	31,48	30,98	30,26
27232/--	3,2	23,11	30,30	34,57	37,30	39,02	40,04	40,51	40,55	40,23	39,58	38,66
27236/--	3,6	31,65	41,50	47,35	51,08	53,44	54,83	55,48	55,53	55,09	54,21	52,95
27340/--	4,0	36,60	47,99	54,76	59,07	61,80	63,41	64,16	64,22	63,71	62,69	61,23
27344/--	4,4	42,57	55,82	63,68	68,70	71,88	73,75	74,63	74,70	74,10	72,92	71,22
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,49	14,95	16,96	18,22	19,00	19,44	19,63	19,62	19,44	19,11	18,66
27120/--	2,0	15,33	19,93	22,61	24,29	25,33	25,93	26,18	26,16	25,92	25,49	24,88
27127/--	2,7	18,93	24,62	27,93	30,01	31,29	32,03	32,34	32,32	32,02	31,48	30,74
27232/--	3,2	24,19	31,46	35,69	38,34	39,98	40,92	41,32	41,29	40,91	40,23	39,27
27236/--	3,6	33,13	43,09	48,88	52,51	54,76	56,04	56,59	56,55	56,03	55,09	53,78
27340/--	4,0	38,31	49,83	56,53	60,72	63,33	64,81	65,44	65,40	64,79	63,71	62,20
27344/--	4,4	44,56	57,96	65,74	70,62	73,65	75,38	76,11	76,06	75,36	74,10	72,34
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	11,91	15,34	17,29	18,49	19,21	19,60	19,74	19,68	19,47	19,11	18,63
27120/--	2,0	15,88	20,46	23,06	24,65	25,62	26,14	26,32	26,25	25,96	25,48	24,84
27127/--	2,7	19,62	25,27	28,48	30,45	31,64	32,29	32,52	32,43	32,06	31,48	30,69
27232/--	3,2	25,07	32,29	36,39	38,91	40,43	41,25	41,55	41,43	40,97	40,22	39,21
27236/--	3,6	34,33	44,22	49,84	53,29	55,37	56,49	56,90	56,74	56,11	55,08	53,70
27340/--	4,0	39,70	51,14	57,64	61,63	64,04	65,34	65,81	65,62	64,89	63,70	62,10
27344/--	4,4	46,17	59,48	67,04	71,68	74,48	75,99	76,54	76,32	75,47	74,09	72,23



**Table 38A: Refrigerant R449A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,22	15,57	17,43	18,55	19,20	19,52	19,61	19,50	19,24	18,84	18,33
27120/--	2,0	16,29	20,76	23,25	24,73	25,60	26,03	26,14	26,00	25,65	25,12	24,44
27127/--	2,7	20,13	25,65	28,71	30,55	31,62	32,16	32,30	32,12	31,69	31,03	30,19
27232/--	3,2	25,72	32,77	36,69	39,04	40,40	41,09	41,27	41,04	40,49	39,65	38,58
27236/--	3,6	35,22	44,88	50,25	53,46	55,33	56,27	56,51	56,20	55,45	54,31	52,83
27340/--	4,0	40,73	51,90	58,11	61,82	63,99	65,08	65,36	65,00	64,12	62,80	61,10
27344/--	4,4	47,37	60,37	67,58	71,91	74,42	75,69	76,01	75,60	74,58	73,05	71,06

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	12,41	15,64	17,39	18,41	18,98	19,24	19,26	19,10	18,79	18,35	17,80
27120/--	2,0	16,55	20,85	23,19	24,55	25,31	25,65	25,68	25,47	25,05	24,47	23,74
27127/--	2,7	20,44	25,76	28,65	30,33	31,27	31,69	31,73	31,46	30,95	30,23	29,32
27232/--	3,2	26,12	32,91	36,60	38,75	39,95	40,49	40,54	40,20	39,54	38,62	37,47
27236/--	3,6	35,77	45,07	50,12	53,07	54,71	55,45	55,51	55,05	54,15	52,89	51,31
27340/--	4,0	41,37	52,13	57,97	61,37	63,27	64,13	64,20	63,67	62,63	61,17	59,34
27344/--	4,4	48,11	60,63	67,42	71,38	73,59	74,58	74,67	74,05	72,84	71,14	69,01

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 38B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 38B

Table 39A: Refrigerant R450A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,26	12,99	14,35	15,03	15,27	15,20	14,91	14,43	13,80	13,04	12,17
27120/--	2,0	13,68	17,31	19,13	20,03	20,35	20,26	19,87	19,23	18,40	17,39	16,22
27127/--	2,7	16,90	21,38	23,63	24,74	25,14	25,03	24,54	23,76	22,72	21,48	20,03
27232/--	3,2	21,60	27,32	30,20	31,62	32,13	31,99	31,37	30,36	29,04	27,45	25,61
27236/--	3,6	29,58	37,42	41,36	43,31	44,00	43,81	42,96	41,58	39,77	37,59	35,06
27340/--	4,0	34,20	43,27	47,83	50,08	50,87	50,65	49,67	48,08	45,99	43,46	40,55
27344/--	4,4	39,78	50,33	55,63	58,25	59,17	58,92	57,77	55,93	53,49	50,56	47,16
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,57	13,21	14,49	15,07	15,23	15,09	14,74	14,20	13,53	12,73	11,82
27120/--	2,0	14,08	17,61	19,31	20,09	20,30	20,12	19,64	18,93	18,03	16,97	15,76
27127/--	2,7	17,40	21,75	23,85	24,81	25,07	24,85	24,26	23,38	22,27	20,96	19,46
27232/--	3,2	22,24	27,80	30,48	31,71	32,05	31,76	31,01	29,89	28,47	26,79	24,88
27236/--	3,6	30,45	38,07	41,74	43,43	43,89	43,49	42,46	40,93	38,98	36,68	34,07
27340/--	4,0	35,21	44,02	48,27	50,22	50,75	50,29	49,10	47,33	45,08	42,42	39,40
27344/--	4,4	40,96	51,20	56,14	58,41	59,03	58,50	57,11	55,05	52,43	49,34	45,82
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,77	13,29	14,44	14,93	14,99	14,78	14,35	13,76	13,03	12,19	11,24
27120/--	2,0	14,35	17,71	19,25	19,89	19,98	19,70	19,13	18,34	17,37	16,24	14,98
27127/--	2,7	17,73	21,87	23,78	24,57	24,68	24,33	23,63	22,65	21,45	20,06	18,51
27232/--	3,2	22,66	27,96	30,39	31,41	31,55	31,10	30,20	28,95	27,42	25,65	23,66
27236/--	3,6	31,03	38,29	41,62	43,01	43,21	42,58	41,35	39,65	37,55	35,12	32,40
27340/--	4,0	35,88	44,27	48,12	49,73	49,96	49,24	47,82	45,84	43,42	40,61	37,46
27344/--	4,4	41,73	51,50	55,97	57,84	58,11	57,27	55,62	53,32	50,50	47,23	43,57
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,86	13,22	14,24	14,61	14,58	14,28	13,79	13,13	12,35	11,46	10,47
27120/--	2,0	14,47	17,61	18,98	19,47	19,44	19,04	18,37	17,50	16,46	15,27	13,95
27127/--	2,7	17,88	21,76	23,44	24,05	24,01	23,52	22,70	21,62	20,33	18,86	17,24
27232/--	3,2	22,85	27,81	29,96	30,74	30,68	30,06	29,01	27,63	25,98	24,11	22,03
27236/--	3,6	31,29	38,08	41,03	42,09	42,02	41,16	39,72	37,84	35,58	33,01	30,17
27340/--	4,0	36,18	44,04	47,44	48,68	48,59	47,60	45,93	43,75	41,14	38,17	34,89
27344/--	4,4	42,08	51,22	55,18	56,62	56,52	55,36	53,43	50,89	47,85	44,40	40,58

**Table 39A: Refrigerant R450A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,84	13,01	13,89	14,15	14,02	13,64	13,07	12,35	11,51	10,57	9,54
27120/--	2,0	14,44	17,34	18,51	18,85	18,69	18,18	17,42	16,46	15,35	14,09	12,72
27127/--	2,7	17,84	21,42	22,86	23,29	23,09	22,46	21,52	20,34	18,95	17,41	15,71
27232/--	3,2	22,80	27,37	29,22	29,76	29,51	28,71	27,51	25,99	24,23	22,25	20,08
27236/--	3,6	31,22	37,48	40,02	40,76	40,41	39,31	37,67	35,60	33,18	30,47	27,50
27340/--	4,0	36,11	43,34	46,28	47,13	46,73	45,46	43,56	41,16	38,36	35,23	31,80
27344/--	4,4	42,00	50,42	53,83	54,82	54,35	52,88	50,66	47,87	44,62	40,98	36,99

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,71	12,68	13,42	13,56	13,35	12,89	12,24	11,46	10,57	9,58	8,50
27120/--	2,0	14,27	16,90	17,89	18,08	17,79	17,17	16,32	15,28	14,08	12,76	11,33
27127/--	2,7	17,62	20,88	22,10	22,33	21,97	21,21	20,16	18,87	17,39	15,76	14,00
27232/--	3,2	22,53	26,69	28,24	28,54	28,09	27,11	25,76	24,12	22,23	20,15	17,89
27236/--	3,6	30,85	36,55	38,67	39,09	38,46	37,13	35,28	33,03	30,45	27,59	24,50
27340/--	4,0	35,67	42,26	44,72	45,20	44,48	42,94	40,79	38,19	35,21	31,91	28,33
27344/--	4,4	41,49	49,15	52,02	52,57	51,73	49,94	47,45	44,42	40,95	37,11	32,95

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 39B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 39B

Table 40A: Refrigerant R452A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	8,52	11,14	12,63	13,51	13,99	14,18	14,14	13,92	13,53	13,00	12,32
27120/--	2,0	11,37	14,85	16,84	18,02	18,66	18,91	18,86	18,56	18,05	17,33	16,43
27127/--	2,7	14,04	18,35	20,80	22,26	23,05	23,36	23,30	22,93	22,30	21,41	20,30
27232/--	3,2	17,94	23,44	26,58	28,44	29,45	29,85	29,77	29,30	28,48	27,36	25,93
27236/--	3,6	24,58	32,11	36,40	38,95	40,34	40,88	40,78	40,13	39,01	37,47	35,52
27340/--	4,0	28,42	37,13	42,10	45,04	46,65	47,28	47,16	46,41	45,12	43,34	41,08
27344/--	4,4	33,06	43,19	48,97	52,39	54,26	55,00	54,85	53,98	52,48	50,41	47,78
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,08	11,78	13,29	14,16	14,63	14,81	14,76	14,52	14,14	13,61	12,96
27120/--	2,0	12,10	15,70	17,72	18,89	19,51	19,75	19,68	19,37	18,85	18,15	17,28
27127/--	2,7	14,95	19,40	21,89	23,34	24,11	24,40	24,31	23,93	23,29	22,42	21,34
27232/--	3,2	19,10	24,79	27,97	29,82	30,80	31,17	31,06	30,57	29,75	28,65	27,27
27236/--	3,6	26,16	33,95	38,31	40,84	42,19	42,69	42,55	41,87	40,75	39,23	37,35
27340/--	4,0	30,26	39,26	44,30	47,23	48,79	49,38	49,21	48,43	47,13	45,38	43,20
27344/--	4,4	35,19	45,67	51,53	54,93	56,75	57,43	57,23	56,33	54,82	52,78	50,24
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,54	12,27	13,76	14,60	15,03	15,16	15,08	14,81	14,40	13,86	13,20
27120/--	2,0	12,72	16,36	18,35	19,47	20,04	20,22	20,11	19,76	19,21	18,48	17,61
27127/--	2,7	15,71	20,21	22,66	24,05	24,75	24,98	24,84	24,41	23,73	22,84	21,75
27232/--	3,2	20,08	25,82	28,96	30,73	31,63	31,91	31,74	31,18	30,32	29,18	27,79
27236/--	3,6	27,50	35,37	39,66	42,08	43,32	43,71	43,47	42,71	41,52	39,96	38,06
27340/--	4,0	31,80	40,91	45,87	48,67	50,10	50,55	50,27	49,39	48,02	46,22	44,02
27344/--	4,4	36,99	47,58	53,35	56,61	58,27	58,80	58,47	57,45	55,86	53,76	51,20
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,91	12,61	14,04	14,82	15,19	15,27	15,13	14,83	14,38	13,81	13,13
27120/--	2,0	13,21	16,82	18,72	19,76	20,25	20,36	20,18	19,77	19,18	18,42	17,51
27127/--	2,7	16,33	20,78	23,13	24,41	25,02	25,15	24,93	24,43	23,69	22,75	21,63
27232/--	3,2	20,86	26,55	29,55	31,19	31,96	32,14	31,85	31,21	30,27	29,07	27,64
27236/--	3,6	28,57	36,36	40,48	42,72	43,78	44,01	43,63	42,75	41,46	39,82	37,86
27340/--	4,0	33,04	42,05	46,81	49,40	50,63	50,90	50,46	49,44	47,95	46,05	43,78
27344/--	4,4	38,43	48,91	54,45	57,46	58,89	59,21	58,69	57,51	55,77	53,56	50,92

**Table 40A: Refrigerant R452A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,18	12,80	14,14	14,84	15,13	15,15	14,96	14,60	14,11	13,50	12,79
27120/--	2,0	13,58	17,07	18,86	19,78	20,18	20,20	19,94	19,47	18,82	18,01	17,06
27127/--	2,7	16,77	21,09	23,30	24,44	24,93	24,95	24,64	24,05	23,25	22,25	21,08
27232/--	3,2	21,43	26,95	29,76	31,23	31,85	31,88	31,48	30,73	29,70	28,42	26,93
27236/--	3,6	29,35	36,91	40,77	42,77	43,62	43,67	43,12	42,09	40,68	38,93	36,88
27340/--	4,0	33,94	42,69	47,15	49,46	50,45	50,50	49,87	48,68	47,05	45,02	42,66
27344/--	4,4	39,48	49,65	54,84	57,53	58,68	58,74	58,00	56,62	54,72	52,37	49,62

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,34	12,84	14,07	14,67	14,88	14,83	14,58	14,17	13,63	12,98	12,24
27120/--	2,0	13,79	17,12	18,76	19,56	19,85	19,78	19,44	18,89	18,18	17,31	16,32
27127/--	2,7	17,04	21,15	23,18	24,17	24,52	24,43	24,02	23,34	22,45	21,39	20,16
27232/--	3,2	21,77	27,03	29,61	30,88	31,33	31,21	30,68	29,82	28,69	27,33	25,76
27236/--	3,6	29,82	37,02	40,56	42,29	42,91	42,75	42,02	40,84	39,29	37,43	35,28
27340/--	4,0	34,48	42,81	46,91	48,91	49,62	49,44	48,60	47,24	45,44	43,28	40,80
27344/--	4,4	40,11	49,80	54,56	56,89	57,72	57,51	56,53	54,94	52,86	50,35	47,46

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 40B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 evaporatore capacity by dividing by the appropriate correction factor found in Table 40B

**Table 41A: Refrigerant R452B - Capacities in kW (1)**

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,61	18,27	21,30	23,44	24,99	26,13	26,93	27,47	27,79	27,91	27,86
27120/--	2,0	18,14	24,37	28,40	31,25	33,33	34,84	35,92	36,64	37,06	37,23	37,16
27127/--	2,7	22,41	30,10	35,08	38,60	41,16	43,03	44,36	45,25	45,77	45,98	45,89
27232/--	3,2	28,64	38,46	44,83	49,32	52,60	54,98	56,68	57,82	58,49	58,75	58,64
27236/--	3,6	39,22	52,67	61,39	67,55	72,04	75,31	77,63	79,19	80,10	80,46	80,31
27340/--	4,0	45,36	60,92	71,00	78,13	83,31	87,09	89,78	91,58	92,64	93,05	92,88
27344/--	4,4	52,76	70,86	82,59	90,88	96,91	101,30	104,43	106,53	107,76	108,24	108,04
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,52	19,40	22,54	24,73	26,33	27,49	28,31	28,87	29,21	29,35	29,33
27120/--	2,0	19,36	25,88	30,05	32,99	35,11	36,66	37,76	38,50	38,95	39,14	39,11
27127/--	2,7	23,91	31,96	37,12	40,74	43,36	45,27	46,63	47,55	48,11	48,35	48,31
27232/--	3,2	30,56	40,84	47,43	52,06	55,41	57,85	59,59	60,76	61,47	61,78	61,72
27236/--	3,6	41,85	55,93	64,96	71,30	75,89	79,23	81,61	83,22	84,19	84,61	84,54
27340/--	4,0	48,40	64,68	75,13	82,46	87,77	91,63	94,38	96,25	97,37	97,85	97,77
27344/--	4,4	56,29	75,24	87,39	95,91	102,09	106,58	109,79	111,95	113,25	113,82	113,72
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,31	20,34	23,52	25,73	27,32	28,47	29,29	29,84	30,17	30,31	30,29
27120/--	2,0	20,42	27,13	31,37	34,32	36,44	37,97	39,06	39,79	40,23	40,42	40,39
27127/--	2,7	25,22	33,50	38,74	42,38	45,00	46,90	48,24	49,15	49,69	49,92	49,88
27232/--	3,2	32,23	42,81	49,50	54,16	57,51	59,93	61,65	62,80	63,50	63,79	63,74
27236/--	3,6	44,14	58,63	67,80	74,17	78,76	82,08	84,43	86,01	86,96	87,37	87,30
27340/--	4,0	51,05	67,81	78,41	85,78	91,08	94,92	97,64	99,47	100,57	101,04	100,96
27344/--	4,4	59,38	78,87	91,20	99,78	105,95	110,41	113,58	115,71	116,98	117,53	117,44
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,99	21,08	24,25	26,44	27,99	29,11	29,90	30,42	30,72	30,84	30,80
27120/--	2,0	21,32	28,11	32,34	35,25	37,33	38,82	39,87	40,57	40,97	41,13	41,08
27127/--	2,7	26,34	34,72	39,94	43,54	46,11	47,95	49,24	50,10	50,60	50,80	50,74
27232/--	3,2	33,65	44,36	51,04	55,64	58,92	61,27	62,92	64,02	64,66	64,92	64,83
27236/--	3,6	46,09	60,76	69,90	76,20	80,69	83,91	86,18	87,68	88,56	88,91	88,79
27340/--	4,0	53,31	70,27	80,84	88,12	93,32	97,05	99,66	101,40	102,42	102,82	102,69
27344/--	4,4	62,00	81,73	94,03	102,50	108,55	112,88	115,93	117,95	119,13	119,60	119,45

**Table 41A: Refrigerant R452B - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,54	21,61	24,73	26,86	28,36	29,43	30,17	30,65	30,92	31,01	30,94
27120/--	2,0	22,05	28,82	32,98	35,82	37,82	39,24	40,23	40,87	41,23	41,35	41,26
27127/--	2,7	27,24	35,60	40,73	44,24	46,71	48,47	49,69	50,48	50,92	51,07	50,96
27232/--	3,2	34,80	45,48	52,05	56,52	59,69	61,93	63,49	64,50	65,07	65,26	65,12
27236/--	3,6	47,67	62,29	71,29	77,41	81,75	84,82	86,96	88,34	89,12	89,38	89,19
27340/--	4,0	55,13	72,04	82,44	89,53	94,54	98,10	100,56	102,17	103,06	103,36	103,14
27344/--	4,4	64,12	83,80	95,89	104,14	109,97	114,11	116,97	118,84	119,88	120,23	119,97

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,94	21,94	24,97	27,01	28,45	29,45	30,14	30,57	30,80	30,85	30,75
27120/--	2,0	22,59	29,25	33,30	36,03	37,94	39,28	40,19	40,77	41,07	41,14	41,01
27127/--	2,7	27,90	36,13	41,12	44,50	46,86	48,51	49,64	50,35	50,73	50,81	50,65
27232/--	3,2	35,65	46,17	52,55	56,86	59,87	61,99	63,43	64,34	64,82	64,93	64,72
27236/--	3,6	48,83	63,23	71,97	77,87	82,00	84,90	86,88	88,12	88,78	88,93	88,64
27340/--	4,0	56,47	73,13	83,23	90,06	94,84	98,19	100,47	101,91	102,67	102,84	102,51
27344/--	4,4	65,69	85,06	96,81	104,75	110,31	114,21	116,87	118,54	119,42	119,62	119,24

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 41B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45	
$F_{sub}$	1,00	1,06	1,11	1,16	1,22	1,27	1,32	1,43	1,48	

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 41B

Table 42A: Refrigerant R454B - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,75	18,47	21,53	23,70	25,28	26,43	27,25	27,81	28,14	28,28	28,24
27120/--	2,0	18,33	24,63	28,71	31,59	33,70	35,24	36,33	37,08	37,52	37,70	37,65
27127/--	2,7	22,65	30,42	35,46	39,03	41,63	43,53	44,88	45,80	46,34	46,57	46,51
27232/--	3,2	28,94	38,88	45,32	49,88	53,20	55,63	57,36	58,53	59,23	59,51	59,43
27236/--	3,6	39,63	53,24	62,06	68,30	72,85	76,17	78,55	80,15	81,11	81,50	81,39
27340/--	4,0	45,84	61,57	71,77	78,99	84,25	88,09	90,84	92,69	93,80	94,25	94,13
27344/--	4,4	53,31	71,61	83,48	91,87	97,99	102,46	105,66	107,81	109,10	109,63	109,48
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,66	19,60	22,76	24,99	26,60	27,78	28,62	29,19	29,54	29,70	29,68
27120/--	2,0	19,55	26,13	30,35	33,31	35,46	37,03	38,16	38,92	39,39	39,59	39,58
27127/--	2,7	24,14	32,27	37,49	41,15	43,81	45,75	47,13	48,08	48,65	48,91	48,89
27232/--	3,2	30,86	41,24	47,91	52,59	55,99	58,46	60,24	61,44	62,18	62,51	62,48
27236/--	3,6	42,25	56,48	65,60	72,02	76,67	80,06	82,49	84,14	85,15	85,60	85,56
27340/--	4,0	48,87	65,32	75,87	83,29	88,67	92,59	95,40	97,31	98,47	98,99	98,95
27344/--	4,4	56,84	75,97	88,25	96,87	103,13	107,69	110,96	113,18	114,53	115,14	115,09
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,45	20,53	23,74	25,98	27,59	28,76	29,59	30,15	30,49	30,64	30,63
27120/--	2,0	20,60	27,37	31,65	34,63	36,78	38,34	39,44	40,20	40,65	40,85	40,83
27127/--	2,7	25,45	33,81	39,10	42,78	45,43	47,36	48,73	49,65	50,21	50,47	50,44
27232/--	3,2	32,53	43,20	49,96	54,67	58,06	60,52	62,27	63,45	64,17	64,49	64,46
27236/--	3,6	44,54	59,16	68,42	74,87	79,51	82,88	85,27	86,90	87,88	88,32	88,28
27340/--	4,0	51,51	68,42	79,13	86,58	91,95	95,85	98,62	100,49	101,63	102,14	102,09
27344/--	4,4	59,92	79,58	92,03	100,70	106,95	111,48	114,70	116,89	118,21	118,80	118,75
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,13	21,26	24,46	26,67	28,25	29,38	30,18	30,72	31,03	31,17	31,14
27120/--	2,0	21,50	28,35	32,62	35,56	37,66	39,17	40,24	40,95	41,37	41,55	41,51
27127/--	2,7	26,56	35,02	40,29	43,93	46,52	48,39	49,71	50,59	51,11	51,33	51,28
27232/--	3,2	33,95	44,75	51,49	56,14	59,46	61,84	63,53	64,65	65,32	65,59	65,53
27236/--	3,6	46,49	61,28	70,51	76,87	81,42	84,69	86,99	88,53	89,44	89,82	89,74
27340/--	4,0	53,76	70,87	81,54	88,90	94,16	97,94	100,61	102,39	103,44	103,88	103,78
27344/--	4,4	62,53	82,43	94,85	103,40	109,52	113,92	117,02	119,09	120,32	120,82	120,71



**Table 42A: Refrigerant R454B - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,67	21,79	24,94	27,09	28,61	29,69	30,45	30,94	31,22	31,32	31,26
27120/--	2,0	22,23	29,05	33,25	36,11	38,14	39,59	40,59	41,25	41,62	41,75	41,68
27127/--	2,7	27,46	35,89	41,07	44,61	47,12	48,90	50,14	50,95	51,41	51,58	51,48
27232/--	3,2	35,09	45,86	52,49	57,01	60,21	62,49	64,08	65,12	65,71	65,92	65,80
27236/--	3,6	48,05	62,80	71,88	78,07	82,46	85,58	87,75	89,17	89,98	90,26	90,10
27340/--	4,0	55,57	72,63	83,13	90,29	95,36	98,97	101,48	103,12	104,06	104,39	104,20
27344/--	4,4	64,64	84,48	96,69	105,02	110,92	115,11	118,03	119,95	121,03	121,42	121,20

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	17,07	22,11	25,17	27,24	28,69	29,71	30,41	30,86	31,09	31,15	31,06
27120/--	2,0	22,76	29,48	33,56	36,32	38,25	39,61	40,54	41,14	41,45	41,54	41,42
27127/--	2,7	28,12	36,42	41,46	44,86	47,25	48,93	50,08	50,82	51,21	51,31	51,16
27232/--	3,2	35,94	46,54	52,98	57,33	60,39	62,54	64,01	64,94	65,44	65,57	65,38
27236/--	3,6	49,21	63,73	72,55	78,51	82,69	85,64	87,65	88,93	89,61	89,79	89,53
27340/--	4,0	56,91	73,70	83,90	90,80	95,64	99,04	101,37	102,85	103,64	103,84	103,54
27344/--	4,4	66,19	85,73	97,59	105,61	111,24	115,19	117,90	119,63	120,54	120,78	120,43

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 42B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,11	1,16	1,22	1,27	1,32	1,43	1,48

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 42B

Table 43A: Refrigerant R513A - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,52	12,08	13,37	13,98	14,18	14,08	13,75	13,25	12,58	11,79	10,87
27120/--	2,0	12,69	16,10	17,81	18,64	18,90	18,77	18,33	17,66	16,77	15,71	14,48
27127/--	2,7	15,68	19,89	22,01	23,02	23,35	23,18	22,65	21,81	20,72	19,41	17,89
27232/--	3,2	20,03	25,42	28,12	29,42	29,84	29,63	28,94	27,87	26,48	24,80	22,86
27236/--	3,6	27,43	34,81	38,51	40,30	40,86	40,57	39,63	38,17	36,26	33,97	31,31
27340/--	4,0	31,73	40,26	44,54	46,60	47,26	46,92	45,83	44,14	41,93	39,28	36,21
27344/--	4,4	36,90	46,83	51,81	54,20	54,97	54,58	53,31	51,34	48,78	45,69	42,12
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	9,89	12,41	13,62	14,17	14,30	14,14	13,76	13,20	12,50	11,68	10,74
27120/--	2,0	13,18	16,54	18,16	18,88	19,06	18,84	18,33	17,60	16,66	15,56	14,31
27127/--	2,7	16,28	20,43	22,43	23,33	23,54	23,27	22,65	21,73	20,58	19,22	17,68
27232/--	3,2	20,80	26,11	28,66	29,81	30,08	29,74	28,94	27,78	26,30	24,57	22,59
27236/--	3,6	28,49	35,76	39,25	40,82	41,20	40,73	39,64	38,04	36,02	33,64	30,94
27340/--	4,0	32,94	41,35	45,39	47,21	47,64	47,10	45,83	43,99	41,66	38,91	35,77
27344/--	4,4	38,32	48,10	52,80	54,92	55,42	54,79	53,32	51,17	48,46	45,26	41,61
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,15	12,59	13,70	14,16	14,20	13,97	13,53	12,92	12,17	11,31	10,34
27120/--	2,0	13,53	16,78	18,26	18,87	18,93	18,62	18,03	17,22	16,23	15,08	13,78
27127/--	2,7	16,72	20,72	22,56	23,31	23,38	23,00	22,27	21,27	20,04	18,62	17,03
27232/--	3,2	21,37	26,48	28,83	29,78	29,88	29,39	28,46	27,18	25,62	23,80	21,76
27236/--	3,6	29,26	36,27	39,48	40,79	40,93	40,25	38,98	37,23	35,08	32,59	29,80
27340/--	4,0	33,84	41,94	45,65	47,17	47,33	46,55	45,08	43,05	40,57	37,69	34,46
27344/--	4,4	39,36	48,79	53,10	54,87	55,05	54,15	52,43	50,08	47,19	43,84	40,09
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,32	12,62	13,61	13,96	13,92	13,61	13,10	12,44	11,64	10,74	9,73
27120/--	2,0	13,75	16,82	18,14	18,61	18,56	18,14	17,46	16,58	15,52	14,31	12,97
27127/--	2,7	16,99	20,77	22,41	22,99	22,92	22,41	21,57	20,48	19,17	17,67	16,02
27232/--	3,2	21,71	26,55	28,64	29,38	29,29	28,64	27,57	26,17	24,49	22,59	20,47
27236/--	3,6	29,73	36,36	39,22	40,23	40,12	39,22	37,75	35,83	33,54	30,93	28,04
27340/--	4,0	34,38	42,04	45,35	46,52	46,39	45,36	43,66	41,44	38,79	35,77	32,42
27344/--	4,4	39,99	48,91	52,76	54,12	53,96	52,76	50,79	48,20	45,12	41,61	37,72

**Table 43A: Refrigerant R513A - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,37	12,51	13,37	13,61	13,48	13,09	12,51	11,79	10,94	9,99	8,95
27120/--	2,0	13,82	16,67	17,82	18,14	17,97	17,45	16,68	15,71	14,58	13,31	11,92
27127/--	2,7	17,07	20,59	22,01	22,41	22,19	21,55	20,60	19,41	18,01	16,44	14,73
27232/--	3,2	21,82	26,31	28,13	28,64	28,36	27,54	26,33	24,80	23,02	21,01	18,82
27236/--	3,6	29,88	36,04	38,52	39,22	38,84	37,72	36,05	33,96	31,52	28,78	25,77
27340/--	4,0	34,55	41,67	44,55	45,36	44,92	43,62	41,69	39,27	36,45	33,28	29,81
27344/--	4,4	40,19	48,48	51,82	52,76	52,25	50,74	48,50	45,68	42,40	38,71	34,67

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	10,31	12,27	13,00	13,13	12,91	12,44	11,79	11,00	10,10	9,11	8,03
27120/--	2,0	13,74	16,35	17,32	17,50	17,20	16,58	15,72	14,67	13,47	12,14	10,70
27127/--	2,7	16,98	20,20	21,39	21,62	21,25	20,48	19,41	18,12	16,64	14,99	13,21
27232/--	3,2	21,70	25,81	27,34	27,62	27,15	26,17	24,81	23,15	21,26	19,16	16,89
27236/--	3,6	29,71	35,35	37,44	37,83	37,19	35,84	33,98	31,71	29,11	26,24	23,12
27340/--	4,0	34,36	40,88	43,30	43,75	43,00	41,44	39,29	36,67	33,67	30,35	26,74
27344/--	4,4	39,97	47,55	50,37	50,89	50,02	48,21	45,70	42,65	39,16	35,30	31,11

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 43B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	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 43B

Table 44A: Refrigerant R290 - Capacities in kW (1)

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	13,81	17,96	20,31	21,70	22,45	22,76	22,73	22,42	21,88	21,13	20,20
27120/--	2,0	18,41	23,95	27,08	28,93	29,94	30,35	30,31	29,89	29,17	28,17	26,94
27127/--	2,7	22,74	29,58	33,45	35,73	36,98	37,49	37,43	36,92	36,02	34,80	33,27
27232/--	3,2	29,06	37,80	42,74	45,66	47,25	47,90	47,83	47,18	46,03	44,46	42,51
27236/--	3,6	39,80	51,77	58,54	62,53	64,72	65,61	65,51	64,61	63,05	60,90	58,22
27340/--	4,0	46,03	59,87	67,70	72,31	74,84	75,87	75,76	74,72	72,91	70,42	67,33
27344/--	4,4	53,53	69,63	78,74	84,10	87,04	88,24	88,11	86,90	84,80	81,91	78,31
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,39	18,59	20,90	22,24	22,94	23,20	23,12	22,76	22,18	21,41	20,46
27120/--	2,0	19,19	24,78	27,87	29,65	30,59	30,94	30,83	30,35	29,58	28,55	27,28
27127/--	2,7	23,71	30,61	34,43	36,62	37,78	38,21	38,07	37,49	36,53	35,26	33,70
27232/--	3,2	30,29	39,11	43,99	46,80	48,28	48,82	48,65	47,90	46,68	45,05	43,06
27236/--	3,6	41,49	53,57	60,25	64,10	66,13	66,87	66,63	65,61	63,94	61,71	58,97
27340/--	4,0	47,98	61,95	69,67	74,12	76,47	77,33	77,05	75,87	73,94	71,36	68,20
27344/--	4,4	55,80	72,05	81,03	86,21	88,94	89,94	89,62	88,24	85,99	82,99	79,32
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,87	19,03	21,28	22,53	23,16	23,35	23,20	22,79	22,16	21,34	20,36
27120/--	2,0	19,83	25,38	28,37	30,04	30,88	31,13	30,93	30,38	29,54	28,45	27,14
27127/--	2,7	24,49	31,35	35,04	37,11	38,14	38,45	38,20	37,52	36,48	35,14	33,52
27232/--	3,2	31,30	40,05	44,78	47,42	48,74	49,13	48,82	47,95	46,62	44,90	42,84
27236/--	3,6	42,86	54,86	61,33	64,94	66,75	67,29	66,86	65,67	63,85	61,50	58,67
27340/--	4,0	49,57	63,44	70,92	75,10	77,19	77,81	77,32	75,94	73,84	71,12	67,84
27344/--	4,4	57,65	73,78	82,48	87,34	89,78	90,50	89,92	88,32	85,88	82,71	78,91
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,23	19,30	21,44	22,59	23,12	23,22	23,00	22,52	21,83	20,96	19,93
27120/--	2,0	20,31	25,74	28,58	30,12	30,83	30,96	30,66	30,02	29,10	27,94	26,58
27127/--	2,7	25,09	31,79	35,30	37,20	38,07	38,24	37,87	37,08	35,95	34,51	32,82
27232/--	3,2	32,06	40,62	45,11	47,53	48,65	48,86	48,39	47,38	45,93	44,10	41,95
27236/--	3,6	43,91	55,64	61,79	65,10	66,64	66,93	66,28	64,90	62,91	60,40	57,45
27340/--	4,0	50,77	64,34	71,45	75,28	77,06	77,39	76,65	75,05	72,75	69,85	66,43
27344/--	4,4	59,05	74,83	83,10	87,56	89,62	90,01	89,15	87,29	84,61	81,24	77,27

**Table 44A: Refrigerant R290 - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,47	19,40	21,39	22,42	22,85	22,85	22,55	22,00	21,24	20,32	19,24
27120/--	2,0	20,63	25,86	28,52	29,89	30,46	30,47	30,07	29,33	28,32	27,09	25,65
27127/--	2,7	25,48	31,94	35,23	36,92	37,62	37,64	37,13	36,22	34,98	33,46	31,68
27232/--	3,2	32,56	40,82	45,01	47,18	48,08	48,09	47,45	46,29	44,70	42,75	40,49
27236/--	3,6	44,59	55,90	61,65	64,62	65,85	65,87	64,99	63,40	61,22	58,55	55,45
27340/--	4,0	51,57	64,64	71,29	74,72	76,15	76,17	75,15	73,31	70,79	67,71	64,12
27344/--	4,4	59,97	75,18	82,92	86,91	88,56	88,59	87,41	85,26	82,34	78,75	74,58

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,58	19,31	21,15	22,05	22,37	22,28	21,89	21,26	20,44	19,45	18,32
27120/--	2,0	20,77	25,75	28,20	29,40	29,82	29,71	29,18	28,35	27,25	25,94	24,43
27127/--	2,7	25,65	31,81	34,84	36,32	36,84	36,69	36,04	35,01	33,66	32,03	30,17
27232/--	3,2	32,78	40,64	44,51	46,40	47,07	46,88	46,06	44,74	43,01	40,93	38,56
27236/--	3,6	44,90	55,67	60,97	63,56	64,47	64,21	63,08	61,27	58,90	56,06	52,81
27340/--	4,0	51,92	64,37	70,50	73,50	74,55	74,25	72,95	70,86	68,12	64,83	61,07
27344/--	4,4	60,39	74,87	82,00	85,48	86,70	86,36	84,84	82,41	79,22	75,40	71,03

(1): Capacity with fully open valve and liquid flow from radial to axial connection

TABLE 44B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45	
$F_{sub}$	1,00	1,06	1,12	1,18	1,24	1,30	1,35	1,40	1,45	

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 44B

**Table 45A: Refrigerant R600 - Capacities in kW (1)**

Evaporating Temperature 12 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,55	13,54	16,20	17,06	17,03	16,47	15,54	14,34	12,93		
27120/--	2,0	14,06	18,05	21,60	22,74	22,71	21,96	20,72	19,12	17,24		
27127/--	2,7	17,38	22,31	26,69	28,10	28,06	27,14	25,60	23,62	21,30		
27232/--	3,2	22,20	28,50	34,09	35,90	35,85	34,67	32,70	30,18	27,22		
27236/--	3,6	30,41	39,03	46,70	49,18	49,11	47,48	44,80	41,34	37,28		
27340/--	4,0	35,17	45,14	54,01	56,88	56,79	54,91	51,81	47,80	43,11		
27344/--	4,4	40,90	52,50	62,81	66,15	66,05	63,87	60,25	55,60	50,14		
Evaporating Temperature 4 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,65	13,54	16,02	16,73	16,57	15,90	14,88	13,59	12,11		
27120/--	2,0	14,20	18,06	21,36	22,30	22,10	21,20	19,84	18,13	16,15		
27127/--	2,7	17,55	22,31	26,39	27,56	27,31	26,20	24,51	22,40	19,96		
27232/--	3,2	22,42	28,50	33,71	35,20	34,89	33,47	31,31	28,61	25,50		
27236/--	3,6	30,71	39,04	46,18	48,22	47,79	45,85	42,89	39,19	34,92		
27340/--	4,0	35,51	45,15	53,40	55,76	55,26	53,02	49,60	45,32	40,39		
27344/--	4,4	41,30	52,51	62,11	64,86	64,27	61,67	57,69	52,71	46,97		
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,68	13,52	15,89	16,52	16,31	15,58	14,51	13,19	11,67		
27120/--	2,0	14,24	18,02	21,19	22,03	21,75	20,78	19,35	17,58	15,56		
27127/--	2,7	17,60	22,27	26,18	27,22	26,87	25,68	23,91	21,73	19,23		
27232/--	3,2	22,48	28,45	33,45	34,78	34,33	32,80	30,54	27,76	24,56		
27236/--	3,6	30,80	38,97	45,82	47,64	47,02	44,93	41,84	38,02	33,65		
27340/--	4,0	35,62	45,07	52,99	55,09	54,38	51,96	48,38	43,97	38,91		
27344/--	4,4	41,42	52,42	61,63	64,08	63,25	60,43	56,27	51,14	45,25		
Evaporating Temperature -8 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,71	13,41	15,58	16,06	15,72	14,89	13,72	12,31	10,72		
27120/--	2,0	14,28	17,89	20,78	21,41	20,96	19,85	18,29	16,42	14,30		
27127/--	2,7	17,64	22,10	25,68	26,46	25,90	24,52	22,60	20,29	17,67		
27232/--	3,2	22,54	28,23	32,80	33,80	33,08	31,33	28,88	25,92	22,57		
27236/--	3,6	30,87	38,67	44,93	46,30	45,32	42,92	39,56	35,50	30,92		
27340/--	4,0	35,70	44,72	51,96	53,54	52,41	49,63	45,74	41,06	35,76		
27344/--	4,4	41,52	52,01	60,43	62,27	60,95	57,72	53,20	47,75	41,59		

**Table 45A: Refrigerant R600 - Capacities in kW (1)**

Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,64	13,13	14,98	15,23	14,70	13,71	12,40	10,88	9,18		
27120/--	2,0	14,19	17,51	19,98	20,30	19,60	18,28	16,54	14,50	12,24		
27127/--	2,7	17,53	21,63	24,69	25,09	24,22	22,58	20,44	17,92	15,13		
27232/--	3,2	22,40	27,64	31,54	32,05	30,94	28,85	26,11	22,90	19,33		
27236/--	3,6	30,68	37,86	43,20	43,90	42,38	39,52	35,76	31,36	26,47		
27340/--	4,0	35,48	43,78	49,96	50,77	49,00	45,70	41,36	36,27	30,61		
27344/--	4,4	41,27	50,92	58,11	59,04	56,99	53,15	48,10	42,18	35,61		

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 45B - Correction factors for subcooling  $\Delta t_{sub} \neq 4 \text{ }^\circ\text{K}$**

$\Delta t_{sub} \text{ [}^\circ\text{K]}$	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,09	1,14	1,19	1,23	1,28	1,38	1,43

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 45B

Table 46A: Refrigerant R600a - Capacities in kW (1)

Evaporating Temperature 12 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	9,69	12,59	15,31	16,30	16,43	16,02	15,25	14,19	12,93		
27120/--	2,0	12,91	16,78	20,40	21,72	21,89	21,35	20,32	18,92	17,23		
27127/--	2,7	15,95	20,73	25,21	26,84	27,05	26,38	25,10	23,37	21,29		
27232/--	3,2	20,38	26,49	32,21	34,30	34,57	33,71	32,08	29,87	27,21		
27236/--	3,6	27,92	36,29	44,12	46,99	47,36	46,18	43,94	40,92	37,27		
27340/--	4,0	32,28	41,96	51,01	54,32	54,75	53,39	50,81	47,31	43,09		
27344/--	4,4	37,55	48,80	59,33	63,18	63,68	62,10	59,09	55,02	50,12		
Evaporating Temperature 4 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	9,86	12,71	15,29	16,15	16,17	15,66	14,80	13,68	12,35		
27120/--	2,0	13,14	16,94	20,37	21,52	21,55	20,87	19,73	18,23	16,45		
27127/--	2,7	16,24	20,93	25,17	26,60	26,62	25,80	24,38	22,52	20,33		
27232/--	3,2	20,75	26,74	32,16	33,98	34,02	32,96	31,15	28,78	25,98		
27236/--	3,6	28,42	36,63	44,06	46,55	46,60	45,15	42,67	39,43	35,59		
27340/--	4,0	32,86	42,35	50,94	53,82	53,88	52,20	49,33	45,58	41,15		
27344/--	4,4	38,21	49,26	59,24	62,60	62,67	60,71	57,38	53,01	47,86		
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	9,93	12,74	15,24	16,04	16,00	15,45	14,54	13,38	12,01		
27120/--	2,0	13,23	16,98	20,31	21,37	21,32	20,58	19,38	17,83	16,01		
27127/--	2,7	16,35	20,98	25,10	26,41	26,34	25,43	23,94	22,03	19,78		
27232/--	3,2	20,89	26,81	32,07	33,75	33,66	32,50	30,60	28,15	25,28		
27236/--	3,6	28,62	36,73	43,93	46,23	46,11	44,52	41,91	38,56	34,63		
27340/--	4,0	33,09	42,47	50,79	53,45	53,31	51,47	48,46	44,58	40,04		
27344/--	4,4	38,49	49,39	59,07	62,16	62,01	59,86	56,36	51,85	46,56		
Evaporating Temperature -8 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,04	12,76	15,08	15,74	15,58	14,93	13,94	12,70	11,27		
27120/--	2,0	13,37	17,00	20,10	20,98	20,77	19,90	18,58	16,93	15,02		
27127/--	2,7	16,53	21,01	24,84	25,92	25,66	24,59	22,95	20,91	18,56		
27232/--	3,2	21,12	26,85	31,74	33,12	32,79	31,42	29,33	26,73	23,72		
27236/--	3,6	28,93	36,78	43,48	45,37	44,92	43,04	40,18	36,61	32,49		
27340/--	4,0	33,45	42,52	50,27	52,46	51,93	49,76	46,46	42,33	37,56		
27344/--	4,4	38,90	49,45	58,46	61,01	60,40	57,87	54,03	49,23	43,68		



**Table 46A: Refrigerant R600a - Capacities in kW (1)**

Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		1	2	4	6	8	10	12	14	16	18	20
27115/--	1,5	10,10	12,65	14,69	15,13	14,80	14,00	12,88	11,53	10,00		
27120/--	2,0	13,46	16,86	19,58	20,16	19,72	18,65	17,16	15,36	13,32		
27127/--	2,7	16,63	20,83	24,19	24,92	24,37	23,05	21,20	18,98	16,46		
27232/--	3,2	21,25	26,62	30,91	31,84	31,14	29,45	27,10	24,25	21,03		
27236/--	3,6	29,11	36,46	42,35	43,62	42,66	40,35	37,12	33,22	28,81		
27340/--	4,0	33,66	42,15	48,96	50,43	49,32	46,65	42,91	38,41	33,31		
27344/--	4,4	39,15	49,03	56,94	58,65	57,35	54,25	49,91	44,67	38,74		

(1): Capacity with fully open valve and liquid flow from radial to axial connection

**TABLE 46B - Correction factors for subcooling  $\Delta t_{sub} \neq 4 \text{ °K}$**

$\Delta t_{sub} \text{ [°K]}$	4	10	15	20	25	30	35	40	45
$F_{sub}$	1,00	1,06	1,11	1,16	1,21	1,26	1,31	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 46B

**Table 47A: Refrigerant R1270 - Capacities in kW (1)**

Evaporating Temperature 10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,29	18,84	21,56	23,30	24,41	25,05	25,34	25,34	25,10	24,65	24,00
27120/--	2,0	19,05	25,11	28,74	31,06	32,53	33,39	33,77	33,77	33,45	32,85	31,99
27127/--	2,7	23,54	31,03	35,51	38,38	40,20	41,26	41,74	41,74	41,34	40,59	39,54
27232/--	3,2	30,07	39,63	45,36	49,03	51,35	52,71	53,31	53,32	52,81	51,85	50,50
27236/--	3,6	41,19	54,28	62,12	67,15	70,34	72,19	73,02	73,02	72,32	71,02	69,17
27340/--	4,0	47,64	62,78	71,85	77,67	81,35	83,49	84,45	84,45	83,65	82,14	80,00
27344/--	4,4	55,41	73,02	83,57	90,33	94,62	97,11	98,23	98,23	97,29	95,54	93,05
Evaporating Temperature 0 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	14,99	19,64	22,38	24,11	25,19	25,81	26,07	26,04	25,78	25,32	24,67
27120/--	2,0	19,99	26,18	29,83	32,14	33,58	34,40	34,75	34,71	34,36	33,74	32,88
27127/--	2,7	24,70	32,35	36,86	39,72	41,50	42,51	42,94	42,90	42,47	41,70	40,63
27232/--	3,2	31,55	41,32	47,09	50,73	53,01	54,30	54,85	54,80	54,25	53,27	51,90
27236/--	3,6	43,21	56,60	64,49	69,48	72,60	74,37	75,12	75,05	74,29	72,95	71,09
27340/--	4,0	49,98	65,46	74,59	80,36	83,96	86,01	86,88	86,80	85,93	84,38	82,22
27344/--	4,4	58,13	76,13	86,76	93,47	97,66	100,04	101,05	100,96	99,94	98,14	95,63
Evaporating Temperature -10 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	15,59	20,27	22,98	24,66	25,68	26,25	26,46	26,39	26,09	25,59	24,92
27120/--	2,0	20,78	27,01	30,62	32,86	34,23	34,98	35,27	35,17	34,78	34,11	33,22
27127/--	2,7	25,68	33,38	37,84	40,61	42,30	43,23	43,58	43,47	42,98	42,16	41,05
27232/--	3,2	32,80	42,64	48,34	51,88	54,04	55,22	55,67	55,52	54,90	53,85	52,44
27236/--	3,6	44,93	58,40	66,21	71,05	74,01	75,63	76,24	76,05	75,18	73,75	71,82
27340/--	4,0	51,96	67,55	76,57	82,18	85,60	87,48	88,18	87,95	86,96	85,30	83,06
27344/--	4,4	60,44	78,57	89,06	95,58	99,56	101,74	102,56	102,30	101,14	99,21	96,61
Evaporating Temperature -20 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,07	20,71	23,35	24,95	25,90	26,39	26,54	26,41	26,06	25,52	24,81
27120/--	2,0	21,42	27,61	31,12	33,25	34,52	35,17	35,37	35,20	34,74	34,02	33,08
27127/--	2,7	26,47	34,12	38,45	41,09	42,65	43,47	43,71	43,51	42,93	42,04	40,87
27232/--	3,2	33,82	43,58	49,12	52,49	54,49	55,52	55,83	55,57	54,84	53,70	52,21
27236/--	3,6	46,32	59,69	67,27	71,89	74,62	76,04	76,47	76,11	75,10	73,55	71,51
27340/--	4,0	53,57	69,04	77,81	83,14	86,31	87,95	88,45	88,03	86,87	85,06	82,70
27344/--	4,4	62,31	80,30	90,50	96,70	100,38	102,29	102,87	102,39	101,03	98,94	96,19

**Table 47A: Refrigerant R1270 - Capacities in kW (1)**

Evaporating Temperature -30 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,43	20,97	23,49	24,99	25,85	26,26	26,34	26,15	25,74	25,15	24,40
27120/--	2,0	21,90	27,96	31,32	33,31	34,46	35,00	35,10	34,85	34,31	33,52	32,52
27127/--	2,7	27,07	34,55	38,70	41,17	42,58	43,26	43,38	43,07	42,40	41,42	40,18
27232/--	3,2	34,57	44,13	49,43	52,58	54,39	55,25	55,41	55,01	54,16	52,91	51,33
27236/--	3,6	47,35	60,44	67,70	72,02	74,49	75,68	75,89	75,35	74,17	72,47	70,30
27340/--	4,0	54,77	69,91	78,31	83,30	86,16	87,53	87,78	87,14	85,79	83,82	81,31
27344/--	4,4	63,70	81,31	91,08	96,88	100,21	101,80	102,09	101,36	99,78	97,49	94,57

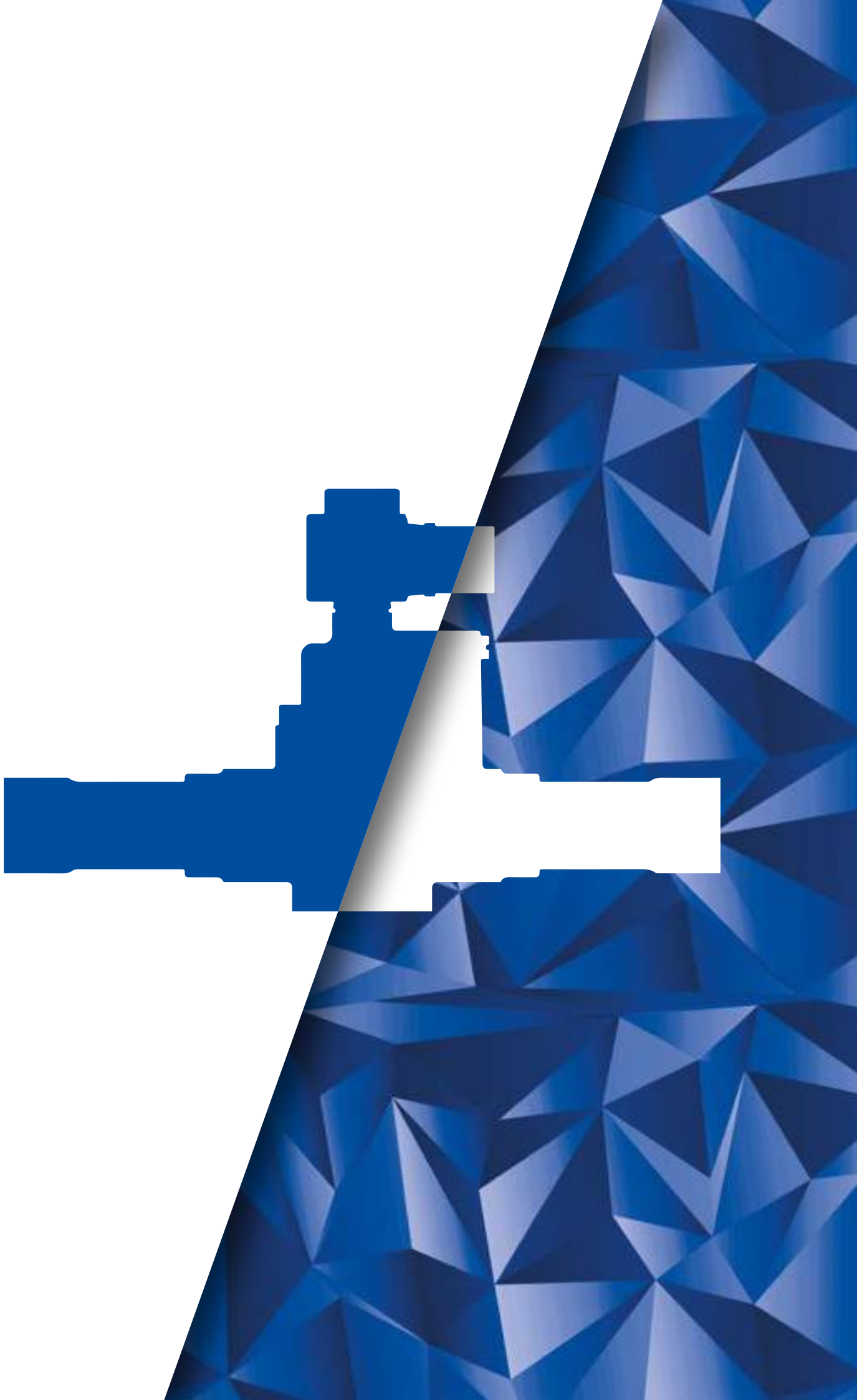
  

Evaporating Temperature -40 °C												
Catalogue number	Equivalent port Ø [mm]	Pressure drop across valve [bar]										
		2	4	6	8	10	12	14	16	18	20	22
27115/--	1,5	16,66	21,05	23,43	24,81	25,57	25,89	25,89	25,63	25,16	24,51	23,71
27120/--	2,0	22,21	28,06	31,24	33,07	34,08	34,51	34,51	34,16	33,54	32,68	31,61
27127/--	2,7	27,44	34,67	38,60	40,87	42,12	42,65	42,64	42,22	41,44	40,38	39,06
27232/--	3,2	35,05	44,29	49,31	52,21	53,80	54,48	54,47	53,93	52,94	51,58	49,90
27236/--	3,6	48,01	60,66	67,53	71,51	73,69	74,61	74,60	73,86	72,51	70,64	68,34
27340/--	4,0	55,53	70,16	78,10	82,70	85,22	86,30	86,29	85,42	83,86	81,70	79,04
27344/--	4,4	64,58	81,60	90,84	96,19	99,12	100,37	100,36	99,35	97,54	95,03	91,93

TABLE 47B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$

TABLE 47B - Correction factors for subcooling $\Delta t_{sub} \neq 4^\circ K$										
$\Delta t_{sub} [^\circ K]$	4	10	15	20	25	30	35	40	45	
$F_{sub}$	1,00	1,06	1,12	1,18	1,24	1,30	1,35	1,40	1,45	

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 47B



The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a 3D effect of depth and shadow. The colors range from light sky blue to deep navy blue.

# SOLENOID VALVES

P  LYHEDRA

# SOLENOID VALVES

## 2.1 – NORMALLY CLOSED SOLENOID VALVES

### APPLICATION

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

These valves have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! The solenoid valves illustrated in this chapter cannot be installed on systems that use HCFC (R22) refrigerant.**

### 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 9300 (coils type HF2)
- Coils in series 9320 (coils type HF3)
- Coils in series 9360 (coils type HF4)

The valves in series 1020N and 1028N 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 differential pressure.**

### CONSTRUCTION

The main parts of the solenoid valves described in this chapter are constructed with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover
- 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.
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for seat gaskets

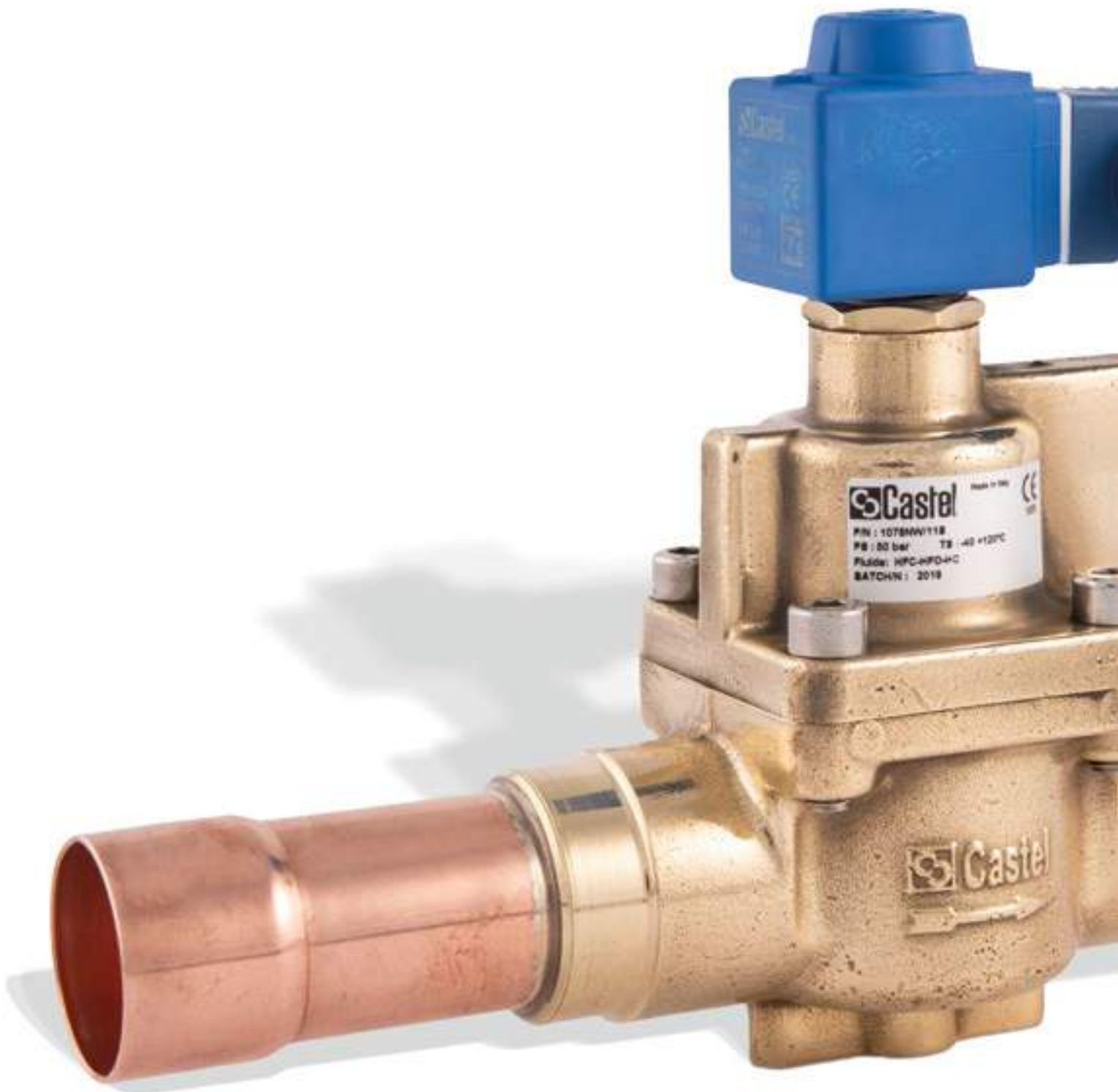
### INSTALLATION

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 and 2 and the capacities indicated in TABLES 4, 5 and 6. 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 and 2 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 1020N and 1028N
- Pilot-operated piston valves in series 1034N, 1038N, 1040N, 1048N, 1049N,
- Pilot-operated diaphragm valves in series 1064N, 1068N, 1070N, 1078N up to 1078/5, 1079N up to 1079/7

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.

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 [m <sup>3</sup> /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	1020N/2#	1/4"	2,5	0,175	0	21	28	35	20	21	50	-40	+130	Art. 4.3
	1020N/3#	3/8"	3	0,23										
Diaphragm Pilot Operated	1064N/3#	3/8"	6,5	0,8	0,05	21	28	35	17	18	50	-40	+120	Art. 4.3
	1064N/4#	1/2"												
	1070N/4#	1/2"	12,5	2,2					10	13				
	1070N/5#	5/8"	16,5	2,61					8	10				
	1090N/5#	5/8"		3,8										
	1090N/6#	3/4"		4,8										
Piston Pilot Operated	1034N/3#	3/8"	6,5	1,0	0,05	21	28	35	10	18	50	-40	+130	Art. 4.3
	1034N/4#	1/2"												
	1040N/4#	1/2"	12,5	2,4					14	18				
	1040N/5#	5/8"	16,5	3,0					8	16				
	1050N/5#	5/8"		3,8										
	1050N/6#	3/4"		4,8										

# = S, A6



TABLE 2: General characteristics of NC valves with ODS connections

Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m <sup>3</sup> /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	1028N/2#	1/4"	–	2,2	0,15	0	21	28	35	20	21	50	–40	+130	Art. 4.3	
	1028N/2#.E	1/4"	–	3	0,23											
	1028N/3#	3/8"	–													
	1028N/M10#	–	10													
Diaphragm Pilot Operated	1068N/3#	3/8"	–	6,5	0,8	0,05	21	28	35	17	18	50	–40	+120	Art. 4.3	
	1068N/M10#	–	10													
	1068N/M12#	–	12													
	1068N/4#	1/2"	–													
	1078N/M12#	–	12	12,5	2,2											
	1078N/4#	1/2"	–													
	1078N/5#	5/8"	16													
	1079N/7#	7/8"	22	16,5	2,61											
	1098N/5#	5/8"	16													
	1098N/6#	3/4"	–													
	1098N/7#	7/8"	22													
	1099N/9#	1.1/8"	–	25,5	10											
	1078N/9#	1.1/8"	–													
1079N/11#	1.3/8"	35														
Piston Pilot Operated	1038N/3#	3/8"	–	6,5	1,0	0,05	21	28	35	10	18	50	–40	+130	Art. 4.3	
	1038N/M10#	–	10													
	1038N/M12#	–	12													
	1038N/4#	1/2"	–													
	1048N/M12#	–	12	12,5	2,4											
	1048N/4#	1/2"	–													
	1048N/5#	5/8"	16													
	1049N/7#	7/8"	22													
	1058N/5#	5/8"	16	16,5	3,8											
	1058N/6#	3/4"	–													
	1058N/7#	7/8"	22													
	1059N/9#	1.1/8"	–													
	1098N/9#	1.1/8"	–	25	10											
	1099N/11#	1.3/8"	35													
	1078NW/11#	1.3/8"	35													
	1079NW/13#	1.5/8"	–	27	16					0,1						
	1079NW/M42#	–	42													
1078NW/13#	1.5/8"	–														
1078NW/M42#	–	42	34	25	0,15											
1079NW/17#	2.1/8"	54														
											14	18				II

# = S, A6

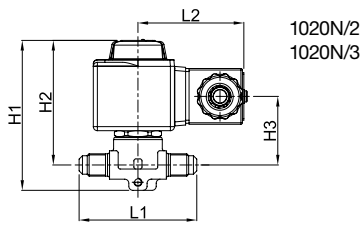
TABLE 3: Dimensions and weights of NC valves with 9300 coils (1)

Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]
		H1	H2	H3	L1	L2	Q	
Direct Acting	1020N/2#	75	62,5	34	58	52	-	340
	1020N/3#				65			355
	1028N/2#				125			350
	1028N/2#.E				125			350
	1028N/3#				125			365
	1028N/M10#				125			365
Diaphragm Pilot Operated	1064N/3#	82	69,5	40	68	52	-	400
	1064N/4#				72			415
	1068N/3#				111			400
	1068N/M10#				111			395
	1068N/M12#				127			420
	1068N/4#				127			420
	1070N/4#	91	75	47	100		45	710
	1070N/5#				106			755
	1078N/M12#				127			690
	1078N/4#				127			680
	1078N/5#				175			775
	1079N/7#				190			765
	1090N/5#	106	78	50	120		57	1035
	1090N/6#				124			1365
	1098N/5#				175			995
	1098N/6#				175			1185
	1098N/7#				180			1170
	1099N/9#				216			1225
	1078N/9#	115	96	72	250		80	2565
	1079N/11#ve				292			2620
Piston Pilot Operated	1034N/3#	92,5	80	50,5	68	52	-	440
	1034N/4#				72			457
	1038N/3#				111			440
	1038N/M10#				111			435
	1038N/M12#				127			462
	1038N/4#				127			462
	1040N/4#	100,5	84,5	56,5	100		45	781
	1040N/5#				106			831
	1048N/M12#				127			759
	1048N/4#				127			748
	1048N/5#				175			853
	1049N/7#				190			842
	1050N/5#	121	93	65	120		57	1157
	1050N/6#				124			1487
	1058N/5#				175			1117
	1058N/6#				175			1307
	1058N/7#				180			1292
	1059N/9#				216			1347
	1098N/9#	157	127	99	235		60	2050
	1099N/11#				277			2130
	1078NW/11#	171	137	110	254		68	2710
	1079NW/13#				278			2750
	1079NW/M42#				278			2750
	1078NW/13#	192	155	128	265		88	3810
	1078NW/M42#				265			3810
	1079NW/17#				280			3880

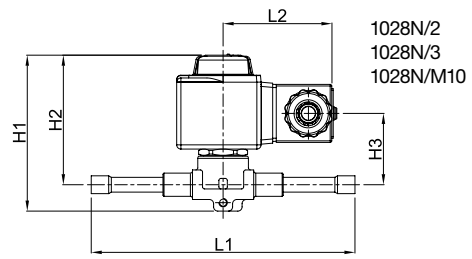
# = S, A6

- (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.

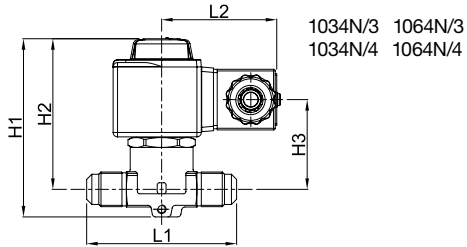
Connectors are not included in the boxes and have to be ordered separately



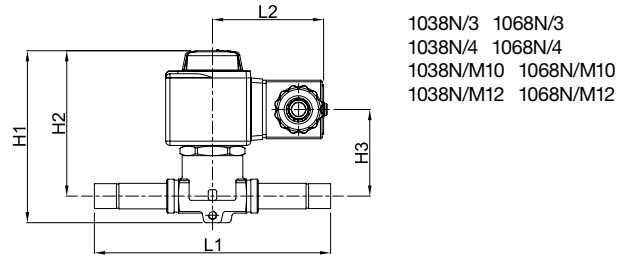
1020N/2  
1020N/3



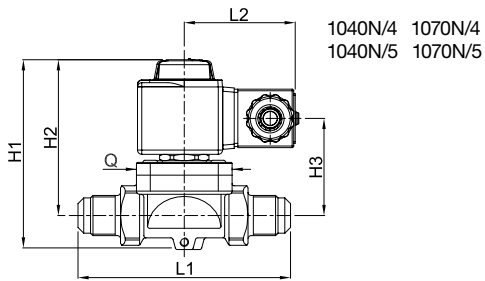
1028N/2  
1028N/3  
1028N/M10



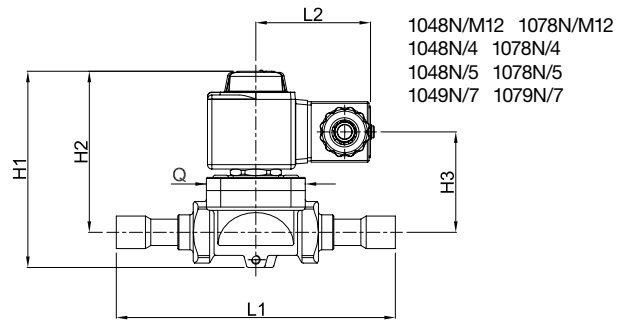
1034N/3 1064N/3  
1034N/4 1064N/4



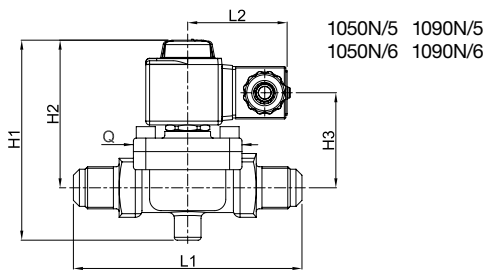
1038N/3 1068N/3  
1038N/4 1068N/4  
1038N/M10 1068N/M10  
1038N/M12 1068N/M12



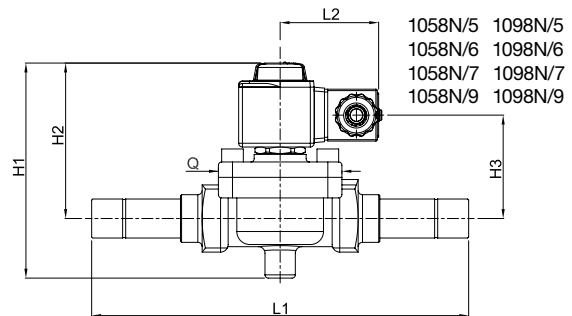
1040N/4 1070N/4  
1040N/5 1070N/5



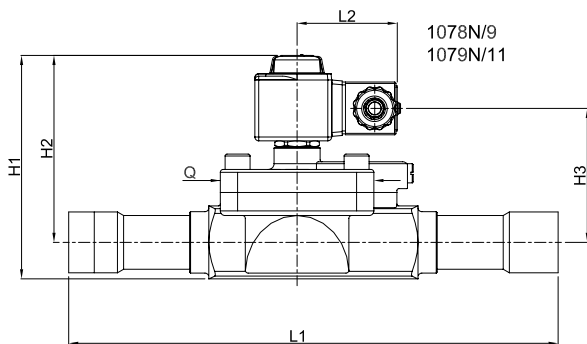
1048N/M12 1078N/M12  
1048N/4 1078N/4  
1048N/5 1078N/5  
1049N/7 1079N/7



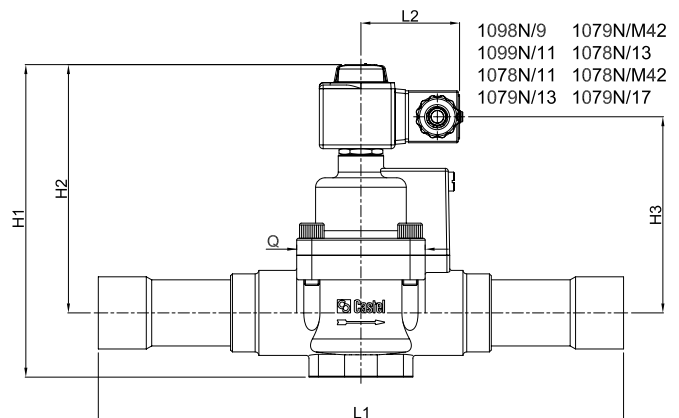
1050N/5 1090N/5  
1050N/6 1090N/6



1058N/5 1098N/5  
1058N/6 1098N/6  
1058N/7 1098N/7  
1058N/9 1098N/9



1078N/9  
1079N/11



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

TABLE 4: Refrigerant flow capacity of NC valves in liquid line [kW]

Operating Principles	Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
Direct Acting	1020N/2#	2,98	4,40	2,08	3,02	3,00	2,01	2,20	2,63	2,74	2,75
	1020N/3#	3,91	5,78	2,74	3,96	3,95	2,65	2,89	3,46	3,60	3,62
	1028N/2#	2,55	3,77	1,79	2,58	2,58	1,73	1,89	2,26	2,35	2,36
	1028N/2#.E	3,91	5,78	2,74	3,96	3,95	2,65	2,89	3,46	3,60	3,62
	1028N/3#										
	1028N/M10#										
1028N/M12#											
Diaphragm Pilot Operated	1064N/3#	13,6	20,1	9,5	13,8	13,7	9,2	10,1	12,0	12,5	12,6
	1064N/4#										
	1068N/3#										
	1068N/M10#										
	1068N/M12#										
	1068N/4#										
	1070N/4#	37,4	55,3	26,2	37,9	37,8	25,3	27,7	33,1	34,4	34,6
	1070N/5#	44,4	65,6	31,1	45,0	44,8	30,0	32,8	39,3	40,8	41,0
	1078N/M12#	37,4	55,3	26,2	37,9	37,8	25,3	27,7	33,1	34,4	34,6
	1078N/4#										
	1078N/5#	44,4	65,6	31,1	45,0	44,8	30,0	32,8	39,3	40,8	41,0
	1079N/7#	44,4	65,6	31,1	45,0	44,8	30,0	32,8	39,3	40,8	41,0
	1090N/5#	64,6	95,5	45,2	65,5	65,2	43,7	47,8	57,2	59,5	59,7
	1090N/6#	81,6	120,6	57,1	82,7	82,4	55,2	60,4	72,2	75,1	75,5
	1098N/5#	64,6	95,5	45,2	65,5	65,2	43,7	47,8	57,2	59,5	59,7
	1098N/6#	81,6	120,6	57,1	82,7	82,4	55,2	60,4	72,2	75,1	75,5
	1098N/7#	96,9	143,2	67,8	98,2	97,9	65,6	71,7	85,7	89,2	89,6
	1099N/9#										
	1078N/9#										
	1079N/11#	170,0	251,3	119,0	172,3	171,7	115,0	125,8	150,4	156,5	157,2
Piston Pilot Operated	1034N/3#	17,0	25,1	11,9	17,2	17,2	11,5	12,6	15,0	15,7	15,7
	1034N/4#										
	1038N/3#										
	1038N/M10#										
	1038N/M12#										
	1038N/4#										
	1040N/4#	40,8	60,3	28,6	41,4	41,2	27,6	30,2	36,1	37,6	37,7
	1040N/5#	51,0	75,4	35,7	51,7	51,5	34,5	37,7	45,1	47,0	47,2
	1048N/M12#	40,8	60,3	28,6	41,4	41,2	27,6	30,2	36,1	37,6	37,7
	1048N/4#										
	1048N/5#	51,0	75,4	35,7	51,7	51,5	34,5	37,7	45,1	47,0	47,2
	1049N/7#	51,0	75,4	35,7	51,7	51,5	34,5	37,7	45,1	47,0	47,2
	1050N/5#	64,6	95,5	45,2	65,5	65,2	43,7	47,8	57,2	59,5	59,7
	1050N/6#	81,6	120,6	57,1	82,7	82,4	55,2	60,4	72,2	75,1	75,5
	1058N/5#	64,6	95,5	45,2	65,5	65,2	43,7	47,8	57,2	59,5	59,7
	1058N/6#	81,6	120,6	57,1	82,7	82,4	55,2	60,4	72,2	75,1	75,5
	1058N/7#	96,9	143,2	67,8	98,2	97,9	65,6	71,7	85,7	89,2	89,6
	1059N/9#										
	1098N/9#										
	1098N/9#	170,0	251,3	119,0	172,3	171,7	115,0	125,8	150,4	156,5	157,2
	1099N/11#										
	1078NW/11#										
	1079NW/13#	272,0	402,1	190,4	275,7	274,7	184,0	201,3	240,6	250,4	251,5
	1079NW/M42#	425,0	628,3	297,5	430,8	429,3	287,5	314,5	376,0	391,3	393,0
1078NW/13#											
1078NW/M42#											
1079NW/17#											

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

TABLE 4: Refrigerant flow capacity of NC valves in liquid line [kW]

Operating Principles	Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
Direct Acting	1020N/2#	2,78	2,12	3,51	3,58	2,55	3,57	4,18	3,71	3,71
	1020N/3#	3,66	2,79	4,61	4,71	3,35	4,69	5,50	4,88	4,88
	1028N/2#	2,39	1,82	3,01	3,07	2,18	3,06	3,59	3,18	3,18
	1028N/2#.E	3,66	2,79	4,61	4,71	3,35	4,69	5,50	4,88	4,88
	1028N/3#									
	1028N/M10#									
1064N/3#										
Diaphragm Pilot Operated	1064N/4#	12,7	9,7	16,0	16,4	11,6	16,3	19,1	17,0	17,0
	1068N/3#									
	1068N/M10#									
	1068N/M12#									
	1068N/4#									
	1070N/4#									
	1070N/5#	35,0	26,7	44,1	45,0	32,0	44,8	52,6	46,6	46,6
	1078N/M12#	41,5	31,7	52,3	53,4	38,0	53,2	62,4	55,3	55,3
	1078N/4#	35,0	26,7	44,1	45,0	32,0	44,8	52,6	46,6	46,6
	1078N/5#	41,5	31,7	52,3	53,4	38,0	53,2	62,4	55,3	55,3
	1079N/7#	60,5	46,1	76,2	77,7	55,3	77,4	90,8	80,6	80,6
	1090N/5#	76,4	58,2	96,2	98,2	69,9	97,8	114,7	101,8	101,8
	1090N/6#	60,5	46,1	76,2	77,7	55,3	77,4	90,8	80,6	80,6
	1098N/5#	76,4	58,2	96,2	98,2	69,9	97,8	114,7	101,8	101,8
	1098N/6#	90,7	69,1	114,3	116,6	83,0	116,2	136,2	120,8	120,8
	1098N/7#	159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
	1099N/9#	159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
	1078N/9#	159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
	1079N/11#	159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
	Piston Pilot Operated	1034N/3#	15,9	12,1	20,1	20,5	14,6	20,4	23,9	21,2
1034N/4#										
1038N/3#										
1038N/M10#										
1038N/M12#										
1038N/4#										
1040N/4#		38,2	29,1	48,1	49,1	34,9	48,9	57,4	50,9	50,9
1040N/5#		47,7	36,4	60,2	61,4	43,7	61,1	71,7	63,6	63,6
1048N/M12#		38,2	29,1	48,1	49,1	34,9	48,9	57,4	50,9	50,9
1048N/4#		47,7	36,4	60,2	61,4	43,7	61,1	71,7	63,6	63,6
1048N/5#		47,7	36,4	60,2	61,4	43,7	61,1	71,7	63,6	63,6
1049N/7#		60,5	46,1	76,2	77,7	55,3	77,4	90,8	80,6	80,6
1050N/5#		76,4	58,2	96,2	98,2	69,9	97,8	114,7	101,8	101,8
1050N/6#		60,5	46,1	76,2	77,7	55,3	77,4	90,8	80,6	80,6
1058N/5#		76,4	58,2	96,2	98,2	69,9	97,8	114,7	101,8	101,8
1058N/6#		90,7	69,1	114,3	116,6	83,0	116,2	136,2	120,8	120,8
1058N/7#		159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
1059N/9#		159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
1098N/9#		159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
1099N/11#		159,1	121,3	200,5	204,6	145,6	203,8	239,0	212,0	212,0
1078NW/11#		254,6	194,1	320,8	327,4	233,0	326,1	382,4	339,2	339,2
1079NW/13#		254,6	194,1	320,8	327,4	233,0	326,1	382,4	339,2	339,2
1079NW/M42#		397,8	303,3	501,3	511,5	364,0	509,5	597,5	530,0	530,0
1078NW/13#	397,8	303,3	501,3	511,5	364,0	509,5	597,5	530,0	530,0	
1078NW/M42#	397,8	303,3	501,3	511,5	364,0	509,5	597,5	530,0	530,0	
1079NW/17#	397,8	303,3	501,3	511,5	364,0	509,5	597,5	530,0	530,0	

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

TABLE 5: Refrigerant flow capacity of NC valves in suction line [kW]

Operating Principles	Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
"Direct Acting"	1020N/2#	-	-	-	-	-	-	-	-	-	-
	1020N/3#										
	1028N/2#										
	1028N/2#.E										
	1028N/3#										
	1028N/M10#										
"Diaphragm Pilot Operated"	1064N/3#	1,46	3,40	1,76	1,82	2,64	1,78	1,18	1,14	1,92	1,76
	1064N/4#										
	1068N/3#										
	1068N/M10#										
	1068N/M12#										
	1068N/4#										
	1070N/4#	4,00	9,35	4,84	4,99	7,26	4,91	3,23	3,12	5,28	4,84
	1070N/5#	4,75	11,09	5,74	5,92	8,61	5,82	3,84	3,71	6,26	5,74
	1078N/M12#	4,00	9,35	4,84	4,99	7,26	4,91	3,23	3,12	5,28	4,84
	1078N/4#										
	1078N/5#	4,75	11,09	5,74	5,92	8,61	5,82	3,84	3,71	6,26	5,74
	1079N/7#	6,9	16,2	8,4	8,6	12,5	8,5	5,6	5,4	9,1	8,4
	1090N/5#										
	1090N/6#										
	1090N/6#										
	1098N/5#	6,9	16,2	8,4	8,6	12,5	8,5	5,6	5,4	9,1	8,4
	1098N/6#	8,7	20,4	10,6	10,9	15,8	10,7	7,1	6,8	11,5	10,6
	1098N/6#	6,9	16,2	8,4	8,6	12,5	8,5	5,6	5,4	9,1	8,4
	1098N/6#	8,7	20,4	10,6	10,9	15,8	10,7	7,1	6,8	11,5	10,6
	1098N/7#	10,4	24,2	12,5	12,9	18,8	12,7	8,4	8,1	13,7	12,5
1099N/9#											
1078N/9#	18,2	42,5	22,0	22,7	33,0	22,3	14,7	14,2	24,0	22,0	
1079N/11#											
"Piston Pilot Operated"	1034N/3#	1,82	4,25	2,20	2,27	3,30	2,23	1,47	1,42	2,40	2,20
	1034N/4#										
	1038N/3#										
	1038N/M10#										
	1038N/M12#										
	1038N/4#										
	1040N/4#	4,37	10,20	5,28	5,45	7,92	5,35	3,53	3,41	5,76	5,28
	1040N/5#	5,46	12,75	6,60	6,81	9,90	6,69	4,41	4,26	7,20	6,60
	1048N/M12#	4,37	10,20	5,28	5,45	7,92	5,35	3,53	3,41	5,76	5,28
	1048N/4#										
	1048N/5#	5,46	12,75	6,60	6,81	9,90	6,69	4,41	4,26	7,20	6,60
	1049N/7#										
	1050N/5#	6,9	16,2	8,4	8,6	12,5	8,5	5,6	5,4	9,1	8,4
	1050N/6#	8,7	20,4	10,6	10,9	15,8	10,7	7,1	6,8	11,5	10,6
	1058N/5#	6,9	16,2	8,4	8,6	12,5	8,5	5,6	5,4	9,1	8,4
	1058N/6#	8,7	20,4	10,6	10,9	15,8	10,7	7,1	6,8	11,5	10,6
	1058N/7#	10,4	24,2	12,5	12,9	18,8	12,7	8,4	8,1	13,7	12,5
	1059N/9#										
	1098N/9#	18,2	42,5	22,0	22,7	33,0	22,3	14,7	14,2	24,0	22,0
	1099N/11#										
	1078NW/11#	29,1	68,0	35,2	36,3	52,8	35,7	23,5	22,7	38,4	35,2
	1079NW/13#										
	1079NW/M42#										
	1078NW/13#	45,5	106,3	55,0	56,8	82,5	55,8	36,8	35,5	60,0	55,0
	1078NW/M42#										
1079NW/17#											

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

TABLE 5: Refrigerant flow capacity of NC valves in suction line [kW]

Operating Principles	Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
Direct Acting	1020N/2#	-	-	-	-	-	-	-	-	-
	1020N/3#									
	1028N/2#									
	1028N/2#.E									
	1028N/3#									
	1028N/M10#									
Diaphragm Pilot Operated	1064N/3#	1,27	1,69	2,79	2,80	1,43	2,44	1,03	1,26	2,78
	1064N/4#									
	1068N/3#									
	1068N/M10#									
	1068N/M12#									
	1068N/4#									
	1070N/4#	3,50	4,64	7,68	7,70	3,94	6,71	2,84	3,48	7,66
	1070N/5#	4,15	5,51	9,11	9,14	4,67	7,96	3,37	4,12	9,08
	1078N/M12#	3,50	4,64	7,68	7,70	3,94	6,71	2,84	3,48	7,66
	1078N/4#									
	1078N/5#	4,15	5,51	9,11	9,14	4,67	7,96	3,37	4,12	9,08
	1079N/7#									
	1090N/5#	6,0	8,0	13,3	13,3	6,8	11,6	4,9	6,0	13,2
	1090N/6#	7,6	10,1	16,8	16,8	8,6	14,6	6,2	7,6	16,7
	1098N/5#	6,0	8,0	13,3	13,3	6,8	11,6	4,9	6,0	13,2
	1098N/6#	7,6	10,1	16,8	16,8	8,6	14,6	6,2	7,6	16,7
	1098N/7#	9,1	12,0	19,9	20,0	10,2	17,4	7,4	9,0	19,8
	1099N/9#									
	1078N/9#	15,9	21,1	34,9	35,0	17,9	30,5	12,9	15,8	34,8
1079N/11#										
Piston Pilot Operated	1034N/3#	1,59	2,11	3,49	3,50	1,79	3,05	1,29	1,58	3,48
	1034N/4#									
	1038N/3#									
	1038N/M10#									
	1038N/M12#									
	1038N/4#									
	1040N/4#	3,82	5,06	8,38	8,40	4,30	7,32	3,10	3,79	8,35
	1040N/5#	4,77	6,33	10,47	10,50	5,37	9,15	3,87	4,74	10,44
	1048N/M12#	3,82	5,06	8,38	8,40	4,30	7,32	3,10	3,79	8,35
	1048N/4#									
	1048N/5#	4,77	6,33	10,47	10,50	5,37	9,15	3,87	4,74	10,44
	1049N/7#									
	1050N/5#	6,0	8,0	13,3	13,3	6,8	11,6	4,9	6,0	13,2
	1050N/6#	7,6	10,1	16,8	16,8	8,6	14,6	6,2	7,6	16,7
	1058N/5#	6,0	8,0	13,3	13,3	6,8	11,6	4,9	6,0	13,2
	1058N/6#	7,6	10,1	16,8	16,8	8,6	14,6	6,2	7,6	16,7
	1058N/7#	9,1	12,0	19,9	20,0	10,2	17,4	7,4	9,0	19,8
	1059N/9#									
	1098N/9#	15,9	21,1	34,9	35,0	17,9	30,5	12,9	15,8	34,8
	1099N/11#									
	1078NW/11#	25,4	33,8	55,8	56,0	28,6	48,8	20,6	25,3	55,7
	1079NW/13#									
1079NW/M42#										
1078NW/13#	39,8	52,8	87,3	87,5	44,8	76,3	32,3	39,5	87,0	
1078NW/M42#										
1079NW/17#										

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

TABLE 6: Refrigerant flow capacity of NC valves in hot gas line line [kW]

Operating Principles	Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
"Direct Acting"	1020N/2#	1,49	3,18	1,68	2,08	2,38	1,67	1,16	1,20	2,07	1,89
	1020N/3#	1,96	4,18	2,21	2,74	3,13	2,19	1,53	1,58	2,71	2,48
	1028N/2#	1,28	2,72	1,44	1,79	2,04	1,43	1,00	1,03	1,77	1,62
	1028N/2#.E	1,96	4,18	2,21	2,74	3,13	2,19	1,53	1,58	2,71	2,48
	1028N/3#										
	1028N/M10#										
1028N/M12#											
"Diaphragm Pilot Operated"	1064N/3#	6,8	14,5	7,7	9,5	10,9	7,6	5,3	5,5	9,4	8,6
	1064N/4#										
	1068N/3#										
	1068N/M10#										
	1068N/M12#										
	1068N/4#										
	1070N/4#	18,7	40,0	21,1	26,2	29,9	21,0	14,6	15,1	26,0	23,7
	1070N/5#	22,2	47,4	25,1	31,1	35,5	24,9	17,3	17,9	30,8	28,1
	1078N/M12#	18,7	40,0	21,1	26,2	29,9	21,0	14,6	15,1	26,0	23,7
	1078N/4#										
	1078N/5#	22,2	47,4	25,1	31,1	35,5	24,9	17,3	17,9	30,8	28,1
	1079N/7#	32,3	69,0	36,5	45,2	51,7	36,3	25,2	26,0	44,8	41,0
	1090N/5#										
	1090N/6#										
	1090N/6#										
	1098N/5#	32,3	69,0	36,5	45,2	51,7	36,3	25,2	26,0	44,8	41,0
	1098N/6#	40,8	87,2	46,1	57,1	65,3	45,8	31,9	32,9	56,6	51,7
	1098N/7#	48,5	103,5	54,7	67,8	77,5	54,4	37,8	39,0	67,3	61,4
	1099N/9#	85,0	181,6	96,0	119,0	136,0	95,4	66,4	68,5	118,0	107,8
	1078N/9#										
1079N/11#											
"Piston Pilot Operated"	1034N/3#	8,5	18,2	9,6	11,9	13,6	9,5	6,6	6,9	11,8	10,8
	1034N/4#										
	1038N/3#										
	1038N/M10#										
	1038N/M12#										
	1038N/4#										
	1040N/4#	20,4	43,6	23,0	28,6	32,6	22,9	15,9	16,4	28,3	25,9
	1040N/5#	25,5	54,5	28,8	35,7	40,8	28,6	19,9	20,6	35,4	32,3
	1048N/M12#	20,4	43,6	23,0	28,6	32,6	22,9	15,9	16,4	28,3	25,9
	1048N/4#										
	1048N/5#	25,5	54,5	28,8	35,7	40,8	28,6	19,9	20,6	35,4	32,3
	1049N/7#										
	1050N/5#										
	1050N/6#	32,3	69,0	36,5	45,2	51,7	36,3	25,2	26,0	44,8	41,0
	1058N/5#	40,8	87,2	46,1	57,1	65,3	45,8	31,9	32,9	56,6	51,7
	1058N/6#	32,3	69,0	36,5	45,2	51,7	36,3	25,2	26,0	44,8	41,0
	1058N/7#	40,8	87,2	46,1	57,1	65,3	45,8	31,9	32,9	56,6	51,7
	1059N/9#	48,5	103,5	54,7	67,8	77,5	54,4	37,8	39,0	67,3	61,4
	1098N/9#	85,0	181,6	96,0	119,0	136,0	95,4	66,4	68,5	118,0	107,8
	1099N/11#										
	1078NW/11#										
	1079NW/13#	136,0	290,6	153,6	190,4	217,6	152,6	106,2	109,6	188,8	172,5
	1079NW/M42#	212,5	454,0	240,0	297,5	340,0	238,5	166,0	171,3	295,0	269,5
	1078NW/13#										
1078NW/M42#											
1079NW/17#											

# = S, A6

continue →

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



TABLE 6: Refrigerant flow capacity of NC valves in hot gas line line [kW]

Operating Principles	Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
Direct Acting	1020N/2#	1,34	1,75	2,68	2,70	1,42	2,23	1,13	1,30	2,52
	1020N/3#	1,76	2,30	3,52	3,55	1,87	2,93	1,49	1,71	3,31
	1028N/2#	1,15	1,50	2,30	2,31	1,22	1,91	0,97	1,12	2,16
	1028N/2#.E	1,76	2,30	3,52	3,55	1,87	2,93	1,49	1,71	3,31
	1028N/3#									
	1028N/M10#									
1064N/3#										
Diaphragm Pilot Operated	1064N/4#	6,1	8,0	12,2	12,3	6,5	10,2	5,2	6,0	11,5
	1068N/3#									
	1068N/M10#									
	1068N/M12#									
	1068N/4#									
	1070N/4#									
	1070N/5#	16,8	22,0	33,7	33,9	17,9	28,1	14,2	16,4	31,7
	1078N/M12#	20,0	26,0	39,9	40,3	21,2	33,3	16,9	19,4	37,6
	1078N/4#	16,8	22,0	33,7	33,9	17,9	28,1	14,2	16,4	31,7
	1078N/5#	20,0	26,0	39,9	40,3	21,2	33,3	16,9	19,4	37,6
	1079N/7#	29,1	37,9	58,1	58,6	30,9	48,5	24,5	28,3	54,7
	1090N/5#	36,7	47,9	73,4	74,1	39,1	61,2	31,0	35,7	69,1
	1090N/6#	29,1	37,9	58,1	58,6	30,9	48,5	24,5	28,3	54,7
	1098N/5#	36,7	47,9	73,4	74,1	39,1	61,2	31,0	35,7	69,1
	1098N/6#	43,6	56,9	87,2	88,0	46,4	72,7	36,8	42,4	82,1
	1098N/7#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
	1099N/9#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
	1078N/9#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
1079N/11#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0	
Piston Pilot Operated	1034N/3#	7,7	10,0	15,3	15,4	8,1	12,8	6,5	7,4	14,4
	1034N/4#									
	1038N/3#									
	1038N/M10#									
	1038N/M12#									
	1038N/4#									
	1040N/4#	18,4	24,0	36,7	37,0	19,5	30,6	15,5	17,9	34,6
	1040N/5#	23,0	29,9	45,9	46,3	24,4	38,3	19,4	22,3	43,2
	1048N/M12#	18,4	24,0	36,7	37,0	19,5	30,6	15,5	17,9	34,6
	1048N/4#	23,0	29,9	45,9	46,3	24,4	38,3	19,4	22,3	43,2
	1048N/5#									
	1049N/7#									
	1050N/5#	29,1	37,9	58,1	58,6	30,9	48,5	24,5	28,3	54,7
	1050N/6#	36,7	47,9	73,4	74,1	39,1	61,2	31,0	35,7	69,1
	1058N/5#	29,1	37,9	58,1	58,6	30,9	48,5	24,5	28,3	54,7
	1058N/6#	36,7	47,9	73,4	74,1	39,1	61,2	31,0	35,7	69,1
	1058N/7#	43,6	56,9	87,2	88,0	46,4	72,7	36,8	42,4	82,1
	1059N/9#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
	1098N/9#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
	1099N/11#	76,5	99,8	153,0	154,3	81,4	127,6	64,6	74,4	144,0
1078NW/11#	122,4	159,7	244,8	246,9	130,2	204,2	103,4	119,0	230,4	
1079NW/13#										
1079NW/M42#										
1078NW/13#										
1078NW/M42#	191,3	249,5	382,5	385,8	203,5	319,0	161,5	186,0	360,0	
1079NW/17#	191,3	249,5	382,5	385,8	203,5	319,0	161,5	186,0	360,0	

# = S, A6

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

# SOLENOID VALVES

## 2.2 – NORMALLY CLOSED PULSE SOLENOID VALVES

### APPLICATION

The normally closed pulse 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 applications that require a solenoid valve that cycles at high frequencies for a short period, to accurately maintain the regulated temperature of the refrigeration fluid. The NC pulse solenoid valves are suitable to be installed on the oil line of a refrigeration systems. They regulate the passage of oil from the separator to the compressor crankcase and they can also be used to inject oil into screw compressors. These valves can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! The solenoid valves illustrated in this chapter cannot be installed on systems that use HCFC (R22) refrigerant.**

### 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.

The pulse solenoid valves are exclusively sold without coil (with the S suffix). For these valves are available:

- Coils in series 9110 (coils type CM2)
- Coils in series 9300 (coils type HF2)
- Coils in series 9320 (coils type HF3)
- Coils in series 9360 (coils type HF4)

The valves series 1328N 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 1338N, 1348N, 1358N are pilot-operated piston 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 piston and keep it lifted off the main opening
  - close the piston and ensure the tightness on the main opening
- Opening/closing of main valve seat is controlled by the piston, while opening/closing of pilot seat is controlled by the mobile plunger of the coil.

**These valves cannot work with zero differential pressure.**

### CONSTRUCTION

The NC pulse solenoid valves are equipped with a specific reinforced magnetic unit (mobile plunger + valve sleeve for holding it), specifically designed to guarantee a very high number of work cycles compared to a normal NC solenoid valve.

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 10088-3 – 1.4305 for mobile plunger valve sleeve
- Ferritic stainless steel EN 10088-3 – 1.4105 for the fixed and mobile plungers
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for seat gaskets

### INSTALLATION

The valve series 1328N, 1338N, 1348N, 1358N can be used as:

- hot gas by-pass valve between the high and the low pressure sides of a system
- liquid injection valve
- oil valve

within the limits of use indicated in TABLE 7 and the capacities indicated in TABLES 9 and 10.

TABLE 7 shows the following functional characteristics of a solenoid valve:

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



**Castel** ITALY  
Type  
HF2  
220-230 V ~  
50-60 Hz  
8W CL-H  
TA 50 °C



to AHRI STANDARD 760 : 2014. This is the maximum pressure differential between inlet and outlet at which a solenoid valve can open.

– No. of Cycles: useful operational life expected for the valve expressed in the number of operating cycles, considering a complete cycle consisting of an opening and successive closing of the valve.

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 1328N
- Pilot-operated piston valves in series 1338N, 1348N

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

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

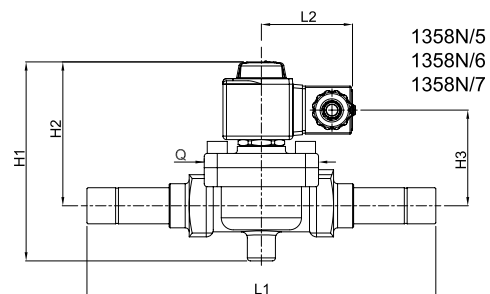
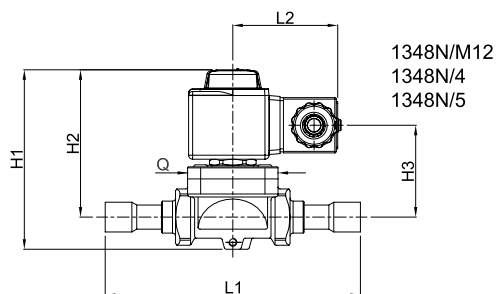
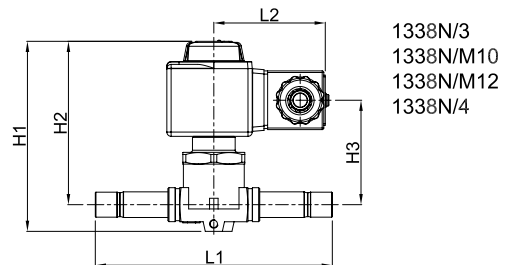
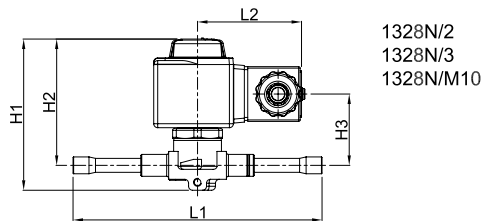


TABLE 7: General Characteristics of NC pulse valves with ODS connections

Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m <sup>3</sup> /h]	Opening Pressure Differential [bar]					PS [bar]	TS [°C]		Cycles No min	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	1328N/2S020	1/4"	–	2,2	0,15	0	28	30	35		21	50	–40	+150	6.000.000	Art. 4.3
	1328N/2S030	1/4"	–	3	0,23		18	21	25		18					
	1328N/3S020	3/8"	–	2,2	0,15		28	30	35		21					
	1328N/3S030	3/8"	–	3	0,23		18	21	25		18					
	1328N/M10S020	–	10	2,2	0,15		28	30	35		21					
	1328N/M10S030	–	10	3	0,23		18	21	25		18					
Piston Pilot Operated	1338N/3S065	3/8"	–	6,5	1,0	0,05	21	28	35		18	50	–40	+150	6.000.000	Art. 4.3
	1338N/M10S065	–	10													
	1338N/M12S065	–	12													
	1338N/4S065	1/2"	–													
	1348N/M12S125	–	12	12,5	2,4	0,07	21	28	35		18					
	1348N/4S125	1/2"	–													
	1348N/5S125	5/8"	16	16,5	3,0											
	1358N/5S165	5/8"	16		3,8											
	1358N/6S165	3/4"	–		4,8											
	1358N/7S165	7/8"	22	5,7	21	28	35		16							

(1) : for use on the oil line TS = -10 / +70 °C

TABLE 8: Dimensions and weights of NC valves with 9300 coils (1)

Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]
		H1	H2	H3	L1	L2	Q	
Direct Acting	1328N/2S020	75	62,5	34	125	52	–	350
	1328N/2S030							
	1328N/3S020							
	1328N/3S030							
	1328N/M10S020							
	1328N/M10S030							
Piston Pilot Operated	1338N/3S065	92,5	80	50,5	111	52	–	440
	1338N/M10S065				127			
	1338N/M12S065							
	1338N/4S065							
	1348N/M12S125	100,5	84,5	56,5	127	–	45	759
	1348N/4S125				127			748
	1348N/5S125				175			853
	1358N/5S165	121	93	65	175	–	57	1117
	1358N/6S165				175			1307
	1358N/7S165				180			1292

(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 9: Refrigerant flow capacity of NC pulse valves in liquid line [kW]

Operating Principles	Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270																			
Direct Acting	1328N/2S020	2,55	3,77	1,79	2,58	2,58	1,73	1,89	2,26	2,35	2,36	2,39	1,82	3,01	3,07	2,18	3,06	3,59	3,18	3,18																			
	1328N/2S030	3,91	5,78	2,74	3,96	3,95	2,65	2,89	3,46	3,60	3,62	3,66	2,79	4,61	4,71	3,35	4,69	5,50	4,88	4,88																			
	1328N/3S020	2,55	3,77	1,79	2,58	2,58	1,73	1,89	2,26	2,35	2,36	2,39	1,82	3,01	3,07	2,18	3,06	3,59	3,18	3,18																			
	1328N/3S030	3,91	5,78	2,74	3,96	3,95	2,65	2,89	3,46	3,60	3,62	3,66	2,79	4,61	4,71	3,35	4,69	5,50	4,88	4,88																			
	1328N/M10S020	2,55	3,77	1,79	2,58	2,58	1,73	1,89	2,26	2,35	2,36	2,39	1,82	3,01	3,07	2,18	3,06	3,59	3,18	3,18																			
	1328N/M10S030	3,91	5,78	2,74	3,96	3,95	2,65	2,89	3,46	3,60	3,62	3,66	2,79	4,61	4,71	3,35	4,69	5,50	4,88	4,88																			
Piston Pilot Operated	1338N/3S065	17,0	25,1	11,9	17,2	17,2	11,5	12,6	15,0	15,7	15,7	15,9	12,1	20,1	20,5	14,6	20,4	23,9	21,2	21,2																			
	1338N/M10S065																																						
	1338N/M12S065																																						
	1338N/4S065																																						
	1348N/M12S125	40,8	60,3	28,6	41,4	41,2	27,6	30,2	36,1	37,6	37,7	38,2	29,1	48,1	49,1	34,9	48,9	57,4	50,9	50,9																			
	1348N/4S125	51,0	75,4	35,7	51,7	51,5	34,5	37,7	45,1	47,0	47,2	47,7	36,4	60,2	61,4	43,7	61,1	71,7	63,6	63,6	63,6																		
	1358N/5S165																																						
	1358N/6S165																																						
1358N/7S165																																							
1358N/5S165	64,6																					95,5	45,2	65,5	65,2	43,7	47,8	57,2	59,5	59,7	60,5	46,1	76,2	77,7	55,3	77,4	90,8	80,6	80,6
1358N/6S165	81,6																					120,6	57,1	82,7	82,4	55,2	60,4	72,2	75,1	75,5	76,4	58,2	96,2	98,2	69,9	97,8	114,7	101,8	101,8
1358N/7S165	96,9	143,2	67,8	98,2	97,9	65,6	71,7	85,7	89,2	89,6	90,7	69,1	114,3	116,6	83,0	116,2	136,2	120,8	120,8																				

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

TABLE 10: Refrigerant flow capacity of NC pulse valves in hot gas line [kW]

Operating Principles	Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
Direct Acting	1328N/2S020	1,28	2,72	1,44	1,79	2,04	1,43	1,00	1,03	1,77	1,62	1,15	1,50	2,30	2,31	1,22	1,91	0,97	1,12	2,16
	1328N/2S030	1,96	4,18	2,21	2,74	3,13	2,19	1,53	1,58	2,71	2,48	1,76	2,30	3,52	3,55	1,87	2,93	1,49	1,71	3,31
	1328N/3S020	1,28	2,72	1,44	1,79	2,04	1,43	1,00	1,03	1,77	1,62	1,15	1,50	2,30	2,31	1,22	1,91	0,97	1,12	2,16
	1328N/3S030	1,96	4,18	2,21	2,74	3,13	2,19	1,53	1,58	2,71	2,48	1,76	2,30	3,52	3,55	1,87	2,93	1,49	1,71	3,31
	1328N/M10S020	1,28	2,72	1,44	1,79	2,04	1,43	1,00	1,03	1,77	1,62	1,15	1,50	2,30	2,31	1,22	1,91	0,97	1,12	2,16
	1328N/M10S030	1,96	4,18	2,21	2,74	3,13	2,19	1,53	1,58	2,71	2,48	1,76	2,30	3,52	3,55	1,87	2,93	1,49	1,71	3,31
Piston Pilot Operated	1338N/3S065	8,5	18,2	9,6	11,9	13,6	9,5	6,6	6,9	11,8	10,8	7,7	10,0	15,3	15,4	8,1	12,8	6,5	7,4	14,4
	1338N/M10S065																			
	1338N/M12S065																			
	1338N/4S065																			
	1348N/M12S125	20,4	43,6	23,0	28,6	32,6	22,9	15,9	16,4	28,3	25,9	18,4	24,0	36,7	37,0	19,5	30,6	15,5	17,9	34,6
	1348N/4S125	25,5	54,5	28,8	35,7	40,8	28,6	19,9	20,6	35,4	32,3	23,0	29,9	45,9	46,3	24,4	38,3	19,4	22,3	43,2
	1348N/5S125																			
	1358N/5S165																			
	1358N/6S165																			
	1358N/7S165	48,5	103,5	54,7	67,8	77,5	54,4	37,8	39,0	67,3	61,4	43,6	56,9	87,2	88,0	46,4	72,7	36,8	42,4	82,1

Standard rating conditions according to AHRI Standard 760-2014

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

# SOLENOID VALVES

## 2.3 – NORMALLY CLOSED SOLENOID VALVES, ATEX – CERTIFIED

### APPLICATION

The “ATEX-Certified” 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.

**The solenoid valves with an “EX” suffix (1028EX, 1068EX, 1078EX, 1079EX, 1098EX, 1099EX) comply with the European Standards EN 80079-36:2016, EN 80079-37:2016 and, therefore, comply with the ESR of Directive 2014/34/EU – ATEX. This equipment is suitable for use on refrigeration systems located in areas classified as “Zone 2” risk of explosion, according to the definition in Annex I of Directive 1999/92/EC.**

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! The solenoid valves illustrated in this chapter cannot be installed on systems that use HCFC (R22) refrigerant.**

### 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.

The “ATEX” valves are sold only in the version with coil series 9100EX (A6 suffix with coil, 9100EX-220/230 VAC, ATEX certified).

For these solenoid valves are available:

- Coils in series 9100EX (coils type HM2)
- Coils in series 9110EX (coils type CM2)

The coils in series 9100EX and 9110EX must be coupled only with connectors 9150EX/R02. The protection rating guaranteed by the coil + connector system is IP65 according to the EN 60529 standard.

The valves in series 1028EX 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 1068EX, 1078EX, 1079EX, 1098EX/7, 1099EX/9 are pilot-operated solenoid valves (diaphragm or piston). 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 differential pressure.**

### CONSTRUCTION

The main parts of the valves 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.
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for seat gaskets

The valves with an “EX” suffix are also equipped with:

- Identification label for compliance of the valve to the ATEX Directive.
- Operating instructions regarding installation of the valve in areas classified as at risk of explosion.
- Operating instructions regarding installation of the coil in areas classified as at risk of explosion.

### INSTALLATION

The valves in series 1028EX, 1068EX, 1078EX, 1079EX, 1098EX, 1099EX can be installed on the three main branches of a system (hot gas line, liquid line, and suction line), while respecting the limits of use and the capacities indicated in TABLE 11.

TABLE 11 shows the following functional characteristics of a solenoid valve:





**Castel** ITALY  
Type H82  
230/230 V ~  
50-60 Hz  
IMQ 13 ATEX 002 X  
Ex mc IIC T3 Gc II 30D  
Ex mc IIC T1 100°C Dc IP65  
Temp. -20/+80°C  
Icc=1500 A  
In=85mA  
CE

**WARNING**  
POTENTIAL ELECTROSTATIC  
CHARGING HAZARD.  
INSTALLATION SHALL BE  
PERFORMED IN ORDER  
TO GIVE MECHANICAL  
PROTECTION TO  
ELECTRICAL CONNECTOR.  
INSTALLATION WITH  
SUITABLE CABLE UP TO 75°C.  
SEE INSTRUCTIONS.

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

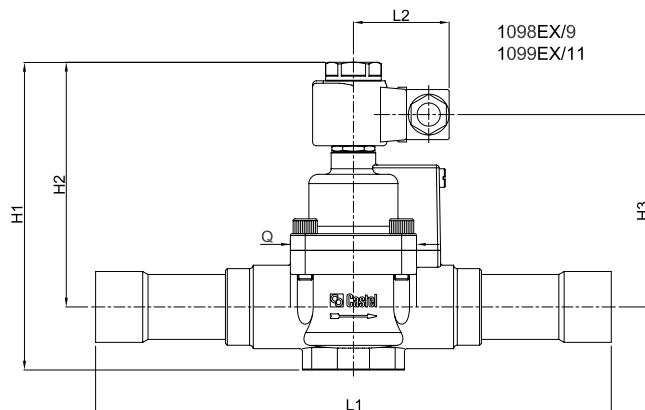
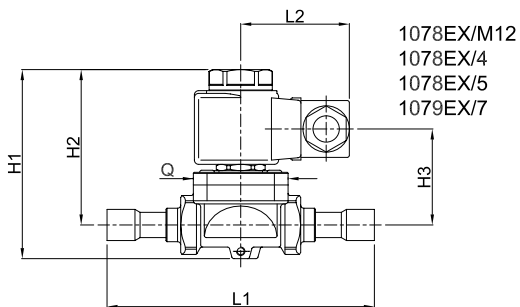
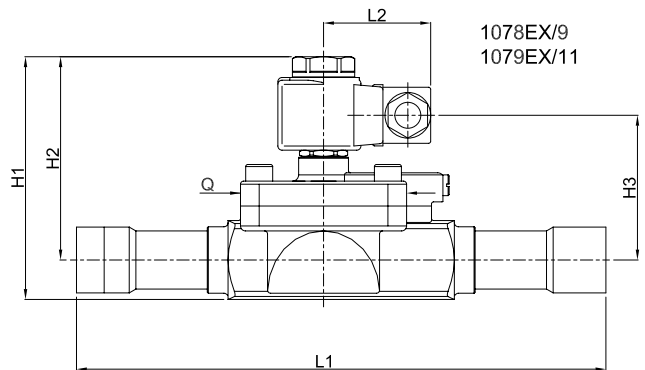
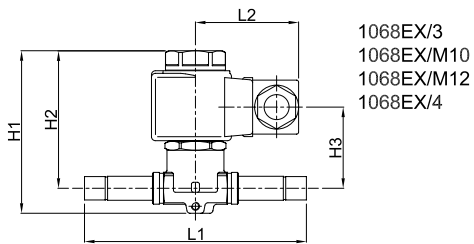
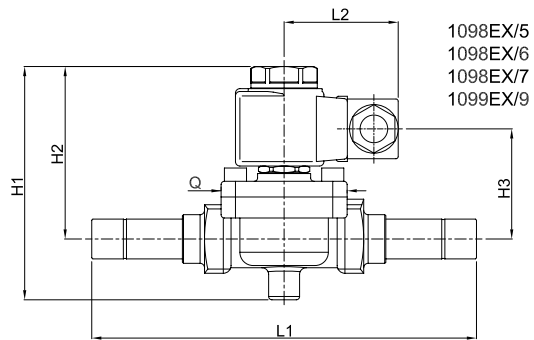
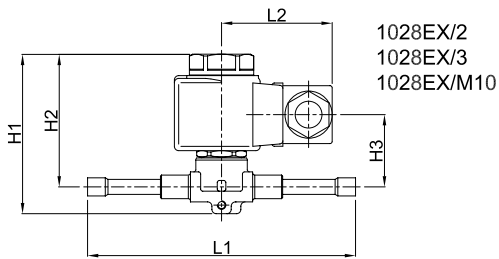
**TABLE 11: General characteristics of NC valves - ATEX conformity for use in EX Zone 2**

Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m <sup>3</sup> /h]	Opening Pressure Differential [bar]		PS [bar]	TS [°C]		Risk Category according to PED Recast
		Ø [in.]	Ø [mm]			min OPD	MOPD		min.	max.	
Direct Acting	1028EX/2A6	1/4"	–	2,2	0,15	0	21	50	–40	+130	Art. 4.3
	1028EX/2A6.E	1/4"	–	3	0,23						
	1028EX/3A6	3/8"	–								
	1028EX/M10A6	–	10								
Diaphragm Pilot Operated	1068EX/3A6	3/8"	–	6,5	0,8	0,05	21	50	–40	+120	Art. 4.3
	1068EX/M10A6	–	10								
	1068EX/M12A6	–	12								
	1068EX/4A6	1/2"	–								
	1078EX/M12A6	–	12	12,5	2,2						
	1078EX/4A6	1/2"	–								
	1078EX/5A6	5/8"	16								
	1079EX/7A6	7/8"	22	16,5	5,7						
	1098EX/7A6	7/8"	22								
	1099EX/9A6	1.1/8"	–	25,5	10						
	1078EX/9A6	1.1/8"	–								
1079EX/11A6	1.3/8"	35									
Piston Pilot Operated	1098EX/9A6	1.1/8"	–	25	10	0,1	21	50	–40	+130	Art. 4.3
	1099EX/11A6	1.3/8"	35								

TABLE 12: Dimensions and weights of NC valves - ATEX conformity for use in EX Zone 2

Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]	
		H1	H2	H3	L1	L2	Q		
Direct Acting	1028EX/2A6	75	62,5	34	125	52	-	350	
	1028EX/2A6.E				125				
	1028EX/3A6				125				
	1028EX/M10A6				125				
Diaphragm Pilot Operated	1068EX/3A6	82	69,5	40	111	52	-	400	
	1068EX/M10A6				111			395	
	1068EX/M12A6				127			420	
	1068EX/4A6				127			420	
	1078EX/M12A6	91	75	47	127			45	690
	1078EX/4A6				127				680
	1078EX/5A6				175				775
	1079EX/7A6				190				765
	1098EX/7A6	106	78	50	180			57	1170
	1099EX/9A6				216				1225
	1078EX/9A6				250				2565
	1079EX/11A6	115	96	72	292			80	2620
	1098EX/9A6				235				2050
	Piston Pilot Operated	1099EX/11A6	157	127	99			277	52

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



# SOLENOID VALVES

## 2.4 – NORMALLY OPEN SOLENOID VALVES

### APPLICATION

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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! The solenoid valves illustrated in this chapter cannot be installed on systems that use HCFC (R22) refrigerant.**

### 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 differential pressure.**

### CONSTRUCTION

The main parts of the solenoid valves described in this chapter are constructed with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover
- 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.
- Hydrogenated nitrile butadiene rubber (HNBR) 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 13 and 14.

TABLES 13 and 14 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 1134N, 1138N, 1140N, 1148N
- Pilot-operated diaphragm valves in series 1164N, 1168N, 1170N, 1178N, 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.

TABLE 13: 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	1164N/3S	3/8"	6,5	0,8	0,05	21	15	50	-40	+120	Art. 4.3
	1170N/4S	1/2"	12,5	2,2		30	30				
	1170N/5S	5/8"		2,61							
	1190N/5S	5/8"	16,5	3,8							
	1190N/6S	3/4"		4,8							
Piston Pilot Operated	1134N/3S	3/8"	6,5	1,0	0,07			30	30	50	-40
	1140N/4S	1/2"	12,5	2,4							
	1140N/5S	5/8"		3,0							
	1150N/5S	5/8"	16,5	3,8							
	1150N/6S	3/4"		4,8							

TABLE 14: General characteristics of NO valves with ODS connections

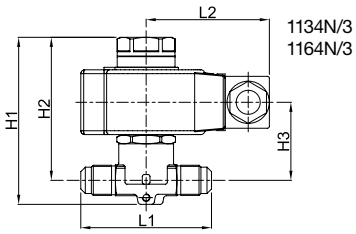
Operating Principles	Catalogue Number	Connections ODS		Seat size nominal Ø [mm]	Kv Factor [m <sup>3</sup> /h]	Opening Pressure Differential [bar]			PS [bar]	TS [°C]		Risk Category according to PED Recast				
		Ø [in.]	Ø [mm]			min OPD	MOPD coils series 9320 / 9120			min.	max.					
							RD6	RD1 RD2								
Diaphragm Pilot Operated	1168N/3S	3/8"	–	6,5	0,8	0,05	21	15	50	–40	+120	Art. 4.3				
	1168N/M10S	–	10													
	1178N/M12S	–	12	12,5	2,2											
	1178N/4S	1/2"	–													
	1178N/5S	5/8"	16	16,5	2,61											
	1198N/5S	5/8"	16													
	1198N/6S	3/4"	–	16,5	3,8											
	1198N/7S	7/8"	22													
1178N/9S	1.1/8"	–	25,5	10	8	8										
Piston Pilot Operated	1138N/3S	3/8"	–	6,5	1,0	0,05	30	30	50	–40	+130	Art. 4.3				
	1138N/M10S	–	10													
	1148N/M12S	–	12	12,5	2,4											
	1148N/4S	1/2"	–													
	1148N/5S	5/8"	16	16,5	3,0											
	1158N/5S	5/8"	16													
	1158N/6S	3/4"	–	16,5	3,8											
	1158N/7S	7/8"	22													
	1198N/9S	1.1/8"	–	25	10								0,1	16	16	
	1178NW/11S	1.3/8"	35	27	16											
	1178NW/13S	1.5/8"	–	34	25								0,15	16	16	II
	1178NW/M42S	–	42													

TABLE 15: Dimensions and weights of NO valves with 9120 coils

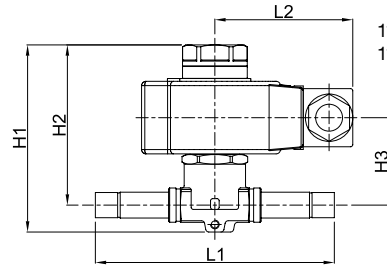
Operating Principles	Catalogue Number	Dimensions [mm]						Weight [g]
		H1	H2	H3	L1	L2	Q	
Diaphragm Pilot Operated	1164N/3S	87	74,5	40	68	65	–	705
	1168N/3S				111			705
	1168N/M10S				111			700
	1170N/4S	96	80	47	100		45	1015
	1170N/5S				106			1060
	1178N/M12S				127			995
	1178N/4S	111	83	50	127		57	985
	1178N/5S				175			1080
	1190N/5S				120			1340
	1190N/6S	111	83	50	124		57	1670
	1198N/5S				175			1300
	1198N/6S				175			1490
	1198N/7S	120	101	72	180		80	1475
	1178N/9S				250			2870
	1134N/3S				97,5			85
1138N/3S	111	775						
1138N/M11S	111	770						
1140N/4S	105,5	89,5	56,5	100	45	1117		
1140N/5S				106		1166		
1148N/M12S				127		1095		
1148N/4S	126	98	70	127	57	1084		
1148N/5S				175		1188		
1150N/5S				120		1462		
1150N/6S	162	132	99	124	60	1792		
1158N/5S				175		1422		
1158N/6S				175		1612		
1158N/7S	176	142	110	180	68	1597		
1198N/9S				235		2355		
1178NW/11S				254		3015		
1178NW/13S	197	160	128	265	88	3820		
1178NW/M42S						3820		

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

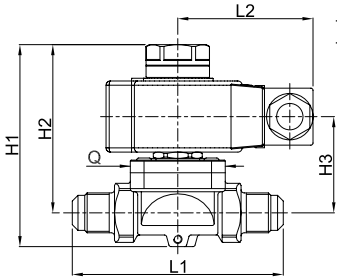




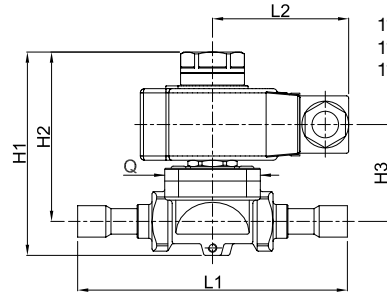
1134N/3  
1164N/3



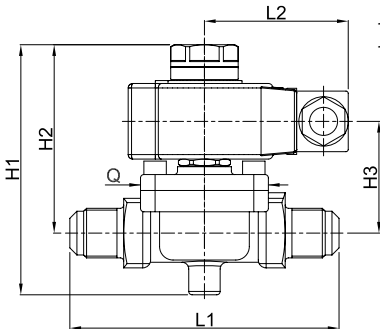
1138N/3 1168N/3  
1138N/M10 1168N/M10



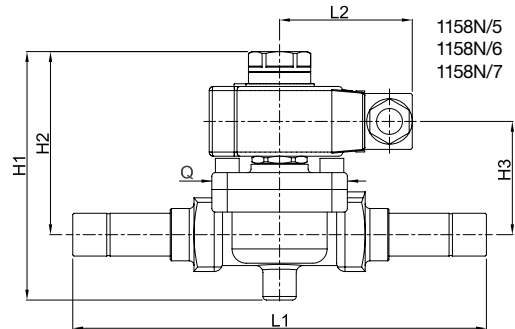
1140N/4 1170N/4  
1140N/5 1170N/5



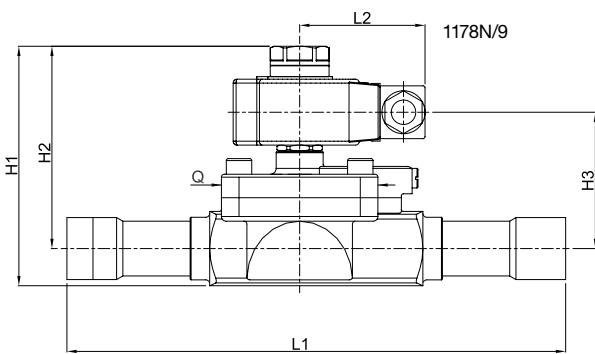
1148N/M12 1178N/M12  
1148N/4 1178N/4  
1148N/5 1178N/5



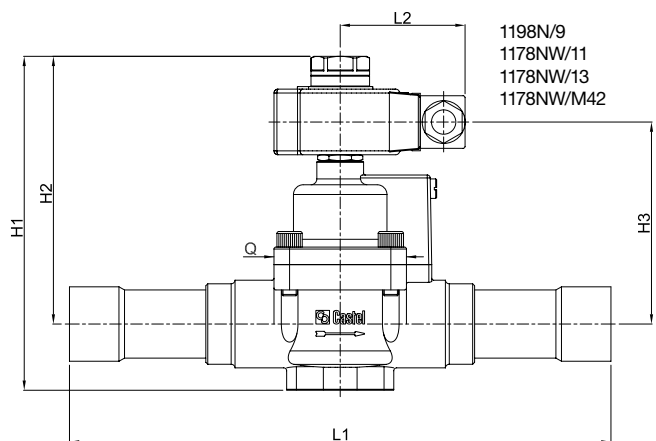
1150N/5 1190N/5  
1150N/6 1190N/6



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



1178N/9



1198N/9  
1178NW/11  
1178NW/13  
1178NW/M42





# SOLENOID VALVES

## 2.5 – MAGNETIC TOOL

### APPLICATION

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

### CONSTRUCTION

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





# COILS

POLYHEDRA

## COILS

## 3.1 – COILS AND CONNECTORS

## APPLICATION

For solenoid expansion valve (Chapter 1) and 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.**

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

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

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

## APPROVALS

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

## CONNECTORS

DIN 43650 standardized connectors 9150 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture. Based on the assembly requirements, these connectors allow you to choose the



orientation of the outer casing with respect to the inner terminal block. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. Three-pole cables with a cross-section greater than or equal to 0.75 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.

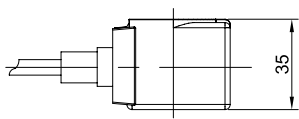
Connectors 9150/R45 and 9150/R90 are equipped with a full-wave bridge rectifier plus VDR for protection. Connector 9150/R90 is the version with a 2 m long, co-moulded cable, with remote rectified circuit (with respect to the connector). The VDR (Voltage e-Dependent-Resistor) device is a special type 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.**

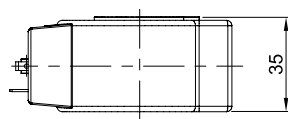
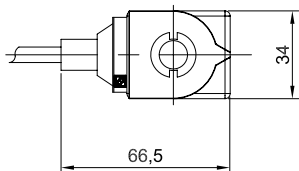
TABLE 1: General characteristics of coils

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.	+10 / -10								
9120/RD1	HM3	12 D.C.	+10 / -5	-	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)	
9120/RD2		24 D.C.									
9120/RD3		27 D.C.									
9120/RD4		48 D.C.									
9120/RD6		220 RAC									
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 A.C.									
9160/RA6		220/230 A.C.									+6 / -10
9160/RA7		240 A.C.	+10 / -10								
9160/RD1		12 D.C.	+10 / -5	-							
9160/RD2		24 D.C.									
9300/RA2	HF2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Terminal block for DIN 43650/A	9150/R## 9900/X##	IP 65 (with connector)	
9300/RA4		110/120 A.C.									+6 / -10
9300/RA6		220/230 A.C.									+6 / -10
9300/RA7		240 A.C.									+10 / -10
9300/RA8		380 A.C.									
9320/RA6	HF3	220/230 A.C.	+6 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9900/X##	IP 65 (with connector)	
9320/RD1		12 D.C.									
9320/RD2		24 D.C.									
9320/RD3		27 D.C.									
9320/RD4		48 D.C.									
9360/RA2	HF4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150, 9900)	
9360/RA4		110 A.C.									
9360/RA6		220/230 A.C.									+6 / -10
9360/RA7		240 A.C.	+10 / -10								
9360/RD1		12 D.C.	+10 / -5	-							
9360/RD2		24 D.C.									

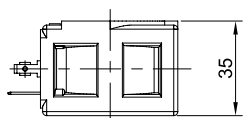
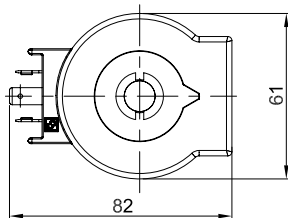




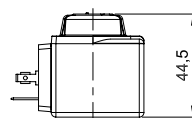
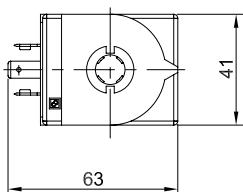
9110 (Type CM2)



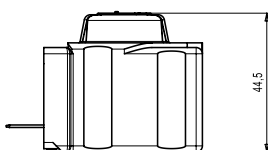
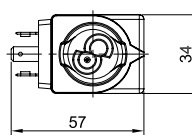
9120 (Type HM3)



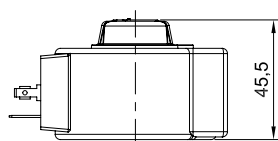
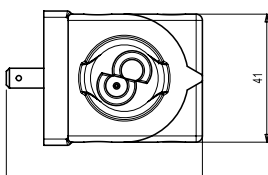
9160 (Type HM4)



9300 (Type HF2)



9360 (Type HF4)



9320 (Type HF3)

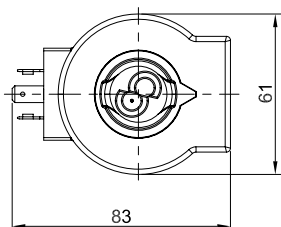
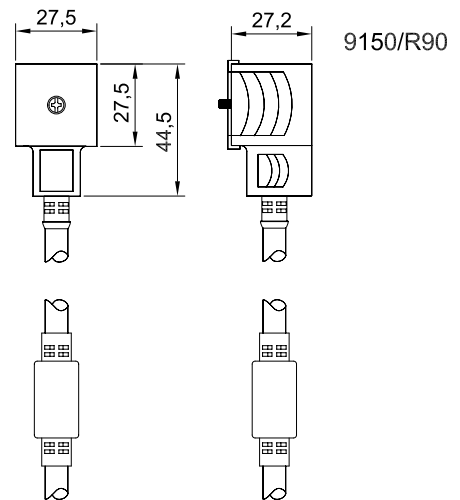
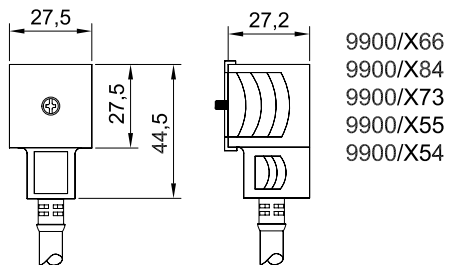
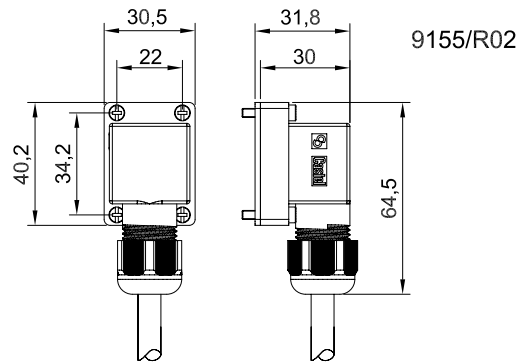
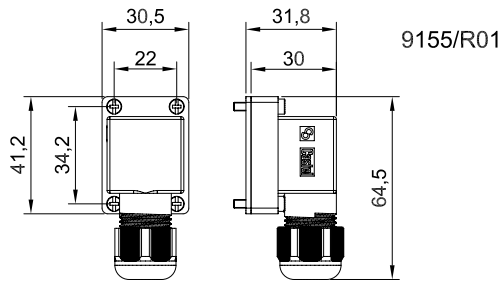
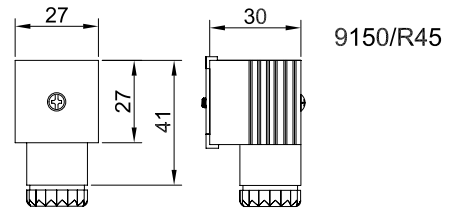
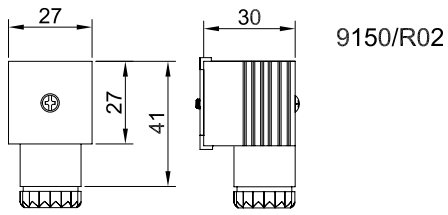


TABLE 2: Consumptions and weights of coils

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

TABLE 3: General characteristics of connectors

Catalogue Number	Supply Voltage [V]		Cable length [m]	Cable thickness [mm <sup>2</sup> ]	Standard	Degree of protection	Class of insulation
	Nominal	Maximum					
9150/R02	-	-	-	-	-	-	Gruppo C VDE 0110-1 / 89
9150/R45	220 A.C.	250 A.C.					
9150/R90	220 A.C.	250 A.C.					
9900/X66	-	-	1	3 x 0,75	DIN 43650	IP65 EN 60529	
9900/X84			1,5				
9900/X73			2				
9900/X55			3				
9900/X54			5				
9900/X93			10				
9901/X41			15				
9155/R01	-	-	-	-	-	IP65/IP68 EN 60529	
9155/R02			1				



## 3.2 – COILS AND CONNECTORS, ATEX – CERTIFIED

**APPLICATION**

For the normally-closed solenoid valves manufactured in compliance with the ATEX Directive (valves with an “EX” suffix presented in Chapter 2), Castel provides its customers with the following types of coils:

- Series 9100EX (coils type HM2)
- Series 9110EX (coils type CM2)

These coils are classified as Group II, Category 3 equipment according to the ATEX Directive (2014/34/EU). This equipment is suitable for use on refrigeration systems located in areas classified as “Zone 2” potentially explosive environments according to the definitions in Annex I of Directive 1999/92/EC.

Coils in series 9100EX must be used only with connector type 9150EX/R02. The protection rating of the coil + connector system is IP65 according to the EN 60529 standard.

**CONSTRUCTION**

The coils in series 9100EX and 9120EX are produced in compliance with European standards EN 60079-0:2009 and 60079-18:2009, which ensure their compliance to the Essential Health and Safety Requirements of Directive 2014/34/EU. The two series of coils are Class F encapsulated and have Class H enamelled copper wire windings, 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 terminals of the coils in series 9100EX consist of two Faston connectors plus a Faston ground connector. Coils in series 9110EX are equipped with a 1 m long power supply cable incorporated in the encapsulated section. The cable has a polyurethane sheath with operating temperature of up to 125 °C and cable insulation in special PVC with an operating temperature of up to 125 °C. All coils in this chapter are suitable for continuous operation. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments

**APPROVALS**

Compliance of the coils in series 9100EX to Directive 2014/34/EU is certified by the Italian notified body IMQ, with certificate No. IMQ 13 ATEX 002X (Certified Type Test).

Protection type of the coils in series 9100EX: Ex mc IIC T5 Gc / Ex

mc IIC T100°C Dc IP65.

Compliance of the coils in series 9110EX to Directive 2014/34/EU is certified by the Italian notified body IMQ, with certificate No. IMQ 13 ATEX 001X (Certified Type Test).

Protection type of the coils in series 9110EX: Ex mc IIC T4 Gc / Ex mc IIC T135°C Dc IP65.

Coils in series 9100EX and 9110EX with 110 VAC, 220/230 VAC and 240 VAC voltages are produced in accordance with the Low Voltage Directive (2006/95/EC). All coils in series 9100EX and 9110EX comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).

**CONNECTOR**

Connector 9150EX/R02 is classified as Group II, Category 3 equipment according to the ATEX Directive (2014/34/EU). This equipment is suitable for use on refrigeration systems located in areas classified as “Zone 2” potentially explosive environments according to the definitions in Annex I of Directive 1999/92/EC.

The DIN 43650 standardized connector 9150EX/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 9150EX/R02 ensures IP65 protection rating according to the EN 60529 standard.



**TABLE 4: General characteristics of coils ATEX compliance for use in EX Zone 2**

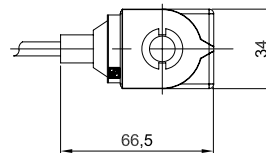
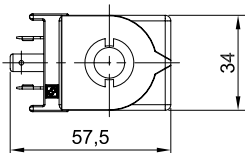
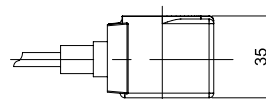
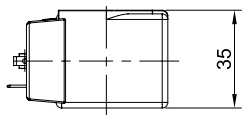
Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Insulation class EN 60730	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9100EX/RA2	HM2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Terminal block for DIN 43650/A	9150EX/R02	IP 65 (with connector)
9100EX/RA4		110 A.C.								
9100EX/RA6		220/230 A.C.	+6 / -10							
9100EX/RA7		240 A.C.								
9110EX/RA2	CM2	24 A.C.	+10 / -10	50 / 60	H	-20	+50	Three wires cable	-	IP 66
9110EX/RA4		110 A.C.								
9110EX/RA6		220/230 A.C.	+6 / -10							
9110EX/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			
				50 [Hz]	60 [Hz]	D.C.	50 [Hz]	60 [Hz]	D.C.	
9100EX/RA2	HM2	24 A.C.	8	920	825	-	527	420	-	230
9100EX/RA4		110 A.C.		230	205		128	114		
9100EX/RA6		220/230 A.C.		120	105		68	58		
9100EX/RA7		240 A.C.		100	87		54	43		
9110EX/RA2	CM2	24 A.C.	8	920	825	-	527	420	-	230
9110EX/RA4		110 A.C.		230	205		128	114		
9110EX/RA6		220/230 A.C.		120	105		68	58		
9110EX/RA7		240 A.C.		100	87		54	43		

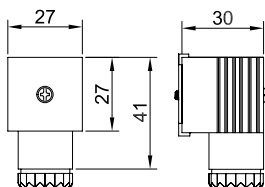
**TABLE 6: General characteristics of connectors**

Catalogue Number	Standard	Degree of protection	Class of insulation	Approval
9150EX/R02	DIN 43650	IP65 EN 60529	Gruppo CVDE 0110-1 / 89	ATEX compliance for use in EX Zone 2



9100EX (Type HM2)

9120EX (Type CM2)



9150EX/R02



## COILS

## 3.3 – “SMART CONNECTOR” SYSTEM

## APPLICATION

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

- Normally-closed solenoid valves
- PWM expansion valves

and allow:

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

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

## CONNECTION CONSTRUCTION

EN 175301-803 (former DIN 43650) standardized connectors 9152 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture.

Connectors 9152 are available in both the direct current version (with 12 VDC and 24 VDC voltages) and in the alternating current version (with 24 VAC or 220/240 VAC voltages).

The direct current versions are equipped with polarity inversion protection.

The alternating current versions are equipped with a bridge rectifier circuit integrated on the circuit.

All versions, both direct current and alternating current, are equipped with a diode device that guarantees surge protection. All versions have the voltage for use and the wiring diagram printed on the casing. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. It is recommended that three-pole cables with a cross-section greater than or equal to 0.75 mm<sup>2</sup> be used. There are no versions with co-moulded cables.

**Each connector in a “SMART CONNECTOR” system must be used only for the type of coil with which it is coupled in the system. Incorrect use of the connector with other types of coils produced by Castel will quickly damage the coil and the connector.**

## COIL CONSTRUCTION

Coils in series HF2 (9300) used in the “SMART CONNECTOR”

systems are special coils available in both the direct current version (with 12 VDC and 24 VDC voltages) and rectified current version (with 24 VRAC, 220 VRAC, or 240 VRAC).

These coils are in Class H, in accordance with IEC standard 85 and their production is compliant with standards EN 60730-1 and EN 60730-2-8. The windings are made of enamelled copper wire, with insulation class H (180 °C), in compliance with IEC standard 85. The terminals of the coils consist of two Faston connectors plus a Faston ground connector. The outer casing is made of waterproof, dielectric resins that guarantee reinforced insulation and allow any type of assembly.

They have Class I protection ratings against electric contacts. Consequently, their safety requires an efficient ground system. A rubber gasket assembled on the lower end of the coil completes the protection of the windings from humidity. When coupled with connectors 9152, these coils guarantee an IP65 protection rating according to standard EN 60529.

The coils are designed for continuous use. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments. The maximum ambient temperature for all coils is 50 °C.

**Each coil in a “SMART CONNECTOR” system must be used only in combination with the type of connector with which it is coupled in the system. Incorrect use of the coil with other types of connectors produced by Castel will quickly damage the coil and the connector.**

## OPERATION

Through the integrated circuit in the connector, and coupling with the specific coil, connectors 9152 are capable of improving the MOPD characteristics of Castel solenoid valves, reducing the power consumption by up to 50% over time, extending the coil life, and decreasing the noise.

The integrated circuit located inside the connector works in different modes based on the power supply voltage. Specifically, there are two main families with different operating logics.

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





during operation.

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

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

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

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

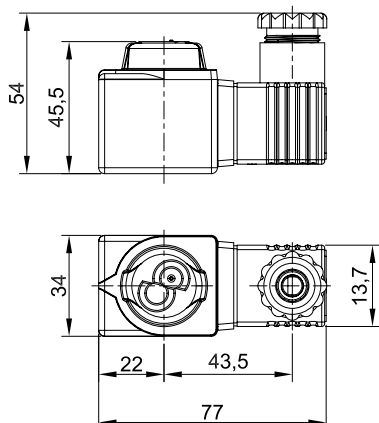
## APPROVALS

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

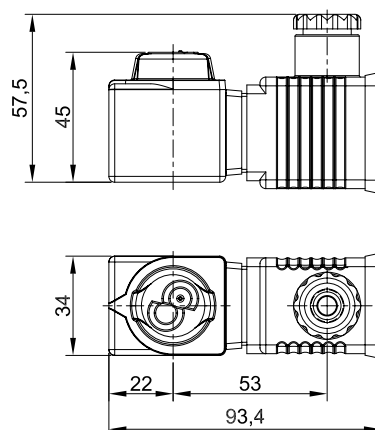
TABELLA 7: General characteristics of systems SMART CONNECTOR

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

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



9910/RD



9910/RA





The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a 3D effect of depth and shadow. The colors range from light sky blue to deep navy blue.

# SAFETY DEVICES

P  LYHEDRA

# SAFETY DEVICES

## 4.1 – SAFETY VALVES IN SERIES 3061

### GENERAL DESCRIPTION

Safety valves in series 3061 are considered “Safety Accessories” according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.

Valves are identified by means of:

- a model number formed of an alphanumerical code that includes:
  - the family identity (for ex. 3061/3)
  - the type of inlet connection (for ex. C = NPT)
  - the set pressure, expressed in bar, multiplied by 10 (for ex. 200)
- an alphanumerical serial number

### CONSTRUCTION

**Body:** squared, obtained through hot moulding and subsequent machining. It houses the following elements:

- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.

Material used: EN 12420-CW617N brass

**Shutter:** obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from modified PTFE (Polytetrafluoroethylene), 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 tampering by means of a threaded cap nut, screwed on outside the brass body and blocked in place through re-flanging.

### 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)

- Simple pressure vessels

(reference Directive: 2009/105/EC)

**Fluids:** the valves in series 3061 can be used with:

a) Refrigerant fluids in vapour or gaseous state belonging to Group 2:

- HFC (R134a, R404A, R407C, R410A, R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A)
- R744

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

b) Refrigerant fluids in vapour or gaseous state belonging to Group 1:

- HFC (R32)
- HFO and HFO/HFC mixture (R1234yf, R452B, R454B)
- HC (R290, R600, R600a, R1270)

with reference to Article 13, Para. 1(a) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

c) 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 cast on the valve body:

- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure

Again, on the body, the following information is laser marked:

- 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.
- 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.
- Calibration certificate for the safety valve, printed on the reverse side of the Compliance Statement.

N.B.: on the website: [www.castel.it](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access the web-page "CERTIFICATION" in the "DOWNLOAD CENTER". On this page, you can download:

- the Compliance Statement / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Compliance Statement 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/EC requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.

As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

- EN ISO 4126-1: 2013: "Safety devices for protection against

excessive pressure – Part 1: Safety valves" indicates the general requirements for safety valves regardless of the fluid for which they were designed.

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

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

To select the safety valves in series 3061, please see Chapter 4.3 "Selection Criteria for Safety Valves" in this technical handbook.

Table 3 provides the maximum discharge capacities of safety valves, models 3061/2, 3061/3 and 3061/4, as a function of various refrigerants and varying Pset for the valve, considering  $T_o$  = Steam saturation temperature at discharge pressure,  $P_o$ .

## VALVE INSTALLATION

**Safety valves type 3061 guarantee repeatable performance. This means that, after the valves have operated, open/close, the initial setting conditions are maintained.** Nevertheless, it is advisable to replace a 3061 valve once it has discharged as during release debris, such as metal shavings or solder impurities, can deposit on the valve gasket. This can inhibit the safety valve from returning to its original conditions.

To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.3 "Selection Criteria for Safety Valves" in this technical handbook.



TABLE 1 : 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 "Kd"		0,89	0,89	0,89
PS [bar]		70		
TS [°C]		- 50 / + 150		
TA [°C]		- 40 / + 50		
Set Pressure Range at atmospheric back pressure Pset [bar]		11 / 60		
Overpressure		+ 10 % of Pset		
Blowdown		- 15 % of Pset		
Helium tightness		- 20 % of Pset (11 bar < Pset < 14 bar)		
		- 15 % of Pset (14,1 bar < Pset < 24 bar)		
		- 10 % of Pset (24,1 bar < Pset < 60 bar)		
Estimated service life		9 years		
Risk Category according to PED Recast		IV		

TABLE 2: Dimensions and Weights of valves 3061

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

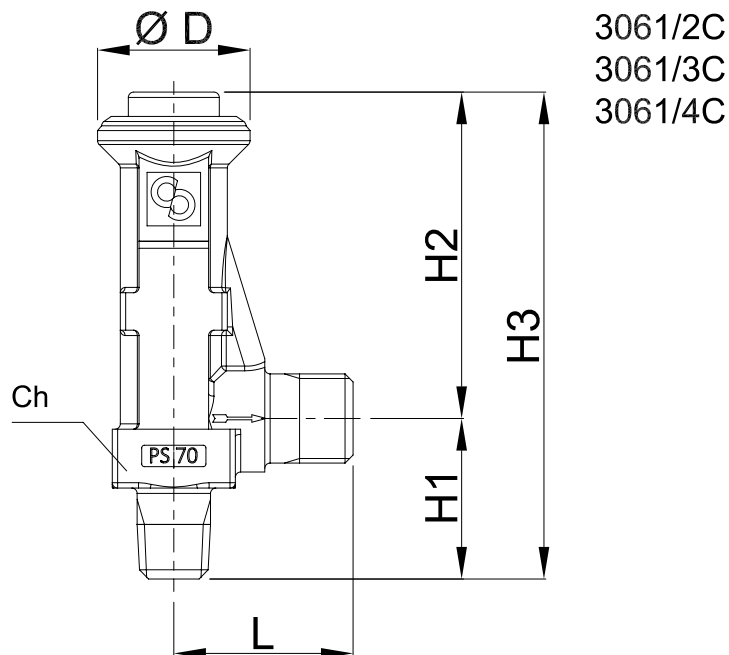


TABLE 3: Maximum discharge capacity of valves 3061

Pset [bar]	Po [barsass]	R134a		R32		R404A		R407C		R410A	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	49,8	749	15,8	574	27,0	768	33,9	700	16,5	671
12,0	14,2	53,0	815	18,6	624	30,2	837	36,9	761	19,4	729
13,0	15,3	56,0	883	21,3	674	33,1	908	39,7	823	22,1	789
14,0	16,4	58,9	951	23,9	724	35,9	979	42,4	886	24,7	849
15,0	17,5	61,7	1021	26,3	775	38,5	1051	44,9	950	27,2	909
16,0	18,6	64,3	1091	28,6	827	41,0	1125	47,3	1014	29,5	971
17,0	19,7	66,8	1163	30,8	879	43,4	1201	49,6	1079	31,8	1033
18,0	20,8	69,2	1236	33,0	931	45,7	1278	51,8	1145	33,9	1096
19,0	21,9	71,5	1311	35,0	984	48,0	1357	54,0	1213	36,0	1159
20,0	23,0	73,7	1387	37,0	1038	50,1	1439	56,0	1281	37,9	1224
21,0	24,1	75,9	1465	38,9	1092	52,1	1522	58,0	1350	39,9	1290
22,0	25,2	77,9	1545	40,7	1147	54,1	1608	59,9	1421	41,7	1356
23,0	26,3	79,9	1627	42,5	1202	56,0	1698	61,7	1492	43,5	1424
24,0	27,4	81,9	1711	44,2	1258	57,9	1790	63,4	1566	45,2	1493
25,0	28,5	83,7	1798	45,8	1315	59,7	1887	65,2	1641	46,9	1563
26,0	29,6	85,6	1888	47,4	1373	61,4	1988	66,8	1717	48,5	1635
27,0	30,7	87,3	1982	49,0	1431	63,1	2096	68,4	1796	50,1	1708
28,0	31,8	89,0	2079	50,5	1491	64,7	2211	70,0	1876	51,6	1783
29,0	32,9	90,7	2182	52,0	1551	66,3	2336	71,5	1959	53,1	1860
30,0	34,0	92,3	2290	53,5	1613	67,8	2475	72,9	2044	54,6	1938
31,0	35,1	93,9	2406	54,9	1675	69,3	2637	74,4	2132	56,0	2019
32,0	36,2	95,4	2532	56,3	1739	70,7	2845	75,7	2224	57,4	2102
33,0	37,3	96,9	2672	57,6	1803	72,1	3294	77,1	2319	58,7	2189
34,0	38,4	98,3	2836	58,9	1869			78,4	2419	60,1	2278
35,0	39,5	99,2	2977	60,2	1937			79,7	2525	61,4	2371
36,0	40,6	99,5	3052	61,5	2006			80,9	2638	62,6	2468
37,0	41,7	99,7	3132	62,7	2077			82,1	2761	63,8	2571
38,0	42,8			63,9	2149			83,2	2896	65,0	2681
39,0	43,9			65,1	2224			84,3	3052	66,2	2798
40,0	45,0			66,2	2301			85,3	3246	67,4	2928
41,0	46,1			67,3	2381			86,1	3567	68,5	3074
42,0	47,2			68,5	2463					69,6	3248
43,0	48,3			69,5	2550					70,7	3488
44,0	49,4			70,6	2640						
45,0	50,5			71,7	2735						
46,0	51,6			72,7	2836						
47,0	52,7			73,7	2945						
48,0	53,8			74,7	3065						
49,0	54,9			75,6	3201						
50,0	56,0			76,6	3364						
51,0	57,1			77,5	3593						
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										

continue →

TABLE 3: Maximum discharge capacity of valves 3061

Pset [bar]	Po [barsass]	R507		R448A		R449A		R450A		R452A	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	25,8	769	31,1	707	31,0	711	55,2	766	28,7	776
12,0	14,2	28,9	838	34,1	768	34,0	773	58,5	836	31,8	845
13,0	15,3	31,9	909	36,9	832	36,9	836	61,7	903	34,6	915
14,0	16,4	34,7	980	39,6	896	39,5	901	64,6	976	37,4	986
15,0	17,5	37,3	1053	42,1	958	42,1	966	67,5	1047	39,9	1058
16,0	18,6	39,8	1127	44,6	1025	44,5	1031	70,1	1118	42,4	1131
17,0	19,7	42,2	1203	46,9	1093	46,8	1098	72,7	1195	44,7	1205
18,0	20,8	44,5	1280	49,1	1156	49,1	1166	75,2	1271	47,0	1281
19,0	21,9	46,8	1360	51,2	1229	51,2	1235	77,5	1346	49,1	1358
20,0	23,0	48,9	1441	53,3	1294	53,2	1305	79,8	1426	51,2	1437
21,0	24,1	50,9	1525	55,2	1363	55,2	1376	82,0	1512	53,2	1518
22,0	25,2	52,9	1612	57,1	1437	57,1	1449	84,1	1594	55,1	1601
23,0	26,3	54,8	1702	58,9	1516	58,9	1523	86,2	1682	57,0	1686
24,0	27,4	56,7	1795	60,7	1590	60,7	1599	88,1	1777	58,7	1774
25,0	28,5	58,5	1893	62,4	1670	62,4	1677	90,1	1862	60,5	1864
26,0	29,6	60,2	1995	64,1	1741	64,1	1757	91,9	1954	62,1	1958
27,0	30,7	61,9	2104	65,7	1831	65,7	1838	93,7	2075	63,7	2055
28,0	31,8	63,5	2221	67,2	1912	67,2	1923	95,4	2184	65,3	2157
29,0	32,9	65,1	2349	68,7	1998	68,7	2009	97,1	2303	66,8	2265
30,0	34,0	66,6	2492	70,2	2090	70,2	2099	98,8	2402	68,3	2379
31,0	35,1	68,1	2663	71,6	2167	71,6	2192	100,3	2543	69,7	2506
32,0	36,2	69,6	2893	73,0	2271	73,0	2292	101,9	2745	68,3	6559
33,0	37,3			74,3	2384	74,3	2390			72,3	2793
34,0	38,4			75,6	2478	75,6	2508			73,5	2980
35,0	39,5			76,9	2610	76,9	2629				
36,0	40,6			78,1	2719	78,1	2760				
37,0	41,7			79,2	2878	79,2	2909				
38,0	42,8			80,3	3058	80,3	3090				
39,0	43,9					80,7	3884				
40,0	45,0										
41,0	46,1										
42,0	47,2										
43,0	48,3										
44,0	49,4										
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										

continue →

TABLE 3: Maximum discharge capacity of valves 3061

Pset [bar]	Po [barsass]	R452B		R454B		R513A		R1234yf		R1234ze	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	19,1	623	19,6	617	47,9	780	50,2	800	61,1	778
12,0	14,2	22,1	677	22,6	671	51,3	850	53,7	873	64,5	847
13,0	15,3	24,8	732	25,3	725	54,4	921	56,9	947	67,7	918
14,0	16,4	27,4	787	28,0	780	57,4	994	59,9	1022	70,8	991
15,0	17,5	29,9	843	30,5	836	60,2	1067	62,9	1100	73,7	1064
16,0	18,6	32,3	899	32,8	892	62,9	1143	65,6	1179	76,5	1139
17,0	19,7	34,5	956	35,1	948	65,4	1220	68,3	1260	79,1	1216
18,0	20,8	36,7	1014	37,3	1005	67,9	1299	70,8	1343	81,7	1295
19,0	21,9	38,8	1073	39,3	1063	70,3	1379	73,2	1429	84,1	1375
20,0	23,0	40,8	1132	41,4	1122	72,5	1462	75,6	1517	86,4	1458
21,0	24,1	42,7	1192	43,3	1182	74,7	1548	77,8	1610	88,7	1543
22,0	25,2	44,6	1253	45,2	1242	76,8	1636	80,0	1706	90,9	1631
23,0	26,3	46,4	1315	47,0	1303	78,9	1728	82,1	1806	93,0	1722
24,0	27,4	48,1	1378	48,7	1366	80,8	1823	84,1	1913	95,0	1817
25,0	28,5	49,8	1442	50,4	1429	82,7	1923	86,1	2027	97,0	1916
26,0	29,6	51,5	1507	52,1	1493	84,6	2028	88,0	2151	98,9	2021
27,0	30,7	53,1	1573	53,6	1559	86,4	2140	89,8	2289	100,7	2133
28,0	31,8	54,6	1640	55,2	1625	88,1	2262	91,6	2451	102,5	2254
29,0	32,9	56,1	1709	56,7	1693	89,8	2395	93,3	2664	104,3	2387
30,0	34,0	57,6	1780	58,2	1763	91,4	2548			106,0	2539
31,0	35,1	59,0	1851	59,6	1834	93,0	2738			107,6	2728
32,0	36,2	60,4	1925	61,0	1907	94,5	3053			109,2	3060
33,0	37,3	61,8	2001	62,4	1981						
34,0	38,4	63,1	2079	63,7	2058						
35,0	39,5	64,4	2159	65,0	2138						
36,0	40,6	65,6	2243	66,2	2219						
37,0	41,7	66,9	2329	67,5	2304						
38,0	42,8	68,1	2419	68,7	2393						
39,0	43,9	69,2	2514	69,9	2486						
40,0	45,0	70,4	2614	71,0	2583						
41,0	46,1	71,5	2721	72,1	2687						
42,0	47,2	72,6	2836	73,2	2799						
43,0	48,3	73,7	2963	74,3	2922						
44,0	49,4	74,7	3109	75,3	3059						
45,0	50,5	75,7	3287	76,3	3222						
46,0	51,6	76,7	3547	77,3	3438						
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										

continue →

TABLE 3: Maximum discharge capacity of valves 3061

Pset [bar]	Po [barsass]	R290		R600		R600a		R1270	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	38,1	505	92,3	527	78,8	540	30,2	489
12,0	14,2	41,6	549	96,3	574	82,7	588	33,5	531
13,0	15,3	44,9	594	100,1	622	86,4	636	36,7	574
14,0	16,4	48,0	639	103,7	670	89,9	686	39,8	617
15,0	17,5	51,0	684	107,2	719	93,3	737	42,7	661
16,0	18,6	53,8	731	110,4	769	96,5	788	45,4	706
17,0	19,7	56,5	778	113,5	820	99,6	841	48,1	750
18,0	20,8	59,2	826	116,5	872	102,5	895	50,6	796
19,0	21,9	61,7	874	119,4	925	105,3	950	53,0	842
20,0	23,0	64,1	924			108,0	1007	55,4	889
21,0	24,1	66,4	974			110,6	1065	57,6	937
22,0	25,2	68,7	1026			113,2	1125	59,8	985
23,0	26,3	70,8	1078			115,6	1187	62,0	1034
24,0	27,4	73,0	1132			118,0	1252	64,0	1085
25,0	28,5	75,0	1188			120,3	1320	66,0	1136
26,0	29,6	77,0	1245			122,5	1391	67,9	1188
27,0	30,7	78,9	1303			124,7	1467	69,8	1242
28,0	31,8	80,8	1364			126,8	1549	71,7	1298
29,0	32,9	82,6	1427			128,8	1640	73,4	1354
30,0	34,0	84,4	1493			130,8	1743	75,2	1413
31,0	35,1	86,2	1563			132,7	1873	76,9	1474
32,0	36,2	87,9	1636			134,5	2129	78,5	1537
33,0	37,3	89,5	1715					80,1	1603
34,0	38,4	91,1	1801					81,7	1672
35,0	39,5	92,7	1898					83,2	1746
36,0	40,6	94,2	2012					84,7	1825
37,0	41,7	95,7	2166					86,2	1912
38,0	42,8							87,6	2011
39,0	43,9							89,0	2129
40,0	45,0							90,4	2298
41,0	46,1								
42,0	47,2								
43,0	48,3								
44,0	49,4								
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								

# SAFETY DEVICES

## 4.2 – SAFETY VALVES IN SERIES 3065

### GENERAL DESCRIPTION

Safety valves in series 3065 are considered “Safety Accessories” according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. These valves are unbalanced, conventional direct-loaded safety valves. The valve is opened by the thrust from the fluid under pressure below the shutter, when said thrust exceeds, under the calibrated conditions, the opposing force of the spring acting on the shutter.

Valves are identified by means of:

- a model number formed of an alphanumerical code that includes:
  - the family identity (for ex. 3065/4)
  - the type of inlet connection (for ex. C = NPT)
  - the set pressure, expressed in bar, multiplied by 10 (for ex. 140)
- an alphanumerical serial number

### CONSTRUCTION

**Body:** squared, obtained through hot moulding and subsequent machining. It houses the following elements:

- the nozzle with flat sealing seat
- the shutter guide
- the set spring slot
- the threaded seat of the setting adjustment ring nut

In the body, above the shutter guide, a small pressure relief hole is provided through which the spring slot communicates with the exit connection. For this reason, during relief, there is a no gas leak through this orifice.

Material used: EN 12420-CW617N brass

**Shutter:** obtained through machining from bar stock and fit with gasket, it ensures the required degree of tightness on the valve seat. The gasket is made from modified PTFE (Polytetrafluorethylene), a material that, during the valve’s estimated service life, maintains good strength and does not cause the shutter to stick on the seat. The shutter is properly guided in the body and the guide action cannot fail. There are no glands or retaining rings that hamper its movement.

Material used: EN 12164-CW614N brass

**Spring:** it opposes the pressure and the fluid dynamic forces, and always ensures closing of the valve following pressure relief. When the shutter has reached the maximum height determined by the mechanical stop, the spring compression does not exceed 80% of the total compression. All the springs are compliant with the compression helical spring requirements defined in EN ISO 4126-7:2013.

Material used: EN 10270-2 - FD steel for springs.

**Calibration system:** hex-head threaded ring nut to be screwed inside the upper portion of the head, compressing the spring below. When calibration is complete, the position of the ring nut is maintained unchanged by applying to the threaded coupling a high mechanical strength and low viscosity bonding agent. The low viscosity promotes penetration. The calibration system is protected against subsequent tampering by means of a threaded cap nut, screwed on outside the brass body and blocked in place through re-flanging.

### 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)

- Simple pressure vessels

(reference Directive: 2009/105/EC)

**Fluids:** the valves in series 3065 can be used with:

d) Refrigerant fluids in vapour or gaseous state belonging to Group 2:

- HFC (R134a, R404A, R407C, R410A, R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A)
- R744

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

e) Refrigerant fluids in vapour or gaseous state belonging to Group 1:

- HFC (R32)
- HFO and HFO/HFC mixture (R1234yf, R452B, R454B)
- HC (R290, R600, R600a, R1270)

with reference to Article 13, Para. 1(a) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

f) 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 cast on the valve body:

- Manufacturer's mark
- Country of manufacturing
- Indication of flow direction
- Maximum allowable pressure

Again, on the body, the following information is laser marked:

- 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.
- 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.
- Calibration certificate for the safety valve, printed on the reverse side of the Compliance Statement.

N.B.: on the website: [www.castel.it](http://www.castel.it) use the "DOWNLOAD" pull-down menu to access the web-page "CERTIFICATION" in the "DOWNLOAD CENTER". On this page, you can download:

- the Compliance Statement / Calibration Certificate for each valve by entering the 7-digit alphanumeric serial number. (SEARCH BY SERIAL NUMBER)
- the general Compliance Statement 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/EC requires that pressure equipment, in which permissible limits are reasonably likely to be exceeded, shall be fitted with suitable protection devices, for instance safety devices such as safety valves. Such devices shall prevent pressure from permanently exceeding the maximum allowable pressure (PS) of the equipment they protect. In any case, a short pressure peak limited to 10% of maximum allowable pressure is permitted.

As to the selection and sizing of the suitable protection device, users shall refer to the specific product and sector standards listed below:

- EN ISO 4126-1: 2013: "Safety devices for protection against

excessive pressure – Part 1: Safety valves" indicates the general requirements for safety valves regardless of the fluid for which they were designed.

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

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

For sizing of the safety valves in series 3065, please see Chapter 4.3 "Selection Criteria for Safety Valves" in this technical handbook. Table 6 provides the maximum discharge capacities of safety valves, models 3065/4 and 3065/6, as a function of various refrigerants and varying Pset for the valve, considering  $T_o$  = Steam saturation temperature at discharge pressure,  $P_o$ .

## VALVE INSTALLATION

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

To calculate the pressure loss in either the upstream line (between vessel and safety valve) or the downstream line (between safety valve and atmosphere) refer to Chapter 4.3 "Selection Criteria for Safety Valves" in this technical handbook.



TABLE 4 : 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	32/45
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 "Kd"		0,87	0,87
PS [bar]		70	
TS [°C]		- 50 / + 150	
TA [°C]		- 40 / + 50	
"Set Pressure Range at atmospheric back pressure Pset [bar]"		11 / 60	
Overpressure		+ 10 % of Pset	
Blowdown		- 15 % of Pset	
Helium tightness		- 20 % of Pset (11 bar < Pset < 18,5 bar)	
		- 15 % of Pset (18,6 bar < Pset < 31 bar)	
		- 10 % of Pset (31,1 bar < Pset < 60 bar)	
Estimated service life		9 years	
Risk Category according to PED Recast		IV	

TABLE 5: Dimensions and Weights of valves 3065

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

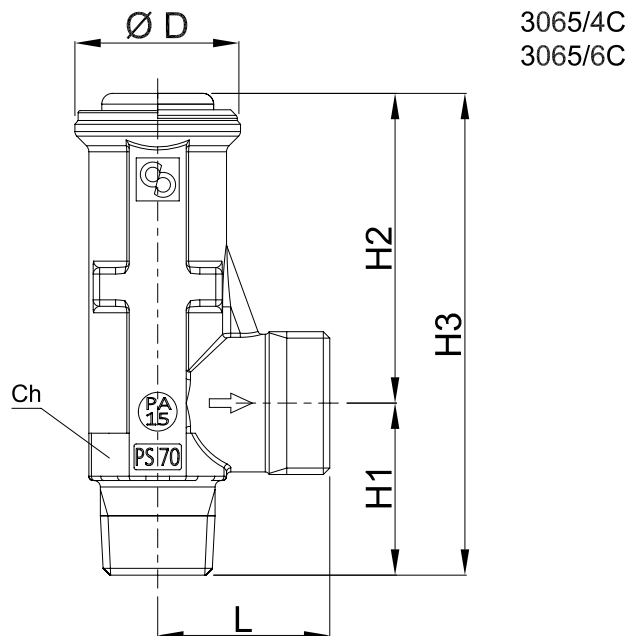


TABLE 6: Maximum discharge capacity of valves 3065

Pset [bar]	Po [barsass]	R134a		R32		R404A		R407C		R410A	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	49,8	2200	15,8	1686	27,0	2257	33,9	2056	16,5	1970
12,0	14,2	53,0	2395	18,6	1832	30,2	2460	36,9	2236	19,4	2143
13,0	15,3	56,0	2593	21,3	1979	33,1	2666	39,7	2418	22,1	2317
14,0	16,4	58,9	2794	23,9	2127	35,9	2875	42,4	2603	24,7	2493
15,0	17,5	61,7	2998	26,3	2277	38,5	3088	44,9	2789	27,2	2671
16,0	18,6	64,3	3206	28,6	2428	41,0	3306	47,3	2978	29,5	2851
17,0	19,7	66,8	3417	30,8	2580	43,4	3528	49,6	3170	31,8	3033
18,0	20,8	69,2	3632	33,0	2735	45,7	3755	51,8	3364	33,9	3218
19,0	21,9	71,5	3851	35,0	2890	48,0	3987	54,0	3562	36,0	3405
20,0	23,0	73,7	4075	37,0	3048	50,1	4226	56,0	3762	37,9	3595
21,0	24,1	75,9	4304	38,9	3207	52,1	4471	58,0	3966	39,9	3788
22,0	25,2	77,9	4538	40,7	3368	54,1	4724	59,9	4173	41,7	3984
23,0	26,3	79,9	4779	42,5	3531	56,0	4986	61,7	4384	43,5	4183
24,0	27,4	81,9	5027	44,2	3696	57,9	5258	63,4	4599	45,2	4386
25,0	28,5	83,7	5282	45,8	3863	59,7	5542	65,2	4819	46,9	4592
26,0	29,6	85,6	5547	47,4	4033	61,4	5840	66,8	5044	48,5	4803
27,0	30,7	87,3	5821	49,0	4205	63,1	6156	68,4	5274	50,1	5017
28,0	31,8	89,0	6107	50,5	4379	64,7	6494	70,0	5510	51,6	5237
29,0	32,9	90,7	6408	52,0	4556	66,3	6861	71,5	5753	53,1	5463
30,0	34,0	92,3	6726	53,5	4737	67,8	7270	72,9	6004	54,6	5693
31,0	35,1	93,9	7067	54,9	4920	69,3	7747	74,4	6263	56,0	5931
32,0	36,2	95,4	7436	56,3	5107	70,7	8358	75,7	6532	57,4	6175
33,0	37,3	96,9	7849	57,6	5297	72,1	9674	77,1	6812	58,7	6428
34,0	38,4	98,3	8329	58,9	5491			78,4	7107	60,1	6691
35,0	39,5	99,2	8744	60,2	5689			79,7	7418	61,4	6964
36,0	40,6	99,5	8966	61,5	5892			80,9	7749	62,6	7251
37,0	41,7	99,7	9199	62,7	6100			82,1	8109	63,8	7552
38,0	42,8			63,9	6313			83,2	8507	65,0	7874
39,0	43,9			65,1	6533			84,3	8965	66,2	8220
40,0	45,0			66,2	6759			85,3	9536	67,4	8600
41,0	46,1			67,3	6993			86,1	10476	68,5	9029
42,0	47,2			68,5	7236					69,6	9541
43,0	48,3			69,5	7489					70,7	10246
44,0	49,4			70,6	7754						
45,0	50,5			71,7	8033						
46,0	51,6			72,7	8330						
47,0	52,7			73,7	8651						
48,0	53,8			74,7	9003						
49,0	54,9			75,6	9402						
50,0	56,0			76,6	9881						
51,0	57,1			77,5	10554						
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										

continue →

TABLE 6: Maximum discharge capacity of valves 3065

Pset [bar]	Po [barsass]	R507		R448A		R449A		R450A		R452A	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	25,8	2260	31,1	2075	31,0	2087	55,2	2250	28,7	2279
12,0	14,2	28,9	2463	34,1	2254	34,0	2271	58,5	2456	31,8	2482
13,0	15,3	31,9	2669	36,9	2443	36,9	2457	61,7	2653	34,6	2687
14,0	16,4	34,7	2879	39,6	2631	39,5	2645	64,6	2867	37,4	2895
15,0	17,5	37,3	3093	42,1	2814	42,1	2836	67,5	3075	39,9	3106
16,0	18,6	39,8	3311	44,6	3011	44,5	3029	70,1	3284	42,4	3321
17,0	19,7	42,2	3533	46,9	3212	46,8	3226	72,7	3510	44,7	3540
18,0	20,8	44,5	3761	49,1	3396	49,1	3425	75,2	3735	47,0	3763
19,0	21,9	46,8	3994	51,2	3611	51,2	3627	77,5	3953	49,1	3990
20,0	23,0	48,9	4234	53,3	3802	53,2	3833	79,8	4187	51,2	4222
21,0	24,1	50,9	4481	55,2	4004	55,2	4043	82,0	4441	53,2	4459
22,0	25,2	52,9	4735	57,1	4221	57,1	4256	84,1	4681	55,1	4702
23,0	26,3	54,8	4999	58,9	4453	58,9	4474	86,2	4939	57,0	4952
24,0	27,4	56,7	5273	60,7	4672	60,7	4697	88,1	5218	58,7	5210
25,0	28,5	58,5	5559	62,4	4905	62,4	4925	90,1	5470	60,5	5475
26,0	29,6	60,2	5860	64,1	5114	64,1	5159	91,9	5740	62,1	5750
27,0	30,7	61,9	6180	65,7	5379	65,7	5400	93,7	6094	63,7	6037
28,0	31,8	63,5	6523	67,2	5617	67,2	5647	95,4	6415	65,3	6336
29,0	32,9	65,1	6899	68,7	5870	68,7	5902	97,1	6766	66,8	6652
30,0	34,0	66,6	7321	70,2	6140	70,2	6165	98,8	7056	68,3	6988
31,0	35,1	68,1	7821	71,6	6365	71,6	6440	100,3	7471	69,7	7360
32,0	36,2	69,6	8498	73,0	6671	73,0	6733	101,9	8061	68,3	19265
33,0	37,3			74,3	7004	74,3	7019			72,3	8203
34,0	38,4			75,6	7278	75,6	7368			73,5	8752
35,0	39,5			76,9	7667	76,9	7721				
36,0	40,6			78,1	7986	78,1	8107				
37,0	41,7			79,2	8453	79,2	8545				
38,0	42,8			80,3	8982	80,3	9076				
39,0	43,9					80,7	11407				
40,0	45,0										
41,0	46,1										
42,0	47,2										
43,0	48,3										
44,0	49,4										
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										

continue →

TABLE 6: Maximum discharge capacity of valves 3065

Pset [bar]	Po [barsass]	R452B		R454B		R513A		R1234yf		R1234ze	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	19,1	1829	19,6	1813	47,9	2290	50,2	2350	61,1	2284
12,0	14,2	22,1	1988	22,6	1971	51,3	2496	53,7	2564	64,5	2489
13,0	15,3	24,8	2149	25,3	2131	54,4	2705	56,9	2781	67,7	2698
14,0	16,4	27,4	2311	28,0	2292	57,4	2918	59,9	3003	70,8	2910
15,0	17,5	29,9	2476	30,5	2454	60,2	3135	62,9	3230	73,7	3126
16,0	18,6	32,3	2641	32,8	2619	62,9	3357	65,6	3462	76,5	3347
17,0	19,7	34,5	2809	35,1	2785	65,4	3583	68,3	3700	79,1	3572
18,0	20,8	36,7	2979	37,3	2953	67,9	3815	70,8	3944	81,7	3803
19,0	21,9	38,8	3151	39,3	3124	70,3	4052	73,2	4196	84,1	4039
20,0	23,0	40,8	3325	41,4	3296	72,5	4296	75,6	4457	86,4	4282
21,0	24,1	42,7	3502	43,3	3471	74,7	4547	77,8	4728	88,7	4532
22,0	25,2	44,6	3681	45,2	3648	76,8	4806	80,0	5010	90,9	4790
23,0	26,3	46,4	3863	47,0	3828	78,9	5075	82,1	5306	93,0	5058
24,0	27,4	48,1	4047	48,7	4011	80,8	5355	84,1	5619	95,0	5337
25,0	28,5	49,8	4235	50,4	4197	82,7	5648	86,1	5954	97,0	5629
26,0	29,6	51,5	4426	52,1	4386	84,6	5958	88,0	6317	98,9	5937
27,0	30,7	53,1	4620	53,6	4578	86,4	6287	89,8	6724	100,7	6265
28,0	31,8	54,6	4818	55,2	4774	88,1	6643	91,6	7199	102,5	6619
29,0	32,9	56,1	5020	56,7	4974	89,8	7035	93,3	7824	104,3	7010
30,0	34,0	57,6	5227	58,2	5178	91,4	7485			106,0	7458
31,0	35,1	59,0	5438	59,6	5387	93,0	8042			107,6	8013
32,0	36,2	60,4	5655	61,0	5600	94,5	8967			109,2	8989
33,0	37,3	61,8	5877	62,4	5820						
34,0	38,4	63,1	6106	63,7	6046						
35,0	39,5	64,4	6343	65,0	6278						
36,0	40,6	65,6	6587	66,2	6519						
37,0	41,7	66,9	6841	67,5	6769						
38,0	42,8	68,1	7106	68,7	7029						
39,0	43,9	69,2	7384	69,9	7301						
40,0	45,0	70,4	7677	71,0	7588						
41,0	46,1	71,5	7991	72,1	7893						
42,0	47,2	72,6	8330	73,2	8222						
43,0	48,3	73,7	8704	74,3	8581						
44,0	49,4	74,7	9132	75,3	8986						
45,0	50,5	75,7	9654	76,3	9465						
46,0	51,6	76,7	10419	77,3	10100						
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										

continue →

TABLE 6: Maximum discharge capacity of valves 3065

Pset [bar]	Po [barsass]	R290		R600		R600a		R1270	
		To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]	To [°C]	Qm [kg/h]
11,0	13,1	38,1	1483	92,3	1549	78,8	1585	30,2	1436
12,0	14,2	41,6	1612	96,3	1686	82,7	1726	33,5	1560
13,0	15,3	44,9	1744	100,1	1826	86,4	1869	36,7	1686
14,0	16,4	48,0	1876	103,7	1968	89,9	2015	39,8	1814
15,0	17,5	51,0	2010	107,2	2112	93,3	2164	42,7	1942
16,0	18,6	53,8	2147	110,4	2259	96,5	2315	45,4	2072
17,0	19,7	56,5	2285	113,5	2408	99,6	2470	48,1	2204
18,0	20,8	59,2	2425	116,5	2561	102,5	2628	50,6	2338
19,0	21,9	61,7	2568	119,4	2718	105,3	2790	53,0	2473
20,0	23,0	64,1	2714			108,0	2956	55,4	2611
21,0	24,1	66,4	2862			110,6	3128	57,6	2751
22,0	25,2	68,7	3013			113,2	3304	59,8	2893
23,0	26,3	70,8	3168			115,6	3487	62,0	3038
24,0	27,4	73,0	3326			118,0	3677	64,0	3186
25,0	28,5	75,0	3489			120,3	3877	66,0	3337
26,0	29,6	77,0	3656			122,5	4086	67,9	3491
27,0	30,7	78,9	3828			124,7	4309	69,8	3649
28,0	31,8	80,8	4007			126,8	4550	71,7	3811
29,0	32,9	82,6	4192			128,8	4816	73,4	3978
30,0	34,0	84,4	4386			130,8	5120	75,2	4150
31,0	35,1	86,2	4590			132,7	5502	76,9	4329
32,0	36,2	87,9	4806			134,5	6255	78,5	4514
33,0	37,3	89,5	5037					80,1	4708
34,0	38,4	91,1	5290					81,7	4912
35,0	39,5	92,7	5574					83,2	5129
36,0	40,6	94,2	5910					84,7	5362
37,0	41,7	95,7	6363					86,2	5617
38,0	42,8							87,6	5906
39,0	43,9							89,0	6252
40,0	45,0							90,4	6748
41,0	46,1								
42,0	47,2								
43,0	48,3								
44,0	49,4								
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								

# SAFETY DEVICES

## 4.3 – 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:

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

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  $p_o$  [kJ/kg] = 1,1 x  $p_{set}$  [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:

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

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:

$$Q_{md} = 60 \times V \times n \times \rho_{10} \times \eta_v \quad [\text{kg/h}]$$

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

- traditional HCFC and HFC refrigerants most commonly used
- new HFO and HFC/HFO blend refrigerants
- natural HC fluids
- $\eta_v$  = 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:

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

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:

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

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.

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

where:

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



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

- Table 3 for valves in series 3061
- Table 6 for valves in series 3065

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

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

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:

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

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<sup>3</sup>/kg]
- $C$  = expansion rate as a function of the  $k$  coefficient in the isentropic equation calculated with the following formula:

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

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

Table 7 provides the  $k$  and  $C$  values for:

- traditional HCFC and HFC refrigerants most commonly used
- new HFO and HFC/HFO blend refrigerants
- natural HC fluids

## 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:

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

where:

- $A_c$  = calculated flow area from the minimum required discharge capacity  $Q_{md'}$  [mm<sup>2</sup>]
  - $A_{in}$  = cross-section area of inlet tube to valve [mm<sup>2</sup>]
  - $K_{dr} = K_d \times 0,9$ , 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

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

### 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:



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

$$p_1 = \sqrt{0,064 \times \zeta \times \left(\frac{A_c}{A_{\text{out}}} \times C \times K_{\text{dr}} \times p_0\right)^2 + p_2^2}$$

[bar abs]

where:

- $P_1$  = inlet pressure to discharge line [bar abs]
- $P_2$  = outlet pressure to discharge line, equal to atmospheric pressure [bar abs]
- $A_c$  = calculated flow area from the minimum required discharge capacity  $Q_{\text{mdr}}$  [mm<sup>2</sup>]
- $A_{\text{out}}$  = cross-section area of valve outlet pipe [mm<sup>2</sup>]
- $K_{\text{dr}} = K_d \times 0.9$ , reduced discharge coefficient
- $C$  = expansion rate as a function of the  $k$  coefficient in the isentropic equation for the refrigerant fluid
- $p_0$  = actual pressure downstream of the safety valve during discharge of the entire flow [bar abs].
- $\xi$  = sum of the of pressure loss coefficients  $\xi_n$  of the piping

The coefficients  $\xi_n$  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

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

#### EXAMPLE 1: Calculation of the flow rate ( $Q_{\text{md}}$ ) 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:

$$V = \frac{\pi}{4} \times 0,0825^2 \times 0,0698 \times 4 = 0,00149 \quad [\text{bar}]$$

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:  $p_{\text{set}} = 25$  bar

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

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:

$$\eta_v = 1 - 0,04 \times \frac{P_{\text{discharge}}}{P_{\text{suction}}} =$$

$$= 1 - 0,04 \times \frac{28,5}{6,33} = 0,82$$

and the minimum required discharge capacity is:

$$Q_{\text{md}} = 60 \times V \times n \times \rho_{10} \times \eta_v =$$

$$= 60 \times 0,00149 \times 1450 \times 27,45 \times 0,82 = 2918$$

[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:

$$Q_m = 0,2883 \times C \times A \times 0,9 \times K_d \times \sqrt{\frac{p_0}{v_0}} =$$

$$= 0,2883 \times 2,51 \times 132,7 \times 0,9 \times 0,87 \times \sqrt{\frac{28,5}{0,0069}} =$$

$$= 4832 \quad [\text{kg/h}]$$

where:

- $C = 2.51$ , corresponding to  $k$  exponent for R407C, equal to 1.14, according to Table 7
  - $K_d = 0.87$ , certified discharge ratio of safety valve 3065/4
  - $v_0 = 0.0069$  [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,  $p_0 = 28.5$  [bar abs]
  - Temperature,  $T_0 = 65.2$  [°C]

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

$$Q_m > 1,25 \times Q_{\text{md}} = 4832 > 1,25 \times 2918 \rightarrow$$

$$\rightarrow Q_{\text{md}'} = 4832 / 1,25 = 3865 \quad [\text{kg/h}]$$

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

$$A_c = 3,469 \times \frac{Q_{\text{md}'}}{(C \times 0,9 \times K_d)} \times \sqrt{\frac{v_0}{p_0}} =$$

$$= 3,469 \times \frac{3865}{(2,51 \times 0,9 \times 0,87)} \times \sqrt{\frac{0,0069}{28,5}} =$$

$$= 106 \quad [\text{mm}^2]$$

### Verification of the system upstream the safety valve

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

- $d_{in} = 17$  [mm], fitting inside diameter
- $A_{in} = 227$  [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:

- $\xi_{1(inlet)} = 0.25$
  - $\xi_{2(length)} = \lambda \times L / d_{in} = 0.02 \times 60 / 17 = 0.07$
- with  $\lambda = 0.02$  for steel pipe

$$\xi_T = \xi_1 + \xi_2 = 0.25 + 0.07 = 0.32$$

Between the safety valve and the steel fitting, a shut-off valve type 3064N/44 is 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
- $kv = 10$  [m<sup>3</sup>/h], valve kv coefficient

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

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

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

Recalling the previously calculated flow area  $A_c$ , the characteristics of safety valve 3065/4 and refrigerant fluid R407C:

- $A_c = 106$  [mm<sup>2</sup>]
- $K_{dr} = 0.89 \times 0.9 = 0.801$
- $C = 2.51$

The pressure loss is given by:

$$\frac{\Delta p_{in}}{p_o} = 0,032 \times \left[ \frac{106}{227} \times 2,51 \times 0,801 \right]^2 \times 0,77 = 0,022$$

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:

- $d_{out} = 30$  [mm], inside pipe diameter
- $A_{out} = 707$  [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:

- $\xi_{1(elbow)} = 0.25$
- $\xi_{2(length)} = \lambda \times L / d_{out} = 0.02 \times 3000 / 30 = 2$  where  $\lambda = 0.02$  for steel pipe

$$\xi_T = \xi_1 + \xi_2 = 0,25 + 2 = 2,25$$

The pressure loss is given by:

$$p_1 = \sqrt{0,064 \times 2,25 \times \left( \frac{106}{707} \right) \times 2,51 \times 0,801 \times 28,5} + 1^2 =$$

$$= 3,41 = \frac{\Delta p_{out}}{p_o} = \frac{3,41 - 1}{28,5} = 0,086 \quad [\text{bar}]$$

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 (Increase in 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:

$$p_0 = (p_{set} \times 1,1) + 1 = (28 \times 1,1) + 1 = 31,8 \quad [\text{bar abs}]$$

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.

$$Q_{md} = \frac{(3600 \times \phi \times A_{surf})}{h_{vap}} =$$

$$= \frac{(3600 \times 10 \times 3,2)}{67,28} = 1712 \quad [\text{kg/h}]$$

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 R404A at pressure,  $p_o$  [kJ/kg]

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

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

$$= 0,2883 \times 2,5 \times 44,2 \times 0,9 \times 0,89 \times \sqrt{\frac{31,8}{0,0042}} =$$

$$= 2220 \quad [\text{kg/h}]$$

where:

- $C = 2.5$ , corresponding to k exponent for R404A, equal to 1.12, according to Table 7
- $K_d = 0.89$ , certified discharge ratio of safety valve 3061/4
- $v_o = 0.0042$  [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,  $p_o = 31,8$  [bar abs]
- Temperature,  $T_o = 64,7$  [°C]

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

$$Q_m > 1,25 \times Q_{md} = 2220 > 1,25 \times 1712 \rightarrow$$

$$\rightarrow Q_{md'} = 2220 / 1,25 = 1776 \quad [\text{kg/h}]$$

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

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

$$= 3,469 \times \frac{1776}{(2,5 \times 0,9 \times 0,89)} \times \sqrt{\frac{0,0042}{31,8}} =$$

$$= 35,4 \quad [\text{mm}^2]$$

#### 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 data is taken from Table A.4:

- $\xi_{1(\text{inlet})} = 0,25$
- $\xi_{2(\text{length})} = \lambda \times L / d_{in} = 0,02 \times 60 / 17 = 0,07$

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
- $kv = 3,3$  [m<sup>3</sup>/h], valve kv coefficient

The pressure loss coefficient  $\xi_R$  of the exchange valve is given by:

$$\xi_R = 2,592 \times \left[ \frac{132,7}{3,3} \right]^2 \times 10^{-3} = 4,19$$

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:

$$\frac{\Delta p_{in}}{p_o} = 0,032 \times \left[ \frac{35,4}{227} \times 2,50 \times 0,801 \right]^2 \times 4,51 =$$

$$= 0,014$$

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 7 : Exponent K of the isentropic equation. Expansion coefficient C. Vapour density  $\varphi$

	R134a	R32	R404A	R407C	R410A	R507	R448A	R449A	R450A	R452A
Gruppo PED	2	1	2	2	2	2	2	2	2	2
k	1,12	1,24	1,12	1,14	1,17	1,10	1,14	1,14	1,11	1,11
C	2,50	2,59	2,50	2,51	2,54	2,48	2,51	2,51	2,49	2,49
10 [kg/m <sup>3</sup> ]	20,23	30,23	41,66	27,45	41,92	44,03	30,63	31,11	18,49	40,62
	R452B	R454B	R513A	R1234yf	R1234ze	R290	R600	R600a	R1270	
Gruppo PED	1	1	2	1	2	1	1	1	1	
k	1,18	1,18	1,11	1,10	1,10	1,19	1,10	1,10	1,14	
C	2,54	2,54	2,49	2,48	2,48	2,55	2,48	2,48	2,51	
10 [kg/m <sup>3</sup> ]	33,48	32,44	23,86	24,27	16,45	13,78	3,87	5,87	16,30	

# SAFETY DEVICES

## 4.4 – BURSTING DISC DEVICES

### GENERAL DESCRIPTION

Bursting disc in series 3070 are considered "Safety Accessories" according to the definition provided in Article 2, Point 4 of said Directive and are subject to the classification indicated in Article 4, Point 1.d) of the same Directive. This device is a pressure relief device that cannot be closed again, in which a bursting disc is sensitive to a positive differential pressure between the upstream and downstream sections. It is designed to burst at a specified pressure.

Bursting discs in series 3070 are identified by means of:

- a model number formed of an alphanumerical code that includes:
  - the family identity (for ex. 3070/44C)
  - the type of connection (C = NPT)
  - the burst pressure, expressed in bar, multiplied by 10 (for ex. 140)
- a serial number for the lot production.

### CONSTRUCTION

**Bursting disc holder:** this is the body of the device; it is manufactured in two halves, screwed together, that hold the burst disc in position. The two body halves are obtained through bar machining. The lower half of the body houses the inlet connection, while the upper half houses the outlet connection and two 1/8" NPT female service ports for installing a gauge or a pressure transducer. If you don't use these ports pay attention to close them with two NPT plugs code 7520/1.

Material used: EN 12164-CW614N brass

**Bursting discs:** the discs are designed and tested, according to the requirements of EN ISO 4126-2:2003, to burst at a pre-defined pressure. This pressure is called specified burst pressure, and is related to an associated temperature and a burst tolerance. The disc is manufactured from a calibrated gauge of nickel sheet, contained by a copper ring case.

### SCOPE

Use: protection against possible overpressure of the apparatuses listed below, with regard to the operating conditions for which they have been designed:

- Refrigeration system or heat pump components, for instance: condensers, liquid receivers, evaporators, liquid accumulators, positive displacement compressor discharge, heat exchangers, oil separators, or piping.
- (reference standard: EN 378-2:2016)

Fluids: the bursting disc devices in series 3070 can be used with:

- a) Refrigerant fluids in vapour or gaseous state belonging to Group 2:
- HFC (R134a, R404A, R407C, R410A, R507)
  - HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, R452A, R513A)
  - R744

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

- b) Refrigerant fluids in vapour or gaseous state belonging to Group 1:
- HFC (R32)
  - HFO and HFO/HFC mixture (R1234yf, R452B, R454B)
  - HC (R290, R600, R600a, R1270)

with reference to Article 13, Para. 1(a) of Directive 2014/68/EU (EC Regulation No. 1272/2008).

- c) 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 (types 3061, or 3065). 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 6 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 4.3.

Bursting disc devices designed to discharge gas or vapour at critical flow must be sized according to the following formula:

$$A_c = 3,469 \times \frac{Q_{md}}{C \times \alpha} \times \sqrt{\frac{v_o}{p_o}} \quad [\text{mm}^2]$$

where:

- $A_c$  = minimum cross-section area of the bursting disc [mm<sup>2</sup>]
- $Q_{md}$  = minimum required discharge flow rate of the bursting disc [kg/h]
- $\alpha$  = bursting disc coefficient of discharge
- $p_o$  = bursting pressure [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 bursting disc inlet, defined by the user or by the designer [m<sup>3</sup>/kg]
- $C$  = expansion rate as a function of the  $k$  coefficient in the isentropic equation To calculate  $C$  and to find the values of  $k$  and  $C$  for the more common refrigerants, see Chapter 4.3.

EN ISO 4126-6:2003 establishes different values for the coefficient of discharge, “ $\alpha$ ”, depending on the nozzle entry configuration where the bursting disc is mounted. The following cases are demonstrated in the aforesaid Standard, Par. C.2.2.1:

- In case of an internally protruding branch/nozzle:  $\alpha = 0.68$
- In case of a flush branch/nozzle whose inlets are not of hydrodynamic configuration:  $\alpha = 0.73$
- In case of a flush branch/nozzle with rounded or chamfered inlets:  $\alpha = 0.80$

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 4.3 “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 (3061 or 3065) with a bursting disc safety device (3070), please follow the procedure provided in Chapter 4.3, 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

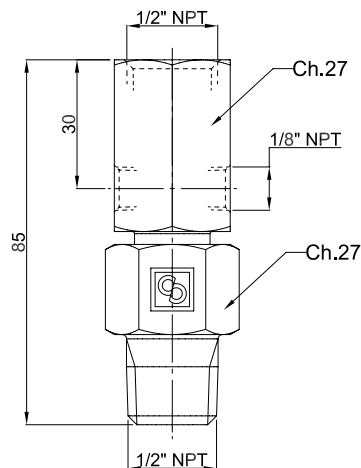
to be protected must be as short as possible. Furthermore, the cross-section of the piping must not be smaller than the valve inlet. In any case, EN 13136:2013 + A1 states that the pressure drop between the protected vessel and the combined device, at discharge capacity, shall not exceed 3% of the pressure 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 Chapter 4.3 "Selection Criteria for Safety Valves" in this technical handbook.

TABLE 8: 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	
		47,0	
50,0			
52,0			
Pb tolerance	from 14 up to 19 bar	+/- 15 %	
	from 21 up to 44 bar	+/- 10 %	
Coincident temperature Ta [°C]		22	
Correction factor of Pb for Ta ≠ 22 °C		-50 °C	1,13
		-35 °C	1,12
		-25 °C	1,10
		-10 °C	1,03
		-0 °C	1,03
		22 °C	1,00
		40 °C	0,99
		60 °C	0,97
		80 °C	0,95
		100 °C	0,94
150 °C	0,93		
Max operating pressure		75 % Pb	
Risk Category according to PED Recast		IV	







# SAFETY DEVICES

## 4.5 – CHANGEOVER VALVES

### APPLICATIONS

Changeover valves in series 3032N 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 3032N/32 are supplied with:

- Two female 1/4” NPT threaded connections with swivel nut, Castel code 3039/2
- Two O-Rings for these connections

These components ensure perfect alignment of a pair of safety valves 3061/2.

Valves models 3032N/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 code 3061/3.

Valves models 3032N/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 code 3061/4.

Valves, models: 3032N/64, 3032N/66, 3032N/88, 3032N/108 not have threaded connections with swivel nuts on the outlet connection. Therefore, safety valves are screwed directly onto the changeover valve.

The valves in series 3032N can be used with the same fluids foreseen for safety valves series 3061 and 3065, specifically:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

**CAUTION! Valves in series 3032N cannot be installed on systems that use HCFC (R22)**

### CONSTRUCTION

Valves in series 3032N 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.

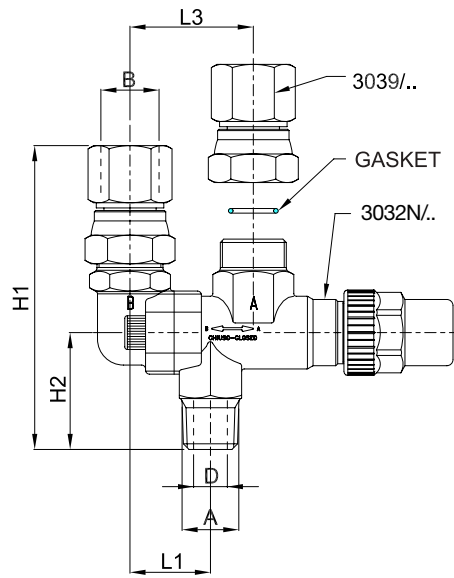
The main parts of the valves in series 3032N are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Steel, with proper surface protection, for the spindle.
- Hydrogenated nitrile butadiene rubber (HNBR) 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.

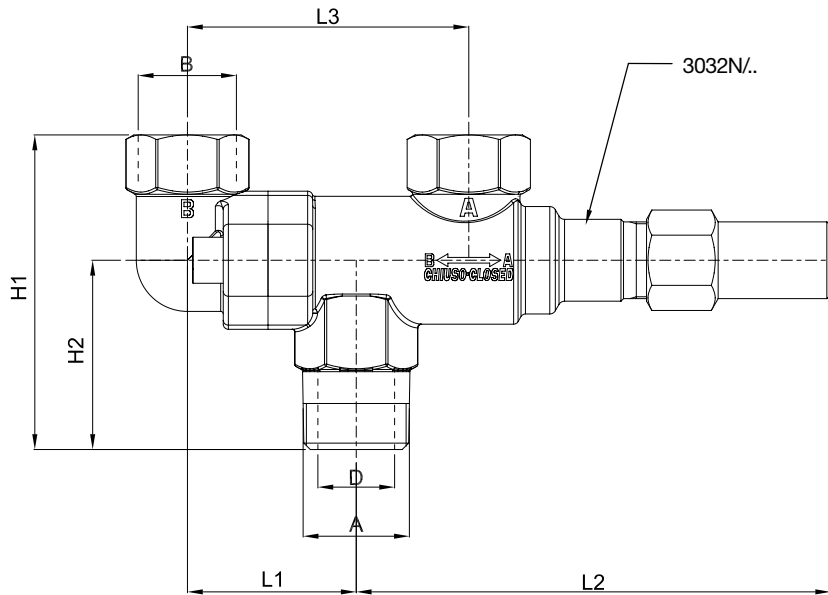


TABLE 9: General characteristics, dimensions and weights of valves 3032N

Catalogue Number	Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Dimensions [mm]							Inlet connection wrench torque (min/max) [Nm]	Weight [g]	Risk Category according to PED Recast	
			min	max	D	A	B	H1	H2	L1	L2				L3
3032N/32	2,5	80	-40	+150	13	3/8" NPT	1/4" NPT	114	42	33	91	50	17/22	775	Art 4.3
3032N/33	2,5				13	3/8" NPT	3/8" NPT	114	42	33	91	50	17/22	775	
3032N/44	3,3				13	1/2" NPT	1/2" NPT	117	45	33	91	50	25/35	775	
3032N/64	9,0				17,5	3/4" NPT	1/2" NPT	95	52	48	133	80	32/45	1750	
3032N/66	9,0				17,5	3/4" NPT	3/4" NPT	95	52	48	133	80	32/45	1750	
3032N/88	14,5				22,0	1" NPT	1" NPT	120	71	66	185	110	50/65	3200	
3032N/108	20,0				31,0	1.1/4" NPT	1" NPT	123	74	66	185	110	60/80	3200	



3032N/32  
3032N/33  
3032N/44



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

# SAFETY DEVICES

## 4.6 – 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 3064N 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 3064N can be used with the same fluids foreseen for safety valves series 3061 and 3065, specifically:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

**CAUTION! Valves in series 3064N cannot be installed on systems that use HCFC (R22)**

- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets in valves series 3064N
- Hot forged brass EN 12420 – CW 617N for the protective cap of the spindle

### CONSTRUCTION

Valves in series 3064N 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.

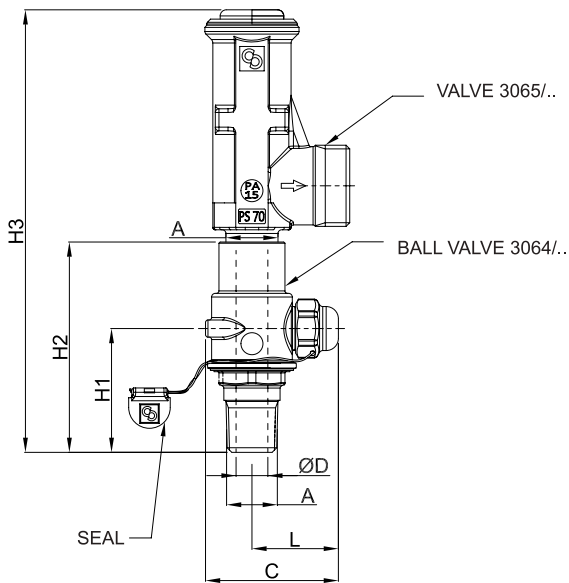
The main parts of the valves in series 3064N are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Hot forged brass EN 12420 – CW 617N, chromium plated, for the ball
- Steel, with proper surface protection, for the spindle.
- P.T.F.E. for the ball seat gaskets

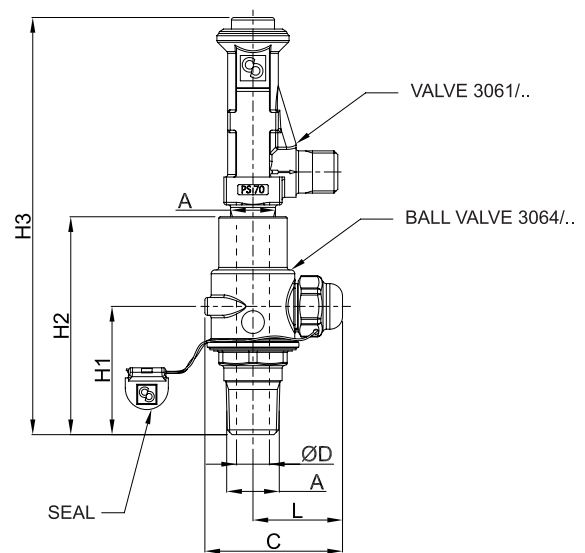


TABLE 10: General characteristics, dimensions and weights of valves series 3064N

Catalogue Number	Designed for valve	Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Dimensions [mm]							Inlet connection wrench torque (min/max) [Nm]	Weight [g]	Risk Category according to PED Recast
				min	max	Ø D	A	C	L	H1	H2	H3			
3064N/22	3061/2C	2,5	80	-40	+150	7	1/4" NPT	47	32	45	74	147	15/20	216	Art. 4.3
3064N/33	3061/3C	5				10	3/8" NPT	47	32	45	74	147	17/22	208	
3064N/44	3061/4C	10				13	1/2" NPT	54	35	51	86	165	25/35	334	
	3065/4C					188									
3064N/88	3030/88C	20	20	1" NPT	78	52	70	119	323	50/65	871				



3064N/44 → 3065/4C



3064N/22 → 3061/2C  
 3064N/33 → 3061/3C  
 3064N/44 → 3061/4C





# SAFETY DEVICES

## 4.7 – FITTING

The fittings in series 3035 allow for the installation of:

- safety valves in series 3061 and 3065
- bursting disc devices in series 3070
- shut-off valves in series 3064N
- changeover valves in series 3032N

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.**

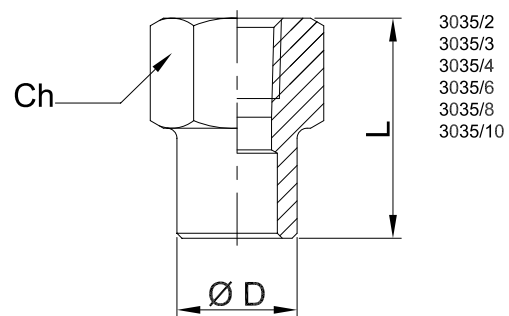
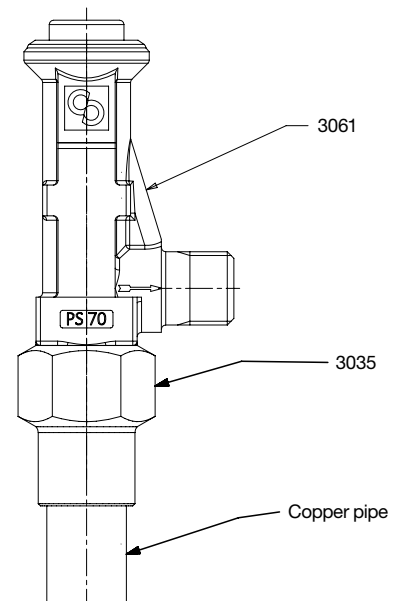
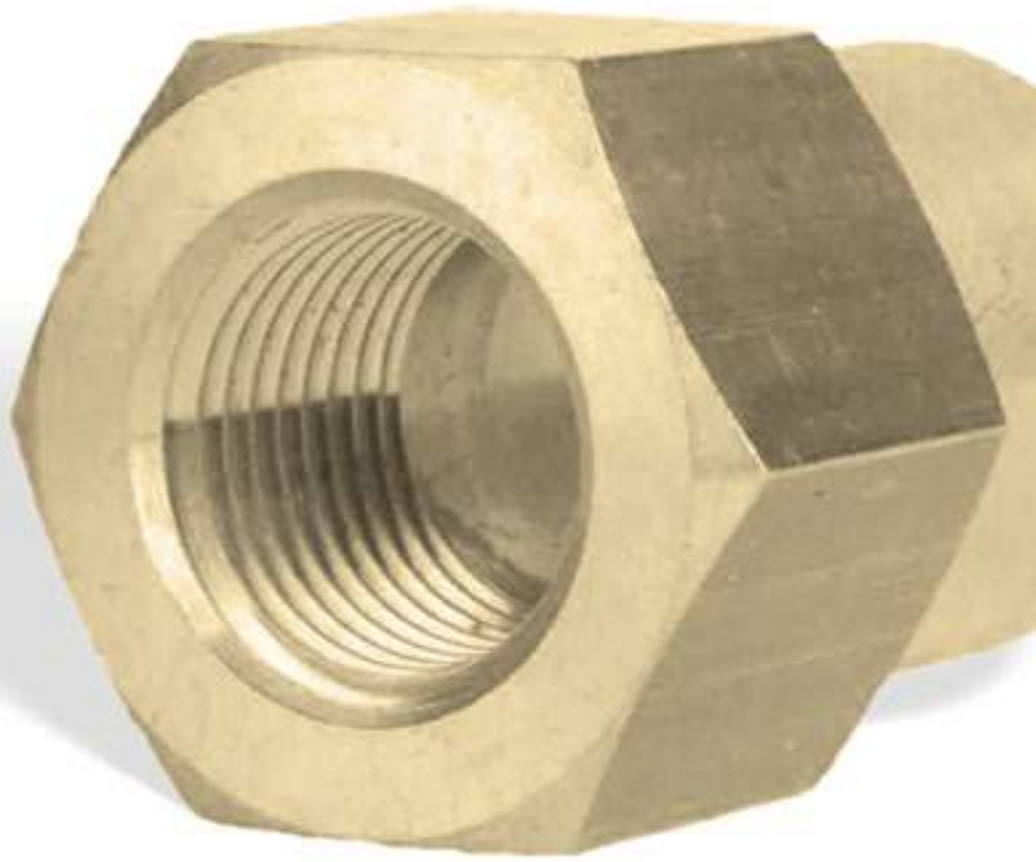


TABLE 11: General characteristics, dimensions and weights of unions 3035

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





# CHECK VALVES

P  LYHEDRA

# 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

To guarantee tightness between body the cover, the valves in series 3112W, 3113W, 3132W, 3133W, 3144W, 3145W, 3184W, 3185W are equipped with laser welds. To guarantee tightness between body the cover, the valves in series 3144NW, 3145NW 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, 3144NW, 3145W, 3145NW, 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, 3144NW, 3145W, 3145NW, 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, 3144NW, 3145W, 3145NW:
  - 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, 3144NW, 3145W 3145NW 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 the check valves in series 3112W, 3113W, 3132W, 3133W, 3144W, 3144NW, 3145W, 3145NW, 3184W, 3185W. These valves are certified UL Listed for the USA with file SA33319, in compliance with American standard UL 207.



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					min.	max.				
		Ø [in.]	Ø [mm]									
3112W/2	1/4"	-	-	0,5	0,04	50 (1)	-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		
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 (1)	-40	+150	Art. 4.3				
3132W/3	3/8"	-	1,5									
3132W/M10	-	10	1,8									
3132W/M12	-	12										
3132W/4	1/2"	-	5,0									
3132W/5	5/8"	16	3,3									
3132W/M18	-	18	5,0									
3132W/6	3/4"	-										
3132W/7	7/8"	22										
3133W/2	1/4"	-	0,5						0,30	50 (1)	-40	+150
3133W/3	3/8"	-	1,5									
3133W/M10	-	10	1,8									
3133W/M12	-	12										
3133W/4	1/2"	-	5,0									
3133W/5	5/8"	16	3,3									
3133W/M18	-	18	5,0									
3133W/6	3/4"	-										
3133W/7	7/8"	22										
3144W/7	7/8"	22	8,1	0,04	50 (2)	-40	+150	Art. 4.3				
3144W/M28	-	28	10,4									
3144W/9	1.1/8"	-	15,6									
3144NW/11	1.3/8"	35										
3144NW/13	1.5/8"	-	27,0									
3144NW/M42	-	42	39,0									
3144NW/17	2.1/8"	54	0,3					50 (2)	-40	+150	Art. 4.3	
3145W/7	7/8"	22										8,1
3145W/M28	-	28										10,4
3145W/9	1.1/8"	-										15,6
3145NW/11	1.3/8"	35										
3145NW/13	1.5/8"	-		27,0								
3145NW/M42	-	42		39,0								
3145NW/17	2.1/8"	54		0,04	50 (1)	-40	+150				Art. 4.3	
3184W/7	7/8"	22										9,0
3184W/M28	-	28										19,0
3184W/9	1.1/8"	-	9,0									
3185W/7	7/8"	22										
3185W/M28	-	28	19,0									
3185W/9	1.1/8"	-	0,3									

(1) : MWP = 600 psi according to UL approval  
 (2) : MWP = 650 psi according to UL approval



TABLE 5: Dimensions and weights of hermetic check valves

Catalogue Number		Dimensions [mm]						Weight [g]					
		L	L1	D	H	H1	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		50	96	24				-	1055		
3132W/M18	3133W/M18		170								115	29	1062
3132W/6	3133W/6		201								148	36	1300
3144W/7	3145W/7	170	-	56	115	29	-	??					
3144W/M28	3145W/M28	232		67					148	36			
3144W/9	3145W/9	255		79					167	44			
3144NW/11	3145NW/11	285		45					146	94	600		
3144NW/13	3145NW/13	111		88					51	196	141	-	1010
3144NW/M42	3145NW/M42	149											
3144NW/17	3145NW/17	285											
3184W/7	3185W/7	111	88	45	146	94	-	600					
3184W/M28	3185W/M28	149	123	51	196	141	-	1010					
3184W/9	3185W/9												

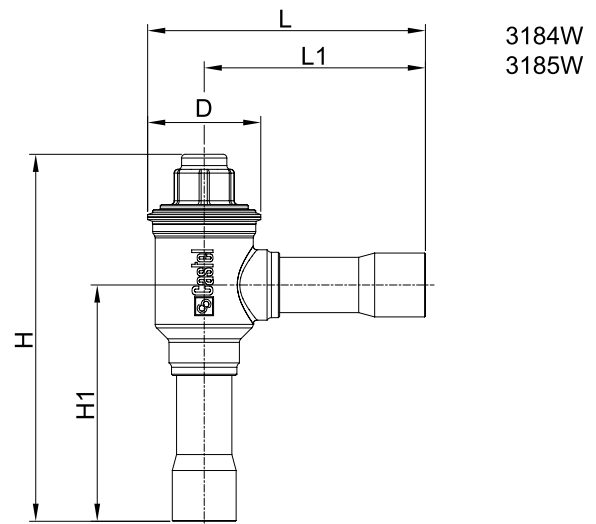
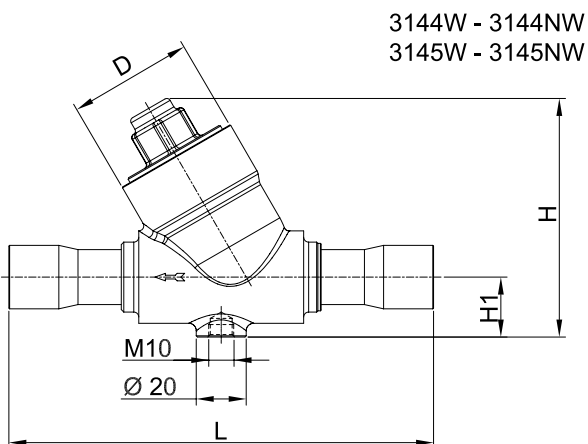
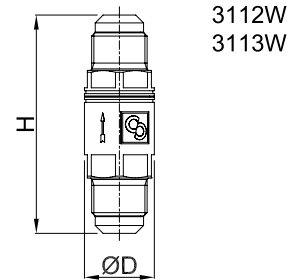
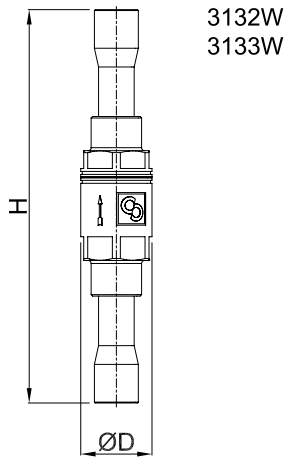


TABLE 3: Refrigerant flow capacity of hermetic check valves in liquid line [kW]

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3112W/2	3113W/2	8,5	12,6	6,0	8,6	8,6	5,8	6,3	7,5	7,8	7,9
3112W/3	3113W/3	25,5	37,7	17,9	25,8	25,8	17,3	18,9	22,6	23,5	23,6
3112W/4	3113W/4	30,6	45,2	21,4	31,0	30,9	20,7	22,6	27,1	28,2	28,3
3112W/5	3113W/5	56,1	82,9	39,3	56,9	56,7	38,0	41,5	49,6	51,6	51,9
3112W/6	3113W/6	85,0	125,7	59,5	86,2	85,9	57,5	62,9	75,2	78,3	78,6
3132W/2	3133W/2	8,5	12,6	6,0	8,6	8,6	5,8	6,3	7,5	7,8	7,9
3132W/3	3133W/3	25,5	37,7	17,9	25,8	25,8	17,3	18,9	22,6	23,5	23,6
3132W/M10	3133W/M10										
3132W/M12	3133W/M12	30,6	45,2	21,4	31,0	30,9	20,7	22,6	27,1	28,2	28,3
3132W/4	3133W/4										
3132W/5	3133W/5	56,1	82,9	39,3	56,9	56,7	38,0	41,5	49,6	51,6	51,9
3132W/M18	3133W/M18	85,0	125,7	59,5	86,2	85,9	57,5	62,9	75,2	78,3	78,6
3132W/6	3133W/6										
3132W/7	3133W/7										
3144W/7	3145W/7	138	204	96	140	139	93	102	122	127	127
3144W/M28	3145W/M28	177	261	124	179	179	120	131	156	163	163
3144W/9	3145W/9										
3144NW/11	3145NW/11	265	392	186	269	268	179	196	235	244	245
3144NW/13	3145NW/13	459	679	321	465	464	311	340	406	423	424
3144NW/M42	3145NW/M42										
3144NW/17	3145NW/17	663	980	464	672	670	449	491	587	610	613
3184W/7	3185W/7	153	226	107	155	155	104	113	135	141	141
3184W/M28	3185W/M28	323	477	226	327	326	219	239	286	297	299
3184W/9	3185W/9										

continue →

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

**TABLE 3: Refrigerant flow capacity of hermetic check valves in liquid line [kW]**

Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
3112W/2	3113W/2	8,0	6,1	10,0	10,2	7,3	10,2	12,0	10,6	10,6
3112W/3	3113W/3	23,9	18,2	30,1	30,7	21,8	30,6	35,9	31,8	31,8
3112W/4	3113W/4	28,6	21,8	36,1	36,8	26,2	36,7	43,0	38,2	38,2
3112W/5	3113W/5	52,5	40,0	66,2	67,5	48,0	67,3	78,9	70,0	70,0
3112W/6	3113W/6	79,6	60,7	100,3	102,3	72,8	101,9	119,5	106,0	106,0
3132W/2	3133W/2	8,0	6,1	10,0	10,2	7,3	10,2	12,0	10,6	10,6
3132W/3	3133W/3	23,9	18,2	30,1	30,7	21,8	30,6	35,9	31,8	31,8
3132W/M10	3133W/M10									
3132W/M12	3133W/M12	28,6	21,8	36,1	36,8	26,2	36,7	43,0	38,2	38,2
3132W/4	3133W/4									
3132W/5	3133W/5	52,5	40,0	66,2	67,5	48,0	67,3	78,9	70,0	70,0
3132W/M18	3133W/M18	79,6	60,7	100,3	102,3	72,8	101,9	119,5	106,0	106,0
3132W/6	3133W/6									
3132W/7	3133W/7									
3144W/7	3145W/7	129	98	162	166	118	165	194	172	172
3144W/M28	3145W/M28	165	126	209	213	151	212	249	220	220
3144W/9	3145W/9									
3144NW/11	3145NW/11	248	189	313	319	227	318	373	331	331
3144NW/13	3145NW/13	430	328	541	552	393	550	645	572	572
3144NW/M42	3145NW/M42									
3144NW/17	3145NW/17	620	473	782	798	568	795	932	827	827
3184W/7	3185W/7	143	109	180	184	131	183	215	191	191
3184W/M28	3185W/M28	302	230	381	389	277	387	454	403	403
3184W/9	3185W/9									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 4: Refrigerant flow capacity of hermetic check valves in suction line [kW]**

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3112W/2	3113W/2	0,9	2,1	1,1	1,1	1,7	1,1	0,7	0,7	1,2	1,1
3112W/3	3113W/3	2,7	6,4	3,3	3,4	5,0	3,3	2,2	2,1	3,6	3,3
3112W/4	3113W/4	3,3	7,7	4,0	4,1	5,9	4,0	2,6	2,6	4,3	4,0
3112W/5	3113W/5	6,0	14,0	7,3	7,5	10,9	7,4	4,9	4,7	7,9	7,3
3112W/6	3113W/6	9,1	21,3	11,0	11,4	16,5	11,2	7,4	7,1	12,0	11,0
3132W/2	3133W/2	0,9	2,1	1,1	1,1	1,7	1,1	0,7	0,7	1,2	1,1
3132W/3	3133W/3	2,7	6,4	3,3	3,4	5,0	3,3	2,2	2,1	3,6	3,3
3132W/M10	3133W/M10										
3132W/M12	3133W/M12	3,3	7,7	4,0	4,1	5,9	4,0	2,6	2,6	4,3	4,0
3132W/4	3133W/4										
3132W/5	3133W/5	6,0	14,0	7,3	7,5	10,9	7,4	4,9	4,7	7,9	7,3
3132W/M18	3133W/M18	9,1	21,3	11,0	11,4	16,5	11,2	7,4	7,1	12,0	11,0
3132W/6	3133W/6										
3132W/7	3133W/7										
3144W/7	3145W/7	15	34	18	18	27	18	12	12	19	18
3144W/M28	3145W/M28	19	44	23	24	34	23	15	15	25	23
3144W/9	3145W/9										
3144NW/11	3145NW/11	28	66	34	35	51	35	23	22	37	34
3144NW/13	3145NW/13	49	115	59	61	89	60	40	38	65	59
3144NW/M42	3145NW/M42										
3144NW/17	3145NW/17	71	166	86	89	129	87	57	55	94	86
3184W/7	3185W/7	16	38	20	20	30	20	13	13	22	20
3184W/M28	3185W/M28	35	81	42	43	63	42	28	27	46	42
3184W/9	3185W/9										

continue →

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 4: Refrigerant flow capacity of hermetic check valves in suction line [kW]

Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
3112W/2	3113W/2	0,8	1,1	1,7	1,8	0,9	1,5	0,6	0,8	1,7
3112W/3	3113W/3	2,4	3,2	5,2	5,3	2,7	4,6	1,9	2,4	5,2
3112W/4	3113W/4	2,9	3,8	6,3	6,3	3,2	5,5	2,3	2,8	6,3
3112W/5	3113W/5	5,2	7,0	11,5	11,6	5,9	10,1	4,3	5,2	11,5
3112W/6	3113W/6	8,0	10,6	17,5	17,5	9,0	15,3	6,5	7,9	17,4
3132W/2	3133W/2	0,8	1,1	1,7	1,8	0,9	1,5	0,6	0,8	1,7
3132W/3	3133W/3	2,4	3,2	5,2	5,3	2,7	4,6	1,9	2,4	5,2
3132W/M10	3133W/M10									
3132W/M12	3133W/M12	2,9	3,8	6,3	6,3	3,2	5,5	2,3	2,8	6,3
3132W/4	3133W/4									
3132W/5	3133W/5	5,2	7,0	11,5	11,6	5,9	10,1	4,3	5,2	11,5
3132W/M18	3133W/M18	8,0	10,6	17,5	17,5	9,0	15,3	6,5	7,9	17,4
3132W/6	3133W/6									
3132W/7	3133W/7									
3144W/7	3145W/7	13	17	28	28	14	25	10	13	28
3144W/M28	3145W/M28	17	22	36	36	19	32	13	16	36
3144W/9	3145W/9									
3144NW/11	3145NW/11	25	33	54	55	28	48	20	25	54
3144NW/13	3145NW/13	43	57	94	95	48	82	35	43	94
3144NW/M42	3145NW/M42									
3144NW/17	3145NW/17	62	82	136	137	70	119	50	62	136
3184W/7	3185W/7	14	19	31	32	16	27	12	14	31
3184W/M28	3185W/M28	30	40	66	67	34	58	25	30	66
3184W/9	3185W/9									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 5: Refrigerant flow capacity of hermetic check valves in hot gas line [kW]**

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3112W/2	3113W/2	4,3	9,1	4,8	6,0	6,8	4,8	3,3	3,4	5,9	5,4
3112W/3	3113W/3	12,8	27,2	14,4	17,9	20,4	14,3	10,0	10,3	17,7	16,2
3112W/4	3113W/4	15,3	32,7	17,3	21,4	24,5	17,2	12,0	12,3	21,2	19,4
3112W/5	3113W/5	28,1	59,9	31,7	39,3	44,9	31,5	21,9	22,6	38,9	35,6
3112W/6	3113W/6	42,5	90,8	48,0	59,5	68,0	47,7	33,2	34,3	59,0	53,9
3132W/2	3133W/2	4,3	9,1	4,8	6,0	6,8	4,8	3,3	3,4	5,9	5,4
3132W/3	3133W/3	12,8	27,2	14,4	17,9	20,4	14,3	10,0	10,3	17,7	16,2
3132W/M10	3133W/M10										
3132W/M12	3133W/M12	15,3	32,7	17,3	21,4	24,5	17,2	12,0	12,3	21,2	19,4
3132W/4	3133W/4										
3132W/5	3133W/5	28,1	59,9	31,7	39,3	44,9	31,5	21,9	22,6	38,9	35,6
3132W/M18	3133W/M18	42,5	90,8	48,0	59,5	68,0	47,7	33,2	34,3	59,0	53,9
3132W/6	3133W/6										
3132W/7	3133W/7										
3144W/7	3145W/7	69	147	78	96	110	77	54	55	96	87
3144W/M28	3145W/M28	88	189	100	124	141	99	69	71	123	112
3144W/9	3145W/9										
3144NW/11	3145NW/11	133	283	150	186	212	149	104	107	184	168
3144NW/13	3145NW/13	230	490	259	321	367	258	179	185	319	291
3144NW/M42	3145NW/M42										
3144NW/17	3145NW/17	332	708	374	464	530	372	259	267	460	420
3184W/7	3185W/7	77	163	86	107	122	86	60	62	106	97
3184W/M28	3185W/M28	162	345	182	226	258	181	126	130	224	205
3184W/9	3185W/9										

continue →

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 5: Refrigerant flow capacity of hermetic check valves in hot gas line [kW]

Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
3112W/2	3113W/2	3,8	5,0	7,7	7,7	4,1	6,4	3,2	3,7	7,2
3112W/3	3113W/3	11,5	15,0	23,0	23,1	12,2	19,1	9,7	11,2	21,6
3112W/4	3113W/4	13,8	18,0	27,5	27,8	14,7	23,0	11,6	13,4	25,9
3112W/5	3113W/5	25,2	32,9	50,5	50,9	26,9	42,1	21,3	24,6	47,5
3112W/6	3113W/6	38,3	49,9	76,5	77,2	40,7	63,8	32,3	37,2	72,0
3132W/2	3133W/2	3,8	5,0	7,7	7,7	4,1	6,4	3,2	3,7	7,2
3132W/3	3133W/3	11,5	15,0	23,0	23,1	12,2	19,1	9,7	11,2	21,6
3132W/M10	3133W/M10									
3132W/M12	3133W/M12	13,8	18,0	27,5	27,8	14,7	23,0	11,6	13,4	25,9
3132W/4	3133W/4									
3132W/5	3133W/5	25,2	32,9	50,5	50,9	26,9	42,1	21,3	24,6	47,5
3132W/M18	3133W/M18	38,3	49,9	76,5	77,2	40,7	63,8	32,3	37,2	72,0
3132W/6	3133W/6									
3132W/7	3133W/7									
3144W/7	3145W/7	62	81	124	125	66	103	52	60	117
3144W/M28	3145W/M28	80	104	159	160	85	133	67	77	150
3144W/9	3145W/9									
3144NW/11	3145NW/11	119	156	239	241	127	199	101	116	225
3144NW/13	3145NW/13	207	269	413	417	220	345	174	201	389
3144NW/M42	3145NW/M42									
3144NW/17	3145NW/17	298	389	597	602	317	498	252	290	562
3184W/7	3185W/7	69	90	138	139	73	115	58	67	130
3184W/M28	3185W/M28	145	190	291	293	155	242	123	141	274
3184W/9	3185W/9									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

### CONSTRUCTION

- These check valves are available in the following two types:
- Valve types 3124N (standard spring) with a low opening differential;  $\Delta p = 0.04$
- Valve types 3125N (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
- Hydrogenated nitrile (HNBR) 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 3124N, 3125N.** 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 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 3124N, 3125N cannot be installed with the valve cover facing downward.**



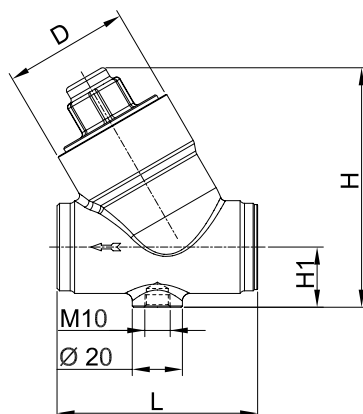


TABLE 6: General characteristics of demountable check valves

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]										
3124N/M22	–	22	8,1	0,04	50	-40	+150	Art. 4.3				
3124N/7	7/8"	–										
3124N/M28	–	28	10,4									
3124N/9	1.1/8"	–										
3124N/11	1.3/8"	35	15,6						II			
3124N/13	1.5/8"	–										
3124N/M42	–	42	27,0									
3124N/17	2.1/8"	54						39,0				
3125N/M22	–	22	8,1							0,3	50	-40
3125N/7	7/8"	–										
3125N/M28	–	28	10,4									
3125N/9	1.1/8"	–										
3125N/11	1.3/8"	35	15,6	II								
3125N/13	1.5/8"	–										
3125N/M42	–	42	27,0									
3125N/17	2.1/8"	54			39,0							

TABLE 7: Dimensions and weights of demountable check valves

Catalogue Number		Dimensions [mm]				Weight [g]
		H	H1	L	Q	
3124N/M22	3125N/M22	96	24	80	50	855
3124N/7	3125N/7					
3124N/M28	3125N/M28					867
3124N/9	3125N/9					
3124N/11	3125N/11	115	29	92	56	1130
3124N/13	3125N/13	??	??	??	??	??
3124N/M42	3125N/M42	??	??	??	??	??
3124N/17	3125N/17	??	??	??	??	??



3124N  
3125N

**TABLE 8: Refrigerant flow capacity of demountable check valves in liquid line [kW]**

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3124N/M22	3125N/M22	138	204	96	140	139	93	102	122	127	127
3124N/7	3125N/7										
3124N/M28	3125N/M28	177	261	124	179	179	120	131	156	163	163
3124N/9	3125N/9										
3124N/11	3125N/11	265	392	186	269	268	179	196	235	244	245
3124N/13	3125N/13	459	679	321	465	464	311	340	406	423	424
3124N/M42	3125N/M42										
3124N/17	3125N/17	663	980	464	672	670	449	491	587	610	613
Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270	
3124N/M22	3125N/M22	129	98	162	166	118	165	194	172	172	
3124N/7	3125N/7										
3124N/M28	3125N/M28	165	126	209	213	151	212	249	220	220	
3124N/9	3125N/9										
3124N/11	3125N/11	248	189	313	319	227	318	373	331	331	
3124N/13	3125N/13	430	328	541	552	393	550	645	572	572	
3124N/M42	3125N/M42										
3124N/17	3125N/17	620	473	782	798	568	795	932	827	827	

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 9: Refrigerant flow capacity of demountable check valves in suction line [kW]**

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3124N/M22	3125N/M22	15	34	18	18	27	18	12	12	19	18
3124N/7	3125N/7										
3124N/M28	3125N/M28	19	44	23	24	34	23	15	15	25	23
3124N/9	3125N/9										
3124N/11	3125N/11	28	66	34	35	51	35	23	22	37	34
3124N/13	3125N/13	49	115	59	61	89	60	40	38	65	59
3124N/M42	3125N/M42										
3124N/17	3125N/17	71	166	86	89	129	87	57	55	94	86
Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270	
3124N/M22	3125N/M22	13	17	28	28	14	25	10	13	28	
3124N/7	3125N/7										
3124N/M28	3125N/M28	17	22	36	36	19	32	13	16	36	
3124N/9	3125N/9										
3124N/11	3125N/11	25	33	54	55	28	48	20	25	54	
3124N/13	3125N/13	43	57	94	95	48	82	35	43	94	
3124N/M42	3125N/M42										
3124N/17	3125N/17	62	82	136	137	70	119	50	62	136	

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 10: Refrigerant flow capacity of demountable check valves in hot gas line [kW]**

Catalogue Number		R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
3124N/M22	3125N/M22	69	147	78	96	110	77	54	55	96	87
3124N/7	3125N/7										
3124N/M28	3125N/M28	88	189	100	124	141	99	69	71	123	112
3124N/9	3125N/9										
3124N/11	3125N/11	133	283	150	186	212	149	104	107	184	168
3124N/13	3125N/13	230	490	259	321	367	258	179	185	319	291
3124N/M42	3125N/M42										
3124N/17	3125N/17	332	708	374	464	530	372	259	267	460	420
Catalogue Number		R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270	
3124N/M22	3125N/M22	62	81	124	125	66	103	52	60	117	
3124N/7	3125N/7										
3124N/M28	3125N/M28	80	104	159	160	85	133	67	77	150	
3124N/9	3125N/9										
3124N/11	3125N/11	119	156	239	241	127	199	101	116	225	
3124N/13	3125N/13	207	269	413	417	220	345	174	201	389	
3124N/M42	3125N/M42										
3124N/17	3125N/17	298	389	597	602	317	498	252	290	562	

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)



The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a 3D effect of interlocking facets. The colors range from a deep navy blue to a lighter, almost white blue, giving it a crystalline or faceted appearance.

# REFRIGERATING SYSTEM PROTECTORS

P  LYHEDRA





# 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.

# REFRIGERATING SYSTEM PROTECTORS

## 6.1 – 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.

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**Note: The indicator in series 3680 and 3780N are excluded from the scope of application of Directive 2014/68/EU as they are piping components. These indicators cannot be installed on systems that use HCFC (R22) refrigerant.**

### OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.

The moisture content values that correspond to the “green” colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, “Chartreuse green”, the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes “yellow”, it’s time to replace the filter dryer.

If the charge and operating conditions of the plant are normal, the refrigerant fluid appears perfectly liquid underneath the “lens” of the indicator. The presence of bubbles indicates that the refrigerant fluid is partially evaporating along the liquid line.

### CONSTRUCTION

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 3680 and 3780N 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 hydrogenated nitrile butadiene (HNBR).

### 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 3680 and 3780N the ring must be disassembled before brazing. Note: the PS declared in Table 1 for saddle-type indicators in series 3680 and 3780N, 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.

### APPROVALS

The liquid indicators in series 3810, 3840, and 3850 and the moisture/liquid indicators 3910 3940, and 3950 are approved by the American certification authority, Underwriters Laboratories Inc. These indicators are certified **UL Listed** for the USA with file SA33318, in compliance with American standard UL 207.



TABLE 1: 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"	-	-						
3810/33		3/8"	-	-						
3810/44		1/2"	-	-						
3810/55		5/8"	-	-						
3810/66		3/4"	-	-						
3840/2	brazing	-	1/4"	-	-	-	50 (1)	-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"	-							
3850/22	male - female	1/4"	-	-						
3850/33		3/8"	-	-						
3850/44		1/2"	-	-						
3850/55		5/8"	-	-						
3850/66		3/4"	-	-						
3680/7	saddle type	-	-	-	7/8"	22	45	-40	+150	excluded
3680/9		-	-	-	1.1/8"	28				
3680/11		-	-	-	1.3/8"	35				

(1) : MWP = 500 psi according to UL approval

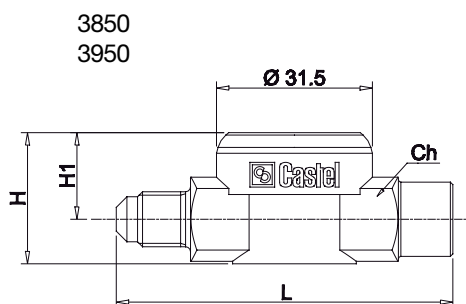
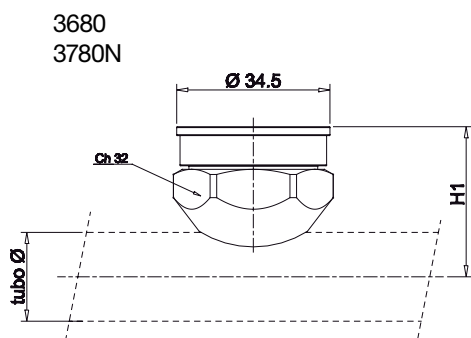
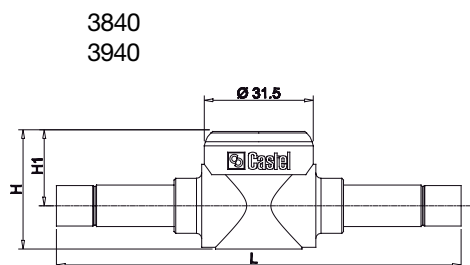
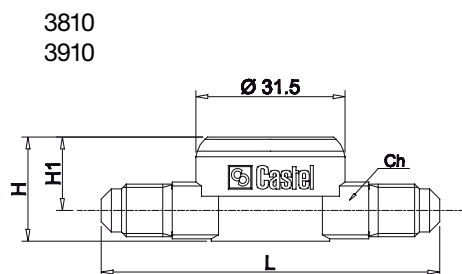
TABLE 2: General characteristics of liquid / moisture indicators

Catalogue Number	Type	Connections					PS [bar]	TS [°C]		Risk Category according to PED Recast
		SAE Flare	ODS		for pipe			min.	max.	
			Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
3910/22	male - male	1/4"	-	-						
3910/33		3/8"	-	-						
3910/44		1/2"	-	-						
3910/55		5/8"	-	-						
3910/66		3/4"	-	-						
3940/2	brazing	-	1/4"	-	-	-	50 (1)	-40	+120	Art. 4.3
3940/3		-	3/8"	-						
3940/M10		-	-	10						
3940/M12		-	-	12						
3940/4		-	1/2"	-						
3940/5		-	5/8"	16						
3940/M18		-	-	18						
3940/6		-	3/4"	-						
3940/7		-	7/8"	22						
3940/9	-	1.1/8"	-							
3950/22	male - female	1/4"	-	-						
3950/33		3/8"	-	-						
3950/44		1/2"	-	-						
3950/55		5/8"	-	-						
3950/66		3/4"	-	-						
3780N/5	saddle type	-	-	-	5/8"	16				excluded
3780N/M18		-	-	-	-	18				
3780N/7		-	-	-	7/8"	22				
3780N/9		-	-	-	1.1/8"	28				
3780N/11		-	-	-	1.3/8"	35				

(1) : MWP = 500 psi according to UL approval

TABLE 3: Dimensions and weights

Catalogue Number		Dimensions [mm]				Weight [g]			
Liquid Indicators	Moisture Liquid Indicators	H	H1	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			
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	37,5	23,5	151				-	306
3840/7	3940/7								
3840/9	3940/9								
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			
-	3780N/5	-	??	-	-	90			
-	3780N/M18		??						
3680/7	3780N/7		33						
3680/9	3780N/9		36						
3680/11	3780N/11		39,5						



# REFRIGERATING SYSTEM PROTECTORS

## 6.2 – HERMETIC FILTER DRIERS

### APPLICATIONS

The hermetic filters 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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.

### APPROVALS

Filters in series 42-43 and DF2-DF3 have been approved by the American certification authority Underwriters Laboratories Inc. Filters in series 42-43 are certified **UL Listed** for the USA with file SA7054, in compliance with American standard UL 207. Filters in series DF2-DF3 are certified **UL-CSA Listed** for the USA and Canada with file SA7054, in compliance with American standard UL 207 and Canadian standard CSA C22.2 No. 140.3-15.

### 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:

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

where:

Q = required refrigeration flow capacity [kW]

$Q_{ref}$  = 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)




**Castel**

FILTER-DRYERS  
 SOLID CORE  
 MWP = 680 PSIG  
 T. RANGE = -40/+170°F  
 SOLID CORE  
 FILTER DRIER  
 R22 - R134a - R404A  
 R407C - R410A - R507  
 Type **DF316/4**  
 3  
 PS = 47 bar  
 TS = -40/+80 °C  
 Lot N. **0717**  
 Made in China


**Castel**

FILTER-DRYERS  
 SOLID CORE  
 MWP = 680 PSIG  
 T. RANGE = -40/+170°F  
 SOLID CORE  
 FILTER DRIER  
 R22 - R134a - R404A  
 R407C - R410A - R507  
 Type **DF316/4**  
 184  
 PS = 47 bar  
 TS = -40/+80 °C  
 Lot N. **0717**  
 Made in China


**Castel**

FILTER-DRYERS  
 SOLID CORE  
 MWP = 680 PSIG  
 T. RANGE = -40/+170°F  
 SOLID CORE  
 FILTER DRIER  
 R22 - R134a - R404A  
 R407C - R410A - R507  
 Type **DF316/4**  
 184


**Castel**

FILTER-DRYERS  
 SOLID CORE  
 MWP = 680 PSIG  
 T. RANGE = -40/+170°F  
 SOLID CORE  
 FILTER DRIER  
 R22 - R134a - R404A  
 R407C - R410A - R507  
 Type **DF316/45**  
 1845  
 PS = 47 bar  
 TS = -40/+80 °C  
 Lot N. **0717**  
 Made in China

## 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

$$Q = Q_{ref} \times L1$$

$$15 = Q_{ref} \times 0.86$$

$$Q_{ref} = 15/0.86 = 17.44 \text{ [kW]}$$

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:

$$(1,050 - 50) \times 34 / 1,000 = 34 \text{ g of H}_2\text{O}$$

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:

$$1 \text{ g H}_2\text{O} = 20 \text{ water drops.}$$

In this case, and when a molecular sieve filter dryer is selected, the following result is obtained:

$$34 \times 20 = 680 \text{ water drops.}$$

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.



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 (1)	-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	155	250	1/4"				
4316/3	4216/3	163			3/8"				
4316/4	4216/4	164			1/2"				
4316/5	4216/5	165			5/8"				
4330/3	4230/3	303	310	500	3/8"				
4330/4	4230/4	304			1/2"				
4330/5	4230/5	305			5/8"				
4332/4	4232/4	304	255	500	1/2"				
4332/5	4232/5	305			5/8"				
4341/4	-	414	330	670	1/2"				
4341/5	4241/5	415			5/8"				
4341/6	4241/6	416			3/4"				
4303/2F (2)	-	-	47	50	1/4"				
4305/2F (2)	-	-	70	80	1/4"				
4308/2F (2)	-	-	103	130	1/4"				
4308/3F (2)	-	-			3/8"				
4316/3F (2)	-	-	155	250	3/8"				

(1) : MWP = 435 psi according to UL approval for filters series 4203 , 4205 , 4216 , 4232, 4303 , 4305 , 4316 , 4332  
MWP = 400 psi according to UL approval for filters series 4208 , 4230 , 4241, 4308 , 4330 , 4341  
(2) : Male-female connections (Inlet female)

TABLE 5: 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		ODM			min.	max.	
					Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
4303/2S	4203/2S	032S	47	50	1/4"	–	3/8"	–	45 (1)	–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			1/2"	–	5/8"	16				
4316/3S	4216/3S	163S	155	250	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				
4332/4S	4232/4S	304S	255	500	1/2"	–	5/8"	16				
4332/5S	4232/5S	305S			5/8"	16	3/4"	–				
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"	–				
4375N/4S (2)	4275N/4S (2)	754S	768	1340	1/2"	–	5/8"	16				
4375N/5S (2)	4275N/5S (2)	755S			5/8"	16	3/4"	–				
4375N/6S (2)	4275N/6S (2)	756S			3/4"	–	7/8"	–				
4375N/7S (2)	4275N/7S (2)	757S			7/8"	–	1.1/8"	–				
4375N/9S (2)	4275N/9S (2)	759S			1.1/8"	–	1.3/8"	35				

(1) : MWP = 435 psi according to UL approval for filters series 4203 , 4205 , 4216 , 4232, 4275, 4303 , 4305 , 4316 , 4332  
MWP = 400 psi according to UL approval for filters series 4208 , 4230 , 4241, 4308 , 4330 , 4341

(2): not UL approved

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	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4303/2	4203/2	6,4	9,9	4,6	6,6	6,8	4,4	4,7	5,7	6,2	6,0
4303/2F	-	6,4	9,9	4,6	6,6	6,8	4,4	4,7	5,7	6,2	6,0
4303/2S	4203/2S	7,9	12,2	5,6	8,1	8,3	5,5	5,7	7,0	7,6	7,4
4303/3	4203/3	14,8	22,8	10,5	15,2	15,6	10,2	10,7	13,0	14,2	13,8
4303/3S	-	18,6	28,7	13,3	19,2	19,7	12,9	13,5	16,4	17,9	17,5
4305/2	4205/2	6,6	10,2	4,7	6,8	7,0	4,6	4,8	5,8	6,4	6,2
4305/2F	-	6,6	10,2	4,7	6,8	7,0	4,6	4,8	5,8	6,4	6,2
4305/2S	4205/2S	8,2	12,6	5,8	8,4	8,6	5,7	5,9	7,2	7,8	7,7
4305/3	4205/3	15,2	23,5	10,9	15,7	16,1	10,5	11,0	13,4	14,6	14,3
4305/3S	4205/3S	19,3	29,7	13,7	19,8	20,3	13,3	14,0	17,0	18,5	18,1
4305/M10S	-	19,3	29,7	13,7	19,8	20,3	13,3	14,0	17,0	18,5	18,1
4308/2	4208/2	6,9	10,6	4,9	7,1	7,3	4,8	5,0	6,1	6,6	6,5
4308/2F	-	6,9	10,6	4,9	7,1	7,3	4,8	5,0	6,1	6,6	6,5
4308/2S	4208/2S	8,4	13,0	6,0	8,7	8,9	5,8	6,1	7,5	8,1	7,9
4308/3	4208/3	17,9	27,6	12,8	18,4	18,9	12,4	13,0	15,8	17,2	16,8
4308/3F	-	17,9	27,6	12,8	18,4	18,9	12,4	13,0	15,8	17,2	16,8
4308/3S	4208/3S	22,6	34,9	16,2	23,3	23,9	15,7	16,4	20,0	21,8	21,2
4308/M10S	-	22,6	34,9	16,2	23,3	23,9	15,7	16,4	20,0	21,8	21,2
4308/M12S	-	28,7	44,3	20,5	29,6	30,3	19,9	20,8	25,4	27,6	26,9
4308/4	4208/4	23,8	36,6	16,9	24,5	25,1	16,4	17,2	21,0	22,8	22,3
4308/4S	4208/4S	28,7	44,3	20,5	29,6	30,3	19,9	20,8	25,4	27,6	26,9
4316/2	4216/2	6,9	10,6	4,9	7,1	7,3	4,8	5,0	6,1	6,6	6,5
4316/3	4216/3	19,5	30,1	13,9	20,1	20,6	13,5	14,2	17,3	18,8	18,3
4316/3F	-	19,5	30,1	13,9	20,1	20,6	13,5	14,2	17,3	18,8	18,3
4316/3S	4216/3S	24,4	37,6	17,4	25,1	25,8	16,9	17,7	21,5	23,5	22,9
4316/M10S	-	24,4	37,6	17,4	25,1	25,8	16,9	17,7	21,5	23,5	22,9
4316/M12S	-	33,8	52,2	24,1	34,9	35,8	23,4	24,5	29,9	32,5	31,7
4316/4	4216/4	28,0	43,1	19,9	28,8	29,6	19,4	20,3	24,7	26,9	26,2
4316/4S	4216/4S	33,8	52,2	24,1	34,9	35,8	23,4	24,5	29,9	32,5	31,7
4316/5	4216/5	37,2	57,4	26,6	38,4	39,3	25,8	27,0	32,9	35,8	34,9
4316/5S	4216/5S	44,7	68,9	31,8	46,0	47,2	30,9	32,4	39,4	43,0	41,9
4316/7S	-	47,3	73,0	33,7	48,8	50,0	32,8	34,3	41,8	45,5	44,4
4330/3	4230/3	21,5	33,1	15,3	22,1	22,7	14,9	15,6	19,0	20,6	20,1
4330/3S	4230/3S	26,9	41,4	19,2	27,7	28,4	18,6	19,5	23,7	25,8	25,2
4330/4	4230/4	30,6	47,2	21,8	31,6	32,4	21,2	22,2	27,1	29,5	28,7
4330/4S	4230/4S	37,0	57,1	26,4	38,2	39,1	25,7	26,9	32,7	35,6	34,7
4330/5	4230/5	38,4	59,2	27,4	39,6	40,6	26,6	27,9	33,9	37,0	36,0
4330/5S	4230/5S	46,2	71,3	33,0	47,6	48,8	32,0	33,5	40,8	44,5	43,3
4330/7S	-	48,8	75,2	34,8	50,3	51,6	33,8	35,4	43,1	46,9	45,8
4330/9S	-	48,8	75,2	34,8	50,3	51,6	33,8	35,4	43,1	46,9	45,8
4332/4	4232/4	33,3	51,3	23,7	34,3	35,2	23,1	24,1	29,4	32,0	31,2
4332/4S	4232/4S	40,2	61,9	28,6	41,4	42,4	27,8	29,1	35,5	38,6	37,7
4332/5	4232/5	39,5	60,9	28,2	40,7	41,8	27,4	28,7	34,9	38,0	37,1
4332/5S	4232/5S	47,8	73,7	34,1	49,2	50,5	33,1	34,6	42,2	46,0	44,8
4341/4	-	34,3	52,9	24,5	35,3	36,2	23,7	24,9	30,3	33,0	32,2
4341/4S	-	40,9	63,1	29,2	42,1	43,2	28,3	29,7	36,1	39,3	38,4
4341/5	4241/5	40,5	62,5	28,9	41,8	42,8	28,1	29,4	35,8	39,0	38,0
4341/5S	4241/5S	49,1	75,6	35,0	50,6	51,8	34,0	35,6	43,3	47,2	46,0
4341/6	4241/6	66,6	102,7	47,5	68,6	70,3	46,1	48,3	58,8	64,0	62,4
4341/6S	4241/6S	66,6	102,7	47,5	68,6	70,3	46,1	48,3	58,8	64,0	62,4
4341/7S	4241/7S	73,5	113,4	52,5	75,8	77,7	50,9	53,3	65,0	70,7	69,0
4375N/4S	4275N/4S	52,9	81,6	37,7	54,5	55,9	36,6	38,4	46,7	50,9	49,6
4375N/5S	4275N/5S	54,0	83,3	38,5	55,7	57,1	37,4	39,2	47,7	51,9	50,7
4375N/6S	4275N/6S	79,9	123,2	57,0	82,3	84,4	55,3	57,9	70,6	76,8	74,9
4375N/7S	4275N/7S	92,0	141,8	65,6	94,8	97,2	63,7	66,7	81,2	88,5	86,3
4375N/9S	4275N/9S	95,6	147,5	68,2	98,6	101,1	66,2	69,4	84,5	92,0	89,7

continue →

(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 6: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number		Refrigerants								
100% molecular sieves	80% molecular sieves + 20% activated alumina	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4303/2	4203/2	5,1	4,6	7,9	8,0	5,4	7,7	8,8	7,7	8,0
4303/2F	–	5,1	4,6	7,9	8,0	5,4	7,7	8,8	7,7	8,0
4303/2S	4203/2S	6,3	5,7	9,7	9,8	6,6	9,5	10,8	9,5	9,9
4303/3	4203/3	11,7	10,7	18,1	18,4	12,4	17,8	20,1	17,7	18,5
4303/3S	–	14,8	13,4	22,8	23,1	15,7	22,4	25,4	22,4	23,3
4305/2	4205/2	5,2	4,8	8,1	8,2	5,6	8,0	9,0	7,9	8,3
4305/2F	–	5,2	4,8	8,1	8,2	5,6	8,0	9,0	7,9	8,3
4305/2S	4205/2S	6,5	5,9	10,0	10,1	6,9	9,8	11,1	9,8	10,2
4305/3	4205/3	12,1	11,0	18,6	18,9	12,8	18,3	20,8	18,3	19,0
4305/3S	4205/3S	15,3	13,9	23,6	23,9	16,2	23,2	26,3	23,1	24,1
4305/M10S	–	15,3	13,9	23,6	23,9	16,2	23,2	26,3	23,1	24,1
4308/2	4208/2	5,5	5,0	8,4	8,6	5,8	8,3	9,4	8,3	8,6
4308/2F	–	5,5	5,0	8,4	8,6	5,8	8,3	9,4	8,3	8,6
4308/2S	4208/2S	6,7	6,1	10,3	10,5	7,1	10,2	11,5	10,1	10,6
4308/3	4208/3	14,2	12,9	21,9	22,2	15,0	21,5	24,4	21,5	22,4
4308/3F	–	14,2	12,9	21,9	22,2	15,0	21,5	24,4	21,5	22,4
4308/3S	4208/3S	18,0	16,4	27,7	28,2	19,0	27,3	30,9	27,2	28,3
4308/M10S	–	18,0	16,4	27,7	28,2	19,0	27,3	30,9	27,2	28,3
4308/M12S	–	22,8	20,7	35,1	35,7	24,1	34,6	39,2	34,5	35,9
4308/4	4208/4	18,9	17,1	29,1	29,5	20,0	28,6	32,4	28,5	29,7
4308/4S	4208/4S	22,8	20,7	35,1	35,7	24,1	34,6	39,2	34,5	35,9
4316/2	4216/2	5,5	5,0	8,4	8,6	5,8	8,3	9,4	8,3	8,6
4316/3	4216/3	15,5	14,1	23,9	24,3	16,4	23,5	26,6	23,5	24,4
4316/3F	–	15,5	14,1	23,9	24,3	16,4	23,5	26,6	23,5	24,4
4316/3S	4216/3S	19,4	17,6	29,9	30,3	20,5	29,4	33,3	29,3	30,5
4316/M10S	–	19,4	17,6	29,9	30,3	20,5	29,4	33,3	29,3	30,5
4316/M12S	–	26,9	24,4	41,4	42,1	28,4	40,8	46,2	40,7	42,3
4316/4	4216/4	22,2	20,2	34,3	34,8	23,5	33,7	38,2	33,6	35,0
4316/4S	4216/4S	26,9	24,4	41,4	42,1	28,4	40,8	46,2	40,7	42,3
4316/5	4216/5	29,6	26,9	45,6	46,3	31,3	44,9	50,8	44,7	46,6
4316/5S	4216/5S	35,5	32,2	54,7	55,5	37,5	53,8	60,9	53,7	55,9
4316/7S	–	37,6	34,2	57,9	58,8	39,8	57,0	64,6	56,9	59,2
4330/3	4230/3	17,0	15,5	26,3	26,7	18,0	25,9	29,3	25,8	26,8
4330/3S	4230/3S	21,3	19,4	32,9	33,4	22,6	32,4	36,7	32,3	33,6
4330/4	4230/4	24,3	22,1	37,5	38,1	25,8	36,9	41,8	36,8	38,3
4330/4S	4230/4S	29,4	26,7	45,4	46,1	31,1	44,6	50,5	44,5	46,3
4330/5	4230/5	30,5	27,7	47,1	47,8	32,3	46,3	52,4	46,2	48,1
4330/5S	4230/5S	36,7	33,4	56,6	57,5	38,9	55,7	63,1	55,5	57,8
4330/7S	–	38,7	35,2	59,7	60,6	41,0	58,8	66,6	58,6	61,0
4330/9S	–	38,7	35,2	59,7	60,6	41,0	58,8	66,6	58,6	61,0
4332/4	4232/4	26,4	24,0	40,8	41,4	28,0	40,1	45,4	40,0	41,6
4332/4S	4232/4S	31,9	29,0	49,2	49,9	33,8	48,4	54,8	48,3	50,2
4332/5	4232/5	31,4	28,5	48,4	49,1	33,2	47,6	53,9	47,5	49,4
4332/5S	4232/5S	37,9	34,5	58,5	59,4	40,2	57,6	65,2	57,4	59,8
4341/4	–	27,2	24,8	42,0	42,6	28,8	41,3	46,8	41,2	42,9
4341/4S	–	32,5	29,5	50,1	50,8	34,4	49,3	55,8	49,1	51,2
4341/5	4241/5	32,2	29,3	49,6	50,4	34,1	48,8	55,3	48,7	50,7
4341/5S	4241/5S	38,9	35,4	60,1	61,0	41,2	59,1	66,9	59,0	61,4
4341/6	4241/6	52,9	48,1	81,5	82,8	56,0	80,2	90,8	80,0	83,3
4341/6S	4241/6S	52,9	48,1	81,5	82,8	56,0	80,2	90,8	80,0	83,3
4341/7S	4241/7S	58,4	53,1	90,1	91,4	61,8	88,6	100,3	88,4	92,0
4375N/4S	4275N/4S	42,0	38,2	64,8	65,8	44,5	63,8	72,2	63,6	66,2
4375N/5S	4275N/5S	42,9	39,0	66,1	67,1	45,4	65,1	73,7	64,9	67,6
4375N/6S	4275N/6S	63,4	57,7	97,8	99,3	67,2	96,2	109,0	96,0	99,9
4375N/7S	4275N/7S	73,0	66,4	112,6	114,3	77,3	110,8	125,5	110,5	115,0
4375N/9S	4275N/9S	75,9	69,0	117,1	118,9	80,4	115,3	130,5	114,9	119,6

continue →

(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	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4303/2	4203/2	7,7	11,9	5,5	7,9	8,1	5,3	5,6	6,8	7,3	7,2
4303/2F	-	7,7	11,9	5,5	7,9	8,1	5,3	5,6	6,8	7,3	7,2
4303/2S	4203/2S	9,5	14,6	6,7	9,8	10,0	6,6	6,9	8,4	9,0	8,9
4303/3	4203/3	17,7	27,3	12,6	18,3	18,7	12,3	12,8	15,6	16,8	16,6
4303/3S	-	22,3	34,4	15,9	23,0	23,6	15,5	16,2	19,7	21,2	20,9
4305/2	4205/2	7,9	12,2	5,7	8,2	8,4	5,5	5,7	7,0	7,5	7,4
4305/2F	-	7,9	12,2	5,7	8,2	8,4	5,5	5,7	7,0	7,5	7,4
4305/2S	4205/2S	10,6	16,4	7,6	10,9	11,2	7,3	7,7	9,4	10,1	10,0
4305/3	4205/3	19,8	30,5	14,1	20,4	20,9	13,7	14,4	17,5	18,8	18,6
4305/3S	4205/3S	25,0	38,6	17,9	25,8	26,5	17,3	18,2	22,1	23,8	23,5
4305/M10S	-	25,0	38,6	17,9	25,8	26,5	17,3	18,2	22,1	23,8	23,5
4308/2	4208/2	8,9	13,8	6,4	9,2	9,4	6,2	6,5	7,9	8,5	8,4
4308/2F	-	8,9	13,8	6,4	9,2	9,4	6,2	6,5	7,9	8,5	8,4
4308/2S	4208/2S	11,0	16,9	7,8	11,3	11,6	7,6	8,0	9,7	10,4	10,3
4308/3	4208/3	23,2	35,8	16,6	24,0	24,6	16,1	16,9	20,5	22,1	21,8
4308/3F	-	23,2	35,8	16,6	24,0	24,6	16,1	16,9	20,5	22,1	21,8
4308/3S	4208/3S	29,4	45,4	21,0	30,3	31,1	20,4	21,4	26,0	28,0	27,6
4308/M10S	-	29,4	45,4	21,0	30,3	31,1	20,4	21,4	26,0	28,0	27,6
4308/M12S	-	37,3	57,5	26,6	38,5	39,4	25,8	27,1	33,0	35,5	35,0
4308/4	4208/4	30,9	47,6	22,0	31,8	32,6	21,4	22,4	27,3	29,4	29,0
4308/4S	4208/4S	37,3	57,5	26,6	38,5	39,4	25,8	27,1	33,0	35,5	35,0
4316/2	4216/2	9,3	14,3	6,6	9,6	9,8	6,4	6,7	8,2	8,8	8,7
4316/3	4216/3	26,4	40,7	18,8	27,2	27,9	18,3	19,1	23,3	25,1	24,7
4316/3F	-	26,4	40,7	18,8	27,2	27,9	18,3	19,1	23,3	25,1	24,7
4316/3S	4216/3S	32,9	50,8	23,5	33,9	34,8	22,8	23,9	29,1	31,3	30,9
4316/M10S	-	32,9	50,8	23,5	33,9	34,8	22,8	23,9	29,1	31,3	30,9
4316/M12S	-	45,7	70,4	32,6	47,1	48,3	31,6	33,1	40,4	43,4	42,8
4316/4	4216/4	37,8	58,2	26,9	38,9	39,9	26,1	27,4	33,4	35,9	35,4
4316/4S	4216/4S	45,7	70,4	32,6	47,1	48,3	31,6	33,1	40,4	43,4	42,8
4316/5	4216/5	50,3	77,5	35,8	51,8	53,1	34,8	36,4	44,4	47,8	47,1
4316/5S	4216/5S	60,3	93,0	43,0	62,1	63,7	41,7	43,7	53,3	57,3	56,5
4316/7S	-	63,9	98,5	45,6	65,8	67,5	44,2	46,3	56,4	60,7	59,9
4330/3	4230/3	29,0	44,7	20,7	29,9	30,6	20,1	21,0	25,6	27,5	27,2
4330/3S	4230/3S	36,3	55,9	25,9	37,4	38,3	25,1	26,3	32,0	34,5	34,0
4330/4	4230/4	41,3	63,8	29,5	42,6	43,7	28,6	30,0	36,5	39,3	38,8
4330/4S	4230/4S	50,0	77,1	35,7	51,5	52,8	34,6	36,3	44,2	47,6	46,9
4330/5	4230/5	51,9	80,0	37,0	53,5	54,8	35,9	37,6	45,8	49,3	48,6
4330/5S	4230/5S	62,4	96,2	44,5	64,3	65,9	43,2	45,2	55,1	59,3	58,5
4330/7S	-	65,9	101,6	47,0	67,9	69,6	45,6	47,8	58,2	62,6	61,8
4330/9S	-	65,9	101,6	47,0	67,9	69,6	45,6	47,8	58,2	62,6	61,8
4332/4	4232/4	46,6	71,9	33,2	48,0	49,2	32,3	33,8	41,2	44,3	43,7
4332/4S	4232/4S	56,2	86,7	40,1	57,9	59,4	38,9	40,8	49,7	53,5	52,7
4332/5	4232/5	55,3	85,3	39,5	57,0	58,5	38,3	40,1	48,9	52,6	51,9
4332/5S	4232/5S	66,9	103,1	47,7	68,9	70,7	46,3	48,5	59,1	63,6	62,7
4341/4	-	51,4	79,3	36,7	53,0	54,4	35,6	37,3	45,4	48,9	48,2
4341/4S	-	61,3	94,6	43,8	63,2	64,8	42,5	44,5	54,2	58,3	57,5
4341/5	4241/5	60,8	93,7	43,4	62,7	64,2	42,1	44,1	53,7	57,8	57,0
4341/5S	4241/5S	73,6	113,5	52,5	75,8	77,8	51,0	53,4	65,0	70,0	69,0
4341/6	4241/6	99,9	154,0	71,2	102,9	105,5	69,2	72,4	88,2	95,0	93,7
4341/6S	4241/6S	99,9	154,0	71,2	102,9	105,5	69,2	72,4	88,2	95,0	93,7
4341/7S	4241/7S	110,3	170,1	78,7	113,7	116,6	76,4	80,0	97,4	104,9	103,5
4375N/4S	4275N/4S	79,4	122,4	56,6	81,8	83,9	55,0	57,6	70,1	75,5	74,4
4375N/5S	4275N/5S	81,0	124,9	57,8	83,5	85,6	56,1	58,8	71,6	77,0	76,0
4375N/6S	4275N/6S	119,8	184,7	85,4	123,5	126,6	83,0	86,9	105,8	113,9	112,4
4375N/7S	4275N/7S	138,0	212,7	98,4	142,2	145,8	95,5	100,0	121,9	131,2	129,4
4375N/9S	4275N/9S	143,5	221,2	102,3	147,8	151,6	99,3	104,0	126,7	136,4	134,5

continue →

(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 7: Refrigerant flow capacity with pressure drop 0,14 bar (1) [kW]**

Catalogue Number		Refrigerants								
100% molecular sieves	80% molecular sieves + 20% activated alumina	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4303/2	4203/2	6,1	5,6	9,4	9,6	6,5	9,3	10,5	9,3	9,6
4303/2F	–	6,1	5,6	9,4	9,6	6,5	9,3	10,5	9,3	9,6
4303/2S	4203/2S	7,6	6,8	11,6	11,8	8,0	11,4	12,9	11,4	11,8
4303/3	4203/3	14,1	12,8	21,7	22,0	14,9	21,3	24,2	21,3	22,2
4303/3S	–	17,8	16,1	27,4	27,8	18,8	26,9	30,5	26,8	27,9
4305/2	4205/2	6,3	5,7	9,7	9,8	6,7	9,5	10,8	9,5	9,9
4305/2F	–	6,3	5,7	9,7	9,8	6,7	9,5	10,8	9,5	9,9
4305/2S	4205/2S	8,5	7,7	13,0	13,2	8,9	12,8	14,5	12,8	13,3
4305/3	4205/3	15,8	14,3	24,2	24,6	16,6	23,8	27,0	23,8	24,8
4305/3S	4205/3S	20,0	18,1	30,7	31,1	21,0	30,2	34,2	30,1	31,3
4305/M10S	–	20,0	18,1	30,7	31,1	21,0	30,2	34,2	30,1	31,3
4308/2	4208/2	7,1	6,5	10,9	11,1	7,5	10,8	12,2	10,7	11,2
4308/2F	–	7,1	6,5	10,9	11,1	7,5	10,8	12,2	10,7	11,2
4308/2S	4208/2S	8,8	7,9	13,4	13,6	9,2	13,2	15,0	13,2	13,7
4308/3	4208/3	18,6	16,8	28,5	28,9	19,5	28,0	31,7	27,9	29,1
4308/3F	–	18,6	16,8	28,5	28,9	19,5	28,0	31,7	27,9	29,1
4308/3S	4208/3S	23,5	21,3	36,1	36,6	24,8	35,5	40,2	35,4	36,8
4308/M10S	–	23,5	21,3	36,1	36,6	24,8	35,5	40,2	35,4	36,8
4308/M12S	–	29,8	26,9	45,7	46,4	31,4	45,0	50,9	44,8	46,7
4308/4	4208/4	24,6	22,3	37,8	38,4	26,0	37,2	42,1	37,1	38,6
4308/4S	4208/4S	29,8	26,9	45,7	46,4	31,4	45,0	50,9	44,8	46,7
4316/2	4216/2	7,4	6,7	11,4	11,5	7,8	11,2	12,7	11,2	11,6
4316/3	4216/3	21,0	19,0	32,3	32,8	22,2	31,8	36,0	31,7	33,0
4316/3F	–	21,0	19,0	32,3	32,8	22,2	31,8	36,0	31,7	33,0
4316/3S	4216/3S	26,3	23,8	40,3	40,9	27,7	39,7	44,9	39,6	41,2
4316/M10S	–	26,3	23,8	40,3	40,9	27,7	39,7	44,9	39,6	41,2
4316/M12S	–	36,5	33,0	55,9	56,8	38,4	55,0	62,3	54,9	57,1
4316/4	4216/4	30,1	27,3	46,2	46,9	31,7	45,5	51,5	45,4	47,2
4316/4S	4216/4S	36,5	33,0	55,9	56,8	38,4	55,0	62,3	54,9	57,1
4316/5	4216/5	40,1	36,3	61,6	62,5	42,3	60,6	68,6	60,4	62,9
4316/5S	4216/5S	48,1	43,5	73,8	74,9	50,7	72,6	82,2	72,5	75,4
4316/7S	–	51,0	46,1	78,2	79,4	53,7	77,0	87,1	76,8	79,9
4330/3	4230/3	23,1	20,9	35,5	36,0	24,4	34,9	39,5	34,8	36,2
4330/3S	4230/3S	29,0	26,2	44,4	45,1	30,5	43,7	49,5	43,6	45,4
4330/4	4230/4	33,0	29,8	50,6	51,4	34,8	49,8	56,4	49,7	51,7
4330/4S	4230/4S	39,9	36,1	61,2	62,2	42,1	60,3	68,2	60,1	62,6
4330/5	4230/5	41,4	37,4	63,5	64,5	43,6	62,5	70,8	62,3	64,9
4330/5S	4230/5S	49,8	45,0	76,4	77,6	52,5	75,2	85,1	75,0	78,0
4330/7S	–	52,6	47,5	80,7	81,9	55,4	79,4	89,8	79,1	82,4
4330/9S	–	52,6	47,5	80,7	81,9	55,4	79,4	89,8	79,1	82,4
4332/4	4232/4	37,2	33,6	57,1	57,9	39,2	56,2	63,6	56,0	58,3
4332/4S	4232/4S	44,9	40,6	68,9	69,9	47,3	67,8	76,7	67,6	70,3
4332/5	4232/5	44,2	39,9	67,8	68,8	46,5	66,7	75,5	66,5	69,2
4332/5S	4232/5S	53,4	48,3	81,9	83,2	56,2	80,6	91,2	80,4	83,7
4341/4	–	41,1	37,1	63,0	64,0	43,3	62,0	70,2	61,8	64,3
4341/4S	–	49,0	44,3	75,1	76,3	51,6	73,9	83,7	73,7	76,7
4341/5	4241/5	48,5	43,9	74,5	75,6	51,1	73,3	82,9	73,1	76,0
4341/5S	4241/5S	58,7	53,1	90,1	91,5	61,9	88,7	100,4	88,4	92,0
4341/6	4241/6	79,7	72,1	122,3	124,1	84,0	120,3	136,2	120,0	124,9
4341/6S	4241/6S	79,7	72,1	122,3	124,1	84,0	120,3	136,2	120,0	124,9
4341/7S	4241/7S	88,1	79,6	135,1	137,1	92,8	132,9	150,5	132,6	138,0
4375N/4S	4275N/4S	63,4	57,3	97,2	98,7	66,7	95,6	108,3	95,4	99,3
4375N/5S	4275N/5S	64,7	58,5	99,2	100,7	68,1	97,6	110,5	97,4	101,3
4375N/6S	4275N/6S	95,6	86,5	146,7	148,9	100,7	144,4	163,4	144,0	149,9
4375N/7S	4275N/7S	110,1	99,6	169,0	171,5	116,0	166,2	188,2	165,8	172,6
4375N/9S	4275N/9S	114,5	103,6	175,7	178,4	120,6	172,9	195,7	172,4	179,4

continue →

(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
R32	15	1,17	1,16	1,16	1,16	1,15	1,15	1,14	1,13	1,12	1,12	1,11
	20	1,12	1,12	1,11	1,11	1,10	1,10	1,09	1,08	1,08	1,07	1,06
	25	1,07	1,07	1,06	1,06	1,05	1,05	1,04	1,04	1,03	1,02	1,01
	30	1,02	1,02	1,01	1,01	1,01	1,00	0,99	0,99	0,98	0,97	0,96
	35	0,97	0,97	0,96	0,96	0,96	0,95	0,94	0,94	0,93	0,92	0,91
	40	0,92	0,92	0,91	0,91	0,90	0,90	0,89	0,89	0,88	0,87	0,86
	45	0,87	0,86	0,86	0,86	0,85	0,85	0,84	0,83	0,83	0,82	0,81
	50	0,81	0,81	0,81	0,80	0,80	0,79	0,79	0,78	0,77	0,77	0,76
	55	0,76	0,76	0,75	0,75	0,74	0,74	0,73	0,73	0,72	0,71	0,70
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

continue →

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
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
R1234yf	15	1,36	1,33	1,30	1,27	1,24	1,21	1,18	1,15	1,12	1,09	1,06
	20	1,29	1,26	1,23	1,20	1,17	1,14	1,11	1,08	1,05	1,02	0,99
	25	1,22	1,19	1,16	1,13	1,10	1,07	1,04	1,01	0,98	0,95	0,92
	30	1,14	1,12	1,09	1,06	1,03	1,00	0,97	0,94	0,91	0,88	0,85
	35	1,07	1,04	1,02	0,99	0,96	0,93	0,90	0,87	0,84	0,81	0,78
	40	1,00	0,97	0,94	0,91	0,89	0,86	0,83	0,80	0,77	0,74	0,71
	45	0,93	0,90	0,87	0,84	0,81	0,78	0,76	0,73	0,70	0,67	0,64
	50	0,85	0,82	0,80	0,77	0,74	0,71	0,68	0,66	0,63	0,60	0,57
	55	0,78	0,75	0,72	0,70	0,67	0,64	0,61	0,58	0,55	0,53	0,50
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
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

continue →



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
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
R452B	15	1,21	1,20	1,19	1,18	1,18	1,17	1,16	1,14	1,13	1,12	1,11
	20	1,15	1,15	1,14	1,13	1,12	1,11	1,10	1,09	1,08	1,07	1,05
	25	1,10	1,09	1,08	1,08	1,07	1,06	1,05	1,03	1,02	1,01	1,00
	30	1,04	1,03	1,03	1,02	1,01	1,00	0,99	0,98	0,97	0,96	0,94
	35	0,98	0,98	0,97	0,96	0,95	0,94	0,93	0,92	0,91	0,90	0,89
	40	0,92	0,92	0,91	0,90	0,89	0,88	0,87	0,86	0,85	0,84	0,83
	45	0,87	0,86	0,85	0,84	0,84	0,83	0,82	0,81	0,79	0,78	0,77
	50	0,80	0,80	0,79	0,78	0,77	0,77	0,76	0,75	0,73	0,72	0,71
	55	0,74	0,74	0,73	0,72	0,71	0,70	0,69	0,68	0,67	0,66	0,65
R454B	15	1,21	1,20	1,19	1,18	1,17	1,16	1,15	1,14	1,13	1,12	1,11
	20	1,15	1,15	1,14	1,13	1,12	1,11	1,10	1,09	1,08	1,06	1,05
	25	1,10	1,09	1,08	1,07	1,07	1,06	1,05	1,03	1,02	1,01	1,00
	30	1,04	1,03	1,03	1,02	1,01	1,00	0,99	0,98	0,97	0,96	0,94
	35	0,98	0,98	0,97	0,96	0,95	0,94	0,93	0,92	0,91	0,90	0,89
	40	0,93	0,92	0,91	0,90	0,90	0,89	0,88	0,87	0,85	0,84	0,83
	45	0,87	0,86	0,85	0,85	0,84	0,83	0,82	0,81	0,80	0,79	0,77
	50	0,81	0,80	0,79	0,79	0,78	0,77	0,76	0,75	0,74	0,73	0,71
	55	0,75	0,74	0,73	0,73	0,72	0,71	0,70	0,69	0,68	0,67	0,65
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

continue →

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
R290	15	1,27	1,25	1,23	1,21	1,19	1,17	1,15	1,13	1,11	1,09	1,06
	20	1,22	1,20	1,18	1,16	1,14	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	1,02	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	0,94	0,92	0,90	0,88	0,86	0,84	0,82	0,80	0,78
	45	0,92	0,90	0,88	0,86	0,84	0,82	0,80	0,78	0,76	0,74	0,72
	50	0,86	0,84	0,82	0,80	0,78	0,76	0,74	0,72	0,70	0,68	0,66
	55	0,80	0,78	0,76	0,74	0,72	0,70	0,68	0,66	0,64	0,62	0,60
R600	15	1,27	1,24	1,22	1,19	1,17	1,14	1,12	1,09	1,07	1,04	1,02
	20	1,22	1,19	1,17	1,14	1,12	1,09	1,07	1,05	1,02	1,00	0,97
	25	1,17	1,15	1,12	1,10	1,07	1,05	1,02	1,00	0,98	0,95	0,93
	30	1,12	1,10	1,07	1,05	1,02	1,00	0,98	0,95	0,93	0,90	0,88
	35	1,07	1,05	1,02	1,00	0,98	0,95	0,93	0,90	0,88	0,86	0,83
	40	1,02	1,00	0,98	0,95	0,93	0,90	0,88	0,86	0,83	0,81	0,79
	45	0,98	0,95	0,93	0,90	0,88	0,86	0,83	0,81	0,79	0,76	0,74
	50	0,93	0,90	0,88	0,86	0,83	0,81	0,78	0,76	0,74	0,71	0,69
	55	0,88	0,85	0,83	0,81	0,78	0,76	0,74	0,71	0,69	0,67	0,64
R600a	15	1,29	1,26	1,23	1,21	1,18	1,16	1,13	1,11	1,08	1,06	1,03
	20	1,23	1,21	1,18	1,16	1,13	1,11	1,08	1,05	1,03	1,00	0,98
	25	1,18	1,16	1,13	1,10	1,08	1,05	1,03	1,00	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	0,90	0,87
	35	1,07	1,05	1,02	1,00	0,97	0,95	0,92	0,90	0,87	0,85	0,82
	40	1,02	0,99	0,97	0,94	0,92	0,89	0,87	0,84	0,82	0,79	0,77
	45	0,97	0,94	0,92	0,89	0,87	0,84	0,82	0,79	0,77	0,74	0,72
	50	0,91	0,89	0,86	0,84	0,81	0,79	0,76	0,74	0,71	0,69	0,66
	55	0,86	0,83	0,81	0,78	0,76	0,73	0,71	0,68	0,66	0,64	0,61
R1270	15	1,25	1,23	1,22	1,20	1,18	1,17	1,15	1,13	1,11	1,09	1,07
	20	1,19	1,18	1,16	1,15	1,13	1,11	1,09	1,08	1,06	1,04	1,02
	25	1,14	1,12	1,11	1,09	1,07	1,06	1,04	1,02	1,00	0,98	0,96
	30	1,08	1,07	1,05	1,03	1,02	1,00	0,98	0,96	0,95	0,93	0,91
	35	1,02	1,01	0,99	0,98	0,96	0,94	0,93	0,91	0,89	0,87	0,85
	40	0,97	0,95	0,94	0,92	0,90	0,89	0,87	0,85	0,83	0,82	0,80
	45	0,91	0,89	0,88	0,86	0,85	0,83	0,81	0,79	0,78	0,76	0,74
	50	0,85	0,83	0,82	0,80	0,79	0,77	0,75	0,74	0,72	0,70	0,68
	55	0,79	0,77	0,76	0,74	0,73	0,71	0,69	0,68	0,66	0,64	0,62

TABLE 9: Water capacity and dehydratable charge of filters with core 100% molecular sieves

Catalogue Number	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]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
4303/2	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
4303/2F																
4303/2S																
4303/3																
4303/3S																
4305/2	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
4305/2F																
4305/2S																
4305/3																
4305/3S																
4305/M10S																
4308/2	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
4308/2F																
4308/2S																
4308/3																
4308/3F																
4308/3S																
4308/M10S																
4308/M12S																
4308/4																
4308/4S																
4316/2																
4316/3																
4316/3F																
4316/3S																
4316/M10S																
4316/M12S																
4316/4																
4316/4S																
4316/5																
4316/5S																
4316/7S																
4330/3	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
4330/3S																
4330/4																
4330/4S																
4330/5																
4330/5S																
4330/7S																
4330/9S																
4332/4	46,6	47,6	38,2	41,5	50,1	51,2	41,1	44,6	40,2	44,2	30,7	33,4	43,2	47,5	33,0	35,9
4332/4S																
4332/5																
4332/5S																
4341/4	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
4341/4S																
4341/5																
4341/5S																
4341/6																
4341/6S																
4341/7S																
4375N/4S	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
4375N/5S																
4375N/6S																
4375N/7S																
4375N/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

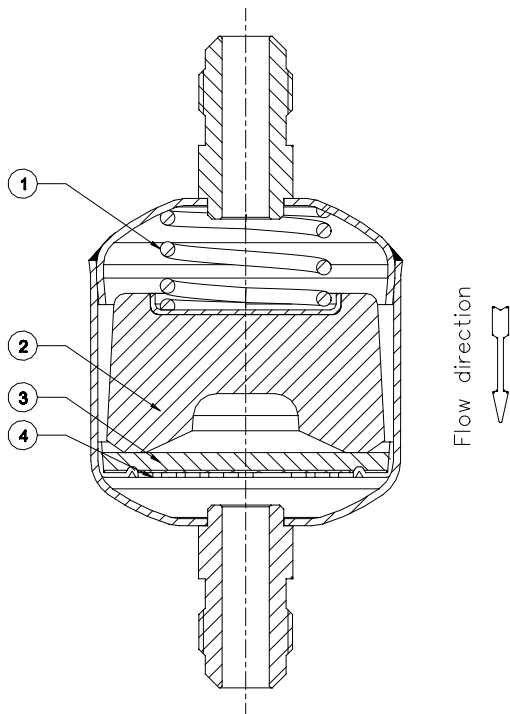
TABLE 10: Water capacity and dehydratable charge of filters with core 80% molecular sieves + 20% activated alumina

Catalogue Number	Water Capacity at + 24 °C (1) [g H2O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H2O]				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	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
4203/2S																
4203/3																
4205/2	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
4205/2S																
4205/3																
4205/3S																
4208/2	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
4208/2S																
4208/3																
4208/3S																
4208/4																
4208/4S																
4216/2	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
4216/3																
4216/3S																
4216/4																
4216/4S																
4216/5																
4216/5S																
4230/3	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
4230/3S																
4230/4																
4230/4S																
4230/5																
4230/5S																
4232/4	39,6	40,5	32,5	35,3	42,6	43,5	34,9	37,9	34,2	37,6	26,1	28,4	36,7	40,4	28,1	30,5
4232/4S																
4232/5																
4232/5S																
4241/5	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
4241/5S																
4241/6																
4241/6S																
4241/7S																
4275N/4S	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
4275N/5S																
4275N/6S																
4275N/7S																
4275N/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

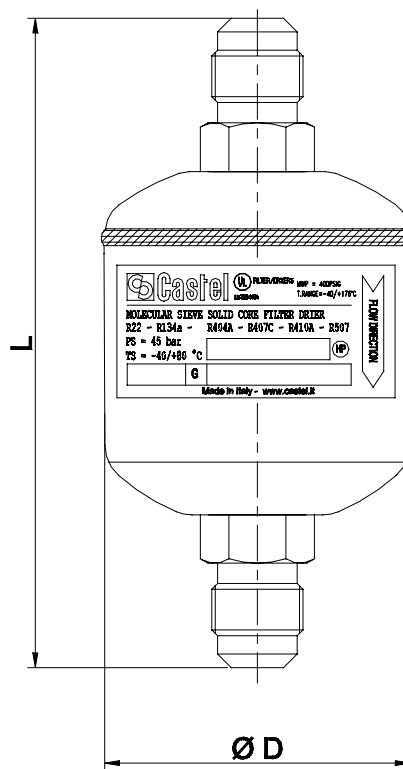
TABLE 11: Dimensions and weights of hermetic filters

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"	-	-	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	
4332/4	4232/4	1/2"	-	-	187	1300	
4332/4S	4232/4S	-	1/2"	-	173	1200	
4332/5	4232/5	5/8"	-	-	196	1320	
4332/5S	4232/5S	-	5/8"	16	179	1250	
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	
4375N/4S	4275N/4S	-	1/2"	-	387	2540	
4375N/5S	4275N/5S	-	5/8"	16	393	2640	
4375N/6S	4275N/6S	-	3/4"	-	398	2820	
4375N/7S	4275N/7S	-	7/8"	-		2900	
4375N/9S	4275N/9S	-	1.1/8"	-		3050	

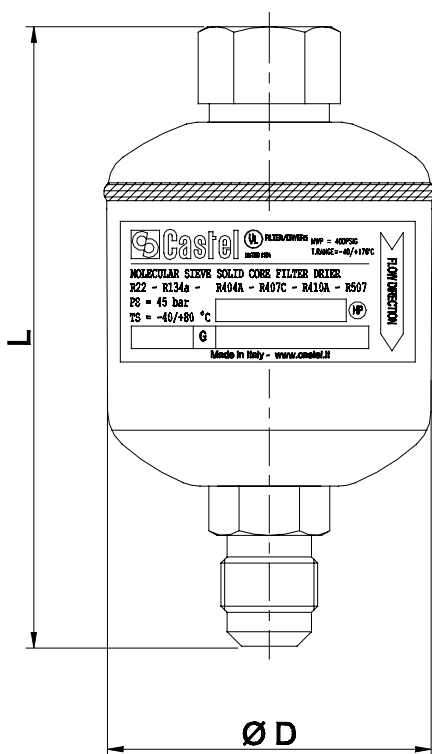


**Solid core dehydrator**

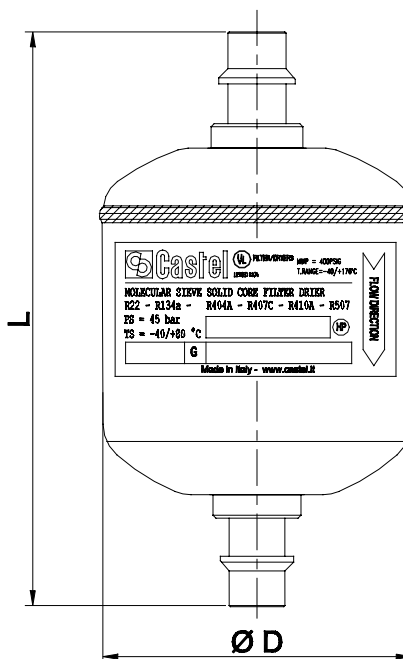
- 1 - Spring
- 2 - Bock
- 3 - Felt
- 4 - Stainless steel mesh



**Male connections**



**Male - female connections  
(female - in)**



**Solder connections**

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 (1)	- 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	250	1/4"				
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 (2)	-	-	58	50	1/4"	50 (1)	- 40	+ 80	Art. 4.3
DF305/2F (2)	-	-	104	80	1/4"				
DF308/2F (2)	-	-	141	130	1/4"				
DF308/3F (2)	-	-			3/8"				
DF316/3F (2)	-	-	183	250	3/8"				

(1) : MWP = 680 psi according to UL approval  
 (2) : 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 (1)	-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
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"	-																																																																																																																																				

(1) : MWP = 680 psi according to UL approval



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	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
DF303/2	DF203/2	7,2	11,0	5,1	7,4	7,6	5,0	5,2	6,3	6,8	6,7
DF303/2F	–	7,2	11,0	5,1	7,4	7,6	5,0	5,2	6,3	6,8	6,7
DF303/2S	DF203/2S	9,3	14,3	6,6	9,5	9,8	6,4	6,7	8,2	8,8	8,7
DF303/3	DF203/3	16,8	25,9	12,0	17,3	17,7	11,6	12,2	14,8	16,0	15,7
DF303/3S	–	17,1	26,4	12,2	17,7	18,1	11,9	12,4	15,1	16,3	16,1
DF305/2	DF205/2	7,5	11,6	5,4	7,7	7,9	5,2	5,5	6,6	7,2	7,1
DF305/2F	–	7,5	11,6	5,4	7,7	7,9	5,2	5,5	6,6	7,2	7,1
DF305/2S	DF205/2S	11,6	18,0	8,3	12,0	12,3	8,1	8,4	10,3	11,1	10,9
DF305/3	DF205/3	17,5	27,0	12,5	18,0	18,5	12,1	12,7	15,5	16,7	16,4
DF305/3S	DF205/3S	18,2	28,0	12,9	18,7	19,2	12,6	13,2	16,0	17,3	17,0
DF305/M10S	–	18,2	28,0	12,9	18,7	19,2	12,6	13,2	16,0	17,3	17,0
DF308/2	DF208/2	7,3	11,3	5,2	7,6	7,8	5,1	5,3	6,5	7,0	6,9
DF308/2F	–	7,3	11,3	5,2	7,6	7,8	5,1	5,3	6,5	7,0	6,9
DF308/2S	DF208/2S	11,2	17,3	8,0	11,5	11,8	7,7	8,1	9,9	10,6	10,5
DF308/3	DF208/3	19,4	30,0	13,9	20,0	20,5	13,5	14,1	17,2	18,5	18,2
DF308/3F	–	19,4	30,0	13,9	20,0	20,5	13,5	14,1	17,2	18,5	18,2
DF308/3S	DF208/3S	19,9	30,7	14,2	20,5	21,0	13,8	14,4	17,6	18,9	18,7
DF308/M10S	–	19,9	30,7	14,2	20,5	21,0	13,8	14,4	17,6	18,9	18,7
DF308/M12S	–	24,9	38,5	17,8	25,7	26,4	17,3	18,1	22,0	23,7	23,4
DF308/4	DF208/4	23,6	36,3	16,8	24,3	24,9	16,3	17,1	20,8	22,4	22,1
DF308/4S	DF208/4S	24,9	38,5	17,8	25,7	26,4	17,3	18,1	22,0	23,7	23,4
DF316/2	DF216/2	8,3	12,7	5,9	8,5	8,7	5,7	6,0	7,3	7,8	7,7
DF316/3	DF216/3	19,5	30,1	13,9	20,1	20,6	13,5	14,2	17,3	18,6	18,3
DF316/3F	–	19,5	30,1	13,9	20,1	20,6	13,5	14,2	17,3	18,6	18,3
DF316/3S	DF216/3S	21,5	33,1	15,3	22,1	22,7	14,9	15,6	19,0	20,4	20,1
DF316/M10S	–	21,5	33,1	15,3	22,1	22,7	14,9	15,6	19,0	20,4	20,1
DF316/M12S	–	29,7	45,8	21,2	30,6	31,4	20,6	21,5	26,2	28,3	27,9
DF316/4	DF216/4	25,2	38,9	18,0	26,0	26,6	17,5	18,3	22,3	24,0	23,7
DF316/4S	DF216/4S	29,7	45,8	21,2	30,6	31,4	20,6	21,5	26,2	28,3	27,9
DF316/5	DF216/5	33,7	51,9	24,0	34,7	35,6	23,3	24,4	29,7	32,0	31,6
DF316/5S	DF216/5S	35,3	54,4	25,2	36,4	37,3	24,4	25,6	31,2	33,6	33,1
DF316/7S	–	45,4	70,0	32,4	46,8	48,0	31,4	32,9	40,1	43,2	42,6
DF330/3	DF230/3	20,4	31,5	14,6	21,1	21,6	14,2	14,8	18,1	19,4	19,2
DF330/3S	DF230/3S	22,2	34,2	15,8	22,9	23,4	15,4	16,1	19,6	21,1	20,8
DF330/4	DF230/4	28,7	44,3	20,5	29,6	30,3	19,9	20,8	25,4	27,3	26,9
DF330/4S	DF230/4S	37,1	57,3	26,5	38,3	39,2	25,7	26,9	32,8	35,3	34,8
DF330/5	DF230/5	37,2	57,4	26,6	38,4	39,3	25,8	27,0	32,9	35,4	34,9
DF330/5S	DF230/5S	43,6	67,2	31,1	44,9	46,0	30,2	31,6	38,5	41,4	40,9
DF330/6	–	40,5	62,5	28,9	41,8	42,8	28,1	29,4	35,8	38,5	38,0
DF330/6S	–	46,4	71,5	33,1	47,8	49,0	32,1	33,6	41,0	44,1	43,5
DF330/7S	–	50,1	77,2	35,7	51,6	52,9	34,7	36,3	44,2	47,6	47,0
DF330/9S	–	50,1	77,2	35,7	51,6	52,9	34,7	36,3	44,2	47,6	47,0
DF341/4	–	36,5	56,3	26,0	37,6	38,6	25,3	26,5	32,2	34,7	34,2
DF341/4S	–	38,1	58,7	27,1	39,2	40,2	26,4	27,6	33,6	36,2	35,7
DF341/5	DF241/5	42,2	65,0	30,1	43,5	44,6	29,2	30,6	37,3	40,1	39,6
DF341/5S	DF241/5S	49,1	75,6	35,0	50,6	51,8	34,0	35,6	43,3	46,7	46,0
DF341/6	DF241/6	66,6	102,7	47,5	68,6	70,3	46,1	48,3	58,8	63,3	62,4
DF341/6S	DF241/6S	66,6	102,7	47,5	68,6	70,3	46,1	48,3	58,8	63,3	62,4
DF341/7S	DF241/7S	71,1	109,6	50,7	73,2	75,1	49,2	51,5	62,8	67,6	66,7

continue →

(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 14: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number		Refrigerants								
100% molecular sieves	80% molecular sieves + 20% activated alumina	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
DF303/2	DF203/2	5,7	5,2	8,8	8,9	6,0	8,6	9,8	8,6	8,9
DF303/2F	–	5,7	5,2	8,8	8,9	6,0	8,6	9,8	8,6	8,9
DF303/2S	DF203/2S	7,4	6,7	11,3	11,5	7,8	11,2	12,6	11,1	11,6
DF303/3	DF203/3	13,4	12,1	20,6	20,9	14,1	20,2	22,9	20,2	21,0
DF303/3S	–	13,7	12,4	21,0	21,3	14,4	20,7	23,4	20,6	21,4
DF305/2	DF205/2	6,0	5,4	9,2	9,3	6,3	9,1	10,3	9,0	9,4
DF305/2F	–	6,0	5,4	9,2	9,3	6,3	9,1	10,3	9,0	9,4
DF305/2S	DF205/2S	9,3	8,4	14,3	14,5	9,8	14,0	15,9	14,0	14,6
DF305/3	DF205/3	14,0	12,6	21,4	21,8	14,7	21,1	23,9	21,0	21,9
DF305/3S	DF205/3S	14,5	13,1	22,2	22,6	15,3	21,9	24,8	21,8	22,7
DF305/M10S	–	14,5	13,1	22,2	22,6	15,3	21,9	24,8	21,8	22,7
DF308/2	DF208/2	5,9	5,3	9,0	9,1	6,2	8,8	10,0	8,8	9,2
DF308/2F	–	5,9	5,3	9,0	9,1	6,2	8,8	10,0	8,8	9,2
DF308/2S	DF208/2S	8,9	8,1	13,7	13,9	9,4	13,5	15,3	13,4	14,0
DF308/3	DF208/3	15,5	14,0	23,8	24,2	16,3	23,4	26,5	23,4	24,3
DF308/3F	–	15,5	14,0	23,8	24,2	16,3	23,4	26,5	23,4	24,3
DF308/3S	DF208/3S	15,9	14,4	24,4	24,7	16,7	24,0	27,1	23,9	24,9
DF308/M10S	–	15,9	14,4	24,4	24,7	16,7	24,0	27,1	23,9	24,9
DF308/M12S	–	19,9	18,0	30,5	31,0	21,0	30,1	34,0	30,0	31,2
DF308/4	DF208/4	18,8	17,0	28,9	29,3	19,8	28,4	32,2	28,3	29,5
DF308/4S	DF208/4S	19,9	18,0	30,5	31,0	21,0	30,1	34,0	30,0	31,2
DF316/2	DF216/2	6,6	6,0	10,1	10,3	6,9	9,9	11,3	9,9	10,3
DF316/3	DF216/3	15,6	14,1	23,9	24,3	16,4	23,5	26,6	23,5	24,4
DF316/3F	–	15,6	14,1	23,9	24,3	16,4	23,5	26,6	23,5	24,4
DF316/3S	DF216/3S	17,1	15,5	26,3	26,7	18,0	25,9	29,3	25,8	26,8
DF316/M10S	–	17,1	15,5	26,3	26,7	18,0	25,9	29,3	25,8	26,8
DF316/M12S	–	23,7	21,4	36,4	36,9	25,0	35,8	40,5	35,7	37,2
DF316/4	DF216/4	20,1	18,2	30,9	31,4	21,2	30,4	34,4	30,3	31,5
DF316/4S	DF216/4S	23,7	21,4	36,4	36,9	25,0	35,8	40,5	35,7	37,2
DF316/5	DF216/5	26,9	24,3	41,2	41,8	28,3	40,6	45,9	40,4	42,1
DF316/5S	DF216/5S	28,2	25,5	43,2	43,9	29,7	42,5	48,2	42,4	44,2
DF316/7S	–	36,2	32,8	55,6	56,4	38,2	54,7	61,9	54,5	56,8
DF330/3	DF230/3	16,3	14,8	25,0	25,4	17,2	24,6	27,9	24,6	25,6
DF330/3S	DF230/3S	17,7	16,0	27,2	27,6	18,7	26,7	30,3	26,7	27,8
DF330/4	DF230/4	22,9	20,7	35,1	35,7	24,1	34,6	39,2	34,5	35,9
DF330/4S	DF230/4S	29,6	26,8	45,5	46,2	31,2	44,8	50,7	44,6	46,5
DF330/5	DF230/5	29,7	26,9	45,6	46,3	31,3	44,9	50,8	44,7	46,6
DF330/5S	DF230/5S	34,8	31,4	53,3	54,2	36,6	52,5	59,4	52,3	54,5
DF330/6	–	32,4	29,3	49,6	50,4	34,1	48,8	55,3	48,7	50,7
DF330/6S	–	37,0	33,5	56,8	57,7	39,0	55,9	63,3	55,8	58,0
DF330/7S	–	40,0	36,1	61,3	62,2	42,1	60,3	68,3	60,2	62,6
DF330/9S	–	40,0	36,1	61,3	62,2	42,1	60,3	68,3	60,2	62,6
DF341/4	–	29,1	26,3	44,7	45,4	30,7	44,0	49,8	43,9	45,7
DF341/4S	–	30,4	27,5	46,6	47,3	32,0	45,9	51,9	45,7	47,6
DF341/5	DF241/5	33,7	30,5	51,7	52,4	35,5	50,8	57,5	50,7	52,8
DF341/5S	DF241/5S	39,2	35,4	60,1	61,0	41,2	59,1	66,9	59,0	61,4
DF341/6	DF241/6	53,1	48,1	81,5	82,8	56,0	80,2	90,8	80,0	83,3
DF341/6S	DF241/6S	53,1	48,1	81,5	82,8	56,0	80,2	90,8	80,0	83,3
DF341/7S	DF241/7S	56,7	51,3	87,0	88,4	59,8	85,6	97,0	85,4	88,9

(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	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
DF303/2	DF203/2	8,6	13,2	6,1	8,8	9,1	5,9	6,2	7,6	8,2	8,0
DF303/2F	–	8,6	13,2	6,1	8,8	9,1	5,9	6,2	7,6	8,2	8,0
DF303/2S	DF203/2S	11,1	17,1	7,9	11,5	11,7	7,7	8,1	9,8	10,6	10,4
DF303/3	DF203/3	20,1	31,1	14,4	20,8	21,3	13,9	14,6	17,8	19,1	18,9
DF303/3S	–	20,6	31,7	14,7	21,2	21,7	14,2	14,9	18,2	19,6	19,3
DF305/2	DF205/2	9,0	13,9	6,4	9,3	9,5	6,2	6,5	8,0	8,6	8,5
DF305/2F	–	9,0	13,9	6,4	9,3	9,5	6,2	6,5	8,0	8,6	8,5
DF305/2S	DF205/2S	15,1	23,3	10,8	15,6	16,0	10,5	11,0	13,4	14,4	14,2
DF305/3	DF205/3	22,8	35,1	16,2	23,5	24,1	15,8	16,5	20,1	21,7	21,4
DF305/3S	DF205/3S	23,6	36,4	16,8	24,3	24,9	16,3	17,1	20,8	22,4	22,1
DF305/M10S	–	23,6	36,4	16,8	24,3	24,9	16,3	17,1	20,8	22,4	22,1
DF308/2	DF208/2	9,5	14,7	6,8	9,8	10,1	6,6	6,9	8,4	9,1	8,9
DF308/2F	–	9,5	14,7	6,8	9,8	10,1	6,6	6,9	8,4	9,1	8,9
DF308/2S	DF208/2S	14,5	22,4	10,4	15,0	15,4	10,1	10,5	12,8	13,8	13,6
DF308/3	DF208/3	25,3	39,0	18,0	26,0	26,7	17,5	18,3	22,3	24,0	23,7
DF308/3F	–	25,3	39,0	18,0	26,0	26,7	17,5	18,3	22,3	24,0	23,7
DF308/3S	DF208/3S	25,9	39,9	18,4	26,7	27,3	17,9	18,8	22,9	24,6	24,3
DF308/M10S	–	25,9	39,9	18,4	26,7	27,3	17,9	18,8	22,9	24,6	24,3
DF308/M12S	–	32,4	50,0	23,1	33,4	34,3	22,5	23,5	28,6	30,8	30,4
DF308/4	DF208/4	30,6	47,2	21,9	31,6	32,4	21,2	22,2	27,1	29,1	28,7
DF308/4S	DF208/4S	32,4	50,0	23,1	33,4	34,3	22,5	23,5	28,6	30,8	30,4
DF316/2	DF216/2	11,1	17,2	7,9	11,5	11,8	7,7	8,1	9,8	10,6	10,4
DF316/3	DF216/3	26,4	40,7	18,8	27,2	27,9	18,3	19,1	23,3	25,1	24,7
DF316/3F	–	26,4	40,7	18,8	27,2	27,9	18,3	19,1	23,3	25,1	24,7
DF316/3S	DF216/3S	29,0	44,7	20,7	29,9	30,6	20,1	21,0	25,6	27,5	27,2
DF316/M10S	–	29,0	44,7	20,7	29,9	30,6	20,1	21,0	25,6	27,5	27,2
DF316/M12S	–	40,1	61,8	28,6	41,3	42,4	27,8	29,1	35,4	38,1	37,6
DF316/4	DF216/4	34,0	52,5	24,3	35,1	36,0	23,6	24,7	30,1	32,4	31,9
DF316/4S	DF216/4S	40,1	61,8	28,6	41,3	42,4	27,8	29,1	35,4	38,1	37,6
DF316/5	DF216/5	45,4	70,1	32,4	46,8	48,0	31,5	32,9	40,1	43,2	42,6
DF316/5S	DF216/5S	47,7	73,5	34,0	49,1	50,4	33,0	34,6	42,1	45,3	44,7
DF316/7S	–	61,3	94,5	43,7	63,1	64,8	42,4	44,4	54,1	58,3	57,5
DF330/3	DF230/3	27,6	42,6	19,7	28,4	29,2	19,1	20,0	24,4	26,3	25,9
DF330/3S	DF230/3S	30,0	46,2	21,4	30,9	31,7	20,7	21,7	26,5	28,5	28,1
DF330/4	DF230/4	38,7	59,7	27,6	39,9	40,9	26,8	28,1	34,2	36,8	36,3
DF330/4S	DF230/4S	50,1	77,3	35,8	51,7	53,0	34,7	36,4	44,3	47,7	47,0
DF330/5	DF230/5	50,3	77,5	35,8	51,8	53,1	34,8	36,4	44,4	47,8	47,1
DF330/5S	DF230/5S	58,8	90,7	41,9	60,6	62,1	40,7	42,6	51,9	55,9	55,1
DF330/6	–	54,7	84,4	39,0	56,4	57,8	37,9	39,7	48,3	52,0	51,3
DF330/6S	–	62,6	96,6	44,7	64,6	66,2	43,4	45,4	55,3	59,6	58,7
DF330/7S	–	67,6	104,2	48,2	69,7	71,4	46,8	49,0	59,7	64,3	63,4
DF330/9S	–	67,6	104,2	48,2	69,7	71,4	46,8	49,0	59,7	64,3	63,4
DF341/4	–	54,7	84,4	39,0	56,4	57,8	37,9	39,7	48,4	52,1	51,3
DF341/4S	–	57,1	88,0	40,7	58,8	60,3	39,5	41,4	50,4	54,3	53,5
DF341/5	DF241/5	63,3	97,6	45,1	65,2	66,9	43,8	45,9	55,9	60,2	59,3
DF341/5S	DF241/5S	73,6	113,5	52,5	75,8	77,8	51,0	53,4	65,0	70,0	69,0
DF341/6	DF241/6	99,9	154,0	71,2	102,9	105,5	69,2	72,4	88,2	95,0	93,7
DF341/6S	DF241/6S	99,9	154,0	71,2	102,9	105,5	69,2	72,4	88,2	95,0	93,7
DF341/7S	DF241/7S	106,6	164,4	76,0	109,9	112,6	73,8	77,3	94,2	101,4	100,0

continue →

(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	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
DF303/2	DF203/2	6,9	6,2	10,5	10,7	7,2	10,3	11,7	10,3	10,7
DF303/2F	–	6,9	6,2	10,5	10,7	7,2	10,3	11,7	10,3	10,7
DF303/2S	DF203/2S	8,9	8,0	13,6	13,8	9,3	13,4	15,2	13,4	13,9
DF303/3	DF203/3	16,1	14,5	24,7	25,0	16,9	24,3	27,5	24,2	25,2
DF303/3S	–	16,4	14,9	25,2	25,6	17,3	24,8	28,1	24,7	25,7
DF305/2	DF205/2	7,2	6,5	11,1	11,2	7,6	10,9	12,3	10,8	11,3
DF305/2F	–	7,2	6,5	11,1	11,2	7,6	10,9	12,3	10,8	11,3
DF305/2S	DF205/2S	12,1	10,9	18,5	18,8	12,7	18,2	20,7	18,2	18,9
DF305/3	DF205/3	18,2	16,4	27,9	28,3	19,1	27,4	31,1	27,4	28,5
DF305/3S	DF205/3S	18,8	17,0	28,9	29,3	19,8	28,4	32,2	28,4	29,5
DF305/M10S	–	18,8	17,0	28,9	29,3	19,8	28,4	32,2	28,4	29,5
DF308/2	DF208/2	7,6	6,9	11,7	11,9	8,0	11,5	13,0	11,5	11,9
DF308/2F	–	7,6	6,9	11,7	11,9	8,0	11,5	13,0	11,5	11,9
DF308/2S	DF208/2S	11,6	10,5	17,8	18,1	12,2	17,5	19,8	17,5	18,2
DF308/3	DF208/3	20,2	18,2	30,9	31,4	21,2	30,5	34,5	30,4	31,6
DF308/3F	–	20,2	18,2	30,9	31,4	21,2	30,5	34,5	30,4	31,6
DF308/3S	DF208/3S	20,6	18,7	31,7	32,2	21,7	31,2	35,3	31,1	32,4
DF308/M10S	–	20,6	18,7	31,7	32,2	21,7	31,2	35,3	31,1	32,4
DF308/M12S	–	25,9	23,4	39,7	40,3	27,3	39,1	44,2	39,0	40,6
DF308/4	DF208/4	24,5	22,1	37,5	38,1	25,8	36,9	41,8	36,8	38,3
DF308/4S	DF208/4S	25,9	23,4	39,7	40,3	27,3	39,1	44,2	39,0	40,6
DF316/2	DF216/2	8,9	8,0	13,6	13,9	9,4	13,4	15,2	13,4	13,9
DF316/3	DF216/3	21,0	19,0	32,3	32,8	22,2	31,8	36,0	31,7	33,0
DF316/3F	–	21,0	19,0	32,3	32,8	22,2	31,8	36,0	31,7	33,0
DF316/3S	DF216/3S	23,1	20,9	35,5	36,0	24,4	34,9	39,5	34,8	36,2
DF316/M10S	–	23,1	20,9	35,5	36,0	24,4	34,9	39,5	34,8	36,2
DF316/M12S	–	32,0	29,0	49,1	49,9	33,7	48,3	54,7	48,2	50,2
DF316/4	DF216/4	27,2	24,6	41,7	42,3	28,6	41,0	46,4	40,9	42,6
DF316/4S	DF216/4S	32,0	29,0	49,1	49,9	33,7	48,3	54,7	48,2	50,2
DF316/5	DF216/5	36,3	32,8	55,6	56,5	38,2	54,7	62,0	54,6	56,8
DF316/5S	DF216/5S	38,0	34,4	58,4	59,3	40,1	57,4	65,0	57,3	59,6
DF316/7S	–	48,9	44,2	75,0	76,2	51,5	73,8	83,6	73,6	76,6
DF330/3	DF230/3	22,0	19,9	33,8	34,3	23,2	33,3	37,7	33,2	34,5
DF330/3S	DF230/3S	23,9	21,6	36,7	37,2	25,2	36,1	40,9	36,0	37,5
DF330/4	DF230/4	30,9	28,0	47,5	48,2	32,6	46,7	52,9	46,6	48,5
DF330/4S	DF230/4S	40,0	36,2	61,4	62,3	42,2	60,4	68,4	60,3	62,7
DF330/5	DF230/5	40,1	36,3	61,6	62,5	42,3	60,6	68,6	60,4	62,9
DF330/5S	DF230/5S	46,9	42,5	72,0	73,1	49,4	70,9	80,2	70,7	73,6
DF330/6	–	43,7	39,5	67,0	68,0	46,0	65,9	74,6	65,8	68,4
DF330/6S	–	50,0	45,2	76,7	77,9	52,7	75,5	85,5	75,3	78,4
DF330/7S	–	54,0	48,8	82,8	84,0	56,8	81,4	92,2	81,2	84,5
DF330/9S	–	54,0	48,8	82,8	84,0	56,8	81,4	92,2	81,2	84,5
DF341/4	–	43,7	39,5	67,0	68,1	46,0	66,0	74,7	65,8	68,5
DF341/4S	–	45,6	41,2	69,9	71,0	48,0	68,8	77,9	68,6	71,4
DF341/5	DF241/5	50,5	45,7	77,5	78,7	53,2	76,2	86,3	76,0	79,1
DF341/5S	DF241/5S	58,7	53,1	90,1	91,5	61,9	88,7	100,4	88,4	92,0
DF341/6	DF241/6	79,7	72,1	122,3	124,1	84,0	120,3	136,2	120,0	124,9
DF341/6S	DF241/6S	79,7	72,1	122,3	124,1	84,0	120,3	136,2	120,0	124,9
DF341/7S	DF241/7S	85,1	77,0	130,5	132,5	89,6	128,5	145,4	128,1	133,3

(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 16: Water capacity and dehydratable charge of filters with core 100% molecular sieves

Catalogue Number	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]			
	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
DF303/2	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
DF303/2F																
DF303/2S																
DF303/3																
DF303/3S																
DF305/2	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
DF305/2F																
DF305/2S																
DF305/3																
DF305/3S																
DF305/M10S																
DF308/2	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
DF308/2F																
DF308/2S																
DF308/3																
DF308/3F																
DF308/3S																
DF308/M10S																
DF308/M12S																
DF308/4																
DF308/4S																
DF316/2	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
DF316/3																
DF316/3F																
DF316/3S																
DF316/M10S																
DF316/M12S																
DF316/4																
DF316/v																
DF316/5																
DF316/5S																
DF316/7S																
DF316/9S																
DF330/3	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
DF330/3S																
DF330/4																
DF330/4S																
DF330/5																
DF330/5S																
DF330/6																
DF330/6S																
DF330/7S																
DF330/9S																
DF341/4	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
DF341/4S																
DF341/5																
DF341/5S																
DF341/6																
DF341/6S																
DF341/7S																

(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

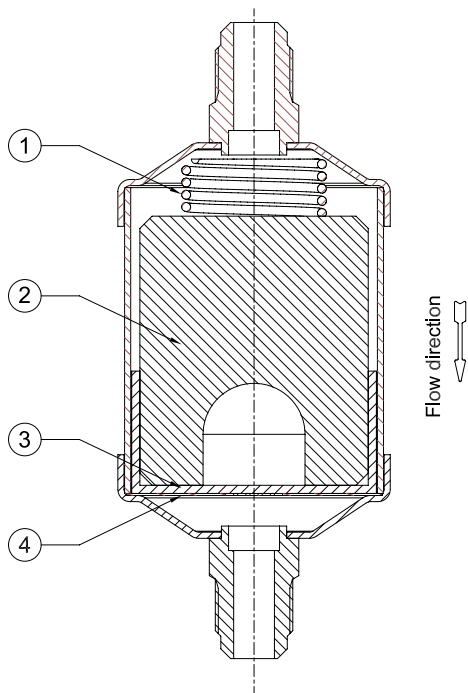
TABLE 17: Water capacity and dehydratable charge of filters with core 80% molecular sieves + 20% activated alumina

Catalogue Number	Water Capacity at + 24 °C (1) [g H2O]				Dehydratable Charge at + 24 °C [kg refrigerant]				Water Capacity at + 52 °C (1) [g H2O]				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																
DF208/2	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
DF208/2S																
DF208/3																
DF208/3S																
DF208/M10S																
DF208/M12S																
DF208/4																
DF208/4S																
DF216/2	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
DF216/3																
DF216/3S																
DF216/M10S																
DF216/M12S																
DF216/4																
DF216/4S																
DF216/5																
DF216/5S																
DF216/7S																
DF216/9S																
DF230/3	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
DF230/3S																
DF230/4																
DF230/4S																
DF230/5																
DF230/5S																
DF230/7S																
DF230/9S																
DF241/5	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
DF241/5S																
DF241/6																
DF241/6S																
DF241/7S																

(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

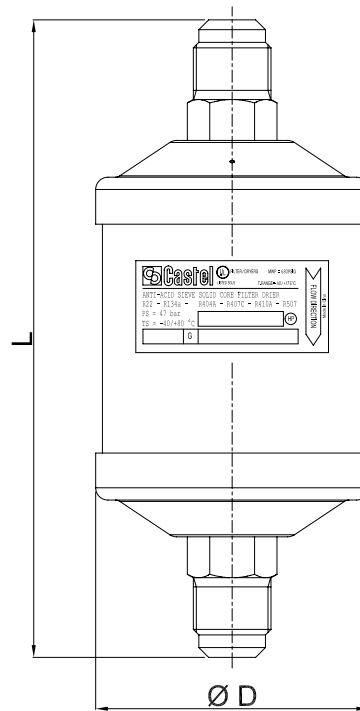
TABLE 18: Dimensions and weights of hermetic filters

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	420
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
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

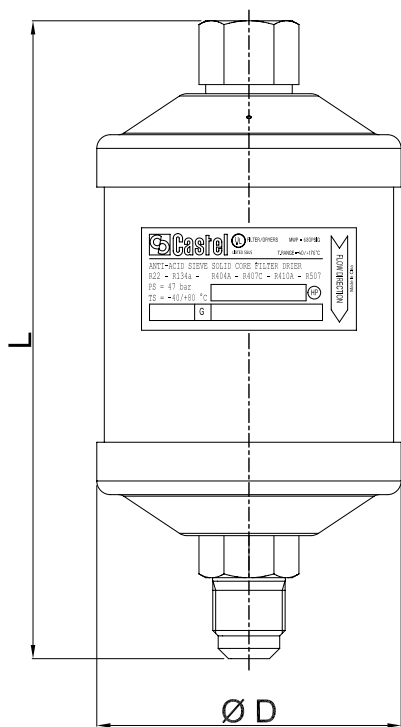


*Solid core dehydrator*

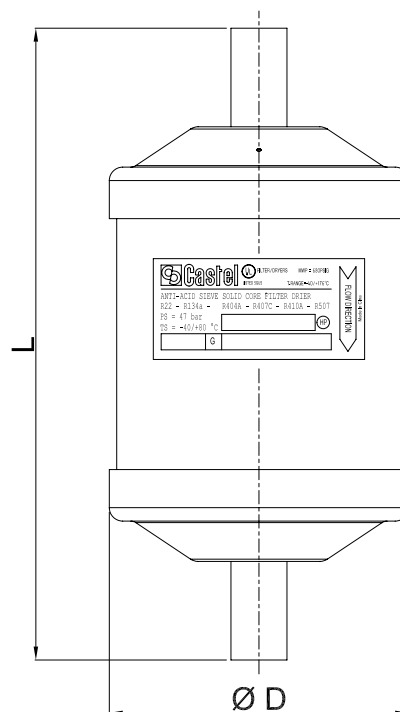
- 1 - Spring
- 2 - Block
- 3 - Felt
- 4 - Stainless steel mesh



Male connections



Male - female connection  
(female in)



Solder connection





# REFRIGERATING SYSTEM PROTECTORS

## 6.3 – HERMETIC FILTER DRIERS, ATEX – CERTIFIED

### APPLICATIONS

The “ATEX-Certified” filters 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.

**The filters with an “EX” suffix (4303EX, 4305EX, 4308EX, 4316EX, 4330EX and 4375EX) comply with the European Standard EN 80079-36:2016 and EN 80079-37:2016 and, therefore, comply with the ESR of Directive 2014/34/EU – ATEX. This equipment is suitable for use on refrigeration systems located in areas classified as “Zone 2” risk of explosion, according to the definition in Annex I of Directive 1999/92/EC.**

They can be installed on systems that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

For different operating conditions apply the following formula:

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

where:

Q = required refrigeration flow capacity [kW]

$Q_{ref}$  = reference refrigeration flow capacity [kW] (see Table 20)

$L_1$  = flow capacity correction factor in presence of operative temperatures different from reference conditions. (See Table 8)

### CONSTRUCTION

The filter body is made completely from steel with copper plated solder connections, offering the possibility to solder the copper pipe inside the connections (ODS).

The cartridges are made from moulding a dehydrating filler made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable deacidifying characteristics.

### FILTER SELECTION BASED ON REFRIGERANT FLOW CAPACITY

Refrigerant flow capacities shown in Table 20 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



**TABLE 19: General characteristics of hermetic filter driers - ATEX Certified**

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
				ODS		ODM			min.	max.	
				Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]				
4303EX/2S	032S	47	50	1/4"	-	3/8"	-	45	-40	+80	Art. 4.3
4305EX/3S	053S	70	80	3/8"	-	1/2"	-				
4305EX/M10S	-			-	10	-	12				
4308EX/3S	083S	103	130	3/8"	-	1/2"	-				
4308EX/M10S	-			-	10	-	12				
4308EX/M12S	-			-	12	-	14				
4308EX/4S	084S			1/2"	-	5/8"	16				
4316EX/3S	163S			3/8"	-	1/2"	-				
4316EX/M10S	-	155	250	-	10	-	12				
4316EX/M12S	-			-	12	-	14				
4316EX/4S	164S			1/2"	-	5/8"	16				
4316EX/5S	165S			5/8"	16	3/4"	-				
4330EX/4S	304S			1/2"	-	5/8"	16				
4330EX/5S	305S	310	500	5/8"	16	3/4"	-				
4330EX/7S	307S			7/8"	-	1.1/8"	-				
4330EX/9S	309S			1.1/8"	-	1.3/8"	35				
4375EX/7S	757S			7/8"	-	1.1/8"	-				
4375EX/9S	759S	600	1340	1.1/8"	-	1.3/8"	35				24

**TABLE 20: Refrigerant flow capacity of filter driers - ATEX Certified**

Catalogue Number	Pressure drop 0,07 bar (1) [kW]								Pressure drop 0,14 bar (1) [kW]							
	R32	R1234yf	R452B	R454B	R290	R600	R600a	R1270	R32	R1234yf	R452B	R454B	R290	R600	R600a	R1270
4303EX/2S	12,2	5,7	9,7	9,8	9,5	10,8	9,5	9,9	14,6	6,9	11,6	11,8	11,4	12,9	11,4	11,8
4305EX/3S	29,7	14,0	23,6	23,9	23,2	26,3	23,1	24,1	38,6	18,2	30,7	31,1	30,2	34,2	30,1	31,3
4305EX/M10S	29,7	14,0	23,6	23,9	23,2	26,3	23,1	24,1	38,6	18,2	30,7	31,1	30,2	34,2	30,1	31,3
4308EX/3S	34,9	16,4	27,7	28,2	27,3	30,9	27,2	28,3	45,4	21,4	36,1	36,6	35,5	40,2	35,4	36,8
4308EX/M10S	34,9	16,4	27,7	28,2	27,3	30,9	27,2	28,3	45,4	21,4	36,1	36,6	35,5	40,2	35,4	36,8
4308EX/M12S	44,3	20,8	35,1	35,7	34,6	39,2	34,5	35,9	57,5	27,1	45,7	46,4	45,0	50,9	44,8	46,7
4308EX/4S	44,3	20,8	35,1	35,7	34,6	39,2	34,5	35,9	57,5	27,1	45,7	46,4	45,0	50,9	44,8	46,7
4316EX/3S	37,6	17,7	29,9	30,3	29,4	33,3	29,3	30,5	50,8	23,9	40,3	40,9	39,7	44,9	39,6	41,2
4316EX/M10S	37,6	17,7	29,9	30,3	29,4	33,3	29,3	30,5	50,8	23,9	40,3	40,9	39,7	44,9	39,6	41,2
4316EX/M12S	52,2	24,5	41,4	42,1	40,8	46,2	40,7	42,3	70,4	33,1	55,9	56,8	55,0	62,3	54,9	57,1
4316EX/4S	52,2	24,5	41,4	42,1	40,8	46,2	40,7	42,3	70,4	33,1	55,9	56,8	55,0	62,3	54,9	57,1
4316EX/5S	68,9	32,4	54,7	55,5	53,8	60,9	53,7	55,9	93,0	43,7	73,8	74,9	72,6	82,2	72,5	75,4
4330EX/4S	57,1	26,9	45,4	46,1	44,6	50,5	44,5	46,3	77,1	36,3	61,2	62,2	60,3	68,2	60,1	62,6
4330EX/5S	71,3	33,5	56,6	57,5	55,7	63,1	55,5	57,8	96,2	45,2	76,4	77,6	75,2	85,1	75,0	78,0
4330EX/7S	75,2	35,4	59,7	60,6	58,8	66,6	58,6	61,0	101,6	47,8	80,7	81,9	79,4	89,8	79,1	82,4
4330EX/9S	75,2	35,4	59,7	60,6	58,8	66,6	58,6	61,0	101,6	47,8	80,7	81,9	79,4	89,8	79,1	82,4
4375EX/7S	141,8	66,7	112,6	114,3	110,8	125,5	110,5	115,0	212,7	100,0	169,0	171,5	166,2	188,2	165,8	172,6
4375EX/9S	147,5	69,4	117,1	118,9	115,3	130,5	114,9	119,6	221,2	104,0	175,7	178,4	172,9	195,7	172,4	179,4

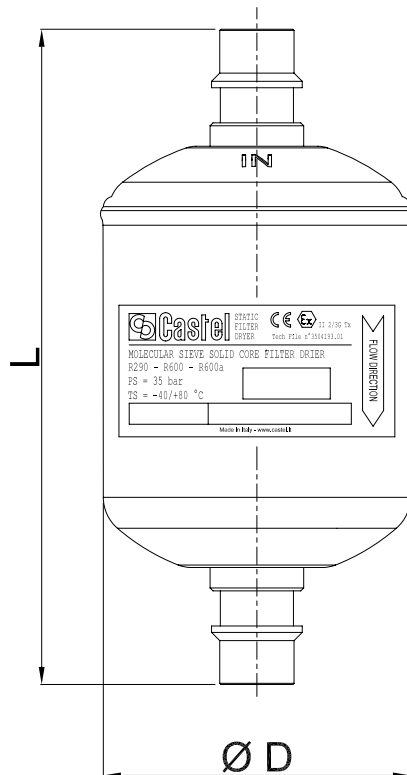
(1) : Maximum values of the refrigerant flow capacity at which the drier can be used when fluid dehydration is not the a major problem, provided that the original moisture is limited before the installation of the drier.

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 )

NOTE: for temperatures different from standard values use correction factors L1 listed on TABLE 8

TABLE 21: Dimensions and weights of filter driers - ATEX Certified

Catalogue Number	Connections			Dimensions [mm]		Weight [g]
	SAE Flare	ODS		Ø D	L	
		Ø [in.]	Ø [mm]			
4303EX/2S	-	1/4"	-	52	94	220
4305EX/3S	-	3/8"	-		112	260
4305EX/M10S	-	-	10		139	345
4308EX/3S	-	3/8"	-			
4308EX/M10S	-	-	10		146	380
4308EX/M12S	-	-	12			
4308EX/4S	-	1/2"	-		146	380
4316EX/3S	-	3/8"	-		73	151
4316EX/M10S	-	-	10	630		
4316EX/M12S	-	-	12	158		640
4316EX/4S	-	1/2"	-	158		640
4316EX/5S	-	5/8"	16	166		640
4330EX/4S	-	1/2"	-	237		1280
4330EX/5S	-	5/8"	16	245		1370
4330EX/7S	-	7/8"	-	250		1420
4330EX/9S	-	1.1/8"	-	250	1450	
4375EX/7S	-	7/8"	-	91	398	2900
4375EX/9S	-	1.1/8"	-		398	3050



- 4303EX
- 4305EX
- 4308EX
- 4316EX
- 4330EX
- 4375EX

# REFRIGERATING SYSTEM PROTECTORS

## 6.4 – HERMETIC FILTER DRIERS WITH MOISTURE INDICATOR

### APPLICATIONS

The hermetic filter driers with moisture indicator in series DI2XXN - DI3XXN 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**These filters cannot be installed on systems that use HCFC (R22) refrigerant.**

### CONSTRUCTION

The filters in series DI2XXN - DI3XXN are drying filters for the liquid line with a moisture/liquid indicator brazed directly onto the outlet of the filter. This unit reduces the amount of field brazing required and the potential risk for refrigerant fluid leaks. The indicators ensure fast safe inspection of the conditions of the refrigerant fluid in the circuit regarding regular flow and the presence of moisture. The filter is completely manufactured in steel, with threaded SAE FLARE or ODS soldered connections in copper. The indicator is manufactured with the glass "lens" directly fused onto a steel metallic ring, with proper surface protection.

The cartridges are made from moulding a dehydrating filler made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable deacidifying characteristics. The manufacturing process allows the product to be compact and strong, making it resistant to impact and abrasion.

### OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.

The moisture content values that correspond to the "green" colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, "Chartreuse green", the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes "yellow", it's time to replace the filter dryer.

If the charge and operating conditions of the plant are normal, the refrigerant fluid appears perfectly liquid underneath the "lens" of the indicator. The presence of bubbles indicates that the refrigerant fluid is partially evaporating along the liquid line.

### INSTALLATION

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

Brazing of the filter/indicator with solder connections should be carried out with care, using a low melting point filler material (min. 5% Ag). Avoid direct contact between the torch flame and the indicator body or glass, which could be damaged and compromise the proper functioning of the indicator.

### APPROVALS

Filters in series DI2XXN - DI3XXN have been approved by the American certification authority Underwriters Laboratories Inc. Filters in series DB3 are certified **UL-CSA** Listed for the USA and Canada with file SA7054, in compliance with American Standard UL 207 and Canadian Standard CSA C22.2 No. 140.3-15.



**Castel**

**UL** **95** FILTER/DRYERS  
LISTED SGUS  
MWP=680PSIG  
T.RANGE=-40/+176°F

**FLOW DIRECTION**

**SOLID CORE  
FILTER DRIER**

R134a - R404A - R407C -  
R410A - R507 - R290

**DI316N/4**     **164**

PS = 47 bar  
TS = -40/+80°C

V



Lot N. **4519**

Made in China



TABLE 22: General characteristics of filter driers with moisture indicator. 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
						min.	max.	
DI305N/2	052	104	80	1/4"	50 (1)	-40	+80	Art. 4.3
DI305N/3	053			3/8"				
DI308N/2	082	141	130	1/4"				
DI308N/3	083			3/8"				
DI308N/4	084			1/2"				
DI316N/2	162	183	250	1/4"				
DI316N/3	163			3/8"				
DI316N/4	164			1/2"				
DI316N/5	165			5/8"				
DI330N/3	303	345	500	3/8"				
DI330N/4	304			1/2"				
DI330N/5	305			5/8"				
DI330N/6	306			3/4"				
DI341N/5	415	384	670	5/8"				
DI341N/6	416			3/4"				

(1) : MWP = 680 psi according to UL approval

TABLE 23: General characteristics of filter driers with moisture indicator. ODS connections

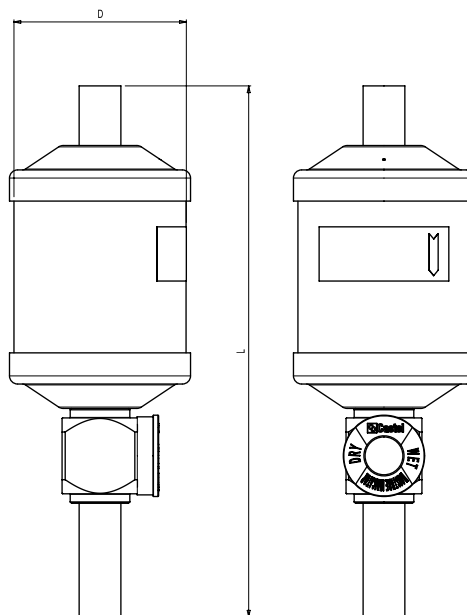
Catalogue Number	International Reference	Block Filtering Surface [cm <sup>2</sup> ]	Nominal Volume [cm <sup>3</sup> ]	Connections		PS [bar]	TS [°C]		Risk Category according to PED Recast
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
DI305N/2S	052S	104	80	1/4"	-	50 (1)	-40	+80	Art. 4.3
DI305N/3S	053S			3/8"	-				
DI305N/M10S	-			-	10				
DI308N/2S	082S	141	130	1/4"	-				
DI308N/3S	083S			3/8"	-				
DI308N/M10S	-			-	10				
DI308N/M12S	-			-	12				
DI308N/4S	084S	183	250	1/2"	-				
DI316N/3S	163S			3/8"	-				
DI316N/M10S	-			-	10				
DI316N/M12S	-			-	12				
DI316N/4S	164S			1/2"	-				
DI316N/5S	165S			5/8"	16				
DI316N/7S	167S	345	500	7/8"	-				
DI330N/3S	303S			3/8"	-				
DI330N/4S	304S			1/2"	-				
DI330N/5S	305S			5/8"	16				
DI330N/6S	306S			3/4"	-				
DI330N/7S	307S			7/8"	-				
DI341N/4S	414S			384	670	1/2"	-		
DI341N/5S	415S	5/8"	16						
DI341N/6S	416S	3/4"	-						
DI341N/7S	417S	7/8"	-						

(1) : MWP = 680 psi according to UL approval



TABLE 24: Dimensions and weights of filters with moisture indicator

Catalogue Number	Connections			Dimensions [mm]		Weight [g]
	SAE Flare	ODS		Ø D	L	
		Ø [in.]	Ø [mm]			
DI305N/2	1/4"	-	-	64	155	650
DI305N/2S	-	1/4"	-		166	650
DI305N/3	3/8"	-	-		165	680
DI305N/3S	-	3/8"	-		169	655
DI305N/M10S	-	-	10		171	
DI308N/2	1/4"	-	-	64	176	760
DI308N/2S	-	1/4"	-		187	750
DI308N/3	3/8"	-	-		186	790
DI308N/3S	-	3/8"	-		190	755
DI308N/M10S	-	-	10		192	750
DI308N/M12S	-	-	12		196	765
DI308N/4	1/2"	-	-		191	810
DI308N/4S	-	1/2"	-	194	770	
DI316N/2	1/4"	-	-	64	196	
DI316N/3	3/8"	-	-		206	880
DI316N/3S	-	3/8"	-		210	860
DI316N/M10S	-	-	10		212	
DI316N/M12S	-	-	12		216	
DI316N/4	1/2"	-	-		211	
DI316N/4S	-	1/2"	-		214	870
DI316N/5	5/8"	-	-		221	
DI316N/5S	-	5/8"	16		221	
DI316N/7S	-	7/8"	-		250	
DI330N/3	3/8"	-	-	76	278	
DI330N/3S	-	3/8"	-		282	
DI330N/4	1/2"	-	-		283	
DI330N/4S	-	1/2"	-		286	
DI330N/5	5/8"	-	-		293	
DI330N/5S	-	5/8"	16		293	
DI330N/6	3/4"	-	-		319	
DI330N/6S	-	3/4"	-		316	
DI330N/7S	-	7/8"	-	321		
DI341N/4	1/2"	-	-	89	287	
DI341N/4S	-	1/2"	-		290	
DI341N/5	5/8"	-	-		297	
DI341N/5S	-	5/8"	16		297	
DI341N/6	3/4"	-	-		323	
DI341N/6S	-	3/4"	-		320	
DI341N/7S	-	7/8"	-		325	



# REFRIGERATING SYSTEM PROTECTORS

## 6.5 – BI-FLOW HERMETIC FILTER DRIERS

### APPLICATIONS

The hermetic filters 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 to be installed on the liquid line of air conditioning systems with reverse-cycle, heat pumps, and refrigeration plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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 27-28 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:

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

where:

Q = required refrigeration flow capacity [kW]

$Q_{ref}$  = reference refrigeration flow capacity [kW] (see Tables 27-28)

$L_1$  = flow capacity correction factor in presence of operative temperatures different from reference conditions. (See Table 8)

### APPROVALS

Filters in series DB3 have been approved by the American certification authority Underwriters Laboratories Inc. Filters in series DB3 are certified **UL-CSA** Listed for the USA and Canada with file SA7054, in compliance with American Standard UL 207 and Canadian Standard CSA C22.2 No. 140.3-15.



TABLE 25: General characteristics of bi-flow 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
						min.	max.	
100% molecular sieves								
DB305/2	052	47	80	1/4"	50 (1)	-40	+80	Art. 4.3
DB308/3	083	78	130	3/8"				
DB308/4	084			1/2"				
DB316/3	163	134	250	3/8"				
DB316/4	164			1/2"				
DB316/5	165			5/8"				
DB330/5	305	274	500	5/8"				

(1) : MWP = 680 psi according to UL approval

TABLE 26: General characteristics of hermetic bi-flow 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
				ODS			min.	max.	
				Ø [in.]	Ø [mm]				
100% molecular sieves									
DB305/2S	052S	47	80	1/4"	-	50 (1)	-40	+80	Art. 4.3
DB308/3S	083S	78	130	3/8"	-				
DB308/4S	084S			1/2"	-				
DB316/3S	163S	134	250	3/8"	-				
DB316/4S	164S			1/2"	-				
DB316/5S	165S			5/8"	16				
DB316/7S	167S			7/8"	-				
DB330/5S	305S	274	500	5/8"	16				
DB330/7S	307S			7/8"	-				
DB330/9S	309S			1.1/8"	-				

(1) : MWP = 680 psi according to UL approval

TABLE 27: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number	Refrigerants									
	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
DB305/2	5,3	8,2	3,8	5,5	5,6	3,7	3,9	4,7	5,1	5,0
DB305/2S	8,3	12,9	6,0	8,6	8,8	5,8	6,1	7,4	7,9	7,8
DB308/3	11,3	17,4	8,0	11,6	11,9	7,8	8,2	10,0	10,7	10,6
DB308/3S	12,6	19,4	9,0	12,9	13,3	8,7	9,1	11,1	11,9	11,8
DB308/4	15,2	23,5	10,9	15,7	16,1	10,5	11,0	13,4	14,5	14,3
DB308/4S	17,0	26,2	12,1	17,5	17,9	11,7	12,3	15,0	16,1	15,9
DB316/3	15,7	24,2	11,2	16,2	16,6	10,9	11,4	13,9	14,9	14,7
DB316/3S	17,6	27,1	12,6	18,1	18,6	12,2	12,8	15,6	16,7	16,5
DB316/4	26,0	40,0	18,5	26,7	27,4	18,0	18,8	22,9	24,7	24,3
DB316/4S	27,9	43,0	19,9	28,7	29,5	19,3	20,2	24,6	26,5	26,1
DB316/5	31,9	49,2	22,8	32,9	33,7	22,1	23,1	28,2	30,3	29,9
DB316/5S	34,3	52,9	24,5	35,3	36,2	23,7	24,9	30,3	32,6	32,2
DB316/7S	37,7	58,1	26,9	38,8	39,8	26,1	27,3	33,3	35,8	35,3
DB330/5	34,0	52,5	24,3	35,1	35,9	23,6	24,7	30,1	32,4	31,9
DB330/5S	36,7	56,6	26,2	37,8	38,8	25,4	26,6	32,4	34,9	34,4
DB330/7S	40,3	62,2	28,8	41,6	42,6	27,9	29,3	35,6	38,4	37,8
DB330/9S	43,1	66,5	30,7	44,4	45,5	29,8	31,3	38,1	41,0	40,4

continue →

(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 27: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number	Refrigerants								
	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
DB305/2	4,2	3,8	6,5	6,6	4,5	6,4	7,3	6,4	6,7
DB305/2S	6,7	6,0	10,2	10,4	7,0	10,1	11,4	10,0	10,4
DB308/3	9,0	8,1	13,8	14,0	9,5	13,6	15,4	13,6	14,1
DB308/3S	10,0	9,1	15,4	15,6	10,6	15,1	17,1	15,1	15,7
DB308/4	12,2	11,0	18,6	18,9	12,8	18,3	20,8	18,3	19,0
DB308/4S	13,5	12,2	20,8	21,1	14,3	20,4	23,1	20,4	21,2
DB316/3	12,5	11,3	19,2	19,5	13,2	18,9	21,4	18,9	19,6
DB316/3S	14,1	12,7	21,6	21,9	14,8	21,2	24,0	21,2	22,0
DB316/4	20,7	18,7	31,8	32,3	21,8	31,3	35,4	31,2	32,5
DB316/4S	22,3	20,1	34,1	34,7	23,4	33,6	38,0	33,5	34,9
DB316/5	25,5	23,0	39,1	39,7	26,8	38,5	43,5	38,3	39,9
DB316/5S	27,4	24,8	42,0	42,6	28,8	41,3	46,8	41,2	42,9
DB316/7S	30,1	27,2	46,2	46,9	31,7	45,4	51,4	45,3	47,1
DB330/5	27,2	24,6	41,7	42,3	28,6	41,0	46,4	40,9	42,6
DB330/5S	29,3	26,5	44,9	45,6	30,8	44,2	50,0	44,1	45,9
DB330/7S	32,2	29,1	49,4	50,2	33,9	48,6	55,0	48,5	50,5
DB330/9S	34,4	31,1	52,8	53,6	36,2	51,9	58,8	51,8	53,9

(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 28: Refrigerant flow capacity with pressure drop 0,14 bar (1) [kW]

Catalogue Number	Refrigerants									
	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
DB305/2	6,6	10,3	4,7	6,9	7,0	4,6	4,8	5,9	6,3	6,2
DB305/2S	10,4	16,1	7,4	10,7	11,0	7,2	7,6	9,2	9,9	9,8
DB308/3	14,1	21,7	10,1	14,5	14,9	9,8	10,2	12,5	13,4	13,2
DB308/3S	15,7	24,2	11,2	16,2	16,6	10,9	11,4	13,9	14,9	14,7
DB308/4	19,0	29,3	13,6	19,6	20,1	13,2	13,8	16,8	18,1	17,8
DB308/4S	21,2	32,7	15,1	21,9	22,4	14,7	15,4	18,7	20,2	19,9
DB316/3	19,6	30,3	14,0	20,2	20,7	13,6	14,2	17,3	18,7	18,4
DB316/3S	22,0	33,9	15,7	22,7	23,3	15,2	16,0	19,4	20,9	20,6
DB316/4	32,4	50,0	23,1	33,4	34,3	22,5	23,5	28,7	30,8	30,4
DB316/4S	34,8	53,7	24,9	35,9	36,8	24,1	25,3	30,8	33,1	32,7
DB316/5	39,9	61,5	28,4	41,1	42,2	27,6	28,9	35,2	37,9	37,4
DB316/5S	42,9	66,1	30,6	44,2	45,3	29,7	31,1	37,9	40,8	40,2
DB316/7S	47,1	72,6	33,6	48,5	49,8	32,6	34,2	41,6	44,8	44,2
DB330/5	42,5	65,6	30,3	43,8	44,9	29,4	30,8	37,6	40,4	39,9
DB330/5S	45,9	70,7	32,7	47,3	48,5	31,8	33,3	40,5	43,6	43,0
DB330/7S	50,4	77,8	36,0	52,0	53,3	34,9	36,6	44,6	48,0	47,3
DB330/9S	53,9	83,1	38,4	55,5	56,9	37,3	39,1	47,6	51,2	50,5

continue →

(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 28: Refrigerant flow capacity with pressure drop 0,14 bar (1) [kW]

Catalogue Number	Refrigerants								
	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
DB305/2	5,3	4,8	8,1	8,3	5,6	8,0	9,1	8,0	8,3
DB305/2S	8,3	7,5	12,8	13,0	8,8	12,6	14,2	12,5	13,0
DB308/3	11,3	10,2	17,3	17,5	11,9	17,0	19,2	16,9	17,6
DB308/3S	12,5	11,3	19,2	19,5	13,2	18,9	21,4	18,9	19,6
DB308/4	15,2	13,7	23,3	23,7	16,0	22,9	26,0	22,9	23,8
DB308/4S	16,9	15,3	26,0	26,4	17,8	25,6	28,9	25,5	26,5
DB316/3	15,7	14,2	24,0	24,4	16,5	23,6	26,8	23,6	24,5
DB316/3S	17,6	15,9	27,0	27,4	18,5	26,5	30,0	26,4	27,5
DB316/4	25,9	23,4	39,7	40,3	27,3	39,1	44,3	39,0	40,6
DB316/4S	27,8	25,2	42,7	43,3	29,3	42,0	47,5	41,9	43,6
DB316/5	31,8	28,8	48,9	49,6	33,5	48,1	54,4	47,9	49,9
DB316/5S	34,2	30,9	52,5	53,3	36,0	51,7	58,5	51,5	53,6
DB316/7S	37,6	34,0	57,7	58,6	39,6	56,8	64,3	56,6	58,9
DB330/5	33,9	30,7	52,1	52,9	35,8	51,2	58,0	51,1	53,2
DB330/5S	36,6	33,1	56,2	57,0	38,6	55,3	62,6	55,1	57,4
DB330/7S	40,3	36,4	61,8	62,7	42,4	60,8	68,8	60,6	63,1
DB330/9S	43,0	38,9	66,0	67,0	45,3	64,9	73,5	64,7	67,4

(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 29: Water capacity and dehydratable charge of hermetic bi-flow filter driers

Catalogue Number	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]			
	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
DB305/2S																
DB308/3																
DB308/3S	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
DB308/4																
DB308/4S																
DB316/3																
DB316/3S																
DB316/4																
DB316/4S	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
DB316/5																
DB316/5S																
DB316/7S																
DB330/5																
DB330/5S	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
DB330/7S																
DB330/9S																

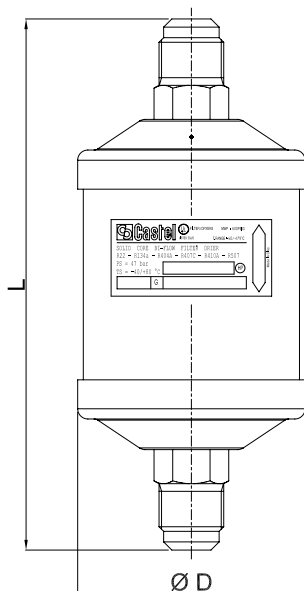
(1) : Water capacity values are referred to the following conditions, fixed in ARI STANDARD 710-2009 and DIN 8949:2000:

- 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

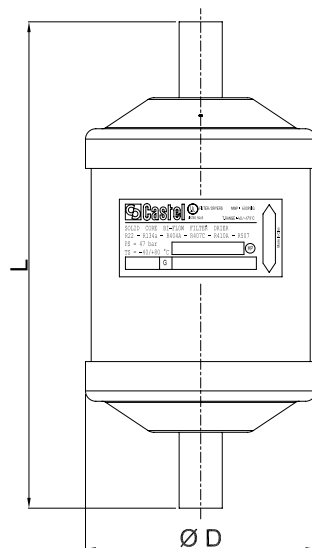


TABLE 30: Dimensions and weights of bi-flow filters

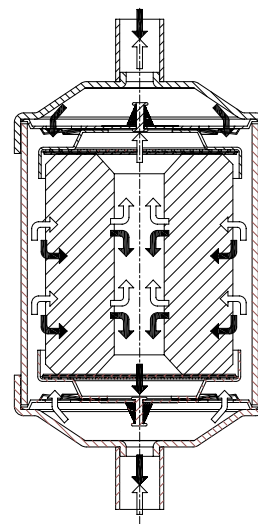
Catalogue Number	Connections			Dimensions [mm]		Weight [g]
	SAE Flare	ODS		Ø D	L	
		Ø [in.]	Ø [mm]			
DB305/2	1/4"	-	-	64	121	480
DB305/2S	-	1/4"	-		113	460
DB308/3	3/8"	-	-	64	152	600
DB308/3S	-	3/8"	-		138	560
DB308/4	1/2"	-	-		157	630
DB308/4S	-	1/2"	-		138	570
DB316/3	3/8"	-	-	64	171	1000
DB316/3S	-	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
DB330/5S	-	5/8"	16	237		1500
DB330/7S	-	7/8"	-	251		1550
DB330/9S	-	1.1/8"	-	259		1590



Male connections



Solder connections



# REFRIGERATING SYSTEM PROTECTORS

## 6.6 – REPLACEABLE SOLID CORE FILTER DRIERS

### APPLICATIONS

The replaceable filter driers in series 4411/XXAF and 4412/XXAF 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

### OPERATION

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

### CONSTRUCTION

**Filter shells:** these are built with an aluminium cover, zinc plated screws, and the steel body is equipped with brazing connections machined from a steel bar EN 10025 S355JR.

They are sold in the following two configurations:

- Codes with an “A” suffix, equipped with 1/4” NPT threaded cover for mounting an access fitting with valve core (for example G9150/R05)
- Codes with a “B” suffix, equipped with blind cover

**Cartridges 4490, type A and type B:** are made from moulding a

dehydrating filler, made completely from 3 Å molecular sieves, with a suitable binder. The choice of using only 3 Å molecular sieves as the dehydrating material grants the cartridge extraordinary moisture adsorption capacity while maintaining reasonable deacidifying characteristics.

**Cartridges 4490, type AA and type AB:** are made from moulding a dehydrating filler, made from 80% 3 Å molecular sieves and 20% activated alumina, with a suitable binder. The use of a blend of molecular sieves – activated alumina, grant the cartridges a 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.

The cartridges have volume of 48 cubic inches (equivalent to about 800 cm<sup>3</sup>), 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. 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.

7 Open the valve on the liquid outlet line.

8 Slowly open the compressor's suction valve and start the compressor and its auxiliaries.

9 Top the charge up, if necessary.

## APPROVALS

Filters in series 4411/XXF and 4412/XXF have been approved by the American certification authority Underwriters Laboratories Inc. with file SA7054, in compliance with American standard UL 207.

TABLE 31: General characteristics of filter driers with replaceable solid core

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
				[cu.in.]	[cm <sup>3</sup> ]	ODS		W		min.	max.	
Theaded cover						Ø [in.]	Ø [mm]	Ø [mm]				
4411/5AF	4490/A 4490/B 4490/AA 4490/AB	1	420	48	800	5/8"	16	21,3	50 (1)	-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				
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					

(1) : MWP = 470 psi according to UL approval

TABLE 32: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number	Refrigerants								
	R134a	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4411/5AF	83	59	85	87	57	60	73	78	77
4411/7AF	145	103	149	153	100	105	128	138	136
4411/9AF	198	141	204	209	137	144	175	188	186
4411/11AF	231	165	238	244	160	168	204	220	217
4411/13AF	248	177	255	262	171	180	219	235	232
4411/M42AF	248	177	255	262	171	180	219	235	232
4411/17AF	248	177	255	262	171	180	219	235	232
4412/7AF	145	103	149	153	100	105	128	138	136
4412/9AF	224	160	231	236	155	162	198	213	210
4412/11AF	304	216	313	321	210	220	268	289	285
4412/13AF	331	236	341	350	229	240	292	315	310
4412/M42AF	331	236	341	350	229	240	292	315	310
4412/17AF	331	236	341	350	229	240	292	315	310

continue →

(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 32: Refrigerant flow capacity with pressure drop 0,07 bar (1) [kW]

Catalogue Number	Refrigerants								
	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4411/5AF	66	60	101	103	69	99	113	99	103
4411/7AF	116	105	177	180	122	175	198	174	181
4411/9AF	158	143	243	246	167	239	270	238	248
4411/11AF	184	167	283	287	194	278	315	278	289
4411/13AF	198	179	303	308	208	298	338	298	310
4411/M42AF	198	179	303	308	208	298	338	298	310
4411/17AF	198	179	303	308	208	298	338	298	310
4412/7AF	116	105	177	180	122	175	198	174	181
4412/9AF	179	162	274	278	188	270	305	269	280
4412/11AF	242	219	372	377	255	366	414	365	380
4412/13AF	264	239	405	412	278	399	452	398	414
4412/M42AF	264	239	405	412	278	399	452	398	414
4412/17AF	264	239	405	412	278	399	452	398	414

(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 33: Refrigerant flow capacity with pressure drop 0,14 bar (1) [kW]

Catalogue Number	Refrigerants								
	R134a	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4411/5AF	99	71	102	105	69	72	87	94	93
4411/7AF	188	134	194	199	130	137	166	179	177
4411/9AF	257	184	265	272	178	187	227	245	241
4411/11AF	300	214	310	317	208	218	265	286	282
4411/13AF	322	230	332	340	223	233	284	306	302
4411/M42AF	322	230	332	340	223	233	284	306	302
4411/17AF	322	230	332	340	223	233	284	306	302
4412/7AF	188	134	194	199	130	137	166	179	177
4412/9AF	291	207	300	307	201	211	257	277	273
4412/11AF	395	281	407	417	273	286	349	375	370
4412/13AF	447	319	461	472	309	324	395	425	419
4412/M42AF	447	319	461	472	309	324	395	425	419
4412/17AF	447	319	461	472	309	324	395	425	419

continue →

(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 33: Refrigerant flow capacity with pressure drop 0,14 bar (1) [kW]

Catalogue Number	Refrigerants								
	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4411/5AF	79	71	121	123	83	119	135	119	124
4411/7AF	150	136	231	234	158	227	257	226	236
4411/9AF	206	186	315	320	216	310	351	309	322
4411/11AF	240	217	368	373	253	362	410	361	376
4411/13AF	257	232	394	400	271	388	439	387	403
4411/M42AF	257	232	394	400	271	388	439	387	403
4411/17AF	257	232	394	400	271	388	439	387	403
4412/7AF	150	136	231	234	158	227	257	226	236
4412/9AF	232	210	356	362	245	351	397	350	364
4412/11AF	315	285	483	491	332	475	538	474	494
4412/13AF	357	323	547	556	376	539	610	537	559
4412/M42AF	357	323	547	556	376	539	610	537	559
4412/17AF	357	323	547	556	376	539	610	537	559

(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 )



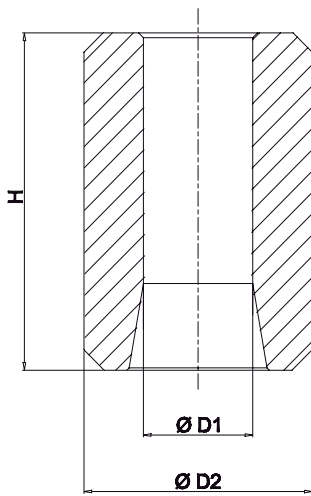
TABLE 34: General characteristics, dimensions and weights of solid cores

Catalogue Number	Batch characteristic	Filtering Surface [cm <sup>2</sup> ]	Nominal Volume		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	47	96	140	730
4490/B (2)								
4490/AA (1)	Moisture and acid adsorption (80% molecular sieve + 20% activated alumina)	420	48	800	47	96	140	730
4490/AB (2)								
4491/A (3)	High moisture adsorption (100% molecular sieve)	630	100	1600	53	122	165	1560
4491/AA (3)								

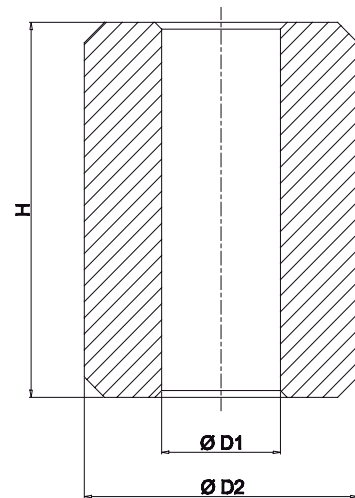
(1): Supplied with cover gaskets as spare part, either for Castel filters or for competitors ones

(2): Supplied without cover gasket as part part

(3): Supplied with cover gasket as spare part



4490



4491

**TABLE 35: Water capacity and dehydratable charge of one solid core**

Catalogue Number	Nominal Volume		Water Capacity at + 24 °C (1) [g H2O]				Dehydratable Charge at + 24 °C [kg refrigerant]			
	[cu. in]	[cm3]	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
4490/A 4490/B	48	800	82	84	67	73	88	90	72	79
4490/AA 4490/AB			70	71	57	62	75	77	61	67
4491/A	100	1600	216	220	177	192	232	237	190	207
4491/AA			183	187	150	163	197	201	161	176

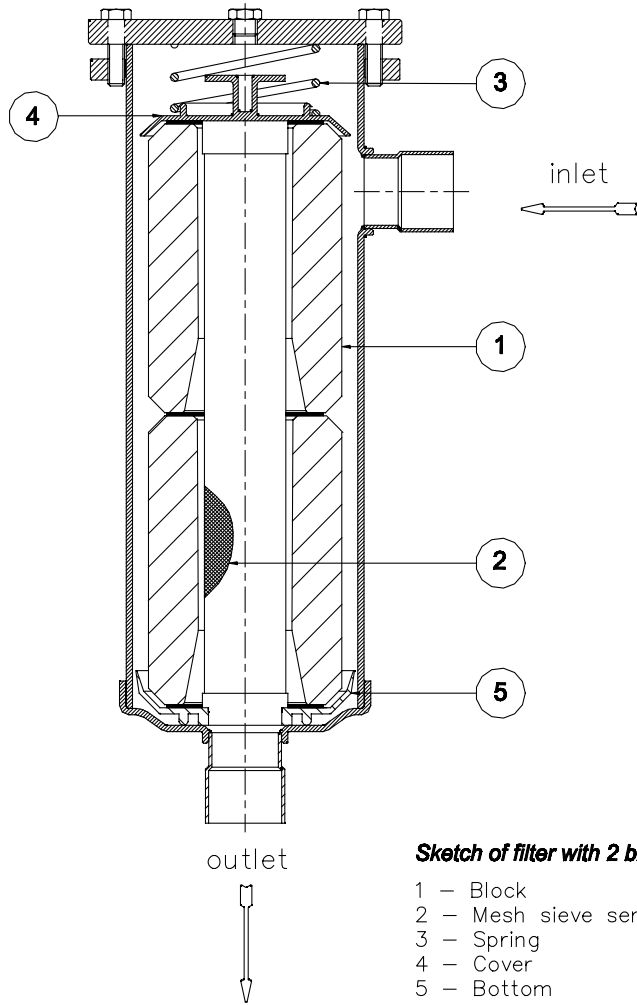
Catalogue Number	Nominal Volume		Water Capacity at + 52 °C (1) [g H2O]				Dehydratable Charge at + 52 °C [kg refrigerant]			
	[cu. in]	[cm3]	R134a	R404A R507	R407C	R410A	R134a	R404A R507	R407C	R410A
4490/A 4490/B	48	800	71	78	54	59	76	84	58	63
4490/AA 4490/AB			60	66	46	50	65	71	50	54
4491/A	100	1600	186	205	142	155	200	220	153	166
4491/AA			158	174	121	131	170	187	130	141

(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

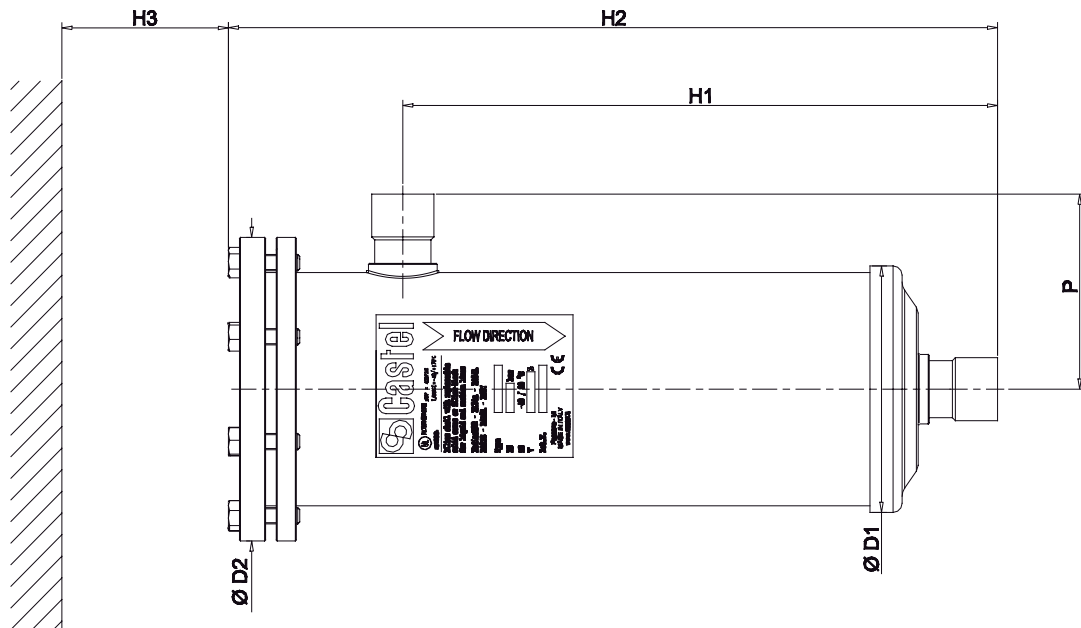
**TABLE 36: Dimensions and weights of filters with steel connections**

Catalogue Number	Connections			Dimensions [mm]						Weight [g]
	ODS		W	Ø D1	Ø D2	H1	H2	H3	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	3920
4411/11AF	1.3/8"	35	42,4			167	254		112	4050
4411/13AF	1.5/8"	-	48,3			158	245		103	4190
4411/M42AF	-	42	48,3			185	245		103	4150
4411/17AF	2.1/8"	54	60,3			158	245	103	4150	
4412/7AF	7/8"	22	26,9			292	379	324	95	5280
4412/9AF	1.1/8"	-	33,7			297	384		100	5320
4412/11AF	1.3/8"	35	42,4			309	396		112	5380
4412/13AF	1.5/8"	-	48,3			300	387		103	5400
4412/M42AF	-	42	48,3			300	387		103	5400
4412/17AF	2.1/8"	54	60,3	300	387	103	5400			



**Sketch of filter with 2 blocks**

- 1 – Block
- 2 – Mesh sieve serving as block support
- 3 – Spring
- 4 – Cover
- 5 – Bottom



# REFRIGERATING SYSTEM PROTECTORS

## 6.7 – REPLACEABLE MECHANICAL CARTRIDGE FILTERS

### APPLICATIONS

The replaceable mechanical filters in series 4411/XXCF 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**Filter shells:** these are built with an aluminium cover, stainless steel screws, and the steel body is equipped with brazing connections machined from a steel bar EN 10025 S355JR.

They are sold only in the configuration of codes with a “C” suffix, equipped with 1/4” NPT threaded cover for mounting access fitting with valve core kit G9150/R05 included in the supply.

**Cartridge 4495:** characterized by a large filter surface, these consist of metal mesh fabric with a controlled porosity filter sieve insert, which can retain solid particles to 20 microns. At both ends, soft felt gaskets ensure perfect seal with the plastic cups.

### APPROVALS

Filters in series 4411/XXCF have been approved by the American certification authority Underwriters Laboratories Inc. with file SA7054, in compliance with American standard UL 207.

TABLE 37: General characteristics of mechanical block filters

Catalogue Number	Number of Cores	Filtering block		Connections			PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		Cat. Number	Filtering Surface [cm <sup>2</sup> ]	ODS		W		min.	max.	min.	max.	
				Ø [in.]	Ø [mm]	Ø [mm]						
4411/57CF	1	4495/C	820	5/8"	16	21,3	50 (1)	-40	+80	-20	+50	II
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						

(1) : MWP = 470 psi according to UL approval



TABLE 38: Refrigerant flow capacity of filtering block 4495/C [kW]

Refrigerants	Evaporating Temperature [°C]	Pressure drop [bar]	Catalogue Number						
			4411/50F	4411/70F	4411/90F	4411/110F	4411/130F	4411/M420F	4411/170F
R134a	4,4	0,14	9,9	22,8	40,6	54,2	61,6	61,6	83,3
	-6,7	0,10	6,6	15,2	26,7	35,7	41,1	41,1	54,8
	-18	0,07	4,3	9,8	16,9	22,6	26,5	26,5	34,7
	-29	0,03	2,2	4,8	8,1	10,9	13,0	13,0	16,7
R32	4,4	0,21	24,1	56,1	101,2	135,2	151,2	151,2	207,6
	-6,7	0,14	16,4	38,0	67,7	90,4	102,6	102,6	138,8
	-18	0,10	11,4	26,2	45,9	61,3	70,6	70,6	94,1
	-29	0,07	7,7	17,6	30,4	40,6	47,4	47,4	62,3
	-40	0,03	4,0	9,0	15,2	20,2	24,3	24,3	31,1
R404A	4,4	0,21	13,8	32,3	58,9	78,7	87,2	87,2	120,8
	-6,7	0,14	9,1	21,1	37,8	50,4	56,8	56,8	77,4
	-18	0,10	6,1	14,1	25,0	33,4	38,1	38,1	51,3
	-29	0,07	3,9	9,0	15,7	20,9	24,3	24,3	32,2
	-40	0,03	1,9	4,4	7,4	9,9	11,8	11,8	15,2
R407C	4,4	0,21	14,7	34,2	61,6	82,2	92,1	92,1	126,3
	-6,7	0,14	9,7	22,3	39,6	52,9	60,2	60,2	81,2
	-18	0,10	6,4	14,7	25,7	34,3	39,7	39,7	52,7
	-29	0,07	4,1	9,4	16,2	21,7	25,4	25,4	33,3
	-40	0,03	2,1	4,6	7,7	10,3	12,5	12,5	15,9
R410A	4,4	0,21	18,7	43,8	79,5	106,2	118,0	118,0	163,1
	-6,7	0,14	12,7	29,4	52,6	70,2	79,2	79,2	107,8
	-18	0,10	8,6	19,9	35,2	47,0	53,7	53,7	72,1
	-29	0,07	5,8	13,2	23,0	30,7	35,6	35,6	47,1
	-40	0,03	3,0	6,7	11,3	15,1	18,0	18,0	23,2

continue →

Standard rating conditions according to AHRI Standard 730-2013									
Condensing temperature	100 °F					(37,8 °C)			
Liquid temperature	90 °F					(32,3 °C)			
Subcooling	10 °R					(5,5 °K)			
Evaporating temperature	40 °F					(4,4 °C)			
Temperature leaving evaporator	50 °F					(9,9 °C)			
Evaporator superheating	10 °R					(5,5 °K)			
Temperature entering filter	65 °F					(18,3 °C)			
Suction superheating	15 °R					(8,4 °K)			
Discharge temperature	150 °F					(65,5 °C)			
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

TABLE 38: Refrigerant flow capacity of filtering block 4495/C [kW]

Refrigerants	Evaporating Temperature [°C]	Pressure drop [bar]	Catalogue Number						
			4411/50F	4411/70F	4411/90F	4411/110F	4411/130F	4411/M420F	4411/170F
R507	4,4	0,21	13,2	30,9	56,2	75,1	83,3	83,3	115,3
	-6,7	0,14	8,7	20,2	36,2	48,3	54,5	54,5	74,2
	-18	0,10	5,8	13,3	23,6	31,5	36,0	36,0	48,4
	-29	0,07	3,8	8,6	14,9	20,0	23,2	23,2	30,6
	-40	0,03	1,9	4,2	7,1	9,5	11,4	11,4	14,7
R1234ze	4,4	0,21	10,0	23,2	41,5	55,4	62,7	62,7	85,1
	-6,7	0,14	6,4	14,8	25,9	34,6	39,8	39,8	53,2
	-18	0,10	4,1	9,5	16,4	21,8	25,5	25,5	33,5
	-29	0,07	2,6	5,9	10,0	13,3	15,8	15,8	20,4
	-40	0,03	1,2	2,8	4,6	6,1	7,5	7,5	9,4
R1234yf	4,4	0,21	10,4	24,2	43,5	43,5	65,2	65,2	89,2
	-6,7	0,14	6,7	15,5	27,4	27,4	41,7	41,7	56,2
	-18	0,10	4,4	10,0	17,4	17,4	26,9	26,9	35,7
	-29	0,07	2,8	6,3	10,8	10,8	17,0	17,0	22,2
	-40	0,03	1,3	3,0	5,0	5,0	8,1	8,1	10,3
R448A	4,4	0,21	14,6	34,1	61,6	82,3	92,0	92,0	126,4
	-6,7	0,14	9,7	22,3	39,7	53,0	60,2	60,2	81,5
	-18	0,10	6,4	14,8	25,9	34,6	39,9	39,9	53,1
	-29	0,07	4,2	9,5	16,4	22,0	25,7	25,7	33,7
	-40	0,03	2,1	4,7	7,8	10,5	12,6	12,6	16,1
R449A	4,4	0,21	14,5	33,8	61,2	81,7	91,3	91,3	125,4
	-6,7	0,14	9,6	22,2	39,4	52,7	59,8	59,8	80,9
	-18	0,10	6,4	14,6	25,7	34,3	39,5	39,5	52,7
	-29	0,07	4,1	9,4	16,3	21,8	25,5	25,5	33,4
	-40	0,03	2,1	4,6	7,8	10,4	12,5	12,5	16,0

continue →

Standard rating conditions according to AHRI Standard 730-2013									
Condensing temperature	100 °F					(37,8 °C)			
Liquid temperature	90 °F					(32,3 °C)			
Subcooling	10 °R					(5,5 °K)			
Evaporating temperature	40 °F					(4,4 °C)			
Temperature leaving evaporator	50 °F					(9,9 °C)			
Evaporator superheating	10 °R					(5,5 °K)			
Temperature entering filter	65 °F					(18,3 °C)			
Suction superheating	15 °R					(8,4 °K)			
Discharge temperature	150 °F					(65,5 °C)			
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

TABLE 38: Refrigerant flow capacity of filtering block 4495/C [kW]

Refrigerants	Evaporating Temperature [°C]	Pressure drop [bar]	Catalogue Number						
			4411/50F	4411/70F	4411/90F	4411/110F	4411/130F	4411/M420F	4411/170F
R450A	4,4	0,21	10,9	25,3	45,3	60,4	68,2	68,2	92,8
	-6,7	0,14	7,0	16,2	28,5	38,0	43,6	43,6	58,3
	-18	0,10	4,6	10,4	18,1	24,1	28,1	28,1	37,1
	-29	0,07	2,9	6,5	11,1	14,8	17,6	17,6	22,8
	-40	0,03	1,4	3,1	5,2	6,9	8,4	8,4	10,6
R452A	4,4	0,21	12,8	29,9	54,4	72,6	80,7	80,7	111,5
	-6,7	0,14	8,4	19,4	34,8	46,5	52,4	52,4	71,4
	-18	0,10	5,5	12,8	22,5	30,1	34,5	34,5	46,2
	-29	0,07	3,6	8,2	14,2	18,9	22,0	22,0	29,1
	-40	0,03	1,8	4,0	6,7	9,0	10,7	10,7	13,8
R452B	4,4	0,21	19,0	44,3	80,1	107,0	119,4	119,4	164,3
	-6,7	0,14	12,5	28,9	51,5	68,8	78,0	78,0	105,6
	-18	0,10	8,4	19,2	33,7	45,0	51,8	51,8	69,1
	-29	0,07	5,5	12,5	21,6	28,8	33,7	33,7	44,3
	-40	0,03	2,8	6,2	10,5	14,0	16,8	16,8	21,4
R454B	4,4	0,21	19,4	45,2	81,8	109,2	121,8	121,8	167,7
	-6,7	0,14	12,8	29,5	52,6	70,2	79,6	79,6	107,9
	-18	0,10	8,5	19,6	34,4	45,9	52,9	52,9	70,5
	-29	0,07	5,6	12,8	22,0	29,4	34,4	34,4	45,2
	-40	0,03	2,8	6,4	10,7	14,3	17,1	17,1	21,9
R513A	4,4	0,21	11,4	26,4	47,5	63,4	71,2	71,2	97,3
	-6,7	0,14	7,4	17,0	30,0	40,1	45,8	45,8	61,6
	-18	0,10	4,8	11,0	19,2	25,6	29,6	29,6	39,3
	-29	0,07	3,1	6,9	11,9	15,9	18,7	18,7	24,4
	-40	0,03	1,5	3,3	5,5	7,4	8,9	8,9	11,4

continue →

Standard rating conditions according to AHRI Standard 730-2013									
Condensing temperature	100 °F					(37,8 °C)			
Liquid temperature	90 °F					(32,3 °C)			
Subcooling	10 °R					(5,5 °K)			
Evaporating temperature	40 °F					(4,4 °C)			
Temperature leaving evaporator	50 °F					(9,9 °C)			
Evaporator superheating	10 °R					(5,5 °K)			
Temperature entering filter	65 °F					(18,3 °C)			
Suction superheating	15 °R					(8,4 °K)			
Discharge temperature	150 °F					(65,5 °C)			
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



TABLE 38: Refrigerant flow capacity of filtering block 4495/C [kW]

Refrigerants	Evaporating Temperature [°C]	Pressure drop [bar]	Catalogue Number						
			4411/50F	4411/70F	4411/90F	4411/110F	4411/130F	4411/M420F	4411/170F
			R290	4,4	0,21	19,1	44,2	78,7	105,0
	-6,7	0,14	12,8	29,4	51,6	68,9	79,3	79,3	105,7
	-18	0,10	8,7	19,8	34,2	45,7	53,4	53,4	70,2
	-29	0,07	5,8	13,0	22,2	29,7	35,2	35,2	45,5
	-40	0,03	2,9	6,5	10,8	14,5	17,6	17,6	22,2
R600	4,4	0,14	8,9	20,1	34,6	46,2	54,3	54,3	71,0
	-6,7	0,10	5,9	13,4	22,7	30,3	36,1	36,1	46,5
	-18	0,07	3,8	8,4	14,1	18,8	22,7	22,7	28,8
	-29	0,03	1,9	4,2	6,8	9,0	11,2	11,2	13,8
R600a	4,4	0,14	9,9	22,6	39,2	52,3	60,9	60,9	80,4
	-6,7	0,10	6,6	15,0	25,7	34,3	40,5	40,5	52,7
	-18	0,07	4,3	9,6	16,2	21,7	26,0	26,0	33,3
	-29	0,03	2,1	4,8	7,8	10,4	12,9	12,9	16,0
R1270	4,4	0,21	21,1	48,8	68,0	87,1	131,5	131,5	178,5
	-6,7	0,14	14,2	32,7	45,2	57,6	88,3	88,3	118,1
	-18	0,10	9,8	22,3	30,5	38,7	60,1	60,1	79,3
	-29	0,07	6,5	14,8	20,1	25,4	40,0	40,0	52,0
	-40	0,03	3,4	7,5	10,1	12,6	20,3	20,3	25,8

Standard rating conditions according to AHRI Standard 730-2013

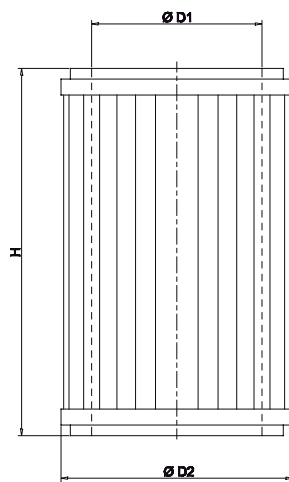
Condensing temperature	100 °F		(37,8 °C)						
Liquid temperature	90 °F		(32,3 °C)						
Subcooling	10 °R		(5,5 °K)						
Evaporating temperature	40 °F		(4,4 °C)						
Temperature leaving evaporator	50 °F		(9,9 °C)						
Evaporator superheating	10 °R		(5,5 °K)						
Temperature entering filter	65 °F		(18,3 °C)						
Suction superheating	15 °R		(8,4 °K)						
Discharge temperature	150 °F		(65,5 °C)						
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

TABLE 39: Dimensions and weights of filters

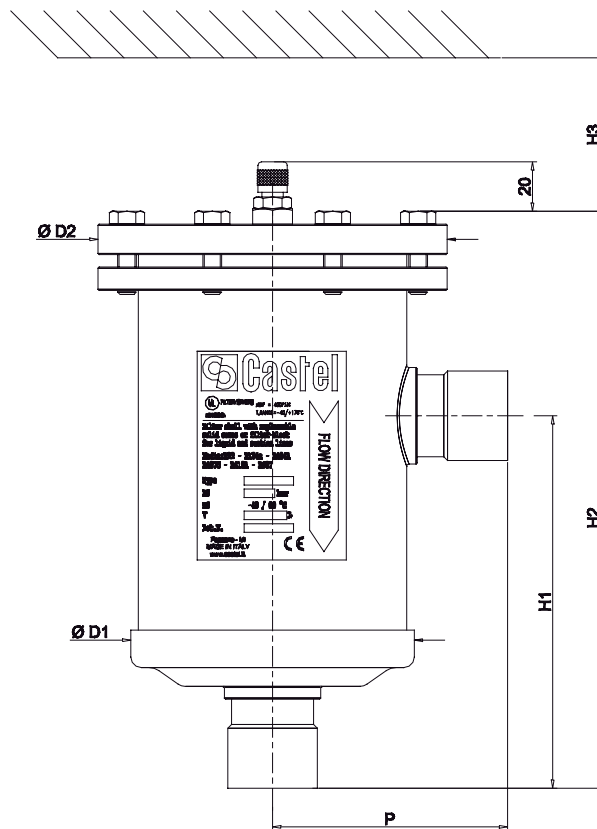
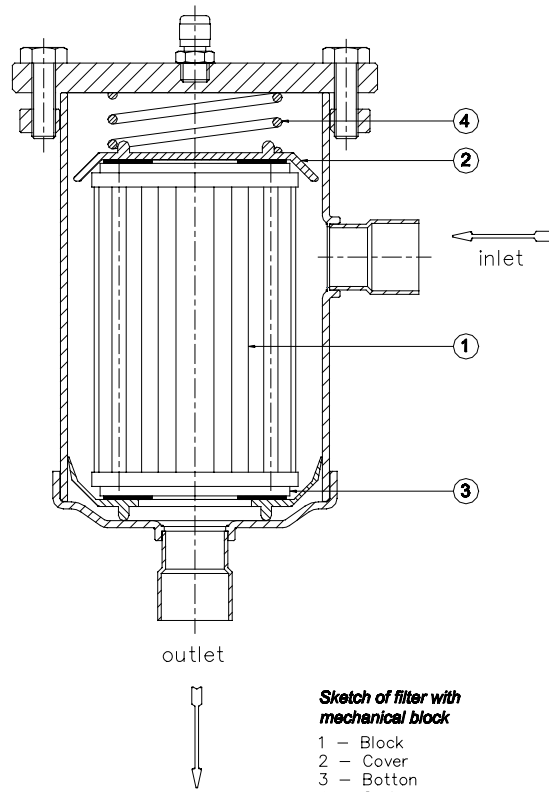
Catalogue Number	Connections			Dimensions [mm]						Weight [g]
	ODS		W	Ø D1	Ø D2	H1	H2	H3	P	
	Ø [in.]	Ø [mm]	Ø [mm]							
4411/5CF	5/8"	16	21,3	121	149	150	237	185	95	3810
4411/7CF	7/8"	22	26,9							3860
4411/9CF	1.1/8"	-	33,7							3920
4411/11CF	1.3/8"	35	42,4			155	242		100	4050
4411/13CF	1.5/8"	-	48,3			167	254			112
4411/M42CF	-	42	48,3			158	245		103	4150
4411/17CF	2.1/8"	54	60,3							

TABLE 40: General characteristic, dimensions and weights of mechanical block

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



4491  
4496



# REFRIGERATING SYSTEM PROTECTORS

## 6.8 – 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

belonging to Group 1 and 2, as defined in Article 13, Chapter 1, Point (a) and (b) of Directive 2014/68/EU, with reference to EC

Regulation No. 1272/2008.

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

### CONSTRUCTION

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.

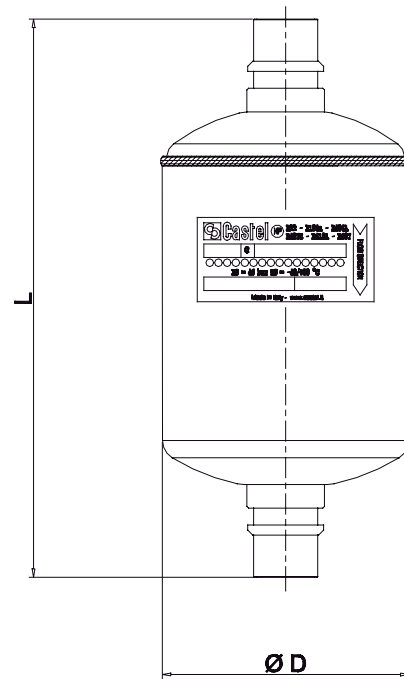
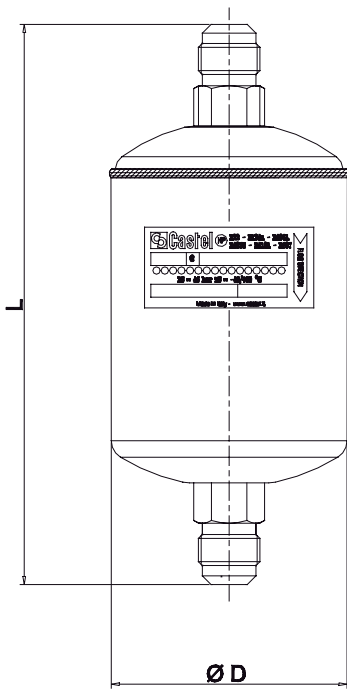
TABLE 41: General characteristics of strainers

Catalogue Number	Filtering Surface [cm <sup>2</sup> ]	Useful Passage Surface [%]	Mesh Opening [mm]	Connections				Kv Factor [m <sup>3</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								3,4		
4520/M12				–	–	12	–	14										
4520/4				–	1/2"	–	5/8"	16										
4520/5				–	5/8"	16	3/4"	–										
4520/M18				142	–	–	18	–									22	8,0



TABLE 42: 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			
4520/4			
4520/5	76	170	245
4520/M18	76	170	495





# REFRIGERATING SYSTEM PROTECTORS

## 6.9 – INSPECTABLE STRAINERS

### APPLICATIONS

The inspectable strainers in series 4720N are considered “Pressure Accessories” according to the definition provided in Article 2, Point 5 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

These strainers have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**These filters cannot be installed on systems that use HCFC (R22) refrigerant.**

of the filter.

The allowed operating positions are the following:

- With horizontal piping axis, removable cover facing downward.
- With vertical piping axis, arrow and removable cover facing downward.

**NOTE: strainers in series 4720N cannot be installed with the cover facing upward, in order to avoid that the dirt accumulated return into the plant when the filter is inspected/cleaned.**

### CONSTRUCTION

The main parts of the inspectionable mesh filters are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for body and cover
- Austenitic stainless steel AISI 304 for the mesh filter
- Unsintered PTFE for the sealing gasket of the mesh filter
- Hydrogenate nitrile rubber (HNBR) for outlet seal gaskets
- Copper tube EN 12735-1 – Cu-DHP for solder connections

### INSTALLATION

The inspectional strainers can be installed on all branches of a refrigeration plant where it is necessary to avoid the accumulation of dirt and sludge inside a highly delicate component.

Table 43 shows the following operational characteristics of an inspectionable mesh filter:

- PS
- TS
- Kv factor

**Copper connections:** The brazing of filters with solder connections should be carried out with care, using a low melting point filler material (min.5 Ag). It is not necessary to disassemble the filters. However, avoid direct contact between the torch flame and the body, which could be damaged and compromise the proper functioning





TABLE 43: General characteristics of inspectable strainer

Catalogue Number	Filtering Surface [cm <sup>2</sup> ]	Useful Passage Surface [%]	Mesh Opening [mm]	Connections		Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast						
				ODS				min.	max.							
				Ø [in.]	Ø [mm]											
4720N/3	13	26	0,1	3/8"	-	2,0	50	-40	+150	Art. 4.3						
4720N/M10				-	10											
4720N/M12				-	12	2,5										
4720N/4				1/2"	-											
4720N/5				5/8"	16	3,0										
4720N/M18	18		26	0,2	-	18					6,0	50	-40	+150	Art. 4.3	
4720N/6					3/4"	-										
4720N/7					7/8"	22										
4720N/M28					-	28										
4720N/9					1.1/8"	-										
4720N/11	31	26		0,2	1.3/8"	35	7,0	50	-40	+150						Art. 4.3
4720N/13	46				1.5/8"	-	10,0									
4720N/M42					-	42										
4720N/17					60	2.1/8"	54									

TABLE 44: Refrigerant flow capacity of inspectable strainers in liquid line [kW]

Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4720N/3	34,0	50,3	23,8	34,5	34,3	23,0	25,2	30,1	31,3	31,4
4720N/M10										
4720N/M12	42,5	62,8	29,8	43,1	42,9	28,8	31,5	37,6	39,1	39,3
4720N/4										
4720N/5	51,0	75,4	35,7	51,7	51,5	34,5	37,7	45,1	47,0	47,2
4720N/M18	102,0	150,8	71,4	103,4	103,0	69,0	75,5	90,2	93,9	94,3
4720N/6										
4720N/7										
4720N/M28										
4720N/9										
4720N/11	119	176	83	121	120	81	88	105	110	110
4720N/13	170	251	119	172	172	115	126	150	157	157
4720N/M42										
4720N/17	255	377	179	258	258	173	189	226	235	236

continue →

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

TABLE 44: Refrigerant flow capacity of inspectable strainers in liquid line [kW]

Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4720N/3	31,8	24,3	40,1	40,9	29,1	40,8	47,8	42,4	42,4
4720N/M10									
4720N/M12	39,8	30,3	50,1	51,2	36,4	51,0	59,8	53,0	53,0
4720N/4									
4720N/5	47,7	36,4	60,2	61,4	43,7	61,1	71,7	63,6	63,6
4720N/M18	95,5	72,8	120,3	122,8	87,4	122,3	143,4	127,2	127,2
4720N/6									
4720N/7									
4720N/M28									
4720N/9									
4720N/11	111	85	140	143	102	143	167	148	148
4720N/13	159	121	201	205	146	204	239	212	212
4720N/M42									
4720N/17	239	182	301	307	218	306	359	318	318

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 45: Refrigerant flow capacity of inspectable strainers in suction line [kW]

Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4720N/3	3,6	8,5	4,4	4,5	6,6	4,5	2,9	2,8	4,8	4,4
4720N/M10										
4720N/M12	4,6	10,6	5,5	5,7	8,3	5,6	3,7	3,6	6,0	5,5
4720N/4										
4720N/5	5,5	12,8	6,6	6,8	9,9	6,7	4,4	4,3	7,2	6,6
4720N/M18	10,9	25,5	13,2	13,6	19,8	13,4	8,8	8,5	14,4	13,2
4720N/6										
4720N/7										
4720N/M28										
4720N/9										
4720N/11	13	30	15	16	23	16	10	10	17	15
4720N/13	18	43	22	23	33	22	15	14	24	22
4720N/M42										
4720N/17	27	64	33	34	50	33	22	21	36	33

continue →

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

TABLE 45: Refrigerant flow capacity of inspectable strainers in suction line [kW]

Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4720N/3	3,2	4,2	7,0	7,0	3,6	6,1	2,6	3,2	7,0
4720N/M10									
4720N/M12	4,0	5,3	8,7	8,8	4,5	7,6	3,2	4,0	8,7
4720N/4									
4720N/5	4,8	6,3	10,5	10,5	5,4	9,2	3,9	4,7	10,4
4720N/M18	9,5	12,7	20,9	21,0	10,7	18,3	7,7	9,5	20,9
4720N/6									
4720N/7									
4720N/M28									
4720N/9									
4720N/11	11	15	24	25	13	21	9	11	24
4720N/13	16	21	35	35	18	31	13	16	35
4720N/M42									
4720N/17	24	32	52	53	27	46	19	24	52

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 46: Refrigerant flow capacity of inspectable strainers in hot gas line [kW]

Catalogue Number	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
4720N/3	17,0	36,3	19,2	23,8	27,2	19,1	13,3	13,7	23,6	21,6
4720N/M10										
4720N/M12	21,3	45,4	24,0	29,8	34,0	23,9	16,6	17,1	29,5	27,0
4720N/4										
4720N/5	25,5	54,5	28,8	35,7	40,8	28,6	19,9	20,6	35,4	32,3
4720N/M18	51,0	109,0	57,6	71,4	81,6	57,2	39,8	41,1	70,8	64,7
4720N/6										
4720N/7										
4720N/M28										
4720N/9										
4720N/11	60	127	67	83	95	67	46	48	83	75
4720N/13	85	182	96	119	136	95	66	69	118	108
4720N/M42										
4720N/17	128	272	144	179	204	143	100	103	177	162

continue →

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

TABLE 46: Refrigerant flow capacity of inspectable strainers in hot gas line [kW]

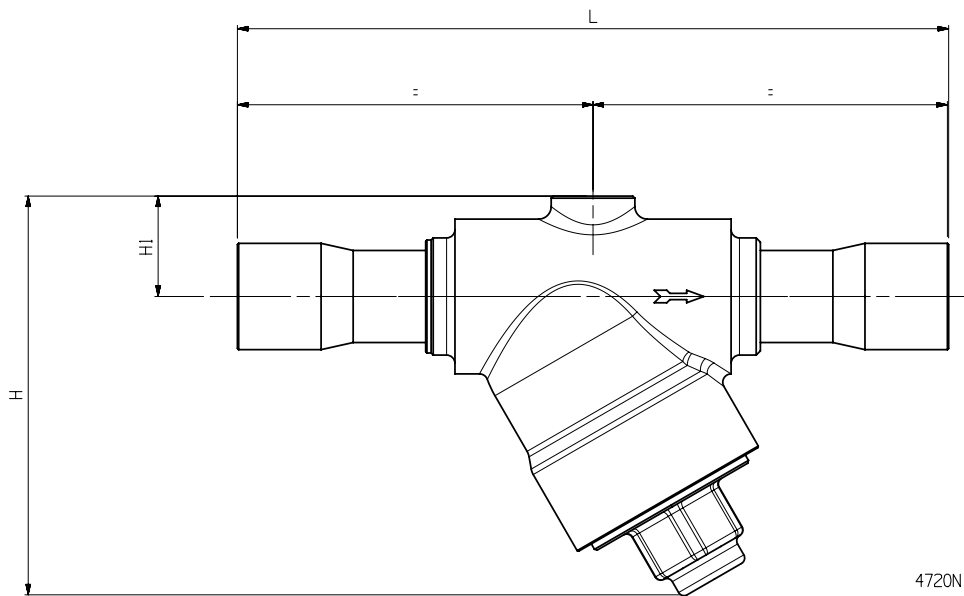
Catalogue Number	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
4720N/3	15,3	20,0	30,6	30,9	16,3	25,5	12,9	14,9	28,8
4720N/M10									
4720N/M12	19,1	25,0	38,3	38,6	20,4	31,9	16,2	18,6	36,0
4720N/4									
4720N/5	23,0	29,9	45,9	46,3	24,4	38,3	19,4	22,3	43,2
4720N/M18	45,9	59,9	91,8	92,6	48,8	76,6	38,8	44,6	86,4
4720N/6									
4720N/7									
4720N/M28									
4720N/9									
4720N/11	54	70	107	108	57	89	45	52	101
4720N/13	77	100	153	154	81	128	65	74	144
4720N/M42									
4720N/17	115	150	230	231	122	191	97	112	216

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



TABLE 47: Dimensions and weights of inspectable strainers

Catalogue Number	Dimensions [mm]				Weight [g]	
	H	H1	L	Q		
4720N/3	55,5	19	134	16	505	
4720N/M10						500
4720N/M12						510
4720N/4					136	510
4720N/5	74,5	19	148	16	510	
4720N/M18	95,5	24	164	24	980	
4720N/6						980
4720N/7					170	1000
4720N/M28						1080
4720N/9					201	108
4720N/11	115	29	208	24	1400	
4720N/13	148	36	241	32	3400	
4720N/M42					3400	
4720N/17	166	44	285	32	5500	





The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a 3D effect of depth and shadow. The colors range from light sky blue to deep navy blue.

# OIL CONTROL SYSTEMS

P  LYHEDRA



# 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

## 7.1 – 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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/X16: adapter, with mobile flange and 1.1/4" – 12 UNF swivel threaded end (rotalock).

Table X shows the correspondence between these adapter kits and the compressor models of several manufacturers.

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).

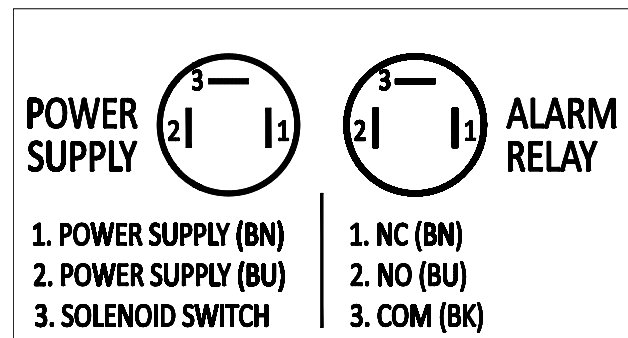




TABLE 1: General characteristics of electronic oil level regulators

Part number	Version	Connections		Cables kit (1)	Opening Pressure Differential [bar]		PS [bar]	TS [°C]		Weight [g]	Risk Category according to PED Recast
		Adapters	Oil inlet		Min	Max		Min	Max		
		(1)	SAE FLARE								
5650/RA2	Right	5690/X11 5690/X12 5690/X13 5690/X14	3/8"	9901/X26	2	30	50	-30	+130	990	Art. 4.3
5650/RA6											
5650/LA2	Left										
5650/LA6											

Note:

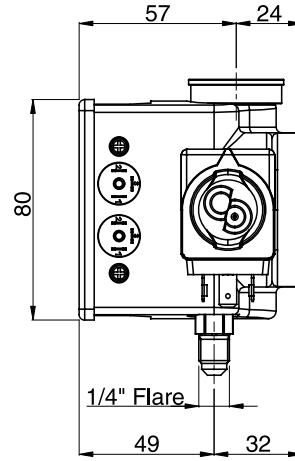
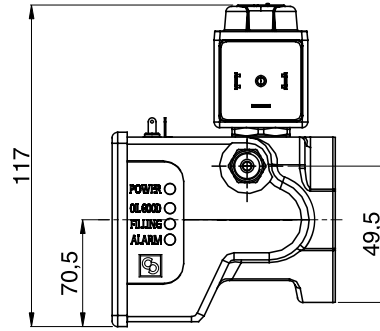
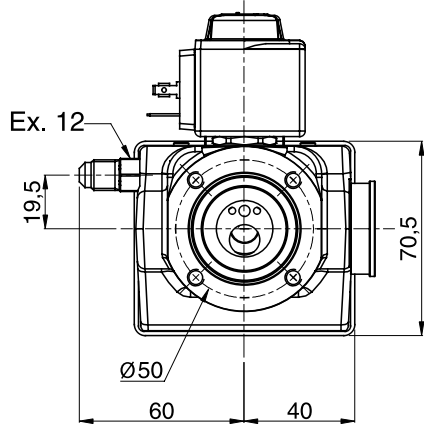
(1) To be ordered separately

TABLE 2: Electrical characteristics

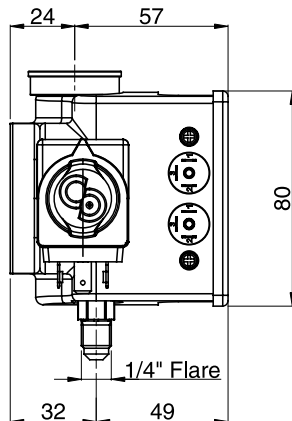
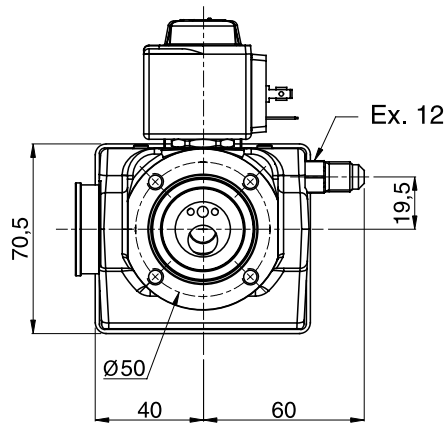
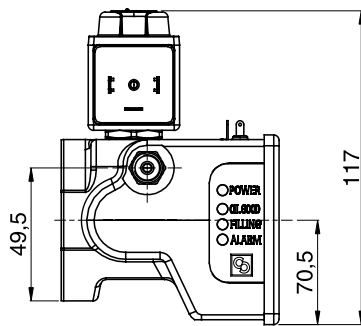
Part number	Voltage [V]	Voltage Tolerance [%]	Frequency [Hz]	Coil (1)					Degree of protection	Alarm contact	
				Tipo	Insulation class EN 60730	Power [W]	Coil consumption at 20 °C [mA]			Admissible load	Max voltage
							Start	Working			
5650/RA2	24 A.C.	+10/-10	50/60	9300/RA2	H	8	920	527	IP 65	3A	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) Enclosed into the package



5650/R



5650/L

TABLE 3: 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		

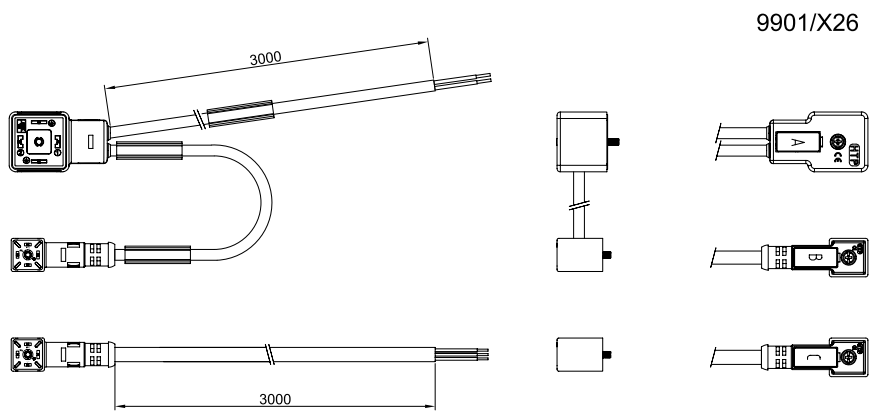
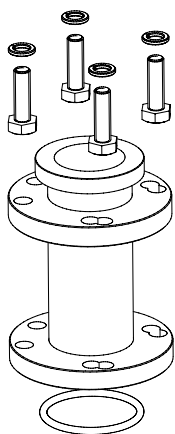
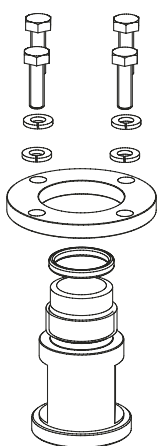


TABLE 4: Adapters characteristics and their use

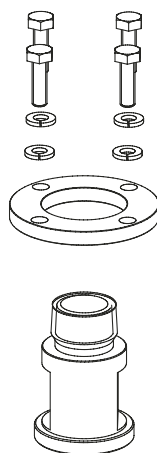
Adapter		Compressors	
Catalogue Number	Connections	Manufacturer	Model number
5690/X11	Flanged with: 3 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 83 mm	Arctic Circle	G2; G4; G6
		Bitzer	4NC...4VC; 6D; 6E; 2H; 2T; 4H; 4T; 4P; 4G; 4H; 4J; 6F; 6G; 6H; 6J; S4 ; S6
		Bock	HA3...HA5; HG3...HG5; HG7; AM; F; O series
		Carrier	EA; ER; 6E; OBE; OBCC
		Copeland	D2; D3; D4; D6; 4CC; 6CC; 4M; 6M; ZBH; DK; DL; DN ;DM
		Dorin	H2; H32; H34; H4; K5; Y6; 2S
		Frascold	Tutti
		Trane	M; R
		PrestCold	P2; P3; P4; P6
5690/X12	Threaded 1-1,8" - 12 UNF	Copeland	DK; DL; DN; ZR; ZZ; HA; KA; EA; 3A; LA; ER; 3R
		Tecumseh	P; R; S; PA; RA; SA; CK; CM; CH; CG
		PrestCold	Pk; PL (depend on size/model)
5690/X13	Threaded 1 - 1,8" - 18 UNEF	Bitzer	2CC...2KC; 4CC...4FC; ESH; 4KTC series
		Bock	HA(12,22,34); HG (12,22,34); HAX(12,22,34); HGX (12,22,34); EX Series
		Dorin	H1; K100...K400; SCC series
		Tecumseh	TAG; TAH
		PrestCold	PK; PL
		ManEurope	Tutti
5690/X14	Threaded 3/4" - 14 NPT	Bitzer	ZL; ZM
		Trane	K series
		Copeland	ZB; ZF; ZS; ZO; ZOD
5690/X15	Flanged with: 3 screws, distance between 1.7/8" 4 screws, distance between 50 mm L = 53 mm		
5690/X16	Rotalock 1.1/4" - 12 UNF		



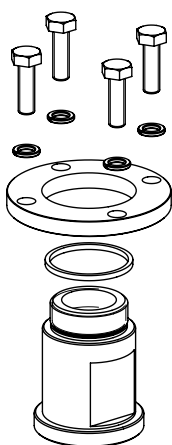
5690/X11  
5690/X15



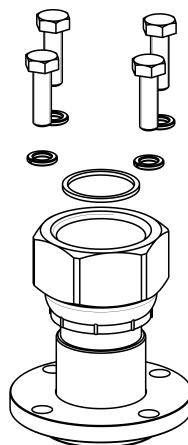
5690/X12



5690/X14



5690/X13



5690/X16

# OIL CONTROL SYSTEMS

## 7.2 – OIL RESERVOIR PRESSURE VALVES

### APPLICATIONS

The oil reservoir pressure valves in series 3150W are considered “Pressure Accessories” according to the definition provided in Article 2, Point 5 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

These valves have been developed by Castel for all those commercial refrigeration systems and civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

### CONSTRUCTION

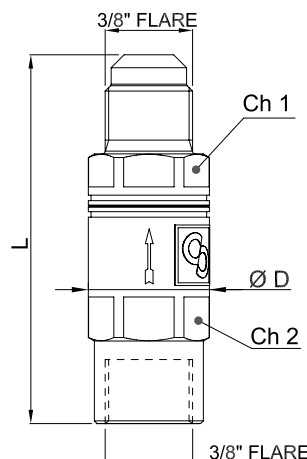
Castel manufactures four oil reservoirs pressure relief valves with different pressures. A higher-pressure differential will increase the oil flow rate from the oil reservoir back to the compressor crankcase. The selection of the model must consider both the individual compressor crankcase pressures 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 5: 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	Ch1	Ch2	[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

## 7.3 – 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 38 provide control of the regular return of oil to the compressor crankcase. They are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**Note: The indicators in series 3680 are excluded from the scope of application of Directive 2014/68/EU as they are piping components. These indicators cannot be installed on systems that use HCFC (R22) refrigerant.**

### CONSTRUCTION

Indicators series 38 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 reflanging 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

The indicators in series 3680 are manufactured with the glass “lens” directly melted onto a steel ring, with proper surface protection, screwed on to the indicator body. Inside the ring, which is supplied with a hydrogenated nitrile butadiene (HNBR) gasket, is a Nylon ball, kept in position in front of the spy glass by a metal mesh disk. The presence of the Nylon ball in the spy glass facilitates immediate reading of the oil level.

### INSTALLATION

The brazing of indicators with solder connections in series 38 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.

For indicators in series 3680 the ring must be disassembled before brazing.

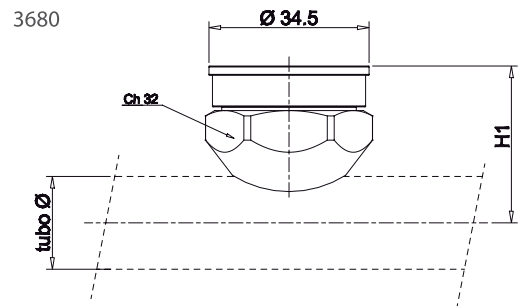
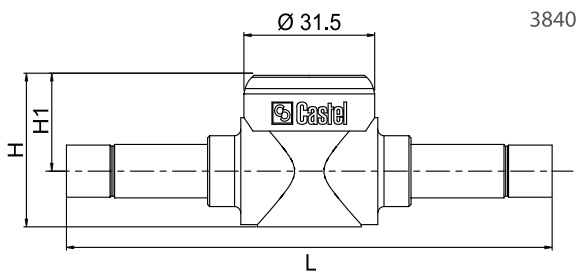
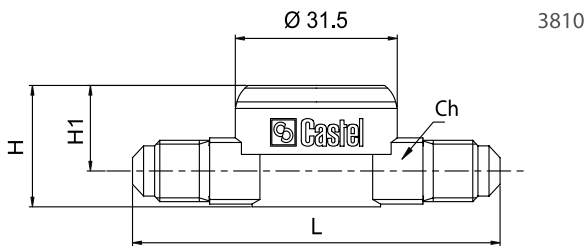
Note: the PS declared in Table 6 for indicators in series 3680, refers only to the body plus the ring (with its o-ring), which the customer must tighten to the torque indicated on the product instruction manual. The aforesaid declaration doesn’t cover any possible leakage or malfunctions due to brazing the body on the copper pipe. The customer is totally responsible for the success of this operation.





TABLE 6: 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	
3840/3		-	3/8"	-						
3840/M10		-	-	10						
3840/M12		-	-	12						
3840/4		-	1/2"	-						
3680/7	saddle type				7/8"	22				esclusi excluded
3680/9					1.1/8"	28				
3680/11					1.3/8"	35				



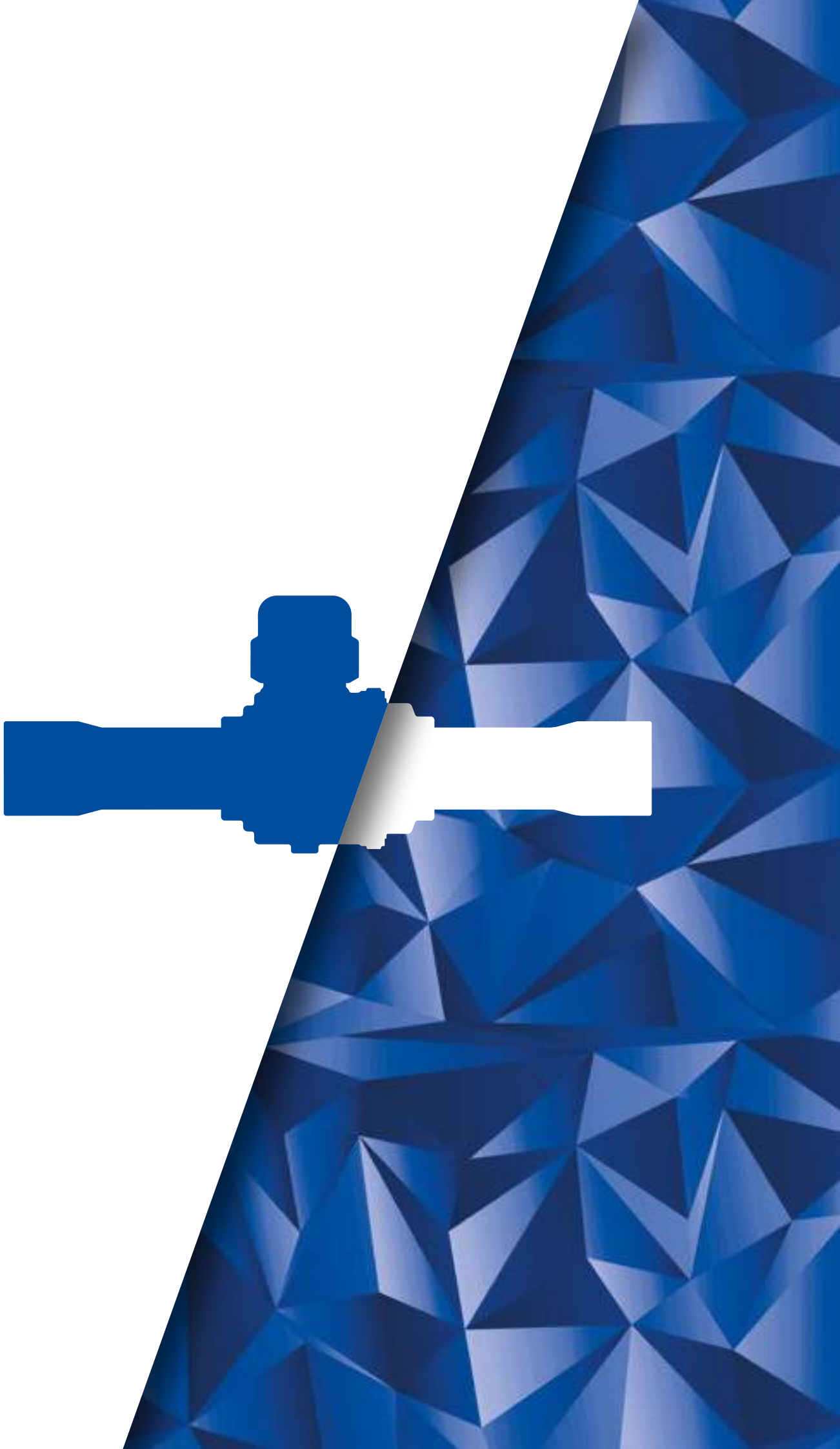
# **OIL CONTROL SYSTEMS**

## **7.4 – STRAINERS**

See: Chapter 6 - Paragraphs 6.8 and 6.9

## **7.5 – NORMALLY CLOSED SOLENOID VALVES**

See: Chapter 2 - Paragraph 2.2



# VALVES

POLYHEDRA

## VALVES

## 8.1 – 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

## HERMETIC VALVES

The hermetic valves are two-way shut-off valves with:

- SAE flare connections for types 6010N
- SAE flare / ODS connections for types 6012N

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

- Hot forged brass EN 12420 – CW 617N for the body.
- Steel, with proper surface protection, or brass for the spindle
- Hydrogenated nitrile butadiene rubber (HNBR) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

## RECEIVER VALVES

The receiver valves are two-way valves with square connections, SAE flare / ODS, types 6110N and 6120N.

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

- Hot forged brass EN 12420 – CW 617N for the body.
- Steel, with proper surface protection, for the spindle.
- Hydrogenated nitrile butadiene rubber (HNBR) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

## CAPPED VALVES

The capped valves are two-way shut-off valves with ODS connections, types 6420N.

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

- Hot forged brass EN 12420 – CW 617N for the body
- Steel, with proper surface protection, for the spindle.
- Hydrogenated nitrile butadiene rubber (HNBR) and aramid fibres for packing gland seal.
- Glass-reinforced PBT for the protective cap that covers the spindle.

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



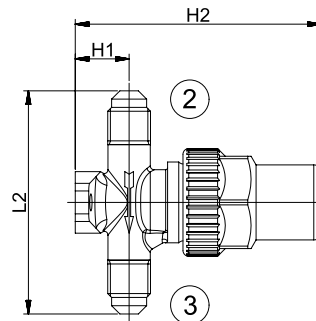
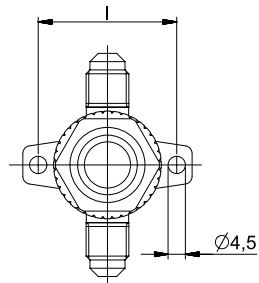
TABLE 1 General characteristics of valves for hermetic systems

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	IN		OUT			min.	max.	
	SAE Flare	ODS	SAE Flare					
6010N/2	1/4"	–	1/4"	0,27	50	-40	+150	Art. 4.3
6012N/22	–	1/4"	1/4"					

TABLE 2: Dimensions and weights of valves for hermetic systems

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

6010N



6012N

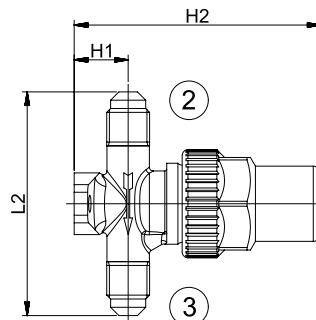
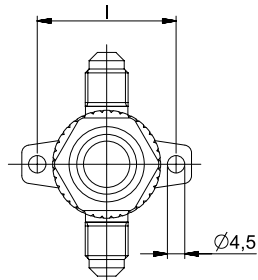




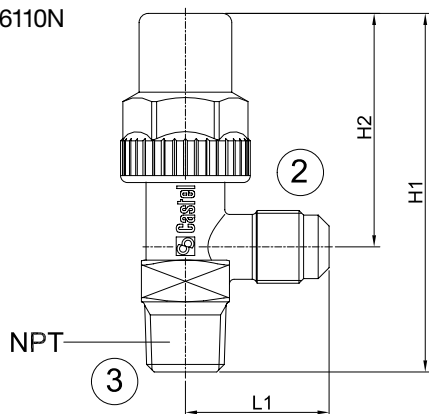
TABLE 3: General characteristics of receiver valves

Catalogue Number	Connections				Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	IN		OUT				min.	max.	
	SAE Flare	NPT	SAE Flare	NPT					
6110N/22	-	1/4"	1/4"	-	0,44	50	-40	+150	Art. 4.3
6110N/X15	1/4" F	-	1/4"	-					
6110N/23	-	3/8"	1/4"	-	0,45				
6110N/32	-	1/4"	3/8"	-					
6110N/33	-	3/8"	3/8"	-	1,35				
6110N/X13	3/8" F	-	3/8"	-					
6110N/43	-	3/8"	1/2"	-	2,40				
6110N/44	-	1/2"	1/2"	-	3,40				
6120N/22	1/4"	-	-	1/4"	0,44				
6120N/23	1/4"	-	-	3/8"	0,45				
6120N/32	3/8"	-	-	1/4"	1,35				
6120N/33	3/8"	-	-	3/8"					
6120N/43	1/2"	-	-	3/8"	2,40				
6120N/44	1/2"	-	-	1/2"	3,40				

TABLE 4: Dimensions and weights of receiver valves

Catalogue Number	Dimensions [mm]				Weight [g]			
	H1	H2	L1	L2				
6110N/22	72	48	27,5	-	110			
6110N/X15	83		29		-	130		
6110N/23	77					31	-	135
6110N/32		50	-					130
6110N/33						87		-
6110N/X13	88	34,5						
6110N/43				55,5		-		
6110N/44	92	72			48			
6120N/22	27,5			77			50	
6120N/23	30	80	55,5		130			
6120N/32				93	-		135	
6120N/33		33					50	140
6120N/43	55,5			225		225		
6120N/44		305						

6110N



6120N

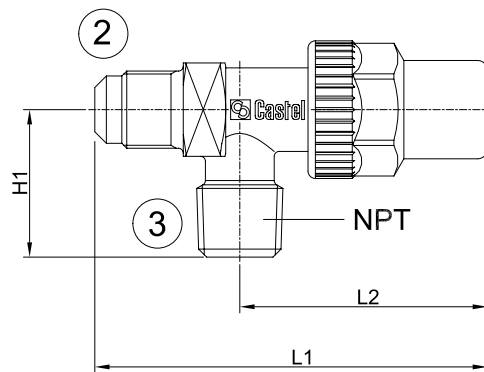
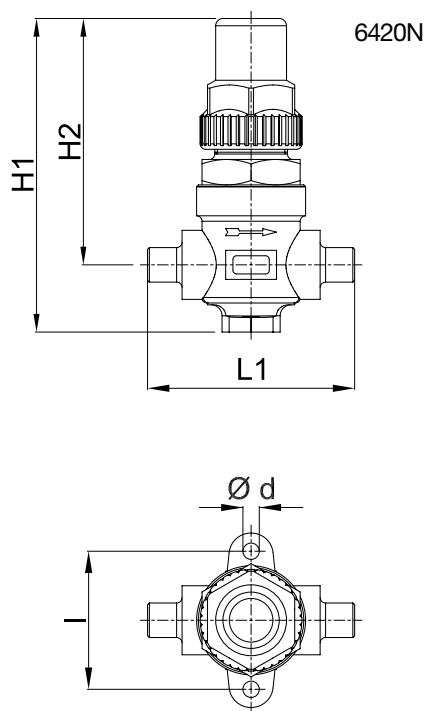


TABLE 5: General characteristics of capped valves

Catalogue Number	Connections			Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	IN	OUT				min.	max.	
	ODS	ODS	SAE Flare					
6420N/2	1/4"	1/4"	-	0,40	50	-40	+130	Art. 4.3
6420N/3	3/8"	3/8"		1,00				
6420N/3S3	3/8"	-	3/8"					
6420N/4	1/2"	1/2"	-	1,45				

TABLE 6: Dimensions and weights of capped valves

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





## VALVES

## 8.2 – TWO-WAYS VALVES WITH BALL SHUTTER

## APPLICATIONS

The 2-ways valves with ball shutter in series 6570N, 6571N 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

## 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:

- 6570N (full port) and 6571N (reduced port) without access fitting.
- 6570N/xxA (full port) and 6571N/xxA (reduced port) with access fitting. The valves are equipped with mechanism 8395/A3 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.
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for the ball seat gaskets

## INSTALLATION

The 2-ways valves with ball shutter can be installed in all sections of a refrigerating system, in compliance with the limits and capacities indicated in Table 7. Table 7 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

Valves with ball shutter in series 6570N, 6571N have been approved by the American certification authority, Underwriters Laboratories Inc. These taps are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207.

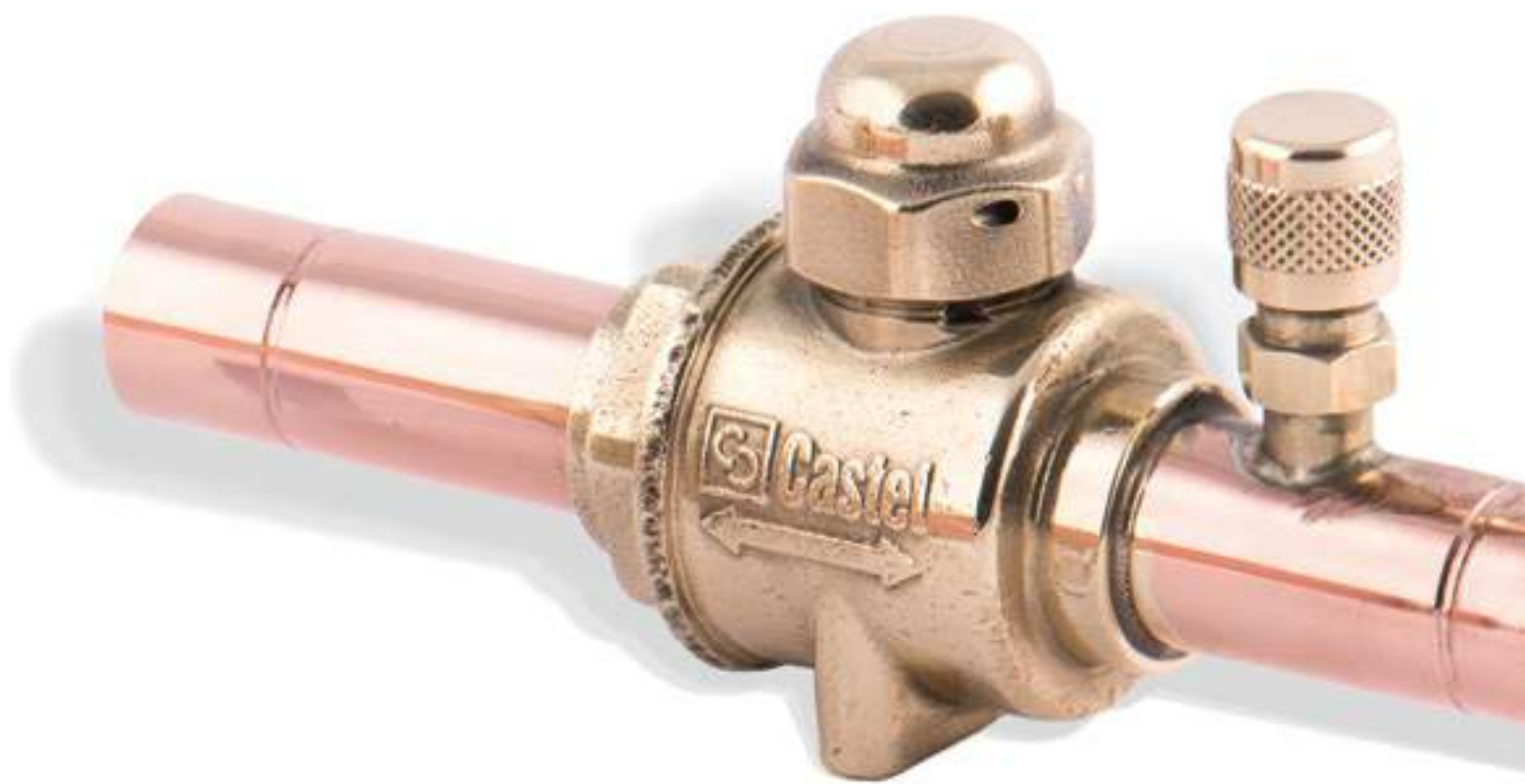


TABLE 7: General characteristics of ball valves, UL approved

Catalogue Number		Connections		Ball Port Ø [mm]	Kv Factor [m <sup>3</sup> /h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
without access fitting	with access fitting	ODS					min.	max.	
		Ø [in.]	Ø [mm]						
6570N/M6	6570N/M6A	–	6	10	0,8	50 (1) (2)	-40	+150	Art. 4.3
6570N/2	6570N/2A	1/4"	–		3				
6570N/3	6570N/3A	3/8"	–						
6570N/M10	6570N/M10A	–	10						
6570N/M12	6570N/M12A	–	12						
6570N/4	6570N/4A	1/2"	–		15				
6571N/5	–	5/8"	16						
6570N/M15	6570N/M15A	–	15						
6570N/5	6570N/5A	5/8"	16						
6570N/M18	6570N/M18A	–	18						
6570N/6	6570N/6A	3/4"	–	19					
6571N/7	–	7/8"	22						
6570N/7	6570N/7A	7/8"	22		25				
6571N/M28	–	–	28						
6571N/9	–	1.1/8"	–	32					
6570N/M28	6570N/M28A	–	28						
6570N/9	6570N/9A	1.1/8"	–		38				
6571N/11	–	1.3/8"	35	50					
6570N/11	6570N/11A	1.3/8"	35		60				380
6570N/13	6570N/13A	1.5/8"	–	73					
6570N/M42	6570N/M42A	–	42						
6570N/17	6570N/17A	2.1/8"	54		82	710			
6570N/M64	6570N/M64A	–	64						
–	6570N/21A	2.5/8"	–		82	710			
	6570N/24A	3"	76						
	6570N/25A	3.1/8"	80						
	6570N/28A	3.1/2"	89						
	6570N/29A	3.5/8"	92						

(1) : MWP = 600 psi for 6570N/.. according to UL approval  
 (2) : MWP = 435 psi for 6571N/.. according to UL approval

TABLE 8: Refrigerant flow capacity of ball valves in liquid line [kW]

Catalogue Number		Refrigerants									
without access fitting	with access fitting	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6570N/M6	6570N/M6A	13,6	20,1	9,5	13,8	13,7	9,2	10,1	12,0	12,5	12,6
6570N/2	6570N/2A										
6570N/3	6570N/3A	51	75	36	52	52	35	38	45	47	47
6570N/M10	6570N/M10A										
6570N/M12	6570N/M12A	85	126	60	86	86	58	63	75	78	79
6570N/4	6570N/4A										
6571N/5	–	289	427	202	293	292	196	214	256	266	267
6570N/M15	6570N/M15A										
6570N/5	6570N/5A	493	729	345	500	498	334	365	436	454	456
6570N/M18	6570N/M18A										
6570N/6	6570N/6A	867	1282	607	879	876	587	642	767	798	802
6571N/7	–										
6570N/7	6570N/7A	1462	2161	1023	1482	1477	989	1082	1293	1346	1352
6571N/M28	–										
6571N/9	–	1989	2940	1392	2016	2009	1346	1472	1760	1831	1839
6570N/M28	6570N/M28A										
6570N/9	6570N/9A	3638	5378	2547	3687	3674	2461	2692	3219	3349	3364
6571N/11	–										
6570N/11	6570N/11A	6460	9549	4522	6547	6525	4370	4780	5715	5947	5974
6570N/13	6570N/13A										
6570N/M42	6570N/M42A	9350	13822	6545	9477	9444	6325	6919	8272	8608	8646
6570N/17	6570N/17A										
6570N/M64	6570N/M64A	12070	17842	8449	12233	12191	8165	8932	10678	11112	11161
–	6570N/21A										
–	6570N/24A	12070	17842	8449	12233	12191	8165	8932	10678	11112	11161
–	6570N/25A										
–	6570N/28A	12070	17842	8449	12233	12191	8165	8932	10678	11112	11161
–	6570N/29A										

continue →

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

TABLE 8: Refrigerant flow capacity of ball valves in liquid line [kW]

Catalogue Number		Refrigerants								
without access fitting	with access fitting	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
6570N/M6	6570N/M6A	12,7	9,7	16,0	16,4	11,6	16,3	19,1	17,0	17,0
6570N/2	6570N/2A									
6570N/3	6570N/3A	48	36	60	61	44	61	72	64	64
6570N/M10	6570N/M10A									
6570N/M12	6570N/M12A	80	61	100	102	73	102	120	106	106
6570N/4	6570N/4A									
6571N/5	–									
6570N/M15	6570N/M15A	270	206	341	348	248	346	406	360	360
6570N/5	6570N/5A									
6570N/M18	6570N/M18A									
6570N/6	6570N/6A									
6571N/7	–	461	352	581	593	422	591	693	615	615
6570N/7	6570N/7A									
6571N/M28	–									
6571N/9	–	811	619	1023	1043	743	1039	1219	1081	1081
6570N/M28	6570N/M28A									
6570N/9	6570N/9A									
6571N/11	–	1368	1043	1724	1760	1252	1753	2055	1823	1823
6570N/11	6570N/11A									
6570N/13	6570N/13A	1861	1419	2346	2394	1704	2384	2796	2480	2480
6570N/M42	6570N/M42A									
6570N/17	6570N/17A	3405	2596	4291	4378	3116	4361	5115	4537	4537
6570N/M64	6570N/M64A	6046	4609	7619	7775	5533	7744	9082	8056	8056
–	6570N/21A									
–	6570N/24A	8751	6672	11028	11253	8008	11209	13145	11660	11660
–	6570N/25A									
–	6570N/28A	11296	8612	14236	14527	10338	14470	16969	15052	15052
–	6570N/29A									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)



**TABLE 9: Refrigerant flow capacity of ball valves in suction line [kW]**

Catalogue Number		Refrigerants									
without access fitting	with access fitting	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6570N/M6	6570N/M6A	1,5	3,4	1,8	1,8	2,6	1,8	1,2	1,1	1,9	1,8
6570N/2	6570N/2A										
6570N/3	6570N/3A	5,5	12,8	6,6	6,8	9,9	6,7	4,4	4,3	7,2	6,6
6570N/M10	6570N/M10A										
6570N/M12	6570N/M12A	9,1	21,3	11,0	11,4	16,5	11,2	7,4	7,1	12,0	11,0
6570N/4	6570N/4A										
6571N/5	–										
6570N/M15	6570N/M15A										
6570N/5	6570N/5A	31	72	37	39	56	38	25	24	41	37
6570N/M18	6570N/M18A										
6570N/6	6570N/6A										
6571N/7	–										
6570N/7	6570N/7A	53	123	64	66	96	65	43	41	70	64
6571N/M28	–										
6571N/9	–										
6570N/M28	6570N/M28A										
6570N/9	6570N/9A	93	217	112	116	168	114	75	72	122	112
6571N/11	–										
6570N/11	6570N/11A	157	366	189	195	284	192	126	122	206	189
6570N/13	6570N/13A	213	497	257	266	386	261	172	166	281	257
6570N/M42	6570N/M42A										
6570N/17	6570N/17A	389	910	471	486	706	477	315	304	514	471
6570N/M64	6570N/M64A	692	1615	836	863	1254	847	559	540	912	836
	6570N/21A										
	6570N/24A	1001	2338	1210	1249	1815	1227	809	781	1320	1210
	6570N/25A										
	6570N/28A	1292	3018	1562	1612	2343	1583	1044	1008	1704	1562
	6570N/29A										

continue →

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 9: Refrigerant flow capacity of ball valves in suction line [kW]**

Catalogue Number		Refrigerants								
without access fitting	with access fitting	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
6570N/M6	6570N/M6A	1,3	1,7	2,8	2,8	1,4	2,4	1,0	1,3	2,8
6570N/2	6570N/2A									
6570N/3	6570N/3A	4,8	6,3	10,5	10,5	5,4	9,2	3,9	4,7	10,4
6570N/M10	6570N/M10A									
6570N/M12	6570N/M12A	8,0	10,6	17,5	17,5	9,0	15,3	6,5	7,9	17,4
6570N/4	6570N/4A									
6571N/5	–									
6570N/M15	6570N/M15A	27	36	59	60	30	52	22	27	59
6570N/5	6570N/5A									
6570N/M18	6570N/M18A									
6570N/6	6570N/6A									
6571N/7	–	46	61	101	102	52	88	37	46	101
6570N/7	6570N/7A									
6571N/M28	–									
6571N/9	–	81	108	178	179	91	156	66	81	177
6570N/M28	6570N/M28A									
6570N/9	6570N/9A									
6571N/11	–	137	181	300	301	154	262	111	136	299
6570N/11	6570N/11A									
6570N/13	6570N/13A	186	247	408	410	209	357	151	185	407
6570N/M42	6570N/M42A									
6570N/17	6570N/17A	340	452	747	749	383	653	276	338	745
6570N/M64	6570N/M64A	604	802	1326	1330	680	1159	490	600	1322
–	6570N/21A									
–	6570N/24A	875	1161	1920	1925	985	1678	710	869	1914
–	6570N/25A									
–	6570N/28A	1129	1498	2478	2485	1271	2166	916	1122	2471
–	6570N/29A									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 10: Refrigerant flow capacity of ball valves in hot gas line [kW]

Catalogue Number		Refrigerants									
without access fitting	with access fitting	R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6570N/M6	6570N/M6A	6,8	14,5	7,7	9,5	10,9	7,6	5,3	5,5	9,4	8,6
6570N/2	6570N/2A										
6570N/3	6570N/3A	26	54	29	36	41	29	20	21	35	32
6570N/M10	6570N/M10A										
6570N/M12	6570N/M12A	43	91	48	60	68	48	33	34	59	54
6570N/4	6570N/4A										
6571N/5	–										
6570N/M15	6570N/M15A	145	309	163	202	231	162	113	116	201	183
6570N/5	6570N/5A										
6570N/M18	6570N/M18A										
6570N/6	6570N/6A										
6571N/7	–										
6570N/7	6570N/7A	247	527	278	345	394	277	193	199	342	313
6571N/M28	–										
6571N/9	–										
6570N/M28	6570N/M28A	434	926	490	607	694	487	339	349	602	550
6570N/9	6570N/9A										
6571N/11	–										
6570N/11	6570N/11A	731	1562	826	1023	1170	820	571	589	1015	927
6570N/13	6570N/13A	995	2125	1123	1392	1591	1116	777	801	1381	1261
6570N/M42	6570N/M42A										
6570N/17	6570N/17A	1819	3886	2054	2547	2910	2042	1421	1466	2525	2307
6570N/M64	6570N/M64A	3230	6901	3648	4522	5168	3625	2523	2603	4484	4096
–	6570N/21A										
–	6570N/24A										
–	6570N/25A										
–	6570N/28A										
–	6570N/29A										

continue →

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

TABLE 10: Refrigerant flow capacity of ball valves in hot gas line [kW]

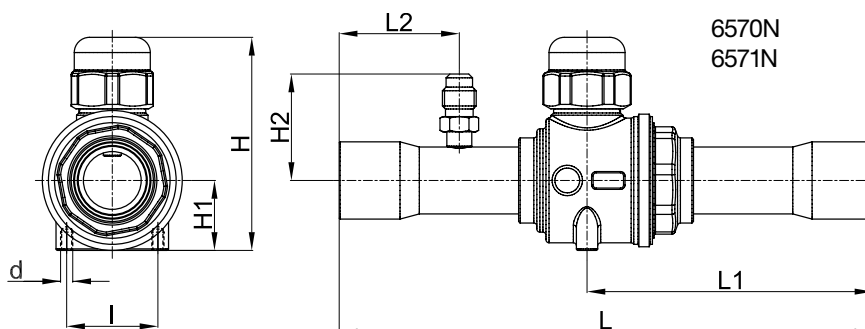
Catalogue Number		Refrigerants								
without access fitting	with access fitting	R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
6570N/M6	6570N/M6A	6,1	8,0	12,2	12,3	6,5	10,2	5,2	6,0	11,5
6570N/2	6570N/2A									
6570N/3	6570N/3A	23	30	46	46	24	38	19	22	43
6570N/M10	6570N/M10A									
6570N/M12	6570N/M12A	38	50	77	77	41	64	32	37	72
6570N/4	6570N/4A									
6571N/5	–									
6570N/M15	6570N/M15A	130	170	260	262	138	217	110	126	245
6570N/5	6570N/5A									
6570N/M18	6570N/M18A									
6570N/6	6570N/6A									
6571N/7	–	222	289	444	447	236	370	187	216	418
6570N/7	6570N/7A									
6571N/M28	–									
6571N/9	–	390	509	780	787	415	651	329	379	734
6570N/M28	6570N/M28A									
6570N/9	6570N/9A									
6571N/11	–	658	858	1316	1327	700	1097	556	640	1238
6570N/11	6570N/11A									
6570N/13	6570N/13A	895	1168	1790	1805	952	1493	756	870	1685
6570N/M42	6570N/M42A									
6570N/17	6570N/17A	1637	2136	3274	3302	1742	2731	1382	1592	3082
6570N/M64	6570N/M64A	2907	3792	5814	5863	3093	4849	2455	2827	5472
–	6570N/21A									
–	6570N/24A	4208	5489	8415	8487	4477	7018	3553	4092	7920
–	6570N/25A									
–	6570N/28A	5432	7086	10863	10955	5779	9060	4587	5282	10224
–	6570N/29A									

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

TABLE 11: Dimensions and weights of ball valves

Catalogue Number		Dimensions [mm]							Weight [g]									
		H	H1	H2	L	L1	L2	l		d								
6570N/M6	6570N/M6A	48	15	29	121	65	25	18	M4	198								
6570N/2	6570N/2A									201								
6570N/3	6570N/3A																	
6570N/M10	6570N/M10A			-	138	73,5	-			208								
6570N/M12	6570N/M12A																	
6570N/4	6570N/4A																	
6570N/M15	6570N/M15A	55	19	32	139	73	30	25,5	M4	311								
6570N/5	6570N/5A																	
6570N/M18	6570N/M18A																	
6570N/6	6570N/6A			-	175	90,5	-			360								
6571N/7	-																	
6570N/7	6570N/7A	70	23	34	175	94	40	30	M6	570								
6571N/M28	-			206	109	-	601											
6571N/9	-																	
6570N/M28	6570N/M28A	79	27	37	204	109	45	30	M6	708								
6570N/9	6570N/9A																	
6571N/11	-			-	245	130	-			840								
6570N/11	6570N/11A																	
6570N/13	6570N/13A	127	44	45	239	126	48	30	M6	1518								
6570N/M42	6570N/M42A																	
6570N/17	6570N/17A	148	54	53	275	149	58	30	M6	2470								
6570N/M64	6570N/M64A	150	55	57	343	186	68	75	M8	4360								
-	6570N/21A									186,5	70	64	365,5	196,5	69	89	M8	6000
-	6570N/24A																	6240
-	6570N/25A									10735								
-	6570N/28A									195	75	68	373	197,5	70,5	75	M8	10790
-	6570N/29A	12789																
-	-	-	-	-	-	-	-	-	-	12807								



## 8.3 – THREE-WAYS MANUAL VALVES WITH BALL SHUTTER

## APPLICATIONS

The 3-ways manual valves in series 6690N and 6690NB 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

– 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.

## 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
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for the ball seat gaskets

## INSTALLATION

**The 3-way ball valves in series 6690N and 6690NB 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



TABLE 12: General characteristics of 3-way manual valves

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS					min.	max.	
	Ø [in.]	Ø [mm]						
6690N/7	7/8"	22	19	10,7	50	-40	+150	Art. 4.3
6690N/M28	-	28	24	15,9				
6690N/9	1.1/8"	-	24	20,3				
6690N/11	1.3/8"	35	28	38,5				II
6690N/13	1.5/8"	-	37	38,5				
6690N/M42	-	42	37	38,5				

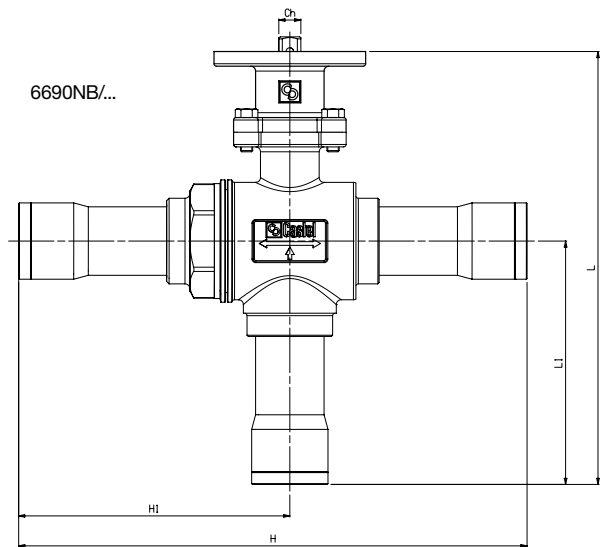
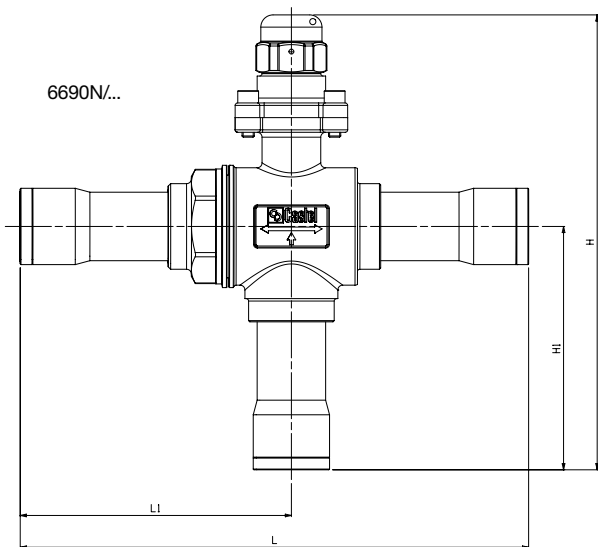
TABLE 13: General characteristics of 3-way valves to be motorized

Catalogue Number	Connections		Ball Port Ø [mm]	Kv Factor [m3/h]	PS [bar]	TS [°C]		Risk Category according to PED Recast
	ODS					min.	max.	
	Ø [in.]	Ø [mm]						
6690NB/7	7/8"	22	19	10,7	50	-40	+150	Art. 4.3
6690NB/M28	-	28	24	15,9				
6690NB/9	1.1/8"	-	24	20,3				
6690NB/11	1.3/8"	35	28	38,5				II
6690NB/13	1.5/8"	-	37	38,5				
6690NB/M42	-	42	37	38,5				



TABLE 14: Dimensions and weights of 3-ways valves

Catalogue Number	Figure	Dimensions [mm]					Weight [g]
		H	H1	L	L1	Ch	
6690N/7	1	165	82	172	94	9	1210
6690N/M28		186	100	208	111		1540
6690N/9		186					1540
6690N/11		203	103	211	113	11	2117
6690N/13		226	121	240	127		3447
6690N/M42		226					3447
6690NB/7	2	156	82	172	94	9	1210
6690NB/M28		177	100	208	111		1540
6690NB/9		177					1540
6690NB/11		186	103	211	113	11	2117
6690NB/13		209	121	240	127		3447
6690NB/M42		209					3447



## 8.4 – THREE-WAYS MOTORIZED VALVES WITH BALL SHUTTER

## APPLICATIONS

The 3-ways motorized valves in series 6690NM 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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

**CAUTION! These valves cannot be installed on systems that use HCFC (R22) refrigerant.**

## 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
- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets
- P.T.F.E. for the ball seat gaskets

## INSTALLATION

The 3-way ball valves in series 6690NM 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.



**TABLE 15: 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]									
6690NM/7A2	24V	7/8"	22	19	11	10	60	90°	50	-40	+150	Art. 4.3
6690NM/7A6	230V											
6690NM/M28A2	24V	-	28	24	16							
6690NM/M28A6	230V											
6690NM/9A2	24V	1.1/8"	-	24	16							
6690NM/9A6	230V											
6690NM/11A2	24V	1.3/8"	35	28	20,5	30	120					II
6690NM/11A6	230V											
6690NM/13A2	24V	1.5/8"	-	37	39							
6690NM/13A6	230V											
6690NM/M42A2	24V	-	42	37	39							
6690NM/M42A6	230V											

**TABLE 16: Electrical characteristics of 3-ways motorized valves**

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Active Power [W]		Apparent Power [VA]		Cable 1 m	Wiring Connections		Protection Degree
				Operation	Standstill	Operation	Standstill		Switching output 2 point (Open/Close)	Continuous output (0 - 10V)	
6690M/7A2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3	5 x 0,5 mm <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 0,75 mm <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 0,5 mm <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 0,75 mm <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 0,5 mm <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 0,75 mm <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 0,75 mm <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 0,5 mm <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 0,75 mm <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 0,5 mm <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 0,75 mm <sup>2</sup>	YES	NO	IP 43

**TABLE 17: Refrigerant flow capacity of 3-way valves in liquid line [kW]**

Catalogue Number			Refrigerants									
			R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6690N/7	6690NB/7	6690NM/7A#	182	269	127	184	184	123	135	161	167	168
6690N/M28	6690NB/M28	6690NM/M28A#	270	400	189	274	273	183	200	239	249	250
6690N/9	6690NB/9	6690NM/9A#										
6690N/11	6690NB/11	6690NM/11A#	345	510	242	350	349	233	255	305	318	319
6690N/13	6690NB/13	6690NM/13A#	655	968	458	663	661	443	484	579	603	605
6690N/M42	6690NB/M42	6690NM/M42A#										

Catalogue Number			Refrigerants								
			R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270
6690N/7	6690NB/7	6690NM/7A#	170	130	215	219	156	218	256	227	227
6690N/M28	6690NB/M28	6690NM/M28A#	253	193	319	325	232	324	380	337	337
6690N/9	6690NB/9	6690NM/9A#									
6690N/11	6690NB/11	6690NM/11A#	323	246	407	415	296	414	485	430	430
6690N/13	6690NB/13	6690NM/13A#	613	467	772	788	561	785	920	816	816
6690N/M42	6690NB/M42	6690NM/M42A#									

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

**TABLE 18: Refrigerant flow capacity of 3-way valves in suction line [kW]**

Catalogue Number			Refrigerants									
			R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6690N/7	6690NB/7	6690NM/7A#	19	45	24	24	35	24	16	15	26	24
6690N/M28	6690NB/M28	6690NM/M28A#	29	68	35	36	52	35	23	23	38	35
6690N/9	6690NB/9	6690NM/9A#										
6690N/11	6690NB/11	6690NM/11A#	37	86	45	46	67	45	30	29	49	45
6690N/13	6690NB/13	6690NM/13A#	70	164	85	87	127	86	57	55	92	85
6690N/M42	6690NB/M42	6690NM/M42A#										

Catalogue Number			Refrigerants									
			R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270	
6690N/7	6690NB/7	6690NM/7A#	17	23	37	37	19	33	14	17	37	
6690N/M28	6690NB/M28	6690NM/M28A#	25	34	55	56	28	48	21	25	55	
6690N/9	6690NB/9	6690NM/9A#										
6690N/11	6690NB/11	6690NM/11A#	32	43	71	71	36	62	26	32	71	
6690N/13	6690NB/13	6690NM/13A#	61	81	134	135	69	117	50	61	134	
6690N/M42	6690NB/M42	6690NM/M42A#										

Standard rating conditions according to AHRI Standard 760-2014

Condensing temperature	110 °F	(43,3 °C)
Liquid temperature	100 °F	(37,8 °C)
Subcooling	10 °R	(5,5 °K)
Evaporating temperature	40 °F	(4,4 °C)
Evaporator superheating	10 °R	(5,5 °K)
Suction line temperature	65 °F	(18,3 °C)
Suction superheating	15 °R	(8,4 °K)
Discharge temperature	160 °F	(71,1 °C)

**TABLE 19: Refrigerant flow capacity of 3-way valves in hot gas line [kW]**

Catalogue Number			Refrigerants									
			R134a	R32	R404A	R407C	R410A	R507	R1234yf	R1234ze	R448A	R449A
6690N/7	6690NB/7	6690NM/7A#	91	194	103	127	146	102	71	73	126	115
6690N/M28	6690NB/M28	6690NM/M28A#	135	289	153	189	216	152	106	109	188	171
6690N/9	6690NB/9	6690NM/9A#										
6690N/11	6690NB/11	6690NM/11A#	173	369	195	242	276	194	135	139	240	219
6690N/13	6690NB/13	6690NM/13A#	327	699	370	458	524	367	256	264	454	415
6690N/M42	6690NB/M42	6690NM/M42A#										

Catalogue Number			Refrigerants									
			R450A	R452A	R452B	R454B	R513A	R290	R600	R600a	R1270	
6690N/7	6690NB/7	6690NM/7A#	82	107	164	165	87	137	69	80	154	
6690N/M28	6690NB/M28	6690NM/M28A#	122	159	243	245	129	203	103	118	229	
6690N/9	6690NB/9	6690NM/9A#										
6690N/11	6690NB/11	6690NM/11A#	155	203	311	313	165	259	131	151	292	
6690N/13	6690NB/13	6690NM/13A#	295	384	589	594	313	491	249	286	554	
6690N/M42	6690NB/M42	6690NM/M42A#										

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

TABLE 20: Dimensions and weights of 3-ways valves

Catalogue Number	Figure	Dimensions [mm]						Weight [g]
		H	H1	H2 (1)	L	L1	Ch	
6690NM/7A2	3	188	82	246	172	94	6	2,6
6690NM/7A6	4	210		246				2,7
6690NM/M28A2	3	210	100	268	208	111		3,5
6690NM/M28A6	4	231		268				3,6
6690NM/9A2	3	210	100	268	208	111		3,5
6690NM/9A6	4	231		268				3,6
6690NM/11A2	4	240	103	273	211	113	10	4,2
6690NM/11A6	4							4,3
6690NM/13A2	4	263	121	293	240	127		5,2
6690NM/13A6	4							5,3
6690NM/M42A2	4	263	121	296	240	127		5,2
6690NM/M42A6	4							5,3

(1): total height with optional auxiliary contact

Fig. 1

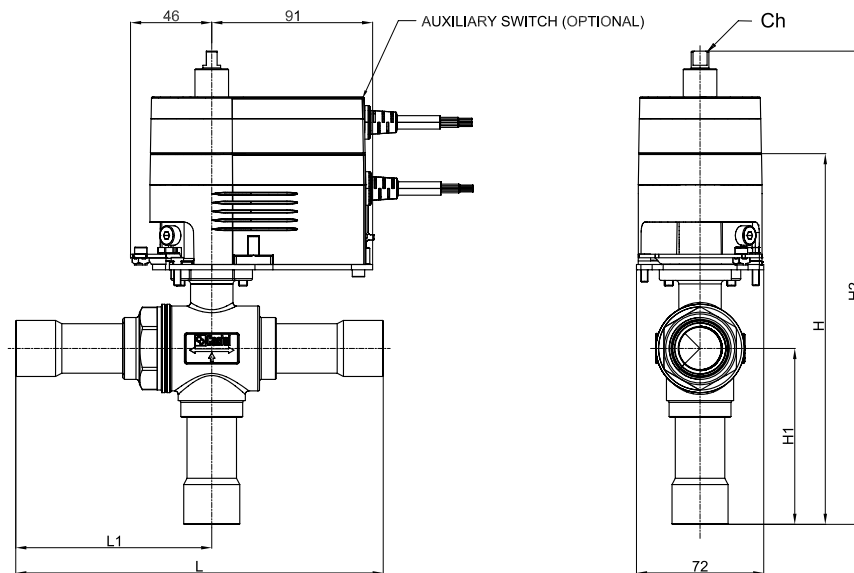
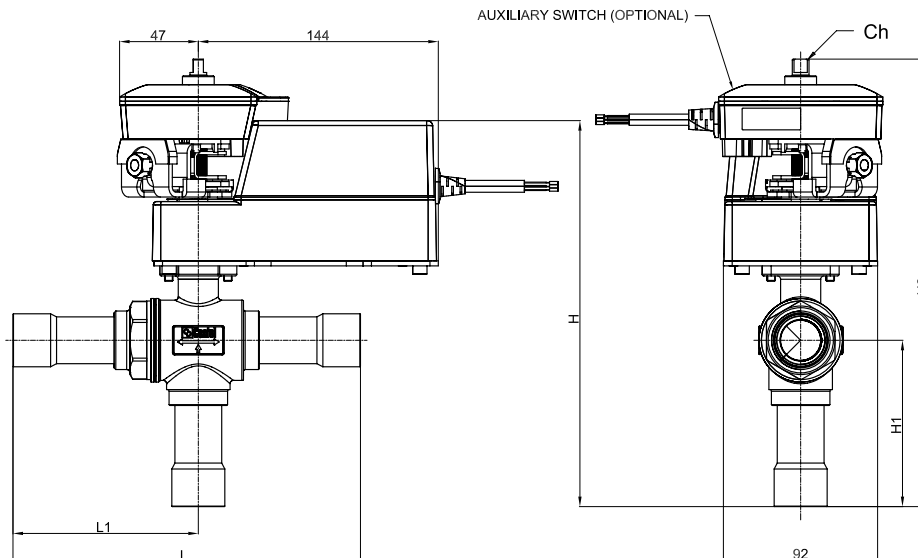


Fig. 2







## 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 6570N and 6571N
- 3-way manual valves with ball shutter in series 6690N and 6690NB

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 6690NM.

## 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.

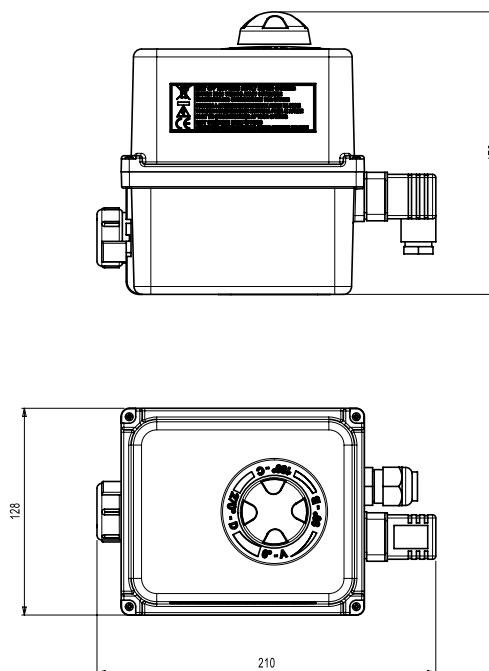
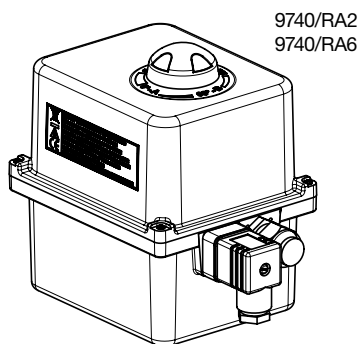
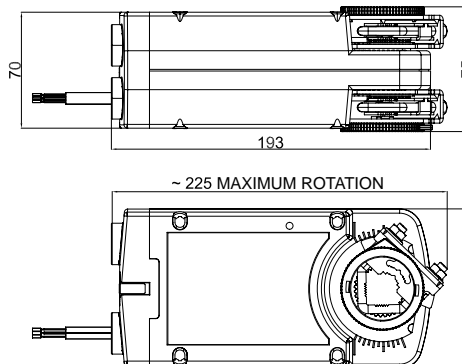
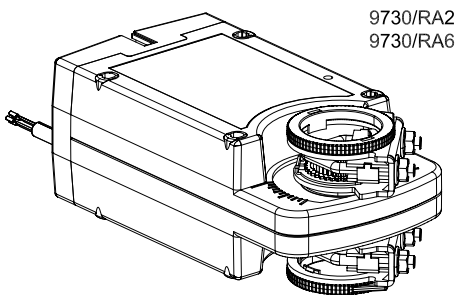
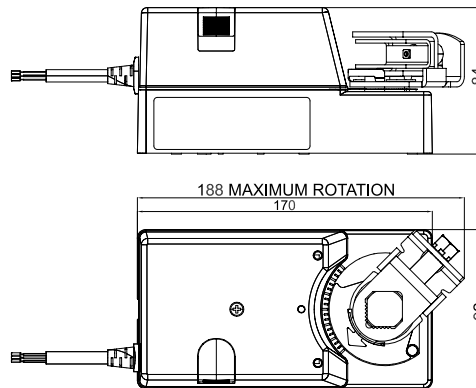
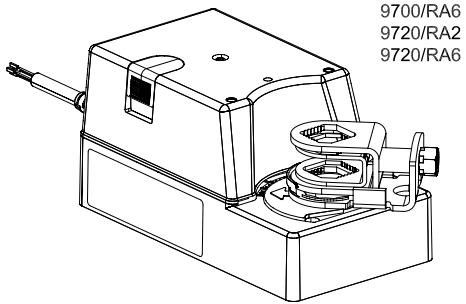
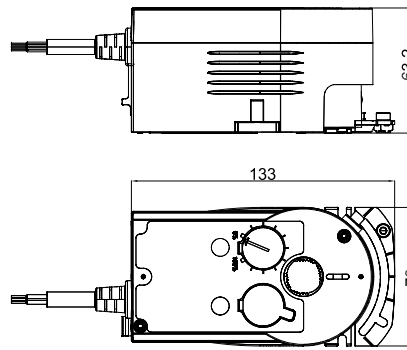
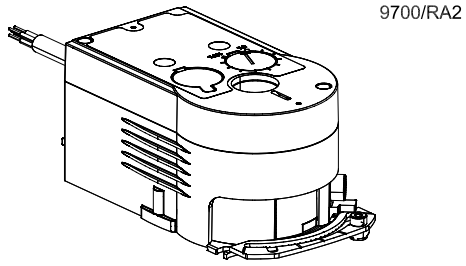


TABLE 21: General characteristics of actuators

Catalogue Number	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Active Power [W]		Apparent Power [VA]	
				Operation	Standstill	Operation	Standstill
9700/RA2	24 A.C.	+20 / -20	50 / 60	4,8	1,5	8,7	3
	24 D.C.	+20 / -20	-				
9700/RA6	230 A.C.	+15 / -15	50 / 60	2,9	0,5	5,6	5,1
9720/RA2	24 A.C.	+20 / -20	50 / 60	2,4	0,26	4,3	0,48
	24 D.C.	+20 / -20	-				
9720/RA6	230 A.C.	+15 / -15	50 / 60	3,7	1,1	4,7	2,7
9730/RA2	24 A.C.	+20 / -20	50 / 60	13,5	1,5	16,5	ND
	24 D.C.	+20 / -20	-				
9730/RA6	230 A.C.	+15 / -15	50 / 60	13	2,0	20	ND
9740/RA2	24 A.C.	+20 / -20	50 / 60	45	ND	60	ND
	24 D.C.	+20 / -20	-				
9740/RA6	230 A.C.	+10 / -10	50 / 60	45	ND	60	ND
	230 D.C.	+10 / -10	-				

Catalogue Number	Torque [Nm]	Running Time [sec]	Rotation Angle	Wiring Connections		Auxiliary switches	Protection Degree	TA [°C]	
				Switching output 2 point (Open/ Close)	Continuous output (0 - 10V)			min.	max.
9700/RA2	10	60	90	YES	YES	external see tab. 22	IP 54	-20	+50
9700/RA6				YES	NO		IP 43		
9720/RA2	30	120		YES	YES	external see tab. 22	IP 54		
9720/RA6				YES	NO		IP 43		
9730/RA2	60	150		NO	YES	ND	IP 54	-30	+50
9730/RA6				YES	NO		IP 54		
9740/RA2	100	120		NO	YES	internal	IP 66	-10	55
9740/RA6				YES	NO		IP 66		



## 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 auxiliary 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.

## OPERATION

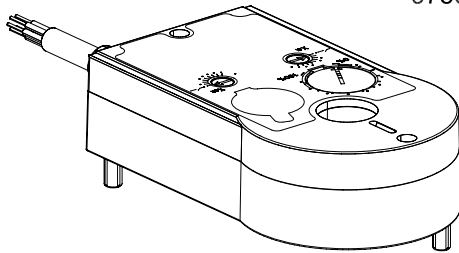
To install the contacts on the actuators and cable them, follow the instructions provided in the package carefully. The settings for the switching positions must be performed using the two trimmers present on the yellow cover (see the instructions).



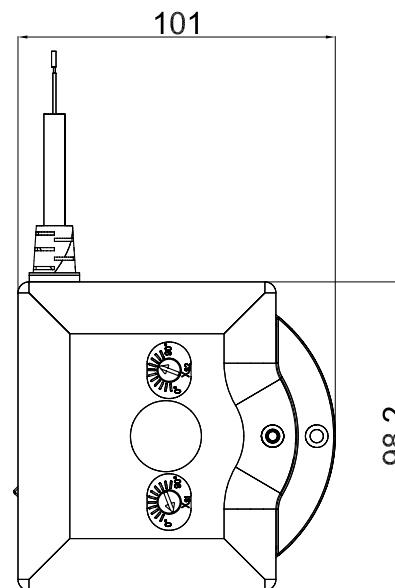
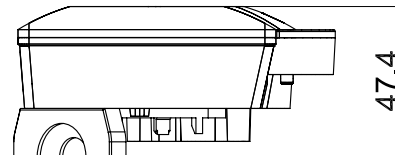
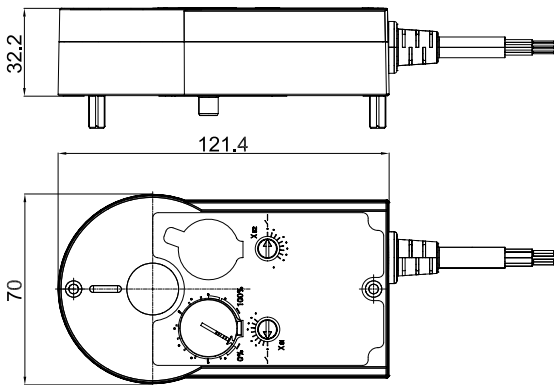
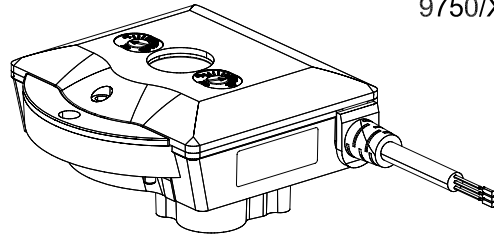
TABLE 22: General characteristics of auxiliary switches

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		

9750/X01



9750/X02







## 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 6570N, 6571N. 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

## OPERATION

To assemble the adapter on the valve and then the actuator to the adapter, carefully follow:

- the instruction sheet in the adapter packaging
- the instruction sheet in the actuator packaging

Table 29 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.



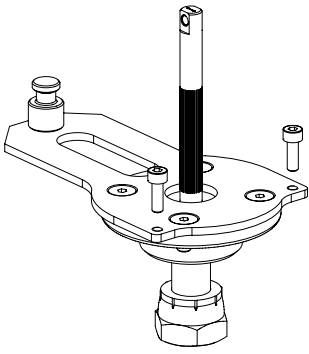
TABLE 23: Coupling schemes: valve + actuator + adapter + switches

Ball Valve Catalogue No		Torque [Nm]	Voltage [V]	Actuator Catalogue No	Adapter Catalogue No	Auxiliary switches Catalogue No				
6570N/M6	6570N/M6A	10	24	9700/RA2	9901/X58	9750/X01				
6570N/3	6570N/3A									
6570N/M10	6570N/M10A									
6570N/M12	6570N/M12A									
6570N/4	6570N/4A									
6571N/5	–									
6570N/M15	6570N/M15A									
6570N/5	6570N/5A									
6570N/M18	6570N/M18A									
6570N/6	6570N/6A									
6571N/7	–									
6570N/7	6570N/7A	10	24	9700/RA2	9901/X60	9750/X01				
6571N/M28	–									
6571N/9	–									
6570N/M28	6570N/M28A						230	9700/RA6	9901/X57	9750/X02
6570N/9	6570N/9A									
6571N/11	–									
6570N/11	6570N/11A	30	24	9720/RA2	9901/X75	9750/X02				
6570N/13	6570N/13A									
6570N/M42	6570N/M42A						230			
6570N/17	6570N/17A	60	24	9730/RA2	9901/X76	–				
				230			9730/RA6			
6570N/M64	6570N/M64A	100	24	9740/RA2	9901/X70	–				
–	6570N/21A				230		9740/RA6	9901/X71		
	6570N/24A									
	6570N/25A									
	6570N/28A									
	6570N/29A							9901/X72		

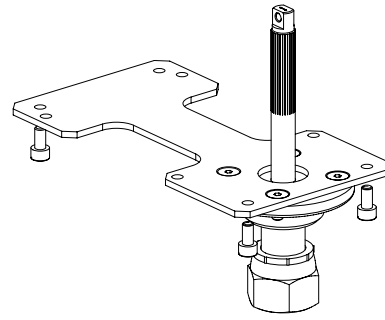
TABLE 24: Dimensions of ball valves with actuator

Ball Valve Catalogue No		Actuator Catalogue No	H	H1	H2 (1)	L	L1	I	d	Ch	Figure		
6570N/3	6570N/3A	9700/RA2	147	15	179	121	65	18	M4	6	1		
6570N/M10	6570N/M10A												
6570N/M12	6570N/M12A												
6570N/4	6570N/4A												
6571N/5	-		138	73,5									
6570N/M15	6570N/M15A		154	19	186	139	73	25,5					
6570N/5	6570N/5A												
6570N/M18	6570N/M18A												
6570N/6	6570N/6A												
6571N/7	-		175	90,5									
6570N/7	6570N/7A		167	23	199	175	94	30					
6571N/M28	-					206	109						
6571N/9	-					204	109						
6570N/M28	6570N/M28A												
6570N/9	6570N/9A		176	27	207	204	109						
6571N/11	-					24	130						
6570N/7	6570N/7A	9700/RA6				188	23	210	175	94	30	M4	6
6571N/M28	-		206	109									
6571N/9	-		197	27	218			204	109				
6570N/M28	6570N/M28A							24	130				
6570N/9	6570N/9A												
6571N/11	-	24	130										
6570N/11	6570N/11A	9720/RA2-RA6	212	32	233	213	114	42	M6	6	2		
6570N/13	6570N/13A		225	39	247	242	129						
6570N/M42	6570N/M42A												
6570N/17	6570N/17A	9730/RA2-RA6	238	49	-	281	153	55	M6	20	3		
6570N/M64	6570N/M64A	9740/RA2-RA6	330	55	-	343	186	75	M8	-	4		
-	6570N/21A												
-	6570N/24A		357	70	-	365	197	89					
-	6570N/25A												
-	6570N/28A												
-	6570N/29A	366	75	-	373	198	75	M8	-				

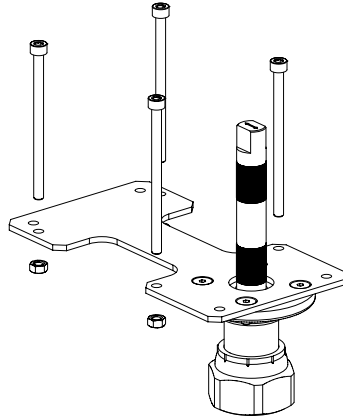
(1): total height with optional auxiliary contact



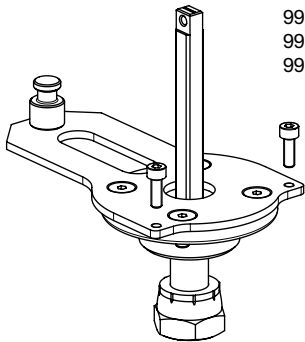
9901/X21  
9901/X27  
9901/X30



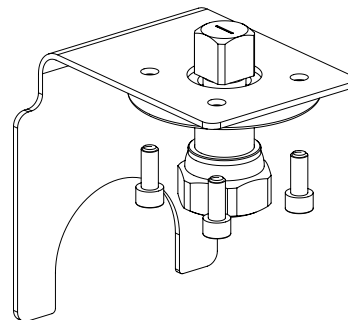
9901/X22  
9901/X23  
9901/X28  
9901/X38



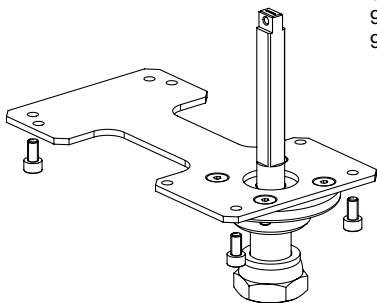
9901/X37  
9901/X39  
9901/X40



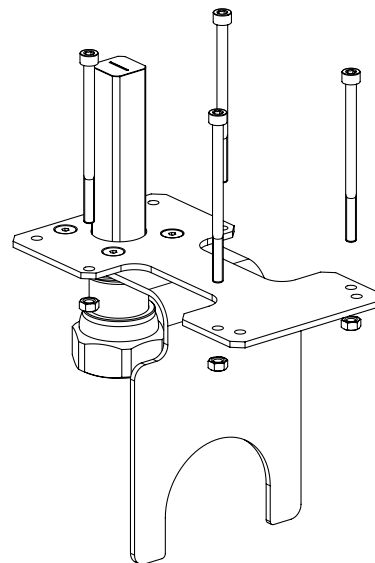
9901/X58  
9901/X60  
9901/X73



9901/X70  
9901/X71  
9901/X72



9901/X57  
9901/X74  
9901/X75



9901/X76

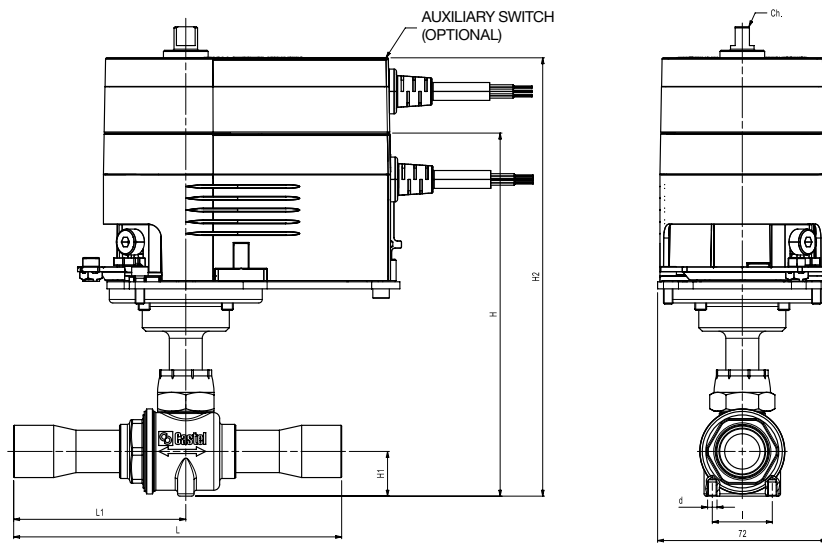


FIGURA 1

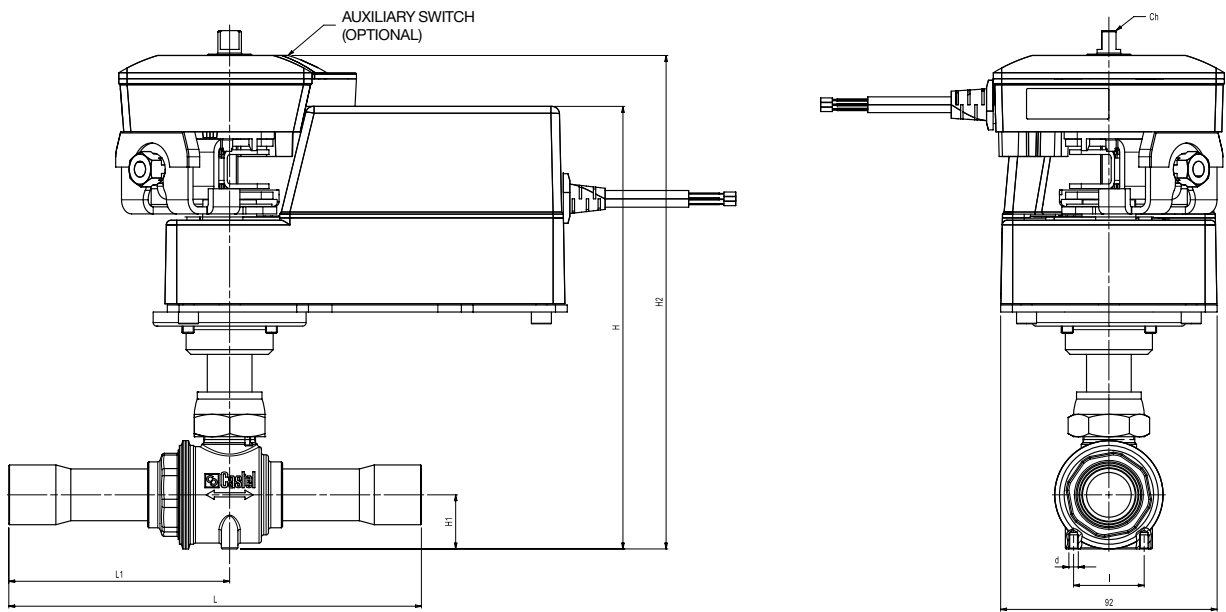


FIGURA 1

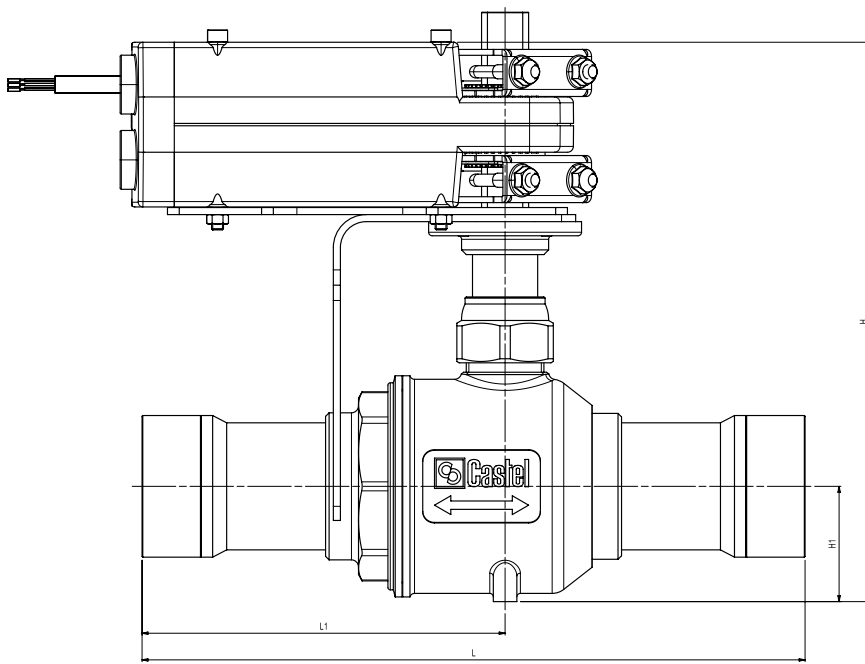


FIGURA 3

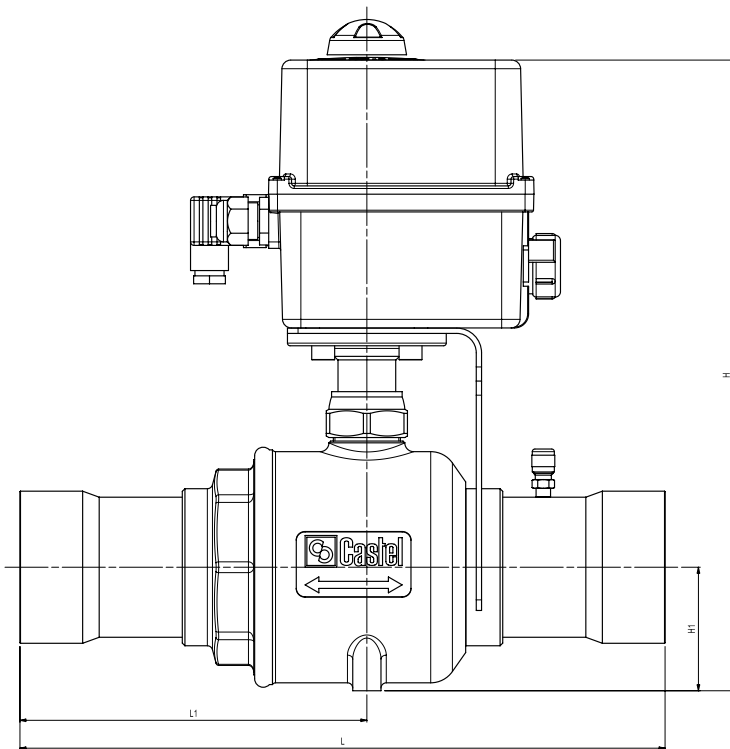


FIGURA 4







The background of the entire page is a complex, repeating pattern of blue geometric shapes, primarily triangles and polygons, creating a faceted, crystalline effect. The colors range from deep navy blue to lighter, almost white highlights, giving it a three-dimensional appearance.

# PIPING ACCESSORIES

P  LYHEDRA

# PIPING ACCESSORIES

## 9.1 – VIBRATION ABSORBERS

### APPLICATIONS

The vibration absorbers in series 7690N are considered “Pressure Accessories” according to the definition provided in Article 2, Point 5 of the Directive 2014/68/EU (PED Recast) and are subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

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 following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

### CONSTRUCTION

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

The main parts of vibration absorbers are manufactured with the following materials:

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

### INSTALLATION

The vibration absorbers can be installed both on suction and discharge lines, as close as possible to the compressor. They are not designed to compensate possible piping misalignment.

Vibration absorbers should be installed perpendicularly to the direction of vibration. In the case of vertical and horizontal vibrations, two vibrations absorbers should be used perpendicular to each other, as shown in Fig. 2 and 3. For the maximum absorption of

vibrations, the refrigerant line should be anchored at the vibration absorber end, as shown in Fig. 2 and 3.

Castel vibration absorbers can be installed vertically too, because they are designed to avoid the retention of condensation in the wavy area near to the connections. There are no issues when employing them at temperatures below 0°C.

Vibration absorbers are not designed to absorb axial or torsional stress. Care should be taken to allow sufficient space to avoid compression or tension, after installation.

High-speed refrigerant fluid can produce vibrations and noise phenomena. In this case, it is recommended that a larger size vibration absorber be installed

The connection of the vibration absorbers to the piping is normally performed by brazing. The specific design and construction of vibration absorbers allows the installer to perform this operation without special protection to prevent overheating, generated in this phase.

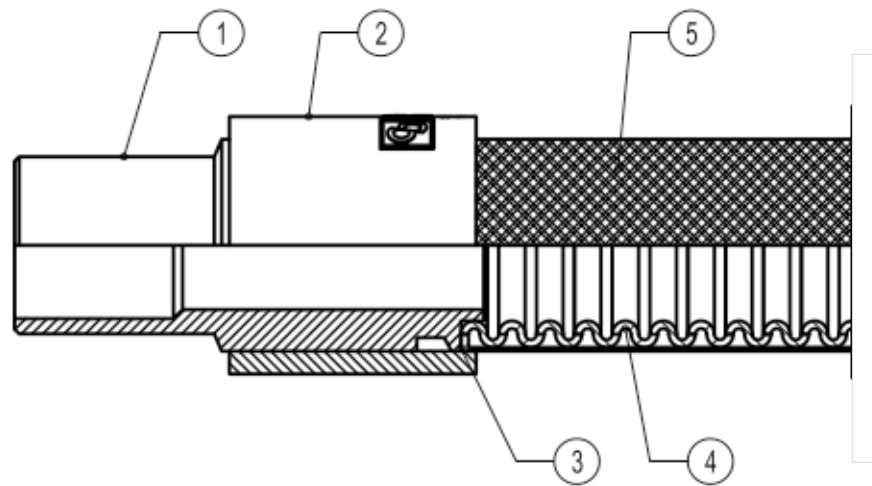
It is given that best installation calls for the vibration absorber to be linear. A misalignment from the axis of no more than 3% of the length of the corrugated hose is allowed.

**WARNING! Ensure a gap corresponding to the 2% of the total length of the vibration absorber to compensate any extensions due to possible thermal expansion.**



TABLE 1: General characteristics of vibration absorbers

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



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

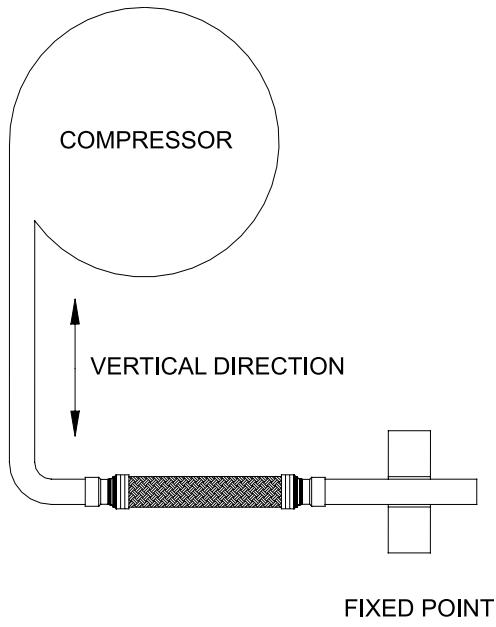


Fig. 2

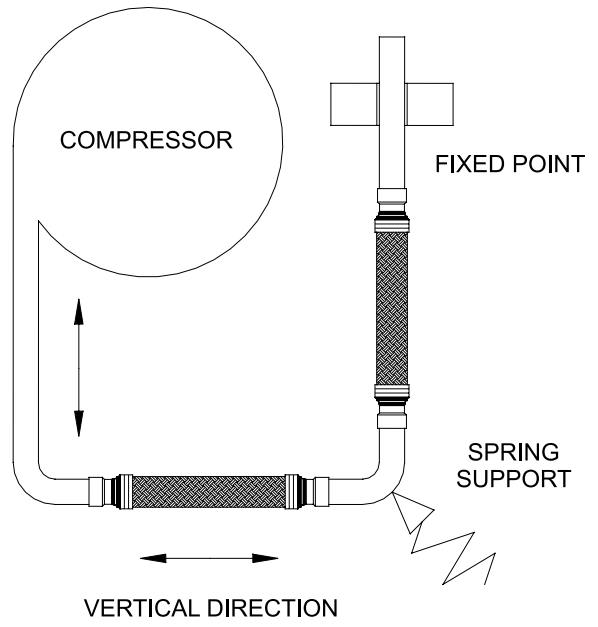
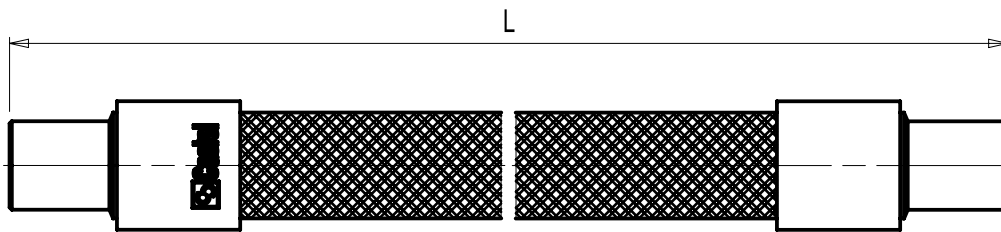


Fig. 3



# PIPING ACCESSORIES

## 9.2 – THREADED BRASS FITTINGS

### APPLICATIONS

The threaded brass fittings are excluded from the scope of application of Directive 2014/68/EU, as specified in Guidelines 1/8 and 1/9, because they are piping components.

These fittings are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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

the following materials:

- Hot forged brass EN 12420 – CW 617N for bushes and flanges.
- Aramid fibres for flange gaskets.

### 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, and all the elbows, T and cross fittings, from series 7210 to series 7410, are manufactured with hot forged brass EN 12420 – CW 617N.

All straight fittings, from series 7110 to series 7170, and all plugs, from series 7510 to series 7520, 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





TABLE 2: General characteristics of flange joints

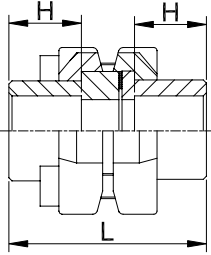
	Catalogue Number	Connections		PS [bar]	TS [°C]		Dimensions [mm]		Wrench torque min/max [Nm]	Weight [g]
		ODS			min	max	H	L		
		Ø [in.]	Ø [mm]							
	7630/7	7/8"	–	45	-40	+130	22	63	20 / 24	612
	7630/9	1.1/8"	–				23			490
	7630/11	1.3/8"	35				24			1100
	7630/13	1.5/8"	–				42 / 50	1412		
	7630/M42	–	42							
	7630/17	2.1/8"	54				25	71	68 / 80	2020

TABLE 3: General characteristics of unions

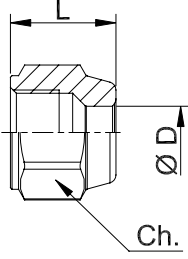
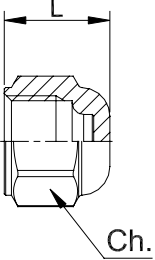
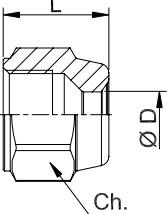
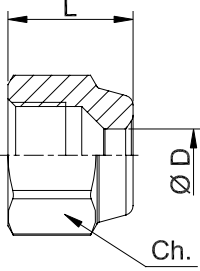
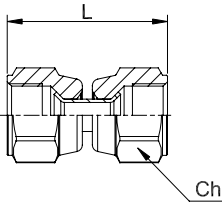
	Catalogue Number	International Reference	SAE Flare	Copper pipe		PS [bar]	Dimensions [mm]			Wrench torque min / max [Nm]	Weight [g]
				Ø [in.]	Ø [mm]		Ø D	L	Ch		
SAE-Flare nuts (inch tubing)											
	7010/22	NS4-4	1/4"	1/4"	6	50	6,5	15,5	17	11 / 14	19
	7010/33	NS4-6	3/8"	3/8"	–		9,7	19,5	22	20 / 25	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
SAE-Flare cap nuts											
	7020/20 (1)	N5-4 CAP NUT	1/4"	blind	blind	120	–	15	16	8,5 / 11,5	16
	7020/X02 (1)	N5-5 CAP NUT	5/16"	blind	blind	120	–	19,5	22	20 / 25	41
	7020/30	N5-6 CAP NUT	3/8"	blind	blind	120	–	22,5	25	34 / 47	60
	7020/40	N5-8 CAP NUT	1/2"	blind	blind	120	–	25	28	54 / 75	71
SAE-Flare reducing nuts (inch tubing)											
	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

TABLE 3: General characteristics of unions

	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			
SAE-Flare nuts (metric tubing)												
	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				36	
	7030/4M10		1/2"		10		10,2	25	25	34 / 47	52	
	7030/4M12				12		12,2				51	
	7030/X04 (2)				12		12,5				19,5	46
	7030/4M14				14		14,2				22,5	48
	7030/5M12		5/8"		12		12,2	25	28	54 / 75	71	
	7030/5M14				14		14,2				69	
	7030/6M14		3/4"		14		14,2	29,5	33	68 / 71	107	
	7030/6M18				18		18,2				102	
	SAE-Flare twin nuts											
	7050/2	US4-4	1/4"	-	-	50	-	32	17	11 / 14	39	
	7050/3	US4-6	3/8"					40	22	20 / 25	75	
	7050/4	US4-8	1/2"					46	25	34 / 47	105	
	7050/5	US4-10	5/8"					51	28	54 / 75	140	

(1): copper gasket doesn't need  
 (2) shortened

TABLE 4: General characteristics of unions

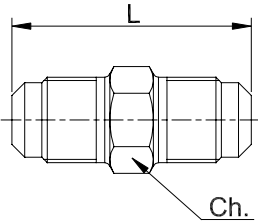
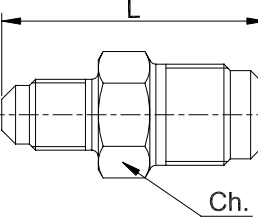
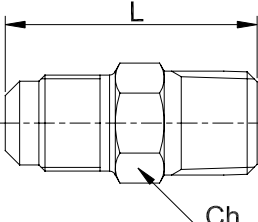
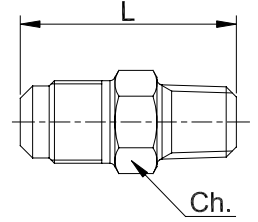
	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare	NPT		L	Ch	
SAE-Flare unions								
	7110/2	U2-4	1/4"	-	120	38	12	23
	7110/3	U2-6	3/8"			44	17	46
	7110/4	U2-8	1/2"			50	20	73
	7110/5	U2-10	5/8"			58	23	113
	7110/6	U2-12	3/4"			63	27	164
	7110/8	U2-16	1"			72	36	304
Reducing SAE-Flare unions								
	7120/23	UR2-64	1/4" x 3/8"	-	120	42	17	38
	7120/24	UR2-84	1/4" x 1/2"			45	20	58
	7120/34	UR2-86	3/8" x 1/2"			48		66
	7120/35	UR2-106	3/8" x 5/8"			52	23	89
	7120/45	UR2-108	1/2" x 5/8"			54	23	98
	7120/46	UR2-128	1/2" x 3/4"			57,5	27	136
	7120/56	UR2-1210	5/8" x 3/4"			61,5	27	150
SAE Flare / NPT unions								
	7130/2	U1-4B	1/4"	1/4"	120	38,1	14	32
	7130/3	U1-6C	3/8"	3/8"		41,2	17	48
	7130/4	U1-8D	1/2"	1/2"		49,8	22	92
	7130/6	U1-12F	3/4"	3/4"		57,6	27	152
	7130/8	U1-16H	1"	1"		68	36	277
SAE Flare / NPT reducing unions								
	7140/21	U1-4A	1/4"	1/8"	120	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

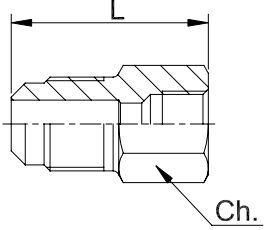
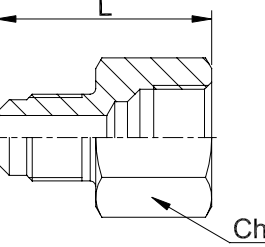
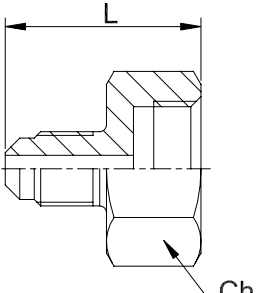
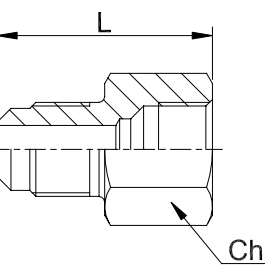
	Catalogue Number	International Reference	Connections						PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT	GAS	ODS			L	Ch	
			m	f			Ø [in.]	Ø [mm]				
Male/female reducing unions (reduced female)												
	7150/21	U3-4A	1/4"	–	1/8" f					29	14	21
	7150/32	UR3-46	3/8"	1/4"						33	17	38
	7150/42	UR3-48	1/2"	1/4"						35	22	75
	7150/43	UR3-68	1/2"	3/8"		–	–	–	120	38	22	66
	7150/54	UR3-810	5/8"	1/2"						45	25	99
	7150/64	UR3-812	3/4"	1/2"						46,5	27	132
	7150/65	UR3-1012	3/4"	5/8"						49,5	30	157
Male/female reducing unions (reduced male)												
	7150/X29	–	–	1/4"	1/8"					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"		–	–	–	120	39		74
	7150/45	UR3-108	1/2"	5/8"						44	30	125
	7150/46	UR3-128	1/2"	3/4"						45	34	142
	7150/56	UR3-1210	5/8"	3/4"						49	34	157
Cylinder adaptors												
	7154/2		1/4"								25	46
	7156/2	–	1/4"						45	29		52
Male/female unions												
	7160/2		1/4"	1/4"						30,5	17	31
	7160/3	–	3/8"	3/8"		–	–	–	45	36	22	57
	7160/4		1/2"	1/2"						41	25	84

TABLE 5: General characteristics of unions

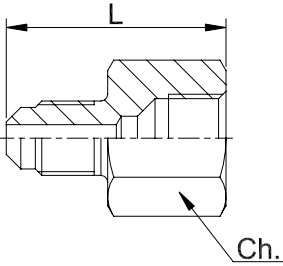
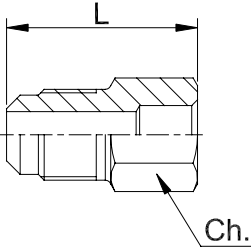
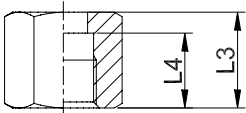
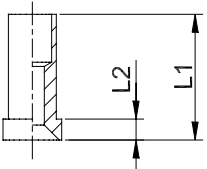

	Catalogue Number	International Reference	Connections						PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT	GAS	ODS			L	Ch	
			m	f			Ø [in.]	Ø [mm]				
Unions SAE-Flare to BSP												
	7164/2		1/4"	-		G1/4" f			45	32,5	20	45
	7166/2	-	-	1/4"		G1/4" m				32	17	25
Male SAE-Flare/solder unions												
	7170/22	US3-44	1/4"				1/4"	-	120	26,5	12	17
	7170/2M8	-					-	8				
	7170/33	US3-66	3/8"				3/8"	-		33	17	39
	7170/3M8	-					-	8				
	7170/3M10	-					-	10				
	7170/34	US3-68	1/2"				1/2"	-		35	20	53
	7170/44	US3-88					-	-				
	7170/4M12	-	-				12	42		23	82	
	7170/55	US3-1010	5/8"				16					
	7170/6M18	-	3/4"				-	18		45,5	27	123
	7170/65	US3-1210					5/8"	16				
	7170/87	US3-1614					7/8"	22				

TABLE 6: General characteristics of unions

	Catalogue Number	Item Position	Connections			PS [bar]	Dimensions [mm]					Wrench torque min / max [Nm]	Weight [g]
			SAE Flare	ODS			L1	L2	L3	L4	Ch		
				Ø [in.]	Ø [mm]								
Flare / ODS adapters													
<p>POS.1</p>  <p>POS.2</p>  <p>POS.3</p> 	9901/X11	1	1/4"	-	6	120	-	-	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/--	1	1/4"	-	-	-	-	16	12,5	17	11 / 14	23		
	1	3/8"	-	-	-	-	18,5	14,7	22	20 / 25	39		
	1	1/2"	-	-	-	-	21	17	27	34 / 47	67		
	1	5/8"	-	-	-	-	22,5	18	30	54 / 75	83		
	1	3/4"	-	-	-	-	25	20	36	68 / 71	129		

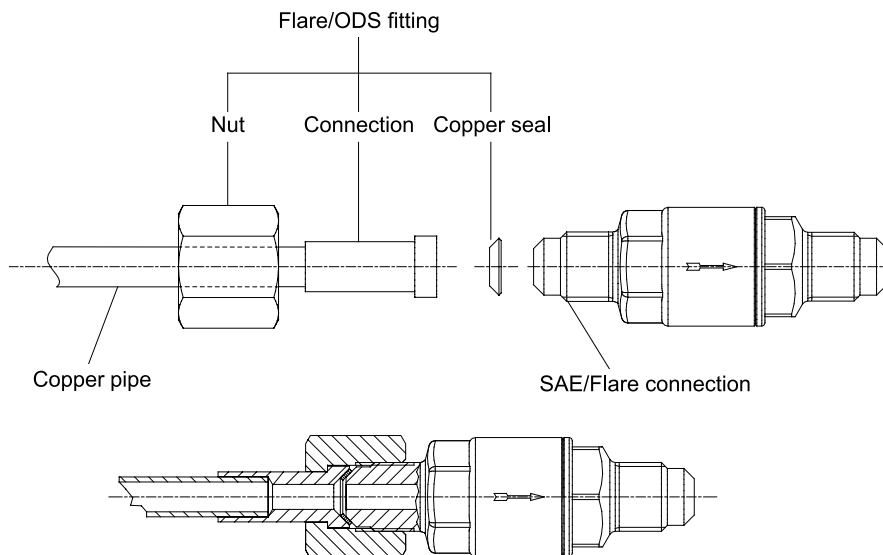


TABLE 7: General characteristics of unions

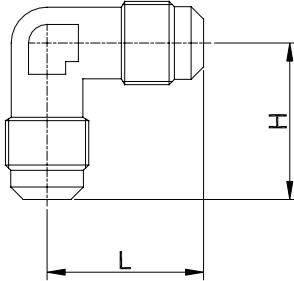
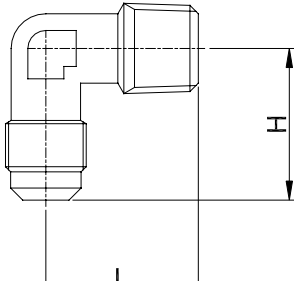
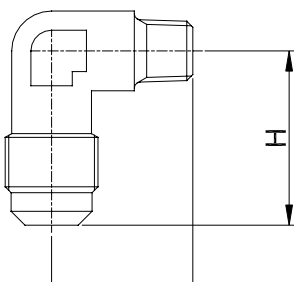
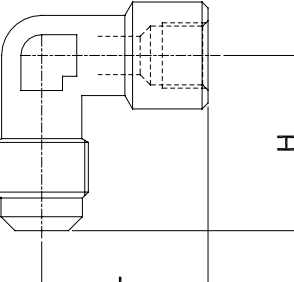
	Catalogue Number	International Reference	Connections			PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare		NPT		H	L	
			m	f					
SAE-Flare elbows									
	7210/2	E2-4	1/4"			120	24,5	24,5	24
	7210/3	E2-6	3/8"				29,5	29,5	60
	7210/4	E2-8	1/2"	-	-		32,5	32,5	80
	7210/5	E2-10	5/8"				36	36	116
	7210/6	E2-12	3/4"				42,5	42,5	192
SAE-Flare / NPT elbows									
	7220/2	E1-4B	1/4"		1/4"	120	26	24	33
	7220/3	E1-6C	3/8"		3/8"		29,5	28,5	54
	7220/4	E1-8D	1/2"		1/2"		32,5	32	91
	7220/6	E1-12F	3/4"		3/4"		42,5	39,5	183
SAE-Flare / reduced NPT elbows									
	7230/21	E1-4A	1/4"		1/8"	120	24,5	23,5	25
	7230/32	E1-6B	3/8"		1/4"		29,5	29,5	46
	7230/43	E1-8C	1/2"		3/8"		32,5	31	97
	7230/54	E1-10D	5/8"		1/2"		36	35	112
Male/female SAE-Flare elbows									
	7240/2		1/4"	1/4"		120	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

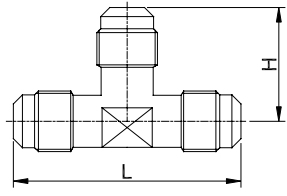
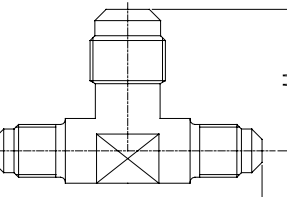
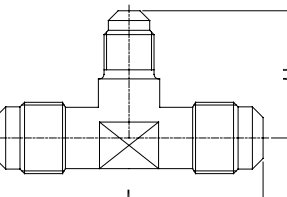
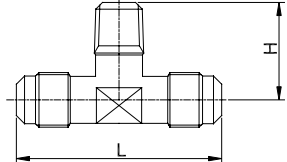
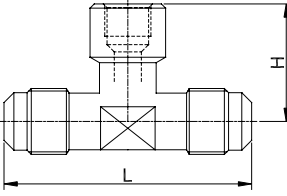
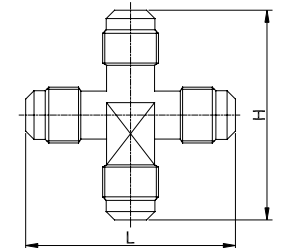
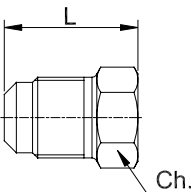
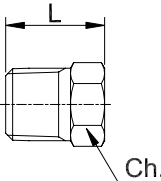
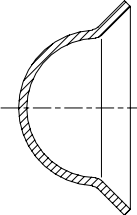

	Catalogue Number	International Reference	Connections					PS [bar]	Dimensions [mm]		Weight [g]
			SAE Flare				NPT (3)		H	L	
			(1)	(2)	(3)	(4)					
SAE-Flare TEE											
	7310/2	T2-4	1/4"	1/4"	1/4"	-	-	120	23,5	47	35
	7310/3	T2-6	3/8"	3/8"	3/8"				29	58	70
	7310/4	T2-8	1/2"	1/2"	1/2"				31,5	63	98
	7310/5	T2-10	5/8"	5/8"	5/8"				36	72	150
	7310/6	T2-12	3/4"	3/4"	3/4"				41,5	83	235
SAE-Flare reducing TEE ( reduced side connections)											
	7320/223	TR2-46	1/4"	1/4"	3/8"	-	-	120	29	56	77
	7320/334	TR2-68	3/8"	3/8"	1/2"				32,5	63	95
	7320/445	TR2-810	1/2"	1/2"	5/8"				38	72	153
	7320/556	TR2-1012	5/8"	5/8"	3/4"				41,5	83	228
SAE-Flare reducing TEE ( reduced central connection)											
	7320/332	TR2-64	3/8"	3/8"	1/4"	-	-	120	28	58	77
	7320/443	TR2-86	1/2"	1/2"	3/8"				32,5	63	101
	7320/554	TR2-108	5/8"	5/8"	1/2"				38	72	149
	7320/665	TR2-1210	3/4"	3/4"	5/8"				41,5	83	232
SAE-Flare / NPT TEE ( taper central connection)											
	7330/221	T1-4A	1/4"	1/4"	-	-	1/8"	120	21	47	33
	7330/222	T1-4B	1/4"	1/4"			1/4"		24	51	45
	7330/332	T1-6B	3/8"	3/8"			1/4"		28	58	65
Male/female SAE-Flare TEE (female central connection)											
	7340/222	T6-4	1/4"	1/4"	1/4"	-	-	120	27,5	56	73
SAE-Flare cross											
	7410/2	C1-4	1/4"	1/4"	1/4"	1/4"	-	120	52	52	72

TABLE 9: General characteristics of unions

	Catalogue Number	International Reference	Connections		PS [bar]	Dimensions [mm]		Wrench torque min/max [Nm]	Weight [g]	
			SAE Flare	NPT		L	Ch			
SAE-Flare plugs										
	7510/2	P2-4	1/4"	-	120	23	12	11 / 14	19	
	7510/3	P2-6	3/8"				26	17	20 / 25	40
	7510/4	P2-8	1/2"				30	20	34 / 47	67
NPT plugs										
	7520/1	121-B-02	-	1/8"	120	15,9	12	10 / 13	12	
	7520/2	121-B-04		1/4"		23,1	14	15 / 20	27	
	7520/3	121-B-06		3/8"		23,2	17	17 / 22	43	
	7520/4	121-B-08		1/2"		29,8	22	25 / 35	87	
	7520/6	121-B-12		3/4"		32,1	27	30 / 40	149	
	7520/8	121-B-16		1"		39	34	60 / 80	279	
Copper seal caps										
	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	
	7560/7	B1-14	7/8"						5,3	
Copper gaskets										
	7580/2 (1)	B2-4	1/4"	-	120	-	-	-	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

## 9.3 – ACCESS FITTINGS AND VALVE CORE

### APPLICATIONS

The access fittings are excluded from the scope of application of Directive 2014/68/EU, as specified in Guidelines 1/8 and 1/9, because they are piping components.

The valve core is considered “Pressure Accessory” according to the definition provided in Article 2, Point 5 of said Directive and is subject to the classification indicated in Article 4, Points 1.c) and 3 of the same Directive.

The access fittings and the valve core are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HFC (R134a, R32, R404A, R407C, R410A, R507)
- HFO, HFO/HFC mixtures (R1234yf, R1234ze, R448A, R449A, R450A, R452A, R452B, R454B, R513A)
- HC (R290, R600, R600a, R1270)

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

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 ÷ 11.5 Nm. **Note: it is not necessary to use a copper gasket between union 7020/20 and the filling connector 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 ÷ 11.5 Nm. **Note: also in this case, it is not necessary to use a copper gasket between union 7020/X02 and the filling connector chosen.**

If a component other than the two blind unions in series 7020 must be tightened on the access fittings (for example a pressure gauge), a tapered gasket with tang (p/n 8580/2) must be positioned between the component and the chosen access fitting.

The access fittings have different shapes and sizes, according

to varying customer requirements. For all access fittings, the valve core seat is manufactured according to the ARI STANDARD 720:1997.

After tightening the valve core inside the access fitting with the dedicated wrench, p/n 8390/A, to the indicated torque, the refrigerant passage, filling or draining is obtained simply by activating the needle on the valve core.

### CONSTRUCTION

The straight fittings are machined by hexagonal brass bar EN 12164 – CW 614N.

The T and cross fittings are hot forged in brass EN 12420 – CW 617N.

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.

Valve core 8395/A3 is equipped with hydrogenated nitrile rubber (HNBR) gaskets

The tapered gasket with tang, 8580/2, is manufactured from copper Cu - ETP UNI 5649.



TABLE 10: General characteristics of access fittings

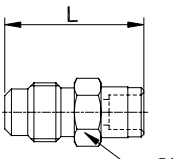
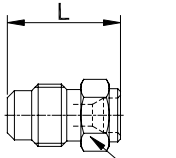
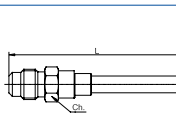
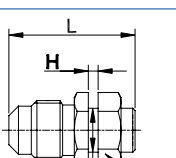
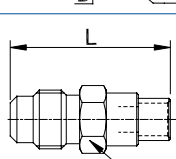
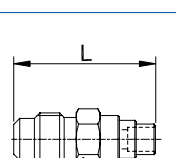
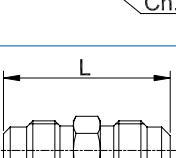
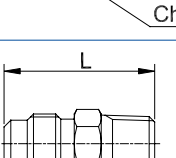
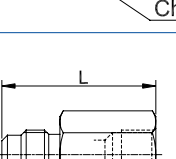
Drawing	Part number	Connections								PS [bar]	Dimensions [mm]				Weight [g]
		SAE Flare			NPT	ODS		IDS			L	Ch	D	H	
		Valve core	m	f		Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]						
Straight access fittings															
	8350/22	1/4"	-	-	-	1/4"	-	3/8"	-	120	26	11	-	-	12
	8350/X10	1/4"	-	-	-	1/4"	-	-	10		26	11	-	-	12
	8350/X01	1/4"	-	-	-	-	6	-	-	120	20	11	-	-	10
	8350/X03	1/4"	-	-	-	-	-	-	6	120	90	11	-	-	23
	8350/X06	1/4"	-	-	-	-	-	1/4"	-		126	11	-	-	28
	8350/X07	1/4"	-	-	-	-	-	1/4"	-		326	11	-	-	58
	8350/X12	1/4"	-	-	-	-	-	-	6		180	11	-	-	
	8350/X09	5/16"	-	-	-	1/4"	-	-	-	50	27	14	9,4	2,1	19
	8351/2	1/4"	-	-	-	-	6	-	8 - 10	120	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	120	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"	-	-	-	-	-	-	120	31	11	-	-	15
	8354/21	1/4"	-	-	1/8"	-	-	-	-	120	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"	-	-	-	-	-	120	35	17	-	-	42

TABLE 11: General characteristics of access fittings

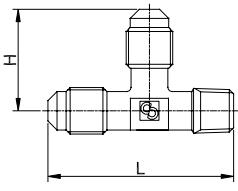
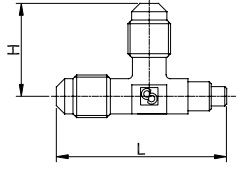
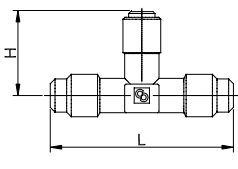
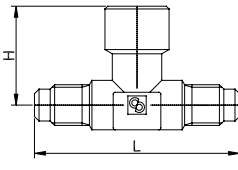
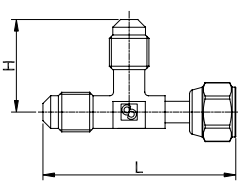
Drawing	Part number	Connections					PS [bar]	Dimensions [mm]			Wrench torque min / max [Nm]	Weight [g]	Note
		SAE Flare		NPT	IDS			L	Ch	H			
		m	f		Ø [in.]	Ø [mm]							
TEE access fittings													
	8380/122	1/4"	-	1/8"	-	-	120	45	-	24	-	31	The valve core may be installed on each of the two 1/4" SAE Flare male connections
	8380/222	1/4"	-	1/4"	-	-		49,5	-	25,5	-	44	
	8380/X01	1/4"	-	-	-	6	120	43	-	24	-	28	
	8380/X02	1/4"	-	-	-	7	120	48	-	22	-	33	
	8380/X09	1/4"	1/4"	-	-	-	120	56	-	27	-	70	
TEE access fittings with swivel nuts													
	8380/X06	1/4"	1/4"	-	-	-	45	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"	-	-	-	45	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

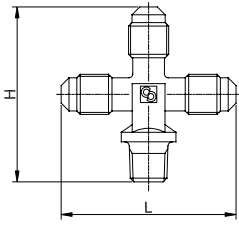
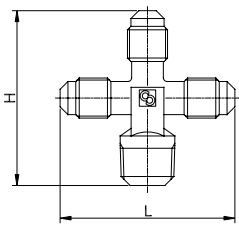
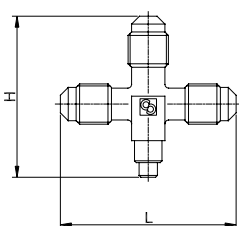
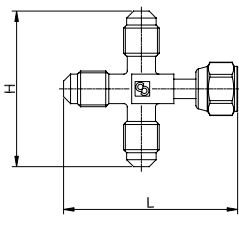
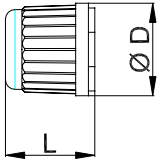
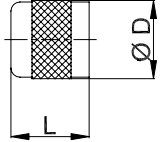
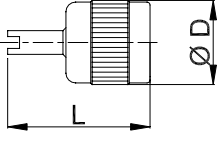
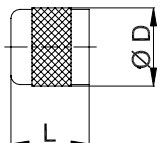
Drawing	Part number	Connections					PS [bar]	Dimensions [mm]			Wrench torque min / max [Nm]	Weight [g]	Note
		SAE Flare		NPT	IDS			L	Ch	H			
		m	f		Ø [in.]	Ø [mm]							
Cross access fittings													
	8382/1222	1/4"	-	1/8"	-	-	120	48	-	50	-	49	
	8382/X02	1/4"	-	1/4"	-	-	120	48	-	50	-	53	The valve core may be installed on each of the three 1/4" SAE Flare male connections
	8382/X01	1/4"	-	-	-	7-10	120	48	-	47	-	47	
	8382/X03	1/4"	-	-	-	6		48	-	44	-	42	
Cross access fittings with swivel nut													
	8382/X04	1/4"	1/4"	-	-	-	45	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



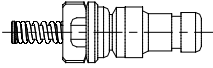
TABLE 13: General characteristics of caps with gasket

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) La chiave serve per il montaggio del meccanismo.
- (1) The key needs to remove the valve core

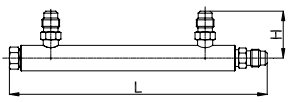
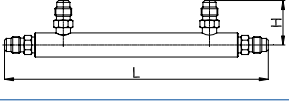
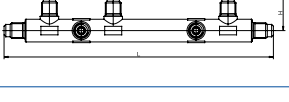
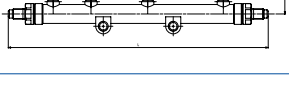
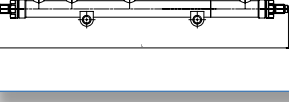
TABLE 14: General characteristics of valve cores

Drawing	Part number	Spring	Gaskets		Refrigerant Fluids	Max Static Pressure [bar]	Operating Pressure [bar]	Operating Temperature [°C]		Peak Temperature (1) [°C]	Dimensions [mm]		Wrench torque min / max (2) [Nm]	Weight [g]
			body	seat				min	max		L	D		
	8395/A3	outside	HNBR	HNBR	HFC (3) HFO (4) HC (5)	140	50	-25	+130	150	16,3	5,2x 0,705 V0.071	0,4/0,5 Nm	0,7

Note:

- (1) permitted value for shot period
- (2) To remove the valve core use the key code 8390/A
- (3) R134a, R32, R404A, R407C, R410A, R507
- (4) R1234yf, R1234ze, R448A, R449A, R450A, R452A
- (5) R290, R600, R600a

TABLE 15: General characteristics of manifolds with access fittings

Drawing	Part number	Connections	PS [bar]	Dimensions [mm]		Weight [g]	Note
		SAE Flare		L	H		
	9900/X87	1/4"	45	162	30	36	N° 3 access fittings
	9900/X47	1/4"	45	175	30	216	N° 4 access fittings
	9900/X81	1/4"	45	190	25	343	N° 7 access fittings
	9901/X43	1/4"	120	275	49	650	N° 6 access fittings
	9901/X44	1/4"	120	335	49	851	N° 6 access fittings





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