

HANDBOOK  
**EXPANSION VALVES**

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 **Castel**<sup>®</sup>  
Italian technology



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## THE NATURAL DEVELOPMENT OF QUALITY

Having achieved the goal of fifty-five years working in the Refrigeration and Air Conditioning Industry, Castel's range of quality products is well known and highly appreciated around the world. Quality is the product of our Company philosophy and marks every step of the production cycle. It is certified by the company's Quality Management System (certified by TUV SUD in accordance with the UNI EN ISO 9001:2008 standard), as well as by the various product certifications of compliance with European Directives and European and extra-European Quality Marks.

Product quality is connected with the quality of manufacturing. We produce on high-tech machinery and updated automatic production lines, operating in compliance with the current safety and environmental protection standards.

Castel offers the Refrigeration and Air Conditioning Market and Manufacturers tested certified products suitable for use with the HCF and HFO refrigerants currently used in the Refrigeration & Air Conditioning Industry.

Based on the experience gained in the refrigeration field using fluorinated fluids, Castel is proud to present the Refrigeration and Air Conditioning Market and Manufacturers two complete lines of products developed and proven for use in systems using natural refrigerants: hydrocarbons (HC fluids) and carbon dioxide (R744).





## DIRECTIVE 2014/68/EU ISSUED OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 15 MAY 2014 ON PRESSURE EQUIPMENT

Directive 2014/68/EU (PED Recast) applies to the design, manufacture and evaluation of compliance of pressure equipment and assemblies with a maximum allowable pressure, PS, greater than 0.5 bar excluding the cases listed in Article 1, Paragraph 2 of the Directive.

Directive 2014/68/EU was transposed into the Italian legal system by Legislative Decree No. 26 dated 15 February 2016, published in the Official Journal of the Republic of Italy No. 53 of 4 March 2016.

The revised PED Recast Directive repeals previous Directive 97/23/EC. More specifically:

- Article 13 of the PED Recast Directive, regarding the classification of pressure equipment, came into force as of 1 June 2015, and repeals Article 9 of the previous PED Directive.
- All other articles of the PED Recast Directive are in force as of 19 July 2016, repealing all articles of the previous PED directive.

All expansion valves illustrated in this technical handbook 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.

## EXTERNAL LEAKAGE

All the products illustrated in this Handbook individually undergo tightness tests as well as specific functional tests. The allowable external leakage, measurable during the test, complies with the requirements of standards:

- EN 12284:2003 – Refrigerating systems and heat pumps - Valves - Requirements, testing and marking
- EN 16084:2011 – Refrigerating systems and heat pumps - Qualification of tightness of components and joints

## PRESSURE CONTAINMENT

All the products illustrated in this Handbook, if submitted to hydrostatic testing, guarantee a pressure strength at least equal to  $1.43 \times PS$  in compliance with Directive 2014/68/EU.

All the products illustrated in this Handbook, if submitted to burst test, guarantee a pressure strength at least equal to  $3 \times PS$  according to EN 378-2: 2016 Standard.

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

## WEIGHT

The weights of the items listed in this Handbook include packaging and are not binding.

## WARRANTY

All Castel products are covered by a 12-month warranty. This warranty covers all products or parts thereof that turn out to be defective within the warranty period. In this case, at his own expenses, the customer shall return the defective item with a detailed description of the claimed defects. The warranty does not apply if the defect of the Castel product is due to mistakes by the customer or by third parties, such as incorrect installation, use contrary to Castel instructions, or tampering. In the event of defects found in its products, Castel will only replace the defective goods and will not refund damages of any kind. Castel reserves the right to make changes or modifications to its products at any time without prior notice.

The products listed in this handbook are protected according to law.

# CHAPTER 1 ■

## THERMOSTATIC EXPANSION VALVES

### FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



#### APPLICATIONS

The thermostatic expansion valves in series 221X, 222X, and 223X illustrated in this chapter are designed to work with the interchangeable orifice assembly, for flexible selection of capacity, and 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

That use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, or R507)

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

#### OPERATION

Thermostatic expansion valves regulate the flow of liquid refrigerant in evaporators. The superheating of the refrigerant fluid controls liquid injection. Thermostatic expansion valves act as throttle between the high and low-pressure sides of refrigeration systems and ensure that the refrigerant flow rate into the evaporator matches the rate of evaporation of liquid refrigerant in the evaporator. If the actual superheating is greater than the set point, the valve feeds the evaporator more liquid refrigerant. If the actual superheating is lower than the set point, the valve decreases the flow of liquid refrigerant to the evaporator. This ensures that the evaporator is utilized fully and that no liquid refrigerant can reach the compressor.

#### CONSTRUCTION

The thermostatic expansion valve consists of two parts that must work together. The first is the body, which acts

as the regulating system actuator. The second is the orifice, which contains the real regulator and performs the expansion of the refrigerating fluid.

**Body assembly:** this consists of two parts: the thermostatic element and the body with its inner components.

The thermostatic element is the valve motor. A sensing bulb is connected to the diaphragm assembly by 1.5 m capillary tubing, which transmits the bulb pressure to the top chamber of the valve's diaphragm. The sensing bulb pressure is directly correlated to the temperature of the thermostatic charge, which is the gas mixture within the bulb.

The body is made from hot forged brass with right-angle connections. The interchangeable orifice assembly can be replaced through the inlet connection. A steel rod slides inside the body and transfers the diaphragm movement to the shutter inside the orifice assembly. When the thermostatic charge pressure increases, the diaphragm will be deflected, transferring this motion to the shutter, which lifts from its seat and allows the liquid to pass through the orifice.

A spring opposes the force underneath the diaphragm and a side set screw can adjust its tension. Static superheating is increased by turning it clockwise and decreased by turning it counter-clockwise.

The thermostatic element is solidly connected by brazing to the forged brass body to avoid any leakage.

The body assembly can be supplied with an internal or external equalizer. Both types can be supplied either with SAE Flare connections or with solder connections (outlet and external equalizer, if present). Both SAE Flare unions, required for threaded connections, and inlet SAE/ODS connection, required for solder connections, must be ordered separately.

Each body assembly is supplied with a strap unit, part no. G9150/R61, that allows the bulb to be fixed to the pipe.

This part can be ordered separately as repair kit, too. The main parts of body assembly are made with the following materials:

- Stainless steel for bulb, capillary tubing, diaphragm casing, diaphragm and rod
- Hot forged brass EN 12420 – CW 617N for the body
- Brass EN 12164 – CW 614N for superheating set screw and spring holder
- Steel DIN 17223-1 for spring
- Copper pipe EN 12735-1 – Cu-DHP for solder connections

**Orifice assembly:** interchangeable orifice assembly provides a wide capacity range, from 0.5 to 15.5 kW (nominal capacity with R22). The external cartridge contains the following elements: housing, shutter (metering device), seat, spring and filter. The solid construction of the orifice assembly and its internal components ensure that shutter and seat can withstand all types of critical stresses (hammering, cavitation, sudden pressure variations at temperature, or contaminants). The spring holds the shutter firmly in contact with the seat to minimize leakage through the valve. To guarantee complete shut-off, a solenoid valve is required upstream from the thermostatic expansion valve. Orifice assemblies are available in these two solutions:

- With conical flanged filter, for valves with SAE Flare threaded connections.
- With flat flanged filter, for valves with ODS solder connections, to use with adapters in series 2271.

Orifice assembly filters can be cleaned or replaced. In the event of replacement, the following two types of filters are available for separate order:

- Filter 2290, for valves with SAE Flare threaded connections.
- Filter 2290/S, for valves with ODS solder connections.

## THERMOSTATIC CHARGES

**Liquid charge:** the behaviour of valves with liquid charge is exclusively determined by the temperature changes at the bulb and they are not subject to any environmental interference. They feature fast response time, reacting quickly in the control circuit. Castel thermostatic expansion valves with liquid charge cannot incorporate MOP functions.

**Gas charge:** the behaviour of valves with gas charge will be determined by the lowest temperature at any part of the expansion valve (thermostatic element, capillary tube or bulb). If any parts other than the bulb are subjected to the lowest temperature, the malfunctioning of the expansion valve can occur (charge migration). Castel thermostatic expansion valves with gas charge always feature MOP function and include ballast bulb. The ballast has a damping effect on the valve regulation and leads to slow opening and fast closure of the valve.

**MOP (Maximum Operating Pressure):** this function limits the evaporator pressure to a maximum value to protect the compressor from the overload condition. MOP

is the evaporating pressure at which the expansion valve will throttle liquid injection into the evaporator, preventing the evaporating pressure from rising. The expansion valve acts as superheating control in the normal working range and acts as a pressure regulator within MOP range.

The MOP point will change if the factory superheating setting of the expansion valve is changed. Superheating adjustments influence the MOP point as follows:

- Increase superheating → Decrease MOP
- Decrease superheating → Increase MOP

**Superheating:** this is the controlling parameter for the expansion valve. Superheating, measured at the evaporator outlet, is defined as the difference between the actual bulb temperature and the evaporating temperature, deduced from evaporator pressure. In order to prevent liquid refrigerant from entering the compressor, a certain minimum superheating value must be maintained. In expansion valve operation, the following terms are used:

- **Static superheating:** this is the superheating above which the valve begins to open. Castel thermostatic expansion valves are factory pre-set to the following static superheating values:
  - 5 °C for Castel valves without MOP
  - 5 °C for Castel valves with MOPUnder nominal operating conditions (see Table 2)
- **Opening superheating:** this is the superheating, above the static superheating, required to produce a given valve potential
- **Operating superheating:** this is the sum of static and opening superheating

**Subcooling:** this is defined as the difference between the condensing temperature (deduced from condensing pressure) and the actual temperature at inlet valve. Subcooling generally increases the refrigeration system potential and must be accounted for when dimensioning an expansion valve. Depending on system design, subcooling may be necessary to prevent gas bubbles from forming in the liquid line. If gas bubbles form in the liquid line, the potential of the expansion valve will be reduced significantly. All potential tables, provided in this chapter, are calculated for a subcooling value of 4 °C. If the actual subcooling value is higher than 4 °C, the valve potential is taken from the evaporator demand divided by the correction factor shown in the tables below each potential table.

## SELECTION

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

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

The following procedure helps the correct dimensioning of

an expansion valve for a refrigeration plant.

#### Step 1

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

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

where:

- $P_c$  = condensing pressure
- $P_e$  = evaporating pressure
- $\Delta p$  = sum of pressure drops in the liquid line, distributor and evaporator

#### Step 2

*Determine required valve capacity.* Use the evaporator capacity,  $Q_e$ , to select the required valve capacity at a given evaporating temperature. If necessary, correct the evaporator capacity based on the subcooling value. Subcooling liquid refrigerant entering the evaporator increase the evaporator capacity such that a smaller valve may be required. The subcooling is calculated using the equation:

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

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

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

#### Step 3

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

#### Step 4

*Select a thermostatic charge.* Choose the type of charge, with or without MOP, and the operating temperature range, normal temperature or low temperature.

#### Step 5

*Choose the type of equalizer:* if a distributor is used, or if there is an appreciable difference in pressure between the valve outlet and the bulb location, an external equalizer is required. Determine the type of connections and their sizes.

#### Step 6

*Order the required components:*

If the connections are SAE Flare, the following two parts must be ordered:

- Body assembly (see Tables 1a and 1b)
- Orifice assembly, including filter (see Table 2)

If ODS connections, you must order the following three parts:

- Body assembly (see Tables 1a and 1b)
- Orifice assembly, including filter (see Table 2)
- Solder connector (see Table 3)

## DIMENSIONING EXAMPLE

• Type of refrigerant	R134a
• Evaporator capacity, $Q_e$	6 kW
• Evaporating temperature, $T_e$	- 10 °C
• Minimum condensing temperature, $T_c$	+ 30 °C
• Liquid refrigerant temperature, $T_l$	+ 20 °C
• Pressure drop in the liquid line, distributor and evaporator, $\Delta p$	1.5 bar

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

- Condensing pressure at + 30 °C -  $P_c = 6.71$  bar
- Evaporating pressure at - 10 °C -  $P_e = 1.01$  bar

$$\Delta p_{\text{tot}} = 6,71 - (1,01 + 1,5) = 4,2 \cdot \text{bar}$$

*Step 2 - Determine required valve capacity*

$$\Delta T_{\text{sub}} = 30 - 20 = 10 \cdot \text{°C}$$

From the subcooling correction factor Table 6B, we find the appropriate correction factor,  $F_{\text{sub}}$ , equal to 1.06 for  $\Delta T_{\text{sub}} = 10$  °C. The required valve capacity is

$$\Delta Q_{\text{sub}} = \frac{6}{1,06} = 5,66 \cdot \text{kW}$$

*Step 3 - Determine required orifice dimension*

Using Table 6A for the capacity for refrigerant fluid R134a, enter the data:

- Pressure drop across the valve = 4.2 bar
- Evaporating temperature = - 10 °C
- Calculated evaporator capacity = 5.66 kW
- Calculated evaporator capacity = 5.66 kW

Select the corresponding orifice, 2205 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity)

## MARKING

Main valve data are indicated on the upper side of the thermostatic element and on the side surface of the orifice assembly cartridge.

On the thermostatic element, you can find the following data:

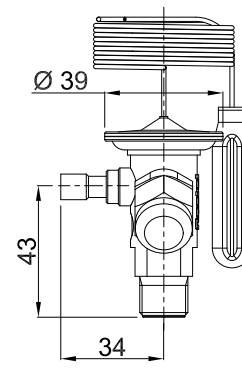
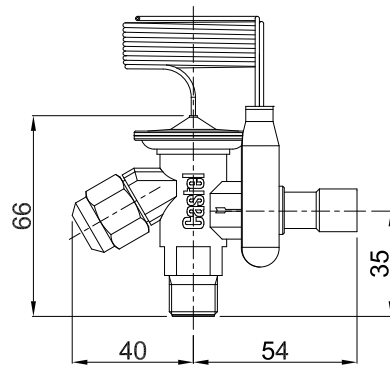
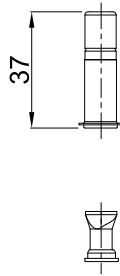
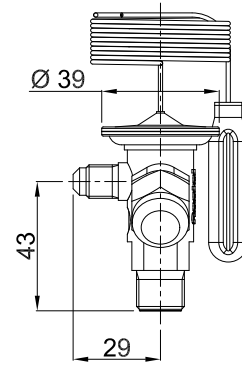
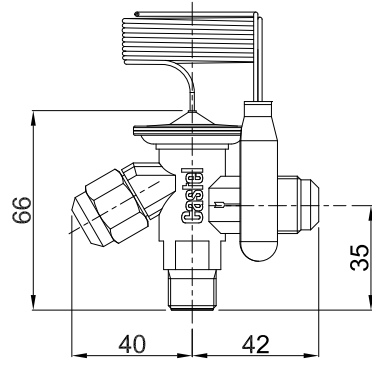
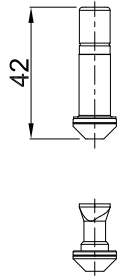
- Valve part number
- Refrigerant fluid
- Evaporating temperature range
- MOP value, if present
- Maximum allowable pressure, PS
- Date of production

On the orifice assembly cartridge, you can find the following data:

- Orifice size
- Date of production

The orifice size is marked on the plastic cap of the orifice assembly package. This cap can be fastened easily around the valve capillary tube to clearly identify the orifice size assembled in the valve.





**TABLE 1: General characteristics of body assemblies of liquid charge thermostatic expansion valves**

Catalogue Number		Connections							Refrigerant	Evaporating Temperature Range [°C]	MOP	Max bulb temperature [°C]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast											
internal equalizer	external equalizer	SAE Flare			ODS [mm]		ODS [in]							min	max	min	max												
		IN	OUT	Equal.	OUT	Equal.	OUT	Equal.																					
2210/4	-	3/8"	1/2"	-	-	-	-	-	R22 R407C	-40 → +10	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3											
2210/M12S			-	-	12	-	-	-											-										
2210/4S			-	-	-	-	1/2"	-											-										
-	2210/4E	1/2"	1/4"	-	-	-	-																						
	2210/M12SE	-	12	6	-	-	-																						
	2210/4SE	-	-	-	1/2"	1/4"	-																						
2220/4	-	3/8"	1/2"	-	-	-	-	R134a											-40 → +10	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3		
2220/M12S			-	-	12	-	-																					-	-
2220/4S			-	-	-	-	1/2"																					-	-
-	2220/4E	1/2"	1/4"	-	-	-	-																						
	2220/M12SE	-	12	6	-	-	-																						
	2220/4SE	-	-	-	1/2"	1/4"	-																						
2230/4	-	3/8"	1/2"	-	-	-	-		R404A R507A	-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3											
2230/M12S			-	-	12	-	-																					-	-
2230/4S			-	-	-	-	1/2"																					-	-
-	2230/4E	1/2"	1/4"	-	-	-	-																						
	2230/M12SE	-	12	6	-	-	-																						
	2230/4SE	-	-	-	1/2"	1/4"	-																						
2239/4	-	3/8"	1/2"	-	-	-	-	R404A R507A											-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3		
2239/M12S			-	-	12	-	-																					-	-
2239/4S			-	-	-	-	1/2"																					-	-
-	2239/4E	1/2"	1/4"	-	-	-	-																						
	2239/M12SE	-	12	6	-	-	-																						
	2239/4SE	-	-	-	1/2"	1/4"	-																						

(1) : when valve is installed. 60 °C with element not mounted

**TABLE 2: General characteristics of body assemblies of MOP charge thermostatic expansion valves**

Catalogue Number		Connections							Refrigerant	Evaporating Temperature Range [°C]	MOP	Max bulb temperature [°C]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast											
internal equalizer	external equalizer	SAE Flare			ODS [mm]		ODS [in]							min	max	min	max												
		IN	OUT	Equal.	OUT	Equal.	OUT	Equal.																					
2211/4	-	3/8"	1/2"	-	-	-	-	-	R22 R407C	+15 °C (95 psi)	100 (1)	34	-60	+120	-40	+50	Art. 4.3												
2211/M12S			-	-	12	-	-	-										-											
2211/4S			-	-	-	-	1/2"	-										-											
-	2211/4E	1/2"	1/4"	-	-	-	-																						
	2211/M12SE	-	12	6	-	-	-																						
	2211/4SE	-	-	-	1/2"	1/4"	-																						
2221/4	-	3/8"	1/2"	-	-	-	-	R134a										-40 → +10	+15 °C (55 psi)	100 (1)	34	-60	+120	-40	+50	Art. 4.3			
2221/M12S			-	-	12	-	-																				-	-	
2221/4S			-	-	-	-	1/2"																				-	-	
-	2221/4E	1/2"	1/4"	-	-	-	-																						
	2221/M12SE	-	12	6	-	-	-																						
	2221/4SE	-	-	-	1/2"	1/4"	-																						
2231/4	-	3/8"	1/2"	-	-	-	-		R404A R507A	-40 → +10	+15 °C (120 psi)	100 (1)	34	-60	+120	-40	+50										Art. 4.3		
2231/M12S			-	-	12	-	-																					-	-
2231/4S			-	-	-	-	1/2"																					-	-
-	2231/4E	1/2"	1/4"	-	-	-	-																						
	2231/M12SE	-	12	6	-	-	-																						
	2231/4SE	-	-	-	1/2"	1/4"	-																						
2234/4	-	3/8"	1/2"	-	-	-	-	R404A R507A										-60 → -25	-20 °C (30 psi)	100 (1)	34	-60	+120	-40	+50	Art. 4.3			
2234/M12S			-	-	12	-	-																					-	-
2234/4S			-	-	-	-	1/2"																					-	-
-	2234/4E	1/2"	1/4"	-	-	-	-																						
	2234/M12SE	-	12	6	-	-	-																						
	2234/4SE	-	-	-	1/2"	1/4"	-																						

(1) : when valve is installed. 60 °C with element not mounted

**TABLE 3: Orifice Assemblies - Rated Capacities in kW**

Catalogue Number		Evaporating Temperature Range [°C]			
Valves with SAE Flare connections	Valves with ODS connections	- 40 → + 10			- 60 → - 25
		R22 R407C	R134a	R404A R507A	R404A R507
220X	220X/S	0,5	0,4	0,38	0,38
2200	2200/S	1,0	0,9	0,7	0,7
2201	2201/S	2,5	1,8	1,6	1,6
2202	2202/S	3,5	2,6	2,1	2,1
2203	2203/S	5,2	4,6	4,2	3,5
2204	2204/S	8,0	6,7	6,0	4,9
2205	2205/S	10,5	8,6	7,7	6,0
2206	2206/S	15,5	10,5	9,1	6,6

Rated capacities, for temperature range - 40 → + 10, are based on:

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

Rated capacities, for temperature range - 60 → - 25, are based on:

- Evaporating temperature  $T_{\text{evap}} = - 30 \text{ °C}$
- Condensing temperature  $T_{\text{cond}} = + 32 \text{ °C}$
- Refrigerant liquid temperature ahead of valve  $T_{\text{liq}} = + 28 \text{ °C}$

**TABLE 4: Solder adapters**

Catalogue Number	ODS Connections	
	[in]	[mm]
2271/M6S	-	6
2271/2S	1/4"	-
2271/3S	3/8"	-
2271/M10S	-	10

**TABLE 5A: Refrigerant R22/R407C - Capacities in kW for temperature range - 40°C → + 10°C**

Orifice code	Pressure drop across valve [bar]								Orifice code	Pressure drop across valve [bar]							
	2	4	6	8	10	12	14	16		2	4	6	8	10	12	14	16
Evaporating temperature = + 10 °C									Evaporating temperature = 0 °C								
220X	0,37	0,48	0,55	0,60	0,63	0,65	0,65	0,67	220X	0,37	0,48	0,55	0,59	0,63	0,65	0,66	0,66
2200	0,87	1,1	1,2	1,3	1,4	1,4	1,4	1,5	2200	0,84	1,0	1,2	1,3	1,3	1,4	1,4	1,4
2201	2,2	2,8	3,2	3,4	3,6	3,7	3,8	3,8	2201	1,9	2,4	2,7	3,0	3,1	3,2	3,3	3,3
2202	3,0	4,0	4,7	5,1	5,4	5,6	5,8	5,8	2202	2,6	3,4	4,0	4,3	4,6	4,8	4,9	5,0
2203	5,4	7,2	8,3	9,1	9,7	10,0	10,2	10,3	2203	4,6	6,1	7,1	7,8	8,2	8,5	8,7	8,8
2204	8,1	10,8	12,5	13,8	14,5	15,0	15,5	15,5	2204	6,9	9,1	10,5	11,5	12,2	12,7	13,0	13,2
2205	10,2	13,6	15,7	17,2	18,3	18,9	19,3	19,5	2205	8,8	11,6	13,3	14,6	15,5	16,1	16,4	16,6
2206	12,6	16,7	19,3	21,0	22,3	23,1	23,5	23,7	2206	10,8	14,2	16,3	17,8	18,9	19,6	20,0	20,2
Evaporating temperature = - 10 °C									Evaporating temperature = - 20 °C								
220X	0,37	0,47	0,53	0,57	0,60	0,63	0,64	0,64	220X		0,44	0,50	0,54	0,57	0,59	0,61	0,61
2200	0,79	0,96	1,1	1,2	1,2	1,3	1,3	1,3	2200		0,88	1,0	1,1	1,1	1,2	1,2	1,2
2201	1,6	2,0	2,3	2,5	2,6	2,7	2,8	2,8	2201		1,7	1,9	2,0	2,2	2,3	2,3	2,3
2202	2,2	2,9	3,3	3,6	3,8	4,0	4,1	4,1	2202		2,4	2,7	2,9	3,1	3,2	3,3	3,3
2203	3,9	5,1	5,9	6,4	6,8	7,1	7,3	7,3	2203		4,2	4,8	5,2	5,5	5,8	5,9	6,0
2204	5,8	7,6	8,7	9,5	10,1	10,5	10,8	10,9	2204		6,2	7,1	7,7	8,2	8,5	8,7	8,8
2205	7,4	9,6	11,0	12,0	12,8	13,3	13,6	13,8	2205		7,9	9,0	9,8	10,3	10,8	11,0	11,2
2206	9,1	11,6	13,5	14,7	15,6	16,2	16,6	16,8	2206		9,6	11,0	11,9	12,6	13,1	13,5	13,7
Evaporating temperature = - 30 °C									Evaporating temperature = - 40 °C								
220X		0,40	0,45	0,49	0,52	0,55	0,56	0,57	220X			0,42	0,45	0,48	0,50	0,52	0,53
2200		0,79	0,9	0,96	1,0	1,1	1,1	1,1	2200			0,8	0,86	0,92	0,95	0,98	0,99
2201		1,4	1,5	1,7	1,8	1,8	1,9	1,9	2201			1,3	1,4	1,4	1,5	1,5	1,6
2202		1,9	2,2	2,7	2,5	2,6	2,6	2,7	2202			1,7	1,9	2,0	2,0	2,1	2,1
2203		3,4	3,9	4,2	4,4	4,6	4,7	4,8	2203			3,1	3,4	3,5	3,7	3,8	3,8
2204		5,0	5,7	6,2	6,6	6,8	7,0	7,1	2204			4,6	4,9	5,2	5,4	5,6	5,7
2205		6,4	7,2	7,8	8,3	8,6	8,8	9,0	2205			5,8	6,3	6,6	6,9	7,1	7,2
2206		7,8	8,8	9,6	10,1	10,5	10,8	11,0	2206			7,1	7,7	8,1	8,4	8,7	8,8

**TABLE 5B: Correction factor for subcooling  $\Delta t_{sub} \neq 4^\circ\text{K}$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
Fsub	1,00	1,05	1,10	1,15	1,20	1,25	1,29	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 5B

**TABLE 6A: Refrigerant R134a - Capacities in kW for temperature range - 40°C → + 10°C**

Orifice code	Pressure drop across valve [bar]					Orifice code	Pressure drop across valve [bar]				
	2	4	6	8	10		2	4	6	8	10
Evaporating temperature = + 10 °C						Evaporating temperature = 0 °C					
220X	0,34	0,43	0,47	0,50	0,51	220X	0,33	0,42	0,46	0,47	0,49
2200	0,71	0,86	0,93	0,97	0,98	2200	0,65	0,78	0,86	0,89	0,91
2201	1,5	1,9	2,1	2,2	2,2	2201	1,3	1,6	1,7	1,8	1,8
2202	2,0	2,6	3,0	3,1	3,2	2202	1,7	2,2	2,4	2,6	2,6
2203	3,6	4,7	5,3	5,6	5,8	2203	3,0	3,9	4,4	4,6	4,7
2204	5,4	7,0	7,8	8,3	8,6	2204	4,5	5,7	6,4	6,8	7,0
2205	6,9	8,9	9,9	10,8	10,9	2205	5,7	7,3	8,1	8,6	8,8
2206	8,4	10,8	12,1	12,8	13,2	2206	7,0	8,9	1,0	10,5	10,8
Evaporating temperature = - 10 °C						Evaporating temperature = - 20 °C					
220X	0,30	0,36	0,43	0,44	0,44	220X	0,28	0,35	0,39	0,41	0,42
2200	0,59	0,70	0,77	0,81	0,82	2200	0,53	0,62	0,69	0,72	0,73
2201	1,0	1,3	1,4	1,5	1,5	2201	0,81	1,0	1,1	1,2	1,2
2202	1,4	1,8	2,0	2,1	2,1	2202	1,1	1,4	1,5	1,6	1,7
2203	2,5	3,1	3,5	3,7	3,8	2203	2,0	2,5	2,8	2,9	3,0
2204	3,6	4,6	5,1	5,4	5,6	2204	2,9	3,6	4,0	4,3	4,4
2205	4,6	5,8	6,5	6,9	7,1	2205	3,7	4,6	5,1	5,4	5,5
2206	5,7	7,1	8,0	8,4	8,6	2206	4,5	5,6	6,2	6,6	6,8
Evaporating temperature = - 30 °C						Evaporating temperature = - 40 °C					
220X	0,25	0,32	0,35	0,37	0,38	220X	0,23	0,28	0,32	0,33	0,34
2200	0,48	0,55	0,61	0,64	0,64	2200	0,44	0,50	0,54	0,56	0,57
2201	0,66	0,80	0,88	0,93	0,95	2201	0,54	0,65	0,72	0,78	0,77
2202	0,9	1,1	1,2	1,3	1,3	2202	0,7	0,9	1,0	1,0	1,0
2203	1,6	2,0	2,2	2,3	2,3	2203	1,3	1,6	1,8	1,9	1,9
2204	2,3	2,9	3,2	3,3	3,4	2204	1,9	2,3	2,6	2,7	2,7
2205	3,0	3,6	4,0	4,2	4,3	2205	2,4	2,9	3,2	3,5	3,5
2206	3,6	4,4	4,9	5,2	5,3	2206	3,0	3,6	4,0	4,2	4,3

**TABLE 6B: Correction factor for subcooling  $\Delta t_{sub} \neq 4^\circ\text{K}$** 

$\Delta t_{sub} [^\circ\text{K}]$	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 evaporator capacity by dividing by the appropriate correction factor found in Table 6B

**TABLE 7A: Refrigerant R404A/R507A - Capacities in kW for temperature range - 40°C → + 10°C**

Orifice code	Pressure drop across valve [bar]								Orifice code	Pressure drop across valve [bar]							
	2	4	6	8	10	12	14	16		2	4	6	8	10	12	14	16
Evaporating temperature = + 10 °C									Evaporating temperature = 0 °C								
220X	0,28	0,35	0,40	0,42	0,43	0,43	0,42	0,41	220X	0,30	0,37	0,41	0,42	0,43	0,43	0,43	0,41
2200	0,67	0,82	0,90	0,94	0,96	0,96	0,93	0,90	2200	0,68	0,80	0,87	0,90	0,92	0,93	0,91	0,87
2201	1,70	2,10	2,30	2,42	2,48	2,46	2,41	2,34	2201	1,53	1,86	2,04	2,13	2,18	2,18	2,15	2,08
2202	2,32	3,00	3,39	3,61	3,73	3,74	3,68	3,59	2202	2,06	2,64	2,95	3,13	3,22	3,25	3,21	3,11
2203	4,15	5,36	6,03	6,43	6,63	6,66	6,55	6,39	2203	3,68	4,72	5,27	5,59	5,75	5,80	5,73	5,55
2204	6,24	8,06	9,06	9,66	9,95	9,98	9,81	9,57	2204	5,49	7,15	7,86	8,33	8,58	8,64	8,53	8,27
2205	7,91	10,17	11,43	12,16	12,53	12,56	12,34	12,03	2205	6,97	8,92	9,95	10,52	10,83	10,90	10,76	10,43
2206	9,71	12,47	13,98	14,86	15,29	15,31	15,05	14,66	2206	8,57	10,93	12,16	12,85	13,21	13,30	13,12	12,72
Evaporating temperature = - 10 °C									Evaporating temperature = - 20 °C								
220X	0,30	0,37	0,40	0,42	0,42	0,42	0,41	0,41	220X		0,35	0,38	0,40	0,39	0,40	0,39	0,38
2200	0,65	0,76	0,82	0,84	0,87	0,87	0,85	0,83	2200		0,70	0,75	0,77	0,79	0,79	0,79	0,76
2201	1,31	1,61	1,74	1,81	1,84	1,85	1,84	1,78	2201		1,34	1,45	1,50	1,52	1,52	1,51	1,47
2202	1,76	2,24	2,50	2,62	2,69	2,71	2,68	2,60	2202		1,85	2,04	2,14	2,17	2,18	2,16	2,09
2203	3,14	4,02	4,47	4,69	4,81	4,84	4,79	4,65	2203		3,32	3,66	3,83	3,89	3,90	3,86	3,75
2204	4,66	5,97	6,61	6,95	7,13	7,18	7,11	6,91	2204		4,88	5,40	5,64	5,75	5,77	5,71	5,56
2205	5,93	7,57	8,39	8,81	9,02	9,08	8,99	8,73	2205		6,20	6,86	7,17	7,29	7,31	7,23	7,05
2206	7,28	9,27	10,26	10,76	11,00	11,08	10,97	10,65	2206		7,60	8,39	8,75	8,91	8,93	8,84	8,61
Evaporating temperature = - 30 °C									Evaporating temperature = - 40 °C								
220X			0,35	0,37	0,36	0,37	0,36	0,35	220X			0,32	0,33	0,33	0,33	0,32	0,32
2200			0,67	0,70	0,70	0,70	0,69	0,67	2200			0,60	0,61	0,62	0,61	0,60	0,59
2201			1,18	1,21	1,23	1,21	1,20	1,17	2201			0,92	0,96	0,97	0,96	0,94	0,91
2202			1,63	1,69	1,71	1,70	1,68	1,64	2202			1,27	1,32	1,33	1,31	1,28	1,24
2203			2,93	3,04	3,07	3,06	3,02	2,93	2203			2,28	2,36	2,38	2,36	2,31	2,24
2204			4,28	4,47	4,52	4,51	4,46	4,35	2204			3,34	3,47	3,50	3,48	3,42	3,33
2205			5,45	5,68	5,74	5,74	5,67	5,52	2205			4,25	4,41	4,45	4,43	4,36	4,24
2206			6,66	6,94	7,02	7,01	6,93	6,75	2206			5,19	5,39	5,45	5,42	5,33	5,19

**TABLE 7B: Correction factor for subcooling  $\Delta t_{sub} \neq 4^\circ\text{K}$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 7B

**TABLE 8A: Refrigerant R404A/R507A - Capacities in kW for temperature range - 60°C → - 25°C**

Orifice code	Pressure drop across valve [bar]								Orifice code	Pressure drop across valve [bar]							
	2	4	6	8	10	12	14	16		2	4	6	8	10	12	14	16
Evaporating temperature = - 25 °C									Evaporating temperature = - 30 °C								
2200	0,57	0,67	0,72	0,73	0,74	0,85	0,74	0,71	2200	0,53	0,64	0,67	0,70	0,70	0,70	0,69	0,67
2201	0,98	1,20	1,31	1,36	1,37	1,37	1,35	1,31	2201	0,88	1,07	1,18	1,21	1,23	1,21	1,20	1,17
2202	1,31	1,65	1,83	1,91	1,93	1,93	1,90	1,85	2202	1,18	1,47	1,63	1,69	1,71	1,70	1,68	1,64
2203	2,35	2,97	3,28	3,42	3,47	3,46	3,42	3,32	2203	2,12	2,65	2,93	3,04	3,07	3,05	3,02	2,93
2204	3,45	4,37	4,82	5,04	5,11	5,12	5,06	4,93	2204	3,09	3,88	4,28	4,47	4,52	4,51	4,46	4,35
2205	4,40	5,56	6,14	6,40	6,49	6,49	6,42	6,26	2205	3,94	4,94	5,45	5,68	5,74	5,74	5,67	5,52
2206	5,40	6,30	7,49	7,81	7,93	7,93	7,85	7,64	2206	4,83	6,06	6,66	6,94	7,02	7,01	6,93	6,75
Evaporating temperature = - 40 °C									Evaporating temperature = - 50 °C								
2200		0,56	0,60	0,61	0,62	0,61	0,60	0,59	2200		0,49	0,53	0,54	0,54	0,53	0,52	0,50
2201		0,65	0,72	0,75	0,77	0,77	0,77	0,75	2201		0,51	0,57	0,60	0,60	0,60	0,60	0,59
2202		1,17	1,27	1,32	1,33	1,31	1,28	1,24	2202		0,91	0,99	1,02	1,02	1,01	0,98	0,95
2203		2,09	2,28	2,36	2,38	2,36	2,31	2,24	2203		1,63	1,73	1,84	1,84	1,81	1,78	1,72
2204		3,03	3,34	3,47	3,50	3,48	3,42	3,33	2204		2,36	2,60	2,69	2,71	2,68	2,63	2,56
2205		3,87	4,25	4,41	4,45	4,43	4,36	4,24	2205		3,02	3,30	3,43	3,45	3,42	3,35	3,26
2206		4,73	5,19	5,39	5,45	5,47	5,33	5,19	2206		3,69	4,04	4,20	4,22	4,18	4,12	4,00
Evaporating temperature = - 60 °C																	
2200			0,46	0,48	0,47	0,45	0,45	0,43									
2201			0,58	0,60	0,60	0,58	0,56	0,54									
2202			0,78	0,80	0,80	0,78	0,75	0,72									
2203			1,40	1,44	1,43	1,40	1,36	1,30									
2204			2,04	2,11	2,11	2,07	2,03	1,96									
2205			2,59	2,69	2,66	2,65	2,59	2,50									
2206			3,16	3,28	3,30	3,25	3,18	3,07									

**TABLE 8B: Correction factor for subcooling  $\Delta t_{sub} \neq 4^\circ\text{K}$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 8B

# CHAPTER 2 ■

## THERMOSTATIC EXPANSION VALVES

### CERTIFIED BY UNDERWRITERS LABORATORIES INC.

#### FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



### APPLICATIONS

The thermostatic expansion valves in series 221XUL, 222XUL, and 223XUL illustrated in this chapter are designed to work with the interchangeable orifice assembly, for flexible selection of capacity, and 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

That use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, or R507)

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

### OPERATION

Please refer to Chapter 1, second paragraph, for the description of the operation of the valves in series 221XUL, 222XUL, and 223XUL as it is identical to that of valves in series 221X, 222X, and 223X.

### CONSTRUCTION

Please refer to Chapter 1, third paragraph, for the description of the operation of the valves in series 221XUL, 222XUL, and 223XUL as it is identical to that of valves in series 221X, 222X, and 223X.

### SELECTION

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

- Type of refrigerant
- Evaporator capacity,  $Q_e$
- Evaporating temperature,  $T_e$
- Minimum condensing temperature,  $T_c$
- Subcooling,  $T_{sub}$
- Pressure drop in the distributor,  $\Delta p$

Refer to Chapter 1, paragraph 5, for the description of the dimensioning procedure for a thermostatic expansion valve in a refrigerating plant.

### MARKING

Main valve data are indicated on the upper side of the thermostatic element and on the side surface of the orifice assembly cartridge.

On the thermostatic element, you can find the following data:

- UL marking
- Valve part number
- Refrigerant fluid
- Evaporating temperature range
- MOP value, if present
- Maximum allowable pressure, PS
- Date of production

On the orifice assembly cartridge, you can find the following data:

- Orifice size
- Date of production

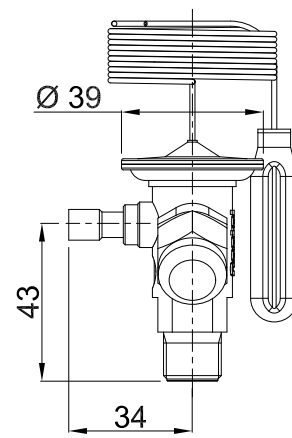
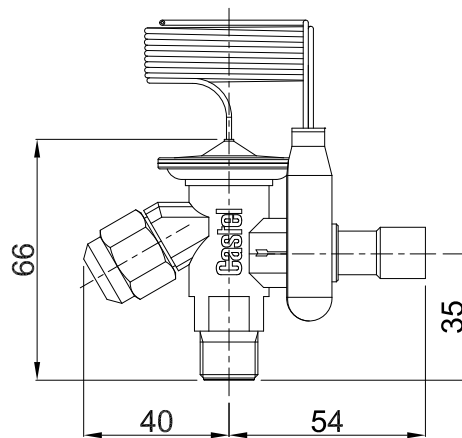
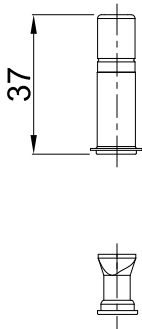
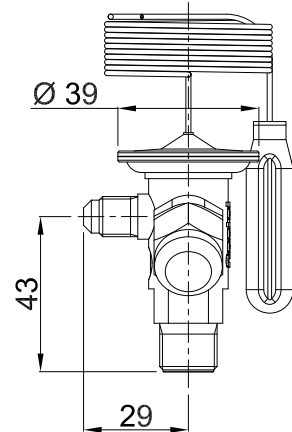
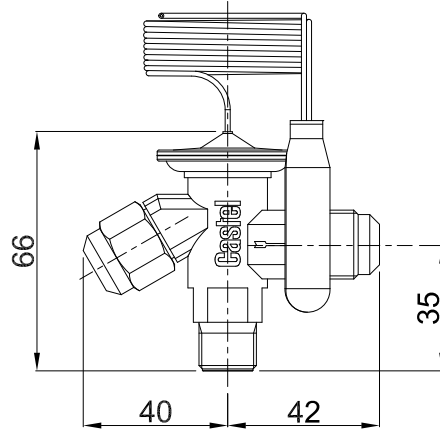
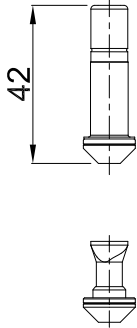
The orifice size is marked on the plastic cap of the orifice assembly package. This cap can be fastened easily around the valve capillary tube to clearly identify the orifice size assembled in the valve.



## CERTIFICATIONS

The American certification authority, Underwriters Laboratories Inc., has approved the thermostatic expansion valves in series 2210UL, 2211UL, 2220UL, 2221UL,

2230UL, 2231UL, 2234UL, and 2239UL. The valves are certified **UL-CSA Listed** for the USA and Canada with file SA33319, in compliance with American standard UL 207 and Canadian standard C22.2 No. 140.3-15.



**TABLE 9: General characteristics of body assemblies of liquid charge thermostatic expansion valves, UL Listed approved**

Catalogue Number		Connections						Refrigerant	Evaporating Temperature Range [°C]	MOP	Max bulb temperature [°C]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast											
internal equalizer	external equalizer	SAE Flare			ODS [mm]		ODS [in]						min	max	min	max												
		IN	OUT	Equal.	OUT	Equal.	OUT											Equal.										
2210UL/4	-	3/8"	1/2"	-	-	-	-	-	R22 R407C	-40 → +10	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3										
2210UL/M12S			-	-	12	-	-	-																				
2210UL/4S			-	-	-	1/2"	-	-																				
-	2210UL/4E	1/2"	1/4"	-	-	-	-																					
	2210UL/M12SE	-	12	6	-	-	-																					
	2210UL/4SE	-	-	1/2"	1/4"	-	-																					
2220UL/4	-	3/8"	1/2"	-	-	-	-	R134a											-40 → +10	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3	
2220UL/M12S			-	-	12	-	-																					-
2220UL/4S			-	-	-	1/2"	-																					-
-	2220UL/4E	1/2"	1/4"	-	-	-	-																					
	2220UL/M12SE	-	12	6	-	-	-																					
	2220UL/4SE	-	-	1/2"	1/4"	-	-																					
2230UL/4	-	3/8"	1/2"	-	-	-	-		R404A R507A	-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3										
2230UL/M12S			-	-	12	-	-																					-
2230UL/4S			-	-	-	1/2"	-																					-
-	2230UL/4E	1/2"	1/4"	-	-	-	-																					
	2230UL/M12SE	-	12	6	-	-	-																					
	2230UL/4SE	-	-	1/2"	1/4"	-	-																					
2239UL/4	-	3/8"	1/2"	-	-	-	-	R404A R507A											-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3	
2239UL/M12S			-	-	12	-	-																					-
2239UL/4S			-	-	-	1/2"	-																					-
-	2239UL/4E	1/2"	1/4"	-	-	-	-																					
	2239UL/M12SE	-	12	6	-	-	-																					
	2239UL/4SE	-	-	1/2"	1/4"	-	-																					

(1) : when valve is installed. 60 °C with element not mounted

**TABLE 10: General characteristics of body assemblies of MOP charge thermostatic expansion valves UL Listed approved**

Catalogue Number		Connections						Refrigerant	Evaporating Temperature Range [°C]	MOP	Max bulb temperature [°C]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast											
internal equalizer	external equalizer	SAE Flare			ODS [mm]		ODS [in]						min	max	min	max												
		IN	OUT	Equal.	OUT	Equal.	OUT											Equal.										
2211UL/4	-	3/8"	1/2"	-	-	-	-	R22 R407C	+15 °C (95 psi)	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3											
2211UL/M12S			-	-	12	-	-											-										
2211UL/4S			-	-	-	1/2"	-											-										
-	2211UL/4E	1/2"	1/4"	-	-	-	-																					
	2211UL/M12SE	-	12	6	-	-	-																					
	2211UL/4SE	-	-	1/2"	1/4"	-	-																					
2221UL/4	-	3/8"	1/2"	-	-	-	-											R134a	-40 → +10	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3	
2221UL/M12S			-	-	12	-	-																					-
2221UL/4S			-	-	-	1/2"	-																					-
-	2221UL/4E	1/2"	1/4"	-	-	-	-																					
	2221UL/M12SE	-	12	6	-	-	-																					
	2221UL/4SE	-	-	1/2"	1/4"	-	-																					
2231UL/4	-	3/8"	1/2"	-	-	-	-	R404A R507A	-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3											
2231UL/M12S			-	-	12	-	-																					-
2231UL/4S			-	-	-	1/2"	-																					-
-	2231UL/4E	1/2"	1/4"	-	-	-	-																					
	2231UL/M12SE	-	12	6	-	-	-																					
	2231UL/4SE	-	-	1/2"	1/4"	-	-																					
2234UL/4	-	3/8"	1/2"	-	-	-	-											R404A R507A	-60 → -25	without	100 (1)	34	-60	+120	-40	+50	Art. 4.3	
2234UL/M12S			-	-	12	-	-																					-
2234UL/4S			-	-	-	1/2"	-																					-
-	2234UL/4E	1/2"	1/4"	-	-	-	-																					
	2234UL/M12SE	-	12	6	-	-	-																					
	2234UL/4SE	-	-	1/2"	1/4"	-	-																					

(1) : when valve is installed. 60 °C with element not mounted

**TABLE 11: Orifice Assemblies - Rated Capacities in kW**

Catalogue Number		Evaporating Temperature Range [°C]			
Valves with SAE Flare connections	Valves with ODS connections	- 40 → + 10			- 60 → - 25
		R22 R407C	R134a	R404A R507A	R404A R507
220X	220X/S	0,5	0,4	0,38	0,38
2200	2200/S	1,0	0,9	0,7	0,7
2201	2201/S	2,5	1,8	1,6	1,6
2202	2202/S	3,5	2,6	2,1	2,1
2203	2203/S	5,2	4,6	4,2	3,5
2204	2204/S	8,0	6,7	6,0	4,9
2205	2205/S	10,5	8,6	7,7	6,0
2206	2206/S	15,5	10,5	9,1	6,6

Rated capacities, for temperature range - 40 → + 10, are based on:

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

Rated capacities, for temperature range - 60 → - 25, are based on:

- Evaporating temperature  $T_{\text{evap}} = - 30 \text{ °C}$
- Condensing temperature  $T_{\text{cond}} = + 32 \text{ °C}$
- Refrigerant liquid temperature ahead of valve  $T_{\text{liq}} = + 28 \text{ °C}$

**TABLE 12: Solder adapters**

Catalogue Number	ODS Connections	
	[in]	[mm]
2271/M6S	-	6
2271/2S	1/4"	-
2271/3S	3/8"	-
2271/M10S	-	10

# CHAPTER 3 ■ SOLENOID EXPANSION VALVES

## FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS, HFO



### APPLICATIONS

The solenoid expansion valves in series 2028 illustrated in this chapter 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

That use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, R410A, or R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, and R452A)

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

The same solenoid valves can also be installed on systems that use the following refrigeration fluids:

- HFC (R32)
- HFO (R1234yf)

classified as A2L in the ASHRAE 34-2013 standard, and belonging to Group 1, as defined in Article 13, Chapter 1, Point (a) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

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

### OPERATION

The valve in series 2028 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 2028 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 2028/3S02 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 14. Inside the valve body is a ring mesh filter that traps dirt and contaminants at the valve inlet.

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

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

- Hot forged brass EN 12420 – CW617N for the body
- Hot forged brass EN 12420 – CW724R for mobile plunger valve sleeve

- Ferritic stainless steel EN 10088-3 – 1.4105 for the fixed and mobile plungers
- Austenitic stainless steel EN 10088-3 – 1.4301 for the mesh filter
- Austenitic stainless steel EN 10088-3 – 1.4305 for orifice
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- P.T.F.E. for seat gaskets
- Chloroprene rubber (CR) for outlet seal gaskets

## SELECTION

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

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

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

### Step 1

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

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

where:

- $p_c$  = condensing pressure
- $p_e$  = evaporating pressure
- $\Delta p$  = sum of pressure drops in the liquid line, distributor and evaporator at the maximum flow rate, that is with the valve always open

### Step 2

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

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

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

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

### 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 18B, 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:

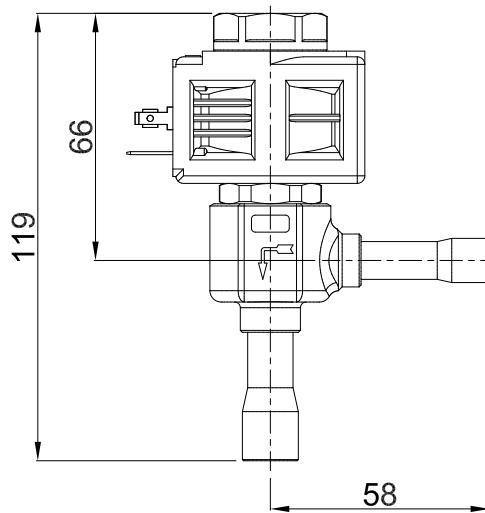
$$Q_{\text{ev}} = 1,25 \cdot 2,39 = 3 \cdot \text{kW}$$

*Step 4 - Determine required orifice dimension.*

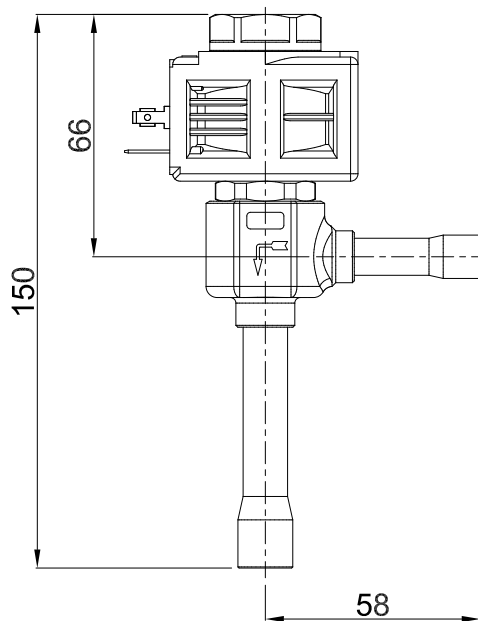
Using table for the capacity for refrigerant fluid R404A, enter the data:

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

Select the corresponding orifice, O4 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity).



2028/3  
2028/M10



2028/4  
2028/M12

**TABLE 13: 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]		TA[°C]		Risk Category according to PED Recast	
		[in]		[mm]			MinOPD	MOPD						min.	max.	min.	max.		
		IN	OUT	IN	OUT			9160 (AC)	9160 (DC)	9320 (AC)									9320 (DC)
2028/3S01	01	3/8"	1/2"	-	-	0	37	37	37	37	PWM (Pulse Width Modulating)	1	45	-40	+100	-40	+50	Art.4.3	
2028/M10S01		-	-	10	12														
2028/3S02	02	3/8"	1/2"	-	-														
2028/M10S02		-	-	10	12														
2028/3S03	03	3/8"	1/2"	-	-														
2028/M10S03		-	-	10	12														
2028/3S04	04	3/8"	1/2"	-	-														
2028/M10S04		-	-	10	12														
2028/3S05	05	3/8"	1/2"	-	-														
2028/M10S05		-	-	10	12														
2028/3S06	06	3/8"	1/2"	-	-														
2028/M10S06		-	-	10	12														
2028/4S07	07	1/2"	5/8"	-	-														
2028/M12S07		-	-	12	16														
2028/4S08	08	1/2"	5/8"	-	-														
2028/M12S08		-	-	12	16														
2028/4S09	09	1/2"	5/8"	-	-														
2028/M12S09		-	-	12	16														

**TABLE 14: Orifices - Rated capacities in kW**

Catalogue number	Orifice Type	Orifice Size [mm]	Refrigerant												
			R134a	R22	R32	R404A	R407C	R410A	R507A	R1234yf	R1234ze	R448A	R449A	R450A	R452A
9150/R63	01	0,5	0,74	1,04	2,44	0,73	1,18	1,16	0,76	0,56	0,59	1,02	1,13	0,63	0,90
9150/R64	02	0,7	1,47	2,08	4,88	1,47	2,35	2,31	1,52	1,12	1,17	2,04	2,26	1,26	1,81
9150/R65	03	0,8	1,74	2,46	5,74	1,73	2,77	2,72	1,79	1,32	1,39	2,40	2,66	1,49	2,13
9150/R66	04	1,1	2,81	3,99	9,34	2,81	4,50	4,42	2,91	2,13	2,24	3,90	4,32	2,40	3,46
9150/R67	05	1,3	4,81	6,81	15,91	4,78	7,68	7,54	4,96	3,65	3,84	6,64	7,37	4,11	5,90
9150/R68	06	1,7	6,67	9,44	22,06	6,63	10,65	10,45	6,88	5,06	5,33	9,21	10,22	5,71	8,19
9150/R69	07	2,3	10,52	14,92	34,94	10,49	16,83	16,54	10,88	7,98	8,39	14,57	16,15	8,98	12,95
9150/R78	08	2,5	12,68	17,96	42,00	12,62	20,26	19,89	13,09	9,62	10,12	17,53	19,44	10,84	15,58
9150/R79	09	2,7	14,07	19,91	46,54	13,99	22,46	22,05	14,51	10,67	11,23	19,43	21,55	12,03	17,27

Rated capacities are based on:

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

**TABLE 15A: Refrigerant R134a - Capacities in kW**

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

**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
$F_{sub}$	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 evaporator capacity by dividing by the appropriate correction factor found in Table 15B



**TABLE 16A: Refrigerant R22 - Capacities in kW**

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

**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	1,05	1,10	1,15	1,20	1,25	1,29	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 16B

**TABLE 17A: Refrigerant R32 - Capacities in kW**

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

**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
$F_{sub}$	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 evaporator capacity by dividing by the appropriate correction factor found in Table 17B

**TABLE 18A: Refrigerant R404A - Capacities in kW**

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

**TABLE 18B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°K]	4	10	15	20	25	30	35	40	45
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 evaporator capacity by dividing by the appropriate correction factor found in Table 18B

**TABLE 19A: Refrigerant R407C - Capacities in kW**

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

**TABLE: 19B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 19B

**TABLE 20A: Refrigerant R410A - Capacities in kW**

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

**TABLE 20B - 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	1,28	1,34	1,41	1,48	1,54

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

**TABLE 21A: Refrigerant R507A - Capacities in kW**

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

**TABLE: 21B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 21B

**TABLE 22A: Refrigerant R1234yf - Capacities in kW**

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

**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	1,07	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 22B

**TABLE 23A: Refrigerant R1234ze - Capacities in kW**

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

**TABLE: 23B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 23B



**TABLE 24A: Refrigerant R448A - Capacities in kW**

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

**TABLE 24B - 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 evaporator capacity by dividing by the appropriate correction factor found in Table 24B

**TABLE 25A: Refrigerant R449A - Capacities in kW**

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

**TABLE: 25B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 25B

**TABLE 26A: Refrigerant R450A - Capacities in kW**

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

**TABLE 26B - 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 evaporator capacity by dividing by the appropriate correction factor found in Table 26B

**TABLE 27A: Refrigerant R452A - Capacities in kW**

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

**TABLE: 27B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 25B

# CHAPTER 4 ■ SOLENOID EXPANSION VALVES CERTIFIED BY UNDERWRITERS LABORATORIES INC. FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS, HFO



## APPLICATIONS

The solenoid expansion valves in series 2028UL illustrated in this chapter 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

That use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, R410A, or R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, and R452A)

belonging to Group 2, as defined in Article 13, Chapter 1(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

Please refer to Chapter 3, second paragraph, for the description of the operation of the valves in series 2028UL, as it is identical to that of valves in series 2028.

## CONSTRUCTION

The valves in series 2028UL 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 2028UL/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 29. Inside the valve body is a ring mesh filter that traps dirt and contaminants at the valve inlet.

Valves in series 2028UL are sold exclusively in the model without coil (suffix S).

## SELECTION

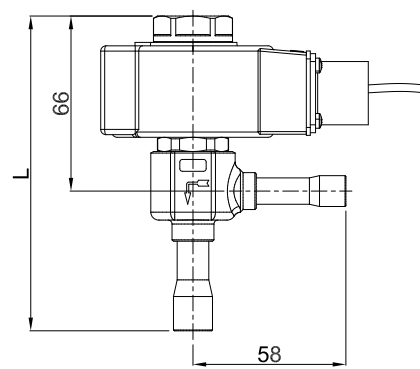
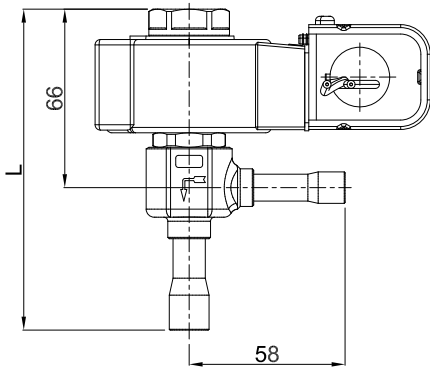
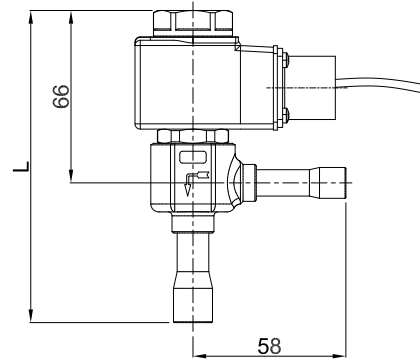
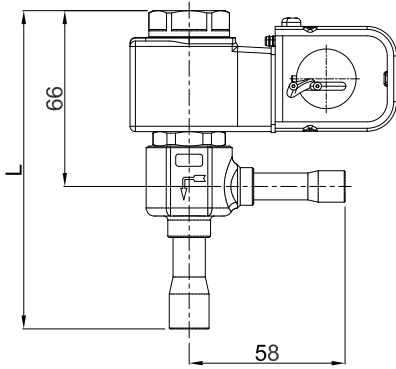
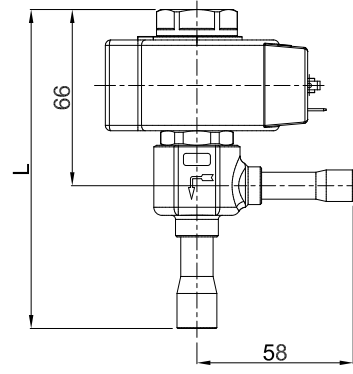
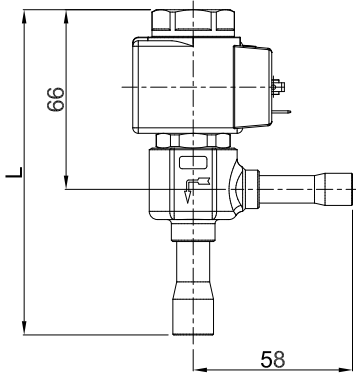
Please refer to Chapter 3, paragraph 4, for the description of the operation of the valves in series 2028UL, as it is identical to that of valves in series 2028.

## CERTIFICATIONS

Le Solenoid expansion valves serie 2028UL sono The American certification authority Underwriters Laboratories Inc. has approved the expansion valves in series 2028UL. The valves are certified **UL-CSA Listed** for the USA and Canada with file MH50005, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.

**N.B.: The UL Listed certification is valid only if the above-listed valves are coupled with the coils in series 9115, 9116, 9185, or 9186 illustrated in Chapter 9. If the same valves are coupled with coils in series 9105 and 9125, again illustrated in Chapter 9, a "UL Listed" certified valve is not obtained; rather, you obtain a "UL Recognized" certified valve.**

The coils in series 9105, 9115, 9116, 9125, 9185, and 9186 with voltages of 120 VAC, 208 VAC, 220/230 VAC, 240 VAC comply with the Low Voltage Directive, 2006/95/EC and the Electromagnetic Compatibility Directive (EMC) 2004/108/EC.



2028UL/3 → L=119  
 2028UL/M10 → L=119

2028UL/4 → L=150  
 2028UL/M12 → L=150

**TABLE 28: General characteristics of PWM expansion valves, UL Listed approved**

Catalogue number	Orifice Type	ODS Connections				Kv Factor [m³/h]	Opening Pressure Differential [bar]			Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		TA[°C]		Risk Category according to PED Recast	
		[in]		[mm]			MinOPD	MOPD					min.	max.	min.	max.		
		IN	OUT	IN	OUT			9105	9125									9125
								9115	9185									9185
2028UL/3S01	01	3/8"	1/2"	-	-	0	37	37	37	PWM (Pulse Width Modulating)	1	45	-40	+100	-20	+50	Art.4.3	
2028UL/M10S01		-	-	10	12													
2028UL/3S02	02	3/8"	1/2"	-	-													
2028UL/M10S02		-	-	10	12													
2028UL/3S03	03	3/8"	1/2"	-	-													
2028UL/M10S03		-	-	10	12													
2028UL/3S04	04	3/8"	1/2"	-	-													
2028UL/M10S04		-	-	10	12													
2028UL/3S05	05	3/8"	1/2"	-	-													
2028UL/M10S05		-	-	10	12													
2028UL/3S06	06	3/8"	1/2"	-	-													
2028UL/M10S06		-	-	10	12													
2028UL/4S07	07	1/2"	5/8"	-	-													
2028UL/M12S07		-	-	12	16													
2028UL/4S08	08	1/2"	5/8"	-	-													
2028UL/M12S08		-	-	12	16													
2028UL/4S09	09	1/2"	5/8"	-	-													
2028UL/M12S09		-	-	12	16													

**TABLE 29: Orifices - Rated capacities in kW**

Catalogue number	Orifice Type	Orifice Size [mm]	Refrigerant												
			R134a	R22	R32	R404A	R407C	R410A	R507A	R1234yf	R1234ze	R448A	R449A	R450A	R452A
9150/R63	01	0,5	0,74	1,04	2,44	0,73	1,18	1,16	0,76	0,56	0,59	1,02	1,13	0,63	0,90
9150/R64	02	0,7	1,47	2,08	4,88	1,47	2,35	2,31	1,52	1,12	1,17	2,04	2,26	1,26	1,81
9150/R65	03	0,8	1,74	2,46	5,74	1,73	2,77	2,72	1,79	1,32	1,39	2,40	2,66	1,49	2,13
9150/R66	04	1,1	2,81	3,99	9,34	2,81	4,50	4,42	2,91	2,13	2,24	3,90	4,32	2,40	3,46
9150/R67	05	1,3	4,81	6,81	15,91	4,78	7,68	7,54	4,96	3,65	3,84	6,64	7,37	4,11	5,90
9150/R68	06	1,7	6,67	9,44	22,06	6,63	10,65	10,45	6,88	5,06	5,33	9,21	10,22	5,71	8,19
9150/R69	07	2,3	10,52	14,92	34,94	10,49	16,83	16,54	10,88	7,98	8,39	14,57	16,15	8,98	12,95
9150/R78	08	2,5	12,68	17,96	42,00	12,62	20,26	19,89	13,09	9,62	10,12	17,53	19,44	10,84	15,58
9150/R79	09	2,7	14,07	19,91	46,54	13,99	22,46	22,05	14,51	10,67	11,23	19,43	21,55	12,03	17,27

Rated capacities are based on:

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

# CHAPTER 5 ■

## SOLENOID EXPANSION VALVES FOR VERY LOW TEMPERATURE

### FOR REFRIGERATION PLANTS THAT USE THE R23 REFRIGERANT



#### APPLICATIONS

The solenoid expansion valves in series 2028R illustrated in this chapter have been designed for installation in very low temperature refrigeration plants that use R23 refrigerant fluid

#### OPERATION

Please refer to Chapter 3, second paragraph, for the description of the operation of the valves in series 2028R, as it is identical to that of valves in series 2028.

#### CONSTRUCTION

The valves in series 2028R are supplied complete with orifice. Nine different orifices with nine different maximum potentials that range from orifice O1 to orifice O9 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 2028R/3S02 identifies a 3/8" valve with solder connections and size O2 orifice. **The orifices are NOT interchangeable because it is strictly prohibited to disassemble this valve for any reason, including for brazing on the system.** Inside the valve body is a ring mesh filter that traps dirt and contaminants at the valve inlet.

Valves in series 2028R are sold exclusively in the model without coil (suffix S).

The main parts of the valves in series 2028R are made from the same materials as the valves in series 2028, with the exception of:

- Copper EN 1625 – Cu-DHP for the outlet gaskets

#### SELECTION

Please refer to Chapter 3, paragraph 4, for the description of the operation of the valves in series 2028R, as it is identical to that of valves in series 2028.

#### DIMENSIONING EXAMPLE

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

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

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

$$\Delta p_{tot} = 21,7 - (7,06 + 2) = 12,6 \cdot \text{bar}$$

*Step 2 - Determine required valve capacity*

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

From the subcooling correction factor Table 31B, we find the appropriate correction factor,  $F_{sub}$ , equal to 1.05 for  $\Delta T_{sub} = 10$  °K. The required valve capacity is

$$Q_{sub} = \frac{2,8}{1,05} = 2,67 \cdot \text{kW}$$

*Step 3 - Capacity correction based on the application*

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

$$Q_{ev} = 1,25 \cdot 2,67 = 3,34 \cdot \text{kW}$$

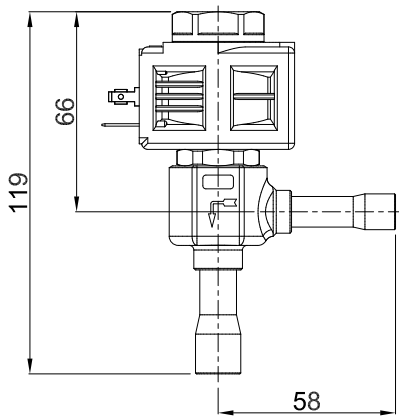
*Step 4 - Determine the orifice size.*

Using the capacity table 31A for R23 refrigerant, enter the data:

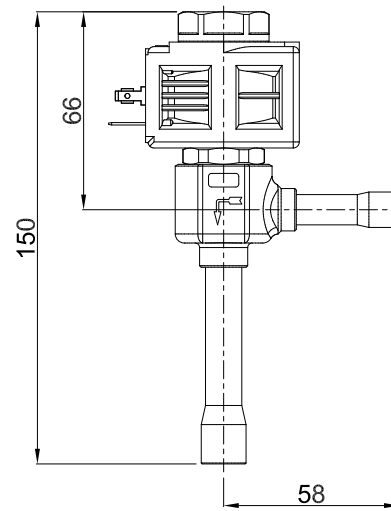
- Pressure drop across the valve = 12.6 bar
- Evaporating temperature = -40 °C
- Calculated evaporator capacity = 3.34 kW

Select the corresponding orifice, O3 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity)





2028R/3  
2028R/M10



2028R/4  
2028R/M12

TABLE 30: General characteristics of PWM expansion valves, suitable for R23

Catalogue number	Ori- fice Type	ODS Connections				Orifice Size [mm]	Kv Factor [m³/h]	Rated capac- ities R23 [kW]	Opening Pressure Differential [bar]				Operating principles	Mini- mum Working Time [s]	PS [bar]	TS [°C]		TA [°C]		Risk Cat- egory accord- ing to PED Recast		
		[in]		[mm]					MinOPD	MOPD						min.	max.	min.	max.			
		IN	OUT	IN	OUT					9160 (AC)	9160 (DC)	9320 (AC)									9320 (DC)	
2028R/3S01	01	3/8"	1/2"	-	-	0,500	0,010	1,50	0		PWM (Pulse Width Modulating)	1	45	-80	+60	-40	+50	Art.4.3				
2028R/M10S01		-	-	10	12																	
2028R/3S02	02	3/8"	1/2"	-	-	0,7	0,017	3,00											37	37	37	37
2028R/M10S02		-	-	10	12																	
2028R/3S03	03	3/8"	1/2"	-	-	0,8	0,023	3,52											37	37	37	37
2028R/M10S03		-	-	10	12																	
2028R/3S04	04	3/8"	1/2"	-	-	1,1	0,043	5,74											27	18	32	32
2028R/M10S04		-	-	10	12																	
2028R/3S05	05	3/8"	1/2"	-	-	1,3	0,065	9,77											18	14	32	32
2028R/M10S05		-	-	10	12																	
2028R/3S06	06	3/8"	1/2"	-	-	1,7	0,113	13,54	10	22	22	22										
2028R/M10S06		-	-	10	12																	
2028R/4S07	07	1/2"	5/8"	-	-	2,300	0,200	21,45	18	14	32	32										
2028R/M12S07		-	-	12	16																	
2028R/4S08	08	1/2"	5/8"	-	-	2,500	0,230	25,78	27	27	27	27										
2028R/M12S08		-	-	12	16																	
2028R/4S09	09	1/2"	5/8"	-	-	2,700	0,250	28,57	10	22	22	22										
2028R/M12S09		-	-	12	16																	

Rated capacities are based on:

- Evaporating temperature  $T_{\text{evap}} = -30 \text{ }^\circ\text{C}$
- Condensing temperature  $T_{\text{cond}} = -4 \text{ }^\circ\text{C}$
- Refrigerant liquid temperature ahead of valve  $T_{\text{liq}} = -8 \text{ }^\circ\text{C}$

**TABLE 31A: Refrigerant R23 - Capacities in kW**

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

**TABLE: 31B - Correction factor 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	1,05	1,10	1,15	1,20	1,25	1,29	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 31B

# CHAPTER 6

## SOLENOID EXPANSION VALVES

### FOR REFRIGERATION PLANTS THAT USE HC REFRIGERANTS



#### APPLICATIONS

The solenoid expansion valves illustrated in this chapter have been developed by Castel for all those refrigeration applications that use the following HC refrigeration fluids: R290, R600, or R600a, belonging to Group 1, defined in Article 13, Chapter 1, Point (a) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

**The solenoid valves in series 2028N must be employed only in refrigeration systems located in areas not classified as at risk of explosion, according to the definition in Annex I of Directive 1999/92/EC.**

**The solenoid expansion valves in series 2028EX comply with the European standard EN 13463-1:2009 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.**

**CAUTION!: The solenoid expansion valves in this chapter cannot be used with mineral oils or alkylbenzenes.**

#### OPERATION

Please refer to Chapter 3, second paragraph, for the description of the operation of the valves in series 2028N and 2028EX, as it is identical to that of valves in series 2028.

#### CONSTRUCTION

The valves in series 2028N and 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 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 33.

Valves in series 2028N are sold exclusively in the model without coil (suffix S).

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

The main parts of the valves in series 2028N and 2028EX are made from the same materials as the valves in series 2028, with the exception of:

- Hydrogenated nitrile butadiene rubber (HNBR) for outlet seal gaskets

#### SELECTION

Please refer to Chapter 3, paragraph 4, for the description of the operation of the valves in series 2028N and 2028EX, as it is identical to that of valves in series 2028.

#### 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

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

*Step 2 - Determine required valve capacity*

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

From the subcooling correction factor Table 34B, we find the

appropriate correction factor,  $F_{sub}$ , equal to 1.12 for  $\Delta T_{sub} = 15$  °K. The required valve capacity is

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

*Step 3 - Capacity correction based on the application*

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

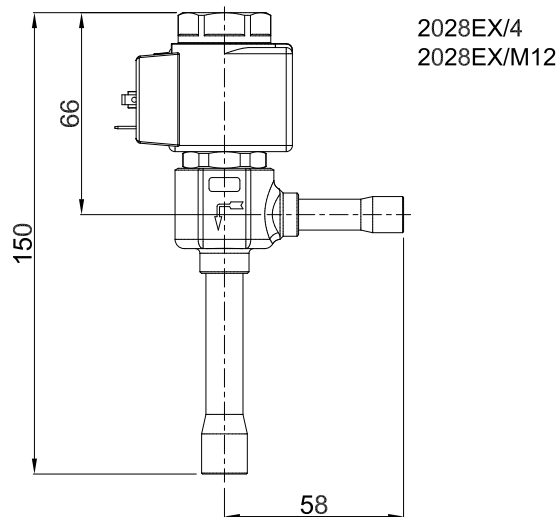
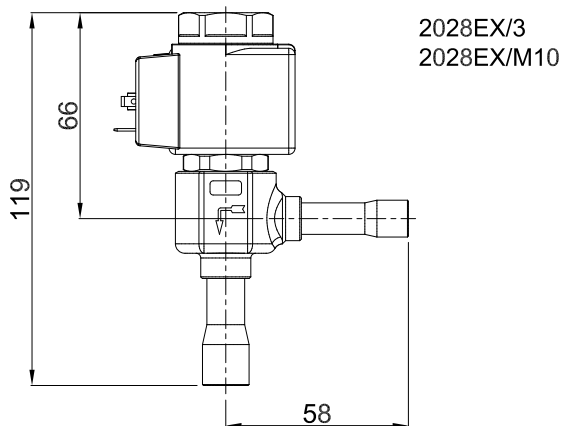
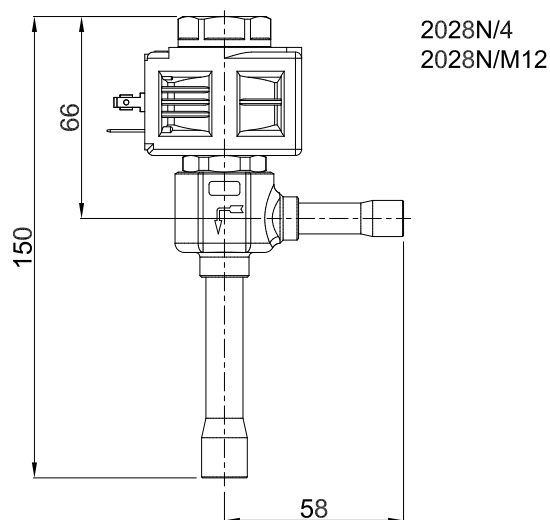
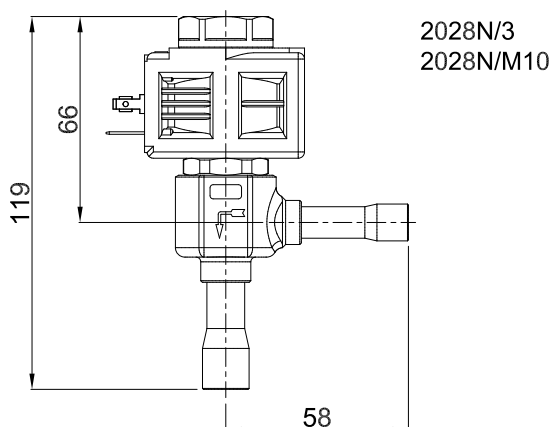
$$Q_{ev} = 1,25 \cdot 2,5 = 3,1 \cdot kW$$

*Step 4 - Determine required orifice size.*

Using the capacity Table 34A 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, 04 (Note: the expansion valve capacity must be equal to or slightly greater than the calculated evaporator capacity)



**TABLE 32: General characteristics of PWM expansion valves, suitable for HC (R290, R600, R600a)**

Catalogue number		Orifice Type	ODS Connections				Kv Factor [m³/h]	Opening Pressure Differential [bar]				Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
ATEX No compliance	ATEX Compliance for use in EX Zone 2		[in]		[mm]			MinOPD	MOPD						min.	max.	min.	max.	
			IN	OUT	IN	OUT			9100EX 9110EX (AC)	9160 (AC)	9160 (DC)								
2028N/3S01	2028EX/3A601	01	3/8"	1/2"	-	-	0	37	37	37	PWM (Pulse Width Modulating)	1	45	-40	+100	-20	+50	Art.4.3	
2028N/M10S01	2028EX/M10A601		-	-	10	12													
2028N/3S02	2028EX/3A602	02	3/8"	1/2"	-	-													
2028N/M10S02	2028EX/M10A602		-	-	10	12													
2028N/3S03	2028EX/3A603	03	3/8"	1/2"	-	-													
2028N/M10S03	2028EX/M10A603		-	-	10	12													
2028N/3S04	2028EX/3A604	04	3/8"	1/2"	-	-													
2028N/M10S04	2028EX/M10A604		-	-	10	12													
2028N/3S05	2028EX/3A605	05	3/8"	1/2"	-	-													
2028N/M10S05	2028EX/M10A605		-	-	10	12													
2028N/3S06	2028EX/3A606	06	3/8"	1/2"	-	-													
2028N/M10S06	2028EX/M10A606		-	-	10	12													
2028N/4S07	2028EX/4A607	07	1/2"	5/8"	-	-													
2028N/M12S07	2028EX/M12A607		-	-	12	16													
2028N/4S08	2028EX/4S08	08	1/2"	5/8"	-	-													
2028N/M12S08	2028EX/M12S08		-	-	12	16													
2028N/4S09	2028EX/4S09	09	1/2"	5/8"	-	-													
2028N/M12S09	2028EX/M12S09		-	-	12	16													

**TABLE 33: Orifices - Rated capacities in kW**

Catalogue number	Orifice Type	Orifice Size [mm]	Refrigerant		
			R290	R600	R600a
9150N/R63	01	0,5	1,10	0,60	0,70
9150N/R64	02	0,7	2,20	1,30	1,50
9150N/R65	03	0,8	2,70	1,50	1,70
9150N/R66	04	1,1	4,20	2,30	2,60
9150N/R67	05	1,3	7,40	4,10	4,60
9150N/R68	06	1,7	10,10	6,40	7,30
9150N/R69	07	2,3	16,10	10,30	11,10
9150N/R78	08	2,5	19,40	13,20	13,40
9150N/R79	09	2,7	21,60	14,70	14,90

Rated capacities are based on:

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

**TABLE 34A: Refrigerant R290 - Capacities in kW**

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

**TABLE: 34B - Correction factor 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 evaporator capacity by dividing by the appropriate correction factor found in Table 34B

**TABLE 35A: Refrigerant R600 - Capacities in kW**

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

**TABLE: 35B - Correction factor 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	1,09	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 35B

**TABLE 36A: Refrigerant R600a - Capacities in kW**

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

**TABLE: 36B - Correction factor 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	1,21	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 36B



# CHAPTER 7 ■ SOLENOID EXPANSION VALVES

## FOR REFRIGERATION PLANTS THAT USE THE R744 REFRIGERANT



### APPLICATIONS

The solenoid expansion valves in series 2028E illustrated in this chapter have been developed by Castel for all the applications that use the sub-critical R744 refrigeration fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

**CAUTION!: the solenoid valves in this chapter cannot be used with other refrigerant fluids.**

### OPERATION

Please refer to Chapter 3, second paragraph, for the description of the operation of the valves in series 2028E, as it is identical to that of valves in series 2028.

### CONSTRUCTION

The valves in series 2028E are supplied complete with orifice. Ten different orifices with ten different maximum potentials that range from orifice 00 to orifice 09 can be assembled. The last two numbers in the part number identify the type of orifice that has been mounted on the valve at the factory. For example, part number 2028E/3S02 identifies a 3/8" valve with solder connections and size 02 orifice. The orifices are interchangeable and can be mounted even after the valve is soldered on the system. If you wish to change orifice, purchase the corresponding spare parts kit, according to the part number indicated in Table 38.

Valves in series 2028E are sold exclusively in the model without coil (suffix S).

The main parts of the valves in series 2028E are made from the same materials as the valves in series 2028, with the exception of:

- Ethylene propylene rubber (EPDM) for outlet seal gaskets

### SELECTION

Please refer to Chapter 3, paragraph 4, for the description of the operation of the valves in series 2028E, as it is identical to that of valves in series 2028.

### DIMENSIONING EXAMPLE

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

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

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

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

*Step 2 - Determine required valve capacity*

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

From the subcooling correction factor Table 39B, we find the appropriate correction factor,  $F_{sub}$ , equal to 1.05 for  $\Delta T_{sub} = 10$  °K. The required valve capacity is

$$Q_{sub} = \frac{2,8}{1,05} = 2,67 \cdot \text{kW}$$

*Step 3 - Capacity correction based on the application*

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

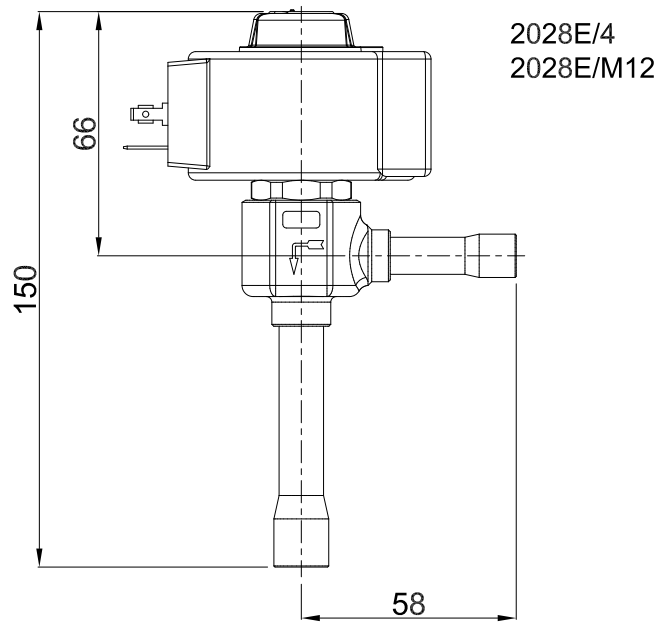
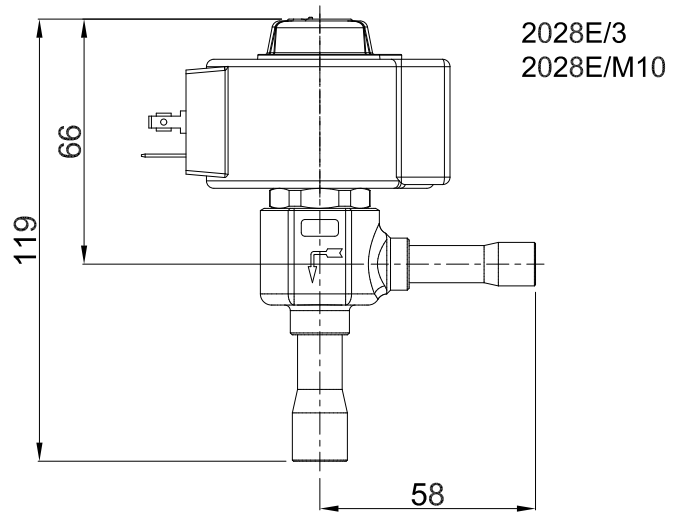
$$Q_{ev} = 1,25 \cdot 2,67 = 3,33 \cdot \text{kW}$$

*Step 4 - Determine required orifice size.*

Using the capacity Table 39A for R744 refrigerant, enter the data:

- Pressure drop across the valve = 14.1 bar
- Evaporating temperature = - 30 °C
- Calculated evaporator capacity = 3.33 kW

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



**TABLE 37: General characteristics of PWM expansion valves, suitable for R744**

Catalogue number	Orifice Type	ODS Connections				Kv Factor [m <sup>3</sup> /h]	Opening Pressure Differential [bar]			Operating principles	Minimum Working Time [s]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		[in]		[mm]			MinOPD	MOPD					min.	max.	min.	max.	
		IN	OUT	IN	OUT			9320 (AC)	9320 (DC)								
2028E/3S00	00	3/8"	1/2"	-	-	0	37	37	PWM (Pulse Width Modulating)	1	80	-50	+100	-40	+50	Art.4.3	
2028E/M10S00		-	-	10	12												
2028E/3S01	01	3/8"	1/2"	-	-												
2028E/M10S01		-	-	10	12												
2028E/3S02	02	3/8"	1/2"	-	-												
2028E/M10S02		-	-	10	12												
2028E/3S03	03	3/8"	1/2"	-	-												
2028E/M10S03		-	-	10	12												
2028E/3S04	04	3/8"	1/2"	-	-												
2028E/M10S04		-	-	10	12												
2028E/3S05	05	3/8"	1/2"	-	-												
2028E/M10S05		-	-	10	12												
2028E/3S06	06	3/8"	1/2"	-	-												
2028E/M10S06		-	-	10	12												
2028E/4S07	07	1/2"	5/8"	-	-												
2028E/M12S07		-	-	12	16												
2028E/4S08	08	1/2"	5/8"	-	-												
2028E/M12S08		-	-	12	16												
2028E/4S09	09	1/2"	5/8"	-	-												
2028E/M12S09		-	-	12	16												

**TABLE 38: Orifices - Rated capacities in kW**

Catalogue number	Orifice Type	Orifice Size [mm]	Refrigerant
			R744
9151E/R13	00	0,3	0,94
9150E/R63	01	0,5	2,30
9150E/R64	02	0,7	4,10
9150E/R65	03	0,8	5,40
9150E/R66	04	1,1	8,22
9150E/R67	05	1,3	14,50
9150E/R68	06	1,7	20,20
9150E/R69	07	2,3	32,10
9150E/R78	08	2,5	38,10
9150E/R79	09	2,7	43,40

Rated capacities are based on:

- Evaporating temperature  $T_{\text{evap}} = -25 \text{ °C}$
- Condensing temperature  $T_{\text{cond}} = 0 \text{ °C}$
- Refrigerant liquid temperature ahead of valve  $T_{\text{liq}} = -4 \text{ °C}$

**TABLE 39A: Refrigerant R744 - Capacities in kW**

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

Continued

**TABLE 39A: Refrigerant R744 - Capacities in kW**

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

**TABLE: 39B - Correction factor for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub} [^\circ K]$	1	4	10	15	20	25	30	35	40	45
Fsub	0,96	1,00	1,05	1,10	1,15	1,20	1,25	1,29	1,39	1,43

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 39B

# CHAPTER 8 ■ STANDARD COILS AND CONNECTORS



## APPLICATIONS

For the solenoid expansion valves presented in Chapters 3 (series 2028), 5 (series 2028R), and 6 (series 2028N), the coils in series 9160 (coils type HM4) and the coils in series 9320 (coils type HF3) are available.

For the solenoid expansion valves presented in Chapter 7 (series 2028E) the coils in series 9320 (coils type HF3) are available.

The coils in series 9320 must be coupled only with connectors 9150/R02 or 9900/X66. The protection rating guaranteed by the coil + connector system is IP65 according to the EN 60529 standard.

Coils in series 9160 must be used preferably with connector type 9155 / R01 and 9155/R02. 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/R02 or 9900/X66. In this case, the protection rating of this system is IP65 according to the EN 60529 standard.

## CONSTRUCTION

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

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

The terminals of the coils in series 9160 and 9320 consist

of two Faston connectors plus a Faston ground connector. All coils in this chapter are designed for continuous use. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments.

## CERTIFICATIONS

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

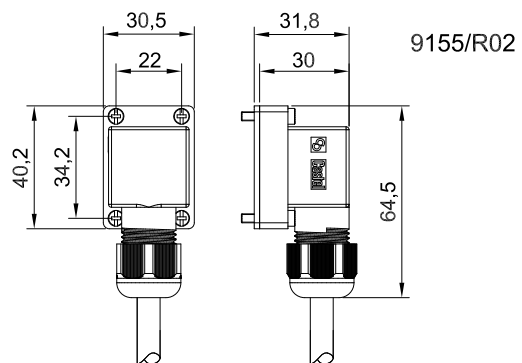
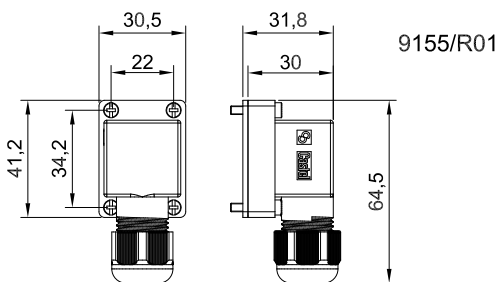
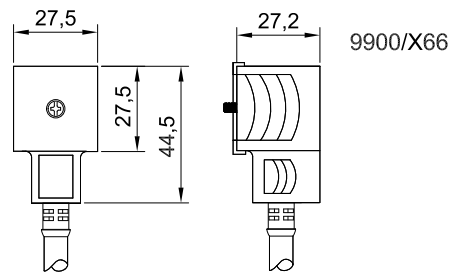
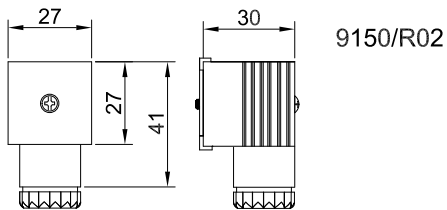
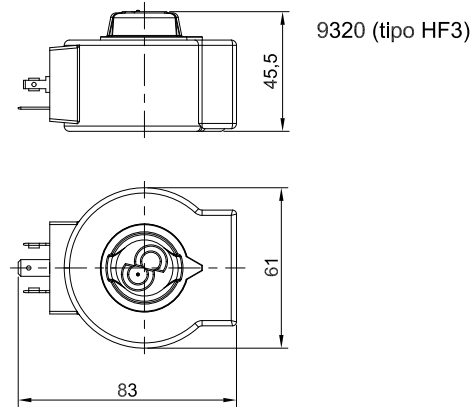
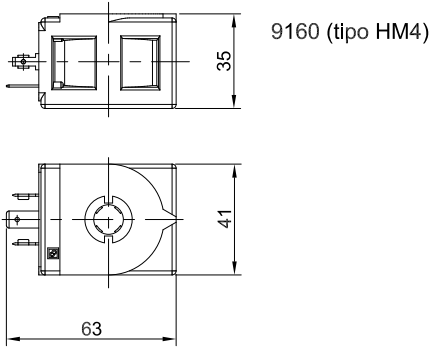
DIN 43650 standardized connectors 9150/R02 represent an effective system for the connection of the coil to the power system, thus ensuring safety also in the presence of moisture. Based on the assembly requirements, these connectors allow you to choose the orientation of the outer casing with respect 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/X66 are available with co-moulded cables, 1 m long. In this version, the orientation of the casing cannot be changed with respect to the terminal block.

Castel developed specific connectors, series 9155/R01, 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. The connectors in series 9155/R02 are available with co-moulded cables, 1 m long. In this version, the orientation of the casing cannot be changed with respect to the terminal block.



**TABLE 40: 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.			
9160/RA2	HM4	24 A.C.	+10 / -10	50 / 60	F	-20	+50	Terminal block for DIN 43650/A	9150/R02 9155/R01 9155/R02 9900/X##	IP 65 (with connectors 9150 , 9900)  IP 65 / IP 68 (with connector 9155)
9160/RA4		110 A.C.								
9160/RA6		220/230 A.C.								
9160/RA7		240 A.C.	+10 / -10							
9160/RD1		12 D.C.		-						
9160/RD2		24 D.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##
9320/RD1		12 D.C.	+10 / -5	-						
9320/RD2		24 D.C.								

**TABLE 41: 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.	
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	
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	

**TABLE 42: General characteristics of connectors**

Catalogue Number	Cable length [m]	Cable thickness [mm <sup>2</sup> ]	Standard	Degree of protection	Class of insulation	Approval
9150/R02	-	-	DIN 43650	IP65 EN 60529	Group C VDE 0110-1 / 89	-
9900/X66	1	3 x 0,75				-
9155/R01	-	-	-	IP65/IP68 EN 60529		-
9155/R02	1	3 x 0,75				-



# CHAPTER 9 ■ COILS AND CONNECTORS

CERTIFIED BY UNDERWRITERS LABORATORIES INC.



## APPLICATIONS

For the solenoid expansion valves approved by the American certification authority, Underwriters Laboratories Inc. and presented in Chapter 4 (series 2028UL), the following coils are available:

- **Series 9105** (coil type HM2), with connection type DIN 43650
- **Series 9125** (coil type HM3), with connection type DIN 43650
- **Series 9115** (coil type CM2-N2), with connection type “Junction Box NEMA 2”.
- **Series 9116** (coil type CM2-N4), with connection type “Conduit Hub NEMA 4”.
- **Series 9185** (coil type CM3-N2), with connection type “Junction Box NEMA 2”.
- **Series 9186** (coil type CM3-N4), with connection type “Conduit Hub NEMA 4”.

Coils in series 9105 and 9125 must be coupled with connector type 9150UL/R02. The protection rating of the coil + connector system is IP65 according to the EN 60529 standard.

The coils in series 9115 and 9185 are complete with a connection system to a metal sheath. The protection rating guaranteed by the “Junction Box” connection system is similar to IP12-32 according to the EN 60529 standard.

The coils in series 9116 and 9186 are complete with a connection system to a metal sheath. The protection rating guaranteed by the “Conduit Hub” connection system is similar to IP54 according to the EN 60529 standard.

## CONSTRUCTION

In compliance with IEC standard 85, the coils in series 9105, 9125, 9115, 9116, 9185 and 9186 have Class F encapsulation and their production is compliant with standards EN 60730-1 and EN 60730-2-8. The windings are made of copper wire, with insulation class H (155°C), in compliance with IEC standard 85. The outer casing is made of waterproof, dielectric resins that guarantee reinforced insulation and allow any type of assembly.

All coils have Class I protection ratings against electric contacts. Consequently, their safety requires an efficient ground system. Rubber gaskets assembled on the upper and lower ends of the coils complete the protection of the windings from humidity.

The coils in series 9105 and 9125 are equipped with three flat terminals, two Faston connections in line plus a Faston ground connection.

The coils in series 9115 and 9185 are equipped with two cables, at least 153 mm long, and ground screw incorporated in the body of the metal casing. The body of the casing is screwed onto the metal reinforcement of the coil and there are two semi-sheared slots to screw on a metal sheath. A metal cover screwed on the body closes the casing and encloses the joints between the power cable and the coil wires.

Coils in series 9116 and 9186 are equipped with two wires, at least 457 mm long. The flange of the nozzle is screwed to the metal reinforcement of the coil. The nozzle is threaded in order to screw on a metal sheath.

All coils in this chapter are designed for continuous use. The solid construction of these coils makes them suitable for use in refrigeration systems operating in heavy-duty environments.

## CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved coils in series 9015, 9125, 9115, 9116, 9185, and 1986. These coils are certified **UL-CSA Recognized** for the USA and Canada with file E243604, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.

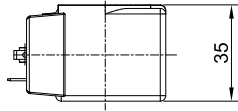
**Only when a coil in series 9115, 9116, 9185 or 9186 is used with a coil-less valve in Chapter 4 (valve in series 2028UL) is a solenoid expansion valve obtained that is “UL Listed” certified according to file MH50005, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.**

**Note: coupling a coil in series 9105 or 9125 with the same valve in series 2028UL does not result in a**

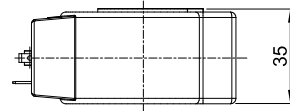
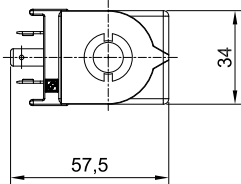
**“UL Listed” certified valve; rather, you obtain a “UL Recognized” certified valve.**

The coils in series 9015, 9125, 9115, 9116, 9185, and 9186 with voltages of 120 VAC, 208 VAC, 220/230 VAC, 240

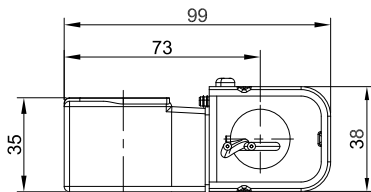
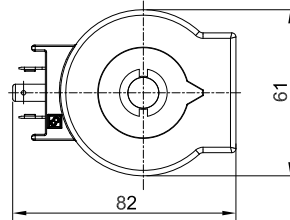
VAC comply with the Low Voltage Directive (2006/95/EC). All coils in this chapter comply with the Electromagnetic Compatibility (EMC) Directive (2004/108/EC).



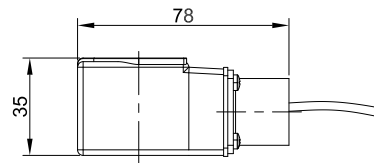
9105 (tipo HM2)



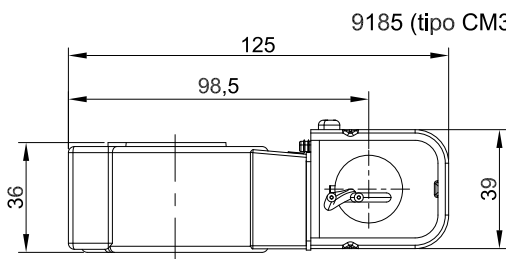
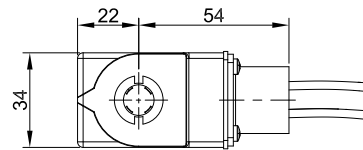
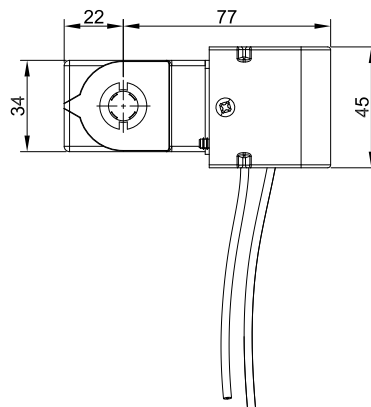
9125 (tipo HM3)



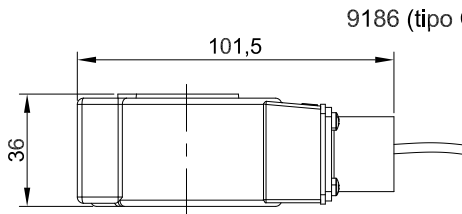
9115 (Tipo CM2-N2)



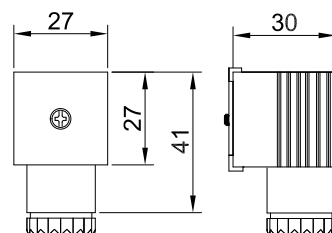
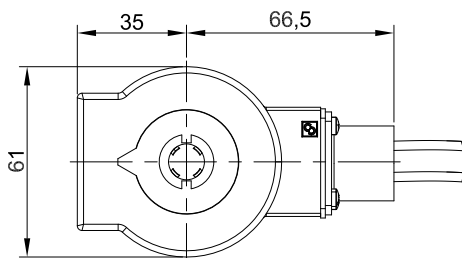
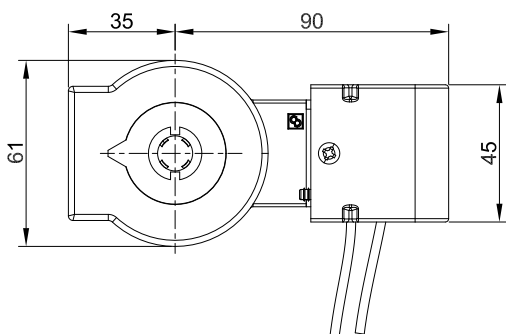
9116 (Tipo CM2-N4)



9185 (tipo CM3-N2)



9186 (tipo CM3-N4)



9150UL/R02

**TABLE 43: General characteristics of coils, UL Recognized approved**

Catalogue Number	Coil Type	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Insulation class IEC 85	TA [°C]		Connection	Connectors	Protection Degree
						min.	max.			
9105/RA2	HM2	24 A.C.	+10 / -10	60	F	-20	+50	Terminal block for DIN 43650/A	9150UL/R02	IP 65 (with connector)
9105/RA4		120 A.C.								
9105/RA5		208 A.C.								
9105/RA6		220/230 A.C.	+6 / -10							
9105/RA7		240 A.C.								
9115/RA2	CM2-N2	24 A.C.	+10 / -10	60	F	-20	+50	Junction box NEMA 2	-	~ IP 12-32
9115/RA4		120 A.C.								
9115/RA5		208 A.C.								
9115/RA6		220/230 A.C.	+6 / -10							
9115/RA7		240 A.C.								
9116/RA2	CM2-N4	24 A.C.	+10 / -10	60	F	-20	+50	Conduit hub NEMA 4	-	~ IP 54
9116/RA4		120 A.C.								
9116/RA5		208 A.C.								
9116/RA6		220/230 A.C.	+6 / -10							
9116/RA7		240 A.C.								
9125/RD1	HM3	12 D.C.	+10 / -5	-	F	-20	+50	Terminal block for DIN 43650/A	9150UL/R02	IP 65 (with connector)
9125/RD2		24 D.C.								
9125/RA2		24 A.C.								
9125/RA4		120 A.C.	+10 / -10	60						
9125/RA5		208 A.C.								
9125/RA6		220/230 A.C.	+6 / -10							
9125/RA7		240 A.C.								
9185/RD1	CM3-N2	12 D.C.	+10 / -5	-	F	-20	+50	Junction box NEMA 2	-	~ IP 12-32
9185/RD2		24 D.C.								
9185/RA2		24 A.C.								
9185/RA4		120 A.C.	+10 / -10	60						
9185/RA5		208 A.C.								
9185/RA6		220/230 A.C.	+6 / -10							
9185/RA7		240 A.C.								
9186/RD1	CM3-N4	12 D.C.	+10 / -5	-	F	-20	+50	Conduit hub NEMA 4	-	~ IP 54
9186/RD2		24 D.C.								
9186/RA2		24 A.C.								
9186/RA4		120 A.C.	+10 / -10	60						
9186/RA5		208 A.C.								
9186/RA6		220/230 A.C.	+6 / -10							
9186/RA7		240 A.C.								

**CONNECTOR**

The American certification authority Underwriters Laboratories Inc. has approved connector 9150UL/R02. This connector is certified **UL-CSA Recognized** for the USA and Canada with file E333724, in compliance with American standard UL 1977 and Canadian standard C22.2 No. 182.3. The DIN 43650 standardized connector 9150UL/R02 represents an effective system for the connection of the coil to the power system, thus ensuring safety also in the

presence of moisture. Based on the assembly requirements, this connector allows you to choose the orientation of the outer casing with respect to the inner terminal block. The gland nut of the outer casing is suitable for receiving cables with an external diameter of 6 to 9 mm and is equipped with a self-locking device. Three-pole cables with a cross-section greater than or equal to 0.75 mm<sup>2</sup> are recommended.

**TABLE 44: Consumptions and weights of coils**

Catalogue Number	Coil Type	Voltage [V]	Power [W]	Consumption at 20 °C [mA]				Weight [g]
				Start		Working		
				60 [Hz]	D.C.	60 [Hz]	D.C.	
9105/RA2	HM2	24 A.C.	11	1746	-	725	-	170
9105/RA4		120 A.C.		353		154		
9105/RA5		208 A.C.		195		84		
9105/RA6		220/230 A.C.		140		63		
9105/RA7		240 A.C.		140		63		
9115/RA2	CM2-N2	24 A.C.	11	1746	-	725	-	310
9115/RA4		120 A.C.		353		154		
9115/RA5		208 A.C.		195		84		
9115/RA6		220/230 A.C.		140		63		
9115/RA7		240 A.C.		140		63		
9116/RA2	CM2-N4	24 A.C.	11	1746	-	725	-	240
9116/RA4		120 A.C.		353		154		
9116/RA5		208 A.C.		195		84		
9116/RA6		220/230 A.C.		140		63		
9116/RA7		240 A.C.		140		63		
9125/RD1	HM3	12 D.C.	24	-	1720	-	1720	470
9125/RD2		24 D.C.		-	895	-	895	
9125/RA2		24 A.C.	20	2060	-	1015	-	
9125/RA4		120 A.C.		506		261		
9125/RA5		208 A.C.		286		152		
9125/RA6		220/230 A.C.		260		133		
9125/RA7		240 A.C.		235		122		
9185/RD1	CM3-N2	12 D.C.	24	-	1720	-	1720	590
9185/RD2		24 D.C.		-	895	-	895	
9185/RA2		24 A.C.	20	2060	-	1015	-	
9185/RA4		120 A.C.		506		261		
9185/RA5		208 A.C.		286		152		
9185/RA6		220/230 A.C.		260		133		
9185/RA7		240 A.C.		235		122		
9186/RD1	CM3-N4	12 D.C.	24	-	1720	-	1720	530
9186/RD2		24 D.C.		-	895	-	895	
9186/RA2		24 A.C.	20	2060	-	1015	-	
9186/RA4		120 A.C.		506		261		
9186/RA5		208 A.C.		286		152		
9186/RA6		220/230 A.C.		260		133		
9186/RA7		240 A.C.		235		122		

**TABLE 45: General characteristics of connectors, UL Recognized approved**

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

# CHAPTER 10

## COILS AND CONNECTORS, ATEX-CERTIFIED



### APPLICATIONS

For the solenoid expansion valves compliant with the ATEX Directive and presented in Chapter 6 (series 2028EX), the following coils are available:

- 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 manufactured 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

### CERTIFICATIONS

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 IIIC T100°C Dc IP65.

Compliance of the coils in series 9110EX to Directive 94/9/EC 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 IIIC 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).

### CONNETTORE

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.



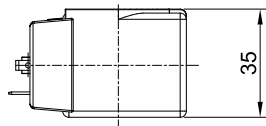
### N.B.: PRODUCT SUITABLE FOR HYDROCARBON REFRIGERANTS

The products in this chapter can be used with HC refrigerants classified as flammable fluids and that are in Safety Group A3 according to Standard EN 378-1:2016. These products must be used exclusively in refrigeration systems that comply with the current regulations for

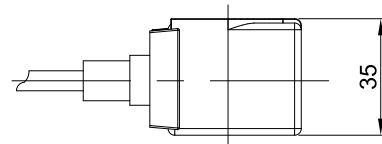
flammable refrigerant fluids (series EN 60335).

Only authorized personnel, qualified to work on flammable refrigeration systems, must perform installation, maintenance and repair operations.

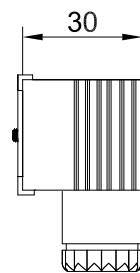
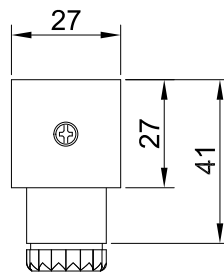
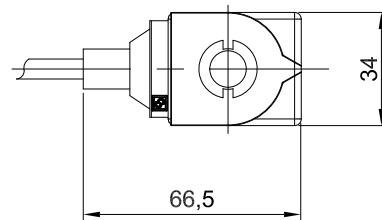
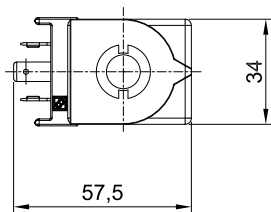
**N.B.: The personnel must carefully follow the operating instructions provided in the packaging of said valves.**



9100EX (tipo HM2)



9120EX (tipo CM2)



9150EX/R02

**TABLE 46: 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.	+10 / -10							
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.	+10 / -10							

**TABLE 47: 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 48: General characteristics of connectors**

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

# CHAPTER 11 ■ “SMART CONNECTOR” SYSTEM



## APPLICATIONS

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 in series 1024, 1028, 1034, 1038, 1040, 1048, 1050, 1058, 1059, 1064, 1068, 1070, 1078, 1079, 1090, 1098 and 1099
- Solenoid expansion valves in series: 2028, 2028N, 2028R, and 2028E, if suitably sized to have opening / closing cycles with a frequency greater than 0.6 seconds.

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 expansion 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.

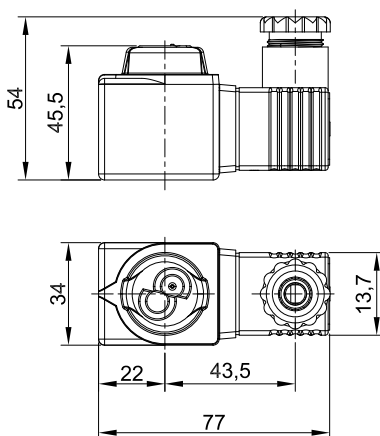
Connectors 9152/RA (alternating current) supercharge the coils 9300 for a pre-set interval. This is called the “Boost” time. It generates a greater attraction force on the valve’s magnetic unit, and consequently increases the MOPD value. Once this period is over, the electronics remove one phase wave 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.

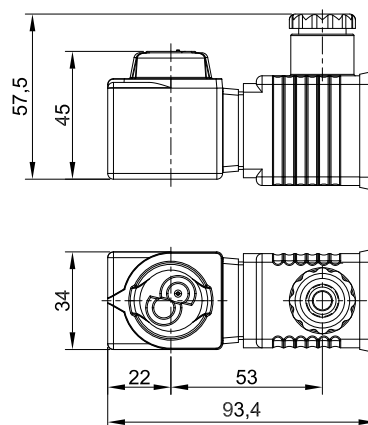
Using the afore-mentioned logic, it is possible to significantly reduce the electricity consumption (which can be important considering the system of refrigerator aisles in a supermarket). Also, it leads to a lower operating temperature of the coil and therefore, in conclusion, less wear on the electromechanical 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. Table 49 shows the main characteristics of the “SMART CONNECTOR” systems. Table 50 indicates the MOPD values that can be attained by the solenoid expansion valves produced by Castel if coupled with the various models of the “SMART CONNECTOR” system.

## CERTIFICATIONS

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



9910/RD



9910/RA

**TABELLA 49: 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	+/-10	-	5	+/-10	H	-20	+50	130	IP65
9910/RA2	24 VAC	+/-10	50/60	7	+/-10	H	-20	+50	200	IP65
9910/RA6	220 VAC	+/-10	50/60	7	+/-10	H	-20	+50	200	IP65
9910/RA7	240 VAC	+/-10	50/60	7	+/-10	H	-20	+50	200	IP65

(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.

**TABELLA 50: PWM expansion valves with SMART CONNECTOR: MOPD values [bar]**

PWM Valves Codes				SMART CONNECTOR										
				9910/RD1	9910/RD2	9910/RA2	9910/RA6	9910/RA7	Codes					
Refrigerants				12 VDC	24 VDC	24 VAC	220 VAC	240 VAC	Voltage [V]					
HCFC - HFC - HFO	R23	HFC - HC - HFO	R744						Frequency [Hz]					
2028/3S01	2028R/3S01	2028N/3S01		37	37	37	37	37						
2028/M10S01	2028R/M10S01	2028N/M10S01												
2028/3S02	2028R/3S02	2028N/3S02												
2028/M10S02	2028R/M10S02	2028N/M10S02												
2028/3S03	2028R/3S03	2028N/3S03												
2028/M10S03	2028R/M10S03	2028N/M10S03												
2028/3S04	2028R/3S04	2028N/3S04												
2028/M10S04	2028R/M10S04	2028N/M10S04												
2028/3S05	2028R/3S05	2028N/3S05												
2028/M10S05	2028R/M10S05	2028N/M10S05												
2028/3S06	2028R/3S06	2028N/3S06												
2028/M10S06	2028R/M10S06	2028N/M10S06												
2028/4S07	2028R/4S07	2028N/4S07												
2028/M12S07	2028R/M12S07	2028N/M12S07												
2028/4S08	2028R/4S08	2028N/4S08								32	32			
2028/M12S08	2028R/M12S08	2028N/M12S08												
2028/4S09	2028R/4S09	2028N/4S09								22	22	32	32	32
2028/M12S09	2028R/M12S09	2028N/M12S09												
-	-	-								2028E/3S00	37	37	37	37
			2028E/M10S00											
			2028E/3S01											
			2028E/M10S01											
			2028E/3S02											
			2028E/M10S02											
			2028E/3S03											
			2028E/M10S03											
			2028E/3S04											
			2028E/M10S04											
			2028E/3S05											
			2028E/M10S05											
			2028E/3S06											
			2028E/M10S06											
			2028E/4S07											
			2028E/M12S07											

# CHAPTER 12

## STEP-MOTOR EXPANSION VALVES

### CERTIFIED BY UNDERWRITERS LABORATORIES INC.

#### FOR REFRIGERATION PLANTS THAT USE HCFC, HFC OR HFO REFRIGERANTS



### APPLICATIONS

Castel step-motor expansion valves in series 26 regulate the flow of refrigerant liquid into evaporators, by modulating the opening and closure of the shutter into a calibrated orifice, allowing a wide range of power variation.

These right-angle valves permit bi-directional flow, with preferential input of liquid from the side connection, ensuring a high precision and reliable control in both directions and contributing to increasing the efficiency of the entire refrigerating system.

These valves are available in the following four “Body Sizes”: 261, 262, 263 and 264 that are related to the size of the valve body used. Each “Body Size” has different calibrated orifices covering four power ranges, increasing gradually. The total power range covered by the four “Body Sizes” varies from 18 to 260 kW, using refrigerant R410A as the reference.

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

- Refrigeration systems (supermarkets)
- Air conditioning systems
- Heat pump systems

That use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, R410A, or R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, and R452A)

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

The same solenoid valves can also be installed on systems that use the following refrigeration fluids:

- HFC (R32)
- HFO (R1234yf)

classified as A2L in the ASHRAE 34-2013 standard, and belonging to Group 1, as defined in Article 13, Chapter 1, Point (a) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

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

### OPERATION

Step-motor expansion valves in series 26 act as a throttle, receiving liquid from the condenser and injecting it into the evaporator, creating the necessary pressure drop across the expansion orifice by adjusting the superheating value in the evaporator.

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. It is capable of varying its throttling capacity very quickly and efficiently, even under significant variations in the potential demand, continuously modulating the refrigerant flow to the evaporator by opening and closing the shutter.

Continuously adjustable valves are equipped with a linear step motor, whose positioning is controlled by an external electronic device called a “driver” or a controller. These devices calculate the superheating by the reading of the pressure and temperature transducers at the evaporator outlet and generate a signal, sent to the step motor, which is transformed into movement / positioning of the valve stem. For this reason, the step-motor expansion valve can provide very accurate regulation of 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.

Thanks to the accurate position control of the shutter, obtained by controlling the angular position of the rotor that commands the forward movement of the actuator, a step-motor expansion valve can repeatedly supply a constant quantity of superheating, with minimum variation, even under highly variable conditions.

Considering the high linearity of the stroke/flow rate characteristic, this valve can be used in an operating range between 10% and 95% (maximum value to be used under transitory conditions) of its 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.

**The performance and life-time of the step-motor expansion valves in series 26 are guaranteed only if there is circulating oil, transported by the refrigerant through the system. In oil-free systems, neither the performance indicated in the capacity tables cannot be guaranteed, nor can the lifetime of the valve.**

**Step drive:** the step motor is an electro-mechanical device that converts electric impulses into discrete mechanical movement, and can be divided into two basic parts:

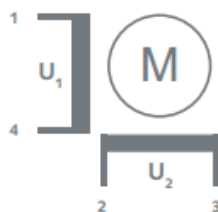
- The stator is a coil with two phase-shifted windings by the angle of rotation desired to be given to the rotor.
- The shaft/rotor is a permanent polarized magnet that is an integral part with the manoeuvring threaded sleeve.

The shaft/rotor of the step motor turns in discrete increments, as many as the electrical impulses applied to the motor in the correct sequence. The rotor follows the rotation of the magnetic field generated around the stator alternatively energizing the various series of the windings.

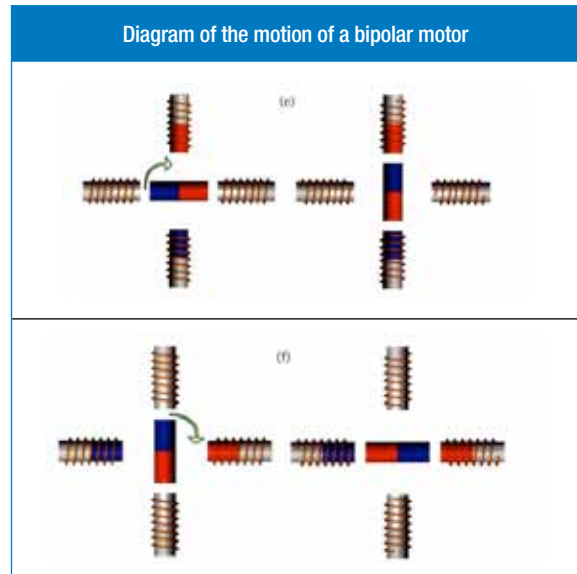
Each step, indicated with a letter U, based on the direction of travel of the current, energizes a magnetic field in one direction rather than the other.

The table summarizes the energizing sequence for the various motor steps, and the position of the resulting magnetic field on which the angular position of the shaft/rotor depends.

Step	← Movement to 100%   Movement to 0% →	
1	-	+ + - - + +
2	+	- + + - - + +
3	-	- + + - - + +
4	+	+ + - - + + - -
Vector direction	↙	↖ ↗ ↘ ↙ ↖ ↗ ↘



The sequence of impulses applied is directly correlated to the direction of rotation of the rotor and the speed of rotation of the rotor is directly correlated to the frequency and number of input impulses.



Inside the manoeuvring threaded sleeve, directly formed inside the rotor, is the threaded screw of the shutter shaft. This system of screw / threaded sleeve ensures the conversion of rotary motion into a translational movement. The precision of this depends on both the pitch angle of the screw and the coupling precision of the motion conversion system.

The shutter's precision of advancement is directly proportional to the type of drive (which can be full-step, half step, or micro-step), the winding angle of the coil/stator steps, and the pitch of the threaded sleeve associated with the rotor. The combination of these three characteristics influences the precision, speed and driving force of the linear actuator. Careful selection regarding the interaction of these three characteristics can generate good valve behaviour and high operational flexibility.

The motorized expansion valves in series 26 are not equipped with position control. Therefore, in order to operate, the actuator hardware uses mechanical limit switches to detect the position. The actuator is capable of sustaining up to 30 million steps with the rotor blocked. This condition allows the valve to be highly reliable over its entire lifetime. Furthermore, the specific choice of the screw pitch makes the actuator motion irreversible. Therefore, even when the valve is not powered, it is capable of maintaining the position reached.

**The step motor is sensitive to the dirt/residue present in the system, transported by the refrigerant. For this reason, it is very important to protect the valve by installing a mechanical filter upstream of the inlet connection.**

**Control system:** in order to operate as an expansion valve, a step-motor valve must be equipped with a control system consisting of both hardware and software. It is the efficiency of this control system and the suitability of its algorithms that guarantee adequate, satisfactory function of the expansion valve.

The actuators of the step-motor expansion valves in series 26 can be powered with 12 V or 24 V, with current phases

that vary from 150 to 600/900 mA. They are capable of supporting both full-step and half-step logic, and can operate at drive speeds up to 20 mm/s (500 steps/s) with 24 V piloting.

During continuous operation, due to their construction, a step motor is subject to step losses. In order to guarantee correct operation over time of the valve, the pilot driver of a motorized valve must implement an algorithm capable of adjusting to recover the steps lost during operation. This is necessary in order to allow for the precise regulation required during the entire regulation time.

Castel does not produce these control systems, drivers, or controllers. Therefore, it has tested and qualified its step-motor expansion valves in series 26 with the following systems, manufactured by Eliwell:

- Drivers models: XVD, XVD Open, V900 and V910
- Controller, model RTX600-VS

The operational characteristics of the valves discussed in this chapter refer to the following devices. In the event of use of drivers or controllers from other manufacturers, please refer to the configuration parameters listed in Table 52.

## CONSTRUCTION

Expansion valves “Body Size” 261 are manufactured in a total hermetic construction making the two main components inseparable:

- Valve body: where the copper connections and the calibrated orifice, directly machined into the body, are located
- Motor unit: where the step motor and all the electrical connections are located

Expansion valves “Body Size” 262, 263 and 264 are semi-hermetically manufactured and the same main components of the valve:

- Valve body: where the copper connections and the calibrated orifice, directly machined into the body, are located
- Motor unit: where the step motor and all the electrical connections are located

are separate, but they are supplied assembled by Castel to the correct torque. It is strongly recommended to not remove the motor unit from the valve body during brazing of the same on the system to avoid damage to the motor / shutter.

For all four “Body Sizes”, brazing must be performed with care, using a low melting point filler material. During brazing, it is important to avoid direct contact between the torch flame and the valve body, possibly protecting it with a wet cloth.

The main parts of valves in series 26 are manufactured 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
- Austenitic stainless steel EN 10088-3 – 1.4301 for the shutter of “Body Sizes” 262 and 263

- Brass bar EN 12164 – CW 614N for the shutter of “Body Sizes” 261 and 264
- Austenitic stainless steel EN 10088-3 – 1.4301 for the hermetic connector
- Copper pipe EN 12735-1 – Cu DHP for solder connections
- Chloroprene rubber (CR) for outlet seal gaskets

## SELECTION

To dimension a step-motor expansion valve in series 26 for a refrigerating system correctly, the following design parameters must be available:

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

The following procedure helps 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 at the maximum flow rate, that is with the valve always open

### Step 2

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

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

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

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

### Step 3

*Capacity correction based on the application.* For the valve to regulate correctly, in both the transitory period until full running is reached, and under stable running conditions, it is necessary to oversize it so that it works correctly over the entire range of capacity for the system.

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

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

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

Step 4

*Determine required orifice size.* Use the pressure drop across the valve, the evaporating temperature and the correct evaporator potential,  $Q_e$ , calculated above, 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 -  $P_c = 23$  bar
- Evaporating pressure at 0 °C -  $P_e = 8$  bar

$$\Delta p_{tot} = 23 - ( 8 + 1 ) = 14 \cdot \text{bar}$$

*Step 2 - Determine required valve capacity*

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

From the subcooling correction factor Table 59B, we find the appropriate correction factor,  $F_{sub}$ , equal to 1.07 for  $\Delta T_{sub} = 10$  °C. The required valve capacity is

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

*Step 3 - Capacity correction based on the application*  
According to the above sizing criterion, a correction of +

25% is applied to the calculated capacity:

$$Q_{ev} = 1,25 \cdot 65,4 = 81,8 \cdot \text{kW}$$

*Step 4 - Determine required orifice dimension.*

Using the data obtained:

- Pressure drop across the valve = 14 bar
- Evaporating temperature = 0 °C
- Calculated evaporator capacity = 81.8 kW

The selection is valve 26340, using Table 59A for the capacity of R410A.

### CONNECTIONS

All the expansion valves in series 26 are equipped with an M12 male connector with 4 pins, but are not equipped with the connection cable to the control/driver system. Therefore, it is necessary to buy separately the cable with M12 female connector with 4 pins that can be supplied in the following 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. Resistance greater than 2 Ohm could lead to a drop in performance of the valve or in the inability to pilot it. In the event of greater overall resistances or longer cables, please contact the Castel Technical Department.

### CERTIFICATIONS

The American certification authority Underwriters Laboratories Inc. has approved the expansion valves in series 261, 262, 263, and 264. The valves are certified **UL-CSA Recognized** for the USA and Canada with file MH50005, in compliance with American standard UL 429 and Canadian standard C22.2 No. 139-13.

Step-Motor expansion valves in series 261, 262, 263 and 264 are manufactured according to Electromagnetic Compatibility (EMC) Directive 2004/108/EC.

**TABLE 51: General characteristics of stepper-motor expansion valves**

Body Size	Catalogue Number	ODS Connections				Equivalent port Ø [mm]	Kv Factor [m³/h]	MOPD [bar]	Operating principles	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		[in]		[mm]							min.	max.	min.	max.	
		IN	OUT	IN	OUT										
261	26115/3	3/8"	3/8"	-	-	1,5	0,25	35	Stepper motor without gearbox	45	-40	+80	-40	+50	Art. 4.3
	26115/M10	-	-	10	10										
	26115/M12	-	-	12	12										
	26115/4	1/2"	1/2"	-	-										
	26120/3	3/8"	3/8"	-	-	2,0	0,34	35							
	26120/M10	-	-	10	10										
	26120/M12	-	-	12	12										
	26120/4	1/2"	1/2"	-	-										
	26127/3	3/8"	3/8"	-	-	2,7	0,40	35							
	26127/M10	-	-	10	10										
	26127/M12	-	-	12	12										
26127/4	1/2"	1/2"	-	-											
262	26227/M12	-	-	12	12	2,7	0,30	35	Stepper motor without gearbox	45	-40	+80	-40	+50	Art. 4.3
	26227/4	1/2"	1/2"	-	-										
	26227/5	5/8"	5/8"	16	16										
	26227/7	7/8"	7/8"	22	22										
	26232/M12	-	-	12	12	3,2	0,40	35							
	26232/4	1/2"	1/2"	-	-										
	26232/5	5/8"	5/8"	16	16										
	26232/7	7/8"	7/8"	22	22										
263	26336/5	5/8"	5/8"	16	16	3,6	0,55	30	Stepper motor without gearbox	45	-40	+80	-40	+50	Art. 4.3
	26336/7	7/8"	7/8"	22	22										
	26336/M28	-	-	28	28										
	26336/9	1.1/8"	1.1/8"	-	-										
	26340/7	7/8"	7/8"	22	22	4,0	0,63	30							
	26340/M28	-	-	28	28										
	26340/9	1.1/8"	1.1/8"	-	-										
	26344/7	7/8"	7/8"	22	22										
	26344/M28	-	-	28	28	4,4	0,93	30							
	26344/9	1.1/8"	1.1/8"	-	-										
264	26456/7	7/8"	7/8"	22	22	5,6	1,50	30	Stepper motor without gearbox	45	-40	+80	-40	+50	Art. 4.3
	26456/M28	-	-	28	28										
	26456/9	1.1/8"	1.1/8"	-	-										
	26456/11	1.3/8"	1.3/8"	35	35										
	26465/7	7/8"	7/8"	22	22	6,5	1,90	30							
	26465/M28	-	-	28	28										
	26465/9	1.1/8"	1.1/8"	-	-										
	26465/11	1.3/8"	1.3/8"	35	35										
	26475/7	7/8"	7/8"	22	22										
	26475/M28	-	-	28	28	7,5	2,20	30							
	26475/9	1.1/8"	1.1/8"	-	-										
	26475/11	1.3/8"	1.3/8"	35	35										

**TABLE 52. General characteristics of electric motor**

BODY SIZE	261	262	263	264
Stepper motor type	bi-polar - permanent magnet	bi-polar - permanent magnet	bi-polar - permanent magnet	bi-polar - permanent magnet
Step mode	full step drive	full step drive	full step drive	full step drive
Duty cycle [%]	100	100	100	100
Nominal voltage [V]	6	24	24	5
Voltage tolerances [%]	+/- ??	+/- ??	+/- ??	+/- ??
Max phase current [mA]	200	200	200	560
Phase current tolerances [%]	+/- ??	+/- ??	+/- ??	+/- ??
Holding current [nA]	50	50 [mA]	50 [mA]	50 [mA]
Nominal power [W]	2,4	4,1 [W]	4,1 [W]	5,1 [W]
Phase resistance [ohm]	35	51	51	11
Resistance tolerances [%]	+/- ??	+/- 10	+/- 10	+/- ??
Phase inductance [mH]	20	38	38	12
Inductance tolerances [%]	+/- ??	+/- 15	+/- 15	+/- ??
Step travel [mm]	0,0254	0,042	0,042	0,013
Speed rotation [steps/sec]	35	20	20	70
Minimum speed rotation [steps/sec]	10	10	10	10
Acceleration/deceleration				
Acceleration/deceleration [ms x 10/step]	50	50	50	50
Nominal total stroke [mm]	10,5	8,5	8,5	12,5
N° steps x nominal stroke	415	195	195	985 pasi
N° steps of extra-travel	100	60	60	150
N° cycles x nominal stroke	500.000 min	500.000 min	500.000 min	500.000 min
Electrical connection	Circular connector M12	Circular connector M12	Circular connector M12	Circular connector M12
Protection degree	IP 67 according to EN 60529	IP 67 according to EN 60529	IP 67 according to EN 60529	IP 67 according to EN 60529

**TABLE 53: Rated capacities in kW of stepper-motor expansion valves (1)**

Body Size	Catalogue number	Equivalent port Ø [mm]	Refrigerant												
			R134a	R22	R32	R404A	R407C	R410A	R507A	R1234yf	R1234ze	R448A	R449A	R450A	R452A
<b>261</b>	26115/--	1,5	12,91	14,38	20,28	11,92	11,80	22,91	12,37	10,18	11,75	14,72	14,72	11,85	14,72
	26120/--	2,0	18,71	21,18	30,26	17,63	17,41	34,10	18,29	14,79	16,95	21,77	21,77	17,17	21,77
	26127/--	2,7	21,72	23,88	33,32	19,73	19,56	37,73	20,47	17,07	19,83	24,37	24,37	19,93	24,37
<b>262</b>	26227/--	2,7	23,15	25,08	34,56	20,64	20,50	39,24	21,41	18,15	21,22	25,49	25,49	21,24	25,49
	26232/--	3,2	29,51	30,64	40,76	24,94	24,91	46,61	25,88	22,95	27,36	30,81	30,81	27,07	30,81
<b>263</b>	26336/--	3,6	35,08	36,57	48,80	29,80	29,74	55,76	30,91	27,30	32,50	36,80	36,80	32,19	36,80
	26340/--	4,0	63,62	65,76	87,13	53,46	53,42	99,70	55,46	49,43	59,08	66,03	66,03	58,38	66,03
	26344/--	4,4	76,24	79,23	105,44	64,50	64,41	120,55	66,91	59,30	70,69	79,66	79,66	69,96	79,66
<b>264</b>	26456/--	5,6	107,36	120,83	171,84	100,42	99,25	193,83	104,17	84,77	97,42	124,01	124,01	98,52	124,01
	26465/--	6,5	136,47	154,10	219,73	128,17	126,62	247,71	132,95	107,82	123,73	158,28	158,28	125,23	158,28
	26475/--	7,5	164,49	186,19	266,01	154,95	153,03	299,76	160,73	130,02	149,05	191,35	191,35	150,94	191,35

(1): Rated capacity with fully open valve and liquid flow from radial to axial connection **Valves operating range from 10% up to 95% of declared nominal capacities**

Rated capacities are based on:

- Evaporating temperature  $T_{\text{evap}} = + 5 \text{ }^{\circ}\text{C}$

- Condensing temperature  $T_{\text{cond}} = + 32 \text{ }^{\circ}\text{C}$

- Refrigerant liquid temperature ahead of valve  $T_{\text{liq}} = + 28 \text{ }^{\circ}\text{C}$



**TABLE 54: Dimensions and weights of stepper-motor expansion valves**

Body Size	Catalogue Number	H	L1	L2	D	Ch	Weight [g]
<b>261 (Fig. 1)</b>	26115/--	160	54	52	40	-	530
	26120/--						
	26127/--						
<b>262 (Fig. 1)</b>	26227/--	178	57	59	50	30	840
	26232/--	178	57	59			
<b>263 (Fig. 2)</b>	26336/--	200	77	73	50	30	910
	26340/--						
	26344/--						
<b>264 (Fig. 2)</b>	26456/--	228	98	91	51	34	1190
	26465/--						
	26475/--						

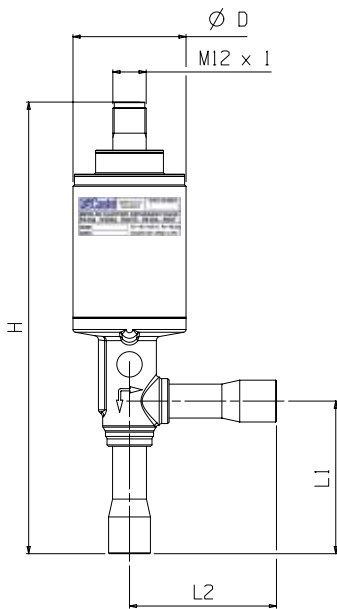


Fig. 1

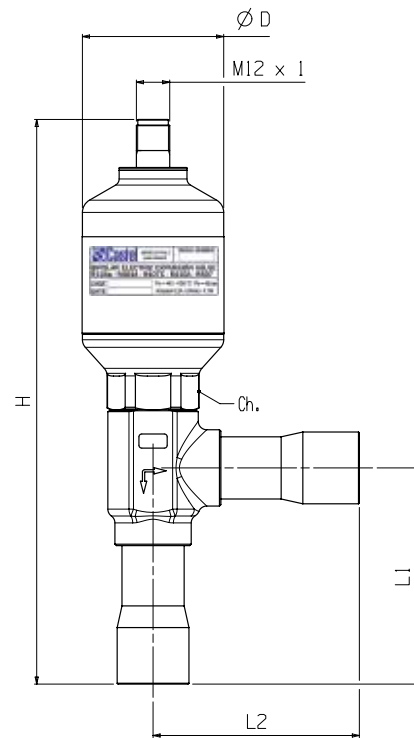
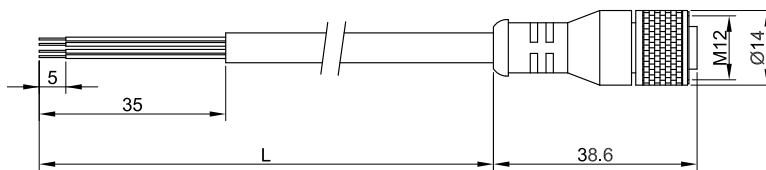


Fig. 2



9901/X28 L=3m

9901/X20 L=15m

**TABLE 55A: 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
26115/--	1,5	10,38	12,80	14,02	14,64	14,89	15,39	15,67	15,77	15,73	15,55	15,25
26120/--	2,0	14,74	18,55	20,56	21,65	22,16	23,02	23,55	23,80	23,81	23,61	23,22
26127/--	2,7	17,74	21,53	23,37	24,23	24,52	25,23	25,60	25,69	25,55	25,19	24,65
26227/--	2,7	19,26	22,95	24,63	25,35	25,49	26,11	26,38	26,38	26,15	25,71	25,09
26232/--	3,2	25,90	29,26	30,43	30,64	30,28	30,58	30,54	30,23	29,69	28,96	28,05
26336/--	3,6	30,64	34,78	36,28	36,60	36,23	36,63	36,62	36,28	35,66	34,81	33,75
26340/--	4,0	56,17	63,08	65,39	65,67	64,78	65,31	65,14	64,40	63,19	61,57	59,61
26344/--	4,4	66,87	75,59	78,67	79,22	78,33	79,11	79,02	78,22	76,84	74,95	72,62
26456/--	5,6	85,17	106,45	117,48	123,33	125,94	130,59	133,39	134,62	134,51	133,22	130,88
26465/--	6,5	107,83	135,31	149,69	157,41	160,95	167,08	170,81	172,52	172,51	170,96	168,05
26475/--	7,5	129,58	163,10	180,75	190,31	194,77	202,35	207,00	209,20	209,28	207,50	204,05
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
26115/--	1,5	10,85	13,10	14,15	14,60	14,70	15,18	15,45	15,54	15,48	15,29	14,98
26120/--	2,0	15,41	18,99	20,75	21,60	21,88	22,71	23,22	23,45	23,44	23,22	22,81
26127/--	2,7	18,55	22,04	23,58	24,17	24,20	24,89	25,24	25,31	25,14	24,77	24,21
26227/--	2,7	20,14	23,49	24,86	25,29	25,17	25,76	26,01	25,99	25,74	25,28	24,65
26232/--	3,2	27,08	29,94	30,72	30,56	29,90	30,17	30,11	29,78	29,22	28,47	27,56
26336/--	3,6	32,04	35,60	36,62	36,51	35,77	36,14	36,11	35,74	35,11	34,23	33,15
26340/--	4,0	58,73	64,56	66,00	65,50	63,95	64,44	64,22	63,44	62,20	60,55	58,55
26344/--	4,4	69,91	77,37	79,41	79,02	77,32	78,05	77,90	77,06	75,63	73,70	71,34
26456/--	5,6	89,05	108,96	118,58	123,02	124,32	128,84	131,50	132,62	132,40	131,01	128,57
26465/--	6,5	112,73	138,50	151,09	157,02	158,89	164,84	168,40	169,96	169,80	168,12	165,08
26475/--	7,5	135,47	166,94	182,43	189,83	192,27	199,63	204,08	206,09	205,99	204,05	200,44
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
26115/--	1,5	11,00	12,96	13,75	14,02	13,95	14,37	14,58	14,62	14,51	14,27	13,92
26120/--	2,0	15,61	18,78	20,16	20,74	20,76	21,50	21,91	22,06	21,97	21,68	21,20
26127/--	2,7	18,80	21,80	22,91	23,21	22,97	23,56	23,82	23,81	23,57	23,13	22,50
26227/--	2,7	20,41	23,23	24,15	24,28	23,88	24,38	24,55	24,45	24,13	23,60	22,91
26232/--	3,2	27,44	29,61	29,84	29,34	28,37	28,55	28,41	28,01	27,39	26,58	25,61
26336/--	3,6	32,47	35,20	35,58	35,05	33,94	34,21	34,08	33,62	32,91	31,96	30,81
26340/--	4,0	59,52	63,84	64,12	62,89	60,69	60,99	60,61	59,68	58,30	56,53	54,42
26344/--	4,4	70,85	76,51	77,14	75,88	73,38	73,87	73,52	72,49	70,89	68,81	66,30
26456/--	5,6	90,24	107,74	115,20	118,12	117,98	121,95	124,11	124,76	124,11	122,31	119,48
26465/--	6,5	114,24	136,95	146,78	150,77	150,78	156,02	158,93	159,89	159,16	156,95	153,41
26475/--	7,5	137,29	165,08	177,23	182,27	182,46	188,95	192,60	193,87	193,09	190,49	186,27

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

Continued

**TABLE 55A: Refrigerant R134a - Capacities in kW (1)**

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
26115/--	1,5	10,66	13,02	14,16	14,70	14,87	15,37	15,65	15,76	15,71	15,53	15,23
26120/--	2,0	15,14	18,87	20,77	21,74	22,14	23,00	23,53	23,78	23,79	23,58	23,19
26127/--	2,7	18,22	21,90	23,60	24,34	24,49	25,20	25,58	25,67	25,52	25,16	24,62
26227/--	2,7	19,79	23,35	24,88	25,46	25,47	26,08	26,36	26,35	26,12	25,68	25,06
26232/--	3,2	26,60	29,76	30,74	30,77	30,26	30,55	30,51	30,19	29,65	28,92	28,02
26336/--	3,6	31,48	35,38	36,65	36,75	36,20	36,60	36,59	36,24	35,62	34,77	33,71
26340/--	4,0	57,71	64,16	66,05	65,94	64,72	65,25	65,07	64,33	63,12	61,50	59,53
26344/--	4,4	68,69	76,89	79,47	79,56	78,26	79,03	78,94	78,14	76,75	74,86	72,53
26456/--	5,6	87,50	108,27	118,67	123,85	125,82	130,47	133,25	134,48	134,36	133,06	130,72
26465/--	6,5	110,77	137,63	151,21	158,08	160,81	166,92	170,64	172,34	172,31	170,76	167,84
26475/--	7,5	133,12	165,89	182,58	191,11	194,59	202,15	206,79	208,97	209,04	207,25	203,79
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
26115/--	1,5	10,98	13,10	14,02	14,38	14,40	14,85	15,10	15,17	15,09	14,88	14,55
26120/--	2,0	15,59	18,98	20,56	21,27	21,43	22,23	22,70	22,89	22,85	22,60	22,16
26127/--	2,7	18,77	22,03	23,37	23,80	23,71	24,36	24,67	24,71	24,51	24,11	23,53
26227/--	2,7	20,38	23,48	24,63	24,90	24,65	25,20	25,43	25,37	25,09	24,61	23,95
26232/--	3,2	27,40	29,92	30,43	30,09	29,28	29,52	29,43	29,07	28,49	27,72	26,78
26336/--	3,6	32,42	35,58	36,28	35,95	35,04	35,37	35,29	34,90	34,23	33,32	32,21
26340/--	4,0	59,42	64,52	65,39	64,50	62,65	63,06	62,78	61,94	60,64	58,94	56,90
26344/--	4,4	70,73	77,32	78,67	77,82	75,75	76,38	76,15	75,23	73,74	71,75	69,32
26456/--	5,6	90,10	108,88	117,48	121,14	121,79	126,08	128,55	129,47	129,08	127,53	124,93
26465/--	6,5	114,06	138,40	149,69	154,62	155,65	161,31	164,61	165,93	165,54	163,65	160,41
26475/--	7,5	137,07	166,82	180,75	186,93	188,35	195,36	199,49	201,20	200,83	198,63	194,77
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
26115/--	1,5	10,76	12,57	13,25	13,41	13,27	13,63	13,79	13,78	13,63	13,35	12,95
26120/--	2,0	15,28	18,21	19,43	19,82	19,74	20,39	20,73	20,80	20,64	20,27	19,73
26127/--	2,7	18,40	21,14	22,08	22,19	21,84	22,35	22,53	22,45	22,14	21,63	20,94
26227/--	2,7	19,98	22,53	23,27	23,21	22,72	23,12	23,22	23,05	22,66	22,08	21,32
26232/--	3,2	26,86	28,71	28,75	28,05	26,98	27,09	26,88	26,41	25,73	24,86	23,84
26336/--	3,6	31,78	34,14	34,28	33,51	32,28	32,45	32,23	31,70	30,91	29,89	28,68
26340/--	4,0	58,25	61,91	61,78	60,12	57,72	57,85	57,33	56,27	54,76	52,87	50,65
26344/--	4,4	69,34	74,19	74,33	72,53	69,79	70,07	69,54	68,34	66,59	64,36	61,71
26456/--	5,6	88,33	104,48	111,00	112,92	112,21	115,68	117,39	117,61	116,57	114,39	111,22
26465/--	6,5	111,82	132,80	141,43	144,12	143,41	148,00	150,32	150,73	149,49	146,80	142,80
26475/--	7,5	134,38	160,07	170,77	174,23	173,55	179,24	182,17	182,77	181,36	178,17	173,39

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

**TABLE: 55B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$** 

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 55B

**TABLE 56A: Refrigerant R22 - 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
26115/--	1,5	10,38	12,80	14,02	14,64	14,89	15,39	15,67	15,77	15,73	15,55	15,25
26120/--	2,0	14,74	18,55	20,56	21,65	22,16	23,02	23,55	23,80	23,81	23,61	23,22
26127/--	2,7	17,74	21,53	23,37	24,23	24,52	25,23	25,60	25,69	25,55	25,19	24,65
26227/--	2,7	19,26	22,95	24,63	25,35	25,49	26,11	26,38	26,38	26,15	25,71	25,09
26232/--	3,2	25,90	29,26	30,43	30,64	30,28	30,58	30,54	30,23	29,69	28,96	28,05
26336/--	3,6	30,64	34,78	36,28	36,60	36,23	36,63	36,62	36,28	35,66	34,81	33,75
26340/--	4,0	56,17	63,08	65,39	65,67	64,78	65,31	65,14	64,40	63,19	61,57	59,61
26344/--	4,4	66,87	75,59	78,67	79,22	78,33	79,11	79,02	78,22	76,84	74,95	72,62
26456/--	5,6	85,17	106,45	117,48	123,33	125,94	130,59	133,39	134,62	134,51	133,22	130,88
26465/--	6,5	107,83	135,31	149,69	157,41	160,95	167,08	170,81	172,52	172,51	170,96	168,05
26475/--	7,5	129,58	163,10	180,75	190,31	194,77	202,35	207,00	209,20	209,28	207,50	204,05
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
26115/--	1,5	10,85	13,10	14,15	14,60	14,70	15,18	15,45	15,54	15,48	15,29	14,98
26120/--	2,0	15,41	18,99	20,75	21,60	21,88	22,71	23,22	23,45	23,44	23,22	22,81
26127/--	2,7	18,55	22,04	23,58	24,17	24,20	24,89	25,24	25,31	25,14	24,77	24,21
26227/--	2,7	20,14	23,49	24,86	25,29	25,17	25,76	26,01	25,99	25,74	25,28	24,65
26232/--	3,2	27,08	29,94	30,72	30,56	29,90	30,17	30,11	29,78	29,22	28,47	27,56
26336/--	3,6	32,04	35,60	36,62	36,51	35,77	36,14	36,11	35,74	35,11	34,23	33,15
26340/--	4,0	58,73	64,56	66,00	65,50	63,95	64,44	64,22	63,44	62,20	60,55	58,55
26344/--	4,4	69,91	77,37	79,41	79,02	77,32	78,05	77,90	77,06	75,63	73,70	71,34
26456/--	5,6	89,05	108,96	118,58	123,02	124,32	128,84	131,50	132,62	132,40	131,01	128,57
26465/--	6,5	112,73	138,50	151,09	157,02	158,89	164,84	168,40	169,96	169,80	168,12	165,08
26475/--	7,5	135,47	166,94	182,43	189,83	192,27	199,63	204,08	206,09	205,99	204,05	200,44
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
26115/--	1,5	11,00	12,96	13,75	14,02	13,95	14,37	14,58	14,62	14,51	14,27	13,92
26120/--	2,0	15,61	18,78	20,16	20,74	20,76	21,50	21,91	22,06	21,97	21,68	21,20
26127/--	2,7	18,80	21,80	22,91	23,21	22,97	23,56	23,82	23,81	23,57	23,13	22,50
26227/--	2,7	20,41	23,23	24,15	24,28	23,88	24,38	24,55	24,45	24,13	23,60	22,91
26232/--	3,2	27,44	29,61	29,84	29,34	28,37	28,55	28,41	28,01	27,39	26,58	25,61
26336/--	3,6	32,47	35,20	35,58	35,05	33,94	34,21	34,08	33,62	32,91	31,96	30,81
26340/--	4,0	59,52	63,84	64,12	62,89	60,69	60,99	60,61	59,68	58,30	56,53	54,42
26344/--	4,4	70,85	76,51	77,14	75,88	73,38	73,87	73,52	72,49	70,89	68,81	66,30
26456/--	5,6	90,24	107,74	115,20	118,12	117,98	121,95	124,11	124,76	124,11	122,31	119,48
26465/--	6,5	114,24	136,95	146,78	150,77	150,78	156,02	158,93	159,89	159,16	156,95	153,41
26475/--	7,5	137,29	165,08	177,23	182,27	182,46	188,95	192,60	193,87	193,09	190,49	186,27

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

Continued

**TABLE 56A: Refrigerant R22 - Capacities in kW (1)**

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
26115/--	1,5	10,66	13,02	14,16	14,70	14,87	15,37	15,65	15,76	15,71	15,53	15,23
26120/--	2,0	15,14	18,87	20,77	21,74	22,14	23,00	23,53	23,78	23,79	23,58	23,19
26127/--	2,7	18,22	21,90	23,60	24,34	24,49	25,20	25,58	25,67	25,52	25,16	24,62
26227/--	2,7	19,79	23,35	24,88	25,46	25,47	26,08	26,36	26,35	26,12	25,68	25,06
26232/--	3,2	26,60	29,76	30,74	30,77	30,26	30,55	30,51	30,19	29,65	28,92	28,02
26336/--	3,6	31,48	35,38	36,65	36,75	36,20	36,60	36,59	36,24	35,62	34,77	33,71
26340/--	4,0	57,71	64,16	66,05	65,94	64,72	65,25	65,07	64,33	63,12	61,50	59,53
26344/--	4,4	68,69	76,89	79,47	79,56	78,26	79,03	78,94	78,14	76,75	74,86	72,53
26456/--	5,6	87,50	108,27	118,67	123,85	125,82	130,47	133,25	134,48	134,36	133,06	130,72
26465/--	6,5	110,77	137,63	151,21	158,08	160,81	166,92	170,64	172,34	172,31	170,76	167,84
26475/--	7,5	133,12	165,89	182,58	191,11	194,59	202,15	206,79	208,97	209,04	207,25	203,79
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
26115/--	1,5	10,98	13,10	14,02	14,38	14,40	14,85	15,10	15,17	15,09	14,88	14,55
26120/--	2,0	15,59	18,98	20,56	21,27	21,43	22,23	22,70	22,89	22,85	22,60	22,16
26127/--	2,7	18,77	22,03	23,37	23,80	23,71	24,36	24,67	24,71	24,51	24,11	23,53
26227/--	2,7	20,38	23,48	24,63	24,90	24,65	25,20	25,43	25,37	25,09	24,61	23,95
26232/--	3,2	27,40	29,92	30,43	30,09	29,28	29,52	29,43	29,07	28,49	27,72	26,78
26336/--	3,6	32,42	35,58	36,28	35,95	35,04	35,37	35,29	34,90	34,23	33,32	32,21
26340/--	4,0	59,42	64,52	65,39	64,50	62,65	63,06	62,78	61,94	60,64	58,94	56,90
26344/--	4,4	70,73	77,32	78,67	77,82	75,75	76,38	76,15	75,23	73,74	71,75	69,32
26456/--	5,6	90,10	108,88	117,48	121,14	121,79	126,08	128,55	129,47	129,08	127,53	124,93
26465/--	6,5	114,06	138,40	149,69	154,62	155,65	161,31	164,61	165,93	165,54	163,65	160,41
26475/--	7,5	137,07	166,82	180,75	186,93	188,35	195,36	199,49	201,20	200,83	198,63	194,77
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
26115/--	1,5	10,76	12,57	13,25	13,41	13,27	13,63	13,79	13,78	13,63	13,35	12,95
26120/--	2,0	15,28	18,21	19,43	19,82	19,74	20,39	20,73	20,80	20,64	20,27	19,73
26127/--	2,7	18,40	21,14	22,08	22,19	21,84	22,35	22,53	22,45	22,14	21,63	20,94
26227/--	2,7	19,98	22,53	23,27	23,21	22,72	23,12	23,22	23,05	22,66	22,08	21,32
26232/--	3,2	26,86	28,71	28,75	28,05	26,98	27,09	26,88	26,41	25,73	24,86	23,84
26336/--	3,6	31,78	34,14	34,28	33,51	32,28	32,45	32,23	31,70	30,91	29,89	28,68
26340/--	4,0	58,25	61,91	61,78	60,12	57,72	57,85	57,33	56,27	54,76	52,87	50,65
26344/--	4,4	69,34	74,19	74,33	72,53	69,79	70,07	69,54	68,34	66,59	64,36	61,71
26456/--	5,6	88,33	104,48	111,00	112,92	112,21	115,68	117,39	117,61	116,57	114,39	111,22
26465/--	6,5	111,82	132,80	141,43	144,12	143,41	148,00	150,32	150,73	149,49	146,80	142,80
26475/--	7,5	134,38	160,07	170,77	174,23	173,55	179,24	182,17	182,77	181,36	178,17	173,39

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

**TABLE: 56B - 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	1,05	1,10	1,15	1,20	1,25	1,29	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 56B

**TABLE 57A: 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
26115/--	1,5	10,75	14,09	16,31	17,96	19,24	20,27	21,09	21,76	22,30	22,72	23,02
26120/--	2,0	15,26	20,42	23,92	26,56	28,64	30,33	31,71	32,84	33,77	34,50	35,05
26127/--	2,7	18,37	23,70	27,18	29,73	31,68	33,24	34,46	35,45	36,23	36,81	37,21
26227/--	2,7	19,95	25,26	28,66	31,10	32,95	34,39	35,52	36,40	37,08	37,57	37,88
26232/--	3,2	26,82	32,19	35,40	37,59	39,14	40,29	41,11	41,70	42,10	42,31	42,35
26336/--	3,6	31,74	38,27	42,21	44,90	46,83	48,26	49,30	50,06	50,58	50,87	50,95
26340/--	4,0	58,18	69,41	76,07	80,56	83,73	86,05	87,69	88,85	89,61	89,97	89,99
26344/--	4,4	69,25	83,18	91,52	97,19	101,23	104,22	106,37	107,92	108,97	109,52	109,64
26456/--	5,6	88,21	117,14	136,67	151,31	162,76	172,05	179,56	185,73	190,76	194,67	197,59
26465/--	6,5	111,67	148,90	174,14	193,12	208,02	220,13	229,94	238,03	244,64	249,81	253,71
26475/--	7,5	134,20	179,47	210,26	233,47	251,72	266,59	278,66	288,62	296,79	303,20	308,06
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
26115/--	1,5	11,72	15,24	17,54	19,23	20,53	21,56	22,40	23,06	23,61	24,03	24,32
26120/--	2,0	16,64	22,08	25,72	28,43	30,56	32,26	33,66	34,80	35,75	36,49	37,04
26127/--	2,7	20,03	25,63	29,23	31,82	33,81	35,35	36,59	37,56	38,35	38,93	39,32
26227/--	2,7	21,75	27,32	30,82	33,29	35,16	36,59	37,71	38,57	39,26	39,74	40,03
26232/--	3,2	29,25	34,82	38,07	40,23	41,76	42,85	43,65	44,19	44,57	44,75	44,75
26336/--	3,6	34,61	41,40	45,39	48,06	49,97	51,34	52,35	53,04	53,55	53,80	53,83
26340/--	4,0	63,44	75,08	81,80	86,23	89,34	91,53	93,11	94,15	94,87	95,16	95,08
26344/--	4,4	75,51	89,97	98,42	104,04	108,02	110,86	112,94	114,36	115,36	115,84	115,85
26456/--	5,6	96,19	126,70	146,97	161,96	173,67	183,01	190,65	196,81	201,95	205,89	208,77
26465/--	6,5	121,77	161,05	187,26	206,72	221,96	234,15	244,14	252,23	259,00	264,22	268,06
26475/--	7,5	146,34	194,13	226,11	249,91	268,60	283,57	295,87	305,84	314,21	320,69	325,49
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
26115/--	1,5	12,39	15,93	18,20	19,83	21,09	22,08	22,87	23,50	24,02	24,39	24,64
26120/--	2,0	17,60	23,09	26,68	29,33	31,40	33,04	34,38	35,47	36,37	37,04	37,52
26127/--	2,7	21,18	26,80	30,32	32,83	34,73	36,21	37,37	38,28	39,02	39,52	39,83
26227/--	2,7	23,00	28,56	31,96	34,34	36,12	37,47	38,51	39,31	39,94	40,34	40,55
26232/--	3,2	30,93	36,40	39,49	41,50	42,91	43,89	44,58	45,04	45,34	45,43	45,33
26336/--	3,6	36,59	43,28	47,08	49,58	51,33	52,57	53,46	54,06	54,47	54,62	54,54
26340/--	4,0	67,08	78,49	84,85	88,95	91,78	93,74	95,09	95,96	96,51	96,61	96,33
26344/--	4,4	79,85	94,07	102,09	107,31	110,97	113,53	115,35	116,55	117,35	117,60	117,36
26456/--	5,6	101,71	132,46	152,44	167,06	178,43	187,43	194,72	200,59	205,44	209,03	211,50
26465/--	6,5	128,77	168,38	194,24	213,23	228,04	239,79	249,35	257,07	263,47	268,24	271,56
26475/--	7,5	154,75	202,95	234,54	257,78	275,95	290,41	302,18	311,71	319,63	325,57	329,74

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

Continued

**TABLE 57A: Refrigerant R32 - Capacities in kW (1)**

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
26115/--	1,5	11,51	15,00	17,29	18,98	20,28	21,32	22,15	22,83	23,38	23,79	24,09
26120/--	2,0	16,34	21,73	25,35	28,06	30,19	31,90	33,30	34,45	35,40	36,14	36,68
26127/--	2,7	19,67	25,23	28,81	31,41	33,40	34,95	36,19	37,19	37,98	38,55	38,94
26227/--	2,7	21,36	26,89	30,37	32,86	34,73	36,17	37,30	38,19	38,87	39,35	39,64
26232/--	3,2	28,71	34,27	37,53	39,71	41,26	42,37	43,18	43,75	44,13	44,32	44,32
26336/--	3,6	33,97	40,74	44,74	47,43	49,36	50,76	51,78	52,51	53,02	53,28	53,32
26340/--	4,0	62,27	73,89	80,63	85,11	88,26	90,50	92,10	93,21	93,94	94,24	94,17
26344/--	4,4	74,13	88,55	97,00	102,68	106,71	109,61	111,72	113,22	114,23	114,71	114,74
26456/--	5,6	94,42	124,69	144,86	159,84	171,58	180,95	188,58	194,85	199,96	203,89	206,77
26465/--	6,5	119,53	158,50	184,57	204,01	219,28	231,50	241,49	249,71	256,45	261,65	265,49
26475/--	7,5	143,65	191,05	222,86	246,64	265,36	280,37	292,66	302,79	311,12	317,57	322,37
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
26115/--	1,5	12,10	15,65	17,94	19,62	20,90	21,91	22,73	23,38	23,91	24,30	24,56
26120/--	2,0	17,18	22,67	26,31	29,01	31,11	32,79	34,16	35,29	36,21	36,91	37,41
26127/--	2,7	20,68	26,32	29,90	32,47	34,41	35,93	37,13	38,09	38,84	39,37	39,71
26227/--	2,7	22,46	28,05	31,52	33,97	35,79	37,18	38,27	39,11	39,76	40,19	40,43
26232/--	3,2	30,19	35,75	38,94	41,04	42,51	43,55	44,29	44,81	45,14	45,26	45,20
26336/--	3,6	35,72	42,50	46,43	49,03	50,86	52,17	53,12	53,79	54,23	54,41	54,37
26340/--	4,0	65,48	77,08	83,68	87,97	90,94	93,01	94,48	95,47	96,08	96,25	96,04
26344/--	4,4	77,95	92,38	100,67	106,14	109,95	112,66	114,61	115,96	116,83	117,16	117,01
26456/--	5,6	99,29	130,08	150,33	165,23	176,78	185,98	193,46	199,56	204,53	208,24	210,86
26465/--	6,5	125,70	165,35	191,55	210,89	225,93	237,94	247,74	255,76	262,30	267,23	270,75
26475/--	7,5	151,06	199,31	231,29	254,95	273,40	288,16	300,23	310,12	318,21	324,35	328,74
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
26115/--	1,5	12,58	16,06	18,28	19,87	21,09	22,05	22,81	23,42	23,91	24,26	24,48
26120/--	2,0	17,86	23,28	26,80	29,39	31,40	32,99	34,29	35,34	36,21	36,84	37,28
26127/--	2,7	21,50	27,02	30,46	32,89	34,73	36,15	37,27	38,15	38,84	39,31	39,57
26227/--	2,7	23,34	28,80	32,11	34,41	36,12	37,41	38,41	39,17	39,76	40,12	40,29
26232/--	3,2	31,38	36,70	39,67	41,59	42,91	43,82	44,46	44,88	45,14	45,19	45,04
26336/--	3,6	37,14	43,64	47,30	49,68	51,33	52,50	53,32	53,87	54,23	54,32	54,18
26340/--	4,0	68,07	79,14	85,24	89,13	91,78	93,60	94,84	95,62	96,08	96,09	95,70
26344/--	4,4	81,03	94,84	102,56	107,53	110,97	113,37	115,05	116,14	116,83	116,96	116,60
26456/--	5,6	103,22	133,55	153,15	167,41	178,43	187,15	194,20	199,88	204,53	207,90	210,14
26465/--	6,5	130,67	169,76	195,14	213,67	228,04	239,44	248,69	256,16	262,30	266,78	269,81
26475/--	7,5	157,03	204,62	235,62	258,31	275,95	289,98	301,38	310,61	318,21	323,80	327,61

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

**TABLE: 57B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 57B

**TABLE 58A: 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
26115/--	1,5	8,15	10,15	11,17	11,67	11,85	12,39	12,78	13,05	13,21	13,27	13,26
26120/--	2,0	11,57	14,70	16,37	17,26	17,63	18,54	19,21	19,68	20,00	20,16	20,20
26127/--	2,7	13,92	17,06	18,60	19,32	19,51	20,31	20,88	21,25	21,45	21,51	21,44
26227/--	2,7	15,12	18,19	19,62	20,21	20,29	21,02	21,52	21,82	21,96	21,95	21,83
26232/--	3,2	20,33	23,18	24,23	24,43	24,10	24,62	24,90	25,00	24,93	24,73	24,41
26336/--	3,6	24,05	27,56	28,89	29,18	28,83	29,50	29,87	30,00	29,95	29,73	29,36
26340/--	4,0	44,09	49,99	52,07	52,36	51,55	52,59	53,12	53,26	53,06	52,58	51,86
26344/--	4,4	52,48	59,90	62,64	63,17	62,33	63,70	64,44	64,69	64,52	64,00	63,18
26456/--	5,6	66,85	84,35	93,55	98,33	100,22	105,15	108,78	111,33	112,95	113,76	113,86
26465/--	6,5	84,63	107,23	119,20	125,51	128,08	134,53	139,30	142,67	144,85	145,99	146,19
26475/--	7,5	101,71	129,25	143,92	151,73	155,00	162,93	168,81	173,00	175,73	177,19	177,51
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
26115/--	1,5	9,03	11,06	12,03	12,45	12,54	13,14	13,58	13,90	14,11	14,22	14,24
26120/--	2,0	12,82	16,03	17,64	18,41	18,67	19,66	20,42	20,97	21,36	21,59	21,69
26127/--	2,7	15,43	18,60	20,04	20,61	20,65	21,55	22,19	22,64	22,91	23,04	23,03
26227/--	2,7	16,76	19,83	21,13	21,56	21,48	22,30	22,87	23,25	23,45	23,51	23,45
26232/--	3,2	22,53	25,27	26,10	26,06	25,51	26,12	26,48	26,63	26,63	26,48	26,21
26336/--	3,6	26,66	30,04	31,12	31,13	30,53	31,29	31,75	31,97	31,99	31,83	31,53
26340/--	4,0	48,87	54,49	56,09	55,85	54,58	55,79	56,47	56,74	56,67	56,31	55,69
26344/--	4,4	58,18	65,29	67,48	67,38	65,99	67,57	68,50	68,92	68,91	68,54	67,86
26456/--	5,6	74,10	91,95	100,76	104,90	106,10	111,54	115,64	118,61	120,64	121,83	122,29
26465/--	6,5	93,81	116,88	128,39	133,88	135,60	142,71	148,08	152,01	154,71	156,34	157,02
26475/--	7,5	112,74	140,88	155,03	161,86	164,09	172,83	179,45	184,32	187,69	189,76	190,65
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
26115/--	1,5	9,56	11,44	12,23	12,50	12,46	13,05	13,49	13,80	14,00	14,11	14,13
26120/--	2,0	13,58	16,58	17,94	18,49	18,55	19,53	20,28	20,82	21,20	21,42	21,52
26127/--	2,7	16,34	19,25	20,39	20,69	20,52	21,40	22,04	22,47	22,74	22,86	22,84
26227/--	2,7	17,75	20,51	21,49	21,65	21,34	22,15	22,71	23,08	23,28	23,33	23,26
26232/--	3,2	23,86	26,15	26,55	26,16	25,35	25,94	26,29	26,44	26,43	26,27	26,00
26336/--	3,6	28,23	31,09	31,66	31,25	30,33	31,08	31,53	31,74	31,75	31,59	31,28
26340/--	4,0	51,76	56,38	57,05	56,07	54,22	55,41	56,08	56,33	56,25	55,87	55,24
26344/--	4,4	61,61	67,56	68,64	67,65	65,56	67,11	68,03	68,42	68,40	68,01	67,31
26456/--	5,6	78,48	95,14	102,50	105,31	105,41	110,79	114,83	117,76	119,73	120,88	121,30
26465/--	6,5	99,35	120,93	130,60	134,41	134,72	141,75	147,05	150,91	153,55	155,12	155,74
26475/--	7,5	119,39	145,77	157,70	162,50	163,02	171,67	178,20	182,99	186,29	188,28	189,11

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

Continued



**TABLE 58A: Refrigerant R404A - Capacities in kW (1)**

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
26115/--	1,5	8,63	10,68	11,69	12,17	12,31	12,89	13,31	13,61	13,80	13,90	13,91
26120/--	2,0	12,26	15,47	17,14	17,99	18,32	19,28	20,01	20,54	20,89	21,11	21,19
26127/--	2,7	14,75	17,96	19,48	20,14	20,27	21,13	21,75	22,17	22,42	22,52	22,49
26227/--	2,7	16,02	19,14	20,53	21,07	21,07	21,86	22,41	22,76	22,94	22,98	22,90
26232/--	3,2	21,54	24,39	25,37	25,46	25,03	25,61	25,94	26,08	26,05	25,88	25,60
26336/--	3,6	25,49	29,00	30,25	30,42	29,95	30,68	31,11	31,30	31,29	31,12	30,80
26340/--	4,0	46,72	52,60	54,51	54,57	53,55	54,70	55,34	55,56	55,45	55,04	54,39
26344/--	4,4	55,61	63,03	65,58	65,84	64,75	66,26	67,12	67,48	67,42	67,00	66,27
26456/--	5,6	70,84	88,76	97,93	102,50	104,11	109,38	113,31	116,14	118,03	119,09	119,43
26465/--	6,5	89,68	112,82	124,78	130,82	133,05	139,94	145,10	148,84	151,37	152,83	153,34
26475/--	7,5	107,77	135,99	150,67	158,16	161,01	169,47	175,84	180,48	183,64	185,49	186,19
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
26115/--	1,5	9,54	11,31	12,20	12,55	12,58	13,19	13,63	13,95	14,16	14,27	14,30
26120/--	2,0	13,54	16,40	17,89	18,56	18,73	19,73	20,49	21,05	21,44	21,68	21,78
26127/--	2,7	16,30	19,03	20,33	20,78	20,72	21,62	22,27	22,72	23,00	23,13	23,12
26227/--	2,7	17,70	20,28	21,43	21,73	21,55	22,37	22,95	23,33	23,54	23,60	23,54
26232/--	3,2	23,79	25,85	26,48	26,26	25,60	26,21	26,57	26,73	26,73	26,58	26,32
26336/--	3,6	28,15	30,74	31,57	31,38	30,63	31,39	31,86	32,08	32,11	31,96	31,66
26340/--	4,0	51,61	55,75	56,90	56,29	54,76	55,97	56,67	56,95	56,88	56,53	55,92
26344/--	4,4	61,43	66,80	68,46	67,92	66,21	67,80	68,74	69,17	69,17	68,81	68,13
26456/--	5,6	78,26	94,07	102,23	105,73	106,45	111,92	116,04	119,04	121,09	122,31	122,78
26465/--	6,5	99,07	119,58	130,25	134,95	136,04	143,19	148,60	152,56	155,29	156,95	157,65
26475/--	7,5	119,06	144,14	157,28	163,14	164,63	173,41	180,08	184,99	188,40	190,49	191,42
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
26115/--	1,5	9,88	11,58	12,22	12,37	12,22	12,79	13,21	13,50	13,68	13,77	13,78
26120/--	2,0	14,03	16,78	17,92	18,29	18,18	19,13	19,85	20,37	20,72	20,92	20,99
26127/--	2,7	16,89	19,48	20,37	20,47	20,12	20,97	21,57	21,98	22,22	22,32	22,28
26227/--	2,7	18,34	20,76	21,47	21,41	20,92	21,70	22,23	22,57	22,75	22,78	22,69
26232/--	3,2	24,65	26,46	26,53	25,88	24,85	25,41	25,74	25,86	25,83	25,65	25,36
26336/--	3,6	29,17	31,46	31,63	30,91	29,73	30,45	30,86	31,04	31,03	30,84	30,51
26340/--	4,0	53,47	57,05	57,00	55,46	53,16	54,28	54,90	55,10	54,97	54,55	53,89
26344/--	4,4	63,65	68,37	68,58	66,91	64,27	65,75	66,59	66,93	66,85	66,41	65,66
26456/--	5,6	81,08	96,28	102,41	104,17	103,33	108,54	112,41	115,18	117,02	118,03	118,32
26465/--	6,5	102,64	122,38	130,49	132,95	132,06	138,86	143,95	147,62	150,07	151,47	151,92
26475/--	7,5	123,35	147,51	157,56	160,73	159,81	168,17	174,45	178,99	182,06	183,84	184,47

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

**TABLE: 58B - 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	1,09	1,17	1,26	1,34	1,42	1,50	1,56	1,63

When subcooling ahead of the expansion valve is other than 4 °K , adjust the evaporator capacity by dividing by the appropriate correction factor found in Table 58B

**TABLE 59A: 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
26115/--	1,5	8,15	10,15	11,17	11,67	11,85	12,39	12,78	13,05	13,21	13,27	13,26
26120/--	2,0	11,57	14,70	16,37	17,26	17,63	18,54	19,21	19,68	20,00	20,16	20,20
26127/--	2,7	13,92	17,06	18,60	19,32	19,51	20,31	20,88	21,25	21,45	21,51	21,44
26227/--	2,7	15,12	18,19	19,62	20,21	20,29	21,02	21,52	21,82	21,96	21,95	21,83
26232/--	3,2	20,33	23,18	24,23	24,43	24,10	24,62	24,90	25,00	24,93	24,73	24,41
26336/--	3,6	24,05	27,56	28,89	29,18	28,83	29,50	29,87	30,00	29,95	29,73	29,36
26340/--	4,0	44,09	49,99	52,07	52,36	51,55	52,59	53,12	53,26	53,06	52,58	51,86
26344/--	4,4	52,48	59,90	62,64	63,17	62,33	63,70	64,44	64,69	64,52	64,00	63,18
26456/--	5,6	66,85	84,35	93,55	98,33	100,22	105,15	108,78	111,33	112,95	113,76	113,86
26465/--	6,5	84,63	107,23	119,20	125,51	128,08	134,53	139,30	142,67	144,85	145,99	146,19
26475/--	7,5	101,71	129,25	143,92	151,73	155,00	162,93	168,81	173,00	175,73	177,19	177,51
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
26115/--	1,5	9,03	11,06	12,03	12,45	12,54	13,14	13,58	13,90	14,11	14,22	14,24
26120/--	2,0	12,82	16,03	17,64	18,41	18,67	19,66	20,42	20,97	21,36	21,59	21,69
26127/--	2,7	15,43	18,60	20,04	20,61	20,65	21,55	22,19	22,64	22,91	23,04	23,03
26227/--	2,7	16,76	19,83	21,13	21,56	21,48	22,30	22,87	23,25	23,45	23,51	23,45
26232/--	3,2	22,53	25,27	26,10	26,06	25,51	26,12	26,48	26,63	26,63	26,48	26,21
26336/--	3,6	26,66	30,04	31,12	31,13	30,53	31,29	31,75	31,97	31,99	31,83	31,53
26340/--	4,0	48,87	54,49	56,09	55,85	54,58	55,79	56,47	56,74	56,67	56,31	55,69
26344/--	4,4	58,18	65,29	67,48	67,38	65,99	67,57	68,50	68,92	68,91	68,54	67,86
26456/--	5,6	74,10	91,95	100,76	104,90	106,10	111,54	115,64	118,61	120,64	121,83	122,29
26465/--	6,5	93,81	116,88	128,39	133,88	135,60	142,71	148,08	152,01	154,71	156,34	157,02
26475/--	7,5	112,74	140,88	155,03	161,86	164,09	172,83	179,45	184,32	187,69	189,76	190,65
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
26115/--	1,5	9,56	11,44	12,23	12,50	12,46	13,05	13,49	13,80	14,00	14,11	14,13
26120/--	2,0	13,58	16,58	17,94	18,49	18,55	19,53	20,28	20,82	21,20	21,42	21,52
26127/--	2,7	16,34	19,25	20,39	20,69	20,52	21,40	22,04	22,47	22,74	22,86	22,84
26227/--	2,7	17,75	20,51	21,49	21,65	21,34	22,15	22,71	23,08	23,28	23,33	23,26
26232/--	3,2	23,86	26,15	26,55	26,16	25,35	25,94	26,29	26,44	26,43	26,27	26,00
26336/--	3,6	28,23	31,09	31,66	31,25	30,33	31,08	31,53	31,74	31,75	31,59	31,28
26340/--	4,0	51,76	56,38	57,05	56,07	54,22	55,41	56,08	56,33	56,25	55,87	55,24
26344/--	4,4	61,61	67,56	68,64	67,65	65,56	67,11	68,03	68,42	68,40	68,01	67,31
26456/--	5,6	78,48	95,14	102,50	105,31	105,41	110,79	114,83	117,76	119,73	120,88	121,30
26465/--	6,5	99,35	120,93	130,60	134,41	134,72	141,75	147,05	150,91	153,55	155,12	155,74
26475/--	7,5	119,39	145,77	157,70	162,50	163,02	171,67	178,20	182,99	186,29	188,28	189,11

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

Continued

**TABLE 59A: Refrigerant R407C - Capacities in kW (1)**

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
26115/--	1,5	8,63	10,68	11,69	12,17	12,31	12,89	13,31	13,61	13,80	13,90	13,91
26120/--	2,0	12,26	15,47	17,14	17,99	18,32	19,28	20,01	20,54	20,89	21,11	21,19
26127/--	2,7	14,75	17,96	19,48	20,14	20,27	21,13	21,75	22,17	22,42	22,52	22,49
26227/--	2,7	16,02	19,14	20,53	21,07	21,07	21,86	22,41	22,76	22,94	22,98	22,90
26232/--	3,2	21,54	24,39	25,37	25,46	25,03	25,61	25,94	26,08	26,05	25,88	25,60
26336/--	3,6	25,49	29,00	30,25	30,42	29,95	30,68	31,11	31,30	31,29	31,12	30,80
26340/--	4,0	46,72	52,60	54,51	54,57	53,55	54,70	55,34	55,56	55,45	55,04	54,39
26344/--	4,4	55,61	63,03	65,58	65,84	64,75	66,26	67,12	67,48	67,42	67,00	66,27
26456/--	5,6	70,84	88,76	97,93	102,50	104,11	109,38	113,31	116,14	118,03	119,09	119,43
26465/--	6,5	89,68	112,82	124,78	130,82	133,05	139,94	145,10	148,84	151,37	152,83	153,34
26475/--	7,5	107,77	135,99	150,67	158,16	161,01	169,47	175,84	180,48	183,64	185,49	186,19
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
26115/--	1,5	9,54	11,31	12,20	12,55	12,58	13,19	13,63	13,95	14,16	14,27	14,30
26120/--	2,0	13,54	16,40	17,89	18,56	18,73	19,73	20,49	21,05	21,44	21,68	21,78
26127/--	2,7	16,30	19,03	20,33	20,78	20,72	21,62	22,27	22,72	23,00	23,13	23,12
26227/--	2,7	17,70	20,28	21,43	21,73	21,55	22,37	22,95	23,33	23,54	23,60	23,54
26232/--	3,2	23,79	25,85	26,48	26,26	25,60	26,21	26,57	26,73	26,73	26,58	26,32
26336/--	3,6	28,15	30,74	31,57	31,38	30,63	31,39	31,86	32,08	32,11	31,96	31,66
26340/--	4,0	51,61	55,75	56,90	56,29	54,76	55,97	56,67	56,95	56,88	56,53	55,92
26344/--	4,4	61,43	66,80	68,46	67,92	66,21	67,80	68,74	69,17	69,17	68,81	68,13
26456/--	5,6	78,26	94,07	102,23	105,73	106,45	111,92	116,04	119,04	121,09	122,31	122,78
26465/--	6,5	99,07	119,58	130,25	134,95	136,04	143,19	148,60	152,56	155,29	156,95	157,65
26475/--	7,5	119,06	144,14	157,28	163,14	164,63	173,41	180,08	184,99	188,40	190,49	191,42
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
26115/--	1,5	9,88	11,58	12,22	12,37	12,22	12,79	13,21	13,50	13,68	13,77	13,78
26120/--	2,0	14,03	16,78	17,92	18,29	18,18	19,13	19,85	20,37	20,72	20,92	20,99
26127/--	2,7	16,89	19,48	20,37	20,47	20,12	20,97	21,57	21,98	22,22	22,32	22,28
26227/--	2,7	18,34	20,76	21,47	21,41	20,92	21,70	22,23	22,57	22,75	22,78	22,69
26232/--	3,2	24,65	26,46	26,53	25,88	24,85	25,41	25,74	25,86	25,83	25,65	25,36
26336/--	3,6	29,17	31,46	31,63	30,91	29,73	30,45	30,86	31,04	31,03	30,84	30,51
26340/--	4,0	53,47	57,05	57,00	55,46	53,16	54,28	54,90	55,10	54,97	54,55	53,89
26344/--	4,4	63,65	68,37	68,58	66,91	64,27	65,75	66,59	66,93	66,85	66,41	65,66
26456/--	5,6	81,08	96,28	102,41	104,17	103,33	108,54	112,41	115,18	117,02	118,03	118,32
26465/--	6,5	102,64	122,38	130,49	132,95	132,06	138,86	143,95	147,62	150,07	151,47	151,92
26475/--	7,5	123,35	147,51	157,56	160,73	159,81	168,17	174,45	178,99	182,06	183,84	184,47

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

**TABLE: 59B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$** 

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 59B

**TABLE 60A: 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
26115/--	1,5	13,66	17,50	19,81	21,31	22,29	22,89	23,19	23,28	23,15	22,83	22,32
26120/--	2,0	19,39	25,36	29,04	31,50	33,17	34,25	34,86	35,12	35,06	34,67	34,00
26127/--	2,7	23,34	29,43	33,00	35,26	36,70	37,53	37,89	37,91	37,61	36,99	36,09
26227/--	2,7	25,35	31,37	34,79	36,89	38,16	38,84	39,05	38,93	38,50	37,76	36,74
26232/--	3,2	34,08	39,98	42,98	44,58	45,33	45,49	45,20	44,60	43,71	42,52	41,08
26336/--	3,6	40,32	47,54	51,25	53,26	54,23	54,49	54,20	53,54	52,51	51,12	49,42
26340/--	4,0	73,91	86,21	92,36	95,55	96,97	97,16	96,41	95,03	93,03	90,42	87,28
26344/--	4,4	87,98	103,32	111,12	115,28	117,24	117,68	116,95	115,43	113,13	110,07	106,34
26456/--	5,6	112,07	145,49	165,93	179,47	188,51	194,27	197,41	198,65	198,04	195,64	191,64
26465/--	6,5	141,87	184,94	211,42	229,06	240,92	248,55	252,80	254,59	253,98	251,06	246,06
26475/--	7,5	170,50	222,91	255,28	276,92	291,54	301,01	306,36	308,71	308,12	304,71	298,78
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
26115/--	1,5	16,62	20,91	23,38	24,93	25,93	26,52	26,83	26,92	26,81	26,47	25,92
26120/--	2,0	23,60	30,30	34,28	36,86	38,60	39,68	40,33	40,62	40,59	40,20	39,48
26127/--	2,7	28,40	35,17	38,95	41,26	42,70	43,48	43,84	43,85	43,55	42,89	41,91
26227/--	2,7	30,84	37,49	41,07	43,17	44,41	44,99	45,17	45,03	44,58	43,78	42,66
26232/--	3,2	41,46	47,78	50,74	52,17	52,75	52,70	52,29	51,59	50,61	49,30	47,70
26336/--	3,6	49,06	56,81	60,49	62,32	63,11	63,13	62,71	61,92	60,80	59,27	57,38
26340/--	4,0	89,94	103,03	109,02	111,81	112,84	112,56	111,54	109,91	107,72	104,84	101,35
26344/--	4,4	107,05	123,47	131,16	134,89	136,43	136,34	135,30	133,50	130,99	127,61	123,48
26456/--	5,6	136,37	173,87	195,86	210,00	219,36	225,07	228,39	229,75	229,31	226,83	222,52
26465/--	6,5	172,63	221,01	249,57	268,03	280,35	287,96	292,47	294,44	294,08	291,08	285,72
26475/--	7,5	207,46	266,39	301,34	324,04	339,26	348,74	354,44	357,03	356,77	353,29	346,92
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
26115/--	1,5	13,02	16,23	18,02	19,13	19,80	20,19	20,35	20,31	20,19	19,88	19,42
26120/--	2,0	18,48	23,51	26,43	28,29	29,46	30,20	30,58	30,65	30,57	30,20	29,58
26127/--	2,7	22,25	27,29	30,03	31,66	32,60	33,10	33,24	33,08	32,79	32,22	31,40
26227/--	2,7	24,16	29,09	31,66	33,13	33,90	34,25	34,25	33,97	33,56	32,89	31,97
26232/--	3,2	32,48	37,08	39,12	40,03	40,27	40,12	39,65	38,92	38,11	37,04	35,74
26336/--	3,6	38,43	44,09	46,64	47,82	48,18	48,06	47,55	46,72	45,78	44,53	43,00
26340/--	4,0	70,44	79,95	84,05	85,80	86,14	85,68	84,58	82,93	81,11	78,76	75,94
26344/--	4,4	83,85	95,81	101,13	103,51	104,15	103,78	102,60	100,72	98,63	95,87	92,52
26456/--	5,6	106,81	134,92	151,01	161,14	167,46	171,33	173,19	173,35	172,66	170,40	166,74
26465/--	6,5	135,22	171,50	192,41	205,68	214,01	219,20	221,78	222,16	221,43	218,67	214,09
26475/--	7,5	162,50	206,72	232,33	248,65	258,98	265,46	268,76	269,38	268,64	265,41	259,96

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

Continued

**TABLE 60A: Refrigerant R410A - Capacities in kW (1)**

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
26115/--	1,5	14,61	18,64	21,02	22,56	23,54	24,15	24,48	24,59	24,49	24,18	23,68
26120/--	2,0	20,74	27,02	30,82	33,35	35,04	36,14	36,80	37,10	37,08	36,72	36,06
26127/--	2,7	24,96	31,36	35,02	37,33	38,76	39,61	40,00	40,04	39,77	39,17	38,28
26227/--	2,7	27,11	33,42	36,93	39,06	40,31	40,98	41,23	41,12	40,71	39,98	38,97
26232/--	3,2	36,44	42,60	45,62	47,20	47,89	48,01	47,72	47,11	46,22	45,03	43,57
26336/--	3,6	43,12	50,65	54,39	56,38	57,29	57,51	57,23	56,55	55,53	54,14	52,42
26340/--	4,0	79,05	91,86	98,02	101,16	102,44	102,54	101,79	100,37	98,38	95,76	92,58
26344/--	4,4	94,10	110,08	117,93	122,05	123,86	124,19	123,47	121,91	119,63	116,56	112,80
26456/--	5,6	119,86	155,01	176,10	190,00	199,14	205,02	208,43	209,81	209,43	207,18	203,27
26465/--	6,5	151,74	197,04	224,39	242,50	254,51	262,31	266,90	268,89	268,58	265,87	261,00
26475/--	7,5	182,35	237,51	270,94	293,18	307,98	317,67	323,45	326,04	325,84	322,69	316,91
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
26115/--	1,5	16,11	20,27	22,64	24,14	25,06	25,61	25,86	25,89	25,75	25,38	24,81
26120/--	2,0	22,87	29,37	33,20	35,69	37,30	38,32	38,87	39,07	38,99	38,55	37,79
26127/--	2,7	27,53	34,09	37,72	39,95	41,26	41,99	42,25	42,17	41,83	41,13	40,11
26227/--	2,7	29,90	36,34	39,77	41,80	42,91	43,45	43,54	43,31	42,81	41,98	40,84
26232/--	3,2	40,19	46,31	49,13	50,51	50,97	50,90	50,40	49,62	48,61	47,28	45,66
26336/--	3,6	47,56	55,06	58,58	60,34	60,99	60,97	60,44	59,56	58,39	56,83	54,92
26340/--	4,0	87,18	99,86	105,57	108,26	109,04	108,71	107,50	105,71	103,46	100,53	97,01
26344/--	4,4	103,77	119,67	127,01	130,61	131,84	131,68	130,40	128,40	125,81	122,37	118,19
26456/--	5,6	132,19	168,52	189,67	203,33	211,98	217,37	220,13	220,97	220,24	217,51	213,00
26465/--	6,5	167,34	214,21	241,67	259,52	270,92	278,11	281,89	283,19	282,44	279,12	273,49
26475/--	7,5	201,11	258,20	291,81	313,75	327,84	336,81	341,62	343,38	342,66	338,78	332,08
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
26115/--	1,5	17,05	21,08	23,28	24,61	25,39	25,84	25,96	25,91	25,66	25,17	24,47
26120/--	2,0	24,21	30,54	34,14	36,40	37,79	38,66	39,02	39,10	38,85	38,23	37,26
26127/--	2,7	29,14	35,45	38,79	40,74	41,81	42,36	42,41	42,21	41,68	40,78	39,56
26227/--	2,7	31,64	37,78	40,90	42,62	43,48	43,84	43,71	43,34	42,66	41,63	40,27
26232/--	3,2	42,54	48,16	50,53	51,50	51,65	51,35	50,60	49,66	48,44	46,88	45,02
26336/--	3,6	50,34	57,26	60,24	61,53	61,79	61,51	60,68	59,60	58,19	56,36	54,16
26340/--	4,0	92,27	103,84	108,57	110,39	110,49	109,68	107,92	105,80	103,10	99,69	95,66
26344/--	4,4	109,83	124,43	130,61	133,18	133,59	132,84	130,91	128,50	125,37	121,35	116,55
26456/--	5,6	139,91	175,23	195,04	207,33	214,79	219,30	220,99	221,15	219,46	215,69	210,04
26465/--	6,5	177,12	222,74	248,52	264,63	274,50	280,57	282,99	283,42	281,45	276,78	269,69
26475/--	7,5	212,85	268,48	300,08	319,92	332,18	339,79	342,95	343,67	341,45	335,94	327,47

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

**TABLE: 60B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$** 

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 60B

**TABLE 61A: 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
26115/--	1,5	8,36	10,46	11,56	12,12	12,35	12,94	13,36	13,66	13,86	13,96	13,97
26120/--	2,0	11,87	15,15	16,95	17,92	18,38	19,35	20,09	20,62	20,98	21,20	21,28
26127/--	2,7	14,29	17,59	19,26	20,06	20,34	21,21	21,83	22,26	22,51	22,62	22,59
26227/--	2,7	15,52	18,75	20,30	20,98	21,15	21,95	22,50	22,85	23,04	23,08	23,00
26232/--	3,2	20,87	23,89	25,09	25,36	25,13	25,71	26,04	26,18	26,16	26,00	25,72
26336/--	3,6	24,69	28,41	29,91	30,29	30,06	30,80	31,23	31,43	31,43	31,25	30,94
26340/--	4,0	45,26	51,52	53,90	54,35	53,75	54,91	55,55	55,79	55,68	55,29	54,64
26344/--	4,4	53,87	61,74	64,85	65,57	64,99	66,51	67,39	67,76	67,71	67,30	66,57
26456/--	5,6	68,63	86,94	96,84	102,08	104,49	109,79	113,75	116,61	118,53	119,62	119,97
26465/--	6,5	86,88	110,51	123,39	130,29	133,54	140,47	145,67	149,45	152,01	153,50	154,04
26475/--	7,5	104,41	133,20	148,98	157,52	161,60	170,11	176,53	181,22	184,41	186,31	187,04
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
26115/--	1,5	9,21	11,34	12,39	12,90	13,05	13,69	14,17	14,52	14,76	14,90	14,96
26120/--	2,0	13,07	16,44	18,16	19,07	19,42	20,48	21,30	21,91	22,34	22,63	22,78
26127/--	2,7	15,73	19,08	20,64	21,35	21,48	22,44	23,15	23,65	23,97	24,14	24,18
26227/--	2,7	17,09	20,33	21,76	22,33	22,34	23,23	23,86	24,28	24,54	24,64	24,62
26232/--	3,2	22,97	25,92	26,88	26,99	26,54	27,20	27,61	27,82	27,86	27,75	27,52
26336/--	3,6	27,18	30,81	32,05	32,24	31,75	32,59	33,12	33,39	33,47	33,36	33,11
26340/--	4,0	49,82	55,88	57,76	57,85	56,77	58,11	58,90	59,27	59,29	59,02	58,48
26344/--	4,4	59,31	66,97	69,50	69,79	68,64	70,38	71,45	71,99	72,10	71,84	71,25
26456/--	5,6	75,54	94,30	103,78	108,65	110,37	116,18	120,61	123,90	126,22	127,68	128,40
26465/--	6,5	95,63	119,87	132,23	138,67	141,05	148,64	154,45	158,79	161,87	163,85	164,87
26475/--	7,5	114,93	144,49	159,67	167,64	170,69	180,02	187,18	192,54	196,38	198,87	200,18
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
26115/--	1,5	9,75	11,74	12,63	12,98	12,99	13,63	14,11	14,45	14,69	14,83	14,88
26120/--	2,0	13,85	17,02	18,52	19,20	19,34	20,39	21,20	21,81	22,24	22,52	22,66
26127/--	2,7	16,67	19,75	21,04	21,49	21,39	22,35	23,05	23,54	23,86	24,02	24,06
26227/--	2,7	18,10	21,05	22,18	22,48	22,25	23,12	23,75	24,17	24,42	24,52	24,49
26232/--	3,2	24,33	26,83	27,40	27,17	26,43	27,09	27,49	27,69	27,72	27,61	27,38
26336/--	3,6	28,79	31,90	32,67	32,46	31,62	32,45	32,97	33,24	33,31	33,20	32,94
26340/--	4,0	52,78	57,86	58,88	58,23	56,54	57,85	58,64	59,00	59,01	58,72	58,18
26344/--	4,4	62,82	69,34	70,84	70,26	68,36	70,07	71,13	71,66	71,76	71,48	70,88
26456/--	5,6	80,03	97,64	105,79	109,37	109,91	115,68	120,07	123,33	125,61	127,05	127,74
26465/--	6,5	101,31	124,12	134,79	139,60	140,47	148,00	153,76	158,06	161,10	163,04	164,02
26475/--	7,5	121,75	149,60	162,76	168,77	169,98	179,24	186,34	191,65	195,44	197,89	199,15

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

Continued

**TABLE 61A: Refrigerant R507A - Capacities in kW (1)**

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
26115/--	1,5	8,83	10,98	12,06	12,61	12,82	13,44	13,90	14,23	14,46	14,59	14,63
26120/--	2,0	12,54	15,91	17,68	18,65	19,07	20,11	20,89	21,48	21,89	22,15	22,28
26127/--	2,7	15,09	18,46	20,09	20,88	21,10	22,03	22,71	23,18	23,48	23,63	23,65
26227/--	2,7	16,38	19,68	21,19	21,84	21,95	22,80	23,40	23,81	24,04	24,12	24,08
26232/--	3,2	22,03	25,08	26,17	26,39	26,07	26,71	27,09	27,27	27,29	27,17	26,92
26336/--	3,6	26,06	29,82	31,21	31,53	31,19	31,99	32,49	32,74	32,79	32,66	32,38
26340/--	4,0	47,78	54,08	56,24	56,57	55,77	57,04	57,79	58,11	58,09	57,77	57,20
26344/--	4,4	56,87	64,81	67,66	68,25	67,42	69,09	70,10	70,58	70,64	70,32	69,69
26456/--	5,6	72,44	91,26	101,04	106,25	108,41	114,05	118,33	121,47	123,65	125,00	125,59
26465/--	6,5	91,71	116,01	128,74	135,61	138,55	145,92	151,53	155,68	158,58	160,40	161,26
26475/--	7,5	110,22	139,83	155,45	163,95	167,66	176,72	183,63	188,77	192,39	194,68	195,80
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
26115/--	1,5	9,54	11,63	12,61	13,03	13,13	13,78	14,26	14,62	14,86	15,01	15,07
26120/--	2,0	13,54	16,85	18,48	19,27	19,54	20,61	21,44	22,06	22,50	22,80	22,95
26127/--	2,7	16,30	19,55	21,00	21,57	21,62	22,59	23,30	23,81	24,14	24,32	24,37
26227/--	2,7	17,70	20,84	22,14	22,57	22,48	23,38	24,02	24,45	24,71	24,83	24,81
26232/--	3,2	23,79	26,56	27,36	27,27	26,71	27,38	27,80	28,01	28,06	27,96	27,74
26336/--	3,6	28,15	31,58	32,62	32,58	31,95	32,80	33,34	33,62	33,71	33,61	33,36
26340/--	4,0	51,61	57,28	58,78	58,46	57,13	58,48	59,30	59,68	59,72	59,45	58,93
26344/--	4,4	61,43	68,64	70,72	70,53	69,07	70,83	71,93	72,49	72,62	72,37	71,80
26456/--	5,6	78,26	96,65	105,61	109,79	111,06	116,93	121,42	124,76	127,12	128,63	129,39
26465/--	6,5	99,07	122,86	134,56	140,13	141,94	149,61	155,49	159,89	163,03	165,07	166,14
26475/--	7,5	119,06	148,09	162,48	169,41	171,76	181,18	188,43	193,87	197,78	200,35	201,73
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
26115/--	1,5	9,93	11,80	12,58	12,84	12,79	13,41	13,87	14,20	14,42	14,55	14,59
26120/--	2,0	14,10	17,10	18,45	18,98	19,03	20,06	20,85	21,43	21,84	22,10	22,22
26127/--	2,7	16,97	19,85	20,97	21,25	21,06	21,98	22,66	23,13	23,43	23,57	23,59
26227/--	2,7	18,43	21,15	22,11	22,23	21,90	22,75	23,35	23,75	23,98	24,06	24,02
26232/--	3,2	24,77	26,96	27,31	26,86	26,01	26,65	27,03	27,21	27,23	27,10	26,85
26336/--	3,6	29,31	32,05	32,56	32,09	31,12	31,92	32,41	32,66	32,71	32,58	32,30
26340/--	4,0	53,73	58,13	58,68	57,57	55,65	56,91	57,65	57,97	57,95	57,63	57,05
26344/--	4,4	63,95	69,66	70,60	69,45	67,28	68,94	69,94	70,42	70,46	70,14	69,51
26456/--	5,6	81,47	98,10	105,42	108,12	108,18	113,80	118,06	121,19	123,35	124,68	125,26
26465/--	6,5	103,13	124,70	134,33	138,00	138,25	145,60	151,18	155,31	158,19	160,00	160,83
26475/--	7,5	123,94	150,30	162,20	166,84	167,30	176,33	183,21	188,32	191,92	194,19	195,29

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

**TABLE: 61B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 61B

**TABLE 62A: 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
26115/--	1,5	7,93	9,63	10,34	10,52	10,39	10,81	11,09	11,25	11,32	11,30	11,20
26120/--	2,0	11,26	13,96	15,16	15,56	15,46	16,17	16,67	16,98	17,14	17,16	17,06
26127/--	2,7	13,56	16,20	17,22	17,42	17,11	17,72	18,12	18,33	18,39	18,31	18,11
26227/--	2,7	14,72	17,27	18,16	18,22	17,79	18,34	18,67	18,82	18,82	18,69	18,44
26232/--	3,2	19,79	22,01	22,44	22,02	21,13	21,48	21,61	21,56	21,37	21,05	20,62
26336/--	3,6	23,42	26,17	26,75	26,31	25,28	25,73	25,92	25,88	25,67	25,30	24,80
26340/--	4,0	42,92	47,47	48,21	47,20	45,21	45,88	46,10	45,94	45,48	44,75	43,80
26344/--	4,4	51,09	56,88	58,00	56,94	54,66	55,57	55,92	55,80	55,30	54,48	53,37
26456/--	5,6	65,08	80,10	86,60	88,65	87,88	91,74	94,39	96,03	96,81	96,83	96,18
26465/--	6,5	82,39	101,82	110,35	113,14	112,31	117,38	120,88	123,07	124,16	124,26	123,49
26475/--	7,5	99,02	122,73	133,24	136,78	135,91	142,15	146,49	149,24	150,62	150,82	149,94
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
26115/--	1,5	8,50	10,10	10,65	10,70	10,43	10,85	11,14	11,30	11,37	11,35	11,26
26120/--	2,0	12,08	14,64	15,62	15,82	15,52	16,24	16,74	17,06	17,22	17,25	17,15
26127/--	2,7	14,54	16,99	17,75	17,70	17,17	17,80	18,19	18,41	18,47	18,40	18,21
26227/--	2,7	15,78	18,11	18,71	18,52	17,86	18,41	18,75	18,90	18,91	18,78	18,53
26232/--	3,2	21,22	23,08	23,12	22,38	21,21	21,57	21,70	21,66	21,47	21,15	20,72
26336/--	3,6	25,11	27,44	27,57	26,74	25,38	25,84	26,03	26,00	25,79	25,43	24,93
26340/--	4,0	46,03	49,76	49,68	47,97	45,38	46,07	46,29	46,15	45,69	44,97	44,03
26344/--	4,4	54,79	59,63	59,77	57,88	54,87	55,80	56,16	56,05	55,56	54,74	53,64
26456/--	5,6	69,79	83,98	89,25	90,10	88,23	92,12	94,80	96,46	97,26	97,31	96,67
26465/--	6,5	88,35	106,74	113,72	115,00	112,76	117,86	121,39	123,62	124,74	124,87	124,13
26475/--	7,5	106,17	128,66	137,32	139,03	136,45	142,73	147,11	149,90	151,33	151,56	150,72
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
26115/--	1,5	8,70	10,05	10,37	10,23	9,78	10,14	10,38	10,50	10,53	10,47	10,34
26120/--	2,0	12,35	14,56	15,21	15,12	14,55	15,18	15,60	15,84	15,94	15,90	15,74
26127/--	2,7	14,87	16,90	17,28	16,93	16,10	16,63	16,96	17,10	17,10	16,96	16,71
26227/--	2,7	16,15	18,01	18,22	17,71	16,74	17,21	17,47	17,56	17,50	17,31	17,01
26232/--	3,2	21,71	22,95	22,51	21,40	19,88	20,16	20,23	20,12	19,87	19,50	19,02
26336/--	3,6	25,69	27,29	26,83	25,56	23,79	24,15	24,26	24,15	23,87	23,44	22,88
26340/--	4,0	47,08	49,49	48,36	45,87	42,54	43,06	43,14	42,87	42,29	41,46	40,42
26344/--	4,4	56,05	59,31	58,18	55,34	51,43	52,16	52,33	52,06	51,43	50,47	49,24
26456/--	5,6	71,39	83,52	86,88	86,15	82,69	86,10	88,34	89,60	90,03	89,71	88,74
26465/--	6,5	90,38	106,16	110,70	109,95	105,68	110,16	113,13	114,83	115,45	115,12	113,94
26475/--	7,5	108,62	127,97	133,66	132,93	127,89	133,41	137,10	139,24	140,07	139,73	138,35

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

Continued



**TABLE 62A: Refrigerant R1234yf - 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
26115/--	1,5	8,27	9,95	10,59	10,72	10,53	10,96	11,25	11,42	11,50	11,48	11,40
26120/--	2,0	11,75	14,42	15,53	15,85	15,67	16,39	16,90	17,23	17,41	17,44	17,36
26127/--	2,7	14,14	16,74	17,64	17,75	17,33	17,96	18,37	18,60	18,67	18,61	18,42
26227/--	2,7	15,36	17,84	18,60	18,57	18,02	18,59	18,94	19,10	19,11	18,99	18,76
26232/--	3,2	20,65	22,74	22,98	22,43	21,41	21,78	21,92	21,88	21,70	21,39	20,97
26336/--	3,6	24,43	27,04	27,40	26,80	25,61	26,09	26,29	26,27	26,07	25,71	25,23
26340/--	4,0	44,79	49,04	49,37	48,09	45,80	46,51	46,75	46,63	46,19	45,49	44,56
26344/--	4,4	53,31	58,77	59,40	58,01	55,37	56,33	56,71	56,63	56,16	55,37	54,28
26456/--	5,6	67,91	82,76	88,70	90,31	89,03	93,00	95,74	97,46	98,32	98,41	97,83
26465/--	6,5	85,97	105,20	113,03	115,27	113,79	118,98	122,60	124,91	126,09	126,29	125,61
26475/--	7,5	103,31	126,80	136,47	139,36	137,70	144,09	148,57	151,46	152,97	153,28	152,52
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
26115/--	1,5	8,64	10,13	10,58	10,52	10,17	10,57	10,84	10,99	11,04	11,00	10,89
26120/--	2,0	12,27	14,68	15,51	15,56	15,14	15,82	16,29	16,58	16,71	16,71	16,59
26127/--	2,7	14,77	17,03	17,62	17,42	16,75	17,34	17,70	17,89	17,93	17,83	17,61
26227/--	2,7	16,03	18,16	18,58	18,22	17,42	17,94	18,24	18,37	18,35	18,20	17,93
26232/--	3,2	21,56	23,14	22,96	22,02	20,69	21,01	21,12	21,05	20,83	20,50	20,05
26336/--	3,6	25,51	27,51	27,37	26,31	24,75	25,17	25,33	25,27	25,03	24,64	24,12
26340/--	4,0	46,76	49,90	49,32	47,20	44,26	44,88	45,05	44,85	44,35	43,58	42,60
26344/--	4,4	55,66	59,80	59,34	56,94	53,51	54,36	54,64	54,47	53,92	53,05	51,90
26456/--	5,6	70,89	84,20	88,61	88,65	86,03	89,74	92,24	93,75	94,40	94,30	93,53
26465/--	6,5	89,75	107,03	112,91	113,14	109,96	114,81	118,12	120,14	121,06	121,01	120,10
26475/--	7,5	107,86	129,01	136,33	136,78	133,06	139,04	143,15	145,68	146,87	146,88	145,82
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
26115/--	1,5	8,67	9,86	10,06	9,81	9,28	9,61	9,81	9,90	9,89	9,80	9,64
26120/--	2,0	12,32	14,29	14,76	14,50	13,82	14,38	14,74	14,93	14,98	14,89	14,69
26127/--	2,7	14,82	16,59	16,77	16,23	15,29	15,76	16,03	16,12	16,07	15,89	15,59
26227/--	2,7	16,10	17,68	17,68	16,98	15,90	16,31	16,52	16,55	16,45	16,21	15,87
26232/--	3,2	21,64	22,54	21,84	20,52	18,89	19,10	19,12	18,96	18,67	18,26	17,75
26336/--	3,6	25,61	26,79	26,04	24,51	22,60	22,89	22,93	22,76	22,43	21,95	21,35
26340/--	4,0	46,94	48,59	46,93	43,98	40,40	40,81	40,78	40,40	39,74	38,83	37,71
26344/--	4,4	55,87	58,23	56,47	53,06	48,85	49,42	49,47	49,08	48,33	47,27	45,94
26456/--	5,6	71,17	82,00	84,32	82,60	78,54	81,59	83,50	84,46	84,60	84,02	82,79
26465/--	6,5	90,10	104,23	107,44	105,43	100,37	104,39	106,93	108,24	108,49	107,81	106,30
26475/--	7,5	108,28	125,64	129,73	127,46	121,46	126,42	129,58	131,25	131,62	130,86	129,08

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

**TABLE: 62B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°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 62B

**TABLE 63A: Refrigerant R1234ze - 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
26115/--	1,5	9,58	12,15	13,60	14,48	14,98	15,21	15,23	15,07	14,78	14,33	13,74
26120/--	2,0	13,60	17,60	19,94	21,41	22,30	22,76	22,89	22,74	22,37	21,76	20,93
26127/--	2,7	16,37	20,43	22,66	23,97	24,67	24,94	24,88	24,55	24,00	23,21	22,22
26227/--	2,7	17,77	21,77	23,89	25,07	25,66	25,81	25,64	25,21	24,57	23,70	22,62
26232/--	3,2	23,90	27,75	29,51	30,30	30,48	30,23	29,68	28,88	27,89	26,69	25,29
26336/--	3,6	28,27	33,00	35,18	36,20	36,46	36,21	35,59	34,66	33,51	32,08	30,42
26340/--	4,0	51,83	59,84	63,41	64,95	65,20	64,56	63,30	61,53	59,36	56,75	53,74
26344/--	4,4	61,70	71,71	76,29	78,35	78,83	78,20	76,79	74,73	72,19	69,08	65,47
26456/--	5,6	78,59	100,98	113,92	121,98	126,75	129,09	129,62	128,62	126,37	122,78	117,99
26465/--	6,5	99,49	128,36	145,15	155,69	161,98	165,16	165,99	164,83	162,06	157,56	151,50
26475/--	7,5	119,56	154,72	175,27	188,22	196,02	200,02	201,16	199,87	196,61	191,23	183,95
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
26115/--	1,5	10,41	13,00	14,44	15,25	15,69	15,84	15,81	15,62	15,27	14,75	14,09
26120/--	2,0	14,78	18,84	21,17	22,55	23,36	23,71	23,77	23,58	23,12	22,40	21,46
26127/--	2,7	17,79	21,87	24,06	25,24	25,84	25,98	25,83	25,45	24,80	23,90	22,78
26227/--	2,7	19,32	23,31	25,36	26,40	26,87	26,88	26,62	26,13	25,39	24,40	23,19
26232/--	3,2	25,97	29,71	31,33	31,91	31,92	31,49	30,82	29,94	28,82	27,48	25,93
26336/--	3,6	30,73	35,33	37,36	38,11	38,19	37,72	36,96	35,94	34,63	33,03	31,19
26340/--	4,0	56,33	64,07	67,32	68,38	68,28	67,26	65,73	63,79	61,35	58,43	55,09
26344/--	4,4	67,05	76,78	81,00	82,50	82,56	81,46	79,73	77,47	74,60	71,12	67,12
26456/--	5,6	85,41	108,12	120,95	128,44	132,74	134,48	134,60	133,33	130,59	126,42	120,97
26465/--	6,5	108,12	137,44	154,12	163,93	169,65	172,05	172,36	170,88	167,48	162,23	155,32
26475/--	7,5	129,93	165,66	186,09	198,18	205,29	208,37	208,88	207,20	203,18	196,90	188,59
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
26115/--	1,5	10,85	13,34	14,56	15,22	15,53	15,56	15,42	15,12	14,70	14,12	13,40
26120/--	2,0	15,41	19,32	21,35	22,51	23,11	23,29	23,17	22,82	22,26	21,45	20,40
26127/--	2,7	18,55	22,43	24,26	25,20	25,57	25,52	25,19	24,63	23,88	22,89	21,66
26227/--	2,7	20,14	23,91	25,57	26,36	26,59	26,41	25,96	25,29	24,45	23,36	22,05
26232/--	3,2	27,08	30,47	31,59	31,85	31,59	30,93	30,05	28,98	27,76	26,31	24,65
26336/--	3,6	32,04	36,23	37,67	38,05	37,79	37,05	36,03	34,78	33,35	31,63	29,66
26340/--	4,0	58,73	65,70	67,88	68,27	67,57	66,07	64,09	61,73	59,08	55,94	52,38
26344/--	4,4	69,91	78,74	81,67	82,37	81,70	80,02	77,74	74,98	71,84	68,10	63,82
26456/--	5,6	89,05	110,88	121,96	128,23	131,36	132,10	131,23	129,05	125,76	121,04	115,02
26465/--	6,5	112,73	140,94	155,40	163,66	167,88	169,01	168,06	165,38	161,29	155,33	147,68
26475/--	7,5	135,47	169,88	187,63	197,86	203,15	204,68	203,66	200,54	195,67	188,52	179,32

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

Continued

**TABLE 63A: Refrigerant R1234ze - Capacities in kW (1)**

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
26115/--	1,5	10,03	12,65	14,11	14,96	15,45	15,65	15,65	15,49	15,18	14,71	14,11
26120/--	2,0	14,25	18,33	20,69	22,13	22,99	23,42	23,53	23,37	22,99	22,35	21,49
26127/--	2,7	17,15	21,27	23,51	24,77	25,44	25,66	25,58	25,23	24,66	23,84	22,81
26227/--	2,7	18,63	22,67	24,79	25,91	26,45	26,56	26,36	25,91	25,24	24,34	23,22
26232/--	3,2	25,04	28,90	30,62	31,31	31,42	31,11	30,51	29,68	28,66	27,41	25,96
26336/--	3,6	29,63	34,36	36,51	37,40	37,59	37,27	36,59	35,63	34,43	32,95	31,23
26340/--	4,0	54,31	62,31	65,80	67,11	67,22	66,44	65,07	63,24	60,99	58,28	55,17
26344/--	4,4	64,65	74,68	79,16	80,96	81,27	80,48	78,94	76,81	74,17	70,94	67,21
26456/--	5,6	82,35	105,16	118,21	126,04	130,67	132,85	133,25	132,19	129,84	126,10	121,13
26465/--	6,5	104,25	133,67	150,62	160,87	167,00	169,97	170,64	169,41	166,51	161,82	155,53
26475/--	7,5	125,29	161,12	181,87	194,49	202,08	205,84	206,79	205,42	202,01	196,41	188,85
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
26115/--	1,5	10,69	13,25	14,60	15,35	15,71	15,83	15,73	15,49	15,11	14,57	13,88
26120/--	2,0	15,18	19,20	21,41	22,69	23,38	23,69	23,65	23,37	22,88	22,12	21,14
26127/--	2,7	18,27	22,29	24,33	25,40	25,86	25,95	25,70	25,23	24,54	23,60	22,44
26227/--	2,7	19,84	23,76	25,65	26,57	26,89	26,86	26,49	25,91	25,12	24,09	22,84
26232/--	3,2	26,67	30,28	31,69	32,11	31,95	31,46	30,66	29,68	28,52	27,13	25,54
26336/--	3,6	31,56	36,00	37,78	38,36	38,22	37,69	36,77	35,63	34,27	32,62	30,72
26340/--	4,0	57,85	65,28	68,09	68,83	68,34	67,19	65,40	63,24	60,71	57,70	54,26
26344/--	4,4	68,86	78,24	81,92	83,04	82,63	81,39	79,34	76,81	73,82	70,23	66,11
26456/--	5,6	87,72	110,17	122,32	129,27	132,86	134,35	133,92	132,19	129,23	124,84	119,15
26465/--	6,5	111,05	140,04	155,86	164,99	169,80	171,89	171,50	169,41	165,74	160,20	152,98
26475/--	7,5	133,45	168,80	188,20	199,47	205,47	208,17	207,83	205,42	201,07	194,44	185,76
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
26115/--	1,5	11,04	13,37	14,51	15,09	15,30	15,27	15,07	14,72	14,25	13,61	12,82
26120/--	2,0	15,68	19,37	21,28	22,31	22,77	22,85	22,65	22,21	21,57	20,67	19,52
26127/--	2,7	18,87	22,49	24,18	24,97	25,19	25,03	24,62	23,97	23,14	22,05	20,73
26227/--	2,7	20,49	23,97	25,50	26,12	26,19	25,91	25,37	24,62	23,69	22,50	21,10
26232/--	3,2	27,55	30,55	31,50	31,57	31,12	30,34	29,37	28,21	26,89	25,34	23,59
26336/--	3,6	32,59	36,32	37,55	37,71	37,23	36,35	35,22	33,86	32,31	30,47	28,38
26340/--	4,0	59,75	65,87	67,68	67,66	66,56	64,81	62,65	60,09	57,24	53,90	50,13
26344/--	4,4	71,12	78,94	81,43	81,63	80,48	78,50	75,99	72,99	69,60	65,60	61,07
26456/--	5,6	90,60	111,16	121,59	127,08	129,40	129,59	128,28	125,62	121,84	116,61	110,06
26465/--	6,5	114,69	141,30	154,93	162,20	165,37	165,80	164,27	160,99	156,26	149,64	141,31
26475/--	7,5	137,83	170,31	187,07	196,09	200,12	200,80	199,07	195,21	189,57	181,62	171,59

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

**TABLE: 63B - 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 evaporator capacity by dividing by the appropriate correction factor found in Table 63B

**TABLE 64A: 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
26115/--	1,5	9,58	12,15	13,60	14,48	14,98	15,21	15,23	15,07	14,78	14,33	13,74
26120/--	2,0	13,60	17,60	19,94	21,41	22,30	22,76	22,89	22,74	22,37	21,76	20,93
26127/--	2,7	16,37	20,43	22,66	23,97	24,67	24,94	24,88	24,55	24,00	23,21	22,22
26227/--	2,7	17,77	21,77	23,89	25,07	25,66	25,81	25,64	25,21	24,57	23,70	22,62
26232/--	3,2	23,90	27,75	29,51	30,30	30,48	30,23	29,68	28,88	27,89	26,69	25,29
26336/--	3,6	28,27	33,00	35,18	36,20	36,46	36,21	35,59	34,66	33,51	32,08	30,42
26340/--	4,0	51,83	59,84	63,41	64,95	65,20	64,56	63,30	61,53	59,36	56,75	53,74
26344/--	4,4	61,70	71,71	76,29	78,35	78,83	78,20	76,79	74,73	72,19	69,08	65,47
26456/--	5,6	78,59	100,98	113,92	121,98	126,75	129,09	129,62	128,62	126,37	122,78	117,99
26465/--	6,5	99,49	128,36	145,15	155,69	161,98	165,16	165,99	164,83	162,06	157,56	151,50
26475/--	7,5	119,56	154,72	175,27	188,22	196,02	200,02	201,16	199,87	196,61	191,23	183,95
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
26115/--	1,5	10,41	13,00	14,44	15,25	15,69	15,84	15,81	15,62	15,27	14,75	14,09
26120/--	2,0	14,78	18,84	21,17	22,55	23,36	23,71	23,77	23,58	23,12	22,40	21,46
26127/--	2,7	17,79	21,87	24,06	25,24	25,84	25,98	25,83	25,45	24,80	23,90	22,78
26227/--	2,7	19,32	23,31	25,36	26,40	26,87	26,88	26,62	26,13	25,39	24,40	23,19
26232/--	3,2	25,97	29,71	31,33	31,91	31,92	31,49	30,82	29,94	28,82	27,48	25,93
26336/--	3,6	30,73	35,33	37,36	38,11	38,19	37,72	36,96	35,94	34,63	33,03	31,19
26340/--	4,0	56,33	64,07	67,32	68,38	68,28	67,26	65,73	63,79	61,35	58,43	55,09
26344/--	4,4	67,05	76,78	81,00	82,50	82,56	81,46	79,73	77,47	74,60	71,12	67,12
26456/--	5,6	85,41	108,12	120,95	128,44	132,74	134,48	134,60	133,33	130,59	126,42	120,97
26465/--	6,5	108,12	137,44	154,12	163,93	169,65	172,05	172,36	170,88	167,48	162,23	155,32
26475/--	7,5	129,93	165,66	186,09	198,18	205,29	208,37	208,88	207,20	203,18	196,90	188,59
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
26115/--	1,5	10,85	13,34	14,56	15,22	15,53	15,56	15,42	15,12	14,70	14,12	13,40
26120/--	2,0	15,41	19,32	21,35	22,51	23,11	23,29	23,17	22,82	22,26	21,45	20,40
26127/--	2,7	18,55	22,43	24,26	25,20	25,57	25,52	25,19	24,63	23,88	22,89	21,66
26227/--	2,7	20,14	23,91	25,57	26,36	26,59	26,41	25,96	25,29	24,45	23,36	22,05
26232/--	3,2	27,08	30,47	31,59	31,85	31,59	30,93	30,05	28,98	27,76	26,31	24,65
26336/--	3,6	32,04	36,23	37,67	38,05	37,79	37,05	36,03	34,78	33,35	31,63	29,66
26340/--	4,0	58,73	65,70	67,88	68,27	67,57	66,07	64,09	61,73	59,08	55,94	52,38
26344/--	4,4	69,91	78,74	81,67	82,37	81,70	80,02	77,74	74,98	71,84	68,10	63,82
26456/--	5,6	89,05	110,88	121,96	128,23	131,36	132,10	131,23	129,05	125,76	121,04	115,02
26465/--	6,5	112,73	140,94	155,40	163,66	167,88	169,01	168,06	165,38	161,29	155,33	147,68
26475/--	7,5	135,47	169,88	187,63	197,86	203,15	204,68	203,66	200,54	195,67	188,52	179,32

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

Continued

**TABLE 64A: Refrigerant R448A - Capacities in kW (1)**

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
26115/--	1,5	10,03	12,65	14,11	14,96	15,45	15,65	15,65	15,49	15,18	14,71	14,11
26120/--	2,0	14,25	18,33	20,69	22,13	22,99	23,42	23,53	23,37	22,99	22,35	21,49
26127/--	2,7	17,15	21,27	23,51	24,77	25,44	25,66	25,58	25,23	24,66	23,84	22,81
26227/--	2,7	18,63	22,67	24,79	25,91	26,45	26,56	26,36	25,91	25,24	24,34	23,22
26232/--	3,2	25,04	28,90	30,62	31,31	31,42	31,11	30,51	29,68	28,66	27,41	25,96
26336/--	3,6	29,63	34,36	36,51	37,40	37,59	37,27	36,59	35,63	34,43	32,95	31,23
26340/--	4,0	54,31	62,31	65,80	67,11	67,22	66,44	65,07	63,24	60,99	58,28	55,17
26344/--	4,4	64,65	74,68	79,16	80,96	81,27	80,48	78,94	76,81	74,17	70,94	67,21
26456/--	5,6	82,35	105,16	118,21	126,04	130,67	132,85	133,25	132,19	129,84	126,10	121,13
26465/--	6,5	104,25	133,67	150,62	160,87	167,00	169,97	170,64	169,41	166,51	161,82	155,53
26475/--	7,5	125,29	161,12	181,87	194,49	202,08	205,84	206,79	205,42	202,01	196,41	188,85
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
26115/--	1,5	10,69	13,25	14,60	15,35	15,71	15,83	15,73	15,49	15,11	14,57	13,88
26120/--	2,0	15,18	19,20	21,41	22,69	23,38	23,69	23,65	23,37	22,88	22,12	21,14
26127/--	2,7	18,27	22,29	24,33	25,40	25,86	25,95	25,70	25,23	24,54	23,60	22,44
26227/--	2,7	19,84	23,76	25,65	26,57	26,89	26,86	26,49	25,91	25,12	24,09	22,84
26232/--	3,2	26,67	30,28	31,69	32,11	31,95	31,46	30,66	29,68	28,52	27,13	25,54
26336/--	3,6	31,56	36,00	37,78	38,36	38,22	37,69	36,77	35,63	34,27	32,62	30,72
26340/--	4,0	57,85	65,28	68,09	68,83	68,34	67,19	65,40	63,24	60,71	57,70	54,26
26344/--	4,4	68,86	78,24	81,92	83,04	82,63	81,39	79,34	76,81	73,82	70,23	66,11
26456/--	5,6	87,72	110,17	122,32	129,27	132,86	134,35	133,92	132,19	129,23	124,84	119,15
26465/--	6,5	111,05	140,04	155,86	164,99	169,80	171,89	171,50	169,41	165,74	160,20	152,98
26475/--	7,5	133,45	168,80	188,20	199,47	205,47	208,17	207,83	205,42	201,07	194,44	185,76
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
26115/--	1,5	11,04	13,37	14,51	15,09	15,30	15,27	15,07	14,72	14,25	13,61	12,82
26120/--	2,0	15,68	19,37	21,28	22,31	22,77	22,85	22,65	22,21	21,57	20,67	19,52
26127/--	2,7	18,87	22,49	24,18	24,97	25,19	25,03	24,62	23,97	23,14	22,05	20,73
26227/--	2,7	20,49	23,97	25,50	26,12	26,19	25,91	25,37	24,62	23,69	22,50	21,10
26232/--	3,2	27,55	30,55	31,50	31,57	31,12	30,34	29,37	28,21	26,89	25,34	23,59
26336/--	3,6	32,59	36,32	37,55	37,71	37,23	36,35	35,22	33,86	32,31	30,47	28,38
26340/--	4,0	59,75	65,87	67,68	67,66	66,56	64,81	62,65	60,09	57,24	53,90	50,13
26344/--	4,4	71,12	78,94	81,43	81,63	80,48	78,50	75,99	72,99	69,60	65,60	61,07
26456/--	5,6	90,60	111,16	121,59	127,08	129,40	129,59	128,28	125,62	121,84	116,61	110,06
26465/--	6,5	114,69	141,30	154,93	162,20	165,37	165,80	164,27	160,99	156,26	149,64	141,31
26475/--	7,5	137,83	170,31	187,07	196,09	200,12	200,80	199,07	195,21	189,57	181,62	171,59

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

**TABLE: 64B - 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 evaporator capacity by dividing by the appropriate correction factor found in Table 64B

**TABLE 65A: 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
26115/--	1,5	9,58	12,15	13,60	14,48	14,98	15,21	15,23	15,07	14,78	14,33	13,74
26120/--	2,0	13,60	17,60	19,94	21,41	22,30	22,76	22,89	22,74	22,37	21,76	20,93
26127/--	2,7	16,37	20,43	22,66	23,97	24,67	24,94	24,88	24,55	24,00	23,21	22,22
26227/--	2,7	17,77	21,77	23,89	25,07	25,66	25,81	25,64	25,21	24,57	23,70	22,62
26232/--	3,2	23,90	27,75	29,51	30,30	30,48	30,23	29,68	28,88	27,89	26,69	25,29
26336/--	3,6	28,27	33,00	35,18	36,20	36,46	36,21	35,59	34,66	33,51	32,08	30,42
26340/--	4,0	51,83	59,84	63,41	64,95	65,20	64,56	63,30	61,53	59,36	56,75	53,74
26344/--	4,4	61,70	71,71	76,29	78,35	78,83	78,20	76,79	74,73	72,19	69,08	65,47
26456/--	5,6	78,59	100,98	113,92	121,98	126,75	129,09	129,62	128,62	126,37	122,78	117,99
26465/--	6,5	99,49	128,36	145,15	155,69	161,98	165,16	165,99	164,83	162,06	157,56	151,50
26475/--	7,5	119,56	154,72	175,27	188,22	196,02	200,02	201,16	199,87	196,61	191,23	183,95
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
26115/--	1,5	10,41	13,00	14,44	15,25	15,69	15,84	15,81	15,62	15,27	14,75	14,09
26120/--	2,0	14,78	18,84	21,17	22,55	23,36	23,71	23,77	23,58	23,12	22,40	21,46
26127/--	2,7	17,79	21,87	24,06	25,24	25,84	25,98	25,83	25,45	24,80	23,90	22,78
26227/--	2,7	19,32	23,31	25,36	26,40	26,87	26,88	26,62	26,13	25,39	24,40	23,19
26232/--	3,2	25,97	29,71	31,33	31,91	31,92	31,49	30,82	29,94	28,82	27,48	25,93
26336/--	3,6	30,73	35,33	37,36	38,11	38,19	37,72	36,96	35,94	34,63	33,03	31,19
26340/--	4,0	56,33	64,07	67,32	68,38	68,28	67,26	65,73	63,79	61,35	58,43	55,09
26344/--	4,4	67,05	76,78	81,00	82,50	82,56	81,46	79,73	77,47	74,60	71,12	67,12
26456/--	5,6	85,41	108,12	120,95	128,44	132,74	134,48	134,60	133,33	130,59	126,42	120,97
26465/--	6,5	108,12	137,44	154,12	163,93	169,65	172,05	172,36	170,88	167,48	162,23	155,32
26475/--	7,5	129,93	165,66	186,09	198,18	205,29	208,37	208,88	207,20	203,18	196,90	188,59
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
26115/--	1,5	10,85	13,34	14,56	15,22	15,53	15,56	15,42	15,12	14,70	14,12	13,40
26120/--	2,0	15,41	19,32	21,35	22,51	23,11	23,29	23,17	22,82	22,26	21,45	20,40
26127/--	2,7	18,55	22,43	24,26	25,20	25,57	25,52	25,19	24,63	23,88	22,89	21,66
26227/--	2,7	20,14	23,91	25,57	26,36	26,59	26,41	25,96	25,29	24,45	23,36	22,05
26232/--	3,2	27,08	30,47	31,59	31,85	31,59	30,93	30,05	28,98	27,76	26,31	24,65
26336/--	3,6	32,04	36,23	37,67	38,05	37,79	37,05	36,03	34,78	33,35	31,63	29,66
26340/--	4,0	58,73	65,70	67,88	68,27	67,57	66,07	64,09	61,73	59,08	55,94	52,38
26344/--	4,4	69,91	78,74	81,67	82,37	81,70	80,02	77,74	74,98	71,84	68,10	63,82
26456/--	5,6	89,05	110,88	121,96	128,23	131,36	132,10	131,23	129,05	125,76	121,04	115,02
26465/--	6,5	112,73	140,94	155,40	163,66	167,88	169,01	168,06	165,38	161,29	155,33	147,68
26475/--	7,5	135,47	169,88	187,63	197,86	203,15	204,68	203,66	200,54	195,67	188,52	179,32

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

Continued

**TABLE 65A: Refrigerant R449A - Capacities in kW (1)**

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
26115/--	1,5	10,03	12,65	14,11	14,96	15,45	15,65	15,65	15,49	15,18	14,71	14,11
26120/--	2,0	14,25	18,33	20,69	22,13	22,99	23,42	23,53	23,37	22,99	22,35	21,49
26127/--	2,7	17,15	21,27	23,51	24,77	25,44	25,66	25,58	25,23	24,66	23,84	22,81
26227/--	2,7	18,63	22,67	24,79	25,91	26,45	26,56	26,36	25,91	25,24	24,34	23,22
26232/--	3,2	25,04	28,90	30,62	31,31	31,42	31,11	30,51	29,68	28,66	27,41	25,96
26336/--	3,6	29,63	34,36	36,51	37,40	37,59	37,27	36,59	35,63	34,43	32,95	31,23
26340/--	4,0	54,31	62,31	65,80	67,11	67,22	66,44	65,07	63,24	60,99	58,28	55,17
26344/--	4,4	64,65	74,68	79,16	80,96	81,27	80,48	78,94	76,81	74,17	70,94	67,21
26456/--	5,6	82,35	105,16	118,21	126,04	130,67	132,85	133,25	132,19	129,84	126,10	121,13
26465/--	6,5	104,25	133,67	150,62	160,87	167,00	169,97	170,64	169,41	166,51	161,82	155,53
26475/--	7,5	125,29	161,12	181,87	194,49	202,08	205,84	206,79	205,42	202,01	196,41	188,85
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
26115/--	1,5	10,69	13,25	14,60	15,35	15,71	15,83	15,73	15,49	15,11	14,57	13,88
26120/--	2,0	15,18	19,20	21,41	22,69	23,38	23,69	23,65	23,37	22,88	22,12	21,14
26127/--	2,7	18,27	22,29	24,33	25,40	25,86	25,95	25,70	25,23	24,54	23,60	22,44
26227/--	2,7	19,84	23,76	25,65	26,57	26,89	26,86	26,49	25,91	25,12	24,09	22,84
26232/--	3,2	26,67	30,28	31,69	32,11	31,95	31,46	30,66	29,68	28,52	27,13	25,54
26336/--	3,6	31,56	36,00	37,78	38,36	38,22	37,69	36,77	35,63	34,27	32,62	30,72
26340/--	4,0	57,85	65,28	68,09	68,83	68,34	67,19	65,40	63,24	60,71	57,70	54,26
26344/--	4,4	68,86	78,24	81,92	83,04	82,63	81,39	79,34	76,81	73,82	70,23	66,11
26456/--	5,6	87,72	110,17	122,32	129,27	132,86	134,35	133,92	132,19	129,23	124,84	119,15
26465/--	6,5	111,05	140,04	155,86	164,99	169,80	171,89	171,50	169,41	165,74	160,20	152,98
26475/--	7,5	133,45	168,80	188,20	199,47	205,47	208,17	207,83	205,42	201,07	194,44	185,76
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
26115/--	1,5	11,04	13,37	14,51	15,09	15,30	15,27	15,07	14,72	14,25	13,61	12,82
26120/--	2,0	15,68	19,37	21,28	22,31	22,77	22,85	22,65	22,21	21,57	20,67	19,52
26127/--	2,7	18,87	22,49	24,18	24,97	25,19	25,03	24,62	23,97	23,14	22,05	20,73
26227/--	2,7	20,49	23,97	25,50	26,12	26,19	25,91	25,37	24,62	23,69	22,50	21,10
26232/--	3,2	27,55	30,55	31,50	31,57	31,12	30,34	29,37	28,21	26,89	25,34	23,59
26336/--	3,6	32,59	36,32	37,55	37,71	37,23	36,35	35,22	33,86	32,31	30,47	28,38
26340/--	4,0	59,75	65,87	67,68	67,66	66,56	64,81	62,65	60,09	57,24	53,90	50,13
26344/--	4,4	71,12	78,94	81,43	81,63	80,48	78,50	75,99	72,99	69,60	65,60	61,07
26456/--	5,6	90,60	111,16	121,59	127,08	129,40	129,59	128,28	125,62	121,84	116,61	110,06
26465/--	6,5	114,69	141,30	154,93	162,20	165,37	165,80	164,27	160,99	156,26	149,64	141,31
26475/--	7,5	137,83	170,31	187,07	196,09	200,12	200,80	199,07	195,21	189,57	181,62	171,59

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

**TABLE: 65B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 65B

**TABLE 66A: 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
26115/--	1,5	9,68	11,78	12,74	13,12	13,14	13,64	13,96	14,13	14,18	14,11	13,94
26120/--	2,0	13,74	17,07	18,68	19,40	19,56	20,42	20,99	21,33	21,46	21,42	21,22
26127/--	2,7	16,54	19,81	21,22	21,72	21,64	22,37	22,81	23,02	23,03	22,86	22,53
26227/--	2,7	17,96	21,12	22,37	22,72	22,51	23,15	23,51	23,64	23,57	23,33	22,94
26232/--	3,2	24,15	26,92	27,64	27,45	26,73	27,12	27,21	27,08	26,76	26,27	25,65
26336/--	3,6	28,57	32,00	32,96	32,80	31,99	32,48	32,64	32,51	32,15	31,59	30,85
26340/--	4,0	52,38	58,04	59,39	58,84	57,19	57,92	58,05	57,70	56,96	55,87	54,49
26344/--	4,4	62,35	69,55	71,45	70,99	69,15	70,15	70,41	70,08	69,26	68,01	66,39
26456/--	5,6	79,42	97,95	106,70	110,52	111,18	115,81	118,86	120,61	121,24	120,88	119,64
26465/--	6,5	100,54	124,50	135,96	141,06	142,09	148,16	152,21	154,58	155,49	155,12	153,62
26475/--	7,5	120,82	150,07	164,16	170,54	171,94	179,43	184,46	187,43	188,63	188,28	186,53
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
26115/--	1,5	10,03	11,91	12,65	12,85	12,71	13,17	13,46	13,60	13,61	13,51	13,32
26120/--	2,0	14,25	17,26	18,55	19,00	18,91	19,71	20,23	20,52	20,61	20,53	20,29
26127/--	2,7	17,15	20,03	21,08	21,27	20,92	21,60	21,99	22,15	22,11	21,90	21,54
26227/--	2,7	18,63	21,35	22,22	22,25	21,76	22,35	22,66	22,74	22,63	22,35	21,92
26232/--	3,2	25,04	27,21	27,45	26,89	25,85	26,18	26,23	26,06	25,69	25,17	24,51
26336/--	3,6	29,63	32,35	32,73	32,12	30,92	31,36	31,45	31,28	30,87	30,26	29,49
26340/--	4,0	54,31	58,67	58,99	57,62	55,29	55,91	55,95	55,51	54,69	53,53	52,08
26344/--	4,4	64,65	70,31	70,97	69,52	66,85	67,72	67,87	67,43	66,50	65,16	63,45
26456/--	5,6	82,35	99,01	105,97	108,23	107,49	111,80	114,56	116,04	116,41	115,82	114,36
26465/--	6,5	104,25	125,85	135,03	138,14	137,37	143,03	146,70	148,72	149,30	148,63	146,83
26475/--	7,5	125,29	151,70	163,04	167,00	166,23	173,22	177,79	180,33	181,13	180,39	178,28
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
26115/--	1,5	10,09	11,64	12,13	12,11	11,79	12,18	12,40	12,48	12,43	12,28	12,03
26120/--	2,0	14,33	16,87	17,78	17,90	17,55	18,23	18,64	18,82	18,82	18,65	18,32
26127/--	2,7	17,24	19,58	20,20	20,04	19,42	19,97	20,26	20,32	20,19	19,89	19,45
26227/--	2,7	18,73	20,87	21,30	20,96	20,19	20,67	20,88	20,87	20,67	20,31	19,80
26232/--	3,2	25,17	26,61	26,32	25,33	23,99	24,21	24,17	23,91	23,46	22,87	22,14
26336/--	3,6	29,79	31,63	31,38	30,26	28,70	29,00	28,98	28,69	28,19	27,49	26,63
26340/--	4,0	54,60	57,37	56,54	54,30	51,32	51,71	51,55	50,93	49,94	48,63	47,04
26344/--	4,4	65,00	68,75	68,03	65,51	62,05	62,63	62,53	61,86	60,73	59,19	57,31
26456/--	5,6	82,79	96,81	101,59	101,98	99,76	103,40	105,55	106,47	106,31	105,22	103,28
26465/--	6,5	104,81	123,05	129,44	130,16	127,49	132,29	135,17	136,44	136,34	135,02	132,61
26475/--	7,5	125,96	148,32	156,29	157,36	154,28	160,21	163,80	165,45	165,41	163,88	161,02

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

Continued



**TABLE 66A: Refrigerant R450A - Capacities in kW (1)**

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
26115/--	1,5	9,91	11,92	12,78	13,07	13,02	13,51	13,82	13,98	14,02	13,94	13,76
26120/--	2,0	14,08	17,27	18,74	19,33	19,38	20,22	20,77	21,10	21,22	21,17	20,96
26127/--	2,7	16,94	20,04	21,29	21,63	21,44	22,15	22,58	22,77	22,77	22,59	22,25
26227/--	2,7	18,40	21,36	22,45	22,63	22,30	22,92	23,27	23,39	23,30	23,05	22,65
26232/--	3,2	24,74	27,23	27,74	27,35	26,48	26,85	26,94	26,79	26,46	25,96	25,33
26336/--	3,6	29,27	32,38	33,07	32,67	31,69	32,17	32,30	32,16	31,79	31,21	30,47
26340/--	4,0	53,65	58,72	59,60	58,62	56,66	57,35	57,46	57,09	56,32	55,21	53,81
26344/--	4,4	63,87	70,36	71,70	70,73	68,50	69,47	69,70	69,34	68,48	67,21	65,56
26456/--	5,6	81,35	99,08	107,07	110,10	110,14	114,68	117,65	119,33	119,88	119,46	118,16
26465/--	6,5	102,99	125,95	136,42	140,53	140,76	146,72	150,66	152,93	153,75	153,30	151,71
26475/--	7,5	123,77	151,81	164,73	169,89	170,34	177,69	182,58	185,43	186,52	186,06	184,21
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
26115/--	1,5	10,10	11,83	12,45	12,55	12,33	12,76	13,02	13,13	13,12	13,00	12,78
26120/--	2,0	14,34	17,14	18,26	18,56	18,34	19,09	19,56	19,81	19,86	19,74	19,47
26127/--	2,7	17,26	19,89	20,75	20,78	20,29	20,92	21,27	21,38	21,31	21,06	20,66
26227/--	2,7	18,74	21,20	21,88	21,73	21,10	21,65	21,91	21,96	21,81	21,50	21,04
26232/--	3,2	25,19	27,02	27,03	26,26	25,07	25,36	25,37	25,16	24,76	24,21	23,52
26336/--	3,6	29,81	32,13	32,22	31,38	29,99	30,37	30,42	30,20	29,75	29,10	28,29
26340/--	4,0	54,64	58,27	58,07	56,29	53,63	54,16	54,11	53,60	52,71	51,48	49,97
26344/--	4,4	65,04	69,82	69,86	67,92	64,84	65,60	65,64	65,10	64,09	62,67	60,89
26456/--	5,6	82,85	98,33	104,33	105,73	104,26	108,29	110,80	112,04	112,19	111,39	109,73
26465/--	6,5	104,88	124,99	132,93	134,95	133,24	138,54	141,88	143,59	143,88	142,94	140,89
26475/--	7,5	126,04	150,65	160,51	163,14	161,24	167,78	171,94	174,11	174,56	173,49	171,07
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
26115/--	1,5	10,20	11,61	12,01	11,91	11,53	11,90	12,10	12,16	12,10	11,93	11,66
26120/--	2,0	14,49	16,82	17,60	17,61	17,17	17,81	18,19	18,34	18,31	18,11	17,77
26127/--	2,7	17,44	19,52	20,00	19,71	18,99	19,51	19,77	19,80	19,65	19,33	18,86
26227/--	2,7	18,94	20,81	21,09	20,62	19,75	20,19	20,37	20,33	20,11	19,73	19,20
26232/--	3,2	25,46	26,52	26,06	24,92	23,46	23,65	23,58	23,30	22,83	22,22	21,47
26336/--	3,6	30,13	31,53	31,07	29,77	28,07	28,34	28,28	27,96	27,43	26,71	25,82
26340/--	4,0	55,22	57,19	55,99	53,41	50,19	50,52	50,30	49,63	48,60	47,24	45,61
26344/--	4,4	65,74	68,53	67,36	64,44	60,68	61,19	61,02	60,29	59,09	57,50	55,57
26456/--	5,6	83,73	96,50	100,58	100,31	97,57	101,02	103,00	103,75	103,45	102,21	100,14
26465/--	6,5	106,00	122,67	128,16	128,03	124,69	129,24	131,90	132,96	132,67	131,16	128,58
26475/--	7,5	127,39	147,86	154,75	154,79	150,89	156,52	159,84	161,23	160,95	159,20	156,13

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

**TABLE: 66B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$** 

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 66B

**TABLE 67A: 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
26115/--	1,5	9,68	11,78	12,74	13,12	13,14	13,64	13,96	14,13	14,18	14,11	13,94
26120/--	2,0	13,74	17,07	18,68	19,40	19,56	20,42	20,99	21,33	21,46	21,42	21,22
26127/--	2,7	16,54	19,81	21,22	21,72	21,64	22,37	22,81	23,02	23,03	22,86	22,53
26227/--	2,7	17,96	21,12	22,37	22,72	22,51	23,15	23,51	23,64	23,57	23,33	22,94
26232/--	3,2	24,15	26,92	27,64	27,45	26,73	27,12	27,21	27,08	26,76	26,27	25,65
26336/--	3,6	28,57	32,00	32,96	32,80	31,99	32,48	32,64	32,51	32,15	31,59	30,85
26340/--	4,0	52,38	58,04	59,39	58,84	57,19	57,92	58,05	57,70	56,96	55,87	54,49
26344/--	4,4	62,35	69,55	71,45	70,99	69,15	70,15	70,41	70,08	69,26	68,01	66,39
26456/--	5,6	79,42	97,95	106,70	110,52	111,18	115,81	118,86	120,61	121,24	120,88	119,64
26465/--	6,5	100,54	124,50	135,96	141,06	142,09	148,16	152,21	154,58	155,49	155,12	153,62
26475/--	7,5	120,82	150,07	164,16	170,54	171,94	179,43	184,46	187,43	188,63	188,28	186,53
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
26115/--	1,5	10,03	11,91	12,65	12,85	12,71	13,17	13,46	13,60	13,61	13,51	13,32
26120/--	2,0	14,25	17,26	18,55	19,00	18,91	19,71	20,23	20,52	20,61	20,53	20,29
26127/--	2,7	17,15	20,03	21,08	21,27	20,92	21,60	21,99	22,15	22,11	21,90	21,54
26227/--	2,7	18,63	21,35	22,22	22,25	21,76	22,35	22,66	22,74	22,63	22,35	21,92
26232/--	3,2	25,04	27,21	27,45	26,89	25,85	26,18	26,23	26,06	25,69	25,17	24,51
26336/--	3,6	29,63	32,35	32,73	32,12	30,92	31,36	31,45	31,28	30,87	30,26	29,49
26340/--	4,0	54,31	58,67	58,99	57,62	55,29	55,91	55,95	55,51	54,69	53,53	52,08
26344/--	4,4	64,65	70,31	70,97	69,52	66,85	67,72	67,87	67,43	66,50	65,16	63,45
26456/--	5,6	82,35	99,01	105,97	108,23	107,49	111,80	114,56	116,04	116,41	115,82	114,36
26465/--	6,5	104,25	125,85	135,03	138,14	137,37	143,03	146,70	148,72	149,30	148,63	146,83
26475/--	7,5	125,29	151,70	163,04	167,00	166,23	173,22	177,79	180,33	181,13	180,39	178,28
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
26115/--	1,5	10,09	11,64	12,13	12,11	11,79	12,18	12,40	12,48	12,43	12,28	12,03
26120/--	2,0	14,33	16,87	17,78	17,90	17,55	18,23	18,64	18,82	18,82	18,65	18,32
26127/--	2,7	17,24	19,58	20,20	20,04	19,42	19,97	20,26	20,32	20,19	19,89	19,45
26227/--	2,7	18,73	20,87	21,30	20,96	20,19	20,67	20,88	20,87	20,67	20,31	19,80
26232/--	3,2	25,17	26,61	26,32	25,33	23,99	24,21	24,17	23,91	23,46	22,87	22,14
26336/--	3,6	29,79	31,63	31,38	30,26	28,70	29,00	28,98	28,69	28,19	27,49	26,63
26340/--	4,0	54,60	57,37	56,54	54,30	51,32	51,71	51,55	50,93	49,94	48,63	47,04
26344/--	4,4	65,00	68,75	68,03	65,51	62,05	62,63	62,53	61,86	60,73	59,19	57,31
26456/--	5,6	82,79	96,81	101,59	101,98	99,76	103,40	105,55	106,47	106,31	105,22	103,28
26465/--	6,5	104,81	123,05	129,44	130,16	127,49	132,29	135,17	136,44	136,34	135,02	132,61
26475/--	7,5	125,96	148,32	156,29	157,36	154,28	160,21	163,80	165,45	165,41	163,88	161,02

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

Continued

**TABLE 67A: Refrigerant R452A - Capacities in kW (1)**

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
26115/--	1,5	10,03	12,65	14,11	14,96	15,45	15,65	15,65	15,49	15,18	14,71	14,11
26120/--	2,0	14,25	18,33	20,69	22,13	22,99	23,42	23,53	23,37	22,99	22,35	21,49
26127/--	2,7	17,15	21,27	23,51	24,77	25,44	25,66	25,58	25,23	24,66	23,84	22,81
26227/--	2,7	18,63	22,67	24,79	25,91	26,45	26,56	26,36	25,91	25,24	24,34	23,22
26232/--	3,2	25,04	28,90	30,62	31,31	31,42	31,11	30,51	29,68	28,66	27,41	25,96
26336/--	3,6	29,63	34,36	36,51	37,40	37,59	37,27	36,59	35,63	34,43	32,95	31,23
26340/--	4,0	54,31	62,31	65,80	67,11	67,22	66,44	65,07	63,24	60,99	58,28	55,17
26344/--	4,4	64,65	74,68	79,16	80,96	81,27	80,48	78,94	76,81	74,17	70,94	67,21
26456/--	5,6	82,35	105,16	118,21	126,04	130,67	132,85	133,25	132,19	129,84	126,10	121,13
26465/--	6,5	104,25	133,67	150,62	160,87	167,00	169,97	170,64	169,41	166,51	161,82	155,53
26475/--	7,5	125,29	161,12	181,87	194,49	202,08	205,84	206,79	205,42	202,01	196,41	188,85
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
26115/--	1,5	10,69	13,25	14,60	15,35	15,71	15,83	15,73	15,49	15,11	14,57	13,88
26120/--	2,0	15,18	19,20	21,41	22,69	23,38	23,69	23,65	23,37	22,88	22,12	21,14
26127/--	2,7	18,27	22,29	24,33	25,40	25,86	25,95	25,70	25,23	24,54	23,60	22,44
26227/--	2,7	19,84	23,76	25,65	26,57	26,89	26,86	26,49	25,91	25,12	24,09	22,84
26232/--	3,2	26,67	30,28	31,69	32,11	31,95	31,46	30,66	29,68	28,52	27,13	25,54
26336/--	3,6	31,56	36,00	37,78	38,36	38,22	37,69	36,77	35,63	34,27	32,62	30,72
26340/--	4,0	57,85	65,28	68,09	68,83	68,34	67,19	65,40	63,24	60,71	57,70	54,26
26344/--	4,4	68,86	78,24	81,92	83,04	82,63	81,39	79,34	76,81	73,82	70,23	66,11
26456/--	5,6	87,72	110,17	122,32	129,27	132,86	134,35	133,92	132,19	129,23	124,84	119,15
26465/--	6,5	111,05	140,04	155,86	164,99	169,80	171,89	171,50	169,41	165,74	160,20	152,98
26475/--	7,5	133,45	168,80	188,20	199,47	205,47	208,17	207,83	205,42	201,07	194,44	185,76
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
26115/--	1,5	11,04	13,37	14,51	15,09	15,30	15,27	15,07	14,72	14,25	13,61	12,82
26120/--	2,0	15,68	19,37	21,28	22,31	22,77	22,85	22,65	22,21	21,57	20,67	19,52
26127/--	2,7	18,87	22,49	24,18	24,97	25,19	25,03	24,62	23,97	23,14	22,05	20,73
26227/--	2,7	20,49	23,97	25,50	26,12	26,19	25,91	25,37	24,62	23,69	22,50	21,10
26232/--	3,2	27,55	30,55	31,50	31,57	31,12	30,34	29,37	28,21	26,89	25,34	23,59
26336/--	3,6	32,59	36,32	37,55	37,71	37,23	36,35	35,22	33,86	32,31	30,47	28,38
26340/--	4,0	59,75	65,87	67,68	67,66	66,56	64,81	62,65	60,09	57,24	53,90	50,13
26344/--	4,4	71,12	78,94	81,43	81,63	80,48	78,50	75,99	72,99	69,60	65,60	61,07
26456/--	5,6	90,60	111,16	121,59	127,08	129,40	129,59	128,28	125,62	121,84	116,61	110,06
26465/--	6,5	114,69	141,30	154,93	162,20	165,37	165,80	164,27	160,99	156,26	149,64	141,31
26475/--	7,5	137,83	170,31	187,07	196,09	200,12	200,80	199,07	195,21	189,57	181,62	171,59

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

**TABLE: 67B - Correction factors for subcooling  $\Delta t_{sub} \neq 4^\circ K$**

$\Delta t_{sub}$ [°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 evaporator capacity by dividing by the appropriate correction factor found in Table 67B

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