



HANDBOOK
REGULATOR VALVES

Ed. 2017



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 solenoid 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.

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

CAPACITY REGULATORS

FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



APPLICATIONS

In air conditioning systems, it is desirable to limit the minimum evaporating pressure during periods of low load to prevent coil icing. In refrigerating systems, it is desirable to limit the minimum evaporating pressure during periods of low load to avoid operating the compressor at a lower suction pressure than it was designed to operate. Capacity regulators in series 3310 and 3315 are practical and economical solutions to these problems as they allow a portion of the hot discharge gas in the high pressure line to bypass directly to the low pressure line, returning the evaporation temperature/pressure to the desired value.

The capacity regulators illustrated in this chapter are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, or R507)
- HFC (R410A), only series 3315

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

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

OPERATION

Capacity regulators adjust the flow of hot gas according to changes of suction pressure, downstream the regulator.

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

The factory pressure settings for capacity regulators in series 3310 and 3315 is 2 bar. This means that until the suction pressure is above 2 bar the regulator remains closed. When the suction pressure drops below 2 bar, it begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 0.6 bar in calibration pressure. The pressure setting ranges are as follows:

- From 0.2 to 6 bar for regulators in series 3310
- From 2 to 7 bar for regulators in series 3315

CONSTRUCTION

The main parts of the capacity regulators are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Brass bar EN 12164 – CW 614N for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

INSTALLATION

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

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

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

SELECTION

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

1. Type of refrigerant

2. Minimum allowable evaporating temperature at reduced load condition. This data depends on the system. In air conditioning systems, this value must be set to prevent coil icing. In refrigerating systems, this value must be set to avoid that the suction temperature is lower than minimum values recommended by compressor manufacturers.

3. Minimum required operating evaporating temperature. This is the temperature when the valve begins to open.

4. Compressor capacity at minimum allowable evaporating temperature Consult the compressor manufacturer for this value.

5. Minimum evaporator load at which the system is to be operated. This depends on the type of system. It can be a percentage of maximum load (15-25%) or it can be zero.

6. Liquid temperature at minimum evaporator cooling load.

The capacity regulator must be selected based on the difference between the compressor capacity (item 4) and the minimum evaporator cooling load (item 5). The refrigerating capacities indicated on Tables 3A, 4A, 5A, 6A and 7A are the regulator capacities, not the system capacities on which the valves are installed. These capacities are based on a reference liquid temperature of 36.7 °C. The data listed on these tables are based on:

- Refrigerant used (item 1)
- Minimum allowable evaporating temperature at reduced load condition (item 2)
- Allowed evaporating temperature (pressure) change

downstream the regulator, this is the temperature (pressure) change necessary to move the valve shutter from the initial starting position to the nominal rating capacity position (temperature in item 3 – temperature in item 2).

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

$$(Q_{\text{compr}} - Q_{\text{evap}}) \times K_{T_{\text{liquid}}} = Q_{\text{Valve}}$$

where:

Q_{compr} = Compressor capacity at minimum allowable evaporating temperature [kW]

Q_{evap} = Minimum evaporator load at which the system is to be operated. [kW]

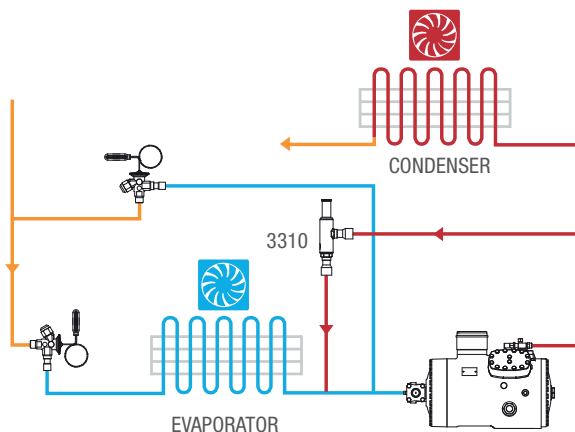
$K_{T_{\text{liquid}}}$ = Correction factor for $T_{\text{liquid}} \neq 36.7$ °C. (See Tables 3B, 4B, 5B, 6B and 7B.)

Q_{valve} = Refrigerating capacity requested at regulator. [kW]

EXAMPLE

Refrigerant:	R404A
Minimum required operating evaporating temperature:	- 15 [°C]
Minimum allowable evaporating temperature at reduced load condition:	- 19 [°C]
Compressor capacity at minimum allowable evaporating temperature:	10 [kW]
Minimum evaporator load at which the system can be operated:	5 [kW]
Liquid temperature at minimum evaporator cooling load:	35 [°C]
Solder connections	

1. Use Table 5B to determine the correction factor for the

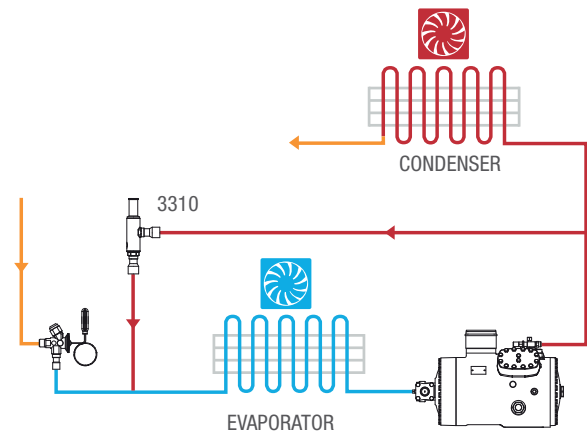


Installation (1)

The regulator is installed as a bypass between compressor discharge and suction line.

The regulator opens as evaporation pressure decreases.

Note: there must be a liquid injection valve for desuperheating suction line gas.



Installation (2)

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

3310

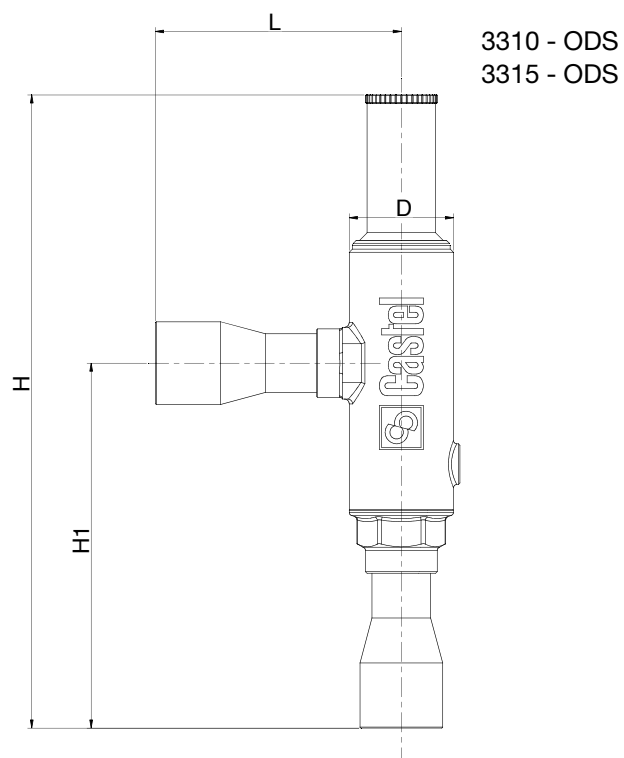
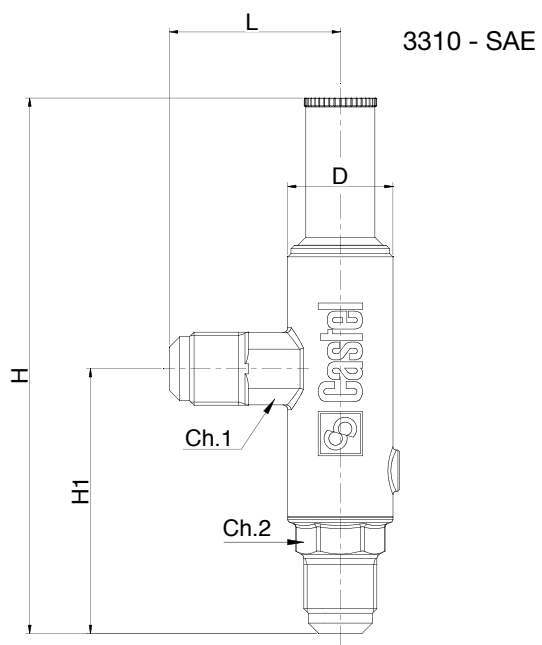
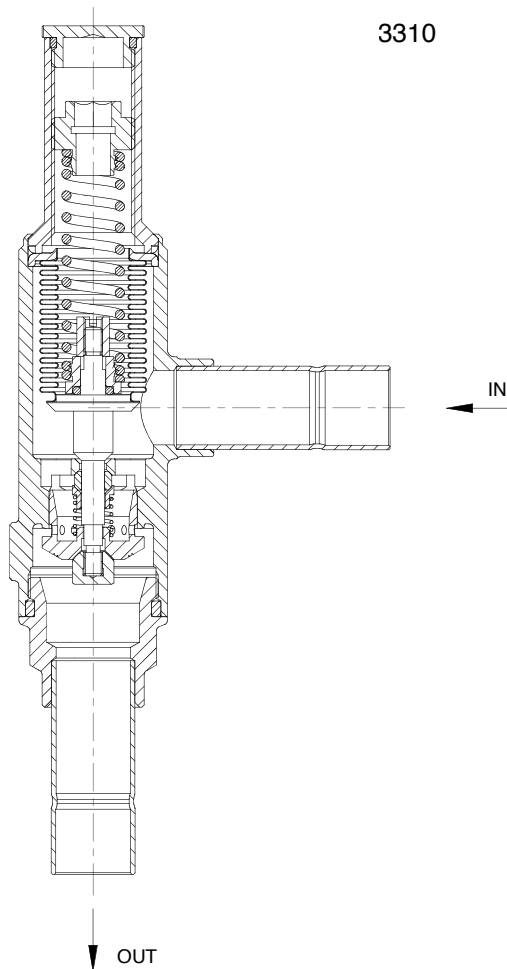


TABLE 1: General characteristics of capacity regulators

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast	
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.		
		Ø [in.]	Ø [mm]											
3310/4	1/2"	–	–	0,70	0,2	6	2	28	– 40	+110	– 40	+50	Art. 4.3	
3310/M12S	–	–	12											
3310/4S	–	1/2"	–											
3310/5	5/8"	–	–	1,26										
3310/5S	–	5/8"	16											
3310/7S	–	7/8"	22											1,84
3315/M12S	–	–	12	0,70	2	7	2	45	– 40	+110	– 40	+50	Art. 4.3	
3315/4S	–	1/2"	–											
3315/5S	–	5/8"	16											1,26
3315/7S	–	7/8"	22											1,84

TABLE 2: Dimensions and weights of capacity regulators

Catalogue Number	Dimensions [mm]						Weight [g]
	H	H ₁	L	D	Ch1	Ch2	
3310/4	159	76,5	48	32	22	24	490
3310/M12S	183	100,5	64		-	-	490
3310/4S	183	100,5	64		-	-	490
3310/5	163	80,5	52		22	24	550
3310/5S	183	100,5	64		-	-	480
3310/7S	194	112	75,5		-	-	560
3315/M12S	183	100,5	64	32	-	-	490
3315/4S	183	100,5	64				490
3315/5S	183	100,5	64				480
3315/7S	194	112	75,5				560

liquid temperature $T_{\text{Liquid}} = 35 \text{ °C}$.

$$K_{\text{Tliquid}} = 1,03$$

2. Calculate the refrigerating capacity requested at regulator.

$$Q_{\text{Valve}} = (Q_{\text{compr}} - Q_{\text{evap}}) \times K_{\text{Tliquid}} = (10-5) \times 1,03 = 5,15 \text{ kW}$$

3. Calculate the evaporating temperature change

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

4. With the following parameters:

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

Choose the proper valve in Table 5A.

The selected valves are:

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

CERTIFICATIONS

Regulators in series 3310 have been approved by the American certification authority Underwriters Laboratories Inc. These regulators are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207. Regulators in series 3315 have not been approved by the American certification authority Underwriters Laboratories Inc.

TABLE 3A : Refrigerant Flow Capacity of capacity regulators 3310 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 3B : Correction factor for liquid temperature different from nominal value

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

TABLE 4A : Refrigerant Flow Capacity of capacity regulators 3310 [kW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		6	0	-5	-10	-15	-20	-25	-30	-35	-40
3310/4 3310/4S 3310/M12S	1	2,25	2,25	2,21	2,16	2,12	2,07	2,03	1,98	1,94	1,89
	2	4,65	4,65	4,56	4,47	4,37	4,28	4,19	4,10	4,01	3,92
	3	6,21	6,21	6,09	5,96	5,84	5,72	5,60	5,47	5,35	5,23
	4	6,90	6,90	6,76	6,63	6,49	6,35	6,22	6,08	5,95	5,81
	5	7,25	7,25	7,10	6,96	6,82	6,67	6,53	6,39	6,24	6,10
	6	8,45	8,45	8,29	8,12	7,95	7,78	7,62	7,45	7,28	7,12
3310/5 3310/5S	1	3,65	3,65	3,57	3,50	3,43	3,36	3,29	3,22	3,15	3,08
	2	6,05	6,05	5,94	5,84	5,73	5,62	5,52	5,41	5,30	5,19
	3	8,22	8,22	8,05	7,88	7,71	7,55	7,38	7,21	7,04	6,87
	4	11,81	11,81	11,57	11,33	11,08	10,84	10,60	10,36	10,12	9,87
	5	14,01	14,01	13,72	13,43	13,15	12,86	12,57	12,28	12,00	11,71
	6	15,94	15,94	15,61	15,28	14,96	14,63	14,30	13,98	13,65	13,32
3310/7S	1	3,44	3,44	3,38	3,33	3,28	3,23	3,18	3,13	3,08	3,03
	2	6,11	6,11	6,01	5,92	5,83	5,74	5,65	5,56	5,47	5,38
	3	7,83	7,83	7,71	7,60	7,48	7,36	7,25	7,13	7,01	6,90
	4	13,66	13,66	13,46	13,26	13,05	12,85	12,65	12,44	12,24	12,04
	5	16,43	16,43	16,19	15,95	15,70	15,46	15,21	14,97	14,72	14,48
	6	21,57	21,57	21,24	20,92	20,60	20,28	19,96	19,64	19,32	19,00

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 4B : Correction factor for liquid temperature different from nominal value

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

TABLE 5A : Refrigerant Flow Capacity of capacity regulators 3310 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 5B : Correction factor for liquid temperature different from nominal value

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

TABLE 6A : Refrigerant Flow Capacity of capacity regulators 3310 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 6B : Correction factor for liquid temperature different from nominal value

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

TABLE 7A : Refrigerant Flow Capacity of capacity regulators 3315 [kW]

Catalogue Number	Evaporator temperature change [°C] (1)	Minimum allowable evaporator temperature at reduced load conditions [°C]									
		8	4,4	0	-5	-10	-15	-30	-35	-30	-35
3315/4S 3315/M12S	1	–	4,11	3,97	3,91	3,84	3,77	3,70	3,63	3,56	3,49
	2	–	7,93	7,67	7,53	7,40	7,26	7,13	6,99	6,86	6,73
	3	–	10,84	10,48	10,29	10,11	9,93	9,74	9,56	9,38	9,19
	4	–	11,83	11,43	11,23	11,03	10,83	10,63	10,43	10,23	10,03
	5	–	12,39	11,97	11,76	11,55	11,34	11,13	10,92	10,71	10,50
	6	–	14,41	13,92	13,68	13,44	13,19	12,95	12,71	12,46	12,22
3315/5S	1	–	6,13	5,88	5,75	5,63	5,50	5,38	5,25	5,13	5,00
	2	–	10,51	10,08	9,87	9,66	9,44	9,23	9,01	8,80	8,58
	3	–	14,56	13,97	13,67	13,37	13,08	12,78	12,48	12,19	11,89
	4	–	20,86	20,01	19,58	19,16	18,73	18,31	17,88	17,46	17,03
	5	–	24,71	23,70	23,20	22,70	22,19	21,69	21,18	20,68	20,18
	6	–	28,09	26,94	26,37	25,80	25,22	24,65	24,08	23,51	22,93
3315/7S	1	–	6,18	5,82	5,64	5,46	5,27	5,09	4,91	4,73	4,55
	2	–	11,01	10,36	10,04	9,71	9,39	9,07	8,74	8,42	8,10
	3	–	14,09	13,26	12,84	12,43	12,02	11,60	11,19	10,77	10,36
	4	–	25,01	23,54	22,81	22,07	21,33	20,60	19,86	19,13	18,39
	5	–	30,36	28,57	27,68	26,79	25,90	25,00	24,11	23,22	22,32
	6	–	40,20	37,84	36,66	35,47	34,29	33,11	31,93	30,74	29,56

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 7B : Correction factor for liquid temperature different from nominal value

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,39	1,31	1,24	1,17	1,11	1,04	0,97	0,9	0,84

CHAPTER 2

CRANKCASE PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



APPLICATIONS

The crankcase pressure regulator is an accessory often used in low temperature cooling systems. It is designed to prevent the compressor motor from overloading when the intake pressure exceeds the manufacturer's recommended operating pressure. This can occur in many low temperature refrigeration systems during or after a defrosting cycle, or after an extended shut-down period.

All crankcase pressure regulators illustrated in this chapter are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants 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, Point (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

Crankcase pressure regulators adjust the flow of hot gas according to changes of suction pressure, downstream the regulator. When the suction pressure is greater than the regulator calibration pressure, the shutter remains closed. As the suction pressure drops below the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in suction pressure. As the suction pressure continues to drop, the

shutter continues to open, until the stroke limit is reached and the regulator is open completely. When the shutter is fully open, a further increase in the valve capacity can be obtained only by increasing the load loss across the valve. Crankcase pressure regulators only modulate based on the outlet pressure change, pressure changes on the inlet side do not affect their opening as the valve is equipped with an equalizer bellows with an area equal to that of the valve seat. The factory pressure settings for crankcase pressure regulators in series 3320 is 2 bar. This means that until the suction pressure is above 2 bar the regulator remains closed. When the suction pressure drops below 2 bar begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 0.6 bar in calibration pressure. The calibration range varies from 0.2 to 6 bar.

CONSTRUCTION

The main parts of the crankcase pressure regulators are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu--DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Austenitic stainless steel AISI 303 for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

INSTALLATION

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

SELECTION

To correctly select crankcase pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:

1. **Type of refrigerant**
2. **Evaporator capacity**, at system working conditions
3. **Designed evaporating temperature (saturated pressure) at design load condition.**
4. **Maximum allowable suction pressure.** Consult the compressor manufacturer for this value. This data identifies the valve calibration pressure.

5. Allowable pressure drop across the valves at design load condition.

The pressure difference between items 3 and 4 determines how much of the valve stroke is utilized. The valve calibration should be as high as possible without exceeding the compressor manufacturer's recommendation. When the full shutter stroke is used, the only way to increase the valve capacity is to accept an increase in the load loss across the valve. Since excessive suction line pressure losses penalize the system capacity, the pressure drop across regulator 3320 should be minimized. The lower the evaporator temperature, the lower the pressure drop allowed. The refrigeration capacities indicated in Tables 10A, 11A, 12A, and 13A are based on a reference liquid temperature of 36.7 °C. With liquid temperatures other than 36.7 °C the required cooling capacity of regulator is:

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

where:

Q_{evap} = Evaporator capacity [kW]

$K_{T \text{ liquid}}$ = Correction factor for $T_{\text{liquid}} \neq 36.7 \text{ }^{\circ}\text{C}$.
(vedere tabelle 10B, 11B, 12B, 13B)

Q_{valve} = Refrigerating capacity requested at regulator. [kW]

EXAMPLE

Refrigerant: R404A
Refrigeration yield of evaporator: 4.5 [kW]
Designed evaporating temperature: -25 [°C]
Maximum allowable suction pressure (regulator calibration): 3.5 [bar]

Pressure drop across the regulator: 0.07 [bar]
Liquid temperature: 35 [°C]
Solder connections

1. Use Table 12B to determine the correction factor for the liquid temperature $T_{\text{Liquid}} = 35 \text{ }^{\circ}\text{C}$. $T_{\text{Liquid}} = 35 \text{ }^{\circ}\text{C}$.

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

2. Calculate the refrigerating capacity requested at regulator.

$$Q_{\text{valve}} = \frac{Q_{\text{evap}}}{K_{T \text{ liquid}}} = \frac{4,5}{1,03} = 4,36 \text{ kW}$$

3. With the following parameters:

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

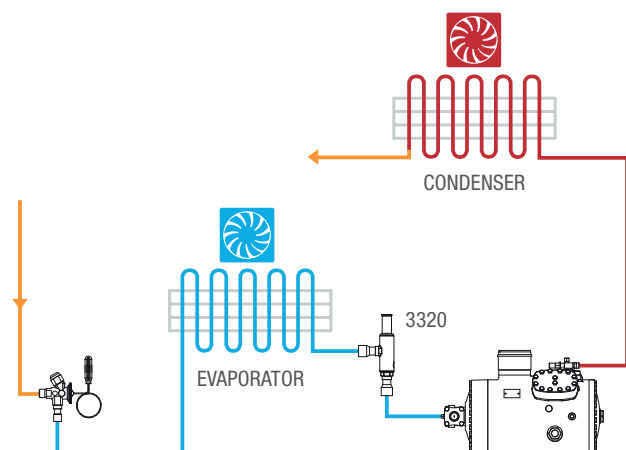
Select the right valve from Table 12A.

The selected valves are:

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

CERTIFICATIONS

Crankcase pressure regulators in series 3320 have been approved by the American certification authority Underwriters Laboratories Inc. These regulators are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207.



Installation

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

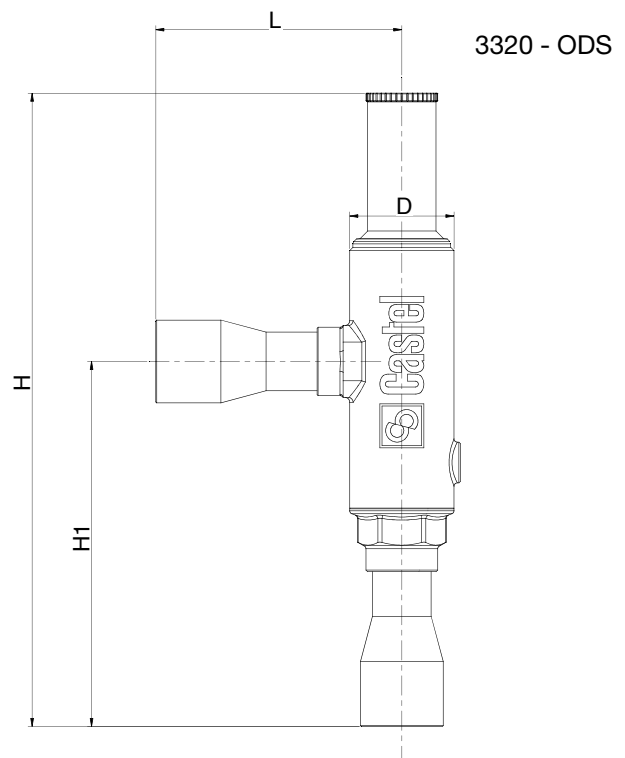
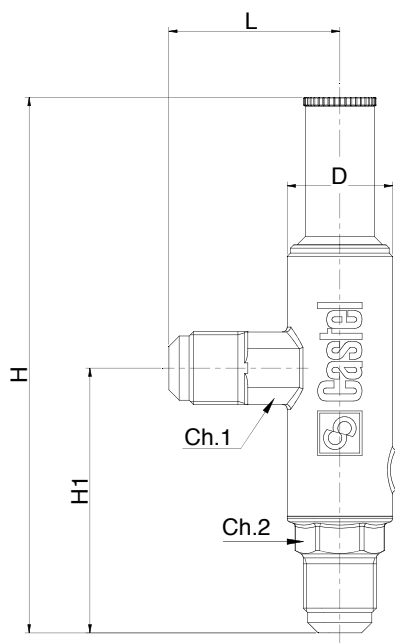
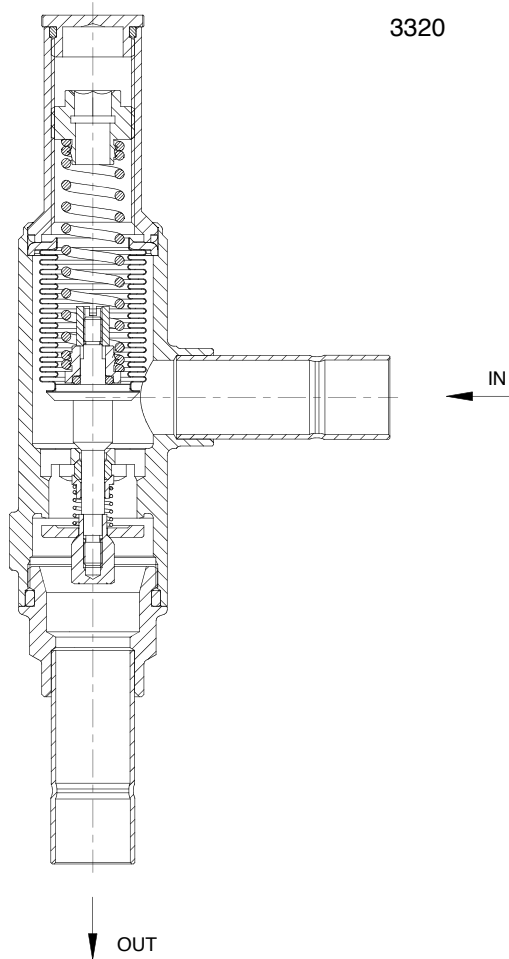


TABLE 8: General characteristics of crankcase pressure regulators

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast	
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.		
		Ø [in.]	Ø [mm]											
3320/4	1/2"	–	–	3,30	0,2	6	2	28	– 40	+110	– 40	+50	Art. 4.3	
3320/M12S	–	–	12											
3320/4S	–	1/2"	–											
3320/5	5/8"	–	–											
3320/5S	–	5/8"	16											
3320/7S	–	7/8"	22											
3320/9S	–	1.1/8"	–	8										
3320/M28S	–	–	28											
3320/11S	–	1.3/8"	35											

TABLE 9: Dimensions and weights of crankcase pressure regulators

Catalogue Number	Dimensions [mm]						Weight [g]
	H	H ₁	L	D	Ch1	Ch2	
3320/4	159	76,5	48	32	22	24	470
3320/M12S	183	100,5	64		-	-	490
3320/4S	183	100,5	64		-	-	490
3320/5	163	80,5	52		22	24	550
3320/5S	183	100,5	64		-	-	480
3320/7S	194	112	75,5		-	-	550
3320/9S	263	151	105	46	-	-	1480
3320/M28S	263	151	105				1460
3320/11S	263	151	105				1490

TABLE 10A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)
 Liquid temperature 98 °F (36,7 °C)
 Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)
 Superheating 25 °R (13,9 °K)

Evaporating temperature 40 °F (4,4 °C)

Discharge temperature 150 °F (65,6 °C)

(1) : This value is the valve pressure setting

Continued

TABLE 10A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

(1) : This value is the valve pressure setting

TABLE 10B : Correction factor for liquid temperature different from nominal value

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

TABLE 11A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)
 Liquid temperature 98 °F (36,7 °C)
 Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)
 Superheating 25 °R (13,9 °K)

Evaporating temperature 40 °F (4,4 °C)

Discharge temperature 150 °F (65,6 °C)

(1) : This value is the valve pressure setting

Continued

TABLE 11A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

(1) : This value is the valve pressure setting

TABLE 11B : Correction factor for liquid temperature different from nominal value

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

TABLE 12A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)
 Liquid temperature 98 °F (36,7 °C)
 Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)
 Superheating 25 °R (13,9 °K)

Evaporating temperature 40 °F (4,4 °C)

Discharge temperature 150 °F (65,6 °C)

(1) : This value is the valve pressure setting

Continued

TABLE 12A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

(1) : This value is the valve pressure setting

TABLE 12B : Correction factor for liquid temperature different from nominal value

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

TABLE 13A : Refrigerant Flow Capacity of crankcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)
 Liquid temperature 98 °F (36,7 °C)
 Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)
 Superheating 25 °R (13,9 °K)

Evaporating temperature 40 °F (4,4 °C)

Discharge temperature 150 °F (65,6 °C)

(1) : This value is the valve pressure setting

Continued

TABLE 13A : Refrigerant Flow Capacity of crandcase pressure regulators 3320 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

(1) : This value is the valve pressure setting

TABLE 13B : Correction factor for liquid temperature different from nominal value

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

CHAPTER 3 ■

EVAPORATING PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



APPLICATIONS

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

All evaporating pressure regulators illustrated in this chapter are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, or R507)
- HFC (R410A), only series 3335

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

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

OPERATION

Evaporating pressure regulators adjust the flow of hot gas according to changes of suction pressure, upstream the regulator. When the evaporating pressure is less than the regulator calibration pressure, the shutter remains closed. As the suction pressure rises above the regulator's calibration setting, the shutter begins to open and modulates

in proportion to the variation in evaporating pressure. As the evaporating pressure continues to rise, the shutter continues to open, until the stroke limit is reached and the regulator is open completely. When the shutter is fully open, a further increase in the valve capacity can be obtained only by increasing the load loss across the valve. Evaporating pressure regulators only modulate based on the inlet pressure change, pressure changes on the outlet side do not affect their opening as the valve is equipped with an equalizer bellow with an area equal to that of the valve seat.

The factory pressure settings for regulators in series 3330 is 2 bar. This means that until the evaporating pressure is less than 2 bar the regulator remains closed. When it rises above 2 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 0.5 bar in calibration pressure (0.3 bar for models 3330/9S, 3330/M28S, and 3330/11S). The calibration range varies from 0.2 to 5.5 bar.

The factory pressure settings for regulators in series 3335 is 8 bar. This means that until the evaporating pressure is less than 8 bar the regulator remains closed. When it rises above 8 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 1.6 bar in calibration pressure. The calibration range varies from 3 to 20 bar.

CONSTRUCTION

The main parts of the evaporating pressure regulators are made with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu–DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Austenitic stainless steel AISI 303 for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

INSTALLATION

Evaporating pressure regulators in series 3330 and 3335 are installed in the suction line between the evaporator and the compressor.

Refrigerating system with one compressor serving two or more evaporators in parallel, where the same evaporating temperature is required. In this case the evaporating pressure regulator is installed on the common suction line (installation example 1).

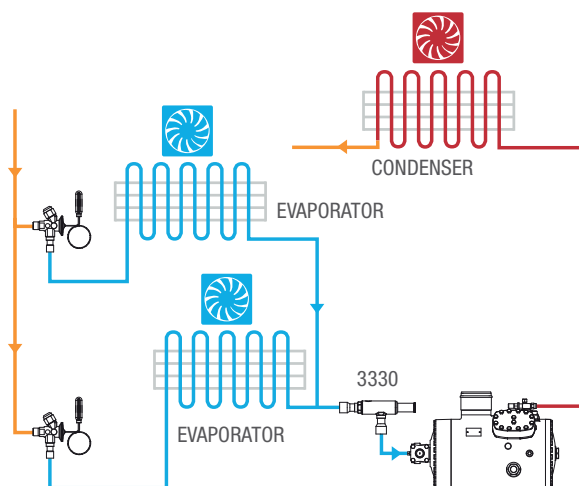
Refrigerating system with one compressor serving two or more evaporators in parallel, where different evaporating temperature are required. In this case the evaporating pressure regulator is installed downstream the evaporator with the highest temperature. Downstream of the evaporators with lower temperatures, it is necessary to install a check valve to avoid refrigerant condensing during compressor stops (installation example 2).

SELECTION

To correctly select evaporating pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:

1. **Type of refrigerant**
 2. **Designed evaporator capacity.**
 3. **Designed evaporating temperature.**
 4. **Minimum evaporating temperature.** This data identifies the valve calibration pressure
 5. **Allowable pressure drop across the valves at design load condition.**
 6. **Liquid temperature**
- The refrigerating capacities indicated on Tables 16A, 17A, 18A, 19A and 20A are calculated as a function of:
- A liquid reference temperature of 36.7 °C.
 - An allowable variation in evaporating pressure of 0.56 bar.
- With liquid temperatures other than 36.7 °C and for variations in evaporating pressure other than 0.56 bar, the required cooling capacity of regulator is:

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



Installation (1)

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

where:

- Q_{evap} = Evaporator capacity [kW]
 $K_{T \text{ liquid}}$ = Correction factor for $T_{\text{liquid}} \neq 36.7 \text{ }^{\circ}\text{C}$.
 (See Tables 16B, 17B, 18B, 19B and 20B.)
 $K_{\Delta P \text{ evap}}$ = Correction factor for $\Delta P_{\text{valve}} \neq 0.56 \text{ bar}$.
 (See Tables 16C, 17C, 18C, 19C, and 20C.)
 Q_{valve} = Refrigerating capacity requested at regulator. [kW]

EXAMPLE

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

1. Use Table 18B to determine the correction factor for the liquid temperature $T_{\text{Liquid}} = 40 \text{ }^{\circ}\text{C}$.

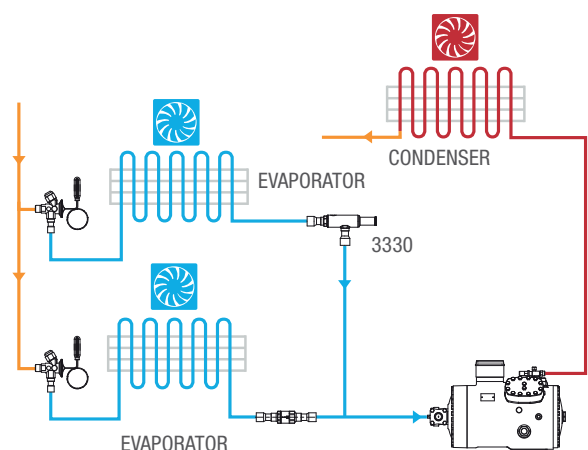
$$K_{T \text{ liquid}} = 0.95$$

2. Using Table 18C, determine the correction factor for the variation in the evaporating pressure.
 $\Delta P = P_{T \text{ progetto}} - P_{T \text{ min asp}} = 5 - 4.2 = 0.8 \text{ bar}$

$$K_{\Delta P \text{ evap}} = 1.3$$

3. Calculate the refrigerating capacity requested at regulator.

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



Installation (2)

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

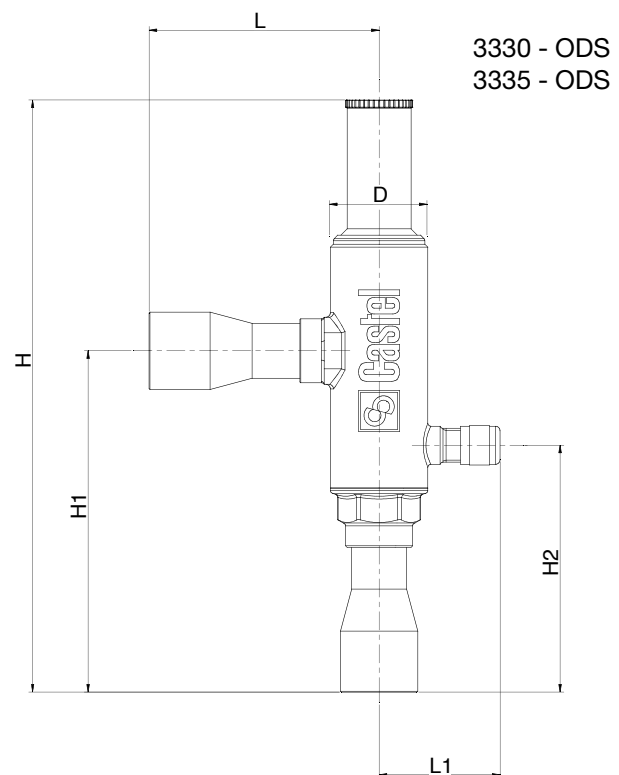
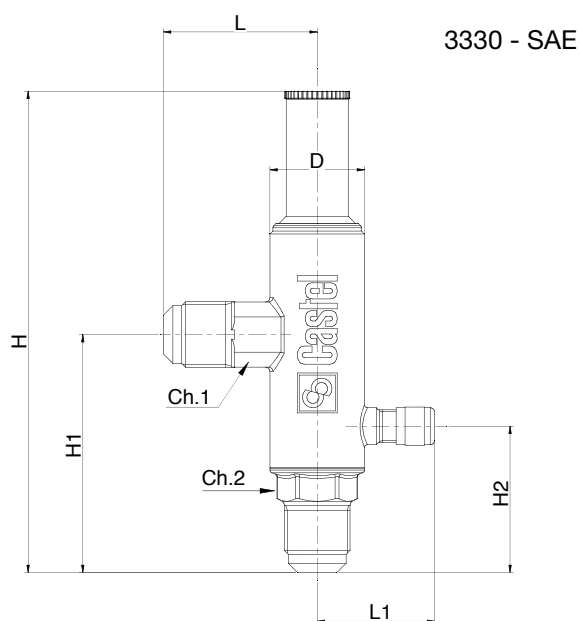
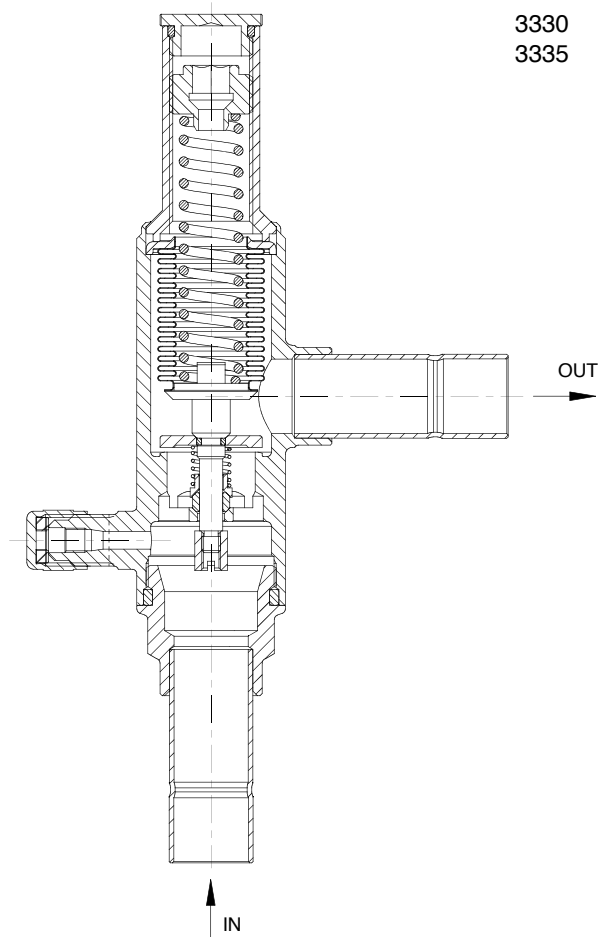


TABLE 14: General characteristics of evaporator pressure regulators

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.	
		Ø [in.]	Ø [mm]										
3330/4	1/2"	–	–	2,7	0,2	5,5	2	28	– 40	+110	– 40	+50	Art. 4.3
3330/M12S	–	–	12										
3330/4S	–	1/2"	–										
3330/5	5/8"	–	–										
3330/5S	–	5/8"	16										
3330/7S	–	7/8"	22										
3330/9S	–	1.1/8"	–	8,4	0,2	5,5	2	28	– 40	+110	– 40	+50	Art. 4.3
3330/M28S	–	–	28										
3330/11S	–	1.3/8"	35										
3335/M12S	–	–	12	2,7	3	20	5	45	-40	+110	-40	+50	Art. 4.3
3335/4S	–	1/2"	–										
3335/5S	–	5/8"	16										
3335/7S	–	7/8"	22										

TABLE 15: Dimensions and weights of evaporator pressure regulators

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H ₁	H ₂	L	L ₁	D	Ch1	Ch2	
3330/4	159	76,5	45,5	48	37	32	22	24	530
3330/M12S	183	100,5	69,5	64			–	–	510
3330/4S	183	100,5	69,5	64			–	–	480
3330/5	163	80,5	49,5	52			22	24	500
3330/5S	183	100,5	69,5	64			–	–	500
3330/7S	194	112	81	75,5			–	–	560
3330/9S	263	151	111	105	44	46	–	–	1470
3330/M28S	263	151	111	105					1470
3330/11S	263	151	111	105					1480
3335/M12S	183	100,5	69,5	64	37	32	–	–	510
3335/4S	183	100,5	69,5	64					480
3335/5S	183	100,5	69,5	64					500
3335/7S	194	112	81	75,5					560

4. With the following parameters

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

Select the right valve from Table 18A.

The selected valves are:

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

CERTIFICATIONS

Evaporating pressure regulators in series 3330 have been approved by the American certification authority Underwriters Laboratories Inc. These regulators are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207. Evaporating pressure regulators in series 3335 have not been approved by the American certification authority Underwriters Laboratories Inc.

TABLE 16A : Refrigerant Flow Capacity of evaporator pressure regulators 3330 [kW]

Catalogue Number	Pressure drop across regulator [bar]	Design evaporator temperature [°C]									
		20	15	10	5	0	-5	-10	-15	-20	-25
3330/4 3330/4S 3330/M12S	0,07	–	–	1,10	0,99	0,88	0,77	0,67	0,57	–	–
	0,14	–	–	2,27	2,03	1,79	1,55	1,34	1,13	–	–
	0,21	–	–	3,70	3,26	2,83	2,39	2,01	1,63	–	–
	0,35	–	–	5,62	4,91	4,21	3,50	2,88	2,26	–	–
	0,42	–	–	7,17	6,18	5,18	4,18	3,44	–	–	–
	0,56	–	–	10,16	8,63	7,10	5,58	4,59	–	–	–
3330/5 3330/5S	0,07	–	–	1,42	1,28	1,15	1,01	0,89	0,77	–	–
	0,14	–	–	2,89	2,60	2,32	2,04	1,80	1,56	–	–
	0,21	–	–	4,37	3,93	3,50	3,07	2,70	2,33	–	–
	0,35	–	–	6,08	5,47	4,87	4,27	3,74	3,21	–	–
	0,42	–	–	8,02	7,20	6,38	5,56	4,87	–	–	–
	0,56	–	–	10,80	9,67	8,54	7,41	6,50	–	–	–
3330/7S	0,07	–	–	1,42	1,27	1,13	0,99	0,86	0,73	–	–
	0,14	–	–	2,92	2,61	2,30	1,99	1,72	1,45	–	–
	0,21	–	–	5,27	4,64	4,00	3,37	2,59	2,26	–	–
	0,35	–	–	7,63	6,67	5,71	4,75	3,91	3,07	–	–
	0,42	–	–	10,81	9,28	7,74	6,21	4,74	–	–	–
	0,56	–	–	13,99	11,88	9,78	7,68	6,32	–	–	–
3330/9S 3330/M28S	0,07	–	–	4,47	4,03	3,60	3,16	2,80	2,43	–	–
	0,14	–	–	9,07	8,18	7,29	6,40	5,65	4,91	–	–
	0,21	–	–	13,71	12,35	11,00	9,64	8,48	7,32	–	–
	0,35	–	–	19,09	17,20	15,30	13,40	11,75	10,09	–	–
	0,42	–	–	25,18	22,60	20,03	17,45	15,30	–	–	–
	0,56	–	–	33,93	30,38	26,83	23,29	20,41	–	–	–
3330/11S	0,07	–	–	4,34	3,90	3,46	3,02	2,64	2,25	–	–
	0,14	–	–	8,94	7,99	7,05	6,10	5,27	4,45	–	–
	0,21	–	–	16,17	14,22	12,28	10,33	7,94	6,93	–	–
	0,35	–	–	23,39	20,45	17,51	14,57	11,99	9,42	–	–
	0,42	–	–	33,15	28,45	23,75	19,05	14,54	–	–	–
	0,56	–	–	42,90	36,45	29,99	23,54	19,38	–	–	–

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 8 psi (0,56 bar)

TABLE 16B : Correction factor for liquid temperature different from nominal value

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

TABLE 16C : Correction factor for evaporator pressure change different from nominal value

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

TABLE 17A : Refrigerant Flow Capacity of evaporator pressure regulators 3330 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			

Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)
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Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 8 psi (0,56 bar)

TABLE 17B : Correction factor for liquid temperature different from nominal value

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

TABLE 17C : Correction factor for evaporator pressure change different from nominal value

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

TABLE 18A : Refrigerant Flow Capacity of evaporator pressure regulators 3330 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 8 psi (0,56 bar)

TABLE 18B : Correction factor for liquid temperature different from nominal value

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

TABLE 18C : Correction factor for evaporator pressure change different from nominal value

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

TABLE 19A : Refrigerant Flow Capacity of evaporator pressure regulators 3330 [kW]

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 8 psi (0,56 bar)

TABLE 19B : Correction factor for liquid temperature different from nominal value

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

TABLE 19C : Correction factor for evaporator pressure change different from nominal value

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

TABLE 20A : Refrigerant Flow Capacity of evaporator pressure regulators 3335 [kW]

Catalogue Number	Pressure drop across regulator [bar]	Design evaporator temperature [°C]									
		10	4,4	0	-5	-10	-15	-20	-25	-30	-35
3335/4S 3335/M12S	0,07	–	2,07	1,86	1,65	1,45	1,26	1,15	1,04	0,94	–
	0,14	–	4,17	3,73	3,28	2,89	2,50	2,28	2,07	1,85	–
	0,21	–	6,81	6,05	5,30	4,61	3,93	3,55	3,17	2,79	–
	0,35	–	10,29	9,12	7,95	6,87	5,79	5,18	4,58	3,97	–
	0,42	–	14,00	12,26	10,52	8,93	7,35	6,48	5,62	4,76	–
	0,56	–	20,85	18,09	15,32	12,83	10,33	9,01	7,68	6,35	–
	0,81	–	27,70	23,91	20,12	16,72	13,32	11,53	9,73	7,93	–
	1,12	–	34,55	29,74	24,92	20,62	16,31	14,05	11,78	9,52	–
3335/5S	0,07	–	2,60	2,34	2,08	1,82	1,55	1,45	1,34	1,24	–
	0,14	–	5,30	4,76	4,22	3,69	3,17	2,95	2,73	2,51	–
	0,21	–	8,00	7,18	6,36	5,55	4,75	4,41	4,08	3,74	–
	0,35	–	11,14	10,00	8,85	7,72	6,58	6,11	5,65	5,18	–
	0,42	–	14,79	13,25	11,70	10,17	8,65	8,01	7,38	6,75	–
	0,56	–	19,96	17,86	15,75	13,67	11,58	10,71	9,85	8,98	–
	0,81	–	25,13	22,47	19,80	17,16	14,51	13,42	12,32	11,22	–
	1,12	–	30,30	27,08	23,86	20,65	17,45	16,12	14,79	13,46	–
3335/7S	0,07	–	2,88	2,59	2,30	2,02	1,75	1,60	1,45	1,30	–
	0,14	–	5,94	5,30	4,67	4,11	3,55	3,25	2,94	2,64	–
	0,21	–	9,66	8,59	7,52	6,55	5,57	5,04	4,50	3,96	–
	0,35	–	14,48	12,83	11,19	9,67	8,14	7,29	6,44	5,59	–
	0,42	–	19,31	16,91	14,51	12,32	10,13	8,94	7,75	6,56	–
	0,56	–	28,75	24,94	21,13	17,69	14,25	12,42	10,58	8,75	–
	0,81	–	38,20	32,97	27,75	23,06	18,37	15,89	13,42	10,94	–
	1,12	–	47,64	41,01	34,37	28,43	22,49	19,37	16,25	13,13	–

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 8 psi (0,56 bar)

TABLE 20B : Correction factor for liquid temperature different from nominal value

Liquid temperature [°C]								
10	15	20	25	30	35	40	45	50
1,39	1,31	1,24	1,17	1,11	1,04	0,97	0,9	0,84

TABLE 20C : Correction factor for evaporator pressure change different from nominal value

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

CHAPTER 4

EVAPORATING PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE THE R744 REFRIGERANT



APPLICATIONS

Evaporating pressure regulators are an accessory designed to maintain a constant evaporating pressure and thereby a constant surface temperature on the evaporator under varying evaporator loads. This valve prevents too low evaporating pressure and therefore protects against freezing in water chiller or against coil icing in air evaporators. These regulators allow multiple evaporators to operate at different temperatures in a system with only one compressor.

The evaporating pressure regulators illustrated in this chapter have been developed by Castel for all applications that use subcritical 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 evaporating pressure regulators in this chapter cannot be used with other refrigerant fluids.

OPERATION

Evaporating pressure regulators adjust the flow of hot gas according to changes of suction pressure, upstream the regulator. When the evaporating pressure is less than the regulator calibration pressure, the shutter remains closed. As the suction pressure rises above the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in evaporating pressure. As the evaporating pressure continues to rise, the shutter continues to open, until the stroke limit is reached and the

regulator is open completely. When the shutter is fully open, a further increase in the valve capacity can be obtained only by increasing the load loss across the valve.

Evaporating pressure regulators only modulate based on the inlet pressure change, pressure changes on the outlet side do not affect their opening as the valve is equipped with an equalizer bellows with an area equal to that of the valve seat

The factory pressure settings for regulators in series 3335EL is 12 bar. This means that until the condensation (discharge) pressure is below 12 bar, the regulator remains closed. When it rises above 12 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2.5 bar in calibration pressure. The calibration range varies from 12 to 36 bar.

CONSTRUCTION

The main parts of the evaporating pressure regulators are made with the following materials:

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

INSTALLATION

Evaporating pressure regulators in series 3335EL are installed in the suction line between the evaporator and the compressor.

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

SELECTION

To correctly select evaporating pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:

1. Type of refrigerant = R744

2. Designed evaporator capacity.

3. Designed evaporating temperature.

4. Minimum evaporating temperature. This data identifies the valve calibration pressure.

5. Allowable pressure drop across the valves at design load condition.

6. Liquid temperature

The refrigerating capacities indicated in Table 23A are based on:

- A liquid reference temperature of -6.7 °C.
- An allowable variation in evaporating pressure of 1.12 bar.

With liquid temperatures other than -6.7 °C and for variations in evaporating pressure other than 1.12 bar, the required cooling capacity of regulator is:

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

where:

Q_{evap} = Evaporator capacity [kW]

$K_{T \text{ liquid}}$ = Correction factor for $T_{\text{liquid}} \neq -6.7 \text{ °C}$.

$K_{\Delta P \text{ evap}}$ = Correction factor for $\Delta P_{\text{valve}} \neq 1.12 \text{ bar}$.

Q_{valve} = Refrigerating capacity requested at regulator. [kW]

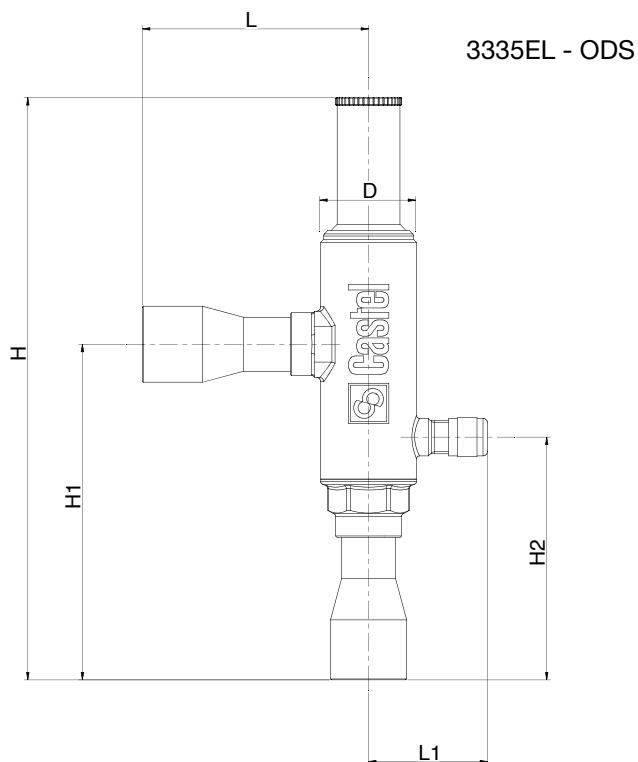


TABLE 21: General characteristics of evaporator pressure regulators for R744

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.	
		Ø [in.]	Ø [mm]										
3335EL/M12S	–	–	12	2,7	12	36	12	45	-40	+120	-40	+50	Art. 4.3
3335EL/4S	–	1/2"	–										
3335EL/5S	–	5/8"	16										
3335EL/7S	–	7/8"	22										

TABLE 22. Dimensions and weights of evaporator pressure regulators for R744

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H ₁	H ₂	L	L ₁	D	Ch1	Ch2	
3335EL/M12S	183	100,5	69,5	64	37	32	-	-	510
3335EL/4S	183	100,5	69,5	64					480
3335EL/5S	183	100,5	69,5	64					500
3335EL/7S	194	112	81	75,5					560

TABLE 23A : Refrigerant Flow Capacity of evaporator pressure regulators 3335EL [kW]

Catalogue Number	Pressure drop across regulator [bar]	Design evaporator temperature [°C]									
		5	0	-5	-10	-15	-20	-25	-30	-35	-40
3335/4S 3335/M12S	0,07	3,85	3,50	3,14	2,79	2,46	2,12	1,94	1,76	1,58	1,40
	0,14	7,81	7,06	6,30	5,55	4,89	4,22	3,86	3,50	3,14	2,77
	0,21	12,80	11,52	10,24	8,97	7,81	6,65	6,00	5,36	4,72	4,08
	0,35	19,39	17,41	15,43	13,45	11,62	9,79	8,77	7,75	6,73	5,70
	0,42	26,64	23,70	20,75	17,80	15,12	12,43	10,97	9,51	8,05	6,59
	0,56	39,96	35,28	30,61	25,93	21,71	17,49	15,24	12,99	10,74	8,49
	0,81	49,24	43,34	37,44	31,53	26,23	20,93	18,13	15,32	12,52	9,71
	1,12	59,53	52,28	45,02	37,77	31,28	24,78	21,36	17,94	14,53	11,11
3335/5S	0,07	4,84	4,40	3,96	3,51	3,07	2,63	2,45	2,27	2,09	1,91
	0,14	9,90	8,98	8,06	7,14	6,25	5,36	4,99	4,61	4,24	3,86
	0,21	14,93	13,54	12,15	10,76	9,39	8,03	7,46	6,90	6,33	5,76
	0,35	20,80	18,86	16,92	14,98	13,06	11,14	10,35	9,55	8,76	7,97
	0,42	27,64	25,03	22,42	19,81	17,22	14,63	13,56	12,49	11,42	10,35
	0,56	37,34	33,78	30,22	26,66	23,13	19,59	18,13	16,67	15,20	13,74
	0,81	43,70	39,53	35,35	31,18	27,04	22,89	21,18	19,46	17,75	16,03
	1,12	51,10	46,22	41,33	36,44	31,57	26,71	24,70	22,69	20,67	18,66
3335/7S	0,07	5,37	4,87	4,38	3,89	3,42	2,96	2,71	2,46	2,20	1,95
	0,14	11,12	10,05	8,97	7,90	6,96	6,01	5,50	4,98	4,47	3,95
	0,21	18,17	16,35	14,54	12,73	11,08	9,43	8,52	7,61	6,70	5,79
	0,35	27,29	24,50	21,72	18,93	16,36	13,78	12,34	10,91	9,47	8,03
	0,42	36,74	32,67	28,61	24,55	20,84	17,14	15,13	13,12	11,11	9,09
	0,56	55,11	48,66	42,20	35,75	29,93	24,12	21,01	17,91	14,81	11,71
	0,81	64,39	56,82	49,24	41,66	34,82	27,97	24,32	20,67	17,01	13,36
	1,12	76,42	67,32	58,23	49,13	40,92	32,71	28,34	23,98	19,61	15,24

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	30°F	-1,2°C	Suction temperature	-5°F	-15°C
Liquid temperature	20°F	-6,7°C	Superheating	15°R	8,4°K
Subcooling	10° R	5,5°K			

Evaporating temperature	-20°F	-28,9°C	Discharge temperature	80°F	26,6°C
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Nominal evaporator pressure change ($T_{\text{design evap}} - T_{\text{min evap}}$) : 16 psi (1,12 bar)

TABLE 23B : Correction factor for liquid temperature different from nominal value

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

TABLE 23C : Correction factor for evaporator pressure change different from nominal value

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

CHAPTER 5

CONDENSING PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



APPLICATIONS

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

Condensing pressure regulators, together with the differential valves, are the solution to this control need. The regulators in series 3340 and 3345 restrict the liquid flow from the condenser to the receiver, reducing the active condenser surface and raising the condensing pressure. The differential valve 3136W by-passes hot gas from the compressor discharge to the receiver, raising the liquid pressure in the receiver.

All condensing pressure regulators illustrated in this chapter are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, or R507)
- HFC (R410A), only series 3345

belonging to Group 2, as defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC

Regulation No. 1272/2008.

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

OPERATION

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

The factory pressure settings for regulators in series 3340 is 8 bar. This means that until the condensation (discharge) pressure is below 8 bar, the regulator remains closed. When it rises above 8 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2.3 bar in calibration pressure (1.5 bar for models 3340/9S, 3340/M28S, and 3340/11S). The calibration range varies from 3 to 20 bar.

The factory pressure settings for regulators in series 3345 is 12 bar. This means that until the condensation (discharge) pressure is below 12 bar, the regulator remains closed. When it rises above 12 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2.5 bar in calibration pressure. The calibration range varies from 18 to 30 bar.

The differential valves adjust the flow of hot gas to the liquid receiver according to the differential pressure between

compressor discharge and liquid receiver The valves 3136W begin to open when the differential pressure reaches 1.4 bar and are fully open when differential pressure is 3 bar

CONSTRUCTION

The main parts of regulators in series 3340 and 3345 are manufactured with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu-DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Austenitic stainless steel AISI 303 for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

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

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

INSTALLATION

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

- In the liquid line between the condenser and the liquid receiver (for regulator selection see Tables 27A, 28A, 29A, 30A and 31A related to liquid line). Valve 3136W is mounted between the compressor discharge and the inlet of liquid receiver. This choice requires a smaller sized regulator as it is controlling liquid refrigerant. It is most suitable for installations in temperate climates (see installation example 1).
- In the discharge line between the compressor and the condenser (for regulator selection see Tables 27B, 28B, 29B, 30B and 31B related to hot gas line). Valve 3136W is mounted between the compressor discharge and the inlet of liquid receiver. A check valve 3132W must be

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

SELECTION

To correctly select condensing pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:

1. **Type of refrigerant**
2. **Designed evaporator (system) capacity.**
3. **Evaporating temperature.**
4. **Condensing temperature.**
5. **Allowable condensing pressure change.**
6. **Allowable pressure drop across the regulator.**

The refrigerating capacities indicated on Tables 27A, 27B, 28A, 28B, 29A, 29B, 30A, 30B, 31A and 31B are calculated as a function of a reference evaporating temperature of 4.4 °C. With liquid temperatures other than 4.4 °C, the required cooling capacity of regulator is:

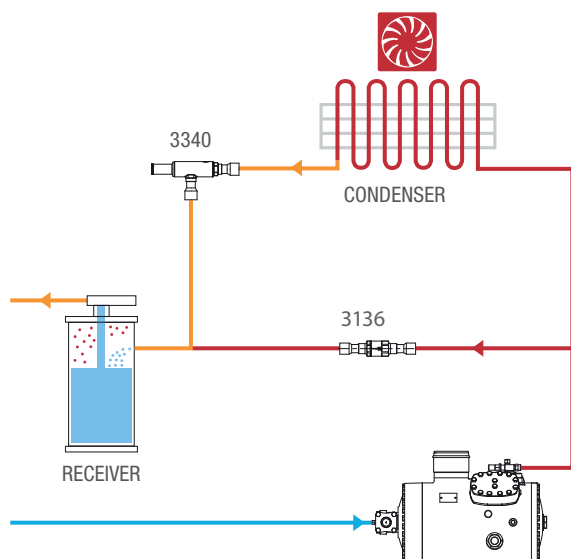
$$\frac{Q_{\text{evap}}}{K_{T \text{ evap}}} = Q_{\text{valve}}$$

where:

- Q_{evap} = Evaporator capacity [kW]
 $K_{T \text{ evap}}$ = Correction factor for $T_{\text{evap}} \neq 4.4 \text{ °C}$.
 (See Tables 27C, 28C, 29C, 30C and 31C.)
 Q_{valve} = Refrigerating capacity requested at regulator. [kW]

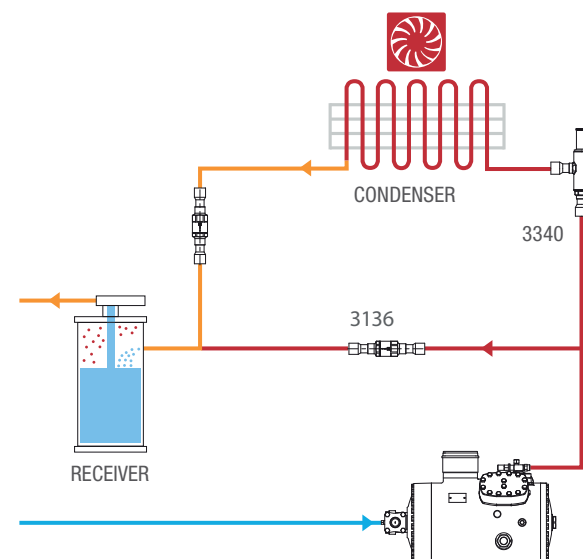
EXAMPLE

Refrigerant:	R404A
Refrigeration yield of evaporator:	20 [kW]
Designed evaporating temperature:	0 [°C]
Condensing temperature:	40 [°C]



Installation (1)

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



Installation (2)

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

Allowed condensing pressure change: 1.5 [bar]
 Pressure drop across the regulator: 0.31 [bar]
 Solder connections

1. Use Table 26C to determine the correction factor for the liquid temperature $T_{\text{evap}} = 0\text{ }^{\circ}\text{C}$.

$$K_{\text{Tevap}} = 1.02$$

2. Calculate the refrigerating capacity requested at regulator.

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

3. With the following parameters:

- Minimum cooling capacity = 19.60 kW
- Condensing temperature = $40\text{ }^{\circ}\text{C}$
- Condensing pressure change = 1.5 bar
- Pressure drop across the valve = 0.31 bar

Select the right valve from Table 29A. The valve selected is 3340/5S.

CERTIFICATIONS

Condensing pressure regulators in series 3340 have been approved by the American certification authority Underwriters Laboratories Inc. These regulators are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207. Condensing pressure regulators in series 3345 have not been approved by the American certification authority Underwriters Laboratories Inc.

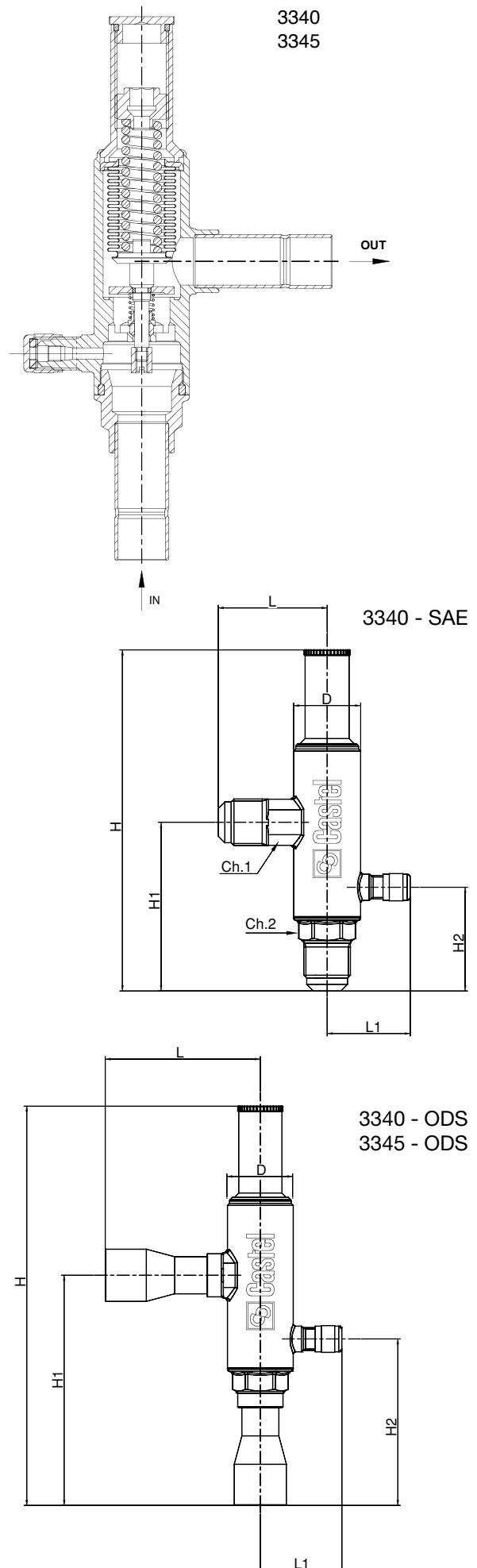


TABLE 24: General characteristics of condensing pressure regulators

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast									
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.										
		Ø [in.]	Ø [mm]																			
3340/4	1/2"	–	–	2,70	3	20	8	28	– 40	+110	– 40	+50	Art. 4.3									
3340/M12S	–	–	12																			
3340/4S	–	1/2"	–																			
3340/5	5/8"	–	–																			
3340/5S	–	5/8"	16																			
3340/7S	–	7/8"	22																			
3340/9S	–	1.1/8"	–	8,4	18	30	10	45	– 40	+110	– 40	+50	Art. 4.3									
3340/M28S	–	–	28																			
3340/11S	–	1.3/8"	35																			
3345/M12S	–	–	12	2,70										18	30	10	45	– 40	+110	– 40	+50	Art. 4.3
3345/4S	–	1/2"	–																			
3345/5S	–	5/8"	16																			
3345/7S	–	7/8"	22																			

TABLE 25: Dimensions and weights of condensing pressure regulators

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H ₁	H ₂	L	L ₁	D	Ch1	Ch2	
3340/4	159	76,5	45,5	48	37	32	22	24	490
3340/M12S	183	100,5	69,5	64			–	–	506
3340/4S	183	100,5	69,5	64			–	–	506
3340/5	163	80,5	49,5	52			22	24	550
3340/5S	183	100,5	69,5	64			–	–	506
3340/7S	194	112	81	75,5			–	–	570
3340/9S	263	151	111	105	44	46	–	–	1520
3340/M28S	263	151	111	105					1520
3340/11S	263	151	111	105					1530
3345/M12S	183	100,5	69,5	64	37	32	–	–	506
3345/4S	183	100,5	69,5	64					506
3345/5S	183	100,5	69,5	64					506
3345/7S	194	112	81	75,5					570

TABLE 26: General characteristics of differential valves

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.		min.	max.	min.	max.	
		Ø [in.]	Ø [mm]									
3136W/M12	—	—	12	1,80	1,4	3	45	— 40	+110	— 40	+50	Art. 4.3
3136W/4	—	1/2"	—									

TABLE 27A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	17,93	17,05	16,07	15,19	14,30	13,15	12,00	11,30	10,59
		0,14	26,22	24,80	23,24	21,81	20,38	18,75	17,10	16,06	15,02
		0,31	45,70	43,03	40,12	37,44	34,75	32,22	29,67	27,59	25,49
		0,65	61,82	57,92	53,71	49,82	45,90	42,56	39,19	36,35	33,50
		1,03	77,67	72,46	66,84	61,63	56,38	52,27	48,14	44,55	40,94
		1,68	106,45	99,02	91,04	83,60	76,12	69,90	63,65	58,62	53,55
	3	0,07	32,36	31,29	28,60	27,53	26,36	25,12	23,78	22,70	21,55
		0,14	46,39	44,80	40,90	39,31	37,57	35,86	34,01	32,41	30,71
		0,31	73,39	70,82	64,60	62,03	59,22	56,43	53,41	51,00	48,43
		0,65	104,52	100,74	91,77	87,99	83,86	80,04	75,91	72,36	68,57
		1,03	128,57	123,78	112,61	107,82	102,58	98,07	93,18	88,67	83,87
		1,68	174,27	167,14	151,46	144,34	136,59	129,93	122,73	116,69	110,26
3340/5 3340/5S	1,5	0,07	29,89	28,42	26,79	25,32	23,84	21,92	20,00	18,83	17,66
		0,14	43,71	41,33	38,73	36,36	33,97	31,24	28,50	26,77	25,03
		0,31	76,17	71,72	66,86	62,40	57,92	53,70	49,46	45,98	42,49
		0,65	103,03	96,54	89,51	83,03	76,50	70,93	65,32	60,59	55,83
		1,03	129,46	120,76	111,40	102,71	93,96	87,12	80,23	74,25	68,23
		1,68	177,42	165,03	151,73	139,34	126,87	116,51	106,08	97,70	89,26
	3	0,07	53,93	52,15	47,67	45,89	43,94	41,87	39,63	37,83	35,91
		0,14	77,32	74,67	68,17	65,52	62,62	59,77	56,69	54,02	51,18
		0,31	122,31	118,03	107,66	103,38	98,70	94,05	89,02	85,00	80,71
		0,65	174,21	167,90	152,96	146,65	139,77	133,41	126,52	120,59	114,29
		1,03	214,29	206,29	187,69	179,69	170,97	163,45	155,30	147,78	139,78
		1,68	290,44	278,57	252,43	240,56	227,64	216,55	204,55	194,48	183,76
3340/7S	1,5	0,07	38,91	38,73	34,68	34,50	34,10	32,83	31,29	30,71	30,02
		0,14	56,59	55,99	49,84	49,25	48,29	46,51	44,32	43,39	42,29
		0,31	89,88	88,50	78,39	77,00	75,01	72,82	70,06	67,90	65,40
		0,65	128,43	125,80	110,83	108,19	104,63	101,57	97,71	94,48	90,75
		1,03	158,18	154,18	135,14	131,13	125,92	122,23	117,59	113,44	108,67
		1,68	209,46	203,51	177,77	171,83	164,21	157,88	150,17	144,17	137,31
	3	0,07	60,79	60,70	53,51	53,42	52,88	51,95	50,58	49,56	48,29
		0,14	86,43	86,19	75,87	75,63	74,72	73,54	71,74	70,17	68,23
		0,31	134,24	133,75	117,64	117,15	115,63	113,60	110,60	108,39	105,65
		0,65	187,42	186,50	163,82	162,90	160,50	157,95	154,08	150,74	146,63
		1,03	226,69	225,29	197,64	196,24	193,03	190,27	185,95	181,62	176,32
		1,68	293,29	290,33	253,67	250,71	245,28	240,57	233,74	228,10	221,22

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 27A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

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

TABLE 27B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)
 Liquid temperature 98 °F (36,7 °C)
 Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)
 Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

Continued

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

TABLE 27B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

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

TABLE 27C : Correction factor for evaporator temperature different from nominal value

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

TABLE 28A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	12,67	12,16	11,66	11,16	10,66	9,94	9,23	8,51	7,78
		0,14	18,42	17,63	16,84	16,05	15,26	14,18	13,08	12,06	11,03
		0,31	31,25	29,40	27,57	25,72	23,86	22,30	20,74	19,24	17,74
		0,65	45,19	42,42	39,65	36,88	34,08	31,71	29,33	27,21	25,08
		1,03	56,48	52,88	49,30	45,70	42,08	38,99	35,87	33,27	30,66
		1,68	77,58	71,84	66,13	60,39	54,62	50,99	47,34	43,76	40,16
	3	0,07	25,93	24,97	24,10	23,14	22,09	21,04	19,91	19,02	18,06
		0,14	37,08	35,69	34,43	33,04	31,53	30,02	28,38	27,06	25,65
		0,31	58,80	56,44	54,28	51,92	49,35	47,05	44,56	42,46	40,23
		0,65	84,03	80,62	77,51	74,11	70,41	67,08	63,49	60,39	57,09
		1,03	103,26	99,04	95,19	90,98	86,39	82,26	77,79	73,86	69,67
		1,68	137,60	131,78	126,46	120,64	114,32	108,65	102,55	98,47	94,12
3340/5 3340/5S	1,5	0,07	21,17	20,33	19,38	18,55	17,71	16,53	15,34	14,13	12,93
		0,14	30,78	29,47	27,99	26,68	25,36	23,56	21,74	20,04	18,32
		0,31	52,22	49,15	45,81	42,74	39,65	37,06	34,46	31,98	29,48
		0,65	75,52	70,90	65,89	61,28	56,63	52,70	48,74	45,22	41,68
		1,03	94,37	88,39	81,93	75,95	69,93	64,78	59,61	55,29	50,96
		1,68	129,63	120,09	109,90	100,36	90,76	84,73	78,67	72,72	66,74
	3	0,07	44,32	42,79	39,06	37,53	35,86	34,18	32,37	30,91	29,36
		0,14	63,37	61,16	55,80	53,60	51,19	48,76	46,14	43,98	41,68
		0,31	100,49	96,73	87,99	84,22	80,11	76,42	72,43	69,02	65,39
		0,65	143,60	138,17	125,64	120,21	114,29	108,96	103,19	98,15	92,79
		1,03	176,46	169,74	154,29	147,57	140,24	133,61	126,44	120,05	113,25
		1,68	235,12	225,84	204,97	195,68	185,57	176,49	166,68	160,05	152,98
3340/7S	1,5	0,07	29,23	29,42	26,65	26,84	26,90	26,28	25,47	24,47	23,33
		0,14	42,10	42,22	38,10	38,22	38,14	37,09	35,76	34,36	32,75
		0,31	70,67	69,56	61,59	60,48	58,89	57,64	55,99	54,16	52,05
		0,65	100,94	99,08	87,48	85,63	83,06	80,92	78,19	75,62	72,66
		1,03	125,22	122,60	107,96	105,34	101,80	98,74	94,90	91,78	88,17
		1,68	167,69	162,21	141,04	135,56	128,68	125,78	121,98	117,54	112,45
	3	0,07	50,98	50,83	44,73	44,58	44,04	43,28	42,15	41,32	40,29
		0,14	72,37	72,12	63,45	63,20	62,40	61,29	59,64	58,36	56,77
		0,31	113,17	112,45	98,63	97,91	96,28	94,70	92,32	90,30	87,81
		0,65	158,86	157,79	138,35	137,28	134,94	132,64	129,20	126,14	122,40
		1,03	194,11	192,75	168,94	167,57	164,64	161,73	157,43	153,41	148,54
		1,68	251,39	249,24	218,11	215,96	211,73	207,62	201,68	198,77	195,01

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature

100 °F (37,8 °C)

Liquid temperature

98 °F (36,7 °C)

Subcooling

2 °R (1,1 °K)

Suction temperature

65 °F (18,3 °C)

Superheating

25 °R (13,9 °K)

Discharge temperature

150 °F (65,6 °C)

Evaporating temperature

40 °F (4,4 °C)

Continued

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

TABLE 28A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 28B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature

100 °F (37,8 °C)

Liquid temperature

98 °F (36,7 °C)

Subcooling

2 °R (1,1 °K)

Suction temperature

65 °F (18,3 °C)

Superheating

25 °R (13,9 °K)

Discharge temperature

150 °F (65,6 °C)

Evaporating temperature

40 °F (4,4 °C)

Continued

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

TABLE 28B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

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

TABLE 28C : Correction factor for evaporator temperature different from nominal value

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

TABLE 29A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	11,30	10,61	9,87	9,19	8,50	8,06	7,62	6,95	6,27
		0,14	16,16	15,20	14,15	13,19	12,23	11,59	10,94	9,95	8,96
		0,31	26,31	24,64	22,83	21,16	19,48	18,14	16,79	15,55	14,30
		0,65	37,42	35,08	32,55	30,21	27,86	25,94	24,00	22,17	20,33
		1,03	46,04	43,21	40,14	37,31	34,46	32,08	29,68	27,35	25,00
		1,68	62,48	58,40	53,99	49,90	45,79	42,63	39,45	36,42	33,38
	3	0,07	22,15	21,52	19,77	19,14	18,45	17,64	16,76	15,81	14,80
		0,14	31,76	30,83	28,30	27,36	26,33	25,21	24,00	22,63	21,17
		0,31	52,00	50,22	45,85	44,07	42,12	40,07	37,86	35,75	33,51
		0,65	74,00	71,40	65,12	62,52	59,68	56,86	53,81	50,79	47,58
		1,03	91,29	88,00	80,19	76,90	73,31	69,94	66,29	62,55	58,57
		1,68	120,77	116,30	105,84	101,36	96,47	92,37	87,92	82,97	77,71
3340/5 3340/5S	1,5	0,07	18,83	17,69	16,45	15,32	14,17	13,44	12,70	11,58	10,45
		0,14	26,93	25,33	23,59	21,99	20,38	19,31	18,24	16,59	14,93
		0,31	43,85	41,07	38,05	35,27	32,47	30,23	27,99	25,92	23,84
		0,65	62,36	58,46	54,25	50,35	46,43	43,23	40,00	36,95	33,88
		1,03	76,73	72,02	66,90	62,19	57,44	53,47	49,47	45,58	41,67
		1,68	104,14	97,33	89,98	83,17	76,32	71,05	65,75	60,71	55,63
	3	0,07	36,91	35,86	32,95	31,91	30,75	29,40	27,94	26,35	24,67
		0,14	52,94	51,38	47,16	45,60	43,89	42,02	40,00	37,71	35,29
		0,31	86,67	83,70	76,41	73,45	70,20	66,79	63,10	59,59	55,86
		0,65	123,33	119,00	108,53	104,20	99,46	94,76	89,68	84,65	79,31
		1,03	152,15	146,67	133,64	128,17	122,18	116,57	110,49	104,25	97,62
		1,68	201,29	193,83	176,39	168,93	160,78	153,95	146,53	138,28	129,52
3340/7S	1,5	0,07	28,72	28,08	27,66	27,02	26,18	25,92	25,54	24,27	22,84
		0,14	40,68	39,83	39,28	38,43	37,29	36,92	36,35	34,47	32,34
		0,31	65,85	64,14	62,93	61,22	59,00	57,39	55,38	53,46	51,26
		0,65	91,91	89,64	88,06	85,79	82,83	80,55	77,71	74,83	71,53
		1,03	111,82	109,20	107,41	104,79	101,34	98,54	95,04	91,29	87,00
		1,68	149,30	145,06	142,00	137,76	132,34	128,71	124,17	119,50	114,16
	3	0,07	45,07	45,08	45,42	45,43	45,11	44,34	43,22	41,84	40,20
		0,14	64,02	63,96	64,37	64,31	63,77	62,76	61,27	59,30	56,95
		0,31	104,06	103,33	103,44	102,71	101,15	98,91	95,86	92,91	89,39
		0,65	145,90	144,72	144,73	143,55	141,17	138,25	134,20	130,02	125,03
		1,03	177,91	176,28	176,13	174,50	171,39	168,07	163,40	158,25	152,10
		1,68	230,21	227,79	227,32	224,90	220,54	217,05	211,92	205,27	197,33

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 29A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

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

TABLE 29B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 29B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)	Discharge temperature	150 °F	(65,6 °C)
Evaporating temperature	40 °F	(4,4 °C)			

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

TABLE 29C : Correction factor for evaporator temperature different from nominal value

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

TABLE 30A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	16,01	15,08	14,08	13,15	12,22	11,52	10,82	9,92	9,02
		0,14	23,06	21,75	20,31	19,00	17,68	16,52	15,35	14,11	12,85
		0,31	36,67	34,37	31,87	29,56	27,24	25,65	24,04	22,24	20,44
		0,65	52,65	49,38	45,84	42,58	39,29	36,67	34,03	31,54	29,04
		1,03	65,41	61,41	57,07	53,06	49,04	45,37	41,69	38,71	35,71
		1,68	90,55	83,88	76,76	70,09	63,38	59,02	54,62	50,52	46,40
	3	0,07	30,94	29,86	27,24	26,16	24,97	23,90	22,73	21,65	20,50
		0,14	44,23	42,71	38,99	37,48	35,82	34,21	32,47	30,86	29,16
		0,31	70,70	67,89	61,59	58,78	55,71	53,36	50,81	48,36	45,75
		0,65	100,68	96,74	87,84	83,90	79,62	76,11	72,32	68,70	64,85
		1,03	124,02	119,26	108,37	103,61	98,41	93,92	89,05	84,43	79,51
		1,68	164,06	157,56	142,98	136,49	129,42	123,12	116,32	110,26	103,82
3340/5 3340/5S	1,5	0,07	26,61	25,07	23,53	21,98	20,43	19,26	18,08	16,58	15,08
		0,14	38,33	36,14	33,95	31,76	29,55	27,61	25,66	23,58	21,48
		0,31	60,96	57,11	53,27	49,42	45,54	42,87	40,19	37,18	34,16
		0,65	87,52	82,06	76,63	71,18	65,68	61,29	56,88	52,72	48,54
		1,03	108,73	102,04	95,39	88,70	81,97	75,85	69,69	64,71	59,70
		1,68	150,53	139,38	128,31	117,16	105,95	98,65	91,31	84,45	77,56
	3	0,07	50,28	48,39	46,68	44,79	42,74	40,86	38,84	36,99	35,03
		0,14	71,87	69,23	66,82	64,18	61,29	58,50	55,49	52,74	49,83
		0,31	114,93	110,04	105,55	100,66	95,34	91,25	86,84	82,65	78,19
		0,65	163,66	156,81	150,54	143,69	136,24	130,16	123,59	117,41	110,83
		1,03	201,60	193,30	185,72	177,42	168,41	160,60	152,18	144,28	135,89
		1,68	266,69	255,38	245,04	233,74	221,47	210,55	198,78	188,43	177,42
3340/7S	1,5	0,07	36,90	36,21	35,78	35,08	34,13	33,61	32,90	31,45	29,81
		0,14	52,80	51,86	51,29	50,36	49,06	47,88	46,39	44,44	42,20
		0,31	83,13	81,03	79,57	77,47	74,74	73,50	71,82	69,28	66,35
		0,65	117,75	114,91	112,95	110,10	106,38	103,70	100,31	96,93	93,03
		1,03	144,15	140,83	138,57	135,24	130,85	126,48	121,13	117,25	112,77
		1,68	197,40	189,76	183,85	176,21	166,83	162,27	156,57	150,96	144,52
	3	0,07	59,19	58,72	58,74	58,27	57,33	56,38	55,00	53,77	52,26
		0,14	83,85	83,26	83,35	82,76	81,49	80,00	77,88	75,98	73,68
		0,31	132,79	130,95	130,28	128,44	125,43	123,49	120,61	117,83	114,42
		0,65	185,23	182,82	182,03	179,62	175,60	172,56	168,18	163,98	158,87
		1,03	226,03	223,29	222,49	219,75	215,06	210,95	205,16	199,66	193,00
		1,68	294,35	290,35	288,93	284,93	278,35	272,19	263,77	256,63	248,02

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 30A : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Liquid line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

TABLE 30B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3340/4 3340/4S 3340/M12S	1,5	0,07	16,01	15,08	14,08	13,15	12,22	11,52	10,82	9,92	9,02
		0,14	23,06	21,75	20,31	19,00	17,68	16,52	15,35	14,11	12,85
		0,31	36,67	34,37	31,87	29,56	27,24	25,65	24,04	22,24	20,44
		0,65	52,65	49,38	45,84	42,58	39,29	36,67	34,03	31,54	29,04
		1,03	65,41	61,41	57,07	53,06	49,04	45,37	41,69	38,71	35,71
		1,68	90,55	83,88	76,76	70,09	63,38	59,02	54,62	50,52	46,40
	3	0,07	30,94	29,86	27,24	26,16	24,97	23,90	22,73	21,65	20,50
		0,14	44,23	42,71	38,99	37,48	35,82	34,21	32,47	30,86	29,16
		0,31	70,70	67,89	61,59	58,78	55,71	53,36	50,81	48,36	45,75
		0,65	100,68	96,74	87,84	83,90	79,62	76,11	72,32	68,70	64,85
		1,03	124,02	119,26	108,37	103,61	98,41	93,92	89,05	84,43	79,51
		1,68	164,06	157,56	142,98	136,49	129,42	123,12	116,32	110,26	103,82
3340/5 3340/5S	1,5	0,07	26,61	25,07	23,53	21,98	20,43	19,26	18,08	16,58	15,08
		0,14	38,33	36,14	33,95	31,76	29,55	27,61	25,66	23,58	21,48
		0,31	60,96	57,11	53,27	49,42	45,54	42,87	40,19	37,18	34,16
		0,65	87,52	82,06	76,63	71,18	65,68	61,29	56,88	52,72	48,54
		1,03	108,73	102,04	95,39	88,70	81,97	75,85	69,69	64,71	59,70
		1,68	150,53	139,38	128,31	117,16	105,95	98,65	91,31	84,45	77,56
	3	0,07	50,28	48,39	46,68	44,79	42,74	40,86	38,84	36,99	35,03
		0,14	71,87	69,23	66,82	64,18	61,29	58,50	55,49	52,74	49,83
		0,31	114,93	110,04	105,55	100,66	95,34	91,25	86,84	82,65	78,19
		0,65	163,66	156,81	150,54	143,69	136,24	130,16	123,59	117,41	110,83
		1,03	201,60	193,30	185,72	177,42	168,41	160,60	152,18	144,28	135,89
		1,68	266,69	255,38	245,04	233,74	221,47	210,55	198,78	188,43	177,42
3340/7S	1,5	0,07	36,90	36,21	35,78	35,08	34,13	33,61	32,90	31,45	29,81
		0,14	52,80	51,86	51,29	50,36	49,06	47,88	46,39	44,44	42,20
		0,31	83,13	81,03	79,57	77,47	74,74	73,50	71,82	69,28	66,35
		0,65	117,75	114,91	112,95	110,10	106,38	103,70	100,31	96,93	93,03
		1,03	144,15	140,83	138,57	135,24	130,85	126,48	121,13	117,25	112,77
		1,68	197,40	189,76	183,85	176,21	166,83	162,27	156,57	150,96	144,52
	3	0,07	59,19	58,72	58,74	58,27	57,33	56,38	55,00	53,77	52,26
		0,14	83,85	83,26	83,35	82,76	81,49	80,00	77,88	75,98	73,68
		0,31	132,79	130,95	130,28	128,44	125,43	123,49	120,61	117,83	114,42
		0,65	185,23	182,82	182,03	179,62	175,60	172,56	168,18	163,98	158,87
		1,03	226,03	223,29	222,49	219,75	215,06	210,95	205,16	199,66	193,00
		1,68	294,35	290,35	288,93	284,93	278,35	272,19	263,77	256,63	248,02

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 30B : Refrigerant Flow Capacity of condensing pressure regulators 3340 [kW]. Hot gas line

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

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F	(37,8 °C)	Suction temperature	65 °F	(18,3 °C)
Liquid temperature	98 °F	(36,7 °C)	Superheating	25 °R	(13,9 °K)
Subcooling	2 °R	(1,1 °K)			
Evaporating temperature	40 °F	(4,4 °C)	Discharge temperature	150 °F	(65,6 °C)

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

TABLE 30C : Correction factor for evaporator temperature different from nominal value

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

TABLE 31A : Refrigerant Flow Capacity of condensing pressure regulators 3345 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3345/4S 3345/M12S	1,5	0,07	18,87	17,73	16,49	15,35	14,20	13,46	12,72	11,60	10,47
		0,14	26,98	25,38	23,63	22,03	20,42	19,35	18,28	16,62	14,96
		0,31	43,94	41,15	38,13	35,34	32,53	30,29	28,04	25,97	23,89
		0,65	62,49	58,58	54,35	50,45	46,52	43,31	40,08	37,03	33,95
		1,03	76,89	72,16	67,04	62,31	57,55	53,57	49,57	45,67	41,75
		1,68	104,35	97,52	90,16	83,34	76,47	71,19	65,88	60,83	55,74
	3	0,07	36,98	35,93	33,02	31,97	30,81	29,46	27,99	26,41	24,72
		0,14	53,04	51,48	47,25	45,70	43,98	42,11	40,08	37,79	35,36
		0,31	86,84	83,87	76,57	73,59	70,34	66,92	63,23	59,71	55,97
		0,65	123,58	119,24	108,75	104,41	99,66	94,95	89,86	84,82	79,47
		1,03	152,45	146,97	133,91	128,42	122,43	116,80	110,71	104,45	97,81
		1,68	201,69	194,21	176,74	169,27	161,10	154,25	146,82	138,56	129,78
	5	0,07	61,64	59,89	55,03	53,28	51,35	49,10	46,66	44,01	41,20
		0,14	88,40	85,81	78,76	76,16	73,30	70,18	66,80	62,98	58,93
		0,31	144,74	139,78	127,61	122,66	117,23	111,54	105,38	99,51	93,28
		0,65	205,97	198,73	181,25	174,02	166,11	158,26	149,76	141,36	132,44
		1,03	254,09	244,94	223,18	214,04	204,04	194,66	184,51	174,09	163,02
		1,68	336,15	323,69	294,57	282,11	268,51	257,09	244,71	230,93	216,29
	7	0,07	86,30	83,85	77,04	74,59	71,89	68,74	65,32	61,62	57,68
		0,14	123,76	120,13	110,26	106,62	102,62	98,25	93,51	88,18	82,50
		0,31	202,63	195,69	178,66	171,72	164,12	156,15	147,53	139,32	130,59
		0,65	288,35	278,23	253,75	243,63	232,55	221,56	209,67	197,91	185,42
		1,03	355,72	342,92	312,46	299,65	285,66	272,53	258,32	243,73	228,23
		1,68	470,61	453,16	412,40	394,96	375,91	359,93	342,59	323,30	302,81
3345/5S	1,5	0,07	31,44	29,54	27,48	25,58	23,67	22,44	21,20	19,33	17,45
		0,14	44,97	42,29	39,39	36,72	34,03	32,25	30,46	27,71	24,94
		0,31	73,23	68,58	63,55	58,90	54,22	50,49	46,74	43,28	39,81
		0,65	104,14	97,64	90,59	84,08	77,54	72,19	66,80	61,71	56,58
		1,03	128,15	120,27	111,73	103,85	95,92	89,29	82,61	76,12	69,59
		1,68	173,92	162,54	150,27	138,89	127,45	118,65	109,81	101,38	92,90
	3	0,07	61,64	59,89	55,03	53,28	51,35	49,10	46,66	44,01	41,20
		0,14	88,40	85,81	78,76	76,16	73,30	70,18	66,80	62,98	58,93
		0,31	144,74	139,78	127,61	122,66	117,23	111,54	105,38	99,51	93,28
		0,65	205,97	198,73	181,25	174,02	166,11	158,26	149,76	141,36	132,44
		1,03	254,09	244,94	223,18	214,04	204,04	194,66	184,51	174,09	163,02
		1,68	336,15	323,69	294,57	282,11	268,51	257,09	244,71	230,93	216,29

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 31A : Refrigerant Flow Capacity of condensing pressure regulators 3345 [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3345/5S	5	0,07	102,73	99,82	91,72	88,80	85,58	81,83	77,76	73,35	68,67
		0,14	147,34	143,01	131,26	126,93	122,16	116,97	111,33	104,97	98,22
		0,31	241,23	232,97	212,69	204,43	195,39	185,89	175,64	165,86	155,47
		0,65	343,28	331,22	302,09	290,03	276,84	263,76	249,61	235,61	220,74
		1,03	423,48	408,24	371,97	356,73	340,07	324,44	307,52	290,15	271,71
		1,68	560,25	539,48	490,96	470,19	447,51	428,49	407,84	384,88	360,49
	7	0,07	143,83	139,75	128,41	124,32	119,82	114,56	108,87	102,70	96,14
		0,14	206,27	200,21	183,77	177,71	171,03	163,75	155,86	146,96	137,51
		0,31	337,72	326,15	297,76	286,20	273,54	260,25	245,89	232,20	217,65
		0,65	480,59	463,71	422,92	406,05	387,58	369,26	349,45	329,85	309,03
		1,03	592,87	571,53	520,76	499,42	476,10	454,22	430,53	406,21	380,39
		1,68	784,35	755,27	687,34	658,26	626,52	599,88	570,98	538,83	504,69
3345/7S	1,5	0,07	44,52	43,53	42,87	41,88	40,57	40,18	39,58	37,63	35,41
		0,14	63,06	61,74	60,88	59,57	57,80	57,22	56,34	53,42	50,13
		0,31	102,06	99,41	97,54	94,89	91,46	88,96	85,84	82,87	79,45
		0,65	142,46	138,94	136,49	132,97	128,38	124,85	120,45	115,98	110,86
		1,03	173,32	169,26	166,49	162,42	157,07	152,73	147,31	141,49	134,84
		1,68	231,42	224,85	220,09	213,52	205,13	199,50	192,46	185,23	176,95
	3	0,07	69,86	69,87	70,40	70,42	69,92	68,72	66,98	64,85	62,32
		0,14	99,24	99,14	99,78	99,68	98,84	97,27	94,97	91,91	88,27
		0,31	161,29	160,16	160,33	159,21	156,77	153,32	148,59	144,02	138,56
		0,65	226,14	224,31	224,33	222,50	218,82	214,29	208,01	201,53	193,80
		1,03	275,76	273,23	273,00	270,47	265,65	260,51	253,28	245,28	235,75
		1,68	356,83	353,08	352,35	348,60	341,84	336,43	328,47	318,16	305,87
	5	0,07	116,43	116,45	117,34	117,36	116,54	114,53	111,64	108,09	103,86
		0,14	165,40	165,23	166,30	166,13	164,74	162,12	158,28	153,18	147,12
		0,31	268,81	266,93	267,22	265,34	261,29	255,53	247,64	240,03	230,93
		0,65	376,90	373,85	373,89	370,84	364,70	357,15	346,69	335,89	323,00
		1,03	459,60	455,39	454,99	450,78	442,75	434,18	422,13	408,81	392,92
		1,68	594,71	588,47	587,24	581,00	569,74	560,72	547,45	530,27	509,78
	7	0,07	163,00	163,04	164,27	164,31	163,15	160,35	156,30	151,33	145,41
		0,14	231,55	231,32	232,82	232,59	230,63	226,97	221,59	214,46	205,96
		0,31	376,34	373,71	374,11	371,48	365,81	357,74	346,70	336,04	323,31
		0,65	527,66	523,39	523,44	519,17	510,58	500,01	485,36	470,24	452,20
		1,03	643,44	637,54	636,99	631,09	619,86	607,85	590,98	572,33	550,09
		1,68	832,60	823,86	822,14	813,40	797,63	785,01	766,43	742,38	713,69

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

TABLE 31B : Refrigerant Flow Capacity of condensing pressure regulators 3345 [kW].Hot gas line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3345/4S 3345/M12S	1,5	0,07	3,47	3,46	3,47	3,48	3,49	3,50	3,51	3,52	3,53
		0,14	4,91	4,90	4,91	4,93	4,94	4,96	4,97	4,99	5,00
		0,31	7,74	7,72	7,74	7,76	7,79	7,81	7,83	7,86	7,88
		0,65	10,91	10,88	10,91	10,95	10,98	11,01	11,04	11,08	11,11
		1,03	13,31	13,27	13,31	13,35	13,39	13,43	13,47	13,51	13,55
		1,68	17,09	17,04	17,09	17,15	17,20	17,25	17,30	17,35	17,40
	3	0,07	7,11	6,92	7,11	7,31	7,50	7,70	7,89	8,09	8,30
		0,14	10,08	9,81	10,08	10,36	10,64	10,91	11,19	11,48	11,77
		0,31	15,90	15,46	15,90	16,34	16,77	17,21	17,65	18,09	18,55
		0,65	22,38	21,76	22,38	22,99	23,61	24,22	24,84	25,47	26,12
		1,03	27,31	26,56	27,31	28,06	28,81	29,56	30,31	31,08	31,87
		1,68	35,09	34,12	35,09	36,05	37,01	37,98	38,94	39,93	40,95
	5	0,07	11,85	11,53	11,85	12,18	12,50	12,83	13,16	13,49	13,83
		0,14	16,80	16,34	16,80	17,27	17,73	18,19	18,65	19,13	19,61
		0,31	26,50	25,77	26,50	27,23	27,95	28,68	29,41	30,16	30,92
		0,65	37,30	36,27	37,30	38,32	39,35	40,37	41,40	42,45	43,53
		1,03	45,52	44,26	45,52	46,77	48,02	49,27	50,52	51,80	53,12
		1,68	58,48	56,87	58,48	60,08	61,69	63,30	64,90	66,55	68,24
	7	0,07	16,59	16,14	16,59	17,05	17,51	17,96	18,42	18,89	19,37
		0,14	23,53	22,88	23,53	24,17	24,82	25,47	26,11	26,78	27,46
		0,31	37,10	36,08	37,10	38,12	39,14	40,16	41,18	42,22	43,29
		0,65	52,22	50,78	52,22	53,65	55,09	56,52	57,96	59,43	60,94
		1,03	63,72	61,97	63,72	65,47	67,22	68,98	70,73	72,52	74,37
		1,68	81,87	79,61	81,87	84,12	86,37	88,62	90,87	93,17	95,54
3345/5S	1,5	0,07	5,78	5,76	5,78	5,80	5,81	5,83	5,85	5,87	5,88
		0,14	8,19	8,17	8,19	8,22	8,24	8,26	8,29	8,31	8,34
		0,31	12,90	12,86	12,90	12,94	12,98	13,02	13,06	13,10	13,13
		0,65	18,19	18,14	18,19	18,24	18,30	18,35	18,41	18,46	18,52
		1,03	22,19	22,12	22,19	22,26	22,32	22,39	22,45	22,52	22,59
		1,68	28,49	28,41	28,49	28,58	28,66	28,74	28,83	28,91	29,00
	3	0,07	11,85	11,53	11,85	12,18	12,50	12,83	13,16	13,49	13,83
		0,14	16,80	16,34	16,80	17,27	17,73	18,19	18,65	19,13	19,61
		0,31	26,50	25,77	26,50	27,23	27,95	28,68	29,41	30,16	30,92
		0,65	37,30	36,27	37,30	38,32	39,35	40,37	41,40	42,45	43,53
		1,03	45,52	44,26	45,52	46,77	48,02	49,27	50,52	51,80	53,12
		1,68	58,48	56,87	58,48	60,08	61,69	63,30	64,90	66,55	68,24

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	100 °F (37,8 °C)	Suction temperature	65 °F (18,3 °C)
Liquid temperature	98 °F (36,7 °C)	Superheating	25 °R (13,9 °K)
Subcooling	2 °R (1,1 °K)		
Evaporating temperature	40 °F (4,4 °C)	Discharge temperature	150 °F (65,6 °C)

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

Continued

TABLE 31B : Refrigerant Flow Capacity of condensing pressure regulators 3345 [kW].Hot gas line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]								
			10	15	20	25	30	35	40	45	50
3345/5S	5	0,07	19,76	19,21	19,76	20,30	20,84	21,38	21,93	22,48	23,05
		0,14	28,01	27,24	28,01	28,78	29,55	30,32	31,09	31,88	32,69
		0,31	44,16	42,95	44,16	45,38	46,59	47,81	49,02	50,26	51,54
		0,65	62,16	60,45	62,16	63,87	65,58	67,29	69,00	70,75	72,55
		1,03	75,86	73,77	75,86	77,94	80,03	82,11	84,20	86,34	88,53
		1,68	97,46	94,78	97,46	100,14	102,82	105,49	108,17	110,92	113,74
	7	0,07	27,66	26,90	27,66	28,42	29,18	29,94	30,70	31,48	32,28
		0,14	39,21	38,13	39,21	40,29	41,37	42,44	43,52	44,63	45,76
		0,31	61,83	60,13	61,83	63,53	65,23	66,93	68,63	70,37	72,16
		0,65	87,03	84,64	87,03	89,42	91,81	94,20	96,60	99,05	101,56
		1,03	106,20	103,28	106,20	109,12	112,04	114,96	117,88	120,87	123,94
		1,68	136,44	132,69	136,44	140,19	143,94	147,69	151,44	155,29	159,23
3345/7S	1,5	0,07	6,67	6,32	6,67	7,02	7,37	7,73	8,08	8,45	8,83
		0,14	9,37	8,87	9,37	9,86	10,35	10,85	11,34	11,86	12,40
		0,31	14,65	13,88	14,65	15,42	16,19	16,97	17,74	18,55	19,39
		0,65	20,27	19,21	20,27	21,34	22,41	23,48	24,55	25,67	26,84
		1,03	24,46	23,17	24,46	25,75	27,04	28,33	29,62	30,97	32,38
		1,68	30,87	29,24	30,87	32,50	34,12	35,75	37,38	39,08	40,86
	3	0,07	10,94	10,26	10,94	11,62	12,30	12,99	13,67	14,38	15,14
		0,14	15,36	14,41	15,36	16,32	17,28	18,23	19,19	20,20	21,26
		0,31	24,02	22,53	24,02	25,52	27,01	28,51	30,01	31,58	33,24
		0,65	33,31	31,23	33,31	35,38	37,46	39,53	41,60	43,79	46,09
		1,03	40,17	37,67	40,17	42,67	45,17	47,68	50,18	52,81	55,58
		1,68	50,47	47,32	50,47	53,61	56,75	59,89	63,04	66,34	69,83
	5	0,07	18,24	17,10	18,24	19,37	20,51	21,64	22,78	23,97	25,23
		0,14	25,60	24,01	25,60	27,20	28,79	30,39	31,98	33,66	35,43
		0,31	40,04	37,54	40,04	42,53	45,02	47,52	50,01	52,63	55,40
		0,65	55,51	52,06	55,51	58,97	62,43	65,88	69,34	72,98	76,81
		1,03	66,95	62,78	66,95	71,12	75,29	79,46	83,63	88,02	92,64
		1,68	84,11	78,87	84,11	89,35	94,59	99,82	105,06	110,57	116,38
	7	0,07	25,53	23,94	25,53	27,12	28,71	30,30	31,89	33,56	35,32
		0,14	35,84	33,61	35,84	38,08	40,31	42,54	44,77	47,12	49,60
		0,31	56,05	52,56	56,05	59,54	63,03	66,52	70,01	73,69	77,55
		0,65	77,72	72,88	77,72	82,56	87,40	92,24	97,08	102,17	107,53
		1,03	93,73	87,90	93,73	99,57	105,41	111,24	117,08	123,22	129,69
		1,68	117,76	110,42	117,76	125,09	132,42	139,75	147,09	154,80	162,93

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 100 °F (37,8 °C)

Liquid temperature 98 °F (36,7 °C)

Subcooling 2 °R (1,1 °K)

Suction temperature 65 °F (18,3 °C)

Superheating 25 °R (13,9 °K)

Discharge temperature 150 °F (65,6 °C)

Evaporating temperature 40 °F (4,4 °C)

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

TABLE 31C : Correction factor for evaporator temperature different from nominal v

Evaporator temperature [°C]								
-40	-30	-20	-15	-10	-5	0	4,4	10
1,17	1,12	1,08	1,06	1,04	1,02	1,01	1	0,98

CHAPTER 6 ■

CONDENSING PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE THE R744 REFRIGERANT



APPLICATIONS

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

Condensing pressure regulators, together with the differential valves in series 3136, are the solution to this control need. The regulators in series 3345EL restrict the liquid flow from the condenser to the receiver, reducing the active condenser surface and raising the condensing pressure. The differential valve 3136W by-passes hot gas from the compressor discharge to the receiver, raising the liquid pressure in the receiver.

The condensing pressure regulators 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 evaporating pressure regulators in this chapter cannot be used with other refrigerant fluids.

OPERATION

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

The factory pressure settings for regulators in series 3345EL is 12 bar. This means that until the condensation (discharge) pressure is below 12 bar, the regulator remains closed. When it rises above 12 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2.5 bar in calibration pressure. The calibration range varies from 12 to 36 bar.

CONSTRUCTION

The main parts of regulators in series 3340 and 3345 are manufactured with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu-DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Austenitic stainless steel AISI 303 for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

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

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

INSTALLATION

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

- In the liquid line between the condenser and the liquid receiver (for regulator selection see Table 34A related to liquid line). Valve 3136W is mounted between the compressor discharge and the inlet of liquid receiver. This choice requires a smaller sized regulator as it is controlling liquid refrigerant. It is most suitable for installations in temperate climates (see installation example 1).
- In the discharge line between the compressor and the condenser (for regulator selection see Table 34B related to the hot gas line). Valve 3136W is mounted between the compressor discharge and the inlet of liquid receiver. A check valve 3132W must be installed between the condenser discharge and receiver inlet to prevent liquid migration during an off cycle. This choice requires a larger sized regulator as it is controlling gaseous refrigerant. It is most suitable for installations in cold climates (see installation example 2).

SELECTION

To correctly select condensing pressure regulators, all information on the system where it will be installed must be available. Selection is based on the following data:

1. Type of refrigerant = R744

2. Designed evaporator (system) capacity.

3. Evaporating temperature.

4. Condensing temperature.

5. Allowable condensing pressure change.

6. Allowable pressure drop across the regulator.

The refrigerating capacities indicated in Tables 34A and 34B are calculated as a function of a reference evaporating temperature of -28.9 °C.

With liquid temperatures other than -28.9 °C, the required cooling capacity of regulator is:

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

where:

Q_{evap} = Evaporator capacity [kW]

$K_{T_{\text{evap}}}$ = Correction factor for $T_{\text{evap}} \neq -28.9 \text{ °C}$.
(See Table 34C.)

Q_{valve} = Refrigerating capacity requested at regulator. [kW]

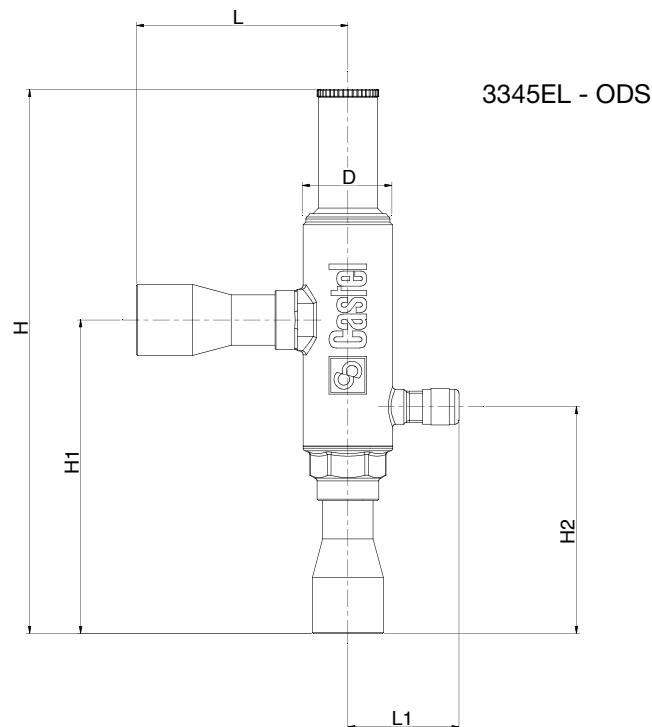


TABLE 32A: General characteristics of condensing pressure regulators for R744

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.	
		Ø [in.]	Ø [mm]										
3345EL/M12S	–	–	12	2,70	12	36	12	45	– 40	+120	– 40	+50	Art. 4.3
3345EL/4S	–	1/2"	–										
3345EL/5S	–	5/8"	16										
3345EL/7S	–	7/8"	22										

TABLE 33: Dimensions and weights of condensing pressure regulators for R744

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H ₁	H ₂	L	L ₁	D	Ch1	Ch2	
3345EL/M12S	183	100,5	69,5	64	37	32	–	–	506
3345EL/4S	183	100,5	69,5	64					506
3345EL/5S	183	100,5	69,5	64					506
3345EL/7S	194	112	81	75,5					570

TABLE 34A : Refrigerant Flow Capacity of condensing pressure regulators 3345EL [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]							
			-15	-10	-5	-2,5	0	2,5	5	10
3345EL/4S 3345EL/M12S	1,5	0,07	33,07	31,63	29,72	27,64	25,73	23,81	22,57	21,33
		0,14	47,29	45,24	42,55	39,62	36,94	34,23	32,44	30,64
		0,31	77,71	73,67	68,99	63,93	59,26	54,55	50,79	47,02
		0,65	110,51	104,77	98,22	91,13	84,59	78,00	72,62	67,20
		1,03	135,98	128,91	120,99	112,40	104,47	96,50	89,82	83,11
		1,68	184,59	174,96	163,51	151,17	139,72	128,21	119,36	110,46
	3	0,07	48,20	46,51	45,19	41,52	40,20	38,74	37,04	35,20
		0,14	69,08	66,70	64,74	59,42	57,46	55,30	52,95	50,40
		0,31	113,59	109,20	105,46	96,28	92,54	88,45	84,15	79,51
		0,65	161,55	155,40	149,94	136,75	131,30	125,33	119,40	113,00
		1,03	199,17	191,71	184,81	168,39	161,49	153,95	146,87	139,21
		1,68	263,04	253,62	244,22	222,25	212,85	202,59	193,97	184,63
	5	0,07	55,427	53,483	51,965	47,749	46,231	44,555	42,601	40,483
		0,14	79,445	76,704	74,451	68,335	66,081	63,598	60,892	57,957
		0,31	130,63	125,58	121,28	110,72	106,43	101,72	96,77	91,436
		0,65	185,78	178,71	172,43	157,27	150,99	144,12	137,31	129,94
		1,03	229,05	220,46	212,53	193,65	185,71	177,04	168,9	160,09
		1,68	302,5	291,67	280,85	255,59	244,78	232,97	223,07	212,32
3345EL/5S	1,5	0,07	55,11	52,72	49,53	46,07	42,89	39,68	37,62	35,55
		0,14	78,82	75,39	70,91	66,04	61,56	57,05	54,07	51,07
		0,31	129,51	122,78	114,98	106,55	98,76	90,92	84,66	78,36
		0,65	184,18	174,61	163,70	151,89	140,98	130,00	121,03	112,01
		1,03	226,63	214,86	201,65	187,33	174,12	160,83	149,70	138,51
		1,68	307,65	291,60	272,52	251,95	232,87	213,68	198,94	184,11
	3	0,07	80,33	77,51	75,31	69,20	67,00	64,57	61,74	58,67
		0,14	115,14	111,17	107,90	99,04	95,77	92,17	88,25	84,00
		0,31	189,32	182,00	175,77	160,47	154,24	147,42	140,26	132,52
		0,65	269,25	259,00	249,90	227,92	218,83	208,88	199,00	188,33
		1,03	331,96	319,51	308,01	280,65	269,15	256,58	244,79	232,02
		1,68	438,40	422,70	407,03	370,42	354,75	337,64	323,29	307,71
	5	0,07	92,378	89,139	86,609	79,581	77,051	74,259	71,002	67,472
		0,14	132,41	127,84	124,09	113,89	110,14	106	101,49	96,595
		0,31	217,71	209,3	202,14	184,54	177,38	169,53	161,29	152,39
		0,65	309,63	297,85	287,39	262,11	251,65	240,21	228,85	216,57
		1,03	381,75	367,44	354,21	322,75	309,52	295,07	281,51	266,82
		1,68	504,16	486,11	468,09	425,99	407,97	388,29	371,78	353,87

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 30°F -1,2°C
 Liquid temperature 20°F -6,7°C
 Subcooling 10° R 5,5°K

Suction temperature -5°F -15°C
 Superheating 15°R 8,4°K

Discharge temperature 80°F 26,6°C

Evaporating temperature -20°F -28,9°C

Continued

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

TABLE 34A : Refrigerant Flow Capacity of condensing pressure regulators 3345EL [kW]. Liquid line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]							
			-15	-10	-5	-2,5	0	2,5	5	10
3345EL/7S	1,5	0,07	81,79	80,42	78,64	77,44	75,66	73,29	72,59	71,51
		0,14	115,84	113,91	111,53	109,98	107,60	104,41	103,36	101,77
		0,31	189,89	184,37	179,58	176,20	171,41	165,21	160,70	155,06
		0,65	264,99	257,34	250,98	246,57	240,21	231,92	225,54	217,58
		1,03	322,36	313,10	305,76	300,75	293,41	283,75	275,90	266,10
		1,68	430,84	418,04	406,17	397,59	385,72	370,56	360,38	347,66
	3	0,07	96,31	94,64	94,67	95,38	95,41	94,73	93,10	90,75
		0,14	136,72	134,45	134,32	135,19	135,05	133,91	131,79	128,67
		0,31	223,55	218,52	216,99	217,23	215,70	212,40	207,72	201,31
		0,65	313,23	306,38	303,90	303,94	301,46	296,47	290,33	281,82
		1,03	381,70	373,61	370,19	369,87	366,44	359,92	352,95	343,15
		1,68	492,87	483,44	478,37	477,37	472,30	463,14	455,81	445,02
	5	0,07	110,75	108,84	108,87	109,69	109,72	108,94	107,07	104,37
		0,14	157,23	154,62	154,46	155,46	155,31	154	151,56	147,97
		0,31	257,09	251,3	249,54	249,81	248,05	244,27	238,88	231,51
		0,65	360,21	352,34	349,49	349,53	346,67	340,94	333,88	324,1
		1,03	438,96	429,65	425,72	425,35	421,41	413,9	405,89	394,62
		1,68	566,8	555,96	550,12	548,98	543,14	532,61	524,18	511,78

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	30°F	-1,2°C	Suction temperature	-5°F	-15°C
Liquid temperature	20°F	-6,7°C	Superheating	15°R	8,4°K
Subcooling	10° R	5,5°K			
Evaporating temperature	-20°F	-28,9°C	Discharge temperature	80°F	26,6°C

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

TABLE 34B : Refrigerant Flow Capacity of condensing pressure regulators 3345EL [kW]. Hot gas line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]							
			-15	-10	-5	-2,5	0	2,5	5	10
3345EL/4S 3345EL/M12S	1,5	0,07	5,78	5,81	5,80	5,81	5,83	5,85	5,87	5,88
		0,14	8,19	8,24	8,22	8,24	8,26	8,29	8,31	8,34
		0,31	12,91	12,98	12,94	12,98	13,02	13,06	13,10	13,13
		0,65	18,20	18,30	18,24	18,30	18,35	18,41	18,46	18,52
		1,03	22,20	22,32	22,26	22,32	22,39	22,46	22,52	22,59
		1,68	28,50	28,66	28,58	28,66	28,75	28,83	28,92	29,00
	3	0,07	11,32	11,92	11,60	11,92	12,25	12,58	12,91	13,24
		0,14	16,04	16,91	16,44	16,91	17,37	17,83	18,30	18,76
		0,31	25,30	26,66	25,92	26,66	27,39	28,12	28,85	29,59
		0,65	35,61	37,52	36,49	37,52	38,55	39,58	40,61	41,65
		1,03	43,45	45,79	44,53	45,79	47,05	48,31	49,56	50,82
		1,68	55,82	58,83	57,21	58,83	60,44	62,06	63,68	65,29
	5	0,07	13,013	13,713	13,336	13,713	14,09	14,466	14,843	15,22
		0,14	18,449	19,441	18,907	19,441	19,976	20,51	21,045	21,579
		0,31	29,09	30,655	29,813	30,655	31,498	32,341	33,183	34,026
		0,65	40,946	43,149	41,963	43,149	43,335	45,521	46,707	47,893
		1,03	49,969	52,656	51,209	52,656	54,104	55,551	56,998	58,446
		1,68	64,196	67,649	65,79	67,649	69,508	71,368	73,227	75,087
3345EL/5S	1,5	0,07	9,64	9,69	9,66	9,69	9,72	9,75	9,78	9,81
		0,14	13,66	13,73	13,69	13,73	13,77	13,82	13,86	13,90
		0,31	21,51	21,63	21,57	21,63	21,70	21,76	21,83	21,89
		0,65	30,33	30,50	30,41	30,50	30,59	30,68	30,77	30,86
		1,03	37,00	37,20	37,09	37,20	37,32	37,43	37,54	37,65
		1,68	47,51	47,77	47,63	47,77	47,91	48,05	48,20	48,34
	3	0,07	18,86	19,87	19,33	19,87	20,42	20,97	21,51	22,06
		0,14	26,74	28,18	27,40	28,18	28,95	29,72	30,50	31,27
		0,31	42,16	44,43	43,21	44,43	45,65	46,87	48,09	49,31
		0,65	59,34	62,53	60,82	62,53	64,25	65,97	67,69	69,41
		1,03	72,42	76,31	74,22	76,31	78,41	80,51	82,61	84,70
		1,68	93,04	98,04	95,35	98,04	100,74	103,43	106,13	108,82
	5	0,07	21,688	22,854	22,226	22,854	23,483	24,111	24,739	25,367
		0,14	30,748	32,402	31,512	32,402	33,293	34,184	35,074	35,965
		0,31	48,484	51,092	49,688	51,092	52,497	53,901	55,305	56,710
		0,65	68,244	71,915	69,938	71,915	73,892	75,868	77,845	79,822
		1,03	83,281	87,761	85,349	87,761	90,173	92,585	94,997	97,410
		1,68	106,99	112,75	109,65	112,75	115,85	118,95	122,05	125,14

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature 30°F -1,2°C
 Liquid temperature 20°F -6,7°C
 Subcooling 10° R 5,5°K

Suction temperature -5°F -15°C
 Superheating 15°R 8,4°K

Discharge temperature 80°F 26,6°C

Evaporating temperature -20°F -28,9°C

Continued

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

TABLE 34B : Refrigerant Flow Capacity of condensing pressure regulators 3345EL [kW]. Hot gas line

Catalogue Number	Condensing pressure change [bar] (1)	Pressure drop across regulator [bar]	Condensing temperature [°C]							
			-15	-10	-5	-2,5	0	2,5	5	10
3345EL/7S	1,5	0,07	14,65	16,24	15,39	16,24	17,10	17,95	18,81	19,67
		0,14	20,57	22,80	21,60	22,80	24,00	25,21	26,41	27,61
		0,31	32,18	35,67	33,79	35,67	37,55	39,43	41,31	43,19
		0,65	44,53	49,36	46,76	49,36	51,97	54,57	57,17	59,77
		1,03	53,72	59,55	56,41	59,55	62,69	65,83	68,97	72,11
		1,68	67,80	75,16	71,20	75,16	79,12	83,09	87,05	91,01
	3	0,07	23,56	26,64	24,98	26,64	28,30	29,96	31,62	33,27
		0,14	33,08	37,40	35,07	37,40	39,73	42,06	44,39	46,72
		0,31	51,72	58,49	54,85	58,49	62,13	65,77	69,42	73,06
		0,65	71,72	81,10	76,05	81,10	86,15	91,20	96,25	101,30
		1,03	86,50	97,81	91,72	97,81	103,90	109,99	116,08	122,17
		1,68	108,67	122,88	115,22	122,88	130,53	138,18	145,83	153,48
	5	0,07	27,093	30,635	28,728	30,635	32,543	34,451	36,359	38,266
		0,14	38,04	43,014	40,335	43,014	45,692	48,371	51,049	53,728
		0,31	59,484	67,262	63,074	67,262	71,451	75,639	79,828	84,016
		0,65	82,477	93,263	87,455	93,263	99,07	104,88	110,69	116,49
		1,03	99,473	112,481	105,48	112,48	119,48	126,49	133,49	140,5
		1,68	124,97	141,31	132,51	141,31	150,11	158,91	167,71	176,5

Standard rating conditions according to AHRI Standard 770-2014

Condensing temperature	30°F	-1,2°C	Suction temperature	-5°F	-15°C
Liquid temperature	20°F	-6,7°C	Superheating	15°R	8,4°K
Subcooling	10° R	5,5°K			
Evaporating temperature	-20°F	-28,9°C	Discharge temperature	80°F	26,6°C

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

TABLE 34C : Correction factor for evaporator temperature different from nominal value

Evaporator temperature [°C]									
-40	-35	-30	-25	-20	-15	-10	-5	0	5
1,08	1,04	1,01	0,98	0,95	0,92	0,89	0,87	0,84	0,82

LIQUID RECEIVER PRESSURE REGULATORS

FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS



APPLICATIONS

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

All receiver pressure regulators illustrated in this chapter are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants 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, Point (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

Receiver pressure regulators adjust the flow of the hot gas according to changes of liquid receiver pressure,

downstream stream of the regulator. When the receiver pressure is greater than the regulator calibration pressure, the shutter remains closed. As the receiver pressure drops below the regulator's calibration setting, the shutter begins to open and modulates in proportion to the variation in the receiver pressure. As the receiver pressure continues to drop, the shutter continues to open, until the stroke limit is reached and the regulator is open completely. Liquid receiver pressure regulators only modulate based on the outlet pressure change, pressure changes on the inlet side do not affect their opening as the valve is equipped with an equalizer bellow with an area equal to that of the valve seat

The factory pressure settings for regulators in series 3350 is 8 bar. This means that until the receiver pressure is less than 8 bar, the regulator remains closed. When it drops under 8 bar, the regulator begins to open. According to the characteristics of the refrigerating system it may be necessary to change the factory setting by adjusting the adjustment ring on the top of the regulator body. Turn this ring clockwise to increase the regulator's calibration pressure; turn it counter-clockwise to decrease the calibration pressure. Each turn of the ring corresponds to an increase/decrease of 2.3 bar in calibration pressure. The calibration range varies from 3 to 20 bar.

CONSTRUCTION

The main parts of regulators in series 3350 are manufactured with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu-DHP for solder connections
- Austenitic stainless steel AISI 321 for the bellows
- Brass bar EN 12164 – CW 614N for the shutter
- Brass bar EN 12164 – CW 614N for regulator ring
- Spring steel DIN 17223/84 Class C/D for setting spring
- Chloroprene rubber (CR) for outlet seal gaskets

INSTALLATION

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

CERTIFICATIONS

Receiver pressure regulators in series 3350 have been approved by the American certification authority Underwriters Laboratories Inc. These regulators are **UL Listed** certified for the USA with file SA33319, in compliance with American standard UL 207.

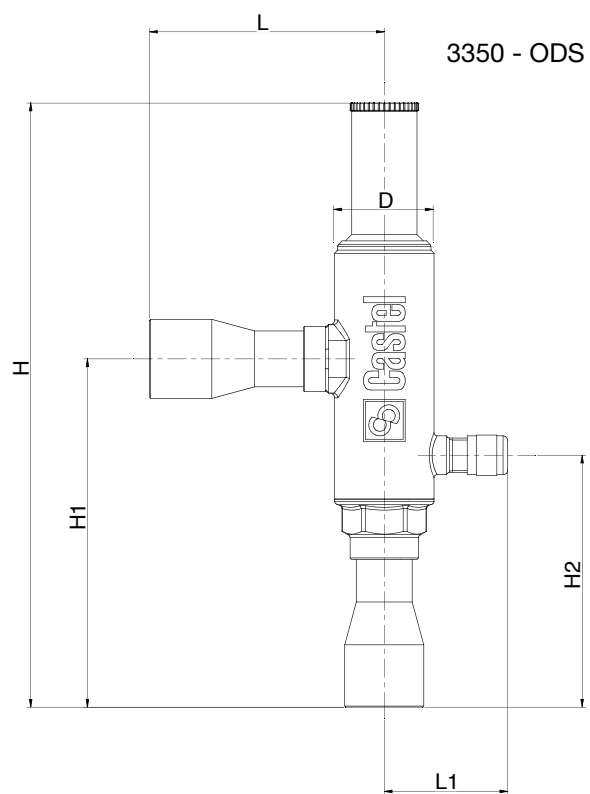
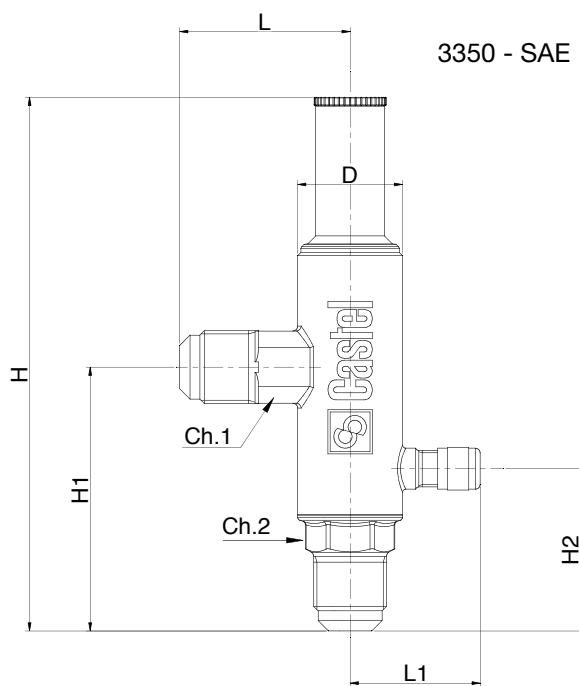
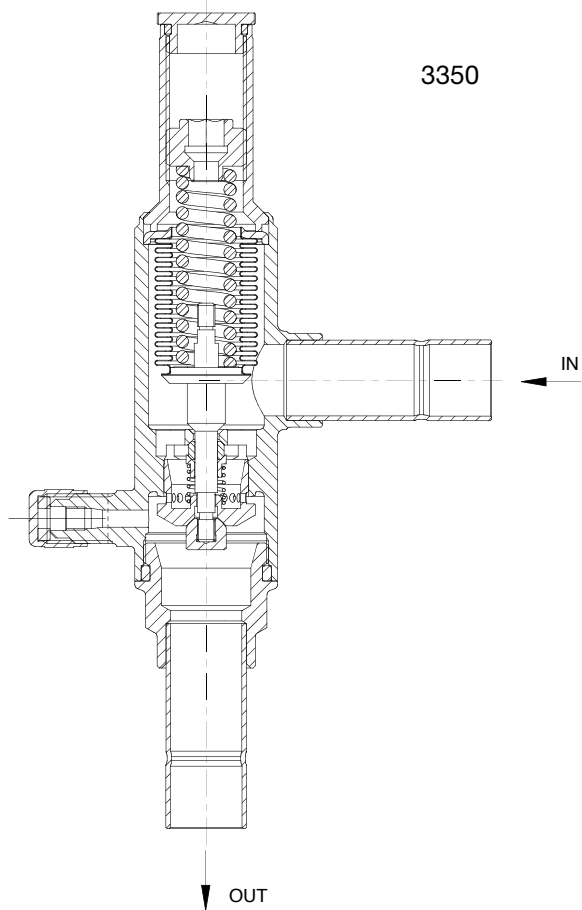


TABLE 35: General characteristics of receiver pressure regulators

Catalogue Number	Connections			Kv Factor [m³/h]	Regulating range [bar]		Factory setting [bar]	PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
	SAE Flare	ODS			min.	max.			min.	max.	min.	max.	
		Ø [in.]	Ø [mm]										
3350/4	1/2"	–	–	1,80	3	20	8	28	– 40	+110	– 40	+50	Art. 43.3
3350/M12S	–	–	12										
3350/4S	–	1/2"	–										
3350/5	5/8"	–	–										
3350/5S	–	5/8"	16										
3350/7S	–	7/8"	22										

TABLE 36: Dimensions and weights of receiver pressure regulators

Catalogue Number	Dimensions [mm]								Weight [g]
	H	H ₁	H ₂	L	L ₁	D	Ch1	Ch2	
3350/4	159	76,5	45,5	48	37	32	22	24	4902
3350/M12S	183	100,5	69,5	64			–	–	506
3350/4S	183	100,5	69,5	64			–	–	506
3350/5	163	80,5	49,5	52			22	24	550
3350/5S	183	100,5	69,5	64			–	–	506
3350/7S	194	112	81	75,5			–	–	570

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