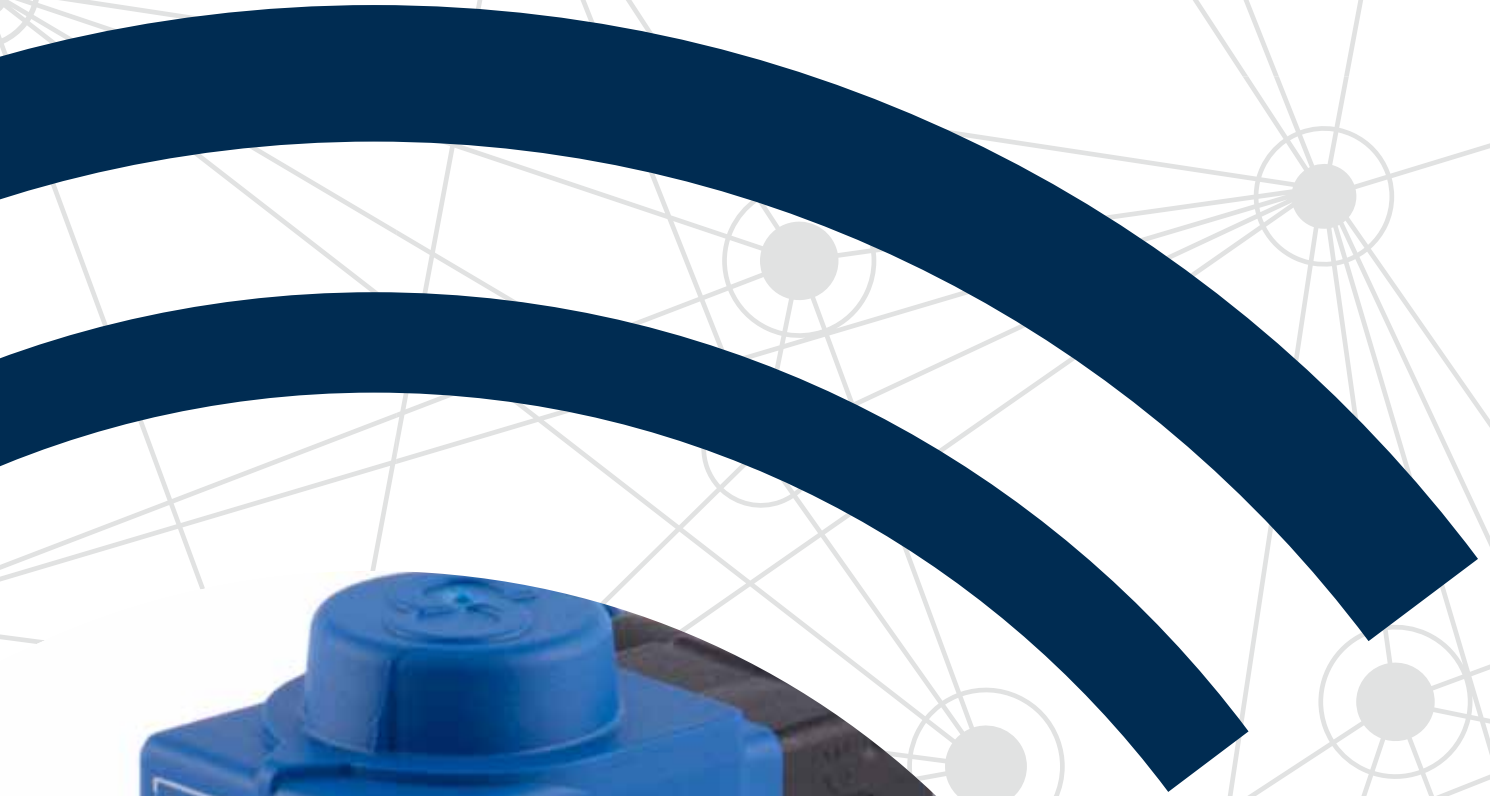




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PWM expansion valves 2028



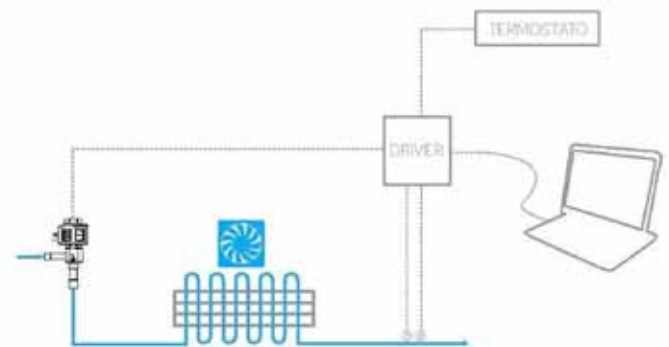
Application

Solenoid expansion valve Castel type 2028 regulates the refrigerant flow into the evaporator by modulating the opening time phase of the plug and so permitting a wide range of power.

This valve must be used with a coil type HM4 (see table 2), controlled by an electronic regulator device (not supplied by Castel).

This valve is most frequently used in refrigeration systems, in particular refrigerated cabinets in the supermarket, which use the following refrigerant fluids: R22, R134a, R404A, R407C ; R410A, R507 proper to the Group II (as defined in Article 9, Section 2.2 of Directive 97/23/EC and referred to in Directive 67/548/EEC).

- Austenitic stainless steel EN 10088-3 – 1.4301 for the filter
- Ferritic stainless steel EN 10088-3 – 1.4105 for mobile and fixed plugs
- Austenitic stainless steel EN 10088-3 – 1.4305 for orifices
- Chloroprene rubber (CR) for outlet seal gaskets
- P.T.F.E. for seat gaskets



Commercial refrigeration	Superstore
	Supermarket
	Grocery stores
	Hotels
	Restaurants
Industrial refrigeration	Manufacturing processes
	Food distribution
Civil conditioning	Air conditioning/Civilians heat pumps with inverter compressor

Operation

Valve type 2028 is a lamination device that receives liquid from the condenser and injects it into the evaporator, operating the necessary pressure drop across the expansion orifice.

It's an ON/OFF valve that must be regulated with the "Pulse Width Modulation" (PWM) method and it can be actuated by a very simple electronic controller. In according to the PWM method, the evaporator refrigerant capacity QT , required in a fixed period "T", is delivered by the valve in a time interval "t", shorter than "T". During the period "t" the valve opens and permits maximum flow (ON phase); in the remaining period "T-t" the valve closes with no flow (OFF phase).

For an effective PWM regulation, the valve must be sized in such a way that in the hardest conditions of the system, the orifice of the valve is big enough to deliver the refrigerant requested; in these extreme conditions the valve will last opened for the entire period "T".

The use of an electronic regulator allows a more accurate metering of the refrigerant reaching a greater efficiency (and then a sensible decrement of the machinery management costs) and a faster response to the variations of the evaporation load.

Costruction

Valve is supplied complete with its orifice; there are nine different orifices corresponding to seven different evaporator capacities that increase passing from orifice 01 to orifice 09. The last two numbers in the code identify what size of orifice has been mounted on the valve into the factory; for example the code 2028/3S02 identifies a valve with 3/8" solder connections, size 02 orifice. The orifices are interchangeable and can be mounted even if the valve is soldered on the system; in this case use the corresponding spare parts kit, in according to table 3.

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

- Hot forged brass EN 12420 – CW 617N for body and the housing pipe of the mobile plug
- Copper tube EN 12735-1 – Cu-DHP for solder connections

Coils and connectors

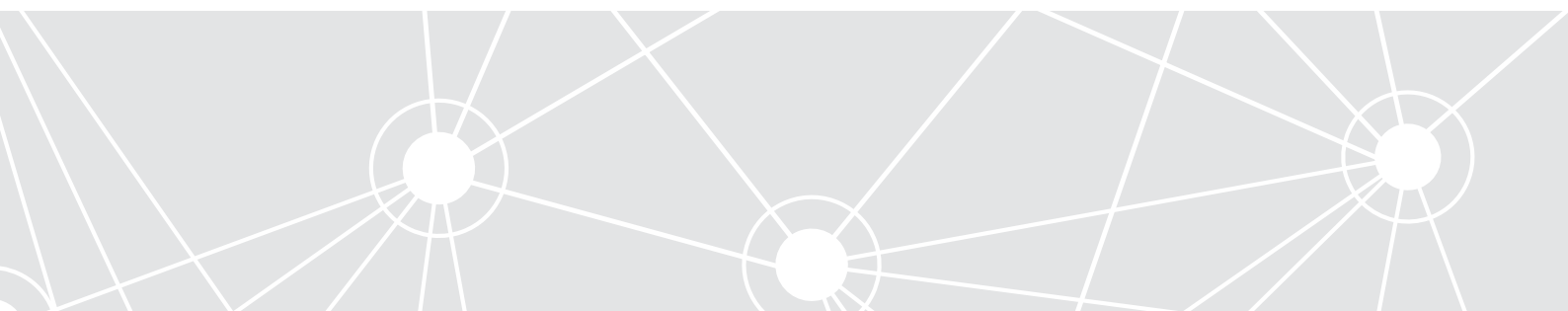
Coils type HM4 must be mounted on these valves. Table 2 presents the most important characteristics of coils and corresponding connectors. For further technical characteristics about HM4 coils and their connectors see to the "Solenoid valve" handbook.

General Characteristics of PWM Expansion Valves

Catalogue number	ODS Connections				Orifice Size [mm]	Kv Factor [m ³ /h]	Opening Pressure Differential [bar]			Operating principles	Minimum Working Time [s]	TS [°C]		PS [bar]	Risk Category according to PED
	[in]		[mm]				MinOPD	MOPD							
	IN	OUT	IN	OUT				AC	DC			min.	max.		
2028/3S01	3/8"	1/2"	-	-	0,5	0,010	0	18	18	PWM (Pulse Width Modulating)	1	-40	100	45	Art. 3.3
2028/M10S01	-	-	10	12											
2028/3S02	3/8"	1/2"	-	-	0,7	0,017									
2028/M10S02	-	-	10	12											
2028/3S03	3/8"	1/2"	-	-	0,8	0,023									
2028/M10S03	-	-	10	12											
2028/3S04	3/8"	1/2"	-	-	1,1	0,043									
2028/M10S04	-	-	10	12											
2028/3S05	3/8"	1/2"	-	-	1,3	0,065									
2028/M10S05	-	-	10	12											
2028/3S06	3/8"	1/2"	-	-	1,7	0,113									
2028/M10S06	-	-	10	12											
2028/4S07	1/2"	5/8"	-	-	2,3	0,200									
2028/M12S07	-	-	12	16											
2028/4S08	1/2"	5/8"	-	-	2,5	0,230									
2028/M12S08	-	-	12	16											
2028/4S09	1/2"	5/8"	-	-	2,7	0,250									
2028/M12S09	-	-	12	16											

General Characteristics of coils

Coil Type	Catalogue number	Voltage [V]	Voltage tolerance [%]	Frequency [Hz]	Consumption at 20 °C [mA]				Connections	
					Start		Working		Protection Degree IP65	Protection Degree IP65/IP68
					50 [Hz]	D.C.	50 [Hz]	D.C.		
HM4	9160/RA2	24 A.C.	+6 / -10	50	1490	-	700	-	9150/R02	9155/R01
	9160/RA4	110 A.C.			330		156			
	9160/RA6	220/230 A.C.			162		76			
	9160/RD1	12 D.C.	-	1350	1350					
	9160/RD2	24 D.C.		650	650					



Orifices - Rated capacities in kW

Catalogue number	Orifice Type	Orifice Size [mm]	Refrigerant				
			R22	R134a	R404A R507	R407C	R410A
9150/R63	01	0,5	1,0	0,9	0,8	1,1	1,3
9150/R64	02	0,7	1,9	1,7	1,6	2,0	2,4
9150/R65	03	0,8	2,5	2,0	1,9	2,4	3,0
9150/R66	04	1,1	3,9	3,2	2,9	3,8	4,8
9150/R67	05	1,3	6,7	5,6	5,1	6,7	8,4
9150/R68	06	1,7	9,2	7,7	7,0	9,1	11,4
9150/R69	07	2,3	14,7	12,2	11,3	15,3	18,2
9150/R78	08	2,5	17,4	14,7	13,5	17,7	21,6
9150/R79	09	2,7	19,3	16,3	15,0	19,6	24,1

Rated capacities are based on:

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

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

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

Refrigerant R22 - Capacities in kW

Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,7	0,9	1,0	1,1	1,1	1,1	1,2	1,2	1,2
02	1,3	1,7	1,9	2,1	2,2	2,2	2,3	2,3	2,3
03	1,7	2,2	2,5	2,7	2,8	2,9	2,9	3,0	3,0
04	2,7	3,5	3,9	4,2	4,4	4,5	4,6	4,7	4,7
05	4,7	6,0	6,7	7,3	7,6	7,8	7,9	8,1	8,1
06	6,4	8,3	9,2	9,9	10,4	10,6	10,8	11,0	11,0
07	10,3	13,2	14,7	15,8	16,6	17,0	17,3	17,6 (1)	17,6 (2)
08	12,2	15,7	17,4	18,8	19,7	20,2	20,5	20,9 (1)	20,9 (2)
09	13,5	17,4	19,3	20,8	21,8	22,4 (1)	22,8 (2)	23,2 (2)	23,2 (2)

(1) : differential pressure non available with coils 9160/RD2

(2) : differential pressure non available with coils 9160/RD1 and 9160/RD2



Refrigerant R134a - Capacities in kW

Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,6	0,8	0,9	0,9	1,0	1,0	1,0	1,0	0,9
02	1,2	1,5	1,7	1,8	1,8	1,9	1,9	1,8	1,8
03	1,4	1,8	2,0	2,1	2,2	2,2	2,2	2,2	2,1
04	2,3	2,9	3,2	3,5	3,6	3,6	3,6	3,6	3,5
05	3,9	5,0	5,6	6,0	6,1	6,2	6,2	6,1	6,0
06	5,4	6,9	7,7	8,2	8,4	8,5	8,5	8,4	8,2
07	8,5	10,9	12,2	13,0	13,4	13,5	13,5	13,4 (1)	13,0 (2)
08	10,3	13,2	14,7	15,7	16,2	16,3	16,3	16,2 (1)	15,7 (2)
09	11,4	14,7	16,3	17,4	17,9	18,1 (1)	18,1 (2)	17,9 (2)	17,4 (2)

Refrigerant R404A/R507 - Capacities in kW

Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,6	0,7	0,8	0,8	0,8	0,8	0,8	0,8	0,8
02	1,1	1,4	1,6	1,7	1,7	1,7	1,7	1,6	1,5
03	1,3	1,7	1,9	2,0	2,1	2,1	2,0	2,0	1,9
04	2,1	2,7	2,9	3,1	3,2	3,2	3,2	3,1	2,9
05	3,7	4,7	5,1	5,5	5,6	5,6	5,5	5,4	5,1
06	5,0	6,4	7,0	7,4	7,6	7,6	7,5	7,4	6,9
07	8,0	10,2	11,3	11,9	12,2	12,2	12,0	11,8 (1)	11,1 (2)
08	9,6	12,3	13,5	14,3	14,6	14,6	14,4	14,2 (1)	13,4 (2)
09	10,7	13,7	15,0	15,9	16,2	16,2 (1)	16,0 (2)	15,8 (2)	14,9 (2)

Refrigerant R407C - Capacities in kW

Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,8	1,0	1,1	1,2	1,2	1,3	1,3	1,3	1,3
02	1,4	1,8	2,0	2,2	2,3	2,4	2,4	2,4	2,4
03	1,7	2,1	2,4	2,6	2,7	2,8	2,8	2,9	2,9
04	2,7	3,4	3,8	4,1	4,3	4,4	4,5	4,6	4,6
05	4,7	6,0	6,7	7,3	7,6	7,8	7,9	8,1	8,1
06	6,4	8,2	9,1	9,8	10,3	10,5	10,7	10,9	10,9
07	10,7	13,8	15,3	16,5	17,3	17,7	18,1	18,4 (1)	18,4 (2)
08	12,4	15,9	17,7	19,1	20,0	20,5	20,9	21,2 (1)	21,2 (2)
09	13,7	17,6	19,6	21,2	22,1	22,7 (1)	23,1 (2)	23,5 (2)	23,5 (2)

(1) : differential pressure non available with coils 9160/RD2

(2) : differential pressure non available with coils 9160/RD1 and 9160/RD2

Refrigerant R410A - Capacities in kW

Orifice Type	Pressure drop across valve [bar]								
	2	4	6	8	10	12	14	16	18
01	0,9	1,1	1,3	1,4	1,5	1,5	1,6	1,6	1,6
02	1,6	2,1	2,4	2,6	2,8	2,9	2,9	3,0	3,0
03	2,0	2,7	3,0	3,3	3,5	3,6	3,7	3,8	3,8
04	3,2	4,3	4,8	5,3	5,6	5,8	5,9	6,1	6,1
05	5,6	7,4	8,4	9,2	9,7	10,0	10,2	10,5	10,6
06	7,7	10,1	11,4	12,5	13,1	13,6	13,9	14,3	14,4
07	12,2	16,0	18,2	19,8	20,9	21,6	22,2	22,7 (1)	22,9 (2)
08	14,5	19,0	21,6	23,5	24,8	25,7	26,4	27,0 (1)	27,2 (2)
09	16,1	21,2	24,1	26,3	27,7	28,7 (1)	29,4 (2)	30,1 (2)	30,4 (2)

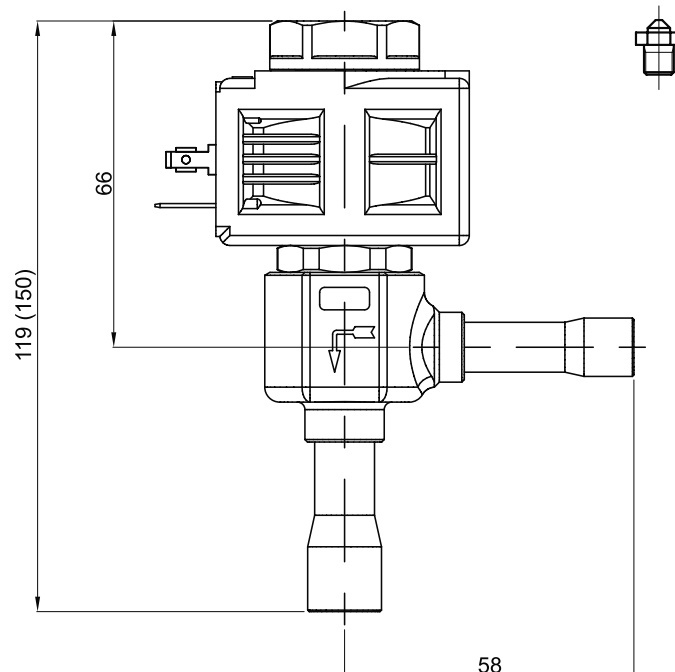
(1) : differential pressure non available with coils 9160/RD2

(2) : differential pressure non available with coils 9160/RD1 and 9160/RD2

Correction factor for subcooling $\Delta t_{sub} \rightarrow 4^{\circ}\text{C}$

Refrigerants	4K	10K	15K	20K	25K	30K	35K	40K	45K	50K
R22	1	0,94	0,9	0,87	0,83	0,8	0,77	0,74	0,72	0,69
R134a	1	0,93	0,88	0,84	0,8	0,76	0,73	0,7	0,68	0,65
R404A/R507	1	0,91	0,83	0,78	0,73	0,68	0,65	0,61	0,59	0,56
R407C	1	0,93	0,88	0,83	0,79	0,75	0,72	0,69	0,66	0,64
R410A	1	0,95	0,9	0,85	0,81	0,77	0,73	0,7	0,67	0,64

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





IC_01_VE PWM

Castel has always been aware of environmental sustainability issues and gives its contribution to a cleaner environment, supplying the refrigeration and air conditioning industry with state-of-the-art and environment-friendly technology. With its commitment and steady research in its laboratories, Castel has developed a whole range of products using natural refrigerants, which reduce emissions to the minimum.



ISO 14001

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