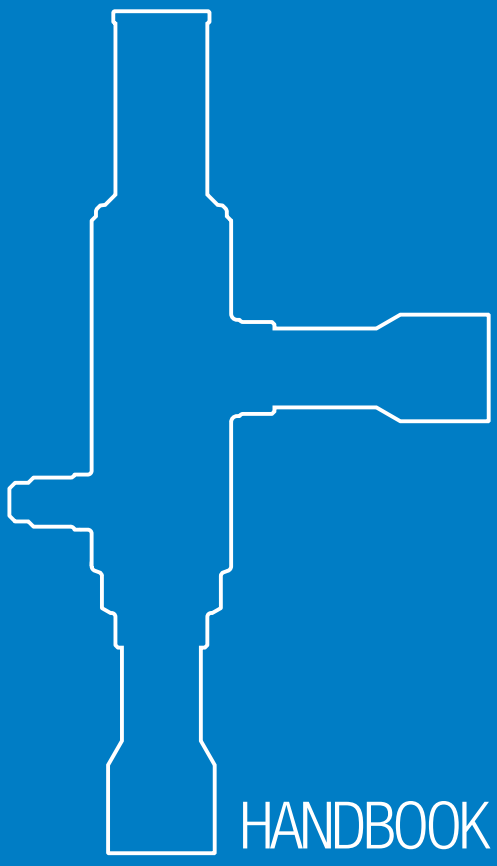

HANDBOOK

REGULATOR VALVES

Castel®
Italian technology

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CHAPTER 8
WATER REGULATING VALVES
FOR REFRIGERATION PLANTS THAT USE HCFC OR HFC REFRIGERANTS

APPLICATIONS
Water regulating valves, usually used with condensers fed with either mains or well water, keep the condensation pressure constant at a pre-set value by adjusting the water flow so as to ensure balanced heat exchange under all conditions.
At plant start-up, this adjustment is designed to allow the thermostatic valve to rapidly reach normal operating conditions and subsequently, during operations, to avoid excessive pressure increases or decreases under different load conditions.
An excessive rise of high pressure affects the refrigerating capacity of the system On the other hand, lowering the high pressure leads to insufficient refrigerant feed to the evaporator with consequent increased overheating of the gas and a parallel reduction in the gas pressure at the compressor suction.
Castel valves are appropriate for HCFC and HFC refrigerants and only for mains or well water.

OPERATION
The moving elements of the valve are a metal bellows and a shutter.
The thrust of the refrigerant condensation pressure outside the bellows favours the opening of the valve and the thrust of the adjustment spring on the shutter acts to close it.
Given a specific spring setting, the valve progressively opens as the condensation pressure increase, and closes when this pressure decreases.
When the compressor stops, the valve closes: water is no longer fed into the condenser, providing significant operating economy.
Valves are calibrated to a pressure of 7.5 bar. This calibration setting can be modified by turning the regulating screw.
There are three reference notches on the spring cover marked with letters A, B and C. Each notch is equivalent to a different spring setting.
- Letter A is equivalent to about 7.5 bar (valid for R134a at a condensation temperature of 30°C)
- Letter B is equivalent to about 14 bar (valid for R404A, R407C and R507 at a condensing temperature of 30°C)
- Letter C is equivalent to about 18 bar (maximum working pressure).

CONSTRUCTION
The main parts of the check valves are made with the following materials:
- Hot forged brass EN 12420 – CW 617N for body and cover
- Austenitic stainless steel AISI 303 for the seat
- Nitrile rubber (NBR) for the seat gaskets
- Rubber coated fabric (NBR) for the membranes.

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

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

Thermal power to be dispersed at the condenser (see Table 2 for the thermal factor):

18.6 x 1.325 = 24.65 [kW]

Water flow rate:

(24.65 x 860)/10 = 2120 l/h =2.12 [m³/h]

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

Δp = 3 – 2.5 = 0.5 bar

At Δp = 0.5 bar, when pressure valve 3210/04 is fully opened, it ensures the required flow rate (Fig. 2).
When the intersection point of the pressure differential across the valve and flow rate falls within the area defined by the curves of two valves, select the valve with larger diameter.

The fully closed pressure of the valve must be equal to the refrigerant saturation pressure at the ambient air temperature at which the condenser is installed. When the valve begins to open, the pressure is about 0,2 bar greater than the fully closed pressure.

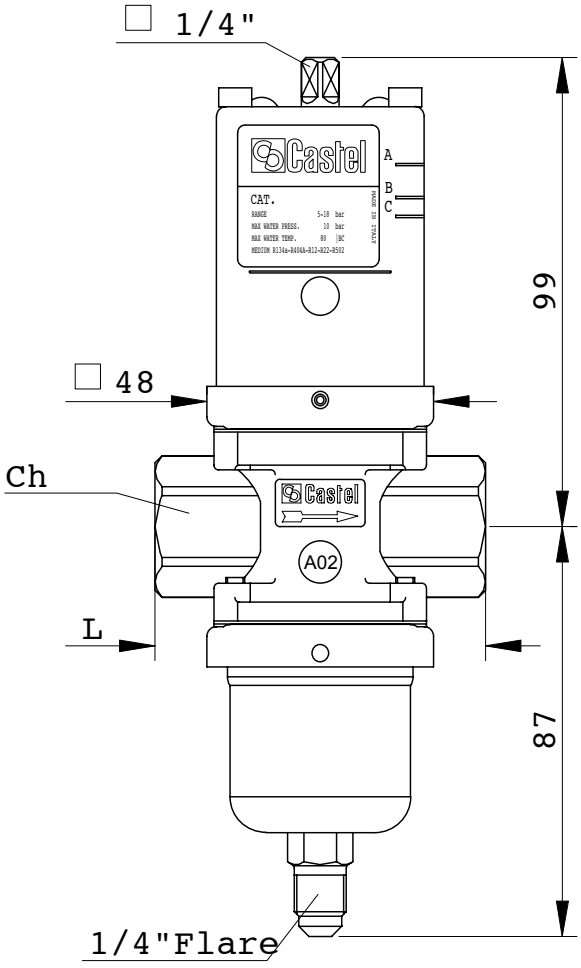

TABLE 37: General characteristic of water regulating valves

Catalogue Number	Connections UNI ISO 228/1	Working pressure [bar]	Maximum water pressure [bar]	Maximum water temperature [°C]	Kv Factor [m³/h]	Refrigerant max working pressure [bar]	Ch	L	Weight [g]
3210/03	G 3/8"	5 - 20	10	80	2	22	27	70	1015
3210/04	G1/2"				3				985
3210/06	G 3/4"				4,7		32	74	1010

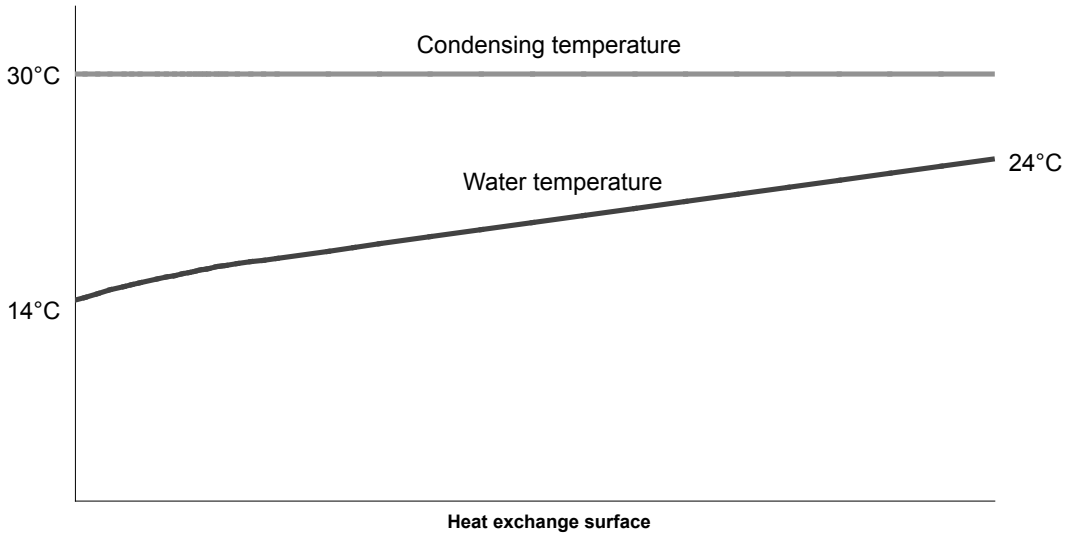

Fig. 1 - Heat exchange pattern in the condenser

CHARACTERISTICS CURVES

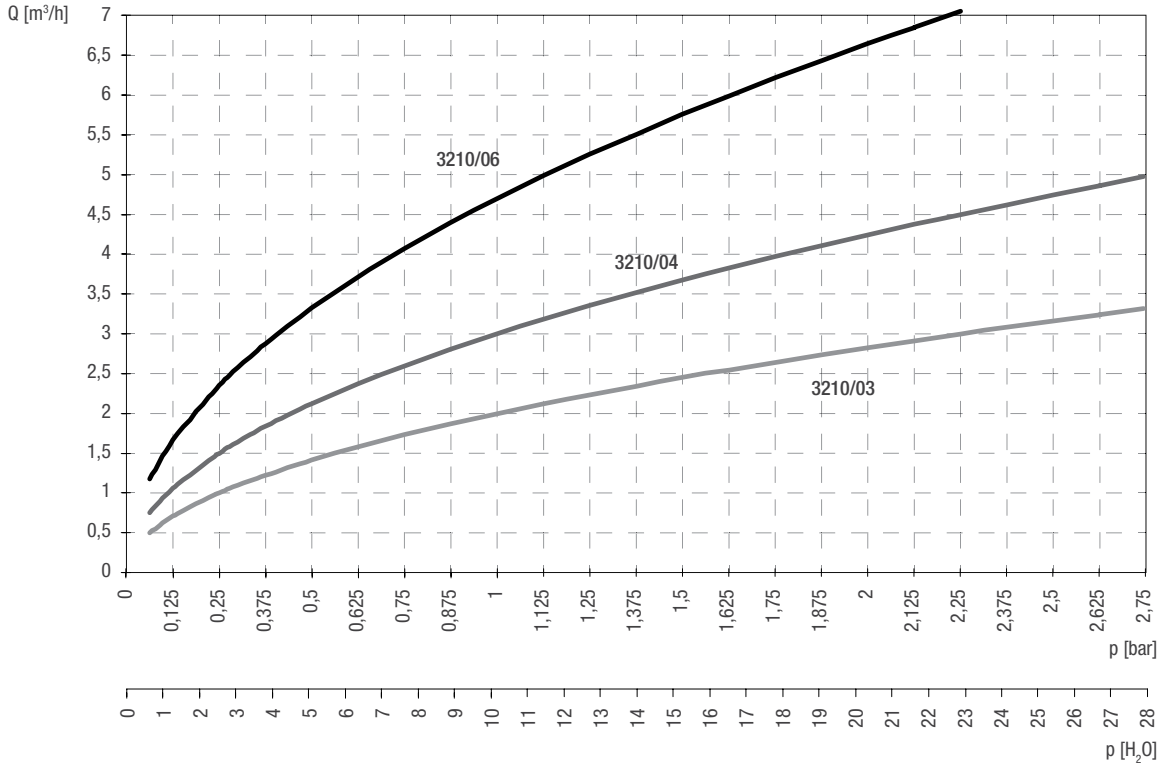

Fig. 2 - Charactestics curves when the valves are completly open

TABLE 38:Thermal factor for hermetic refrigeration compressor. Relationship between the total heat to be disposed of at the level of the condenser and refrigeration capacity at the level of the eavaporator

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

TABLE 39: Thermal factor for open compressor(direct or belt driven). Relationship between the total heat to be disposed of at the level of the condenser and refrigeration capacity at the level of the eavaporator

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

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