Water regulating valves

Castel®

WATER REGULATING VALVES

APPLICATIONS

The water regulating valve, employed with condenser fed with either main or well water, keeps the condensation pressure constant at the previously set value by adjusting the water flow so as to ensure a balanced heat exchange under all conditions.
At plant start-up, this adjustment is designed to allow the thermostatic valve rapidly reaches normal operating conditions and subsequently, during operations, to avoid excessive pressure increases or decreases under different flow conditions. An excessive rise of high pressure affects the refrigerating capacity of the system. On the other side, pressure lowering leads to insufficient refrigerant feeding of the evaporator with a consequent increased gas overheating and parallel reduction of gas pressure at compressor suction.
Castel valves are appropriate for refrigerant fluids HCFC and HFC and only for main and well water.

OPERATIONS

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 in the opposite sense. Given a specific setting of the spring, the valve progressively opens in line with the increasing condensation pressure, and closes when this pressure decreases.
When the compressor stops, the valve closes: water is no longer fed into the condenser, this being a notable operating economy.
Valve setting is performed in the works at a pressure of 7,5 bars. Setting is modified by turning the control screw.
Three reference notches, marked with letters A, B, and C, are present on the spring cover. Each notch is equivalent to a different spring setting. The notches are referred to the following condensation pressures:

- letter A equivalent to about 7.5 bar (valid for R134a at a temperature of condensation of 30 °C);
- letter B equivalent to about 14 bar (valid for R404A, R407C and R507 at a temperature of condensation of 30 °C);
- letter C equivalent to about 18 bar (top limit of working pressure)

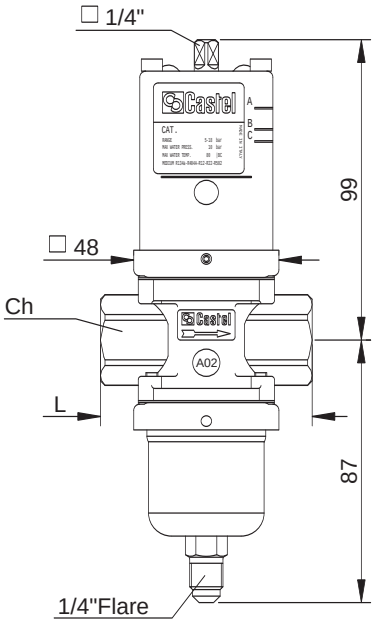

TABLE 1: General Characteristics									
Catalogue number	Connections UNI ISO 228/1	Working pressure [bar]	Maximum water pressure [bar]	Maximum water Temperature [°C]	Kv Factor [m^3/h]	Refrigerant max. working pressure [bar]	Ch	L	Weight [g]
3210/03	G 3/8"	5 - 18	10	80	2	20	27	70	1015
3210/04	G 1/2"				3				985
3210/06	G 3/4"				4,7		32	74	1010

MATERIALS

The materials used for the main parts are:
- ST-UNI-EN 12165 - CW617N hot-forged brass for the main body;
- austenitic stainless steel – AISI 303 for the seat;
- nitril rubber (NBR) for seat gasket;
- NBR coated-fabric for diaphragms.

INSTALLATION

The valve will be mounted on the water outlet side of the condenser, preferably vertically, with the bellows downward.
The high pressure connection to the bellow must show no deflection.
The arrow on the valve body shows water flow direction.

EXAMPLE OF VALVE SELECTION

A refrigerating system including 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 on the basis of the water/refrigerant heat exchange in the condenser:
  approximately 6 °C above the water temperature at the outlet, equivalent to 30 °C (with a corresponding saturation pressure) (fig. 1).
- Refrigeration yield at the level of the evaporator:
  18,6 kW under the following operating conditions,
  condensation temperature: + 30 °C;
  evaporation temperature: –15 °C.

Thermal power to be disposed of at the level of the condenser (Table 2):

18,6 x 1,325 = 24,65 [kW]

Water flow rate:

$$\frac{24,65 \times 860}{10} = 2120 \text{ l/h} = 2,12 \text{ [m}^3\text{/h]}$$

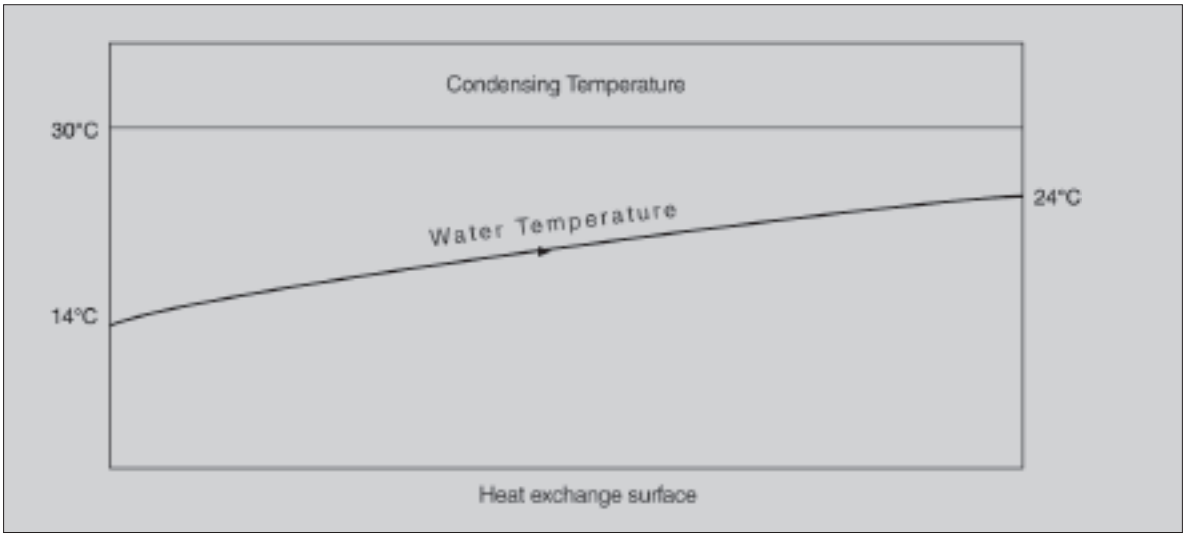

Fig. 1 – Heat exchange pattern in the condenser.

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 water regulating valve has this pressure differential at its disposal:

$\Delta p = 3 - 2,5 = 0,5$ bar

At $\Delta p = 0,5$ bar the 3210/04 valve, completly opened, ensures the required flow rate (fig. 2).

When the point of intersection of pressure differential through the valve and flow range is within the area between the curves of two valves, select the valve with larger diameter.

When the valve is completely closed, the pressure must be the same as the refrigerant saturation pressure at the air temperature of the place where the condenser is installed. When the valve begins to open, the pressure is about 0,2 bar above the pressure when the valve is totally closed.

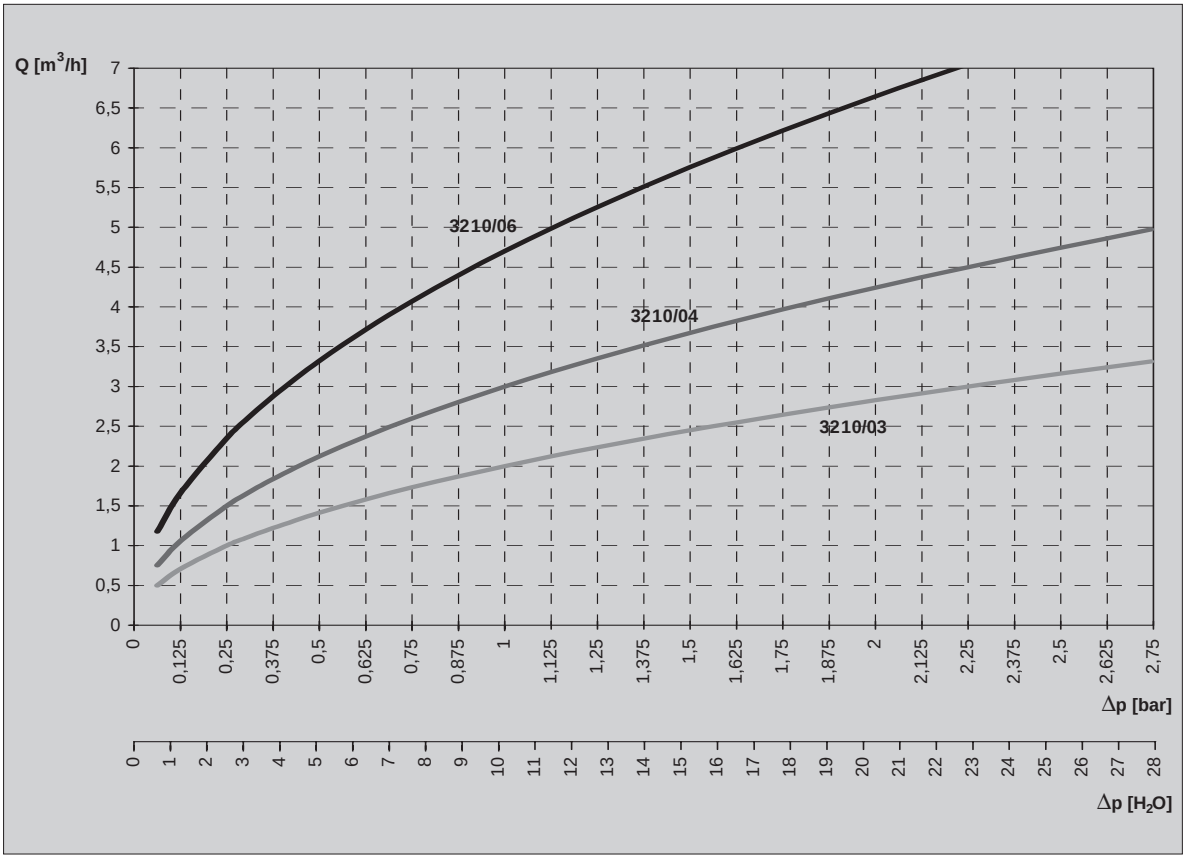

Fig. 2 – Characteritics curves when the valves are completely open

TABLE 2: Thermal factor for hermetic refrigeration compressors. Relationship between the total heat to be disposed of at the level of the condenser and refrigeration capacity at the level of the evaporator

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 3: Thermal factor for open compressors (direct or belt driven). Relationship between the total heat to be disposed of at the level of the condenser and the refrigeration capacity at the level of the evaporator

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