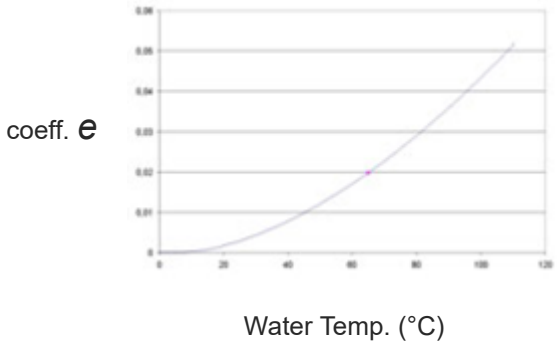
Sizing for the heating expansion vessels

For a correct dimensioning of the vessel, these parameters should be known:
C water volume inside the system including boiler, pipes and heating bodies considering a 15-20% safe weighting.
By and large, C is between 10 and 20 l each 1000 Ikcal/h
(1.163 kW) of the heating power of the boiler..

e **Water dilation coefficient:** the maximum difference between the calibration temperature of the boiler thermostat and the water temperature with the system switched off. See table below for sample.

Coefficient e of water dilation



Temperature difference (°C)	*e* coefficient
0	0.00013
10	0.00027
20	0.00177
30	0.00435
40	0.01210
50	0.01450
55	0.01710
60	0.01980
65	0.02270
70	0.02580
75	0.02900
80	0.03240
85	0.03590
90	0.03960
100	0.04340
110	0.05150

P_{ia} **Absolute precharge pressure of the expansion vessel**, sum of the relative precharge value of the vessel (determined by the system) and the air pressure:

$P_{ia} = P_{ir} + P_{atm}$

P_{fa} **Absolute test pressure of the safety valve,** sum of the relative precharge value of the valve and the air pressure:

$P_{fa} = P_{fr}$ ¡À P_{atm}

Given these parameters, the formula is as follows:

$$V_i = \frac{e \cdot C}{\frac{P_{fa} - P_{ia}}{P_{fa}}}$$

V, is the result, measured in liters, of the calculation. For a correct dimensioning, choose the smallest expansion vessel

Example of calculation

C = 550 l	quantity of water in the installation
t_i = 5 °C	water temperature with the system switched off
t_f = 70 °C	water temperature with the system operating
Δ(t) = 70 °C - 5 °C =65°C	temperature difference
e = 0,0198	dilation coefficient measured by temperature difference, see table above
P_{ir} = 1,5 bar	relative system precharge pressure
P_{ia} = 1,5 bar + 1 bar = 2,5 bar	absolute system precharge pressure
P_{fr}= 3 bar	relative safety valve test pressure
P_{fa} = 3 bar + 1 bar = 4 bar	absolute safety valve test pressure

$$\frac{0{,}01985 \cdot 550}{(4 - 2{,}5)/4} = 29{,}04 \longrightarrow \text{Maxivarem LR UR 35 l}$$

Dimensioning of an expansion vessel for conditioning systems

The water circuit on a conditioning system provides cold water from a refrigeration group and returns it after heating.
The pi pressure is equal to the maximum system pressure, that is the maximum temperature reached by the system, preventively calculated 50 °C.
The pf pressure is the value reached at minimum temperature, about 4 °C (in case of lower temperature, please check for possible modifications to the equation).
The capacity of the tank is given by:

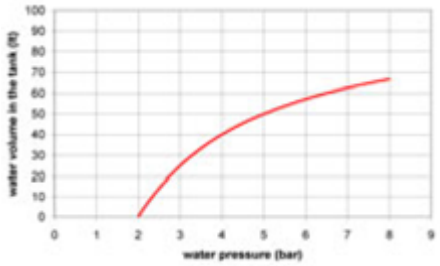
$$V_i = \frac{e \cdot C}{\frac{P_{ia} - P_{fa}}{P_{ia}}}$$

Useful volume of water in the tank

The value of the air pressure in the tank balances the water pressure. Considering the air compression isotherm, the pV product is constant. Introducing water in the tank, the air volume decreases, increasing pressure.
See the table below for an example of constant pV ratio in a 100 lts. tank with an absolute precharge pressure of 2 bar (constant pV ratio: 200).

Water pressure (bar))	Water content (lts.)
2	0
4	40
8	65

100 lts. tank with precharge pressure of 2 bar



The safety valve

The valve shutter is activated by the steam under pressure. It opens overcoming the force applied to the shutter by a spring. At preset pressure, the security valve starts to open, and at the nominal discharging pressure (usually more than 10% of the calibration) it is completely open. The valve closes at 80% of the preset value. This device guarantees the external discharging of the steam that could form within the system after exceeding of the preset thermostatic values.

Notes

The International Standard of Measurements uses the pascal unit (Pa). 1 bar = 10^5 Pa. The water content of a tank is always less than the nominal capacity of the tank. Upon request, Varem provides a CD-ROM with an application of dimensioning. Find further technical information on the technical sheets of the products.