Sizing of an expansion tank with a fixed diaphragm

Technical data

The expansion tank's useful volume must correspond to the expansion volume (*Ve*), in practice the maximum change of the water volume which can occur in the plant is the following one:

$$V_e = C \times (\mu_2 - \mu_1) \quad \text{[litres]}$$

where:

μ_2 = water specific volume at the maximum operative temperature [litres/kg].

μ_1 = water specific volume at the minimum operative temperature [litres/kg].

C = plant's total capacity (boiler, pipes, charges, etc.) [kg].

The V*t* total volume of the closed expansion tank with a bladder is calculated according to the following formula:

$$V_t = \frac{V_e}{1 - \frac{P_p}{P_e}} \quad \text{[litres]}$$

In order avoid calculating $1 - \frac{P_p}{P_e}$, the table 2 reporting the results of these calculations has been drawn up.

V_e= volume of expansion (litres)

P_e= System's max. working pressure, or adjustment pressure of the safety valve (bar) (absolute pressure)

P_p= precharge pressure of the expansion tank (bar) (absolute pressure)

This starting value of absolute pressure won't be less than 1,5 bar.

The working pressure must be equivalent to the opening pressure of security valve less 10% [working Pressure = (security valve P. - 10%)].

A ±10% tolerance of the system's total volume is allowed in the choice of the tank.

"water specific volume at different temperatures"

Table 1

T °C	υ litres/Kg	T °C	υ litres/Kg	T °C	υ litres/Kg	T °C	υ litres/Kg
- 10	1,00186	16	1,00103	36	1,00632	80	1,0290
- 5	1,00070	18	1,00138	38	1,00706	85	1,0324
0	1,00013	20	1,00177	40	1,0078	90	1,0359
2	1,00003	22	1,00221	45	1,0099	95	1,0396
4	1,00000	24	1,00268	50	1,0121	100	1,0434
6	1,00003	26	1,00320	55	1,0145	10	1,0515
8	1,00012	28	1,00375	60	1,0171	120	1,0600
10	1,00027	30	1,00435	65	1,0198	130	1,0795
12	1,00048	32	1,00497	70	1,0227	140	1,0795
14	1,00073	34	1,00563	75	1,0258	150	1,0903

Table 2 a

Max working pressure	precharge pressure (bar)								
	1	1,5	2	2,5	3	3,5	4	4,5	5
1,5	0,2								
2	0,333	0,167							
2,5	0,429	0,286	0,143						
3	0,5	0,375	0,25	0,125					
3,5	0,556	0,444	0,333	0,222	0,111				
4	0,6	0,5	0,400	0,3	0,2	0,1			
4,5	0,636	0,545	0,455	0,364	0,273	0,182	0,091		
5	0,667	0,583	0,5	0,417	0,333	0,25	0,167	0,083	
5,5	0,692	0,615	0,538	0,462	0,385	0,308	0,231	0,154	0,07
6	0,714	0,643	0,571	0,5	0,429	0,357	0,286	0,21	0,14
6,5	0,733	0,667	0,60	0,533	0,467	0,4	0,333	0,26	0,2
7	0,75	0,688	0,625	0,563	0,5	0,438	0,375	0,31	0,25
7,5	0,765	0,706	0,647	0,588	0,529	0,471	0,412	0,35	0,29
8	0,778	0,722	0,667	0,611	0,556	0,5	0,444	0,38	0,33
8,5	0,789	0,737	0,684	0,632	0,579	0,526	0,474	0,42	0,36
9	0,8	0,75	0,7	0,65	0,6	0,55	0,5	0,45	0,4
9,5	0,81	0,762	0,714	0,667	0,619	0,571	0,524	0,47	0,43
10	0,818	0,773	0,727	0,682	0,636	0,591	0,545	0,5	0,45

Table 2 b

Max working pressure	precharge pressure (bar)								
	5,5	6	6,5	7	7,5	8	8,5	9	9,5
6	0,07								
6,5	0,13	0,06							
7	0,18	0,12	0,06						
7,5	0,23	0,17	0,11	0,06					
8	0,28	0,22	0,16	0,11	0,06				
8,5	0,31	0,26	0,21	0,16	0,1	0,05			
9	0,35	0,3	0,25	0,21	0,15	0,1	0,05		
9,5	0,38	0,33	0,28	0,24	0,19	0,14	0,1	0,05	
10	0,41	0,36	0,32	0,27	0,23	0,18	0,14	0,09	0,045