sizing the system expansion vessel

❄ *Step 1* - *Select the parameters*

The following factors affect the vessel selection and the appropriate values should be assigned:

1. Total height of system
2. Flow/return temperature
3. Pressure developed by circulating pump(s)
4. Maximum allowable pressure in system as dictated by components in system (ie Radiators, Boilers, Heater Batteries).
5. Maximum allowable vessel working pressure
6. Maximum allowable vessel acceptance
7. System water content

❄ *Step 2* - *Calculate the cold water fill pressure*

The cold water fill pressure **must** be in excess of the static head exerted by the height of water in the system,

$$\text{ie: } \frac{\text{Height in metres (as in 1)} + 3^{*}}{10} = \text{C.F.P. (bar).}$$

(allow extra 3 metres to assist venting)

N.B. The C.F.P. is also the air/nitrogen charge pressure in the expansion vessel.

Example: Height of system = 10m then $\frac{10 + 3}{10}$ = 1.3 bar cold fill pressure and vessel charge pressure

❄ *Step 3* - *Calculate the final working pressure*

In strict theory the final working pressure would be calculated by assessment of maximum allowable system pressure, as dictated by the components in the system, and their vertical position in the system relative to the expansion vessel.

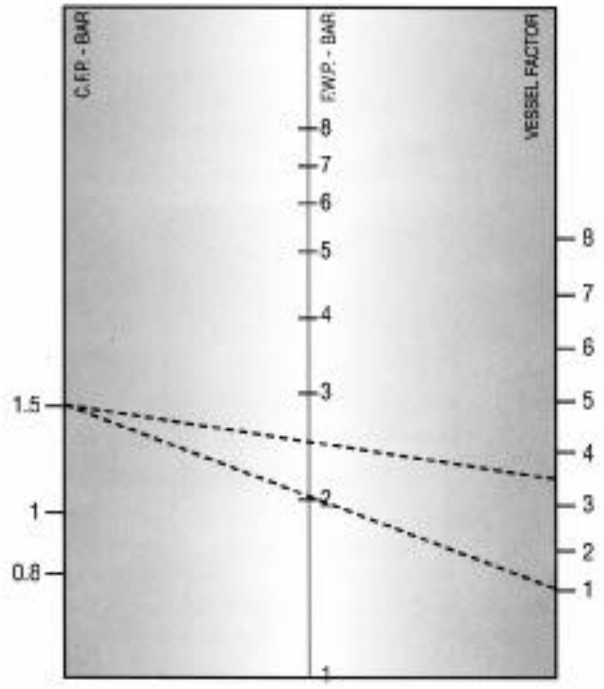
In practise, normally a final working pressure is selected to give a reasonable vessel factor. This is perfectly acceptable on most systems where the maximum allowable pressure in the system, as dictated by the components, is considerably higher than the cold fill pressure i.e. 3 - 4 bar differential.
Example: Maximum allowable pressure in the system = 4 bar.
Assume a cold fill pressure as calculated in step 2 = 1.3 bar

Table 1

Only use if maximum system temperature is above 95°C.

See additional notes.

Vapour Pressure Allowance	
Flow - °C	Allowance - bar
95	0.2
100	0.5
105	0.8
110	1.2
115	1.6
120	2.0
125	2.5
130	3.1
135	3.7
140	4.4



Graph 1
Calculation of vessel factor

and a final working pressure of 2.5 bar is selected, then the vessel factor of 4 is interpolated from Graph 1, or if a final working pressure of 2.0 bar is selected, the vessel factor would be 2. (The higher the vessel factor, the smaller the vessel.)

We would recommend that if any doubt arises you should contact our technical department, as in certain circumstances the maximum allowable pressure can be quite low, i.e. cast iron pipework systems.

❄ *Step 4* - *Obtaining the vessel factor*

You have now calculated the cold fill pressure and selected the final working pressure. Use these two parameters to arrive at the vessel factor by interpolation from Graph 1.

Maximum System Temperature °C													
VESSEL FACTOR	30	35	40	45	50	55	60	65	70	75	82	85	90
8	0.01	0.014	0.018	0.023	0.028	0.033	0.038	0.044	0.052	0.058	0.067	0.072	0.08
7	0.012	0.016	0.02	0.026	0.031	0.037	0.042	0.05	0.057	0.064	0.073	0.082	0.09
6	0.014	0.018	0.023	0.029	0.036	0.042	0.05	0.057	0.066	0.074	0.084	0.091	0.103
5	0.015	0.02	0.027	0.034	0.041	0.05	0.057	0.066	0.077	0.085	0.10	0.108	0.117
4	0.019	0.025	0.032	0.04	0.05	0.06	0.068	0.079	0.092	0.105	0.12	0.13	0.143
3	0.023	0.03	0.04	0.05	0.062	0.074	0.085	0.010	0.114	0.13	0.15	0.16	0.18
2	0.03	0.04	0.054	0.069	0.082	0.10	0.115	0.133	0.155	0.17	0.20	0.22	0.24
1	0.045	0.06	0.08	0.1	0.125	0.15	0.175	0.20	0.23	0.26	0.30	0.325	0.3675

Table 2 - *Calculation of system factor*

❄ *Step 5- Obtaining the system factor*

Using the vessel factor, interpolate from Table 2 to find the system factor, the temperature shown as being maximum system temperature.
Please note: for chilled water systems we recommend using 30°C as the maximum system temperature.

❄ *Step 6- Calculating the expansion vessel size*

The actual expansion vessel size can now be calculated by multiplying the system factor by the system water content.
***N.B.** if the system water content is not known, then allow 12L per kW of boiler output.*

Additional notes

Where the maximum system temperature is above 95°C, then an addition should be made to the cold fill pressure. Use Table 1 to obtain the value, which should be added to the initial cold fill pressure.

Furthermore, an intermediate vessel or antigravity loop should be incorporated into the system to protect the expansion vessel from excessively high temperatures. The size of this vessel should be calculated by multiplying the factor from Table 3 below by the system water content.

Table 3 *Intermediate Vessel Selection*

Flow Temp - °C	Selection Factor F
90°	0.0015
100°	0.004
110°	0.008
120°	0.013
130°	0.019
140°	0.027

For extremely high temperatures (MTHW) then please consult our technical department, for advice.

Worked example *(using parameters from above)*

❄ *Step 2*
Cold fill pressure = 1.3 bar *(from example in Step 2)*

❄ *Step 3*
Final working pressure = 2.5 bar *(selected after overview of Step 1)*

❄ *Step 4*
Obtain vessel factor by interpolation from graph 1 = 4

❄ *Step 5*
Obtain system factor from Table 2, using a system maximum temperature of 90°C - 0.143

❄ *Step 6*
Obtain vessel selection by multiplying system water content (actual or calculated) by the system factor from step 5
(in this example 1200L x 0.143 = 171.60L)

Recommended vessel = 200L with 1.3 bar charge.

expansion vessels

for central heating systems & chilled water application

- Manufactured to BS 4814
- Standard range 5 bar maximum working pressure
- Ultra range 10 bar maximum working pressure
- Range - Dimensions given are for ***standard range***; dimensions for ***ultra range*** are available on request.

Dimensions

4 - 50 litre vessels require wall bracket		
Capacity (litres)	Diameter (mm)	Height (mm)
4	226	180
8	228	295
12	298	260
18	298	365
25	328	405
35	380	402
50	380	537
80 - 1000 litre, includes floor stand		
80	450	614
105	500	668
150	500	891
200	600	860
250	630	970
300	630	1135
400	630	1510
500	750	1350
750	on request	on request
1000	on request	on request

Heating Expansion Vessels should, whenever possible, be installed into the heating system, on the return pipework, on the inlet side of the pump. This will ensure that the entire system is above atmospheric pressure, and that pump pressure is additive.

For high temperature systems, above 95° C a vessel, and/or an anti-gravity loop, with a volume not less than 8% of the main vessel volume should be installed between the system and the main expansion vessel, to prevent excessive temperature in the main vessels.

Potable water

Expansion vessel details available on request.