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Calculation of a Flexcon expansion vessel



The following terms are important for the correct choice of a Flexcon vessel:

- **Gross vessel contents**

This is the total contents of the Flexcon vessel.

- **Useful (or nett) vessel contents**

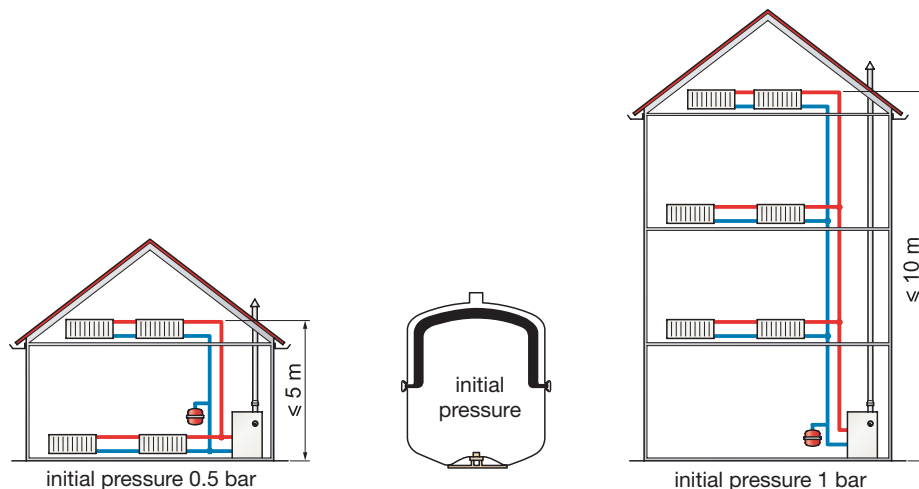
This is the maximum quantity of water that can be included above the diaphragm.

- **Static height**

This is the distance between the connection point of the Flexcon vessel and the highest point of the installation, measured in metres of water column (1 m water column = 0.1 bar).

- **Initial pressure of the Flexcon vessel**

This is the pressure, measured at the nitrogen valve in an unloaded state and at ambient temperature. This pressure must correspond with the static height, rounded off upwards to a multiple of 0.5 bar. This is to prevent cold water being forced into the Flexcon vessel in a cold state.



- **Final pressure**

This is the maximum allowable pressure of the installation at the Flexcon vessel. This final pressure is equal to the blow-off pressure of the Prescor safety valve, providing the Prescor safety valve is fitted at the same height as the Flexcon vessel.

- **Efficiency**

This is the ratio between gross contents and nett contents.

$$\text{Efficiency} = \frac{\text{gross contents}}{\text{nett contents}}$$

The efficiency is determined by the ratio between initial pressure and final pressure. In formula form (Boyle's law), this is given as follows:

$$\text{Efficiency} = \frac{\text{final pressure} - \text{initial pressure}}{\text{final pressure}}$$

Note: Pressures in bar absolute.

Max. efficiency is limited to 62.5%, see also table on page 3.

- **Water contents of the system**

This is the sum of the water contents of the heat source, radiators and pipe-work, etc., after they have been filled and vented. When calculating a Flexcon expansion vessel, it is recommended to add a reserve of 25%.

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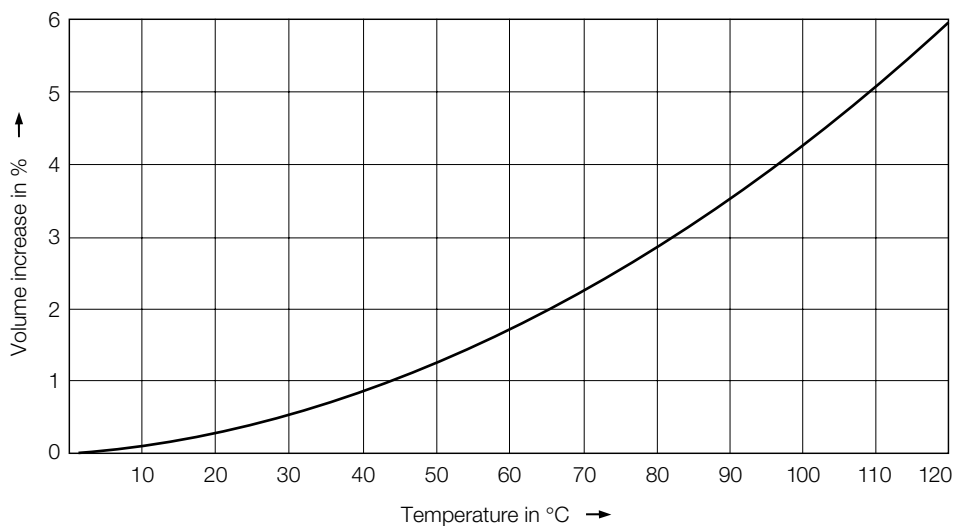


● **Volume increase of water as a percentage**

The following table contains data about the volume increase of water as a percentage for temperature rises of water from 10 °C to 110 °C.

Temperature rise	Volume increase
10 - 40 °C	0.75%
10 - 50 °C	1.18%
10 - 60 °C	1.68%
10 - 70 °C	2.25%
10 - 80 °C	2.89%
10 - 90 °C	3.58%
10 - 100 °C	4.34%
10 - 110 °C	5.16%

The following graph shows the figures for other temperatures.



● **Expansion volume**

The expansion volume is determined as follows:

expansion volume = water contents x volume increase at the average heating temperature.

Example: heating temperature 90/70 °C (mean 80 °C) = 2.89%.

● **Gross contents of the Flexcon vessel**

The gross contents of the Flexcon vessel are determined as follows:

$$\text{gross contents of Flexcon vessel} = \frac{\text{expansion volume}}{\text{efficiency}}$$



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Efficiency



The following table shows the efficiency, on which the capacity tables in this documentation are based.

Efficiency for Flexcon expansion vessels with fixed diaphragm is limited to max. 62.5%.

Static height in m	Initial pressure in bar	Final pressure in bar						
		2.0	3.0	4.0	5.0	6.0	7.0	8.0
5	0.5	0.50	0.63	-	-	-	-	-
10	1.0	0.33	0.50	0.60	-	-	-	-
15	1.5	0.17	0.38	0.50	0.58	-	-	-
20	2.0	-	0.25	0.40	0.50	0.57	0.63	-
25	2.5	-	0.13	0.30	0.42	0.50	0.56	0.61
30	3.0	-	-	0.20	0.33	0.43	0.50	0.56
35	3.5	-	-	0.10	0.25	0.36	0.44	0.50
40	4.0	-	-	-	0.17	0.29	0.38	0.44
45	4.5	-	-	-	-	0.21	0.31	0.39
50	5.0	-	-	-	-	0.14	0.25	0.33
55	5.5	-	-	-	-	-	0.19	0.28
60	6.0	-	-	-	-	-	0.13	0.22
65	6.5	-	-	-	-	-	-	0.17

Approximation of the water contents of the installation

To be able to determine the required contents of the Flexcon vessel, the water contents of the installation must be calculated.

If it is not possible to calculate the water contents of the installation, then these contents can be approximated with the aid of the following practical figures.

Central heating installation with	Watercontents in litres	
	per 1.0 kW (860 kcal/h)	per 1.165 kW (1,000 kcal/h)
Convectors and/or air heaters	5.2	6
Air treatment installations	6.9	8
Panel radiators	8.6	10
Column radiators	12.0	14
Radiating ceilings and/or floor heating	21.5	25
Extensive pipe-work installation (district heating)	25.8	30

The water contents of the installation can be approximated by multiplying the power of the installation by the values given in the table. The table applies to new installations. It is recommended to choose higher values for existing installations. For budgetary purposes, you can find which Flexcon vessel you need for a certain installation capacity in kW in the PDF file Flexcon capacity tables.



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Calculation examples of Flexcon vessels

Example 1

Data

- water contents (including 25% reserve) = 425 litres
- average heating temperature (90/70 °C) = 80 °C
- installation height = 8 m
- final pressure = 3 bar
- Flexcon vessel and boiler placed at the **bottom** of the installation.

Calculation

Volume increase in % = 2.89% ≈ 2.9%

$$\text{Expansion volume} = \frac{425 \times 2.9}{100} = 12.3 \text{ litres}$$

$$\text{Efficiency} = \frac{(3 + 1) - (1 + 1)}{(3 + 1)} = 0.50$$

$$\text{Required gross contents of the Flexcon vessel} = \frac{12.3}{0.50} = 24.6 \text{ litres}$$

Vessel to be selected: Flexcon 25/1.

Example 2



Data

- water contents (including 25% reserve) = 7,000 litres
- average heating temperature (90/70 °C) = 80 °C
- installation height = 30 m
- final pressure = 2.5 bar
- Flexcon vessel and boiler placed at the **top** of the installation.

Calculation

Volume increase in % = 2.89% ≈ 2.9%

$$\text{Expansion volume} = \frac{7,000 \times 2.9}{100} = 203 \text{ litres}$$

$$\text{Efficiency} = \frac{(2.5 + 1) - (0.5 + 1)}{(2.5 + 1)} = 0.57$$

$$\text{Required gross contents of the Flexcon vessel} = \frac{203}{0.57} = 356 \text{ litres}$$

Vessel to be selected: Flexcon 425/0.5.

Example 3

Data

- water contents unknown
- boiler power = 55 kW
- average heating temperature (90/70 °C) = 80 °C
- installation height = 12 m
- final pressure = 3 bar
- Flexcon vessel and boiler placed at the **bottom** of the installation.
- Installation parts: 100% panel radiators (= 8.6 l/kW).

Calculation

Approximation of the installation water contents = 55 x 8.6 x 1.25 = 591.3 litres (including 25% reserve).

Volume increase in % = 2.89% ≈ 2.9%

$$\text{Expansion volume} = \frac{591.3 \times 2.9}{100} = 17.1 \text{ litres}$$

$$\text{Efficiency} = \frac{(3 + 1) - (1.5 + 1)}{(3 + 1)} = 0.375$$

$$\text{Required gross contents of the Flexcon vessel} = \frac{17.1}{0.375} = 45.6 \text{ litres}$$

Vessel to be selected: Flexcon 50/1.5.