Expansion vessels for primary circuit in solar thermal systems

259 series

Technical specifications

Materials:
- Body: steel
- Membrane: 8–33 l, butyl; 50 l SBR
- Type of membrane: 8–33 l, with bladder; 50 l with diaphragm
- Pipe connection: galvanised steel
- Colour: white

Performance:
- Medium: water, glycol solutions
- Max. percentage of glycol: 50%
- Maximum working pressure: 10 bar
- Pre-charge pressure: 2.5 bar
- System working temperature range: -10–120°C
- Membrane working temperature range: -10–70°C

Construction: conforms to EN 13831

Application:
- primary circuit in solar thermal systems

Connections:
- 8–33 l, 3/4" M (ISO 228-1); 50 l, 3/4" M (ISO 7-1)

Function

The closed expansion vessel with membrane consists of a closed container divided into two parts by a membrane which separates water from gas (nitrogen or air) and which acts as an expansion compensation device.

After the temperature of the medium increases, the pressure inside the vessel keeps rising from its cold preset value, until the maximum expansion value is reached.

Product range

259 series Welded expansion vessel for primary circuit in solar thermal systems, CE certified capacity (litres): 8, 12, 18, 25, 33, 50

Dimensions

<table>
<thead>
<tr>
<th>Code</th>
<th>Litres</th>
<th>Ø (mm)</th>
<th>H (mm)</th>
<th>Mass (kg)</th>
</tr>
</thead>
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<tr>
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<tr>
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<td>3.5</td>
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<tr>
<td>259025</td>
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<td>280</td>
<td>500</td>
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</tr>
<tr>
<td>259033</td>
<td>33</td>
<td>354</td>
<td>450</td>
<td>6.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Litres</th>
<th>Ø (mm)</th>
<th>H (mm)</th>
<th>I (mm)</th>
<th>Mass (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>259050</td>
<td>50</td>
<td>354</td>
<td>450</td>
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</tbody>
</table>
Solar thermal systems

Sizing method - Solar thermal systems

\[ e = \text{medium expansion coefficient at various temperatures (see table 1)} \]
\[ e = \frac{n}{100} \]
\[ k = 1.1; \text{safety coefficient which takes into account:} \]
\- the possible evaporation of the medium due to stagnation in the panel
\- an initial water reserve in the vessel to compensate for any loss of medium in the circuit as a whole
\- the contribution of the pump head in relation to the position of the vessel (positioned on the circuit flow line)

Definition of volumes

\[ V_n = \text{vessel volume (l), to be calculated} \]
\[ V_p = \text{content of medium in the solar panels (l)} \]
\[ V_a = \text{content of water in the system (Vp + volume in the pipes) (l)} \]
\[ V_e = \text{expansion volume due to the water heating up (l)} \]
\[ V_u = \text{useful volume of the vessel:} \]
\[ V_u = (V_a \cdot e + V_p) \cdot k \]

Pressure definition - all the pressures listed below are measured at the pressure gauge (relative pressure):

\[ P_{st} = \text{hydrostatic pressure at the point of installation (bar)} \]
\[ P_{vs} = \text{safety relief valve setting pressure (bar)} \]
\[ P_{d} = \text{vaporisation pressure (bar) (Table 2)} \]
\[ \Delta P_{pump} = \text{pump head (bar)} \]
\[ P_{0} = \text{vessel pre-charge pressure at the gas side (bar)} \]

\[ P_{ar} = \text{relative filling pressure at the water side (bar) = } P_{0} \]
\[ P_{ar} = \text{average recommended value} = P_{st} + 0.5 \text{ (bar)} \]

\[ P_{er} = \text{maximum system working pressure at the gas side (bar), i.e.} \]
\[ P_{er} = P_{vs} - 0.5 \text{ bar (10% Pvs if Pvs > 5 bar)} \]

The capacity of a closed expansion vessel with membrane (diaphragm) for solar thermal systems is calculated by applying the following formula:

\[ V_n = V_u \cdot \left( \frac{P_{er} + 1}{P_{er} - P_{0}} \right) \quad (1) \]

Example:

Sizing an expansion vessel for a solar thermal system with the following technical specifications:

\[ V_p = \text{content of medium in the solar panels} = 4 \text{ l} \]
\[ V_a = \text{content of water in the system} (Vp + volume in the pipes) = 20 \text{ l} \]
\[ e = \text{medium expansion coefficient for glycol solutions} = 0.07 \]
\[ (at 120°C and 30% glycol) \]
\[ P_{vs} = \text{safety relief valve setting pressure} = 6 \text{ bar} \]
\[ P_{st} = \text{hydrostatic pressure} = 1.5 \text{ bar} \]

Solution:

\[ P_{ar} = \text{relative filling pressure at the water side (recommended average value)} = P_{st} + 0.5 + 0.5 = 2 \text{ bar} \]
\[ P_{0} = \text{vessel pre-charge pressure at the gas side} = P_{ar} = 2 \text{ bar} \]
\[ P_{er} = \text{maximum relative system working pressure at the gas side} = P_{vs} - 0.5 = 5.5 \text{ bar} \]

\[ V_u = \text{useful volume of the vessel} = (V_a \cdot e + V_p) \cdot k = (20 \cdot 0.07 + 4) \cdot 1.1 = 5.94 \text{ l} \]

Formula (1) above is applied to calculate the volume of the vessel \[ V_n \]:

\[ V_n = 5.94 \cdot \left( \frac{5.5 + 1}{5.5 - 2} \right) = 11.03 \text{ l} \]

A 12 l vessel should therefore be selected (this must be preset to 2 bar)

Installation

If the temperature at the point of installation (1) causes the vessel to reach a temperature over 70°C, it is advisable to adopt suitable system devices, such as an intermediate through-vessel (2).

Table 1 - Indicative coefficient “n” as the temperature “T(°C)” varies in relation to the temperature of 10°C, with and without glycol “%”

<table>
<thead>
<tr>
<th>°C</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>110</th>
<th>120</th>
<th>130</th>
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</thead>
<tbody>
<tr>
<td>% glycol 0</td>
<td>0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>% glycol 10</td>
<td>0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>% glycol 20</td>
<td>0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
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<td>0.1</td>
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<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Table 2 - Glycol solution vaporisation pressure (bar)

<table>
<thead>
<tr>
<th>°C</th>
<th>100</th>
<th>110</th>
<th>120</th>
<th>130</th>
<th>140</th>
<th>150</th>
<th>160</th>
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<th>190</th>
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</thead>
<tbody>
<tr>
<td>% glycol 30</td>
<td>0</td>
<td>0.3</td>
<td>0.8</td>
<td>1.4</td>
<td>2.3</td>
<td>3.2</td>
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<td>7.2</td>
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<tr>
<td>% glycol 40</td>
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<td>0.2</td>
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<td>4.0</td>
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</tr>
</tbody>
</table>

259 series

Expansion vessel for primary circuit in solar thermal systems, CE certified. Connection 3/4” M (from 8 to 33 l ISO 228-1 thread; 50 l ISO 7-1 thread). Steel body. Bladder membrane in butyl (from 8 to 33 l); diaphragm membrane in SBR (50 l). Galvanised steel connection to pipe. White colour. Medium water and glycol solutions; maximum percentage of glycol 50%. Maximum working pressure 10 bar. Pre-charge pressure 2.5 bar. System working temperature range -10-120°C; membrane working temperature range -10-70°C.

SPECIFICATION SUMMARY

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