eres

solar expansion vessel

altecnic

eres solar expansion vessels

Introduction

Eres are able to offer a complete range of solar expansion vessels to meet the requirements of most solar system designs.

Eres expansion vessels are manufactured to meet the requirements of PED 97/23/EC Directive and BS EN 13831:2007 'Closed expansion vessels with built in diaphragm for installation in water' and are suitable for closed solar energy heating systems in accordance with DIN4757-2 'Solar heating plants operating on organic media; Requirements relating to safe design and construction' and BS EN 12977 & DD CEN/TS 12977 'Thermal solar systems and components. Custom built systems & performance test methods'.

Design

The vessel is fabricated by welding the various sections together which results in a very reliable structure suitable for internal pressures up to 10 bar.

Epoxy coated and available in white.

The Eres diaphragm has been specially developed for solar applications.

Suitable for temperatures up to 130˚C, resistant to ethylene or propylene glycol mixtures and has low gas permeability.

How It Works

An expansion vessel must ensure the solar system can work safely, particularly during periods when hot water is not being drawn off.

During this period modern solar collectors may reach temperatures up to 200°C and consequently the fluid within the system can either evaporate or reach levels that can damage all the components within the solar energy system over time.

In order to resist the highest possible stagnation temperatures, a special heat-resistant diaphragm has been developed that can withstand up to 130°C.

In the event that the diaphragm within the expansion vessel could be subjected to temperatures above 130˚C, the vessel must be protected by an additional vessel (VDI 6002 directive).

All Eres solar expansion vessels are suitable for installation in solar systems complying with DIN 4757 and EN 12977 and are suitable for use with a mixture of water and propylene or ethylene glycol.

The expansion vessels are tested according to the Pressure Systems Directive.

The diaphragm within the expansion vessel ensures that the system pressure does not exceed or go below the limits specified.

The diaphragm separates the space inside the vessel occupied by the gas and by the solar liquid. The initial pressure of the gas side must be regulated before turning on the system.

The diaphragm allows the liquid to expand into the gas chamber when the volume of the solar liquid expands due to the raise in temperature, maintaining the pressure inside the solar system at the approved maximum value.

When the temperature of the solar liquid cools, the volume decreases, the diaphragm returns to its initial position and the pressure remains constant at the approved minimum value.

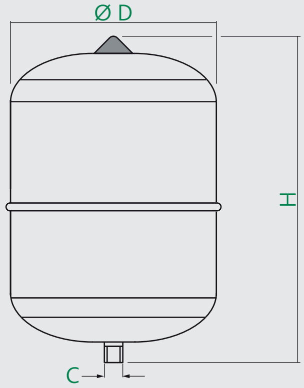
Materials

Component	Material
Shell	Carbon Steel
Connections	Carbon Steel
Diaphragm	Elastomer
Coating	Powder Epoxy

Technical Specification

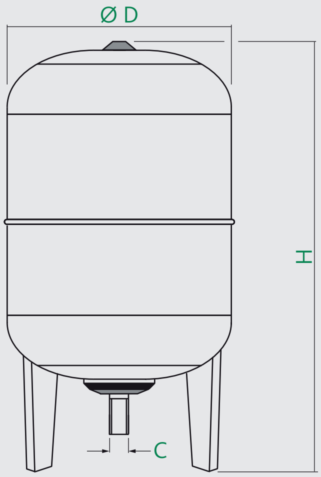
Max. working pressure	10 bar (SX-24MFO - 8 bar)
System operating range	-10˚C to 120˚C
Diaphragm operating range	-10˚C to 130˚C
Factory air precharge	1.5 bar

Dimensions - Fixed Diaphragm



Prod Code	Capacity	ØD	H	C
	litres	mm	mm	Connection
SX-5SMFO	5	200	240	G¾"
SX-8SMFO	8	200	335	G¾"
SX-12SMFO	12	270	302	G¾"
SX-18SMFO	18	270	405	G¾"
SX-24SMFO	24	320	425	G¾"

Dimensions - Replaceable Diaphragm



Prod Code	Capacity	ØD	H	C
	litres	mm	mm	Connection
SX-35SMRP	35	360	615	G1"
SX-50SMRP	50	360	750	G1"
SX-80SMRP	80	450	750	G1"
SX-100SMRP	100	450	850	G1"

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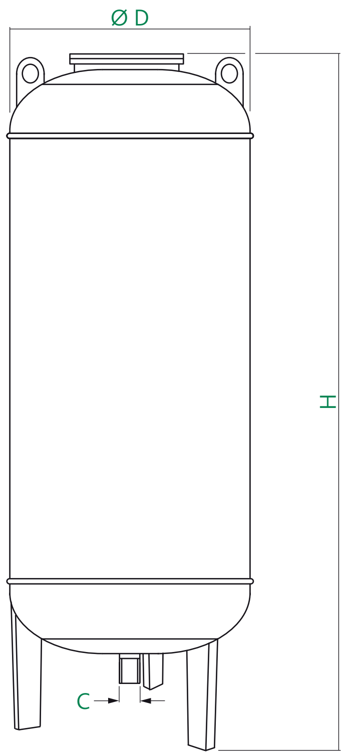
Dimensions - Replaceable Diaphragm



Prod Code	Capacity	ØD	H	C
	litres	mm	mm	Connection
SX-200SMRP	200	485	1400	G1½”
SX-350SMRP	350	485	1965	G1½”
SX-500SMRP	500	600	2065	G1½”
SX-700SMRP	700	700	2215	G1½”

Additional Vessel

A review of international regulations covering solar energy systems recommends an additional vessel, when the fluid volume between the collector and expansion vessel is approximately 50% or less than the ‘wet’ side volume (between the expanded diaphragm and the vessel inlet).

European Directive VDI 6002 covers this approach.

For solar panels located on the roof, due to the relatively short pipe lengths, fitting an addition vessel is usually not required.

The additional tank can protect the diaphragm in the expansion vessel from excessive temperatures.

The correctly sized additional vessel allows a reduction in temperature of the solar liquid in the expansion system.

Accessories

A range of accessories are available to enable the vessels to be fitted quickly and easily; contact Sales for details.

Sizing an expansion vessel for solar systems

Unlike the expansion vessel for a standard central heating system, sizing the expansion vessel for a solar system requires the following to be considered;

- The expanded volume of the solar fluid.
- The steam volume due to the evaporation of the solar fluid .
- An adequate amount of solar fluid stored in the expansion vessel to compensate for the reduction in volume due to low working temperatures during winter time.

The formula to size the expansion vessels for solar systems is the following:

$$V_N = [(V_e + V_v + V_d) \times (P_{max} + 1)] / (P_{max} - P_{prec})$$

V_N: nominal volume of the expansion vessel [litres]

V_e: expansion volume of the solar fluid [litres]. The expansion volume is calculated as follows:

$$V_e = n \times V_a$$

V_v: amount of solar fluid stored in the expansion vessel [litres]. The amount of solar fluid is calculated as follows:

$$V_v = 0.02 \times V_a$$

The minimum amount of solar fluid stored in the expansion vessel must always equal 3 litres.

V_d: volume of steam [litres]. The volume of steam is calculated as follows:

$$V_d = 1.1 \times (V_c + V_t)$$

P_{max}: maximum working pressure of solar system [bar]

P_{prec}: pre-charge pressure of the expansion vessel [bar]

In order to calculate the nominal volume of the expansion vessel, you need to know following data:

V_c: volume of solar collector [litres]. Given the overall surface of the solar collector, it is possible to estimate the volume of the solar collectors considering: 1 liter/m² for flat solar collector and 2 litres/m² for vacuum solar collector.

V_t: volume of solar collector connecting pipes [litres]

V_a: total of the volume of the solar collector, volume of the heat exchanger, volume of the pipes in the building and the volume of the solar collector connecting pipes.

T_{max}: maximum working temperature of the solar system [°C]

n: expansion coefficient of the solar fluid. Expansion coefficient of solar fluid depends on maximum working temperature and the percentage of glycol in the solar fluid itself: it is possible to calculate the expansion coefficient by using tables.

P_{vs}: opening pressure of the safety valve [bar]. It is possible to calculate the maximum working pressure of the solar system as follows :

$$P_{vs} \leq 5 \text{ bar}, \quad P_{max} = P_{VS} - 0.5 \text{ [bar]}$$

$$P_{vs} > 5 \text{ bar}, \quad P_{max} = 0.9 \times P_{VS} \text{ [bar]}$$

P_{min}: minimum working pressure on the expansion vessel [bar].

Minimum working pressure on the expansion vessel equals the sum of the pressure due to the static head on the expansion vessel and the minimum working pressure of the solar system.

Sizing an expansion vessel for solar systems

The minimum working pressure of the solar system is usually in the range of 0.5 - 1.5 bar.

The pre-charge pressure of the expansion vessel, P_{prec}, must equal the minimum working pressure on the expansion vessel, P_{min}.

ATTENTION

The calculation performed by means of the above formula gives only an approximation of the volume needed for the expansion vessel and must be verified by the system designer taking into account the actual characteristics of the system and of the solar fluid.

Sizing an expansion vessels for a solar system - example

You can consider a solar system with the following characteristics:

Volume of the solar collector, V_c = 60 litres

Volume of solar collector connecting pipes, V_t = 25 litres

Overall volume of the pipes in the building and of other system components = 80 litres

Percentage of glycol in the solar fluid, 40%

Max. working temperature of the solar system, T_{max} = 130 °C

Opening pressure of the safety valve, P_{sv} = 6 bar

Minimum working pressure of the solar system, 0.7 bar

Static head on expansion vessel, H = 20m

Performing the calculation:

$$V_a = 60 + 25 + 80 = 165 \text{ litres}$$

$$V_d = 1.1 \times (60 + 25) = 93.5 \text{ litres}$$

$$V_v = 0.02 \times (60 + 25 + 80) = 3.3 \text{ litres}$$

$$P_{max} = 0.9 \times 6 = 5.4 \text{ bar}$$

$$P_{prec} = P_{min} = 2 + 0.7 = 2.7 \text{ bar}$$

Given the maximum working temperature and the percentage of glycol in the solar fluid, the expansion coefficient is approximately 0.09. The expanded volume of the solar fluid is:

The nominal volume of the vessel is:

$$V_N=[(14.8+93.5+3.3) \times (5.4 + 1)]/(5.4 - 2.7) = 264.5 \text{ litres}$$

A 350 litre Eres expansion vessel is required.

E & O.E

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