

solar systems

solarplus Applications: expansion vessels for solar systems



Zilmet, an internationally operating company with over 50 years of experience has grown to be the biggest European producer of expansion vessels.

With a complete range of tanks for heating and cold water, ZILMET supplies innovative and specific products, among which expansion vessels for solar systems as well as stainless steel vessels for harsh environments. The key to success is the completely automatic production lines coupled with an extreme flexibility. Thanks to a marked increase in its range of products, today ZILMET is capable of offering equipment for pressure maintenance, within a complete program of technical installation and in line with the most recent legal norms.

...the first “real” solar vessel was created by ZILMET fifteen years ago.

According to the DIN 4757 standards, ZILMET is certified for this type of solar vessel since 1996, being the first manufacturer and, therefore, the series SOLARPLUS became the “design of the solar technique”. Our experience in this sector is consolidated by more than 750,000 solar vessels produced and sold over the years.

Thank to its experience, Zilmet is now able to offer a complete system of expansion vessels that satisfy any solar system manufacturer’s specific requirement. Our range includes the SOLARPLUS, SOLARPLUS TM with interchangeable membrane, accessories for fast assembling, additional tanks VSG for temperature decrease, the new SOLARPLUS SAFE that combines a SOLARPLUS tank with a VSG in line tank. Brazed and plate heat exchangers for solar-system applications are also available.

■ general features

Technical specifications of SOLARPLUS expansion vessel: membrane expansion vessels manufactured according to PED 97/23/EC and EN 13831 standards, suitable for closed solar energy heating systems according to DIN 4757 and EN 12977. The vessel is equipped with a special solar membrane designed as a diaphragm, that separates the gas from the solar liquid.

Zilmet developed **(ZILAN)** membrane for SOLARPLUS expansion tanks. **(ZILAN)** is an high-temperature membrane, that resists up to 212 °F. **(ZILAN)** is a membrane made of synthetic rubber, product of decades of experience in installing Zilmet expansion tanks in solar collector energy systems. **(ZILAN)** synthetic rubber membrane is specifically designed for SOLARPLUS expansion tanks.





The vessel

- completely welded, thus particularly reliable and resistant up to a max pressure of 10 bar.
- painted with epoxy powder and available in grey, white or red.
- easy to install

The membrane

The **ZILAN** membrane is the result of a long-term experience in the installation of ZILMET tanks in thermal solar systems, as a consequence:

- Resists to temperatures up to 212 °F
- Resists to various ethylene- or propylene-glycolic mixture
- Membrane has a low gas permeability
- It is DIN 4807-3 certified

In a diaphragm tank the fluid is in direct contact with the inner walls so its temperature cools down without being in contact with the membrane only. We do not have a “thermos effect” which occurs in bag membrane tanks where the air between the tank and solar liquid does not let the fluid lose its heat quickly.

The peculiar structure and the unique features of the SOLARPLUS series guarantee safe and long-lasting performances.

How it works

The expansion vessel must ensure that the solar system can work safely (DIN 4757 and EN 12997) inside the solar circuit, particularly during the stand-by phase.

When inactive, modern solar collectors may reach temperatures up to 200°C (392°F) and consequently the fluid within the system can either evaporate or reach levels that can damage all the elements in the solar energy system in time.

In order to be able to resist the highest possible inactivity temperatures, ZILMET has developed **ZILAN** membrane for SOLARPLUS that can withstand up to 100°C (212°F).

In case of high temperatures in the membrane of the expansion vessel, the vessel must be protected by an additional vessel (VDI 6002 directive).

All ZILMET expansion vessels are fit for the installation in the solar system according to DIN 4757 and EN 12977 and they work with a mixture of water and propylene or ethylene glycol. The vessels are tested according to the pressure systems Directive.

The membrane pressure expansion vessel ensures that the system pressure does not exceed or does not go below the limits set in the planning phase. The membrane 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 membrane stretches along the gas chamber when the volume of the solar liquid increases because of the heat. Consequently the available space for the solar fluid increases and the pressure inside the system remains constant at the approved maximum value. But when the volume of the solar liquid decreases because of the cooling, the membrane returns to the initial pre-established pressure value. The available space for the solar liquid decreases and the pressure inside the system remains constant at the approved minimum value.

■ technical and dimensional data

Model	Code	Capacity	Ø Diameter	H Height	E	Connection
		litri	mm	mm		
SOLAR - PLUS 12	11A2001210	12	270	264	-	3/4"G
SOLAR - PLUS 18	11A2001811	18	270	349	-	3/4"G
SOLAR - PLUS 25	11A2002506	25	300	392	-	3/4"G
SOLAR - PLUS 35 W.F.*	11A2003304	35	380	367	125	3/4"G
SOLAR - PLUS 50 W.F.*	11A2005002	50	380	505	153	3/4"G
SOLAR - PLUS 80	11A2008001	80	450	608	150	1"G
SOLAR - PLUS 105	11A2010503	105	500	665	165	1"G
SOLAR - PLUS 150	11A2015000	150	500	897	216	1"G
SOLAR - PLUS 200	11A2020000	200	600	812	225	1"G
SOLAR - PLUS 250	11A2025000	250	630	957	245	1"G
SOLAR - PLUS 300	11A2030000	300	630	1105	245	1"G
SOLAR - PLUS 400	11A2040000	400	630	1450	245	1"G
SOLAR - PLUS 500	11A2050000	500	750	1340	290	1"G
SOLAR - PLUS 600	11A2060000	600	750	1555	290	1"G

*with feet

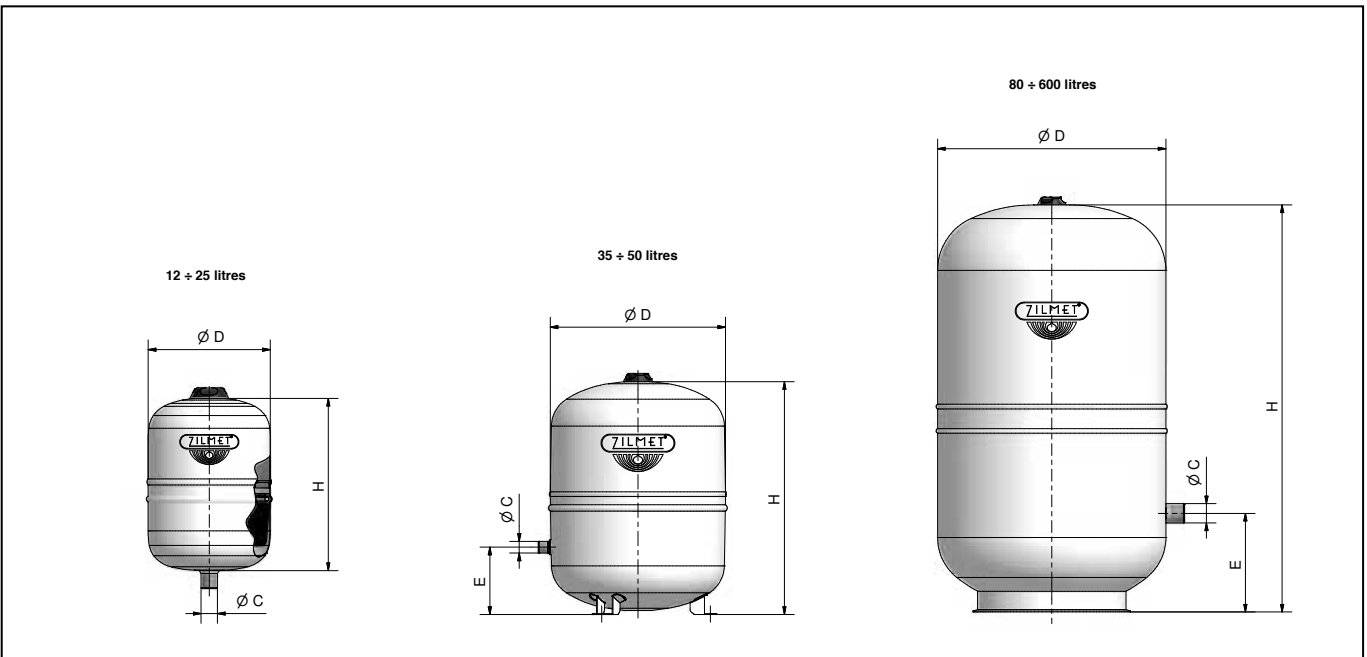
■ material description

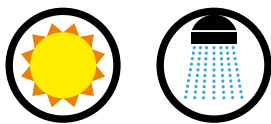
Description	Material
shell	carbon steel
connections	carbon steel
membrane	ZILAN special solar membrane
colour	white / red

■ operating conditions

max. working pressure	10 bar
system operating temperature	-10 ÷ 110 °C
membrane operating temperature	-10 ÷ 100 °C
factory precharge	2.5 bar

■ technical drawings





solar systems

solarplus tm Applications: expansion vesse for solar systems. **with replaceable membrane**



SOLARPLUS TM is a vertical vessel with a bottom flange to allow replacing the membrane whenever necessary. This tank can handle pressures up to 10 bar.

■ technical and dimensional data

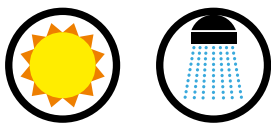
Model	Code	Capacity	Ø Diameter	H Height	Connection
		litri	mm	mm	
SOLARPLUS TM 12	11H2001200	12	270	295	3/4" G
SOLARPLUS TM 18	11H2001800	18	270	390	3/4" G
SOLARPLUS TM 24	11H2002400	24	270	470	3/4" G
SOLARPLUS TM 80	1102008000	80	450	830	1" G
SOLARPLUS TM 100	1102010000	100	450	910	1" G
SOLARPLUS TM 200	1102020000	200	550	1235	1 1/2" G
SOLARPLUS TM 300	1102030000	300	630	1365	1 1/2" G
SOLARPLUS TM 500	1102050000	500	750	1560	1 1/2" G

■ accessories

Zilmet offers various accessories for all working conditions of the solar energy system. These accessories are for the quick and safe replacement of the tank as well as the addition of another tank. The stop valve with discharge makes the annual pressure check just a matter of a few minutes.

Code	Model	Description	Connection
912508	ZWH B	Universal bracket for wall assembly up to 25 litres	-
912507	ZWH HP	Wall support for Solarflex up to 25 litres	-
912503	ZWH M	Fast assembly for 35 and 50 litres	-
910105	ZSKV	Butterfly solar valve completely in metal	3/4" G
910106	ZSKV	Butterfly solar valve completely in metal	1" G
930106	ZSKE	Fast escape clutch	
944007	ZSP1	Connecting vessel set, made up of flexible pipe 0.5 m., butterfly solar valve and wall support	





solar systems

additional vessel VSG

Applications: additional vessel for temperature reducing.



According to our experience and the reviewing of different international regulations on solar energy an additional tank is recommended when the fluid volume between the collector and the expansion vessel is approx 50% or less than the 'wet' side volume (between the expanded diaphragm and the vessel inlet). This approach is covered by the European Directive VDI 6002.

This requisite is rarely carried out for heating systems placed on the roofs due to the fact that the piping is short. The additional tank can protect the membrane from excessive temperatures. The correctly sized additional tank allows the decrease in the temperature of the solar liquid in the expansion system.

technical and dimensional data

Model	Code	Capacity	Ø Diameter	H Height	E	Connection
		litres	mm	mm		
VSG 5	11A0000512	5	160	270	-	N°2 x 3/4"G
VSG 8	11A0000837	8	200	280	-	N°2 x 3/4"G
VSG 12	11A0001216	12	270	264	-	N°2 x 3/4"G
VSG 18	11A0001836	18	270	349	-	N°2 x 3/4"G
VSG 35	11A0003510	35	380	367	125	N°2 x 3/4"G
VSG 50	11A0005022	50	380	505	153	N°2 x 3/4"G
VSG 105	11A0010518	105	500	665	165	N°2 x 1"G
VSG 200	11A0020013	200	600	812	225	N°2 x 1"G
VSG 400	11A0040017	400	630	1450	245	N°2 x 1"G

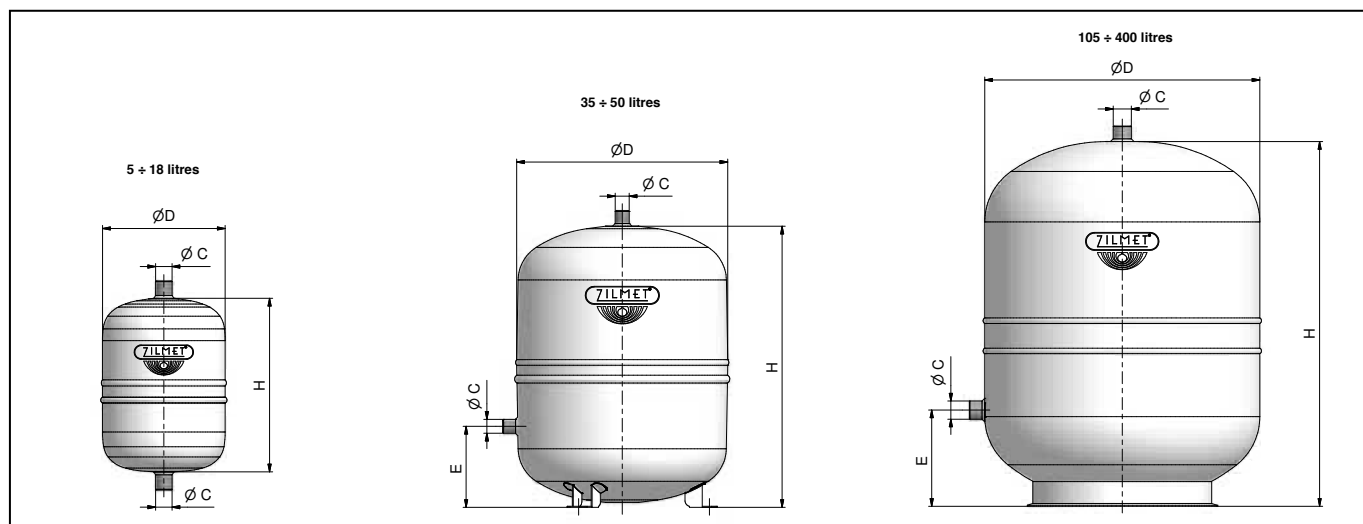
material description

Description	Material
shell	carbon steel
connections	carbon steel
colour	white

operating conditions

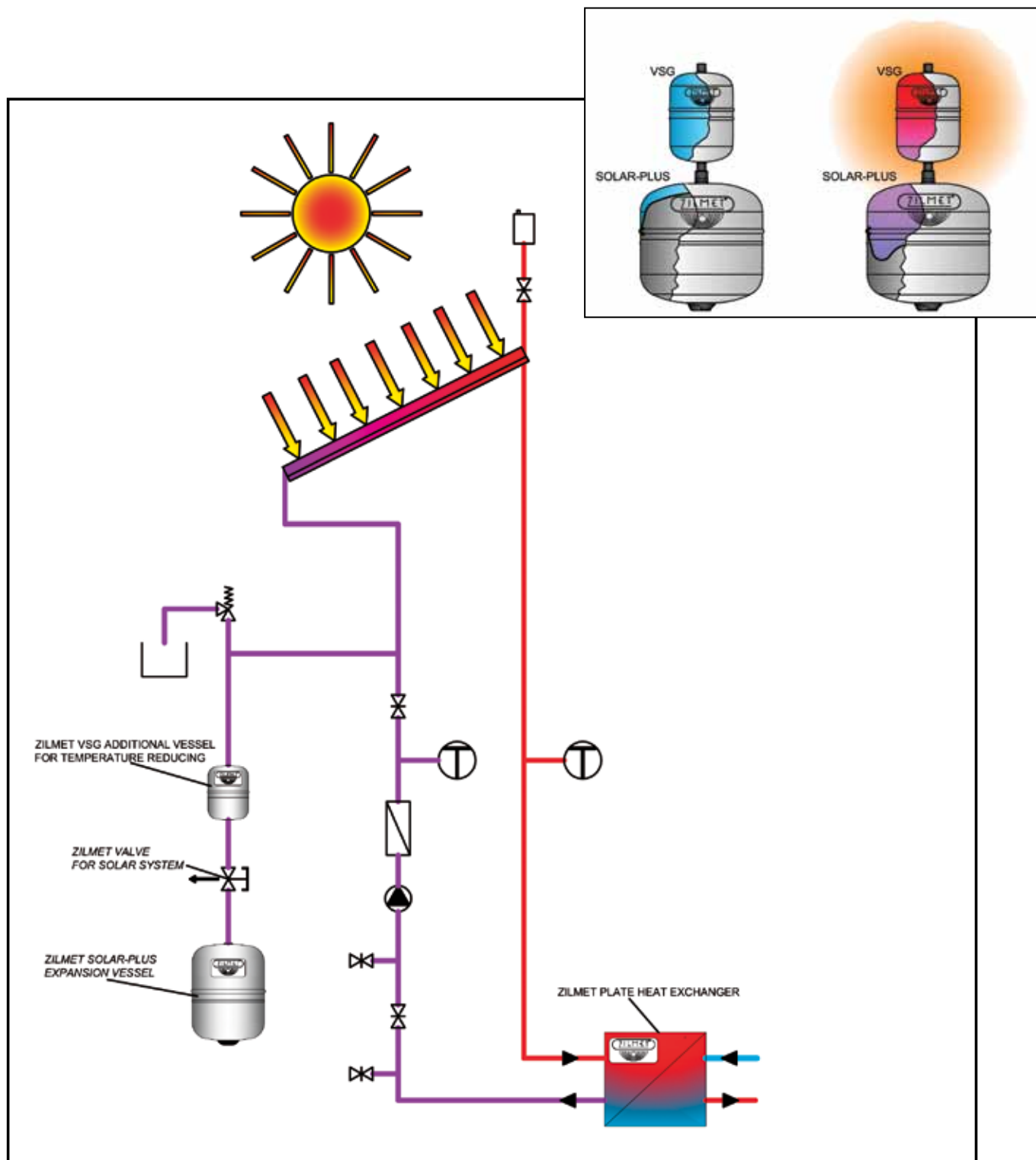
max. operating pressure	10 bar
operating temperature	-10 ÷ 110 °C

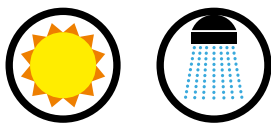
technical drawings



Operation of VSG vessel

When there is excessively high temperature in the solar energy system (in some cases even vapor), the hot fluid mixes with the cold stagnant fluid in the additional tank VSG. Therefore we have a cooling of the hot fluid through dispersion in the VSG tank. In this way the membrane of the SOLARPLUS vessel is protected from excessive temperatures.





solar systems

solarplus safe

Applications: expansion vessel for solar systems.



Solarplus SAFE: two in one

SOLARPLUS SAFE is a completely new product that combines the best of SOLARPLUS and the solar flow-through inline-vessel in only one vessel. The new expansion vessel is suitable for the use in solar systems according to EN 12976 and ENV 12977 (DIN 4757). The SOLARPLUS SAFE expansion vessel ensures safe operation of the solar expansion vessel even in case of excessive temperatures

Advantages

Less space	40% less space needed
Less time	50% less installation time required

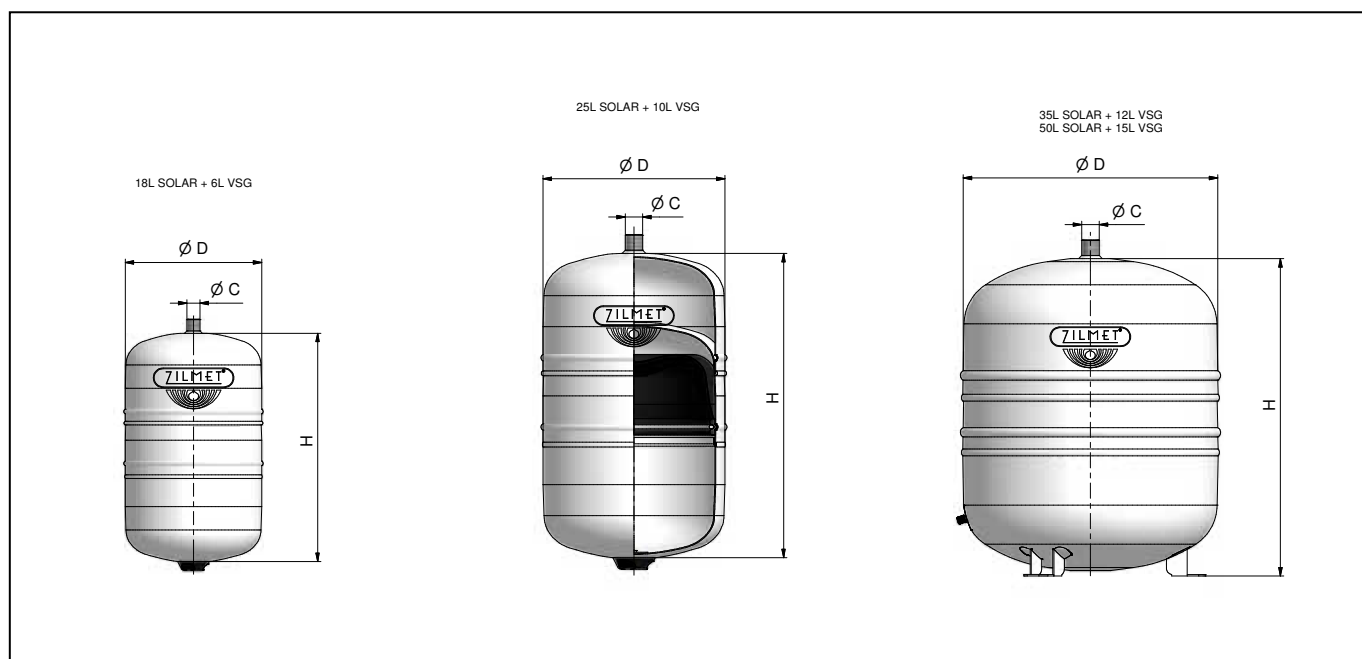
technical specifications

Approval	European Directive 97/23/EC
Available sizes	SOLARPLUS 18, 25 and 35 litres and Solar in-line vessel 6, 10 and 12 litres
Max. operating pressure	10 bar
Operating temperature	-10°C ÷ 110°C
Max. temperature on the membrane	100°C
Factory precharge pressure	2.5 bar
Membrane	ZILAN membrane
Colour	white epoxy-powder coating

technical and dimensional data

Model	Code	Capacity	Ø Diameter	H Height	Ø Connection
		litres	mm	mm	
SOLAR PLUS SAFE	11A2001822	18L SOLAR + 6L VSG	270	453	¾"G
SOLAR PLUS SAFE	11A2002522	25L SOLAR + 10L VSG	300	526	¾"G
SOLAR PLUS SAFE	11A2003319	35L SOLAR + 12L VSG W.F.	380	480	¾"G
SOLAR PLUS SAFE	11A2005010	50L SOLAR + 15L VSG	380	650	¾"G

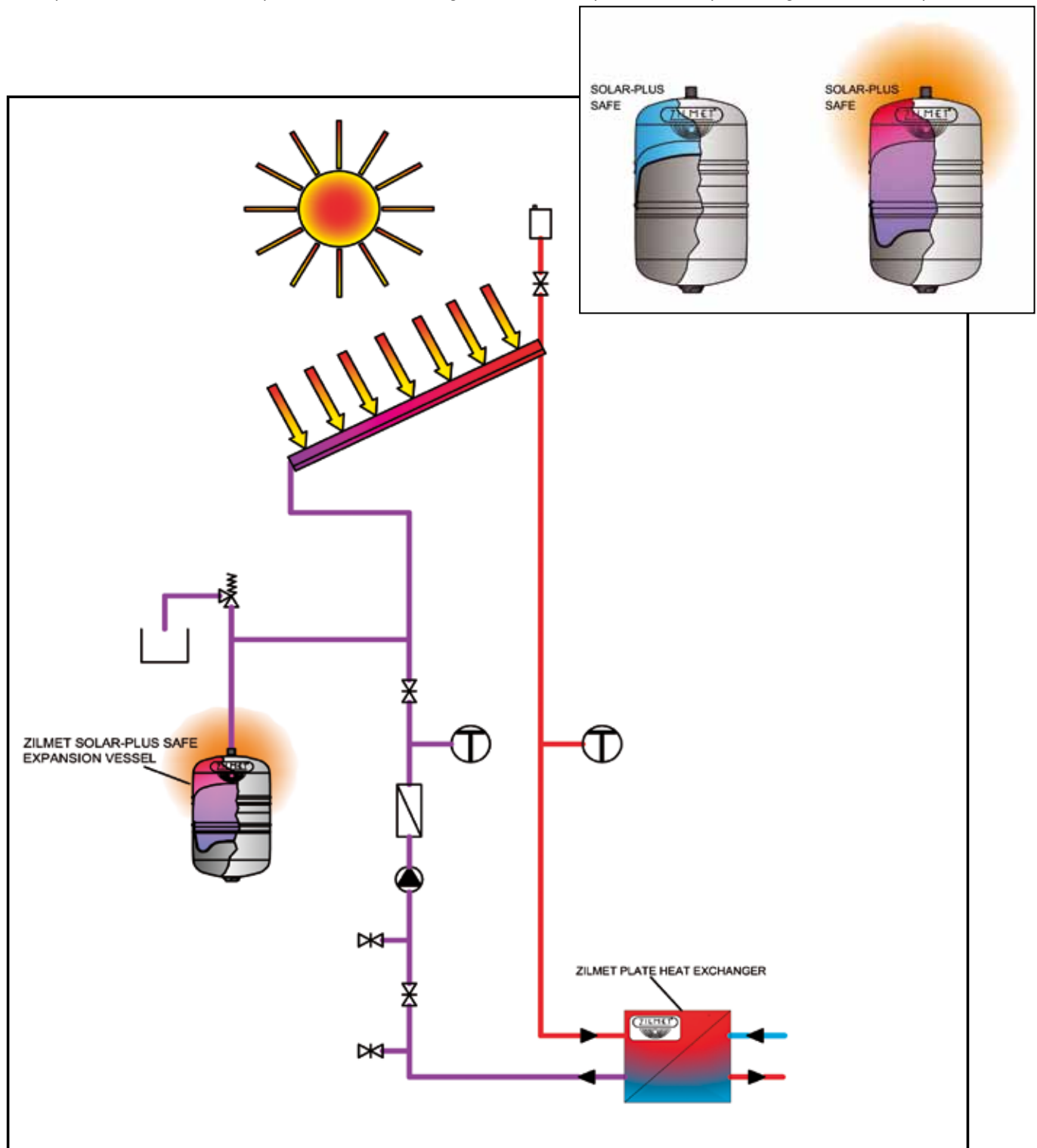
technical drawings



Operations of SOLARPLUS SAFE

The new product line combines the SOLARPLUS with a solar flow-through vessel VSG. Time for installation and even space are significantly reduced.

In case of stagnancy of the solar system liquid, the superheated solar liquid pushes the cold solar liquid from the in-line (tank) chamber into the area of the solar expansion vessel. Therefore, the special membrane of the integrated SOLARPLUS expansion vessel is protected against excessive temperatures.



■ sizing an expansion vessel for solar systems

Unlike the expansion vessels for standard central heating systems, sizing the expansion vessels for solar systems requires to consider not only the expansion volume of the solar fluid, but also steam volume due to the evaporation of the solar fluid itself and a proper amount of solar fluid stored in the expansion vessel to compensate reduction in volume due to low working temperatures during winter time.

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

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

In order to protect the membrane in the expansion vessel from the thermal stress due to high working temperatures, it is advisable to install a properly sized VSG additional vessel.

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:

$$V_v = 0.02 \times V_a$$

Anyway the amount of solar fluid stored in the expansion vessel must always equal 3 litres at least.

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 volume of the solar system [litres]. The total volume of the solar system equals the sum 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 on percentage of glycol in the solar fluid itself: it is possible to calculate the expansion coefficient by using proper 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 :

$$P_{\text{vs}} \leq 5 \text{ bar}, P_{\max} = P_{\text{vs}} - 0,5 \text{ [bar]}$$

$$P_{\text{vs}} > 5 \text{ bar}, P_{\max} = 0,9 \times P_{\text{vs}} \text{ [bar]}$$

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: 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, anyway, has to be verified by a specialized and authorized technician for keeping into account the real characteristics of the system and of the solar fluid.

■ sizing of expansion vessels for solar systems - 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%

Maximum 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, $H = 20$ m

You can perform calculations as follows:

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

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

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

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

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

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

$$V_e = (0.09 \times 165) = 14.8 \text{ litres}$$

The nominal volume of the expansion vessel is:

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

You have to choose a 300-litres SOLARPLUS expansion vessel

SOLARPLUS and VSG additional vessel choice table

Data mentioned in the table below are indicative for the choice of Solarplus and VSG additional vessel.

Final choice to be verified according to single installation specific characteristics.

Note: data in the table are based on $P_{VS} = 6 \text{ bar}$ $T_{max} = 130 \text{ °C}$ and 40% glycole percentage.

Collector surface		6 m ²			10 m ²			15 m ²			20 m ²		
Static height	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	
m	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	
5	10,4	18	5	14	25	5	19,5	35	12	25	50	12	
10	13,4	18	5	17	25	5	22,5	35	12	28	50	12	
15	16,4	25	5	20	35	12	25,5	50	12	31	80	18	
20	19,4	25	5	23	35	12	28,5	50	12	34	80	18	
Collector surface		25 m ²			30 m ²			35 m ²			40 m ²		
Static height	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	
m	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	
5	29,5	50	12	42	80	18	47,5	80	18	54	105	35	
10	32,5	80	18	47	80	18	52,5	105	35	59	105	35	
15	35,5	80	18	52	105	35	57,5	105	35	64	150	50	
20	38,5	80	18	57	105	35	62,5	150	35	69	150	50	
Collector surface		45 m ²			50 m ²			55 m ²			60 m ²		
Static height	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	
m	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	
5	59,5	105	35	65	150	50	70,5	150	50	76	150	50	
10	64,5	150	50	70	150	50	75,5	150	50	81	150	50	
15	69,5	150	50	75	200	100	80,5	200	100	86	200	100	
20	74,5	150	50	80	200	100	85,5	200	100	91	200	100	
Collector surface		70 m ²			80 m ²			100 m ²			150 m ²		
Static height	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	V _A	Solarplus	VSG	
m	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	litres	
5	87	150	50	98	200	100	155	300	100	225	400	200	
10	92	200	100	103	200	100	163	300	100	233	500	200	
15	97	200	100	108	250	100	171	400	200	241	500	200	
20	102	250	100	113	300	100	179	500	200	249	600	200	

ATTENTION: The calculation gives only an approximation of the volume needed for the expansion vessel and, anyway, has to be verified by a specialized and authorized technician for keeping into account the real characteristics of the system and of the used fluid.

plate heat exchangers for solar systems

In addition to the expansion vessels range, Zilmet also produces heat exchangers, brazed-plate and jointed plate, with several operating pressures. The solar heating, in all its applications, is the ideal way to use Zilmet plate heat exchangers.



Headquarters

Via del Santo, 242 - 35010 Limena (PD) - Italy
Tel. +39 049 7664901 • Fax +39 049 767321
www.zilmet.com
zilmet@zilmet.it

Production plants - Italy

Limena (PD) Via del Santo, 242
Via Visco, 2 • Via Colpi, 30
Via Tamburin, 15/17
Bagnoli di Sopra (PD) - Via V Strada, 21/23

Branches

Zilmet Deutschland GmbH
www.zilmet.de
Zilmet USA
www.zilmetusa.com