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solar plus

H W I U U
C O S B P L



Expansion vessels for solar systems





The Zilmet group

Zilmet, an internationally operating company, has with 45 years experience grown to be **the biggest European producer** of expansion vessels.

Having a covered area of over 150.000 m² with 6 production facilities, employs 450 persons who annually produce **over 6 million vessels** that are sold worldwide.

With a complete gamma of heating and cold water tanks, ZILMET supplies **innovative and special** products which include **expansion vessels for solar systems as well as stainless steel vessels**.

The keys to success are the completely automatic production lines connected to 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 up-dating of the most recent legal norms.



...the first “true” solar vessel

was created by ZILMET ten years ago and that was just the beginning.

According to the DIN 4757 standards, ZILMET obtains the certification in 1996 for this type of solar vessel, being its first producer and, therefore, the series SOLARPLUS became the “pattern of the solar technique”.

This technique was developed during the following years and it was adapted to the necessities of the solar sector.

- The membrane can withstand temperatures up to 100° C
- Working pressure 10 bar
- Capacities up to 600 litres
- Vessels with interchangeable membrane
- Various colours and models

Our experience in this sector is consolidated by more than 500.000 solar vessels produced in these last years.

INNOVATION: Special vessels for temperature reduction

ZILMET possesses the innovative solution for reducing the temperature when there is excessive thermal solicitation of the membrane in case of stopping. This combination guarantees the protection of the membrane against extremely high temperatures.

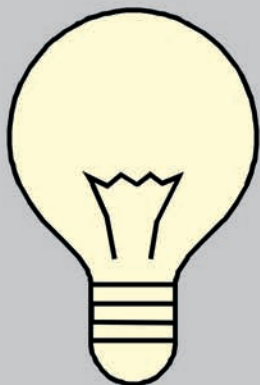
This means that:

Solarplus with 100°C
permanent temperature
of the membrane

combined
with

additional vessel
for temperature
reducing





Expansion vessels – why?

The expansion vessel must ensure that the solar system is able to work safely (DIN 4757 and EN 12997) inside the solar circuit, even during and after the stand-by phase.

Modern solar vessels can reach temperatures up to 200° C during inactivity. Their consequence is the evaporation of the solar liquid and reaching extreme temperatures in the solar circuit, up to the solar station. This damages parts of the system, such as pumps, joints, washers and, most of all, the membrane from the expansion vessel.

Furthermore, in case of prolonged heat absorption without removal, for example in the summer, when the heating is turned off or in the absence of electricity, the pressure of the solar system can rise to the point of activating the security valve.

In order to be able to support the highest possible inactivity temperatures, ZILMET developed a special heat-resistant membrane for SOLARPLUS: **it resists up to 100°C.**

The intrinsic security degree requested by the current measures can be reached only through an expansion vessel with membrane of adequate dimensions.

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

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

Functioning of the expansion vessels

The membrane pressure expansion vessel ensures that the system pressure does not exceed or go under the limits established in the planning phase.

The membrane divides the space inside the vessel occupied by the gas and by the solar liquid. The initial pressure p_0 of the gas environment must be regulated before turning it on (according to DIN 4757, page 8/9).

The membrane stretches in the gas environment when the volume of the solar liquid increases because of the heat. Consequently, the space at the disposal of the solar liquid rises 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 turns back to the correct initial pre-established value of the pressure. Consequently, the space at the disposal of the solar liquid decreases and the pressure inside the system remains constant at the approved minimum value.

SOLARPLUS

Pressure expansion vessel with membrane produced under the PED 97/23/CE and EN 13831 directive, fit for the use in closed solar energy heating systems according to DIN 4757 and EN 12977.

Inside the vessel there is a special solar membrane structured as a diaphragm membrane that separates the gas from the solar liquid.

The vessel:

- completely welded structure, thus particularly reliable and resistant up to 10,0 bar pressure.
- coated with powder which is available in white, silver and red
- special fast assembly system

The membrane

The Solarplus membrane is the result of a long-term experience in the installation of the ZILMET vessels in the thermal solar systems:

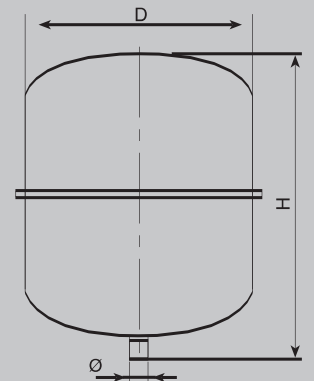
- possible loading of the membrane through the solar liquid up to 100°C
- stability of any mixture of propylene or ethylene glycol ratio.
- particularly reduced permeability
- certified under DIN 4807

Since the solar membrane is structured as diaphragm membrane, the penetrating solar liquid comes into contact with the wall of the vessel and could therefore get cooled, in order to protect the membrane. Therefore, there is no "thermos effect", as in vessels with a bladder membrane, because the space of the gas prevents the liquid from rapid heat loss.

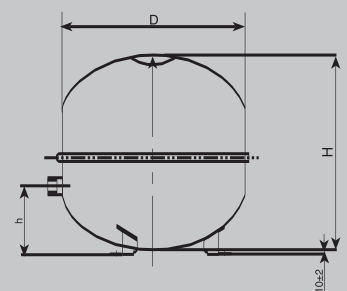
The result of the particular structure and of the unique features of the SOLARPLUS series

a long-life bound to a high functioning safety!

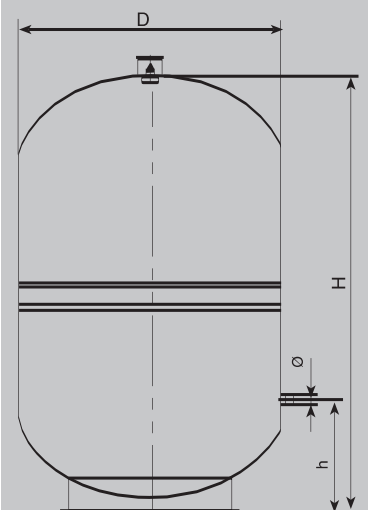
Type Volume/litres	D Diameter mm.	H Structure height mm.	Distance h	Connection	Article number
SOLARPLUS 12	270	270		G 3/4"	11A2001210
SOLARPLUS 18	270	350		G 3/4"	11A2001811
SOLARPLUS 25	300	392		G 3/4"	11A2002506
SOLARPLUS 35	380	400	135	G 3/4"	11A2003304
SOLARPLUS 50	380	537	150	G 3/4"	11A2005002
SOLARPLUS 80	450	600	140	G 1"	11A2008000
SOLARPLUS 105	500	710	165	G 1"	11A2010500
SOLARPLUS 150	500	940	215	G 1"	11A2015000
SOLARPLUS 200	630	875	225	G 1"	11A2020000
SOLARPLUS 250	630	957	215	G 1"	11A2025000
SOLARPLUS 300	630	1190	210	G 1"	11A2030000
SOLARPLUS 400	630	1495	245	G 1"	11A2040000
SOLARPLUS 500	750	1395	300	G 1"	11A2050000
SOLARPLUS 600	750	1620	290	G 1"	11A2060000



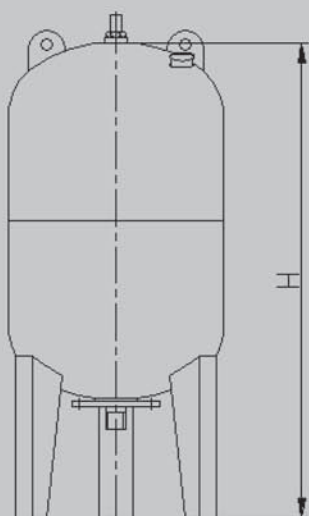
12 - 25 Litres



35 - 50 Litres
with feet for
quick installation



from 80 Litres
with base



SOLARPLUS TM with interchangeable membrane

The extension of the SOLARPLUS series due to the SOLARPLUS TM series would offer you a product of a much higher value.

All the SOLARPLUS TM vessels are produced as structures to be placed vertically with a connecting flange situated on the bottom, through which, if necessary, the membrane can be changed. **Use field up to 10,0 bar.**

Type Volume/litres	D Diameter mm.	H Structure height mm.	h Distance mm.	Connection	Article number
SOLARPLUS TM 80	450	830	165	G 1"	1102008000
SOLARPLUS TM 100	450	910	165	G 1"	1102010000
SOLARPLUS TM 200	550	1235	185	G 1 1/2"	1102020000
SOLARPLUS TM 300	630	1365	185	G 1 1/2"	1102030000
SOLARPLUS TM 500	750	1560	185	G 1 1/2"	1102050000

SOLARFLEX

Depending on the size, the SOLARFLEX standard line is used for the lower pressures. The SOLARFLEX, like the SOLARPLUS vessels, are provided with a diaphragm membrane that can support **up to 70°C** and therefore used in a more limited pressure zone.

Type Volume/litres	Functioning pressure bar	D Diameter mm.	H Structure height mm.	Connection	Article number
SOLARFLEX 12	10	270	270	G 3/4"	0810012
SOLARFLEX 18	10	270	375	G 3/4"	0810018
SOLARFLEX 25	8	300	420	G 3/4"	0810025
SOLARFLEX 35	6	380	380	G 3/4"	0810035

Accessories

ZILMET offers different accessories depending on the type of solar systems. The accessories make the assembly easier by the rule book of membrane expansion vessels and of the additional vessels: **fast and safe assembly**. The **butterfly solar escape valve** makes the necessary annual check of the initial pressure possible and it actually makes the **maintenance of the vessels a question of minutes**.

Type	Description	Connection	Article number
ZWH B	Universal brace for wall assembly up to 25 litres		0050004
ZWH H	Wall support for Solarflex up to 25 litres		0050000
ZWH-HP	Wall support for Solarflex up to 24 litres		0050002
ZSM	Fast assembly for 35 and 50 litres		0050001
ZSKV 3/4"	Butterfly solar valve completely in metal	Dice 3/4" / external 3/4"	0530001
ZSKV 1	Butterfly solar valve completely in metal		0530010
ZSKE	Fast escape clutch	Internal / external 3/4"	0542000
ZFS05	Flexible pipe 0,5 m., DN 20	Dice 2x3/4"	0580050
ZFS10	Flexible pipe 1,0 m., DN 20	Dice 2x3/4"	0580060
ZEWS05	Corrugated steel pipe 0,5 m., DN 20	Dice 2x3/4"	0580040
ZEWS10	Corrugated steel pipe 1,0 m., DN 20	Dice 2x3/4"	0580030
ZSP1	Connecting vessel set, made up of flexible pipe 0,5 m., butterfly solar valve and wall support	Structure 3/4"	0580100
ZVP3	Analogical initial pressure gauge up to 3,5 bar		0510001
ZVP7	Analogical initial pressure gauge up to 7,0 bar		0510002
ZEM	Analogical initial pressure gauge up to 7,0 bar		0510003



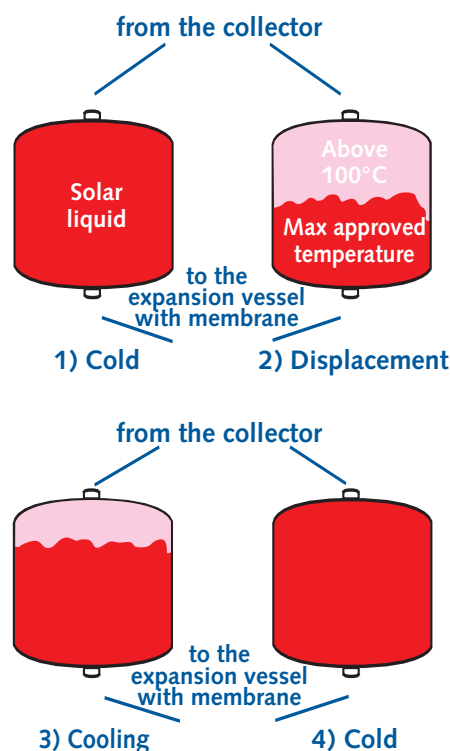
Additional vessel

The **VDI 6002 directive** recommends an additional vessel "...when the contents of the piping between the collectors' field and the expansion vessel with membrane is lower than 50% of the reception of liquids capacity of the vessel of adequate dimensions". This minimum requirement is rarely fulfilled in the case of the heating centers with short pipes situated on roofs. The additional ZILMET vessels effectively protect the membrane against excessive temperatures that could damage it. The solar liquid temperature in the expansion pipe can be diminished through an additional vessel of adequate dimensions.

Functioning

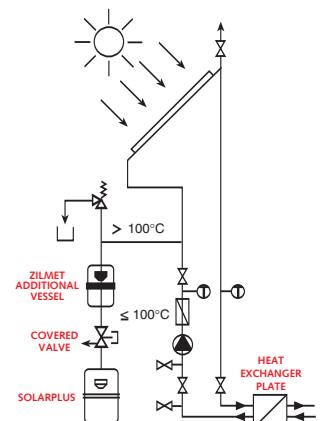
The solar liquid remains in the additional vessel (1). In case of excessive temperatures or in case of extreme steam, this will get mixed up with the cold solar liquid present in the additional vessel (2). The solar liquid will get cold in the non-insulated additional vessel (3). Thus, the safety regulations will ensure that the membrane will be protected against excessive temperatures.

Functioning of the additional vessel



* maximum approved temperature of the membrane 100°C or 70°C

Type Volume/litres	Diameter mm.	Height without connections mm.	Connection	Article number
VSG 5	160	270	2 x R 3/4"	11A0000512
VSG 12	250	270	2 x R 3/4"	11A0000837
VSG 18	270	350	2 x R 3/4"	11A0001216





FORMULA



CALCULATE THE DIMENSIONS OF THE EXPANSION VESSEL

Unlike the expansion vessels in the heating sector, those that are used in solar systems have the task to compensate not only the volume expansion of the heat, but also its more or less accentuated diminishing in case of cooling (e.g. in the winter).

For this purpose, it is recommended a liquid container (V_V) corresponding to about 2% of the system volume (V_A), however not lower than 2 litres.

The determination of the evaporation volume (V_D) is done according to the regulations of ENV 12977-1: "...the expansion vessel must be in such a condition that it could compensate a volume corresponding to the total volume of the heat vehicle, of the collectors' group and of all the pipes between the collectors, plus 10%.

Despite the calculation of the evaporation volume (V_D), the very large steam tunnels can be stretched to solar stations. Other specific criteria of each system to be taken into account are:

the emptying compartment and the performances of the collector steam, the capacity and the insulation of the pipes and the system pressure.

In case the evaporation volume cannot be calculated, it can be approximately estimated to 1 litre/m² for the flat collectors and to 2 litres/m² for the vacuum packed pipes.

In order to protect the expansion vessel in a reliable way against extreme temperatures there should be used an additional vessel of adequate dimensions.

Volume of the expansion vessel

ZILMET offer to their clients a free calculation programme on CD, where all the necessary information can be requested and automatically entered in the formulae. The formula on the base of the calculation is taken from the DIN 4807 directive.

The calculation of the necessary volume for the expansion vessel V_N can be made whether by taking into account the evaporation or without taking it into account:

The formula:

$$V_e = V_A \times n$$

Without evaporation:

$$V_N = \frac{(V_e + V_V) \times (p_e + 1)}{p_e - p_0}$$

With evaporation:

$$V_N = \frac{(V_e + V_V + V_D) \times (p_e + 1)}{p_e - p_0}$$

For this calculation are necessary the following data

- V_N : nominal volume of the expansion vessel;
 V_e : expansion volume, calculated as $n \times V_A$;
 n : expansion coefficient, depending on the composition of the solar liquid, therefore on the ratio of water to glycol (examine the producer instructions) as the difference between the expansion factor between the temperature of the first filling and that of the maximum chosen temperature;
 V_A : The system volume, corresponding to the contents of the collectors, of the pipes, of the connections and of the heat exchange unit;
 V_V : the liquid container volume in the expansion vessel;
 V_D : steam volume in case of stagnation;
 p_e : system pressure at the highest approved temperature
 $p_e = p_{sv} \times p_{da}$;
 p_{sv} : activation pressure of the safety valve, calculated as $p_e + p_{da}$;
 p_{da} : difference of pressure during functioning of the safety valve:
 $p_{sv} - 10\%$ oppure $p_{sv} - 0,5 \text{ bar}$ for safety valves with an activation pressure up to 5,0 bar;
 p_0 : minimum functioning pressure of the solar installation, corresponding to the initial pressure to be inserted in the gas space of the expansion vessel.

Calculation example

Flat collectors, surface of the collectors 6,0 m², volume of the collectors 3,6 l., length of the pipes 16,0 m, pipes DN 15, volume of the heat exchange unit 2,0 l., activation pressure of the safety valve 6,0 bar, static height 10,0 m, evaporation temperature 130°, part of the ethylene glycol 40%.

$$V_N = \frac{(V_e + V_V) \times (p_e + 1)}{p_e - p_0}$$

$$V_e = n \times V_A$$

$$n = 8,48\%$$

$$V_e = (3,6 \text{ l.} + 3,3 \text{ l.} + 2,0 \text{ l.}) \times 8,48\% = 0,75 \text{ l.}$$

$$V_V = 2,0 \text{ l.}$$

$$V_D = 3,6 \text{ l.} + 10\% = 4,2 \text{ l.}$$

$$p_e = 6,0 \text{ bar} - 10\% = 5,4 \text{ bar}$$

$$p_0 = 1,0 \text{ bar} + 1,5 \text{ bar} \times 2,5 \text{ bar}$$

$$V_N = \frac{(0,75 + 2,0 + 4,2) \times (5,4 + 1)}{5,4 - 2,5} \longrightarrow V_N = 15,4 \text{ litres}$$

Chosen model: SOLARPLUS 18



EXAMPLE



Selection table SOLARPLUS and additional vessels

The following table has to be seen as an indicator in choosing the SOLARPLUS dimensions and the corresponding ZILMET additional vessel.

A detailed interpretation should be performed on the different systems for every single installation.

$p_{SV} = 6,0 \text{ bar}$, $p_0 = 2,5 \text{ bar}$, part of the ethylene glycol¹ 40% (up to $-25,2^\circ\text{C}$)

Surface of the collector m ²	Volume of the installation V _A in l.	Expansion n in %	Liquid container V _V in l.	Steam ² V _E in l.	SOLARPLUS litres	Volume ³ of the additional vessel in l.
6	9	8,48	2	4,2	18	5
10	15	8,48	2	6,6	24	12
15	21	8,48	2	9,9	35	12
20	27	8,48	2	13,2	50	18
30	35	8,48	2	19,8	80	25
35	48	8,48	2	22,1	80	25
40	87	8,48	2	28	105	35

$p_{SV} = 6,0 \text{ bar}$, $p_0 = 3,0 \text{ bar}$, part of the ethylene glycol 40% (up to $-25,2^\circ\text{C}$)

Surface of the collector m ²	Volume of the installation V _A in l.	Expansion n in %	Liquid container V _V in l.	Steam ² V _E in l.	SOLARPLUS litres	Volume ³ of the additional vessel in l.
6	9	8,48	2	4,2	18	5
10	15	8,48	2	6,6	24	12
15	21	8,48	2	9,9	35	12
20	27	8,48	2	13,2	50	18
30	35	8,48	2	19,8	80	25
35	48	8,48	2	22,1	80	25
40	87	8,48	2	28	105	35

$p_{SV} = 3,0 \text{ bar}$, $p_0 = 1,5 \text{ bar}$, part of the ethylene glycol 50% (up to $-37,6^\circ\text{C}$)

Surface of the collector m ²	Volume of the installation V _A in l.	Expansion n in %	Liquid container V _V in l.	Steam ² V _E in l.	SOLARPLUS litres	Volume ³ of the additional vessel in l.
6	9	8,80	2	4,2	24	12
10	15	8,80	2	6,6	35	12
15	21	8,80	2	9,9	50	18
20	27	8,80	2	13,2	80	24
30	35	8,80	2	19,8	105	35
35	48	8,80	2	22,1	105	35
40	87	8,80	2	28	150	50

$p_{SV} = 3,0 \text{ bar}$, $p_0 = 2,0 \text{ bar}$, part of the ethylene glycol 50% (up to $-37,6^\circ\text{C}$)

Surface of the collector m ²	Volume of the installation V _A in l.	Expansion n in %	Liquid container V _V in l.	Steam ² V _E in l.	SOLARPLUS litres	Volume ³ of the additional vessel in l.
6	9	8,88	2	4,2	50	18
10	15	8,88	2	6,6	80	25
15	21	8,88	2	9,9	105	35
20	27	8,88	2	13,2	150	50
30	35	8,88	2	19,8	200	80
35	48	8,88	2	22,1	200	80
40	87	8,88	2	28	300	105

- ¹ Tyfocor, ethylene glycol.
- ² In the case of the flat collectors; higher temperatures can be created for the vacuum packed pipes.
- ³ Recommendation: calculate the minimum volume under the VDI 6002 regulation. The exact calculation of the dimension must be done system by system.

Assembly and starting up

The expansion vessel can be assembled inside the reflux of the solar installation on the lock side (exit pressure) but also on the aspiration side (entrance pressure) of the circulation pump. Since there are no interruptions between the collector and the expansion vessel, the latter is frequently assembled on the lock side of the pump.

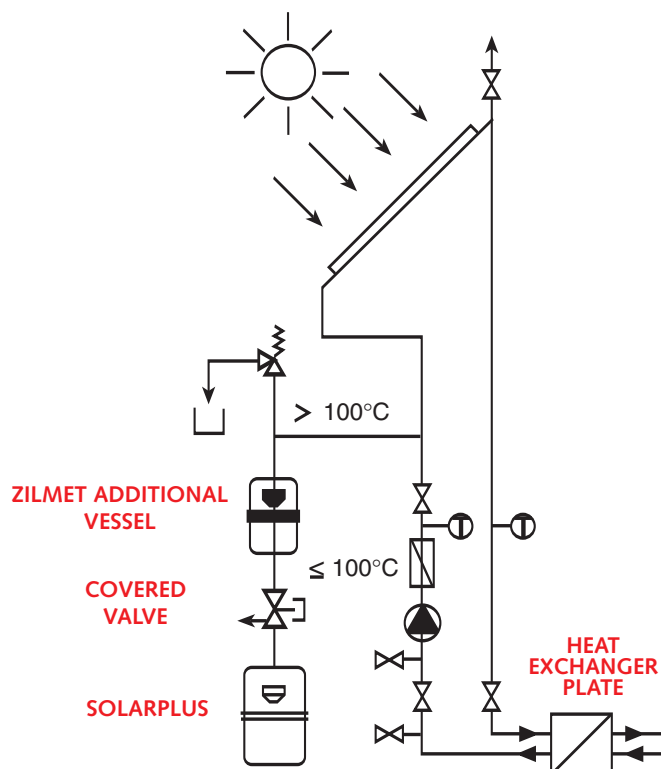
Especially the exit pressure does not have to go under the minimum entrance pressure that must be present at the aspiration block (see producer instructions). According to EN 12828, a **covered escape valve** can be assembled directly to the connection of the expansion vessel system as a maintenance connection.

A covered valve ensures the impossibility of involuntary closing. In case of use of the additional vessel, the valve must be situated between the former and the expansion vessel. The expansion vessel can be emptied in case of maintenance through the system after the closing of the valve itself by emptying the covered valve.

At start up of the solar system, the initial pressure (p_0) of the expansion vessel with membrane must be adjusted system by system.

Additional vessel

The additional vessel must be placed directly in the expansion pipe between the collector cycle and the expansion vessel. There must not be any interruptions in the pipes. The additional vessel must not be insulated. The additional vessels with a total weight (containing more solar liquid) of more than 30 kg must be either fixed on the wall or vertically assembled on the floor.



solar plus

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