Technical Bulletin:

Solar Thermal Expansion Tank Sizing Guide

For Bosch and Buderus Solar Thermal Systems

BOSCH

Introduction

The following sizing guide offers step by step calculations to determine the minimum volume of expansion. This value is used to select the minimum expansion tank size for your solar thermal system.

Step 1: Calculate system volume

$$V_{total} = V_{pipng} + V_{collectors} + V_{pump\ station} + V_{heat\ exchanger}$$

- **V_{pipng} =** Total length of pipe in feet x volume per foot
- **$V_{collectors}$ =** Number of collectors x volume/collector
- **$V_{pump\ station}$ =** 0.25 gallon
- **$V_{heat\ exchanger}$ =** Total volume of heat exchanger/coils

Table 1

Pipe dimension Ø x wall thickness	Specific line volume
½"	0.012 gal/foot
¾"	0.025 gal/foot
1"	0.043 gal/foot
1¼"	0.066 gal/foot
1½"	0.093 gal/foot

Table 2

Collector	Fluid volume per collector
SKS 4.0-s	0.38 gal
SKS 4.0-w	0.46 gal
SKN 3.0-s	0.23 gal
SKN 3.0-w	0.33 gal
FKT-1s	0.38 gal
FKT-1w	0.46 gal
FKC-1s	0.23 gal
FKC-1w	0.33 gal

Step 2: Calculate initial pre-charge pressure of the expansion tank:

$$P_{initial} = .4455\ psi/ft \times H_{static} + 10.3\ psi$$

- **H_{static} =** Vertical measurement from center of expansion tank to top of collectors

$P_{initial}$ = _____

Step 3: Calculate liquid expansion volume

$$V_{expansion} = V_{total} \times \text{liquid expansion coefficient}$$

- **V_{total} =** Value from Step 1
- **Expansion coefficient =** 0.10

$V_{expansion}$ = _____

Step 4: Calculate vapor expansion of collectors during stagnation

$$V_{vapor\ exp.} = V_{collectors}$$

- **$V_{collectors}$ =** Value from Step 1

$V_{vapor\ exp.} = V_{collectors}$ = _____

Table 3

Solar Storage Tank			Indirect coil content in gallons
Scope	**Type**	**Brand/model**	
DHW heating	dual-coil	Logalux SM300	2.11
		Logalux SM400	2.5
	single-coil with electric back-up	Sol-Ret 80 gal.	2.2
		Sol-Ret 120 gal.	2.6
DHW heating and central heating	combi storage tank	Logalux PL750/25	0.36
Solar preheat	single coil	SST150-40	1.6
		SST250-65	1.9
		SST300-80	2.1
		SST450-119	3.2

Step 5: Calculate minimum expansion tank volume

Minimum Volume of Expansion =

($V_{expansion}$ + $V_{vapor\ exp.}$) x (P_{sv} + 14.5 psi) / (P_{sv} – $P_{initial}$)

- **$V_{expansion}$ =** value from Step 3
- **$V_{vapor\ exp.}$ =** value from Step 4
- **$P_{initial}$ =** value from Step 2
- **P_{sv} </ =** 0.9 x relief valve discharge rating

Minimum volume of expansion = _____

EXAMPLE:

Assume you are sizing the expansion tank for 10 x SKS4.0 landscape collectors. The main pipe run between the Storage tank and the collectors has been determined to be 3/4“ diameter copper pipe. Total installed length of pipe will be 110 feet. The vertical measurement from where the expansion tank will be mounted to the top of the collectors is 40 feet. Three SM400 dual-coil storage tanks have been selected to be piped in parallel to provide the solar storage volume using boilers as the back-up energy source. The pressure relief valve for this system is rated at 87 psig. Calculate the minimum size expansion tank needed for this system

Step 1: Calculate the total system fluid volume

V_{piping}: .025 gal/foot x 110‘ =	2.75 gallons
$V_{collectors}$: .46 gal/collector x 10 =	4.60 gallons
$V_{pump\ station}$:	0.25 gallons
$V_{heat\ exchanger}$: 3 x 2.5 gal/coil =	7.50 gallons
V_{total}:	**15.10 gallons**

Step 2: Calculate the initial precharge of the expansion tank

$P_{initial}$ = (.4455 x 40 feet) + 10.3 psi = **28.12 psig**

Step 3: Calculate the liquid expansion volume

V_{total} = 15.1
$V_{expansion}$ = 15.1 x .10 = **1.51 gallons**

Step 4: Calculate vapor expansion of collectors during stagnation

$V_{collectors}$ = .46 gal/collector x 10 collectors = 4.6 gallons
$V_{vapor\ expansion}$ = **4.6 gallons**

Step 5: Calculate the minimum expansion tank volume

Minimum Volume of Expansion =
(1.51 + 4.6) x ((0.9 x 87) + 14.5) / ((0.9 x 87) - 28.12) = **11.3 gallons**

11.3 gallons would be the minimum volume of the expansion tank sized for this system. Larger sized expansion tanks for closed loop solar thermal systems are always acceptable. It is always recommended to use the next larger sized expansion tank if your calculation puts you close to the capacity of an expansion tanks acceptance volume

BOSCH
Bosch Thermotechnology Corp.
50 Wentworth Avenue
Londonderry, NH 03053

Tel: 1-800-283-3787
Fax: 1-603-584-1687
www.boschsolar.com