Thermic Fluid Expansion Tank Volume

Expansion volume of a thermic fluid (hot oil) system from cold and hot densities and the expansion tank volume for the share of the tank you allow it to fill.

Method: Mass conservation (volume change from density change)

Input parameters

Unit system: SI

Parameter	Value	Unit
System fluid volume when cold (heater, pipes, users)	10.000	m³
Thermic fluid	Enter the properties below	
Cold filling temperature (for the fluid tables)	30.000	°C
Maximum operating temperature (for the fluid tables)	300.00	°C
Density at the cold filling temperature	870.00	kg/m³
Density at the maximum operating temperature	700.00	kg/m³
Share of the tank the expansion may fill Space between the cold level and the high-level alarm, as a share of the tank volume; your design rule or code sets it.	60.000	%

Calculated results

Parameter	Value	Unit
Expansion tank volume	4.0476	m³
Expansion of the fluid	2.4286	m³
Volume expansion, share of cold volume	24.286	%

Formula and method

$$e = \frac{\rho_c}{\rho_h} - 1 \qquad \Delta V = V e \qquad V_t = \frac{\Delta V}{f}$$

Variables

V	system fluid volume when cold	m³
fluid	fluid chosen, or properties entered	–
T_c	cold filling temperature (tabulated fluids)	K
T_h	maximum operating temperature (tabulated fluids)	K
ρ_c	density at filling temperature	kg/m³
ρ_h	density at maximum operating temperature	kg/m³
f	share of the tank the expansion may fill	–
V_t	expansion tank volume	m³
ΔV	fluid expansion	m³
e	volume expansion ratio	–

Method and standards

Mass conservation: the fluid's mass is fixed, so its volume grows as density falls. Densities at the cold and hot temperatures. Fluid properties: either typed in, or taken from the makers' published liquid tables for Therminol 55 (Eastman bulletin TF8994), Therminol VP-1 (Eastman bulletin TF9141), DOWTHERM A (Dow technical data sheet; no kinematic viscosity tabulated) and Therminol 66 (Eastman bulletin SFE-HTF-19853), interpolated linearly between the published points (viscosity linearly in its logarithm) and never extrapolated. More fluids will be added as their makers' tables are captured.

Assumptions and limits

- Whole system at the maximum temperature; no fluid loss.

- The tank volume covers the expansion only; the low-level reserve and vapour space must fit in the share f you choose (no minimum reserve is checked).
- With a tabulated fluid the temperatures are used and the typed densities ignored; with "enter the properties" the densities are used and the temperatures ignored.

References

- Mass conservation (volume change from density change)

Report details

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Release checks	6 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/thermic-fluid-heaters/thermic-fluid-expansion-tank

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Reopens the calculator with the inputs of this report.