Chilled Water Thermal Storage Tank Size

Volume, mass and diameter of a stratified chilled water storage tank for a cooling energy, from the temperature difference and the tank figure of merit.

Method: Sensible heat storage; E = m cp ΔT (ASHRAE Handbook—HVAC Systems and Equipment, Thermal storage); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Cooling energy to store	5,000.0	kWh
Return minus supply temperature	8.0000	K
Mean water temperature	8.0000	°C
Figure of merit (usable share of the theoretical capacity)	90.000	%
Water height in the tank	10.000	m

Calculated results

Parameter	Value	Unit
Water density at the mean temperature	999.85	kg/m³
Water specific heat at the mean temperature	4.1988	kJ/(kg·K)
Water mass	595.41	t
Water volume	595.50	m³
Inside diameter for the water height	8.7075	m

Notes for this case

- Water properties from IAPWS-IF97 at 1 atm. Add volume for the diffusers, the thermocline and free board.

Formula and method

$$m = \frac{E}{c_p \, \Delta T \, FOM}, \quad V = \frac{m}{\rho}, \quad D = \sqrt{\frac{4V}{\pi H}}$$

Variables

E	Cooling energy to store	J
ΔT	Return minus supply temperature	K
T_m	Mean water temperature	K
FOM	Figure of merit (usable share of the theoretical capacity)	-
H	Water height in the tank	m
ρ	Water density at the mean temperature	kg/m³
c_p	Water specific heat at the mean temperature	J/(kg·K)
m	Water mass	kg
V	Water volume	m³
D	Inside diameter for the water height	m

Method and standards

Sensible storage in water; density and specific heat at the mean temperature from IAPWS-IF97.

Assumptions and limits

- Stratified tank; liquid water at 1 atm.

References

- Sensible heat storage
- E = m cp ΔT (ASHRAE Handbook—HVAC Systems and Equipment, Thermal storage)
- IAPWS-IF97 water properties

Report details

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Release checks	3 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/hvac/chillers/chilled-water-thermal-storage

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.