Cylindrical Tank Steel Weight from Plate Thickness

Steel mass of a cylindrical tank or vessel from diameter, shell length, shell and head thicknesses and head type, with an allowance for nozzles and attachments.

Method: Shell and head geometry (definitions; standard head area and volume factors)

Input parameters

Unit system: SI

Parameter	Value	Unit
Inside diameter	3.0000	m
Shell length (tangent to tangent)	8.0000	m
Shell thickness	8.0000	mm
Head thickness	10.000	mm
Head type	2:1 ellipsoidal	
Steel density	7,850.0	kg/m³
Allowance for nozzles, supports and welds	10.000	%

Calculated results

Parameter	Value	Unit
Shell mass	4,747.6	kg
Mass of two heads	1,541.9	kg
Total with allowance	6,918.5	kg
Internal volume	63.617	m³

Notes for this case

• Head surface area factors (× D²): flat 0.785, 2:1 ellipsoidal 1.084, hemispherical 1.571, torispherical (ASME flanged and dished, crown radius D, knuckle 6 % of D) about 0.931; volumes 0, πD³/24, πD³/12 and about 0.0809D³ per head. Head area uses D + t_h, volume the inside D. Straight flanges ignored.

Formula and method

$$m_s = \pi(D + t_s)Lt_s\rho, \quad m_h = 2k_A(D + t_h)^2 t_h\rho, \quad V = \frac{\pi D^2}{4}L + 2k_V D^3$$

Variables

D	Inside diameter	m
L	Shell length (tangent to tangent)	m
t_s	Shell thickness	m
t_h	Head thickness	m
heads	Head type	-
ρ	Steel density	kg/m³
f_a	Allowance for nozzles, supports and welds	-
m_s	Shell mass	kg
m_h	Mass of two heads	kg
m	Total with allowance	kg
V	Internal volume	m³

Method and standards

Geometry.

Assumptions and limits

- Head factors are for the standard shapes: 2:1 ellipsoidal, hemispherical and ASME flanged-and-dished torispherical (crown radius equal to D, knuckle radius 6 % of D). Other torispherical heads (10 % knuckle, Klöpper, Korbbogen) differ by several per cent.
- Head plate area is taken on the diameter D + t_h (near the mean surface); the head volume uses the inside diameter D. A flat head is a disc of diameter D + t_h: a plate that overhangs the shell, and straight flanges, add mass.
- Thin-walled approximation.

References

- Shell and head geometry (definitions; standard head area and volume factors)

Report details

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

This calculator online

https://calc.firecad.com/mechanical/vessels/tank-steel-weight

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Reopens the calculator with the inputs of this report.