Ellipsoid Volume and Surface Area

Volume and surface area of an ellipsoid from its three semi-axes, by the exact volume formula and Knud Thomsen's approximation for the surface.

Method: Ellipsoid volume; Knud Thomsen surface approximation

Input parameters

Unit system: SI

Parameter	Value	Unit
Semi-axis a	3.0000	m
Semi-axis b	2.0000	m
Semi-axis c	1.0000	m

Calculated results

Parameter	Value	Unit
Volume	25.133	m^3
Surface area (Thomsen)	48.972	m^2
Volume relative to a sphere of radius a	22.222	%
Radius of a sphere of equal volume	1.8171	m

Notes for this case

• V = (4/3)πabc exactly. The surface of a general ellipsoid needs elliptic integrals; Knud Thomsen's formula S ≈ 4π[((ab)^p + (ac)^p + (bc)^p)/3]^{1/p}, p = 1.6075, is within about 1.1 % for any shape and exact for a sphere. Ellipsoidal heads and tank ends use half of these values.

Formula and method

$$V = \frac{4}{3}\pi abc, \quad S \approx 4\pi \left[\frac{(ab)^p + (ac)^p + (bc)^p}{3}\right]^{1/p}, \; p = 1.6075$$

Variables

a	Semi-axis a	m
b	Semi-axis b	m
c	Semi-axis c	m
V	Volume	m^3
S	Surface area (Thomsen)	m^2
V/V_{sphere}	Volume relative to a sphere of radius a	-
r_{eq}	Radius of a sphere of equal volume	m

Method and standards

Ellipsoid.

Assumptions and limits

- Surface by approximation (about 1 % worst case).

References

Ellipsoid volume; Knud Thomsen surface approximation

Report details

Report reference	FCC-XJ15-8VF9 (the same inputs always give the same reference)
Generated	23 November 2026, 18:08 UTC
Calculator	Ellipsoid Volume and Surface Area
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/general/geometry/ellipsoid-volume-surface

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.