Mass Moment of Inertia of Common Solids

Mass moment of inertia and radius of gyration of a solid or hollow cylinder, sphere, rod or rectangular plate about its usual axis, from mass and size.

Method: Textbook mechanics (standard results for uniform solids)

Input parameters

Unit system: SI

Parameter	Value	Unit
Body and axis	Solid cylinder or disc, about its axis	
Mass	50.000	kg
Outer radius, or length (rod), or side a (plate)	0.25000	m
Inner radius (hollow) or side b (plate)	0.15000	m

Calculated results

Parameter	Value	Unit
Mass moment of inertia	1.5625	kg·m²
Radius of gyration √(J/m)	0.17678	m
GD² (= 4J; kgf·m² numerically in SI and MKS, lb·ft² in FPS)	6.2500	kg·m²

Formula and method

$$J_{disc} = \frac{1}{2}mr^2, \quad J_{hollow} = \frac{1}{2}m(r_o^2 + r_i^2), \quad J_{sphere} = \frac{2}{5}mr^2, \quad J_{rod} = \frac{1}{12}mL^2, \ \frac{1}{3}mL^2$$

$$k = \sqrt{J/m}$$

Variables

shape	Body and axis	-
m	Mass	kg
a	Outer radius, or length (rod), or side a (plate)	m
b	Inner radius (hollow) or side b (plate)	m
J	Mass moment of inertia	kg·m²
k	Radius of gyration √(J/m)	m
GD^2	GD² (= 4J; kgf·m² numerically in SI and MKS, lb·ft² in FPS)	kg·m²

Method and standards

Integration of r² dm.

Assumptions and limits

- Uniform density.

References

- Textbook mechanics (standard results for uniform solids)

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/mechanical/statics-dynamics/mass-moment-of-inertia

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.