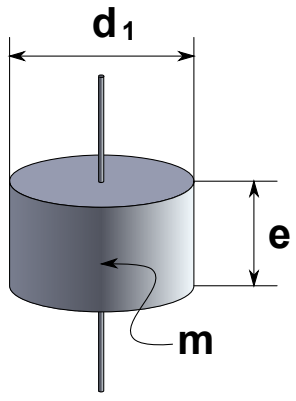
Simple Body Inertia

Constants	
Pi	$\pi \simeq 3.14159265$
Inputs	
No. of Bodies	no
Mass	$m \ [kg]$
Radius	$r \ [mm]$
Specific Weight	$\rho \left[\frac{kg}{m^3}\right]$
Outer Diameter	$d_1 \ [mm]$
Inner Diameter	$d_2 \ [mm]$
Thickness	$e \ [mm]$
Length	$l \ [mm]$
Width	$b \ [mm]$

Disclaimer

This tool has been created to assist engineers with the sizing of the different parts of the system. Calculations might not cover all corner cases. and results should always be checked by a qualified engineer. Under no circumstances shall we beheld responsible to any damages to persons or property due to correct or incorrect use of this tool, or to errors in it.

Centered Coaxial Solid Cylinder



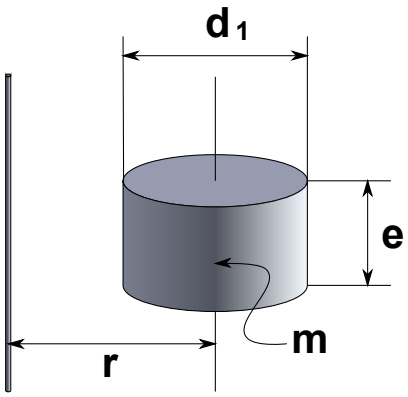
Mass

$$m = \rho \cdot \frac{\pi \cdot \left(\frac{d_1}{1000}\right)^2 \cdot \frac{e}{1000}}{4} \ [kg]$$

Inertia

$$I = m \cdot \frac{\left(\frac{d_1}{1000}\right)^2}{8} \ [kg \cdot m^2]$$

Offset Coaxial Solid Cylinder



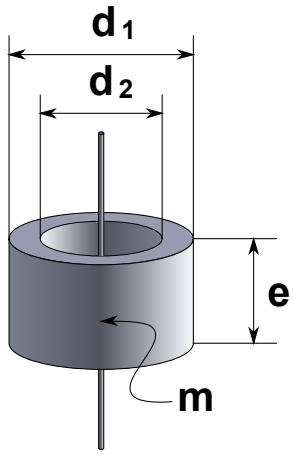
Mass

$$m = no \cdot \rho \cdot \frac{\pi \cdot \left(\frac{d_1}{1000}\right)^2 \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \frac{\left(\frac{d_1}{1000}\right)^2}{8} + \left(\frac{r}{1000}\right)^2 \quad [kg \cdot m^2]$$

Centered Coaxial Hollow Cylinder



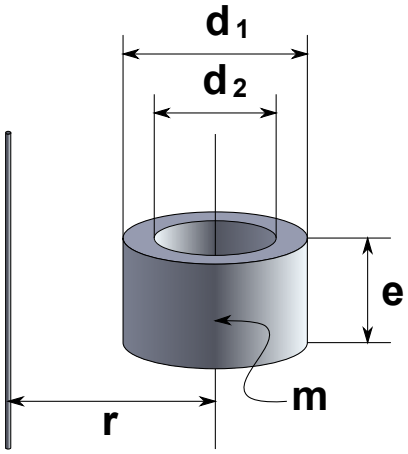
Mass

$$m = \rho \cdot \frac{\pi \cdot \left(\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2\right) \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \frac{\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2}{8} \quad [kg \cdot m^2]$$

Offset Coaxial Hollow Cylinder



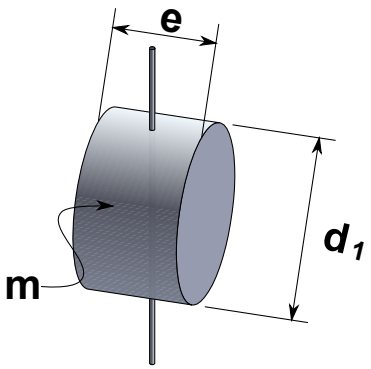
Mass

$$m = no \cdot \rho \cdot \frac{\pi \cdot \left(\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2\right) \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \frac{\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2}{8} + \left(\frac{r}{1000}\right)^2 \quad [kg \cdot m^2]$$

Centered Transversal Solid Cylinder



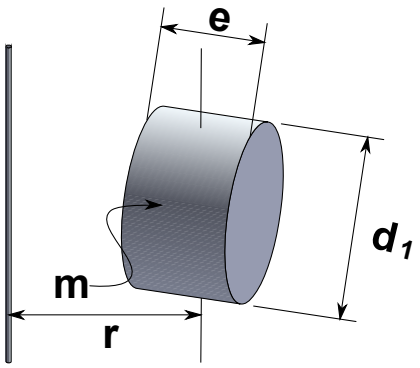
Mass

$$m = \rho \cdot \frac{\pi \cdot \left(\frac{d_1}{1000}\right)^2 \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \left(\frac{\left(\frac{e}{1000}\right)^2}{12} + \frac{\left(\frac{d_1}{1000}\right)^2}{16} \right) \quad [kg \cdot m^2]$$

Offset Transversal Solid Cylinder



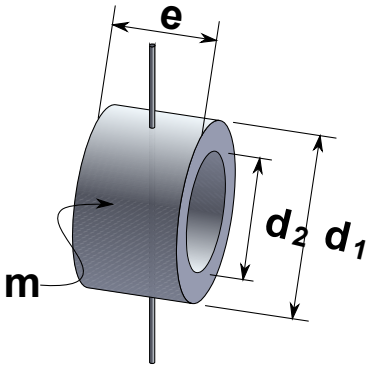
Mass

$$m = no \cdot \rho \cdot \frac{\pi \cdot \left(\frac{d_1}{1000}\right)^2 \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \left(\frac{\left(\frac{e}{1000}\right)^2}{12} + \frac{\left(\frac{d_1}{1000}\right)^2}{16} + \left(\frac{r}{1000}\right)^2 \right) \quad [kg \cdot m^2]$$

Centered Transversal Hollow Cylinder



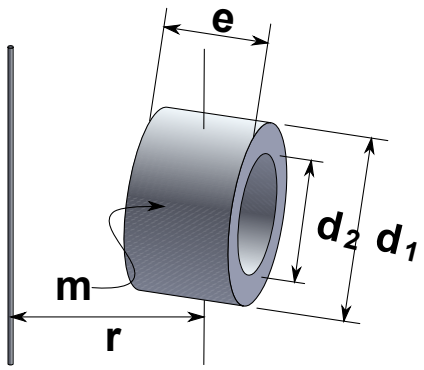
Mass

$$m = \rho \cdot \frac{\pi \cdot \left(\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2 \right) \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \left(\frac{\left(\frac{e}{1000}\right)^2}{12} + \frac{\left(\frac{d_1}{1000}\right)^2 - \left(\frac{d_2}{1000}\right)^2}{16} \right) \quad [kg \cdot m^2]$$

Offset Transversal Hollow Cylinder



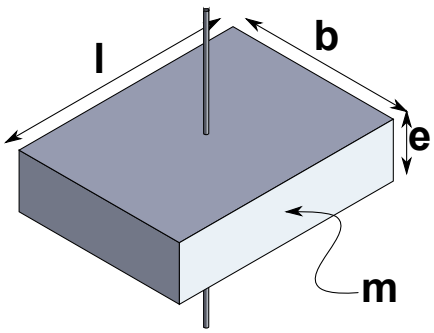
Mass

$$m = no \cdot \rho \cdot \frac{\pi \cdot \left(\left(\frac{d_1}{1000} \right)^2 - \left(\frac{d_2}{1000} \right)^2 \right) \cdot \frac{e}{1000}}{4} \quad [kg]$$

Inertia

$$I = m \cdot \left(\frac{\left(\frac{e}{1000} \right)^2}{12} + \frac{\left(\frac{d_1}{1000} \right)^2 - \left(\frac{d_2}{1000} \right)^2}{16} + \left(\frac{r}{1000} \right)^2 \right) \quad [kg \cdot m^2]$$

Centered Rectangular Parallelepiped



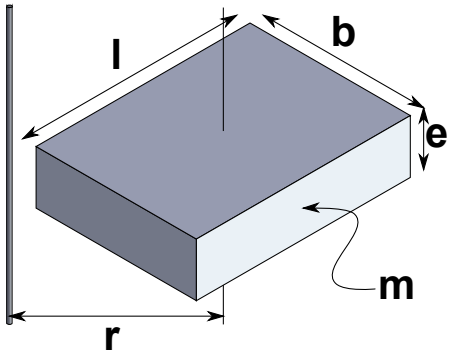
Mass (Rectangular Parallelepiped)

$$m = \rho \cdot \frac{l}{1000} \cdot \frac{b}{1000} \cdot \frac{e}{1000} \quad [kg]$$

Inertia

$$I = m \cdot \frac{\left(\frac{l}{1000} \right)^2 + \left(\frac{b}{1000} \right)^2}{12} \quad [kg \cdot m^2]$$

Offset Rectangular Parallelepiped



Mass

$$m = no \cdot \rho \cdot \frac{l}{1000} \cdot \frac{b}{1000} \cdot \frac{e}{1000} \quad [kg]$$

Inertia

$$I = m \cdot \left(\frac{\left(\frac{l}{1000} \right)^2 + \left(\frac{b}{1000} \right)^2}{12} + \left(\frac{r}{1000} \right)^2 \right) \quad [kg \cdot m^2]$$

Densities of Common Materials

Pure Metals

	Density (kg/m³)
Aluminum	2698
Copper	8960
Gold	19282
Iron	7874
Lead	11342
Platinium	21460
Litium	534
Magnesium	1738
Nickel	8912
Silver	10501
Tin	7287
Titanium	4540
Zinc	7134

Metal Alloys

	Density (kg/m³)		
Ferrous			
Cast Irons	7050	—	7250
High Carbon Steels	7800	—	7900
Medium Carbon Steels	7800	—	7900
Low Carbon Steels	7800	—	7900
Stainless Steels	7600	—	8100
Non-Ferrous			
Aluminum Alloys	2500	—	2900
Copper Alloys	7400	—	8940
Lead Alloys	10000	—	11400
Magnesium Alloys	1740	—	1950
Nickel Alloys	8830	—	8950
Titanium Alloys	4400	—	4800
Zinc Alloys	4950	—	7000

Ceramics

	Density (kg/m³)		
Glasses			
Borosilicate Glass	2200	—	2300
Glass Ceramic	2200	—	2800
Silica Glass	2170	—	2220
Soda-Lime Glass	2440	—	2490
Porous			
Brick	1900	—	2100
Concrete, typical	2200	—	2600
Stone	2500	—	3000
Technical			
Alumina	3500	—	3980
Aluminum Nitride	3260	—	3330
Boron Carbide	2350	—	2550
Silicon	2300	—	2350
Silicon Carbide	3000	—	3210
Silicon Nitride	3000	—	3290
Tungsten Carbide	15300	—	15900

Composites

	Density (kg/m³)		
Metal			
Aluminum/Silicon Carbide	2660	—	2900
Polymer			
CFRP	1500	—	1600
GFRP	1750	—	1970

Solid Polymers

	Density (kg/m³)		
Elastomers		—	
Butyl Rubber	900	—	920
EVA	945	—	955
Isoprene (IR)	930	—	940
Natural Rubber (NR)	920	—	930
Neoprene (CR)	1230	—	1250
Polyurethane Elastomers (elPU)	1020	—	1250
Silicone Elastomers	1300	—	1800
Thermoplastic			
ABS	1010	—	1210
Cellulose Polymers (CA)	980	—	1300
Ionomer (I)	930	—	960
Nylons (PA)	1120	—	1140
Polycarbonate (PC)	1140	—	1210
PEEK	1300	—	1320
Polyethilene (PE)	939	—	960
PET	1290	—	1400
Acrylic (PMMA)	1160	—	1220
Acetal (POM)	1390	—	1430
Polypropylene (PP)	890	—	910
Polystyrene (PS)	1040	—	1050
Polyuretane Thermoplastics (tpPU)	1120	—	1240
PVC	1300	—	1580
Teflon (PTFE)	2140	—	2200
Thermoset		—	
Epoxies	1110	—	1400
Phenolics	1240	—	1320
Polyester	1040	—	1400

Polymer Foams

	Density (kg/m³)		
Flexible Polymer Foam (VLD)	16	—	35
Flexible Polymer Foam (LD)	38	—	70
Flexible Polymer Foam (MD)	70	—	115
Rigid Polymer Foam (LD)	36	—	70
Rigid Polymer Foam (MD)	78	—	165
Rigid Polymer Foam (HD)	170	—	470

Natural Materials

	Density (kg/m³)		
Banboo	600	—	800
Cork	120	—	240
Human Body	950	—	1100
Leather	810	—	1050
Wood, typical	600	—	800