

■ Greek Symbols

Uppercase	Lowercase	Pronunciation	Conventional Usage
A	α	alpha	Angle, Coefficient
B	β	beta	Angle, Coefficient
Γ	γ	gamma	Angle, Weight Per Unit Area, Relationship(Uppercase)
Δ	δ	Delta	Small Change, Density, Displacement
E	ε	epsilon	Small Amount, Distortion
Z	ζ	zeta	Variable
H	η	eta	Variable
Θ	θ	theta	Angle, Temperature, Time
I	ι	iota	Radius of Gyration
K	κ	kappa	Wavelength, Characteristic Value
Λ	λ	lambda	Friction Coefficient
M	μ	mu	10 ⁻⁶ (Micro)
N	ν	nu	Frequency
Ξ	ξ	xi	Variable
O	ο	omicron	Circle Ratio(3.14159...)
Π	π	pi	Angle
P	ρ	rho	Symbol of Product(Uppercase)
Σ	σ	sigma	Radius, Density
T	τ	tau	Stress, Standard Deviation
Φ	φ	upsilon	Summation(Uppercase)
Ω	ω	omega	Time Constant, Time, Torque
ϕ	φ	phi	Angle, Function, Diameter
χ	χ	chi	Angle, Function
ψ	ψ	psi	Angular Velocity=2πf
Ω	ω	omega	Ohm:Unit of Electric Resistance(Uppercase)

Reference unless otherwise specified, lowercase letters are the norm.

■ Name of Elements and Atomic Symbols

Atomic Number	Name	Symbol	Atomic Number	Name	Symbol
1	Hydrogen	H	53	Iodine	I
2	Helium	He	54	Xenon	Xe
3	Lithium	Li	55	Cesium	Cs
4	Beryllium	Be	56	Barium	Ba
5	Boron	B	57	Lanthanum	La
6	Carbon	C	58	Cerium	Ce
7	Nitrogen	N	59	Praseodymium	Pr
8	Oxygen	O	60	Neodymium	Nd
9	Fluorine	F	61	Promethium	Pm
10	Neon	Ne	62	Samarium	Sm
11	Sodium	Na	63	Europium	Eu
12	Magnesium	Mg	64	Gadolinium	Gd
13	Aluminum	Al	65	Terbium	Tb
14	Silicon	Si	66	Dysprosium	Dy
15	Phosphorus	P	67	Holmium	Ho
16	Sulfur	S	68	Erbium	Er
17	Chlorine	Cl	69	Thulium	Tm
18	Argon	Ar	70	Ytterbium	Yb
19	Potassium	K	71	Lutetium	Lu
20	Calcium	Ca	72	Hafnium	Hf
21	Scandium	Sc	73	Tantalum	Ta
22	Titanium	Ti	74	Tungsten	W
23	Vanadium	V	75	Rhenium	Re
24	Chromium	Cr	76	Osmium	Os
25	Manganese	Mn	77	Iridium	Ir
26	Iron	Fe	78	Platinum	Pt
27	Cobalt	Co	79	Gold	Au
28	Nickel	Ni	80	Mercury	Hg
29	Copper	Cu	81	Thallium	Tl
30	Zinc	Zn	82	Lead	Pb
31	Gallium	Ga	83	Bismuth	Bi
32	Germanium	Ge	84	Polonium	Po
33	Arsenic	As	85	Astatine	At
34	Selenium	Se	86	Radon	Rn
35	Bromine	Br	87	Francium	Fr
36	Krypton	Kr	88	Radium	Ra
37	Rubidium	Rb	89	Actinium	Ac
38	Strontium	Sr	90	Thorium	Th
39	Yttrium	Y	91	Protactinium	Pa
40	Zirconium	Zr	92	Uranium	U
41	Niobium	Nb	93	Neptunium	Np
42	Molybdenum	Mo	94	Plutonium	Pu
43	Technetium	Tc	95	Americium	Am
44	Ruthenium	Ru	96	Curium	Cm
45	Rhodium	Rh	97	Berkelium	Bk
46	Palladium	Pd	98	Californium	Cf
47	Silver	Ag	99	Einsteinium	Es
48	Cadmium	Cd	100	Fermium	Fm
49	Indium	In	101	Mendelevium	Md
50	Tin	Sn	102	Nobelium	No
51	Antimony	Sb	103	Lawrencium	Lr
52	Tellurium	T			

Reference This table is based on Appendix A(Names and Symbols of Elements)of ISO 31/8-1980 (Amounts and Units of Physical Chemistry and Molecular Physics) and Appendix C(Names and Symbols of Radionuclides) of ISO 31/9-1980(Amounts and Units of Atomic Physics and Nuclear Physics).

■ Characteristics of Materials

Material	Specific Gravity	Thermal Expansion Coefficient ×10 ⁻⁶ /°C	Young's Modulus {Kg/mm ² }
Mild Steel	7.85	11.7	21000
NAK80	7.8	12.5	20500
SKD11	7.85	11.7	21000
SKD61	7.75	10.8	21000
SKH51	8.2	10.1	22300
Carbide V30	14.1	6.0	56000
Carbide V40	13.9	6.0	54000
Cast Iron	7.3	9.2~11.8	7500~10500
SUS304	8.0	17.3	19700
SUS440C	7.78	10.2	20400
Oxygen Free Coppers C1020	8.9	17.6	11700
6/4 Brass C2801	8.4	20.8	10300
Beryllium Copper C1720	8.3	17.1	13000
Aluminum A1100	2.7	23.6	6900
Duralumin A7075	2.8	23.6	7200
Titanium	4.5	8.4	10600

■ How to Calculate the Volume

Solid	Volume V	Solid	Volume V	Solid	Volume V	Solid	Volume V
	$V = \frac{\pi}{4} d^2 h$ $= \frac{\pi}{4} d^2 \left(\frac{h_1+h_2}{2} \right)$		$V = \frac{\pi^2}{4} d^2 \frac{\sqrt{a^2+b^2}}{2}$		$V = \frac{2}{3} \pi r^2 h$ $= 2.0944 r^2 h$		$V = \frac{\pi h}{6} (3a^2 + 3b^2 + h^2)$
	$V = \frac{h}{3} A = \frac{h}{6} \pi r^2$ A=Area of Base r=Radius of inscribed circle a=Length of a side of a regular polygon n=Number of the sides of a regular polygon		$V = \frac{\pi}{4} d^2 (\ell + \ell' - \frac{d}{3})$		$V = 2\pi^2 R r^2$ $= 19.739 R r^2$ $= \frac{\pi^2}{4} D d^2$ $= 2.4674 D d^2$		When the circumference makes a curve equal to the circular arc, $V = \frac{\pi \ell}{12} (2D^2 + d^2)$ When the circumference makes a curve equal to a parabolic line, $V = 0.209 \ell (2D^2 D d + 1/4 d^3)$
	$V = \frac{\pi h^2}{3} (3r - h)$ $= \frac{\pi h}{6} (3a^2 + h^2)$ a is the radius.		$V = \frac{\pi}{4} h (D^2 - d^2)$ $= \pi h (D - d)$ $= \pi h (d + t)$		$V = \frac{\pi}{3} r^2 h$ $= 1.0472 r^2 h$	■ How to Calculate the Weight Weight W[g]= Volume[cm ³]× Specific Gravity [EX.]Material:Mild Steel D=∅16 L=50mm the weight is: The specific gravity of ∅ = $\frac{\pi}{4} D^2 \times L \times W$ $= \frac{\pi}{4} \times 1.6^2 \times 5 \times 7.85$ ≈ 79 [g]	
	$V = \frac{4}{3} \pi abc$ In case of spheroid (b=c) $V = \frac{4}{3} \pi ab^2$		$V = \frac{h}{3} (A + a + \sqrt{Aa})$ A,a=Area of both ends		$V = \frac{4}{3} \pi r^3 = 4.1888 r^3$ $= \frac{\pi}{6} d^3 = 0.5236 d^3$		

Cross Section	A	e	I	Z=I/e	Cross Section	A	e	I	Z=I/e
	bh	$\frac{h}{2}$	$\frac{bh^3}{12}$	$\frac{bh^2}{6}$		πab	a	$\frac{\pi}{4} ba^3 = 0.7854 ba^3$	$\frac{\pi}{4} ba^3 = 0.7854 ba^3$
	h ²	$\frac{h}{2}$	$\frac{h^4}{12}$	$\frac{h^3}{6}$		$\frac{\pi}{2} r^2$	$e_1 = 0.4244r$ $e_2 = 0.5756r$	$\left(\frac{\pi}{8} - \frac{8}{9\pi} \right) r^4$ $= 0.1098r^4$	$Z_1 = 0.2587r^3$ $Z_2 = 0.1908r^3$
	h ²	$\frac{h}{2} \sqrt{2}$	$\frac{h^4}{12}$	$0.1179h^3 = \frac{\sqrt{2}}{12} h^3$		$\frac{\pi}{4} r^2$	$e_1 = 0.4244r$ $e_2 = 0.5756r$	0.055r ⁴	$Z_1 = 0.1296r^3$ $Z_2 = 0.0956r^3$
	$\frac{bh}{2}$	$\frac{2}{3} h$	$\frac{bh^3}{36}$	$\frac{bh^2}{24}$		b(H-h)	$\frac{H}{2}$	$\frac{b}{12} (H^3 - h^3)$	$\frac{b}{6H} (H^3 - h^3)$
	$(2b+b_1) \frac{h}{2}$	$\frac{1}{3} \times \frac{3b+2b_1}{2b+b_1} h$	$\frac{6b^2+6bb_1+b_1^2}{36(2b+b_1)} h^3$	$\frac{6b^2+6bb_1+b_1^2}{12(2b+b_1)} h^2$		A ² -a ²	$\frac{A}{2}$	$\frac{A^4-a^4}{12}$	$\frac{1}{6} \frac{A^4-a^4}{A}$
	$\frac{3\sqrt{3}}{2} r^2$	$\sqrt{\frac{3}{4}} r = 0.866r$	$\frac{5\sqrt{3}}{16} r^4 = 0.5413r^4$	$\frac{5}{8} r^3$		A ² -a ²	$\frac{A}{2} \sqrt{2}$	$\frac{A^4-a^4}{12}$	$\frac{A^4-a^4}{12A} \sqrt{2}$ $= 0.1179 \frac{A^4-a^4}{A}$
	$\frac{3\sqrt{3}}{2} r^2$	r	$\frac{5\sqrt{3}}{16} r^4 = 0.5413r^4$	$\frac{5}{8} r^3$		$\frac{\pi}{4} (d_2^2 - d_1^2)$	$\frac{d_2}{2}$	$\frac{\pi}{64} (d_2^4 - d_1^4)$ $= \frac{\pi}{4} (R^4 - r^4)$	$\frac{\pi}{32} \left(\frac{d_2^4 - d_1^4}{d_2} \right)$ $= \frac{\pi}{4} \times \frac{R^4 - r^4}{R}$
	2.828r ²	0.924r ²	$\frac{1+2\sqrt{2}}{6} r^4$ $= 0.6381r^4$	0.6906r ³		a ² - $\frac{\pi d^2}{4}$	$\frac{a}{2}$	$\frac{1}{12} (a^4 - \frac{3\pi}{16} d^4)$	$\frac{1}{6a} (a^4 - \frac{3\pi}{16} d^4)$
	0.8284a ²	$b = \frac{a}{1+\sqrt{2}}$ $= 0.4142a$	0.0547a ⁴	0.1095a ³		2b(h-d) $+ \frac{\pi}{4} d^2$	$\frac{h}{2}$	$\frac{1}{12} \left\{ \frac{3\pi}{16} d^4 + b(h^3 - d^3) + b^2(h-d) \right\}$	$\frac{1}{6h} \left\{ \frac{3\pi}{16} d^4 + b(h^3 - d^3) + b^2(h-d) \right\}$
	$\pi r^2 = \frac{\pi d^2}{4}$	$\frac{d}{2}$	$\frac{\pi d^4}{64} = \frac{\pi r^4}{4}$ $= 0.0491d^4$ $= 0.05d^4$ $= 0.7854r^4$	$\frac{\pi d^3}{32} = \frac{\pi r^3}{4}$ $= 0.0982d^3$ $= 0.1d^3$ $= 0.7854r^3$		2b(h-d) $+ \frac{\pi}{4} (d_1^2 - d_2^2)$	$\frac{h}{2}$	$\frac{1}{12} \left\{ \frac{3\pi}{16} (d_1^4 - d_2^4) + b(h^3 - d_1^3) + b^2(h-d_1) \right\}$	$\frac{1}{6h} \left\{ \frac{3\pi}{16} (d_1^4 - d_2^4) + b(h^3 - d_1^3) + b^2(h-d_1) \right\}$
	$r^2 \left(1 - \frac{\pi}{4} \right)$ $= 0.2146r^2$	$e_1 = 0.2234r$ $e_2 = 0.7766r$	0.0075r ⁴	$\frac{0.0075r^4}{e_2}$ $= 0.00966r^3$ $\approx 0.01r^3$					

A:Sectional area e:Distance of Center of Gravity I:Geometrical Moment of Inertia
Z=I/e:Cross Section Coefficient