# [Technical Data] Quantifiers, Unit Symbols, Chemical Symbols and Symbols of Elements Excerpts from JIS Z 8202
# Calculation of Cubic Volume and Weight/Physical Properties of Materials

## Greek Symbols

| Uppercase | Lowercase | Pronunciation | Conventional Usage |
|---|---|---|---|
| Α | $\alpha$ | alpha | Angle, Coefficient |
| Β | $\beta$ | beta | Angle, Coefficient |
| Γ | $\gamma$ | gamma | Angle, Weight Per Unit Area, Relationship(Uppercase) |
| Δ | $\delta$ | Delta | Small Change, Density, Displacement |
| Ε | $\varepsilon$ | epsilon | Small Amount, Distortion |
| Ζ | $\zeta$ | zeta | Variable |
| Η | $\eta$ | eta | Variable |
| Θ | $\theta$ | theta | Angle, Temperature, Time |
| Ι | $\iota$ | iota | |
| Κ | $\kappa$ | kappa | Radius of Gyration |
| Λ | $\lambda$ | lambda | Wavelength, Characteristic Value |
| Μ | $\mu$ | mu | Friction Coefficient $10^{-6}$(Micro) |
| Ν | $\nu$ | nu | Frequency |
| Ξ | $\xi$ | xi | Variable |
| Ο | ο | omicron | |
| Π | $\pi$ | pi | Circle Ratio(3.14159...) Angle Symbol of Product(Uppercase) |
| Ρ | ρ | rho | Radius, Density |
| Σ | $\sigma$ | sigma | Stress, Standard Deviation Summation(Uppercase) |
| Τ | $\tau$ | tau | Time Constant, Time, Torque |
| Υ | $\upsilon$ | upsilon | |
| Φ | $\phi$, φ | phi | Angle, Function, Diameter |
| Χ | $\chi$ | chi | |
| Ψ | $\psi$ | psi | Angle, Function |
| Ω | ω | omega | Angular Verocity=2πf Ohm:Unit of Electric Resistance(Uppercase) |

Reference unless otherwise specified, lowercase letters are the norm.

## Characteristics of Materials

| Material | Specific Gravity | Thermal Expansion Coefficient ×10⁻⁶/°C | Young's Modulus {Kgf/mm²} |
|---|---|---|---|
| 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 |

## 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 | Phosphorous | 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 | R | 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).

## How to Calculate the Volume

| Solid | Volume V |
|---|---|
| Turncated Cylinder | $V=\frac{\pi}{4}d^2h$ $=\frac{\pi}{4}d^2\left(\frac{h_1+h_2}{2}\right)$ |
| Pyramid | $V=\frac{h}{3}$ A=$\frac{h}{6}$ arn 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 |
| Spherical Crown | $V=\frac{\pi h^2}{3}(3r-h)$ $=\frac{\pi h}{6}(3a^2+h^2)$ a is the radius. |
| Ellipsoid | $V=\frac{4}{3}\pi abc$ In case of spheroid (b=c) $V=\frac{4}{3}\pi ab^2$ |
| Oval Ring | $V=\frac{\pi^2}{4}d^2\frac{\sqrt{a^2+b^2}}{2}$ |
| Cross Cylinder | $V=\frac{\pi}{4}d^2\left(\ell+\ell'-\frac{d}{3}\right)$ |
| Hollow(Cylinder) | $V=\frac{\pi}{4}h(D^2-d^2)$ $=\pi th(D-t)$ $=\pi th(d+t)$ |
| Turncated Pyramid | $V=\frac{h}{3}(A+a+\sqrt{Aa})$ A.a=Area of both ends |
| Spherical Segment | $V=\frac{2}{3}\pi r^2h$ $=2.0944r^2h$ |
| Torus | $V=2\pi^2Rr^2$ $=19.739Rr^2$ $=\frac{\pi^2}{4}Dd^2$ $=2.4674Dd^2$ |
| Circular Cone | $V=\frac{\pi}{3}r^2h$ $=1.0472r^2h$ |
| Sphere | $V=\frac{4}{3}\pi r^3=4.1888r^3$ $=\frac{\pi}{6}d^3=0.5236d^3$ |
| Spherical Belt | $V=\frac{\pi h}{6}(3a^2+3b^2+h^2)$ |
| Barrel | 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, $V=0.209\ell(2D^2+Dd+1/4d^2)$ |

## How to Calculate the Weight

Weight W[g]= Volumn[cm³]× Specific Gravity

[Ex.]Material:Mild Steel

D=Ø16 L=50mm the weight is:

The specific gravity of W= $\frac{\pi}{4}D^2\times L\times W$

$=\frac{\pi}{4}\times1.6^2\times5\times7.85$

$\approx79$[g]



# [Technical Data]
# Calculation of Area, Center of Gravity, Geometrical Moment of Inertia

| Cross Section | A | e | I | Z=I/e |
|---|---|---|---|---|
| | bh | $\frac{h}{2}$ | $\frac{bh^3}{12}$ | $\frac{bh^2}{6}$ |
| | $h^2$ | $\frac{h}{2}$ | $\frac{h^4}{12}$ | $\frac{h^3}{6}$ |
| | $h^2$ | $\frac{h}{2}\sqrt{2}$ | $\frac{h^4}{12}$ | $0.1179h^3=\frac{\sqrt{2}}{12}h^3$ |
| | $\frac{bh}{2}$ | $\frac{2}{3}h$ | $\frac{bh^3}{36}$ | $\frac{bh^2}{24}$ |
| | $(2b+b_1)\frac{h}{2}$ | $\frac{1}{3}\times\frac{3b+2b_1}{2b+b_1}h$ | $\frac{6b^2+6bb_1+b_1^2}{36(2b+b_1)}h^3$ | $\frac{6b^2+6bb_1+b_1^2}{12(3b+2b_1)}h^2$ |
| | $\frac{3\sqrt{3}}{2}r^2$ $=2.598r^2$ | $\sqrt{\frac{3}{4}}r=0.886r$ | $\frac{5\sqrt{3}}{16}r^4=0.5413r^4$ | $\frac{5}{8}r^3$ |
| | | r | | $\frac{5\sqrt{3}}{16}r^3=0.5413r^3$ |
| | $2.828r^2$ | $0.924r^2$ | $\frac{1+2\sqrt{2}}{6}r^4$ $=0.6381r^4$ | $0.6906r^3$ |
| | $0.8284a^2$ | $b=\frac{a}{1+\sqrt{2}}$ $=0.4142a$ | $0.0547a^4$ | $0.1095a^3$ |
| | $\pi r^2=\frac{\pi d^2}{4}$ | $\frac{d}{2}$ | $\frac{\pi d^4}{64}=\frac{\pi r^4}{4}$ $=0.0491d^4$ $\approx0.05d^4$ $=0.7854r^4$ | $\frac{\pi d^3}{32}=\frac{\pi r^3}{4}$ $=0.0982d^3$ $\approx0.1d^3$ $=0.7854r^3$ |
| | $r^2\left(1-\frac{\pi}{4}\right)$ $=0.2146r^2$ | $e_1$ $=0.2234r$ $e_2$ $=0.7766r$ | $0.0075r^4$ | $\frac{0.0075r^4}{e_2}$ $=0.00966r^3$ $\approx0.01r^3$ |

| Cross Section | A | e | I | Z=I/e |
|---|---|---|---|---|
| | $\pi ab$ | a | $\frac{\pi}{4}ba^3=0.7854\,ba^3$ | $\frac{\pi}{4}ba^2=0.7854\,ba^2$ |
| | $\frac{\pi}{2}r^2$ | $e_1$ $=0.4244r$ $e_2$ $=0.5756r$ | $\left(\frac{\pi}{8}-\frac{8}{9\pi}\right)r^4$ $=0.1098r^4$ | $Z_1=0.2587r^3$ $Z_2=0.1908r^3$ |
| | $\frac{\pi}{4}r^2$ | $e_1$ $=0.4244r$ $e_2$ $=0.5756r$ | $0.055r^4$ | $Z_1=0.1296r^3$ $Z_2=0.0956r^3$ |
| | b(H−h) | $\frac{H}{2}$ | $\frac{b}{12}(H^3-h^3)$ | $\frac{b}{6H}(H^3-h^3)$ |
| | $A^2-a^2$ | $\frac{A}{2}$ | $\frac{A^4-a^4}{12}$ | $\frac{1}{6}\frac{A^4-a^4}{A}$ |
| | $A^2-a^2$ | $\frac{A}{2}\sqrt{2}$ | $\frac{A^4-a^4}{12}$ | $\frac{A^4-a^4}{12A}\sqrt{2}$ $=\frac{0.1179(A^4-a^4)}{A}$ |
| | $\frac{\pi}{4}(d_2^2-d_1^2)$ | $\frac{d_2}{2}$ | $\frac{\pi}{64}(d_2^4-d_1^4)$ $=\frac{\pi}{4}(R^4-r^4)$ | $\frac{\pi}{32}\left(\frac{d_2^4-d_1^4}{d_2}\right)$ $=\frac{\pi}{4}\times\frac{R^4-r^4}{R}$ |
| | $a^2-\frac{\pi d^2}{4}$ | $\frac{a}{2}$ | $\frac{1}{12}\left(a^4-\frac{3\pi}{16}d^4\right)$ | $\frac{1}{6a}\left(a^4-\frac{3\pi}{16}d^4\right)$ |
| | 2b(h−d) $+\frac{\pi}{4}d^2$ | $\frac{h}{2}$ | $\frac{1}{12}\left\{\frac{3\pi}{16}d^4+b(h^3-d^3)+b^3(h-d)\right\}$ | $\frac{1}{6h}\left\{\frac{3\pi}{16}d^4+b(h^3-d^3)+b^3(h-d)\right\}$ |
| | 2b(h−d)+ $\frac{\pi}{4}(d_1^2-d^2)$ | $\frac{h}{2}$ | $\frac{1}{12}\left\{\frac{3\pi}{16}(d_1^4-d^4)+b(h^3-d_1^3)+b^3(h-d_1)\right\}$ | $\frac{1}{6h}\left\{\frac{3\pi}{16}(d_1^4-d^4)+b(h^3-d_1^3)+b^3(h-d_1)\right\}$ |

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