

Conversion Factors

DIMENSION	METRIC	METRIC/ENGLISH
Acceleration	1 m/s ² = 100 cm/s ²	1 m/s ² = 3.2808 ft/s ² 1 ft/s ² = 0.3048* m/s ²
Area	1 m ² = 10 ⁴ cm ² = 10 ⁶ mm ² = 10 ⁻⁶ km ²	1 m ² = 1550 in ² = 10.764 ft ² 1 ft ² = 144 in ² = 0.09290304* m ²
Density	1 g/cm ³ = 1 kg/L = 1000 kg/m ³	1 g/cm ³ = 62.428 lbm/ft ³ = 0.036127 lbm/in ³ 1 lbm/in ³ = 1728 lbm/ft ³ 1 kg/m ³ = 0.062428 lbm/ft ³
Energy, heat, work, and specific energy	1 kJ = 1000 J = 1000 N · m = 1 kPa · m ³ 1 kJ/kg = 1000 m ² /s ² 1 kWh = 3600 kJ	1 kJ = 0.94782 Btu 1 Btu = 1.055056 kJ = 5.40395 psia · ft ³ = 778.169 lbf · ft 1 Btu/lbm = 25,037 ft ² /s ² = 2.326* kJ/kg 1 kWh = 3412.14 Btu
Force	1 N = 1 kg · m/s ² = 10 ⁵ dyne 1 kgf = 9.80665 N	1 N = 0.22481 lbf 1 lbf = 32.174 lbm · ft/s ² = 4.44822 N 1 lbf = 1 slug · ft/s ²
Length	1 m = 100 cm = 1000 mm = 10 ⁶ μm 1 km = 1000 m	1 m = 39.370 in = 3.2808 ft = 1.0926 yd 1 ft = 12 in = 0.3048* m 1 mile = 5280 ft = 1.6093 km 1 in = 2.54* cm
Mass	1 kg = 1000 g 1 metric ton = 1000 kg	1 kg = 2.2046226 lbm 1 lbm = 0.45359237* kg 1 ounce = 28.3495 g 1 slug = 32.174 lbm = 14.5939 kg 1 short ton = 2000 lbm = 907.1847 kg
Power	1 W = 1 J/s 1 kW = 1000 W = 1 kJ/s 1 hp [‡] = 745.7 W	1 kW = 3412.14 Btu/h = 1.341 hp = 737.56 lbf · ft/s 1 hp = 550 lbf · ft/s = 0.7068 Btu/s = 42.41 Btu/min = 2544.5 Btu/h = 0.74570 kW 1 Btu/h = 1.055056 kJ/h
Pressure or stress, and pressure expressed as a head	1 Pa = 1 N/m ² 1 kPa = 10 ³ Pa = 10 ⁻³ MPa 1 atm = 101.325 kPa = 1.01325 bar = 760 mm Hg at 0°C = 1.03323 kgf/cm ² 1 mm Hg = 0.1333 kPa	1 Pa = 1.4504 × 10 ⁻⁴ psi = 0.020886 lbf/ft ² 1 psi = 144 lbf/ft ² = 6.894757 kPa 1 atm = 14.696 psi = 29.92 inches Hg at 30°F 1 inch Hg = 13.60 inches H ₂ O = 3.387 kPa
Specific heat	1 kJ/kg · °C = 1 kJ/kg · K = 1 J/g · °C	1 Btu/lbm · °F = 4.1868 kJ/kg · °C 1 Btu/lbmol · R = 4.1868 kJ/kmol · K 1 kJ/kg · °C = 0.23885 Btu/lbm · °F = 0.23885 Btu/lbm · R
Specific volume	1 m ³ /kg = 1000 L/kg = 1000 cm ³ /g	1 m ³ /kg = 16.02 ft ³ /lbm 1 ft ³ /lbm = 0.062428 m ³ /kg
Temperature	T(K) = T(°C) + 273.15 ΔT(K) = ΔT(°C)	T(R) = T(°F) + 459.67 = 1.8T(K) T(°F) = 1.8 T(°C) + 32 ΔT(°F) = ΔT(R) = 1.8* ΔT(K)
Velocity	1 m/s = 3.60 km/h	1 m/s = 3.2808 ft/s = 2.237 mi/h 1 mi/h = 1.46667 ft/s 1 mi/h = 1.6093 km/h
Viscosity, dynamic	1 kg/m · s = 1 N · s/m ² = 1 Pa · s = 10 poise	1 kg/m · s = 2419.1 lbm/ft · h = 0.020886 lbf · s/ft ² = 0.67197 lbm/ft · s

*Exact conversion factor between metric and English units.

‡Mechanical horsepower. The electrical horsepower is taken to be exactly 746 W.

DIMENSION	METRIC	METRIC/ENGLISH
Viscosity, kinematic	1 m ² /s = 10 ⁴ cm ² /s 1 stoke = 1 cm ² /s = 10 ⁻⁴ m ² /s	1 m ² /s = 10.764 ft ² /s = 3.875 × 10 ⁴ ft ² /h 1 m ² /s = 10.764 ft ² /s
Volume	1 m ³ = 1000 L = 10 ⁶ cm ³ (cc)	1 m ³ = 6.1024 × 10 ⁴ in ³ = 35.315 ft ³ = 264.17 gal (U.S.) 1 U.S. gallon = 231 in ³ = 3.7854 L 1 fl ounce = 29.5735 cm ³ = 0.0295735 L 1 U.S. gallon = 128 fl ounces
Volume flow rate	1 m ³ /s = 60,000 L/min = 10 ⁶ cm ³ /s	1 m ³ /s = 15,850 gal/min = 35.315 ft ³ /s = 2118.9 ft ³ /min (CFM)

*Exact conversion factor between metric and English units.

Some Physical Constants

PHYSICAL CONSTANT	METRIC	ENGLISH
Standard acceleration of gravity	$g = 9.80665 \text{ m/s}^2$	$g = 32.174 \text{ ft/s}^2$
Standard atmospheric pressure	$P_{\text{atm}} = 1 \text{ atm} = 101.325 \text{ kPa}$ $= 1.01325 \text{ bar}$ $= 760 \text{ mm Hg (0}^\circ\text{C)}$ $= 10.3323 \text{ m H}_2\text{O (4}^\circ\text{C)}$	$P_{\text{atm}} = 1 \text{ atm} = 14.696 \text{ psia}$ $= 2116.2 \text{ lbf/ft}^2$ $= 29.9213 \text{ inches Hg (32}^\circ\text{F)}$ $= 406.78 \text{ inches H}_2\text{O (39.2}^\circ\text{F)}$
Universal gas constant	$R_u = 8.31447 \text{ kJ/kmol} \cdot \text{K}$ $= 8.31447 \text{ kN} \cdot \text{m/kmol} \cdot \text{K}$	$R_u = 1.9859 \text{ Btu/lbmol} \cdot \text{R}$ $= 154.37 \text{ ft} \cdot \text{lbf/lbmol} \cdot \text{R}$

Commonly Used Properties

PROPERTY	METRIC	ENGLISH
<i>Air at 20°C (68°F) and 1 atm</i>		
Specific gas constant*	$R_{\text{air}} = 0.2870 \text{ kJ/kg} \cdot \text{K}$ $= 287.0 \text{ m}^2/\text{s}^2 \cdot \text{K}$	$R_{\text{air}} = 0.06855 \text{ Btu/lbm} \cdot \text{R}$ $= 53.34 \text{ ft} \cdot \text{lbf/lbm} \cdot \text{R}$ $= 1716 \text{ ft}^2/\text{s}^2 \cdot \text{R}$
Specific heat ratio	$k = c_p/c_v = 1.40$	$k = c_p/c_v = 1.40$
Specific heats	$c_p = 1.007 \text{ kJ/kg} \cdot \text{K}$ $= 1007 \text{ m}^2/\text{s}^2 \cdot \text{K}$ $c_v = 0.7200 \text{ kJ/kg} \cdot \text{K}$ $= 720.0 \text{ m}^2/\text{s}^2 \cdot \text{K}$	$c_p = 0.2404 \text{ Btu/lbm} \cdot \text{R}$ $= 187.1 \text{ ft} \cdot \text{lbf/lbm} \cdot \text{R}$ $= 6019 \text{ ft}^2/\text{s}^2 \cdot \text{R}$ $c_v = 0.1719 \text{ Btu/lbm} \cdot \text{R}$ $= 133.8 \text{ ft} \cdot \text{lbf/lbm} \cdot \text{R}$ $= 4304 \text{ ft}^2/\text{s}^2 \cdot \text{R}$
Speed of sound	$c = 343.2 \text{ m/s} = 1236 \text{ km/h}$	$c = 1126 \text{ ft/s} = 767.7 \text{ mi/h}$
Density	$\rho = 1.204 \text{ kg/m}^3$	$\rho = 0.07518 \text{ lbf/ft}^3$
Viscosity	$\mu = 1.825 \times 10^{-5} \text{ kg/m} \cdot \text{s}$	$\mu = 1.227 \times 10^{-5} \text{ lbf/ft} \cdot \text{s}$
Kinematic viscosity	$\nu = 1.516 \times 10^{-5} \text{ m}^2/\text{s}$	$\nu = 1.632 \times 10^{-4} \text{ ft}^2/\text{s}$

Liquid water at 20°C (68°F) and 1 atm

Specific heat ($c = c_p = c_v$)	$c = 4.182 \text{ kJ/kg} \cdot \text{K}$ $= 4182 \text{ m}^2/\text{s}^2 \cdot \text{K}$	$c = 0.9989 \text{ Btu/lbm} \cdot \text{R}$ $= 777.3 \text{ ft} \cdot \text{lbf/lbm} \cdot \text{R}$ $= 25,009 \text{ ft}^2/\text{s}^2 \cdot \text{R}$
Density	$\rho = 998.0 \text{ kg/m}^3$	$\rho = 62.30 \text{ lbf/ft}^3$
Viscosity	$\mu = 1.002 \times 10^{-3} \text{ kg/m} \cdot \text{s}$	$\mu = 6.733 \times 10^{-4} \text{ lbf/ft} \cdot \text{s}$
Kinematic viscosity	$\nu = 1.004 \times 10^{-6} \text{ m}^2/\text{s}$	$\nu = 1.081 \times 10^{-5} \text{ ft}^2/\text{s}$

* Independent of pressure or temperature