

Unit Equivalents

Metric to American Metric to Metric

American to Metric American to American

Area:

$$1 \text{ mm}^2 = 0.00155 \text{ in.}^2 = 0.00001076 \text{ ft}^2$$

$$1 \text{ cm}^2 = 0.155 \text{ in.}^2 = 0.001076 \text{ ft}^2$$

$$1 \text{ m}^2 = 1550 \text{ in.}^2 = 10.76 \text{ ft}^2$$

$$1 \text{ in.}^2 = 645.2 \text{ mm}^2 = 6.452 \text{ cm}^2$$

$$= 0.0006452 \text{ m}^2$$

$$1 \text{ ft}^2 = 92903 \text{ mm}^2 = 929.03 \text{ cm}^2$$

$$= 0.0929 \text{ m}^2$$

$$1 \text{ acre} = 43560 \text{ ft}^2$$

$$1 \text{ circular mil} = 0.7854 \text{ square mil}$$

$$= 5.067 \times 10^{-10} \text{ m}^2 = 7.854 \times 10^{-5} \text{ in.}^2$$

Density and Specific Gravity:

$$1 \text{ g/cm}^3 = 0.036 \text{ lb/in.}^3 = 62.43 \text{ lb/ft}^3$$

$$= 1000 \text{ kg/m}^3 = 1 \text{ kg/L}$$

$$= 62.43 \text{ lb/ft}^3 = 8.345 \text{ lb/US gal}$$

$$1 \text{ kg/m}^3 = 0.062 \text{ lb/ft}^3$$

$$1 \text{ m g/m}^3 = 4.37 \times 10^{-7} \text{ grains/ft}^3$$

$$1 \text{ lb/in.}^3 = 27.68 \text{ g/cm}^3 = 27 \text{ 680 kg/m}^3$$

$$1 \text{ lb/ft}^3 = 0.0160 \text{ g/cm}^3 = 16.02 \text{ kg/m}^3$$

$$= 0.0160 \text{ kg/L}$$

Specific gravity relative to water (SGW) of 1.00 = 62.43 lb/ft³ at 4°C or 39.2°F*

Specific gravity relative to dry air (SGA) of 1.00 = 0.0765 lb/ft³

$$= 1.225 \text{ kg/m}^3$$

$$1 \text{ lb/US gal} = 7.481 \text{ lb/ft}^3 = 0.1198 \text{ kg/L}$$

$$1 \text{ g/ft}^3 = 35.3 \times 10^6 \text{ m g/m}^3$$

$$1 \text{ lb/1000 ft}^3 = 16 \times 10^6 \text{ m g/m}^3$$

Energy, Heat and Work:

$$1 \text{ cal} = 0.003968 \text{ Btu}$$

$$1 \text{ kcal} = 3.968 \text{ Btu} = 1000 \text{ cal} = 4187 \text{ J}$$

$$= 0.004187 \text{ MJ}$$

$$1 \text{ J} = 0.000948 \text{ Btu} = 0.239 \text{ cal} = 1 \text{ W} \cdot \text{s}$$

$$= 1 \text{ N} \cdot \text{m} = 10^7 \text{ erg} = 10^7 \text{ dyne} \cdot \text{cm}$$

$$1 \text{ W} \cdot \text{h} = 0.85483 \text{ kcal (Int'l Table)}$$

$$3413 \text{ Btu} = 1 \text{ kW} \cdot \text{h}$$

$$1 \text{ Btu} = 0.2931 \text{ W} \cdot \text{h}$$

$$= 252.0 \text{ cal} = 0.252 \text{ kcal}$$

$$= 778 \text{ ft} \cdot \text{lb}$$

$$= 1055 \text{ J} = 0.001055 \text{ MJ} = 1.055 \text{ GJ}$$

$$1 \text{ ft} \cdot \text{lb} = 0.1383 \text{ kg} \cdot \text{m} = 1.356 \text{ J}$$

$$1 \text{ hp} \cdot \text{hr} = 1.98 \times 10^6 \text{ ft} \cdot \text{lb}$$

$$1 \text{ therm} = 1.00 \times 10^5 \text{ Btu}$$

$$1 \text{ bhp (boiler horsepower)} = 33 \text{ 475 Btu/hr}$$

$$= 8439 \text{ kcal/h} = 9.81 \text{ kW}$$

Heat Content and Specific Heat:

$$1 \text{ cal/g} = 1.80 \text{ Btu/lb} = 4187 \text{ J/kg}$$

$$1 \text{ cal/cm}^3 = 112.4 \text{ Btu/ft}^3$$

$$1 \text{ kcal/m}^3 = 0.1124 \text{ Btu/ft}^3 = 4187 \text{ J/m}^3$$

$$1 \text{ cal/g} \cdot \text{°C} = 1 \text{ Btu/lb} \cdot \text{°F} = 4187 \text{ J/kg} \cdot \text{K}$$

$$1 \text{ Btu/lb} = 0.5556 \text{ cal/g} = 0.5556 \text{ kcal/kg}$$

$$= 2326 \text{ J/kg}$$

$$1 \text{ Btu/ft}^3 = 0.00890 \text{ cal/cm}^3$$

$$= 8.899 \text{ kcal/m}^3 = 0.0373 \text{ MJ/m}^3$$

$$1 \text{ Btu/US gal} = 0.666 \text{ kcal/L}$$

$$1 \text{ Btu/lb} \cdot \text{°F} = 1 \text{ cal/g} \cdot \text{°C} = 4187 \text{ J/kg} \cdot \text{K}$$

Heat Flow, Power:

$$1 \text{ N} \cdot \text{m/s} = 1 \text{ W} = 1 \text{ J/s}$$

$$= 0.001341 \text{ hp} = 0.7376 \text{ ft} \cdot \text{lb/sec}$$

$$1 \text{ kcal/h} = 1.162 \text{ J/s} = 1.162 \text{ W}$$

$$= 3.968 \text{ Btu/hr}$$

$$= 0.001 \text{ Thermies/heure}$$

$$1 \text{ kW} = 1000 \text{ J/s} = 3413 \text{ Btu/hr} = 1.341 \text{ hp}$$

$$= 660.6 \text{ kcal/hr}$$

$$1 \text{ MW} = 3413000 \text{ Btu/hr}$$

$$1 \text{ Btu/hr} = 0.2520 \text{ kcal/h}$$

$$= 0.000393 \text{ 1 hp}$$

$$= 0.2931 \text{ W} = 0.2931 \text{ J/s}$$

$$1 \text{ hp} = 33 \text{ 000 ft lb/min} = 550 \text{ ft lb/sec}$$

$$= 745.7 \text{ W} = 745 \text{ J/s}$$

$$= 641.4 \text{ kcal/h}$$

$$1 \text{ boiler hp} = 33 \text{ 475 Btu/hr} = 34.5 \text{ lb steam/hr from and at 212 F}$$

Heat Flux and Heat Transfer Coefficient:

$$1 \text{ cal/cm}^2 \cdot \text{s} = 3.687 \text{ Btu/ft}^2 \cdot \text{sec}$$

$$= 41.87 \text{ kW/m}^2$$

$$1 \text{ cal/cm}^2 \cdot \text{h} = 1.082 \text{ W/ft}^2 = 11.65 \text{ W/m}^2$$

$$1 \text{ kW/m}^2 = 317.2 \text{ Btu/ft}^2 \cdot \text{hr}$$

$$1 \text{ Btu/ft}^2 \cdot \text{sec} = 0.2713 \text{ cal/cm}^2 \cdot \text{s}$$

$$1 \text{ Btu/ft}^2 \cdot \text{hr} = 0.003153 \text{ kW/m}^2$$

$$= 2.713 \text{ kcal/m}^2 \cdot \text{h}$$

$$1 \text{ kW/ft}^2 = 924.2 \text{ cal/cm}^2 \cdot \text{h}$$

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* 62.35 lb/ft³ at 60°F, 15.6°C; 8.335 lb/USgal.

Unit Equivalents (continued)

Metric to American Metric to Metric

1 kW/m²·°C=1 kW/m²·K
 =176.2 Btu/ft²·hr·°F
 =860.4 kcal/hr·m²·°C
 1 J/m²·s·K=0.1722 Btu/ft²·hr·°F

Length:

1 mm=0.10 cm=0.039 37 in.
 =0.003 281 ft
 1 m=100 cm=1000 mm=39.37 in.
 =3.281 ft=1.094 yard
 1 km=0.6214 mile

Pressure:

1 N·m²=0.001 kPa=1.00Pa
 1 mm H₂O=0.0098 kPa
 1 mm Hg=0.1333 kPa=13.60mm H₂O
 =1 torr=0.01933 lb/in.²
 1 kg/cm²=98.07 kPa=10000 kg/m²
 =10000 mm H₂O=394.1 in H₂O
 =735.6 mm Hg=28.96 in Hg
 =227.6 oz/in.²=14.22 lb/in.²
 =0.9807 bar
 1 bar=100.0 kPa=1.020 kg/cm²
 10200 mm H₂O=401.9 in. H₂O
 750.1 mm Hg=29.53 in. Hg
 =232.1 oz/in.²=14.50 lb/in.²
 =100000 N/m²
 1 g/cm²=0.01422 lb/in.²
 =0.2276 oz/in.²
 =0.3937 in. H₂O
 (For rough calculations, 1 bar=1 atm=1 kg/cm²
 =10 m H₂O=100 kPa)

American to Metric American to American

1 Btu/ft²·hr·°F=4.89 kcal/m²·h·°C
 =5.67 W/m²·K

1 in.=25.40 mm=2.540 cm=0.02540 m
 1 ft=304.8 mm=30.48 cm=0.3048 m
 1 mile=5280 ft; 1 nautical mile=6076 ft
 1 micron=1 μ =10⁻⁶ m=1 micrometer
 1 Angstrom unit=1 Å =10⁻¹⁰ m

1 in. H₂O*=0.2488 kPa=25.40 mm H₂O
 =1.866 mm Hg
 =0.00254 kg/cm²=2.540g/cm²
 1 in. Hg=3.386 kPa=25.40 mm Hg
 =345.3 mm H₂O=13.61 in H₂O
 =7.858 oz/in.²=0.491 lb/in.²
 =25.4 torr
 1 lb/in.²=6.895 kPa=6895 N/m²
 =703.1 mm H₂O=27.71 in. H₂O
 =51.72 mm Hg=2.036 in. Hg
 =16.00 oz/in.²
 =0.0703 kg/cm²=70.31 g/cm²
 =0.06897 bar
 1 oz/in.²=0.4309 kPa
 =43.94 mm H₂O=1.732 in. H₂O
 =3.232 mm Hg
 =0.00439 kg/cm²=4.394 g/cm²
 1 atm**=101.3 kPa=101325 N/m²
 =10330 mm H₂O=407.3 in. H₂O
 =760.0 mm Hg=29.92 in. Hg
 =235.1 oz/in.²=14.70 lb/in.²
 =1.033 kg/cm²
 =1.013 bar

Temperature:

$C = \frac{5}{9} (F - 32)$
 $F = (\frac{9}{5} C) + 32$
 $K = C + 273.15 = (\frac{5}{9})F + 273.15$
 $R = F + 459.67$

$F = (\frac{9}{5}) (K - 273.15)$

Thermal Conductivity:

1 W/m·°K=0.5778 Btu ft/ft²·hr·°F
 =6.934 Btu·in./ft²·hr·°F
 1 cal·cm/cm²·s·°C=241.9 Btu·ft/ft²·hr·°F
 =2903 Btu in./ft²·hr·°F
 =418.7 W/m·K

1 Btu·ft/ft²·hr·°F=1.730 W/m·K
 =1.488 kcal/m·h·K
 1 Btu·in./ft²·hr·°F=0.1442 W/m·K
 1 Btu·ft/ft²·hr·°F=0.004139 cal·cm/cm²·s·°C
 1 Btu·in./ft²·hr·°F=0.0003445 cal·cm/cm²·s·°C

Thermal Diffusivity:

1 m²/s=38760 ft²/hr
 1 m²/h=10.77 ft²/hr

1 ft²/hr=0.000025 8 m²/s=0.0929 m²/h

Torque (Bending Moment):

1 lb. (force) inch=0.11298 N·m

1 lb·in.=1.152 kg·cm
 1 lb·ft=0.1383 kg·m

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*1"wc = 1"wg

**Normal atmosphere = 760 torr (mm Hg at 0°C)—not a "technical atmosphere", which is 736 torr or 1 kg/cm². Subtract about 0.5 lb/in² for each 1000 ft above sea level.

Unit Equivalents (continued)

Metric to American Metric to Metric	American to Metric American to American
Velocity:	
1 cm/s=0.3937 in./sec=0.03281 ft/sec =10.00 mm/s=1.969 ft/min	1 in./sec=25.4 mm/s=0.0254 m/s =0.0568 mph
1 m/s=39.37 in./sec=3.281 ft/sec =196.9 ft/min=2.237 mph =3.600 km/h=1.944 knot	1 ft/sec=304.8 mm/s=0.3048 m/s =0.6818 mph 1 ft/min=5.08 mm/s=0.00508 m/s =0.0183 km/h 1 mph=0.4470 m/s=1.609 km/h =1.467 ft/sec 1 knot=0.5144 m/s 1 rpm=0.1047 radians/sec
Viscosity, absolute, μ :	
0.1 Pa·s=1 dyne·s/cm ² =360 kg/h·m =1 poise=100 centipoise =242.1 lb mass/hr·ft =0.002089 lb force sec/ft ²	1 lb mass/hr·ft=0.000008634 lb force·sec/ft ² =0.413 centipoise =0.000413 Pa·s
1 kg/h·m=0.672 lb/hr·ft=0.00278 g/s cm =0.00000581 lb force·sec/ft ²	1 lb force·sec/ft ² =115800 lb mass/hr·ft =47880 centipoise =47.88 Pa·s
μ of water*=1.124 centipoise =2.72 lb mass/hr·ft =2.349 x 10 ⁻⁵ lb sec/ft ²	1 reyn=1 lb force·sec/in ² =6.890 x 10 ⁶ centipoise μ of air*=0.0180 centipoise =0.0436 lb/hr·ft =3.763 x 10 ⁻⁷ lb·sec/ft
Viscosity, kinematic, ν:	
1 cm ² /s=0.0001 m ² /s =1 stoke=100 centistokes =0.001076 ft ² /sec =3.874 ft ² /hr	1 ft ² /sec=3600 ft ² /hr=92 900 centistokes =0.0929 m ² /s
1 m ² /s=3600 m ² /h =38 736 ft ² /hr=10.76 ft ² /sec	1 ft ² /h=0.000 278 ft ² /sec=25.8 centistokes =0.000 025 8 m ² /s
ν of water*=1.130 centistokes =32 SSU =1.216 x 10 ⁻⁵ ft ² /sec	ν of air*=14.69 centistokes =1.581 x 10 ⁻⁴ ft ² /sec
Volume: **	
1 cm ³ (cc)=0.00001 m ³ =0.0610 in. ³ =0.0338 US fluid oz	1 in. ³ =16.39 cm ³ =0.0001639 m ³ =0.01639 L
1 L (dm ³)=0.0010 m ³ =1000 cm ³ =61.02 in. ³ =0.035 31 ft ³ =0.2642 US gal	1 ft ³ =1728 in. ³ =7.481 US gal =6.229 Br gal =28 320 cm ³ =0.02832 m ³ =28.32 L =62.427 lb of 39.4°F (4°C) water =62.344 lb of 60°F (15.6°C) water
1 m ³ =1000 L=1000000 cm ³ =61020 in. ³ =35.31 ft ³ =220.0 Br gal =6.290 bbl =264.2 US gal =1.308 yd ³	1 US gal=3785 cm ³ =0.003785 m ³ =3.785 L=231.0 in. ³ =0.8327 Br gal=0.1337 ft ³ =sp gr x 8.335 lb =8.335 lb of water =1/42 barrel (oil)
	1 Br gal=277.4 in. ³ =0.004546 m ³ =4.546 L =1.201 US gal
	1 bbl, oil=9702 in. ³ =5.615 ft ³ =0.1590 m ³ =159.0 L =42.00 US gal =34.97 Br gal.

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* At stp.

** Volume equivalents are for the same temperature and pressure in both sets of units.

A standard cubic foot or scfh is measured at 60 F and 29.92" Hg.

A standard cubic metre or sm³/h is measured at 15 C and 760 mm Hg.

A normal cubic metre or nm³/h is measured at 0 C and 760 mm Hg.

Unit Equivalents (continued)

Metric to American Metric to Metric	American to Metric American to American
Volume Flow Rate:*	
1 cm ³ (cc)/s=1 x10 ⁻⁶ m ³ /s	1 gpm (gal/min)=60.0 gph (gal/hr)
1 L/s=1x10 ⁻³ m ³ /s	=0.01667 gps (gal/sec)
1 m ³ /h=4.403 US gpm (gal/min)	=0.00223 cfs (ft ³ /sec)
=0.5887 ft ³ /min	=8.022 cfm (ft ³ /hr)
	=0.8326 Br gpm
	=0.227 m ³ /h=0.06308 L/s
	=1.429 bbl/hr=34.29 bbl/day
	1 gph (gal/hr)=0.00105 L/s
	=0.0000371 cfs (ft ³ /sec)
	1 cfm (ft ³ /min)=6.18 Br gpm
	=0.000471 m ³ /s
	1 cfs (ft ³ /sec)=448.8 gpm
	=22250 Br gph
Weight, Force, Mass:	
1 m g=1.544x10 ⁻⁵ grains	1 oz avdp mass=28.35 g=0.02835 kg
=2.205x10 ⁻⁹ lb avdp mass	1 lb avdp mass=453.6 g=0.4536 kg
1 g=0.03527 oz avdp mass	=4.536 x10 ⁸ m g
1 kg mass=1000 g mass	1 lb avdp force=0.4536 kg force
=35.27 oz avdp mass	=4.448 N
=2.205 lb avdp mass	1 lb=7000 grains
1 kg force=1000 g force=9.807 N	1 short ton=2000 lb=907.2 kg
=2.205 lb avdp force	1 long ton=2240 lb=1015.9 kg
1 metric ton=1000 kg=2205 lb	

* Volume equivalents are for the same temperature and pressure in both sets of units.

A standard cubic foot or scfh is measured at 60°F and 29.92" Hg.

A standard cubic meter or sm³/h is measured at 15°C and 760 mm Hg.

A normal cubic meter or nm³/h is measured at 0°C and 760 m Hg.

Source: *North American Combustion Handbook, 3rd Edition, Vol. II, 1995.*