

Conversion factors for various engineering units

Multiply	By	To Obtain
Acres	43560	Sq. ft.
Acre feet	43560	Cubic ft.
Acre feet	325851	Gallons
Acre feet	1233.49	Cubic meters
Atmospheres	76.0	Cm of mercury
Atmospheres	29.92	Inches of mercury
Atmospheres	33.90	Feet of water
Atmospheres	14.70	Lb/sq. in.
Barrels - Cement	376	Lb - cement
Bags or Sacks - Cement	94	Lb - cement
Board - feet	144 sq. in. x 1 in.	Cubic in.
British Thermal Units	777.5	Foot lbs.
British Thermal Units	0.0003927	Horsepower - hrs.
British Thermal Units	0.0002928	Kilowatt - hrs.
Btu/min.	12.96	Foot lbs./sec
Btu/min.	0.02356	Horsepower
Btu/min.	0.01757	Kilowatts
Btu/min.	17.57	Watts
Centimeters	0.3937	Inches
Centimeters	0.01	Meters
Centimeters	10	Millimeters
Centimeter of mercury	0.01316	Atmospheres
Centimeter of mercury	0.4461	Ft. of water
Centimeter of mercury	136	Kg/sq. meter
Centimeter of mercury	27.85	Lb/sq. meter
Centimeter of mercury	0.1934	Lb/sq. in.
Centimeters/seconds	1.969	Feet/min.
Centimeters/seconds	0.03281	Feet/sec.
Cm/sec./sec.	0.03281	Feet/sec./sec.
Cubic centimeters	0.00003531	Cubic ft.
Cubic centimeters	0.06102	Cubic in.
Cubic centimeters	0.000001308	Cubic yds.
Cubic centimeters	0.0002642	Gallons
Cubic centimeters	0.03381	Ounces (fluid)
Cubic Cm/min.	0.002118	Cu. ft./hr.
Cubic Cm/min.	0.002641	Gal./min.
Cubic feet	1728	Cubic in.
Cubic feet	7.48052	Gallons
Cubic feet	59.84	Pints (liq.)
Cubic feet	29.92	Quarts (liq.)
Cubic feet/min.	472.0	Cubic cm/sec.
Cubic feet/min.	0.1247	Gal/sec. 7.48 gal/min
Cubic feet/sec.	0.646317	Million gal./day
Cubic feet/sec.	448.831	Gal/min.
Cubic inches	0.0005787	Cubic ft.
Cubic inches	0.00002143	Cubic yds.
Cubic inches	0.004329	Gal
Cubic meters	35.31	Cu. ft.
Cubic meters	61.023	Cu. in.
Cubic meters	1.308	Cu. yds.
Cubic meters	264.2	Gal
Cubic yards	27	Cu. ft.
Degrees (angle)	60	Minutes
Degrees (angle)	0.01745	Radians
Degrees (angle)	3600	Seconds
Degrees/sec.	0.01745	Radians/sec.
Degrees/sec.	0.1667	Revolutions/min.
Degrees/sec.	0.002778	Revolutions/min.
Fathoms	6	Feet
Feet	30.48	Centimeters
Feet	12	Inches
Feet	0.3048	Meters
Feet of water	0.0295	Atmosphere
Feet of water	0.8826	In. of mercury
Feet of water	62.43	Lb/sq. ft.
Feet of water	0.4335	Lb/sq. in.
Feet/min.	0.01667	Feet/sec.
Feet/min.	0.01136	Miles/hr.
Feet/sec.	0.6818	Miles/hr.
Foot lb.	0.001286	Btu
Foot lb.	0.000000505	Horsepower hrs.
Foot lb.	0.0000003766	Kilowatt hrs.

Multiply	By	To Obtain
Foot lb/min.	0.001286	Btu/min.
Foot lb/min.	0.01667	Ft. lb/sec.
Foot lb/min.	0.0000303	Horsepower
Foot lb/min.	0.0000266	Kilowatts
Foot lb/sec.	0.0717	Btu/min.
Foot lb/sec.	0.001818	Horsepower
Foot lb/sec.	0.001356	Kilowatts
Gallons	3785	Cubic cm.
Gallons	0.1337	Cubic ft.
Gallons	231	Cubic in.
Gallons (Imperial)	1.20095	U.S. gallons
Gallons (U.S.)	0.83267	Imperial gallons
Gallons water	8.3453	Pounds of water
Gallons/min.	0.002228	Cu. ft./sec.
Gallons/min.	8.0208	Cu. ft./hr.
Grains/U.S. gallons	17.118	Parts/million
Grains/U.S. gallons	142.86	Lb/million
Grains/U.S. gallons	14.254	Parts/million
Grams	0.03527	Ounces
Grams	0.002205	Pounds
Grams/cu. cm	62.43	Pounds/cu. ft.
Grams/cu. cm	0.03613	Pounds/cu. in.
Grams/liter	58.417	Grains/gal.
Grams/liter	8.345	Pounds/1000 gal.
Grams/liter	0.062427	Pounds/cu. ft.
Grams/liter	1000	Parts/million
Horsepower	42.44	Btu/min.
Horsepower	33000	Ft. lb/min.
Horsepower	550	Ft. lb/sec.
Horsepower	0.7457	Kilowatts
Horsepower (boiler)	33479	Btu/hr.
Horsepower (boiler)	9.803	Kilowatts
Horsepower hours	2547	Btu
Horsepower hours	7457	Kilowatt hours
Inches	2.540	Centimeters
Inches of mercury	0.03342	Atmospheres
Inches of mercury	1.133	Ft. of water
Inches of mercury	70.73	Lb/sq. ft.
Inches of mercury	0.4912	Lb/sq. in.
Inches of water	0.002458	Atmospheres
Inches of water	0.07355	Inches in mercury
Inches of water	5.202	Lb/sq. ft.
Inches of water	0.03613	Lb/sq. in.
Inches of water	0.5781	Ounces/sq. in.
Kilograms	2.205	Lb
Kg/meter	0.6720	Lb/ft
Kg/sq. meter	0.003281	Feet of water
Kg/sq. meter	0.2048	Lb/sq. ft.
Kg/sq. meter	0.001422	Lb/sq. in.
Kilometers	3281	Feet
Kilometers	0.6214	Miles
Kilometers	1094	Yards
Kilometers/hr.	27.78	Centimeters/sec.
Kilometers/hr.	54.68	Feet/min.
Kilometers/hr.	0.9113	Feet/sec.
Kilometers/hr.	0.6214	Miles/hr.
Kilowatts	56.92	Btu/min.
Kilowatts	44250	Ft. lb/min.
Kilowatts	737.6	Ft. lb/sec.
Kilowatts	1.341	Horsepower
Kilowatts	1000	Watts
Kilowatt hrs.	3415	Btu
Kilowatt hrs.	2655000	Ft. lb.
Kilowatt hrs.	1.341	Horsepower - hrs.
Liters	0.03531	Cu. ft.
Liters	61.02	Cu. in.
Liters	0.2642	Gallons
Meters	100	Centimeters
Meters	3.281	Feet
Meters	39.37	Inches
Meters	1.094	Yards
Meters/sec.	196.8	Ft./min.

ENGINEERING INFORMATION - UNIT CONVERSIONS

16.5

REV. 4-99

Conversion factors for various engineering units (continued)

Multiply	By	To Obtain
Millimeters	0.1	Centimeters
Millimeters	0.03937	Inches
Milligrams/liter	1	Parts/million
Million gal/day	1.54723	Cu. ft./sec.
Ounces	437.5	Grains
Ounces	28.349527	Grams
Ounces	0.0625	Pounds
Ounces (fluid)	1.805	Cu. in.
Ounces (fluid)	0.02957	Liters
Ounces/sq. in.	0.0625	Lb/sq. in.
Parts/million	0.0584	Grains/U.S. gal
Parts/million	8.345	Lb/million gal
Pounds	16	Ounces
Pounds	7000	Grains
Pounds	453.5924	Grams
Pounds of water	0.01602	Cu. ft.
Pounds of water	27.68	Cu. in.
Pounds of water	0.1198	Gallons
Pounds/cu. ft.	0.0005787	Lb/cu. in.
Pounds/cu. in.	1728	Lb/cu. ft.
Pounds/sq. ft.	0.01602	Feet of water
Pounds/sq. ft.	0.006945	Pounds/sq. in.
Pounds/sq. in.	2.307	Feet of water
Pounds/sq. in.	2.036	Inches of mercury
Quarts (liquid)	57.75	Cu. in.
Radians	57.30	Degrees
Radians	3438	Minutes
Radians	0.637	Quadrants
Radians/sec.	57.30	Degrees/sec.
Radians/sec.	0.1592	Revolutions/sec.
Radians/sec.	9549	Revolutions/min.
Revolutions	360	Degrees
Revolutions	4	Quadrants

Multiply	By	To Obtain
Revolutions	6.283	Radians
Revolutions/min.	6	Degrees/sec.
Revolutions/min.	0.1047	Radians/sec.
Revolutions/min.	0.01667	Revolutions/sec.
Square feet	0.00002296	Acres
Square feet	144	Sq. in.
Square kilometers	247.1	Acres
Square kilometers	10760000	Sq. ft.
Square kilometers	0.3861	Sq. miles
Square kilometers	1196000	Sq. yds.
Square meters	0.0002471	Acres
Square meters	10.76	Sq. ft.
Square meters	0.0000003861	Sq. miles
Square meters	1.196	Sq. yards
Square miles	640	Acres
Square miles	27880000	Sq. ft.
Square millimeters	0.00155	Sq. in.
Square yards	0.0002066	Acres
Square yards	9	Sq. ft.
Square yards	0.0000003228	Sq. miles
Temp. (°C) + 273	1	Abs. temp. (°C)
Temp. (°C) + 17.78	1.8	Temp (°F)
Temp. (°F) + 460	1	Abs. temp. (°F)
Temp. (°F) - 32	5/9	Temp (°C)
Watts	0.05692	Btu/min.
Watts	44.26	Ft. lb/min.
Watts	0.001341	Horsepower
Watts	0.010	Kilowatts
Yards	91.44	Centimeters
Yards	3	Feet
Yards	36	Inches
Yards	0.9144	Meters

English to Metric Conversions

AREA		
To convert from	to	multiply by
acre	meter ² (m ²)	4.046 856 E+03
circular mil	meter ² (m ²)	5.067 075 E -10
foot ²	meter ² (m ²)	9.290 304* E -02
inch ²	meter ² (m ²)	6.451 600* E -04
mile ² (U.S. statute)	meter ² (m ²)	2.589 988 E+06
section	meter ² (m ²)	2.589 988 E+06
township	meter ² (m ²)	9.323 957 E+07
yard ²	meter ² (m ²)	8.361 274 E -01

BENDING MOMENT or TORQUE		
To convert from	to	multiply by
dyne-centimeter	newton-meter (N•m)	1.000 000* E -07
kilogram-force-meter	newton-meter (N•m)	9.806 650* E+00
ounce-force-inch	newton-meter (N•m)	7.061 552 E -03
pound-force-inch	newton-meter (N•m)	1.129 848 E -01
pound-force-foot	newton-meter (N•m)	1.355 818 E +00

ENERGY (includes Work)		
To convert from	to	multiply by
British thermal unit (International Table)	joule (J)	1.055 056 E+03
electron volt	joule (J)	1.602 19 E -19
erg	joule (J)	1.000 000*E -07
foot-pound-force	joule (J)	1.355 818 E+00
foot-poundal	joule (J)	4.214 011 E -02
joule, international U.S.(INT-US)	joule (J)	1.000 182 E+00
joule, U.S.legal 1948 (JUS-48)	joule (J)	1.000 017 E+00
kilowatt-hour	joule (J)	3.600 000*E+06
kilowatt-hour, international U.S.(kWhINT-US)	joule (J)	3.600 655 E+06
kilowatt-hour,U.S. legal 1948(kWhUS-48)	joule (J)	3.600 061 E +06
watt-hour	joule (J)	3.600 000*E+03
watt-second	joule (J)	1.000 000*E +00

* Exact - not rounded

English to Metric Conversions (continued)

FORCE		
To convert from	to	multiply by
dyne	newton (N)	1.000 000*E -05
kilogram-force	newton (N)	9.806 650*E+00
kip	newton (N)	4.448 222 E+03
ounce-force (avoirdupois)	newton (N)	2.780 139 E -01
pound-force (lbf avoirdupois)	newton (N)	4.448 222 E+00
poundal	newton (N)	1.382 550 E -01

MASS		
To convert from	to	multiply by
carat (metric)	kilogram (kg)	2.000 000* E-04
grain	kilogram (kg)	6.479 891*E -05
gram	kilogram (kg)	1.000 000*E -03
hundredweight (long)	kilogram (kg)	5.080 235 E+01
hundredweight (short)	kilogram (kg)	4.535 924 E+01
kilogram-force-second ² /meter (mass)	kilogram (kg)	9.806 650*E+01
kilogram-mass	kilogram (kg)	1.000 000*E+00
ounce-mass (avoirdupois)	kilogram (kg)	2.834 952 E -02
ounce-mass (troy or apothecary)	kilogram (kg)	3.110 348 E -02
pennyweight	kilogram (kg)	1.555 174 E -03
pound-mass (lbm avoirdupois)	kilogram (kg)	4.535 924 E -01
pound-mass (troy or apothecary)	kilogram (kg)	3.732 417 E -01
slug	kilogram (kg)	1.459 390 E+01
ton (assay)	kilogram (kg)	2.916 667 E -02
ton (long, 2240 lbm)	kilogram (kg)	1.016 047 E+03
ton (metric)	kilogram (kg)	1.000 000*E+03
ton (short,2000 lbm)	kilogram (kg)	9.071 847 E+02

MASS/AREA		
To convert from	to	multiply by
pound-mass/foot ²	kilogram/meter ² (kg/m ²)	4.882 428* E+00

HEAT		
To convert from	to	multiply by
Btu* in./s • ft ² • °F (k, thermal conductivity)	watt/meter-kelvin (W/m•K)	5.192 204 E+02
Btu* in./h • ft ² • °F (k, thermal conductivity)	watt/meter-kelvin (W/m•K)	1.442 279 E -01
Btu* /ft ²	joule/meter ² (J/m ²)	1.135 653 E+04
Btu* h • ft ² • °F (C, thermal conductance)	Watt/meter ² -kelvin (W/m ² •K)	5.678 263 E+00
Btu* /pound-mass	joule/kilogram (J/kg)	2.326 000*E+03
Btu* lbm • °F (c, heat capacity)	joule/kilogram-kelvin (J/kg•K)	4.186 800*E+03
Btu* /s • ft ² • °F	Watt/meter ² -kelvin (W/m ² •K)	2.044 175 E+04
cal * /g	joule/kilogram (J/kg)	4.186 800*E+03
cal */g• °C	joule/kilogram-kelvin (J/kg•K)	4.186 800*E+03
clo	kelvin-meter ² /watt (K•m ² /W)	2.003 712 E -01
deg F • h • ft ² /Btu* (R, thermal resistance)	kelvin-meter ² /watt (K•m ² /W)	1.761 102 E -01
ft ² /h (thermal diffusivity)	meter ² /second (m ² /s)	2.580 640*E -05

* International Table

MASS/VOLUME (Includes Density and Mass Capacity)		
To convert from	to	multiply by
grain (lbm avoirdupois/7000)/gallon (US liquid)	kilogram/meter ³ (kg/m ³)	1.711 806 E-02
gram/centimeter ³	kilogram/meter ³ (kg/m ³)	1.000 000*E+03
ounce (avoirdupois)/gallon (UK liquid)	kilogram/meter ³ (kg/m ³)	6.236 021 E+00
ounce (avoirdupois)/gallon (US liquid)	kilogram/meter ³ (kg/m ³)	7.489 152 E+00
ounce (avoirdupois) (mass) /inch ³	kilogram/meter ³ (kg/m ³)	1.729 994 E+03
pound-mass/foot ³	kilogram/meter ³ (kg/m ³)	1.601 846 E+01
pound-mass/inch ³	kilogram/meter ³ (kg/m ³)	2.767 990 E+04
pound-mass/gallon (UK liquid)	kilogram/meter ³ (kg/m ³)	9.977 633 E+01
pound-mass/gallon (US liquid)	kilogram/meter ³ (kg/m ³)	1.198 264 E+02
slug/foot ³	kilogram/meter ³ (kg/m ³)	5.153 788 E+02
ton (long, mass)/yard ³	kilogram/meter ³ (kg/m ³)	1.328 939 E+03

LENGTH		
To convert from	to	multiply by
angstrom	meter (m)	1.000 000*E -10
astronomical unit	meter (m)	1.495 98 E+11
caliber (inch)	meter (m)	2.540 000*E -02
fathom	meter (m)	1.828 800*E+00
fermi (femtometer)	meter (m)	1.000 000*E -15
foot	meter (m)	3.048 000*E -01
inch	meter (m)	2.540 000*E -02
league (international nautical)	meter (m)	5.556 000*E+03
league (statute)	meter (m)	4.828 032*E+03
league (U.K. nautical)	meter (m)	5.559 552*E+03
light year	meter (m)	9.460 55 E+15
microinch	meter (m)	2.540 000*E -08
micron	meter (m)	1.000 000*E -06
mil	meter (m)	2.540 000*E -05
mile (international nautical)	meter (m)	1.852 000*E+03
mile (U.K. nautical)	meter (m)	1.853 184*E+03
mile (U.S. nautical)	meter (m)	1.852 000*E+03
mile (U.S. statute)	meter (m)	1.609 344*E+03
parsec	meter (m)	3.083 74 E+16
rod	meter (m)	5.029 200*E+00
statute mile (U.S.)	meter (m)	1.609 344*E+03
yard	meter (m)	9.144 000*E -01

TEMPERATURE		
To convert from	to	multiply by
degree Celsius	kelvin (k)	tK = t°C + 273.15
degree Fahrenheit	kelvin (k)	tK = (t°F + 459.67)/1.8
degree Rankine	kelvin (k)	tK = t°R/1.8
degree Fahrenheit	degree Celsius	5°C = (t°F - 32)/1.8

TIME		
To convert from	to	multiply by
day (sidereal)	second (s)	8.616 409 E+04
hour (sidereal)	second (s)	3.590 170 E+03
minute (sidereal)	second (s)	5.983 617 E+01
second (sidereal)	second (s)	9.972 696 E -01
year (sidereal)	second (s)	3.155 815 E+07

* Exact - not rounded

English to Metric Conversions (continued)

PRESSURE or STRESS (Force/Area)		
To convert from	to	multiply by
atmosphere (normal = 760 torr)	pascal (Pa)	1.013 25 E+05
atmosphere (technical = 1 kgf/cm ²)	pascal (Pa)	9.806 650*E+04
bar	pascal (Pa)	1.000 000*E+05
centimeter of mercury (0°C)	pascal (Pa)	1.333 22 E+03
centimeter of water (4°C)	pascal (Pa)	9.806 38 E+01
decibar	pascal (Pa)	1.000 000*E+04
dyne/centimeter ²	pascal (Pa)	1.000 000*E -01
foot of water (39.2°F)	pascal (Pa)	2.988 98 E+03
gram-force/centimeter ²	pascal (Pa)	9.806 650*E+01
inch of mercury (32°F)	pascal (Pa)	3.386 389 E+03
inch of mercury (60°F)	pascal (Pa)	3.376 85 E+03
inch of water (39.2°F)	pascal (Pa)	2.490 82 E+02
inch of water (60°F)	pascal (Pa)	2.488 4 E+02
kilogram-force/centimeter ²	pascal (Pa)	9.806 650*E+04
kilogram-force/meter ²	pascal (Pa)	9.806 650*E+00
kilogram-force/millimeter ²	pascal (Pa)	9.806 650*E+06
kip/inch ² (ksi)	pascal (Pa)	6.894 757 E+06
millibar	pascal (Pa)	1.000 000*E+02
millimeter of mercury (0°C)	pascal (Pa)	1.333 224 E+02
poundal/foot ²	pascal (Pa)	1.488 164 E+00
pound-force/foot ²	pascal (Pa)	4.788 026 E+01
pound-force/inch ² (psi)	pascal (Pa)	6.894 757 E+03
psi	pascal (Pa)	6.894 757 E+03
torr (mm Hg, 0°C)	pascal (Pa)	1.333 22 E+02

VELOCITY (includes Speed)		
To convert from	to	multiply by
foot/hour	meter/second (m/s)	8.466 667 E -05
foot/minute	meter/second (m/s)	5.080 000*E -03
foot/second	meter/second (m/s)	3.048 000*E -01
inch/second	meter/second (m/s)	2.540 000*E -02
kilometer/hour	meter/second (m/s)	2.777 778 E -01
knot (international)	meter/second (m/s)	5.144 444 E -01
mile/hour (U.S. statute)	meter/second (m/s)	4.470 400*E -01
mile/minute (U.S. statute)	meter/second (m/s)	2.682 240*E+01
mile/second (U.S. statute)	meter/second (m/s)	1.609 344*E+03
mile/hour (U.S. statute)	kilometer/hour	1.609 344*E+00

VOLUME/TIME (includes Flow)		
To convert from	to	multiply by
foot ³ /minute	meter ³ /second (m ³ /s)	4.719 474 E -04
foot ³ /second	meter ³ /second (m ³ /s)	2.831 685 E -02
inch ³ /minute	meter ³ /second (m ³ /s)	2.731 177 E -07
yard ³ /minute	meter ³ /second (m ³ /s)	1.274 258 E -02
gallon (U.S. liquid)/day	meter ³ /second (m ³ /s)	4.381 264 E -08
gallon (U.S. liquid)/minute	meter ³ /second (m ³ /s)	6.309 020 E -05

VOLUME (includes capacity)		
To convert from	to	multiply by
acre-foot	meter ³ (m ³)	1.233 482 E+03
barrel (oil, 42 gal)	meter ³ (m ³)	1.589 873 E -01
board foot	meter ³ (m ³)	2.359 737 E -03
bushel (U.S.)	meter ³ (m ³)	3.523 907 E -02
fluid ounce (U.S.)	meter ³ (m ³)	2.957 353 E -05
foot ³	meter ³ (m ³)	2.831 685 E -02
gallon (Canadian liquid)	meter ³ (m ³)	4.546 090 E -03
gallon (U.K. liquid)	meter ³ (m ³)	4.546 092 E -03
gallon (U.S. dry)	meter ³ (m ³)	4.404 884 E -03
gallon (U.S. liquid)	meter ³ (m ³)	3.785 412 E -03
inch ³	meter ³ (m ³)	1.638 706 E -05
liter ⁴	meter ³ (m ³)	1.000 000*E -03
ounce (U.K. fluid)	meter ³ (m ³)	2.841 307 E -05
ounce (U.S. fluid)	meter ³ (m ³)	2.957 353 E -05
peck (U.S.)	meter ³ (m ³)	8.809 768 E -03
pint (U.S. dry)	meter ³ (m ³)	5.506 105 E -04
pint (U.S. liquid)	meter ³ (m ³)	4.731 765 E -04
quart (U.S. dry)	meter ³ (m ³)	1.101 221 E -03
quart (U.S. liquid)	meter ³ (m ³)	9.463 529 E -04
stere	meter ³ (m ³)	1.000 000*E+00
tablespoon	meter ³ (m ³)	1.478 676 E -05
teaspoon	meter ³ (m ³)	4.928 922 E -06
ton (register)	meter ³ (m ³)	2.831 685 E+00
yard ³	meter ³ (m ³)	7.645 549 E -01

* Exact - not rounded