

Standard Prefixes for Metric Units

SI prefix*	Symbol	Multiple
exa	E	1 000 000 000 000 000 000 = 10 ¹⁸
peta	P	1 000 000 000 000 000 = 10 ¹⁵
tera	T	1 000 000 000 000 = 10 ¹²
giga	G	1 000 000 000 = 10 ⁹
mega	M	1 000 000 = 10 ⁶
kilo	k	1 000 = 10 ³
hecto	h	100 = 10 ²
deka	da	10 = 10 ¹
deci	d	0.1 = 10 ⁻¹
centi	c	0.01 = 10 ⁻²
milli	m	0.001 = 10 ⁻³
micro	μ	0.000 001 = 10 ⁻⁶
nano	n	0.000 000 001 = 10 ⁻⁹
pico	p	0.000 000 000 001 = 10 ⁻¹²
femto	f	0.000 000 000 000 001 = 10 ⁻¹⁵
atto	a	0.000 000 000 000 000 001 = 10 ⁻¹⁸

*SI = International System of units.

Greek Letters

alpha	A	α, a	nu	N	ν
beta	B	β	xi	Ξ	ξ
gamma	Γ	γ	omicron	Ο	ο
delta	Δ	δ, δ	pi	Π	π
epsilon	Ε	ε, ε	rho	Ρ	ρ
zeta	Ζ	ζ	sigma	Σ	σ, σ
eta	Η	η	tau	Τ	τ
theta	Θ, Θ	θ, θ	upsilon	Υ	υ
iota	Ι	ι	phi	Φ	φ, φ
kappa	Κ	κ	chi	Χ	χ
lambda	Λ	λ	psi	Ψ	ψ
mu	Μ	μ	omega	Ω	ω

Conversion Factors A to Convert Input X to Output Y Using the Formula Y = AX*

Multiply input X	by factor A	to get output Y	Multiply input X	by factor A	to get output Y
British thermal unit, Btu	1055	joule, J	moment of inertia, lbm · ft ²	0.0421	kilogram-meter ² , kg · m ²
Btu/second, Btu/s	1.05	kilowatt, kW	moment of inertia, lbm · in ²	293	kilogram-millimeter ² , kg · mm ²
calorie	4.19	joule, J	moment of section (second moment of area), in ⁴	41.6	centimeter ⁴ , cm ⁴
centimeter of mercury (0°C)	1.333	kilopascal, kPa	ounce-force, oz	0.278	newton, N
centipoise, cP	0.001	pascal-second, Pa · s	ounce-mass	0.0311	kilogram, kg
degree (angle)	0.0174	radian, rad	pound, lb*	4.45	newton, N
foot, ft	0.305	meter, m	pound-foot, lb · ft	1.36	newton-meter, N · m
foot ² , ft ²	0.0929	meter ² , m ²	pound/foot ² , lb/ft ²	47.9	pascal, Pa
foot/minute, ft/min (fpm)	0.0051	meter/second, m/s	pound-inch, lb · in	0.113	joule, J
foot-pound, ft · lb	1.35	joule, J	pound-inch, lb · in	0.113	newton-meter, N · m
foot-pound/second, ft · lb/s	1.35	watt, W	pound/inch, lb/in	175	newton/meter, N/m
foot/second, ft/s	0.305	meter/second, m/s	pound/inch ² , psi (lb/in ²)	6.89	kilopascal, kPa
gallon (U.S.), gal	3.785	liter, l	pound-mass, lbm	0.454	kilogram, kg
horsepower, hp	0.746	kilowatt, kW	pound-mass/second, lbm/s	0.454	kilogram/second, kg/s
inch, in	0.0254	meter, m	quart (U.S. liquid), qt	946	milliliters, ml
inch, in	25.4	millimeter, mm	section modulus, in ³	16.4	centimeter ³ , cm ³
inch ² , in ²	645	millimeter ² , mm ²	slug	14.6	kilogram, kg
inch of mercury (32°F)	3.386	kilopascal, kPa	ton (short 2000 lbm)	907	kilogram, kg
kilopound, kip	4.45	kilonewton, kN	yard, yd	0.914	meter, m
kilopound/inch ² , kpsi (ksi)	6.89	megapascal, MPa (N/mm ²)			
mass, lb · s ² /in	175	kilogram, kg			
mile, mi	1.610	kilometer, km			
mile/hour, mi/h	1.61	kilometer/hour, km/h			
mile/hour, mi/h	0.447	meter/second, m/s			

*The U.S. Customary System unit of the pound-force is often abbreviated as lbf to distinguish it from the pound-mass, which is abbreviated as lbm. In most places in this book the pound force is usually written simply as the pound and abbreviated as lb.

List of Symbols in General Use in Machine Design

<i>A</i>	Area; constant	<i>k</i>	Spring rate; endurance-limit modification factor; radius of gyration	α	Coefficient of thermal expansion; thread angle; axial fatigue-stress correction factor; angle
<i>a, a</i>	Acceleration	<i>L</i>	Length; life; lead	β	Partial bearing angle
<i>a</i>	Constant; dimension; addendum	<i>l</i>	Length	Γ	Pitch angle; gamma function
<i>b</i>	Weibull exponent; dedendum; section width; dimension; constant; fatigue-strength exponent	<i>M, M</i>	Moment	γ	Shear strain; pitch angle; articulation angle
<i>C</i>	Coefficient; spring index; bearing-load rating; column end-condition constant; gear factor; center distance; specific heat; diametral clearance	<i>m</i>	Mass, margin of safety; slope; contact ratio; module	Δ	Increment or change
<i>c</i>	Clearance; radial clearance; distance from neutral axis in beam; fatigue ductility exponent; coefficient of viscosity	<i>n</i>	Design factor; strain-hardening exponent; speed in rpm	δ	Total deformation or elongation
<i>D, d</i>	Diameter	<i>P, P</i>	Force	ϵ	Unit engineering strain
<i>E</i>	Modulus of elasticity; kinetic energy	<i>P</i>	Diametral pitch; bearing pressure	e	True strain; eccentricity ratio
<i>F, F</i>	Force	<i>p</i>	Pressure; linear or circular pitch	η	Efficiency
<i>F</i>	Face width	<i>Q</i>	First moment of area; flow volume	η	Factor of safety (distinguished from design factor <i>n</i>)
<i>f</i>	Frequency; coefficient of friction	<i>q</i>	Load intensity; notch sensitivity; arc length	θ	Twist angle; slope; a Weibull parameter
<i>G</i>	Shear modulus of elasticity	<i>R</i>	Reliability; reduction in area	λ	Lead angle
<i>g</i>	Acceleration due to gravity	<i>r</i>	Radius; radial direction indicator; correlation coefficient	μ	Population mean; absolute viscosity
<i>H</i>	Hardness number; heat gained or lost; power	<i>S</i>	Strength; bearing characteristic number; scale	ν	Poisson's ratio
<i>h</i>	Section depth; bearing clearance	<i>s</i>	Sample standard deviation; distance	ρ	Radius of curvature; density
<i>I</i>	Moment of inertia; second area moment; geometry factor	<i>T</i>	Torque; temperature	Σ	Summation sign
<i>i</i>	Integer	<i>t</i>	Thickness; tangential direction; time	σ	Normal stress (engineering or nominal)
<i>J</i>	Polar moment of inertia; second polar area moment; geometry factor; mechanical equivalent of heat	<i>U</i>	Energy; velocity; coefficient	$\bar{\sigma}$	True stress
<i>j</i>	Integer	<i>V</i>	Shear force; velocity; rotation factor for bearings	σ	Population standard deviation
<i>K</i>	Stress-concentration factor; wear factor; Wahl correction factor; gear factor; bearing-rating ratio; strength coefficient; stress-intensity factor; bolt-torque coefficient	<i>W</i>	Weight; load; cold-work factor	τ	Shear stress
		<i>X</i>	Radial factor for bearings	ϕ	Pressure angle; angle
		<i>x</i>	Rectangular coordinate; distance	ψ	Helix angle
		<i>Y</i>	Thrust factor for bearings	ω	Angular velocity
		<i>y</i>	Rectangular coordinate; distance		
		<i>Z</i>	Section modulus; viscosity		
		<i>z</i>	Rectangular coordinate; distance; standard statistical variable		