

## A.2 Engineering Conversion Factors

**TABLE A.2a**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
	<b>A</b>		ares	sq yards	119.60
abcoulomb	statcoulombs	$2.998 \times 10^{10}$	ares	acres	0.02471
acre	sq chain (Gunters)	10	ares	sq meters	100.0
acre	rods	160	Astronomical unit	kilometers	$1.495 \times 10^8$
acre	sq links (Gunters)	$1 \times 10^5$	atmospheres	ton/sq in.	0.007348
acre	hectare or sq hectometer	0.4047	atmospheres	cm of mercury	76.0
acres	sq ft	43,560.0	atmospheres	ft of water (at 4°C)	33.90
acres	sq meters	4,047.0	atmospheres	in. of mercury (at 0°C)	29.92
acres	sq miles	$1.562 \times 10^{-3}$	atmospheres	kg/sq cm	1.0333
acres	sq yards	4,840.0	atmospheres	kg/sq meter	10,332.0
acre-feet	cubic ft	43,560.0	atmospheres	pounds/sq in.	14.70
acre-feet	gallons	$3.259 \times 10^5$	atmospheres	tons/sq ft	1.058
amperes/sq cm	amps/sq in.	6.452		<b>B</b>	
amperes/sq cm	amps/sq meter	$10^4$	barrels (U.S., dry)	cubic in.	7056.0
amperes/sq in.	amps/sq cm	0.1550	barrels (U.S., dry)	quarts (dry)	105.0
amperes/sq in.	amps/sq meter	1,550.0	barrels (U.S., liquid)	gallons	31.5
amperes/sq meter	amps/sq cm	$10^{-4}$	barrels (oil)	gallons (oil)	42.0
amperes/sq meter	amps/sq in.	$6.452 \times 10^{-4}$	bars	atmospheres	0.9869
ampere-hours	coulombs	3,600.0	bars	dynes/sq cm	$10^6$
ampere-hours	farads	0.03731	bars	kg/sq meter	$1.020 \times 10^4$
ampere-turns	gilberts	1.257	bars	pounds/sq ft	2,089.0
ampere-turns/cm	amp-turns/in.	2.540	bars	pounds/sq in.	14.50
ampere-turns/cm	amp-turns/meter	100.0	baryl	dyne/sq cm	1.000
ampere-turns/cm	gilberts/cm	1.257	bolt (U.S. cloth)	meters	36.576
ampere-turns/in.	amp-turns/cm	0.3937	Btu	liter-atmosphere	10.409
ampere-turns/in.	amp-turns/meter	39.37	Btu	ergs	$1.0550 \times 10^{10}$
ampere-turns/in.	gilberts/cm	0.4950	Btu	foot-lb	778.3
ampere-turns/meter	amp-turns/cm	0.01	Btu	gram-calories	252.0
ampere-turns/meter	amp-turns/in.	0.0254	Btu	horsepower-hr	$3.931 \times 10^{-4}$
ampere-turns/meter	gilberts/cm	0.01257	Btu	joules	1,054.8
angstrom unit	in.	$3.937 \times 10^{-9}$	Btu	kilogram-calories	0.2520
angstrom unit	meter	$1 \times 10^{-10}$	Btu	kilogram-meters	107.5
angstrom unit	micron or $\mu\text{m}$	$1 \times 10^{-4}$	Btu	kilowatt-hr	$2.928 \times 10^{-4}$
are	acre (U.S.)	0.02471	Btu/hr	foot-pounds/sec	0.2162

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
Btu/hr	gram-cal/sec	0.0700	centimeters of mercury	kg/sq meter	136.0
Btu/hr	horsepower-hr	$3.929 \times 10^{-4}$	centimeters of mercury	pounds/sq ft	27.85
Btu/hr	watts	0.2931	centimeters of mercury	pounds/sq in.	0.1934
Btu/min	foot-lb/sec	12.96	centimeters/sec	feet/min	1.1969
Btu/min	horsepower	0.02356	centimeters/sec	feet/sec	0.03281
Btu/min	kilowatts	0.01757	centimeters/sec	kilometers/hr	0.036
Btu/min	watts	17.57	centimeters/sec	knots	0.1943
Btu/sq ft/min	watts/sq in.	0.1221	centimeters/sec	meters/min	0.6
bucket (Br. dry)	cubic cm	$1.818 \times 10^4$	centimeters/sec	miles/hr	0.02237
bushels	cubic ft	1.2445	centimeters/sec	miles/min	$3.728 \times 10^{-4}$
bushels	cubic in.	2,150.4	centimeters/sec/sec	feet/sec/sec	0.03281
bushels	cubic meters	0.03524	centimeters/sec/sec	km/hr/sec	0.036
bushels	liters	35.24	centimeters/sec/sec	meters/sec/sec	0.01
bushels	pecks	4.0	centimeters/sec/sec	miles/hr/sec	0.02237
bushels	pints (dry)	64.0	chain	inches	792.00
bushels	quarts (dry)	32.0	chain	meters	20.12
	<b>C</b>		chains (surveyors' or Gunter's)	yards	22.00
calories, gram (mean)	Btu (mean)	$3.9685 \times 10^{-3}$	circular mils	sq cms	$5.067 \times 10^{-6}$
candle/sq cm	lamberts	3.142	circular mils	sq mils	0.7854
candle/sq in.	lamberts	0.4870	circumference	radians	6.283
centares (centiares)	sq meters	1.0	circular mils	sq inches	$7.854 \times 10^{-7}$
Centigrade	Fahrenheit	$(C^\circ \times 9/5) + 32$	cords	cord feet	8
centigrams	grams	0.01	cord feet	cubic feet	16
centiliter	ounce fluid (U.S.)	0.3382	coulomb	statcoulombs	$2.998 \times 10^9$
centiliter	cubic in.	0.6103	coulombs	farads	$1.036 \times 10^{-5}$
centiliter	drams	2.705	coulombs/sq cm	coulombs/sq in.	64.52
centiliters	liters	0.01	coulombs/sq cm	coulombs/sq meter	$10^4$
centimeters	feet	$3.281 \times 10^{-2}$	coulombs/sq in.	coulombs/sq cm	0.1550
centimeters	inches	0.3937	coulombs/sq in.	coulombs/sq meter	1,550.0
centimeters	kilometers	$10^{-5}$	coulombs/sq meter	coulombs/sq cm	$10^{-4}$
centimeters	meters	0.01	coulombs/sq meter	coulombs/sq in.	$6.452 \times 10^{-4}$
centimeters	miles	$6.214 \times 10^{-6}$	cubic centimeters	cubic ft	$3.531 \times 10^{-5}$
centimeters	millimeters	10.0	cubic centimeters	cubic in.	0.06102
centimeters	miles	393.7	cubic centimeters	cubic meters	$10^{-6}$
centimeter-dynes	cm-grams	$1.020 \times 10^{-3}$	cubic centimeters	cubic yards	$1.308 \times 10^{-6}$
centimeter-dynes	meter-kg	$1.020 \times 10^{-8}$	cubic centimeters	gallons (U.S. liq.)	$2.642 \times 10^{-4}$
centimeter-dynes	pound-feet	$7.376 \times 10^{-8}$	cubic centimeters	liters	0.001
centimeter-grams	cm-dynes	980.7	cubic centimeters	pints (U.S. liq.)	$2.113 \times 10^{-3}$
centimeter-grams	meter-kg	$10^{-5}$	cubic centimeters	quarts (U.S. liq.)	$1.057 \times 10^{-3}$
centimeter-grams	pound-feet	$7.233 \times 10^{-5}$	cubic feet	bushels (dry)	0.8036
centimeters of mercury	atmospheres	0.01316	cubic feet	cubic cm	28,320.0
centimeters of mercury	feet of water	0.4461	cubic feet	cubic in.	1,728.0



**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
ergs	joules	$10^{-7}$	feet/sec/sec	meters/sec/sec	0.3048
ergs	kg-calories	$2.389 \times 10^{-11}$	feet/sec/sec	miles/hr/sec	0.6818
ergs	kg-meters	$1.020 \times 10^{-8}$	feet/100 feet	percent grade	1.0
ergs	kilowatt-hr	$0.2778 \times 10^{-13}$	foot-candle	lumen/sq meter	10.764
ergs	watt-hours	$0.2778 \times 10^{-10}$	foot-pounds	Btu	$1.286 \times 10^{-3}$
ergs/sec	Btu/min	$5.688 \times 10^{-9}$	foot-pounds	ergs	$1.356 \times 10^7$
ergs/sec	ft-lb/min	$4.427 \times 10^{-6}$	foot-pounds	gram-calories	0.3238
ergs/sec	ft-lb/sec	$7.3756 \times 10^{-8}$	foot-pounds	hp-hr	$5.050 \times 10^{-7}$
ergs/sec	horsepower	$1.341 \times 10^{-10}$	foot-pounds	joules	1.356
ergs/sec	kg-calories/min	$1.433 \times 10^{-9}$	foot-pounds	kg-calories	$3.24 \times 10^{-4}$
ergs/sec	kilowatts	$10^{-10}$	foot-pounds	kg-meters	0.1383
	<b>F</b>		foot-pounds	kilowatt-hr	$3.766 \times 10^{-7}$
farads	microfarads	$10^6$	foot-pounds/min	Btu/min	$1.286 \times 10^{-3}$
farad/sec	ampere (absolute)	$9.6500 \times 10^4$	foot-pounds/min	foot-pounds/sec	0.01667
farads	ampere-hours	26.80	foot-pounds/min	horsepower	$3.030 \times 10^{-5}$
farads	coulombs	$9.649 \times 10^4$	foot-pounds/min	kg-calories/min	$3.24 \times 10^{-4}$
fathom	meter	1.828804	foot-pounds/min	kilowatt	$2.260 \times 10^{-5}$
fathoms	feet	6.0	foot-pounds/sec	Btu/hr	4.6263
feet	centimeters	30.48	foot/pounds/sec	Btu/min	0.07717
feet	kilometers	$3.048 \times 10^{-4}$	foot-pounds/sec	horsepower	$1.818 \times 10^{-3}$
feet	meters	0.3048	foot-pounds/sec	kg-calories/min	0.01945
feet	miles (naut.)	$1.645 \times 10^{-4}$	foot-pounds/sec	kilowatts	$1.356 \times 10^{-3}$
feet	miles (stat.)	$1.894 \times 10^{-4}$	furlongs	miles (U.S.)	0.125
feet	millimeters	304.8	furlongs	rods	40.0
feet	mils	$1.2 \times 10^4$	furlongs	feet	660.0
feet of water	atmospheres	0.02950		<b>G</b>	
feet of water	in. of mercury	0.8826	gallons	cubic cm	3,785.0
feet of water	kg/sq cm	0.03048	gallons	cubic ft	0.1337
feet of water	kg/sq meter	304.8	gallons	cubic in.	231.0
feet of water	pounds/sq ft	62.43	gallons	cubic meters	$3.785 \times 10^{-3}$
feet of water	pounds/sq in.	0.4335	gallons	cubic yards	$4.951 \times 10^{-3}$
feet/min	cm/sec	0.5080	gallons	liters	3.785
feet/min	ft/sec	0.01667	gallons (liq. Br. Imp.)	gallons (U.S. liq.)	1.20095
feet/min	km/hr	0.01829	gallons (U.S.)	gallons (Imp.)	0.83267
feet/min	meters/min	0.3048	gallons of water	pounds of water	8.3453
feet/min	miles/hr	0.01136	gallons/min	cubic ft/sec	$2.228 \times 10^{-3}$
feet/sec	cm/sec	30.48	gallons/min	liters/sec	0.06308
feet/sec	km/hr	1.097	gallons/min	cubic ft/hr	8.0208
feet/sec	knots	0.5921	gauss	lines/sq in.	6.452
feet/sec	meters/min	18.29	gauss	webbers/sq cm	$10^{-8}$
feet/sec	miles/hr	0.6818	gauss	webbers/sq in.	$6.452 \times 10^{-8}$
feet/sec	miles/min	0.01136	gauss	webbers/sq meter	$10^{-4}$
feet/sec/sec	cm/sec/sec	30.48	gilberts	ampere-turns	0.7958
feet/sec/sec	km/hr/sec	1.097	gilberts/cm	amp-turns/cm	0.7958

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
gilberts/cm	amp-turns/in.	2.021	gram-centimeters	kg-cal	$2.343 \times 10^{-8}$
gilberts/cm	amp-turns/meter	79.58	gram-centimeters	kg-meters	$10^{-5}$
gills (British)	cubic cm	142.07			
gills	liters	0.1183		<b>H</b>	
gills	pints (liq.)	0.25	hands	centimeters	10.16
grade	radian	.01571	hectares	acres	2.471
grains	drams (avoirdupois)	0.03657143	hectares	sq feet	$1.076 \times 10^5$
grains (troy)	grains (avdp.)	1.0	hectograms	grams	100.0
grains (troy)	grams	0.06480	hectoliters	liters	100.0
grains (troy)	ounces (avdp.)	$2.0833 \times 10^{-3}$	hectometers	meters	100.0
grains (troy)	pennyweight (troy)	0.04167	hectowatts	watts	100.0
grains/U.S. gal	parts/million	17.118	henries	millihenries	1,000.0
grains/U.S. gal	pounds/million gal	142.86	hogsheads (British)	cubic ft	10.114
grains/Imp. gal	parts/million	14.286	hogsheads (U.S.)	cubic ft	8.42184
grams	dynes	980.7	hogsheads (U.S.)	gallons (U.S.)	63
grams	grains	15.43	horsepower	Btu/min	42.44
grams	joules/cm	$9.807 \times 10^{-5}$	horsepower	ft-lb/min	33,000.0
grams	joules/meter (newtons)	$9.807 \times 10^{-3}$	horsepower	ft-lb/sec	550.0
grams	kilograms	0.001	horsepower (metric)	horsepower (550 ft-lb/sec)	0.9863
grams	milligrams	1,000.0	(542.5 ft lb/sec)	ft-lb/sec)	
grams	ounces (advp.)	0.03527	horsepower (550 ft lb/sec)	horsepower (metric)	1.014
grams	ounces (troy)	0.03215	horsepower	(542.5 ft-lb/sec)	
grams	poundals	0.07093	horsepower	kg-calories/min	10.68
grams	pounds	$2.205 \times 10^{-3}$	horsepower	kilowatts	0.7457
grams/cm	pounds/inch	$5.600 \times 10^{-3}$	horsepower	watts	745.7
grams/cubic cm	pounds/ cubic ft	62.43	horsepower (boiler)	Btu/hr	33.479
grams/cubic cm	pounds/cubic in.	0.03613	horsepower (boiler)	kilowatts	9.803
grams/cubic cm	pounds/mil-foot	$3.405 \times 10^{-7}$	horsepower-hr	Btu	2,547.0
grams/liter	grains/gal	58.417	horsepower-hr	ergs	$2.6845 \times 10^{13}$
grams/liter	pounds/1,000 gal	8.345	horsepower-hr	ft-lb	$1.98 \times 10^6$
grams/liter	pounds/cubic ft	0.062427	horsepower-hr	gram-calories	641,190.0
grams/liter	parts/million	1,000.0	horsepower-hr	joules	$2.684 \times 10^6$
grams/sq cm	pounds/sq ft	2.0481	horsepower-hr	kg-calories	641.1
gram-calories	Btu	$3.9683 \times 10^{-3}$	horsepower-hr	kg-meters	$2.737 \times 10^5$
gram-calories	ergs	$4.1868 \times 10^7$	horsepower-hr	kilowatt-hr	0.7457
gram-calories	foot-pounds	3.0880	hours	days	$4.167 \times 10^{-2}$
gram-calories	horsepower-hr	$1.5596 \times 10^{-6}$	hours	weeks	$5.952 \times 10^{-3}$
gram-calories	kilowatt-hr	$1.1630 \times 10^{-6}$	hundredweights (long)	pounds	112
gram-calories	watt-hr	$1.1630 \times 10^{-3}$	hundredweights (long)	tons (long)	0.05
gram-calories/sec	Btu/hr	14.286	hundredweights (short)	ounces (avoirdupois)	1,600
gram-centimeters	Btu	$9.297 \times 10^{-8}$	hundredweights (short)	pounds	100
gram-centimeters	ergs	980.7	hundredweights (short)	tons (metric)	0.0453592
gram-centimeters	joules	$9.807 \times 10^{-5}$	hundredweights (short)	tons (long)	0.0446429

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
	<b>I</b>		kilograms/cubic meter	pounds/cubic ft	0.06243
inches	centimeters	2.540	kilograms/cubic meter	pounds/cubic in.	$3.613 \times 10^{-5}$
inches	meters	$2.540 \times 10^{-2}$	kilograms/cubic meter	pounds/mil-foot	$3.405 \times 10^{-10}$
inches	miles	$1.578 \times 10^{-5}$	kilograms/meter	pounds/ft	0.6720
inches	millimeters	25.40	kilograms/sq cm	dynes	980,665
inches	mils	1,000.0	kilograms/sq cm	atmospheres	0.9678
inches	yards	$2.778 \times 10^{-2}$	kilograms/sq cm	feet of water	32.81
inches of mercury	atmospheres	0.03342	kilograms/sq cm	inches of mercury	28.96
inches of mercury	feet of water	1.133	kilograms/sq cm	pounds/sq ft	2,048.0
inches of mercury	kg/sq cm	0.03453	kilograms/sq cm	pounds/sq in.	14.22
inches of mercury	kg/sq meter	345.3	kilograms/sq meter	atmospheres	$9.678 \times 10^{-5}$
inches of mercury	pounds/sq ft	70.73	kilograms/sq meter	bars	$98.07 \times 10^{-6}$
inches of mercury	pounds/sq in.	0.4912	kilograms/sq meter	feet of water	$3.281 \times 10^{-3}$
inches of water (at 4°C)	atmospheres	$2.458 \times 10^{-3}$	kilograms/sq meter	inches of mercury	$2.896 \times 10^{-3}$
inches of water (at 4°C)	inches of mercury	0.07355	kilograms/sq meter	pounds/sq ft	0.2048
inches of water (at 4°C)	kg/sq cm	$2.540 \times 10^{-3}$	kilograms/sq meter	pounds/sq in.	$1.422 \times 10^{-3}$
inches of water (at 4°C)	ounces/sq in.	0.5781	kilograms/sq mm	kg/sq meter	$10^6$
inches of water (at 4°C)	pounds/sq ft	5.204	kilogram-calories	Btu	3.968
inches of water (at 4°C)	pounds/sq in.	0.03613	kilogram-calories	foot-pounds	3,088.0
International ampere	ampere (absolute)	0.9998	kilogram-calories	hp-hr	$1.560 \times 10^{-3}$
International volt	volts (absolute)	1.0003	kilogram-calories	joules	4,186.0
	<b>J</b>		kilogram-calories	kg-meters	426.9
joules	Btu	$9.480 \times 10^{-4}$	kilogram-calories	kilojoules	4.186
joules	ergs	$10^7$	kilogram-calories	kilowatt-hr	$1.163 \times 10^{-3}$
joules	foot-pounds	0.7376	kilogram meters	Btu	$9.294 \times 10^{-3}$
joules	kg-calories	$2.389 \times 10^{-4}$	kilogram meters	ergs	$9.804 \times 10^7$
joules	kg-meters	0.1020	kilogram meters	foot-pounds	7.233
joules	watt-hr	$2.778 \times 10^{-4}$	kilogram meters	joules	9.804
joules/cm	grams	$1.020 \times 10^4$	kilogram meters	kg-calories	$2.342 \times 10^{-3}$
joules/cm	dynes	$10^7$	kilogram meters	kilowatt-hr	$2.723 \times 10^{-6}$
joules/cm	joules/meter (newtons)	100.0	kilolines	maxwells	1,000.0
joules/cm	poundals	723.3	kiloliters	liters	1,000.0
joules/cm	pounds	22.48	kilometers	centimeters	$10^5$
	<b>K</b>		kilometers	feet	3,281.0
kilograms	dynes	980,665.0	kilometers	inches	$3.937 \times 10^4$
kilograms	grams	1,000.0	kilometers	meters	1,000.0
kilograms	joules/cm	0.09807	kilometers	miles	0.6214
kilograms	joules/meter (newtons)	9.807	kilometers	millimeters	$10^6$
kilograms	poundals	70.93	kilometers/hr	yards	1,094.0
kilograms	pounds	2.205	kilometers/hr	cm/sec	27.78
kilograms	tons (long)	$9.842 \times 10^{-4}$	kilometers/hr	ft/min	54.68
kilograms	tons (short)	$1.102 \times 10^{-3}$	kilometers/hr	ft/sec	0.9113
kilograms/cubic meter	grams/cubic cm	0.001	kilometers/hr	knots	0.5396
			kilometers/hr	meters/min	16.67

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
kilometers/hr	miles/hr	0.6214	liters	cubic ft	0.03531
kilometers/hr/sec	cm/sec/sec	27.78	liters	cubic in.	61.02
kilometers/hr/sec	ft/sec/sec	0.9113	liters	cubic meters	0.001
kilometers/hr/sec	meters/sec/sec	0.2778	liters	cubic yards	$1.308 \times 10^{-3}$
kilometers/hr/sec	miles/hr/sec	0.6214	liters	gallons (U.S. liq.)	0.2642
kilowatts	Btu/min	56.92	liters	pints (U.S. liq.)	2.113
kilowatts	ft-lb/min	$4.426 \times 10^4$	liters	quarts (U.S. liq.)	1.057
kilowatts	ft-lb/sec	737.6	liters/min	cubic ft/sec	$5.886 \times 10^{-4}$
kilowatts	horsepower	1.341	liters/min	gals/sec	$4.403 \times 10^{-3}$
kilowatts	kg-calories/min	14.34	lumens/sq ft	foot-candles	1.0
kilowatts	watts	1,000.0	lumen	spherical candle power	0.07958
kilowatt-hr	Btu	3,413.0	lumen	watt	0.001496
kilowatt-hr	ergs	$3.600 \times 10^{13}$	lumen/sq ft	lumen/sq meter	10.76
kilowatt-hr	ft-lb	$2.655 \times 10^6$	lux	foot-candles	0.0929
kilowatt-hr	gram-calories	859,850.0			
kilowatt-hr	horsepower-hr	1,341		<b>M</b>	
kilowatt-hr	joules	$3.6 \times 10^6$	maxwells	kilolines	0.001
kilowatt-hr	kg-calories	860.5	maxwells	webers	$10^{-8}$
kilowatt-hr	kg-meters	$3.671 \times 10^5$	megalines	maxwells	$10^6$
kilowatt-hr	pounds of water	3.53	megohms	microhms	$10^{12}$
	evaporated from and at		megohms	ohms	$10^6$
	212°F		meters	centimeters	100.0
kilowatt-hr	pounds of water raised	22.75	meters	feet	3.281
	from 62° to 212°F		meters	inches	39.37
			meters	kilometers	0.001
knots	ft/hr	6,080.0	meters	miles (naut.)	$5.396 \times 10^{-4}$
knots	kilometers/hr	1.8532	meters	miles (stat.)	$6.214 \times 10^{-4}$
knots	nautical miles/hr	1.0	meters	millimeters	1,000.0
knots	statute miles/hr	1.151	meters	yards	1.094
knots	yards/hr	2,027.0	meters	varas	1.179
knots	ft/sec	1.689	meters/min	cm/sec	1.667
			meters/min	ft/min	3.281
	<b>L</b>				
league	miles (approx.)	3.0	meters/min	ft/sec	0.05468
light year	miles	$5.9 \times 10^{12}$	meters/min	km/hr	0.06
light year	kilometers	$9.46091 \times 10^{12}$	meters/min	knots	0.03238
lines/sq cm	gauss	1.0	meters/min	miles/hr	0.03728
lines/sq in.	gauss	0.1550	meters/sec	ft/min	196.8
lines/sq in.	webers/sq cm	$1.550 \times 10^{-9}$	meters/sec	ft/sec	3.281
lines/sq in.	webers/sq in.	$10^{-8}$	meters/sec	kilometers/hr	3.6
lines/sq in.	webers/sq meter	$1.550 \times 10^{-5}$	meters/sec	kilometers/min	0.06
links (engineer's)	inches	12.0	meters/sec	miles/hr	2.237
links (surveyor's)	inches	7.92	meters/sec	miles/min	0.03728
liters	bushels (U.S. dry)	0.02833	meters/sec/sec	cm/sec/sec	100.0
liters	cubic cm	1,000.0	meters/sec/sec	ft/sec/sec	3.281

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
meters/sec/sec	km/hr/sec	3.6	milliliters	liters	0.001
meters/sec/sec	miles/hr/sec	2.237	millimeters	centimeters	0.1
meter-kilograms	cm-dynes	$9.807 \times 10^7$	millimeters	feet	$3.281 \times 10^{-3}$
meter-kilograms	cm-grams	$10^5$	millimeters	inches	0.03937
meter-kilograms	pound-feet	7.233	millimeters	kilometers	$10^{-6}$
microfarad	farads	$10^{-6}$	millimeters	meters	0.001
micrograms	grams	$10^{-6}$	millimeters	miles	$6.214 \times 10^{-7}$
microhms	megohms	$10^{-12}$	millimeters	mils	39.37
microhms	ohms	$10^{-6}$	millimeters	yards	$1.094 \times 10^{-3}$
microliters	liters	$10^{-6}$	million gals/day	cubic ft/sec	1.54723
microns	meters	$1 \times 10^{-6}$	mils	centimeters	$2.540 \times 10^{-3}$
miles (naut.)	miles (statute)	1.1516	mils	feet	$8.333 \times 10^{-5}$
miles (naut.)	yards	2,027.0	mils	inches	0.001
miles (statute)	centimeters	$1.609 \times 10^5$	mils	kilometers	$2.540 \times 10^{-8}$
miles (statute)	feet	5,280.0	mils	yards	$2.778 \times 10^{-5}$
miles (statute)	inches	$6.336 \times 10^4$	miner's inches	cubic ft/min	1.5
miles (statute)	kilometers	1.609	minims (U.K.)	cubic cm	0.059192
miles (statute)	meters	1,609.0	minims (U.S., fluid)	cubic cm	0.061612
miles (statute)	miles (naut.)	0.8684	minutes (angles)	degrees	0.01667
miles (statute)	yards	1,760.0	miles (naut.)	feet	6,080.27
miles/hr	cm/sec	44.70	miles (naut.)	kilometers	1.853
miles/hr	ft/min	88.0	miles (naut.)	meters	1,853.0
miles/hr	ft/sec	1.467	minutes (angles)	quadrants	$1.852 \times 10^{-4}$
miles/hr	km/hr	1.609	minutes (angles)	radians	$2.909 \times 10^{-4}$
miles/hr	km/min	0.02682	minutes (angles)	seconds	60.0
miles/hr	knots	0.8684	myriagrams	kilograms	10.0
miles/hr	meters/min	26.82	myriameters	kilometers	10.0
miles/hr	miles/min	0.1667	myriawatts	kilowatts	10.0
miles/hr/sec	cm/sec/sec	44.70		<i>N</i>	
miles/hr/sec	ft/sec/sec	1.467	nepers	decibels	8.686
miles/hr/sec	km/hr/sec	1.609	newton	dynes	$1 \times 10^5$
miles/hr/sec	meters/sec/sec	0.4470		<i>O</i>	
miles/min	cm/sec	2,682.0	ohm (International)	ohm (absolute)	1.0005
miles/min	ft/sec	88.0	ohms	megohms	$10^{-6}$
miles/min	km/min	1.609	ohms	microhms	$10^6$
miles/min	knots/min	0.8684	ounces	drams	16.0
miles/min	miles/hr	60.0	ounces	grains	437.5
mil-feet	cubic in.	$9.425 \times 10^{-6}$	ounces	grams	28.349527
milliers	kilograms	1,000.0	ounces	pounds	0.0625
millimicrons	meters	$1 \times 10^{-9}$	ounces	ounces (troy)	0.9115
milligrams	grains	0.01543236	ounces	tons (long)	$2.790 \times 10^{-5}$
milligrams	grams	0.001	ounces	tons (metric)	$2.835 \times 10^{-5}$
milligrams/liter	part/million	1.0	ounces (fluid)	cubic in.	1.805
millihenries	henries	0.001			



**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
ounces (fluid)	liters	0.02957	pounds	dynes	$44.4823 \times 10^4$
ounces (troy)	grains	480.0	pounds	grains	7,000.0
ounces (troy)	grams	31.103481	pounds	grams	453.5924
ounces (troy)	ounces (avdp.)	1.09714	pounds	joules/cm	0.04448
ounces (troy)	pennyweights (troy)	20.0	pounds	joules/meter (newtons)	4.448
ounces (troy)	pounds (troy)	0.08333	pounds	kilograms	0.4536
ounce/sq in.	dynes/sq cm	4309	pounds	ounces	16.0
ounces/sq in.	pounds/sq in.	0.0625	pounds	ounces (troy)	14.5833
			pounds	poundals	32.17
	<b>P</b>		pounds	pounds (troy)	1.21528
parsec	miles	$19 \times 10^{12}$	pounds	tons (short)	0.0005
parsec	kilometers	$3.084 \times 10^{13}$	pounds (troy)	grains	5,760.0
parts/million	grains/U.S. gal	0.0584	pounds (troy)	grams	373.24177
parts/million	grains/Imp. gal	0.07016	pounds (troy)	ounces (avdp.)	13.1657
parts/million	pounds/million gal	8.345	pounds (troy)	ounces (troy)	12.0
pecks (U.K.)	cubic in.	554.6	pounds (troy)	pennyweights (troy)	240.0
pecks (U.K.)	liters	9.091901	pounds (troy)	pounds (avdp.)	0.822857
pecks (U.S.)	bushels	0.25	pounds (troy)	tons (long)	$3.6735 \times 10^{-4}$
pecks (U.S.)	cubic in.	537.605	pounds (troy)	tons (metric)	$3.7324 \times 10^{-4}$
pecks (U.S.)	liters	8.809582	pounds (troy)	tons (short)	$4.1143 \times 10^{-4}$
pecks (U.S.)	quarts (dry)	8	pounds of water	cubic ft	0.01602
pennyweights (troy)	grains	24.0	pounds of water	cubic in.	27.68
pennyweights (troy)	ounces (troy)	0.05	pounds of water	gallons	0.1198
pennyweights (troy)	grams	1.55517	pounds of water/min	cubic ft/sec	$2.670 \times 10^{-4}$
pennyweights (troy)	pounds (troy)	$4.1667 \times 10^{-3}$	pound-feet	cm-dynes	$1.356 \times 10^7$
pints (dry)	cubic in.	33.60	pound-feet	cm-grams	13,825.0
pints (liq.)	cubic cm	473.2	pound-feet	meter-kg	0.1383
pints (liq.)	cubic ft	0.01671	pounds/cubic ft	grams/cubic cm	0.01602
pints (liq.)	cubic in.	28.87	pounds/cubic ft	kg/cubic meter	16.02
pints (liq.)	cubic meters	$4.732 \times 10^{-4}$	pounds/cubic ft	pounds/cubic in.	$5.787 \times 10^{-4}$
pints (liq.)	cubic yards	$6.189 \times 10^{-4}$	pounds/cubic ft	pounds/mil-foot	$5.456 \times 10^{-9}$
pints (liq.)	gallons	0.125	pounds/cubic in.	gm/cubic cm	27.68
pints (liq.)	liters	0.4732	pounds/cubic in.	kg/cubic meter	$2.768 \times 10^4$
pints (liq.)	quarts (liq.)	0.5	pounds/cubic in.	pounds/cubic ft	1,728.0
Planck's quantum	erg/sec	$6.624 \times 10^{-27}$	pounds/cubic in.	pounds/mil-foot	$9.425 \times 10^{-6}$
poise	gram/cm sec	1.00	pounds/ft	kg/meter	1.488
pounds (avoirdupois)	ounces (troy)	14.5833	pounds/in.	gm/cm	178.6
poundals	dynes	13,826.0	pounds/mil-foot	gm/cubic cm	$2.306 \times 10^6$
poundals	grams	14.10	pounds/sq ft	atmospheres	$4.725 \times 10^{-4}$
poundals	joules/cm	$1.383 \times 10^{-3}$	pounds/sq ft	feet of water	0.01602
poundals	joules/meter (newtons)	0.1383	pounds/sq ft	inches of mercury	0.01414
poundals	kilograms	0.01410	pounds/sq ft	kg/sq meter	4.882
poundals	pounds	0.03108	pounds/sq ft	pounds/sq in.	$6.944 \times 10^{-3}$
pounds	drams	256.0	pounds/sq in	atmospheres	0.06804

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
pounds/sq in.	feet of water	2.307	rod	chain (Gunters)	0.25
pounds/sq in.	inches of mercury	2.036	rod	meters	5.029
pounds/sq in.	kg/sq meter	703.1	rods (surveyors' meas.)	yards	5.5
pounds/sq in.	pounds/sq ft	144.0	rods	feet	16.5
<b>Q</b>			<b>S</b>		
quadrants (angle)	degrees	90.0	scruples	grains	20
quadrants (angle)	minutes	5,400.0	seconds (angle)	degrees	$2.778 \times 10^{-4}$
quadrants (angle)	radians	1.571	seconds (angle)	minutes	0.01667
quadrants (angle)	seconds	$3.24 \times 10^5$	seconds (angle)	quadrants	$3.087 \times 10^{-6}$
quarts (dry)	cubic in.	67.20	seconds (angle)	radians	$4.848 \times 10^{-6}$
quarts (liq.)	cubic cm	946.4	slug	kilogram	14.50
quarts (liq.)	cubic ft	0.03342	slug	pounds	32.17
quarts (liq.)	cubic in.	57.75	sphere	steradians	12.57
quarts (liq.)	cubic meters	$9.464 \times 10^{-4}$	square centimeters	circular mils	$1.973 \times 10^5$
quarts (liq.)	cubic yards	$1.238 \times 10^{-3}$	square centimeters	sq ft	$1.076 \times 10^{-3}$
quarts (liq.)	gallons	0.25	square centimeters	sq in.	0.1550
quarts (liq.)	liters	0.9463	square centimeters	sq meters	0.0001
<b>R</b>			square centimeters	sq miles	$3.861 \times 10^{-11}$
radians	degrees	57.30	square centimeters	sq millimeters	100.0
radians	minutes	3,438.	square centimeters	sq yards	$1.196 \times 10^{-4}$
radians	quadrants	0.6366	square feet	acres	$2.296 \times 10^{-5}$
radians	seconds	$2.063 \times 10^5$	square feet	circular mils	$1.833 \times 10^8$
radians/sec	degrees/sec	57.30	square feet	sq cm	929.0
radians/sec	rev/min	9.549	square feet	sq in.	144.0
radians/sec	rev/sec	0.1592	square feet	sq meters	0.09290
radians/sec/sec	rev/min/min	573.0	square feet	sq miles	$3.587 \times 10^{-8}$
radians/sec/sec	rev/min/sec	9.549	square feet	sq millimeters	$9.290 \times 10^4$
radians/sec/sec	rev/sec/sec	0.1592	square feet	sq yards	0.1111
revolutions	degrees	360.0	square inches	circular mils	$1.273 \times 10^6$
revolutions	quadrants	4.0	square inches	sq cm	6.452
revolutions	radians	6.283	square inches	sq ft	$6.944 \times 10^{-4}$
revolutions/min	degrees/sec	6.0	square inches	sq millimeters	645.2
revolutions/min	radians/sec	0.1047	square inches	sq mils	$10^6$
revolutions/min	rev/sec	0.01667	square inches	sq yards	$7.716 \times 10^{-4}$
revolutions/min/min	radians/sec/sec	$1.745 \times 10^{-3}$	square kilometers	acres	247.1
revolutions/min/min	rev/min/sec	0.01667	square kilometers	sq cm	$10^{10}$
revolutions/min/min	rev/sec/sec	$2.778 \times 10^{-4}$	square kilometers	sq ft	$10.76 \times 10^6$
revolutions/sec	degrees/sec	360.0	square kilometers	sq in.	$1.550 \times 10^9$
revolutions/sec	radians/sec	6.283	square kilometers	sq meters	$10^6$
revolutions/sec	rev/min	60.0	square kilometers	sq miles	0.3861
revolutions/sec/sec	radians/sec/sec	6.283	square kilometers	sq yards	$1.196 \times 10^6$
revolutions/sec/sec	rev/min/min	3,600.0	square meters	acres	$2.471 \times 10^{-4}$
revolutions/sec/sec	rev/min/sec	60.0	square meters	sq cm	$10^4$

**TABLE A.2a Continued**  
Conversion Factors

<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>	<i>To Convert</i>	<i>Into</i>	<i>Multiply by</i>
square meters	sq cm	$10^4$	tons of water/24 hrs	gallons/min	0.16643
square meters	sq in.	1,550.0	tons of water/24 hrs	cubic ft/hr	1.3349
square meters	sq miles	$3.861 \times 10^{-7}$			
square meters	sq millimeters	$10^6$		<b>V</b>	
square meters	sq yards	1.196	volt/inch	volt/cm	0.39370
square miles	acres	640.0	volt (absolute)	statvolts	0.003336
square miles	sq ft	$27.88 \times 10^6$			
square miles	sq km	2.590		<b>W</b>	
square miles	sq meters	$2.590 \times 10^6$	watts	Btu/hr	3.4129
square miles	sq yards	$3.098 \times 10^6$	watts	Btu/min	0.05688
square millimeters	circular mils	1,973.0	watts	ergs/sec	107.0
square millimeters	sq cm	0.01	watts	ft-lb/min	44.27
square millimeters	sq ft	$1.076 \times 10^{-5}$	watts	ft-lb/sec	0.7378
square millimeters	sq in.	$1.550 \times 10^{-3}$	watts	horsepower	$1.341 \times 10^{-3}$
square mils	circular mils	1.273	watts	horsepower (metric)	$1.360 \times 10^{-3}$
square mils	sq cm	$6.452 \times 10^{-6}$	watts	kg-calories/min	0.01433
square mils	sq in.	$10^{-6}$	watts (abs.)	kilowatts	0.001
square yards	acres	$2.066 \times 10^{-4}$	watts (abs.)	Btu (mean)/min	0.056884
square yards	sq cm	8,361.0	watt-hours	joules/sec	1.0
square yards	sq ft	9.0	watt-hours	Btu	3.413
square yards	sq in.	1,296.0	watt-hours	ergs	$3.60 \times 10^{10}$
square yards	sq meters	0.8361	watt-hours	foot-pounds	2,656.0
square yards	sq miles	$3.228 \times 10^{-7}$	watt-hours	gram-calories	859.85
square yards	sq millimeters	$8.361 \times 10^5$	watt-hours	horsepower-hr	$1.341 \times 10^{-3}$
			watt-hours	kilogram-calories	0.8605
			watt-hours	kilogram-meters	367.2
			watt-hours	kilowatt-hr	0.001
	<b>T</b>		watt (International)	watt (absolute)	1.0002
temperature (°C) + 273	absolute temperature (°K)	1.0	webers	maxwells	$10^8$
temperature (°C) + 17.78	temperature (°F)	1.8	webers	kilolines	$10^5$
temperature (°F) + 460	absolute temperature (°R)	1.0	webers/sq in.	gauss	$1.550 \times 10^7$
temperature (°F) – 32	temperature (°C)	5/9	webers/sq in.	lines/sq in.	$10^8$
tons (long)	kilograms	1,016.0	webers/sq in.	webers/sq cm	0.1550
tons (long)	pounds	2,240.0	webers/sq in.	webers/sq meter	1,550.0
tons (long)	tons (short)	1.120	webers/sq meter	gauss	$10^4$
tons (metric)	kilograms	1,000.0	webers/sq meter	lines/sq in.	$6.452 \times 10^4$
tons (metric)	pounds	2,205	webers/sq meter	webers/sq cm	$10^{-4}$
tons (short)	kilograms	907.1848	webers/sq meter	webers/sq in.	$6.452 \times 10^{-4}$
tons (short)	ounces	32,000.0			
tons (short)	ounces (troy)	29,166.66		<b>Y</b>	
tons (short)	pounds	2,000.0		centimeters	91.44
tons (short)	pounds (troy)	2,430.56	yards	kilometers	$9.144 \times 10^{-4}$
tons (short)	tons (long)	0.89287	yards	meters	0.9144
tons (short)	tons (metric)	0.9078	yards	miles (naut.)	$4.934 \times 10^{-4}$
tons (short)/sq ft	kg/sq meter	9,765.0	yards	miles (stat.)	$5.682 \times 10^{-4}$
tons (short)/sq ft	pounds/sq in.	2,000.0	yards	millimeters	914.4
tons of water/24 hr	pounds of water/hr	83.333	yards		

**TABLE A.2b***Units of Area*

1 cir mil <sup>a</sup> = 0.000000785 sq in.	1 sq yd = 1296 sq in. = 9 sq ft = 0.0002066 acres
1 sq in. = 1,273,200 cir mils = 0.00694 sq ft = 0.000772 sq yd	1 acre = 43,560 sq ft = 4840 sq yd = 4096 sq m
1 sq ft = 144 sq in. = 0.01111 sq yd = 0.00002296 acres	

<sup>a</sup>A cir (circular) mil is the area of a circle of 1/1000 in. dia. Thus, a round rod of 1-in. dia. has an area of 1,000,000 cir mils.

**TABLE A.2c***Units of Density*

1 lb/cubic in. = 1728 lb/cubic ft = 0.864 tons <sup>a</sup> /cubic ft = 23.3 tons/cubic yd = 231 lb/gal	1 ton/cubic yd = 0.0429 lb/cubic in. = 74.1 lb/cubic ft = 0.0370 tons/cubic ft = 9.90 lb/gal
1 lb/cubic ft = 0.000579 lb/cubic in. = 0.000500 tons/cubic ft = 0.0135 tons/cubic yd = 0.1337 lb/gal	1 lb/gal = 0.00433 lb/cubic in. = 7.48 lb/cubic ft = 0.00374 tons/cubic ft = 0.1010 tons/cubic yd
1 ton/cubic ft = 1.157 lb/cubic in. = 2000 lb/cubic ft = 27 tons/cubic yd = 267 lb/gal	

<sup>a</sup>Tons are short = 2000 lb.

**TABLE A.2d***Units of Work, Energy, Heat*

1 Btu = 9340 in.-lb = 778.3 ft-lb = 0.0002938 kW hr <sup>a</sup> = 0.0003931 hp hr	1 kW hr = 3413 Btu = 31,873,000 in.-lb = 2,656,100 ft-lb = 1.342 hp hr
1 in.-lb = 0.0001070 Btu = 0.0833 ft-lb = 0.0000003137 kW hr = 0.000000421 hp hr	1 hp hr = 2544 Btu = 23,760,000 in.-lb = 1,980,000 ft-lb = 0.7455 kW hr
1 ft-lb = 0.001284 Btu = 12 in.-lb = 0.00000376 kW hr = 0.00000505 hp hr	

<sup>a</sup>1 kilowatthour = 3413 Btu, and 1 Btu = 778.3 ft-lb.

**TABLE A.2e***Units of Mass Flow*

1 lb/sec = 60 lb/min = 3600 lb/hr = 86,400 lb/day = 2,628,000 lb/mo <sup>a</sup> = 31,536,000 lb/yr	1 lb/day = 0.00001157 lb/sec = 0.000694 lb/min = 0.0417 lb/hr = 30.4 lb/mo = 365 lb/yr
1 lb/min = 0.01667 lb/sec = 60 lb/hr = 1440 lb/day = 43,800 lb/mo = 525,600 lb/yr	1 lb/mo = 0.000000381 lb/sec = 0.0000228 lb/min = 0.001370 lb/hr = 0.0329 lb/day = 12 lb/yr
1 lb/hr = 0.0002778 lb/sec = 0.01667 lb/min = 24 lb/day = 730 lb/mo = 8760 lb/yr	1 lb/yr = 0.0000000317 lb/sec = 0.000001903 lb/min = 0.0001142 lb/hr = 0.002740 lb/day = 0.0833 lb/mo

<sup>a</sup>Month used is exactly 1/12 year = 30.4 days.

**TABLE A.2f***Units of Volume Flow*

1 cubic ft/sec = 60 cubic ft/min = 3600 cubic ft/hr = 7.48 gal/sec = 448.8 gal/min = 26,930 gal/hr	1 gal/sec = 0.1337 cubic ft/sec = 8.02 cubic ft/min = 481 cubic ft/hr = 60 gal/min = 3600 gal/hr
1 cubic ft/min = 0.01667 cubic ft/sec = 60 cubic ft/hr = 0.1247 gal/sec = 7.48 gal/min = 448.8 gal/hr	1 gal/min = 0.002228 cubic ft/sec = 0.1337 cubic ft/min = 8.02 cubic ft/hr = 0.01667 gal/sec = 60 gal/hr
1 cubic ft/hr = 0.0002778 cubic ft/sec = 0.01667 cubic ft/min = 0.002078 gal/sec = 0.1247 gal/min = 7.48 gal/hr	1 gal/hr = 0.0000371 cubic ft/sec = 0.002228 cubic ft/min = 0.1337 cubic ft/hr = 0.0002778 gal/sec = 0.01667 gal/min

**TABLE A.2g***Units of Length*

1 in. = 0.0833 ft = 0.0277 yd = 0.0000158 miles	1 yd = 36 in. = 3 ft = 0.000568 miles
1 ft = 12 in. = 0.333 yd = 0.000189 miles	1 mile = 63360 in. = 5280 ft = 1760 yd

**TABLE A.2h**  
Linear Conversion

<i>Inches to Millimeters</i> 1 inch = 25.4 millimeters						<i>Millimeters to Inches</i> 1 millimeter = .03937 inches							
<i>Inches</i>	<i>Millimeters</i>	<i>Inches</i>	<i>Millimeters</i>	<i>Inches</i>	<i>Millimeters</i>	<i>Millimeters</i>	<i>Inches</i>	<i>Millimeters</i>	<i>Inches</i>	<i>Millimeters</i>	<i>Inches</i>	<i>Millimeters</i>	<i>Inches</i>
1/16	1.6	2.0	50.8	4.5	114.3	1.0	0.0394	3.5	0.1378	6.0	0.2362	8.5	0.3346
1/8	3.2	2.1	53.3	4.6	116.8	1.1	0.0433	3.6	0.1417	6.1	0.2402	8.6	0.3386
3/16	4.8	2.2	55.9	4.7	119.4	1.2	0.0472	3.7	0.1457	6.2	0.2441	8.7	0.3425
1/4	6.4	2.3	58.4	4.8	121.9	1.3	0.0512	3.8	0.1496	6.3	0.2480	8.8	0.3465
5/16	7.9	2.4	61.0	4.9	124.5	1.4	0.0551	3.9	0.1535	6.4	0.2520	8.9	0.3504
3/8	9.5	2.5	63.5	5.0	127.0	1.5	0.0591	4.0	0.1575	6.5	0.2559	9.0	0.3543
7/16	11.1	2.6	66.0	5.5	139.7	1.6	0.0630	4.1	0.1614	6.6	0.2598	9.1	0.3583
1/2	12.7	2.7	68.6	6.0	152.4	1.7	0.0669	4.2	0.1654	6.7	0.2638	9.2	0.3622
9/16	14.3	2.8	71.1	6.5	165.1	1.8	0.0709	4.3	0.1693	6.8	0.2677	9.3	0.3661
5/8	15.9	2.9	73.7	7.0	177.8	1.9	0.0748	4.4	0.1732	6.9	0.2717	9.4	0.3701
11/16	17.5	3.0	76.2	7.5	190.5	2.0	0.0787	4.5	0.1772	7.0	0.2756	9.5	0.3740
3/4	19.1	3.1	78.7	8.0	203.2	2.1	0.0827	4.6	0.1811	7.1	0.2795	9.6	0.3780
13/16	20.6	3.2	81.3	8.5	215.9	2.2	0.0866	4.7	0.1850	7.2	0.2835	9.7	0.3819
7/8	22.2	3.3	83.8	9.0	228.6	2.3	0.0906	4.8	0.1890	7.3	0.2874	9.8	0.3858
15/16	23.8	3.4	86.4	9.5	241.3	2.4	0.0945	4.9	0.1929	7.4	0.2913	9.9	0.3898
				10.0	254.0							10.0	0.3937
1.0	25.4	3.5	88.9			2.5	0.0984	5.0	0.1969	7.5	0.2953		
1.1	27.9	3.6	91.4			2.6	0.1024	5.1	0.2008	7.6	0.2992		
1.2	30.5	3.7	94.0			2.7	0.1063	5.2	0.2047	7.7	0.3031		
1.3	33.0	3.8	96.5			2.8	0.1102	5.3	0.2087	7.8	0.3071		
1.4	35.6	3.9	99.1			2.9	0.1142	5.4	0.2126	7.9	0.3110		
1.5	38.1	4.0	101.6			3.0	0.1181	5.5	0.2165	8.0	0.3150		
1.6	40.6	4.1	104.1			3.1	0.1220	5.6	0.2205	8.1	0.3189		
1.7	43.2	4.2	106.7			3.2	0.1260	5.7	0.2244	8.2	0.3228		
1.8	45.7	4.3	109.2			3.3	0.1299	5.8	0.2283	8.3	0.3268		
1.9	48.3	4.4	111.8			3.4	0.1339	5.9	0.2323	8.4	0.3307		

By moving the decimal place, conversions for figures larger than 10 may be obtained.

**TABLE A.2i***Units of Power*

1 kW	1 ft-lb/hr
= 1.3415 hp	= 0.000000376 kW
= 738 ft-lb <sup>a</sup> /sec	= 0.000000505 hp
= 44,268 ft-lb/min	= 0.000278 ft-lb/sec
= 2,656,100 ft-lb/hr	= 0.01667 ft-lb/min
= 0.948 Btu/sec	= 0.000000357 Btu/sec
= 56.9 Btu/min	= 0.00002141 Btu/min
= 3413 Btu/hr	= 0.001284 Btu/hr
1 hp	1 Btu/sec
= 0.7455 kW	= 1.055 kW
= 550 ft-lb/sec	= 1.416 hp
= 33,000 ft-lb/min	= 778 ft-lb/sec
= 1,980,000 ft-lb/hr	= 46,700 ft-lb/min
= 0.707 Btu/sec	= 2,802,000 ft-lb/hr
= 0.424 Btu/min	= 60 Btu/min
= 2544 Btu/hr	= 3600 Btu/hr
1 ft-lb/sec	1 Btu/min
= 0.001355 kW	= 0.01759 kW
= 0.001818 hp	= 0.02359 hp
= 60 ft-lb/min	= 12.98 ft-lb/sec
= 3600 ft-lb/hr	= 778 ft-lb/min
= 0.001284 Btu/sec	= 46,700 ft-lb/hr
= 0.0771 Btu/min	= 0.01667 Btu/sec
= 4.62 Btu/hr	= 60 Btu/hr
1 ft-lb/min	1 Btu/hr
= 0.00002259 kW	= 0.0002931 kW
= 0.0000303 hp	= 0.0003932 hp
= 0.01667 ft-lb/sec	= 0.2163 ft-lb/sec
= 60 ft-lb/hr	= 12.98 ft-lb/min
= 0.00002141 Btu/sec	= 778 ft-lb/hr
= 0.001284 Btu/min	= 0.0002778 Btu/sec
= 0.0771 Btu/hr	= 0.01667 Btu/min

<sup>a</sup>Ft-lb means foot-pound, the work done in moving against one pound force a distance of one foot.

**TABLE A.2j***Units of Pressure*

1 in. water <sup>a</sup>	1 oz/sq ft
= 0.0833 ft water	= 0.01203 in. water
= 0.0735 in. Hg	= 0.001002 ft water
= 0.577 oz/sq in.	= 0.000886 in. Hg
= 0.831 oz/sq ft	= 0.00694 oz/sq in.
= 0.0361 lb/sq in.	= 0.000434 lb/sq in.
= 5.20 lb/sq ft	= 0.0625 lb/sq ft
1 ft water	1 lb/sq in.
= 12 in. water	= 27.71 in. water
= 0.882 in. Hg	= 2.31 ft water
= 6.93 oz/sq in.	= 2.04 in. Hg
= 998 oz/sq ft	= 16 oz/sq in.
= 0.433 lb/sq in.	= 2304 oz/sq ft
= 62.4 lb/sq ft	= 144 lb/sq ft
1 in. Hg	1 lb/sq ft
= 13.61 in. water	= 0.1924 in. water
= 1.131 ft water	= 0.01604 ft water
= 7.84 oz/sq in.	= 0.01418 in. Hg
= 1129 oz/sq ft	= 0.1111 oz/sq in.
= 0.491 lb/sq in.	= 16 oz/sq ft
= 70.5 lb/sq ft	= 0.00694 lb/sq in.
1 oz/sq in.	
= 1.732 in. water	
= 0.1443 ft water	
= 0.1276 in. Hg	
= 144 oz/sq ft	
= 0.0625 lb/sq in.	
= 9 lb/sq ft	

<sup>a</sup>in. water means inches of water at 60°F.

in. Hg means inches head of mercury at 32°F.

**TABLE A.2k***Pressure Conversion*

*1 pound per square inch =  
0.0703 kilograms per square centimeter*

<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>
1.00	0.0703	2.25	0.1582	4.50	0.3164	8.25	0.5800
1.10	0.0773	2.30	0.1617	4.75	0.3339	8.50	0.5976
1.20	0.0844	2.40	0.1687	5.00	0.3515	8.75	0.6151
1.25	0.0879	2.50	0.1758	5.25	0.3691	9.00	0.6327
1.30	0.0914	2.60	0.1828	5.50	0.3867	9.25	0.6503
1.40	0.0984	2.70	0.1898	5.75	0.4042	9.50	0.6679
1.50	0.1055	2.75	0.1933	6.00	0.4218	9.75	0.6854
1.60	0.1125	2.80	0.1969	6.25	0.4394	10.00	0.7030
1.70	0.1195	2.90	0.2039	6.50	0.4570		
1.75	0.1230	3.00	0.2109	6.75	0.4746		
1.80	0.1265	3.25	0.2285	7.00	0.4921		
1.90	0.1336	3.50	0.2461	7.25	0.5097		
2.00	0.1406	3.75	0.2636	7.50	0.5273		
2.10	0.1476	4.00	0.2812	7.75	0.5448		
2.20	0.1547	4.25	0.2988	8.00	0.5624		

*1 kilogram per square centimeter =  
14.223 pounds per square inch*

<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>	<i>kg/cm<sup>2</sup></i>	<i>lb/in.<sup>2</sup></i>
1.0	14.22	2.5	35.56	4.0	56.89	7.5	106.67
1.1	15.65	2.6	36.98	4.1	58.31	8.0	113.78
1.2	17.07	2.7	38.40	4.2	59.74	8.5	120.90
1.3	18.49	2.8	39.82	4.3	61.16	9.0	128.01
1.4	19.91	2.9	41.25	4.4	62.58	9.5	135.12
1.5	21.33	3.0	42.67	4.5	64.00	10.0	142.23
1.6	22.76	3.1	44.09	4.6	65.43		
1.7	24.18	3.2	45.51	4.7	66.85		
1.8	25.60	3.3	46.94	4.8	68.27		
1.9	27.02	3.4	48.36	4.9	69.69		
2.0	28.45	3.5	49.78	5.0	71.12		
2.1	29.87	3.6	51.20	5.5	78.23		
2.2	31.29	3.7	52.63	6.0	85.34		
2.3	32.71	3.8	54.05	6.5	92.45		
2.4	34.14	3.9	55.47	7.0	99.56		

**TABLE A.2I***Pressure Head Conversion*

The center column, marked “Known,” may be used either for head in feet or for pressure in pounds per square inch—when used as head, the corresponding pressure is found in the column at the left designated as “Pressure Wanted”; when used as pressure, the corresponding head is found in the column at the right designated as “Head Wanted.” For example: a 10-foot head has a pressure of 4.33 pounds per square inch, and a 10-pound pressure has a head of 23.094 feet. By moving the decimal place, quantities larger than 100 may be used.

<i>Pressure Wanted lb/in.<sup>2</sup></i>	<i>Known Pressure or Head</i>	<i>Head Wanted ft H<sub>2</sub>O</i>	<i>Pressure Wanted lb/in.<sup>2</sup></i>	<i>Known Pressure or Head</i>	<i>Head Wanted ft/H<sub>2</sub>O</i>	<i>Pressure Wanted lb/in.<sup>2</sup></i>	<i>Known Pressure or Head</i>	<i>Head Wanted ft H<sub>2</sub>O</i>	<i>Pressure Wanted lb/in.<sup>2</sup></i>	<i>Known Pressure or Head</i>	<i>Head Wanted ft H<sub>2</sub>O</i>
0.433	1	2.309	11.259	26	60.044	22.084	51	117.779	32.909	76	175.514
0.866	2	4.619	11.692	27	62.354	22.517	52	120.089	33.342	77	177.824
1.299	3	6.928	12.125	28	64.663	22.950	53	122.398	33.775	78	180.133
1.732	4	9.238	12.558	29	66.973	23.383	54	124.708	34.208	79	182.433
2.165	5	11.547	12.991	30	69.282	23.816	55	127.017	34.642	80	184.752
2.598	6	13.856	13.424	31	71.591	24.249	56	129.326	35.075	81	187.061
3.031	7	16.166	13.857	32	73.901	24.682	57	131.636	35.508	82	189.371
3.464	8	18.475	14.290	33	76.210	25.115	58	133.945	35.941	83	191.680
3.897	9	20.785	14.723	34	78.520	25.548	59	136.255	36.374	84	193.990
4.330	10	23.094	15.156	35	80.829	25.981	60	138.564	36.807	85	196.299
4.763	11	25.403	15.589	36	83.138	26.414	61	140.873	37.240	86	198.608
5.196	12	27.713	16.022	37	85.448	26.847	62	143.183	37.673	87	200.918
5.629	13	30.022	16.455	38	87.757	27.280	63	145.492	38.106	88	203.227
6.062	14	32.332	16.888	39	90.067	27.713	64	147.803	38.539	89	205.537
6.495	15	34.641	17.321	40	92.376	28.146	65	150.111	38.972	90	207.846
6.928	16	36.950	17.754	41	94.685	28.579	66	152.420	39.405	91	210.155
7.361	17	39.260	18.187	42	96.995	29.012	67	154.730	39.838	92	212.465
7.794	18	41.569	18.620	43	99.304	29.445	68	157.039	40.271	93	214.774
8.227	19	43.879	19.053	44	101.614	29.878	69	159.349	40.704	94	217.084
8.660	20	46.188	19.486	45	103.923	30.311	70	161.658	41.137	95	219.393
9.093	21	48.497	19.919	46	106.232	30.744	71	163.967	41.570	96	221.702
9.526	22	50.807	20.352	47	108.542	31.177	72	166.277	42.003	97	224.012
9.959	23	53.116	20.785	48	110.851	31.610	73	168.586	42.436	98	226.321
10.392	24	55.426	21.218	49	113.161	32.043	74	170.896	42.869	99	228.631
10.825	25	57.735	21.651	50	115.470	32.476	75	173.205	43.302	100	230.940



**TABLE A.2m**  
Temperature Conversion

<i>Degrees–Fahrenheit to centigrade</i>				
	$-^{\circ}\text{C} = 5/9 (^{\circ}\text{F} + 32)$ $+^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$			
$^{\circ}\text{F}$	0	25	50	75
-200	-128.9	-142.8	-156.7	-170.6
-100	-73.3	-87.2	-101.1	-115.0
-0	-17.8	-31.7	-45.6	-59.4
+0	-17.8	-3.9	+10.0	+23.9
100	+37.8	+51.7	65.6	79.4
200	93.3	107.2	121.1	135.0
300	148.9	162.8	176.7	190.6
400	204.4	218.3	232.2	246.1
500	260.0	273.9	287.8	301.7
600	315.6	329.4	343.3	357.2
700	371.1	385.0	398.9	412.8
800	426.7	440.6	454.4	468.3
900	482.2	496.1	510.0	523.9
1000	538.0	551.7	565.6	579.4
1100	593.2	607.2	621.1	635.0
<i>Degrees–centigrade to Fahrenheit</i>				
	$-^{\circ}\text{F} = (9/5 \times ^{\circ}\text{C}) - 32$ $+^{\circ}\text{F} = (9/5 \times ^{\circ}\text{C}) + 32$			
$^{\circ}\text{C}$	0	25	50	75
-200	-328	-373	-418	
-100	-148	-193	-238	-283
-0	+32	-13	-58	-103
+0	+32	+77	+122	+167
100	212	257	302	347
200	392	437	482	527
300	572	617	662	707
400	752	797	842	887
500	932	977	1022	1067
600	1112	1157	1202	1247
700	1292	1337	1382	1427

**TABLE A.2n**  
Units of Time

1 sec	1 day
= 0.01667 min	= 86,400 sec
= 0.0002778 hr	= 1440 min
= 0.00001157 days	= 24 hr
= 0.0000003805 mo <sup>a</sup>	= 0.0329 mo
= 0.0000000317 yr	= 0.002740 yr
1 min	1 mo
= 60 sec	= 2,628,000 sec
= 0.01667 hr	= 43,800 min
= 0.000694 days	= 730 hr
= 0.0000228 mo	= 30.4 days
= 0.000001903 yr	= 0.0833 yr
1 hr	1 yr
= 3600 sec	= 31,536,000 sec
= 60 min	= 525,600 min
= 0.0417 days	= 8760 hr
= 0.001370 mo	= 365 days
= 0.0001142 yr	= 12 mo

<sup>a</sup>Month used is exactly 1/12 year.

**TABLE A.2o**  
Units of Velocity

ft/sec	1 m/min
= 60 ft/min	= 88 ft/sec
= 3600 ft/h	= 5280 ft/min
= 0.01136 m/min	= 316,800 ft/h
= 0.682 mi/h	= 60 mi/h
1 ft/min	1 mi/h
= 0.01667 ft/sec	= 1.467 ft/sec
= 60 ft/h	= 88 ft/min
= 0.0001894 m/min	= 5280 ft/h
= 0.01136 mi/h	= 0.01667 m/min
1 ft/h	
= 0.002778 ft/sec	
= 0.01667 ft/min	
= 0.00000316 m/min	
= 0.0001894 mi/h	

f = ft; h = hours; m = miles, m = minutes, sec = seconds.

**TABLE A.2p***Viscosity Conversion*

<i>Kinematic Viscosity Centistokes = K</i>	<i>Seconds Saybolt Universal</i>	<i>Seconds Saybolt Furol</i>	<i>Seconds Redwood</i>	<i>Seconds Redwood Admiralty</i>	<i>Degrees Engler</i>	<i>Degrees Bardey</i>
1.00	31	—	29.1	—	1.00	6200
2.56	35	—	32.1	—	1.16	2420
4.30	40	—	36.2	5.10	1.31	1440
5.90	45	—	40.3	5.52	1.46	1050
7.40	50	—	44.3	5.83	1.58	838
8.83	55	—	48.5	6.35	1.73	702
10.20	60	—	52.3	6.77	1.88	618
11.53	65	—	56.7	7.17	2.03	538
12.83	70	12.95	60.9	7.60	2.17	483
14.10	75	13.33	65.0	8.00	2.31	440
15.35	80	13.70	69.2	8.44	2.45	404
16.58	85	14.10	73.3	8.86	2.59	374
17.80	90	14.44	77.6	9.30	2.73	348
19.00	95	14.85	81.5	9.70	2.88	326
20.20	100	15.24	85.6	10.12	3.02	307
31.80	150	19.3	128	14.48	4.48	195
43.10	200	23.5	170	18.90	5.92	144
54.30	250	28.0	212	23.45	7.35	114
65.40	300	32.5	254	28.0	8.79	95
76.50	350	35.1	296	32.5	10.25	81
87.60	400	41.9	338	37.1	11.70	70.8
98.60	450	46.8	381	41.7	13.15	62.9
110.	500	51.6	423	46.2	14.60	56.4
121.	550	56.6	465	50.8	16.05	51.3
132.	600	61.4	508	55.4	17.50	47.0
143.	650	66.2	550	60.1	19.00	43.4
154.	700	71.1	592	64.6	20.45	40.3
165.	750	76.0	635	69.2	21.90	37.6
176.	800	81.0	677	73.8	23.35	35.2
187.	850	86.0	719	78.4	24.80	33.2
198	900	91.0	762	83.0	26.30	31.3
209	950	95.8	804	87.6	27.70	29.7
220	1000	100.7	846	92.2	29.20	28.2
330	1500	150	1270	138.2	43.80	18.7
440	2000	200	1690	184.2	58.40	14.1

**TABLE A.2p Continued***Viscosity Conversion*

<i>Kinematic Viscosity Centistokes = K</i>	<i>Seconds Saybolt Universal</i>	<i>Seconds Saybolt Furol</i>	<i>Seconds Redwood</i>	<i>Seconds Redwood Admiralty</i>	<i>Degrees Engler</i>	<i>Degrees Bardey</i>
550	2500	250	2120	230	73.00	11.3
660	3000	300	2540	276	87.60	9.4
770	3500	350	2960	322	100.20	8.05
880	4000	400	3380	368	117.00	7.05
990	4500	450	3810	414	131.50	6.26
1100	5000	500	4230	461	146.00	5.64
1210	5500	550	4650	507	160.50	5.13
1320	6000	600	5080	553	175.00	4.70
1430	6500	650	5500	559	190.00	4.34
1540	7000	700	5920	645	204.50	4.03
1650	7500	750	6350	691	219.00	3.76
1760	8000	800	6770	737	233.50	3.52
1870	8500	850	7190	783	248.00	3.32
1980	9000	900	7620	829	263.00	3.13
2090	9500	950	8040	875	277.00	2.97
2200	10000	1000	8460	921	292.00	2.82

The viscosity is often expressed in terms of viscosimeters other than the Saybolt Universal. The formulas for the various viscosimeters are given opposite.

If viscosity is given at any two temperatures, the viscosity at any other temperature can be obtained by plotting the viscosity against temperature in degrees Fahrenheit on special log paper. The points for a given oil lie in a straight line.

$$\text{Kinematic viscosity} = \frac{\text{absolute viscosity}}{\text{specific gravity}}$$

$$\text{Redwood K} = 0.26t - \frac{180}{t} \text{ (British)}$$

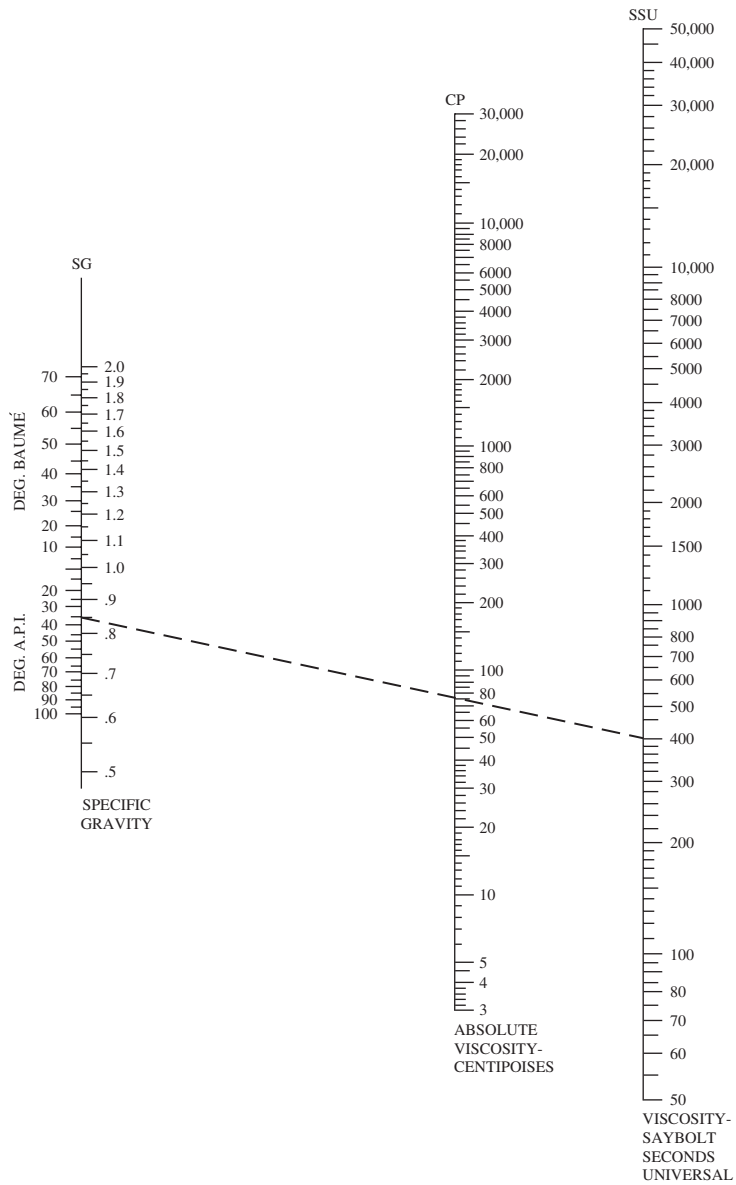
$$\text{Redwood Admiralty K} = 2.7t - \frac{20}{t} \text{ (British)}$$

$$\text{Saybolt Universal K} = 0.22t - \frac{195}{t} \text{ (American)}$$

$$\text{Saybolt Furol K} = 2.2t - \frac{184}{t} \text{ (American)}$$

$$\text{Engler K} = 0.147t - \frac{374}{t} \text{ (German)}$$

**TABLE A.2q**  
Viscosity Conversion Chart



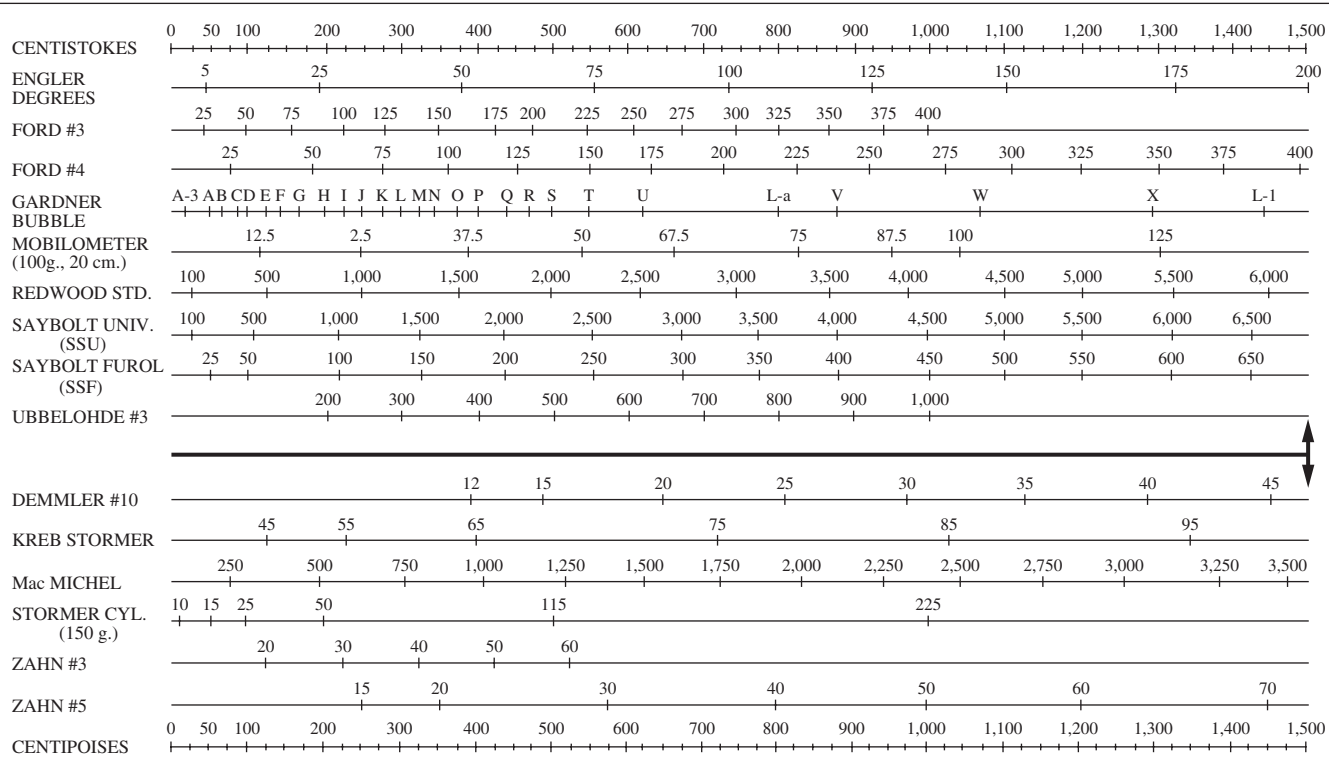
This chart enables the direct conversion of a viscosity in centipoises to a SSU viscosity. As an example, suppose the liquid under consideration has a specific gravity of .85 and a viscosity of 75 centipoises. To determine the viscosity in SSU, lay a straight edge between 75 on the CP scale and .85 on the G scale. The viscosity in SSU can be read directly on the SSU scale. In this instance, the SSU viscosity is 400 (see dotted line).

If the viscosity value is given in centistokes (kinematic viscosity), it can be used directly on the viscosity correction nomograph. The relationship between the absolute viscosity and the kinematic viscosity is expressed by the following formula:

$$\text{Centipoises} = \text{Centistokes} \times \text{Specific Gravity}$$

**TABLE A.2r**

*Approximate Viscosity Conversion Chart*



Note: Scales in lower section read directly in centipoises. Those above read in centistokes (to convert into centipoise, multiply by liquid specific gravity).

**TABLE A.2s***Units of Volume*

1 cubic in.	1 cubic yd
= 0.00433 gal	= 46,656 cubic in.
= 0.000579 cubic ft	= 202.0 gal
= 0.0000214 cubic yd	= 27 cubic ft.
	= 0.000620 acre ft
1 gal	1 acre ft
= 231 cubic in.	= 325,800 gal
= 0.1337 cubic ft.	= 43,560 cubic ft
= 0.00495 cubic yd	= 1613 cubic yd
= 0.0000307 acre ft <sup>a</sup>	
1 cubic ft	
= 1728 cubic in.	
= 7.48 gal	
= 0.0370 cubic yd	
= 0.0000230 acre ft	

<sup>a</sup>acre ft of water is the volume in 1 ft of depth covering 1 acre.

**TABLE A.2t***Units of Weight*

1 g	1 lb
= 0.00229 oz <sup>a</sup>	= 7000 g
= 0.0001429 lb	= 16 oz
= 0.0000000714 tons	= 0.000500 tons
1 oz	1 ton
= 438 g	= 14,000,000 g
= 0.0625 lb	= 32,000 oz
= 0.00003125 tons	= 2000 lb

<sup>a</sup>Avoirdupois oz and lb and short ton of 2000 lb.

**TABLE A.2u***Weight Conversion*

1 kilogram = 2.2046 pounds, 1 pound = 0.4536 kilograms

lb	kg/lb	kg	lb	kg/lb	kg	lb	kg/lb	kg	lb	kg/lb	kg	lb	kg/lb	kg
2.205	1.0	0.454	6.614	3.0	1.361	11.023	5.0	2.268	15.432	7.0	3.175	19.841	9.0	4.082
2.425	1.1	0.499	6.834	3.1	1.406	11.243	5.1	2.313	15.653	7.1	3.221	20.062	9.1	4.128
2.646	1.2	0.544	7.055	3.2	1.452	11.464	5.2	2.359	15.873	7.2	3.266	20.282	9.2	4.173
2.866	1.3	0.590	7.275	3.3	1.497	11.684	5.3	2.404	16.094	7.3	3.311	20.503	9.3	4.218
3.086	1.4	0.635	7.496	3.4	1.542	11.905	5.4	2.449	16.314	7.4	3.357	20.723	9.4	4.264
3.307	1.5	0.680	7.716	3.5	1.588	12.125	5.5	2.495	16.535	7.5	3.402	20.944	9.5	4.309
3.527	1.6	0.726	7.937	3.6	1.633	12.346	5.6	2.540	16.755	7.6	3.447	21.164	9.6	4.355
3.748	1.7	0.771	8.157	3.7	1.678	12.566	5.7	2.586	16.975	7.7	3.493	21.385	9.7	4.400
3.968	1.8	0.816	8.377	3.8	1.724	12.787	5.8	2.631	17.196	7.8	3.538	21.605	9.8	4.445
4.189	1.9	0.862	8.598	3.9	1.769	13.007	5.9	2.676	17.416	7.9	3.583	21.826	9.9	4.491
4.409	2.0	0.907	8.818	4.0	1.814	13.228	6.0	2.722	17.637	8.0	3.629	22.046	10.0	4.536
4.630	2.1	0.953	9.039	4.1	1.860	13.448	6.1	2.767	17.857	8.1	3.674			
4.850	2.2	0.998	9.259	4.2	1.905	13.669	6.2	2.812	18.078	8.2	3.720			
5.071	2.3	1.043	9.480	4.3	1.950	13.889	6.3	2.858	18.298	8.3	3.765			
5.291	2.4	1.089	9.700	4.4	1.996	14.109	6.4	2.903	18.519	8.4	3.810			
5.512	2.5	1.134	9.921	4.5	2.041	14.330	6.5	2.948	18.739	8.5	3.856			
5.732	2.6	1.179	10.141	4.6	2.087	14.550	6.6	2.994	18.960	8.6	3.901			
5.952	2.7	1.225	10.362	4.7	2.132	14.771	6.7	3.039	19.180	8.7	3.946			
6.173	2.8	1.270	10.582	4.8	2.177	14.991	6.8	3.084	19.400	8.8	3.992			
6.393	2.9	1.315	10.803	4.9	2.223	15.212	6.9	3.130	19.621	8.9	4.037			