

WEIGHTS AND MEASURES

Source: National Institute of Standards and Technology, U.S. Dept. of Commerce

The International System of Units (SI)

Two systems of weights and measures coexist in the U.S. today: the **U.S. Customary System** and the **International System of Units** (SI, after the initials of *Système International*). SI, commonly identified with the **metric system**, is actually a more complete, coherent version of it. Throughout U.S. history, the Customary System (inherited from, but now different from, the British Imperial System) has been generally used; federal and state legislation has given it, through implication, standing as the primary weights and measures system. The metric system, however, is the only system that Congress has ever specifically sanctioned. An 1866 law reads:

“It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.”

Since that time, use of the metric system in the U.S. has slowly and steadily increased, particularly in the scientific community, the pharmaceutical industry, and the manufacturing sector—the last motivated by the practice in international commerce, in which the metric system is now predominantly used.

On Feb. 10, 1964, the National Bureau of Standards (now known as the National Institute of Standards and Technology) issued the following statement:

“Henceforth it shall be the policy of the National Bureau of Standards to use the units of the International System (SI), as adopted by the 11th General Conference on Weights and Measures (October 1960), except when the use of these units would obviously impair communication or reduce the usefulness of a report.”

On Dec. 23, 1975, Pres. Gerald R. Ford signed the Metric Conversion Act of 1975. It defines the metric system as being the International System of Units as interpreted in the U.S. by the secretary of commerce. The Trade Act of 1988 and other legislation declare the metric system the preferred system of weights and measures for U.S. trade and commerce, call for the federal government to adopt metric specifications, and mandate the Commerce Dept. to oversee the program. However, the metric system has still not become the system of choice for most Americans' daily use.

The following 7 units serve as the base units for the system: **length**—meter; **mass**—kilogram; **time**—second; **electric current**—ampere; **thermodynamic temperature**—kelvin; **amount of substance**—mole; and **luminous intensity**—candela.

Frequently Used Conversions

Boldface indicates exact values. For greater accuracy, use the “multiply by” number in parentheses. For weights, *avdp* is an abbreviation for *avoirdupois* weight, the system of weights applied to all goods except medicines, precious metals, and precious stones (see p. 397). For more detailed tables, see pp. 396-399.

U.S. Customary to Metric				Metric to U.S. Customary			
	If you have:	Multiply by:	To get:		If you have:	Multiply by:	To get:
Length	inches	25.4	millimeters	Length	millimeters	0.04 (0.03937)	inches
	inches	2.54	centimeters		centimeters	0.4 (0.3937)	inches
	inches	0.0254	meters		meters	39 (39.37)	inches
	feet	0.3 (0.3048)	meters		meters	3.3 (3.280840)	feet
	yards	0.9 (0.9144)	meters		meters	1.1 (1.093613)	yards
	miles ¹	1.6 (1.609344)	kilometers		kilometers	0.6 (0.621371)	miles
Area	sq. inches	6.5 (6.4516)	sq. cm.	Area	sq. cm.	0.16 (0.15500)	sq. inches
	sq. feet	0.09 (0.09290341)	sq. meters		sq. meters	10.8 (10.76391)	sq. feet
	sq. yards	0.84 (0.83612736)	sq. meters		sq. meters	1.2 (1.195990)	sq. yards
	acres	0.4 (0.4046873)	hectares		hectares	2.5 (2.471044)	acres
	sq. miles	2.6 (2.58998811)	sq. kilometers		sq. kilometers	0.39 (0.386102)	sq. miles
	Weight	ounces (avdp)	28 (28.349523125)		grams	Weight	grams
pounds (avdp)		454 (453.59237)	grams	grams	0.002 (0.00220462)		pounds (avdp)
pounds (avdp)		0.45 (0.45359237)	kilograms	kilograms	2.2 (2.204623)		pounds (avdp)
short tons ²		0.91 (0.90718474)	metric tons	metric tons	1.1 (1.102311)		short tons
long tons ³		1 (1.0160469088)	metric tons	metric tons	0.98 (0.9842065)		long tons
Liquid meas.		ounces	0.03 (0.02957353)	liters	Liquid meas.		liters
	cups	0.24 (0.23658824)	liters	liters		4.2 (4.226752)	cups
	pints	0.47 (0.473176473)	liters	liters		2.1 (2.113376)	pints
	quarts	0.95 (0.946352946)	liters	liters		1.1 (1.056688)	quarts
	gallons	3.79 (3.785411784)	liters	liters		0.26 (0.264172)	gallons

(1) Statute mile. (2) A short ton is 2,000 pounds. (3) A long ton is 2,240 pounds.

Temperature Conversions

The left-hand column below gives a temperature according to the **Celsius** scale, and the right-hand gives the same temperature according to the **Fahrenheit** scale. The lowest number on each scale is equivalent to absolute zero, the temperature at which all motion within a molecule would stop.

For temperatures not shown: To convert Fahrenheit to Celsius by formula, subtract 32 degrees and divide by 1.8; to convert Celsius to Fahrenheit, multiply by 1.8 and add 32 degrees.

Note: Although the term *centigrade* is still frequently used, the International Committee on Weights and Measures and the National Institute of Standards and Technology have recommended since 1948 that this scale be called *Celsius*.

Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit	Celsius	Fahrenheit
-273.15	-459.67	-45.6	-50	-1.1	30	30	86	66	150
-250	-418	-40	-40	0	32	32.2	90	70	158
-200	-328	-34.4	-30	4.4	40	35	95	80	176
-184	-300	-30	-22	10	50	37	98.6	90	194
-157	-250	-28.9	-20	15.6	60	37.8	100	93	200
-150	-238	-23.3	-10	20	68	40	104	100	212
-129	-200	-20	-4	21.1	70	43	110	121	250
-101	-150	-17.8	0	23.9	75	49	120	149	300
-100	-148	-12.2	10	25	77	50	122	150	302
-73.3	-100	-10	14	26.7	80	54	130	200	392
-50	-58	-6.7	20	29.4	85	60	140	300	572

Boiling and Freezing Points

Water boils at 212°F (100°C) at sea level. For every 550 feet above sea level, boiling point of water is lower by about 1°F. Methyl alcohol boils at 148°F. Average human oral temperature, 98.6°F. **Water freezes** at 32°F (0°C).

Mathematical Formulas

Note: The value of π (the Greek letter pi) is approximately 3.14159265 (equal to the ratio of the circumference of a circle to the diameter). The equivalence is typically rounded further to 3.1416 or 3.14.

To find the Circumference of a:

Circle: Multiply the diameter by π .

To find the Area of a:

Circle: Multiply the square of the radius (equal to $\frac{1}{2}$ the diameter) by π .

Rectangle: Multiply the length of the base by the height.

Sphere (surface): Multiply the square of the radius by π and multiply by 4.

Square: Square the length of one side.

Trapezoid: Add the 2 parallel sides, multiply by the height, and divide by 2.

Triangle: Multiply the base by the height, divide by 2.

To find the Volume of a:

Cone: Multiply the square of the radius of the base by π , multiply by the height, and divide by 3.

Cube: Cube the length of one edge.

Cylinder: Multiply the square of the radius of the base by π and multiply by the height.

Pyramid: Multiply the area of the base by the height and divide by 3.

Rectangular Prism: Multiply the length by the width by the height.

Sphere: Multiply the cube of the radius by π , multiply by 4, and divide by 3.

Playing Cards and Dice Chances

5-Card Poker Hands

Hand	Number possible	Odds against
Royal flush	4	649,739 to 1
Other straight flush	36	72,192 to 1
Four of a kind	624	4,164 to 1
Full house	3,744	693 to 1
Flush	5,108	508 to 1
Straight	10,200	254 to 1
Three of a kind	54,912	46 to 1
Two pairs	123,552	20 to 1
One pair	1,098,240	4 to 3 (1.37 to 1)
Nothing	1,302,540	1 to 1
TOTAL	2,598,960	

Bridge

The odds—against suit distribution in a hand of 4-4-3-2 are about 4 to 1, against 5-4-2-2 about 8 to 1, against 6-4-2-1 about 20 to 1, against 7-4-1-1 about 254 to 1, against 8-4-1-0 about 2,211 to 1, and against 13-0-0-0 about 158,753,389,899 to 1.

Dice

(probabilities on 2 dice)

Total	Odds against (single toss)	Total	Odds against (single toss)
2	35 to 1	8	31 to 5
3	17 to 1	9	8 to 1
4	11 to 1	10	11 to 1
5	8 to 1	11	17 to 1
6	31 to 5	12	35 to 1
7	5 to 1		

Large Numbers

No. of zeros	U.S.	British ¹ , French, German	No. of zeros	U.S.	British ¹ , French, German
6	million	million	42	tredecillion	septillion
9	billion	milliard	45	quattuordecillion	1,000 septillion
12	trillion	billion	48	quindecillion	octillion
15	quadrillion	1,000 billion	51	sexdecillion	1,000 octillion
18	quintillion	trillion	54	septendecillion	nonillion
21	sextillion	1,000 trillion	57	octodecillion	1,000 nonillion
24	septillion	quadrillion	60	novemdecillion	decillion
27	octillion	1,000 quadrillion	63	vigintillion	1,000 decillion
30	nonillion	quintillion	100	googol	googol
33	decillion	1,000 quintillion	303	centillion	—
36	undecillion	sextillion	600	—	centillion
39	duodecillion	1,000 sextillion	googol	googolplex	googolplex

(1) In recent years, it has become more common in Britain to use U.S. terminology for large numbers.

Prime Numbers

A prime number is any positive integer greater than or equal to 2 that is divisible only by two positive integers, 1 and itself.

Prime Numbers to 1,009

	2	3	5	7	11	13	17	19	23
29	31	37	41	43	47	53	59	61	67
71	73	79	83	89	97	101	103	107	109
113	127	131	137	139	149	151	157	163	167
173	179	181	191	193	197	199	211	223	227
229	233	239	241	251	257	263	269	271	277
281	283	293	307	311	313	317	331	337	347
349	353	359	367	373	379	383	389	397	401
409	419	421	431	433	439	443	449	457	461
463	467	479	487	491	499	503	509	521	523
541	547	557	563	569	571	577	587	593	599
601	607	613	617	619	631	641	643	647	653
659	661	673	677	683	691	701	709	719	727
733	739	743	751	757	761	769	773	787	797
809	811	821	823	827	829	839	853	857	859
863	877	881	883	887	907	911	919	929	937
941	947	953	967	971	977	983	991	997	1,009

U.S. Customary Weights and Measures

Length

12 inches (in)	= 1 foot (ft)
3 feet	= 1 yard (yd)
5½ yards	= 1 rod (rd), pole, or perch (16½ feet)
40 rods	= 1 furlong (fur)
	= 220 yards
	= 660 feet
8 furlongs	= 1 statute mile (mi)
	= 1,760 yards
	= 5,280 feet
3 miles	= 1 league (land)
	= 5,280 yards
	= 15,840 feet
6076.11549 feet	= 1 international nautical mile

Volume (Liquid Measure)

When necessary to distinguish the liquid pint or quart from the dry pint or quart, the word *liquid* or the abbreviation *liq* is used in combination with the name or abbreviation of the liquid unit.

4 gills (gi)	= 1 pint (pt)
	= 28.875 cubic inches
2 pints	= 1 quart (qt)
	= 57.75 cubic inches
4 quarts	= 1 gallon (gal)
	= 231 cubic inches
	= 8 pints
	= 32 gills

Volume (Dry Measure)

When necessary to distinguish the dry pint or quart from the liquid pint or quart, the word *dry* is used in combination with the name or abbreviation of the dry unit.

2 pints (pt)	= 1 quart (qt)
	= 67.2006 cubic inches
8 quarts	= 1 peck (pk)
	= 537.605 cubic inches
	= 16 pints
4 pecks	= 1 bushel (bu)
	= 2,150.42 cubic inches
	= 32 quarts

Area

Squares and cubes of units are sometimes abbreviated by using superscripts. For example, ft² means square foot, and ft³ means cubic foot.

144 square inches	= 1 square foot (ft ²)
9 square feet	= 1 square yard (yd ²)
	= 1,296 square inches
30¼ square yards	= 1 square rod (rd ²)
	= 272¼ square feet
160 square rods	= 1 acre (A)
	= 4,840 square yards
	= 43,560 square feet

Weight and Measurement Equivalents

In this table it is necessary to distinguish between the *international* and the *survey* foot. The international foot, defined in 1959 as exactly equal to 0.3048 meter, is shorter than the old survey foot by exactly 2 parts in 1 million. The survey foot is still used in data expressed in feet in geodetic surveys within the U.S. In this table the survey foot is indicated with capital letters.

When the name of a unit is enclosed in brackets, e.g., [1 hand], either (1) the unit is not in general current use in the U.S. or (2) the unit is believed to be based on custom and usage rather than on formal definition.

Equivalents involving decimals are, in most instances, rounded to the 3rd decimal place; exact equivalents are so designated.

Lengths

1 angstrom (Å)	= 0.1 nanometer (exactly)
	= 0.000 1 micrometer (exactly)
	= 0.000 000 1 millimeter (exactly)
	= 0.000 000 004 inch
1 cable's length	= 120 fathoms (exactly)
	= 720 FEET (exactly)
	= 219 meters
1 centimeter (cm)	= 0.3937 inch
1 chain (ch) (Gunter's or surveyor's)	= 66 FEET (exactly)
	= 20.1168 meters
1 chain (engineer's)	= 30.48 meters (exactly)
	= 100 feet
1 decimeter (dm)	= 3.937 inches
1 degree (geographical)	= 364,566.929 feet
	= 69.047 miles (avg.)
	= 111.123 kilometers (avg.)
of latitude	= 68.708 miles at equator
	= 69.403 miles at poles
of longitude	= 69.171 miles at equator

640 acres	= 1 square mile (mi ²)
1 mile square	= 1 section (of land)
6 miles square	= 1 township
	= 36 sections
	= 36 square miles

Cubic Measure

1 cubic foot (ft ³)	= 1,728 cubic inches (in ³)
27 cubic feet	= 1 cubic yard (yd ³)

Gunter's, or Surveyor's, Chain Measure

7.92 inches (in)	= 1 link (li)
100 links	= 1 chain (ch)
	= 4 rods
	= 66 feet
80 chains	= 1 statute mile (mi)
	= 320 rods
	= 5,280 feet

Avoirdupois Weight

When necessary to distinguish the avoirdupois ounce or pound from the troy ounce or pound, the word *avoirdupois* or the abbreviation *avdp* is used in combination with the name or abbreviation of the avoirdupois unit. The *grain* is the same in avoirdupois and troy weight.

27 ¹¹ / ₃₂ grains	= 1 dram (dr)
16 drams	= 1 ounce (oz)
	= 437½ grains
16 ounces	= 1 pound (lb)
	= 256 drams
	= 7,000 grains
100 pounds	= 1 hundredweight (cwt)*
20 hundredweights	= 1 ton
	= 2,000 pounds*

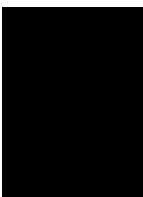
In *gross* or *long* measure, the following values are recognized.

112 pounds	= 1 gross or long hundredweight*
20 gross or long hundredweights	= 1 gross or long ton
	= 2,240 pounds*

*When the terms *hundredweight* and *ton* are used unmodified, they are commonly understood to mean the 100-pound hundredweight and the 2,000-pound ton, respectively; these units may be designated *net* or *short* when necessary to distinguish them from the corresponding units in gross or long measure.

Troy Weight

24 grains	= 1 pennyweight (dwt)
20 pennyweights	= 1 ounce troy (oz t)
	= 480 grains
12 ounces troy	= 1 pound troy (lb t)
	= 240 pennyweights
	= 5,760 grains



1 meter (m)	= 39.37 inches = 1.09361 yards
1 micrometer (µm)	= 0.001 millimeter (exactly) = 0.00003937 inch
1 mil	= 0.001 inch (exactly) = 0.0254 millimeter (exactly)
1 mile (mi) (statute or land)	= 5,280 FEET (exactly) = 1.609344 kilometers (exactly)
1 international nautical mile (nmi)	= 1.852 kilometers (exactly) = 1.150779 statute miles = 6,076.11549 feet
1 millimeter (mm)	= 0.03937 inch
1 nanometer (nm)	= 0.001 micrometer (exactly) = 0.0000003937 inch
1 pica (typography)	= 12 points
1 point (typography)	= 0.013837 inch (exactly) = 0.351 millimeter
1 rod (rd), pole, or perch	= 16½ FEET (exactly) = 5.029 meters
1 yard (yd)	= 0.9144 meter (exactly)

Areas or Surfaces

1 acre	= 43,560 square FEET (exactly) = 4,840 square yards = 0.405 hectare
1 are (a)	= 119.599 square yards = 0.025 acre
1 bolt (cloth measure): length	= 100 yards (on modern looms)
width	= 45 or 60 inches
1 hectare (ha)	= 2.471 acres
[1 square (building)]	= 100 square feet
1 square centimeter (cm ²)	= 0.155 square inch
1 square decimeter (dm ²)	= 15.500 square inches
1 square foot (ft ²)	= 929.030 square centimeters
1 square inch (in ²)	= 6.4516 square centimeters (exactly)
1 square kilometer (km ²)	= 247.104 acres = 0.386102 square mile
1 square meter (m ²)	= 1.196 square yards = 10.764 square feet
1 square mile (mi ²)	= 258.999 hectares
1 square millimeter (mm ²)	= 0.002 square inch
1 square rod (rd ²), sq. pole, or sq. perch	= 25.293 square meters
1 square yard (yd ²)	= 0.836127 square meter

Capacities or Volumes

1 barrel (bbl), liquid	= 31 to 42 gallons*
*There are a variety of "barrels" established by law or usage. For example: federal taxes on fermented liquors are based on a barrel of 31 gallons; many state laws fix the "barrel for liquids" as 31½ gallons; one state fixes a 36-gallon barrel for cistern measurement; federal law recognizes a 40-gallon barrel for "proof spirits"; by custom, 42 gallons constitute a barrel of crude oil or petroleum products for statistical purposes, and this equivalent is recognized "for liquids" by 4 states.	
1 barrel (bbl), standard for fruits, vegetables, and other dry commodities except dry cranberries	= 7,056 cubic inches = 105 dry quarts = 3.281 bushels, struck measure
1 barrel (bbl), standard, cranberry	= 86 ⁴⁵ / ₆₄ dry quarts = 2.709 bushels, struck measure = 5,826 cubic inches
1 board foot (lumber measure)	= a foot-square board 1 inch thick
1 bushel (bu) (U.S.) (struck measure)	= 2,150.42 cu in (exactly) = 35.239 liters
[1 bushel, heaped (U.S.)]	= 2,747.715 cubic inches = 1.278 bushels, struck measure*
*Frequently recognized as 1¼ bushels, struck measure.	
[1 bushel (bu) (British Imperial) (struck measure)]	= 1.032 U.S. bushels, struck measure = 2,219.36 cubic inches
1 cord (cd) firewood	= 128 cubic feet (exactly)
1 cubic centimeter (cm ³)	= 0.061 cubic inch

1 cubic decimeter (dm ³)	= 61.024 cubic inches
1 cubic inch (in ³)	= 0.554 fluid ounce = 4.433 fluid drams = 16.387 cubic centimeters
1 cubic foot (ft ³)	= 7.481 gallons = 28.317 cubic decimeters
1 cubic meter (m ³)	= 1.308 cubic yards
1 cubic yard (yd ³)	= 0.765 cubic meter
1 cup, measuring	= 8 fluid ounces (exactly) = ½ liquid pint (exactly)
[1 dram, fluid (fl dr) (British)]	= 0.961 U.S. fluid dram = 0.217 cubic inch = 3.552 milliliters
1 dekaliter (daL)	= 2.642 gallons = 1.135 pecks
1 gallon (gal) (U.S.)	= 231 cubic inches (exactly) = 3.785 liters = 0.833 British gallon = 128 U.S. fluid ounces (exactly)
[1 gallon (gal) British Imperial]	= 277.42 cubic inches = 1.201 U.S. gallons = 4.546 liters = 160 British fluid ounces (exactly)
1 gill (gi)	= 7.219 cubic inches = 4 fluid ounces (exactly) = 0.118 liter
1 hectoliter (hL)	= 26.418 gallons = 2.838 bushels
1 liter (L) (1 cubic decimeter exactly)	= 1.057 liquid quarts = 0.908 dry quart = 61.024 cubic inches
1 milliliter (mL) (1 cu cm exactly)	= 0.271 fluid dram = 16.231 minims = 0.061 cubic inch
1 ounce, liquid (U.S.)	= 1.805 cubic inches = 29.574 milliliters = 1.041 British fluid ounces
[1 ounce, fluid (fl oz) (British)]	= 0.961 U.S. fluid ounce = 1.734 cubic inches = 28.412 milliliters
1 peck (pk)	= 8.810 liters
1 pint (pt), dry	= 33.600 cubic inches = 0.551 liter
1 pint (pt), liquid	= 28.875 cubic inches (exactly) = 0.473 liter
1 quart (qt), dry (U.S.)	= 67.201 cubic inches = 1.101 liters = 0.969 British quart
1 quart (qt), liquid (U.S.)	= 57.75 cubic in (exactly) = 0.946 liter = 0.833 British quart
[1 quart (qt) (British)]	= 69.354 cubic inches = 1.032 U.S. dry quarts = 1.201 U.S. liquid quarts
1 tablespoon	= 3 teaspoons*(exactly) = 4 fluid drams = ½ fluid ounce (exactly)
1 teaspoon	= 1/3 tablespoon*(exactly) = 1 1/3 fluid drams*

*The equivalent "1 teaspoon = 1 1/3 fluid drams" has been found to correspond more closely with the actual capacities of teaspoons in use than the equivalent "1 teaspoon = 1 fluid dram" which is given by many dictionaries.

Weights or Masses

1 assay ton** (AT)	= 29.167 grams
**Used in assaying. The assay ton bears the same relation to the milligram that a ton of 2,000 pounds avoirdupois bears to the ounce troy; hence, the weight in milligrams of precious metal obtained from one assay ton of ore gives directly the number of troy ounces to the net ton.	
1 bale (cotton measure)	= 500 pounds in U.S. = 750 pounds in Egypt
1 carat (c)	= 200 milligrams (exactly) = 3.086 grains
1 dram avoirdupois (dr avdp)	= 27 11/32 (= 27.344) grains = 1.772 grams
1 gamma (g)	= 1 microgram (exactly), see below
1 grain	= 64.7989 milligrams

1 gram = 15.432 grains = 0.035 ounce, avoirdupois	1 pound, troy (lb t) = 5,760 grains (exactly) = 0.823 pound, avoirdupois = 373.242 grams
1 hundredweight, gross or long*** (gross cwt) = 112 pounds (exactly) = 50.802 kilograms	1 stone, (avdp) = 14 pounds avdp (exactly) = 6.350 kilograms
1 hundredweight, net or short (cwt or net cwt) = 100 pounds (exactly) = 45.359 kilograms	1 ton, gross or long*** (gross ton) = 2,240 pounds (exactly) = 1.12 net tons (exactly) = 1.016 metric tons
1 kilogram (kg) = 2.20462 pounds	***The gross or long ton and hundredweight are used commercially in the U.S. to only a limited extent, usually in restricted industrial fields. These units are the same as the British ton and hundredweight.
1 microgram (µg) = 0.000001 gram (exactly)	1 ton, metric (t) = 2,204.623 pounds = 0.984 gross ton = 1.102 net tons
1 milligram (mg) = 0.015 grain	1 ton, net or short (sh ton) = 2,000 pounds (exactly) = 0.893 gross ton = 0.907 metric ton
1 ounce, avoirdupois (oz avdp) = 437.5 grains (exactly) = 0.911 troy ounce = 28.3495 grams	
1 ounce, troy (oz t) = 480 grains (exactly) = 1.097 avoirdupois ounces = 31.103 grams	
1 pennyweight (dwt) = 1.555 grams	
1 pound, avoirdupois (lb avdp) = 7,000 grains (exactly) = 1.215 troy pounds = 453.59237 grams (exactly)	

Electrical Units

The **watt** is the unit of power (electrical, mechanical, thermal, etc.). Electrical power is given by the product of the voltage and the current.

Energy is sold by the **joule**, but in common practice the billing of electrical energy is expressed in terms of the **kilowatt-hour**, which is 3,600,000 joules or 3.6 megajoules.

The **horsepower** is a nonmetric unit sometimes used in mechanics. It is equal to 746 watts.

The **ohm** is the unit of electrical resistance and represents the physical property of a conductor that offers a resistance to the flow of electricity, permitting just 1 ampere to flow at 1 volt of pressure.

Measures of Force and Pressure

Dyne = force necessary to accelerate a 1-gram mass 1 centimeter per second squared = 0.000072 poundal	Pascal (pressure) = 1 newton per square meter = 0.020885 pound per square foot
Poundal = force necessary to accelerate a 1-pound mass 1 foot per second squared = 13,825.5 dynes = 0.138255 newtons	Atmosphere (air pressure at sea level) = 2,116.102 pounds per square foot = 14.6952 pounds per square inch = 1.0332 kilograms per square centimeter = 101,323 newtons per square meter
Newton = force needed to accelerate a 1-kilogram mass 1 meter per second squared	

Spirits Measures

Pony = 0.5 jigger	Quart = 32 shots	For champagne only:
Shot = 0.667 jigger = 1.0 ounce	Magnum = 2 quarts = 2.49797 bottles (wine)	Rehoboam = 3 magnums
Jigger = 1.5 shots	For champagne and brandy only:	Methuselah = 4 magnums
Pint = 16 shots = 0.625 fifth	Jeroboam = 6.4 pints = 1.6 magnum = 0.8 gallon	Salmanazar = 6 magnums
Fifth = 25.6 shots = 1.6 pints = 0.8 quart = 0.75706 liter		Balthazar = 8 magnums
		Nebuchadnezzar = 10 magnums
		Wine bottle (standard) = 0.800633 quart = 0.7576778 liter

Miscellaneous Modern Measures

Caliber—the diameter of a gun bore. In the U.S., caliber is traditionally expressed in hundredths of inches, e.g., .22. In Britain, caliber is often expressed in thousandths of inches, e.g., .270. Now it is commonly expressed in millimeters, e.g., the 5.56 mm M16 rifle. Heavier weapons' caliber has long been expressed in millimeters, e.g., the 155 mm howitzer. Naval guns' caliber refers to the barrel length as a multiple of the bore diameter. A 5-inch, 50-caliber naval gun has a 5-inch bore and a barrel length of 250 inches.

Decibel (dB)—a measure of the relative loudness or intensity of sound. A 20-decibel sound is 10 times louder than a 10-decibel sound; 30 decibels is 100 times louder; 40 decibels is 1,000 times louder, etc.

One decibel is the smallest difference between sounds detectable by the human ear. A 120-decibel sound is painful.

10 decibels	a light whisper
20	quiet conversation
30	normal conversation
40	light traffic
50	typewriter, loud conversation
60	noisy office
70	normal traffic, quiet train
80	rock music, subway
90	heavy traffic, thunder
100	jet plane at takeoff

Em—a printer's measure designating the square width of any given type size. Thus, an em of 10-point type is 10 points. An en is half an em.

Gauge—a measure of shotgun bore diameter. Gauge numbers originally referred to the number of lead balls just fitting the gun barrel diameter required to make a pound. Thus, a 16-gauge shotgun's bore was smaller than a 12-gauge shotgun's. Today, an international agreement assigns millimeter measures to each gauge.

Gauge	Bore diameter (in mm)	Gauge	Bore diameter (in mm)
6	23.34	14	17.60
10	19.67	16	16.81
12	18.52	20	15.90

Horsepower—the power needed to lift 550 pounds 1 foot in 1 second or to lift 33,000 pounds 1 foot in 1 minute. Equivalent to 746 watts or 2,546.0756 Btu/h.

Karat or carat—a measure of fineness for gold equal to 1/24 part of pure gold in an alloy. Thus 24-karat gold is pure; 18-karat gold is 3/4 alloy. The *carat* is also used as a unit of weight for precious stones; it is equal to 200 milligrams or 3.086 grains.

Knot—a measure of the speed of ships. A knot equals 1 nautical mile per hour.

Quire—25 sheets of paper.

Ream—500 sheets of paper.