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LAND SEA AIR SPACE

TECHNICAL REPORT J916

METRIC EQUIVALENTS OF U.S. CONVENTIONAL UNITS OF MEASURE—SAE J916

SAE Recommended Practice

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1. Foreword—

1.1 This report is designed to assist users of the SAE Handbook in conversion of dimensions and units of measure between the U.S. conventional[1] system and the metric[2] system. The same accuracy is obtainable with either system of units. The difference is in the names and relationships only. This SAE Recommended Practice is consistent with conversion practices of ISO R370, USASI, and ASTM.

1.2 The report includes the following: General Rules; Rules for Conversion from Inch to Metric; Rules for Converting from Metric to Inch; Rules for Rounding; Rules for Converting Toleranced Dimensions; Rules for Temperature Scale Conversion; all with supporting tables. Also included are useful tables for converting quantities and units of space, mechanics, electricity and light, and reciprocal units.

1.3 The term "exactly" has been used with all exact conversion factors. Conversion factors not so labeled have been rounded in accordance with the rounding procedures contained in this practice.

2. General—

2.1 In general, where converting between SI and customary U.S. units, the number of significant figures in the converted value should depend on the specified or implied tolerance of the value in the original measurement system. Care should be taken to avoid excessively literal conversions.

2.2 Where feasible, the rounding of metric or inch equivalents should be in reasonable, convenient, whole numbers. The word "nominal" (nom) or "approximately" (approx) may be employed to identify such loose equivalents.

2.3 Where dimensional interchangeability is involved, the methods described in Section 6 of this SAE Recommended Practice should be employed. Selection of method A or method B will depend on the functional interchangeability required and on the relationship of the limits in the original dimensioning system to the limits of mating or related parts.

2.4 Nominal size callout or identification shall preferably remain in the units of the system from which the nominal was taken. For example, a 1/4-20 UNC 2A screw thread should continue to be identified in this manner, regardless of whether it is a part of a metric tabulation or shown on a metric illustration. However, on metric tabulations and illustrations, the controlling dimensions of the part, such as the major, pitch, or minor diameters, in the case of the thread should be in millimeters on millimeter illustrations or tables; similar rules apply, for millimeter nominals and controlling dimensions when used in inch illustrations or tables.

2.5 In text or illustrations based on U.S. customary units, metric equivalents if used shall be enclosed in parentheses following the U.S. units and identified with the appropriate metric symbol. Similarly with metric based text or illustrations, U.S. units if used shall be enclosed in parentheses following the metric units and be appropriately identified.

2.6 All illustrations and tables shall be suitably labeled to identify fundamental units of measurement used.

3. Inch-Millimeter Linear Dimensioning Conversion—

3.1 Factor: 1 inch (in) =25.4 millimeters (mm) (exactly).

3.2 Table 1A provides values for converting from decimal inches to millimeters. In using this table, the inch value to be converted should be written to as many decimal places as accuracy requires. The value should then be split into groups of not more than two significant digits each. The inch equivalent of each group should be taken from Table 1A and tabulated as in Example 1, proper regard being given to the position of the decimal point in each case.

TABLE 1A—CONVERSION FROM DECIMAL INCHES TO MILLIMETERS

in	mm	in	mm	in	mm
1	25.4	36	914.4	71	1 803.4
2	50.8	37	939.8	72	1 828.8
3	76.2	38	965.2	73	1 854.2
4	101.6	39	990.6	74	1 879.6
5	127.0	40	1 016.0	75	1 905.0
6	152.4	41	1 041.4	76	1 930.4
7	177.8	42	1 066.8	77	1 955.8
8	203.2	43	1 092.2	78	1 981.2
9	228.6	44	1 117.6	79	2 006.6
10	254.0	45	1 143.0	80	2 032.0
11	279.4	46	1 168.4	81	2 057.4
12	304.8	47	1 193.8	82	2 082.8
13	330.2	48	1 219.2	83	2 108.2
14	355.6	49	1 244.6	84	2 133.6
15	381.0	50	1 270.0	85	2 159.0
16	406.4	51	1 295.4	86	2 184.4
17	431.8	52	1 320.8	87	2 209.8
18	457.2	53	1 346.2	88	2 235.2
19	482.6	54	1 371.6	89	2 260.6
20	508.0	55	1 397.0	90	2 286.0
21	533.4	56	1 422.4	91	2 311.4
22	558.8	57	1 447.8	92	2 336.8
23	584.2	58	1 473.2	93	2 362.2
24	609.6	59	1 498.6	94	2 387.6
25	635.0	60	1 524.0	95	2 413.0
26	660.4	61	1 549.4	96	2 438.4
27	685.8	62	1 574.8	97	2 463.8
28	711.2	63	1 600.2	98	2 489.2
29	736.6	64	1 625.6	99	2 514.6
30	762.0	65	1 651.0	100	2 540.0
31	787.4	66	1 676.4		
32	812.8	67	1 701.8		
33	838.2	68	1 727.2		
34	863.6	69	1 752.6		
35	889.0	70	1 778.0		

NOTE: All values in this table are exact.

3.3 To maintain precision during conversion without retaining an unnecessary number of digits, the millimeter equivalent of each group should be carried to one decimal place more than the inch value being converted and shall be rounded[3] to the appropriate significant figure in the last decimal place. The sum of the group of equivalents should then be rounded[3] off to one less decimal place than the original inch value.

EXAMPLE 1—Convert 2.4637 in to millimeters:

2.0000 in = 50.80000 mm exactly
0.4600 in = 11.68400 mm exactly
0.0037 in = 0.09398 mm exactly

2.4637 in = 62.57798 mm

or, correct to 3 decimal places:

2.4637 in = 62.578 mm

3.4 Table 1B provides values for conversion from fractional inches to millimeters. Combinations of inch and fractional inch millimeter equivalents may be tabulated to obtain desired millimeter conversion. As in paragraph 3.3, the millimeter value should be rounded to one less than the decimal equivalent of the inch fraction taken to the intended or implied precision.

4. Millimeter-Inch Linear Dimensioning Conversion—

4.1 Factor: 1 mm = 0.03937008 in (approx).

4.2 Table 2 provides values for converting from millimeters to

[1]U.S. conventional units refers to the customary U.S. units such as inch, foot, yard, mile, pound (avdp), U.S. gallon and its subdivisions.

[2]The metric units and conversion factors presented here are based on the "International System of Units," commonly abreviated "SI," fixed by the General Conference on Weights and Measures; this system is also known as the Giorgi or MKSA [meter-kilogram (mass)-second-ampere] system. This system has been adopted by the International Organization for Standardization in ISO Recommendation R31.

[3]See Section 5, Rules for Rounding.

TABLE 1B—CONVERSION FROM FRACTIONAL INCHES TO MILLIMETERS

in		mm	in		mm
1/64	0.015 625	0.396 875	33/64	0.515 625	13.096 875
1/32	0.031 250	0.793 750	17/32	0.531 250	13.493 750
3/64	0.046 875	1.190 625	35/64	0.546 875	13.890 625
1/16	0.062 500	1.587 500	9/16	0.562 500	14.287 500
5/64	0.078 125	1.984 375	37/64	0.578 125	14.684 375
3/32	0.093 750	2.381 250	19/32	0.593 750	15.081 250
7/64	0.109 375	2.778 125	39/64	0.609 375	15.478 125
1/8	0.125 000	3.175 000	5/8	0.625 000	15.875 000
9/64	0.140 625	3.571 875	41/64	0.640 625	16.271 875
5/32	0.156 250	3.968 750	21/32	0.656 250	16.668 750
11/64	0.171 875	4.365 625	43/64	0.671 875	17.065 625
3/16	0.187 500	4.762 500	11/16	0.687 500	17.462 500
13/64	0.203 125	5.159 375	45/64	0.703 125	17.859 375
7/32	0.218 750	5.556 250	23/32	0.718 750	18.256 250
15/64	0.234 375	5.953 125	47/64	0.734 375	18.653 125
1/4	0.250 000	6.350 000	3/4	0.750 000	19.050 000
17/64	0.265 625	6.746 875	49/64	0.765 625	19.446 875
9/32	0.281 250	7.143 750	25/32	0.781 250	19.843 750
19/64	0.296 875	7.540 625	51/64	0.796 875	20.240 625
5/16	0.312 500	7.937 500	13/16	0.812 500	20.637 500
21/64	0.328 125	8.334 375	53/64	0.828 125	21.034 375
11/32	0.343 750	8.731 250	27/32	0.843 750	21.431 250
23/64	0.359 375	9.128 125	55/64	0.859 375	21.828 125
3/8	0.375 000	9.525 000	7/8	0.875 000	22.225 000
25/64	0.390 625	9.921 875	57/64	0.890 625	22.621 875
13/32	0.406 250	10.318 750	29/32	0.906 250	23.018 750
27/64	0.421 875	10.715 625	59/64	0.921 875	23.415 625
7/16	0.437 500	11.112 500	15/16	0.937 500	23.812 500
29/64	0.453 125	11.509 375	61/64	0.953 125	24.209 375
15/32	0.468 750	11.906 250	31/32	0.968 750	24.606 250
31/64	0.484 375	12.303 125	63/64	0.984 375	25.003 125
1/2	0.500 000	12.700 000	1	1.000 000	25.400 000

NOTE: All values in table are exact.

TABLE 2—CONVERSION FROM MILLIMETERS TO INCHES

mm	in	mm	in	mm	in
1	0.039 370 08	36	1.417 322 8	71	2.795 275 6
2	0.078 740 16	37	1.456 692 9	72	2.834 645 7
3	0.118 110 24	38	1.496 063 0	73	2.874 015 7
4	0.157 480 31	39	1.535 433 1	74	2.913 385 8
5	0.196 850 39	40	1.574 803 1	75	2.952 755 9
6	0.236 220 47	41	1.614 173 2	76	2.992 126 0
7	0.275 590 55	42	1.653 543 3	77	3.031 496 1
8	0.314 960 63	43	1.692 913 4	78	3.070 866 1
9	0.354 330 71	44	1.732 283 5	79	3.110 236 2
10	0.393 700 8	45	1.771 653 5	80	3.149 606 3
11	0.433 070 9	46	1.811 023 6	81	3.188 976 4
12	0.472 440 9	47	1.850 393 7	82	3.228 346 5
13	0.511 811 0	48	1.889 763 8	83	3.267 716 5
14	0.551 181 1	49	1.929 133 9	84	3.307 086 6
15	0.590 551 2	50	1.968 503 9	85	3.346 456 7
16	0.629 921 3	51	2.007 874 0	86	3.385 826 8
17	0.669 291 3	52	2.047 244 1	87	3.425 196 8
18	0.708 661 4	53	2.086 614 2	88	3.464 566 9
19	0.748 031 5	54	2.125 984 2	89	3.503 937 0
20	0.787 401 6	55	2.165 354 3	90	3.543 307 1
21	0.826 771 7	56	2.204 724 4	91	3.582 677 2
22	0.866 141 7	57	2.244 094 5	92	3.622 047 2
23	0.905 511 8	58	2.283 464 6	93	3.661 417 3
24	0.944 881 9	59	2.322 834 6	94	3.700 787 4
25	0.984 252 0	60	2.362 204 7	95	3.740 157 5
26	1.023 622 0	61	2.401 574 8	96	3.779 527 6
27	1.062 992 1	62	2.440 944 9	97	3.818 897 6
28	1.102 362 2	63	2.480 315 0	98	3.858 267 7
29	1.141 732 3	64	2.519 685 0	99	3.897 637 8
30	1.181 102 4	65	2.559 055 1	100	3.937 008
31	1.220 472 4	66	2.598 425 2		
32	1.259 842 5	67	2.637 795 3		
33	1.299 212 6	68	2.677 165 4		
34	1.338 582 7	69	2.716 535 4		
35	1.377 952 8	70	2.755 905 5		

NOTE: The inch values in this table are rounded off.

decimal inches. In using this table, the millimeter value to be converted should be written to as many decimal places as the desired accuracy requires. The value should then be split into groups of not more than two significant digits each. The inch equivalent of each group should be taken from Table 2 and tabulated as in Example 2, proper regard being given to the position of the decimal point in each case.

4.3 To maintain precision during conversion without retaining an unnecessary number of digits, the inch equivalent of each group should be carried to four decimal places more than the millimeter value being converted and shall be rounded[2] to the appropriate significant figure in the last decimal place. The sum of the group of equivalents should then be rounded[1] off to two more decimal places than the original millimeter value.

EXAMPLE 2—Convert 105.23 mm to inches:

100.00 mm = 3.937008 in (from Table 2)
5.00 mm = 0.196850 in (rounded to sixth decimal place)
0.23 mm = 0.009055 in (rounded to sixth decimal place)

105.23 mm = 4.142913 in

or, corrected to 4 decimal places:

105.23 mm = 4.1429 in

5. Rounding Off Values[1]—The following rules assure that the sum of a related group of values which are rounded will remain statistically the same. It may, however, be desirable, in the case of rounding dimensional limits to round toward the interior of the tolerance zone (as in method B, paragraph 6.1.2) or toward minimum material in all cases (as in paragraph 6.4.5).

5.1 Where the digit next beyond the last digit to be retained is less than 5, the last digit retained should not be changed. EXAMPLE: 4.46325 if rounded off to three places, would be 4.463.

5.2 Where the digits beyond the last digit to be retained amount to more than 5 followed by zeros, the last digit retained should be increased by one. EXAMPLE: 8.37652 if rounded off to three places, would be 8.377.

5.3 Where the digit next beyond the last digit to be retained is exactly 5, the last digit retained, if even, is unchanged; but if odd, the last digit is increased by one. EXAMPLE: 4.36500 in becomes 4.36 when rounded off to two places. 4.35500 in also becomes 4.36 when rounded off.

6. Conversion of Toleranced Dimensions[5]—The use of the conversion factor of 1 in = 25.4 mm exactly, generally produces converted values containing more decimal places than are required for the desired accuracy. It is, therefore, necessary to round these values suitably, and at the same time to maintain the degree of accuracy in the converted values compatible with that of the original values.

6.1 **General**—The number of decimal places given in Tables 3 and 4 for rounding off toleranced dimensions relates the degree of accuracy to the size of the tolerance specified. Two methods of using these tables are given: Method A, which rounds to values nearest to each limit, and method B which rounds to values always inside the limits.

6.1.1 In method A, rounding off is effected to the nearest rounded

TABLE 3

Original Tolerance, in		Round Off to Whole Number, mm
At Least	Less Than	
0.000 01	0.000 1	0.000 01
0.000 1	0 001	0.000 1
0.001	0.01	0.001
0.01	0.1	0.01
0.1	1	0.1

TABLE 4

Original Tolerance, mm		Round off to Whole Number, in
At Least	Less Than	
0.0005	0.005	0.000 001
0.005	0.05	0.000 01
0.05	0.5	0.000 1
0.5	5	0.001
5	50	0.01

[1] Adopted from SAE Aerospace-Automotive Drawing Standards.
[5] Adapted from ISO Recommendation R370.

value of the limit, so that, on average, the converted tolerances remain statistically identical with the original tolerances. The limits converted by this method, considered as being acceptable for interchangeability, serve as a basis for inspection.

6.1.2 In method B, rounding off is done systematically TOWARD THE INTERIOR of the tolerance zone so that the converted tolerances are never larger than the original tolerances. This method must be employed when the original limits have to be respected absolutely—in particular, when components made to converted limits are to be inspected by means of original gages.

6.1.3 These two methods form the subject of paragraphs 6.2 and 6.3 which relate respectively to the conversion of inches into millimeters and of millimeters into inches, and paragraph 6.4 with various special methods.

6.2 **Conversion of Inches to Millimeters**—

6.2.1 METHOD A—The use of this method guarantees that even in the most unfavorable cases neither of the two original limits will be exceeded (nor diminished) by more than 2% of the value of the tolerance. Proceed as follows:

(a) Calculate the maximum and minimum limits in inches.

(b) Convert the corresponding two values exactly into millimeters by means of the conversion factor 1 in = 25.4 mm. (See Table 1A.)

(c) Round off the results obtained to the nearest rounded value as indicated in Table 3, depending on the original tolerance in inches, that is, on the difference between the two limits in inches. See Example 3.

6.2.2 METHOD B—This method must be employed when the original limits may not be violated even slightly. In extreme cases, this method may increase the lower limit a maximum of 4% of the tolerance and decrease the upper limit a maximum of 4% of the tolerance.

(a) Proceed as in paragraph 6.2.1, method A, steps (a) and (b).

(b) Round off each limit toward the interior of the tolerance, that is, to the next lower value for the upper limit and to the next higher value for the lower limit.[6] See Example 3.

EXAMPLE 3—A dimension is expressed in inches as: 1.950 ± 0.016
The limits are: 1.934 — 1.966
Conversion of the two limits into millimeters gives: 49.1236 — 49.9364

Method A—The tolerance equals 0.032 in and thus lies between 0.01 and 0.1 in. Rounding these values off to the nearest 0.01 mm, the values in millimeters to be employed for these two limits are: 49.12 — 49.94

Method B—Rounding off towards the interior of the tolerance, millimeter values for these two limits are: 49.13 — 49.93

This reduces the tolerance to 0.80 mm instead of 0.82 mm given by method A.

6.3 **Conversion of Millimeters to Inches**—

6.3.1 METHOD A—The use of this method guarantees that even in the most unfavorable cases neither of the two original limits will be exceeded (nor diminished) by more than 2.5% of the value of the tolerance.

(a) Calculate the maximum and minimum limits in millimeters.

(b) Convert the corresponding two values into inches by means of the conversion factor 1 mm = 1/25.4. (See Table 2.)

(c) Round off the results obtained to the nearest rounded value as indicated in Table 4, depending on the original tolerance in millimeters, that is, on the difference between the two limits in millimeters. See Example 4.

6.3.2 METHOD B—This method must be employed when the original limits may not be violated even slightly. In extreme cases, this method may increase the lower limit a maximum of 5% of the tolerance, and decrease the upper limit a maximum of 5% of the tolerance.

(a) Proceed as in paragraph 6.3.1, method A, steps (a) and (b).

[6] If the digits to be rounded are zeros, the retained digits remain unchanged.

(b) Round off each limit, toward the interior of the tolerance, that is, to the next lower value for the upper limit and to the next higher value for the lower limit.[6] See Example 4.

EXAMPLE 4—A dimension is expressed in millimeters as: 49.2 ± 0.4
The limits are: 48.8 — 49.6
Conversion of the two limits into inches gives: 1.92126 — 1.95276

Method A—The tolerance equals 0.8 mm, and thus lies between 0.5 and 5 mm. Rounding these values off to the nearest 0.001 in, the values in inches to be employed for these two limits are: 1.921 — 1.953

Method B—Rounding off towards the interior of the tolerance, inch values for these two limits are: 1.922 — 1.952

This reduces the tolerance to 0.030 in instead of the 0.032 in given by method A.

6.4 **Special Methods**—

6.4.1 BASIC SIZE AND DEVIATIONS—In order to avoid accumulation of roundoff errors, the two limits of size must be converted separately; thus, they must first be calculated if the dimension consists of a basic size and two tolerances. However, (except when method B is specified) as an alternative, the basic size may be converted to the nearest rounded value and each of the tolerances converted toward the interior of the tolerance. This method, which sometimes makes conversion easier, gives the same maximum guarantee of accuracy as method A, but usually results in smaller converted tolerances.

6.4.2 LIMITATION IMPOSED BY ACCURACY OF MEASUREMENTS—If the increment of rounding given for the tolerances in Tables 3 and 4 is too small for the available accuracy of measurement, limits which are acceptable for interchangeability must be determined separately for the dimensions.

EXAMPLE 5: Where accuracy of measurement is limited to 0.001 mm, study shows that values converted from 1.0000 ± 0.0005 in can be rounded off to 25.413 and 25.387 mm instead of 25.4127 and 25.3873 mm with little disadvantage, since neither of the two original limits is exceeded by more than 1.2% of the tolerance.

6.4.3 POSITIONAL TOLERANCE—If the dimensioning consists solely of a positional tolerance around a point defined by a nontoleranced basic dimension, the basic dimension must be converted to the nearest rounded value and the positional variation (radius) separately converted by rounding downwards, these roundings depending on twice the original radial tolerance, that is, the diameter of the tolerance zone.

6.4.4 TOLERANCED DIMENSION APPLIED TO A NONTOLERANCED POSITION DIMENSION—If the toleranced dimension is located in a plane, the position of which is given by a nontoleranced basic or gage dimension, such as when dimensioning certain conical surfaces, proceed as follows:

(a) Round off the reference gage arbitrarily, to the nearest convenient value.

(b) Calculate exactly, in the converted unit of measurement, new maximum and minimum limits of the specified tolerance ZONE, in the new plane defined by the new basic dimension.

(c) Round off these limits in conformity with the present rules. See Example 6.

EXAMPLE 6: A cone of taper 0.05 in/in has a diameter of 1.000 ± 0.002 in in a reference plane located by the nontoleranced dimension 0.9300 in. By virtue of the taper of the cone, the limits of the tolerance ZONE depend on the position of the reference plane. Consequently, if the dimension 0.9300 in = 23.6220 mm is rounded off to 23.600 mm, that is, a reduction of 0.022 mm, each of the two original limits, when converted exactly into millimeters, must be corrected by 0.022 × 0.05 = 0.0011 mm, in the appropriate sense, before being rounded off.

6.4.5 CONSIDERATION OF MAXIMUM AND MINIMUM MATERIAL CONDITION —Assemblability of mating parts depends on a "go" condition at the maximum material limits of the parts. The minimum material limits which are determined by the respective tolerances are often not as critical from a functional standpoint. Accordingly, it may be desirable to employ a combination of methods A and B in certain conversions by using method B for the maximum material limits and method A for the minimum material limits. Alternatively, it may be desirable to round automatically the converted minimum material limits outside the original limits to provide greater tolerances for manufacturing.

7. Temperature Scale Conversion[7]—

7.1 Temperature in degrees Celsius[8] (C) equals 5/9 (F-32), where F is temperature in degrees Fahrenheit.

7.2 The basic rule is that all equivalents shall be the nearest tenth of a Celsius degree, but the following exceptions are established:

(a) Fahrenheit temperatures indicated to be "approximate" or "not higher than" or "not lower than" (or other designation as a maximum or a minimum) shall have their equivalents shown to the nearest even Celsius degree.

(b) The conversion of the tolerance requirements shall be as shown in Table 7.

8. Other Conversion Factors—

8.1 Tables 5, 6, 8, and 9 provide additional useful conversion factors.[9]

[7] Adopted from SAE AMS Manual for Fahrenheit to Celsius.
[8] Formerly known as Centigrade.
[9] Adapted from ASTM Metric Practice Guide.

TABLE 5—QUANTITIES AND UNITS OF MECHANICS[a]

Multiplicant	Multiplier	Result
MASS AND WEIGHT (FORCE)[b]		
ounce (avdp) (oz)	28.3495	gram (g)
pound (avdp) (lb)	0.45359237 (exactly)	kilogram (kg)
pound-force (lbf)	4.448222	newton (N)
short ton (2000 lb) (t)	907.185	kilogram (kg)
	0.907185	metric ton (mt)
long ton (2240 lb) (l t)	1016.05	kilogram (kg)
FORCE/AREA		
pound-force per square inch (psi)	0.070307	kilogram-force per square centimeter (kgf/cm²)
	689.4757	newton per square meter (N/m²)
pound-force per square foot (psf)	4.88243	kilogram-force per square meter (kgf/m²)
	47.88026	newton per square meter (N/m²)
MASS/VOLUME (DENSITY)		
ounce per cubic inch (oz/in³)	1729.994	kilogram per cubic meter (kg/m³)
pound per cubic foot (lb/ft³)	16.01846	kilogram per cubic meter (kg/m³)
	0.01601846	gram per cubic centimeter (g/cm³)
ton (long) per cubic yard (long ton/yd³)	1328.939	kilogram per cubic meter (kg/m³)
MASS/CAPACITY		
ounce per gallon (US) (oz/gal)	7.489152	gram per liter (g/l)
pound per gallon (US) (lb/gal)	119.8264	gram per liter (g/l)
BENDING MOMENT OR TORQUE		
pound-force-inch (lbf-in)	0.1129848	newton-meter (N·m)
	1.12985 × 10⁶	dyne-centimeter (dyne·cm)
pound-force-foot (lbf-ft)	1.355818	newton-meter (N·m)
	1.355818 × 10⁷	dyne-centimeter (dyne·cm)
ounce-force-inch (ozf-in)	0.0070616	newton-meter (N·m)

Multiplicant	Multiplier	Result
VELOCITY		
foot per second (ft/s)	0.3048 (exactly)	meter per second (m/s)
mile per hour (mph)	1.609344 (exactly)	kilometer per hour (km/h)
	0.44704 (exactly)	meter per second (m/s)
FLOW		
cubic foot per minute (cu ft/min)	0.4719474	liter per second (l/s)
gallon (US) per minute (gal/min)	0.0630902	liter per second (l/s)
HEAT		
British thermal unit (Btu)	1055.056	joule (J)
Btu per pound (Btu/lb)	2.326 (exactly)	joule per gram (J/g)
POWER		
horsepower (hp)	745.700	watt (W)
Btu per hour (Btu/h)	0.293071	watt (W)
foot-pound per second (ft-lb/s)	1.35582	watt (W)
HEAT TRANSFER		
Btu·in/h·ft² F (k, thermal conductivity)	0.1442285	W/m·K
Btu/h·ft²·F (C, thermal conductance)	5.678286	W/m²·K
F·h·ft²/Btu (R, thermal resistance)	0.1761094	K·m²/W
Btu/lb·F (c, heat capacity)	4186.8 (exactly)	J/kg·K
ft²/h (thermal diffusivity)	25.8064 (exactly)	mm²/s
WATER VAPOR TRANSMISSION[c]		
grain/h·ft² (water vapor transmission) (gr/h·ft²)	16.7	gram/24 h·m² (g/24 h·m²)
perm (permeance) (perm)	0.659	metric perm (m perm)
perm-inch (permeability) (perm-in)	1.67	metric perm centimeters (m perm cm)

[a] Adapted from ASTM Metric Practice Guide.

[b] The metric technical unit of force is the kilogram-force; this is the force which, when applied to a body having a mass of 1 kg, gives it an acceleration of 9.80665 m/s/s, the standard acceleration of free fall toward the earth's center for sea level at 45 deg latitude. The SI unit of force is the newton (N), which is defined as that force which, when applied to a body having a mass of 1 kg, gives it an acceleration of 1 m/s/s. These units must be distinguished from the (inconstant) local weight of a body having a mass of 1 kg; that is, the weight of a body is that force which a body is attracted to the earth and is equal to the mass of a body multiplied by the local acceleration due to gravity. However, because many engineers still use kilogram-force units and pound-force units, these are recognized in this document, but the term "force" should always be included. Note that the abbreviation for pound-force per square inch is psi. The newton will find increasing use as a unit of force.

[c] See ASTM E 96, Methods of Test for Water Vapor Transmission of Materials in Sheet Form, 1964 Book of ASTM Standards, Part 30, and ASTM C 355, Methods of Test for Water Vapor Transmission of Materials Used in Building Construction.