



(ALSO SEE SECTION 5, PARAGRAPH 5-16 FOR CONVERSION TABLES.)

M2.1 SCOPE.

M2.1.1 Purpose. This SECTION portrays the methods of converting the quantities of various systems of American measurement to the International System of Units (SI) and from the SI units to American units.

M2.2 APPLICABLE DOCUMENTS. Note: DoD Policy Memo 05-3 “Elimination of Waivers to Cite Military Specifications and Standards in Solicitation and Contracts” has eliminated the need for waivers to use MIL-SPECS and MIL-STDS on DoD contracts. (See PREFACE 1, Section 2)

- FED-STD-376 Preferred Metric Units for Use by the Federal Government
- ISO 1000 SI Units and Recommendations for the Use of their Multiples and of Certain Other Units
- NIST SP 330 The International System of Units (SI)
- ASTM SI 10 Standard for Metric Practice (X-Ref: IEEE SI 10)

M2.3 DEFINITIONS. Not Applicable

M2.4 CONVERSION OF LINEAR UNITS.

M2.4.1 Converting Inch To Millimeter. One inch equals 25.4 millimeters, exactly. Therefore, to convert any inch dimension to a millimeter dimension multiply the inch dimension by 25.4.

M2.4.2 Converting Millimeter To Inch. To convert a millimeter dimension to an inch dimension exactly, divide the millimeter dimension by 25.4.

M2.5 CONVERSION OF EXPLICIT TOLERANCES.

M2.5.1 Methods Of Tolerance Conversion. Two methods of tolerance conversion are presented:

M2.5.1.1 Method A. Rounds to values nearest to the limits of the tolerance. Proceed as follows:

- a. For each dimension, calculate the maximum and minimum limits.
- b. Convert the corresponding inch values into millimeter values, as directed in PARAGRAPH M2.4.1.
- c. The use of the conversion factor (1" = 25.4 mm) generally produces converted values containing more decimal places than are required for the desired degree of accuracy. Therefore, the converted valves must be rounded to a practical degree of accuracy, as shown in Table M2-1.

M2.5.1.2 Method B. Rounds each limit toward the interior of the tolerance zone. Proceed as in Method A, steps "a" and "b". Then round each converted value toward the interior of the tolerance zone. See TABLE M2-1. Also see SECTION 5, PARAGRAPH 5.4.3.4 for rounding.

TOTAL TOLERANCE IN INCHES	ROUND THE MILLIMETERS CONVERSION TO:
More than .4	Whole millimeter 1
.4 to .04	1 decimal place 0.1
.04 to .004	2 decimal places 0.01
.004 to .0004	3 decimal places 0.001
.0004 to .00004	4 decimal places 0.0001

ROUNDING OFF TOLERANCE ON CONVERSION INCH TO METRIC
TABLE M2-1



M2.6 CONVERSION OF TEMPERATURE UNITS.

M2.6.1 SI Unit Of Temperature. The SI unit of temperature is the kelvin. (Ref. PARAGRAPH M1.3.5.)

M2.6.2 Other Kelvin Identifications. Kelvin temperature is also called "absolute temperature" and "thermodynamic temperature". No conversion is required between values bearing these designations.

M2.6.3 Kelvin And Celsius Comparison Of Increments. Kelvin units and Celsius degrees are equal temperature increments, but the kelvin temperature scale and the Celsius temperature scale differ in the location of their zeros. See TABLE 2M-2.

M2.6.3.1 Kelvin To Celsius Conversion Factor. Subtract 273.15 from kelvin temperature (from "absolute temperature" or "thermodynamic temperature") to get Celsius temperature.

M2.6.3.2 Celsius To Kelvin Conversion Factor. Add 273.15 to Celsius temperature to get kelvin temperature. See TABLE M2-2.

CONDITION	THERMODYNAMIC TEMPERATURE	CELSIUS TEMPERATURE
Water boils	373.15 K	100 °C
Body temperature	310.15 K	37 °C
Triple point of water	273.16 K	0.01 °C
Celsius Zero	273.15 K	0.00 °C
Absolute Zero	0.00 K	-273.15 °C

CELSIUS TO KELVIN CONVERSION TABLE
 TABLE M2-2

NOTES:

- As laboratory techniques improved, it was observed that the triple point of pure water was not 0.00 °C but was actually 0.01 °C. Therefore, you will see absolute zero as being 273.15 °C below Celsius zero, and as being 273.16 °C below the triple point of pure water.
- There must be a space placed between the temperature value and the symbol, °C as noted below:
 i.e. 100 °C

M2.6.4 Kelvin Versus Rankine Size Of Degree. The kelvin and the Rankine temperature scales share the same zero point (absolute zero) but the magnitude of their units (or degrees) differs. The kelvin unit is 1.8 times larger than the Rankine degree.

M2.6.4.1 Rankine To kelvin Conversion Factor. To change Rankine temperature to kelvin temperature, divide the Rankine temperature by 1.8. The quotient is kelvin units.

e.g. Rankine to kelvin

$$\text{kelvin} = \frac{\text{Rankine}}{1.8} - 273.15$$



M2.6.4.2 Rankine To Celsius Conversion Factor. To change Rankine temperature to Celsius temperature, divide the Rankine temperature by 1.8 From this quotient, subtract 273.15 to get degrees Celsius.

e.g. Rankine to Celsius

$$\text{Celsius} = \frac{\text{Rankine}}{1.8} - 273.15$$

M2.6.5 Celsius To Kelvin Conversion Factor. Although it is proper to say, "degree Celsius" it is incorrect to speak of kelvin degrees. Kelvin temperature is referred to as "zero kelvin, or 240 kelvin, or 380.95 kelvin" etc. To change degrees Celsius to kelvin temperature, add 273.15 to degrees Celsius.

e.g. Celsius to kelvin

$$\text{kelvin} = \text{Celsius} + 273.15$$

M2.6.6 Kelvin Versus Fahrenheit Size Of Degree. The kelvin and Fahrenheit temperature scales differ in their zero points and in the size of their degrees. The kelvin unit is 1.8 times larger than the Fahrenheit degree, and their zeros are 255.37 kelvin apart.

M2.6.7 Fahrenheit To Kelvin Conversion Factor. To change Fahrenheit temperature to kelvin, add 459.67 to the Fahrenheit temperature and divide that sum by 1.8. The quotient is in kelvin units.

e.g. Fahrenheit to kelvin

$$\text{kelvin} = \frac{(\text{Fahrenheit} + 459.67)}{1.8}$$

M2.6.8 Fahrenheit To Degrees Celsius Conversion Factor. To change Fahrenheit temperature to degrees Celsius, subtract 32 from the Fahrenheit temperature, and divide that difference by 1.8. The quotient is in degrees Celsius.

e.g. Fahrenheit to Celsius

$$\text{Celsius} = \frac{(\text{Fahrenheit} - 32)}{1.8}$$



FAHRENHEIT / CELSIUS CONVERSION					
°F	°C	°F	°C	°F	°C
-40	-40	320	160	1040	560
-30		340		1060	
-20	-30	360	180	1080	580
-10		380		1100	
0	-20	400	200	1120	600
10		420		1140	
20	-10	440	220	1160	620
30	0	460	240	1180	640
40		480		1200	
50	10	500	260	1220	660
60		520		1240	
70	20	540	280	1260	680
80		560		1280	
90	30	580	300	1300	700
100		600		1320	
110	40	620	320	1340	720
120		640		1360	
130	50	660	340	1380	740
140		680		1400	
150	60	700	360	1420	760
160		720		1440	
170	70	740	380	1460	780
180		760		1480	
190	80	780	400	1500	800
200		800		1520	
210	90	820	420	1540	820
220		840		1560	
230	100	860	440	1580	840
240		880		1600	
250	110	900	460	1620	860
260		920		1640	
270	120	940	480	1660	880
280		960		1680	
290	130	980	500	1700	900
300		1000		1720	
310	140	1020	520	1740	920
320		1040		1760	
	150		540		940
					960



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M2.7 Frequently Used Conversions. A partial list of measurements more frequently used are listed in Table M2-3. See ASTM SI 10 for additional listings.

MEASUREMENT	TO CONVERT		
	FROM	TO	MULTIPLY BY
Acceleration meters/ second ² (m/s ²)	foot/second ² (ft/s ²)	m/s ²	0.304 8
	m/s ²	ft/s ²	3.280 8
Area meter ² (m ²)	acre	m ²	4 046.86
	foot ² (ft ²)	m ²	0.092 903
	hectare (ha)	m ²	10 000.
	inch ² (in ²)	m ²	0.000 645 16
	mile ²	m ²	2 589 988.
	acre	ha	0.404 7
	ha	acre	2.471
	m ²	ft ²	10.763 92
m ²	in ²	1 550.003	
Bending Moment or Torque newton meter (Nm)	kilogram-force meter (kgfm)	Nm	9.806 650
	ounce-force-inch (oz fin)	Nm	0.007 062
	pound-force-inch (lb fin)	Nm	1.129 848
	pound-force-foot (lb fft)	Nm	1.355 818
	Nm	lb fft	0.737 562
Energy (work) joule (J)	British thermal unit (Btu)	J	1 055.056
	calorie (cal)	J	4.186 8
	foot-pound-force (lb f)	J	1.355 818
	kilowatt-hour (kWhr)	J	3 600 000.
	watt-hour (Whr)	J	3 600.
	watt-second (Ws)	J	1.000
Force newton (N)	dyne	N	0.000 01
	kilogram-force (kgf)	N	9.806 650
	kilopond	N	9.806 650
	ounce-force (ozf)	N	0.278 014
	pound force (lb f)	N	4.448 222
	N	kgf	0.101 972
	N	lb f	0.224 809
Length meter (m)	foot (ft)	m	0.304 8
	inch (in)	m	0.025 400
	mile (U.S. statute) (mi)	m	1 609.344
	m	ft	3.280 84
	mm	in	0.039 37
	km	mi	0.621 371
Mass kilogram (kg)	ounce-mass (ozm)	kg	0.028 349 52
	pound-mass (lb m)	kg	0.453 592 4
	ton (long, 2240 lb m)	kg	1 016.047
	ton (short) 2000 lb m)	kg	907.184 7
	kg	lb m	2.204 6
Mass/Volume or Density kilogram/meter ³ (kg/m ³)	pound-mass/ foot ³ (lb m/ft ³)	kg/m ³	16.018 46
	pound-mass/inch ³ (lb m/in ³)	kg/m ³	27 679.90
	kg/m ³	lb m/ft ³	0.062 428

FREQUENTLY USED CONVERSIONS

TABLE M2-3 (Continued on next page)



M2.7 (Continued)

MEASUREMENT	TO CONVERT		
	FROM	TO	MULTIPLY BY
Power watt (W)	Btu per hour (Btu/hr) foot-pound-force/second * horsepower (550 ft lb f/s) W W *(ftlb f/s)	W W W Btu hr ftlb f/s	0.293 071 1.355 82 745.699 9 3.412 14 0.737 56
Pressure or Stress Force/Area = Pascal(Pa)	kilogram-force/centimeter ² (kgf/cm ²) kilogram-force/meter ² (kgf/m ²) kilogram-force/millimeter ² (kgf-force/mm ²) pound-force foot ² .(lb f/ft ²) pound-force /inch ² (psi) Mpa Mpa	Pa Pa Pa Pa Pa kgf/mm ² psi	98 066.50 9.806 650 9 806 650. 47.880 26 6 894.757 0.101 972 145.037 745
Temperature Kelvin (K)	degree Celsius (°C) degree Fahrenheit (°F) degree Fahrenheit (°F) K °C K	K K °C °C °F °F	tK = tC+273.15 tK=(tF+459.67)/1.8 tC=(tF-32)/1.8 tC=tK-273.15 tF=(1.8) tC+32) tF=1.8 (tK-273.15)+32
Velocity or Speed meters/second	foot/second (ft/s) Kilometer hour (km/h) mile/hour (mph) mile/hour (mph) m/s kph	m/s m/s m/s km/h ft/s mph	0.304 8 0.277 778 0.447 040 1.609 3 3.280 8 0.621 4
Volume meter ³ (m ³)	foot ³ (ft ³) Gallon (U.S. liquid) (gal) inch ³ (in ³) liter (L) yard ³ (yd ³) liter (L) m ³ quart (U.S. liquid) (qt) gal	m ³ m ³ m ³ m ³ m ³ qt yd ³ l l	0.028 316 8 0.003 785 412 0.000 016 387 0.001 000 0.764 555 1.056 688 1.307 951 0.946 353 3.785 412
Volume/Time meter ³ /second (m ³ /s)	foot ³ /minute (ft ³ /min) foot ³ /minute (ft ³ /s) m ³ /s	m ³ /s m ³ /s ft ³ /s	0.000 47 0.028 317 35.314 475

FREQUENTLY USED CONVERSIONS

TABLE M2-3 (Continued from previous page)



51	23.5	151	68.5	251	114.0	351	159.5	451	205.0	551	250.0	651	295.5	751	341.5	851	386.5	951	431.5
52	24.0	152	69.0	262	114.5	352	160.0	452	205.5	552	250.5	652	296.0	752	341.5	852	386.5	952	432.0
53	24.5	153	69.5	253	115.0	353	160.5	453	205.5	553	251.0	653	296.5	753	342.0	853	387.0	953	432.5
54	24.5	154	70.0	254	115.5	354	161.0	454	206.0	554	251.5	654	297.0	754	342.5	854	387.5	954	433.0
55	25.0	155	70.5	255	116.0	355	161.5	455	206.5	555	252.0	655	297.5	755	343.0	855	388.0	955	433.5
56	25.5	156	71.0	256	116.5	356	162.0	456	207.0	556	252.5	656	298.0	756	343.0	856	388.5	956	434.0
57	26.0	157	71.5	257	117.0	357	162.5	457	207.5	557	253.0	657	298.5	757	343.5	857	389.0	957	434.5
58	26.5	158	72.0	258	117.5	358	162.5	458	208.0	558	253.5	658	298.5	758	344.0	858	389.5	958	435.0
59	27.0	159	72.5	259	117.5	359	163.0	459	208.0	559	254.0	659	299.0	759	344.0	859	390.0	959	435.0
60	27.5	160	73.0	260	118.0	360	163.5	460	209.0	560	254.5	660	299.5	760	345.0	860	390.5	960	435.5
61	28.0	161	73.5	261	118.5	361	164.0	461	209.5	561	254.5	661	300.0	761	345.5	861	391.0	961	436.0
62	28.5	162	73.5	262	119.0	362	164.5	462	210.0	562	255.0	662	300.5	762	346.0	862	391.5	962	436.5
63	29.0	163	74.0	263	119.5	363	165.0	463	210.5	563	255.5	663	301.0	763	346.5	863	391.5	963	437.0
64	29.5	164	74.5	264	120.0	364	165.5	464	210.5	564	256.0	664	301.5	764	347.0	864	392.0	964	437.5
65	29.5	165	75.0	265	120.5	365	166.0	465	211.0	565	256.5	665	302.0	765	347.5	865	392.5	965	438.0
66	30.0	166	75.5	266	121.0	366	166.5	466	211.5	566	257.0	666	302.5	766	348.0	866	393.0	966	438.5
67	30.5	167	76.0	267	121.5	367	166.5	467	212.0	567	257.5	667	303.0	767	348.0	867	393.5	967	439.0
68	31.0	168	76.5	268	122.0	368	167.0	468	212.5	568	258.0	668	303.5	768	348.5	868	394.0	968	439.5
69	31.5	169	77.0	269	122.5	369	167.5	469	213.0	569	258.5	669	304.0	769	349.0	869	394.5	969	440.0
70	32.0	170	77.5	270	122.5	370	168.0	470	213.5	570	259.0	670	304.0	770	349.5	870	395.0	970	440.0
71	32.5	171	78.0	271	123.0	371	168.5	471	214.0	571	259.5	671	304.5	771	350.0	871	395.5	971	440.5
72	33.0	172	78.5	272	123.5	372	169.0	472	214.5	572	259.5	672	305.0	772	350.5	872	396.0	972	441.0
73	33.5	173	78.5	273	124.0	373	169.5	473	215.0	573	260.0	673	305.5	773	351.0	873	396.0	973	441.5
74	34.0	174	79.0	274	124.5	374	170.0	474	215.5	574	260.5	674	306.0	774	351.5	874	396.5	974	442.0
75	34.5	175	79.5	275	125.0	375	170.5	475	215.5	575	261.0	675	306.5	775	352.0	875	397.0	975	442.5
76	34.5	176	80.0	276	125.5	376	171.0	476	216.0	576	261.5	676	307.0	776	352.0	876	397.5	976	443.0
77	35.0	177	80.5	277	126.0	377	171.5	477	216.5	577	262.0	677	307.5	777	352.5	877	398.0	977	443.5
78	35.5	178	81.0	278	126.5	378	171.5	478	217.0	578	262.5	678	308.0	778	353.0	878	398.5	978	444.0
79	36.0	179	81.5	279	127.0	379	172.0	479	217.5	579	263.0	679	308.0	779	353.5	879	399.0	979	444.5
80	36.5	180	82.0	280	127.5	380	172.5	480	218.0	580	263.5	680	308.5	780	354.0	880	399.5	980	445.0
81	37.0	181	82.5	281	127.5	381	173.0	481	218.5	581	264.0	681	309.0	781	354.5	881	400.0	981	445.0
82	37.5	182	83.0	282	128.0	382	173.5	482	219.0	582	264.0	682	309.5	782	355.0	882	400.5	982	445.5
83	38.0	183	83.5	283	128.5	383	174.0	483	219.5	583	264.5	683	310.0	783	355.5	883	401.0	983	446.0
84	38.5	184	83.5	284	129.0	384	174.5	484	220.0	584	265.0	684	310.5	784	356.0	884	401.0	984	446.5
85	39.0	185	84.0	285	129.5	385	175.0	485	220.0	585	265.5	685	311.0	785	356.5	885	401.5	985	447.0
86	39.5	186	84.5	286	130.0	386	175.5	486	220.5	586	266.0	686	311.5	786	357.0	886	402.0	986	447.5
87	39.5	187	85.0	287	130.5	387	176.0	487	221.0	587	266.5	687	312.0	787	357.0	887	402.5	987	448.0
88	40.0	188	85.5	288	131.0	388	176.0	488	221.5	588	267.0	688	312.5	788	357.5	888	403.0	988	448.5
89	40.5	189	86.0	289	131.5	389	176.5	489	222.0	589	267.5	689	313.0	789	358.0	889	403.5	989	449.0
90	41.0	190	86.5	290	132.0	390	177.0	490	222.5	590	268.0	690	313.0	790	358.5	890	404.0	990	449.5
91	41.5	191	87.0	291	132.0	391	177.5	491	223.0	591	268.5	691	313.5	791	359.0	891	404.5	991	450.0
92	42.0	192	87.5	292	132.5	392	178.0	492	223.5	592	269.0	692	314.0	792	359.5	892	405.0	992	450.0
93	42.5	193	88.0	293	133.0	393	178.5	493	224.0	593	269.0	693	314.5	793	360.0	893	405.5	993	450.5
94	43.0	194	88.0	294	133.5	394	179.0	494	224.5	594	269.5	694	315.0	794	360.5	894	406.0	994	451.0
95	43.5	195	88.5	295	134.0	395	179.5	495	225.0	595	270.0	695	315.5	795	361.0	895	406.5	995	451.5
96	44.0	196	89.0	296	134.5	396	180.0	496	225.0	596	270.5	696	316.0	796	361.5	896	407.0	996	452.0
97	44.0	197	89.5	297	135.0	397	180.5	497	225.5	597	271.0	697	316.5	797	362.0	897	407.5	997	452.5
98	44.5	198	90.0	298	135.5	398	181.0	498	226.0	598	271.5	698	317.0	798	362.5	898	408.0	998	453.0
99	45.0	199	90.5	299	136.0	399	181.0	499	226.5	599	272.0	699	317.5	799	363.0	899	408.5	999	453.5
100	45.5	200	91.0	300	136.5	400	181.5	500	227.0	600	272.5	700	318.0	800	363.0	900	408.5	1000	454.0

POUNDS INTO KILOS
WEIGHT CONVERSION
TABLE M2-4



NOTES: