

Useful Figures

THE EARTH

DIMENSIONS

Equatorial diameter	7,926.677 st. mi.
Polar diameter (axis)	7,899.988 st. mi.
Difference in diameters	26.689 st. mi.
<i>This difference is 1/297th of the greater diameter.</i>	
Mean diameter (for rough scaling)	ab. 500,000,000 in.
Equatorial circumference	24,902 st. mi.
Meridional circumference	24,860 st. mi.
Area	ab. 198,950,000 sq. mi.
Curvature of surface	ab. .7 ft. in 1 mi.
Difference between arc and chord length	.02 ft. in 11½ mi.

TERRESTRIAL ARCS

DEGREES

360° = a full circle
360° = 21,600' = 1,296,000"
180° = a semi-circle
90° = a quadrant
60° = a sextant
45° = an octant
1° = 60 minutes
60" = 1 minute

RELATION OF ARCS TO TIME

In 24 hr. the earth turns 360°
In 1 hr. the earth turns 15°
In 4 min. the earth turns 1°
In 1 min. the earth turns 15" <i>1/4</i> th of a degree
In 1 sec. the earth turns 15" <i>1/4</i> th of a minute

LENGTHS OF ARCS IN SECONDS OF LONGITUDE

For the lengths (miles-per-degree) of east-west arcs at various latitudes, see the diagram on p. 48.

An east-west second

at Lat. 0 is 101.45 ft.	at Lat. 50 is 65.34 ft.
5 101.07	55 58.32
10 99.92	60 50.85
15 98.02	65 42.99
20 95.37	70 34.80
25 92.	75 26.34
30 87.93	80 17.88
35 83.2	85 8.87
40 77.83	90 0.
45 71.86	

THE MILITARY MIL

1 mil (as of an arc) = $\frac{1}{6400}$ of a circumference

1 mil (as of a chord) = $\frac{1}{1000}$ of a radius

*Explanation: If instead of dividing the circle into 360 equal parts, as for degrees, we divide it into 6400, we shall get the unit of angular measure known as the mil. The radius lines marking off one of those equal parts form an angle of 1 mil. They mark off on the circumference an arc of 1 mil. And the length of the chord subtending that arc is equal, practically, to 1/1000 of the radius. The word mil is derived directly from the Latin word for "thousand": mille.**

1 mil = ab. .056° or ab. 3' 22.2"

17.8 mils (ab.) = 1°

1,000 mils (or a radius) = an arc of ab. 57° 17' 44.8"

* "A mil is the angle subtended by an arc of 1 unit on a radius of 1,000 units . . ." War Department, FM 21-26, p. 20.

DISTANCE MEASURES

ENGLISH UNITS

1 rod (or pole)	= 16½ ft.
	= 5½ yd.
	= 1/320 st. mi.
1 furlong	= 660 ft.
	= 220 yd.
	= 40 rods
	= ¼ st. mi.
1 statute mile	= 63,360 in.
	= 5,280 ft.
	= 1,760 yd.
	= 320 rods
	= 8 furlongs
1 league	= 15,840 ft.
	= 5,280 yd.
	= 3 st. mi.

SURVEYOR'S, OR GUNTER'S, CHAIN

Used in U. S. public-land surveys

1 link	= 7.92 in.
	= .66 ft.
100 links	= 1 chain
1 chain	= 66 ft.
	= .0125 st. mi.
80 chains	= 1 st. mi.

ENGINEER'S CHAIN

1 link	= 1 ft.
100 links	= 1 chain
1 chain	= 100 ft.
	= .0180 st. mi.
52.80 chains	= 1 st. mi.
(52 ch. and 80 li.)	= 1 st. mi.)

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Area	ab. 196,950,000 sq. mi.
Curvature of surface	ab. .7 ft. in 1 mi.
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An east-west second		at Lat. 50 is 65.34 ft.	
at Lat. 0 is 101.45 ft.			
5	101.07	55	58.32
10	99.92	60	50.85
15	98.02	65	42.99
20	95.37	70	34.80
25	92.	75	26.34
30	87.93	80	17.88
35	83.2	85	8.87
40	77.83	90	0.
45	71.86		

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ODD LAND UNITS

- 1 arpent = ab. 186.88 ft. or ab. 11.5 rods, i.e. the length of one side of a square arpent. *Parts of Canada.*
- 1 perch = 1 rod (or pole) = 5.5 yd. *Canada, England, and U. S.*
- 1 vara = 33.33 in. *Texas. In Spanish-America, the vara varies in length from 31.5 in., in Colombia, to 43.31 in., in Brazil, which is the same legalized value it has in Portugal.*

MARITIME UNITS

- 1 fathom = 6 ft. = ab. 1/1,000 n. mi.
- 1 cable's length = 720 ft. *U. S. Navy*
= 120 fathoms *U. S. Navy*
= 608 ft. *Brit. Navy*
= ab. .10 n. mi. *Brit. Navy*
= 600 ft. *occasionally*
= 100 fathoms *occasionally*
- 1 nautical mile = 6,080.2 ft. *U. S.*
= 6,080 ft. *Brit., "Admiralty" mi.*
= 6,076.097 ft. *International Hydrographic Office*
= 1', or 1/60° of a great circle of the earth
= 1/21,600 of a great circle of the earth
= ab. 10 cables
= 1.1516 st. mi.
- 3 nautical miles = 1 league *marine*
- 60 nautical miles = 1°
- 66 nautical miles = 76 st. mi. (= ab. 122 kilometers)
- 1 knot = 1 n. mi. per hour
= 1.1516 st. mi. per hour (= 1.8532 kilometers per hour)

METRIC UNITS

Denomination	Value	Equivalent
1 millimeter	= 1/1000 m. = 1/10 cm.	= .039 in.
1 centimeter	= 1/100 m.	= .393 in.
1 decimeter	= 1/10 m. = 10 cm.	= 3.937 in.
1 meter (primary unit)	= 1,000 mm. = 100 cm.	= 39.37 in. or, 3.28 ft. or, 1.09 yd. or, .00062 mi.
1 decameter	= 10 m.	= 32.808 ft.
1 hektometer	= 100 m.	= 328.08 ft.
1 kilometer	= 1,000 m.	= 3,280.833 ft. or, 3,280 ft. 10 in. = .62137 st. mi. or, ab. 3/4 st. mi.
1 myriameter	= 10,000 m. = 10 km.	= 6.2137 st. mi.
1 megameter	= 1,000,000 m. = 1,000 km.	= 621.37 st. mi.

AREA MEASURES

ENGLISH UNITS

Denomination	Value	Metric Equivalent
1 sq. inch		= 6.452 sq. cm.
1 sq. foot	= 144 sq. in.	= 929 sq. cm.
1 sq. yard	= 1,296 sq. in. = 9 sq. ft.	= .8361 sq. m.
1 sq. rod, perch, or pole	= 272.25 sq. ft. = 30.25 sq. yd.	= 25.29 sq. m.
1 acre	= 43,560 sq. ft. = 4,840 sq. yd. = 160 sq. rods	= 4,047 sq. m. = 40.4687 ares = .4047 hectares

A square field of 1 acre has each of its sides about 209 ft. long.

1 sq. mile = 640. acres = 2.59 sq. km.

1 township = 36 sq. mi.

Public-land systems of U. S. and Can.

ODD UNITS

1 rood = 40 sq. rods
= .25 acre

In Eng. and Scot. In the Union of So. Africa a rood is 17.07 sq. yd., or 14.28 sq. m.

1 arpent = .84 acre = 34.2 ares.

Sometimes called the "French acre." Used in parts of Can. Appears, with variations of value, in old land deeds in parts of Ala., Fla., La., and Miss.

METRIC UNITS

Denomination	Value	Equivalent
1 centiare = 1 sq. m.		= 1,550 sq. in. = 1.196 sq. yd.
1 are = 100 sq. m.		= 119.6 sq. yd. = .0247 acre
1 hectare = 10,000 sq. m.		= 2.471 acres = 100 ares

CONVERSION FACTORS

To change one kind of measure into another only requires multiplying by the conversion factor. Suppose we are told that a certain distance is ten kilometers. How many miles is that? We first find out what the equivalent of one kilometer is in terms of miles. This is .6214 st. mi. That equivalent is also a conversion factor. So:

If 1 km. = .6214 st. mi.

10 km. = 10 × .6214 = 6.214 st. mi.

DISTANCES—METERS AND FEET

As the meter is the primary, or basic, unit for the entire metric system, a table of conversion factors in meters and in feet will work for all the different units of the metrical system. For instance, a kilometer is 1000 meters. So, to multiply a meter by 1000, simply move the decimal point three places to the right:

1 m. = 3.280833 ft.

1 km. = 3280.833 ft.

The following condensed conversion table appears in various U.S.C.G.S. publications. It is intended for use in the field, where no computing machines are available, and where the mapper wishes to make conversions quickly, "avoiding some of the labor of hand multiplication." The simple example to illustrate the use of this table is converting 24.6 ft. to meters.

20 ft. = 6.096 m. *Get this by taking the factor which is the value in meters corresponding to 2 ft., then by moving the decimal point one place to the right.*

4 ft. = 1.219 m.

.6 ft. = .183 m. *Get this by taking the value for 6 ft. and moving decimal point one place to left, and then rounding off the number.*

Sum 24.6 ft. = 7.498 m.

Meters into feet		Feet into meters	
1	3.280833	1	.3048006
2	6.561667	2	.6096012
3	9.842500	3	.9144018
4	13.123333	4	1.2192024
5	16.404167	5	1.5240030
6	19.685000	6	1.8288037
7	22.965833	7	2.1336043
8	26.246667	8	2.4384049
9	29.527500	9	2.7432055
10	32.808333	10	3.0480061

DISTANCES, MISCELLANEOUS

To change	Multiply	By factor
Millimeters to inches:	millimeters	× .03937
Inches to millimeters:	inches	× 25.4
Meters to yards:	meters	× 1.094
Yards to meters:	yards	× .9144
Meters to statute mi.:	meters	× .000621
Miles to meters:	miles	× 1609.35
Meters to nautical mi.:	meters	× .000540
Nautical mi. to meters:	nautical mi.	× 1853.25
Kilometers to statute mi.:	kilometers	× .6214
Miles to kilometers:	miles	× 1.609
Nautical to statute mi.:	nautical mi.	× 1.151553
Statute to nautical mi.:	statute mi.	× .868893

AREAS

To change	Multiply	By factor
Sq. centimeters to sq. ins.:	sq. centimeters	× .1550
Sq. ins. to sq. centimeters:	sq. inches	× 6.452
Sq. meters to sq. feet:	sq. meters	× 10.764
Sq. feet to sq. meters:	sq. feet	× .0929
Sq. meters to sq. yards:	sq. meters	× 1.196
Sq. yards to sq. meters:	sq. yards	× .8361
Hectares to acres:	hectares	× 2.471
Acres to hectares:	acres	× .4047
Sq. kilometers to sq. miles*:	sq. kilometers	× .3861
Sq. miles to sq. kilometers:	sq. miles	× 2.59

* Statute miles.

ANGLES

Degrees to mils:	degrees	× 17.8
Mils to degrees:	mils	× .056*
Percent of grade to degrees:	percent	× .573

To change degrees to percent of grade see table "Methods of Expressing Gradients," p. 252.

* 1° = 17.8 mils approximately. .056° is 3' 52".

CONVERSION OF COMPASS POINTS TO DEGREES

Angular Points		Angular measure		Angular Points		Angular measure	
<i>North to East:</i>				<i>South to West:</i>			
North	0	0		South	16	180	
N. by E.	1	11	15	S. by W.	17	191	15
NNE.	2	22	30	SSW.	18	202	30
NE. by N.	3	33	45	SW. by S.	19	213	45
NE.	4	45		SW.	20	225	
NE. by E.	5	56	15	SW. by W.	21	236	15
ENE.	6	67	30	WSW.	22	247	30
E. by N.	7	78	45	W. by S.	23	258	45
<i>East to South:</i>				<i>West to North:</i>			
East	8	90	0	West	24	270	
E. by S.	9	101	15	W. by N.	25	281	15
ESE.	10	112	30	WNW.	26	292	30
SE. by E.	11	123	45	NW. by W.	27	303	45
SE.	12	135		NW.	28	315	
SE. by S.	13	146	15	NW. by N.	29	326	15
SSE.	14	157	30	NNW.	30	337	30
S. by E.	15	168	45	N. by W.	31	348	45
				North	32	360	

A quarter point is 2° 48' 45". The quarter points proceed thus:

North—N½E—N¾E—N¾E

N. by E.—N. by E½E—N. by E¾E

and so on, around the compass. For a complete table showing all the quarter points and their values in angular measure, see American Practical Navigator by Nathaniel Bowditch, U. S. Hydrographic Office.

TOPOGRAPHIC MAP SYMBOLS

VARIATIONS WILL BE FOUND ON OLDER MAPS

Hard surface, heavy duty road, four or more lanes		Boundary: national	
Hard surface, heavy duty road, two or three lanes		state	
Hard surface, medium duty road, four or more lanes		county, parish, municipio	
Hard surface, medium duty road, two or three lanes		civil township, precinct, town, barrio	
Improved light duty road		incorporated city, village, town, hamlet	
Unimproved dirt road—Trail		reservation, national or state	
Dual highway, dividing strip 25 feet or less		small park, cemetery, airport, etc.	
Dual highway, dividing strip exceeding 25 feet		land grant	
Road under construction		Township or range line, U.S. land survey	
Railroad: single track—multiple track		Township or range line, approximate location	
Railroads in juxtaposition		Section line, U.S. land survey	
Narrow gauge: single track—multiple track		Section line, approximate location	
Railroad in street—Carline		Township line, not U.S. land survey	
Bridge: road—railroad		Section line, not U.S. land survey	
Drawbridge: road—railroad		Section corner: found—indicated	
Footbridge		Boundary monument: land grant—other	
Tunnel: road—railroad		U.S. mineral or location monument	
Overpass—Underpass		Index contour	
Important small masonry or earth dam		Intermediate contour	
Dam with lock		Supplementary contour	
Dam with road		Depression contours	
Canal with lock		Fill	
Buildings (dwelling, place of employment, etc.)		Levee	
School—Church—Cemeteries		Mine dump	
Buildings (barn, warehouse, etc.)		Tailings	
Power transmission line		Strip mine	
Telephone line, pipeline, etc. (labeled as to type)		Sand area	
Wells other than water (labeled as to type)		Perennial streams	
Tanks; oil, water, etc. (labeled as to type)		Elevated aqueduct	
Located or landmark object—Windmill		Water well—Spring	
Open pit, mine, or quarry—Prospect		Small rapids	
Shaft—Tunnel entrance		Large rapids	
Horizontal and vertical control stations		Intermittent lake	
Label, spot, bench elevation		Foreshore flat	
Label, spot, bench, park, road, level elevation		Sounding—Depth curve	
Label, spot, bench, spot, park, road, level elevation		Exposed wreck	
Label, spot, bench, spot, park, road, level elevation		Peck, bare or wash—dangerous to navigation	
Label, spot, bench, spot, park, road, level elevation		Marsh (swamp)	
Label, spot, bench, spot, park, road, level elevation		Submerged marsh	
Label, spot, bench, spot, park, road, level elevation		Wooded marsh	
Label, spot, bench, spot, park, road, level elevation		Woods (or brush) woods	
Label, spot, bench, spot, park, road, level elevation		Yard	
Label, spot, bench, spot, park, road, level elevation		Foundation area	
Label, spot, bench, spot, park, road, level elevation		House division area	