Surveying Units and Terms

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Here is our list of **units of measure, surveying terms, surveyors' slang and abbreviations, water descriptions**, and **trees**.

Home

Land Record Reference

If you don't see your favorite obscure units or terms, please let us know. We're happy to add to our list.

Units of Measure

- **Acre** - The (English) acre is a unit of area equal to 43,560 square feet, or 10 square chains, or 160 square poles. It derives from a plowing area that is 4 poles wide and a furlong (40 poles) long. A square mile is 640 acres. The Scottish acre is 1.27 English acres. The Irish acre is 1.6 English acres.
- **Arpent** - Unit of length and area used in France, Louisiana, and Canada. As a unit of length, approximately 191.8 feet (180 old French 'pied', or foot). The (square) arpent is a unit of area, approximately .845 acres, or 36,802 square feet.
- **Chain** - Unit of length usually understood to be *Gunter's chain*, but possibly variant by locale. See also *Rathbone's chain*. The name comes from the heavy metal chain of 100 links that was used by surveyors to measure property bounds.
- **Colpa** - Old Irish measure of land equal to that which can support a horse or cow for a year. Approximately an Irish acre of good land.
- **Compass** - One *toise*.
- **Cuerda** - Traditional unit of area in Puerto Rico. Equal to about .971 acres. Known as the "Spanish acre".
- **Engineer's Chain** - A 100 foot *chain* containing 100 links of one foot apiece.
- **Furlong** - Unit of length equal to 40 poles (220 yards). Its name derives from "furrow long", the length of a furrow that oxen can plow before they are rested and turned. See *Gunter's chain*.
- **Ground** - A unit of area equal to 2400 sq. ft., or 220 sq. meters, used in India.
- **Gunter's Chain** - Unit of length equal to 66 feet, or 4 poles. Developed by English polymath Edmund Gunter early in the 1600's, the standard measuring chain revolutionized surveying. Gunter's chain was 22 yards long, one tenth of a *furlong*, a common unit of length in

the old days. An area one chain wide by ten chains long was exactly an acre. In 1595 Queen Elizabeth I had the mile redefined from the old Roman value of 5000 feet to 5280 feet in order for it to be an even number of furlongs. A mile is 80 chains.

- **Hectare** - Metric unit of area equal to 10,000 square meters, or 2.471 acres, or 107,639 square feet.
- **Hide** - A very old English unit of area, a hide was of variable size depending on locale and the quality of the land. It was the amount of land to support a family, and ranged from 60 to 180 acres. After the Norman conquest in 1066 it became standardized at around 120 acres.
- **Hundred** - An adminstrative area larger than a village and smaller than a county. In England it was 100 *hides* in size, and the term was used for early settlements in Virginia, Maryland, and Delaware.
- **Labor** - The labor is a unit of area used in Mexico and Texas. In Texas it equals 177.14 acres (or 1 million square varas).
- **League (legua)** - Unit of area used in the southwest U.S., equal to 25 labors, or 4428 acres (Texas), or 4439 acres (California). Also, a unit of length-- approximately three miles.
- **Link** - Unit of length equal to 1/100 chain (7.92 inches).
- **Morgen** - Unit of area equal to about .6309 acres. It was used in Germany, Holland and South Africa, and was derived from the German word Morgen ("morning"). It represented the amount of land that could be plowed in a morning.
- **Out** - An 'out' was ten chains. When counting out long lines, the chain carriers would put a stake at the end of a chain, move the chain and put a stake at the end, and so on until they ran "out" of ten stakes.
- **Perch** - See *pole* .
- **Point** - A point of the compass. There are four cardinal points (North, South, East, West), and 28 others yielding 32 points of 11.25 degrees each. A survey line's direction could be described as a compass point, as in "NNE" (north northeast). To improve precision, the points would be further subdivided into halves or quarters as necessary, for example, "NE by North, one quarter point North". In some areas, "and by" meant one half point, as in "NE and by North".
- **Pole** - Unit of length and area. Also known as a *perch* or *rod*. As a unit of length, equal to 16.5 feet. A mile is 320 poles. As a unit of area, equal to a square with sides one pole long. An acre is 160 square poles. It was common to see an area referred to as "87 acres, 112 poles", meaning 87 and 112/160 acres.
- **Pueblo** - A Spanish grant of less than 1000 acres.
- **Rancho** - A Spanish grant of more than 1000 acres.
- **Rathbone's Chain** - A measuring *chain* two poles, or 33 feet, in length.
- **Rod** - See *pole*

- **Rood** - Unit of area usually equal to 1/4 acre.
- **Toise** - Traditional French unit of length equal to 6 old French 'pieds' or feet, or 6.4 English feet.
- **Vara** - Unit of length (the *"Spanish yard"*) used in the U.S. southwest. The vara is used throughout the Spanish speaking world and has values around 33 inches, depending on locale. The legal value in Texas was set to 33 1/3 inches early in the 1900's.
- **Virgate** - An old English unit of area, equal to one quarter of a *hide*. The amount of land needed to support a person.

Standard Surveying Terms

- **Aliquot** - The description of fractional section ownership used in the U.S. public land states. A parcel is generally identified by its *section*, *township*, and *range*. The aliquot specifies its precise location within the section, for example, the northwest quarter of the southeast quarter.
- **Auditor's map** - was made by the County Surveyor at the request of the auditor for tax purposes. Many were made in the 1800's. Very little field work was done. The map was created bu the use of various documents, piecing together other surveys, a few rough measurements in the field, etc. Generally, not accurate.
- **Azimuth** - The number of degrees from north (or other reference direction) that a line runs, measured clockwise.
- **Baseline** - In the U.S. Public land surveying system, a surveyed east-west (i.e. latitudinal) reference line, often hundreds of miles in length, from which *tiers* of *townships* are are surveyed to the north and south. There are approximately two dozen baselines in the lower 48 states. See also *meridian*.
- **Bearing** - See *azimuth*. Bearings taken with a compass will be referenced to magnetic north unless otherwise noted.
- **Benchmark** - A survey mark made on a *monument* having a known location and elevation, serving as a reference point for surveying.
- **Call** - Any feature, landmark, or measurement called out in a survey. For example, "two white oaks next to the creek" is a call. So is "North 3 degrees East 120 poles".
- **Chain carrier** - An assistant to the surveyor, the chain carriers moved the surveying chain from one location to another under the direction of the surveyor. This was a position of some responsibility, and the chain carriers took an oath as "sworn chain carriers" that they would do their job properly.
- **Chord** - The straight line connecting the end points of an arc.

- **Condition** - See *Conditional line*.
- **Conditional line** - An agreed line between neighbors that has not been surveyed, or which has been surveyed but not yet granted.
- **Corner** - The beginning or end point of any survey line. The term corner does not imply the property was in any way square.
- **Declination** - The difference between magnetic north and geographic (true) north. Surveyors used a compass to determine the direction of survey lines. Compasses point to magnetic north, rather than true north. This declination error is measured in degrees, and can range from a few degrees to ten degrees or more. Surveyors may have been instructed to correct their surveys by a particular declination value. The value of declination at any point on the earth is constantly changing because the location of magnetic north is drifting. More information about historical values of declination is available.
- **First station** - See *Point of Beginning*
- **Flag** - A bright plastic ribbon tied to a lath stake. Used to mark points along a survey line.
- **Gore** - A thin triangular piece of land, the boundaries of which are defined by surveys of adjacent properties. Loosely, an overlap or gap between properties. See also *strip*.
- **Landmark** - A survey mark made on a 'permanent' feature of the land such as a tree, pile of stones, etc.
- **Line Tree** - Any tree that is on a property line, specifically one that is also a corner to another property.
- **Merestone** - A stone that marks a boundary. See *monument*.
- **Meridian** - In the U.S. public land surveying system, a surveyed north-south (i.e. longitudinal) reference line, often hundrends of miles in length, from which *ranges* are surveyed to the east and west. There are approximately two dozen meridians in the lower 48 states. See also *baseline*.
- **Mete** - In the context of surveying, a measure, i.e. the direction and distance of a property line.
- **Metes and Bounds** - An ancient surveying system that describes the perimeter of a parcel of land in terms of its bearings and distances and its relationship to natural features and adjacent parcels.
- **Monument** - A permanently placed survey marker such as a stone shaft sunk into the ground.
- **Open line** - A survey line, usually the final one, that is not measured and marked (blazed) by the surveyor but is instead calculated.
- **Point of Beginning** - The starting point of the survey
- **Point of intersection** - The point where two non-parallel lines intersect. More specifically, the point where two tangents to a curved line intersect.

- **Plat** - A drawing of a parcel of land. More specifically, the drawing created by the surveyor that shows the field work, with bearings, distances, etc.
- **Plot plan** - A diagram showing the proposed or existing use of a specific parcel of land.
- **Protraction** - in the rectangular survey system, the representation of a boundary or corner not run, marked, or fixed by the field survey as evidenced by the field notes. For example, a surveyed section might be protracted into lots by someone in the office.
- **Quarter corner** - in the public land surveying system, a point halfway between the corners of a *section*. A section can be divided into four equal quarters by connecting its quarter corner points. A section's quarter corners are identified by the section line they are located on (north, south, east, west).
- **Range** - In the U.S. public land surveying system, a north-south column of *townships*, identified as being east or west of a reference longitudinal *meridian*, for example, Range 3 West. See *township*.
- **Searles Spiral** - A surveying technique used by railroad surveyors in the the late 1800s and early 1900s whereby they approximate a spiral by use of multiple curved segments.
- **Section** - In the U.S. public land surveying system, an area one mile square. See *aliquot*.
- **Strip** - A rectangular piece of land adjoining a parcel, created when a resurvey turns up a tiny bit larger than the original survey. The difference is accounted for by temperature or other effects on measuring chains. See also *gore*.
- **Tangent line** - A line that touches a circle at exactly one point and which makes a right angle with the circle's radius. For example, a circle that fills a square has four tangent points and the square's sides are tangent lines. An arc (curve) in a survey is part of a larger circle. One can construct tangent lines at the end points of the arc.
- **Tie line** - A survey line that connects a point to other surveyed lines.
- **Tier** - In the U.S. public land surveying system, an east-west row of *townships* identified as being north or south of a latitudinal *baseline*.
- **Total station** - A survey instrument that combines a theodolite and distance meter.
- **Township** - In the U.S. public land surveying system, an area six miles square, containing 36 *sections*. The townships are organized in *tiers* and *ranges*, identified with respect to a *baseline* and *meridian*. For example, Township 13 North Range 6 West describes a township's location.
- **Traverse** - 1) any line surveyed across a parcel, 2) a series of such lines connecting a number of points, often used as a base for triangulation.

- **Trocha** - Spanish for 'path'. In the southeast U.S. it is used for a cut or cleared survey line.
- **Witness Tree** - Generally used in the U.S. public land states, this refers to the trees close to a section corner. The surveyor blazed them and noted their position relative to the corner in his notebook. Witness trees are used as evidence for the corner location.
- **Zenith angle** - An angle measured from a vertical reference. Zero degrees is a vertical line pointing up, 90 degrees is horizontal, and 180 degrees is straight down.

Surveyors' Slang

Surveying, like any profession, has its special terms and slang. Some are just humorous, some help distinguish similar sounds (e.g. eleven and seven), and some are just plain strange!

- **Balls** - Slang for numeric .00, as in 4-balls (4.00)
- **Beep** - Verb. To use a magnetic detector to look for iron pipe, etc.
- **Blood** - To slowly raise the levels rod in order that the instrument man can read the foot markings.
- **Boot** - To raise the levels rod some number of inches so as to be visible to the instrument man, e.g. "Boot 6!" means "raise it 6 inches."
- **Blue topping** - In road or grading work the surveyor sets stakes and paints their tops blue to represent the required elevation. Graders then work to just cover the blue tops of the stakes.
- **Box** - Data collector.
- **Bug** - To use a magnetic locator to search for an iron pipe.
- **Bullseye** - Zero degrees of inclination.
- **Burn** - See *shoot*
- **Burn one** - Measure from the one foot mark on the tape rather than from the end of the tape in order to increase the accuracy of the measurement.
- **Bust** - Closure error, i.e. the amount by which the survey fails to perfectly close.
- **Cap** - A metal or plastic cover on the end of a rebar or pipe, typically stamped or printed with the surveyor's license number or other identifier.
- **Cut line** - To clear vegetation for a line of sight between two survey control points.
- **Double nickel** - Slang for .55, as in 6-double nickel (6.55)
- **Dummy or dummy-end** - The base or zero end of a tape or chain, as

in "hold dummy at the face of the curb."

- **Dump** - Download data from the data collector.
- **EDM** - Electromagnetic Distance Measurement device, the instrument used by modern surveyors that replaces the use of measurement chains. It determines distance by measuring the time it takes for laser light to reflect off a prism on top of a rod at the target location.
- **Ginney** - A wooden dowel 6-9 inches in length with a sharpened end. Set in the ground to mark survey points.
- **Glass** - The *EDM* prism.
- **Gun** - Originally, a transit, but potentially any measurement instrument in use, e.g. theodolite, *EDM*, or Total Station.
- **Hours** - Degrees
- **Hub and Tack** - A 2" by 2" stake that is set in the ground and that contains a nail ("tack") that precisely marks the point being set.
- **Jigger** - Transit (Australia and New Zealand)
- **Legs** - Tripod
- **Pogo** - Prism pole
- **Pole** - Approximate unit of measure (about 0.1 foot) used for stake out, e.g. "Move a pole to the left and drive that hub in"
- **Punk** - See *railroad*.
- **Railroad** - Slang for eleven, as in 42-railroad (42.11)
- **Rodman** - The person holding the rod with the *EDM* prism. This person is the modern version of a chain carrier or chain man.
- **Shoot** - Measure distance with an *EDM*
- **Spike** - Usually a 60 penny nail used to mark survey points in hard ground.
- **Stob** - In the southeast U.S., a wooden stake or post, but in modern surveying, a piece of rebar used to mark a property boundary.
- **Tie** - To locate something with the transit or other measuring device.
- **Top** - Slang for eleven. See *railroad*.
- **Trip** - Slang for triple digits, as in trip5 means 555, and 43trip7 means 43.777
- **Turn** - The rodman is told to stay in place while the gun or level is moved to a new location.
- **Wave** - To slowly move the levels rod back and forth in order to confirm that a measurement was made when the rod was truly vertical.
- **Zero** - Zero degrees, minutes, and seconds. A perfect zero.

Surveyors' Abbreviations

You might find the following corner descriptions on a plat drawing.

- **B.R.L.** - Building restriction line.
- **CIP** - Capped iron pin
- **EIP** - Existing iron pipe
- **FD** - Found
- **IPF** - Iron pipe found
- **IRF** - Iron rod found
- **L.O.D.** - Limit of Disturbance. The area to be cleared, graded, etc.
- **LS** - Licensed Surveyor #
- **MAG** - New concrete nails are magnetic nails and are stamped with MAG on the head and are easier to find with metal detectors.
- **N/F** - Now or formerly
- **NPP** - Nail in power pole
- **NTCFP** - Nail on top of corner fence post
- **NTFP** - Nail on top of fence post
- **PI** - *Point of intersection*
- **PK** - Point Known, *PK nail*
- **PK nail** - A concrete nail made by Parker Kaelon, stamped PK, that marks a survey point. See also *hub and tack*.
- **R/C** - Rod and cap, or rebar and cap
- **R/W** - Right of way
- **SR** - Steel rebar
- **SRS** - Steel rod set (rebar or other steel)
- **WC** - Witness corner

Water Terms

- **Arroyo** - A small steep-walled (usually) dry watercourse with a flat floor. A gulch or gully. Chiefly in the U.S. southwest.
- **Bank** - Edge of a stream.
- **Bed and banks** - For property lines that cross a body of water, this term is used to explicitly refer to the bottom of the water.
- **Bottom** - Land along a river.
- **Branch** - Small stream.
- **Brook** - Small stream.
- **Creek** - Small stream.
- **Drain** - Small dry stream or gully.
- **Draughts of** - (pronounced drafts). See *waters of*.

- **Drean** - See *drain*.
- **Ford** - Shallow part of a stream or river where one could cross.
- **Fork** - Meeting point of two streams. "In the fork of" means between two branches.
- **Gut** - A narrow passage between hills. A stream in such a passage. A *drain*.
- **Head** - The *source* of a stream.
- **Headwaters** - The smallest streams that combine to make a larger stream.
- **Kill** - (Dutch) Creek.
- **Lower** - Toward the mouth of a stream. Further down along its course. Opposite of *upper*.
- **Meander** - "with the meanders of the stream" means the survey line follows the twists and turns of the stream.
- **Mouth** - The place where a stream enters another, larger stream.
- **Narrows** - Narrow part of a stream.
- **River** - Large stream.
- **Run** - Small stream.
- **Shoal** - Shallows.
- **Spring** - A pool or other source of water that feeds a stream.
- **Swamp** - In the southeastern U.S., a stream, particularly one that has has swampy parts. A marsh.
- **Thalweg** - 1. An imaginary line connecting the lowest points of a valley. 2. The line connecting the lowest points of a stream's channel. 3. The surface midline of a channel.
- **Thread** of a creek. A figurative expression used to signify the center line of the main channel of a stream when the flow rate is low.
- **Upper** - Toward the head of a stream. Further up along its course. Opposite of *lower*.
- **Vly** - (Dutch) Swampy lowland.
- **Waters ("watters") of** - In the drainage of. On the branches of.

Trees

- **Alder** -
- **Ash** - has tough, straight-grained wood
- **Aspen** - a type of *poplar*
- **Basswood** - see *linden*
- **Beech** - smooth gray bark and small edible nuts

- **Birch**, (burch) -
- **Black gum** - see *tupelo*
- **Blackjack** - a type of small *oak*
- **Black oak** -
- **Black walnut** -
- **Box elder** -
- **Box oak** -
- **Buckeye** -
- **Buffaloberry** -
- **Cedar** -
- **Cherry** -
- **Chestnut** - American chestnut has been virtually destroyed by blight.
- **Chestnut oak** - has leaves resembling a chestnut
- **Chittamwood** - see *Wooly Bumelia*
- **Cottonwood** -
- **Dogwood** -
- **Elder** -
- **Elm** -
- **Fir** -
- **Gum** - subtypes: black, sweet
- **Hackberry** - has cherry-like fruit
- **Hawthorn** -
- **Hazel** -
- **Hemlock** -
- **Hickory**, hiccory, hickry - has edible nuts and hard wood
- **Hornbeam** - has hard, heavy wood
- **Ironwood** - see *hornbeam*
- **Juniper** -
- **Larch** -
- **Laurel** -
- **Lightwood** - highly resinous pine, suitable for stakes
- **Live oak** -
- **Lowerwood** - transcription error for *sourwood*
- **Maple**, (maypole)
- **Mountain birch** -
- **Oak**, (oake) - subtypes: black, box, chestnut, live, pin, post, red, scrub, shrub, Spanish, swamp white, white
- **Pawpaw** -
- **Persimmon** - has plum-like fruit
- **Pine** -

- **Pin oak** -
- **Pohiccory** - see *hickory*
- **Ponderosa pine** -
- **Poplar**, popular -
- **Post oak** - wood used for posts
- **Red cedar** -
- **Red oak** -
- **Sapling**, (saplin) - young tree
- **Sassafras** - bark used in medicines and beverages
- **Scrub oak** - usually found in dry, rocky soil
- **Serviceberry** - (sarvisberry)
- **Sour gum** - see *tupelo*
- **Sourwood** - sorrel tree
- **Spanish oak** -
- **Spruce** -
- **Sugar tree** - sugar maple
- **Sumac** - (shumac)
- **Swamp white oak** - heavy, hard wood used in shipbuilding, furniture, etc.
- **Sweet gum** - hard reddish brown wood used for furniture
- **Sycamore** -
- **Tamarack** - an American larch having reddish brown bark
- **Tamarisk** - small shrub found in the southwest
- **Tupelo** -
- **Walnut** - black
- **White oak** -
- **Wooly Bumelia** - leaves resemble a live oak with a fine fur-like fuzz on the underside.
- **Yew** -

Sources

You can find definitions for most of these units, terms, and words in any good unabridged dictionary. There are also books dealing with units of measure and surveying.

- Wm. Johnston, "For Good Measure".
- Untitled. Book listing State and Federal Laws relating to measures.
- Funk & Wagnall's Unabridged Dictionary, 1963

- Webster's Unabridged Dictionary, 1959
- Oxford English Dictionary
- Robert's Dictionnaire de la Langue Francaise, 1979
- Discussions with Mr. Galtjo Geertsema, Land Surveyor; Ms. Patricia Law Hatcher, lecturer on land records.
- "Land and Property Research in the U.S", Wade Hone, 1997
- Contributions from surveyors.

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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.
This difference is 1/297th of the greater diameter.	
Mean diameter (for rough scaling)	ab. 500,000,000 in.
Equatorial circumference	24,902 st. mi.
Meridional circumference	24,860 st. mi.
Area	ab. 196,950,000 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′ *¼th of a degree*
In 1 sec. the earth turns 15″ *¼th 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	17.68
35	83.2	85	8.87
40	77.83	90	0.
45	71.86		

THE MILITARY MIL

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

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

*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
= ⅛ 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.)

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.	= .039 in.
	= 1/10 cm.	
1 centimeter	= 1/100 m.	= .393 in.
1 decimeter	= 1/10 m.	= 3.937 in.
	= 10 cm.	
1 meter (primary unit)	= 1,000 mm.	= 39.37 in.
	= 100 cm.	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. ⅝ st. mi.
1 myriameter	= 10,000 m.	= 6.2137 st. mi.
	= 10 km.	
1 megameter	= 1,000,000 m.	= 621.37 st. mi.
	= 1,000 km.	

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.	= .8361 sq. m.
	= 9 sq. ft.	
1 sq. rod, perch, or pole	= 272.25 sq. ft.	= 25.29 sq. m.
	= 30.25 sq. yd.	
1 acre	= 43,560. sq. ft.	= 4,047. sq. m.
	= 4,840. sq. yd.	= 40.4687 ares
	= 160. sq. rods	= .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.

1 METER = 3.2808333..... ft.

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.	× .868393

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

	Points	Angular measure °	′		Points	Angular measure °	′
North to East:				*South to West:*			
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
East to South:				*West to North:*			
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—N¼E—N½E—N¾E
N. by E.—N. by E¼E—N. by E½E

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.*