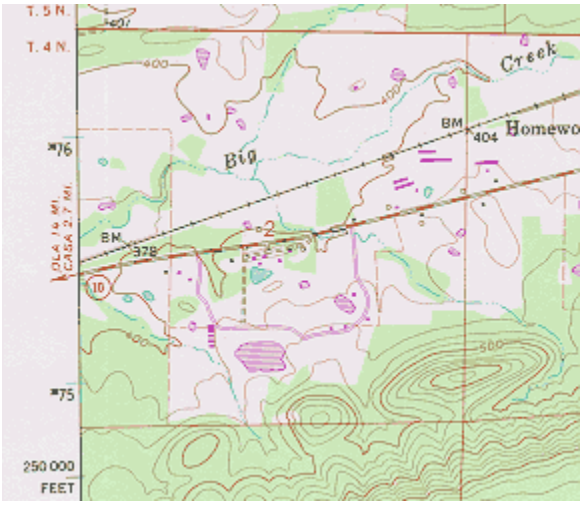
UNITED STATES

SEARCH AND RESCUE TASK FORCE

Compass Basics

Quick Map Basics Review For Compass Use



Part of a 7.5-minute topographic map at 1:24,000 scale

A topographic map tells you where things are and how to get to them, whether you're hiking, biking, hunting, fishing, or just interested in the world around you. These maps describe the shape of the land. They define and locate natural and manmade features like woodlands, waterways, important buildings, and bridges. They show the distance between any two places, and they also show the direction from one point to another.

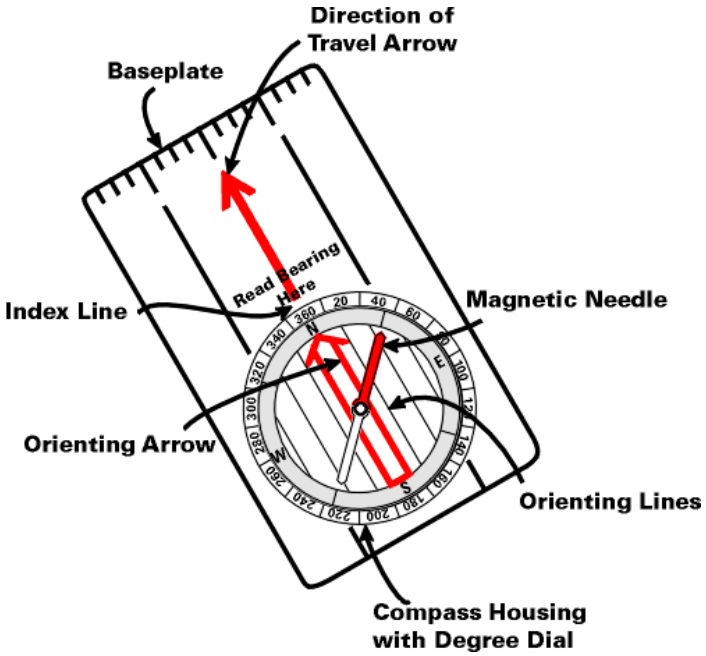
Distances and directions take a bit of figuring, but the topography and features of the land are easy to determine. The topography is shown by contours. These are imaginary lines that follow the ground surface at a constant elevation; they are usually printed in brown, in two thicknesses. The heavier lines are called index contours, and they are usually marked with numbers that give the height in feet or meters. The contour interval, a set difference in elevation between the brown lines, varies from map to map; its value is given in the margin of each map. Contour lines that are close together represent steep slopes.

Natural and manmade features are represented by colored areas and by a set of standard symbols on all U.S. Geological Survey (USGS) topographic maps. Woodlands, for instance, are shown in a green tint; waterways, in blue. Buildings may be shown on the map as black squares or outlines. Recent changes in an area may be shown by a purple overprint. a road may be printed in red or black solid or dashed lines, depending on its size and surface. A list of symbols is available from the Earth Science Information Center (ESIC).

From Here to There - Determining Direction With Compass

The compass consists of a magnetized metal needle that floats on a pivot point. The needle orients to the magnetic field lines of the earth. The basic orienteering compass is composed of the following parts:

- **Base plate**
- **Straight edge and ruler**
- **Direction of travel arrow**
- **Compass housing with 360 degree markings**
- **North label**
- **Index line**
- **Orienting arrow**
- **Magnetic needle (north end is red)**



To determine the direction, or bearing, from one point to another, you need a compass as well as a map. Most compasses are marked with the four cardinal points —north, east, south, and west—but some are marked additionally with the number of degrees in a circle (360 north is 0 or 360, east is 90, south is 180, and west is 270). Both kinds are easy to use with a little practice. The illustrations on the reverse side show how to read direction on the map.

One thing to remember is that a compass does not really point to true north, except by coincidence in some areas. The compass needle is attracted by magnetic force, which varies in different parts of the world and is constantly changing. When you read north on a compass, you're really reading the direction of the magnetic north pole. A diagram in the map margin will show the difference (declination) at the center of the map between compass north (magnetic north indicated by the MN symbol) and true north (polar north indicated by the "star" symbol). This diagram also provides the declination between true north and the orientation of the Universal Transverse Mercator (UTM) grid north (indicated by the GN symbol). The declination diagram is only representational, and true values of the angles of declination should be taken from the numbers provided rather than from the directional lines. Because the magnetic declination is computed at the time the map is made, and because the position of magnetic north is constantly changing, the declination factor provided on any given map may not be current. Contact the National Geophysical Data Center (NGDC) to obtain current and historical magnetic declination information for any place in the United States.

Taking a compass bearing from a map:

- **Draw a straight line on the map passing through your location and your destination and extending across any one of the map borders.**

- **Center the compass where your drawn line intersects the map border, align the compass axis N-S or E-W with the border line, and read on the compass circle the true bearing of your drawn line. Be careful to get the bearing in the correct sense because a straight line will have two values 180° apart. Remember north is 0, east is 90, and so on.**
- **To use this bearing, you must compensate for magnetic declination. If the MN arrow on the map magnetic declination diagram is to the right of the true north line, subtract the MN value. If the arrow is to the left of the line, add the value.**

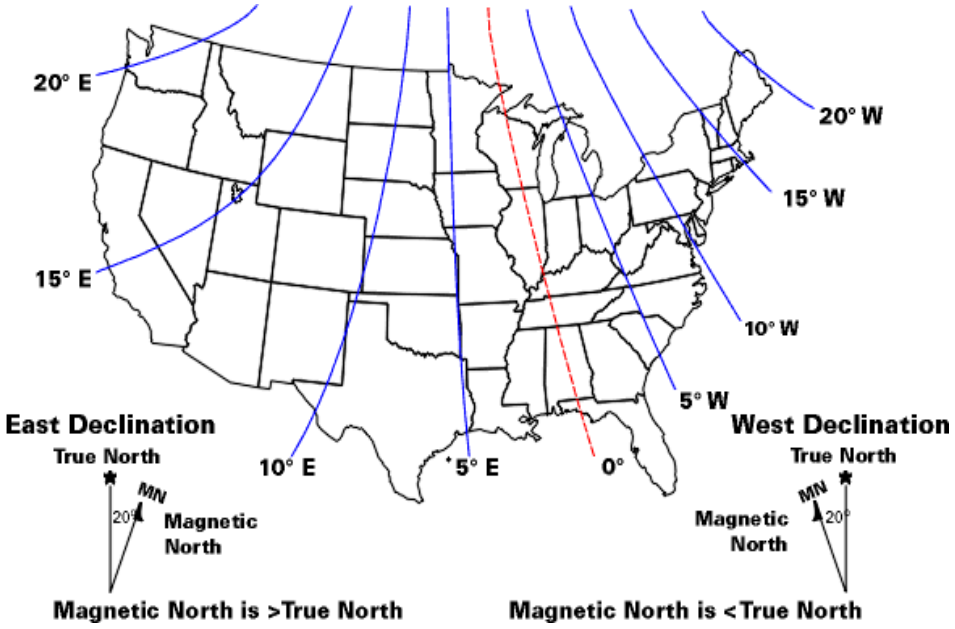
(1) Drawing a straight line over the map edge

(2) Reading the compass on the map

(3) Using the magnetic declination diagrams

What is North?

- **True North: (also known as Geographic North or Map North) is the geographic north pole where all longitude lines meet. All maps are laid out with true north directly at the top. Unfortunately for the wilderness traveler, true north is not at the same point on the earth as the magnetic north Pole which is where your compass points.**
- **Magnetic North: Think of the earth as a giant magnet (it is actually). The shape of the earth's magnetic field is roughly the same shape as the field of a bar magnet. However, the earth's magnetic field is inclined at about 11° from the axis of rotation of the earth, so this means that the earth's magnetic pole doesn't correspond to the Geographic North Pole and because the earth's core is molten, the magnetic field is always shifting slightly. The red end of your compass needle is magnetized and wherever you are, the earth's magnetic field causes the needle to rotate until it lies in the same direction as the earth's magnetic field. This is magnetic north (marked as MN on a topographic map). The picture below shows the magnetic lines for the United States. If you locate yourself at any point in the U.S., your compass will orient itself parallel to the lines of magnetic force in that area.**



Declination

You can see that location makes a great deal of difference in where the compass points. The angular difference between true north and magnetic north is known as the declination and is marked in degrees on your map. Depending on where you are, the angle between true north and magnetic north is different. In the U.S., the angle of declination varies from about 20 degrees west in Maine to about 21 degrees east in Washington. The magnetic field lines of the earth are constantly changing, moving slowly westward (½to 1 degree every five years). This is why it is important to have a recent map. An old map will show a declination that is no longer accurate, and all your calculations using that declination angle will be incorrect. As you will see, understanding this distinction becomes important when navigating with a map and a compass. More on declination below...

Which North to Use

So we have two types of north to contend with. When you look at your map, it is drawn in relation to true north;, when you look at your compass, it points to magnetic north. T to make the map and compass work together you must decide on one North as your point of reference and base all your calculations on that. As you can see the following chart, failure to take declination into account can put you way off target.

Declination or Degrees Off Course	Error Off Target after Walking 10 Miles
1°	920 feet (280meters)
5°	4,600 feet (1,402 meters)
10°	9,170 feet (2,795 meters)

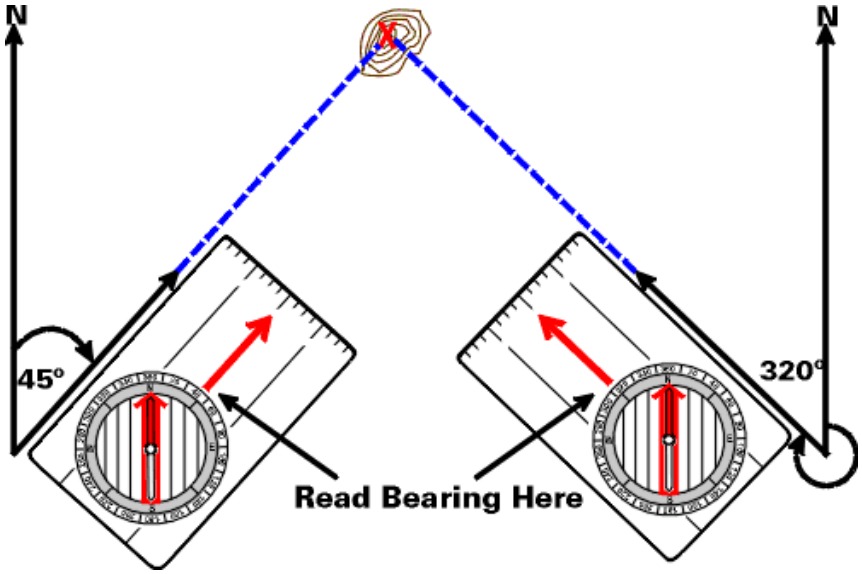
Using Map and Compass

What's your Map Declination?

The first thing you need to know is where you are in relation to magnetic north. You can find this information by looking on your map legend. If you look at a map of North America you will see the line roughly marking 0° declination. If you are on the line where the declination is 0 degrees, then you don't have to worry about any of this, since magnetic north and map north are equivalent. If you are to the right of that line, your compass will point toward the line (to the left) and hence the declination is to the west. If you are to the left of the line, your compass will point toward the line (to the right) and hence the declination is to the east.

Bearings:

The compass is used primarily to take bearings. A bearing is a horizontal angle measured clockwise from north (either magnetic north or true north) to some point (either a point on a map or a point in the real world). Bearings are used to accurately travel to a destination or to locate your position. If you are working from your map, it is called a map bearing and the angle you are measuring is the angle measured clockwise from true north on your map to this other point on the map. If you are taking a bearing off a real point on the landscape with a compass, you are using your compass to measure the angle clockwise from magnetic north to this point on the landscape. This is called a magnetic bearing. Remember that the bearing is measured clockwise. If you think of true north as 12 o'clock then a bearing to the right of that (1 o'clock) is greater than true north and a bearing to the left of True north (11 o'clock) is less than true north.



Adjusting Your Compass for the Local Declination:

Another way to deal with declination is to adjust your compass. Some compasses have an outer degree ring that can be unlocked either with a set screw or a latch. This allows you to reset the compass to account for declination. For example, if the declination were 14 degrees East, you could rotate the degree dial to the right so that the magnetic needle was pointing to 14 degrees instead of 360 degrees. Once you do this, you will no longer have to add or subtract for declination because your compass is aligned to true north. Now when the compass needle is inside the orienting needle, the compass bearing that you read off your compass will be in relation to true north instead of magnetic north. If you have a fixed-ring compass, you can mark the declination angle on the compass ring with a piece of tape.

Check Your Position Regularly

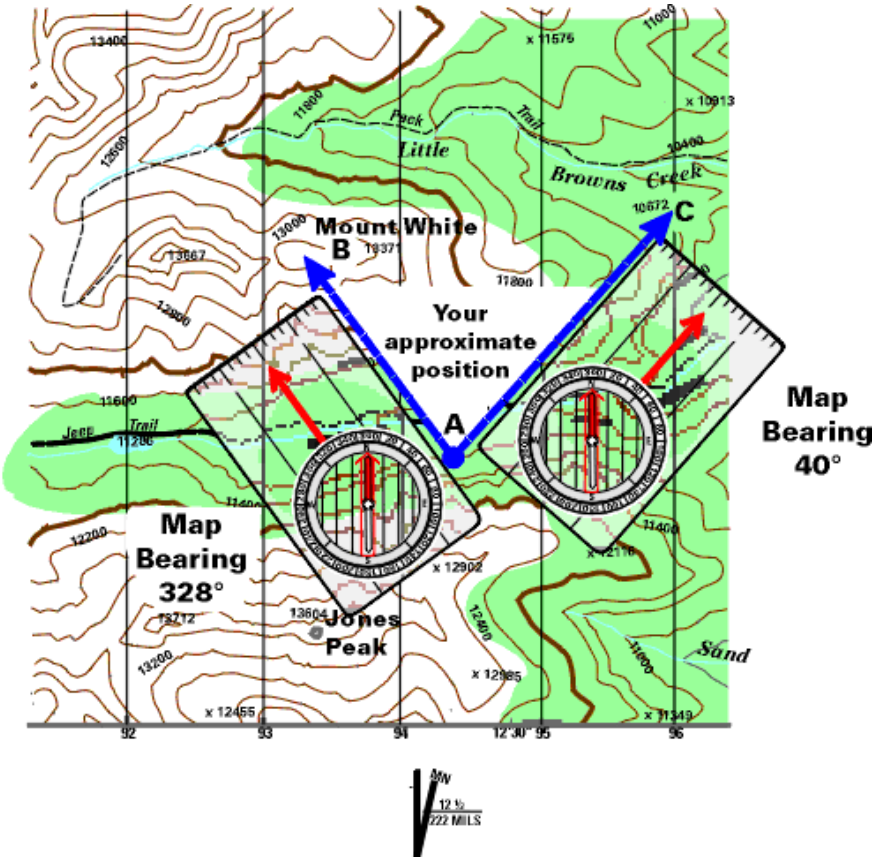
Make it a habit of keeping your map and compass handy and refer to them every hour or so to locate your position (more often in low visibility). Keep track of your starting time, rest breaks and lunch stops, and general hiking pace. This will also give you an idea of how far you have traveled.

What If You Get Lost?

Triangulation:

Triangulation is used to locate your position when two or more prominent landmarks are visible. Even if you are not sure where you are, you can find your approximate position as long as you can identify at least 2 prominent landmarks (mountain, end of a lake, bridge, etc.) both on the land and on your map.

1. **Orient the map.**
2. **Look around and locate prominent landmarks.**
3. **Find the landmarks on the map (preferably at least 90 degrees apart).**
4. **Determine the bearing of one of the landmarks.**
5. **Place the compass on the map so that one side of the base plate points toward the landmark.**
6. **Keeping the edge of the base plate on the symbol, turn the entire compass on the map until the orienting arrow and the compass needle point to north on the map.**
7. **Draw a line on the map along the edge of the base plate, intersecting the prominent landmark symbol. Your position is somewhere along this line.**
8. **Repeat this procedure for the other prominent landmark. The second landmark should be as close to 90 degrees from the first as possible. Your approximate position is where the two lines intersect.**
9. **You can repeat this process a third time to show an area bounded by three lines. You are located within this triangle.**
10. **If you are located on a prominent feature marked on the map such as a ridge, stream, or road, only one calculation from a prominent landmark should be necessary. Your position will be approximately where the drawn line intersects this linear feature.**



Compass Glossary

Here are some definitions that will make it easier to understand the compass:

- ***adjustable compass*** **- a compass whose azimuth circle can be rotated relative to the lubber's line.**
- ***azimuth circle*** **- a circular compass scale graduated in angular units: degrees, cardinal points, or other units, usually clockwise from north or 0°.**
- ***bearing*** **- the angular direction to a landmark.**
- ***boxing mark*** **- a box, arrow, line, or other mark permanently fixed to point to the N or 0° index on a compass azimuth circle. The boxing mark is usually part of the capsule. To "box" a compass, align the compass needle or card with the boxing mark, north-to-north, or with N or 0° on the azimuth circle.**
- ***capsule*** **- a sealed transparent case which houses the compass needle, the azimuth circle, and the boxing mark. The capsule may be filled with liquid to amp needle or card swinging.**
- ***card*** **- an azimuth circle mounted on a compass needle. The card rotates relative to the lubber's line.**
- ***course*** **- angular direction of travel.**
- ***fix*** **- the position indicated by the intersection of two or more lines of bearing.**
- ***landmark*** **- a recognizable real object in the terrain.**
- ***lubber's line*** **- a line or mark on the compass body that points toward the direction of travel. Simple compasses may use north or 0º on the azimuth circle as a lubber's line. On sighting compasses the sight centerline is the lubber's line.**
- ***magnetic declination*** **- easterly or westerly angular difference between the direction to the earth's geometric and magnetic poles.**
- ***magnetic inclination*** **- the vertical component of the earth's magnetic field which causes compasses needles to dip.**
- ***map object*** **- a picture or symbol used on a map to represent a landmark or other object.**
- ***needle*** **- a magnetized pointer resting on a pivot in the capsule, free to rotate relative to the lubber's line and azimuth circle.**
- ***north - grid north*****: the direction to the earth's geometric north pole along a meridian.**
- ***north - magnetic north*****: the apparent direction to the earth's magnetic north pole, not usually indicated by a grid on maps. This net magnetic north comprises all the magnetic effects acting on your compass.**
- ***true north*****: the direction to the earth's geographic north pole, indicated in life approximately by Polaris; indicated on maps by DMS scales and tick marks along the map borders.**
- ***orienteering compass*** **- an adjustable compass with special features that make it more convenient to use in the field with maps.**
- ***orienting lines*** **- visible lines in the capsule engraved parallel to the boxing mark; used as reference lines when marking angles on the map with an orienting compass.**
- ***sighting compass*** **- a compass with a mirror or peep sight aligned with the lubber's line.**

- ***simple compass*** **- a compass with the lubber's line fixed at north or 0°, and a fixed azimuth circle.**

A Word of Caution

Compass readings are also affected by the presence of iron and steel objects. Be sure to look out for—and stay away from—pocket knives, belt buckles, railroad tracks, trucks, electrical lines, and so forth when using a compass in the field.