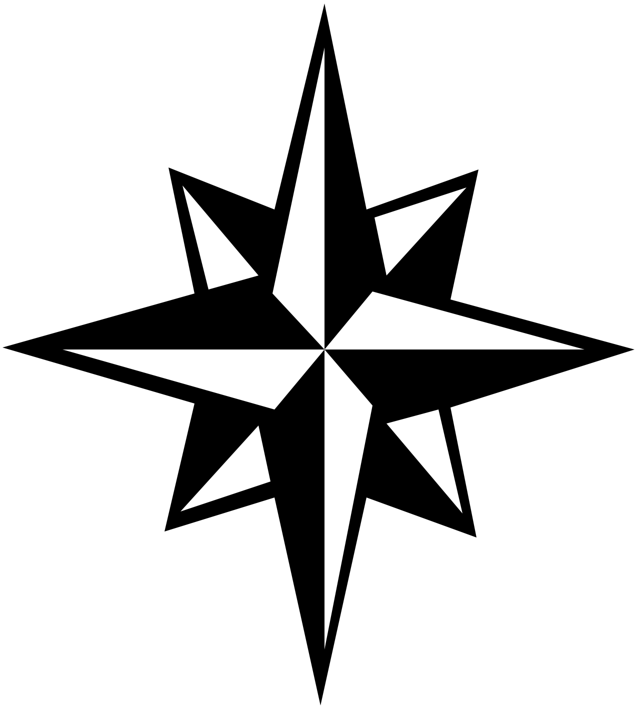
LAND NAVIGATION HANDBOOK



Marine Barracks
Washington, DC

Table Of Content

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Contents of a Map

Marginal Information

Maps are considered equipment. Before you use it you must read the instructions. These instructions are on the outer edges of the map and are called marginal information. All maps are different so examine the marginal information on each map carefully.

Marginal information includes the following (numbers in parenthesis correspond to the map numbers on the next page):

(1) Sheet Name
(2) Sheet Number
(3) Series Name
(4) Scale
(5) Series Number
(6) Edition Number
(7) Index to Boundaries
(8) Adjoining Sheets Diagram
(9) Elevation Guide
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(23) Legend
(24) Special Notes
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(26) Stock Number Identification
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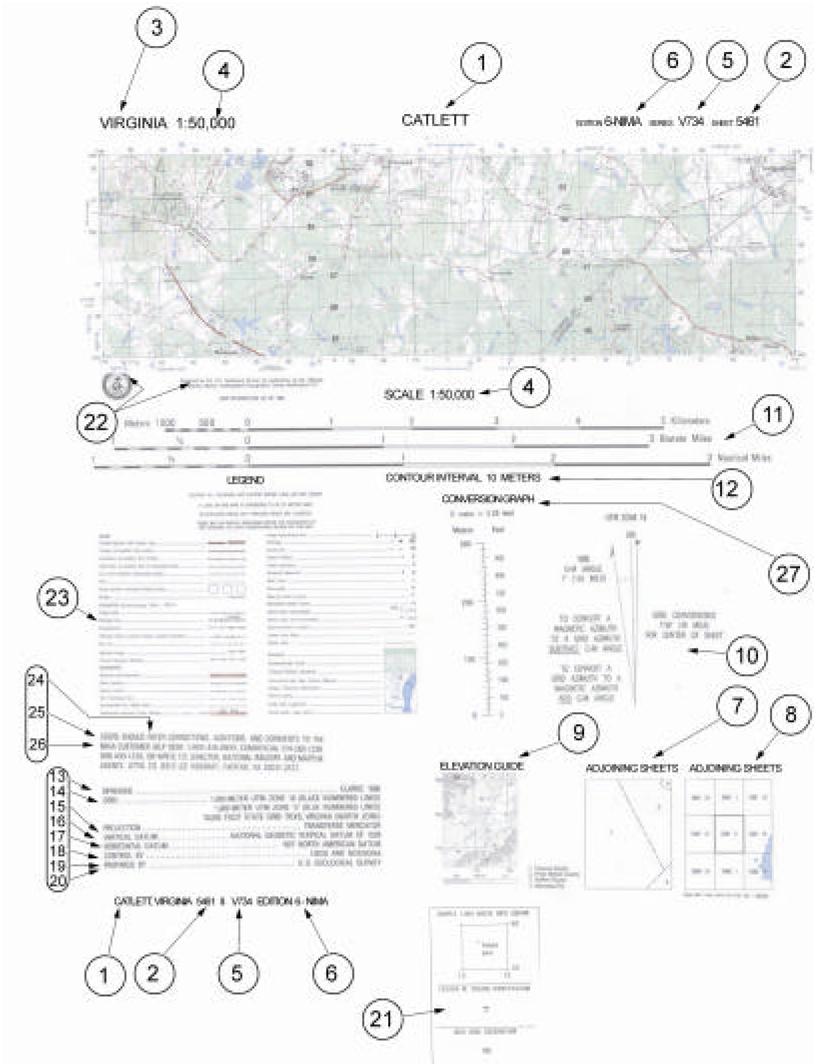

VIRGINIA 1:50,000
CATLETT
EDITION 6-NIMA SERIES V734 SHEET 5461
SCALE 1:50,000
CONTOUR INTERVAL 10 METERS
LEGEND
CONVERSION GRAPH
ELEVATION GUIDE
ADJOINING SHEETS
ADJOINING SHEETS
CATLETT VIRGINIA 5461 II V734 EDITION 6-NIMA

Colors On A Map

Black: Indicates manmade features, such as buildings and roads.

Blue: Identifies hydrographic or water features, such as lakes, swamps, rivers, and drainage.

Green: Identifies vegetation with military significance, such as woods and orchards.

Reddish-brown: On newer maps, red and brown have been combined to identify all cultural features and elevation. This color is easier to see while using a red lens flashlight.

Brown: Identifies all relief features and elevations, such as contour lines.

Red: Classifies cultural features, such as populated areas, main roads, and boundaries.

Other: Occasionally other colors may be used to show special information. These are indicated in the marginal information as a rule.

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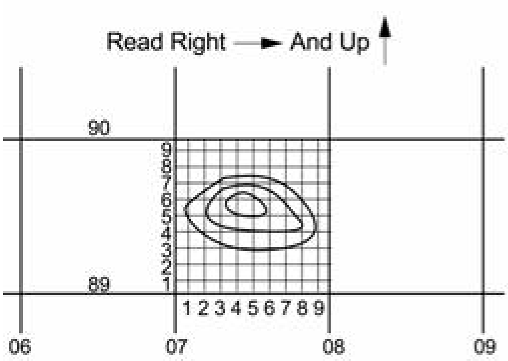
Grid System

Gridlines are a series of straight lines intersected to form a series of squares. Two digits are printed in large type at each end of the grid-lines. These numbers will be the main reference for finding your grid or location.

- Vertical grid lines run from top to bottom of the map sheet. Grid north/south.
- Horizontal grid lines run left to right of the map sheet. Grid west/east.

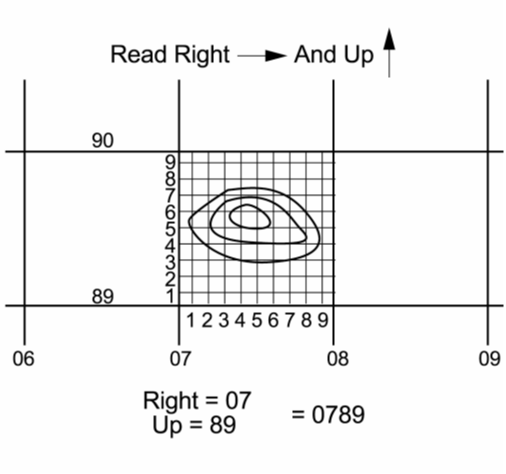
How to Read a Grid

The designation of a certain point or grid is always based on this principal. Read right then up. Always read right on the vertical grid lines, and then up on the horizontal grid lines.

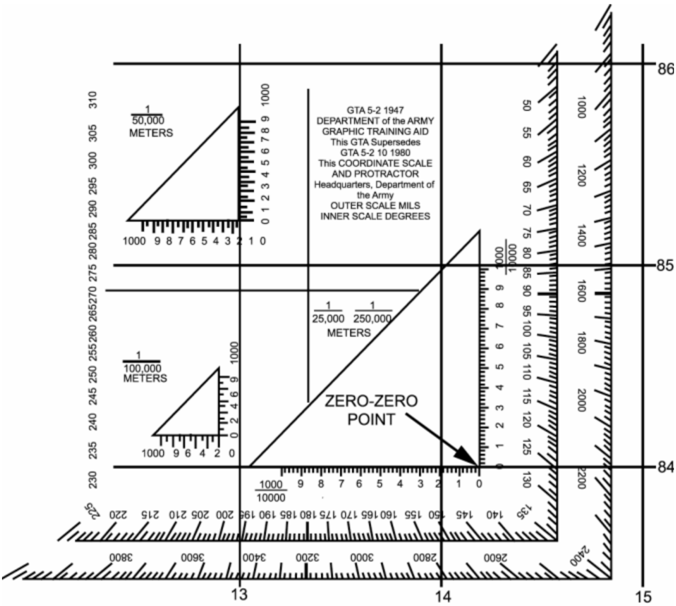


4-, 6-, and 8-Digit Grid

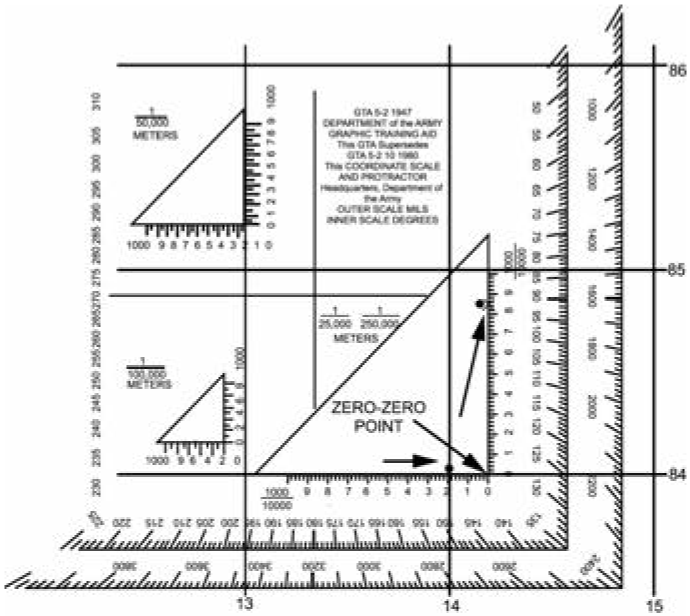
The 4-digit grid is broken down by reading right on the vertical grid lines until you come to the first two numbers of the grid. Then read up on the horizontal grid lines until you reach the second two numbers of the grid. The grid square you will be looking at will be the top right square from the intersection of the two points.



The 6-digit grid begins the same as the 4-digit grid. Then break the grid square down into 10 sections. The 3rd number will be read right and the 6th number will be read up.

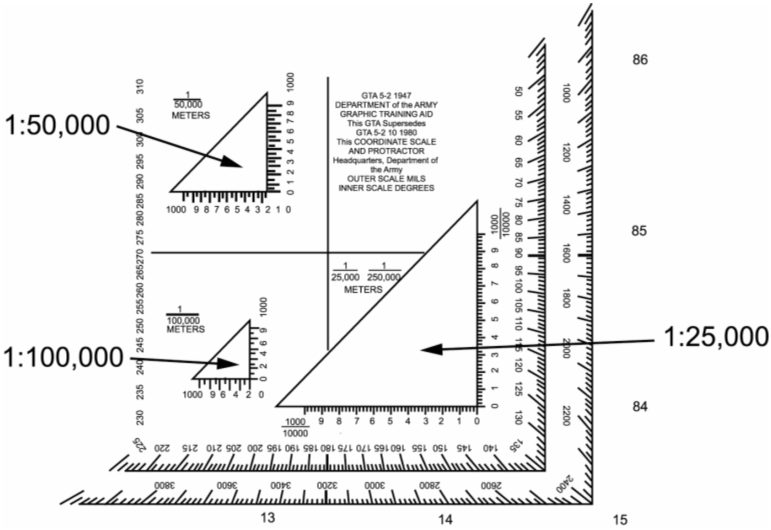


The 8-digit grid begins the same as both 4- and 6-digit grids. Using the grid square divided in ten parts, you then divide it even farther. The 4th number will be read right and estimated. The 8th number will be read up and estimated.

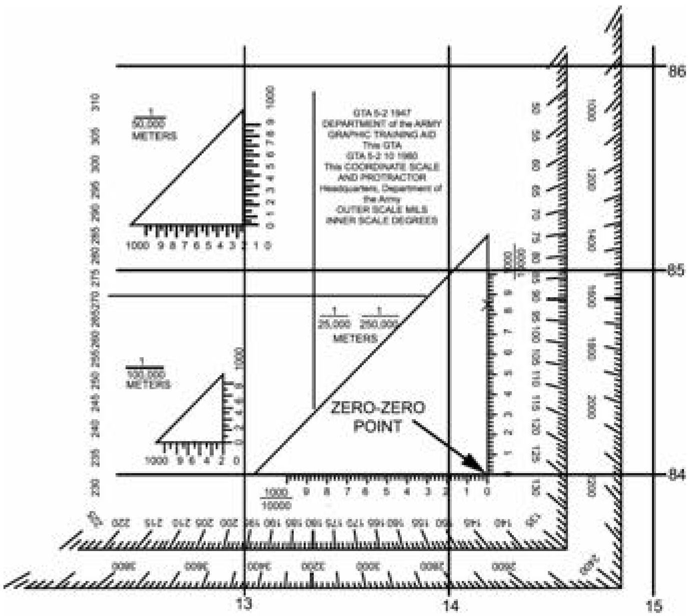


Use of the Coordinate Scale

To use the coordinate scale for determining grid coordinates, make sure that the appropriate scale is being used on the corresponding map and the scale is right side up, 1:25,000/ 1:50,000/ 1:100,000.



Placing the scale with the zero-zero point at the lower left corner of the grid square. Keeping the horizontal line of the scale directly on top of the east-west grid line, slide it to the right until the vertical line of the scale touches the point for the desired coordinates.

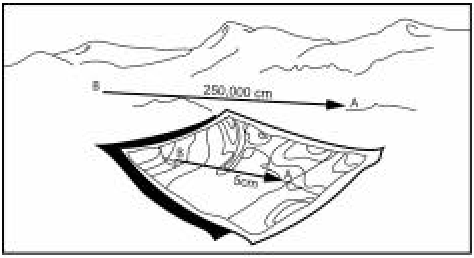


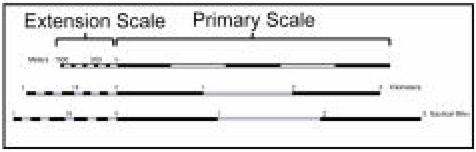
Distance and Direction

Once you find a point on a map, you need to find out what the distance is from point A to point B. The direction is also needed.

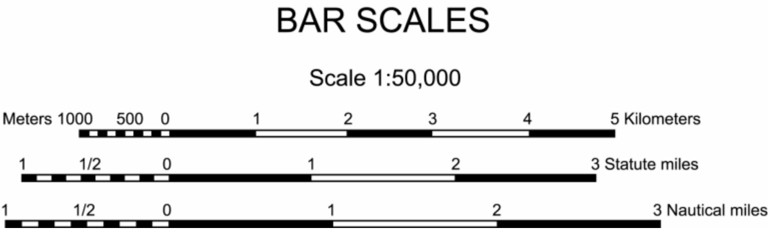
How to Use Scales

The numerical scale of a map indicates the relationship of distance measured on a map and the corresponding distance on the ground. One inch on the map determines either 25,000/ 50,000/ or 100,000 inches on actual ground.



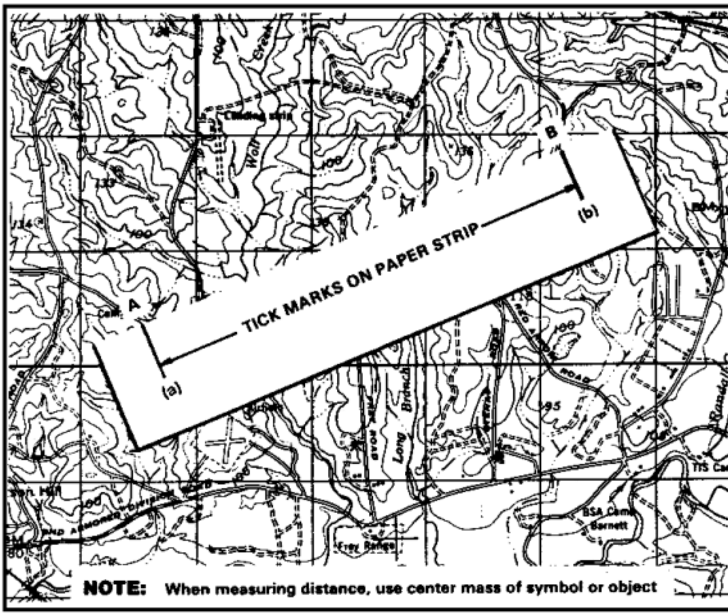


Below is an example of a bar scale.

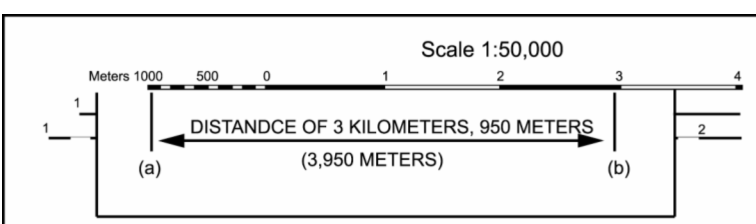


Measuring Straight-line Distance:

To determine straight-line distance between two points on a map, lay a straight-edged piece of paper on the map so that the edge of the paper touches both points and extends past them. Make a tick mark on the edge of the paper at each point.

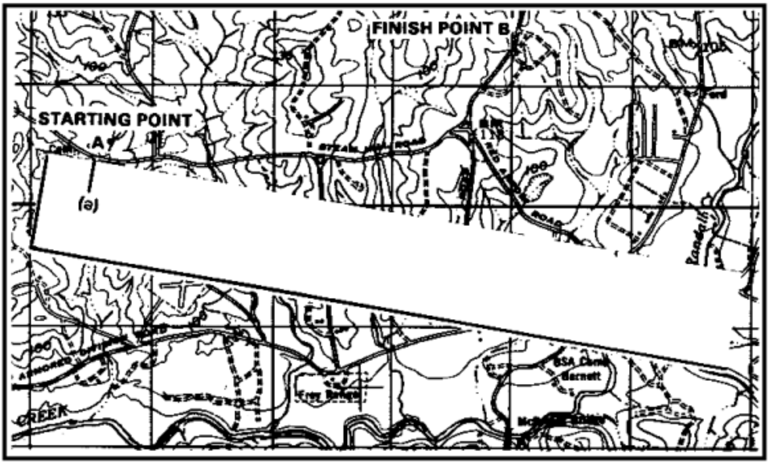


To convert the map distance to ground distance, move the paper down to the graphic bar scale, and align the right tick mark (b) with a printed number in the primary scale so that the left tick mark (a) is in the extension scale.

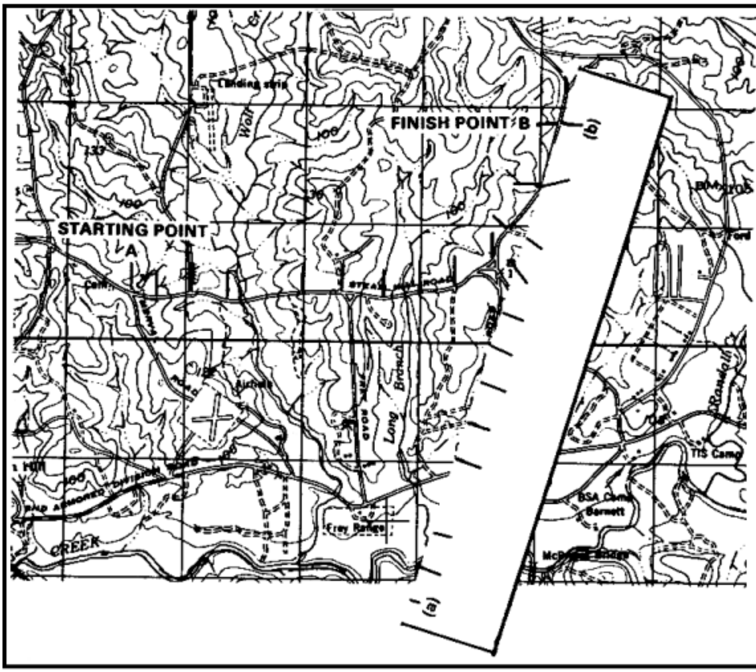


Measuring Curved-line Distance:

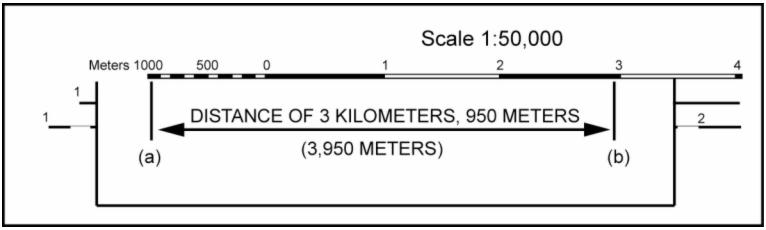
To measure distance along a winding road, stream, or other curved line, the straight edge of a piece of paper is used. Place a tick mark on the paper and map at the beginning point from which the curved line is to be measured. Align the edge of the paper along a straight portion and make a tick mark on both map and paper when the edge of the paper leaves the straight portion of the line being measured.



Keeping both tick marks together (on paper and map), place the point of the pencil close to the edge of the paper on the tick mark to hold it in place and pivot the paper until another straight portion of the curved line is aligned with the edge of the paper. Continue in this manner until the measurement is completed.



When you have completed measuring the distance, move the paper to the graphic scale to determine the ground distance. The only tick marks you will be measuring the distance between are tick marks (a) and (b). The tick marks in between are not used.

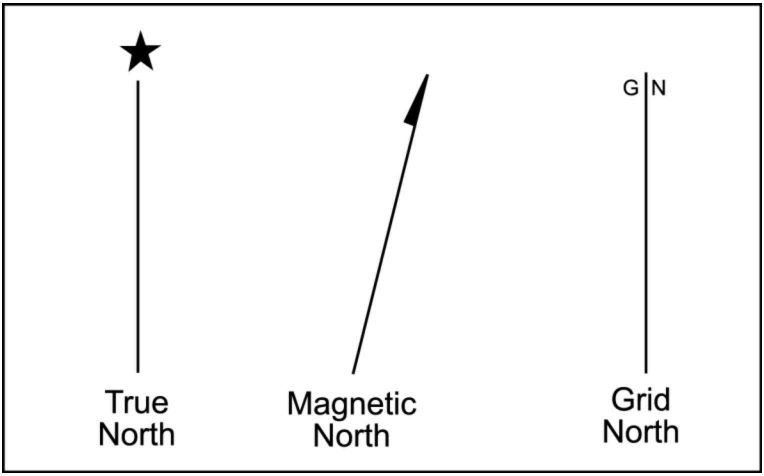


Different Types of North

True North is a line from any point on the earth surface to the North Pole. All lines of longitude are true north lines. A star usually represents true north.

Magnetic North is the direction to the north magnetic pole, as indicated by the north-seeking needle or a magnetic instrument. A line ending with a half arrowhead usually symbolizes magnetic north. Magnetic readings are obtained with magnetic instruments, such as lensatic and M2 compasses.

Grid North is the north that is established by using the vertical grid lines on the map. The letters GN or the letter y may symbolize grid north.

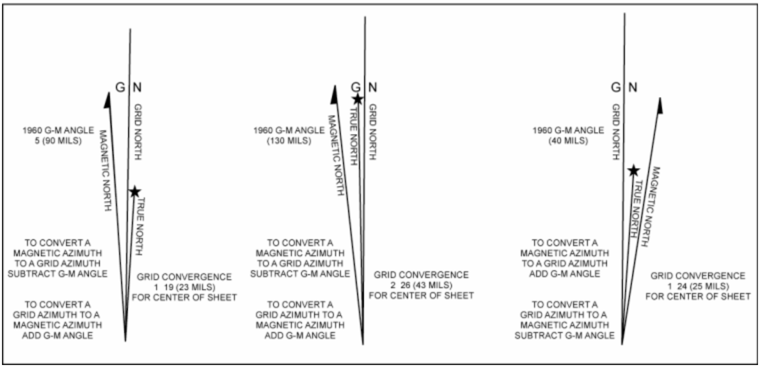


Understanding the Declination Diagram/G-M Angle

Declination Diagram: Declination is the angular difference between true north and either magnetic or grid north. There are two declinations, a magnetic declination and a grid declination. The declination diagram shows the angular relationship, represented by prongs, among these three norths.

G-M Angle (Grid-Magnetic Angle): The G-M angle value is the angular size that exists between grid north and magnetic north and the year it was prepared. This value is expressed to the nearest 1/2 degree, with mil equivalents shown to the nearest 10 mils. The G-M angle is important to you, the map reader/land navigator, because it will affect the accuracy of navigation skills in the field.

G-M Conversion: There is an angular difference between the grid north and the magnetic north that is caused by the attraction of the earth's magnetic field (Northern Canada) on all compasses. Since the location of this magnetic field does not correspond exactly with the grid-north lines on the maps, a conversion from magnetic to grid or vice versa is needed. Simply refer to the conversion notes that appear in conjunction with the diagram explaining the use of the G-M angle. One note provides instructions for converting magnetic azimuth to grid azimuth, the other, for converting grid azimuth to magnetic azimuth. The conversion (add or subtract) is governed by the direction of the magnetic-north prong relative to that of the north-grid prong.



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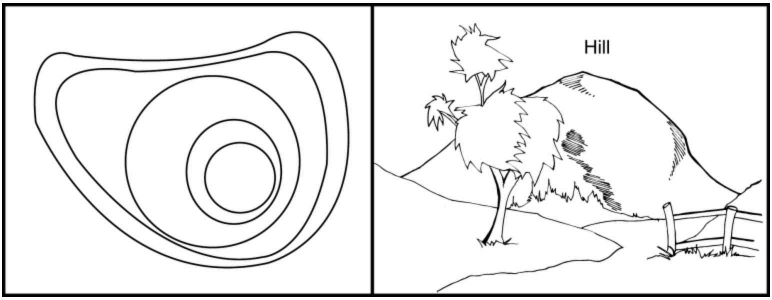
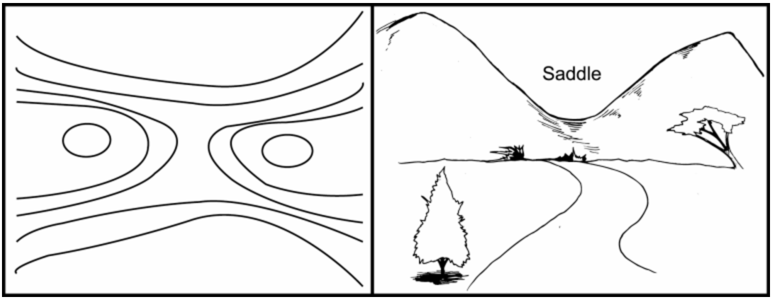
Elevation and Relief

Terrain Features

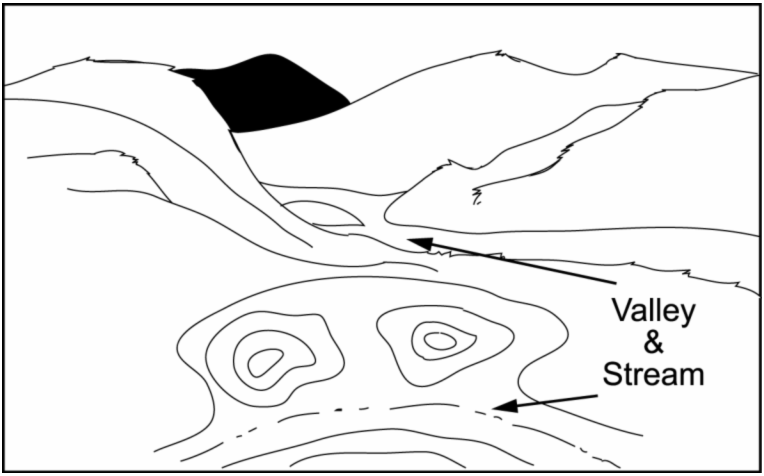
Hill



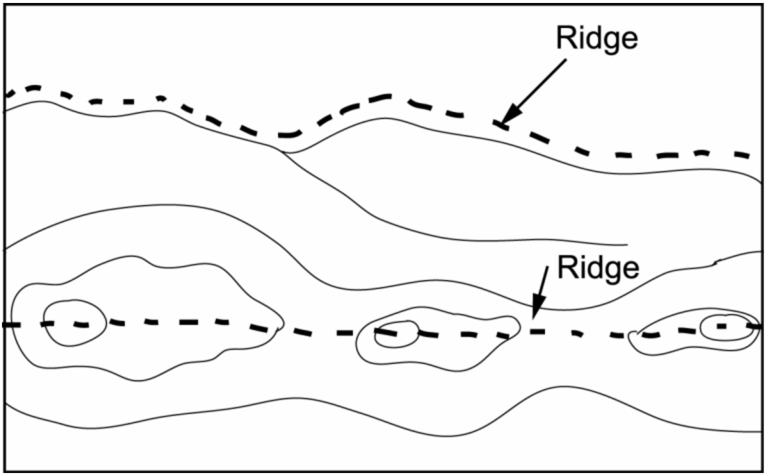
Saddle



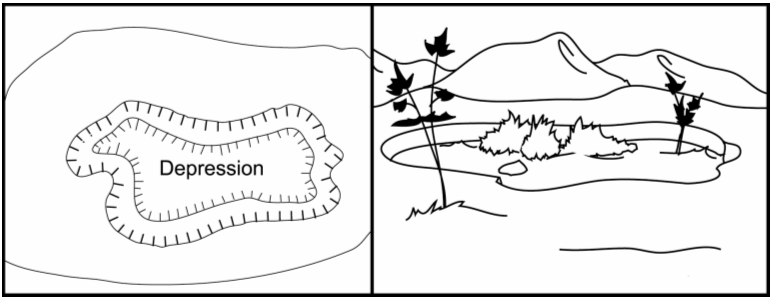
Valley



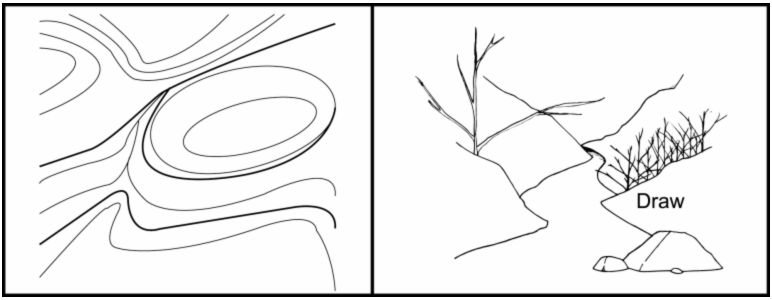
Ridge



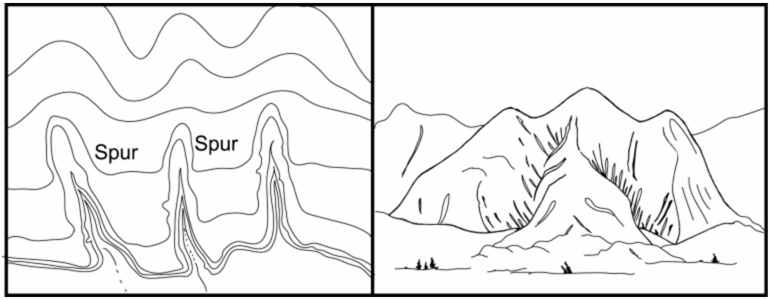
Depression



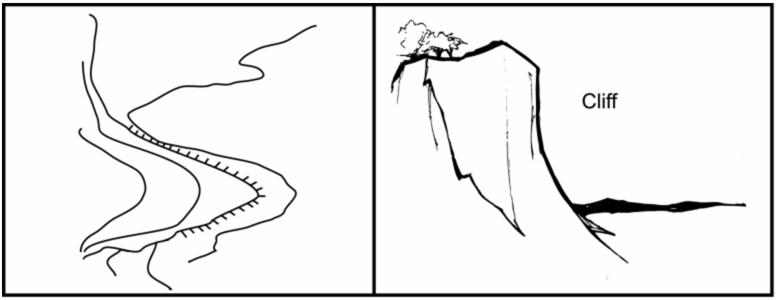
Draw

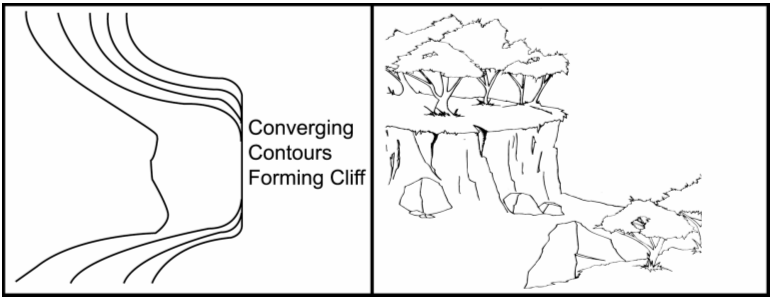


Finger/Spur

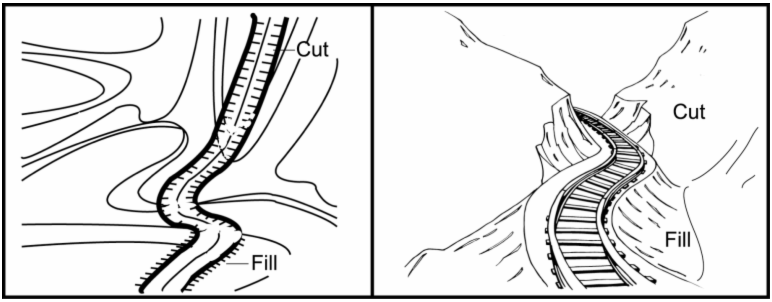


Cliff

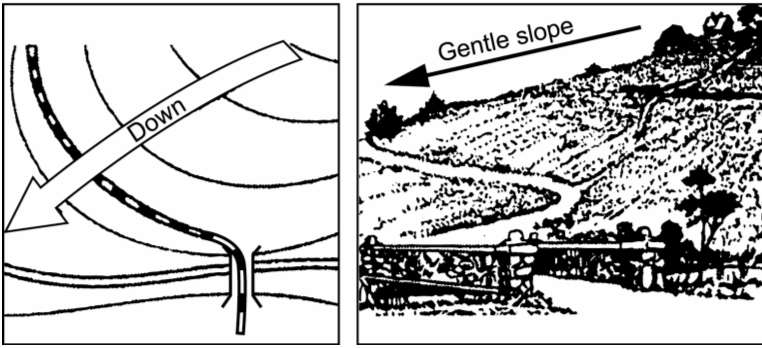




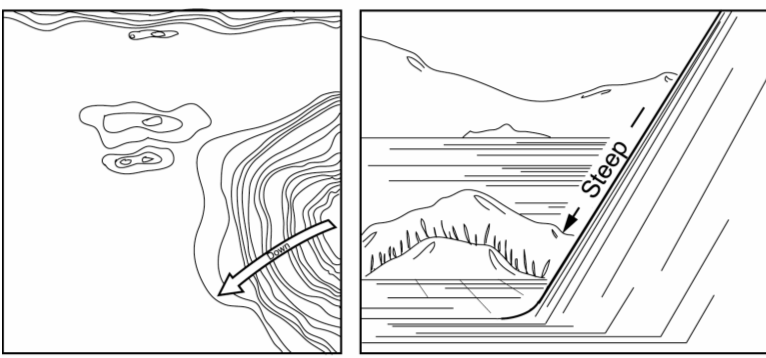
Cut/Fill



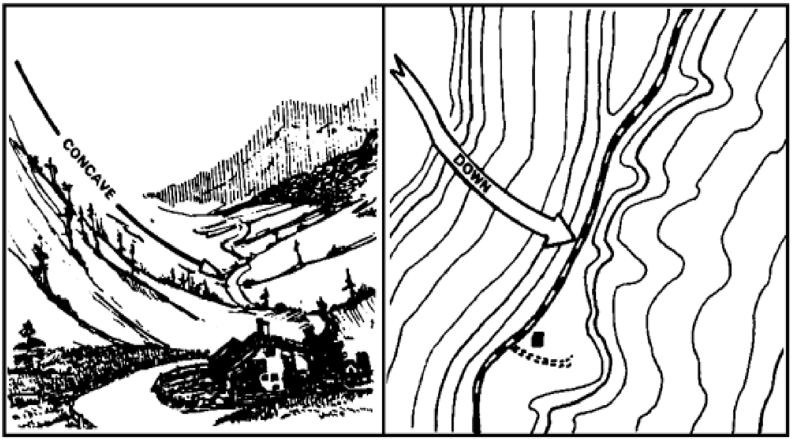
Gentle Slope



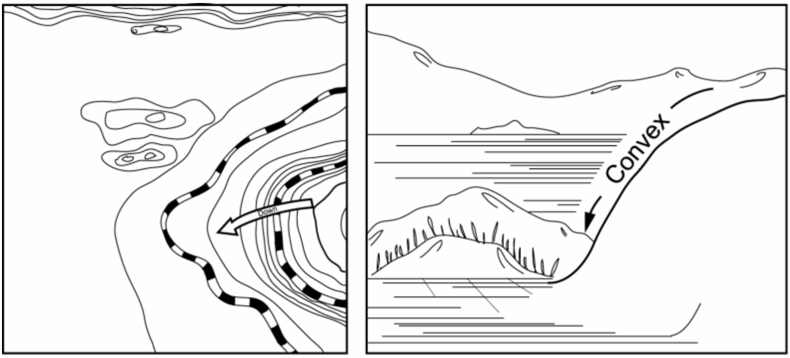
Steep Slope



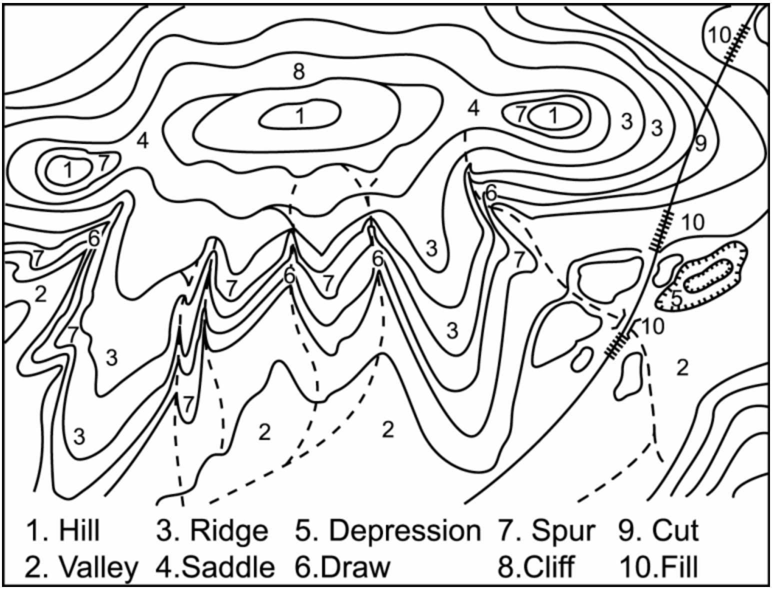
Concave Slope



Convex Slope



Terrain features do not normally stand-alone. To understand how various terrain features are depicted on a map by contour lines, carefully examine the illustration below:



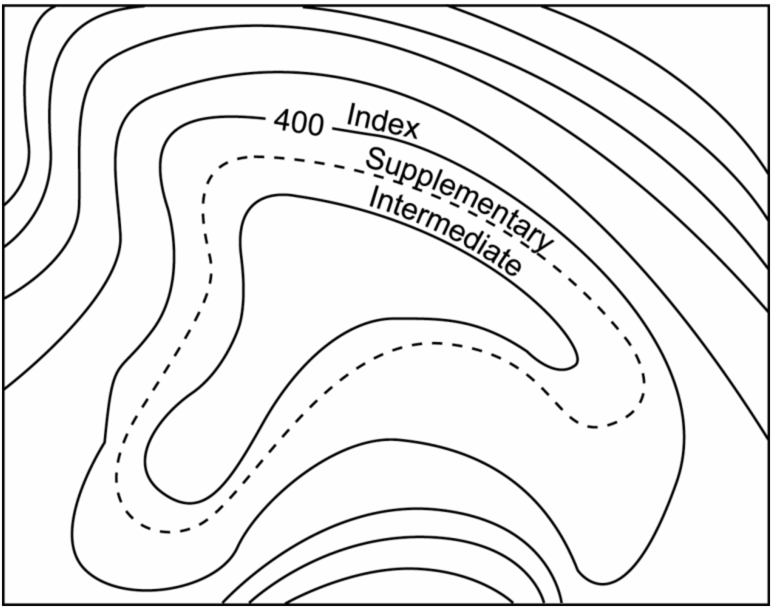
Contour Lines

Contour lines are the most common method of showing relief and elevation on a standard topographic map. A contour line represents an imaginary line on the ground, above or below sea level. All points on the contour line are at the same elevation. The elevation represented by contour lines is the vertical distance above or below sea level. The three types of contour lines used on a standard topographic map are as follows:

Index: Starting at zero elevation or mean sea level, every fifth contour line is a heavier line. These are known as index contour lines. Normally, each index contour line is numbered at some point. This number is the elevation of that line.

Intermediate: The contour lines falling between the index contour lines are called intermediate contour lines. These lines are finer and do not have their elevations given. There are normally four intermediate contour lines between index contour lines.

Supplementary: These contour lines resemble dashes. They show sudden changes in elevation of at least one-half the contour interval.



Contour Interval

Before the elevation of any point on the map can be determined, you must know the contour interval for the map you are using. The contour interval measurement given in the marginal information is the vertical distance between adjacent contour lines. To determine the elevation of a point on the map, find the numbered index contour line nearest the point you are trying to determine. Then determine if your point is higher or lower elevation than the index contour line. Once that is established, you can count the number of contours higher or lower and, by referencing the marginal data, be able to get your actual elevation.

Lensatic Compass

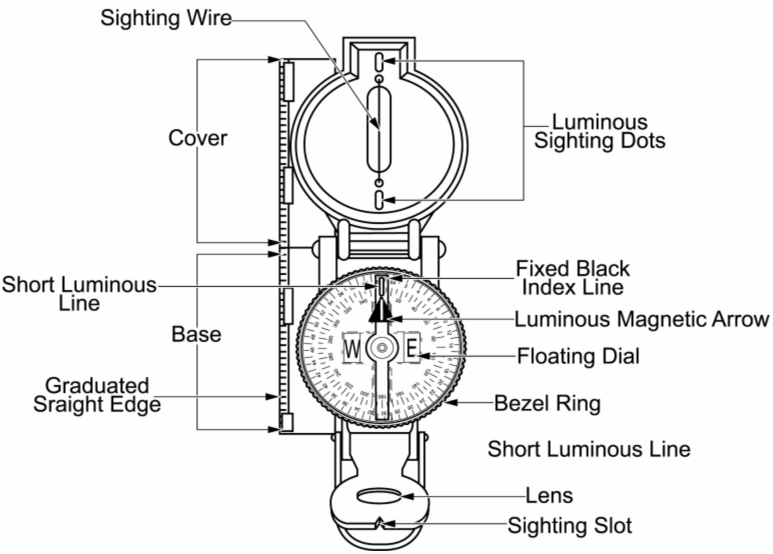
Description/Nomenclature

-Description

Compasses are the primary navigation tools to use when moving in an outdoor world where there is no other way to find directions. The lensatic compass is the most common and simplest instrument for measuring direction.

-Nomenclature

The lensatic compass consists of three major parts: cover, base, and lens. These three major components can be broken down even further.



When the compass is opened, the left side is a graduated coordinate scale. In newer compasses, this scale is 1:50,000 and in older compasses it is 1:25,000. Be sure to check the scale before using it.

Handling the Lensatic Compass

Compasses are delicate instruments and should be cared for accordingly. A detailed inspection is required when first obtaining and using a compass. One of the most important parts to check is the floating dial, which contains the magnetic needle. You must also make sure the sighting wire is straight, the glass and crystal parts are not broken, the numbers on the dial are readable, and most important, that the compass does not stick.

Metal objects and electrical sources can affect the performance of a compass. However, nonmagnetic metals and alloys do not affect compass readings. The following are suggested as approximate safe distances to ensure its proper functioning:

High-tension power lines	55 meters
Field gun, truck, or tank..	10 meters
Telegraph or telephone wires and barbed wire	10 meters
Machinegun..	2 meters
Steel helmet or rifle	½ meter

Note: Compass in good working condition is very accurate. However, a compass has to be checked periodically on a known line of direction, such as a surveyed azimuth using a declination station. Compasses with more than 3 degrees ± variation should not be used. If traveling with the compass unfolded, make sure the rear sight is fully folded down onto the bezel ring. This will lock the floating dial and prevent vibration, as well as protect the crystal and rear sight from damage.

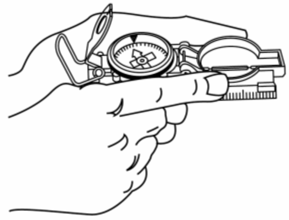
Using the Lensatic Compass

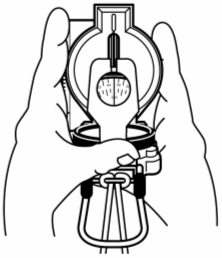
Center-hold Technique - To find directions or azimuths with a compass there are several techniques you can use. The first technique is the center-hold technique.

Step	Action
1	Open the compass to its fullest so that the cover forms a straight-edge with the base.
2	Move the lens (rear sight) to the rear most position, allowing the dial to float freely.
3	Place your thumb through the thumb loop, form a steady base with your third and fourth fingers, and extend your index finger along the side of the compass.
4	Place the thumb of the other hand between the lens (rear sight) and the bezel ring; extend the index finger along the remaining side of the compass, and the remaining fingers around the fingers of the other hand.
5	Pull your elbows firmly into your sides; this will place the compass between your chin and your belt.
6	To measure an azimuth, simply turn your entire body toward the object, pointing the compass cover directly at the object. Once you are pointing at the object, look down and read the azimuth from beneath the fixed black index line.

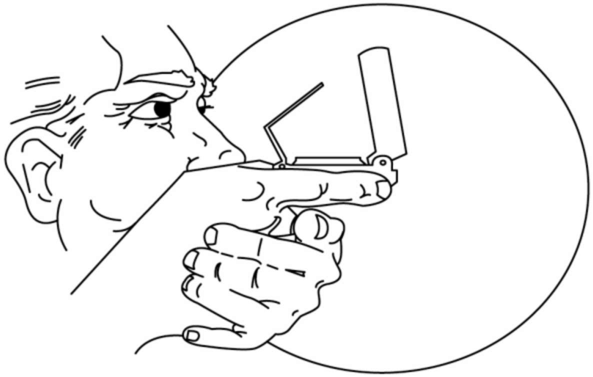
Advantages:

- It is faster and easier to use.
- It can be used under all conditions of visibility.
- It can be used when navigating over any type of terrain.
- It can be used without putting down the rifle; however, the rifle must be slung well back over either shoulder.
- It can be used without removing the steel helmet or eyeglasses.





The Compass-To-Cheek Technique - Fold the cover of the compass containing the sighting wire to a vertical position; then fold the rear sight slightly forward. Look through the rear-sight slot and align the front-sight hairline with the desired object in the distance. Then glance down at the dial through the eye lens to read the azimuth.



Orientating a Map Using the Lensatic Compass

A map is oriented when it is in a horizontal position with its north and south corresponding to the north and south on the ground. When orienting a map with a compass remember that the compass measures magnetic azimuths, therefore, you need to pay special attention to the declination diagram.

Use the following techniques to orient your map:

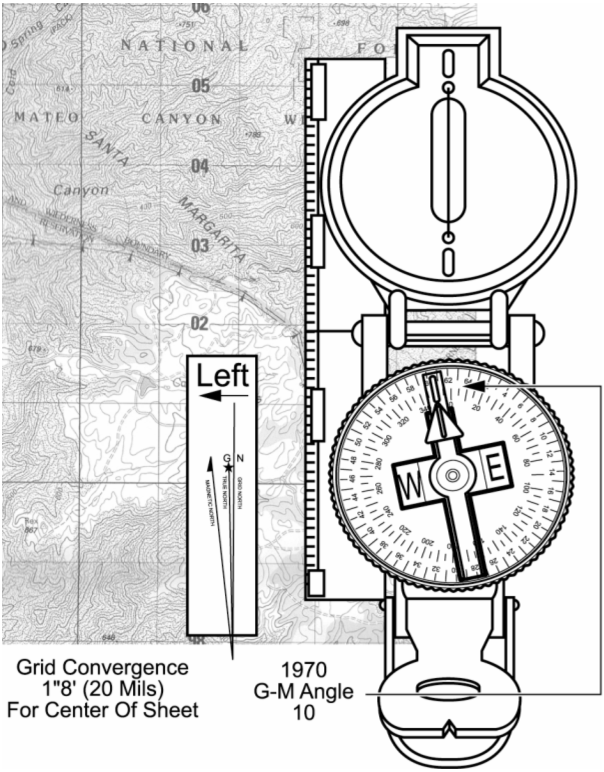
First Technique:

- Determine the direction of the declination and its value from the declination diagram.

- With the map in a horizontal position, take the straightedge on the left side of the compass and place it alongside the north-south grid line with the cover of the compass pointing toward the top of the map. This will place the fixed black index line of the compass parallel to north-south grid lines of the map.

- Keeping the compass aligned as directed above, rotate the map and compass together until the magnetic arrow is below the fixed black index line on the compass. At this time, the map is close to being oriented.

- Rotate the map and compass in the direction of the declination diagram.



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Ensure that the magnetic north arrow on your compass is the exact same degree left or right of the grid north as it shows in the declination diagram on the map that you are using.

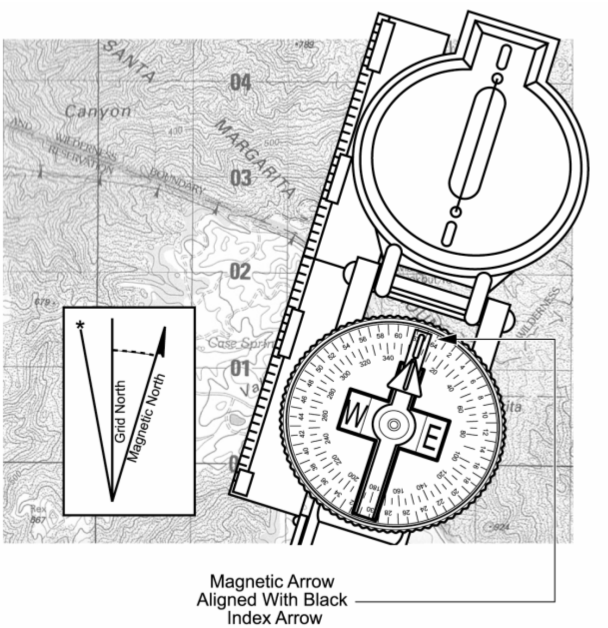
Second Technique:

A map can also be oriented with a compass using the following techniques.

- Determine the direction of the declination and its value from the declination diagram.

- Using any north-south grid line on the map as a base, draw a magnetic azimuth equal to the G-M angle given in the declination diagram with the protractor.

- If the declination is easterly (right) or westerly (left), the drawn line is equal to the value of the G-M angle. Then align the straightedge, which is on the left side of the compass, alongside the drawn line on the map. Rotate the map and compass until the magnetic arrow of the compass is below the fixed black index line. The map is now oriented.



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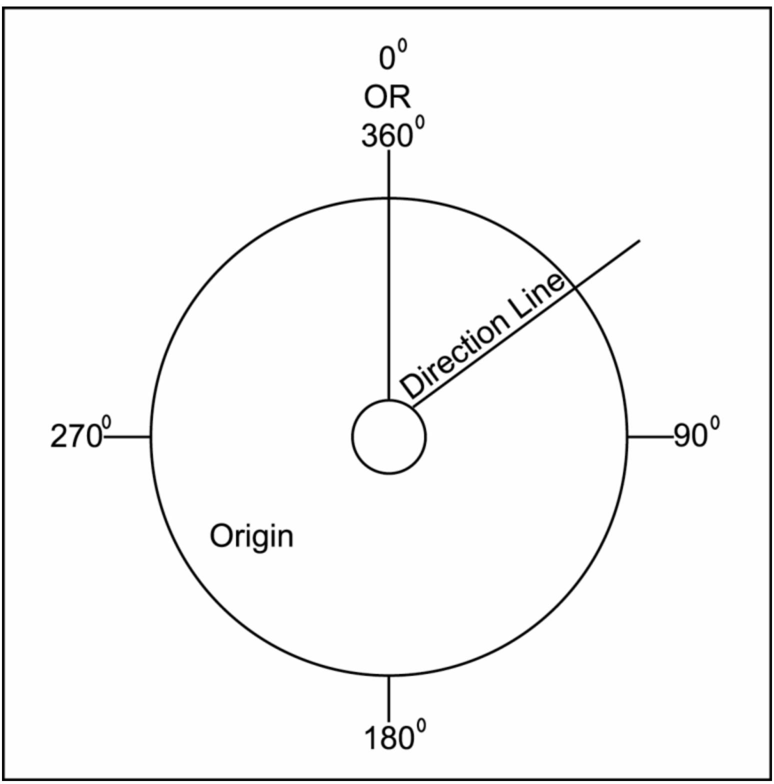
Using a Lensatic Compass to Navigate

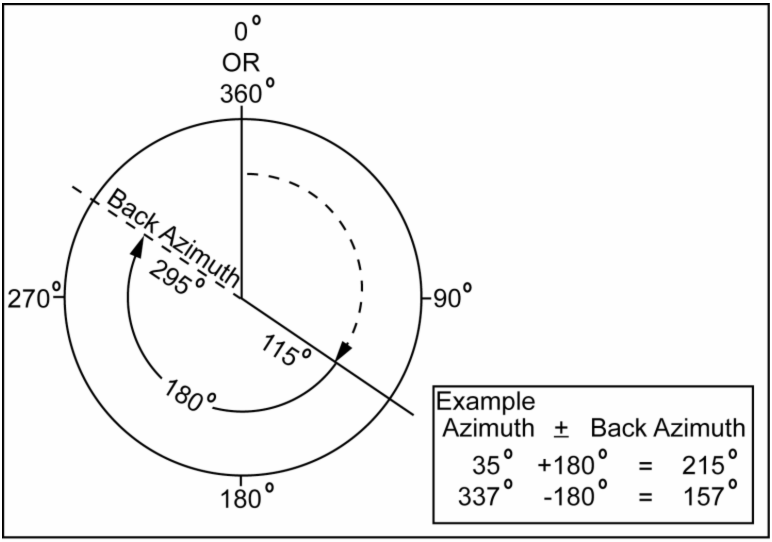
Finding an Azimuth

An azimuth is defined as a horizontal angle measured clockwise from a north base line. This north base line could be true north, magnetic north, or grid north.

When using an azimuth, the point from which the azimuth originates is the center of an imaginary circle. This circle is divided into 360 degrees.



Back Azimuth - A back azimuth is the opposite direction of an azimuth. It is comparable to doing an "about face." To obtain a back azimuth from an azimuth, add 180 degrees if the azimuth is 180 degrees or less; or subtract 180 degrees if the azimuth is 180 degrees or more. The back azimuth of 180 degrees may be stated as 0 degrees or 360 degrees. You should be careful when converting azimuths into back azimuths, as a mistake could be disastrous.

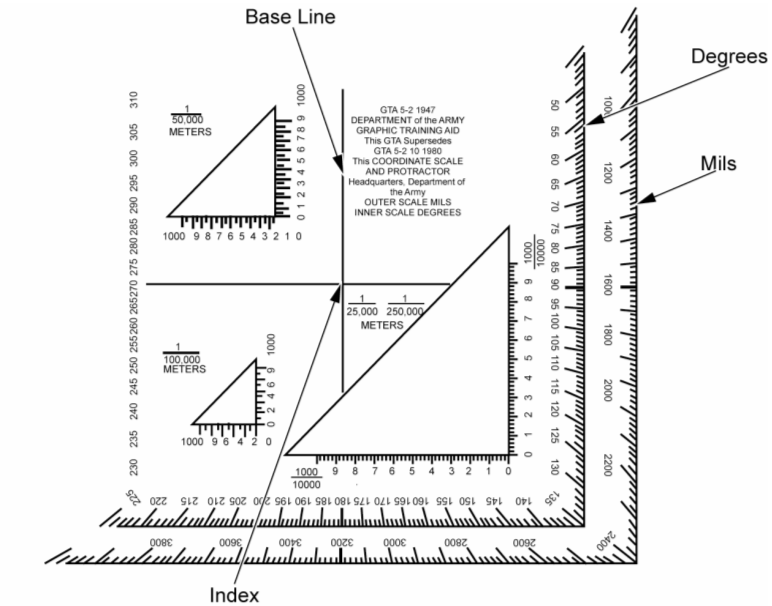


When an azimuth is plotted on a map between point A (starting point) and point B (ending point), the points are joined together by a straight line. A protractor is used to measure the angle between grid north and the drawn line, and this measured azimuth is the grid azimuth.

Remember you are measuring from a starting point to an ending point. If your reading is taken from the ending point, the grid azimuth will be opposite and the user will go in the wrong direction.

Although there are several types of protractors, such as the GTA 5-2 1947 or the GTA 5-2-12, 1981, they share similar characteristics. The index mark is the center of the protractor. On the outer edge are two scales, one in degrees and one in mils. The degree scale is graduated from 0 degrees to 360 degrees. A line from 0 to 180 degrees is called the base line. Where the base line intersects the horizontal line, between 90 degrees and 270 degrees, is the index or center of the protractor.

When using the protractor, the base line is always oriented parallel to a north-south grid line. The 0-degree or 360-degree mark is toward the top or north on the map and the 90-degree mark is to the right.



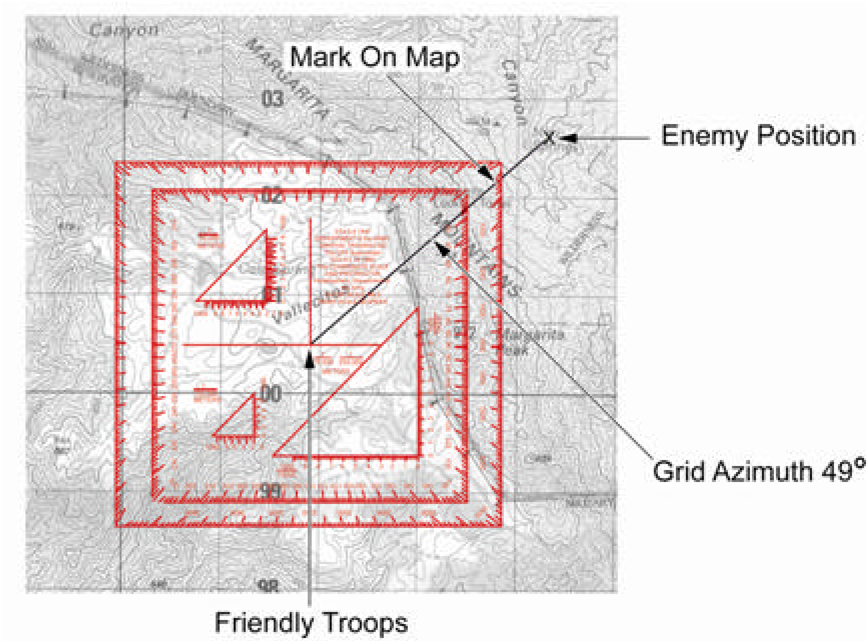
To determine the grid azimuth:

- Draw a line connecting the two points (A&B).
- Place the index of the protractor at the point where the drawn line crosses a vertical (north-south) grid line.
- Keeping the index at this point, align the 0°-180° line of the protractor on the vertical grid line.
- Read the value of the angle from the scale; this is the grid azimuth from point A to point B.

To plot an azimuth from a known point on a map:

- Place the protractor on the map with the index mark at the center of mass of the known point and the 0°-180° base line parallel to a north-south grid line.
- Make a mark on the map at the desired azimuth.
- Remove the protractor and draw a line connecting the known point and the mark on the map. This is the grid direction line.

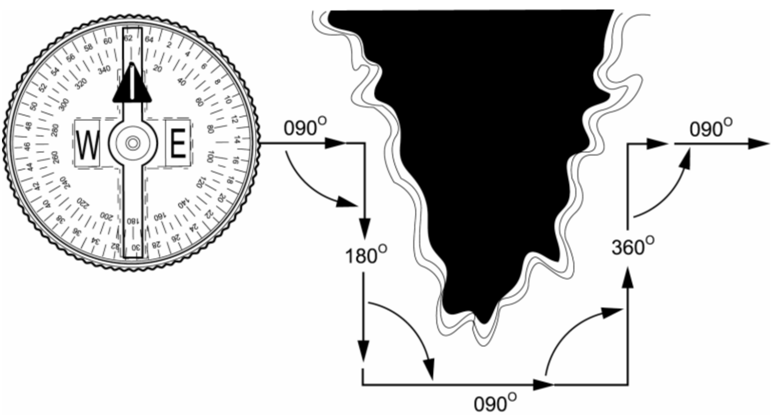
Note: If the azimuth given is magnetic, it must be converted to grid. Also the azimuth will be to the nearest 1/2 degree and that distance has no affect on the azimuth.


Mark On Map
Enemy Position
Grid Azimuth 49°
Friendly Troops

Bypassing Obstacles

To bypass enemy positions or obstacles and still stay oriented, detour the obstacle by moving at right angles for specified distances. For example, while moving on an azimuth of 90°, change your azimuth to 180° and travel for 100 meters; change your azimuth to 90° and travel for 150 meters; change your azimuth to 360° and travel for 100 meters; then change your azimuth to 90° and you are back on your original azimuth line.

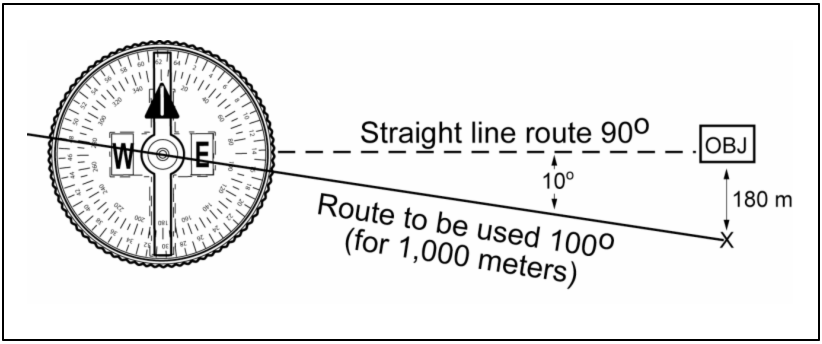
Bypassing an unexpected obstacle at night is a fairly simple matter. To make a 90-degree turn to the right, hold the compass in the center-hold technique; turn until the center of the luminous letter E is under the luminous line (do not move the bezel ring). To make a 90-degree turn to the left, turn until the center of the luminous letter W is under the luminous line. This does not require changing the compass setting bezel ring), and it ensures accurate 90-degree turns.



Deliberate Offset

A deliberate offset is a planned magnetic deviation to the right or left of an azimuth to an objective. Use it when the objective is located along or in the vicinity of a linear feature such as a road, stream, and so forth. Because of errors in the compass or in map reading, the linear feature may be reached without knowing whether the objective lies to the right or left. A deliberate offset by a known number of degrees in a known direction compensates for possible errors and ensures that upon reaching the linear feature, the user knows whether to go right or left to reach the objective. Ten degrees is an adequate offset for most tactical uses. Each degree offset will move the course about 18 meters to the right or left for each 1,000 meters traveled.

For example, in the picture shown below the number of degrees offset is 10. If the distanced traveled to "x" is 1,000 meters, then "x" is located about 180 meters to the right of the objective.



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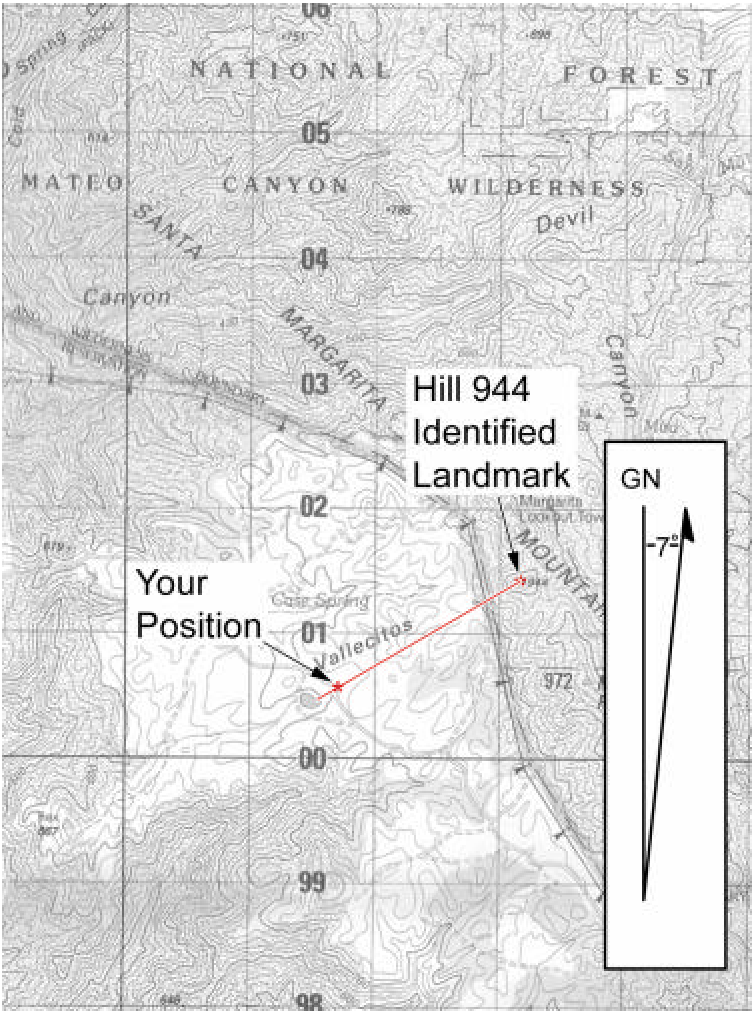
Determining Your Location by Resection

Resection is the method of locating one's position on a map by determining the grid azimuth to a well-defined location that can be pinpointed on the map. For greater accuracy, the desired method of resection would be to use three well-defined locations.

<u>One Point Resection</u>

A one-point resection is the method of locating one's position on the map when the person is located on a linear feature on the ground, such as a road canal stream, etc. The steps are as follows:

- Orient the map using a compass or by terrain association.
- Find a distant point that can be identified on the ground and on the map.
- Determine the magnetic azimuth from your location to the distant known point.
- Convert the magnetic azimuth to a grid azimuth.
- Convert the grid azimuth to a back azimuth. Using a protractor, scale the back azimuth on the map from the known position back toward your unknown position.
- Your location is where the line crosses the linear feature. Determine the grid coordinates to the desired accuracy.

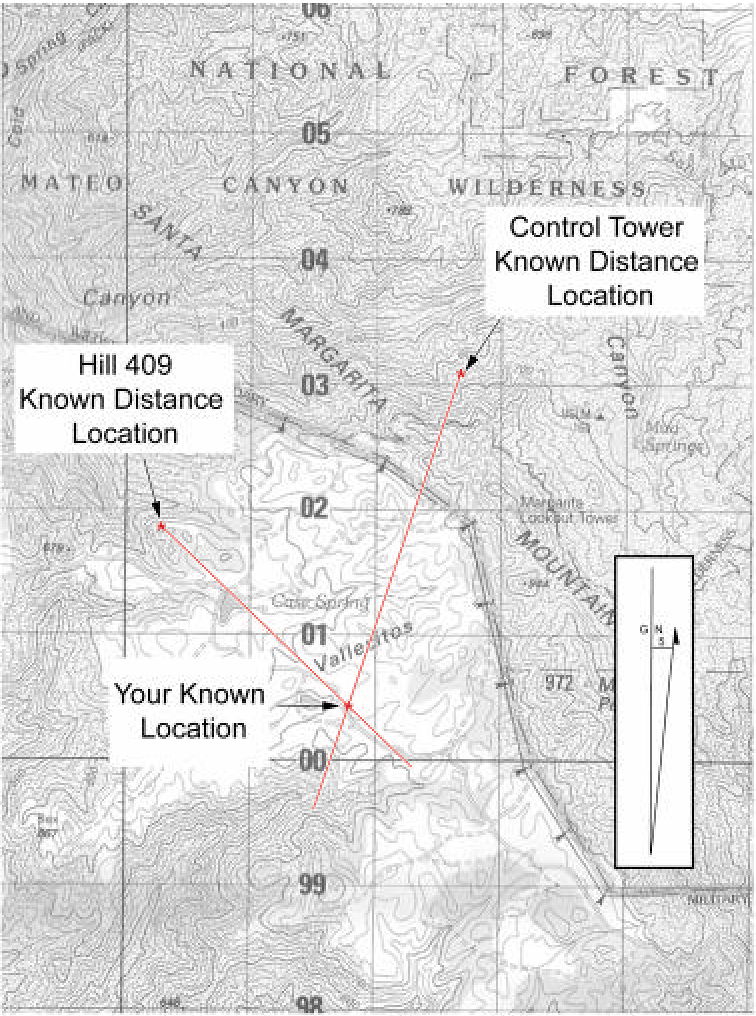


NATIONAL
FOREST
MATEO
CANYON
WILDERNESS
SANTA
MARGARITA
Canyon
Devil
Hill 944
Identified
Landmark
GN
-7º
Your
Position
Vallecitos
MOUNTAIN
972

Two Point Resection

Map and Compass Method:

- Orient the map using the compass.
- Identify two or three known distant locations on the ground and mark them on the map.
- Measure the magnetic azimuth to the known position from your location using a compass.
- Convert the magnetic azimuth to a grid azimuth.
- Convert the grid azimuth to a back azimuth. Using a protractor, scale the back azimuth on the map from the known position back toward your unknown position.
- Repeat the steps for a second position and a third position, if desired.
- The intersection of the lines is your location. Determine the grid coordinates to the desired accuracy.

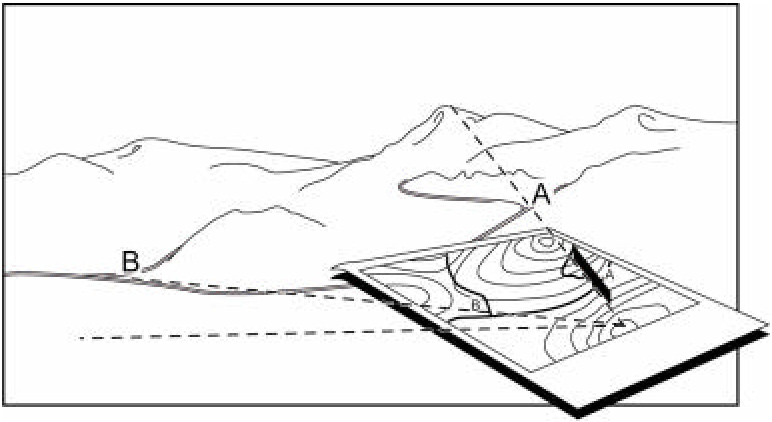


From your unknown location to hilltop 408 magnetic azimuth
$312^{o} + 5^{o}$E = 317^{o} G - 180^{o} = 137^{o} back azimuth
From your unknown location to control tower magnetic azimuth
13^{o} +5^{o}E = 18^{o} G + 180^{o} = 198^{o} back azimuth

Straightedge Method:

When no compass is available, the straightedge method can be used to find your position.

- Orient the map on a flat surface by the terrain association method.
- Locate at least two known distant locations or prominent features on the ground and mark them on the map.
- Lay a straightedge on the map using a known position as a pivot point. Rotate the straightedge until the known position on the map is aligned with the known position on the ground.
- Draw a line along the straightedge away from the known position on the ground toward your position.
- The intersection of the lines on the map is your location. Determine the grid coordinates to the desired accuracy.



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Determining a Distant Location by Intersection

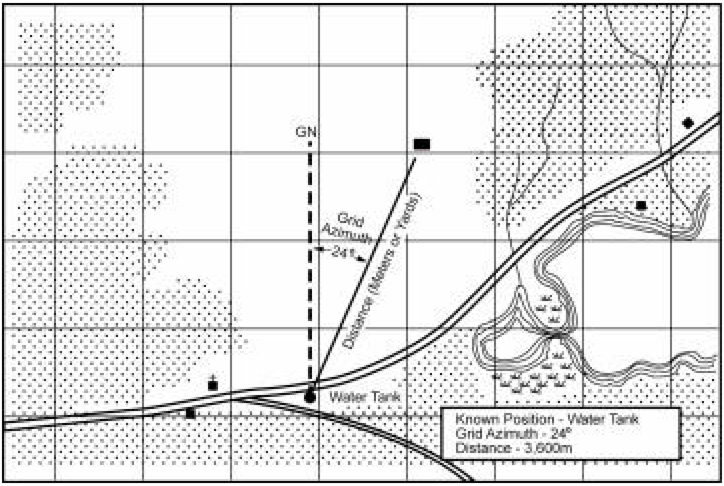
Intersection is the location of an unknown point by successively occupying one, two, or preferably three known positions on the ground and then map sighting on the unknown locations. It is used to locate distant or inaccessible points or objects, such as enemy targets, danger areas, and so forth. There are two methods of intersection.

One Point Intersection

Used to determine the location of a distant object located on or near a linear feature. Complete the steps as follows:

- From your known position, shoot an azimuth to the distant object. It is recommended to use the compass-to-cheek technique.
- Plot this azimuth on your map using either a compass or a protractor (if you use a protractor, don't forget to convert the magnetic azimuth to a grid azimuth). The distant object is located where your plotted azimuth crosses the linear feature.
- If the distant object is not on or near a linear feature, then you must estimate the distance between you and the distant object and plot this along your plotted azimuth.

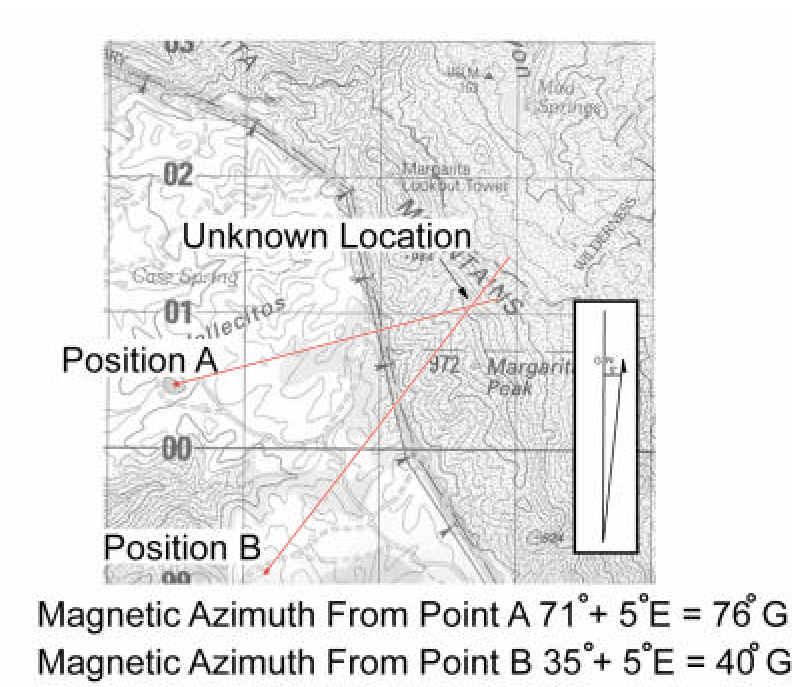
*YOU MUST KNOW YOUR OWN LOCATION TO USE THIS METHOD.



Two Point Intersection

Map and Compass Method:

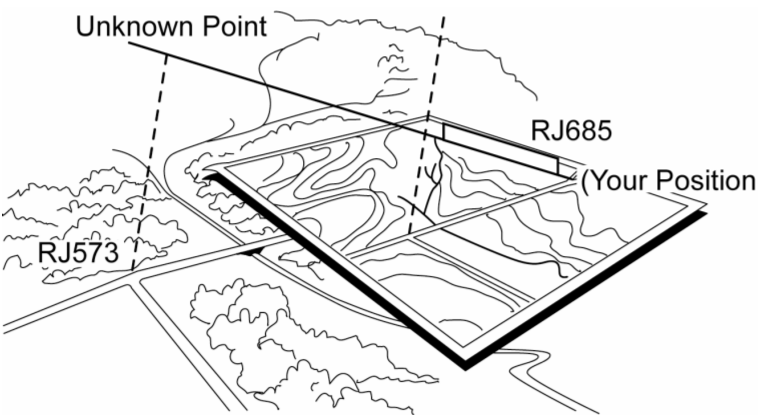
- Orient the map using the compass.
- Locate and mark your position (A) on the map.
- Determine the magnetic azimuth to the unknown position using the compass
- Convert the magnetic azimuth to grid azimuth.
- Draw a line on the map from your position on this grid azimuth.
- Move to a second known point (B) and repeat the first five steps.
- The location of the unknown position (C) is where the lines cross on the map. Determine eight-digit grid coordinates to the desired accuracy.



Straightedge Method:

When a compass is not available, use the straightedge method of intersection.

- Orient the map on a flat surface by the terrain association method.
- Locate and mark your position on the map.
- Lay a straightedge on the map with one end at the user's position (A) as a pivot point; rotate the straightedge until the unknown point is sighted along the edge.
- Draw a line along the straightedge.
- Repeat the above steps at position (B) and check for accuracy.
- The intersection of the lines on the map is the location of the unknown point (C). Determine the grid coordinates to the desired accuracy.



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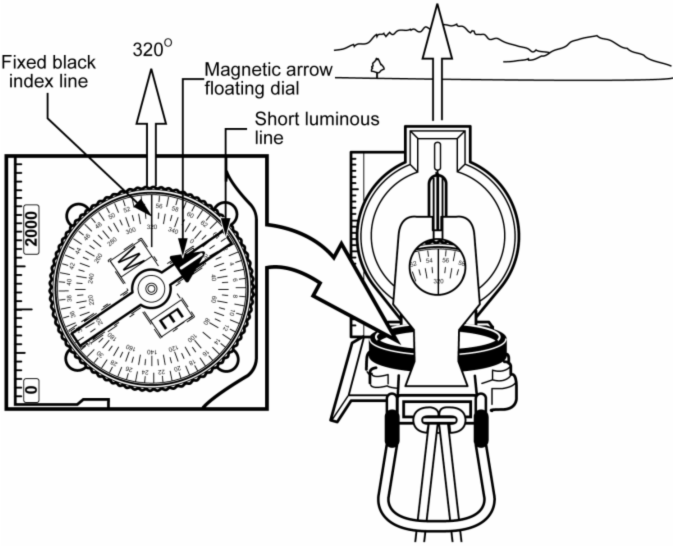
Land Navigation at Night

Setting The Compass for Night Land Navigation

- Rotate the bezel ring until the luminous line is over the fixed black index line.
- Find the desired azimuth and divide it by three. The result is the number of clicks that you have to rotate the bezel ring. Remember that the bezel ring contains 3-degree intervals (clicks). Sometimes the desired azimuth is not exactly divisible by three, causing an option of rounding up or rounding down. If the azimuth is rounded up, this causes an increase in the value of the azimuth, and the object is to be found on the left. If the azimuth is rounded down, this causes a decrease in the value of the azimuth, and the object is to be found on the right.
- Count the desired number of clicks. If the desired azimuth is smaller than 180°, the number of clicks on the bezel ring should be counted in a counterclockwise direction. For example, the desired azimuth is 51°. Desired azimuth is 51° ÷ 3 = 17 clicks counterclockwise. If the desired azimuth is larger than 180°, subtract the number of degrees from 360° and divide by 3 to obtain the number of clicks. Count them in a clockwise direction. For example, the desired azimuth is 330°.
  360° - 330° = 30° ÷ 3 = 10 clicks clockwise.



Following a Compass During Night Land Navigation

- With the compass preset as described above, assume a center-hold technique and rotate your body until the north-seeking arrow is aligned with the luminous line on the bezel. Then proceed forward in the direction of the front cover's luminous dots, which are aligned with the fixed black index line containing the azimuth.

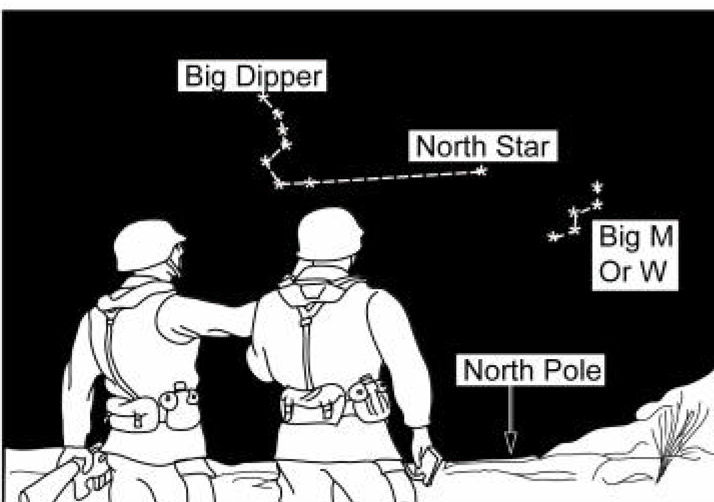
- When the compass is to be used in darkness, an initial azimuth should be set while light is still available, if possible. With the initial azimuth as a base, any other azimuth that is a multiple of three can be established through the use of the clicking feature of the bezel ring.

Land Navigation Using Natural Means

Direction By Use Of The Stars

The North Star, also known as the Polar Star or Polaris can be used to gain a general direction at night.

The North Star is less than 1 degree off true north and does not move from its place because the axis of the earth is pointed toward it. The North Star is in the group of stars called the Little Dipper. It is the last star in the handle of the dipper. Two stars in the Big Dipper are helpful in finding the North Star. They are called the Pointers, and an imaginary line drawn through them five times their distance points to the North Star. There are many stars brighter than the North Star, but none is more important because of its location. However, the North Star can only be seen in the northern hemisphere so it cannot serve as a guide south of the equator. The farther one goes north, the higher the North Star is in the sky. Above latitude 70 degrees, it is too high in the sky to be useful.

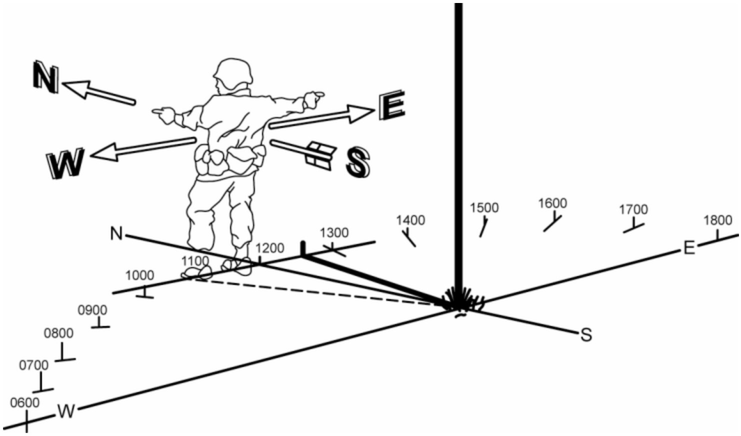


Depending on the star selected for navigation, azimuth checks are necessary. A star near the north horizon serves for about 30 minutes. When moving south, azimuth checks should be made every 15 minutes. When traveling east or west, the difficulty of staying on azimuth is caused more by the likelihood of the star climbing too high in the sky or losing itself behind the western horizon than it is by the star changing direction angle. When this happens, it is necessary to change to another guide star. The Southern Cross is the main constellation used as a guide south of the equator and the above general directions for using north and south stars are reversed. When navigating using the stars as guides, the user must know the different constellation shapes and their locations throughout the world.

Shadow-tip Method

This simple and accurate method of finding direction by the sun consists of four basic steps.

- Step 1. Place a stick or branch into the ground at a level spot where a distinctive shadow will be cast. Mark the shadow tip with a stone, twig, or other means. This first shadow mark is always the west direction.



- Step 2. Wait 10 to 15 minutes until the shadow tip moves a few inches. Mark the new position of the shadow tip in the same way as the first.

- Step 3. Draw a straight line through the two marks to obtain an approximate east-west line.

- Step 4. Standing with the first mark (west) to your left, the other directions are simple; north is to the front, east is to the right, and south is behind you.

A line drawn perpendicular to the east-west line at any point is the approximate north-south line. If you are uncertain which direction is east and which is west, observe this simple rule: The first shadow-tip mark is always in the west direction, everywhere on earth.

The shadow-tip method can also be used as a shadow clock to find the approximate time of day.

- To find the time of day, move the stick to the intersection of the east-west line and the north-south line, and set it vertically in the ground. The west part of the east-west line indicates 0600 hours, and the east part is 1800 hours, anywhere on earth, because the basic rule always applies.

- The north-south line now becomes the noon line. The shadow of the stick is an hour hand in the shadow clock, and with it you can estimate the time using the noon line and the 6 o'clock line as your guides. Depending on your location and the season, the shadow may move either clockwise or counterclockwise, but this does not alter your manner of reading the shadow clock.

- The shadow clock is not a timepiece in the ordinary sense. It makes every day 12 unequal hours long, and always reads 0600 hours at sunrise and 1800 hours at sunset. The shadow clock time is closest to conventional clock time at midday, but the spacing of the other hours compared to conventional time varies somewhat with the locality and the date. However, it does provide a satisfactory means of telling time in the absence of properly set watches.

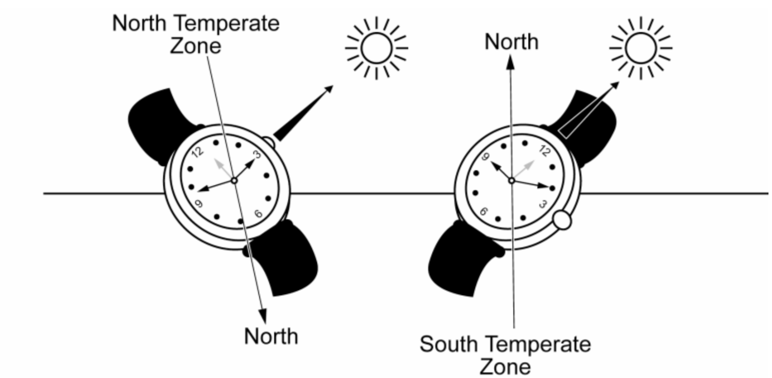
*The shadow-tip system is not intended for use in Polar Regions, which the Department of Defense defines as being above 60 degrees latitude in either hemisphere. Distressed persons in these areas are advised to stay in one place so that search/rescue teams may easily find them. The presence and location of all aircraft and ground parties in Polar Regions are reported to and checked regularly by governmental or other agencies, and any need for help becomes quickly known.

Watch Method

A watch can be used to determine the approximate true north and true south. There are different procedures for each temperate zone.

- North Temperate Zone. In the North Temperate Zone only, the hour hand is pointed toward the sun. A south line can be found midway between the hour hand and 1200 hours, standard time. If on daylight saving time, the north-south line is found between the hour hand and 1300 hours. If there is any doubt as to which end of the line is north, remember that the sun is in the east before noon and in the west after noon.

- South Temperate Zones. In the South Temperate Zone the 1200 - hour dial is pointed toward the sun, and halfway between 1200 hours and the hour hand will be a north line. If on daylight saving time, the north line lies midway between the hour hand and 1300 hours.



*The watch method can be in error, especially in the lower latitudes, and may cause circling. To avoid this, make a shadow clock and set your watch to the time indicated. After traveling for an hour, take another shadow-clock reading. Reset your watch if necessary.

Land Navigation Route Card

CHECK POINT	**GRID**	**AZIMUTH**	**DISTANCE**	**PACE**

Land Navigation Route Card

CHECK POINT	GRID	AZIMUTH	DISTANCE	PACE

Land Navigation Route Card

CHECK POINT	GRID	AZIMUTH	DISTANCE	PACE

NOTES