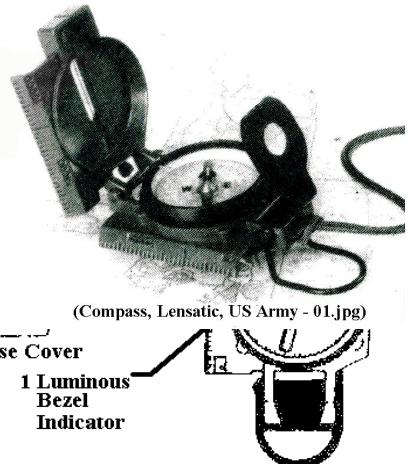
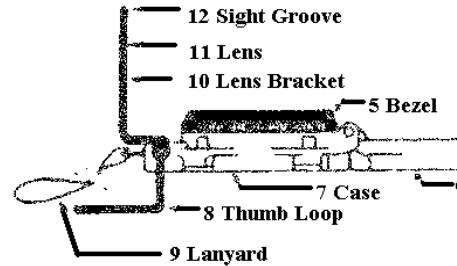
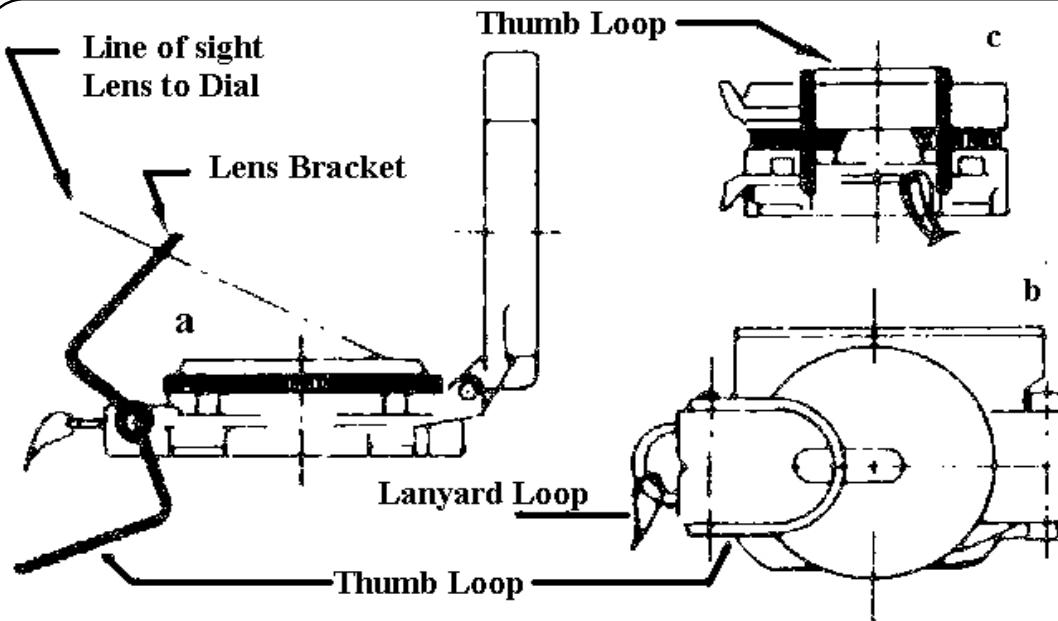
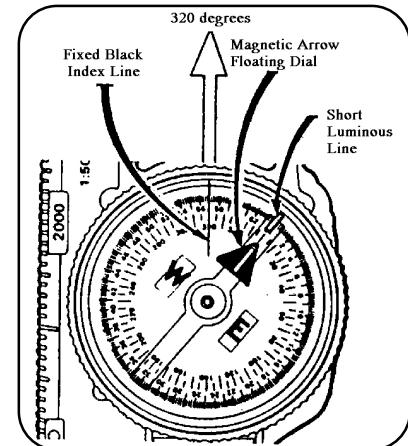


(Compass, Lensatic, US Army - 02.jpg)



Instructions for the US Army Lensatic Compass. Contains several different discussions.



(Compass, Lensatic, US Army - 03.jpg)

Compass, Lensatic, US Army, Instructions

Instructional Booklet for Military Lensatic, Magnetic Compass

Cammenga & Associates, Inc; 100 Aniline Ave;
Holland, Michigan, 49424; Phone (616) 392-7999

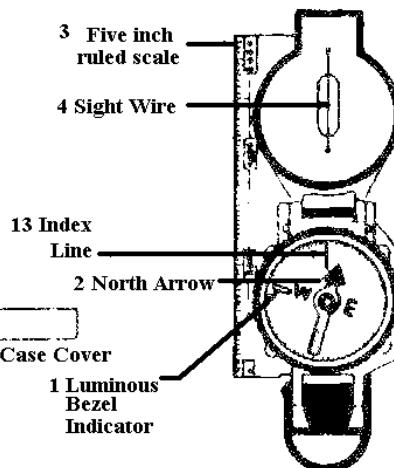
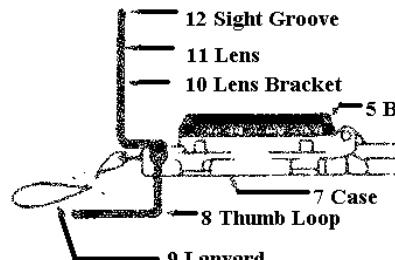
A. INTRODUCTION

The instructions in this booklet are for the Lensatic, Magnetic Compass currently being distributed by the US Army and Troop Command. This compass is known throughout the world for its precision, reliability, versatility, ruggedness and much more. It has helped to save lives in time of war and provided many with recreational and commercial usefulness in times of peace.

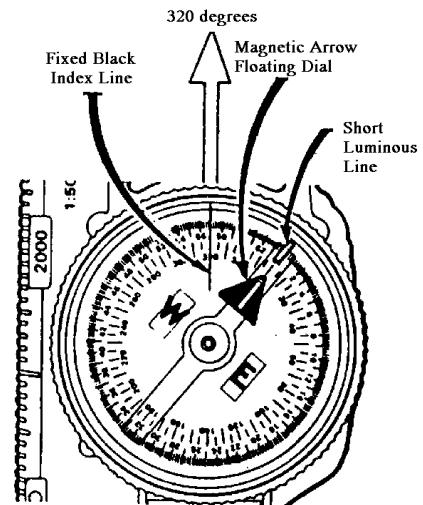
The Lensatic compass is used to determine 'azimuths' or 'compass bearings' (horizontal angles). It is also used to follow a course over the ground, orient or set a map, and determine position of objects in relation to a map.

B. PARTS OF THE LENSATIC COMPASS

(Compass, Lensatic, US Army
- 02.jpg)



Compass, Lensatic, US Army, closeup:



(From another source)

1. LUMINOUS BEZEL INDICATOR: Used to mark a course direction during day or night.
2. N – ARROW OF DIAL: locates magnetic North. The dial is divided into two scales;
 - a. OUTER -(Black Printing) Graduated in Mils.
6400 Mils to a Circle
Distance Between Black Marks = 20 Mils
Distance Between Black Numerals = 200 Mils
 $N = 64$ (6400) $E = 16$ (1600), $S = 32$ (3200), $W = 48$ (4800)

- b. INNER -(Red Printing) Graduated in Degrees
360 Degrees to a Circle
Distance Between Red Marks = 5 Degrees
Distance Between Red Numerals = 20 Degrees
N = 0, E = 90, S = 180, W = 270 Degrees

- 3. **FIVE -INCH RULED SCALE (120 MILLIMETERS):** Graduated at a ratio of 1:50,000. Distance on a 1:50,000 scale map can be measured (with the straight edge) up to 6000 meters 3.7 miles. The straight edge is useful for measuring distances, orienting a map and aligning bearings.

Note: The map scale index is usually found in the marginal information: However, the corresponding ground distances of some commonly used map scales are shown below:

| SCALE | ON MAP | DISTANCE OVER GROUND |
|--------------|---------------|-----------------------------|
| 1:10,560 | 6" | 1 MILE |
| 1:25,000 | 1" | APPROXIMATELY 2000 FT |
| | 2.5" | 1 MILE |
| | 4 CM | 1 KM |
| 1:31,680 | 2" | 1 MILE |
| 1:50,000 | 1.25" | 1 MILE |
| | 2 CM | 1 KM |

Numbers such as: (12), are shown in the picture (Compass, Lensatic, US Army - 02.jpg)

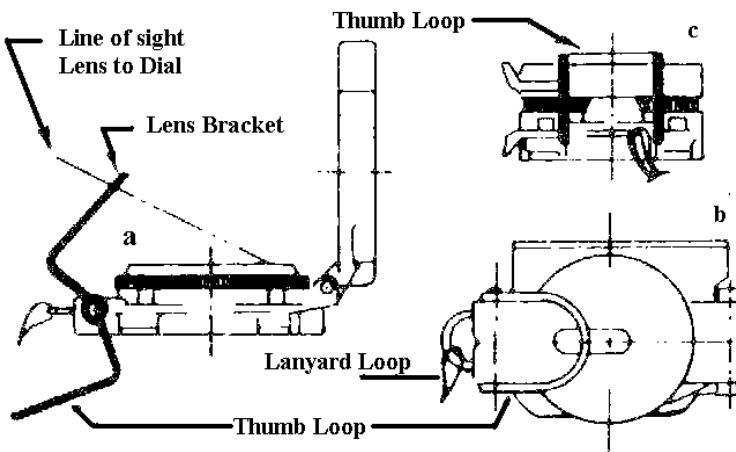
- 4. **SIGHT WIRE:** Used (along with the sight groove (12) of the lens bracket (10) to set a course over the ground; or determine an azimuth (bearing, direction) by sighting on prominent terrain features and reading the compass dial through the lens (11).

- 5. **BEZEL:** Contains the luminous bezel indicator (1). Has a serrated edge and rotates with a distinct clicking action. Each click moves the luminous bezel indicator over a 3 degree arc.

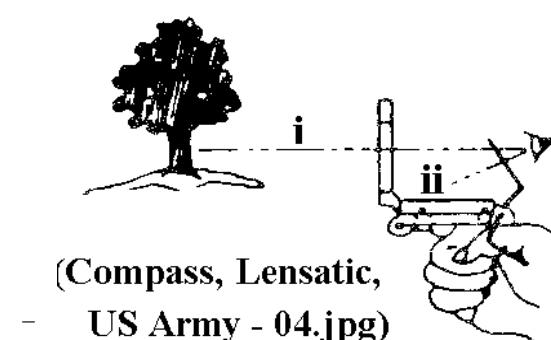
- 6. **CASE COVER:** Closes to protect the compass and reduce carrying size. When opened wide (Compass, Lensatic, US Army - 02.jpg, left side) it can be used as a straight edge or ruler. When perpendicular as in (Compass, Lensatic, US Army - 03.jpg, a), the SIGHT WIRE (4) is used to set course.

- 7. **CASE:** Contains and protects the dial assembly.

- 8. **THUMB-LOOP:** Locks the compass in the closed position (Compass, Lensatic, US Army - 03.jpg, b, c) When opened as (Compass, Lensatic, US Army - 03.jpg, a) It facilitates holding the compass to a set course to determine an azimuth. (Compass, Lensatic, US Army - 04.jpg)



(Compass, Lensatic, US Army - 03.jpg)



(Compass, Lensatic, US Army - 04.jpg)

9. **LANYARD:** A loop of braided nylon cord to secure the compass around the neck and ease access to it when carried in a shirt pocket.
10. **LENS BRACKET:** When pushed all the way down it lifts the dial off the pivot. When the compass is not being used, it is important to raise the dial in order to prevent damage to the pivot (point on which the dial balances).
11. **LENS:** High quality magnifier (about 2.5 inch focal length) to read the compass dial when positioned about 30 degrees off perpendicular. Handle carefully with clean tissue. Caution: close lens bracket against bezel glass before closing hinged cover. (Note that this lens is made of plastic, and not glass.)
12. **SIGHT GROOVE:** Used to set a course over the ground to determine an azimuth when it is used along with the sight wire (4), the index line (13) and the dial (2).
13. **INDEX LINE:** Black line etched on the crystal over the dial. Used to read an azimuth.

C. SIGHTING AN AZIMUTH (Taking a Compass Bearing)

1. Open the lensatic compass as shown in (Compass, Lensatic, US Army - 03.jpg, left side).
 - a. Cover should be perpendicular (90 degrees) to the case.
 - b. Lens bracket should be tilted about 30 degrees from perpendicular. Be sure the dial floats freely.
2. Sight the Lensatic Compass.
 - a. Insert thumb through thumb loop (Compass, Lensatic, US Army - 04.jpg)
 - b. Hold the compass level on the platform formed by the thumb and bent index finger (Compass, Lensatic, US Army - 04.jpg) .
 - c. Raise the compass to eye level (Compass, Lensatic, US Army - 04.jpg)
 - d. Align the center of the sighting groove in the lens bracket with the sight wire and a distant object - dotted line i (Compass, Lensatic, US Army - 04.jpg)
3. Without moving your head, or the compass, read the azimuth through the lens of the lens bracket, -dotted line ii (Compass, Lensatic, US Army - 04.jpg) The azimuth, in degrees, is the red number on the dial lying directly under the black index line of the compass crystal. The azimuth, in mils is the black number on the outer perimeter of the dial.

D. TO SET A COURSE (FOLLOW A BEARING)

1ST METHOD

- a. With the lensatic compass opened wide ((Compass, Lensatic, US Army - 02.jpg -b) and held level, turn it horizontally until the azimuth is directly under the black index line. Example: you want to follow a bearing of 120 degrees. Position the 120 degree mark under the index line.
- b. Holding the lensatic compass in this position, rotate the bezel until the luminous indicator is over the N arrow of the dial. The direction indicated by the open compass is the desired course. As long as the bezel is not rotated, the course can be checked by turning the open compass so that the luminous bezel indicator is directly over the n arrow of the dial.

2ND METHOD

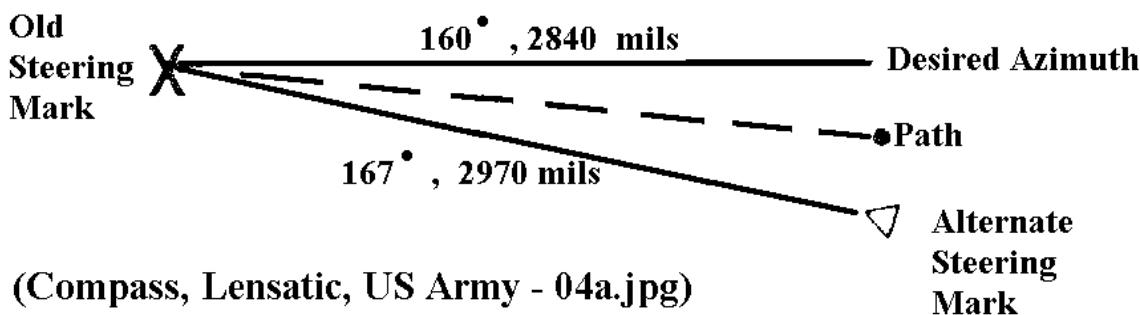
- a. Turn the fully opened lensatic compass and rotate the bezel to align the luminous bezel indicator, the black index line and the **N** arrow of the dial.
- b. Subtract the number of degrees, in your desired azimuth, from 360 degrees.
- c. Keeping the **N** arrow under the index line, turn the luminous bezel indicator to this result.
EXAMPLE: You want to follow a course of 120 degrees. Subtract 120 degrees from 360 degrees, leaving 240 degrees. Keeping the N arrow under the index line, rotate the bezel until the luminous bezel indicator is over 240 degrees.
- d. Turn the compass until the **N** arrow lies directly under the luminous bezel indicator. The direction indicated by the open compass cover points the desired course.

3RD METHOD

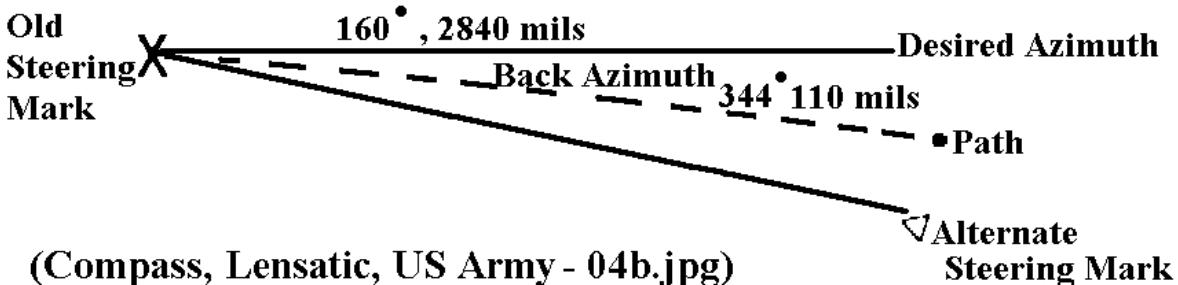
- a. Turn the fully opened compass and rotate the bezel to align the lights in the cover with the luminous bezel indicator.
- b. Rotate the bezel counterclockwise to the azimuth desired.
Each distinct click of the bezel represents 3 degrees.
Example: You want to follow a course of 120 degrees. Divide 120 by 3. The result is 40; therefore rotate the bezel 40 clicks counter-clockwise.
- c. Turn the compass until the **N** arrow lies directly under the luminous bezel indicator. The direction, indicated by the lights in the compass cover, points the desired course.

E. PROCEEDING ALONG AN AZIMUTH

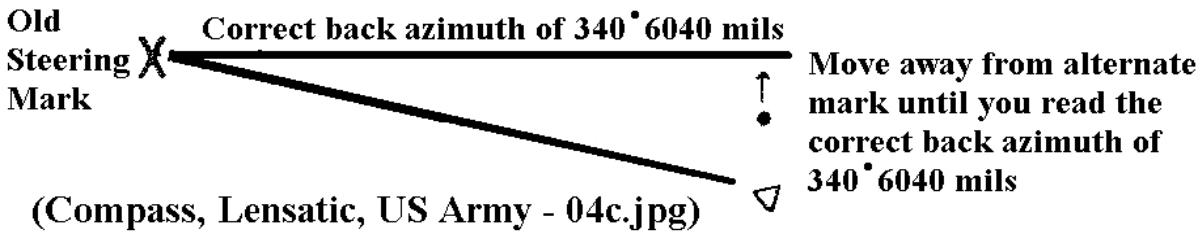
1. With your lensatic compass pointing along a desired azimuth. Select an easily identified object that is in line with the sighting groove of the lens bracket and the sight wire (Compass, Lensatic, US Army - 04.jpg). This 'steering mark' should be distinct from surroundings. It should be visible at all times along the route and should be identifiable when reached. The greater the distance to a steering mark, the fewer steering marks you will need to reach your goal.
2. If your steering mark is lost to view, stop, re-sight and select a new steering mark immediately.
3. If a good steering mark is not in line with your desired azimuth, select an alternative steering mark off to the side.



a. Estimate the distance the steering mark is to the side of the desired course. (160 degrees, 2840 mils). Alternate is 167 degrees, 2970 mils.



b. Head for the point on the traveled path that is beside the alternative steering mark. At this position sight a back azimuth to your old steering mark. (A back azimuth is 180 degrees away from a traveled azimuth. If the traveled azimuth is less than 180 degrees (3200 mils), add 180 degrees and if the traveled azimuth is more than 180 degrees, subtract 180 degrees. In (Compass, Lensatic, US Army - 04b.jpg), the back azimuth is 344 degrees (6110 mils).



c. Correct back azimuth of original course is 340 degrees which is 180 degrees plus the traveled azimuth of 160 degrees; therefore, you will have to move perpendicularly until you can sight a back azimuth of 340 degrees (6040 mils) when sighting your old steering mark. You are now back on your correct, originally desired course.

4. In darkness, chose steering marks that are closer together and have a distinct silhouette against the sky.

5. Military experience advises against frequent unnecessary sightings and walking while watching the compass; however, when steering marks cannot be used, the fully opened compass pointing the travel direction should be held in front of the chest. (See H. -night-time use).

F. ADJUSTING MAP BEARINGS FOR VARIATION - Setting the map.

If you are unfamiliar with declination, review 3, 4 of K. (Definitions).

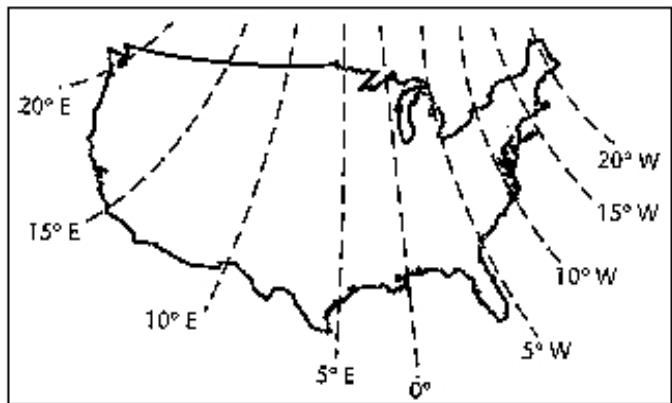
1ST METHOD - With magnetic N (MN) arrow shown

(see declination diagram, "Compass, Lensatic, US Army - 06.jpg", section K).

- a. Place the map flat, away from metallic objects.
- b. Place the fully opened lensatic compass on map with the edge of the scale alongside the magnetic N arrow of the declination diagram. Adjust the map (with the compass on it) so that the compass cover points to magnetic North (N arrow of compass is pointing directly to index line).

The map is now oriented to the terrain.

[Picture at right from another source.]

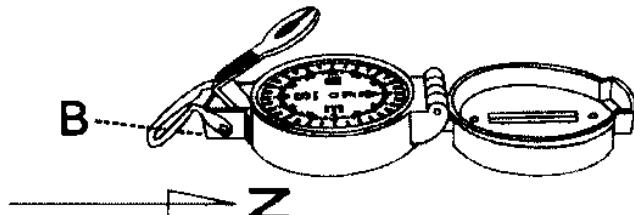


[Simplistic picture shown again later.

MAP ORIENTATION BY COMPASS

Lay the map down on a flat level surface, then align the north indicating line on the map with magnetic North of the compass.

The map is now oriented.]



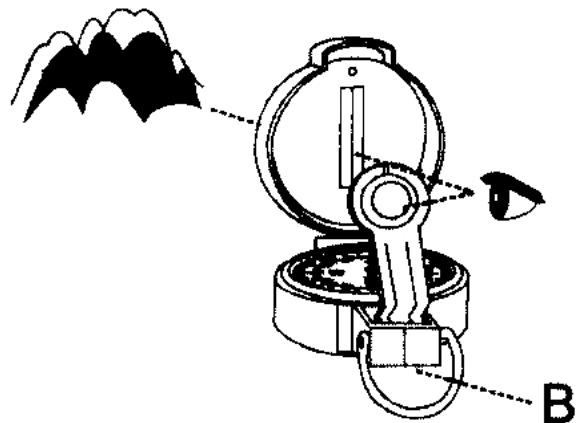
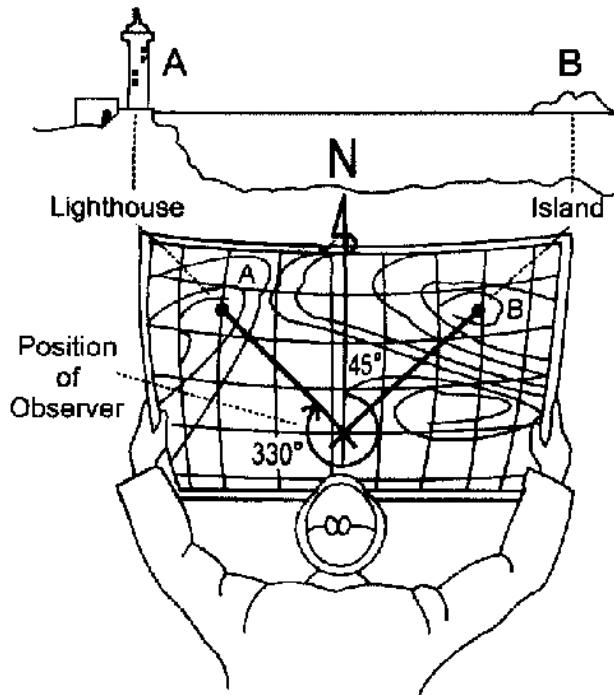
2ND METHOD - With no magnetic N arrow shown on the map.

- a. Find the magnetic declination in the map margin. This will state the deviation to be so many degrees E or W of true North. Example: Magnetic declination 11 degrees W means the N arrow of the lensatic compass will point 11 degrees West of true North.
- b. Place the fully opened lensatic compass on the map with the edge of the scale alongside a North-South Meridian (longitudinal line, grid line). The compass cover should be pointing toward the top of the map.
- c. Turn the map and the compass together until the N arrow of the dial is the same number of degrees E or W of the index line as stated on the map. The map is now oriented to the terrain.

3RD METHOD - When your position on the map is known.

- a. Select a prominent terrain feature on the ground.
- b. Sight an azimuth from your position on the ground to the selected terrain feature.
- c. Align the fully opened compass on the map so that the scale edge runs through the selected terrain feature and your known position.
- d. Turn the map and compass together until the azimuth sighted (in b, above), lies under the index line. The map is now oriented to the terrain.

The following pictures, from another source, are included here to help you along. Below, You are where the two rays intersect each other.



Above, A magnetic azimuth of any object is the compass reading of a direct line across the center of the compass to the object.

When taking the azimuth reading, set sight on object through the slot and wire, then read the degree scale through lens.

G. LOCATING YOUR POSITION ON A MAP BY MEANS OF INTERSECTING AZIMUTHS

1. Orient the map to the terrain.
2. Sight an azimuth to any visible terrain feature that appears on the map.
3. Place the fully opened lensatic compass on the map with the ruled edge running through the terrain feature and with the compass reading me same as the azimuth sighted. Draw a line along the ruled edge
4. Pick another visible terrain feature and sight its azimuth. For greater accuracy the two lines should be approximately right angles.
5. Repeat step 3.
6. The point of intersection accurately locates your position on me map.
7. From here you can determine the azimuth or bearing to any terrain feature shown on the map as long as your map is oriented.

Keep reading, I have included other versions of how to use this compass in later pages. The material repeats, so you can finally get it. People learn better by studying several versions.

H. NIGHT-TIME USE:

1. Try to determine a course (azimuth) to be followed while there is still light.
2. To set a course, follow instructions under :
F. ADJUSTING MAP VARIATIONS FOR VARIATION
- 3RD METHOD - d.
3. With your course determined, hold the lensatic compass open and level in both hands, with the index fingers of the right hand along the side of the compass. Position the compass approximately halfway between the chin and the belt, keeping the n arrow under the luminous bezel indicator.
5. Proceed forward in the direction that the index finger is pointed.



I. INDUCTION DAMPING:

The lensatic compass is induction damped verses. Liquid damped instruments are subject to leaking and eventual failure. Induction damping allows the dial to seek magnetic North and come to a complete rest in much less time than a unit without induction damping. It is a velocity dependent force; that is, as the speed of the oscillation of the dial comes to rest, the damping force is zero.

J. GENERAL - THE LENSATIC COMPASS.

- F Has a dial balanced on a precision made synthetic sapphire jeweled bearing.
- F Is induction damped by means of a copper damping shell so that dial comes to rest within six seconds.
- F Has a rubber cup sealing the copper damping shell, making the compass waterproof.
- F Is tested to operate at temperature ranges from -50 degrees F. to +160 degrees F.
- F Is made to meet rigid U.S. Military Specifications.
- F Has been used for many years by Armed Forces around the world.
- F Has been judged to be the most accurate, dependable, rugged and versatile compass that is available.
- F Because of its compact size, light weight and accuracy, is ideally suited for boating, camping, cross-country skiing, fishing, hunting and orienteering. ***Important - readings should never be taken near visible masses of iron or electrical circuits, because of their effects on the compass magnet. The following are suggested as approximate safe distances to insure proper functioning of the compass.***

- a. High tension power lines 55 meters (60 yards)
- b. Car, truck, camper 18 meters (20 yards)
- c. Telephone lines, wire fences 10 meters(11 yards)
- d. Shotgun, rifle, metal boxes. Etc. 0.5 meters(1.5 feet)

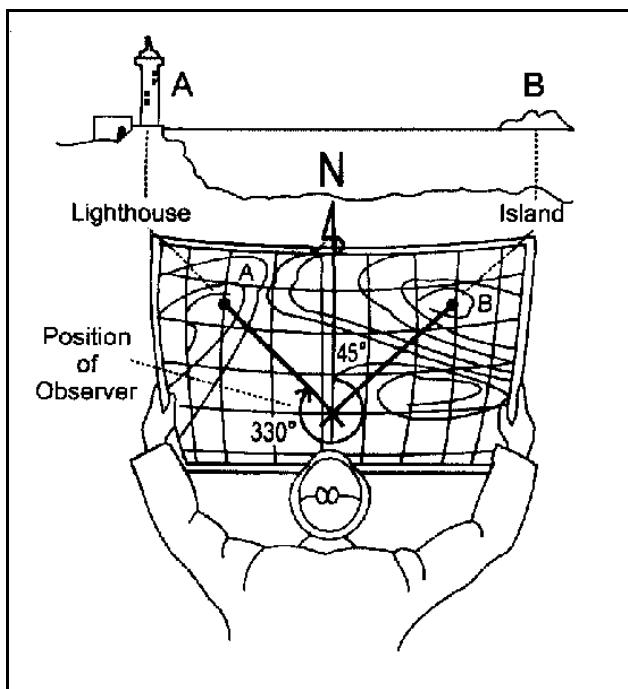
HOW TO USE THE ENGINEER COMPASS

(Lensatic compass) This is from the little paper that came with my five-dollar compass. It is included in case you did not follow the previous pages.

Finding real position on Map by compass

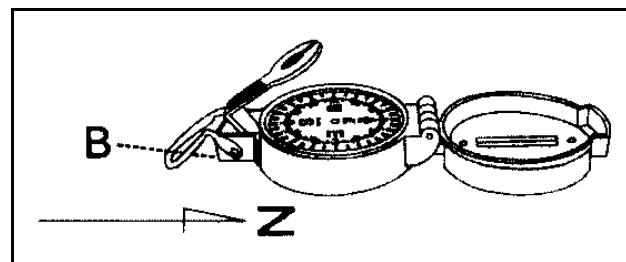
Take two azimuth bearings on separate characteristic points visible on the terrain and indicated on the map. Then on your oriented map, take the angle degree reading according to (a), and then draw two rays from each of the above points according to the angle reading, where the two rays intersect is your present location.

Below - You are where the two rays intersect each other.



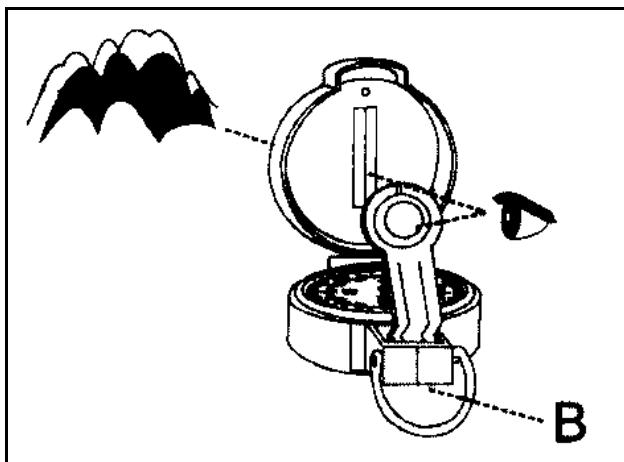
[Though both compasses are used the same way, I am told that the US Army Lensatic compass will give you readings accurate to three degrees. Some can employ it to within one degree.

The best hoped for in the above mentioned five-dollar compass is about five degrees. Significant for long distances.]



Map Orientation by Compass

Lay the map down on a flat level surface, then align the north indicating line on the map with magnetic north of the compass. The map is now oriented.



Magnetic Azimuth

A magnetic azimuth of any object is the compass reading of a direct line across the center of the compass to the object.

When taking the azimuth reading, set sight on object through the slot and wire, then read the degree scale through lens.

Walking in darkness & dense fog and through rough terrain

The line on the glass bezel is for quick walking through rough terrain : - (on the surface of the glass are found two lines, long and short. They form an angle of 45 degrees with each other.) First, turn your compass to face True North, then rotate the luminous line on your glass bezel to whatever number of degrees you wish to walk; example - move bezel 20 notches till line is on 60 degrees the when compass is aligned with North. Now you may take a quick reading at any time. While you are walking, just turn your compass towards the Magnetic North and walk in the direction of the line on the bezel.

Bezel rotates 360 degrees and is marked off in 3 degree notches for easy computation. (A glass plate may be turned around to produce a scratching sound. Each sound denotes the rotation by 3 degrees.)

Map & Compass; Using; The Leisurely Backpacker http://www.leisurelybackpacker.com/a_compass.htm
This version is an easy -to -read one from the internet.

The Leisurely Backpacker - Using Map & Compass

I'm including this brief overview for people who are unfamiliar with map reading and the use of a compass. Many a hiker has found himself in the woods with a compass or map, or both, and when unsure of their location, been struck by the realization that even though they have the appropriate navigational tools, they do not have the knowledge to use them. This overview should be considered just that, an overview. For a more complete explanation of using a map and compass in the wilderness, I suggest reading June Fleming's excellent book, *Staying Found*.

Topographic Maps

There are several kinds of maps available on the marketplace; too many to list here. The type of map I'm going to discuss here is the topographic map. A topographic map uses contour lines to portray the shape and elevation of the land. These lines are the twisted, curved brown lines that connect points of equal elevation on the map. The contour interval is the set distance between contour lines on a given map, measures in feet or meters. This interval can be found near the map's scale, which is usually located in the map legend. These contour lines make it possible for a topographic map to render the tree-dimensional ups and downs of the terrain on the two-dimensional surface of the map.

Topographic maps show both natural and man-made (cultural) features. They use symbols, lines and colors to portray map features. Topo maps show areas shaded in various colors to represent land cover. Areas on a topo map that are shaded green represent vegetation, usually wooded cover (trees) or brush. Areas of blue and blue lines indicate bodies of water. Areas that are white are usually areas with little or no vegetation, such as desert or rocky alpine areas. Wilderness, national park, and national forest boundaries consist of black, dashed, dotted lines tinted with green, brown or gray shades. Consult the map legend for specific tints. Features that are denoted by lines are: topographic contours, shown in brown, streams, rivers and lakes in blue, and roads, trails, and boundary lines, usually in black. Some lines are solid, some are dashed, and the width and darkness of lines often vary in order to distinguish features from one another.

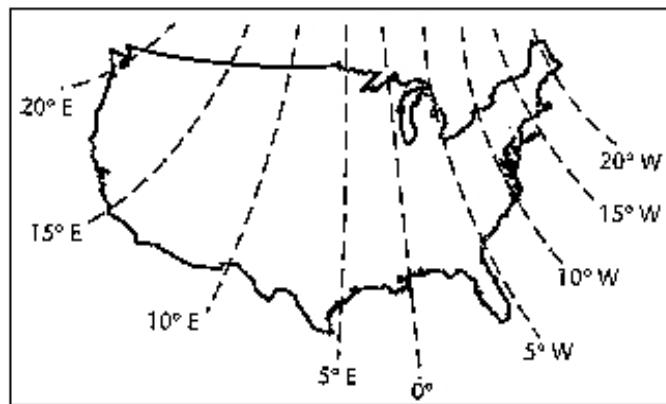
The Compass

It is important to know how to use a compass if you plan on venturing into the backcountry. First, a quick explanation on what a compass is. A map compass has a magnetized needle in a liquid-filled vial that can be rotated relative to its clear base. Around this vial is an azimuth ring that indicates 0-360 degrees. Declination (explained below) can be accounted for by offsetting the orienting arrow the appropriate number of degrees east or west. Map compasses can be used for navigating precisely with or without a map.

The magnetic needle on a compass points to magnetic north. The dial, orienting arrow, and sighting line are used to help you find East, West, South, and the points in between.

Declination

Unfortunately, true north and magnetic north are not located at the same place. A compass needle points to magnetic north; the number of degrees East or West that magnetic north and true north are separated by is known as declination. Many compasses have built-in declination adjustments; others do not. For accurate compass readings, it is necessary to account for declination. The isogonic chart at right roughly shows declination for the United States.



If, for example, you are in the White Mountains of New Hampshire, you will have a west declination of about 16 degrees, meaning that magnetic north is 16 degrees west of true north. By aligning your magnetic needle 16 degrees west of true north (360 degrees minus 16 degrees, or 344 degrees), the azimuth ring will then be correctly oriented for true north. For compasses that do not have built-in declination adjustments, it is common practice to place a small piece of tape at the declination point of the azimuth ring. In other words, if you are in an area with a westerly declination, align the magnetic end of your compass needle to 360 minus the declination. If, however, you are in an area with an easterly declination, align the magnetic end of your compass needle to the number (degree) on your dial that is the declination.

Taking a Bearing

A bearing is a degree reading taken from your position to another object. If, for example, a mountain peak was directly east of your position, the bearing of the mountain would be 90 degrees. If the peak was directly south, its bearing would be 180 degrees, and if the peak was directly west, 270 degrees. To take a bearing, hold the compass level in front of you. With the sighting line on the base of the compass pointing straight at the object you are taking a bearing on, turn the dial until the magnetic needle is lined up with your declination tape (or the orienting arrow, if your compass has a built-in adjustment for declination). The degree reading indicated at the sighting line is the bearing to your object.

Using Map & Compass for Navigation

I'd like to explain how to pinpoint your location while you are backcountry. You can locate yourself by the intersection of lines. If you are already on a marked trail, or along a stream, or on a ridgeline, then you already have one line, and need only one more to determine your location on the map. If you aren't on a known line, then you'll need two lines to determine your location. To get the line(s) you need, take bearings on identifiable landmarks. When you plot these bearings on your map, their point of intersection indicates your location.

First, use your compass to orient your map and place the map on a flat surface (the ground) and anchor the corners with rocks. Then, take a bearing on a landmark some distance away that is also identified on the map. Next, set the compass on the map with a front corner of the baseplate aligned with the landmark. Now rotate the compass, keeping the pivot point on the landmark, until the magnetic needle is again aligned with your declination tape. Draw a line along the edge of the compass base, from the pivot point back. Repeat this procedure with another landmark; the intersection of the lines on the map indicate your location.

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Using Map and Compass the Army Way

Tools (Materials needed for students to complete project):

Lensatic compass (one for each pair of students)

Protractor (one for each student)

Topographical map of location for Student Activity four

(one for each pair of students)

Paper for computing back azimuths

Sharp pencil (.05 lead) for plotting azimuths

Classroom with overhead projector

Outside area with 10 known points

(identifiable on a map and over 1000 meters from working area)

Lesson 1: Determining magnetic azimuths using a lensatic compass. The center hold technique is the fastest and easiest way to measure a magnetic azimuth.



1. Make sure the needle on the lensatic compass is floating freely.

2. Hold the compass between the forefingers and thumbs of both hands and pull your elbows down to your sides (Figure 1). This action will place the compass between your chin and waist.

3. To measure an azimuth, simply turn your entire body toward the object, pointing the zero or index mark directly at the distant known location.

4. Once you are pointing at the object, look down and read the azimuth from beneath the fixed black index line. The second diagram at right (Figure 2) illustrates a magnetic azimuth of 320 degrees.

You must measure at least two well defined distant locations that can be pinpointed on the map. Two is what we will cover in this lesson but three would be more accurate. To determine the second azimuth repeat steps 2 to 4 on another well defined distant location.

Be sure you are away from power lines, vehicles or other metal objects when using a compass, these objects will affect its performance!

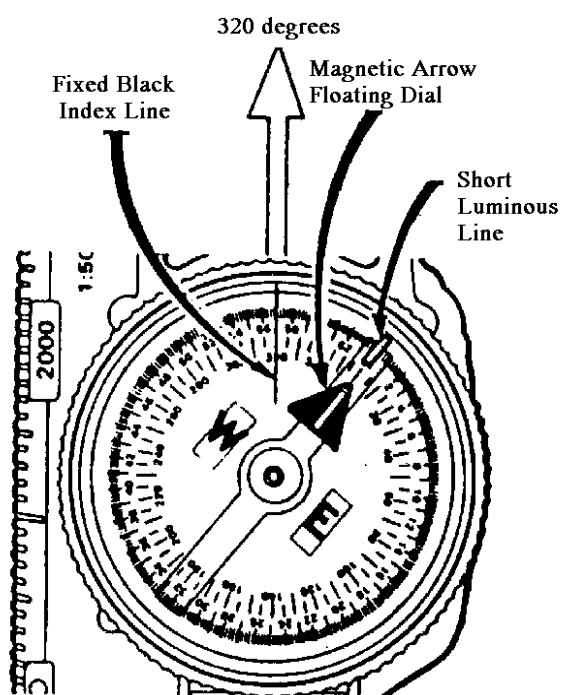
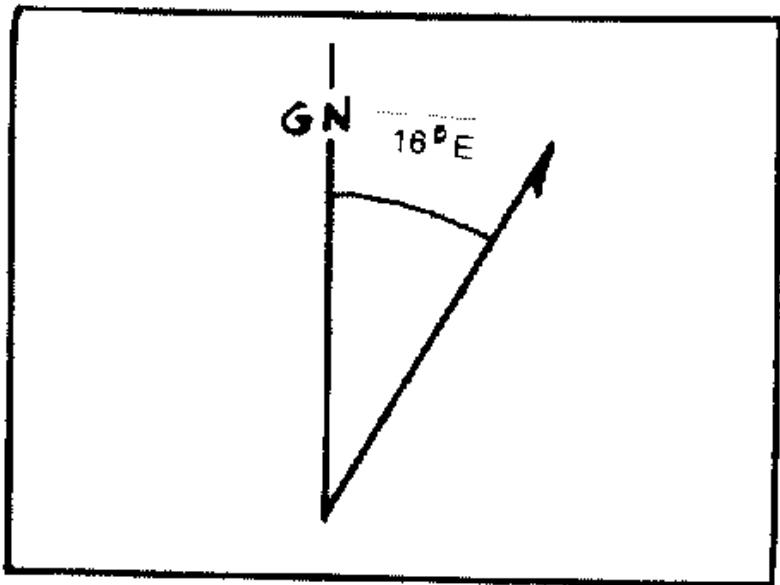
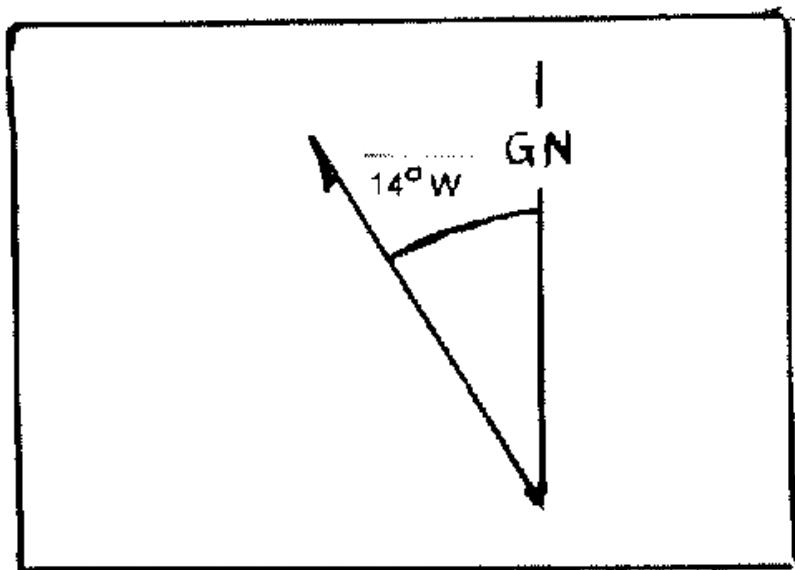


diagram is to the right of the grid North line (marked with an E in the G-M angle) add the G-M angle to the magnetic azimuth. If the result of this addition is larger than 360 degrees you must subtract 360 degrees to determine the grid azimuth.



If the magnetic North arrow is to the left of the grid North line (marked with a W in the G-M angle) subtract the G-M angle to determine the magnetic azimuth. If the result of this subtraction is a negative number you must add 360 degrees to determine the grid azimuth.



The angular difference between grid and magnetic North is caused by the attraction of the Earth's magnetic field. This field is found in Northern Canada.

Lesson 3: Convert grid azimuths to back azimuths

You have done the first two of the four steps in locating yourself on a topographical map. You have located two distant known points. You have converted their magnetic direction to a grid (or map) direction. You know the direction to them but not to your location. To determine your location you must compute the back direction. The back azimuth is determined by adding or subtracting 180 degrees to the grid azimuth. This lesson will assist you in learning how to convert the grid azimuth to a back azimuth. In the fourth (last lesson) you will be able to plot the two back azimuths and determine your location. First you learn to convert grid azimuths to back azimuths.

To determine back azimuths that are less than 180 degrees
add 180 degrees.

To determine back azimuths that are more than 180 degrees
subtract 180 degrees.

Examples:

Grid azimuth = 107 degrees (add 180) $107 + 180 = 287$ degrees

Grid azimuth = 243 degrees (subtract 180) $243 - 180 = 063$ degrees

Lesson 4: Convert grid azimuths to back azimuths Plot back azimuths. Determine location on a topographical map

You have done the first three of the four steps in locating yourself on a topographical map. You have located two distant known points. You have converted their magnetic direction to a grid (or map) direction. You know the direction to them but not to your location. Now that you have learned to convert the grid azimuths to back azimuths you are ready to finish up. This lesson helps you understand how to plot the back azimuths. The two or three back azimuths will intersect at a location on the map. Where they intersect is your location (X marks the spot).

Orient the map toward the North 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 first of the two or three known positions from your location using a compass (lesson 1).

Convert the magnetic azimuth to a grid azimuth (lesson 2).

Convert the grid azimuth to a back azimuth (lesson 3).

Using a protractor, draw the back azimuth on the map from the known distant position back toward your unknown position.

Repeat the steps in blue for a second and optional third known distant position.

The intersection of the lines is your location.

K. DEFINITIONS

Grid Lines

1. **AZIMUTH** (bearing, direction) - A horizontal angle in respect to North (degrees, 6400 mils). It is read on the dial of the lensatic compass in either degrees or mils, by the number directly under the black index line.

Example: Azimuth of 90 degrees or 1600 mils (Read 16) is due East.

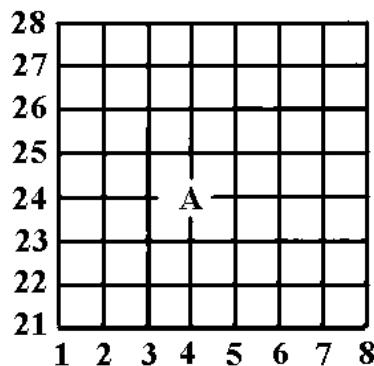
2. **COORDINATES** The North / South and East / West lines on a Map (grid lines). Positions are determined on a map by intersecting coordinates. The lower left is the origin and coordinates are read to the right and then up.

3. **NORTH** Generally a topographical map (a map using contour lines to show elevation and make possible the identification of canyons, peaks, ridges and other terrain features) shows three North's in the declination diagram.

a. **TRUE NORTH** The actual position of the North Pole of the Earth's surface. It is the Northerly Point toward which the Meridians (North, South or longitudinal lines) between the Poles are drawn. Maps generally are oriented to true North. (Shown at left by a ray or line tipped with a star \star).

b. **MAGNETIC NORTH** An irregular and wavering magnetic force which tends to run generally Northward and Southward, causing a compass to point variously, depending on location. These magnetic 'Polar Areas' are more than 1000 miles away from the North and South Poles and it is in these directions that the compass magnet points. (Shown by a ray tipped with **MN** and / or a single barbed spear.)

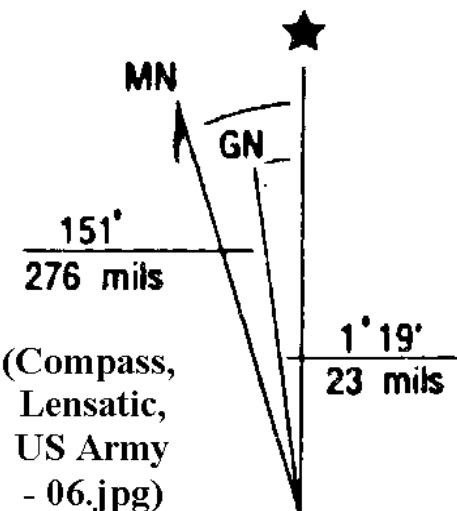
c. **GRID NORTH** The North indicated by the Map Meridians running longitudinally. Because of the Earth's curvature, these lines are often pulled a little away from the true Meridian in order to provide a straight line, rectangular layout of coordinates. (Shown above by a ray tipped with **GN**.)



The Position of A is read 4 -24

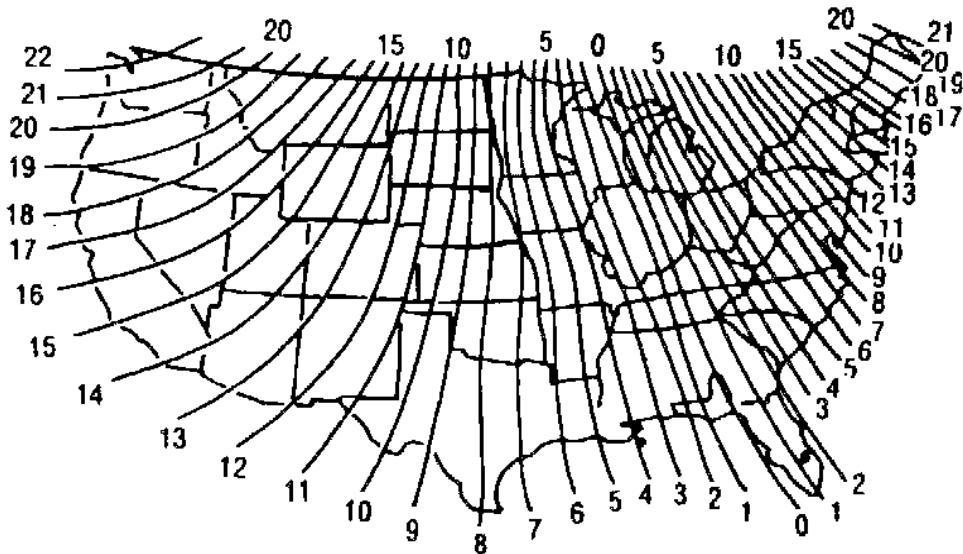
Read the number along the right first and then the number the from bottom to the top.

(Compass, Lensatic, US Army - 05.jpg)



(Compass, Lensatic, US Army - 06.jpg)

4. **MAGNETIC DECLINATION** The horizontal angle (difference in degrees) between Magnetic North and True North. The Magnetic Declination Angle varies from area to area and from time to time; generally about $1'$ (one minute) per year. (There are 60 minutes to one degree). The picture below shows an Isogonic Chart for the U.S. This chart is helpful to understand how Magnetic North readings will vary from True North for different parts of the country. This declination (variation, angular difference) will be shown in the Declination Diagram or stated in the marginal information on your Map.



(Compass, Lensatic, US Army - 07.jpg)

- A. Lines to the left of the Zero Declination Line on the Isogonic Chart are called Easterly Variation. The **N** Arrow of the lensatic compass will point East of True North.
- B. Lines to the right of the Zero Declination Line on the Isogonic Chart are called Westerly Variation. The **N** Arrow of the lensatic compass will point West of True North.
- C. When the lensatic compass is used with a map or in conjunction with a map bearing, an adjustment should be made to allow for the variation. This is not necessary for rough compass work. In areas where the variation is slight, or for maps that use Magnetic North to locate the longitudinal grid lines (such as some orienteering maps).