GTA 05-02-013

HOW TO AVOID GETTING LOST

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PREFACE

This GTA illustrates the fundamentals of map reading. It supports individual and unit training for basic map-reading programs of the Active Army (AA), the Reserve Component (RC), and the Army National Guard (NG).

The information presented herein conforms as closely as possible to approved Department of the Army (DA) doctrine and is intended to complement existing training literature.

The proponent for this publication is Headquarters, US Army Training and Doctrine Command (TRADOC). To submit changes for improving this publication, use DA Form 2028 (Recommended Change to Publications and Blank Forms) and forward to Commandant, US Army Maneuver Support Center (MANSCEN), ATTN: ATZT-DT-WR-E, Fort Leonard Wood, Missouri 65473-8929.

INTRODUCTION

When you get lost in combat, you may encounter the enemy, fail your mission, and have trouble getting back to your unit.

To avoid getting lost, use—

- A map.
- A compass.
- Other ways to find directions.
- Common sense.

From this GTA, you will learn what you will need to know about military maps and direction finding so that you can move about with confidence without getting lost.

The first thing you should know about a map is that it is nothing more than a drawing of a section of the earth's surface as you would see it if looking straight down from an airplane.

Maps show man-made objects such as roads, buildings, and bridges. All of these man-made objects are represented by a symbol, and the symbols are explained in the lower left hand corner of every map in a section called the "legend" (Figure 1).

Besides giving symbols for man-made objects, the legend gives the color coding used on the map and explains the meaning of other symbols, which gives you a better idea of what the ground actually looks like. Be sure to always look at the legend before using your map.

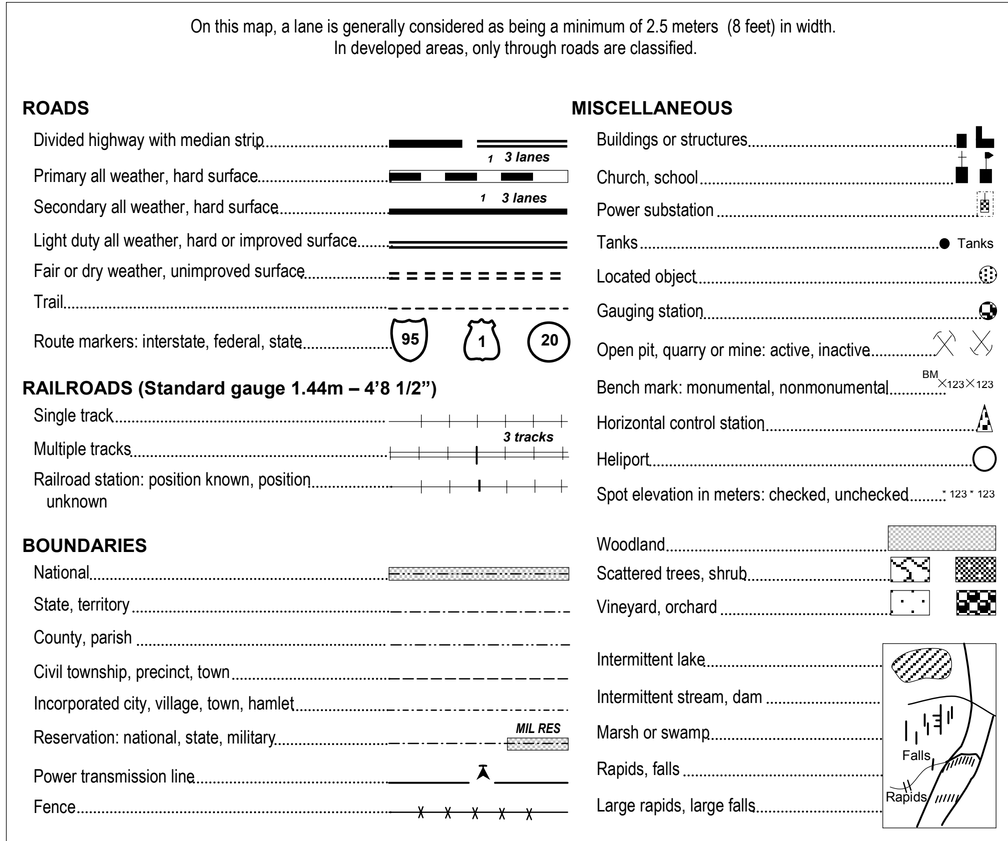

Figure 1. Example Map Legend

FINDING YOUR LOCATION

To avoid getting lost, you have to know how to find your location. There are no street addresses in a combat area. However, by using a military map, you can find your location without difficulty. Maps have black lines running up and down (north and south) and crosswise (east and west). These lines form small squares called "grid squares" that are numbered along the outside edge of the map picture. Using these numbers, you can identify each grid square.

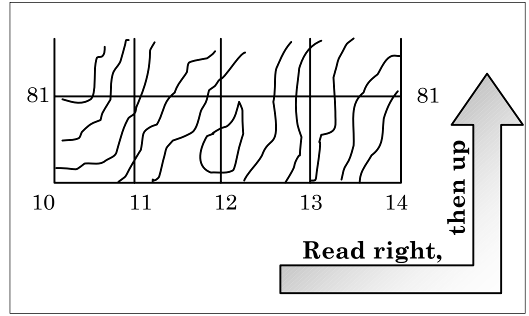

Figure 2. Map Grid Squares

No two squares have the same number. To get the right numbers for a certain grid square, read from left to right along the bottom and locate the line that borders the grid square on the left. Then read up and find the east-west line that borders the grid square along the bottom (Figure 2).

Figure 3 shows your location as grid square 1181. How do you know this? Start from the left and read right until you come to 11, and then read up to 81. Your location is somewhere in the grid square of 1181. Remember to read from left to right, then up.

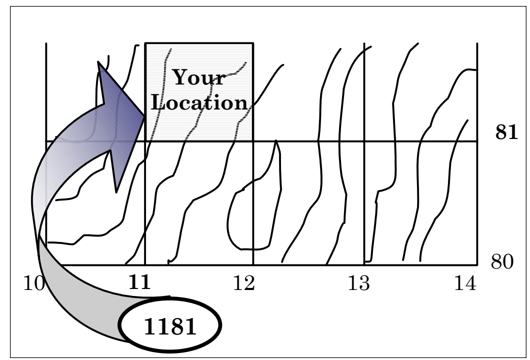

Figure 3. Grid-Square Location

Grid square 1181 gives your general location, but there is a lot of area inside that grid square. To make your location even more accurate, you will need to add another number to the first half and another to the last half.

To get these numbers, imagine that each grid square has ten lines inside it running north and south, and another ten lines running east and west. This makes 100 small squares (Figure 4). You can estimate where these imaginary lines are.

Suppose that you are halfway between line 11 and line 12. Your first added number is 5 and the first half of your location is 115. And suppose that you are also three tenths of the way between line 81 and line 82. Then the second half of the number is 813. (If you were exactly on line 81, the second half would be 810.)

Figure 4 shows that if you were located where the dot is in grid square 1181, your location would be 115813.

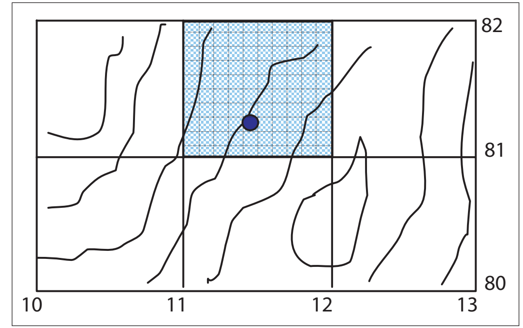

Figure 4. Grid-Square Coordinates

These six numbers are called your "coordinates." They give your location, and if you always know your coordinates, you can never be lost.

If you have GTA 5-2-12, you do not have to worry about estimating where you are inside a certain grid square or use imaginary lines because you can determine your exact coordinates (Figure 5).

The coordinate scale and protractor is a square piece of clear, thin plastic—frequently called a "protractor" for short. The protractor helps to measure small distances inside grid squares. You can also measure angles with it. You will learn more about measuring angles later. Your squad leader can show you exactly how to use the protractor.

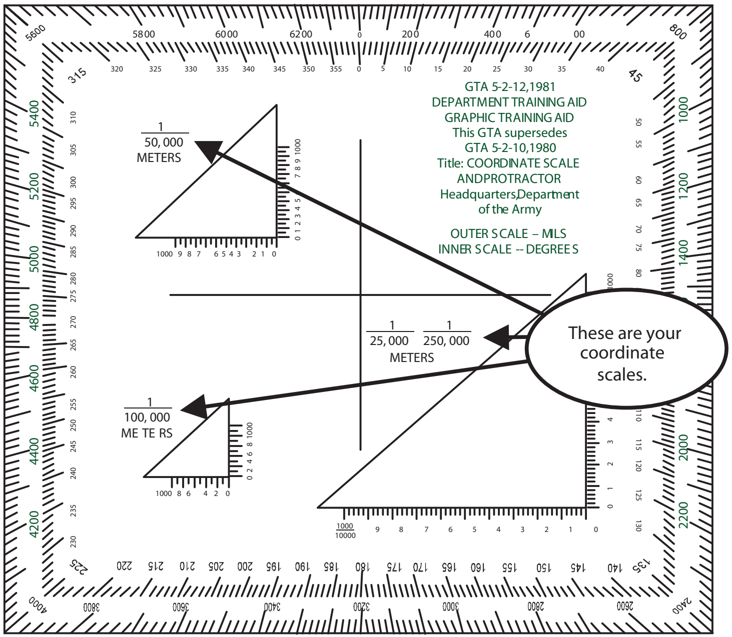

Figure 5. Coordinate Scale and Protractor

DETERMINING THE DISTANCE

You can also use your map to measure the distance between two places because maps are drawn to scale. This means that a certain distance on the map equals a certain distance on the earth. This scale is printed at the bottom and at the top of the map (for example, *Scale 1:50,000*). This signifies that 1 inch on the map equals 50,000 inches on the ground. In fact, any ground distance equals 50,000 times that distance on the map.

NOTE: Always check the scale on your map before trying to measure distance because different maps have different scales.

Two methods by which to determine distance are the—

- Bar scale method.
- Pacing method.

Bar Scale Method

There are three different bar scales at the bottom of your map. Use these scales to help convert map distance into miles, meters, or yards. To figure the distance on the ground using the bar scale method, take a ruler (straightedge) or use the edge of a piece of paper and put a tick mark on it at the straight-line distance between your two points (Figure 6). Then put the ruler or paper beneath one of the bar scales and read the ground distance in miles, meters, or yards.

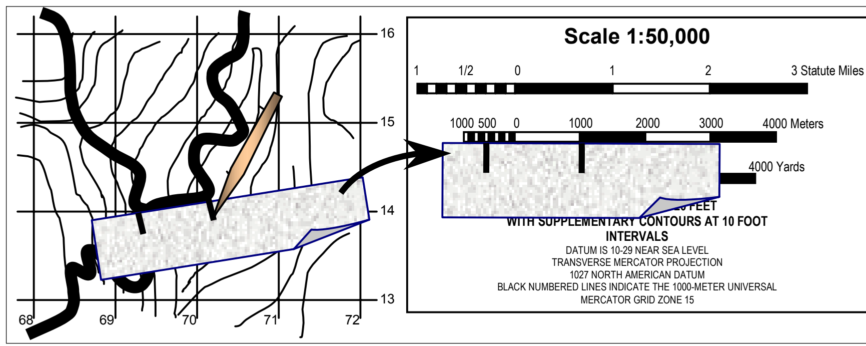

Figure 6. Finding Straight-Line Distance Using Bar Scales

Estimating the scale between the marks, the bar scale in Figure 6 shows a ground distance of about 1,520 meters.

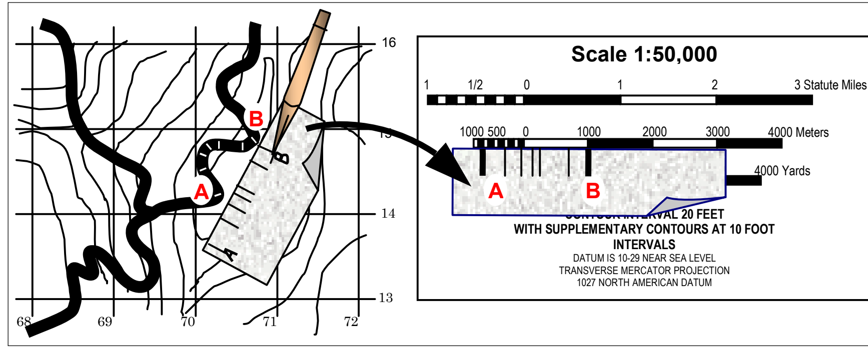

Figure 7. Finding Distance Around Curves Using Bar Scales

Suppose you want to find the distance between point A and point B around a curve in a road (Figure 7). Take a strip of paper, make a small tick mark on it, and line up the tick mark with point A. Align the paper with the road's edge until you come to a curve, make another tick mark on the paper and on the map, then pivot the paper so it continues along the road's edge. Repeat this until you get to point B, always following along the road's edge with your paper. Make a mark on your paper at point B, then go to the bar scales to find the distance.

Pacing Method

When you have to go a certain distance on foot without any landmarks to guide you, you can measure distance pretty accurately by counting your paces. The average pace is just a little less than 1 meter. The average person uses 116 paces to travel 100 meters.

NOTE: If you find that you do not take 116 paces for 100 meters, determine how many paces you do take by pacing yourself on a known 100-meter distance.

When traveling cross-country, as you do in the field, you will use more paces to travel 100 meters—usually about 148 instead of 116. This is because you are not traveling over level ground and must use more paces to make up for your movement up and down hills. Pace yourself over at least 600 meters of cross-country terrain in order to learn how many paces it takes you to travel an average 100 meters. Be sure you know how many paces it takes you to walk 100 meters on both level and cross-country terrain.

The big problem in pacing is maintaining a straight line. At night, the average person tends to walk in a circle if he does not use a compass. During the day, you should use a compass and steering points (well-defined objects in your direction of travel toward which you may steer). Also, remember to figure only the straight-line distance when you have to walk around an obstacle.

Another problem in pacing is keeping count of the paces taken. One way to keep count is to use pebbles. For instance, suppose you want to pace off 1 kilometer. (One kilometer is 1,000 meters or the distance between two of the black grid lines on your map.) Put 10 pebbles in your right pocket. When you go 100 meters, move one pebble to your left pocket and start your count over. When all 10 pebbles have been moved to your left pocket, you have traveled 1 kilometer. Another way to keep count is by tying knots in a string—one knot per 100 kilometers.

FINDING THE CORRECT DIRECTION

You have learned how to find your location (map coordinates) and how you can use the map scale to determine the distance. The next step is to find the correct direction. These three things will keep you from getting lost.

The top of the map is north, the right edge is east, the bottom is south, and the left edge is west. The direction from one point to another point (either on the map or on the ground) is called an azimuth.

Azimuth

Azimuths are given in degrees in a clockwise direction. Since there are 360° in a circle, your azimuth can be any number up to 360°. Due east is 90°, due south is 180°, due west is 270°, and due north is 360° (Figure 8).

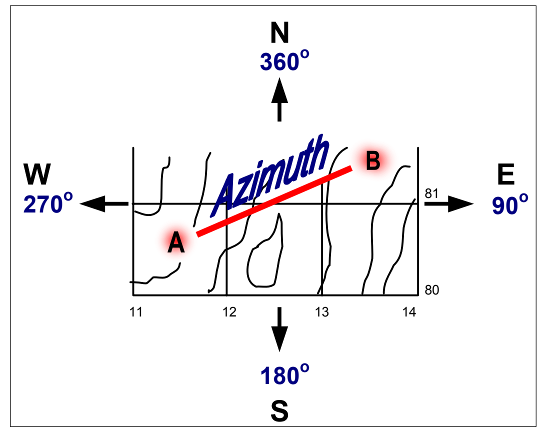

Figure 8. Azimuth

To get the right azimuth from a map, you have to use a protractor. If your coordinate is 220850 and you want to find the azimuth to a certain road junction, draw a line from your location to the road junction. Then place the protractor as shown in Figure 9.

Be sure to line it up properly, keeping the cross-center lines of the protractor parallel with the grid lines. The azimuth as shown by the protractor is 223°.

Suppose you follow the 223° azimuth to the road junction, and then you want to go back to your original location. To do this, you must take a back azimuth. Simply subtract 180° from the first azimuth. Your back azimuth is 223° minus 180°, which equals 43°.

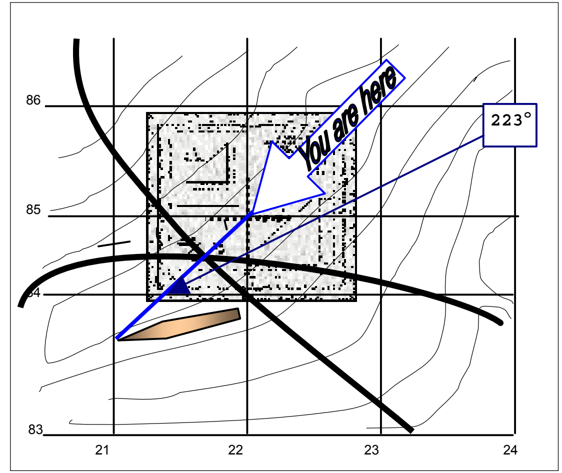

Figure 9. Finding Azimuths Using a Protractor

If you cannot subtract 180° from your first azimuth because it is too small, then just add 180°. For example, if your azimuth was 40°, you know that you cannot subtract 180° from it, so add 180°. The back azimuth would be 40° plus 180°, which equals 220°. Remember, a back azimuth goes in the opposite direction from the azimuth.

CAUTION

When converting azimuths to back azimuths use extreme care when adding or subtracting the 180°. A simple mathematical mistake could cause disastrous consequences.

North

The north-south lines on a map give grid north. The compass needle points to magnetic north. Grid north and magnetic north usually have a few degrees difference. Neither points straight at the North Pole—that is called "true north." However, it is not necessary to know where true north is to avoid getting lost in a combat area.

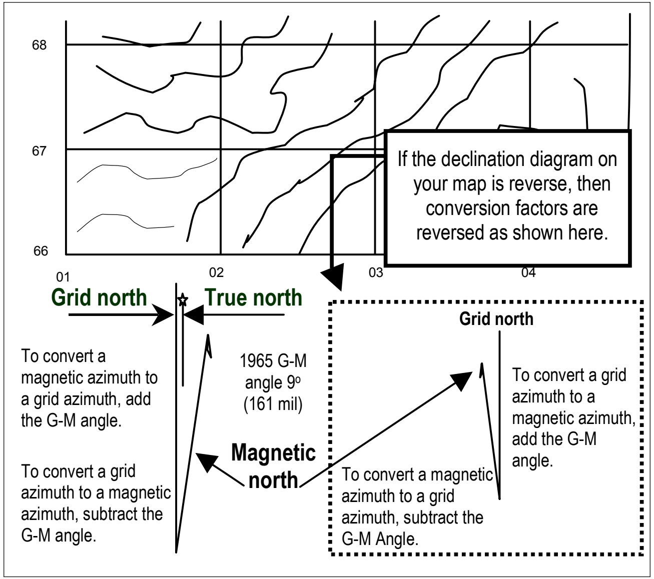

Figure 10. North

The difference in degrees for every map between grid north and magnetic north is shown at the bottom of the map (Figure 10). This difference is called the "G-M angle" (Figure 11). The diagram at the bottom of newer maps shows how to change grid azimuths to magnetic azimuths and magnetic azimuths to grid azimuths.

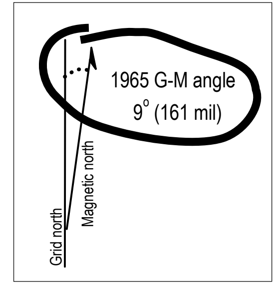

Figure 11. G-M Angle

For example, you aim your compass at a distant tower and get a compass reading of 190º (Figure 12). This is called a magnetic azimuth. The diagram on the map shows that the G-M angle is 9º. To convert the magnetic azimuth to a grid azimuth, add the G-M angle 9º to the compass reading of 190º. This gives you a grid azimuth of 199º. Most times, the G-M angle is so small that you do not have to be concerned with it. It depends on what region of the world you are in. Your squad leader will tell you if the G-M angle is large enough in your area to have to apply it.

Compass

Use your compass to find or follow an azimuth. The compass arrow points towards magnetic north. The arrow is also attracted by any mass of metal such as a jeep, a truck, your rifle, your helmet, and even electrical power lines. Therefore, to get correct readings when using your compass, avoid any metal objects. To shoot an azimuth, use the center-hold technique (Figure 13). It is faster, easier, and more accurate than the old sighting method.

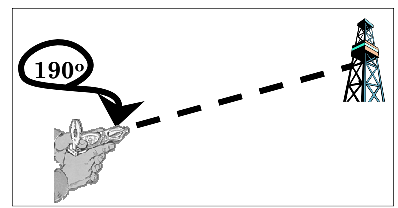

Figure 12. Magnetic Azimuth

First, open the compass so that the cover forms a straight edge with the base. The lens of the compass is moved out of the way. 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. Next, place the thumb of your other hand between the eyepiece and the lens, extend your index finger along the other side of the compass and your remaining fingers around the fingers of your other hand, and pull your elbows firmly into your sides. This puts the compass between your chin and your belt.

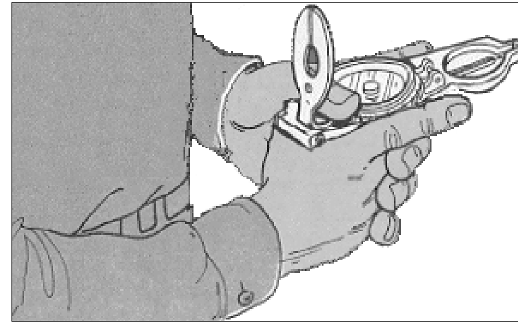

Figure 13. Center-Hold Technique

To measure an azimuth, turn your entire body toward the object, pointing the compass cover directly at the object. Once you are pointing at the object, simply look down and read the azimuth from beneath the fixed black index line. You can even use this method at night.

If you are land navigating, stop occasionally to check the azimuth along which you are moving to keep from going in circles. You can move from object to object along your path of travel by shooting an azimuth to each object and then moving to that object. Repeating this process while you navigate should keep you on a straight path.

It is important to know your compass. The lensatic compass shown in Figure 14 is the most common and simplest instrument used for measuring direction. Your compass is a sensitive instrument and care should be taken in its use and handling.

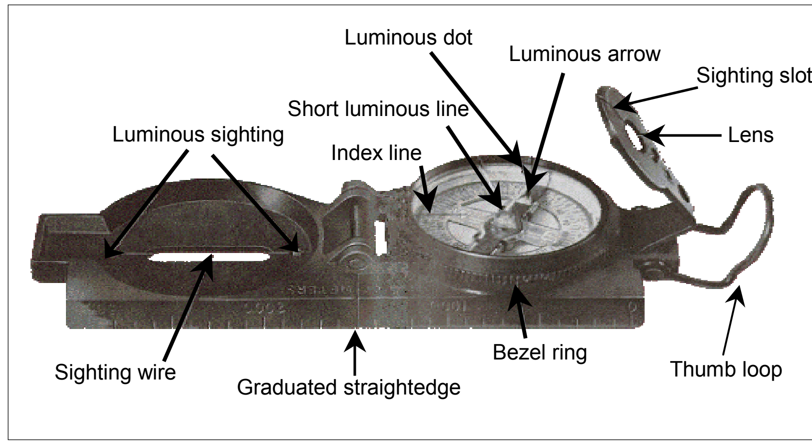

Figure 14. The Lensatic Compass

Your compass can also be used at night. The lensatic compass shown has luminous lines and dots. The bezel ring is a ratchet device that clicks when turned. All of these features are built into the compass to help you set an azimuth and follow it at night. How to keep your compass on course at night takes a little know-how. Your squad leader will assist you with all you need to know, or you can use Field Manual (FM) 21-26.

OTHER METHODS OF FINDING DIRECTION

There are other methods of finding your direction when you do not have a compass. Several of these methods include the—

- Shadow-tip field-expedient method.
- Watch method.
- Star method.

Shadow-Tip Field-Expedient Method

The old rule that "the sun rises in the east and sets in the west" is a pretty good rule, but it is not quite right. Very seldom does the sun lie due east (exactly 90^{o}) or due west (exactly 270^{o}) on the horizon. Where exactly it does rise and set depends on where you are on the earth's surface and also on what time of year it is. In the morning, the sun rises almost east and in the afternoon it sets almost west. However, you can still use the sun to find direction by using the shadow-tip field-expedient method. This method is quick, easy, and very accurate. Figure 15 illustrates how to do it in three simple steps.

Step 1. Place a stick or branch in 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 west.

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. This second shadow mark is always east.

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

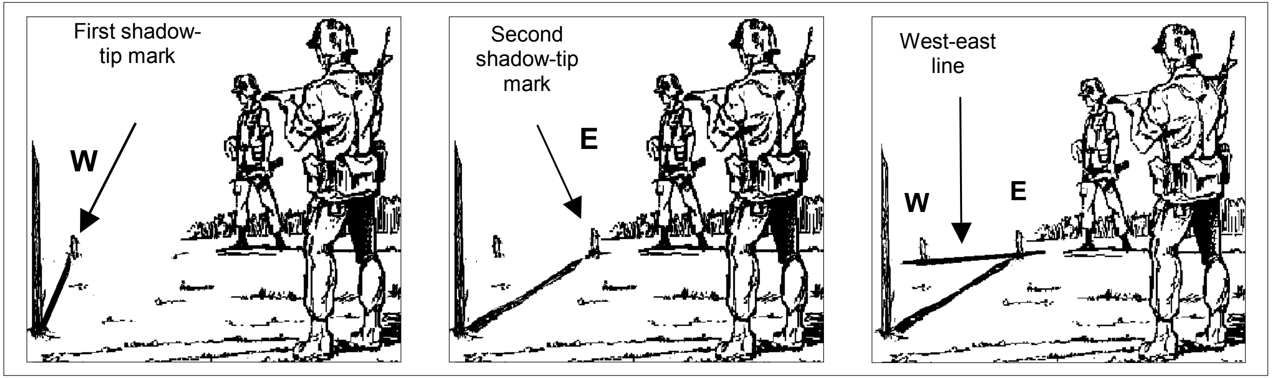

Figure 15. Shadow-Tip Field-Expedient Method

Now, to determine your north-south line, stand with the first mark (west) to your left (Figure 16). The other directions are north to the front, east to the right, and south behind you.

Remember to place your stick vertically into the ground. Mark the tip of each shadow. The first tip is always west and the second tip is always east. Draw a north-south line perpendicular to the west-east line.

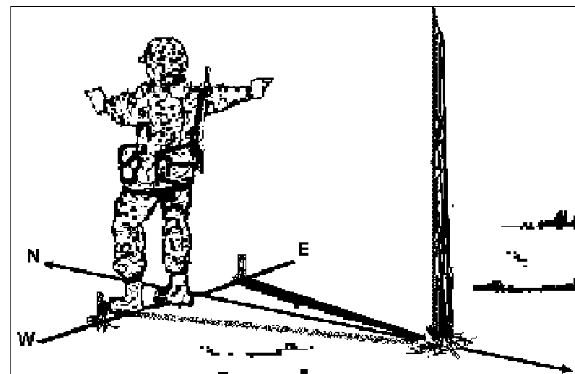

Figure 16. North-South Line

Watch Method

You can use your watch to determine the approximate true north and true south. However, it is not as accurate as the shadow-tip method.

In the North temperate zone, point the hour hand toward the sun (Figure 17). Your south line is 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.

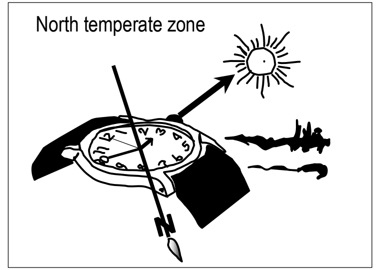

Figure 17. North Temperate Zone

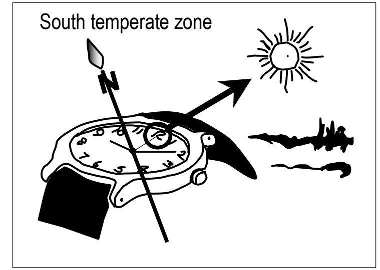

Figure 18. South Temperate Zone

This method is different in the South temperate zone (Figure 18). Point the 1200 hour toward the sun, and midway between the 1200 hour and the hour hand will be your north line. If on daylight saving time, the north line lies midway between the hour hand and 1300 hours. **NOTE: 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.**

Star Method

At night, you can locate north by finding the North Star, Polaris (Figure 19). First, find the Big Dipper. The last two stars of the dipper's cup point directly at Polaris—about 5 times as far out as the distance between those two stars. Facing Polaris, you are looking north, with east on your right and west on your left.

Once you are able to find north (using your compass, the sun, your watch, or the stars), you are then ready to locate your position on the map. There are many good ways to locate your position on the map. First, do one important thing—orient your map. **NOTE: Your map must be oriented so that north, south, east, and west on the map point the same way as they do on the ground.**

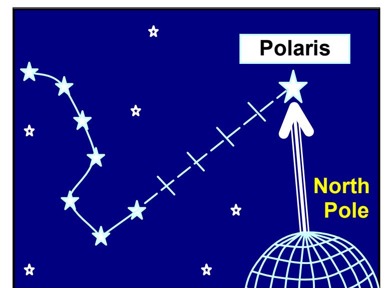

Figure 19. Polaris

FINDING YOUR POSITION

Resection

To locate your position when you do not know exactly where you are, orient your map as closely as possible by using one of the methods previously mentioned.

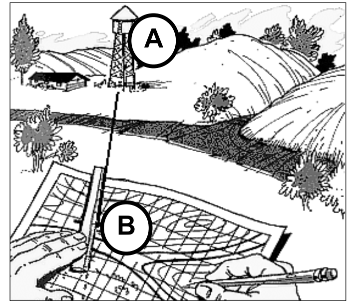

Figure 20. Water Tower

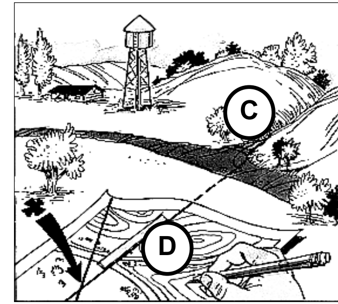

Figure 21. Road Junction

Next, look for a feature such as the water tower (A) that you can find on the map (Figure 20). Put a ruler or straightedge on the map, and place its edge right next to the water tower symbol (B) on the map. Then align the straightedge so that it points exactly at the real water tower. Draw a line along the ruler (the line will cross the water tower symbol on the map).

Find another feature such as the road junction (C), and do the same thing (Figure 21). When you lay the straightedge on your map and point it at the real road junction, its edge crosses over the road junction on the map (D). Draw another line along the ruler until it crosses (intersects) the first line. The point where the lines intersect is your location. This is called “resection.” A third line may help locate your position more accurately. Remember not to move your map once you have it properly oriented.

Modified Resection

If you know that you are located somewhere along a certain linear feature on the map such as a road or riverbank, then you can use an easier method to pinpoint your location—a method called “modified resection.”

First, orient your map. Then locate a feature that you can also find on the map, such as the water tower in the previous example. Just as before, put a straightedge through the water tower symbol on the map and align the straightedge so that it points exactly at the real water tower. Draw a line along the ruler. The point where the line crosses the linear feature you are on is your location. If you do not have a regular straightedge, use your rifle's cleaning rod, a section of radio antenna, or even the edge of a C-ration box.

NOTE: Always orient your map as closely as you can—using your compass is the best way.

Figure 22 shows another way of using resection and modified resection to locate your position even closer than what you have just learned.

First, using your compass, shoot azimuths to your reference points, such as the water tower and the road junction. Next, convert the magnetic azimuths to grid azimuths, then determine the grid back azimuths and plot them on your map.

Your position is where these grid back azimuths intersect. For more details on this method, ask your squad leader or use FM 21-26.

Intersection

Suppose you want to find the location of a certain object that you can see in the distance, such as an enemy observation post (OP), but it is not on your map (Figure 23). First, shoot an azimuth to the object using your compass. If you have to, convert the magnetic azimuth to a grid azimuth. Next, draw a line on the map from your location along the grid azimuth that you came up with. The enemy OP lies somewhere along this line.

To find out where, move to another location where you can observe the same enemy OP or have another friendly element located somewhere else (who also sees the enemy OP) shoot an azimuth to it (Figure 24).

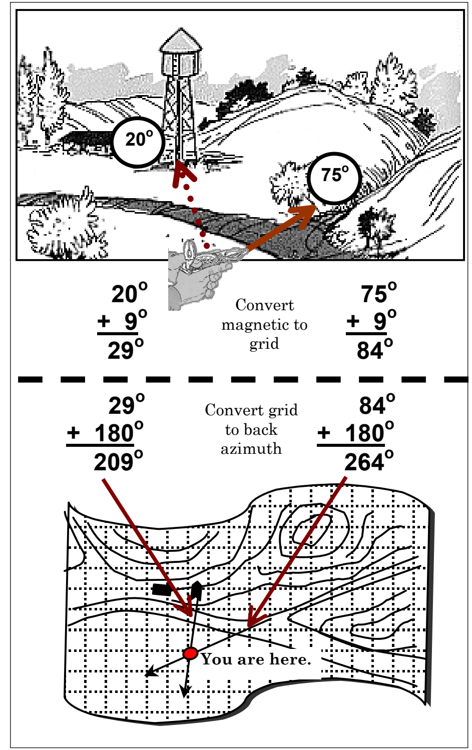

Figure 22. Calculating Azimuths

As before, convert the azimuth from magnetic to grid and draw it on your map (out from the point where the azimuth was taken). The enemy OP lies where the second line intersects with the first line. This method is called "intersection."

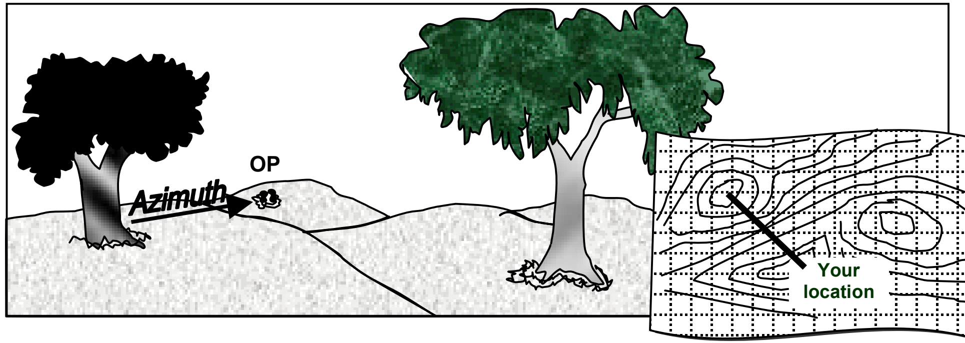

Figure 23. Intersection Process – Step 1

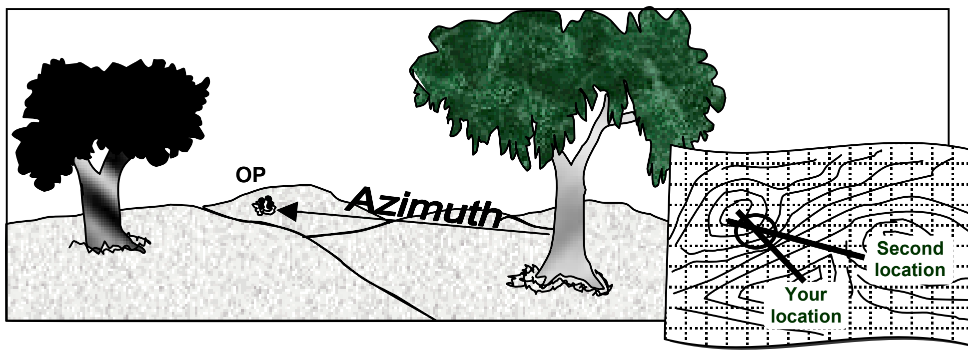

Figure 24. Intersection Process – Step 2

DETERMINING RELIEF AND ELEVATION

Your military map shows something important ordinary maps do not. This is elevation and relief—the slopes, hills, and valleys. You have already learned about locating points, measuring distances, and finding the right direction. But, you should also check hills and valleys along the direction you intend to travel before you start.

Elevation of a point on the earth's surface is the vertical distance it is above or below sea level. Relief is the representation (as depicted by the mapmaker) of the shapes of hills, valleys, streams, or terrain features on the earth's surface. There are several methods used by mapmakers to depict relief and elevation of the terrain. Contour lines are the most common method used on a standard military map.

Contour Lines

Contour lines are shown as brown lines on a map. Each line depicts the height above sea level. Contour lines never cross one another.

Printed at the bottom of the map is the contour interval, which is the difference in height (elevation) between one brown line and the one next to it. On a map with a scale of 1:50,000, the contour interval is usually 20 feet.

This would make point A 80 feet lower than point B (Figure 25). You can determine this because every fifth line is heavier than the rest and has a number that gives its elevation. You could also get an idea of how steep the slope is if you knew the ground distance between point A and point B.

The rate of rise or fall of a terrain feature is known as its slope. Contour lines widely spaced show a gentle slope; closer contour lines show a steeper slope. Figure 26 shows how the same hill would look from the ground. Note that side A would be the easier side to climb.

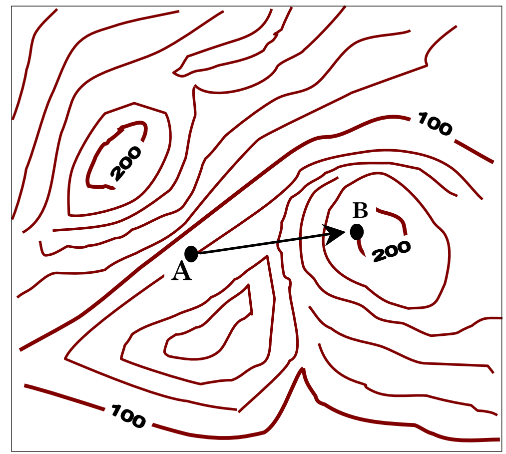

Figure 25. Contour Lines and Intervals

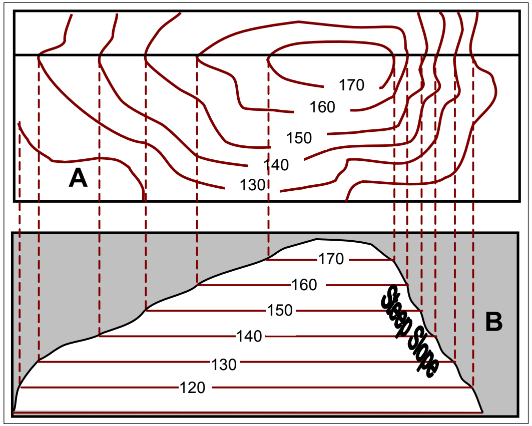

Figure 26. Determining Slope

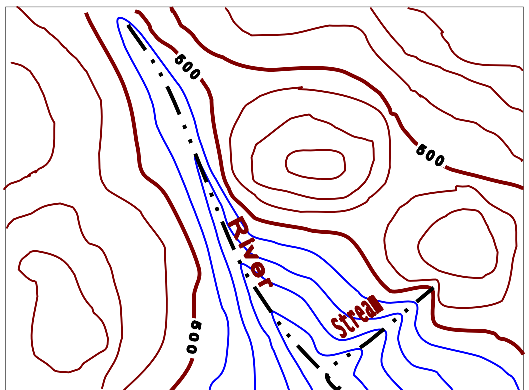

Figure 28. Stream

When the contour lines are close together at the top of a hill, the hilltop is pointed. The hilltop is flat when the contour lines are widely spaced at the top (Figure 27).

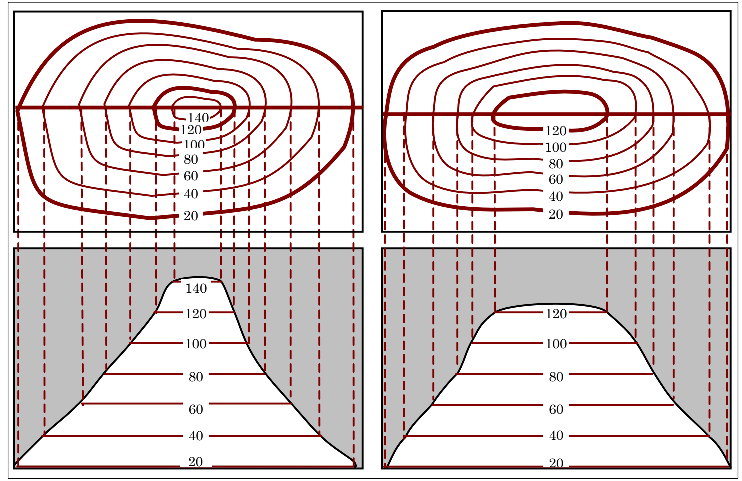

Figure 27. Hilltop Contour Intervals

Contour lines across a stream always come together in a V-shape (Figure 28).

The legend on the map shows water as blue. To determine the direction that the water is flowing, look at the contour lines. The V-shape always points upstream or toward high ground. So looking for a stream is a good way to find valleys. **NOTE: Remember to look at the slope (close contour lines equal a steep slope) before following a valley.**

Sometimes contour lines show two hilltops fairly close together. The lower terrain between the two hilltops is called a saddle (Figure 29).

If you are in a saddle, there is high ground in two opposite directions and lower ground in the other two directions. A saddle is normally represented as an hourglass shape. Going through a saddle is sometimes the easiest route to use to get beyond the two hills. Of course, you would not want to go through a saddle if the enemy was on the hills.

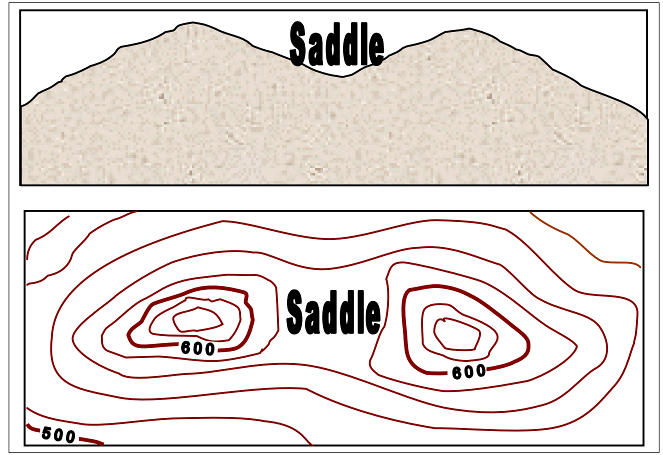

Figure 29. Saddle

Another terrain feature you should be familiar with is a ridge (Figure 30). A ridge is a fairly long, narrow section of terrain. If you are standing on a ridge, the ground will go uphill in one direction and downhill in the other three. Contour lines that form a ridge tend to be either U- or V-shaped. The closed end of the contour line points away from high ground. The path of the ridge, depending on your geographic location, may be either an almost unnoticeable slope or a very obvious incline.

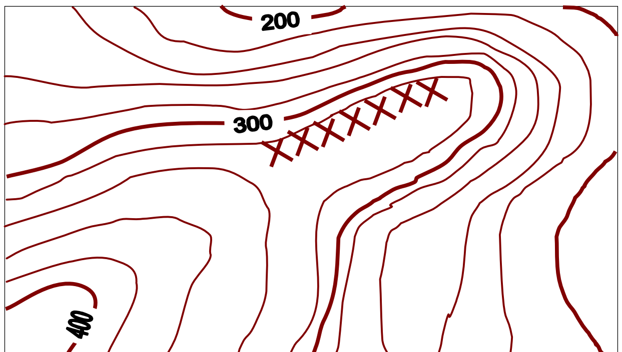

Figure 30. Ridge

You can also use contour lines to determine the line of sight from one point to another. For example, you are at point A and you want to see point B. To determine the line of sight, draw a line from point A to point B on your map (Figure 31). Note that it crosses some contour lines with higher elevation than both points. Therefore, you know you will not be able to see point B.

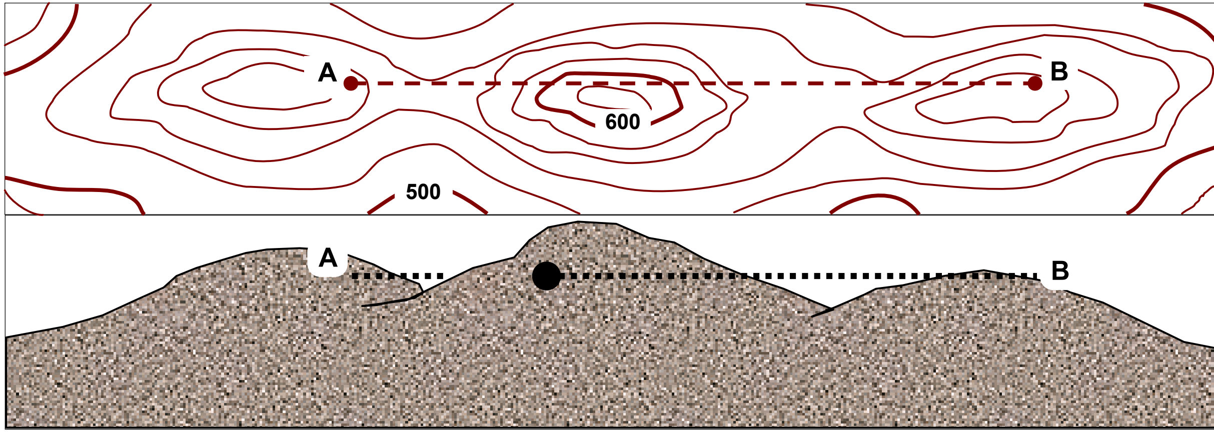

Figure 31. Determining Line of Sight

Remember that a contour line is a brown line on your map that connects points of the same elevation. You can find the contour interval in the margin at the bottom of your map. The heavy brown lines (every fifth one) have the elevation printed on them. You can tell from looking at your map what the slopes, hills, and valleys will look like on the ground.

CONCLUSION

You have learned from this booklet how to find your location and write it as a six-digit number coordinate. You have also learned how to measure distance, find directions, and read contour lines. If you use this information, you can avoid getting lost.

Practice and review this information before you have to navigate. Do not wait until you are lost before trying to remember what you should already know about map reading and land navigation. Also, take time to review FM 21-26.