REENACTORPRO

PRO TIPS:
Map Reading

Lesson 4: Angular measure and azimuths

References: **FM 21-25; FM 21-26; Map Lesson 4 in map section.**

Study assignment: read FM 21-25 Chapters 7 to 9, then go through this lesson and take the self-assessment quiz at the end.

Finding directions

Soldiers need to be able to specify directions—not just "the way to the PX" or "South", but precise angular measures. With this information in hand, for example, we can find our precise coordinates on a map my triangulation, adjust artillery fire, or locate and report enemy activity visible from yout location.

To do this, we require: a map; a protractor; a compass; and some special knowledge of how to use them.

Why bother" Because most reenactor units will go into the field several times a year, and it helps to know where you are and how to get where you're going. AND—as with map reading in general—it's a basic soldier skill taught to recruits in basic training. No reenactor who expects to interpret soldier experience should ignore basic soldier skills.

Degrees and angular measure

For navigation and routine map work, we generally us the degree as our measure. A full circle comprises 360 degrees (and has since the days of Babylonian astronomy!). Most of us know that a quarter of a circle is 90 degrees, half a circle is 180 degrees, and so on. In this lesson we will build on that, and add some rules of thumb that will help you handle a compass.

Note that gunnery uses a different angular measure: *mils*. A *mil* is 1/6400 of a circle. We do this because specifying a precise direction through a gun sight is hard if you're juggling degrees, minutes, and seconds. A mil is fine enough to allow us to use one simple statement of shift ("RIGHT THREE MILS, FIRE FOR EFFECT"). We will consider mils in other training topics.

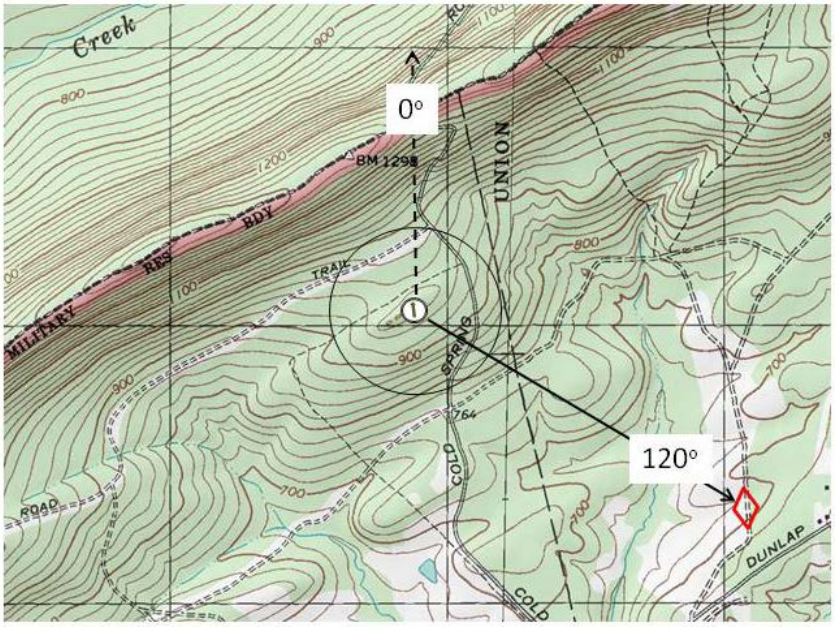
The azimuth

A compass direction is called an *azimuth*. It's an odd word, and comes to us from Arabic. It expresses an angular direction from due north measures in degrees, from one defined point to another defined point. For exaple, a location due east from where you stand lies along an azimuth of 90º.

(That's simple enough, but it gets messier, since there are really three definitions of "north": grid north, magnetic north, and true north. We'll be worrying mostly about the first two.)

Always remember: no matter which direction you are facing, north is always 0º. When you use the GPS in your car, you can generally set it so "up" is the direction you are taveling, or set it so "up" is north. Not so standing in the field with a compass.

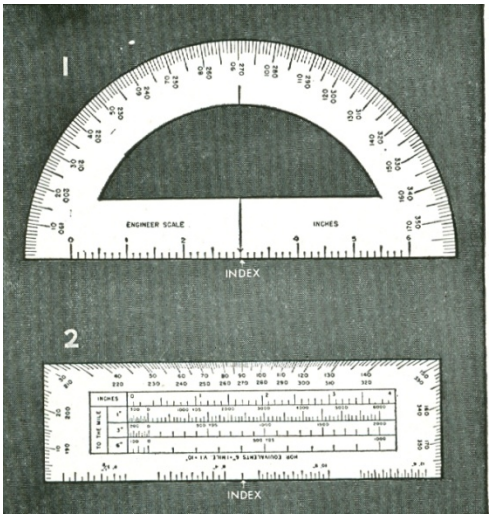
So, let's go stand in the field. Actually, on a hilltop.



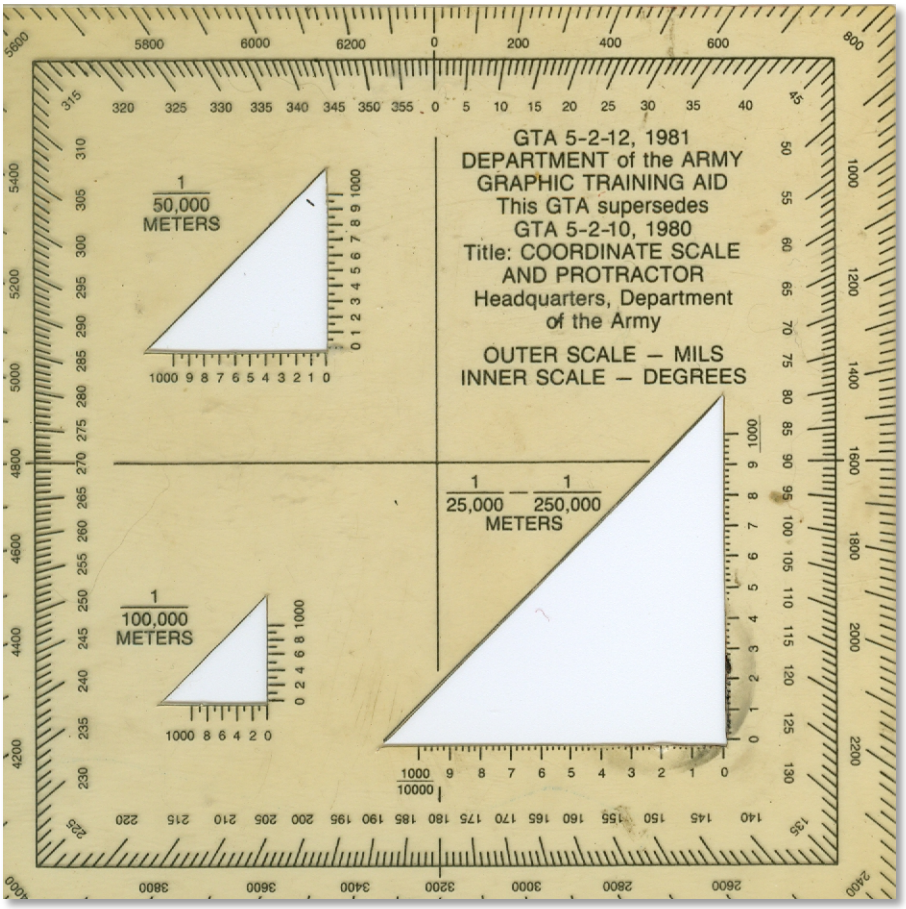
You are standing on the hill crest in the center of the map display (at the small compass symbol) manning an observation post (OP). You notice something moving north on a secondary road a bit over a kilometer away; it is a German tank (the red diamond is the military symbol for an enemy tank). You need to report its location, want to use a distance and an azimuth.

You determine the azimuth from your position to be 120º at a range of about 1.55 km.

First, how did you find the azimuth? There are two possible ways. First, we assume you have a map. If the target is at a known point and the target is at a known point, all you have to do is draw a line between them and fins the azimuth using your handy map protractor. Here are two examples of map protractors issued in WWII:



I prefer to use my own handy protractor, the kind I used for decades. It's transparent plastic and I can put it directly on the monitor screen to extract measurements. Note that it also has grid scales. The outer azimuth scale is in mils; the inner one in degrees.



The back azimuth

On occasion you may want to calculate a back azimuth, which is the opposite direction of an azimuth; in this example, it is the azimuth the German tank commander has calculated for a shot from his location to yours. Take a moment to move to your alternate OP position.

How do you calcumate a back azimuth? Easy, and you don't even need a protractor. Just remember this rule:

If the azimuth is less than 180, add 180 to get the back azimuth. If your azimuth is more than 180, subtract 180.

In our example, your azimuth (no need to call it a "front azimuth") is 120º. That is less than 180, so add 180. 120 + 180 = 300º. So the German tank commander sighting you on *his* compass is reading 300.

Declination

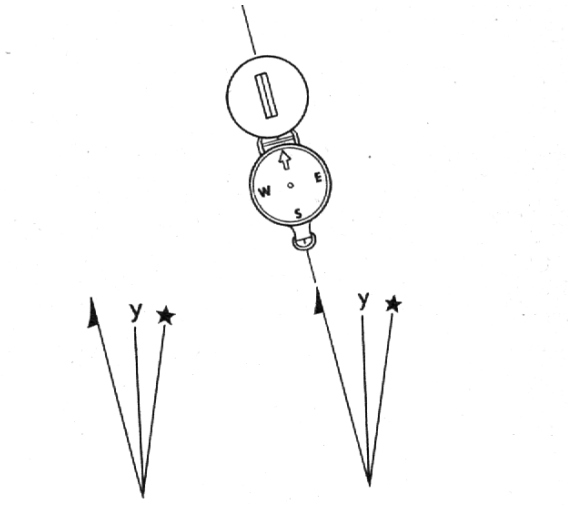
Now the bad news: there are really three "norths".

True north is the exact direction to the geographic North Pole, the point at which all the longitude lines meet. This doesn't change; it's arbitrary. It is important on large maps. But you will be using a small-scale map, and because of the mechanics of the projection used to translate a piece of a sphere onto a flat piece of paper, it isn't quite the same as the vertical grid lines on your map.

Grid north is a map convention based on the closest approximation of a polyconic projection to a small patch of the world. (If you're determined to be a map geek, check this out in **FM 21-26 Advanced Map and Aerial Photograph Reading** in the resource library.) The vertical grid lines on your map are aligned to grid north.

Magnetic north is north as read on the floating needle of your magnetic compass. The compass points to the magnrtic north pole, confluence of the top end of the lines of electromagnetic energy that surround the world and produced by sloshy rotation of molten ferromagnetic core materials in the center of the planet. But the magnetic north pole wanders around like a drunken monkey as time passes, and coincides with true north or grid north only by occasional accidents.

The differences between these directions is called **declination**. Here is a declination diagram for a particular map:

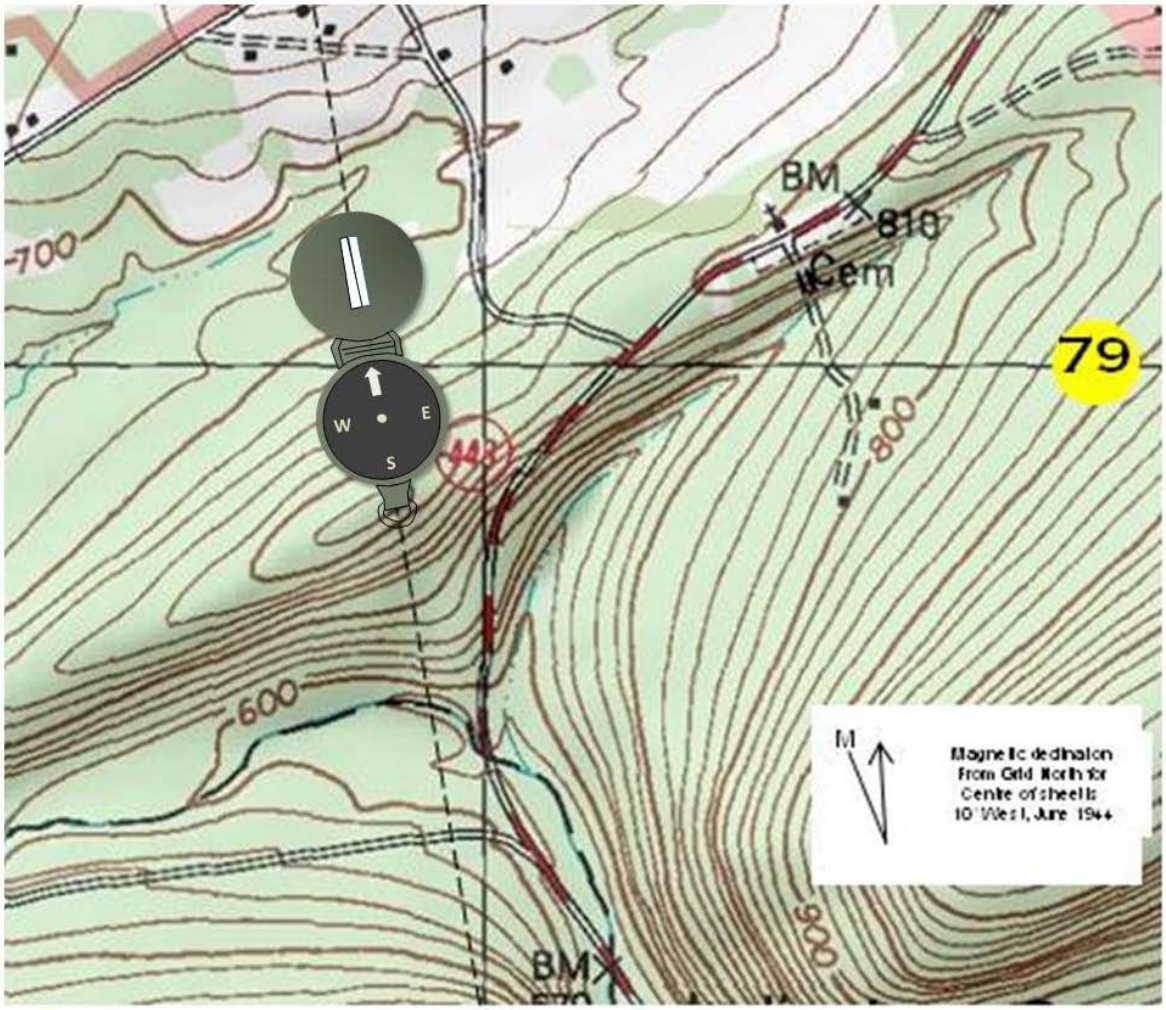


The half-arrow ponts to magnetic north, the y to grid north, and the star (representing Polaris) to true north. On a map, the angular declination will be marked in degrees.

I say "for a particular map" because the declinations differ from place to place. There are places (which are found along "orthogonic lines" where grid and magnetic north are the same. Fort Benning Georgia lies close to an orthogonic line.

So, how do we shift from one to another north? What's most important is grid to magnetic and back—the GM angle.

First, we will **orient** the map. Find a flat spot, preferably with a view of the surrounding terrain, and place the map oriented roughly north.



In WW II, maps were sometimes issued with *pivot line* printed; sometimes soldiers added them based on the declination diagram. In this case, the origin of the line, called a *pivot point*, is at the bottom edge of the mapped area, and the junction of the vertical grid line 64 and the edge of the map. Grid line 64 points to grid north; the dootted pivot line points 10º west of grid north (note the declination diagram inset, slowing a GM declination of 10º west at that location as of June 1944.

Unfold the compass so that it can be laid directly along the pivot line. Then gently turn the entire map, without displacing the compass, so that the compass arrow points north. The map is now oriented to the ground it describes.

Without consulting the map, we can add a GM correction factor for our compass azimuths using the "left add—right subtract" (LARS) rule. First, find the map's GM angle by inspecting the declination diagram. On this map we see that it is 10º west (left) of grid north.

If the azimuth you are converting to is left of the azimuth you are converting from, **add** the GM angle. If the line is to the right, subtract the GM angle.

Example: You shoot a magnetic azimuth to a landmark with a resulting value of 60º. The GM angle from your map is 10º left (west); therefore, add 10º to your magnetic azimuth line to find a grid angle of 70º.

Finding your location on a map

You have a map and a compass. Orient the map. Now look around and try to find two spots shown on the map that are visible—a hilltop, rainroad bridge, whatever you can identify. Shoot compass azimuths to those two points.

Convert them to back azimuths.

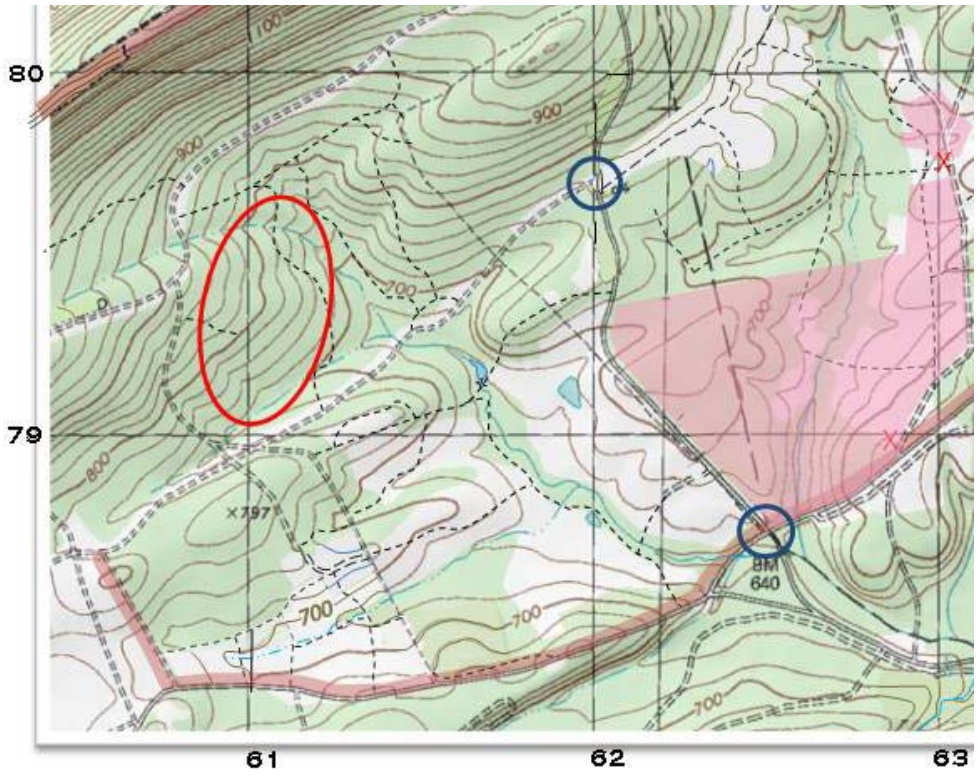
From each known point, draw a line along the back azimuth for that point. (It helps if the reference points are not close together!)

The lines will meet at your location. Since your location and the two reference points form a triangle, this is called "triangulation." (We're getting into the hard stuff now.)

If you are standing along a road or some other identifiable line on the map, but you don't know exactly where, the process is simpler. Find a single reference point, find its back azimuth, and draw a line from thnat point to the point it crosses your road. **Note**: Be certain you are on the road you think you are on!

Example:

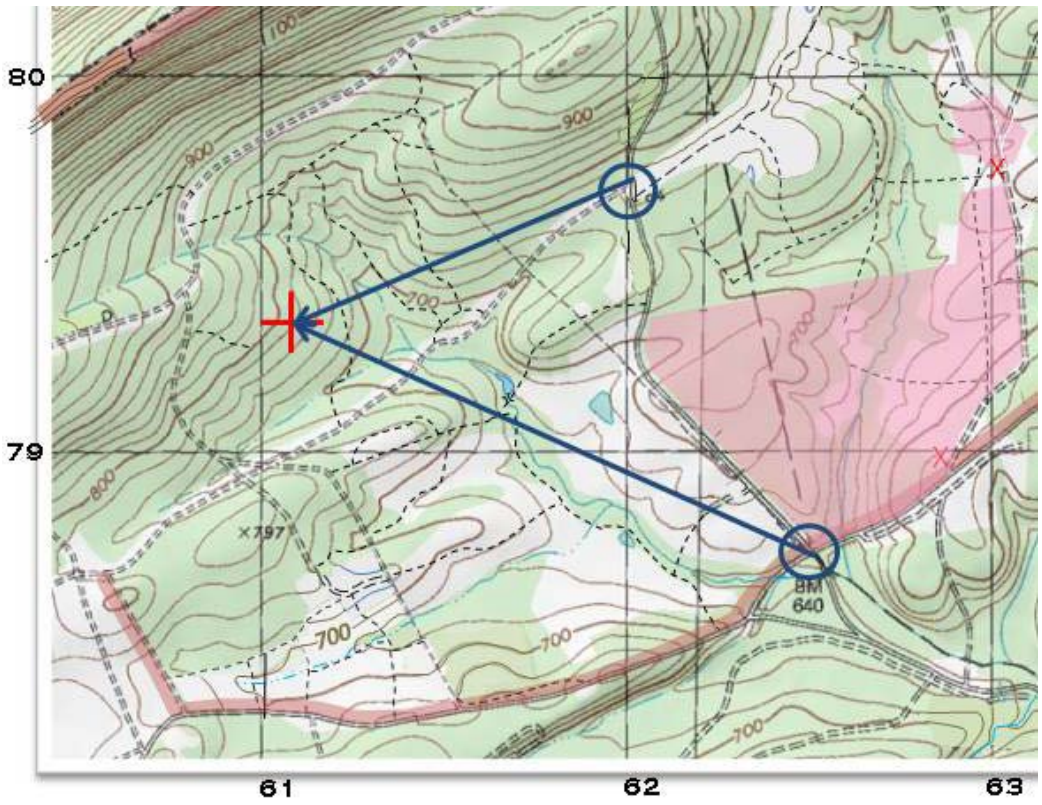
You know you are on a hillside, somewhere within the red oval. Peeking between the trees, you can see two road junctions recognizable from the map (blue circles). You shoot two azimuths and find the northern RJ at 67º by mthe compass (magnetic azimuth; the southern



RJ is at 115º. Because the GM declination is 10º west, we convert to grid: 77º and 125º.

Because the GM declination is west (left) we apply the LARS rule to find the back azimuths; since both front azimuths are less than 180º, we ADD 180º ("left add, right subtract"), resulting in back azumuths (grid) of 257º and 305º.

Using a pencil and the straight edge of your protractor (you will need a protractor for this), draw lines along the back azimuths. If you have (a) identified the right landmarks and (b) done your work properly, you are standing at the point where the lines intersect (red cross).



Actually using the compass in the field, during daylight hours and at night, is fairly complicated and hard to teach without actually going to the field. More information is found in **FM 21-25**, and a look at **FM 21-75 Scouting, patrolling, and sniping** can also help. The best strategy is to learn the theory hers, then find a compass and learn to do it in practice.

LESSON SUMMARY

1. Specifying and using angular measures (azimuths) with map and compass is critical to specifying places and things on the map.

2. Compass directions may be specified in degrees or mils; for most applications we will use degrees.

3. There are three "norths": true north, grid north, and magnetic north. You will have to be able to convert from grid to magnetic azimuths and back to reduce error.

4. Map reading requires skilled use of compass and protractor; precision is required, and "eyeball" will not be enough.

5. You will need to calculate back azimuths (the direction exactly opposite a given azimuth) for essential battlefield judgment.

Take the self-test for this lesson, then go to Lesson 5.

LESSON 5 will introduce you to the critical skills of terrain analysis—how to look at a map and visualize the terrain and how it will influence battle: cover and concealment, observation and fields of fire, key terrain, obstacles, and avenues of maneuver.