INTRODUCTION TO NAVIGATION AND BEARINGS
South Bay/ Long Beach WTC Group 1

THE COMPASS ITSELF:
Orienting/Declination Arrow
Parallel Meridian Lines
Rotating Bezel Ring:
- North 0 or 360°
- East 90°
- South 180°
- West 270°

Base Plate
Magnetized Needle
Liquid Filled Capsule
Viewing Site
Index Line/ Direction of Travel
(Hinged Mirror Cover & Viewing Site-Optional Preference)
Clinometer

WHAT ARE BEARINGS?

DECLINATION-WHAT IS IT? WHY NEED IT?
Map Location?
Tape Arrow or Adjustable?

THE COMPASS BASIC TASKS:
Take a bearing
Plot a bearing

AVOID MAGNETIC OBJECTS
Simple things can distort your readings

HOW TO FOLLOW A COMPASS BEARING IN THE FIELD
Distant Object Method
Reduced Visibility Method
Dead Reckoning
Hiking Past an Obstruction

GETTING BACK AND FINDING THE CAR
Very useful!!

BEARINGS ON THE MAP:

To TAKE a bearing on a map:
Place your compass on the map with one long edge of the base plate running directly between two points of interest. Note that your compass (Mirror or Top) is facing in the direction of travel you intend to go.

Rotate the compass bezel so the meridian lines are parallel to the north-south lines on the map. NOTE: Be sure the orienting/declination arrow is pointing toward the top of the map (North) or you will 180 degrees off.

Now read the number that is at the index line. This is the bearing from point A to B.

"Hint" With the map oriented North-Remember if 90°-east (or right), 180°-south (or down), 270°-west (or left). Look at the direction from A to B. Does your bearing make sense or are you 180° off?

To PLOT a bearing on a map:
You usually have two pieces of information, a bearing and a place (Point A). Then you can find Point B.

Set the known bearing on your compass. Place the compass on the map with the long edge of the base plate touching point A. Rotate the ENTIRE compass, NOT the bezel, until the meridian lines are parallel to the north-south lines on the map. NOTE: Be sure the orienting/declination arrow is pointing toward the top of the map (North) or you will 180 degrees off.

Now draw your line along the base plate to find point B.

BEARINGS IN THE FIELD:

To TAKE a bearing in the field:
Sighting Mirror- Point arms length, sight through the V notch. Rotate bezel so orienting\declination arrow with north seeking end of the magnetic arrow are aligned. Read bearing at index mark.

"Hint" Most people are one eye dominant. There is a line down through the mirror. When taking your bearings, align this line with the center pivot point of the magnetic needle.

Belly Button Method- Aim at the object from your waist. Rotate bezel so orienting/declination arrow with north seeking end of the magnetic arrow are aligned. Read bearing at index mark.

Keep away from magnetic objects
Do bearings three times for consistency

To PLOT a bearing in the field:

Basically the opposite/reverse of taking a bearing.
Obtain your desired bearing from the map. Hold the compass directly in front of you. Rotate your whole body, including feet, so orienting/declination arrow with north seeking end of the magnetic arrow are aligned.

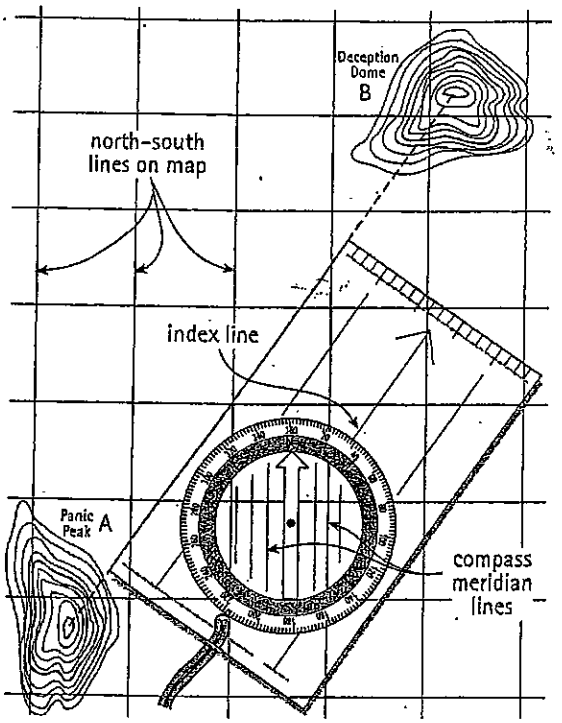


Fig. 4-5. Taking a bearing on a map with the compass as a protractor (magnetic needle omitted for clarity)

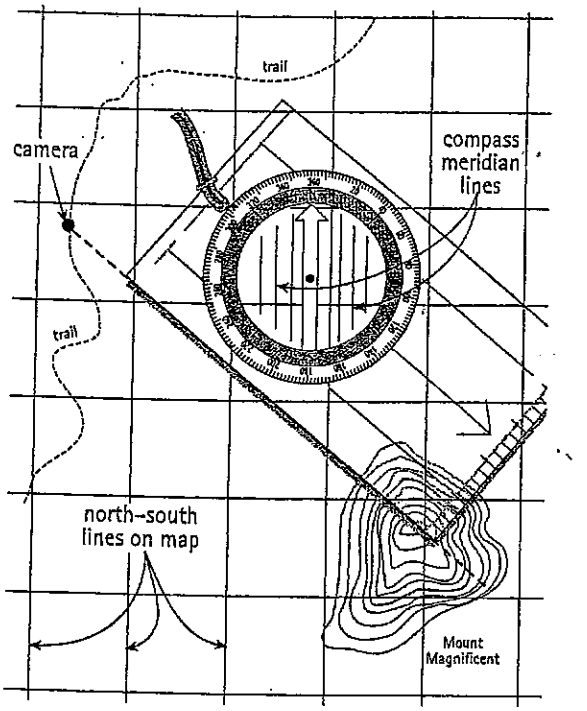


Fig. 4-6. Plotting a bearing on a map with the compass as a protractor (magnetic needle omitted for clarity)

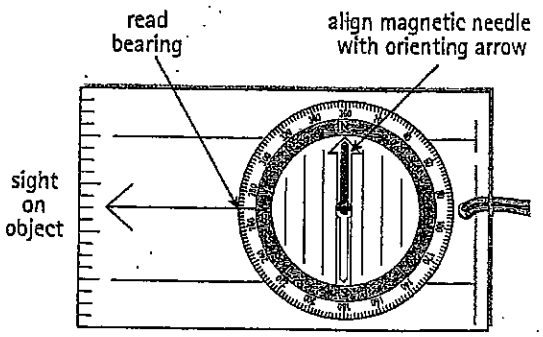


Fig. 4-7. Taking a compass bearing in the field in an area with zero declination

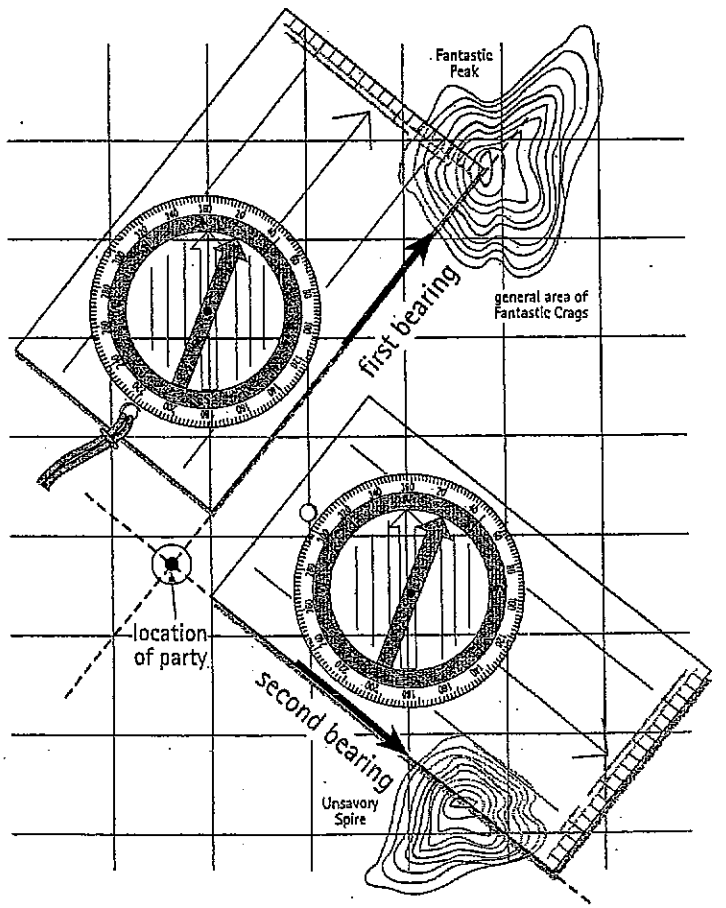
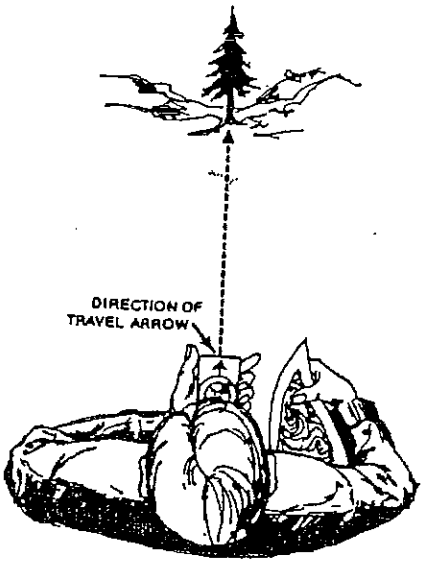


Fig. 4-13. Orientation with area position known (magnetic needle omitted for clarity)



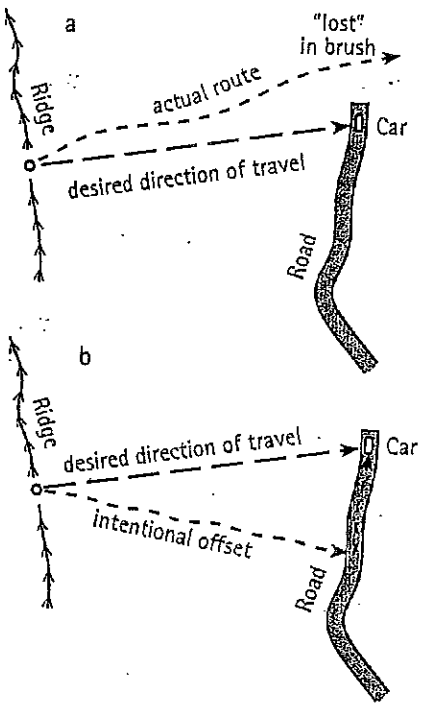


Fig. 4-3. Navigating to a specific point on a line: a, inevitable minor errors can sometimes have disastrous consequences; b, to avoid such problems, follow a course with an intentional offset.

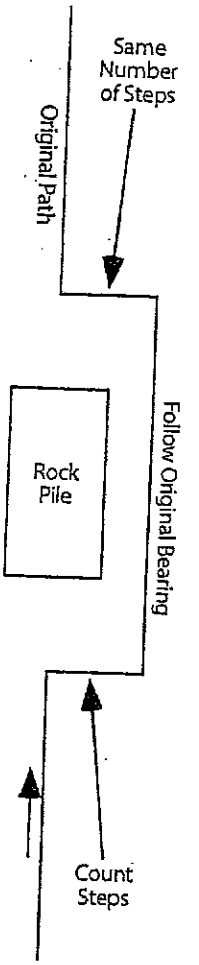


FIGURE 3-18.
Hiking past an obstruction

UTM GRIDS AND COORDINATES

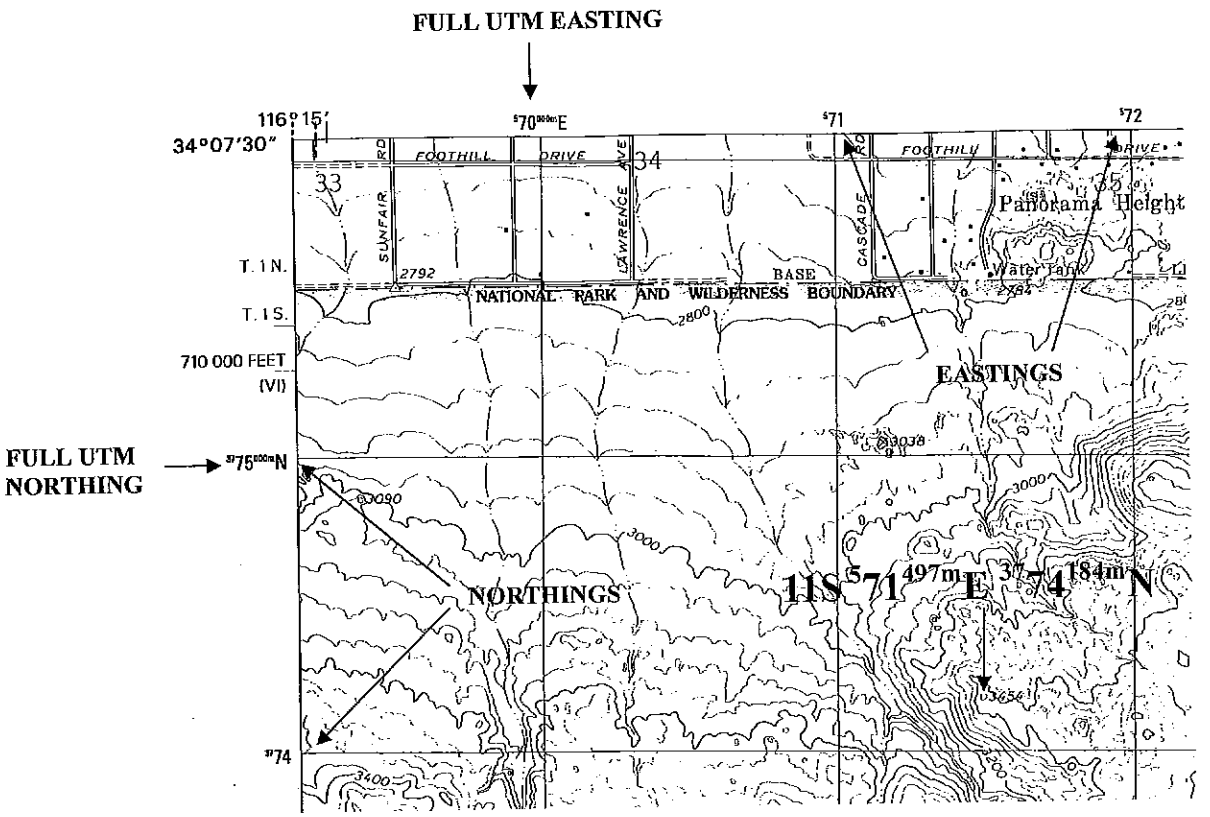
The UTM grid system helps you find the coordinate for any point on the map. This system is particularly helpful when using a GPS device.

All USGS topographic maps printed in the last 30 years include UTM grid tick marks, in blue, on the margin of the map. Corresponding tickmarks are on both the top, bottom, and side margins of the map. Some maps are printed with a fine-lined UTM grid. However, many USGS 1:24,000 scale topographic maps do not have gridlines printed on them. For those maps, you can add a UTM gridline by drawing lines between corresponding tickmarks.

The map below is the northwest corner of the Indian Cove quadrangle (7.5 minute series, scale 1:24,000). It is printed with UTM gridlines. The numbers along the top of the map (and bottom) are called eastings, which provide an east-west position. The numbers on the left side of the map (and the right side) are called northings. They give you a north-south position. The UTM grid is based on meters and the gridlines are always 1 kilometer (1000 meters or .62 mile) apart on 7.5 minute maps. It is easy to estimate distance because the distance between each gridline is the same.

Location in the UTM system is defined by the coordinates of the point, giving the easting first and then the northing. The convention of east (right) first, then north (up) can be remembered by the mnemonic "read right up."

The full UTM coordinate for Peak 3454 is shown on the map and explained on the next page.



OVERVIEW OF EASTINGS, NORTHINGS AND UTM COORDINATES

Eastings

Increasing easting numbers means you are going east.
Full easting coordinate number: $^{5}\mathbf{70}^{000m}$E.
$^{5}\mathbf{71}$ is a shorthand method of describing $^{5}\mathbf{71}^{000m}$E; $^{5}\mathbf{72}$ is a shorthand for $^{5}\mathbf{72}^{000m}$E
Distance between $^{5}\mathbf{70}^{000m}$E and $^{5}\mathbf{71}$ is 1000 meters (1 kilometer).
Distance between $^{5}\mathbf{71}$ and $^{5}\mathbf{72}$ is 1000 meters (1 kilometer).
The last three numbers stand for number of meters east of the easting gridline:

$^{5}\mathbf{71}^{100m}$E indicates that the coordinate is 100 meters east of the $^{5}\mathbf{71}$ gridline.
$^{5}\mathbf{71}^{831m}$E indicates that the coordinate is 831 meters east of the $^{5}\mathbf{71}$ gridline.

[What the numbers mean: The world is divided into 60 UTM zones, each 6° wide. The meredian (center) of each zone is assigned the value $^{5}\mathbf{00}^{000m}$E. Eastings within each zone will range from $^{1}\mathbf{66}^{640m}$E in western area of the zone to $^{8}\mathbf{33}^{360m}$E in the eastern area of the zone. An easting of $^{5}\mathbf{70}^{000m}$E means that it is 70,000 meters east of the zone meridian (570,000 - 500,000 = 70,000), whereas an easting of $^{4}\mathbf{30}^{000m}$E means that its 70,000 meters west of the zone meridian (500,000 - 430,000 = 70,000).]

Northings

Increasing northing numbers means you are going north.
Full northing coordinate number: $^{37}\mathbf{75}^{000m}$N.
$^{37}\mathbf{74}$ is a shorthand method of describing $^{37}\mathbf{74}^{000m}$N; $^{37}\mathbf{73}$ is a shorthand for $^{37}\mathbf{73}^{000m}$N
Distance between $^{37}\mathbf{75}^{000m}$N and $^{37}\mathbf{74}$ is 1000 meters (1 kilometer).
Distance between $^{37}\mathbf{74}$ and $^{37}\mathbf{73}$ is 1000 meters (1 kilometer).
The last three numbers stand for the number of meters north of the northing gridline:

$^{37}\mathbf{74}^{100m}$N indicates that the coordinate is 100 meters north of the $^{37}\mathbf{74}$ gridline.
$^{37}\mathbf{74}^{831m}$N indicates that the coordinate is 831 meters north of the $^{37}\mathbf{74}$ gridline.

[What the numbers mean: For locations north of the equator, values range from $^{00}\mathbf{00}^{000m}$N to $^{93}\mathbf{34}^{080m}$N. A northing value of $^{37}\mathbf{75}^{000m}$N means that the point lies 3,775,000 meters north of the equator.]

UTM Coordinates

The form of a complete UTM coordinate is zone, easting and northing.
The zone is printed on the map. For the Indian Cove map, it is zone 11.
The Military Grid Reference System divides each zone horizontally into 8° sections and assigns a letter to them. For the Indian Cove map, it is zone "S."
The complete UTM coodinate for Peak 3454 is:

11S $^{5}\mathbf{71}^{497m}$E $^{37}\mathbf{74}^{184m}$N. This gives the UTM coordinate to within a one meter square area.

There are a number of ways to abbreviate this coordinate:

Drop the zone number:	$^{5}\mathbf{71}^{497m}$E $^{37}\mathbf{74}^{184m}$N
Drop the superscript:	$\mathbf{71}^{497m}$E $\mathbf{74}^{184m}$N
Accuracy to within 10 meters square:	$\mathbf{71}^{49}$E $\mathbf{74}^{18}$N
Accuracy to within 100 meters square:	$\mathbf{71}^{4}$E $\mathbf{74}^{1}$N

Other conventions used to abbreviate this same coordinate:

Six Digits (accurate to within 100 meters square):	714 741
Eight Digits (accurate to within 10 meters square):	7149 7418
Ten Digits (accurate to within 1 meter square):	71497 74184

FINDING UTM COORDINATES ON A MAP

Visually: You can obtain an accurate coordinate to within about 100 meters simply by using your eyes. On the map below, Peak 3543 (**A**) looks about six-tenths of the way between eastings ^{5}**71** and ^{5}**72** and about halfway between northings ^{37}**73** and ^{37}**74**. Therefore, the UTM Coordinate of 11S ^{5}**71**^{600m}E ^{37}**73**^{500m}N would be accurate to within 100 meters. The *TOPO!* computer program gives the coordinate as 11S ^{5}**71**^{588m}E ^{37}**73**^{545m}N.

With a Map Ruler: The map ruler used below gives 50 meter increments and accuracy will be between 25-50 meters. On the map below, Peak 3510 (**B**) is 350 meters east of easting ^{5}**72**. Using the ruler (not illustrated), the peak is 850 meters north of northing ^{37}**74**. Therefore, the UTM Coordinate of 11S ^{5}**72**^{350m}E ^{37}**74**^{850m}N would be accurate to within 50 meters. *TOPO!* gives the coordinate as 11S ^{5}**72**^{348m}E ^{37}**74**^{841m}N.

With a UTM Ruler: The corner of this special ruler is placed on the target location. The horizontal scale measures the easting; it is found by where the scale intersects the easting gridline. The vertical scale measures the northing; it is found where the scale intersects the northing gridline. The UTM Ruler used below is in 20 meter increments and can produce accuracy to within 10-20 meters. On the map below, Point **C** is where an intermittent stream crosses the 3000 foot index contour line. It is 260 meters east of easting ^{5}**70** and 720 meters north of northing ^{37}**74** resulting in coordinate of 11S ^{5}**70**^{260m}E ^{37}**74**^{720m}N. *TOPO!* gives the coordinate as 11S ^{5}**70**^{257m}E ^{37}**74**^{727m}N.