Navigation

Travelling through wild countryside is achieved by the use of a map and a compass. The map conveys a detailed picture of the landscape and terrain we are travelling across and the compass provides us with a tool that will steer us in the correct direction. The secret of good navigation is a good knowledge of map reading and interpretation. The compass although important is secondary to good map reading skills.

The importance of being able to read a map and compass proficiently can not be highlighted enough. I mean lets face it; you don't want to be one of those people who have to be rescued by the Mountain Rescue team because they got lost when a little mist came down. Or on a more sombre note, you don't want to be one of those people who are less fortunate and are not rescued in time.

The Map

Map border information

All map users should be familiar with the information available in written and pictorial form around the edges of the map. This data identifies and explains the map, giving details not only for use in connection with the map itself, but also the date of the information and the sources from which it has been compiled.

The type of information and the layout may differ slightly from one map to another. Listed below are the items that are normally part of the standard layout:

Map title, type of map (e.g. topographical, geological, etc.), map edition and sheet number, magnetic variation diagram, grid reference block, legend of symbols, control and production data, index to adjoining sheets, reliability diagram, representative fraction, linear scale bar, contour interval.

Understanding your map

In order to draw a map of manageable size we use a process of scaling to insure the correct miniaturisation of the landscape on the map. A useful scale is 1:50,000 (1 unit on the map = 50,000 of these units on the ground, e.g. 1cm = 50,000cm, or 500m; i.e. 2cm to 1km).

The most common map used for mountaineering is the **Discovery Series**, published by Ordnance Survey Ireland (OSi). Each map covers an area of 40km x 30km and is produced at a scale of 1:50000. There are 89 sheets in the series; 71 are published by OSi and 18 by Ordnance Survey Northern Ireland.

Apart from features such as roads, buildings, rivers and vegetation, the key element to any topographical map is the contour line. Each line represents a particular constant elevation. The contour interval is the vertical height rise represented by each successive line - this is usually about 10m or 20m (40 or 80ft on US maps). Major contour lines are printed darker and labelled with the height somewhere along their length. The closer together the contour lines, the steeper the slope.

A useful tip is to keep the maps in plastic bags or special map cases, or to laminate them. A soggy mass of wet paper will not be of great help in escaping from tricky situations.

Grid lines

As lines of latitude and longitude on most maps are usually curved and an accurate reference to a position in such terms (geographical) needs to be quoted down to decimal points of a second, employing up to 20 numerals, a simpler system of grid referencing is used.

Maps are provided with a system of squares called a grid and the ground distance represented between the grid lines that form the squares is usually quoted in the marginal information of the map. The purpose of this grid is to allow us to identify every part of the map with a unique number system (grid reference). These grid lines which correspond with the lines of longitude and latitude also enable us to identify the north of the map and aid with compass alignment. You will notice that each line is given a number; this will enable us to create the grid reference number.

In summary, the grid lines on Ordnance Survey maps are used to:

- Determine the grid reference of a location
- Find a location from to its grid reference.

Grid Reference

On Ordnance Survey maps the grid lines are 1km apart, regardless of the scale of the map.

- Northings - the figures are read vertically bottom to top up the map and the lines that join these figures run horizontally left to right.
- Eastings - the figures are read horizontally left to right across the map and the lines that join these figures run vertically top to bottom.

Grid references should be read from the map in the following order:

- Eastings (i.e. across the map east to west)
- Northings (i.e. down the map north to south

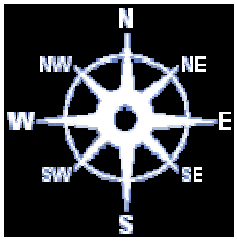
N.B. Eastings; Northings = E then N (alphabetical order)

A grid reference is a series of numbers (co-ordinates) which gives us the exact location on a map. It is created by using the grid lines which appear on all ordinance survey maps using the following steps.

1. Find your location on the map. If possible choose a recognisable feature rather than a point in the middle of nowhere.
2. Find the grid letter on the national grid by looking at your map. These are printed in blue and are large in size. Quote the letter of the sector your position is in.
3. Start at the bottom left hand side of the map and move across the grid lines till you arrive at the grid line nearest your location. The number of the line is the first two numbers of your reference.
4. You should then divide up the grid square into tenths. Half way is .5, three quarter the way is .8 etc. State the location of your position as a decimal. This number is the third number of the reference.
5. Repeat the same steps for the grid lines that cross the map and this will give you the 3 figure reference for you location.
6. You now have your six figure reference for your position.

The Compass

This is a very easy lesson, and is not sufficient for those who would like to travel safely in unfamiliar terrain. The first thing you need to learn, are the **Cardinal Points** of the compass:

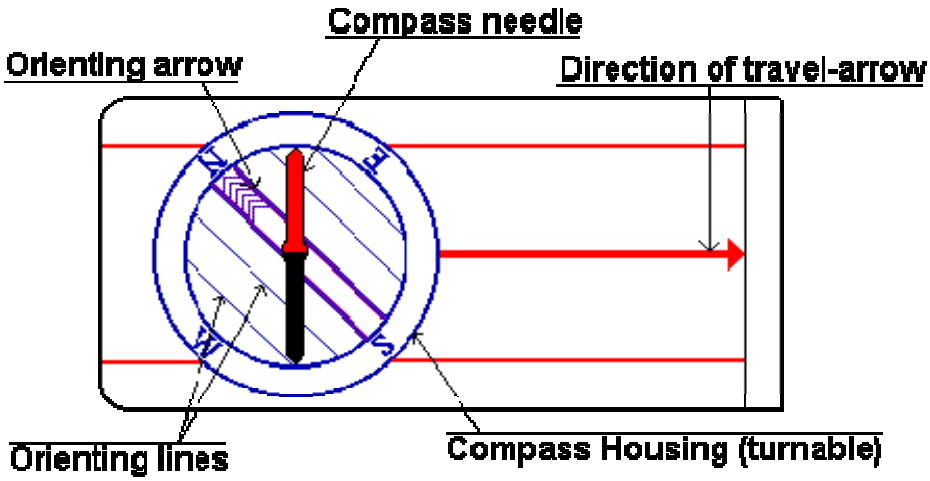


- North - 0°/360°
- East - 90°
- South - 180°
- West - 270°

These cardinal points are then further subdivided (North-east, North-west, South-east and South-west), as shown top the right. North is the most important.

There are several kinds of compasses; however a basic Silva Compass will provide you will all the functions you are likely to need. This type of compass is shown below.

There are several variations of this type of compass – some have a red and black needle, others have different scale along the sides, but they all consist of the same basic components shown below.



The Silva Compass is made up of three parts - the needle, the compass housing and the base plate. The needle is coloured red and white (or black) and the red end points to north the white to the south. The compass housing revolves and determines any desired bearing or direction of travel. The base plate is used to indicate line of travel.

While a compass, in theory, should always point towards magnetic north, they also respond to all magnetic fields and iron objects. Beware of metal objects in your pockets, forces and batteries in night navigation, watches, ice axes, and even some metallic areas of the earth's crust.

Things to Watch Out For:

- Metal objects can cause the needle to deviate from north. Stand clear of metal objects.
- Always hold the compass flat - it allows the needle to move round freely
- Take care of your compass - a damaged compass could become inaccurate
- Always use an up to date map as old maps may be missing information or may even detail landmarks that are no longer there.
- Replace your compass if it develops a large air bubble.

True, Grid and Magnetic North

There are three *norths* commonly in use when reading maps and navigating:

- **True North** and south are located at the geographic poles.

- **Grid North** is the direction to which all of the Ordnance Survey maps are orientated. All the map bearings that are taken use grid north.
- **Magnetic North** is the direction that a compass points to. In Ireland this is approximately **6° to 8° west of grid north**.

The difference between grid and magnetic north is referred to as the **magnetic variation** and must be taken into account when translating bearings from or onto maps.

Navigation

Navigating by Map Alone

Most navigation is actually done without constant reference to the compass. The map is orientated using the compass, and then the features on the ground are matched to the map. In general this is sufficient to allow you to navigate to the destination, perhaps with occasional checks of the compass against the map to confirm orientation.

Navigating by Map and Compass

In extreme conditions, or in bad visibility, the map features alone may not suffice. You must then navigate using more advanced skills, with the compass playing a large role. The compass is essentially a simple device, but one fraught with problems for the untrained.

When traveling from one point to another you may sometimes follow a simple heading such as 'due north' or 'directly west'. However, navigation is very seldom this straightforward and considerable accuracy is required, for example, if you need to find a small feature such as a cairn, or navigating in thick fog or at night. In circumstances like this, you have to use *bearings*.

The compass circle is divided into the familiar 360°, with north being at 0°, east 90°, south 180°, and west 270°. These numbers are referred to as bearings. Experienced navigators can be accurate to within a few meters over large distances.

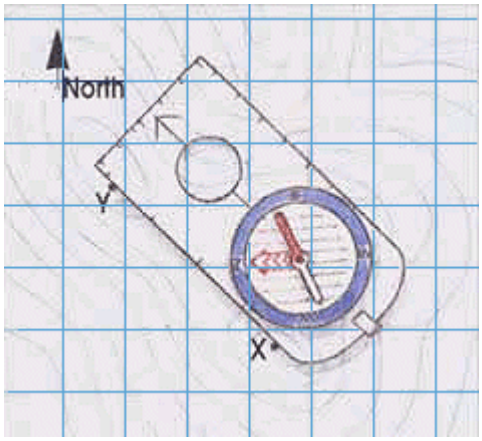
The compass has two functions. One is to take bearings, either (e.g. a distant hill) or by measuring a bearing from one point to another on a map. The other function is to plot or follow bearings. This is when the compass is set to a particular bearing, either by taking sightings along the compass or via measurement on the map. That bearing is followed on the ground or on the map to arrive at a point.

- Determine the grid reference of a location
- Find a location from to its grid reference.

Taking a Bearing

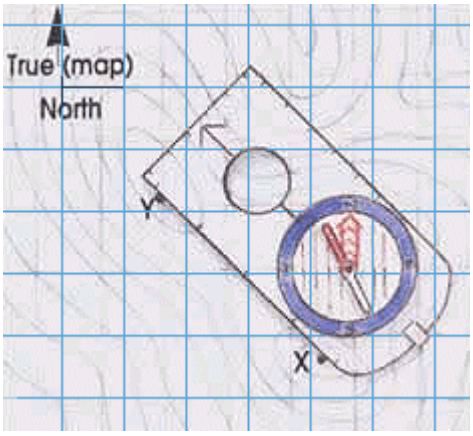
Before you take a bearing, first make a rough guess the bearing you are about to calculate, by looking at the map. Alarm bells should begin to ring when your guess is way out (usually about 180°!) from the bearing you have worked out.

1. Lay out map and compass on top
2. Place edge of compass along the desired line of travel (X – Y), X being your current position and Y being where you want to go. The direction arrow on the compass should point towards the place you wish to go.



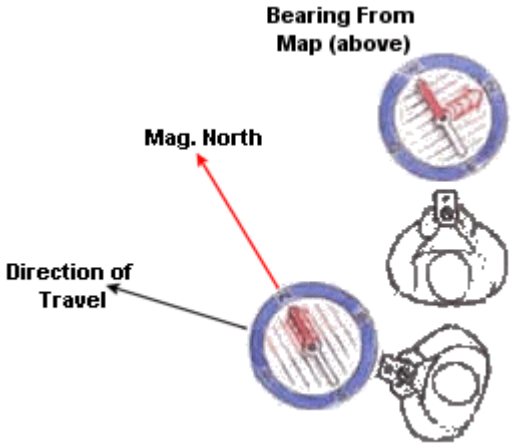
[Mistake #1 - You have the compass back to front i.e. going from Y to X]

3. Move the compass housing until the north - south lines on the transparent base of the compass housing are parallel with the grid lines on the map. The orienteering arrow on the compass housing should be pointing north. You should be as accurate as possible when lining up these lines as a movement each way will add or subtract degrees from your final bearing and result in bad navigation and missing your destination by hundreds of metres.



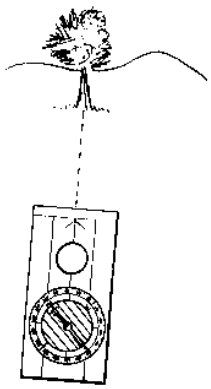
[Mistake No 2 - lining up the orienting lines with North on your dial pointing to the left right or bottom of your map; MUST be to top]

4. Lift up the compass from the map and read the bearing indicated on the compass dial. Then, add on the magnetic variation (e.g. Galway = 6°) and move the compass housing to this setting.
5. The compass is now set. Hold the compass in your hand and move your body around until the needle of the compass is correctly aligned with the north - south markings on the housing. The direction of travel arrow on the compass now points in the direction you need to travel to your next destination.



This exercise is repeated from point to point as you travel on your journey.

Following a Bearing



In bad conditions, it is easy to lose track of where you are even using a map and compass. Maintaining direction can be done by sighting along the line of travel and identifying a feature, e.g. a prominent rock, on that line. Head for this feature, then resight to the next visible feature. This process is repeated until you reach your destination. It is not advisable to follow your bearing by looking at the compass and watching the movement of the needle. As you walk you will have to move from side to side to avoid obstacles so this method of following the bearing is discouraged in favour of line of sight identification method.

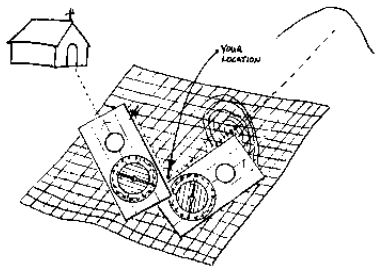
However, if you find yourself in heavy fog or at night you will use the method of looking at the compass to find your way. In fog or at night you could use members of your party to line up on the bearing under your direction and you then travel to these members. This is a more accurate method than looking at the compass.

Back Bearing

If you think you have erred from your line of travel you can check your bearing by using a back bearing. To do this you turn around and point the compass back to your last location. The white part of the needle should now point north. If it is slightly out then it is possible, by walking left or right until the needle lines up, to correct your line of travel.

Finding your position on a map

To find your position on a map we use a process called resection. This is preformed by plotting at least two points on the map to determine your position.



First select a landmark that you can identify on the map and from the position you are standing.

Point the compass at the landmark and move the housing until the needle and north - south marking align. Read off the bearing on the dial. Now subtract the magnetic variation from that bearing. (e.g. bearing of 88° less 6° total 82°). You then place the compass on the map with the edge of the base plate on the symbol for identifiable feature. Without adjusting the compass move the whole compass round this point until north - south lines are parallel with grid lines. If you have a pencil, draw a light line along the side of the base plate. Your position is somewhere along this line.

You now select another feature which can be seen and identified from your position and repeat the process. If possible choose a feature which is nearly 90° from

the previous position used. By doing this, your new line will accurately cross the line drawn from the other feature. If the two points selected are two close to each other then the lines will tend to merge and will result in a less accurate determination of your position. Where the two lines cross is your position.

Normally, two bearing are all that is required however, if you wish you can use three to confirm exactly where you stand.

Calculating Route Times

Nasmith's Rule

Nasmith's rule is a method of determining speed of travel over the mountainous terrain. It states that if a person walks at 3 miles per hour, a half hour must be added to this calculation for every 1000 ft climbed. This calculation can be converted into a metric measurement thus - we walk at 5 kilometers per hour and allow 30 minutes for every 300 meters climbed. For the purposes of calculating time traveled with young people it is better to use a figure of 4 kilometres per hour.

These calculations can be simplified:

- 15 mins per 1 km
- 7.5 mins per ½ km

Or in terms of height:

- 1 minute for every 10 meters

These simplifications allow us to calculate route times with ease. Measure the distance with the rule on your compass (2 centimeters = 1 km = 15 mins travel time). Count the number of contour lines passed on the route up the mountain (each contour line = 10 meters = 1 minute extra to your travel time). You do not add on time if you are descending a mountain or high ground. Be careful reading contour lines on the map. You may have to calculate the height gained in meters or feet depending on the map used. (If you are using the discovery series of maps it will be meters). For example, if your start position is at 150m, and your destination is at the 250m line, you therefore have to climb 100m; meaning that 10 minutes must be added to your distance traveled time to give the correct arrival time.

4 kilometers per hour is a suggested average for hiking across easy ground with a light pack. If you intend to carry heavy packs or if you are traveling through rough countryside then you will have to adjust this figure. The figures below are a rough guide.

- Road – 4 kilometers per hour
- Open Field – 3.3 kilometers per hour
- Open Forest – 2.7 kilometers per hour
- Mountain – 2.4 kilometers per hour