

The Navigator's Dozen

The 12 most important mountain navigation skills

1. Symbols and Grid References	1	7. Route Choice	5
2. Map scales and measuring distances	2	8. Navigation Strategies	5
3. Setting the map	3	9. Estimating time from distance and vice versa	6
4. Ticking off features	3	10. Taking and following a compass bearing	7
5. Identifying catching features	3	11. Aspect of slope	9
6. Contour interpretation	3	12. Relocation strategies	10

1. Symbols and Grid References

Symbols

A map is a scaled-down representation of the land, so there has to be a reduction in the amount of information it contains. A wide variety of features have to be represented by a sign or symbol of one kind or another. These symbols are described in the key. Many symbols are shown at a standard size and are not to scale.

In general:

- Water features and their names are coloured blue
- Woodland and forest areas are shaded green
- Man-made features have a black outline
- Contours which represent height are coloured brown.

Grid References

The British National Grid provides a numerical system for defining a specific location, a bit like a systematic address. A grid reference refers not to a specific point but to an area, and the more digits in the reference the smaller the area.

The British National Grid covers Great Britain and its offshore islands. It is split into several 100km×100km squares which are identified by a unique two-letter prefix. Edinburgh is in grid square NT, the Isle of Lewis is in square NB.

Each of these large squares is broken down further into smaller squares 1 kilometre on each side. These are the blue squares you see on an OS map.

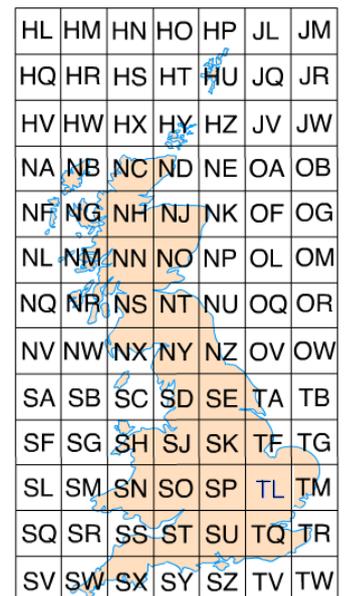
- **Eastings** are the vertical lines running north-south, labelled at the top and bottom edges of the map
- **Northings** are the horizontal lines running east-west, labelled at the left and right edges of the map.

Every 1km square has a unique four-figure grid reference which you work out by giving the prefix letters, then the easting of the left edge of the square, followed by the northing of the bottom of the square, eg NT 6450. This has an accuracy of 1 kilometre squared.

It is usually most useful to give a six-figure grid reference, with an accuracy of 100 metres squared.

1. Grid Letters

- The grid letters are shown in the corners of (newer) OS maps and, where they change across one map, they are shown at the edges.



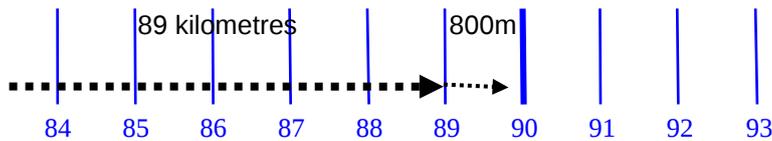
HL	HM	HN	HO	HP	JL	JM
HQ	HR	HS	HT	HU	JQ	JR
HV	HW	HX	HY	HZ	JV	JW
NA	NB	NC	ND	NE	OA	OB
NF	NG	NH	NJ	NK	OF	OG
NL	NM	NN	NO	NP	OL	OM
NQ	NR	NS	NT	NU	OQ	OR
NV	NW	NX	NY	NZ	OV	OW
SA	SB	SC	SD	SE	TA	TB
SF	SG	SH	SJ	SK	TF	TG
SL	SM	SN	SO	SP	TL	TM
SQ	SR	SS	ST	SU	TQ	TR
SV	SW	SX	SY	SZ	TV	TW

NH 898 079

Grid Letters Easting Northing

2. Easting – along the corridor

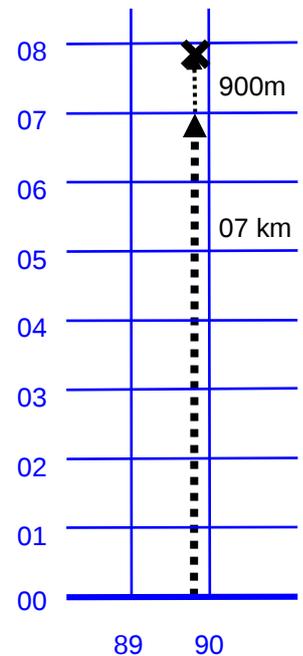
- The first two digits tell you how many **vertical** grid lines to count, moving east from the west edge of the 100km grid square. The lines are labelled on the **top and bottom edges** of the map.
- For the third digit, measure the tenths of a square (100m) **east** from the vertical grid line.



3. Northing – and up the stairs

Now you have already found the easting, stick to it.

- The first two digits tell you how many **horizontal** grid lines to count, moving north from the south edge of the 100km grid square. The lines are labelled on the **left and right edges** of the map.
- For the third digit, measure the tenths of a square (100m) **north** from the horizontal grid line.



2. Map scales and measuring distances

Scale is the relationship between distance on the ground and distance on the map is the scale of the map, expressed as a ratio.

1:250,000

1:50,000

1:40,000

1:25,000

For example, 1:50,000 means that 1 mm on the map represents 50,000 mm on the ground, i.e. 50 metres.

We talk about large and small scale maps. A larger scale map means a larger map for the same area of ground.

A map contains a selection of information about the ground area. Some information is lost. A large scale map contains more information than a smaller scale map.

If you need more detail, you need a larger scale map. However, a larger scale map will itself be larger and more difficult to manage. So we choose a scale as a compromise between how large a map we can manage and how much information we need for the use of the map.

- **1:250,000** 1mm to 250m 0.4mm to 100m 4mm to 1km 4cm to 10km
Ideal for road atlases, e.g. OS Road Maps
- **1:50,000** 1mm to 50m 2mm to 100m 2cm to 1km 20cm to 10km
A clear picture of the land, enough for long distance walking in mountain areas, e.g. OS Landranger
- **1:25,000** 1mm to 25m 4mm to 100m 4cm to 1km 40cm to 10km
Much more information and a greater number of ground features, including field boundaries in rural areas, great for country walking, but a smaller area is covered on each map, e.g. OS Explorer and Harvey Superwalker
- **1:40,000** 1mm to 40m 2.5mm to 100m 2.5cm to 1km 25cm to 10km
A happy medium, great for hillwalking. Used only in Harvey Maps' British Mountain Maps series, made for selected mountain areas, specifically designed for walkers, containing only relevant information.

Methods of measuring distances on the map:

- Count the grid squares
- Use a ruler and multiply or divide the number of mm by the number of metres as given above.
- Use a piece of string and measure it on the scale bar at the bottom of the map.
- Use your compass' scale markings and romer scale.

3. Setting the map

- **Rotating the map** so that **all the features are lined up in the right direction from your own location**. The writing on the map may be upside down or sideways but this is OK.
- First you must identify your location on the map – an approximate position is usually enough.
- **In good visibility set the map by eye** – identify prominent features on the ground such as hills, ridges, valleys and tracks and turn the map so that the features on the ground line up with the map.
- **If identifiable features are not visible or decisive or there is some doubt, use the compass**: put the compass anywhere on the map and turn both together until the red needle points towards the top of the map.
- **Keep the map set when you change direction** – turn yourself around the map.

4. Ticking off features

- **Being observant, having your map handy and checking your current position continuously** as your walk progresses. Your map must be kept in your hand, folded showing your route.
- Keep a constant eye on the terrain and relate this to the map as your walk progresses. You should be checking the immediate and distant terrain noting key features such as high points, valleys, streams and changes of direction.
- **As you pass by each feature you can 'tick it off'**. This helps to re-affirm your position continuously.
- It is most effective if you **thumb the map** – hold it with your thumb at your last known position and move your thumb each time you pass a tick off feature. This means it is quicker to find your position when you need to make a decision.
- If you spot a feature that fails to appear on the map, then you need to be more cautious and look for other bits of information to help you confirm where you are.
- Three different kinds of features:
 - **Spot features**. - single point features e.g. summit, path junction or walled enclosure – gives you an exact position.
 - **Linear features**. - anything elongated but narrow e.g. path, stream or narrow ridge – you are somewhere along this.
 - **Area features**. E.g. lochs, woodland or broad cols – you are in or beside this.

5. Identifying catching features

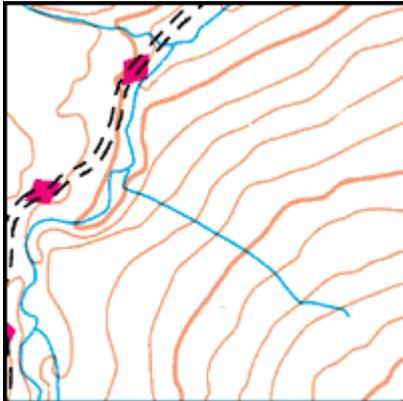
- **Catching features are features in the landscape that will tell you if you have overshot your target**.
- Catching features should be identified before you set off for your target.
- Choose something you can't miss, just beyond your target.
- Sometimes your catching feature will be your target itself, e.g. a well defined track that you couldn't possibly miss.
- Timing and pacing can also be used as catching features – if you expect a leg to take ten minutes and you have walked for fifteen, you have probably gone too far.

6. Contour interpretation

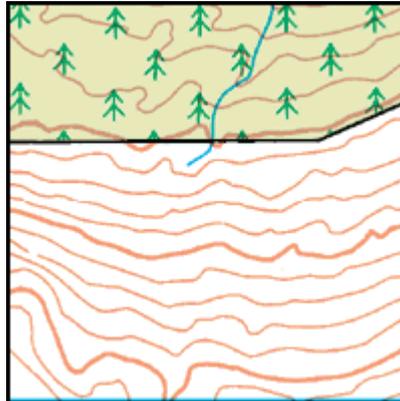
- Contour interpretation is about relating the contour features on the map to the real features on the ground.
- A contour line is a line on the map joining points of equal height.
- How do we know if the contours on the map are going uphill or downhill?
 - The height labels on the contour lines are always printed facing uphill.
 - Rivers and streams flow downhill.

- The Vertical Interval is the height between each contour, this will be shown in the key. Ordnance Survey maps have a 10 metre vertical interval, British Mountain Maps use 15m.
- The closer together contour lines are the steeper the ground, and vice versa.

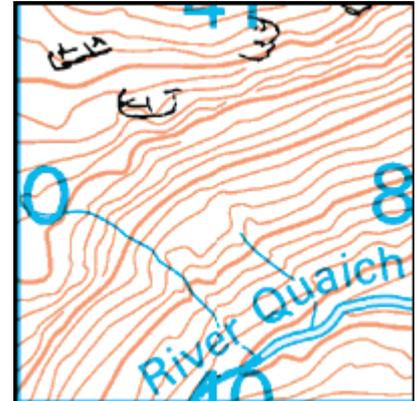
Types of contour feature



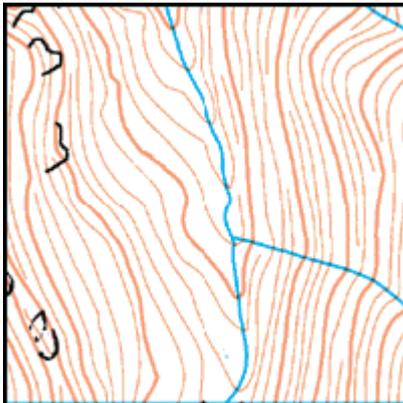
Gentle slope



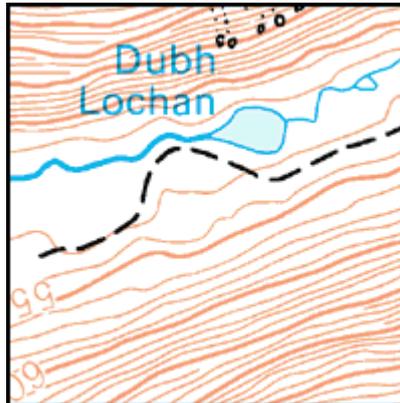
Medium slope



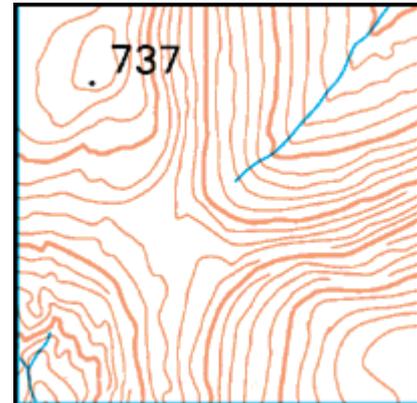
Steep slope *note missed contours*



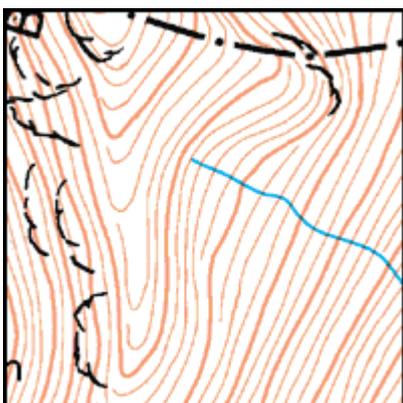
V-shaped valley



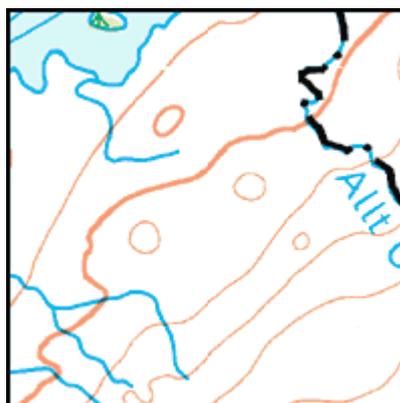
U-shaped valley



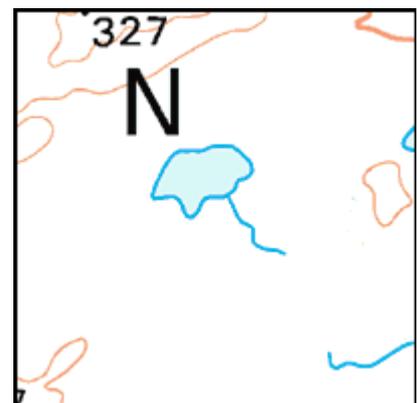
Saddle (or col or bealach)



Ridge and spur



Ring contours – **knolls, hills and summits**. Unless labelled, a ring contour is always a high point.



flat areas - the absence of contours

7. Route Choice

is the selection of **features** on the map which can be identified on the ground to create navigational **legs** along a route that avoids major **hazards** and is **practical** to follow.

Three main factors which should be taken into consideration:

- **Features:** Plan your route between features on the map which are not too far from each other (ideally no more than one kilometre) which you will be able to identify without doubt on the ground when you reach them. The best features are those that do not change with time, i.e. contour features, e.g. ring contours, saddles and changes in slope angle.
- **Legs:** Whatever your navigation strategy, there is always a margin of error. Breaking a journey into short legs means you are more likely to catch yourself before drifting off your route. Legs should end at prominent features as above.
- **Hazards:** The chosen route and features should avoid hazards. For example, a cliff edge may be a very prominent feature but going to it may draw you into a dangerous situation.
- **Practicality:** Features should be chosen so that travelling from one feature to the next does not waste valuable time and energy. Stick to good paths where they exist. Try to avoid losing height which will have to be regained to reach the next feature, and vice versa, avoid excessive avoidable climbs.

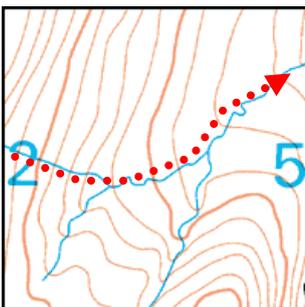
8. Navigation Strategies

Every leg should use one or more of these strategies. It is critical to choose the right strategy for each situation.

(a) Handrailing

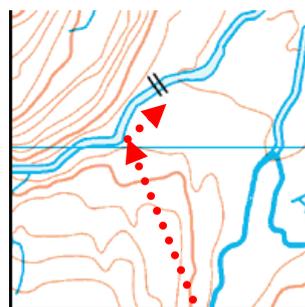
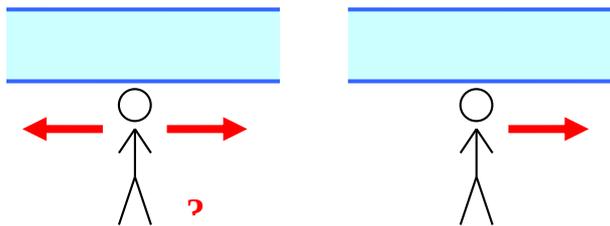
Following a line feature that takes us towards the target.

- Line features: Paths and tracks, walls, rivers and burns, ridges, edges.
- Edges of area features, e.g. lochsides, the coast, forest edges



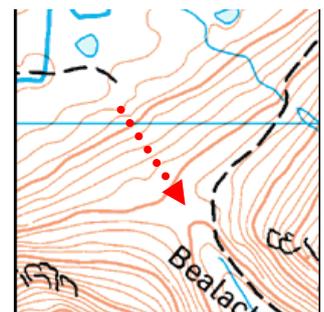
(b) Aiming Off

When the target lies on a linear feature such as a ridge, stream or track, by intentionally aiming off to one side of the target we will know which way to turn.



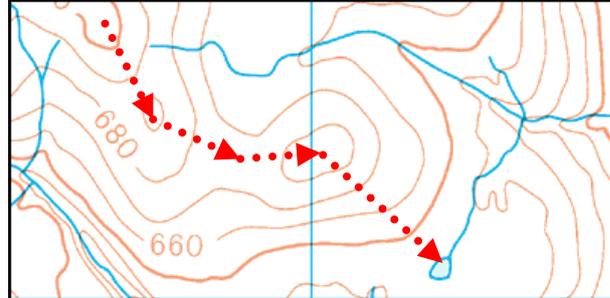
(c) Attack Points

a feature that is relatively close to your target but is more significant and easier to find, e.g. a small hill or bealach may be seen from a distance when a path on the ground cannot be seen.



(d) Dead Reckoning

- Navigating using the compass, timing and pacing to follow a series of straight lines from one feature to another.
- The last resort, where no other strategies are possible, e.g. on featureless plateaux, in dense forests and in poor visibility.
- Should always be broken down into small legs between 50m and 500m, with awareness of the margin of error.
- Be aware of slope aspect, ascent and descent.
- Delegate roles in the team, and keep in close contact.
- Have a plan for getting around obstacles.
- Each leg should end at an identifiable feature
- Identify tick-off features and catching features.



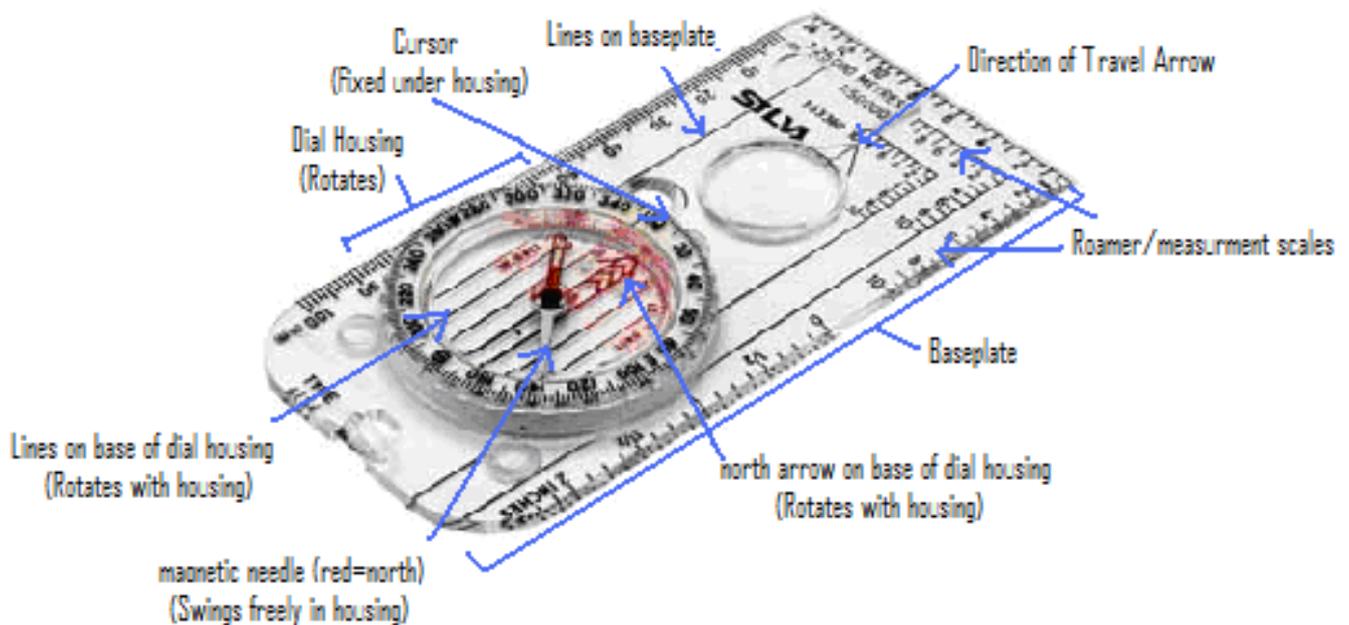
9. Estimating time from distance and vice versa

- This is a crucial skill not only for planning but also for navigation.
- You will need to measure the distance on the map between your present location and the target you are walking to. You should measure accurately to the nearest 100m.
- You need to know your walking speed for the terrain. This will vary with fitness, pack weight, length of journey, wind, terrain and slope angle. This knowledge comes with practice.
- Use a stopwatch, or write down your start time.
- Calculate the time you expect to take by dividing the distance by your speed, or use a timing chart.
- e.g. 800m at 4km/h: $0.8\text{km} \div 4 \text{ km/h} = 0.2\text{h} = 12\text{min}$
- OR $4\text{km/h} = 15\text{min/km}$, so $0.8\text{km} \times 15\text{min/km} = 12\text{min}$. Use whichever method makes most sense to you.
- Add 1 minute for every 10 metres height gain (1 minute per contour on OS maps, or for big climbs, 5 minutes between index contours).
- When going downhill, ignore height loss, it does not affect your timings much.
- This doesn't allow for rests or stops.
- Check your watch or stopwatch regularly.
- None of this is of any use if you don't have a watch!

Distance metres	Speed km/hour			
	5	4	3	2
1000	12	15	20	30
900	11	13½	18	27
800	9½	12	16	24
700	8½	10½	14	21
600	7	9	12	18
500	6	7½	10	15
400	5	6	8	12
300	3½	4½	6	9
200	2½	3	4	6
100	1	1½	2	3
50	½	¾	1	1½
Time minutes				
+ 1 minute for every 10 m ascent.				

10. Taking and following a compass bearing

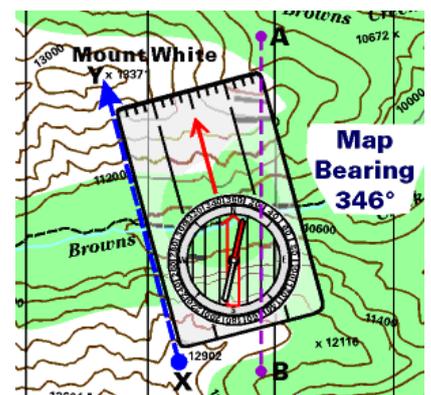
Parts of the compass



- The **Direction of Travel** arrow shows you the way you want to go, both on the map and on the ground.
- The **number on the bezel** at the cursor indicates the bearing, both on the map and on the ground.
- The red end of the **arrow on the base of the housing** ("the Shed") should be lined up with North on the map.
- The red end of the **needle** ("Fred") points to Magnetic North on the ground.

Taking the correct bearing from the map

- It is important to be as precise as possible.
- You need a firm surface to hold the compass firmly in place on the map. Fold the map in a map case, or use one knee.
- The map does not need to be set for this stage.
- Before placing the compass on the map, estimate what the bearing will be.
- Line up both your current position, and your target, with the edge of the compass baseplate. Ensure the direction of travel arrow points the way you want to go.
- Rotate the housing so that the lines on the base of the housing are parallel with the north-south grid lines on the map. The red ends of the lines should point to north on the map. Ignore the needle.
- Read the bearing at the cursor (in line with the Direction of Travel arrow).
- Adjust the bearing for Magnetic Variation: add 2 degrees. This variation changes over the years - confirm that you are using the correct variation by checking the details on the map.
- Double check that the bearing you have is similar to the rough estimate which you took at the beginning, if not, try again.



Transferring your bearing to the ground

- Hold your compass squarely in front of your stomach, with the Direction of Travel arrow pointing forwards.

- Turn your body, watching the needle, until the needle lines up exactly with the arrow on the base of the housing. This is known as “boxing the needle”, or “putting Red Fred in his Shed”.
- Don’t turn the housing or the compass!
- The Direction of Travel arrow now tells you which way to go.

Following the bearing accurately

- The least accurate way to follow the bearing is to simply line up the needle as described above and “walk on the needle” keeping the needle lined up with the north arrow, and following the direction of travel arrow. Most people have a tendency to drift off to one side or the other so this is not accurate over long distances, or if there are obstacles to go around.
- To be more accurate, stand still and look up from the compass to find a distinct feature which lies on the bearing. This feature will be on a straight line between you and your target. Once you have identified a feature, there is no need to use the compass again until you reach it. You can take any route around obstacles to get to the feature. Once you reach the feature, transfer the bearing to the ground, select another feature and repeat until you either reach your target, or your timing indicates that you should have done.
- Even at times when you only need a rough direction, for example when handrailing, it is still good practice to take a rough bearing and to use the compass to keep a general check on your direction. This may prevent a major navigational error, especially in disorientating bad weather.

Taking a bearing from the ground to map

- This is used to check your exact position, e.g. when you know you are on a line feature and you can identify a feature on the ground and on the map that is off to one side of the line feature.
- Hold the compass squarely in front of you and turn so the Direction of Travel arrow points at the feature.
- Turn the housing so the needle lines up exactly with the north arrow on the base of the housing (box the needle).
- Subtract 2 degrees for magnetic variation – the bearing is now on the cursor.
- Place the compass on the map, lining up one edge with the feature on the map, and turn the whole compass (not the housing!) so that the lines in the base of the housing line up with the north-south grid lines, red to north on the map.
- Your position is somewhere on the edge of the compass!

11. Aspect of slope

Which way is down?

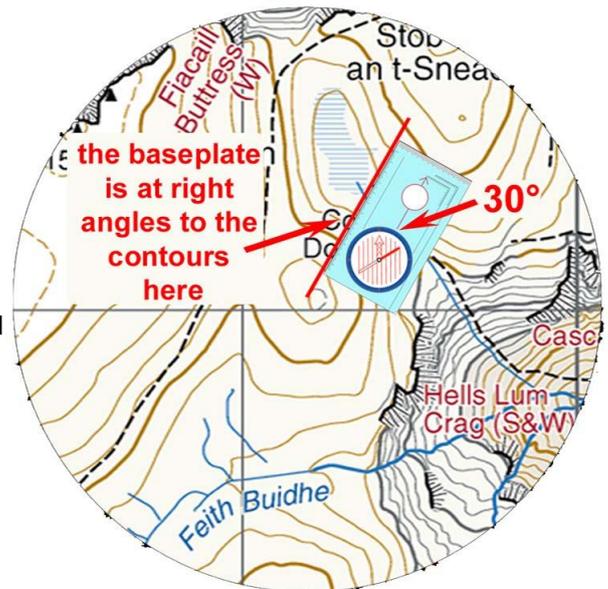
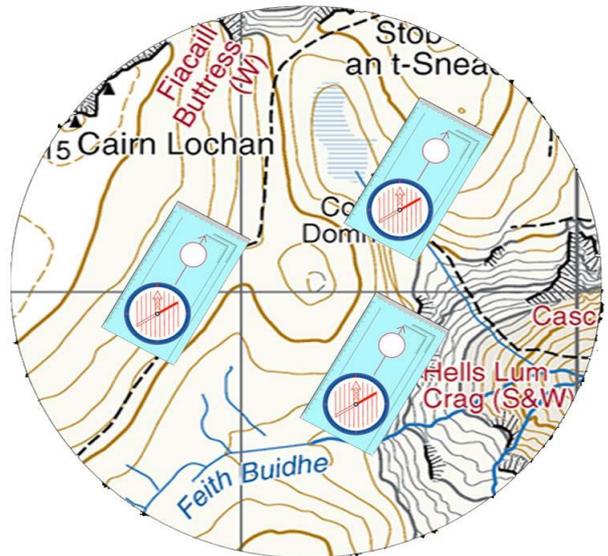
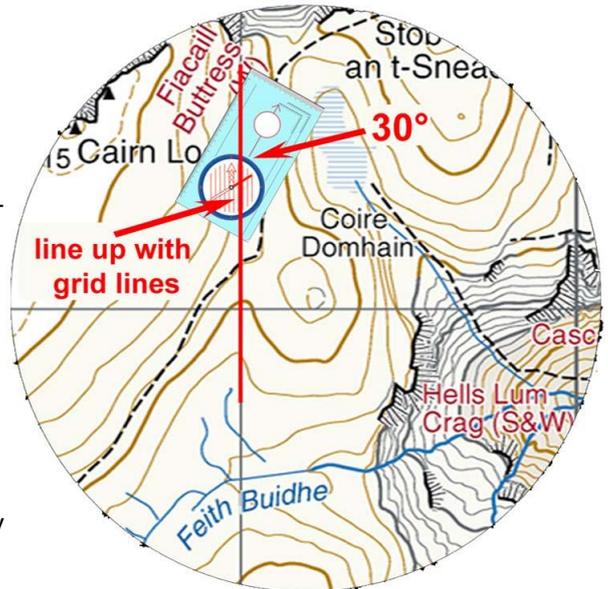
Using slope aspect can be a very useful tool to help you relocate. In its simplest form just use the points of the compass - north, east, south and west - to work out which direction the slope you are on is facing and then look at the map to find the slope which faces this way.

Slope aspect is an advanced technique and demands care, thought and accuracy. A slight mistake can have serious consequences.

However, if you have limited visibility, it might be the only information you can gain without moving and can be a good way to start relocating. It is especially useful in rugged terrain, in areas with steep cliffs or on snow-covered terrain. It does not work on the flat.

Slope aspect can be used more precisely by taking a bearing of the direction in which the slope faces.

- **Face directly downhill.**
- Hold the compass squarely in front of you with the Direction of Travel arrow pointing straight downhill.
- Turn the housing so the needle lines up exactly with the north arrow on the base of the housing (**box the needle**).
- Subtract 2 degrees for magnetic variation – the bearing is now on the cursor.
- Place the compass on the map, **in the approximate area you think you are in**, and turn the whole compass (not the housing!) so that the lines in the base of the housing line up with the north-south grid lines, red to north on the map.
- Slide the compass around the area you think you are in **without turning the compass or the housing**. Look for areas where the **contours are at 90° to the edge of the compass**. Check that contours **go downhill in the direction of travel**.
- All of the areas you have identified have the same aspect of slope as where you are. If you are lucky there will be only one.
- Make a plan which allows you to rule out the possibilities, by looking for nearby identifying features from the map and paying attention to possible nearby hazards.



12. Relocation strategies

in case you lose track of where you are.

The overriding principle is to tackle the problem in a structured, methodical manner and try to stay calm.

Step 1 - Don't panic. Stay calm and don't do anything rash. Most important, don't simply start walking in different directions changing bearings every minute or two in the hope that things will be sorted. This strategy rarely works.

Step 2 - Begin to gather some information

- i. Work out how long you've been walking since you last knew where you were. Use the timing rule to estimate how far you have travelled from that point
- ii. Think about any distinctive features you have passed since that point. Look at the map and you may spot one (or several) of these features. This may help narrow down your likely position.
- iii. If you have been walking along a linear feature such as ridge or forest edge then take a bearing along that feature. You may be able to spot this feature on the map or discount some features which do not match this bearing.
- iv. Triangulation: If you can see a couple of identifiable features (perhaps briefly as the cloud lifts) then take a bearing on each, and plot them on your map. Where the lines intersect should tell you where you are (3 features = more accurate).
- v. If you are with other people then speak to them. They may have observed something you missed or have a clearer idea about your current location.

Step 3 - plan what to do and take action.

- That plan has to be controlled and involve actions that can be retraced should they not work out. It is important to check your observations as you walk against details on the map. If the two sources of information line up then you're on your way to determining your location, if not you may need to rethink.
- Strategies:
 - i. Decide to walk in a given direction on a bearing you think will take you to your next attack point. Work out the bearing and keep to it. Before you set off work out from the map exactly how the land should change as the leg unfolds. Record the time you started walking and keep a note of how long you travel. If your expectations (time and features) are not realised then you can return to your position by reversing the bearing and recording walking time.
 - ii. You may decide to aim for some kind of bounding or linear feature you know is in your broad area. This might be a forest edge, stream or path/track. Take a bearing to the feature and use it as a collector. Once you meet the feature you should be in a good position to work out where you are. This might involve moving along the feature for a short distance in order to gather more information.
 - iii. You may be able to retrace your route back to your last known position so that you can start all over again. If you are able to do this then make sure that the next time you set off, your navigation is accurate! On your way back you may cross a feature that gives you a good clue as to your whereabouts.

If it transpires that nothing works and night time is fast approaching then rather than stumbling in the dark with little sense of direction or knowledge of what terrain may unfold then you might consider staying fast until daybreak and clear weather.

Remember that it is possible that features can change on the ground after maps are drawn or maps can be inaccurate. Contours are the most reliable features. If one feature doesn't fit but all others do, consider the possibility that the map is inaccurate.