

17b – IN-FLIGHT NAVIGATION

SPL syllabus Exercise 17b: In-Flight Navigation.			
(i)	Maintaining track and re-routing considerations	(v)	Uncertainty of position procedure
(ii)	Use of radio and phraseology (if applicable)	(vi)	Lost procedure
(iii)	In-flight planning	(vii)	Use of additional equipment where required
(iv)	Procedures for transiting regulated airspace or ATC liaison where required	(viii)	Joining, arrival and circuit procedures at remote aerodromes

INTRODUCTION

As discussed in the previous section of this chapter, given the complexity of today's airspace, the use of GPS based moving maps with electronic airspace warnings are essential. It will be very helpful if their training is conducted using the same type, or at least, very similar equipment.

THEORY

(i) Maintaining track and re-routing considerations

Correcting for drift: drift is the effect the wind has on a glider's track. The difference between track and heading is greatest when the wind is at right angles to the heading. The effect on the glider's ground speed is greatest when the glider is heading either directly into wind, or downwind.

Pilots flying their first few cross countries are unlikely to be doing so in strong winds. However, even moderate winds can result in significant drift, especially if a lot of time is spent thermalling.

Figure 1 (opposite) shows how a crosswind affects a glider's track over the ground. In addition to causing the glider to track downwind relative to its heading, whilst thermalling, the glider will drift even further downwind. That means that for the periods that we are gliding between thermals, we need to make a bigger offset for drift than if we did not have to stop to climb. If we spend 50% of the time thermalling, the offset is roughly twice as much.

Therefore, when flying crosswind, if there is a choice whether to route upwind or downwind of the route heading, routing upwind is preferable. Otherwise we will end up further off track than we need to be.

(ii) Use of radio and phraseology (if applicable)

Cross-country glider pilots should be strongly encouraged to get and use a FRTOL (R/T licence). However, a FRTOL is not a requirement for cross-country flying or to use gliding frequencies (details from Laws and Rules). Using the radio can cause a significant increase in a pilot's workload. A FRTOL, however, enables a pilot to communicate with airfields, and potentially access some additional airspace. Calls to airfields when passing close by, can improve everyone's situation awareness and safety. (See chapter K).

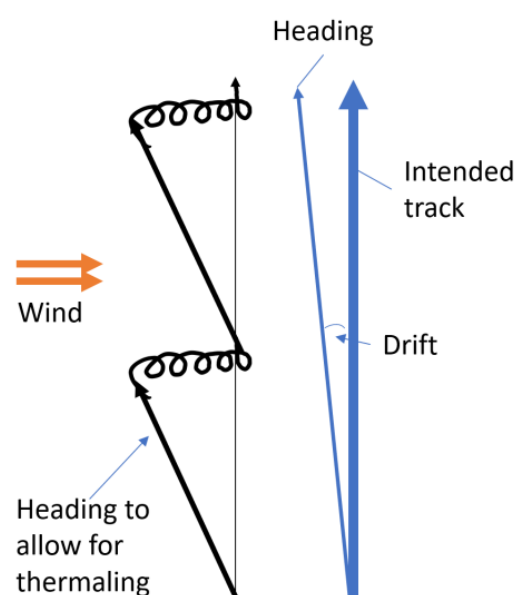


Figure 1. Heading and Track

Occasional, unlicensed calls made to achieve safe outcomes have not been known to cause complaint, especially if done with a degree of competence.

(iii) In-flight planning

The pre-flight planning should have been done thoroughly, but it is possible that we will need to adapt to changing circumstances for example, because of the weather. So, it may be necessary to divert to an airfield enroute, unexpectedly. In that event, making sure we have all the information we need to hand, prior to getting there, is essential.

This information can be written on the map or alternatively may be available in the nav system if the pilot knows how to access it easily.

In the event of such a diversion we need to be able to make a reasonable estimate of the track and distance to be flown, and the effect of wind to achieve that new track. Easy when using a GPS, but more difficult when flying using purely a chart. This can be practiced on the ground.

(iv) Procedures for transiting regulated airspace or ATC liaison where required

There are several circumstances during a cross-country flight where use of the radio is something between helpful and essential.

- To enable you to use an airfield as a land out option safely.
- To liaise with ATC when in the vicinity of an airfield with, for example, an instrument approach to improve the situational awareness of you, other pilots, and ATC, and thus everyone's safety.
- To gain permission to enter or cross controlled airspace.

The last of these is probably the least often used by glider pilots. However, there are pieces of controlled airspace (typically Class D) that are not heavily used, and where, with the appropriate techniques, a clearance to enter or cross should be easily obtained.

(v) Uncertainty of position procedure

Reading a map is not difficult but it does require practice.

If you don't know where you are, (assuming you are uncertain of your position due to a GPS failure) and you flounder on hoping, perhaps, that some voice from above will tell you the way, then you will probably stay lost or worse still, infringe airspace.

If it is possible that you have strayed into airspace – follow the lost procedure (next section vi)

If you are confident you are clear of airspace, try to find some lift to "park up" in whilst you work out your position. You should look at the world and fit that to the map, rather than try to fit the map to the world.

If you are well clear of controlled airspace:

- Guestimate where you might be from your last known position and the general direction of travel
- Look around for a prominent landmark e.g. a lake, a large town, hills etc.
- Note a clear, secondary feature and its relation to the first.
- Use the compass or sun's position to help orientate yourself. Look at the map and attempt to locate the first feature at approximately the right distance from your last known position.
- Still looking at the map say (e.g.), *if that is Northampton I'm looking at, then I should be able to see a motorway to the West of the town, and a large u-shaped reservoir to the North* - one of these could be your secondary feature. What you can see will depend on the visibility, your altitude, and the direction you are looking from.
- If the features are visible, and in their correct relation, make further checks to be sure. For example, there should be a river and several small lakes to the south of the town.
- If none of the features check out in relation to each other or the map, look out at the features once again (or choose different ones), and then go back to the map and attempt to make another identification, following through the steps as before.

It is very easy to fail to keep a thorough lookout whilst trying to re-establish one's position. Keep a good lookout.

(vi) Lost procedure

If you really are lost, there is help available, if you call for it, on 121.500 – the Distress and Diversion frequency (D&D). Do not be shy about using it – especially if you may be in or near airspace. That it is what it is there for. The controllers are well used to fumbling radio calls and welcome the training. Right from the first transmission, a call for help demonstrates that a pilot is being mature about their problem. Best of all is the fixing service; given nothing more than your transmissions, they have the technology to work out where you are. 'London Centre' is their call sign. Call and tell them that you are lost and need assistance. They will ask you to make long transmissions (just repeat your callsign a few times asking for a fix), so that they can use their triangulation system to fix you – they can give you your position relative to a town / city, to an airfield, or to GPS coordinates. Position fixes should be obtainable down to and about 3,000 feet outside the London TMA.

(vii) Use of additional equipment where required

Cross-country gliders should carry Flarm. The trainee should understand how to use Flarm, in particular:

- what the various warnings mean
- have an understanding that Flarm displays directional information relative to track, not heading, and when that might be important.

The later point can be significant in strong winds. It is also possible that the trainee will fly a glider with a transponder, in which case they also need to be familiar with its use.

(viii) Joining, arrival and circuit procedures at remote aerodromes

The trainee should be familiar with the likely joining and circuit procedures at any airfield they plan to land at, and the standard procedures for unplanned airfields. Most airfields provide very useful information online, that should be studied in advance. Standard procedures are well covered of this in the BGA FRTOL course and trainees should be encouraged to do the course even if they do not choose to do the test at the end to get the licence.

TEACHING CONSIDERATIONS

Equipment

A moving map with a good-sized screen mounted securely in the glider can be enough to provide navigation and airspace information. This requires a good fixed or mobile battery supply more than sufficient for the planned flight and possibly a duplicated battery system. Nonetheless, a backup should be carried and used in the event of fault or uncertainty.

Less capable systems (such as a phone running one or other glider navigation package) can be used, but they may require a more substantial use of a complementary paper chart.

Non-moving-map GPSs can provide good navigation information, but require more care in their use, particularly if a direct-to is chosen to a diversion, that potentially routes through airspace.

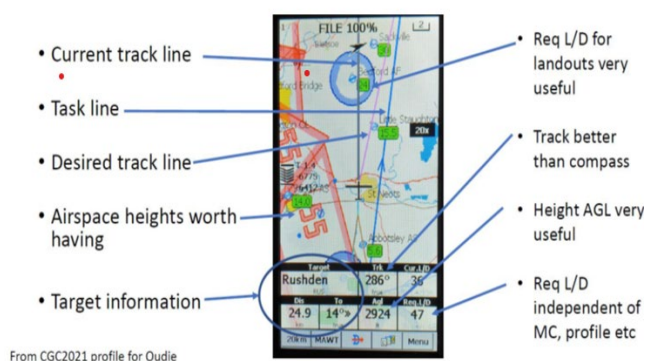
The trainee should understand how to navigate using a paper map and compass – that being the ultimate backup to a GPS system failure. But cross-country navigation by map and compass alone should be strongly discouraged in any situation where proximity to airspace could be a concern.

If possible, it is good to use the navigation system that the trainee will use when they start going cross-country, so encourage them to research and choose one. Learning to use a moving map GPS is mostly about managing the kit, rather than the flying, so most of it should be done on the ground, or possibly in a good simulator.

They should know how to:

- load current airspace and waypoints (and know what they have got).
- make sure that the nav' system is set up to show relevant airspace, and alert if they get close.
- load NOTAMs if appropriate.
- find airfield and radio details (from the nav system, from a Frequency Reference Card, etc).
- load a task with appropriate turning-point zone settings for a cross-country badge flight.
- fly the task, whilst understanding their diversion and land-out options as they pass appropriate choices.
- make a diversion choice, select a go-to in the nav system, then fly there.

You can give advice as to a suitable simple setup for the moving map, for example that shown in Figure 2



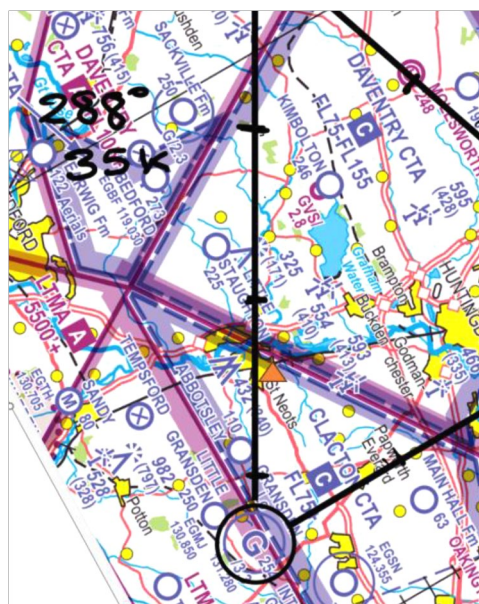
A properly marked and folded map is essential in addition to the moving map, especially if it is relatively difficult to get airspace information from the nav' system.

Flying with just paper map and compass.

The backup to the normal use of moving map GPS is 'Pilotage' navigating using the map and comparing it with the features on the ground to establish your position.

We know what track we want, and what our drift is likely to be. So, making allowance for wind, we pick a point on the horizon and head towards it. We compare map and ground features to work out where we are. As we move along our task, the features we choose will change.

If we know where we are, we work map to ground, maintaining at least three known "fixes" which change as we move along the track **figure 3**.



At the position shown by the orange triangle in Figure 3, we should be able to see:

- Grafham water in our 1 o'clock - a large body of water with its major axis along our track.
- Little Staughton airfield just left of our nose an airfield with lots of solar panels.
- St Neots close in our 9 o'clock.
- Railway across track.
- Lakes across track.
- Major road across track on far side of town.

If lost, we work ground to map i.e. look for features we can see on the ground and find several distinguishing characteristics and compare them with the map. For example, in Figure 5 below)



- Large town directly behind triangular town
- Line of water beyond
- Small town other side of water
- Triangular town



- Triangular town
- Line of water beyond
- Large town behind
- Small town other side of water

Working ground to map, we look for features we can see on the ground and find several distinguishing characteristics and compare them with the map. For example, in Figure 5, we can look at what's ahead and identify things which we can see on the map in Figure 6. In this way we can fix our position.

We should demonstrate, where possible, the effects of visibility and height. As we get lower, we can see less far, small features may seem significant but may not be on the map. As atmospheric visibility decreases, we also see less far, so we have fewer clues to work with. Navigation in poor VFR conditions can be very difficult.

Visibility can be much worse into sun, and that cloud shadows often obscure ground features.

In the air the trainee should be taught about how to fly using this setup.

- Looking only occasionally at the map – and picking a feature in the distance and flying towards that, making suitable allowance for drift.
- Looking out thoroughly before and after looking in at either GPS or paper map. Ensure the trainee keeps the 'look-in' time to a minimum.
- Making use of the paper map to give better situational awareness than some moving maps provide and to review airspace on track.
- Carrying out nav tasks early in the cruise after leaving a thermal, but ensure they know where to go (heading or feature) before they leave the climb.

Track/heading or north up?

The question of how to orientate the map or moving map is the subject of much debate. There are pros and cons of each method. Explain what they are and allow trainees to make the decision. Pros and cons are:

Heading up: The world and the map correspond, which is very useful when identifying features and, on a portrait, orientated moving map, you can see furthest in the direction you are going which is better than seeing what's behind you.

But on a paper map, the writing may not be horizontal and figuring out the actual heading can be more difficult (though can be helped by a compass rose).

Our ability to recognise familiar patterns or shapes of features, is compromised and when thermalling the device is of limited use.

North up: you can read the text on a paper map easily and it is relatively easy to identify north.

But you have to rotate features in your mind to compare them with what's out the window.