

# EUROCONTROL guidance notes for pilots

## 7. VOR/DME/ADF Navigation



### AIRSPACE INFRINGEMENT

Infringement of controlled airspace, danger and restricted areas, etc. is a serious aviation hazard and occurs when an aircraft enters the airspace without permission. This happens several times a day in the busiest areas of European airspace, creating the hazard of a mid-air collision.

This is one of a series of Guidance Notes (GN) intended to help you keep out of trouble. The others are listed at the foot of the next page.

A major cause of airspace infringement is navigational error. This GN contains some advice on navigation using VOR, DME and ADF.

### CHART CHOICE

The best chart choice for navigation using radio aids alone is usually an en-route chart of the type published commercially. These charts show all radio beacons, as well as airfields, airways and other airspace reservations. The chart coverage available depends on where you plan to fly and whether you will be in upper or lower airspace. However, if you intend navigating visually, you should use the appropriate visual navigation chart as described in GN 2. Such VFR charts contain information about the navigation aids, too. Make sure you have the latest version.

Check for recent changes to navigation aids and airspace restrictions - and temporary restrictions caused by, for exam-

ple, a military exercise, parachute dropping, or a flying display. Mark these on your map if they will be active while you are in the air. GN 3 (Getting Aeronautical Information Before Flight) has more about this.

### RADIO NAVIGATION AIDS

The three most common types of radio navigation aid are:

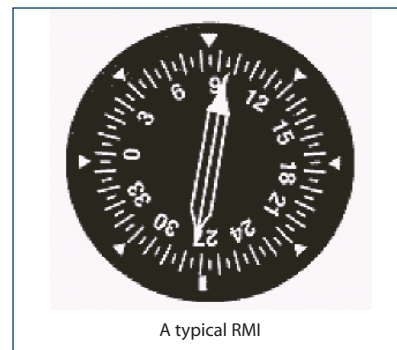
- **VOR** indicates the magnetic bearing from the station to the aircraft (the Radial). The original instrument, the Omni-Bearing Selector (OBS) indicates the aircraft's position relative to the radial the pilot has selected, and requires careful interpretation.
- **ADF** (Automatic Direction Finding) indicates relative bearing to a radio beacon, called an NDB (Non-directional Beacon). The original Relative Bearing Indicator (RBI) only shows that relative bearing, and can still be found.
- **DME** (Distance Measuring Equipment) indicates the distance in nautical miles from the beacon to the aircraft. The display is usually digital.

VOR and DME beacons are often located at the same position, with the same published frequency.

VOR radials and ADF bearings can be indicated in various ways. A RMI (Radio Magnetic Indicator), as shown above, indicates the aircraft's heading together with

the navigation aid bearings which the pilot has selected in both magnetic and relative directions. The aircraft heading (085° in this case) is shown at the top. The needle indicates the magnetic bearing from/to the beacon (095°/275°), or you can read the relative bearing between the needle and the pointer (10° right). There may be a switch to select which input is displayed (e.g. VOR1, VOR2, or ADF). Many RMIs have two pointers so that you can use two VORs or a VOR and an ADF at the same time. Modern Horizontal Situation Indicators (HSI) indicate in the same way. The older instrument, the RBI indicating only the NDB's relative bearing.

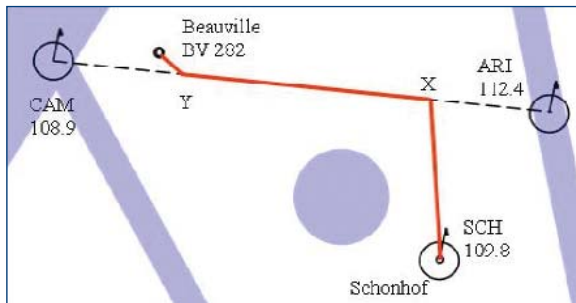
After tuning them to the correct frequency, VOR, DME and NDBs must be identified aurally using the Morse Code identification signal, before you use the information.



### PLANNING YOUR ROUTE

The simplest way to navigate using radio aids is to fly from one beacon to another - in the same way as you would inside air-

ways. If you can use navigation aids which are outside controlled airspace, then this is simple; but if not, you will have a little more work to do.



In the example shown, a pilot wants to fly from Schonhof to Beauville, avoiding the controlled airspace shown in blue. The aircraft is equipped with one VOR, one DME and one ADF. SCH, ARI and CAM are all VORs; SCH and CAM are also DMEs; there is an NDB, code BV, at Beauville. The pilot plans to follow the route shown in red and completes a flight plan. The track from Schonhof to X (350°M) is chosen to keep well clear of controlled airspace. From X, the pilot will follow the track from ARI to CAM (265°M). The distance from SCH to X is 45NM and from CAM to Y (where he/she will turn towards Beauville) is 30NM.

The pilot tunes SCH VOR/DME and identifies the code. After takeoff, the pilot turns to establish on the 350°M bearing from SCH and follows this track (allowing for drift) until the DME from SCH is approaching 45NM. The VOR is then tuned to 112.4, the code is identified and the pilot turns onto track 265°M when this bearing from ARI is indicated on the RMI (the DME will

read 45NM at this point). The pilot then tunes the DME to 112.4 and identifies the code (ARI). When the DME shows that the aircraft is roughly half way between ARI and CAM, the pilot retunes the VOR to 108.9, identifies the code (CAM) and establishes on the bearing (085°M) from CAM (track still 265°M). The pilot then tunes the ADF to 282 and identifies NDB BV. When the DME indicates 30NM, the pilot turns to fly towards

Beauville, homing in to NDB BV using the ADF.

Without a DME, the pilot must pre-plan radials or ADF bearings for his turning points and switch between beacons regularly.

### BACKING UP VISUAL NAVIGATION

If you are navigating visually, and especially in poor weather (see GN 6), pre-plan VOR radials and DME ranges for each turning point and fix point, ideally with the station in line with track or on the beam at the point. Fly your plan, using visual features (VOR radials are only accurate to  $\pm 5$  degrees at best), but if you miss a fix point, aim to line yourself up with radio aids for the next one.

### CROSSING AIRWAYS

As advised in GN 10, if you plan to cross an airway, do so at a navigation aid or reporting point and make your track cross at right angles so that you spend the mini-

mum time in controlled airspace. Make sure you ask for clearance early and know your ETA to the edge of controlled airspace accurately. Do this even if you plan to go under the airway, for weather may force you to fly higher than you planned. If there is a DME at your chosen crossing point, this will be easy. If not, measure the critical bearings from a nearby VOR or NDB and note them on your chart.

### HAVE A SAFE FLIGHT

We hope you have found this useful. If you have any suggestions for improvement, please let us know.

### OTHER GUIDANCE NOTES

1. Rules for VFR Flight
2. Flight preparation
3. Getting Aeronautical Information Before Flight
4. Getting Meteorological Information Before Flight
5. Using Meteorological Information for Planning
6. Visual Navigation
7. VOR / DME / ADF Navigation
8. GPS Navigation
9. Getting Aeronautical & Met Information In Flight
10. Entering Controlled Airspace
11. Getting the Most out of your Transponder

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## WEBSITEinfo [www.eurocontrol.int/safety](http://www.eurocontrol.int/safety)

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