NDB TRACKING & INTERCEPTING

What is an NDB?

An NDB is a beacon that transmits radio energy in all directions, and stands for 'non directional beacon'. It is associated with an ADF (automatic direction finder) in the aircraft, which points at the beacon, and gives a magnetic bearing to the beacon (QDM). NDB's transmit on low/medium frequency between 200 and 1750kHz. The range of NDB's is usually fairly small, although some powerful ones exist for long range navigation. Their primary use tends to be as airfield locators and instrument approach aids (including holding), although they can also be used for en-route navigation.

Considerations

- Range and accuracy.
- Cockpit instrumentation.
- Actions prior to using an NDB.
- NDB position fixing and tracking.
- Intercepting tracks using an NDB.

Range and accuracy

NDB's suffer from several forms of interference such as night effect (especially dawn/dusk) and thunderstorm activity. These problems are well covered during ATPL ground studies, so these notes will not cover this area in any detail. The DOC (designated operation coverage) for NDB's is given in the AIP (en-route or aerodrome sections), and states the range expected for daytime use. NBD signals can be accurate to +/- 2 degrees, but this depends on various factors, including class of beacon and atmospheric effects. The most common type of NDB is class B, with accuracy of +/- 5 degrees.

Cockpit instrumentation

In the cockpit we have two parts to the ADF:

1. The ADF display itself. There are several types, but these notes will look at the RMI (remote magnetic indicator).
2. The ADF section of the radio panel.

Figure 1

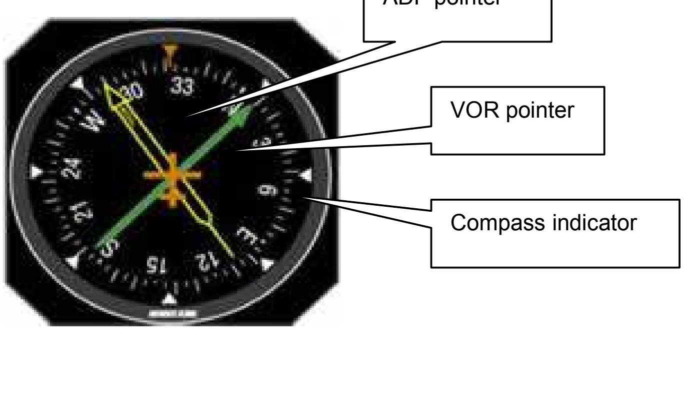


Figure 1 shows a typical ADF display. The compass card rotates automatically with the HSI (see VOR notes), showing aircraft heading at the top. The yellow needle points to the beacon, with the head showing QDM (magnetic bearing to) and the tail showing QDR (magnetic bearing from). It is quite common to also have a green VOR pointer on the display also, which is discussed in the VOR notes).

The second part of the equipment is the ADF radio box, which shows frequency in use, and can be altered in a similar way to the COMM frequencies.

Actions prior to using an NDB

Prior to use, the following actions must be taken:

1. **SELECT** the frequency of the NDB. This is given on maps/approach plates, or in the AIP (en-route or aerodrome sections).
2. **IDENTIFY** the beacon by listening to the Morse code identifier. This is a two or three-letter identifier for the beacon transmitted as Morse code. A positive ident must be established prior to use. Also, because the instrumentation has no failure flag, the ident should be periodically rechecked.
3. Check the **DISPLAY** is reading correctly and giving a sensible display. This includes confirming the RMI is slaving, and that the needle is not stuck.

NDB position fixing and tracking

Figure 2

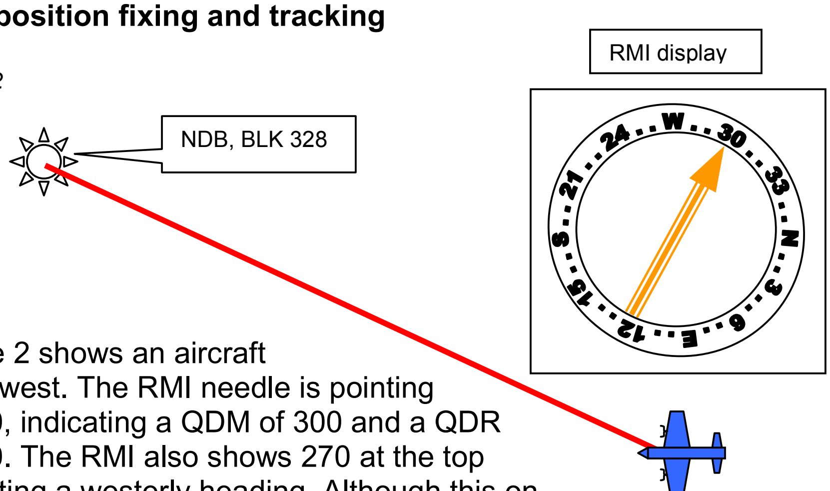


Figure 2 shows an aircraft flying west. The RMI needle is pointing to 300, indicating a QDM of 300 and a QDR of 120. The RMI also shows 270 at the top indicating a westerly heading. Although this on it's own does not fix the aircraft's position, linked to a DME/VOR or by cross-cutting a 2nd NDB it can be seen that position fixing is fairly straightforward.

Once our position has been established we can use the instrument for tracking to or from the beacon. We will look at an aircraft tracking to the beacon from the east, overflying the beacon, and continuing to track to the west.

Figure 3

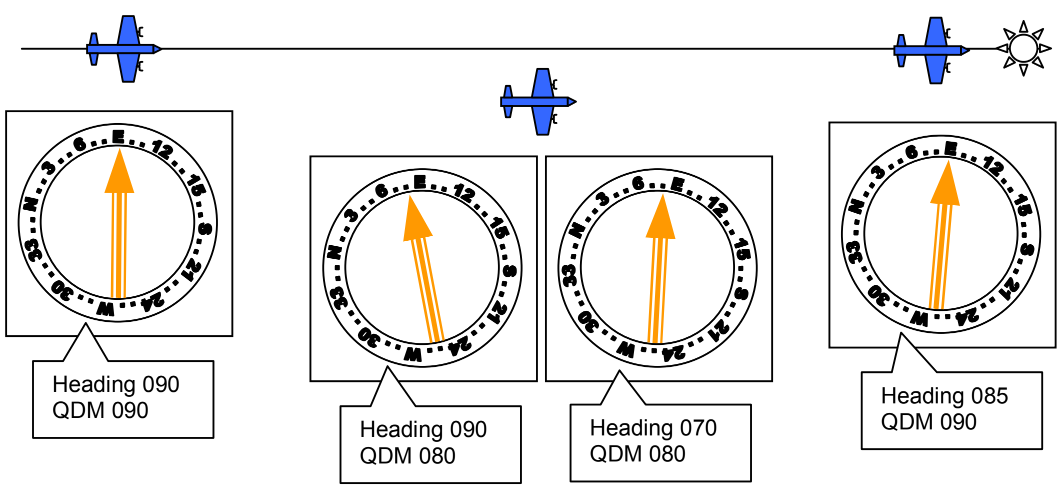
Figure 3 shows the situation in zero wind conditions. Initially the aircraft has a heading of 270, with a QDM of 270. As it passes over the beacon the needle will flip. The rate at which it turns depends on accuracy of tracking. Once through the overhead the instrument shows a heading of 270, and now a QDR of 270 (QDM 090).

Zero wind conditions are obviously rare, so we must consider what to do with drift allowance, and how to make track corrections. In order to do this we must look at the basic rules of using the NBD:

- If we **WANT** more QDM, we must STEER less.
- If we **WANT** less QDM, we must STEER more.
- If we **WANT** more QDR, we must STEER more.
- If we **WANT** less QDR, we must STEER less.

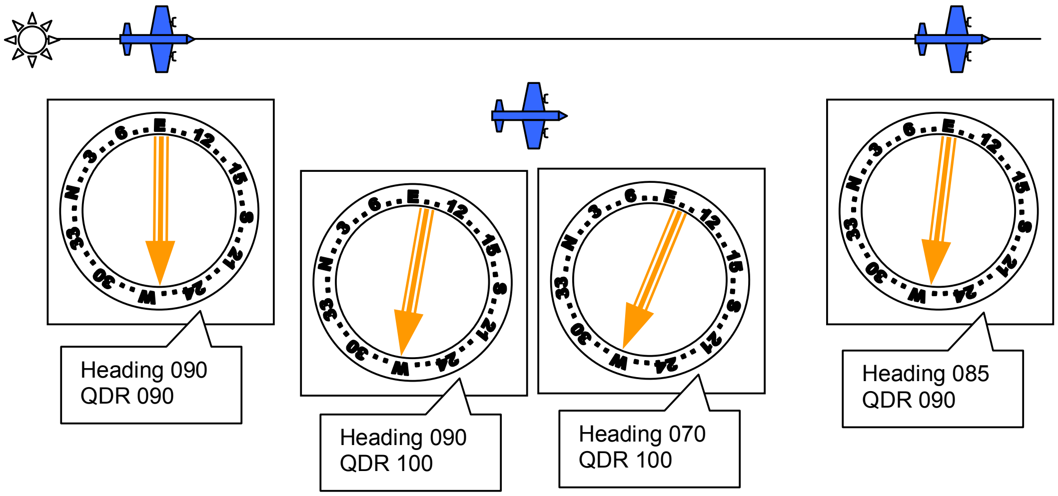
Figures 4 & 5 show examples in order to explain this further, with examples of tracking a QDM and a QDR with unplanned wind from the north of track.

Figure 4 – QDM



As the aircraft is blown off track the ADF pointer begins to move. In the example the error is noticed when the QDM has fallen to 080. We now WANT more QDM, so must STEER less. In order to correct we double the error. This gives a new heading of 070 (2 x 10 degrees, steer less). We continue to fly this corrected heading until the ADF pointer shows our required track. Once back on track we fly a compromise heading (in this case 085) to prevent the error from reoccurring.

Figure 5 – QDR



This time as the aircraft is blown off track the tail of the needle indicates an increasing QDR. The error is noticed when the QDR is 100. To correct we WANT less QDR, so must STEER less. As we want 10 degrees less QDR we should steer 20 degrees less heading, making 070. As the needle moves back to show a QDR of 090 we apply a compromise heading of 085 to prevent further errors.

Clearly in practice we do not want such large errors to occur, so any movement of the needle should be dealt with promptly. Also, when tracking, it can be seen that the needle should be 'sheltered from the wind' by the relevant drift correction angle. Needle sensitivity is also important. This is discussed in the VOR notes, and the same principles apply to NDB tracking.

Intercepting tracks using an NDB

The same principles apply to intercepting tracks using the NDB as for a VOR. The main difference is that we do not get a 'fly left or right' indication from the instrument. The basic rules of using the NDB must therefore be applied to determine the application of the intercept angle.

Figure 6

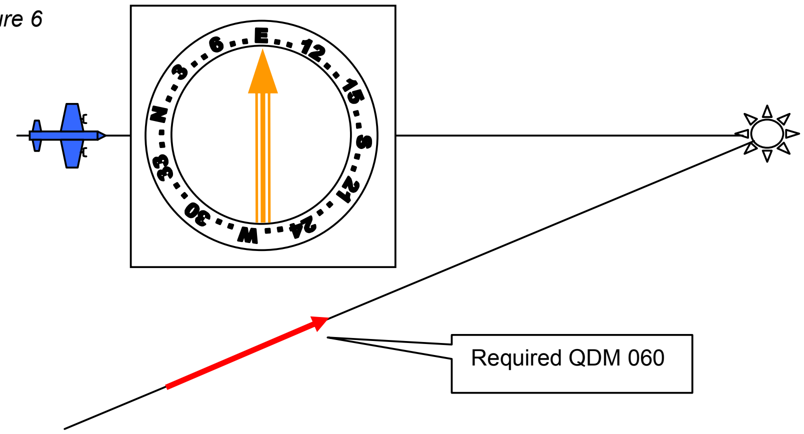


Figure 6 shows an aircraft tracking towards an NDB with a QDM of 090. A track of 060 is now required:

1. Apply the rule – WANT less, STEER more. We therefore know we will need to increase our heading.
2. Work out the intercept angle – 30 degrees difference x 2 = 60 degrees intercept.
3. **Apply the intercept to our desired track in the correct sense**. In this case a track of 060 PLUS 60 = heading 120.
4. Turn onto heading (in this case right 30 degrees), and allow ADF needle to fall to 060, before taking up an appropriate heading for the new track.
5. Note that we have a 60 degree turn to make to pick up our new track, so we must allow for this as the ADF needle approaches 060, and turn slightly before. How much before depends on the rate of movement of the needle (related to distance from the beacon).

<u>Wind considerations:</u>

When strong wind conditions exist, it may be appropriate to increase/decrease the intercept angle, should the heading result in a strong crosswind component.

Note: when tracking a beacon, any required corrections are applied to heading, as heading is relevant to track (with a wind allowance in place). When intercepting a track, any intercept angles are applied to required track.