HOLDING PROCEDURES

What is a hold?

A holding pattern is a procedure usually associated with an instrument approach, although a pilot may be asked to hold at any time. The main purpose of a hold is to allow air traffic controllers to control the flow of traffic from the en-route stage of flight into the procedure to land. Other purposes are to allow traffic to 'shuttle' (ie descend), and also to be orientated for a procedure. Weather may also result in a need to hold.

Considerations

These briefing notes will consider the following areas:

- Beacon use associated with a hold.
- The design of a hold, with the key sections.
- Hold entry from the various sectors.
- Flying the hold, with consideration for wind.
- Intercepting the inbound track.
- Making corrections in order to improve the holding pattern.

Beacon use

A holding pattern is normally centered over a beacon, although it may be away from the beacon on a radial/DME distance. As with all beacon use, the instrument should be selected, identified and the display set up in the correct sense prior to use. When using an NDB the signal should be regularly identified due to the lack of any failure flag. One check of the ident per hold is satisfactory (ie once every 4 minutes).

Design of the hold

Figure 1

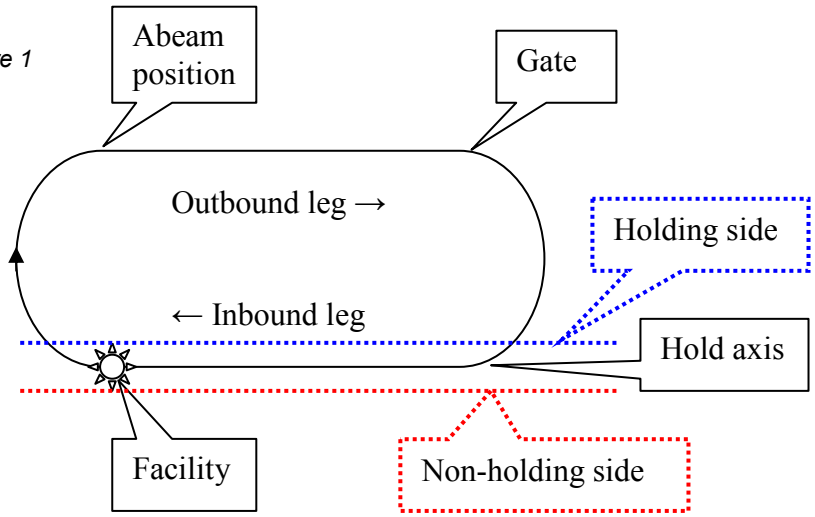


Figure 1 shows a **standard hold**. this is where All turns are right hand from over the beacon.

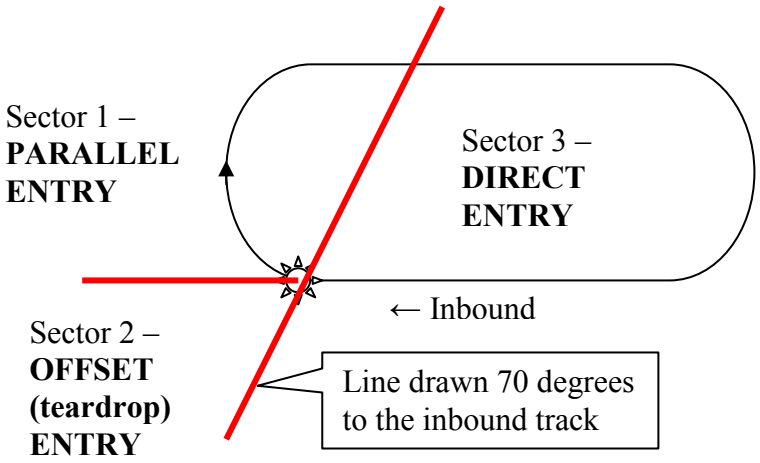
A **non-standard hold** is a mirror image around the inbound axis, with all turns to the left.

The hold is based around 2 legs of 1 minute each, plus 2 rate 1 turns of 1 minute each, so each hold should be completed in approx. 4 minutes. We are interested in all the features shown in figure 1 to fly the hold accurately.

Hold entry

The hold is divided into 3 sectors, and our entry is based on **aircraft heading** in relation to these sectors. Figure 2 shows a standard hold based around an inbound track of 270 to the facility.

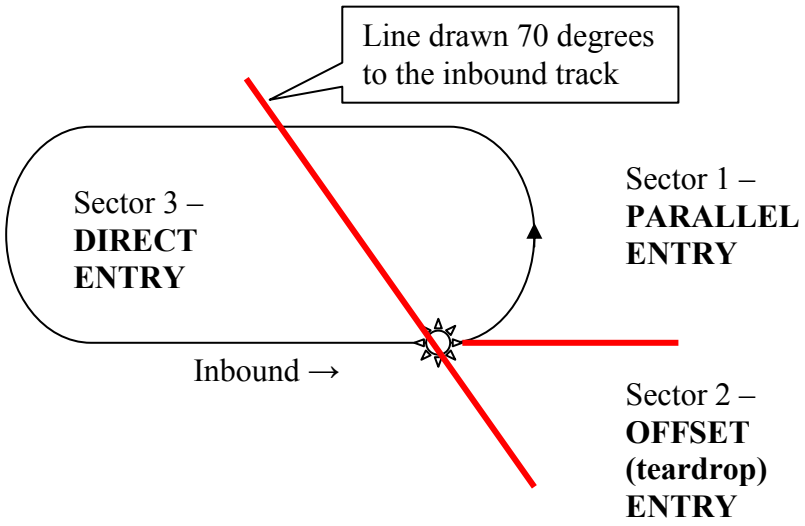
Figure 2



So, if the aircraft heading was 090-200 then we would enter using a parallel entry. Heading 200-020 would result in a direct entry, and a heading of 020-090 would be an offset entry. When our heading is +/- 5 degrees of the sector boundaries we can choose which entry we wish to make.

Non-standard hold sectors are shown in figure 3 below.

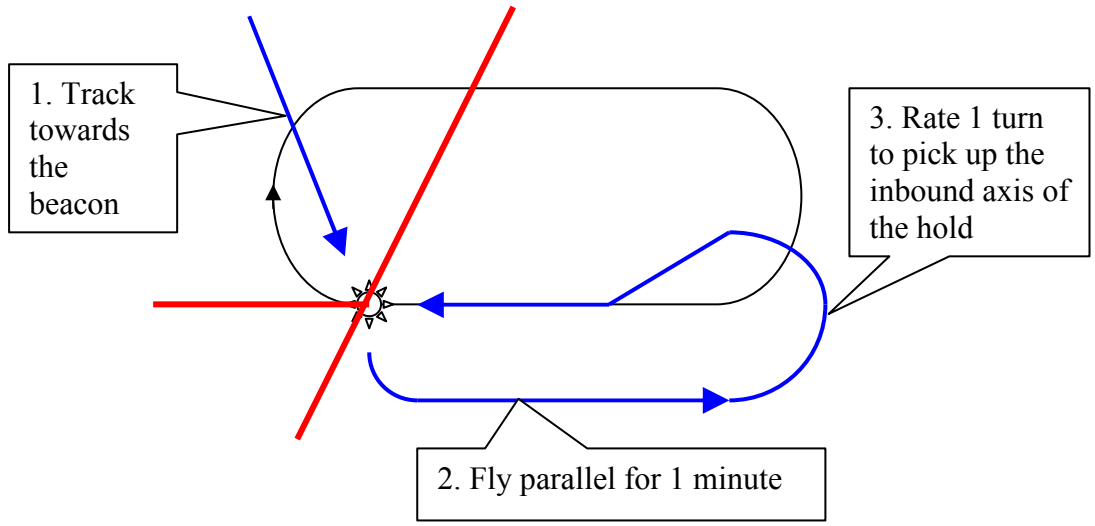
Figure 3



Sector 1 – parallel entry

When entering from sector 1 the aircraft should be flown inbound to the beacon with a constant track. Once overhead the beacon a turn is made to track parallel and reciprocal to the inbound track. After 1 minute a turn is then made towards the holding side, and a track picked up to intercept the inbound axis of the hold, allowing a direct entry to be made.

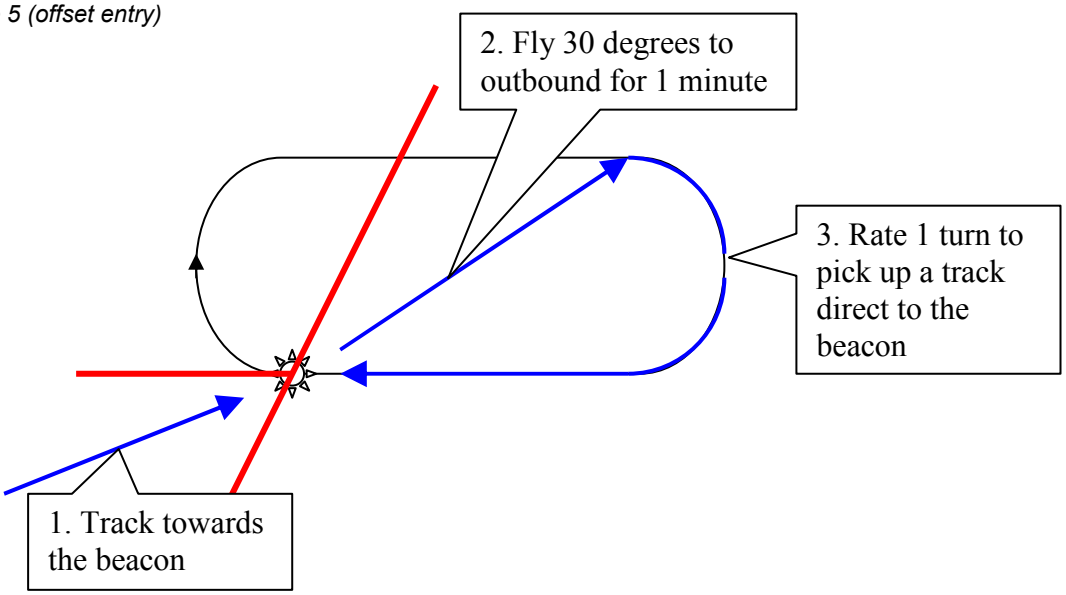
Figure 4 (parallel entry)



Sector 2 – offset entry

When entering from sector 2 the aircraft should be flown inbound to the beacon with a constant track. Once overhead the beacon a turn is made onto a track of 30 degrees offset to the outbound holding track. After 1 minute a turn is made to intercept the inbound track in order to make a direct entry to the hold.

Figure 5 (offset entry)



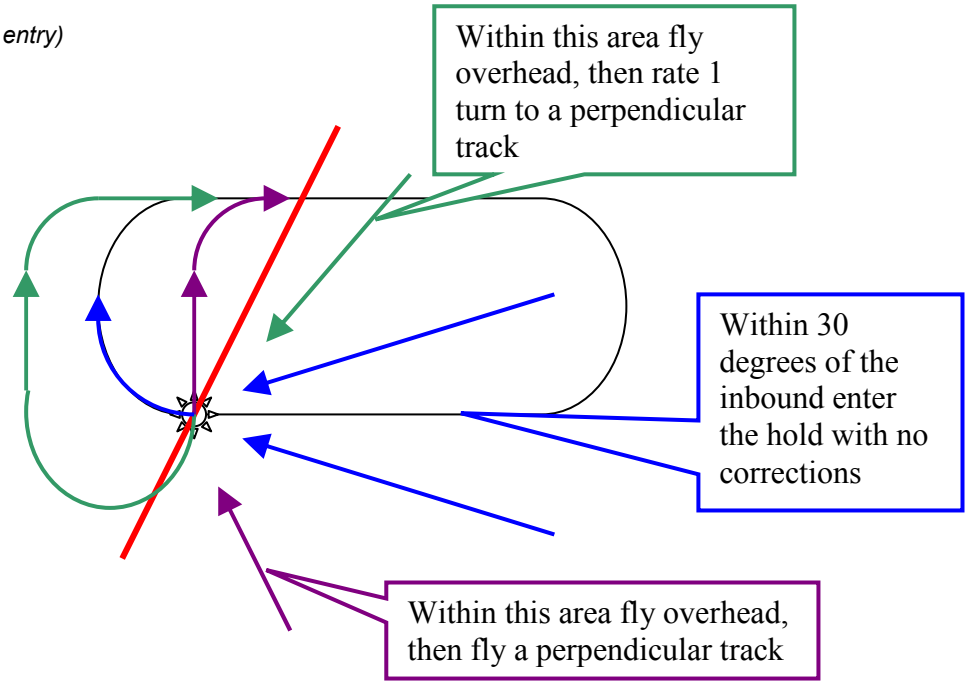
In the above example once overhead the beacon the aircraft is flown on a track of 060 (30 degrees off the outbound track 090) before returning to the beacon.

Sector 3 – direct entry

From sector 3 the aircraft is already positioned and orientated to proceed directly into the hold, and so from overhead the beacon the aircraft commences a hold. There are however some considerations needed with

regards the exact heading/track of the aircraft towards the beacon, as fairly obtuse angles exist at the extremity of the sector.

Figure 6 (direct entry)



As can be seen in figure 6 above, when making a direct entry from outside 30 degrees either side of the inbound track corrections need to be applied, otherwise the aircraft will not pick up the outbound track at an appropriate distance to the beacon. Once overhead the beacon the aircraft should be flown on a perpendicular track (turning to achieve if necessary) for a maximum of 18 seconds (depending on angle of entry), prior to continuing the turn onto the outbound track. (The exact amount of time to use is the angle from the inbound track divided by 10, then multiplied by 2. For example an entry at 60 degrees to the inbound would mean flying perpendicular for 60/10 x 2 = 12 seconds.)

Flying the holding pattern

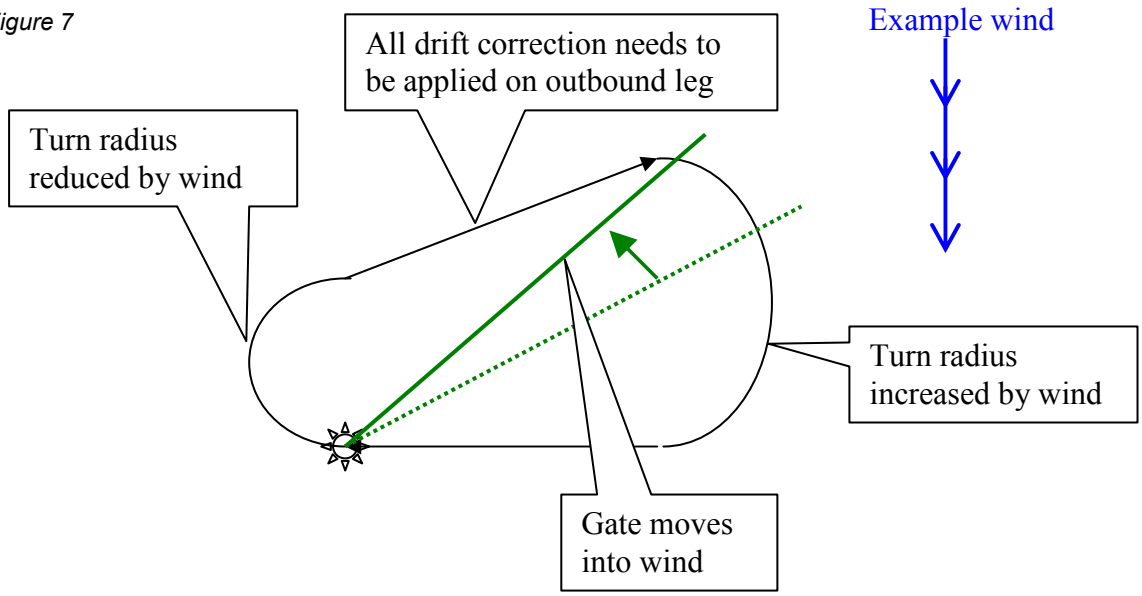
Once the entry has been made, we now need to fly an accurate hold of approximately 4 minutes, returning to the beacon within 5 degrees of the inbound track. Using figure 1 for reference we should do the following:

1. Make a rate 1 turn over the beacon to the outbound track (1 minute).
2. Start our timing at the abeam position, as only 3 minutes of the hold are timed (QDM/QDR/radial 90 degrees to inbound/outbound).
3. Fly outbound for 1 minute, not allowing QDR/radial to indicate that we have passed our ‘gate’. The gate is a line 30 degrees offset from the outbound track in still wind, and is considered further on page 6.
4. Make a rate 1 turn onto our inbound track. This turn always begins based on our time, and not on reaching the gate. This will be discussed further when we consider intercepting the inbound track. As we have started the timing at the abeam position the timer should indicate 3 minutes once the hold is completed.

Wind corrections - drift

As conditions of nil wind seldom exist we need to understand what to do in order to still fly the hold accurately with drift. The problem we have is that we cannot make any corrections for wind whilst turning, so the only chance we have to correct for wind in the 2 turns is on the outbound leg.

Figure 7



In order to fly accurately we need to apply all the drift for the outbound leg and the 2 turns on the outbound leg. **We therefore apply 3 x drift to this leg**. Our gate also needs to move into wind in order to allow for the changed turn radius for our return to the beacon. **The inbound leg is flown with single drift only**.

Notes on drift correction:

1. When applying drift in the other sense (towards the inbound track), it is safer to **only apply 2 x drift** and expect to hold off on the inbound turn. If we do not do this we are in danger of flying through our inbound track and having to turn back to re-intercept the inbound.
2. The gate should move by the same amount as the single drift being applied, usually up to a maximum of 10 degrees.
3. When the drift being applied moves the heading to within 30 degrees of a headwind, **then only 2 x drift** should be applied.

Wind corrections – headwind/tailwind

Any headwind/tailwind component will also cause a need for corrections. Again, the only chance we get to correct for this is on the outbound leg. Clearly, if we fly for 1 minute into a headwind, our inbound leg with a tailwind will be much less than 1 minute, so the hold will take less than the 4 minutes we are trying to achieve. **We should therefore correct by +/- 1 second for each knot of headwind/tailwind**.

Intercepting the inbound track

As has been discussed, the final aim of flying a good hold is to intercept our inbound track (+/- 5 degrees). In order to achieve this we need to use instrument indications to assess our position and determine any corrective action on the inbound turn. The first such indication is our gate, and the second is our QDM/radial with a portion of the inbound turn remaining.

Using the gate:

The gate is a point that we have determined will allow us enough space to turn onto our inbound track (30 degrees to the outbound in still wind). It is a position we must not pass therefore, until our calculated outbound time is up. Should our NDB/VOR indications show that we are approaching our gate, we fly the plane along the gate until our timing indicates we should start our turn inbound. This is achieved by tracking the QDR/radial of the gate with an appropriate heading.

If we have not reached our gate when the outbound leg is complete we still commence the turn. From this position however we should expect to have to hold off on the turn as we are starting from a wide position.

Reading the turn:

If we start the inbound turn at our gate, and our calculations have been good, then we should be close to our inbound track at the end of the turn. However, by assessing the inbound QDM/radial with 60 degrees of turn remaining we can increase accuracy further.

Figure 8

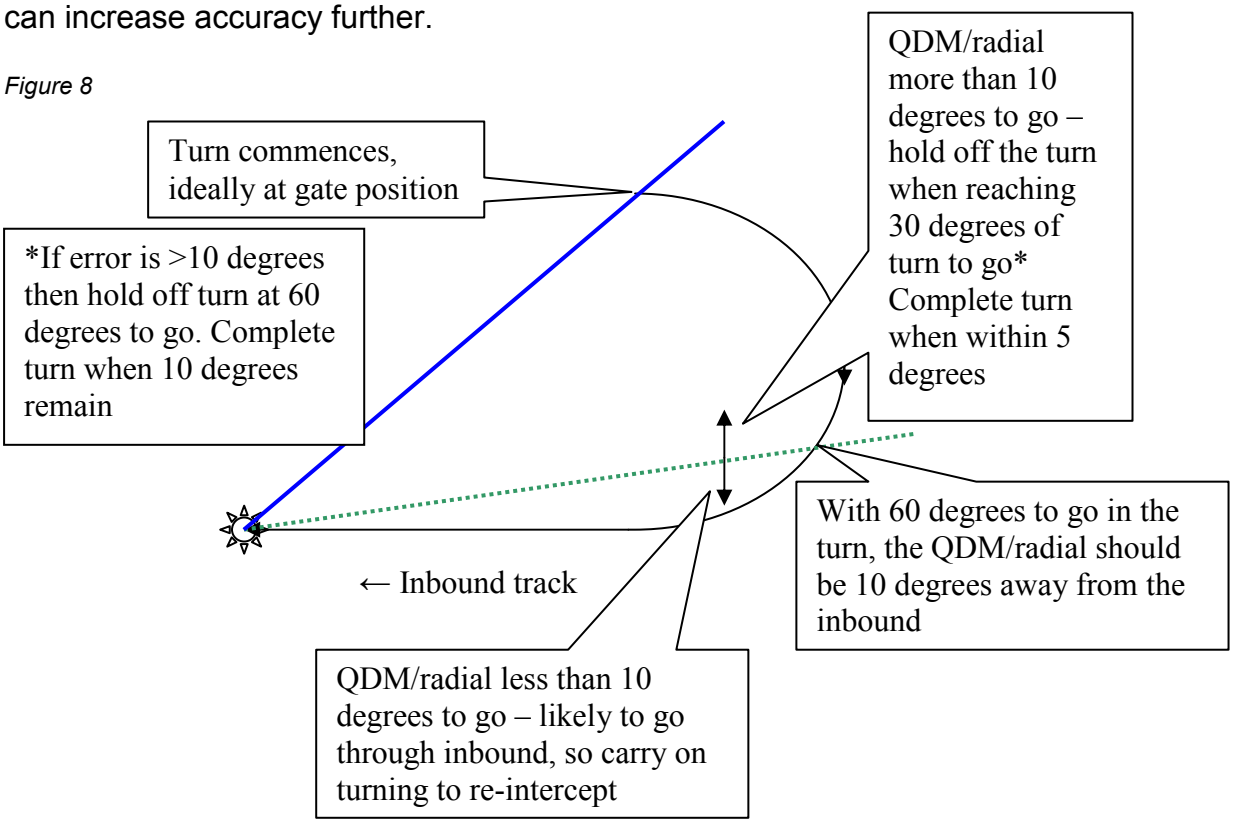
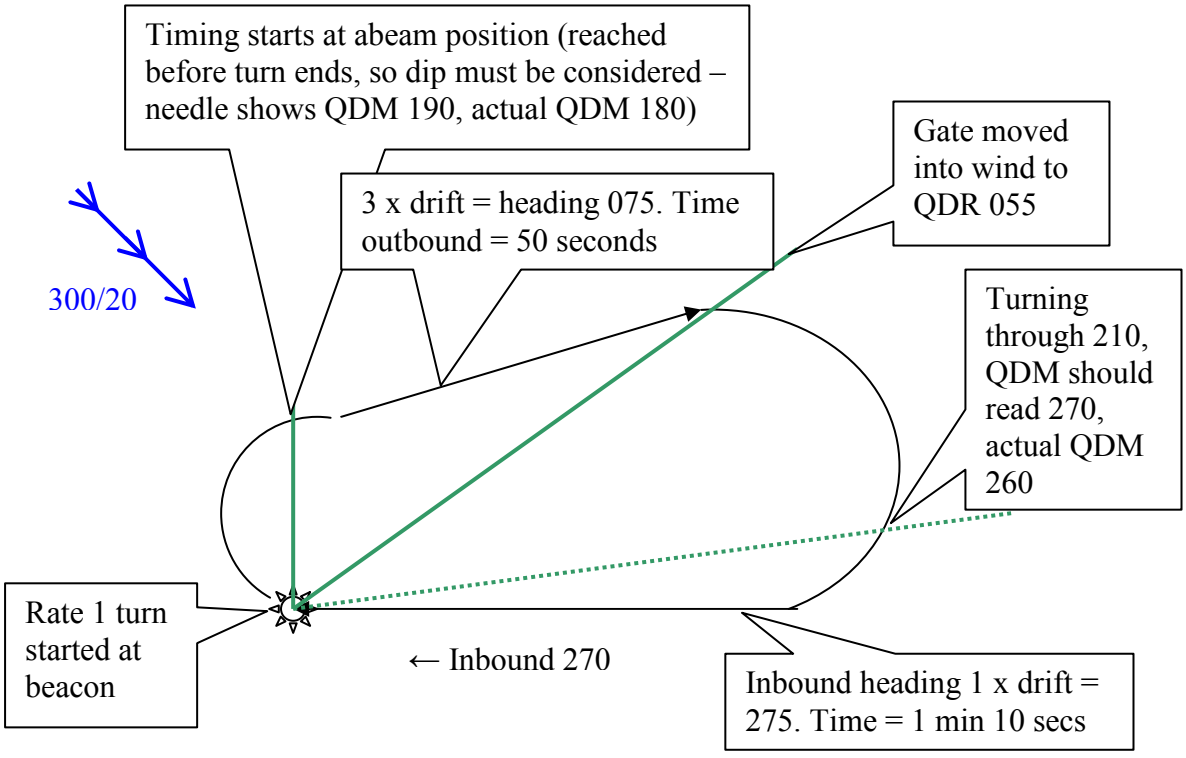


Figure 8 shows what we should expect to do with 60 degrees of turn remaining. However, when carrying out an NBD hold we must also consider **'needle dip'**. This is where the head of the needle dips towards the down going wing whilst turning, due to the loop antenna taking time to resolve the signal. This dip error is usually in the region of 10 degrees.

When applying dip error to the situation, then the QDM should read the inbound track with 60 degrees of turn to go.

An example of a hold

In order to put all of the above into practice, lets look at an example. We will consider a standard hold, with an inbound track of 270 degrees, based on an NDB. The wind is 300/20kts. In the Seneca our maximum drift at hold power is therefore 10 degrees.



Notes on corrections:

1. Corrections on timing should also be applied to hold entry.
2. Single drift corrections should also be made to headings during hold entry.
3. Flying holds is not 'an exact science'. Practice at the procedures will develop skills at reading the instruments. The '60 to go check' is also an approximation, as the position of the aircraft at this point is influenced by wind. The amount of dip also varies from aircraft to aircraft.
4. When flying a VOR hold, then intercepting the inbound track is made easier with indications from the track deviation bar.

Improving holding patterns

With practice, a pilot should be aware of any errors in calculation during a hold, and therefore be able to improve the pattern with each further hold. The main errors which may occur, and corrections to be applied are as follows:

1. The timing varied significantly from the planned 3 (timed) minutes. Alter the amount of time on the outbound leg

2. The hold was too wide, with a large amount of holding off required. Alter the outbound drift allowance, and move the gate back slightly towards the hold (assuming the gate was reached).

3. The aircraft flew through the inbound track. Alter the outbound drift allowance and move the gate further away from the hold.

4. The gate was reached before the inbound turn, but the inbound turn worked out well. Alter the outbound drift to delay reaching the gate, but do not move the gate.