DME ARC

1. Introduction

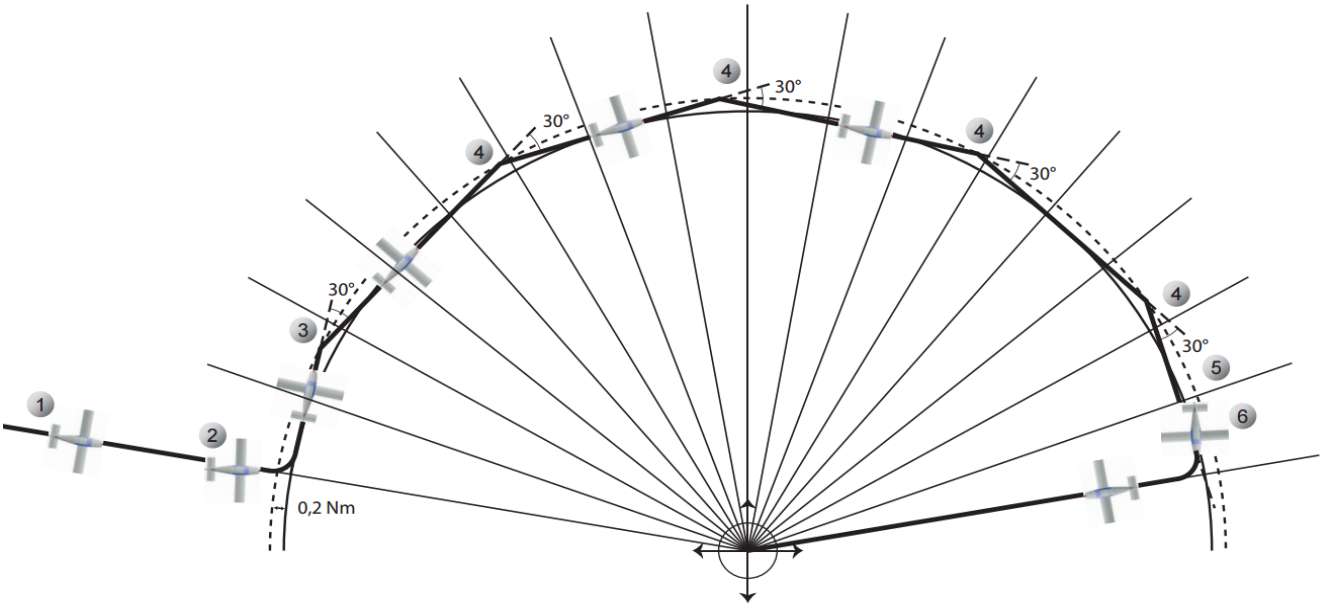
This documentation will introduce the general theory to deal with a DME arc.

The point in performing such manoeuver is to switch from a VOR radial to another one, or to typically join the beginning of an approach while relying on conventional means of navigation (Bearing given by a VOR/LOC or less commonly by a NDB, and distance by a DME).

2. Theoretical Knowledge

2.1. Lateral Flightpath

Due to human limitations, it is practically impossible to fly at a constant distance from the navaid. For this reason, we will actually fly several segments around the navaid, maintaining a constant mean distance.



The goal is to enter the arc perpendicularly by using anticipation to establish at the desired DME distance.

As soon as the DME deviation is more than 0.2NM, a heading change should be done.
This heading change will allow the DME distance to decrease no more than 0.5NM before increasing again.

- The heading change is **30°** for DME arc from **10NM to 20NM**
- The heading change is **20°** for DME arc from **20NM to 35NM**

When approaching the exiting radial, anticipation should be calculated as to establish on this radial.

2.2. Anticipation with DME Arc

When entering the DME arc (position n°2 on previous figure), the anticipation for a 90° interception turn, is determined by a cross track distance:

$$\text{Cross Track Distance (NM)} = \frac{\text{Ground Speed (kts)}}{200}$$

Example: If your ground speed is 260KT, Cross track distance = 260 /200 = 1.3 NM.

When leaving DME arc (position n°6 on previous figure), the anticipation for a 90° interception turn on the exit radial is determined by an anticipation radial:

$$\text{Anticipation Radial (°)} = \frac{\text{Ground Speed (kts)}}{5\times \text{DME Arc Distance (NM)}} = \frac{\text{Ground Speed (kts)}}{10 \times \text{Time to DME (min)}}$$

Example: if your exit radial is 85° and you follow a 16NM DME arc and your ground speed is 280KT at the end of the arc, anticipation radial = 280/(5*16)=280/80=3.5°. The exit radial will be in our example (see previous figure) 85-3.5° = 81.5°. In a real case, you should take 81° or 82°.

Because of 30° heading change, you should not arrive at 90° of the desired track, the intercept turn can be:

- As low as 60°, therefore anticipation should be slightly lowered
- As high as 120°, therefore anticipation should be slightly increased.

2.3. Vertical Flightpath

While performing the arc, you may need to continue your descent.

This descent may be initiated when passing a radial or you may need to determine by yourself a Point of Descent (POD) if you have to be at a defined altitude during or exiting the arc.

Length of a DME arc:

$$\text{Length (NM)} = \frac{\text{Radius (NM)}\times \text{Angle (°)}}{60}$$

As it is easier to determine our position by getting the current radial than knowing how much distance has been traveled, here is a formula to convert a distance into an angle:

Distance – Radial Conversion:

$$\text{Angle to exiting radial (°)} = \frac{\text{Arc InDescent Distance (NM)}\times \text{Total Arc Angle (°)}}{\text{Total Arc Length (NM)}}$$

Pay attention to the local QNH. When changing the altimeter setting from standard setting, the true altitude may be subsequently different from the pressure altitude.
Therefore, descent calculations should be based upon true altitude.

2.4. Effect of the wind

Taking into account the wind is critical when performing a DME arc.

As a matter of fact, depending on the entry and exit radial, the wind can completely revert during the arc. This can lead to overshoot of the maximum arc distance (0.2 NM), and can potentially drive the aircraft outside the protection area.

On each segment, a mean drift must be calculated and an adapted heading should be adopted to fly a correct track after the heading change.

The drift can be calculated using this formula:

Drift Angle:

Drift (°) = Base Factor × Crosswind (kts)

Base factor (min/NM) = 60 / TrueAirSpeed

If the drift is not accurate enough and the DME distance still increases or decreases, a 10° heading change should be made to accomplish a corrective action.

3. Conclusion

This document presents the simplest method to fly a DME arc.

There are other methods like “twist 10° turn 10°”, “twist 15° turn 15°” or “twist 20° turn 20°” but these are more complicated.

To illustrate this document, a tutorial is available, based on a real procedure, flown with a Beechcraft 90, look at our HQ training documentation.