VOR/DME APPROACH WITH B737

1. Introduction

This documentation will present an example of VOR/DME approach performed with Boeing 737 at LFRS runway 21.
This type of approach is a non-precision approach due to the fact that only lateral guidance is provided using a VOR. The pilot-in-command is in charge of the descent.

1.1. VOR

VOR (VHF omnidirectional radio range) is a radio beam transmitter that provides a VHF radio signal on the air in order to determine their position and stay on course by receiving radio signals transmitted from ground beacon.

1.2. Charts

Each VOR approach, during instrument flight rules (IFR) operations, is published on instrument approach procedure chart named IAC chart.
This chart shall include:

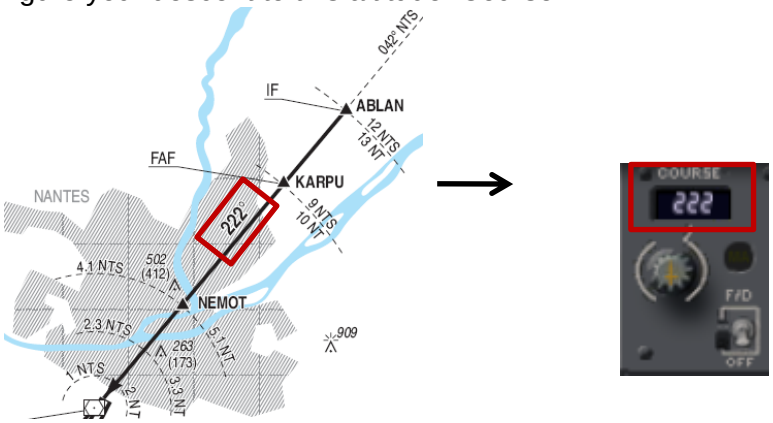
- Radio frequencies
- Navigation aid and course
- Descent profile
- Prescribed minimum visibility requirements.

2. First step

During approach phase of your flight, you must configure your aircraft for the ILS approach.

1. Take the VOR frequency from charts : configure your radio navigation receiver NAV1 = 115.500

2. Take the ILS course and interception altitude of localizer from charts: configure the course and configure your descent to this altitude. Course = 222°



3. Before establishing the VOR radial

Before joining the localizer, you must check the following points:

1. Aircraft speed shall be reduced between **180KT to 220KT**.
2. Aircraft descent altitude shall be set to the **interception altitude** of localizer published on charts.
3. Aircraft flaps are set to **5° position**.
4. **222°** Course is selected
5. Set auto brake to adequate value
6. On Boeing aircraft, you can intercept and follow automatically the radial using **VORLOC** button. You may also use **HDG** to intercept the radial manually.

A VOR approach can be performed manually by the pilot. The use of autopilot is not mandatory.

If you are far from VOR Radial, VOR indicator are set to maximum deviation and remains at this position (like the image hereunder). If you are closed to the path, the indicator will move to the central position.

4. Establishing the VOR radial

When the VOR indicator is moving to the central position, you must turn the VOR beacon.

You must handle your heading in order to keep VOR indicator near the centre position.
If you do that, you will keep the approach alignment until the runway in sight.

When the VOR indicator is on the left that means that the VOR radial is on the left of aircraft or the aircraft is on the right of VOR radial.

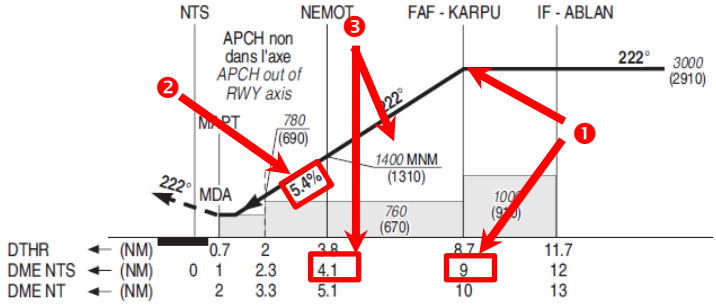
The spoilers can be armed at this stage.

5. Descent preparation

As there is no descent guidance for the pilot or the autopilot, the pilot shall calculate his descent rate based on the aerodrome approach charts:

1. Descent point is located at Final Approach fix (FAF) = 9NM DME NTS VOR
2. Descent rate is 5.4%
3. Intermediate check point is to be at 1400ft minimum at 4.1 NM DME NTS VOR,

In your aircraft, you don't have any % scale for descent rate. But you can use an approximation of the descent rate in feet/minute using this calculation:



Descent rate (ft/min) = Ground speed (KT) × Descent Angle (%)

Example: 180KT × 5.4% = 970 ft/min
If you want calculation you can use approximation 5% descent rate for a 3° (5.4%) descent angle: 180 KT × 5% = 900ft/min

In VOR DME approach, you must not be at lower altitude published at intermediate check point. You must be above or equal this altitude until you cross the point.

This value can be check or taken form a table given in some airport charts:

This table show the descent rate (VSP) in ft/min and time from FAF to Threshold in function of ground speed on final.

		130 kt	150 kt	170 kt
FAF - DTHR	8.7 NM	4 min 01	3 min 29	3 min 04
FAF - MAPT	8.0 NM	3 min 42	3 min 12	2 min 49
VSP (ft/min)		720	830	940

Sometime a cross check table shows altitude in function of DME distance.

DME NT NM	9	8	7	6	5	4	3
DME NTS NM	8	7	6	5	4	3	2
ALT (HGT)	*2670* (2580)	*2340* (2250)	*2010* (1920)	*1680* (1590)	*1350* (1260)	*1020* (930)	*690* (600)

6. Start descent on final approach

When reaching the Final Approach Fix (FAF), 9NM DME (in our example), we will start our descent.

In practical, the descent shall be anticipated using about 0.3NM in order to have right descent rate and not to be at too high altitude during the descent.

The pilot shall perform these tasks:

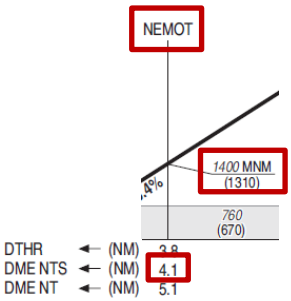
1. Reduce speed between 160KT to 180KT
2. Set Flaps to 15° or position 2.
3. Set altitude on Autopilot panel <u>closed and above</u> **MDA** (Alt = 600ft > 520ft MDA=minimum descent altitude)
4. Set vertical descent rate 950ft (value not shown on this image)
5. When descent rate is established, the gear can be extended.
6. Pilot will check permanently the altitude with altitude found on charts in function of distance

CAT	VOR/DME	
	MDA (H)	RVR
A	480 (390)	2500
B	490 (400)	2500
C	520 (430)	3000
D	540 (450)	3000

Gear down can help pilot slow down the aircraft on descent.

7. Intermediate point check

Descent shall be verified at intermediate check point.



In our example, the check is the fix NEMOT at 4.1 DME NTS.
Aircraft shall not descent below this value within the acceptable altitude tolerance.

1. When descent rate is stabilized before the intermediate check point, the speed is set down to Vref+5 (around 140kt)
2. If the gear is not extended, it is time to extend them
3. Flaps must be set to Maximum position 40° or the position before 30° in function of your final approach speed selected.
4. Adjust your descent rate (ft/min) in function of aircraft speed. (140kt ➔ -700ft/min)
5. If you are in manual mode, check in permanence the deviation from the radial on navigation display
6. Start to check if you have the runway in sight.

In the example above, the aircraft is below the target altitude inside the altitude tolerance (<100ft)

8. Approach minimum

When the runway is in sight, the pilot leaves the radial in order to align the aircraft on final (on visual approach):

1. Autopilot and Auto throttle shall be disconnected by the pilot at the latest at this time.
2. During visual approach, don't hesitate to use visual approach aids like PAPI or VASI.

CAT	VOR/DME MDA (H)	RVR
A	480 (390)	2500
B	490 (400)	2500
C	520 (430)	3000
D	540 (450)	3000

If the runway is not in sight, the pilot continues the procedure and the descent to the minimum descent altitude (MDA) and before the missed approach point (MAPt).

- If the runway is in sight before reaching MAPt, the pilot can perform visual approach and landing procedure.
- If the runway is **not** in sight reaching MAPt, the pilot shall initiate go-around and perform the missed approach procedure or follow ATC clearance if different.

The MAPt is the missed approach point. It is the final point of the procedure where, if the runway is not in sight, a go-around shall be performed by the pilot.

The MDA is the minimum descent altitude. Pilot shall not descent below this altitude during any non-precision approach when the runway is not in sight. Pilot shall maintain this altitude until go-around decision or visual approach if the conditions can permit it.