



VOR/DME APPROACH WITH B737

1. Introduction

This documentation presents an example of a VOR/DME approach performed with a 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 an aircraft's position and stay on course by receiving radio signals transmitted from a ground beacon.

1.2. Charts

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

This chart includes:

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

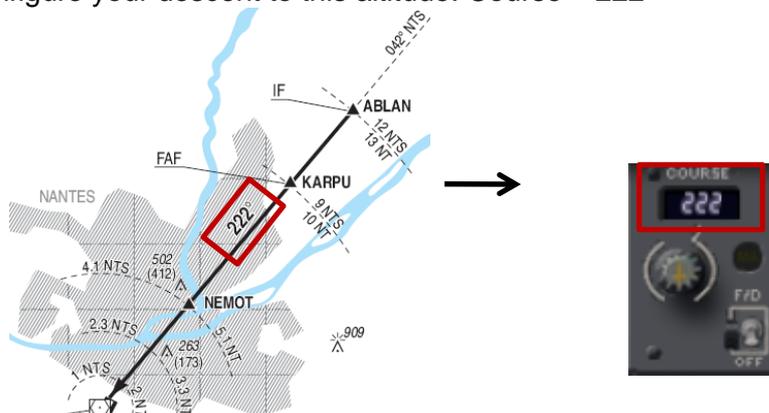
2. First step

During the 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 the localizer from charts: configure the course and configure your descent to this altitude. Course = 222°



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3. Before establishing the VOR radial

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

1. Aircraft speed shall be reduced to between **180KT and 220KT**.
2. Aircraft descent altitude shall be set to the **interception altitude** of the 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 the **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 the VOR Radial, the VOR indicator is set to maximum deviation and remains at this position (like the image hereabove). If you are close to the path, the indicator will move to the central position.

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4. Establishing the VOR radial

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

You must handle your heading in order to keep the VOR indicator near the centre position.
By doing so, you will keep the approach alignment until the runway is in sight.

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

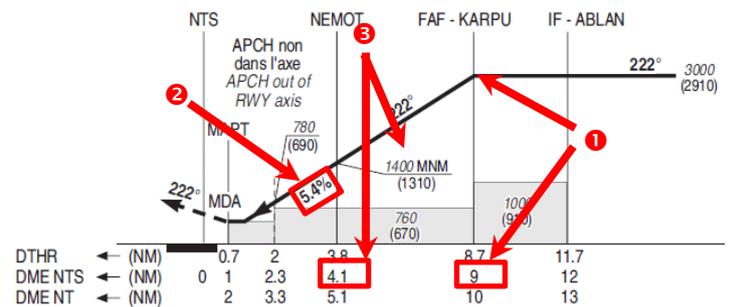
The spoilers can be armed at this stage.

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 at 1400ft minimum at 4.1 NM DME NTS VOR.

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



$$\text{Descent rate (ft/min)} = \text{Ground speed (KT)} \times \text{Descent Angle (\%)}$$

Example: $180\text{KT} \times 5.4\% = 970 \text{ ft/min}$

If you want a calculation, you can use an approximation of 5% descent rate for a 3° (5.4%) descent angle:
 $180 \text{ KT} \times 5\% = 900\text{ft/min}$

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

This value can be checked or taken from a table given in some airport charts:

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

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

Sometimes a cross check table shows the 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	2670	2340	2010	1680	1350	1020	690
(HGT)	(2580)	(2250)	(1920)	(1590)	(1260)	(930)	(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 practice, the descent shall be anticipated using about 0.3NM in order to have the right descent rate and not to be at too high altitude during the descent.

The pilot shall perform these tasks:

1. Reduce speed to between 160KT and 180KT
2. Set Flaps to 15° or position 2.
3. Set the altitude on the Autopilot panel close and above MDA (Alt = 600ft > 520ft MDA=minimum descent altitude)
4. Set the vertical descent rate to 950ft (value not shown in this image)
5. When the descent rate is established, the gear can be extended.
6. The pilot will permanently check the altitude against the 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

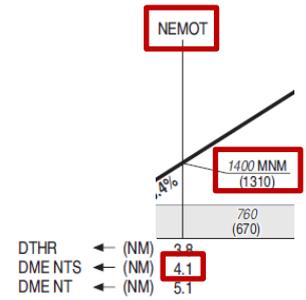
Gear down can help the pilot slow down the aircraft on descent.



7. Intermediate point check

Descent shall be verified at the intermediate check point.

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



1. When the descent rate is stabilized before the intermediate check point, the speed is set down to $V_{ref}+5$ (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 the aircraft speed. (140kt \rightarrow -700ft/min)
5. If you are in manual mode, continuously check the deviation from the radial on the navigation display
6. Start to check if you have the runway in sight.



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

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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 point in time.
2. During visual approach, do not hesitate to use visual approach aids like PAPI or VASI.



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 the MAPt, the pilot can perform a visual approach and landing procedure.
- If the runway is **not** in sight reaching the MAPt, the pilot shall initiate a 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. The pilot shall not descend below this altitude during any non-precision approach when the runway is not in sight. The pilot shall maintain this altitude until the go-around decision or visual approach if the conditions so permit.

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