

VII.A. Intercepting and Tracking Navigational Systems and DME Arcs

References: FAA-H-8083-9; FAA-H-8083-15

Objectives	The student should develop knowledge of the elements related to operation and use of VORs.
Key Elements	<ol style="list-style-type: none">1. Always check the VOR ID2. Never fly the tail of the CDI (avoid reverse sensing)3. VORs are Line-of-sight
Elements	<ol style="list-style-type: none">1. Using the VOR2. Tracking with the VOR3. VOR Tips4. Intercepting and Maintaining a Selected Course5. Intercepting and Maintaining a DME Arc
Schedule	<ol style="list-style-type: none">1. Discuss Objectives2. Review material3. Development4. Conclusion
Equipment	<ol style="list-style-type: none">1. White board and markers2. References
IP's Actions	<ol style="list-style-type: none">1. Discuss lesson objectives2. Present Lecture3. Ask and Answer Questions4. Assign homework
SP's Actions	<ol style="list-style-type: none">1. Participate in discussion2. Take notes3. Ask and respond to questions
Completion Standards	The students understands the VOR, and has the ability to VORs for navigation as well as approach procedures

Instructors Notes:

Introduction:

Attention

Interesting fact or attention grabbing story

Overview

Review Objectives and Elements/Key ideas

What

The VOR (or very high frequency omni-directional range) is an instrument used for navigation and approach procedures in the IFR system. Since the student is already familiar on a basic level with VORs from the PPL, this lesson will provide a more in depth overview of using the VOR, and tracking and intercepting radials.

Why

VORs are the backbone of the federal airway system and are used on almost every flight. Beyond airways, many airports use approaches based off of nearby or on-field VORs. The VOR is an extremely important piece of the IFR system.

How:

1. Using the VOR

A. Identifying It

- i. Station can be identified by its Morse code identification or a voice stating the name and VOR
- ii. If the VOR is out of service, the coded identification is removed and not transmitted
 - a. It should not be used for navigation
- iii. VOR receivers have an alarm flag to indicate when signal strength is inadequate
 - a. The plane is either too far or too low and is out of the line-of-sight of the transmitting signal

B. There are 2 required components for VOR radio navigation

- i. The ground transmitter and the receiver
 - a. Gnd Trnsmt is at a specific position on the ground and transmits on an assigned frequency
 - b. The airplane equipment includes the receiver with a tuning device and a VOR instrument
 - The navigation instrument consists of:
 - a An OBS (Omnibearing Selector), referred to as the course selector
 - b A CDI (Course Deviation Indicator) Needle
 - c A To/From Indicator
- ii. The course selector is an azimuth dial that is rotated to select a radial/determine the radial on
 - a. In addition, the magnetic course TO or FROM the station can be determine
- iii. When the OBS is rotated, the CDI moves to show the position of the radial relative to the plane
- iv. If OBS is rotated to center the CDI, the radial (MC FROM)/its reciprocal (MC TO) can be found
- v. The CDI will also move to the right or left if the airplane is away from the radial selected

C. TO and FROM

- i. By centering the needle, either the course "FROM" or "TO" the station will be indicated
 - a. If the flag displays "TO," the course on the course selector must be flown to the station
 - b. If "FROM" is displayed and the course shown followed, the plane flies away from the station

2. Tracking with VOR

- A. Tune the VOR frequency and check the identifiers to verify the desired VOR is being received
- B. Rotate the OBS to center the CDI with a "TO" indication

- i. If centered with a "FROM" indication, rotate 180°
 - a. From indicates the radial we are on, TO indicates TO the station
- C. Turn to the heading indicated on the VOR azimuth dial or course selector
 - i. This will track directly to the station in a no wind situation
- D. If there is a X-wind, and heading is maintained, you will drift off course
 - i. If the X-wind is from the R, the airplane will drift to the L of course
 - a. The CDI will gradually moving R
 - ii. To return to the desired radial, the heading must be altered to the R
 - a. As the plane returns, the needle will move back to the center
 - iii. When centered, the airplane is on the radial, now it must be crabbed to the right, into the wind
 - a. This will establish wind correction (the amount necessary will depend on the wind strength)
 - Trial and error will establish the necessary heading to maintain the desired track
- E. Upon arriving, and passing the VOR station, the "TO" indication will change to a "FROM" indication
 - i. Generally, the same procedures apply for tracking outbound as inbound
 - a. If the intent is to continue on the same heading the course selector shouldn't be changed
 - b. If tracking outbound on a different course, the new course must be set into the selector
 - Turn to intercept this course and track the same as previously discussed
- F. Reverse Sensing
 - i. If flying toward a VOR with a FROM indication, CDI will indicate opposite the direction it should
 - a. If the plane drifts to the R of course, the needle will move R, or point away from the radial
 - ii. And vice versa (from a station with a TO indication and opposite drift indications)

3. VOR Tips

- A. Positively identify the station by its code or voice identification
- B. Remember, VOR signals are line-of-sight
- C. When navigating TO, determine the inbound radial and use it (Don't reset the radial, correct drift)
- D. When flying TO a station always fly the selected course with a TO indication
- E. When flying FROM a station always fly the selected course with a FROM indication

4. Intercepting and Maintaining a Selected Course

- A. Where are we? What radial is the aircraft on?
- B. Where do we want to go? Which direction is the course and do we want to fly inbound or outbound?
- C. How do we get there? We determine the difference between the heading we are flying and the radial we want to intercept. We double the difference and apply it in the direction we want to fly.
- D. Does it make sense? Will the bearing we have chosen get us to the course we want to fly?

5. Intercepting and Maintaining a DME arc

- A. Intercept the radial designated in the approach
 - i. Fly outbound on that radial until reaching the DME distance required
- B. Make a 90° right turn approx $\frac{1}{2}$ mile before reaching the DME distance
 - i. Also, turn the OBS needle 10° in the direction you will be flying
- C. When the needle re-centers, turn it 10° further and make a 3 second standard rate turn
 - i. When the needle re-centers, do the same until reaching approx 10° prior to the inbound course
- D. If the DME distance is getting too far or too close, adjust the turns as necessary to regain the distance
- E. OR, load the DME arc approach in the GPS and follow the needle!

Common Errors:

- Incorrect tuning and identification procedures
- Failure to properly set the navigation selector on the course to be intercepted

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- Failure to use the proper procedures for course DME arc interception and tracking
- Improper procedures for intercepting a course or localizer from a DME arc

Conclusion:

Brief review of the main points