Area of Operation **VII** - Task **A**

Intercepting and Tracking Nav Systems & DME Arc

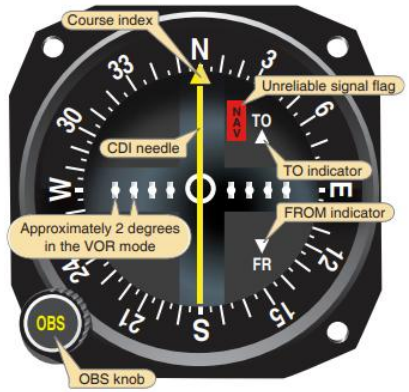
Content

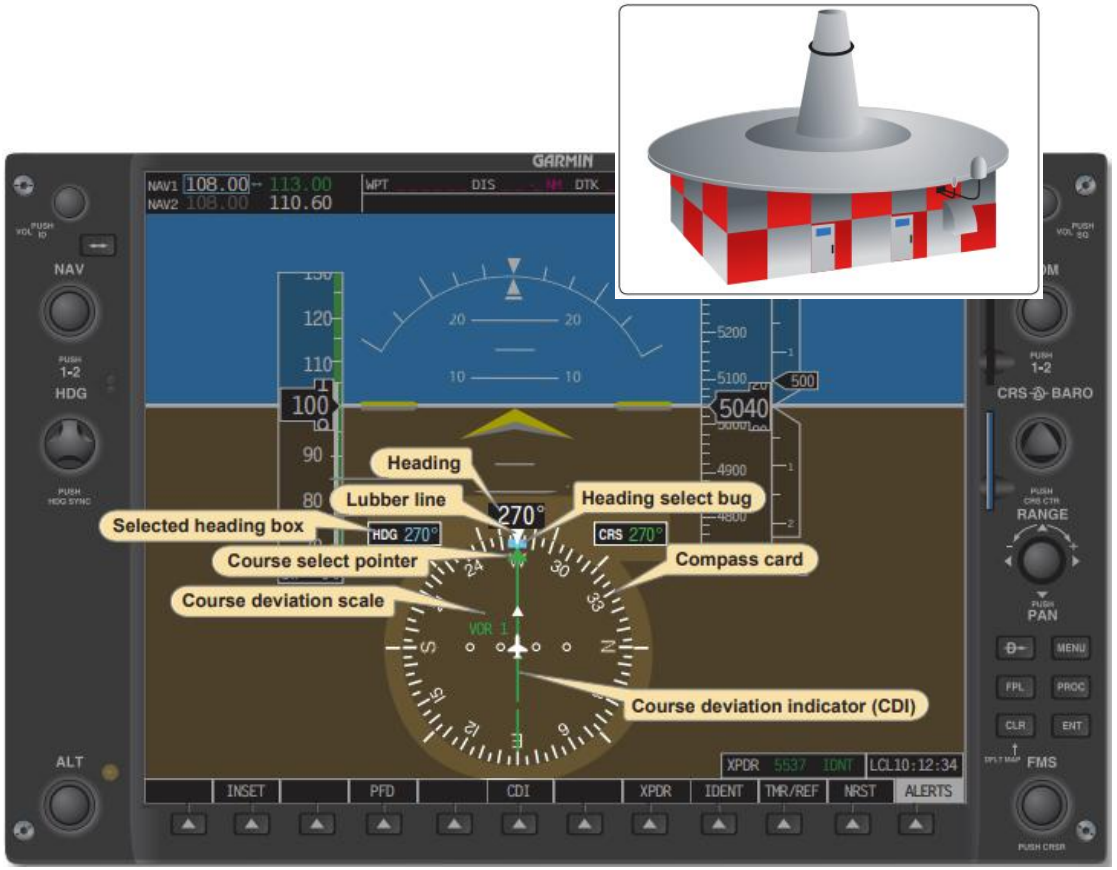
westflying

Key References:
- Instrument Flying Handbook

1. Introduction

- **What**: A VOR is a navigation and approach instrument. VORs were once the backbone of the IFR airway system.
- **Why**: Although GPS has became the preferred means of navigation, the ability to navigate through VORs and intercept/track radials are still required in multiple situations, including holds and approaches.
- **VOR Components**:
  - Ground Transmitter
    - ✓ *Transmits on assigned frequency*
    - ✓ *Oriented to magnetic north*
    - ✓ *360 radials*
    - ✓ *Various strengths and operating ranges*
  - Aircraft Receiver
    - ✓ *Antenna: Receives transmitter signals*
    - ✓ *Tuning Device: Tunes/identifies freq*
  - VOR Instrument:
    - ✓ *Course Selector (OBS)*
    - ✓ *Course Deviation Indicator (CDI)*
    - ✓ *To/From Indicator*

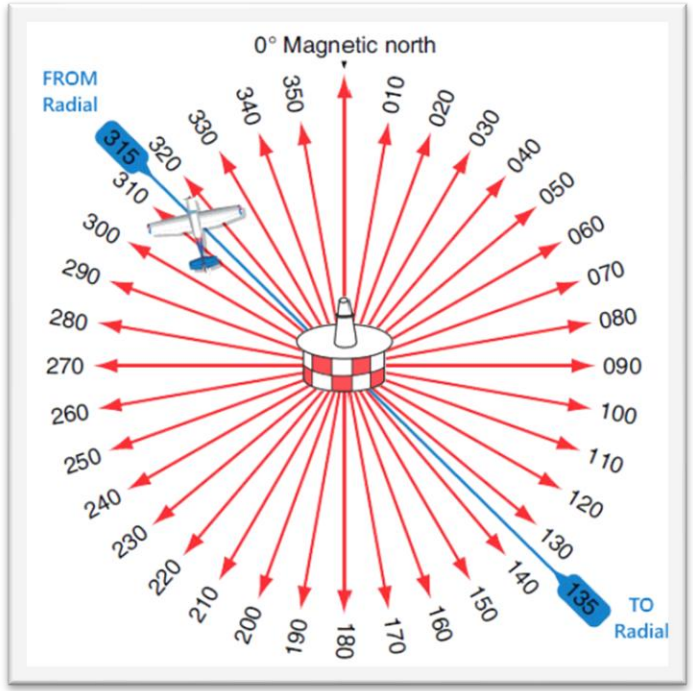


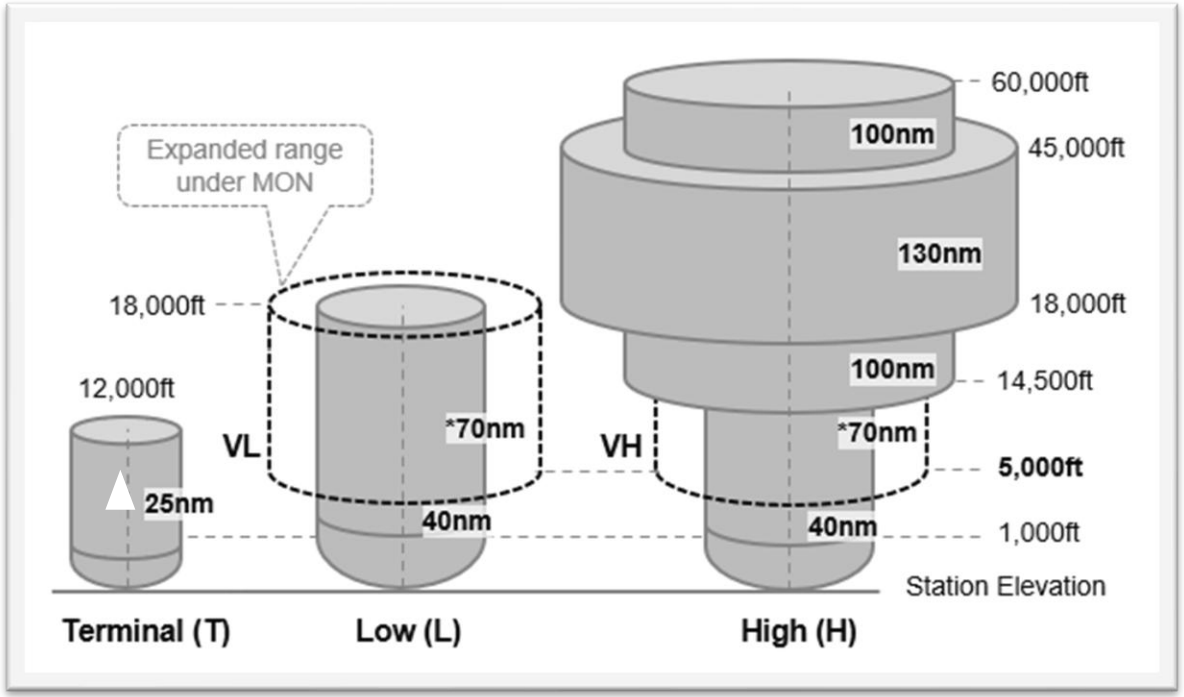


2. VOR (VHF Omni-Directional Range) AIM 1-1-3

What:

- Allow the pilot to fly magnetic courses or identify radials by using stations as reference (radio signal emitted from the ground)
- 3 Classes: Terminal, Low, High ➔ Based on Service Volumes
- Different variations: VOR, VOR/DME (VOR+DME), VORTAC (VOR + TACAN)



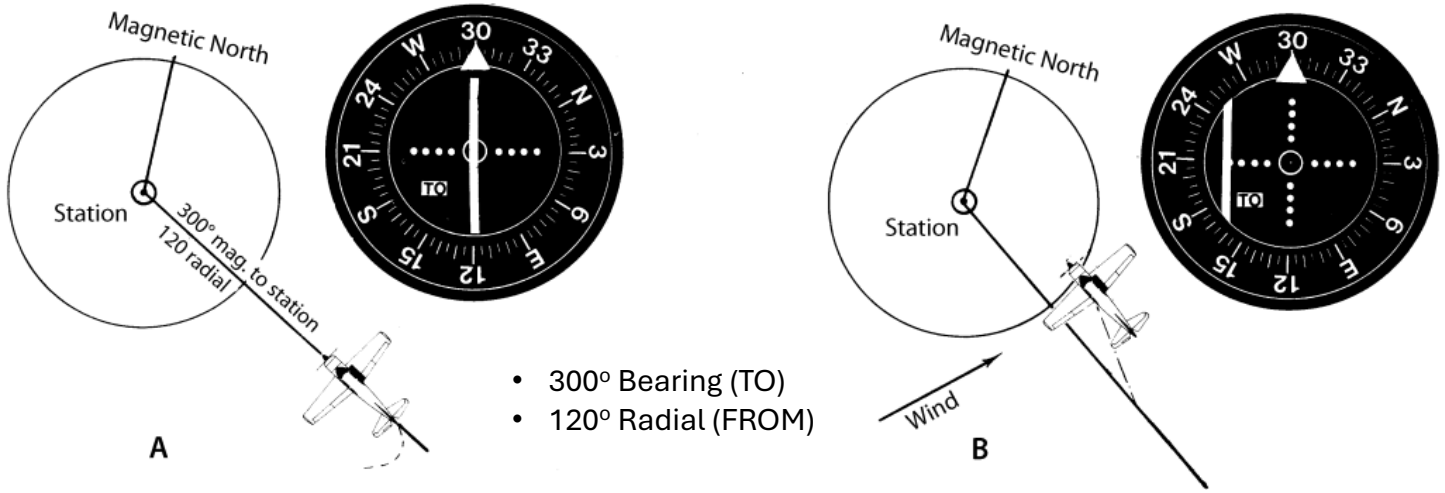


Service Volumes expanded under MON

2. VOR (VHF Omni-Directional Range) AIM 1-1-3

How it Works

- Station: emits a rotating signal (30 times/sec) + ref signal when crossing 360 radial
- Aircraft Receiver: calculates difference between both signals to find its radial
- 108.0 to 117.95 MHz *(excl LOC frequencies of 108.10-111.95 w/ odd tents)*
- Limitations: Line-of-Sight, Cone of confusion, Reverse Sensing
- Minimum Operational Network (MON): VOR within 100nm (>5000ft)
  - ✓ *Reduction from 896 to 590 VORs, expanding service volumes*
- If errors: VOR ➔ no sound/identifier; Receiver ➔ Red Flag or Missing needle



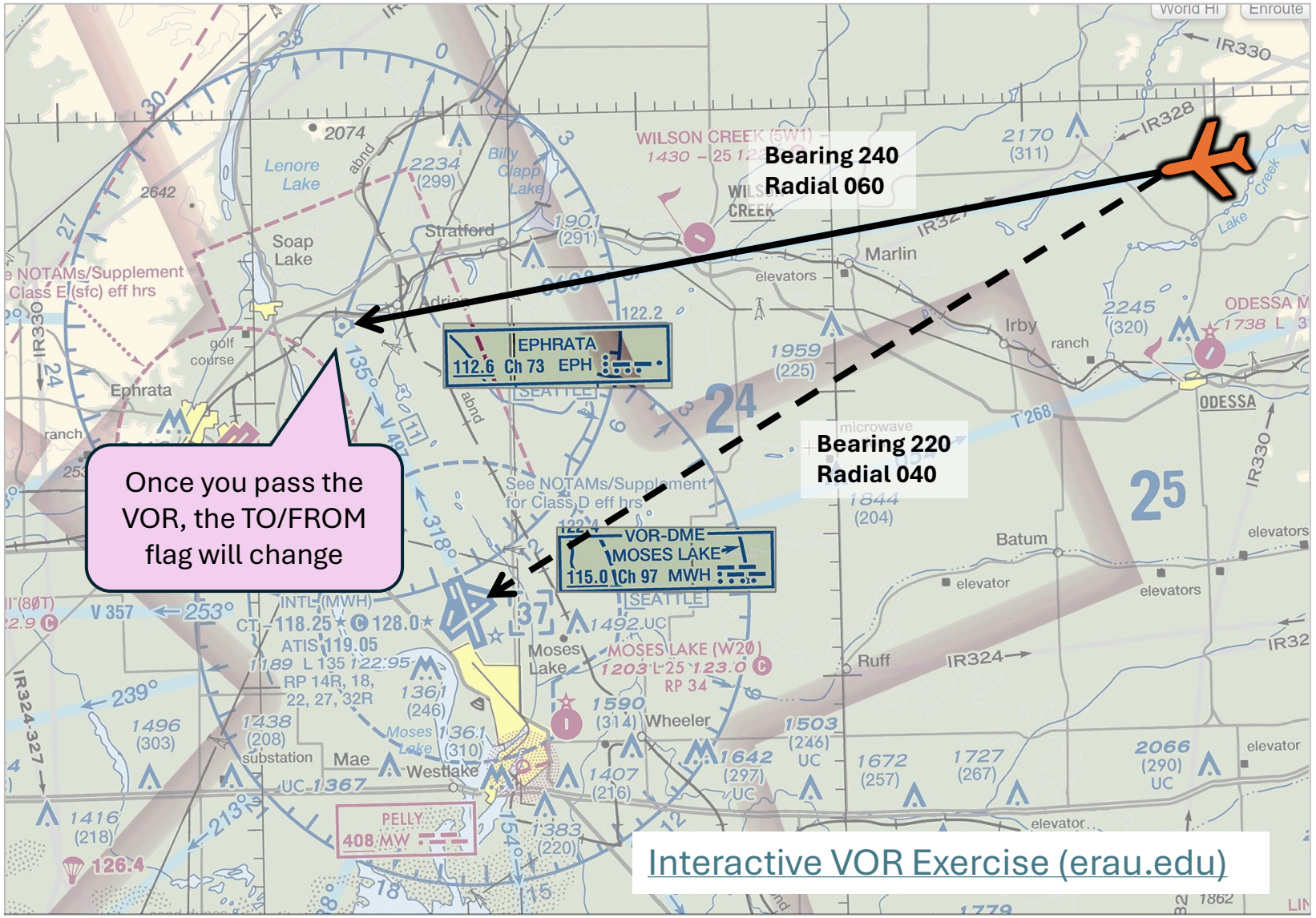
- 300° Bearing (TO)
- 120° Radial (FROM)

VOR Receiver Checks (§91.171)

Every 30 days for IFR Navigation

- VOT (360 From) ➔ ±4°
- Dual VOR ➔ ±4°
- Ground Checkpoint ➔ ±4°
- Repair Station ➔ ±4°
- VOR Airborne Checkpoint ➔ ±6°
- Above landmark within 20nm of a VOR, low altitude ➔ ±6° of selected radial
- Record:
  - ✓ *Date*
  - ✓ *Error*
  - ✓ *Place*
  - ✓ *Signature*

2. VOR (VHF Omni-Directional Range)



Heading

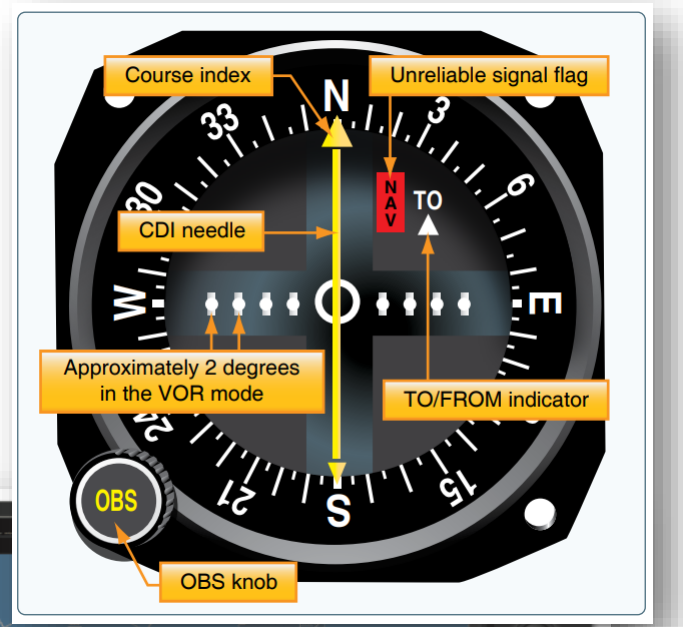
VOR 1
Ephrata Vortac

VOR 2
Moses Lake VOR

3. Tracking & Interception with VOR

Steps for VOR Navigation

1. Tune to the VOR frequency and identify it
2. Turn the OBS to determine the bearing you are in (needle centered w/ TO indication)
3. Turn the aircraft until your heading aligns to the VOR course selected
4. If you want to cross the VOR in a different radial, turn the OBS to the desired bearing
5. Turn the airplane to intercept the radial that leads to the desired bearing
6. Wind correction:
    - If drifting, turn 10º into the wind
    - Adjust WCA depending on the results (under/over-shoot)



Avoid reverse sensing

- If flying to the VOR, flag w/ TO
- If flying from the VOR, flag w/ FROM
- *Note: no reverse sensing in the G1000*

Flying heading 030 towards the 240 radial (intercept) and fly bearing 060

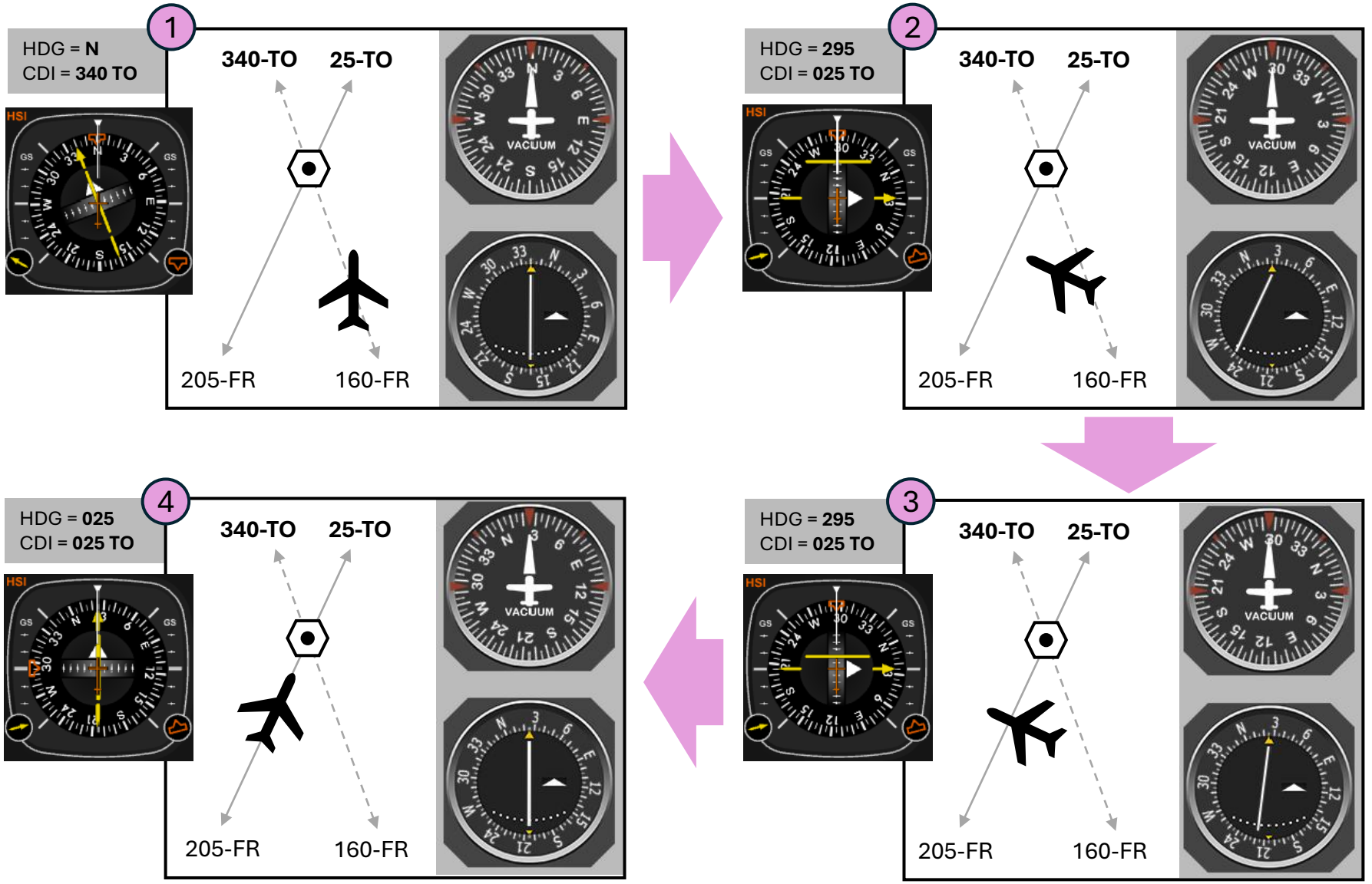
3. Tracking & Interception with VOR

Intercepting a Course

1. Find the radial you are on
2. Tune to the desired bearing
   - Use the OBS
   - Intercept between 20-90
   - Turn the aircraft
3. When the needle gets closer, start the turn as you intercept
4. Fly the new bearing/radial

Example:

- ✓ Flying N on radial 160 (340 TO)
- ✓ Wants to intercept radial 205 (means bearing of 025 TO)
- ✓ Set heading to intercept between 20-90º (such as 025 – 90 = 295)



Basic VOR sim

Advanced VOR Sim

4. DME (Distance Measurement Equipment) AIM 1-1-7

What

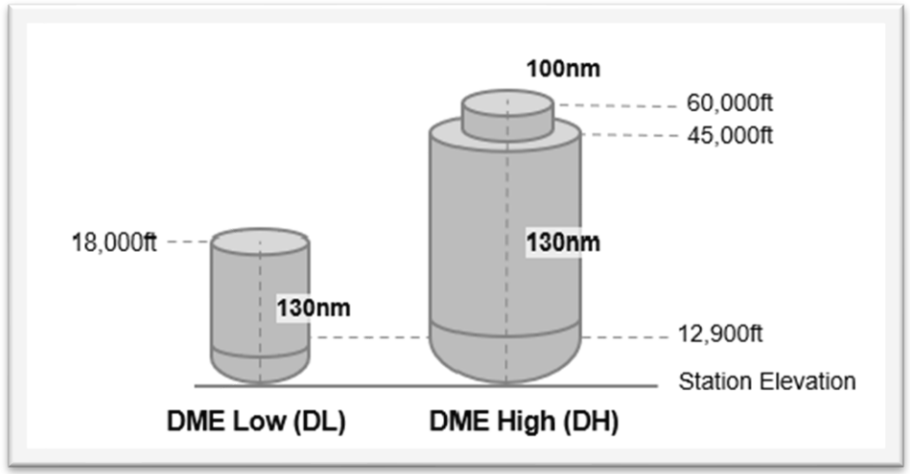
- Provides distance from a station
- 2 classes: Low and High depending on Service Volume

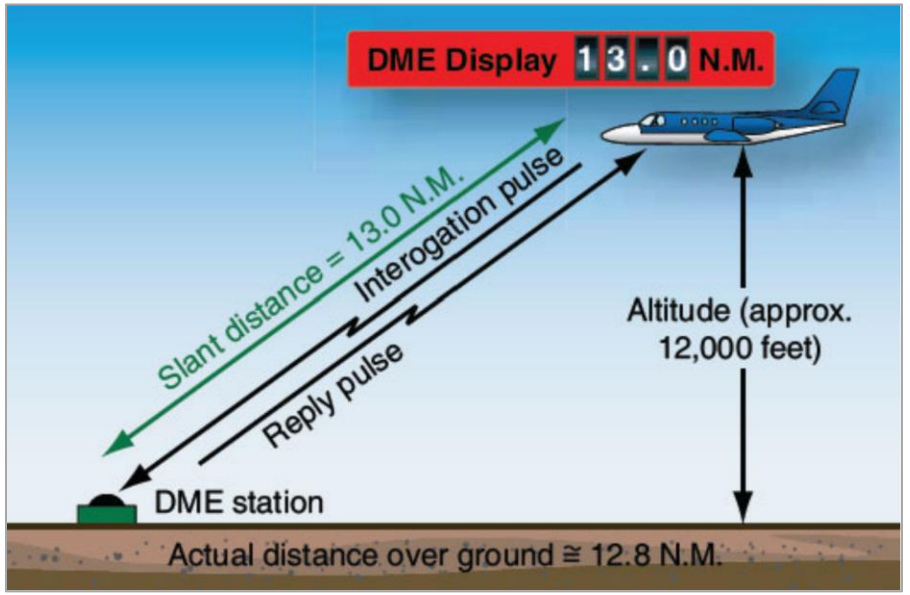
How it Works

- Airplane interrogates, station responds ➔ Receiver calculates distance
- UHF: Operates in the 962-1213 MHz frequencies (paired w/ VOR freq)
- Limitations:
  - Line-of-sight
  - Slant Range
    - ✓ *The higher you are and the closer you are →the higher the error*
    - ✓ *Negligible 1nm horizontal per 1000ft alt*

- DME receiver can be replaced by a RNAV system (G172 doesn't have a DME)
- DME receiver (or RNAV) is required above FY240 (FAR 91.205)

Service Volumes expanded under MON



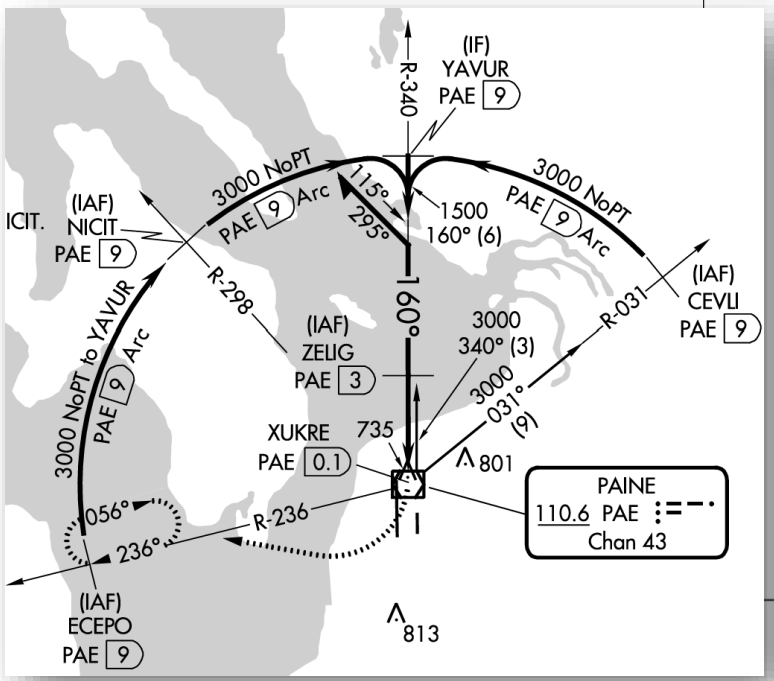


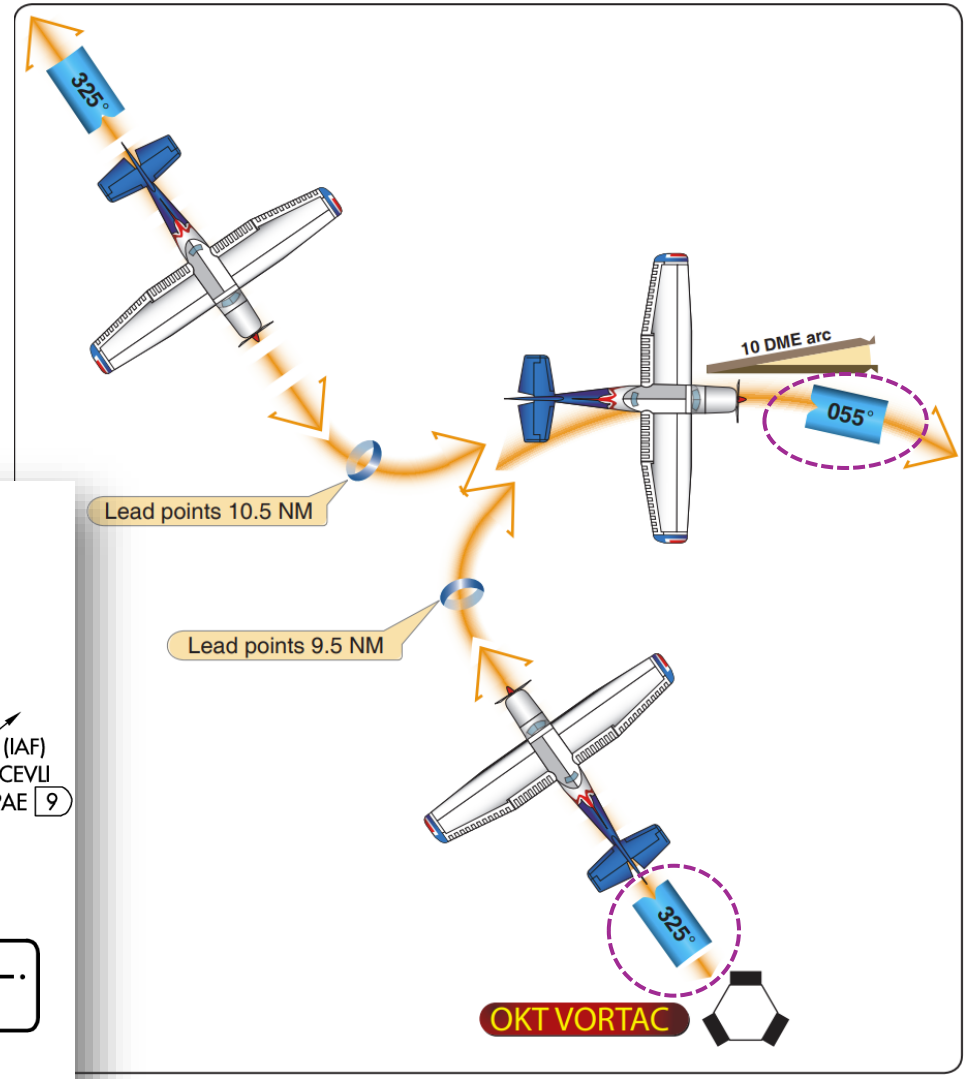
5. DME Arc | How to Enter

- **DME Arc is a track that is a constant distance from the VOR**
- **Intercept the lead-in radial on the approach**
- **Lead the turn to the arc by ½ mile**
  - Set your heading bug to the initial heading of the arc
  - Make a 90º turn
  - Roll out & rotate the OBS 10º in the direction of turn
- **When the OBS centers**
  - 3s standard rate turn (app 10º)
  - Rotate the OBS another 10º
  - Repeat until approximately 10º from inbound course
    - *Turn 10, Twist 10*
  - Keep tracking the DME and make corrections (next slide)
- **Turn to intercept the inbound course**

Tolerance ±1nm

56º – 90º ➔ 326º

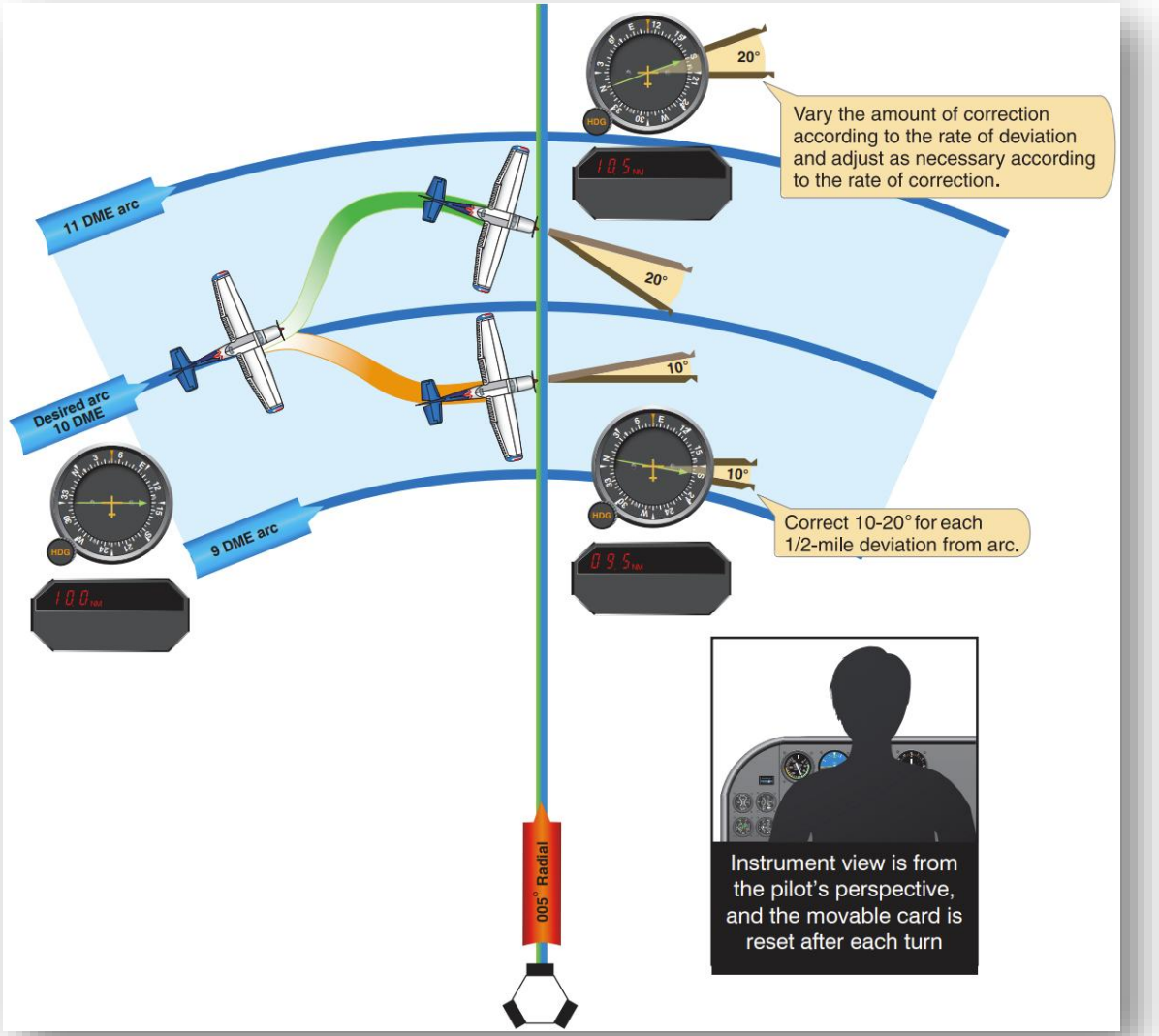




5. DME Arc | Making Corrections

If DME distance is too high or low, adjust the amount of turn

- **Inside the Arc (DME is too low)**
  - Rotate the OBS 10º, then reduce or eliminate the turn
- **Outside the Arc (DME is too high)**
  - Rotate the OBS 10º, then increase the amount of turn
- **If you have GPS:**
  - Follow the magenta line



Note: using a bearing pointer (ADF) improves situational awareness. Be mindful it won't always point 90º since your heading will be correcting for the winds

Questions?