FAA Lesson Plan

En Route Stage 4
Radar Controller Training

Student

Radar Vectoring
Lesson 9

55055
V.1.06

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LESSON PLAN DATA SHEET

COURSE NAME:	RADAR CONTROLLER TRAINING
COURSE NUMBER:	55055

LESSON TITLE:	RADAR VECTORING

DATE REVISED:	2014-04
VERSION:	V.1.06

REFERENCES:	JO 7110.65V, Air Traffic Control; JO 7610.4S, Special Operations; JO 7210.3Y, Facility Operation and Administration; JO 7210.37G, En Route Minimum Instrument Flight Rules (IFR) Altitude (MIA) Sector Charts; Aeronautical Information Manual (AIM); TI 6110.100, En Route Automation Modernization (ERAM) Air Traffic Manual (ATM): R-Position User Manual; CFR Title 14, Aeronautics and Space; 14 CFR Part 91, General Operating and Flight Rules; 14 CFR Part 95, IFR Altitudes; 14 CFR Part 97, Standard Instrument Procedures

HANDOUTS:	NONE

EXERCISES:	NONE

END-OF-LESSON TEST:	YES

OTHER PERTINENT INFORMATION:	THIS LESSON IS BASED ON ERAM BUILD EAC1500. THE LESSON HAS BEEN REVIEWED AND REFLECTS CURRENT ORDERS AND MANUALS AS OF APRIL 2014.

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INTRODUCTION

Vectoring aircraft is a technique that can benefit both the pilot and the controller, resulting in a safe, orderly, and expeditious flow of traffic and reducing delays for both arrivals and departures. In addition, National Security measures include a confidence maneuver, which helps in determining whether the pilot in command (PIC) is still in control of the aircraft and is able to comply with ATC instructions. This is another reason for vectoring.

Purpose   In this lesson, you will learn the reasons, methods, and phraseology for issuing vectors, and Minimum IFR Altitude (MIA) charts. The concept and definition of a confidence maneuver will be discussed in this lesson.

INTRODUCTION *(Continued)*

Objectives

Objectives

At the end of this lesson, you will be able to identify:

1. Reasons and methods for issuing vectors
2. Appropriate vectoring and phraseology
3. Features of the Heading Menu
4. Procedures for updating heading information in the fourth line of a Full Data Block (FDB)
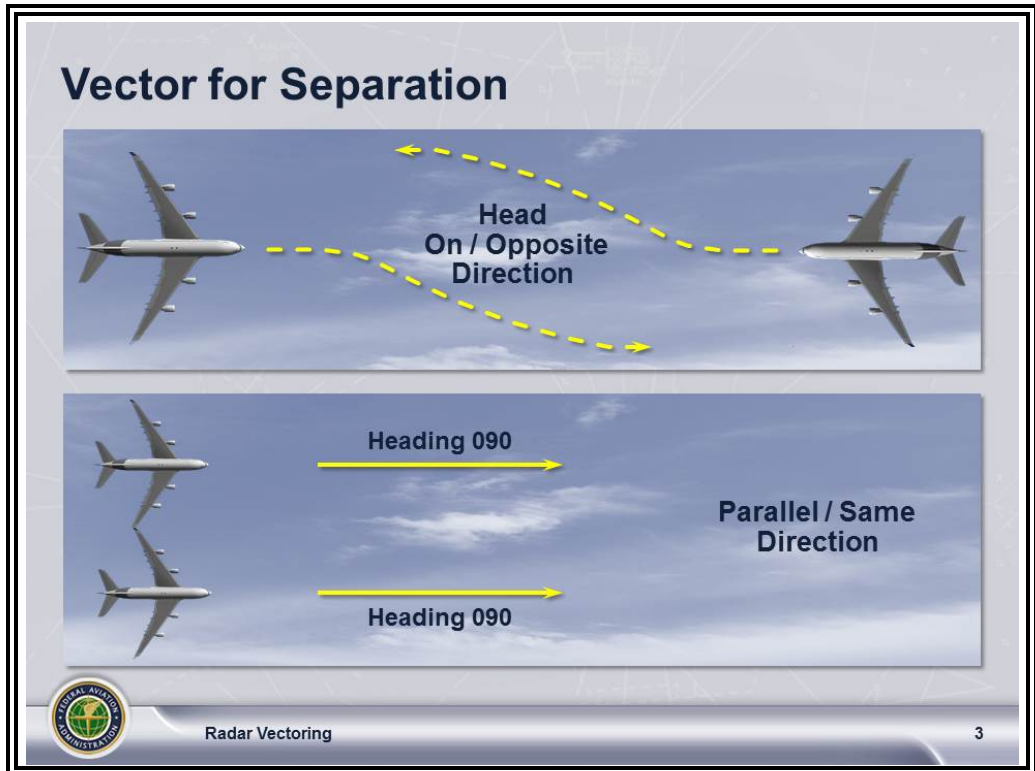5. The primary purposes of an MIA chart

Radar Vectoring   2

VECTORING

Vector Definition
JO 7110.65,
Pilot/Controller
Glossary

📖 A **vector** is a heading issued to an aircraft to provide navigational guidance by radar.

Application
JO 7110.65,
par. 5-6-1

⊙ Reasons for vectoring aircraft include:
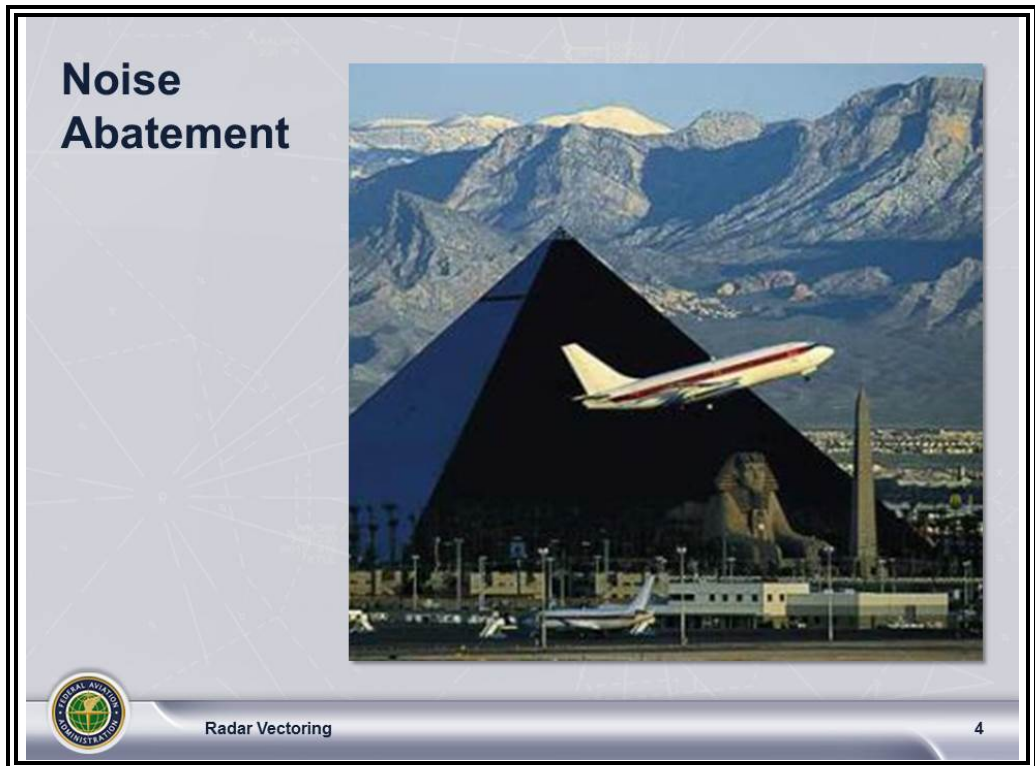
- Separation

- Other aircraft

- Airspace

- Safety

Example: Skydivers - vector around jump area

VECTORING *(Continued)*

- ⊙ Noise abatement:

  - Used mainly by terminal controllers

  - Usually in effect during nighttime hours

- ⊙ Confidence maneuver:

  - To determine if the pilot in command (PIC) is able to receive and comply with ATC instructions

    – Consists of one or more turns

    – A climb or descent

    – Other maneuvers

  - Can be requested through the Domestic Event Network (DEN) after reestablishing radio contact with a NORDO aircraft

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VECTORING *(Continued)*
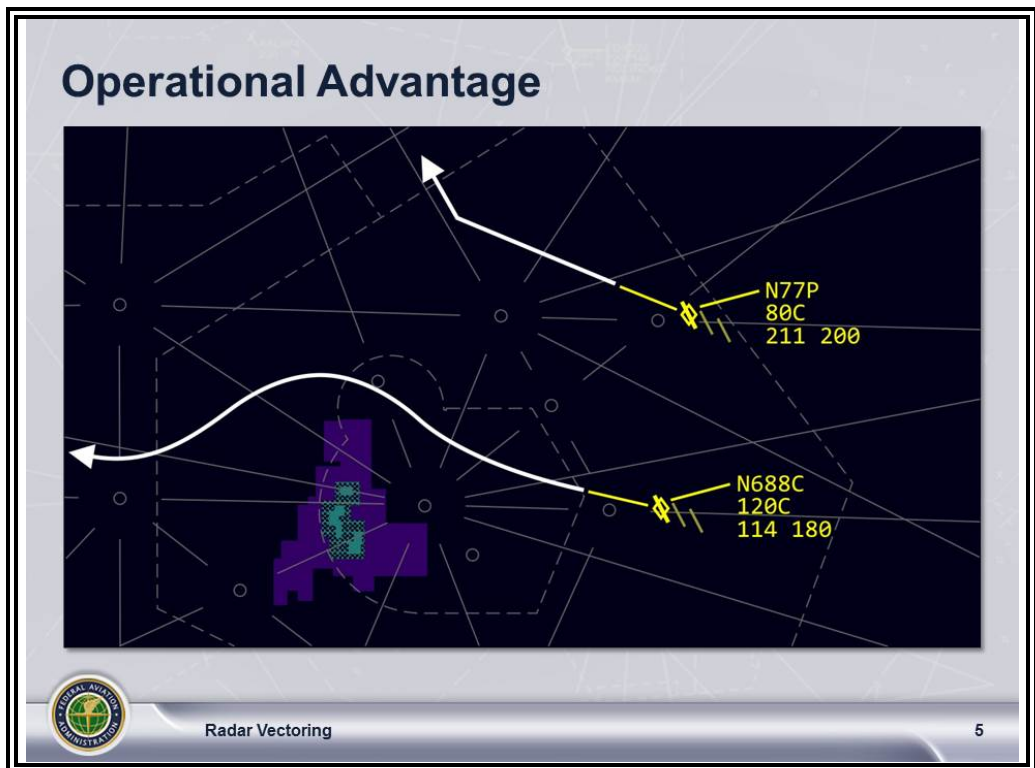
- ◉ Operational advantages to the controller:

  - Avoids congested area

  - Maintains radar contact by avoiding nonradar areas

- ◉ Pilot requests:

  - More expeditious route

  - To avoid:

    – Altitude change

    – Areas of weather

    – Special Use Airspace

- ◉ To allow RNAV aircraft on RNAV route to remain on their own navigation to the extent possible

VECTORING *(Continued)*

Application (Cont'd)
JO 7110.65, par. 5-6-3

⊙ Vector aircraft at or above the MVA or the minimum IFR altitude unless the aircraft is operating VFR.

NOTE: Facilities which have established procedures for VECTORS BELOW MINIMUM ALTITUDE should discuss FAA Order JO 7110.65, paragraph 5-6-3 and the local procedures.

Minimum Altitude Definitions
JO 7110.65, Pilot/Controller Glossary;
14 CFR Part 91;
14 CFR Part 95;
14 CFR Part 97

📖 **Minimum IFR Altitudes (MIAs)** are minimum altitudes for IFR operations as prescribed in 14 CFR, Part 91. These altitudes are published on aeronautical charts and prescribed in 14 CFR Part 95 for airways and routes, and in 14 CFR Part 97 for standard instrument approach procedures. If no applicable minimum altitude is prescribed in 14 CFR Part 95 or 14 CFR Part 97, the following minimum IFR altitude applies:

a. In designated mountainous areas, 2,000 feet above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown, or

b. Other than mountainous areas, 1,000 feet above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown, or

c. As otherwise specified by the Administrator or assigned by ATC.

📖 **Minimum Vectoring Altitude (MVA)** is the lowest MSL altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures, and missed approaches. The altitude meets IFR obstacle clearance criteria. It may be lower than the published MEA along an airway or J-Route segment. It may be utilized for radar vectoring only upon the controller's determination that an adequate radar return is being received from the aircraft being controlled. Charts depicting minimum vectoring altitudes are normally available only to the controllers and not to pilots.

VECTORING *(Continued)*
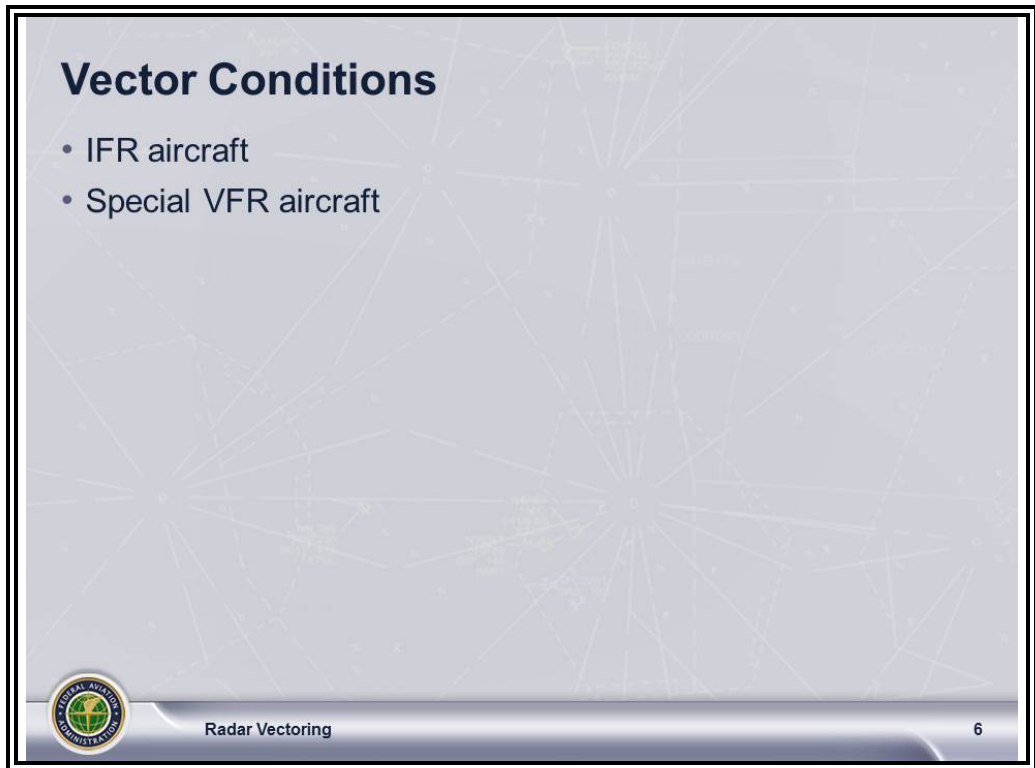
- ⊙ Vector IFR aircraft if:

  - •   Within controlled airspace

  - •   At or above the appropriate minimum altitude

  - •   Within your area of jurisdiction, unless otherwise coordinated

  - •   Permitted to resume its own navigation within radar coverage

- ⊙ Vector special VFR aircraft if:

  - •   Controller responsibilities:

    - –   Within your area of jurisdiction
    - –   At or above the appropriate minimum altitude
    - –   Only within Class B, C, D, or E surface areas
    - –   Can return to its nonradar routing within radar coverage

  - •   Pilot responsibilities:

    - –   Remain clear of clouds
    - –   Maintain 1 mile visibility

VECTORING *(Continued)*

Application
JO 7110.65,
par. 5-6-1;
CFR Title 14

Vector VFR Aircraft

Note: VFR aircraft not at an altitude assigned by ATC may be vectored at any altitude. It is the responsibility of the pilot to comply with the applicable parts of CFR Title 14.

N21V VFR/125 212 190
N42K VFR/85 110 180
N123P VFR/65 311 150
N510M VFR/85 426 124
TFR AOB 100

1 Necessary for air safety, or
2 Pilot requests, or
3 Controller suggests vector, pilot concurs, or
4 Special program is established

Radar Vectoring   Click to Play Animation   7

⊙ Vector VFR aircraft if:

1. It is necessary for air safety, or
2. Pilot requests, or
3. Controller suggests vector and pilot concurs, or
4. Special program is established

NOTE: VFR aircraft not at an altitude assigned by ATC may be vectored at any altitude. It is the responsibility of the pilot to comply with the applicable parts of CFR Title 14.

⊙ Vector in Class G Airspace only:

• If pilot requests

• As an additional service

Review

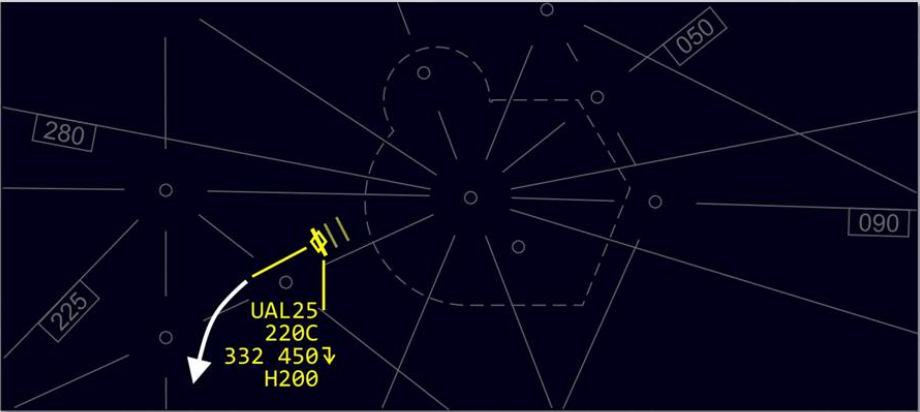◇**QUESTION:** List some reasons to issue vectors to aircraft.

METHODS

Specify Direction of Turn and Magnetic Heading to be Flown

"UNITED TWENTY-FIVE, TURN LEFT HEADING TWO ZERO ZERO."

Radar Vectoring 8

⊙ Vector aircraft by specifying:

- Direction of turn, if appropriate, and

- Magnetic heading to be flown

✈ **Phraseology**

"TURN LEFT/RIGHT HEADING (degrees)."

METHODS *(Continued)*

"FLY HEADING (degrees)."

Phraseology

Continued on next page

METHODS *(Continued)*

**Application
(Cont'd)**
JO 7110.65,
pars. 5-4-11, 5-6-2

✈ "FLY PRESENT HEADING."

Phraseology

Continued on next page

METHODS *(Continued)*

Application (Cont'd)
JO 7110.65, pars. 5-4-11, 5-6-2

✈ **Phraseology**

"DEPART (fix) HEADING (degrees)."

Continued on next page

METHODS *(Continued)*

To Turn an Aircraft a Specified Number of Degrees

AAL22
220C
215 460↓
30L

DAL642
220C
114 450

"AMERICAN TWENTY-TWO, TURN THIRTY DEGREES LEFT, VECTOR FOR TRAFFIC."

Radar Vectoring   12

⊙ The number of degrees to turn, in group form, and direction of turn.

✈ **Phraseology**

"TURN (number of degrees) DEGREES LEFT/RIGHT."

NOTE: This is used primarily when heading is not known.

⊙ When initiating a vector, advise the pilot of the purpose.

✈ **Phraseology**

"VECTOR TO (fix or airway)."

"VECTOR TO INTERCEPT (name of NAVAID) (specified) RADIAL."

"VECTOR FOR SPACING."

"VECTOR TO FINAL APPROACH COURSE."

⊙ Or, if the pilot does not have knowledge of the type of approach:

✈ **Phraseology**

"VECTOR TO (approach name) FINAL APPROACH COURSE."

METHODS *(Continued)*

Application (Cont'd)
JO 7110.65, par. 5-6-2; AIM, PCG, S-6

⊙ For NO-GYRO procedures:

* Type of vector

* Direction of turn

* When to stop turn

➔
Phraseology

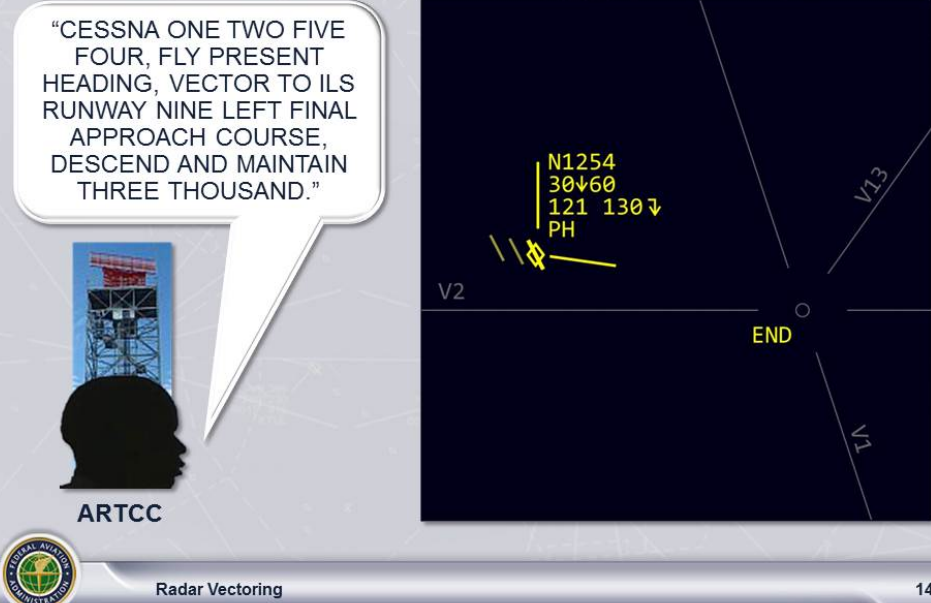"THIS WILL BE A NO-GYRO VECTOR, TURN LEFT/RIGHT, STOP TURN."

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Application (Cont'd)
JO 7110.65, pars. 5-4-11, 5-6-2

⊙ Include altitude to maintain and appropriate restrictions when:

- The vector will take the aircraft off an assigned procedure which contains altitude instructions:

    – Instrument approach

    – Nonradar Standard Instrument Departure (SID)

    – Flight Management System Procedure (FMSP)

- The previously issued clearance included crossing restrictions

⊙ Advise the pilot of what to expect when the vector is completed.

✈ **Phraseology**

"EXPECT TO RESUME (Route, SID, STAR, FMSP, etc.)."

⊙ Issue/reissue applicable restrictions or advise pilot to comply with restrictions when you instruct the aircraft to resume a procedure containing restrictions.

METHODS *(Continued)*

"RESUME (name/number FMSP/SID/Transition/STAR). COMPLY WITH RESTRICTIONS."

⊙ Inform the pilot when a vector will take the aircraft across a previously assigned route.

✈ **Phraseology**

"EXPECT VECTOR ACROSS (NAVAID radial) (airway/route/course) FOR (purpose)."

Review

Response Item

To specify the direction of turn and the magnetic heading to be flown, the phraseology is "_____."

   A. TURN LEFT/RIGHT HEADING (degrees)
   B. LEFT/RIGHT TURN (degrees)
   C. TURN LEFT/RIGHT (degrees)

Radar Vectoring   Click to Show Answer   15

◇ **QUESTION:** How are degrees spoken when issuing a specific heading to an aircraft?

◇ **QUESTION:** When would you be required to issue an altitude to maintain and appropriate restrictions with a vector?

Continued on next page

METHODS *(Continued)*

Review (Cont'd)

Response Item

The phraseology to specify a magnetic heading to be flown is
"_____."

    A. MAINTAIN HEADING (degrees)

    B. TURN TO HEADING (degrees)

    C. FLY HEADING (degrees)

Radar Vectoring   Click to Show Answer   16

Response Item

To vector an aircraft without specifying the heading to be flown,
the phraseology is "_____."

    A. TURN LEFT/RIGHT (number of degrees) DEGREES

    B. LEFT/RIGHT TURN (number of degrees) DEGREES

    C. TURN (number of degrees) DEGREES LEFT/RIGHT

Radar Vectoring   Click to Show Answer   17

METHODS *(Continued)*

Response Item

The phraseology to specify that an aircraft continue on its present heading is "_____."

- A. FLY PRESENT HEADING
- B. MAINTAIN PRESENT HEADING
- C. CONTINUE PRESENT HEADING

Radar Vectoring   Click to Show Answer 18

Response Item

To instruct an aircraft to discontinue the turn issued as part of a NO-GYRO vector, the phraseology is "_____."

- A. NOW FLY HEADING (number) DEGREES
- B. STOP TURN
- C. MAINTAIN PRESENT HEADING

Radar Vectoring   Click to Show Answer 19

METHODS *(Continued)*

Issuing the Vector
JO 7110.65,
par. 5-6-2
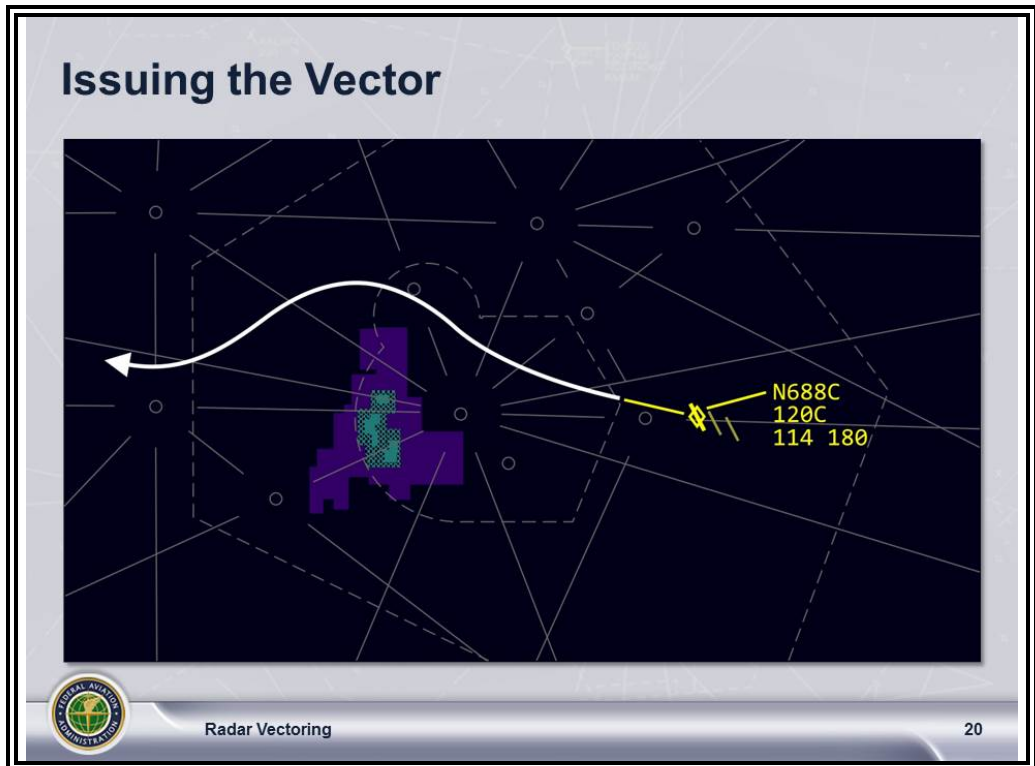
⊙ Determine the optimum routing based on these factors:

- Wind

- Weather

- Traffic

- Pilot requests

- Noise abatement

- Adjacent sector requirements

- Letters of Agreement

⊙ Ensure an aircraft's heading, if needed for spacing/separation, by assigning it.

- Don't assume an aircraft will continue on the same track without a heading assignment.

METHODS *(Continued)*

Issuing the Vector (Cont'd)
JO 7110.65, par. 5-6-2

⊙ Allow for increased compliance time and distance when aircraft is at:

- Higher altitude

- Greater airspeed

⊙ Techniques:

- Utilize minimum heading changes.

- Turn slower aircraft behind faster aircraft if both are similar distances from converging points.

⊙ Consider these conditions to obtain desired track:

- Effects of wind

- Ground speed

- Turning distance
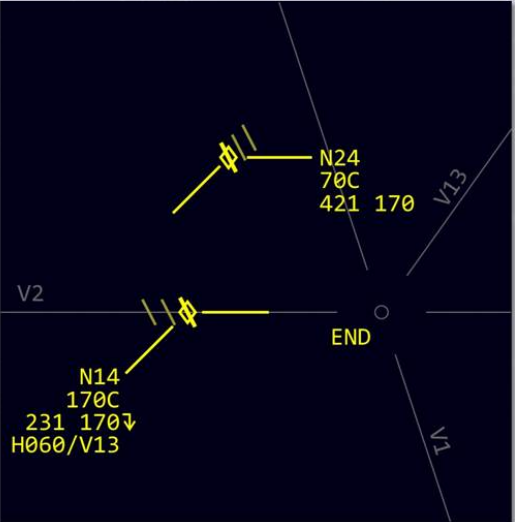
METHODS *(Continued)*
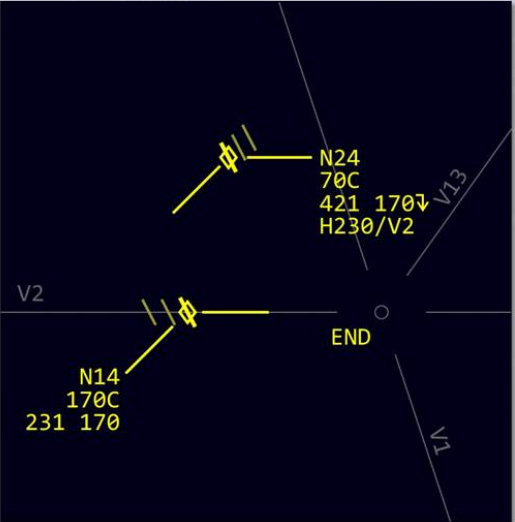
Terminating a Vector
JO 7110.65, pars. 5-4-11, 5-6-2

⊙ Provide radar navigational guidance until the aircraft is either:

- Established within the airspace to be protected for the nonradar route to be flown, or

- On a heading that will, within a reasonable distance, intercept the nonradar route to be flown and informed of its position.

- If aircraft is RNAV, FMS, or DME-equipped and being vectored toward a VORTAC/TACAN or waypoint, and if aircraft is within the service volume of a NAVAID, position information is not required.

Terminating a Vector (Cont'd)
JO 7110.65, pars. 5-4-11, 5-6-2

⤳
Phraseology

"(Position with respect to the course/fix along route) RESUME OWN NAVIGATION,"

or

"FLY HEADING (degrees). WHEN ABLE PROCEED DIRECT (name of fix),"

or

"RESUME (name/number FMSP/SID/Transition/STAR/procedure)."

◉ Aircraft vectored off of an RNAV route must be recleared to the next waypoint or as requested by the pilot.

◉ Update the route of flight in the computer when flight data processing is available, unless:

• An operational advantage is gained, and

• Coordination is accomplished.

UPDATING FDB FOURTH LINE WITH HEADING INFORMATION

Heading Menu
JO 7110.65,
par. 5-4-11

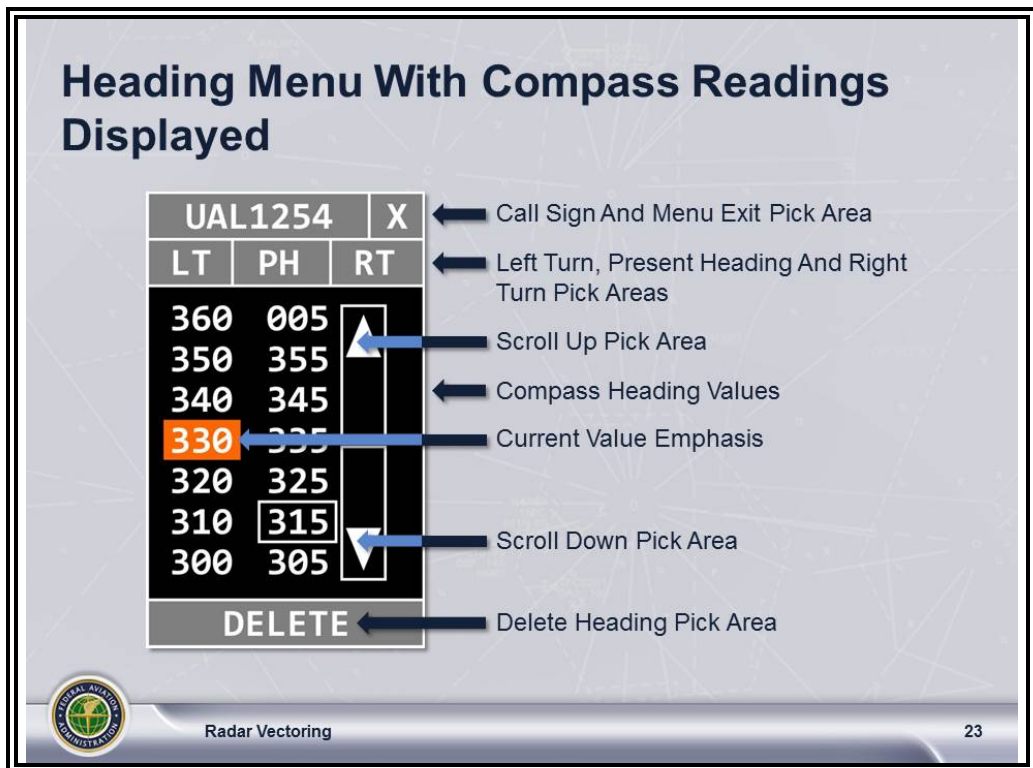## Heading Menu With Compass Readings Displayed

UAL1254		X	← Call Sign And Menu Exit Pick Area
LT	PH	RT	← Left Turn, Present Heading And Right Turn Pick Areas

```
360  005  ▲  ← Scroll Up Pick Area
350  355
340  345     ← Compass Heading Values
330  335     ← Current Value Emphasis
320  325
310  315
300  305  ▼  ← Scroll Down Pick Area

DELETE       ← Delete Heading Pick Area
```

Radar Vectoring   23

⊙ The Heading Menu allows the user to update the fourth line of a Full Data Block (FDB) with a new heading value or remove the heading value from the fourth Line of an FDB.

• The user can select the heading value from a list with the trackball cursor or type the heading value from the keyboard.

UPDATING FDB FOURTH LINE WITH HEADING INFORMATION *(Continued)*

Heading Menu (Cont'd)
JO 7110.65, par. 5-4-11

⊙ En route fourth line data block usage

- The en route fourth line data block must be used to forward only the specific control information. Any additional control information must be forwarded via other communication methods. En route fourth line data block free text area may be used by individual sector teams for recording any additional information the team deems appropriate for managing the sector, but must be removed prior to initiation of identification transfer.

- The en route fourth line data block area must be used for coordination purposes only in association with radar identified aircraft.

- When automated information transfer (AIT) procedures are applied, en route fourth line usage for transfer of control information must be specifically defined within facility AIT directive.

- Coordination format for assigned headings must use the designation character H preceding a three−digit number.

  EXAMPLE: H080, H270

- Aircraft assigned a heading until receiving a fix or joining a published route must be designated with assigned heading format followed by the fix or route.

  EXAMPLE: H080/ALB, 080/J121, PH/ALB

NOTE: The notation PH may be used to denote present heading.

NOTE: The character H may be omitted as a prefix to the heading assignment only if necessary due to character field limitations, and it does not impede understanding.
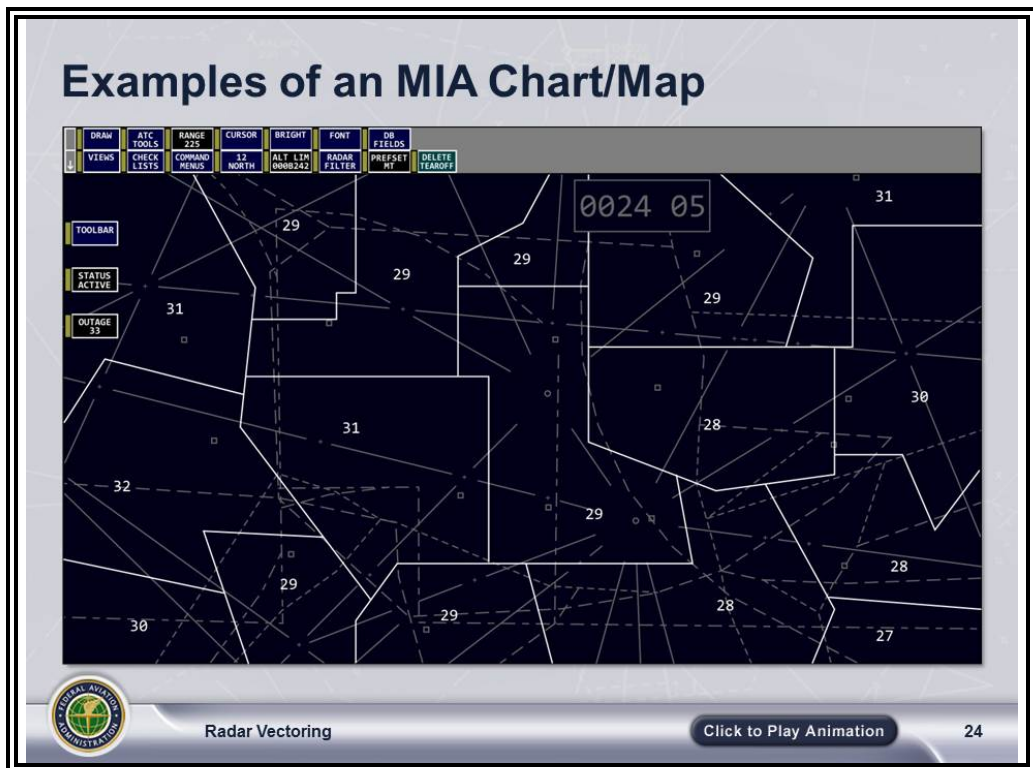
MINIMUM IFR ALTITUDE (MIA) CHARTS

MIA Charts/Maps
JO 7210.3, pars. 3-8-1, 3-8-3, 6-4-2
JO 7210.37G, Appendix B

Examples of an MIA Chart/Map

- A Minimum IFR Altitude (MIA) chart is used for off-airway IFR operations where no MEAs are published.

- It allows lower altitudes when vectoring an aircraft for an approach in mountainous terrain.

- It provides you with:

  - MIA information

  - Standard obstacle clearance

- An MIA chart is displayed at each low altitude sector.

- Each facility must adapt E-MSAW terrain alert volumes (TAVs) for any sector which owns airspace to the surface.

- The MIA/TAV map will be displayable on the Situation Display.

- The MIA/TAV may contain many separate areas, each depicting a different MIA.

CONCLUSION

Summary
- ⊙ Reasons for vectoring

- ⊙ Methods and Phraseology

- ⊙ Heading Menu features

- ⊙ Updating FDB Fourth Line with heading information

- ⊙ Minimum IFR Altitude (MIA) charts

End-of-Lesson Test
- ⊙ Your instructor will now administer the End-of-Lesson Test.