Federal Aviation Administration

55054003

EN ROUTE RADAR ASSOCIATE CONTROLLER TRAINING PART C: ADVANCED CONCEPTS

Lesson 14: Radar Vectoring, Speed Adjustment, and Scanning

Version: 1.0 2022.08

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LESSON PLAN DATA SHEET

Course Name	En Route Radar Associate Controller Training Part C: Advanced Concepts
Course Number	55054003
Lesson Title	Radar Vectoring, Speed Adjustment, and Scanning for Radar-Associate Position
Duration	2 hours 45 minutes (includes lesson, , practice exercise, and ELT)
Version	1.0 2022.08
Reference(s)	JO 7110.65, Air Traffic Control; TI 6110.101, En Route Automation Modernization RA-Position User Manual; TI 6110.100, En Route Automation Modernization R-Position User Manual; JO 7210.3, Facility Operation and Administration; FAA-H-8083-25B, Pilot's Handbook of Aeronautical Knowledge; ERAM ATCHI MISC 230.05, ERAM Air Traffic Computer-Human Interface; 14 CFR 91.117, Aircraft speed; AC 61-107B, Aircraft Operations at Altitudes Above 25,000 Feet Mean Sea Level
Prerequisites	NONE
Handout(s)	⊙ Practice Exercise
Exercise / Activity	⊙ Practice Exercise: Scanning
Scenario	NONE
Assessments	⊙ YES - Written (Refer to ELT01_L14, print prior to class)
Materials and Equipment	⊙ Pencil and/or pen
Other Pertinent Information	⊙ **Ensure lesson materials are downloaded to the classroom computer** ⊙ This lesson is based on ERAM EAE410 ⊙ The lesson has been reviewed and reflects current orders and manuals as of April 2022.

LESSON ICON LEGEND

	Description
	The Activity icon indicates an exercise, lab, or hands-on activity.
	The Discussion Question icon signals a discussion question to be asked to the students.
	The Handout icon indicates a handout is to be distributed to the students.
	The Instructor Note icon is in hidden text and indicates text that is for the instructor only.
	The Multimedia icon indicates a video or audio clip is in the presentation.
	The Phraseology icon indicates that phraseology is in the content.
	The WBT icon indicates a component of web-based training.
	The Click icon indicates a PPT slide with click-based functionality to present additional information.
	The Definition icon indicates a published definition.

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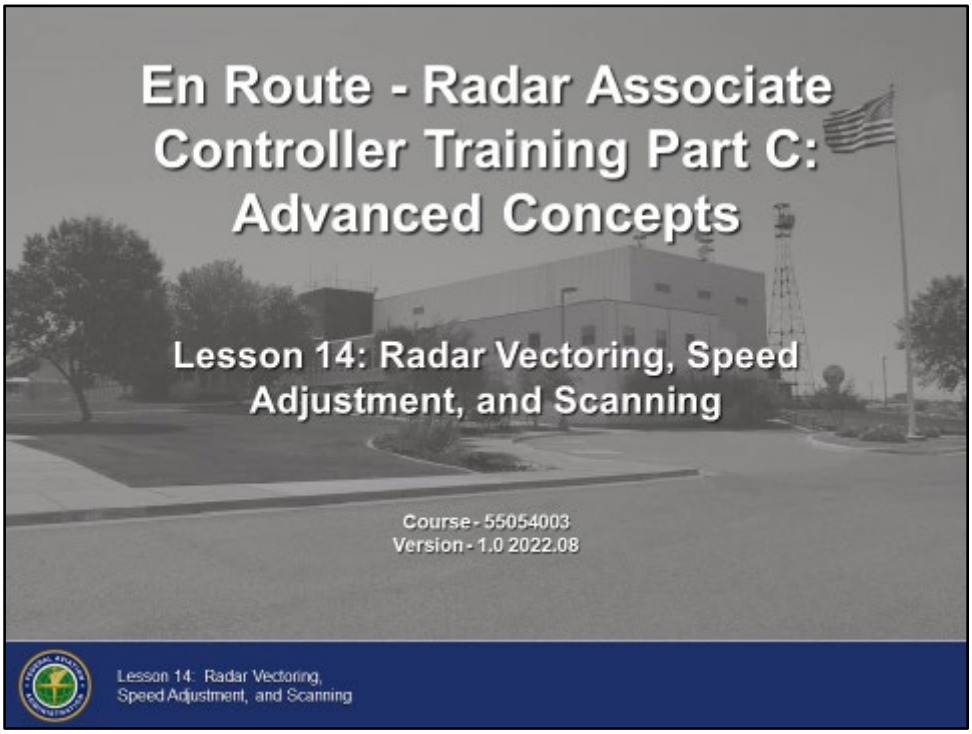
LESSON INTRODUCTION

Overview

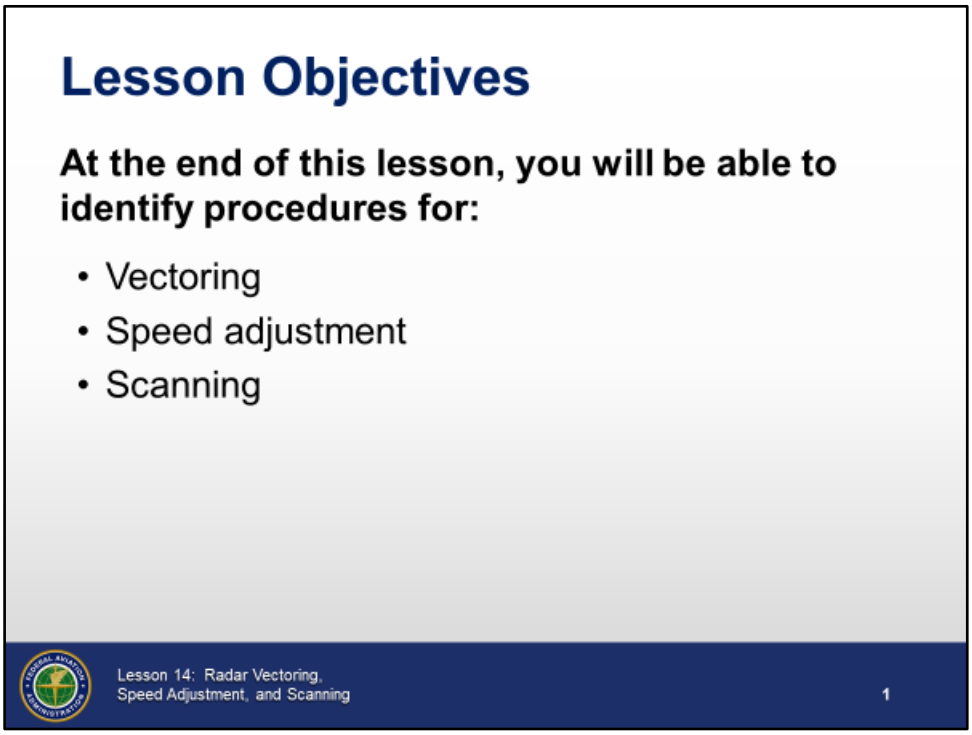


As a Radar Associate Controller, you will be required to make control decisions to accomplish your duties. Vectoring, speed adjustment, and scanning are skills that benefit both the pilot and the sector team, resulting in a safe, orderly, and expeditious flow of air traffic.

In this lesson, you will learn the reasons, methods, and phraseology for issuing vectors and speed adjustments. You will also learn techniques for scanning the Situation Display and EDST.

LESSON INTRODUCTION *(CONT'D)*

Lesson Objectives



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

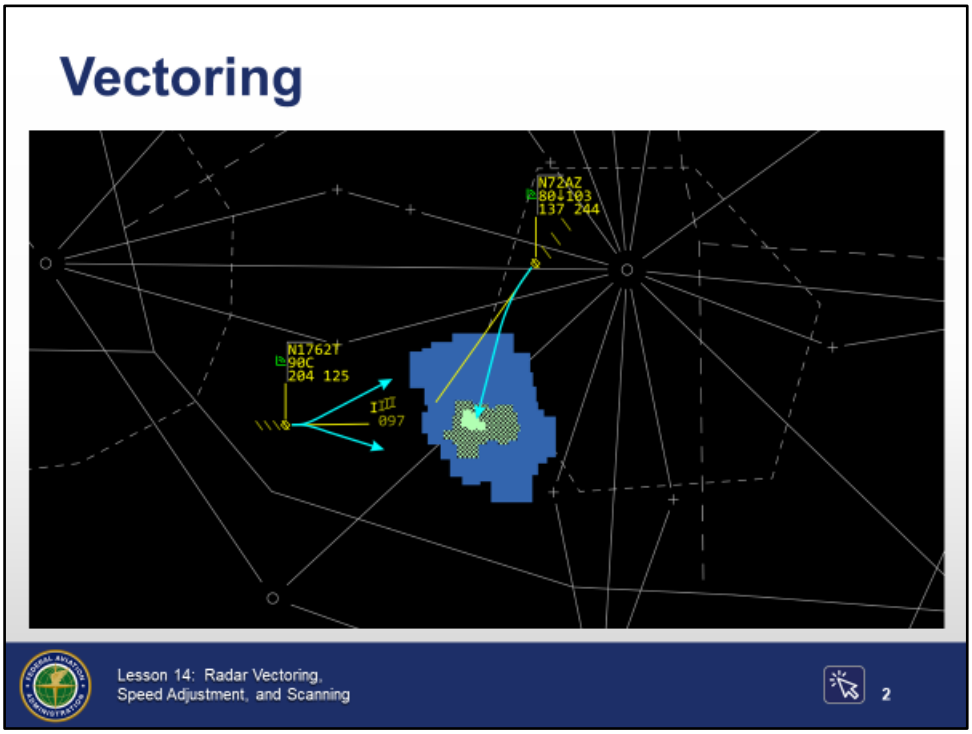
- Vectoring
- Speed adjustment
- Scanning

NOTE: There will be a graded end-of-lesson test upon completion of the lesson. The passing score is 70%. If you do not achieve a score of 70%, you will be provided study time and one retake of an alternate end-of-lesson test.

VECTORING

Vectoring

JO 7110.65, pars. 5-6-1, 5-6-2, PCG



VECTOR - A heading issued to an aircraft to provide navigational guidance by radar.

STANDARD RATE TURN - A turn of 3 degrees per second.

NOTE: Rate of turn at higher altitudes may be lower.

⊙ Vectors may be initiated by ATC or requested by the pilot for:

- Separation

  Example: Conflicting traffic

Continued on next page

VECTORING *(CONT'D)*

Vectoring (Cont'd)

JO 7110.65, pars. 4-4-4, 5-6-1, 5-6-2, PCG

JO 7210.3, par. 2-1-2

- Safety

Examples: Uncontrolled traffic

Weather

Terrain

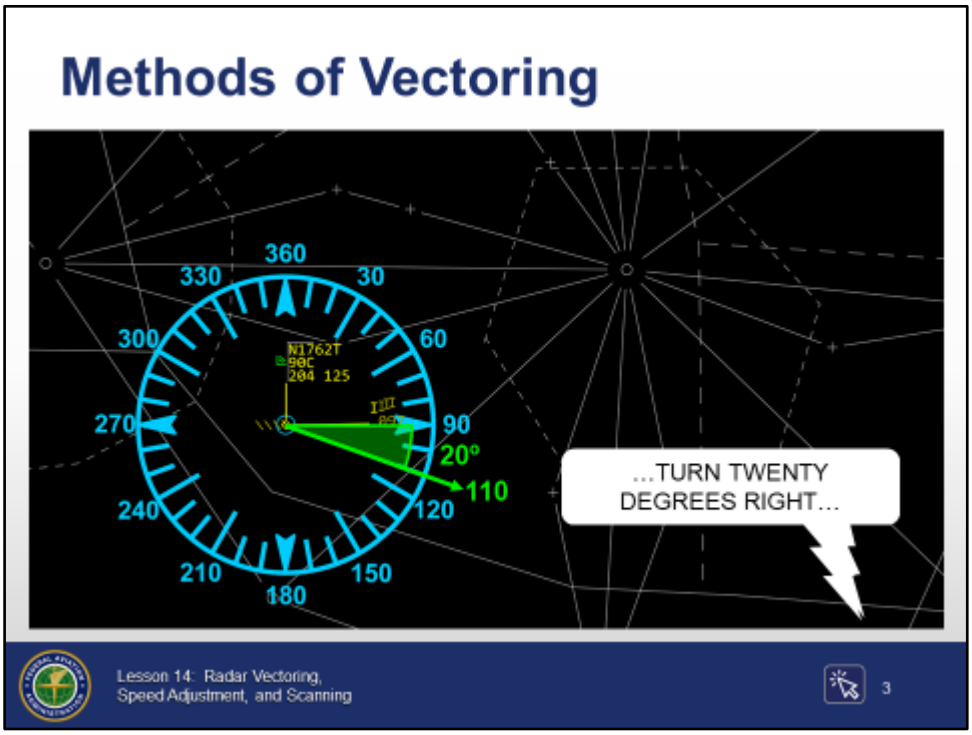
- Noise abatement
  - Guidance is contained in Standard Operating Procedures (SOP) or other facility directives
- Operational advantage
  - Maneuvers that benefit sector traffic
  - Comply with Traffic Management Initiatives (TMI)
- Navigation
  - When any part of an airway or route is unusable because of NAVAID status, clear aircraft that are not RNAV capable via radar vectors
- Confidence maneuver

CONFIDENCE MANEUVER - One or more turns, a climb or descent, or other maneuver to determine if the pilot in command is able to receive and comply with ATC instructions.

- Pilot request

Methods for Vectoring

JO 7110.65, par. 5-6-2



- Vector aircraft by specifying one of the following:
  - Direction of turn, if appropriate, and magnetic heading to be flown

TURN LEFT/RIGHT HEADING (degrees)

FLY HEADING (degrees)

FLY PRESENT HEADING

DEPART (fix) HEADING (degrees)

Example: "…TURN RIGHT, HEADING ONE ONE ZERO…"

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Methods for Vectoring (Cont'd)

JO 7110.65, pars. 5-6-2, 5-10-3, PCG

FAA-H-8083-25B, p. G-14

- Number of degrees, in group form, to turn and the direction of turn

TURN (number of degrees) DEGREES LEFT/RIGHT

Example: "… TURN TWENTY DEGREES RIGHT…"

NOTE: When you issue a specific heading like ZERO EIGHT ZERO, the direction comes first. When issuing a number of degrees like THIRTY DEGREES, the direction of turn comes after the number of degrees.

- For NO-GYRO procedures, the type of vector, direction of turn, and when to stop turn
  - NO-GYRO vector is given to a pilot who has lost their directional gyro

DIRECTIONAL GYRO (DG) - A mechanical instrument that displays heading based on a 360° azimuth. The heading indicator is not affected by the forces that make the magnetic compass difficult to interpret.

  - When issued a NO-GYRO vector, the pilot will make a standard rate turn
    - Optionally, the pilot may be instructed to make a half standard rate turn to allow finer adjustments

⊙ When initiating a vector, advise the pilot of:

- The purpose
- If appropriate, what to expect when radar navigational guidance is terminated

⊙ Provide radar navigational guidance until the aircraft is:

- Established within the airspace to be protected for the route to be flown, or
- On a heading that will, within a reasonable distance, intercept the route to be flown, and informed of its position unless the aircraft is RNAV, FMS, or DME equipped and being vectored toward a VORTAC/TACAN or waypoint and within the service volume of the NAVAID

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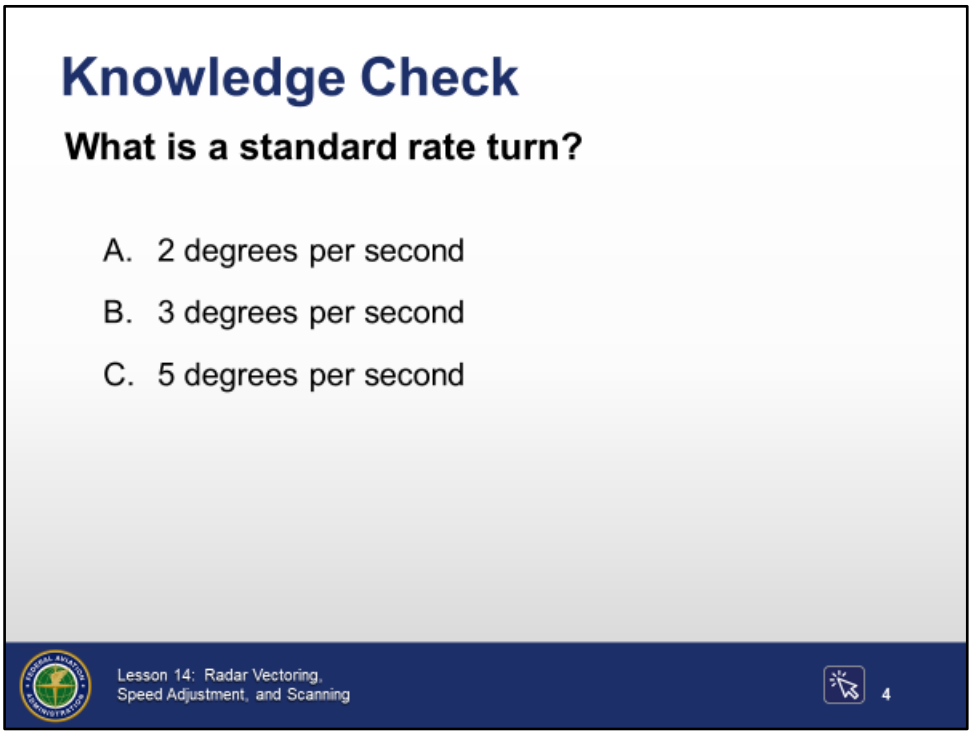
VECTORING *(CONT'D)*

Methods for Vectoring (Cont'd)

JO 7110.65, par. 5-6-2

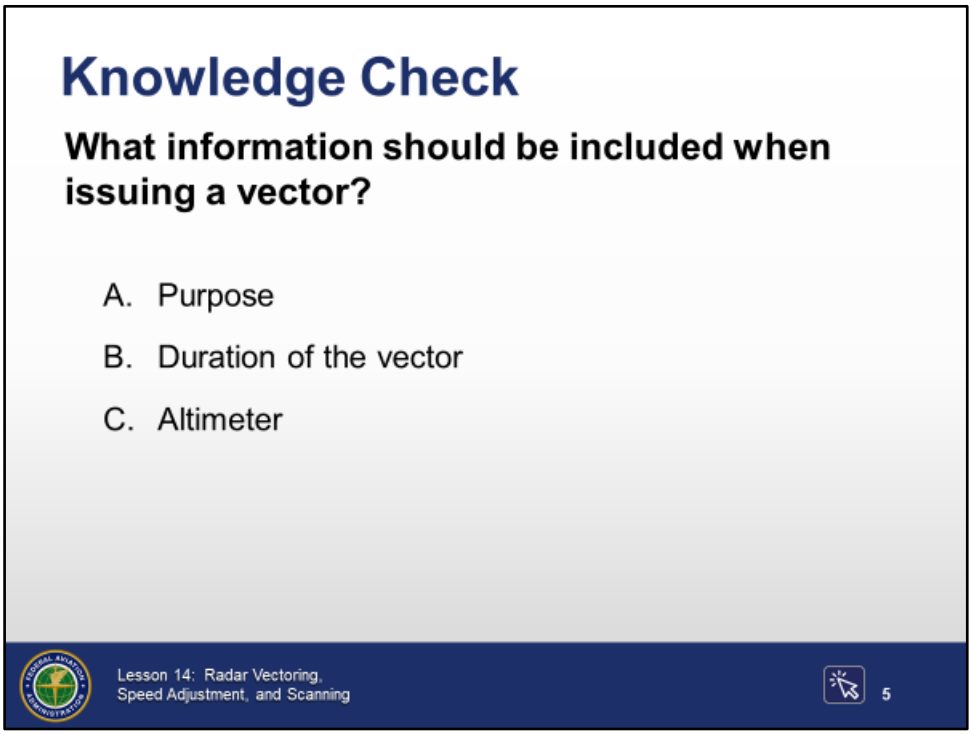
- Aircraft may not be vectored off an Obstacle Departure Procedure (ODP), or issued an altitude lower than published altitude on an ODP, until at or above the MVA/MIA, at which time the ODP is canceled and may not be resumed
- Aircraft vectored off an RNAV route must be recleared to the next waypoint or as requested by the pilot
- Update the route of flight in the computer unless an operational advantage is gained and coordination is accomplished
- Inform the pilot when a vector will take the aircraft across a previously assigned nonradar route

Knowledge Check



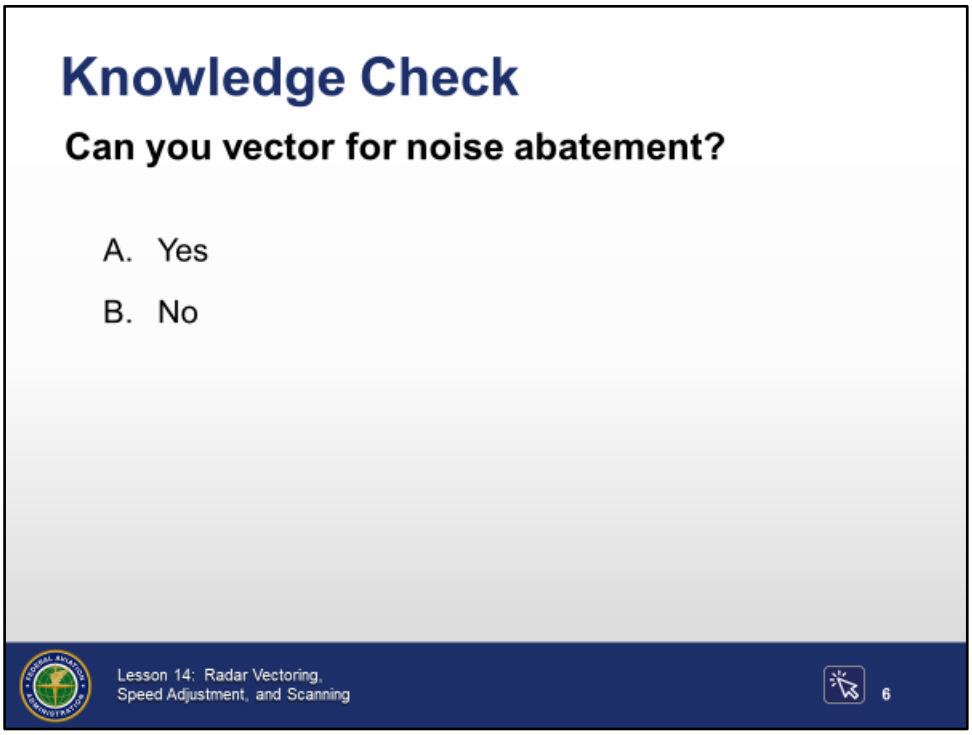
Question: What is a standard rate turn?

Knowledge Check



Question: What information should be included when issuing a vector?

Knowledge Check

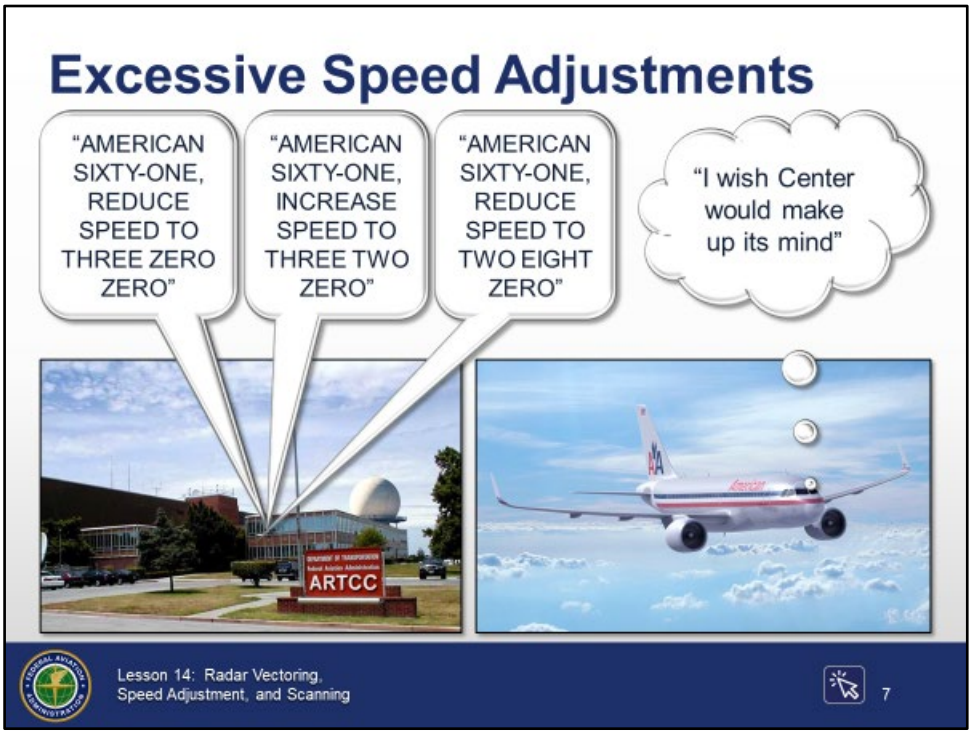


Question: Can you vector for noise abatement?

SPEED ADJUSTMENT PROCEDURES

Excessive Speed Adjustments

JO 7110.65, par. 5-7-1



Examples:

"AMERICAN SIXTY-ONE, REDUCE SPEED TO THREE ZERO ZERO"

"AMERICAN SIXTY-ONE, INCREASE SPEED TO THREE TWO ZERO"

"AMERICAN SIXTY-ONE, REDUCE SPEED TO TWO EIGHT ZERO"

- Keep speed adjustments to the minimum necessary to achieve or maintain:
  - Required spacing
  - Desired spacing
- Avoid adjustments requiring alternate increases and decreases

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SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Excessive Speed Adjustments (Cont'd)

JO 7110.65, par. 5-7-1

⊙ Terminate speed adjustments when no longer needed

NOTE: It is the pilot's responsibility and prerogative to refuse speed adjustment that he/she considers to be excessive or contrary to aircraft operating specifications.

⊙ Determine the number of miles needed for spacing and the point at which spacing needs to be accomplished

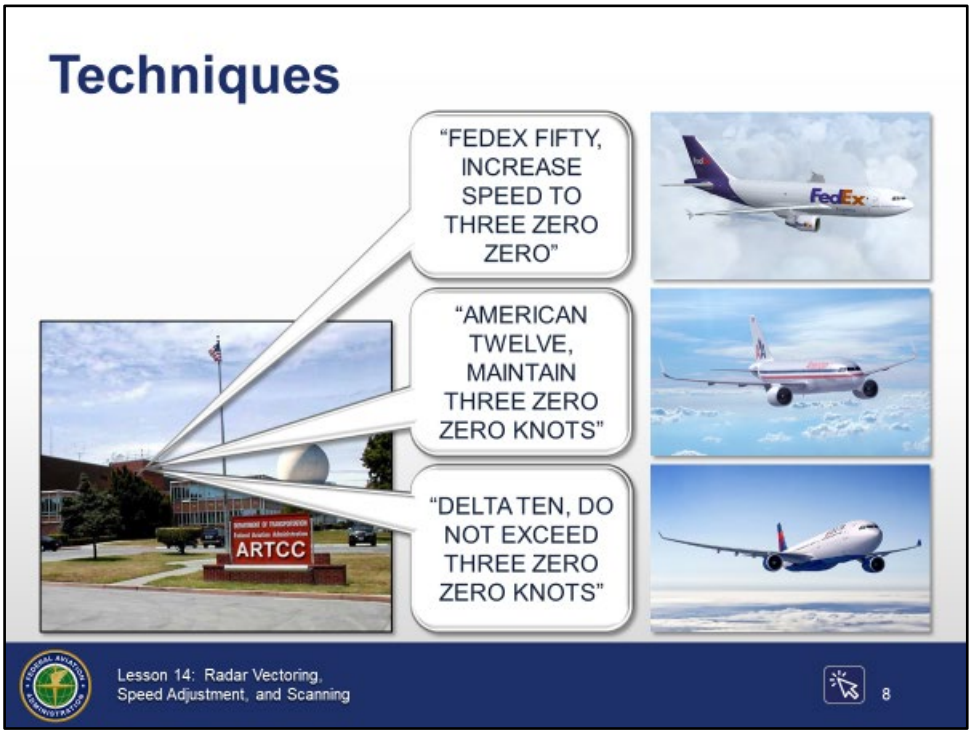
⊙ Implement speed adjustment based on the following principles:

- Priority of speed adjustment instructions is determined by:
  - Relative speed and position of aircraft involved
  - Spacing requirement
- Time and distance required to accomplish speed adjustment is determined by aircraft:
  - Configuration
  - Altitude
  - Speed

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Techniques

JO 7110.65, par. 5-7-1



- Compensate for compression by using one of the following techniques:
  - Increase leading aircraft first

    Example: "FEDEX FIFTY, INCREASE SPEED TO THREE ZERO ZERO"

  - Reduce trailing aircraft first

    Example: "DELTA TEN, DO NOT EXCEED THREE ZERO ZERO KNOTS"
- Assign a specific airspeed if required to maintain spacing

  Example: "AMERICAN TWELVE, MAINTAIN THREE ZERO ZERO KNOTS"
- Speed adjustments are not achieved instantaneously

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SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Techniques (Cont'd)

JO 7110.65, par. 5-7-1

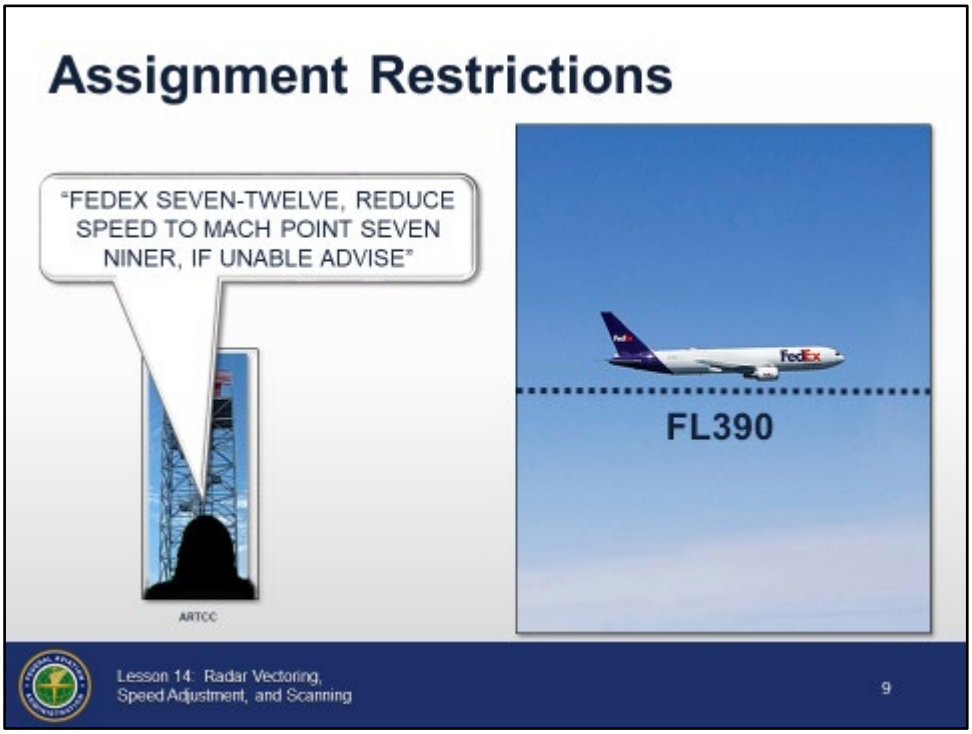
- Allow increased time and distance to achieve speed adjustments in the following situations:
  - Higher altitudes
  - Greater speed
  - Clean configuration

    NOTE: A clean configuration is flaps and landing gear up.
- Allow aircraft to operate in clean configuration as long as circumstances permit
- Keep number of speed adjustments per aircraft to the minimum required to achieve and maintain spacing

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Assignment Restrictions

JO 7110.65, par. 5-7-1



- Do not assign speed adjustment to aircraft:
  - At or above FL390, without pilot consent

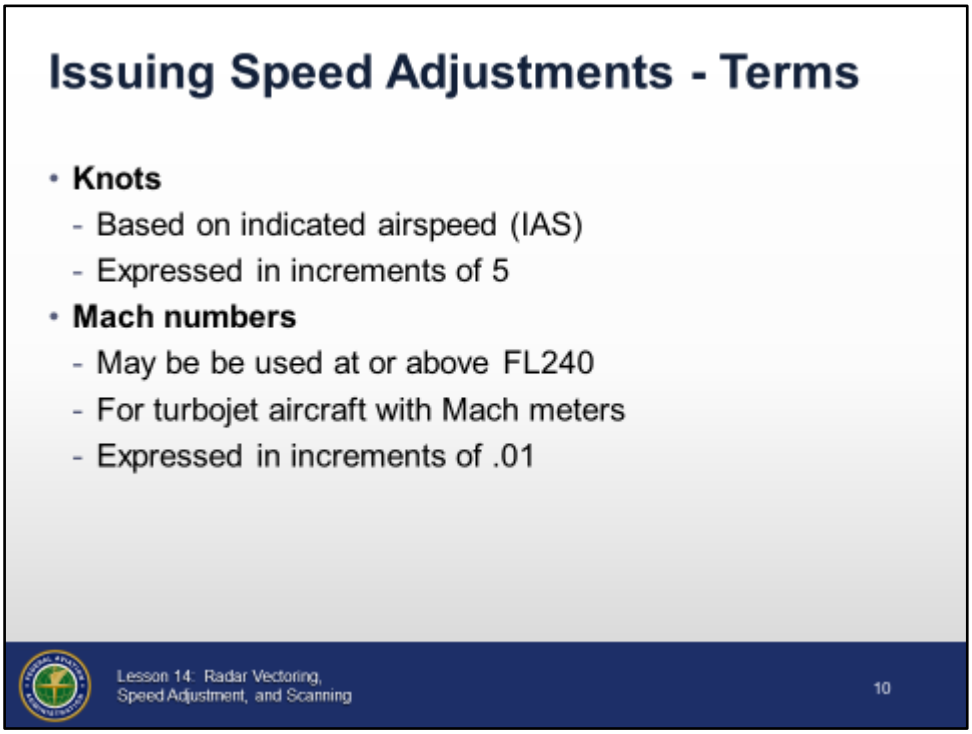
    Example: "FEDEX SEVEN-TWELVE, REDUCE SPEED TO MACH POINT SEVEN NINER, IF UNABLE ADVISE"
  - Executing a published high altitude instrument approach procedure
  - In a holding pattern
  - Inside the final approach fix on final, or a point 5 miles from the runway, whichever is closer to the runway

  NOTE: Large, heavy and super aircraft at high altitudes have very narrow cruise or airspeed margins. Some weight/altitude/airspeed combinations are impossible to achieve.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Issuing Speed Adjustment - Terms

JO 7110.65, par. 5-7-1



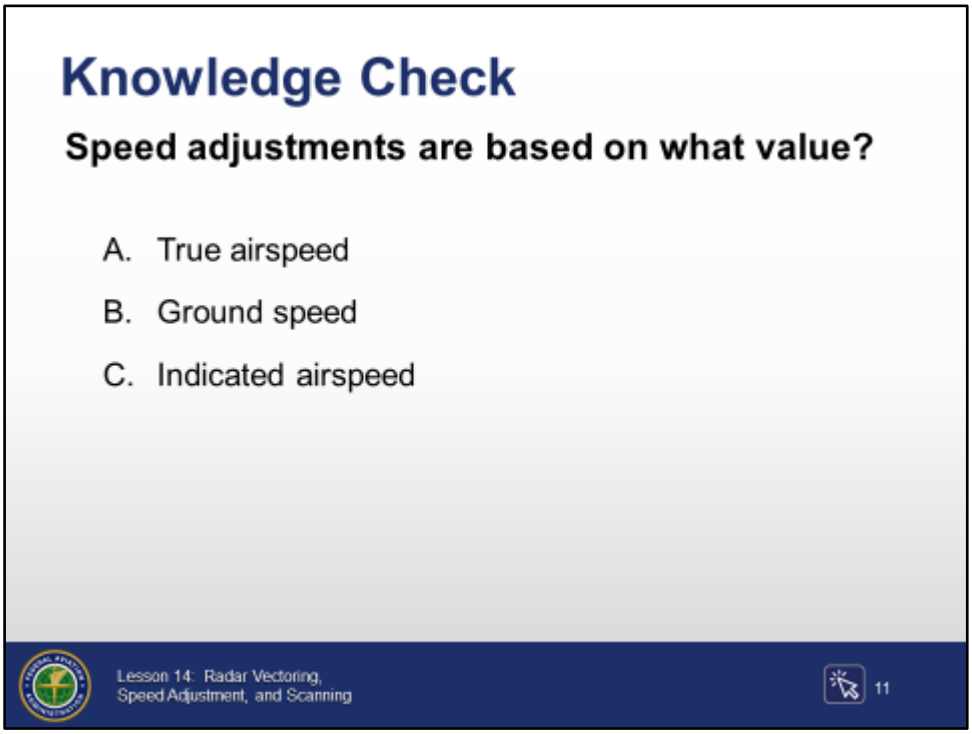
- Knots
  - Based on indicated airspeed (IAS)
  - Expressed in increments of 5
    - CPDLC increments are 10 for crossing restrictions
- Mach numbers
  - May be used at or above FL240
  - For turbojet aircraft with Mach meters
  - Expressed in increments of .01

    Examples: Mach .69, .71, .75, .82, etc.

  NOTE: Although Mach numbers may be used at or above FL240, they are typically used at or above FL290.
- Pilot must maintain speed within plus or minus 10 knots or .02 Mach number of the specified speed
- Consider that ground speed may vary with altitude when assigning speeds to achieve spacing between aircraft at different altitudes
  - Further adjustments may be necessary to achieve desired spacing

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

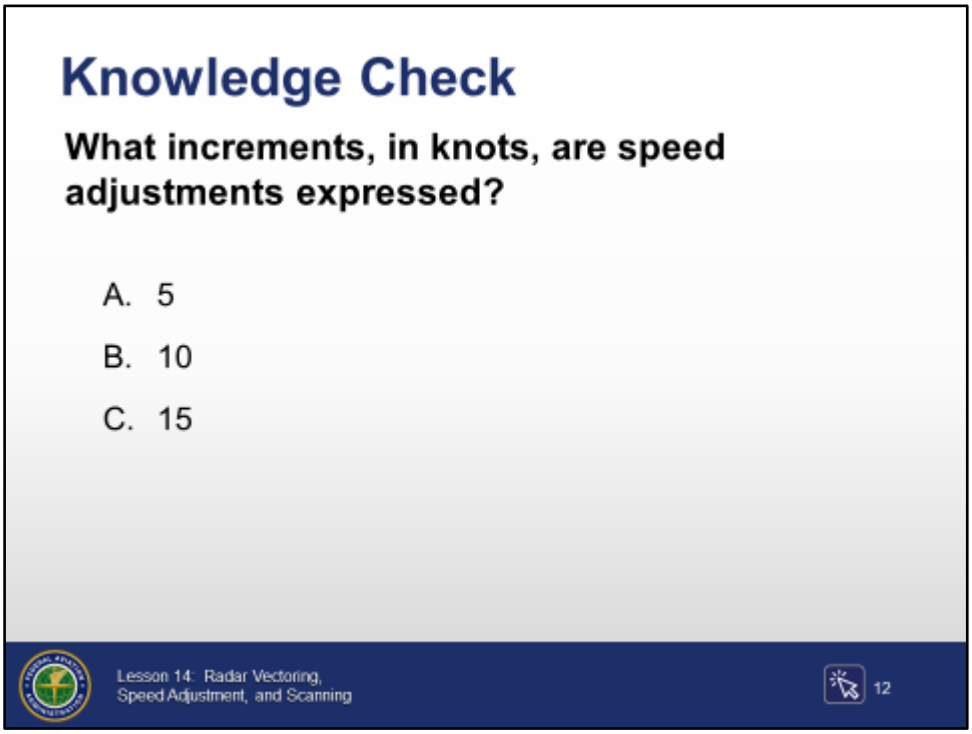
Knowledge Check



Question: Speed adjustments are based on what value?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

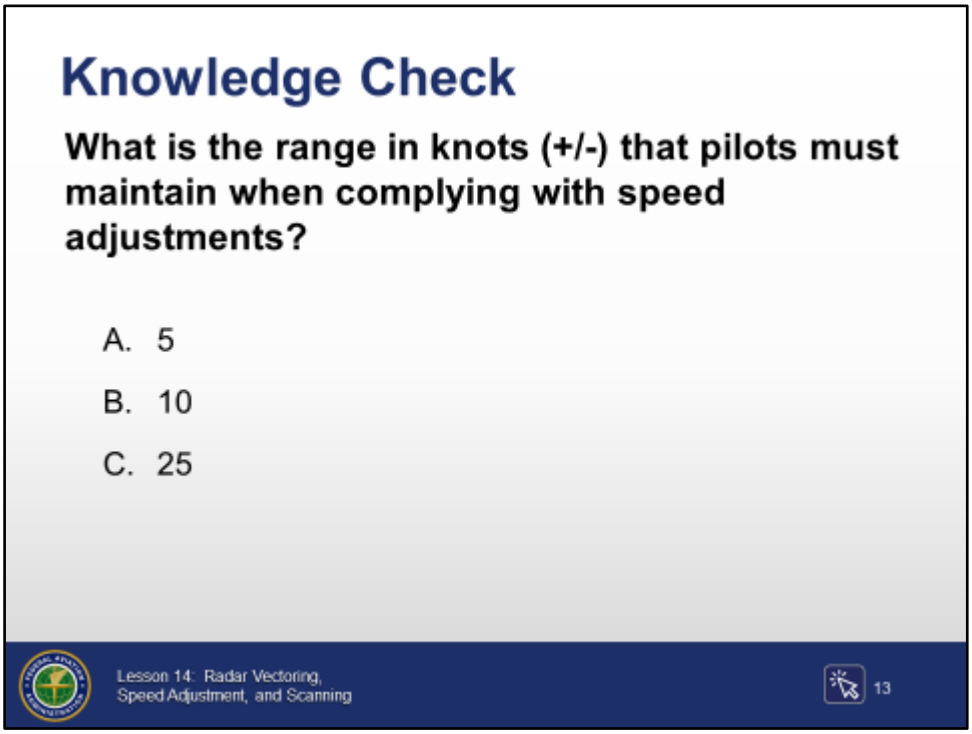
Knowledge Check



Question: What increments, in knots, are speed adjustments expressed?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Knowledge Check



Question: What is the range in knots (+/-) that pilots must maintain when complying with speed adjustments?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

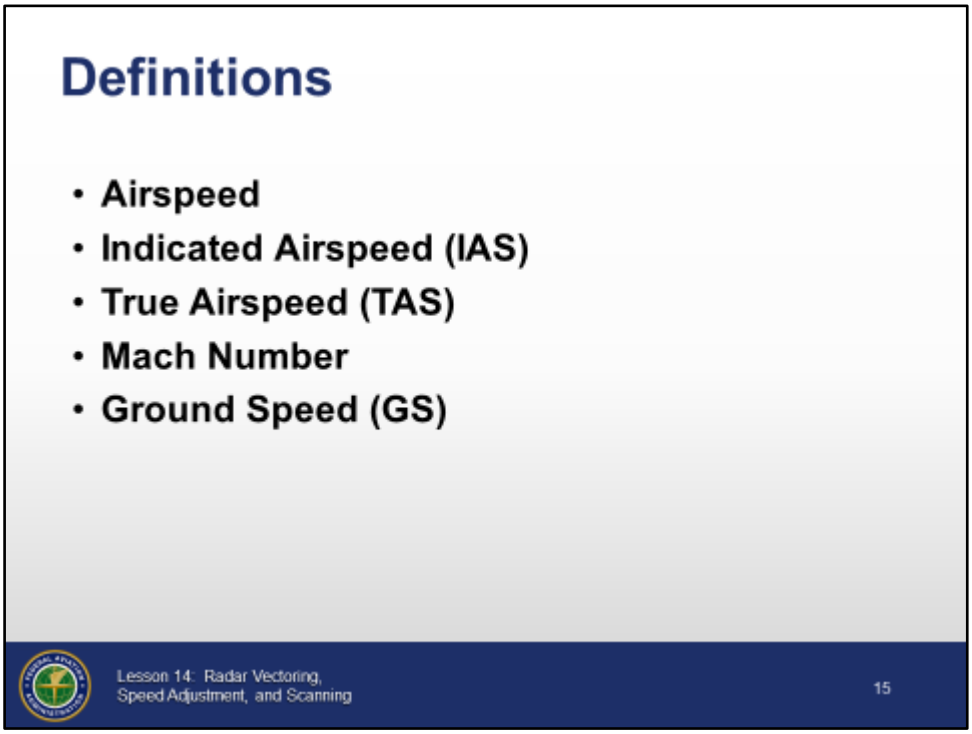
Airspeed and Mach

- Every aircraft in flight has a true airspeed (TAS), an indicated airspeed (IAS), and a Mach number (M)
  - The relationship between the three is not always obvious
  - It is important that you gain an understanding of how they differ and when they are to be used

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Definitions

JO 7110.65 par. 5-7-1, PCG



AIRSPEED - The speed of an aircraft relative to its surrounding air mass. The unqualified term airspeed means one of the following: true airspeed (TAS) or indicated airspeed (IAS).

INDICATED AIRSPEED (IAS) - Speed shown on the aircraft airspeed indicator. This is the speed used in pilot/controller communications under the general term airspeed.

TRUE AIRSPEED (TAS) - Speed of an aircraft relative to undisturbed air. Used primarily in flight planning and in the en route portion of flight. When used in pilot/controller communications, it is referred to as true airspeed and not shortened to airspeed. TAS is IAS corrected for air density and instrument and position errors (Calibrated Airspeed).

MACH NUMBER - The ratio of true airspeed to the speed of sound, e.g., MACH .82, MACH 1.6.

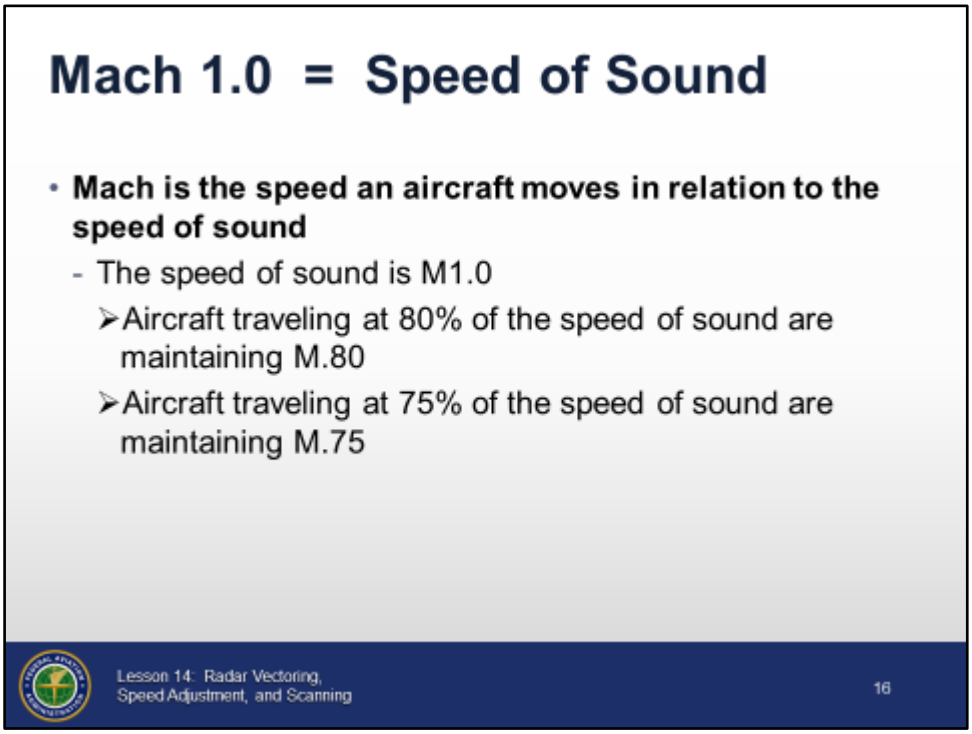
NOTE: At or above FL240, speeds may be expressed in terms of Mach numbers.

GROUND SPEED (GS) - Speed of an aircraft relative to the surface of the earth. It is the result of true airspeed affected by winds. TAS +/- wind speed = GS.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

What is Mach?

FAA-H-8083-25B, pp. 5-44, 5-45



- Mach is the speed an aircraft moves in relation to the speed of sound
  - The speed of sound is M1.0

  Examples: Aircraft traveling at 80% of the speed of sound are maintaining M.80.

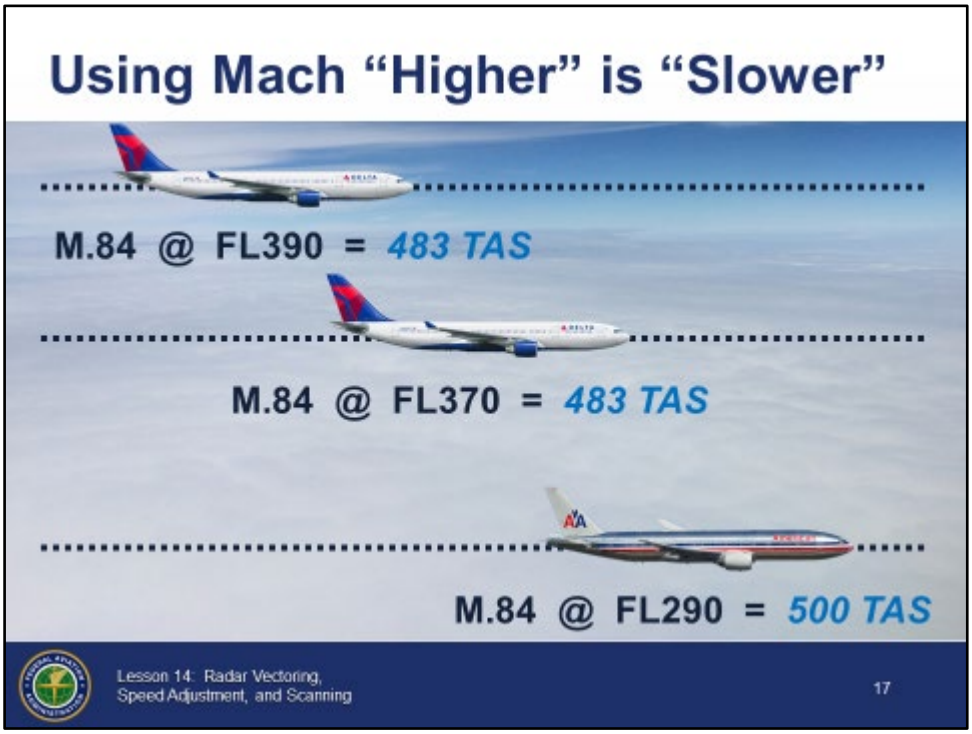
  Aircraft traveling at 75% of the speed of sound are maintaining M.75.
  - The speed of sound is a complex formula taking into account:
    - Density of the atmosphere
    - Temperature
    - Other factors

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

What is Mach? (Cont'd)

FAA-H-8083-25B, pp. 5-44, 5-45

AC 61-107B, par. 3-2

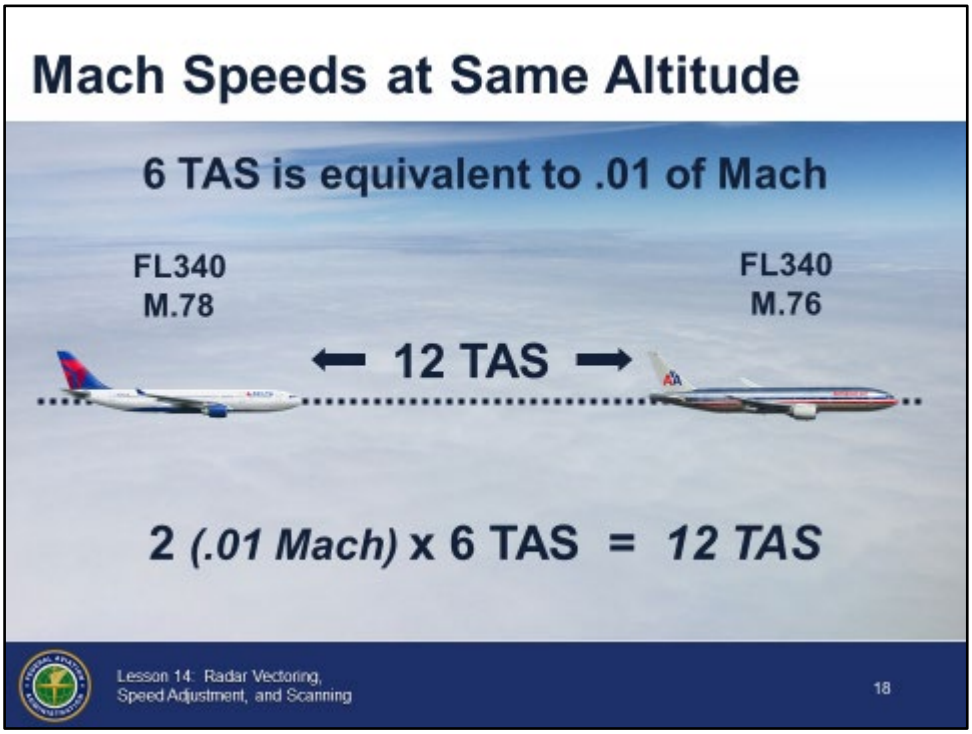


- For ATC purposes, you can think of the speed of sound as a function of temperature, with colder temperatures equating to slower speeds
- At sea level, the standard temperature is 59 degrees Fahrenheit while at FL360, the standard temperature is -69.7 degrees Fahrenheit
- Therefore, at a constant Mach number, the higher an aircraft climbs, the slower its TAS
- Conversely, at a constant Mach number, the lower an aircraft descends, the faster its TAS
- At and above FL360, the temperature remains virtually the same, so the speed of sound does not vary above FL360
  - Therefore, at FL360 or above, aircraft at different altitudes but assigned the same Mach number will have the same true airspeed

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Guidance for Assigning Mach

FAA-H-8083-25B, pp. 5-44, 5-45



- 6 TAS is equivalent to .01 of Mach

  Example: If an aircraft at FL340 is maintaining M.78 and another aircraft at FL340 is maintaining M.76, there will be a 12 TAS difference between the two aircraft. A difference of M.02, 6 TAS per M.01, results in 12 TAS difference.

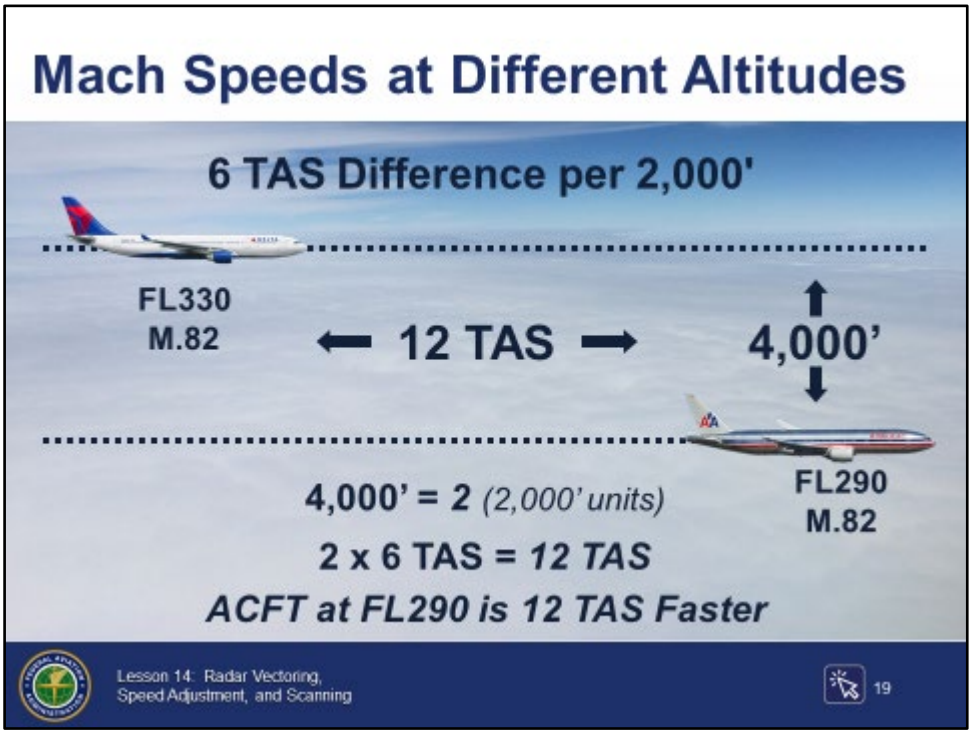
  2 (.01 Mach) x 6 TAS = 12 TAS

NOTE: All examples assume a no wind situation; therefore, a difference of 12 TAS will equate to a 12 knot difference in ground speed.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Guidance for Assigning Mach (Cont'd)

FAA-H-8083-25B, pp. 5-44, 5-45



- 6 TAS difference for every 2,000' of altitude

  Example: An aircraft is at FL330 is assigned M.82 while another aircraft is at FL290 is assigned M.82

  Since higher is slower, and the aircraft at FL330 is 4,000' higher than the aircraft at FL290, there will be an equivalent of M.02 in speed difference, or 12 TAS

  4,000' = 2 *(2,000' units)*

  2 x 6 TAS = 12 TAS

  The aircraft at FL290 will be moving 12 TAS faster than the aircraft at FL330

  NOTE: In the above example increasing the higher aircraft by M.02, or reducing the lower aircraft M.02 will match true airspeeds.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Guidance for Assigning Mach (Cont'd)

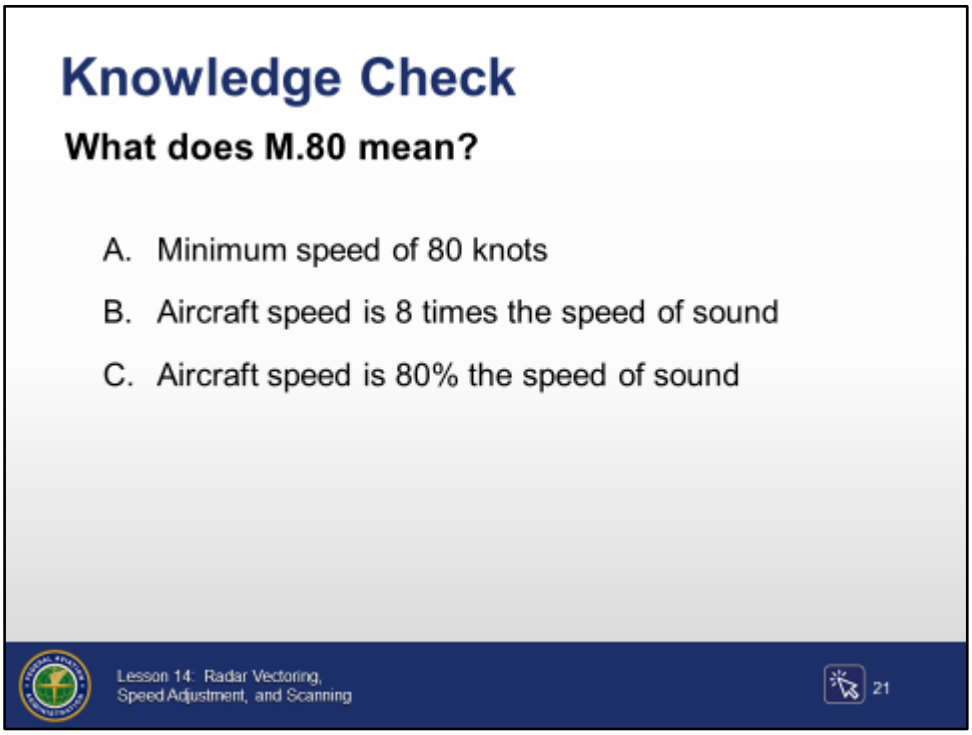
FAA-H-8083-25B, p. 5-45

- Assigning Mach at or above FL240 stems from pilot instrumentation and aircraft operating envelopes
- At lower altitudes, speed limitations are expressed in IAS
- The pilot will transition from measuring the aircraft's speed in IAS to Mach number at some point
    - Does not imply that IAS cannot be used at higher altitudes, but that aircraft instrumentation favors the use of Mach numbers at higher altitudes

NOTE: Aircraft have an upper Mach limit. As altitude increases and the speed of sound decreases, the Mach limit approaches the stall speed of the airframe. This means that the aircraft cannot fly faster because of the Mach limit or fly slower because of the stall speed. The Mach limit is indicated to the pilots by a red-and-white indicator referred to as the barber pole.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

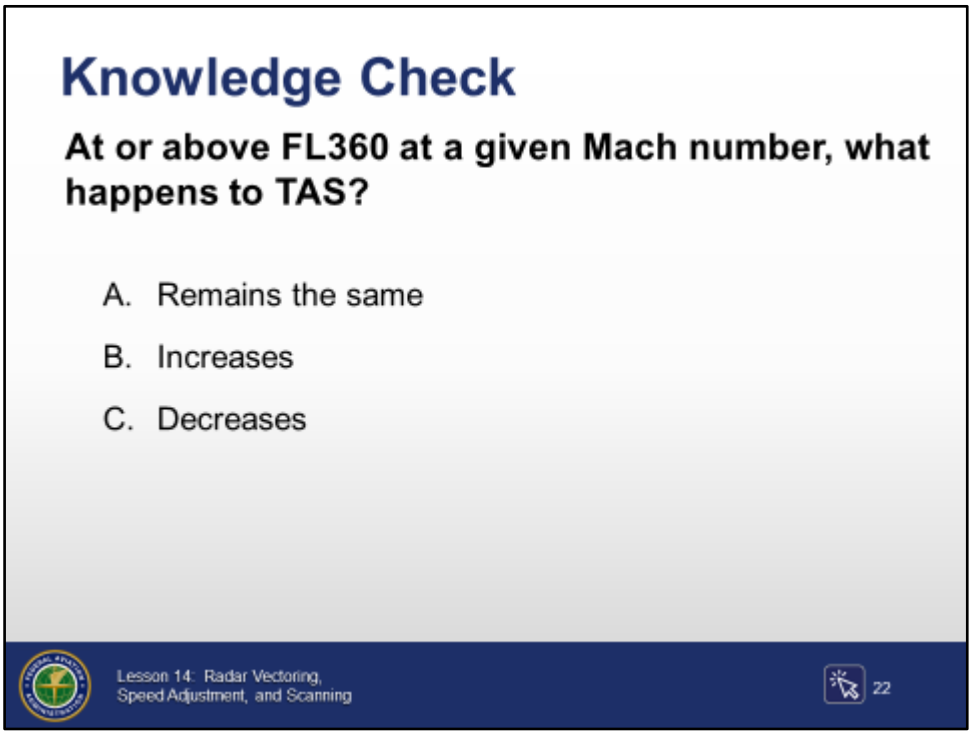
Knowledge Check



Question: What does M.80 mean?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

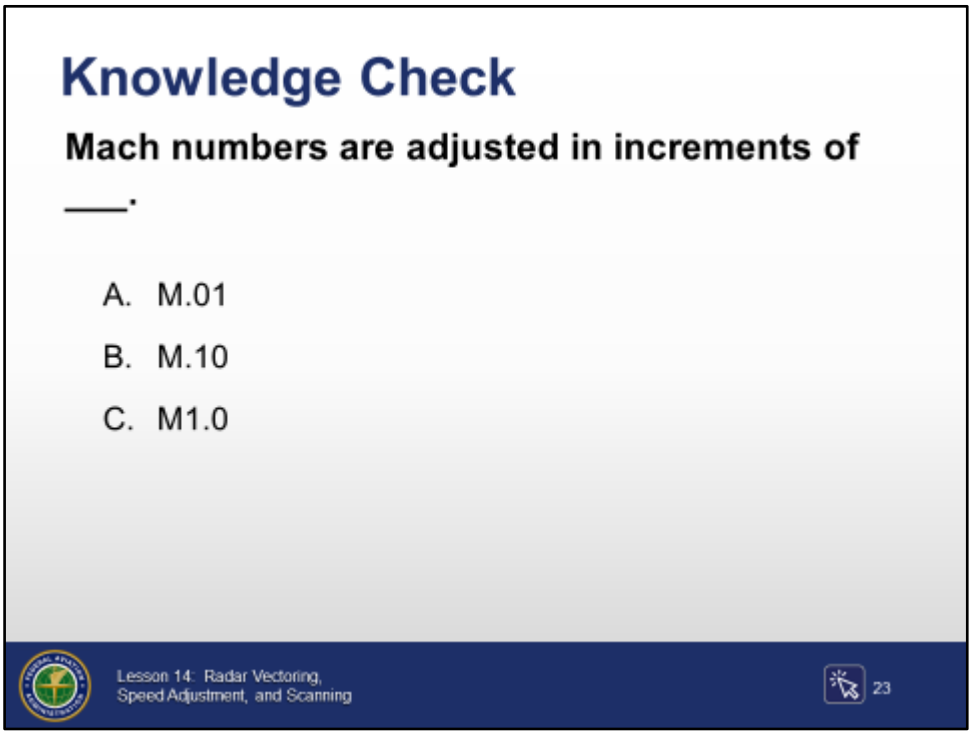
Knowledge Check



Question: At or above FL360 at a given Mach number, what happens to TAS?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

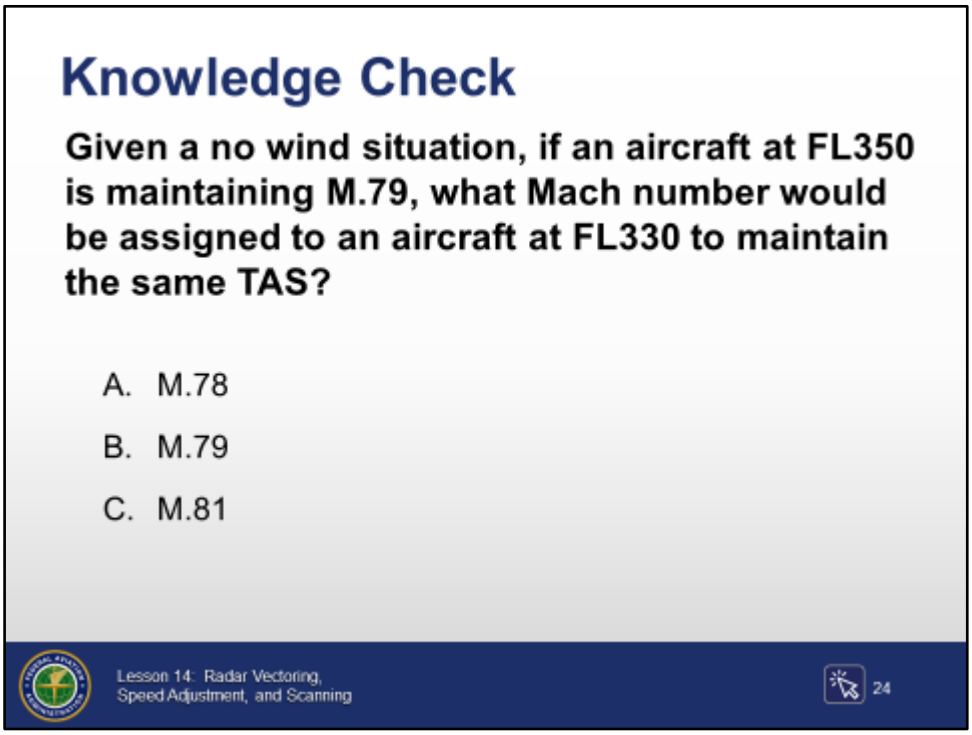
Knowledge Check



Question: Mach numbers are adjusted in increments of ___.

SPEED ADJUSTMENT PROCEDURES (*CONT'D*)

Knowledge Check

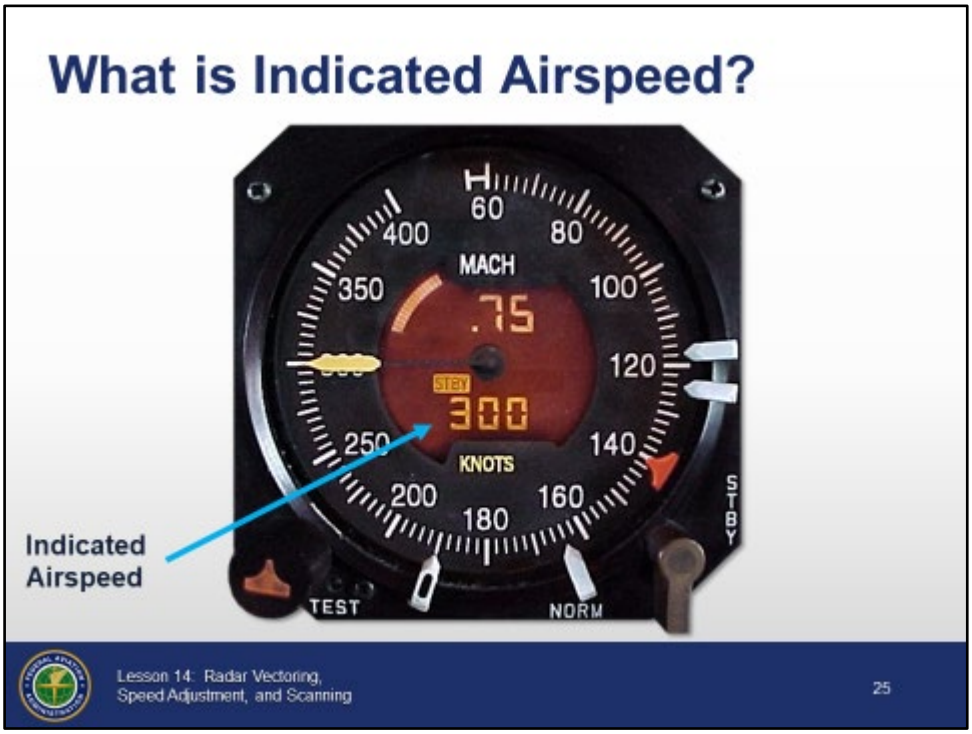


Question: Given a no wind situation, if an aircraft at FL350 is maintaining M.79, what Mach number would be assigned to an aircraft at FL330 to maintain the same TAS?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

What is IAS?

JO 7110.65, PCG

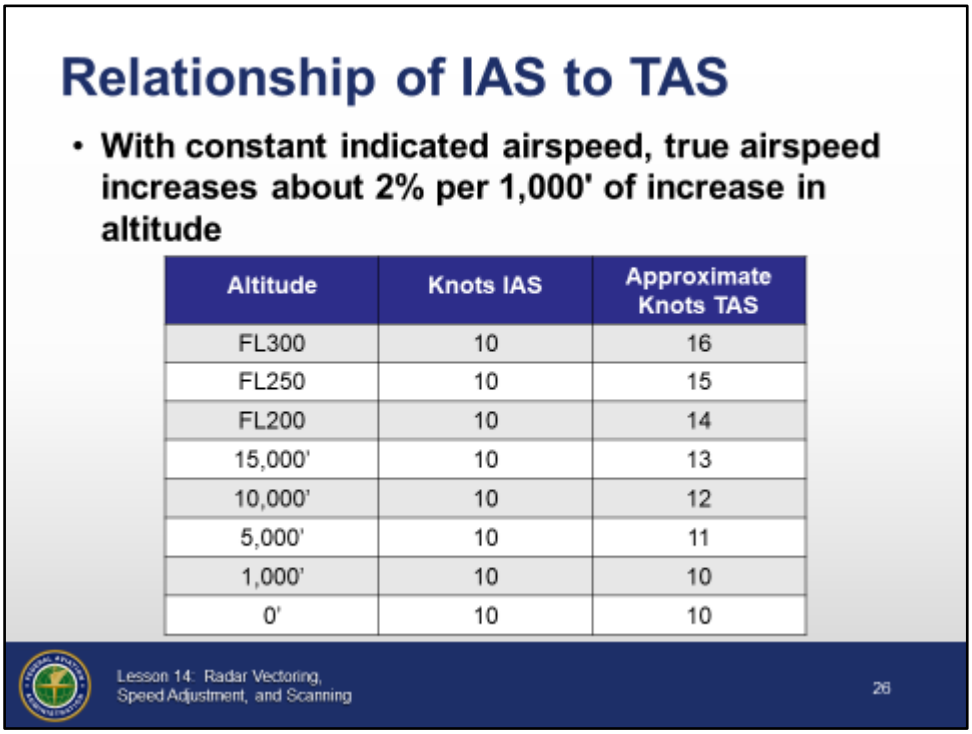


- Indicated airspeed is the airspeed shown on the aircraft airspeed indicator
  - This is the speed used in pilot/controller communications under the general term "airspeed"
  - Airspeed is the speed of an aircraft relative to its surrounding air mass

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Relationship of IAS to TAS

AC 61-107B, par. 2-10



- With constant indicated airspeed, true airspeed increases about 2% per 1,000' of increase in altitude
- Due to low air density at higher altitudes, the airspeed indicator reads less than the actual speed of the aircraft
- At sea level, there is virtually no difference between IAS and TAS
- If an aircraft in a descent is assigned a constant IAS, the TAS of the aircraft will decrease as altitude is lost

Examples: At FL300, a 10 IAS adjustment results in a 16 TAS change.

At 1,000', the same 10 IAS results in a 10 TAS change.

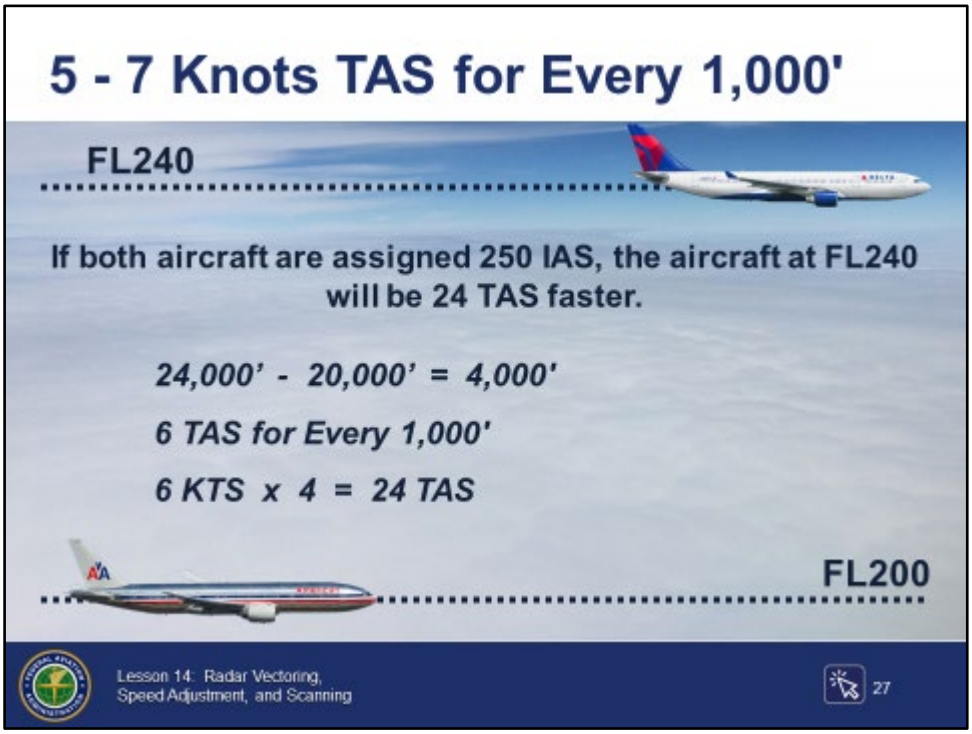
NOTE: TAS without a wind speed component = ground speed.

NOTE: Aircraft in trail assigned the same airspeed and in a descent, i.e., an arrival stream, will slow as they descend, causing compression.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Guidance for IAS Use

AC 61-107B, par. 2-10



- For IAS assignment, assume 5-7 knots TAS variance for every 1,000' of altitude change above FL200

  NOTE: For the calculations in this lesson, 6 TAS will be used.

  Example: Aircraft at FL240 assigned 250 IAS will be traveling 24 TAS faster than aircraft assigned 250 IAS at FL200.

  24,000' - 20,000' = 4,000'

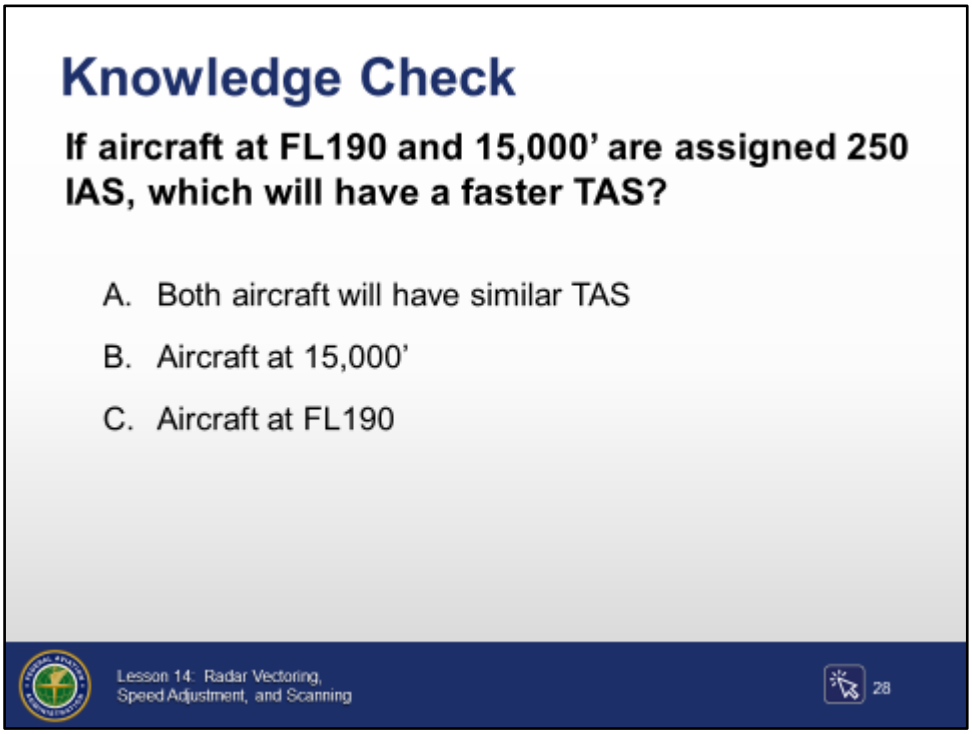
  6 TAS for every 1,000'

  6 TAS X 4 = 24 TAS

NOTE: As an aircraft gets closer to mean sea level (MSL), less variance in TAS will be seen for every thousand feet of altitude difference. Below 10,000' the variance is so slight that you can typically expect no change.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

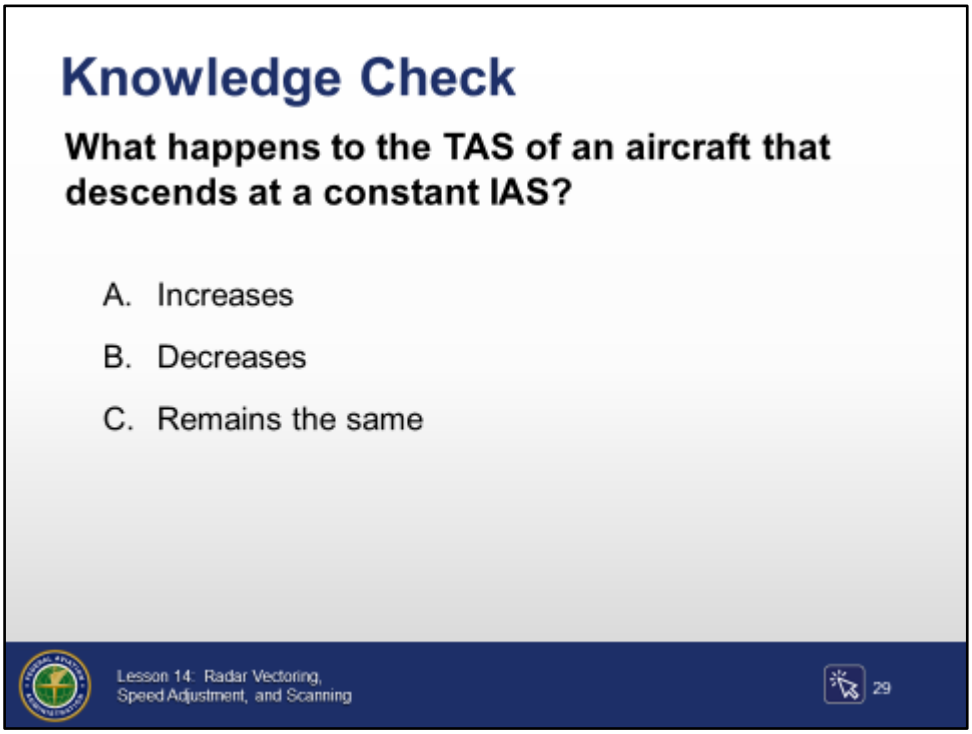
Knowledge Check



Question: If aircraft at FL190 and 15,000' are assigned 250 IAS, which will have a faster TAS?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Knowledge Check



Question: What happens to the TAS of an aircraft that descends at a constant IAS?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Minima Below 10,000'

JO 7110.65, pars. 3-1-11, Note, 5-7-2, Note

14 CFR 91.117

- Speed in excess of 250 knots below 10,000' within domestic airspace is prohibited, unless otherwise authorized by the FAA administrator

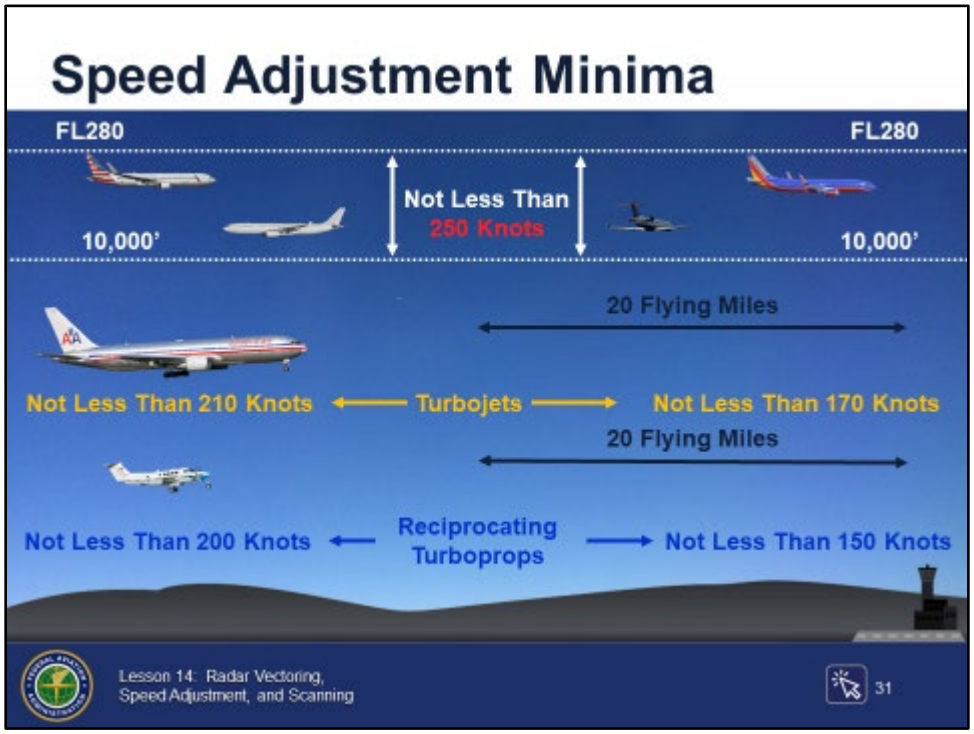
  NOTE: Speed in excess of 250 knots is allowed when required or recommended in the airplane flight manual or when required by military operating procedures.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Speed Adjustment Minima

JO 7110.65, par. 5-7-3

14 CFR Part 1



⊙ When assigning airspeeds, use the following minima:

- To aircraft operating between FL280 and 10,000', a speed not less than 250 knots or the equivalent Mach number
- A pilot will advise if unable to comply with the speed assignment

  NOTE: On a standard day, the Mach numbers equivalent to 250 knots calibrated airspeed (subject to minor variations) are:

  FL240 - 0.6

  FL250 - 0.61

  FL260 - 0.62

  FL270 - 0.64

  FL280 - 0.65

  FL290 - 0.66

Continued on next page

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Speed Adjustment Minima (Cont'd)

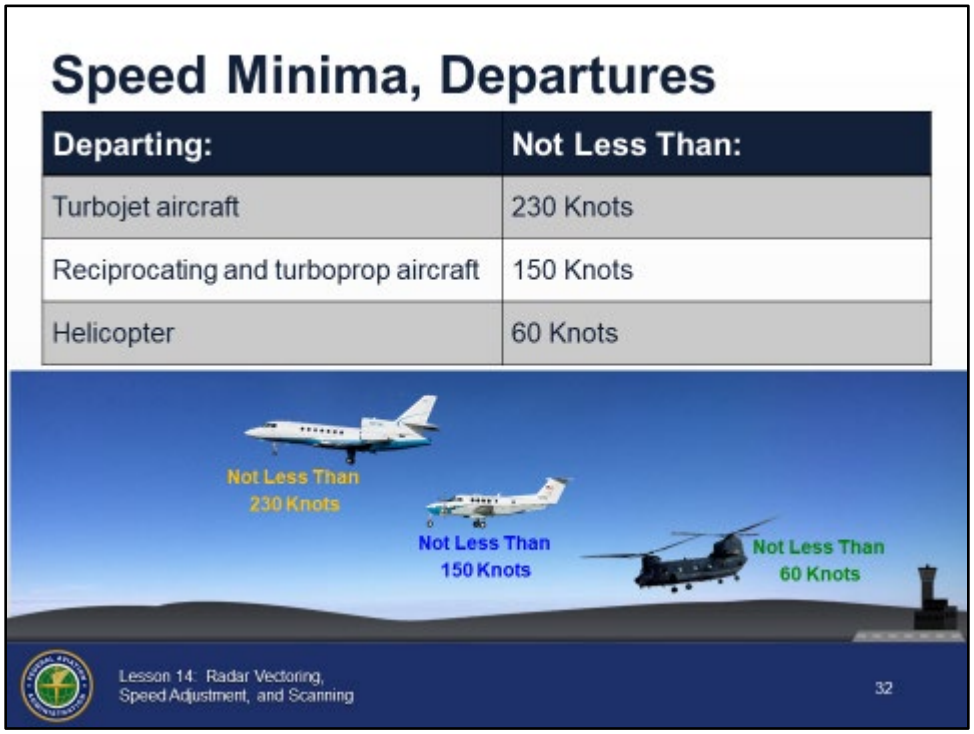
JO 7110.65, par. 5-7-3

- When an operational advantage will be realized, speeds lower than the recommended minima may be applied
- Turbojet arrival aircraft operating below 10,000':
  - More than 20 flying miles from the runway threshold
    - Not less than 210 knots
  - Within 20 flying miles of the runway threshold
    - Not less than 170 knots
- Reciprocating and turboprop arrival aircraft below 10,000'
  - More than 20 flying miles from the runway threshold
    - Not less than 200 knots
  - Within 20 flying miles of runway threshold
    - Not less than 150 knots

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Speed Minima, Departures

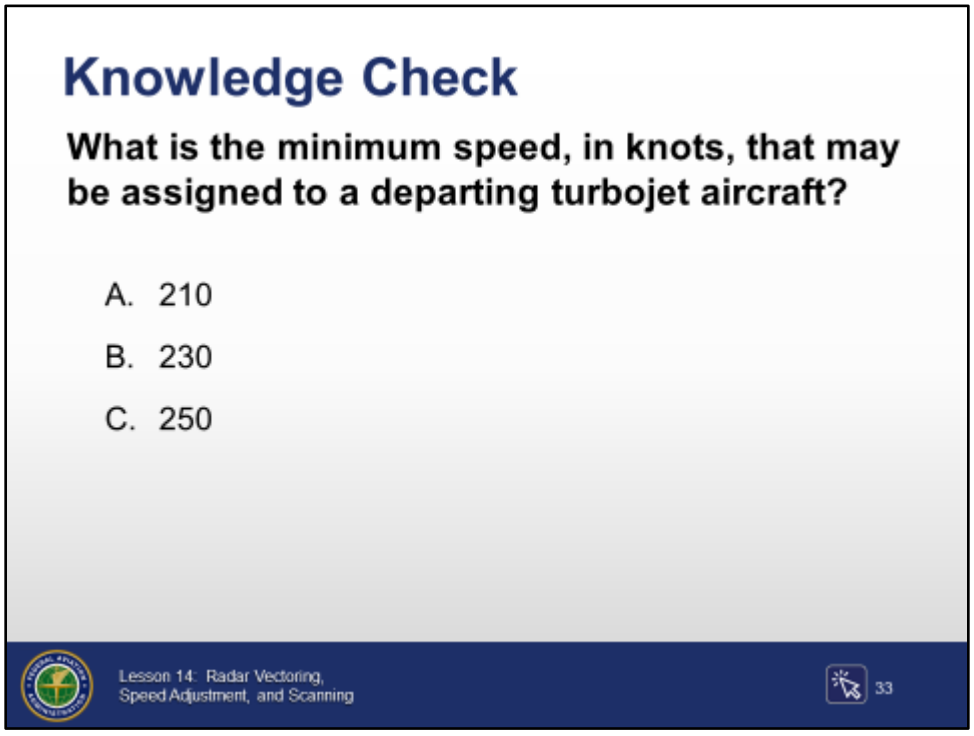
JO 7110.65, par. 5-7-3



- Minima for departures
  - Turbojet aircraft:
    - Not less than 230 knots
  - Reciprocating and turboprop aircraft:
    - Not less than 150 knots
  - Helicopters:
    - Not less than 60 knots

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

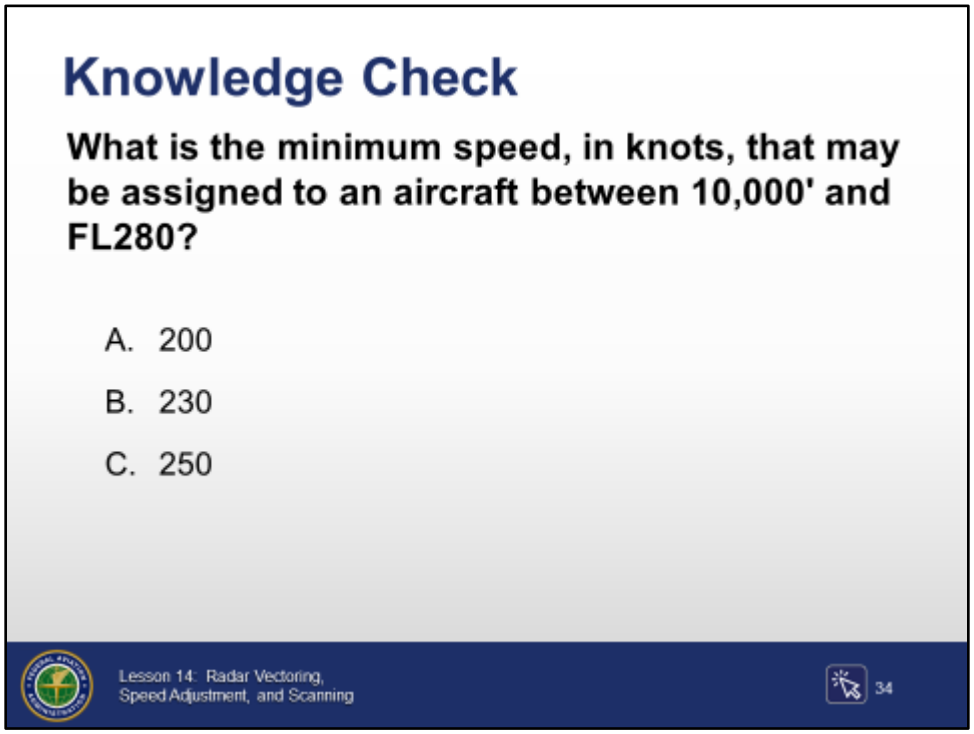
Knowledge Check



Question: What is the minimum speed, in knots, that may be assigned to a departing turbojet aircraft?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

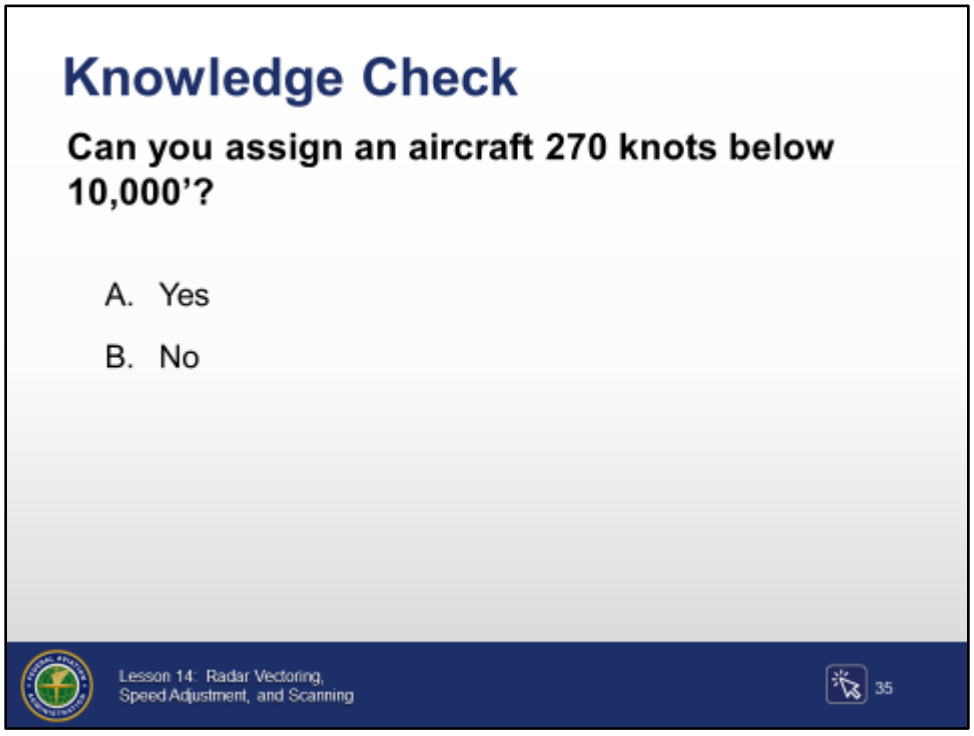
Knowledge Check



Question: What is the minimum speed in knots that may be assigned to an aircraft between 10,000' and FL280?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Knowledge Check

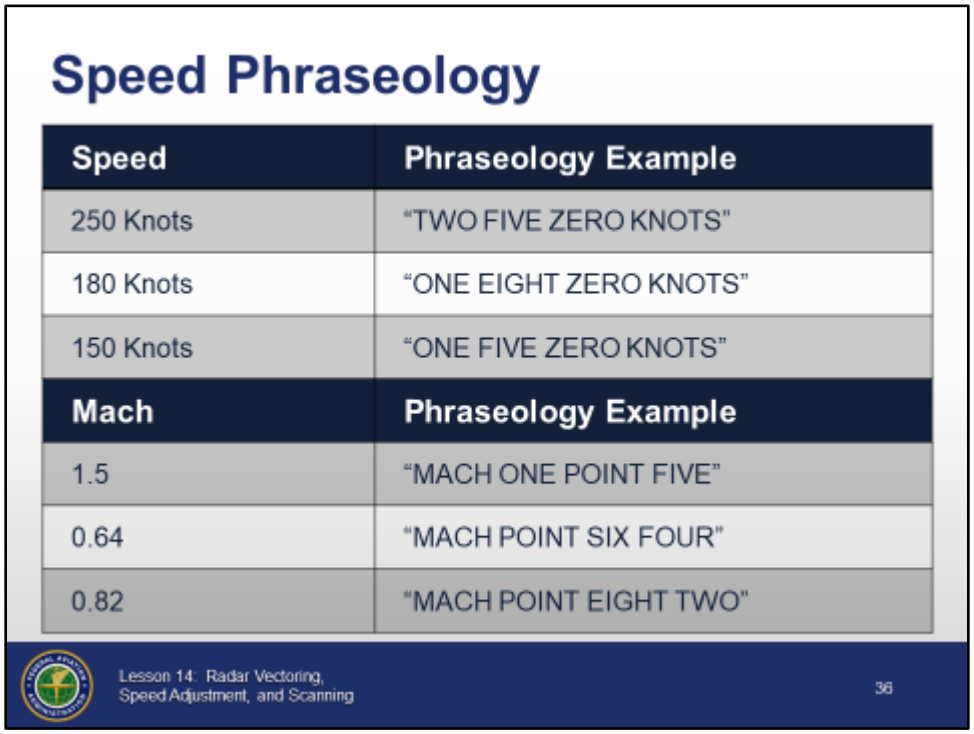


Question: Can you assign an aircraft 270 knots below 10,000'?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Speed Phraseology

JO 7110.65, par. 2-4-17



⊙ State speeds as follows:

- The separate digits of the speed, followed by the word KNOTS, where applicable, or
- The separate digits of the Mach number preceded by Mach

Examples: 250 Knots -"TWO FIVE ZERO KNOTS"

180 Knots - "ONE EIGHT ZERO KNOTS"

150 Knots - "ONE FIVE ZERO KNOTS"

Mach 1.5 - "MACH ONE POINT FIVE"

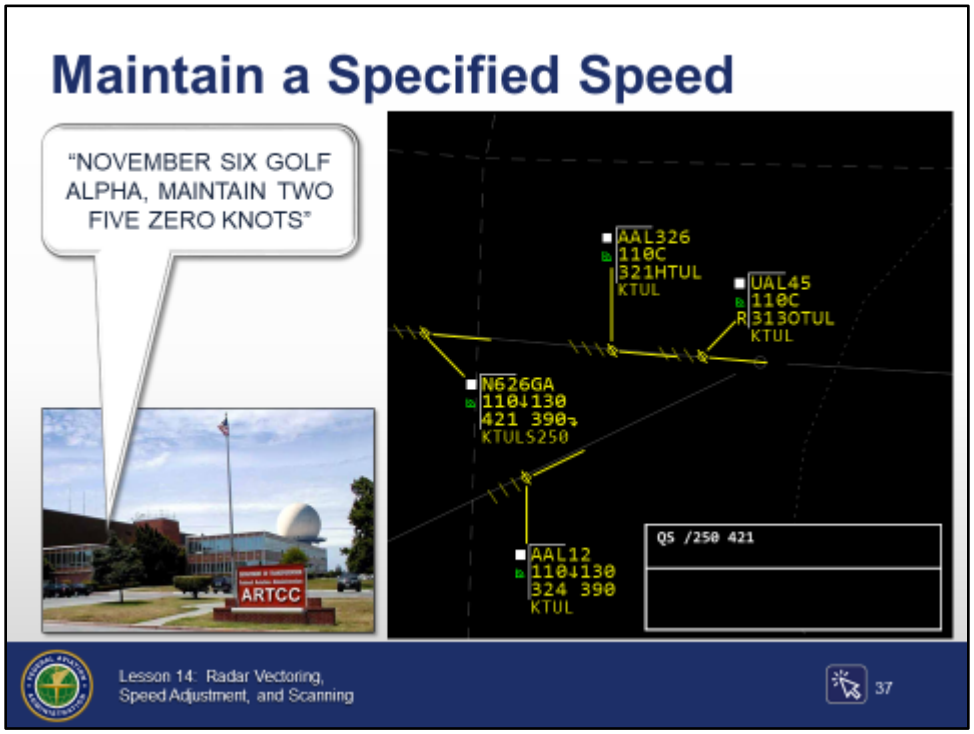
Mach 0.64 - "MACH POINT SIX FOUR"

Mach 0.82 - "MACH POINT EIGHT TWO"

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Maintain Specified Speed

JO 7110.65, par. 5-7-2



- Instruct aircraft to maintain present or specific speed

MAINTAIN PRESENT SPEED

MAINTAIN (specific speed) KNOTS

Example: "NOVEMBER SIX GOLF ALPHA, MAINTAIN TWO FIVE ZERO KNOTS"

Continued on next page

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Maintain Specified Speed (Cont'd)

JO 7110.65, par. 5-7-2

- Maintain specified speed or greater/less


MAINTAIN (specific speed) KNOTS OR GREATER/LESS

or


DO NOT EXCEED (speed) KNOTS

- Maintain the highest or lowest practical speed (used primarily for sequencing)


MAINTAIN MAXIMUM FORWARD SPEED

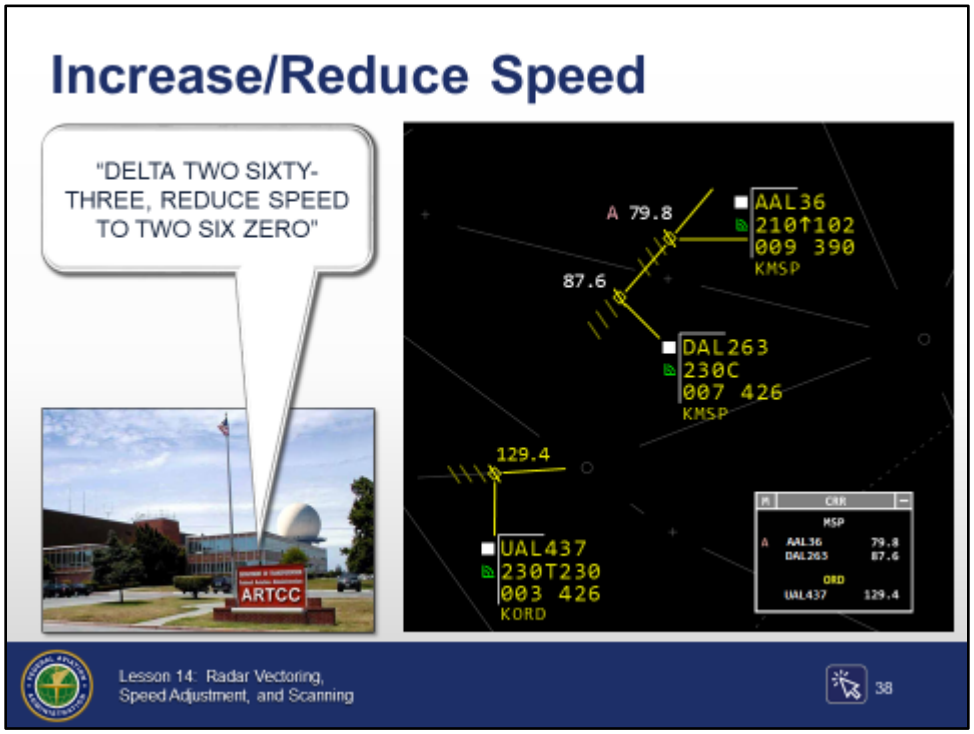
or


MAINTAIN SLOWEST PRACTICAL SPEED

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Increase/Reduce Speed

JO 7110.65, par. 5-7-2



- Increase or reduce to a specified speed or by a specified number of knots (spoken in group form)

INCREASE/REDUCE SPEED TO (specified speed in knots)

Examples: "AMERICAN THIRTY-SIX, INCREASE SPEED TO THREE ONE ZERO"

"DELTA TWO SIXTY-THREE, REDUCE SPEED TO TWO SIX ZERO"

or

Continued on next page

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Increase/Reduce Speed (Cont'd)

JO 7110.65, par. 5-7-2

INCREASE/REDUCE SPEED TO MACH (Mach number)

or

INCREASE/REDUCE SPEED (number of knots) KNOTS

⊙ At or above FL390

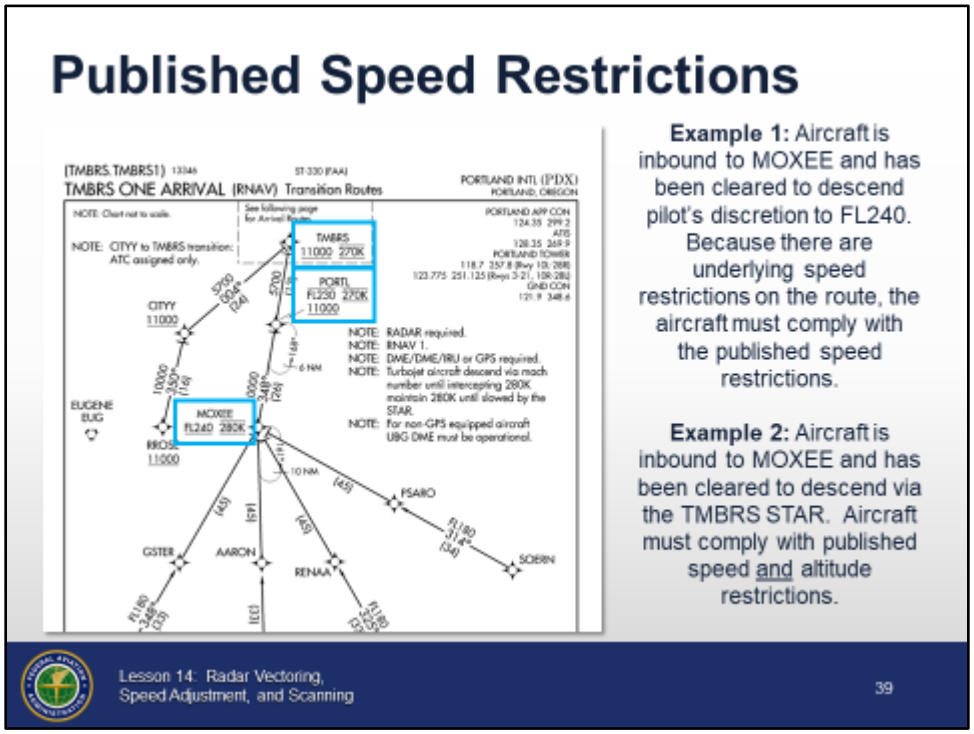
- Obtain pilot concurrence for a speed adjustment at or above FL390

(Speed adjustment), IF UNABLE ADVISE

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

Published Speed Restrictions

JO 7110.65, pars. 4-5-7, 5-7-2



- When cleared along a route or procedure that contains published speed restrictions, the pilot must comply with those speed restrictions independent of a climb via or descend via clearance
  - Due to variations of aircraft types, Flight Management Systems, and environmental conditions, you should anticipate that aircraft will begin speed adjustments at varying locations along cleared routes or procedures that contain published speed restrictions
  - Issuing speed adjustments to aircraft flying procedures with published speed restrictions may impact the pilot's ability to fly the intended flight profile of the procedure
  - Pilots must comply with speed restrictions on the SID or STAR unless canceled by ATC

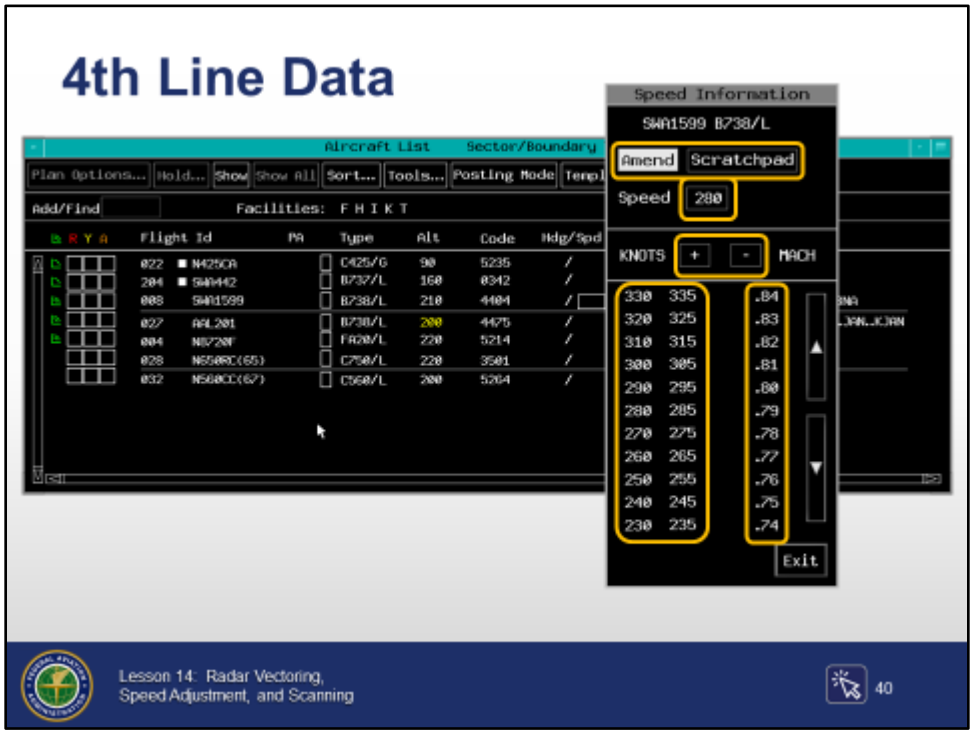
SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

4th Line Data

JO 7110.65, pars. 5-4-8, 5-4-10, 5-7-1, 13-1-8

TI 6110.101, sec. 5.2.11

ERAM ATCHI MISC 230.05, par. 3.8.55



- The 4th line of the FDB is used to non-verbally coordinate speed control information
  - Coordination format for assigned airspeeds is an "S", followed by a three-digit number
  - Coordination format for assigned a Mach number is an "M", followed by the two-digit assigned value
  - A plus "+" notation may be added to denote an assigned speed at or greater than the displayed value
  - A minus "-" notation may be added to denote an assigned speed at or less than the displayed value
- The EDST may also be used to enter 4th line data:
  - TBP an entry's speed field to open the Speed Information menu

Continued on next page

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

4th Line Data (Cont'd)

TI 6110.101, sec. 5.2.11

- Select Amend or Scratchpad

  NOTE: Scratchpad speeds displayed on EDST are not coordinated.
- Type a speed in the text box
- Increment/decrement the default speed with +/-
- Select a speed in knots or Mach number from the menu

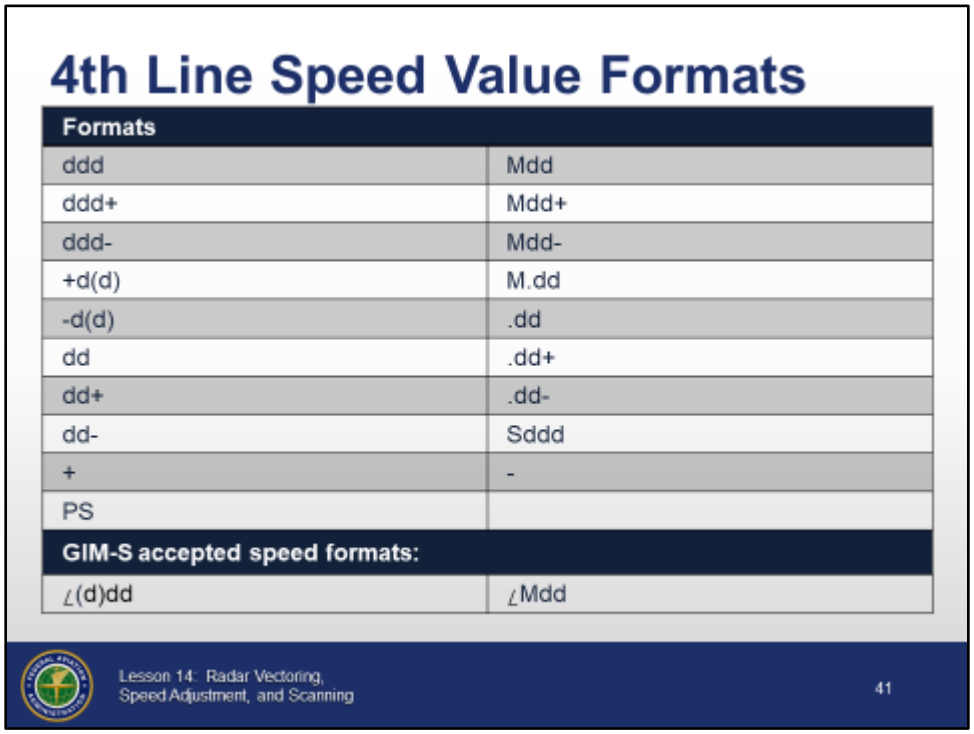
SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

4th Line Speed Formats

JO 7110.65, pars. 5-4-8, 5-4-10

TI 6110.101, sec. 13.2.2.1 and Table B-1

TI 6110.108



- The table lists 4th line speed formats that are allowed by automation
- Speed entry 4th Line:

  Syntax: QS /ddd <FLID> KBE
- Delete 4th Line Speed Info:

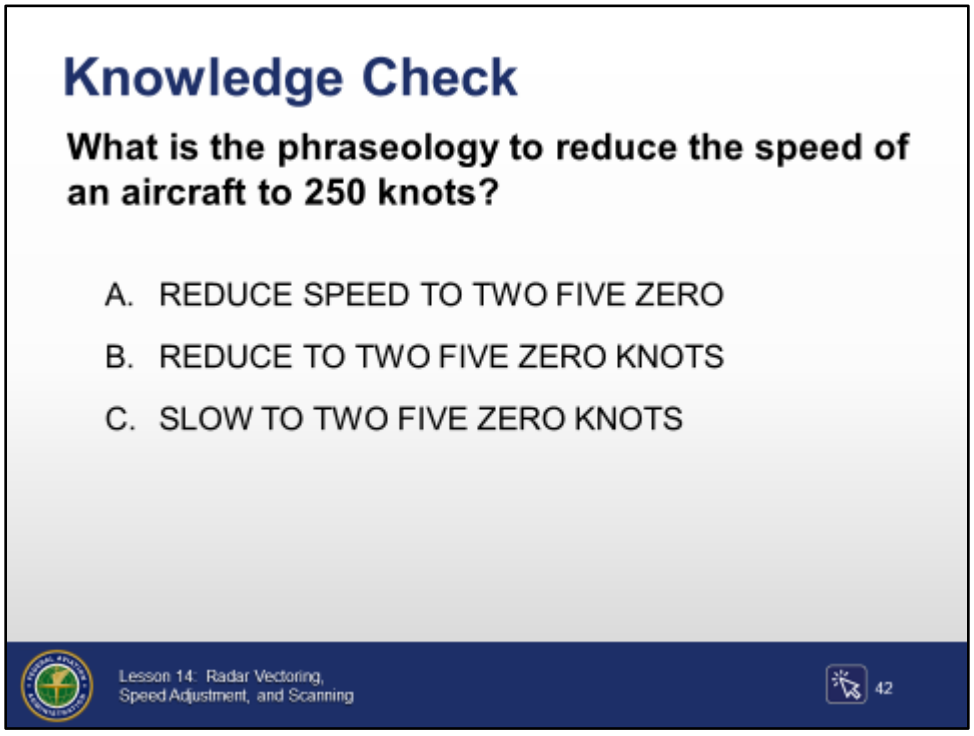
  Syntax: QS /✱ <FLID> KBE
- Hide or unhide 4th Line Info:

  Syntax: QS <FLID> KBE

  NOTE: When 4th line is hidden, it is indicated by the Heading/Speed/Free Form Text Indicator "↴" after speed in the FDB.

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

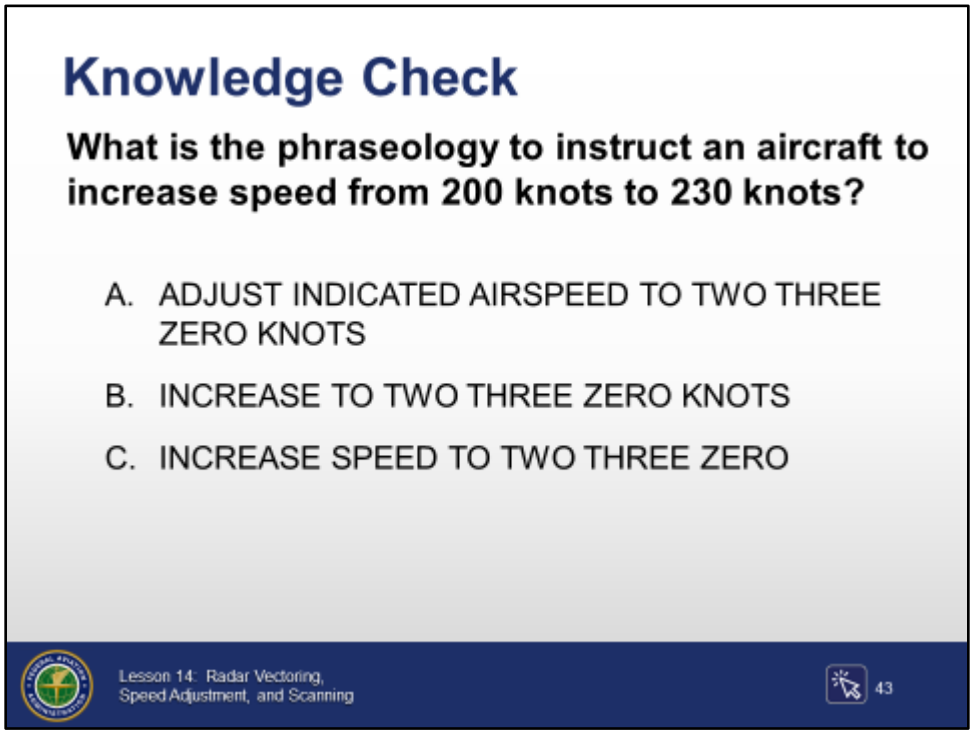
Knowledge Check



Question: What is the phraseology to reduce the speed of an aircraft to 250 knots?

SPEED ADJUSTMENT PROCEDURES *(CONT'D)*

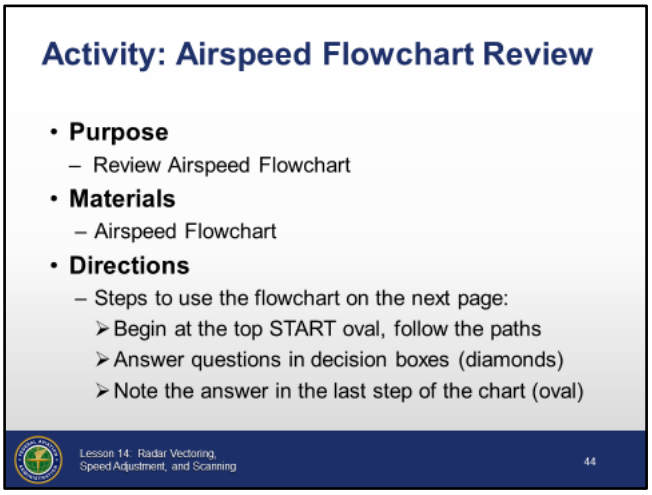
Knowledge Check



Question: What is the phraseology to instruct an aircraft to increase speed from 200 knots to 230 knots?

ACTIVITY: AIRSPEED FLOWCHART REVIEW

Activity: Airspeed Flowchart Review



Purpose

Review Airspeed Flowchart

Materials

⊙ Airspeed Flowchart

Directions

The flowchart on the next page represents a step-by-step process to determine the changes to true airspeed that occur as aircraft change altitude.

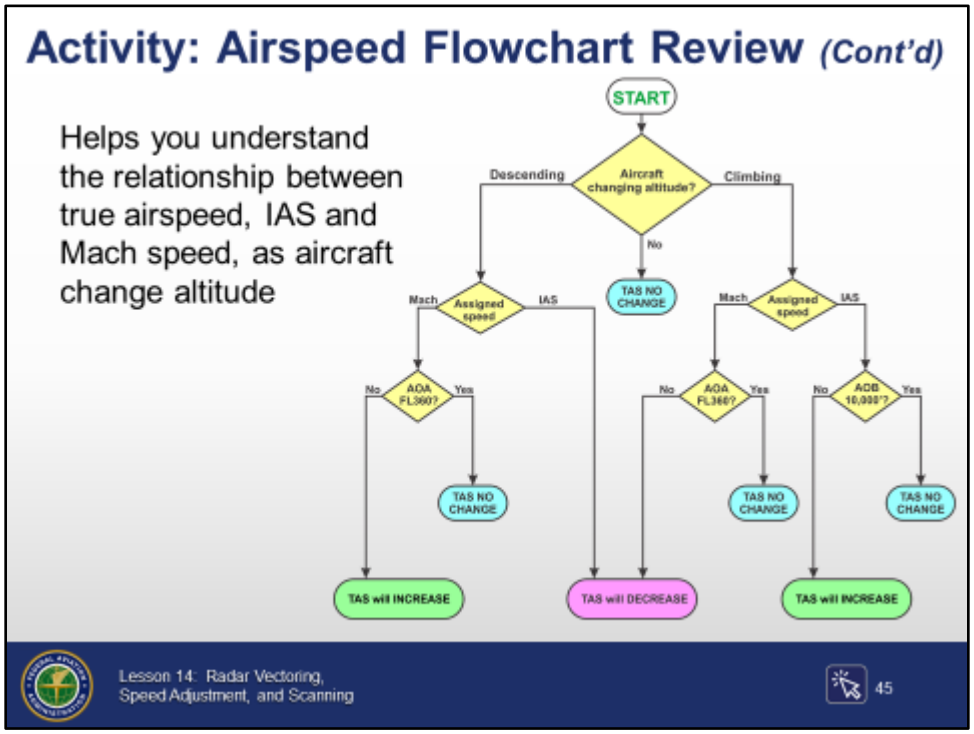
⊙ Steps to use the flowchart on the next page:

- Begin at the top START oval, follow the paths
- Answer questions in decision boxes (diamonds)
- Note the answer in the last step of the chart (oval)

⊙ Use the flowchart to help answer the situations on the following pages

ACTIVITY: AIRSPEED FLOWCHART REVIEW *(CONT'D)*

Activity: Airspeed Flowchart Review (Cont'd)



- True airspeed flowchart
  - Helps you understand the relationship between true airspeed, IAS, and Mach number as aircraft change altitude

Situation #1: A flight at FL290 is descending with an assigned Mach number speed restriction.

Question: Will true airspeed and ground speed change? If so, will it increase or decrease?

Continued on next page

ACTIVITY: AIRSPEED FLOWCHART REVIEW *(CONT'D)*

Activity: Airspeed Flowchart Review (Cont'd)

Situation #2: A flight at FL370 is climbing with an assigned Mach number speed restriction.

Question: Will true airspeed and ground speed change? If so, will it increase or decrease

Situation #3: A flight at 15,000' is climbing with an assigned IAS restriction.

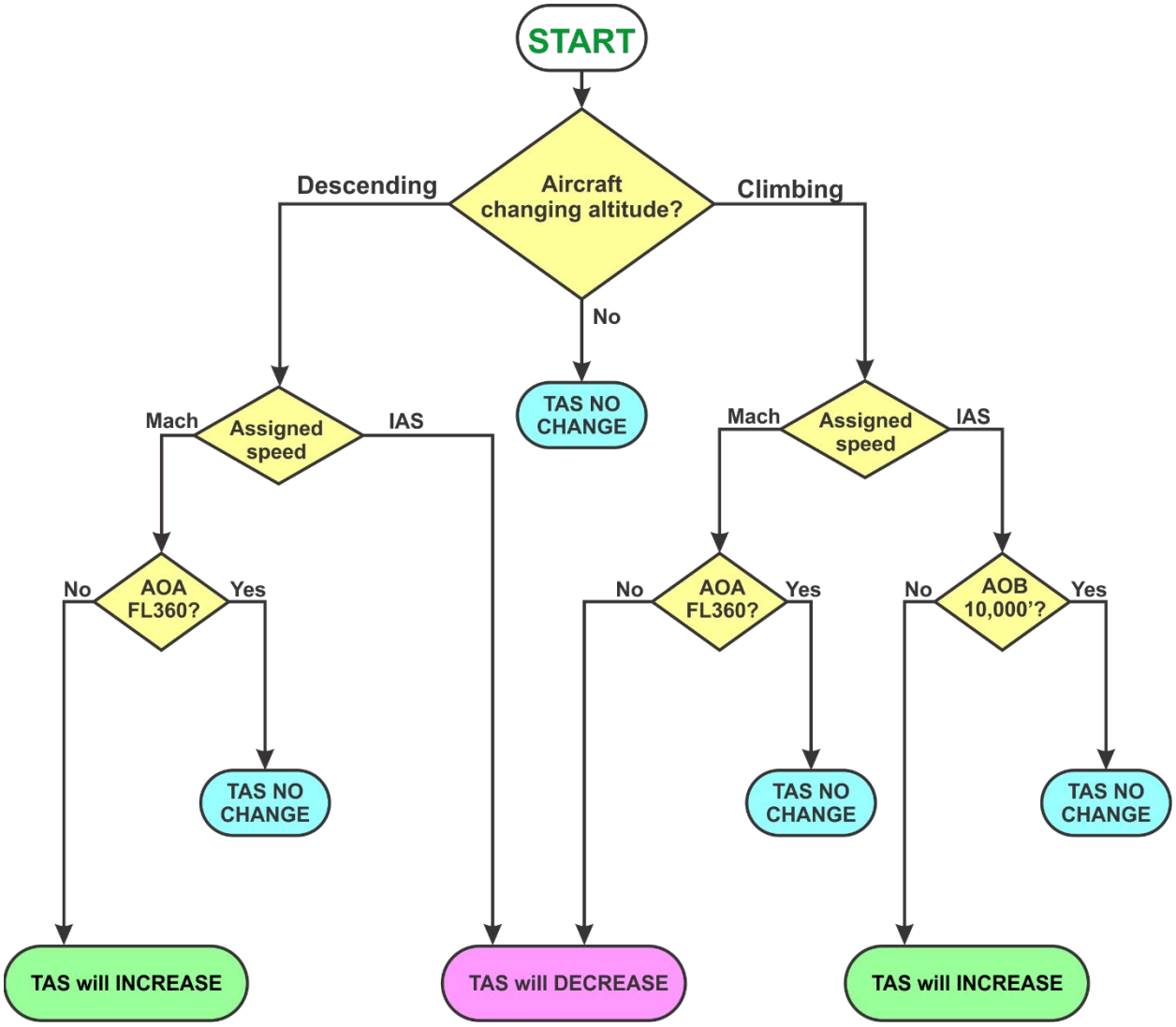
Question: Will true airspeed and ground speed change? If so, will it increase or decrease?

Situation #4: A flight at FL220 is descending with an assigned IAS restriction.

Question: Will true airspeed and ground speed change? If so, will it increase or decrease?

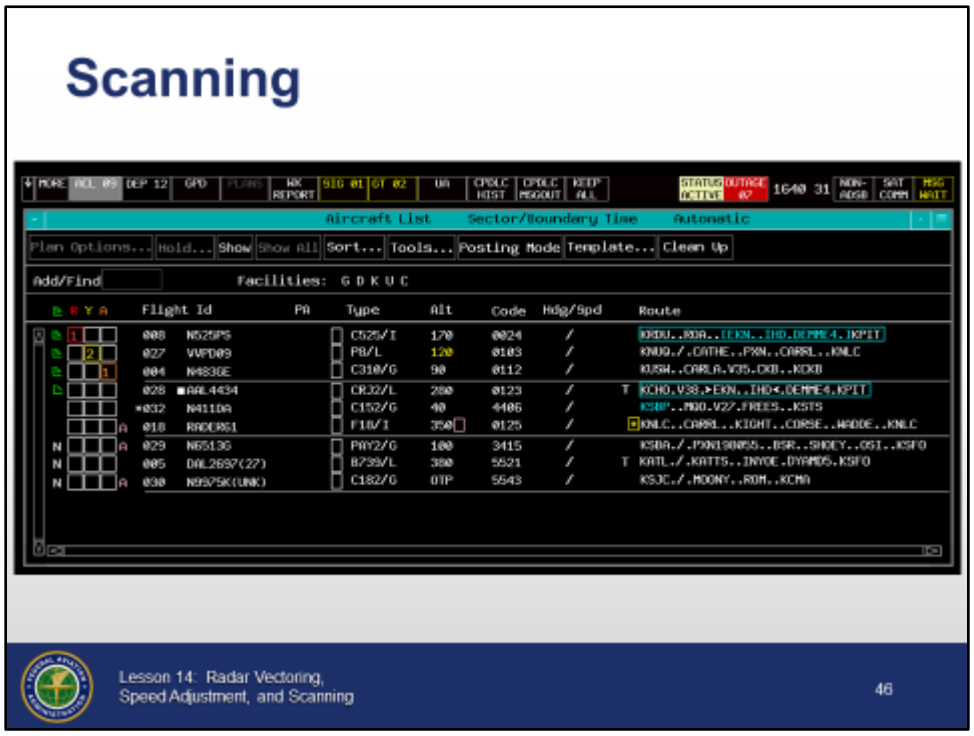
TRUE AIRSPEED FLOWCHART

This flowchart helps you understand the relationship between true airspeed, IAS and Mach number as aircraft change altitude.



SCANNING PROCEDURES

Introduction



- An efficient method of scanning allows effective correlation of data from multiple sources
- Develop a method of scanning that will allow you to make sound control decisions in a timely manner that will assist the radar controller

  NOTE: The method outlined in this lesson is only one possible technique for developing a scan, and is by no means the only way to accomplish this task. Each individual must find the process that works for him/her, and continually strive for increased awareness of all aspects of the events which take place at their sector.

  NOTE: Appendix B gives examples of the scanning process.

SCANNING PROCEDURES *(CONT'D)*

Sector Team Responsibilities

JO 7110.65, par. 2-10-1

SCANNING - To examine systematically in order to obtain data. Scanning allows you to determine if the sector is free of conflict and meets the objectives of a safe, orderly, and expeditious flow of traffic.

SECTOR - The area of control responsibility (delegated airspace) of the en route sector team and the team as a whole.

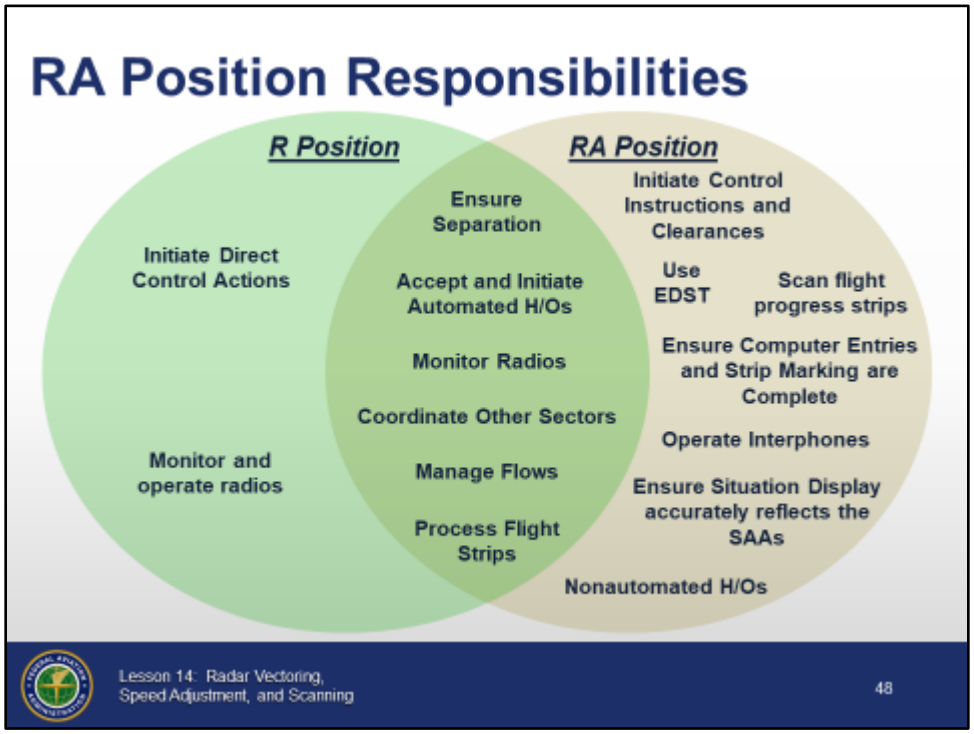
⊙ Team members

- Radar (R) Position
- Radar Associate (RA) Position
- Radar Coordinator (RC) Position
- Radar Flight Data (FD) Position
- Nonradar Position (NR)

NOTE: The RC Position, FD Position, and NR Position responsibilities are not covered in this lesson.

Radar Associate (RA) Position Responsibil-ities

JO 7110.65, par. 2-10-1



- RA responsibilities:
  - Ensure separation
  - Use EDST to plan, organize, and expedite the flow of traffic
  - Initiate control instructions and clearances
  - Operate interphones
  - Accept and initiate nonautomated handoffs
    - Ensure R Position is made aware of the actions
  - Assist the R Position by accepting or initiating automated handoffs, which are necessary for the continued smooth operation of the sector
    - Ensure that the R Position is made immediately aware of any action taken
  - Coordinate
    - Including point outs

Continued on next page

SCANNING PROCEDURES *(CONT'D)*

Radar Associate (RA) Position Responsibilities (Cont'd)

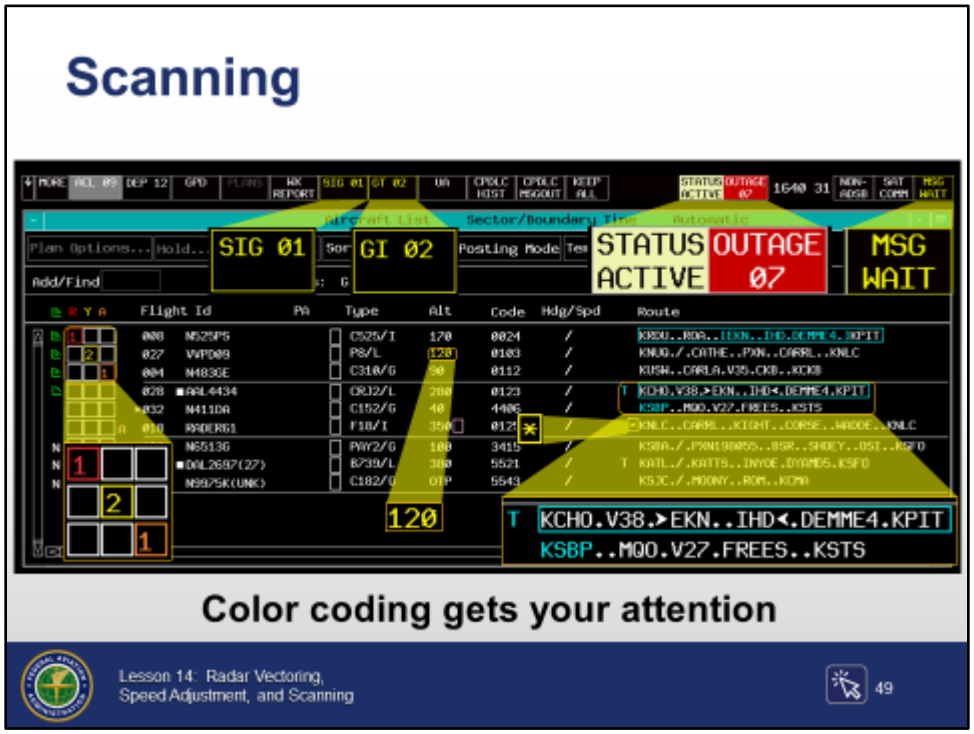
JO 7110.65, par. 2-10-1

- Monitor radios
  - When not performing higher priority duties
- Scan flight progress strips and/or EDST data
  - Correlate with radar data
- Manage flight progress strips and/or electronic flight data
- Ensure computer entries are completed on instructions issued or received
  - Enter instructions issued or received by the R Position when aware of those instructions
- Ensure strip marking and/or EDST data entries are completed on instructions issued or received
  - Record instructions issued or received by the R Position when aware of them
- Adjust equipment at RA Position to be usable by all members of the team
- Where authorized, perform EDST data entries to keep the activation status of designated EDST Airspace Configuration Elements current
- Ensure the Situation Display accurately reflects the status of all Special Activities Airspaces (SAAs)
- Scan your display for electronically distributed information, evaluate the information, and take action as appropriate

Scanning the EDST

JO 7110.65, pars. 2-10-1, 13-1-2 to 13-1-5, 13-1-9

TI 6110.101, sec. 2.1, 2.2



- Actively scan the EDST
  - EDST displays information pertaining to the system and specific flights
- Status colors emphasize new or amended information
  - Evaluate and take action as appropriate on all ACL alerts and other indications
- Prioritize the evaluation and resolution of alerts to ensure the safe, expeditious, and efficient flow of air traffic
- Scan for aircraft-to-aircraft and aircraft-to-airspace alerts
  - When a conflict probe alert is displayed, evaluate the alert and take appropriate action as early as practical, in accordance with duty priorities

Continued on next page

Scanning the EDST (Cont'd)

JO 7110.65, pars. 2-10-1, 13-1-2 to 13-1-5, 13-1-9

TI 6110.101, secs. 2.1, 2.2

- When sector priorities permit, consider the following in determining a solution:
  - Solutions that involve direct routing, altitude changes, inappropriate altitude for direction of flight, and/or removal of restrictions
  - Impact on surrounding sector traffic and complexity levels, flight efficiencies, and user preferences

⊙ When an ACL or DL entry has a Remarks indication, the Remarks field of the flight plan must be viewed

- Changes to the Remarks field must also be viewed

⊙ Inappropriate Altitude for Direction of Flight (IAFDOF) coding

- Must be acknowledged only after the appropriate action has been completed

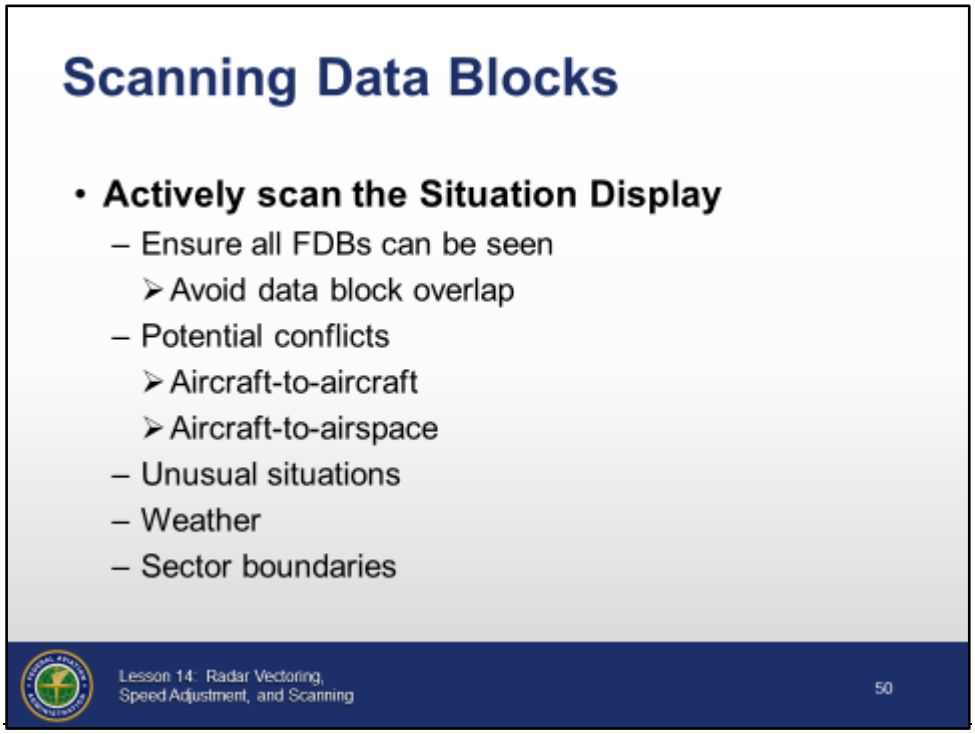
⊙ Scan for route notifications

- Embedded Route Text (ERT) coding
  - Issue and send or acknowledge the route prior to initiating a handoff
- Route Action Notifications (RAN)
  - ATC preferred routes must be amended at the first control position that displays the RAN, unless verbally coordinated or as specified in appropriate facility directives

Scanning Data Blocks

TI 6110.100, secs. 1.2.2, 4.3, 5-3-8

JO 7110.65, par. 2-10-1



⊙ Actively scan the Situation Display

- Ensure all FDBs can be seen
  - Avoid data block overlap
- Potential conflicts
  - Aircraft-to-aircraft
  - Aircraft-to-airspace
- Unusual situations
- Weather
- Sector boundaries

CONCLUSION

Lesson Summary

- Vectoring
  - Reasons for vectoring
  - Methods for vectoring
- Speed adjustment
  - Excessive speed adjustments
  - Techniques
  - Assignment restrictions
  - Issuing speed adjustment
  - Airspeed and Mach
  - Guidance for assigning Mach
  - Guidance for IAS use
  - Speed adjustment minima

Continued on next page

CONCLUSION *(CONT'D)*

Lesson Summary (Cont'd)

- Speed phraseology
- 4th line data
- 4th line Speed formats

⊙ Scanning

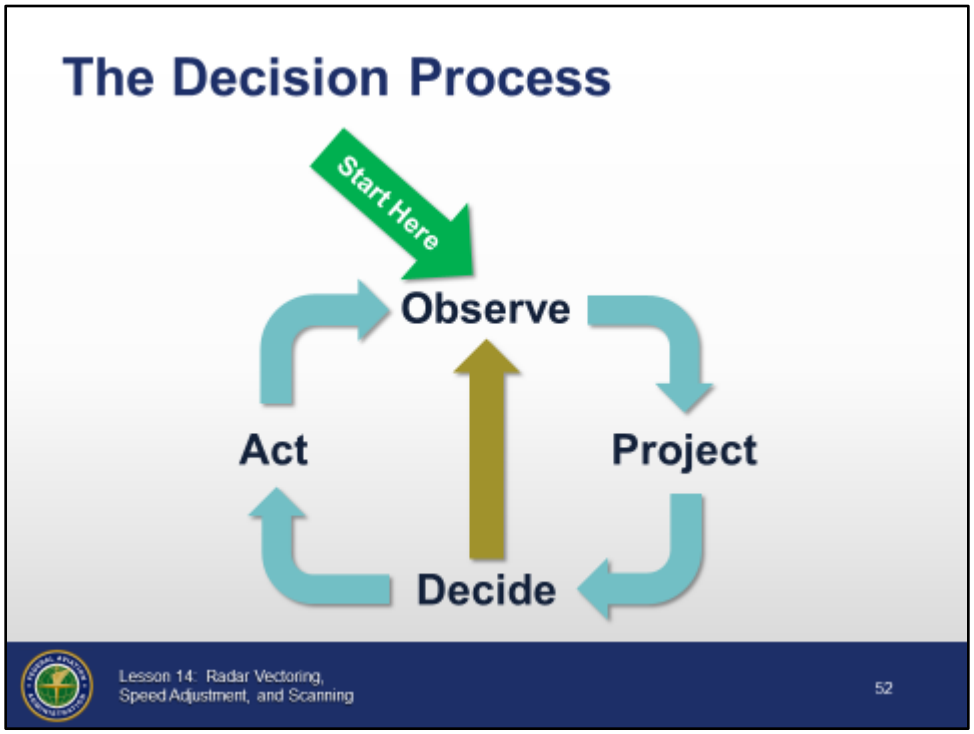
- Sector team responsibilities

⊙ End-of-Lesson Test

⊙ Scanning activity

SCANNING PROCEDURES

The Decision Process



NOTE: This appendix provides examples of how scanning process works.

- A decision process air traffic controllers can utilize:
  - Observe
    - Area of responsibility
  - Project
    - The future position and analyze data to form a current mental picture
  - Decide
    - What actions, if any, are necessary
  - Act
    - Intervene, issue a new or amended clearance
- Occasionally you will decide no action is necessary and the observation cycle begins again
- It may be necessary to amend a planned action in order to incorporate the new information noted during the observation phase

Continued on next page

SCANNING PROCEDURES *(CONT'D)*

Scanning the EDST

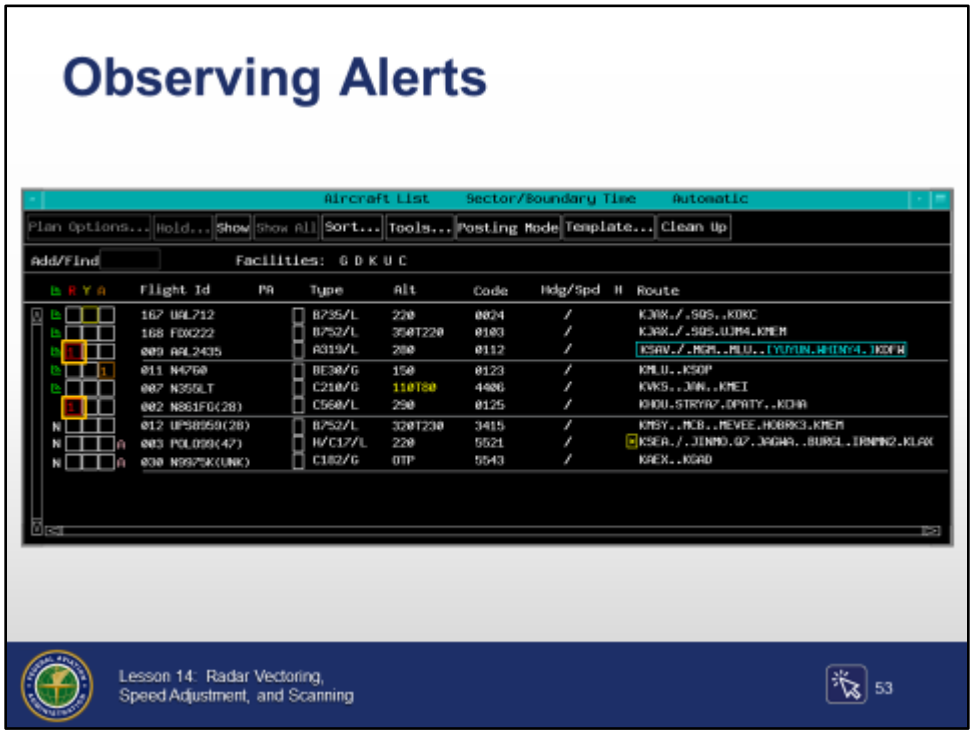
- The decision cycle is a loop
  - Use the current information to maintain awareness of the current and future situation
- For new entries mentally ask the following questions:
  - Who?
    - Flight call sign and type may require special handling
      - Air Force One
      - MEDEVAC
  - Where?
    - Route of flight
      - Is this the preferred route?
      - Incomplete route indicators: XXX, ???
    - Destination
      - Any traffic management programs?
  - What?
    - Any LOA/SOP requirements to be met?
- Flights can be mentally grouped into four categories:
  - Overflights
    - Aircraft passing through your sector that will not change altitude or route, unless requested by the pilot
  - Departures
    - Aircraft not yet at requested altitude
    - Consider any traffic that may impede a climb
    - Does the flight have a later restriction that makes the requested altitude impracticable?
  - Arrivals
    - Descend to meet LOA/SOP restrictions
    - Approach control services, if provided
      - Weather at destination
      - NAVAID status
      - Current NOTAMs
  - Special flights such as:
    - Air refueling
    - Photo or air sampling missions
    - Military training routes

SCANNING PROCEDURES *(CONT'D)*

Observing Alerts

JO 7110.65, par. 13-1-2

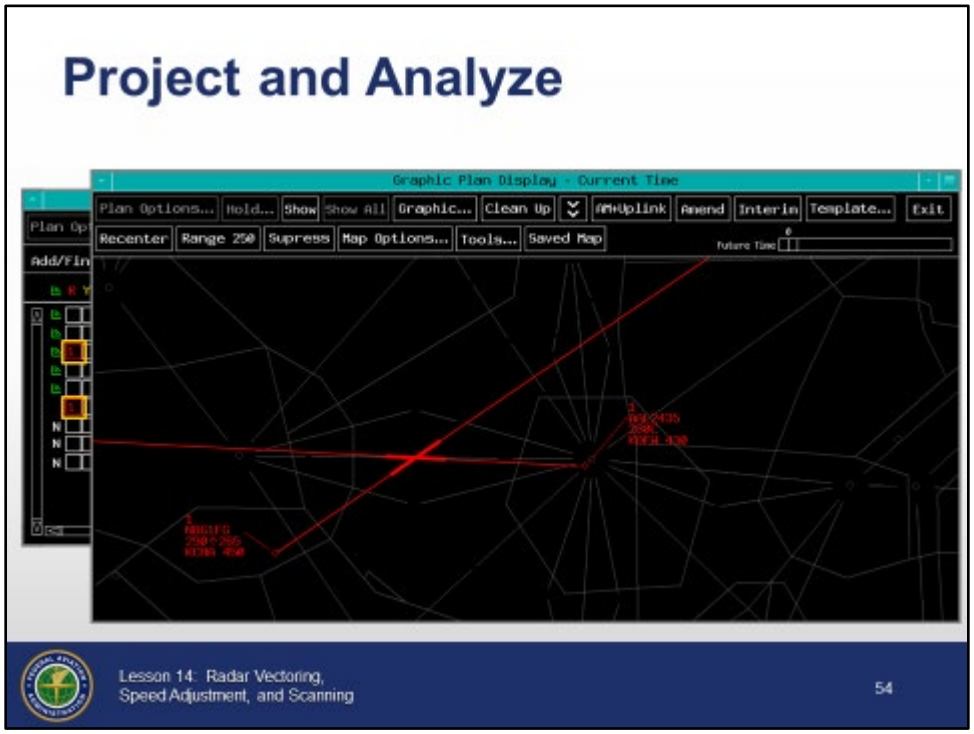
TI 6110.101, sec. 5.2.2



- When an alert is observed, investigate and evaluate
  - TBE on an alert box to Show All alerts of that type for the entry on the GPD

Project and Analyze

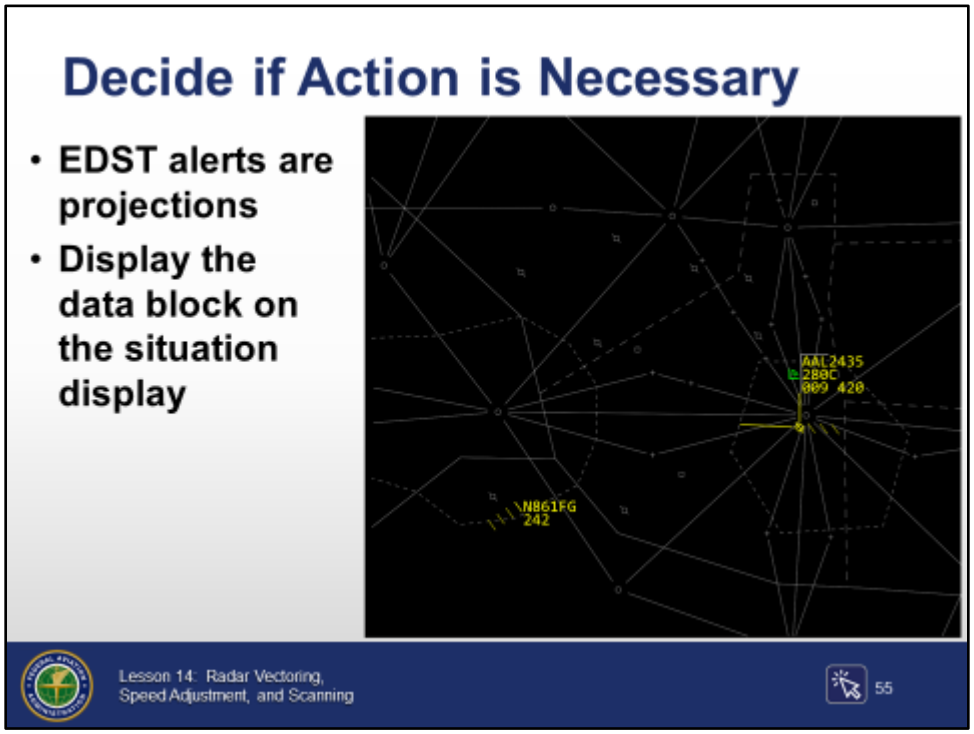
JO 7110.65, pars. 2-4-2, 2-10-1



- Project - Future Positions and Analyze
  - Alert planning
    - Meeting the objective of a safe, orderly, and expeditious flow of traffic
    - Will planned maneuvers make the alert invalid?
  - Potential conflict
    - What maneuvers are available to resolve conflict?
    - EDST Conflict Probe can be a helpful tool
    - Correlate EDST information with Situation Display and other resources

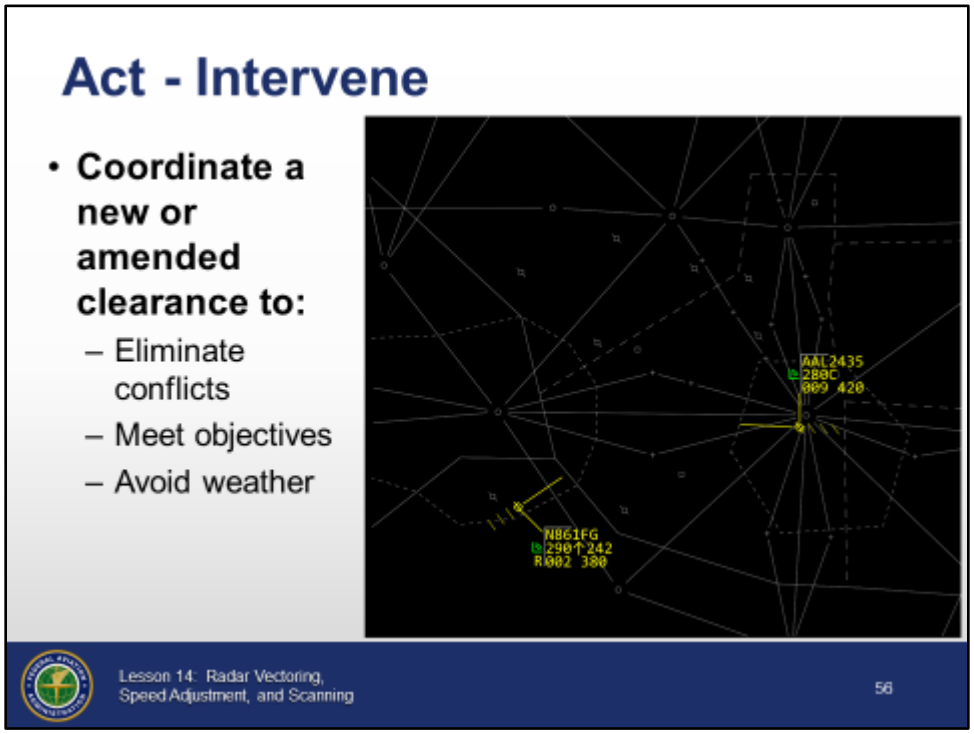
SCANNING PROCEDURES *(CONT'D)*

Decide if Action is Necessary



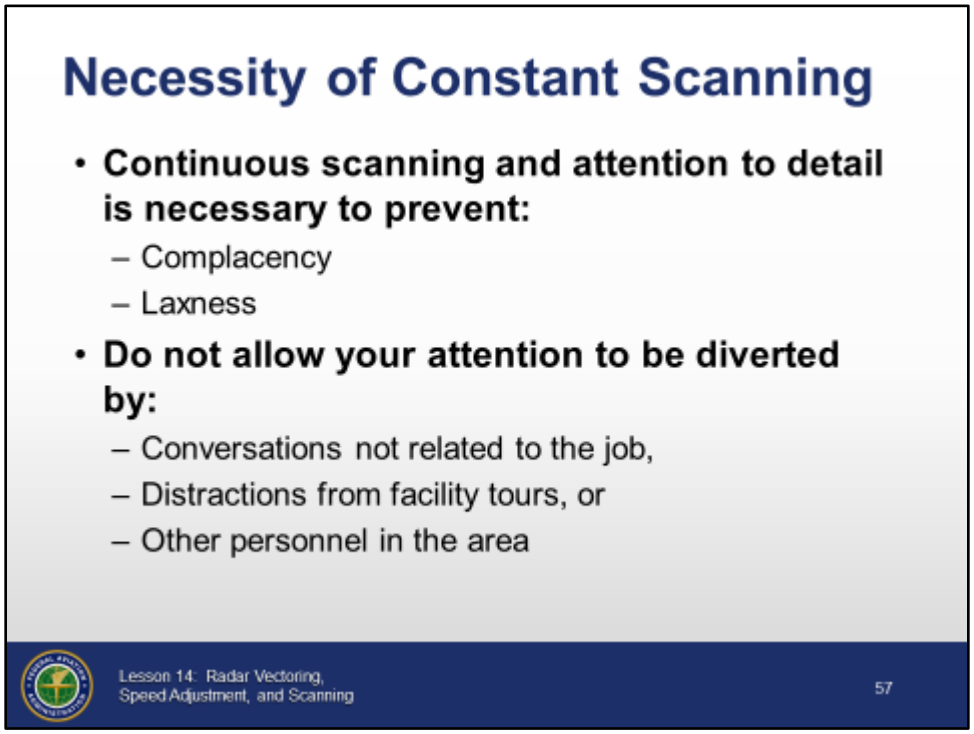
- Decide - What actions, if any, are necessary?
- EDST alerts are projections
- For dynamic traffic situations display the data block to check the targets actual position and altitude on the situation display
  - Ideal clearance solves both:
    - Separation problem - meeting established minima
    - Control problem - complying with LOA, SOP and TM initiatives

Act - Intervene



- Act - Intervene
  - Where necessary, coordinate a new or amended clearance to:
    - Eliminate conflicts
    - Meet objectives
    - Avoid weather

Necessity of Constant Scanning



- Continuous scanning and attention to detail is necessary to prevent:
  - Complacency
    - Lack of activity
  - Laxness
    - Treat each situation as unique
    - Traffic may be similar but it's up to you to determine what is different or unusual
- Do not allow your attention to be diverted by:
  - Conversations not related to the job
  - Distractions from facility tours
  - Other personnel in the area
- Be aware of situations that can cause your scan to break down:
  - Tunnel vision
    - Keep your scan moving
    - Make time to observe low activity areas

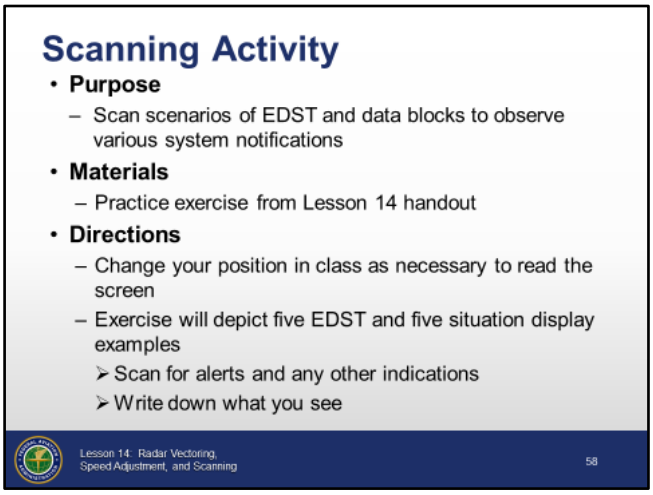
Continued on next page

SCANNING PROCEDURES *(CONT'D)*

Necessity of Constant Scanning (Cont'd)

- Shift focus from the Situation Display to the EDST
  - Inaccurate data
    - Address and correct any deficiencies
  - Update the EDST and flight strips promptly
  - Complete coordination in a timely manner

SCANNING ACTIVITY



Purpose

Scan slides of EDST and data blocks to observe various system notifications

Materials

Handout:

- Practice exercise from Lesson 14 handout

Directions

This exercise takes approximately 45 minutes to complete.

- Change your position in class as necessary to read the screen

Continued on next page

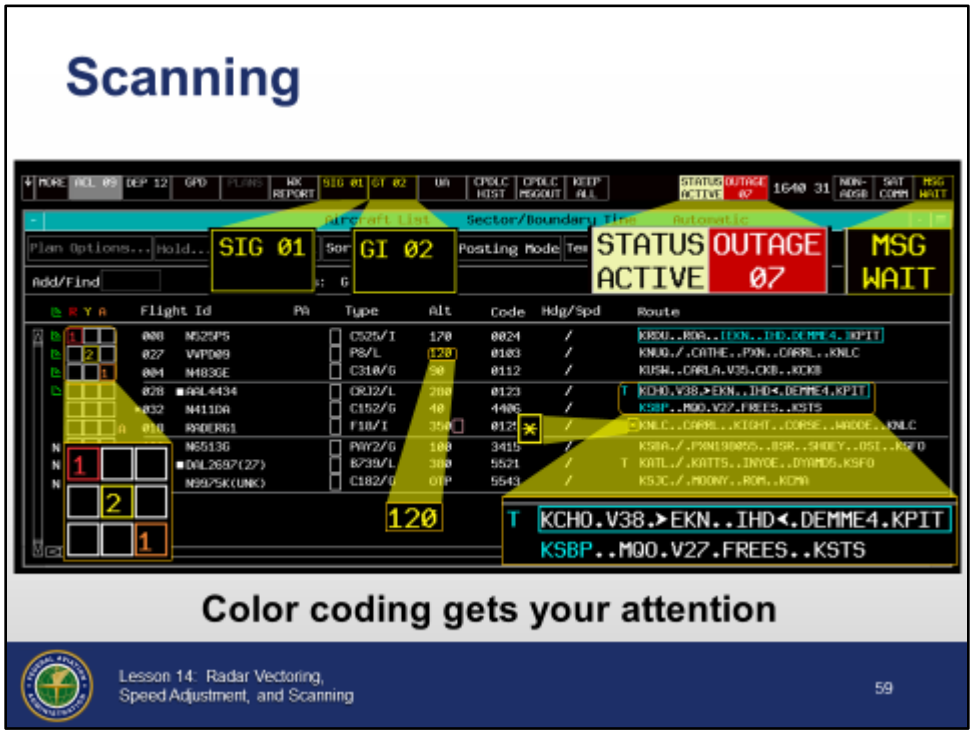
SCANNING ACTIVITY *(CONT'D)*

Directions (Cont'd)

- The exercise slides will depict five EDST and five situation display examples
  - Scan for alerts and any other indications that signify action may be necessary
  - Write down what you see, such as:
    - Alerts
    - New entry coding
    - Climb and descent
    - VCI status
    - IAFDOF
    - Route field indicators
    - Data block altitude and field E indicators
    - Position symbol status, etc.
  - Each slide has time limit
    - The first EDST scenario has a 2 minute, 30 second time limit
    - Situation display scenarios have a 1 minute, 30 second time limit
    - A countdown timer will appear when 20 seconds remains in each scenario
    - Record your observations before the timer expires

SCANNING ACTIVITY *(CONT'D)*

Example Slide



- Toolbar coding gets your attention with color changes
- Other ACL fields also use color to alert you to new or changing information

SCANNING ACTIVITY *(CONT'D)*

Scenario 1

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 2

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 3

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 4

- Use the space below for notes

Continued on next page

SCANNING ACTIVITY *(CONT'D)*

Scenario 4 (Cont'd)

- If needed, use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 5

- Use the space below for notes

Continued on next page

SCANNING ACTIVITY *(CONT'D)*

Scenario 5 (Cont'd)

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 6

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 7

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 8

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 9

- Use the space below for notes

SCANNING ACTIVITY *(CONT'D)*

Scenario 10

- Use the space below for notes