Federal Aviation Administration

Initial En Route Qualification Training

Instructor
Lesson 36
Radar Separation and Safety Alerts

Course 50148001

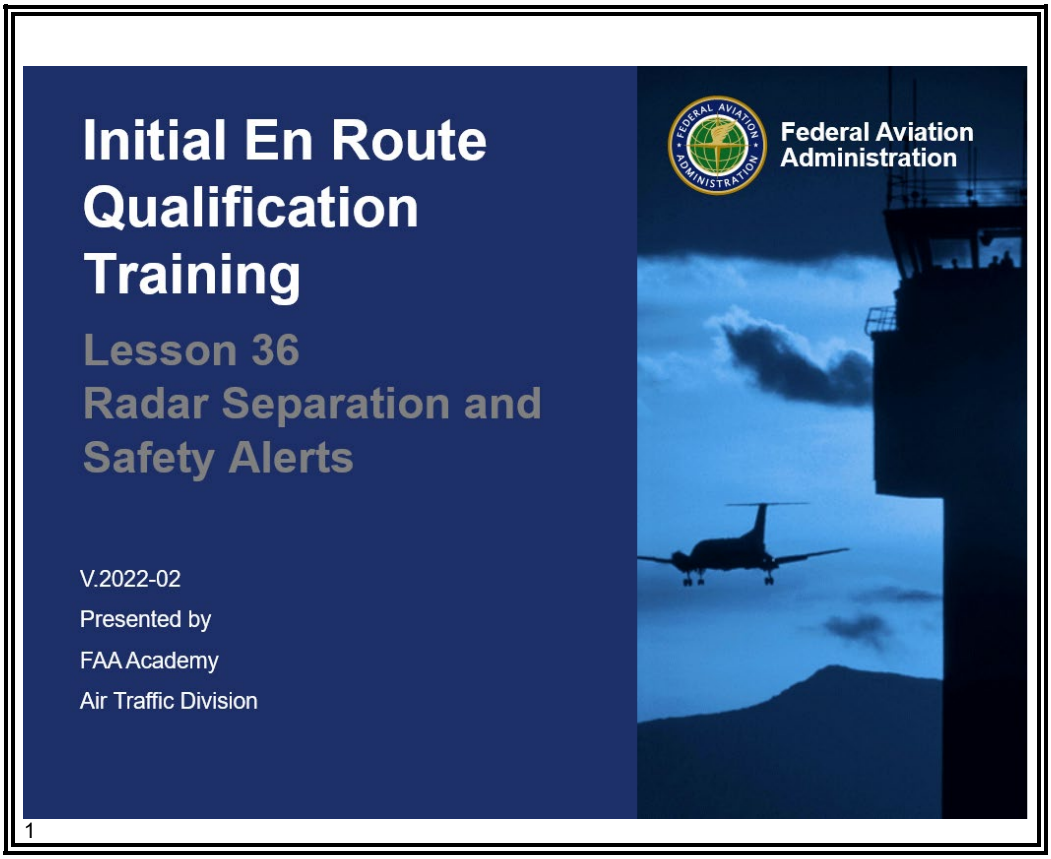
LESSON PLAN DATA SHEET

COURSE NAME:	INITIAL EN ROUTE QUALIFICATION TRAINING
COURSE NUMBER:	50148001
LESSON TITLE:	RADAR SEPARATION AND SAFETY ALERTS
DURATION:	2+30 HOUR(S)
DATE REVISED:	2022-02
VERSION:	V.2022-02
REFERENCE(S):	FAA ORDER JO 7110.65, AIR TRAFFIC CONTROL; FEDERAL AVIATION REGULATIONS (FAR), PART 91.215; FAA ORDER JO 7110.311C, PROCEDURAL GUIDANCE FOR FAA ORDER JO 7110.65 FOLLOWING EN ROUTE AUTOMATION MODERNIZATION (ERAM) IMPLEMENTATION
HANDOUT(S):	NONE
EXERCISE(S)/ ACTIVITY(S):	DETERMINING MINIMUM SEPARATION EXERCISE
END-OF-LESSON TEST:	YES *(REFER TO ELT36.PDF)*
PERFORMANCE TEST:	NONE
MATERIALS:	NONE
OTHER PERTINENT INFORMATION:	NONE

☞ ***NOTE:*** *As you prepare for this lesson, recall and be prepared to talk about examples and personal experiences that illustrate or explain the teaching points in the lesson.*

INTRODUCTION

Gain Attention



Earlier in the course, you learned nonradar separation rules and procedures, and applied those rules and procedures during nonradar scenarios. This lesson will cover the separation standards used in a radar environment.

INTRODUCTION *(Continued)*

Opening Scenario

Your primary task as an air traffic controller is to separate aircraft and provide safety alerts. As a member of a radar team, even a radar associate controller can be held responsible for a loss of separation. In order to perform these tasks while providing a safe and expeditious flow of traffic, you **must** first know the separation requirements.

Purpose

This lesson covers the minimum radar separation required between aircraft, between aircraft and the boundary of adjacent radar or nonradar controlled airspace, and between aircraft and obstructions.

It also covers the issuance of safety alerts, the Conflict Alert feature, and procedures for altitude verification and visual separation.

INTRODUCTION *(Continued)*

Lesson Objectives

LESSON OBJECTIVES

- On an End-of-Lesson Test and in accordance with FAA Order JO 7110.65, you will identify:
  - Radar separation procedures and minima
  - Safety alert procedures
  - Conflict Alert procedures
  - Mode C validation conditions

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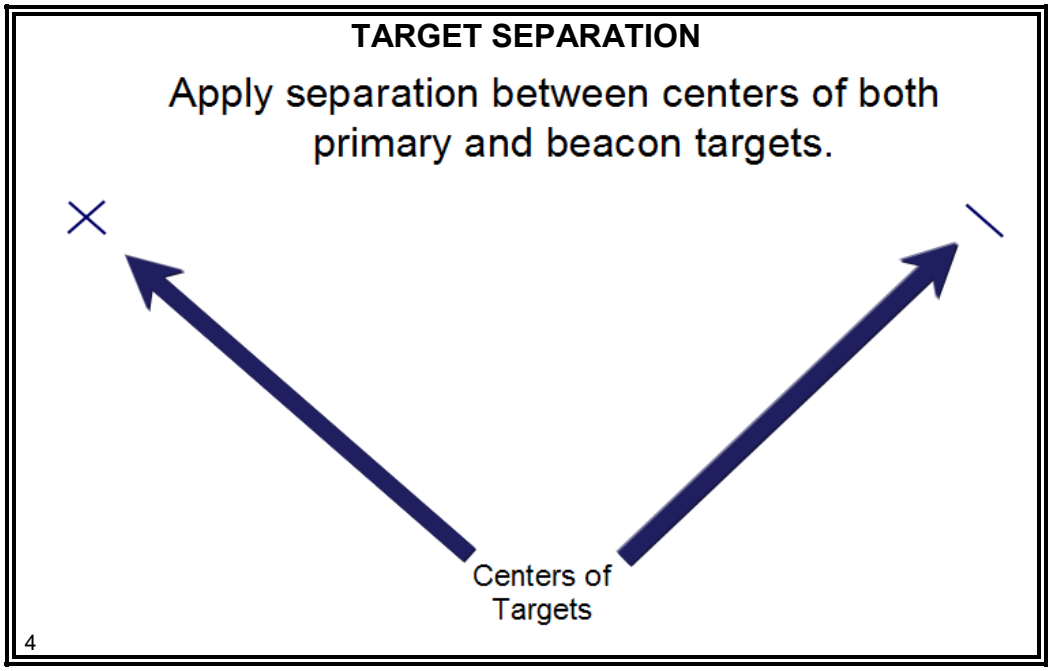
☞ ***NOTE:*** *Teach from graphic.*

RADAR SEPARATION

Target Separation
JO 7110.65, par. 5-5-2



- Separation is applied between the centers of targets.

Rules
JO 7110.65, pars. 5-5-1, 5-14-7;
JO 7110.311C, par. 5-14-7

- Radar separation **shall** be applied to all RNAV aircraft on a random route at or below FL450.

NOTE: This rule may apply, for example, in circumstances of radar outages. In such a case, aircraft would be put on other than random routes.

- Radar separation may be applied between:
  - Radar-identified aircraft
- Do **not** use information in data blocks displaying “CST” or “FRZN” in the application of either radar or non-radar separation.

NOTE: Coast track has **no** target and represents an approximate position **only**.

RADAR SEPARATION *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What part of a target shall be used as a reference point for separation?

5

☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *The center*

KNOWLEDGE CHECK

QUESTION: Radar separation **shall** be applied to all RNAV aircraft operating at or below what altitude?

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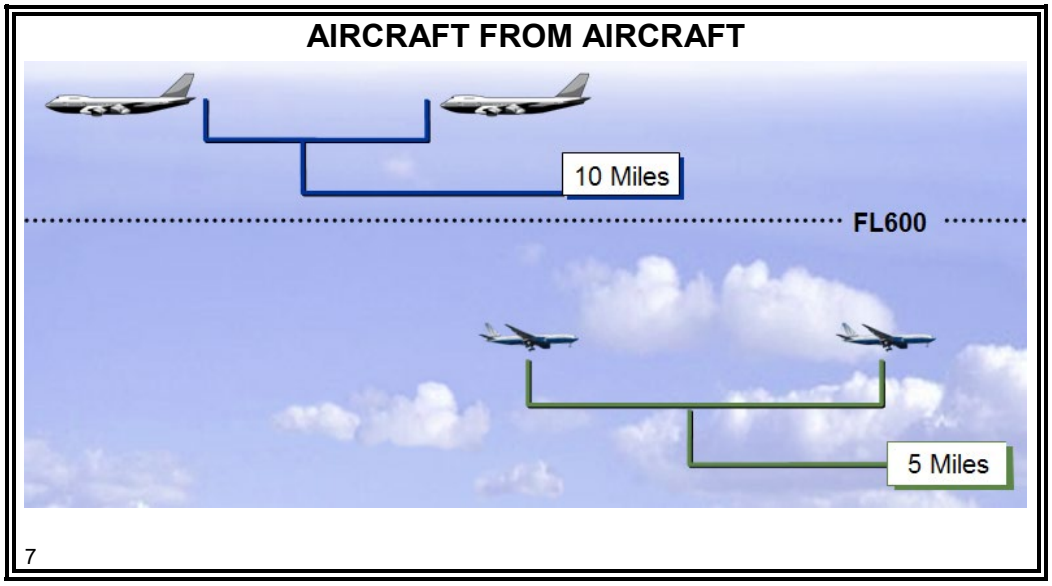
☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *FL450*

RADAR SEPARATION *(Continued)*

Minima - Aircraft from Aircraft
JO 7110.65, par. 5-5-4



- Separate an aircraft from another aircraft:
  - At or above FL600 - 10 miles
  - Below FL600 - 5 miles
  - Up to and including FL230 and within 40 miles of the antenna - 3 miles if specified in a facility directive
    - The controller would have been briefed about where this can be applied
  - When transitioning from terminal to en route – 3 miles increasing to 5 miles or greater, provided:
    - Aircraft are diverging or lead aircraft is faster
    - Separation is constant or increasing
    - 5 miles or other appropriate separation is obtained within the first center sector
    - Procedure is covered by a Letter of Agreement and limited to specific routes and/or sector positions

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RADAR SEPARATION *(Continued)*

Minima - Aircraft from Aircraft (Cont'd)
JO 7110.65, par.
2-4-14, 5-5-4, 7-2-1

- Super separation standards
  - Behind a Super – 5 miles
  - When a Super is operating at or below 250 KIAS and below FL240:
    - → Heavy — 6 miles
    - → Large — 7 miles
    - → Small — 8 miles
  - Visual separation rules specified in JO 7110.65, Chapter 7, Section 2, **shall not** be applied with respect to a Super.
- Include the expression “SUPER” immediately after the aircraft call sign in communications with a terminal facility about Super operations when communicating with/about a Super with regard to an airport where the en route center is providing approach control service, and when issuing traffic advisories regarding a Super.

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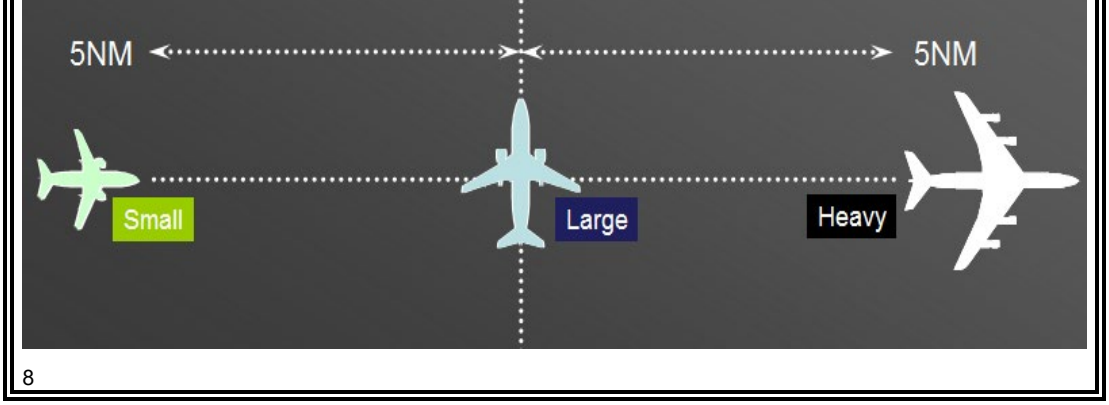
RADAR SEPARATION *(Continued)*

Minima - Aircraft from Aircraft (Cont'd)
JO 7110.65, par. 5-5-4



- Wake turbulence
  - Separate an aircraft operating directly behind and less than 1,000 feet below, or following an aircraft conducting an instrument approach by:
    - → 4 miles - heavy behind a heavy
    - → 4 miles - large/heavy behind a B757
    - → 5 miles - small behind a B757
    - → 5 miles - small/large behind a heavy

NOTE: In instances where 3 miles separation is available, wake turbulence separation standards **shall** take precedence.

RADAR SEPARATION *(Continued)*

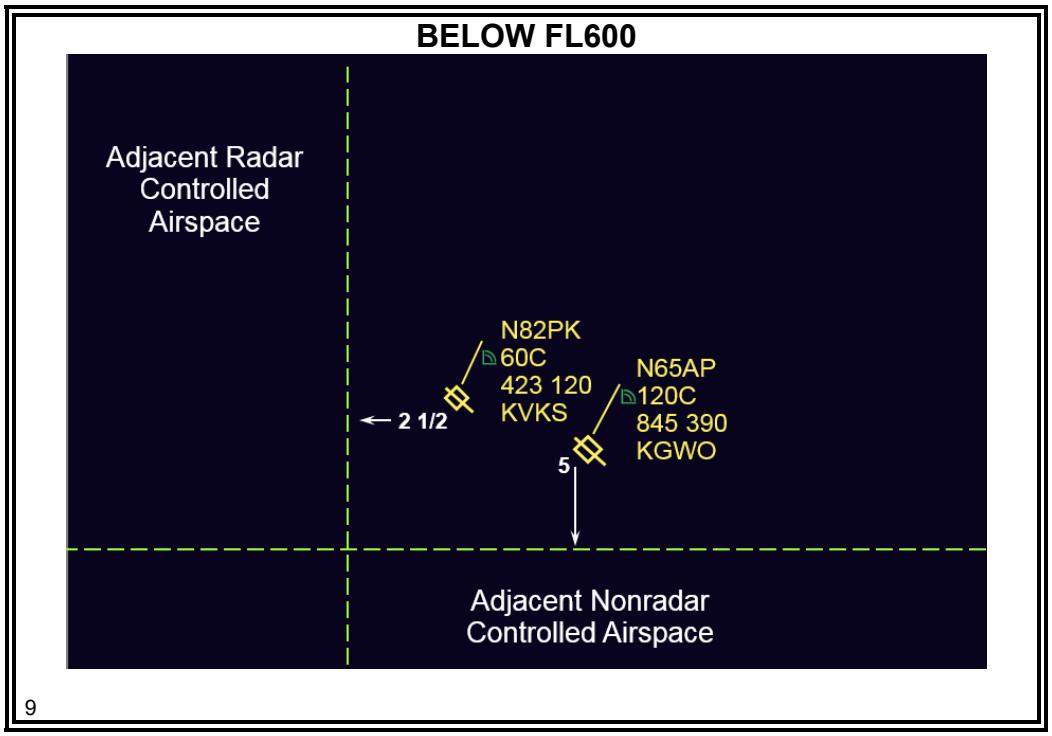
Minima - Aircraft from Obstructions
JO 7110.65, par. 5-5-9

⊙ Separate aircraft from obstructions by:

- 5 miles

☞ ***NOTE:*** *Explain altitude options as opposed to 5 miles radar separation from obstructions. MIAs, MEAs, and MOCAs can also be used to provide obstruction clearance.*

Minima - Aircraft from Adjacent Airspace
JO 7110.65, par. 5-5-10



⊙ Separate aircraft from adjacent airspace:

- Below FL600
  - Adjacent radar controlled airspace - 2½ miles
  - Adjacent nonradar controlled airspace - 5 miles

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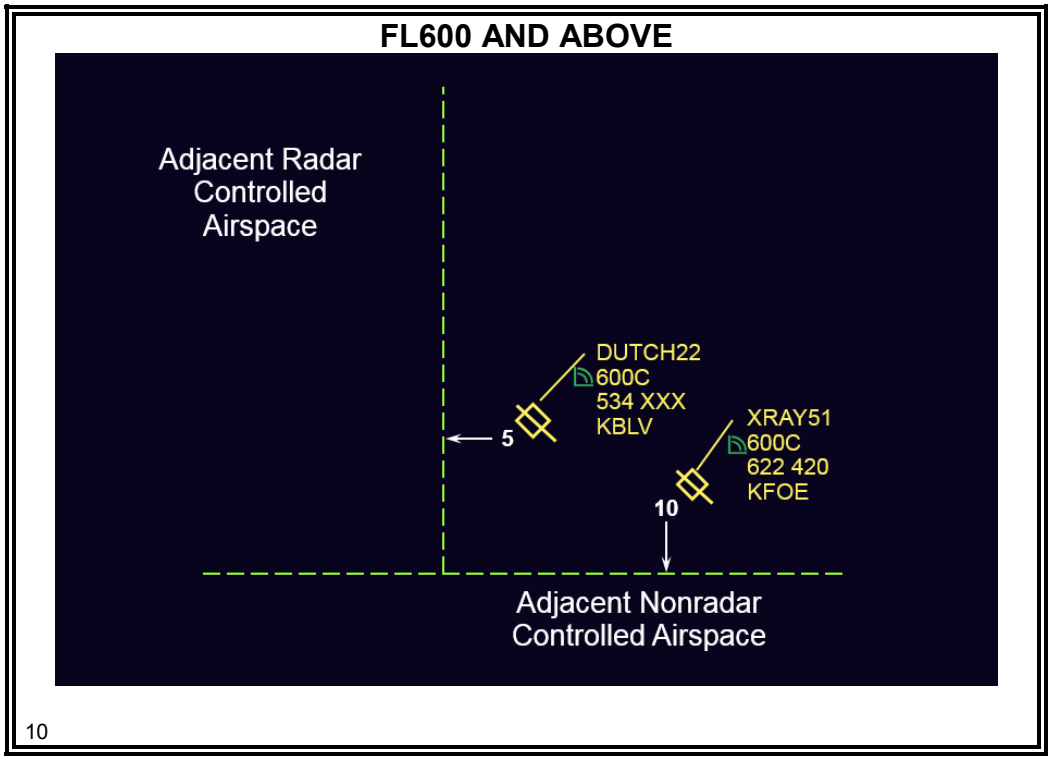
RADAR SEPARATION *(Continued)*

Minima - Aircraft from Adjacent Airspace (Cont'd)
JO 7110.65, par. 5-5-10



- FL600 and above
  - Adjacent radar controlled airspace - 5 miles
  - Adjacent nonradar controlled airspace - 10 miles

RADAR SEPARATION *(Continued)*

Minima - Aircraft from SUA/ATCAA
JO 7110.65, par. 9-3-2

☞ ***NOTE:*** *Special Use Airspace includes: Prohibited/Restricted/Warning Areas and Military Operations Area (MOA). This will be covered in detail in the Military Operations lesson.*

⊙ Separate aircraft from Special Use Airspace (SUA) and Air Traffic Control Assigned Airspace (ATCAA):

- Involving aircraft operations
  - Lateral
    - → Below FL600 - 3 miles
    - → FL600 and above - 6 miles
  - Vertical (above/below)
    - → FL290 and below - 500 feet
    - → Above FL290 - 1,000 feet
- Where identified by facility management as established for security reasons or to contain hazardous activities **not** involving aircraft operations
  - The above lateral minima for these Prohibited/Restricted areas do **not** apply
  - Vector aircraft to avoid airspace

☞ ***NOTE:*** *Clearances of nonparticipating aircraft in/through/adjacent to the area may be provided for in a Letter of Agreement/facility directive and negate this separation minima.*

⊙ If the pilot of the nonparticipating aircraft exercises their discretion to deviate from a clearance and the aircraft's track will not maintain the required minima from the SUA, the controller must ascertain if the pilot is exercising emergency authority.

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RADAR SEPARATION *(Continued)*

Minima - Aircraft from SUA/ATCAA (Cont'd)
7110.65, par. 2-1-27

- If so, the controller should provide assistance and obtain the necessary information (which you will learn later in the Emergencies lesson).
- If not, the controller should provide appropriate pilot deviation notification
- Additionally, the controller must attempt to:
  - Hand off the aircraft to the Using agency and transfer communications or
  - Point out the aircraft to the Using agency
  - Continue to provide safety alerts and traffic advisories as appropriate.
  - Continue to coordinate with the Using agency until the situation is resolved
  - Assist the aircraft in exiting the SUA
- If the handoff or point out is unsuccessful, the controller must advise the Using agency of the pilot's actions, if able.

RADAR SEPARATION *(Continued)*

Minima - Formation Flights
JO 7110.65, par. 5-5-8

⊙ Separation for formation flights

- Aircraft from a standard formation flight
  - – Add 1 mile to appropriate radar minima
- Two standard formation flights from each other
  - – Add 2 miles to the appropriate radar minima
- Aircraft from a nonstandard formation flight
  - – Apply appropriate minima to the perimeter of the airspace encompassing the nonstandard formation or from the outermost aircraft
  - – If necessary, assign appropriate beacon code to each aircraft in the formation or to the first and last aircraft in trail

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What is the minimum lateral radar separation between two aircraft at FL210?

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☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *5 miles*

KNOWLEDGE CHECK

QUESTION: What is the minimum lateral separation between an aircraft at 160 and a Military Operations Area (MOA)?

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☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *3 miles*

EXERCISE: DETERMINING MINIMUM SEPARATION

Exercise

DETERMINING MINIMUM SEPARATION EXERCISE

Purpose: to practice determining minimum separation

Directions: answer the corresponding questions

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Directions

Answer questions 1 through 5 using the graphic that precedes the question(s). Write your answers on the lines provided.

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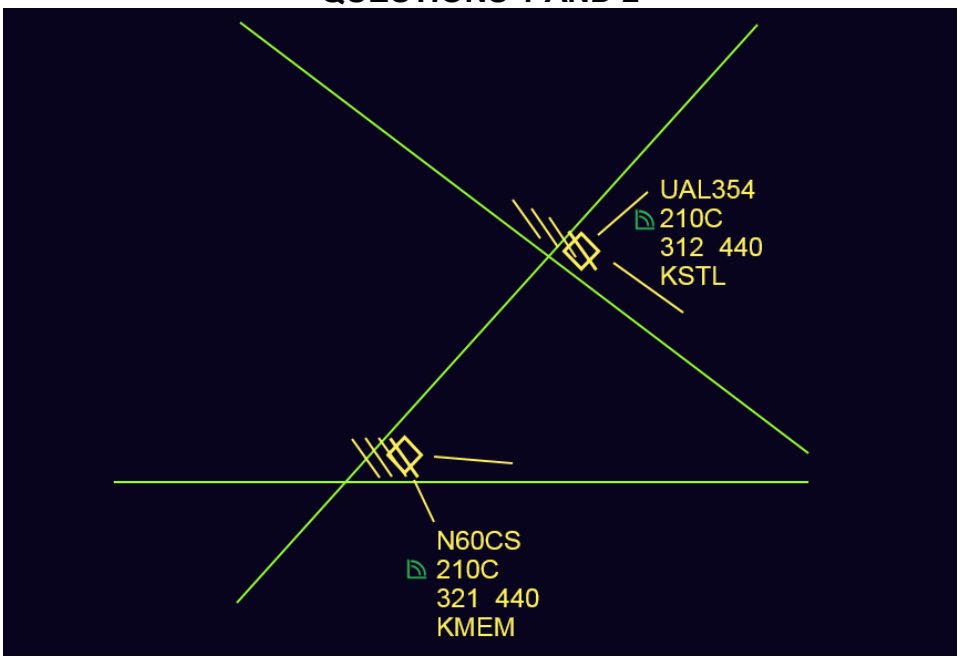
EXERCISE: DETERMINING MINIMUM SEPARATION
(Continued)

Questions

QUESTIONS 1 AND 2



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1. What is the minimum radar separation required between UAL354 and N60CS?

   ANSWER: *5 miles*

2. Would the distance of these aircraft from the radar antenna have any bearing on the required minimum separation?

   ANSWER: *Yes. If aircraft are within 40 miles of the antenna and below FL230, facility directives may specify 3 miles.*

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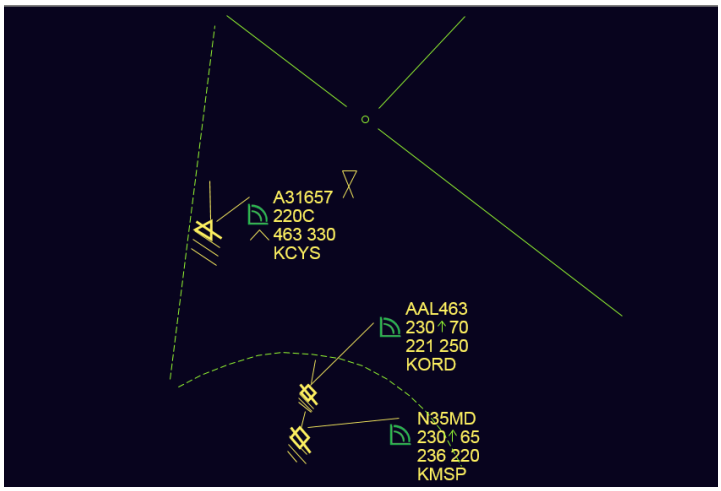
EXERCISE: DETERMINING MINIMUM SEPARATION
(Continued)

Questions (Cont'd)

QUESTIONS 3-5



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3. AAL463 and N35MD are being handed off to an ARTCC from approach control. The distance between these two aircraft is **only** 3½ miles. Is this less than minimum separation? Explain your answer.

ANSWER: *No. Both aircraft are in approach control airspace where separation minima is 3 miles. If covered in an LOA, when transitioning from terminal to en route, 3 miles increasing to 5 miles is sufficient if:*

- *AAL463 is faster than N35MD.*
- *First center sector will establish standard separation.*

4. The minimum altitude that will provide vertical separation above the obstruction depicted is 10,500 feet. What is the minimum distance required to provide lateral radar separation from the obstruction?

ANSWER: *5 miles*

5. A31657 is on a radar vector. What is the minimum distance the aircraft can be vectored to the radar-controlled airspace boundary depicted along the left edge of the display?

ANSWER: *2½ miles. Radar separation from radar controlled airspace below FL600 is 2½ miles.*

SAFETY ALERTS

Duty Priority
JO 7110.65, pars. 2-1-2, 2-1-6, 5-14-1;
JO 7110.311C, par. 5-14-1

⊙ Give equal priority to issuing safety alerts and separating aircraft.

- Perform the action most critical from a safety standpoint

⊙ Once observed and recognized, issue a safety alert when aircraft is in a position which places it in unsafe proximity to:

- Terrain
- Obstructions
- Other aircraft

⊙ Don't assume that because another controller has responsibility for the aircraft, the unsafe situation has been observed and the safety alert issued. Inform the appropriate controller.

NOTE: "Another controller" includes controllers on your sector. A Radar controller should respond to all safety alerts. Safety alerts apply to both VFR and IFR aircraft. Between ERAM facilities, alerts external to your facility require informing the appropriate controller only if the sector is adjacent to yours.

- Coordination is **not** required when immediate action is dictated

⊙ Discontinue issuance of further alerts when pilot informs you that action is being taken to resolve the unsafe situation.

Origin of Alerts
JO 7110.65, pars. 2-1-6, 5-14-2

⊙ En Route Minimum Safe Altitude Warning (E-MSAW)

⊙ Automatic altitude readouts

⊙ Conflict/Mode C Intruder alert

⊙ Pilot Reports (PIREPs)

NOTE: Safety alerts apply to both VFR and IFR aircraft.

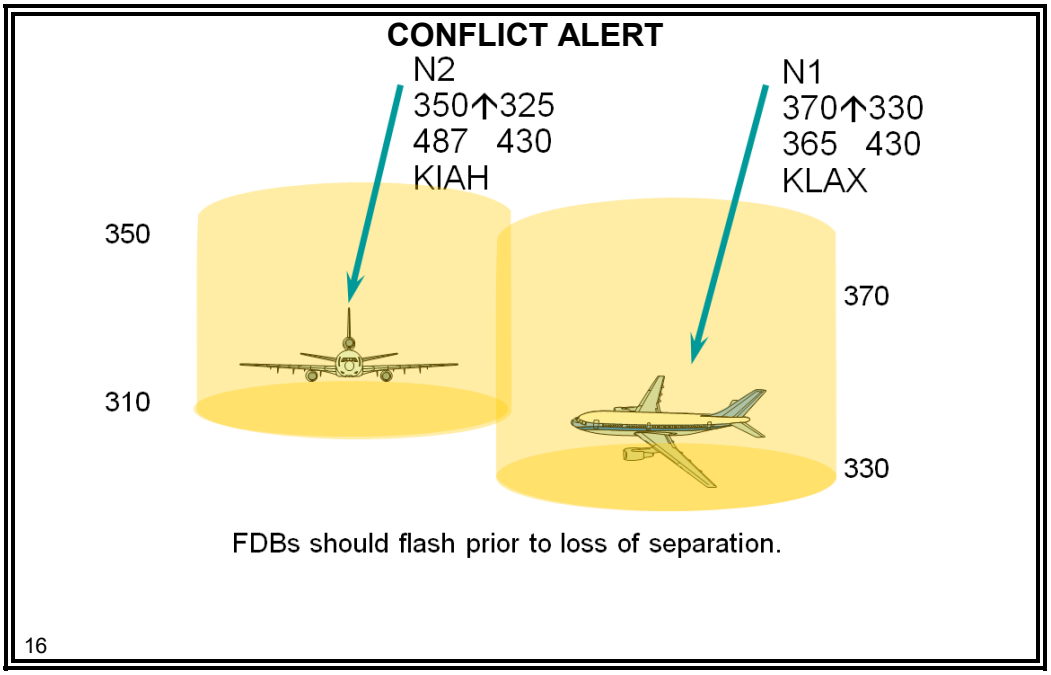
SAFETY ALERTS *(Continued)*

Relevant Terms
JO 7110.65, Pilot/Controller Glossary

📖 **Conflict Alert (CA)** is a function of certain air traffic control automated systems designed to alert radar controllers to existing or pending situations between tracked targets (known IFR or VFR aircraft) that require immediate attention/action.

📖 **Mode C Intruder (MCI) alert** is a function of certain air traffic control automated systems to alert radar controllers to existing or pending situations between a tracked target (known IFR or VFR aircraft) and an untracked target (unknown IFR or VFR aircraft) that require immediate attention/action.

Aircraft Conflict/Mode C Intruder Alerts
JO 7110.65, pars. 2-1-5, 2-1-6, 5-14-1



⊙ Issue a traffic alert immediately when a known conflict with other aircraft exists.

- Offer alternate course of action, if feasible
- End transmission with the word “immediately”

☞ ***NOTE:*** *Use the word “immediately” **only** for imminent situations.*

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SAFETY ALERTS *(Continued)*

Aircraft Conflict/Mode C Intruder Alerts (Cont'd)
JO 7110.65, pars. 2-1-6, 5-14-1;

- FDBs will flash when targets are within a predetermined parameter of each other and less than minimum vertical separation exists
  - Alert is based on Mode C readout or controller-reported altitude; therefore, timely altitude updates are imperative

☞ ***NOTE:*** *Facility can determine flying time parameters for CA activation.*

⊙ Don't rely totally on computerized alert.

- May activate late, or
- Won't activate unless altitude is known

⊙ Conflict Alert may be suppressed/restored by the controller.

- Constitutes controller acknowledgment
- Indicates appropriate action has been or will be taken

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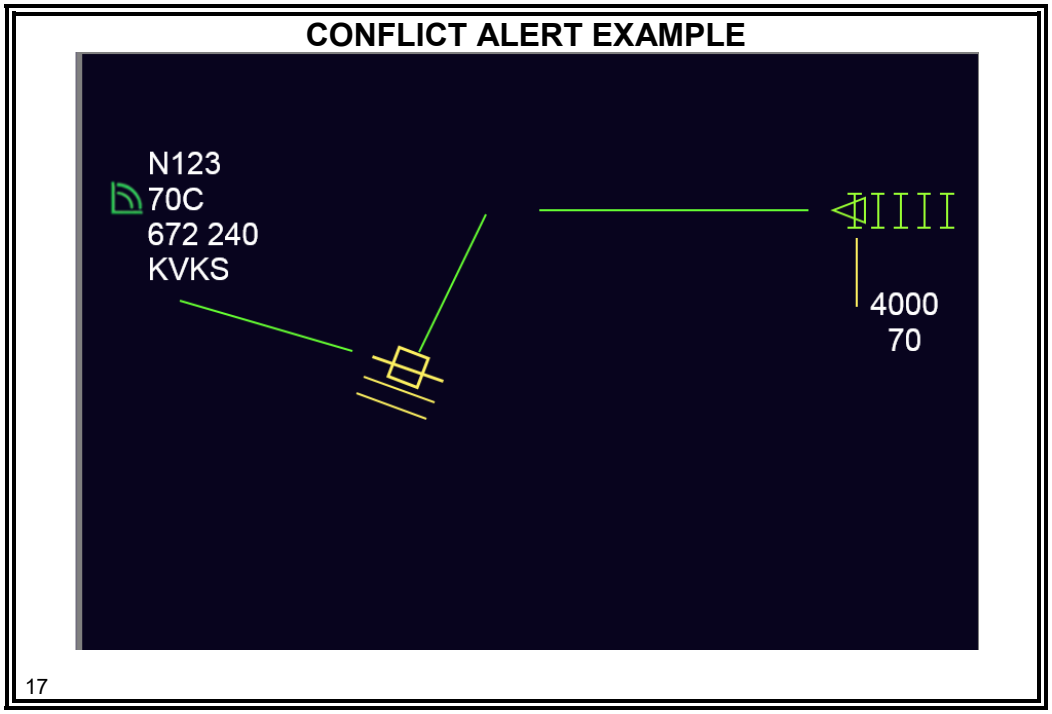
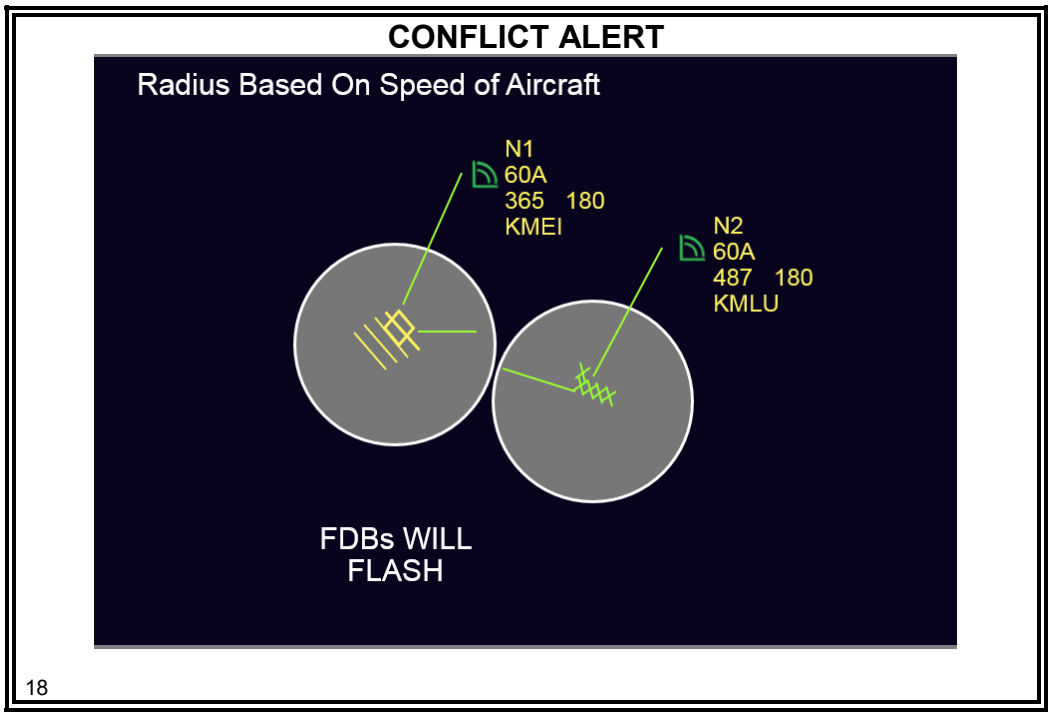
SAFETY ALERTS *(Continued)*

Aircraft Conflict/Mode C Intruder Alerts (Cont'd)
JO 7110.65, par. 5-14-1;



☞ ***NOTE:*** *Click once to show flashing FDBs.*



☞ ***NOTE:*** *Click once to show FDBs flashing.*

SAFETY ALERTS *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What are some conditions that might affect whether a controller will recognize a safety alert situation?

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☞ ***NOTE:*** *Click once to show answer.*

ANSWERS: *Workload, traffic volume, quality/limitations of radar, and available lead time to react. Controllers **must** remain vigilant for these conditions and inform other controllers if appropriate*

KNOWLEDGE CHECK

QUESTION: Safety alerts shall receive the same priority as ____.

A. traffic advisories

B. separation of IFR traffic

C. weather information

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☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *B*

Continued on next page

SAFETY ALERTS *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: You observe an unsafe situation which necessitates the issuance of a safety alert. The aircraft involved is **not** in your area of jurisdiction, but is the responsibility of another controller. You should ____.

A. inform the appropriate controller

B. issue the safety alert yourself

C. disregard, because the aircraft is not under your control

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☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *A*

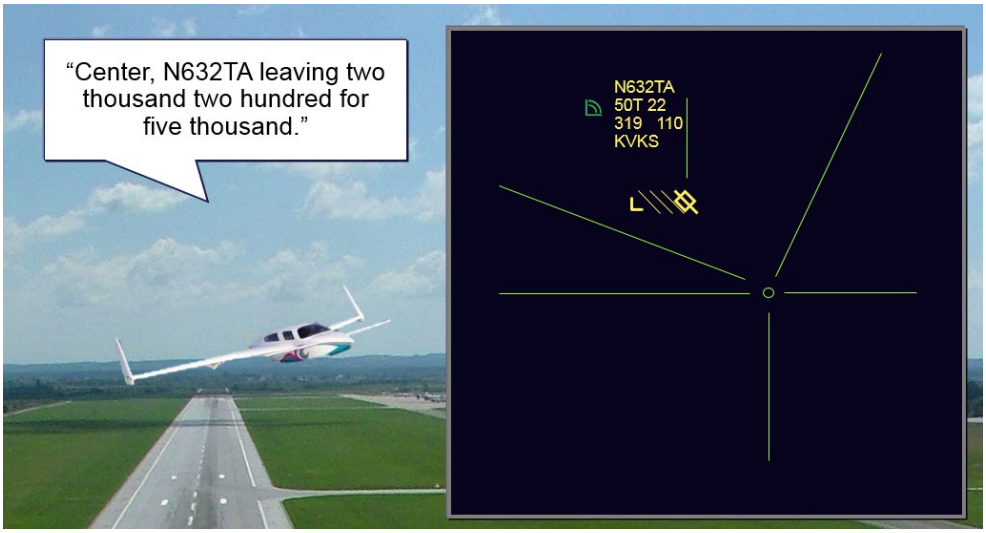
VALIDATION OF MODE C READOUT

Altitude Readout Definition
JO 7110.65, Pilot/Controller Glossary

Altitude readout is an aircraft's altitude, transmitted via the Mode C transponder feature, that is visually displayed in 100-foot increments on a radar display having readout capability.

Validate Mode C
JO 7110.65, par. 5-2-17 ; JO 7110.311C, par. 5-2-18

MODE C VALIDATION



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⊙ Ensure validity of each aircraft after:

- Accepting an interfacility handoff
- Initial track start
- Track start from Coast/Suspend tabular list
- Missing or unreasonable Mode C readouts

NOTE: Validating Mode C is a shared responsibility of the radar team.

NOTE: A previously validated Mode C may **not** be used for separation when the exceptional vertical rate indicator (an "X" appended to the Mode C readout) is displayed. If this occurs, the Mode C altitude readout must be revalidated after the X is no longer displayed in the data block.

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VALIDATION OF MODE C READOUT

Validate Mode C (Cont'd)
JO 7110.65, par. 5-2-17 ; JO 7110.311C, par. 5-2-18

✈ **Phraseology**

⊙ Consider readout valid when:

- It varies less than 300 feet from pilot reported altitude, or

"SAY ALTITUDE/FLIGHT LEVEL."

- You receive a continuous readout from aircraft on the airport and the readout varies by less than 300 feet from field elevation, or
- Verbal coordination with another facility with validated altitude information shows exact correlation between your data block and theirs.

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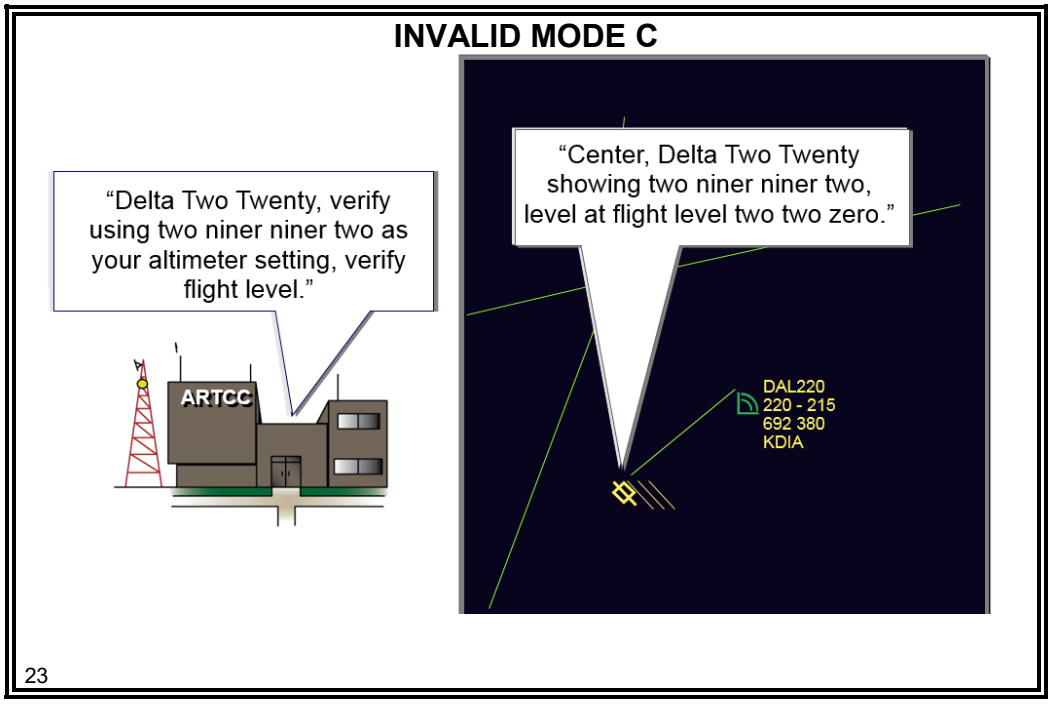
VALIDATION OF MODE C READOUT *(Continued)*

Validate Mode C (Cont'd)
JO 7110.65, par. 5-2-18; FAR, Part 91.215



☞ ***NOTE:*** *Click twice to complete communication between Center and DAL220.*

⊙ If unable to validate the readout, do **not** use Mode C information for separation.

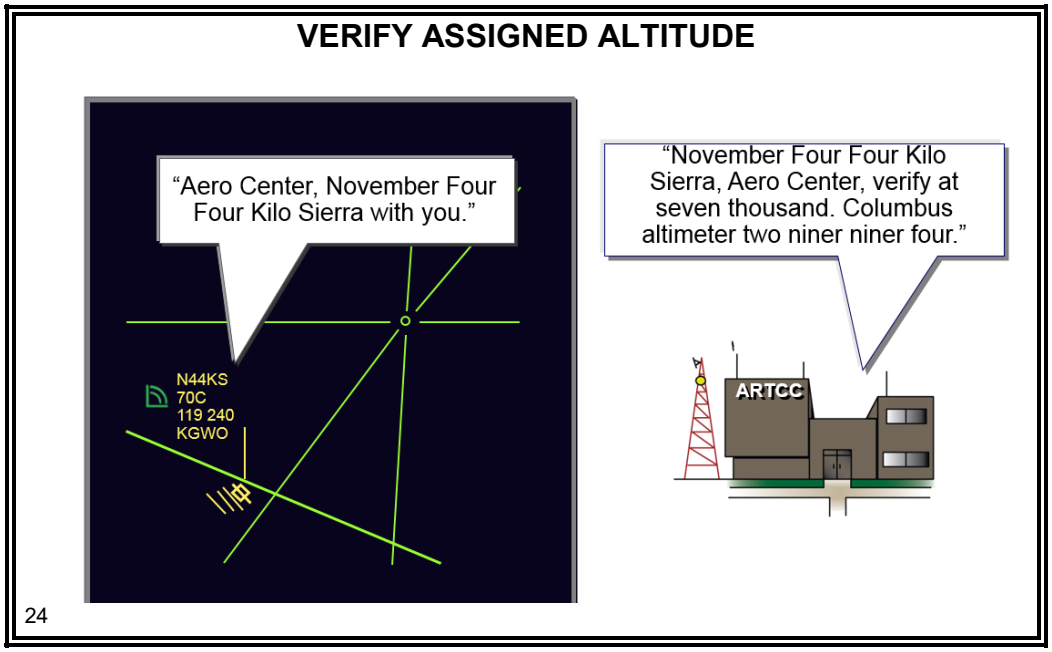
⊙ When you observe an invalid Mode C readout below FL180:

- Issue the correct altimeter setting and request the pilot to verify altitude
- If Mode C readout is still invalid:
  - Instruct the pilot to turn off altitude-reporting part of transponder and include reason
  - Notify area supervisor-in-charge of the aircraft call sign

NOTE: Aircraft are required by FAR, Part 91.215 to have an operating transponder with Mode C when operating in Class A airspace. Should the pilot lose altitude reporting capability, verbally obtain approval before allowing the aircraft to enter the receiving controller's airspace. See JO 7110.65, pars. 5-2-14 and 5-2-16 for supporting information.

ALTITUDE CONFIRMATION

Mode C
JO 7110.65,
par. 5-2-18



- ⊙ Request pilot to verify assigned altitude on initial contact, unless:
  - Pilot states assigned altitude, or
  - You assign a new altitude to a climbing/descending aircraft, or
  - Mode C readout is valid and indicates that the aircraft is established at the assigned altitude

Non-Mode C
JO 7110.65,
par. 5-2-19

- ⊙ Request pilot to verify assigned altitude on initial contact, unless:
  - Pilot states the assigned altitude, or
  - You assign a new altitude to a climbing/descending aircraft

AUTOMATIC ALTITUDE REPORTING

Altitude Reporting
JO 7110.65, par. 5-2-21

✈ **Phraseology**

⊙ Inform aircraft when you want it to turn the automatic altitude reporting feature on/off:

"SQUAWK ALTITUDE."

or

"STOP ALTITUDE SQUAWK."

⊙ **Not** all aircraft have the capability to disengage altitude squawk independently from beacon code squawk.

- On some aircraft, both functions are controlled by the same switch
  - May lose beacon code on these aircraft

Knowledge Check

KNOWLEDGE CHECK

QUESTION: When would a controller request a pilot to turn off the automatic altitude reporting feature?

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☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *When the altitude displayed differs by 300 feet or more from the pilot's reported altitude.*

IN CONCLUSION

Lesson Review

LESSON REVIEW

The following topics were covered in this lesson:

- Radar separation
- Safety alerts
- Validation of Mode C readout
- Altitude confirmation
- Automatic altitude reporting

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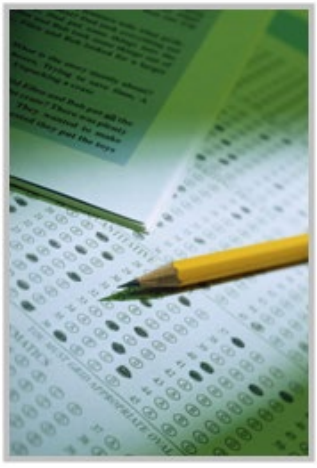
☞ ***NOTE:*** *Teach from graphic. Review and elaborate briefly on the topics covered in this lesson.*

End-of-Lesson Test

END-OF-LESSON TEST

Radar Separation and Safety Alerts



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