Federal Aviation Administration

Initial En Route Qualification Training

Instructor
Lesson 16
Vertical Separation

Course 50148001

LESSON PLAN DATA SHEET

COURSE NAME:	INITIAL EN ROUTE QUALIFICATION TRAINING
COURSE NUMBER:	50148001
LESSON TITLE:	VERTICAL SEPARATION
DURATION:	3+30 HOURS
DATE REVISED:	2022-02
VERSION:	V.2022-02
REFERENCE(S):	FAA ORDER JO 7110.65, AIR TRAFFIC CONTROL; GEN04009
HANDOUT(S):	NONE
EXERCISE(S)/ ACTIVITY(S):	ACTIVITY: IDENTIFYING POTENTIAL CONFLICTS EXERCISE: APPLYING VERTICAL SEPARATION
END-OF-LESSON TEST:	YES *(REFER TO ELT16.PDF)*
PERFORMANCE TEST:	NONE
MATERIALS:	NONE
OTHER PERTINENT INFORMATION:	*INSTRUCTOR KEY FOR THE ELEARNING(S) IS INCLUDED AS AN APPENDIX IN THIS DOCUMENT*

☞ ***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

Separation of aircraft and issuing safety alerts is your highest priority as an air traffic controller. Vertical separation is the first type of separation that you will be taught here at the Academy and the most commonly applied type of separation. Vertical separation, together with the skills and procedures you have learned to this point, will help you issue control instructions that both ensure safety and maximize the efficiency of the NAS.

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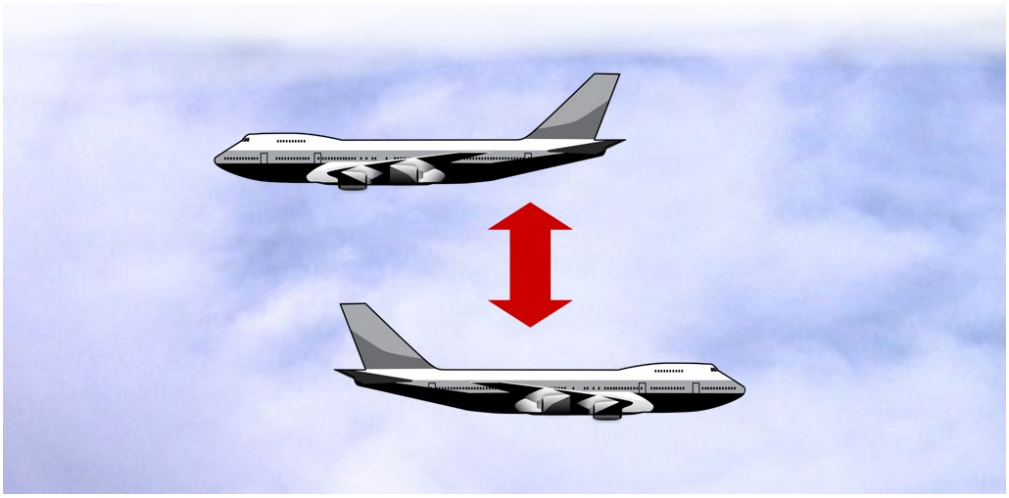
INTRODUCTION *(Continued)*

Opening Scenario

VERTICAL SEPARATION



2

It's critical for safety that aircraft maintain required vertical separation. As a controller, you need to understand the rules that apply to vertical separation so that you can control the aircraft efficiently and effectively.

Purpose

This lesson will cover vertical separation rules and the procedures used to apply them.

Lesson Objectives

LESSON OBJECTIVES

- On an End-of-Lesson Test and in accordance with FAA Order JO 7110.65, you will identify standards, procedures, and phraseology as they apply to vertical separation.

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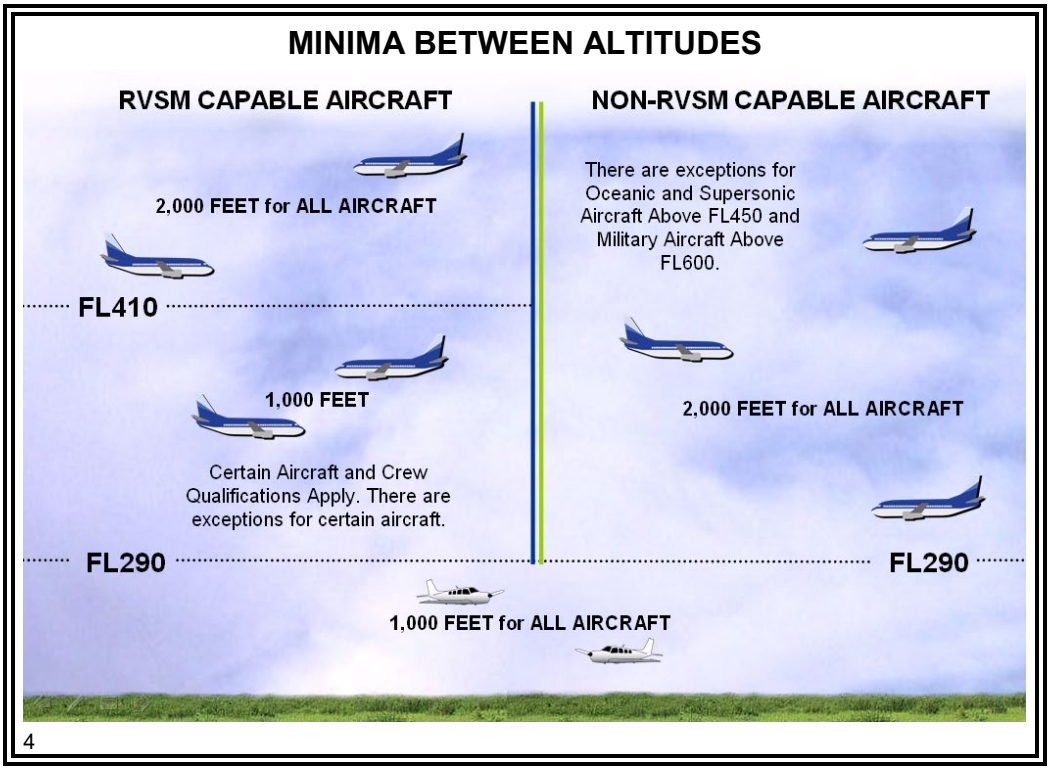
☞ ***NOTE:*** *Teach from graphic.*

MINIMA BETWEEN ALTITUDES

Minima
JO 7110.65,
par. 4-5-1,
GEN04009



- Separate IFR aircraft by assigning different altitudes using the following minima:

  - Up to and including FL410 - 1,000 feet

    - **Exception:** 2000 feet at or above FL290 between non-RVSM aircraft and all other aircraft at or above FL290

NOTE: RVSM – Reduced Vertical Separation Minimum requires certain aircraft and pilot capabilities which permit the use of 1000 feet of separation for aircraft between FL290 and FL410.

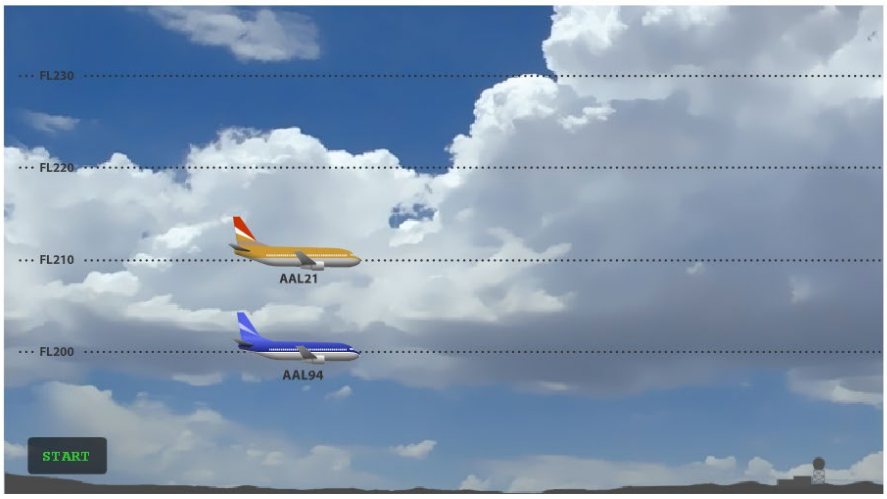
  - Above FL410 - 2,000 feet

☞ ***NOTE:*** *Exceptions mentioned in the above slide are covered in later stages of training.*

ALTITUDE ASSIGNMENT

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

ALTITUDE ASSIGNMENT



ATC: *"American Twenty-One, climb and maintain flight level two three zero."*

AAL21: *"American Twenty-One, leaving flight level two one zero to maintain flight level two three zero."*

ATC: *"American Ninety-Four, climb and maintain flight level two one zero."*

AAL94: *"American Ninety-Four, leaving flight level two zero zero to maintain flight level two one zero."*

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☞ ***NOTE:*** *Introduce topic and then click **START** to play animation. "Animation Complete" will display when the animation is finished. Click the **REPLAY** button to play animation again.*

☞ ***NOTE:*** *Click outside the animation to advance to the next slide.*

⊙ Assign an altitude to an aircraft after the aircraft previously at that altitude has been issued a climb/descent clearance and is observed (valid Mode C), or reports leaving the altitude.

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ALTITUDE ASSIGNMENT *(Continued)*

Application (Cont'd)
JO 7110.65, pars. 4-5-7, 5-5-5, 6-6-1

✈ **Phraseology**

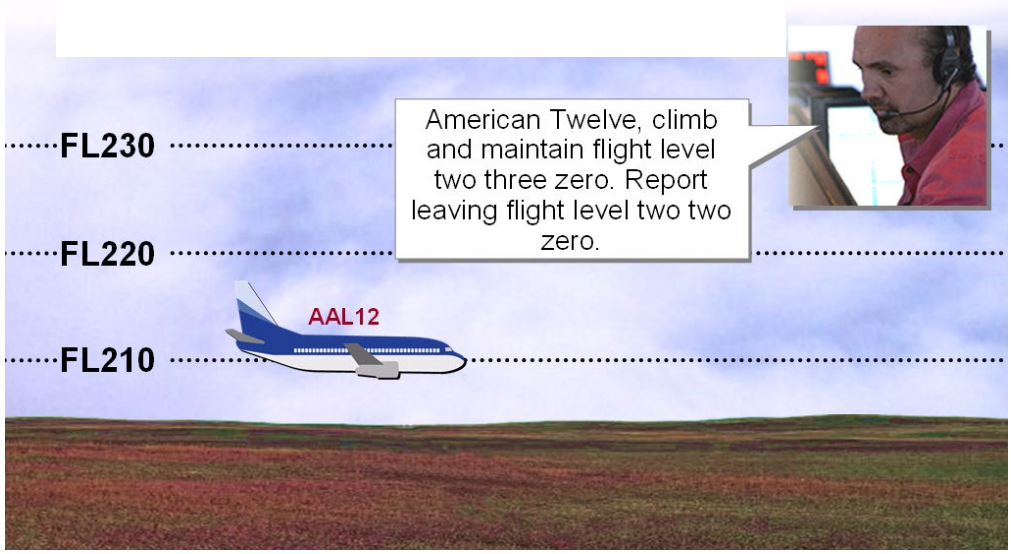
"MAINTAIN/CRUISE (altitude)."

"CLIMB AND MAINTAIN (altitude)."

"DESCEND AND MAINTAIN (altitude)."

NOTE: For more altitude phraseology, see JO 7110.65, par. 4-5-7.

PHRASEOLOGY EXAMPLE – ALTITUDE ASSIGNMENT



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⊙ To obtain an altitude report, use the following phraseology:

✈ **Phraseology**

"REPORT LEAVING/REACHING (altitude/flight level)."

"REPORT LEAVING ODD/EVEN ALTITUDES/FLIGHT LEVELS."

If aircraft is known to be operating below the lowest usable flight level:

"SAY ALTITUDE."

If aircraft is known to be operating at or above the lowest usable flight level:

"SAY FLIGHT LEVEL."

If aircraft's position relative to lowest usable flight level is unknown:

"SAY ALTITUDE OR FLIGHT LEVEL."

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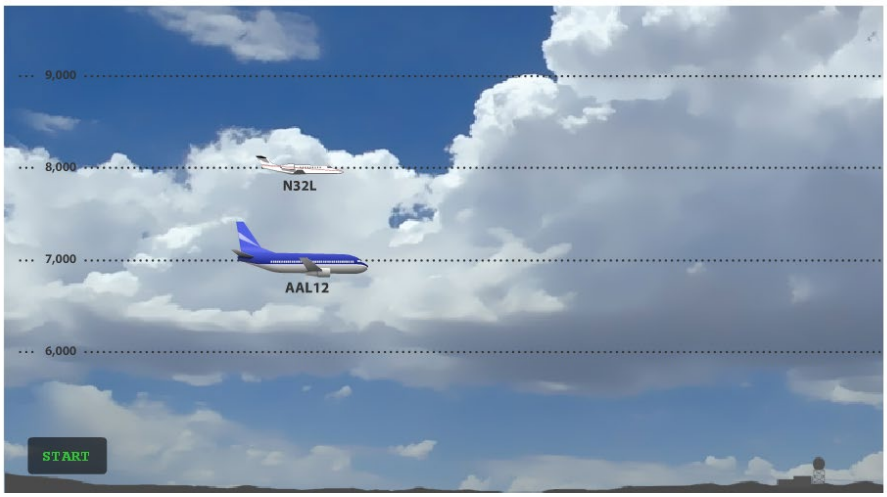
ALTITUDE ASSIGNMENT *(Continued)*

Application (Cont'd)
JO 7110.65, pars. 4-5-7, 6-6-1

PHRASEOLOGY EXAMPLE – ALTITUDE REPORT



ATC:	*"Citation Three Two Lima, climb and maintain niner thousand."*
N32L:	*"Roger. Citation Three Two Lima, leaving eight thousand for niner thousand."*
AAL12:	*"Aero Center, American Twelve, request climb to eight thousand.*
ATC:	*"American Twelve climb and maintain eight thousand."*
N32L:	*"American Twelve, leaving seven thousand for eight thousand."*

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☞ ***NOTE:*** *Introduce topic and then click **START** to play animation. "Animation Complete" will display when the animation is finished. Click the **REPLAY** button to play animation again.*

☞ ***NOTE:*** *Click outside the animation to advance to the next slide.*

⊙ When applying vertical separation minima, consider:

- Known aircraft performance characteristics
- Information indicating that climb/descent rates are **not** consistent with rates recommended in the AIM
  - This information may be pilot-furnished or Mode C observed

ALTITUDE ASSIGNMENT *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

QUESTION: How would you ask AAL20 to advise you when it reaches 6,000 feet?

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

ANSWER: *"American Twenty, report reaching six thousand."*

KNOWLEDGE CHECK

QUESTION: What phraseology would be used to descend N50M and N21P?

N21P PA23/A T140 66 02	STUEE 0640 *0640*	13 07 *13* MHZ	110✓ ↓90	MEI	KSHV V18 KMEI/0748	
N50M BE65/A T160 66 02	STUEE 0643 *0643*	12 07 *12* MHZ	90✓ ↓70	MEI	KSHV V18 KMEI/0746	

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

ANSWER: *"Queen Air Five Zero Mike, descend and maintain seven thousand. Report leaving niner thousand." When N50M reports leaving niner thousand: "Apache Two One Papa, descend and maintain niner thousand."*

Continued on next page

ALTITUDE ASSIGNMENT *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: What phraseology would be used to clear N50M and N21P to their requested altitudes?

N21P PA23/A T140 66 03	GLH 0658	13 07 13 0713 SQS	110✓ ↑130	IGB	KTXK GLH V278 IGB KUBS/0749
N50M BE65/A T160 66 03	GLH 0700	12 07 12 0711 SQS	90✓ ↑110	IGB	KTXK GLH V278 IGB KUBS/0749

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

ANSWER: *"November Two One Papa climb and maintain one three thousand, report leaving one one thousand." When N21P reports leaving 110, "November Five Zero Mike climb and maintain one one thousand."*

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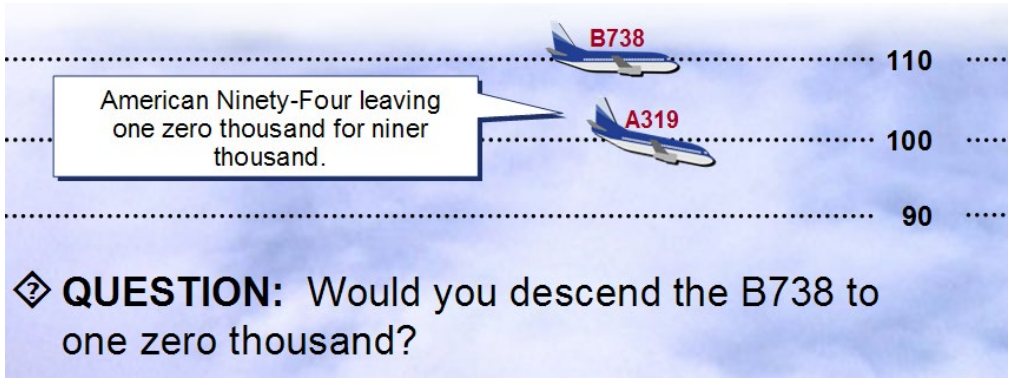
ALTITUDE ASSIGNMENT *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK



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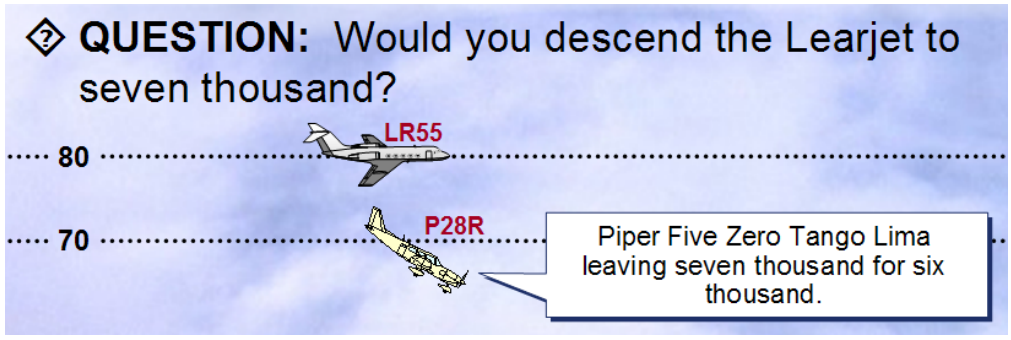
☞ ***NOTE:*** *Click once to show answer.*

ANSWER: *Yes, the aircraft performance characteristics in this situation are compatible*

KNOWLEDGE CHECK



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

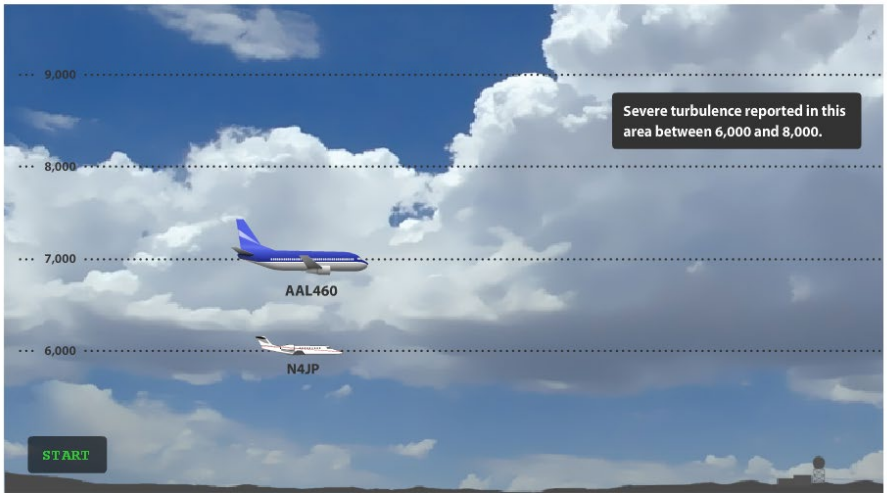
ANSWER: *No, the vast difference in aircraft performance characteristics in this situation makes this altitude unsafe.*

EXCEPTIONS TO ALTITUDE ASSIGNMENT

Exceptions
JO 7110.65,
pars. 4-5-7, 6-6-2

V.1.03
2012-02

EXCEPTIONS – SEVERE TURBULENCE



ATC: *"American Four Sixty, climb and maintain niner thousand."*

AAL460: *"American Four Sixty, leaving seven thousand to maintain niner thousand."*

N4JP: *"Aero Center. November Four Juliett Papa. Request climb to seven thousand."*

ATC: *"November Four Juliett Papa. Standby."*

ATC: *"American Four Sixty, report leaving eight thousand."*

AAL460: *"Aero Center, American Four Sixty leaving eight thousand to maintain niner thousand."*

ATC: *"November Four Juliett Papa, climb and maintain seven thousand."*

Pilot: *"Roger. November Four Juliett Papa leaving six thousand to maintain seven thousand."*

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☞ ***NOTE:*** *Introduce topic and then click **START** to play animation. "Animation Complete" will display when the animation is finished. Click the **REPLAY** button to play animation again.*

☞ ***NOTE:*** *Click outside the animation to advance to the next slide.*

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EXCEPTIONS TO ALTITUDE ASSIGNMENT *(Continued)*

Exceptions (Cont'd)
JO 7110.65, pars. 4-5-7, 6-6-2

⊙ Assign an altitude to an aircraft **only** after the aircraft previously at that altitude has reported at or passing through another altitude separated from the first by the appropriate minima when:

- Severe turbulence is reported

☞ ***NOTE:*** *Explain the effects of severe turbulence on an aircraft's ability to maintain altitude. Every effort should be made to keep aircraft clear of severe turbulence.*

- Military aircraft are conducting aerial refueling
- The aircraft previously at that altitude has been issued:
  - Climb/descent at pilot's discretion
    - → Crossing restriction permits descent at pilot's discretion. The pilot may level off at any altitude, but once an altitude is vacated, the pilot may **not** return to it.
    - → Approach clearance also permits descent at pilot's discretion—the aircraft **must** comply with restrictions on approach plate.
  - Cruise clearance

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EXCEPTIONS TO ALTITUDE ASSIGNMENT *(Continued)*

Exceptions (Cont'd)
JO 7110.65, pars. 4-5-7, 6-6-2

V.1.03
2012-02

EXCEPTIONS – PILOT DISCRETION #1

ATC:	*"November Two Five Lima Romeo. Cross one seven miles Northwest of Jackson VORTAC, at and maintain six thousand."*
N25LR:	*"November Two Five Lima Romeo, leaving one three thousand to cross one seven miles northwest Jackson VORTAC, at and maintain six thousand."*
N45GB:	*"Aero Center November Four Five Golf Bravo, request descent to one two thousand for chop."*
ATC:	*"November Four Five Golf Bravo. Standby."*
ATC:	*"November Two Five Lima Romeo. Report leaving one one thousand."*
N25LR:	*"Aero Center. November Two Five Lima Romeo leaving one one thousand at this time."*
ATC:	*"November Two Five Lima Romeo. Roger."*
ATC:	*"November Four Five Golf Bravo. Descend and maintain one two thousand."*
N45GB:	*"November Four Five Golf Bravo. Leaving one four thousand for one two thousand."*

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☞ ***NOTE:*** *Introduce topic and then click **START** to play animation. "Animation Complete" will display when the animation is finished. Click the **REPLAY** button to play animation again.*

☞ ***NOTE:*** *Click outside the animation to advance to the next slide.*

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EXCEPTIONS TO ALTITUDE ASSIGNMENT *(Continued)*

Exceptions (Cont'd)
JO 7110.65, pars. 4-5-7, 6-6-2

V.1.03
2012-02

EXCEPTIONS – PILOT DISCRETION #2

ATC:	*"November Two Five Lima Romeo. Cleared approach Vicksburg Airport."*
N25LR:	*"November Two Five Lima Romeo leaving seven thousand on approach."*
N45GB:	*"Aero Center November Four Five Golf Bravo, request descent to seven thousand for chop."*
ATC:	*"November Four Five Golf Bravo. Standby."*
ATC:	*"November Two Five Lima Romeo. Report leaving six thousand."*
N25LR:	*"November Two Five Lima Romeo leaving six thousand at this time."*
ATC:	*"November Two Five Lima Romeo. Roger."*
ATC:	*"November Four Five Golf Bravo. Descend and maintain seven thousand."*
N45GB:	*"November Four Five Golf Bravo. Leaving niner thousand for seven thousand."*
ATC:	*"November Four Five Golf Bravo. Roger."*

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☞ ***NOTE:*** *Introduce topic and then click **START** to play animation. "Animation Complete" will display when the animation is finished. Click the **REPLAY** button to play animation again.*

NOTE: Most altitude changes in nonradar scenarios at Aero center will be pilot's discretion.

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EXCEPTIONS TO ALTITUDE ASSIGNMENT *(Continued)*

Exceptions (Cont'd)
JO 7110.65, pars. 4-5-7, 6-6-2

⊙ Assignment

- ATC may issue a specified altitude over a specified fix for that portion of a descent clearance where descent at pilot's discretion is permissible

Example: The clearance is "Cross eight miles northeast Magnolia VORTAC at or below one zero thousand, descend and maintain seven thousand." The crossing restriction at or below one zero thousand is a pilot's discretion descent, but the descent to seven thousand is **not**.

✈ **Phraseology**

"CLIMB/DESCEND AT PILOT'S DISCRETION."

– Issue specific altitude clearance instructions.

✈ **Phraseology**

"CLIMB/DESCEND NOW TO (altitude), THEN CLIMB/DESCEND AT PILOT'S DISCRETION MAINTAIN (altitude)."

⊙ Removal of pilot's discretion

- Issue new clearance

✈ **Phraseology**

"AMEND ALTITUDE."

⊙ Advantages of pilot's discretion:

- Pilot can choose when to start climb or descent
- Pilot may level off at intermediate altitude, but after vacating an altitude, **cannot** return to vacated altitude
- Discretion clearance may conserve fuel for aircraft

⊙ Disadvantages of pilot's discretion:

- Controller **must** protect more altitudes, which may interfere with sequencing and separation of traffic

☞ ***NOTE:*** *Emphasize the shaded area of the animation.*

EXCEPTIONS TO ALTITUDE ASSIGNMENT *(Continued)*

Cruise Clearance
JO 7110.65, Pilot/Controller Glossary

⊙ Pilot is assigned altitude to cruise the airspace from ATC assigned altitude to minimum IFR altitude.

NOTE: Controller **must** protect those altitudes.

⊙ Pilot may climb, descend, or level off at any altitude within block.

- Once pilot reports leaving an altitude, they **cannot** return to that altitude

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EXCEPTION TO ALTITUDE ASSIGNMENT *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

– Severe turbulence exists.

N32WM C421/A T210 G210 66 **123** 02	STUEE 0922	44 09 MHZ	150✓	MEI	KSHV V18 KMEI/1002	1515

– N32WM requests descent to 9,000 feet.

N30PP BE80/A T200 G200 66 **323** 02	STUEE 0917	41 09 MHZ	130✓	MEI	KSHV V18 KMEI/1012	2334

– N30PP requests descent to 7,000 feet.

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☞ ***NOTE:*** *Have students answer the following questions based on the strips above.*

QUESTION: What is the procedure to clear each aircraft above to its requested altitude?

ANSWER: *When N30PP reports leaving 80, N32WM can be assigned 90. Aircraft can also be stepped down*

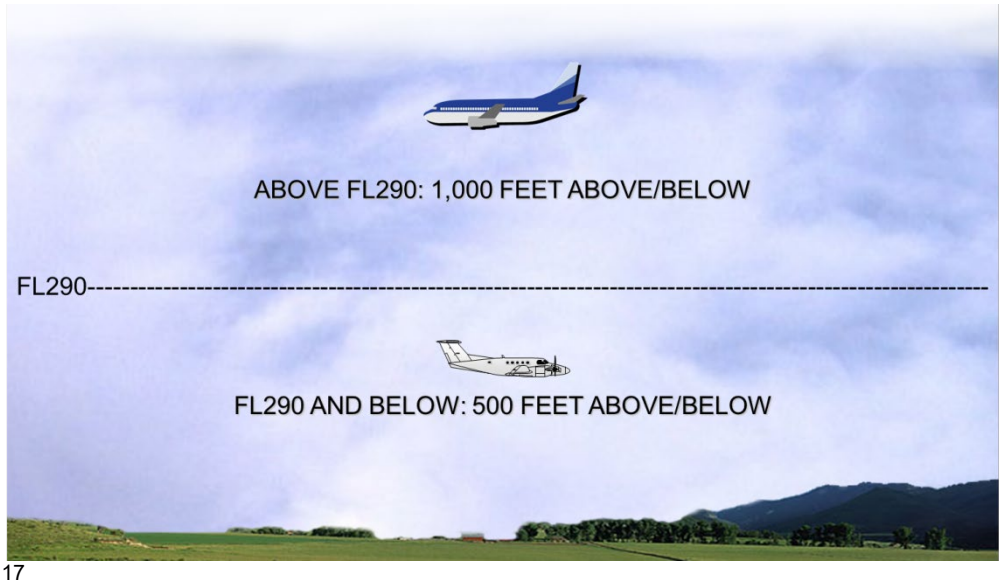
QUESTION: When aircraft are **not** climbing/descending at pilot's discretion, how is vertical separation applied?

ANSWER: *By assigning an altitude only after the aircraft previously at that altitude has reported leaving the altitude*

SEPARATION FROM SPECIAL USE AND ATC ASSIGNED AIRSPACE (ATCAA)

Minima
JO 7110.65,
par. 9-3-2

MINIMA FROM SUA/ATCAA



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☞ ***NOTE:*** *Discuss VFR/IFR usable altitudes.*

⊙ Separate nonparticipating aircraft from active Special Use or ATC assigned airspace by the following minima:

- FL290 and below - at least 500 feet above/below altitude limits of airspace

NOTE: Altitudes are assigned in 1,000 foot increments.

- Above FL290 - at least 1,000 feet above/below altitude limits of airspace

EXERCISE: APPLYING VERTICAL SEPARATION

Exercise

APPLYING VERTICAL SEPARATION EXERCISE

Purpose: to practice applying the rules of vertical separation

Directions: record the clearance and control information on the flight progress strips and write the appropriate clearances in the spaces provided

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Directions

Using the following flight progress strips, record the clearance and control information for each problem. Write the appropriate clearances in the spaces provided. Keep in mind that there may be more than one solution to each problem.

Continued on next page

EXERCISE: APPLYING VERTICAL SEPARATION

(Continued)

Problem #1

PROBLEM 1

Assign A43661 120 and A44321 140.

TIME: 1258

A44321 C130/A T310 66 02	MEI 1242	56 12 56 1256 MHZ	120✓	STUEE	KMEI V18 KSHV	
A43661 C130/A T310 66 02	MEI 1241	55 12 55 1255 MHZ	100✓	STUEE	KMEI V18 KSHV	

19

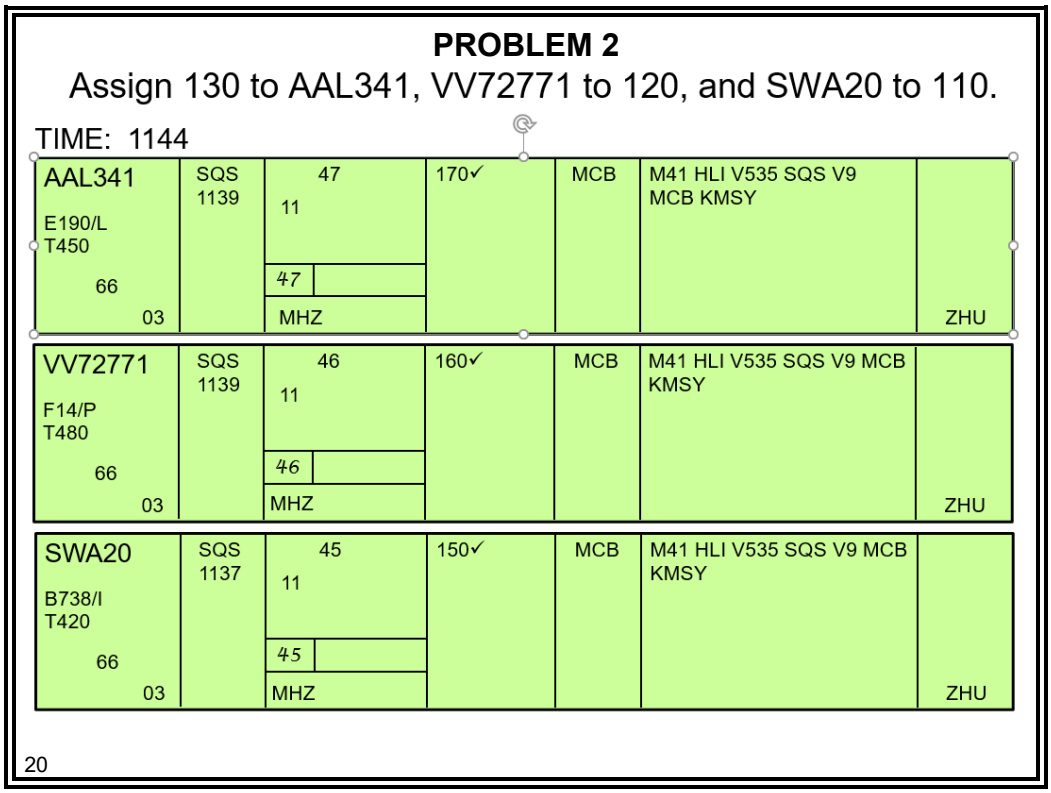
Possible solution: *Have A44321 climb and maintain 14,000 and report leaving 12,000. After receiving the report leaving 12,000, have A43661 climb and maintain 12,000.*

☞ ***NOTE:*** *Discuss other ways to solve the problem.*

Continued on next page

EXERCISE: APPLYING VERTICAL SEPARATION
(Continued)

Problem #2



Possible solution: *Have SWA20 descend and maintain 11,000 and report leaving even altitudes. As you receive the even altitude reports, descend VV72771 to those altitudes and request VV72771 to report leaving odd altitudes. As VV72771 reports leaving odd altitudes, descend AAL341 to those altitudes.*

☞ ***NOTE:*** *Discuss other ways to solve the problem.*

Continued on next page

EXERCISE: APPLYING VERTICAL SEPARATION
(Continued)

Problem #3

PROBLEM 3

Assign N42P 10,000 feet and N674S 8,000 feet for traffic.

TIME: 0738

N674S C310/A T170 66 01		↑ 0731/0732 KGWO P0730	~~6~~0✓	MHZ 60	KGWO SQS V9 MCB V555 KPCU /0108	D-A
N42P PA23/A T160 66 01		↑ 0730/0730 KGWO P0730	~~8~~0✓ ~~60~~	MHZ 80	KGWO SQS V9 MCB V555 KPCU /0110	D-A

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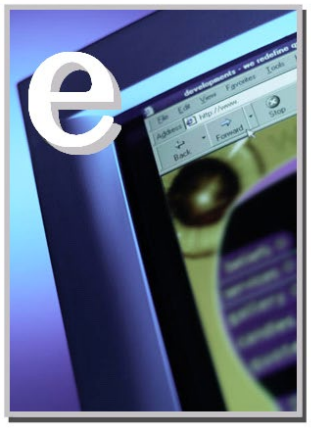
Possible solution: *Have N42P climb and maintain 10,000 and report leaving 8,000. When N42P reports leaving 8,000, assign 8,000 to N674S.*

☞ ***NOTE:*** *Discuss other ways to solve the problem.*

ACTIVITY: IDENTIFYING POTENTIAL CONFLICTS

Activity

IDENTIFYING POTENTIAL CONFLICTS ACTIVITY



Purpose: to practice identifying potential conflicts

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☞ ***NOTE:*** *Have the students access the IET eLearning menu and select the activity for Lesson 16.*

☞ ***NOTE:*** *Explain to students that in this activity the sets of strips are sorted and sequenced within the appropriate bay header. The students need to review the strips for conflicts—look for aircraft at the same altitude, determine if 10 minute separation exists, and then verify that the 10 minute separation is appropriate.*

Description

In this activity, you will practice identifying potential conflicts on flight progress strips.

Directions

Access the IET eLearning menu. Select **Lesson 16 – Vertical Separation**. Click on the title to launch the **Identifying Potential Conflicts** activity.

Time Allotted

30 minutes

☞ **NOTE:** *Refer to the appendix for the Instructor Key for this eLearning activity. Remember to disable the eLearning capability after students complete the eLearning.*

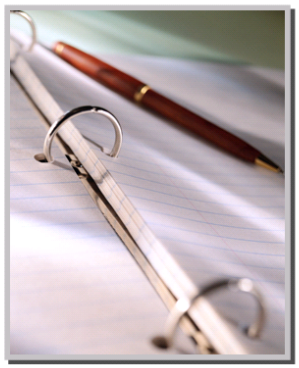
IN CONCLUSION

Lesson Review

LESSON REVIEW

The following topics were covered in this lesson:

- Minima between altitudes
- Altitude assignment
- Exceptions to altitude assignment
- Separation from Special Use and ATC Assigned Airspace (ATCAA)



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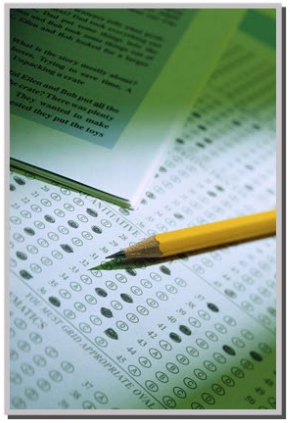
☞ ***NOTE:*** *Teach from graphic. Review and elaborate briefly on the topics covered in this lesson.*

End-of-Lesson Test

END-OF-LESSON TEST

Vertical Separation



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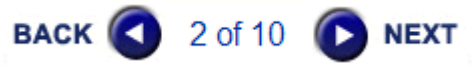
APPENDIX: INSTRUCTOR KEY FOR ELEARNING ACTIVITY

Purpose

This document serves as a guide for facilitating the eLearning activities of the Initial En Route Training course and provides an overview of the objectives and content of the eLearning activities within this lesson.

Navigation

- To navigate within the eLearning activities, a Navigation Bar is positioned at the top right of the page and contains the following options:
  - MAIN MENU: Allows students to access a main menu listing all of the eLearning activities
  - RESOURCES: Allows students to access additional resources, including:
    - → A **Glossary** link
    - → A **References** link
    - → A **Help** link
  - EXIT: Allows students to exit from the eLearning activity at any time



- To navigate within an activity, a navigation tab is also positioned near the top right of the screen, just below the navigation bar.
- The navigation tab contains the following buttons:
  - BACK: When active, returns students to the previous page
  - NEXT: When active, allows students to advance to the next page

NOTE: Inactive **BACK** and **NEXT** buttons indicate students are at the beginning or at the end of a lesson.

Navigation Tips

- To refresh a page or reset an activity, press **F5**.
- You can advance to a specific page in the activity without completing the activity. Click the **NEXT** or **BACK** buttons until the page is displayed.

Continued on next page

APPENDIX: INSTRUCTOR KEY FOR ELEARNING ACTIVITIES *(Continued)*

Lesson Title	Lesson 16 Vertical Separation
eLearning Objective	The objective of this eLearning is to reinforce the ability to quickly and accurately detect conflicts and the position of red Ws on flight progress strips
Lesson Activity	⊙ Lesson 16 contains one eLearning activity: • Activity 1: Identifying Potential Conflicts
Activity Description	Students are presented with six sets of flight strips. Each set represents a bay in which the flight strips have already been sequenced and sorted. Students **must** drag and drop the red W to the correct location on the flight strips containing a conflict. Students may also drag and drop direction arrows onto the flight strips (**no** feedback will be provided on right or wrong arrows. Any arrow can be dragged onto any flight strip). After the placement of the red Ws is evaluated, a series of questions are presented based on the same strips.
Activity Content	⊙ Page 1 contains an activity introduction. ⊙ Pages 2-7 contain flight strip graphics and drag and drop activities.
Activity Specifics	Questions • To complete a question series, students should click **CONTINUE**. • Students have two attempts to perform the drag and drops and respond to questions before receiving feedback.