BASICS FOR AIR TRAFFIC CONTROL – SEPARATION

MODULE OVERVIEW

Purpose: The purpose of this module is to introduce you to the different types of separation used every day by controllers to provide safe, orderly, and expeditious separation of air traffic within the National Airspace System (NAS).

MODULE OUTLINE

Lesson: Vertical Separation

Purpose: The purpose of this lesson is to identify vertical separation and the minimum requirements when performing vertical separation.

Objective:

- Identify vertical separation and basic minimum requirements for providing separation

Topics:

- Separation
  - Applied Separation
  - Separation Minima
- Flight Level (FL)
- Vertical Separation
  - Vertical Minima
  - Reduced Vertical Separation Minima (RVSM)
- Knowledge Check
- Review/Summary

Question and Answer Session – *Parking Lot*

Lesson: Nonradar Separation

Purpose: The purpose of this lesson is to identify is to identify other types of nonradar separation in addition to vertical separation and the basic minimum requirements of each.

Objective:

- Identify types of nonradar separation and basic minimum requirements for providing separation

Topics:

- Nonradar Lateral Separation
  - Nonradar Lateral Separation Methods
- Longitudinal Separation
  - Longitudinal Separation Courses
  - Nonradar Longitudinal Separation Minima
  - Nonradar Longitudinal Separation Example
- Knowledge Check
- Review/Summary

Question and Answer Session – *Parking Lot*

Lesson: Radar Separation

Purpose: The purpose of this lesson is to identify radar separation and the minimum requirements when applying radar separation.

Objective:

- Identify radar separation and basic minimum requirements for providing separation

Topics:

- Radar Separation
  - Terminal Minima
  - En Route Minima
  - Radar vs. Nonradar Separation
- Knowledge Check

Video – FAA Separation (14:05 mins.)

- Separation Review
- Review/Summary

Question and Answer Session – *Parking Lot*

Lesson: Visual Separation

Purpose: The purpose of this lesson is to describe the conditions under which visual separation can be provided.

Objective:

- Identify visual separation and basic minimum requirements for providing separation

Topics:

- Visual Separation
  - Tower Applied
  - Pilot Applied
- Visual Separation in Conjunction with Visual Approach Procedures
- Knowledge Check
- Review/Summary

Lesson: Runway Separation

Purpose: The purpose of this lesson is to explain the basics of and requirements for runway separation as they pertain to different runway configurations.

Objective:

- Identify runway separation and basic minimum requirements for providing separation

Topics:

- Runway Separation
- Same Runway Separation
  - Minimum Distance Between Aircraft
  - Departure vs. Arrival
- Intersecting and Nonintersecting Converging Runway Separation
- Knowledge Check
- Review/Summary

Question and Answer Session – *Parking Lot*

Lesson: Holding Procedures

Purpose: The purpose of this lesson is to identify holding procedures and requirements when performing holding procedures.

Objective:

- Identify basic holding procedures and requirements to perform holding

Topics:

- Holding Terms and Definitions
- Holding Uses
- Typical Holding Pattern
  - Standard/Nonstandard
  - Outbound Leg
  - Inbound Leg
- Lateral Separation in Holding Patterns

Video – Holding Separation (1:53 mins.)

- Knowledge Check
- Review/Summary

Activity – Types of Separation

Question and Answer Session – *Parking Lot*

Game – Situation Separation

Question and Answer Session – *Parking Lot*

End-of-Module (EOM) Test

INTRODUCTION

LESSONS	■ Vertical Separation ■ Nonradar Separation ■ Radar Separation ■ Visual Separation ■ Runway Separation ■ Holding Procedures
TOTAL ESTIMATED RUN TIME	4 hrs. 15 mins.
MODULE CONTENT	■ Module Overview ■ Lesson: Vertical Separation ■ Q&A Session – Parking Lot ■ Lesson: Nonradar Separation ■ Q&A Session – Parking Lot ■ Lesson: Radar Separation ■ Q&A Session – Parking Lot ■ Lesson: Visual Separation ■ Lesson: Runway Separation ■ Q&A Session – Parking Lot ■ Lesson: Holding Procedures ■ Activity – Types of Separations ■ Q&A Session– Parking Lot ■ Game – Situation Separation ■ Q&A Session – Parking Lot ■ End-of-Module Test

FACILITATOR INSTRUCTIONS	**DELIVERY METHOD**
■ Instruct students to select ***Separation*** module link within Blackboard ■ Instruct students to read the module introduction and then wait quietly for additional instructions	Blackboard
	EST. RUN TIME
	2 mins.

Safe movement through the National Airspace System (NAS) requires that aircraft maintain distance between them. In Air Traffic Control (ATC), separation refers to keeping aircraft spaced appropriately. A controller's primary responsibility is to ensure separation of aircraft.

To effectively provide ATC service and issue appropriate ATC clearances, you must understand all separation rules and know how to apply them. Failure to apply proper separation can result in catastrophes.

The purpose of this module is to introduce you to the different types of separation used every day by controllers to provide safe, orderly, and expeditious separation of air traffic within the NAS.

Note: *This module is only an introduction. In the following course, you will learn separation criteria and the application of specific rules.*

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Vertical Separation*** lesson in Blackboard ■ Instruct students to navigate to the ***Vertical Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 15 mins.

VERTICAL SEPARATION

Purpose: The purpose of this lesson is to identify vertical separation, and the minimum requirements when performing vertical separation.

Objective:

- Identify vertical separation and basic minimum requirements for providing separation

References for this lesson are as follows:

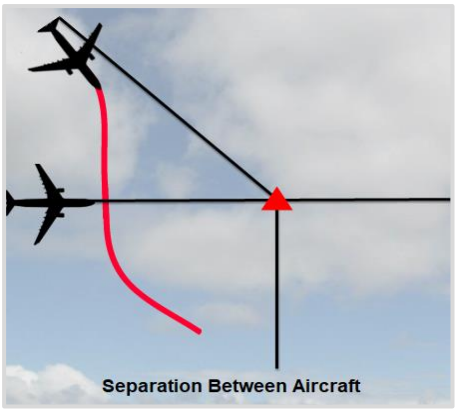
- FAA Order JO 7110.65, Air Traffic Control
- Aeronautical Information Manual (AIM)

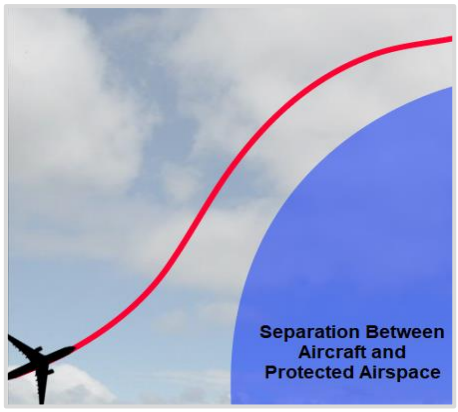
Separation

Applied Separation

The Air Traffic Control (ATC) system has the requirement to prevent a collision between aircraft operating in the system. This is accomplished by applying separation between aircraft and between aircraft and protected airspace.

Separation is the spacing of aircraft to achieve safe and orderly movement in flight, and while landing or taking off.



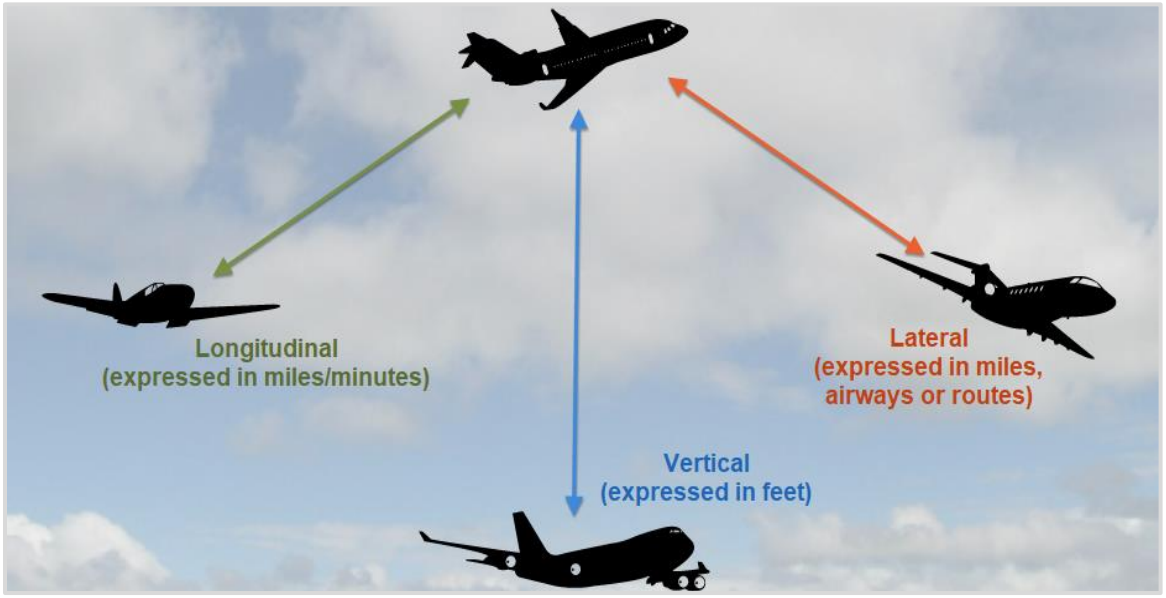


Separation Minima

In a radar or nonradar environment, aircraft can be separated: vertically, laterally, and longitudinally.

Separation minima refers to the minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of ATC procedures.

Note: *There are different minimum vertical, lateral, and longitudinal separation that are applied in both radar and nonradar environments, but there are different minimum distances (separation minima) used depending on whether it is a radar or nonradar environment.*

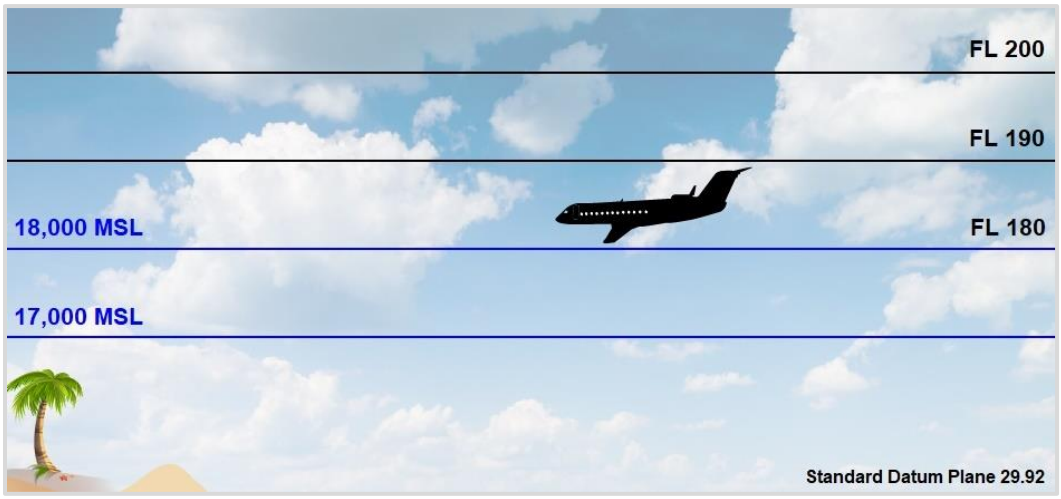


Flight Level (FL)

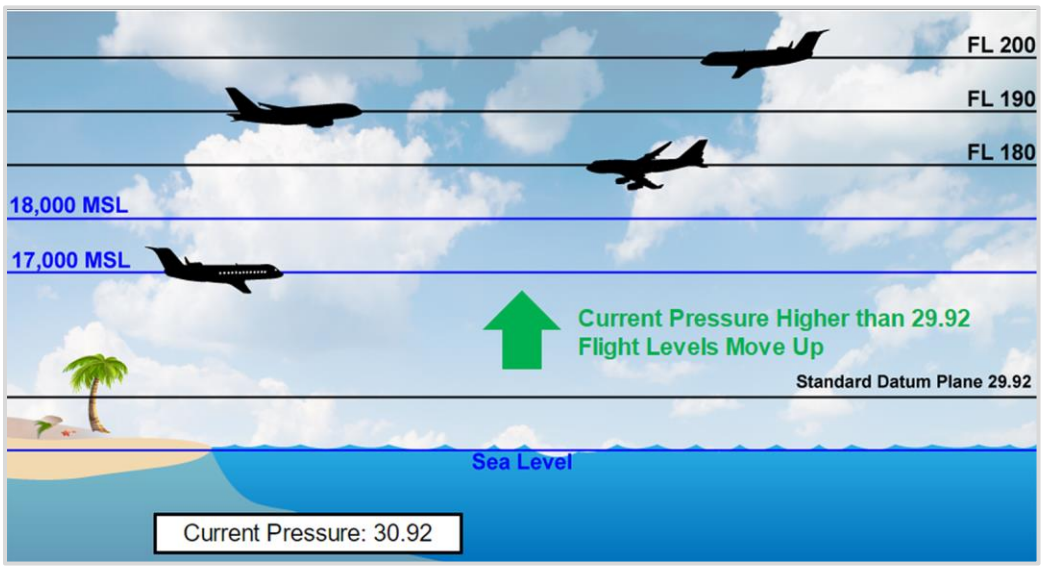
To understand vertical separation, you must first have an understanding of flight levels. **Flight Level (FL)** is a level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet.

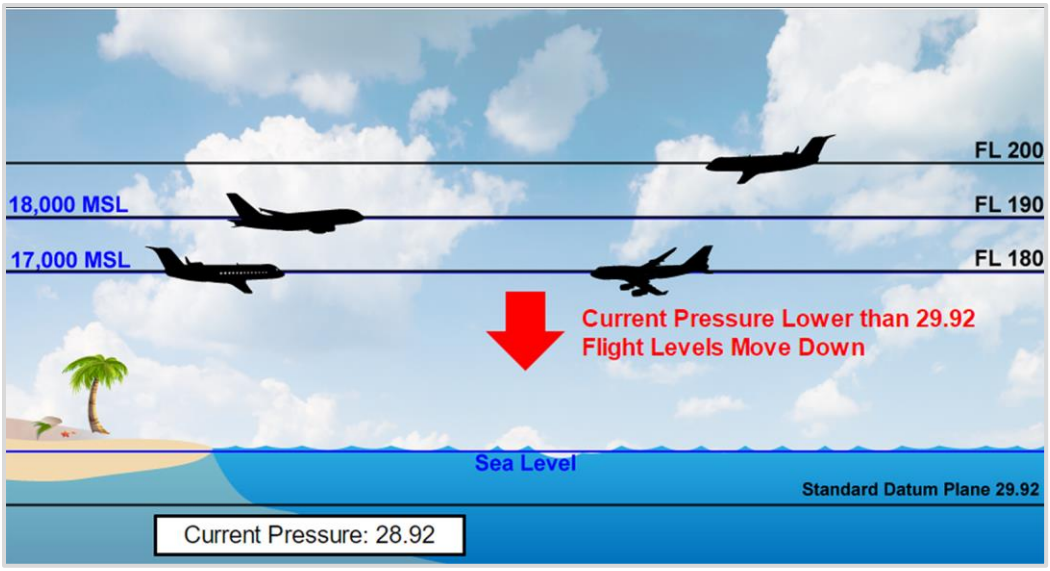
All aircraft operating at or above 18,000 MSL shall have the altimeter set to 29.92, regardless of the local altimeter settings at stations they fly over.

Aircraft Altimeter



If aircraft do not use the same setting, safety issues arise.

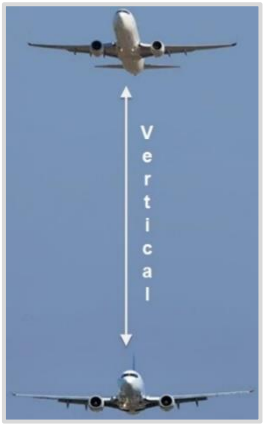




Note: *Two aircraft could be flying at* ***different*** *heights, even though their altimeters show the* ***same*** *altitude. Two aircraft could be flying at the* ***same*** *height, even though their altimeters show* ***different*** *altitudes.*

Vertical Separation

Vertical separation is the separation between aircraft expressed in units of vertical distance.

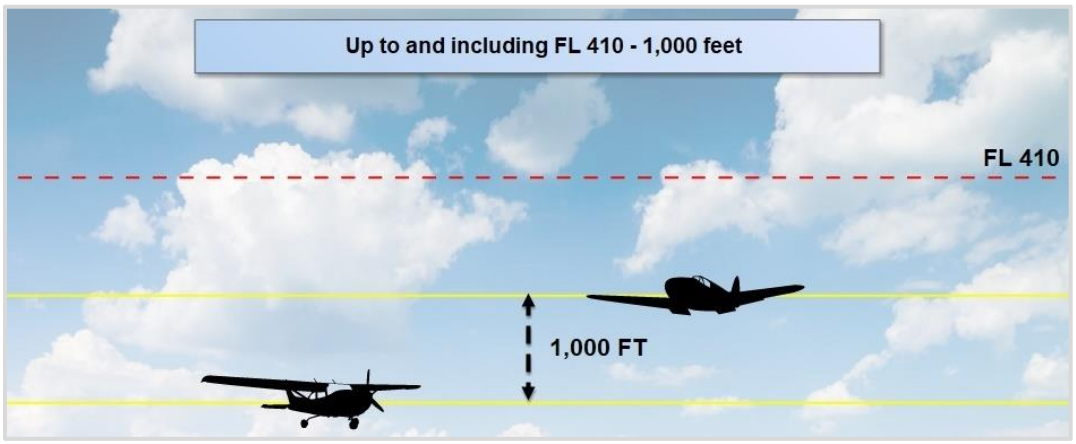


Instrument Flight Rules (IFR) aircraft are assigned different altitudes/flight levels to meet standard separation requirements.

Note: *Vertical separation minima are the same in the radar environment as they are in the nonradar environment. Vertical separation does not rely on radar data for its application.*

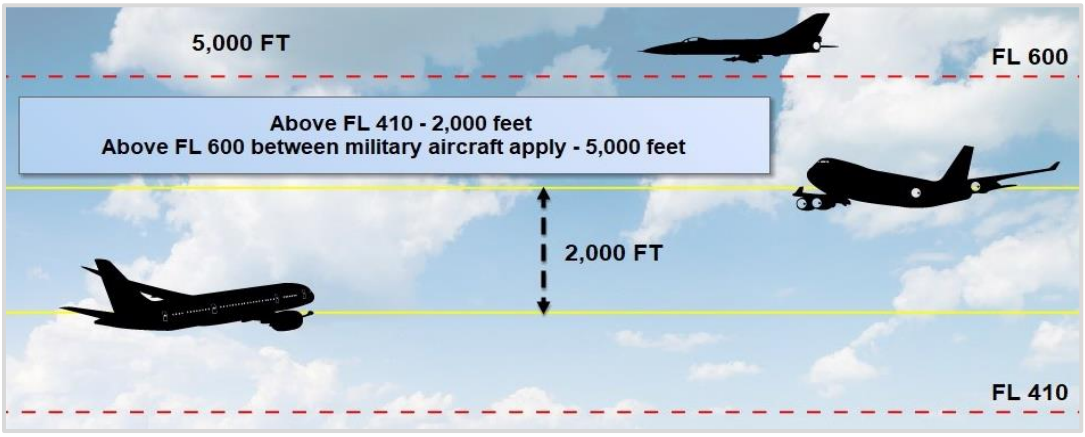
Vertical Minima

The basic minimum altitude separation between IFR aircraft is:



RVSM

Reduced Vertical Separation Minimum (RVSM) aircraft are those equipped with the required vertical navigation avionics.



Exception:

- Apply 2,000 feet at or above FL 290 between non-RVSM aircraft and all other aircraft at or above FL 290

Note: *The separation minima increases with altitude because altimeter errors are more likely at higher altitudes.*

Reduced Vertical Separation Minima (RVSM)

Some aircraft are not equipped with the required vertical navigation avionics. Therefore, standard separation (1,000 feet between FL 290 to FL 410) cannot be applied. These aircraft are referred to as non-RVSM aircraft.

Non-RVSM aircraft may only climb or descend through RVSM altitudes (FL 290 to FL 410). While transiting this airspace, 2,000 feet vertical separation must be maintained with all other aircraft.

Exceptions:

The following aircraft may be assigned altitudes between FL 290 and FL 410 without RVSM equipment, but require 2,000 vertical separation:

- Department of Defense (DOD) aircraft
- DOD-certified aircraft operated by NASA
- MEDEVAC
- Manufacturer's aircraft being flown for certification and development
- Foreign state aircraft

Note: *These exceptions are accommodated on a workload or traffic-permitting basis.*

Application of RVSM separation standards to formation flights is dependent upon the RVSM status of all aircraft involved. RVSM separation is only applied to formation flights consisting of all RVSM-approved aircraft.

Knowledge Check A

REVIEW what you have learned so far about vertical separation. ANSWER the questions below.

1. Match the terms associated with separation with the definition of the term. Enter your answers in the spaces below.

   b The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of ATC procedures

   d Separation between aircraft expressed in units of vertical distance

   c The spacing of aircraft to achieve safe and orderly movement in flight and while landing and taking off

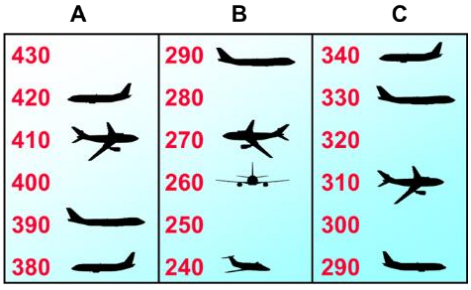
   a A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury

   a. Flight level
   b. Separation minima
   c. Separation
   d. Vertical separation

2. The ATC system is required to apply separation between an aircraft operating in the system and which of the following? *(Select all correct answers that apply.)*
   - ❑ **Protected airspace**
   - ❑ The environment
   - ❑ **Other aircraft**
   - ❑ Reported bird activity

3. All aircraft operating at or above _____ shall have the altimeter set to _____, regardless of the local altimeter settings at stations they fly over. *(Select the correct answer.)*
   - ❑ 17,000 MSL; 29.99
   - ❑ FL 180; 29.29
   - ❑ FL 170; 92.29
   - ❑ **18,000 MSL; 29.92**

4. Which of the following column(s) displays less than minimum vertical separation occurring between flight levels? *(Select the correct answer.)*
   - ❑ **A**
   - ❑ B
   - ❑ C
   - ❑ A and B



5. What is the basic minimum altitude for vertical separation between IFR aircraft at FL 390? *(Select the correct answer.)*
   - ❑ 5,000 feet
   - ❑ **1,000 feet**
   - ❑ 2,000 feet
   - ❑ 4,000 feet

Vertical Separation Summary

Vertical separation standards have been established to facilitate the safe navigation of aircraft in controlled airspace. It is your responsibility, as an air traffic controller, to fully understand and apply these standards to safely manage air traffic.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Review content presented in ***Vertical Separation*** lesson ■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content	Facilitated Discussion **EST. RUN TIME** 20 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Nonradar Separation*** lesson in Blackboard ■ Instruct students to navigate to the ***Nonradar Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 10 mins.

NONRADAR SEPARATION

Purpose: The purpose of this lesson is to identify other types of nonradar separation in addition to vertical separation and the basic minimum requirements of each.

Objective:

- Identify types of nonradar separation and basic minimum requirements for providing separation

References for this lesson are as follows:

- FAA Order JO 7110.65, Air Traffic Control

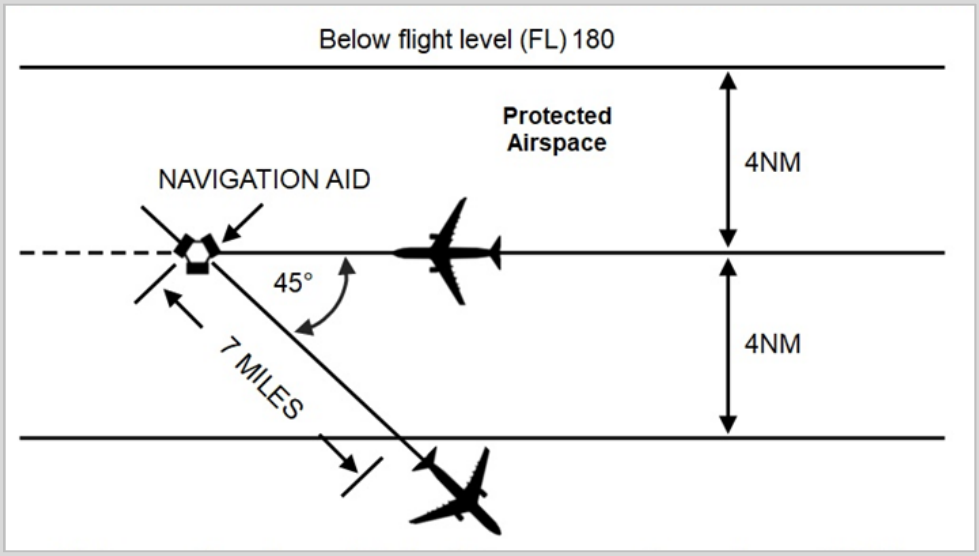
Nonradar Lateral Separation

Lateral Separation: the lateral spacing of aircraft at the same altitude by requiring operation on different routes or in different geographical locations.

Lateral separation is applied in traffic situations when neither vertical nor longitudinal separation exists.

Nonradar Lateral Separation Methods

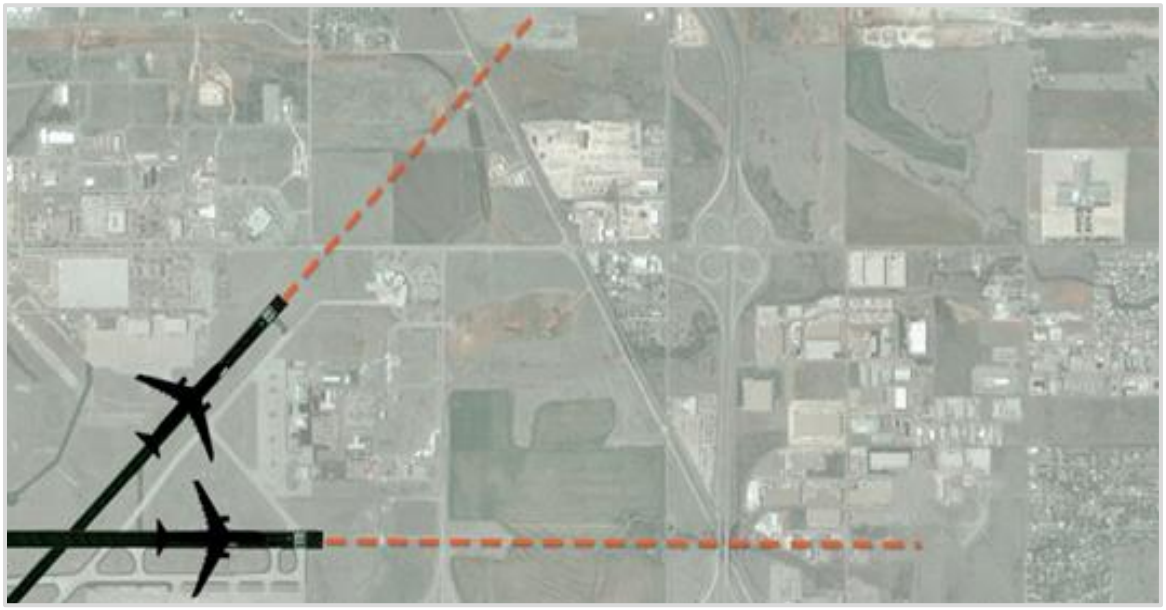
Aircraft are cleared to fly on different airways or routes whose widths or protected airspace do not overlap.



Minima on diverging radials for distance measuring equipment (DME) application (compensates for DME slant range)

Note: *Around each aircraft (to each side and ahead) is protected airspace. This slide is just an example. Many variables determine an aircraft's lateral protected airspace (i.e., altitudes, distance from NAVAID, type of NAVAID).*

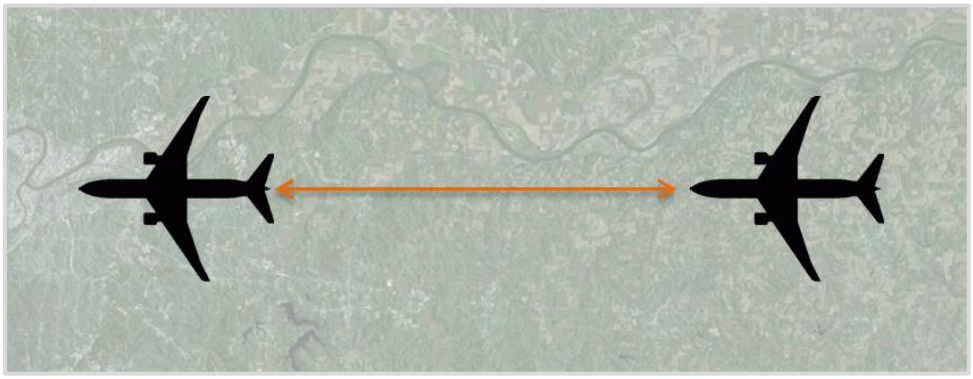
Clear departing aircraft to fly specified headings that diverge by at least 45 degrees.



Note: *Application of initial separation departure rules will be taught in the follow-on course.*

Longitudinal Separation

Longitudinal Separation: the longitudinal spacing of aircraft at the same altitude by a minimum distance expressed in units of time or miles.



Longitudinal Separation Courses

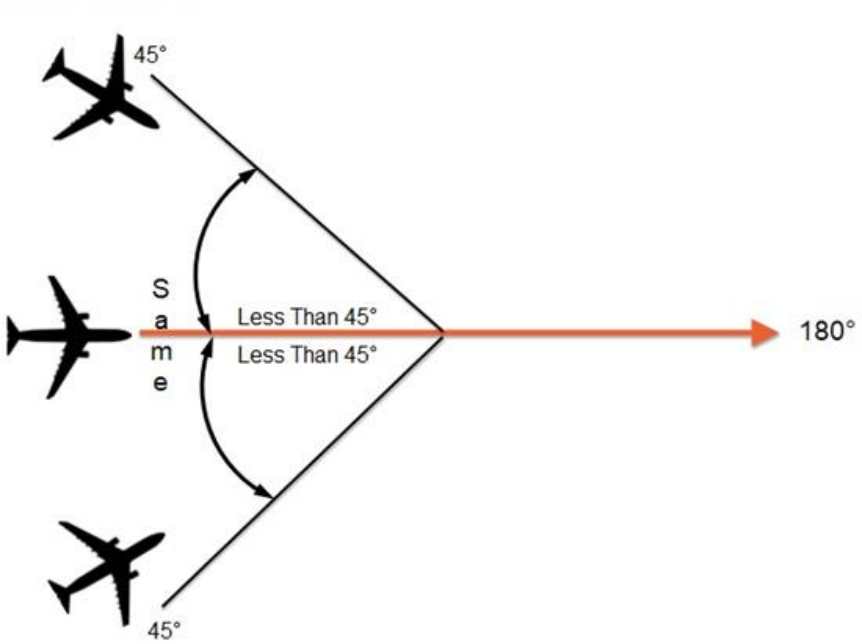
There are three basic courses in relation to other aircraft.

- Same Courses
- Crossing Courses
- Opposite/Reciprocal Courses

Note: *The definitions will be applied later in training.*

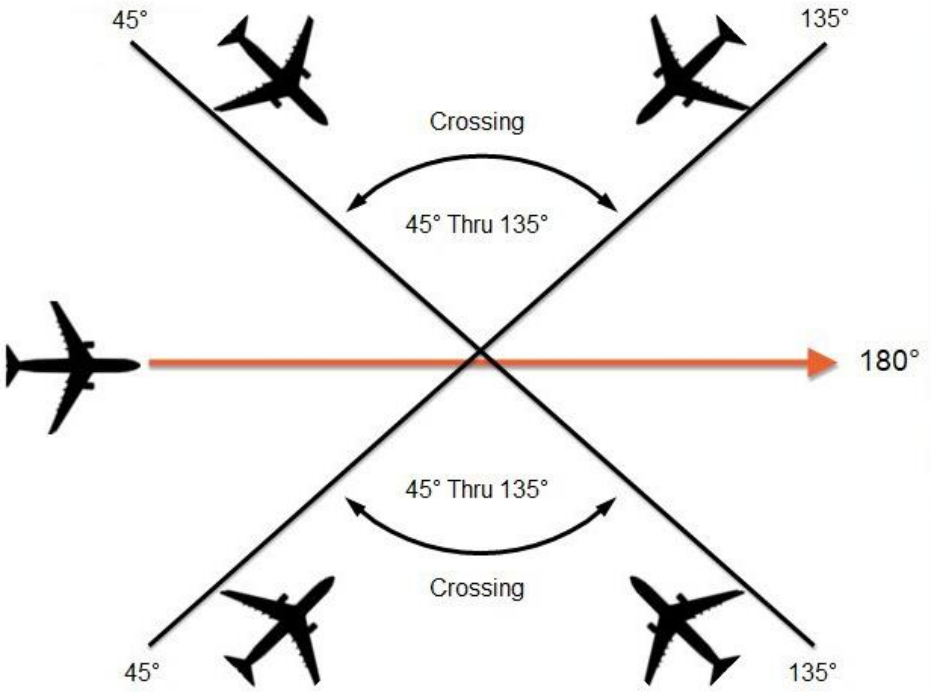
Same Course

Same Courses are courses whose protected airspaces overlap, intersect, or are coincident, and whose angular difference is less than 45 degrees.



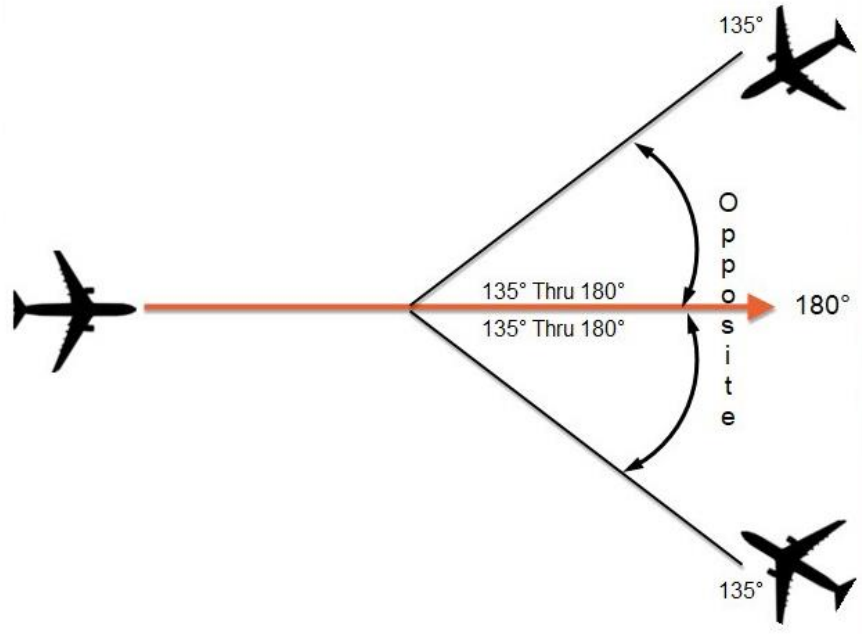
Crossing Courses

Crossing Courses are intersecting courses whose angular difference is 45 through 135 degrees inclusive.



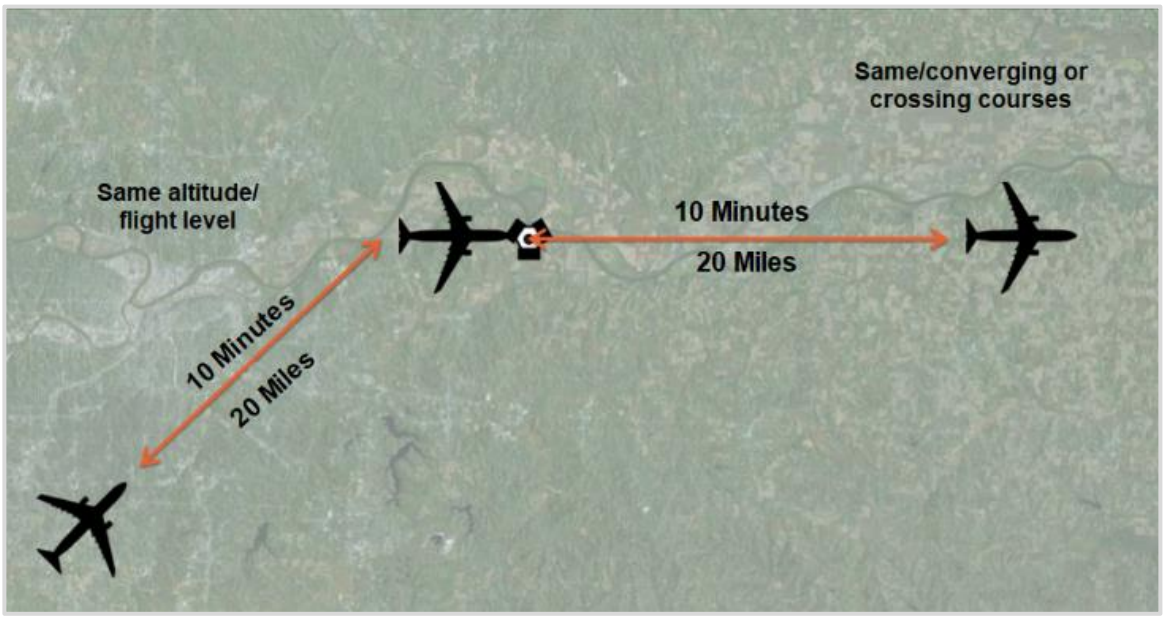
Opposite/Reciprocal Courses

Opposite/ Reciprocal Courses are courses whose protected airspaces overlap, intersect, or are coincident, and whose angular difference is greater than 135 degrees through 180 degrees inclusive.



Nonradar Longitudinal Separation Minima

The standard minima for nonradar longitudinal separation is 10 minutes or 20 miles between DME-equipped aircraft. Depending on speed, 10 minutes is usually more than 20 miles.

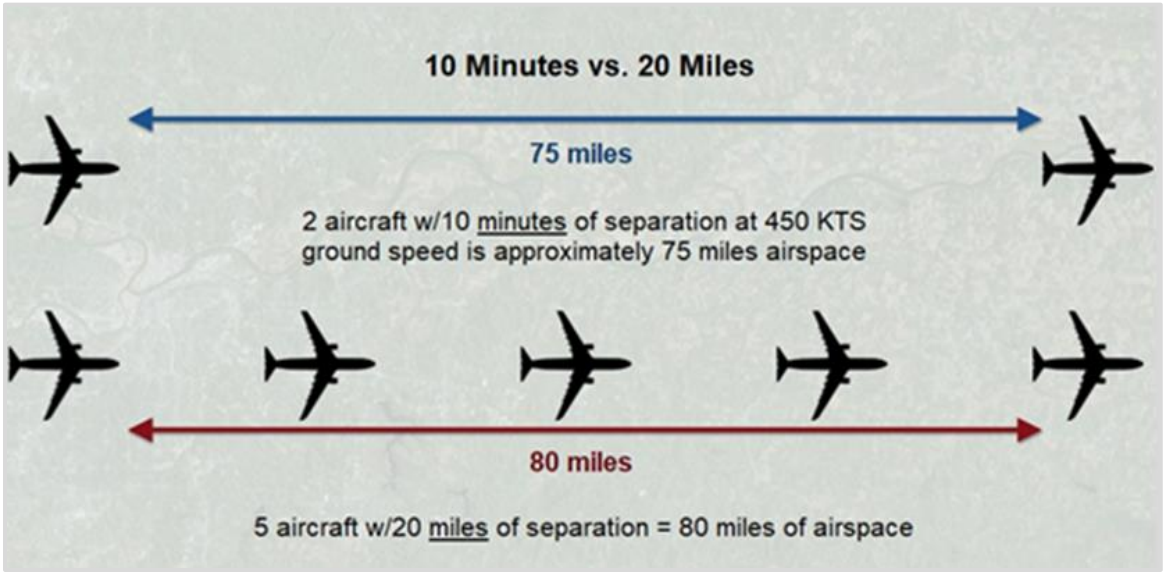


Pilot Position Reports

Establishing nonradar longitudinal separation using DME requires pilot position reports; always get the report of the lead aircraft first. Use DME procedures and minima only when direct pilot/controller communications are maintained.

Nonradar Longitudinal Separation Example

Using 450 knots (KTS) ground speed, separation between two aircraft with ***10 minutes*** in trail is approximately 75 miles, and five aircraft with ***20 miles*** of separation is 80 miles.

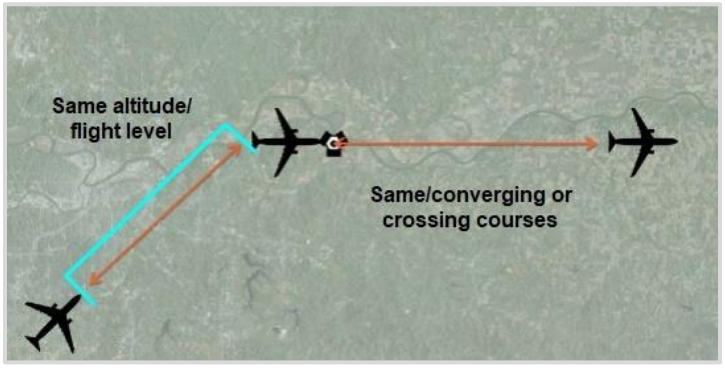


Knowledge Check B

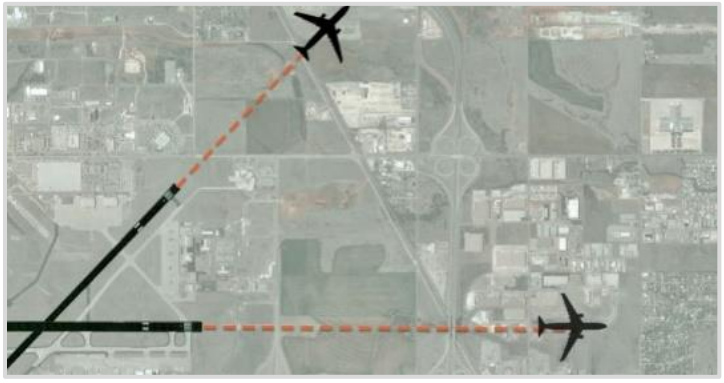
REVIEW what you have learned so far about nonradar separation. ANSWER the questions below.

View the image, then select the correct answer.

1. What is the minimum longitudinal separation required in **miles** and in **minutes** with both aircraft using DME? *(Select the correct answer.)*
   - ❑ 23 miles/ 12 minutes
   - ❑ **20 miles/ 10 minutes**
   - ❑ 30 miles/ 15 minutes



2. In the example below, what type of separation is being applied? *(Select the correct answer.)*
   - ❑ Vertical
   - ❑ Longitudinal
   - ❑ **Lateral**

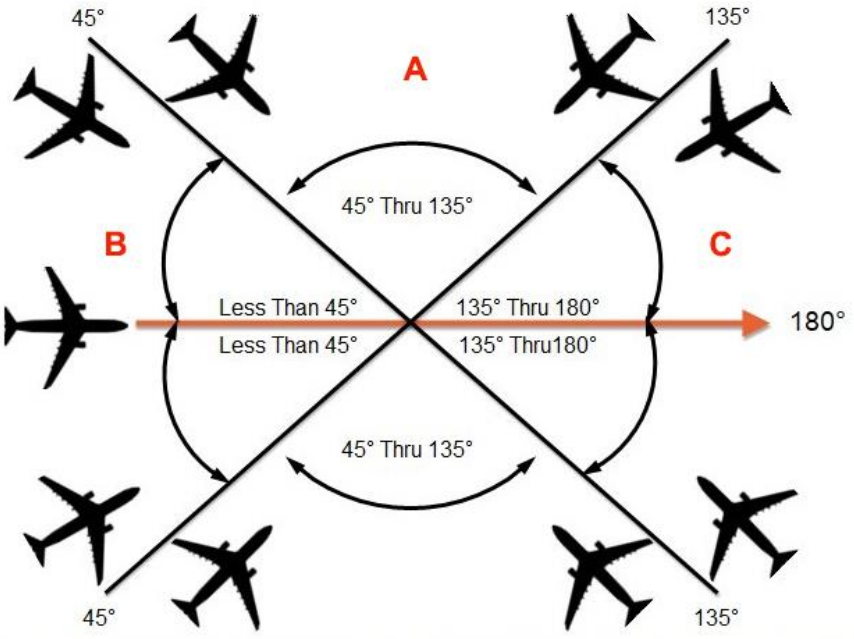


3. Using the Word Bank, label the courses appropriately. Enter your answers in the spaces below.
***Word Bank**: Opposite, Same, Crossing*

A. Crossing

B. Same

C. Opposite



Nonradar Separation Summary

Nonradar separation includes vertical, lateral, and longitudinal separation.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Review content presented in ***Nonradar Separation*** lesson ■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content	Facilitated Discussion **EST. RUN TIME** 15 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Radar Separation*** lesson in Blackboard ■ Instruct students to navigate to the ***Radar Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 24 mins.

RADAR SEPARATION

Purpose: The purpose of this lesson is to identify radar separation, and the minimum requirements when applying radar separation.

Objective:

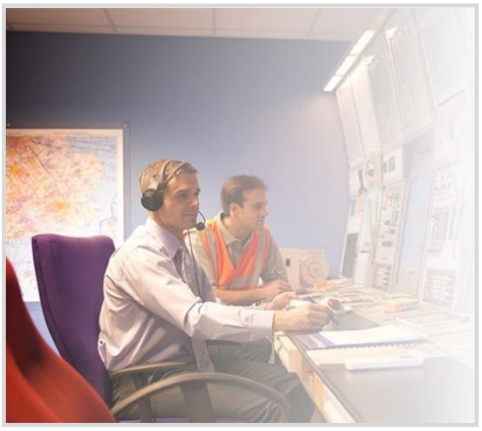
- Identify radar separation and basic minimum requirements for providing separation

References for this lesson are as follows:

- FAA Order JO 7110.65, Air Traffic Control

Radar Separation

Radar separation is radar spacing of aircraft in accordance with established minima.

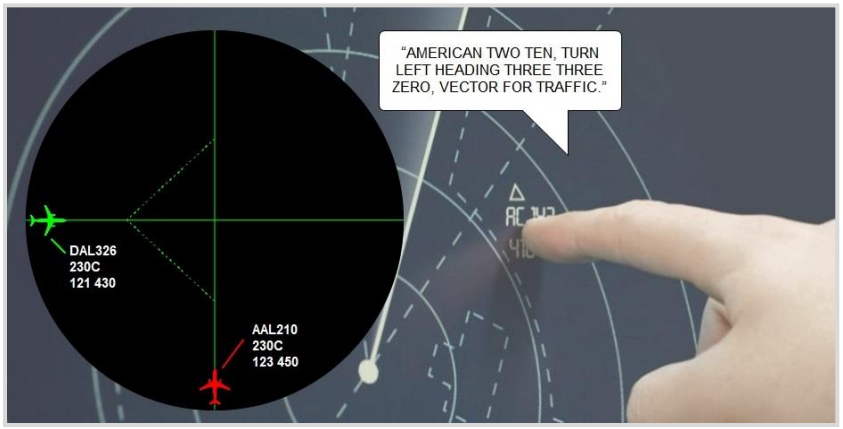


Radar separation is applied between:

- Radar identified aircraft
- Radar identified aircraft and adjacent airspace
- Radar identified aircraft and obstructions depicted on the radar display

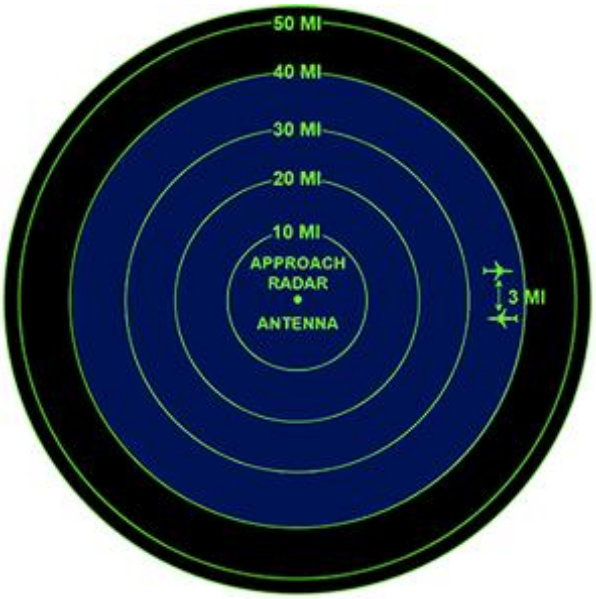
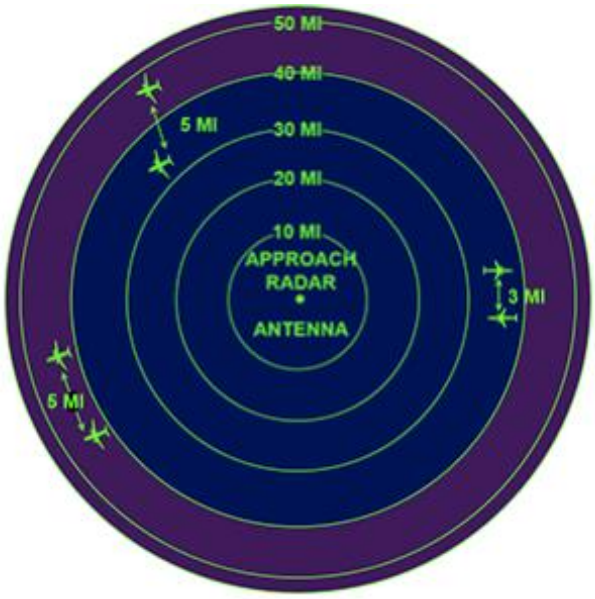
Separation minima requirements are established for:

- Terminal
- En route



Terminal Minima

When using ASR (Airport Surveillance Radar) or Digital Terminal Automation System (DTAS), radar separation depends on the distance the aircraft are from the antenna. Use the following minima:

When both aircraft are **less than 40 miles** from the antenna**, 3 miles** separation is required.	When either or both aircraft are **40 miles or more** from the antenna, **5 miles** of separation are required.
	

FUSION and Terminal Mosaic/Multi-Sensor Mode display aircraft using more than one radar source.

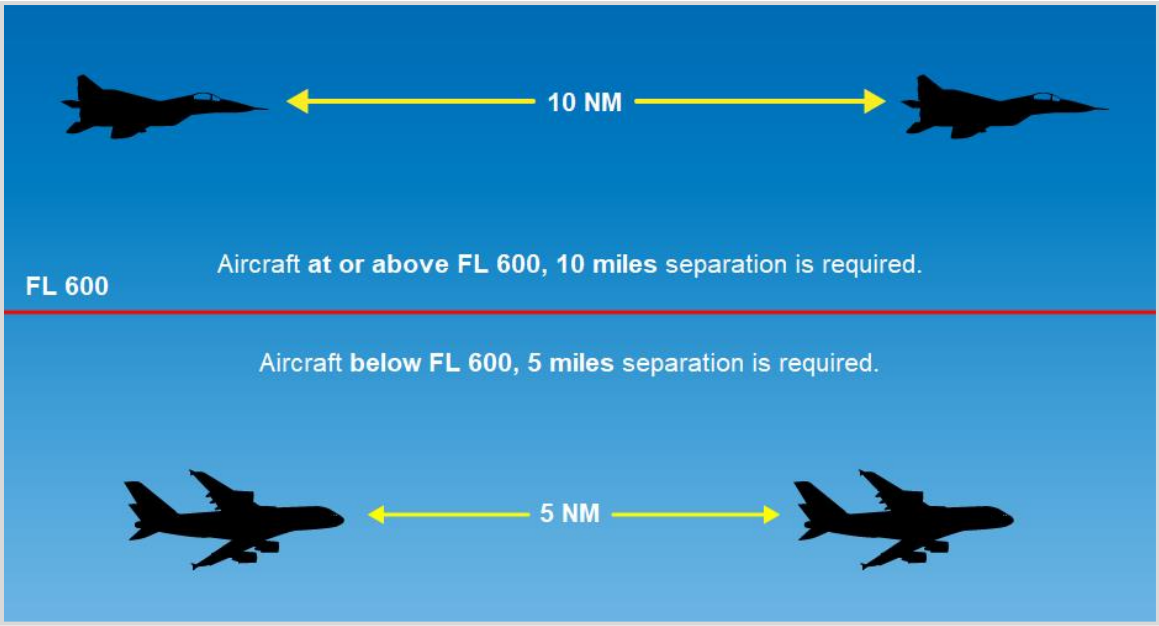
Use the following minima:

- FUSION
  - Fusion target symbol – 3 miles
  - When displaying ISR (Increased Separation Required) in the data block – 5 miles

- Terminal Mosaic/Multi-Sensor Mode
  - Below FL 600 − 5 miles
  - At or above FL 600 − 10 miles
  - Facility directives may specify 3 miles separation under certain conditions

An example of a FUSION display

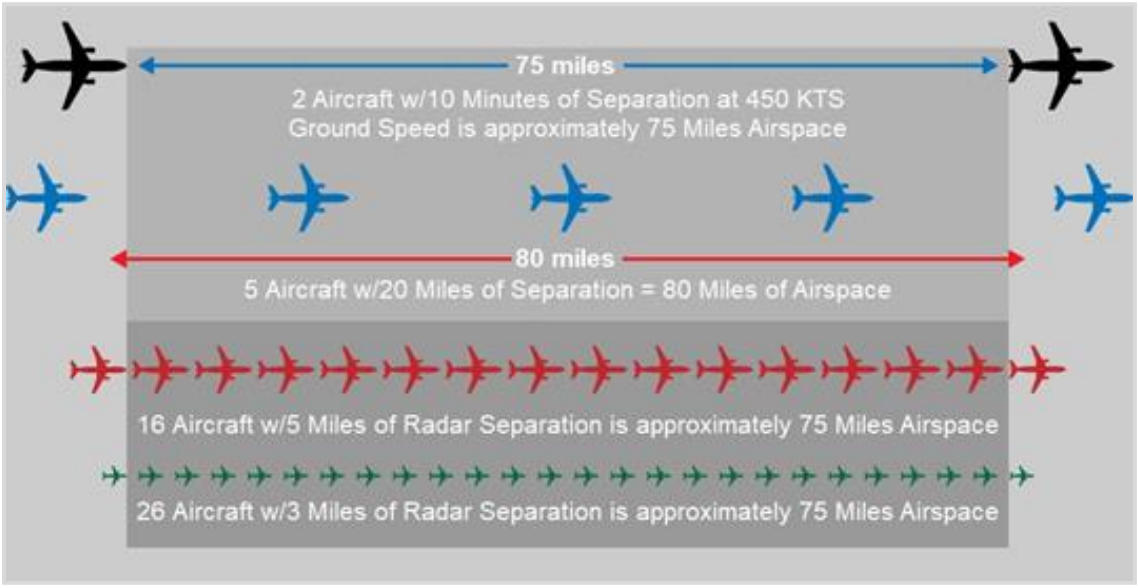
En Route Minima



Note: *JO 7110.65 Chapter 5 contains greater detail for separation minima required under different conditions.*

Radar vs. Nonradar Separation

Radar operations gain a significant advantage over nonradar operations.



Knowledge Check C

REVIEW what you have learned so far about radar separation. ANSWER the questions below.

1. The minimum terminal radar separation required for two aircraft 30 NM from the antenna is _____. *(Select the correct answer.)*
   - ❑ 1 mile
   - ❑ **3 miles**
   - ❑ 5 miles
   - ❑ 10 miles

2. The minimum en route radar separation required for two aircraft below FL 600 is _____. *(Select the correct answer.)*
   - ❑ 1 mile
   - ❑ 3 miles
   - ❑ **5 miles**
   - ❑ 10 miles

Video – *FAA Separation* (14:05 mins.)

Separation Review

Before we move to visual and runway separation, let's review what you have already learned about separation.

- Separation is the spacing of aircraft to ensure the safe and orderly movement of aircraft, while in flight or on the ground
- Separation occurs in both radar and nonradar environments
- Different separation minima are applied depending on the environment (radar/nonradar)

Radar Separation Summary

Aircraft flying under air traffic control supervision in controlled airspace can get within close proximity to other aircraft. Controllers apply radar separation minima procedures to keep aircraft separated safely at all times.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Review content presented in ***Radar Separation*** lesson ■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content	Facilitated Discussion **EST. RUN TIME** 10 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Visual Separation*** and ***Runway Separation*** lessons in Blackboard ■ Instruct students to navigate to the ***Visual Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of ***Visual Separation*** instruct students to navigate to the ***Runway Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 8 mins.

VISUAL SEPARATION

Purpose: The purpose of this lesson is to describe the conditions under which visual separation can be provided.

Objective:

- Identify visual separation and basic minimum requirements for providing separation

References for this lesson are as follows:

- FAA Order JO 7110.65, Air Traffic Control
- Aeronautical Information Manual (AIM)

Visual Separation

Visual Separation: a means employed by Air Traffic Control (ATC) to separate aircraft in terminal areas and en route airspace in the National Airspace System (NAS). There are two viewpoints from which to effect this separation:

Tower Applied

The tower controller sees the aircraft involved and issues instruction as necessary to ensure that aircraft avoid each other.

Visual separation may also be used up to, but **NOT** including, FL 180 under the following conditions:

- Direct communication is maintained with one of the aircraft involved, or ensure there is an ability to communicate immediately with applicable military aircraft
- The tower visually observes the aircraft, issues timely traffic advisories, and provides visual separation between the aircraft
- Issue control instructions, as necessary, to ensure continued separation between the applicable aircraft

Note: *More requirements of visual separation will be covered in later stages of training.*

Pilot Applied

A pilot sees the other aircraft involved and, upon instructions from the controller, provides his/her own separation by maneuvering his/her aircraft as necessary to avoid it. This may involve following another aircraft or keeping it in sight until it is no longer a factor.

Maintain communication with at least one of the aircraft involved and ensure there is an ability to communicate with the other aircraft.

The pilot sees the other aircraft and is instructed to maintain visual separation from the aircraft as follows:

- Tell the pilot about the other aircraft; Include position, direction, type, and unless it is obvious, the other aircraft's intention
- Obtain acknowledgment from the pilot that the other aircraft is in sight
- Instruct the pilot to maintain visual separation from that aircraft

Visual separation may be applied when other approved separation is assured before and after the application of visual separation. Always ensure that other separation will exist.

- Visual Separation Considerations
  - Aircraft performance characteristics
  - Wake turbulence
  - Closure rate
  - Route of flight
  - Known weather conditions
  - Aircraft position

Note: *Visual separation is* ***NOT*** *authorized when lead aircraft is a super.*

Visual Separation in Conjunction with Visual Approach Procedures

Controllers may use visual separation in conjunction with visual approach procedures.

Clear an aircraft for a visual approach when:

- The aircraft is number one in the approach sequence, or
- The aircraft is to follow a preceding aircraft and the pilot reports the preceding aircraft in sight and is instructed to follow it, or
- The pilot reports the airport or runway in sight but not the preceding aircraft. Radar separation must be maintained until visual separation is provided.

Knowledge Check D

REVIEW what you have learned so far about visual separation. ANSWER the questions below.

1. What are some of the factors that should be considered during visual separation? *(Select all correct answers that apply.)*
   - ❑ **Closure rate**
   - ❑ Flight plan type
   - ❑ **Aircraft performance**
   - ❑ Radar location
   - ❑ **Wake turbulence**

2. Under which conditions can you clear an aircraft for a visual approach? *(Select all correct answers that apply.)*
   - ❑ **The pilot reports the preceding aircraft in sight and is instructed to follow**
   - ❑ The aircraft is in the approach sequence on course with the runway
   - ❑ **The pilot reports the airport or runway in sight but NOT the preceding aircraft, as long as radar separation is maintained until visual separation is provided**
   - ❑ **The pilot reports the runway is in sight with NO preceding aircraft**

Visual Separation Summary

When you are directing aircraft to land, there are times when visual separation is the easiest and best way to go. However, you must remember the conditions under which it is okay to provide visual separation. Your ability to separate landing aircraft is paramount in providing safety to the pilots and their passengers.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ ***Note: Runway Separation*** lesson should have already been enabled in Blackboard, if not ensure it is enabled ■ Instruct students to navigate to the ***Runway Separation*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 10 mins.

RUNWAY SEPARATION

Purpose: The purpose of this lesson is to explain the basics of and requirements for runway separation as they pertain to different runway configurations.

Objective:

- Identify runway separation and basic minimum requirements for providing separation

References for this lesson are as follows:

- FAA Order JO 7110.65, Air Traffic Control
- Aeronautical Information Manual (AIM)

Runway Separation

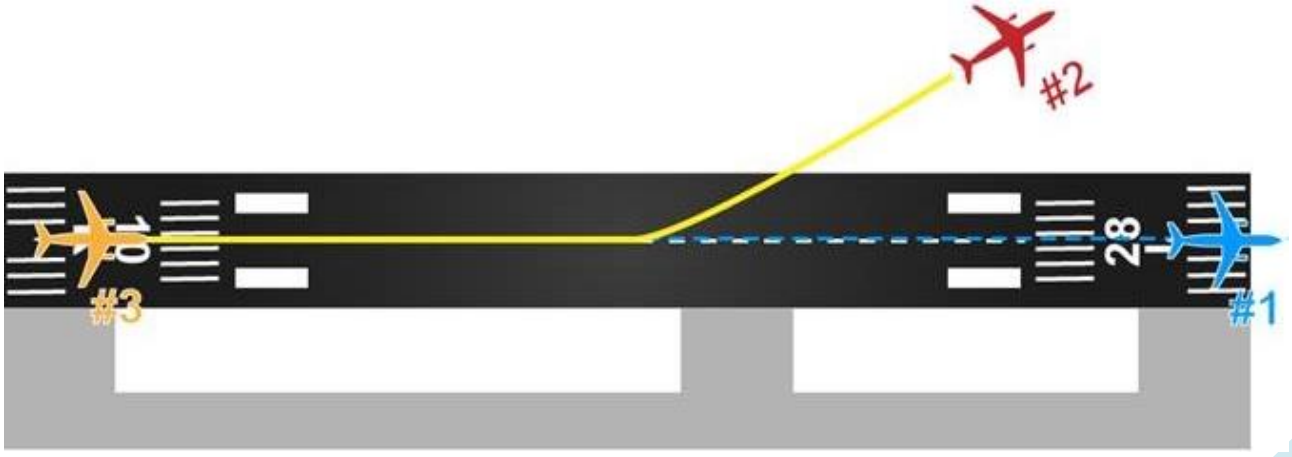
Runway separation is applied by tower controllers only. Generally, only one aircraft at a time is authorized to use a specific runway. There are several situations where runway separation is applied.

- Runway Separation Situations:
  - Same runway separation
    - Minimum distance between aircraft
    - Departure vs. arrival
  - Intersecting and nonintersecting converging runway separation

Same Runway Separation

When providing same runway separation:

- Ensure takeoff roll does **NOT** begin until a preceding departing aircraft has crossed the runway end (Aircraft #1) or has turned to avert a conflict (Aircraft #2)
- Ensure an arriving aircraft does **NOT** cross the landing threshold (Aircraft #3) until a preceding departing aircraft has crossed the runway end or has turned to avert a conflict



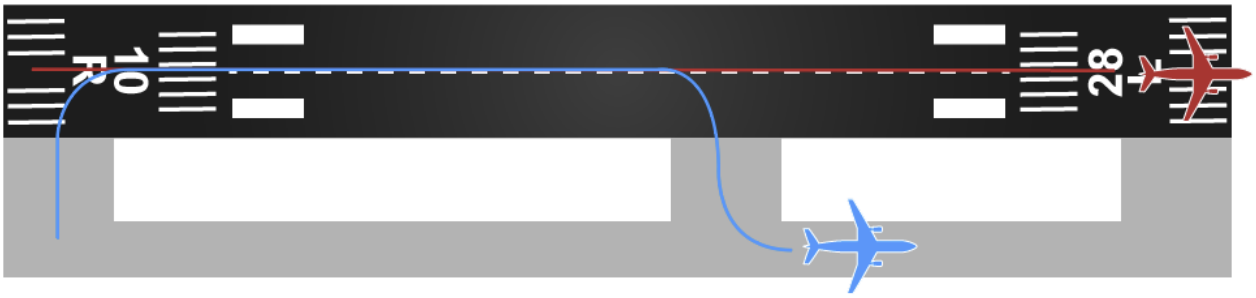
Minimum Distance Between Aircraft

If you can determine distances by reference to suitable landmarks, the other aircraft needs only be airborne if the appropriate minimum distance exists between aircraft.

Landmark	Distance Between Aircraft
Reference to suitable landmarks, including: ■ Runway markings ■ Runway intersections ■ Taxiways ■ Buildings adjacent to a runway ■ A navigational aid (NAVAID) adjacent to a runway	The following minimum distances exist between aircraft: ■ If a Category I aircraft is following another Category I or a Category II aircraft – 3,000 feet and airborne ■ If a Category II aircraft is following either a Category I or II – 4,500 feet and airborne ■ If either aircraft is a Category III – 6,000 feet and airborne ***Note:*** *Aircraft categories will be discussed later in the course.*

Departure vs. Arrival

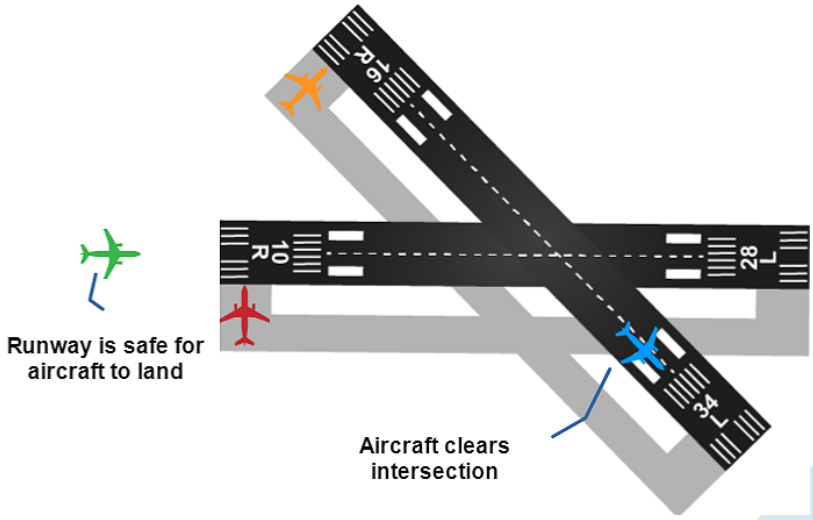
Ensure takeoff roll does **NOT** begin until preceding arriving aircraft has taxied off the runway.

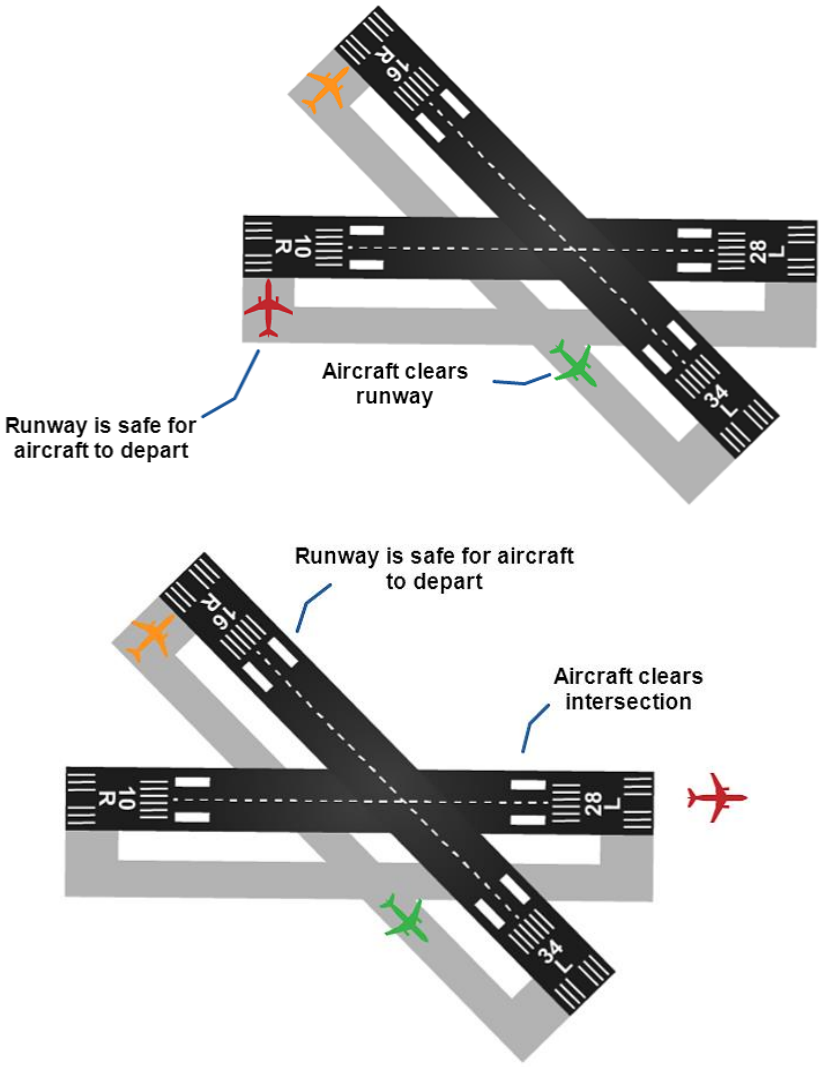


Intersecting and Nonintersecting Converging Runway Separation

Intersecting Runway Separation

Issue traffic information to each aircraft operating on intersecting runways. Separate departing aircraft from another aircraft using an intersecting runway by ensuring that the departure does not begin takeoff roll until certain conditions exist for any preceding departing or arriving aircraft.



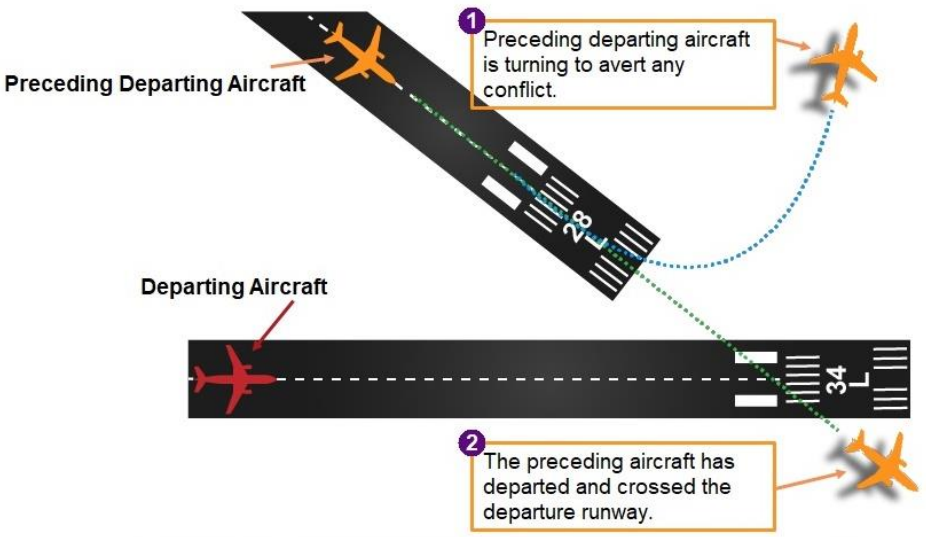


Separate departing aircraft from another aircraft using an intersecting runway by ensuring that the departure does not begin takeoff roll until one of the following exists:

Preceding Departing Aircraft	Preceding Arriving Aircraft
Ensure preceding departing aircraft: ■ Has departed and passed the intersection ■ Is turning to avert any conflict	Ensure preceding arriving aircraft: ■ Is clear of the landing runway ■ Completed the landing roll and: • Will hold short of the intersection, or • Has passed the intersection

Nonintersecting Converging Runway Separation

Separate departing aircraft from an aircraft using a nonintersecting runway when the flight paths intersect by ensuring that the departure does not begin takeoff roll until one of the following exists:



Knowledge Check E

REVIEW what you have learned so far about runway separation. ANSWER the questions below.

1. On the same runway, what conditions must exist for the preceding departing aircraft before allowing another aircraft to takeoff? *(Select all correct answers that apply.)*
   - ❑ **The aircraft must cross the runway end**
   - ❑ The aircraft must stop at the end
   - ❑ The aircraft must touch down
   - ❑ **The aircraft must turn to avert a conflict**

2. Which conditions must exist for preceding departing aircraft before a takeoff roll begins for another aircraft on nonintersecting runways? *(Select all correct answers that apply.)*
   - ❑ The runway end has been crossed
   - ❑ Takeoff roll has been initiated
   - ❑ **Has departed and crossed the departure runway**

Runway Separation Summary

During terminal operations, aircraft are closer together than at any other point. You must closely follow the guidelines and rules for each type of runway configuration.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Review content presented in ***Visual and Runway Separation*** lessons ■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content	Facilitated Discussion
	EST. RUN TIME
	20 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Holding Procedures*** lesson in Blackboard ■ Instruct students to navigate to the ***Holding Procedures*** lesson in Blackboard ■ Instruct students to work individually through the lesson content ■ Upon completion of the lesson, students should review previously introduced content or wait quietly until other students have completed	Blackboard **EST. RUN TIME** 10 mins.

HOLDING PROCEDURES

Purpose: The purpose of this lesson is to identify holding procedures and requirements when performing holding procedures.

Objective:

- Identify basic holding procedures and requirements to perform holding

References for this lesson are as follows:

- FAA Order JO 7110.65, Air Traffic Control
- Aeronautical Information Manual (AIM)

Holding Terms and Definitions

The following terms and definitions are associated with holding procedures.

- **Hold Procedure –** A predetermined maneuver that keeps an aircraft within a specified airspace while awaiting further clearance from air traffic control. Also used during ground operations to keep aircraft within a specified area or at a specified point while awaiting further clearance from air traffic control.
- **Holding Fix –** A specified fix identifiable to a pilot by NAVAIDs or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding.
- **Clearance Limit –** The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.
- **Expect Further Clearance (EFC) –** The time a pilot can expect to receive clearance beyond a clearance limit.

Holding Uses

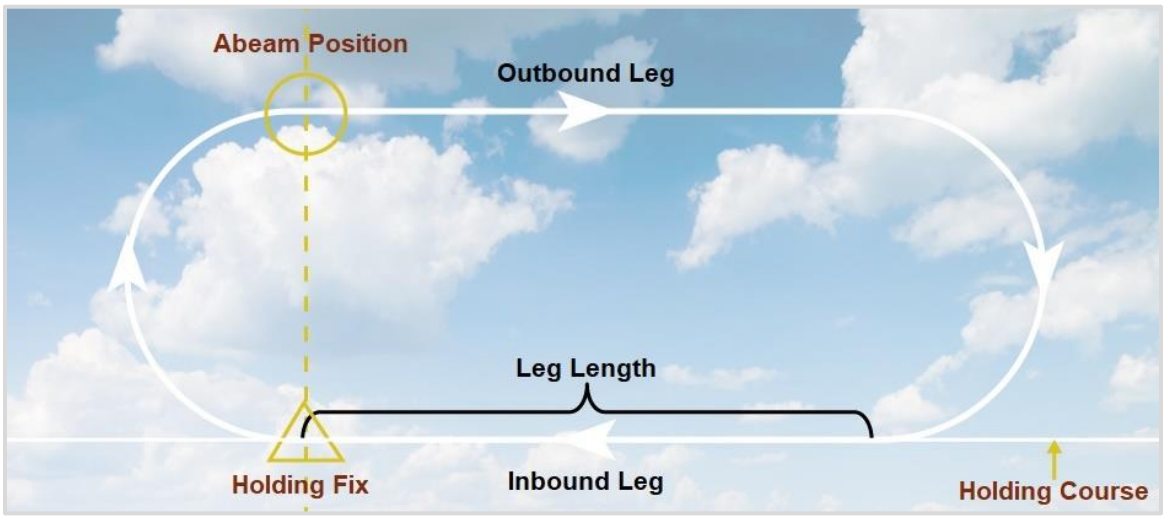
Holding is used for:

- Traffic En Route
- Arrival Delays
- Spacing / Flow Control
- Weather at Destination

Typical Holding Pattern

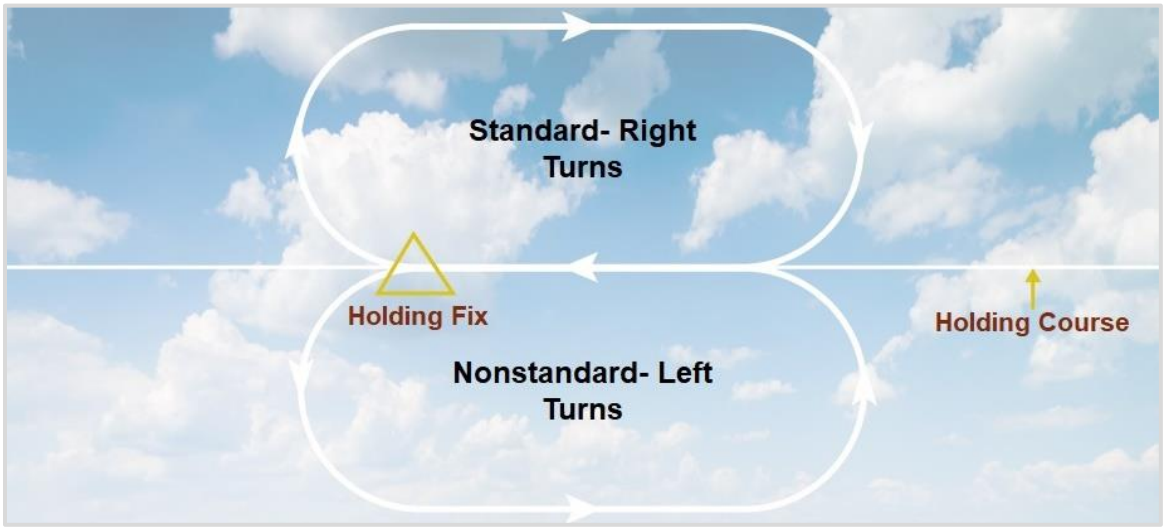
A **holding fix** is a specified fix identifiable to a pilot by NAVAIDs or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding.

An aircraft is **abeam** a fix, point, or object when that fix, point, or object is approximately 90 degrees to the right or left of the aircraft track. Abeam indicates a general position rather than a precise point



Standard/Nonstandard

- **Standard Pattern**
  - ***Right*** turns
  - One-minute leg (1½ minute above 14,000 MSL)
- **Nonstandard Pattern**
  - ***Left*** turns
  - Other than standard timing, or distance measuring equipment (DME) leg length



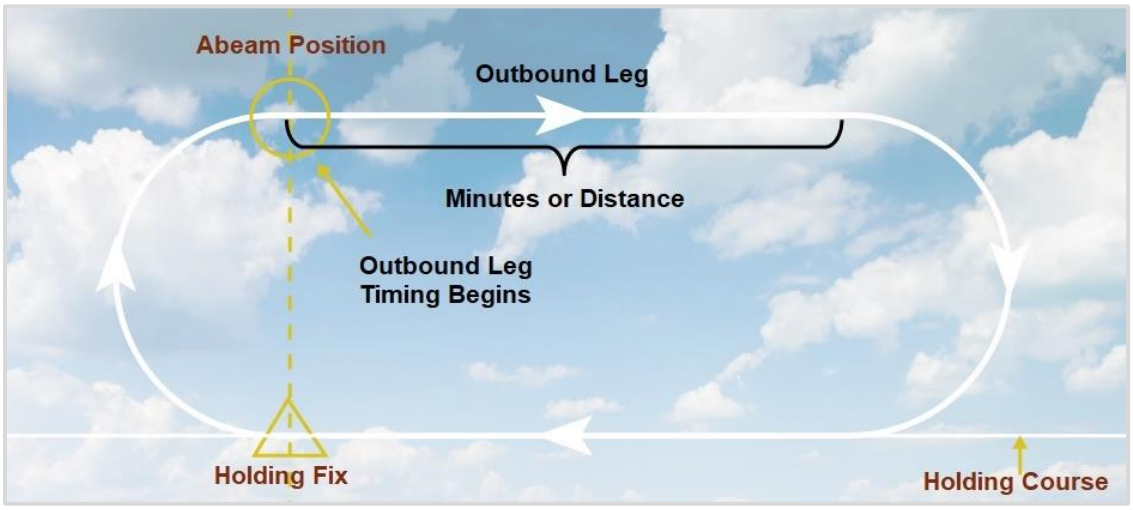
Outbound Leg

The outbound course of a DME holding pattern is called the **outbound leg** of the pattern.

- The length of the outbound leg may be specified by the controller

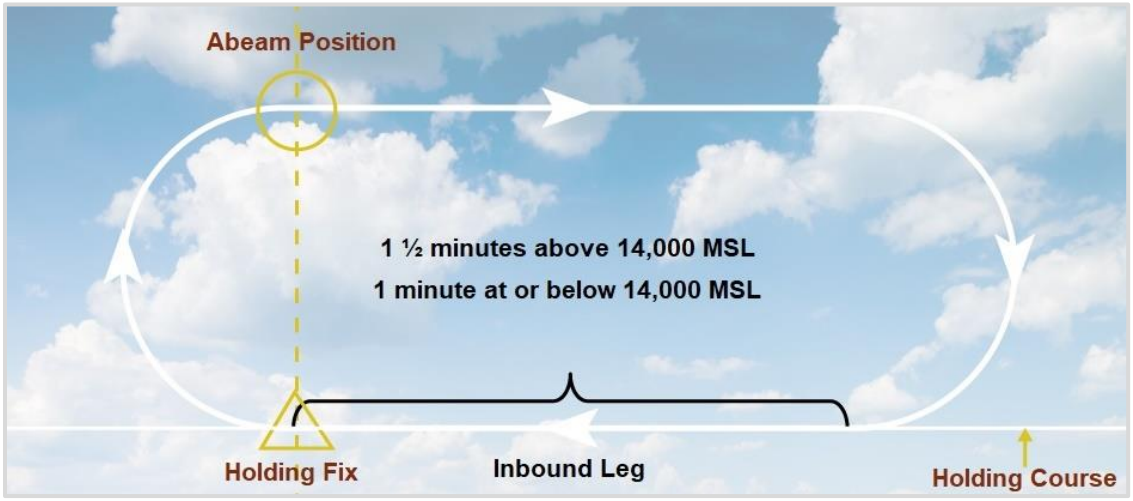
The **outbound leg** timing begins over/abeam the fix, whichever occurs later.

- If the abeam position cannot be determined, start timing when turn to outbound is completed



Inbound Leg

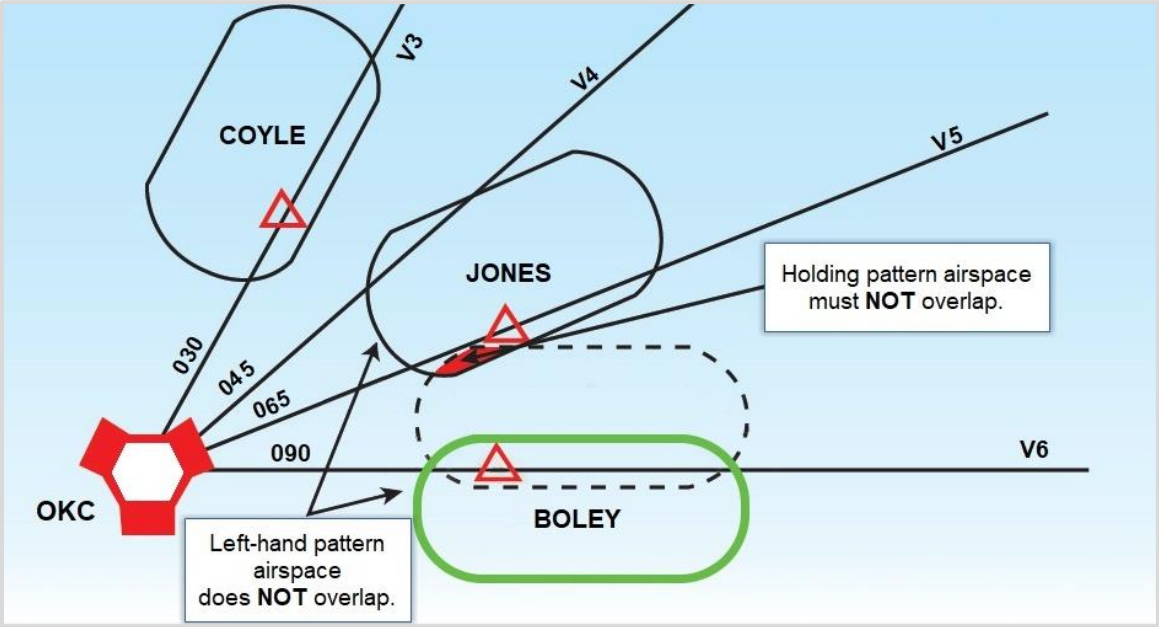
The **inbound** *radial, course, bearing, azimuth, airway, or route* to the holding fix on which the aircraft is to hold, usually expressed in units of time or distance.



Lateral Separation in Holding Patterns

Clear aircraft to hold over different fixes at the same altitude if their holding pattern airspace areas do **NOT** overlap:

- Each other
- Other airspace to be protected



Video – *Holding Separation* (1:53 mins.)

Knowledge Check F

REVIEW what you have learned so far about holding procedures. ANSWER the questions below.

1. Match the terms associated with holding procedures with the definition of the term. Enter your answers in the spaces below.

c	The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance	a. EFC
a	The time a pilot can expect to receive clearance beyond a clearance limit	b. Hold procedure
d	A specified fix identifiable to a pilot by NAVAIDs or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding	c. Clearance limit
b	A predetermined maneuver that keeps an aircraft within a specified airspace while awaiting further clearance from ATC	d. Holding fix

2. What must a controller ensure when directing aircraft to hold over different fixes at the same altitude? *(Select the correct answer.)*
   - ❑ All aircraft are turning left
   - ❑ Time of leg lengths are equal
   - ❑ **Holding pattern airspaces don't overlap**
   - ❑ Aircraft are using the same NAVAID to hold from

3. Which of the following procedures are applied by ATC for a typical holding pattern with a standard pattern? *(Select all correct answers that apply.)*
   - ❑ Two-minute legs above 14,000 MSL
   - ❑ DME leg length
   - ❑ **One-minute legs**
   - ❑ Left turns
   - ❑ **Right turns**

Holding Procedures Summary

Air traffic control orders aircraft into holding patterns for many reasons. Depending on the reason for the hold, several aircraft may fly the same holding pattern at the same time, separated by only 1,000 feet or more. As a controller, you must ensure the safety of all aircraft placed into a holding pattern until they can proceed with their flight.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Types of Separation*** activity in Blackboard ■ Instruct students to navigate to the ***Exercise and Activities*** folder in Blackboard ■ Instruct students to locate student activity ***Types of Separation*** ■ The activity will be performed individually ■ Instruct students to answer each question ■ At the end of the activity, the activity will evaluate the students' performance ■ Suggest allowing opportunities to repeat the activity during periods of down time	Activity **EST. RUN TIME** 15 mins.

ACTIVITY: TYPES OF SEPARATIONS (ANSWER KEY)

Note: *This is a matching activity where students will select the answer from these options: Vertical, Longitudinal, Lateral, Radar, and Visual. The questions in the key and their distractors may appear in a different order than displayed here due to activity question randomization.*

Question	Answer
1. Of the options listed below, which type of separation is being applied here?	**Lateral**
2. Of the options listed below, what separation is being applied by clearing an aircraft to depart at a specified time?	**Longitudinal**
3. Of the options listed below, what type of separation is being applied here?	**Radar**
4. Of the options listed below, what separation is being applied here?	**Vertical**
5. Of the options listed below, what type of separation is being applied when a pilot sees another aircraft and is instructed by the tower controller to follow that aircraft?	**Visual**

6. Of the options listed below, what separation is being applied when aircraft are cleared to hold over different fixes, as shown here?	**Lateral**
7. These two aircraft are at a terminal facility. Of the options listed below, which type of separation is shown here?	**Radar**
8. Of the options listed below, which type of separation is used to instruct a pilot to arrive at a fix at a specified time?	**Longitudinal**
9. Of the options listed below, what type of separation is being applied here?	**Vertical**
10. Of the options listed below, what separation would allow the scenario shown here?	**Longitudinal**
11. If you are holding two aircraft at different fixes whose protected airspace overlaps, what separation would you use of the options listed below?	**Vertical**

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Review content presented on any of the content discussed in the ***Holding Procedures*** lesson or ***Types of Separations*** activity. ■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content	Facilitated Discussion **EST. RUN TIME** 15 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Situation Separation*** game in Blackboard ■ Instruct students to navigate to the ***Exercises and Activities*** folder in Blackboard ■ Instruct students to locate ***Situation Separation*** game located in this folder ■ The game will be performed individually ■ Instruct students to answer each question ■ The game will evaluate the students' performance at the end ■ Suggest allowing opportunities to repeat the game during periods of down time	Game **EST. RUN TIME** 15 mins.

GAME: SITUATION SEPARATION (ANSWER KEY)

Note: *The questions in the key and their distractors may appear in a different order than displayed here due to game question randomization.*

Question	Answer
1. What is the minimum runway separation between two departing CAT III aircraft, departing on runway 18R?	**6,000 feet and airborne** 1,000 feet 4,500 feet and airborne 3,000 feet
2. What must ATC ensure when using nonradar departure divergence?	**Assign courses that diverge by at least 45 degrees** Visual separation exists There are two available runways that intersect Wait 10 minutes between successive departures
3. Which of the following actions must be completed by departing aircraft, before ATC allows a following aircraft to take off on the same runway?	**Departing aircraft has crossed the runway end; and** **Departing aircraft has turned to avoid contact** Departing aircraft must reach runway end
4. Which type of separation is achieved by the assignment of altitudes or flight levels?	**Vertical separation** Lateral separation Visual separation All of the above
5. How many miles are required between two en route aircraft at FL 270 when using standard radar separation?	**5** 20 10 3
6. What is the standard minima for nonradar longitudinal separation?	**10 minutes or 20 miles** 1,000 feet or 20 minutes 2,000 feet or 10 minutes 10 minutes or 10 miles

Question	Answer
7. What is the minimum vertical separation between RVSM-equipped IFR aircraft, flying up to and including FL 410?	**1,000 feet** 4,000 feet 5,000 feet 2,000 feet
8. What is the minimum radar separation required between two en route aircraft below FL 600?	**5 miles** 10 miles 20 miles 3 miles
9. At what altitude can a controller use visual separation?	**Up to, but not including, FL 180** Up to and including 18,000 feet MSL At FL 180 and below Up to, but not including, 18,000 feet AGL
10. What is the most important factor a controller must ensure, when clearing aircraft to hold over different fixes, at the same altitude?	**Holding pattern airspace areas do not overlap** Aircraft hold from same abeam position Aircraft are directed to follow a standard pattern Leg lengths are always specified in minutes
11. If two aircraft are 34 miles from the radar antenna, what is the minimum terminal radar separation that is required between the aircraft?	**3 miles** 15 miles 1 mile 10 miles
12. Which of the following are true statements when issuing holding procedures?	**Standard holding procedures always use right turns; and** **A holding fix is specified by ATC** Holding procedures are only issued for weather Holding pattern leg lengths are always specified in miles

Question	Answer
13. In order for a tower to provide visual separation between two arriving IFR aircraft, what conditions must be present?	**Both aircraft must be visually observed by the tower** One of the aircraft must be visually observed by the tower The pilots of both aircraft must see each other None of these
14. Which of the following conditions must be present for a tower controller to use visual separation?	**All of the above** **The tower controller sees the aircraft involved;** **The capability to communicate immediately must be available;** **Communication with at least one of the aircraft is maintained**
15. If a preceding aircraft is on a visual approach to runway 18R, what must happen in order for the following aircraft to be cleared for visual approach?	**Following aircraft must have preceding aircraft in sight and be told to follow** Following aircraft must have the airport in sight Following aircraft states it is ready to land Following aircraft must see other aircraft landing on runway 18L

SUMMARY

The purpose of this module was to introduce you to the different types of separation used every day by controllers to provide safe, orderly, and expeditious separation of air traffic within the National Airspace System (NAS).

In accordance with FAA Order JO 7110.65, Air Traffic Control, and the Aeronautical Information Manual (AIM), you should now be able to:

- Identify vertical separation and basic minimum requirements for providing separation
- Identify types of nonradar separation and basic minimum requirements for providing separation
- Identify radar separation and basic minimum requirements for providing separation
- Identify visual separation and basic minimum requirements for providing separation
- Identify runway separation and basic minimum requirements for providing separation
- Identify basic holding procedures and requirements to perform holding

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ Navigate to the ***Parking Lot*** link within Blackboard and review any student questions ■ Address ***Parking Lot*** questions and facilitate a brief discussion of the lesson content ■ Instruct students to prepare for the End-of-Module test by putting away their Student Guides	Facilitated Discussion **EST. RUN TIME** 20 mins.

FACILITATOR INSTRUCTIONS	DELIVERY METHOD
■ **ENABLE *Separation End-of-Module Test*** link in Blackboard ■ Instruct students: ○ Clear desks ○ Do not write anything during or after the test ○ Navigate to the ***Separation End-of-Module Test*** link in Blackboard ○ Once they are satisfied with their responses, click “Save and Submit;” do not click “OK” to review results until directed to do so ○ Choose “Cancel” if they receive a warning message that the test has unanswered questions; choosing OK will submit the test and not allow them to go back and answer the questions ○ Leave the room after submitting the test and return at the “Be Back” time ■ ***Note:*** *This test is scored but not graded* ■ During test, monitor students to ensure a secure testing environment ■ Identify the most commonly missed questions by reviewing student statistics in Blackboard ■ Instruct students to click “View Results” when ready to review commonly missed questions ■ Review commonly missed questions with students	Blackboard Assessment **EST. RUN TIME** 20 mins.

END-OF-MODULE TEST (ANSWER KEY)

Note: *Test questions in Blackboard are presented to the students in random order. Please be aware the test key question order will not match the student version.*

1. Aircraft that are **NOT** equipped with the required vertical navigation avionics must be separated by how many feet as they climb or descend through the RVSM altitudes? *(Select the correct answer.)*
   - ❑ **2,000**
   - ❑ 4,000
   - ❑ 1,000
   - ❑ 500

   Reference(s): JO 7110.65, Chap. 4

2. What is the vertical separation minima between two IFR aircrafts below FL 180? *(Select the correct answer.)*
   - ❑ **1,000 feet**
   - ❑ 500 feet
   - ❑ 2,000 feet
   - ❑ 4,000 feet

   Reference(s): JO 7110.65, Chap. 4

3. Longitudinal separation is applied between aircraft on _____. *(Select the correct answer.)*
   - ❑ **All of the answers**
   - ❑ Same courses
   - ❑ Crossing courses
   - ❑ Opposite/Reciprocal courses

   Reference(s): JO 7110.65, Chap. 1

4. What is the standard minima for nonradar longitudinal separation? (*Select the correct answer.)*
   - ❑ **10 minutes or 20 miles**
   - ❑ 20 minutes or 20 miles
   - ❑ 450 knots or 75 miles
   - ❑ 450 knots or 10 miles

   Reference(s): JO 7110.65, Chap. 6

5. Radar separation is applied between an aircraft and which of the following? *(Select the correct answer.)*
   - ❑ **All of the answers**
   - ❑ Another aircraft
   - ❑ Adjacent airspace
   - ❑ Obstructions on the radar display

   Reference(s): JO 7110.65, Pilot/Controller Glossary

6. What must ATC do prior to authorizing pilot-applied visual separation? *(Select the correct answer.)*
   - ❑ **Maintain communication with at least one of the aircraft involved and ensure there is an ability to communicate with the other aircraft**
   - ❑ Discontinue control instructions
   - ❑ Maintain radar surveillance and ensure there is an ability to communicate with the other aircraft
   - ❑ Issue traffic and weather advisories and issue control instructions to the lead aircraft

   Reference(s): JO 7110.65, Chap. 7; AIM, Chap. 7

7. What must ATC ensure before clearing an aircraft for takeoff after previously arriving aircraft has landed? *(Select the correct answer.)*
   - ❑ **Takeoff roll does not begin until preceding aircraft has taxied off the runway**
   - ❑ Arriving aircraft has passed the halfway point of runway
   - ❑ Distances between aircraft can be determined by suitable landmark
   - ❑ Both aircraft have established communication by tower

   Reference(s): JO 7110.65, Chap. 3

8. How would a pilot proceed in a standard holding pattern below 14,000 feet MSL? *(Select the correct answer.)*
   - ❑ **Turn right and maintain 1-minute leg**
   - ❑ Turn left and maintain 1-minute leg
   - ❑ Turn left and maintain DME leg
   - ❑ Turn right and maintain DME leg

   Reference(s): AIM, Chap. 5