Federal Aviation Administration

Initial En Route Qualification Training

Lesson 17
Longitudinal Separation

Course 50148001

LESSON PLAN DATA SHEET

COURSE NAME:	INITIAL EN ROUTE QUALIFICATION TRAINING
COURSE NUMBER:	50148001
LESSON TITLE:	LONGITUDINAL SEPARATION
DURATION:	8+00 HOURS
DATE REVISED:	2022-02
VERSION:	V.2022-02
REFERENCE(S):	FAA ORDER JO 7110.65, AIR TRAFFIC CONTROL
HANDOUT(S):	longpttask.f2k - LONGITUDINAL SEPARATION PART-TASK STRIPS
EXERCISE(S)/ ACTIVITY(S):	EXERCISE: APPLYING LONGITUDINAL SEPARATION
END-OF-LESSON TEST:	YES
PERFORMANCE TEST:	NONE
MATERIALS:	NONE
OTHER PERTINENT INFORMATION:	LONGITUDINAL SEPARATION PART-TASK LAB WILL BE COMPLETED AT THE END OF THIS LESSON FOLLOWING A REVIEW OF NONRADAR LAB PROCEDURES.

INTRODUCTION

In a previous lesson, you learned how to apply vertical separation. In this lesson, you will apply longitudinal rules between same courses and opposite courses aircraft using time and distance.

The en route controller, using a combination of vertical, lateral, and longitudinal rules, can safely and efficiently move aircraft through the NAS.

INTRODUCTION *(Continued)*

LONGITUDINAL SEPARATION

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Longitudinal separation is a very important tool used by the controller to separate aircraft. There will be situations when the use of vertical and/or lateral separation rules becomes impossible. You **must** be able to apply the rules of longitudinal separation when the need arises.

Purpose

⊙ This lesson will cover rules and procedures concerning longitudinal separation between aircraft:

- On the same course
- On converging courses
- On crossing courses
- On opposite direction courses
- Changing altitudes

INTRODUCTION *(Continued)*

Lesson Objectives

LESSON OBJECTIVES

- On an End-of-Lesson Test, and in accordance with FAA Order JO 7110.65, you will identify longitudinal separation minima for aircraft on same, converging, crossing, or opposite-direction courses

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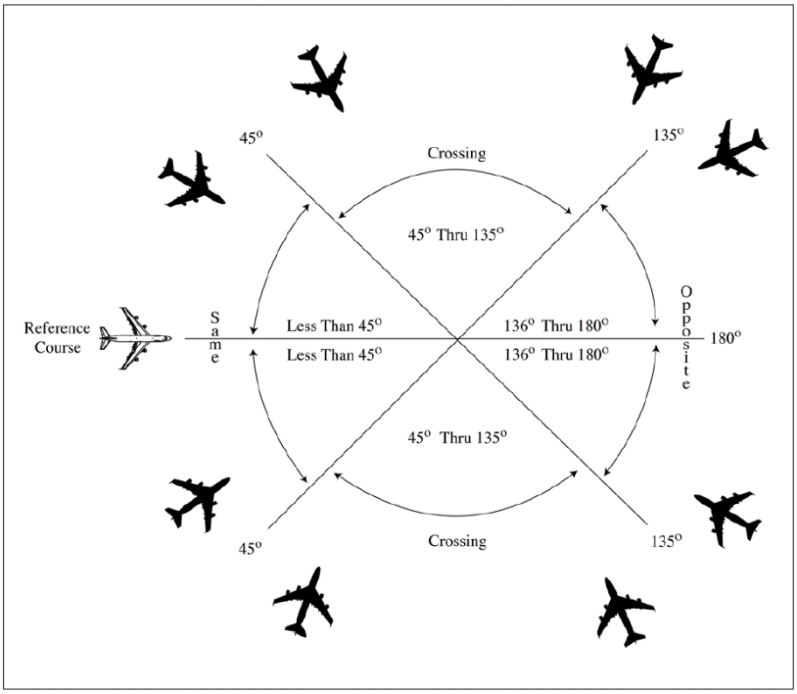
COURSE DEFINITIONS

Courses Chart
JO 7110.65, par. 1-2-1

DIVERGENCE



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Same Courses
JO 7110.65, par. 1-2-2a

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

Crossing Courses
JO 7110.65, par. 1-2-2b

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

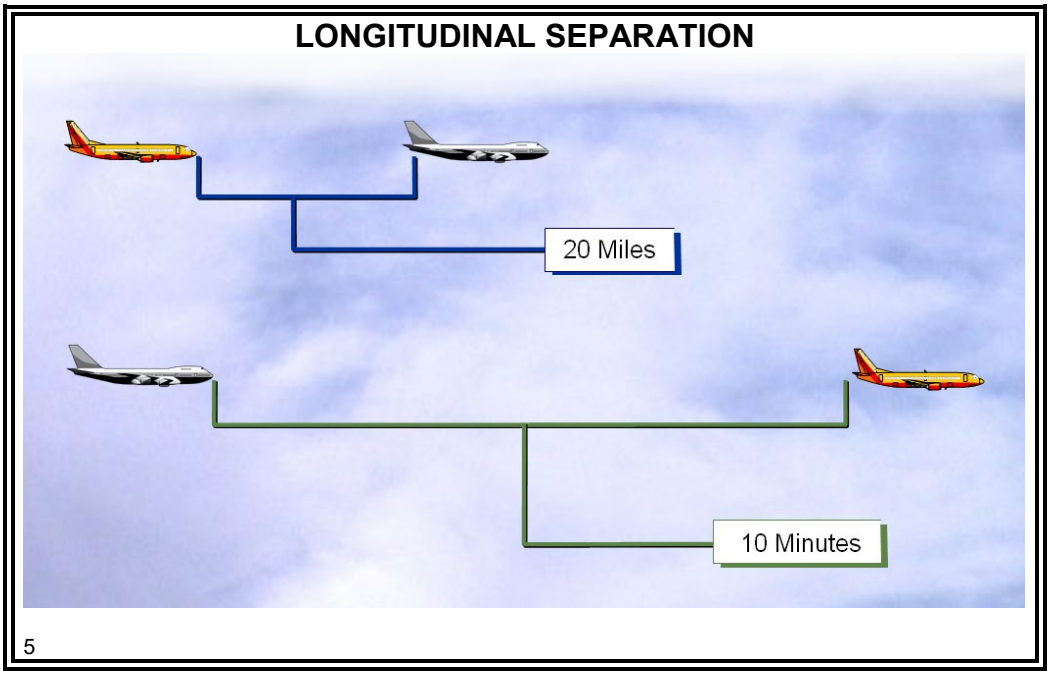
Opposite / Reciprocal Courses
JO 7110.65, par. 1-2-2c

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

NOTE: Later in this lesson “estimated to pass” minima on opposite courses will be covered. In Aero Center “estimated to pass” situations should be converted to vertical or lateral situations by using the alternate airways if possible. Tail to tail and DME passage rules for opposite courses will be demonstrated in part task exercises and scenarios.

APPLYING LONGITUDINAL SEPARATION

Longitudinal Separation Definition
JO 7110.65, Pilot/Controller Glossary



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

APPLYING LONGITUDINAL SEPARATION *(Continued)*

Methods
JO 7110.65,
par. 6-4-1

METHODS FOR LONGITUDINAL SEPARATION

Separate aircraft longitudinally by requiring them to use one of the following methods, as appropriate:

- Depart at a specified time
- Arrive at a fix at a specified time
- Hold at a fix until a specified time
- Change altitude at a specified time or fix

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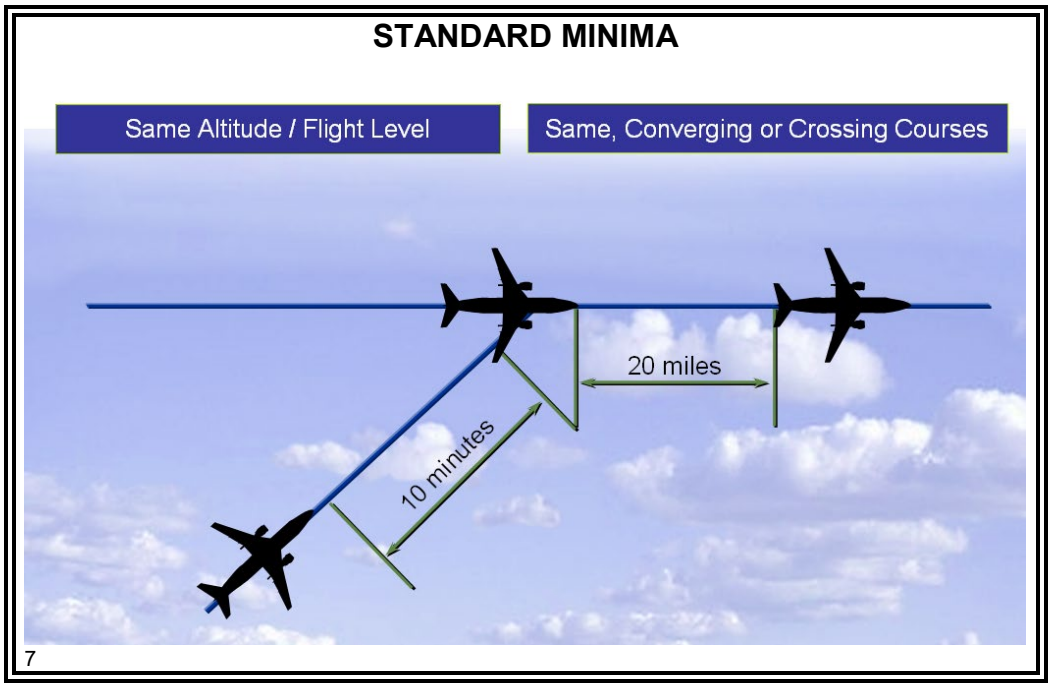
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES

Mileage-Based Procedures
JO 7110.65, par. 6-1-1, Pilot/Controller Glossary

⊙ Use mileage-based (DME and ATD) procedures and minima **only** when direct pilot-controller communications are maintained.

📖 **Along-Track Distance (ATD)** is the distance measured from a point in space by systems using area navigation reference capabilities that are **not** subject to slant range errors.

Standard Minima
JO 7110.65, par. 6-4-2



⊙ 20 miles between:

- DME-equipped aircraft
- RNAV-equipped aircraft using ATD
- DME and ATD equipped aircraft, provided
  - DME aircraft is at or below 10,000 or farther than 10 miles from the DME NAVAID

NOTE: Using **"**Say DME" instead of "Say position" ensures all aircraft use DME mileages which allow all aircraft to have the same slant range error.

⊙ 10 minutes between all other aircraft

NOTE: **Must** coordinate with next facility/sector if **less than** 10 minutes.

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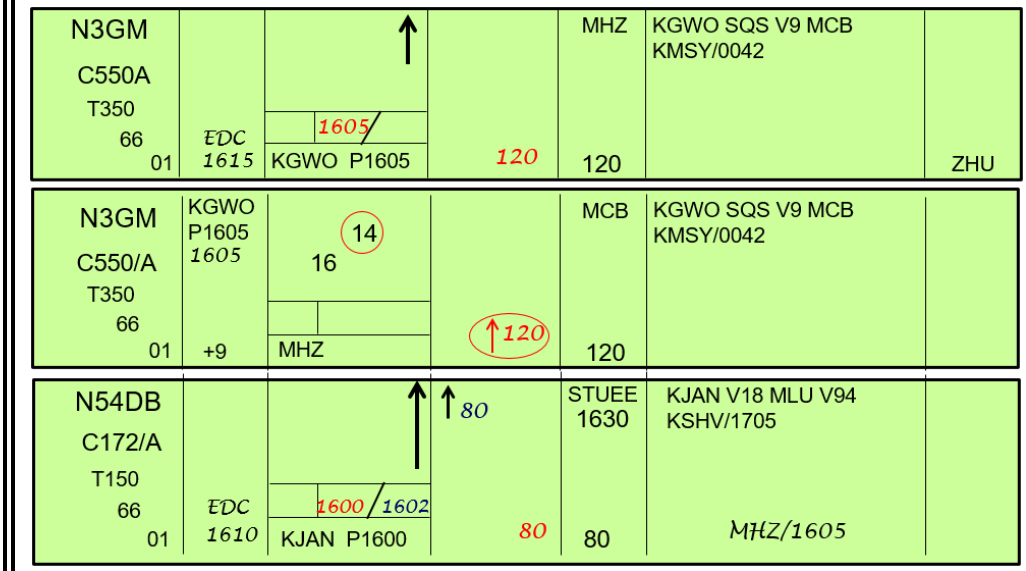
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Standard Minima (Cont'd)

NOTE: If an aircraft departs KJAN or KGWO and separation is needed at the MHZ or SQS VORTAC for other traffic, an airport departure time does not provide separation because the airports and VORTACs are not co-located.

You must solicit either a DME report or VORTAC/FIX report to ensure separation. If a MHZ or SQS VORTAC time is needed for separation on a departure aircraft, you must record the time in space 26 of the flight progress strip using the format MHZ/1210. If a current position report is solicited, you must record the time in space 26 of the flight progress strip using the format 15NW/1213 or 15NWSQS/1225.

SEPARATION WHEN AIRPORT AND VORTAC ARE NOT CO-LOCATED



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- In this example, N54DB departed with a KJAN departure time of 1602. Greenwood Tower later requests a clearance for N3GM. After running the times out, there appears to be 12 minutes separation at MHZ . The KJAN Airport and the MHZ VORTAC are not co-located, but are 10 miles apart. Therefore, a position report is required to ensure separation at the MHZ VORTAC. This report must be solicited prior to issuing a clearance to N3GM.

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What time must “B” arrive over the fix in order to effect minimum separation?

A. 1505

B. 1510

C. 1523

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Continued on next page

MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

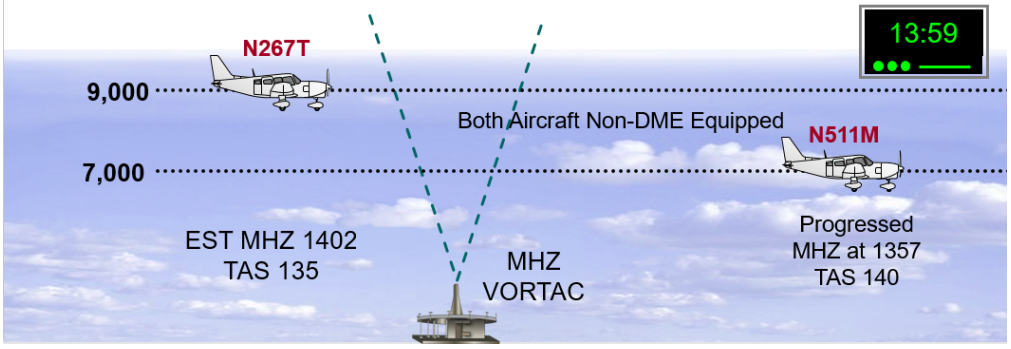
KNOWLEDGE CHECK

QUESTION: At 1359, N267T requests 7,000. The controller should _____.

A. assign 7,000 after N267T reports Magnolia

B. clear N267T to 7,000 at 1402

C. advise N267T unable 7,000



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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: What is the earliest time N22L may depart and climb to eight thousand?

N22L AC68/A T175 66 01		↑ KGWO P1620		MHZ 80	KGWO SQS V9 KMCB/0055	
N52B C310/A T180 66 01		T→SW-SQS ↑ 1610/1615 KGWO P1615	↑80	MHZ 80	KGWO SQS V9 KMCB/0055	D-A

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: RCH1586 has requested 120 at Magnolia. May this altitude be assigned?

A33296 C130/U T280 66 03	GLH 1918	24 19 23 1924 MHZ	120✓	MCB 1940	KLRF GLH V74 MHZ V555 MCB KBIX	ZHU
RCH1586 C130/U T280 66 03	GLH 1913	19 19 19 1919 MHZ	140✓	MCB 1935	KLRF GLH V74 MHZ V555 MCB KBIX	ZHU

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: The DME report required from AAL5 at 1846 to assign AAL5 one three thousand is _____ SW or more.

A. 10
B. 40
C. 50

AAL5 B733/A T450 66 02	STUEE 1845	55 18 55 MHZ	150✓	MEI	KDFW MLU V18 KMEI	
COA20 B733/A T450 66 02	STUEE 1840	50 18 50 MHZ	130✓	MEI	KDAL MLU V18 KMEI 30SW/1846	

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

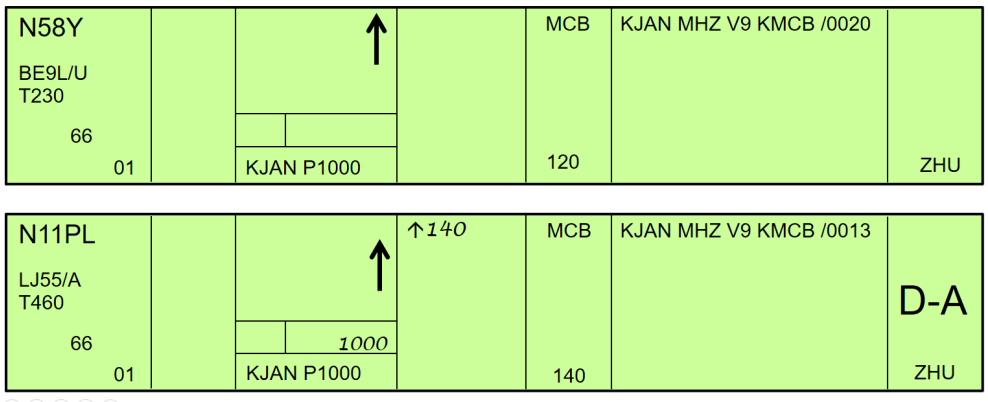
KNOWLEDGE CHECK

QUESTION: The earliest N58Y may depart is _____.

A. 1010

B. 1005

C. 1003



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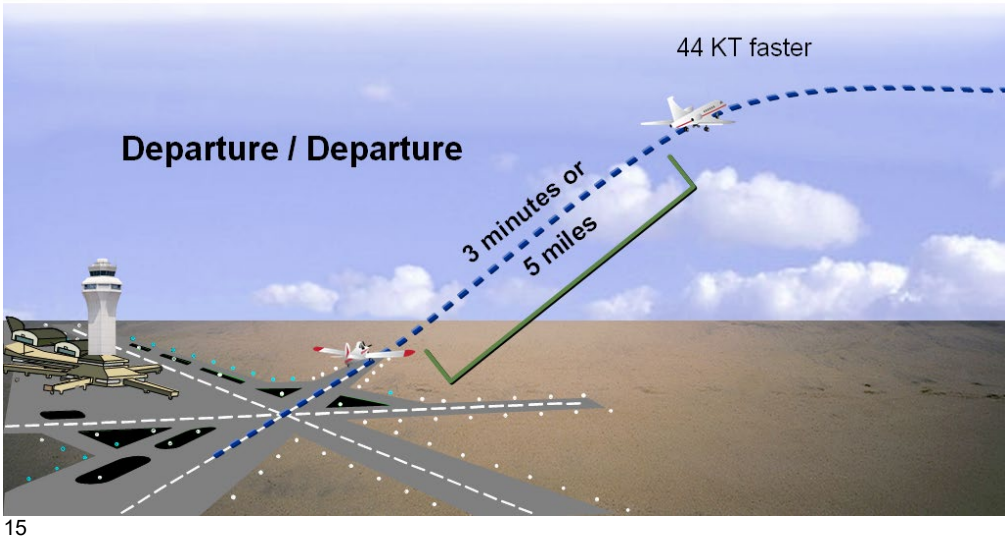
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

44-KNOT SPEED DIFFERENTIAL



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44-Knot Rule
JO 7110.65,
par. 6-4-2

⊙ Minima when lead aircraft is at least 44 knots faster between:

- Non-DME aircraft - 3 minutes
- DME and/or RNAV using ATD aircraft - 5 miles
- DME and ATD aircraft - 5 miles
  - DME aircraft is at or below 10,000 or farther than 10 miles from the DME NAVAID

NOTE: Using **"**Say DME" instead of "Say position" ensures all aircraft use DME mileages which allow all aircraft to have the same slant range error.

⊙ Use when:

- A departing aircraft follows an aircraft which has taken off from the same or an adjacent airport
- An enroute aircraft follows an enroute aircraft
- A departing aircraft follows an enroute aircraft

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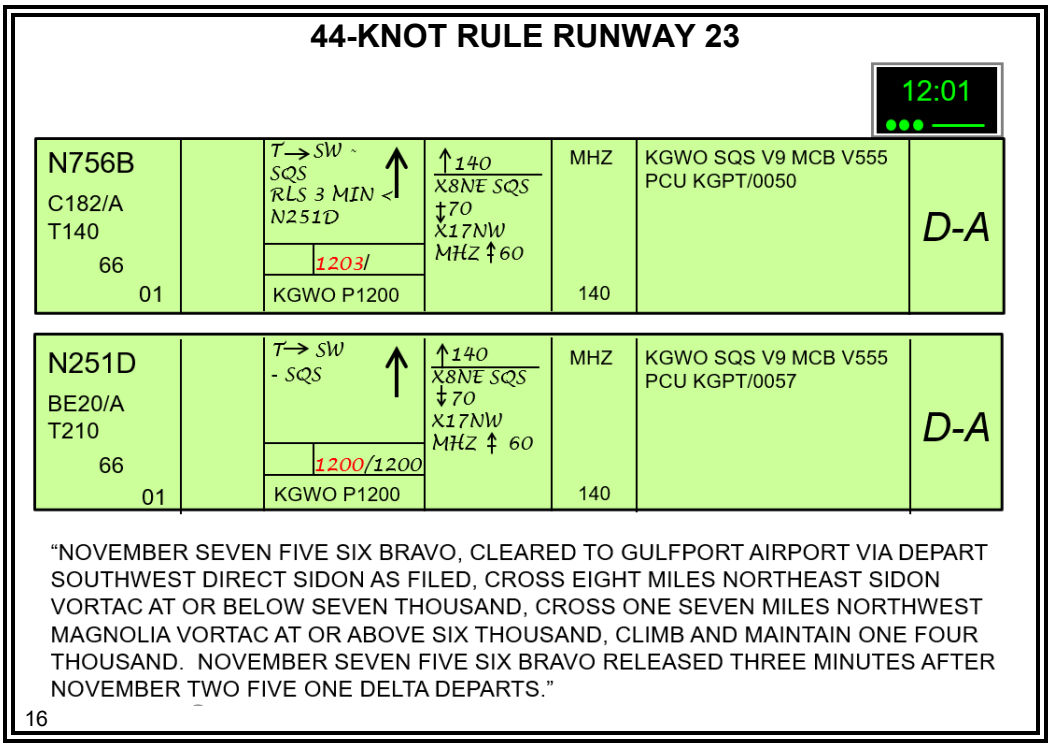
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

44-Knot Rule (Cont'd)
JO 7110.65, par. 6-4-2



Phraseology 44 Knot Rule

⊙ "NOVEMBER SEVEN FIVE SIX BRAVO, CLEARED TO GULFPORT AIRPORT VIA DEPART SOUTHWEST DIRECT SIDON AS FILED, CROSS EIGHT MILES NORTHEAST SIDON VORTAC AT OR BELOW SEVEN THOUSAND, CROSS ONE SEVEN MILES NORTHWEST MAGNOLIA VORTAC AT OR ABOVE SIX THOUSAND, CLIMB AND MAINTAIN ONE FOUR THOUSAND. NOVEMBER SEVEN FIVE SIX BRAVO RELEASED THREE MINUTES AFTER NOVEMBER TWO FIVE ONE DELTA DEPARTS."

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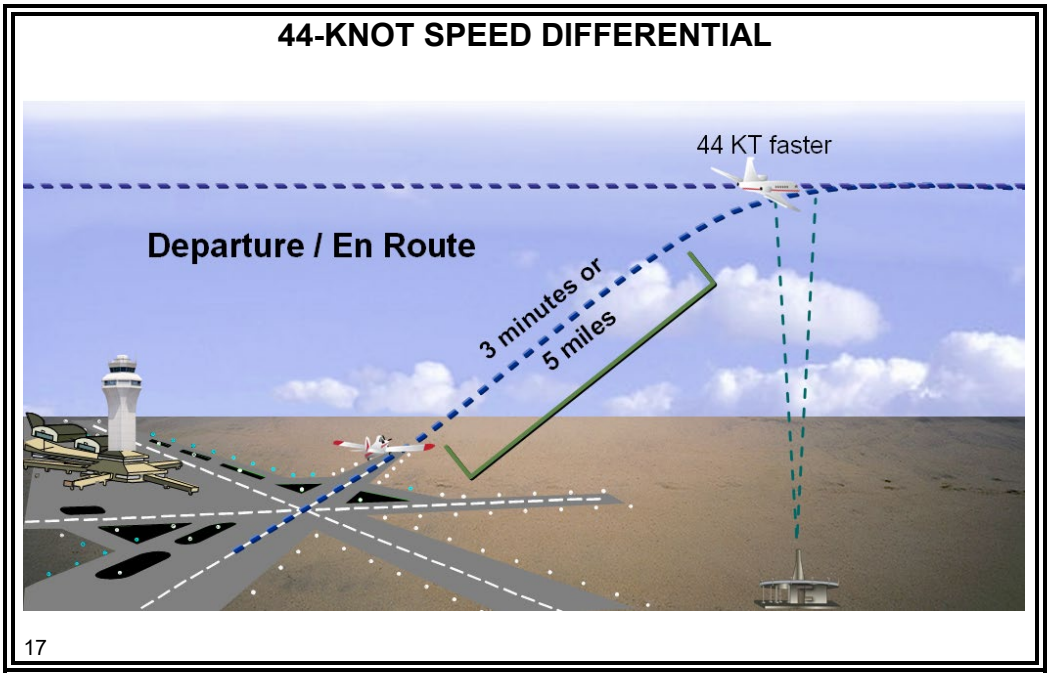
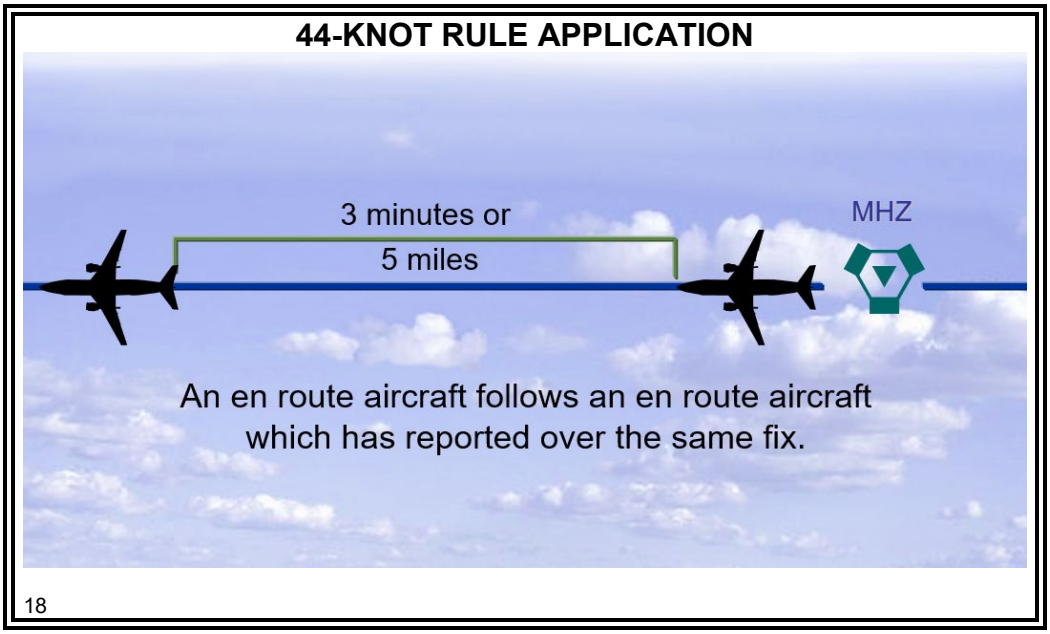
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

44-Knot Rule (Cont'd)
JO 7110.65, par. 6-4-2



- A departing aircraft follows an en route aircraft which has reported over a fix serving a departure airport



- An en route aircraft follows an en route aircraft which has reported over the same fix

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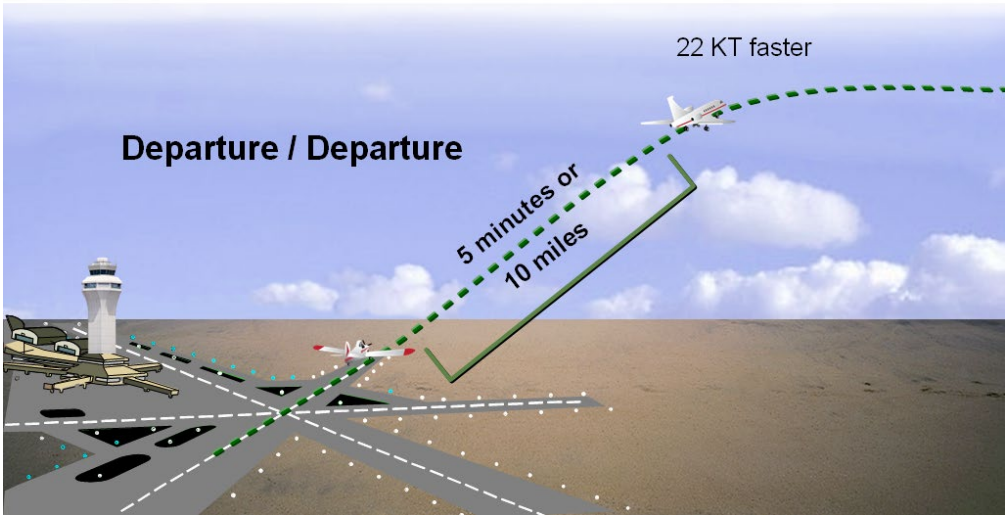
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

22-Knot Rule
JO 7110.65,
par. 6-4-2

22-KNOT SPEED DIFFERENTIAL



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- Minima when lead aircraft is at least 22 knots faster between:
  - Non-DME aircraft - 5 minutes
  - DME and/or RNAV using ATD aircraft - 10 miles
  - DME and ATD aircraft - 10 miles
    - DME aircraft is at or below 10,000 or farther than 10 miles from the DME NAVAID

NOTE: Using “Say DME” instead of “Say position” ensures all aircraft use DME mileages which allow all aircraft to have the same slant range error.

- Use when:
  - A departing aircraft follows an aircraft which has taken off from the same or an adjacent airport
  - An enroute aircraft follows an enroute aircraft
  - A departing aircraft follows an enroute aircraft

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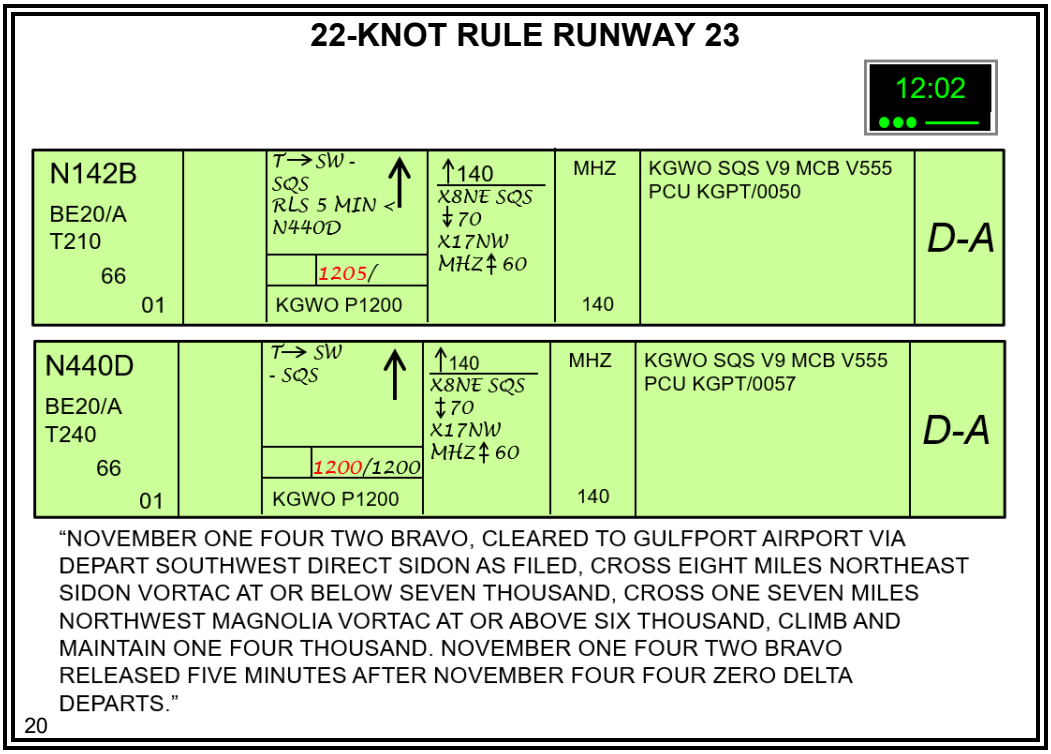
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

22-Knot Rule
JO 7110.65,
par. 6-4-2



Phraseology 22 Knot Rule

⊙ "NOVEMBER ONE FOUR TWO BRAVO, CLEARED TO GULFPORT AIRPORT VIA DEPART SOUTHWEST DIRECT SIDON AS FILED, CROSS EIGHT MILES NORTHEAST SIDON VORTAC AT OR BELOW SEVEN THOUSAND, CROSS ONE SEVEN MILES NORTHWEST MAGNOLIA VORTAC AT OR ABOVE SIX THOUSAND, CLIMB AND MAINTAIN ONE FOUR THOUSAND. NOVEMBER ONE FOUR TWO BRAVO RELEASED FIVE MINUTES AFTER NOVEMBER FOUR FOUR ZERO DELTA DEPARTS."

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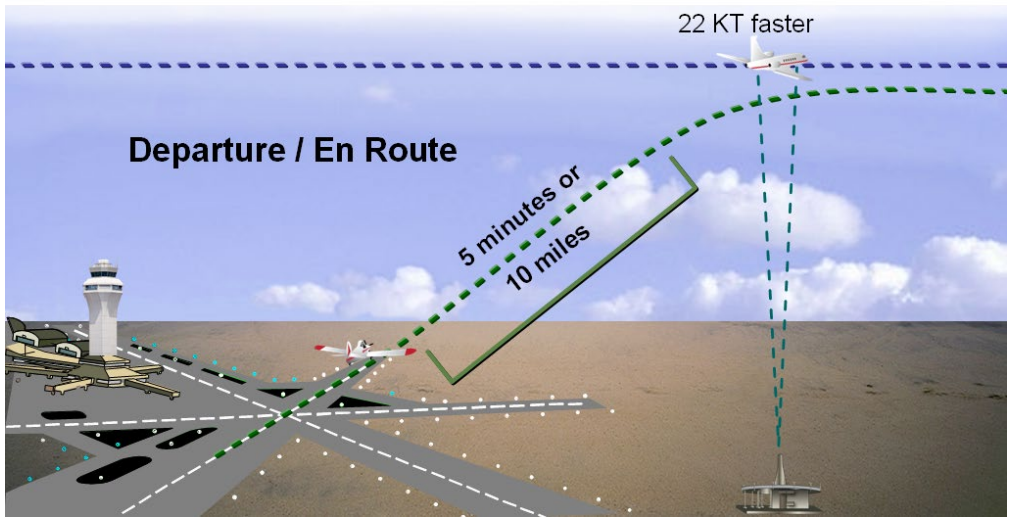
MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

22-Knot Rule (Cont'd)
JO 7110.65, par. 6-4-2

22-KNOT SPEED DIFFERENTIAL



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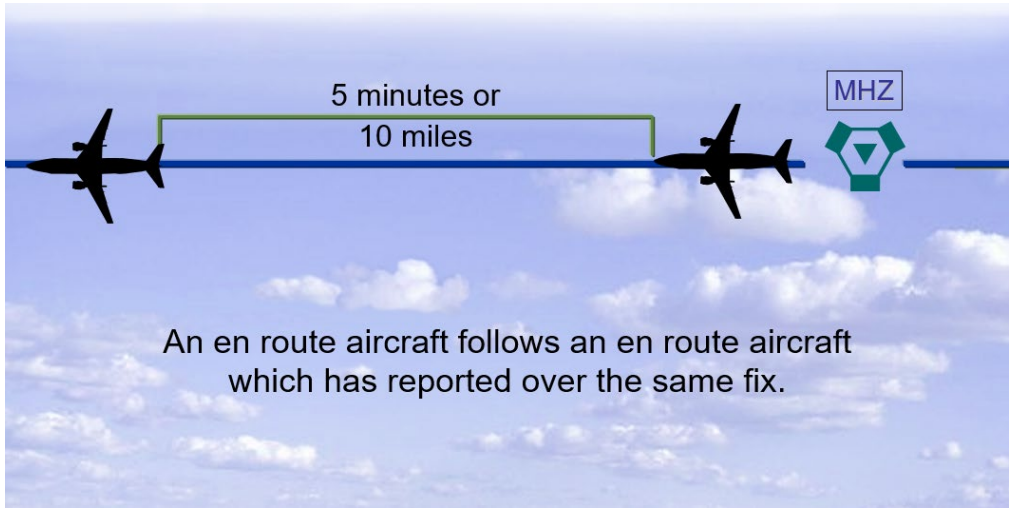
- A departing aircraft follows an en route aircraft which has reported over a fix serving the departure airport

22-KNOT RULE APPLICATION



22

- An en route aircraft follows an en route aircraft which has reported over the same fix

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check

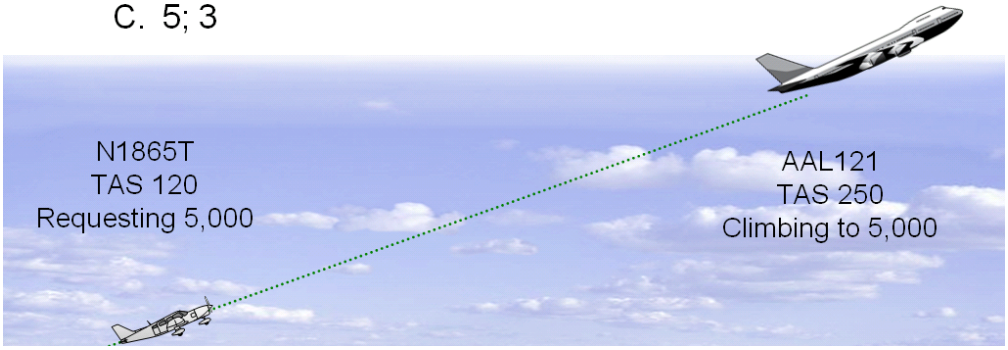
KNOWLEDGE CHECK

QUESTION: The minimum separation allowed between AAL121 and N1865T is _____ miles or _____ minutes.

A. 10; 3

B. 5; 5

C. 5; 3



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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

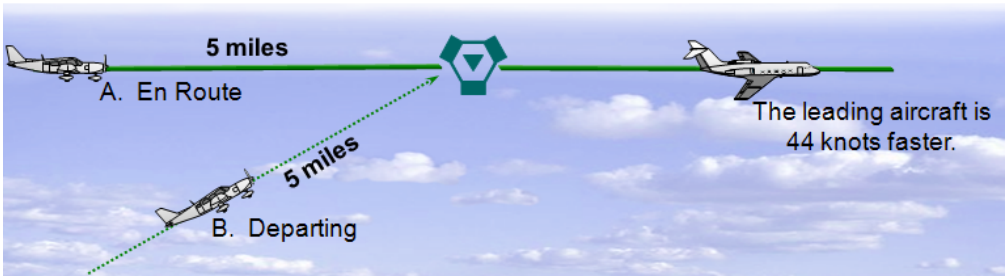
QUESTION: Which aircraft may be assigned the same altitude as the lead aircraft?

A. Either A or B

B. A only

C. B only

D. Both A and B



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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: May N24Y be assigned niner thousand?

A. Yes

B. No

N24Y C421/U T215 66 02	STUEE 1504	25 15 25 MHZ	110✓	MEI	KSHV MLU V18 KMEI/1545	
A15289 BE20/A T240 66 02	STUEE 1501	20 15 20 MHZ	90✓	MEI	KSHV MLU V18 KMEI	

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MINIMA ON SAME, CONVERGING, OR CROSSING COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: N66N has a clearance to climb and maintain 120. Does this clearance provide longitudinal separation?

A. Yes

B. No

N473B F27/A T220 66 02	MEI 1546	05 16 05 1605 MHZ	120✓	STUEE 1626	KMEI V18 MLU KSHV/1655	
N66N AC56/A T180 66 01		↑ 1600/1600 KJAN P1600	↑120	STUEE 120	KJAN V18 MLU KSHV/0102	D-A

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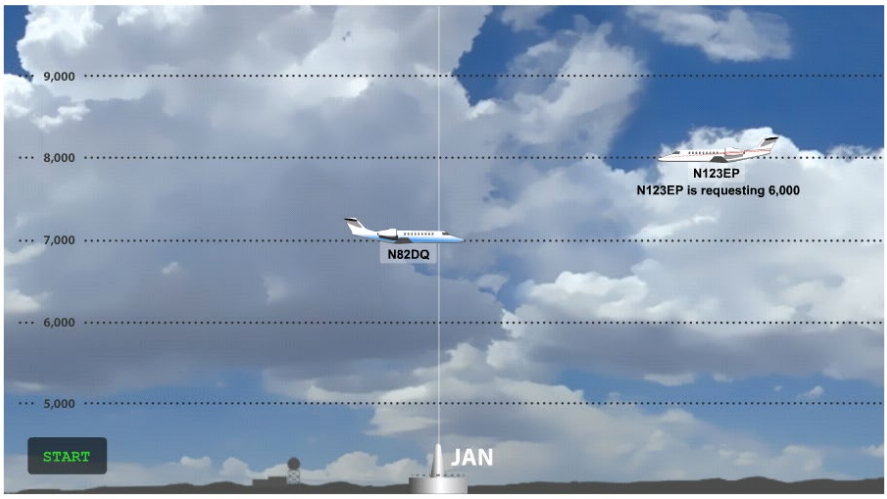
MINIMA ON OPPOSITE COURSES

Separation
JO 7110.65,
par. 6-4-3

OPPOSITE COURSE – AIRCRAFT REPORTING SAME NAVAID



N82DQ: "Aero Center, November Eight Two Delta Quebec, progressing Magnolia VORTAC at zero two five four, at seven thousand, estimating Meridian VORTAC zero three one seven. Nashville next."

ATC: "November Eight Two Delta Quebec. Contact Aero Center one two niner point zero one two miles southeast Magnolia VORTAC."

N82DQ: "November Eight Two Delta Quebec, roger."

N123EP: "November One Two Three Echo Papa, progressing Magnolia VORTAC at 0256, at eight thousand, estimating STUEE intersection zero three one five. Monroe next."

ATC: "November One Two Three Echo Papa descend and maintain six thousand."

N123EP: "November One Two Three Echo Papa descending to six thousand."

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⊙ Discontinue vertical separation when:

- Both aircraft have reported passing NAVAIDs, DME fixes, or waypoints indicating they have passed each other

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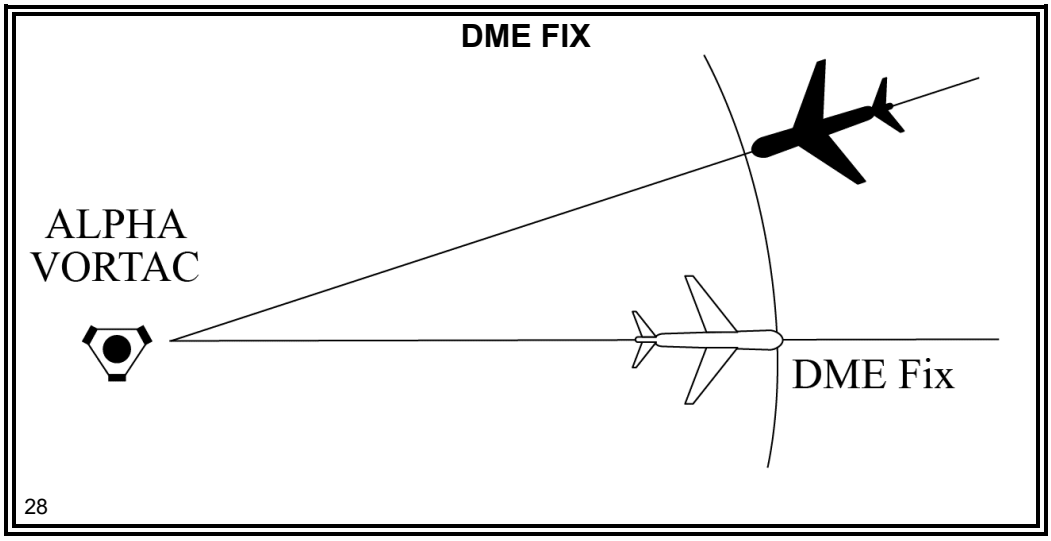
MINIMA ON OPPOSITE COURSES *(Continued)*

Separation (Cont'd)
JO 7110.65, par. 6-4-3



DME Fixes
JO 7110.65, par. 6-4-3a

- Both aircraft have reported passing NAVAIDs, DME fixes, or waypoints indicating they have passed each other.
- Advise pilot to use DME distances when applying DME separation.

✈ **Phraseology**

"USE DME DISTANCES."

Continued on next page

MINIMA ON OPPOSITE COURSES *(Continued)*

Separation (Cont'd)
JO 7110.65, par. 6-4-3

OPPOSITE COURSE – AIRCRAFT REPORTING SAME DME FIX

N123EP: *"Aero Center. November One Two Three Echo Papa request descent to six thousand"*

ATC: *"November One Two Three Echo Papa. Say DME west Magnolia VORTAC."*

N123EP: *"November One Two Three Echo Papa, one one miles west Magnolia VORTAC"*

ATC: *"November One Two Three Echo Papa, roger"*

ATC: *"November Eight Two Delta Quebec say DME west Magnolia VORTAC."*

N82DQ: *"November Eight Two Delta Quebec niner miles west Magnolia VORTAC."*

ATC: *"November Eight Two Delta Quebec, roger.*

ATC: *"November One Two Three Echo Papa, descend and maintain six thousand."*

N123EP *"November One Two Three Echo Papa descending to six thousand."*

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– Procedure may be applied on diverging airways or radials of the same NAVAID

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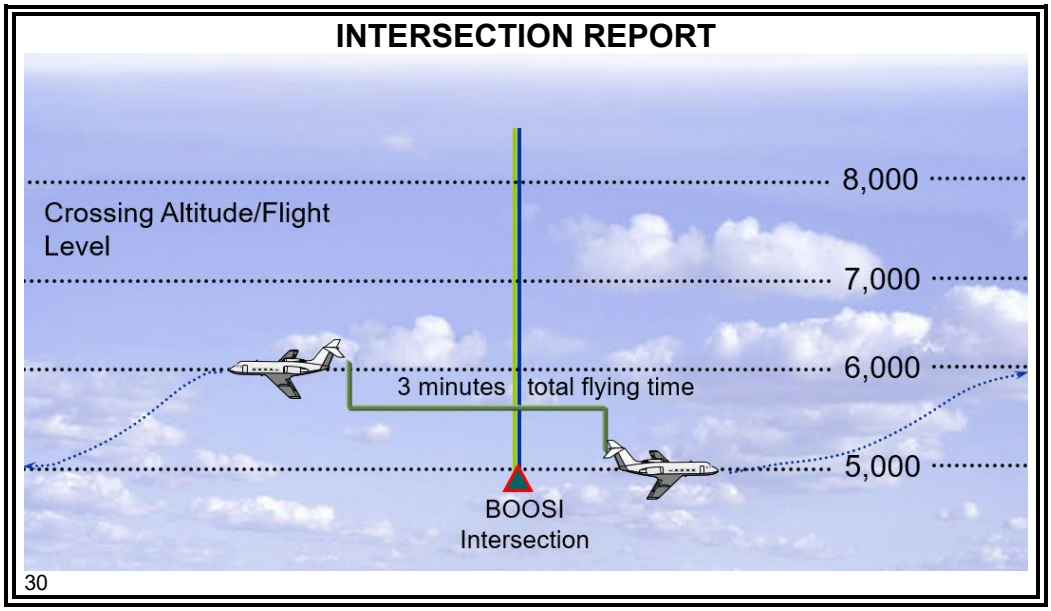
MINIMA ON OPPOSITE COURSES *(Continued)*

Separation (Cont'd)
JO 7110.65, par. 6-4-3



⊙ Both aircraft have reported passing the same intersection/waypoint and are at least 3 minutes apart

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MINIMA ON OPPOSITE COURSES *(Continued)*

Knowledge Check

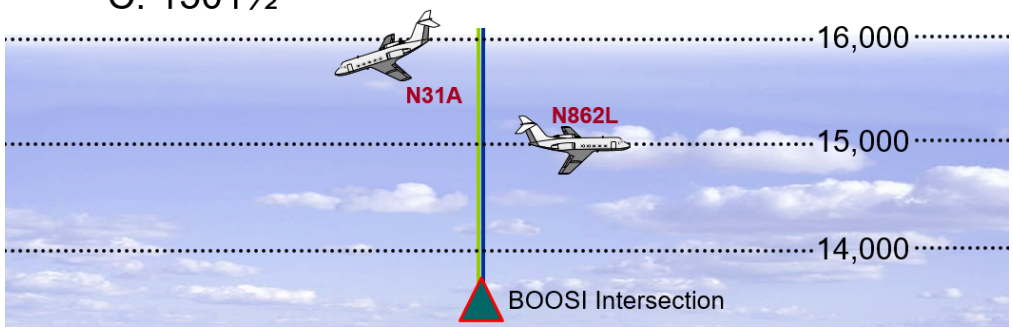
KNOWLEDGE CHECK

QUESTION: Both aircraft reported passing BOOSI intersection at 1500. What is the earliest time N31A may be cleared to 140?

A. 1510

B. 1503

C. 1501½



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MINIMA ON OPPOSITE COURSES *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: SWA22 and AAL31 are opposite direction and progressed BOOSI intersection at 1012 and 1014, respectively. What is the earliest time you may discontinue vertical separation?

A. 1015

B. 1014½

C. 1014

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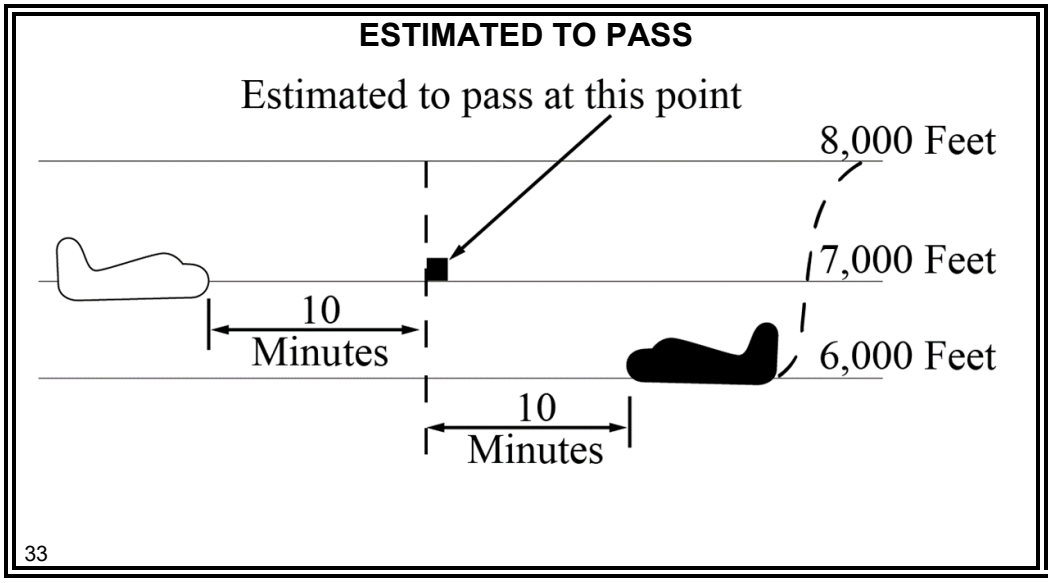
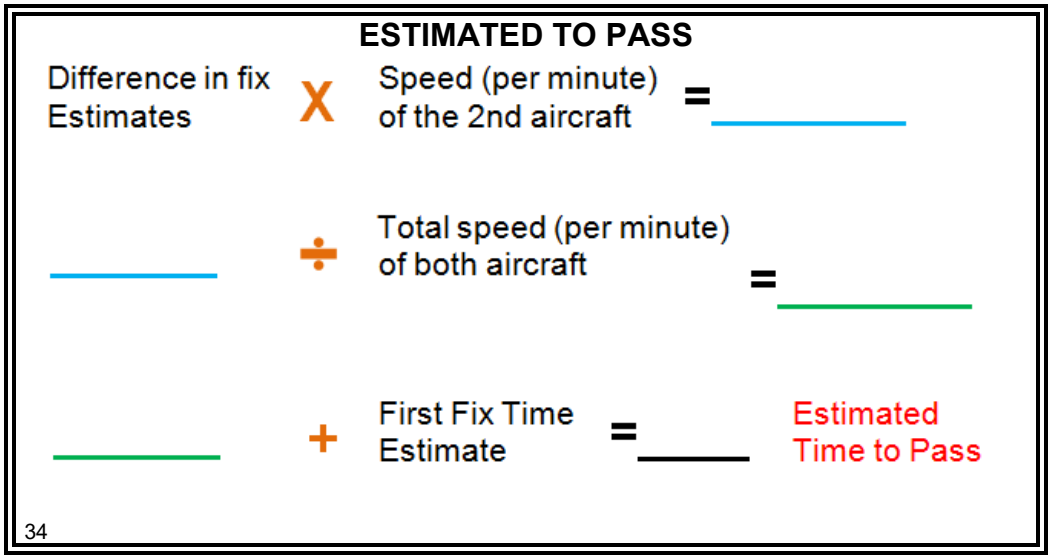
MINIMA ON OPPOSITE COURSES *(Continued)*



Estimated to Pass
JO 7110.65, par. 6-4-3

- Separate aircraft traveling opposite courses by assigning different altitudes consistent with the approved vertical separation from *10 minutes* before, until *10 minutes* after they are estimated to pass.

Formula



- Formula to calculate “estimated to pass”.

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MINIMA ON OPPOSITE COURSES *(Continued)*

Estimated to Pass (Cont'd)

- The strips below demonstrate how to use the formula. N33T progressed STUEE at 2336 and requested descent to 70. Coordination with sector 65 has been completed.

N33T C182/A T120 66 02	STUEE 2336	14 00 14 MHZ	90✓↓70 70 > 2356 70	MEI	KSHV ./. MLU V18 KMEI	
N22B C421/A T240 66 01	MEI 2344	02 00 03 MHZ	80✓	STUEE	KMEI V18 MLU KSHV	

Calculation

12 x 2 = 24
24 / 6 = 4
0002 + 4 = 0006 est. to time to pass

Questions

- At time 0006 where is N22B?
- At time 0006 where is N33T?

Solution

- The planes are vertically separated at 9 thousand and 8 thousand respectively, to use longitudinal separation to allow N33T to descend to 7 thousand a time restriction 10 prior to the estimate to pass is required.
- "…DESCEND SO AS TO REACH SEVEN THOUSAND BEFORE TWO THREE FIVE SIX..."

NOTE: In Aero Center "estimated to pass" situations should be converted to vertical or lateral situations by using the alternate airways if possible.

EXERCISE: APPLYING LONGITUDINAL SEPARATION

Exercise

APPLYING LONGITUDINAL SEPARATION EXERCISE

Purpose: to practice applying longitudinal separation rules

Directions: use longitudinal separation rules and provided aids to answer questions and issue clearances

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Directions

For questions 1 through 6, record clearance instructions and any other necessary data on the flight progress strips. Write the steps you took to resolve each situation in the space provided.

Continued on next page

EXERCISE: APPLYING LONGITUDINAL SEPARATION
(Continued)

Questions

QUESTION 1 – 20 MILES DME

AAL5 B732/A T450 66 04	ZAMMA 1840	47 18 47 | 1847 MHZ	160✓	HEZ 1858	KBHM IGB V245 HEZ V71 KBTR	ZHU
UAL20 B732/A T450 66 04	MEI 1835	44 18 42 | 1844 MHZ	140✓	HEZ 1855	KBHM MEI V18 MHZ V245 HEZ V71 KBTR	ZHU

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1. AAL5 is requesting 14,000. Write the DME separation required and the procedure you should use to determine if separation exists.

Continued on next page

EXERCISE: APPLYING LONGITUDINAL SEPARATION
(Continued)

Questions (Cont'd)

QUESTIONS 2 AND 3 – 44/22-KNOT RULE - RUNWAY 23

12:01

AAL5 B752/A T460 66 03	HLI 1149	01 12 01 1201 SQS	140✓	MHZ 1209	KMEM HLI V535 SQS V9 MCB V194 KBTR
N440D BE20/A T240 66 01		↑ KGWO P1200		MHZ 140	KGWO SQS V9 MCB V555 PCU KGPT/0057
N142B BE20/A T270 66 01		↑ KGWO P1200		MHZ 140	KGWO SQS V9 MCB V555 PCU KGPT/0050

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2. AAL5 reported SQS VORTAC at 1201. N142B requests clearance from KGWO Airport at 14,000. When can N142B depart?

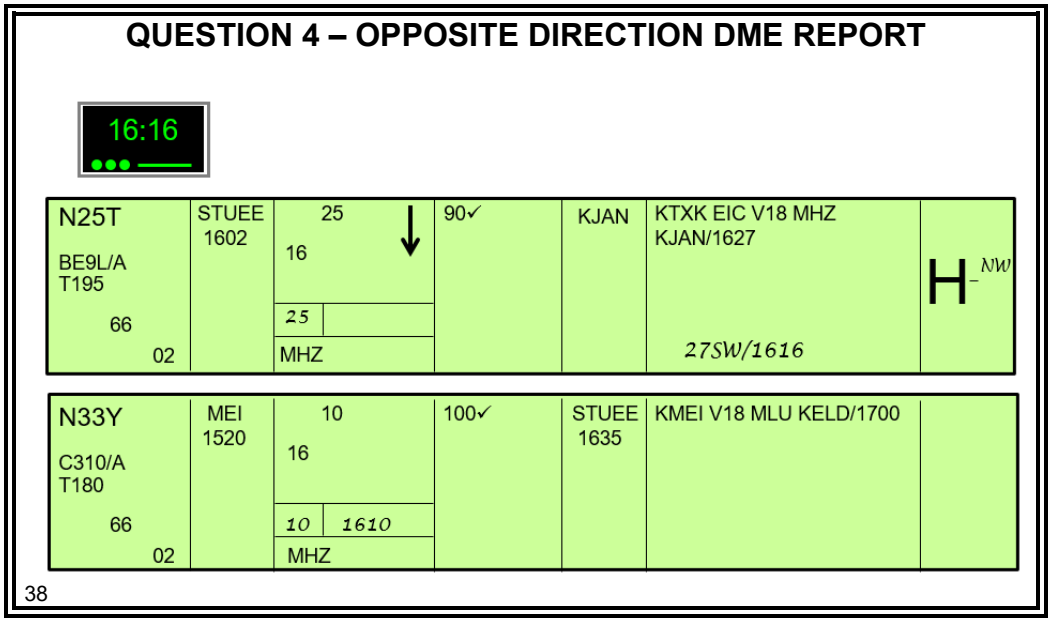
3. Using the flight progress strips in question 2, determine the minimum longitudinal separation that can be used for N440D to depart after N142B.

Continued on next page

EXERCISE: APPLYING LONGITUDINAL SEPARATION
(Continued)

Questions (Cont'd)

QUESTION 4 – OPPOSITE DIRECTION DME REPORT



4. N33Y is requesting 8,000 feet. Based on the information gathered from the flight strips of N33Y and N25T, what procedure should be followed to provide descent and separation from N25T using DME?

Continued on next page

EXERCISE: APPLYING LONGITUDINAL SEPARATION
(Continued)

Questions (Cont'd)

QUESTION 5 – OPPOSITE DIRECTION INTERSECTION REPORT

AAL14 B752/A T480 66 02	STUEE 1717	27 17 27 MHZ	170✓	MEI 1736	KTXK MLU V18 MEI KATL HEDUD/1724	
UAL22 B722/A T480 66 02	MEI 1711	20 17 20 1720 MHZ	160✓	STUEE 1730	KBHM MEI V18 MLU KELD HEDUD/1723	ZFW

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5. UAL22 reported HEDUD intersection at 1723. AAL14 reported HEDUD at 1724. What is the earliest time AAL14 can descend to 15,000?

Continued on next page

EXERCISE: APPLYING LONGITUDINAL SEPARATION
(Continued)

Questions (Cont'd)

QUESTION 6 – OPPOSITE DIRECTION COURSES REROUTE TO USE LATERAL SEPARATION

AAL536 B737A T410	MHZ 0016	24 00 SQS	150 ✓	HLI	KMSY ./. MCB V9 SQS V535 HLI ./. KEVV	
AAL528 B737/A T410	HLI 2349	02 00 03 SQS	140 ✓ ↑160 140 / 17SE X 17NE MHZ@160	MHZ 0010	KTTH ./. HLI V535 SQS V9 MCB ./. KBTR V555 MHZ	

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6. AAL528 checks on frequency at 140 estimating SQS at 0003 requesting climb to 160. This separation can be solved by rerouting AAL528 and applying lateral separation. Lateral separation is the next lesson, so the required restrictions are given. What is the phraseology to reroute AAL528 and issue the restrictions/climb?

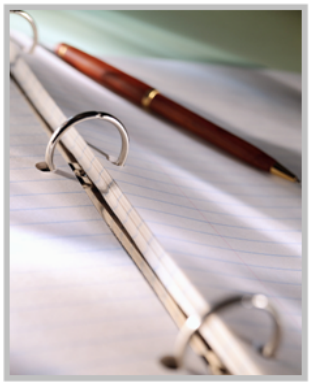
IN CONCLUSION

Lesson Review

LESSON REVIEW

The following topics were covered in this lesson:

- Applying longitudinal separation
- Minima on same, converging, or crossing courses
- Minima on opposite courses
- DME longitudinal separation for RNAV aircraft along VOR routes



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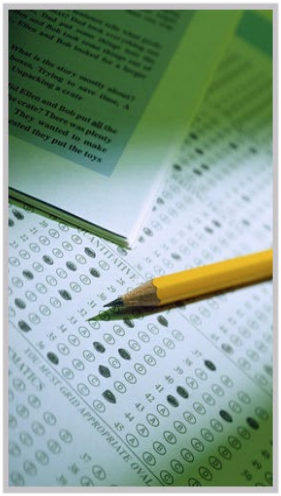
IN CONCLUSION *(Continued)*

End-of-Lesson Test

END-OF-LESSON TEST

Longitudinal Separation



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Part-Task Lab

- You will now review the nonradar lab procedures and then complete the Longitudinal Separation part-task lab using longpttask.f2k strips.