VOR PROGRAM BOOK

JUNE 1965

PREPARED BY

ACADEMIC AND SYNTHETIC TRAINER DIVISION

DEPARTMENT OF FIXED WING TRAINING

UNITED STATES ARMY AVIATION SCHOOL

FORT RUCKER, ALABAMA

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Department of Fixed Wing Training
Academic and Synthetic Trainer Division
Fort Rucker, Alabama

PROGRAMMED TEXT

TITLE: VOR Program Book SUBJECT NO. 629-3
SCOPE: Principles of operation, aircraft receiving equipment and flight procedures of the VHF omnirange.
REFERENCES: TM 1-225, chapter 10
MATERIALS ISSUED TO STUDENTS: VOR Program Book VOR Program Answer Book
PREPARED BY: Harry I. Sands, Jr. DATE: January 1965
REVISED BY: Capt Peter H. Mitchell DATE: June 1965
APPROVED BY: Major Theodore S. Ferry DATE: June 1965 FOR THE DIRECTOR

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INTRODUCTION

This booklet is written to "teach" you omni. It will take the place of your classroom instructor, although he will be available if you need him. Each page of the booklet presents one small bit of information and then normally requires that you answer a question or solve a problem. The answer, or answers, will always appear at the very top of the next page. Also, this booklet is not printed in the usual way. Page 2 is not on the back of page 1, etc. You must go all the way through the book from front to back (from page 1 to page 70), then turn it around and upside down and go back through the book from back to front (from page 71 to page 138).

This booklet is an accountable item and will be turned in on the last day of the academic portion of the course. Since future classes will use the same books, please do not make marks of any kind in this book.

It is very important that you write the answer to every question or problem. A student recording sheet will be provided for this purpose. Just reading and answering "mentally" will not do; you will not remember as much as you are suppose to unless you write the answer to every question.

File No. 54-629-3

PERFORMANCE OBJECTIVES

VOR

(Reference: TM 1-225, chapter 12 (draft revision))

1. KNOWLEDGES:

   a. Operation of the ARN-30A tuning head.

      (1) Given a photograph of the ARN-30A tuning head and indicator (ID 453), write the steps used to tune the receiver to a given station.

      (2) Given objective multiple-choice test items, recall and identify the following:

         (a) Assigned frequency span for VHF omni stations.

         (b) Significance of no station identification and/or flag in the UP position.

         (c) Function of the OMNI/VAR-LOC switch on the ARN-30A.

   b. General characteristics of VHF omni stations. Given objective multiple-choice test items, recall and identify the following:

      (1) VHF characteristics, line-of-sight and static-free.

      (2) Maximum reliable altitudes and distances for interference-free reception on direct flights.

         (a) TVOR - 12,000 feet, 25 miles.

         (b) VOR - 18,000 feet, 40 miles.

   c. Omni receiver checks.

(1) State in writing how frequently omni receiver checks are required by Federal air regulations.

(2) List in order of preference three types of omni receiver checks (i.e., VOT, ground-check radials, and airborne-check radials).

(3) Locate in the Jeppesen Manual published omni receiver checks for specific stations and write the published frequency (VOT), radial and location.

(4) List the steps in sequence for performing an omni receiver check.

(5) Write the allowable tolerance for -

(a) VOT and VOR ground-check radials.

(b) Airborne checks.

(c) Needle sensitivity (ID 453).

(6) Write pilot's action in event receiver is out of tolerance.

d. Orientation - course indicator (ID 453).

(1) List in sequence the steps used in orienting the aircraft on a radial.

(2) With the use of illustrations showing the course indicator (ID 453) and heading indicator, solve the following type problems, given -

(a) Indications on ID 453, write the direction to station, radial on which located, and location of aircraft with respect to station (e.g., N, NE, etc.).

(b) Indications on ID 453 and heading, write the location (i.e., right - left) of a specified radial.

(c) Radial on which presently located and heading, describe the indications on the ID 453 with a given course selected.

(d) Heading and course indicator readings from two stations, plot on a chart (or diagram) the location and heading of the aircraft.

e. Identifying an intersection - ID 453. With the aid of a radio navigation chart (or diagram), solve position-fixing (intersection) problems of the following type, given -

(1) Radial from one station, name of intersection, heading and track of aircraft and indications of the ID 453, write the location of the aircraft with respect to the intersection.

(2) Name of the intersection, write -

(a) Names of the stations forming the intersection.

(b) Frequencies of the stations in (a).

(c) Radials which form the intersection.

(d) MRA for the intersection if published.

(3) Radial from one station, name of intersection, heading and present location of the aircraft with respect to the intersection, write the indication of the needle (i.e., left - right) based on a -

(a) FROM reading.

(b) TO reading.

f. Tracking and station passage - ID 453 -

(1) Write the instrument indication used to determine station passage.

(2) List the four steps used in a tracking sequence.

(3) Given a track to maintain and indications of the ID 453, write -

(a) Needle indication for a left or right crosswind which has blown the aircraft off course.

(b) Acceptable limits of needle deflection prior to a tracking correction.

(c) Initial heading to be used in returning to track.

(d) Indication which denotes reinterception of track.

(e) Heading used in a first-trial drift correction.

(f) Needle reactions which result from either overcorrecting or undercorrecting.

(g) Heading to be used in intercepting the track a second (or subsequent) time.

(h) The second-trial drift correction.

g. Track interception - ID 453.

(1) Solve the following track interception problems. Given present heading, desired track, present indications of ID 453, radio navigation chart (or diagram), and desired angle of intercept, find direction to turn (right-left), intercept heading, and new setting of course selector.

(2) List the steps in the track interception procedure using the parallel-double-the-angle method.

(3) Using the double-the-angle method of track interception, write the rule for estimating time to station.

(4) Write the angular limitations of the double-the-angle method.

VOR PROGRAM BOOK

The VHF omnidirectional range system is one of the major radio navigational systems in use today. It is also called VOR or simply omni.

The name VHF omnidirectional range tells us that the frequency band on which the system operates is very high frequency (VHF).

Omnidirectional means that the aircraft can navigate inbound to, or outbound from, a VOR station in all directions.

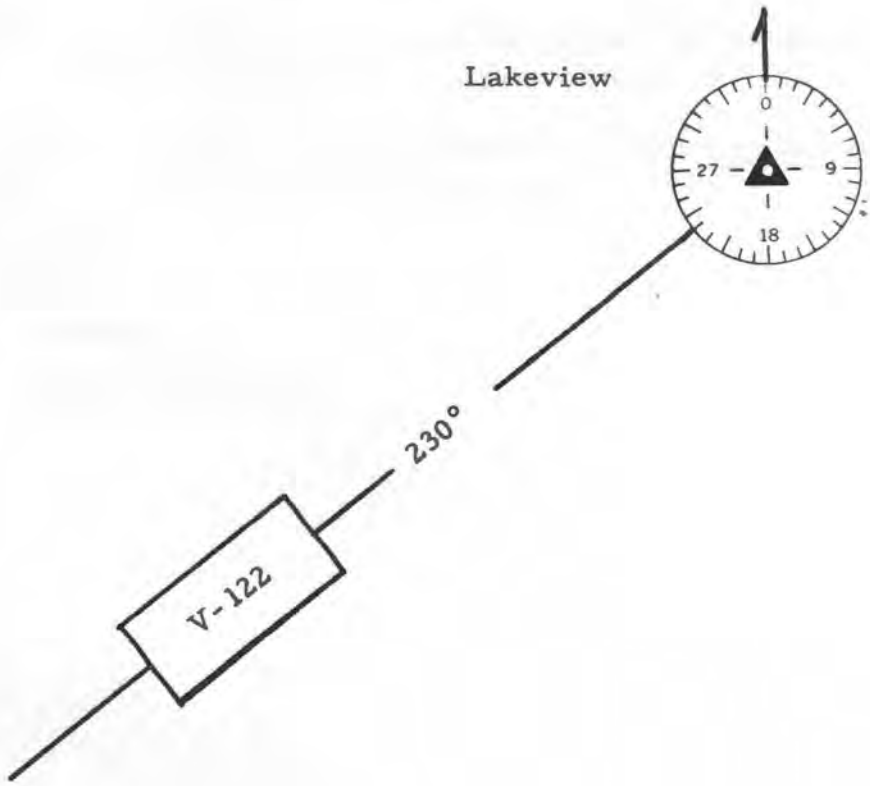
The word omni means (pick one) -

a. Inbound.

b. Outbound.

c. All.

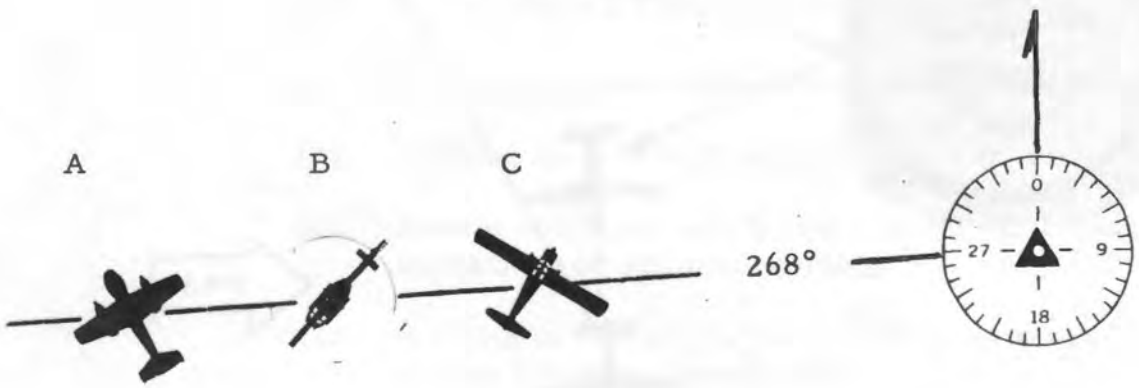
ANSWER: (c) All



The omnirange transmits 360 courses - one for each degree. The aviator can pick any of these 360 courses for navigation into, or away from, the station. These 360 courses radiate from the station and are called radials. Some radials are selected for airways.

In the chart diagram above, the 230° radial from Lakeview is used for airway V-122 (Victor - one twenty-two). The reciprocal of the 230° radial goes into Lakeview VOR. If you were flying inbound to Lakeview on V-122, your course would be 50° .

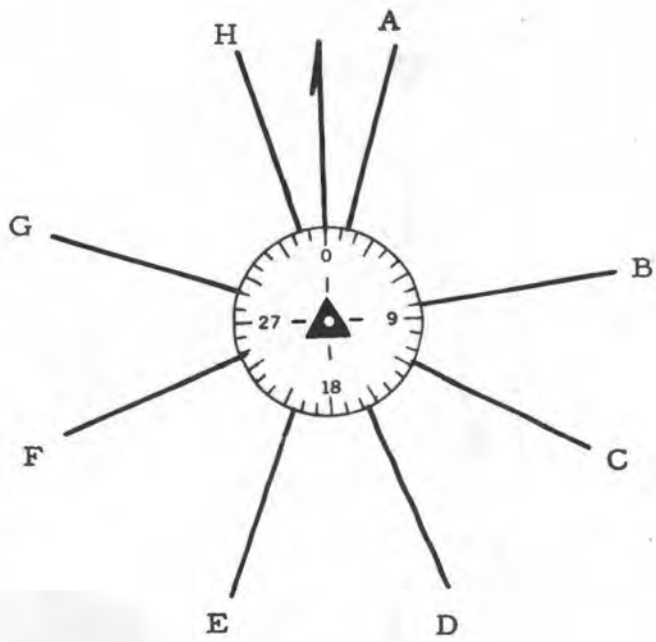
ANSWER: 050°



Aircraft A, B, and C above are all located on the 268° radial from the VOR station, although each is flying a different heading.

To fly inbound to the VOR station, each aircraft must turn to a heading of 86°.

ANSWER: 088°



Radials are printed on navigation charts as magnetic outbound courses from the omni stations.

Match each magnetic direction below with one of the lettered radials in the diagram above.

1. 345°.
2. 080°.
3. 116°.
4. 248°.
5. 155°.
6. 290°.
7. 204°.
8. 013°.

ANSWERS: 1. H, 2. B, 3. C, 4. F, 5. D, 6. G, 7. E, 8. A

Review Summary

All statements below are true except one. Read each one and identify the false statement.

A. The omnirange, also known as the VOR, operates in the VHF band.

B. The VOR is omnidirectional, meaning that the navigational signal is transmitted in all directions.

C. For practical purposes, we consider that there are 360 omni radials transmitted from a VOR station.

D. All omni radials are transmitted from the VOR station.

E. An aircraft may fly outbound on a radial, inbound on a radial, or may be crossing a radial.

F. The 045° radial proceeds northeast and southwest from the omni.

ANSWER: F. 045°, northeast only

VHF Omnirange Control Unit

The omni equipment that is found in most (but not all) Army aircraft is the ARN-30A and consists of -

1. The radio receiver and antenna units.

2. The course-indicator unit.

3. The control unit, or tuning head.

The control unit, or tuning head, is used to turn the set on and select the correct receiving frequency. This control unit (shown above) may be located in any convenient place in the cockpit (for example: overhead, left wall, right wall, between the seats, etc.).

Inspect the control unit above. What range of frequencies is indicated by the graduations on the tuning dial? From _____ mc to _____ mc.

ANSWER: 108 mc to 135 mc

The omni receiver can be tuned to receive frequencies between 108 mc and 135 mc.

However, omni stations transmit on frequencies between 108 mc and 118 mc. The receiver frequencies between 118 mc and 135 mc may be used for reception of voice communications from various stations, but they are not used for omni navigation because omni stations transmit on frequencies between _____ mc and _____ mc.

ANSWER: 108 mc and 118 mc

All omni stations are assigned some frequency between 108 mc and 118 mc. Another type of navigational aid, the ILS localizer (LOC), also uses a part of this band. ILS localizers are assigned some frequency between 108 mc and 112 mc. Localizers (LOC) are assigned the odd digits (for example: 109.5) between 108 mc and 112 mc.

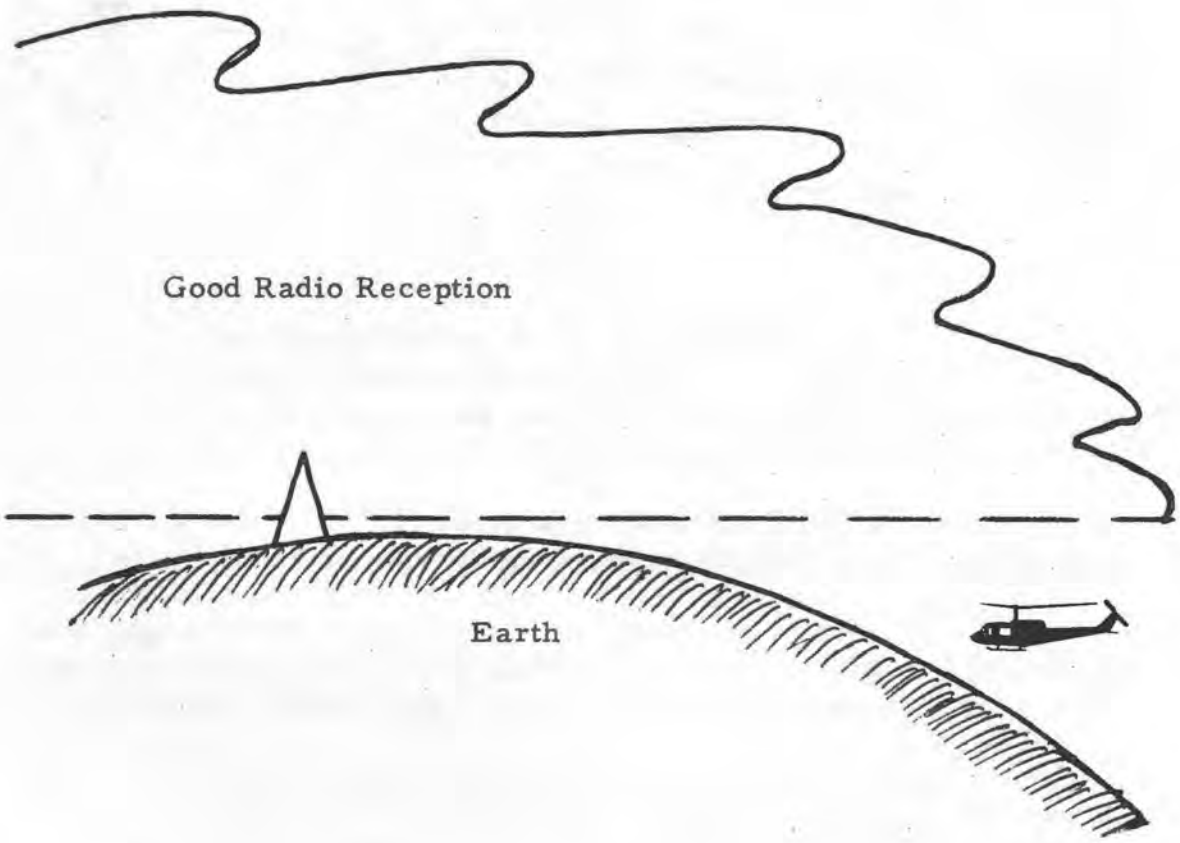
Omni stations are assigned even digits (for example: 109.6) between 108 mc and 112 mc. Omni stations may be assigned any _____(even-odd) frequency between 108 mc and 112 mc and also any other frequency between 112 mc and _____ mc.

ANSWER: Even, 118 mc

Between 108 mc and 112 mc, omni stations are assigned even frequencies, and localizers (LOC) are assigned odd frequencies. By each frequency below, indicate "O" for omni or "L" for localizer.

108.2_____ 109.3_____ 111.6_____ 109.8_____

ANSWERS: 108.2 - "O", 109.3 - "L", 111.6 - "O", 109.8 - "O"

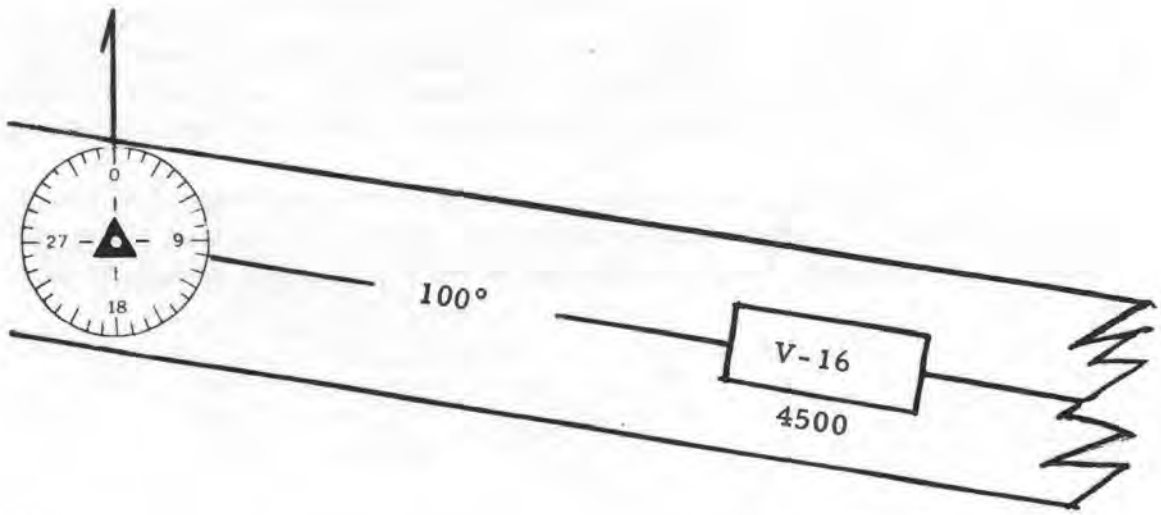


The VHF frequency band has a disadvantage known as "line-of-sight" transmission. The diagram above shows the curvature of the earth and the "line-of-sight" transmission from the station. The aircraft is outside the reception area of the station. To receive a good signal from the station, the aircraft should increase (pick one):

a. Volume.

b. Altitude.

ANSWER: b.



Line-of-sight transmission will not permit good reception at low altitudes if the aircraft is too far away from the station. In mountainous regions the line-of-sight transmission is disrupted at low altitudes by the terrain.

However, radio navigation charts show minimum enroute altitudes (MEA) on airways for IFR flight. These MEA's have been flight-checked and the signal from the omni station has been found to be reliable at the published MEA.

Example: The 100° radial from the omni station above is used to form the airway (V-16). Beneath the airway designator (V-16) the minimum enroute altitude for instrument (IFR) flight is shown as _____ feet.

ANSWER: 4500 feet

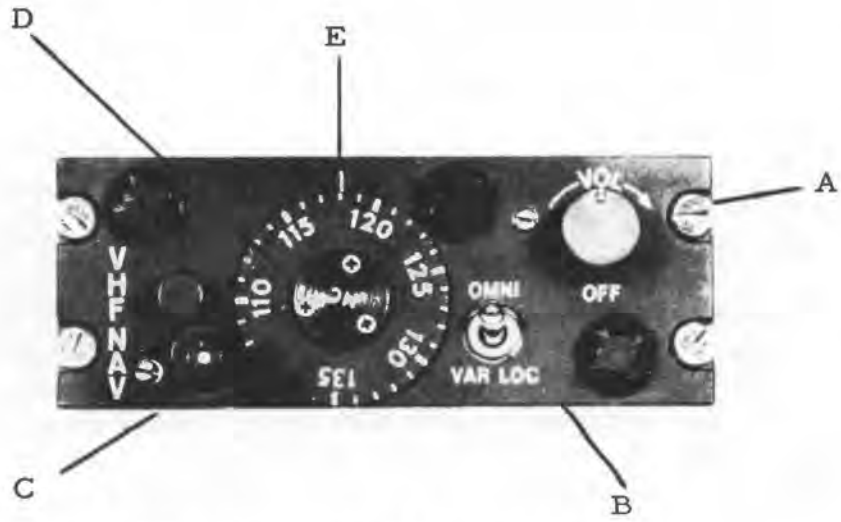
The M_____ E_____ A_____ have been flight-checked to determine that a reliable signal from the omni station can be received. Instrument (IFR) flight cannot be conducted below the MEA.

VFR flight may be conducted at lower altitudes; however, the aviator should keep in mind that at low altitudes the signal from the omni station may not be received reliably since the transmission is limited by line _____ _____.

ANSWER: Minimum enroute altitude; line of sight

One great asset gained by the use of VHF is the reduction of static disturbances. Even in periods of thunderstorm activity, the audio reception over the VHF omni receiver is good since VHF reception is not affected by _____.

ANSWER: Static



VHF Omnirange Control Unit

The control unit is used for tuning the station.

1. The set is turned on by rotating knob A _____ (clockwise, counterclockwise). The volume is adjusted by continued rotation of knob A.

2. Selector switch B is used to select the proper function. If the equipment is being used to tune an omni station, the selector switch should be placed _____ (up - down) in the omni position.

3. The omni receiver is also used with the ILS localizer (LOC). When tuning an ILS localizer, the selector switch should be placed in the _____ (up - down) position. If the switch is placed in the wrong position, the equipment will not function properly.

4. The crank C is used to rotate the frequency dial D until the correct frequency appears under the index E. The frequency shown in the diagram above is (pick one): (a) 118 mc, (b) 115.6 mc.

ANSWERS: 1. Clockwise, 2. Up, 3. Down, 4. (a) 118 mc

1. The part of the frequency dial from 118 mc up to 135 mc may be used for voice communications with various stations, but may not be used for omni reception because omni stations transmit only on frequencies between _____ mc and _____ mc. (If you have forgotten, look back at page 7.)

2. When the frequency dial is set for the correct frequency, the station identification should be audible in the headset. Station identification consists of three letters transmitted in code or at some stations transmitted in code and voice alternately.

3. Station identification is normally transmitted continuously, but sometimes is deliberately removed from the transmitting cycle to indicate that the station is unreliable although it is still broadcasting a navigational signal. If the identification cannot be received, the station must be assumed to be _____.

ANSWERS: 1. 108 mc and 118 mc, 3. Unreliable

Course Indicator

When the identification is heard in the headset, the aviator turns his attention to another component of the omni equipment, the course indicator.

The course indicator is mounted on the instrument panel, usually directly in front of the aviator. It displays to the pilot, in a visual fashion, the omni information used for navigation.

At the bottom center of the course indicator is a small alarm flag labeled OFF. This flag is showing at any time the receiver is not tuned or the signal is not being received reliably.

If the receiver is tuned and a reliable signal is being received, the OFF will not _____.

If the OFF flag will not disappear, or if the identification sounds faulty, a slight adjustment of the frequency dial on the control unit will usually cause better reception of the signal.

ANSWER: Show (appear)

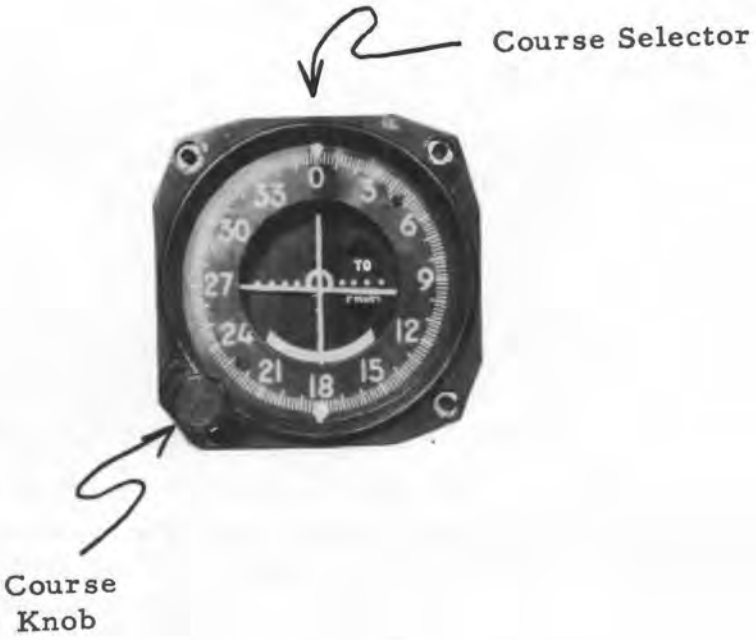
Review of Tuning

1. With the control unit (also called a tuning head), turn on the set, adjust the volume, place the OMNI/VAR LOC switch in the OMNI position, rotate the dial with the crank until the correct station frequency appears under the index.

2. Listen for three-letter identification in code, or in code and voice alternately. If there is not identification, assume that the station is unreliable.

3. Look at the course indicator. The alarm flag (OFF flag) should drop out of sight. Make slight adjustments with the tuning crank if necessary. If the flag will not disappear, the signal is not reliable. You may be too low, or too far away, or there may be some malfunction in the receiver.

4. After the station has been correctly tuned and a reliable signal is being received, the volume may be reduced so that the aviator can just barely hear the signal. The omni navigation signal is fed to the course indicator which gives a visual presentation. The volume can be increased to receive weather broadcasts at 15 and 45 minutes past the hour. Of course, the volume must be increased each time a new station is tuned because the new station must be identified.

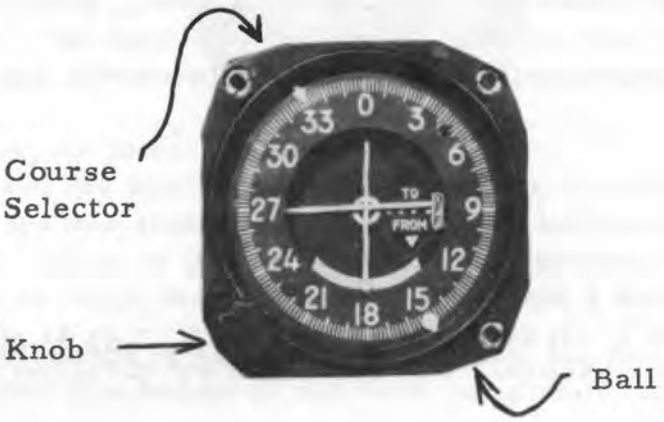


Course Indicator

The course indicator instrument, located on the instrument panel, displays the omni navigational information to the aviator. The aviator looks at the course indicator to use omni for navigation.

The course knob is rotated by the aviator to move the course selector. The course selector (above) is set on _____ °.

ANSWER: 0° (or 360°) Note. 0° is usually labeled on the instruments.



The course selector ball is opposite the course selector on the reciprocal direction. It also moves when the knob is rotated. The course selector above is set on _____° and the ball is on _____°.

ANSWER: 330° - 150°

Glide Slope Receiver OFF Flag

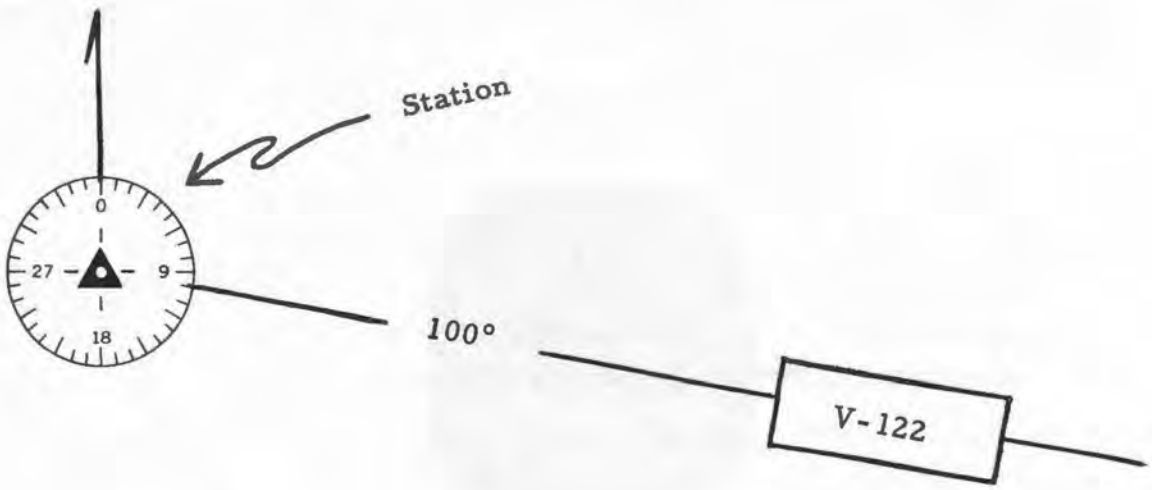
Horizontal Bar

Course Indicator

Omni equipment is also used with the instrument landing system (ILS). A horizontal bar on the course indicator represents the glide slope of the ILS. An OFF flag at the right side of the indicator shows if the glide slope receiver is working reliably.

The horizontal bar and the glide slope OFF flag have nothing to do with omni.

These will be disregarded in the remainder of this booklet.



If an aviator wants to fly into, or away from, an omni station, he should set the course selector on the inbound or outbound course he intends to follow.

Courses published on navigational charts are always the outbound courses called radials.

In the chart diagram above if an aviator wants to fly outbound from the station, he would set the course selector on _____°. To fly inbound to the station on V-122, the aviator would set the course selector on ____°.

ANSWER: 100° - 280°

TO-FROM Indicators

Every setting of the course selector arrow causes the TO-FROM indicator to show if the selected course goes toward (TO) the station or away from (FROM) the station.

The TO-FROM indicator is also called a sense indicator.

The sense indicator above shows that the 310° course goes _____ (to - from) the station.

ANSWER: To

A

Note. The actual course indicator is a black-faced instrument with white markings. The instrument is showing TO if white appears in the TO window and vice versa.

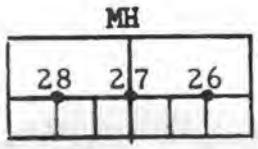
The TO-FROM indicator does not tell you anything about the heading of the aircraft. The heading is shown on the compass or heading indicator.

The TO-FROM shows where the selected course goes, either to or from the station, based on the present position of the aircraft.

The indicator above shows that from the present location of the aircraft the _____° course goes _____ the station.

By looking only at the course indicator, can you determine if the aircraft is heading to or from the station? _____

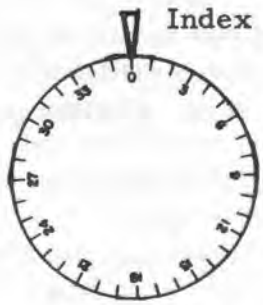
ANSWERS: 030° - From - No



The aircraft heading is shown on a magnetic compass or heading indicator. There are several types of heading indicators in use (see below). These may be simple directional gyros or may be fancy compass systems. In this booklet the heading will be shown on an indicator like the one above. It is showing a magnetic heading of _____°.

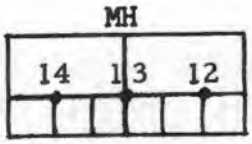
Heading Indicators

Fixed card: Rotating arrow shows heading.



Rotating card: Fixed index shows heading under index.

ANSWER: 270°



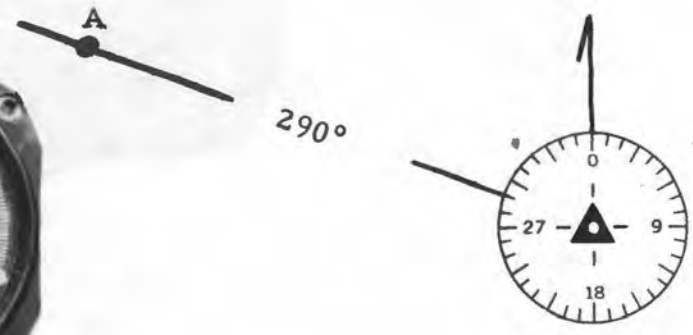
The TO-FROM indicator tells the aviator, "I don't know what heading you are flying, and I don't care, but if you fly what is set under the course selector, I will tell you if it goes to or from the station."

The heading indicator above shows that the aircraft is flying a heading of _____°, but, the course indicator shows the course selector set to a course of _____°. The TO-FROM indicator says that the course set under the course selector goes _____ the station.

Is the aircraft actually flying a heading that will take it to the station?

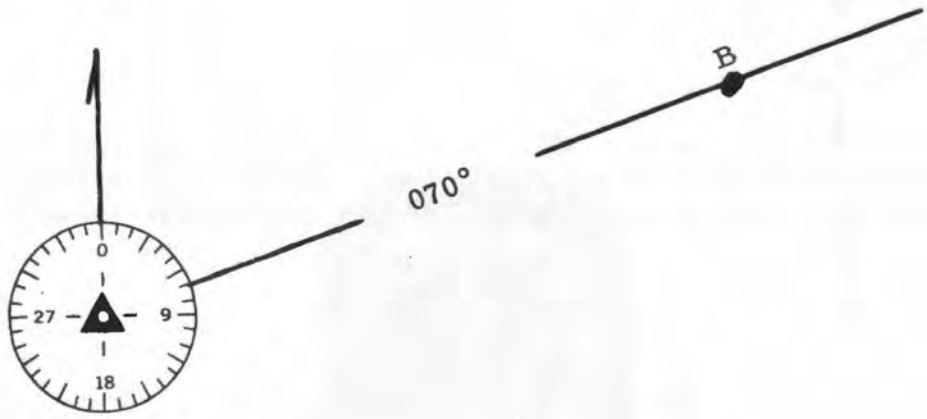
_____

ANSWERS: 130° - 300° - To - No



An aviator located at point A on the 290° radial sets the course selector on 290° and the TO-FROM indicator shows FROM because the 290° course (radial) goes _____ the station.

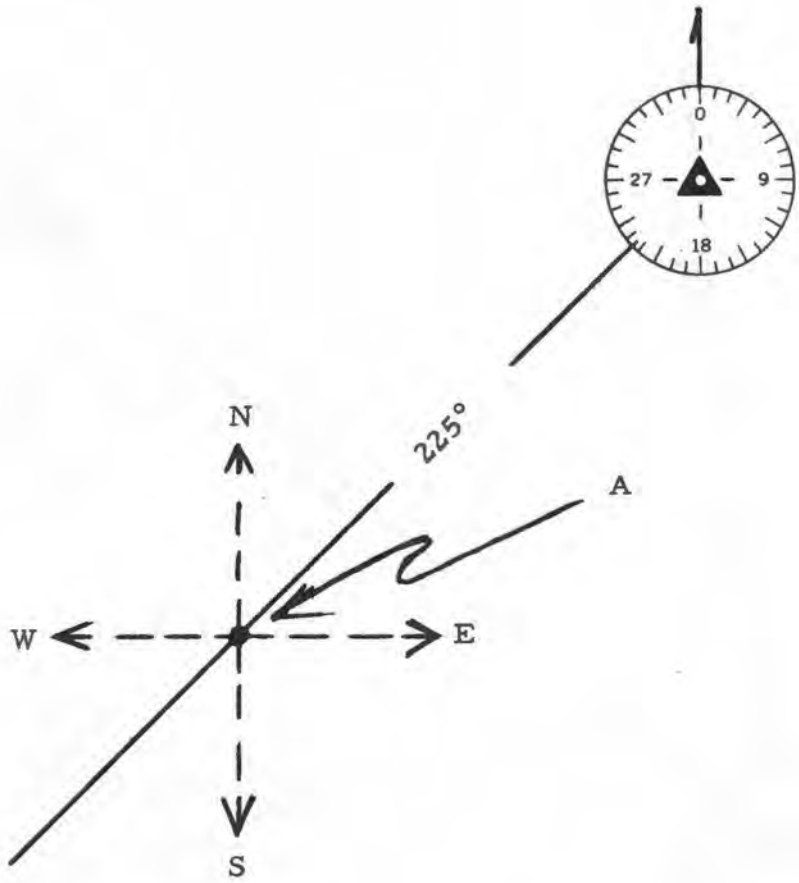
ANSWER: From



An aviator located at point B above sets the course selector on 070° and the sense indicator shows _____.

If the course selector is set on _____° (reciprocal of 070°), the TO-FROM indicator will show TO.

ANSWERS: From - 250°



The heading of the aircraft has no effect on the indication of the TO-FROM indicator. An aircraft located at point A above might be headed north, east, south, or west (or in any direction), but if the course selector is set on 45°, the TO-FROM window will show _____.

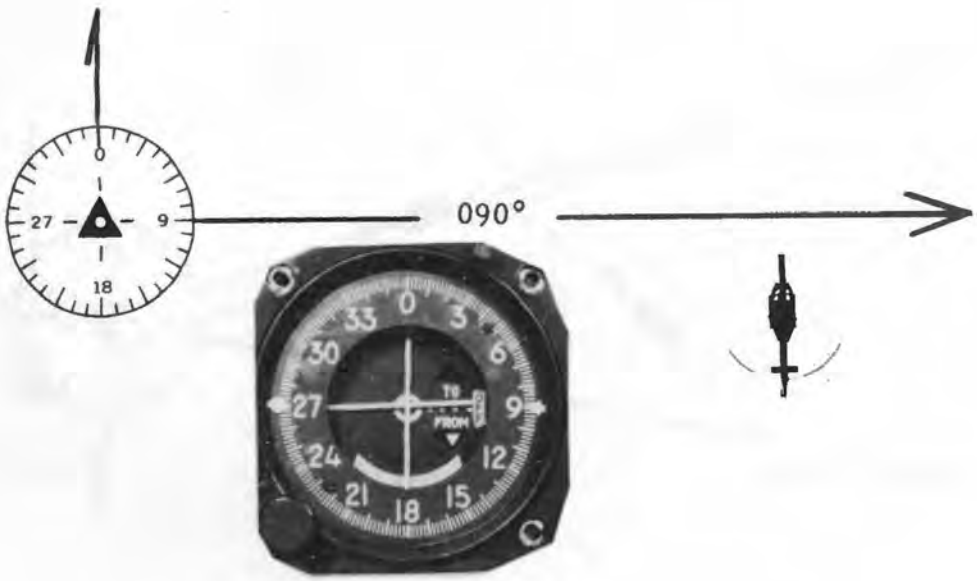
The TO-FROM indicator simply says that from point A there are some courses which go toward (TO) the station and others which go away from (FROM) the station.

ANSWER: TO

For example: If an aircraft is located at point B above, southeast of the station, the sense indicator will show TO if the course selector is set on courses like 300°, 310°, 315°, 325°, etc. because from point B, all of these courses go generally toward (TO) the station.

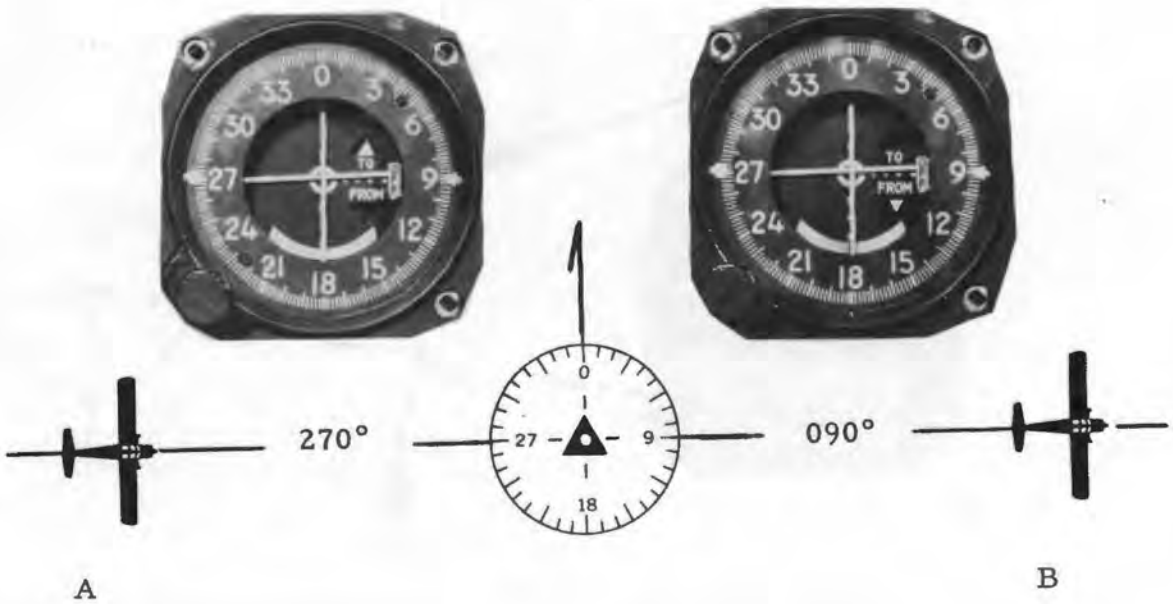
But while the aircraft is located at point B, if the course selector is set to courses like 100°, 120°, 130°, 150°, etc., the sense indicator will show _____, because these courses generally go away from the station.

ANSWER: FROM



The aircraft above is flying a heading of 0°. The course-selector arrow is set on 090° and the TO-FROM indicator is showing _____, because if the aircraft turned to a heading of 090°, the aircraft would be going _____(to - from) the station.

ANSWERS: FROM - From



The aircraft at position A above is flying directly to the station on a course of 090°. After passing the station (point B), a course of 090° goes outbound from the station. The sense indicator changes to _____ as the aircraft flies over the station.

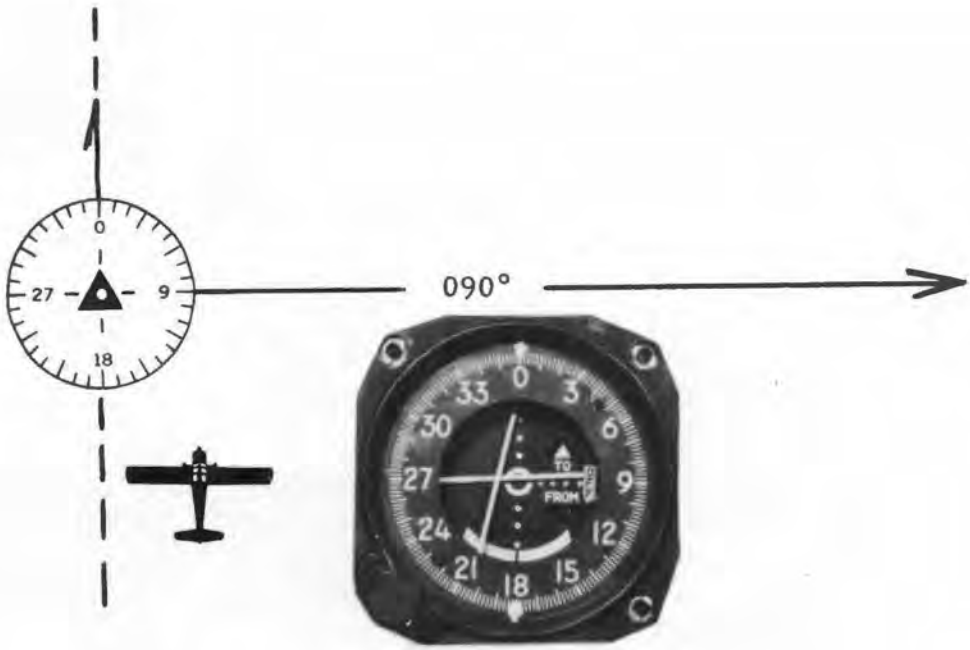
ANSWER: FROM

One major purpose of the TO-FROM indicator is to show the aviator that the aircraft is passing over the station.

While passing over the station, the TO-FROM indicator may bob up and down several times. When it drops to FROM and stays there, the aviator makes a time check to establish the station-passage time. This time is used in position reports and in navigation calculations.

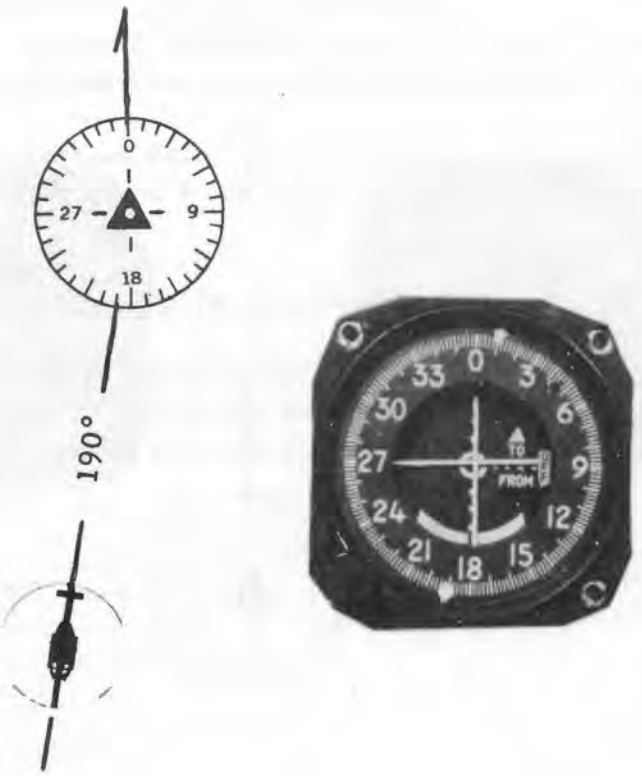
Station-passage time is the time that the TO-FROM indicator changes from _____ to _____.

ANSWER: TO - FROM



The aircraft above is flying a heading of 0°, course selector is set on 0° and the sense indicator is showing TO. Although the aircraft is not flying directly toward the station, it is getting closer to the station and will continue to do so until it crosses the _____° radial at which time the TO-FROM indicator will change to _____, since the 0° course will then be going away from the station.

ANSWERS: 090° - FROM



Remember that the heading of the aircraft has no effect on the TO-FROM indicator. Although the aircraft above is flying a heading that takes it away from the station, the course selector is set on 010°and the TO-FROM indicator is showing _____, because if the aircraft turned and flew the course of _____°, it would go to the station.

ANSWER: TO - 010°

Review of the TO-FROM Indicator

1. The TO-FROM indicator is also called a sense indicator.

2. Based on the position of the aircraft and the station, the TO-FROM indicator shows if the selected course goes generally to or from the station.

3. For every course which is selected, the sense indicator will show either a TO or FROM.

4. The TO-FROM indicator is used to show the aviator when the aircraft passes the station. Going inbound, the indicator will show TO. It will bob up and down and settle on FROM as the aircraft passes the station, or flies abeam the station. The time at which this occurs is the station-passage time, used for position reporting and navigational calculations.

5. The TO-FROM indicator does not show which way the aircraft is actually flying. The aviator must look at the heading indicator to see what the actual heading of the aircraft is. The TO-FROM indicator shows only what the selected course will do, based on the present position of the aircraft and the location of the station.

A

Right Needle

B

Centered Needle

C

Left Needle

The course indicator has a vertical needle pivoted at the top which can swing right and left. The needle represents the selected course. If the needle deviates from center, it is showing the direction and amount of course deviation.

When the needle is vertically centered (B above), the aircraft is located on the selected course.

B above shows that the aircraft is located on the selected course of _____° and that this course goes _____(to - from) the station.

ANSWERS: 060° - From

If the deviation needle is centered, we can always determine the course to the station and the radial on which the aircraft is located.

The course to the station is the reciprocal of the _____ from the station.

Since the course selector and ball are on reciprocal directions, we know that if the course selector is showing the radial from the station, the ball will show the _____ to the station.

ANSWERS: Radial - Course

The course selector and sense indicator above show that the 100° course goes to the station. The centered needle shows that the aircraft is on that course. The ball shows that the aircraft is on the _____° radial.

ANSWER: 280°

When the instrument is showing TO and the needle is centered, the course selector shows the course to the station and the ball shows the _____ on which the aircraft is located.

ANSWER: Radial

The indications above show that the course to the station is _____°
and the aircraft is on the _____° radial.

ANSWERS: 210° - 030°

The sense indicator shows FROM, meaning that the selected course (120°) goes from the station. The centered needle shows that the aircraft is on the course.

Since the aircraft is on the 120° course from the station, we say the aircraft is on the 120° radial. However, the course to the station is indicated by the ball, _____°.

ANSWER: 300°

When the needle is centered and the indicator shows TO, we read the course to the station under the course selector and the radial under the ball (above left).

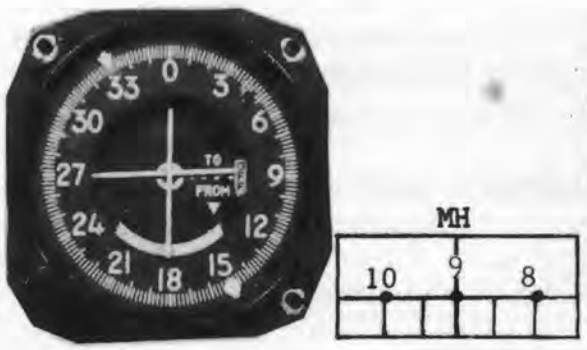
When the needle is centered and the indicator shows FROM, we read the radial under the course selector and the course to the station under the ball (above right).

The instrument (above left) shows that the aircraft is on the _____° radial.

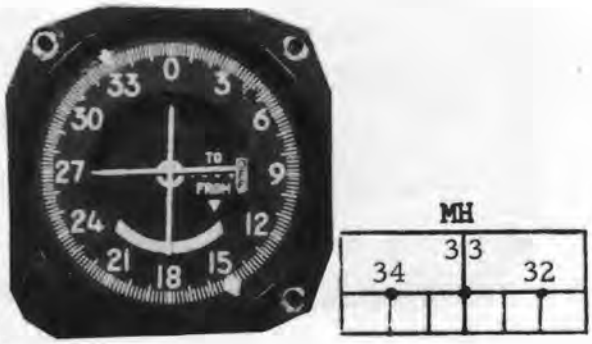
The instrument (above right) shows that the aircraft is on the _____° radial.

ANSWERS: 70° - 170°

A



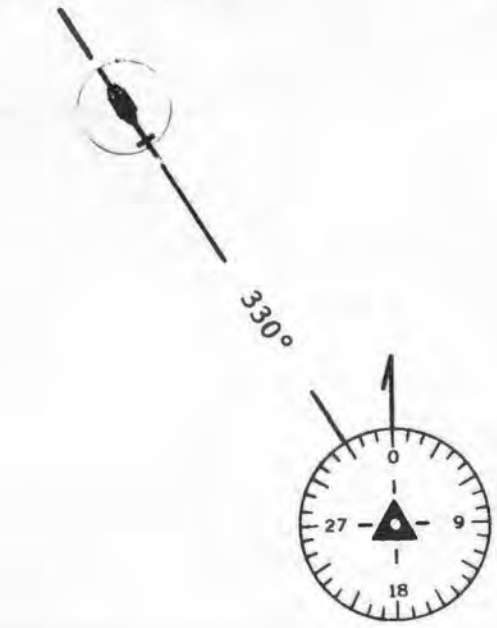
B



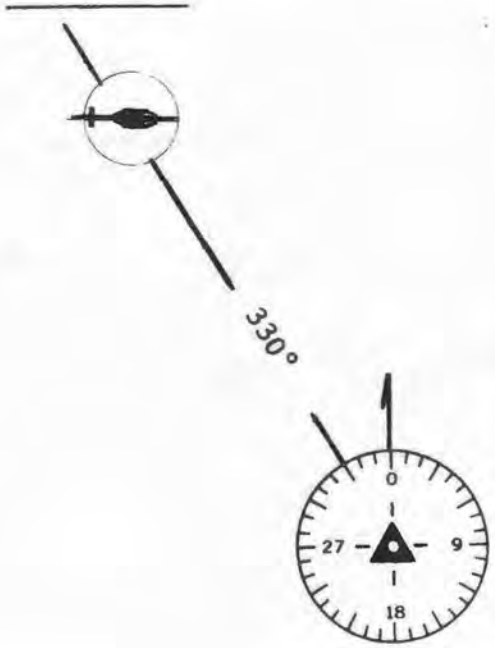
With the needle centered, the course indicator will show you the course to the station and the radial on which the aircraft is located. But, you must look at the heading indicator to see where the aircraft is actually going.

Match the instruments (A and B above) with the diagrams (1 and 2 below).

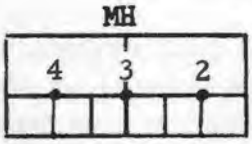
1. _____



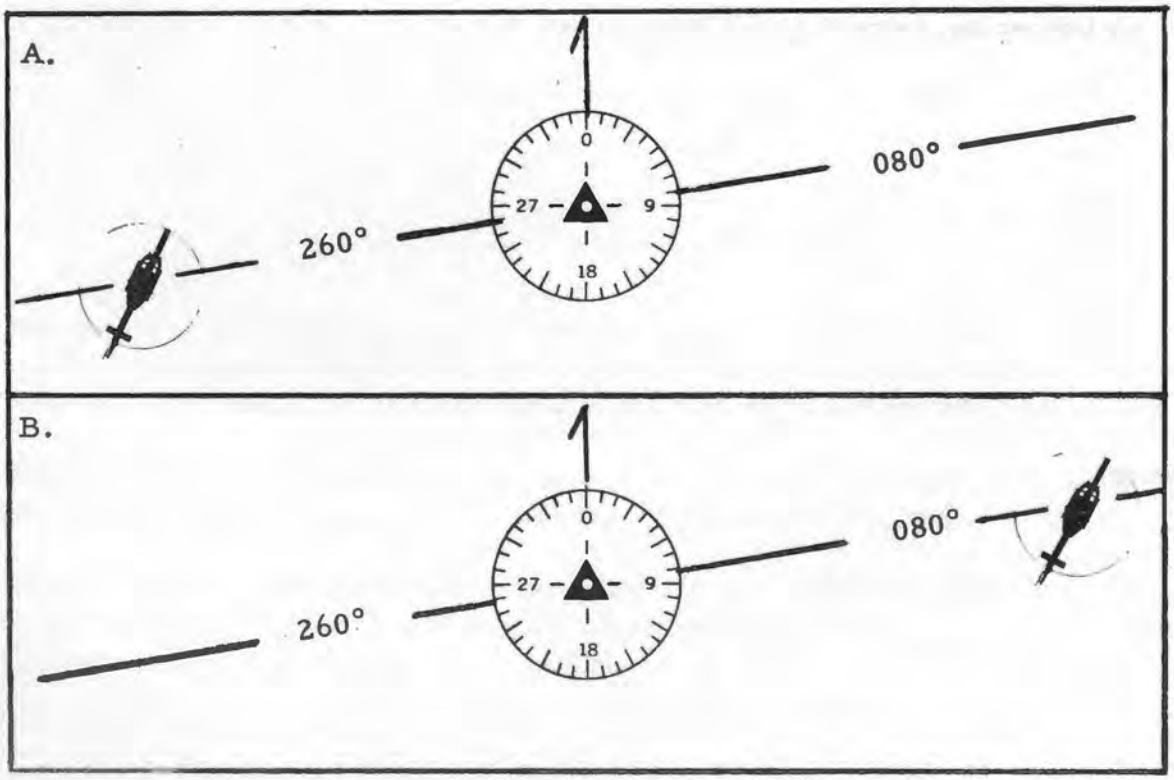
2. _____



ANSWERS: 1. B, 2. A



The instruments above show that the aircraft is located on the 080° course to the station - the 260° radial. But, the aircraft is flying a heading of 030°. Which diagram below corresponds to the instruments readings? (A or B)



ANSWER: A

The process of orienting yourself with respect to an omni station consists of tuning and identifying the station, then rotating the course selector knob until the needle centers and the sense indicator shows TO.

When these things have been completed, the direction to the station is read under the course selector and the radial under the ball.

Assuming that the station has been properly tuned and identified, the instrument above shows that the aircraft is located on the _____° course to the station, or the _____° radial.

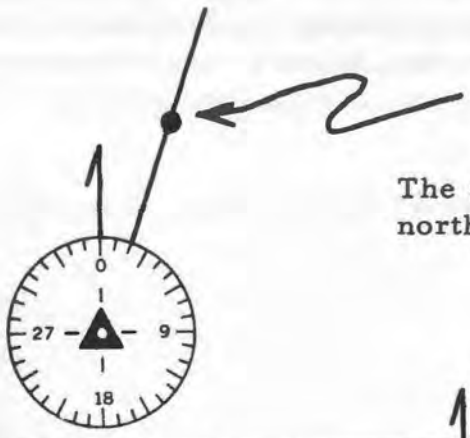
ANSWERS: 300° - 120°

Assume the station has been tuned and identified, the instrument at right shows that the course to the station is 020° and the aircraft is located on the 200° radial.

Which diagram below corresponds to the indications on the instrument?

A. _____ B. _____

A.



The aircraft is here, north, northeast of the station.

B.

The aircraft is here, south, southwest of the station.

ANSWER: B

The instrument above is showing that the aircraft is -

a. West, northwest of the station on the 290° radial. (Page 50).

b. East, southeast of the station on the 110° radial. (Page 49).

ANSWER: a

If you picked "b" to answer item number 48, you are missing the point. Analyze it this way -

1. The course selector is on 110°.

2. The TO-FROM is showing TO; therefore, the 110° course goes to the station.

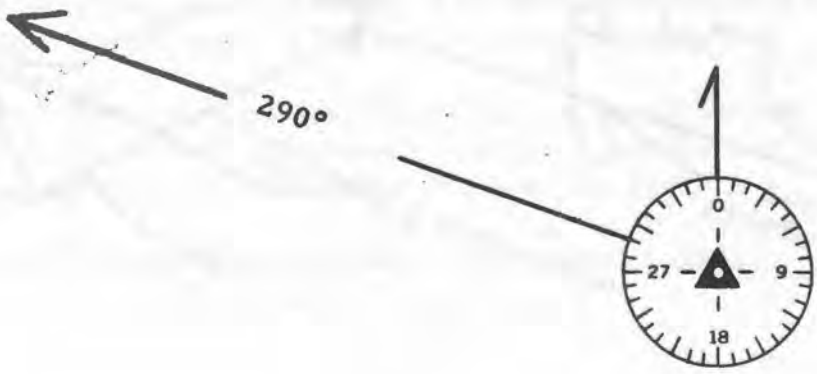
3. The needle is centered; therefore, the aircraft is on the 110° course which goes to the station.

4. A radial is an outbound course from a station. If the instrument is showing TO, the radial is read under the ball.

5. The ball on the instrument below is on 290°, which, of course, is the reciprocal of the 110° course to the station. Therefore, the aircraft is on the 290° radial.

6. The only problem now is to realize that the 290° radial proceeds from the station in a west, northwest direction (diagram below).

(Now continue on page 50)



ANSWER: (to page 48) a
(continue below)

Normally, at the Aviation School the orientation procedure is performed with the sense indicator showing TO. But, of course, you can orient yourself by rotating the course selector knob until the needle is centered and the sense indicator shows FROM. You should understand how to orient the aircraft with either a TO or a FROM indication.

If the sense indicator is showing FROM, and the needle is centered, the radial on which the aircraft is located is shown under the course selector, and the direction to the station is under the ball.

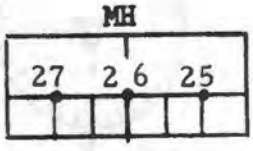
The indicator above shows that the aircraft is located on the _____° radial and the course to the station is _____°.

ANSWERS: 330° - 150°

If the aviator is flying a heading which is approximately the same as the selected course or if the aviator assumes that he is flying a heading which is the same as the selected course and the needle is deflected to the right of center, this means that the selected course is to the right.

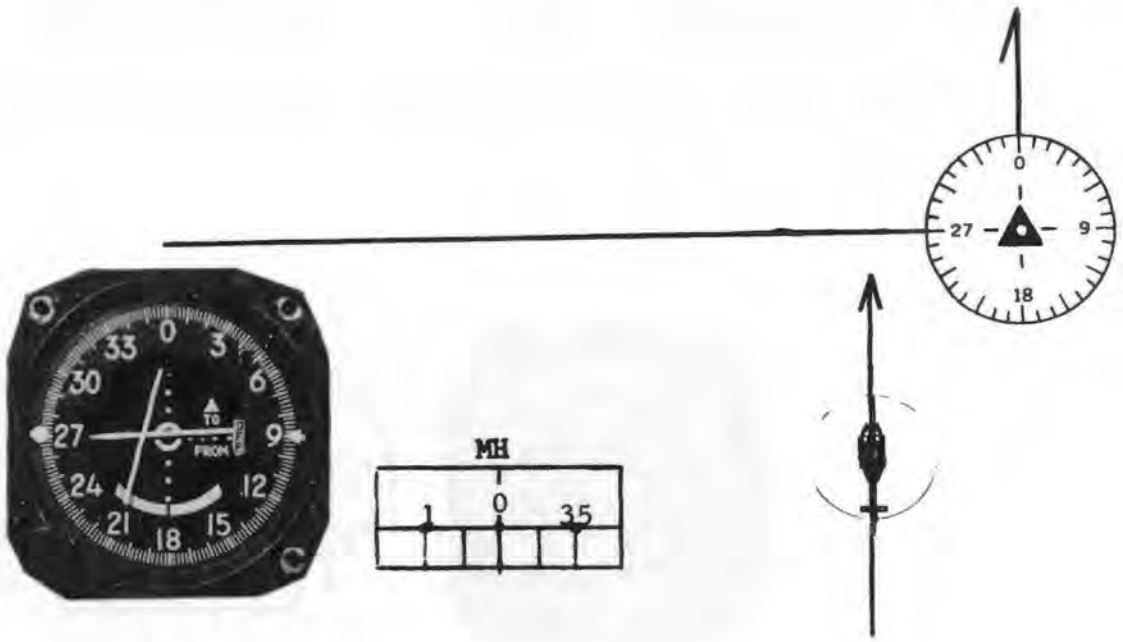
Assume you are flying a heading which is the same as the selected course (above). The needle is deflected to the right; this means that the selected course of _____° is to the _____.

ANSWERS: 180° - Right



The heading indicator shows the aircraft (above) is flying a heading of _____°. The selected course is also _____°. The needle shows that the selected course lies to the _____ of the aircraft.

ANSWERS: 260° - 260° - Left

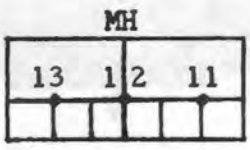


The actual heading of the aircraft does not have a direct effect on the needle at a particular time. The aviator can <u>assume</u> that he is flying the same course that is set on the course selector.

The needle in the illustration above is to the left; the course selector is set on 090°; and the sense indicator shows TO.

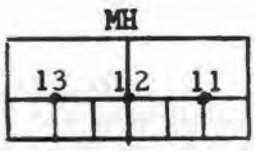
Although the aircraft is flying a heading of 0°, the aviator can assume that he is flying a heading of 090° and interpret the instrument by saying, "If I were flying a heading of 090°, the selected course would be to my _____."

ANSWER: Left

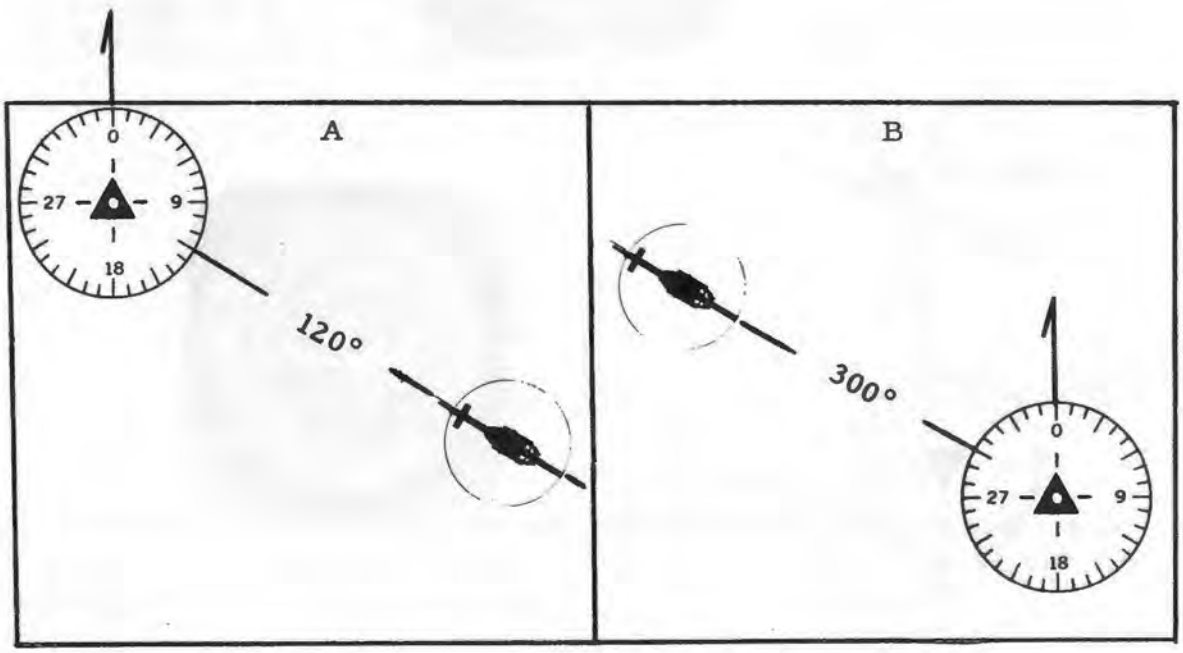


The magnetic heading indicator above shows that the aircraft heading is _____°. The course selector arrow is set on _____°. The TO-FROM indicator shows that the selected course goes _____ (to - from) the station.

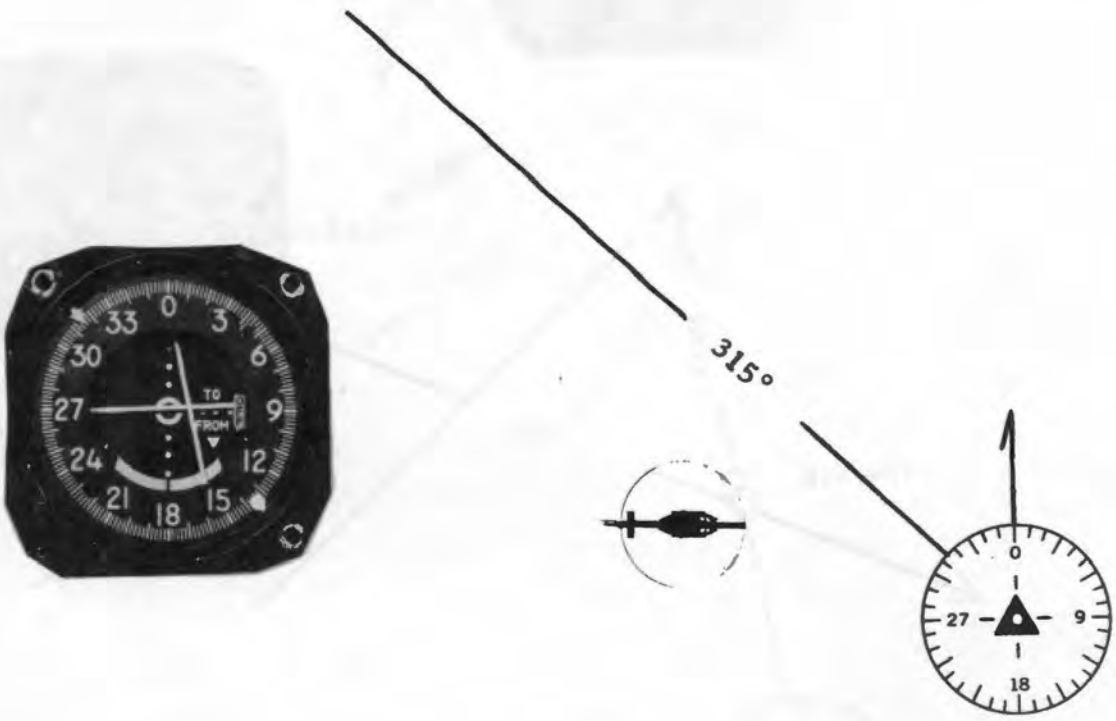
ANSWERS: 120° - 120° - From



The deviation indicator is centered showing that the aircraft is on the selected course of 120°. Which chart diagram below corresponds to the instrument indications above: A _____ or B _____?



ANSWER: A



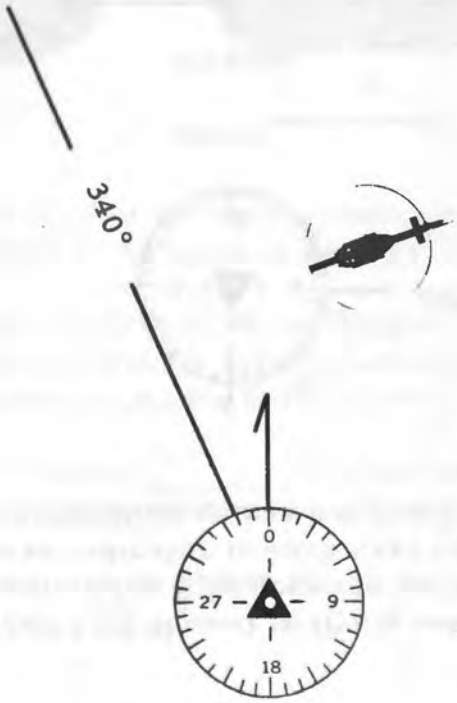
If the aviator turned to a heading of 315° (above), the 315° radial would be to the _____ (right - left) of the aircraft.

ANSWER: Right

A

B

Which set of instruments above (A or B) corresponds to the chart diagram below? (Hint: Assume that the aircraft is flying the course shown on the course selector, then determine which needle is showing the correct indication.)



ANSWER: B

A
2° Left

B
4° Left

C
6° Left

D

E

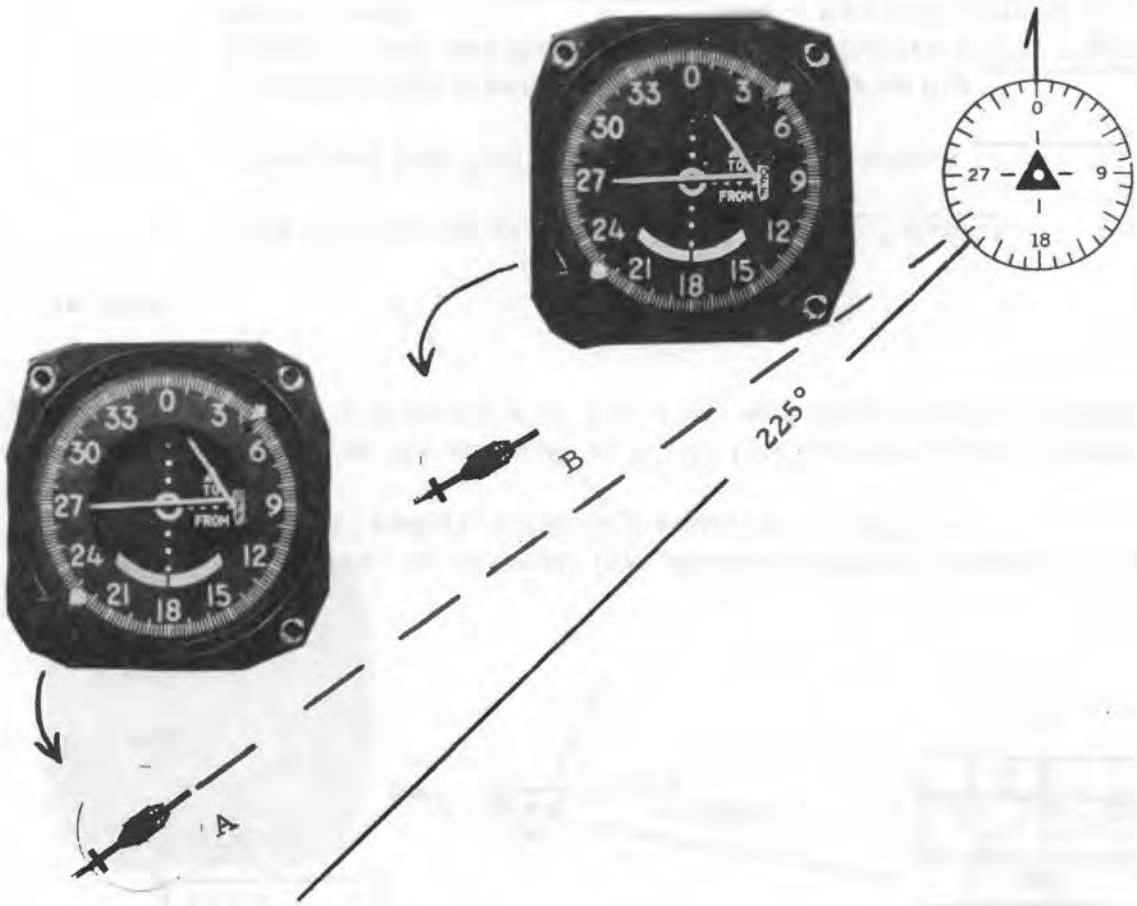
The horizontal scale on the face of the course indicator is graduated to show the degree of deflection of the vertical needle.

The edge of the small inner circle (called the doughnut) represents 2° deflection (A above). Each successive dot represents two more degrees deflection. This is illustrated in A, B, and C above.

The needle in D above is deflected _____° to the left. The needle in E above is deflected the maximum amount; it cannot swing further.

The maximum deflection that can be shown on the course indicator from the center to either side is _____°.

ANSWERS: 8° - 10°

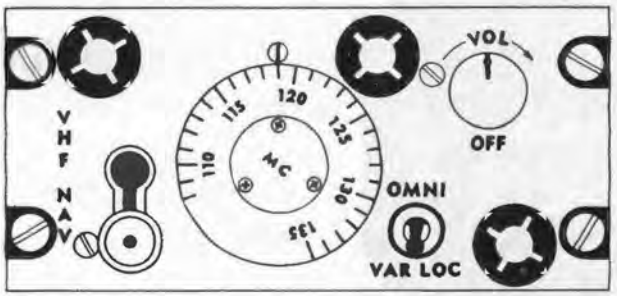


Aircraft A above is exactly 10° off his selected course and the needle is showing 10° right.

Aircraft B is more than 10° off his selected course but the needle cannot show more than 10°.

Therefore, a fully-deflected needle indicates that the aircraft is _____°, or <u>more</u>, from the selected course.

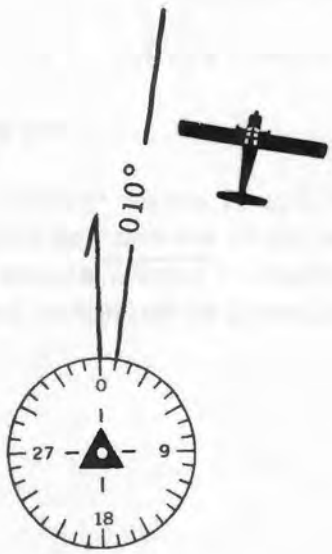
ANSWER: 10°



You recall that in tuning a station you placed the OMNI/VAR LOC switch in the OMNI position. If you fail to do this, the vertical needle will not accurately represent 10°. When the switch is set to VAR LOC for tuning an ILS localizer, the vertical needle is supposed to represent only 2° to 2 1/2° deflection from center to each side.

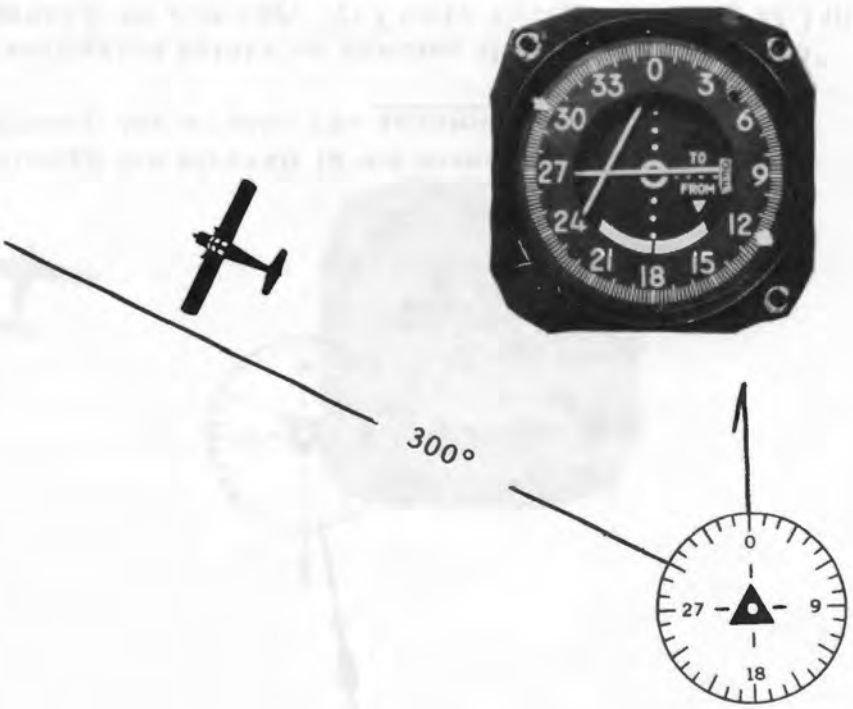
With the equipment set as shown above, you should not tune an omni station. The needle will not represent _____ from center to each side.

ANSWER: 10°



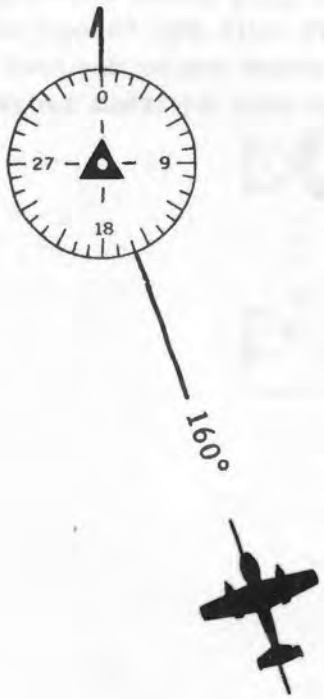
The course selector above is set for the aircraft to fly outbound on the 010° radial, but the aircraft is not exactly on course. The course is _____° to the left of the aircraft because the needle is deflected _____° left.

ANSWERS: 7° - 7°



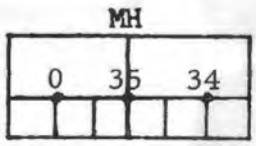
The instruments above show that the 300° radial is 8° to the left of the aircraft; therefore, the aircraft must be located on the _____° radial.

ANSWER: 308°



The aircraft above is inbound on a course of 340°, or the ball shows that the aircraft is on the _____° radial. If the course selector is rotated to 350° (ball on 170°), the needle would swing to the _____, because the 350° inbound course (170° radial) is the _____ of the present position of the aircraft.

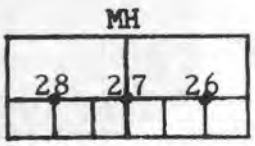
ANSWERS: 160° - Left - Left

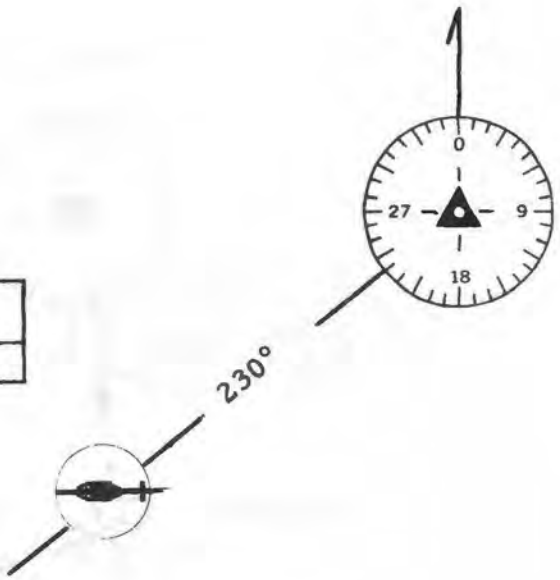


By looking at the instruments above, you can see that the aircraft is located on the _____° radial and is flying a heading of _____°.

Based on this, you know that the 330° radial is _____° to the _____ (left - right) of the aircraft.

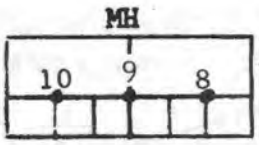
ANSWERS: 350° - 350° - 20°- Left





The aircraft above is, at present, located on the 230° radial but the heading indicator shows that the aircraft is flying a heading of 270°. If the aircraft maintains the 270° heading, the needle will swing to the _____.

ANSWER: Left



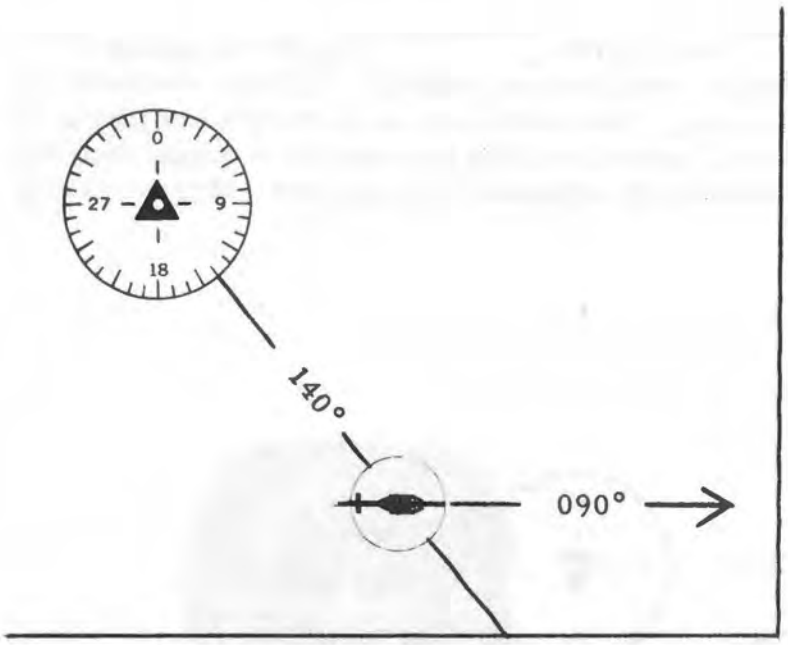
Based on the instrument readings above, draw on your answer sheet -

1. A dot representing an omni station.

2. A line from the station representing the radial on which the aircraft is located.

3. An aircraft crossing the radial on the heading shown.

ANSWERS: (See diagram)

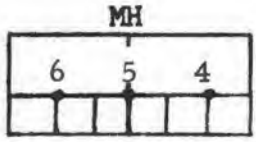


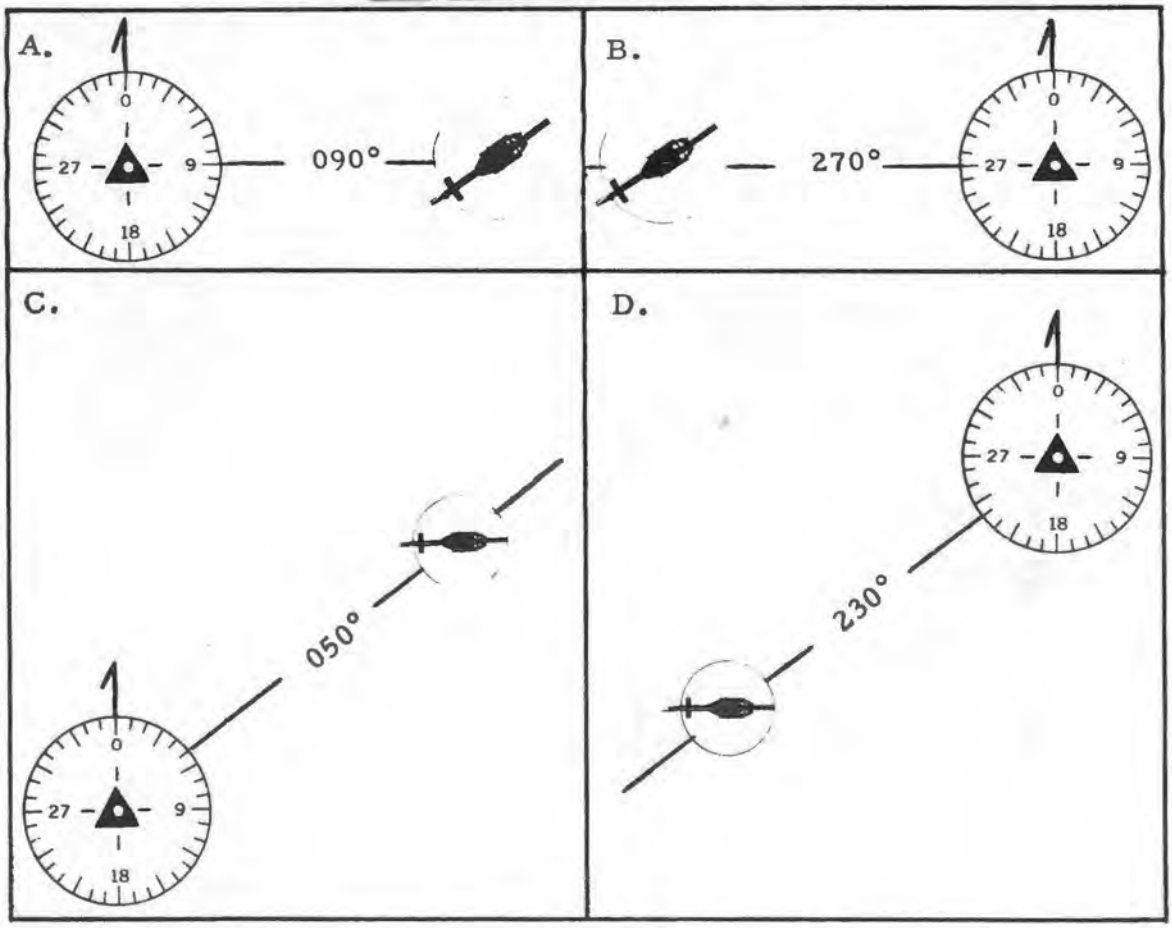
The indicator above shows that the 270° radial is 6° left of the aircraft.

On what radial is the aircraft located?

ANSWER: 276°

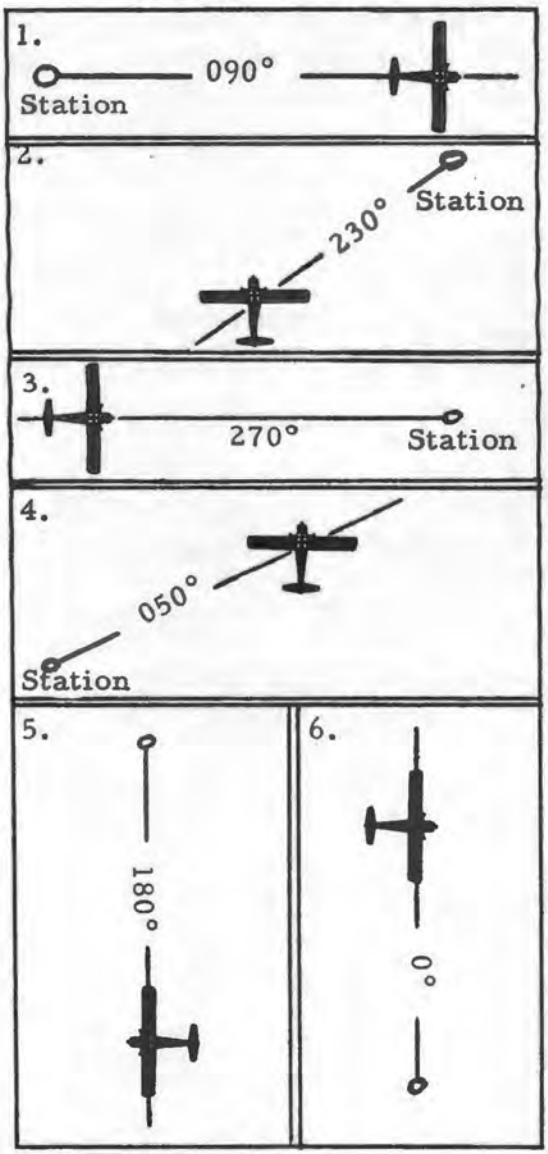
Which chart diagram below corresponds to the instrument readings?

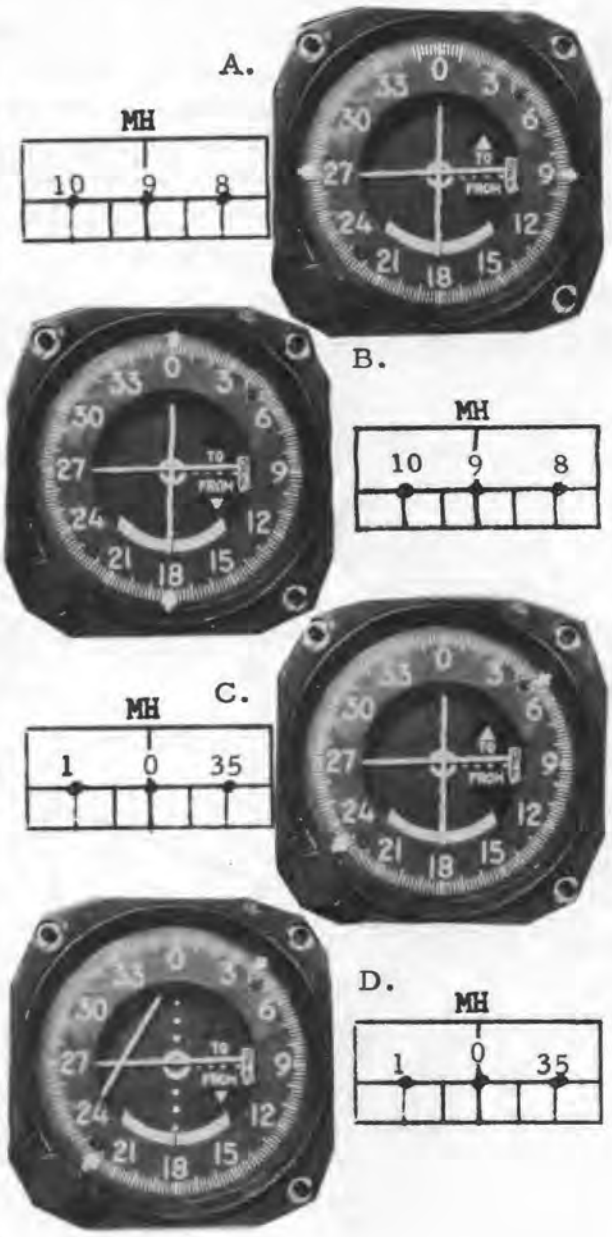




ANSWER: A

Match the diagrams below with the instruments. Only four diagrams will match. Look at the instrument first and study it, then pick a diagram which matches.





ANSWERS: A. 3, B. 6, C. 2, D. 4

Orientation Review

Match the statements below with the instruments. Note. Only four of the statements will match. (Hint: Study the instrument first, beginning with A, then find a statement which matches.)

1. The aircraft is east, northeast of the station on the 066° radial.

2. The aircraft is west, southwest of the station on the 246° radial.

3. The aircraft is on the 030° radial.

4. The aircraft is on the 210° radial.

5. The 170° radial is 10° east of the present location of the aircraft.

6. The aircraft is located on the 0° radial.

7. The 290° radial is 8° away from the aircraft.

8. The aircraft is located on the 102° radial.

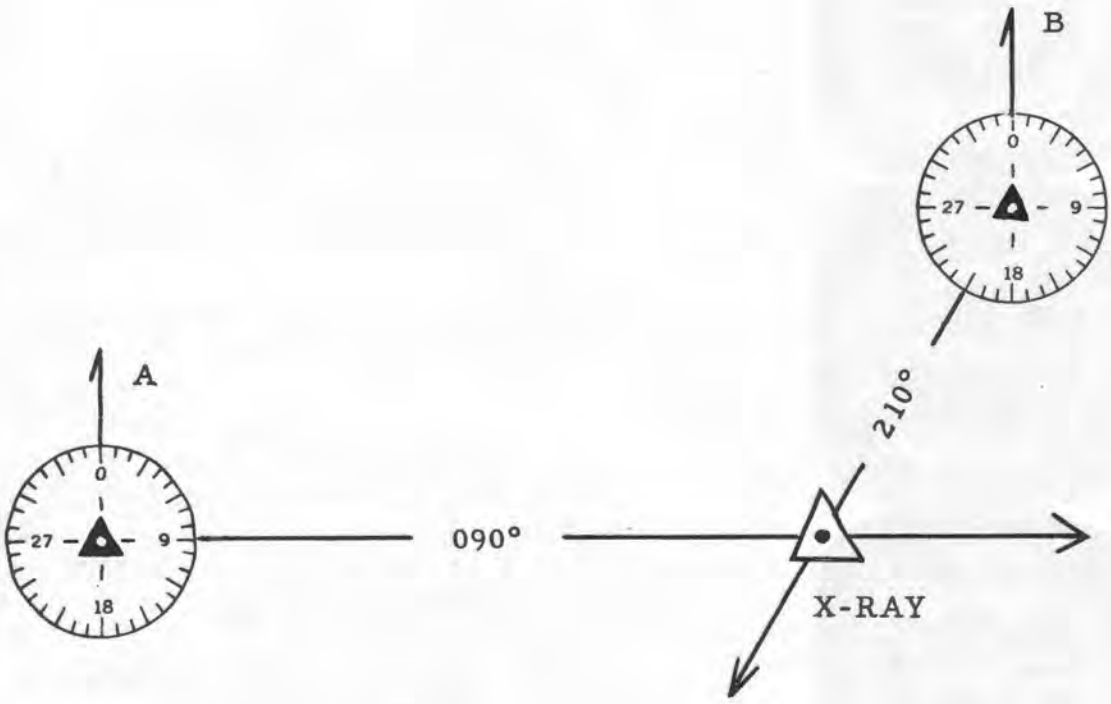
A.

B.

C.

D.

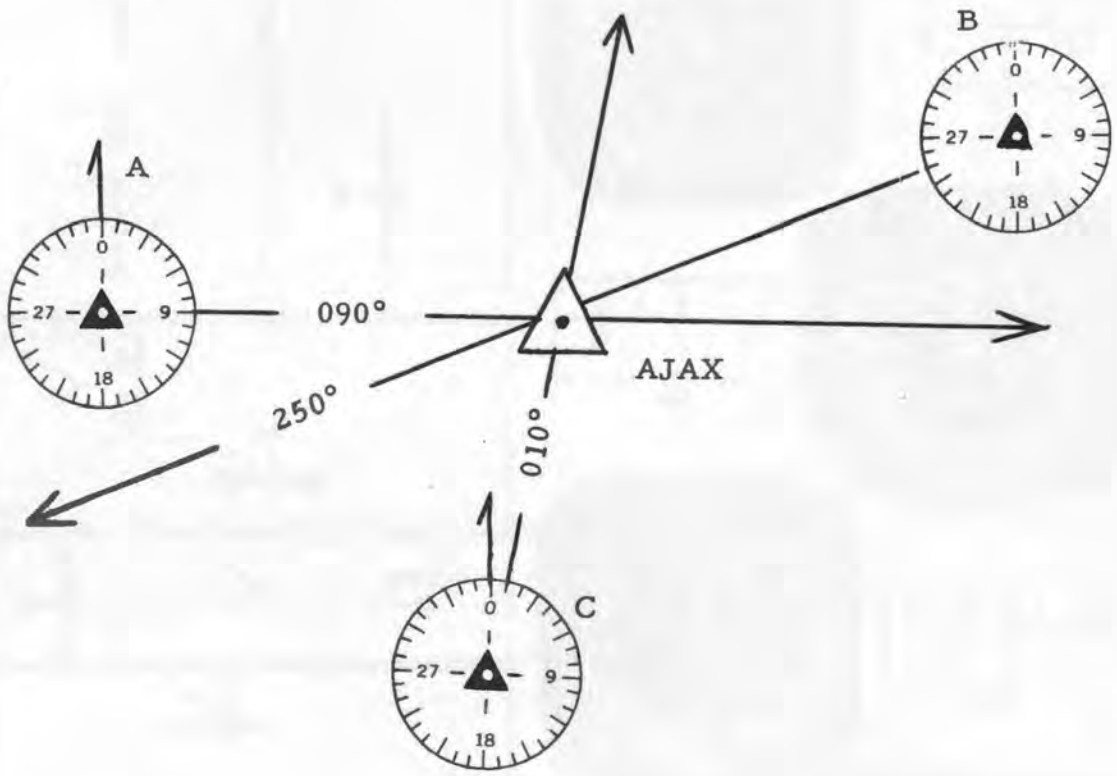
ANSWERS: A. 4, B. 8, C. 1, D. 5



Radio navigation charts display numerous points which represent the intersection of radial from two or more omni stations. These intersections may be used for fixing position, reporting, etc.

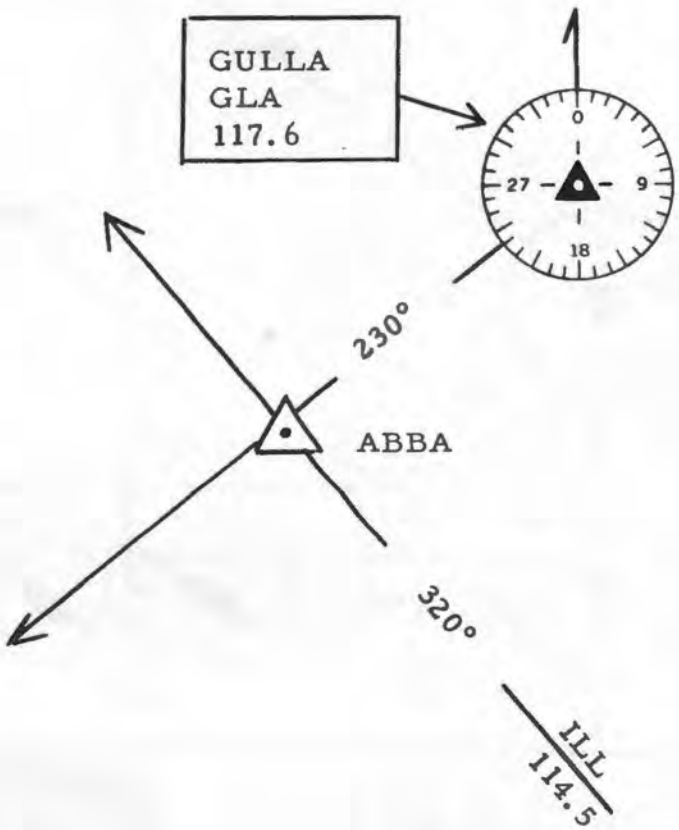
In the diagram above, the small triangle labeled X-RAY is the intersection of the _____° radial from station A and the _____° radial from station B.

ANSWERS: 090° - 210°



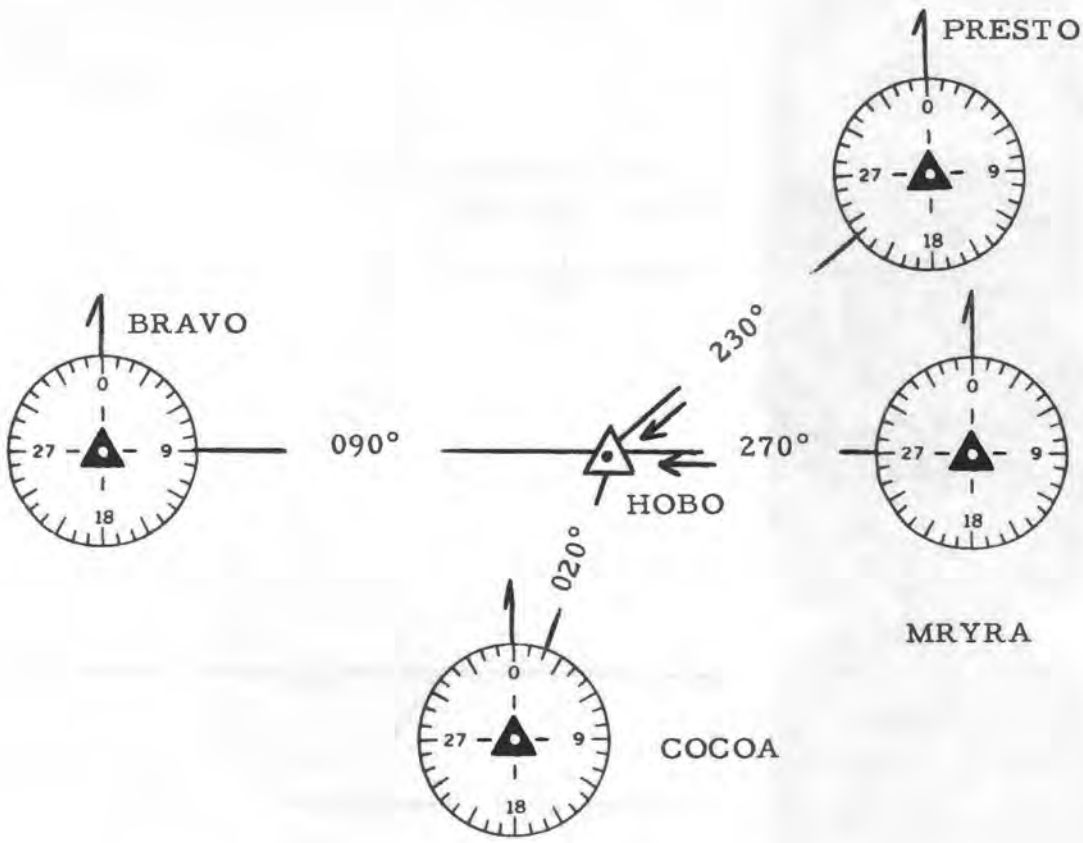
Intersections are formed by radials from two or more omni stations which intersect at an angle of 30° or more. The most accurate intersection occurs when the radials intersect at 90°. If the radials intersect by less than 30°, the intersection is usually not accurate enough for a precise fix. In the diagram above, the AJAX Intersection could most accurately be formed by the 090° radial from station A and the _____° radial from station _____.

ANSWERS: 010° - Station C



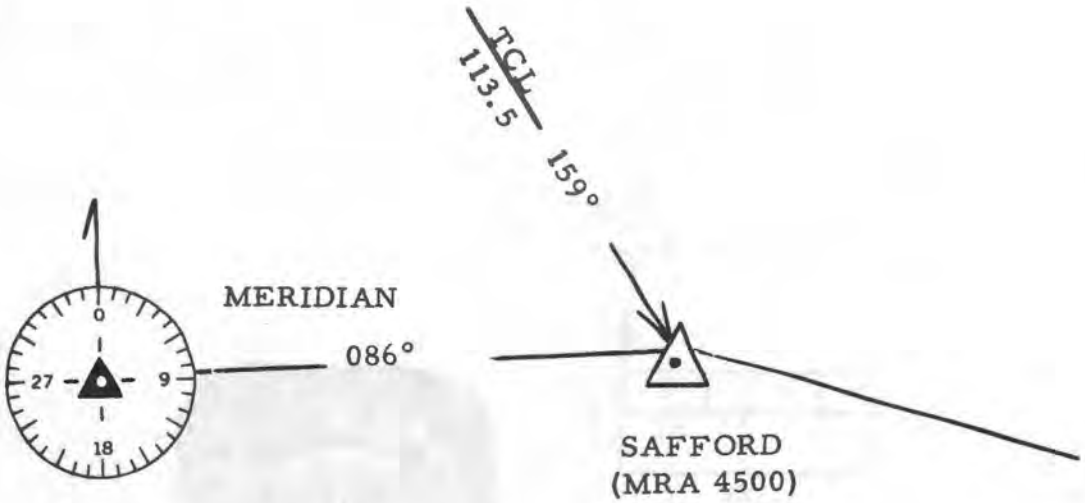
Navigation charts show the radials and stations which are used to form an intersection. In the illustration above, the 230° radial from station GULLA forms the ABBA Intersection with the _____° radial from station ILL (identification) which transmits on a frequency of 114.5 mc.

ANSWER: 320°



Where multiple stations are possible for forming an intersection, the stations which are used and flight-checked for accuracy are indicated by small arrows near the intersection. The small arrows by the HOBO Intersection indicate that the intersection is formed by the 230° radial from PRESTO and the _____° radial from _____.

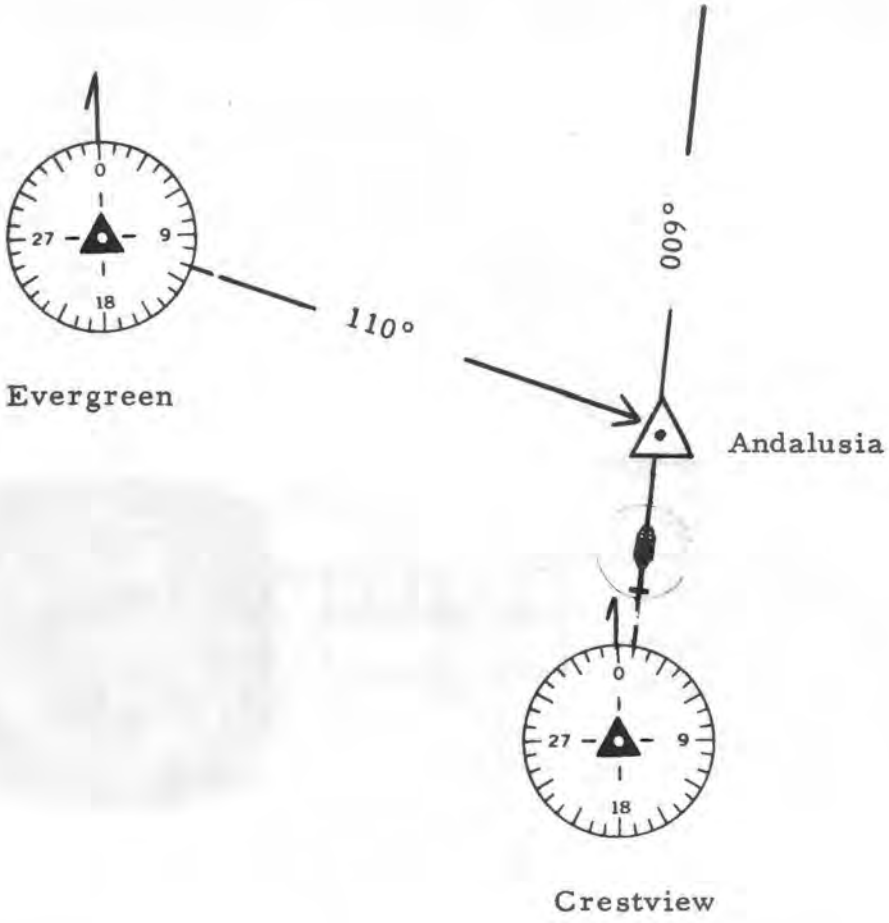
ANSWERS: 270° - MRYRA



We saw earlier that omni stations are restricted to line-of-sight transmission and for this reason cannot always be received at low altitudes. Occasionally, a minimum altitude at which an aircraft can fix an intersection is shown by the intersection on the chart. This altitude is called the minimum reception altitude (MRA).

The MRA for the intersection above is _____ feet.

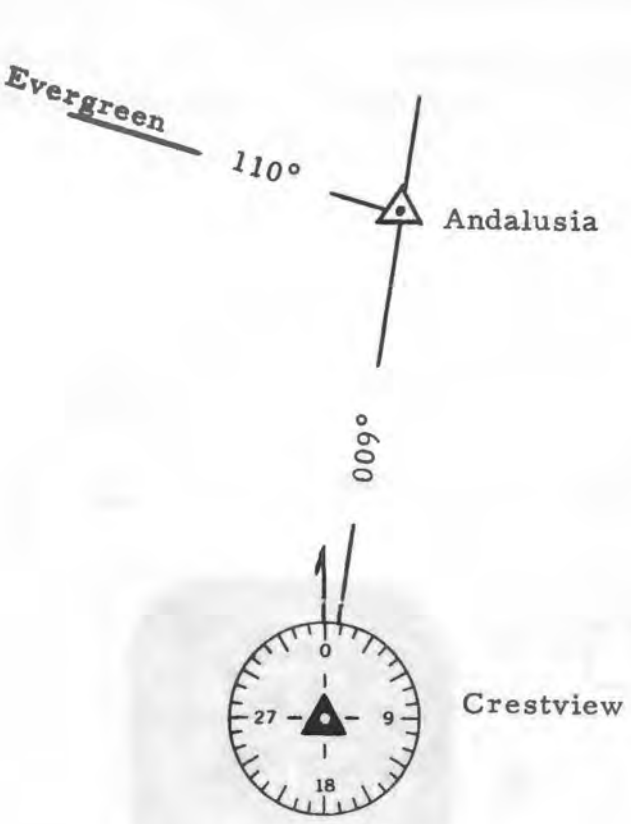
ANSWER: 4500 feet



To fix the Andalusia Intersection, the aviator will fly outbound from Crestview on the 009° radial. The aviator will establish the heading necessary to keep the aircraft on the 009° radial CEW.

Next, the aviator will tune and identify Evergreen. The aviator knows that he will be over the Andalusia Intersection at the time he crosses the _____° radial from Evergreen.

ANSWER: 110°



A.

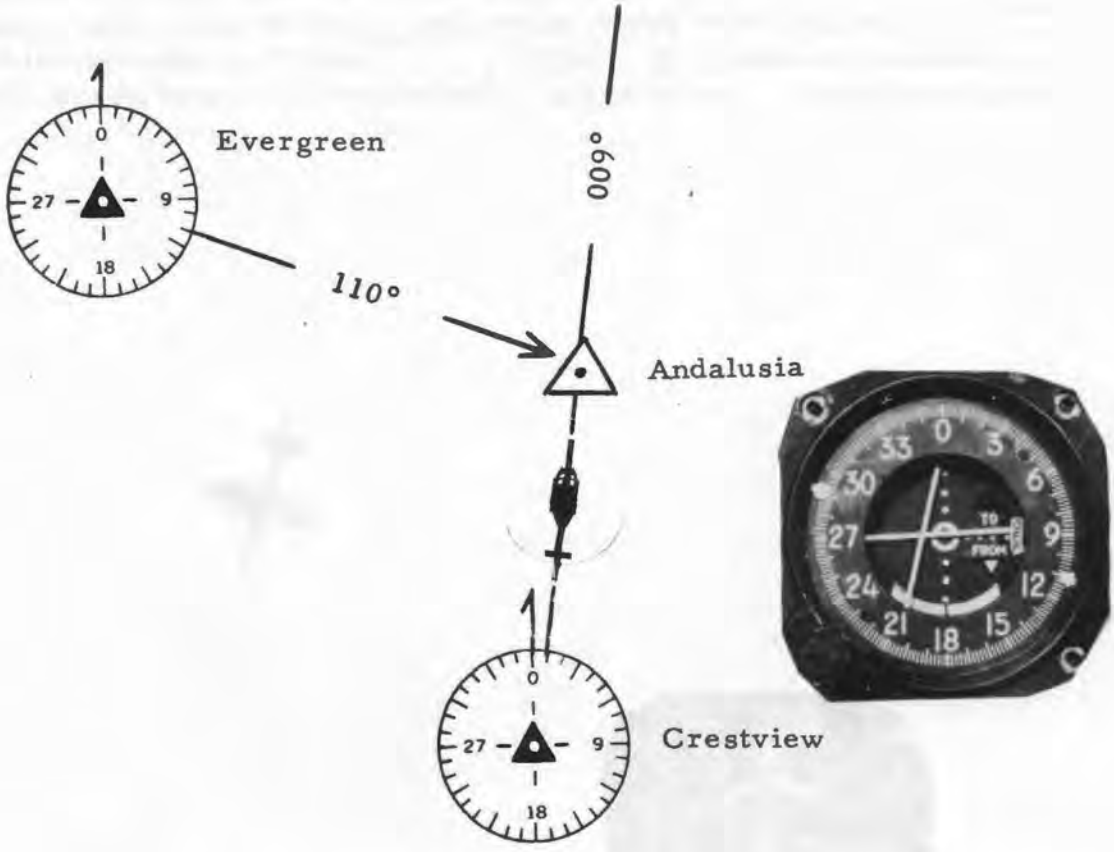
B.

C.

After tuning and identifying Evergreen (EVR), the aviator will set the course selector on 110°, causing the TO-FROM indicator to show FROM because the 110° course goes from Evergreen.

Which of the course indicators above shows that the aircraft is <u>on</u> the 110° radial from Evergreen?

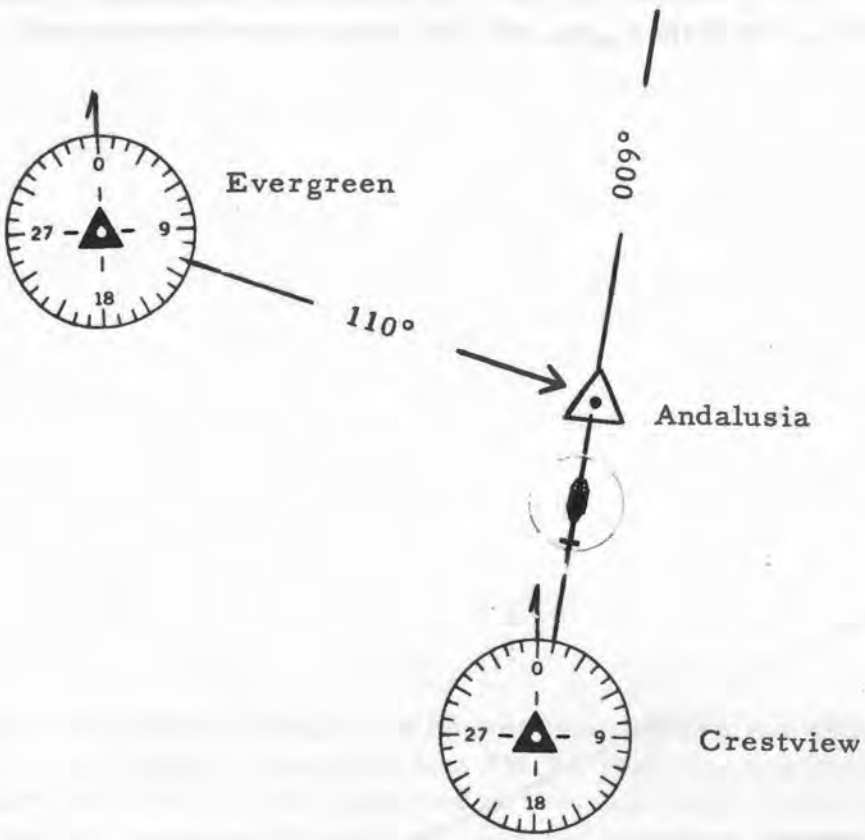
ANSWER: B



Aviators must be able to glance at the course indicator and know quickly the position of the aircraft with respect to the intersection. In the diagram above, the aircraft has not reached Andalusia Intersection. The aviator has tuned EVR and has set the course selector to 110° causing the TO-FROM indicator to read FROM.

The station which has been tuned is to the left. Notice that before the aircraft reaches the intersection, the needle is also deflected to the _____ (left - right).

ANSWER: Left



Remember that although the aircraft is not actually flying 110° (the radial from Evergreen), the aviator can assume that he is.

If he makes this assumption before he reaches the intersection (110° radial from Evergreen), he can say, "If I were flying a heading of 110°, the left needle is telling me that the 110° radial is to my left." In other words, in this particular case, the left needle means that the aircraft is _____ (north - south) of the 110° radial which fixes the intersection.

ANSWER: South

When a station is tuned to fix an intersection and the course selector is set on the radial, resulting in a FROM reading, the aviator can always expect the needle to be deflected to the same side on which the station is located, prior to the time the aircraft reaches the intersection.

That is -

a. If the course selector is set on the _____,

b. And the TO-FROM indicator reads _____,

c. And the station which is tuned is to the left,

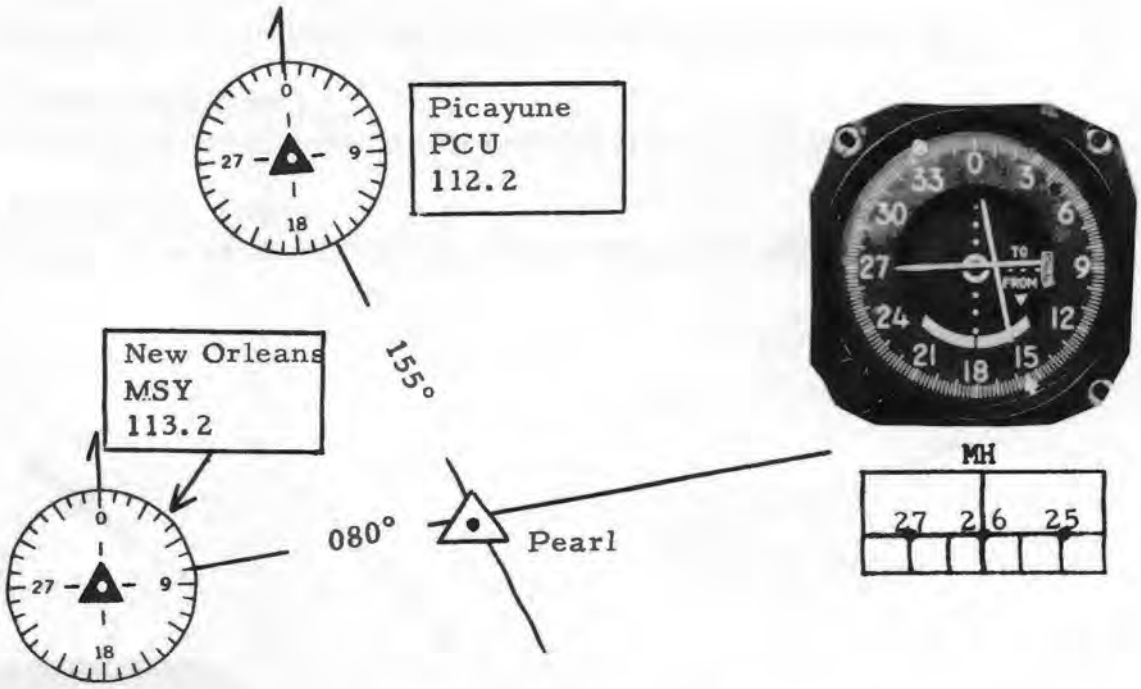
d. The needle will be deflected to the _____, prior to the time the aircraft reaches the intersection.

ANSWERS: a. Radial, b. FROM, d. Left

In the case of the Andalusia Intersection which we have been looking at, the needle was supposed to be deflected to the left before the aircraft reached Andalusia.

Therefore, after the aircraft passes the Andalusia Intersection, the needle should be deflected to the _____.

ANSWER: Right



In the diagram above, an aircraft (not shown) is flying inbound to New Orleans on the 080° radial, following a course of 260°.

To fix the position of the aircraft at Pearl Intersection, the aviator tunes Picayune on a frequency of 112.2 mc and identifies the station (PCU).

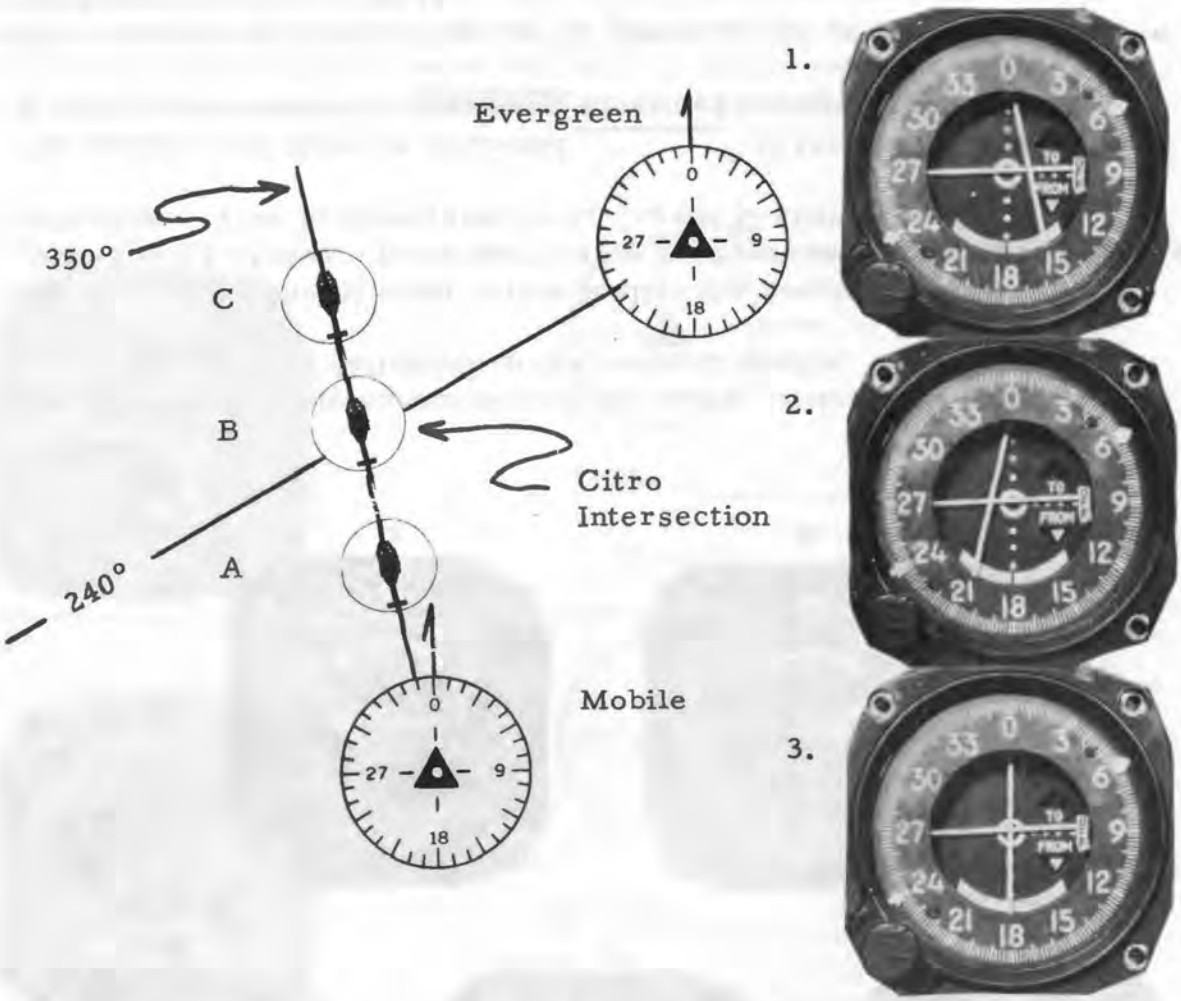
He then -

a. Sets the course selector on the _____° radial.

b. Observes that the TO-FROM indicator shows _____.

c. Realizes that since the station (PCU) is to his _____ (right - left) and the needle is also deflected to the right, the aircraft _____ (has - has not) passed the Pearl Intersection.

ANSWERS: a. 155°, b. FROM, c. Right - Has not



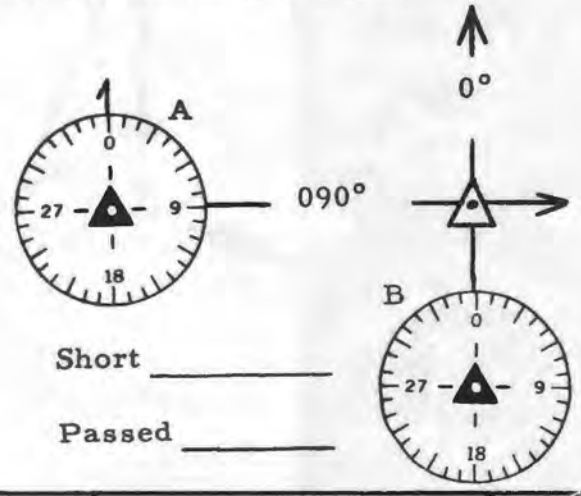
In the situation above, the aircraft is flying outbound on the 350° radial from Mobile (MOB). The aviator has tuned and identified Evergreen (EVR) in order to fix the position of the aircraft over the Citro Intersection.

Match the successive positions of the aircraft (A, B, and C) with the course indicators (1, 2, and 3).

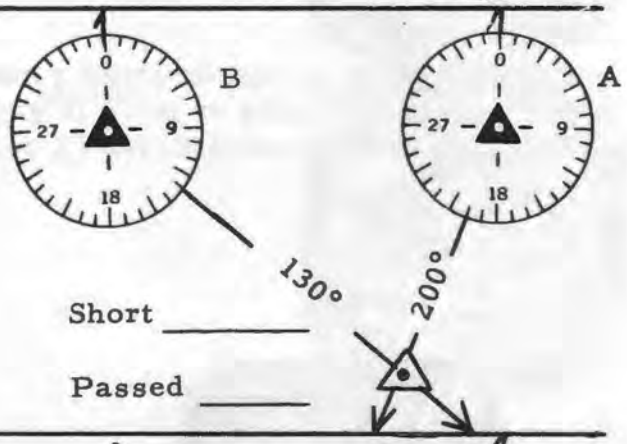
ANSWERS: A. 1, B. 3, C. 2

In each case below, the aircraft (not shown) is flying outbound from station A; the aviator has tuned station B in order to fix the intersection. Look at the diagram and course indicator in each case to determine if the aircraft has passed the intersection or has not reached it.

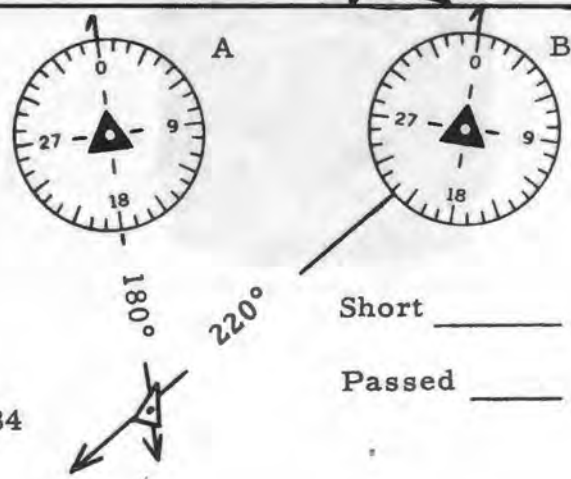
1.



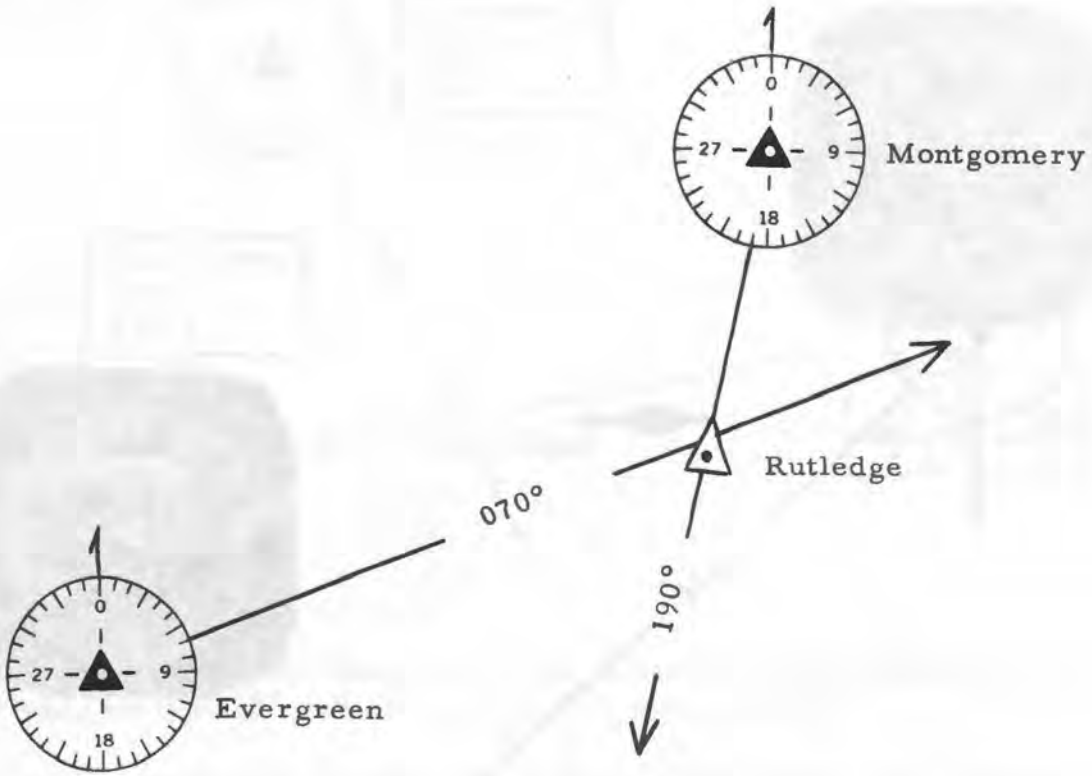
2.



3.



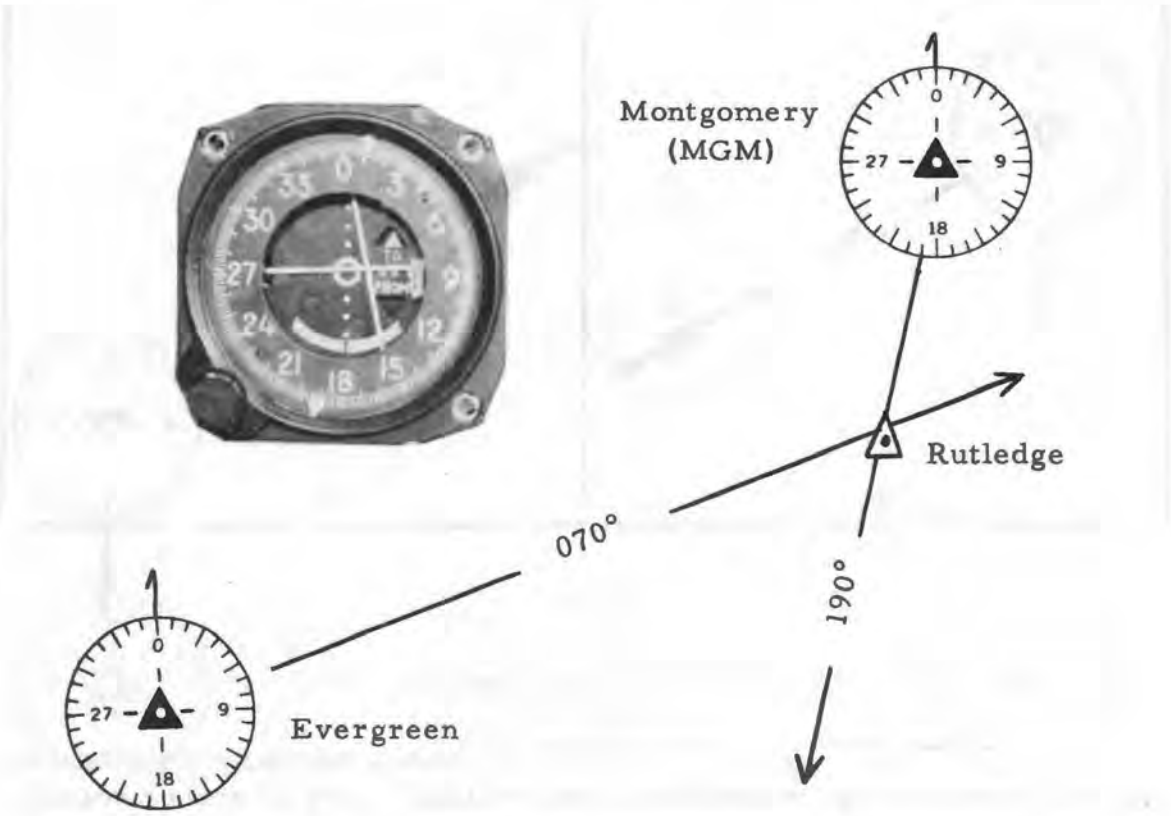
ANSWERS: 1. Short, 2. Passed, 3. Passed



In some cases, it is necessary for an aviator to determine his arrival over an intersection and then turn to fly inbound to another station. In the diagram, the flight path is from Evergreen to Rutledge Intersection, and then to Montgomery.

In fixing the position at Rutledge Intersection, it _____ (would - would not) be practical to set the course selector on 190° because the inbound course to Montgomery is 010°.

ANSWER: Would not

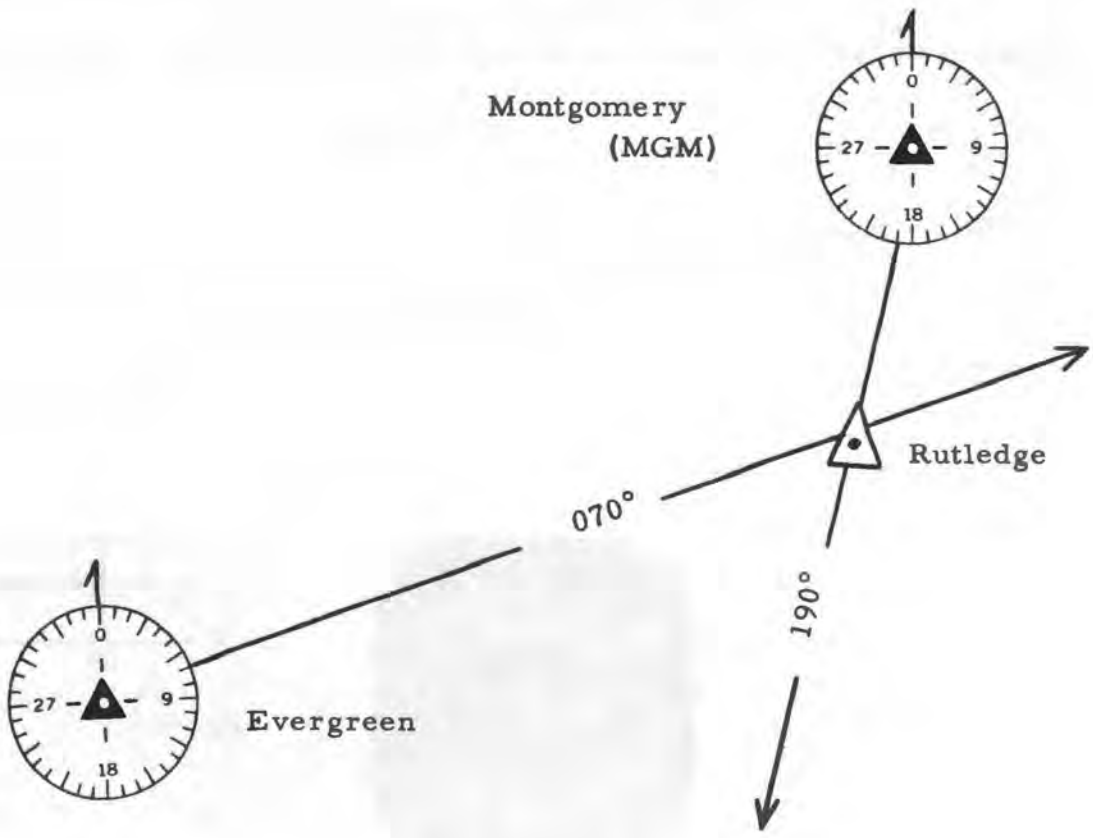


In fixing the Rutledge Intersection, the course selector should be set to the inbound course - 010°. This will cause the TO-FROM indicator to show TO.

How is the aviator to interpret the right needle of the omni indicator?

He may <u>assume</u> that he is flying the same course that is set on the course selector (010°) and say, "If I were flying a heading of 010°, a right needle would mean that the 010° course (to MGM) would be to my right; therefore, I am _____ (east - west) of the Rutledge Intersection."

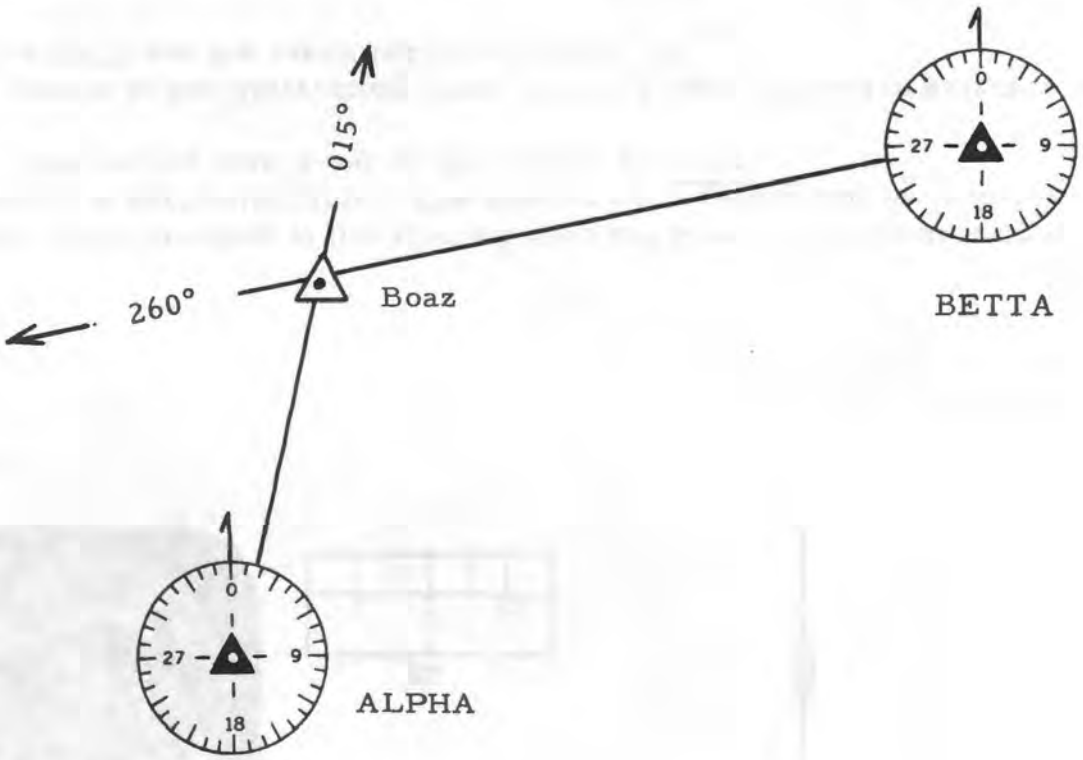
ANSWER: West



You should remember that if the course selector is set on the radial, causing the sense indicator to show FROM, the needle would be deflected to the same side as the station (MGM) prior to reaching the intersection.

But, if you set the course selector for the inbound course, causing the sense indicator to show TO, the needle will be deflected to the _____ (same - opposite) side as the station prior to reaching the intersection.

ANSWER: Opposite

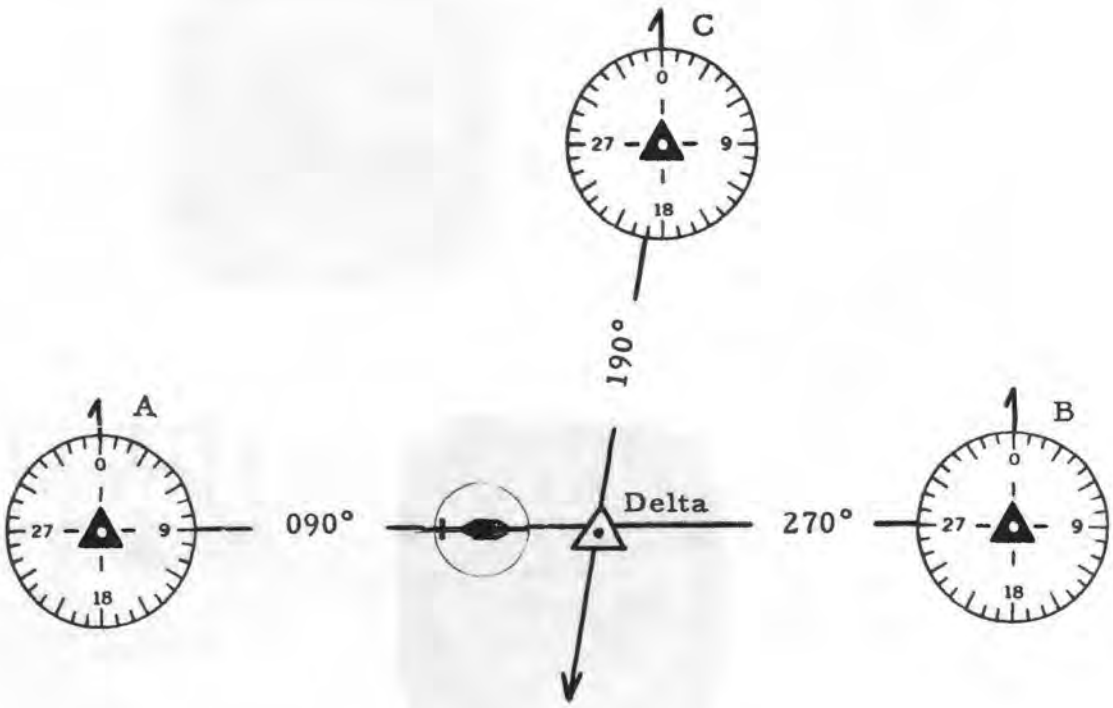


You are flying from ALPHA to BETTA via the Boaz Intersection.

Before reaching the Boaz Intersection, you tune BETTA and set the course selector on _____° which causes the sense indicator to show TO.

You should expect the omni needle to be deflected to the _____ (left - right).

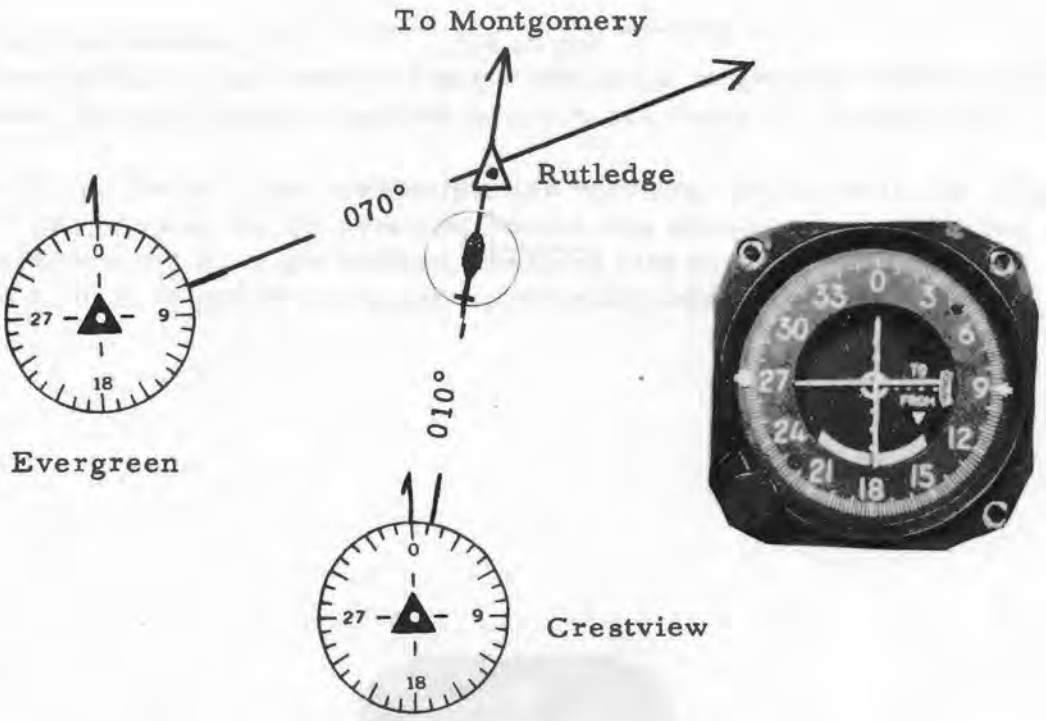
ANSWERS: 080° - Left



Another useful technique in checking the position of the aircraft in relation to an intersection is to find out what radial the aircraft is presently crossing and then compare it with the radial on the chart which passes through the intersection.

In the diagram above, the aviator is flying outbound from station A on the 090° radial. At the time he crosses the 190° radial from station C, he will be over the Delta Intersection. However, before the aircraft arrives at the Delta Intersection, it will be crossing radials from station C which are _____(more than - less than) 190°.

ANSWER: Mor than



In the diagram above, the aircraft is flying outbound from Crestview toward Montgomery. Rutledge Intersection is on the 070° radial from Evergreen.

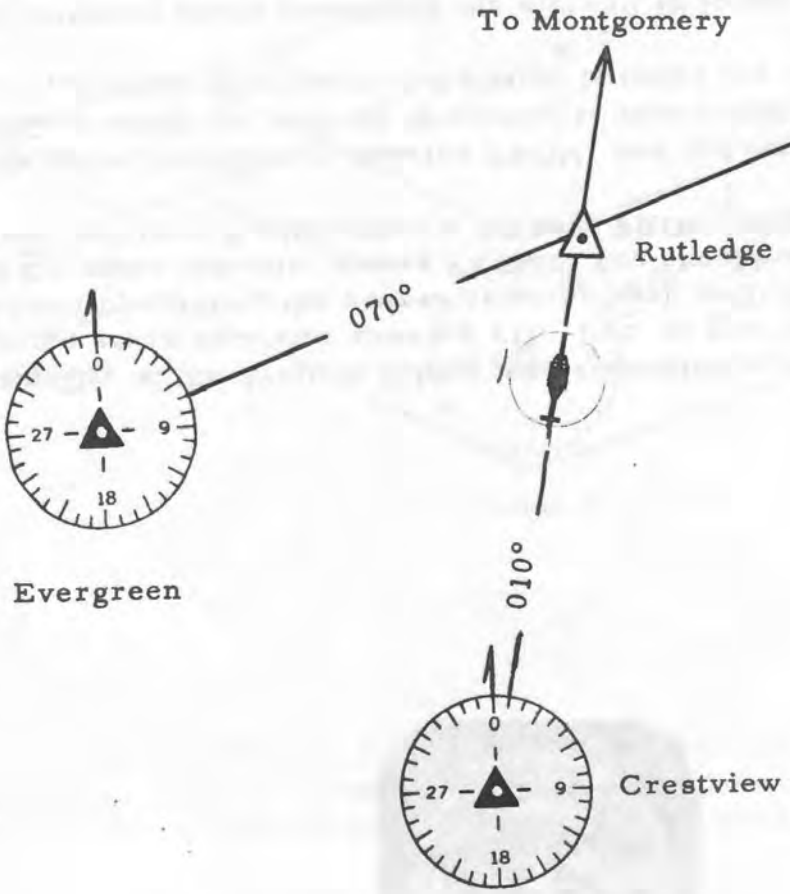
To verify that the aircraft has not yet reached Rutledge Intersection, the aviator tunes and identifies Evergreen. He then rotates the course selector in the vicinity of radials which are greater than 070°.

The needle centers on the radial shown on the course selector.

What radial (from Evergreen) is the aircraft crossing? _____°

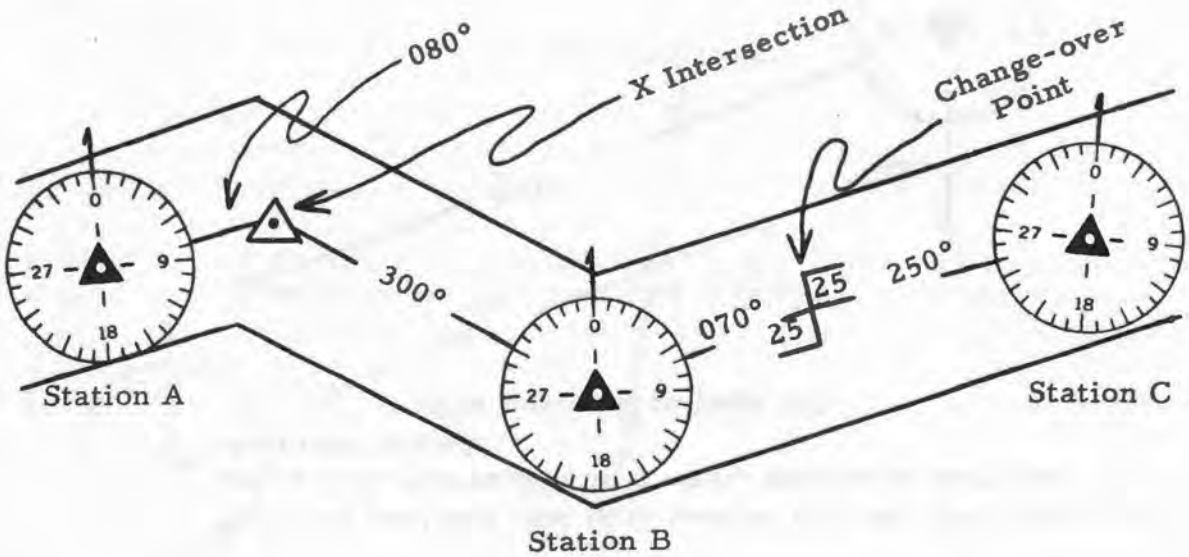
Does this verify that the aircraft has not yet reached Rutledge? _____

ANSWERS: 090° - Yes



After determining that Rutledge is still ahead of the aircraft, the aviator sets the course selector on the 070° radial in order to fix Rutledge. This causes the needle to deflect to the _____ (left - right) since the aircraft is still short of Rutledge.

ANSWER: Left



Omni is used principally for enroute navigation from station to station by tracking along the airways which are formed by omni radials. To navigate from station A to station C above, the aviator would -

1. Fly outbound from station A on the _____° radial to the X Intersection.

2. At the X Intersection, intercept the 300° radial from station B and track inbound to station B on a course of _____°.

3. Turn at station B and fly outbound on the _____° radial to the change-over point.

4. At the change-over point, tune in station C and continue flying inbound to station C on the course of _____°.

ANSWERS: 1. 080°, 2. 120°, 3. 070°, 4. 070°

Radio tracking is a procedure aviators use to establish a heading which will keep the airplane or helicopter on a given radio track (course). As used here, the terms track and course are interchangeable.

Without prior knowledge of winds, an aviator can determine the drift correction to stay on a given course by a systematic bracketing procedure.

In figure 1 (page 136), the aircraft at position A starts outbound on course, flying a heading of 080°. The course selector is set on _____° with the sense indicator showing _____.

ANSWER: 080° - FROM

There is a crosswind causing the aircraft to be blown off course. This is indicated by the omni needle being deflected. A deflection of 5° or more is significant; the aviator should make a correction to return to the desired track.

At position B in figure 1 (page 136), the aircraft is still flying a heading of 080°, but the right deflection of the needle shows that -

1. The crosswind is from the _____(right - left).

2. The desired track is to the aviator's _____ (right - left).

3. To return to the track, the aviator must turn _____ (right - left).

ANSWERS: 1. Right, 2. Right, 3. Right

For airplanes and faster helicopters, a standard correction of 20° is used to return to the track after drifting off.

At position C in figure 1 (page 136), the aircraft has turned to a new heading of _____° to return to the _____° track.

ANSWERS: 100° - 080°

At position D, the aircraft has reintercepted the track at a 20° angle. This is indicated to the pilot when the omni needle centers.

Once back on track, the aviator applies a first-trial drift correction to stay on track. The first-trial drift correction is one-half the amount of correction used to return to track.

Since airplanes and faster helicopters use a 20° correction to return to track, these aircraft would apply a first-trial drift correction of 10°.

At point E in figure 1 (page 136), a 10° drift correction is being applied. The aircraft is flying a heading of _____° to maintain a track of _____°.

ANSWERS 090° - 080°

In slower helicopters, a standard correction of 30° is used to return to the track after drifting off.

In figure 2 (page 137), the wind has blown the helicopter off track at point B. The aviator knows this because the omni needle has deflected to the right.

At point C, the aviator has turned 30° right from a previous heading of 010° to a new heading of _____°.

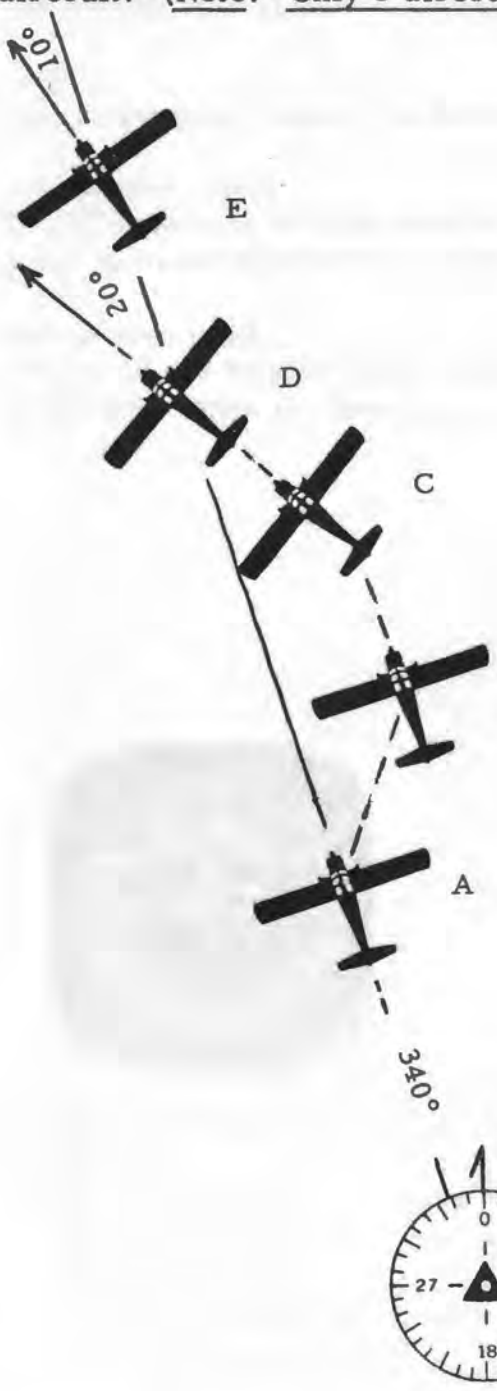
The helicopter has returned to the track at point D; the omni needle has recentered.

The first-trial drift correction is one-half the amount used to return to the track, or 15°.

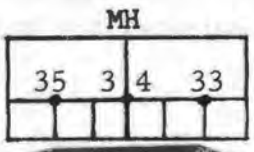
A first-trial drift correction of 15° is being applied at point E. The aviator is flying a heading of _____° to maintain a track of _____°.

ANSWERS: 040° (point C); 025° - 010° (point E)

Match the instruments (1, 2, and 3) with a corresponding position of the aircraft. (Note. Only 3 aircraft positions will match.)

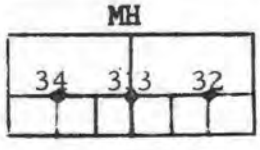


1. ____



2. ____

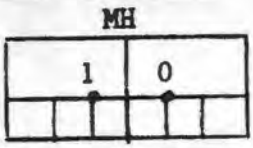
3. ____



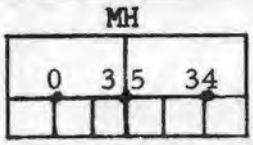
ANSWERS: 1. B, 2. C, 3. E

Match the instrument readings (1, 2, and 3) with corresponding positions of the helicopter.

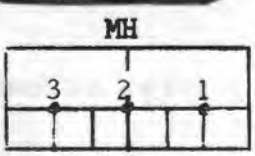
1. ____

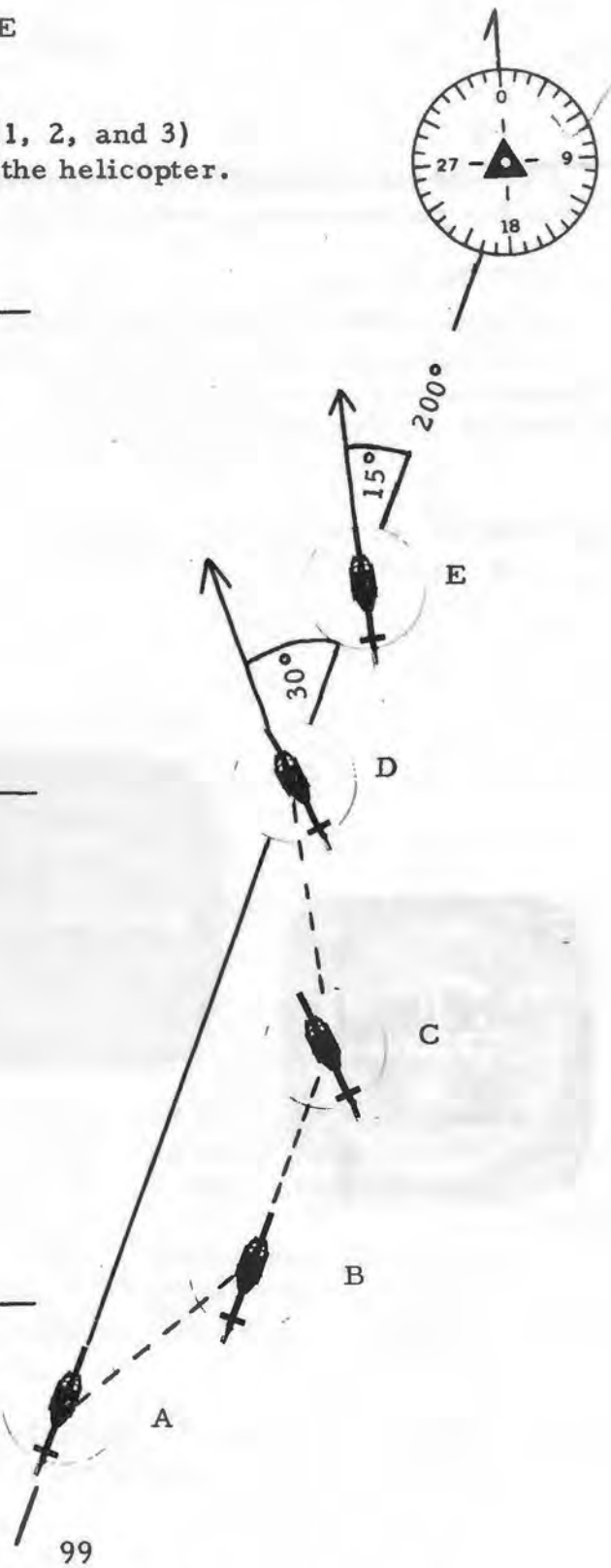


2. ____



3. ____





ANSWERS: 1. E, 2. C, 3. A

1. If an airplane is on track and is blown off by a crosswind, the standard correction to return to track is _____°.

2. If a helicopter is on track and is blown off by a crosswind, the standard correction to return to track is _____°.

3. After returning to track, a drift correction of 10° is applied to remain on track for airplanes or faster helicopters. 15° is used as the first-trial drift correction for slower helicopters.

4. An airplane attempting to maintain an outbound track of 300° is blown off by a left crosswind. The omni needle moves to the left; the aviator must turn left to get back on track. He would turn to a heading of _____°.

5. After returning to the track (needle recenters), the aviator would apply a 10° first-trial drift correction by flying a heading of _____°.

ANSWERS: 1. 20°, 2. 30°, 3. ---, 4. 280°, 5. 290°

A helicopter (TAS 70 knots) is tracking inbound on a track of 060°. The omni needle deflects 5° to the right.

1. The aviator turns _____ (right - left) to a heading of _____°.

2. The needle recenters (back on track); the aviator now turns to a heading of _____°.

ANSWERS: 1. Right - 090°, 2. 075°

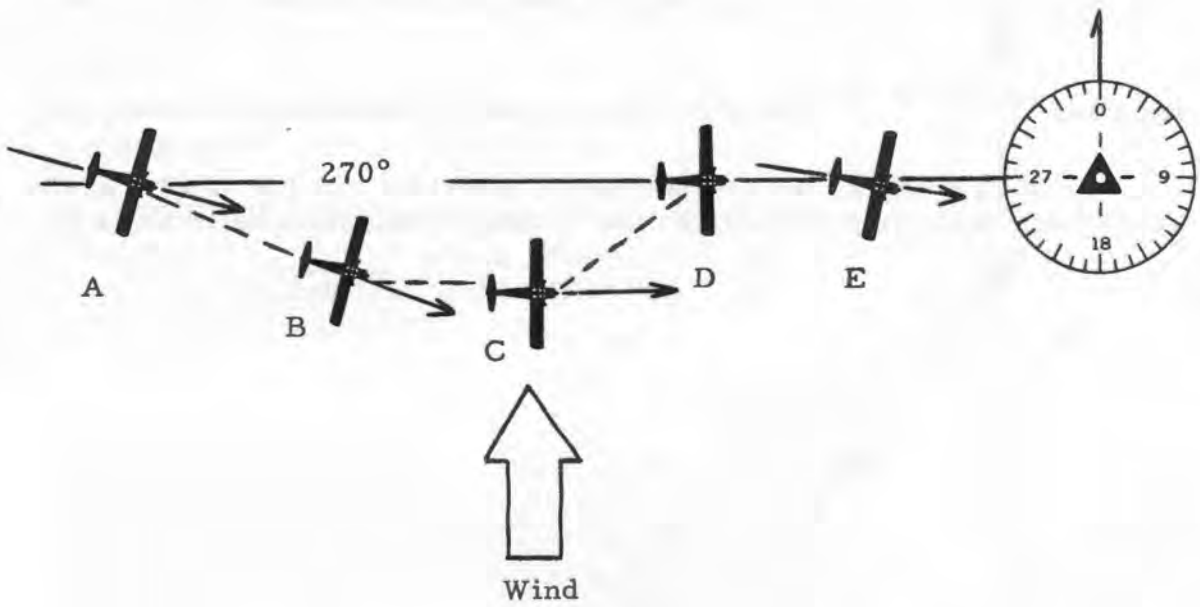
The first-trial drift correction of 10° (airplanes) may be too much or not enough for the actual crosswind condition.

At point A in figure 3 (page 138), the airplane is holding a heading of 020° to maintain an inbound track of 030°. However, the wind is stronger than anticipated and the aircraft is blown off at point B (downwind).

At point C, the aviator turns to a heading that will intercept the track at a 20° angle. This heading, _____°, takes the aircraft back to the track at point D.

At point E, the aviator is holding a heading of _____° to apply a second-trial drift correction of 15° since the first trial-drift correction of 10° was too small.

ANSWERS: 010° (point C) - 015° (point E)



The airplane at point A above is holding a 10° drift correction for the right crosswind. But at point B, the airplane has drifted off course (upwind).

The 10° drift correction is too much. At point C, the airplane turns parallel to the intended track; the wind will blow the aircraft back on track at point D.

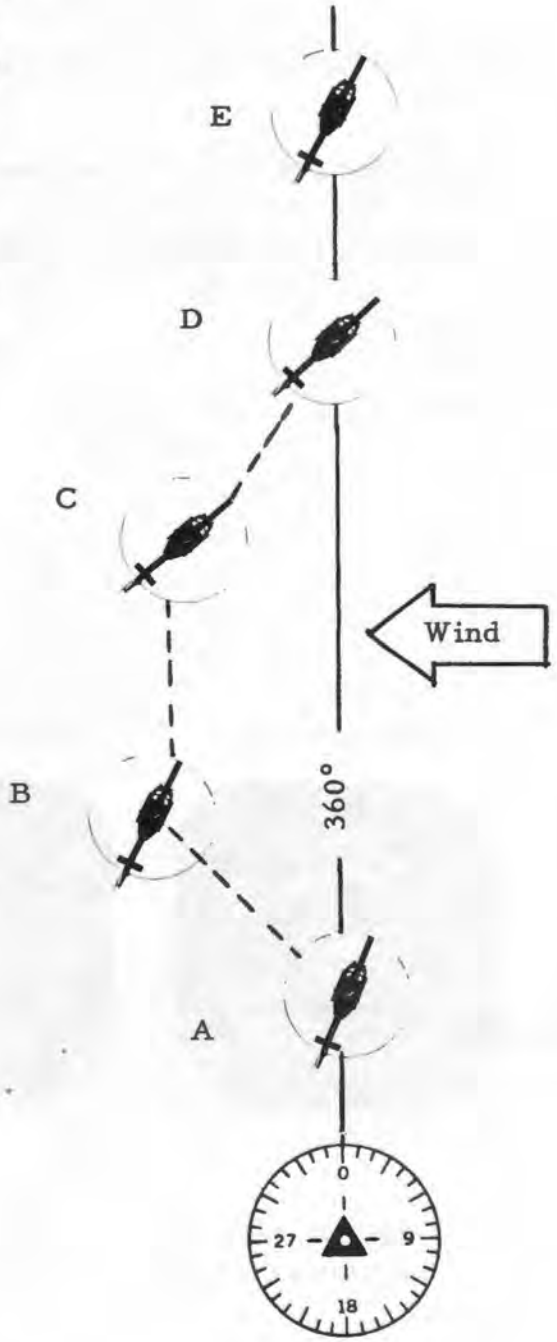
The aviator applies a second-trial drift correction of 5° at point E by holding a heading of _____° to maintain the 090° track inbound.

ANSWER: 095°

A helicopter using a first-trial drift correction of 15° may discover that 15° is too much or not enough. In the diagram (opposite), the helicopter at point A is holding a heading of 015° to maintain the track of 0°.

It is blown off track at B, then turns to a heading of 030° at C to return.

After returning (D), the aviator holds a heading of _____° which provides for a second-trial drift correction of 20° at point E.

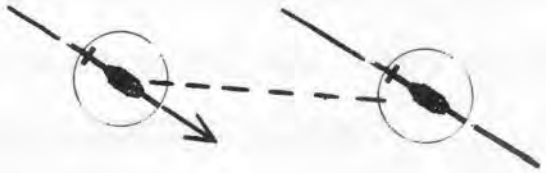


ANSWER: 020°

A helicopter is holding a heading of 135° to maintain a track of 120°.

The 15° correction is too much and the helicopter drifts upwind.

The aviator turns parallel to the track and the wind blows the aircraft back to the track.



Since the first-trial drift correction was too much, the aviator now applies a 10° correction by holding a heading of _____° to maintain the track of 120°.

ANSWER: 130°

If the wind is unusually strong and the initial correction of 20° or 30° is not enough to return the aircraft to the track, then an additional amount of correction may be necessary.

As much as 40°, or even 50°, may be necessary if the wind is strong and the airspeed is not great.

An airplane tracking inbound on a track of 030° is blown off track by a right crosswind. The aviator sees the omni needle move to the right.

The aviator turns to a heading of 050°, using the standard correction to get back to the track. Nothing happens. The omni needle remains deflected to the right in spite of the 20° correction.

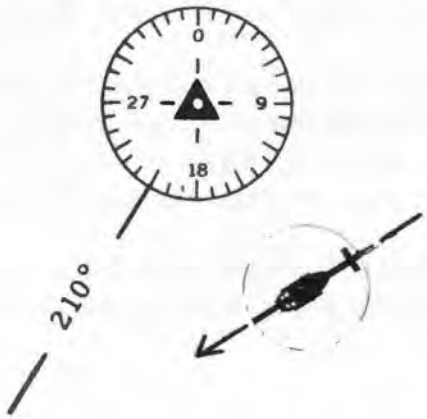
The aviator decides to use a 040° correction to get back to the 030° track. What heading should he turn to? _____ °

ANSWER: 070°

After returning to the track by using a 40° interception, the aviator will use one-half that amount for trial drift correction to remain on track. He should turn to a heading of _____°.

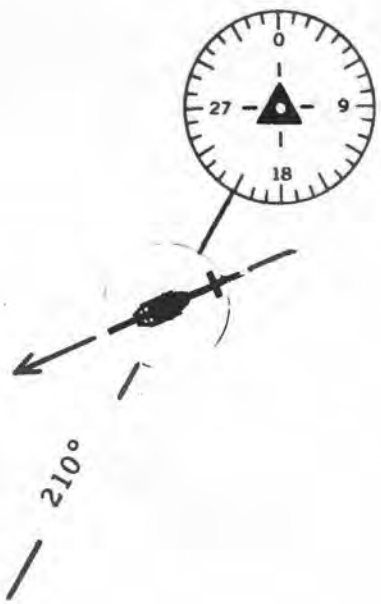
ANSWER: 050°

A helicopter pilot discovers that a heading of 240° will not return him to the 210° track. (The omni needle will not center.)



He decides to use a 50° correction to return to the 210° track. What heading should he turn to? _____°

After returning to the track, the aviator will use a trial drift correction of 25°. What heading should he turn to? _____°



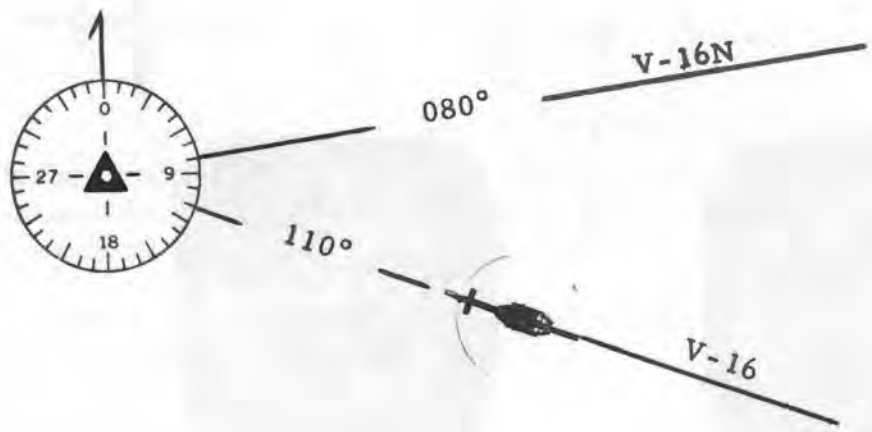
ANSWERS: 260° - 235°

You have learned how to get back on track after being blown off track, and to execute a bracketing procedure in order to determine the drift correction necessary to maintain a given track.

Now let's see how to intercept a given track when the aircraft is located on a completely different radial.

The initial interception of a track is usually easy enough since the aviator knows where he is in relation to the track to be intercepted.

For example: You are tracking outbound on V-16 and air traffic control instructs you to intercept and track outbound on V-16N.



Based on the chart diagram above, you know that -

1. You are presently located on the _____ ° radial.

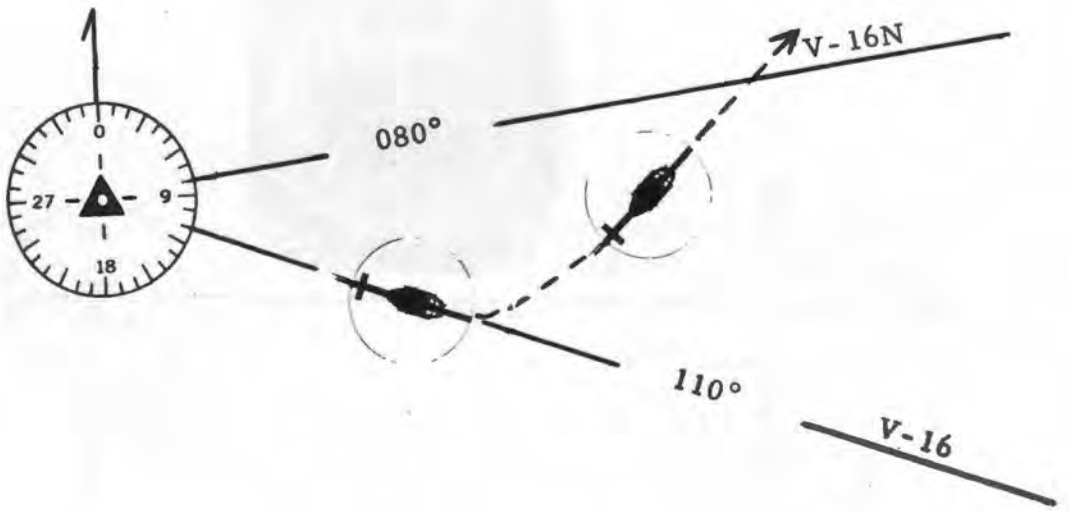
2. V-16N is the _____ ° radial.

3. V-16N is 30° to your _____ (left - right).

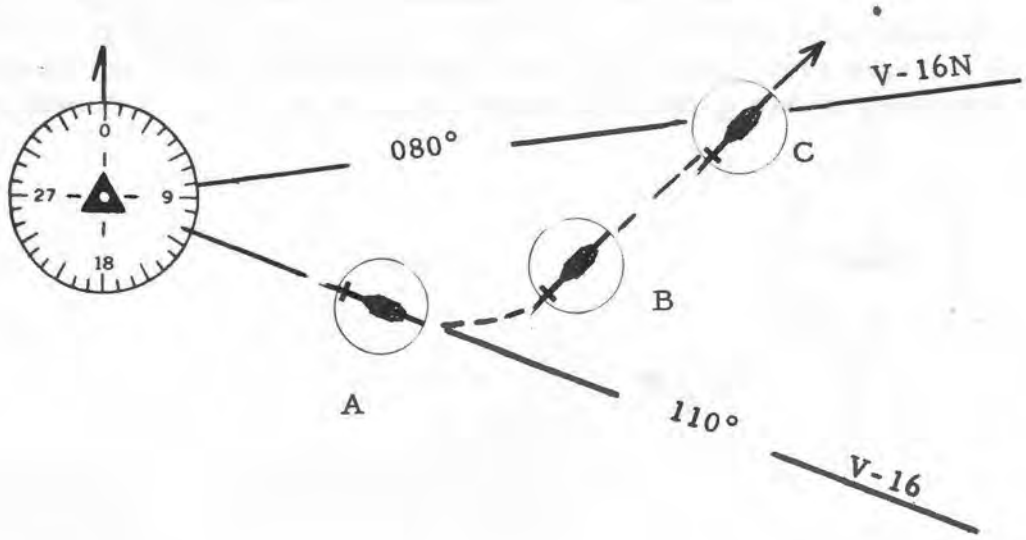
ANSWERS: 1. 110°, 2. 080°, 3. Left

The track interception of V-16N is easy since a glance at the chart diagram shows where it is in relation to your present position. If you make a large enough turn to the left, you will intercept V-16N. The intercept angle that is used in many, but not all, cases is 45°.

To intercept V-16N (080° radial) from your present position at a 45° angle (outbound), you would turn to a heading of _____°.



ANSWER: 035°



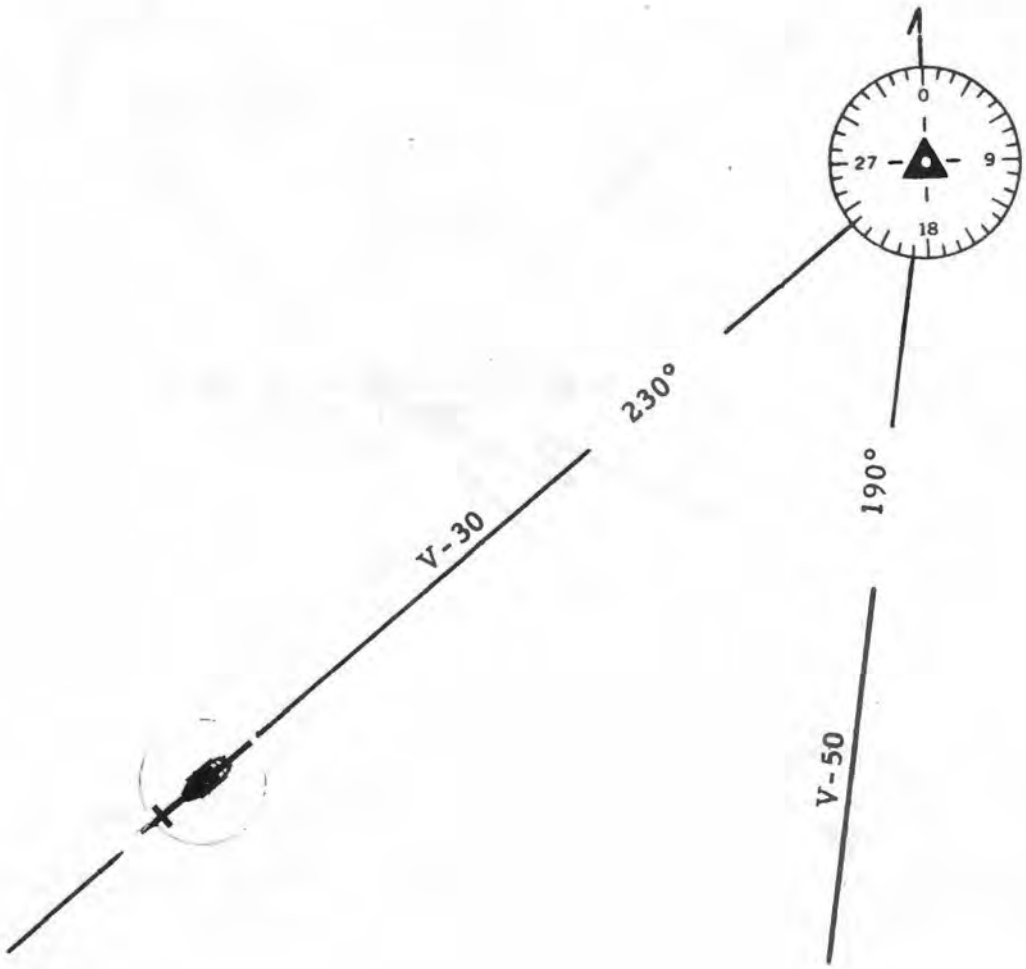
The course selector must be reset to intercept the new track of 080°.

The aviator turns to a heading of 035°, sets the course selector to _____°, and while at position B, observes that the omni needle is deflected to the _____ (left - right).

The aviator knows when he reaches position C because the omni needle centers on the outbound course of 080°.

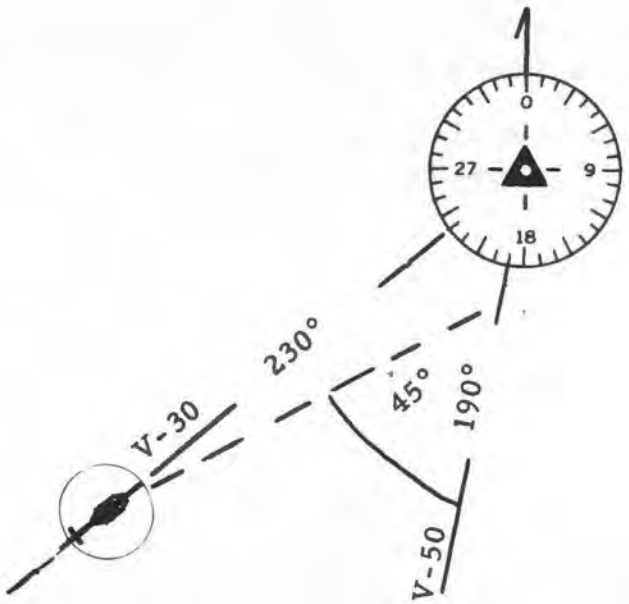
ANSWERS: 080° - Left

A different example will show that a 45° intercept angle is not always desirable. You are tracking inbound on V-30 and air traffic control instructs you to intercept and track inbound on V-50. What is the angular difference between V-50 and V-30? _____°

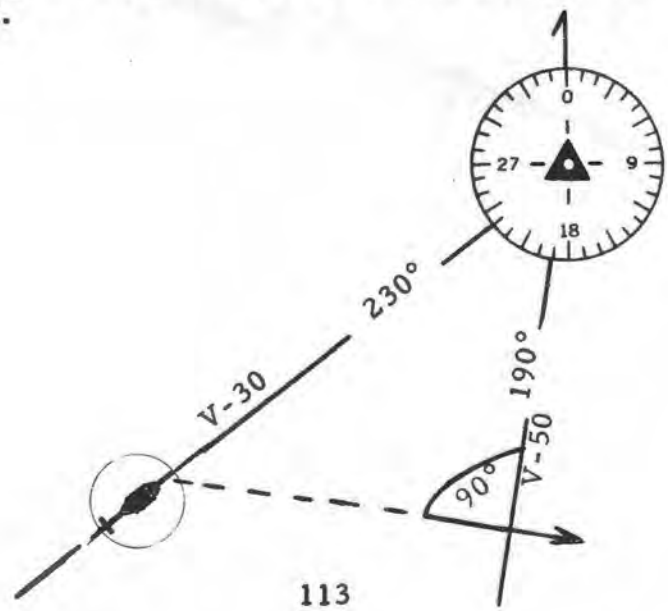


ANSWER: 040°

If the aviator attempts to intercept V-50 at a 45° angle from his present position, the intercept would not be accomplished until the aircraft is very close to the station.



The situation above can be avoided if the aviator intercepts the new track at a 90° angle. To do this, the aviator would turn right to a heading of _____°.

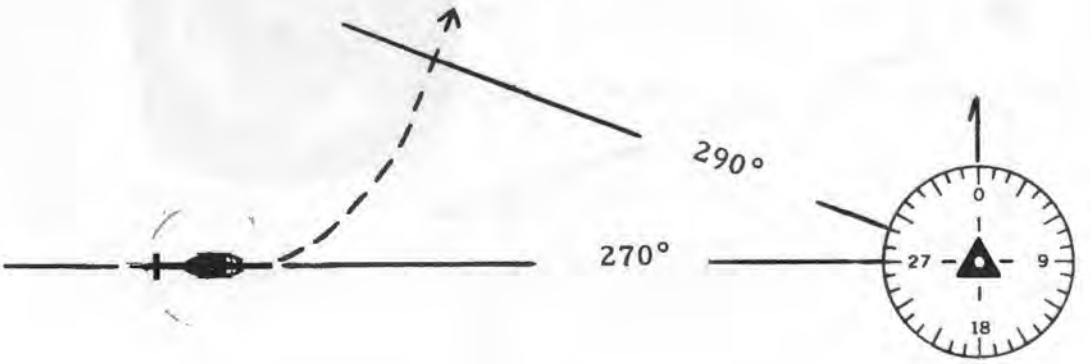


ANSWER: 100°

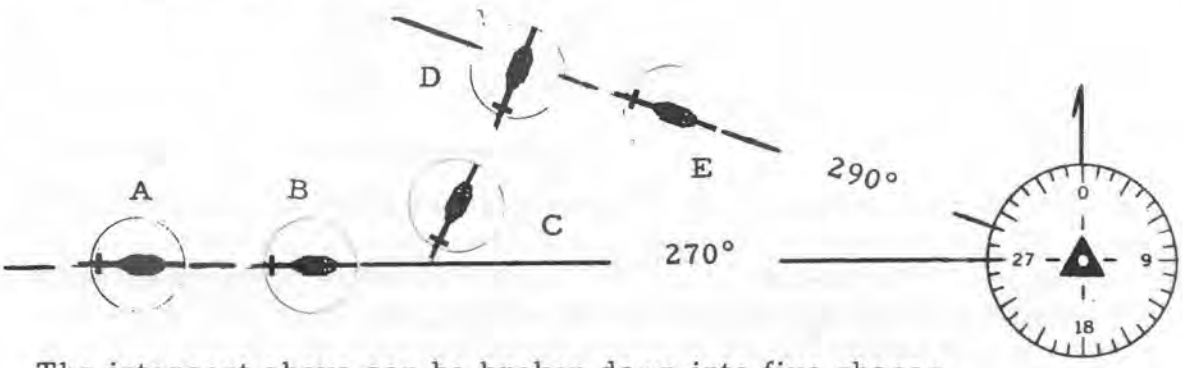
If the angular difference between the present location of the aircraft and the new track is large, the aviator should plan on intercepting the new track at a 90° angle. A 90° intercept angle should also be used at any time air traffic control instructs the aviator to "expedite." In the situation below, air traffic control has directed the aviator to intercept and track inbound on the 290° radial and has specified "expedite."

1. The inbound track on the 290° radial is _____°.

2. To "expedite" the intercept, the aviator would turn _____ (left - right) to a heading of _____°.



ANSWERS: 1. 110°, 2. Left - 020°



The intercept above can be broken down into five phases.

A. The aviator is tracking inbound on the 270° radial and receives instructions to intercept and track inbound on the 290° radial.

B. The aviator realizes that he must turn left and reset the course selector for the new track.

C. The aviator completes the turn to the heading which will intercept the new track at the desired angle.

D. The new track is intercepted at the time the needle centers with the course selector set for the new track.

E. The aviator completes the turn inbound to the station and starts the tracking procedure on the new track.

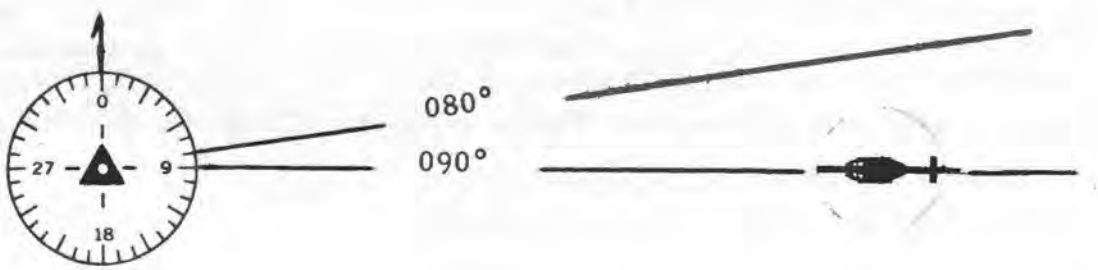
For each aircraft position (A, B, C, D, and E), complete the missing information in the table below -

	Heading	Course Selector Setting	Needle Position (Left - Right - Centered)
A.	090°	090°	Centered
B.	°	°	
C.	°	°	
D.	°	°	
E.	°	°	

ANSWERS: B. 090° - 110° - Left
C. 020° - 110° - Left
D. 020° - 110° - Centered
E. 110° - 110° - Centered

The interception of a new track is usually made at a 45° or 90° angle, depending on the circumstances. However, the aviator may decide to use still a different interception angle if good judgment dictates it.

In the situation below, the aviator is very close to the station tracking inbound on a track of 270° (090° radial). The aviator is instructed to intercept and track inbound on the 260° track (080° radial). Since the aircraft is very close to the station, the aviator knows that a 45° intercept is not practical. He elects to use a 20° intercept and turns to a heading of _____° to intercept the 260° track at a 20° angle.



ANSWER: 280°

Although 45° and 90° are used as standard intercept angles, the aviator may use a different angle if he deems it appropriate, provided it will not conflict with the air traffic clearance issued by ATC. The aviator must consider the following questions in deciding how to intercept:

a. What is the angular difference between my present location and the new track?

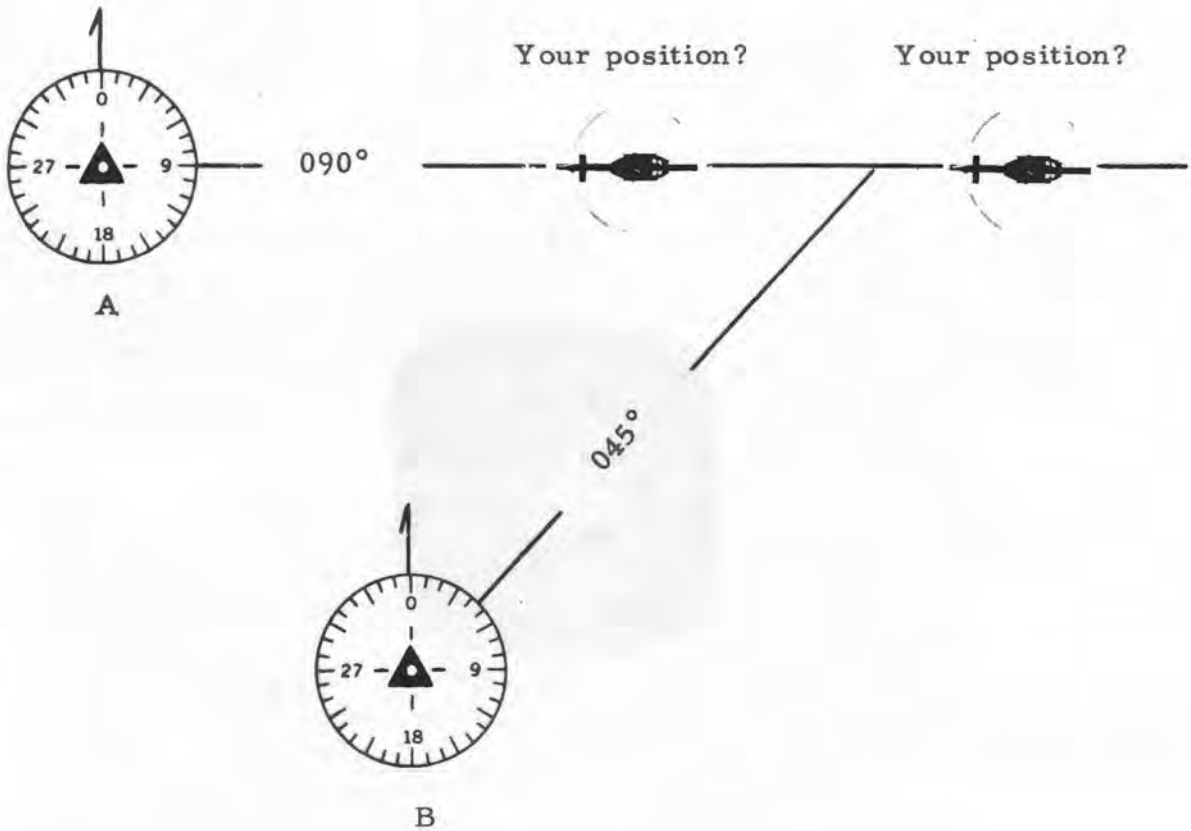
b. How close to the station am I?

c. What does my ATC clearance require?

GO TO THE NEXT PAGE

The track interception situations we have looked at so far have been fairly simple because the aviator knew where he was located with respect to the new track he wanted to intercept.

Suppose you are tracking outbound from station A on the 090° radial and you are instructed to intercept and track outbound on the 045° radial from station B. You are not oriented with respect to the new station B. You don't know immediately if the 045° radial from station B is ahead of you or behind you. What do you do?



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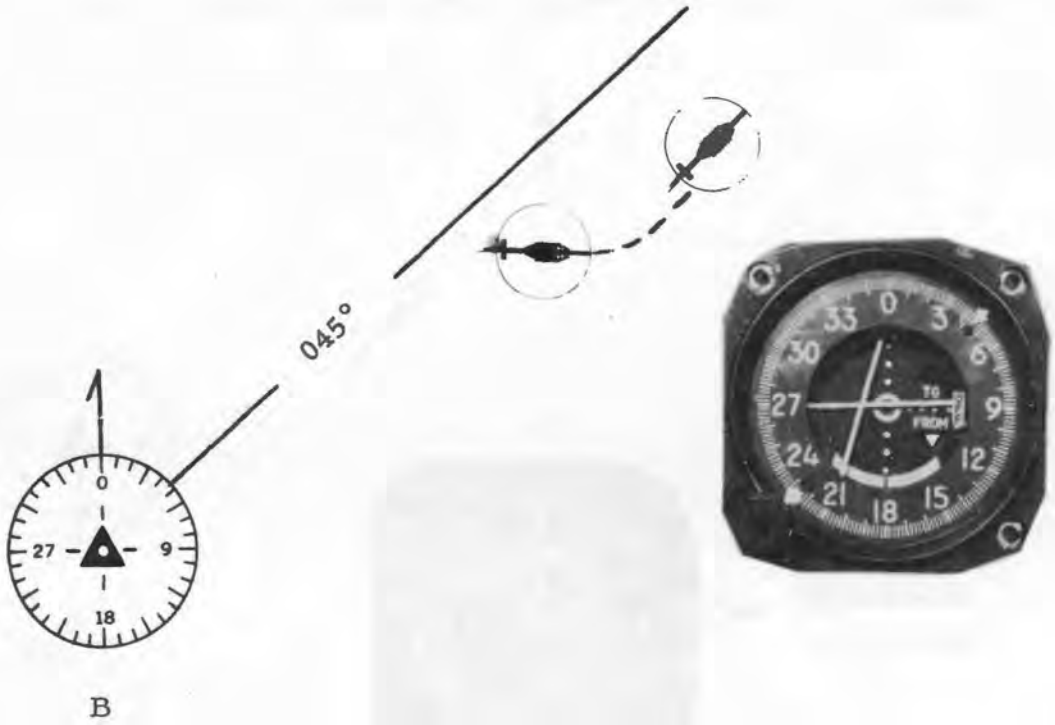
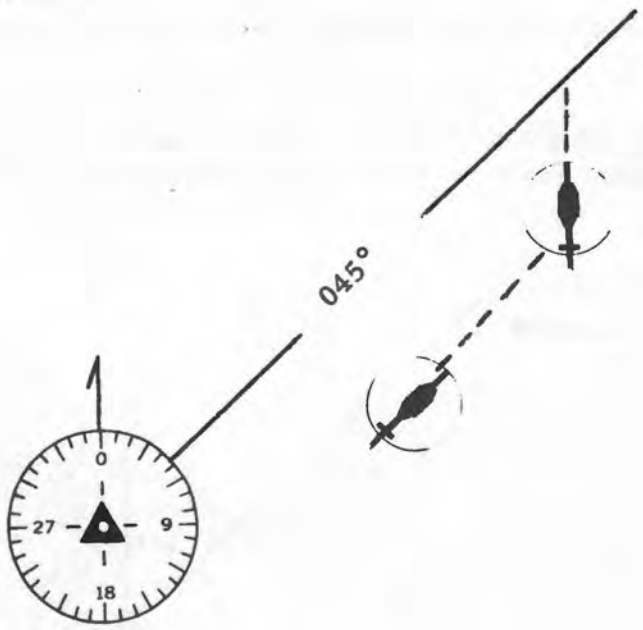
To solve the problem, turn parallel to the desired course, tune and identify station B, and set the course selector on 045°. The deviation needle will now show you where the track is.



The needle is deflected to the _____ (left - right) which means that the 045° track is to the _____ and consequently the aviator must turn to the _____ (left - right) in order to intercept the 045° track.

ANSWERS: Left - Left - Left



B

The aviator can now complete the interception by turning to the appropriate heading for interception. Assuming that the aviator desires to use a 45° interception angle, he would turn to a heading of _____° to intercept the 045° radial at a 45° angle.

ANSWER: 0°

Turning parallel to a track is a very simple and very effective way of determining exactly where the track is located (left or right). Of course, it is not practical or necessary to turn parallel to the track if you know exactly where it is.

Examples:

A. You are tracking outbound on the 230° radial, heading 230°. You are instructed to intercept the 270° radial and track outbound. Do you know where the 270° track is? (left - right) _____
Would you turn parallel to the 270° track? _____

B. You are somewhere generally south of a station. You are instructed to intercept and track inbound on the 175° radial (355° inbound). (Not related to question A.) Do you know where the desired inbound track (355°) is located? _____
Would you turn parallel to the track to help in locating it? ____
_____

ANSWERS: A. Yes (right); No - don't parallel.
B. No - you don't know where the track is exactly.
Yes - you should turn parallel to help locate it.

Track Interception Review

1. When given a new track to intercept, determine immediately if it is to your left or right. You will normally know this, based on your present location. If you cannot readily determine the exact location of the new track, then turn parallel to it.

2. If the new track is based on a new station, tune and identify the new station. Set the course selector on the new track to be intercepted. Observe the reaction of the omni needle. If you have turned parallel to the track to help locate it, the needle will tell you if the track is left or right.

3. Turn to intercept the new track at a reasonable angle. The standard angle is 45°. If the new track is too far from your present location (usually over 30°), then 45° is not a good intercept angle; use 90°. Also, if ATC directs you to "expedite", you should intercept the new track at a 90° angle. If you are very close to the station and the new track is close to your present position, then use a shallow intercept angle, about 20°.

4. As you are approaching the new track (just before the needle centers), you should begin your turn to the new track heading. This is called "leading the needle." You will have to practice it to avoid overshooting or undershooting. The amount of needle lead depends on the shallowness or steepness of the intercept angle, the distance out from the station, and the wind.

This concludes the coverage in this booklet of the omni flight procedures. Proceed now to the last section in the booklet dealing with omni receiver checks.

FAR part 91 requires that omni equipment, which is going to be used for IFR flight, be maintained and inspected under an FAA-approved procedure.

Or, the equipment must be operationally checked within the preceding ten hours of flight time and within ten days before flight.

Therefore, if you are flying IFR with equipment which is not maintained and inspected under an FAA-approved procedure, you must insure that an operational check has been performed on the equipment within the preceding _____ hours and within _____ days before flight.

ANSWER: 10 hours and ..... 10 days

FAR 91 also states that each person performing an operational check on VOR equipment enter the following information in the aircraft log or other permanent record:

a. Date.

b. Place.

c. Bearing error.

d. Signature.

If you are about to make an IFR flight using omni equipment, you would check the aircraft log or other permanent record to see that an operational check had been made within the preceding _____ hours flight time _____ (and - or) the preceding 10 days.

ANSWERS: 10 hours and 10 days

There are four prescribed methods by which an operational check of omni equipment may be performed. In addition, there is a method prescribed which may be used in lieu of the others in aircraft equipped with dual omni receivers and indicators.

The four methods will be given here in the order of preference.

Use of the Radiated Test Signal (VOT)

Many airports are equipped with a system that emits a continuous omni test signal in the immediate vicinity of the airport. To test the equipment by the use of this radiated test signal, which is called VOT, the aviator would -

a. Look up the airport in current navigational publications to determine the frequency on which the test signal is being broadcast.

b. Tune the frequency and listen for the test identification which consists of either a continuous 1020 cps tone or a continuous series of dots.

c. Set the course selector on 0° (ball on 180°). The sense indicator should read FROM.

d. Check the needle for a centered position.

e. If the needle is not exactly centered, move the course selector slightly. A maximum error of ± 4° is allowed.

1. When performing an operational check of a VOR receiver using a radiated test signal (VOT), the equipment is within permissible tolerance if the needle centers with the course selector set between 356° and 004° since a ± 4° is allowed from a setting of 0°. (True - False)

2. Using the radiated test signal (VOT), the sense indicator should show _____ (TO-FROM) with the course selector set on 0°.

3. Transmitting frequencies for VOT signals at various airports are published in _____.

4. VOT identification consists of a continuous 1020 cps tone or a continuous series of _____.

ANSWERS: 1. True, 2. FROM, 3. Current navigational publications, 4. Dots

Designated Ground-Check Point

If the VOT signal is not available at the airport of departure, the aviator should use a designated ground-check point.

To use an approved ground-check point, the aviator would consult current navigational publications to determine if the airport has a published ground-check point. If it does, it will look like this -

DOTHAN, ALA.--186°, intersection of ramp and taxi strip NW of terminal building.

The aviator would tune and identify Dothan VOR and then set the course selector on _____°. He would taxi the aircraft to the intersection of the _____ and taxi strip NW (northwest) of the terminal building.

ANSWERS: 186° - Ramp

After taxiing to the designated spot with the course selector set on 186°, the aviator would check to see that the indicator showed FROM and the needle was centered.

A tolerance of ± 4° is also allowed on this ground-check. Therefore, if the needle will not center with the course selector on 186°, the aviator could rotate the course selector between 182° and _____°.

If the needle centers within the ± 4° tolerance, the set is usable for IFR flight.

ANSWER: 190°

Airborne Receiver Check Point

A third type omni receiver check is the airborne receiver check point. It involves flying the aircraft over a designated point, setting the course selector on a given radial, and checking to see that the needle centers.

Airports that do not have either the VOT or a published ground-check point may have a published airborne check in the vicinity. It would appear in publications like this -

CHAMPAIGN, ILL:--175° over grain elevator 8 mi.
S at Pesotum, Ill; 2000'.

To perform the check, the aviator would tune and identify the Champaign VOR and then -

a. Set the course selector on _____°. This would cause a FROM indication.

b. Fly the aircraft (visually) over the _____, which is located 8 miles south at Pesotum, Illinois.

The reference to 2000 feet means that this is the minimum altitude at which the check can be performed reliably. Many airborne checks have such an altitude restriction included. However, many more do not have any reference to altitude.

ANSWER: 175° - Grain elevator

The tolerance allowed for an airborne receiver check is ± 6°. That is, if the needle will center when the course selector is set within 6° of the published setting, the set is usable for IFR flight.

In performing the check at Champaign, Illinois, the course selector setting should be 175°; however, if the needle will not center on 175°, the allowed tolerance would permit the aviator to rotate the course selector between _____° and _____°.

ANSWERS: 169° - 181°

Nonpublished Check

If the airport of departure is not served by a VOR, published ground-check, or published airborne check and it is necessary to check the VOR receivers, the check may be performed as follows:

a. Select a VOR radial that lies along the centerline of an established VOR airway.

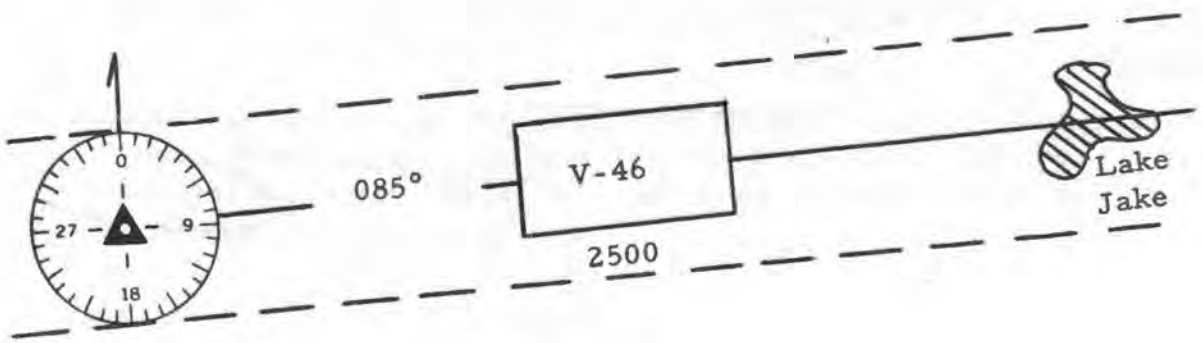
b. Select a prominent ground point along the radial, preferably more than 20 miles from the VOR.

c. Fly the aircraft over the selected point, and with the course selector set on the radial, the omni needle should center. ± 6° tolerance is allowable on this check also.

In the example below, Lake Jake is a prominent ground point more than 20 miles from the VOR located on an airway radial. To use this as a VOR receiver check point, the aviator should -

a. Tune and identify the station, and set the course selector on _____° which will cause a FROM indication.

b. Fly over Lake Jake and observe the omni needle centering. If the needle does not center with the course selector set on 085°, it may be moved between _____° and _____° since a tolerance of ± 6° is allowed.



ANSWERS: a. 085°, b. 079° - 091°

In Summary

There are four methods prescribed for checking VOR receivers.

1. Radiated test signal (VOT). Can be received at any spot on airport. Set course selector on 0° FROM and check for centered needle - ± 4° tolerance allowed.

2. Published ground-check. Check current publications for course-selector setting and designated spot on airport. Taxi to spot, set course selector, check for centered needle - ± 4° tolerance allowed.

3. Published airborne check. Check current publications for course-selector setting and designated air check point. Set the course selector, fly to the designated point, check for centered needle - ± 6° tolerance allowed.

4. Nonpublished check. Pick an airway radial; select a prominent ground-check point more than 20 miles from VOR. Set course selector on radial, fly to check point, check for centered needle - ± 6° tolerance allowed.

Dual-Receiver Check

If an aircraft is equipped with dual VOR receivers, one may be checked against the other in lieu of the four prescribed checks. A dual-receiver check is performed as follows:

a. Tune and identify one omni station with both omni receivers.

b. Rotate the course selectors of each omni indicator until both of them show a centered needle and the same indication on the sense indicator (both show TO or both show FROM).

c. Check the course-selector settings. These should both be the same or within an allowed tolerance of $\pm 4°$. If the sets do not check within 4° of each other, each will have to be checked independently to determine if one is within tolerance.

Needle Swing

While checking the accuracy of the omni needle for centering on specified course-selector settings, the aviator should also check the needle swing.

Since the full needle swing from center to either side is 10°, the needle should be checked to see if it will swing this amount.

Suppose in performing an accuracy check,the needle centers on the prescribed course-selector setting - for example: 160°.

The needle should give a full swing if the course selector is rotated from 160° to 170°, or from 160° to _____°.

No exact tolerance is specified in FAR 91 for needle swing, but the full swing of the needle should normally be between 8° and 12°.

ANSWER: 150°

The program you have just completed on omni was intended as an introduction to the basic procedures and information pertinent to the subject.

You must now develop skill in using the procedures and information by practice in the aircraft or instrument trainer.

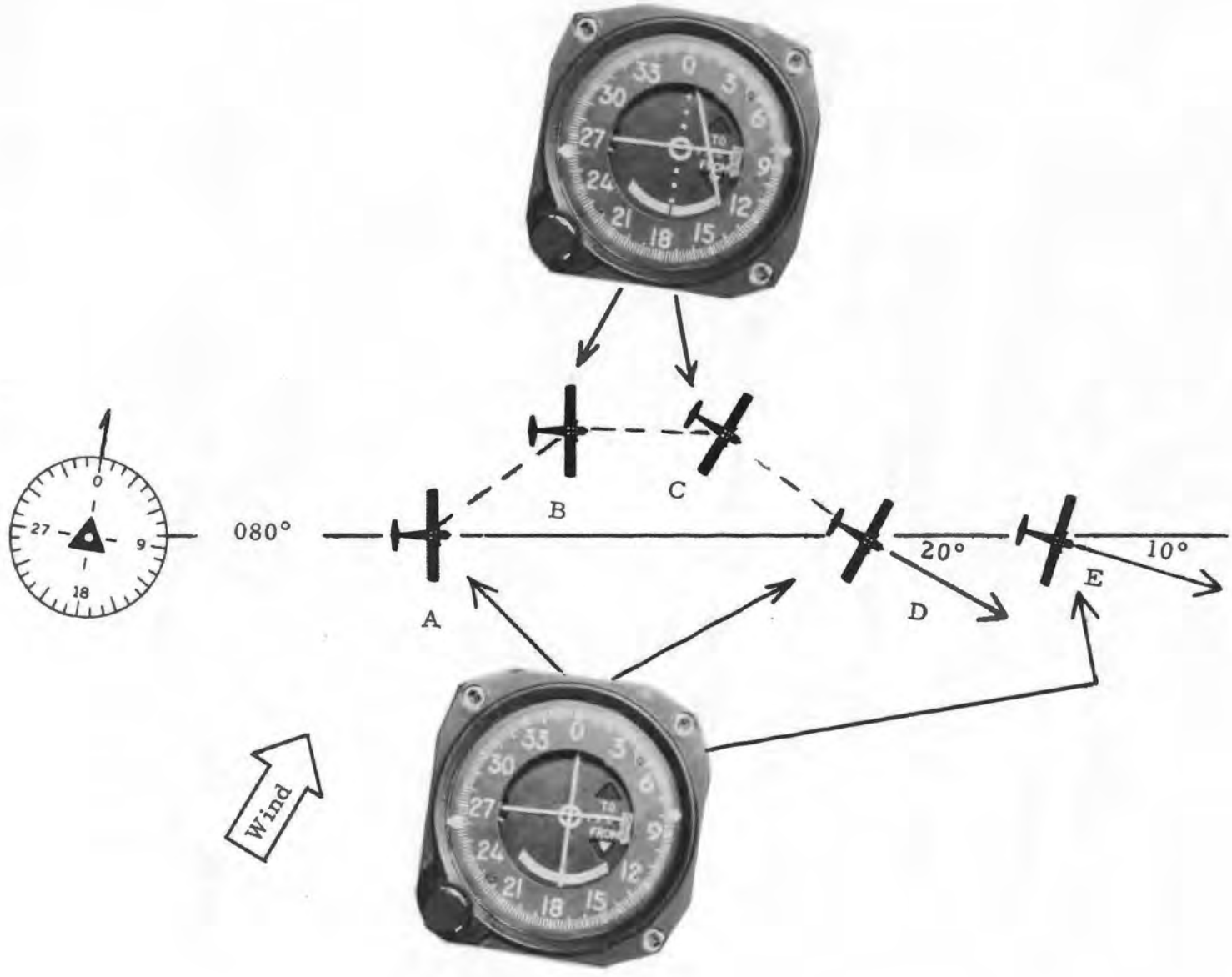


Figure 1

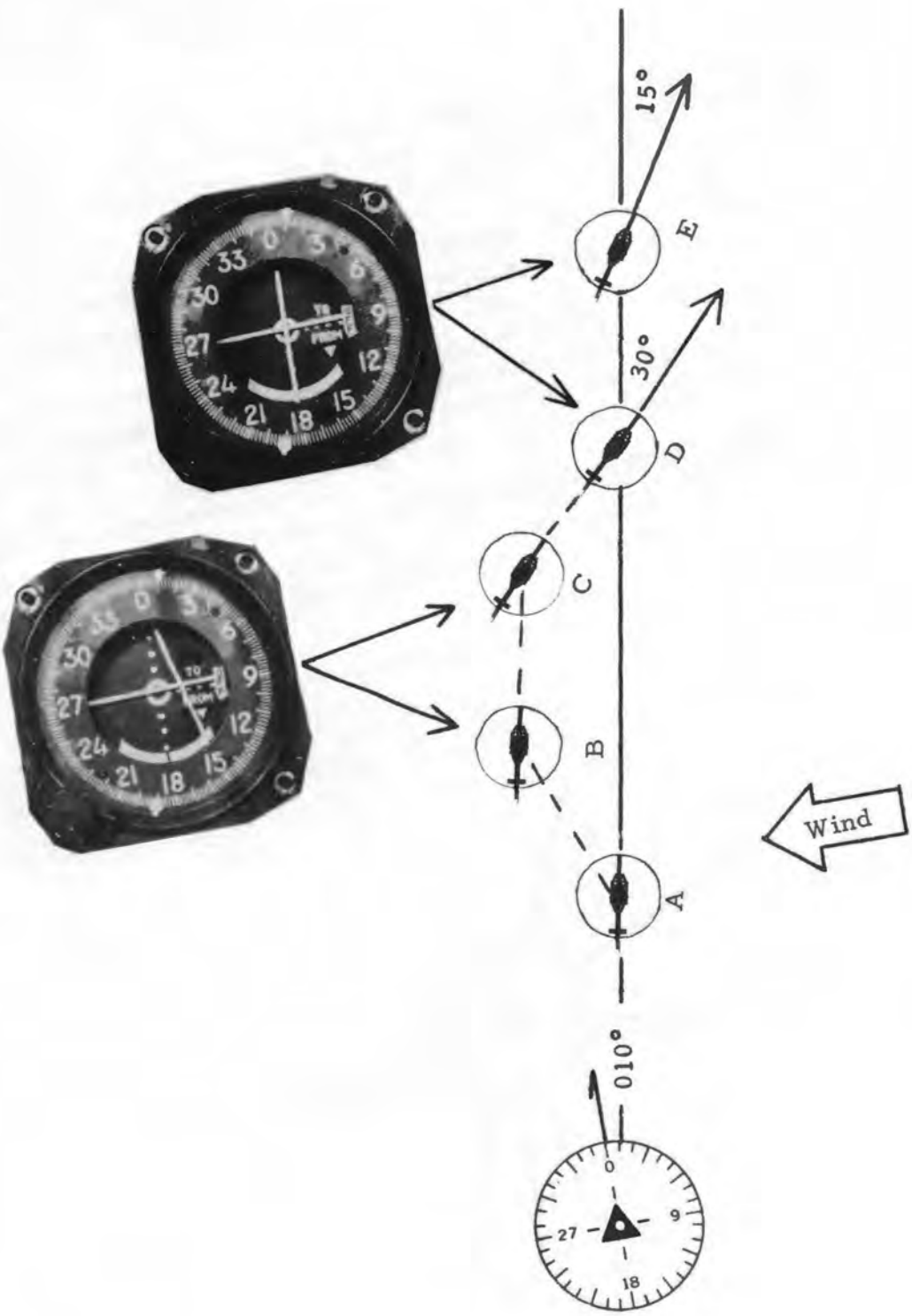


Figure 2

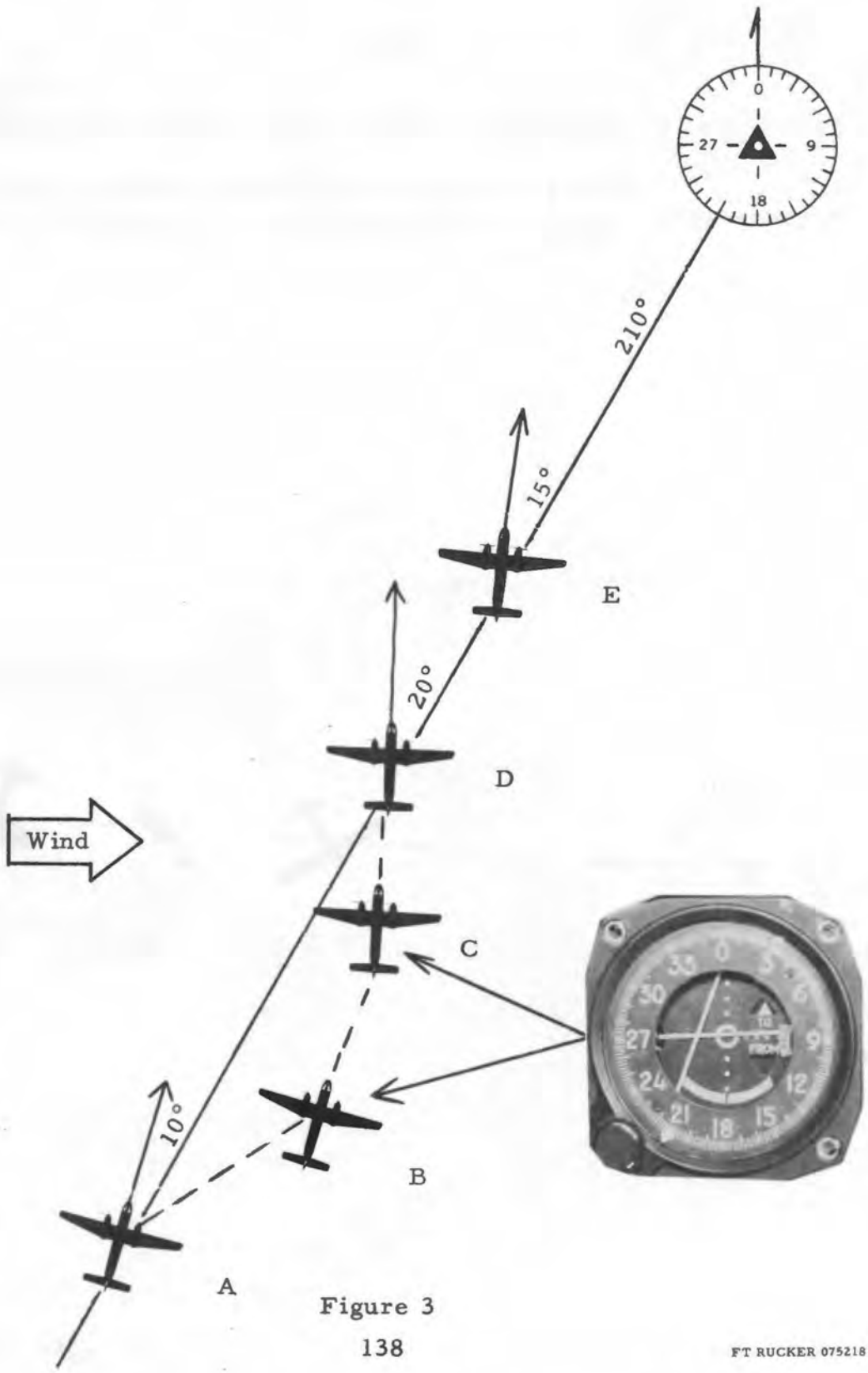


Figure 3

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(A to) A is leading to station & ball show radial.

Flag is from (A) pointer show radial & ball ~~dot~~ leading to station