USAAVNS PT 7

PROGRAMED TEXT

VOR - ENROUTE

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UNITED STATES ARMY AVIATION SCHOOL

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HEADQUARTERS
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PROGRAMMED TEXT
DRAFT

TITLE: VOR Procedures (Enroute)
SCOPE: Principles of operation, aircraft receiving equipment and enroute flight procedures of the VHF omnirange.
REFERENCES: TM 1-225
MATERIALS ISSUED TO STUDENTS: None
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APPROVED BY: DATE:

CONTENTS

PREFACE

This program includes the fundamentals of VHF Omni Navigation enroute procedures. It does not duplicate coverage of general characteristics and VOR airway data discussed in USAAVNS PT's 104, 113, and 119. Completion of those texts prior to this one will be helpful but is not essential for an understanding of enroute procedures.

The scope of the program is limited to Course Indicator displays; it does not include omni display on the Radio Magnetic Indicator (RMI) which can be found in PT 12 and PT 118. USAAVNS PT 121, should be used for instruction related to VOR approaches and terminal procedures.

From this program the student can expect a clear explanation of principles and procedures; but, complete understanding and proficiency will be possible only after application in the synthetic flight trainer and in the aircraft.

VOR ENROUTE PROCEDURES

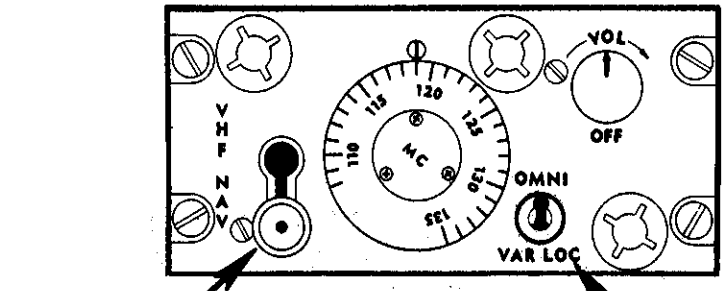
OBJECTIVES

The student should be able to

1. Tune and identify VOR stations using the ARN 30A, or ARN 30D and E.
2. State the meaning of the warning flag after a station has been tuned.
3. Describe the technique used to signify that a transmitting station is undergoing maintenance and the signal is unreliable.
4. Perform an operational check of VOR equipment.
5. State the permissible errors for ground and airborne checks.
6. Locate and interpret receiver check data in FLIP.
7. Identify station passage.
8. Describe the reaction of the TO-FROM indicator for any given location and course selector setting.
9. For any given course indicator display, chart display, and heading, or a combination of these, identify:
   a. Location of specified radials/courses.
   b. Deviation from specified courses/radials.
   c. Intercept headings in specified cases.
   d. Tracking corrections in specified cases.
   e. Position in relation to specified intersections.

VOR or OMNI receivers found in Army aircraft may be of several types. Some Army aircraft are equipped with the ARN 30A which has a "coffee grinder" type frequency selector and a switch for choosing either the OMNI mode or the VAR LOC mode.

Don't worry about the VAR LOC mode at present. If your aircraft is equipped with this type tuning head and you intend to navigate using VOR stations - the selector switch should be placed in the _____ _____position.



ARN-30A Control Panel

Coffee Grinder

Selector Switch

Answer: OMNI

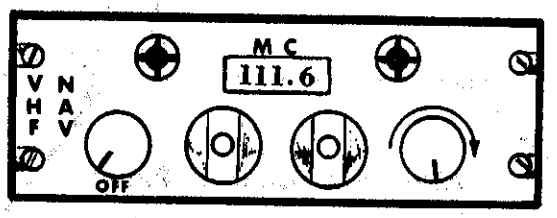
FRAME 2

A second type of VHF NAV (OMNI) receiver you will find in Army aircraft is the ARN 30D (or ARN30E). These have digital tuning which simplifies frequency selection. The left digital knob is used to set-up the whole number part of the frequency and the right knob is used to set-in the decimal part.

Quick and accurate frequency selection is more easily obtained with the

_____ARN 30A

_____ARN 30D (or E)

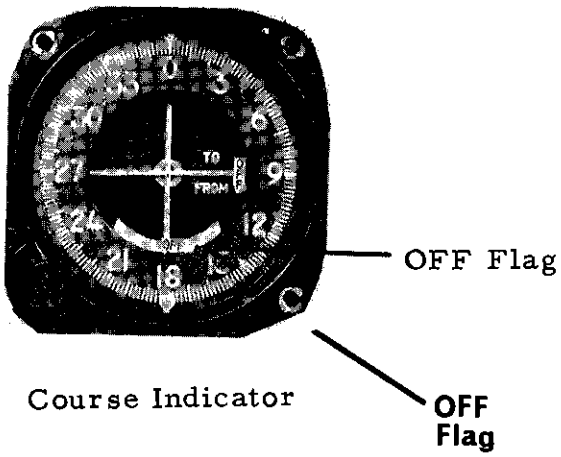


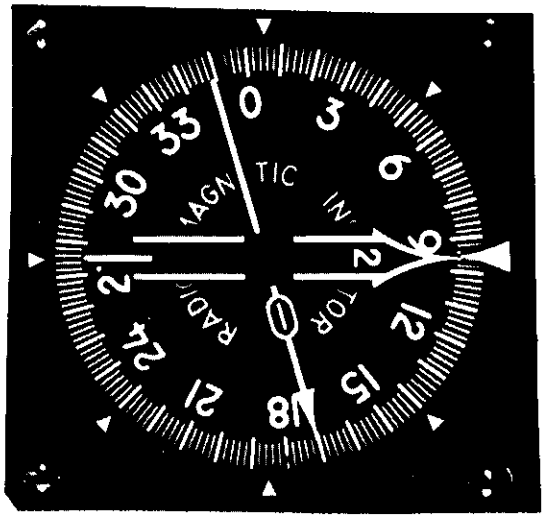
ARN 30 D or ARN 30 E

Answer: ✓ ARN 30D (or E)

FRAME 3

Omni navigational signals from the ground station are displayed in the cockpit on either a Radio Magnetic Indicator (RMI) or VOR Course Indicator. Most Army aircraft are equipped with both instruments. This program will be concerned only with the Course Indicator.





The OFF flag at the bottom center of the course indicator is also called a warning flag. It shows if the set is off. Also, when the set is on and a faulty signal is being received the OFF flag will _____ _____.

Answer: appear (or, be visible)

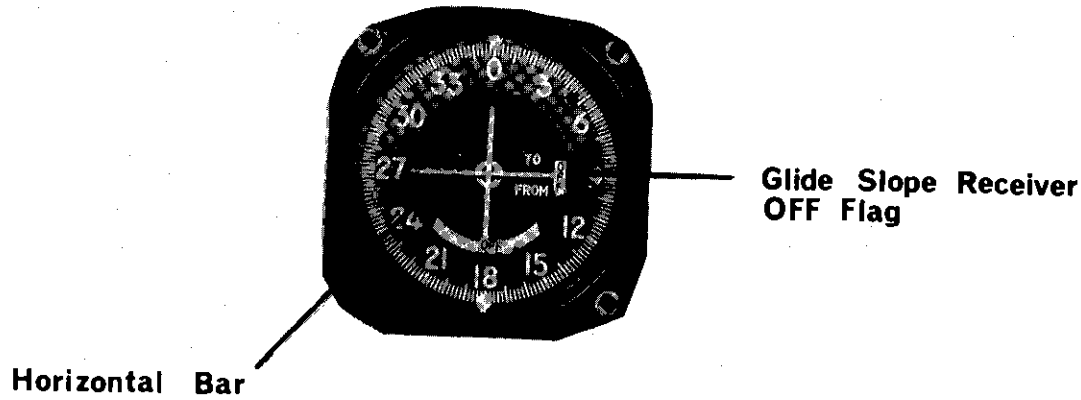
FRAME 4

The Course Indicator 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 glide slope OFF flag have absolutely nothing to do with flying with Omni. Therefore, in the remainder of this book, and while flying with omni, you should:

a. Pay careful attention to the horizontal bar and glide slope OFF flag.

b. Ignore the horizontal bar and glide slope OFF flag.

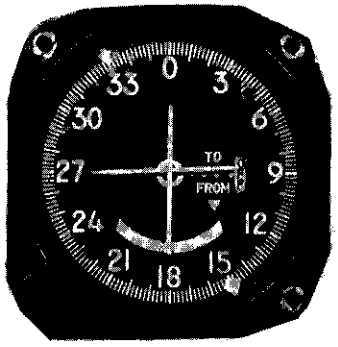


Course Indicator

Answer: B. Ignore the horizontal bar and glide slope OFF flag.

FRAME 5

After tuning and identifying a station, the pilot looks at the indicator and sees that the off flag at bottom center has disappeared. He knows that the signal being received is_____
(reliable/faulty)



In another case the pilot sees the OFF flag after tuning and identifying the station. Even though the station is transmitting a good signal and the pilot has identified the station, the OFF flag means the reception of the signal is_____.

This can be caused by: (pick the best answer)

A. aircraft too low for "line-of-sight" reception from station.

B. aircraft too far away from station.

C. either A or B or both.

Answer: reliable
unreliable
C. either A or B or both. (too low and/or too far away)

FRAME 6

At certain times the omni may transmit a faulty signal. Monitoring equipment will detect faulty signals being transmitted and alert maintenance personnel. If a station is undergoing maintenance but still transmitting, this will be made known to the pilots by removal of the station identification from the transmitting cycle. A pilot knows that an unreliable signal is being transmitted if he is unable to receive the _____ _____.

A pilot tunes and identifies a station but sees the OFF flag. This means that a faulty signal is being

A. transmitted

B. received

A pilot tunes a station and the OFF flag disappears but he cannot receive the station identification. This means that

A. his receiver is malfunctioning

B. an unreliable signal is being transmitted - station undergoing maintenance.

Answer: station identification
B. received

B. unreliable signal being transmitted - station undergoing maintenance

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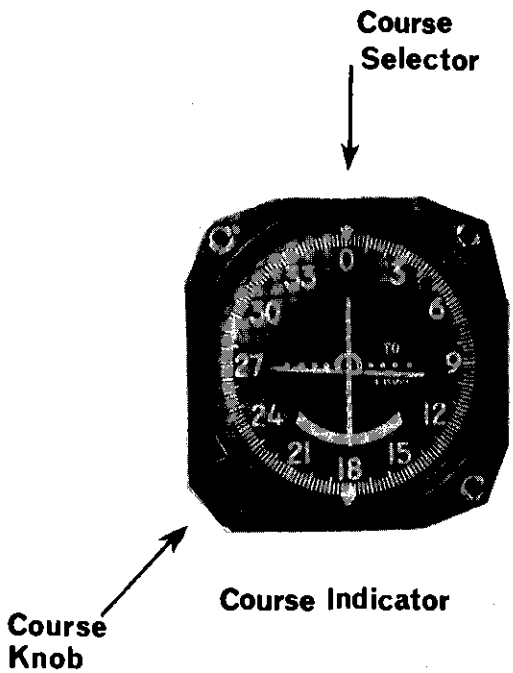
FRAME 7

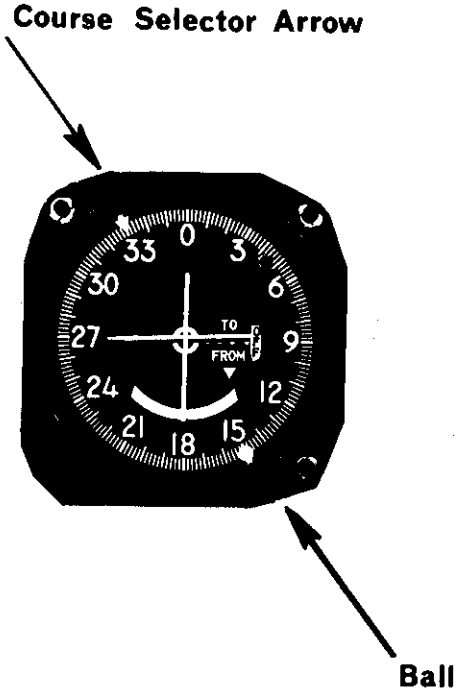
Pilots rotate the Course Knob which moves the Course Selector to the desired course. You must set the course selector accurately. Below the pilot has selected a course of_____°



Answer: 0° (360°)

FRAME 8

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

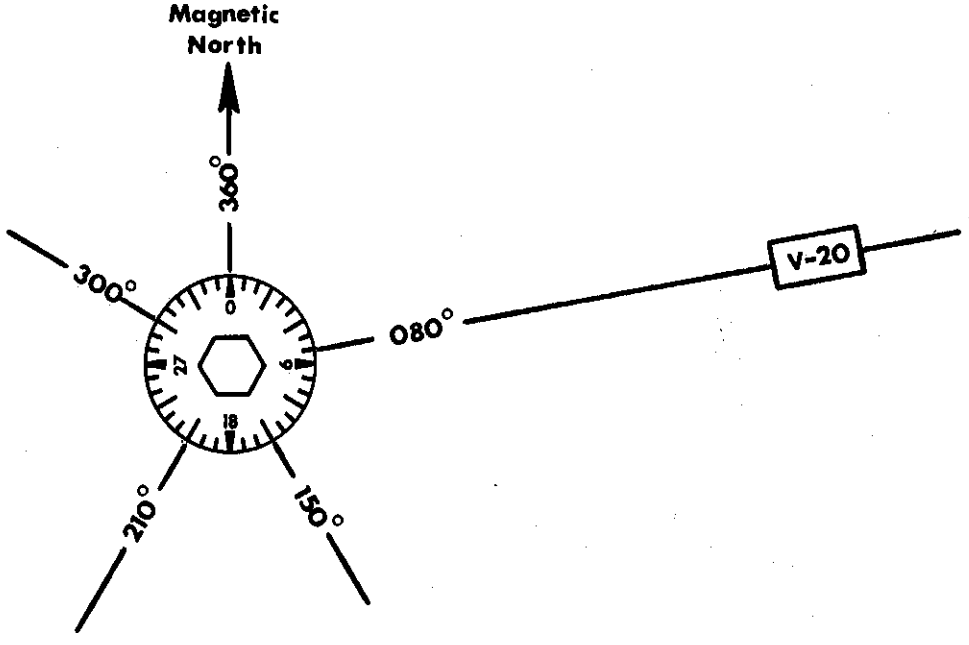


Answers: 330° (arrow)

150° (ball)

FRAME 9

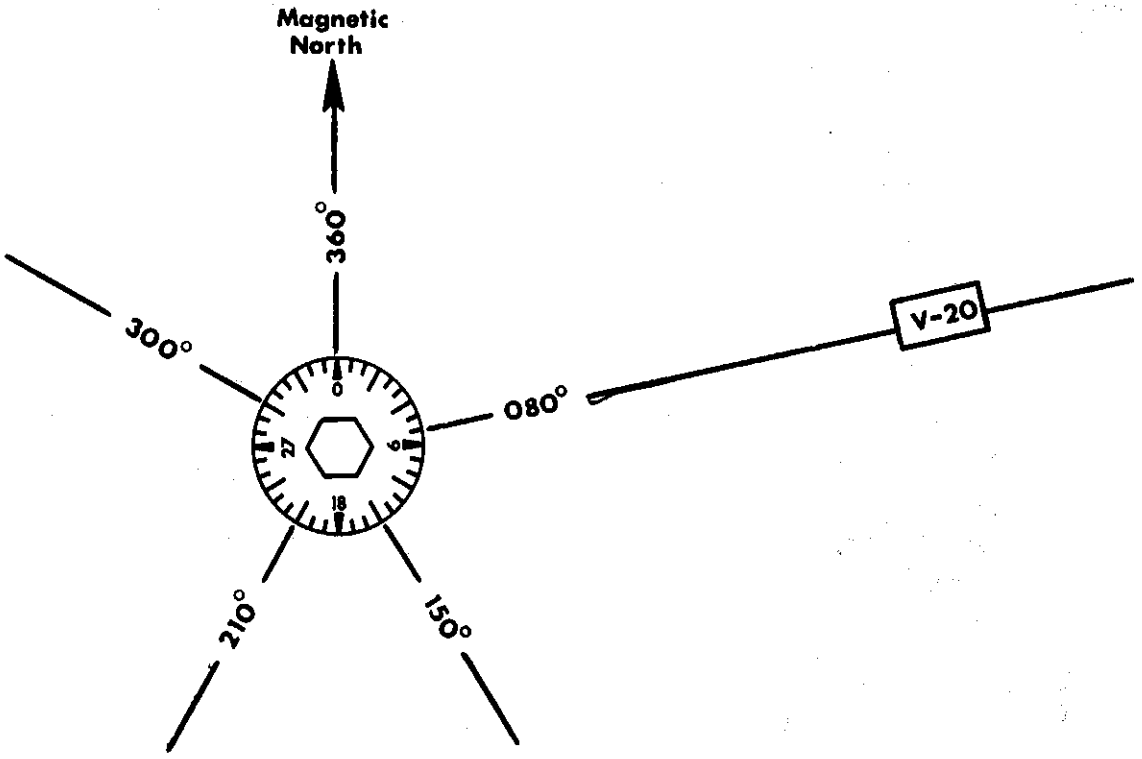
Radio navigation charts similar to the illustration below show omni stations with a compass rose. The station transmits a course line for every degree of the compass - 360 courses. Outbound courses from an omni station are called radials. Although the pilot could fly into or away from the omni station on any one of the 360 radials (depending on his location), certain radials are designated as omni airways. These airways are called victor airways and designated with the letter V and a number. In the illustration, airway_____, is made up of the_____° radial from the station.



Answer: V-20, 080°

FRAME 10

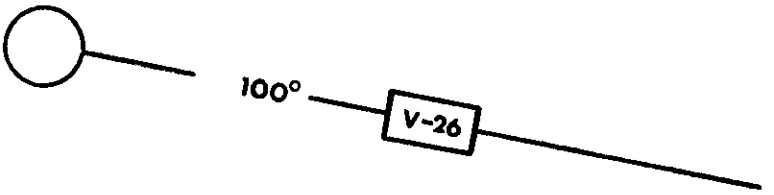
Notice that the 360° radial from the station is aligned with magnetic north and that the radial directions printed on the chart are outbound from the station. If you were near the station on airway V-20 and wished to fly outbound on the airway, you would manually rotate the course knob to set the course selector arrow on _____°. But, if you were on airway V-20 some distance away and wished to fly inbound toward the station you would set the course selector arrow on _____°.

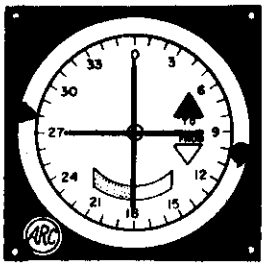


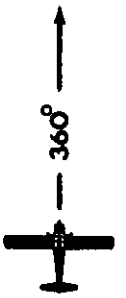
Answers: 080°
260°

FRAME 11

Do not confuse the course selector arrow (or ball) with the heading of the aircraft. The course selector arrow and ball will move only when you rotate the knob. You use the course selector to pick the course (radial) you want to fly. But, at the time you set the course selector your actual heading may be anything. In the situation below you are flying toward (approaching) the_____° radial. Your heading at the present time is_____.° When you reach the airway (V-26) you want to turn toward the station and fly inbound. You should set the course selector on the course you desire to fly inbound, which is_____° At the time you reach the airway you will turn left (inbound) until your heading is also _____°







Answers: 100^{o} (radial)
360^{o} (heading)
280^{o} (inbound - reciprocal of 100^{o} radial)
280^{o} (inbound - heading)

FRAME 12

REVIEW

1. Factors which may cause unreliable reception of an omni station are:

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2. If reception is faulty as a result of one of the factors above, the

   a. OFF flag will appear
   b. Identification will not be heard

3. The course selector (arrow) setting automatically shows heading of the aircraft._____True_____False.

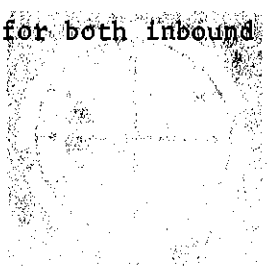
4. The course selected by the pilot is set under the course selector arrow. Its reciprocal appears under the_____.

5. Omni courses published on charts are called_____. They are published as_____(inbound/outbound)

6. The orientation of the 0^{o} (360^{o}) outbound omni course is toward _____(true/magnetic) north.

7. Omni airways are called_____airways and designated with the letter_____.

8. Although only certain courses may be published on charts, every omni station produces_____courses which may be used for both inbound and outbound flight.



Note: If you miss a question check the referenced frame

Answers:
1. too low, too far away, receiver malfunction (frame 5)
2. a. OFF flag will appear (frames 5 & 6)
3. False (frame 11)
4. ball (frame 8)
5. radials, outbound (frame 9)
6. magnetic (frame 10)
7. victor, V (frame 9)
8. 360 (frame 9)

FRAME 13

The course indicator includes a sense indicator - more commonly called a TO-FROM indicator.

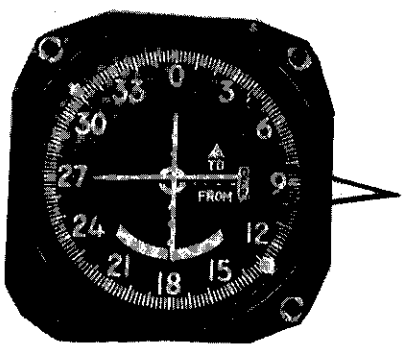
Every setting of the course selector causes the TO-FROM indicator to show whether the selected course goes toward (TO) or away from (FROM) the station.

The white marker appearing in the TO window below means that the selected course of 310° goes toward the station.

The aircraft must be located in some present position such that if the aircraft were to fly the 310° course it would be going toward the station. The present location of the aircraft must be:

A. southeast of the station.

B. northwest of the station.



TO- FROM Indicator

Aircraft Here???

STATION

Aircraft Here???

Answer: A. Southeast of station

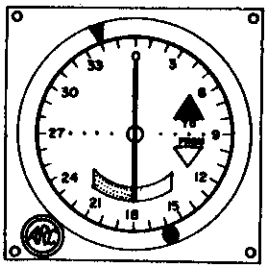
FRAME 14

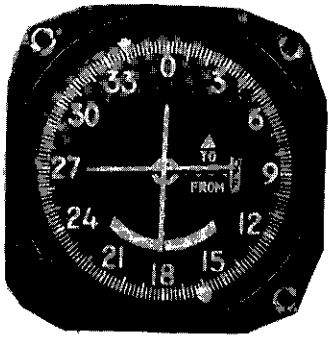
This program may represent the course indicator with an actual photograph or a line drawing. On actual photographs the indications are white on a black face. On line drawings the indications are black on a white face.

Which statement is correct?

_____The photo shows that 340° goes TO the station and the line drawing shows that 340° goes FROM the station.

_____Both instruments show that 340° goes TO the station.





Answer: ✓ both instruments show that 340° goes TO the station.

FRAME 15

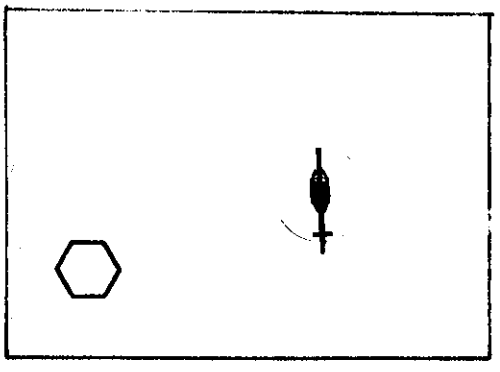
The TO-FROM indicator does not tell you anything about the actual heading of the aircraft. In the case below the pilot has selected a course of 225° and since his present location is northeast of the station, the 225° course would take him TO the station. Therefore, the TO-FROM indicator shows TO.

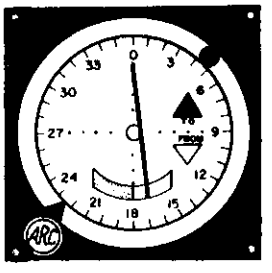
Notice that the aircraft has not yet turned to a heading of 225. Actually the present heading of the aircraft is taking it further away from the station. But, the TO-FROM indicator says: "If you fly the course that you have selected, it will take you closer TO the station."

Suppose the pilot rotates the course knob and selects another course - for example: 090°. As soon as he sets the course arrow on 090° the TO-FROM indicator will react by saying: "If you fly a course of 090° from your present location, it will take you:

A. further away FROM THE STATION

B. closer TO the station

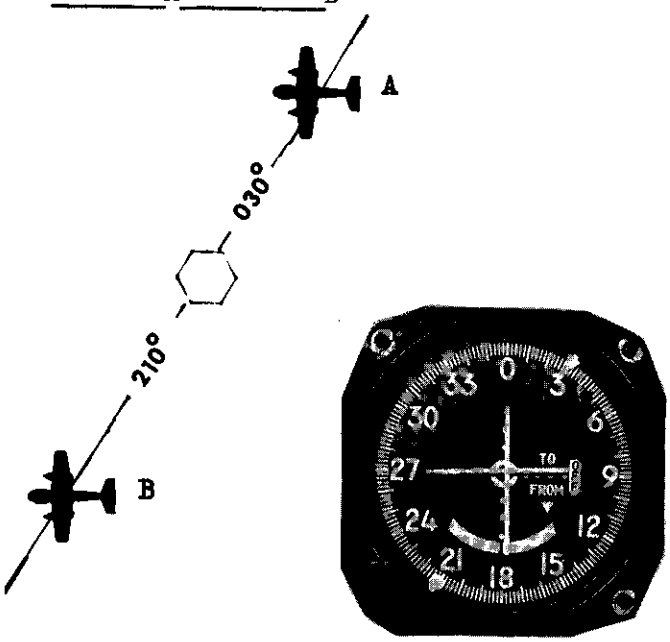




Answer: A. further away FROM the station

FRAME 16

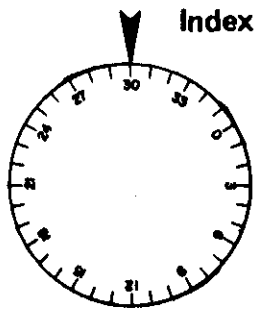
The illustration below shows that the selected course of 030° (if flown) will take the aircraft further away FROM the station. The course indicator does NOT give any indication of the actual heading of the aircraft. This course indicator corresponds to the aircraft at position: _____A_____B

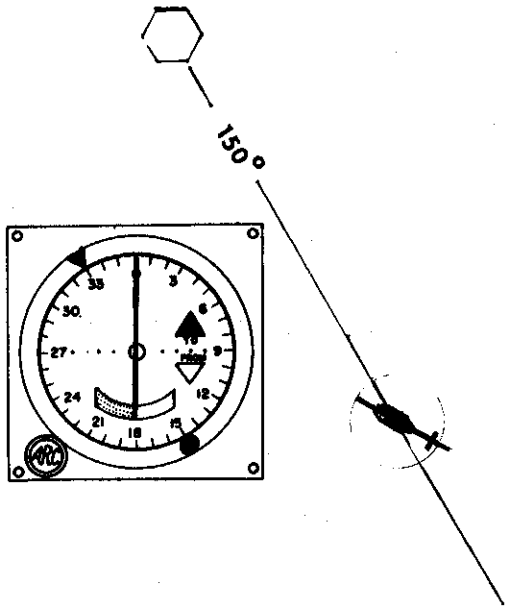


Answer: A.

FRAME 17

There are several kinds of primary heading indicators; the magnetic compass is a back-up, or secondary heading indicator. To show headings in this program we will use a rotating compass card with heading shown under the index. The instruments below show that from the present location of the aircraft, the course TO the station is _____°. But the aircraft is flying a heading of _____°. In order to fly to the station, the pilot should turn _____ (left/right) to a heading of _____°.

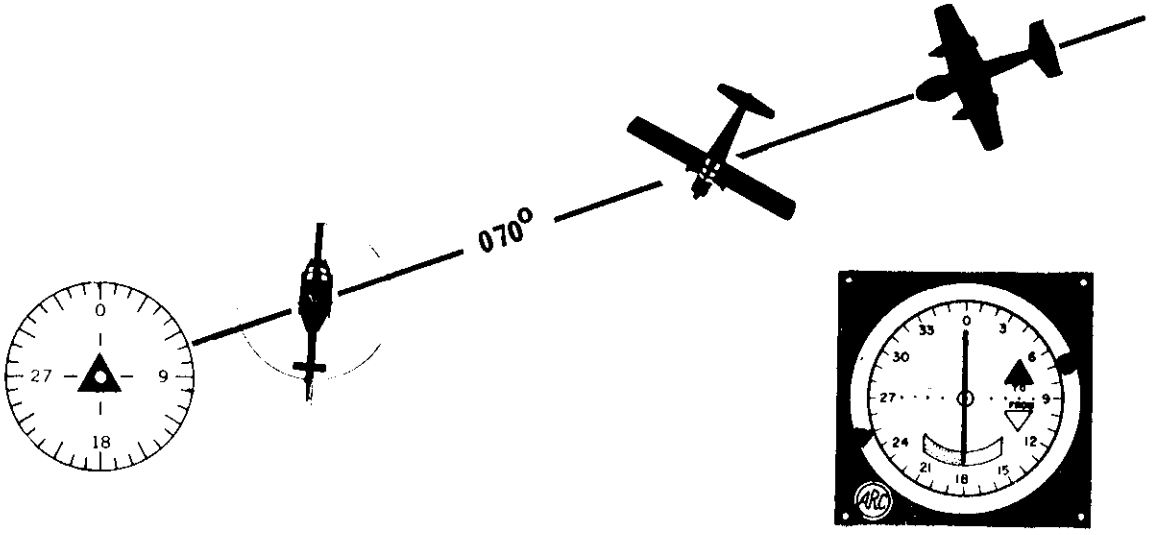




Answer: 330°, 300°, right, 330°

FRAME 18

The three aircraft below are located on the 070° radial although each is on a different heading. Each pilot has the course selector set on 250° and in each aircraft the TO-FROM shows TO because if the aircraft actually flew the selected course of 250°, it would take them TO the station.



The reaction of the TO-FROM (sense) indicator depends only on the course which is set on the course selector and

A. the location of the aircraft with respect to the station.

B. the heading of the aircraft.

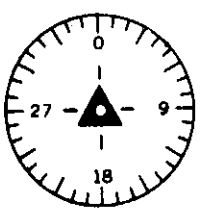
C. the location of the aircraft and its heading.

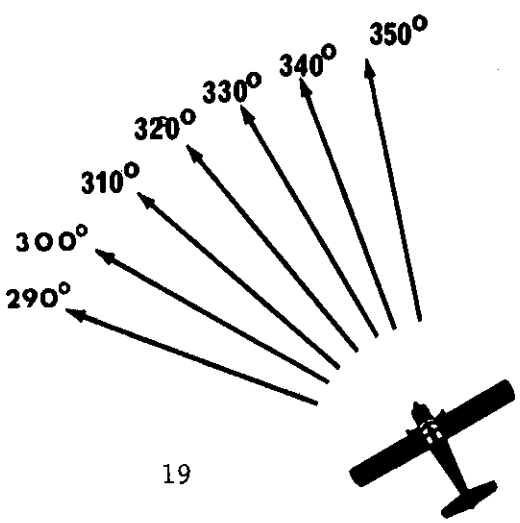
Answer: A. the location of the aircraft with respect to the station.

FRAME 19

Assume an aircraft is located generally in the southeast quadrant of a station. There are many different courses which would take the aircraft closer TO the station although there is only one which goes exactly to the station.

The TO-FROM indicator must always react to the selected course. If any of the courses shown below are selected the sense indicator will react by showing _____(TO/FROM).





Answer: TO

FRAME 20

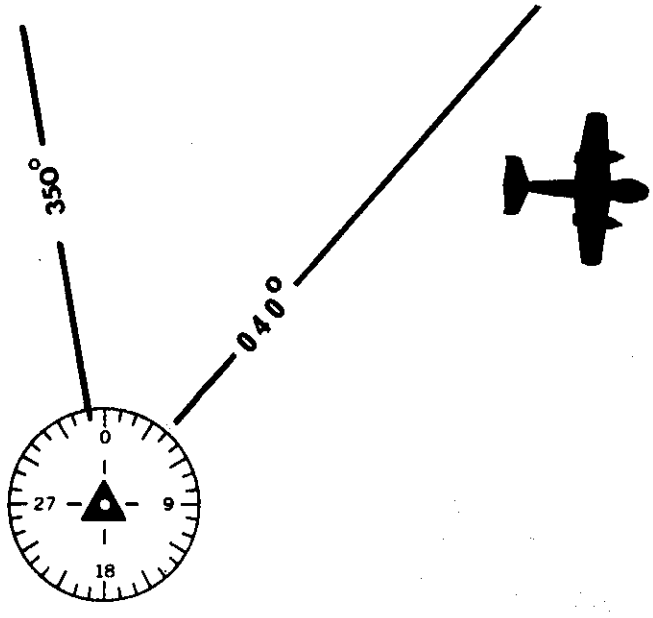
The aircraft below is not exactly on the 040° radial - and his heading is not 040°.

But if the aircraft flew a course of 040° from its present position, it would be going from the station so, the TO-FROM indicator shows FROM when the course selector is set on 040°.

If the pilot were to set the course selector on 350°, the TO-FROM indicator would show_____, because if the aircraft turned and flew 350° (from its present position) it would be

A. getting closer TO the station.

B. getting further away FROM the **station.**

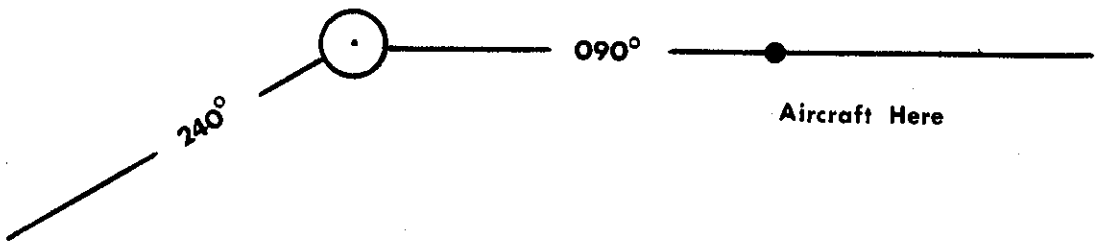


Answer: FROM

B.

Frame 21

An airoraft is located on the 090° radial and the pilot sets the course selector arrow on 240°. What will the TO-FROM indicator show? _____.



Answer: TO

FRAME 22

At many airway VOR stations, the pilot must make a position report or take a time check to compute ground speeds and revise estimates.

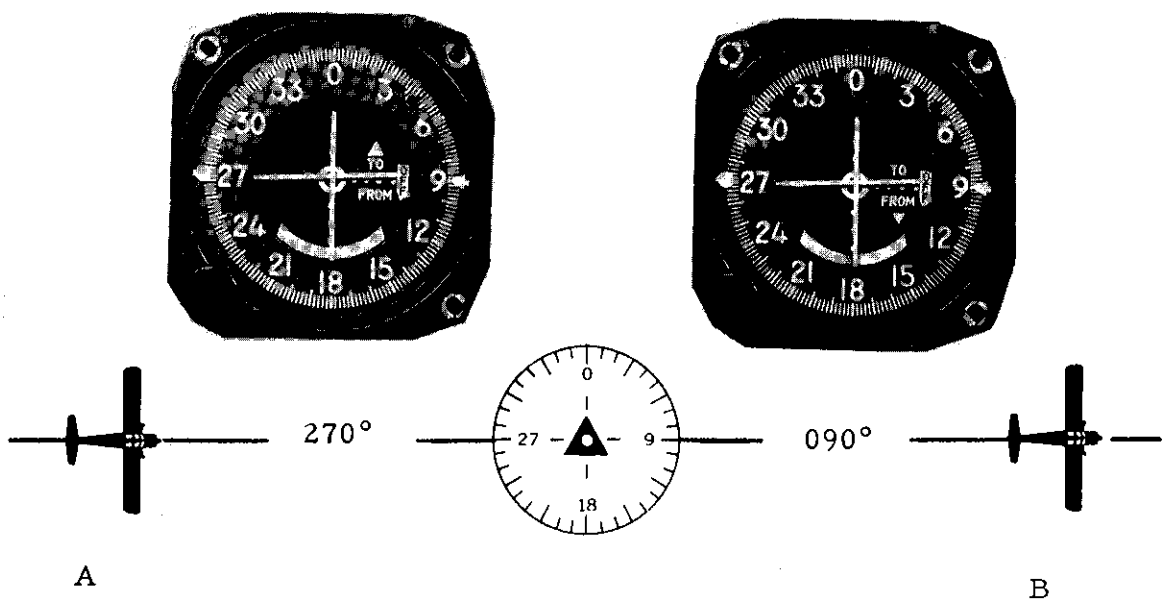
As the aircraft flew over the station below from point A to point B, was it necessary to change the course selector setting? ____Yes ____No

What happened to the TO-FROM indicator? _____

_____.

If the aircraft were in the clouds under actual instrument conditions, how would the pilot know exactly when he passed the station? _____

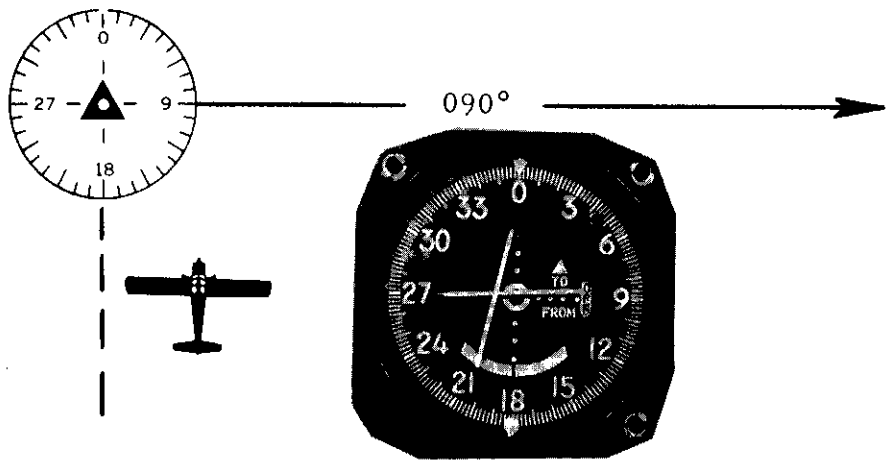
_____.



Answer: ✓ No,
changed from TO, to FROM
when the TO-FROM indicator reverses.

FRAME 23

Although the aircraft below will not fly over the station, at what point will the TO-FROM indicator reverse? _____



Answer: When the aircraft crosses the 090° radial, abeam the station.

FRAME 24

REVIEW

1. The sense indicator will show TO or FROM depending on
(check each item as Yes or No)

   A. the course set up with the course selector.

   B. the heading of the aircraft

   C. the location of the aircraft and station

2. After a station has been tuned using the correct frequency, the OFF flag (warning flag) appears. What does this indicate?

---

3. A pilot is unable to receive station identification even though the course indicator is reacting to a signal. What does this mean?

---

4. For each situation below showing location of aircraft with respect to the station, and the course set under the course selector arrow, write in the reaction of the TO-FROM indicator.

Aircraft Location	Selected Course	TO-FROM
Northeast	090°	_____
Northwest	180°	_____
Southwest	270°	_____
Southeast	300°	_____

Answers:
1. A. Yes, B. No, C. Yes
2. Faulty signal being received
3. Unreliable signal being transmitted
4. FROM, TO, FROM, TO

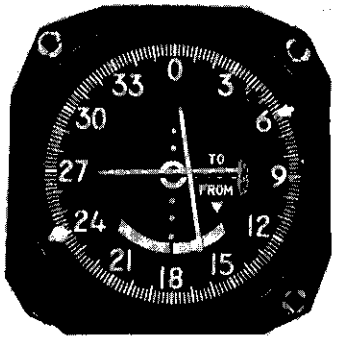
FRAME 25

The vertical needle of the course indicator - also called the deviation indicator is pivoted at the top and swings right and left to show that the course is right or left, or an "on course" position.

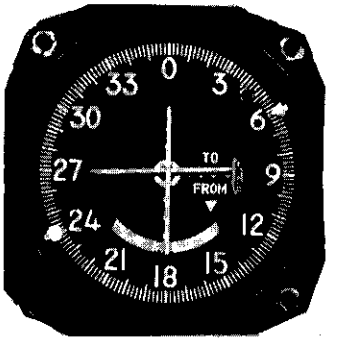
The needle represents the course set under the course selector arrow and shows if the aircraft is flying that course. When the needle swings to the right it means that the course is to the pilot's right and he must turn right to get back on course.

Match the A,B,C indicators below with the aircraft numbered 1, 2, 3.

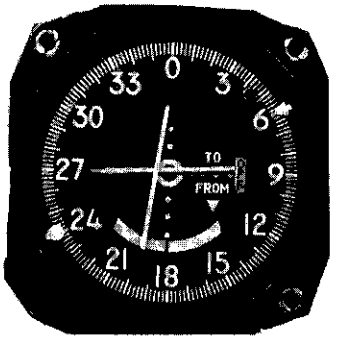
A

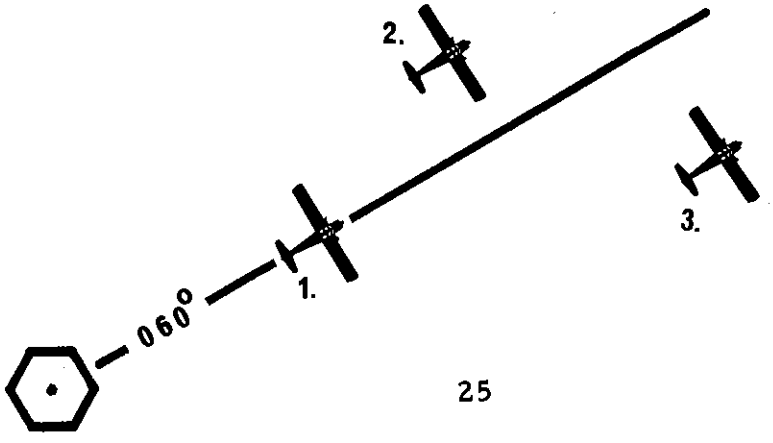


B



C





1. _____
2. _____
3. _____

Answers: 1. B

2. A

3. C

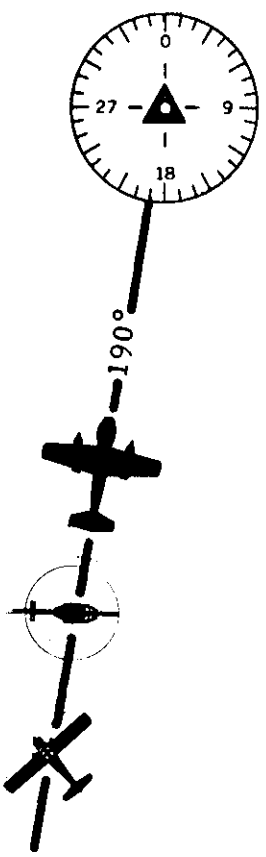
FRAME 26

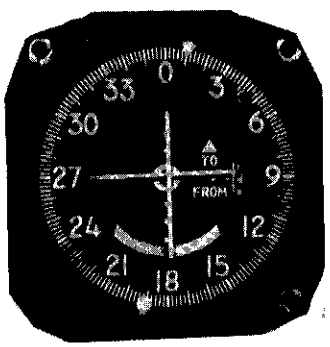
When the deviation indicator is centered the aircraft is on the course which is set under the course selector arrow.

As shown earlier, the indications on the course indicator do not depend on the heading of the aircraft at a particular time.

The course indicator below represents what each pilot would see in the aircraft shown.

In each case the pilot knows that the course to the station is _____° and that he is located on the _____° radial.





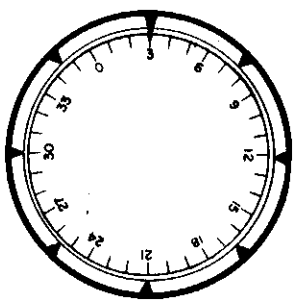
Answer: 010°, 190°

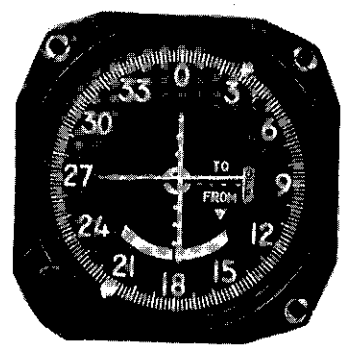
FRAME 27

You may refer to a course as going to or from a station. But, radials are always from a station and are printed on charts as such.

The course selector "ball" is exactly opposite the course selector arrow and therefore shows the reciprocal of the course under the arrow.

A pilots orients himself by looking at the TO-FROM, the needle, and the course selector arrow and ball. Inspect the course selector and answer the questions below.





1. The course set under the course selector arrow is _____°.
2. The selected course goes _____(TO/FROM) the station.
3. The course to the station is _____°.
4. Is the aircraft on the selected course? ____Yes ____No.
5. On what radial is the aircraft? _____°
6. Does the heading indicator show the aircraft flying the selected course? _____Yes _____No
7. The station is approximately south southwest of the aircraft. ____Yes ____No

Answer:
1. 030°
2. FROM
3. 210°
4. Yes
5. 030°
6. Yes
7. Yes

FRAME 28

If you are flying in the vicinity of an omni station and need to orient yourself with respect to the station follow these steps.

1. Tune and identify the station.
2. Rotate the course selector knob until the needle is centered and the TO-FROM shows TO.
3. Then read -

   - course TO the station under the course selector arrow.

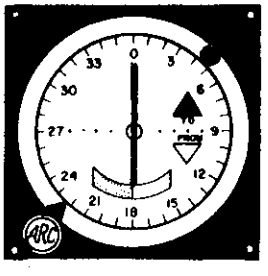
   - radial FROM the station under the ball.

Example: Assume the station has been properly tuned and identified. The course indicator shows:

1. Course TO station is_____°
2. Radial FROM station is_____°
3. Aircraft is:

   A. northeast ot station

   B. southwest of station



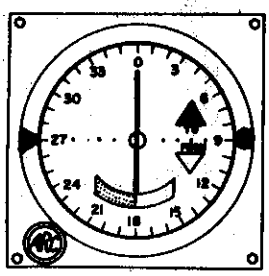
Answers: 1. 225°
2. 045°
3. A. Northeast

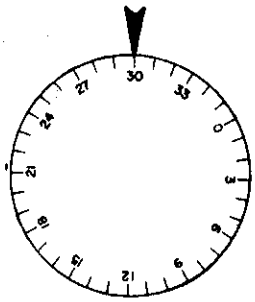
FRAME 29

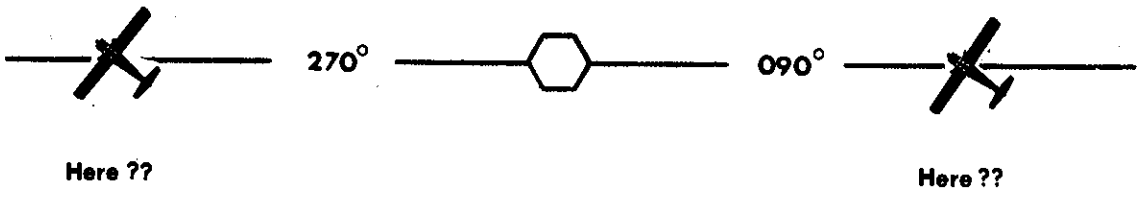
1. In the situation below, the course to the station is _____°; the aircraft is on the _____°radial.

2. If the pilot holds his present heading, will he fly off the radial he is now on? _____Yes _____No (calm winds)

3. To stay on the radial and fly to the station, the pilot needs to turn _____(left/right) to a heading of _____°.







Answer: 1. 270°, 090°
2. Yes
3. left, 270°

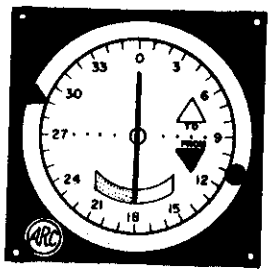
FRAME 30

You may also orient yourself with respect to the station by rotating the course selector knob until the needle centers and the sense indicator shows FROM. In that case, the course <u>from</u> the station (the radial) is read under the course selector arrow and its reciprocal appearing under the ball is the course <u>to</u> the station.

1. In this case the <u>radial</u> (course <u>from</u> station) is _____°?
2. The course to the station is _____°
3. The aircraft is:

   A. east southeast of the station.

   B. west northwest of the station.



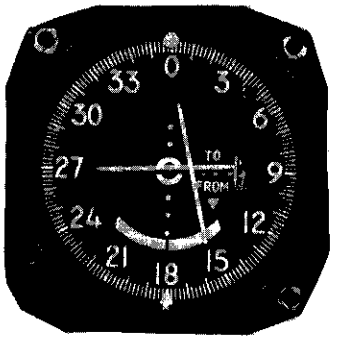
Answers: 1. 290°
2. 110°
3. B. West northwest

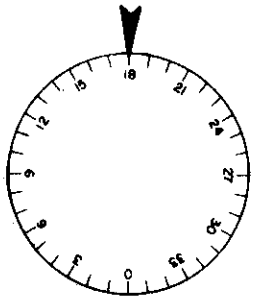
FRAME 31

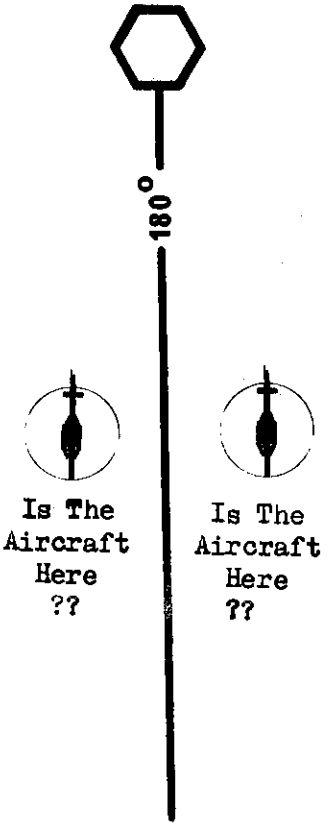
You may need to orient yourself with respect to a given course or radial.

Assume you want to fly away from the station on the 180° radial. After turning to a heading of 180, tuning the station, and setting the course selector to the desired course of 180°, you see that you are not on course since the needle is not centered.

The needle is to the _____, which means that the desired course is also to the _____. The aircraft is _____ (east/west) of the course.







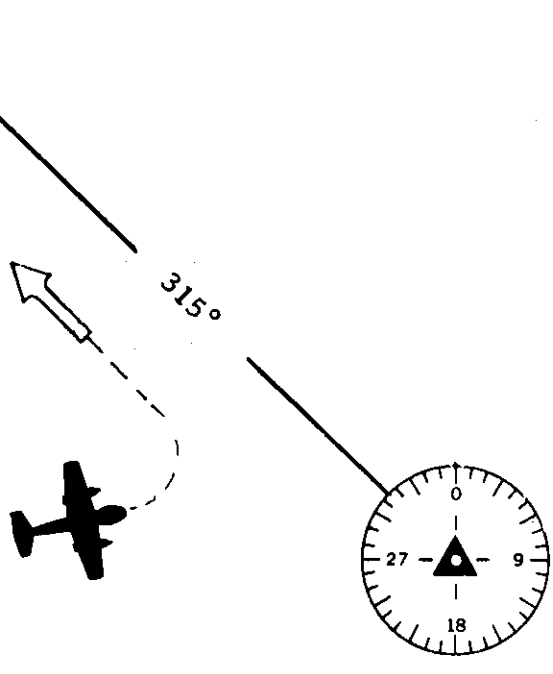
Answer: right, right, east

FRAME 32

Don't forget that the course indicator is not sensitive to your aircraft heading at a particular time. It is sensitive to your location and the selected course.

In the case below the needle is to the right. This does not mean the selected course is to the pilot's right because the aircraft heading does not agree with the selected course.

Assume the pilot turned and rolled out on a heading of 315°. Now, the aircraft heading agrees with the selected course; the needle deflected to the right means the desired (selected) course is_____.



Answer: right

FRAME 33

Even though the aircraft heading does not agree with the selected course, the pilot can imagine that it does. He can look at the selected course and the deflection of the needle and say:

"If I were flying that course it would be to my...."

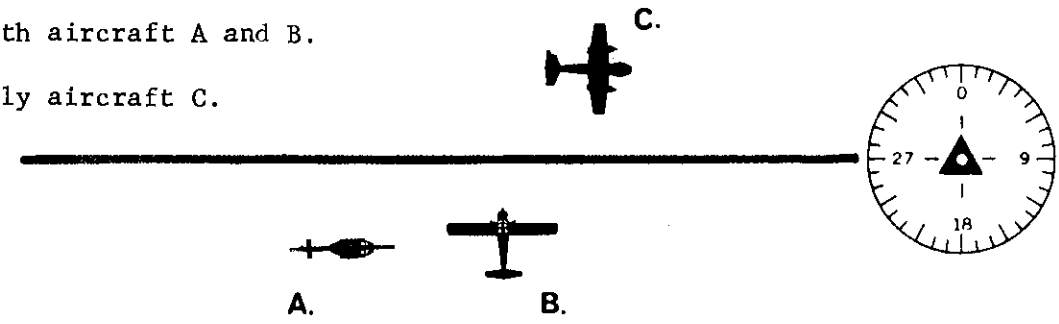
The course indicator shown below may represent one or more of the aircraft shown. Inspect the illustration and mark the correct statement. The diagram represents

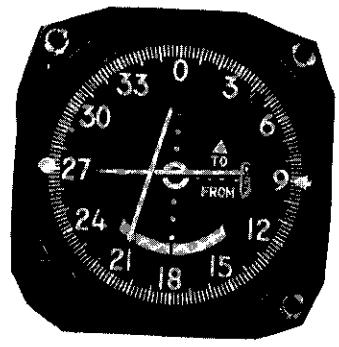
A. only aircraft A.

B. only aircraft B.

C. both aircraft A and B.

D. only aircraft C.



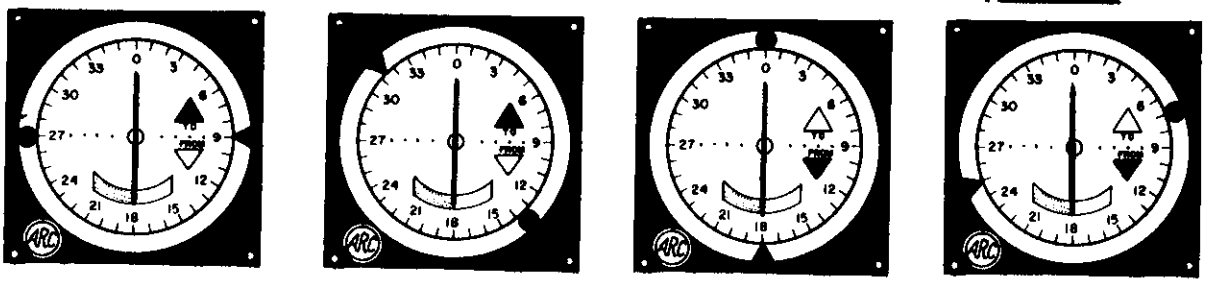


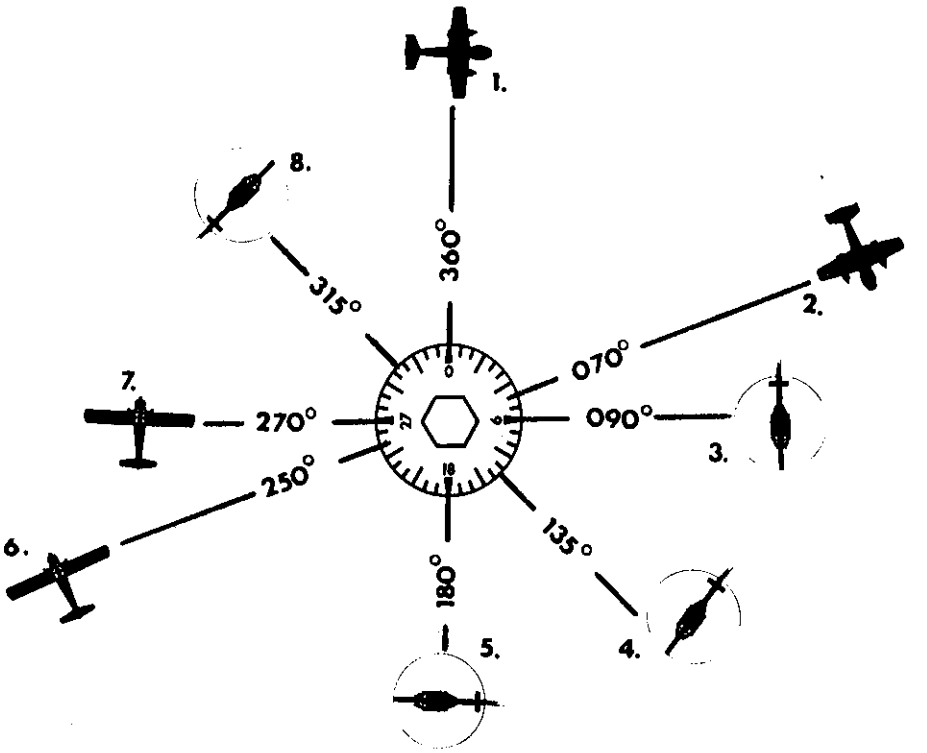
Answers: C. Both aircraft A and B

FRAME 34

Match the course indicators (A,B,C, and D) with the corresponding aircraft locations.

A. _____ B. _____ C. _____ D. _____





Answers: A. 7
B. 4
C. 5
D. 6

FRAME 35

REVIEW

1. With the station properly tuned and identified, the vertical needle centered, and the sense indicator showing TO, the radial on which the aircraft is located appears under the course selector _____(arrow/ball)

2. An aircraft is flying parallel to its intended course with the course selector set properly. The vertical needle is deflected left; this means:

A. the aircraft is left of the course

B. the course is left of the aircraft

3. An aircraft is exactly southwest of an omni station and the pilot desires to fly inbound to the station. How should the course indicator settings and indications appear?

	Course Selector Arrow	Course Selector Ball	Sense Indicator	Needle
A.	045	225	FROM	Centered
B.	225	045	TO	Centered
C.	225	045	FROM	Centered
D.	045	225	TO	Centered

Answers: 1. ball
2. B. course is left of aircraft
3. D.

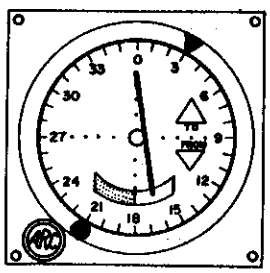
FRAME 36

The center circle on the course indicator - often called the "doughnut" has a row of horizontal dots to the right and left.

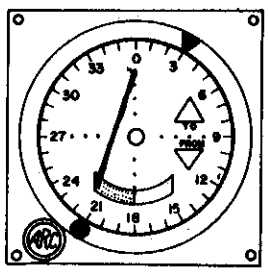
The edge of the doughnut and the dots represent the number of degrees between the position of the aircraft and the selected course. The edge of the doughnut represents 2° off and each successive dot is 2 additional degrees. "A" below shows the course as 2° right, B shows the course as 4° left.

C below shows the course as _____ $^{\circ}$ _____(left/right).

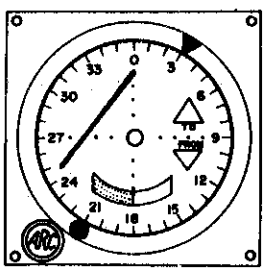
The indicator is capable of showing a maximum of _____ $^{\circ}$ right or left.



A



B



C

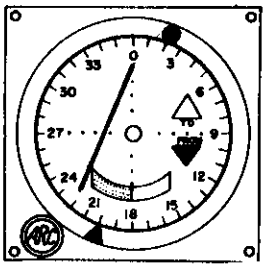
Answer: 8°, left
10°

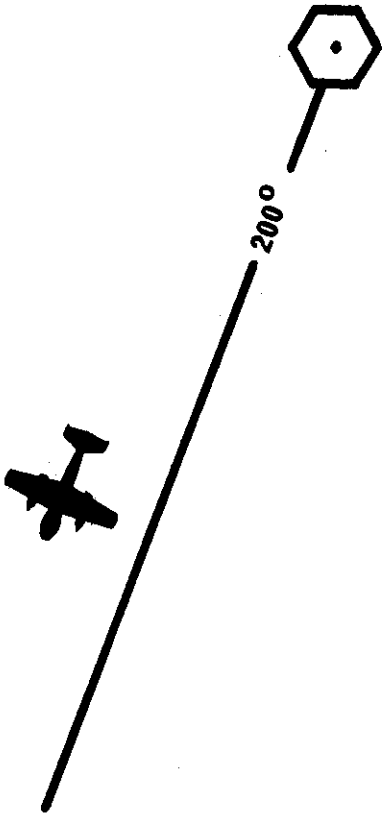
FRAME 37

In the situation below the aircraft is not exactly on the 200° radial. The deviation needle is deflected _____$^{\circ}$ to the left which means that the 200° radial is _____$^{\circ}$ left.

NOTE: The aircraft is flying parallel to the 200° radial holding a heading of 200°.

What radial is the aircraft on? _____.



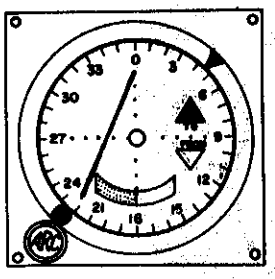


Answers: 5°, 5°
205° radial

FRAME 38

The aircraft below are off the desired course of 045° inbound. However, they are in different positions and the course indicator shown is correct for only one of the aircraft. Which aircraft matches the course indicator?

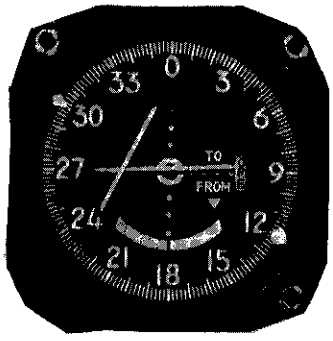
_____A _____B _____C

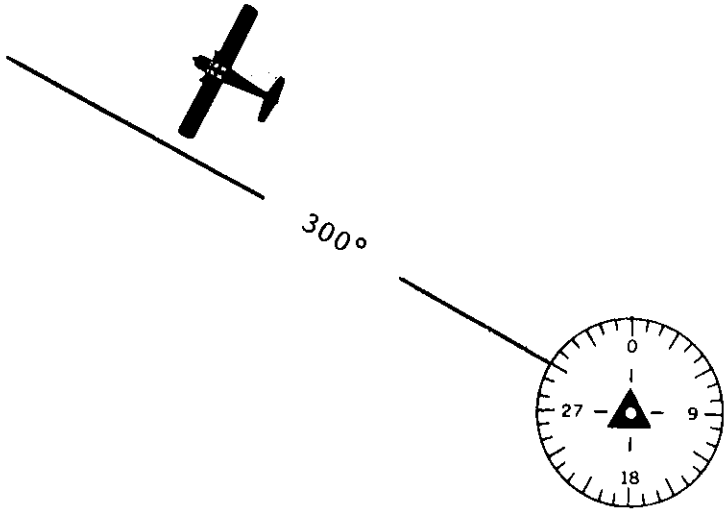


Answers: ✓ B

FRAME 39

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

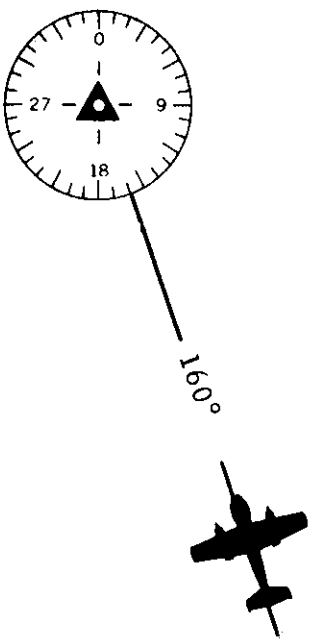




Answers: 308°

FRAME 40

The aircraft 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 to the _____ of the present position of the aircraft.



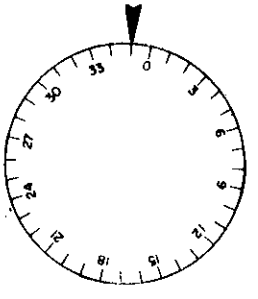
Answers: 160°, left, left.

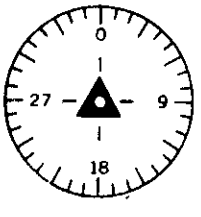
FRAME 41

The aircraft is located on the _____° radial and is flying a heading of _____°.

The 330° radial is _____° to the _____ (left - right) of the aircraft.

(sketch in the radials from the station if you need to)

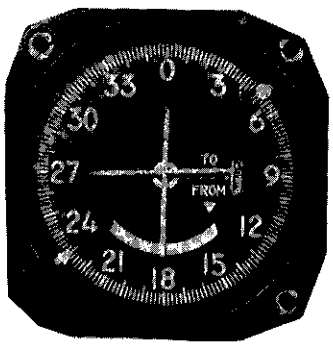


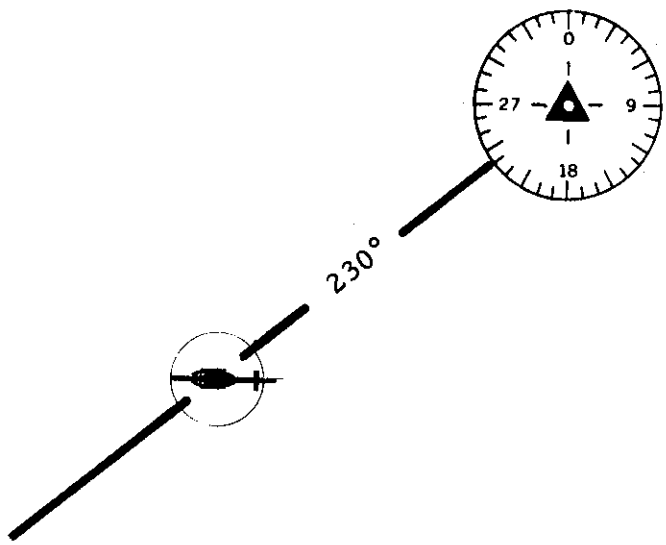


Answers: 350°, 350°,
20°, left

FRAME 42

The aircraft is on the 230° radial but flying a heading of 270°. If the aircraft holds the 270° heading, the deviation needle will swing to the _____.

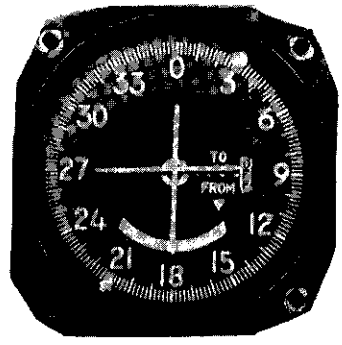




Answer: left

ORIENTATION - REVIEW

FRAME 43



1. The instrument shows that the aircraft is

   A. south southwest of station on 030° radial.

   B. north northeast of station on 210° radial.

   C. south southeast of station on 210° radial.

   D. north northeast of station on 30° radial.

2. The instrument shows that

   A. the aircraft is 4° right of the 070° radial. (aircraft on 74° radial)

   B. the 070° radial is 4° right of the aircraft. (aircraft on 66° radial)

   C. the aircraft must turn 4° left to make the needle center.

   D. the station is approximately east northeast of the aircraft

Answers: 1. C

2. B

ORIENTATION - REVIEW FRAME 44

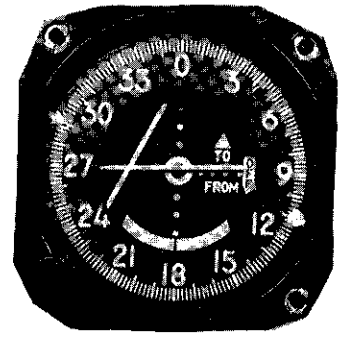
1. The instrument shows that the aircraft is approximately 8°

   A. north of the 290° radial

   B. south of the 290° radial

   C. north of the 110° radial

   D. south of the 110° radial



2. The instrument shows that the aircraft is on the

   A. 180° radial north of the station

   B. 180° radial south of the station

   C. 360° radial north of the station

   D. 360° radial south of the station