Headquarters
Department of the Army
Field Manual

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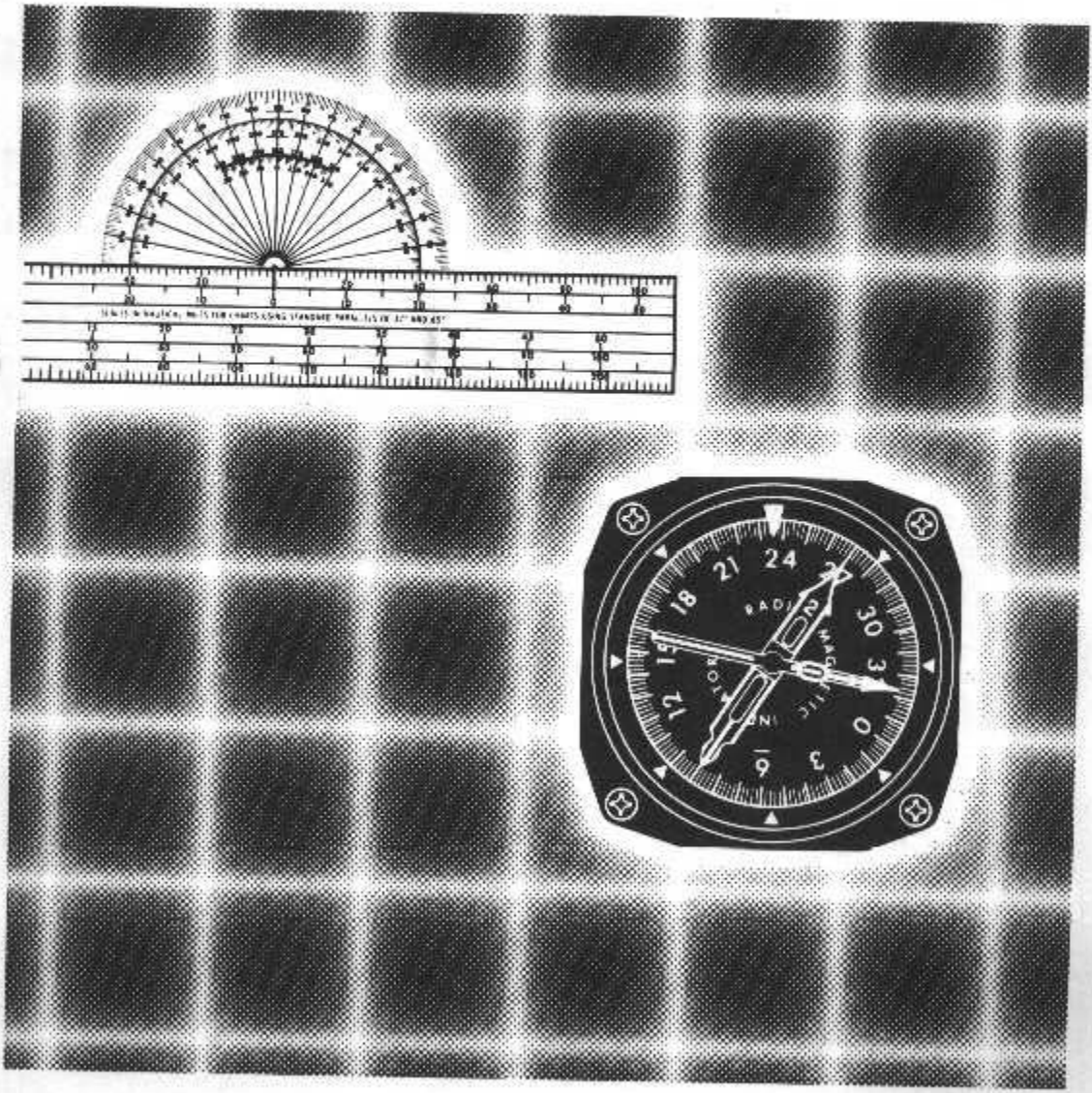
Instrument Flying and Navigation for Army Aviators

FM 1-240



the aircraft is located. A simple method to become oriented with respect to a desired track is as follows:

(1) Tune and identify the station.

(2) Turn the shortest way from the present heading of the aircraft to a heading that is parallel to either the course heading or its reciprocal.

(3) Set the course selector to the course or its reciprocal depending upon which heading the aircraft is flying.

(4) Observe the deflection of the deviation indicator. The course lies to the same side as the indicator is deflected. The TO-FROM indicator will now indicate if the station is ahead or behind the aircraft.

(5) Turn toward the course to a heading which will intercept the course at an appropriate angle.

NOTE: This procedure is true only when the heading of the aircraft is within 90 degrees of the course indicated by the course arrow.

13–14. Estimating time and distance to a station

a. In most situations, an aircraft will be flying in a region where two VOR stations are within reception distance. The position of the aircraft and an estimate of time and distance to either station may be determined by plotting the course or bearing to each station on a navigation chart. The aircraft will be located at the position where the courses or bearings cross.

b. In some isolated cases, it may be necessary to estimate the time or distance to a station by using the signal from a single station. One technique of doing this is pointed out in the note in paragraph 13–13*b*.

c. A different method is illustrated in figure 13–18. The aircraft is inbound to the station on the 200-degree radial. Estimating the time and distance to this station is shown in figure 13–18.

(1) Turn the aircraft through 80 degrees (left in fig 13–18).

(2) Move the course selector 10 degrees (from 020 degrees at point A to 030 degrees at point B) to a known radial ahead of the aircraft.

(3) Wait for the deviation indicator to center and take a time check (1412:50 for example).

(4) Move the course selector an additional 10 degrees (from 030 degrees at point B to 040 degrees at point C).

(5) Wait for the deviation indicator to center and take a second time check such as 1414:55, or 2 minutes and 5 seconds elapsed during the 10-degree bearing change.

(6) Turn inbound to the station (D) and estimate the time to the station by applying the formula below. (The data is taken from situation in fig 13–18.)

Time Remaining to Station =

$$\frac{\text{Minutes Flown} \times 60}{\text{Degree Change}} - \frac{\text{Seconds Flown}}{\text{Degree Change}}$$

Time Remaining to Station =

$$\frac{2 \text{ Min } 5 \text{ Sec} \times 60}{10^\circ} - \frac{125 \text{ Seconds}}{10^\circ} = 12.5 \text{ Minutes}$$

NOTE: If aircraft is turned 80 degrees right (1) above), move course selector from 020 degrees to 010 degrees in (2) above and from 010 degrees to 360 degrees in (4) above.

(7) The approximate distance to the station may be estimated by using the following formula.

Distance to Station =

$$\frac{\text{True Airspeed} \times \text{Minutes Flown}}{\text{Degree Change}}$$

(8) Substituting the data from figure 13–8, assume the true airspeed is 120 knots.

Distance to Station =

$$\frac{120 \times 2 \text{ Min } 5 \text{ Sec}}{10} = 25 \text{ Nautical Miles}$$

NOTE: Seconds must be changed to fractional or decimal parts of a minute.

d. The following limiting factors should be kept in mind when applying the above time-and-distance formulas:

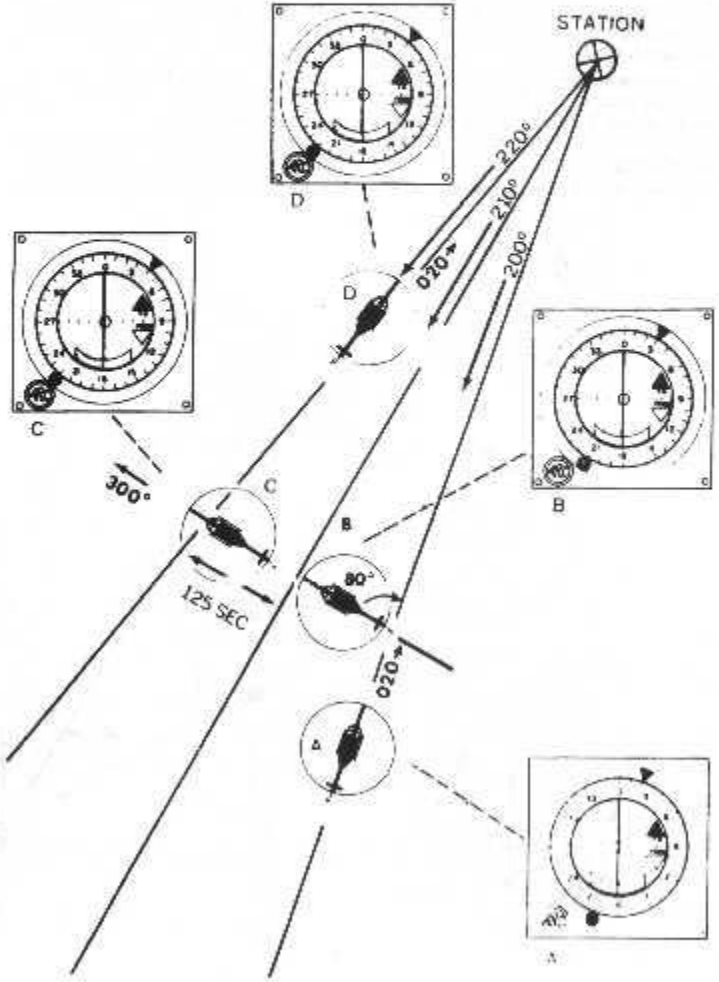


Figure 13–18. Estimating time and distance (VOR)

(1) They are based on the assumption that a 1-degree angle is 1-mile wide 60 miles away from the station. This is an approximation.

(2) They do not take into account wind conditions that may cause ground speeds to vary considerably on headings which differ by 90 degrees.

(3) To determine time-distance required, the aircraft must turn so that it will fly abeam the station during the time required for the aircraft to fly through a 10-degree change in the course selector reading.

(4) The bearing change selected (change in the course selector setting) may vary from 5 degrees to 15 degrees. Ten degrees is used as a mathematical convenience in the above problems.

Section III
Receiver Checks

13–15. Accuracy

VOR receivers and their associated indicators must be checked periodically for accuracy. There are several types of checks which can be performed to ensure equipment accuracy. In performing these checks, current data for designated station frequencies, specific VOR radials, and station identifications are contained in current navigational publications.

13–16. Radiated test signal

Equipment installed at many airports transmits a continuous test signal receivable at any point on the airport. Although designed primarily as a ground test system, this equipment is also usable at relatively low altitudes in flight over the airport. The procedure for using the radiated test signal VOR receiver testing facility (VOT) to check receivers is as follows:

a. Tune the frequency of the VOT.

b. Listen for the proper identification, either a continuous series of dots or a continuous 1,020-cycle tone.

c. Check for the disappearance of the warning flag.

d. Set the course to either 180 degrees or 360 degrees.

e. Check the reaction of the TO-FROM indicator. If the course is set on 180 degrees, the indicator should read TO. If the course arrow is set on 360 degrees, the indicator should read FROM.

f. Check the course deviation indicator. It should be centered. If the needle is not centered, rotate the course selector until the indicator centers. If the course selector does not have to be rotated more than 4 degrees in order to center the needle, the equipment is within tolerance for flight under IFR. If the needle will not center within a 4-degree tolerance, the equipment is unreliable for flight under IFR. Should the VOR receiver be coupled to a radio magnetic indicator, the bearing pointer will indicate 180 degrees regardless of the course selector setting.

13–17. Other ground checks

Not all airports have equipment for radiated test signals. However, many airports have VOR stations situated nearby from which selected radials can be used for checkpoints. In the illustration (fig 13–19), the 120-degree radial from a station passes directly over the end of runway 27. An exact spot is marked on this runway. The aircraft is taxied to this spot and the receiver check is performed in the following manner:

a. Tune to the frequency of the station.

b. Listen for the correct station identification.

c. Check for the disappearance of the warning flag.

d. Set the course selector to the specific radial for the check.

e. Check the reaction of the TO-FROM indicator. It should indicate FROM.

f. Check the course deviation indicator for a centered position. Plus or minus 4 degrees tolerance is allowed on the course selector setting for centering the needle. If movement of the course selector within 4 degrees of the published radial will cause the deviation needle to center, the equipment is usable. Equipment that does not meet these tolerance limits is unreliable for flight under IFR.

13–18. Airborne check

a. At airports where radiated test signals or other ground check radials have not been established, an airborne check radial may exist. Airborne checks are performed like ground checks except that an airborne checkpoint is specified instead of a designated spot at the airport. For example, if a prominent water tower exists within a few miles of the VOR station, a certain radial can be selected that passes over this tower. As the aircraft flies over the tower, the accuracy of the equipment can be checked. A published airborne check over the tower may appear in navigational publications as "KIRKSVILLE, MO—138°, 8.2 NM; over water tower at La Plata; 2500'."

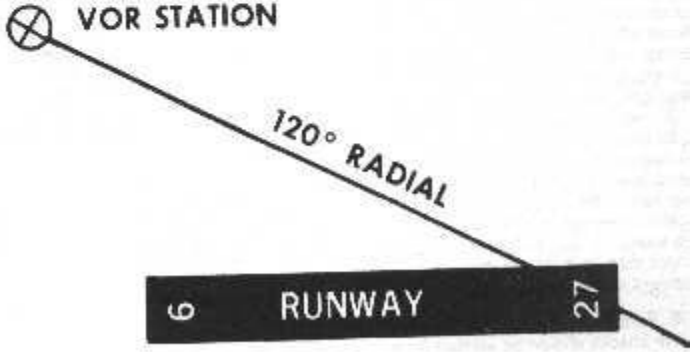


Figure 13–19. Ground receiver check (VOR)

b. To perform the airborne check—

(1) Tune and identify the Kirksville, MO, VOR.

(2) Set the course on 138 degrees and check for a "FROM" reading.

(3) Fly over the water tower described at an altitude of 2500 feet.

(4) When over the water tower, check the deviation indicator for a centered position with a FROM indication. If the needle is within 6 degrees of center, or if a course selector movement of 6 degrees or less from the published radial will cause the needle to center, the equipment is within tolerance. Equipment that does not meet these tolerance limits should not be used for flight under IFR.

c. The list of VOR airborne check points is published in the area planning documents (AP1, AP2, and AP3) under country listing (DOD FLIP).

13–19. Dual VOR receivers

If an aircraft is equipped with dual receivers, one receiver may be checked against the other. If receivers are within 4 degrees of each other, both may be considered reliable. To perform this check, do the following:

a. Tune and identify the same VOR station with both VOR receivers.