Department of Transportation
FEDERAL AVIATION ADMINISTRATION

IFR PILOT EXAM-O-GRAM* NO. 23

Fundamental ADF Procedures

A review of errors being made on Instrument Pilot Written Tests reveals that many applicants are hazy about basic ADF procedures. Proficiency in Automatic Direction Finder (ADF) procedures is essential to the instrument pilot. A poor understanding of this important navigational tool can lead to critical errors under instrument conditions. An instrument pilot should be able to establish a track to a Radio Beacon (RBn) or to a Locator Outer Marker (LOM) by the use of ADF. During off-airways flying, beyond the range of VORs, the only electronic navigational aids available may be low or medium frequency homers. In an emergency the pilot may even have to use a commercial broadcast station. On flights beyond the borders of the United States, he frequently finds that ADF is still the primary radio aid to navigation. This Exam-O-Gram will cover fundamental ADF definitions and procedures. Refer to VFR Exam-O-Gram No. 39 for the use of ADF for VFR navigation.

ADF and VOR -- Before starting a discussion of ADF, a distinction should be made between the indications of the ADF and the VOR receivers. The ADF needle points to the station regardless of aircraft heading and position (Fig. 1). The VOR receiver, with the CDI centered, indicates the magnetic bearing from the aircraft to the station (Fig. 2 "315 TO"), or from the station to the aircraft (Fig. 2 "270 FROM"), regardless of aircraft heading. This Exam-O-Gram will cover ADF only.

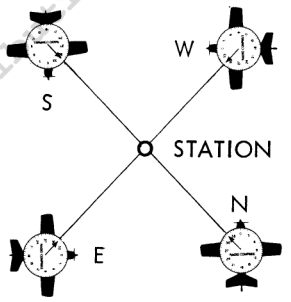

Fig. 1

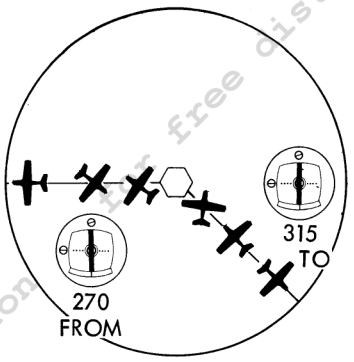

Fig. 2

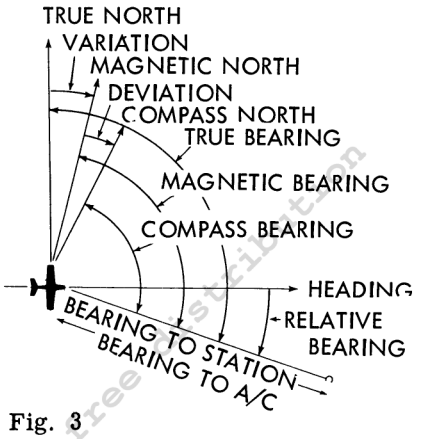

Fig. 3

WHAT IS A BEARING? -- This is the relation (direction) of one object or point to another object or point. As applied to ADF, it is simply the direction of a line from the aircraft to the station or from the station to the aircraft (Fig. 3).

HOW DO YOU FIND AN ADF RELATIVE BEARING? -- The relative bearing of the aircraft to the station is the angular relationship between the aircraft heading and the station, measured clockwise from the nose of the aircraft (Fig. 3). This bearing is read directly on the ADF dial, measured clockwise from zero.

Note: We shall consider only the fixed azimuth dial which is typical of most light plane installations.

HOW DO YOU FIND A MAGNETIC BEARING? -- A magnetic bearing is the direction of an imaginary line from the aircraft to the station or from the station to the aircraft, referenced to magnetic north. To determine the magnetic bearing to the station, add the magnetic heading of the aircraft to the relative bearing shown on the ADF dial (Fig. 3). If the sum is more than 360°, subtract 360. The reciprocal of this bearing is the magnetic bearing from the station to the aircraft. Any time the magnetic heading is "North," the ADF needle indicates the magnetic bearing to the station (Fig. 1 "N"). Any time the magnetic heading is "South," the ADF needle indicates the magnetic bearing from the station (Fig. 1 "S").

HOW DO YOU FIND TRUE OR COMPASS BEARINGS? -- Use the same procedure that has been described for finding magnetic bearings, substituting true heading or compass heading for magnetic heading. A compass bearing may be changed to a magnetic bearing by applying deviation. A

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magnetic bearing may be changed to a true bearing by applying variation (Fig. 3).

WHAT IS ADF HOMING? -- ADF homing is flying the aircraft on any heading required to keep the ADF needle on zero until the station is reached. Refer to VFR Exam-O-Gram No. 39.

WHAT IS ADF TRACKING? -- This is the ADF procedure of flying a straight geographical flight path inbound to or outbound from a low or medium frequency facility. A heading is established that will maintain the desired track regardless of wind drift.

HOW DO YOU TRACK INBOUND? -- (Fig. 4) Turn the aircraft until it is pointed directly toward the station with an ADF relative bearing of zero. While holding a constant heading, any deflection of the ADF needle indicates a crosswind. If the needle deflects right, the crosswind is from the right and vice versa. The needle indicates the direction of the turn required to intercept the track. The turn should be made when there is a definite needle deflection of 2 to 5 degrees. The angle of interception will depend on the rate at which the aircraft drifted from the track, the distance from the station and how quickly you wish to return to track. In the illustration a 20° correction is applied when a 5° drift is noted.

Position #1 -- Turn the aircraft until the ADF needle indicates zero.

Position #2 -- Maintain a constant heading until an off-course drift is indicated by a 5° needle deflection.

Position #3 -- Turn 20° in the direction of the needle deflection. Now the needle indicates a relative bearing on the opposite side of zero. As you approach track, the needle continues to move further away from zero.

Position #4 -- When the needle deflection equals the angle of interception, the aircraft is back on the desired track. In actual practice you should lead the turn to the inbound heading before the track is intercepted. The amount of lead will depend on distance from the station, rate at which track is approached, and rate of turn.

Position #5 -- The aircraft is turned to a heading which you estimate will compensate for wind drift. In the illustration, a 10° left correction for right drift has been applied. The ADF needle indicates a relative bearing of 10°. As long as the relative bearing remains constant, the aircraft is on track. If the wind is under-estimated and an off-course drift is indicated by a decrease in the relative bearing, turn to the original interception heading. When the track has been re-intercepted, turn to a heading which will include a larger drift correction, for example, 15°. If the original drift correction of 10° is an over-estimate, the ADF needle will show a gradual increase in relative bearing. To return to track, parallel it and let the wind drift you back. When the ADF needle is on zero, turn into the wind with a reduced drift correction angle, for example, 5°.

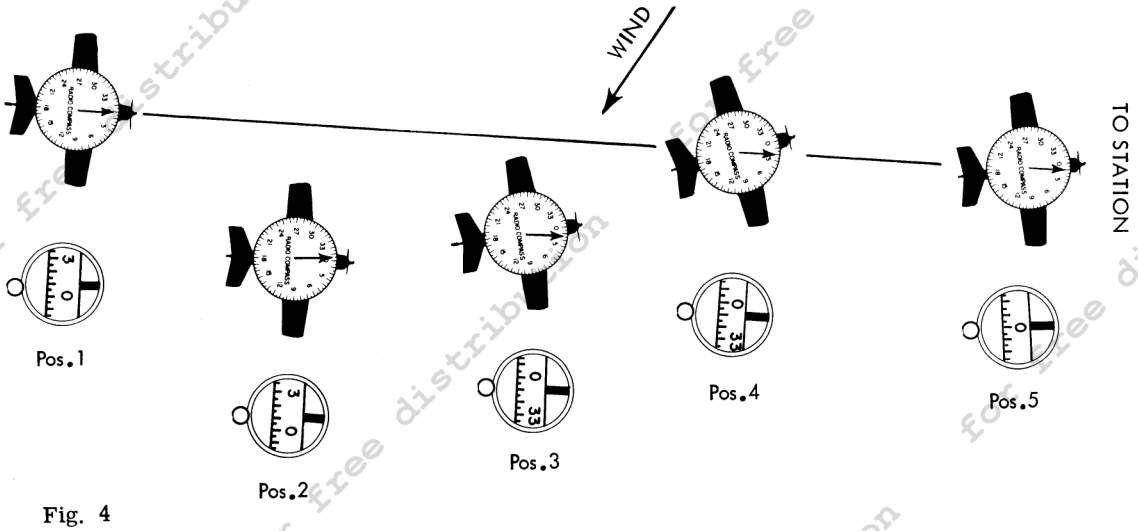

Fig. 4

HOW DO YOU TRACK OUTBOUND? -- (Fig. 5) The procedures are basically the same as for inbound tracking. The main difference is that the ADF needle moves further away from the 180° position as the change of heading is made toward the desired track.

Position #1 -- Turn the aircraft until the ADF needle is on the 180° position. The station is now directly behind.

Position #2 -- Maintain this heading until the needle deflects away from the 180° position. If the needle (pointer end) is deflected to the right of 180 (counter-clockwise), the crosswind is from the right and if the needle is deflected to the left of 180 (clockwise), the crosswind is from the left. In the illustration, a 5° left deflection is shown, indicating a left crosswind.

Position #3 -- Turn 20° in the direction of the needle deflection. After this turn has been made, notice the needle has moved further away from the 180° position in the same direction as the original deflection. As you approach the desired track, the needle moves back toward the 180° position.

Position #4 -- When the needle deflection equals the angle of interception, the aircraft is back on track. Lead the turn to the outbound heading using the same technique that was described earlier.

Position #5 -- The aircraft is turned to a heading which you estimate will compensate for wind drift. Minor corrections are made following the same technique that was described under inbound tracking.

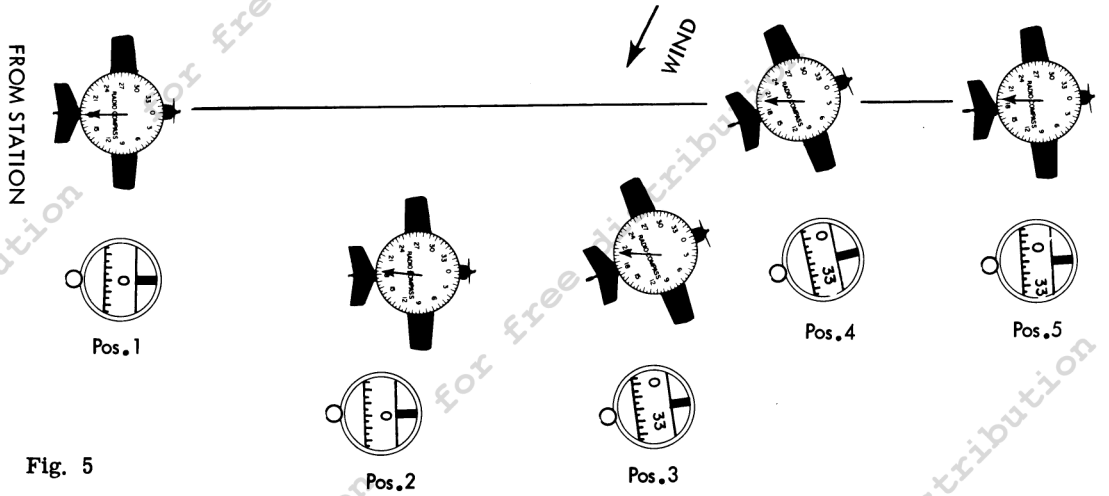

Fig. 5

HOW DO YOU INTERCEPT PRE-DETERMINED BEARINGS? -- You may be cleared to track inbound to or outbound from a radio fix on a definite magnetic bearing. The procedure for intercepting a desired bearing is the same as for simple tracking except the angle of interception is usually greater.

INTERCEPTION OF AN INBOUND BEARING -- (Fig. 6)

Position #1 -- Determine your position in relation to the station by turning the aircraft to the heading of the bearing to be intercepted. If the ADF needle is to the right of zero, the station is to your right and vice versa. Note the number of degrees the needle is deflected right or left from zero, then double this needle deflection. This is the interception angle. Since it is not feasible to intercept a bearing at more than a 90° angle, limit the angle of interception to 90°. An interception can be made at angles less than those calculated by this method, however, doubling the angle of needle deflection will normally result in an interception of a desired bearing at a comfortable distance from the station.

Position #2 -- Turn the aircraft toward the desired bearing the number of degrees determined for the interception angle.

Position #3 -- Maintain the interception heading until the ADF needle is deflected the same number of degrees from zero as the interception angle.

Position #4 -- Turn inbound and continue normal tracking procedures. Lead the turn using the same technique that was described earlier.

* Exam-O-Grams are non-directive in nature and are issued solely as an information service to individuals interested in Airman Written Examinations.

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INTERCEPTION OF AN OUTBOUND BEARING -- (Fig. 7)

Use the same procedures as for the inbound interception, substituting the 180° position for the zero position of the ADF needle. After you complete the intercepting turn, the ADF needle will move further away from the 180° position as was the case in intercepting an outbound track. Hold the heading until the angular deflection of the ADF needle from the 180° position is equal to the angle of interception. Now turn outbound and continue tracking procedures.

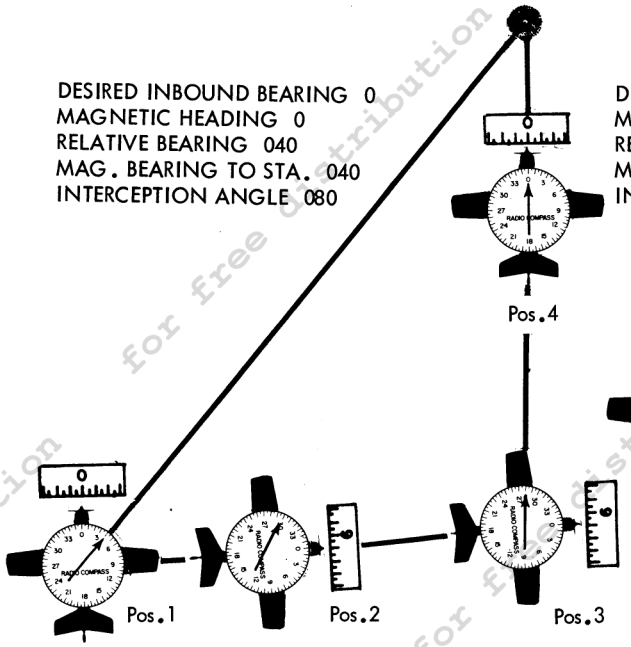

Fig. 6

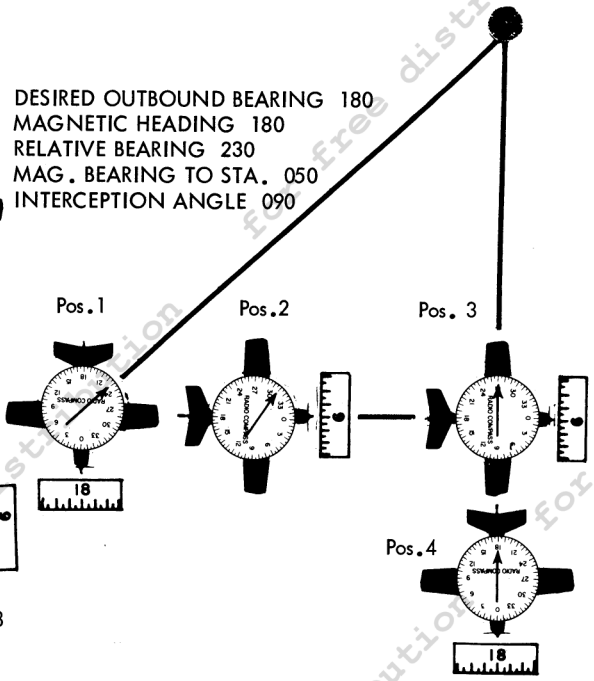

Fig. 7