



HAROLD
HOLMES'

COCKPIT CLASSROOM

ADF NAVIGATION

THE ADF SYSTEM of navigation has been with us for a long time. As a flight instructor and pilot examiner, I have found the ADF is more difficult to learn than VOR. It should be pointed out that knowledge of ADF is important on any FAA flight test or written exam. Recently, Ken Stremming and I have developed a new system which simplifies the learning of ADF navigation. The newly created program consists of video tapes on ADF and an instruction manual on both ADF and VOR navigation. The purpose of this article is to present some of the basic principles of ADF as they are presented in the instruction manual and tapes.

The manual refers to the ADF transmitter as being non-directional in nature. This is especially true when comparing ADF bearings with VOR radials. The fact re-

mains that the ADF transmitter does have radials just like VOR even though they are called bearings. They still play the same role as VOR radials emitted from a VOR transmitter. Knowledge of the fact that the ADF transmitter has radials indexed to magnetic north (just like the VOR transmitter), it will greatly facilitate your orientation as to the ADF transmitter to which you are tuned.

Diagram A depicts the more modern NDB receiver in that it has an LED (Light Emitting Diode) face rather than a printed one. The operation is the same, however, so the first thing you do is to turn the function switch to REC. Then turn the band selector switch to the frequency range of the NDB transmitter to which you want to tune. Next turn the volume (VOL) control knob well up so you can hear the aural sound that will be coming from the station after you turn the selector (SEL) knob to the identifying numbers that will appear in the rectangular face. And as with the Omni make sure you have the correct station by listening for the appropriate Morse Code signal from that particular NDB to which you are tuned. Once you are sure you have correctly identified the station, turn the function switch to ADF. It is at this time that you will see the ADF Direction Indicator needle move and point to the NDB transmitter to which you are tuned.

ADF Direction Indicator Bearings

Of all the things concerning the ADF Direction Indicator system of navigation it is the "bearings" that will confuse you the most. The word "bearing", as you may already know, is the terminology used by the men who sail the oceans and inland waterways. It is used to determine a position TO or FROM a navigation point on land or from ship to ship, aircraft to aircraft or aircraft to ship.

There is the 'true bearing' (measured clockwise from true north), 'magnetic bearing' (measured clockwise from the nose of your aircraft). ALL BEARINGS ARE ALWAYS MEASURED CLOCKWISE, either from true north, magnetic north or from the nose of your aircraft to the NDB to which you are tuned.

DIAGRAM A.

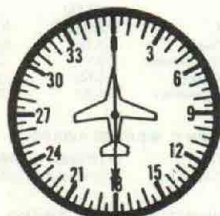
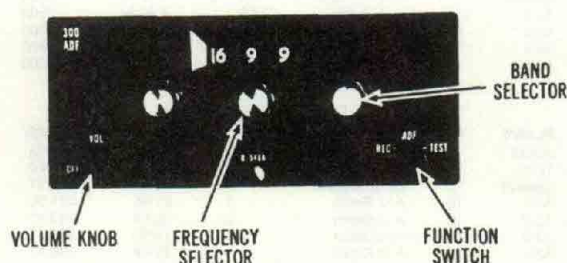


DIAGRAM B.

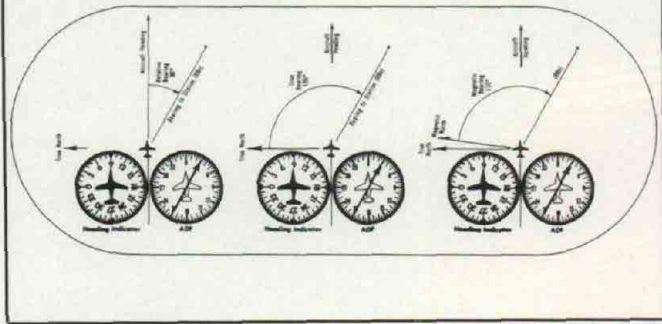


Diagram B shows how each bearing is arrived at using the formulas in the above paragraph. Study all three so you'll know when you're asked on the FAA exam. For study and illustration purposes in this manual we will concern ourselves with only the 'relative bearing', i.e., the bearing/radial TO or FROM the NDB relative to the flight path of your aircraft. **AGAIN, THIS IS ALWAYS MEASURED CLOCKWISE — ALWAYS CLOCKWISE — FROM THE NOSE OF YOUR AIRCRAFT.**

The ADF Direction Indicator is 'tied in' to the NDB on the ground just as the Course Deviation Indicator in the Course Deviation Indicator system of navigation is 'tied in' to the Omni station on the ground. The Omni station on the ground emanates electronic signals to all points of the compass which are picked up by the Course Deviation Indicator in your aircraft telling you 'where you are' in relation to the station, i.e., what radial you are on. The NDB of the ADF Direction Indicator system of navigation also emanates electronic signals to all points of the compass. **BUT** we're not supposed to say that because technically it doesn't work that way, but it does emanate or radiate something because when you tune your ADF receiver to it the needle of your ADF Direction Indicator will point right to the NDB no matter where you are in relation to the NDB. So to make it less confusing, think of the NDB as having radials just like the Omni and when you're going TO or FROM the NDB on a certain bearing think of it as a radial too!

To understand what bearing/radial you're on while using the ADG Direction Indicator system of navigation requires you to do mathematical calculations in your head in order to know what magnetic heading you should use to take you TO or FROM the NDB. You can do it by superimposing the ADF Direction Indicator needle onto the face of the Heading Indicator, but most all instructors and the FAA want you to be able to tell them how you arrive at the correct magnetic heading mathematically. The VOR/ADF manual, which is visualized, includes numerous illustrations to enhance learning of ADF navigation.

Things To Remember When Flying ADF

When flying INBOUND or TO an NDB know that a LEFT turn will always cause the ADF needle to move RIGHT and a turn to the RIGHT will always cause the ADF needle to move LEFT. **THAT'S VERY BASIC, BUT VERY IMPORTANT.**

When flying OUTBOUND or FROM an NDB, a LEFT turn will always cause the ADF needle to move LEFT and a turn to the RIGHT will always cause the ADF needle to move RIGHT. **AGAIN — VERY BASIC, BUT VERY IMPORTANT.**

After correcting for wind:

If the ADF needle moves toward the nose of your aircraft (0) while tracking 'inbound', this indicates that your

wind correction angle is **NOT ENOUGH** — take a greater wind correction angle and check the ADF needle after you are in wings-level flight to see if it was enough.

If the ADF needle moves towards the tail of your aircraft (180°), this indicates that your wind correction angle is **TOO MUCH** — in this case you can either reduce the wind correction angle or allow the wind to move you back on course. An alliteration which will help here is if the ADF needle moves **Towards the Tail means Too much correction** for wind drift — the **3 T's**.

When making ADF approaches — after crossing the NDB, fly outbound for approximately two (2) minutes. Then start a left or right procedure turn at a 45° angle to the outbound course. (Note — when performing a **LEFT PROCEDURE TURN**, 225° and 45° are the 'magic' numbers and when performing a **RIGHT PROCEDURE TURN**, 135° and 315° are 'magic' numbers.)

Important

When using the ADF you must constantly 'cross-check' the Heading Indicator with the Magnetic Compass. Heading Indicators have inherent precession error of one degree (1°) for every five minutes of flight and three degrees (3°) for every fifteen minutes of flight. That means that for every fifteen minutes of flight you can be three degrees (3°) off course. And after one hour of flight, if you haven't corrected your Heading Indicator, you will be 15° off course. Too much for precision flying.

Some of the most common errors in using ADF equipment on flight tests include the following:

- Improper tuning and station identification of station.
- Dependence on homing rather than proper tracking, commonly results from reliance on the ADF indications instead of correlating them with heading indications.
- Poor orientation, due to failure to follow proper steps in orientation and tracking.
- Careless interception angles, very likely if you rush the initial orientation procedure.
- Overshooting and undershooting predetermined magnetic bearings often due to forgetting the course interception angles used.
- Failure to maintain selected headings. Any heading change is accompanied by an ADF needle change. **The instruments must be read in combination before any interception is made.**
- Failure to understand the limitations of the radio compass and the factors that affect its use.
- Overcontrolling track corrections close to the station (chasing the ADF needle) due to failure to understand or recognize station passage.

One of the most serious errors is the failure to re-set the heading indicator with the magnetic compass prior to executing an ADF approach.

When Ken Shemming and I prepared the manual, it was decided to use a number of illustrations. Ken, an avid EAA member, is also a superb artist and has put both his writing and artistic ability to work in developing a very unique manual.

The Omni (VOR) and ADF video tape accompanies the ADF/VOR Instruction Manual. Both the tape and manual depict relationships between the Course Deviation Indicator (CDI), Heading Indicator (H.I.) and the ADF direction indicator used for navigation, flying a VOR or ADF approach and entering holding patterns. An informal survey of radio equipment used in sport airplanes, indicates that most sport pilots use at least one VOR and/or ADF for navigation. We hope that this manual will help all pilots develop a better understanding of ADF equipment and its use in navigation.