

An Introductory Lesson On The ADF

Automatic Direction Finder

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Skill Level: Basic



The ADF or Automatic Direction Finder is a navigation instrument that is widely used by pilots in typical light aircraft. In general, pilots are introduced to the ADF, its function and its use when they begin their cross country navigation training. As the pilot progresses in his flying ratings, he becomes more familiar with the valuable functionality this instrument provides in both VFR and Instrument Flight Rules flying.

When I was new to flight simulation some years ago, each new instrument I discovered and learned to use made my time spent in front of the simulator more and more enjoyable. Part of the fun of flight simulation is discovering and learning how to use those instruments on the flight simulator cockpit panel.

In this particular article, you're going to find out about the basic functions of the ADF and I'll be presenting some simple exercises for you to do using Microsoft Flight Simulator 95 or V5.1 as a way of introducing you to how the ADF functions. These will be simple lessons but will provide you with a good grounding for subsequent more advanced lessons on the ADF.

ADF Basics

The ADF is a very basic instrument. In its simplest form it is a needle on a stationary compass card that points to an NDB station (Non Directional Beacon).

As simple as the ADF may be in its design and function it is used by the pilot in flight for at least five different purposes:

1. Position Fixing i.e. determining the aircraft's position
2. Enroute navigation
3. Instrument approaches
4. Holding
5. Indication on the commencement point of a more sophisticated instrument approach

The first two items are used by a pilot in both VFR and IFR conditions and the latter three items are exclusively used in IFR flight.

The important point to remember here is that the ADF is the instrument in the aircraft and the NDB is the beacon on the ground that it points to.

The Non Directional Beacon

The NDB is the station on the ground that emits the signal that the ADF tunes to. Its signal is emitted in all directions so it doesn't matter where the aircraft's position is relative to the station, the ADF will still pick up its signal.

The Anatomy Of The ADF

The diagram shown illustrates the anatomy of the ADF. As you can see the ADF consists of a needle that has a head and a tail and it is laid over and rotates around a fixed (non-rotatable) compass rose. This particular type is called a fixed card ADF.

The purpose of the discussion we are about to go into is to teach you ADF basics as a grounding for a future lesson which will be an introduction to using the ADF for enroute navigation.

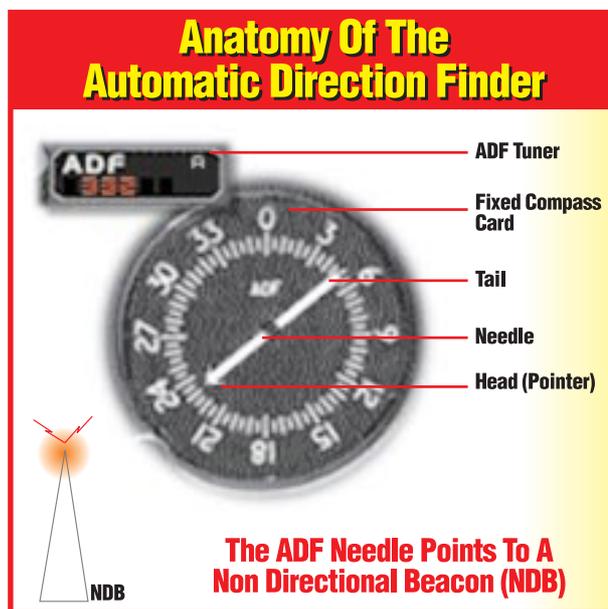
Before you can even begin lessons on using the ADF to navigate cross country, you must be shown and understand the basics of how the instrument works.

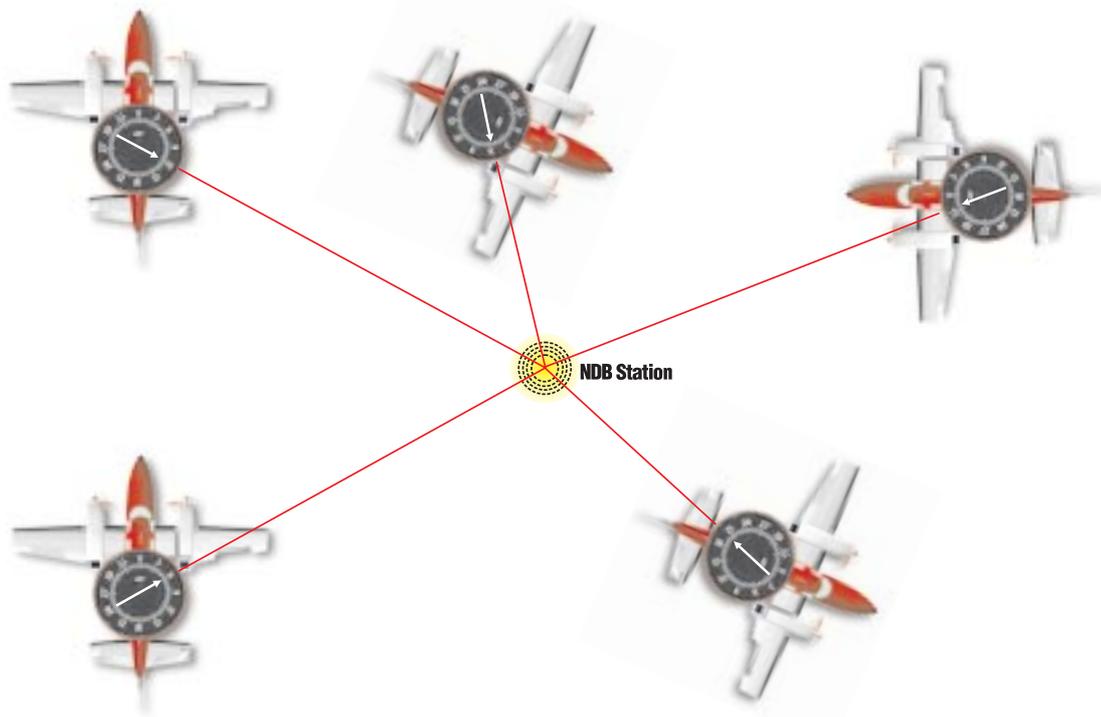
Basic Function

The ADF, when tuned to the NDB, will point to the NDB station. The direction it is pointing is relative to the heading (nose) of the aircraft. So in interpreting the ADF the nose of the aircraft is 0° and the direction of the arrow pointing to the NDB is relative to this 0° (nose) heading.

The NDB is tuned using the ADF nav radio which is the radio on your stack with the three digits. To tune an NDB simply dial up its frequency and the ADF needle will, if in radio range, point towards it. NDB signals can normally be received for around 50 nautical miles but it is dependent upon your altitude and the power the NDB station is generating. A particular NDB known as a locator and is used to help a pilot on a precision ILS approach usually only has a range of around 20-30 miles simply because that is all that is required for the locator to serve its function.

Refer to the diagram on the next page. It shows several examples of the ADF indication in several different aircraft positions relative to an NDB. As you can see from the diagram, if you want to head directly towards an NDB just put the arrow on the nose i.e. change the aircraft's heading so that the ADF is pointing straight ahead. If you fly for long enough you will fly directly towards and over the NDB.





Note that the ADF always points to the NDB station. The heading to the station is relative to the position of the heading of the aircraft.



The ADF on the Flight Simulator instrument panel

Station Passage

Flying over the top of any navigation aid is known as station passage. You know when you've reached station passage when the ADF needle flips. Remember the ADF's needle is always pointing towards the NDB station. When you're approaching the station it is in front of you and after you pass over it the NDB station is now behind you. The ADF still always points to it.

An Exercise Using Microsoft Flight Simulator

In this exercise, we're going to do a bit of flying around and over an NDB in Chicago known as ERMIN. ERMIN is about 15 nm from Meigs field which is where you are going to be departing from.

Load your Flight Simulator now and if Meigs is not your default start location, place yourself at Runway 36 at Meigs. Today we're going to be flying in VFR conditions with zero wind. Wind takes ADF theory to a whole new level and for now we just want to learn the basics of operation and see how the ADF behaves.

Before we continue it is important to note that Microsoft Flight Simulator doesn't have the ADF gauge visible on the main instrument panel. To activate it you need to press the Shift-Tab combination. Press Shift-Tab now. You'll see that VOR 2 has now been replaced with the ADF.

Take note of the direction of the ADF. It is pointing straight

up because it is not tuned to a NDB.

Now use your mouse to tune the ADF radio. You want to select 332 as the frequency. As soon as you've selected 332 look at your ADF. Note that the needle is now pointing at around 230. It is tuned to ERMIN and is now pointing to the ERMIN NDB. To get to ERMIN, all you really need to do is take off and follow the needle.

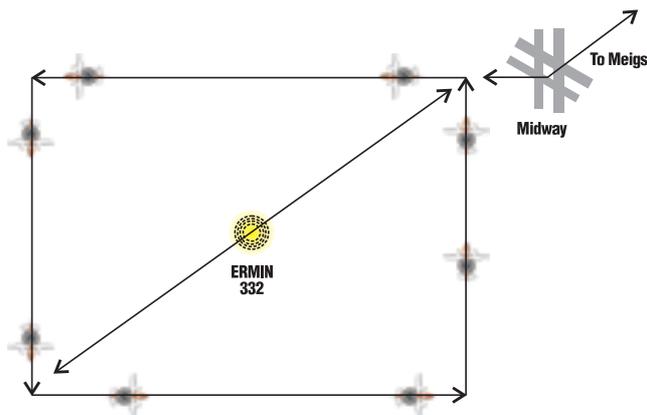
We're not going to fly directly to ERMIN though. We're initially going to do our exercises around the station to study the behaviour of the NDB.

What we are going to do today is depart Meigs to the west on the crosswind leg and fly towards ERMIN as we climb to 4,000 ft. On our way, we'll overfly Chicago Midway which will be the starting point of our exercise. *Study the diagram on the next page.* For our exercise we're going to fly a square pattern around ERMIN and watch the ADF needle behave as we turn onto each leg. After that you're going to learn to recognise station passage and fly directly towards and over the top of ERMIN and watch the needle flip as we get station passage. After that you'll be free to fly on your own over and around the nav-aid and experiment as you please in order to understand the instrument more. The only real way to learn anything is to practice it yourself.

When you're ready let's start our take off roll. Remember we're departing on a left crosswind i.e. we're going to make a left turn after departure. So gently apply full power and get this bird off the ground. When you're at 500 feet turn left heading 270 and continue the climb. Keep your eye on the ADF and note that you turn left the ADF needle turns too. You'll be heading just to the left of Sear's tower. Continue the climb to 2000 feet and maintain a heading of 270 degrees. When you reach 2,000, you're going to head directly towards ERMIN. You'll note that before you do that the ADF needle is pointing to the left of centre. Now, while maintaining 2000 feet turn left until the ADF needle is on the nose i.e. pointing to 0° on the card. You are now heading direct to ERMIN. Midway will be on

Our Exercise

Takes us out from Meigs Field to Ermin overflying Midway on the way. We are flying a square pattern around the NDB and watching the ADF behave. Note that the needle always points to the NDB. As we turn at each leg also note the the ADF needle turns faster as it is always giving information relative to the heading of the aircraft. When you complete these legs then track towards the aid and over the top of it to study the ADF's behaviour during station passage.



Station Passage



your nose so it means we are going to be overflying it. Your heading at about this time should be 220° and the needle should be on the nose. *Make small adjustments to your heading to get it on the nose and then maintain the heading that keeps it there.* When you've established a heading now continue your climb to 4000 feet. When you get to 4,000 set your autopilot to altitude hold. We want to concentrate on the ADF today.

When you're over the top of Midway, ERMIN should still be on the nose. Turn right heading 270°. You'll note that the ADF needle is now to the left reading about 305°. Continue on this heading for about 3 minutes. As you continue flying note that the needle is slowly turning anticlockwise. That is because your aircraft's position is changing and therefore the heading to the station is changing. When the ADF needle gets to about 240 then turn left again onto a heading of 180 degrees. Take note as you take up each new heading that the ADF needle swings swiftly as our heading relative to the station is also changing swiftly. When you roll out the ADF needle will indicate around 320. Continue heading 180 and again note that the ADF needle slowly rotating anticlockwise. Again our position relative to the NDB is changing and so is the angle to the NDB relative to our nose. When the ADF is 240, turn left heading 90 degrees and continue

again for about 3 minutes until the ADF reaches 240 and finally turn onto a northerly heading. Our square pattern will be complete when the ADF needle points to 240. As you turn onto north you'll note that Midway is just to the right.

Station Passage

You're now going to head directly towards the NDB station and fly over the top. Your heading will be approximately 230°. Make whatever correction you need to keep the needle indicating zero. As you approach the NDB station notice that the needle is more sensitive. When this happens you're very close to station passage so be ready to see the needle flip. As you pass over the needle will flip and now point to 180 because the station is now behind you. Continue out for a few minutes and turn back in towards the station to see it again.

While we're up here spend about 20 minutes flying around the NDB station. You know where the station is so keep this in your mental picture as you experiment for yourself as much as you need to until you feel you understand the basics.

Let's finish off with an idea of what's to come in future lessons. When you've finished your practice, perform one more leg over the aid and

when you get station passage turn on to a heading of 040°. Midway should be on your nose. Maintain a heading of 040°. What you have just done is departed the NDB on the 040 track and this is something we'll be covering in in a future article i.e. tracks to and from an NDB station, a major aspect of the ADF you'll need to understand for enroute navigation.

After you pass Midway, continue on a heading of 040° until you have Meigs visual. ATC clears you to enter a long base for Runway 36 when visual. Begin your descent to pattern altitude (1600 ft) and when in a good position for base turn right heading 090° "You're number one and clear to land."

So there you have it. The basics of the Automatic Direction Finder.

Points To Remember

All you need to remember is that the ADF always points to the NDB station and it's always relative to the position of the heading of your aircraft. To fly directly to the NDB just put the needle on the nose.

When you have some spare time, do some more of what you've learned today. The more you do it the more familiar you will become and the more ready you'll be to advance to the next level in our lessons on the ADF coming up in a future issue of Computer Pilot. ➔