familiar with the equipment installed. It is not unknown for pilots to operate inadvertently in one of the RNAV modes when the operation was not intended by overlooking switch positions or annunciators. The reverse has also occurred with a pilot neglecting to place the unit into one of the RNAV modes by overlooking switch positions or annunciators. As always, the prudent pilot is not only familiar with the equipment used, but never places complete reliance in just one method of navigation when others are available for cross-check.

Automatic Direction Finder (ADF)

Many general aviation-type aircraft are equipped with ADF radio receiving equipment. To navigate using the ADF, the pilot tunes the receiving equipment to a ground station known as a nondirectional radio beacon (NDB). The NDB stations normally operate in a low or medium frequency band of 200 to 415 kHz. The frequencies are readily available on aeronautical charts or in the A/FD.

All radio beacons except compass locators transmit a continuous three-letter identification in code except during voice transmissions. A compass locator, which is associated with an instrument landing system, transmits a two-letter identification.

Standard broadcast stations can also be used in conjunction with ADF. Positive identification of all radio stations is extremely important and this is particularly true when using standard broadcast stations for navigation.

NDBs have one advantage over the VOR. This advantage is that low or medium frequencies are not affected by line-of-sight. The signals follow the curvature of the Earth; therefore, if the aircraft is within the range of the station, the signals can be received regardless of altitude.

The following table gives the class of NDB stations, their power, and usable range:

NONDIRECTIONAL RADIOBEACON (NDB)
(Usable Radius Distances for All Altitudes)

Class	Power (Watts)	Distance (Miles)
Compass Locator	Under 25	15
MH	Under 50	25
H	50–1999	*50
HH	2000 or more	75

*Service range of individual facilities may be less than 50 miles.

One of the disadvantages that should be considered when using low frequency (LF) for navigation is that low frequency signals are very susceptible to electrical disturbances, such as lightning. These disturbances create excessive static, needle deviations, and signal fades. There may be interference from distant stations. Pilots should know the conditions under which these disturbances can occur so they can be more alert to possible interference when using the ADF.

Basically, the ADF aircraft equipment consists of a tuner, which is used to set the desired station frequency, and the navigational display.

The navigational display consists of a dial upon which the azimuth is printed, and a needle which rotates around the dial and points to the station to which the receiver is tuned.

Some of the ADF dials can be rotated to align the azimuth with the aircraft heading; others are fixed with 0° representing the nose of the aircraft, and 180° representing the tail. Only the fixed azimuth dial is discussed in this handbook. *[Figure 15-36]*

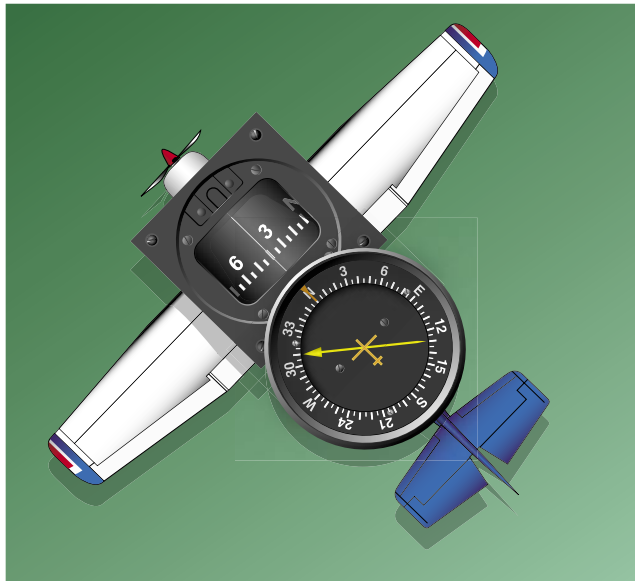

Figure 15-36. *ADF with fixed azimuth and magnetic compass.*

Figure 15-37 illustrates terms that are used with the ADF and should be understood by the pilot.

To determine the magnetic bearing "FROM" the station, 180° is added to or subtracted from the magnetic bearing to the station. This is the reciprocal bearing and is used when plotting position fixes.

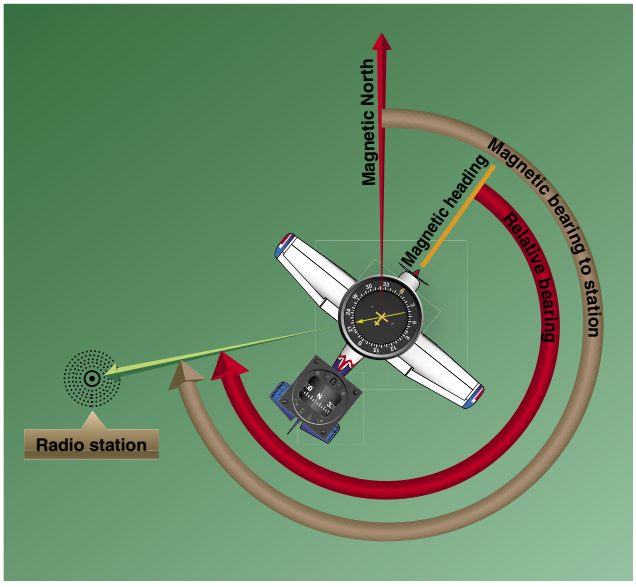

Figure 15-37. *ADF terms.*

Keep in mind that the needle of fixed azimuth points to the station in relation to the nose of the aircraft. If the needle is deflected 30° to the left for a relative bearing of 330°, this means that the station is located 30° left. If the aircraft is turned left 30°, the needle moves to the right 30° and indicates a relative bearing of 0°, or the aircraft is pointing toward the station. If the pilot continues flight toward the station keeping the needle on 0°, the procedure is called homing to the station. If a crosswind exists, the ADF needle continues to drift away from zero. To keep the needle on zero, the aircraft must be turned slightly resulting in a curved flightpath to the station. Homing to the station is a common procedure, but results in drifting downwind, thus lengthening the distance to the station.

Tracking to the station requires correcting for wind drift and results in maintaining flight along a straight track or bearing to the station. When the wind drift correction is established, the ADF needle indicates the amount of correction to the right or left. For instance, if the magnetic bearing to the station is 340°, a correction for a left crosswind would result in a magnetic heading of 330°, and the ADF needle would indicate 10° to the right or a relative bearing of 010°. *[Figure 15-38]*

When tracking away from the station, wind corrections are made similar to tracking to the station, but the ADF needle points toward the tail of the aircraft or the 180° position on the azimuth dial. Attempting to keep the ADF needle on the 180° position during winds results in the aircraft flying a curved flight leading further and further from the desired track. To correct for wind when tracking outbound, correction should be made in the direction opposite of that in which the needle is pointing.

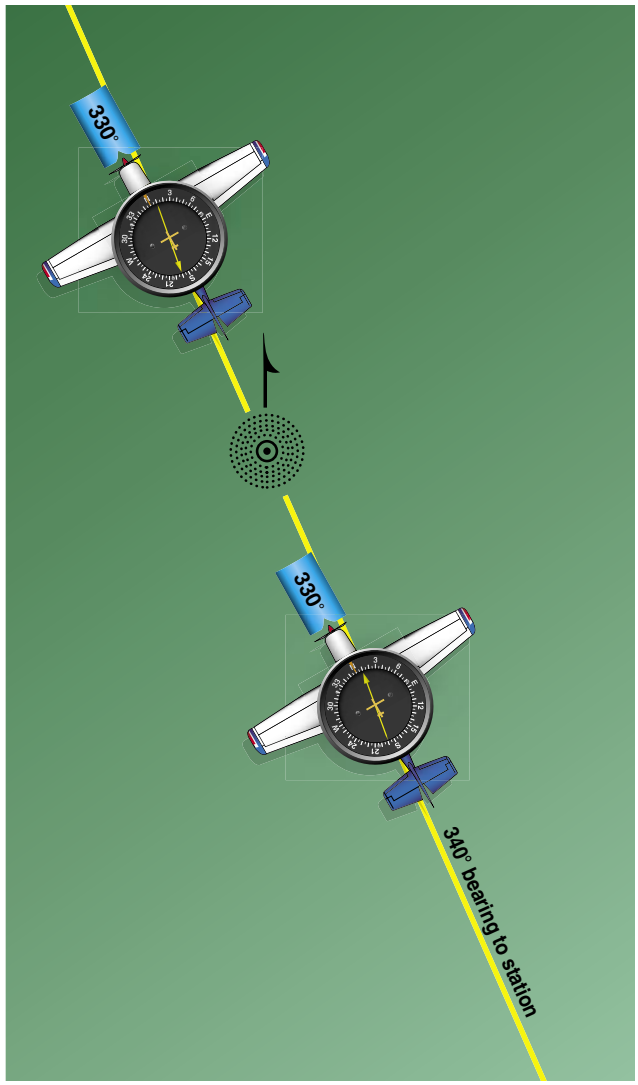

Figure 15-38. *ADF tracking.*

Although the ADF is not as popular as the VOR for radio navigation, with proper precautions and intelligent use, the ADF can be a valuable aid to navigation.

Loran-C Navigation

Long range navigation, version C (LORAN-C) is another form of RNAV, but one that operates from chains of transmitters broadcasting signals in the LF spectrum. World Aeronautical Chart (WAC), sectional charts, and VFR terminal area charts do not show the presence of LORAN-C transmitters. Selection of a transmitter chain is either made automatically by the unit, or manually by the pilot using guidance information provided by the manufacturer. LORAN-C is a highly accurate, supplemental form of navigation typically installed as an adjunct to VOR and ADF equipment. Databases of airports, NAVAIDs, and ATC facilities are frequently features of LORAN-C receivers.