

## BEARINGS AND RADIALS EXPLAINED

**Bearing** ("Brg") is the horizontal direction of one terrestrial point from another. It is [generally] expressed as an angular distance from 000° (north) clockwise through 360°. [1] If the bearing is expressed in terms of true north, the bearing is called a **true bearing**. If the reference direction is the heading [2] of the aircraft, the bearing is called a **relative bearing**. The *bearing* of a radio station is the reciprocal of the *direction of propagation* of the radio wave. [3]

A **radio bearing** is a bearing obtained by radio.

A **visual bearing** is a bearing obtained visually.

Before plotting relative bearings they should be converted to true bearings by adding them to the momentary true heading of the aircraft when the bearings were taken, dropping 360° when the sum exceeds this amount. Thus, **TB = RB + TH** (TB is the true bearing, RB is the relative bearing, and TH is the true heading.) [4]

If the bearing line is to be plotted as a straight line on a Mercator chart, a correction, called **conversion angle**, should be applied. [5]

A **radial**, being a line of sight, is one of an infinite number of directions of radio wave propagation from an **omnidirectional range** or **omnirange** VOR. If suitable airborne instrumentation is available, the radial (direction) on which the aircraft is located can be identified. [6] The radial on which an aircraft is located is therefore *independent of the aircraft heading*.

In the airborne VOR receiver there is an **omnirange course deviation indicator** ("CDI") and an **omnibearing selector** ("OBS") or **radial selector**. Owing to the nature of VOR signal transmissions and the way they are used for direction finding, there is a 180° ambiguity and so the CDI is equally sensitive to signals coming from either of two opposite directions (i.e. two radials, 180° apart, from the same VOR). To resolve this, an additional circuit is installed and it will indicate via a flag **TO** or **FROM**.

In your question you have proposed *centering* the CDI needle on radial 180. It therefore stands to reason that in the absence of a TO/FROM flag, your receiver (aircraft) could be located either on a bearing of 180° *from* the station, or on a bearing of 000° *from* the station. If you had another source of position information you could say with some confidence where you were. Alternatively you could use the radial selector knob to choose a radial. If you were located on a bearing line of 000° *from* the VOR, **regardless of aircraft heading**, and had selected radial 180, then the TO flag would be displayed. If you were to selected radial 360 then the FROM flag would appear. Understand this crucial point - the instantaneous indication depends on *location* and not on *heading*.

In this example, if an NDB is co-located with the VOR station then the receiver - the **automatic direction finder** ("ADF") - will display a **radio bearing**. That is, the needle will point to the station, and there is no need for a TO/FROM flag as the needle has an arrowhead to indicate the direction. The **radio bearing** to the NDB *from* the aircraft will be 180°. However, returning to the definition of a

bearing above, there are two possible reference directions - true north (or magnetic north if variation is applied) and the aircraft heading. There are therefore two different kinds of radio bearing indicators: the **relative bearing indicator** ("RBI") and the **radio magnetic indicator** ("RMI"). In our example where we shall assume zero variation, if the aircraft heading were 360°M (M=magnetic), the radio bearing to the NDB would be **180° relative** and also **180° true**. If the heading were 180°M the radio bearing would be 000° relative and 180° true. Thus, neglecting corrections for the conversion angle, the true bearing (from the aircraft) is independent of heading. Notwithstanding this, the direction information obtained by the ADF is, in the simplest case, a **relative bearing**. If a true bearing is required - or perhaps, a magnetic bearing - it will be necessary to **add** the relative bearing to the true heading, or magnetic heading, respectively, to obtain a true bearing, or magnetic bearing, respectively. There are some important practical considerations involved in plotting a position or bearing line which are best dealt with by consulting with appropriate literature on the topic (e.g. conversion angle, effect of latitude, which value of variation to use when correcting/un-correcting, etc.)

### References

[1] Bowditch, N. (2002). *The American Practical Navigator*. Bethesda, MD: National Imagery and Mapping Agency. Art. 107.

[2] Viz., the angle between the fore-and-aft axis of the aircraft and the line of sight to the object, always measured clockwise from 000° at the nose of the aircraft through 360°. Radio waves propagate along [lines of sight](#) - although if the wave travels between two media of different [refractive indices](#) it will not strictly follow a straight line.

[3] US Hydrographic Office. (1963 CP). *Air Navigation - H.O. Pub. No. 216*. Washington: US GPO. Art. 107.-- See related: [US Air Force Pamphlet 11-216](#).

[4] *Ibid.*, art. 903-904.

[5] *Ibid.*, art. 1115. C.f. N. Bowditch, *op. cit.*, p. 744.

[6] *Ibid.*, art. 1117.