

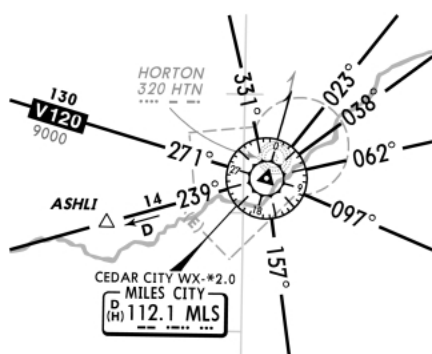
# JEPP'S BRIEFING



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You're cleared via V-120 which passes Miles City, Montana (MLS) and then goes on to Lewiston, Montana (LWT) as it proceeds westbound. As you study your enroute chart and look at the radials on the chart, on your GPS avionics or your FMS, the numbers don't seem to "add up."

The charted radial from MLS is 271 and the radial used inbound to LWT is 089. Right away, you notice that 271 and 089 are not reciprocals of each other. Maybe that is the problem. Then you look at your avionics system and the outbound bearing from MLS displays as 274. And that doesn't match the chart. Why aren't we all playing off the same page?



## Airway Radials

First, all airway bearings (radials) are computed using great circle (geodesic) calculations in true rather than magnetic. The math to accomplish this is the same for Jeppesen, the FAA, the military, and NACO (National Aeronautical Charting Office). This means that airways that run true north and south will usually be the reciprocals of each other - at least for the true bearings. On all airways that run east and west, the bearings will virtually always not be reciprocals. The longer the airway length and the closer to the north and south poles, the greater the difference between the airway reciprocal numbers.

So - if you had an airway formed by two VORs that were on exactly the same latitude, the eastbound radial would have to be greater than 90 and the westbound radial would also have to be larger

## The Chart Clinic - Database Series

than 270. The longer the airway, the greater the difference.

The second reason for the difference can usually be associated with the station declination (magnetic variation) of the VORs at each end of the airway. If the situation of a north-south airway where the true bearings at each VOR were reciprocals of each other, the magnetic radials would not be the same unless the two VORs had exactly the same station declination.

On V-120 between MLS and LWT, some of the difference between the reciprocals is caused by MLS with a station declination of 15.0E, while the magnetic variation in the area is 12.1E. With a station declination difference of 2.9, that is one cause of the difference.

## Difference in Avionics Systems

Even though the airway radials are part of the ARINC 424 Navigation Specifications, the avionics systems do not carry the published radial in their airborne databases. Instead, they obtain the latitude and longitude for the VORs from the database for each end of the airway and perform their geodesic calculations onboard to obtain the radials. Most of the avionics systems use formulas that result in the same true bearings.

But from there, many variations occur. From the true bearing, some manufacturers apply the station declination from the database (the best solution since the station declination is available from the database). Because of space limitations, many avionics systems don't carry the station declination onboard, but instead, have a couple of different means of determining the magnetic variation (not station declination) in the area of each VOR. One avionics system actually carries the magnetic earth model along in the system - however the magnetic variation is only good for one time in the life cycle of the avionics system. The philosophy of the avionics system was that it had a life cycle of about 20 years so the earth model was loaded for the middle of the life cycle. That means the magnetic variation is good for the avionics system when it is 10 years old. At the beginning of the avionics' life, the variation is quite wrong but it gets better over time. After 10 years, it begins deteriorating again.

Another avionics system applies the variation that is correct at the time of flight, but that can be as many as four degrees in error since VORs are not realigned to the local magnetic variation until there is a significant difference between the station declination and the actual magnetic variation at the VOR site. And this is all because the local magnetic variation continues to change over the surface of the earth.

But - the good news is that all avionics systems will track precisely between the two VORs very accurately - it's just that the numbers don't match up.

## What is an NDB?

The question of "What is an NDB?" seems a little strange coming from someone familiar with the avi-

ation industry. But, the question is a loaded one when it comes to databases.

When the first avionics systems and databases were originally designed, no one believed there would ever be a need to have an NDB in the database for navigation. After all, the signals are not clean and smooth, they don't emit defined radials, and they have no DME signals from the NDB.

The first databases included only the NDB locations, not the NDBs. The early systems had a great capability to fly to an NDB as a waypoint, but not as an NDB. Since the early systems only used NDB locations as waypoints, a scheme in ARINC 424 was created to use the identifiers of the NDBs followed by the letters "NB" to create five letters that could be recognized as NDB waypoints. As an example, the CZL NDB had the letters CZLNB assigned in the database. This system is still used by many avionics systems today. The avionics systems will display the letters CZLNB while the paper charts will display CZL.

In the early 1980s, an innovative avionics company decided it would be a good idea to display the NDB frequency for pilots so they requested that NDBs as nav aids be included in the database. This was the first time NDBs were specified in the ARINC 424 standard as being available as NDBs. However, the intent was still to fly to NDBs as waypoints and not as nav aids so they were still in the database with their identifiers plus the two letters "NB." A couple of ARINC 424 revisions later, the philosophy of NDBs changed to include them as true nav aids. This meant that for the first time that users of databases could actually enter the identifier of an NDB and proceed to the nav aid. The avionics systems still don't use the NDB signals for navigation, but they do navigate to and from NDB locations.

**Except** - many NDBs and locators are associated with the terminal environment and this causes significant duplication. As an example, there are 48 NDBs with the identifier "R" and more than 30 more with the identifier "A." If you enter the identifier "R" in some avionics systems, you have the potential of sorting through a list of 48 duplicate identifiers. In order to reduce the search time for the NDB that is the one you want, the avionics manufacturers have come up with various methods to display the NDBs with a priority. The priority sometimes is based on your distance from the duplicate, sometimes based on whether it is on your route of flight, sometimes based on the airport you are going to, and sometimes on a combination of criteria.

## Cut-off Dates

You would have thought that aeronautical databases would have a later cut-off date for information than paper. There is a date when any information changes just can't make it into the database or onto the paper because there is a date before every publication date when the information is "frozen" and has to go to press. Typical cut-off dates for paper are about 10 days before the effective date. For elec-

tronic databases, the cut-off date is 21 days before the effective date. Hey - it's electronic - "What's wrong with this picture?"

Because of the distribution system of electronics, the database cut-off date is earlier. The biggest time delay is the time it takes to find airplanes and get the new data loaded. With paper, the latest revision is sent in the mail or sent to the airline dispatch office and pilots pick up their revision on the way to the airplane - and all the paper distribution is done.

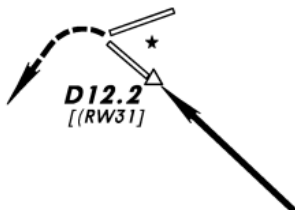
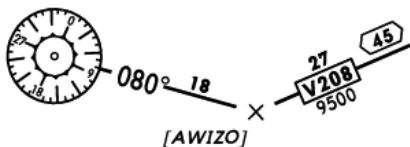
With databases, the information must reach an airline domicile early enough to "catch" the airplane sometime when it gets back to the domicile to get the data loaded. Some times this takes days - so there needs to be a way to have enough lead time to ensure the airplane has enough time to get the data in advance of the effective date.

Additionally, there is a significant amount of processing with the production of each data card, data disc, CD, memory card, tape, or other media before it can be placed in the mail. And then there is the problem of customs when a hard media rather than paper goes past the customs officers.

So - if there is a difference between the charts and the database? The paper is typically more current and should be referred to for the final authority. Also, each database is issued only once each 28 days whereas the approach charts, SID (DP) and STAR charts are issued every other week in some areas and each week in other areas - much more often than electronic data.

## Waypoint Identifiers

The database identifiers are being added to the approach charts, SIDs (DPs), and STARS. When identifiers are created primarily for avionics systems and are not needed by air traffic control communications, the identifier is included on the chart, but in brackets. These fixes are called Computer Navigation Fixes (CNFs) and are included on charts with brackets. The FAA has been leading the world in creating these fixes to help ensure compatibility between charts and avionics displays of databases.



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AWIZO is not required for conventional navigation on V208 but is required when flying fix to fix with a database. Runway thresholds are included on applicable approaches with the letters RW followed by the runway number. RW31 is the runway threshold location for runway 31.

In the next article, we will look at the many means of determining the "best numbers" to fly a stabilized approach. ☒



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