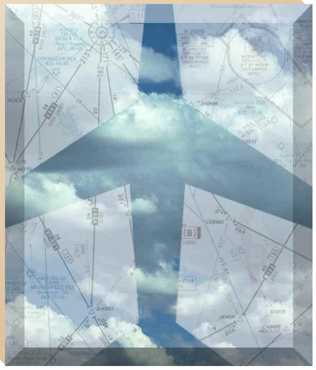
JEPP'S BRIEFING



The Chart Clinic – First in a Series

By James E. Terpstra

When you think of IFR charts, approach procedures, MEAs, MOCAs and the myriad of other associated acronyms, you hardly think of the type of reading material you would snuggle up with near a fireplace on a cold, winter evening. No one would confuse "Fate is the Hunter," "Overflight," or "Bombs Away," with the legend pages of the Airway Manual!

This series of articles is written so that pilots can get the most value from their Jeppesen Airway Manuals.™ Most of the charts and symbols are very familiar, because you use them on every trip. Other pages are read less often than the telephone book.

When using an IFR service, all materials can be lumped into one of two categories—enroute or terminal. The enroute operations use low altitude enroute charts, high altitude enroute charts, area charts, or RNAV/GPS enroute charts. Terminal operations normally use approach charts, standard instrument departures (SIDs) (soon to be called departure procedures (DPs), and standard terminal arrival routes (STARs). The opening subject of this series will be enroute charts.

Enroute Charts

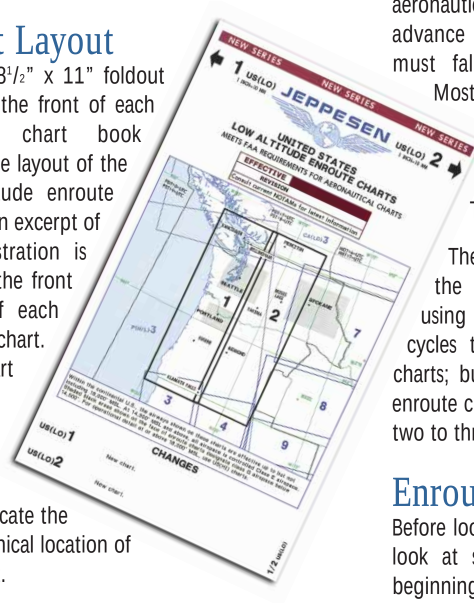
The first enroute charts used by most pilots are the low altitude enroute charts which portray the Victor airways. These low altitude airways are used in the airspace between the minimum usable IFR altitude up to 17,999' MSL. The high altitude enroute charts display the Jet airways, which begin at 18,000' MSL and proceed up through FL 450.

To cover the entire United States with low altitude enroute charts, there are 52 charts, even though a subscriber to the full US coverage doesn't get every one of the 52 charts. These charts are labeled at US(LO)1/2 through US(LO)51/52. It would be simple to design a chart series to cover the entire United States if our population were distributed equally throughout all the geographical coverages. Unfortunately, certain "hot spots," such as New York City, Miami, Dallas, and Los Angeles, attract large masses of people. These centers also require large masses of VORs and airways, condensed in small areas. Because of the unequal distribution of facilities, the enroute charts use different scales for chart depiction. Most of the scales used for the US are 1" = 10 NM, although a few of the charts use the scale of 1" = 20 NM. But, let's not get too academic. The real reason for mentioning scale is a reminder that when "eyeballing" distances on charts, an inch may represent five minutes on one chart and two and a half minutes on another chart. This can be developed into a "rule of thumbnail:"

> *Assuming your aircraft flies 300 knots, each nautical mile goes by in .2 minutes. This means that a "thumbnail" measurement on the 20 NM scale chart takes 3 minutes; on the 15 NM scale, a "thumbnail" takes 2 minutes; on the 10 NM scale, a "thumbnail" takes 1.5 minutes. Even though the distances are printed on the charts, there are many times when it is nice to know quickly how far an airport is off an airway, or your time to an intersection.*

Chart Layout

A large 8½" x 11" foldout page in the front of each enroute chart book shows the layout of the low altitude enroute charts. An excerpt of this illustration is also on the front panel of each enroute chart. The chart outlines shown by heavy lines indicate the geographical location of the chart.



The shaded areas found on the front panel are used to depict the locations where area charts are provided. Because of some of the "hot spots" mentioned earlier, it is necessary to provide area charts with a larger scale to show more detail with less clutter in some of the major terminal areas. There are 18 area charts in the US for these "hot spots," using the scale of 7.5 NM to the inch on most charts.

Area charts are considered enroute charts and therefore are located with the enroute charts in your shipment. When you receive an Airway Manual service, however, we recommend that each area chart be removed from the enroute chart location and filed with the appropriate city. This keeps the area chart near the approach charts, SIDs and STARs and provides a better terminal package when operating to or from large airports.

Revision Cycle

If you owned your own VORTAC station and found when tuning to its frequency that you were receiving interference from a neighboring VORTAC, your first reaction would be to change your neighbor's VORTAC frequency (or your own), effective tomorrow. However, that wouldn't allow enough time to distribute the new VORTAC frequency to all users of the national airspace system.

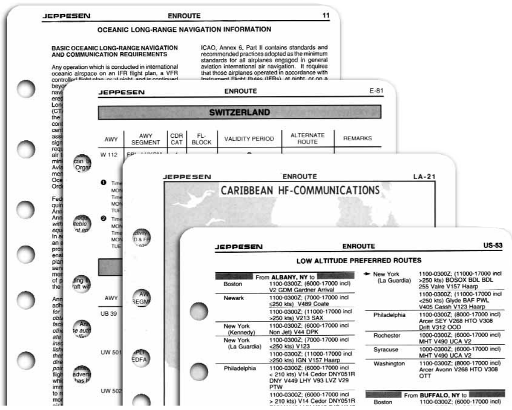
To solve this type of problem, the International Civil Aviation Organization (ICAO) member nations have agreed that at least 42 days of advance notice will be given when major aeronautical changes are made. Not only is the advance notice required, the effective date must fall on "day 1" of a 28-day cycle. Most of the 184 ICAO nations have agreed to this same cycle. Changes to the enroute charts are effective 0901Z on "day 1," which always falls on a Thursday.

The high and low altitude enroute charts in the United States and Canada are revised using every other 28-day cycle. During some cycles there are no changes to the enroute charts; but even if no changes are made to an enroute chart, it is reprinted and distributed every two to three cycles.

Enroute Text Pages

Before looking at the enroute chart symbols, let's look at some of those "front" pages at the beginning of the enroute manual. Each text page has a name centered at the top indicating the section to which it belongs. These names match the tab pages, which are used as dividers. In addition to the section name, a page number is found in the upper left or right corner. If the page number is "US-8," for example, that page would be found only in the United States Airway Manual. If the page number is not prefixed with letters, then that page is an international page and is included with all Airway Manual subscriptions.

When studying the legend pages and chart symbols, it helps if you understand that they are international in nature and description. This technique allows US pilots to use international charts and non-US pilots to use US charts without



learning new symbols or abbreviations. For example, the letters "CTR" are used to indicate a control zone rather than the Letters "CZ" which seem to make more sense. The letters "CTR" are the official ICAO abbreviation for control zone.

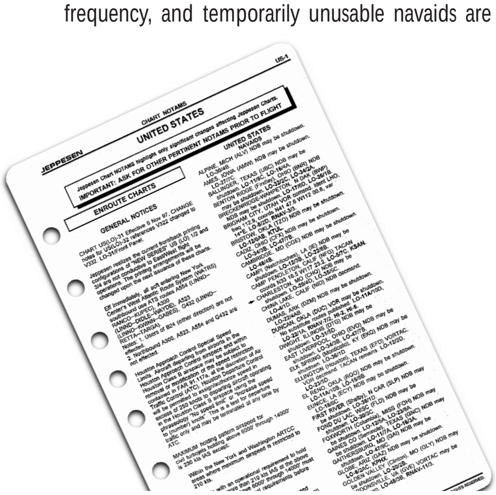
Other pages found in the front of the enroute chart binder include:

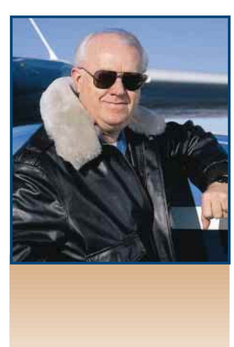
- Air Defense Identification Zones
- Florida Keys Free Area
- In Flight Weather Advisory Reference Locations
- Stratification of United States Airspace System
- High Density Traffic Airports
- Preferred IFR Routes
- Tower Enroute Control (TEC) City Pairs

The list above is a reminder to refer to those pages occasionally. This will help you keep current on some of the seemingly "trivia" items that have been forgotten since ground school days.

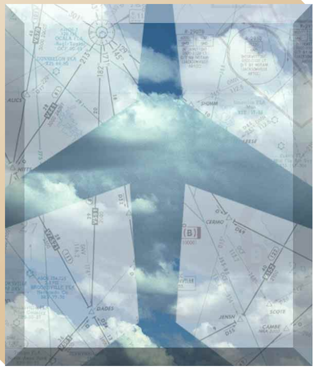
Another important section is the "Chart NOTAMs." The Chart NOTAMs are included behind their own tab. These pages are revised and reissued every two weeks. Pertinent NOTAMs (longer than the daily NOTAMs) in the national airspace system are included in the revision notice pages. The NOTAMs listed in the enroute section are appropriate to the enroute charts and are listed by the chart on which they are found. Notices of facility shutdowns, changes of frequency, and temporarily unusable navaids are included in the revision notice. Changes to these pages are indicated with a large arrow on the left side of the NOTAM information. *These pages should be reviewed before every flight.*

Even though the legend pages aren't recreational reading, we recommend that you spend a few hours on the next layover reading those "enroute" pages.





James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Second in a Series

BY JAMES E. TERPSTRA

This series of articles is designed for instrument pilots who want to get the maximum value from their Jeppesen charts. In last month's article, we covered those seemingly "millions" of chart symbols. This month we'll take a tour of enroute charts.

The portion of the Jeppesen Enroute Chart most often overlooked is the front panel. It contains some helpful information, plus other data that can be critical to flight.

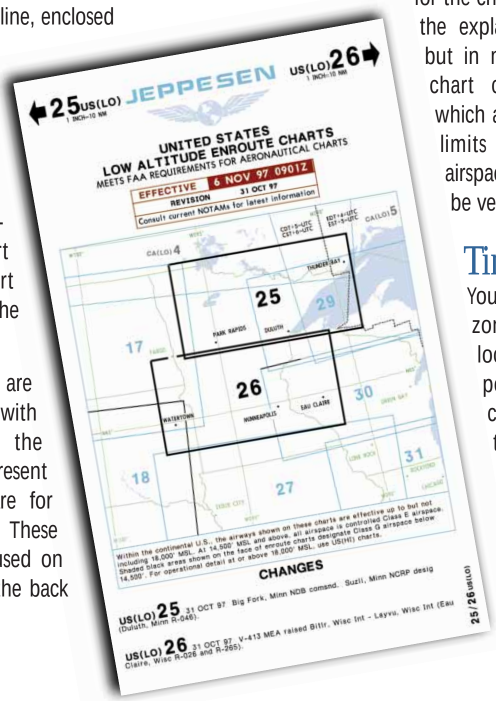
At the top of each chart are two numbers that show the title. Each number has an arrow directing the pilot to turn to the desired geographical area. Immediately below each chart number is the scale of the charts.

As mentioned previously, most nations have agreed to the ICAO 28-day cycle (or every other 28-day cycle for the US and Canada). As shown below in the illustrated enroute chart panel, the effective date of this chart is 6 November 1997. This date represents "day 1" of the cycle. More specifically, the chart is effective at 0901 Zulu.

Within the Neatline

The enroute chart outline, enclosed within the solid line, includes a wealth of information when examined closely. Note the solid lines in the middle of the illustrated enroute chart show that the chart "in your hand" is the US(LO)25 and 26.

A number of cities are included on the chart with a dot located near the city. These dots represent city locations and are for orientation purposes. These also are the names used on the index panels on the back side of the chart.



On most enroute charts, there are one or more shaded areas on the front panel that represent areas covered by area charts. With the redraw of the low altitude enroute charts in 1997 using better scales, many of the area charts are no longer needed. The location of each area chart is identified by the name of the area chart plus the small city dot.

One of the most useful pieces of information on each of the charts is the information included below the front map layout under the title "**CHANGES**." Each time a change is made to an enroute chart, the chart is revised, and the change that caused the revision is listed on the front panel of the chart. As an example, in the illustration shown below, the Big Fork, Minnesota NDB was commissioned. Also the Suzli, Minn NCRP (non-compulsory reporting point) has been designated on US(LO) chart 25. To help locate the effected change, the radial from the reference facility (in this case the 046° radial from the Duluth, Minn VOR) is included.

Chart Validity

Pilots trained in the United States know that low altitude airways are good up to, but not including 18,000 feet. They also know that all airspace at 14,500 feet and above is controlled – but what if you are going to fly in South America, in Africa, over Australia? Well, you get the idea.

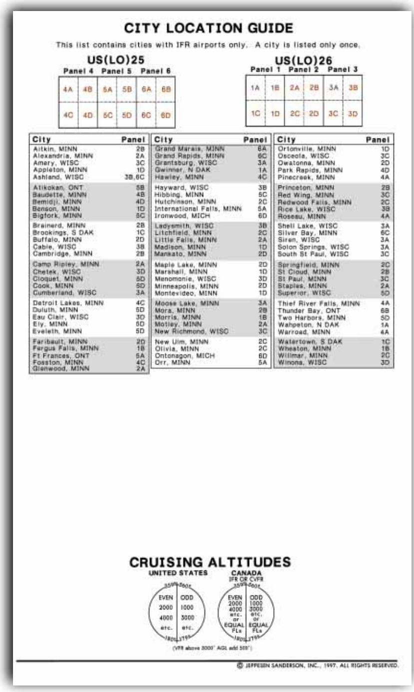
That is why there is a paragraph just below the chart layout diagram. In that paragraph, there is an explanation of the airspace and airway limits for the chart. In the United States, the explanation is quite simple, but in many areas, the enroute chart covers many countries which all seem to have different limits to their airways and airspace. So this paragraph can be very important.

Time Zones

You will note that the time zone boundaries are not located on the internal portion of each enroute chart, but are found on the front panel. The boundary between time zones is represented by a series of letter "T's." With the change to daylight savings time in the spring and back every fall, charts include the conversion to Coordinated Universal Time (UTC) for both daylight savings time and standard time within each time zone. This conversion factor can be found toward the top of the Index of Charts on the front panel of each enroute chart.

City Location Guide

Below the list of changes is a City Location Guide to help you find cities much easier. There is a miniature chart layout with the identifier of each panel on the face of the enroute chart as well as a list of all the cities on the chart which have an IFR airport. Some of the cities have more than one airport. As an example, Minneapolis, which has five IFR airports, can be found on panel 2D.



CITY LOCATION GUIDE

This list contains cities with IFR airports only. A city is listed only once.

US(LO)25 — Panel 4, Panel 5, Panel 6

4A	4B	5A	5B	6A	6B
4C	4D	5C	5D	6C	6D

US(LO)26 — Panel 1, Panel 2, Panel 3

1A	1B	2A	2B	3A	3B
1C	1D	2C	2D	3C	3D

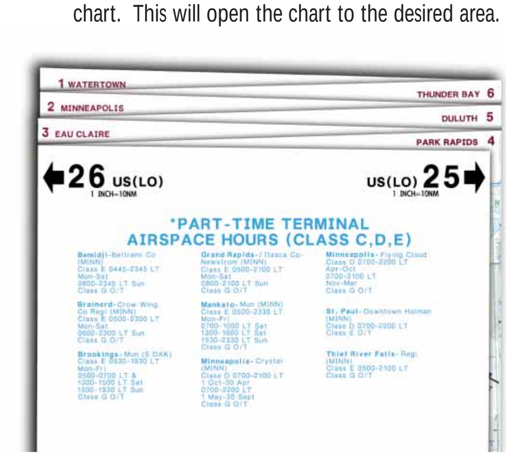
City	Panel	City	Panel	City	Panel
Aitkin, MINN	2B	Grand Marais, MINN	6A	Ortonville, MINN	1D
Alexandria, MINN	2A	Grand Rapids, MINN	6C	Osceola, WISC	3C
Amery, WISC	3C	Grantsburg, WISC	3A	Owatonna, MINN	2D
Appleton, MINN	1D	Gwinner, N DAK	1A	Park Rapids, MINN	4D
Ashland, WISC	3B,6C	Hawley, MINN	4C	Pinecreek, MINN	4A
Atikokan, ONT	5B	Hayward, WISC	3B	Princeton, MINN	2B
Baudette, MINN	4B	Hibbing, MINN	5C	Red Wing, MINN	3C
Bemidji, MINN	4D	Hutchinson, MINN	2C	Redwood Falls, MINN	2C
Benson, MINN	1D	International Falls, MINN	5A	Rice Lake, WISC	3B
Bigfork, MINN	5C	Ironwood, MICH	6D	Roseau, MINN	4A
Brainerd, MINN	2B	Ladysmith, WISC	3B	Shell Lake, WISC	3A
Brookings, S DAK	1C	Litchfield, MINN	2C	Silver Bay, MINN	6C
Buffalo, MINN	2D	Little Falls, MINN	2A	Siren, WISC	3A
Cable, WISC	3B	Madison, MINN	1D	Solon Springs, WISC	3A
Cambridge, MINN	2B	Mankato, MINN	2D	South St Paul, WISC	3C
Camp Ripley, MINN	2A	Maple Lake, MINN	2D	Springfield, MINN	2C
Chetek, WISC	3D	Marshall, MINN	1D	St Cloud, MINN	2B
Cloquet, MINN	5D	Menomonie, WISC	3D	St Paul, MINN	3C
Cook, MINN	5D	Minneapolis, MINN	2D	Staples, MINN	2A
Cumberland, WISC	3A	Montevideo, MINN	1D	Superior, WISC	5D
Detroit Lakes, MINN	4C	Moose Lake, MINN	3A	Thief River Falls, MINN	4A
Duluth, MINN	5D	Mora, MINN	2B	Thunder Bay, ONT	6B
Eau Clair, WISC	3D	Morris, MINN	1B	Two Harbors, MINN	5D
Ely, MINN	5D	Motley, MINN	2A	Wahpeton, N DAK	1A
Eveleth, MINN	5D	New Richmond, WISC	3C	Warroad, MINN	4A
Faribault, MINN	2D	New Ulm, MINN	2C	Watertown, S DAK	1C
Fergus Falls, MINN	1B	Olivia, MINN	2C	Wheaton, MINN	1B
Ft Frances, ONT	5A	Ontonagon, MICH	6D	Willmar, MINN	2C
Fosston, MINN	4C	Orr, MINN	5A	Winona, WISC	3D
Glenwood, MINN	2A				

Cruising Altitudes

A reminder showing the appropriate cruising altitudes for VFR and IFR is included in schematic form at the bottom of the front panel. FAR 91.179 says that the east-west hemispheric rules apply *only* for operations in non-controlled airspace. Therefore, the odd or even thousand-foot altitudes do not apply within *controlled* airspace since ATC assigns the appropriate altitude for IFR operations. Remember, that degrees 360 through 179, and 180 through 359, apply to the magnetic *course* and not to the magnetic *heading*. This is true in the United States but varies occasionally for international operations.

Zig-dex

It sounds like a fancy marketing term (it is) — but it really works! The marketing term for the zigzag index located on the back panel of each low altitude enroute chart is "Zig-dex". To use the Zig-dex, simply place the thumb of either the right or left hand on the name at the top of the back panel and slide the thumb to the inside of the chart. This will open the chart to the desired area.



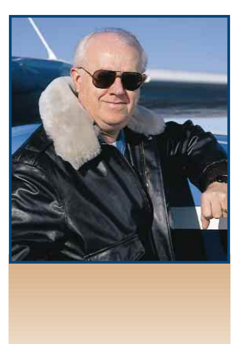
To further coordinate the Zig-dex names, refer to the geographical coverage in the first illustration in this article. The names that are shown are the same names that appear at the top of each Zig-dex panel. For example, on the front panel of US(LO)26, Watertown, Minneapolis, and Eau Claire are shown with dots. These are the same names at the top of the back panel.

Also, notice the panel numbers next to the city names at the top of the Zig-dex. These are used as reference numbers for the City Location Guide. For example, use your left thumb and press the panel labeled "2 Minneapolis" and slide your thumb inside and now you should be able to see Minneapolis in the lower right corner which is panel 2D. (If you actually have the US(LO)25/26, try it. It really works!!)

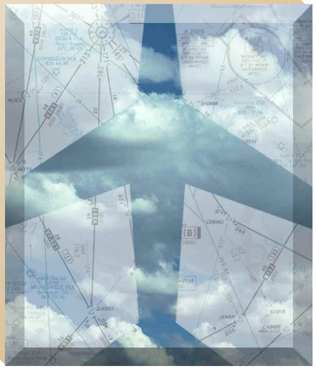
Airspace Restricted Areas

Normally, all of the information concerning special use airspace (SUA) areas are found on the face of the enroute chart near the respective area. In cases where chart congestion limits the amount of room, special use airspace and their limits are listed on the bottom of the front panel just above the cruising altitude symbol, or at the top of the back panel. Additionally, all part-time terminal airspace is included on the chart panel. For example, the Class E terminal airspace around Bemidji-Beltrami County Airport is effective from 0445 to 2345 local times on Mondays through Saturdays, and 0800 to 2345 on Sundays. During the other times, it is Class G airspace.

This article concludes the discussion of the enroute text pages and the front and back panel information on the enroute charts. In the next article, the inside of the chart will be explored.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Third in a Series

BY JAMES E. TERPSTRA

Flying off the edge of an enroute chart is not quite as hazardous as flying off the edge of a flat earth, but if the chart border data is not utilized, it could be as disconcerting. Running out of chart seems to happen at the most inopportune time, but the changes can be made easily if the border information is used.

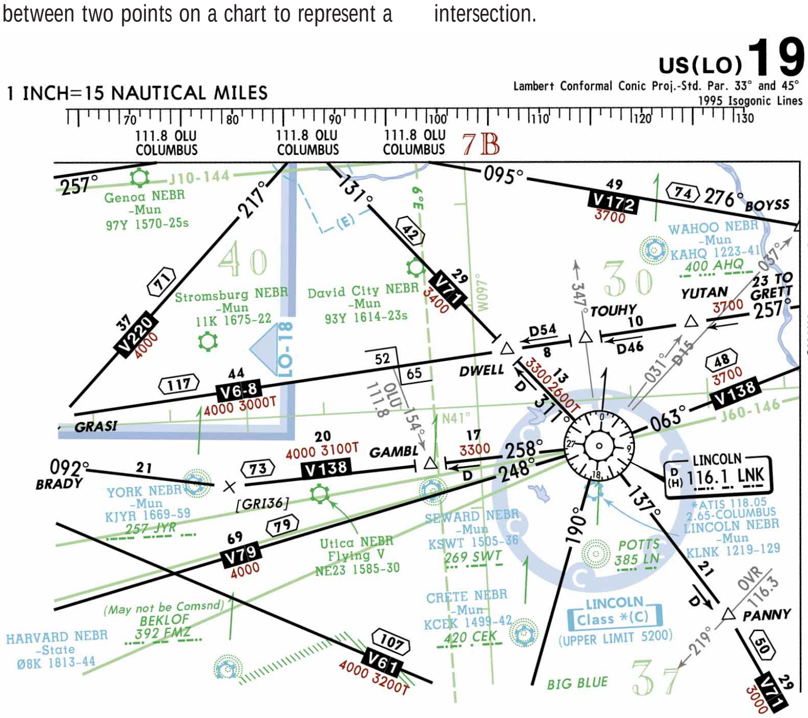
When approaching the edge of a chart, there is a way to tell which adjoining chart to use — the shaded blue line about two inches from the top of the chart (see illustration below) indicates that US(LO)18 is the next chart to the north and west.

If the chart and map makers had been allowed input, the earth would *not* have been a sphere — it would have been a cube. Trying to project a curved surface onto a flat piece of paper is like fitting a round peg into a square hole. To solve this problem, Jeppesen has selected the Lambert Conformal Conic Projection for most enroute charts, as indicated in the upper right or left corner of each chart. The reason for mentioning projection? You can draw a straight line between two points on a chart to represent a great circle route — the shortest distance between two points on our curved earth.

Once you have selected the correct chart, how do you locate your position fix or destination airport? Latitude and longitude lines and their values are shown throughout the chart. In the chart illustration, just to the northwest of the Lincoln VOR, is the intersection of 41° north latitude and 97° west longitude. The coordinate values are shown adjacent to the latitude and longitude lines. This makes it relatively easy to find locations on the chart, such as the Wahoo, Nebraska Airport at N41°14.4' W96°35.7'.

More examples of border information showing "off-the-chart" facilities are also on the chart illustration. On the top and right edges outside the neatline, the next VORs used on the airways are Columbus and Omaha. When an intersection is the next enroute fix beyond the chart edge, the intersection name and the distance to that intersection are indicated just inside the neatline. This can be seen just above the Lincoln VOR on V-6-8 at the right of the chart. The Grett Intersection is 23 miles beyond Yutan Intersection on V-6-8.

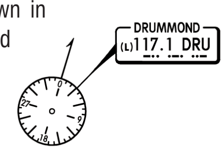
The Panny Intersection just southeast of the Lincoln VORTAC is formed by the 137° radial from Lincoln and the 219° radial from the Omaha (OVR) VORTAC that is just outside the chart border. When this situation occurs, the three-letter ident from the navaid off the chart will be included plus its frequency and the radial forming the intersection.



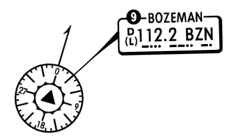
Navigation Aids

VOR, VORTAC, NDB, ILS and LF — these terms are bantered around frequently by pilots. I have even heard it said that pilots learn their language very well so they cannot be understood by the "lesser" of their peers.

Every VOR facility has a compass rose surrounding the location of the VOR. A single line extends from the 360° radial to indicate magnetic north. The small tick at the end of the line is used to measure angles with the PV-5 plotter. A box immediately adjacent to the VOR compass rose gives the name, frequency, three-letter identifier and Morse code identifier for the VOR and its class. This information is shown in the example for the Drummond VOR. The shadow area on the right and bottom of the box denotes that the Drummond VOR is part of the enroute structure.



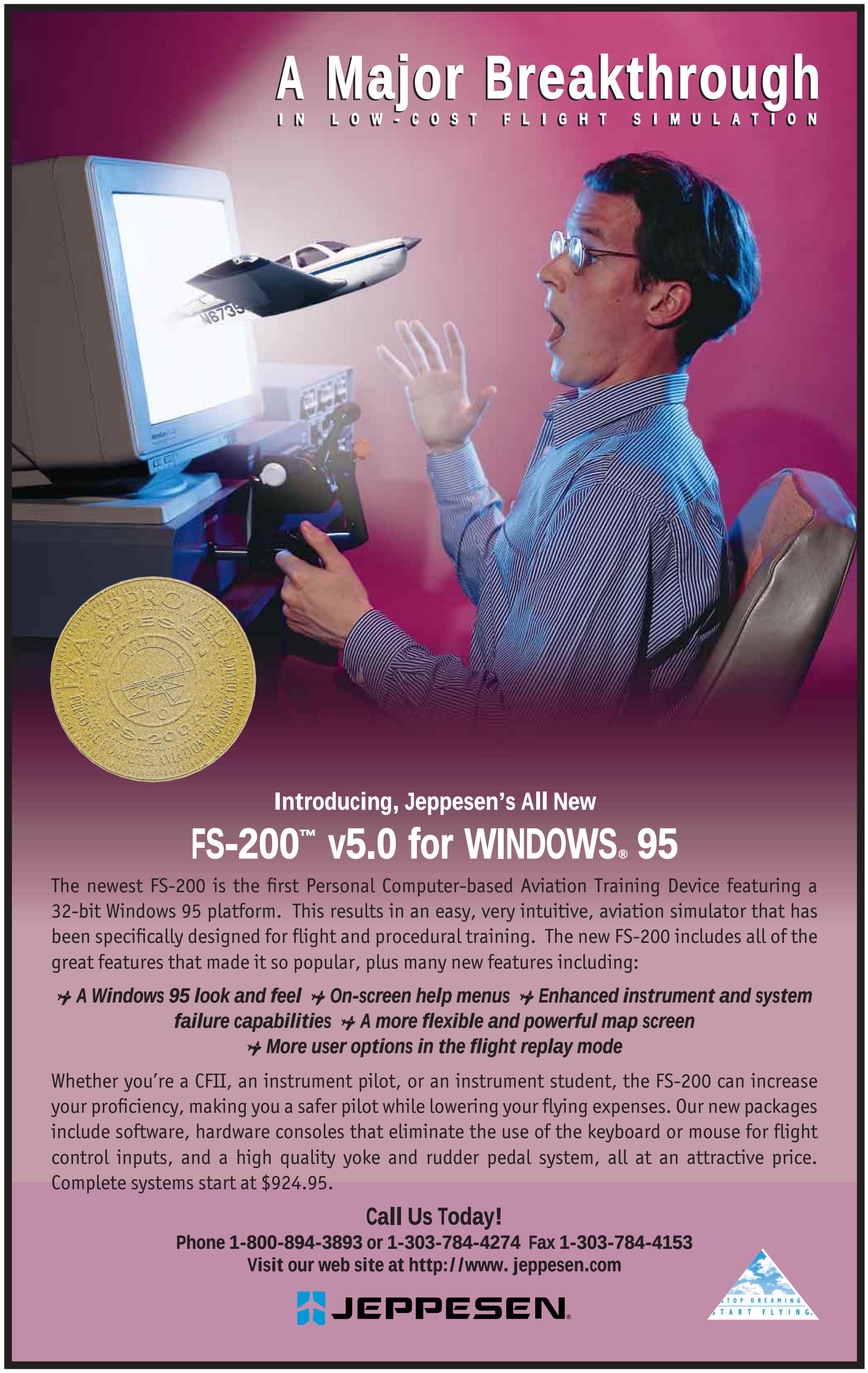
There are two ways of determining if a VOR has DME capability. A VORTAC station that provides DME information is indicated by both a scalloped circle inside the compass rose and a small letter "D" to the left of the VORTAC frequency. For example, the Bozeman VORTAC in the illustration shows both symbols.



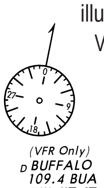
Reporting Points

The Bozeman VOR is a compulsory reporting point, as indicated by the solid triangle in the center of the compass rose. In the past, and on international charts, an open triangle in the center of a VOR shows that it is a *noncompulsory* reporting point. By looking at the actual enroute charts for the United States, you will see that all the noncompulsory triangles are missing from the center of the VOR symbols. Why? All navaids, when used for overflights on either airways or direct flights, are potentially reporting points. The navaids are mostly noncompulsory reporting points so there is no need to add the triangle symbol in the middle of each VOR symbol.

Over the years, the FAA has reduced the number of compulsory reporting points because of the large increase in radar capability and coverage. There are only a handful of compulsory reporting points remaining in areas where radar coverage is minimal. As an example of the decrease in compulsory reporting points, there is only one compulsory intersection on US(LO)7 that covers the less populated areas of Montana and northern Wyoming and Idaho.

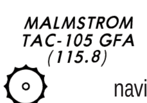


Note the number "9" on the navaid facility box for Bozeman. This indicates additional information somewhere on the same enroute chart panel. On the chart, a note on the top half of the panel states there is a crossing altitude for V-86 and V-365 that is formed by the Bozeman VOR. In Canada, there are no crossing altitudes that are separately stated because the MEA of the next airway segment always indicates the crossing altitude at a VOR or intersection.

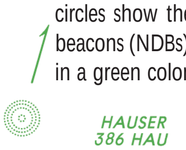


Terminal VORs and VORTACs are normally used only in the terminal area for approaches and usually have a range not more than 25 NM. In the illustration, the letter "T" just to the left of the VOR frequency of 109.4 MHZ shows that the Buffalo VOR is a terminal VOR. The terminal VOR name, frequency and three-letter identifier are not enclosed in a box that indicates it is not part of an airway. Most terminal VORs are for IFR use, but the letters "VFR only" enclosed in parentheses indicate that Buffalo can only be used for VFR navigation.

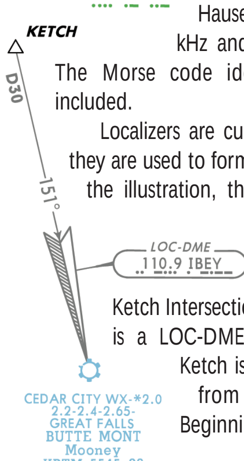
Other Navaids



Pure TACANs do not have compass roses since the azimuth cannot be used by most civilian pilots. When the TACAN channel is compatible with the civilian VHF frequencies, the VHF frequency will be placed below the TACAN name in parentheses. For example, the Malstrom TACAN can be used for DME information by tuning to 115.8 MHZ. The code "TAC-105" is used solely by military navigation receivers to tune TACAN channel numbers.

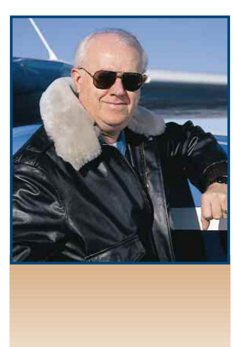


A series of dots forming three concentric circles show the location of non-directional radio beacons (NDBs). The NDBs are normally presented in a green color on enroute charts and each has a magnetic north tick mark above the facility the same as VORs. The Hauser NDB transmits on 386 kHz and has an identifier of HAU. The Morse code identifier for each NDB is included.

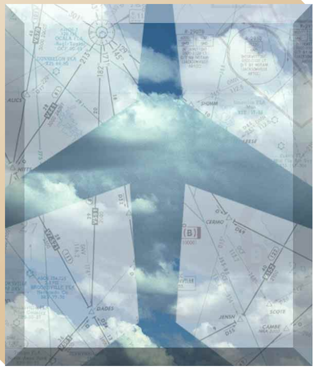


Localizers are currently included only when they are used to form an enroute intersection. In the illustration, the Butte, Montana localizer transmits on 110.9 MHZ and has an ident of IBEY. It is used to form the Ketch Intersection. Since the Butte localizer is a LOC-DME facility, the formation of Ketch is also made by the 30 DME from the localizer DME. Beginning in June, the Jeppesen enroute charts will also depict all the localizers to indicate their availability. The localizers that perform an enroute function will be included with their frequencies, and the ones depicted to show localizer availability will be shown without their frequencies.

In the next article, we will talk about all the communication information found on the face of the chart as well as the front panel.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Fourth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

If you want to start a good discussion – maybe even a good argument – in a room full of instructors, just ask the question, "If you had to lose all your nav or all your comm equipment, which would you rather be without?" If you ask this question to pilots who always fly at large airports, they might say "take away my nav but let me talk to the controller to keep me away from traffic." If you ask a pilots who fly in remote areas, they might respond with, "who needs controllers as long as I can navigate?"

Now ask the same question about the function of an enroute chart. Is it for navigation, or is it for communication? And then the next question, "What about the guys who design the charts? What do they think is more important – nav or comm?" One thing we learned at Jeppesen after we published the new low altitude enroute chart series was that pilots have a lot more use for the communications on the enroute charts than we first believed. The good news is that the communications tabulations on the front panels of the low altitude charts are coming back.

Sometimes, we would like to have you on the receiving end of the "Jeppesen Listens" response cards. You would get an earful! We hear you – and this time you were shouting, not just talking.

Communications Tabulations

For discussion purposes, a section of the new "Comm Tabs" from US(LO) 7/8 is illustrated. The first entry for Great Falls, Mont shows "p8B" to the right of the city name. These characters indicate that the Great Falls airport can be found on panel 8 of the chart in quadrant B. Each panel is labeled at the top of the "Zigdex." Each panel is included on the chart between the "outside" folds. These are the folds that are naturally on the left and right when you open to only one section of the chart. When the chart is opened this way, there are four sections labeled A, B, C, and D. This indexing system on the Comm Tabs negates the need for the "City Location Guide" which will disappear.

You might wonder why the letters "MONT" represent the abbreviation for Montana instead of

GREAT FALLS, MONT p8B
Great Falls Int'l **App(R)/Dep(R)** 119.3. **Twr** 118.7. **Gnd** 121.7.
HAILEY, IDAHO p2A
Friedman Meml **Hailey** ***Twr** 125.6. **Gnd** 121.7.
HELENA, MONT p8C
Helena Regl ***App/*Dep** 119.5. ***Twr** 118.3. **Gnd** 121.9.
IDAHO FALLS, IDAHO p2B
Fanning **Idaho Falls *Twr** 118.5. **Gnd** 121.7.
JEROME, IDAHO p2C
Jerome Co **Twin Falls *App/*Dep** 126.7.
LAUREL, MONT p9C
Laurel Mun **Billings App(R)/Dep(R)** 120.5.
LEWISTON, IDAHO p6D
Lewiston - Nez Perce Co **Lewiston *Twr** 119.4. **Gnd** 121.9.
MISSOULA, MONT p7D
Missoula Int'l **Spokane *App(R)/*Dep(R)** 124.9. **Missoula *Twr** 118.4. **Gnd** 121.9.
MOUNTAIN HOME, IDAHO p1B/1D
Mountain Home AFB **App(R)/Dep(R)** 124.8. **Twr** 133.85. **Gnd** 120.5.
Mountain Home Mun **App(R)/Dep(R)** 124.8.
NAMPA, IDAHO p1B
Nampa Mun **Boise App(R)/Dep(R)** 119.6.
OGDEN, UTAH p2D
Ogden-Hinckley **Salt Lake City App(R)/Dep(R)** 121.1. ***Twr** 118.7. **Gnd** 121.7.
POCATELLO, IDAHO p2D
Pocatello Regl ***Twr** 119.1. **Gnd** 121.9.
SALT LAKE CITY, UTAH p3C
Salt Lake City Intl **App(R)/Dep(R)** (N of 41°N below 8000' 121.1) (105°-249° Rwy 16L Rwy 16R Rwy 17 124.3) (297°-005° N of 41°N 8000' 124.9) (341°-104° 135.5) (250°-340° 125.7 126.25) (105°-249° Rwy 34L Rwy 34R Rwy 35 128.1). Class B (N of 41°N 121.1) (S of 41°N 120.9). **Twr** (Rwy 17-35 and Rwy 14-32 118.3) (Rwy16L-34R 119.05) (Rwy 16R - 34L 132.65). **Gnd** 121.65.

the state postal code letters "MT." Well, let me ask you this: What are the two-letter identifiers for Germany, Switzerland, Spain, and the Netherlands? They happen to be DE, CH, ES, and NL. Our two-letter postal codes may be known by pilots from the United States, but they are not necessarily known by pilots from other nations that fly to the United States. We use the longer abbreviations as a way to make them more meaningful rather than trying to remember the names for MT, MI, MA, MS, MN, etc.

Under the entry for Great Falls, note that the words **Great Falls**, **App(R)/Dep(R)**, **Twr**, and **Gnd** are in bold. When the words and letters are in bold type, this indicates the names to be used in voice communications. For example, a call to approach control would be "Great Falls Approach," not "Great Falls International Approach" because the word Int'l is not in bold. At Hailey, Idaho, it is easy to see that a call to the tower would be "Hailey Tower" and not "Friedman Memorial Tower."

The capital letter "R" in parentheses after the letters "App" at Great Falls indicates that radar is available for the approach controllers at Great Falls. Keep in mind that the lack of the letter "R" does not necessarily mean that radar is not available. It is always a good idea to ask when first contacting Approach Control. The communications information included on the Comm Tabs includes the frequencies and call names for approach and departure control, tower, and ground control as well as radar capability (when known).

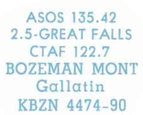
Some airports are just complicated! As an example, the Approach Control sectorization for Salt Lake City, Utah has divisions broken up by radials, runways, Class B airspace, altitudes, and latitudes. It doesn't get much more difficult to figure out which frequency to use to initiate a call to Salt Lake City Approach. (Actually just file IFR to Salt Lake and the center will hand you off with the right frequency.) But, if you are VFR to Salt Lake and need an IFR clearance to get into the airport, or if you just want to contact the right frequency when landing VFR, all the sectorization warrants a little study beforehand.

With the Comm Tabs, it is just as important to know what *is not* included as what *is* included. Because more information is now included on the "face" of the charts, it is not necessary to duplicate the information on the Comm Tabs. As an example, ATIS is now included with the airport and is not in the Comm tabs. Other information now on the face of the chart but not in the Comm Tab listing includes LAA, CTAF, Flight Service Stations, and ASOS and AWOS. Clearance delivery frequencies are included only on the IFR airport diagram charts.

Communications – On the Face of the Chart

All Flight Service Station (FSS) frequencies are shown on the face of the chart near the location of their antennae. This can be just above the navaid frequency box, above the airports where the remote sites might be located, or at remote sites indicated by a small dot enclosed by a small circle. Since the first two digits of all Flight Service Station frequencies are "12" these two numbers do not appear with the FSS frequencies. One of the original FSS frequencies, 122.1 MHz, has almost disappeared. In the first comm receivers, there was a limited number of VHF transmit frequencies and 122.1 was one of them. Most Flight Service Stations were able to receive on that frequency and transmit back on the VOR. Today, however, most stations have the capability to transmit and receive on the same frequency, such as 122.2 MHz and 123.6 MHz.

Most of the FSS frequencies are on or near airports rather than VORs, so we'll look at three different airports to see how to find FSS frequencies. We'll first look at Bozeman, an airport that formerly had a Flight Service Station but is now served by Great Falls FSS about 100 miles away. Available frequencies are now "stacked" above the airport information in the following sequence (when available): ATIS, ASOS, AWOS-3, RCO, LAA, and CTAF. At Bozeman, the current weather can be received by listening to the ASOS frequency of 135.42.



If you want to talk to the FSS near Bozeman, you can call Great Falls Flight Service on 122.5 MHz. This is important for opening and closing VFR flight plans as well as closing IFR flight plans. After Salt Lake Center has cleared you for the approach and you are ready to cancel IFR and your flight plan, Great Falls will take care of you on 122.5. Remember, since Great Falls has many VHF frequencies, you need to inform them you are listening on 122.5. For example, you would call "Great Falls Radio, Baron 7928R listening 122.5"

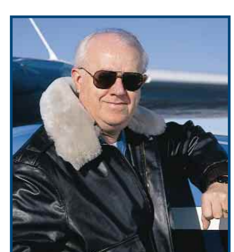
Beginning with the June enroute chart revisions, the CTAF (Common Traffic Advisory Frequency) will also be included with each airport. At Bozeman, the CTAF is 122.7 MHz.

When operating at airports that have only a Flight Service Station and no tower, the FSS should be contacted on 123.6 MHz – but this is rare! The service provided by FSS called LAA (Local Airport Advisory) is disappearing into history as Flight Service Stations are consolidating. The remaining Flight Service Stations are mostly located at airports with towers, so LAA is rarely available. When it is there, the letters LAA will be shown above the airport name with the frequency of 123.6 MHz.

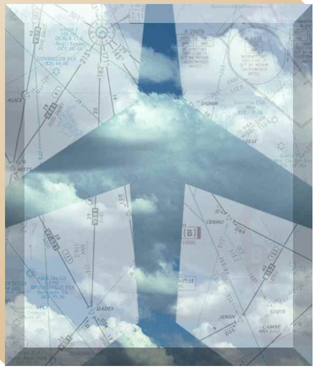
At Butte, Montana, a remote site for the Cedar City Flight Watch is located near the airport. This is indicated by Cedar City WX – *2.0. The asterisk in front of the frequency indicates that Flight Watch is available only on a part time basis. The Great Falls FSS has remote communications at Butte on the frequencies of 122.0, 122.4, and 122.65 MHz.

At Helena, ATIS is available on 120.4 MHz but is only part time, which again is shown by the asterisk. Since the tower at Helena is part time, the CTAF frequency of 118.3 MHz (which is the same as the day time tower frequency) is to be used when the tower is closed during night time hours. Great Falls FSS can be contacted on 122.55 MHz.

There are many more communication frequencies on the face of the chart. We will continue our discussion next month with more of the "comms."



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Fifth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

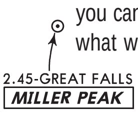
Probably the most commonly used — and the most taken for granted — IFR capabilities are the FAA-established communication networks. As long as you can talk with somebody, you can get just about any request that you want. But take those communications away, as in a communication failure, and you feel blindfolded.

Most communication facilities are shown either on the face of the Jeppesen chart or on the front panel. If you want to listen to the "party line" while enroute, set your comm frequency to 122.2 MHz. Since every flight service station has 122.2 as a standard, you will almost always be listening to some communication with an FSS. Unfortunately, you will also hear many people "walking over" someone else on the 122.2. If you need to talk to an FSS, you might prefer to use a more discrete frequency.

Since 122.2 MHz is so commonly used, the FAA began giving 50 kHz spacing to most flight service stations in the mid 1970s. Such frequencies as 123.65, 122.75 and 122.05 are almost like having a discrete frequency to the flight service station. The FAA does not assign the same frequency to nearby flight service stations. This is particularly helpful when flying at high altitudes, since you can call flight service stations on a less congested frequency.

These frequencies, can be located on your charts above the airports where there are transmitting and receiving antennae. In some areas, the FAA also has placed remote sites called RCOs (Remote Communication Outlets) to facilitate a broader availability of communications capability. Near Missoula, Montana, there are two different types of RCOs.

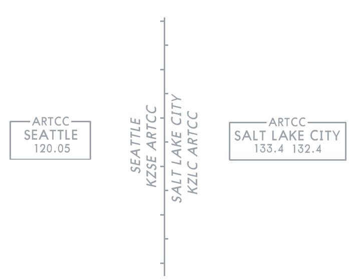
The exact locations of the remote sites are shown as a small dot with a circle around them. The MILLER PEAK remote site name is included within a rectangle. When near the Miller Peak remote site, you can call Great Falls FSS on 122.45 MHz. So what words should you use when calling at the remote site? Your call would be "Great Falls Radio, Baron 1709M, listening on 122.45." This frequency is one of the discrete frequencies assigned to Great Falls FSS. Most likely, when using this frequency, you would not be on a party line. When calling Great Falls, telling them which frequency you are using is important because they don't always have all their transmitting frequencies turned on. They monitor all their frequencies so they can hear you, but if you don't tell them what frequency you are using, they may not know on what frequency to call you back. What is the use for the name "MILLER PEAK" at the remote site? It has no operational use from a pilot standpoint, but is there for reference when coordinating the FSS frequencies with the RCO when revisions are made by the FAA.



There are also a number of remote sites for the Flight Watch capability. There is a Flight Watch remote site near Missoula called UNIVERSITY MTN. At University Mountain, you can call Cedar City Flight Watch on 122.0 MHz.

Center Frequencies

When handed off to an Air Route Traffic Control Center (ARTCC), the previous controller will assign the new frequency. However, sometimes you are unable to contact the Center before you are already beyond the previous Center's frequency range. In this case, the Center frequencies on the face of the chart can be very helpful. In the illustration, the Salt Lake City Center has sector frequencies of 133.4 and 132.4 MHz. These Center frequency boxes can be used for finding the nearest frequency within the aircraft range. They also can be used for making initial contact with the Center for "pop up" clearances. The exact location for the Center transmitter is usually not known. The frequency boxes are placed as close as possible to the known location to ensure you are in the general area when you have lost contact with the previous Center, or when you call as a "pop up."



To be consistent on an international basis, the ARTCC boundaries are now depicted the same as equivalent functions around the world. The ARTCC boundaries are shown with a thin line with ticks alternating on both sides of the exact ARTCC boundary. In locations outside the United States, Flight Information Regions (FIRs) and Upper Information Regions (UIRs) are essentially the same as U.S. Centers.

With the Center boundaries, the names and identifiers of the Centers with the letters ARTCC are shown.

An interesting issue on the Center names and frequencies is that the letters "ARTCC" are included at the top of the Center frequency box and with the Center boundary information. But — ARTCC is not what you call "Center." When calling Seattle ARTCC on 120.05 MHz, you would call "Seattle Center, Navaho 527J, . . . " The proper name is learned in ground school and you have used it ever since. But what is the logic? In Europe and other areas, the names of the various control agencies change so much from country to country that the name used in the airplane call is included within the box. As an example, you would call London Control for the equivalent to the U.S. Center facility so the full name "London Control" is included in the frequency box. International standardization still has a long way to go.

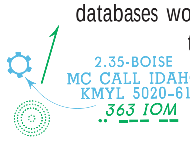
On many charts for areas outside the United States, the frequency boxes are made with a number of small telephone symbols. Additionally, the boundaries of communications areas are depicted with small telephone symbols that indicate air-to-ground communications can be found on the front communications panel.

Airport Information

Note that the name for the Mc Call, Idaho, is printed in blue type and uses all capital letters, and the Council airport is printed in green ink and uses upper and lowercase letters. This system provides an easy way to determine if an instrument approach procedure is available at that airport. When the airport name is in all capital letters, the airport has some type of approved standard instrument approach procedure. Non-IFR airports are printed in upper and lowercase letters. The blue and green colors are added to the new U.S. low altitude charts, but are not differentiated this way on international charts.

On the "top of the stack" of the airport information, the city name is shown. Sometimes this is called the "location name" because the name may not always be a city. Below the city name, the airport name is shown when different, which is most of the time. There are additional pieces of information as well. First is the four-letter identifier, if the identifier is made up of all letters and no numbers. If there are numbers in the identifier, then only the three-alphanumeric identifier is shown.

The airport identifiers were added on the enroute charts so that it would be easy to have the identifier handy for entering into GPS panel-mounted and hand-held receivers that have airborne databases. The U.S. and Canada airport identifiers include three-letter, three-alphanumeric, and four-alphanumeric identifiers. Outside the U.S. and Canada, airports have four letters, because the International Civil Aviation Organization (ICAO) has a standard of four letters for all airport identifiers. The identifiers in GPS databases work consistently for entering three or four characters within one receiver, but there are no standards from one receiver to the next. The FAA and Canada are working on a solution so that you can always know exactly what identifier to enter for an airport. The identifiers for FMSs almost always use the four-letter ICAO identifier for accessing airports.



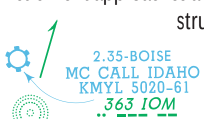
To the right of the airport identifier is the elevation for each airport, followed by the length of the longest runway rounded to the nearest 100 feet, using 70 feet or higher as the rounding value.

The Council, Idaho, airport is named Council Municipal Airport. The letters following the small dash before the letters "Mun" show the abbreviation for a municipal airport. The council airport has a three-alphanumeric identifier of U82.

NDB Navaids

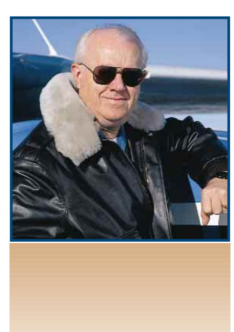
At Mc Call, Idaho, there is an NDB near the airport with the same name. This is shown by the frequency of 363 kHz and the three-letter identifier IOM below the airport identifier. To differentiate the information and make it easier to see, the NDB information is in green.

Most NDBs in the United States are used for instrument approaches and are not part of the airway structure, so the NDB information is not included in a navaid facility box. The NDBs are frequently near an airport, so the information is included with the airport when the name of the airport and NDB are the same. This saves space on the face of the chart and makes them easy to find because of their association with the airport.

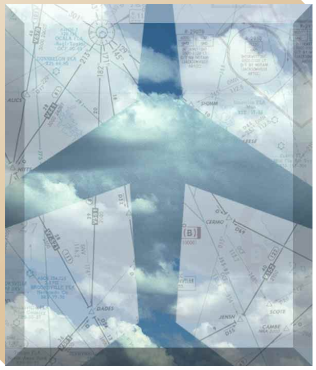


There is an interesting exception to the NDBs in the United States. At Hailey, Idaho, there is an NDB that also is used to form three airways in and out of Hailey (Hailey is the airport for the Sun Valley, Idaho ski area). The Hailey NDB forms Victor 101 and 484 so is depicted using a navaid facility box. Hailey also has a DME, so the DME channel of 25 and the civilian frequency of 108.8 MHz are included below the NDB facility box. It is relatively common to have a DME located at an NDB in many places around the world.

In the next issue, we will further explore the designation of airways, MEAs, MOCAs, etc.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Sixth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Running up and down Kill Devil Hill at Kitty Hawk, North Carolina, the Wright Brothers' primary concern was whether or not they had a steady, strong breeze. When Orville's 12-second, 120-foot flight finally launched off the track on December 17, 1903, the traffic pattern was clear except for a few birds. But things have changed in aviation. If the Wrights made the same flights today, they would need one mile visibility and have to remain clear of clouds as long as they stayed less than 1,200 feet AGL. That same flight today proceeding four miles east would be in Warning Area W-72A and proceeding 12 miles southwest, it would be in Restricted Area R-5314C.

As the numbers of aircraft, pilots, and flights increase, so does the amount of designated airspace. Each additional airspace designation seems to carry with it new equipment requirements, such as transponders, encoding altimeters, TCAS, and other sophisticated types of avionics gear.

Controlled Airspace

Over the years, the lack of controlled airspace has instead become an abundance of controlled airspace. Many of us grew up in the aviation world with Terminal Control Areas (TCAs), Continental Control Area, Positive Control Area, and other types of airspace with names that implied their meaning. But that has all changed. Back in September of 1993, the FAA decided to change the naming conventions of different types of airspace to match the terms used by ICAO.

That is good news and bad news. The good news is that the airspace classifications that we learn will help all of us understand requirements that are essentially the same all over the world. One type of controlled airspace labeled with a letter is supposed to be the same regardless of where in the world we fly. Also, since the letters of the alphabet closer to the letter "A" are generally more restrictive, the system is logical. The bad news? Letters have no intuitive meaning. The term "Positive Control Area" definitely said something by its name. The term "Terminal Control Area" implied a meaning for the airspace around an airport. Now, Terminal Control Areas have become Class B airspace and Positive Control Areas are Class A airspace.

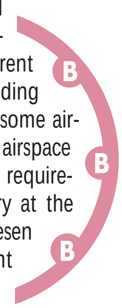
Class A Airspace

Class A airspace is the most restrictive and requires the most amount of pilot experience and control by ATC. The classes of airspace were created and then specified in FAR Part 71. This FAR also says if there are overlapping types of airspace, then the one that is the most restrictive is the one that applies. In the United States, Class A airspace begins at 18,000 feet MSL and extends up to FL 600. Class A airspace does not include any airspace less than 1,500 feet above the ground (a small area above Mt. McKinley in Alaska). All aircraft in Class A airspace must be operated under an Instrument Flight Rule and the pilot must have at least an instrument rating. Above FL 600? Well if you can get there, you are back in Class E airspace.

There is no symbol that is used for Class A airspace since it covers the entire United States. A note on the front panel of the high altitude enroute chart states that all the airspace in the U.S. and Canada at and above 18,000 feet MSL up to and including FL 600 is Class A airspace.

Class B Airspace

In the mid 1970s, the FAA created a new type of airspace surrounding about 21 terminal areas in order to have more complete control over all aircraft operating in that airspace surrounding the airport. The current Class B airspace is an inverted wedding cake concept which allows flights for some aircraft beneath the edges of the Class B airspace without meeting all of the Class B requirements. The Class B airspace boundary at the uppermost level is shown on the Jeppesen enroute and area charts by a light magenta shaded area. Inset in the Class B line is the capital letter B to additionally identify the airspace type.



The equipment, pilot, and other requirements for Class B airspace operations are included in FAR 91.117, 91.131, and 91.215. In the beginning of TCAs, there were three different classes which had different requirements, but all Class B airspace is under one category, and the operation, equipment, and pilot requirements are the same for all Class B locations.

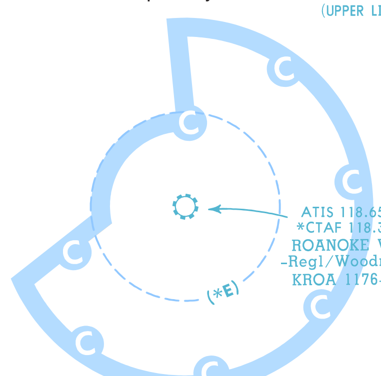
A requirement for a 4096 code transponder with mode C automatic altitude reporting capability is associated with Class B airspace, but the boundaries for the transponder requirement are not exactly the same as the Class B airspace. The transponder requirement is for all operations within 30 nautical miles of a Class B airport up to 10,000 feet MSL or the ceiling of Class B, whichever is lower. When the change was made for the mode C requirement from 10,000 feet MSL all the way down to the ground, it became know as the "Mode C veil" since it did not match the floors of the different Class B sectors. A listing of the 33 Class B airports with Mode C veils can be found in FAR Part 91, Appendix D, Section 1.

The maximum airspeed below the Class B airspace area is 200 knots and the max speed inside the Class B airspace is 250 knots even though the maximum speed below 2,500 feet above the surface and within 4 nautical miles of a Class C or D airport is 200 knots. The FAA is currently experimenting with eliminating the 250-knot maximum airspeed within Class B airspace.

Class B airspace charts are included as 10-1A charts at the beginning of each of the Jeppesen approach charts at airports where Class B airspace is in effect. The Class B charts show the designated vertical and horizontal limits of each sector. A textual description of the Flight Procedures is also included on the Class B pages.

Class C Airspace

The airspace around airports formerly known as Airport Radar Service Areas (ARSAs) is now Class C airspace. Two-way radio communications with the appropriate ATC facility (usually approach control) are required prior to entry into this airspace. The airspace around Class C airports has a speed limit of 200 knots for aircraft at or below 2,500 feet above the surface within 4 nautical miles of the primary airport. A transponder with Mode C altitude reporting is required within the limits of the Class C airspace. The symbol for the Class C airspace around an airport is similar to the Class B airspace symbol. The



main difference is that the Class C airspace symbol is blue and contains the letter "C" on the perimeter. The top of the Class C airspace around each airport is included below the box which includes the name of the airport in the Class C airport. At Roanoke, Virginia, note the upper limit of the Class C airspace is 5,200 feet.

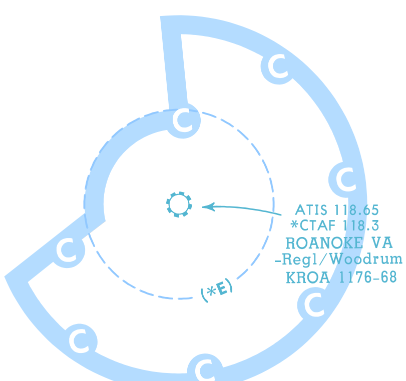
Class D Airspace

The airspace formerly known as Airport Traffic Areas has been classified as Class D airspace. These are airports where there is an operating control tower. Anyone operating in Class D airspace must establish two-way communications with the tower before operating in the airspace. The same maximum airspeed regulations apply to Class D airspace that are in effect within Class C airspace. A Mode C transponder is not specifically required, however.

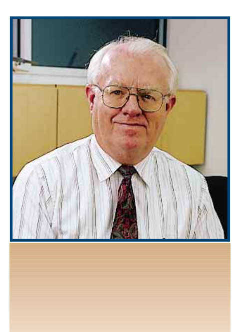
If there is Class D airspace around an airport, you can tell by looking at the dashed line surrounding the airport. A letter "D" will be included in parentheses in the dashed line.

Class E Airspace

There are two principally different areas for Class E airspace. All airspace at and above 14,500 feet MSL is controlled airspace and is known as Class E airspace. This area was formerly known as the Continental Control Area. Class E airspace around an airport was established for one purpose -- to keep VFR pilots out of the designated airspace when the ceiling becomes less than 1,000 feet or the visibility less than three statute miles. The size and shape of the Class E airspace is based on the type of IFR approach into the airport. Class E airspace is shown with a dashed line with the letter "E" included within parentheses in the dashed line. The designation of controlled airspace is included on the IFR charts to let the instrument pilot know when it is necessary to change from VFR to IFR.

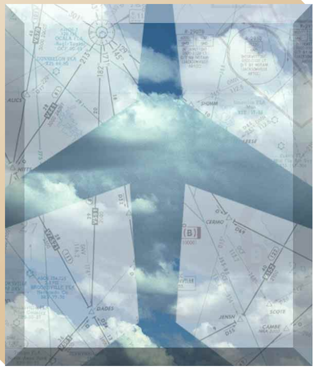


Class E airspace around an airport is an often misinterpreted section of airspace. It does **not** need to have a control tower. It does **not** need a Flight Service Station. In order for Class E airspace to be established around an airport, there must be some type of approved weather reporting service. This reporting can be done by tower personnel, FSS personnel, or any other person approved by the National Weather Service. There are some locations where an ASOS (Automated Surface Observation System) is used to provide the weather in Class E airspace. In the next article, we will continue with controlled airspace and special use airspace.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email:
JimTerps@jeppesen.com

JEPP'S BRIEFING



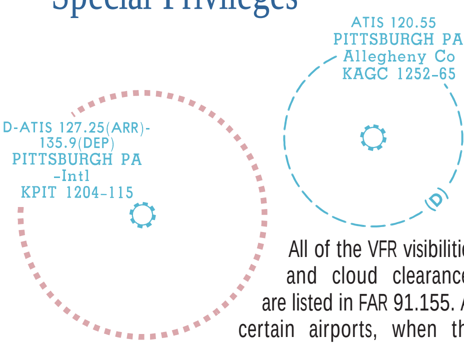
The Chart Clinic – Seventh in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

It was about an hour before sunset. Sitting on the ramp at Centennial Airport we could see the sun shining to the west. We wanted to go out and practice some air work before dark. But the ATIS was reporting the ceiling to be 800 feet overcast with a visibility of 10 miles. It sure felt like VFR with all that visibility, but anything below a ceiling of 1,000 feet at Centennial with its control tower makes the airport IFR. Now the question -- can we depart the airport VFR and go out to do some air work?

Time to get out the area chart and look at the controlled airspace boundary lines around Centennial Airport. Is it made up with dashed lines? Or is it made up of those small magenta squares?

Special Privileges



All of the VFR visibilities and cloud clearances are listed in FAR 91.155. At certain airports, when the weather conditions are less than 1,000-3, you can exercise the special VFR privileges listed in FAR 91.157. At any airport within Class C, D, or E airspace, shown on the chart as a series of dashed blue lines, such as Pittsburgh Allegheny County Airport shown in the accompanying illustration, you can request and receive a special VFR clearance if the visibility is at least one mile and you remain clear of clouds. Special VFR is not authorized, however, at Pittsburgh International Airport. As shown in the illustration, this is made clear by a series of shaded magenta squares outlining the Class D airspace.

Part-Time Controlled Airspace

The blue dashed line around South Lake Tahoe includes the letter "D" which is prefixed by an asterisk. The asterisk indicates the Class D airspace is only in effect on a part time basis. To determine the hours when the Class D airspace is in effect, the back panel of the enroute chart has a complete listing of all the part-time Class C, D, and E airspace on the chart. The listing for South Lake Tahoe shows that the Class D airspace is effective from 0800 to 2000 local time. When the Class D airspace is not in effect, note that the airspace becomes Class G for the other times (O/T). Note that the effective hours are shown as *local time* on the Jeppesen charts.

Bases of Controlled Airspace

In the United States, the base of the controlled airspace starts either on the surface, at 700 feet AGL, 1,200 feet AGL, or a designated MSL base altitude. When the base of the controlled airspace is 700 feet AGL, that airspace is designated as a transition area. The base of the controlled airspace on airways is 1,200 feet AGL and extends four nautical miles on both sides of the airway centerline. Some transition areas also have a base of 1,200 feel AGL.

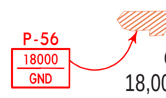
All airspace which is controlled below 14,500 feet is shown on the charts by the white areas. In the illustration, note that the airspace southeast of the Smith, Nevada airport is shaded. This means that the base of the controlled airspace southeast of Smith is at 14,500 feet MSL, which is the base of the Class E airspace. What does this mean? If you depart the Smith Airport as an FAR 91 operator, you can fly southeast bound in IFR weather conditions without an IFR flight plan and without an ATC clearance. This may be legal, but remember that ATC has no jurisdiction over that airspace below 14,500 feet and, therefore, does not provide separation.

For an IFR flight from Smith to South Lake Tahoe, the situation changes. You cannot penetrate the controlled airspace to the west of Smith without an IFR flight plan and an ATC clearance.

Special Use Airspace (SUA)

Large chunks of airspace are reserved for military operations and other special interest groups. These types of airspace fall into the general category of special use airspace and are commonly referred to as SUAs. SUAs include prohibited areas and restricted areas. Warning areas and military operations areas are technically not special use airspace which are designated in FAR Part 73, but are similar because of the types of restrictions and activities.

No flights are allowed within ***prohibited*** areas. In the United States, the best known prohibited area is P-56 which encompasses the White House and Capitol Buildings in Washington, D.C. The box adjacent to the special use airspace designation includes the upper and lower limits of the area and indicates that P-56 extends from the ground to 18,000 feet.



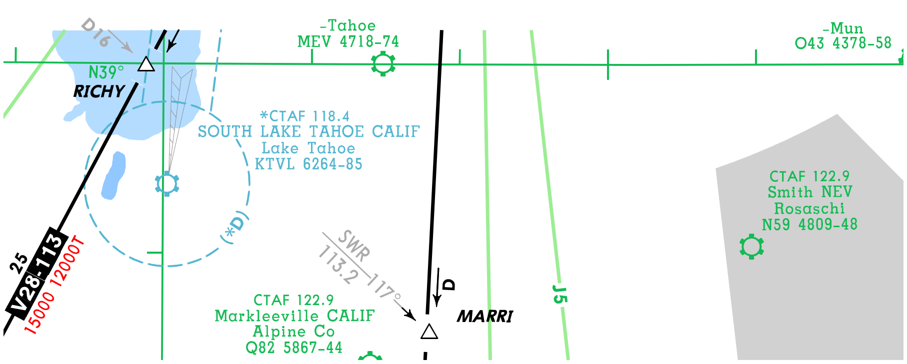
An area designated as a ***restricted*** area denotes the existence of unusual and often invisible hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Unauthorized penetration of these restricted areas could ruin your whole day. Approval to operate within the restricted areas can be obtained through communications with air traffic control centers, flight service stations, or the controlling agency. Restricted area R-2517 northwest of Los Angeles extends out to sea only three miles, and warning area W-532 extends out beyond the three-mile limit. (The three-mile limit, established in the 1700s, was the range of a cannon.)

To proceed through a restricted area when operating IFR, simply file a flight plan via the airways that proceed through that restricted area. If the clearance is received "cleared as filed," authorization is granted to proceed through the restricted area. It may be a bit chancy to file through the restricted area because two different things could happen. First, your IFR clearance might not come back as "cleared as filed," and then it will take some time to copy a new clearance and figure out a new set of routes and ETAs. Additionally, if the clearance does come "as filed," it is possible that the center will issue an amended clearance once you are enroute if ATC is notified by the military that they are using the restricted airspace.

Warning Areas

A warning area is airspace extending from three nautical miles outward from the coast of the United States and contains activity that may be hazardous to nonparticipating aircraft. The purpose of warning area is to warn nonparticipating pilots of the potential danger.

Activities conducted within ***warning*** areas may be as hazardous as those in restricted areas; however, warning areas cannot be designated by the FAA as a restricted area because they are over international waters not subject to FAA restrictions. The FAA claims jurisdiction over the airspace out to 12 nautical miles. Warning areas are regulatory from 3 to 12 n.m. and nonregulatory beyond 12 n.m.

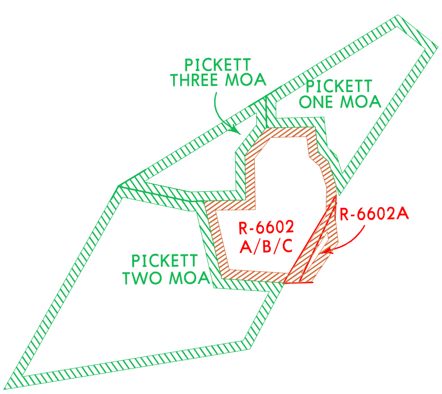


Military Operations Areas

There are a number of locations throughout the United States where military operations are conducted that are unlike those in restricted or warning areas. These areas are called ***Military Operations Areas*** (MOAs) and are designated on charts only in the low altitude airspace. On the charts, MOAs are depicted with their lateral boundaries, but the vertical limits and hours of operation are included on the panel of the charts with the name of the controlling facility. In the illustration, the Pickett MOA is divided into three different areas with different vertical limits. The details are on the chart panel.

When flying VFR, you can fly through these areas without getting a special clearance; however, it is obviously important to be on alert for military activity. When flying IFR, a flight plan through an MOA will usually be approved. But frequently there are operations in the MOA that require ATC to give an IFR clearance around the MOA. If that happens and the new routing is significantly longer, it is wise to check on the altitudes of the MOA, because frequently a lower or higher altitude may allow you to avoid the MOA by flying below or above it.

There are a couple of things about MOAs that are not very well known. Most MOAs extend into the high altitude airspace but you as a pilot have no way of knowing where these areas are located. These areas exist by special letters between the military and the FAA and are called ATCAAs. In the areas where the MOAs extend into the high altitude, they usually extend to FL240, but can extend much higher.



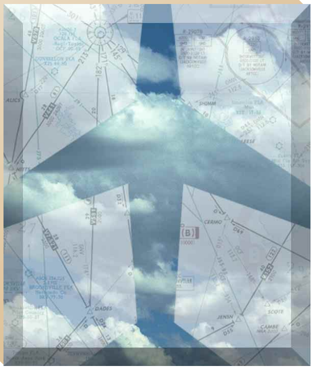
Restrictive Airspace Symbology

The boundaries of restricted areas and military operating areas have a slightly different look. The boundary around R-6602 has more hashes per inch than the boundaries that depict the Pickett military operations area. Prohibited areas use the same boundary as restricted areas whereas warning areas have the same boundary as MOAs.

The difference between the symbols signals that a clearance is required prior to entering the special use airspace. Areas that are depicted with the higher intensity symbol require communications prior to entry. Areas depicted with the more widely spaced hash lines symbology do not require communications or a clearance, but show areas where you should exercise extra visual surveillance for unusual flight activity.

In the next article on Jeppesen charts, we will consider the symbols used to make up the airway structure, the symbols and uses of MEAs, MOCAs and MRAs.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Eighth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

When driving your car and cruising along Interstate Highway 70, you have a road map and a *constant* series of highway identification signs telling you where you are and when to change highways when you want. Flying along V-70, you have an enroute navigation chart—but *no* airway identification signs to see out the window. The only way you even know you are on the right airway is by a panel full of knobs, dials, buttons, CDI needles, HSIs, some electronic displays, etc. Maybe that's why pilots are a different "breed of cat." That's why Jeppesen puts so many symbols on our charts.

Let's look at the depiction of those highways in the sky. During most of this discussion, refer to the illustration which is an excerpt from US(LO)7 near the Great Falls, Montana area.

Airway Designations

Originally, our airborne highways were numbered the same as the ground highways beneath them. As an example, V-2 from Seattle to Boston closely parallels U.S. Highway 2 across the northern United States. Also, the even numbered airways generally run east and west, whereas the north-south airways are labeled with the odd numbers similar to the Interstate highway numbering system. Note that V-21 (odd number) runs north and south near the Great Falls VORTAC.

All airways in the United States are formed by ***magnetic*** radials from VORs (and a couple NDBs). The design using magnetic was incorporated so the airplane's magnetic heading corresponds with the magnetic radial in a no-wind condition. There are a number of aviation committees working on the possibility of converting *everything* to true instead of magnetic, but the obstacles to a conversion make the transition a very difficult project.

Due to the high magnetic variation values near the North Pole, courses which define airways from a VOR or NDB in the Northern Domestic Airspace of Canada are designated as ***true*** rather than magnetic. On the enroute charts, the airways in the Canadian Northern Domestic Airspace are designated as true by using the letter "T" which follows the degrees in true from the facility which forms the airway.

Minimum Altitudes

FAR Part 91.177 states that no person may operate an aircraft under IFR below the applicable minimum altitudes prescribed in Parts 95 and 97. All of the MEAs, MOCAs, MRAs, and MCAs found on the charts are those altitudes prescribed in Part 95. (Part 97 defines the minimum altitudes for instrument approach procedures). This means each Victor airway has a usable envelope with a base at the MEA or MOCA, and the top at 17,999 feet. The MEAs and MOCAs on the charts have a 2,000-foot obstruction clearance criteria applicable in mountainous terrain and a 1,000-foot obstruction clearance for non-mountainous terrain. For a chart depicting the mountainous terrain, refer to Jeppesen Enroute page US-3.

In the enroute chart illustration, refer to the numbers 11000 and 10300T on V-187 (Great Falls 106 radial). The 11000 represents the minimum enroute altitude (MEA), and the 10300T represents the minimum obstruction clearance altitude (MOCA). Both the MEA and MOCA provide the *same* obstruction clearance. The only difference is that radio navigation signal coverage is provided along the *entire* airway segment at the MEA, but the MOCA provides radio navigation signal coverage only within 22 nautical miles of the VOR. From an application standpoint, what this means is that if you are cleared for an approach while still on an airway, you can descend from the MEA to the MOCA when within 22 nautical miles from the VOR.

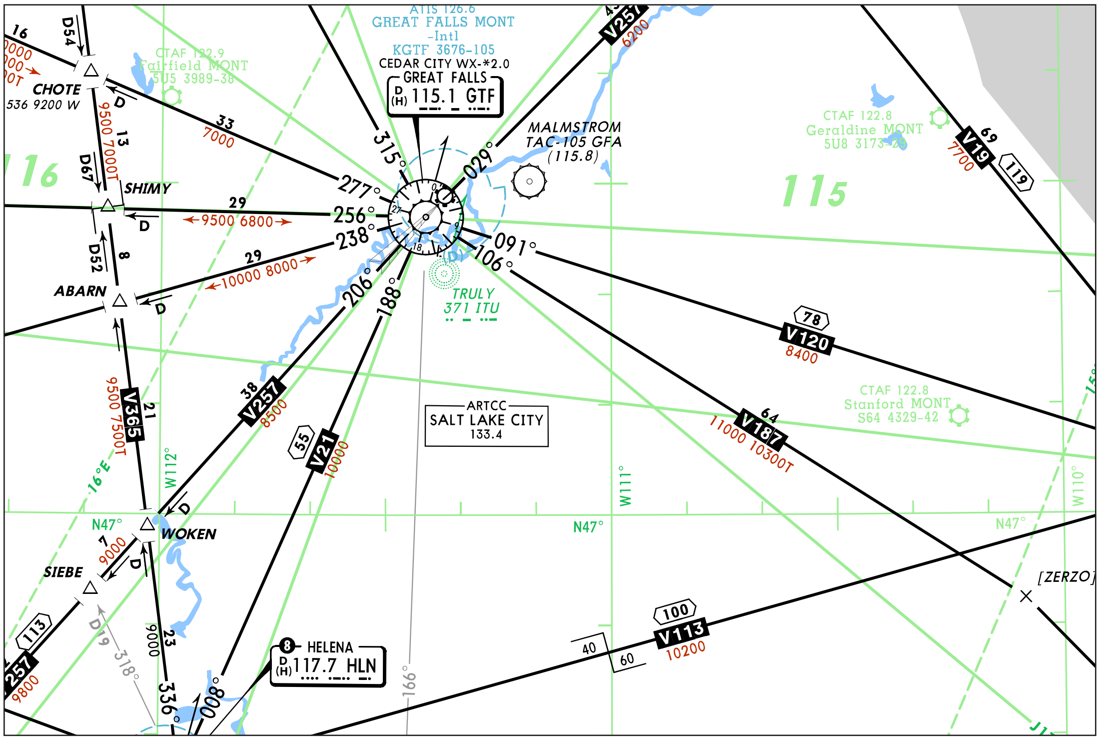
West of the Great Falls VORTAC on the 256 radial, note there are two different MEAs. The 9,500-foot altitude is the MEA westbound and the 6,800-foot altitude is the MEA eastbound. The different MEA values are used because of minimum climb gradient values which must be considered westbound from Great Falls. No minimum *descent* gradient values have been established; therefore, when flying eastbound to Great Falls, you may descend (if cleared to do so) to 6,800 feet after crossing Shimy Intersection.

On V-120 (GTF 091 radial), only one minimum altitude is stated. In this case 8,400 feet can be considered *both* the MEA and the MOCA since both altitudes have the same obstruction clearance.

Proceeding westbound from Great Falls on the 277 radial, the MEA changes from 7,000 to 10,000 feet crossing Chote Intersection. When the MEA changes at an intersection, a small "T" bar is at the end of the airway line designation, next to each intersection. There is no MEA change southeast of Great Falls on V-187 (106 radial); therefore, the airway line proceeds to the "X" and stops without the small "T."

Mileages/Changeover Points

The numbers adjacent to the airway designators, and enclosed in the six-sided box, represent the total distance between navigation facilities. When an airway between navaids is broken by intersections, the various leg lengths are shown by numbers not enclosed in a box. The segment distances are included between any combination of navaids, intersections, and mileage breaks. As an example, the number 78 in the six-sided box above the designator for V-120 indicates the total distance on that airway between navaids. On the next airway to the south (V-187), the distance of 64 is only from the VOR to the "X."



The FAA has defined points between navigation facilities along airways which are called changeover points (COPs). The COPs indicate you should change over your navigation equipment to the facility ahead from the navaid behind you.

The COPs assure continuous reception of navigational signals at the MEA and also assure that you will not receive azimuth signals from two different navigation facilities on the same frequency. ***Every airway has a changeover point.***

Even though V-120 (GTF 091 radial) does not have a COP symbol, the changeover from navaid to navaid is technically at the midpoint, or 39 nautical miles. When flying eastbound from Great Falls on V-187 (GTF 106 radial), the changeover point is at the bend in the airway. In most cases when a mileage break (designated by the letter "X") is found on an airway, it can be considered as the COP, even if a turn is not obvious.

When the changeover point is not at the midpoint or a mileage break, a COP symbol is placed on the airway. When flying eastbound on V-113 from Helena, you should change over to the next navaid when 40 nautical miles from Helena. There also is a COP at the Shimy Intersection (HLN 336 radial) when flying on V-356. There are no mileages indicated on the COP at Shimy, since the DME mileages are included on the airway. When the COP is not at an intersection, the distances to each navaid are included with the COP symbol.

Intersections

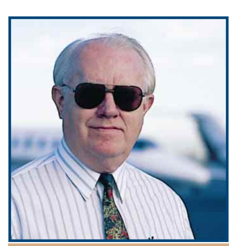
Intersections on airways, also known as reporting points, are used for ATC purposes, locations for altitude changes, and as transition points to depart the enroute structure for an approach. If the intersection is a non-compulsory reporting point, it will be depicted as an open triangle. Compulsory reporting point intersections appear as a solid triangle. The "X" symbol east of GTF is not an intersection, but a bend in the airway which is also called a mileage break. Because these fixes are in Jeppesen's database, the database identifier [ZERZO] is included in brackets for the use with airborne databases. The FAA is in the process of naming all these fixes with unique five-letter names. These fixes are called computer navigation fixes (CNFs), and are not to be used in communication with ATC.

To determine which facilities form an intersection, a couple of different symbols are used. The Abarn Intersection (GTF 238 radial) is formed by the radials from Great Falls and Helena. This is indicated by the small arrows adjacent to the airway line next to the intersection ***from*** the forming facility. Note that there is a small letter "D" under the arrow near Abarn Intersection which points from the Great Falls VORTAC. This means that Abarn Intersection can be identified using DME from GTF. Even though the Helena VORTAC has DME capability, the Abarn Intersection ***cannot*** be identified using the DME from Helena since the letter "D" is not located adjacent to the forming arrow. It is apparent that everything from the Helena VORTAC is OK, but the lack of a DME formation from HLN at Abarn may be an FAA oversight.

Southwest of Great Falls on the 206 radial is the Siebe Intersection, which can be identified *only* by using the radials from Great Falls and Helena. (Siebe can be formed by the DME from Helena but that surely isn't practical when flying the airway.)

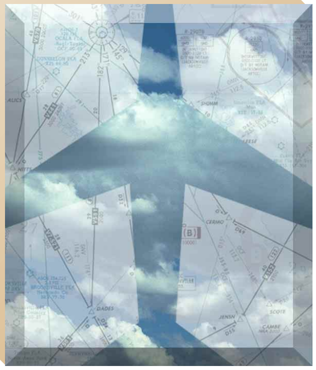
The depiction of the DME distance is portrayed differently depending on whether the intersection is the first fix from a navaid or if it is beyond the first fix. When an intersection is the first reporting point from a VORTAC, the leg distance can be used as the DME distance; therefore, the letter "D" stands alone without the DME distance designation. Since the Shimy Intersection is not the first intersection away from Helena, but can be identified by a DME distance, the leg segment distance can't be used without adding it to the previous leg distance. To avoid mathematics, the distance of 52 is specified next to "D" by the Shimy Intersection.

In the next article on airway chart usage we'll look at the FAA's new announcement on using GPS as a substitute for DMEs and NDBs and continue the discussion of the enroute charts.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING



The Chart Clinic – Ninth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

It's pretty obvious that the shortest distance between two points is a straight line. When flying, one can argue whether that is a geodesic line, a great circle line, and whether or not either one of those is accomplished by drawing a straight line on a piece of paper. And when that flat piece of paper represents a portion of our round world, it becomes even more interesting – and maybe a bit confusing. But the real challenge is to make the shortest distance a reality – in a world of airways that zig zag across the country.

Do you have to fly the airways? What about altitudes on your own direct routes? What about radar coverage? What about communications coverage? What about GPS?

Off-Airway Navigation

There are a number of ways to create shorter routes and fly off the airways. Two series of Jeppesen charts can be used to draw direct routes. The easiest is the RNAV enroute series which uses 11 charts to cover the entire U.S. In the next article, we will discuss the RNAV enroute charts and concentrate this month on the conventional IFR charts.

The Jeppesen low and high altitude enroute charts can also be used to create direct routes. However, many of the charts do not share the same scale as the adjacent chart, so a straight line is virtually impossible to use as a direct route for long distances. On the high altitude charts, the west half of the U.S. is charted at the same scale of 40 nautical miles to the inch. In the east half, the scale is 25 miles to the inch so it is possible to plot longer distances on the high charts.

Precision Plotting

Are Jeppesen charts plotted accurately enough to draw a direct route that can be flown? Generally speaking, yes. If the charts were not plotted accurately, a straight line drawn adjacent to a restricted area may in fact penetrate the restricted area. Jeppesen uses a computer graphic system which generates and maintains the charts. The computer graphic system uses the same navigation database that is the basis for most airborne FMS and GPS databases. Because of this compatibility, *all* information which has a latitude and longitude is plotted at precisely the exact location where it exists on the earth.

So-called "attribute" information about a facility, such as frequencies, identifiers and names, are *moved away* from the VOR so that the attributes can easily be read. Other exceptions? When the missed approach point is on the end of the runway, the small triangle used to depict the MAP in the plan view will be moved slightly toward the FAF so it can be read. Otherwise, the runway symbol would cut up the triangle so badly that it wouldn't be easily discernible.

What all this accuracy really means is that a straight line drawn on a Jeppesen chart *can* be used to determine if a direct route will avoid airspace such as Class B airspace, restricted areas, prohibited areas, etc. Because Jeppesen uses the Lambert Conformal Conic projection for the enroute charts, a straight line is as close as possible to a geodesic line (better than a great circle route.) The closer that your route is to the two standard parallels of 33° and 45° on the chart, the better your straight line. *There are cautions, however.* Placing our round earth on a flat piece of paper will cause distortions, particularly on long east-west routes. If your route is 180° or 360°, there is virtually no distortion in the course line.

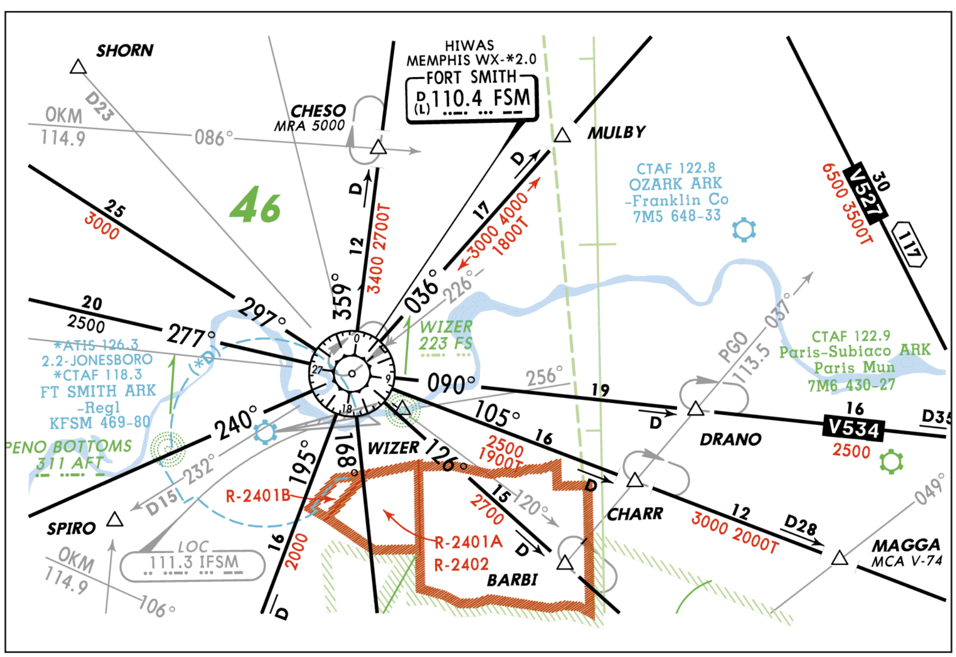
About the only way to precisely determine if you have accurately flown adjacent to the restricted airspace is by the use of some of the airborne Jeppesen GPS databases which include a graphic display of the airspace on the GPS receiver display. But, from a practical standpoint when not using an airborne database, leaving a few miles as a buffer will ensure that you stay away from protected airspace.

In the illustration below, a straight line from the Paris Municipal (Arkansas) Airport to the Fort Smith Regional Airport will pass just north of restricted area R-2401A and B and R-2402. Since both airports and the restricted areas are precisely plotted, there is an assurance that you will stay north of the restricted areas. From a practical standpoint, it might be smart to go direct from Paris to the Wizer NDB. This route will go even further north of the restricted areas and place you over the final approach fix to runway 25 at Fort Smith.

VORs for Direct Route Navigation

One of the most common means for flying direct routes is to use conventional navigation such as VORs. When flying direct off-airway routes, remember to apply the FAA distance limitations. The FAA has established an operational service volume for each class of VHF navaid to ensure adequate signal coverage and frequency protection from other navaids on the same frequency. The maximum distances vary with the altitudes to be flown. When using VORs for direct route navigation, the maximum distances between navaids specified with the appropriate altitudes are as follows:

Below 18,000'	80 NM
14,500' to 17,999' using H class navaids	200NM
18,000' to FL450	260NM
Above FL450	200NM



There are times when ATC will initiate a direct route that exceeds the stated distances. When that happens, ATC will provide radar monitoring and navigational assistance as necessary.

GPS for Direct Route Navigation

The use of GPS for direct route navigation has made the job of flying direct *much* easier. Most handheld GPSs, as well as all panel mount GPS receivers, have a navigation database, so the entry of destinations as well as waypoints is simply a matter of knowing the identifier of the place you want to go.

The FAA acknowledges there is an "increasing use of self-contained airborne navigational systems which do not rely on the VOR/VORTAC/TACAN system." When filing for long direct routes using GPS and not the VOR navaids, the routes will be *approved only* in a radar environment. In this case, you are responsible for navigating on your direct route. ATC is there for ATC purposes, not for providing navigation.

GPS as a Substitute

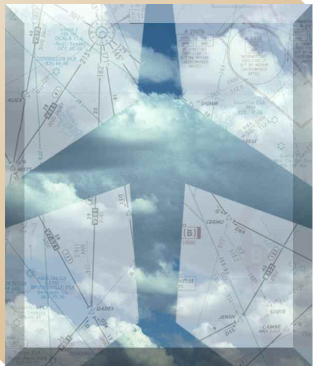
The FAA recently issued a notice announcing that GPS can be used as a substitute for all DMEs and NDBs in the United States. This has many interesting implications. Let's assume ATC asked you to report passing the CHARR Intersection southeast of Fort Smith VOR on the airway. Using the VOR to navigate on the 105° radial, when the GPS reads 16 miles from FSM, you would be at the CHARR intersection. The GPS distance from FSM would be legal as the formation. From a more practical standpoint, it would be easier to enter CHARR in the GPS receiver and have the intersection called from the database. In this case, the GPS would continuously read the distance to go to CHARR, and the GPS would also continuously provide the time to get there.

The GPS is now authorized to navigate to and from an NDB and to determine when you are over the NDB position. For the direct route from Paris, Arkansas, to the Wizer NDB, the GPS can be used for both navigating and determining position, but the coordinates for the Wizer NDB must be retrieved from the GPS airborne database. Additionally, the database must be current. One of the nice features of this authorization is that the Wizer NDB could be out of service and the GPS could still be used to fly to the NDB's location.

Very important – in order to be authorized to substitute the GPS for NDBs and DMEs, the GPS avionics must be approved for terminal IFR operations. This new authorization essentially *deletes the requirement for an ADF receiver to be in the airplane*. There is one use that still remains for the ADF. It is still required to shoot an NDB approach which has not been approved as an overlay approach. Also, this authorization is good only for the U.S.

In the next issue, we will look at some of the RNAV charts, the high altitude enroute charts, and some charts outside the United States.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Tenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Back then we thought we were pretty sophisticated! Not by today's standards, but with the technology that was available then, maybe we were. Back in 1968, just the idea of not having to fly over navaids on an IFR cross country was brand new. Narco first sold their CLC-60 RNAV computer in 1968 and it was an amazing tool. It worked, but there was a lot of effort to create an RNAV flight plan. To create each waypoint, the bearing and distance had to be computed or plotted so the RNAV system knew where to electronically move a VORTAC.

That first RNAV computer used the existing VOR and DME receivers in the airplane as its input and then the user entered the radial and distance where to move the VORTAC. In the first RNAV computer, the system allowed an offset of only 42 nautical miles, but it was a computer which could be used to create and fly direct routes without having to fly over any existing navaid facilities.

This concept was so new, the use of RNAV would also create interesting discussions with controllers. While en route, there were times you wanted to go to an intersection via present position direct and the controller would ask, "Can you really do that in that little airplane?"

Off-Airway Navigation

In the previous article, we discussed flying shorter distances by flying off the airways. There are two series of Jeppesen charts that can be used to draw direct routes. The Jeppesen high and low altitude enroute charts are one of the ways to make it happen. The easiest is the RNAV enroute series which uses 11 charts to cover the entire U.S. Most of these charts are drawn to a scale of 30 nautical miles to the inch, so it is easy to place adjacent charts next to each other and have a straight line go across more than one chart. The Area Navigation Enroute Charts were first published in 1968 when Narco introduced their CLC-60 RNAV computer to the marketplace.

To look at the charts in a way they would typically be used, let's look at a flight from Centennial Airport just southwest of Denver, Colorado to Westcliffe Airport toward the bottom of the illustration.

For most airports on the chart, there is a tabular listing in front of the chart subscription series that gives detailed information for establishing a waypoint at an airport. As an example, look at the entry for Centennial. It lists the airport as "CENTENNIAL/DENVER" to include both the airport and city name. To the right of the airport name is the airport elevation of 5,880 feet. The next line includes Centennial's coordinates for those systems which can use coordinates but do not have a stored database of airport coordinates. To the right of the coordinates is the airport identifier.

Following the coordinates are two VORTACs or VORDMEs that are within 40 nautical miles of the airport with the bearings and distances to the airport reference point (ARP). At Centennial, the two navaids and their bearings and distances are Falcon (FQF) and Jeffco (BJC). With the RNAV systems that electronically move VORTACs, a waypoint can be created at Centennial by tuning to FQF's frequency of 116.3 and setting the bearing to 224.9° and the distance to 12.8 nautical miles and activating the RNAV function. Some RNAV systems have the ability to input the VORTAC elevation to automatically compensate for the DME's slant range distance. For those systems the FQF elevation of 5,789 feet would be entered.

Note that Jeffco is listed as the second navaid but it is not the second closest VORTAC to Centennial. The second navaid is selected for the listing at a location that may provide a better navaid if approaching from the west rather than having both VORTACs located very close to each other.

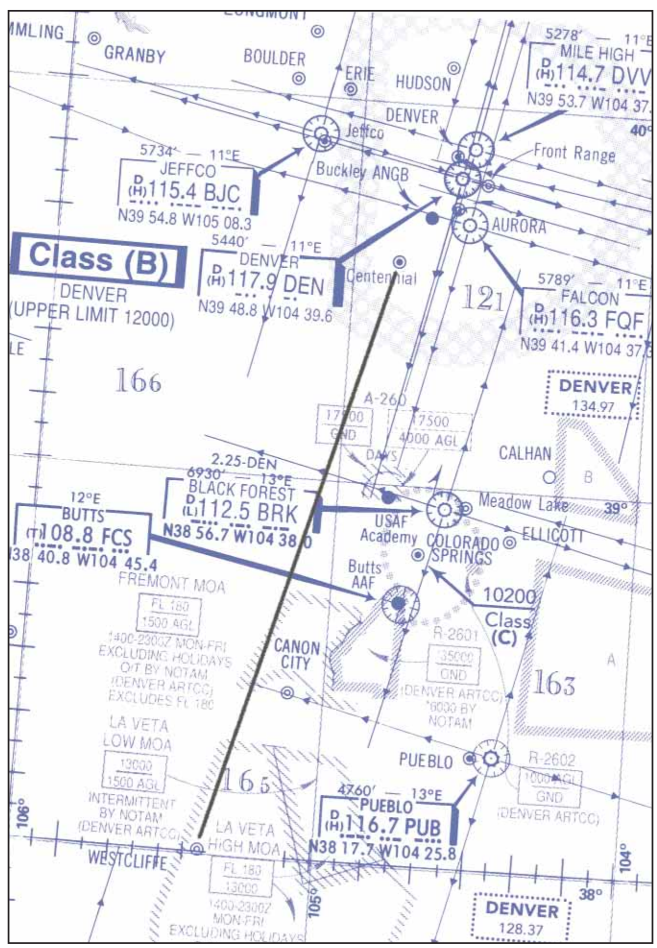
Since the flight is going to the south, the best navaid to tune when departing Centennial Airport is the Falcon VOR because it is the most southern of the navaids that are within reception range. Before departure, you would tune the VOR frequency to 116.3 MHz and enter 224.9 degrees and 12.8 NM into the RNAV computer. The magnetic course to set from Centennial is 185°. With the RNAV set up this way, you would fly with a FROM indication when departing Centennial.

There is another method for determining the RNAV bearing and distance offset that works better if the RNAV has a distance capability of 199 nautical miles or more. Since Westcliffe Airport is not that far away, you could calculate the bearing and distance from FQF all the way to Westcliffe and be able to depart Centennial with a TO indication and the distance to go would read the distance remaining to the Westcliffe. Since the bearing and distance from FQF to Westcliffe is 185° and 106.6 NM, these values set into the RNAV make it much easier to fly the route. Typically when departing an airport, the departure pattern is not on a straight line out of the airport. With the destination set in the RNAV, as soon as you are out of the pattern, you can set in the bearing to Westcliffe and that becomes the new magnetic course. *It's easier this way!*

CENTENNIAL/DENVER				5880
N39 34.2	W104 51.0		APA	
116.3	FQF	224.9/12.8		5789
115.4	BJC	135.8/24.5		5730

Determining Magnetic Courses

The magnetic course from Centennial to Westcliffe can be determined by a number of methods. The easiest method, of course, is a computer flight planning software package. But, since that is not always convenient when sitting at the airport or in the airplane, there is a Jeppesen plotter included with the RNAV charts that can be used to plot the course. If there is a GPS receiver in the airplane, the destination airport would be set in the GPS receiver and the magnetic course is automatically computed. In the VORTAC RNAV systems, the course has to



be pre-determined and set in the course selector before departing the airport to provide course guidance right after takeoff when the VOR is within navaid reception range.

Since the Falcon VOR can't be used for the *entire* flight, you will need to tune to the next VOR sometime after leaving Centennial. The first RNAV waypoint is easy to determine by looking at the route of flight and the location where it crosses the 270° radial of the Black Forest VOR. There are four cardinal compass points on the VOR which have radials extended 40 nautical miles from each VOR. The 40 miles is based on the FAA's service volume for "L" class navaids. Even though the VORs can be electronically moved much farther than 40 nautical miles, the reception range still is 40 NM for "L" class navaids. The service volume of the different classes of navaids is shown in a graphic on the RNAV charts.

On each of the four extended radials of the VORTACs, there are small tick marks spaced at 10 nautical mile intervals. By looking at the route of flight, you can see the route crosses the 270° radial at 19 miles. You can create a waypoint by tuning to Black Forest on 112.5 MHz, setting the RNAV bearing to 270° and the RNAV distance to 19 NM and engaging the RNAV function. When filing the flight plan, the waypoint description would be written as BRK270019.

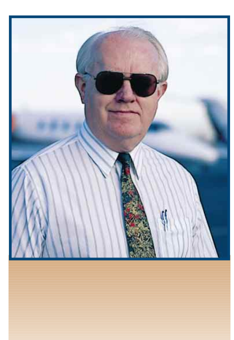
For the **altitude** on this flight, it is easiest to use the grid MORAs (minimum off-route altitudes) that are included at one-degree intervals. There is a number just to the east of Centennial Airport which contains a large number "12" and the smaller number "1." This MORA indicates the minimum flight altitude of 12,100 feet which will clear all terrain and obstacles by at least 2,000 feet. We will discuss more details regarding altitudes in the next article.

Long-Distance Flights

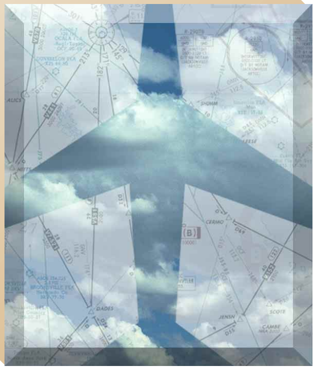
One of the most important items on the RNAV charts is the graphic portrayal of the special use airspace (SUA). One of the biggest problems in creating a direct route is trying to determine if the route will go through a prohibited or restricted area or MOAs. For most direct routes, the chances of going through special use airspace are good. The FAA says that all direct routes should be planned to avoid prohibited or restricted airspace by at least three nautical miles. If a bend in a direct route is required to avoid SUA, the turning point needs to be part of the flight plan.

For all random RNAV flights, there needs to be a least one waypoint in each ARTCC through whose area the random route will be flown. These waypoints must be located within 200 NM of the preceding center's boundary. When specifying these waypoints, they can be communicated in the flight plan using the frequency/bearing/distance format or latitude and longitude. All aircraft flying with latitude and longitude systems flying above FL 390 must use latitude and longitude to define the turning point. The format for latitude and longitude is four numbers for the latitude and five numbers for the longitude separated by a forward slash "/." As an example, a turning point at N39° 28.0' W104° 54.5' would be stated as 3928/10455 on the flight plan.

In the next article, we will look at the high altitude charts and some international charts.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Eleventh in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Imagine, for a moment, that you are flying DC-3s over the bush country of Africa or the jungles of South America in the 1940s and 1950s. NDBs were the main radio navigation aid and formed the few airways that did exist. And, failures of NDB ground stations in those days were not uncommon. VORs were starting to appear in the late 50s, but they were few and far between.

When the airway structures were being put together in early aviation, many governments simply provided the NDBs and connected them with only an airway name – and that's it. Airway A-1 (amber 1) would be published with the airway designator and sometimes a minimum reception altitude, but rarely would an altitude be provided for just obstacle clearance. This would mean that a minimum altitude would be provided for normal operations, but with an engine failure, there was no minimum altitude which provided obstacle clearance. When talking to pilots who flew in that era, they will almost always tell you about the numerous engine failures they had during their careers.

Pilots in those days started to ask Jeppesen to provide minimum obstacle clearance altitudes because of all the engine failures. Airlines needed them for drift down information. But governments weren't prepared to provide the information – and most countries still don't provide minimum obstacle clearance altitudes even today.

MORAs

The answer? We created MORAs – minimum off route altitudes. There are two types of MORAs – one is called a route MORA and the other is the grid MORA. Because of the imprecise navigation provided by NDBs and the ADFs used in the airplanes, the early route MORAs provided an obstacle clearance within 10 nautical miles on both sides of the airways and within a 10-nautical mile radius around the ends of the airways. The 10-nautical mile criteria is with us today. To create the route MORAs today, the enroute chart compilers at Jeppesen analyze the visual aeronautical charts for each respective location around the world to determine the ground elevations below the airways to produce the route MORA for each airway segment.

Not only did engines fail, but the NDBs and ADFs did also. But even more peculiar was the fact that some governments would turn their NDBs off if they thought no one was using them at the moment. It saved power, and no one would have to stand by the electrical generator to run the NDB.

This meant that even though the NDB was not very precise, sometimes they weren't even there. In that case, even the 10-nautical mile radius wasn't adequate. So – the grid MORA was created. The grid MORAs provided (and still do) an obstacle clearance altitude within a latitude and longitude grid block, usually of one degree by one degree.

Obstruction Criteria

In order to provide one standard for the whole world, the minimum vertical distance between the MORA and the highest obstacle along the route was determined to be either 1,000 feet or 2,000 feet, depending on the elevation of the terrain and obstacles below. When flying over precipitous terrain and when flying at higher altitudes, the amount of error between indicated altitude and true altitude increases. As a result, 1,000 feet of obstacle clearance was provided for the lower altitudes. For all terrain and obstacles greater than 5,000 feet, it was decided to create an obstacle clearance of 2,000 feet.

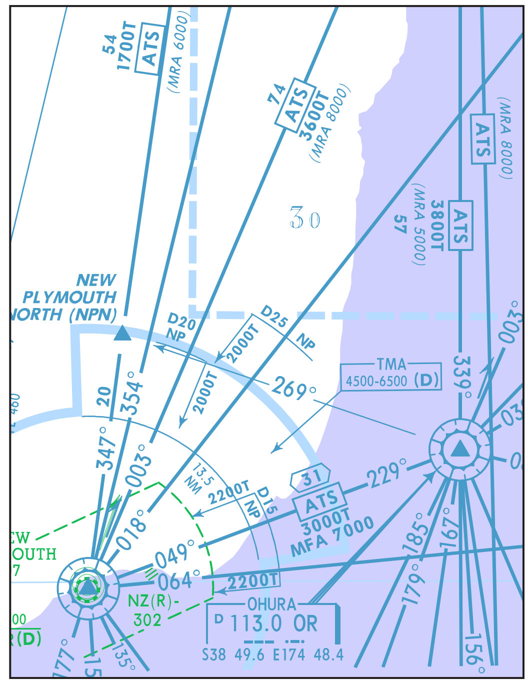
On Jeppesen charts, all MORA altitudes which are 6,000 feet or lower have an obstacle clearance of 1,000 feet. If the MORA altitudes are 7,000 feet or greater, the obstacle clearance is 2,000 feet.

Meanwhile, the FAA was also creating minimum altitudes that took into consideration the effects of precipitous terrain. The FAA created designated mountainous terrain which included a large portion of the western United States and some areas in the east. When the FAA creates minimum altitudes, they also use 2,000 feet of obstacle clearance, but the 2,000 feet only applies in designated mountainous terrain. There are some cases where the FAA provides obstacle clearance as low as 1,600 feet in the designated mountainous terrain area. The 1,600-foot value can be used when there are very good local altimetry sources and when the local terrain is not very precipitous.

In 1995, the FAA and the military liked the concept of the MORA and decided to create a similar concept. One of the difficulties with the MORA is that it provides *only* obstacle clearance. MEAs in the United States provide not only obstacle clearance, but they also provide a minimum altitude for reception of both navigation aids and communication, and they also are within controlled airspace.

Because the FAA and the military wanted the minimum altitudes to imply *only* obstacle clearance, they created a new minimum altitude called the Off Route Obstacle Clearance Altitude (OROCA) which meets the same criteria as Jeppesen's MORAs. One exception is that the OROCA provided by the FAA now includes 2,000 feet of obstacle clearance altitude only in designated mountainous terrain areas. The OROCA is also only provided in the United States by the FAA. The MORAs on Jeppesen charts in the United States are the same altitudes as the OROCAs.

An interesting irony? The MORAs which were created in the late 1940s have now again become very important. Engines and navigation are much more reliable, so they are not needed as much as they were for emergencies. But, with GPSs and FMSs, direct routes are flown off airways, and the only available minimum altitudes are the MORAs.

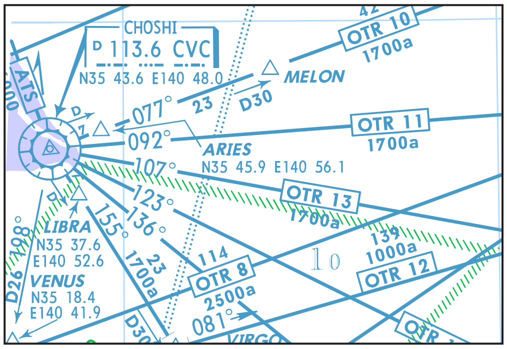


The grid MORAs are found on all the enroute and area charts. (This is not done in some areas where incomplete surveys of the terrain are provided by a government.) In the illustration above, northwest of the Ohura VOR in New Zealand, the value of 30 indicates that the MORA in the latitude/longitude grid bounded by S38° to S39° and E174° to E175° is 3,000 feet above sea level. The large numbers indicate the altitude in thousands of feet and the small number is the altitude in hundreds of feet.

In the illustration at the top of next column, east of the Chosi (Japan) VOR, the oceanic route OTR 11 has an altitude designated as 1700a. The letter "a" to the right of the altitude value indicates that this is a route MORA. There are not as many route MORAs as there were in the past because governments are specifying more minimum route altitudes than before.

Minimum Enroute Altitudes

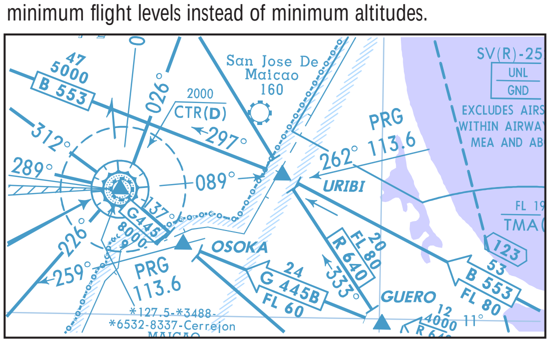
As an interesting note, the International Civil Aviation Organization (ICAO) does not have MEA as an official abbreviation. The MEA's are used only by the United States, Canada, and a few other countries.



In the United States, both the minimum enroute altitude (MEA) and the minimum obstruction clearance altitude (MOCA) are provided by official FAA sources. These altitudes are not provided by all governments, however. In the illustration at left, north of the Ohura VOR, the ATS (Air Traffic Service) route shows 3800T. The New Zealand government supplies a minimum obstacle clearance altitude, but not an MEA. The MOCA is 3,800 feet. There is no MEA on this route, but there is a minimum reception altitude (MRA) indicated by the MRA 5000 in parentheses. Northwest of the Ohura VOR are numbers 2000 followed by the letter T. These are associated with DME rings of 15, 20 and 25 nautical miles from NP. When these are depicted, this means the minimum obstacle clearance altitude inside these rings is 2,000 feet. These are used frequently in Australia and New Zealand as a way of indicating the minimum altitude when arriving at an airport and not flying on the airways.

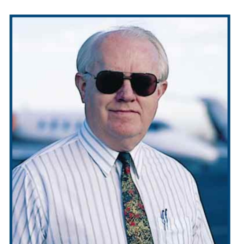
Note that the airway north of Ohura is simply labeled ATS which means it is an air traffic service route. *It does not have a unique airway identifier!* This means it has no way of getting into the airborne databases since it can't be uniquely identified.

In many countries, the minimum altitudes to be flown on airways are not really altitudes – instead they are flight levels. In the third illustration, shown below, the minimum altitude for B 553 is 5,000 feet on the northwest end of the airway and the minimum is flight level 80 on the southeast end of the airway. When the minimum is FL80, this means the altimeter will read 8,000 (feet) with the altimeter set to 29.92" or 1032.5 hectoPascals. The philosophy changes when you change from the Columbia to Venezuela when flying in South America. Most airways in Europe also have minimum flight levels instead of minimum altitudes.



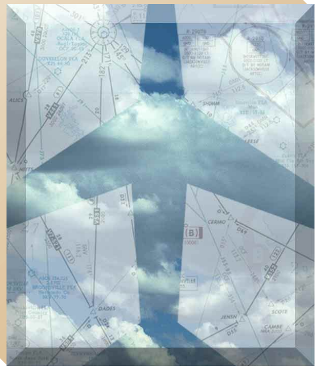
We have many areas that need worldwide standardization. Minimum altitudes for airways is one of them.

In the next article we will conclude the discussion of enroute charts.



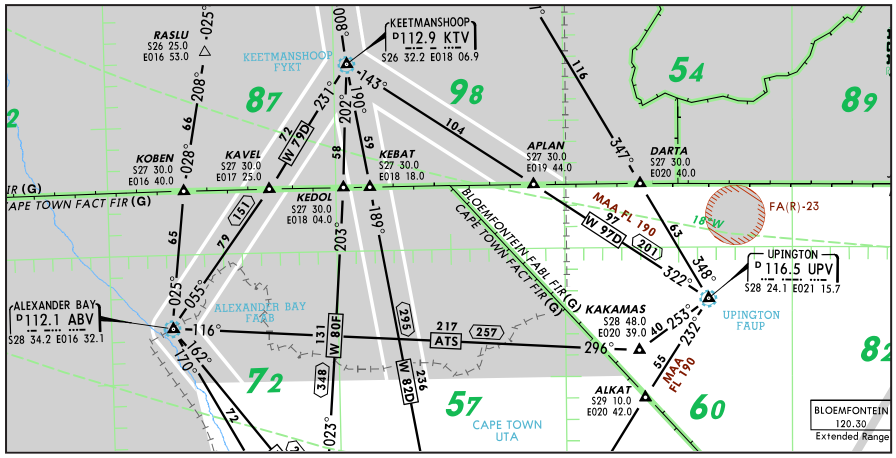
James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING



The Chart Clinic – Twelfth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen



the world. Note the airways near the Alexander Bay, Keetmanshoop, and Upington VORs. The Whiskey 97D (W 97D) airway on the 322 radial from the Upington VOR begins in controlled airspace which is depicted by an area that is completely white. After passing the Aplan intersection, the airspace around the airway is depicted in gray. On each side of the airway, a thin white line parallels the airway to the Keetmanshoop VOR. The white lines on both sides indicate that W 97D is an advisory route only and ***no traffic separation is provided.*** Air traffic control provides advisories of other ***known*** IFR traffic along an advisory route. The letter "D" used as a suffix for the airway identifier indicates there is advisory service only on the airway.

Northwest of the Upington VOR, an airway (W 89F) proceeds north on the 348 radial. After passing the Darta intersection, the airway is surrounded by a gray color that indicates no air traffic control. Even though these airways are used in the high altitude structure, they are not in controlled airspace, and the ground infrastructure does not support air traffic control. On this airway, there is no separation from other IFR traffic by ATC. The letter "F" used as the airway identifier suffix indicates the availability of flight information, but not air traffic control separation.

Because of the lack of air traffic control over Africa, IATA has established "In-Flight Broadcast Procedures" (IFBP). This note is included on the enroute charts in many locations with an explanation of the procedures. Even in cases where air traffic services are provided, they are frequently on HF and the quality of the radio signals is very difficult. So, the IATA procedures are in effect even when in an ATC environment in Africa.

The IATA procedure is essentially a transmission "in the blind" for all other traffic in the area. All aircraft in the area monitor 126.9 MHZ which contributes to the "party line" of awareness for all aircraft. The amount of traffic in South Africa is increasing and the frequency is starting to become so congested that IATA is working on developing a second frequency. As the note on the chart states, more information on the IATA procedure is found in the Enroute pages A-31 and A-32.

IATA In-Flight Broadcast Procedures (IFBP)

In addition to normal ATS reporting procedures, **IFBP** in English on **126.9** are in use over most of the African continent in the following format:

"All stations this is .... (call sign)
Flight Level ....
Northbound .... (From - To) **via ....** (airway)
Estimated Position .... At .... (UTC)
.... (call sign)
Flight Level .... *"*

For more details regarding the changes of cruising level, collision avoidance, Transponder and TCAS operation refer to text page Enroute A-31/A-32.

As you fly over the the third world country below you, visualize the conditions for the local residents. The roads have potholes large enough to swallow your car, the telephones usually don't work, the electricity is sporadic, finding clean water is virtually impossible, and the local hospital has no medicine. And - the local aviation authorities are competing for the same funds to build the aviation infrastructure. The Civil Aviation Authorities need funds to install VORs, NDBs, and ILSs. They also need funds to employ airspace specialists to create and maintain the airway system, as well as the instrument approach procedures.

These conditions are not imaginary. They are being reported by the International Air Transport Association (IATA). IATA talks about times when you file a flight plan and the coordination is so inefficient that you may arrive at your destination before your flight plan does.

These conditions help to explain the large amount of a gray color that represents non-controlled airspace on some enroute charts. Over Africa, as an example, 80% of the airspace is not controlled. Radar coverage, where it exists, is mostly limited to the terminal areas around major cities.

Worldwide Symbology

After flying IFR and VFR in the United States for many years, most of us are very familiar with domestic chart symbols and terminology. With the increase in the range of jets, the easing of world political situations, and the tremendous increase in companies doing business overseas, international flying is becoming more common for pilots. This article concludes the series on enroute charts with a look at some differences on Jeppesen charts printed for use in areas other than the United States.

As mentioned in previous articles, the symbols and abbreviations on the charts in the United States lean toward using international symbols. The charts were designed in this manner so you that can fly worldwide without experiencing major chart-reading difficulties after you leave the U.S. borders.

Chart coverage spans the entire world—except for Antarctica. Chart service is available even for such places as Togo, Gambia, Russia and the Peoples Republic of China. The chart symbols are the same, whether you are flying near Chicago, Mazar-I-Sharif, Abidjan, Bamako, Tiruchchirappalli, or Kuala Lumpur.

For the beginning of the foreign chart discussion, refer to the first illustration, which is an excerpt of the African high altitude chart that is north of Cape Town, South Africa.

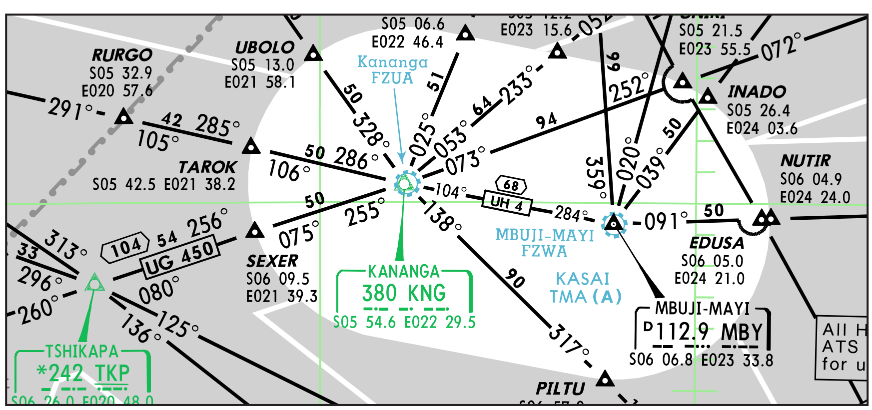
Airway Controlled Airspace

In North America and Europe all airways are surrounded by controlled airspace, which means that IFR traffic separation is provided by ATC. This is not true, however, in all parts of

High and "Both" Altitude Airways

Many of the airways throughout the world are not designated as low altitude or high altitude airways, and can be considered as "both" altitude airways even they are not officially designated that way. The airways in the first illustration are Whiskey (W) airways, do not have a designation of either high or low, and can be used in either of the altitude structures. The ATS route with no identifier can also be used in both high and low altitudes.

In most locations in the world, the designation of high altitude airways is created by using the letter "U" as a prefix to a letter which is pronounced with the phonetic alphabet. The airway between the Tshikapa and Kananga NDBs is labeled UG 450 and is referred to in ATC com-



munications as Upper Whiskey 450. Proceeding east from Kananga, the airway is Upper Hotel 4.

Low Frequency Airways

The navigational facilities that are used to form part of an airway structure are enclosed within a shadow box. The Kananga NDB, therefore, has a shadow box enclosing its frequency of 380 kHz, the three-letter identifier KNG, and the Morse code identifier.

When an airway is formed by an NDB, the magnetic bearing from the NDB station is provided adjacent to the NDB similar to a VOR airway. When an airway is formed by an NDB, the course is a ***magnetic bearing from*** an NDB *instead* of a radial. The UH 4 airway east of Kananga NDB is formed by the 104-degree bearing from Leon and proceeds to the Mbuji-Mayi VOR via the 284 radial from Mbuji-Mayi.

By looking at the Sexer intersection (west of Kananga NDB) you can see that the latitude and longitude values have been included on the chart. All intersections and navaid facilities which are used as part of the high altitude route structure have the latitude and longitude included. These were originally included for aircraft equipped with INS systems, but are now a good way to cross check between the coordinates on the chart and in the FMS or GPS databases to ensure you are going to the place you think you are.

On some high altitude enroute charts, airports are depicted with their International Civil Aviation Organization (ICAO) identifier. The ICAO identifier for the Kananga airport is FZUA. The first two letters, FZ, are the two letters for the ICAO identifier for the country of DR of Congo. For countries that have two letters for their ICAO identifier, all airports in the country will begin with those two letters. This is why it is virtually impossible for the IATA and the ICAO identifiers for airports to be similar in most countries.

In the first illustration, there is a restricted area north of the Upington VOR designated as FA(R)-23. In most countries, the (ICAO) identifier is included with each restricted area. In this case, the letters "FA" represent the two-letter ICAO identifier for South Africa. Following the ICAO identifier is the letter "R" indicating restricted area, and the restricted area's number designation.

West of the Upington VOR is a straight line with small ticks on alternating sides. This is the designation of the boundaries between Flight Information Regions (FIR). On the northeast side, the Bloemfontein FIR (FABL) is the air traffic control, to the extent to which it exists. On the southwest side, the Cape Town FIR (FACT) Flight Information Region provides advisory service for traffic.

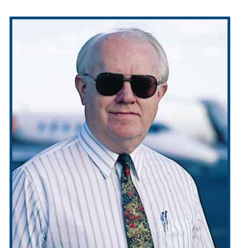
Airport Controlled Airspace

Many types of controlled airspace surrounding airports in the United States have a direct parallel to the airspace surrounding airports outside the U.S. This makes flying in many countries easier.

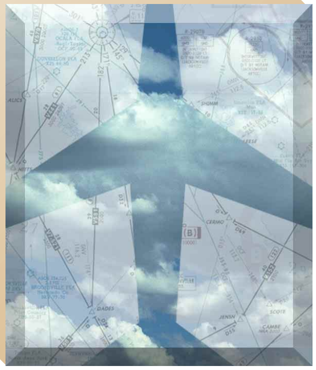
Control zones outside the U.S. are indicated by the letters "CTR." There are many countries throughout the world that have not yet converted to the ICAO standard for airspace designations such as class A, B, C, etc.

Note that Sexer intersection is a compulsory reporting point which is indicated by the solid, filled-in intersection symbol. The Sexer intersection is on the TMA boundary for the Kasai TMA (terminal control area). The ICAO definition for terminal control area is a control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes. The letter "A" in parentheses indicates this airspace as class A airspace. Since the airspace surrounding the Kananga and Mbuji-Mayi airports is controlled airspace, the area around the airports is depicted as white which is the international designation of controlled airspace.

This concludes the series on enroute charts. Next month will begin a discussion of terminal charts.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



BY JAMES E. TERPSTRA
SR. CORPORATE VICE PRESIDENT, JEPPESEN

The Chart Clinic – Thirteenth in a Series

When the weather is as clear as a bell, finding a runway is easy, even with relatively little piloting experience. Just pull out the sectional chart, find a few landmarks near the airport and "drive" on home. But, place a cloud "mask" completely around the airplane and obscure the ground, the sky, and all landmarks, then it takes experience, certificates, ratings, properly equipped airplanes, ATC, clearances, and magic sheets of paper called approach charts.

Through the maze of printing, important numbers penetrate to display the frequencies, courses, distances and altitudes. The approach chart is the graphic presentation of these numbers which experienced pilots use to find the destination runway — with precision and — legally.

Approach Charts vs. Approach Procedures

Instrument approach procedures are designed by government authorities. After each approach procedure is issued by the FAA, the official FAA Form 8260 in *narrative* format is distributed to charting agencies, such as NOS (National Ocean Service), Jeppesen, and others.

Since approach *charts* are graphic representations of approach *procedures*, the charts carry a "heavy weight" – they are portrayals of Federal Aviation Regulations. Each approach you "shoot" is in compliance with FAR Part 97 (plus numerous other FARs.) Approach procedures go through most of the same rulemaking steps that other FARs do. After a procedure is designed by FAA Aviation Standards (AVN), the approach is eventually listed with other FARs in the Federal Register. It now becomes law–altitudes, courses, distances, everything. To fly legally, you must comply with the numbers on each approach chart.

In the United States, the approach procedures are designed in accordance with the FAA's TERPs (United States Standard for Terminal Instrument Procedures.) In most other countries around the world, approach procedures are designed in accordance with the ICAO PansOps guidelines, so there are subtle differences. But in each case, the approach procedures are still designed by the government authorities. In a later article, we will discuss the segments according to the TERPs specifications.

Approach Chart Sequence

To help find the proper approach chart in your Airway Manual, Jeppesen has designed a chart filing system. The filing system helps in two ways. First of all, it helps when trying to find an approach chart while airborne. Secondly, when filing revisions, you should be able to tell exactly where each approach chart is to be placed.

As an additional aid, the approach chart city name, state, and airport name are printed on the approach chart using the *same* wording as is found on the enroute chart. The names of the states for each airport are included on the enroute charts making it easier to determine which state tab to look under to find the approach chart.

Alphabetically by State

Within each Airway Manual, the approach charts are arranged alphabetically by the state name. State tabs are included prior to the first airports for each state. A complete USA coverage containing enroute, area, departure, STAR, and approach charts would include eight two-inch leather or plastic binders. The various regional coverages contain fewer states, but each manual is still arranged alphabetically by state. Jeppesen charts supplied to airline pilots are sequenced alphabetically by the city name and *not* by the state name.

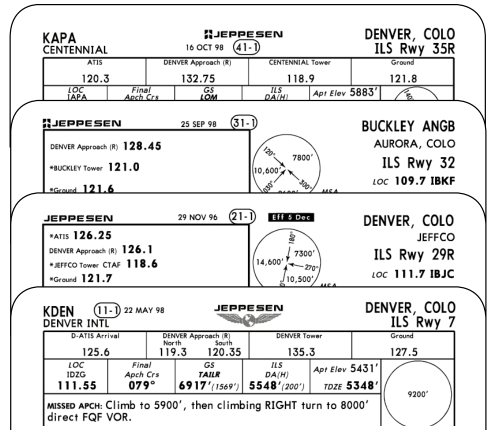
Alphabetically by City

Within each state, the approach charts are sequenced alphabetically by the city name. Sometimes, however, it may be difficult to find a city name, since the airport may be listed under another city. For example, to find the approach chart for Hartford, Connecticut you must look under Windsor Locks. Doesn't make sense? Jeppesen lists the associated city name according to the FAA documents used to make approach charts. You say that still doesn't help you find the airport? There are two things which help. By referring to the enroute chart, you can see the exact way the airport is listed in the approach charts. The other solution is to contact the airport sponsor or operator and have them officially change the associated city through their normal FAA channels.

Index Numbers

Frequently, there are many airports listed under one city name. In order to keep the sorting system straight in your Airway Manual, Jeppesen uses an index number which is at the top of every approach chart. This index number is usually a three- or four-digit number enclosed in an oval at the top of each chart. This index number helps to sort airports within city names and it also helps to sort the approaches in proper sequence at each airport.

As an example, refer to the following illustration which shows the approach charts for Denver, Colorado. The first digit is used to sequence airports under a single city name.



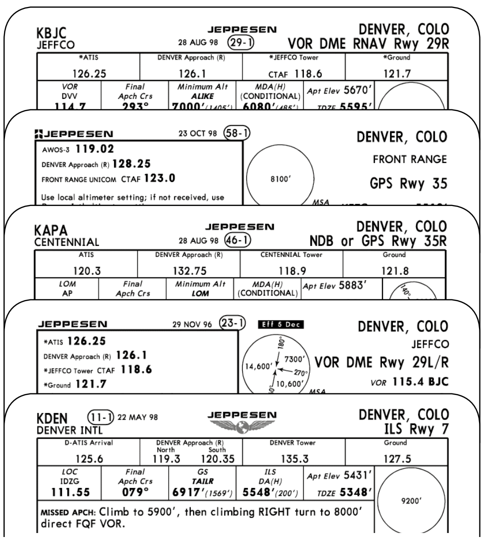
The first number "1" in the index number "11-1" at Denver is used for Denver International Airport, the principal airport. All approach charts for Denver International have an index number beginning with the number "1."

Jeffco Airport is listed as the second airport under Denver and has an index number of "21-1." Buckley Air National Guard Base is the third airport listed under Denver and uses the index number "31-1." (The name Buckley is above Aurora, a suburb of Denver, since this is an approach chart supplied only to subscribers of the military approach chart series.) Centennial Airport is the fourth airport that is listed under Denver and has the index number "41-1."

The first number is arbitrarily chosen and doesn't necessarily indicate a descending order of airport capability. The second number within the index oval is also used for sorting, but the number has a bit more significance from a pilot perspective. The approach with the greatest precision and the lowest minimums usually has a lower index number than the approaches with higher minimums. As an example, at Denver International Airport the second digit "1" in the "11-1" index number is used for ILS approaches. By using this system, the "best" approaches are found at the beginning of each airport listing. As you flip the pages for each airport, you will notice the minimums usually go higher. The following numbers represent the type of approaches that will be found according to the second digit of the index number:

0 — Area, SID (DP), STAR, Taxiway Facilities, Class B Airspace, etc.
1 — ILS, MLS, LOC, LDA, SDF
2 — Reserved
3 — VOR
4 — TACAN
5 — Reserved (Formerly Low Frequency Range)
6 — NDB (ADF)
7 — DF
8 — GPS, PAR, ASR, SRA, SRE
9 — VOR DME RNAV, Vicinity Charts, Visual Arrival, Visual Departure

In the illustration below, the second digit of the first chart is a “1” for ILS Rwy 7, the second digit of the second chart is a “3” for the Jeffco VOR DME Rwy 29L/R approach. The second digit of the third chart is a “6” for the Centennial NDB or GPS Rwy 35R approach. The second digit on the fourth chart is an “8” for the Front Range GPS Rwy 35 approach. The second digit on the Jeffco chart is a “9” for the VOR DME RNAV Rwy 29R approach.



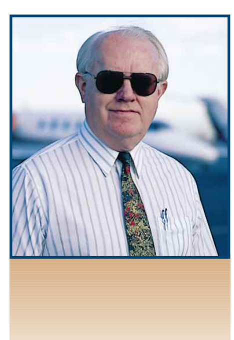
The number “0,” when used as the second digit, applies to non-approach charts included with each city. The Denver Area Chart uses a second digit “0” followed by “-1.” The third digit in the “10” series indicates the type of chart. The “-1” is used for area charts, the “-1A” is used for Class B Airspace charts, the “-2” is used for STAR charts and the “-3” is used for DP or SID charts.

The Last Digit

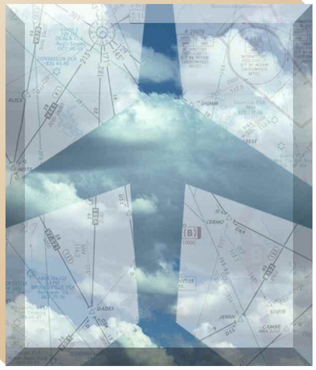
When more than one of the same *type* of approach is found at an airport, the first two numbers of the index are the same. To provide proper sequencing of the charts, the third digit becomes significant. As an example, the first chart for Denver International is “11-1” for the *ILS* Rwy 7 approach. The index “11-2” is for the *ILS* Rwy 8 approach and the index “11-3” is for the *ILS* Rwy 16 approach. Within a type of procedure, such as the ILS, the approach charts are being changed to be sequenced by runway number so it is easier to find a specific approach at a larger airport.

At larger airports, the airport diagram has an index number of 10-9 so it can be sequenced in front of the approach charts. At most smaller airports, Jeppesen publishes a large-scale airport diagram on the reverse side of the first approach chart for the airport. When the airport diagram is printed on the back of the first approach chart, the index number is the same as the front side of the approach chart.

The next article in this series on Jeppesen charts will discuss the heading and border data on the top of the approach charts and the border information on the bottom of the charts. Additionally, we will begin looking at the planview.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com



By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

The Chart Clinic – Fourteenth in a Series

KDEN (11-4) 22 MAY 98 JEPPESEN DENVER, COLO
DENVER INTL ILS Rwy 17L

D-ATIS Arrival	DENVER Approach (R) North / South	DENVER Tower	Ground
125.6	119.3 / 120.35	124.3	121.85

LOC IBXP	Final Apch Crs	GS IRINE	ILS DA(H)	Apt Elev / TDZE	MSA
110.15	170°	6895′(1559′)	5536′(200′)	Apt Elev 5431′ / TDZE 5336′	9200′ MSA DEN VOR

MISSED APCH: Climb to 5900′, then climbing LEFT turn to 8000′ via 090° heading and outbound on DVV VOR R-122 to HOKER INT .

1. RADAR required. 2. Simultaneous approaches authorized with Rwys 16 and 17R.

Skybird 1227K: Midtown Tower, Skybird 1227K, 20 miles west, request advisories, landing.
Tower: Skybird 27K, active runway 27, wind 280 degrees at 15 knots, altimeter 30.12, enter and report left downwind.
Skybird 27K: Midtown Tower, Skybird 27K is over the smokestack west of town, wind appears to be from the east, request straight-in landing Runway 9.
Tower: 27K, if you're landing at the smokestack, land east; if you're landing at Midtown, plan Runway 27.

We all have similar stories to relate which we've heard via communications. Some of them have happened to us. Communications are our heart beat. Most of us feel, "Give me a mike and I can handle almost anything. But take that mike away, and my command capability disappears."

Some of the most important information for us is the communications frequencies — and they are at the top of every Jeppesen approach chart. These frequencies are placed in the order they are used when arriving at the airport.

Heading Data - Briefing Strip™

The Briefing Strip™ format is designed to be a checklist of some of the most important items when first studying an approach chart. It has items in addition to the communications data such as the primary navaid for the approach, the final approach course, field elevation and procedure identification. The approach procedure identification is shown under the city name. If the approach has straight-in landing minimums, the straight-in runway will be included following the approach type.

The first illustration for Denver, Colorado shows this is the ILS approach to runway 17L. Any other runway would require the use of circling minimums (if they are available). For example, since this approach is labeled ILS Rwy 17L, straight-in minimums *could not* be used for landing on Runway 17R. If a procedure were titled VOR Rwy 35L/R, straight-in landing minimums would be authorized on both of the parallel runways identified by title. In some cases, a side-step runway is authorized with straight-in landing minimums, but they are usually *higher* than for the runway in the approach procedure title.

When the approach procedure does not authorize straight-in landing minimums, a hyphen and a letter will follow the type of approach. According to the TERPs procedure design criteria, straight-in landing minimums are not available when the final approach segment is more than 30 degrees from the runway alignment, the final approach is too steep, or the final approach doesn't come close enough to the runway threshold (or extended centerline).

The procedure identification includes the type of radio equipment to be used to fly the approach. In the US, Canada, and other countries which use the TERPs procedure design criteria, the procedure identification includes the type of navigation aids which provide final approach guidance. If the approach is labeled VORTAC, VOR DME, ILS DME or LOC DME, DME ***must*** be used in addition to azimuth guidance. If DME is stated only in the plan and profile views, then its use is optional; however, the minimums may be adversely affected in such a case. The method used by the TERPs procedure designers to identify instrument approach procedures is very consistent.

For ILS approaches, the localizer, glide slope, outer marker (or authorized substitute), plus stated visual aids must be used to get the lowest minimums. On ILS approaches, if some components or visual aids are not available or are not used, higher minimums usually apply.

Most countries follow the ICAO standards which state that the types of navaid(s) on which the instrument approach procedure is established shall be part of the identification. As a result, titles such as VOR NDB ILS DME Rwy 15 might be a procedure identification used by a country to indicate all the types of navaids that might be used on the approach, depending on the transition and the missed approach. The approach procedure identifications are from the applicable authoritative source in each country, so they can vary from country to another. In general, the title is a common reference to be used by both the controller and pilot to ensure both are "playing" off the same page.

After the communications boxes, the primary facility upon which the approach is predicated is included with its identifier and frequency. Other navaids necessary for the approach are found in the plan view. The final approach course is included as part of the briefing as well as the FAF and the lowest landing minimum. On ILS approach charts, the altitude of the glide slope at the LOM (or its substitute) is included as a means of cross checking the altimeter when passing the fix. On non-precision approaches, the minimum altitude at the FAF is shown.

By definition, the field elevation is the elevation of the *highest* usable landing surface on the airport. That elevation is included toward the right of the Briefing Strip™ (plus next to the runway in the profile). The touchdown zone elevation (TDZE) is included with the airport elevation.

Minimum Sector Altitudes

Most important — the minimum sector altitudes (MSA) listed in the heading data of Jeppesen approach charts are included for emergency use only in the United States and most countries. An MSA provides at least 1,000 feet of obstruction clearance within a 25-nautical mile radius of the fix designated below the MSA circle. The 1000-foot clearance applies in both mountainous and non-mountainous areas.

The center of the MSA is normally the locator on ILS or localizer approaches, the VOR on VOR or VOR/DME approaches, and the NDB on NDB approaches. On GPS approaches, the MSA is typically centered on the landing run-

KBJC JEPPESEN DENVER, COLO
JEFFCO 28 AUG 98 (29-1) VOR DME RNAV Rwy 29R

*ATIS	DENVER Approach (R)	*JEFFCO Tower	*Ground
126.25	126.1	CTAF 118.6	121.7

VOR DVV	Final Apch Crs	Minimum Alt ALIKE	MDA(H) (CONDITIONAL)	Apt Elev / TDZE	MSA
114.7	293°	7000′(1405′)	6080′(485′)	Apt Elev 5670′ / TDZE 5595′	14,600′ MSA STAMS

MISSED APCH: Climbing RIGHT turn to 7000′ direct ALIKE and hold.

1. When Twr inop, use Denver Intl altimeter setting.
2. Pilot controlled lighting 118.6.

way threshold. MSAs are usually not provided on back course or radar approaches.

MSA sectors are designated between two magnetic bearings to the facility upon which the MSA is based. There are two reasons why the MSAs should not be used as normal flight altitudes:

1. In mountain terrain areas, FAR 91.177 states that an altitude of 2,000 feet must be maintained above the highest obstacle...(for direct routes).

2. Since MSAs are not flight altitudes, the FAA does not monitor new obstructions as critically as those which underlie flight paths.

Communications

Each Jeppesen approach chart includes most IFR communication frequencies for arrivals at each airport at the top of the approach chart. Refer to the Denver, Colorado ILS Rwy 17L approach chart for a discussion of frequencies to be utilized at the international airport.

The first communications box includes the ATIS frequency used for arriving at the airport. If the term "arrival" is included, it means there is a different ATIS frequency for departures and will be included on the airport diagram chart. At Denver, the letter "D" precedes ATIS since the ATIS is transmitted digitally as well as by the conventional analog voice. For cockpits so equipped, the ATIS digital signal is received and then displayed in text form on one of the panel displays.

When the local weather is available from an automated system such as ASOS (Automated Surface Observation System), it is shown with the frequency. The information is often transmitted on a discrete VHF frequency, but will sometimes be transmitted on the voice portion of a local navaid.

Approach Control

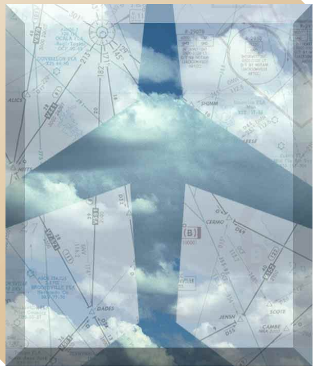
When an airport is served by an approach control, the frequencies will be included after the ATIS box. A letter "R" in parentheses in the approach control box indicates the availability of radar. It is interesting to note that where the (R) *doesn't appear*, that doesn't mean that radar is not available, it just means that the local radar facility has not announced they will provide radar when requested.

At Denver, the approach control is divided into two different areas. When arriving from the north, 119.3 MHz is the approach control frequency, and when arriving from the south, the frequency is 120.35 MHZ. Sometimes, the different areas are defined by specific degrees such 270° clockwise to 090°. The center point for the sectorization is not always known; neither can you tell from the information given whether the sector bearings are magnetic or true.

In the early 1980s, the FAA initiated a concept called the "*initial contact frequency*." Each tower, approach, departure, and ground control facility is supposed to designate a single frequency for "initial contact." In some cases, you will see only one approach control frequency when you know there are more. This is because of the "initial contact" concept. If you are VFR and need to contact and approach control facility and you do not know the sector frequency, the approach control facility has agreed to respond to "pop ups" on the initial contact frequency. Approach will then assign the appropriate frequency to you.

Next Month: In the next article in this series, we will continue with the heading information and then begin analyzing the content of the approach chart plan view.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Fifteenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

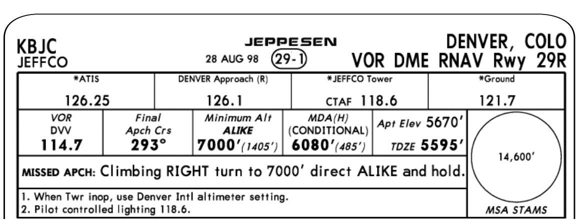
There are times when you especially recognize the importance of communications. During the Oshkosh EAA Convention, departing IFR is efficient - but not according to conventional rules. During the busiest times, IFR clearances have been received by telephone on the ground, then the clearances to taxi and takeoff are done by listening only and by watching FAA controllers with large colored paddles on the ramp and near the runway end. After departing, the tower will then give the clearance to contact departure control. This is the first time the microphone is needed.

After takeoff, imagine reaching down for the mike and finding it missing. This is one of the many true stories about Oshkosh and actually happened in IFR conditions. That's when you realize how important it is to talk to ATC.

In the last article in the series, we began our discussions on the approach chart heading which includes the communications available at the airport. In this issue, we continue discussing communications.

Tower

After the ATIS and approach, the next frequencies are included in the tower box and include tower, UNICOM, and sometimes flight service station frequencies. At major airports such as Denver International, there are numerous tower frequencies, but only the one that is applicable for the straight-in landing runway for the approach is shown. The other tower frequencies are included on the other approach charts.



When communications are only available part time, an asterisk is placed just before the communication function. At Jeffco, the ATIS, Tower, and Ground Control do not operate 24 hours a day. An asterisk is placed just to the left of the tower name to indicate its part-time status - because the tower is not full time, the letters "CTAF" are included to indicate the Common Traffic Advisory Frequency. The CTAF is the frequency designed for the purpose of carrying out airport advisory practices while operating to or from an uncontrolled airport. The CTAF may be a UNICOM, Multicom, FSS, or tower frequency. UNICOM is included on the approach chart only when it is the CTAF.

When an airport has no control tower, the flight service station and its frequencies will be placed in the communications area. When neither a tower nor an FSS is at the airport, other available frequencies such as UNICOM or Multicom may be listed. Refer to the ILS Rwy 12 approach at Huron, South Dakota, which has an FSS on the airport and can be contacted by calling "Huron Radio." The Huron Flight Service Station provides local airport advisories at Huron which is indicated by the letters "LAA" included within the parentheses. Even though Huron Radio has other frequencies, the frequency of 123.6 MHz is the CTAF, so 123.6 should be used when operating at the Huron airport. A call for airport advisories would be to Huron Radio.

Ground Control

The ground control frequency (most of which are in the 121.6 to 121.9 MHz bandwidth) is listed in the far right box labeled "ground." If there are different ground control frequencies for different parts of the airport, they will be listed in the ground control box with the area where they are to be used. Since clearance delivery is a departure frequency, it will be shown only on the airport chart when it is available at an airport.

ARTC Center as Approach Control

When the services normally provided by approach and departure controls are provided by a center, the center information will be included in the approach box. At locations such as Huron, South Dakota, an approach control is not available at the airport or nearby. In these cases, the air route traffic control center in the area usually provides the functions normally given by approach control. At Huron, Minneapolis Center provides the approach control service on 126.25 MHz.

In other locations such as Myrtle Beach, South Carolina, the approach control is not a 24-hour facility, so the Jacksonville Center provides the approach control services on 128.7 MHz. At both the Myrtle Beach and Yankton airports, the Center has radar capability, but the radar is not usable down to the FAF crossing altitude. You should not expect vectoring service or other radar services. So the (R) is not included with the Center name.

UNICOM

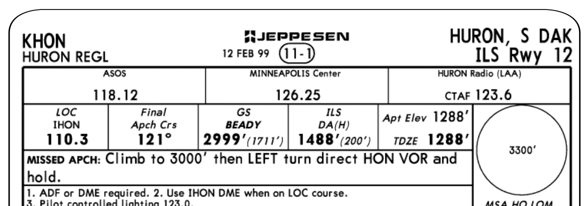
At Yankton, South Dakota, the CTAF frequency is 122.8 MHz. This is an unusual case where Jeppesen provides the UNICOM frequency on an IFR approach chart. The official call sign for the UNICOM is Chan Gurney Municipal UNICOM, but you probably will not hear all those words spoken by local pilots when calling UNICOM.

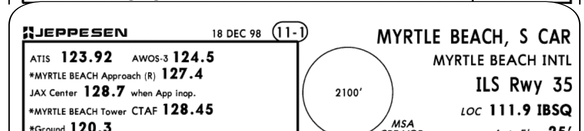
Altimeter Settings

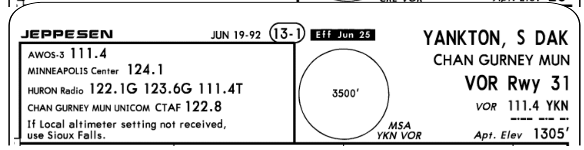
In the design of instrument approach procedures and the applicable minimums, the FAA bases their specifications on an altimeter setting from the local airport. With these criteria, it is very important to have a local altimeter setting. There are many methods used on the approach charts to indicate the altimeter source, depending on the type used.

In addition to the ATIS, ASOS and AWOS-3 are shown when available. At Huron, the ASOS (Automated Service Observation System) is available on 118.12 MHz. At Myrtle Beach, the altimeter is available on both the ATIS on 123.92, and the AWOS-3 (Automated Weather Observing System) on 124.5 MHz.

Since an altimeter setting is necessary for flying the approach, the remote altimeter source is specified when the local altimeter setting is not available. The remote altimeter is included in the notes box on the new Briefing Strip™ charts and in the heading box on the earlier charts.







At Denver Jeffco Airport, the chart indicates that when the tower in inoperative, you should use the Denver International altimeter setting. The altimeter setting will be provided by Denver Approach Control. At Yankton, South Dakota, if the local altimeter setting is not received, you should then use the altimeter setting from Sioux Falls. At Yankton, the Sioux Falls altimeter setting would be given by the Minneapolis Center.

When the altimeter setting is obtained from a source more than 5 NM from the airport reference point (ARP) for an airport, the required obstacle clearance (ROC) is increased for the final (except precision final), step-down, circling, and intermediate segments. The landing minimums are also adversely affected.

As a bit of interesting trivia, a remote altimeter setting source is not authorized for a remote distance greater than 75 NM, or for an elevation differential between the remote altimeter source and the landing area that is greater than 6,000 feet. You can see the importance of local altimeter settings and the ability to know how to obtain remote altimeter settings when a local one is not available.

Legend Pages

The approach chart legend pages have no more recreational reading value than the enroute legend pages, but they are there. They are also some of the most important recommended reading you can do. The details of the symbols and their meanings are included with some explanatory comments when appropriate.

Remember when reading the legend that it is written to satisfy international requirements, not just those for the United States. Most countries have not adopted the U.S. TERPs (United States Standard for Terminal Instrument Procedures), so the definitions of various approach segments may not be what you learned in ground school. Most countries have adopted the ICAO approach procedure design criteria called PansOps.

Chart NOTAMs

When there are temporary changes to enroute or terminal charts, these changes are included in Jeppesen's Chart NOTAMs under the "Chart NOTAM" tab. Changes to the enroute charts are listed first, followed by changes to the terminal charts. The Chart NOTAMs are sometimes used for last-minute changes that missed the cutoff dates for changes. These NOTAMs are usually produced every two weeks. It is important to note that the Chart NOTAMs only highlight changes to the Jeppesen charts and do not substitute for the NOTAMs issued by a briefer or received through an online service.

Area Charts and Class B Airspace Charts

As you probably noticed, Area charts and Class B Airspace charts use the approach chart index number system. Many people prefer to file the Area charts and Class B Airspace charts behind the enroute charts since area and Class B Airspace charts normally serve a larger area than just one city. Others prefer to take the Area and Class B Airspace charts out of the enroute chart binder and place them with each city in front of the Departure and STAR charts. The index numbering system on these charts is compatible with the approach chart series, so this second filing system is quite easy.

Approach Charts and Airport Diagram Philosophy

Since the approach charts are used for arriving at the airport, we have listed the communication frequencies in the order of use when flying to the airport. Included with the approach charts are the airport diagram charts and they are designed to be used both at the end of the approach and for departing the airport. All the communication frequencies on the airport diagram are listed in the order of use when departing the airport. The airport charts also include takeoff and alternate minimums and IFR Departure Procedures (now Obstacle Departure Procedures) to keep airplanes away from rock piles on climb out.

In the next article, we will begin exploring the approach chart plan view.

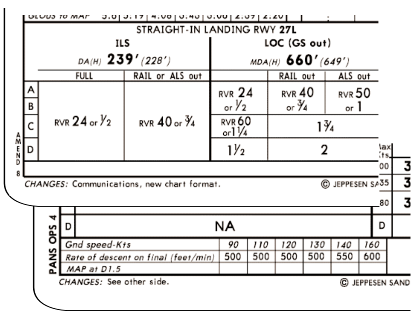
James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Sixteenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

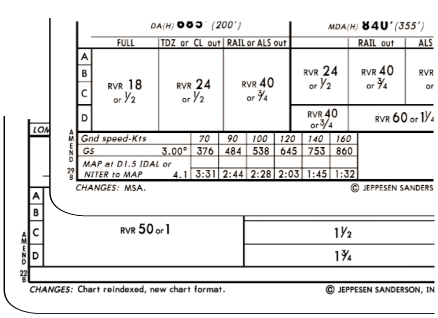
There is always at least one day every other week that you know the postman will stop at your mailbox. That familiar brown envelope from Denver or Frankfurt contains charts to fill some of your leisure hours. Each week, approximately 53,000 changes are made to Jeppesen charts. Despite numerous attempts to consolidate as many of these changes as possible, new and revised pages still keep flowing.

Changes



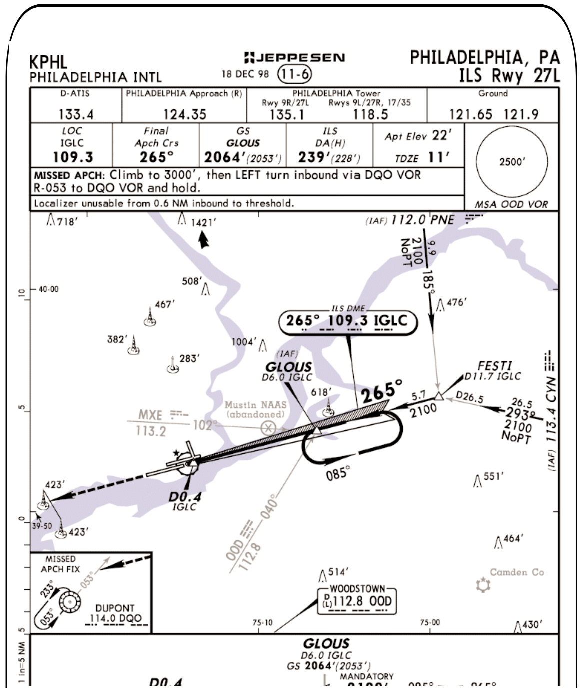
When charts are issued, the items changed are indicated at the lower left of each approach, SID (Departure Procedure), STAR and Class B Airspace chart. The charts in the first illustration indicate some samples of reasons for approach chart changes. The changes for the top chart indicate that the communications have been revised. And, since many of the charts get revised every week, the chart formats are also revised to include the new Briefing Strip™ format.

Some of the other changes in the illustration don't seem quite so obvious. For example, why are some charts shipped with changes marked as "See Other Side?" When you see this change note, flip the approach chart to the reverse side and you will note that some type of change was made which required the reissuance of that approach sheet. We formerly used the words "None" for the Changes note on the side that had no changes, but the complaints were numerous - the solution? "See Other Side."



Occasionally a chart has been in the field so long that it should be revised even though there are no aeronautical changes to make a revision necessary. This type of chart is marked with the notation "Reissue."

Since the charts are maintained in a specific sequence within each airport, it is sometimes necessary to relocate an approach chart from the back of one page to the front of a following page. For example, this change will occur when a localizer back course approach is added to the service and must be sequenced between the front course ILS and an existing VOR or NDB approach. As new charts are revised, Jeppesen is also sequencing the approach charts so they are sequenced by runway number within an approach procedure type. In these situations, the changes are noted as "Chart reindexed."



Amendment Numbers

Amendment numbers are included on the charts as a record of the changes that have been made by the FAA. These numbers are located in the left margin at the bottom of each approach chart. Since each chart contains regulatory information, the standard instrument approach procedure (SIAP) is listed in the Federal Register. Normally, each time a procedure change is made to the approach chart, the approach goes through regulatory action and the amendment number is increased by one. However, an approach chart is often revised with no change in the amendment number. This is done when non-procedure information, such as a communication frequency, is revised.

The first chart in the illustration shows the amendment number as "0." This means that this is the original issue of the chart and no revisions have been made. The second chart includes the words "PANS OPS" which means that the country which issued this chart has stated that their instrument approach procedure complies with the ICAO PANS OPS criteria for the design of instrument approach procedures. The next chart says Amend 29B which means that this is the 29th revision of procedure information since the chart was first issued. The letter "B" means this is the second CCP NOTAM issued against the 29th amendment.

Plan View

The plan view is the largest area on the approach chart and is located immediately below the heading or Briefing Strip. This section shows the approach procedure, including the feeder routes used to connect the approach with the enroute structure. The entire area within the plan view is drawn to scale. The scale is located in the left margin, next to the plan view, and normally has a conversion factor of one inch equals five nautical miles. Occasionally, though, the navigation information portrayed in the plan view covers such a large geographical area that it is necessary to use a scale of 7.5 nautical miles per inch. When this scale is used, it is shown on the left side of the plan view.

Plan View Symbols

Most of the symbology used on enroute charts is identical to the symbology used on approach charts. This procedure allows you to transition from enroute charts to approach charts without learning a second set of symbols. The following discussion of approach chart symbology pertains to the Philadelphia, Pennsylvania ILS Rwy 27L approach.

The localizer front course symbol is displayed as a tapered arrow, pointing to the airport. A series of light, parallel diagonal lines indicate the right side of the localizer when proceeding inbound. The shading was originally created to match the blue and yellow sectors displayed on the early generation course deviation indicators. The shaded side of the localizer symbol represented the blue sector.

The localizer back course is included on the opposite end of the runway only when it is used for a missed approach or part of a transition. It is also included on back course approaches.

The inbound magnetic course of the localizer is provided in **bold** numbers, while the outbound course is shown adjacent to the holding pattern outbound track, or next to the procedure turn when it is used for the course reversal. For example, the inbound course at

Philadelphia is 265 degrees and the outbound course is 085 degrees.

The frequency of the localizer may be found in two places on the chart. One location is in the Briefing Strip. The letters “LOC” appear in the Briefing Strip, followed by the localizer identifier and frequency. This frequency is also included within the elongated oval on the plan view. The oval includes the localizer inbound course, the localizer frequency, and the identifier with letters and Morse code. At Philadelphia, the letters “ILS DME” are at the top of the frequency box to indicate that the facility includes the localizer, glide slope, and a frequency-paired DME.

Several other navigation aids which are used for the approach are normally also included in the plan view. The Philadelphia ILS approach is unusual in that it does not have a middle marker, outer marker, or compass locator. A number of years ago, the FAA changed the policy so that an outage of the MM did not cause the minimums to be raised. Consequently, many middle markers disappeared since they no longer provided lower minimums. A locator outer marker (LOM) is usually at the non-precision FAF, but at Philadelphia, the FAF can be identified by DME or cross radials from the MXE and OOD VORs.

The PNE VOR toward the top of the plan view is an initial approach fix (IAF) and is used to form the initial approach segment from the enroute structure to the FESTI intersection. The PNE VOR is off the chart to the north so the frequency, identifier, and Morse code are shown for two reasons. First, it is used to identify the beginning of the segment with the identifier to match with the identifier on the enroute chart navaid. Secondly, the PNE VOR is used to form the FESTI intersection.

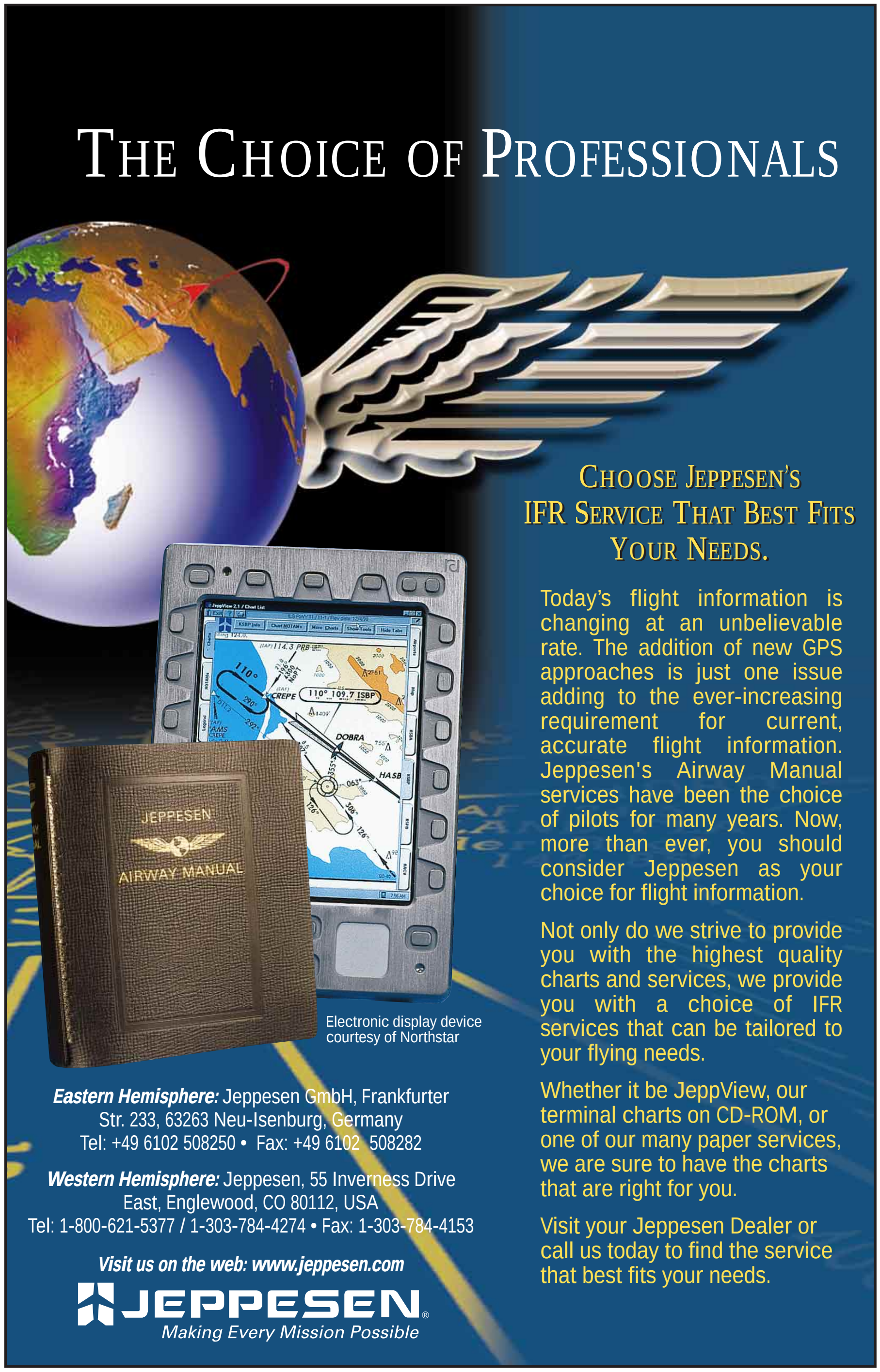
Thickness of Lines

On the route from PNE, note there are two different thicknesses of the route. The first portion of the route is drawn with a heavy line and terminated with a large arrowhead. This means that the route can be flown as a transition. Additional information is provided for this flight track. The route also includes the distance (9.9), the altitude (2,100) and the magnetic course (185). At the end of the thick line, a light-weight line continues to FESTI and terminates with a small arrowhead. The light-weight line indicates that PNE is one of the formation facilities for FESTI. PNE would be used to form FESTI for the initial approach segment along the 293 radial from the CYN VOR on the east side of the chart.

The GLOUS intersection has a number of formations. The first is the localizer track. It can also be formed by the ILS DME as well as identified by the radials from OOD and MXE. The radials from OOD and MXE are shown in a light-weight line with a small arrowhead. The difference here is significant since the light line shows these are *not transitions* that can be flown from the OOD or MXE to the GLOUS intersection.

The heavy black line on the approach chart indicates the procedure track. When a procedure turn is authorized on an approach procedure for the course reversal, the procedure turn will also be indicated with a heavy black line. At Philadelphia, the holding pattern is depicted at GLOUS intersection with a heavy black line. This means the holding pattern is part of the procedure, and is the course reversal instead of a procedure turn.

In the next article, we will continue our discussion of the plan view.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

The Chart Clinic – Seventeenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

It's been called the bird's eye view. It's been called God's view. It is also known as the over view. There probably have been many other names used to describe the plan view. It is the view from high above and is the only portion of the chart that is to scale. It probably can be considered the part of the chart that gives the best overall orientation for the approach procedure.

Terrain

On the Bozeman, Montana ILS Rwy 12 approach chart, the large areas shown in brown represent terrain information. In the early 1990s, Jeppesen began depicting terrain in a brown color on all the approach charts that met the criteria of a terrain-critical airport. In order for terrain to be depicted on the approach chart, there must be terrain within the plan view that is at least 4,000 feet above the airport or terrain that reaches 2,000 feet above the airport and is within six miles of the airport. If there is terrain on any one approach chart for an airport that qualifies for terrain, then all the approach charts for that airport will have the terrain depicted even though one of the charts might not otherwise qualify.

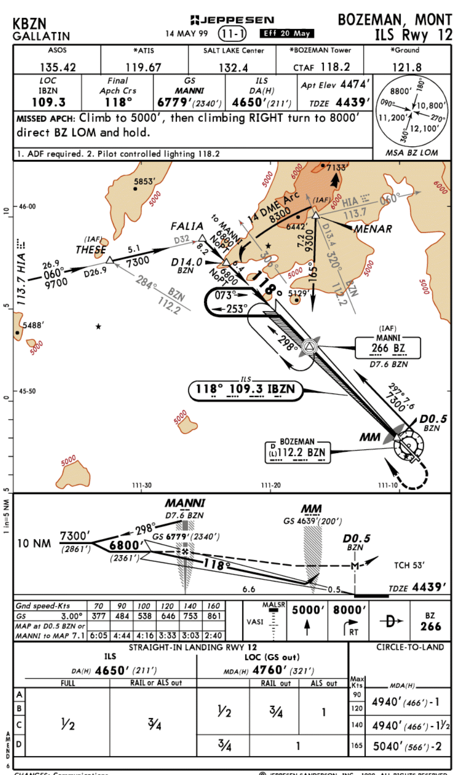
It is interesting to note that the terrain is depicted in brown, and not green. Green was formerly used to depict terrain on the area charts when terrain was first introduced on the area charts in 1975. When it was decided to depict the terrain on approach charts, a study was made and the first prototype terrain approach charts were given to a number of pilots. The first charts were printed with green terrain and another set were printed with brown terrain.

The pilots in the testing program were first given the charts in both green and brown and were asked if they preferred the green terrain or the brown terrain. The majority said they preferred green (which was our first preference.) Then the pilots were given the same set of charts to be flown in the simulator. There were flight instructors who gave many clearances to simulate ATC vectors that came close to the terrain.

After the simulator tests, the evaluation pilots were then asked again if they preferred the green or the brown. What we discovered was an amazing change. The large majority of pilots chose the brown over the green even though they had chosen the green before the simulator ride. The evaluators asked why brown instead of green and why they changed their minds. Comments came back "Green is too pastoral. Brown scares me." "The brown colored terrain is *serious*."

As a result of the tests, the terrain is now depicted in brown. Once it has been established that the terrain will be depicted on a chart, the first contour level is the first 1,000 level above the airport elevation. At Bozeman, since the airport elevation is 4,474 feet, the first contour level is 5,000 feet. The terrain contours are spaced at 1,000-foot intervals. Each contour is labeled with the MSL value. The areas between the contour lines are printed in brown with increasing levels of color intensity as the elevations change so the darkest color of brown is the highest level.

Note on the ILS approach chart for Bozeman that the highest elevation in the plan view is 7,133 feet. This peak is less than 4,000 feet above the airport elevation, but the chart has contours on it. Because the VOR Rwy 12 approach chart at Bozeman has an elevation of 9,650 feet in the plan view and it is considerably higher than 4,000 feet above the airport, it qualifies for contours. Therefore, all approach charts into Bozeman then get the colored terrain contours.



Other Details on the Plan View

The *longitude* for the plan view area is included on the bottom edge of the plan view and the *latitude* is provided on the left edge. Before the mid 1970s, Jeppesen charts included city patterns, major highways, and railroad tracks. They were dropped after a Jeppesen seminar when it was decided the charts were primarily IFR and not VFR. The congestion was reduced and now only large rivers and bodies of water are included in the plan view. Additionally, reference points such as towers, tall buildings, antennas, and other objects are included with their elevations for orientation to the area over which the instrument approach is conducted. Minimum altitudes of the instrument approach provide prescribed clearances of terrain and structures beneath the flight path.

Procedure Turn

A procedure turn is depicted on Jeppesen approach charts with the outbound and inbound headings at 45 degree angles to the approach course. At Bozeman, after tracking the localizer outbound from MANNI, the heading away from the localizer is 253° and the heading used to intercept the localizer course inbound at the completion of the turn is 073°. The procedure turn is prescribed when it is necessary to reverse direction to establish the aircraft inbound on an intermediate or final approach course. It is a required maneuver, except under the following conditions:

1. The symbol "NoPT" is shown.
2. Radar vectoring is provided.
3. A one-minute holding pattern is published in lieu of a procedure turn.
4. A teardrop course reversal is depicted.
5. The procedure turn is not authorized.

The altitude prescribed for the procedure turn is a *minimum* altitude until the aircraft is established on the inbound course. The maneuvering must be completed within the distance specified in the profile view and on the same side as the procedure turn symbol.

Although 45° turns are provided on the approach chart for the procedure turn, the point at which the turn may be started and the type and rate of turn are left to the discretion of the pilot. When a procedure turn is depicted, there are various options. In addition to the procedure turn, the race track pattern or the teardrop procedure turn can be substituted. However, when a holding pattern or teardrop procedure turn is depicted, the holding pattern or the teardrop course reversal must be flown as shown on the chart.

There are a number of ways to transition to the ILS approach. If flying from the Bozeman VOR, the feeder route to the outer marker is 297°, the minimum altitude is 7,300 feet, and the distance is 7.6 nautical miles. The depiction of this outbound track is a bit unusual. It is *offset* to the side of the localizer to better depict all the relevant information. At Bozeman, when flying from the VOR, it is required to fly a course reversal at the LOM. Since the procedure turn is shown with the heavy line used to depict the procedure turn, it is the primary course reversal. The holding pattern at the LOM is shown with a light line. The light line for the holding pattern indicates it is for the missed approach, not the primary course reversal.

There are a couple of routes that can be flown into Bozeman that don't require a course reversal. At the left of the plan view, the route from the Whitehall VOR (HIA) passes the THESE intersection and then proceeds to the FALIA intersection which is on the localizer. From FALIA, the letters NoPT are adjacent to the localizer. The letters NoPT stand for no procedure turn. NoPt is actually regulatory which means you must fly a straight-in approach from FALIA. If you need to make a course reversal because of excessive altitude, you must inform ATC since they are planning their spacing with other aircraft based on you proceeding straight in over the LOM.

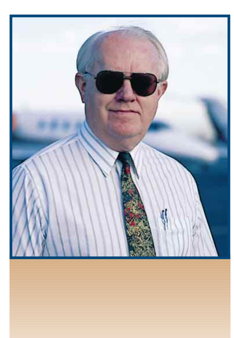
The THESE intersection is on V-343 so when flying to Bozeman on V343, no procedure turn is authorized (or required) from THESE. When approaching Bozeman from the northwest on V-365 (BZN 320° radial), you have a couple of options. If you have DME, you could fly the 14 DME arc to intercept the localizer. The minimum altitude on the DME arc is 8,300 feet which would be flown until intercepting the localizer. The lead-in radial (BZN 306°) was originally established by the FAA as the point where you would change your VHF navaid tuning from the BZN VOR to the IBZN localizer. If you have two nav receivers, that requirement doesn't really exist, but it is a good indicator to tell you that you are about to intercept the localizer.

What is the value of the 14.0 DME fix on the localizer? If you look closely, that is the end of the DME arc and the beginning of the segment on the localizer when flying from the DME arc. The altitude of 6,800 feet from 14.0 DME shows that you can descend to 6,800 feet after flying the DME arc and intercepting the localizer.

Can you begin your descent at the lead-in radial? Not really, since the FARs state that you can't descend to the next altitude until established on the next approach procedure course.

When approaching from the northwest on V-365 without a DME, you could begin your approach at the MENAR intersection which is on V-365. At the MENAR intersection, you would proceed direct to the MANNI LOM at 9,300 feet or higher. Since the letters NoPt are not included on the feeder route from MANNI, you would be required to fly the procedure turn (or other course reversal) at MANNI.

In the next article, we will discuss the approach segments.



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

The Chart Clinic – Eighteenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Communications failure? When do you finally leave your enroute altitude to descend for the approach? FAR 91.185 says "proceed to a fix from which an approach begins and commence descent . . . " Okay, where does the approach begin? What if the weather goes below minimums while on an approach? Can you continue the approach? Have you passed the precision final approach fix?

Every time we start to tackle the interpretation of some of the FARs for the terminal area, it seems that a couple of gaps prevent us from coming to the final solution. This article will cover the segments of the approach and, we hope, close some of those gaps.

If you prefer studying the approach criteria from the original source, the FAA Handbook, "United States Standard for Terminal Instrument Procedures" (TERPs), is available for review at most FAA offices. You may obtain a copy of the TERPs Handbook (8260.3A) for a nominal fee by making a written request to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 050-007-00345-5. The international equivalent of the TERPs criteria is the ICAO Pans-Ops which contains the design criteria for instrument approach procedures. Most countries of the world use the ICAO Pans-Ops for procedure design, although each country typically has many exceptions to the Pans-Ops in its purest form. The Pans-Ops can be obtained from ICAO in Montreal, PQ, Canada. Most of in this article is based on the U.S. TERPs criteria and U.S. FARs, but much of it is applicable in other parts of the world.

Final Approach Segment

When looking at an approach chart to determine the segments, it is usually easiest to start at the airport and work through the approach backwards because the location of the final has the least flexibility. The last segment when coming into the airport is the final approach segment, which begins at the final approach fix (FAF). The final approach fix is usually the outer marker on localizer approaches, and the VOR is the FAF on VOR or VOR/DME approaches when the VOR is not on the airport. For NDB approaches with the NDB located off the airport, the NDB usually forms the FAF. In any case, the final approach fix is designated in the profile view on Jeppesen approach charts with a small Maltese cross.

In the late 1980s, a major concept change was created by the FAA to solve an operational problem. Operators who fly according to FARs 121, 129, and 135 are required to abandon the approach if the weather goes below minimums when on final approach. When the TERPs criteria were first adopted in November 1967, the FAF was located at the outer marker (OM) for virtually all ILS approaches. This made it easy to determine the point at which to abandon the approach since the FARs said that once the final approach fix was passed and the weather was reported below minimums, the captain could, at his discretion, continue the approach. So if the weather went below minimums before the OM, the approach should be abandoned. If the OM had been passed, the captain could make the decision to continue.

Things don't always stay easy in this business. At one airport, the final approach course and descent began well before the OM. The actual glide slope capture was about seven or eight miles before the OM. At this airport, the weather was fluctuating above and below minimums for most of the day, and a number of captains decided to continue the approach after capturing the glide slope, but still before the OM.

The FAA violated every flight crew who continued the approach if they had not passed the OM and the weather went below minimums. The FARs didn't address the flights that had intercepted the glide slope way back in the intermediate segment. Because of this problem, the FAA redefined the final approach fix for precision approaches. By definition, the FAF on a precision approach is the point where the minimum glide slope intercept altitude intercepts the glide slope. So when the minimum glide slope intercept altitude intercepts the glide slope at a point two miles outside the outer marker, that is the FAF. When looking at an ILS approach, there usually is a Maltese cross at the OM. The Maltese cross is the FAF for the localizer portion of the approach, but not for the ILS approach.

Technically, the precision final approach fix is *not really a fix*, but a *point*. In ICAO terms, the precision final approach fix would be called the final approach point. The difference is that a fix is a location over the ground whereas a point is a point in space.

End of Final Approach Segment

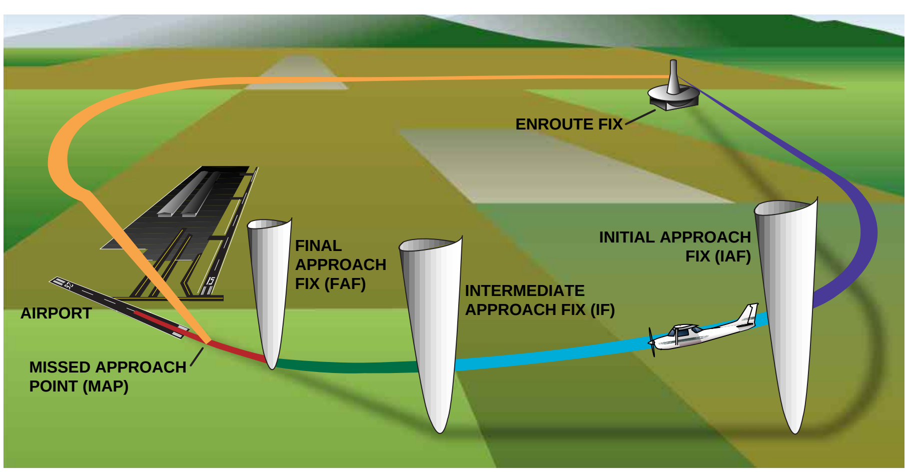
Refer to artwork for the approach segments and note that the final approach segment begins at the FAF and ends at the missed approach point (MAP). On non-precision approaches (no electronic glide slope), the missed approach point usually is located at the landing threshold (which may be a displaced threshold). On non-precision approaches, the missed approach point is most often determined by timing from the FAF.

When flying approaches without an electronic glide slope, the lowest altitude to which you can descend is a minimum descent altitude (MDA). This means you should descend after the FAF until reaching that altitude, and then level off at the MDA until the specified time has elapsed. Remember that the time on the approach chart is based on *ground speed*. To fly this segment accurately, you should compute the true airspeed from the indicated airspeed and pressure altitude, and then apply the wind to come up with the correct ground speed.

On a precision approach (one with an electronic glide slope), the missed approach point is the intersection of the localizer, the glide slope, and an altitude usually 200 feet above the touchdown zone elevation. This minimum altitude is called the decision altitude (DA). Timing is not necessary while descending on the glide slope, but the altitude must be monitored closely when approaching the minimum altitude. Unless visual contact has been made with the runway environment, you must immediately execute a missed approach at the point where the airplane is on the localizer and glide slope and reaches the DA.

Decision Altitude versus Decision Height

When the TERPs criteria first went into effect, the minimum altitude on precision approaches was called a decision height (DH).



Technically, this is not correct since the point is determined by barometric altitude - which measures altitude, not height. Jeppesen charts have been including the letters DA(H) for decision altitude (height) with both figures since the mid-1980s to show both values. The FAA is gradually adopting the term decision altitude to replace decision height. All new WAAS and LAAS approaches will have minimums expressed as decision altitudes (heights).

Making the Miss Early

After passing the FAF, there are times the decision is made to execute the missed approach - well before the MAP. Assume for a moment that the missed approach instructions say the missed approach is a climbing right turn to an altitude at a holding fix. If the decision is made to miss the approach before reaching the missed approach point, when can the turn be initiated? When should the climb be initiated?

Since the approach procedure segments are designed with very specific trapezoids that protect the airspace around defined approach tracks, the aircraft is protected *only within these trapezoids*. Therefore, when executing a missed approach prior to the MAP, the final approach track must be flown until passing the MAP, and then the turn can be made. The altitude is a different story. The climb can be initiated immediately; but as soon as the airplane is cleaned up, you have to make the mandatory report to ATC that you have made the missed approach. You can continue to climb to the missed approach procedure altitude. If you need to fly an altitude other than specified in the missed approach procedure, you can discuss this with ATC.

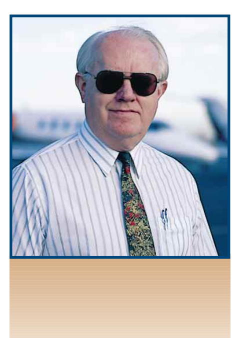
Final Approach Descent Gradients

The optimum descent gradient on the final approach is 300 feet per nautical mile and the maximum descent is 400 feet per nautical mile. The obstruction clearance on final varies according to the type of approach and other criteria such as: length of the final, distance to the altimeter source, and alignment of the final to the landing runway. One important item to remember is that the MDA does not necessarily provide a clear zone all the way from the FAF to the MAP.

Rules are made to be broken - (not really a good thing to say in this business.) But there are legitimate cases. As an example, the maximum descent gradient of 400 feet per nautical mile is equivalent to 3.77º. If you look closely at the Van Nuys, California ILS Rwy 16R approach, the glide slope angle is 3.90º. It is obviously higher than the maximum. So what about the rules in TERPs?

The terrain is so high to the north of Van Nuys that if the glide slope had to be lower, the approach could not be installed at the airport. When this happens, the instrument approach procedure design specialist has worked out all possible means of complying with TERPs, but when they find they cannot, they submit the exception to a special FAA office that specializes in handling waivers to TERPs. Although the exceptions are rare, they are granted when necessary.

In the next article, we will continue discussing the segments of the approach. By the way, where does the approach begin? According to paragraph 230 of TERPs, the approach begins at the initial approach fix (IAF).



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

The Chart Clinic – Nineteenth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Let's ponder for a moment an interesting question about minimums and obstacles. If you were flying a helicopter on a VOR approach, could you descend vertically down to the MDA at the FAF and be safe all the way to the MAP? The answer? Only if you receive a clearance from the "Bureau of Mines." In other words, the MDA *does not* provide obstacle clearance from the FAF to the MAP on a non-precision approach.

The question was meant to be mind stimulating - and because sometimes it may be difficult to stay above the minimum altitudes, it is good to understand some of the protection that is built into instrument approach procedures by the people who design them.

Now for a little explanation of the answer. In the FAA's TERPs criteria, paragraph 289 says "Existing obstacles located in the final approach area within 1 mile past the point where a fix can first be received may be eliminated from consideration by application of a descent gradient of 1 foot vertically for every 7 feet horizontally. This 7:1 descent gradient shall begin at the point where the fix can first be received at a height determined by subtracting the final approach required obstacle clearance (ROC) from the minimum altitude required at the fix."

A good example of this can be found on the VOR or GPS-A approach into Corona, California. The approach is from the Paradise VOR that sits on top of a hill. The VOR elevation is 1,495 feet. After passing the VOR, the descent can be down to the circling MDA at 1,480 feet. Although the VOR is only 15 feet above the MDA, the MDA on other approaches could possibly be as much as 504 feet below an obstacle right at the FAF if the FAF was a VOR.

Stepdown Fixes

Occasionally a fix is located on the final approach segment between the FAF and the MAP. This fix is not a final approach fix, but it is called a stepdown fix and is used on non-precision approaches. When this fix can be identified during the approach, you normally get lower minimums after passing the stepdown fix.

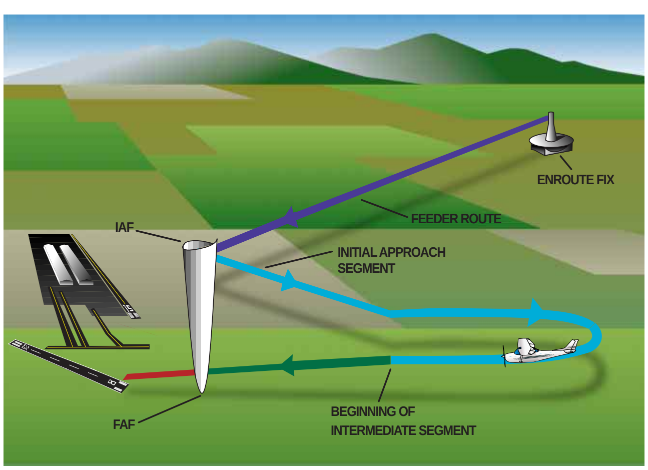
The stepdown fix is used primarily for two reasons. First, there are many cases in which there is a high obstacle in the final approach segment that would cause very high landing minimums. In this case, the FAA will designate a stepdown which is placed beyond the controlling obstruction in the final approach segment. After you have identified and passed the fix, you can descend to the MDA for the airport.

The second reason is when the final approach segment is excessively long, the TERPs criteria requires the MDA to be raised. When the final approach segment exceeds six miles, the MDA is increased at a rate of five feet for each one-tenth of a mile over six miles. When a stepdown fix is incorporated in the final approach segment, the basic obstacle clearance is applied between the stepdown fix and the MAP.

Sometimes, a constant descent rate cannot be made from the FAF down to the runway since a stepdown fix altitude might be higher than the constant descent angle from the FAF to the runway. In these cases the descent rate *after* the stepdown fix will not exceed 400 feet per nautical mile, or 3.77°, and still have straight-in landing minimums.

Intermediate Segment

The intermediate segment is located just outside the final approach segment and is designed primarily to get the airplane set for the final descent into the airport. It is the segment in which aircraft configuration, speed, and positioning adjustments are made for entry to the final approach segment. The intermediate segment begins at the intermediate fix (IF) and ends at the final approach fix.



The intermediate segment is designed to be aligned with the final approach segment; however, this may not always be practical because of terrain or other obstacles. When the final and intermediate courses are not identical, the intermediate segment will be at an angle not greater than 30 to the final approach course.

Because the intermediate segment is used to prepare the aircraft speed and configuration for entry into the final approach segment, the gradient normally is as flat as possible. The optimum descent gradient in the intermediate segment normally does not exceed 150 feet per mile. The maximum permissible gradient is 318 feet per mile, except for a localizer approach published in conjunction with an ILS procedure. In this case, a higher descent gradient equal to the commissioned glideslope angle (provided it does not exceed 3°) may be used.

The optimum length of the intermediate segment is 10 nautical miles; however, the minimum length is five miles and the maximum length is 15 miles. A minimum of 500 feet of obstacle clearance is provided in the primary area of the intermediate segment. The width of the intermediate segment varies according to the width of the final approach segment at the final approach fix.

Initial Approach Segment

The initial approach segment is located just outside the intermediate segment. It is designed to transition incoming traffic from the enroute structure to the intermediate segment. However, when the intermediate fix is part of the enroute structure, an initial approach segment might not be designated. In this case the approach begins at the intermediate fix.

The initial approach segment can be flown using many methods. The following list contains some of these:

DME arc • VOR radial • NDB course
Heading (dead reckoning) • Radar vectors
Procedure turns • Holding patterns
Combinations of the above

In most cases, the beginning of the initial approach segment is identified with the letters "IAF." This IAF is the fix referred to in FAR 91.185 as "a fix from which the approach begins" for the point where the descent to the airport can be initiated. The IAF is also a fix that is required for GPS receivers which are certified to fly approach procedures. In GPS receivers all approaches are retrieved from the databases beginning at the IAF.

There is no standard length for the initial approach segment, but it rarely exceeds 50 miles. The standard width for the primary area is four miles on each side of the initial approach course. When any portion of the initial approach is more than 50 miles from the navigation facility, the width and obstruction criteria for the enroute airways apply to the portion more than 50 miles from the navaid.

The initial approach segment altitude provides a minimum of 1,000 feet obstruction clearance within four miles each side of the course centerline. The obstruction clearance outside the four-mile range is minimal, which means—*stay on course.*

The turn from the initial approach segment to the intermediate segment cannot exceed 120°. When the angle exceeds 90°, a lead-in radial is provided which gives at least two miles of lead for determining when to turn inbound on the intermediate course.

When a DME arc is used for an initial approach segment, the minimum radius of the arc is seven miles. When the last portion of the DME arc exceeds a 90° angle to the intermediate segment, lead-in radials which are at least two miles before the intermediate segment are included in the approach procedure.

Whenever a procedure turn is depicted as part of an approach procedure, a procedure turn forms an initial approach segment. This is also true for tear drop course reversals and holding patterns, or race track patterns that are used to align the airplane with the final approach course just prior to the FAF.

The procedure turn forms an initial approach segment until the inbound course is intercepted. Look at the illustration and note that after intercepting the inbound course you are on the intermediate segment. For this reason, you can descend to the final approach fix crossing altitude after completion of the procedure turn. Remember that the initial approach segment obstruction clearance altitude is 1,000 feet, whereas the intermediate segment obstruction clearance is 500 feet.

Some approach procedures are based on VORs or NDBs located on the airport. On these types of approach procedures, after completing the procedure turn and established on the inbound course, you have intercepted the *final approach segment* for the descent to the MDA. With this type of approach, the intermediate segment and final approach fix are eliminated.

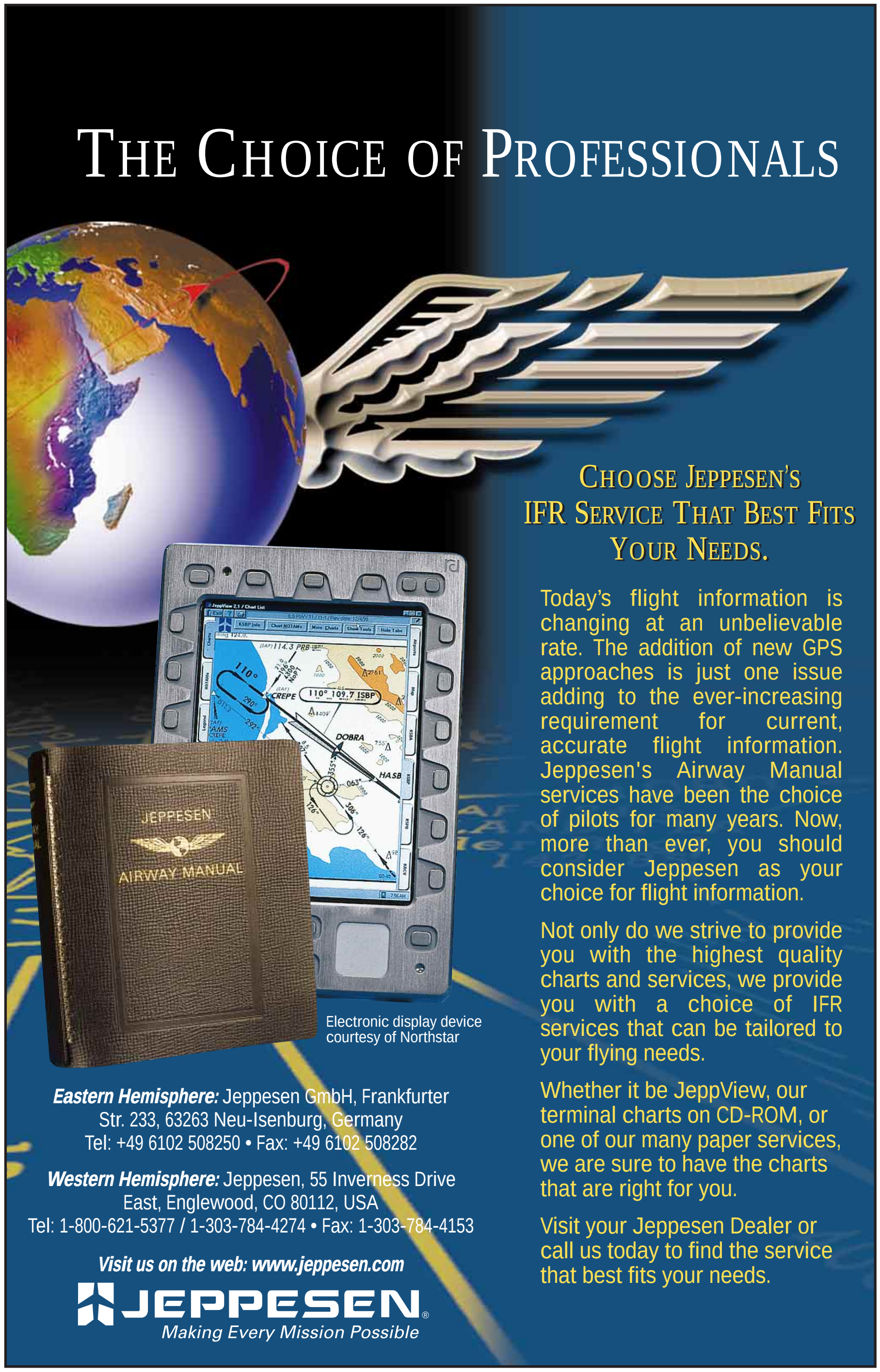
Feeder Route

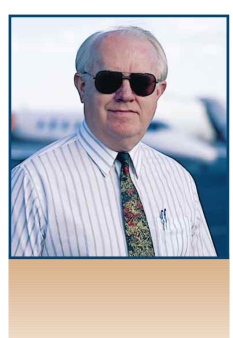
On some approaches, the initial approach fix is not part of the enroute structure. For these approaches, it is necessary to designate a transition course between the enroute fix and the approach structure. This transition course is called a "feeder route." A route from the VOR to the outer marker is a feeder route, and it is not defined as an approach segment if a procedure turn is executed after passing the outer marker. The obstruction clearance criteria for enroute airways are applied to feeder routes.

If a landing cannot be made, a missed approach procedure must be flown. The missed approach segment begins at the missed approach point (MAP) and ends at an enroute fix, or upon returning to the final approach fix (initial approach fix in this case). The missed approach segment can consist of straight courses or turns and is performed any time visual contact with the runway environment hasn't been made by the time you've reached the precision approach DA(H) or the non-precision MAP.

Segments on Approach Charts

All the knowledge in the world won't help until we start making applications to the real world. In the next article, we will refer to an approach chart to determine the various segments and feeder routes.





James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

The Chart Clinic – Twentieth in a Series

Segments on Approach Charts

It is quite fascinating to look at the TERPs criteria to understand some of the background used by the FAA to create instrument approach procedures, but all the knowledge in the world doesn't help until we start making applications to the real world. We'll look at the Manitowoc, Wisconsin VOR or GPS Rwy 17 approach chart to apply part of the theory to actual practice.

Let's assume you are arriving from the north over the Green Bay VOR and you have a communications failure. Since the FARs state that you can descend out of your enroute altitude when you have arrived "over the fix from which the approach begins," can you start down over Green Bay or do you have to wait until over the Manitowoc VOR? If you look over the Manitowoc VOR facility box, you can see the small letters *"IAF"* in parentheses on top. This means the MTW VOR is the initial approach fix and the approach begins at the MTW VOR when arriving from Green Bay.

If you are at a relatively low altitude over the MTW VOR, you can make a right turn at the VOR and proceed outbound for the procedure turn. While you are in the procedure turn, you are in the initial approach segment and therefore have 1,000 feet of obstacle (and terrain) clearance. This gives you a good buffer, but remember that instrument approach procedures are graphic representations of FAR Part 97 so that if you descend below the specified procedure turn altitude too early, you are in violation of FAR Part 97.

NoPT

When you arrive from over Green Bay, it looks pretty easy to just "slide over" to the left and catch the 166° inbound course, which would make it simple to "shoot" a straight-in approach. Since the inbound course from Green Bay is so close to the final approach segment, it may look like a natural to use 166° and eliminate all the flying for the course reversal — And it is less than 30° difference. Is it legal? Is it authorized? How can you tell?

It is expected that you will perform the procedure turn every time you arrive over the fix that starts the procedure turn - *except* - when the letters "NoPT" are shown on the feeder route that goes to the fix. NoPT stands for No Procedure Turn. According to the FARs, this means not only that no procedure turn is expected, but that you also cannot even execute the procedure turn unless you notify ATC of your intentions to fly a procedure turn.

Since the letters "NoPT" do not appear on the route from Green Bay, a procedure turn is required. However, there is an exception to the NoPT statement. When you're given radar vectors and the controller clears you for the "straight-in approach," the approach clearance specifies that no procedure turn is required (or authorized).

Excessive Altitude

The next question for the communications failure from Green Bay is "If I am at an excessively high altitude, where should I lose all the altitude?" First, look at the "target" altitude for the approach after the MTW VOR and it is the procedure turn altitude at 2,400 feet. That is the first altitude after passing MTW VOR outbound. If your descent rate will get you comfortably down to 2,400 feet within the procedure turn distance, then the procedure turn is a good option.

If the altitude change is too much, you can enter the holding pattern and descend while holding. But the next question might be, "How to get out of the holding pattern and do the approach?" The FAA has said that a race track course reversal is an authorized substitute for the procedure turn and the holding pattern can be considered a race track procedure.

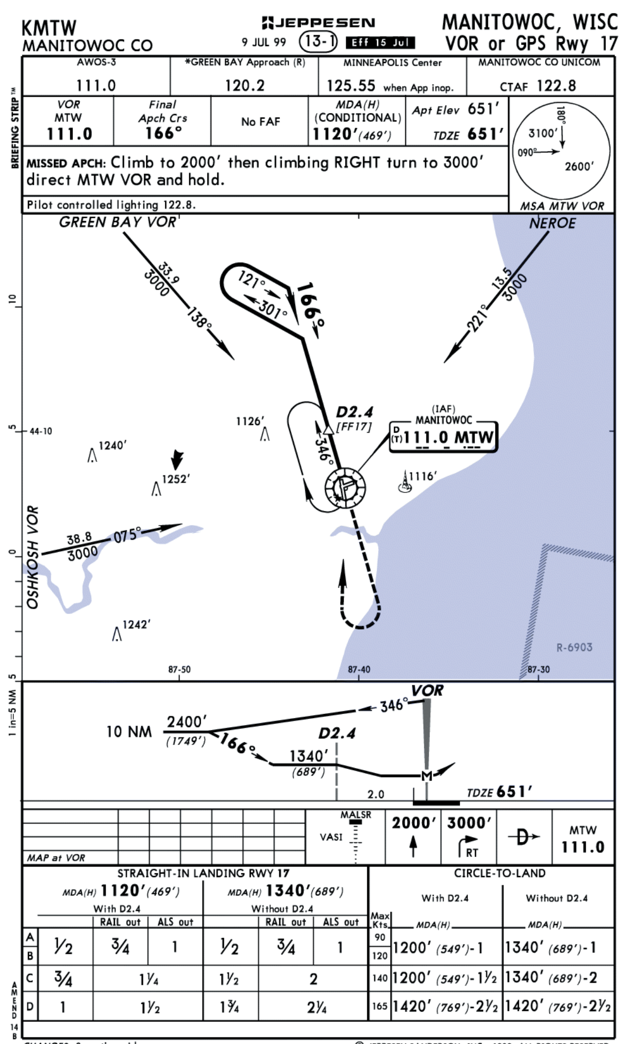
The minimum altitude for the race track course reversal is 2,400 feet, the same figure as the procedure turn altitude. When down to 2,400 feet, the next altitude is 1,340 feet. The descent from 2,400 can be initiated when established on the inbound course of 166°. As soon as you are inbound, you are now on the final approach segment.

Intermediate Segment

What happened to the intermediate segment? On the VOR or GPS approach to runway 17 at Manitowoc, there is no intermediate segment. The procedure turn is the initial approach segment until intercepting the inbound course and then you are on the final approach segment. In this case, there is no final approach fix. In FAA and ICAO procedures, the intercept point to the final approach segment is known at the final approach point. It is not a fix since the exact location varies depending on how the approach is flown, where the wind is coming from, the speed of the airplane, and other variables.

Final Approach Segment

In the plan view, there is a fix identified as 2.4 DME from the MTW on the 346° radial. When flying outbound to the procedure turn, it has no significance. It is, however, important when inbound on final. Since this approach is an "or GPS" approach, it is an overlay approach where a certified IFR approach GPS receiver is allowed to fly the



approach without the availability of the VOR. Along with the DME distance at the fix, the alphanumeric characters "FF17" appear in brackets below the D2.4.

All fixes in the GPS database must have an identifier. When the FAA establishes a five-letter identifier that is pronounceable and unique, the FAA's identifier is used for the fix in the database. When an FAA identifier is not established, a unique five-character identifier must be established for the fix. The ARINC 424 Specification titled *Navigation Database Standards* has been established by industry and government representatives worldwide and includes standards for how waypoints and fixes will be identified when names are not provided by government authorities.

Since the FAA requires that all GPS approaches have a final approach segment that begins at a final approach fix and ends at a missed approach fix, a "pseudo FAF" is established at a location according to specifications established by the FAA. Once the pseudo FAF is established, then the ARINC 424 rules are applied to create the waypoint identifier. Basically, the ARINC rules state that a final approach fix should use the letters "FF" followed by the runway number. Other fixes use letters that are appropriate to their use on approaches. For example, missed approach fixes use the letters "MA," stepdown fixes use the letters "SD," runway fixes use the letters "RW," etc.

At Manitowoc, the identifier FF17 is used for the waypoint identifier in the database for the "pseudo" FAF. One of the important reasons for the pseudo FAF is that it is the location where the course deviation indicator changes to final approach sensitivity.

If your airplane is equipped with either a DME or approved GPS receiver, you can descend down to the straight-in landing minimums once you have passed 2.4 DME or the FF17 waypoint. For a straight-in landing, the MDA is 1,120 feet. If you don't have either of these receivers in your airplane, then the altitude of 1,340 feet at the 2.4 DME is your MDA.

In either case, the final approach segment ends at the MTW VOR. By the time you reach the MAP, and if you are still at the MDA because you haven't had visual contact with the runway or its environment, it is really too late to land if you see the runway at the MAP. The descent gradient from the VOR at the MDA can't make a landing happen. A missed approach is then initiated.

Missed Approach

The icons below the profile view indicate an initial climb to 2,000 feet, followed by a right climbing turn to 3,000 feet, and then direct to the MTW VOR. The missed approach text completes the missed approach instructions with an indication to hold. The graphic depiction in the plan view shows the hold on the 346° radial. The instrument approach ends at the missed approach hold.

In the next article, we will continue to apply the segments to approach charts.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

The Chart Clinic – Twenty First in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

This may take a bit of imagination, but picture a very high wall running down the centerline of the final approach course from some point outside the final approach fix (FAF) to a point beyond the missed approach point (MAP). On that wall, we will paint a line representing the flight path and mark the altitudes to be flown. Additionally, let's paint some vertical symbols to represent navaids. Since the wall is a couple of thousand feet high and quite a few miles long, obviously it won't fit into your Jeppesen manual. So, next, we'll reduce the size to make it fit the manual, apply some fancy pilot-talk name to it, and call it the "approach profile view." The only hole in the whole story? *The profile view is not drawn to scale.*

The first profile we'll look at is an excerpt from the Bozeman, Montana, ILS Rwy 12 approach. The most predominant feature which is common to all *profile views* is the heavy, solid black line which represents the flight track. The flight track is portrayed schematically (not to scale) and depicts the altitudes and magnetic courses to be flown. On the Bozeman ILS Rwy 12 profile, this flight track starts at the beginning of the procedure turn and proceeds past the missed approach point. On the final approach segment, the solid line represents the profile when using the ILS glide slope. Notice that the glide slope is intercepted just prior to reaching the LOM (locator outer marker) and proceeds inbound to the airport via the 118-degree magnetic course on the localizer, then continues to the missed approach point near the middle marker. At the missed approach point, the solid line makes a sharp upward turn indicating that a climb should be initiated immediately upon reaching the MAP if a missed approach is necessary.

The dashed line in the profile just above the glide slope represents the flight path for the non-precision approach. This flight path is flown when the glide slope is inoperative or is not utilized. When executing a non-precision approach, you would maintain the intermediate segment altitude (6,800 feet) until crossing the LOM; therefore, the dashed line does not descend until reaching the LOM in the profile view. Note that the dashed line descends until a point just prior to the middle marker, where it levels out into a straight line. This indicates the non-precision approach is flown in a descent until the MDA, then the altitude is maintained until arriving at the missed approach point. Note that the dashed line stays level until it is over the end of the runway, then begins its sharp upturn. This illustrates that the non-precision missed approach point is over the end of the runway. The large stylized letter "M" in the profile view is a further method of highlighting the MAP location.

Marker Beacons

Fan markers (OM and MM) are shown as vertical shaded areas in the profile view. This symbol is used to denote the relatively large area where the marker beacons can be heard while flying an approach. The letters "MM" for the middle marker are shown immediately above the symbol. The outer marker is collocated with the locator at Bozeman, which is indicated by the solid vertical line at the locator outer marker position. MANNI, the name of the locator is shown just above the LOM symbol.

The numbers below the name MANNI and the letters "MM" represent the altitude of the glide slope at the outer and middle markers. At the compass locator at the outer marker, the altitude of the glide slope is 6,779 feet above mean sea level. When flying this ILS approach, you will be 2,340 feet above the touchdown zone when you cross the LOM, (assuming you have a centered glide slope needle). At the middle marker, you will be 200 feet above the touchdown zone. The 200-foot altitude, when compared to the straight-in height above touchdown zone (HAT), will give you an idea of where your missed approach point is in relation to MM position. At Bozeman, the decision height is 211 feet, so you will be at the DA(H) just before you arrive at the MM.

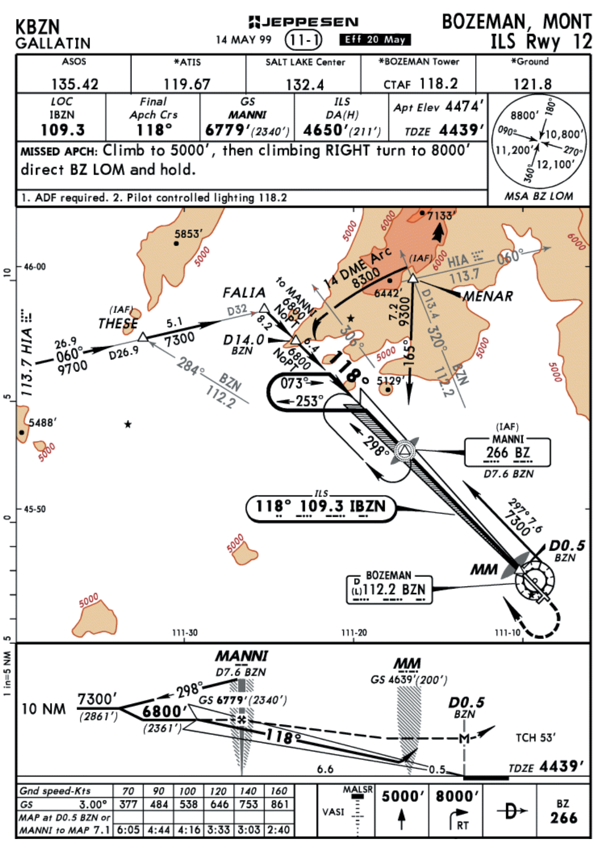
Procedure Turn

The procedure turn information is depicted to the left in the profile of this ILS approach. The "10 NM" states that the procedure turn (if flown) is to be executed within 10 nautical miles of the LOM. When flying the procedure turn, it should be flown on the west side of the inbound course. To stay at least 1,000 feet above all obstacles while performing the procedure turn, an altitude of 7,300 feet is considered a minimum. The numbers 2861 in parentheses just below the procedure turn altitude represent the altitude above the touchdown zone, ***not the altitude above the ground***. Altitudes are important for those operators who set their altimeters so they read zero upon landing, these altitudes then become the flight altitudes on the approach. It is also important to note that all the altitudes in the profile view are the *minimum altitudes* unless designated with the word "mandatory," "maximum," or "recommended."

Precision FAF

After the procedure turn is completed and you are established on the localizer inbound, a descent can be made to the intermediate segment altitude of 6,800 feet. This altitude of 6,800 feet should be maintained until intercepting the glide slope (or passing the LOM if the glide slope is not used). The intermediate segment ends and the final approach segment begins at the LOM. This is depicted by the Maltese cross at the LOM which designates the final approach fix (FAF) for the non-precision approach (when the glide slope is not used.)

A number of years ago, the FAA created a definition for the final approach fix on precision approaches. Because FAR Part 121 and 135 operators can continue the approach if the weather goes below minimums and the airplane has passed the final approach fix, it was necessary to define a precision FAF when using the glide slope.



The precision FAF is now at the intersection of the glide slope intercept altitude and the glide slope. This is indicated on Jeppesen charts at the beginning of the glide slope symbol in the profile view. It is also the point where the glide slope line begins its descent.

When straight-in landing minimums are authorized, the touchdown zone elevation (TDZE) for the straight-in landing runway is shown in the lower right corner of the profile view adjacent to the runway symbol. Both the airport elevation and the TDZE are included in the Briefing Strip™ when there are straight-in landing minimums. The touchdown zone elevation is defined as the highest elevation in the first 2,300 feet of runway beyond the landing threshold. Note that the numbers in parentheses in the profile view relate to the touchdown zone elevation. These same numbers relate to the airport elevation when only circling minimums are authorized.

The altitude of the glide slope above the landing threshold is included in the profile view. At Bozeman, the glide slope is 53 feet above the landing threshold. This information is included above the touchdown zone elevation. As an important piece of trivia, the 53 height is actually the height of the glide slope antenna in the airplane (unless the aircraft manufacturer has applied a factor to correct for the antenna location).

Profile Distances

In most cases, two sets of distances are given near the bottom line of the profile view. The distances below the line represent the distance to the landing threshold and the numbers above the line are the distance between fixes in the profile view. At Bozeman, the location of the final approach fix can be determined by DME. When the DME reads 7.6 from the BZN VOR DME (not BZN ILS DME), you are at the non-precision FAF. The LOM is 7.1 nautical miles from the landing threshold. Since the distances of 7.6 and 7.1 could easily be confused, we decided to eliminate the distance below the line when a fix can be determined by the DME as a way of preventing the wrong number to be used to identify the fix by DME. If DME was not authorized at Bozeman, the number 7.1 would be placed below the line at the LOM location in the profile view to show the distance from the FAF to the runway threshold (or zero point). The numbers above the line are the distance between fixes in the profile view. At Bozeman, the distance from the LOM to the MM is 6.6 nautical miles.

At Bozeman, the FAA has established a DME fix at the non-precision missed approach point. In most cases, the missed approach point is determined by timing from the FAF, but the FAA is gradually establishing DME fixes at the MAP as a much easier way to determine the MAP location. The DME takes all the guess work out of determining the MAP location since it wipes out the errors caused by varying airspeeds and wind speeds on the final approach.

In the next article, we will continue the discussion of the profile view.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

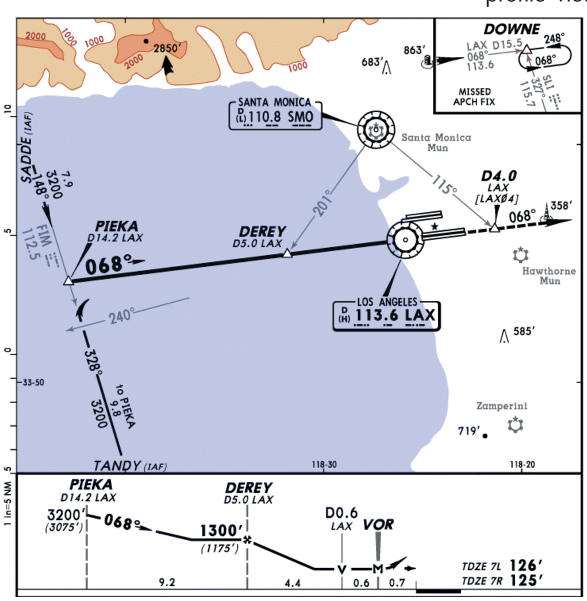
JEPP'S BRIEFING

The Chart Clinic – Twenty Second in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

If you want to start a lively discussion, call the non-precision approach a "dive and drive" approach. Is there truth to the term? Is it derogatory? Are these approach procedures designed to encourage "dive and drive" flying? Can all non-precision approaches be flown with constant descent angles similar to an ILS? Should they?

To answer some of those questions, we should look at the instrument approach procedure design specifications in the TERPs criteria. By design, the ILS glide slope is specified to be a minimum of three degrees. This means that ILS approaches are designed to be flown as constant angle descents from the final approach fix (FAF) all the way down to landing. *That is not true for non-precision approaches.* Non-precision approaches were not designed for optimum descent rates - they were designed so that we as pilots would be at the minimum altitude in each segment of the approach. Specifically, the altitude over the FAF approach fix was designed to be the minimum altitude to clear all obstacles in the intermediate segment by 500 feet.



Los Angeles, Calif, VOR or GPS Rwy 7L/R

Shallow Final Approach Segments

In the first illustration of a non-precision profile view, look at the altitudes on the VOR or GPS Rwy 7L/7R approach at Los Angeles, California International Airport. At DEREY, the FAF, the altitude is 1,300 feet and the runway 7R touchdown zone elevation (TDZE) is 125 feet. By adding 50 feet to the TDZE, that is a descent of 1,125 feet in 5.7 nautical miles. That computes to be 197 feet per mile, or 1.86 degrees. **Very shallow!** On the other hand, the ILS glide slope minimum rate of descent is 318 feet per mile, or three degrees. If you fly a constant descent rate of about three degrees on the LAX VOR approach, you will be down to the minimum descent altitude (MDA) in 2.2 miles, *or 3.5 miles before the end of the runway.*

There are advantages and disadvantages in reaching the MDA so early. The advantage is that you get plenty of time to look for the runway, or its environment, while flying at the MDA. The disadvantage in many airplanes is that at the lower approach speeds, the body angle is high and it is hard to see over the panel. So with the descent from the FAF, level off at the MDA, then another descent to the runway, one can easily see where the term "dive and drive" comes from. There is also a strong inclination to start descending below the MDA early if there is visual ground contact. Statistically, the largest percentage of fatal accidents happen in the last portion of non-precision approaches.

Looking at some of the specific procedure information on the Los Angeles chart, the profile view starts at PIEKA intersection. By referring to the plan view you can see that the thickest line on the approach procedure is the line from PIEKA to the missed approach point. In the plan view, the altitude and distances are not shown since all this information is depicted in the profile view. The altitude at PIEKA is 3,200 feet since that is the altitude when arriving there from the transitions from SADDE and TANDY that are shown in the plan view.

Parenthetical Heights

When at PIEKA, the MSL altitude is 3,200 feet and the height above the TDZE is 3,075 which is shown in parentheses. Remember that the numbers in parentheses **are not above the ground below you.** When at PIEKA, you are over the Pacific ocean (obviously sea level), so your height above the surface below you is 3,200 feet and not the number in parentheses. In this case, the height above the surface below you is not significant, but a mountain could be below PIEKA as high as 2,200 feet for the initial approach segments into PIEKA.

Intermediate Segment

PIEKA is an intermediate fix, and it is the beginning of the intermediate segment to DEREY. In the TERPs criteria and ICAO Pans-Ops documents, the intermediate segment is used to slow the airplane down and get it configured to enter the final approach segment. The intermediate segment has an optimum descent gradient of only 150 feet per nautical mile. The actual angle from PIEKA to DEREY is 2.00 degrees which is less than the maximum of 3 degrees for the intermediate segment and it is still less than the normal precision final approach segment.

PIEKA intersection is formed by the FIM (Fillmore) 148° radial, the 14.2 DME from the LAX VORTAC, and the 068° inbound course to LAX. To keep the profile view clean and uncluttered, we decided to include only the DME values in the profile view since they are the values that continue to change while on final. The intersection values are referred to once when setting them up to form the intersection, and from that point you only have to watch the movement of the VOR needle to tell when you are at an intersection. Also, to keep the chart presentation clean, only the letter "D" is included with the DME values to indicate that an intersection or fix can be formed by a DME.

Each type of fix has a different symbol in the profile view to assist in telling the type of fix to expect when flying the approach. Since PIEKA and DEREY are intersections, a vertical dashed line is used for their depiction. The VOR has a solid black vertical line that tapers from larger at the top to smaller at the bottom. An NDB is depicted the same way since it is a navaid. On the approach at Los Angeles there is a VDP indicated by the stylized letter "**V.**" The vertical line for a VDP is a very thin vertical line since it is not a mandatory fix when shooting the approach. The other fixes in the profile at Los Angeles are required for this approach.

Visual Descent Point

On the final approach segment at Los Angeles the FAA has established a visual descent point (VDP). By definition, the VDP is at the intersection of the lowest MDA and a three-degree descent to the runway. With the latest TERPs change, the VDP angle will be the same as the visual guidance slope indicator (VGSI) where it exists on the straight-in landing runway. VGSI is another way of saying VASI (visual approach slope indicator) or PAPI (precision approach path indicator). A VDP is established only at locations where there is a DME to establish its position. The VDP is primarily an advisory location to help establish where a normal descent to the runway can be flown from an MDA. This helps to keep the airplane above obstacles until a normal final descent is made.

At Los Angles, the missed approach point is at the LAX VOR which is 0.7 miles prior to the end of the runway. Notice there are two arrows after the MAP. The upper one indicates a pull up for the missed approach procedure after the VOR and the other one indicates that the portion of the approach from the VOR to the runway is flown in visual conditions. Remember the missed approach can be executed from any place on final, but the exact track for the final approach must be flown until passing the VOR. A missed approach climb can be started significantly before the VOR (as long as ATC knows).

There is a small vertical line above the runway threshold to indicate the end of the segment after the VOR. This is the end of the 0.7 mile segment. The TDZEs for both runways are shown above the runway symbol since this approach is designed for straight-in landings on both runway 7L and 7R.

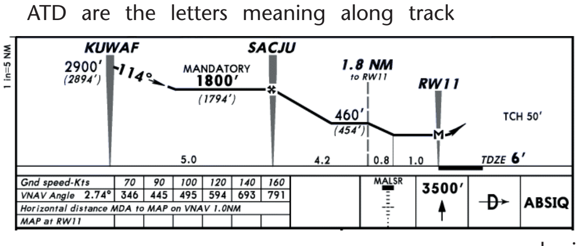
Minimum, Maximum, etc.

All the altitudes in the Jeppesen profile views are *minimum* altitudes except where specifically stated as *maximum, mandatory,* or *recommended.* Look at the profile view for the Oakland, California GPS Rwy 11 approach. The final approach fix altitude at SACJU is a mandatory altitude of 1,800 feet. The letters "MANDATORY" are included in all capital letters so they are easily seen. At Oakland, it is important to be **AT** 1,800 feet at SACJU since the departures out of San Francisco International Airport just to the south need the airspace above the FAF into Oakland.

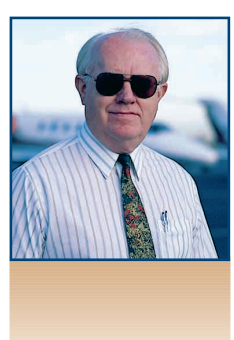
The altitude indicators of MAXIMUM and RECOMMENDED were used occasionally in the past, but are very rare today.

After passing SACJU at Oakland, there is a stepdown fix that is known as an ATD fix. ATD are the letters meaning along track distance and are used to indicate the formation of the stepdown fix as 1.8 miles along the track prior to the RW11 which is the missed approach point.

In the next article, we will continue looking at the profile view with an emphasis on constant angle descents.



Oakland, Calif, GPS Rwy 11



James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

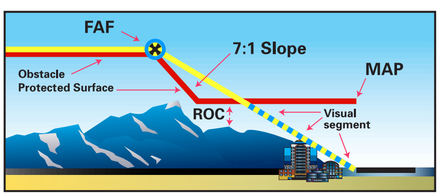
By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

The Chart Clinic – Twenty Third in a Series

When you descend down to the minimum descent altitude (MDA), is it a "hard" altitude? Can you descend below the MDA while still in instrument conditions? What about the decision altitude (DA)? Is it legal to descend below the DA while executing a missed approach? Why is there a difference?

MDA Protection

As can be seen from the illustration, the MDA is protected starting at one mile after first receiving the FAF all the way to the missed approach point (MAP). Obstacles within the first mile after the FAF that fall below the 7:1 slope do not need to be considered in establishing the MDA. According to the TERPs criteria, the MDA is the lowest altitude to which descent shall be authorized in procedures not using a glideslope. Aircraft are not authorized to descend below the MDA until the runway environment is in sight and the aircraft is in a position to descend for a normal landing.



Because of the design of the MDA, the obstacle which controls the MDA could be close to the end of the runway and actually penetrate through a line which proceeds straight from the FAF to the end of the runway. This is the reason the MDA must be maintained all the way to the missed approach point (MAP) and a *descent below the MDA is not authorized* until visual conditions exist.

The MDA for straight-in landings can be as low as 250 feet and the MDA for approaches where only circling minimums exist can be as low as 350 feet for category A aircraft and higher for the other aircraft categories. The MDA typically is higher than the minimum because of obstacles, remote altimeter sources, and other factors such as excessively long final approach segments.

Constant Angle Non-Precision Approaches

In the Jeppesen NavData™ database for airborne systems such as GPS and FMS, there is a vertical navigation (VNAV) angle for virtually every non-precision approach procedure in the world. All of the descent angles are based on a series of rules which are written in the ARINC 424 specifications. The rules essentially state that a straight line will be drawn from 50 feet above the runway threshold back up to the altitude at the FAF. A calculation will then be made to determine the angle for the descent line. This is the method specified in both the TERPs criteria and the ARINC specs and is rounded to one hundredth of a degree. The descent angle will be at least 3.00°. If the computed descent angle is less than 3.00°, the angle will be raised to the minimum of 3°.

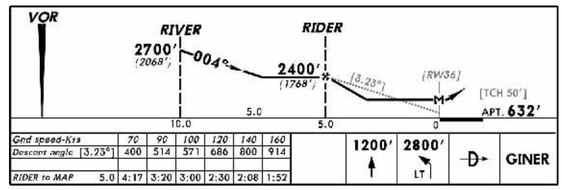
When flying this VNAV descent angle, you can fly a stabilized descent from the FAF to a landing. In order to display this new information, all the non-precision approach charts produced by Jeppesen will have a modified profile view and conversion table beginning in an early December 1999 revision. The first profile view illustration shows a sample of the new profile view.

Look at the profile view and note the dotted line from the RIDER intersection (FAF) to the runway threshold. The dotted line will always match the angle in the database. To show that the descent line is computed and in the database, the dotted line is shown in a gray color rather than the dark black lines used for the other profile view information. The computed descent angle is 3.23° and is included in brackets to show the database information.

Also included in the profile view is the threshold crossing height (TCH) which has a default value of 50 feet. The value may be other than 50 feet when it is determined to have a different requirement because of various government criteria. On this approach, the missed approach point is the threshold on runway 36. The identifier RW36 is shown in the profile view inside of brackets and in a gray color to depict the database identifier for the MAP.

The conversion table also shows the descent angle in brackets and in hundredths of a degree. The most valuable information for aircraft not equipped with VNAV is the descent rate in feet per minute at various ground speeds. Assuming a ground speed of 100 knots, a descent rate of 571 feet per minute should accomplish a stabilized descent from the FAF to the runway. Since it is virtually impossible to maintain a perfect ground speed while flying a final approach segment, it might be suggested to add a few feet per minute to the descent rate to ensure that you don't overshoot the runway threshold.

Using this procedure, you generally will reach your MDA at about the distance from the runway that is the same as the minimum visibility. In some cases, the visibility might be slightly different from the distance when reaching the MDA because of lighting or higher MDAs.



Descent Angles to Clear Stepdown Fixes

On many approaches, a straight line from the final approach fix down to the TCH is actually too low for a stepdown fix and will cross the stepdown fix below its minimum altitude. In these cases, the descent angle is calculated from the altitude at the TCH back up to the stepdown fix altitude. By FAA and ICAO Pans Ops criteria, the stepdown fix descent rate to the runway has to meet the same criteria as any other portion of the final approach segment. The optimum descent gradient on the final approach segment is 300 feet per mile (close to 3°) and cannot be steeper than 400 feet per mile (3.77°).

On the profile view that shows KENDO as the FAF, notice that there is a short level segment after the FAF. This means that the descent angle of 3.50° is not from the FAF, but was calculated between the stepdown fix and the runway threshold. To fly the 3.50° descent angle to the runway, the descent is delayed until 6.9 NM to RW29. This distance is shown in gray just after the FAF, and is marked by a small vertical line at the point of the delayed descent.

Using the MDA as a DA

There are many aircraft today that are equipped with vertical navigation equipment and are capable and authorized to fly the computed descent angle on non-precision approaches. Because of this capability and the airlines' desire to use more of the capability in their FMSs, the FAA issued a Joint flight Standards handbook bulletin for Air Transportation (HBAT) and General Aviation (HBGA). The Bulletin number is HBAT 99-08 and HBGA 99-12 and is applicable to operators under FAR 121, 125, 129, or 135.

The profile view with KENDO as the FAF shows a slightly different depiction of the descent angle. Instead of a dotted line, there is a dashed line from the FAF down to the MDA. Note that the dashed line stops at the MDA and is followed by a small arrow that curves up at the MDA. This shows that the MDA can be used as a DA(H).

Once the statement is made that *the MDA can be used as a DA(H)*, a lot of explaining is necessary. And a lot of conditions must be met.

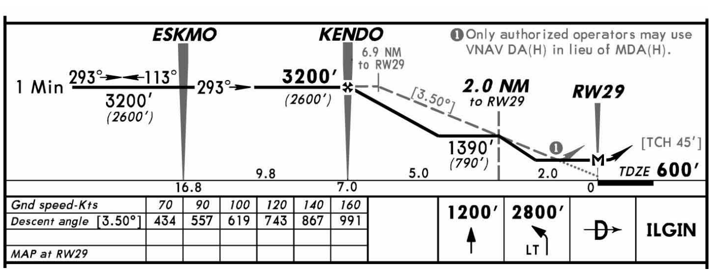
There is a small ball flag with the number "1" at the bottom of the dashed line. The ball flag refers to the note that states, "Only authorized operators may use VNAV DA(H) in lieu of MDA(H)." First, special approval from the FAA is necessary for each operator to gain this new benefit. And - the approval is only for certain airplanes used by the operator.

And the big "IF." The MDA may be used as a DA only if there has been a visual segment obstacle assessment made for the straight-in landing runway. The FAA has stated that there has been an obstacle assessment when the runway has a VASI or PAPI as a visual guidance system indicator, an electronic glideslope, or an RNAV approach published with a decision altitude.

Since an obstacle assessment has been made, the FAA has authorized the DA since it is assumed that a momentary descent will be made below the DA during the execution of a missed approach.

When there is a VDP, it should be at the point where the descent angle meets the MDA.

Most aviation authorities and industry leaders have recognized the safety benefits that will be gained by reducing the number of non-precision approaches that don't have vertical guidance. The addition of vertical guidance should help to reduce the number of CFIT (controlled flight into terrain) accidents. Recently, the NTSB has recommended that aircraft with onboard capabilities for vertical guidance should be required to use them during non-precision approaches. They have also recommended that within 10 years all non-precision approaches approved for air carriers should incorporate constant-angle descents with vertical guidance from onboard systems.



In the next article, we will begin the discussion of missed approaches.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Twenty Fourth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

So far everything is going okay. Approach Control has cleared us for the approach, we are final approach fix (FAF) inbound, flaps are set, the gear's hanging, and the tower says, "cleared to land, RVR now 1800 feet." That statement usually makes us sit a little tighter in the seat. And, frequently, it means that the airport is below landing minimums for some operators.

About this time, our scan of the panel breaks a little longer than normal to look at those minimums again. Jeppesen's philosophy is "give the pilot all the minimums information needed on the applicable charts." This means that inoperative components don't send you digging into the FARs or a table to find out how much the minimums have gone up. Just move your eyes slightly to the right and the adjusted minimums are there.

Let's look at the minimums in the first illustration for ILS Runway 1 at Reagan National Airport in Washington, D.C. Notice that the lowest minimums are to the far left. As components or visual aids go inop, the minimums go higher to the right in the minimums box.

At the top of each minimums box is the statement which specifies the only runway where straight-in landing minimums apply. If straight-in landing minimums apply to any other runway, such as a side step runway, a separate column will be listed.

A block of minimums on the right side of the minimums box includes the circle-to-land minimums which apply to all runways other than the runway specified at the left in the minimums box. At some airports, straight-in landing minimums are not authorized since the final approach course is more than 30 degrees from the landing runway, or the airplane may not be in a position from which a normal landing can be made. Whenever the descent gradient from the final approach fix to the runway threshold exceeds 400 feet per nautical mile, straight-in landing minimums are not authorized.

The letters A, B, C and D at the left of the minimums box represent the aircraft categories. The aircraft categories are based on a speed equal to 1.3 times V_{SO} at the maximum certificated landing weight. When the TERPs criteria were first implemented in 1967, the aircraft weight was also used to determine the aircraft category, but the weight has now been eliminated. The aircraft categories are:

Category A: Speed less than 91 knots.
Category B: Speed 91 knots or more but less than 121 knots.
Category C: Speed 121 knots or more but less than 151 knots.
Category D: Speed 141 knots or more but less than 166 knots.
Category E: Speed 166 knots or more. (Category E pertains to a couple of military aircraft and is not included on Jeppesen approach charts.)

The aircraft categories apply to both straight-in landing and circle-to-land minimums. Since the categories are based on a computed number and not the actual approach speed, there are many who recommend using the category appropriate for the approach speed, not the stalling speed times 1.3. In some countries (not the USA), it is required that you use the actual approach speed rather than the computed value.

Minimum Altitudes

The minimum altitudes for landing are spread across the top of the minimums box and include altitudes labeled as DA, MDA, HAT and HAA. At Washington National, there are three main columns titled "ILS," "LOC (GS out)," and "CIRCLE-TO-LAND." The column to the farthest left under the ILS title is labeled as "FULL," which means the *four* components of a Category I ILS (localizer, glide slope, outer marker, and middle marker) and the associated visual aids. It is interesting that FAR 91.175 still lists the middle marker as a basic component of the ILS even though its loss has no effect on landing minimums. Since an MM that is inoperative no longer causes the landing minimums to be raised, many of the middle markers are being removed. Some countries still have a penalty for the MM out.

Gnd speed-Kts	70	90	100	120	140	160
GS 3.00°	377	485	538	646	754	861
MAP at D1.0 IDCA or OXONN to MAP 4.6	3:57	3:04	2:46	2:18	1:58	1:44

ALSF-II | 500′ | 2000′ LT | DCA via 111.0 R-325

	STRAIGHT-IN LANDING RWY 1 ILS DA(H) 215′(200′)			LOC (GS out) MDA(H) 480′(465′)		CIRCLE-TO-LAND	
	FULL	TDZ or CL out	ALS out		ALS out	Max Kts	MDA(H)
A	RVR 18 or 1/2	RVR 24 or 1/2	RVR 40 or 3/4	RVR 24 or 1/2	RVR 50 or 1	90	620′(604′)-1
B						120	660′(644′)-1
C				RVR 40 or 3/4	RVR 60 or 1 1/4	140	1 660′(644′)-1 3/4
D				RVR 50 or 1	1 1/2	165	1 700′(684′)-2 1/4

1 Not authorized Northeast of Rwys 15/33.

AMEND 40

CHANGES: Rwy number, chart reindexed.

At Reagan National, the full ILS authorizes you to descend to 215 feet as the decision altitude. You will notice that all precision landing minimums are labeled as DA(H) instead of DH since the minimum altitude of 215 feet is actually an *altitude* and *not a height*. The number in parentheses just to the right of the decision altitude is the height above touchdown zone (HAT). An HAT figure is used for straight-in landing minimums. The DA and HAT can be verified by cross checking the touchdown zone elevation of 15 feet next to the runway in the profile view.

If the touchdown zone (TDZ) lights or the centerline lights are not in service, refer to the next column to the right, and note that the visibility has increased from 1,800 feet RVR to 2,400 feet RVR.

If the glide slope is not used, the approach is no longer a precision approach and the minimum altitude becomes a minimum descent altitude (MDA) instead of a decision altitude. At Reagan National, when the glide slope is not used, the MDA becomes 480 feet. The number in parentheses to the right of the MDA is still a height above touchdown zone (HAT) even though the glide slope is inoperative. The number remains an HAT since the MDA is a specified altitude above the touchdown zone of the straight-in landing runway. Note that the MDAs are rounded to the higher 20-foot increment (10 feet in some countries) and the DAs are to the nearest foot.

All circle-to-land minimums are expressed as an MDA even though the glide slope may be used to descend to a circling MDA. The circle-to-land MDA is usually higher than the straight-in landing MDA. This is because the TERPs criteria specify that the lowest circle-to-land MDA will not be less than 350 feet above the airport, whereas the straight-in landing MDA can be as low as 250 feet above the landing touchdown zone elevation. The altitude in parentheses to the right of the circling MDA is expressed as the height above the airport (HAA). Since the circle-to-land minimums are not referenced to any one runway, the touchdown zone elevation is not applicable and the airport elevation is used. A cross-check of this can be verified by comparing the circle-to-land MDA and HAA with the airport elevation.

Visibilities

The normal Category I ILS straight-in landing minimum visibility is one-half statute mile. If touchdown zone lights and centerline lights are available, this minimum visibility can be as low as an RVR of 1,800 feet. At Reagan National, the landing visibility is an RVR of 1,800 feet or 1/2 mile of meteorological observed visibility when all the lights are working. The RVR is applicable only to Runway 1 and cannot be used to determine the visibility for landing on another runway.

When some of the components or visual aids are not available, the landing visibility may be adversely affected. When the approach light system (ALS) is out, the visibility is increased to an RVR of 4,000 feet or 3/4 mile.

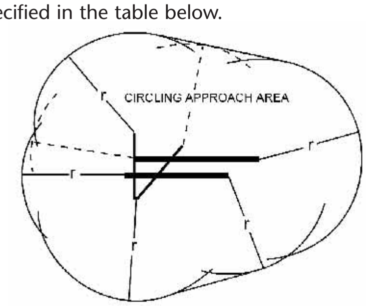
FAR 91.175 *"Takeoff and Landing under IFR"* states that "a compass locator or precision radar may be substituted for the outer or middle marker." It also states that "DME, VOR, or nondirectional beacon fixes authorized in the standard instrument approach procedure or surveillance radar may be substituted for the outer marker." This authorization was very important when penalties were required with the loss of the marker beacons, but the substitution is not as relevant today. Part 91 pilots still must receive the OM or an authorized substitute.

If the glide slope is out, the authorized visibility minimums are increased for aircraft categories A, B, C, and D. If the glide slope and Approach Lighting System (ALS) is also out, the visibilities are increased even more. Note that the visibility for category D aircraft with the GS and ALS out is expressed in miles only since 1-1/2 miles are beyond the range of the RVR.

The circle-to-land MDA and minimum visibility are usually different for every aircraft category. Category A Airplanes have an MDA of 620 feet and a visibility of one mile. The MDA for Category B airplanes is increased 40 feet to 660 feet and the Category C circle-to-land visibility is increased to 1 3/4 statute miles. Category D airplanes have the highest MDA of 700 feet with a visibility of 2 1/4 miles.

Note the restriction to circling for Category C and D aircraft shown below the circling minimums. Circling is not authorized Northeast of runways 15/33 for the larger airplanes. Since the Washington National airport is so close to downtown Washington, D.C., circling northeast of the airport could easily stray into P-56, the prohibited area over the White House.

It can easily be seen why the circling approaches should be kept in close to the airport since the protected areas do not have that large of a margin. A minimum of 300 feet above all obstacles is provided for all aircraft categories within the respective areas. The areas become significantly larger for high-speed airplanes. The radii and lowest MDAs for circling to land are specified in the table below.



Approach Category	Radius (R) in Miles
A	1.3
B	1.5
C	1.7
D	2.3
E	4.5

Lowest Standard Circling Minimums				
Approach Category	A	B	C	D
HAA in feet	350	450	450	550
Visibility in miles	1	1	1-1/2	2

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

JEPP'S BRIEFING

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

The Chart Clinic – Twenty Fifth in a Series

The typical non-precision approach procedure may not require tuning of a myriad of radios, but neither does it allow minimums as low as a precision approach. This article will continue the discussion of the approach charts by looking at the non-precision minimums table.

VOR Approach Minimums

The minimums table for VOR and NDB approaches normally contains significantly less data than for ILS approaches since fewer options are available. However, some VOR and NDB approaches give credit for approach lighting systems, high-intensity runway lights, and runway alignment indicator lights. These approaches use more complex minimums tables to reflect increased minimums when the visual aids are unavailable and visibility credits are taken away.

Gnd speed-Kts	70	90	100	120	140	160	REIL PAPI-L	6000' RT		AKO 114.4
MAP at D1.7 or VOR to MAP 1.7	1:27	1:08	1:01	0:51	0:44	0:38				

	STRAIGHT-IN LANDING RWY 29 MDA(H) 5120'(439')	Max Kts	CIRCLE-TO-LAND MDA(H)
A	1	90	5160'(446')-1
B	1	120	5180'(466')-1
C	1¼	140	5300'(586')-1½
D	1½	165	5300'(586')-2

AMEND 0

CHANGES: Procedure ident, new chart format.

AKRON, COLO VOR Rwy 29

Non-precision approaches, such as VOR and NDB approaches, only include minimum descent altitudes (MDAs) in the minimums boxes and do not include a DA(H) (decision altitude and height) as minimum altitudes. Similar in philosophy to the ILS minimums, the lowest landing visibility minimums are included at the left of the minimums table. The straight-in landing runway is specified both in the minimums box and in the title. Refer to the landing minimums for the VOR approach for Akron, Colorado and note that only Runway 29 is authorized for straight-in landing minimums. When landing straight-in, you may descend to the MSL altitude of 5,120 feet. Since straight-in landing minimums are authorized, the number in parentheses (439') to the right of the MDA represents the Minimum Descent Height above the touchdown zone (HAT), and not the height above the airport (HAA). On this approach, Category A, B, C, and D aircraft are authorized for the same straight-in landing MDA(H), but have different visibility minimums.

The circle-to-land minimums are included at the right side of the minimums table similar to the circle-to-land minimums on ILS approaches. The big difference in the minimums, however, is that the numbers in parentheses are Heights Above Airport (HAA) since circling minimums are based on the airport elevation and not a runway or TDZ elevation. In most cases, as is seen at Akron, the faster categories of aircraft have higher circle-to-land minimums. Although not shown on the chart, the TERPs circling areas for each category are not to be exceeded while making a circling approach, regardless of the published visibility. The TERPs circling area radii for category A is – 1.3 NM, B – 1.5 NM, C – 1.7 NM, and D – 2.3 NM. The circling minimum visibilities sometimes are larger than the circling areas *– but the TERPs circling areas still apply*. If you fly the circling approach at a higher speed than the straight-in landing, you should move to a higher approach category in many cases.

Sometimes, only circle-to-land minimums are authorized on an approach chart. When that happens, the conditions required for straight-in landing minimums were not met. In order for straight-in landing minimums to be authorized, three conditions must be met. First, the final approach segment must be aligned within 30° of the straight-in landing runway. Second, the final approach segment must cross the runway threshold, or at least the extended runway centerline within 3,000 or 5,200 feet (depends on whether the navaid is on or off the airport). And third, the final approach segment descent gradient cannot exceed 400 feet per nautical mile (3.77°). In some cases, the final approach segment is exactly lined up with the runway but the descent gradient is too steep. In these cases, you can still land straight in even though only the circling minimums are published.

Complex Approach Minimums

The minimums for Pasco, Washington VOR or GPS Rwy 21R represent one of the most complex sets of minimums for a non-precision approach. To get the lowest MDA(H) of 840 feet at Pasco, you must meet all of the following conditions: (1) obtain a local altimeter setting; (2) be able to identify the 2.5 DME fix; and (3) land straight-in on runway 21R. With this many options available, the minimums seem to take up most of the space on the approach chart. These options also affect the size of the profile view of the approach chart.

	STRAIGHT-IN LANDING RWY 21R With D2.5			Without D2.5				CIRCLE-TO-LAND With D2.5	Without D2.5
	With Local Altimeter Setting MDA(H) 840'(440')			MDA(H) 1040'(640')				With Local Altimeter Setting	
		RAIL out	ALS out		RAIL out	ALS out	Max Kts	MDA(H)	MDA(H)
A	RVR 24 or ½	RVR 40 or ¾	RVR 50 or 1	RVR 24 or ½	RVR 40 or ¾	RVR 50 or 1	90	880'(473')-1	1040'(633')-1
B	RVR 24 or ½	RVR 40 or ¾	RVR 50 or 1	RVR 24 or ½	RVR 40 or ¾	RVR 50 or 1	120	880'(473')-1	1040'(633')-1
C	RVR 40 or ¾	RVR 60 or 1¼		RVR 60 or 1¼	1¾		140	880'(473')-1½	1040'(633')-1¾
D	RVR 50 or 1	1½		1½	2		165	1040'(633')-2	1040'(633')-2
	With Walla Walla Altimeter Setting MDA(H) 1000'(600')			MDA(H) 1200'(800')				With Walla Walla Altimeter Setting	
		RAIL out	ALS out		RAIL out	ALS out	Max Kts	MDA(H)	MDA(H)
A	1¼	1¾		1¼	1¾		90	1040'(633')-1¾	1200'(793')-1¾
B	1¼	1¾		1¼	1¾		120	1040'(633')-1¾	1200'(793')-1¾
C	1½	2		2	2½		140	1040'(633')-2¼	1200'(793')-2½
D	1¾	2¼		2¼	2¾		165	1200'(793')-2¾	1200'(793')-2¾

AMEND 4

MAP at VOR

CHANGES: See other side.

PASCO, WASH VOR or GPS Rwy 21R

When a stepdown fix, such as the 2.5 DME fix, is provided, the altitude over the stepdown fix typically becomes the MDA(H) if the fix is not identified. At Pasco, the altitude over the stepdown fix is 1,040 feet, assuming a local altimeter setting is obtained at the airport. The Ball Flag 1 to the left of the stepdown fix altitude in the profile refers you to the note which specifies an altitude of 1,200 feet over the 2.5 DME fix if the Walla Walla altimeter setting is used.

When a double stacked set of minimums is provided, the lowest minimums are to the left in the upper box. When the 2.5 DME fix Intersection is not identified, the MDA of 1,040 feet is shown in the right side of the upper straight-in landing minimums box. All of the minimums in the upper minimums box are authorized only when a local altimeter setting is available. This applies to both the straight-in landing and circle-to-land minimums.

When the altimeter setting is derived from a remote source more than five miles from the airport reference point (ARP), the MDA(H) is increased by a factor that considers both the distance to the remote altimeter as well as the elevation difference between the landing airport and the remote altimeter airport. At Pasco, this raises the MDA 160 feet when the altimeter setting is obtained from Walla Walla. This change in the altimeter source requires you to look in the lower set of minimums to find the appropriate MDA(H) for straight-in and circle-to-land minimums.

The preceding discussion of minimums at Pasco should remind us of one important thing – you should review the approach chart before flying the final approach segment inbound.

Conversion Table

Toward the bottom of each approach procedure chart, a conversion table is provided. This table relates the airplane ground speed to the recommended descent rate and time from the FAF to the non-precision missed approach point (MAP). To be a real purist, the ground speed in the conversion table should be calculated by applying pressure altitude and temperature to the calibrated airspeed to arrive at the true airspeed. Then, the wind should be applied to the true airspeed to get an accurate ground speed. And – this means you have to fly the same numbers all the way down final. If you have DME and the DME station is directly in front or behind you, you can get your ground speed from the DME.

On ILS approaches, the glide slope angle is expressed in decimal degrees on the line below the ground speeds. The figures in the ground speed line represent the recommended rates of descent to maintain the glide slope at the stated ground speeds. Some pilots use this as a check to monitor the wind shear, which is noticed by a significant increase or decrease in the descent rate to maintain the glide slope.

The bottom line of the conversion table specifies the time from the final approach fix to the missed approach point ***for non-precision approaches***. This timing will ***not*** work correctly for determining the distance from the final approach fix to the decision altitude since the decision altitude is usually one-half mile prior to the end of the runway. The distance of 6.3 (nautical miles) in the bottom line is the distance from the FAF to the runway threshold at the Denver Centennial Airport. This distance will not be the same when the non-precision missed approach point is at a location other than the end of the runway or displaced threshold. There are some cases where timing is not included. This means that timing is not authorized, and another means of identifying the missed approach point is required, such as DME for a DME-only fix at the MAP on a VOR DME approach.

In the next issue, we will analyze additional approach minimums. Additionally, missed approach procedures will be discussed.

Gnd speed-Kts	70	90	100	120	140	160
GS 3.00°	379	487	542	650	758	866
CASSE to MAP 6.3	5:24	4:12	3:47	3:09	2:42	2:22

DENVER, COLO ILS Rwy 35R

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Twenty Sixth in a Series

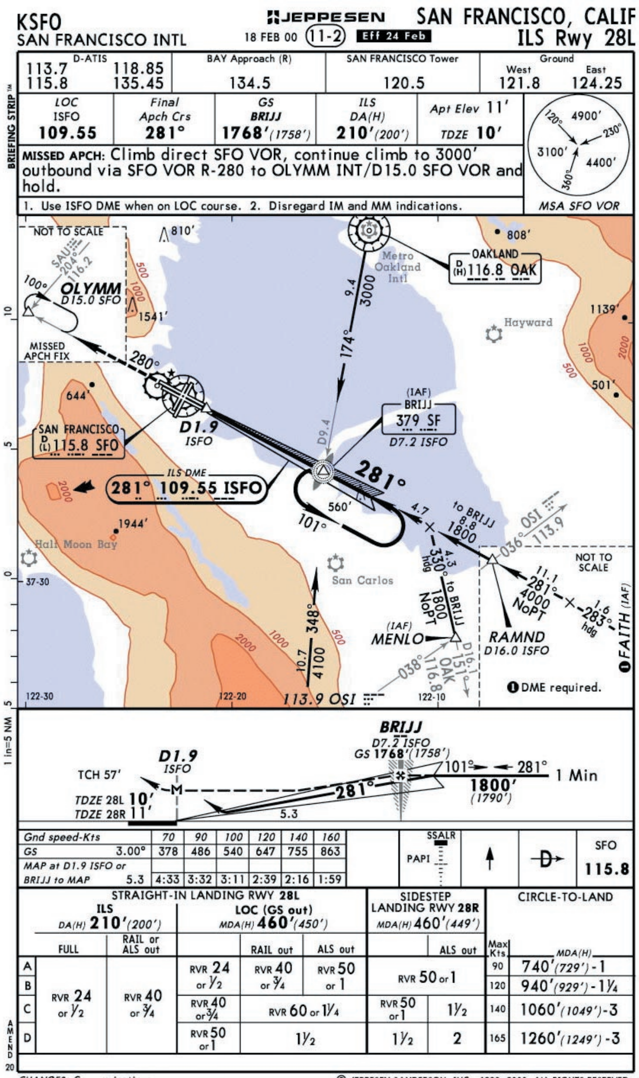
By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

You are shooting the ILS Rwy 28L approach. After you report the marker inbound, the tower advises you to expect landing on Runway 28 Right. Can you land on the parallel runway that doesn't have the straight-in landing minimums and still not have to use circling minimums?

Sidestep Minimums

At some airports, where an ILS approach is installed on one of two parallel runways, the FAA has prescribed straight-in landing minimums to the "other" runway which does not have the localizer installation. This was done so that the circle-to-land minimums do not have to apply to the "other" runway. The sidestep minimums are authorized when the centerlines of the parallel runways are no more than 1,200 feet apart. When the sidestep maneuver is authorized for the non-ILS runway, a separate straight-in landing minimum column will be included in the minimums box. For example, the ILS Runway 28L approach to San Francisco has a minimums column titled "SIDESTEP LANDING RWY 28R."

The straight-in landing minimums for the localizer-equipped runway are for Runway 28L, shown on the left side of the minimums box. The sidestep straight-in landing minimums for Runway 28R are shown to the right. Since the glide slope cannot be used all the way to runway 28R, the landing minimums are expressed as a minimum descent altitude rather than a DA(H).



The MDA of 460 feet for Runway 28R is 250 feet greater than the DA(H) for 28L, but is significantly better than the circle-to-land minimums of 740, 940, 1060, or 1260 feet if the sidestep landing maneuver was not listed as a separate set of minimums. The visibility minimums, however, are higher for the sidestep runway.

When can you break off from the localizer to land on Runway 28R? You can start the sidestep maneuver as soon as the *runway environment is in sight.*

What is not obvious by looking at the stated minimums is that most US airlines have elected to eliminate circle-to-land operations and the minimums for circling in those cases automatically get raised to at least 1000-3 (VFR) if not landing on the straight-in landing runway.

Night Minimums

Occasionally, operations at an airport may be limited at night. Because runway lighting is required for approval of night instrument operations, some approaches are authorized only during the day. In some cases, the mountainous terrain around an airport is so significant, some night operations may be limited or not authorized at night. This is true for the landing minimums at Eagle, Colorado. Notice the note below the circle-to-land minimums on the Eagle approach chart that states that "Circling is not authorized South of Runway 7-25 at night." This is because of the very high mountains that cannot be seen at night when below the MDA.

	Max Kts	CIRCLE-TO-LAND MDA(H)
A	90	9140'(2605')-1¼
B	120	9140'(2605')-1½
C	140	1 9140'(2605')-3
D	165	

1 Circling not authorized South of Rwy 7-25 at night.

EAGLE, COLORADO circle-to-land minimums

Where is "South of Runway 7-25" which is the area not authorized? If you imagine a straight line which extends down the centerline of Runway 7-25 and then extend that line way out beyond both ends of each runway, no flight operations can be conducted on the south side of that imaginary line. The TERPs criteria limits night operations because of *close-in unlighted obstacles.*

When is night? FAR 1.1 General Definitions state: "Night means the time between the end of evening civil twilight and the beginning of morning civil twilight as published in the American Air Almanac, converted to local time." The sunset and sunrise tables are also included in the Jeppesen J-AID.

Missed Approaches

Making a missed approach is not the most fun part of a procedure and besides, it never seems to happen at the right time. But, it is with us and it can be very important.

There are three places on the approach chart where the missed approach information can be found. The principal missed approach information in narrative style is located at the top of the approach chart of the new Briefing Strip™ format. The missed approach terminology used in the heading group is the same as the words used by the government approach procedure design specialists when they designed the approach procedure.

The missed approach procedure is *graphically depicted in the plan view* using a dashed heavy line and the initial portion is depicted with icons below the profile view. The missed approach procedure track in the plan view is depicted similar to an airplane's missed approach flight path; but that does not necessarily indicate that it is drawn to scale.

When a missed approach procedure terminates in a holding pattern, the holding pattern is depicted in the plan view with a light weight line whereas a holding pattern shown with a thick line is part of the primary procedure.

The missed approach procedure for San Francisco, California represents a typical missed approach from a precision approach procedure. When arriving at the decision height when using the glide slope or when reaching the non-precision missed approach point at the runway when not using the glide slope, if you do not have visual contact with the runway environment or are not in a position from which a *normal landing* can be made, then the missed approach procedure should be followed.

In the profile view at San Francisco, there are two different pull-up arrows that are depicted. One is shown on the glide slope symbol indicating that the missed approach would be executed before reaching the runway when using the glide slope. If the glide slope is not used, then the dashed line after passing the FAF shows a level flight segment at the MDA. The missed approach pull-up arrow for the non-precision approach begins at the runway threshold at the letter "M" symbol indicating the non-precision MAP.

At San Francisco, you should climb to the SFO VOR and then continue to climb straight ahead to 3,000 feet and fly outbound on the SFO VOR 280° radial to the OLYMM intersection and then enter the holding pattern.

The holding pattern at San Francisco is easy from an entry standpoint since it is a direct entry. In most other locations, the holding pattern is established so the inbound leg is aimed back toward the airport so a parallel or tear drop entry is usually the case.

At San Francisco, you will not be cleared for the approach from the holding pattern since it is not located at the final approach fix. If you want to shoot another approach, it will require that you start all over again with vectors from Bay Approach Control.

Inset for Missed Approach Fixes

When the missed approach holding is so long that it would not normally fit with the plan view that is drawn to scale, we use an *inset* to depict the missed approach holding fix. As an example, the OLYMM intersection and the holding pattern for the missed approach would fall outside the plan view if the missed approach procedure was drawn to scale. In order to graphically depict the holding pattern and the formation of the OLYMM Intersection, it is drawn in an inset and not to scale. The small inset is used to make it easier to visualize the missed approach holding pattern and the holding fix.

On some approach procedures, the words "or as directed" are included to specify that the missed approach procedure will be flown unless ATC gives you a different clearance than the printed missed approach procedure. In any case, ATC can direct you to do a missed approach procedure other than the one which is specified on the approach chart.

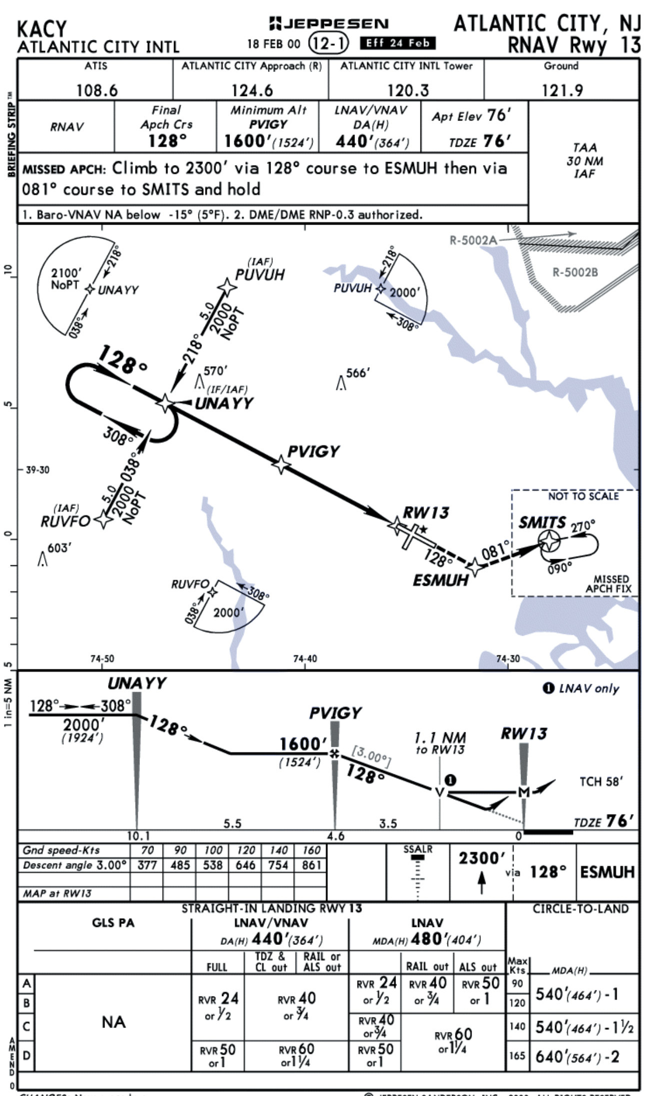
This article concludes the discussion of the front side of Jeppesen Instrument Approach Procedure Charts. In the next article, the discussion will pertain to the airport chart which is frequently found on the back side of the first approach procedure for an airport.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Twenty Seventh in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Remember the old adage you learned back in ground school? "High to low, hot to cold, look out below." Well, it seems to be taking on a whole new level of importance. The "high to low" is based on altimeter settings which can cause a problem with an altimeter setting at the airport which is lower than the altimeter setting in your airplane. This can be corrected by adjusting the altimeter in your aircraft to the local altimeter setting when shooting an approach and landing.



The "hot to cold" situation is a more serious consideration. When flying into an airport with very low temperatures, the error will work itself to zero when touching down at the airport with the correct altimeter setting, but there can be a *significant difference* when still shooting the approach. The altimeter does not compensate for extreme low temperatures away from the airport even with a correctly set local altimeter setting.

With a temperature at the airport that is -30° C, your true altitude at the final approach fix could be more than 200 feet lower than your altimeter indicates you are. And with the required obstacle clearance of 500 feet approaching the FAF, you have already used up much of the safety margin of the approach obstacle clearance protection.

Temperature Note

The FAA has issued a new series of approach procedures which became effective on 24 February, 2000. On these charts, the temperature note has appeared for the first time. Look at the bottom of the Briefing Strip™ on the Atlantic City RNAV Rwy 13 chart and you will see the note: 1. Baro-VNAV NA below -15° (5°F). VNAV (vertical navigation) is authorized on this chart, but extreme low temperatures would place the airplane too close to the obstacles while following the VNAV path. This is true not only for VNAV, but it is also true for flying the altimeter without VNAV guidance. What to do if the temperature is below -15°? The remainder of the approach procedure is still good, it's just the VNAV that is not authorized. Even though the VNAV is the only thing that is affected by temperature on the chart, it is still wise to consider the extreme low temperatures for all segments of the approach.

The FAA will be issuing an Advisory Circular, "Altimeter Errors at Cold Temperatures," that spells out many of the conditions surrounding extreme temperatures. One of the statements in the Advisory Circular is, "It's particularly important to make altitude adjustments on initial, intermediate, and final approach segments in mountainous areas or any obstacle-rich environment because unusually cold surface temperatures can cause significant differences between true and indicated altitudes."

RNAV (Where is GPS?)

Effective with the 24 February effective date, the FAA will no longer issue any new approach procedures with GPS in the title. Existing GPS procedures will continue to receive updates, but all new GPS approach procedures are titled with the term "RNAV" instead of "GPS." This is based on the industry's request to the FAA to allow flight management systems (FMSs) to use the approximately 2,500 GPS approaches created by the FAA in the past five years. With the current GPS approach procedures, FMSs without GPS as part of the input signal are not allowed to fly any of the 2,500 GPS approach procedures.

With the new title of RNAV, many of the FMSs will now be able to use the new approach procedures. Some of the considerations for the use include individual airline approval to use the procedures and the specific ability of the FMS. To facilitate the use of FMSs, a new note is appearing at the bottom of the Briefing Strip. It reads, 2. DME/DME RNP - 0.3 authorized.

Terminal Arrival Areas (TAA)

Imagine that you are arriving at Atlantic City from the southwest and are given radar vectors, and then a clearance direct to the UNAYY intersection and cleared for the approach. Without the TAAs, there are differences of opinion between controllers and pilots in various parts of the US about whether there is a requirement or an expectation on whether or not you are required to execute the course reversal at UNAYY. Also, if the controller gives you an altitude of 2,100 feet until UNAYY – is that a good altitude? A healthy skepticism of clearances and altitude assignments is valuable and you now have something to refer for your own check and balance system for altitude assignments.

Look at the Atlantic City, New Jersey RNAV Rwy 13 approach chart plan view, and you will note a new type of transition for approaches. In the best sense, the TAAs are the first true free flight procedures because you now have altitude and course information for *any direction* when arriving at Atlantic City to shoot an approach. In the upper left corner of the plan view, there is a half circle with a waypoint symbol on the straight line segment. The waypoint name is UNAYY, the same as the waypoint on the final approach course. Inside the half circle is the number 2100' and the letters **NoPT**. The straight line of the TAA is defined by the 218° inbound course and the 038° inbound course.

What does this mean? It means that when you get a clearance for the RNAV Rwy 13 approach from any inbound course of 038° clockwise around to 218°, you can descend down to 2,100 feet as soon as you are within 30 nautical miles of UNAYY, which is the IAF. Once you arrive at UNAYY, you not only do not have to make a procedure turn (holding pattern course reversal in this case), but you cannot do the course reversal unless you request one from ATC and get approval to do so.

The FAA has designed the TAAs so that it will be very unusual to have to perform a course reversal such as a procedure turn or holding pattern. With the design of the TAA, it is possible in virtually all cases to fly the approach from any direction and fly to a fix from which a straight-in approach without a procedure turn is possible.

When you arrive from the southeast, you would fly to RUVFO on any course from 308° clockwise to 038°. Once you have arrived at RUVFO, you would then fly to UNAYY and then turn on to final to the airport. Look at the TAA quarter circle toward the bottom of the plan view and you can see a slight distance from the RUVFO waypoint symbol to the 308° line. This distance represents the distance from RUVFO to UNAYY and shows that the area is protected from the centerline of the final approach course outbound to RUVFO as the IAF. There was a considerable amount of flight testing conducted to determine the default distance of five nautical miles from the IAF (such as RUVFO) to the IF (such as UNAYY) to be sure the distance was short enough to allow flying "by" the RUVFO and UNAYY fixes with fast airplanes. The distance of the segment should also be short enough so you don't have an excessive amount of miles when shooting the approach.

Where is the MSA?

With the introduction of TAAs, there is no need for MSAs since the TAAs are essentially in the same location as the MSAs. However, in the case of TAAs, they represent flight procedures and altitudes that can be flown in IMC conditions whereas MSAs cannot be used as flight altitudes since they are considered emergency use altitudes only.

GLS PA

There is a new column of minimums on the RNAV charts labeled GLS PA which appeared for the first time effective 24 February. GLS is the acronym for GNSS Landing System (or global navigation satellite system.) Although there no landing minimums in the column for the approach at Atlantic City, the minimums will be available for aircraft equipped with precision approach capable WAAS receivers operating to their fullest capability when WAAS becomes operational. WAAS augments the basic GPS satellite constellation with additional ground stations and enhanced position/integrity information transmitted from geostationary satellites. The WAAS capability, when available, will support minimums as low as 200 feet HAT and 1/2 statue mile visibility.

The letters PA indicate precision approach runway markings. When the letters PA are not in the title of the minimums column, this means the runway doesn't have precision approach markings and the lowest minimums will not be available.

LNAV/VNAV

The second main column heading is LNAV/VNAV which stands for lateral navigation/vertical navigation. Since the LNAV/VNAV systems provide vertical guidance, the procedure minimum altitude is a DA(H) instead of an MDA. Without the WAAS, the VNAV is a computed descent path based on the descent angle published on the chart and in the database and the electronic signal sent by an appropriately equipped altimeter into the airborne computer. Since the vertical navigation is computed from the altimeter information, any anomalies in the altimeter based on incorrect altimeter settings, etc. will cause the VNAV path to be incorrect. *This is why it is very important to have the correct local altimeter setting and a compensation for extremely low temperatures.*

Aircraft which are RNP 0.3 approved with an approved IFR approach barometric (BARO) VNAV systems are allowed to use the VNAV path and the decision altitude at Atlantic City. Aircraft equipped with other IFR RNAV systems such as FMS and BARO-VNAV may also use the LNAV/VNAV minimums. For aircraft equipped with GPS receivers (and no VNAV), the minimums to be used are those in the column with the title labeled LNAV. RNP, by the way, stands for required navigation performance and could be the subject of a whole article.

In the profile view, note that the solid line for the descent path continues below the MDA for VNAV equipped aircraft and the line also levels off at the MDA for aircraft without VNAV.

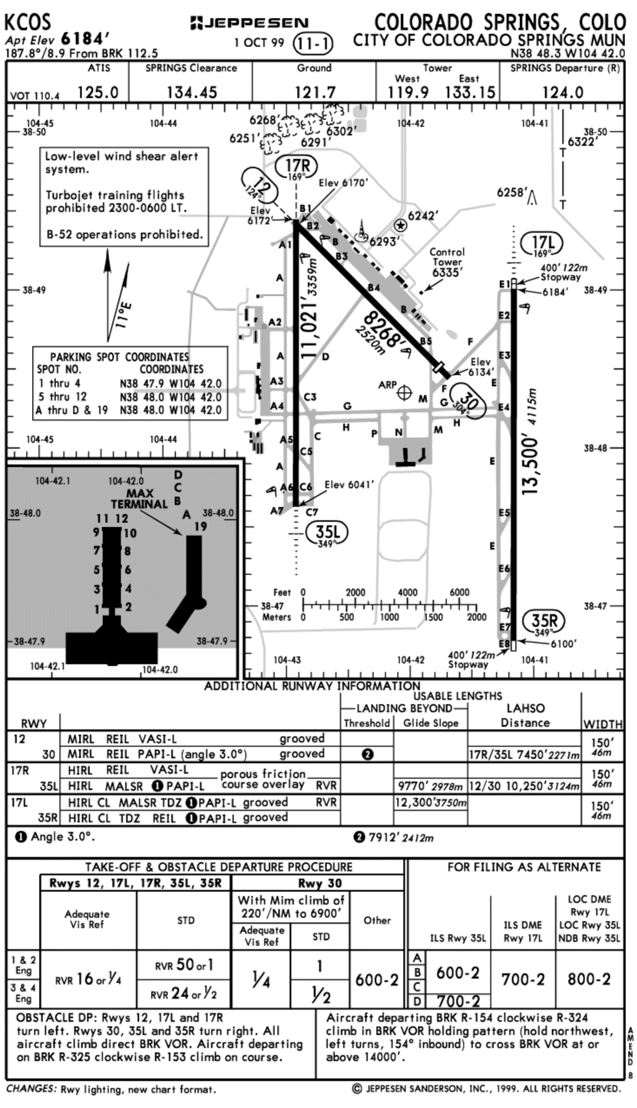
In the next issue, we will look at the airport charts.

James E. Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Twenty Eighth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Perhaps the most difficult part of any flight is trying to find your way around the taxiways at a strange airport. When you are airborne, you have a whole panel full of gadgets to tell where you are. But once on the ground, especially at night – *you seem to be on your own for navigating.* If you are sitting in the cockpit of a 747, you have a chance of seeing the big picture, but if you are in a 172, all you can see is a sea of blue lights. Nice for the blue lights to show there are taxiways, but in a small airplane they all seem to be the same.



Help in solving this dilemma is provided by an airport diagram for each airport. Airport charts are gradually being located in front of the approach charts or are located on the reverse side of the first approach chart for each airport.

Heading and Border Data

The top of each airport diagram page provides standard information which includes the associated city and state name for the airport, plus the official airport name. The airport latitude and longitude coordinates are depicted below the airport name. The geographic coordinates are actually the coordinates of the airport reference point (ARP) which is depicted in the plan view by a circle which encloses a plus symbol. The letters "ARP" are shown next to this symbol. For example, at Colorado Springs, the ARP is located just to the left of Runway 30. If you navigate with an airborne database to the identifier KCOS, you will navigate direct to the grass in the middle of the airport.

Every country that is a member of the International Civil Aviation Organization (ICAO) has been assigned a one- or two-alpha identifier. For example, the single letter "K" has been assigned to the United States. The four-letter identifier for a United States airport is derived by using the letter "K" before the FAA-designated three-letter identifier for that airport. On Jeppesen charts, each United States airport which has been assigned a three-letter identifier will have the letter "K" as the first letter of its identifier. Airports that have been assigned a letter/number combination will have just those three characters without the letter "K." At Colorado Springs, the ICAO airport identifier is KCOS. Another important use of the identifier is access to the database. On some airborne receivers, the four letters are required and on other systems, only the three letters are required to access the airport. When filing a flight plan to Colorado Springs, the letters "COS" should be used for domestic flights and the letters "KCOS" should be used for international flights to or from Colorado Springs.

On the new Briefing Strip™ format, the database identifier for the airport is at the upper left with the official airport elevation included below the identifier. In most countries, (including the US), this elevation is defined as the highest usable landing surface on the airport.

The index number for the airport diagram chart is the same as that used for the approach chart when it is on the reverse side of the first approach chart. Otherwise, the airports are gradually being assigned the index number 10-9 so they will be the first chart in front of the approach charts.

Communications

On the approach charts, the frequencies are listed in the order of use *arriving* at the airport. Conversely, on the airport charts, the frequencies are listed in the order of use when *departing* the airport. The first communication box at KCOS shows the ATIS of 125.0. In the first box, note that a VOR test (VOT) signal is available on the frequency of 110.4 MHz. When clearance delivery is available, it will follow the ATIS box. The remaining communication boxes include the ground control, tower, and departure control. At KCOS, the letter "R" in parentheses after Springs Departure indicates the availability of radar.

Special Notes

A box will be created in the plan view when special notes are provided at the airport. At Colorado Springs, the note box shows there is a low-level wind shear alert system and that there are some aircraft and time restrictions.

The note box on the approach chart includes other information, such as bird warnings, restrictions to air carrier traffic, restrictions to non-powered aircraft, and unusual airport locations. If you disregard some of these notes, the consequences can be serious. As an example, there is a note "Certain turbo jet aircraft permanently excluded after one violation of single event noise violation limit of 95 dB" at Santa Monica, California. It may cost you a bundle to get your business jet back home.

Since there are airline gates at KCOS, the parking spot coordinates are included in the plan view to help align the inertial navigation systems before departing the airport.

Airport Plan View

The airport diagram is drawn to scale, except for the *width* of some overruns, stopways, taxiways, perimeter roads, and approach lights. The scale used for the airport diagram can range from one inch per 1,000 feet up to one inch per 6,000 feet. A bar scale at the bottom of each airport diagram shows the scale in feet and meters.

Latitude and longitude grid tick marks are placed around the perimeter of the airport plan view to help operators of latitude/longitude systems determine their exact coordinates on the airport to align the inertial navigation systems when not at a gate.

For each runway, the threshold elevation is shown. To determine the runway slope, the runway elevations at both ends can be used with the runway length that is shown adjacent to the runway symbol. Also, at each of the runway ends, the runway number is shown with the magnetic bearing down the centerline of the runway. This is a good way to check the heading indicator while on the initial takeoff roll.

Additional Runway Information

Some of the required airport information cannot be portrayed in enough detail by using only the airport diagram. This type of information is shown below the airport diagram in the box titled "Additional Runway Information." The second column in this box includes lighting details for each runway. Some of the most common lighting installations included in the lighting column are runway lights, approach lighting systems, touchdown zone lights, and VASI or PAPI installations. Runway visual ranges (RVRs), when installed, are also included with the runway light information.

The last four columns in the runway information box include runway length and width specifications. As an example, Runway 30 at Colorado Springs has a displaced threshold. You have 7,912 feet of runway beyond the displaced threshold when landing. If you fly the ILS 35L glideslope with a centered glideslope needle all the way to touchdown on Runway 35L, you will have 10,250 feet of runway left after touchdown. This is noted in the additional runway information box labeled “Landing Beyond-Glide Slope.” The third column of the usable runway lengths show the LAHSO (Land and Hold Short Operations) distances. The width of each runway is specified in the last column of the additional runway information box.

Other runway information, as such runway grooving or porous friction course overlay, is included in other runway information footnotes. The ILS Category II holding lines are depicted on the chart in their respective locations.

Some topographical features are included in the airport diagram plan view as a VFR aid when approaching a new terminal area. The vertical parallel lines between Runways 35L and 35R represent the highway to the airline passenger terminal. Roads are included with railroad tracks, rivers, and water bodies.

Take-Off & Obstacle Departure Procedure

Not everyone is required to have take-off minimums, but for those who need to comply with them, they are located at the bottom of the airport diagram when there is room. At some large airports, a separate page includes the Additional Runway Information with the take-off and alternate airport minimums.

The standard take-off minimums are 1(statute) mile for one and two-engine aircraft and 1/2 mile visibility for aircraft with three or four engines. This is shown under the column titled “STD.” Operators with FAA-approved “Ops Specs” are able to get the standard reduction down to 1/4 mile visibility which is shown under the column titled “Adequate Vis Ref.” Adequate Vis Ref means that at least one of a number of visual aids are available (and seen). The visual aids are spelled out in the Ops Specs, plus they are listed in the legend pages. Because of obstacles at Colorado Springs off the end of Runway 30, there is a minimum climb gradient. If that can’t be met, then the take-off minimums require a ceiling of 600 feet plus a visibility of two miles.

When using Colorado Springs as an alternate airport for a different primary destination, the forecast ceiling and visibility requirements change, depending on which approach you plan to use (and is forecast to be operating at your estimated time of arrival at KCOS as an alternate.)

Obstacle DPs

In 1998, the FAA changed the name of the IFR Departure Procedures to Obstacle Departure Procedures. They also changed the name of SIDs (Standard Instrument Departures) to Departure Procedures (DPs). This was done to more closely align the criteria and paths of SIDs and IFR Departure Procedures to the same specs.

In some locations, the IFR Departure Procedures are so complicated in text form that the FAA will be modifying them to graphic obstacle departure procedures and will give them a name similar to the name assigned to SIDs. At KCOS, the Obstacle DP is specified for every runway with a specific direction of turn after takeoff to avoid nearby Pikes Peak. After the turn, the path is direct to the VOR. Aircraft that depart the VOR on the 325 degree radial clockwise to the 153 radial, can climb on course from the VOR. Other aircraft (essentially those headed over Pikes Peak) need to climb in a holding pattern at the VOR until reaching 14,000 feet. When leaving the VOR west bound at 14,000 feet, that should be plenty of altitude to clear Pikes Peak.

This article concludes the airport diagram illustration discussion. In the next issue, we will look at standard instrument departures (SIDs) and standard terminal arrival routes (STARs).

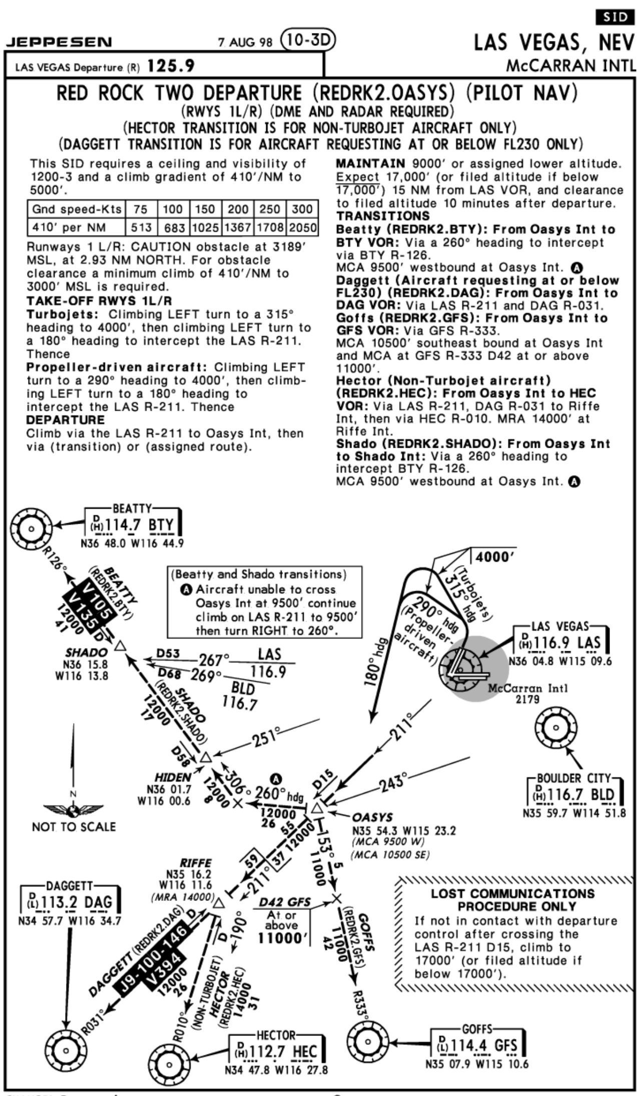
James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Twenty Ninth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

If it were always VFR at mountainous airports, and if there were no other airplanes at the hub airports, you could depart an airport and do almost anything you wanted. Unfortunately, cumulogranite clouds surround many airports. Also, ATC gives us departure paths other than direct routes at busy airports. These published paths are generally designed to comply with ATC departure procedures and are now called Departure Procedures (DPs). They started their life with the name standard instrument departures (SIDs).



The development of DPs was an evolutionary process. Pilots and controllers wanted complicated verbal departure procedures committed to paper to simplify clearance delivery procedures. Initially, DPs were available in narrative form only back in the late 1960s, but they were made into graphics a short time later because of Jeppesen user comments.

If you depart an airport which has one or more published DPs, you can expect to be cleared via one of these procedures. However, to accept a DP in your clearance, you must possess at least the text description of the DP. If you don't want to follow a DP, include a note stating "no DPs" in the remarks section of the FAA flight plan. Adherence to all restrictions on the DP is required unless clearance to deviate is received from ATC.

Most Departure Procedures are divided into two main parts: the actual departure, followed by the transitions. The first portion begins at the airport and terminates at a fix such as a navaid, intersection, DME fix, or RNAV waypoint. The transitions start at the fix where the standard instrument departure terminates and the transition, by design criteria, is supposed to end at an enroute fix.

Refer to the "Red Rock Two Departure" from Las Vegas, Nevada, which is a typical Departure Procedure. *This DP is still titled "SID" and will be changed to DP when it is revised for other aeronautical reasons.* Most of the symbols used on the DP charts are the same as those used on the enroute navigation charts (with some exceptions). The navigation frequency box is the same as used on the high altitude charts. These facility boxes include the latitude/longitude coordinates for aircraft equipped with latitude/longitude systems, but no airborne database. The same symbols also are used on both types of charts for: MEA designations, leg segment distances, DME fix identifiers, changeover point symbols, and magnetic radial designations.

One major difference found on the DP charts, when compared to other Jepp charts, is that the DPs are *not drawn to scale.* Although the layout of the fixes on the chart are drawn schematically, the mileages cannot be determined accurately by the use of a plotter. DPs that are drawn to scale would be desirable, but with so much detail next to the airport as well as transitions which are often hundreds of miles long, a chart that was drawn to scale would force the initial departure information to be too small to read.

The main body of the DP is depicted with a heavy, solid line, and the DP transitions are designated with heavy, dashed lines for distinction.

Departure Procedure Names

Each DP is named according to the last fix on the main portion of the DP. At Las Vegas, the DP ends at the Oasys intersection, but since there already is an Oasys DP, another name had to be selected. The title "Red Rock" was arbitrarily chosen since there are no rules for alternate names. The number designator in the DP title represents the revision number of the particular DP. This is particularly useful in communications with ATC. For example, when this departure procedure is revised, it will be titled "Red Rock Three Departure." When the controller assigns you the Red Rock Three Departure, and your DP chart still reads "Red Rock Two Departure," you know immediately that you didn't file last week's revision.

The computer code in parentheses to the right of the departure name is *not* used in communications; however, this code can be helpful in many cases. When filing an IFR flight plan from Las Vegas which includes this DP, you should give the computer code in the flight plan. The computer code in parentheses is only for the segment from the airport to the end of the DP, but not to the end of the transition you might want to fly. If your request includes both a DP and a transition, the DP and the transition code both should be used. This will expedite the processing of your IFR flight plan through the flight service station and the air route traffic control center.

To the right of the computer code are the words "Pilot Nav" in parentheses. There are also DPs with the word "Vector" in parentheses. Both of these sets of words are meant to indicate the primary means of navigation on the particular DP. However, the distinction between the two is sometimes a little blurry, so the terms will be dropped in the future.

Flying the DP

As a practical application, let's fly the Red Rock Two Departure and Goffs Transition from a takeoff on Runway 1L. The IFR clearance given to you by Las Vegas Clearance Delivery would be something like this: "Saberliner 737R, cleared to Douglas Airport as filed, Red Rock Two departure, Goffs Transition, maintain..."

Now check the narrative description of the DP. The notation in parentheses under the title indicates this departure is only for Runways 1 Left and Right and that DME and radar are required for this DP. You will also notice there are restrictions on the Hector and Daggett Transitions. The first portion of the DP text states that this procedure requires a *ceiling* of 1,200 feet and a *visibility* of 3 miles, plus a minimum climb rate of 410 feet per nautical mile to 5,000 feet. These minimum climb rates are stated in the DP text only when they exceed a rate of 152 feet per nautical mile. Below the climb gradient statement, there is a table that gives the climb rate in feet per minute at various ground speeds so that you have some numbers that are meaningful when reading the panel instruments.

The information in the takeoff paragraph states that departures for turbojets should be a climbing left turn to a 315° heading to 4,000 feet, then a climbing left turn to a 180° heading to intercept the Las Vegas 211° radial. *Then* the word "Thence" which starts the departure path that states a climb via the Las Vegas 211° radial to the Oasys intersection followed by the transition or other route from Oasys. It's not stated in each DP, but the initial turn after lift off should be *after reaching 400 feet above the airport* since that is standard for all departures.

On this departure, there is a Lost Communications procedure that is enclosed in a box comprised of hashed lines that state what to do if not in contact with departure control. The Lost Communications procedure is available only on a few departure procedures. When the Lost Communications are not available in text form on the procedure, then the standard FAR Part 91 lost communications procedures apply.

DP Transition

The information included in the transitions paragraph includes the departure procedures for either normal procedures or for a communications failure. For this hypothetical flight, the course after Oasys goes to the Goffs VORTAC. Since we are flying the Goffs Transition, the computer code (REDRK2.GFS) should be used when filing the flight plan to help expedite it through the flight service station and air route traffic control center. The transition identifier is shown adjacent to the transition track.

The Goffs Transition departs Oasys intersection via the Goffs 333 radial. Note the number 153 in large type right after Oasys. This shows the course setting to use when departing Oasys, so you don't have to mathematically derive the reciprocal of the 333 radial from the Goffs VOR. The Goffs Transition narrative is duplicated in the graphic depiction of the transition, so you will eventually see the text description of the transitions disappear from the DP pages. This should make it much easier to read, since much of the textual "clutter" will disappear.

At Oasys, note that there are two MCAs (minimum crossing altitudes). MCAs are specified for obstacle clearance, whereas the 11,000-foot altitude restriction at the 42 DME fix from Goffs is an ATC restriction (even though the MEA on the transition is also 11,000 feet). The MCA of 10,500 feet at Oasys is applicable for flights to the southeast which is the direction of the Goffs Transition.

On the Daggett Transition, there are a couple of unusual pieces of information. On the transition, there is a changeover point (COP) which is 37 miles from Las Vegas and 59 miles to the Daggett VOR. Also, there is an MRA (minimum reception altitude) at the Riffe intersection which is 14,000 feet. Most likely, the MRA is to receive the Hector VOR since you are already high enough at the MEA of 12,000 feet to receive the Daggett VOR. So, if you are using the DME from Daggett, you can ignore the MRA at Riffe.

In the next article, we will conclude the series with a discussion on STARs.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Thirtieth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

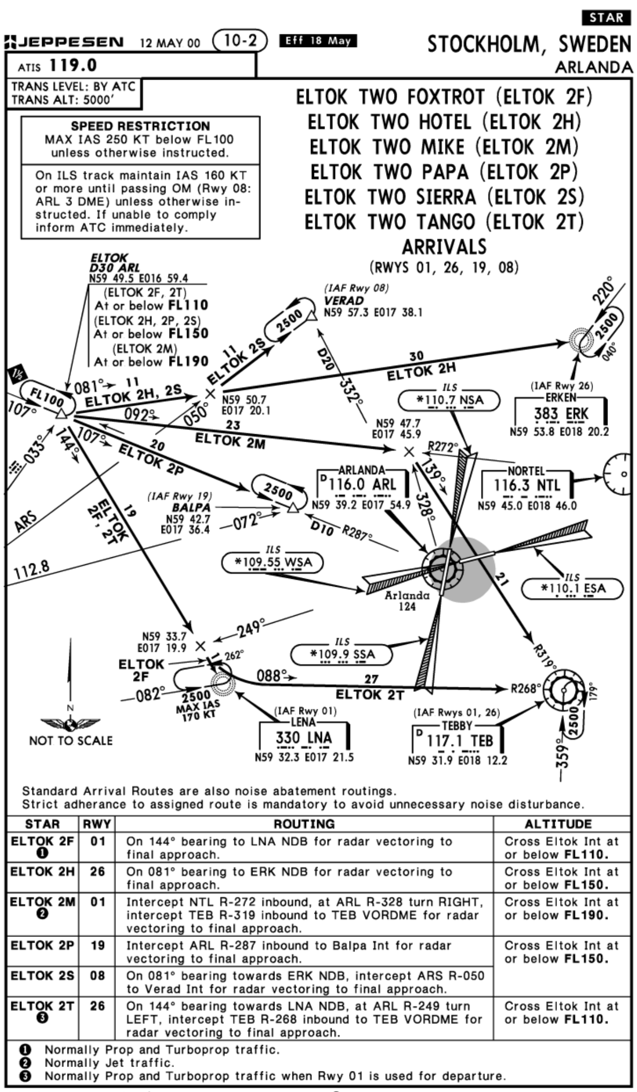
Communications — it's probably the most important thing we have between pilot and controller. Whether it's via voice or some of the new digital technology, there still is the need for pilot and controller to be on the same wavelength. STARs really represent part of that communication — once you have accepted clearance for a STAR, you have just communicated with the controller what route you will be flying, what altitudes, and what airspeeds on some STARs.

When the repetitive complex departure clearances by controllers turned into SIDs in the late 70s, the idea caught on quite quickly. Eventually, most of the major airports in the US developed standard departures with graphics for printed publication. The idea seemed so good that the standard arrival clearances also started being published in text and graphic form. To develop an acronym similar to SIDs, the FAA named the new procedures Standard Terminal Arrival Routes and came up with the name STARs. The name has stuck ever since (contrary to SIDs becoming DPs in the US.)

The principal difference between SIDs (DPs) and STARs is that the DPs start at the airport pavement and connect to the enroute structure. STARs on the other hand, go the opposite direction and start in the enroute structure but don't make it down to pavement; they end at a point where an instrument approach procedure takes you the rest of the way to the ground.

Heading and Border Data

Each STAR has a reverse-type block in the upper right corner of the chart to indicate its status as a standard arrival chart. In the top center of the chart, the index number is shown with the revision date plus the effective date. The effective date is included only if the chart isn't effective when it first gets into your hands. The index number for STARs is 10-2 followed by letter suffixes for the succeeding STARs. For example, the second STAR at Stockholm is 10-2A and the third chart is 10-2B. By using the index number of 10-2, the STARs are sequenced in the manual after the area charts and before the SID charts.



STAR	RWY	ROUTING	ALTITUDE
ELTOK 2F ❶	01	On 144° bearing to LNA NDB for radar vectoring to final approach.	Cross Eltok Int at or below FL110.
ELTOK 2H	26	On 081° bearing to ERK NDB for radar vectoring to final approach.	Cross Eltok Int at or below FL150.
ELTOK 2M ❷	01	Intercept NTL R-272 inbound, at ARL R-328 turn RIGHT, intercept TEB R-319 inbound to TEB VORDME for radar vectoring to final approach.	Cross Eltok Int at or below FL190.
ELTOK 2P	19	Intercept ARL R-287 inbound to Balpa Int for radar vectoring to final approach.	Cross Eltok Int at or below FL150.
ELTOK 2S	08	On 081° bearing towards ERK NDB, intercept ARS R-050 to Verad Int for radar vectoring to final approach.	
ELTOK 2T ❸	26	On 144° bearing towards LNA NDB, at ARL R-249 turn LEFT, intercept TEB R-268 inbound to TEB VORDME for radar vectoring to final approach.	Cross Eltok Int at or below FL110.

❶ Normally Prop and Turboprop traffic.
❷ Normally Jet traffic.
❸ Normally Prop and Turboprop traffic when Rwy 01 is used for departure.

CHANGES: STARs renumbered.

The heading includes the ATIS frequency when one is available. At Stockholm, the ATIS can be received on 119.0 MHz.

In the US, Canada, and many other countries, the common altitude for changing to the standard altimeter setting of 29.92 inches of mercury (or 1013.2 hectopascals or millibars) when climbing to the high altitude structure is 18,000 feet. When descending from high altitude, the altimeter should be changed to the local altimeter setting when passing through FL180. In most countries throughout the world, however, the change to or from the standard altimeter setting is not done at the same altitude all the time. As an example, at Stockholm the flight level where you change your altimeter setting to the local altimeter setting is specified by ATC each time you arrive at Stockholm. This information is shown just below the ATIS frequency with the words: TRANS LEVEL: BY ATC. When departing from Stockholm, the altimeter should be set to the standard altimeter setting when passing through 5,000 feet. This means that altimeter readings when flying above 5,000 feet will actually be flight levels, not feet. This is common for Europe, but very different for pilots used to flying in the United States and Canada.

Look at the minimum altitude for the holding pattern at Eltok Intersection. Inside the holding pattern symbol, the letters "FL" precede the numbers "100." With a minimum altitude specified as a flight level instead of an altitude, you can assume the transition level will be at FL100 or lower.

Speed Limit

In many countries, there is a standard speed limit of 250 knots IAS below 10,000 feet for the entire country. But, in most countries, that standard does not exist for all locations. In Sweden, there is a speed limit of 250 knots when arriving in Stockholm. This speed restriction is shown in the plan view portion of the STAR chart. In addition to the 250 knot speed restriction, there is a speed restriction to maintain at least 160 knots IAS on the ILS track until passing the outer marker (when using ILS Rwy 08, the 160-knot speed minimum should be used up to the ARL 3 DME fix since ILS Rwy 08 does not have an OM). For both the maximum and minimum speed limits, these can be changed by ATC. For the minimum speed limit, if you are flying in an airplane that can't go as fast as 160 knots IAS, you must inform ATC immediately.

What's In a Name?

The international naming standard for STARs states that they will be given a name that is the same as the first fix on the STAR. In the US, typically there are enroute transitions before the STAR itself. So the STAR name is usually the same as the last fix on the enroute transitions where they come together to begin the body of the STAR.

At Arlanda Airport in Stockholm, Sweden, the Eltok Two STAR begins to the west of the airport and splits into a number of routes designed to go to initial approach fixes on approaches into the airport. In the US, these separate routes would be considered runway transitions from the STAR, but at Stockholm, each route has a unique name to distinguish it from the other routes. Each of these routes uses a phonetic letter of the alphabet.

If you plan to use the STAR to transition to the ILS Rwy 01 approach, you would file for and receive a clearance for the Eltok Two Tango Arrival. Eltok Two Tango proceeds from the Eltok Intersection and follows a course of 144° toward the Lena (LNA) NDB. The route from the Eltok Intersection shows the route identifiers of Eltok 2F and Eltok 2T adjacent to the flight track. After turning left at the 249º radial, the STAR goes to the Tebby VOR. Above the VOR facility box, there is a note that states that Tebby is the IAF for Runways 01 and 26.

At the bottom of the page, detailed information in text form is provided. The narrative information has a ballflag number 1 under the title, pointing to the note at the very bottom which states that the Eltok Two Tango Arrival is normally for piston and turboprop airplanes.

In the text, the routing is specified as following the 144 bearing toward the LNA NDB. At the ARL 249º radial, you should turn left and intercept the TEB 268º radial inbound to the TEB VOR\DME. When you are close to the TEB VOR, you can expect radar vectors to the final approach. If you look at the ILS Rwy 01 approach, you will notice there are no specified routes from the TEB VOR — so what do you do if you have a communication failure? It's a question with no specific answer.

In the ELTOK 2T text, notice it states "at ARL R-249 turn LEFT..." In computer talk, this means the fix formed by the 249º radial is a fly-over fix. ATC expects you to fly over the radial and then begin the turn. If this were a GPS approach, a circle would be around the fix to indicate its fly-over status. The fix formed by the 249º radial and the 144º bearing is included in the GPS and FMS databases with the identifier of D249S. On the Jeppesen charts, the database identifiers are gradually being added to the SID and STAR charts. They are being depicted within brackets to indicate they are computer navigation fixes.

Altitude Assignments

Many STARs include altitude restrictions. At Stockholm, there are three different altitude assignments at the Eltok Intersection depending on which route is followed after Eltok. For the Eltok Two Tango Arrival, the altitude over Eltok is a maximum altitude of FL110. Sometimes the altitudes are "hard" altitudes specified as "at" altitudes, and sometimes the altitudes are minimum altitudes and are specified as "at or above" altitudes. These differences in how the altitudes are stated means you need to pay close attention to how the words are written.

On the Eltok Two Tango Arrival, the last fix is the Tebby VOR. If a clearance for the approach hasn't been received by the time you are at Tebby, there is a holding pattern south of the VOR. Inside the holding pattern symbol, the number "2500" is included. This is another piece of altitude information. The minimum altitude for holding south of Tebby is 2,500 feet (notice the altitude is feet, not FL; therefore you would have been given the local altimeter setting by the time you reached Tebby for holding).

Noise Abatement

At the bottom of the plan view, there are words that state this STAR is designed for noise abatement. If the routes are strictly adhered to, there will be no unnecessary noise disturbance. In the US, many SIDs and STARs are also designed for noise abatement purposes, but those words are not included on US charts.

This concludes the Chart Clinic series of articles. It has been a pleasure writing the articles and receiving all the feedback many of you have given. Your responses tell me you all have a sincere desire to learn as much as possible about the airspace system in which we fly and to understand how that information is shown on charts. Thank you.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

Jeppesen Electronic Chart Clinic
First in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

There is magic in the air. No more paper. No more revisions. No more pages with coffee stains. No more pages torn from continuous use. Let the electrons do their work. Let the image project from a screen that is bright at night as well as during the day.

As you can imagine, behind all that magic exists much thought, energy, planning, and manipulation of those bits and bytes to make it happen. This article is the first in a series discussing the new generation of aeronautical charts that are beginning to appear in cockpits.

All Electronic Charts are not Created Equal

Basically, there are three different types of formats for displaying aeronautical charts in electronic format. Let's discuss their formats to help understand why some images look different from others and why some have different capabilities. The three types of electronic chart formats include raster, vector, and data base generations.

Charts that are in raster form have the capability to look virtually the same as an original chart. Charts in raster form are typically loaded into a computer by scanning an original chart and converting it to pixels (picture elements). One of the advantages of raster charts is that they are easy to capture, don't require a lot of original creation since the electronic image has already been created for paper.

The most common examples of raster charts are sectional charts, WACs, and other visual aeronautical charts where the tremendous amount of details that have been accumulating over the years on master maps don't have to be redone for electronics.

When the visual aeronautical charts are scanned in color, the size of the file is incredibly large. As an example, the WAC charts vary in size from about 7 MB all the way up to more than 12 MB. And that is for one chart. Because of the large size of the files, the visual charts are typically stored and kept on a CD-ROM where the full world set will fit on one CD. The WAC charts could be stored in smaller files, but the "crispness" or resolution of the charts would deteriorate and much of the detail would be lost. Another means to reduce the size of the files would be to store less color in each of the pixels but then the end result would not appear as close to the original printed charts.

Geo-Referencing

Thanks to the ingenuity of programmers, scanned charts can be geo-referenced. This means that each location on a chart can be set to recognize its real position in latitude and longitude coordinates and has the capability with software to match signals with inputs from GPS receivers. This capability creates the ability to have a moving map when connected to a GPS receiver that has compatibility with the format of the messages sent from the GPS receiver.

All the above represents good news. So why aren't all charts done in raster? There are numerous limitations that are overcome by other formats.

Fat Pixels

One of the weakest features of scanned charts (besides their size) is that scanned images can be enlarged only a limited amount before the image deteriorates significantly. Each pixel in a scanned map is a finite size.

If the chart is zoomed in a number of levels, each pixel becomes larger and larger. Since each pixel is typically a square dimension, the enlargement of a number of pixels starts to make the image very ragged (in the industry we call that the "jaggies").

In the illustration, you can see that the obstacles, when enlarged, are quite difficult to read with the elevation of 5,884 feet for the twin towers.

Another disadvantage to raster is that the image is what we call a "dumb" image. It lacks the intelligence to differentiate between different elements or items on the chart. Since the file is composed of just a series of pixels, the pixels don't have the intelligence to know if they are a VOR, an NDB, an airport, a body of water, or the title of the chart. This makes it virtually impossible to be able to turn information on or off as it is needed or no longer wanted.

Raster has another significant disadvantage. Many of us who fly airplanes like to have the top of the chart or map that we are using pointing the same way we are flying. I recall flying with a private pilot student on a heading of south while flying parallel to a highway and railroad. While trying to teach chart reading, I was trying to explain that he should look on the chart and note that the lake was to the left of the railroad. Now look outside and the lake was to the right of the railroad. After about five minutes of being confused about trying to identify our current position and flying the cross country, my student took the map and rotated it 180° and now everything to the right of the road on the chart was also to the right of the road looking outside. Much easier.

Raster maps can be used in avionics systems to fly heading up or track up, but when a raster map is rotated, so is all the text. Consequently, the text may be upside down or at some other angle that makes it difficult to read.

Ever fly off the edge of a chart? That happens not only in the paper world, but it also happens in the electronic world with scanned charts. When charts are scanned, the implementation of going from one chart to another can be smooth, depending on the software that is being used. But sometimes it takes quite a while for the adjacent chart to be recognized, to be retrieved from the storage device, and then "edge-mapped" to ensure seamless transition from one chart to the next.

Have you ever noticed when you change from one electronic chart to the next, that not everything lines up, and that the colors are not exactly the same? That happens because printed charts were not designed to be scanned and used electronically from one to the next.

In the next article, we will continue the discussion of chart formats. In this series, we will discuss which electronic charts work in which airplanes, cover the certification of electronic charts, database-driven charts, and explore other issues related to the future of electronic charting.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: jim.terpstra@jeppesen.com

Digital Briefing

Jeppesen Electronic Chart Clinic
Second in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Details, details, details. In the world of aeronautical charts you know the magnitude of details to get the content and the image just right. And now - add on top of that the world of bits and bytes to those charts. For every little piece of information that shows up in print, there is an additional world to make that information show up in the digital world.

Some of that electronic data has no intelligence - we say it has just a pretty face. Raster charts are like that. To go one step higher in the intellectual chain, enter into the world of vector.

Vector Images

For those of us in the world of aviation, we know the term "vector" as something ATC gives us mostly in the terminal environment to efficiently move airplanes. If you ask controllers, they will tell you vectors are the simplest and earliest versions of RNAV. Controllers can place you anywhere without having to fly over a navaid.

To draw a parallel between the controller's vector and how the term "vector" is used in creating graphic images, imagine the controller's vector as a place where you began your particular flight path. At the point where the vector began, that is a point on the ground. The controller's vector then began as a heading which took you in a direction. That heading is compared to the line on a chart. When the controller gives you a change in your heading, the point at which the heading changed can also be defined as a point on the ground.

Looking back on those clearances, you had two points on the ground connected by a heading which created a track over the ground. That is exactly how vector charts and images are drawn.

When a graphic artist wants to define a line on a chart in vector format, he or she defines the starting point and the ending point. Once the beginning and ending points have been defined, then the line connecting those two points is defined.

For aeronautical charts, the beginning and ending points are typically defined as points of latitude and longitude. As an example, the line on a chart can connect a VOR and an intersection. The VOR and the intersection are both defined in the database each with a latitude and longitude. The line connecting the VOR and the intersection is then described with a number of attributes. The attributes usually include a description that says the line is solid (no dashes), it has a width, and it has a color. The attributes may even have a link (or connection) to a field in the database that describes additional information such as the minimum altitude, the aeronautical description of the line such as an initial approach segment, etc.

Defining the Ends of the Legs

For each line on a vector chart, the beginning and ending points are defined as a specific latitude and longitude. This allows each point on the chart to be precisely geo-referenced so that each point may be linked with GPS signals for moving map displays. Since each point is defined as a latitude and longitude location, the point will precisely match the latitude and longitude of the GPS signals. With charts based on vector formats, the airplane symbol generated by the GPS signal will be depicted *exactly* at the location on the chart that matches the airplane's location. Raster charts have the geo-referencing correct at many locations on the chart, but the points in between the geo-referenced spots will be inaccurate by the amount of stretching of the paper or the inexact plotting by the cartographer who originally drew the chart by hand.

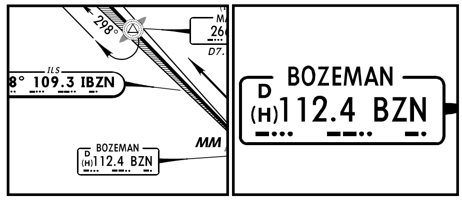
If the beginning point of a line is defined as a VORTAC, the automated cartography (or computer graphics system) that drew the vector chart used a "call" to access the VORTAC symbol out of a graphics symbol file. Each of the symbols in a vector chart is also drawn as a vector symbol.

So What Does This Vector Chart Mean for Me?

Assuming the GPS you are using has RAIM and other means to ensure its accuracy and integrity, the GPS signal that is used to overlay your airplane's position on a chart will be very precise. But if you are using that signal over a raster chart, the signal will be more accurate than the chart you are using. You might be lined up perfectly on the extended centerline of a runway on a Sectional Chart or WAC and find when you match that up with the outside world, you are not on the same path. That is because the geo-referencing is averaged and not precise over the entire chart.

On vector charts, when your airplane is lined up on the extended centerline, you can look outside and you will also see your airplane lined up exactly on the real extended centerline. On vector charts, when you pass over a fix or navaid on the chart, you are also precisely passing over that same fix or navaid in the real world.

Vector charts provide other advantages also. When you zoom close in to make the images and chart content larger, the lines and symbols are redrawn from the vector descriptions. Since they are redrawn, the larger images will be as crisp and clean as when viewed in their original size. This allows all images to be easily read at any zoom level.



In the illustration, note that the small navaid facility box for the Bozeman VOR is crisp in its regular size as it appears in vector format in JeppView. When zoomed into the maximum, the facility box for Bozeman remains just as crisp. This is because the image is regenerated from the vector points when zooming in closely. The "crispness" applies to text as well as lines.

Does File Size Matter?

In the previous article, the statement was made that the electronic sectional or WAC chart files were incredibly large at 7 to 12 megabytes. Is that really large with today's computers? *Yes.* The size by itself is not particularly large for ground-based computers, but when placed into an airplane, that size for a complete coverage of charts usually requires a CD. As you remember from training days, anything that spins wants to stay in its own plane of rotation. Can you imagine a CD not wanting to change its plane of rotation as you change the pitch and bank of your airplane? Files that are smaller fit on fixed media that don't rotate.

Also, with raster charts, the millions of pixels need to change location very fast on a moving map display in an airplane moving 200 to 300 knots. In order to get the raster pixels to move smoothly, it takes a lot of processing power. That's also expensive in an airplane when you consider certification.

Vector images can be stored in substantially smaller files. Vector files generally consume only 10% to 50% of the file size for an equivalent image, depending on the type of aeronautical chart.

In the next issue, we'll discuss charts that are generated out of a database "on the fly" without an image that has been previously composed by a graphic artist sitting on the ground.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: jim.terpstra@jeppesen.com

Jeppesen Electronic Chart Clinic
Third in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

At first glance, a chart is a chart is a chart is a chart. It's a little like when you got your first car. You probably were most concerned that it had four tires and a radio. As you gained more experience and the original thrill was behind you, other things became important - such as cruise control, stereo with lots of watts, ABS brakes, air conditioning, power windows, power seats - and you know the rest.

As you become more familiar with electronic charts, your wants and desires become more like your experience after your first car. Other things on charts become important. Things like clarity of the image, color, ease of changing from one chart to the other, and additional things such as the ability to turn off some of the information that is no longer important to you.

In the first two articles in this series on electronic charts, we discussed charts created using raster and vector technology. In this article, we will discuss charts that are "created on the fly" from an airborne database.

Database Charts

The term "database charts" is not exactly a standard term, so let me explain what is meant by those words. In a database chart, there is no graphic image that has been created by someone before you see it. The image, or chart, that you see is dynamically created by software each time you make a request to view the image and it gets regenerated each time you zoom, pan, or look somewhere else in the area of chart coverage.

With a database chart, there is a file stored in your computer. That file contains a database of textual descriptions of aeronautical information, although it will most likely be in a binary format when carried on board the airplane. As an example, the information about the Bozeman VOR in the database would include its identifier, frequency, latitude, longitude, elevation, class, service volume, station declination (magnetic variation), DME capability, etc. The actual VORDME symbol for the Bozeman VOR is not stored with the Bozeman VOR record in the database.

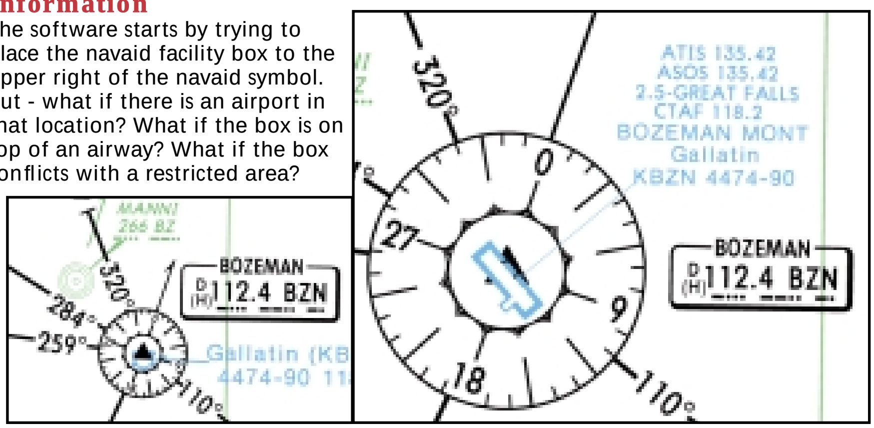
If you want to look at a chart of the Bozeman area, you would make the software program open a window near the Bozeman area. When you open the window, you can decide to have the window appear as a low altitude enroute chart, assuming you have the appropriate software. After you make that decision, the software knows you need the Bozeman VOR to appear in the window with all the other information that is included on the enroute chart. The software knows the size of the window and the latitude and longitude of the four corners and therefore searches the database and finds all information included in that latitude/longitude area. When it finds that the Bozeman VOR is inside that window, it accesses that database to find everything it is supposed to know about the VOR.

When it finds the Bozeman VOR record of information, it reads the record and sees the attribute that states the VOR is actually a VORDME and has a station declination of 11° east. From that information, the software then accesses a symbol file and places it at the correct geographical location on the chart. The software uses the station declination to know how many degrees to rotate the symbol so that the north arrow actually points to magnetic north.

To complete the visual image of the chart, the software must access the database to find the other attributes that describe the VOR and display that information in the navaid facility box. Now the software is presented with a challenge. Where to place the facility box?

Placing Aeronautical Information

The software starts by trying to place the navaid facility box to the upper right of the navaid symbol. But - what if there is an airport in that location? What if the box is on top of an airway? What if the box conflicts with a restricted area?



Since the exact location of attributes such as a navaid facility box can change, the rules within the software state that all information that has a geographical location will be drawn first. This means that VORs, NDBs, airports, intersections, waypoints, restrictive area boundaries, and other aeronautical information that has a specific latitude and longitude on the earth's surface will be placed first and will not be moved - at all. This means that if a VOR is located on an airport, the two symbols that depict this information will appear on top of each other. That's OK. That's reality.

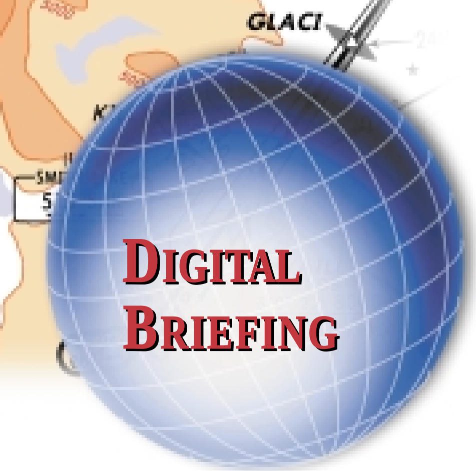
Aeronautical charts that use the raster or vector technology typically have been created on the ground by experts in chart design and compilation. These chart compilers have performed all the drafting and compilation while at a desk so all the composition of information is laid out so that the information is easily read. One of the things the compilers do is to make sure that all information is placed in a location that has the minimum amount of conflict with other information.

So what do you do with the attributes that are generated by software from a database? After the fixed locations are generated, the software then attempts to place the facility box in the default location to the upper right of the navaid symbol. Smart software has what is known as "visual conflict detection" and "visual conflict resolution." It is one thing for the software to know that the facility box has a conflict with other information on the chart - but it is quite a leap beyond that to know what to do when the conflict has been detected.

The two illustrations depict the same location on an electronic enroute chart, but at different zoom levels. In the left illustration, the navaid facility box is as large as the VOR symbol and in the right, the navaid facility box is much smaller. Also, in the left illustration, the airport symbol is depicted, whereas in the right illustration, the runway layout can be seen.

In the next article, we will look at the advantages and disadvantages of the three types of formats: raster, vector, and database.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com



Digital Briefing

Jeppesen Electronic Chart Clinic Fourth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

There are millions and millions of bits and bytes all packed together trying to make something meaningful. All those zeros and ones racing around in that silicon trying to create an image that you and I know as a chart. To keep all of them in order is something beyond me, but the software programmers have a talent that seems to defy logic.

What comes out in the end, however, is something we make judgments about. Something that is the same as what we are used to on paper. This is one of the reasons that electronic charts appear similar to paper charts. Industry standardization committees have stated that the new generation of electronic charts should be created in a way so that a whole new learning process does not need to be accomplished to read electronic charts. It is called human factors.

We have all learned to read VFR and IFR charts during the process of becoming pilots. Human factors experts say that old habits die hard so changes should be evolutionary, not revolutionary. So then, why have electronic charts at all?

Why Electronic Charts?

Probably the best advantage of electronic charts is the new situational awareness that comes with having your airplane's position move on top of the chart display. Another obvious reason is not having to carry pounds and pounds of paper. A nice benefit with electronic charts is the savings of time necessary to file revisions.

But let's go beyond the obvious.

What if only the information you needed for each phase of flight was in front of you? What if you flew an approach and all the information behind you went away? What if only those communication frequencies for your specific flight appeared on the chart? What if none of the radials from a VOR that formed an intersection appeared on the chart because you were flying with a GPS using an overlay approach and the VOR was not necessary?

To look at the possibilities for this magic, we should review again the three main types of electronic charts. Raster charts are those that have been electronically scanned, geo-referenced (synchronizing latitude/longitude positions on paper), and then placed in a chart software program. The visual aeronautical charts such as Sectionals, WACs, TPCs, etc. fall into that category. In the FlightMap software program, virtually all the visual aeronautical charts are available. This means you can fly with an electronic chart that is identical to the familiar paper charts because the image is the same due to scanning technology.

Raster charts make it easy to fly with the familiar symbols such as roads, railroads, city patterns, water bodies, cities, man-made obstacles, color contours, etc. And the magic allows you to see all those images in your airplane with your airplane's position moving on top of the chart. It also makes it virtually impossible to not know where you are. But with raster, placing your heading at the top of the screen makes all the words and symbols upside down if you are flying south. And zooming in will cause the images to start breaking up so if you keep the zoom levels reasonable, they still look good.

One Grade Up

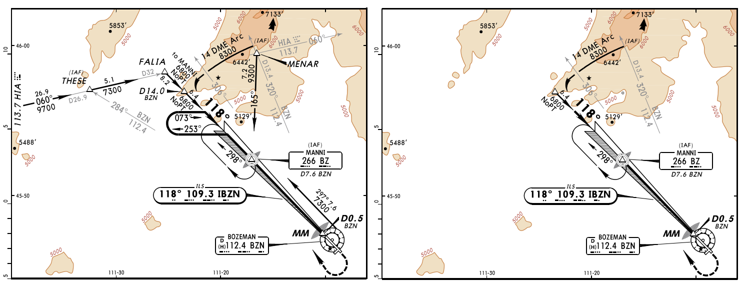
Raster charts have the limit of zooming, but vector charts do not. This means you can zoom into a level that allows you to see lots of details without having the image break apart. Vector also is much more precise than raster so your airplane's position should be within meters on the chart if your GPS sensor has that precision. You can precisely tell how close you are to your intended path.

Vector charts also carry intelligence. So if you want to search for something on the chart, a good search engine will find what you are looking for. All of the charts in JeppView are vector charts. When you look at the detail of any information on an approach chart, SID, STAR, or airport diagram, you will see what you are after in very readable detail at even the closest zoom level.

Vector charts also consume significantly less computer storage space which doesn't seem important in this day of gigabyte and terabyte storage. But, it is important when you consider the ability to move all the bits and bytes around at tremendous speeds for smooth movement in a fast airplane.

More Intelligence

Let's now explore the intelligence that is available in charts that are generated out of a database. Since the final graphic that you see on the screen for an approach chart is created from the information in the database, the intelligence exists to draw a chart that exactly meets the needs of you and your aircraft and your intended route of flight. To best illustrate this, look at the two different charts for the ILS Rwy 12 approach at Bozeman, Montana. The chart on the left is the plan view as it exists today. The chart on the right is the way it would be drawn if you flew the approach using the DME arc.



The FAA has designed the approach procedure in a way that facilitates arrivals from numerous directions. There is no radar at Bozeman so there are more feeder routes and initial approach segments than at locations where radar is available. If you are arriving from the northwest, there is a feeder route that starts at the Whitehall (HIA) VOR and proceeds via the 060° radial past THESE intersection to the FALIA intersection where you intercept the localizer and follow it to the airport.

MENAR intersection is on V-365 so it is also available for transitioning from enroute to the approach; however, it requires flying the procedure turn. If arriving from the east on Victor airways, the Bozeman VOR forms the airway and is also the beginning of the feeder route to the outer marker from which a procedure turn would be flown.

For illustration purposes, assume you have a DME and are arriving from the north on V-365. The beginning of the DME arc is the BZN 320° radial which is the radial that also forms V-365. Since the radials match, this allows you to fly the DME arc from the airway. Assuming you have a GPS or FMS, and also assuming that your new chart subscription is electronic and is connected to the avionics system, the approach transitions that you have elected not to use would not be displayed.

Numerous questions arise about how the decisions are going to be made for your selection of the appropriate transition to fly, but you can see the future with charts that include only what you need, when you need it.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com

Digital Briefing

Jeppesen Electronic Chart Clinic
Fifth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

So now that you have the ability to display an enroute chart electronically, you also have the ability to modify what gets displayed and what does not get turned on. How much freedom do you want to create your own image? How much freedom *should* you have to create your own chart?

These are questions that you have obviously asked. And they are questions that many have asked.

The electronic enroute chart that is available in FliteStar® and FliteMap® has many options. But there are some fundamental rules that should never be violated. As an example of rules not to be broken, you as a pilot don't have the ability to change a VOR frequency, its name or its location. One of the basic rules is that you have the ability to change what is displayed and what is not displayed, but you *don't have the ability to change* information.

Determining Minimum IFR Altitudes

One of the first questions you might want to ask yourself is, "Should I fly airways or should I fly direct since I have an IFR GPS in my airplane?" One of the considerations, of course, is the determination of the minimum altitude. If you are flying in most places in the world at FL180, consideration for the minimum altitude is not a big deal since you are well above any terrain or obstacles. But if you wish fly a direct route at 8,000 from Salt Lake City, Utah to Denver, Colorado, terrain and obstacles are very important.

With FliteStar, there are many ways to determine the minimum altitude for an IFR (or VFR) flight across the Rocky Mountains. For starters, a flight plan can be computed between Salt Lake City (KSLC) and Centennial Airport (KAPA) using the option of favored route type. By selecting an RNAV direct route using GPS, the distance is 334.8 nautical miles - but radar coverage over the Rockies at lower altitudes is pretty spotty so it is probably better to try a computer flight plan on airways to see if the flying distance is very much longer. A computed flying plan on Victor airways comes up with a total distance of 351.8 nautical miles - only17 miles farther.

A whole discussion emerges. What will air traffic control allow on direct flights? What will they do if they lose you from radar coverage? What altitudes will they allow when they can't see you on radar? Do they have altitudes for direct routes?

The easy answer to all this is to file the airways, then all the airway minimum altitudes become usable. But with GPS, why zig zag across the country when a straight line is more efficient? Even though the 17-mile difference is negligible, there are many other cases where the difference in distance is significant.

All Air Route Traffic Control Centers (ARTCCs) have minimum IFR altitudes (MIAs) for their areas of coverage. These altitudes are known only to the Centers and are not published anywhere. But, they are available after you are airborne and ask for the minimum IFR altitudes in their sectors while flying direct. That doesn't do much good, however, for planning purposes.

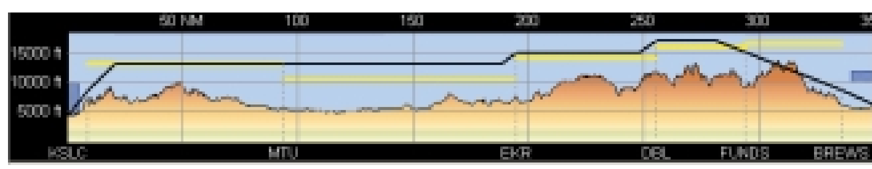
Determining the minimum altitudes for an IFR direct route is relatively easy. On the low altitude paper charts, the MORAs (Minimum Off Route Altitudes) are depicted in one-degree blocks inside of each degree of latitude and longitude. In FliteStar, the MORAs are included in the navigation log after the flight plan is computed. For the route from KSLC to KAPA, the MORAs are 14,100 feet, 16,800 feet, and 16,600 feet. Mighty high. The MORAs in the United States are the same figures as the OROCAs (Off Route Obstacle Clearance Altitudes) provided by the FAA. The MORAs and OROCAs provide 1,000 feet of obstacle clearance everywhere except in the designated mountainous terrain areas where 2,000 feet of obstacle clearance is provided.

ATC still hasn't decided if the MORAs are considered IFR minimum altitudes. As of now, they still believe the MORAs should be used only for consideration of obstacles but not minimum IFR altitudes since MORAs do not necessarily provide for communications coverage.

Consideration for Oxygen

The MORAs are so high that oxygen would be required for most of the route. By computing a flight plan using the airways, lower MEAs can be found that will allow for lower altitudes for portions of the flight. In FliteStar, the computed flight plan produces both a plan view and a profile view of the computed route.

Refer to the illustration of the profile view of the computed flight plan on airways from KSLC to KAPA. You can see the yellow horizontal lines that represent the MEAs on the selected airways. When responding to the queries on the flight plan wizard, an altitude of 13,000 feet was selected. The black line shows the requested 13,000-foot altitude, and that it is a satisfactory altitude until passing Meeker (EKR). After EKR, a higher altitude must be used because of the higher MEAs. After passing Table Mountain (DBL), an even higher altitude should be requested for crossing the Continental Divide just in front of you.



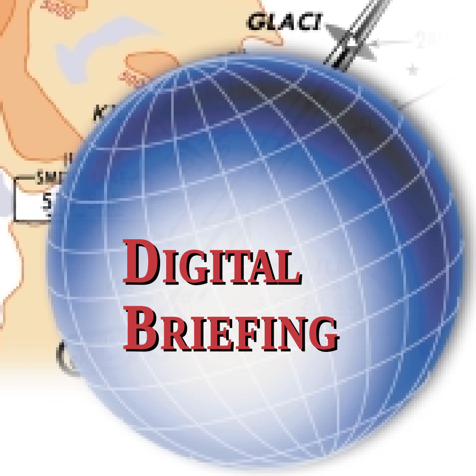
By looking at the yellow horizontal line, you can see that the MEA between Myton (MTU) and EKR is down to 10,000 feet, so a lower altitude could be requested for that 101.2-nautical mile segment if it is more comfortable without wearing oxygen equipment.

After DBL, the MEA becomes even higher after the FUNDS intersection, but by that time you would normally want to start a descent into the Denver area. The black line in the profile view cuts through the brown terrain near Denver. This indicates that if you start a normal descent into KAPA from your cruising altitude, your descent route would be below the terrain west of Denver.

From a practical standpoint, Denver Center would most likely have you in radar contact near the FUNDS intersection. Once you are in radar contact, Center would then be able to give you vectors with the minimum altitudes to start your descent and avoid the mountains.

In the next article, we will continue to look at the electronic enroute chart.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com



Jeppesen Electronic Chart Clinic
Sixth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Electronic enroute charts are here today. There are improvements that will make them even better in the future. When looking at the future, it is very difficult to predict what we will be using 5, 10 or 20 years from now. Here is what some of the true giants of the computing industry have said about the future of computing:

"I think there is a world market for about five computers." Thomas J. Watson, Chairman of IBM, 1943.

"There is no reason for anyone to have a computer in their home." Kenneth Olson, President of Digital Equipment Company, 1977.

"640K RAM ought to be enough memory for anybody." Bill Gates, CEO of Microsoft, 1981.

In this article, we continue to look at electronic enroute charts, as they are today rather than how they will look in the future. We wish our "crystal ball" was very clear, but right now we can only speculate about what we will see in hardware, software, data and displays in the next generation.

Flight Planning with Electronic Enroute Charts

Electronic enroute charts are now more than "just a pretty face." There is intelligence behind each image you see on a screen. And each image has a connection to other images on the screen. As an example, each airway is electronically connected to the navaid at the end of each airway. Also, each intersection on the airway is connected to the airway. Further, each airway is connected to the minimum altitudes for each segment.

So what does this mean to you?

For flight planning purposes, everything is connected so that any automatic routing will connect your departure airport to your destination airport via intersections, VORs, and airways when you elect to fly via the airways. If there is a turn at a VOR required to create the most efficient route, the connections will automatically be made. Since the data is electronic, the end result will also be a navigation log with all the VOR frequencies, leg lengths, airway minimum altitudes, etc. which provides a lot of intelligence for making decisions upon whether or not you want to fly via the computed route.

Removing Information

With an electronic chart image generated dynamically from a database, each class of element can be displayed or it can be turned off. As an example, you could turn off all the NDBs if you were on a GPS direct route using the electronic enroute chart in flight. The more information that is turned on, the more potential for "clutter" to be on the screen - the more that is turned off, the easier it is too see what's really important for your particular flight.

A paper chart is not the same as an electronic chart. When you look at a paper chart, all the information is arranged in such a way so that important information is not printed on top of other important information. A cartographer sitting at a desk with lots of time and experience has made the decisions for the placement of all the information.

The intelligence of a cartographer sitting at a work station just cannot be duplicated today with computers (at least not for a reasonable cost). When a new area is viewed on an electronic chart, the computer has to make many, many decisions on the proper placement of each item. Sometimes when the conflicts are just too great, the computer makes difficult decisions that are different than those a human would make. For example, some information might just get eliminated from the screen. Because of the computer's decisions, it is frequently best to turn off information that is not needed.

On a GPS direct flight, airports and VORs might also be considered for elimination since they can be turned on quickly if you need to know about airports along your route. On GPS flights, one of the more important pieces of information to leave displayed are the restricted areas, prohibited areas, and other areas that should be avoided. Each of these categories of information has its own "button" on the control bar, allowing it to be quickly turned on or off.

Vector Chart Themes

During most of my flying, I filed IFR flight plans even when the weather was CAVU. It is a good way to be in constant contact with ATC, and it keeps you current with copying clearances and conforming to IFR procedures so that when the weather is genuinely IMC, it is nothing out of the ordinary.

This means always carrying IFR enroute charts plus the appropriate terminal procedures for each flight. Additionally, I always carried Sectional Charts with me for both my passengers and myself. For passengers, it is a good way to get them involved in what is happening and it typically makes for more contented passengers. Then, when a large city or body of water comes within sight, you can look at the Sectional Chart and know where you are.

With electronic enroute charts, the "look and feel" of the chart can be changed depending on what type of information you want to see. As an example, the electronic chart can look like an IFR low altitude enroute chart, a high altitude chart, a VFR chart, or a number of other charts. While flying a GPS direct route, if you spot a ground feature you want to identify, you can turn on the vector theme for VFR charts and all of the things you are used to seeing on the Sectional Chart appear on the screen. Try that with a paper IFR chart!

In the illustration, the area around Wenatchee, Washington appears in a VFR vector theme.

Track Up versus North Up

Flying south? If you are flying south along the river toward Wenatchee, the airport would be to your left. But if you look at the VFR chart with the north at the top, the airport is to the right of the river. Confusing? Sometimes it's just easier to turn the chart upside down so the top of the chart is south when you are flying south, then everything will appear in its proper orientation.

With electronic charts, you can set the display to read "track up." Assuming your electronic chart is connected to your GPS or FMS, this means that the top of the enroute chart will always be the view out your front window. Now things to the right of the airplane appear on the right side of the chart display. With charts that are dynamically generated from a database, this means all the text is also generated "on the fly." The good news is that the text will always be "read right" so it will not be upside down when the chart is rotated with the front end of the airplane.

In the next article, we'll begin looking at the plans the FAA has for the level of certification they expect for various types of electronic chart installations.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com

Digital Briefing

Jeppesen Electronic Chart Clinic
Seventh in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Now let's see . . . we have categories. Category I, II, and III for how close you can get to the runway without seeing it. Category A, B, C, D, and E for defining the different stall speeds of airplanes with respect to landing minimums. And we also have classes. Class A, B, C, D, E, and G for airspace definitions. And now we have yet another group of classes. As you now begin to use electronic charts in your airplane, the requirements are broken down into Classes 1, 2, and 3.

The FAA has issued Advisory Circular 120-76, which specifies the different classes of Electronic Flight Bags (EFB). Electronic charts are but part of the larger group of digital information comprising any EFB.

What is an Electronic Flight Bag?

An EFB is an electronic display system consisting of the display, software, and data which were initially meant to replace all the paper carried around in those 30+ pound flight bags, but EFBs actually do much more. We, as pilots, have long recognized the benefits of adapting portable computing devices, such as laptop computers and personal digital assistants (PDAs), to perform a variety of functions traditionally served by paper. These portable electronic devices (PEDs) are now being used to replace the hard copy chart information contained in our flight bags. Thus, the term Electronic Flight Bag has entered into our vernacular.

EFB applications being deployed today do even more than the paper they are replacing. Not only do they deliver more information, they do so in a robust, integrated fashion that further enhances situational awareness and safety in all phases of flight, both in the air and on the ground.

Each of the three classes defined by the Advisory Circular allows for different functions; however, it should be noted that, with the exception of Subpart F—which applies to operators of large and turbine-powered, multi-engine airplanes—the Advisory Circular does not apply to FAR Part 91 operators.

The "lowest" of the three classes might be considered Class 1 since it covers electronic equipment that is completely portable. The next higher class, which allows more capability, is Class 2. It covers PEDs that are mounted to the aircraft in a docking station or cradle that has received a supplemental type certificate (STC). The highest class, with the most capability, is Class 3. It covers EFBs that are installed avionics systems that may have ***all*** EFB functions.

Class 1 Requirements

Class 1 consists of laptops, PDAs, or any electronic computing device that generally includes commercial-off-the-shelf (COTS) computer operating systems. They can be used for a number of "things", including non-interactive performance calculations, the hosting of Flight Operations Manuals or Airplane Flight Manuals, flight logs, FARs, weight and balance calculations, etc. Class 1 EFB systems are not attached to an aircraft-mounting device and do not require an administrative control process (a logbook entry) for use in your aircraft.

You may replace many documents with a Class 1 device, but the device cannot be used for takeoff or landing and cannot be connected to a GPS. Also, it cannot be "hardwired" to your aircraft's power, but it may be connected to recharge the battery.

In summary, the requirements for Class 1 EFB systems are:

- May be used on the ground and during flight as a source of *supplemental information.*
- Must be battery powered and must not be connected to your aircraft's power during normal use.
- Batteries may be recharged onboard the aircraft when not in use.
- May not provide a data link connectivity to other aircraft systems during flight.
- May not use a GPS source.
- The EFB, including the charger, must be stowed for takeoff and landing.

The most common question is, "Do I still need paper?" The AC says the Class 1 EFB is for "supplemental use only" and goes on to say, "the operator must have paper onboard at all times." These statements apply to FAR Part 91, Subpart F operators, and may not apply to other Part 91 operations.

For use under FAR Parts 121, 125, and 135, the principal operations inspector (POI) needs to evaluate and accept the data as presented. Additionally, for operators under FAR Part 121 and 135, training is required as appropriate.

Class 2 Requirements

Class 2 consists of PEDs that are connected to an aircraft mounting device during normal operation and require an administrative control process for use in the aircraft. A Class 2 EFB may use the aircraft's power and have data link connectivity. The mounting devices for the EFB require aircraft evaluation group (AEG) evaluation and certification approval from the FAA certification branch.

One of the big advantages of Class 2 over Class 1 is that the EFB can read (but not send) data from the aircraft busses, that includes the GPS, as long as it can be proven that there is no interference. In Class 2, the mounting device for the EFB must be a structural cradle that can be proven crashworthy.

Class 2 devices can do everything that Class 1 devices can. Additionally they can also be used for reference materials and checklists using pre-composed information, approach charts, navigation charts, and performance calculations. One of the best features of Class 2 is the ability to have dynamic interactive electronic aeronautical charts (e.g., enroute, area, and airport surface maps) using a moving map display that includes centering and rotating the chart; although Class 2 does not allow the display of your own aircraft's position on the chart. The FAA believes that placing your airplane on the display of a moving electronic chart would be so compelling that it would be very tempting to use it for primary navigation. In order to provide a system that includes navigation, a higher level of integrity for the software is required.

In summary, the requirements for Class 2 EFB systems are:

- When a POI is involved, the POI should document the EFB Class 2 compliance for performing its intended function. This is primarily related to COTS electronic equipment such as pen tablet computers.
- Mounting in a crashworthy cradle.
- EFB data link ports require FAA certification approval to ensure non-interference and isolation from aircraft systems.
- Operators must determine non-interference with existing flight systems for all phases of flight.
- Class 2 EFB systems are portable equipment and may be removed from the aircraft through an administrative control process (logbook entry).
- For a Class 2 paperless cockpit, each flight crew member must have an independent EFB system.
- A Class 2 "reduced paper" cockpit requires a single reliable EFB system and one complete paper set of all applicable data.
- Paper can be removed from the flight deck for a Class 2 system by FAA approval after proving the reliability of the system for a 6-month period and filing a report. For air carriers, the authorization must be granted via issuance of OpsSpec A025. For the six-month operational evaluation period, both the EFB and paper copies are required.
- The FAA Certification Branch evaluation and design approval for class 2 devices is limited to airworthiness approval of the cradle (crashworthiness), data link connectivity, and the EFB power connection.
- Reference material, checklists, performance calculations, and navigation charts, such as approach charts, need to be pre-composed. This means they cannot be generated "on the fly" from a database and cannot use software to compute aircraft performance. The pages of information have to be created on the ground and then loaded in the EFB in the airplane.

Class 3 Requirements

Class 3 EFB systems are considered installed equipment and require a Supplemental Type Certificate (STC) or certification design approval that includes, but is not limited to, conducting a functional hazard assessment and compliance with RTCA document DO-178B. DO-178B is the document used by the FAA to certify software in aircraft systems such as autopilots, FMSs, and many other computer-based systems in modern aircraft.

The Class 3 EFB system certification requirements may enable additional functionality (e.g., GPS, or Automatic Dependent Surveillance-Broadcast (ADS-B), that can provide moving maps suitable for situational awareness or navigation).

Class 3 systems are the most sophisticated of the three, because they are the systems which are installed in the aircraft panel and integrated with the other avionics in the airplane. Because of this level of sophistication and integration, the FAA will be involved in the certification of the system.

What about Currently Installed Systems?

There are EFB systems in the field which have obtained Operational Approval. They are still OK. *Since the Advisory Circular describes just one means of certification and is not new rulemaking, any currently operational systems are valid.*

After reading through the Advisory Circular, it becomes apparent that the FAA wants to facilitate the move to a paperless cockpit. They are, however, reluctant to approve everything that comes to them just because it will relieve a lot of effort and provide many new safety features (situational awareness, as an example). The FAA wants to walk before they run to ensure the new systems provide all the reliability necessary to keep the aeronautical information in front of us at all times. This is obviously important when operating in IMC.

In the next article, we will continue by exploring electronic approach charts, SIDs (DPs), STARs, and the other terminal charts.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing. For comments, please Email: jim.terpstra@jeppesen.com

Digital Briefing

Jeppesen Electronic Chart Clinic
Eighth in a Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Filing revisions . . . and more revisions . . . and more revisions. As a full-time instrument flight instructor for years, filing revisions was the last thing on the list of priorities to be accomplished. After the revisions pile became higher than comfortable, watching football on Sunday afternoon became a two-pronged task—file those revisions while keeping an eye on the game.

A few weeks ago while filing a complete *worldwide* set of approach charts, SIDs, STARs, airport diagrams, etc., the revisions took about 35 seconds. Actually, as I sat there and waited for the revision process to complete itself, I was complaining internally about how long it was taking. Then, suddenly, I realized I was complaining about a mere 35 seconds, and that the same process with paper charts would have taken hours instead of seconds.

More than a "Dumb Page Turner"

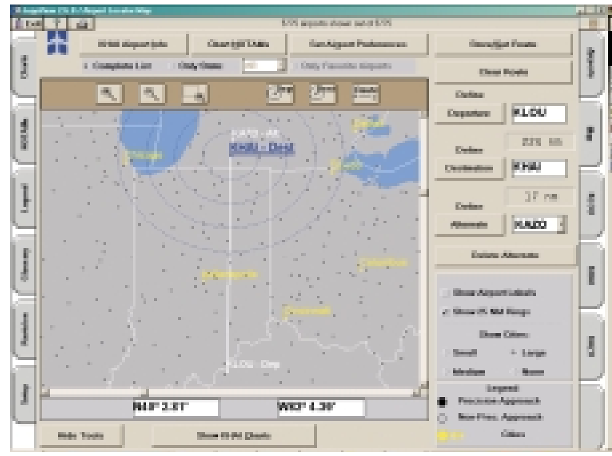
Electronic charts, however, should do more than just replicate paper. Even though the reduction in revision filing time alone seems worth it, other features that take advantage of the many benefits offered by electronic media are also available.

But first, the format of the charts. All Jeppesen charts are produced by computer graphics, and have been since 1982. They are generated from a worldwide aeronautical database, the same as used in airborne avionics. When they are completed, they go through a process wherein the same files are routed in two directions. Files are converted to raster format and sent to the printer, and also sent in vector format to the master file for JeppView.

Why do you want to know this? If you have both a paper and JeppView subscription, all the charts are the same. The charts you print from JeppView will be identical to those published in your paper subscription.

When JeppView First Starts

When your JeppView application is first opened, the screen shows a view of your coverage area. Little white dots represent the location of every IFR airport in your coverage. In addition, the JeppView disc in your drive is coded with four digits separated by a hyphen. There are 26 JeppView discs issued each year (one every 14 days), and the discs are numbered according to the disc number followed by the year in two digits. The current disc at the time of this writing is 20-02, or the 20th disc of 2002. If your disc is out of date, a message will be displayed that lets you make the decision as to whether you use the out-of-date disc for a couple of weeks.



When you respond to "Continue," the next display shows the list of cities and five columns labeled: ICAO, IATA, Airport Name, City Name, and State. To find an airport, you can type in any of the types of information indicated by the titles of the columns. As an example, you can type in KLAS, the ICAO identifier for Mc Carran Field in Las Vegas, NV; you can type in LAS, the IATA identifier; you can type in Las Vegas; you can type in Mc Carran; or you can type in NV. The search engine allows many different ways to access an airport, but, of course, all search engines work best when given unique information to search with. Typically, using the ICAO identifier produces the best results.

Also, you don't always need all of the letters when searching for something. As an example, you can key in MC CAR and it will find KLAS and only one other airport. From there, you then press the listing for Las Vegas and the list of procedures for "Vegas" shows up.

By touching each column label, it causes the list to be displayed alphabetically by the specific label you just touched. This is helpful if you want to see all the airports for one city, for instance.

If you want to see only those airports for a given state (or country), two buttons at the top of the screen allow you to choose "Complete List" or "Only State:" so only the charts for the selected state appear in the list of available cities. This is helpful if you know you will need fuel about the time you cross over the state of Arkansas, and the list of available airports is much shorter than your entire subscription coverage.

Tabs for Airports in Flight Plan

Let's take a flight from Bowman Field in Louisville, Kentucky, to the Haines Airport in Three Rivers, Michigan. Since Bowman Field is the departure airport, you can touch the listing and drag it over to the window next to the word Departure, and the airport identifier KLOU appears on the Departure Tab on the right side of the screen. Next, drag the Three Rivers airport listing to the window next to the Destination window, and the letters KHAI show up on the Destination Tab and the great circle distance of 224 nautical miles appears between the two locations. The illustration shows the airport identifiers as they appear on the tabs.

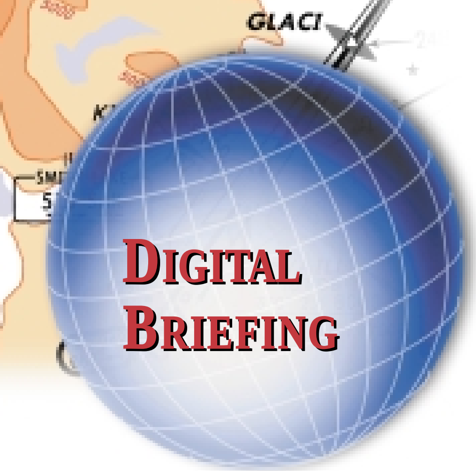
To easily find an alternate, touch the Map Tab. When the map appears, use the right mouse button to select the area you would like to review for possible alternates. To aid in your selection of an alternate, check the "Show 25 NM Rings" box, and distance rings will be shown at 25-mile intervals.

For demonstration purposes, let's select KAZO, Kalamazoo, Michigan, since it has an ILS approach and is within the first 25 NM ring. Now, touch the KAZO identifier and drag it into the Alternate Airport box, and the letters KAZO appear on the Alternate Tab. In addition, the distance between your destination and alternate, 17 nautical miles, is shown, displaying distance by great circle route.

When you make the flight from Louisville to Three Rivers, the locations will still be under the Departure, Destination, and Alternate Tabs respectively. Just before departure, touch the Departure Tab (KLOU), and the listing for the Bowman Field airport appears. From that point, you can touch the airport chart and any others you need for take off and departure from Louisville.

In the next article, we will continue discussing JeppView.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com



DIGITAL BRIEFING

JEPPESEN ELECTRONIC CHART CLINIC NINTH IN A SERIES

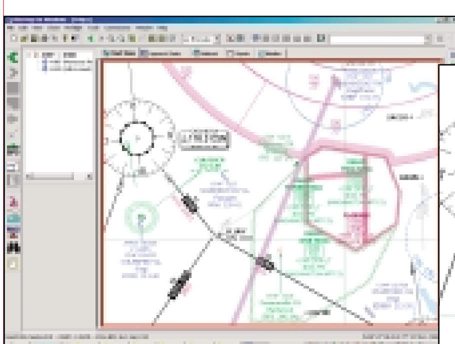
BY JAMES E. TERPSTRA
SR. CORPORATE VICE PRESIDENT, JEPPESEN

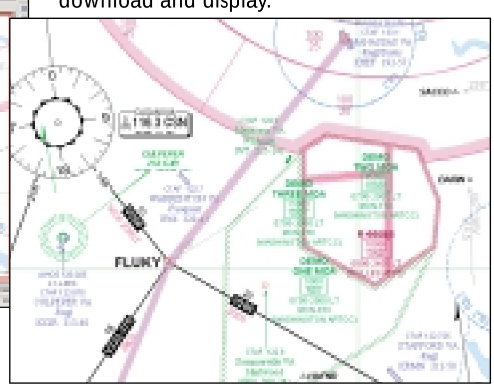
Desktop computers, laptops, tablet computers . . . we certainly live in an age of change. In 1973, the first electronic handheld calculator was available for about $349, and the adapter was an option for another $49. That electronic calculator could add, subtract, multiply, and divide and was about 2" thick.

And those were the "good ol' days"?

The personal computer (based on DOS) was introduced in 1982 with no hard drive, one 720-kilobyte floppy drive, and only 640 kilobytes of memory and that was an option. In 1986, a 10-megabyte hard drive was over $600 and was almost the size of a shoebox.

Today we are the fortunate beneficiaries of huge advances in computer technology. Speeds are up, storage is massive, screen resolutions are color photo quality . . . all of which make electronic charts possible.





Direct route altered to avoid R-6608B

Taking a Trip with Electronic Charts

To illustrate the use of electronic charts, let's take a trip from Manassas, Virginia, to the resort airport at Hilton Head, South Carolina. For the flight, we'll fly a normally aspirated Cessna 210 with a GPS that is IFR certified for enroute, terminal, and approaches.

Using the flight planning features of Jeppesen FliteMap®, a direct flight from Manassas (KHEF) to Hilton Head (KHXD) is shown to be 419.6 nautical miles. Upon a closer look at the straight line between the two airports, the route passes through the edge of Restricted Area R-6608B which is from the ground up to 10,000 feet MSL. Oops! For a route clear of the restricted area, "grab" the route of flight on the screen with the cursor and drag it to the closest intersection (FLUKY). When filing an electronic flight plan through DUAT, or by calling a Flight Service Station, it is easier to use intersections as descriptions for the route of flight.

About midway through the flight, there is another restricted area, and FliteMap shows the altitude restrictions for R-5311A, B, and C. Looking at the altitudes for all three areas, we need to fly around R-5311, so the route of flight should be "rubber banded" again to the west to avoid the restricted area. The route of flight can be dragged over to the MYOWN intersection, which avoids R-5311.

Straight-In Approach at Hilton Head

At Hilton Head, there are five instrument approach procedures. One of them is the GPS Rwy 21 approach, in which you arrive from the north. A straight line from the MYOWN intersection to Hilton Head can be slightly modified with the "rubber band" in FliteMap to make the route straight to the TERLY intersection, the GPS Rwy 21 initial approach fix. With these slight modifications to route around the restricted areas and to fly direct to the IAF, the total distance including the GPS approach is only about one mile further than a straight line between the two airports.

Weather

For current weather, click on the Weather tab toward the top of FliteMap, and a screen appears for dialing DUAT. Once connected, using either a dial-up or Internet connection, a wide selection of weather and preflight services is available. Included are "Standard WX: Route", "Radar Maps [NEXRAD]" and many others, all of which are available for download and display.

After obtaining the current weather, it can be overlaid on top of the route of flight to see what impact it may have on our route. For this flight, the NEXRAD weather shows some thunderstorms, but they are far enough away that they shouldn't impact the flight. In addition, winds aloft can be displayed graphically, using wind arrows to show their impact at our chosen cruising altitude of 8,000 feet.

Chart NOTAMs

Before departure, there are a number of sources we can turn to for NOTAM information. The DUAT services and the Flight Service Stations can inform you of recently issued NOTAMS which might affect this flight. Additionally, JeppView has two locations to obtain NOTAMS affecting charts. At the top of the page when charts are in view, a tab for "Chart NOTAMs" will show whether or not there are any NOTAMs that affect the chart with information that has changed between chart cycles. For Hilton Head, the only Chart NOTAM is a generic NOTAM about Phase 3 Overlay GPS approach procedures.

To the left of the chart, another tab labeled "NOTAMs" shows the chart NOTAMs for the enroute charts. If any NOTAMs affect the enroute chart information, the temporary information can be found by clicking on this tab. Remember, the most current NOTAMs are only available from DUATs and Flight Service Stations.

Other JeppView® Tabs

Other useful information about Hilton Head such as fuel, oxygen, magnetic variation, latitude and longitude, time zone, and other details can be found by pressing the tab that includes the airport's identifier plus the word "Info."

Did you forget what LAA means? How about ASOS or AWOS or TWEB or VDP? A tab labeled "Glossary" is on the left side. Also, the meanings of the symbols found on approach charts, SIDs, and STARs, as well as enroute chart information can be found under the tab labeled "Legend."

While flying into Hilton Head, you most likely will have the GPS Rwy 21 chart in view. If Savannah Approach changes the approach in use, the tab at the top labeled with the airport identifier followed by the word "Charts" will let you find the additional charts for Hilton Head without having to start all over looking for Hilton Head in a long list of other airports.

Looking closely at some of the JeppView buttons, you will notice that some are marked with underlines. These indicate the availability of shortcuts using the CTRL key in combination with other keys, and help to find things without having to chase around with the small cursor. Using CTRL-C, the list of other charts for the active airport appears. If you are looking at a chart and want to find another airport, CTRL will display the master list of airports. CTRL-I will display the airport information and CTRL-N will display the Chart NOTAMs.

Printing

Once you have selected the airports, you can print all the charts to carry with you as a backup if you view the charts electronically while enroute. If you want to reduce the total number of charts you print, you can select the chart types you desire, so that if you don't want to fly DPs (SIDs) or STARs, they won't be printed. When printing, you can select the option to print each chart on a separate sheet of paper. The charts are a little oversized, but they are very easy to read.

The printer icon at the very top of the display launches your print efforts. If you want, the charts can be printed two on a full size sheet of paper, which makes the charts the same size you are used to seeing.

In the next article, we will finish with a view of the future for electronic charting.

Jim Terpstra is senior corporate vice president, flight information technology at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: jim.terpstra@jeppesen.com

The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Technology has given us many new "gadgets" to make our life easier. We enjoy cell phones, e-mail, surfing the web, flying point to point using GPS and its "magic." Glass displays help us visualize our position better than we've ever had. That is the good news - but life is not as simple as it used to be.

Before GPS, when the FAA or other government authorities issued a new VOR approach procedure, you filed your revision and then when you flew the approach, you simply tuned to the VOR, set the course selector, and that was about it.

Now, when a new GPS approach is issued, you need to file the paper revision, make sure you get the latest database update, and make sure you load the new database into your GPS in the airplane. Then when you fly the approach, you need to get the paper chart, get the airport identifier, access the airport identifier from the database in the GPS, find the list of approach procedures for the airport, select it, then look at the list of initial approach fixes, find out which IAF is appropriate for the direction you're coming from, then select the IAF and fly the approach.

Yes, GPS is a good thing - the navigation is more precise and VFR airports are now becoming IFR without anyone having to fund a ground-based navaid. Runways now have instrument approaches when they didn't before and straight-in landing minimums are now more common.

RNAV is GPS is RNAV

Back in the 1970s, the FAA began publishing RNAV approach procedures that were based on VOR DMEs and VORTACs. The "magic" of RNAV then was that you could move any VOR DME to any location you wanted as long as you were within range of the VOR DME. If the VOR DME wasn't on the centerline five miles out to form the FAF, you simply moved it to a FAF location created by the FAA and flew the approach. These RNAV approaches were known as "station mover" RNAV approaches and were created by the FAA until they reached about 500 RNAV approaches in the United States.

The "station mover" RNAV approaches are still with us today - but are now known by a different name. The FAA began a program about three years ago to rename all the RNAV approaches that were VOR DME based. That program is now complete and all the approaches have been retitled VOR DME RNAV Rwy XX approaches. About 300 of these approach procedures still exist.

And why would the FAA want to go through all the effort to rename the RNAV approach procedures to VOR DME RNAV approaches, you ask?

In 1994, the FAA issued the first GPS approach chart and has continued to create and issue about 500 new GPS approach procedures per year. That is the good news. But the bad news was that with all this effort being expended by the FAA, none of the airlines could use any of these approaches because GPS receivers had not been part of the airline avionics suite until fairly recently. That meant that all the new GPS approach procedures were usable by only one segment of the aviation industry.

The airline industry said to the FAA that they would also like to take advantage of all the new approach procedure capability but, with the name GPS in the title, they were not able to fly the approach procedures even though most of the airlines have very sophisticated Flight Management Systems (FMSs). Many corporate operators also had the same dilemma - lots of new approach procedures, new sophisticated FMSs, and no ability to fly the GPS approaches.

Well, the FAA listened! Beginning with the 24 February 2000 revision, all new GPS approach procedures were issued with the name RNAV. Then things started to fall apart.

Database a Basic Element of GPS Approaches

The database is such an important component of GPS approaches that the approaches cannot be flown without the database. The airborne databases provided by Jeppesen are created and produced according to the ARINC 424 specification "Navigation Databases." Virtually all avionics systems use databases that are produced according to the ARINC 424 standard. The ARINC Committee was formed in September 1973 and has continued to meet once or twice a year to steadily improve the database standard.

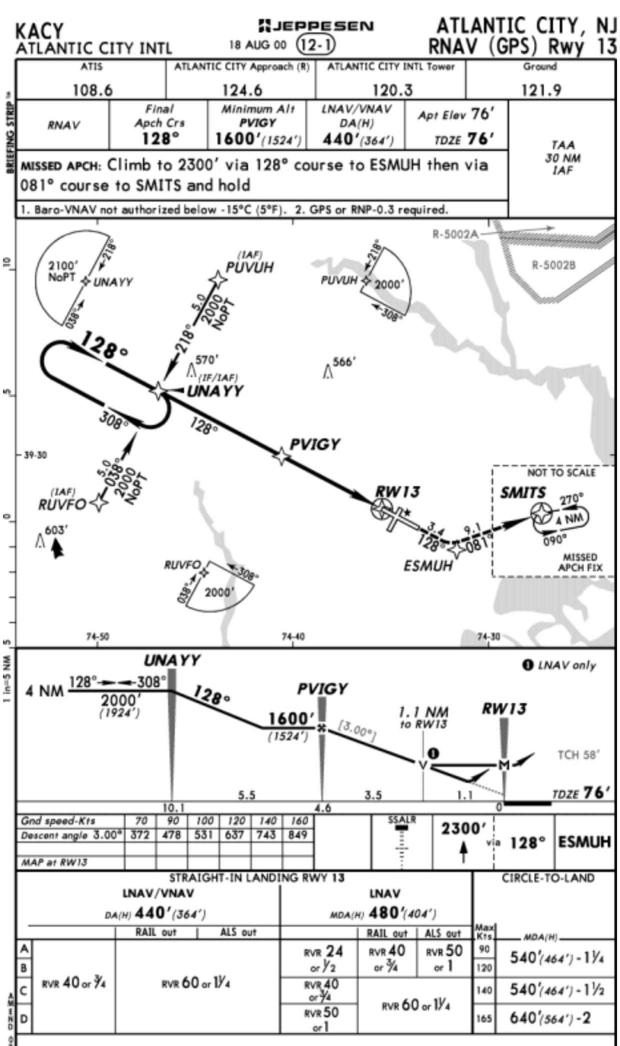
When the FAA began issuing GPS approach procedures with the new name RNAV, the coordination between the FAA and the industry for this new type of procedure had not been accomplished. In the ARINC spec, there is a field used to identify the route type. In this case, an approach procedure is a route which consists of many segments starting in the enroute environment and continuing through the missed approach segment. The route ID for approaches has a single character followed by the runway number. As an example, a VOR Rwy 09L approach would be coded in the database as V09L. An NDB Rwy 26 approach would be coded as N26 and so on.

The letter "R" was established early in the ARINC 424 development to be used for RNAV approaches which were the "station mover" variety. A VOR DME RNAV Rwy 35R approach is coded as R35R. Just recently, RNAV approaches that required GPS were given the route identifier of "P" since the letter "G" had already been taken. The ARINC spec was also revised to accommodate RNAV approaches that were based on GPS. Since the letter "R" had already been used, the letter "E" was used to indicate an RNAV approach based on GPS.

All this confusing? Without getting into any more detail, when the GPS approaches were issued as RNAV approaches, no one in the industry (database suppliers and avionics manufacturers) was ready to use the new code "E." Therefore a decision was made to use the existing letter "R" for RNAV or "P" for GPS. If the letter "P" had been used, the GPS approach name in the avionics would not have matched the RNAV name on the chart nor the RNAV clearance given by the controller. Not good. So the decision was made to use the letter "R" so the approach procedure name in the avionics, charts, and clearances all matched.

GPS Avionics Needs GPS Approaches

GPS receivers that are certified to fly IFR approaches require the code letter "P" in order to activate the Receiver Autonomous Integrity Monitoring (RAIM) function. The RAIM checks the reception of the satellites to ensure that the required amount of GPS satellites and the



quality of the GPS satellite signals is OK for IFR approaches. With the code letter "R", the avionics doesn't know the approach is a GPS approach so the RAIM is not activated in some avionics systems.

Another need for the GPS route identifier "P" in the database is that the course deviation indications are required to become more sensitive at the final approach fix. On the VOR DME RNAV approaches, there is no requirement for a change of sensitivity at the FAF so the coding of the GPS approaches as RNAV didn't activate the sensitivity change at the FAF.

But, did it help the airlines? Yes in some cases, but not all Flight Management Systems were able to use the RNAV procedures because of things such as RNP requirements.

What's the Solution?

Beginning with the 25 January 2001 effective date, the name of the RNAV approach procedures will change. Refer to the RNAV (GPS) Rwy 13 approach into Atlantic City, New Jersey and you can see the format and name for the new title for GPS approaches. You might ask "What good does that new title do?" Beginning with the January revision, all approach procedures in the database will have dual coding for an interim period. This means that GPS receivers will receive the database coding with the letter "P" for the RNAV (GPS) approaches and the Flight Management Systems will receive the database coding with the letter "R" for the RNAV (GPS) approaches.

Beginning in January, when you receive a clearance for the Atlantic City RNAV (GPS) Rwy 13 approach, the controller will refer to it as the RNAV approach and you will find it listed in your avionics unit as a GPS approach. Since the letters GPS are in the title (even though in parentheses), the title on the approach chart will be virtually the same as on the avionics equipment.

The FAA Handbook 7110.65 which specifies the terminology used by controllers and pilots will be revised to reflect the new approach procedure titles. Since the letters GPS are in parentheses, they will be silent in the approach clearances. The clearance for the Atlantic City approach from the controller will be "... cleared RNAV Rwy 13 approach."

Coordination

No one is an island - especially in this world of electronics. All of our dependencies spread across many organizations to successfully implement new technology. We collectively need to look at new ways of doing business when coordination is required.

When new ideas are implemented by governments authorities, coordination needs to happen much further in advance. The FAA has agreed to begin a prototyping method of delivery for new advances to ensure that everybody who has responsibility in the process has a chance to test the capability before it is turned over for final use. Before WAAS approaches are commissioned, the FAA has agreed to issue new sample approaches for prototyping to ensure the databases and avionics have the ability to implement them before the effective date. This new process should help the learning curve for the final users since new things can be introduced once.

Now that databases are central to IFR and VFR navigation, any changes to new types of approaches and equipment requirements need to be coordinated with everyone in the "string" of implementation. The next article will continue on databases with a discussion on the new duplication of approach procedures to the same runway.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

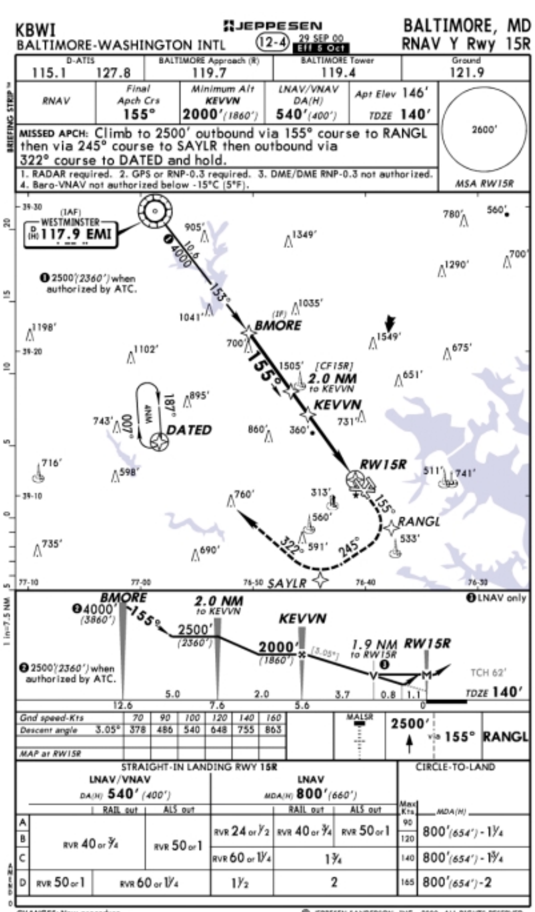
For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Power is set for cruise, engines are synched, trim is all set, comm radios properly tuned, GPS receiver set to a waypoint close to the destination. Time to engage the autopilot and time to start studying the approach charts again -- before having to use all the numbers and lines on the chart while shooting the approach.

Baltimore is your destination. As you get closer, you tune into the ATIS, weather is 600 broken, 2 miles vis, wind 130° at 12 knots, landing runways 15 left and right. So now you know you'll need to shoot an approach. As you look through the approach charts, you find six approaches to the two parallel runways -- two ILS approaches, one VOR DME, and three RNAV approaches. OK -- it makes sense to have an ILS for each of the two parallel runways, but why three RNAV approaches to two runways?



And if you look closer at the RNAV approaches, there are two of them to the same runway -- Rwy 15R. After looking at the titles a little closer, the RNAV Rwy 15R approaches actually have a small difference. The first one has the letter "Y" after the word "RNAV" and the second approach has the letter "Z" after the word "RNAV."

Multiple RNAV Approaches to the Same Runway

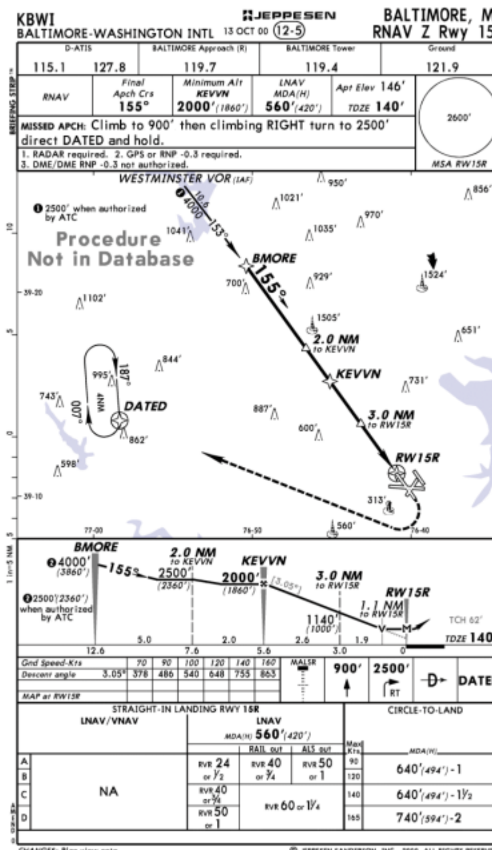
Because databases cannot handle duplicate file names, two approach procedures with the identical name to the same runway cannot be included in the database. Recently, the FAA issued two different RNAV approach procedures to Rwy 15R at Baltimore, Maryland. The FAA coordinated with industry to handle the duplicate name situation and they adopted the use of a phonetic letter as a suffix to the procedure type to handle the duplication problem.

Refer to the two approaches at Baltimore. The first RNAV approach is named RNAV Y Rwy 15R and the second RNAV approach is named RNAV Z Rwy 15R. The policy is to use a letter starting at the end of the alphabet and proceed backward so as not to be confusing with approaches that don't have straight-in landing minimums. You recall that circle-to-land only approaches use the alphabet letters starting at the beginning of the alphabet. That letter appears after the approach procedure type. Then, the runway number is eliminated to indicate no straight-in landing minimums. So, a circling approach would be identified as VOR - A.

When the controller issues a clearance for the approach to Baltimore, the clearance would be " . . . cleared for the RNAV Yankee Rwy 15R approach." The phonetic letter is pronounced by the controller in the clearance.

Why Two Virtually Identical Approaches?

The FAA is trying hard to accommodate both the panel mounted GPS receivers as well as the Flight Management Systems that have VNAV capability. On the RNAV Z approach, there is a stepdown fix (after KEVVN waypoint) to provide better minimums for the GPS receivers that don't have VNAV. The stepdown fix which is 3.0 NM to the runway allows the avionics without VNAV to pass the final approach segment controlling obstacle and continue on down to an MDA of 560 feet.



Since there is VNAV on RNAV Y Rwy 15R, there is no need for a stepdown fix -- the VNAV will keep you above the final approach segment obstacle. Without VNAV, the stepdown fix is necessary to clear the obstacle.

For aircraft with FMSs, the RNAV Y approach was created by the FAA to utilize the VNAV to pass the controlling obstacle on a descending path. Since the VNAV provides descent guidance all the way from the FAF to the RW15R missed approach point, the VNAV guidance clears the obstacle without having to identify the stepdown fix which is included in the other procedure.

On the RNAV Y approach, the LNAV minimums are considerably higher (800 feet) than the LNAV minimums on the RNAV Z approach (560 feet). This is because there is no stepdown fix on the VNAV approach so the controlling obstacle is higher for no VNAV.

Because of the two different means of clearing the obstacle on the final approach segment, you can see some of the main differences in the minimums box of both approaches. The minimums for RNAV Y Rwy 15R include a decision altitude (DA) because the minimums are based on lateral navigation (LNAV) and vertical navigation (VNAV) and the minimums are slightly lower than the RNAV Z Rwy 15R approach. The RNAV Z Rwy 15R approach has minimums which are expressed as a minimum descent altitude (MDA) because there is no vertical navigation.

Visual Descent Point

The visual descent points are in different locations because they are based on reaching the MDA on the descent angle of 3.05° from the FAF down to 62 feet above the threshold. Since the MDA of 800 feet on RNAV Y Rwy 15R is reached before the MDA of 560 feet on RNAV Z Rwy 15R, the VDP is further from the runway on RNAV Y Rwy 15R. The FAA has a policy of adding more and more VDPs on RNAV approaches and other approaches where there is a DME that can be used on the approach.

One of the main differences can be found by looking at the missed approach procedures on both charts. The missed approach on RNAV Y Rwy 15R climbs straight ahead to 2,500 feet direct to RANGL waypoint, then a right turn direct to SAYLR, and then a right turn direct to DATED waypoint which is the missed approach holding fix. The missed approach point and missed approach holding fix both have a symbol with a circle around them. This means they are fly-over fixes. The RANGL and SAYLR waypoints are fly-by fixes and are depicted as waypoint symbols without circles around them. On the missed approach depiction (with dashed lines), the actual track does not pass through RANGL and SAYLR since turn anticipation at each fix will cause them to be passed on the missed approach, but you will not fly over them.

All missed approach points and missed approach holding fixes are fly-over waypoints by definition. Virtually all other fixes are fly-by fixes. The advantage of a fly-by waypoint is that a good rate of turn will cause you to be on the centerline of the next leg after passing the waypoint rather than trying to re-intercept the course after over shooting the fix when turning.

Procedure Not in Database

In the plan view of the Baltimore RNAV Z Rwy 15R approach, there is a note "Procedure Not in Database." As stated earlier, the FAA and industry coordinated the use of the phonetic alphabet starting with the letter "Z" and moving backward in the alphabet to indicate duplication of approach procedures. The coordination of the phonetic letter was accomplished but the coordination of the implementation date was not.

This meant that the avionics systems and the databases were not ready to implement the duplicate function when the FAA began issuing the new duplicate approaches. A decision was then made to include one approach procedure in the database and not both. The approach procedure with the best minimums and VNAV capability was selected so the RNAV Y Rwy 15R approach was selected. This left RNAV Z Rwy 15R as an approach procedure on paper without a database. Since the FAA requires that the GPS approaches must be in the database, it was decided to publish the RNAV Z Rwy 15R in the approach manuals, but include the note "Procedure Not in Database" to indicate that a clearance for that approach could not be accepted since there were no database records to support it.

The industry should be able to support multiple approaches of the same type to the same runway sometime in the Spring 2001 so the chart will be revised to take the "Procedure Not in Database" note off the chart when duplicate approaches can be utilized in airborne databases.

In the next article, we will begin exploring why some information is different on the charts then on the avionics displays.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

When you first learned how to fly, most likely you learned to navigate using the Sectional Chart (scale of 1:500,000) and then gradually moved through the 1:1,000,000 charts and then learned how to use the IFR charts which had a number of different scales. After learning pilotage and dead reckoning, your instructor probably showed you the "magic" of the VOR that lets you know your azimuth to or from the station. And if you were lucky, the airplane had a DME so you could tell how far you were away from the VORTAC.

Well, that "magic" turned into something even better with the introduction of GPS. Now you can enter the airport identifier for wherever you wish to go and the GPS receiver will take you there via the shortest distance — a great circle route (or geodesic line for the perfectionists). But — did you ever think that the only way you could shoot an approach would be to have a current database on board your airplane? And — the FAA TSO-C129 document which approves your GPS requires you to use that database for approaches without hand entering any of the fixes.

Databases — What are They?

Databases are a collection of information. This collection of data could be in paper form, but for our discussion, we'll consider only computer databases. Also, there is a major difference between software and databases. When referring to software, people sometimes include databases in that definition. For the purposes of our discussion, software is the application that gives the ability to access and use the database. And databases include only information — they do not include the software to manipulate the databases.

One of the basic principles of databases is that information can be entered only once and then used again many, many times. A good example of this is the Mile High VORTAC (DVV) near Denver which is used on seven airways, three SIDs, four STARs, five ILS approaches, one VOR DME RNAV approach, the formation facility for 25 intersections, and numerous company routes or flight plans.

Look at the illustration titled *Navigation Database Structure* and you can see three large levels of horizontal rectangles, each with different types of information. The highest level (1) includes Flight Plans (also called Company Routes). The flight plans are at the highest level since they are a collection of all kinds of data specified in a unique sequence. The next level down (2) includes route information such as airways, SIDs, STARs, and approaches. The next level down (3) includes geographical fixes and navaids on the earth's surface, and all have coordinates expressed with latitude and longitude.

At the bottom of the illustration are a number of individual database elements, each with a different type of function.

Fix Location

For discussion purposes, let's start with the largest rectangle that includes all the database geographic locations. And — let's begin the discussion with the VOR which is one of the most common elements in the database. Each VOR is entered with its two- or three-letter identifier, frequency, latitude, longitude, ICAO identifier, navaid class (specifies if there is DME, the navaid service volume, weather broadcast, and whether or not the DME is collocated with the VOR), DME latitude and longitude, DME identifier (when different), DME elevation, Datum Code (whether or not the coordinates are WGS-84), station declination (magnetic variation at date of commissioning or last realignment), VOR name, and date of last revision. Additionally, if the VOR is a terminal VOR, the associated airport's identifier is included with the VOR record.

As can be seen, it is best to enter the information about a VOR once so it can be changed only once when revisions come from all the 200 plus governmental authorities around the world. If the VOR information was included with each item where it had an association, the amount of revision activity would be multiplied by the number of times it was used. And the most important part of the activity is that the number of mistakes are reduced substantially.

The most common elements found in the database are the fixes which include intersections, waypoints, turning points, and mileage breaks. Because of the way airborne databases are designed and the way the avionics work that include those databases, **every geographical aeronautical location in the world needs to be included in the database with a unique, five-character identifier**. When using only VOR navigation and you flew an airway that had a bend in it, you would fly out on one radial, tune the second VOR receiver to the next VOR and set the next inbound course on the second VOR head. When both needles were centered, you could say that you were at the bend in the airway and then make the turn to the next VOR. With GPSs and FMSs, it just doesn't work that way. GPS receivers and FMS systems need to have a fix at the bend — then fly from the first VOR and to the bend as a waypoint and *then* make the turn and proceed to the next VOR.

As you can imagine, *not all governments in the world recognize the needs of airborne databases* so each fix must have an identifier created if the government does not assign a unique, five-character identifier to their locations. So, now you ask, "What if a government doesn't assign the appropriate identifier?" In order to provide standards for the industry so everyone could make waypoint assignments using the same methods when not established by the individual countries, the ARINC 424 Navigation Database Standards committee established rules by which identifiers would be created. We will discuss these later in the article.

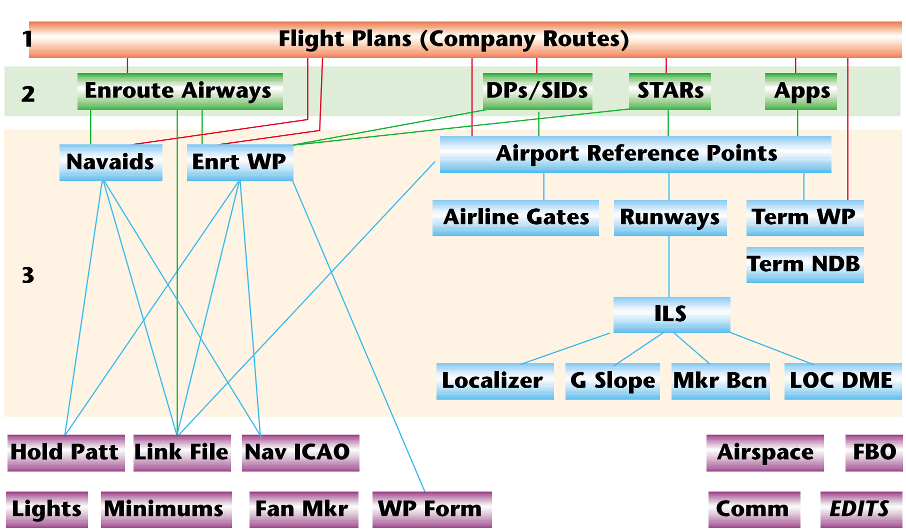
Route Records

The rectangle (2) next to the top includes the route records. The importance of the route records is that they string together all the airway segments, SID, STAR, and approach segments in the proper sequence with the appropriate information so there is a continuity of where an airway goes when you use it in your airborne database.

Looking closely at the illustration, you will see a number of lines extending from each type of route down to the different types of fix records in the large rectangle below. As an example, Victor 8 near Denver is described with the following fixes: RIL, TRUEL, RLG, PENEY, DVV, HOYTT, AKO,... In the airway record for Victor 8, there are a number of fields including information such as the airway identifier (V-8), altitude information (minimum and maximum when appropriate), magnetic course (inbound and outbound), leg distance, latest date of revision, and sequence number.

Why is a sequence number required? It is not something that is supplied by any country, but it is critical to keep all the fixes on an airway in the proper sequence. For example, the fixes mentioned above are all in the right order, but if there was no way in the database to ensure they

Navigation Database Structure



were strung together properly, you might end up making a 180° turn back to a fix you actually crossed before. For a bit of trivia, all the airways are sequenced from the west going to the east or starting from the south going to the north for north/south airways.

For the V-8 example above, the first route record would include the identifier of RIL. When the airborne database encounters the letters RIL as you request V-8, the software knows you need coordinates for the fix on V-8 to successfully fly the airway. The software uses the letters RIL to search the files that include the fixes. Just the letters RIL are not good enough because there could be an NDB with that identifier, there could be a waypoint (in some countries) with that identifier, and there could be a VOR with that identifier. To make matters worse, there could be numerous VORs with the letters RIL as their identifiers.

To help the software identify the correct fix file in which to look, there is a pointer in the enroute airway record that identifies the letters RIL as a VOR so the computer will look into the navaid file for the correct coordinates. To ensure the correct VOR with the identifier RIL is found, the ICAO identifier is included in the enroute airway record *and* in the VOR record to get the correct coordinates.

ARINC 424 — Navigation Database Standards

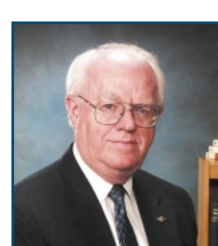
The first use of databases in commercial airline service in the United States was in June 1973 when National Airlines installed and flew the Collins ANS-70 and AINS-70 RNAV systems in their DC-10s. Because this was the first installation of an airborne database, Jeppesen produced the database in a way that was very oriented to solving the needs of the Collins systems. The next airborne database was used in Delta Airlines L-1011s with a system manufactured by ARMA corporation. The database requirements for the ARMA system were significantly different than those needed for the Collins system. The third avionics manufacturer wanted yet a different format.

Every avionics system is built with different features and capabilities and the way in which they implement the functions of database structures and inter relationships between airways, navaids, waypoints, etc. In order to bring economics of volume to databases, a committee first met in Los Angeles in September 1973 under the sponsorship of Aeronautical Radio, Inc. (ARINC) to begin work on aeronautical databases. After meetings every other month, the first standard was published in July 1975.

One of the principle standards that pilots see every day in airborne databases (and on charts) came out of those committee meetings. It was decided that all fixes would have five characters and that is what led to all the intersection and waypoint names in the world having five characters.

When a country does not specify a five-character name, *one is made up according to the ARINC rules*. The first rule is to use the identifier of the forming navaid followed by the nautical mile distance. As an example, an unnamed intersection 45 NM away from Denver would have the identifier of DEN45. That worked well until there were unnamed fixes on a DME ring associated with an approach. It's obvious that on an 11 DME arc, you couldn't have five or six fixes all with the same identifier of DEN11 (databases just don't like duplicates.) The solution for that problem was to create an identifier starting with the letter D to indicate DME followed by the radial of the forming VOR. After the radial, a letter would follow. The letter to follow starts with "A" meaning 1 DME. Therefore, a fix on the 11 DME arc at the 305° radial would get the identifier D305K.

Many more standards exist in the ARINC 424 specification. Some of these will be covered in future articles plus we will discuss how approach routes are coded into the database.



James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

Just imagine. Flying an approach where all the autopilot commands for heading select, VOR radial capture, descent to preset altitude, course capture, nav tracking, etc. are already in your database for your approach. And — what if not only all the autopilot commands were there, what if all the exact courses and altitudes were already there for your approach. You may ask, "Is that possible?"

Just thinking about that possibility, you can imagine that sometime in the way-out future, all that could be carried on board your airplane. But — the reality is that all of those autopilot commands are in the database and have been for some time. Today, all of the track and altitude information with the commands for the autopilot are there for virtually all the approaches, SIDs, and STARs in the world.

As a caveat, even though all the segments and approaches are in the master database, not all avionics systems have created the ability for all of the segments to be in airborne database. Additionally, not all autopilots have the connection to the avionics systems to implement all the commands.

Again, you ask, "How does all that work?"

Paths and Terminators

When RNAV was first introduced, the avionics systems only flew from point to point. This meant that every flight had to fly to a fix for every maneuver for an approach or other procedure. That eliminated the ability for an airplane to fly exactly the instructions prescribed in published approach procedures, DPs (SIDs), and STARs. As an example, the first systems were not able to fly a heading to an altitude before making a turn. And as you know, it is very common for departures from runways to maintain runway heading until you get to an altitude to clear obstacles or other ATC instructions to keep you separated from airspace used by other aircraft. It also was not possible to fly a heading or magnetic course until intercepting the next leg such as an airway or the inbound course for final approach.

In about 1977, a new concept was developed for database and airborne capability. It was called "air mass legs." This meant that the new systems would be able to fly exactly what was on the chart and what ATC wanted for departure and arrival procedures. ARINC 424, the worldwide navigation database standard, was revised in version three to enable navigation systems to fly without regard to predetermined fixes; but, in the same way they would be flown if the pilot was to do it all manually. Version three now made it possible for the navigation data to be loaded into the airborne systems and fly the procedures automatically with the flight management systems and the autopilot.

What is a path/terminator? In the simplest of terms, it is a means of prescribing the way in which a path is to be flown, and how the path is to be terminated. For every path/terminator, there are two characters in the database, the first column specifies the path to be flown and the second column specifies how the path should be stopped. As an example, the letters "CI" indicate that the equipment should *fly a course* and that it should *end when the next path is intercepted.*

In all, the ARINC 424 document has a total of 23 path/terminators. To implement all 23 path/terminators takes an incredible amount of programming for airborne avionics. As you can imagine, the number of implementations is much larger when you consider that each of the 23 path/terminators could be followed by each of the other 23 path/terminators. It is really significant when you know that most of the avionics systems actually are working with two path/terminators at a time because the next path/terminator has to be in memory for activation by the autopilot when the existing leg is completed. This requires significant programming and therefore not all avionics systems carry all of the path/terminators. Additionally, ARINC 424 document does not allow all legs to follow all other legs.

Track to a Fix (TF) Leg

The most common leg segment type is one that has been implemented in all avionics systems that have an aeronautical database. It is the great circle track between two fixes. In pilot "talk" that means the magnetic course between fixes. This path/terminator is called track to a fix and uses the letters "TF" in ARINC "talk." The TF leg starts at a fix and then proceeds direct **TO** the next fix via the track connecting the two fixes.

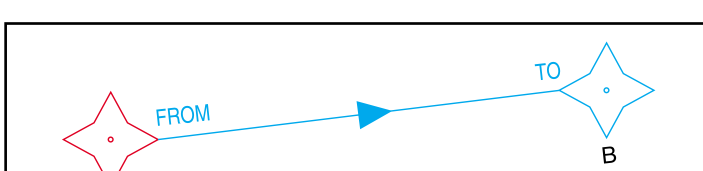
All airway segments in all databases are TF legs. This means that every turn point on every airway must be a fix in the database. And — each fix needs to have an identifier in the database. That is why you see so many computer navigation fixes (CNFs) on the enroute charts. Most intersections on the charts have names assigned to them that are used in pilot/controller communications, but those fixes not required for ATC communications show the name/identifier in brackets on the enroute charts. The CNFs are used for navigation only and are not part of the pilot/controller conversations.

From a navigation standpoint, as soon as any fix is passed, the navigation system switches to the next waypoint and then proceeds **TO** that next waypoint. You've noticed that I have emphasized the word **TO** a couple of times. Compared to VOR navigation where you frequently fly from the VOR until passing the cross over point, using the TF leg in airborne databases, you will never fly from a waypoint, but will always fly **TO** a waypoint. This means you *won't have diverging* tracks from a fix but will *always have converging* tracks to the next fix. Even though the outbound course from the previous fix is not used for navigation, in some avionics systems it is included in the database to display the published radial from a fix such as a VOR.

One of the advantages of the TF leg is that the magnetic variation makes no difference to the resultant track. One of the problems with some types of navigation is that there is an attempt to use magnetic variation to produce the magnetic course from a computed true course and then apply magnetic variation. That may sound good, except, if the magnetic course used by the avionics is different than that used by the government authorities who design procedures, the resultant magnetic course shown in the airplane will be different than on the chart which reflects the government values.

Because of the accuracy of the TF leg, the FAA specified that all final approach segments will be created using the TF leg. This ensures that all approaches will fly toward the landing runway (or missed approach point if not on the runway). This also helps the FAA ensure that there will not be any track differences because of magnetic variation.

The TF leg is one of the few legs that are allowed for new procedures that is designed for RNP RNAV. RNP (required navigation performance) is the new means used by ICAO and many countries to specify a type of navigation accuracy.



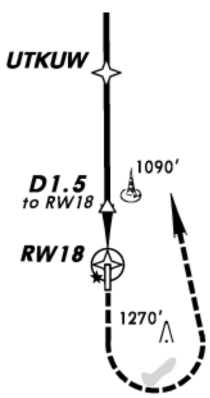
Track to a Fix (TF)

Fly-By Fixes

Technically, all fixes in the enroute environment are fly-by fixes. This means that when making any turns over a fix such as a navaid, waypoint, or intersection, you should start your turn before arriving at the fix. Another way of saying the same thing is that you should "lead the turn," or "anticipate the turn," and not wait until crossing the fix before initiating the turn.

In one sense the term "fly-by fix" seems a little misleading because when you fly over a fix on a straight line, you will fly over the fix and it might seem like that should be called a "fly- over fix." *By definition, a fly-over fix is one where there is to be no turn anticipation.* So when you fly over a fix on a straight line, turn anticipation is not relevant.

The only places where "fly-over fixes" are coded in the database are on SID (DP), STAR, and approach coding where the intent is to fly over a fix before making a turn. Whenever a fix is designated as a "fly-over fix," the fix will have a circle around it to positively identify the fix where turn anticipation is not allowed. The circle around the fix has been used in the United States since 1994 and is now the ICAO standard for fly-over fixes.



In the excerpt from the Fairfield, Iowa RNAV (GPS) approach chart, UTKUW is a fly-by fix and RW18 is a fly-over fix. At Fairfield, the fly-over fix at RW18 ensures your avionics doesn't start a turn before it passes over the runway threshold.

Initial Fix (IF) Leg

Since the TF leg is used to define the path **TO** the next waypoint (or fix), there must be a way to define the beginning fix for a leg segment. Since equipment that uses airborne databases doesn't work like setting an inbound course to a VOR, an "anchor" fix is established for the beginning of a leg.

The leg segment is called an IF leg but really shouldn't be called a leg since it is a fix (initial fix) and not a defined leg. The "next leg" is shown with the IF leg (fix) for the purposes of illustration, but the next leg is not included with the coding of the IF leg in the database. It is only a point in space.

The determination of what leg types to code in the database for approaches, SIDs, and STARs is made by Jeppesen NavData analysts by interpreting the intent of the various government procedure designers who create the procedures.

Initial Fix (IF)

In the next article, we will continue the discussion of database leg types and the coding of SIDs (DPs), STARs, and approaches.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com

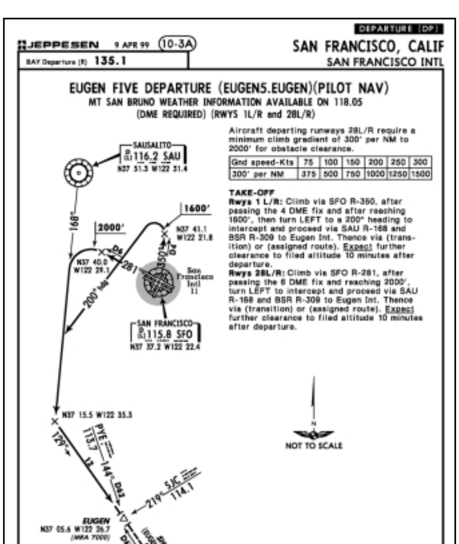
The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

"Snowbird 527, cleared to Houston as filed, Eugen Five Departure, Salinas Transition, maintain 6,000 feet." Assuming the active runways for departures are runways 1 left and right, the published departure for both runways proceeds on a series of headings, courses, and tracks that connect you to your planned enroute airways. As a pilot, when you fly the Eugen departure procedure with your FMS or your GPS, things happen. And sometimes they happen at different times than you expect. Then you ask, "Why?"

The departure says the first thing to do is to climb out on the SFO 350˚ radial. The radial is to be flown until passing the 4 DME fix and after reaching 1,600 feet. Then turn left to fly a heading of 200˚ to intercept and fly the SAU 168˚ radial and the BSR 309˚ to Eugen intersection. All of this happens in only a few minutes, but to make this all happen automatically, a number of codes need to be loaded into the database that represent the paths to be flown and the way they are terminated.

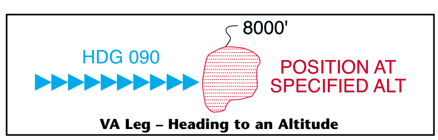
Each of the path/terminators is determined by the database supplier since they are not



specified by the governments who design the basic procedure. ATC typically designs departures based on where they want the airplanes to go, and they leave the details of how to comply with the pilot when flying manually and up to the database coder when flying with an automated navigation system.

The First Path/Terminator Leg after Takeoff

If you were to fly the Eugen Five departure procedure without automation, you would maintain runway heading up to some predetermined altitude before turning left to capture the SFO 350˚ radial. And – what would that altitude be? Should it be at 35 feet above the runway? At 50 feet? Or can your turn start when you are comfortable to make the turn? The altitude for making the turn is specified in the *Aeronautical Information Manual* and states, "Obstacle clearance for all departures, including diverse, is based on the pilot crossing the end of the runway at least 35 feet AGL, climbing to 400 feet above the departure end of runway elevation before turning, and at least 200 feet per nautical mile unless a higher climb gradient is specified in the DP, or unless required to level off by a crossing restriction."



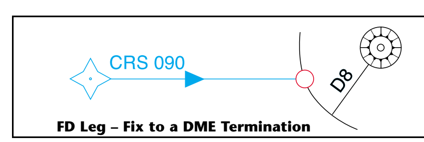
VA Leg – Heading to an Altitude

Because of the AIM statement and other statements similar to this in FAR Parts 23 and 25, *virtually all the first legs after takeoff include are coded as a VA leg*. Since the first letter (V in VA) indicates the path and the second letter indicates how the path is terminated, this means the path is a heading (V implies vector, or heading) and is terminated when reaching an altitude (the A in VA). The first leg on the Eugen Five departure from runway 1 left and right is a VA leg and it includes a heading of 012˚ to an altitude of 411 feet (400 feet above the airport elevation of 11 feet). As the leg is implemented in the avionics system, it reads the compass system, and provides the autopilot or flight director with a steering command that will null out any deviation from the desired heading. If installed, the system will also be monitoring its barometric altitude input, then sequence legs when the terminating altitude of 411 feet has been reached. (Note: The altimeters in most single-engine aircraft are simple pneumatic altimeters, which do not have external digital output capabilities.) As soon as the altitude is reached, the computer will then sequence to the next leg which will capture and track the 350˚ radial from the SFO VOR.

In the illustration of the VA leg, the path shows as a series of arrows followed by a "blob" which implies the end of the heading leg could be in many different locations depending on the wind and the climb rate of the airplane.

Fix to a DME Termination

The next portion of the takeoff procedure says to "Climb via SFO R-350, after passing the 4 DME fix and after reaching 1,600 feet, . . . " Since this leg is to end at a DME fix (actually the 4 DME arc since a heading will rarely reach a given fix), the leg terminates at a DME reading and the second letter of the path/terminator is the letter "D" (for DME). The 350˚ radial actually begins back at the VOR so the leg begins back at the VOR. *Thise leg type is termed an FD leg*. This leg has two conditions – both the 4 DME and 1,600 feet so both conditions are loaded into the computer. Since both conditions must be met, the airplane won't turn with an electronic coupled departure until both conditions are satisfied. If the airplane reaches 1,600 feet *after passing* the 4 DME, the airplane will turn after reaching 1,600 feet. If the airplane reaches 1,600 feet *before passing* the 4 DME fix, it will wait until passing the 4 DME fix.

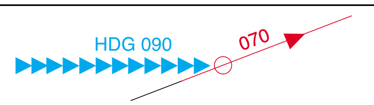


FD Leg – Fix to a DME Termination

Look closely at the wording for the termination of the leg. It says "after passing 4 DME . . . " This means that the *4 DME fix is a fly-over fix* and not a fly-by fix. The database rules in the avionics system state that all legs that end as a DME fix will be fly-over fixes. This ensures that the airplane will not turn before 4 DME is reached.

Heading to an Intercept

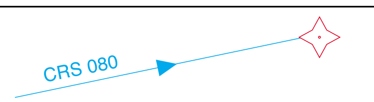
After passing the 4 DME fix, the departure runway takeoff continues by turning left to a heading of 200˚ to intercept and proceed via the SAU 168˚ radial. To make the computer fly a heading of 200˚, the first letter of the path terminator is "V" for vector. (Actually, the letter "H" makes more sense but it was already taken for holding patterns). The termination end of the heading leg occurs when the radial is intercepted. The path terminator for this type of leg is VI – heading to an intercept. In the database coding, the heading of 200˚ is included with the record. Also, since the heading has such a large turn, there is a command of L (left) included to ensure the airplane doesn't turn right after passing the 4 DME fix.



VI Leg – Heading to Intercept Next Leg

Course to a Fix

Once the airplane has intercepted the 168˚ radial from Sausalito (SAU), it captures and flies the radial until the turning point indicated by the letter "X" on the Departure Procedure chart. Since all systems that use airborne databases need identifiers on fixes that establish turning points, an identifier is created for the turning point. The turning point is 36 nautical miles from SAU, so the identifier SAU36 is created and loaded into the database.



CF Leg – Course to a Fix

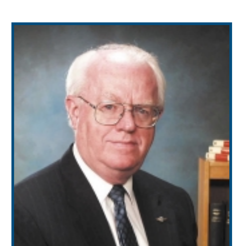
Track to a Fix

From the SAU36 fix to Eugen, which is the end of the takeoff procedure, a TF leg (track to a fix) is used. The turning point is considered a fly-by fix so you can expect the aircraft to begin the turn slightly before SAU36 so it can easily capture and fly the 129˚ course to Eugen.

BIG LIMITATION

By looking at all the coding it takes to make this procedure work, you can see that it takes some very sophisticated equipment to make all the legs work. The autopilot needs input from the heading indicator, from the altimeter, from the VOR radials, and from the database. Even though some of the avionics systems have the ability to interface with some of the other aircraft systems, not all avionics have implemented all the path/terminators. When flying the Eugen Five Departure with some avionics systems, it is quite likely that the first sequence your system would show is a straight line from the airport to the Eugen intersection. This makes it necessary for you to manually fly all the legs and end each one as stated in the takeoff procedure.

In the next article, we will look at many of the differences that you will see between the information on your charts and what you see on your avionics display – and why.



James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com

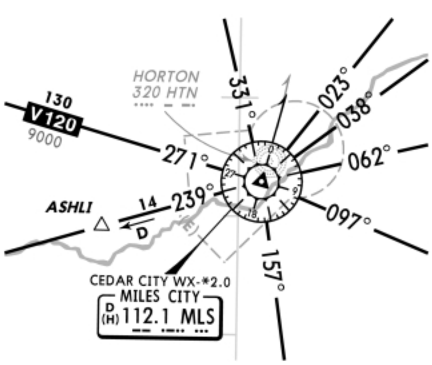
JEPP'S BRIEFING

The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

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 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 aviation 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 navaids 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 navaids 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 navaids. This meant that for the first time that users of databases could actually enter the identifier of an NDB and proceed to the navaid. 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 electronic 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.

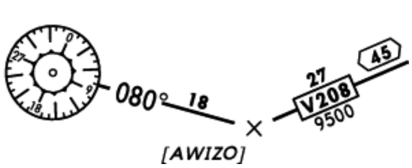
With databases, the information must reach an airline domicile early enough to "catch" the airplane sometime when it gets back to the domicile to get the data loaded. Some times this takes days - so there needs to be a way to have enough lead time to ensure the airplane has enough time to get the data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

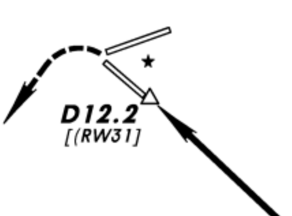
Additionally, there is a significant amount of processing with the production of each data card, data disc, CD, memory card, tape, or other media before it can be placed in the mail. And then there is the problem of customs when a hard media rather than paper goes past the customs officers.

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

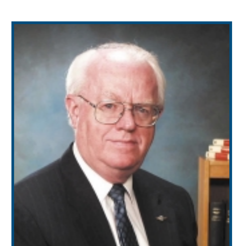
The database identifiers are being added to the approach charts, SIDs (DPs), and STARs. When identifiers are created primarily for avionics systems and are not needed by air traffic control communications, the identifier is included on the chart, but in brackets. These fixes are called Computer Navigation 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.



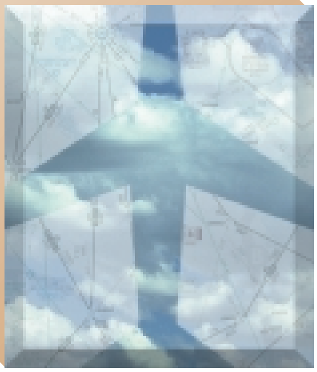


AWIZO is not required for conventional navigation on V208 but is required when flying fix to fix with a database. Runway thresholds are included on applicable approaches with the letters RW followed by the runway number. RW31 is the runway threshold location for runway 31.

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



James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

At one time while teaching a student to fly the pattern and landings, he was working, working, working to get the airplane exactly on the right path - both laterally and vertically. It seems the harder he worked, the more the airplane was all over the sky. Swing to the left, swing to the right, and then he'd over correct and then the turns back and forth became more and more - well, we've all been there at one time. At this rate, solo was a long way off.

The next time around, we did a two-mile final and I gave him a temporary new "rule" - he wasn't allowed to touch the control wheel. He had to have the airplane in trim and he could only move the rudder pedals with his heals firmly anchored on the floor. It turned out to be the best approach and landing he'd ever made - and he soloed only a few lessons later.

The same applies to IFR approaches. The fewer dials that are moving, and the better the trim, the easier it is to shoot an instrument approach down to minimums and then a landing. When the only instrument that is changing is the altimeter (and radar altimeter), small differences that typically happen on an approach because of turbulence, wind gusts, etc. are easily corrected. When power changes, airspeed changes, vertical speed changes, and trim changes all happen on the approach, even the most current instrument pilot has to be absolutely on top of everything to hope the outcome of the approach is as expected.

Stabilized Approach

The Flight Safety Foundation, the Air Transport Association, NBAA, the FAA, and others have all endorsed the concept of a stabilized approach. The leading cause of accidents resulting in CFIT (controlled flight into terrain) has been while flying non-precision approaches. An interesting observation is that most of the approach and landing accidents happen during the last 10 miles while on final approach. Most of the non-precision approach accidents happen on the extended centerline of the landing runway. This means that the lateral navigation has been very good - but what happened with the vertical navigation?

There are several reasons for the wrong vertical navigation. A common problem has been with crews that have mis-identified their location and believed they were one fix further along the path than they really were. This meant they descended to the altitude for a fix before they actually arrived there. This can happen when there is mental overload. This can happen from fatigue.

This all results in the belief that if stabilized approaches were the normal operation, there would be more time to scan the instruments and avionics to know precisely where you are.

Dive and Drive

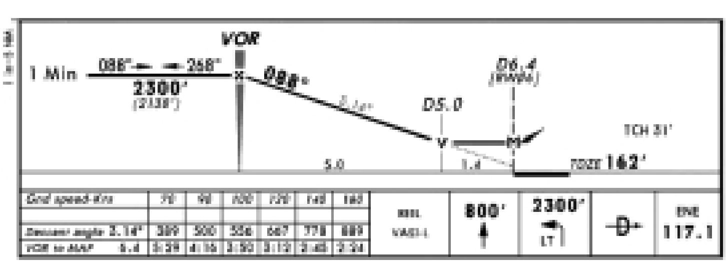
This "less than complimentary" term has been used to describe operations in which the airplane descends as rapidly as possible after crossing each fix and then levels off until arriving at the next fix. There are two good rationales for why this is considered valid. First, you get down earlier and have a better chance of getting below the clouds to get into visual conditions. Second, if there are icing conditions, you can descend faster to get below the freezing level.

This is also why there are so many CFIT accidents on non-precision approaches. If there are icing conditions, it may be better to get below the icing and work harder on shooting the approach. But is 500 feet going to make the difference to get below the icing?

FAA Initiative

The United States Standard for Terminal Instrument Procedures (TERPs) document was significantly revised in revision 17 to include descent angles on non-precision approaches. The FAA recognized the safety improvements for stabilized approaches and began adding descent angles to all non-precision approach procedures such as VOR, NDB, GPS, and RNAV. The new RNAV (GPS) precision approaches now include VNAV (vertical navigation) angles and minimums that use a decision altitude (DA) instead of the minimum descent altitude (MDA).

The first non-precision approach issued by the FAA with a descent angle was the Biddeford, Maine VOR Rwy 6 approach. It was issued in August 1998 and was the first of many that have been published by the FAA. The profile for Biddeford is illustrated.



In the profile view, a number of pieces of information have been added. The descent angle of 3.14° has been added above the descent line. A dotted line has been added below the MDA which indicates the path of the descent if continuing below the MDA in visual conditions. For the first time, a TCH has been added to a non-precision approach. The TCH of 31 feet indicates the path where the constant descent angle crosses the threshold.

In the conversion table below the profile view, the descent angle of 3.14° has been added with the rate of descent in feet per minute at various ground speeds. As an example, an approach flown at a ground speed of 100 knots could use a descent rate of 556 feet per minute from the 2,300-foot altitude over the FAF down to crossing the runway threshold at 31 feet.

Several things to remember are that the descent still takes you down to an MDA and not a DA. So you will need to stop your descent just before reaching the MDA so that you don't go below it (unless of course you are visual). Also, if you don't have VNAV equipment in your airplane and your ground speed is a bit high, your descent path will take you to a point farther down the runway than you want. Therefore, it is safe to have your descent rate slightly higher than charted so you don't land long.

Since this is still a non-precision approach, the MAP is still at the runway threshold. At Biddeford, there are two ways of identifying the MAP. The first (and most difficult) is timing. The conversion table gives various times based on ground speeds. The second is GPS. There are two ways to use your GPS to identify the MAP. One way is to keep your GPS set to the VOR and read the output just like a DME. The easier way is to fly to the RW06 waypoint in the database. Of course, to use the GPS as a substitute, it must be panel mounted and certified according to the FAA TSO-C129 as an IFR certified system to fly GPS approaches.

When flying the VOR approach, can you use the VDP (visual descent point) as your MAP? Many professional pilots and airline pilots treat the VDP as an MAP. If you were to level off at the MDA (which happens at the VDP) and fly after the VDP, any descent you would make to the runway after that would be considerably steeper than the approach from the VOR. Because of the high descent rates after reaching the VDP (assuming leveling at the MDA because of the airport not in sight), many pilots believe it is better to begin executing the missed approach if the airport is not in sight at the VDP.

But - remember there are two parts of a missed approach - one is the track and the other is the altitude. This means, if you begin your missed approach at the VDP, you can *only initiate the climb* before the MAP. You can't begin to execute the missed approach procedure track until *after* passing the MAP.

The design criteria for the installation of visual guidance systems such as VASI and PAPI are to align them with the glide slope on runways equipped with an ILS. There are no design criteria for aligning the visual systems with non-precision approach procedures. As a result, you will occasionally find that a perfectly executed, stabilized, non-precision approach will cause you to be above or below the VASI or PAPI when you break out under the clouds. When the FAA creates the descent angle, they will include a note that states "VGSI and descent angles not coincident." VGSI means visual guidance slope indicator.


1. Obtain local altimeter setting on CTAF; if not received, use Sanford.
2. VDP and descent angle/gradient not authorized with Sanford altimeter setting.
3. VGSI and descent angles not coincident. 4. Pilot controlled lighting 135.0.

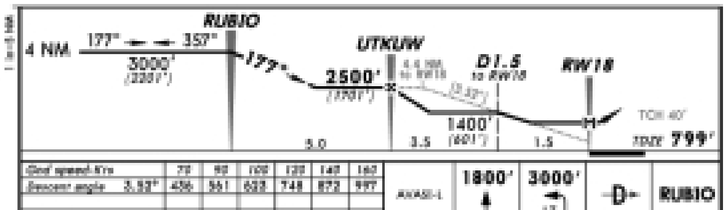
Database Angles

In Jeppesen's database, virtually every non-precision approach includes a descent angle. All the GPS and FMS systems that provide VNAV capability can use the VNAV angle and fly the approach virtually the same as an ILS approach. Systems with VNAV give displays the same as glide slope displays and provide "up and down" indications to show deviations away from the VNAV path.

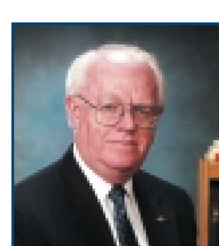
All the angles in the database for non-precision approaches are created according to the specifications included in the ARINC 424 document, *Standards for Aeronautical Databases.* The ARINC specs contain a very important rule which we consider to be RULE NUMBER 1 - whatever is provided by the government authorities is what is included in the database. From that point, since most governments do not provide descent angles, there are 13 different examples of how a descent angle is to be calculated for the database.

All descent angles in the database that are calculated are essentially nothing more than "connecting the dots." And the "dots" are the FAF altitude and the TCH altitude. By connecting these two points, most descent angles are easily computed. These angles are then the angles in the database. There are a number of complex problems to make it work, but fortunately these are in the minority of locations.

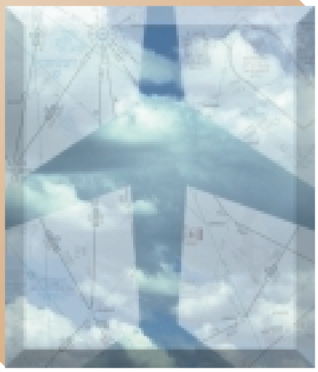
One major exception to the "connect the dots" philosophy is when the straight line from the FAF to the TCH results in an altitude that will be lower than the altitude at a stepdown fix. In the example from Fairfield, Iowa, the stepdown fix on the RNAV (GPS) Rwy 18 approach is above the straight line from the FAF to TCH. To accommodate this, there is a slight delay after passing the FAF to ensure a stabilized approach down to the TCH. Since the FAF to threshold is 5.0 miles, there is a 0.6 mile delay after UTKUW to follow the 3.52˚ descent path. The descent angle of 3.52˚ is in the database.



In the next article, we will conclude the database series with a discussion of what is **not included** in the database.



James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.
For comments, please Email: JimTerps@jeppesen.com



The Chart Clinic – Database Series

By James E. Terpstra
Sr. Corporate Vice President, Jeppesen

While riding jumpseat in an airline in the far east, our CEO watched as the crew received a clearance from ATC for a hold at an intersection at FL250. Our CEO looked at the high altitude enroute chart and saw a nonstandard, left turn holding pattern depicted at the intersection.

The crew had the FMS engaged so that a holding pattern could be entered automatically. It was going to be easy. The inbound leg for the holding pattern was the airway they were flying so the entry to the holding pattern would be a direct entry. To everyone's surprise, at the intersection the airplane entered into a standard holding pattern with right turns. Uh oh.

What happened?

As you can imagine, many questions started. Why did the airplane enter a standard holding pattern instead of a nonstandard hold with left turns? Was the holding pattern in the database wrong? Was the holding pattern missing from the database? Could a holding pattern from the low altitude structure have been inadvertently entered into the database?

A thorough check of Jeppesen's master aeronautical database revealed that the holding pattern was there with the left turns. OK so far. Did the correct holding pattern get extracted for that airline? Yes, that was correct. After chasing the problem, it was interesting what was found.

Many of the early FMSs had very limited storage capacity and airlines have struggled with a balancing act of including as much as possible while discarding only non-essential information. In the case of the holding pattern, the airline had made the decision to add a number of new approach procedures to their database, but in the process they had to make a tough decision - and that decision was to eliminate all the holding patterns from their databases to make room for the additional approaches. And somehow, that information had failed to reach the crews. The crew was unaware that the holding patterns were missing from their databases until they had the misfortune to make a hold in the wrong direction.

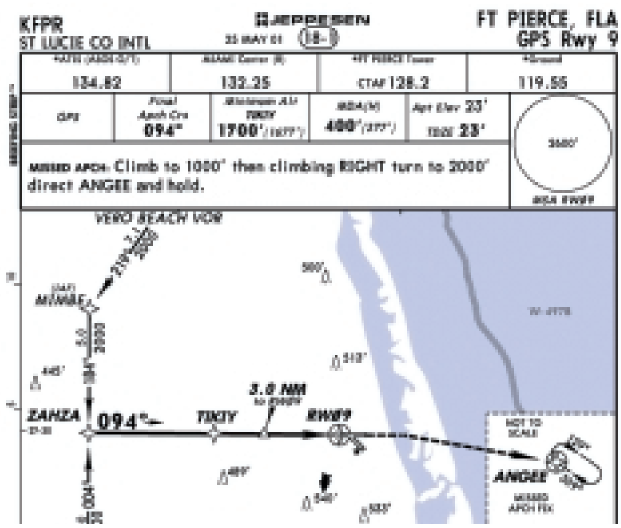
Final Authority in the Cockpit

There have been many discussions about the differences between what is seen on the paper charts and what is carried aboard the airplane in databases. And when there are differences, what should be considered the final authority - charts or databases? The answer has to be the paper charts - for lots of reasons.

The discussion about the holding patterns is one example of why charts have to be the final authority. This also leads to the awareness that airborne databases are not substitutes for charts - they are supplemental information with different goals than the role of paper charts. As important as databases are, they really are onboard the airplane to provide navigation guidance and situational awareness, but they are not intended as a substitute for paper charts.

Missing Path Terminators

In order to make all the FMS and GPS avionics fly the intended paths on DPs (SIDs), STARs, and approaches, the database includes path/terminators that define courses, paths, and the way that each of the paths is terminated. Most of the legs on GPS approaches are TF legs, or tracks between two fixes. Since the TF legs represent the predominant leg type, some GPS manufacturers have implemented *only* TF legs. If you don't pay close attention to what the chart says and fly only the paths on the GPS avionics, you may end up flying a path that does not comply with the defined approach procedure.



As an example, refer to the Ft. Pierce, Florida GPS Rwy 9 approach procedure. The missed approach procedure says to climb to 1,000 feet and then make a climbing right turn to 2,000 feet direct to the ANGEE fly-over waypoint and hold. In some GPS systems, the path from the MAP to ANGEE is a straight line. That creates two problems. First, the path makes a shortcut which may take you close to some obstacle that is the reason for the straight ahead climb. Second, some GPS avionics systems have not implemented the concept of fly-over waypoints. By definition, all waypoints are fly-by waypoints unless specifically designated as fly-over waypoints. This means that the GPS might begin a turn before arriving at the waypoint instead of waiting until *after* you pass it.

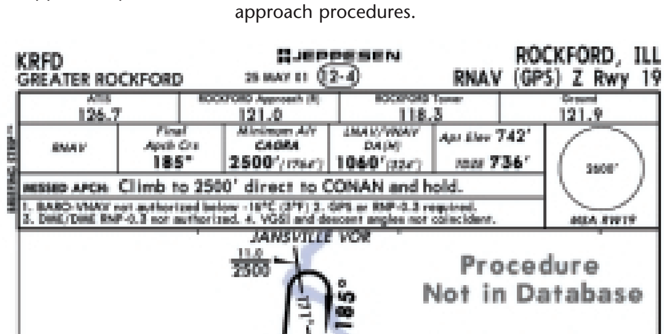
Since the MAP at Ft. Pierce (and all other GPS and RNAV approaches) is a fly-over waypoint, the FAA intends for you to *pass the MAP before* initiating the missed approach procedure. If your GPS doesn't have an implementation for the fly-over fixes, you need to ensure you pass the MAP before initiating any turn. At Ft. Pierce, the fly-over designation is academic since the missed approach proceeds straight ahead anyway, but many missed approaches begin with a turn so you need to watch what your course guidance is telling you.

Why are some Approaches Missing?

In December 1992, the first approach procedures were published that authorized the GPS Phase Two overlay program. That program authorized GPSs to be used to fly all 4,500 non- precision, non-localizer approach procedures in the United States. These were called GPS overlay procedures. When the GPS was used to fly the overlay approach procedure, the underlying VOR or NDB had to be *monitored*, but the GPS could be used to navigate the approach.

Later, the FAA initiated the Phase Three GPS program by specifying some procedures that could be flown *without monitoring* the navaid on which the procedure was based. Not only did the navaid not have to be monitored, it actually could be off the air and the GPS could be used to fly the approach. All of the Phase Three approaches are identified with the words "or GPS" in the procedure title.

As the FAA began their program to create 500 new GPS approach procedures per year, they published procedures to runways that had Phase Two or Three overlay procedures. As the duplication started, it was agreed there was no need to have both GPS procedures and overlay procedures. All of the Phase Two overlays were gone by January 2001. The Phase Three overlay procedures are going away as the FAA creates new RNAV (GPS) approach procedures. All the Phase Two approach procedures have been removed from the GPS databases and the Phase Three approaches are being deleted as they are replaced with standalone GPS or RNAV approach procedures.



FMS and GPS Approach Database Differences

FMS databases include most ILS, localizer, VOR, and NDB approaches in their area of coverage whereas GPS databases include only those approaches that are authorized to be used by GPS avionics systems. This does not mean, however, that all approaches that are charted are included in the database. As an example, some GPS approach procedures have not been designed with transitions, but require RADAR vectors for the approach. By definition in the FAA TSO-129a, all GPS avionics require an initial approach fix (IAF) to start the approach. If there is no IAF on the approach, the GPS avionics can't have the approach in the database. In other cases, the approach starts at the intermediate fix (IF) which is the final approach course fix (FACF) and specified by the FAA to be an IAF. This duplicate designation causes some avionics systems to reject the approach from the database. This dual designation problem is being fixed and many approach procedures will be added to the GPS database.

Also, some approach procedures are just too complicated to be coded into a database. Some circle-to-land approaches fall in this category and many of them are missing. Other approaches have multiple transitions and some of them can't be coded. In these cases, the charted approach can be flown but not with the automated systems that use databases.

Two Approaches to the same Runway

The FAA and other government authorities publish more than one approach to the same runway. In the database, duplicates cannot be accepted. To solve this dilemma, a letter has been added after the navaid type in the approach procedure title. The letters that are used start at the end of the alphabet so that they aren't confused with the letters at the beginning of the alphabet that are used to indicate approaches that don't have straight-in landing minimums.

As an example, at Rockford, Illinois there are two RNAV (GPS) approach procedures to Runway 19. Many of the avionics systems were designed to handle only one approach to a runway and couldn't anticipate the solution of using a letter to make the procedures unique. Because of the expense of modifying software on avionics, many systems won't be able to handle both procedures. As a result, you will see a note "Procedure Not in Database" on some of the approach charts until the capability exists to have both procedures in the database.

Can the Database Substitute for a Chart?

GPS and FMS avionics systems are designed to be navigation tools - not aeronautical charts. Charts are *always* needed for complete information. Many items that are on charts are in the databases, but not all information is included such as controlled airspace, restrictive airspace, minimum airway altitudes, obstacles, terrain, communications frequencies, Center boundaries, political boundaries - and the list goes on.

Will the database ever include all the information on a chart? Yes. Will it be soon? No, there is a need for a whole new design of software and displays - but the paperless cockpit is coming.

Conclusion

This is the last article in the database series and concludes the Jeppesen articles. I trust the information has helped to understand the background and reasons behind the information shown on our paper charts and the data contained in aeronautical databases.

James E. Terpstra is senior corporate vice president, aviation affairs at Jeppesen. His ratings include ATP, single and multi-engine, airplane and instrument flight instructor. His 6,000+ hours include 3,200 instructing.

For comments, please Email: JimTerps@jeppesen.com