

RNAV, TAA and WAAS:

A New Approach to Flying Is Here



Photo by Paul Bowen

by Stan Smith

You are I are on the verge of losing some old friends. For years, we've grown to know, love and practice NDB, VOR, LOC/DME and ILS approaches. However, these old, familiar procedures may not be around for much longer. In fact, they soon may be classified as dinosaurs and headed to the bone yard.

While extinction may be delayed, some of the new kids are already on the block, and others are just around the corner. Let's take a look at how GPS technology is (and will be) implemented to get you from the calm and comfort of enroute cruise down to CAT

I minimums using these new friends: RNAV, TAAs, WAAS and new IAP formats.

Area Navigation (RNAV)

Waypoints are replacing fixes as Flight Management Systems (FMS) and Global Positioning Systems (GPS) use waypoints predicated on latitude and longitude versus bearing and distance. As we march toward point-to-point free flight in the enroute structure, the FAA has also developed ways for us to transition from cruise flight to the terminal area and ultimately down to approach minimums – all using RNAV and improved GPS.

As with any new system there are new procedures, and with new procedures there are usually new formats to explain them. Terminal Arrival Area (TAA) procedures are already on the street and new GPS Instrument Approach Procedure charts utilizing Wide Area Augmentation System (WAAS) are next.

Terminal Arrival Area (TAA)

One of the great advantages of RNAV systems is the ease with which we can proceed "DIRECT TO" any given waypoint. This provides flexibility and opens up more sky to air traffic control.

In order to provide a more seamless transition from the enroute structure to the terminal environment the FAA designed the TAA.

The generic TAA is called the Basic “T” design and is based on the simple concept that in a perfect world, an RNAV-equipped aircraft can leave the enroute structure and proceed direct to one of several IAFs, which establishes the aircraft on a straight-in, left base, or right base to final (See Figure 1). During this direct routing to the appropriate IAF you will descend from the enroute MEA to an altitude as depicted for the sector.

The Basic “T” has three depicted IAFs. These IAFs are arranged in a straight line, three to six miles apart, with the center IAF being equidistant from the two outer IAFs and also serving as the Intermediate Fix (IF) for the approach. The IAFs are

aligned perpendicular to the Intermediate Segment, which is an extension of the final segment for the approach and these two lines intersect at the IF forming a “T.” The aircraft azimuth from the IAF/IF will determine which IAF is utilized.

The descent into the IAF is protected because TAA minimum altitude(s) are established around the IAFs and provide the same obstacle clearance as an MSA (See Figure 2 on page 31). The area “above” or “outward” from the IF/IAF line is known as the “straight-in area.” This area is a semi-circle centered on the IF/IAF, above the “T,” usually with a 30-nm radius and appears on the plan view. Aircraft entering from this area will normally proceed directly to the center IAF/IF and fly a straight-in type approach.

The two quarter-circle areas “below” the IAFs are called Left Base Area and Right Base Area. If

approaching from the area that straddles the border of the Left and Right Base Areas, determine the appropriate IAF based on magnetic bearing not to the left or right IAF, but rather to the IAF/IF. Aircraft approaching from these directions should fly to the respective outer IAF and track the appropriate Initial Segment, effectively establishing them on a left or right instrument base to final. TAA minimum altitudes are also established for each Base Area, normally out to 30 nm and referenced off the respective IAF waypoint as depicted on the plan view icons.

It’s Never a Perfect World

That was the Basic “T” in a perfect world, but how often does that happen? More often than you might think because another great advantage of the RNAV approach is that the Final Segment can be easily aligned with the landing runway. There is no need to accommodate the myriad of problems associated with fixed navaid approaches so waypoints may be arbitrarily positioned as needed. However, exceptions being the rule in aviation, there are multiple variations to the Basic “T.”

The changes can be small or elaborate depending on the airport, airspace and terrain involved. The Basic “T” changes can be as simple as unequal distances between Left and Right Initial Segments to the IF/IAF.

In other instances one or both of the outer IAFs may be eliminated completely. This would render one (or both) of the base turns non-existent. In such cases, expect a “hold-in-lieu-of-PT” holding pattern included at the IF/IAF and a course reversal from the sector not annotated as “NoPT.”

Anytime a course reversal pattern is annotated, the pilot is expected to execute the course reversal unless being radar vectored to final, cleared a timed approach from a holding fix, or “NoPT” is specified for that portion of the procedure. The TAA procedure may annotate the “NoPT” along the Initial Segment or within the respective area icon.

Other variations include a change in the shape of the pattern to more of a “Y” design. Parallel runway operations may be addressed by the addition of a second and parallel

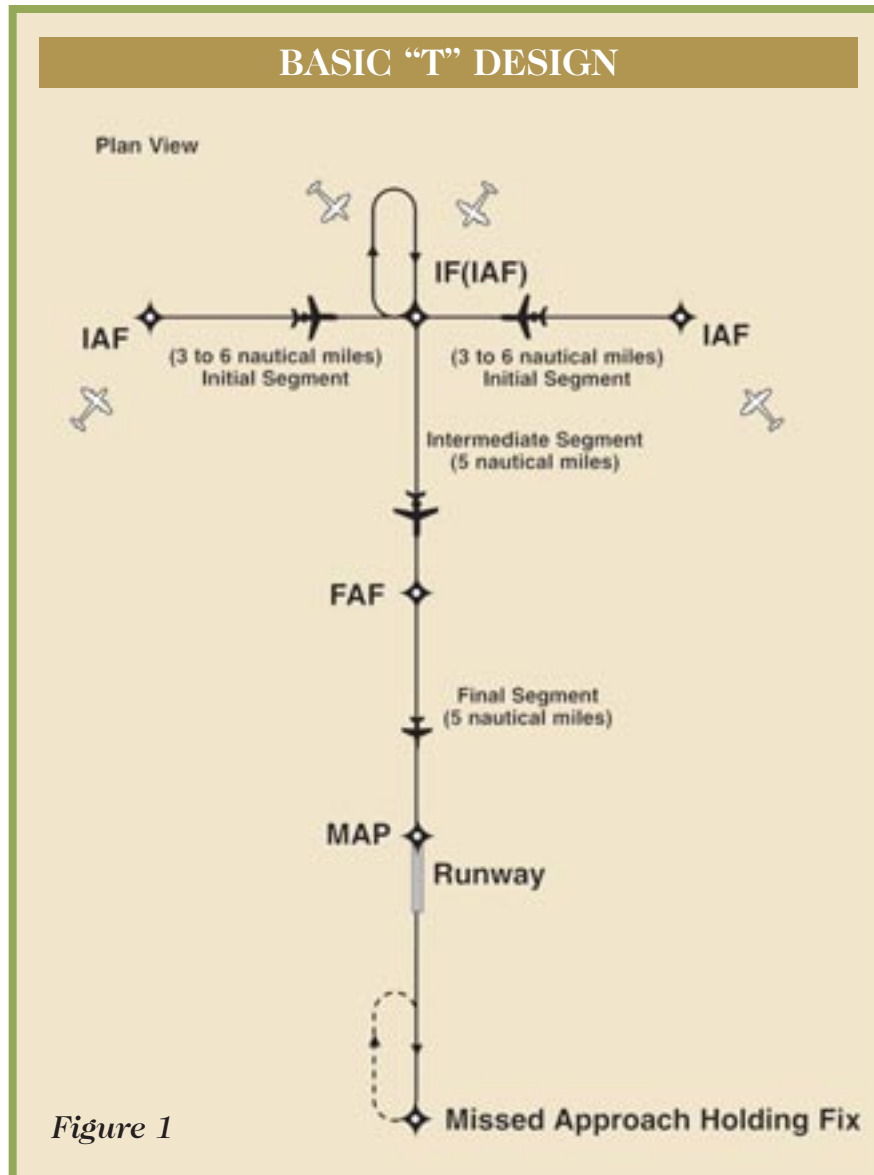


Figure 1

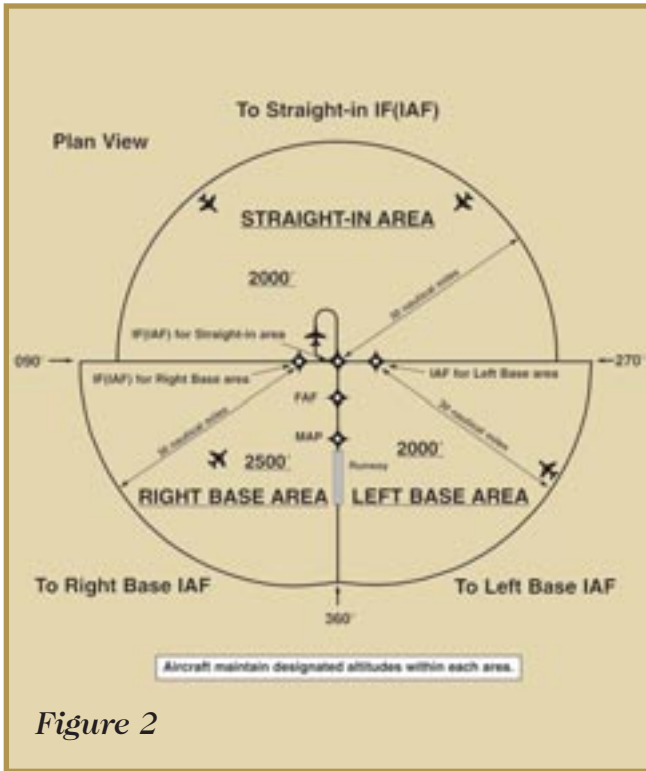


Figure 2

Intermediate and Final Segment. This means a second IF/IAF, however only one initial, intermediate, and final segment combination will be displayed on each approach chart.

Just as an MSA may be segmented with different altitudes, the TAA may also be segmented into sectors, but also radius (distance from one of the IAFs) subdivisions. They are displayed by icons in the corner of the plan view of the IAP and defined by magnetic course "TO" the appropriate IAF waypoint.

TAA minimum altitudes can be further subdivided with step-down altitudes defined by RNAV distances from the appropriate IF (IAF). This is typically done to accommodate high terrain, noise abatement, or obstructions in that sector.

Wide Area Augmentation System (WAAS)

Today's GPS satellites and receivers provide aviators monumental improvements over past area navigation systems and often permit accuracy of about 30 meters. However, the next step is WAAS.

WAAS will reduce that accuracy to nearly three meters and provide added reliability monitoring. This incredible accuracy and continuous system monitoring means GPS approach minimums predicated on WAAS may be comparable to present ILS CAT I minimums.

WAAS is the system developed by the FAA and DOT for the United States. Other countries and regions will have similar and compatible systems with different acronyms like EGNOS (Europe) and MSAS (Japan). We might see WAAS implemented in the United States before the end of this year.

In pilot terms, how does WAAS increase accuracy? A series of 25 ground stations are located around the United

States. These stations are geographically fixed, so they can be used as known reference points. Two master stations collect data from the ground stations and NAVSTAR (GPS) satellites. The master stations calculate corrections for orbit drift, clock drift, poor atmospheric conditions and reduced satellite integrity. Correction messages are then relayed via two additional satellites that are in geosynchronous orbits. Any WAAS-enabled GPS receiver may use utilize the data; however, the information is undependable outside the intended area.

New RNAV IAP Format

GPS/RNAV (and soon WAAS) has spawned a proliferation of new IAPs. In order to reduce the number of charts, the FAA was going to publish "unaugmented" GPS and WAAS IAPs on the same chart. That plan has changed due to manufacturers' problems with various Flight Management Systems not always recognizing the appropriate approach. However, the format for the minimum data does include new information such as LNAV/VNAV data.

The new approach plates (See Figure 3) may include up to four categories of approach minimums: WAAS,

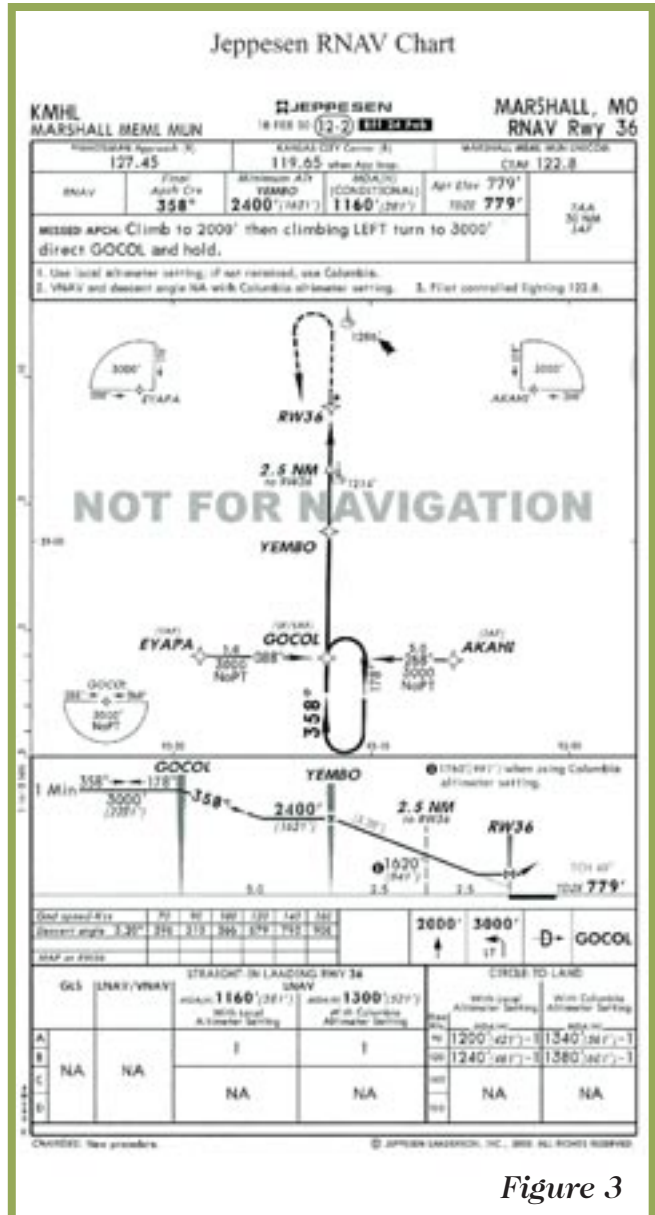


Figure 3

LNAV/VNAV, LNAV, and CIRCLING. Those procedures permitting vertical guidance will designate a Decision Altitude (DA) and those without vertical guidance will use a Minimum Descent Altitude (MDA). Remember, in order to use vertical guidance to a Decision Altitude, you must have AC 90-97 authorization.

When implemented the most capable WAAS approaches will be annotated as “WAAS PA” and may be flown to minimums as low as 200 feet height above touchdown (HAT) and on-half statute mile (sm) visibility. Remember, just like an ILS, the “WAAS PA” approach requires a fully capable precision approach system that includes appropriate approach lighting. If the “WAAS PA” (“PA” missing) notation is not present, don’t expect minimums any lower than 300 (HAT) and three-quarters sm.

If the WAAS is not fully capable, you will be permitted to regress to the less-than-optimum LNAV/VNAV minimums. Both horizontal and vertical navigation will be available, however the reduced accuracy and reliability (compared to WAAS) require heightened minimums. If cleared for the “RNAV RWY xx” approach, you may fly to the minimums appropriate to your AFM, operating procedures, equipment and status.

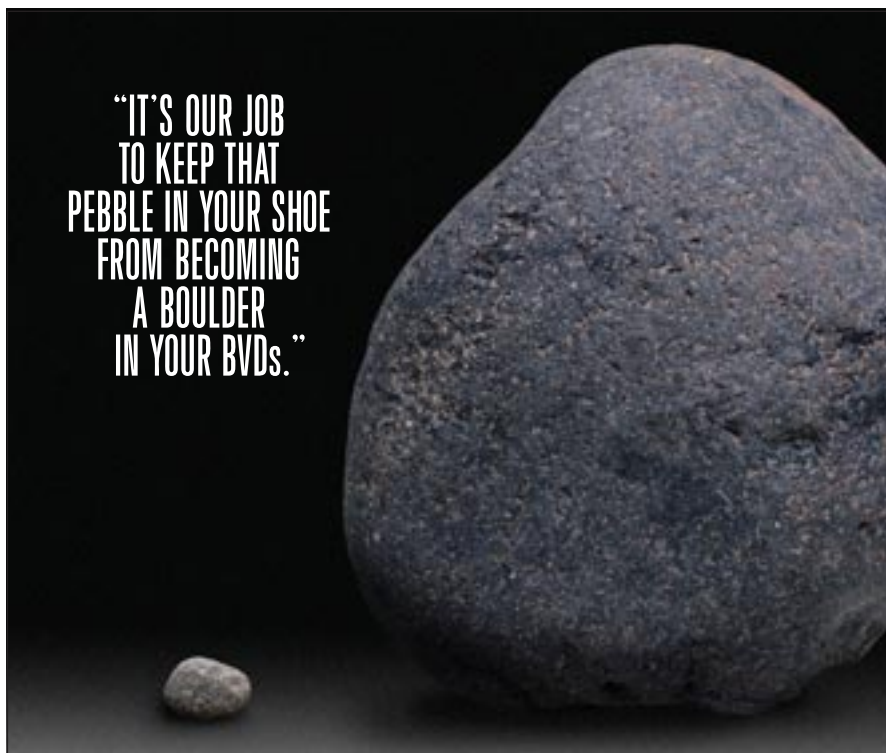
Your Old Friends Haven’t Abandoned You Just Yet

The VOR, NDB and ILS approaches won’t disappear tomorrow. But if you’ve been content to take the vectors to ILS final, figuring at worst you’ll get the VOR final, it is definitely time to practice the FMS stuff. Most of what you’ve read here is in the AIM. Take a look and at your next recurrent training or biennial flight review, practice your RNAV TAA procedures to LNAV/VNAV minimums.

The author would like to thank Mr. Bob Dilla for contributing his expertise on this subject. Bob teaches Enrichment Training at FlightSafety International’s Raytheon Aircraft Learning Center in Wichita, Kan.



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