Upgrading to the World of WAAS

BY SCOTT M. SPANGLER

With all due respect to the centennial anniversary of the Wright brothers' first flight, the second century of powered flight really began at 1201 EDT on July 10, 2003. That's when the FAA turned on the wide area augmentation system — WAAS for short.

Some might argue it really began about a decade earlier, with civilian access to GPS, but it is the improved lateral and vertical accuracy WAAS delivers to the satellite system's signal that frees aviation from the limits imposed by terrestrial navaids.

In time, GPS/WAAS's increased positional accuracy will enable more direct-to flights and increase airspace capacity through reduced separation standards. As a primary source of navigation, it will make avionics-dedicated ground-based navaids unnecessary.

WAAS's immediate benefit is the Category 1 instrument approaches it brings to airports without the expense of building and maintaining an ILS system at each of them. All the airport needs is the appropriate runway lights. As of February 2008, the FAA had published 1,028 LPV (localizer precision with vertical guidance) approaches at 577 airports, and more are on the way (*see sidebar page 49*).

What makes WAAS work is a network of wide-area reference stations (WRS). They are strategically located across the nation, including in Hawaii, Alaska and Puerto Rico, ensuring coverage beyond the edges of United States airspace and into Canada and Mexico. This network sends GPS position information to a WAAS master station.

The master station compares the GPS position to each precisely surveyed WRS location, generates an "augmentation message," and delivers it through geostationary satellites. WAAS/GPS receivers use the augmentation information to calculate an airplane's position with reliable accuracy, delivering LPV decision altitudes of 200 to 250 feet above the runway.

Equally important, WAAS tells pilots where the GPS system is unusable because of system errors or other problems. It has six seconds to either correct the error or notify pilots they are receiving "hazardously misleading information" and should not use it for navigation. You can even check the real-time status of WAAS online at www.nstb.tc.faa.gov.

Photo courtesy of Cirrus Design.

To fly in the world of WAAS, owners of Cirrus SRs must upgrade both their Avidyne glass and the Garmin GNS 430s. If they have steam gauges, owners save on the Avidyne software, but they need annunciators because the Garmins are below the acceptable viewing area.

Upgrading to WAAS

To fly in the world of WAAS, aircraft must be equipped with

a receiver meeting the requirements of TSO-C145a or TSO-C146a (*see sidebar page 50*). How expensive and complicated this will be depends on what currently is in your panel.

If you have one or two of the 75,000 Garmin GNS 400/500 series units now flying, upgrading to WAAS is a fairly simple, quick and affordable process, depending on your airplane. If you're flying non-WAAS Garmin glass, like the G1000, which is sold only to OEMs, Garmin's Jessica Myer said the airframe manufacturer handles upgrades.

If you're not flying Garmin, another choice is to trade in your old boxes for new Garmin GNS 400/500W series boxes, which are running better than $10,000 to $16,000 each, depending on your installation.

If you decide to wait, Honeywell/Bendix-King announced its new multi-function display, the KSN 770, at EAA AirVenture 2007. It is a big-screen (5.7-inch diagonal) WAAS/GPS navigator and software-based VHF and nav radio. Honeywell expects it to earn FAA certification in late 2008.

Garmin Upgrade

Announced in February 2007, the Garmin 400/500 series WAAS upgrade program works through the dealer network, said Todd Adams, manager of Lancaster Avionics, an AEA member in Lititz, Pa. As the portal for the work done at the factory, dealers contacted their customers and scheduled the upgrades.

At first, some of Adams' customers wanted to trade their legacy units for the new WAAS GNS 430/530Ws. After comparing what they got for the money, all but one opted for the upgrade, Adams said. Functionally, "there's no difference between buying a new GNS 430/530W and upgrading a legacy unit."

Garmin replaces the GPS engine, processor and software, and provides a new antenna, 16 MB datacard, and all the necessary documentation and training materials. If the legacy unit doesn't already have it, Garmin throws in the supplemental noncertified terrain/obstacle database. The upgraded GNS meets all of the TSO-C146a specifications.

If the aircraft has two GNS units, Adams recommends pilots upgrade both to preserve their cross-fill capabilities and the use of the same database. Owners who registered with dealers prior to Aug. 31, 2007, paid $1,500 per unit for the factory work. After that, the per-unit cost rose to $2,995. The upgrade price does not include any repairs, such as scratched lens or sticky buttons. Garmin charges a flat-rate repair charge appropriate to any additional problems.

Garmin has been meeting its projected in-house turnaround time of three working days, and it's not charging for the overnight

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The Garmin GNC 250XL in this Cessna is well within the 11.8-inch acceptable viewing area, so upgrading to a WAAS-certified Garmin GNS 430/530W would require no annunciators.

WAAS GPS APPROACHES

With the advent of WAAS, the FAA has renamed GPS instrument approach procedures to reflect the system's increased capabilities.

- **LNAV:** Lateral navigation is the new name for a nonprecision GPS approach. Because this approach does not have vertical guidance, it has a minimum descent altitude (MDA), just like a conventional nonprecision approach. Typically, an LNAV MDA is 400 feet above the runway.

- **LNAV/VNAV:** Lateral navigation/vertical navigation approach information is provided by an approved WAAS GPS or a flight management system with a VNAV-approved barometric altimeter. With an electronic glidepath, the approach has a decision altitude (DA) that is usually 350 feet above the runway.

- **LPV:** Localizer performance with vertical guidance is a new approach requiring a WAAS unit approved for it. Much more precise than LNAV/VNAV, LPV is the operational equivalent of a Category I ILS approach and has a DA between 200 to 250 feet above the runway.

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return, Adams said. The upgrade fee does not include the dealer's labor and materials.

Avoiding Upgrade Surprises

Any number of things can increase upgrade time and costs, but given a chance to inspect the airplane before the upgrade, a dealer should be able to predict many of them.

If, for example, the GNS units are outside of the approved field of view, "I'll see that you need annunciators, which are going to cost this much…" Adams said.

Before pulling the boxes, Lancaster Avionics starts the WAAS upgrade by documenting every setting on the unit's installation and calibration pages, which only the shop can access. This has many benefits. Most importantly, it helps the shop confirm the components that interface with the Garmin comply with the upgrade's supplemental type certificate. Any interface that does not comply will require additional work and an FAA field approval, according to Adams, giving several common examples.

Aircraft with the Sandel SN3308 electronic HSI require some rework to depict GPS vertical deviation and the required annunciation, with the exception of INTEG. Aircraft with an S-TEC ST-901 steering adapter likely will need a relay or additional wire between the GNS and the ST-901 converter.

The upgraded GNS will not talk to the Garmin GDL 49 datalink system. Owners who want this capability will need the new GDL 69 system, which delivers XM WX Satellite Weather and XM Satellite Radio.

In short, every upgrade is unique, Adams said, and the only way a dealer can predict the time and cost is to examine the installation.

Efficiently configuring upgraded WAAS units is a second benefit of the pre-upgrade documentation. When Garmin returns the upgraded GNS, "it's like a brand-new unit, all of the [previous] settings are wiped out," Adams said. This includes user-defined settings, and Adams recommends pilots document them before the upgrade. If they have special-use operations, stored flight plans for a pipeline patrol, CAP or Coast Guard operations, "pilots should write them down so they can reload them afterward."

Pilots also can see for themselves if their GNS units are in the "acceptable viewing area." (However, the shop makes the final determination.) In other words, the pilot can see the needed annunciations on the screen without excessive head movement, never a good thing when flying an instrument approach to minimums.

Assuming a standard installation, the GNS 430/530 is to the pilot's right and on the same vertical plane as the six-pack instruments. (Units below this plane, as in the Cirrus SR series, are outside of the acceptable area.) To be in the acceptable area, the unit's left bezel edge must be no more than 11.8 inches from the center of the pilot's scan, a line that typically bisects the attitude indicator.

If the bezel is more than 11.8 inches, but less than 13.41 inches, the upgrade needs a VLOC/GPS annunciator. If it is beyond 13.41 inches, it needs all of them: VLOC/GPS, MSG, WPT, APR, TERM and INTEG. An option is to install an appropriate EHSI or primary flight display that will display the GPS annunciations.

Included in the factory price is a new antenna. It has the same footprint as the old one, but it requires a new TNC connector and a specific length of a higher-grade coax. GPS is sensitive to radio frequency interference, and WAAS is even more so, according to Adams.

Black RG58 coax does not provide the necessary shielding; WAAS's minimum requirement is orange-tan colored RG400 or RG142B/U.

TSO DETERMINES GPS CAPABILITIES

To use GPS for navigation, the equipment must be certified in accordance with TSO-C129, "Airborne Supplemental Navigation Equipment Using the GPS," and the installation must be done in accordance with AC 20-138, "Airworthiness Approval of GPS Navigation Equipment for Use as a VFR and IFR Navigation System," or AC 20-130A, "Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors."

For WAAS, the equipment must meet the requirements of TSO-C145a, "Airborne Navigation Sensors Using the GPS Augmented by the Wide Area Augmentation System," or, to qualify as the primary source of navigation, TSO-C146a, "Stand-Alone Airborne Navigation Equipment Using the GPS Augmented by the Wide Area Augmentation System."

Most general aviation WAAS receivers comply with TSO-C146a, which applies to panel-mounted navigation equipment (as opposed to sensors providing data to a flight management system).

To provide proper attenuation, the cable must run between 6.5 feet and 35 feet long. Adding cable corrects a shortage, but if there is no way to shorten the run, Adams said going to an even higher grade of coax should meet the attenuation requirements.

To fly in the world of WAAS, aircraft must be equipped with a receiver meeting the requirements of TSO-C145a or TSO-C146a. How expensive and complicated this will be depends on what currently is in your panel.

Cirrus Challenges

When upgrading a Cirrus SR series airplane with Avidyne glass, owners not only will need to upgrade the Garmin 430s, but also they will need Avidyne Release 7 software and two Cirrus antenna kits, which take the place of the Garmin units.

Obviously, a Cirrus with steam gauges doesn't need the new software, but it will need annunciators because the GNS units are below the acceptable viewing area.

Avidyne Release 7 delivers WAAS to the primary flight display and multi-function display without any wiring changes. If the owner is running Release 6.0 or better and the unit is under warranty, the upgrade is $2,395, plus shipping, labor and applicable tax. Beyond warranty, it is $3,895. (All other aircraft are eligible for the Avidyne WAAS upgrade contingent on the airframe manufacturer's requirements.)

To order the upgrade, owners must register their PFD/MFD at www.myavidyne.com and provide the serial numbers of the PFD, MFD and aircraft, along with the N-number, make and model to the dealer performing the upgrade. Projected downtime is 10 working days for the PFD, not counting shipping; dealers can upgrade the MFD in the field.

The Garmin upgrade is the same, except Cirrus owners save $440 on each Garmin antenna. Instead, they must purchase the Cirrus antenna kit appropriate for their aircraft and accompanying service bulletin. The kit for the No. 1 GPS is $1,878 if XM weather is installed, and $1,240 without XM. The kit for the No. 2 GPS is $1,226 or $1,141, depending on the compliance with another mod.

Final Steps

After reinstalling the upgraded GNS units, the dealer configures them according to their pre-upgrade documentation, making any changes as necessary. Then comes the great unknown: the final check of the Garmin box and everything that interfaces with it.

Radio frequency interference (RFI) is the greatest unknown, Adams said, reiterating WAAS is even more sensitive to it than a straight GPS.

"Even though it passed the test before doesn't mean it's going to pass the test now," he said. "If there's a problem, then we have to jump through all kinds of hoops until it's resolved. So, until that's done, you don't

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Universal Avionics Adds to WAAS Family

Universal Avionics Systems Corp. offers a WAAS flight management system with the ability to fly LPV, LNAV/VNAV and LNAV-only approaches. Universal's WAAS-FMS family includes the UNS-1Ew, UNS-1Espw, UNS-1Fw and UNS-1Lw.

These WAAS-enabled systems contain a precise, augmented GPS receiver capable of navigating approaches to ILS minimums.

According to Universal Avionics, its WAAS-enabled super flight management systems are designed to be compatible with the systems being implemented in Europe (EGNOS), Japan (MSAS) and other future systems compliant with the standards established in RTCA CO-229, in addition to the support for WAAS in the United States.

Universal Avionics recently announced its new LP/LPV monitor, which provides specialized monitoring and position information for RNAV (GPS) LP/LPV approaches. Together, the LP/LPV monitor and the Universal WAAS-FMS make it possible to obtain operational approval for WAAS LPV approaches in a single Universal Avionics WAAS-FMS installation. The monitor will be certified to TSO-C146b, Class Gamma-3 and is expected to be available later in 2008.

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know exactly what it's going to cost."

When the WAAS upgrade is complete, there should be a maintenance record (logbook) entry stating as such, and an FAA Form 337 testifying the upgrade was done in accordance with the STC, assuming it has been, Adams said. Owners should have a new set of Garmin operating manuals, a new training CD, and information on how to contact Jeppesen to change to a WAAS database subscription. As soon as they get the flight manual supplement, pilots should add it to that section of the airplane's pilot operating handbook.

Owners should not ignore the last document: Instructions for Continued Airworthiness. This document explains the annual inspection required of every Garmin GNS 430/530W. The good news is, any airframe and powerplant technician can perform the four-step inspection:

• Make sure the box is secure in the rack.

• Make sure all the faceplate legends are legible.

• Make sure none of the wiring is chaffing.

• Make a logbook entry stating the system was examined in accordance with the Instructions for Continued Airworthiness.

Without this examination, pilots cannot use their upgraded units for VFR or IFR navigation or communications, Adams said.

"I've been telling pilots to call the mechanic who does their annual inspection immediately and have them add this inspection to the airplane's list of things to do," he said.

In so doing, the aircraft will be legally welcome in the great world of WAAS. ■