

# King Air

A MAGAZINE FOR THE OWNER/PILOT OF KING AIR AIRCRAFT

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## NextGen Navigation

How VOR remains important in a GPS world

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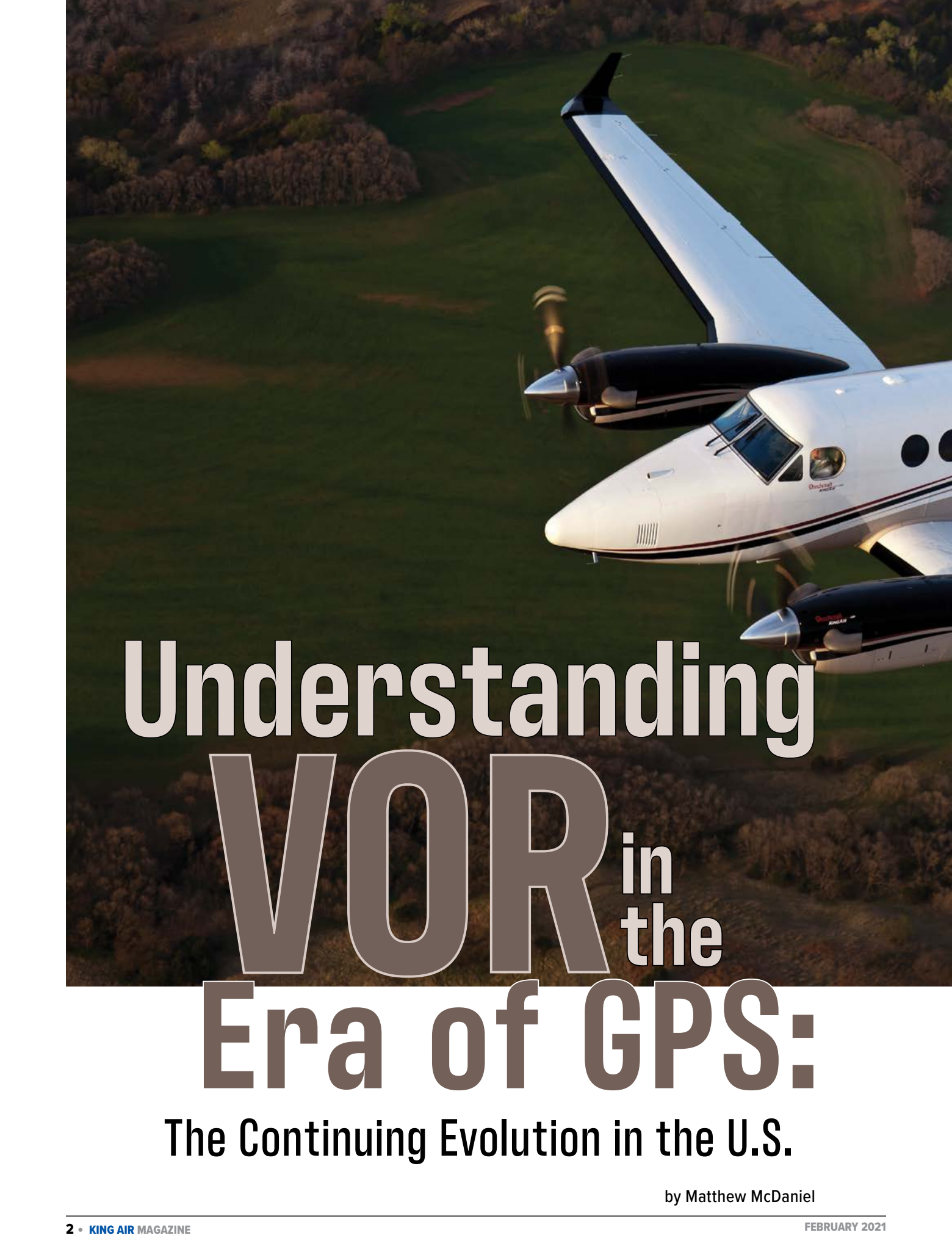
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# Understanding VOR<sup>in</sup> the Era of GPS:

The Continuing Evolution in the U.S.

by Matthew McDaniel





Credit: Textron Aviation

already know what most readers are thinking, “Why should I care about VORs anymore?” Global Positioning System (GPS) has become the default form of navigation for all segments of general aviation (GA), while ILS and RNAV/GPS (with vertical guidance) approaches have become the norm at both large and small airports.

Chances are, most of us can’t even remember the last time we flew an approach without some type of vertical guidance, much less a standard VOR approach. This is especially true when you are talking about flying such approaches in actual Instrument Meteorological Conditions (IMC) down to or near published approach minimums. So, I can appreciate your reluctance to read further, but stick with me here.

The Very High Frequency Omnidirectional Range (VOR) is far from dead (or even dying) and is a critical component to the U.S. navigation network on several

levels. Not the least of which is ensuring the ability for instrument equipped aircraft to continue navigating (both in the enroute and terminal phases of flight)

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should the integrity of the current GPS system be compromised for any reason for any length of time. GPS signal outages are not uncommon. The military intentionally jams (blocks) specific GPS signals regularly for a variety of reasons related to national security and military training exercises. Occasionally, GPS satellites go offline as they reach the end of their lifespan or are undergoing remote updating or maintenance. Such outages are generally limited in scope and include a heads-up to pilots in the form of Notices to Airman (NOTAMs). But, because the GPS system is satellite based (rather than ground based, like VORs) it is more susceptible to a variety of less predictable outages, such as cosmic events or malicious enemy attack. Of course, failures of onboard GPS equipment, related wiring or antennas, etc. is always a possibility, as well.

There is little doubt that Performance Based Navigation (PBN), Required Navigation Performance (RNP), and a variety of other tongue-twisters related to GPS have totally changed the landscape of long, short and terminal range navigation. That has made the chores of navigation exponentially easier and safer for pilots. Nonetheless, GPS is not, and never will be, a failure-proof system. A ground based backup system for navigation is critical to maintaining and protecting the National Airspace System (NAS). Maintaining our knowledge and skills related to the use of that backup system is no less critical.

### The VOR Revolution

Like many prior navigational advances, the introduction of the VOR was truly revolutionary. It was not dependent upon visual conditions or low altitude flying, such as lighted airways and ground markings were. It was not dependent upon the pilot's ability to constantly monitor and decipher audible signals, such as the AN Radio Range

system was. VOR navigation was not limited to only a few specific courses, such as the Four Course Range. It was not susceptible to atmospheric interference such as Non-Direction Beacons (NDBs). Nor were the pilots using it nearly as prone to misinterpreting its information and creating dangerous navigation errors. VORs provide an infinite number of precise radials, broken into 360 one-degree segments, that the pilot can track to/from the facility with a high degree of accuracy thanks to easy to interpret cockpit equipment. Its only real limit is range, as dictated by the strength of the facility's signal and the line-of-sight between said facility and the receiving aircraft. VOR navigation might seem quite antiquated now, compared to the precision and ease of today's various forms of GPS navigation. Nonetheless, it was a massive leap forward in technology when it was introduced nearly 75 years ago. Additionally, it has proven to be highly dependable, making it the longest-standing navigation system in the U.S. National Airspace System (NAS), with no end date to that streak in sight.

### VOR Expansion

Development of the VOR began in 1937, but it was not until 1946 (soon after World War II) that the first station became operational and well into the 1950s before their installations had become more widespread. While those early VOR stations were combination vacuum tube and mechanical devices, solid state technology began to take hold within the VOR network in the 1960s. It was after that point that VORs became common enough to be adopted as the world standard for air navigation. After the introduction of the VOR, variations on its concept soon developed. Different types of VORs emerged to support different types of navigation. Big and powerful VORs, which could be received 100-plus miles away were great for use as both enroute and terminal navigation facilities. ➤



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## Candidate Discontinuance VORs & MON Airports



● Retained VORs (589)

● Candidate Discontinuance VORs (307)

Candidate Discontinuance VORs	
Service Area	VOR #
Western	18
Central	181
Eastern	108
<b>Total</b>	<b>307</b>



Approaches: ● ILS/LOC – 130 ● VOR – 68  
The circles depict 100 nm around the MON airports. MON airports ensure that an aircraft is within 100 nm of a location where an LOC, ILS or VOR approach may be flown.

VOR Configurations (as of September 10, 2020)				
	Retention #	Discontinuance (Remaining) #	Current Total	Total Discontinued
VOR	16	7	23	6
VOR/DME	214	105	319	48
VORTAC	359	113	472	28
<b>Total</b>	<b>589</b>	<b>225</b>	<b>814</b>	<b>82</b>

Figure 1: This late Oct. 2020 FAA graphic shows the VOR MON network, as well as the MON Airport network on the left. The geographic makeup of VORs to be decommissioned and the types and numbers of VORs to be retained is charted on the right. (Source: [faa.gov](http://faa.gov))

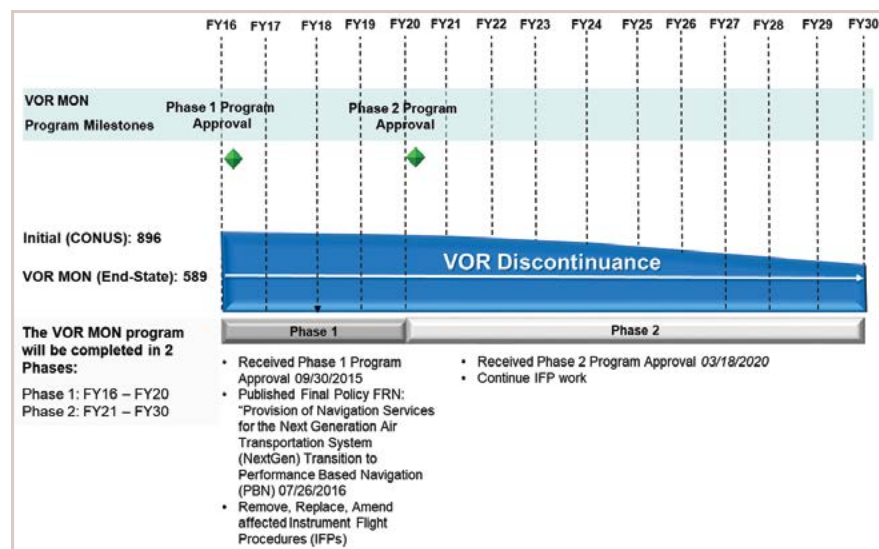


Figure 2: Timetable of the VOR MON program. (Source: [faa.gov](http://faa.gov))

But they were expensive to build and purchase and also expensive to maintain. Such VORs became known as High VORs and are usable both at low altitude and throughout the U.S. Flight Levels (18,000 to 60,000 feet). Thus, they were used to define the network of high altitude airways (Jet Airways). Low VORs were used as a cheaper solution to fill the geographic gaps between the cost prohibitive High VORs. They were used to

supplement the VOR network, so that additional low altitude airways (Victor Airways) could be developed at less expense. Finally, Terminal VORs exist strictly to support terminal procedures (VOR approaches or to define mandatory intersections on other types of approaches). Terminal VORs are the least expensive, are not used in the Airway networks, and have the most limited range and altitude capabilities.

VOR can also be co-located with other navigation equipment. Distance Measuring Equipment (DME), co-located with a VOR station, known as a VOR/DME, can exist in High, Low or Terminal VOR stations. Tactical Air Navigation (TACAN) can also be co-located with a VOR, known as a VORTAC. VORTACs including the VOR station itself, DME and TACAN azimuth information (which is used mainly by U.S. military aircraft).

VOR usage as a primary source of navigation has not had any one peak point in history. Airlines and high-end corporate aviation began to rely on it less as Inertial Navigation, OMEGA and LORAN systems became available. Yet, at the same time, those systems were too heavy, complex or expensive to see widespread use within GA, keeping VOR as GA's main navigational tool. Eventually, OMEGA and LORAN systems become more common place in lower-end jets, turboprops and GA aircraft, relegating VOR to an enroute backup, while still remaining a primary system for terminal procedures (especially at smaller airports). GPS became popular in smaller aircraft as a means of VFR navigation first (it was not certified for IFR usage until later). Because of the high cost of the initial generation of IFR-certified GPS equipment, legacy airliners often flew on for decades using VOR and ADF, rather than the new-fangled GPS navigation. Yet, as we all know, GPS eventually eclipsed all other forms of navigation for terminal, short and long range. Meanwhile, VOR soldiered along, always the trusty backup, but all too often ignored by pilots and instructors alike.

Many speculated the VOR would soon go the way of the Dodo. The rapid development and expansion of GPS and Satellite Based Approach Systems (SBAS) has been "taking over aviation," particularly since 2007 when WAAS GPS equipment first began to appear in the GA fleet. Fortunately, the FAA and the various aviation advocacy



groups better understood the necessity of maintaining multiple forms of navigational systems. Yes, VOR stations are costly, have range limitations and require maintenance. Thus, some will be allowed to fade into history. However, a Minimum Operational Network (MON) of them will remain for the foreseeable future.

## VORs Evolution to MON

In late 2011, the FAA published its first notice for public comment related to its proposal to draw down the VOR network within the Continental U.S. (CONUS) to a MON. After the normal process of comment evaluation, proposals and notices was complete, a plan for transitioning to NextGen navigation systems was published by the FAA in July 2016. It included a plan for transitioning to PBN and for establishing a VOR MON. Phase I of that plan was to run from Fiscal Year (FY) 2016-2020. Before Phase I began, the FAA owned 957 VORs. Another 100 non-federal VORs were also in operation around the U.S. Some VORs were decommissioned during Phase I, but the primary goal during that time was to remove, replace or amend affected Instrument Flight Procedures (IFP), which would allow for more widespread VOR decommissioning during Phase II. By the time you read this, Phase II will have already begun and is currently scheduled to run through 2030. During Phase II, the federal VOR count will fall to 589, but without a significant loss of capability for the average user (see **Figures 1** and **2**, opposite page).

The creation of the VOR MON was a well thought out plan, allowing critical VORs to remain and for an expansion in service volume in many of those. Additionally, a network of Minimum Operational Network Airports (MONA, also known as “Safe Landing Airports”) was established to ensure that, in the event of a widespread GPS outage, all aircraft operating within CONUS would be within 100 nautical miles

of an airport with a VOR or ILS approach procedure that does not require GPS, Radar Coverage, DME or ADF to legally fly. Of course, any suitable airport or approach procedure that is even closer at the time of total GPS signal loss may be utilized.

## Should They Stay or Should They Go?

It is important for us, as pilots, to fully understand what defines the VOR MON network and what VOR capability changes have developed to facilitate it. First, what criteria was used for decommissioning versus retention decisions? Beyond those VORs used to support ILS, LOC or VOR approaches at Safe Landing Airports, additional factors were applied. Any VOR falling into the following categories will be retained:

- VORs which support international oceanic routes
- A sufficient network of VORs to provide coverage at/above 5,000 feet AGL
- VORs in the Western U.S. Mountainous Area (WUSMA) which anchor Victor Airways through high elevation terrain
- Any VOR required for military use
- All VORs outside of CONUS

Additionally, no non-FAA VORs were considered for decommission as part of the VOR MON plan. Yet, those VORs are not part of the VOR MON network either. So, they can be thought of as VORs in addition

to the VOR MON. However, since they are not FAA owned, they could be subject to decommission by their owner/operators at any time. Fortunately, all DME, TACAN and communication capabilities will be retained and reconfigured as necessary, even if the VOR they are co-located with is to be decommissioned. This will not only protect the integrity of DME and TACAN units, but also important communications services, such as Hazardous Inflight Weather Advisory Services (HIWAS) and Remote Communications Outlets (RCO).

## Conclusion

With the transition to VOR MON and the Safe Landing Airports networks, the FAA has begun implementing some charting changes related to both (specifically, refer to **Figure 3**). To facilitate the reduction in VOR numbers within CONUS, while retaining a VOR network with consistent reception capabilities at/above 5,000 feet AGL, two new Standard Service Volumes (SSV) are being added to VORs on the retention list. While these new SSVs do not require major equipment changes, they do represent a change in the SSVs many of us have learned and memorized during initial and recurrent instrument training. Specifically, for High VORs, a 70-nautical-mile SSV will now exist between 5,000 feet and 14,500 feet Above Transmitter Height (ATH). For Low VORs, the same 70-nautical-mile SSV will extend from 5,000 feet

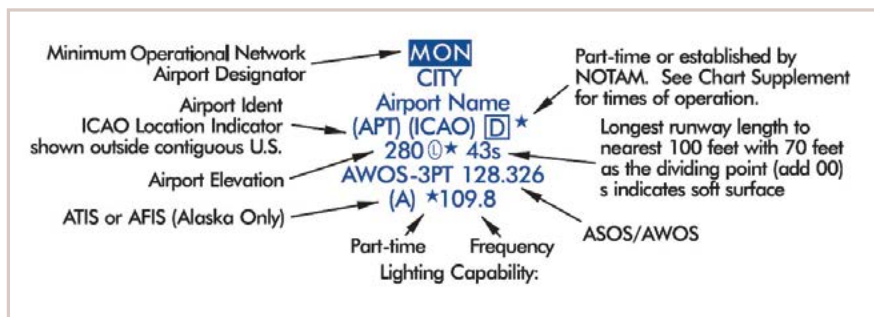


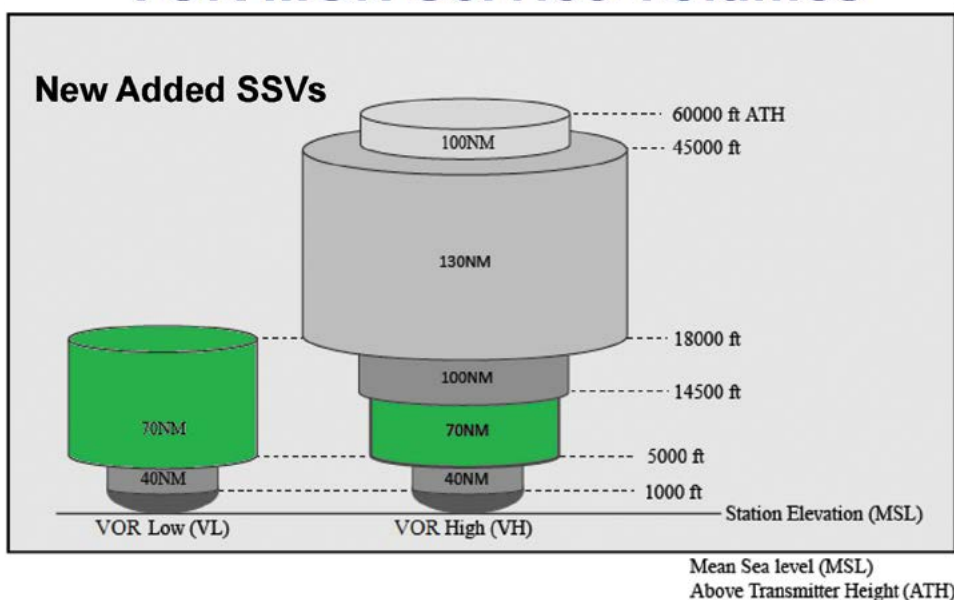
Figure 3: Charting example (with descriptions) of a MON Airport on a NOAA (government) Low Enroute IFR chart. (Source: [faa.gov](http://faa.gov))

# VOR MON Service Volumes

Figure 4: New VOR MON Standard Service Volumes (SSV) added to High and Low VORs are shown in green. Grey SSVs were pre-existing before the changes for the VOR MON project began and will remain on all VORs within the VOR MON network. (Source: [faa.gov](http://faa.gov))

up to 18,000 feet ATH. To see how these new SSVs integrate into the pre-existing SSVs for High and Low VORs, refer to **Figure 4**.

While total loss of GPS navigation signal without warning remains a rare occurrence, it is not at all beyond the realm of possibility. When that time comes (without warning or as predicted by NOTAM), will you be ready? Have you studied or practiced navigating solely by use of VOR (or VOR/DME) lately? When was the last time you shot an old-school VOR approach without vertical guidance? Or thought about DME slant range error,

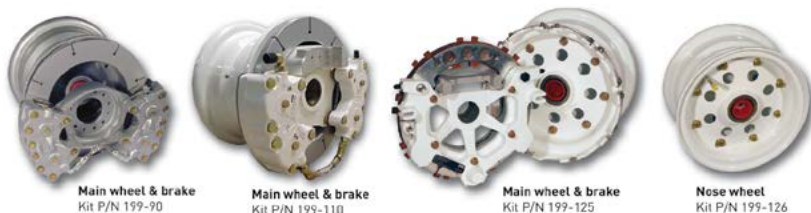


reverse sensing, or the VOR cone of silence? Can you still fly a DME Arc without any help from GPS distance information? Can you do it using a standard VOR Omni Bearing Selector (OBS), as well as via a Radio Magnetic Indicator (RMI) needle? Those skills are likely to be woefully

unpracticed and unused in the era of GPS. Yet, they are not skills we can simply allow to entirely escape our grasp. Grab your favorite flight instructor, saddle up your favorite training aircraft or simulator and go pretend it's 1980-something. It will only seem like a futile exercise until your first GPS signal loss on an IMC flight to a LIFR airport. Then you'll likely be thankful for the VOR MON and MONA networks, as well as your own commitment to stay proficient in all forms of navigation that your aircraft is equipped for. **KA**

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Matthew McDaniel is a Master & Gold Seal CFII, ATP, MEI, AGI, & IGI and Platinum CSIP. In 30 years of flying, he has logged over 19,500 hours total, over 5,700 hours of instruction-given, and over 2,500 hours in various King Airs and the BE-1900D. As owner of Progressive Aviation Services, LLC ([www.progaviation.com](http://www.progaviation.com)), he has specialized in Technically Advanced Aircraft and Glass Cockpit instruction since 2001. Currently, he is also an Airbus A-320-Series Captain for an international airline, holds 8 turbine aircraft type ratings, and has flown nearly 90 aircraft types. Matt is one of less than 15 instructors in the world to have earned the Master CFI designation for 9 consecutive two-year terms. He can be reached at: [matt@progaviation.com](mailto:matt@progaviation.com) or (414) 339-4990.





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An overhead view of the Beechcraft museum's campus, located adjacent from the Tullahoma Regional Airport (THA).

(Photo credit: Bob Burns)



# Save the Date!

## King Air Gathering

### Sept. 23-26, 2021

by Kim Blonigen

**M**ark your calendars to attend The King Air Gathering (KAG) 2021 being held at The Beechcraft Museum, situated adjacent to the Tullahoma, Tennessee, Regional Airport (THA), Sept. 23-26.

King Air owners and operators who have attended previous Gatherings enjoy the knowledge they get from the educational speakers, being able to talk one-on-one to King Air-specific vendors about their products and services and getting to know other King Air operators.

Look for more details including the agenda and speakers of this popular, well-attended event, as well as registration details, in a future issue of *King Air* magazine. **KA**

The Beechcraft museum currently houses 36 aircraft, including the first Travel Air Mystery Ship shown here in the museum's Beech Center. In addition, the museum showcases a large variety of aviation artifacts and memorabilia.

(Photo credit: Bob Burns)





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# Corrosion

by Dean Benedict

It's a tribute to the King Air brand that so many are still flying today after 30 or even 40 years since manufactured; but the longer an airplane is "alive and kicking" the greater the opportunity for development of corrosion. When assessing the condition of any King Air, I've got the possibility of corrosion uppermost in my mind. In fact, I'm packing my bags right now to visit a King Air in Florida with known corrosion issues.

Atmospheric conditions have a corrosive effect on all metals. Aluminum, the primary material long used in aircraft construction due to its light weight, is susceptible to corrosion from air pollutants and is particularly sensitive to the salt-laden environments found in coastal communities. But it is not alone. The components in your engines are made of much tougher material since they are subjected to extremes of heat, fuel and exhaust. These sophisticated alloys are equally at risk for corrosion. Even fiberglass and composites

are vulnerable to the corrosive effect of sunlight and air pollutants.

True story: An owner/operator parked his King Air on the ramp of his home airport, located less than 10 miles from the ocean. He always tailed it into the wind. He hoped this would keep the onshore breezes away from his engine intakes and minimize the adverse effects of the ocean air. However, when it came time for borescope inspections, his theory, and his bank account, were blown to bits. Corrosion was severe and



---

**“Corrosion is like cancer. Once it starts, if not attended to, it will spread and become more destructive.”**

---

widespread inside both engines. Many components required expensive repair and others had to be replaced (with no core credit).

### **A Tale of Two King Airs**

Years ago, I had a couple of King Air 90s coming into my shop, each of them for the first time. One, a C90, was being ferried in from Hawaii. The other, an older E90, had been in the California desert for a while.

Months of preparation went into getting the C90 over to the mainland, and during that time I worried myself sick over the prospect of finding corrosion everywhere. I dreaded having to deliver the bad news. The E90, on the other hand, was of less concern. I'm very familiar with how King Airs fare in a desert climate; extensive corrosion was the last thing I expected to find.

To my surprise, the Hawaiian C90 was essentially corrosion-free! The engines looked like new inside, and we were hard-pressed to find one speck of corrosion on the airframe. How could this be? The maintenance manual has several sections directed toward King Airs operating in highly corrosive environments. The operator of this C90 had followed those instructions to a “T” and with great results. I might add, this C90 was built in 1980, so given its age, this corrosion-free condition was even more impressive.

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Corrosion on the exterior (left) and interior (right) of the barrel of a King Air's landing gear. It spreads and grows into the material and needs to be removed by sanding or scraping and if not thoroughly removed it will grow back.

(Photo credit: Trace Aviation)

In the other case, the E90 fared very poorly in the corrosion department. We found it at every turn. The spar caps were corroded, as well as the skin joints that meet the spar caps. We found it inside the wing. The props were coming off for overhaul, but even before we removed them, corrosion was visible all over the hubs. The inside surface

of the nacelle tank cover panels were riddled with it. (Take note, this is a particularly vulnerable spot for corrosion on any King Air.) The more we inspected, the more corrosion we found. Everything I expected to find on the C90 from Hawaii was what I found on this E90 after being out in the desert. How could this be? Well, the logbooks and maintenance



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records eventually told the story. At one point this aircraft had been a bank repo. It reportedly sat outside, somewhere in Georgia, and nobody touched it for two years. That took a serious toll on it.

## Remedies

The spar cap corrosion was a huge red flag on the E90. I immediately called in an NDT specialist for an eddy current inspection to assess the condition of the wing spars. Fortunately for the owner, all damage found was within limits and could be treated. We were able to peel the skins back and take out the corroded panels. We then removed the corrosion, treated those areas as directed by the maintenance manual and the accepted standards of the industry. Before reinstallation, everything was sealed with zinc phosphate (once known as zinc chromate – that ubiquitous yellow-green paint found everywhere behind an aircraft's cosmetic surfaces).

Corrosion is like cancer. Once it starts, if not attended to, it will spread and become more destructive. Moving the E90 out of Georgia to the desert may have slowed down the spread of corrosion, but it didn't stop it. Like fungus or mold, corrosion grows into the material. It must be removed by sanding or scraping; if not thoroughly removed it will grow back. After removal, the affected area must be treated. Alodine is one example. It is used on aluminum to prevent corrosion.

Sometimes corrosion is so severe that the only option is akin to surgery – the affected areas are cut out and replaced. The treatment of corrosion, done properly, is labor-intensive and therefore expensive, but it has to be done. Paint shops find and treat corrosion all the time once the old paint has been stripped. Corrosion lurks unnoticed beneath paint. It has to get pretty bad before it disturbs the paint above it. When this happens, you'll see bubbly patches or clusters of tiny craters

in the paint. Just remember that paint is *not* a remedy for corrosion. It only offers additional protection to a corrosion-free surface that has been properly treated and sealed.

## Preventive Measures

If you operate your King Air regularly in an environment that promotes corrosion, I will assume your shop is following the maintenance manual guidelines for operation in such conditions. But if they only see your aircraft once a year during Phase Inspections, there are a few things you could do in the interim. For example, if you are based on the coast and your sphere of operation is in that local area, consider compressor turbine washes at the end of every day you fly. You might do it every day or once per week, depending on your usage of the aircraft.

There is a compressor wash kit that can be installed on King Airs to make daily compressor washes convenient. Charter operators on the coast do this all the time. It may sound expensive and time consuming now, but when hot section inspections or overhauls come due, you will be singing a much happier tune. At minimum, a good clean water wash (where permitted) will do wonders. If de-ionized water is available, that's even better.

Lastly, don't forget the ACF-50. Every King Air owner should keep ACF-50 close at hand. Whenever you clean the aircraft or wipe anything down, spray every moving joint with ACF-50. This is a well-known, anti-corrosive agent. If I were made of aluminum and lived on the beach, I would bathe in the stuff. Continual use of ACF-50 is probably what preserved the Hawaiian C90 so well. I would definitely recommend using it on the aforementioned panels that actually seal the nacelle tanks (underneath the panels in the wing) as they are particularly corrosion-prone. On model 200s, 300s and 350s, the aux tanks have the same design and the same corrosion vulnerability.

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An aileron from a King Air that has so much corrosion it's beyond repair. A King Air is mostly made up of aluminum which is susceptible to corrosion from air pollutants, and in particular salt-laden environments found in coastal areas.

A King Air doesn't have to hang out on the beach to suffer the effects of a salt-laden environment. It might be many miles inland but still subject to salty air, heat

and humidity, depending on the prevailing winds or local weather patterns. A King Air that lives in the desert but regularly flies to the beach is likewise vulnerable.

Corrosion concerns everyone. There are no exemptions.

Frankly, if you operate regularly in a challenging environment, get with your shop and have them print out the pertinent sections of the maintenance manual that address the conditions in which you operate. Review that information and do everything you can, in between scheduled maintenance appointments, to augment the preventative measures regularly taken by your shop.

A well-maintained King Air is a beauty to behold and to fly. **KA**

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Dean Benedict is a certified A&P, AI with over 45 years of maintaining King Airs. He's the founder and former owner of Honest Air Inc., a maintenance shop that specialized in Beech aircraft with an emphasis on King Airs. In his new venture, BeechMedic LLC, Dean consults with King Air owners and operators on maintenance management & supervision, troubleshooting, pre-buys, etc. He can be reached at [dr.dean@beechmedic.com](mailto:dr.dean@beechmedic.com) or (702) 773-1800.



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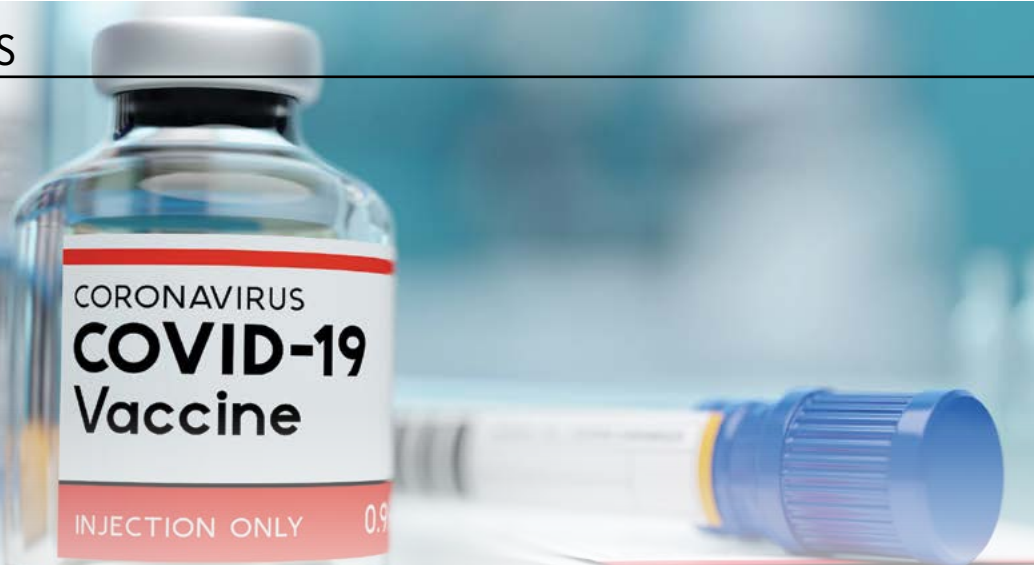
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# FAA Approves COVID Vaccine for Pilots and NBAA Announces IRS Final Ruling Advocacy Win

by Kim Blonigen

## FAA Issues Order Authorizing Pilots to Receive COVID-19 Vaccine

Following the Emergency Use Authorization from the U.S. Food and Drug Administration (FDA) for Pfizer, Inc.'s COVID-19 vaccine in mid-December, the Federal Aviation

Administration (FAA) determined that pilots may receive the vaccine under the conditions of their FAA-issued airman medical certification. Without such an order, pilots receiving vaccines that have not received full FDA approval risk invalidating their medical certificate.

To maintain the highest level of safety, the agency will require a

48-hour waiting period to monitor side effects before flying, which is similar to what is enforced for vaccines for tuberculosis and typhoid. This waiting period is required after each distribution of those vaccines given in two doses, currently Pfizer and Moderna.

The FAA anticipates taking no additional measures to ensure safety after the initial 48-hour window but states the agency's medical professionals will continuously monitor the initial distribution of the novel vaccine and documented clinical results and will adjust these recommendations as needed.

The order also states that the FAA will evaluate vaccines from other manufacturers as they receive FDA authorization in the coming weeks and months and will advise pilots of any waiting periods required for those vaccines.

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## NBAA Celebrates Successful Advocacy in IRS Final Ruling Affecting Aircraft Management Companies

The National Business Aviation Association (NBAA) announced it was successful in its advocacy efforts for business aviation during the passage of the Tax Cuts and Jobs Act (TCJA). The association led an industry regulatory effort to provide certainty and clarity for aircraft management companies and owners regarding their federal excise tax (FET) obligations.

In 2017, following a yearslong advocacy campaign led by NBAA, lawmakers introduced key tax reforms, such as 100% bonus depreciation for new and preowned property, including business aircraft. The TCJA also made clear the 7.5% FET on commercial air transportation is not due when owners conduct flights on their own aircraft with a management company's assistance. The legislative provision explained that such flights are subject to the non-commercial fuel tax and exempt from the percentage tax ending significant uncertainty that had devastating impacts for aircraft management companies.

The NBAA and its Tax Committee championed industry efforts to work with the Department of the Treasury and IRS on regulations that correctly implement the TCJA management company provision. That effort has now resulted in a final rule from the IRS that represents the successful conclusion to prevent the improper and retroactive application of FET to management companies and aircraft owners.

In its final rule, the IRS adopted several significant changes suggested by NBAA to eliminate potential confusion and provide clear standards for taxpayers and the government. For example, the rule affirms that owner trust arrangements, used to register thousands of business aircraft for regulatory compliance purposes, are eligible for the FET exemption. Also, the final regulations abandon a proposal to expand the definition of leases disqualified from the FET exemption, which would have severely limited the exemption's application to many common aircraft ownership structures.

The final rule also eliminates a complicated allocation method that would have been required when owners take flights on a substitute aircraft. Instead, only the fair market value of those specific charter flights involving substitute aircraft will generally be subject to FET. It also clarifies that aircraft owners qualify for the FET exemption regardless of whether they conduct flights on their own aircraft under Part 91 or Part 135 of the Federal Aviation Regulations.

The final rule has yet to be released as of this writing. **KA**

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# Landing Alignment – Get It Straight!

by Tom Clements

**A** student who was going through initial King Air training once said to me, “I felt comfortable flying the King Air in an hour, but it took about a month to learn how to start the SOB!” I think we would all agree that the King Air – all the various models – are delightful flying machines and, indeed, quite easy to fly. To land them perfectly, however, is a difficult goal to achieve. In fact, it is difficult in *any* flying machine. This article will present a few of my observations about what is often wrong with the landings and present some suggestions for corrections.

Almost without exception, a pilot new to the King Air will land left of the runway centerline if he/she is sitting in the left seat. Likewise, they will land right of the centerline if sitting in the right seat. My theory is that their subconscious mind is making them “leave room” for this “big” airplane into which they are transitioning. Landing on the runway’s centerline is one of the criteria for a “perfect landing.” No, not 100% of the time. For example, a strong crosswind may lead the pilot to land on the downwind side of the runway and roll out toward the upwind side ... a classic technique that decreases

the actual crosswind component. But with typical light winds aligned with the runway, aiming for the centerline is the preferred technique. One never knows when a brake may bind or a tire may blow or a propeller might not reverse as expected so having the most maneuvering room on both sides of the airplane upon landing makes logical sense.

There’s an easy fix for the tendency to “leave room for the airplane” on the runway. It is this: Don’t fly the airplane; fly your seat.

What do I mean by “fly your seat?” I mean make your seat be the airplane’s centerline. When you fly a Piper Cub or a single seat warbird this is a given ... you are indeed sitting on the airplane’s centerline, on its longitudinal axis. Now make your own seat – whether slightly left or right of the actual longitudinal axis – be the axis you care about, the one you make move with the aircraft controls. I will let you in on a secret: If you fly so as to put the runway’s centerline right between the butt cheeks sitting in your seat, the airplane’s nose tire(s) will be closer to the centerline than if you “left room” for the airplane. (And, yes, with practice and understanding you can slide your seat just far enough left or right that indeed the airplane’s nose tire is tracking the centerline stripes.)

Have you been taught this important technique? When first transitioning into an airplane that you have not flown before, do this when taxiing out for departure: Put your seat exactly on the taxiway centerline and set your sight as far down the straight taxiway as you can. Now pick a point on the windshield, the glareshield or the instrument panel that aligns exactly centered in your line of sight to the far end of the taxiway. What if no obvious point can be found? Then lick your thumb, reach forward and place a thumb smudge on the windshield. That’s the longitudinal axis for your seat!

Now let’s make our “perfect” landing. First, we need to comply with the criteria presented on the Landing Distance charts in the POH if our results are going to be anywhere close to what the manufacturer thinks they will be. The charts present an “Approach Speed.” This is the speed at 50 feet above touchdown as the round out and flare begins. The term “Approach Speed,” to most pilots, refers to the speed they target from the Final Approach Fix (FAF) to the Missed Approach Point (MAP). But the term on the landing distance charts refers to the 50-foot speed and is calculated as 30% above stall speed in the landing configuration ( $1.3 \times V_{SO}$ , in most cases).

With this speed at 50 feet above touchdown, power levers now being reduced to idle and the tires rolling on the runway surface 1,000 feet further forward, an actual touchdown speed is not presented on the charts. However, my discussions with the Beechcraft test pilots as well as my personal experience and observations leads me to believe the touchdown occurs between 10 and 15 knots below the listed Approach Speed.

It’s helpful that most precision approaches – ones with vertical reference – use a TCH (Threshold Crossing Height) very close to 50 feet and that solid paint stripes denote the point 1,000 feet from the runway’s approach end. Those can be wonderful aids in our quest for the perfect landing.

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But when we are touching down on the short dirt strip at the ranch, we are forced to do our best “guesstimate” and place the 50 foot point at a location a little short of the actual runway, so that our touchdown point is safely near the actual threshold.

I, as well as many other aviation writers, have used lots of ink discussing crosswind landing technique. I won't belabor that topic again but suffice it to say that now's the time that standard rudder/aileron coordination gets rightfully ignored. Instead, we use the rudder to align the longitudinal axis with the runway and we use the ailerons to prevent drift. Touching down first on the upwind main tire is the proper outcome that this achieves. If we let the airplane touchdown while drifting sideways and/or without the proper alignment then the airplane pays the price and the passengers readily feel the mistake. Yes, you can walk away from the landing and the airplane can even be flown again ... but perfect it isn't!

My observation is that very often the slight jerk felt at touchdown is not due to left or right drift but instead is due to improper alignment. That is where the technique of “flying your seat” really pays a benefit. Make certain the rudder pedals have been used properly so as to put your seat's longitudinal axis (remember the smudge mark?) smack dab on the far end of the runway. Ahhhh ... isn't that nice? No jerk today.

How's your ego? Is it strong enough that you are willing to sacrifice the quest for a squeaker today? I am sure you, like I, have been guilty of floating well past your touchdown aiming point, keeping a little power on, feeling for the runway, and hoping for that magical moment when it's hard to tell the airplane is rolling and no longer flying. We've all done this ourselves and watched as other pilots strive for the squeaker. But you know what? Unless a good dose of luck is on your side, this technique merely makes the touchdown jolt occur farther down the runway than the aiming point. Right? In my opinion, a so-gentle-that-it's-hardly-felt touchdown plays no part in the perfect landing criteria. Sure, on the 10,000-foot-long runway with the FBO at the far end and light winds, who can resist striving for a squeaker? I am sure that I can't. But avoid making this a part of your normal technique. On speed, on centerline, no drift and perfectly aligned ... those are what constitute a perfect landing. At least that's *my* opinion. **KA**

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King Air expert Tom Clements has been flying and instructing in King Airs for over 46 years and is the author of “The King Air Book” and “The King Air Book II.” He is a Gold Seal CFI and has over 23,000 total hours with more than 15,000 in King Airs. For information on ordering his books, contact Tom direct at [twcaz@msn.com](mailto:twcaz@msn.com). Tom is actively mentoring the instructors at King Air Academy in Phoenix.

If you have a question you'd like Tom to answer, please send it to Editor Kim Blonigen at [editor@blonigen.net](mailto:editor@blonigen.net).



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IN HISTORY

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# Wichita Orphans (Part Two)



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The Cessna P-10 was designed as a high-performance, multi-engine trainer powered by two Jacobs radial engines, each rated at 300 horsepower. A large canopy covered the two-seat cockpit.

(Wichita State University Libraries, Special Collections and University Archives via Robert J. Pickett Collection/Kansas Aviation Museum)



Cessna Aircraft Company's experimental C-106, P-7 and P-10 were designed and developed amidst the fury of World War II but failed to progress beyond the prototype stage.

by Edward H. Phillips



**D**uring the winter of 1940, western Europe was quiet. Poland had fallen to the Nazis, part of Finland was under Soviet control and a brief but tranquil three-month period known as the “Phony War” settled over the continent. Earlier that year when Germany had conquered Denmark, Norway and the Low Countries, the ugly reality of America’s involvement in the conflict began to look like a real possibility – only France and England stood between Adolph Hitler and the Statue of Liberty in New York Harbor.

In Wichita, Kansas, the board of directors at the Cessna Aircraft Company came to the same realization that if the United States was left to face Hitler alone, she was woefully unprepared for the fight to come. Fortunately, there were 3,000 miles of Atlantic Ocean between

America and Europe that stood as a major obstacle to any invading German force. If Uncle Sam had to take up the sword, then he would need airplanes, thousands of them, from single-engine primary trainers to four-engine heavy bombers and everything in between.

Flight tests of the prototype C-106 led to construction of a second airplane, the C-106A. It featured geared radial engines, full-feathering, constant-speed propellers and a larger cargo door. The two Loadmasters built were cut up for scrap in 1943. (Wichita State University Libraries, Special Collections and University Archives via Robert J. Pickett Collection/Kansas Aviation Museum)



Cessna General Manager Dwane Wallace envisioned the new twin-engine Model T-50 as a strong candidate for a multi-engine trainer. He soon began preparing for large scale production of the *Bobcat* (as it was unofficially known) if war came to Wichita's doorstep. The T-50 was the company's first twin-engine ship and the prototype flew March 26, 1939. In June 1940, the board of directors approved a major expansion of the facilities to accommodate anticipated orders for the T-50 and, possibly, the single-engine Model C-145/C-165 *Airmaster*. Wallace, however, realized that there would be little or no demand for a military version of the *Airmaster*, and the last of 186 airplanes was built in 1941.

Completed at a cost of \$50,000, the expansion added 28,000 square feet of floor space dedicated to final assembly operations. Although the company had sold a small number of the twin-engine ships to the Civil Aeronautics Authority and commercial operators, the T-50's true potential was in the military marketplace. Wallace had held meetings with representatives of the United States Army Air Corps about the airplane's specifications and performance. The Army was interested in replacing aging, obsolete trainers but Congress still held a tight rein on the nation's purse strings and there was little money available to upgrade and modernize the Air Corps.

President Franklin D. Roosevelt changed that when, in the wake of France's capitulation to the Germans, he called for production of 50,000 airplanes as part of America's "Arsenal of Democracy." Congress relaxed its grip on the budget and soon hundreds of millions of

dollars were made available. The Air Corps sought to revitalize its air fleet and twin-engine trainers were high on its list of priorities. Cessna received orders for 33 military versions of the T-50 designated AT-8, and soon the Royal Canadian Air Force (RCAF) placed orders for 180 airplanes designated Crane I.

As the fateful year 1941 arrived, more than 1,500 workers labored in three shifts to build the AT-8 and Crane I. Later that year the Cessna engineering staff initiated a program to improve performance of the aircraft. The project was classified as "P-7" and centered on a series of upgrades to the existing *Bobcat* and redesignated T-50A. The only major improvements were installation of Jacobs L6MB static, air-cooled radial engines, each rated

at 300 horsepower, replacing the 225-horsepower L4MB powerplants of the T-50. Because the P-7 would be capable of higher speeds and feature increased wing loading compared to its predecessor, the wood wings and empennage surfaces were sheathed with plywood that also provided increased torsional strength for the entire wing structure.

In addition, the airplane would have a higher maximum gross weight and needed a new landing gear arrangement to handle the increase. Cessna reportedly purchased main landing gear from North American Aviation that was used on its T-6 advanced trainer and modified the gear to fit the T-50A. Only one prototype was built and first flew June 2, 1941, with veteran Cessna pilot Mort Brown at the controls. Flight testing demonstrated that the airplane possessed a significant improvement in takeoff, climb and maximum speed, achieving more than 200 mph. A series of tests continued through that summer and the ship was often flown by Dwane Wallace. The Army Air Corps and the RCAF, however, expressed little interest in the P-7 project and no orders were forthcoming, chiefly because both air forces were content with the AT-8 and Crane I that already were in full production. The P-7 eventually was dismantled at the factory and disappeared.

Cessna's engineers, however, were already working on another design intended to be a potential replacement for the venerable T-50. Known around the factory as Project P-10, the airplane essentially was a high performance, multi-engine trainer that made extensive use of the T-50 airframe and components but was equipped with



a bubble-type canopy enclosing a cockpit featuring side-by-side seating for the instructor and student. Wingspan was reduced slightly and the wings, empennage and fuselage were covered in plywood. Aluminum alloys were used to construct the engine nacelles and cowlings for the two Jacobs L6MB radial engines, each producing 300 horsepower.

As with the P-7, Cessna engineers used a modified version of the AT-6's main landing gear to support the heavier P-10 on the ground. On October 6, 1940, Mort Brown climbed into the P-10's cockpit and took the ship up for its first flight. He noted that the airplane had excellent visibility from the cockpit and very good performance compared to the AT-8. More flight tests followed until late that year when Brown turned over responsibility for flying the P-10 to Carl Winstead, another company pilot and long-time member of Wichita's aviation fraternity. Unfortunately, the Army Air Corps was not interested in the P-10 because it had a sufficient number of training aircraft on order through 1944, and no contracts were forthcoming. According to Cessna Aircraft Company records, the airplane was dismantled at the factory in October 1941 and, as with the P-7, disappeared.

One other important story about Wichita during the war centers on Cessna's participation in the U.S. Army's quest to assemble a large force of combat gliders. In 1942 the Allies began planning for "Operation Overlord" – invasion of Hitler's "Fortress Europe." An important part of that highly complex plan was the use of gliders to airlift troops and equipment behind enemy lines. The glider of choice was the Waco CG-4, designed by the Waco Aircraft Company located in Troy, Ohio. In June, Wichita received orders to help build the aircraft and commanded to give the work top priority. Delivery of more than 700 gliders was to be accomplished by October.<sup>1</sup>

Cessna Aircraft Company's role was building the outer wing panels. To accomplish that task on time, a special factory boasting 108,000 square feet was erected in only 30 days near Hutchinson, Kansas, 50 miles northwest of Wichita. Beech Aircraft Corporation was assigned responsibility for the inner wing panels. Beech and Cessna delivered their assemblies to the Boeing-Wichita Division that retained overall responsibility for the program. The gliders were assembled and delivered to the U.S. Army as scheduled and played their part well in the early morning



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hours of June 6, 1944, acting as the spearhead of a massive Allied force invasion.

When 1943 arrived, Cessna management was looking to the future when demand for the military T-50 would inevitably decline as Germany, Japan and Italy were defeated. That year the Allies were in ascendancy across every front as Germany was battered by bombs and weakened by fighting on two fronts; Japan was on the defensive throughout the Pacific and Italy was on the brink of collapse.

Meanwhile, back in Wichita as hundreds of Cessna twin-engine trainers continued to roll off the assembly lines, the engineering department was working on an-

other airplane that could help the Army transport supplies to soldiers fighting at the European and Pacific fronts. It would be built of non-strategic materials, possess good overall performance and be capable of operating from short, unimproved airstrips that were commonplace in a war zone.

Designated Project P-260 and nicknamed by Cessna as the *Loadmaster*, the design featured the company's characteristic all-wood, full-cantilever wing mounted atop a welded steel tube fuselage. The conventional landing gear was fully retractable, and two Pratt & Whitney R-1340S3-H1 radial engines that each produced 600 horsepower (takeoff rating). The forward fuselage section around

the cockpit and the wing nacelles were the only assemblies that used aluminum alloy – the fuselage was covered in fabric doped and shrunk to fit. The wings were sheathed in plywood as were the horizontal and vertical stabilizers. The flight control surfaces were made of welded steel tubing covered with fabric.

The Army Air Corps like the *Loadmaster* and assigned the designation "C-106" to the high-wing monoplane. The prototype made its first flight January 1943 and was the largest Cessna airplane built up to that time. As the flight test program progressed, the engineers needed a pilot with experience flying large aircraft, and they had just the right man in mind. "Deed" Levy, well known and a highly experienced pilot for the Boeing-Wichita Division, was called in to help evaluate the airplane's handling characteristics. Levy's suggestions coupled with those of Air Corps pilots led to construction of an improved, second prototype, the C-106A. It featured three-blade propellers, geared engines and a redesigned fuselage that included a larger cargo door to better facilitate loading and unloading operations.

With a wingspan of 64.7 feet and a length of 51.1 feet, the C-106A weighed in empty at 9,000 pounds and could be loaded up to a maximum takeoff weight of 14,000 pounds. Maximum speed was projected to be 195 mph. The C-106A took to the skies over Wichita April 9, 1943, and won Cessna Aircraft Company a contract for 500 of the transports. Unfortunately, the Air Corps later decided it could not justify manufacturing the airplane due to high priority for materials to build other aircraft. The contract was canceled and both the C-106 and C-106A were scrapped at the factory.



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A few other projects developed by Cessna Aircraft during the war are worthy of mention, although none progressed beyond the drawing board or mock-up stages:

In May 1941, a two-place version of the Bobcat, dubbed the T-55, was designed with two, 300-horsepower Jacobs radial engines providing a maximum speed of 225 mph. None were built.

One year later in 1942, Cessna engineers planned to install four Pratt & Whitney R-985-T1B3 *Wasp Junior* radial engines to an enlarged T-50 airframe transforming it into a four-engine trainer for heavy bomber aircrews. No further development occurred.

The T-70 navigator trainer was proposed in 1941 as a low-wing cabin monoplane powered by two Pratt & Whitney R-1340 radial engines. Seating 10 students in its spacious interior, the T-70 was designed to a maximum gross weight of 12,000 pounds and a maximum speed of 220 mph. The design was shelved in part because the Beechcraft AT-11 navigator trainer was already in production and serving that role well.

Project P-370 was known at the Cessna factory as the *The Family Car of the Air* during its development in 1944. Intended for the postwar lightweight airplane market, the P-370 made it to the mock-up stage but the project was canceled in 1945.

Perhaps the most bizarre project conceived by Cessna engineering during the war was the CTP-1 (Cessna Torpedo Plane) – a remote-controlled drone powered by

The C-106 was a good design and the Army Air Corps was interested in mass production of the twin-engine freighter, but only two were built. (Wichita State University Libraries, Special Collections and University Archives via Robert J. Pickett Collection/Kansas Aviation Museum)

a 200-horsepower engine and fitted with a 500-pound explosive warhead. The crude guidance system activated electric servos that deflected the rudder and elevators to control the flight path. The concept called for the CTP-1 to be guided over the target, the wings would be blown off by a charge and the fuselage would plummet downward and strike the enemy a mighty blow. None were built. **KA**

#### Notes:

- 1 The Waco CG-4 was built by 16 subcontractors during the war. A total of 13,909 were manufactured. The glider could carry 15 troops or a howitzer and fewer soldiers as well as supplies. The glider's wing spanned more than 83 feet. Gross weight was 9,000 pounds and maximum towing speed was 150 mph. The gliders were usually towed aloft by U.S. Army Air Forces Douglas C-47 and Royal Air Force Dakota transports.

Ed Phillips, now retired and living in the South, has researched and written eight books on the unique and rich aviation history that belongs to Wichita, Kan. His writings have focused on the evolution of the airplanes, companies and people that have made Wichita the "Air Capital of the World" for more than 80 years.

### Textron Aviation Announces King Air Technical Webinar

Textron Aviation has announced it will host a LIVE Technical Session with King Air aircraft experts Feb. 25, 2021, at 2-3 p.m. CST.

The webinar will include demonstrations of resources to streamline owner/operator's accounts, review of service bulletins and maintenance practices, addressing frequently asked questions posed to its product support lines, and take questions from attendees.

Registration is required. For questions you may send an email to [txtavsupport@txtav.com](mailto:txtavsupport@txtav.com) or contact your Textron Aviation representative at (316) 517-8270 or +1.844.44.TXTAV for international calls.

### Garmin Receives Approval for its GFC 600 Digital Autopilot in select King Air C90 and E90 aircraft

Garmin® International Inc. recently announced it has received Federal Aviation Administration (FAA) Supplemental Type Certificate (STC) approval for the GFC™ 600 digital autopilot in select Beechcraft King Air C90 and E90 aircraft<sup>1</sup>. The GFC 600 digital autopilot is optimized for turbine aircraft, delivering superior in-flight characteristics and new operational capabilities such as Vertical Navigation (VNAV), automatic Course Deviation Indicator (CDI) switching when paired with a GTN Series navigator, enhanced go-around capability and much more.

The GFC 600 certification for the Beechcraft King Air C90 and E90 provides owners and operators an autopilot upgrade that boasts superior integration potential with G600 and G600 TXi™ flight displays, the GI 275 electronic flight instrument, as well as the GTN™ and GTN Xi Series of navigators. The self-contained autopilot controller incorporates backlit keys and a bright, sunlight readable display that depicts autopilot status and mode selection. An intuitive built-in control wheel also provides convenient adjustment of aircraft pitch, airspeed and vertical speed modes. When the level button is selected, the aircraft automatically returns to straight-and-level flight.

Environmentally hardened autopilot servos designed for harsh operating conditions contain brushless DC motors offering improved performance and reducing maintenance requirements when compared to decades-old servo designs on the market today. In addition, these servos are optimized for turbine aircraft by offering more torque to help better command and respond to control demands required of turbine aircraft.

Standard mark-width (6.25-inch) design of the GFC 600 mode controller ensures the autopilot controller allows for routine installation into the aircraft's avionics stack. Autopilot mode annunciation is available on the G600 TXi touchscreen glass flight display, as well as the G600 flight display. The addition of an optional autopilot annunciator panel also displays the selected autopilot mode in the pilot's primary field of view and retains an identical footprint of third-party autopilot annunciators on the market.

In addition to traditional autopilot capabilities such as altitude hold, vertical speed and heading modes, the GFC 600 also includes:

- Premium functions and advanced capabilities such as altitude pre-select<sup>2</sup> and indicated airspeed hold mode
- Pilots can select, couple and fly various instrument approaches, including GPS, ILS, VOR, LOC and back course approaches<sup>3</sup>
- Built-in GPS roll steering capability eliminates the need for external roll steering converters, allowing for smoother navigation tracking when installed with a compatible navigator
- Level Mode button, which automatically engages the autopilot to restore the aircraft to straight and level flight
- Underspeed protection helps prevent the pilot from stalling the aircraft
- Overspeed protection helps prevent the pilot from exceeding aircraft maximum speed (VNE)
- Yaw Damping (YD) mode minimizes yawing oscillations while also helping to maintain coordinated flight
- Flight Director command bars can be displayed on flight display such as the G600 and G600 TXi
- Pilots can fly coupled 'go-arounds' during missed approach sequencing. A remotely-installed go-around button commands the Flight Director to display the appropriate pitch attitude required for the missed approach procedure and activates a loaded missed approach when paired with a GTN 650/750 or GTN 650Xi/750Xi navigator
- Included pitch-trim servo adds automatic trim and improved manual electric trim
- Control wheel steering is available, which allows the pilot to adjust pitch, roll, altitude hold, vertical speed or airspeed references using the control yoke while the autopilot is engaged



As a standard feature, pilots receive Garmin Electronic Stability and Protection (ESP™) with the GFC 600 digital autopilot, which works to assist the pilot in maintaining the aircraft in a stable flight condition. ESP functions independently of the autopilot and works in the background to help pilots avoid inadvertent flight attitudes or bank angles and provide airspeed protection while the pilot is hand-flying the aircraft.

The GFC 600 digital autopilot for the Beechcraft King Air C90/E90 is available immediately through select Garmin authorized dealers. To view the most up-to-date aircraft STC list, certifications that are expected to begin in the next 12-months, or to express interest in a specific aircraft make/model for the GFC 600, visit [www.garmin.com/GFC600](http://www.garmin.com/GFC600). For additional information, visit [www.garmin.com/aviation](http://www.garmin.com/aviation).



Notes:

1. STC approved for Beechcraft King Air C90, C90-1, C90A, C90B, C90SE, C90GT, C90GTi, E90, and does not include those aircraft equipped with Garmin G1000/G1000 NXi, or Collins Pro Line integrated flight decks.
2. Requires compatible flight display.
3. GFC 600 requires an external navigator for navigation and approach functions. See website for additional compatibility information.



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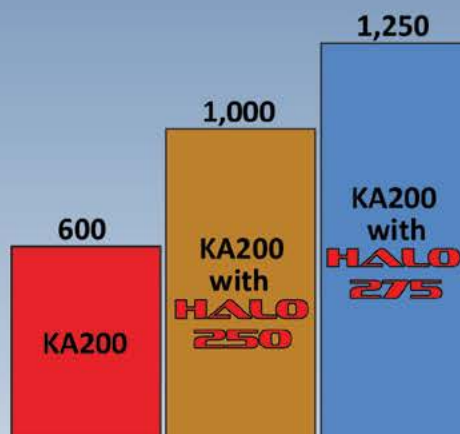
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