King Air

A MAGAZINE FOR THE OWNER/PILOT OF KING AIR AIRCRAFT

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Strong and Steady

King Air Market Continues to be Solid

King Air
March 2023 Volume 17 / Number 3
A MAGAZINE FOR THE OWNER/PILOT OF KING AIR AIRCRAFT

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The King Air Ma

Strength in Stability

by Chip McClure

The King Air 350 market which was lagging behind in 2021 is now seeing inventory very low and prices continuing to rise.

The current aircraft market is enough to make your head spin! Is it getting better or is it getting worse? Are inventory levels actually going up or is it just a bunch of junk listed on *Controller.com*? What will I pay? Am I able to complete a prebuy inspection? Is it still a seller's market? Or is it a buyer's market? What about supply chain issues? If I pay too much to buy an airplane, is that the end of my pain or just the beginning?

I heard you can't get windshields, pre-coolers, wingnuts … or pilots. What? Now we have to worry about aircraft parts too?

The company that makes Hawker windshields went out of business. The company that makes pre-coolers is in Israel, but the metal comes from Ukraine. What's a wingnut and why can't you get them? Tires? It's also challenging to get new tires? What's this unobtanium that everyone keeps talking about? With a client's Hawker currently AOG waiting on gear parts and a Mustang in a prebuy at Textron waiting on pre-coolers, the jet world feels a little scary right now, but what about our beloved King Airs?

The answer is things are looking "pretty good"!

We are waiting for a King Air windshield, but it sounds like a delay, not a disaster. Our client just ordered Raisbeck Leading Edges and Ram Air Recovery for the same airplane and those items have already been received. There was a little wait for their lockers and sweet new 5-blade composite props, but we can deal with that.

The great news for King Air owners and operators is that other than a little hiccup in windshields, Goodyear tires and the lack of replacement automatic window shades for King Air 250s, we are faring really well.

This is mostly because the King Air fleet is the largest fleet of business aircraft ever produced, a total of 7,820 King Airs of various models have been manufactured! As of the writing of this article, there are still 6,165 King Airs listed as "in operation," which is nearly 79%! That says a lot about the durability of these airframes considering the first King Air rolled off the line in 1964, but it also means that over 1,600 airplanes are no longer in operation – many of which gave up their lives so that their parts keep other King Airs alive. Their airframes resting eternally in salvage yards from Kansas to Oklahoma, to Brandon, Mississippi (a shoutout to my buddy Carl at Davis Aviation). But it's not just an abundant supply of used parts and spares, the network of vendors that manufacture components for King Airs is vast. In many cases, there is more than one supplier for a specific part or component. I mentioned Goodyear tires because they're hard to get, but the Michelin tires are not, so in a time when many jets are grounded because of flat spots our beloved King Airs fly on!

What does this mean for King Air values and the King Air market in general? *Stability.*

The King Air market is still complicated, but it is stable. The first thing to understand is that it's really several individual markets,

Textron is no longer manufacturing the King Air 90 series aircraft; its pricing on the used market is elevated but stabilized. (Credit: Michael Coleman)

divided by major model groups and also by age. Thankfully, we don't see any issues that will taint the entire market – not supply chain problems and parts availability or concerns about dispatch reliability. The vulnerable King Air remains solid.

So, where are we today?

The question I get asked most often is, "What is going to happen with King Air prices?"

I wish I knew; I mean really knew! The reality is, it is no more possible to predict what aircraft values will do in the future than it is to predict what the stock market will do, but we can read the tea leaves and plan accordingly.

So, to answer the question, are the current prices going to remain this high? Yes, I believe they are at least for newer airplanes. In fact, they may even go up more. We do not see any signs that prices are going to drop. With a steady increase in demand and limited inventory, the best we can hope for is stability. We're already there for the late model 90 and 200 series King Airs (more on this later).

As I mentioned earlier, the King Air market is really divided among models, the 90 series, 200 series and 350 series being the most common. You then have the "late models," the "legacy models" and the "old models." It hasn't been that long ago that I would have said that the older and legacy airplanes were in the ›

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The introduction of the King Air 360 included a new redesigned cabin and new interior options. Electric air conditioning was added as a standard starting this year. There continues to be a backlog of orders for new aircraft. (Courtesy: Textron Aviation)

same market as the new airplanes of the same series, but that has changed. The reality is that banks and finance companies have been harder on older aircraft for many years. While that put downward pressure on the values (think cash buyer), that was the only real problem.

In today's market we have another factor: insurance. If you tell a prospective buyer they can't get financing, many will just pay cash. But if you tell them their insurance may be a lot more expensive, they start to think a newer airplane might be worth looking into. This is not only an unease for buyers of older airplanes, it is a concern for those purchasing newer airplanes, as well.

The reality is that the older airplanes will be leaving the operational fleet in record numbers over the next few decades. Of the 6,165 King Airs still flying, more than 2,000 are over 40 years old! The fact is that the already scarce late model King Airs are probably going to become even harder to find. There are a lot of new turboprop airplanes being built, not just King Airs, but Pilatus, TBMs, Pipers and the new Beechcraft Denali. The new airframes will help, but overall, as the older airplanes fall away and the only replacement options are new airplanes, the prices will continue to rise.

The other issue is that the TBMs and Piper M600 might be a decent replacement for the 90 series aircraft, the Pilatus and the Denali very good replacements

The King Air 200 market seems to be stable with prices elevated from last year, but no longer increasing for now.

for the King Air 200 series but … what about the 350 series?

Textron built just over 20 King Air 360s last year and that wasn't because of lack of sales; they sold every one they could build and have a serious backlog of orders. Thankfully, the oldest 350 was born in 1990 so they aren't aging out anytime soon, but they still aren't being produced fast enough to meet demand and there aren't any real substitutes. This is why I saved the 350 series for later.

In my 2021 King Air market article, I talked about how King Air values were going up and the 350s were lagging behind. Those who heeded my advice are thankful they did! The average 350 has gone up at least $1 million and the later models closer to $2 million.

While the King Air 90 and 200 markets seem to be stable with prices elevated from the year before but no longer increasing, the 350 market is showing its independence. Inventory is very low and prices continue to rise.

In summary, the market for King Airs is stable and strong, no matter what happens overall. Our King Airs will continue to be the safe harbor in any storm. They're reliable, economical to operate, and the safest investment you'll likely make in a business class aircraft. KA

Chip McClure has been in the aviation industry for over 20 years. He and his wife Amy founded Jet Acquisitions in 2015; the firm exclusively represents turbine aircraft buyers and specializes in King Airs, as well as all models of current production turboprops and jets.

Why the Evolution to Propellers with More Blades?

by Martin Albrecht (President, MT Propellers) | Provided by BLR Aerospace

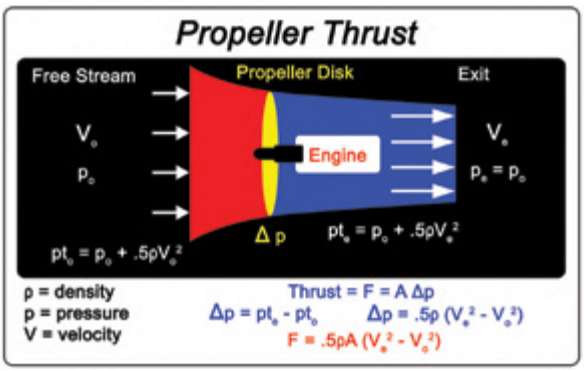
With the improvement in materials and Computational Fluid Dynamics (CFD) software, the trend toward more blades on propellers is clear. From the original standard of 3-blade propellers, technological advancements have allowed for the development of 5-blade or even 7-blade propellers, which are increasingly common for turboprop applications.

Classic propellers were made with hubs from steel and utilized aluminum blades. Propellers with more than three blades or even five blades, were not possible because of engine and airframe limitations due to the limiting factor of their weight.

With the availability of newer materials, the transition to propellers made with light-weight aluminum hubs combined with light-weight composite blades was made possible. Composite blades can now be made from a special high strength, plasticized structural wood combined with carbon fiber layers or a foam core wrapped with carbon fiber.

These new materials allowed for four, five or even seven-blade propeller systems with minimal increases in the overall weight. Additionally, with lighter weight blades, a reduction of gyroscopic moment lowers the loads on the engine/airframe by up to 40%.

A propeller produces thrust through a momentum transfer from the propeller to the air by the rotation of the propeller blades. Propellers are designed to produce maximum thrust from the torque (a function of HP and RPM) supplied from the engine.



The purpose of a propeller is to convert engine power, delivered by the rotating engine shaft, into thrust and to do so as efficiently as possible throughout the flight envelope. Propeller efficiency is therefore a function of the ratio of the power produced by the propeller to the engine power applied to it.

The definition is as follows:

Thrust Power [W] = Thrust [N] * Velocity (Distance [m] / Time [s])

Torque Power [W] = Torque [Nm] * Rotational Speed [RPM] / 60 sec

Propeller Efficiency = Thrust Power [W] / Torque Power [W]

With the improvements in propeller system design over the years, efficiencies of 87-90% are possible in propeller systems produced today.

A propeller is designed just like an aircraft wing to create lift. The optimum lift for the highest efficiency occurs with a Coefficient of Lift (C_L) between 0.4 and 0.7, ideally reduced to a minimum at the blade tip.

Propeller performance is characterized by thrust, propeller efficiency and power coefficient. The power coefficient is related to how much power it takes to turn the propeller and the propeller aerodynamic loading. Power Coefficient (C_P) can be defined by the following equation:

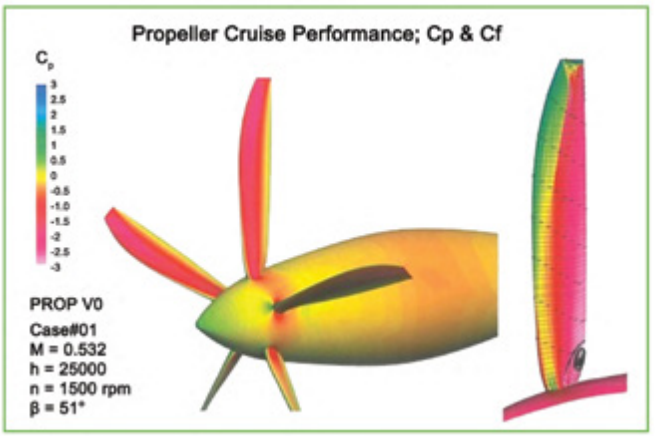
$$C_P = \frac{P*1000}{\rho*(N/60)^3*D^5}$$

where P is Power, z is the density of air, N is propeller RPM and D is propeller diameter.

As can be seen in the equation above, a change in the diameter of the propeller has five times more impact on aerodynamic loading than changing Power.

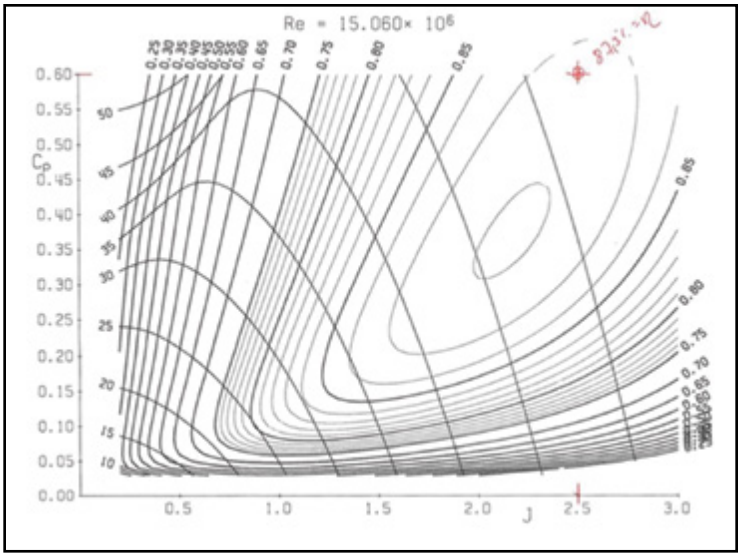
Modern simulation software (CFD) takes into account the aerodynamic flow, including compressibility losses on the blades at high Mach numbers. By shaping the blade with twist, providing an ideal angle of attack with oncoming air along the blade and incorporating a scimitar shape, swept-back blades similar to airplane wings, the critical Mach numbers can be avoided, minimizing compressibility losses especially at higher altitudes (low air density) and higher speeds (see Propeller Cruise Performance image, opposite page).

The very best contemporary propellers can approach 90% peak conversion efficiency, but with any propeller, the efficiency drops very rapidly as the tip velocity exceeds its optimal value, typically in the 0.84 to 0.88 Mach range. Propeller performance maps (see example



below) provide propeller efficiency at various combinations of advance ratio, blade pitch angle and power loading. The advance ratio is the ration of oncoming airflow, or true airspeed, versus propeller blade tip speed.

"Propeller systems with additional blades improve propeller efficiency, converting engine power to thrust, and the lift distribution along the blades, making takeoff, climb and cruise performance comparable to larger diameter or fewer blade propeller systems."



Propeller Performance Map

The ideal design solution would be the slowest turning propeller with the biggest diameter possible while staying below a maximum blade tip Mach number of 0.88 at high speed. A good example of this configuration is the P51 Mustang from World War II, one of the fastest propeller fighters ever built.

Of course, the maximum allowable propeller diameter is limited by the airframe designer. Therefore, to achieve the highest efficiency possible only the propeller RPM, diameter and the number of blades can be varied.

A change in RPM results in a change in pitch, thanks to the propeller governor. However, propeller RPM is not only a factor in propeller efficiency but also in other airplane performance related characteristics. Such factors include airplane speed and cruise fuel efficiency, endurance and specific range capability, noise and vibration. These airplane level factors are also important as they relate to propeller design and RPM.

Reducing the diameter of the propeller, not only lowers the level of noise produced, it also reduces compressibility losses, increasing the propeller efficiency. Without the addition of more blades, the older classic propellers would be aerodynamically overloaded resulting in partial stall and lower overall efficiency.

As engine power is increased, the propeller needs to transmit this power to the air flow passing through the propeller disk to generating thrust. A parameter used to evaluate this relationship is the Solidity Ratio, a ratio of propeller blade area to overall propeller disk area, defined as:

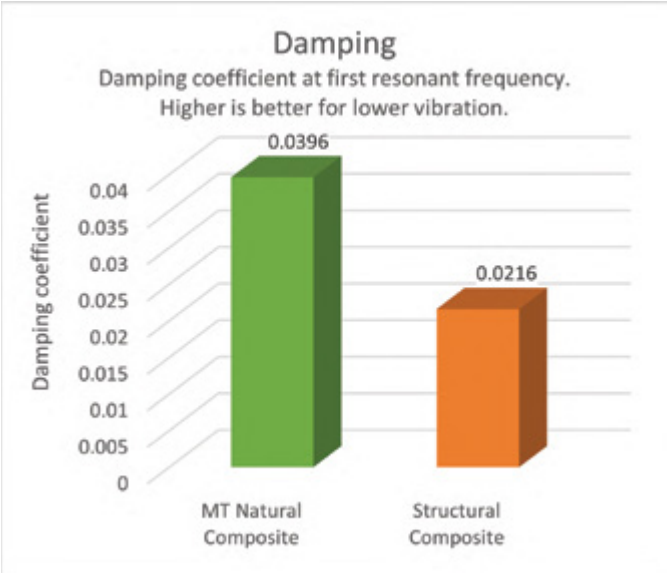
$$\sigma \equiv \frac{A_b}{A_d} = \frac{NcR}{\pi R^2} = \frac{Nc}{\pi R}$$

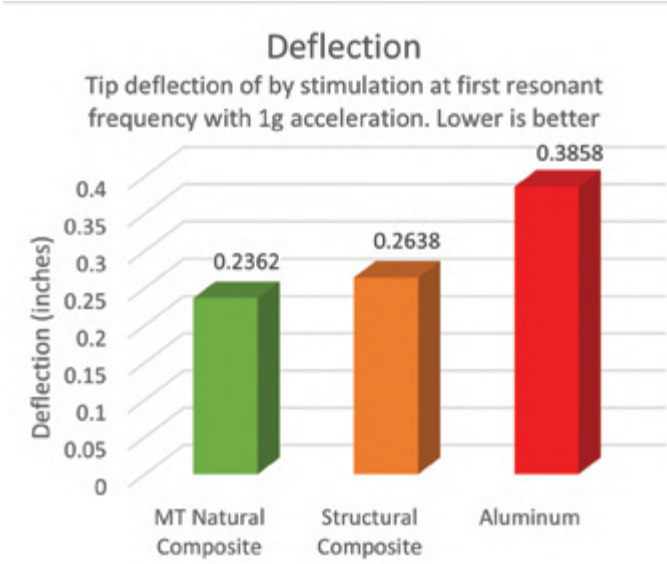
where N is the number of blades, c is the chord of the blade and R is the diameter of the propeller disk.

The more power available from the engine, the higher the required solidity ratio to absorb that power. Increasing the chord of the blades is an option, however, this leads to increased interference between the blades reducing the propeller efficiency as well as higher blade pitch change forces and lower blade frequencies increasing the risk of a resonance. Therefore, the addition of blades to the propeller system is the best approach to increasing the solidity ratio.

Propeller systems with additional blades improve propeller efficiency, converting engine power to thrust, and the lift distribution along the blades, making takeoff, climb (single- and multi-engine) and cruise performance comparable to larger diameter or fewer blade propeller systems. This propeller combination of more blades with a smaller diameter, results in a reduction in airframe noise results as the blade tips are quieter at the lower Mach number and at a greater distance to the fuselage, making the flight even more comfortable and reducing fatigue in the flight crew and passengers. The additional benefit of having a smaller propeller diameter is the additional ground clearance to mitigate FOD damage to the blades, which is critical if operating on unimproved runways.

Propeller design is not only governed by aerodynamics but also the structural requirements. The lower weights of newer blade materials reduce the loads not only on the blade itself, but also on the propeller



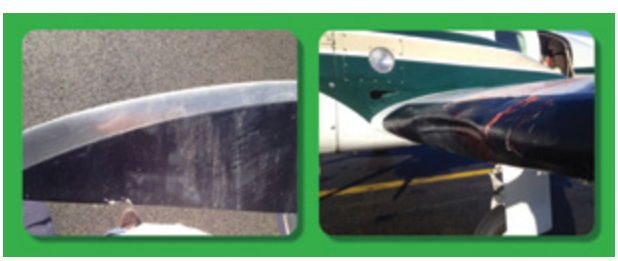


hub and related blade retention hardware. By designing the lightest blades with the best vibration dampening qualities, the structural requirements of the hub and retention hardware can be more easily addressed.

The trend from metal, to structural composite, and finally natural composite blade construction shows the clear vibration and damping characteristic improvements gained with each respective technological advancement. The above figure shows the vibration and damping characteristics associated with various blade designs.

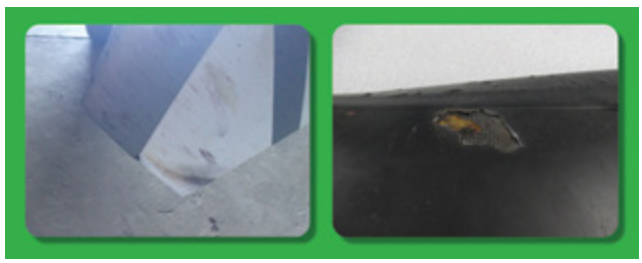
With respect to durability, all major propeller manufacturers have certified the use of composite blades to the latest 14 CFR Part 35 requirements, or the equivalent CS-P certification requirements, to take advantage of their benefits. Bird strike testing is a major activity in the certification of these blades. The testing involves firing hundreds of birds at the blades in a series of tests, under strict conditions defined by the certification authority, to demonstrate survivability of such impacts.

The following photos show the damage to the propeller blade (left) and the wing leading edge (right) from an in-service incident where an 8-pound stork impacted a turboprop airplane during takeoff.



In addition to the bird strike requirements for the certification of composite blades, lighting strike can be a major challenge in the certification process. All composite blades must meet lightning strike requirements, with the ideal design practice being that the load carrying structure is not conductive. In the situation where the load carrying structure is conductive, a lightning strike would necessitate scrapping of the blade. In the case where a natural composite is used as the load bearing structure, after lightning strike, the blade can be repaired, in many cases with a field-repair and/or overhauled.

The photos below provide an example of a lightning strike on a natural composite blade. The picture on the left shows where the lighting strike hit the blade, and the picture on the right where the lighting left the blade.



In addition to lower weights and the corresponding structural and vibration advantages, composite blades have the advantage of longevity. Unlike metal propeller blades, composite blades are resistant to corrosion. Additionally, composite blades are easier to maintain and repair. Unlike composite propellers, the performance of metal propellers begin to deteriorate from the day they are installed as a result of the grinding away of surface blemishes, gouges and other FOD damage, permanently removing material during overhaul and repair. During their limited service life, metal blades surfaces deviate further and further from their designed outer mold line (OML) until ultimately they must be replaced. On the other hand, composite blades are repaired by removing damage, then adding material back onto the blade, thereby restoring its OML. In this way, many composite blades have unlimited life and use. The oldest composite blades have now been in service for 80 years and are still airworthy.

Improvements in design methodology, analysis tools and new materials technologies have allowed propeller designers to push their designs closer and closer toward the maximum possible efficiencies by adding more propeller blades, going beyond what was possible with the limitations of classis designs and materials. The byproducts of these efficiencies, in the form of lower noise, lower vibration and improved durability and longevity clearly align with the desire of operators to lower operating costs and improve the overall experience for their crew and passengers. Higher blade counts are propelling the industry into the future.

Taking it to a New Level

King Air Gathering

April 12-14, 2023 • St. Augustine, Florida

by Kim Blonigen

The very first King Air Gathering (KAG) was held in April 2017 after a few King Air enthusiasts (King Air Expert Tom Clements included) discussed that it may be time to plan a "gathering" of King Air owners/pilots with the following goals guiding them: 1) get a group of like-minded owner-pilots together to share information and to see what the "other guy" is doing with his King Air. 2) Have an outstanding group of experts who can put on hard-hitting presentations.

After word started getting around, various King Air aftermarket vendors indicated a strong willingness to attend. They could exhibit their products and services to educate the attendees about the various possibilities there were to improve their aircraft. Just under 50 King Air owners/pilots attended the first gathering and each one held the following years gained more support from sponsors, vendors, speakers and attendees.

Making a Great Event Even Better

This year King Air Nation has made it a goal to "take an already great event to a new level" by hosting KAG at an upscale location, providing a broader variety of speakers, more specialized (by King Air model series) breakout sessions to provide specific information for your aircraft type and expanded social events including

Textron Aviation is excited to bring in Chef Amanda Freitag for a cooking demonstration and tasting experience for the King Air Gathering Companions! The two-hour session will finish with an interactive Q&A with Amanda herself.

Born and raised in New Jersey, chef, author, and television star Amanda Freitag has become a culinary maven. Following her graduation from the Culinary Institute of America, Amanda worked in a diverse mix of restaurants in New York City, including Jean-George Vongerichten's Vong, Verbena, Il Buco, Cesca, and The Harrison, running the culinary gamut of Mediterranean, Italian, and Classic American. She sharpened her skills through world travel, including working under Chef Alain Passard in Paris, and continued expanding her culinary expertise into a variety of international cuisines.

Outside of the restaurant business, Amanda has become a household name for her work both on and off the television screen. She is well known for being a judge on Food Network's "Chopped" and has appeared on "Iron Chef America", "Next Iron Chef", "Unique Eats", "Beat Bobby Flay," Guy Fieri's "Tournament of Champions," and many more.

Her mission to make cooking more approachable inspired the creation of her cookbook "The Chef Next Door," her set of five unique spice blends, a collection of ready-to-pour bottled cocktails, and other ongoing culinary projects. Amanda has also earned notoriety on social media for her tutorial series "EasyAF," where she shows audiences that delicious food can be fun and simple to make in the comfort of your own home.

a dinner sponsored by Textron Aviation with a live auction, as well as adding activities for companions.

Besides being invited to the social activities of the KAG, there are a variety of other events planned specifically for your companion. On Thursday afternoon, a very special event being provided by Diamond sponsor Textron Aviation – a cooking demonstration and tasting experience by Food Network's Chef Amanda Freitag (see more details at left). Friday, there will be a private tour of historical downtown St. Augustine with lunch and shopping afterward.

Special pricing on rooms is being offered for King Air Gathering attendees. To book your room online go to Marriott Renaissance Hotels website. If you'd rather make the reservations by telephone, call (904) 940-8000 and use code "KINGAIR" to receive the special rate.

“This year King Air Nation has made it a goal to ‘take an already great event to a new level’ … ”

One of the companion activities is a private tour of Old Town St. Augustine with lunch and shopping.

The King Air Gathering will be held at the World Golf Village Resort in historic St. Augustine, Florida.

There is an abundance of more detailed information about the gathering that can be found at: *www.kingairnation/gathering*. You can also go to KingAirevents.com, where there are instructions on how to register. If you haven't registered yet, NOW is the time before it's sold out!

Don't miss the opportunity to join with other King Air owners and pilots while educating yourself about all things King Air. Make plans now to attend King Air Gathering 2023, being held at the World Golf Village in St. Augustine, Florida, Wednesday, April 12 through Friday, April 14. KA

Beechcraft King Air 260 Chosen as New U.S. Navy Multi-Engine Training System (METS)

Textron Aviation recently announced it has been awarded the Multi-Engine Training System (METS) contract by Naval Air Systems Command (NAVAIR) through a full and open competition.

The contract award is for up to 64 special mission King Air 260 aircraft, which will be known as the T-54A. The initial Lot I award will procure 10 new Beechcraft King Air 260 commercial aircraft and associated support. Lot II and Lot III, if the options are exercised, would each procure up to 27 aircraft. Aircraft deliveries are planned from 2024 to 2026.

The King Air 260 aircraft acquired under the METS contract will replace the Chief of Naval Air Training (CNATRA) fleet of T-44C Pegasus aircraft. The T-44C Pegasus is a variant of the twin-engine and pressurized Beechcraft King Air 90 and has been in service since 1977.

The company says METS will provide an intermediate and advanced training platform for U.S. Navy, U.S. Marine Corps and U.S. Coast Guard aviators into the P-8, EP-3, KC-130, E-6, E-2, CMV-22, CV-22 and MV-22 aircraft.

METS specific capabilities include factory options for TACAN (Air to Air), angle of attack (AOA), V/UHF

“ ... METS will provide an intermediate and advanced training platform for U.S. Navy, U.S. Marine Corps and U.S. Coast Guard aviators ... ”

The METS T-54A interior includes an observer/jump seat and passenger mission seats, as well as other specific capabilities including TACAN (Air to Air), angle of attack (AOA), V/UHF radio, digital audio system, engine trend monitoring and full-face oxygen masks.

radio, digital audio system, engine trend monitoring, condition based maintenance plus, observer/jump seat, passenger mission seats and full-face oxygen masks.

"With its advanced technology, the new METS platform will be more representative of fleet aircraft," said Capt. Holly Shoger, Naval Undergraduate Flight Training Systems Program Office (PMA-273) program manager. "The T-54A will include an updated avionics suite, automation qualities, and virtual reality and augmented reality devices to better prepare students for the advanced aircraft they will fly in the fleet."

The King Air 260 METS aircraft will be delivered in a fully compliant, METS mission ready configuration from Textron Aviation's King Air production line in Wichita, Kansas. KA

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Takeoff OAT Restrictions

by Tom Clements

During one of the past King Air Gatherings, I was asked about engine ice vane usage on the ground. Specifically, a concern was expressed about a temperature restriction stated in the Pilot's Operating Handbook (POH) for the model 200-series. Is a limit being violated at times when ice vanes are being used? A follow-up question asked about a similar concern for the 300-series. I plan to review and discuss these questions and more in this article.

Realize that all King Airs have an OAT limit above which they are not allowed to operate. In almost all cases this is expressed as ISA + 37°C. Many folks think "Golly, 37°C is only 98.6°F, so there'll be lots of times that we cannot fly!" Wrong! The 37°C temperature is not the same as "ISA + 37°C." ISA stands for "International Standard Atmosphere," the engineering-accepted model of the average worldwide atmosphere. This is the one with a Sea Level temperature of 15°C or 59°F and a lapse rate of 2°C for each 1,000 feet up to the stratosphere that starts at FL350. ISA + 37°C is a shorthand way of saying, "The OAT that is 37°C above the standard temperature for that altitude."

Therefore, at Sea Level, the King Air's limiting OAT for operation

is 52°C (15 + 37). This equates to about 125°F. Does it ever hit that sweltering temp? Sure, but it's quite rare. Can you figure what the limit is at 10,000 feet? Since the standard atmosphere experiences a drop of 2°C for every thousand feet, we would have decreased 20° from Sea Level to 10,000. That puts ISA at -5°C. Adding 37 more gives 32°C, or about 90°F … mighty warm at 10K!

I heard from experimental flight test colleagues at Beech that the limiting factor for hot weather operation is the size and capability of the engine oil cooler. We all know that performance decreases as temperature increases. Although performance would definitely degrade, the actual reason why there is an OAT limit is based on the ability of the oil cooler to keep oil temperature from exceeding its limit. As a side note, the fact that the Blackhawk XP67A engine modification to the 350 adds a fixed "cowl flap" at the oil cooler's outlet yet still has an OAT limit 3° cooler than before – ISA + 34°C now – lends support to the assumption that oil cooling is the reason for the OAT limit. (If that poses an operational problem for XP67A airplanes based in hotter climates, a larger oil cooler is available that brings the OAT limit back up to the original value.)

When the model 200 first appeared, its POH stated that engine ice vanes could not be extended when the OAT exceeds 15°C. This applied for all operating conditions, ground and flight. Again, we return to oil cooling considerations. Unlike the King Airs that preceded the 200, as well as those that came later with the "Pitot Cowl" design, the cowling used for the 200-series is unique. When the ice vanes are extended, the "bypass door" also opens to allow the deflected ice particles to harmlessly leave the cowling. Oil cooling suffers now because the bypassing air is no longer able to flow across the oil cooler's fins. From its market introduction in 1974 up until the 1993 model year, the +15°C ice vane limitation was heeded with no operational difficulty experienced.

In 1993, beginning with serial number BB-1444, the B200 incorporated many welcome improvements. Among these were the advent of four-blade propellers as standard equipment, replacing the three-blade Hartzells and McCauleys of the past. The higher low idle compressor speeds and flatter low pitch stop blade angles – required to ensure that propeller speed remained above the new minimum propeller speed limit, a limit imposed to avoid the "reactionless vibration" mode that may lead to propeller damage – conspired to make FOD (foreign object damage) much more likely. Soon after the 300 model made its appearance in 1984, reports began arriving at Beech of numerous cases of first-stage compressor FOD on the PT6A-60A engines used on this new model. The distance from propeller tip to the ground is less in a 300 than in a 200. Combining that fact with the 300's pitot cowl and four-blade

standard propellers with their higher idle speeds, FOD became much too common!

The easy solution was to change the procedure such that ice vanes – now correctly called "engine anti-ice" on the later King Air models – were deployed for all ground operation. The location of the oil cooler in the pitot cowl causes oil cooling to not be negatively impacted due to engine anti-ice activation. Thus, there really was no downside risk associated with this new procedure of "ice vanes extended for all ground ops."

Therefore, when this same FOD worry started affecting B200s of 1993 and after design – as well as earlier 200s and B200s that were now being retrofitted with four-blade props – the solution was easy … copy the 300 technique and use ice vanes all the time while on the ground. Oops! What about that +15°C limit that applies to the 200-series but not the 300-series?

For a few years, the limitation was basically ignored. Personal observation has convinced me that it is extremely rare for oil temperature to hit the maximum redline even in Phoenix, Arizona, in the summer months with a lengthy ground delay. Whew, I am happy for that! Then Beech got around to revising the POH and removing the +15°C limit. Now there is a "Note" in the "Before Engine Starting" section of the normal checklist that reads as follows: "The engine ice vanes should be extended for all ground operations to minimize ingestion of ground debris. Turn engine anti-ice off, when required, to maintain oil temperature within limits."

If you, unlike I, do indeed find that you must turn engine anti-ice off because of hot oil, then avoid using beta and reverse even if it means riding the brakes at times.

Under the title of "Icing Limitations" found in Section 2 of the B200's POH it states: "ICE VANES, LEFT and RIGHT, shall be extended for operations in ambient temperatures of +5°C or below when flight free of visible moisture cannot be assured." The next statement is: "ICE VANES, LEFT and RIGHT, shall be retracted for all takeoff and flight operations in ambient temperatures of above +15°C."

It is obvious that FOD due to ground debris is not a problem in flight. It is also not a problem during takeoff unless the takeoff is aborted and reverse remains in use to too low of an airspeed. Hence, when doing the runway lineup procedure on warmer days, it is time to retract the vanes. Not only is better oil cooling assured but more takeoff power can now be achieved with less chance of being ITT-limited.

Now let's examine the 300-series "Icing Limitations" found in Section 2 of its POH. This one is nearly identical to the 200, except for substituting "Engine Anti-Ice" for "Ice Vanes": "ENGINE ANTI-ICE, LEFT and RIGHT, shall be ON for operations in ambient temperatures of +5°C or below when flight free of visible moisture cannot be assured." The next statement is: "ENGINE ANTI-ICE, LEFT and RIGHT, shall be OFF for all takeoff and flight operations in ambient temperatures of above +10°C."

Do you notice what is different between the 300 and 200 in the second limitation? The ambient temperature got dropped by 5°: +10°C for the 300 and +15°C for the 200. Why the difference?

Since the pitot cowl of the 300 negates any oil cooling worry, the reason has nothing to do with the oil cooler's effectiveness. Rather, it comes from wanting to ensure proper takeoff performance. When there is no need for ice protection, why subject the engine to the slight power loss that goes hand-in-hand with ice vane deployment? The "Minimum Takeoff Power" numbers – from the graph in the Performance section of the POH – are based on the assumption that ice vanes will not be deployed during takeoff when unneeded.

In a similar manner, this helps explain the 300-series' POH

statement that, on first reading, makes no sense: "For takeoff, Generator Load must not exceed 30% with air conditioning on, nor 50% with air conditioning off." Since the condenser blower operates whenever AC is operating with the nose gear extended, and since this blower uses about 50 amps, it seems that the generator load would be higher, not lower, with AC on. Right? Yes, that is correct … but it's not what the restriction is addressing.

The engine is subject to three things that can cause available takeoff power to be less than optimal even though the engine itself is fine: (1) Cowling inefficiencies, caused by ice vane deployment; (2) Compressor shaft load or drag caused by the need to drive the AC's compressor (on the right engine); and (3) Compressor shaft load caused by generator load (on both engines). If we have little electrical load – no electric heater or windshield heat in use – then we can abide the AC drag and still have sufficient power available to the propeller to meet takeoff power design criteria. However, if the generators are working their guts out, then we don't have enough "leftover" power to load up the compressor with the AC's compressor drag.

To summarize then, the 300's requirement to not use engine anti-ice for takeoff when OAT is above +10°C is based not on oil cooling concerns but instead is based on eliminating the cowling inefficiencies that could lead to inability to meet the Minimum Takeoff Power target torque.

For all of the other King Air models – 90-series, 100-series – you, like the 300-series, have no tie-in between ice vane deployment and oil cooling. If you have a three-blade propeller, especially if it's combined with the original "Chin" style of cowling, there is no concern about FOD due to ground debris even with the ice vanes retracted. On the other hand, four blade props combined with the pitot cowl – F90-1s, C90As and after – have enough FOD potential that engine anti-ice ON while on the ground is strongly recommended.

But consider this: Leaving the ice vanes up on a four-blade 200 or any member of the 300-series is asking for FOD … leading to a very expensive repair. But having the ice vanes down on your B90 causes no problems whatsoever. If you, like many pilots, fly a variety of King Air models, then there is absolutely nothing wrong with making "Ice Vanes down for all Ground Ops" your SOP (Standard Operating Practice). Are ITTs affected? Is engine starting affected? No! The only negative associated with this procedure is forgetting to retract them when taking the runway and hence not being able to attain your target minimum takeoff power.

I'll leave you with this thought, readers: Forgetting to retract the ice vanes for takeoff may not be as bad as you think it is. Why? Because the ram air loss at takeoff speed – 100 knots? – is a whole lot less than what you are used to seeing when you pull those ice vane handles out (or activate the switches) before entering that cloud deck below you while in a descent doing 200+ knots. You dig? Groovy, man! KA

King Air expert Tom Clements has been flying and instructing in King Airs for over 50 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.* 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.*

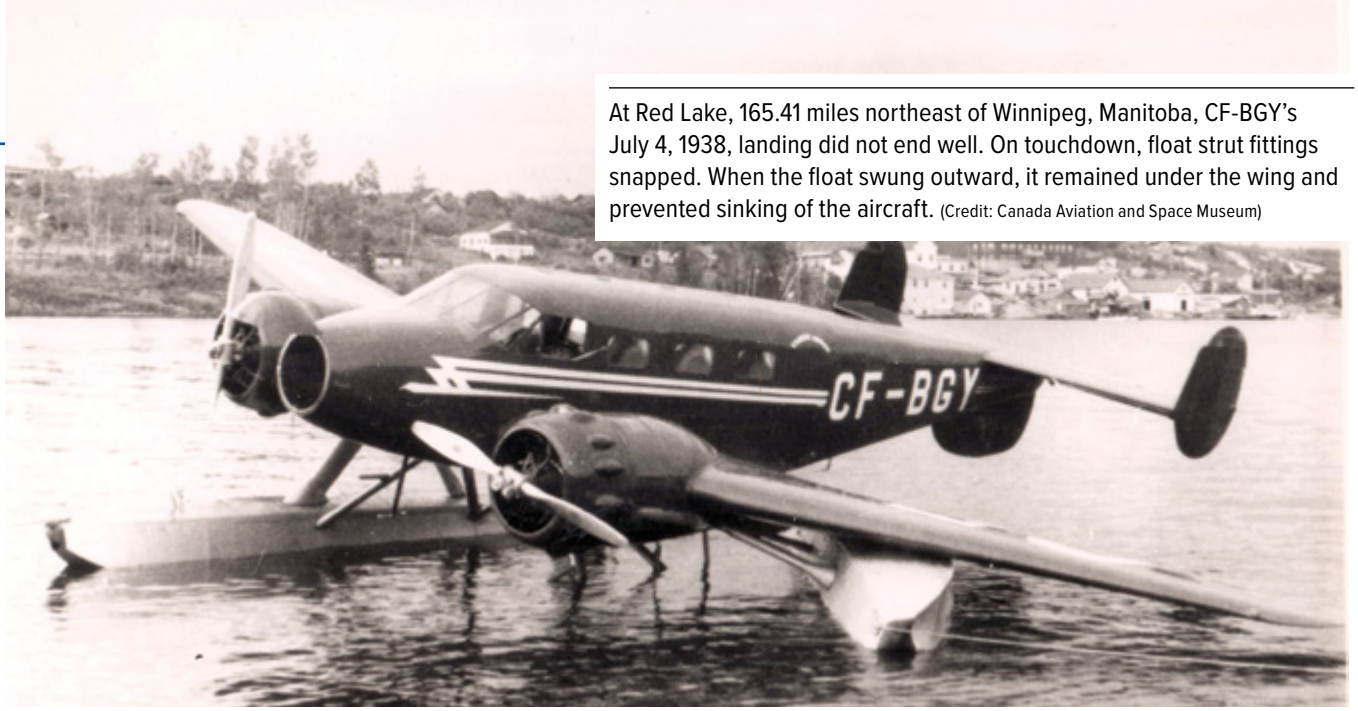
Bygone Bush Beech 18

by Robert Grant

On May 20, 1938, the Department of Transport (Canada's FAA) reported that CF-BGY's seaplane floats and ventral fin weighed 840 pounds and without load, the seaplane version showed 4,742 pounds with a 1,008-pound carrying capacity. (Credit: Thunder Bay Flying Club)

Loaders rolling dynamite kegs into a ski-equipped Beechcraft S18A-172, registered CF-BGY, in Hudson, Canada (located 166 miles northwest of Lake Superior) recognized the "twin-tailed wonder" as the first of its type working commercially beyond the U.S.-Canada border. No one on that frigid January day in 1938 could have known that lessons learned would one day be incorporated into the King Air aircraft family. A National Advisory Committee for Aeronautics (NACA) 23000 wing series became the general airfoil following through the years in commercial and corporate aviation.

Designed by former farm boy Walter H. Beech and Engineer T. A. Wells, prototype Model 18 NC 15810's inaugural flight took place Jan. 15, 1937, with test pilot James N. Payton in Wichita, Kansas. In April, Beech's personal demonstrations from Montreal, Ottawa, Toronto and other foreign locales attracted interest including a ground-breaking order from bush air service owner Robert Wright Starratt of Starratt Airways and Transportation



At Red Lake, 165.41 miles northeast of Winnipeg, Manitoba, CF-BGY's July 4, 1938, landing did not end well. On touchdown, float strut fittings snapped. When the float swung outward, it remained under the wing and prevented sinking of the aircraft. (Credit: Canada Aviation and Space Museum)

who appreciated 55 mph landings and 167 mph cruise speeds. His stalwart fabric-covered Fairchilds, Fokkers and other aircraft types servicing high-pressure clients in gold mines and native communities functioned adequately and profitably enough. Still, Starratt despaired of ripped fabric surfaces and frequent engine failures. He and his four sons determined the parameters: twin-engine safety, durable coverings and long-range fuel tanks. "Bring it on!" one company pilot sputtered when told of electric flaps and insulated interiors.

The Model 18 concept satisfied the Starratts, but few of their boreal bush destinations offered airstrips or airports. Skis and seaplane floats needed to be part of the picture. The Beechcraft arrived with a reinforced

The short tail ski and its elastic cords likely forced CF-BGY's pilots to make wide turns while taxiing. (Credit: Canada Aviation and Space Museum)

Beech Model 18 CF-BMI represented the epitome of business aviation at the time of purchase by the Hudson's Bay Company. The Edo floats were priced at $7,500 by 1940. (Credit: Hudson's Bay Company Archives)

one-piece welded steel tubing center section and multi-spar wings; even a seven-pound toilet, reading lights,and ashtrays came with the package. By the time Starratt signed agreements with Montreal distributor Aircraft Industries of Canada, technicians had arranged ski testing and seaplane float installation.

Wichita delivered NC18578 (s/n 169) to Edo's College Point plant on Long Island. To Beech's chagrin, his designated pilots lacked seaplane experience and soon spun the example of "airborne artistry" into Jamaica Bay. Thanks to Model 18 integrity, both men survived. A replacement later registered CF-BGY arrived and water trials continued, but this time, Starratt sent a pilot wise in handling license-built Edo 55-7170 seaplane floats.

With experimental flying completed, mechanics re-installed CF-BGY's wheels Dec. 15, 1937, for customs clearance in Montreal. Ski flying trials commenced in 15 inches of snow in a 12-mph wind at nearby Cartierville with Vickers units assembled in Montreal. A federal inspector did not appear overwhelmed with the 47-foot, 8-inch wingspan and 123-inch cabin length.

"Owing to abrupt sides of these skis, short turns in heavy snow should not be made. In addition, these skis tend to stick when starting aircraft after standing in heavy snow," said Department of Transport's S. Graham. "Although they bear the warning 'Do Not Walk,' they would likely be battered in northern operations."

Model 18 CF-BGY became the first twin-engine Beech type assigned to harsh hinterlands beyond the Kansas wheat fields. Starratt found himself with the fifth example produced and powered by 350hp Wright R-760-2 radial engines and Hamilton Standard propellers cruising at 1,900 rpm. Dive speeds reached 200 mph, and empty weight on skis came in at 4,626 pounds, including ski legs, forks and fittings.

Agreements signed and fuel tanks topped to 160 U.S. gallon capacity, Starratt pilots finally departed Montreal for a 906-mile journey to Hudson where advanced field tests showed 340-yard ski takeoffs and 35 U.S. gallons hourly fuel consumption with the seven-cylinder engine. By Jan. 4, 1938, line pilots reveled in cabin heaters and kapok-insulated walls; no more heavy mitts, parkas or exterior fabric coverings ripped on spruce branches or ice shards. With a robin egg-blue paint scheme, the "Wichita Wonder" and the appropriately dressed bush pilots took on the coniferous jungles.

On most flights, the passenger seats stayed behind as loaders pushed, rolled and towed freight from nearby railway boxcars. Plywood sheeting protected floors and goods such as ball bearings and roped kegs of applesauce,

An emergency landing in remote wilderness required ingenuity to return CF-BMI to flyable status. Without onboard spare parts, all materials including rudder and propeller needed to be flown to the site by bush planes such as Fairchilds and Fokkers. (Credit: Hudson's Bay Company Archives)

bacon or bread went aloft. Occasional medevac flights from Native American villages or trap lines broke routine. The "fastest (air)plane in Canada" began paying its way.

When seaplane season arrived, Starratt began encountering regulatory issues. Export documents specified two-crew operations for the airplane although all Hudson assignments occurred in VFR day-only conditions. A superfluous co-pilot meant 170 pounds of less payload. Aircraft Industries and W. H. Beech negotiated with aviation hierarchies in both countries and arranged a single pilot with a right front seat passenger.

On May 8, 1938, an inspector confirmed CF-BGY's 4,272-pound empty weight and reviewed the 7,7140-pound seaplane gross weight with nine people, including the pilot. Floats weighed 840 pounds, and takeoff across the water lasted 17 seconds. A ventral fin added surface area for stability and pullup water rudder cables eased steering when taxiing. Considered leaders in an expanding northern transportation industry, the Starratts rejoiced in what author Joseph P. Juptner described as an "odd concept" flagship.

Their smugness did not last. On June 2, 1938, a cracked elevator and rudder hinges appeared in a report and one month later, a snapped diagonal strut resulted in float damage and wrinkled skin panels. "The bottom crown of the left engine nacelle was stove in," added pilot Humphrey O. Madden. A factory representative rushed from Wichita to oversee repair and within a few days, the fatigued Fairchilds and Fokkers welcomed their sister ship back.

Nightfall in sub-zero-degree winters meant canvas covers every evening to prevent icing. In the early morning, mechanics placed blowpots (similar to large blow torches) under nacelles to warm the engines. Ice crystal fog often brought zero visibility and snow squalls created white-out conditions when aircrew could not differentiate between snow and sky for safe landings. Despite mastering hardships and hazards, the Starratts never anticipated the tragic event, which became an unwelcome first in Beech's history.

On Jan. 17, 1941, 24-year-old Bud Starratt, son of the founder, did not return from a routine trip. Search pilot-operations manager Dale S. Atkinson discovered the vaguely outlined wreckage in snow 32 miles southeast of the mining settlement of Red Lake. The pilot and passenger had lost their lives in Canada's first Model 18 fatality. Investigators attributed the loss to carbon monoxide from a defective heater.

Shortly after, the Starratts returned to their wood-wing fleet.

Impressed with Beech demonstration tours, the Hudson Bay Company's Air Transport Division purchased an S18D-224 version April 24, 1939, to reduce transportation times. The "bush-corporate" entity specialized in long-distance hauls above forest or tundra and anticipated reducing three-week dog team and canoe trip travel to three-hour flights. Sadly, the "top-notch backcountry bush airplane," as Beechcraft historian Robert K. Parmerter called CF-BMI, met its demise within two years of delivery after an Aug. 12, 1941, water touchdown on Richmond Gulf of eastern Hudson Bay.

"I realized the landing would be hard on the aircraft and started to open the throttles to keep in the air when we collided with a second wave. I knew something had

been damaged but did not know what it was," said pilot Duncan McLaren. "The machine was beached as rapidly as possible on a very rocky shoreline."

Within weeks, McLaren returned to Richmond Gulf for CF-BMI's rescue. Four hours after arrival, the Model 18 floated, ready to go. Tides and 55-mph winds prevented takeoff and forced the three-person team into a pup tent but CF-BMI "… seemed to be weathering the blow safely." When they awoke, the crew was mortified to find one wing standing vertically in the water, the other pointing up and one float completely submerged. For some reason, the float covers had not been re-attached.

"It is my opinion that the aircraft would be broken up very quickly by the combination of rough water, currents and tides and water," concluded McLaren. Accordingly, Waco biplane removed him and his party, and the company ordered another Model 18 to be registered CF-BVM (s/n 18D-169).

During delivery from Long Island's Roosevelt Field, the intense 37°C outside air temperature solidified breather lines and caused CF-BVM's left engine failure November 27, 1941. Hardened summer lubricating grease – fine for Wichita but not for subzero cold – accounted for further damage when landing gear would not fully lower. Repairs completed, the crew anticipated departure for Winnipeg but mysterious flames during the night of Jan. 23, 1942, rendered a "Destroyed by Fire" verdict. Inspectors suggested a dropped cigarette may have been the cause. Twice bitten, the Hudson's Bay Company moved on to other makes.

Nevertheless, the Model 18 matured through incredible hardships, and 8,980 went to military and civil users in 32 versions before production ceased November 26, 1969. The twin-tail silhouette and slender airframe spread the Beech reputation worldwide thanks to the basic design drafted by Beech and Wells. No one loading freight from snowbanks or boulder-covered shorelines could have envisioned the remarkable capacities, speeds and pressurized comfort of the future King Air line. KA

Robert S. Grant has published over 2,500 articles featured in magazines, journals and newspapers within six countries, as well as producing five books. He flies contract aircraft from his home near Ottawa, Canada, when possible and his logbook shows over 22,200 total flying hours which include 500 hours in the Beechcraft King Air 100A and King Air 200 models. Having worked worldwide in various aircraft types, Grant prefers flying in African countries, in addition to Canada.

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