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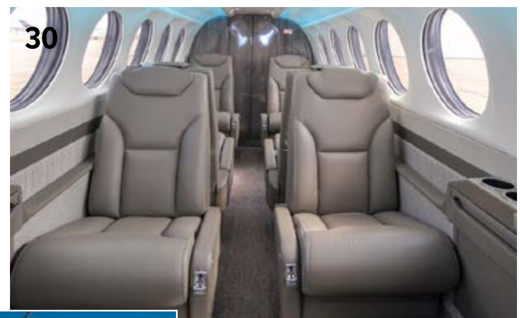

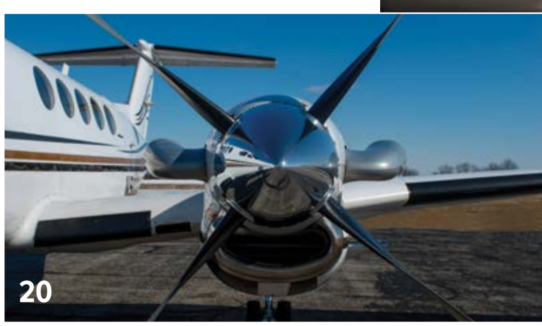

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Credit: Jacob Canty

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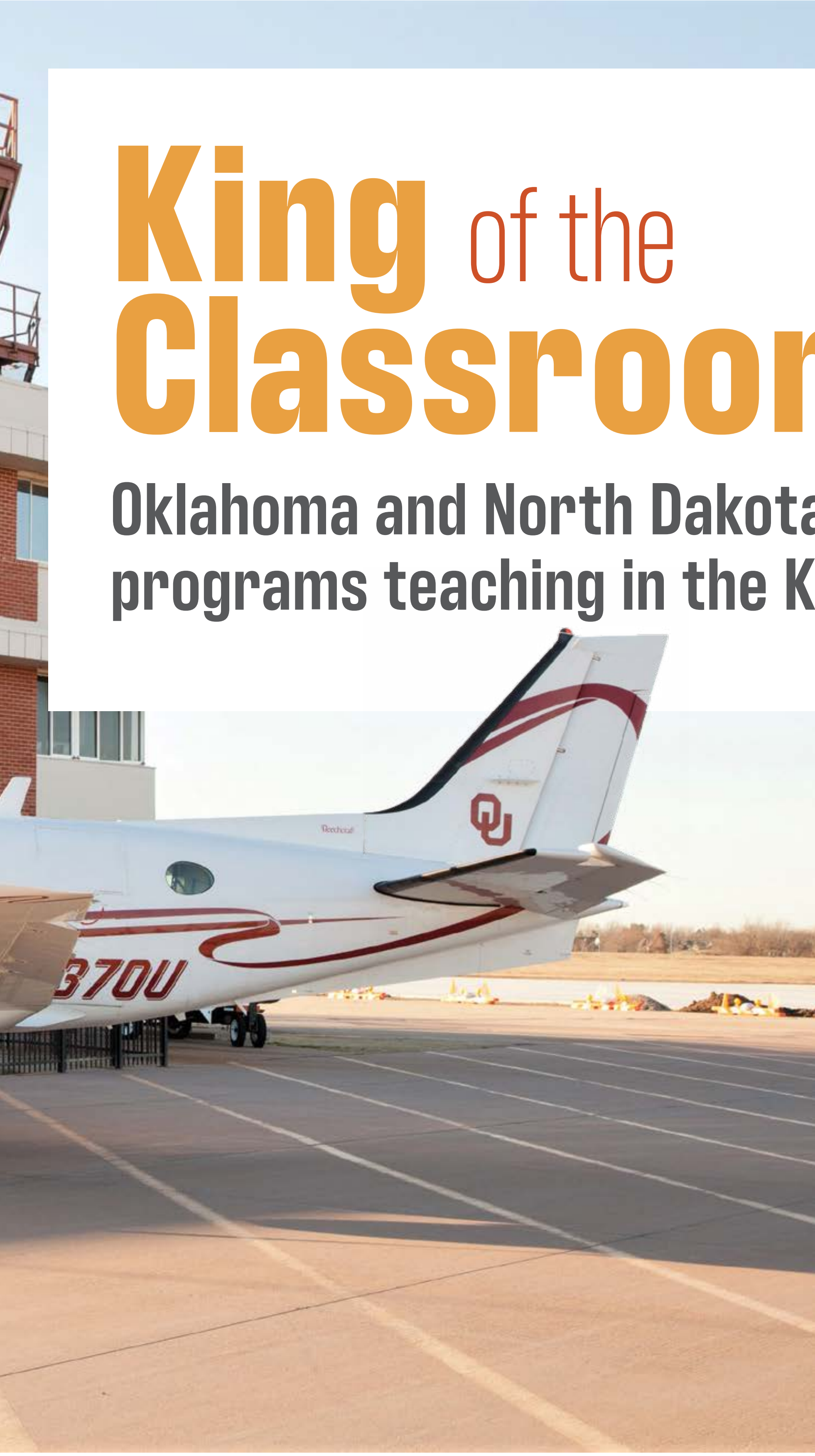
The University of Oklahoma's 1996 King Air C90A is representing OU's colors of white and crimson and its logo on the tail. It is hangared at the University of Oklahoma Max Westheimer Airport (KOUN), which is owned by the school.
(College of Professional and Continuing Studies, University of Oklahoma)



King of the Classroom

Oklahoma and North Dakota aviation programs teaching in the King Air

by Grant Boyd

In terms of the thousands of aircraft that comprise the fixed-wing fleets at American universities that host aviation programs, Beechcraft King Air models are relatively uncommon. Unsurprisingly, entry-level trainers such as the Piper Archer and Cessna 172 are a dime a dozen in these programs, with other manufacturers' single-engine fixed-gear trainers, single-engine complex aircraft and light twins rounding out the majority of fleets.

Through a partnership with Rockwell Collins, UND's King Airs were upgraded to Pro Line Fusion avionics. The partnership allowed UND to provide feedback on the avionics while at the same time giving students the opportunity to learn a popular avionics system. (Credit: Jacob Canty)

While King Airs are flown at several colleges across the country in faculty and staff transport roles, there are several aviation programs that offer training in some model of twin turboprop to their students. Among the short list of schools operating these aircraft are the University of Oklahoma and the University of North Dakota, both well-respected universities turning out dozens of professional pilots in every graduating class.

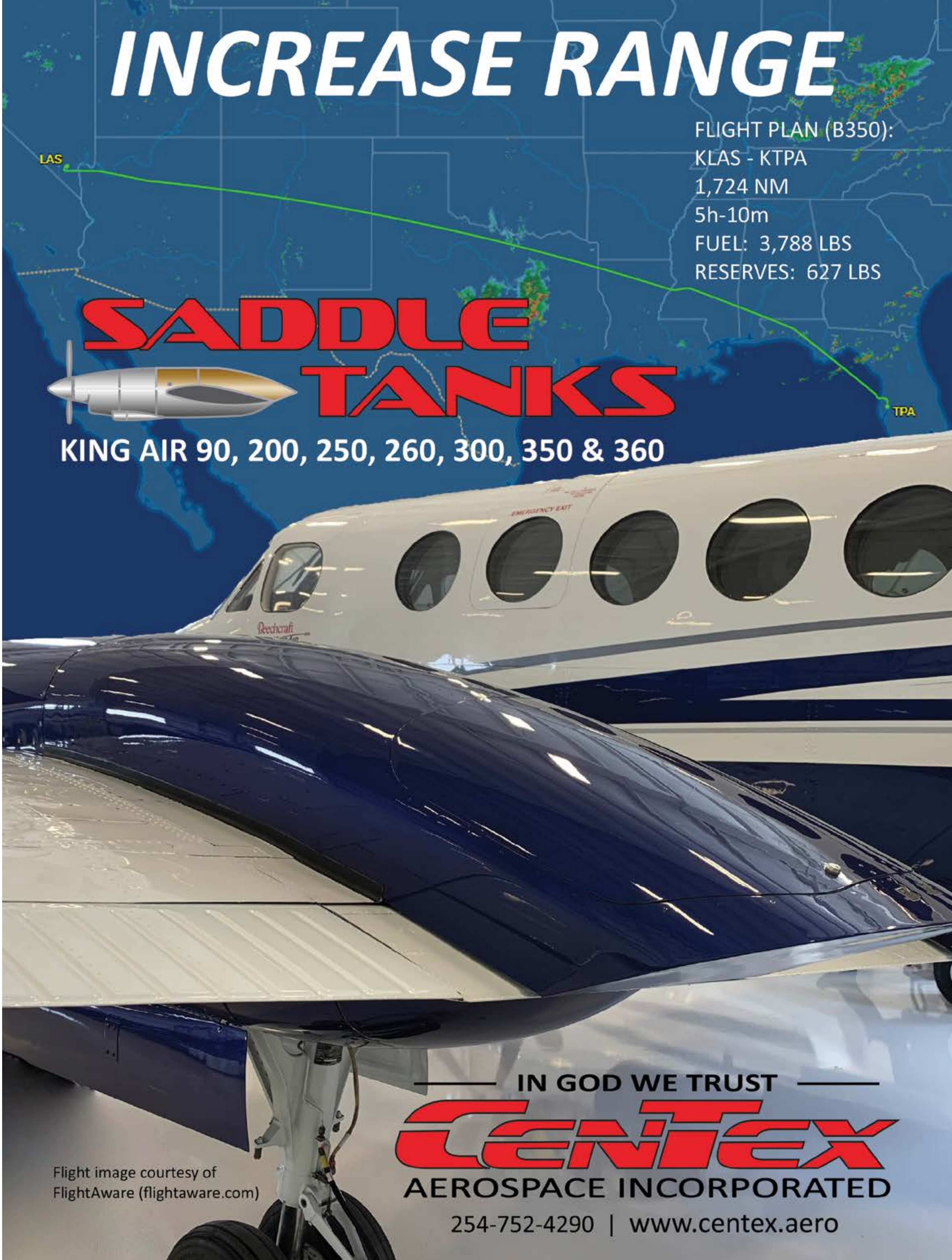
University of Oklahoma

The aviation program at the University of Oklahoma (OU) has been a staple since 1947 at the largest college in the state. Though the current fleet is primarily Piper-based, they do incorporate other aircraft and systems allowing for an array of training, building from the simple to the complex.

As they work through their ratings, the school's roughly 165 flight students become familiar with more complex aircraft during their multi-engine training. Whether this is completed in one of the school's two Piper PA44-180 Seminoles or their Advanced Aviation Training Device (AATD), the groundwork is laid for future flights that are not offered in many other college aviation programs.

This is because the program has a 1996 Beechcraft C90A (serial number LJ-1428). N370U has been in the program since 2005, when the aircraft was purchased to replace the school's Aero Commander, which was used for many years for advanced multi-engine training. The King Air is currently employed as the flight article in support of OU's Turbine Transition Course, which students are able to take once they have their commercial pilot certificate with multi-engine class and instrument ratings.

This class is a requirement for Professional Pilot track students and an elective for other flight scholars. Eric Metoyer, assistant director for the School of Aviation Studies, provides some insight into the course's history. "The university desired an aircraft that had turbine engines to provide higher performance," he says. "They were needed to help OU create a turbine transition class thus allowing our students to train to the next level of flight performance. Exposing students to flying aircraft with turbine engines helped close the gap in knowledge and skill between twin reciprocating engines and the jet engines of business and commercial aviation. Providing our students the opportunity to fly a twin-turbine aircraft definitely sets the University of Oklahoma apart from many other programs. Having spoken with regional and major airline representatives numerous times, I certainly get the impression that they hold our turbine transition training in high regard."



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N37OU is used for the aviation program's Turbine Transition Course. The class is structured like other flight courses at the university, with an extensive ground school segment and an in-flight portion. Students receive three hours of college credit and log five flight hours in the aircraft. (Credit: College of Professional and Continuing Studies, University of Oklahoma)

The class is structured like other flight courses at the university, with an extensive ground school segment and an in-flight portion.

"Students receive three hours of college credit and log five flight hours in the aircraft," Metoyer continues. "As important and significant as the flying, our students undergo approximately eight weeks of ground school while meeting three times per week. The challenge is not insignificant as the students receive volumes of information with stage check exams along the way. This ground school mimics military and professional ground schools by forcing students to 'drink from a firehose.' We find this approach truly prepares the students for the follow-on training they will inevitably receive as they move on to the next rung in their career progression. The airlines and military expect students to be able to digest large volumes of information in a short time and come out with a thorough

understanding of complex systems. We pride ourselves in the knowledge that our students leave OU well prepared for that environment."

The intensive ground school is broken up into four stages. During the initial stage, students are introduced to various types of gas generators, turbofans and turboprops, along with the different types of thrust reversers. They also work toward obtaining knowledge related to various propeller and electrical systems. In order to complete this stage, students are required to a score 70% or better on a written exam, which is reviewed afterward with an instructor to ensure any

content related to incorrect responses are fully understood by the student. All four stages require the same passing percentage to progress.

The second stage introduces knowledge related to various hydraulic systems, control inputs, as well as pressurization and fuel systems found on turbine aircraft. The student will also receive thorough knowledge of the related systems for the Beechcraft King Air Model 90.

Students then go on to learn about various methods of ice and rain protection, landing gear systems and annunciator systems during the third stage. At this point, they also become familiar with fire protection systems as well as limitations, in addition to determining performance and weight and balance in turbine aircraft. This is followed by the final stage, where students are introduced to the performance factors, weight and balance, and the advanced weather and navigation equipment found on turbine aircraft.

N370U is hangared at the University of Oklahoma Max Westheimer Airport (KOUN), which is owned by the school. The five hours of flight time is split amongst three flights, with the first and third averaging one and a half hours long and the second two hours. During each lesson the instructor will also assume the role of nonflying pilot and will assist the student with execution of checklists, radios and navigation. Most flights are limited within the three practice areas to the south of KOUN, with boundaries extending roughly 20 nautical miles south and 25 nautical miles on each side.

The aircraft itself has largely remained "stock," although it has undergone improvements over the years, including a new interior and several upgrades to comply with Federal Aviation Administration (FAA) requirements. Among these betterments are an upgrade from the original GNS400 to a GTN725, a digital radar replacing the original, and a system upgrade to WAAS and ADS-B (in and out). Of course, the King Air's paint scheme is white and Oklahoma crimson with an OU logo on the tail.

University of North Dakota

The University of North Dakota (UND) in Grand Forks is almost universally known for two things: ice hockey and aviation. UND's John D. Odegard School of Aerospace Sciences is in its 53rd year of operation and boasts nearly 1,800 enrolled undergraduate students and 120 aircraft, with degree options ranging from Air Traffic Management to Commercial Aviation. In addition to Grand Forks, the John D. Odegard School of Aerospace Sciences, UND Aerospace Foundation and Chandler-Gilbert Community College have a long-term partnership to operate the Phoenix Flight Training Center in Mesa, Arizona, where


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The UND Grand Forks location is a Part 145 Certified Repair Station and performs a majority of their own maintenance, including Phase inspections on the King Airs. (Credit: Jacob Canty)

40 aircraft fly 50,000-plus training hours annually.

Initial training begins in the Cessna 172S or Piper Archer aircraft and goes to Piper Seminole aircraft for multi-engine coursework. Ultimately, students have the opportunity to train in King Airs between the two UND aviation campuses. Flight training occurs in North Dakota out of Grand Forks International (KGFK) and in Arizona out of Phoenix-Mesa Gateway (KPHX).

The department added the first of its three King Air C90GTi aircraft in October 2008. Over the course of the models' tenure with the program, they have collectively flown nearly 40,000 hours with roughly 75% of the hours originating in North Dakota.

Currently N23ND (2009, serial number LJ-1944) is the lone twin turboprop in North Dakota while N26ND (2009, serial number LJ-1956) and N330PE (2008, serial number LJ-1917) are typically operated out of the Grand Canyon State. All were upgraded to Pro Line Fusion® avionics between June 2018 and 2020, a project that was undertaken as a partnership between Rockwell Collins and the school. The majority of the avionics equipment was donated by Rockwell Collins and the UND Aerospace Foundation paid to have the conversions completed. According to Chuck Pineo, executive director of the Foundation, the partnership has allowed the group "to showcase and provide feedback on the avionics," while at the same time allowing students to learn a popular avionics system.

Additional work on the aircraft has also been completed from updates on two of the aircraft's interiors to engine overhauls. The Foundation, which owns the aircraft, plans to paint two of the aircraft in the coming year. While much of this

The University of North Dakota utilizes three King Air C90GTi models for its "High Performance Aircraft" courses. It was determined by the school as the best aircraft to meet international course requirements. Each of the King Airs average approximately 122 training hours per month. (Credit: Jacob Canty)

work was completed at outside facilities, a majority of routine maintenance is completed in-house. Generally, the aircraft based in Mesa are repositioned to Grand Forks during training flights for maintenance.

"UND does a majority of our own maintenance and that is performed at the Grand Forks location under our Part 145 Certified Repair Station," says Dick Schultz, director of flight operations. "UND has provided specific training of the King Air for several mechanics and has purchased necessary tooling and equipment to complete phase inspections [in-house]."

Each of UND's King Air aircraft averages 122 hours of training per month. N23ND trained 52 students in 2020 with 1,055 flight training hours. N26ND and N330PE combined for 1,873 hours and 95 students.

King Air time is optional for Professional Pilot undergraduates to complete their program, as the school has a CRJ 200 FTD (flight training device) to accommodate required training for the degree. The aircraft are available to all students in the John D. Odegard School of Aerospace Sciences and are the basis for an elective course that while available to all students was created primarily to meet international course requirements.

For instance, students from China in aviation programs abroad must comply with the Civil Aviation Administration of China's TCO (Third Country Operator) requirements for flight training. This includes the option

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of a 20-hour or 50-hour Part 141-approved course, which are called the "High Performance Aircraft 20-Hour Course" and "High Performance Aircraft 50-Hour Course," respectively at UND. The C90GTi aircraft are the only aircraft flown in the classes.

Students from Saudi Arabia also enroll in the program due to one of the country's regional operators (Saudi Aramco) requiring its students to satisfactorily complete the 20-hour course.

UND chose the King Air platform, Pineo says, because it was determined to be the best aircraft to meet international course requirements. "The decision was based on acquisition cost, operating cost, reliability and other factors," he says.

UND Aerospace has found that its flight instructors especially benefit from having flight time in King Airs. Having learned in the aircraft themselves, they have historically been able to quickly transition to instruction in the model and seamlessly instruct rising turboprop pilots. Many graduates stay on at UND full-time, instructing in the twin turboprop and the school's hundred plus other aircraft. Other graduates find themselves in King Airs, whether it be in medevac or corporate operations.

While having a King Air in an aviation program is a rarity of sorts, a couple of schools have sought to replicate the aircraft's operations with flight training devices. Among the programs with these devices are Arizona State University (ELITE Simulation Solutions King Air B200 iGATE 602 model) and Indiana State University (Precision Flight Controls Modular Flight Deck model configured to a King Air 200).

Whether it be in the air or a replicated environment, the Beechcraft King Air is an important aircraft to the nation's aviation programs and helps to prepare students for a litany of flying careers after graduation.

Grant Boyd is a private pilot with seven years of experience in general aviation business from marketing to customer service. He has written more than 85 articles for aviation publications and enjoys learning about aircraft/pilots with unique missions. Grant can be reached at *grantboyd2015@gmail.com*.

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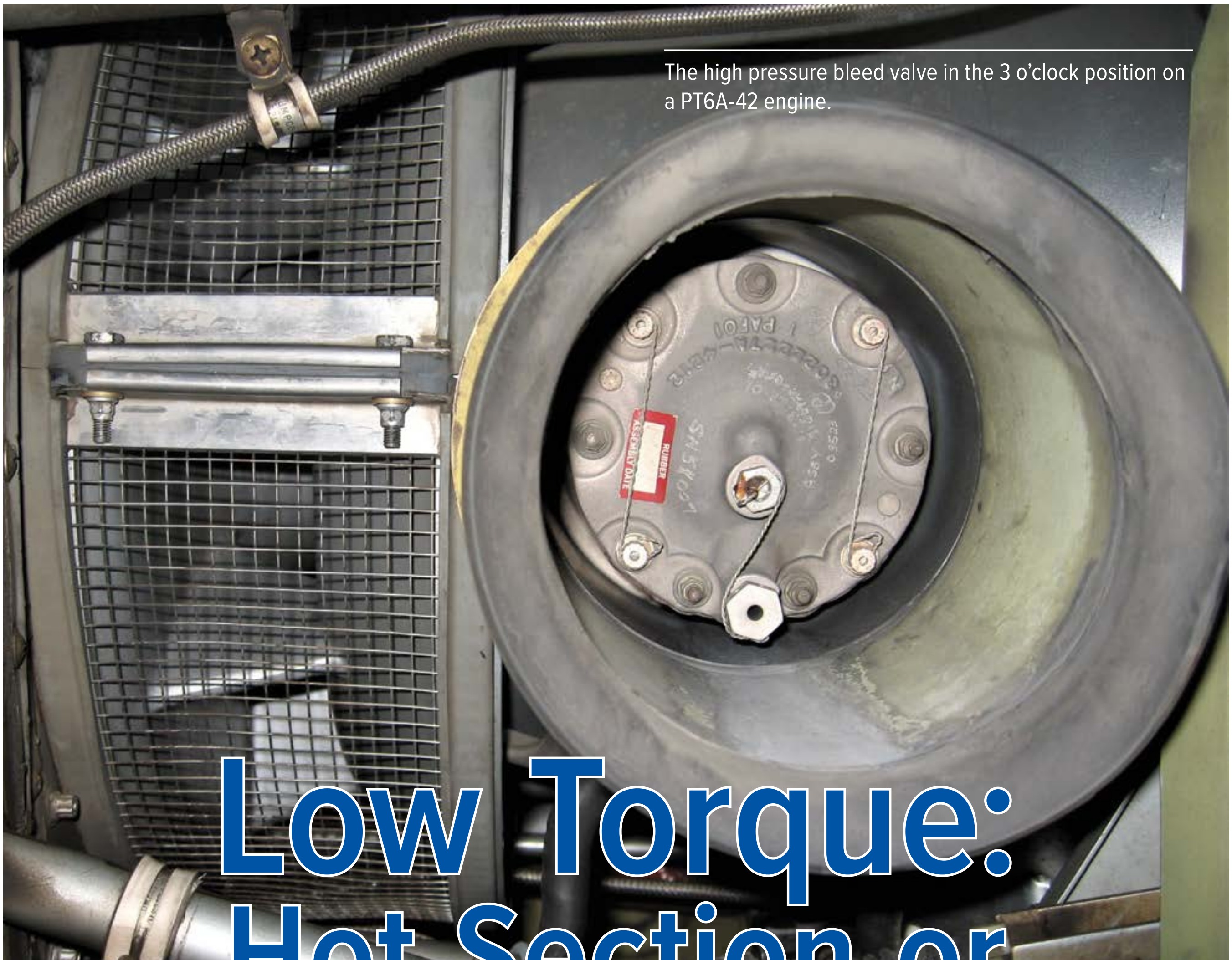

The high pressure bleed valve in the 3 o'clock position on a PT6A-42 engine.

Low Torque: Hot Section or Bleed Valves?

by Dean Benedict

When you reach max power during takeoff, you've got your eye on the ITT and torque. If ITT is high but torque is lagging, you might worry that a hot section problem has developed in the engine. Before leaping to that conclusion, however, consider the compressor bleed valve(s).

All PT6 engines have at least one compressor bleed valve installed just forward of the engine inlet screen, some models have two. These valves (called Bleed Off Valves, or BOVs by many mechanics) serve to vent excess compressor air not needed in the combustion chamber and to prevent compressor stalls.

I don't want to insult anyone's intelligence here, but I want to make sure we are all on the same page. If you live and breathe all things PT6, bear with me for a second. The bleed valves discussed herein have nothing to do with bleed air taken off the engine to run the pressurization and pneumatic air systems.

The PT6A-20, -21, -28 and -135A engines have just one bleed valve located at the 6 o'clock position forward of the engine inlet screen.

(Exception: Very old -20s have the valve inside the inlet screen.) The valve closes at approximately 84-86% N1 (compressor speed, often referred to as Ng). This variable threshold is dependent on outside barometric pressure and compressor efficiency. All compressor bleed valves are operated by P3 compressor discharge air as well as P2.5 air vented from the compressor.

Compressor Bleed Valve Failures

When King Air pilots see low torque coupled with high engine temperature, some will immediately think there is a problem brewing in the hot section. While this might be the case, I have learned through experience that a bad compressor bleed valve can create the same scenario.

Let's consider the bleed valve in the PT6A-20, -21, -28 and -135A engines, which should be closed by 86% N1. Imagine you are accelerating your engines on the ground, the N1s pass through 86% and suddenly one engine starts running hotter than the other. Additionally, the torque on the hotter engine is not coming up as it should, so you add more fuel to get the torque up to where it should be, but now the temperature is going up even further. Hmmm … You take off anyway but find yourself fretting over the hotter engine.

Remember this: If your compressor bleed valve is stuck open, you will see low torque and high temperature. More specifically, you will have low torque, high ITT, raised N1 and raised fuel flow. This points to a bleed valve failing to close properly.

Coke Bottle Check

There is a simple and decidedly low-tech way to check out engine bleed valve function on the ground. Although known for years as a "Coke bottle check," any bottle will do, plastic or glass. Please note: I am not suggesting you actually do this yourself. This is something for your maintenance technician to orchestrate with his team.

He will take a length of tubing about 3/16- or 1/4-inch in diameter that will reach from the bleed valve to a safe distance from the aircraft. The tube is secured very close to the bleed valve and the other end goes in the bottle, which is filled with water. As soon as the engine is started, air bubbles should come out of the tube, indicating the bleed valve is open. Then, the engine is accelerated; once it passes through

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The bleed valve on a King Air C90's PT6A-21 engine in the 6 o'clock position. You can see part of the inlet screen to the right.

the N1 threshold for that particular valve, the air bubbles should stop, indicating that the bleed valve has closed. If the bubbles slow down but do not stop entirely, that indicates the valve isn't closing all the way and should be changed. Obviously, if there is no change in the bubbles, the valve is stuck open.

It's extremely rare for these valves to be stuck closed when they should be open. I've only seen it one time in my 45 years of King Air experience, but if you're getting compressor stalls on the ground, have your engine bleed valve(s) checked.

Two-valve Engines

The PT6A-41 and -42 engines have two bleed valves. The low-pressure valve closes at approximately 65% N1; the high-pressure valve closes at approximately 92% N1. When the rear cowls are open, you can see these valves. If you are standing by the rear cowls and facing forward, the low-pressure valve will be in the nine o'clock position and the high-pressure valve will be in the 3 o'clock position, on each engine.

The -41s and -42s are slightly more difficult to troubleshoot because of the two-valve setup. For example, if the low-pressure bleed valve fails, you might not see much of a spike in temperature or N1 while the engines are between 70-80% N1, which is well past the 65% N1 threshold for the low-pressure valve. Your temp and N1 might be a little higher than expected on the problem engine, but nothing outrageous; however, when you get the engines above 93% N1, it will become very noticeable on that side. Because of this, you might automatically suspect the high-pressure valve is your culprit, but in actual fact, if *either* bleed valve is stuck open, you will see low torque, high ITT, high fuel flow and high N1. The higher you go N1-wise, the greater these anomalies will be.

In order to discern which valve is bad, your mechanic can do a coke bottle check on each one. On King Air 200s, the bleed valves vent through the cowls so the tubing can be attached there. If the first valve that is checked is found stuck totally open, you still need to check the other valve because it may be only partially closing. With two tubes and two bottles, both valves can be checked on one run.

One Valve on the -60As

For you 300 and 350 drivers, Pratt & Whitney went back to a single bleed valve on the PT6A-60A engines, so there's only one valve to be checked. The bleed valve on the -60As closes at approximately 92% N1. It is located in the 3 o'clock position on each engine; and, like the 200s, the cowl is vented to allow the bleed air to escape.

Fortunately, removing bleed valves for repair or exchange is an easy and straightforward process on the 200 and 300 series King Airs. The job is a tad more involved on the 90s and 100s simply because access is a little more complex at that 6 o'clock position.

In summary, if lower torque gets your attention, look also for higher N1, higher ITT and higher fuel flow. If you see these things going hand in hand then inform your shop that you suspect an engine bleed valve problem and let them know what you have observed.

If you truly have a hot section problem, you will see low torque, high ITT, high fuel flow and – here's the kicker – *N1 slower than it should be*. So, before jumping to the wrong conclusion with a low torque situation, take note of the other parameters, and then you will have a better idea of what is going on with that engine. KA

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 and supervision, troubleshooting, prebuys, etc. He can be reached at *dr.dean@beechmedic.com* or (702) 773-1800.

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Reversing Propellers ... and When They Won't

by Tom Clements

Reversing propellers made their appearance on the King Air A90 that ushered in the 1966 model year. The Straight 90 model of 1964 and 1965 utilized non-reversing propellers similar to those that were installed on the Lycoming-powered Queen Airs being concurrently produced. As one would expect, reversing propellers were a big hit and although they were an optional piece of equipment I don't think there was ever an A90 that was not built with this option. It has continued as standard equipment on all models that came after it, right up to and including the 260 and 360 models of today.

All pilots who have undergone initial King Air training have been taught about the propeller system in detail. It is one of the more difficult systems to learn and to understand in-depth. The intent of this article is to discuss the method that allows the propeller to reverse but to explain it in a very nonscientific, nonmechanical, non-engineering manner. Other important propeller-related systems – e.g., the Overspeed and Fuel Topping Governors – will not be reviewed in any depth, although they, too, are important systems for which the competent King Air pilot must have understanding.

To begin, we must understand what makes a "Constant Speed Propeller." Two independent variables determine the speed at which a particular propeller will rotate. The variables are (1) the factors that make the propeller want to rotate; and (2) how much the propeller resists that rotation.

Power and airspeed are the factors causing rotation. From our very first flying lesson, it became immediately obvious that pushing the throttle forward – increasing engine power – made the engine/propeller combination increase its rotational speed. This lesson was almost always conducted in a simple, single-engine airplane with a fixed-pitch propeller. In this simple training airplane we also learned that the propeller speed would vary even when the throttle position was not changed: Pull up into a climb and the prop slows down; nose over into a dive and the prop speeds up. Technically, this is because the angle-of-attack of the fixed pitch propeller blades is increasing as airspeed decreases and vice versa. Non-technically, it's the same effect as when the toy pinwheel held out of Dad's car window rotates faster the faster the car goes. "Windmilling effect" is the name assigned to this phenomenon. The higher the airspeed, the more windmilling effect the propeller experiences.

When adjustable-pitch or variable-pitch propellers made their appearance they were not initially constant speed propellers. Yes, the pilot now had the ability to change the propeller blade angle and hence the propeller's angle of attack but no governor was installed that did this automatically. As power and airspeed increased, it was necessary for the pilot to move the propeller control (sometimes a lever, often times an electrical switch) to make the propeller's angle-of-attack ("bite of air" in layman's terms) increase, providing more resistance to rotation and hence keeping the RPM at the desired amount.

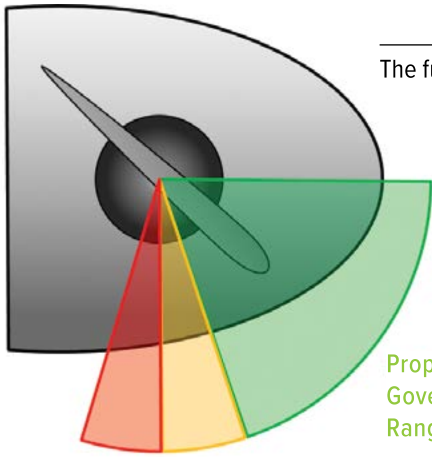
The addition of a Propeller Governor – the device that could change the propeller's bite of air automatically – converted the variable-pitch propeller into the constant speed propeller. You realize this name is a lie, right?! The propeller can only keep the selected speed constant when sufficient power and airspeed exist to raise the speed of the propeller up to the desired RPM. Reduce power and slow the airspeed down and the propeller will eventually slow down also. Vice versa – go into a full-power, redline airspeed dive and there is the possibility the propeller will speed past the selected speed. Why? Because the propeller designers pick low pitch and high pitch limits of blade angle travel. The low pitch limit is selected with the goal of preventing excessive propeller drag. The airplane would "fall out of the sky" in the flare for landing if the low pitch blade angle limit were set too close to flat pitch. Vice versa, why have the high pitch limit set above the value needed to get enough rotational resistance to prevent exceeding maximum propeller speed in a reasonably high-powered, high airspeed dive?

When variable pitch propellers began being installed on multi-engine airplanes it became immediately

obvious that it was desirable to move the high pitch stop to near 90 degrees: the feathered position that provided the least propeller drag when the engine is shutdown. Thus, with very few exceptions, the propellers on multi-engine airplanes are "constant-speed, full-feathering" propellers in which the maximum blade angle possible is indeed near the 90-degree mark.

How do we convert a "constant-speed, full-feathering" propeller into a "constant-speed, full-feathering, reversing" propeller as installed on most all King Airs? Simple: We move the low pitch limit of blade angle travel from the "don't fall out of the sky" position where it existed for so many years and now position it to the "back side" of flat pitch.

"Blade angle" is defined as the angle between the chord line of the propeller's airfoil shape and the plane of propeller rotation … the disk the prop makes as it rotates. Because propellers have a twist in them, the angle depends on how far out from the propeller's center (the chord line for measurement) is selected. A bigger angle exists 1 foot from the center than the one that exists at the two-, three- and four-foot locations. The "30-inch station" (30 inches out from the propeller's center) is the most common choice for blade angle measurement on "smaller" propellers. As the propeller diameter gets larger, it is common to use a point one-foot further out at the 42-inch station.

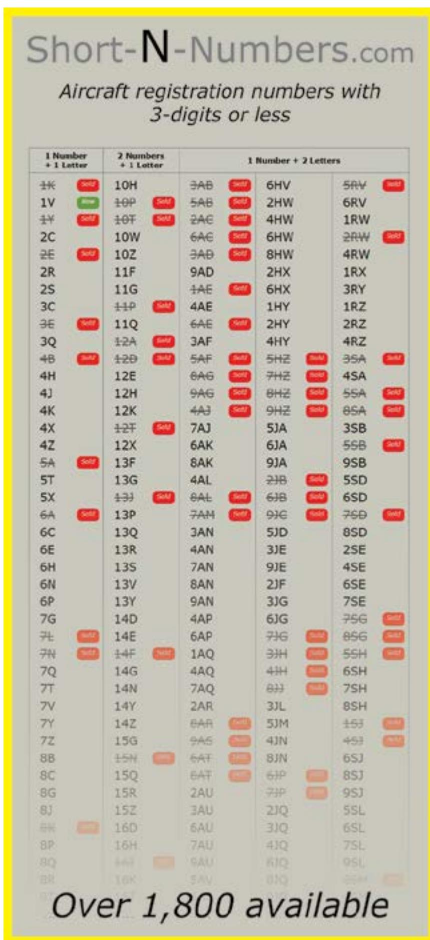


The full range of blade angle travel.

Neglecting the twist in the blades for a moment, the highest blade angle capable of being attained – where metal hits metal and the blade cannot move further unless something drastically breaks – the feathered position, is a 90-degree blade angle. The lowest angle where metal hits metal is now a negative angle, reflecting the fact that the blade bite is now pushing air forward instead of backward. Typically, this limit of travel angle is near -10 degrees.

Allowing the blade angle to go to -10 degrees is surely desirable after landing when a short stop is desired yet without excessive brake usage. Allowing the blade angle to reach -10 degrees while still flying? Not so good!

Therefore, what reversing propellers contain is a variable, movable, Low-Pitch Stop (LPS). The "how" this movement is achieved will be left out of this simplified discussion. But suffice it to say that when the pilot of a King Air lifts up on a power lever and then pulls it aft behind the location of Idle, he or she is indeed repositioning the LPS to lesser and lesser angles, ending up in the most negative blade angle position when the power lever reaches its full-aft, most-rearward position. Vice versa, pushing the power lever forward causes the LPS to come forward.



When a propeller is exhibiting actual constant speed – the RPM is remaining constant even while airspeed and power changes are being made – it implies that the propeller blade angle is variable – able to be changed. Increased power and/or airspeed are balanced by more resistance to rotation as the governor makes blade angle increase. Likewise, reductions in power and/or airspeed are balanced by the governor decreasing blade angle to achieve less resistance to rotation.

When the propeller slows down below the selected governor speed it is because the LPS has been reached. The governor is incapable of reducing rotational resistance because the blade is as flat as it can now go so the constant speed propeller has – at least for now – reverted to a simple, fixed-pitch prop with the blade angle being at the LPS setting.

In the simplest of terms, reversing is nothing more nor less than moving the LPS. I've said it before and I'll say it again: A pilot cannot force the propeller to reverse; he can only allow it to do so.

He allows it to do so by moving the LPS. Thus, when the propeller is underspeeding due to a low power setting combined with a low airspeed, the governor flattens the blade angle until it finds the LPS … which may now be in the negative range since the pilot has moved the power lever aft behind the Idle stop. It makes sense that the Pilot's Operating Handbook (POH) warns the pilot that moving the power levers aft of Idle is only permitting when the airplane is on the ground.

As all of you know, Beta and Reverse are selected by lifting up on the power levers when they hit the Idle stop in the power quadrant and then pulling them further back. That is how we reposition the LPS. Since the power levers must be at Idle before they can be lifted, it means that engine power will be low at this time … High Idle (70% N_g) at most. Thus, one of the two factors

WHY BETA?

Did you ever wonder why the word "Beta" is used when discussing reversing propellers? It is common that engineers use Greek letters when labeling angles. When variable-pitch propellers were invented, the first letter of the Greek alphabet – Alpha – was chosen to represent these variable angles. An engineer might say that the lowest Alpha value is 15 degrees and the highest Alpha value is 28 degrees in a typical constant-speed propeller found on, say, a Bonanza. When the range of blade angles was widened as reversing props made their appearance, the second Greek letter – Beta – was used to describe this new range of blade angles that had not previously existed.

When I first started instructing at the Beech factory in the early 1970s, Beta generally referred to all of the blade angle positions that could be selected when the power levers were behind Idle. We referred to the first "half" of this range as "Beta for Taxi" and the latter half as "Beta Plus Power." Residual thrust is reduced when we allow the propeller to go to flat pitch. Of course, propeller speed increases as the blade angle flattens since there is less resistance to rotation. If, however, the blade angle continues past flat pitch and starts pushing air forward, then the extra resistance to rotation will slow the propeller, leading to a loss of reverse effectiveness. To remedy this undesirable situation the "Beta Cam Box" – to which the power lever's cable connects – is engineered such that the fuel control unit will increase N1, increase power, as the LPS starts going into negative angles. The outcome of this design is that the reduction in forward thrust and the increase in negative thrust should change in a rather linear fashion as the power levers move aft through the Beta and Reverse ranges.

For the last many years "Beta for Taxi" and "Beta Plus Power" have generally been replaced by the terms "Beta" and "Reverse."

that lead to an underspeed condition – low power – is automatically achieved. The second factor needed to reach an underspeed condition – low airspeed – is one of the remaining factors within our control. The other remaining factor is the governor's propeller speed setting.

Back to the simple fixed-pitch prop on the trainer: With idle power, the speed of the propeller follows the speed of the airplane. Go into a dive, the prop goes faster; slow into a climb, it goes slower. Sit on the ramp with no wind at idle and it may only turn 600 RPM or so.

As for King Airs, have you noticed the minimum speed allowed for a windmilling airstart? It's 140 KIAS. Where did this number originate? That is the speed at which the propeller can windmill at takeoff RPM with no engine power whatsoever! The force of the air spinning the propeller at its LPS – alone, with no exhaust gas driving the power turbine – spins the prop right up to redline RPM.

Follow me through on this. Let's use a PT6A-21-powered C90 as an example. At Low Idle, there are indeed some exhaust gases helping to drive the propeller. It will therefore take less windmilling force to achieve the same RPM. Instead of 140 knots required to reach redline propeller speed, now it may happen at 110 knots. At any speed of 110 KIAS or more, we can reach 2,200 RPM at Low Idle. With the propeller levers fully forward, setting the propeller governor at 2,200, we will be seeing 2,200 RPM at any airspeed of 110 or higher. If we were to hold altitude with Low Idle power and allow the speed to decrease, the RPM would start dropping as the speed goes below about 110. At 105 knots the RPM may be down to 2,100; 100 knots might yield 2,000 RPM; 95 knots might yield 1,900 RPM.

Now what if we took this same propeller/engine/airframe combination but installed a new governor that has a maximum speed setting of 1,900 instead of 2,200 RPM? To achieve an underspeed condition – the prerequisite for allowing the propeller to follow the moving LPS into Beta and Reverse – our IAS must be below 95 knots. Do you see where I am going with this? The F90, debuting in 1978, was the first member of the King Air 90-series that used 1,900 instead of 2,200 RPM as its propeller's normal speed limit. Beech felt it necessary to add a statement into the POH stating, "CAUTION: Propellers will not reverse at speeds above 95 KIAS."

I often repeat the adage, "For every good, there's a bad." The good thing about slower propeller speed is less noise. The bad thing is that it makes reverse harder to obtain. More than one King Air pilot has found out the hard way that touching down with too much excess speed is a sin that use of reverse cannot cure! Of course the reason why is that the propeller blade angle is still being

determined by the governor, not by the position of the Low Pitch Stop. The propeller has not yet reached the state in which it is allowing us to bring it into reverse.

I should add here that this discussion about being impossible to reverse when airspeed is high began by mentioning the F90. I used the phrase "same propeller/engine/airframe combination." I lied a little, didn't I? Compared to the C90 of its day, the F90's wings are shorter, it has the T-Tail, it uses -135 engines instead of -21s, and it has four-blade props instead of the three-blades which were still used on the C90s of 1978 vintage. Yet, the relationship of airspeed to propeller speed at idle are still very similar, as I described.

Rest assured that although the 200-series uses 2,000 as its propellers' maximum speed and the 300-series uses a mere 1,700 RPM, these models hit their LPSs quite easily due to their particular propeller's size and shape. With power at Idle, they will be ready to reverse in almost all cases unless the speed at touchdown is much, much, too fast.

The "RVS NOT RDY" annunciator – Reverse Not Ready – illuminates when the landing gear handle goes down. It goes out when we push the propeller levers fully forward. Do you understand the significance of the reminder? Will extinguishing the light by advancing the prop levers guarantee that we can reverse the props? No.

This annunciator simply reminds us that selecting the highest propeller governor speed – which we are doing when the prop levers go fully forward – means that our moving of the LPS will more likely be successful since we are more likely to be in an underspeed condition if the governor is set for its highest governing speed.

You have all seen the placard on the power quadrant that states, "CAUTION: Reverse only with engines running." At the start of this article I promised that my discussion would be in a "nonscientific, nonmechanical, non-engineering manner." Let me try to explain why this caution exists and what it really means.

The only time the power levers can move the Low Pitch Stop to obtain Beta and Reverse is when the blade angle is actually sitting on the LPS. We might say that we need the propeller trying to go flatter, trying to restore the onspeed condition, trying to push the LPS flatter, to help us pull the LPS to smaller and smaller blade angles. If we don't have this help, this push from the propeller, then we feel resistance as we pull back and try to move a LPS that is not yet ready to move. With enough force, we can elongate or stretch the reversing cable. If that occurs, in the least it can set the LPS to an incorrect, higher blade angle. In the worst case, it can cause the propeller to go to and stay in feather!

A sidenote: Most of us have pulled the propeller levers into feather at shutdown while making the mistake of leaving the power levers in Beta: An easy boo-boo to make, right? Well, don't do it again but relax … you probably did no harm. Unless you had the power levers quite deep into Beta – or at the Ground Fine position for those models that have it – combined with a very tight friction setting, the chance of damage is slim.

If you have followed our discussion this far, then it should be obvious that using Reverse in flight to increase the descent rate during an emergency descent is impossible. Power levers to Idle, prop levers fully forward, flaps to approach, landing gear down and we nose over to about -12 degrees pitch attitude to maintain the landing gear extended speed limit. Even with Idle power and maximum propeller speed (N_P) selected, the high airspeed will cause the propellers to be solidly in the prop governing range. If we pull back into Beta now not only are we in violation of the limitation on lifting the power levers in flight but also all we will achieve is the possible stretching of the reversing cable since the blade angle is not even close to the LPS.

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*. 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*.

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The King Arrives

As the decade of the 1960s unfolded, business aviation in America was poised to make a major transition from piston-powered to turbine-powered airplanes. Beech Aircraft Corporation would lead that transition by introducing the Model 65-90 – the first King Air.

by Edward H. Phillips

The first King Air was caught in its element by a Beechcraft photographer during its maiden flight in 1964. The Model 90 ushered in a double jump in technology for business aircraft – turboprop power and a pressurized cabin. More than 100 were built during the initial year of production. (Special Collections and University Archives, Wichita State University Libraries)

In 1961 Olive Ann Beech listened intently to her loyal corps of vice presidents and engineers as they advocated a bold, new step for the company. To convince the "boss" that the risk was worth taking would prove no easy task, but Olive Ann was not afraid of a challenge – she had faced them many times before. Although she was not a pilot or an engineer, she was a superb business owner and had an enviable track record to prove it. Few doubted that fact, and by the early 1960s she had established herself as a rising star in the rough-and-tumble, capricious, male-dominated aviation industry.

The shy girl from rural Kansas was no stranger to aviation – she learned the business as "boss" of the office at the Travel Air Company from 1925-1931, where she was known by her co-workers as strictly "Miss Mellor." In 1930, she changed her last name to Beech and in 1932, amid the depths of the Great Depression, co-founded the infant and struggling Beech Aircraft Company with her husband Walter. She was a key co-executive with Walter during the hectic years of World War II when the company produced more than 7,000 airplanes and built subassemblies for other aircraft.

When Mr. Beech died in November 1950, Olive Ann was more than prepared to step into his shoes as president and chief executive officer and she soon demonstrated that the lessons she had learned during the past 30 years had helped to hone her skills not only as a manager, but also as a "no-nonsense," uncompromising decisionmaker. The "bold, new step" she heard about that day in the boardroom was nothing short of revolutionary.

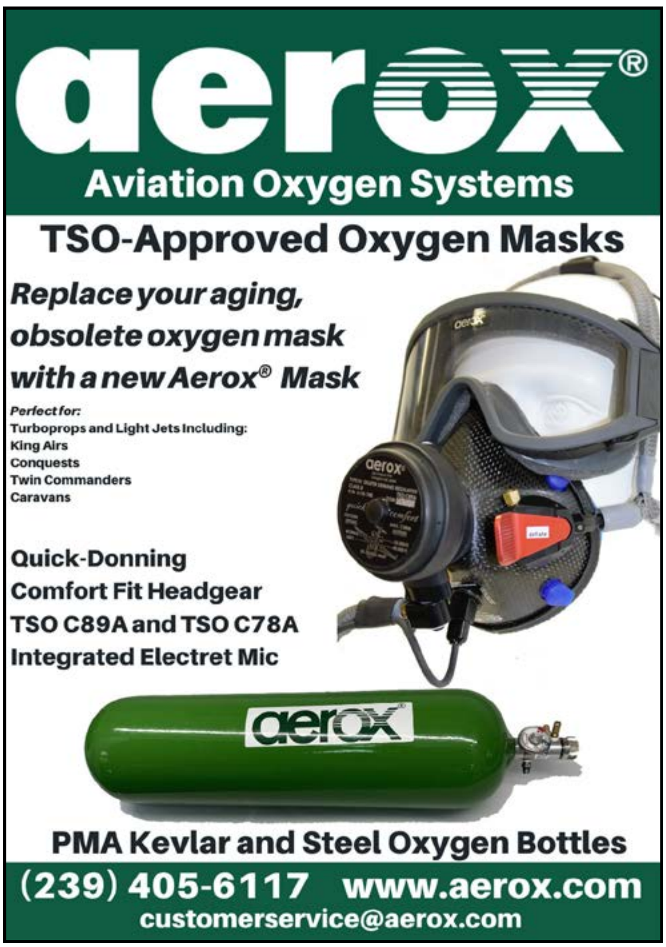
It centered on marrying the proven and robust airframe of the Model 80 series Queen Air with the gas turbine power of Pratt & Whitney's new, innovative PT6A turboprop engine. The PT6 was a major design and technical breakthrough in gas turbine technology that promised to deliver significantly more power than was available using reciprocating engines. Although highly reliable, the large displacement, turbocharged engines built by Continental and Lycoming would remain in demand for years to come; they were approaching the limit of their development in terms of horsepower. The New England-based company's compact, lightweight and powerful PT6A was among the earliest turboprop engines developed specifically for the general aviation segment (which included business aircraft) and delivered 550 shaft horsepower (shp) for takeoff and 500 shp for continuous operation. In addition, it could deliver more than 1,000 pound-feet of torque to the propeller via a simple, reliable, planetary-type reduction gearbox.

Although development of turbojet engines began in the late 1930s, it accelerated quickly during World War II and continued into the 1950s, the focus of engine manufacturers was primarily tied to military and commercial airframes, not business aviation. With the advent of the PT6A, however, gas turbine technology that was forged in the "Jet Age" was finally beginning to trickle down to the general aviation market. As far as Beechcraft's senior engineers were concerned, the Queen Air airframe was a logical match for Pratt & Whitney's powerplant. All that remained was to convince Olive Ann Beech.

Olive Ann Beech at her desk during the postwar years. Prior to the death of her husband Walter Beech in 1950 she already played an increasingly important role in both the management and direction Beech Aircraft Corporation would take in the years ahead. (Courtesy Mary Lynn Oliver)

After a thorough investigation of the facts and input from her officials, she gave a green light to what would become known as "Project King Air." Originally conceived in 1961 as the 300-mph Beechcraft Model 120, the new airplane was officially introduced July 14, 1963, and made its first flight Jan. 24, 1964. The company's engineering department had grafted the PT6A onto the Queen Air airframe, which had been modified to allow the cabin and cockpit to be pressurized to 3.4 psid (pounds per square inch differential).

Pressurization was not new in aviation, having been developed late in the 1930s and employed successfully on airplanes such as Boeing's Model 307 Stratoliner airline transport. But in 1963, it was a novel concept for a small business airplane designed to carry four to six passengers and two pilots, yet the engineers and Beechcraft marketing officials believed it would put the company far ahead of the competition – exactly where Olive Ann Beech wanted it to be.



It should be mentioned that the first airplane built with PT6A engines, designated as the Model 87 and carrying serial number LG-1, had been undergoing rigorous flight tests at the Wichita, Kansas, factory since May 1963. Throughout the airplane's nearly 10 months of intensive testing, company engineers gradually worked out the inevitable "bugs" associated with any new design, especially one that represented a major leap in technology involving not only an entirely new type of engine, but also a highly-modified airframe that came with its own set of unique challenges from the pressurization system.

Designated NU-8F by the Army, the airplane was delivered to Fort Rucker, Alabama, in March 1964 when it began an in-depth evaluation by Army pilots, maintenance officers and mechanics. Prompted in part by the service's success with the L-23F, of which 71 examples were delivered from 1960-1963, the Army brass wanted an opportunity to take a hard, long look at Beech Aircraft's latest creation and investigate its potential for military service.

Meanwhile, back in Wichita, preparations were underway to begin production of the Model 90 King Air. With a wingspan of 45 feet, 10.5 inches, a length of 35 feet, 6 inches and a height of 14 feet, 2.5 inches to the top of its swept vertical stabilizer, the Model 90 had a maximum gross weight of 9,300 pounds and a fuel capacity of 122 gallons of jet fuel carried in nacelle mounted tanks with another 262 gallons in wing tanks. Three-blade, constant-speed, full-feathering propellers were standard equipment.

By comparison with current pressurization systems that are fully automatic and often digitally-controlled, "set-and-forget" installations, the Model 90 had to make do with a single, mechanical, Roots-type supercharger mounted in the left nacelle that supplied adequate airflow to inflate the passenger compartment. The primary reason for this necessity centered on the PT6A engine that, in its early configuration, did not have sufficient capability to produce rated power and "spare" enough bleed air from the compressor section to pressurize the cabin – a less than desirable situation that was remedied with more powerful versions of the engine. A pressure relief valve was set to vent cabin air overboard if pressurization exceeded 4.0 psid.

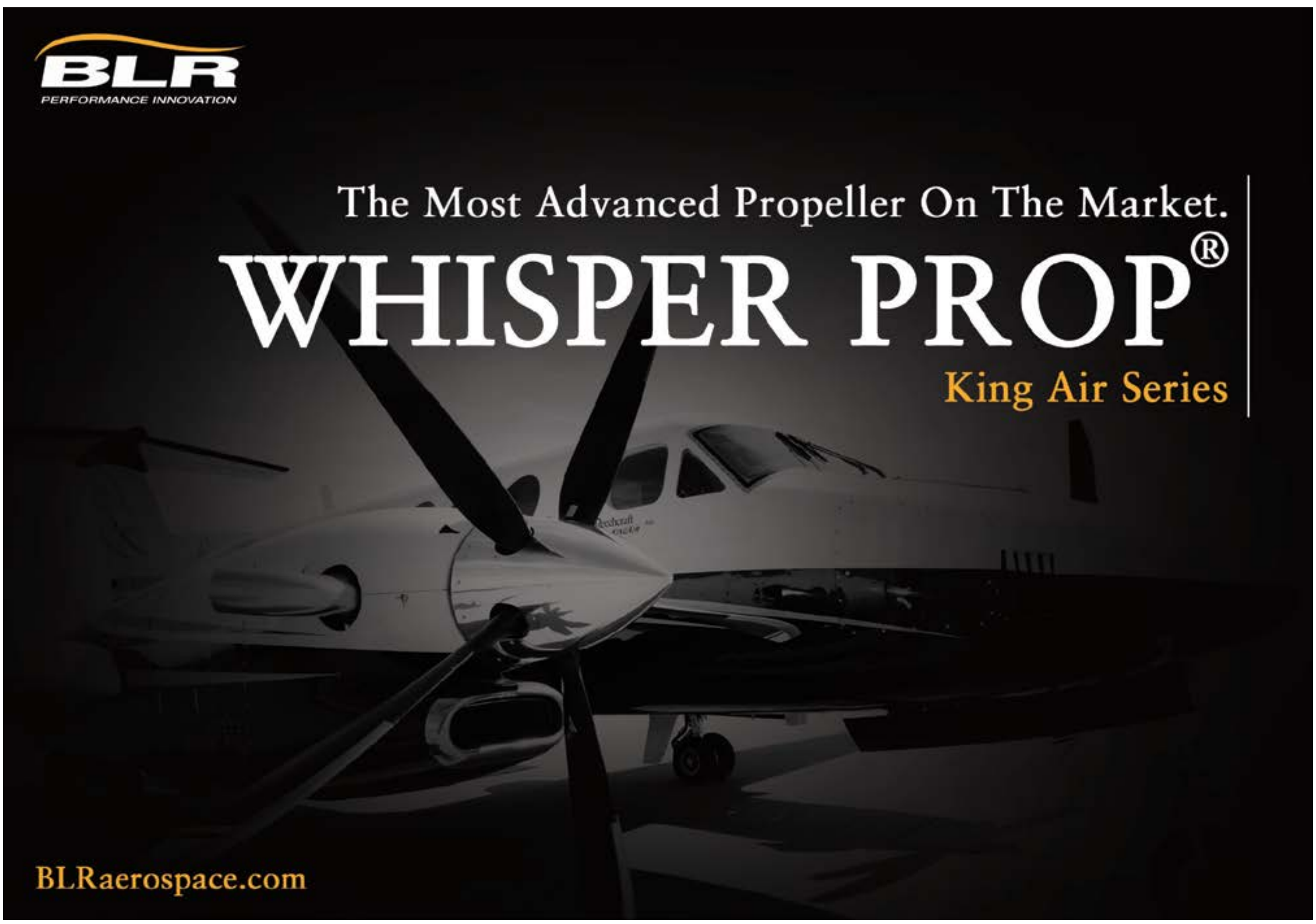
In terms of performance, the Model 90 increased cruise speeds to nearly 300 mph and the Beechcraft marketing department lost no time in espousing the many virtues of the King Air. As aviation pioneer Clyde V. Cessna once said, "Speed is the only reason for flying," and customers were soon selling or trading in their venerable Model 18s or Queen Airs for the ultramodern, 280-mph King Air. The airplane was enthusiastically embraced by every corporation and company that took delivery of the "jetprop" executive transport. Pilots long accustomed to managing piston engines had to learn how to handle the PT6A-6 powerplant as well as the pressurization system. They were, however, soon singing the praises of the Model 90's quiet cabin, fuel-efficient engines, ease of handling and its superior climb and cruise performance compared with the Queen Air or competitor's airplanes.

The company produced 112 Model 90 King Airs from 1964-1966 when production switched to the upgraded Model A90 that first flew Nov. 5, 1965. Equipped with improved PT6A-20 engines developing 550 shp for takeoff, 538 shp for climb and 495 shp for cruise, as well as reversible propellers to reduce landing roll distance, the latest Beechcraft also featured a more capable pressurization system with a maximum differential of 4.6 psid. The upgraded system provided passengers with a sea level cabin up to an altitude of more than 10,000 feet and an 8,000-foot cabin above a cruising altitude of 21,000 feet.

The factory built 206 Model A90s before it was replaced on the assembly lines by the Model B90 that first flew April 13, 1967, and was placed into full production for the 1968 model year. Principal changes from the A90 centered on improved airframe systems but the B90 retained the PT6A-20 engines of its predecessor. Beech manufactured 184 B90s until it was replaced by the Model C90 in 1971.

With the introduction of the King Air, Olive Ann Beech and the Beech Aircraft Corporation had launched business aviation into the "Jet Age" and set yet another standard for the industry to follow. The highly popular King Air series, however, was only beginning to flex its sales muscle and the years ahead would witness development and introduction of an entire "royal family" of turboprop-powered, cabin-class airplanes that served with distinction in both the corporate and military marketplace. KA

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.



Beechcraft King Air 260 Achieves FAA Type Certification

The Federal Aviation Administration (FAA) has approved Certification of the newly upgraded Beechcraft twin turboprop King Air 260. Manufacturer Textron Aviation says the King Air 260 combines the platform's rich history of rugged reliability and versatility with state-of-the-art upgrades and next-generation capability, offering a greater ease of flying.

The upgraded cockpit features the Innovative Solutions & Support (IS&S) ThrustSense Autothrottle system, which supports pilots in their critical mission of delivering people or cargo by automatically managing engine power from the takeoff roll through the climb, cruise, descent, go-around and landing phases of flight. This enhancement reduces pilot workload and is designed to prevent over-speed or under-speed, over-temp and over-torque conditions. The ThrustSense Autothrottle system has been awarded special type certification (STC) approval from the FAA.

Another key update in the cockpit is the new digital pressurization controller, which automatically schedules cabin pressurization during both climb and descent, reducing pilot workload and increasing overall passenger comfort. The pressurization gauges have been integrated with the powerful Collins Aerospace Pro Line Fusion flight deck.

The Collins Multi-Scan RTA-4112 weather radar provides pilots with a fully automatic system that is optimized to detect short-, mid- and long-range weather. The system is designed to present an accurate picture of the weather around the aircraft, further reducing pilot workload.

Another upgrade is in the King Air 260 cabin and features newly designed seats created through an innovative pressure-mapping process that identifies ways to provide a more comfortable, relaxing journey for passengers.

Customer deliveries of the King Air 260 will be commencing soon.

King Air Ground Cooling Aftermarket Upgrade Approved for Model 200 and 300 series

Textron Aviation announced FAA Supplemental Type Certificate (STC) approval for the new Beechcraft King Air Ground Cooling aftermarket upgrade for the Beechcraft King Air 200 and 300 series turboprops. The Ground Cooling system enables King Air operators to cool the cabin before crew and passengers board, by plugging in a Ground Power Unit (GPU) eliminating the need to power air conditioning systems via the aircraft's engine.

The Ground Cooling system, offered exclusively for install at Textron Aviation, is available now. Textron Aviation offers factory-direct service and support through a global network staffed with nearly 3,000 employees. Customers have direct access to a team of expert service representatives offering maintenance, inspections, parts, repairs, avionic upgrades, equipment installations, refurbishments and other specialized services.

West Star Aviation Receives Mexican AFAC Repair Station Certification for Two More Locations

West Star Aviation has announced the recertification for both their East Alton, Illinois, (ALN) and Houston, Texas, (CXO) facilities as Mexican AFAC Repair Stations. This replaces the DGAC Certificate originally issued and provides safety and certification continuity between the FAA and Mexican aviation authorities.

West Star's Grand Junction, Colorado, (GJT) facility was originally certified from the onset of the requirement in 2004, and later its location in Chattanooga, Tennessee, (CHA) bringing the total to four with the certification.

West Star Aviation is an authorized service center for King Airs and specializes in the repair and maintenance of airframes, engines and APUs, avionics installations and repair, major modifications, interior refurbishment, exterior paint, accessory services and parts. For more information visit *www.weststaraviation.com* or call (800) 922-2421.

Prizm lighting in King Air cabin.

Stevens Aerospace Authorized to Install Prizm Cabin Lighting

Stevens Aerospace announces that all four of the company's MRO facilities have been designated as authorized installation centers for the highly regarded PRIZM LED Cabin Lighting systems. The LED lights last 10 to 15 times longer than the more expensive florescent tubes which provides a considerably less cost of ownership.

PRIZM's customizable full-color LED spectrum mood lighting can be controlled three ways: via a mobile app, by browsing directly to the system, or in conjunction with existing cabin lighting controls. The system offers upwash, downwash, lower accent, galley, lavatory and cupholder lighting. It is adaptable on older airframes as well as the newest business aircraft, from jets to turbine-powered aircraft.

Stevens Aerospace provides MRO (maintenance, repair and overhaul) services on a wide range of aircraft, including the King Air. It presently operates facilities in Greenville, South Carolina (GYH), Dayton, Ohio (DAY), Nashville/Smyrna, Tennessee (MQY) and Macon, Georgia (MCN). KA

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