King Air

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IN HISTORY

The "Cookbook" King Airs

During the 1970s and 1980s, the Beech Aircraft Corporation served up the E90 and F90 King Air using special ingredients drawn from their library of recipes.

by Edward H. Phillips

Correction

*Editor's Note: In the June 2021 issue, the historical article titled "*The 'Cookbook' King Airs*" had some inaccuracies that are corrected below. We apologize for any confusion this may have caused.*

The final Model E90 to roll off the assembly lines was serial number LW-347.

Continuing the company's highly successful "Cookbook" approach to creating new aircraft, in 1977 engineers combined the T-tail design of the Super King Air with the fuselage of the Model E90 and the wings and landing gear from Model A100, but the A100's wing fences were deleted before production began. The result was designated the F90 King Air and the preproduction prototype, serial number LA-1, made its first flight January 16, 1978, under the command of company test pilot Marv Pratt. The Federal Aviation Administration (FAA) issued Type Certificate A31CE to the F90 May 18, 1979.

The F90 served as a step up the Beechcraft product line from the E90 and possessed major systems and performance improvements compared to its sibling. Chief among these was installation Pratt & Whitney Canada PT6A-135 turboprop engines, each rated at 750 shp. The powerplants were mated to four-blade propellers rotating at 1,700 RPM in cruise to reduce cabin noise level. Maximum cruise speed increased to 307 mph from the E90's 285 mph, and initial rate of climb was 2,380 feet per minute. In addition, maximum certified altitude increased to 31,000 feet. The F90 featured a dual-tire main landing gear similar to that of the Super King and the company's new 28 VDC multibus electrical system. The system contained five separate buses, automatic load shedding and solid-state current sensors to provide protection against ground faults, thereby quickly isolating a faulty bus.

Initial customer demand for the F90 proved to be strong and 202 airplanes were built between 1979-1983. Production peaked at 75 airplanes in 1981. Later, the prototype F90 served briefly as an engineering testbed for the proposed Model G90 King Air that would have been powered by Garrett TPE-331 engines. For the 1983 model year, Beech Aircraft engineers incorporated technical improvements that were applied to the F90-1, including pitot-type engine cowlings with improved air intake characteristics, and the use of tapered exhaust stacks. The wings held 388 gallons of fuel with another 41 gallons available from auxiliary tanks in the wing center section. KA

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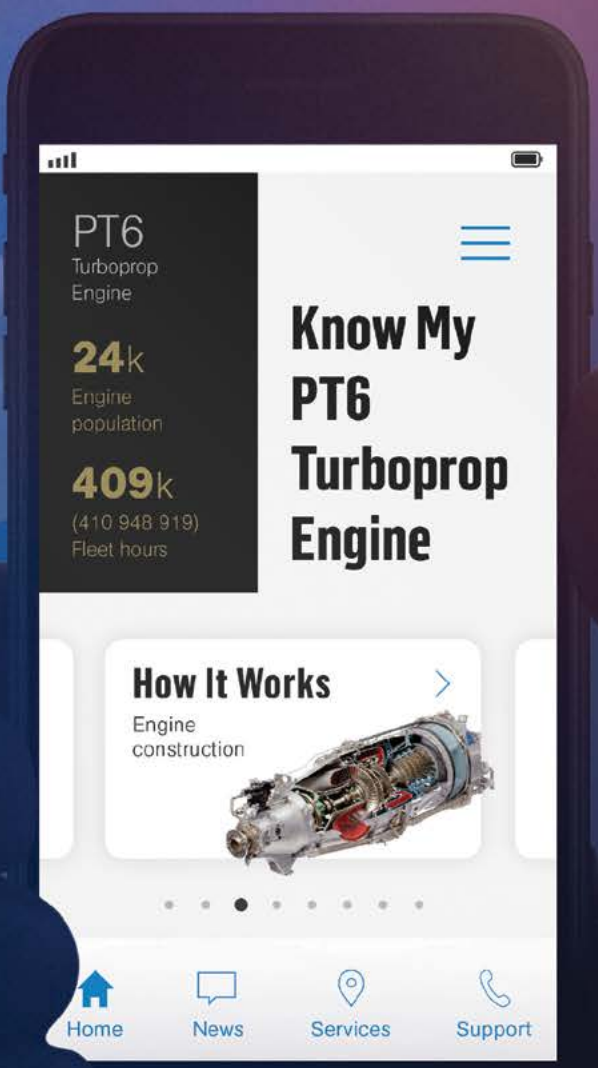
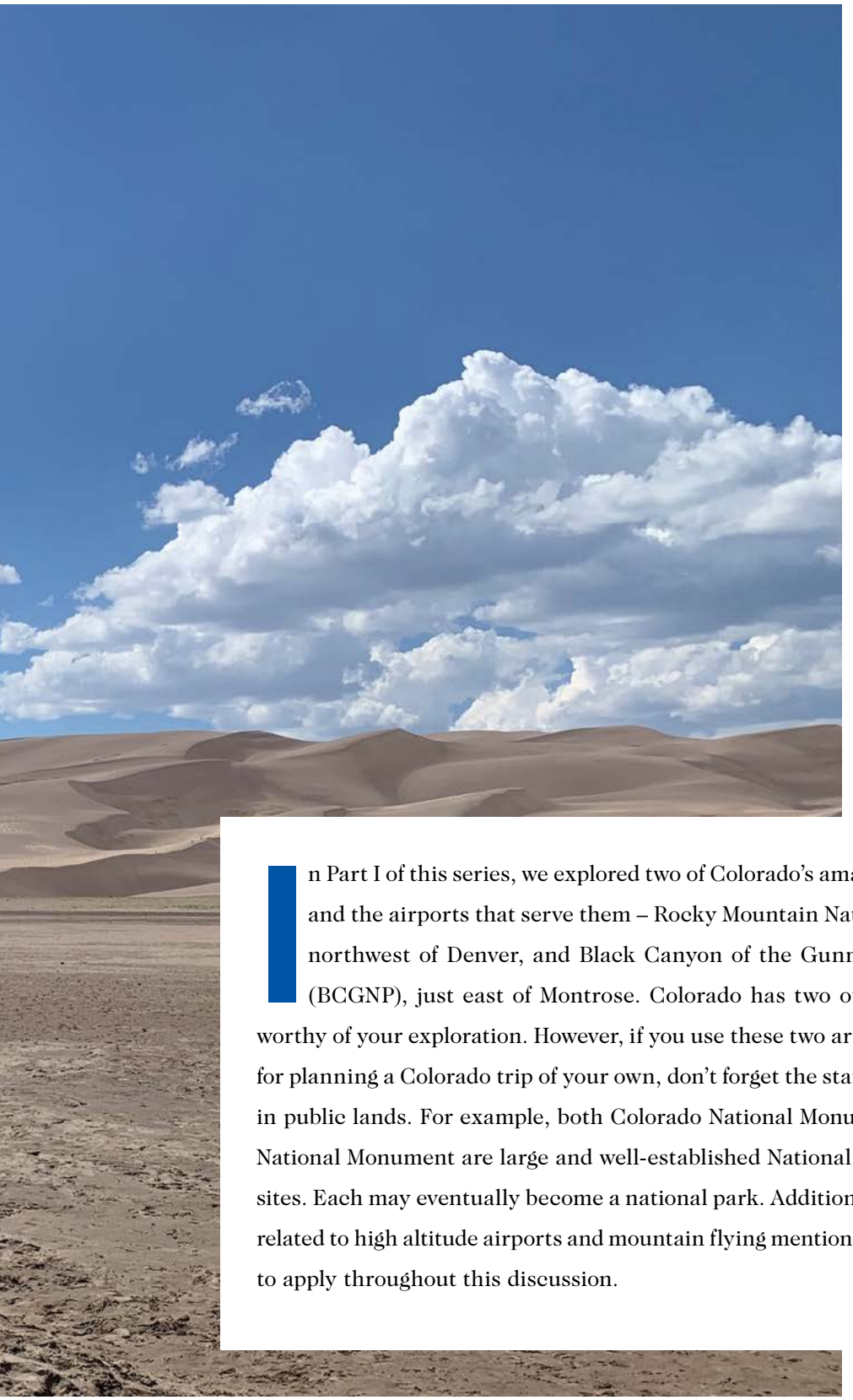


Colorado's Contours, Part II: Discovering the Marvels of Man and Nature

by Matthew McDaniel



Great Sand Dunes National Park, as seen from the Medano Creek bed's "beach" area. The expanse of sand is nearly impossible to comprehend, much less capture in a photo.

In Part I of this series, we explored two of Colorado's amazing national parks and the airports that serve them – Rocky Mountain National Park (RMNP), northwest of Denver, and Black Canyon of the Gunnison National Park (BCGNP), just east of Montrose. Colorado has two other national parks worthy of your exploration. However, if you use these two articles as a motivator for planning a Colorado trip of your own, don't forget the state offers much more in public lands. For example, both Colorado National Monument and Dinosaur National Monument are large and well-established National Park Service (NPS) sites. Each may eventually become a national park. Additionally, all precautions related to high altitude airports and mountain flying mentioned in Part I continue to apply throughout this discussion.

Cliff Palace can be viewed along the Cliff Palace Loop Drive at the southern end of Mesa Verde National Park. It is the largest cliff dwelling in North America and sits at an elevation of approximately 7,000 feet. It contained over 150 rooms and likely housed over 100 people at any given time.

An excavated pit house near Navajo Canyon View in Mesa Verde National Park. Pit houses were the chosen dwellings of the Archaic Mesa Verdeans and date to approximately 1,000 BCE.

Mesa Verde National Park (MVNP)

We ended Part I at Montrose Regional Airport (MTJ) in west-central Colorado. From there, the under 100-nautical-mile flight to the southwest corner of the state will keep you west of the highest terrain within the Colorado Rockies. Of course that only means you'll avoid peaks in the 13,000- to 14,000-foot range. You will still have to overfly the Uncompahgre National Forest, which includes several peaks near or above 10,000 feet. Further southwest, the Little Cone and Lone Cone peaks rise to 11,981 and 12,613 feet, respectively. Lone Cone, the highest point along the route, is almost directly underneath a direct course between MTJ and Cortez Municipal Airport (CEZ). Cortez is the gateway airport into one of the most fascinating archaeological treasures within the United States — Mesa Verde National Park.

Like the park itself, CEZ is a throwback to a bygone era. It's a quiet, non-towered airport with an old-school FBO that prioritizes service over grandiose facilities. Cortez Flying Services offers all the amenities pilots and their aircraft typically need. Plus, it does so in a friendly and reasonably priced fashion. For overnight stays or even day trips into the park, rental cars can be reserved and waiting at CEZ and tie-downs are available to secure your aircraft while you are away. The airport is a single runway (03/21) with four instrument approaches to choose from – GPS LNAV approaches to both runway

ends, plus a legacy VOR approach and a modern GPS LPV approach to Runway 21. The LPV minimums are quite low for a mountain airport, with published minimums of 302 feet AGL. While the VOR and LNAV approaches to 21 keep you reasonably clear of the immediate area's highest terrain, the LNAV to 03 and LPV to 21 are forced to contend with the terrain more creatively. Both thread the needle between the nearly 10,000-foot Sleeping Ute Mountain and the high mesas that encompass much of MVNP (on the inbound segments for the LNAV 03 approach and the missed approach segment for the LPV 21). The runway's 7,205-foot length should prove adequate for all but the most extreme conditions, with proper management of aircraft weight and performance. Once safely landed and parked at CEZ, the wonders of Mesa Verde are mere minutes of driving time away.

While Mesa Verde is most famous for its some 600 ancient cliff dwellings, the park protects over 5,000 sites of ancient archaeological, historical and social significance. Mesa Verde is not only a U.S. National Park but also a UNESCO World Heritage Site. American Indians are known to have inhabited the area within MVNP as early as 9,500 to 7,500 BCE. Around 1,000 BCE, Archaic Mesa Verdeans developed permanent settlements, incorporating pit houses, the remains of which can be viewed at MVNP today. The Ancestral Puebloans began constructing the area's first pueblos between 600 to 650 CE While they steadily improved their culture's farming, housing and food storage technology, they also battled droughts, depopulation, migrations and warring settlements. After a severe drought in the early 12th century, much of the population left their traditional mesa-top dwellings and began constructing and living in cliff dwellings below the mesa tops. These hard-to-reach dwellings helped grow larger and tighter-knit communities in the area by offering protection from both weather and enemies while also consolidating the population and locating them closer to valley water sources. The Ancestral Puebloans constructed and lived within these now-famous dwellings for around 100 years before migrating elsewhere due to decades of severe drought and especially harsh winters. Yet, since their rediscovery between 1873 and 1885, they have captured and held the imagination of millions who struggle to imagine how ancient people managed to build and survive within villages clinging to jagged cliff faces.

Mesa Verde is one of those places you can endlessly read about yet fail to fully appreciate it until you've seen it firsthand and walked among its sites. From CEZ, follow Highway 160 northeast for five minutes, into and through Cortez. Another 10 minutes east of town and you'll arrive at the MVNP Visitor & Research Center.

A view of Mesa Verde National Park. Early inhabitants of the area lived on the mesa tops. It was not until around the 12th century CE that they began to move their homes and villages below the mesa tops, into the natural alcoves and ledges on the cliff sides.

Via Mesa Top Ruins Road and the park's north entrance, you'll begin your journey back in time.

You can enjoy MVNP with scenic drives and various overlooks, some within walking distance to many archaeological sites and cliff dwellings. Of course, the park has plenty of hiking if you have the time and inclination. The Mancos Valley Overlook is the first point of interest after entering the park. Beyond it, the Morefield Campground provides access to several trails – two easy, 2-mile, out-and-back trails and the Prater Ridge Trail, which is a more challenging 7.8-mile loop. Continuing along this picturesque mountain ridge, stop at the various overlooks to take photos. Wetherill Mesa Road branches into the western reaches of MVNP and provides access to the Step House (the only cliff dwelling you can tour self-guided). Beyond Step House, the 6-mile Long House Loop paved trail provides access to that dwelling (tickets required) and several other sites. However, keep in mind, Wetherill Mesa Road is only open May-September (weather permitting) and is limited to smaller vehicles. Thus, the more popular option (especially for day-trippers) is to continue south to the Chapin Mesa Archaeological Museum and Spruce Tree House. Adjacent to the museum is several easy trails through canyons leading to ancient petroglyphs. The paved road then branches into two loop drives. The Mesa Top Loop takes visitors to several Archaic-era pit houses and villages and the fascinating Sun Temple (all open year-round). Saving the best for last, the Cliff Palace Loop (closed in winter) leads to Balcony House and perhaps MNVP's most photographed site, Cliff Palace. Both are accessible via ticketed, guided tours only.

Regardless of where your MVNP touring takes you, you'll have to backtrack to the north park entrance through which you came. During that drive, you are sure to be taking in the scenery while also deep in the awe-struck wonder of what the ancient people who inhabited this area centuries and millennia before were able to accomplish. Their engineering skills were well developed, but their survival skills were acute enough to be willing to abandon their unique dwellings and move on when required. Mesa Verde is teeming with information gained through decades of dedicated research and preservation efforts. Yet, it's also a collection of endless mysteries that you will carry with you back into Cortez and beyond.

Great Sand Dunes National Park (GSDNP)

From Cortez eastward, it is roughly a 130-mile flight to reach the San Luis Valley. Along the way, the route passes along the southern reaches of the San Juan Mountains, where extensive soaring activity is common

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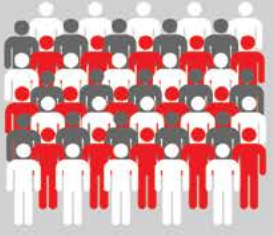

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Vegetation (small and large) provide some degree of stability to about 89% of Great Sand Dunes National Park's 330 square miles of sand. The other 11% is made up of the main dunefield, which shifts and moves as the winds drive it … ever moving, ever evolving.

as glider pilots take advantage of the nearly endless supply of ridge lift. Summit and Conejos Peaks will be immediately south of the route, while Horseshoe Mountain will be north – all rise above 13,000 feet. These mountains are jagged and fall sharply into San Luis Valley's sub-8,000-foot elevations.

Several airports are available to choose from within the valley. Del Norte's Rominger Field (RCV) and Monte Vista Municipal (MVI) have single runways exceeding 7,000 feet and offer fuel and basic services. However, for easy access to rental cars, more hotel choices and a greater variety of available services, Alamosa's San Luis Valley Regional (ALS) is the obvious choice. With over 8,500 feet of runway (02/20), served by an ILS and two GPS/LPV approaches, ALS can meet both the performance and weather needs of most any GA aircraft (turbine or piston). Centric Aviation is equally well suited to serve the pilot's needs, and a call ahead will ensure they have all the amenities awaiting your arrival. Once in your rental car, a very different national park experience awaits only 45 minutes away.

Of course, MVNP has gorgeous natural beauty and unspoiled acres to gaze upon and wander through. But it is mainly the elements built by ancient man that visitors seek there. Conversely, Great Sand Dunes National Park is mostly untouched by human habitation, where nature and wildlife are presented in stunning vistas and solitude. The tallest dunes in North America reside there. One reaches 755 feet tall (Star Dune) and continuously changes height, shape and dimension. Winds and streams, freezing and thawing are the powerful forces combined to erode mighty mountains down to these towering piles of sand. Over 330 square miles of prehistoric mountains have been reduced to sand within GSDNP and about 11% of those sands make up the desolate dunefield. Outside the dunefield, the sands are mostly hidden (and stabilized) by plants and grasses. Adjacent to the park, Great Sand Dunes National Preserve protects much of the Sangre De Cristo Mountains, which are part of the greater ecosystem that created (and continues to build) the dunes over the last 400,000 years or so.

Touring GSDNP is a different national park experience. It is loosely divided into "Main Use" and "Mountain Use" areas. In the Main Use area, climbing the dunes is popular, as is sledding or sandboarding back down them. It is also a real workout to trudge through the deep sand, up steep inclines. At least two hours is required (round trip) to hike/climb from the Visitor Center parking to High Dune (the second-highest dune in the park, at 699 feet tall). The sand temperature can exceed 140° F during the summer months, so take appropriate precautions for health and safety. Yet, the views of the entire dunefield from atop the tallest dunes are spectacular. Roughly April through June, Medano Creek flows past the base of the dunes and can be wonderfully refreshing to splash in after a hot dune hike. A short (30-minute) grassland trail hike is accessible from the Visitor Center too. Nearby, the Montville/Mosca Pass Trailhead leads hikers into three ridge view trails. These hikes can be a shady respite from the dune area, ranging from 30 minutes to 3.5 hours.

Leaving the paved road north of the Main Use area, The Point of No Return is exactly as the name implies. From there, everything beyond is accessible by hiking or high-clearance vehicle only. The Sand Pit Picnic

area is closest, requiring a 1.5-hour hike (round trip). For the truly hardy, the Sand Ramp Trail is 11 miles (each way) along the eastern and northern edges of the dunefield, ending at the northern end of the Star Dune Complex. The Medano Pass Primitive Road leads out of GSDNP and into the preserve. There, several other long, backcountry hikes to mountain lakes are available. Still, all are beyond the scope of this article, as they would not be accessible via a typical rental car. Even sticking to the Main Use area of GSDNP, it is a truly unique park. Because it is close to a versatile airport and is relatively small by western national park standards, it's a great day or weekend trip destination. If your timing allows, be sure to stay after dark. Stargazing over the dunes is incredible, thanks to the lack of light pollution in the vast, open area. Wildlife viewing is also best in the low light of sunrise and sunset, when elk, mule, deer and pronghorn are more likely to venture into open areas to graze.

Colorado has no shortage of awe-inspiring destinations to tour aerially and terrestrially. Perhaps the most popular state for mountain recreation of all sorts, it is also equally popular for gaining mountain flying training and experience. In many of the mountain flying courses I've taught over the years, Colorado has been the state of choice to begin the course. Its many national parks, national monuments and other NPS sites alone could keep one busy touring for years. Add to that its many fun and challenging airports, beautiful mountain villages and endless unspoiled backcountry, and it's hard to imagine anyone ever feeling like they've seen all that Colorado has to offer. Whether it is for business or pleasure, make it a point to add some Colorado flying and tourism to your travel wish list. Then, with proper training completed, start trading those wishes for experiences. The mountains await. KA

Matthew McDaniel is a Master & Gold Seal CFII, ATP, MEI, AGI, IGI and Platinum CSIP. In 30 years of flying, he has logged over 19,500 hours total, over 5,600 hours of instruction-given and over 2,500 hours in various King Airs and the BE-1900D. As owner of Progressive Aviation Services, LLC (*www.progaviation.com*), he has specialized in Technically Advanced Aircraft and Glass Cockpit instruction since 2001. Currently, he is also an Airbus A-320-series captain for an international airline, holds eight turbine aircraft type ratings and has flown over 95 aircraft types. Matt is one of less than 15 instructors in the world to have earned the Master CFI designation for nine consecutive two-year terms. He can be reached at: *matt@progaviation.com* or (414) 339-4990.

Icing in Flight

Part I

by Tom Clements

This article is written in hopes that it will serve as a useful reminder about how to configure your King Air for in-flight icing encounters. If you have any significant amount of flight time in a King Air, I suppose that you have become quite comfortable with flying and handling the airplane in icing conditions. At first, many pilots fear that those big wing leading edges will collect ice with a vengeance. Yet, with experience, the operators come to realize that the wing does exceedingly well during ice encounters. In fact, the smaller leading edges of the tail surfaces collect ice significantly faster than the wing. Overall, however, when properly configured and flown, the King Air is one of the most desirable flying machines in which to ride when icing becomes a concern.

Of course, icing *avoidance* is always a good idea! A slight detour around a cloud buildup or even a major course modification to avoid the worst of a line of thunderstorms shows a conservative, proper and safety-conscience attitude. Sometimes, however, the decision will be made to fly into visible moisture when the OAT is +5° or below. Do you recognize the latter portion of that sentence? It is in all of Beech's POMs and POHs as the definition of icing conditions: Visible moisture when the OAT is +5° or below.

" ... when properly configured and flown, the King Air is one of the most desirable flying machines in which to ride when icing becomes a concern."

Beech has never specified if the OAT to which they refer is the actual Outside Air Temperature – OAT or SAT (Static Air Temperature) – or is it the Indicated Outside Air Temperature – IOAT or RAT (Ram Air Temperature). Some pilots worry that since there can be as much as an 8°C "ram rise" difference between OAT and IOAT, it could be ill-advised to use IOAT since it actually would be below freezing outside while the IOAT remained in the above freezing range.

Fret not. We instructors at the Beechcraft Training Center always taught this as IOAT: Simply what you read off the OAT gauge. You see, if the OAT probe itself is experiencing a temperature increase due to the compressing of the air as it encounters the probe, would it not be logical to assume that the rest of the airframe also is experiencing some compressibility heating? Whether that theory is 100% correct or not I believe no one truly knows. However, over 57 years of King Air operation – 1964 to 2021 – have verified that problems are not caused by using the reading on the gauge, *not* corrected for compressibility.

Not until the last couple of decades or so have any King Airs been equipped with OAT/SAT readings on their EFIS displays. Yet, these airplanes also have the IOAT readout on the sidewall by the pilot's left elbow. Both for the temperature reference in looking up cruise power torque settings, as well as for deciding if icing conditions exist, the elbow gauge is the one to use. Now, if there is a difference more than the ram rise value of around 7°, you may want to have that looked at by the shop when convenient. For many, many years this mechanical gauge looked almost exactly like our moms' turkey thermometers. In fact, it was not uncommon to call it by that name. Later King Airs have the mechanical dial face replaced with a digital electronic readout, yet it is still just displaying the temperature of the metal probe. In most cases, the probe has been relocated from the sidewall to the lower, left portion of the nose skin next to the left nosewheel gear door.

Here's another piece of historical trivia you may find of interest: Before the OAT gauge was located by the pilot's elbow, it was in the cockpit overhead. For many years, it was just above the pilot's windshield. All the pilot had to do was tip his head back a bit and he/she would be looking right at it. Complaints started being received, however, about a whistling noise that was created by this probe when it collected some ice. The Beech design team corrected that by moving the probe back from near the windshield's top edge to a place behind the lighting control panel. Now the pilot had to twist and crane his neck to get the reading – not nearly as convenient as it had been in its original location.

Also, to see the gauge at night, it has a post light next to it with a momentary push-on switch nearby. To avoid the neck-craning contortion, Beech eventually moved the gauge to the left sidewall. But guess what? It took a couple of years for the switch to get moved there also. There are quite a few King Airs in which, at night, you first have to locate the light switch in the overhead panel, rest your finger on it, then turn your attention to the gauge by your elbow. Now push the switch and take the reading. Hey, even Beechcrafts aren't always 100% perfect!

How many switches or push-pull controls must be activated in icing conditions according to your POM/POH? A heckuva lot! The lowest number is 10 and the highest is 14! We will be counting them out in the upcoming paragraphs.

There are two or four switches to the left of the pilot's control wheel: Two Engine Auto-Ignition switches and, for the later models, two Engine Anti-Ice switches. On the subpanel to the right of the control wheel we find a bunch more: Two Pitot Heat switches, two Fuel Vent Heat switches and a single Stall Warning Heat switch make up five of the switches on the right subpanel. These five switches have become known as the "Hot Five" and many King Air pilots operate them all the time when airborne, turning them on at "Runway Lineup" and off in the "After Landing" procedure. I have no complaint whatsoever with this process. However, I personally don't do it. It's not a POH procedure but rather comes from FlightSafety and U.S. Army training tradition. Wrong? No way! Maybe it's because I have resided in Arizona for the last 34 years, but I just don't see the need for running the Hot Five when it's warm and clear, so typical of the United States' southwestern states. My technique isn't more "right" than running the Hot Five always, it's just my habit/preference.

Another piece of historical trivia before I finish counting out the remainder of the ice protection switches: It's impossible to turn on the Hot Five in a King Air 100 (the original "Straight" 100 made from 1969 to 1971, not the A100 nor the B100). The 100 model has no fuel vent heat! Although most of us think that the heated "standpipe" vent tube is a backup for the recessed vent (and that it is!) that's not why it's there. As you know, fuel vents serve two purposes. First, they allow air to enter the tank as fuel is consumed to prevent a vacuum from being created which could collapse a bladder tank. Second, they provide an overboard path for fuel when it expands, usually due to heat buildup, causing thermal expansion.

Apparently, both Beech and the Federal Aviation Administration (FAA) agreed that the recessed fuel vent on each side of a King Air, by its recessed nature, was not prone to becoming blocked by ice. Hence, no backup was necessary. In the model 100 *only*, enough expansion space exists in its tanks that thermal expansion causing the fuel to overflow the tank is not possible. The 100's fuel system, although similar to the A90, B90 and C90 system has some significant changes. One of these is that its maximum capacity is 370 gallons, not the 384 of the others. No other King Air fuel system is exactly like it.

All the other King Air models, however, are capable of thermal expansion causing the need to vent fuel overboard. If this fuel were to come out of the recessed fuel vent in flight, it would flow back along the bottom wing skin. A concern arises about the potential for fire caused by this fuel on the wing. Hence, the real reason for the standpipe vent is to expel the expanding fuel far enough away from the wing skin such that it blows away free and clear, posing no increased fire hazard. But, since this standpipe vent is indeed a ready collector of ice, it has to be heated. That's why all King Air models

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with the exception of the Straight 100, have the left and right Fuel Vent Heat switches.

As the "Hot Five" become the "Hot Three" on 100s, here's another interesting tidbit: They become the "Hot Four" on some A90 and B90 models because some of these airplanes have no Stall Warning Heat switch.

The actual stall warning vane (the movable piece) has always been heated. Whenever the battery switch comes on, the heat is there. For a while, that was the only heat associated with the stall transducer. But then some concern arose about the stall warning becoming inaccurate when ice accumulated on the metal plate *behind* the vane. Safeflight, the manufacturer of the system, began offering heating for this plate and Beech added that on the assembly line and added the Stall Warning Heat switch in the cockpit. The previous airplanes now had a mandatory kit available that added the plate's heating element. However, rather than force the operator to run an additional wire from the wing to the cockpit and add a new switch on the subpanel, they tied this component into the Right Pitot Heat switch. (Realize that all earlier King Airs had the right pitot tube midway out on the wing, not on the nose.)

Due to the extensiveness of items to cover in this article, it will have two parts. Next month we will continue to discuss the ice protection systems King Airs have and the difference between the various models. KA

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.

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by Dean Benedict

Due diligence, simply stated, is "examining things or people before buying or employing them." (*macmillanthesaurus.com*)

I'm talking about a prepurchase inspection, aka, the pre-buy. There is a lot of pushback against them, which makes no sense to me. In buying a King Air, you're going to part with upward of a million dollars (or maybe a mere half-million!). Why risk inheriting an expensive-to-fix problem after spending all that money? Normally, a pre-buy gives the buyer a list of squawks and the seller takes care of the airworthy ones or the buyer passes on the deal. In the case of an "as-is, where-is" deal, you really need to know what you are getting yourself into.

Rationalizations

Buyers who skip a pre-buy are looking at the price of the aircraft with tunnel vision. They balk at spending an additional $12-15K and rationalize their decision in various ways. I've probably heard every excuse there is for skimping or skipping a pre-buy. "It's got a fresh Phase 1 and 2." Or "It just came out of a Phase." That's nice, but you need all four Phase inspections to completely inspect a King Air. Each Phase includes a portion of the checklist that concentrates on a specific area of the aircraft, in addition to the common inspection items that occur every time. You need *all four*.

My favorite: "The hot sections were just done 150 (or 50 or 20) hours ago!" Remember, it only takes one bad start to ruin an engine. The term "fresh hots" on an aircraft writeup means nothing. A borescope inspection on each engine is essential in a pre-buy. Do it before the Phase 1-4.

A Broker's Plea

Recently on an online forum, Chip McClure – a well-known aircraft broker in the King Air community – vented his frustration at buyers foregoing pre-buys. His subject line was "QUIT buying King Airs without a PRE-BUY!" Why would a broker

say this? Could it be that some of his buyers ran into big problems post-purchase and complained bitterly to him? His post drew a big response.

I had already planned on writing this article but hesitated. A fair portion of my consulting is pre-buy related and I don't want it to look like I'm shamelessly promoting myself. Then after Chip's post I wondered if I would be beating a dead horse with this topic. On the other hand, I've been asked repeatedly to write about pre-buys.

The road to buying an aircraft is not always smooth. There are buyers that are laser focused on the purchase price alone; they loathe the idea of spending a penny more. I wish these buyers would look at the bigger picture. All aircraft come with a future of maintenance obligations; the point of a pre-buy is to avoid buying one full of hidden nightmares. Consider it as hedging your bet on the King Air you aim to purchase.

Lipstick on a Pig

I was contacted by the director of maintenance (DOM) of a small charter operation. They were looking to add another King Air to their 135 certificate and he found one he really liked. He'd already reviewed the logbooks and they looked great. The pictures were fabulous – new paint, nice interior and a new panel! What's not to like? The DOM took his own crew to inspect this gem but he wanted me there to ensure they didn't overlook anything crucial. In person, this King Air exceeded all expectations. Everything about it was pristine. The paint was gorgeous. The interior was beautifully done. The cockpit was a pilot's dream. The presentation of this product was first class all the way.

The DOM and I dug into the logbooks while his guys opened panels. The most recent records were in good order, but everything prior was a total disaster. Aircraft total time was a guessing game with 3,000 hours missing in one book and 2,000 hours suddenly gained in another. Engine records did not reference airframe total time, which made a bad situation worse. Everything was out of chronological order. As we attempted to compile a timeline, we found chunks of time with no records at all. Major portions of the records were in Spanish with no translation. These maintenance records were "strike one."

The recent log entries had many squawks with "light corrosion" listed, but when looking at them many were far from "light." Example: Corroded rivets were found in the tail and removed for correction; the stringer was removed and more corrosion was found underneath it. Although these corrosion squawks were remedied, they posed a red flag. In my experience, wherever

A closeup of corrosion shows how destructive it can be. Get a corrosion inspection before engine borescopes or Phase 1-4 inspections portions of a pre-buy.

you find corrosion, there's going to be more. These log entries had my antennae on alert.

I stepped into the hangar to look at the aircraft. The engine cowls were open. As I peered in I could see corrosion on the outside of the reduction gearbox, clearly visible to the naked eye. I thought if the outside was this bad, what does the inside look like? Unfortunately, a borescope won't show me the inside of the reduction gearbox, but I didn't really need to see it. I know what corrosion can do in an engine. There is more steel and aluminum in there than you might think – "strike two."

The splice plates were deeply corroded and had not been squawked or remedied. This would be a very expensive fix and apparently the seller was not entertaining any reduction in price. So that was it – "strike three" and game over. We packed up and left. One of the prospective buyers was on-site with us and took everyone to dinner afterward. He told me he learned his lesson about pre-buys and was grateful his DOM had insisted I be brought to the job. He admitted being seduced by the dazzling paint job and the new panel. He was ready to sign on the dotted line and was thankful for our diligence on his behalf.

A Preliminary Check for Corrosion

Chip's post mentioned a few areas of concern that he sees cropping up repeatedly in recently purchased King Airs where no pre-buy was performed. Corrosion was at the top of his list. I've written about corrosion in this publication several times, including the February issue this year. In a nutshell, corrosion is destructive and once it starts spreading, it doesn't stop. Also, corrosion that is found but not treated correctly will come back.

As the King Air fleet gets older, corrosion becomes a greater concern to prospective buyers. Chip had a brilliant idea – he proposed that buyers have a corrosion inspection completed before the engine borescopes and Phase 1-4. Coincidentally, I was engaged to do exactly that! A couple of months before Chip's post, a buyer hired me to inspect a B200 specifically for corrosion. This buyer already owned one King Air, but after the purchase some serious corrosion issues were discovered. The remedy was very costly. When he found himself in the market for another King Air, he hired me to complete a focused check on corrosion, before proceeding with the rest of his pre-buy plans. The subject aircraft had been in South America and the prospective buyer was in Africa. COVID-19 restrictions had made travel unfeasible for the buyer, so he had the aircraft moved to a shop in the U.S. where the borescope and Phase 1-4 would be performed.

Before the Phases, however, I performed the corrosion check. If I found anything that could kill the deal, the buyer could then cut his losses and save his Phase 1-4 money for the next prospect. This arrangement worked well. I used a "Corrosion Control Checklist" from the King Air 200 maintenance manual. It's an optional guide for

corrosion control, designed to be added to a Phase inspection for King Airs operating in corrosive environments. It covers the whole aircraft. I didn't find anything major, just a little corrosion up in the tail that would be easily remedied by the shop using the standard protocol for corrosion correction. I was in and out in a day; the rest of that buyer's due diligence continued on.

Borescope Inspections

For years I have been preaching the importance of a borescope inspection on the engines as part of the pre-buy. Timing is crucial. Have it done before the Phase 1-4. If it reveals a significant problem, you can cancel the Phase inspections and save that money for the next deal. Chip McClure concurs. Buyers not having a borescope of the engines done prior to purchase is one of his pet peeves. A borescope can't get to the whole engine, but it goes where it counts the most – in the hot section. A really good technician can peek into the compressor. Anyone who balks at borescoping the engines before purchase should contrast the cost of a borescope with the repair bills for a damaged hot section. You will find them paltry by comparison. Don't forget: One bad start can ruin an engine.

Black Death

Black Death is another problem on Chip's list. He has seen buyers skip a pre-buy only to find this serious air conditioning problem post-purchase. It is a relatively new area of concern that I addressed in the August 2017 issue of this magazine. I field more phone calls on air conditioning (AC) than any other topic. Some mechanics are trained in it and truly understand it. Others will tell you, frankly, that they don't mess with AC and they should be thanked for their honesty. Far too many mechanics, trying to be helpful, will fiddle with servicing the AC or flushing the system, when they really don't know what they are doing. Unwittingly they make things worse. The primary cause of Black Death is improper maintenance of the AC system over time. If you buy an airplane "plagued" with Black Death, the only remedy is to replace every line in the system that moves Freon. It is a very expensive job.

Structural Cracks

Pressurization cycles repeated over time eventually create cracks in the aircraft structure. Like corrosion, these cracks are cropping up more frequently as the King Air fleet ages. And yes,

they're on Chip's list of problems he sees when no pre-buy was performed. There is an inspection that addresses this issue. It entails removal of the interior and all floor boards. This gives a good look at the inside surface of the belly skin – a good place to check for corrosion too. More importantly, cracks in the stringers and other structures below the floor can be found and remedied. You may have heard of this inspection. It's a Phase 3.

A Prudent Prepurchase Plan

The term "pre-buy" is bandied about in two ways. As a general term, it refers to everything a buyer might do as part of their due diligence. Specifically, it means Phase Inspections 1-4, paid for by the buyer as a part of their prepurchase actions. Used in the general sense, an overall pre-buy strategy would consist of logbook analysis, engine borescopes, perhaps a preliminary check for corrosion, Phase Inspections 1-4, ground runs and acceptance flight – in that order.

Logbooks: Before anything else, a buyer needs to get the maintenance records analyzed by an expert in King Air maintenance. A CAMP report (or equivalent) is a start but nothing replaces the actual logs. I cannot emphasize this strongly enough. I never met a maintenance management program report without mistakes or conflicting data. They always give rise to more questions. When I get to the actual logs, I comb them for corroboration and clarification of the report. Along the way, I learn more about that King Air. A 100-page CAMP report won't say when the aircraft moved from a dry desert climate to a humid, salt-laden environment, or how long it remained there. Sometimes I have to read between the lines. Damage history can be deduced from studying the logbooks and 8130 certificates. The logbooks tell a story that no amount of data entry into a program can ever convey.

Borescopes and Preliminary Corrosion Check: Do these checks before the Phase 1-4 so you can cancel the phase inspections if either disqualifies the aircraft for you. The corrosion check is not meant to be a shortcut around the Phases. My client from Africa did it as part of his pre-buy to ensure the King Air under consideration was a worthy candidate for a Phase 1-4.

Phase Inspections 1-4: I've been working on King Airs since the 1970s and pre-buy inspections have always been a Phase 1-4. Do them all. Just don't expect the shop to sign it off specifically as a "pre-buy inspection." No one does that anymore. Buyers interpreted that as some kind of guarantee and endless warranty.

Final Ground Runs & Acceptance Flight: Once you are at this point, buyer anticipation is running high, but these steps must not be rushed. This is your opportunity to ensure

Having the logbooks of a prospective King Air thoroughly inspected by an expert can tell a lot about the aircraft's history.

that everything up to now has been done properly. Systems that worked great on the ground might behave differently in the air. Most importantly, some things can only be checked accurately in the air. Be prepared for squawks to crop up at the 11th hour.

The Case for a (Good) Broker

When my wife was a realtor she learned that if buyers and sellers meet, it usually kills the deal. Personality conflicts, offhand comments, preferences on appearance – the silliest things can ruin an otherwise good deal. Aviation is no different. That's why there are brokers. A buffer between the interested parties can be very helpful. Are you required to have a broker? No. Many deals go through without one. But buyers without a broker will sometimes try to rely on me for things outside my purview. Purchase agreements come to mind. I may have plenty of ideas on what should be incorporated into one, but I don't draw them up. Also, you need a title search and you might need help from the seller to clear any clouds. A good broker can drive this through and then some.

Caveat Emptor!

No one has a crystal ball. Whether you own a King Air already, or are thinking of buying one, there is no guarantee of perfection. It's an airplane; they break. If you or someone you know is in the market to buy one, please listen to Chip. Don't buy a King Air without a pre-buy. Do your homework. Hedge your bet. The prepurchase actions discussed here are your best shot to ensure you are making a prudent decision. Caveat emptor! Do your due diligence! 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. Currently, with BeechMedic LLC, Dean consults with King Air owners, operators and maintenance shops on all things pertaining to King Air maintenance. This includes troubleshooting, pre-buys and maintenance management. He can be reached at *dr.dean@beechmedic.com* or (702) 524-4378.

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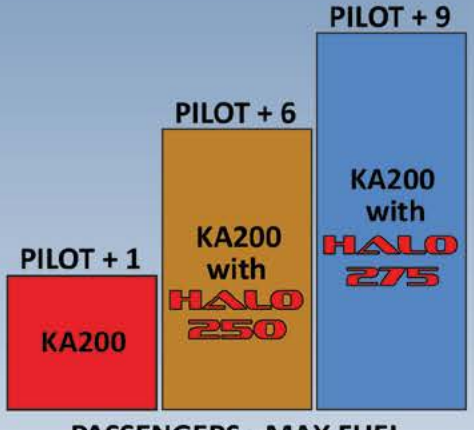

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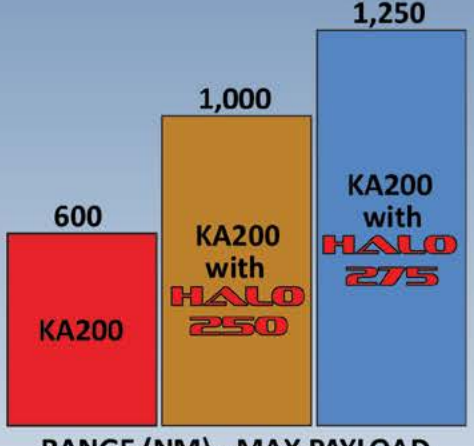

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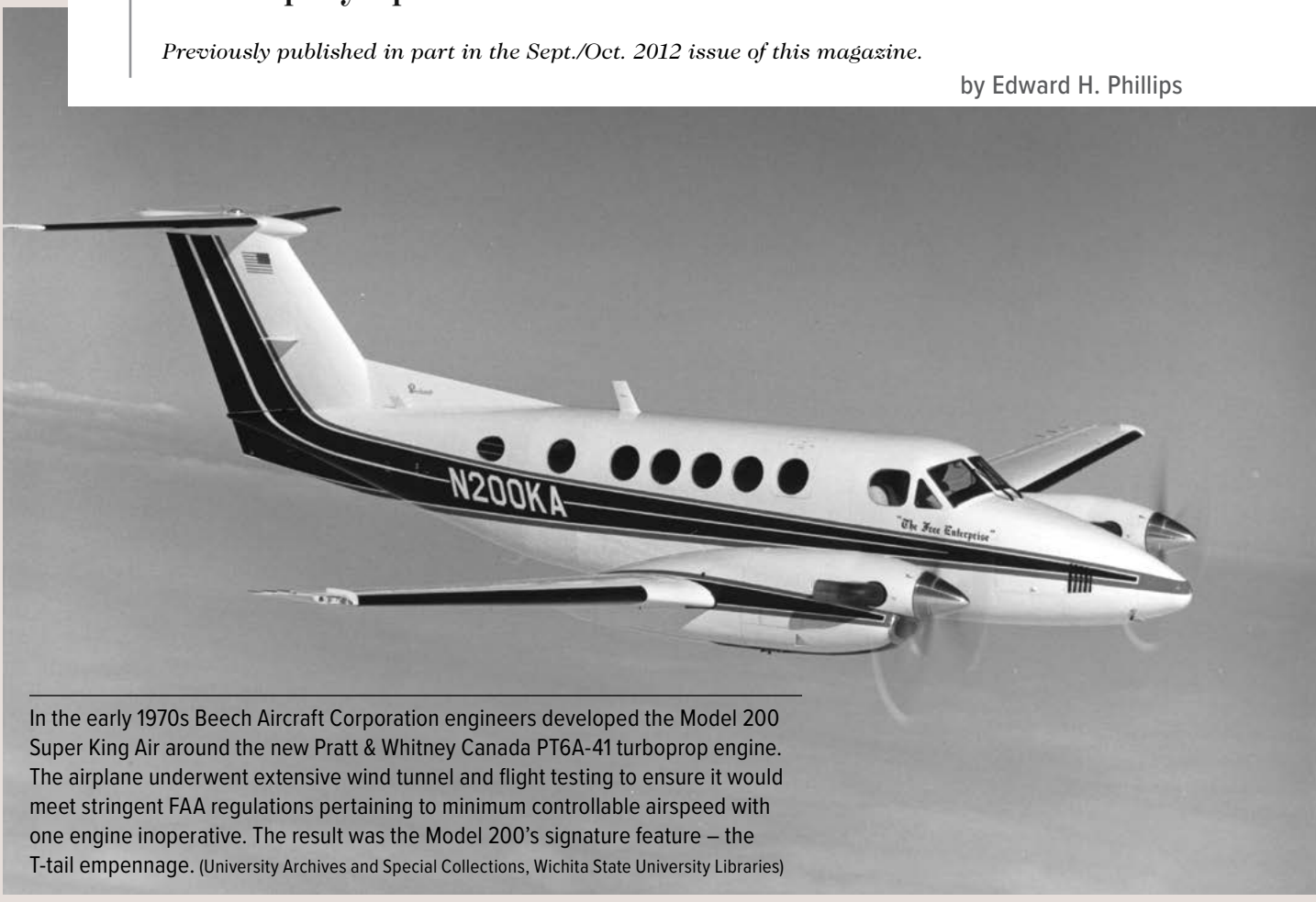
The Super King Air Arrives

Beech Aircraft Corporation tightened its grip on the twin-engine turboprop market by introducing the Model 200 Super King Air – an airplane that quickly established itself as the crown jewel of the company's product line.

Previously published in part in the Sept./Oct. 2012 issue of this magazine.

by Edward H. Phillips



In the early 1970s Beech Aircraft Corporation engineers developed the Model 200 Super King Air around the new Pratt & Whitney Canada PT6A-41 turboprop engine. The airplane underwent extensive wind tunnel and flight testing to ensure it would meet stringent FAA regulations pertaining to minimum controllable airspeed with one engine inoperative. The result was the Model 200's signature feature – the T-tail empennage. (University Archives and Special Collections, Wichita State University Libraries)

In 1973 as Beech Aircraft Corporation approached the 10th anniversary of its highly successful King Air series of business aircraft, the time was ripe for the company to take the King Air platform to the next level of performance and utility. The existing flagships of the Beechcraft fleet were the Model A100 and B100 that introduced customers to a larger cabin and higher cruise speeds than the Model 90 series, but the company's engineering and marketing departments knew they had to create a better King Air to expand the product line.

Research and development work was underway by 1969 and resulted in a concept known initially as the Model 101 that eventually was replaced by the designation "Model 200." Early in the development process, it was decided that the new Beechcraft would be powered by Pratt & Whitney Canada PT6 engines that had powered the Model 90 and Model 100/A100 airplanes. The new "Super King Air," however, would require engines of increased shaft horsepower to achieve performance goals that included a cruise speed in excess of 300 mph.

As part of the company's research and development program for the new King Air, Beech engineers sought a more powerful version of the venerable PT6 to power the airplane and Pratt & Whitney Canada responded with the PT6A-41 engine. It was longer and heavier than the PT6A-20-series engines that had powered previous King Airs but incorporated an improved gas generator and power turbine design that, along with other systems and material upgrades, allowed the engine to produce 850 shp at outside air temperatures of up to 106° F.

The choice of the PT6A-41, however, drove a number of important design, performance and certification issues that would prove challenging to resolve. These included relocating the engines higher and farther outboard on the wing center section than those of the A100/B100 to accommodate the new propellers, which were designed with a larger diameter to absorb the -41 engine's power.

In addition, relocating the engines farther outboard had the advantage of providing a wider center section that would increase total fuel capacity to 544 gallons,

The Super King Air's flight deck was similar to those of its siblings but featured digital avionics, weather radar and autopilot/flight director. Overhead console housed ammeter, DC load meters and lighting rheostats; subpanels contained switches for primary and secondary airframe systems. (University Archives and Special Collections, Wichita State University Libraries)

as well as positioning the propellers farther away from the cockpit and cabin to reduce noise and vibration. As a result of these modifications to the basic A100/B100, wingspan was increased to 54 feet, 6 inches and maximum takeoff weight rose to 12,500 pounds with a useful load of 5,275 pounds.

Although the changes were highly desirable from the standpoint of marketing and customer satisfaction, one undesirable result of the engine's placement centered on meeting FAA regulations for minimum controllable airspeed with one engine inoperative. Engineering realized that the additional two-foot span (on each side) of the redesigned center section would increase the effect of yaw if one engine failed in flight. They also knew that the rudder played a crucial role in countering that yaw and providing the pilot with adequate directional control.

The PT6 Engine's Role

It is easy to overlook the highly significant role that the Pratt & Whitney Canada PT6 engine has played in development not only of the King Air, but of the business aircraft industry in both fixed-wing and rotary-wing designs. As early as 1958, Pratt & Whitney Canada had conducted widespread research aimed at determining market reaction to a new, proposed turbine engine. As part of that survey the company sent teams to various general aviation airframe manufacturers including Beech Aircraft Corporation, Cessna Aircraft Company and Piper Aircraft Corporation.[1]

The Canadian manufacturer was well aware that its chief competitors, Allison and Rolls-Royce, already had excellent engines such as the T56 and the "Dart," respectively, powering larger aircraft. In addition, Allison was hard at work developing a small, lightweight turboprop engine in the 250 shaft horsepower (shp) range, and the "Dart" was available in versions up to 2,000 shp. After considering market reaction and the competition, company officials decided to proceed with development of a new turboprop engine in the 450- to 500-shp class.

A key goal of the ambitious program was to build an engine that could operate for about the same costs as a piston engine of equal power. To help achieve that point, which would be a major factor in selling the engine to airframe manufacturers such as Beech Aircraft that was long accustomed to the attributes of the reciprocating engine, a team led by Kenneth Sullivan and Elvie Smith urged adoption of a free-turbine design instead of the more conventional fixed-shaft configuration.

There were a number of distinct advantages to the free-turbine approach. First, the engine would require fewer components because the gas generator and the power turbine were not connected to each other. Instead, the two sections were "coupled" only by the hot exhaust gases flowing from the gas generator across the power turbine, which drove the reduction gearbox and propeller. Second, starting would be simplified because the battery would be rotating only the gas generator, not the entire engine (particularly advantageous in extreme cold weather conditions). Third, the airframe structure required to support the engine would be simplified and weigh less than that required for a fixed-shaft configuration.

In February 1960, a prototype PT6 was undergoing testing but soon encountered a litany of technical problems and issues. Fortunately for the program, these eventually were resolved by a team of engineers led by Bruce Torrell. The next year an engine was test-flown on the nose of a Royal Canadian Air Force Beechcraft "Expeditor" (Canadian military version of the Model 18 Twin Beech), and in July 1961 a Hiller "Ten99" helicopter became the first aircraft to be powered solely by a PT6 engine. Despite overall progress with the program, skeptical voices within New England-based parent company Pratt & Whitney called for an end to the PT6 initiative.

The future suddenly looked increasingly bleak for the PT6. Then, at just the right moment in time, an airframe manufacturer in Kansas played a key role in preserving the PT6 initiative and saving it from oblivion. Beech Aircraft Corporation engineers were casting about the industry in an effort to find a turbine engine to power the U.S. Army's proposed NU-8F utility aircraft based on the piston-powered Model 80 Queen Air. Beech Aircraft combined the fuselage of the Model 80 with the wings of the Model 50 Twin Bonanza and installed two PT6A-20 engines each rated at 550 shp. Flight testing by the Army proved successful and led to production of 141 U-21A "Ute" transports in the mid-to-late 1960s.[2]

Beech Aircraft, long known worldwide as a premier builder of general aviation and business airplanes for both commercial and military customers, was quick to capitalize on the success of the NU-8F. In the wake of that program's success and having won the approval of "mahogany row's" chief official, Olive Ann Beech, company officers introduced the Model 90 King Air in July 1963.

An often overlooked and underappreciated fact is that by introducing both an unproven engine on an equally unproven airframe in a marketplace firmly dominated by the piston engine, the leadership team at Beech Aircraft Corporation took a tremendous gamble that business aircraft operators would buy the King Air. In the years ahead, that gamble would pay off handsomely and form the foundation of a mutually beneficial relationship between an airframe and engine manufacturer that continues unabated today. Having committed itself to the future of business aviation, Beech Aircraft's prototype Model 90 made its first flight from Beech Field on January 24, 1964, and "the rest," as the saying goes, "is history. "

As for the PT6 turboprop series, as of 2012* Pratt & Whitney Canada had manufactured more than 43,000 of the "little engines that could" in more than 90 versions for aviation applications. According to the company, the engines currently are in service with more than 6,500 operators in 170 countries and have accumulated more than 335 million flying hours since the engine's introduction in the early 1960s.

Footnotes:

1. Sullivan, Mark P.; "Dependable Engines – The Story of Pratt & Whitney"; American Institute of Aeronautics and Astronautics, Inc., 2008

2. Harding, Stephen; "U.S. Army Aircraft Since 1947"; Airlife Publishing Ltd, 1990

* Numbers reflect what they were the year the article was first published.

Unfortunately, it was determined through wind tunnel tests that the empennage configuration of the A100/B100 did not provide good airflow characteristics for the rudder under single-engine conditions, particularly at increased angles of attack normally associated with single-engine operations. As a result, Beechcraft engineers designed a T-tail configuration that not only proved acceptable under single-engine minimum controllable airspeeds but met FAA certification rules without imposing high rudder pedal forces on the pilot.

Compared to the Model A100/B100's conventional empennage, the T-tail design required fewer pitch trim changes as flaps were extended, and with the horizontal stabilizer moved to the top and aft (because of the vertical stabilizer's sweptback design), the elevators proved quite powerful even at aft CG loading. "Now, with a much smaller horizontal surface than the 100," [Beech engineers] "could revert to conventional trim tabs on the elevators and yet achieve a 4-inch greater CG range for the same cabin dimensions," King Air expert Tom Clements said.

With the empennage configuration established, the Model 200 program moved forward. In 1970 two prototype airplanes were built, BB-1 and BB-2 (the letters "BB" were chosen to identify the Model 200 series and remain in use for production aircraft). BB-1 first flew October 27, 1972, with Beech Aircraft engineering flight test pilot Bud Francis at the controls and he also commanded BB-2 during its inaugural flight December 15 of that year.

The T-tail and rudder combination, although it proved highly effective under single engine conditions, required a cautious approach to flight testing as pilots carefully probed its characteristics. Clements recalls that as a result, BB-1 was equipped with a stick shaker, stick pusher, a rudder boost system and one additional safety system – a drag chute housed in a special tail cone. If the airplane failed to recover from a stall under aft center of gravity (CG) and high angle of attack conditions by pitching nose-up instead of nose down, the chute could be deployed by an explosive charge and "break" the stall.

Following an exhaustive flight test program that spanned more than a year, the FAA certified the Model 200 in December 1973 and initial customer deliveries began in February 1974. In addition to commercial sales, the U.S. Army and Air Force were quick to order military versions of the Model 200 for use as VIP and utility transports.

In 1974, serial numbers BB-3, -4 and -5 were converted for the Army and carried the Beech Aircraft designation "A100-1." That year the Air Force ordered a batch of 14 airplanes designated "C-12A" (Beech Model A200), and the factory produced another 20 airplanes in 1975 for the Army and Air Force. The last 20 C-12A aircraft were delivered to the Air Force in 1978.

A continuous program of airframe and engine systems and performance upgrades were incorporated into more than 830 Model 200s that rolled off the assembly line from 1974-1981. With the introduction of the Super King Air, Beech Aircraft Corporation had demonstrated once again the company's determination to build the best business aircraft in the world. During the next 40 years, the Model 200 gradually came to dominate the upper end of the cabin-class turboprop business aircraft market. It proved not only a successful addition to the company's list of crowning achievements but was the most worthy King Air yet to bear the Beechcraft name. 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.

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