Meet the Mod Masters: Hampton Aviation

by Matt Thurber

From outward appearance, King Air N713GD looks like a relatively ordinary B200, although a sharp observer can probably tell that it's been modified. In fact, this King Air has a new lease on life, having been rescued by the experts at Hampton Aviation, completely torn down, repaired, then put back together with fresh interior and paint, Raisbeck Epic upgrade, and more recently, two unique modifications—anti-skid brakes and electric air-conditioning.

The two modifications are not easy to spot, so here is a guide.

Looking at the King Air's main landing gear, each wheel sports a special hubcap filled with electronics. The wires from the hubcap are routed through the axle and emerge in a bundle clamped parallel to the brake line, so that's another clue. The final change that's apparent is a special Vivisun switchplate on the instrument panel.

Those are all the physical hints that this King Air carries the Advent Aircraft Systems eABS (electronic anti-skid braking system) supplemental type certificate (STC) upgrade. Of course there is more to it, such as additional wiring, an electronic control box mounted in

each wing's forward root, and two brake control modules (BCMs) mounted in the inboard wing leading edges. The result of this installation is the ability to land using less runway without reverse thrust, which is better for the propellers, and most important, no more flat-spotting or rupturing tires from pilots standing on the brakes too hard and causing a wheel to lock up.

The other modification is even more subtle, apparent from the outside by a 220-volt male plug recessed into the aft belly. Inside the cabin, the gasper air outlets mounted in the headliner are supplemented by evenly spaced heat-exchanger vents. This is the Peter Schiff Aero (PSA) air-conditioning STC, and what makes it unusual is that it is electrically driven, replacing the King Air's original engine-driven-compressor air-conditioning with a system that delivers cold air directly from heat exchangers located at the headliner vents.

Hampton Aviation opened seven years ago, after the current owners purchased the former Mac Air, moving into a new 100- by 200-foot hangar, then opening a paint shop. Earlier this year, Hampton added another hangar measuring 110 by 125 feet. The company's specialty is heavy airframe structural repairs, particularly on the King Air 200/300 series, including the military RC-12. For that airplane, Hampton Aviation is the only repair facility to have designed its own tooling to manufacture replacement bonded lower-wing spar caps. Under Hampton's service life extension program, which is done under contract to Northrop Grumman, Hampton doubles the King Air's airframe service life to 15,000 hours. Another Hampton military program is major repair to Air Force T-1As (Beechjet 400s), due to lavatory leaks that caused corrosion.

Hampton Aviation sheet metal technicians can manufacture parts in the company's machine shop, including King Air wing leading edges on a massive bending machine. For finer sheet metal crafting, an English wheel and an electric shrinker and stretcher are available. "When it comes to structures, we're not afraid of anything," said sales and marketing manager Tom Canavera.

Because of its military contracts, Hampton Aviation must comply with strict quality standards. All toolboxes are shadowed (tools tracked individually and inventoried at the beginning and end of every shift). Even the smallest debris is inventoried and disposed of inside the secure tool room, including seemingly innocuous items such as acid brushes. No electrical equipment is allowed below 18 inches above the floor, a fire-prevention measure. Before any engine run and test flight, a complete inventory of the facility and tools is done, and personnel conduct a FOD walk on the hangar floors and ramp areas. The facilities and the airport undergo a four- to five-day military aircraft operations inspection every three years.

Every airplane that has left the Hampton facility after major rework, which is now more than 30 King Airs, "left with zero discrepancies," said Canavera. Hampton has the capacity

to handle additional work and is expanding into the civil market, offering maintenance and repair services, paint, interior refurbs, and modifications such as Advent's eABS and PSA's air-conditioning and products from Raisbeck, BLR, and StandardAero. Recently, Hampton Aviation became a Garmin authorized dealer and expects to add Rockwell Collins and L-3 Aviation Products dealerships shortly, which will allow the company to offer ADS-B Out upgrades.

The company's quality standards, he said, "have a direct benefit to the [civil] side. When airplanes leave here, they are super clean. We like doing things right." ■

Anti-skid brakes reduce wear on tires and propellers

Earlier this decade, Advent Aircraft president Ron Roberts was working on an electronic anti-skid braking system (eABS), and running some tests in a Cessna Conquest II at West Star Aviation in Colorado. Roberts, who used to work for a light airplane OEM, wondered why there was no reasonably priced ABS for general aviation airplanes without power

The cockpit switch for the Advent Aircraft Systems electronic anti-skid brakes shows the system is armed and ready for a max-performance stop.

brakes. “I had a motorcycle with anti-skid brakes,” he said. “It worked very well, and if I can put it on a low-priced motorcycle, we ought to be able to put it on a little jet airplane.”

Roberts had been discussing eABS with some OEMs, including Eclipse Aerospace, and an Eclipse v-p happened to be visiting West Star at the same time.

Roberts asked the v-p if he would like to try the eABS on the Conquest, which he did. The v-p then asked Advent to devote all of its resources to perfecting the system on the Eclipse 500 very light jet, which had been experiencing some blown-tire incidents. The result was the first eABS supplemental type certificate for Advent.

“It was driven by the technology being available as a result of Ron’s design,” said Advent managing director Ken Goldsmith. Since that certification, Advent has sold more than 110 eABS kits to Eclipse, and more are on backorder.

On some airplanes, the lightweight Eclipse 500/550 is a good example; with full flaps and a bit too much speed, it’s not hard for the wings to still generate lift after touchdown, and thus not bear enough weight onto the wheels to keep them from locking up when the brakes are applied. This is a delicate balance with any high-performance airplane not equipped with anti-skid brakes; there just isn’t any way for a pilot to know that the brakes are locking the wheels, and pilots have to be careful when trying to extract maximum landing performance. Typically, a pilot doesn’t have confidence in landing as short as possible because of trying to prevent the wheels from locking and flat-spotting or blowing a tire.

After developing the Eclipse eABS, Advent designed systems for the Pilatus PC-12, King Air 200/300 series, and the Beechcraft T-6B/C military trainer/light attack aircraft.

More than 135 eABS systems are installed, and the system is factory standard on new Eclipse 550s. The STC for the T-6, PC-12, and King Airs was issued about a year ago, and sales for those models are starting to ramp up. Advent is working with aircraft manufacturers on adding eABS as an option on new airplanes at the factory.

According to Goldsmith, Textron Aviation Defense is including eABS as standard equipment on new T-6C orders and as a retrofit for existing fleets. “On the T-6, where there is no reverse available, you see big increases in tire life. Anecdotal [evidence suggests] up to a 300 percent improvement in tire wear. You can make a hard landing and a hard accelerate-stop, and there is no tire wear.”

During tests in the King Air 200, Hampton Aviation was able to achieve a landing roll of 1,108 feet, 242 feet less than the 1,350 feet in the AFM, without using reverse thrust.

In general, anti-skid brakes help pilots extract maximum landing performance. Advent sold its first King Air kit to an operation that kept suffering from flat-spotted tires. The risk is that if the tire blows, then the wheel could be damaged and would need a detailed eddy current inspection. And if this happens at an airport without maintenance support, delays

and expenses could mount.

Advent develops the STCs for eABS upgrades, and its dozens of dealers worldwide can install the kit supplied by Advent. King Air owners can have eABS installed by Textron Aviation service centers. The eABS system is certified by the FAA, Transport Canada, and EASA, and in Australia via reciprocity with the FAA.

The eABS kit costs $55,890 for a King Air and $50,604 for a PC-12. Installation takes five to 10 days, depending on the airplane, with the dual-wheel King Air more complex than the single-wheel PC-12. A King Air kit adds 29 pounds to the airplane's empty weight.

The kit's main components are the two BCMs installed in series in the brake lines for the left and right main landing gear, plus wheel speed transducers, digital electronic control units, and in the cockpit, a Vivisun on/off switch/annunciator. There is no need to modify the braking system's master cylinders or landing gear.

The eABS work by modulating the hydraulic pressure delivered to each wheel's brakes. The unique feature of the Advent ABS is that it compares the wheel speed, as measured by the transducer in each wheel, to aircraft speed, derived from onboard GPS. If the aircraft is going faster than 10 knots, anti-skid will work. Below 10 knots, braking is normal, with no anti-skid protection.

However, the brakes will not operate if wheel speed is not at least 85 percent of the aircraft's groundspeed. "If wheel speed slows to less than 85 percent of groundspeed," Roberts explained, "the system reduces brake pressure." Because the eABS is electronic, it can rapidly modulate the brake pressure to prevent the wheel from skidding. This helps especially when applying brakes on uneven surfaces or where one wheel is on ice or snow and the other is on a clean surface.

Technically, a pilot could land an eABS-equipped airplane with the brakes fully applied, and because the wheels do not match the groundspeed of the airplane when it touches down, the wheels would simply roll. "The wheel is going way too slow for the brakes to actuate," he said. As the wheel goes over the 85-percent groundspeed threshold, then the eABS would allow the brakes to work to stop the airplane. All this time the pilot could have kept maximum pressure on the brakes. Of course, it is not recommended to land with the brakes on.

Making It Stop

During a visit to Hampton Aviation, I was able to try a high-speed abort in the company's King Air, after witnessing test pilot Earl Covel perform a high-performance landing. I experienced the feel of eABS in the aforementioned operator's PC-12, following pilot Gideon Clement's demonstration of a maximum performance landing after a trip around the traffic pattern at Stewart International Airport in Newburgh, New York.

Clement flies two PC-12s equipped with eABS out of Stewart, and he took me for a short flight to demonstrate eABS in his company's PC-12 NG. The wind was steady, and Clement brought the PC-12 right over the numbers on Runway 34, crossing the fence at 80 kias with flaps set to full and weight at touchdown about 8,000 pounds. He later calculated the flight manual landing ground roll without reverse thrust and with a 5.6-knot headwind factor at 775 feet. As soon as the PC-12 touched the ground, he lowered the nose and stepped hard on the brakes. The PC-12 was stopped in about 600 feet, he estimated.

For my turn on the brakes, Clement added power, then pulled the power lever back at about 80 knots. I pushed as hard as I could on the brakes and at the same time tried to stay on the centerline. I could feel the anti-skid pulsing to keep the wheels from locking up, and I kept the pressure on through the pulsing, and the PC-12 came to a rapid stop. Keeping the airplane straight was no problem, and I could appreciate the confidence that eABS gives the pilot to use the brakes to maximum effectiveness without worrying about blowing a tire.

The experience in the Hampton King Air 200 was much the same. Test pilot Earl Covel flew around the Mena traffic pattern, then did a maximum performance touchdown and rollout, bringing the King Air to a rapid stop in less than 800 feet. I then did a high-speed abort, where we sped to 85 knots, and after Covel cut the power, I braked hard, bringing the King Air to a smooth, rapid stop. I could feel the brakes pulsing, and I was briefly tempted to let up on the brake pedals, but kept stepping on them firmly. The eABS clearly works well, and looking over the tires on both airplanes afterward, I could see no hint of having put them through any kind of trauma.

"The thing that's most appealing to me," said Covel, "is not ruining the tires if you should have to jump on the brakes. There've been incidents of people landing with their foot kind of resting on the brake and flat-spotting a tire when they land. It can't happen with this airplane."

Clement says that eABS helps him get the full potential from the PC-12, and he likes the confidence that eABS provides. For example, there is no trouble landing in a crosswind on a relatively short runway, because he doesn't have to worry about the upwind wing lightening the load on that side's landing gear and risking a flat-spotted tire. "On those days when you need to carry a few extra knots," he said, "you can still stand on the brakes."

New Programs

Advent is working on improving the anti-skid brakes on the Fabrica Militar de Aviones IA 63 jet trainer, and provided its standard eABS for the Calidus B-250 light attack turboprop.

The next business aviation project on Advent's drawing board is the Beechjet/Hawker 400, including re-engined versions from Nextant and Textron Aviation, which aren't equipped

with thrust reversers. "We're serious about improved anti-skid for the Beechjet," Goldsmith said. "It's a substantial improvement to the [existing] system." The Beechjet upgrade would also be available to the U.S. Air Force, which has a fleet of the military version, the T-1A Jayhawk.

Textron Aviation's in-development Denali single-engine turboprop would also be a candidate for eABS. "If the anti-skid on the PC-12 is making that a better airplane and allowing it to realize its full potential, then the Denali should be the same," he said. "I'm not sure if the Denali has anti-skid, but I understand that customers are asking for it. We're going to offer it for the Denali, for the aftermarket if Textron Aviation doesn't offer it."

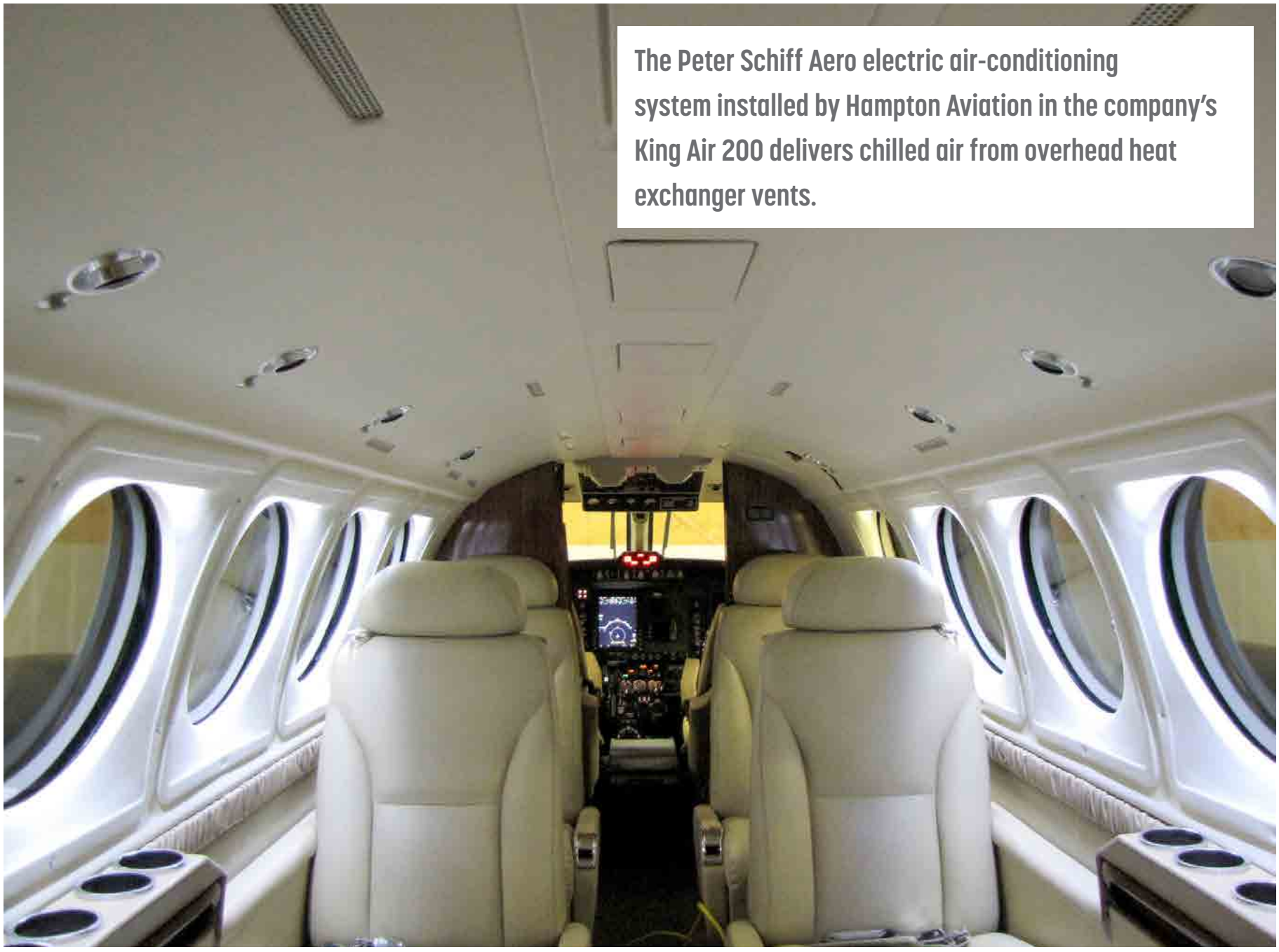
Textron Aviation helped Advent by providing a new King Air 350i for eABS installation and testing, which included a detailed analysis of improved stopping distances. While the current STC doesn't include an AFM revision to reflect shorter stopping distances, Advent has submitted a separate STC application for those improvements, and this is pending with the FAA. Goldsmith would like to conduct the same testing and seek a similar new STC with reduced stopping distances for the B200 series. "Medevac operations need to get into some tough airports," he said, "and they have to [plan for shorter] runway lengths. If we can get them a couple hundred extra feet, that could make the difference for a King Air mission versus a helicopter."

Fixing King Air air-conditioning

Inventor and A&P mechanic Peter Schiff's exploration into the world of aircraft air-conditioning (AC) started when he owned a Twin Commander and designed and certified a better environmental-control and pressurization system for that airplane. About six years ago, he thought the AC portion of the system might work well in the King Air, but there was a key difference: the King Air's ducting system is much more extensive than in the Twin Commander, and pushing cold air efficiently through all that ducting just wasn't going to work. According to Schiff, this is still a problem in existing King Air AC systems.

What Schiff wanted was an all-electrical AC system, because running the right engine on a King Air just to try to cool the cabin is inefficient and noisy. He also wanted to design a system that would eliminate all the drawbacks that he found in the King Air's existing AC system. These include using the area under the floorboards as a return duct. "The system has to cool not only the cabin but the space under the floor," he said.

Another problem is having to run huge blowers to pump air through the condenser and high-volume ductwork, he explained. Later model King Airs have two large blowers just for the aft cabin, and the energy needed to run the blowers adds more heat to the system.



The Peter Schiff Aero electric air-conditioning system installed by Hampton Aviation in the company's King Air 200 delivers chilled air from overhead heat exchanger vents.

Finally, the original forward evaporator is the type that requires a purge valve to prevent the refrigerant (R134a in modern systems, R12 in older systems) from clogging up the system.

Schiff figured there must be a better way to cool the interior of a King Air, and he put his company—PSA—to work to come up with a solution.

The result is a unique electrically powered, patented AC system that eliminates the engine-driven compressor, solves the ducting problem, and can run from a ground power unit or 220-volt extension cord while on the ground.

The main difference between the typical King Air AC and the PSA 830 CCA is that the former requires an engine-driven compressor and the latter's compressor is electric.

In a traditional vapor-cycle aircraft AC system, the engine-driven compressor compresses the R134a refrigerant, which is still a gas at this point, and converts it to a high-pressure gas.

This heated pressurized gas flows through the condenser in the nose of the aircraft, and while a fan blows outside air over the condenser, the gas turns into a high-pressure liquid. A filter/dryer traps moisture to prevent the moisture from freezing and blocking the system.

The high-pressure liquid now flows into an evaporator, with a restrictor expansion valve that causes the liquid to turn back into a gas, a process that removes heat from the refrigerant (heat of vaporization). A fan blowing air across the evaporator captures the cooled air, which is distributed throughout the cabin ducting.

In the King Air, there is one evaporator for the flight deck, and one (or two in later models) for the cabin.

The PSA 830 CCA retains the forward evaporator, ducts, fan, and vents to cool the flight deck. Additional outlet vents are added in some models.

In the cabin, PSA replaces the original evaporator with one that cools a water/glycol mixture instead of air. From that evaporator—and this is a central feature of the PSA patent—a small brushless electric pump moves the cooled water/glycol to heat exchangers installed in the cabin overhead, typically six in a King Air, or seven if one is mounted in the lavatory area. "It's like a radiator core that cools each seat position individually," said Schiff.

On the ground, Peter Schiff Aero's electric air-conditioning system in the King Air runs off a 220-volt extension cord plugged into a receptacle in the aft lower fuselage.

There is a huge advantage to using a cooled liquid versus pumping air through large ducts, and that is, he said, "A liquid will transfer 830 times as much cold as an equivalent air duct. That's why we call it the model 830." The hoses have less surface area, he explained, so less of the cold is lost compared to large-area ducting.

The resulting system is tremendously efficient and useful. For example, instead of starting an engine to cool the cabin, in a CCA-equipped King Air, all that is needed is to plug a 220-volt extension cord into a male plug that is mounted in the aft belly of the fuselage. There is no need to open the door and turn on any switches; the system runs automatically once power is applied.

After the cabin is cooled and everyone climbs aboard, with the AC still running powered by the extension cord, the pilot can start the engines, switch on the generators to take over the electrical load, then have someone outside the airplane unplug the extension cord. An external APU can also be used to run the system.

The CCA system imposes only a nominal load on the electrical system, and there are no limitations for when it can run, so it can be used during all taxi and takeoff operations.

The CCA scroll-type compressor is more efficient because it is powered by a five-hp, variable-speed, brushless, soft-start motor. The motor weighs just 6.3 pounds instead of the heavier typical on-off-switched engine-driven compressor found in most AC systems. "We don't have the old technology of switching the compressor on and off, which would require huge starting currents in the case of an electric motor," said Schiff.

The PSA AC is charged with R422 refrigerant, which has a higher evaporation pressure that helps the refrigerant move more readily through the long refrigeration lines back to the compressor.

Maintenance of the PSA AC system is far simpler, with easy access under the cabin floor walkway. The water/glycol mix needs an occasional top-off using a syringe, about every two months. The variable-speed compressor motor lasts much longer and does not shed aluminum, Schiff said, as do compressors on older King Air systems.

The PSA 830 CCA air-conditioning system is STC'd and PMA'd in the King Air 200 through 350. The kit price is $54,000 for the 200/300 series, and $58,000 for the King Air 350. Installed cost averages about $102,000, depending on the amount of interior work that needs to be done to gain access to the airframe. Government/military airplanes have simpler interiors, according to Hampton Aviation sales and marketing manager Tom Canavera.

Hampton holds an exclusive dealership for government/military/fleet programs and is also a dealer for private King Airs. ■