B/CA Analysis:
Beech King Air C90-1

A comfortable cabin, improved cruise speeds and a cockpit that is suited to single-pilot operations make the Beech King Air C90-1 a viable entrant in the fiercely competitive entry-level turboprop market.

By Richard N. Aarons

A decade ago, the Beech name was synonymous with turboprops. Of course, the pre-Rockwell Aero Commander company was in the turboprop business then as was Mitsubishi, but the royal Beech line did, in fact, rein.

Today, the Beech line of turboprops still rules the market, but the competition at the "entry level" has become fierce. The Piper Cheyenne, Cessna Conquest I (nee Corsair), Gulfstream Commander 840 and Mitsubishi Solitaire all are scrambling for attention and dollars in the light turboprop market-a place once pretty much occupied by Beech alone.

Beech's offering in the entry-level market has long been the Series 90 King Air, a Pratt & Whitney PT6-powered, seven- to eight-place executive transport. In various configurations, the King Air 90 series — "A" through "E" — cultivated a significant crop of turboprop converts and branded them as Beech owners to be moved up the King Air line over the years. (The T-tail F90 King Air has developed its own following and tends to be a mid-line aircraft rather than an entry level machine.)

Recently, however, the quick and cost competitive Cheyenne I and Cessna Conquest I have cultivated significant crops of entry-level owners of their own — operators who become branded as Piper or Cessna owners and move up to bigger Cheyennes or to the Conquest II.

It was clear to planners at Beech that the King Air 90s had to be more competitive if Beech's share of the entry-level market was to be maintained. As Beech saw it, the company already had the edge in industry acceptance. Everybody knew that Beech built quality airplanes, and most pilots talked of Beech craftsmanship and support in glowing terms.

The problem was that most pilots and potential operators also saw Beech products as expensive and, in the case of the C90, is slower than the competition. The performance of the C90 would have to be improved, but the cost would have to be held down. The answer was found in the C90-1.

Actually, when the King Air C90-1 was introduced in January 1982 it replaced two Beech models: the C90 and the faster, more expensive E90.

It's tempting to describe the C90-1 in terms of one or the other of these retired machines, but the C90-1 really incorporates the best features of both. However, just to get the obvious out of the way, the King Air C90-1 is identical to its Series 90 predecessors in appearance and both internal and external dimensions. But a practiced eye would notice a beefed-up airstair door or extra stiffening structure in the tail area.

The strengthened door is designed to handle an increase in pressurization from 4.6 psi to 5.0 psi. The tail stiffening is designed to handle the additional loads imposed by the extraction of additional cruise power at high altitudes.

The need for tail stiffening takes a bit of explanation.

Despite what you may have read elsewhere, powerplants in the old C90 and the C90-1 are identical in every aspect. The powerplant is the Pratt & Whitney PT6A-21 flat-rated to 550 slip.

The difference between the C90 and C90-1 powerplants can be found in the maximum observed inlet turbine temperature limits of the engines on each aircraft. Pratt & Whitney

imposes a maximum observed cruise ITT limit of 680°C on the engine-just as it always has. However Beech had imposed a lower limit of 635°C on the old C90 (for high-altitude airframe structural limitations.) The new Beech temperature limit is identical with the old P&W limit (but not the old C90 limit); TBO remains unchanged at 3,500 hours.

The higher C90-1 limit enables the operator to extract higher speeds with, of course, higher fuel flows. For example, the C90 has a max midweight cruise speed of about 222 knots at FL 120 burning a total of 514 pounds per hour. The C90-1 has a max cruise speed of 237 knots at FL 120 while burning a total of 596 pounds per hour. (On our test flight, B/CA noticed that the C90-1 actually burns about 10 to 15 percent less fuel than AFM tables indicate. This phenomenon has been observed by owner-operators as well. Therefore, the actual high-speed cruise fuel flow is closer to 540 pounds per hour.)

The difference in speed at recommended long-range cruise is significant too. For example, the old C90 max-range cruise speed was 212 knots at FL 240. Total fuel burn was 363 pounds per hour. (We picked FL 240 as the max altitude because the airplane could deliver an 8,000-foot cabin there.)

The C90-1 with its slightly higher pressurization limit can deliver an 8,000-foot cabin at FL 260 where it cruises at 221 knots while burning 374 pounds per hour. (That fuel flow is an AFM value. The actual value is closer to 340 pounds.) Obviously then, the C90-1 can deliver either more range or better speed than its predecessor at only a slight increase in fuel cost.

Classic Beech Handling

The C90-1 enjoys the classic Beech handling qualities-light control pressures, quick response and total harmony. During our test flight we had the opportunity to try out the C90-I's handling characteristics in all corners of the envelope and found absolutely no bugs.

Stalls in all configurations were preceded by a mild buffet and punctuated by a mild break. Accelerated stalls (those approached with a high g load) were well announced and easily handled.

Stability in all modes was positive and well damped. This means less fatigue for the C90-1 pilot and a smoother ride for the passenger.

Flight control surfaces are conventional as are the cables, pushrods and bell cranks that activate them.

The C90-1 is equipped with electric trim, but our guess is that most pilots will ignore it and use the big horizontal trim wheel on the left side of the control pedestal. The wheel has a large mechanical advantage and provides instant results.

Aileron and rudder trim is controlled mechanically by using large knobs on the pedestal. The hand-size knobs are easy to find without groping and have mechanical advantages similar to the elevator trim. This enables the pilot to get plenty of trim (during an engine-out emergency, for example) with very little movement of the knob-certainly an advantage when quick action is required.

The electrically controlled and actuated wing flaps are the only components of the C90-1 flight control system that, in our opinion, could do with some improvement. The flaps are certainly aerodynamically effective, but the control system seems clumsy for an airplane that otherwise exhibits superb human factors engineering.

The flap control lever is on the pedestal just below the condition levers. Flap travel is registered in terms of percentages of full travel between UP (zero percent) and DOWN (100 percent). Intermediate markings are at 20,35 (APPROACH), 40, 60 and 80.

The AFM tells the rest of the flap control lever story. "A side detent provides for quick selection of the APPROACH position. From the UP position to the APPROACH position, the flaps

cannot be stopped in an intermediate position. Between APPROACH and-4MWN, the flaps can be stopped anywhere by moving the handle to the DOWN position, until the flaps reach the desired position, then moving the flap switch handle back to APPROACH. The flaps can be raised to any position between DOWN and APPROACH by raising the handle to up until the desired setting is reached, then returning the handle to APPROACH. Selecting APPROACH will stop flap travel anytime the flaps are deflected more than 35 percent."

In our opinion, that type of system is much too complicated for a million-dollar-plus airplane when simple and precise follow-the-lever flap position control technology is available.

Instruments and avionics systems for the C90-1 come in a wide assortment of packages to provide price flexibility for the entry-level turboprop buyer. A B/CA-equipped C90-1 lists for about $1.075 million; that price includes panel-mount avionics, an integrated flight control system and the usual turboprop bells and whistles such as altitude alerters, radar and dual transponders.

The C90-1 we flew was equipped to B/CA standards, and, in our opinion, was in no way deficient. Beech said that a buyer could spend as much as $500,000 more on his C90-1 if he wanted "the works," but few entry-level purchasers do.

The C90-1 cockpit is roomy and comfortable, and the seats are fully articulating. Cockpit visibility is good-not excellent-just good.

The panel-mounted Collins avionics package was nicely laid out, although the altitude alerter, located to the right of the quadrant, was a bit far from the action.

The aircraft's flight control system, the King KFC-250, functioned every bit as well as competitive systems costing considerably more. The ride was soft, altitude and airway intercepts were perfect and the control-wheel steering option is a dandy feature.

Layout of controls, switches and breakers is totally logical. Another B/CA e once observed that the Cessna Citation cockpit is so logical that even if you never been in a Citation you would switches just where your minds eye sensed they should be - that's good man factors engineering. Well, the same can be said for the C90-1. When you reach for something for the first time "just seems to be there."

Although many C90s are flown by two pilots, most are used in single-pilot operations. It is therefore important that all essential switches, breakers and controls be reached from the left seat without extraordinary contortions on the pilot's 1 Fortunately, a lone C90-1 pilot can get hands on everything. The C90-1's electrical system drives the landing gear flaps as well as the usual avionics and accessories. Two 250-amp starter-generators are at the heart of the system and backed up by one 34-amp hour, 20 nicad.

A multi-layered bus design enables almost any system or appliance to d power from any functioning source. Load shedding is quick, as is recovery from about all power rerouting tasks.

Low Inflight Workload

The C90-1 requires little inflight arrangement. The electrical system is turned on, the starters are switched over to the generator modes and the avionics inverters are brought on line for AC power either generator working by itself can hold up a full IFR complement of avionics anti-ice engine inlet lips and windshield subsystems.

The fuel system, like the electrical system, is straightforward and requires no inflight management other than to sure you don't run out of gas.

The tanks, pumps and plumbing that make the management chore simple are a bit more complicated, however. I wing houses five interconnected cells. However, only two of those cell each side have filler necks, a total of filler necks on the aircraft. (Fueling is gravity type.) In a pinch, operations can be conducted from ground level but you'd run the risk of scratching some paint.

The boost pumps are turned on at beginning of flight and left that way until shutdown. Crossfeed is accomplished with a transfer pump and cross valves.

The C90-I's cabin interior accommodations are Beech quality all the way; that is one of the strongest selling points the new C90-1.

On a typical 200- to 300-nm trip, the C90-1 passenger may spend a few more minutes in the air than his counterparts in the other entry-level turboprops, but Beech believes he'll happily take the extra minutes in order to enjoy the C90-1's cabin comfort.

Indeed, the cabin is comfortable. Aisle height is about six inches better than its principal competitor, and its cabin width is equal to the median in this class.

Large, round windows with polarizing sunscreens provide a sense of spaciousness. Outside visibility is excellent.

Cabin noise levels are low, especially when the cockpit-cabin divider door is closed. The demonstrator we flew had a slight hiss on the door seal, but most airplanes in this class seem to develop door seal hisses after the first 100 hours.

Beech is conservative, especially with its airport performance numbers. The airplane is capable of flying before reaching a recommended 97-kt decision speed, but sticking to the ground until that point gives good margin above Vmc (92 kts) and gets you unstuck right at VXSE (101 kts). Best engine-out rate of climb is 108 kts at the max takeoff weight of 9,650 pounds.

Ground steering is accomplished through a steerable nosewheel linked to the rudder pedals, We found the C90-1 to be highly maneuverable in tight quarters, and the aircraft exhibited an excellent ground tracking on takeoff and roll out. Rotation control forces are light, and the electrically actuated gear retracts quickly, a real plus during a go-around.

The autofeather system installed on our demonstrator took all the sweat and most of the foot out of sudden engine-out simulations. Loss of an engine immediately after liftoff really requires no pilot action other than keeping speeds up and the nose pointed in the right direction. The autofeather system stows the errant engine for you while you keep everything right-side up. It's a real plus and should be offered as standard or optional equipment on all turboprops.

A climb speed of 140 to 150 kts provides plenty of forward visibility and a solid 1,500-fpm rate of climb.

Traffic pattern work is slow and easy. Using 120 to 140 kts for pattern and approach maneuvering provides a sufficient safety margin and a good ride. Crossing the fence at 90 to 100 kts provides a soft touchdown.

After evaluating the new C90-1 both in flight and on paper, we can only conclude that Beech has accepted the challenge to produce a competitive entry-level turboprop. So, if you are looking for an economical turboprop, don't overlook this one. B/CA