N249CP

1979 Beech C90

Cost of Ownership

Aircraft S/N: LJ-841

Prepared by the worldwide aviation specialists at RidgeAire, Inc.

Conklin & de Decker
Aviation Information

Financial Analysis of the King Air C90A with the Blackhawk XP*135A* Engine Upgrade

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Rev. 1/09

Introduction

Blackhawk Modifications, Inc. has an engine modification program to upgrade the PT6A-21 engine of the King Air C90 family to a PT6A-135A engine. The PT6A-135A engine upgrade offers several advantages:

- More power at altitude
- Faster cruise speed at altitude
- Potential for reduced operating costs
- Potential for enhanced resale value

This report examines each in turn.

Note: The costs and assumptions used are typical estimates based on known costs and market conditions. These calculations do not represent any financial guarantee of return.

Enhanced performance

The King Air C90GT with the PT6A-135A engines has the same performance at a given weight as the Blackhawk XP$_{135A}$. All XP$_{135A}$ performance estimates were based on the C90GT flight manual performance data. For the standard C90, the C90A flight manual performance data was used.

Up to about 14,000 feet at ISA, the PT6A-21 delivers its full take-off torque. At recommended cruise[1] this is 1,315 ft/lbs per engine. Above this altitude, the engine loses torque and at 26,000 feet produces only 862 ft/lbs torque. This yields 235 KTAS for a mid-weight King Air C90A.

At normal cruise, the PT6A-135A produces 1,520 ft/lbs torque up to 18,000 feet[2]. At 26,000 feet, it still produces 1,170 ft/lbs torque – 36% more power than the PT6A-21.

This additional power results in faster climbs to higher altitudes.

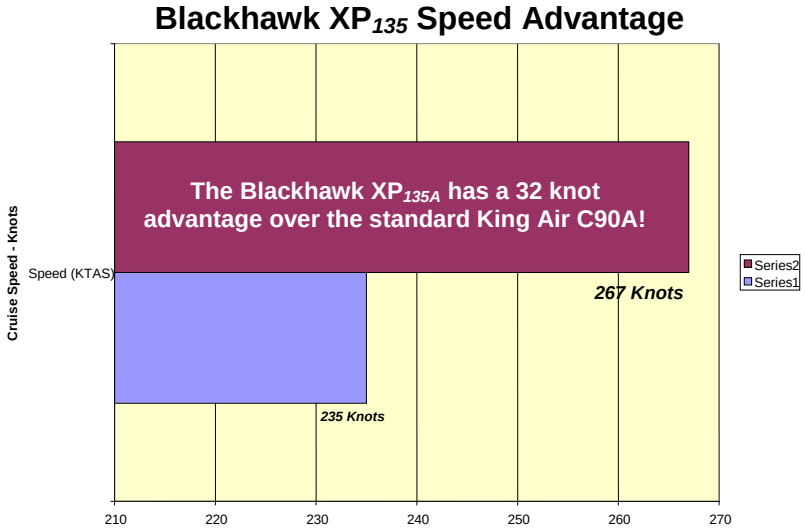
Time to Climb - Minutes

Take-off at 9,000 lbs, ISA, No-wind	**C90A**	**XP$_{135A}$**	The *XP* Advantage
To FL160	9	7	An average of 20% quicker climb time
To FL220	14	12	
To Fl 260	19	15	

[1] Model C90A performance, page 5-32
[2] Model C90GT performance, page 5-46

Cruise Performance			
8,500 lbs, Max Cruise 1900 RPM, ISA			
FL160	**C90A**	**XP$_{135A}$**	The *XP* Advantage
Torque (ft/lbs/Engine)	1,246	1,520	
Fuel Flow (lbs/Hr)	592	642	
Speed (KTAS)	247	272	25 Knots Faster
FL220	**C90A**	**XP$_{135A}$**	The *XP* Advantage
Torque (ft/lbs/Engine)	1,014	1,355	
Fuel Flow (lbs/Hr)	490	576	
Speed (KTAS)	242	271	29 Knots Faster
FL260	**C90A**	**XP$_{135A}$**	The *XP* Advantage
Torque (ft/lbs/Engine)	862	1,170	
Fuel Flow (lbs/Hr)	422	504	
Speed (KTAS)	235	267	32 Knots Faster

The XP$_{135A}$ cruise speeds are from 10% to 14% greater than the standard C90A.



If long range and efficiency is required, you still have the option of climbing to higher altitudes and reducing power to maximum range cruise. Even though the PT6A-135A is more powerful than the PT6A-21, if needed, it can also be more efficient.

Efficient Performance			
8,500 lbs, Max Range 1900 RPM, ISA			
FL260	**C90A**	**XP$_{135A}$**	The *XP* Advantage
Fuel Flow (lbs/hr)	304	302	Less Fuel,
Speed (KTAS)	195	202	More Speed

For "real world" considerations, we calculated a pair of typical trips. One was a trip with four passengers, 300 NM. We used NBAA IFR fuel reserves for a 100 NM alternate. Because the Blackhawk XP$_{135A}$ has a significant power advantage over the C90A, it arrives sooner, and yet, burns less fuel.

	King Air C90A	**Blackhawk XP$_{135A}$**
Trip Distance	300 NM	300 NM
Altitude	FL 160	FL 220
Time (take-off to touch down)	1 hr 18.5 mins.	1 hrs 13.7 mins.
Average Speed	229 kts	244 kts
Average Fuel Used	784 lbs	758 lbs

For a long range trip, we assumed three passengers and 700 NM. We used NBAA IFR fuel reserves for a 100 NM alternate. Again, since the Blackhawk XP$_{135A}$ has a significant power advantage over the C90A, it arrives sooner and burns less fuel.

	King Air C90A	**Blackhawk XP$_{135A}$**
Trip Distance	700 NM	700 NM
Altitude	FL 220	FL 260
Time (take-off to touch down)	3 hrs 2.6 mins.	2 hrs 47.3 mins.
Average Speed	230 kts	251 kts
Average Fuel Used	1,520 lbs	1,453 lbs

For the long range trip, the Blackhawk XP$_{135A}$ arrives over a quarter-hour sooner while burning 10 gallons less fuel.

Based on the 300 NM trip, we calculated the annual hours for 63,023 NM utilization – equates to the average utilization[3] of 275 hours/year for a PT6A-21 powered model C90.

	King Air C90A	**Blackhawk XP$_{135A}$**
Flight Time for 63,023 NM/Yr	275.0 hrs	258.1 hours
Fuel for 63,023 NM/Yr	24,570 gallons	23,751 gallons

For an average year's travel, the Blackhawk XP$_{135A}$ saves both time and fuel versus the standard King Air C90A.

[3] *Vref* Aircraft Value Reference (resale price guide) average annual hours for a C90

Reduced Operating Costs

The PT6A-135A, in addition to being more powerful than the PT6A-21 engine, also costs less to maintain.

Engine Reserve Set-Aside Per Engine

PT6A-21	Cost	Interval		
Mid-life	$32,100	1800 hrs		
Overhaul	$244,000	3600 hrs		
Total for two engines	$552,200		$153.39	per hour set aside

PT6A-135A	Cost	Interval		
Mid-life	$30,000	1800 hrs		
1st Overhaul	$200,000	3600 hrs		
Total for two engines	$460,000		$127.78	per hour set aside

At a PT6A-21 overhaul, the engine conversion to the Blackhawk XP$_{135A}$ would avoid a potential overhaul expense of $488,000 for a pair of engines.

Using the *Conklin & de Decker Life Cycle Cost* data, we calculated the average hourly costs for a King Air C90A and a Blackhawk XP$_{135A}$. The costs calculated were for 10 years and are averages for the following items:

- **Fuel.** Fuel burn was calculated for a 300-nautical-mile trip using the manufacturer's aircraft performance manuals. It was assumed that four passengers plus bags (200 lb each) were on board; fuel reserves were based upon an NBAA IFR 100 NM alternate. Standard conditions (ISA), no-wind were used.
- **Maintenance Labor.** This is the labor required to accomplish scheduled and unscheduled maintenance on this aircraft.
- **Parts.** This is the cost of parts required to accomplish all unscheduled and minor scheduled maintenance on this aircraft.
- **Inspections.** This covers set-asides for the estimated cost of major airframe inspections.
- **Engine Restoral.** As calculated above. Assumes the engines make it to overhaul without incurring a premature removal and that the expenses are typical for that engine.
- **Parts Guaranteed Mx Plan.** N.A.
- **Airframe Guaranteed Mx Plan.** N.A.
- **Avionics Guaranteed Mx Plan.** N.A.

- **Component Overhaul (All).** This covers set-asides for the estimated cost of major component overhauls. This includes the propellers.
- **Life Limited Components (All).** This covers set-asides for the estimated cost of major life limited components.

The average *Non-fuel Variable Costs* were calculated and then the fuel savings were calculated separately. The non-fuel variable costs are detailed in Appendix A and are:

	King Air C90A	**Blackhawk XP$_{135A}$**
Non Fuel Cost/Flight Hour	$539.91	$443.53

For an average year:

King Air C90A	
NM Flown/Year	63,023
Hours	275.0
Variable cost/hr - no fuel	$539.91
Fuel cost/hr ($4.75/gal)	$432.25
Average Variable Cost/Hr	$972.16
TOTAL Variable Cost/Year	$267,344.00

Blackhawk XP$_{135A}$	
NM Flown/Year	63,023
Hours	258.1
Speed Advantage at Cruise	24.0
Variable cost/hr - no fuel	$443.53
Fuel cost/hr ($4.75/gal)	$446.50
Average Variable Cost/Hr	$890.03
TOTAL Variable Cost/Year	$229,718.00
Annual Operating Cost Savings	**$37,626.00**

At $4.75 per gallon average fuel cost, the typical annual operating cost of a Blackhawk XP$_{135A}$ is 14% less than for a C90A.

When to do the conversion?

At Overhaul:

The typical cost of the Blackhawk conversion is $674,000 installed ($639,000 for the engines plus $35,000 for installation parts & labor).

Conversion at Overhaul

(2) PT6A-21 overhaul avoided	($488,000)
(2) PT6A-135A conversions	$674,000
Net Cost = Initial Investment	$186,000

When accounting for the PT6A-21 overhaul costs avoided, the Blackhawk conversion has a net cost of only $186,000.

These costs ignore the value added to a PT6A-135A powered King Air XP$_{135A}$.

Potential for Added Resale Value

The Blackhawk XP$_{135A}$ has established a record of increased value after the conversion. A popular aircraft value reference, *Vref*, in their appraisal points for the King Air C90 adds **$674,000** to the aircraft value for Blackhawk conversion[4]. That price happens to be the *full cost of the conversion with installation* with no discount.

It is doubtful to assume that an operator will perform the conversion just to sell their King Air immediately afterwards. However, if a sale after conversion were required, there is a very high likelihood of enhanced value.

What about over a period of time? Return on Investment has a number of ways to be calculated. In this analysis we used the following considerations:

- Five years operation at 258 hours per year with operating cost savings.
- A reduction in the enhanced value of the Blackhawk XP$_{135A}$ engines based upon the *Vref* value adjustment method for engine time of a PT6A-135A of $55.55 per engine hour. (First overhaul estimate of $200,000 divided by 3600 hours).

For our analysis, we also conservatively assumed that the Blackhawk XP$_{135A}$ conversion would only add 90% of the cost of conversion to the value of the aircraft. We also looked at the annual operating cost savings of operating the Blackhawk XP$_{135A}$ as compared to a standard C90A. If performing the conversion at the time the PT6A-21 engines are due for overhaul, the five year Return on Investment looks like this:

[4] *Vref* for Windows, 2008 – Volume 4.

Return on Investment *(convert at OVH)*	**Blackhawk XP_{135A}**	**Total Operating Cost Savings** *(cumulative)*	**Annual Return**
Enhanced Engine Value after Conversion	$606,600		
After Year 1	$577,922	$37,626	$615,548
After Year 2	$549,244	$75,252	$624,496
After Year 3	$520,566	$112,878	$633,444
After Year 4	$491,888	$150,504	$642,392
After Year 5	$463,210	$188,130	$651,340
		Initial Investment	($186,000)
		Added Residual Value	$463,210
		Operating Costs Saved	$188,130
		Excess return over initial investment vs. having to payout at overhaul	***$465,340***

After five years operation, there is still a net excess return over the initial investment of the Blackhawk XP_{135A} conversion.

Conclusion

Our analysis shows that for a King Air C90A operator whose engines require overhaul, an engine upgrade to the PT6A-135A offers increased performance, increased efficiency, and net cost savings due to the value added offsetting the expense of the conversion.

Appendix A – Non Fuel Variable Cost

Calculated with Conklin & de Decker *Aircraft Cost Evaluator* (Win)
Type of Operation: Corporate
Program Length: 10 years

Direct Cost (average)	Used King Air C90A	Used Blackhawk XP_{135A}
Fuel	-	-
Fuel Additives/Lubricants	-	-
Maintenance Labor	$172.87	$142.93
Parts	$174.17	$133.06
Inspections	$8.19	$8.20
Engine Restoral	$153.39	$127.78
Engine Guaranteed Mx Plan	-	-
Part Guaranteed Mx Plan	-	-
Airframe Guaranteed Mx Plan	-	-
Avionics Guaranteed Mx Plan	-	-
Component Overhaul (all)	$18.71	$17.32
Life Limited Components (All)	$12.58	$14.24
Other Services	-	-
Flight Hour Cost	-	-
Fixed Cost	-	-
Landing/Parking Fees	-	-
Crew Expenses	-	-
Small Supplies	-	-
Total Direct Cost per Hour/10 yr. avg.	**$539.91**	**$443.53**