The Price Of A Free Lunch
by Mike Dennis

It’s August 2004 at the EAA AirVenture Convention in Oshkosh, Wisconsin. The day is clear, the sky blue. The temperature is about 80° with a light breeze. I’m sitting at a picnic table, under a shade umbrella, enjoying the free lunch provided by Flying Magazine, visiting with my friend Dick Koenig, the publisher of Flying. Dick has been politely listening to me babble on about our Pilatus PC-12. We’ve flown 462 for a little over a year and a half. We’ve accumulated 700 hours flying to get our technicians and engineers to far flung civilian or military customers, and attending trade shows around the country. We’ve been to almost every state including Alaska, and made two round trips to Germany from Oregon. The airplane is always stuffed full of people and whatever product and equipment they need. Nothing is ever left behind for lack of room or weight carrying ability. We’ve operated the aircraft from as little as 2,700’ of grass, gravel, dirt and asphalt runway. We crossed the country in 8½ hours total time, including lunch and fuel in Kansas. We had five guys, two weeks luggage and so much equipment it took a car and a minivan (with the back seat removed) to haul it all. We were parked on a ramp crowded with every kind of fabulous airplane. My son looked around and told me, “This airplane has ruined my favorite part of aviation.” “What’s that?” I asked, knowing what he was going to say. “You know, the part where you look around a ramp like this and think, someday it would be nice to have one of those, or one of those, or one of those. Now... I just look at them all and think, poor bastards.”

I think it’s very nice of Flying Magazine to provide this lunch to their advertisers. Now, I’m pretty sure there’s an ulterior motive; but a motive of good intent. Dick uses the lunch to make introductions he thinks may benefit both the people and the industry. Today it’s my turn. Dick has decided I must meet Chris Finnoff, the first President of Pilatus USA and one of the people responsible for the early success of the Pilatus PC-12 in the US. Currently Chris owns Finnoff Aviation.

It didn’t take long to discover that we’re both huge fans of the PC-12. We talked about the airplane for a little over four hours without running out of things to discuss. We discovered we’d both independently come to the conclusion that the airplane might benefit from a more modern propeller design. We both had made inquiries with various propeller manufacturers about designing a five blade propeller. We didn’t feel the airplane was taking full advantage of the available power. A five blade propeller would absorb more of the power, allow a smaller blade diameter; which would reduce tip noise and the odd number of blades might smooth the vibration. Our head engineer at Oregon Aero, Dr. Steve Hooper, used complex math to explain much of the noise and vibration was a function of the even number of blades, something about blade resonance and shaft flexing. The five blade configuration might calm the shafts and reduce noise. I thought it would look cool...

Not much came of our pursuit for several years. In 2008, Chris called me to tell me MT Propeller, from Germany, was interested in designing a new propeller for the PC-12.

Was it ok with me if he pursued this? I’ve had a great deal of experience with FAA certification processes, including a number of certified crashworthy seat designs, several STCs, Parts Manufacturing Authorization, much work toward achieving AS9100 certification, and renewal of our Repair Station certificate under new rules. All of which left me less than enthusiastic about another certification project. I told him, “Sure, go ahead and make your large fortune into a small one. I want a new propeller for myself when the program is complete.” I suggested he sharpen his pencil, figure out exactly how much time and money the project was going to take. Multiply by three and feel satisfied and successful if this was even close to the finished costs in time, trouble and money. Believe it or not, I’m an optimist. As it turned out I was wrong... and the error wasn’t leaning toward optimism!

In June of 2009, Chris asked if I was going to POPA in Memphis. I told him no as we had other more pressing tasks. Sounding slightly disappointed Chris said, “Oh, well... the new propeller is done and I need to put it on a nicer airplane than the test plane. It’s a poor display aircraft. I was thinking maybe you might want to put the prop on your airplane and take it to POPA. I would pay the expenses.” I set records for changing multiple plans, and called my brother Casey. He’s a good pilot, an easy sell and he’s willing to carry the heavy end of the log.

We flew to Mojave, California to have the propeller installed. On the flight from Oregon, Casey used a high quality sound meter inside the airplane to establish a noise baseline. The meter was configured to record noise levels in the dBA weighted scale. This is a scale that indicates the average sound pressure in the frequency range most humans perceive, approximately 600 to 6,000 hertz. Hertz is the way acoustics engineers say cycles per second. We see this scale used frequently when headset manufacturers make claims for protection from noise. Using this scale to compare “noise” attenuation is okay for marketing purposes, but it’s inadequate for understanding the real impact of sound pressure in a given environment. I’ll spare the pain of slipping into a fully developed discussion about sound and human response. At the simplest level, let’s just say big total numbers are bad, smaller total numbers are good, and very small changes in the number make very big changes in the perceived noise.

By the time we arrived in Mojave, we had a very good set of baseline acoustic numbers. We should be able to accurately determine whether the new propeller provides any measurable acoustical improvement. Measurable improvements are more desirable than merely subjective observation, you know, like... “Wow! That seems way better than before!”

We arrived curious to find out how long this modification was going to take. The first challenge was finding the flight test center. The problem was there was a cyclone fence between us and the hanger. We were on the wrong side and couldn’t see

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how to get to the right side. We called ground control for help. He said “Go back out to the ramp, taxi north a half mile or so, turn east, taxi halfway to Nevada, turn right and follow the taxiway in a big archback to where you started.” This was one of the most difficult and time-consuming parts of the installation.

To install the propeller, we needed three mechanics, (actually two big guys and one mechanic). Three mechanics seem like overkill but they’re usually available in an airplane maintenance facility. The two big guys were there to hold everything in place so the mechanic could remove the propeller hub nuts, then lift the propeller off the hub.

The installation required removing the original propeller. We set the old propeller aside, opened the huge box the new propeller comes in. We got the two big guys, and had them lift the new one on. They told us, “The new one is lighter.” It is, but only by five pounds. It feels lighter because the weight is distributed in a manner making handling the prop less awkward. The mechanic reinstalled the hub nuts. Next, they installed the new spinner, which is exactly five pounds lighter than the aluminum one. This spinner is larger as it’s a lighter plastic composite. Yes, it’s chrome and, no...I don’t know how they do that! The total installed weight is ten pounds less than the original prop. This is a welcome change in a plane that can be nose heavy when there are two people in front, no people or baggage in the back, no second battery in the tail, and the fuel load gets light. Then we waited for the propeller balancing guy to show up. It required a minimum effort to balance the propeller. It came out of the box nearly perfect. Those Germans!

The DER completed the all the paperwork, including a temporary Market Experimental registration. The FAA had not as yet completed the formality of agreeing with the EASA who had certified the propeller in Europe. We’re ready to go. Total elapsed time since we arrived - 3.5 hours! Standing back, looking at the airplane, this prop looks like the propeller that should have been on this airplane from the beginning. Very, very, cool!

Are there any special operating restrictions? Only one. Ignore the blinking warning light cautioning you about propeller speed on the ground. This propeller has no restricted operating range. The moment of truth, the first start. Remember how exciting it was to fly this airplane? Now you get to restart the excitement clock! This is no longer the same plane! Everything it did well before...it now does better!!!

We pushed the start button, waiting for the familiar auditory and vibration clues to signal a successful start. Then waited and waited. The engine started with no propeller vibration and minimal propeller noise. There was a faint sound from outside, like a swarm of bees. It was like turning on an electric window fan. We looked at each other and asked, “Is it running? I think its running. Yup, the gauges say it’s running. We can finish the start procedure.” After completing the post start tests, checklist items, listening to the ATIS and got our clearance, it’s time to taxi. We release the brakes. Surprise! The airplane begins moving forward slowly with no additional throttle. No fuss, no extra throttle to get it going, it just starts to slide along like a cake of soap on ice. Cool! This is different already.

We taxied to the end of the runway. The tower gave us permission to take off. We lined up and gently added power. The acceleration was something new and a little confusing. My mind was about three seconds behind the airplane. We shot past the normal rotation speed of eighty knots, reached ninety plus before I realized it, and finally rotated. The rate of climb kept increasing until it was indicating 2,230’ per minute. We were full of fuel with only two on board, but this was better than we’d ever seen before by a significant margin. The outside temperature at Mojave was in excess of 90°. With this same load at sea level on a cool day, we’ve seen the initial rate of climb touch 3,000’ per minute. At a cruising altitude of FL260, we again did a noise survey of the inside of the cabin. The subjective change was startling. It seemed so much quieter. The meter verified this; the passenger cabin noise level decreased by seven db, and the cockpit had decreased by six db.

To those of you unaccustomed to measuring sound pressure, these numbers might seem small, but they’re fantastically large. A simple and accurate way to understand the magnitude
of the change is to think of sound pressure as a function of distance from a noise source. For a given level of noise, imagine the noise source is 100' away. A three db reduction of this noise is equivalent to moving away from the noise source, double, or 200' feet away. Another three db reduction is equivalent to doubling this distance. Now the noise source seems like its 400' feet away. One more db for a total of seven in the cabin is like being 550' feet away from the source. The six db reduction is equivalent to quadrupling the distance from the noise. Small numbers make big changes! In the PC-12, the pilots will still want to wear headsets, but if it’s necessary to take the headset off to talk to a passenger... it is possible to speak in a normal voice. From the front, we’re able to hear and understand much of what is being said in the cabin. The passengers are now talking in normal tones with no difficulty.

Along with a reduction in noise, the airplane is as smooth as a table top. No shake, no buzzing vibration, nothing from start to shut down. The most commonly used word to describe the experience is “smooth.” Our passengers love the improvement. The pilots who fly the airplane long hours enjoy a significant reduction in fatigue. Over time, Casey noticed he was able to drink more water on a long trip without the, uh, side effects we’re all familiar with. It seems the vibration was actually shaking the, uh, (well you know), out of us. I thought this might just be Casey, but after more than 200 flight hours behind the new propeller, I’m here to report, he’s right.

People are curious whether there was any modification required for the prop heaters and how well they functioned with five blades versus four. There’s no modification required during installation, and they function as well as, or possibly better than the four blade installation. The natural composite blade cores are excellent thermal insulators, and don’t draw off heat from the heaters like the aluminum blades. We have flown the plane with the new propeller in ice conditions with no discernable accumulation.

The length of each blade is one and a half inches less, producing a lower tip speed. This reduces tip noise and ground clearance is increased reducing the likelihood of FOD (Foreign object damage). Outside noise has been reduced significantly. We haven’t measured this yet, but we surprise ramp attendants everywhere with our stealthy arrival. They’re never three to meet us because they don’t hear us coming. We have a feather inhibit switch installed, so our shut downs are not the normal PT6 “wompf!” Instead the prop winds down slowly, never picking up FOD, while pulling cooling air through the engine core. When the temperature comes down and the prop slows, I release the switch and presto... the blades turn to feather and the prop stops. A quick restart will never see the ITT beyond the yellow arc. I told you about the feather inhibit switch as a clue how to protect your investment in a new propeller.

The ramp attendant, who is surprised that we’re there at all, watches the prop slowly spin down, I can see him mentally counting blades, “Five?” It’s like a cow looking at a new gate, “Five, where’d it come from, what’s it for, who put it there?” Since we have the only PC-12 with this prop, our days of entertaining ourselves this way need be savored. These guys are going to get used to this as more of these fine propellers enter the fleet.

The airplane accelerates quicker, lifts off sooner, climbs measurably faster and cruises maybe a couple knots faster. Reducing power for the descent is smooth, without any discernable sense of deceleration, although the rate of descent doesn’t seem to be compromised. If you need it, the plane can still come down like a box of rocks. The speed in the pattern is more stable and less prone to variations in the indicated airspeed. Trim so the AOA (angle of attack) pointer is on the doughnut or slightly less. Small pitch adjustments on final are possible without excessive swings in airspeed. Cross the numbers with about seven pounds of torque. Reduce the power to idle while simultaneously flaring, and the airplane will settle gracefully without falling out from under you. Unless, of course you decided to flare twenty feet high. Raise the flaps, use reverse and brakes as necessary. The rollout will be significantly shorter. The first ten landings were all greasers. I would like to take the credit, but ten in a row is too many good landings to blame on the pilot.

Beyond the operational benefits, there’s a good argument to be made for the propeller’s value proposition over time. The mandatory overhaul interval is six years or 4,000 hours. There’s no overhaul kit to buy. The overhaul process

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is disassemble and inspect. If the measurements are within specification; reassemble. The cost of the overhaul should be about half of the previous overhaul. The blades have no mandatory life limit requiring eventual replacement like the aluminum blades. The blades don’t erode and can be repaired. Small nicks are simply filled with epoxy, faired and repainted. Believe it or not, more extensive damage, like a ground strike, can also be repaired. Reduced vibration will save wear and tear on everything.

Do I like this propeller? As soon as we returned from Mojave, I called Chris Finnoff and told him I had both good and bad news. The good news was the performance improvements exactly match the claims made in the literature. The bad news...he was never going to get it back. I have over 3,500 hours in PC-12s; I’ve owned two. I’ve made 16 transatlantic crossings. I fly the airplane twice as many hours a year as I drive my car. And still...the day after we installed the new propeller - Casey and I were at the airport doing “touch and go” for the fun of it!

If you choose to install one of these beauties, try this. Line up at the end of the runway, stand on the brakes, hard, run the power full up. There’s no nasty cavitation noise, but there is a lot of anxious shaking from an airplane trying to go. Release the brakes, and hang on as the seat hits you in your back. Really! And, if you’re a regular passenger in the aft cabin, you’ll love the new smooth, quieter ride!

I began this story with a free lunch in Oshkosh, and ended up with a new propeller on our PC-12. This is proof indeed that there’s still no such thing as a free lunch!

I end this with a small disclaimer. I have no financial investment in this project. My only interest is to help improve the utility of this fantastic airplane.

All boats go up together with a rising tide...

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