2005 AOPA COMMANDER COUNTDOWN aopa.org/sweeps

Flying high and breathing deep

Two more upgrades enhance the Commander

BY STEVEN W. ELLS

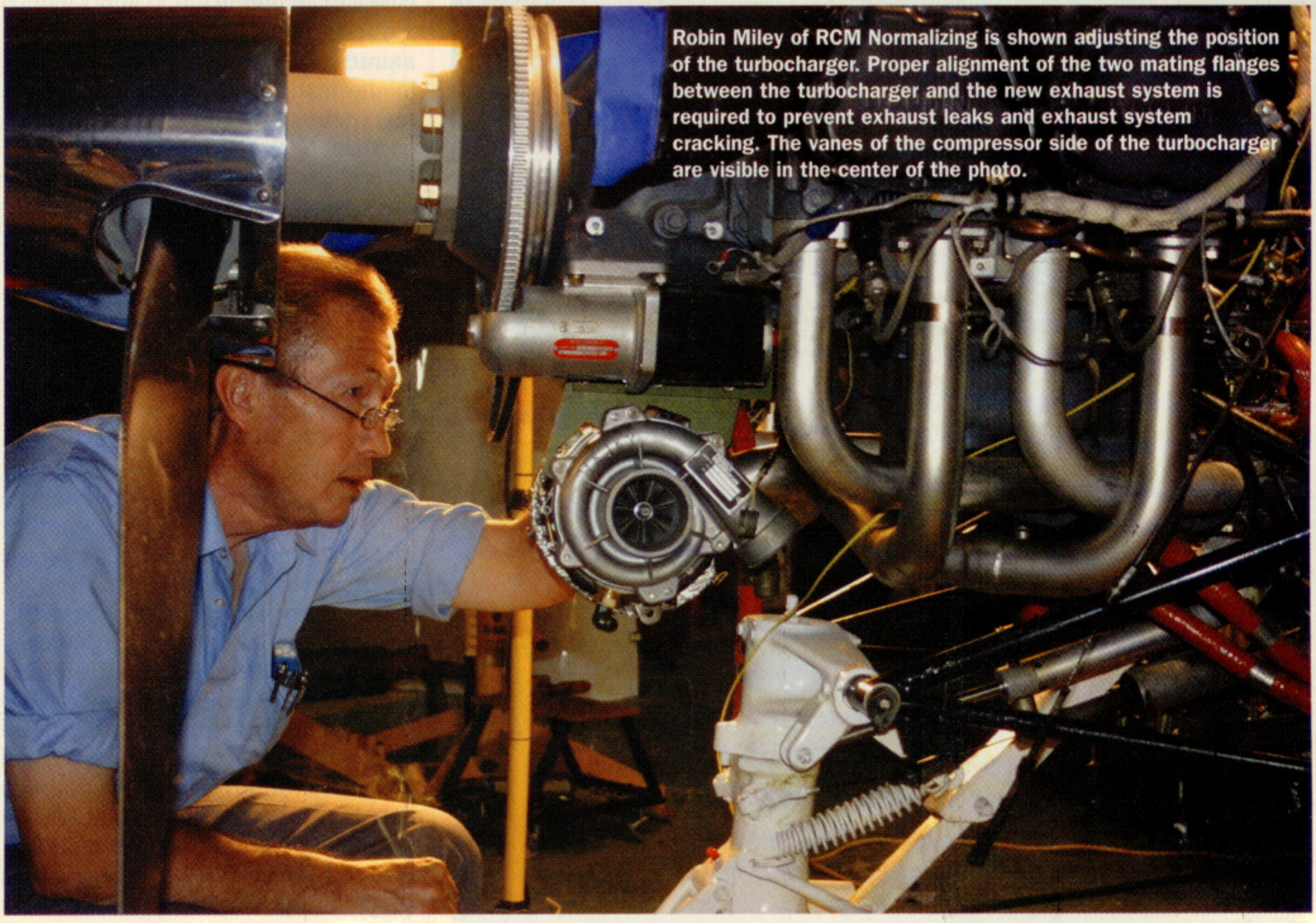
"N112WN, this is Salt Lake Center. I'm going to need you at 14,000 feet in 30 miles. Are you able?"

"Salt Lake, N112WN can climb to 14,000—should I start up now?"

When Salt Lake City Approach said that would be fine, I rolled in a little nose-up trim and N112WN, AOPA's 2005 sweepstakes airplane, a Rockwell Commander 112A, started climbing.

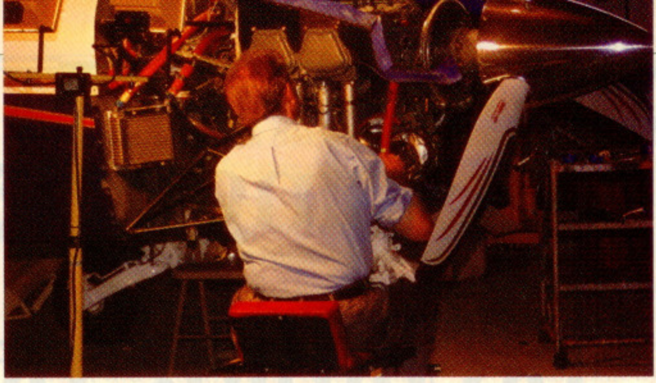
It wasn't always like this. Last month, readers learned of the Commander's struggle to maintain 10,500 feet msl as afternoon thermals repeatedly bumped us around during the last leg of a cross-country flight to Big Piney, Wyoming (see "2005 AOPA Sweepstakes: The Big XC II: The Wx Solution," August *Pilot*). The Chelton Flight Systems EFIS (electronic flight information system) display showed that a nose-high attitude was required to maintain level flight. The result of this was increased drag, which decreased airspeed, which decreased lift—a tightening circle that would have eliminated IFR flying in some areas of the mountainous West simply because many western routings have minimum en route altitude (MEA) floors above 10,000 feet msl.

The reason for the Commander's newfound altitude ability: a turbonormalizer installation from RCM Normalizing, of Big Piney.



Robin Miley of RCM Normalizing is shown adjusting the position of the turbocharger. Proper alignment of the two mating flanges between the turbocharger and the new exhaust system is required to prevent exhaust leaks and exhaust system cracking. The vanes of the compressor side of the turbocharger are visible in the center of the photo.

PHOTOGRAPHY BY THE AUTHOR



Robin Miley installs the turbonormalizer system on N112WN in a hangar his father built in the 1970s at Big Piney airport (left).

Stronger at altitude

The RCM turbonormalizer is a simple bolt-on system that gives the pilot the power to increase the air pressure delivered to the engine-induction system—up to the redline limit of 28 inches of manifold pressure—as needed to maintain adequate engine power output. This air is slightly pressurized when compared to the surrounding atmospheric air pressure. Remember that as an airplane climbs, it climbs up into a blanket of air that has weight. During the climb, the weight of the air—and the (atmospheric) pressure of that blanket of air—decreases in a predictable manner. This decrease in pressure (and the proportional decrease in air density) lessens engine power output because less air is entering the combustion chambers of the engine and lessens propeller thrust and wing lift because of the fall of air density.

Because of a lack of aftermarket drag-reducing modifications such as wing root-to-fuselage and landing-gear fairing—like the ones installed on the 2004 AOPA Win-A-Twin Sweepstakes airplane—a drag-reduction solution to improve performance wasn't an option.

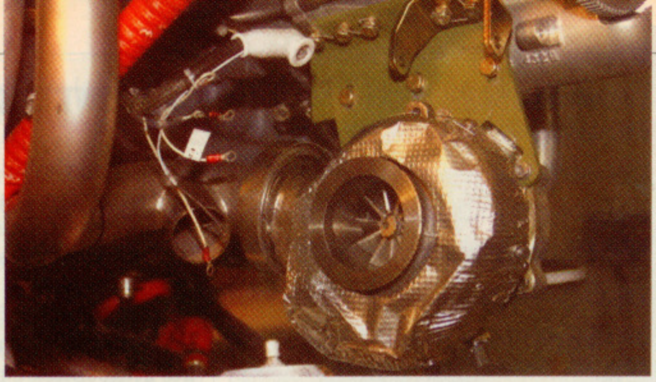
The new Hartzell three-blade Top Prop already featured the latest light-airplane propeller technology as witnessed by the curved leading edges of the blended scimitar propeller blades, so improving propeller efficiency wasn't an option.

A complete set of Micro AeroDynamics vortex generators—those tiny blades installed on the Commander a few inches aft of both wing leading edges along the bottom of the horizontal stabilizer and along both sides of the vertical stabilizer—works wonders to keep the airflow attached to the surfaces at slow airspeeds, but has little effect at cruise airspeeds.

The only solution for more performance was the turbonormalizer. And the only company that owned a supplemental type certificate for this mod on a Commander 112 was RCM Normalizing—a one-man shop owned by Robin Miley.

Miley is also the airport manager at Big Piney-Marbleton Airport, so when he isn't maintaining Commanders—he is one of the most experienced maintenance contributors on the Commander Owners Group (COG) Internet chat room and maintenance forums—he is selling Jet-A and 100LL fuel and, during winter months, plowing snow.

This installation was simple; the only cutting that the modification required was the removal of the landing light from the nose cowl so that a preshaped bulge could be installed in its



A foil heat blanket covers the turbine side of the Kelly Aerospace turbocharger (right). The round tube behind the white wire is the exhaust bypass portion of the system.

place. This bulge looks good, lessens cowling drag, and provides clearance for the turbocharger assembly.

The installation begins

There are four major components to the RCM turbonormalizer. The first is the turbocharger, which can be described as a device made up of three stacked pieces. One piece is the turbine wheel. The second piece in the stack is the center bearing and oil lubrication path that supports, lubricates, and cools the shaft between the turbine and the compressor wheels. The scroll-type air compressor completes the stack. The three parts are held together by special V-shape clamps.

The unit is mounted under the front of the engine with the turbine on the copilot's side of the airplane, the shaft oriented horizontally, and the compressor on the pilot's side. It's all supported by sturdy bracketry that is bolted in place. This compact unit—approximately 7 inches in diameter—uses the turbine wheel to extract energy from the engine exhaust stream. The rotation of the turbine wheel is carried via the shaft through the center bearing to the compressor wheel, which generates compressed air that is ducted into the engine-induction system.

Oil under pressure from the engine oil system is routed to the turbocharger center bearing and then is returned to the engine oil sump via flexible oil lines and an oil scavenge pump. Both the scavenge pump and the turbocharger are proven components from Kelly Aerospace, of Montgomery, Alabama.

The other components are an intercooler—an air-to-air radiator that lowers the temperature of the air from the compressor before it's ducted into the engine-induction system, thereby maintaining good engine durability margins—and a safety valve commonly called a *pop-off valve*.

Spring pressure holds the tapered pop-off valve against a seat. The valve, which is located between the compressor and the intercooler, is closed during normal operations. But if the compressor outlet pressure exceeds the system limits, then the valve automatically opens, preventing engine damage because of excessive manifold pressures.

Easy to use

The pilot controls the manifold pressure by turning a vernier control that is identical to a vernier-type mixture (or rpm) control found in many airplanes. Screwing the vernier in and out—there's a red placard near the control warning against any abrupt movements—controls the position of the wastegate, which is a simple center-pivoting door in the turbine wheel-exhaust system. By screwing the vernier control in, the pilot closes the wastegate and directs more exhaust onto the turbine wheel. This increases the speed of the turbine wheel and the compressor wheel—since they are connected by a common shaft—enabling the pilot to control the manifold pressure to suit the atmospheric pressure conditions. Exhaust energy in excess of what is needed to maintain the desired manifold pressure exits past the wastegate to the exhaust pipe. The system is capable of, and certified to produce, 28 inches of manifold pressure up to a ceiling of 16,500 feet—the same manifold pressure the 200-horsepower Lycoming IO-360 generates on its on at sea level.

The RCM Normalizing system is a well-thought-out, durable installation. Miley has flown behind the installation in his Commander 112A for more than 1,600 hours and he insists that the key to durability is the pilot's commitment to a few simple operating rules.

Miley stipulates that the engine be idled at 1,000 to 1,200 rpm for a full five minutes before shutdown. This procedure forces a river of heat-absorbing engine oil to circulate through the center bearing housing of the turbo, thereby cooling the assembly. Failure to sufficiently cool the turbo will result in coking of the center bearing and shaft. This slows rotational speeds and lessens turbo efficiency. Miley is equally adamant about the necessity of warming up the engine—and especially the engine oil—before takeoff.

In addition to nearly 6,500 feet of increased ceiling that comes with the installation of the turbonormalizing system, the Commander pilot enjoys true airspeeds near 140 knots, a dozen knots faster than the stock airplane.

Easy breathing at altitude

The winner of the Commander will be able to take advantage of the increased altitude performance by opening the valve of the 22-cubic-foot aluminum oxygen bottle that's conveniently strapped in a nifty bag onto the back of the copilot's seat. This complete portable system from Precise Flight, of Bend, Oregon, features two PreciseFlow oxygen conservers—a new product that both saves oxygen and improves blood-oxygen saturation levels. These conservers automatically pulse a shot of oxygen upon each inhalation through what Precise Flight calls its *lumen dual-type cannulas*. These cannulas are included with each conserver, and they're quite a bit lighter, very comfortable, and less obtrusive than the more common Oxymizer cannulas.

According to Precise Flight data, the 22-cubic-foot bottle in the Commander has sufficient capacity to provide oxygen for one person using an Oxymizer cannula and A-3 flow meter at 14,000 feet msl for 18.7 hours. The PreciseFlow oxygen conservers further conserve oxygen and increase bottle durations by a factor of three to six, according to Precise Flight. Filling the bottle cost $30 at Million Air in Salt Lake City. Even if the conservers only extend the duration by a factor of three, the oxygen cost will be reduced from $1.60 a flight hour to just more than 50 cents per hour.

Many pilots don't realize that hypoxia can start affecting them, and their passengers' at altitudes as low as 5,000 feet msl. If you find yourself behind the airplane when flying, or always have a headache after a few hours of flying, an oxygen system will increase your enjoyment of the flying experience, and make flying safer.

Fun on the run

The latest cross-country flight for the Commander was easy. Since the Big Piney airport is at 6,990 feet msl and temperatures dropped to near 40 degrees Fahrenheit at night, the Reiff engine preheater system was plugged into the nearest 110-volt outlet the night before departing Wyoming.

This system consists of four small heating pads that are bonded to metal bands that are 18 inches long. One band is installed around the base of each engine cylinder immediately above the cylinder hold-down nuts by simply threading the end of the band into a coarsely threaded screw on the opposite end of the band. Tightening the screw draws the clamp tight around the cylinder base. The standard system—there's also a Turbo and a Turbo XP system with higher-capacity heaters—features 50-watt cylinder heaters and a 100-watt heating pad bonded to the engine oil sump. Pluses of the Reiff preheating systems are that the heating elements are easily removable in case the airplane is sold or a cylinder is removed for maintenance and—unlike some other types of preheating systems—none of the components interferes with the installation of cylinder-head temperature probes.

When I arrived at the airport the airplane was ready. I got aboard, rigged the oxygen system, slipped the comfortable Lightspeed Thirty 3G noise-canceling headset on, and worked my way through the preflight checklist. Then I taxied onto Runway 31 at Big Piney, checked the compass and the EFIS for runway alignment, and slowly fed in throttle. The maximum manifold pressure before closing the turbonormalizer wastegate was 22 inches—a few turns of the vernier wastegate control and the manifold pressure was at 26—and it rose up to 28 inches because of ram pressure during the takeoff run. Back-pressure at 70 knots and I was flying. Gear up, turn left toward Fort Bridger VOR, and start climbing.

As the Commander climbed into that blanket of air, there was less air above the airplane, and the manifold pressure dropped. It was a simple matter to reach down and give the vernier control another half-twist. Maintaining a 500-feet-a-minute climb up to 14,000 feet was effortless. Engine oil and cylinder head temperatures remained cool throughout the climb.

At the end of the climb a cruise power setting of 26 inches, 2,400 rpm, and 12 gallons per hour was set and the trim was rolled forward to maintain level flight. The only other task was to click the dial on the oxygen conserver to align with the cruise altitude, keep track of navigation, and—aided by the long-reaching "eye" of the Ryan 9900BX TCAS (traffic alert and collision avoidance system)—keep alert for traffic. A quick check with a pulse oximeter revealed that my oxygen-blood saturation level was 96 percent—it was a wonderful day to fly.

Fibber McGee and Molly were living life on the old-time radio channel on the Sirius radio subscription piped into the headsets via the PS Engineering PS 8000SR audio panel. Visibility was 50 miles, the air was smooth, and the Commander was purring westward, carrying an *AOPA Pilot* editor home for the Fourth of July holiday. AOPA

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i Links to additional information about the 2005 Sweepstakes aircraft may be found on AOPA Online (www.aopa.org/pilot/links.shtml).