Western Skyways

Attention to Detail

by John T. Kounis
photos by John T. Kounis and George A. Kounis

I had a sad feeling as I primed my engine and cranked the starter for the last time. Since installing a Western Skyways Gold Seal Engine in my Cessna 185 five years ago, I had flown it more than 1,800 hours. I hadn't been particularly gentle with the engine, pushing it at high power settings on 105° F days in the Mojave Desert, or starting it after a quick preheat on a 10° F ramp in Boston. Yet, the engine never let me down. I remember long flights at night crossing the Great Lakes as fog enveloped the coastline. I worried about how cold the water below was and how successful a ditching would be. As always, the engine's reassuring drone continued on. Other times, I depended on the engine for every last horsepower on takeoffs from mountain strips as short as 900 ft.—and I was never disappointed.

My engine was running fine despite being at TBO, with compressions of 66 to 70 on all cylinders. But it was time to exchange my trusted friend for a shiny, overhauled engine that was waiting for me. As I climbed out of the Los Angeles basin, I leveled off at 11,500 ft., leaned the engine one last time, and pointed the nose toward Montrose, Colorado, and the Western Skyways overhaul facility.

History

In 1943, Ernie Helms and Vern Hickman founded the original Western Skyways in Troutdale, Oregon (just east of Portland). It soon became a major player in the aviation industry. As the largest Cessna dealer on the West Coast, it offered numerous aircraft STCs, such as camera hole modifications on Cessna 206s. They also had a paint and interior shop, and did engine rebuilds. In fact, the company was rebuilding Continental engines years before Continental did (Continental was only selling factory-new engines back then). In 1988, AAR Corp., which had purchased Western Skyways in 1975, announced that it was liquidating AAR Western Skyways, and that more than four decades of engine overhaul service would end. About the same time, Monarch Aviation in Grand Junction, Colorado, opened West Star Engine Corporation, bringing on board former Western Skyways employees David Leis, Perry Nicholson, and John Robinson.

Unfortunately, legal battles developed and David, Perry, and John formed a new engine company in 1994 with the help of Al Head, who used to own National Aircraft Salvage. The new company was based in Montrose, and named "Western Skyways" to assure customers that the same expertise and years of experience were still there. They purchased much of the original equipment they had used at AAR Western Skyways in Troutdale. Air taxi operators—who demand low cost and high quality—provided the majority of business, and Western Skyways made a name for itself overhauling Continental TSIO-520 engines for Cessna 402s, from Hawaii to the Grand Canyon.

The Shop

The shop is in a large hangar west of Montrose Airport's Runway 17/35, about 2,000 ft. north of the threshold. After I taxied up, the sales representative, Trent Tubbs, greeted me at my airplane.

I'd had three engines previously installed in airplanes, and each time the procedure had been similar. As the first step, someone would hook a hoist to the engine and remove it. Not so at Western Skyways. Before anything was removed, Service Manager Ryan Dickerson showed up, clipboard in hand. He ran the engine, noting temperatures, pressures, fuel flow, and any squawks, establishing a baseline to work from. This attention to detail is an example of the quality of work at the shop.

While any A&P can sign off an engine overhaul, I chose Western Skyways due to the added confidence that it is an FAA-approved repair station with product liability insurance, an employee drug testing program, and mechanics with extensive experience specifically related to engine overhauls (see sidebar, "Selecting an Engine Shop"). With close to 70 employees overhauling 35 to 40 engines per month, the company is small enough to give extra care to each engine, yet large enough to provide superior service and quality control. Customized service includes attentive support from David Cartwright, the Customer Liaison, who maintains contact with clients through the overhaul process, informing them of current status or scheduling and parts issues. I was also happy to find out that their prices are consistently lower than factory overhauls.

Disassembly/Inspection

While the service department was preparing for engine removal, David Leis, vice president of sales, gave me a tour of the factory. We started at the disassembly facility, where once again, attention to detail was obvious. Before work begins, an

THIS ATTENTION TO DETAIL IS AN EXAMPLE OF THE QUALITY OF WORK AT THE SHOP.

"Engine Overhaul and Assembly Log" is created. This comprehensive, seven-page document records the condition of every critical engine part and accessory, and each step of the overhaul process. Every item is signed off by a mechanic and verified by an inspector.

Literally hundreds of signoffs occur before an engine overhaul is complete. For example, years after my engine overhaul, I will be able to find out who performed the dye penetrant inspection on my starter adapter housing and who inspected that work.

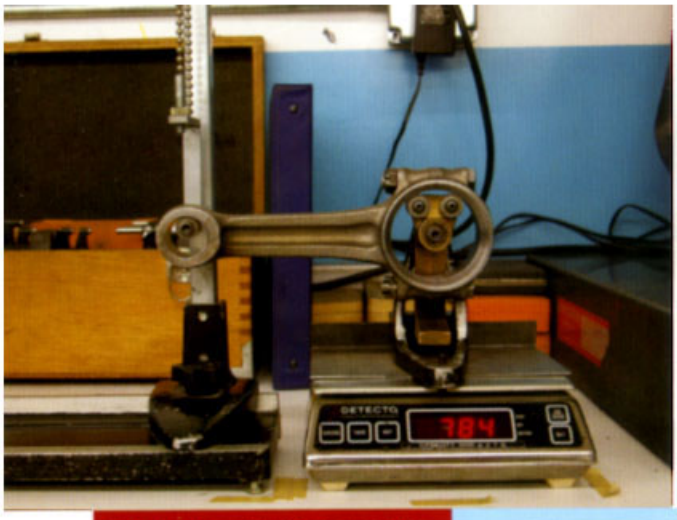
Some innovations are elaborate, like quality control checks throughout the engine overhaul process. Others are simple, such as the use of a single cart per engine overhaul. At many overhaul shops, when an engine is disassembled, reusable parts are removed and put into the assembly process later. With this practice, an engine can be rebuilt with a crankcase, crankshaft, and connecting rods from different engines. At Western Skyways, a single cart is assigned to an engine. All parts from that engine are kept on the cart as it moves through the rebuild process. With this discipline, parts are not exchanged between engines, which is useful because engine parts tend to wear in such a way as to mate each other. It is best to keep all the "mated" parts together to minimize additional wear from overhaul to overhaul.

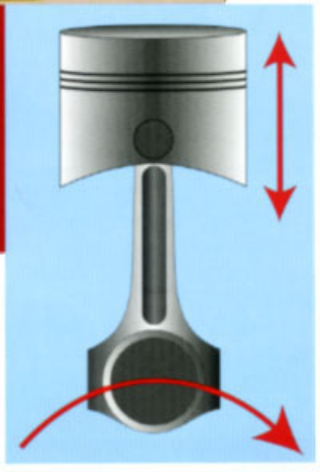
Opposite page: John Frost and Tory Nicholson complete engine installation on the author's airplane; the shop is qualified to work on a wide variety of aircraft.

Top to bottom: The shop is west of Rwy 17/35; Dye penetrant inspections reveal damage invisible to the naked eye, such as this crack in a crankshaft flange; Service Manager Ryan Dickerson and Tom Faris remove the author's engine.

Rebuild Process

Once the engine has been disassembled and inspected, the rebuild process begins. The first step is to remove all mandatory replacement parts. When evaluating an engine shop, I would ask to see the list of parts that they replace regardless of condition. Such items include obvious parts like cylinders, pistons, gaskets, spark plugs, and bearings, and not-so-obvious ones like certain bolts, nuts, clamps, and hoses. When I requested the replacement parts list for my engine, within two minutes, David Leis produced Teledyne Continental Service Bulletin SB97-6, which lists all mandatory replacement parts. However, Western Skyways will not reuse certain parts even if permitted. This is documented





Only the big end of a connecting rod spins with the crankshaft (right); by weighing each end separately (above), the rotating masses are equalized for smoothest operation.

Below: Precision dynamic crankshaft balancing also ensures smooth engine operation.

on Western Skyways' 100% Parts Pull List, which is a superset of the manufacturer list.

As inspection continues, tolerances are checked, and parts go through magnetic particle, dye penetrant, or other inspections. All details are called out in the Overhaul and Assembly log.

There was a time when cylinder overhauls were a large part of Western Skyways' business, but now that ECI and Superior are providing brand new cylinders at competitive prices, that business has dwindled. Western Skyways still overhauls cylinders, but David admits that most go to customers who are close to TBO and just want a single cylinder or two to get to the next overhaul. About the recent trend in cylinder work, David commented, "Any competition I really like. More competition keeps everyone honest in the industry. It keeps prices down. After ECI and Superior started offering brand new cylinders, factory prices of cylinders plummeted overnight. Now the consumer wins; few people buy used cylinders anymore."

The Cylinder Shop may have slowed down, but other divisions are working at full speed. The Accessory Shop, headed by Ron Epperson who started at AAR Western Skyways in 1976, handles overhauls from alternators and starters to more complicated components such as wastegates, turbochargers, and complete fuel systems. In fact, many smaller engine shops send their accessories here for service. Manager Tony Bogart maintains a large inventory in the New & Used Parts Division, including crankshafts, crankcases, valves, and camshafts.

One of the most painstaking processes is crankshaft balancing. Many customers comment on how smooth Western Skyways engines are and that such claims are not just hype. Smooth operation translates to an entire array of benefits: less metal fatigue, fewer loose rivets, reduced instrument wear and tear, longer engine mount life, less cracking, etc. Western Skyways achieves this via a time-consuming process.

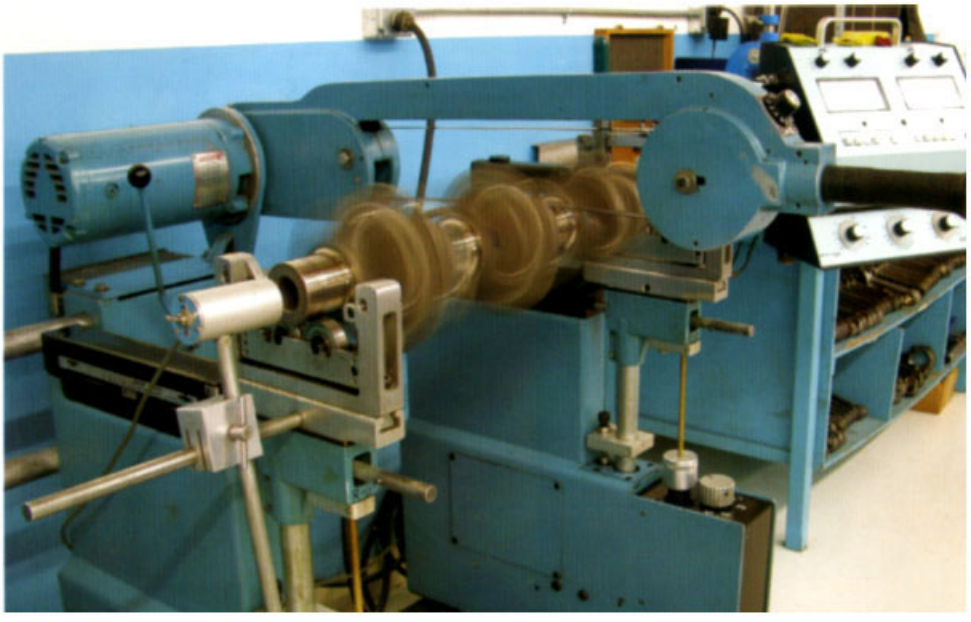
When you think about the chaos that occurs inside an internal combustion engine, it's difficult to understand how one can run smoothly. A couple of thousand times a minute pistons are charging up and down, connecting rods are moving in and out while they're spinning off-center around a crankshaft, eccentric cams on the camshaft are thrusting pushrods back and forth... all these metal pieces can create vibration with the slightest imbalance. Even a minor vibration that isn't felt by the pilot can have detrimental effects on the life of engine parts, instruments, etc. Western Skyways abates this vibration by precision dynamic balancing of the crankshaft.

A crankshaft is a complicated shape to balance, and being attached to connecting rods only makes things worse. The large end of each connecting rod spins with the crankshaft and makes up part of the rotating mass, while the small end is connected to the piston; it moves back and forth, so it carries no rotational energy. Many engine shops statically balance a crankshaft, but this does not take into account the effects of other parts moving at different radii from the crankshaft axis. As dictated by the engine manufacturers, most engine shops match the connecting rod weights to each other. Western Skyways goes a step further by weighing *each end* of the connecting rods and trimming the ends down to match the end-weights as well as overall weights.

To demonstrate why static balancing is not sufficient, imagine a Cessna 337 that has a propeller in the front and another in the rear, with a single shaft connecting the front and rear propellers (bear with me on this... I know that Cessna 337s don't have a single shaft going through the cabin to connect the propellers). If all propeller blades weigh the same, the entire assembly is balanced. Now, remove the front left blade and rear right blade. The assembly is still *statically balanced*, since the remaining blades balance each other out. However, if you start the engines, the airplane would violently tear itself apart, since each blade has huge rotational imbalances.

Western Skyways has specialized equipment to *dynamically balance* a crankshaft to reduce these imbalances to exacting tolerances. SAE standards call for a maximum imbalance of 0.84 in-oz. Western Skyways is more demanding, with a tolerance of

MANY CUSTOMERS COMMENT ON HOW SMOOTH WESTERN SKYWAYS ENGINES ARE AND THAT SUCH CLAIMS ARE NOT JUST HYPE.



0.50 in-oz. Tests performed by Western Skyways on Continental engines indicate that factory tolerances are about 1.0 in-oz for factory-new engines, and 2.0 in-oz on factory overhauled engines. A typical balancing job at Western Skyways requires up to eight hours per crankshaft, but the benefits are worth it: a smooth-running engine with minimal wear and tear, and fewer dents in the pocketbook.

Along with my engine, I received a computer printout of the serial and part numbers of every part that went into it. So why do I care if my camshaft serial number is RA10390-5? Well, let's assume that an Airworthiness Directive is issued for camshafts with serial numbers RA10380-0 to RA10385-9. Wouldn't it be a lot easier to read the computer printout than to remove the engine and split the crankcase to read the number stamped on the end of the camshaft?

One person is responsible for the final assembly of each engine.

Western Skyways customizes their work according to client specifications. For example, I had them exchange the standard Champion spark plugs with Unison Autolite XL Fine Wire Aviation Spark Plugs. After I read Greg Illes's article in the May/June 2005 issue extolling their long life and low maintenance (many times that of massive-electrode plugs), I had to have a set for myself.

Throughout the teardown process, multiple persons may work on an engine, but once the final assembly begins, one person is responsible for the build-up of the engine through to completion, assuring continuity and accountability. The sheet I received with my engine shows that "T. Nicholson" spent 16.8 hours in the final assembly of my engine.

Porting & Flow Balancing

I often push my engine to the limit. Whether flying photo shoots with a P-51 Mustang at 140 KIAS, pulling my Cessna 185 around behind the power curve at 55 KIAS to photograph a Tiger Moth, or taking off from unpaved airstrips as short as 900 ft., I demand maximum performance. So, of course, I asked about porting and flow balancing my engine. If Formula One drivers can extract every last horsepower by doing it, why can't I?

It sounds good at first. Each cylinder has a different airflow, so why not match the airflow and grind out the intake ports so that each cylinder gets the same amount of air? Well, there is a big difference between a Formula One motor and an airplane engine. A Formula One motor extracts nearly five horsepower per cubic inch while turning at 18,000 RPM. Airplane engines, on the other hand, usually do not have tuned intake systems; they plod along at a maximum of 2,500 RPM or so while producing about one-half horsepower per cubic inch. Furthermore, it's perfectly acceptable for a Formula One engine to only last for one race; in fact, according to the official Formula One website, "unsurprisingly, engine failure remains one of the most common causes of retirement in races."

Engine Components, Inc. (ECI) studied porting more than a decade ago and abandoned the idea. David showed me an ECI memo number 9207-4, dated July 2, 1992, which stated performance increases were insignificant or could not be measured and that the integrity of the cylinder was compromised, which could lead to cracks. Therefore, David Leis advises against porting and flow balancing. "Western Skyways sells what is *real*," says David. "Dynamic balancing has proven its value again and again, while porting and flow balancing will only give you a weaker cylinder." That said, Western Skyways will still port and flow balance an engine if the customer requests it, but few do after seeing the facts.

Engine Testing

After my engine was balanced and assembled, the next step was to run it in Western Skyways' test cell. Many smaller shops simply install an overhauled engine and test it on the airplane. Unfortunately, due to cooling problems, it is impossible to have a long ground run without overheating and damaging the engine. So guess what? You're the test pilot when you take your zero-hour, rebuilt engine on its first flight.

Reputable engine shops run the engine for a couple of hours before installation in a test cell with a special shroud to permit cooling airflow during the test run. Norm Riarden, who has been testing engines since the AAR Western Skyways days in 1975, heads the test cell group. They run the engine for about two hours, measuring thrust; cylinder head and exhaust temperatures on all cylinders; oil pressure; and other engine operating parameters. Then they shut down the engine, change the oil and filter, and inspect for any metal chips or particles. Only after a successful test cell run is an engine delivered to the customer.

Installation and First Flight

Even if it's a long flight to Montrose (as in my case), I recommend customers have Western Skyways perform the engine removal and installation. An exchange engine can be waiting for you when you arrive, so the engine swap takes about a week, and your engine will be installed with the same professionalism with which it was rebuilt. It's also a great excuse to tour the Rockies and Black Canyon of the Gunnison National Park.

When I got my airplane keys back, I felt like I was getting a brand new airplane. The engine was shiny, the prop was smooth, and the oil on the dipstick was clean. I started the engine, and right away

Selecting an Engine Shop

Choosing a shop for your next overhaul can be a daunting task. If possible, visit each shop personally for an inspection. Here are a few questions suggested by the experts to help you evaluate a shop.

- Are they FAA certified?
- Do they have an employee drug-testing program?
- Does the shop employ A&P rated mechanics with extensive experience?
- Do they maintain full liability insurance?
- Are their engines brought to New Factory limits or simply to Service Limits?
- Do their warranty terms reflect confidence in their product?
- Do they perform a full test cell engine run?
- Do they use new parts or remanufactured parts?
- Do you get an itemized listing of all parts installed?
- Do they provide fast and convenient service if there is a problem?
- Will they still be here five years from now?

was rewarded with Western Skyways' legendary smoothness. As I pushed the throttle in for takeoff, the response was immediate and smooth. I checked all the instruments during the takeoff roll and was startled to see the fuel flow at redline, indicating 25 gph. Before the overhaul, I had never seen it exceed 22 gph. Then I realized what had happened: The fuel flow is *supposed* to reach redline on a full-power, full-rich takeoff. Western Skyways had not installed either of my previous engines, so my fuel system had never been adjusted correctly. Since I had purchased the airplane nine years ago, it had been running consistently too lean, potentially robbing me of power and cooling at low altitudes.

Before turning me loose, I was briefed thoroughly on engine break-in procedures. I was advised to run as high a power setting as possible—75 percent if I could get it. This creates high cylinder pressure, which pushes the rings out against the cylinder walls and assists with engine break-in. "Don't baby it!" they emphasized. In addition, I should vary the RPM every 15 to 20 minutes during cruise, avoid flights shorter than one hour, and carry a bit of power at all times (i.e., avoid having the air drive the propeller, which allows the rings to go slack). I followed their recommendations and made all wheel landings, carrying some power through the entire landing. One thing that made an impression on me: Some airplanes tend to shudder a little when the RPM is changed, particularly when running a very low RPM. The Western Skyways engine was smooth throughout the entire operating range.

Engines

Western Skyways overhauls Lycoming and Continental engines, and will outfit them with factory-new, overhauled, ECI, or Millennium cylinders. I chose an overhauled Western Skyways Gold Seal Engine with Millennium Cylinders based on my previous good experience.

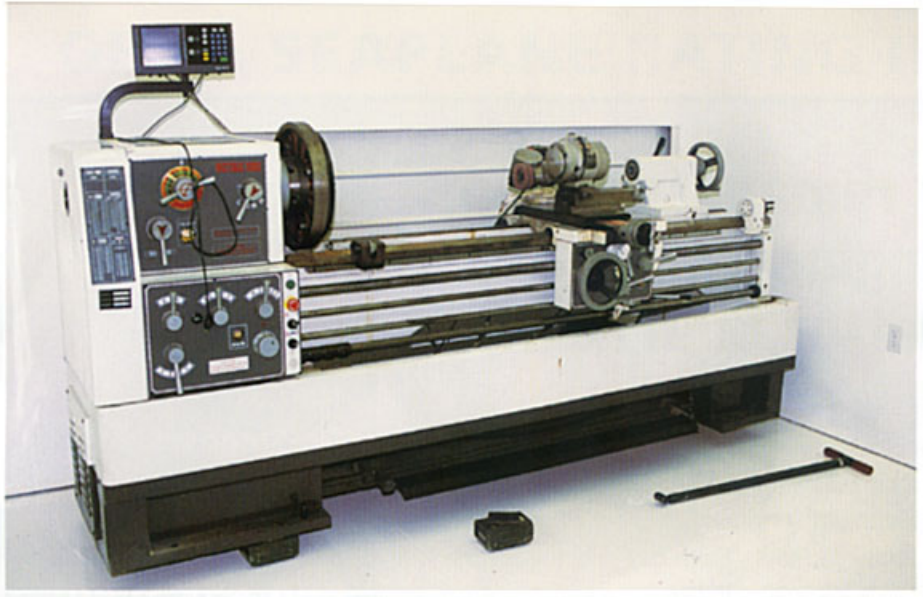
Mechanics report that factory-new cylinders often need replacement after 200 to 600 hours in service, whereas Millennium Cylinders will make it to TBO. My experience confirms this. According to the logbook of the engine that was in my airplane when I bought it, the owner performed a complete top overhaul before the engine had reached half of its 1,700-hour TBO. After I purchased the airplane, I needed to replace another cylinder prior to TBO due to compression that had plummeted below 30/80. However, five years ago, I purchased an overhauled engine from Western Skyways with Millennium Cylinders. All cylinders made it to TBO with no replacements. Furthermore, compression on all cylinders was above 65/80 at TBO—well within limits for new cylinders.

Courtesy Western Skyways

Western Skyways engine installations are top notch; customers often opt for new hoses, baffling, and engine mounts.

After Superior Aircraft Parts, Inc., introduced its Millennium Cylinders, Western Skyways discovered a surprising fact when they would remove them at engine overhaul: They were still within factory-*new* tolerances, despite having reached TBO. David attributes this to their hardened steel barrels and 0.008 to 0.012-inch barrel choke (features that are now also available from ECI in their new TITAN cylinders).

Western Skyways was so impressed with Superior's parts, they flew to the company



DAVID COMMENTED: "ANY COMPETITION I REALLY LIKE. MORE COMPETITION KEEPS EVERYONE HONEST IN THE INDUSTRY."

to collaborate on new product development. After several brainstorming sessions, Superior introduced the new Millennium Engine. It is essentially a Continental or Lycoming engine with many Superior parts and Millennium Cylinders, with the same build-up process that Western Skyways employs. The result is a dependable engine with an unparalleled warranty.

Most engine overhaul warranties are prorated after six months to one year at a usage of around 40 hours per month. In other words, if your TBO is 1,700 hours and you experience a problem after 24 months, the warranty is prorated at: (24 months x 40 hours per month) / 1,700 hours = 56%. The result is you are responsible for 56%, and the warranty only covers 44% of the repair costs, even if you've only flown a couple of hundred hours. Superior's new Millennium engine is not prorated, its warranty is for 100% of all parts and labor for five years or TBO (whichever comes first). Now that's a company that stands behind its product! The price of a Millennium engine is roughly the same as for a factory-remanufactured engine, despite the improved warranty. For the first two years after the Millennium engine's introduction, Western Skyways enjoyed the exclusive contract to build the engine.

On the Horizon

In addition to piston engine overhauls, the company is planning expansion into new markets in the next few months. Recently, Bonanza owners have been taking advantage of Western Skyways' STC for turbo-normalizing Continental IO-520 engines in S35, V35, and A36 models. In the next 90 days, expansion of the STC to the IO-550 engine will be complete, so IO-550-equipped Bonanzas can be turbo-normalized, or IO-520 engines can be upgraded to a turbo-normalized IO-550.

For decades, TSIO-520 engines from Cessna 402s operated by charter companies comprised a large part of Western Skyways' business. However, more and more operators are converting to turbine engines, and Western Skyways will be expanding to accommodate that need. With eleven years of experience at Pratt & Whitney, Tom Barry has joined Western Skyways to head up their new turbine engine shop. Starting in September, they will start servicing the venerable PT-6 engines, in use on Cheyennes, King Airs, Caravans, and Conquests, as well as the JT-15 engine in use on Citation Is and IIs. The new shop will be in the JetAway hangar adjacent to the Western Skyways piston engine facilities.

The company hosts fly-ins for groups of ten or more airplanes, and plans more in the future. For a recent World Beechcraft Society fly-in, Western Skyways provided the organization free use of their hangar, tours of the surrounding mountains, live music for events, and talks by Superior Air Parts personnel and fuel system experts. Fly-in organizers can make arrangements with David Leis.

Departure

After I departed Montrose, I climbed to cruise altitude and set course for home. The five-hour flight was trouble-free with everything in the green, so I had time to reflect on my experience. After my old engine had been disassembled, the mechanics showed me many of my old engine parts before they discarded them. I thought about the pistons and rings sitting in a trash heap back at the shop. Despite the fact that they looked fine to me and had given me years of service, exchanging them was the safest thing to do. I wondered where my old engine would end up after getting new cylinders. Maybe it would sit on the wing of a twin flying tourists around the Hawaiian Islands, or in the nose of a Cessna 185 flying hunters in Alaska, or in a cropduster doing low-level aerobatics under power lines. I hope the new owner has the same years of flawless operation I enjoyed out of my engine. ■

I chose Western Skyways based on the excellent experience with my last engine and the attention to detail shown at their facility. Prices vary widely, based on many factors. For a quote to overhaul your piston engine, contact Trent Tubbs or Eric Barker; for turbine quotes, contact David Leis, (970) 249-0232 or (800) 575-9929, www.westernskyways.com.

Above: Specialized equipment will soon help with quality turbine overhauls.
Below: Engines are first run in the company's test cell before delivery to a customer.