

**BREATHING LIFE BACK INTO A TIRED ENGINE, PART 2** p.26

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September 2021 • cessnaflyer.org

## THE PARADOX OF CHOICE: AIRPLANE EDITION

p.38



### Comment Strategy, Part 2

p.24

### Managing CHTs

p.18

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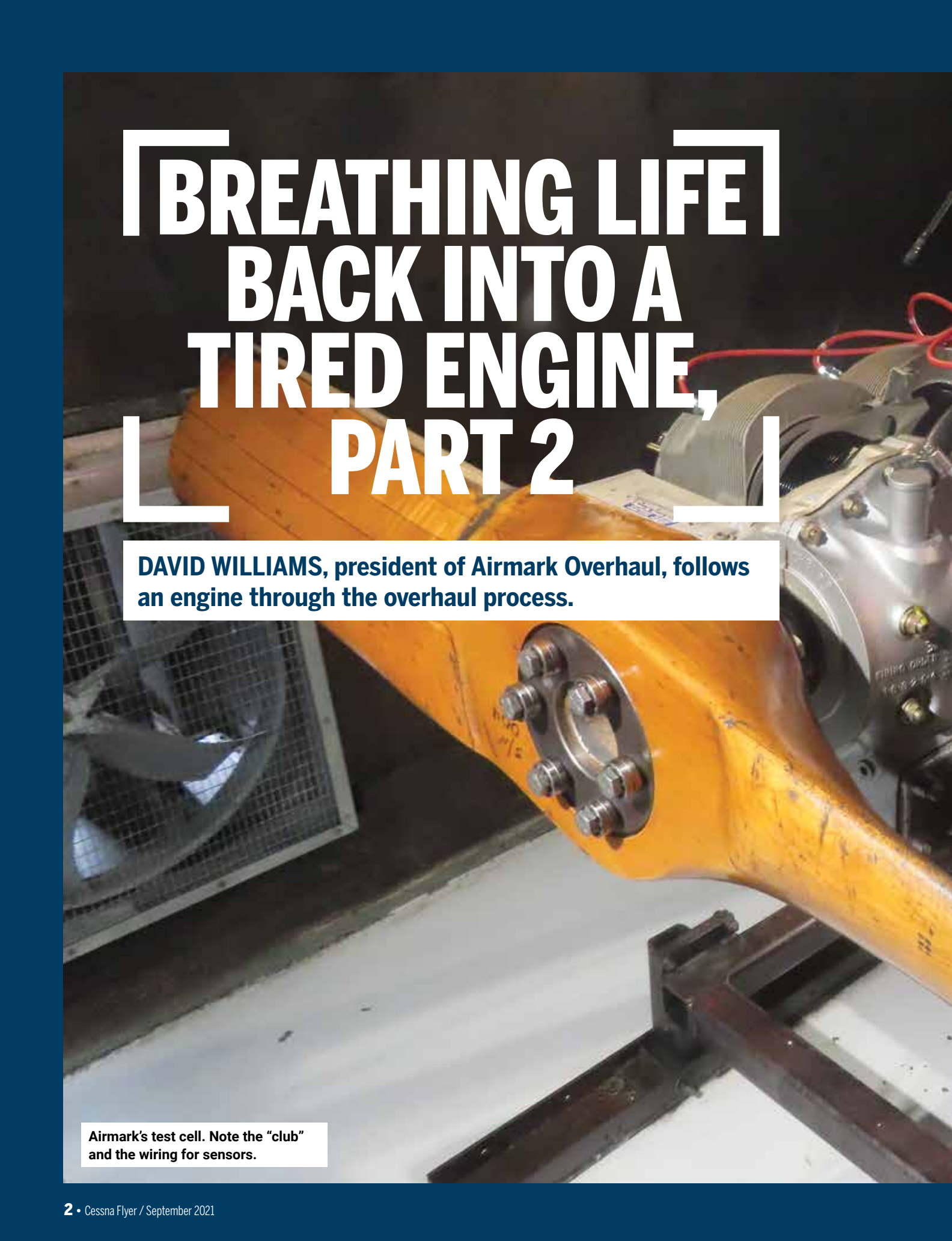
### Barometric Altimetry

p.48

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### Engine Preheating

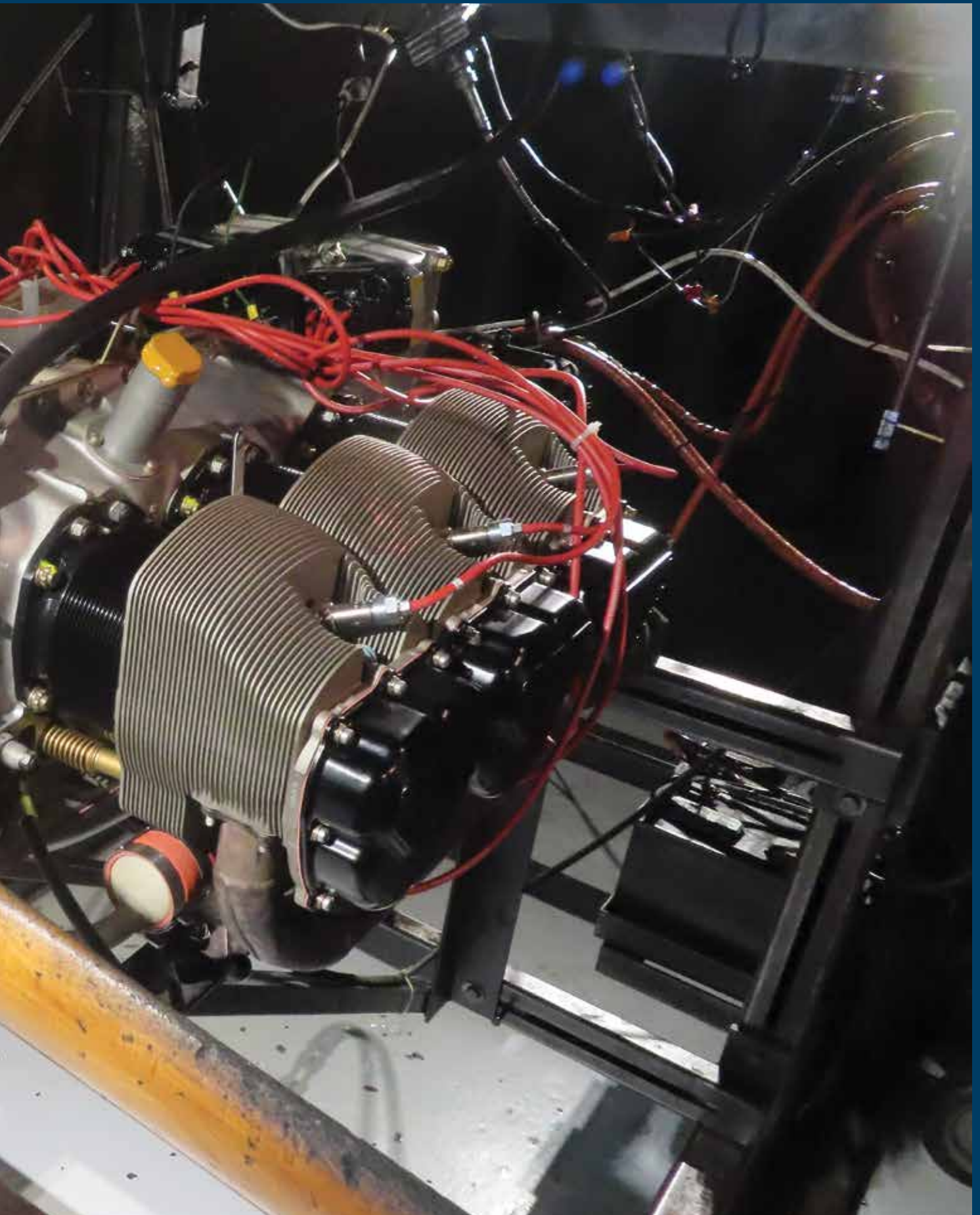
p.52



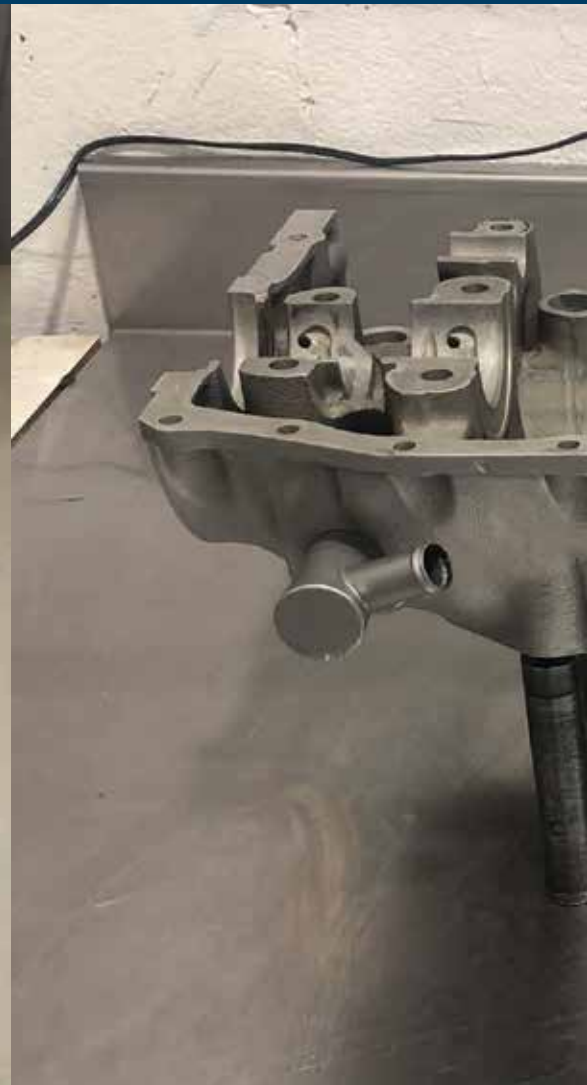
# BREATHING LIFE BACK INTO A TIRED ENGINE, PART 2

**DAVID WILLIAMS**, president of Airmark Overhaul, follows an engine through the overhaul process.

Airmark's test cell. Note the "club" and the wiring for sensors.



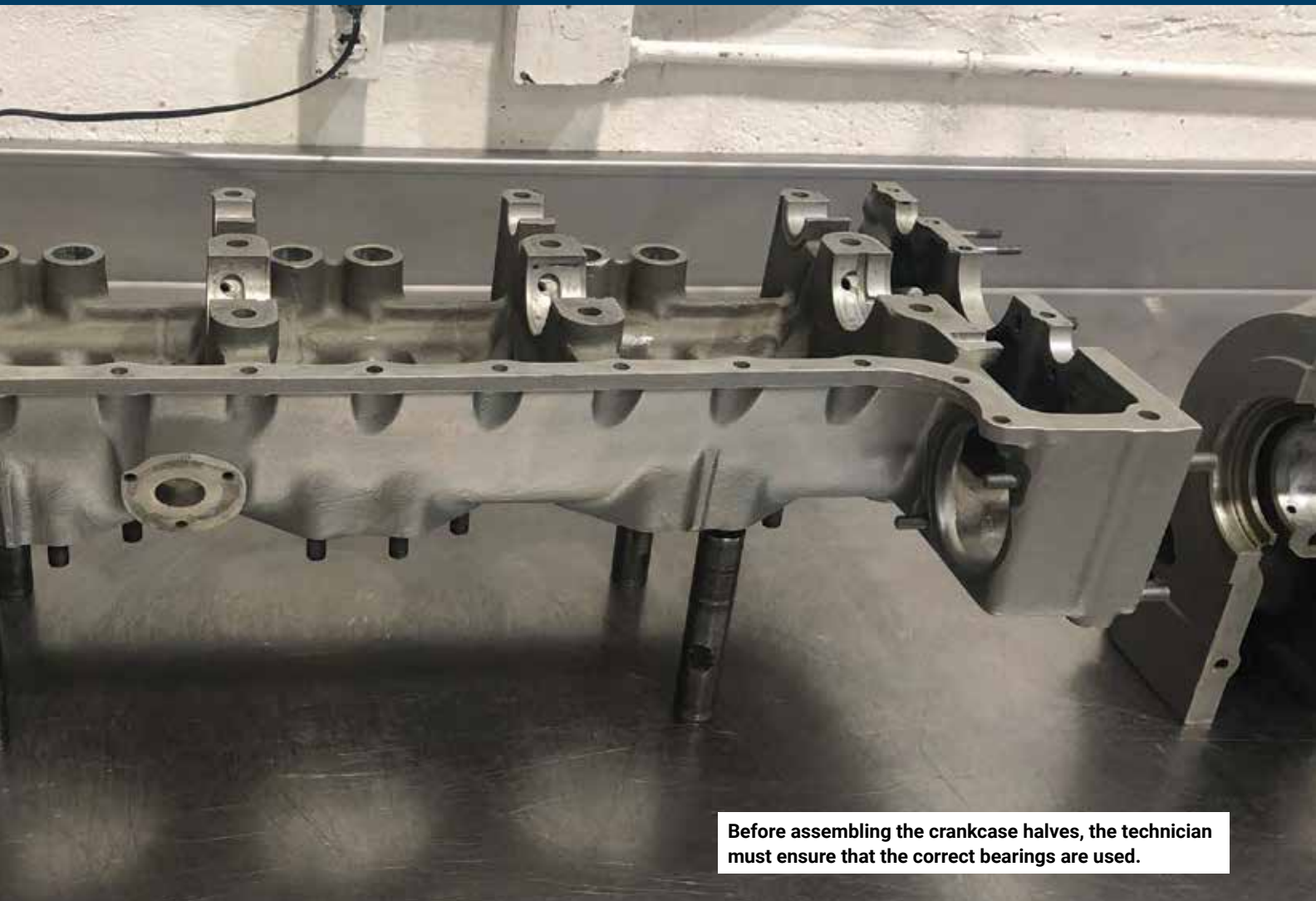
The crankshaft and counterweights are placed on the buildup stand.



Last month, I described the disassembly and inspection of Airmark client Sal Staiano's Continental O-470-L engine. Despite being some 800 hours over TBO, with the last overhaul in 1970, the engine's reusable components were in good shape. This month, I will detail the process of reassembling the engine, testing it, and returning it to the customer.

Like Picasso at his canvas, an Airmark technician assigned to the task must prepare for the assembly process. The parts and sub-assemblies are directed back to the master engine work order cart, where the technician's competent hands begin the creation and new life for Staiano's Continental O-470-L engine.

During assembly, the "one engine, one technician" philosophy comes into play. Unlike factory assembly lines, Airmark designates one technician as responsible for the product. He or she will painstakingly create a work of art, with pride and expertise.



Before assembling the crankcase halves, the technician must ensure that the correct bearings are used.

### Assembly process

The assembly process begins by placing the crankshaft and counterweights onto the buildup stand. These have already been magnetic particle inspected, ultrasonically inspected, polished, re-bushed, assembled, and dynamically balanced.

From there, the connecting rods are assembled and torqued to the crankshaft. The connecting rods have previously been magnetic particle inspected, checked for twist and bend, re-bushed, and statically balanced. The connecting rods must be re-bushed in accordance with Continental Critical Service Bulletin 07-01A to prevent failure of the parts.

The technician will then begin assembly of the crankcase. The crankcase has been cleaned, inspected with liquid penetrant, and painted. Special attention is given to the cleanliness of the oil galley.

The technician verifies that the bearings ordered comply with Continental Service Bulletin M97-5, which applies

to certain early engines with flanged bearings, like this O-470-L engine. Compliance with this bulletin is required to ensure that there is even loading of the thrust bearing, and to ensure that failure does not occur from breakage of the thrust face from the bearing.

Once the crankcase halves have been prepared, the crankshaft assembly is lowered into the crankcase half. Proper sealants and procedures must be followed in accordance with the Continental M-0 manual. It is very important to know where *not* to place string and sealants. Use of sealants in prohibited areas can cause loss of preload and lead to future problems, including failure of the engine.

A new camshaft, new camshaft gear, and a new crankshaft gear were needed for this particular installation. New through studs are inserted and the process of pulling the crankcase halves together begins. Continental requires new hardware to be installed and prohibits the use of cadmium-plated hardware.

**Unlike factory assembly lines, Airmark designates one technician as responsible for the product.**



**New cylinders from Superior Air Parts await installation.**

Once these steps are complete, the cylinders are prepped for installation. Staiano ordered new Superior Air Parts cylinders with matching piston weights. This is a very good choice, and not only for the performance of the cylinders. There is also a bonus of cost savings.

On the 470-series engines, there is about a \$1,600 savings from using Superior cylinders, compared to Continental OEM cylinders. Cost savings and improved performance is a winning combination.

Here at Airmark, we do not recommend overhauled cylinders, because if a facility overhauls the cylinders correctly, the cost to perform the overhaul to the cylinders comes close to the cost of the new Superior cylinders.

With overhauled cylinders, you have

exhaust port walls that have become thinner from erosion, and thus are more susceptible to cracking, setting up future problems.

Also, if a barrel plating process is accomplished, this can weaken the threads between the head and barrel. Installing overhauled cylinders is only a last-resort option, such as when there is an availability issue.

Airmark will verify that there is no leakage past the valves and seats, the ring gaps and ring alignment are properly maintained, and the pistons have the required skirt-to-barrel clearance. Special attention is given to the proper cylinder base nut torque patterns that are required to prevent future crankcase damage from cracking and fretting.

New lifter bodies are installed and

the proper bleed down inspection of lifters is accomplished to ensure proper dry tappet valve lash once the remaining valve train parts are assembled. The valve covers are then installed.

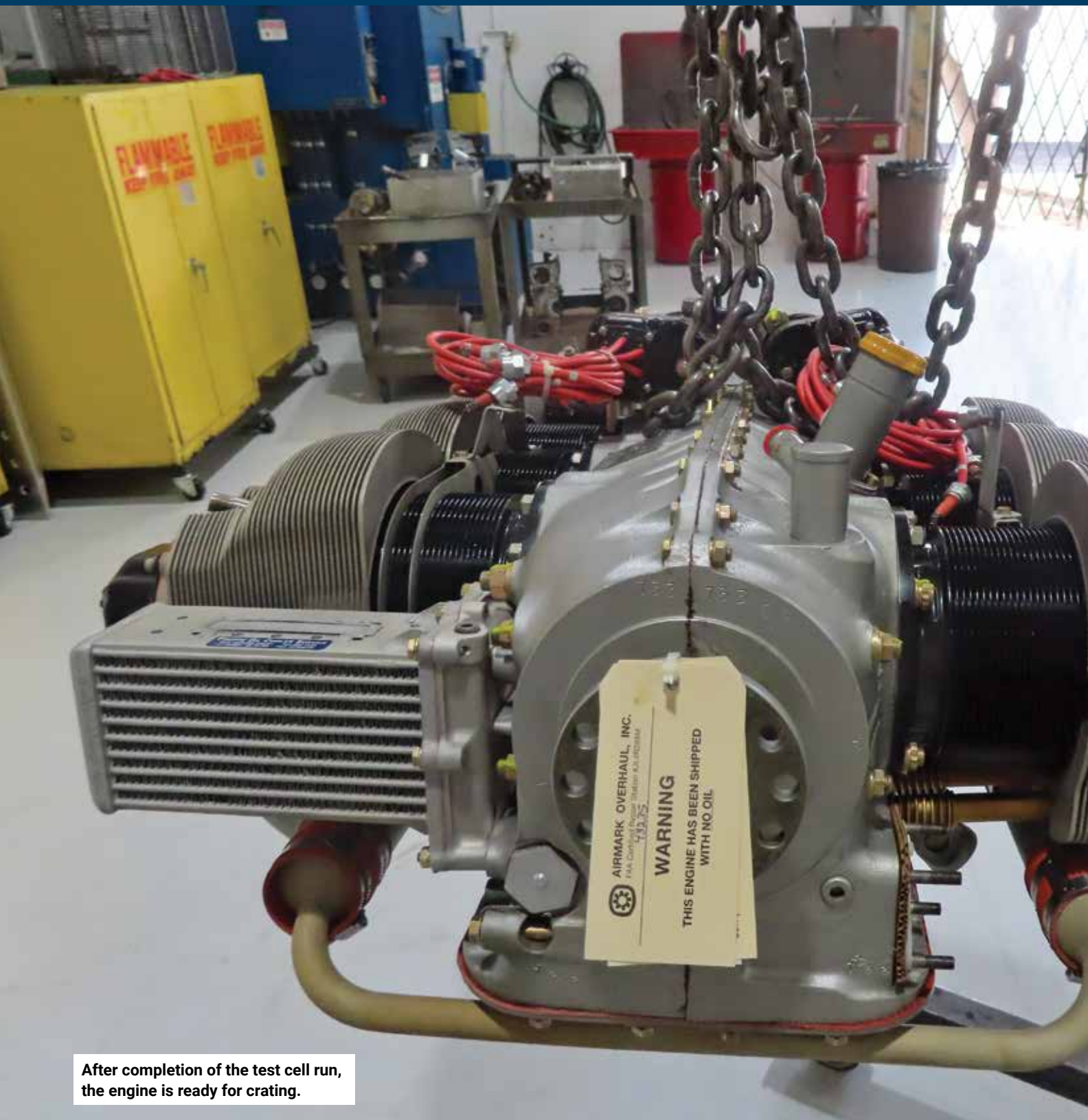
Now, the technician prepares for assembly of the intake system and accessories. This engine had Bendix/CMI magnetos, and these were sent to Airmark's accessory division. They were overhauled in-house by Airmark, and both magnetos were converted to the new-style short-cover configuration.

### **Stress test**

When the engine is directed to the test cell, it always reminds me of the doctor ordering a stress test. The engine, just like our bodies during a stress test, is put through the rigors



The engine on the buildup stand, before installation of accessories.



After completion of the test cell run, the engine is ready for crating.

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of endurance, strength, and ability to maintain performance. The diagnostic test cell creates a final testament to a product the customer can enjoy and be proud of for years to come.

During the test run, engine parameters are verified with calibrated gauges. Power is verified with a calibrated test club which absorbs the horsepower at a certain rate, while providing cooling air over the engine. Cooling shrouds are lowered into place for optimal airflow across the engine.

Airmark's test cell is equipped with a fuel flow meter, oil and fuel pressure gauges, individual cylinder head temperature probes, and an RPM meter.

The engine's oil filters and screens are inspected for contamination to determine that the engine is operating properly and has no metal contamination present. The oil consumption is determined by an oil consumption run, which involves weighing the oil going through the engine versus the oil weight once removed.

This O-470-L engine performed flawlessly, as it was taken through the manufacturer's prescribed run times and regimens.

» *Continued on Page 36*

# Major Overhaul: An Owner's Perspective

**By CFA Member Sal Staiano**

Our 63-year-old engine's first overhaul was done in 1970 at 1,087 hours.

In the 40 years since that first overhaul, the engine accumulated another 2,314 hours; 814 hours past TBO. It was finally time for another overhaul.

A strange phenomenon with this engine is that it has never used oil! I changed the oil every 20 hours, and in 15 years never had to add a quart in between oil changes. However, for the last month it was in the airplane, 2 quarts of oil had to be added. This was a change that prompted our decision to have the engine overhauled.

The engine had taken us throughout the Northeast U.S., on 15 trips to Oshkosh, and as far west as Colorado. It was still running well, but with plans for multiple cross-country trips, it was time. Since COVID-19 had restricted a lot of our flying, it made sense to do the overhaul now.

The removal and installation was done by Stateline Aviation at Alexandria Airport (N85), in Pittstown, New Jersey. Brent Kowalenko A&P/IA, along with A&P mechanics John Carvino and Ashley Holcombe, performed the work.

After removal of the engine, we found the engine mount had a crack, and the tubes that pass by the exhaust were badly pitted. The engine mount was sent to Aerospace Welding for overhaul and powder coating.

The prop governor was sent to Sensenich Propeller. The prop had been overhauled 120 hours previously, so that was left alone. The vacuum pump was sent to Accessories Inc. of Wichita to be overhauled.

The old baffles were in bad shape after 63 years of use, so it was decided rather than try to repair them, they were replaced with new Airforms baffles.

The overhaul of the engine was done by Airmark Overhaul Inc. This included Superior Air Parts Millennium cylinders, new cam, lifters, and gearing. The carburetor, starter oil cooler, and magnetos were overhauled. David Williams and the staff of Airmark were very responsive and answered any and all questions I had throughout the process. On completion, they provided details on all parts and operations performed.



Careful crating ensures that the engine and accessories will be received undamaged and ready for installation.

As part of the engine overhaul, I decided to install a new Insight G2 engine analyzer to replace my old Insight unit, so I could better monitor the progress and operation of the new overhaul. Reiff band and pan heaters were also installed to better preheat the engine during the winter.

On startup of the newly overhauled engine, the starter barely turned the engine over. As it turns out, the old wiring from the battery behind the baggage compartment that runs to the starter was not adequate. It was aluminum and undersized, and was now not capable of supplying sufficient amperage for starting. The wiring was replaced and the problem was solved.

Some leakage was observed from the prop. It turned out to be a bad O-ring that seals the prop where it is bolted to the crankshaft. Once that was replaced, the leak stopped.

The final step in the overhaul process is engine break-in. Using mineral oil, the engine will be flown as per Airmark's recommended break-in procedure for the next 25 hours. Once oil consumption has stabilized and cylinder temperatures are in the normal range, Continental's recommended oils can be used.

**INSIGHT INSTRUMENT CORP.**

[insightavionics.com](http://insightavionics.com)

**SUPERIOR AIR PARTS**

[superiorairparts.com](http://superiorairparts.com)

**OTHER**

**ACCESSORIES INC. OF WICHITA**

[accessories-inc.com](http://accessories-inc.com)

**AEROSPACE WELDING MINNEAPOLIS**

[awi-ami.com](http://awi-ami.com)

**REIFF PREHEAT SYSTEMS**

[reiffpreheat.com](http://reiffpreheat.com)

**SENENICH PROPELLERS**

[sensenich.com](http://sensenich.com)

**STATE LINE AVIATION LLC**

[alexandriafield.com/maintenance\\_shop](http://alexandriafield.com/maintenance_shop)

**RESOURCES**

**CFA SUPPORTERS**

**AIRFORMS INC.**

[airforms.biz](http://airforms.biz)



## » Continued from Page 34

After the testing is completed, the cylinders are checked again for proper compressions and any unusual oil deposits on the spark plugs. The propeller governor circuit is verified with a bleed down check to ensure proper propeller operation.

### Final preparation for delivery

Once the engine is removed from the test cell, it is readied for delivery. All final safety wire of required items is completed. Proper plugs are utilized to prevent external contamination from entering the engine from exposed openings. The engine is then secured into a shipping crate to avoid damage during shipment. All loose parts are separately boxed and padded as necessary.


Staiano received a new logbook, with his old logbook returned. He also received a work order packet consisting of 41 pages, detailing all the work accomplished by Airmark to his engine, including a list of Airworthiness Directive and Service Bulletin compliance.

FAA Approved Repair Facilities like Airmark are meticulous with checklists

and recordkeeping for a reason. In order to earn and keep our FAA approval, we are under continual monitoring. We are required to have properly trained technicians, correct and up-to-date manuals, calibrated assembly tools and testing equipment, parts traceability, a quality control program verifying the work, a drug and alcohol program, and proper facilities and lighting for the work to be accomplished.

Put all this together and it seems clear to me that facilities such as Airmark are the right choice for your engine overhaul and will provide the peace of mind you deserve with every flight.

We followed up with Mr. Staiano to be sure all went well with the engine installation and that he was completely satisfied with the performance and operation of the engine. I am proud to say that we have another happy Airmark customer. All of us at Airmark wish Sal Staiano blue skies and tailwinds!

 **DAVID WILLIAMS**, president of Airmark Overhaul Inc., is an A&P mechanic and has been involved in the General Aviation industry for over 35

years. He began working at AeroCraft Accessories Inc. as an accessory technician. AeroCraft was combined with Airmark Engines Inc., where he worked as an engine mechanic and managed the facility. The combination of the two companies created what is now called Airmark Overhaul Inc., a full-service engine overhaul and repair facility with powerplant, accessory, and NDT capabilities. When not at his passion he calls work, he enjoys spending time with his wife and fishing the South Florida saltwater. Send questions or comments to [editor@cessnaflyer.org](mailto:editor@cessnaflyer.org).

## RESOURCES

### CFA SUPPORTERS

**AIRMARK OVERHAUL INC.**  
[airmarkoverhaul.com](http://airmarkoverhaul.com)

**CONTINENTAL AEROSPACE TECHNOLOGIES**  
[continental.aero](http://continental.aero)

**SUPERIOR AIR PARTS**  
[superiorairparts.com](http://superiorairparts.com)

