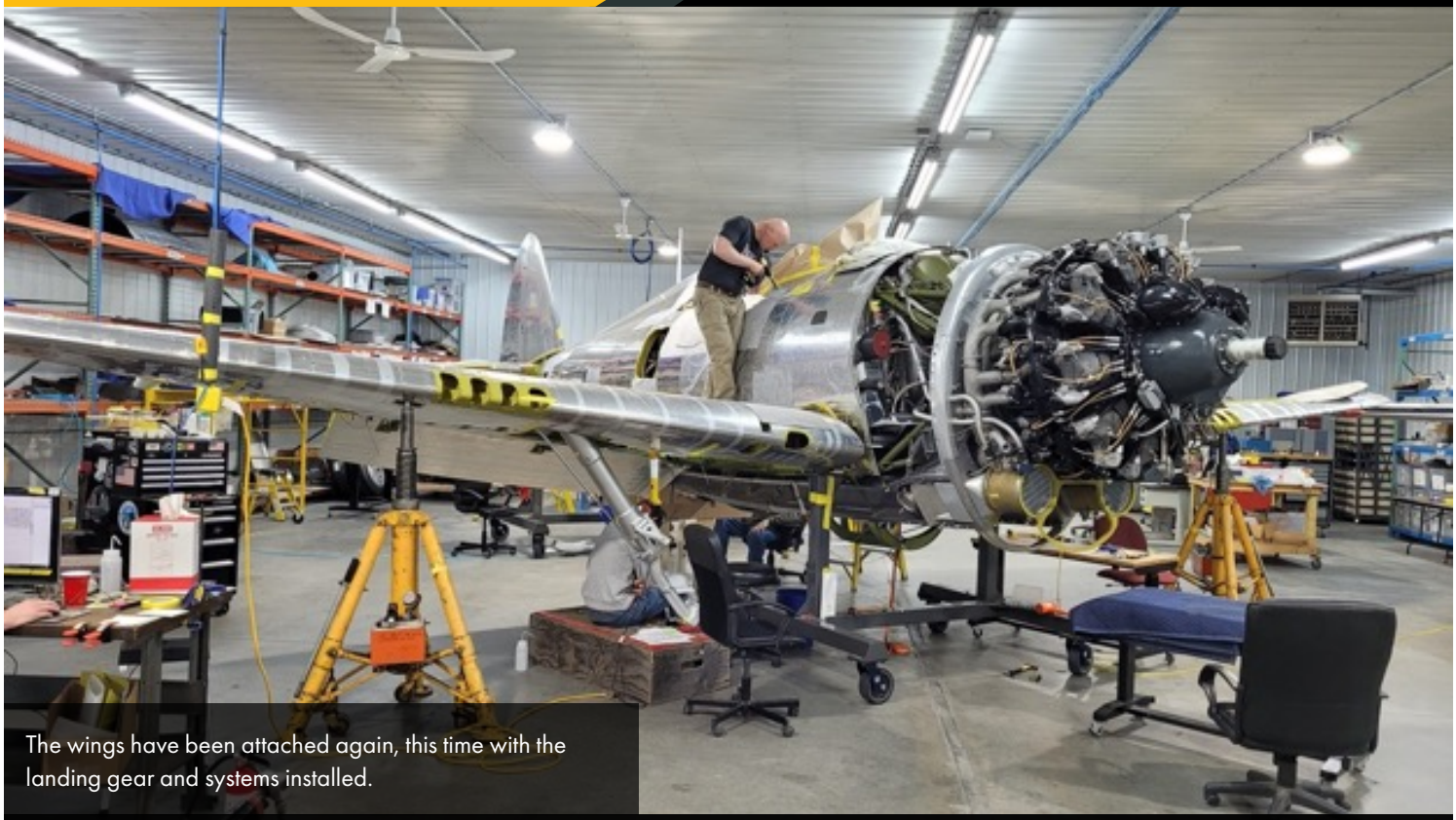
APRIL/MAY

Dakota Territory Air Museum's P-47 Update

by Chuck Cravens

AIRCORPS AVIATION



The wings have been attached again, this time with the landing gear and systems installed.

DAKOTA TERRITORY AIR MUSEUM

www.dakotaterritoryairmuseum.com

Update

The flaps, elevators, cowling, and wingtips were areas of restoration progress this month. The fuselage work was concentrated on the cockpit, where the pilot's seat has been installed, and on finishing the turbosupercharger ducting. The wings were attached near the end of the month. We will also examine some of the 'teething problems'' the early P-47s experienced as they were introduced to combat.

Fuel Gauge

Work continues on the fuel level sender and fuel gauge.

The fuel gauge reads both main and auxiliary tank fuel levels.

Elevator and Flaps

Work on the final control surfaces to be restored continues, but is nearing completion.

Brad works on the elevator.

With the installation of the trim tab, the elevator is essentially complete.

Flaps

Driving rivets in tight places, like the trailing edges of control surfaces, requires some ingenuity and special tooling.

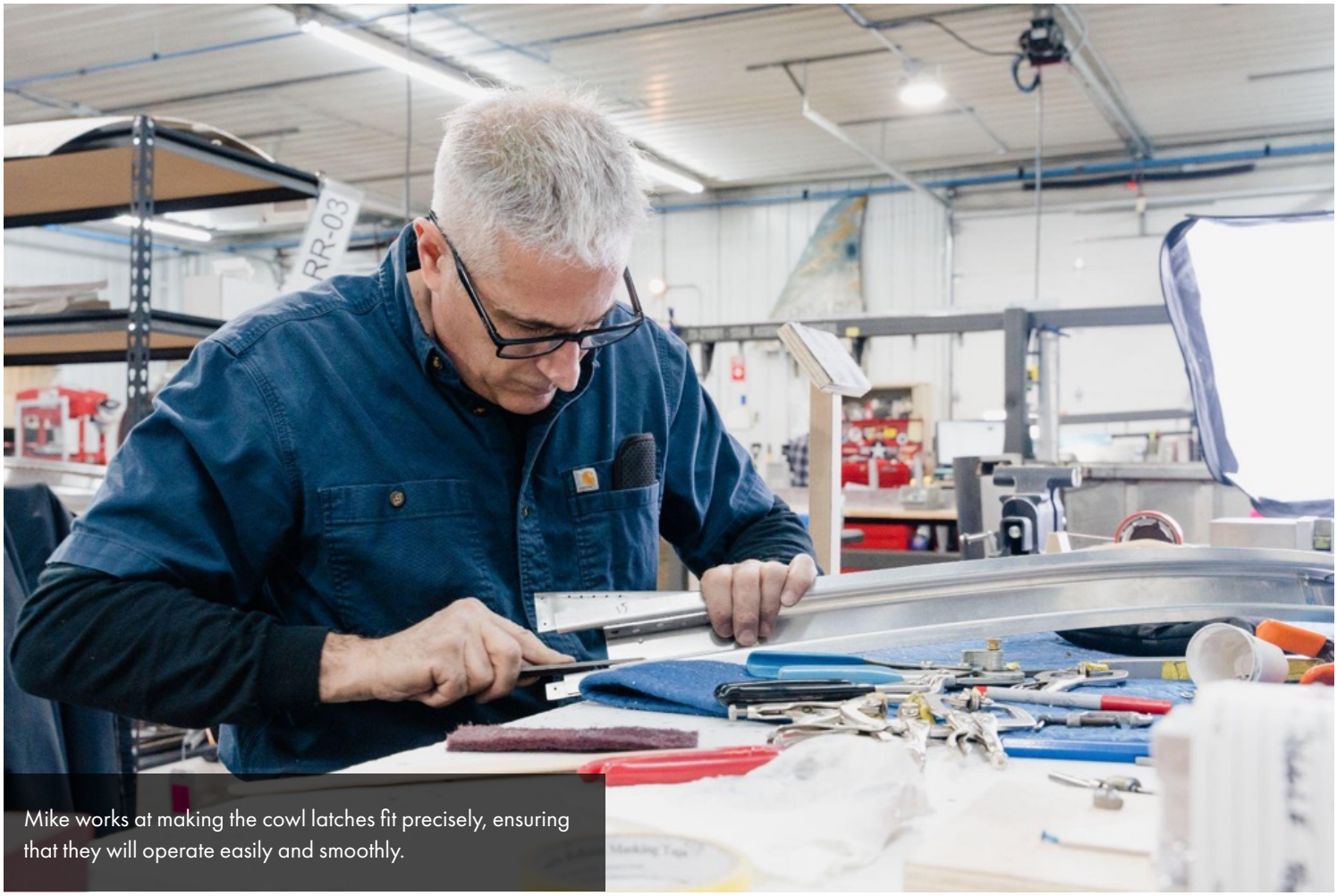
This is a special bucking bar the guys made to get into the tight spaces at the trailing edge between the flap skins.

Here Cory has the bucking bar inserted between the skins as Randy drives a rivet.

In tight spaces like these' teamwork is essential in driving these difficult rivets.

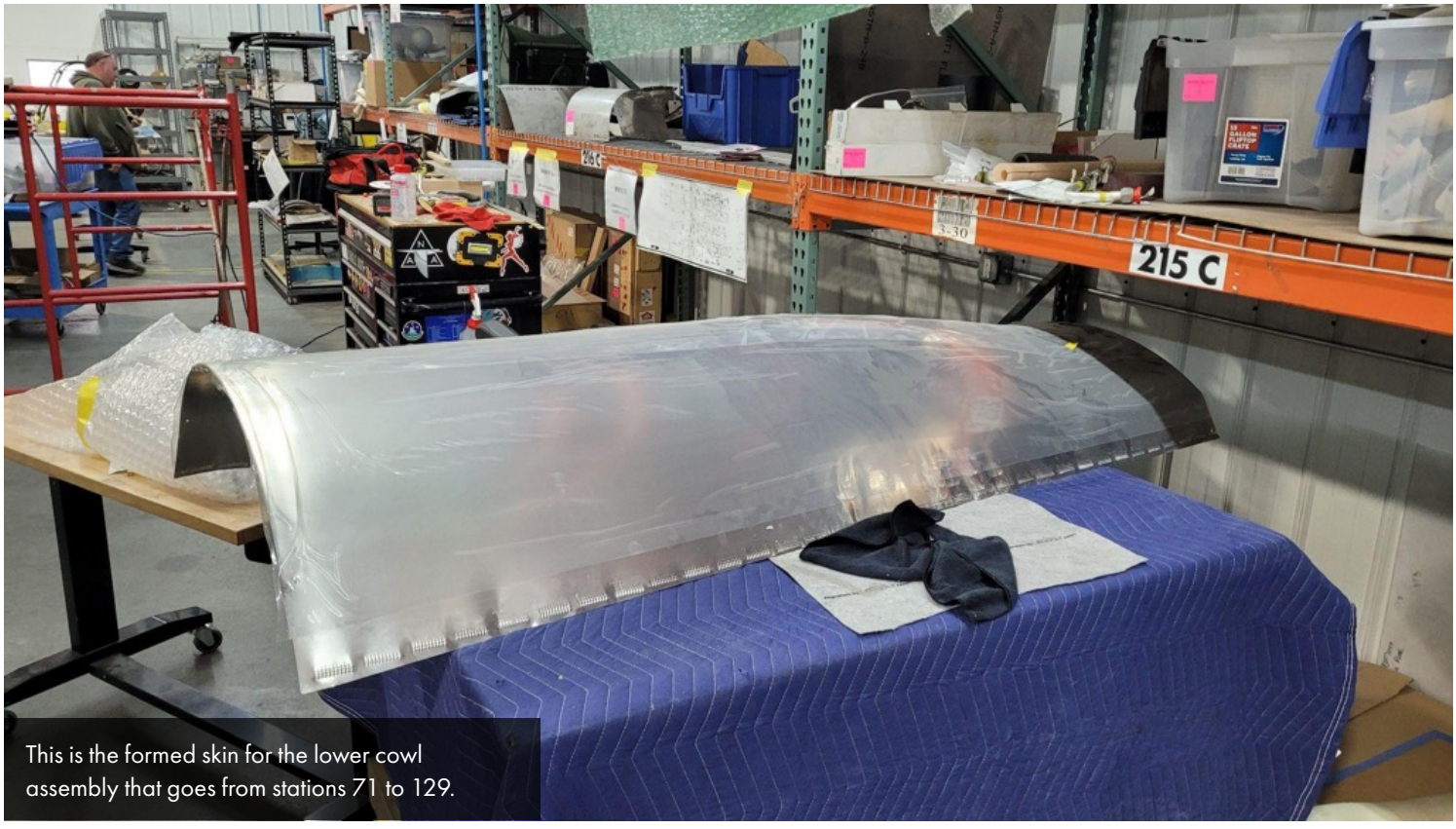
Cowl

Mike continues fabrication work on the cowl for the P-47. It is a precision task to be sure all the latches work smoothly and securely.



Mike works at making the cowl latches fit precisely, ensuring that they will operate easily and smoothly.

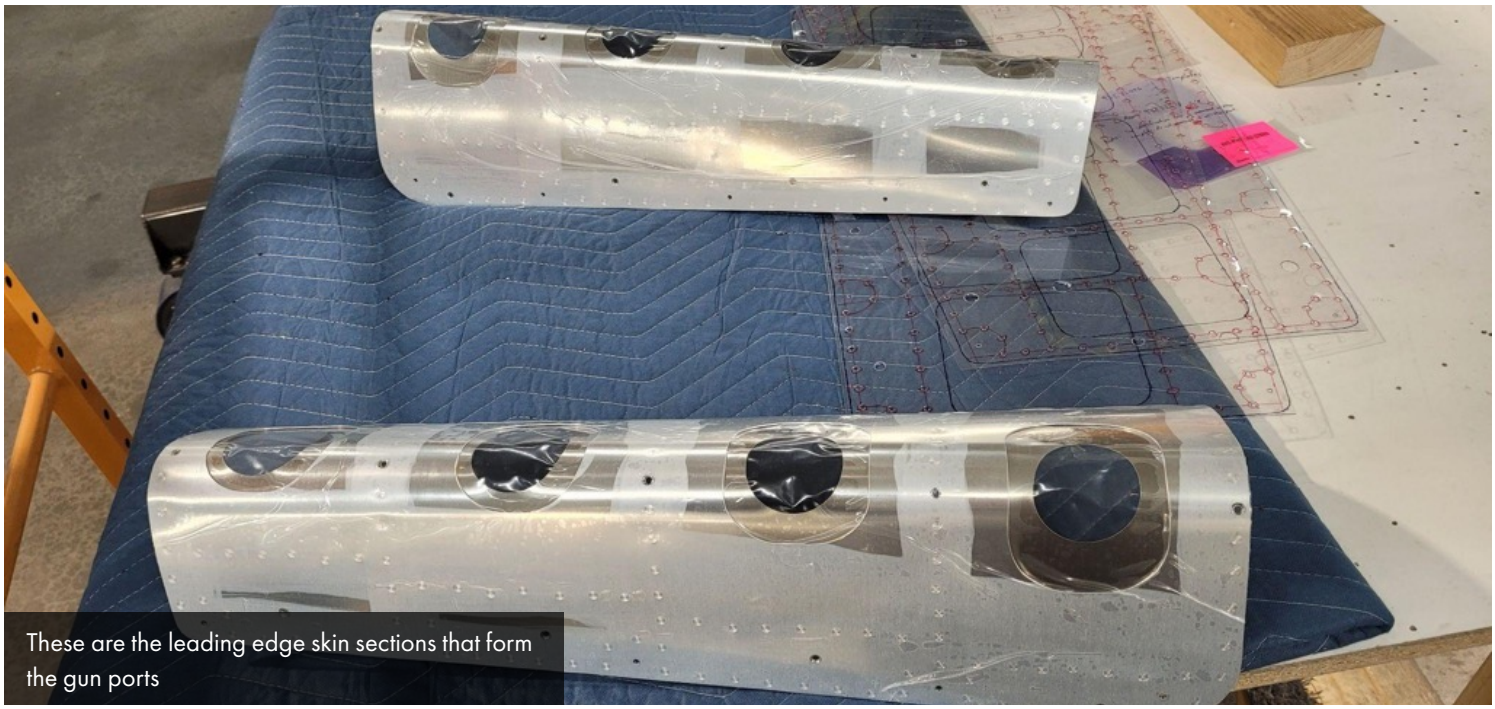
It takes a great deal of handwork to fit the cowl latches.



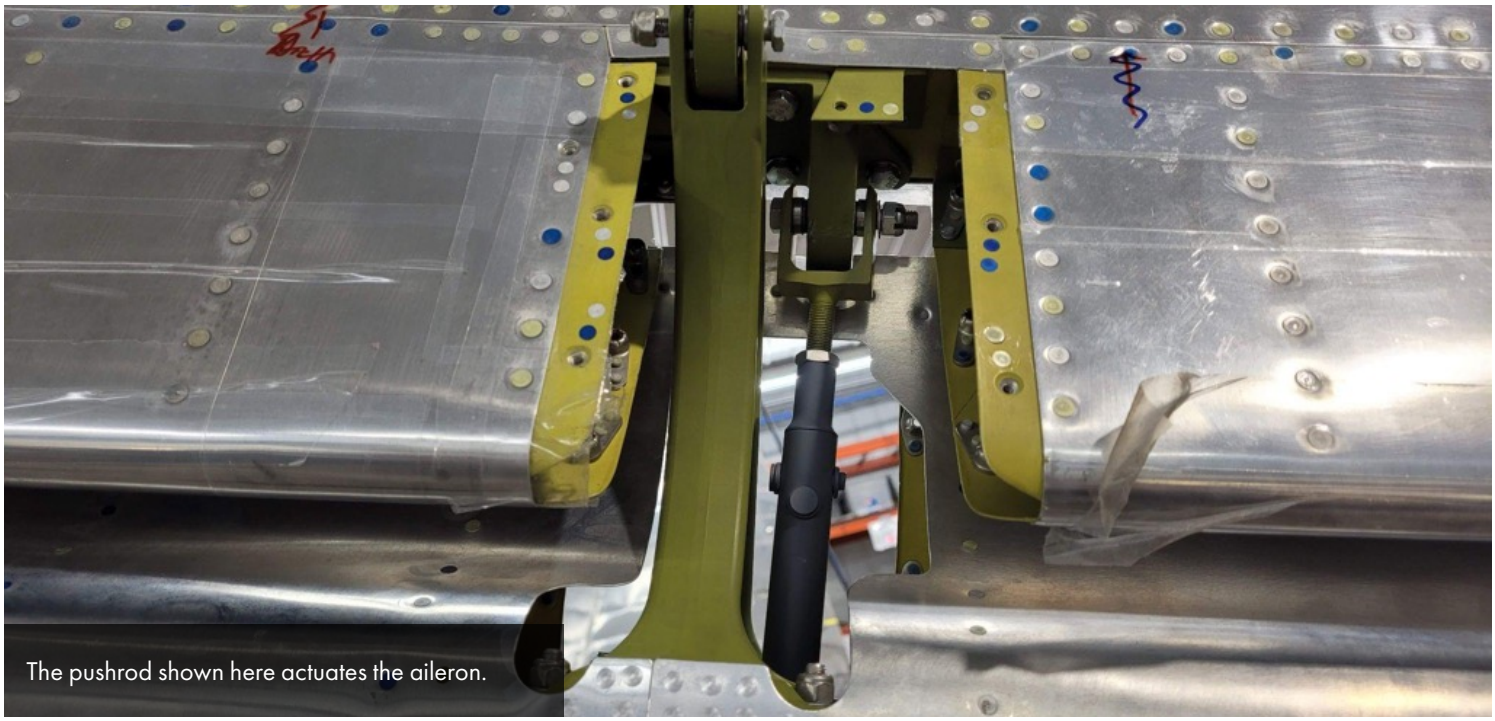
This is the formed skin for the lower cowl assembly that goes from stations 71 to 129.

Wings

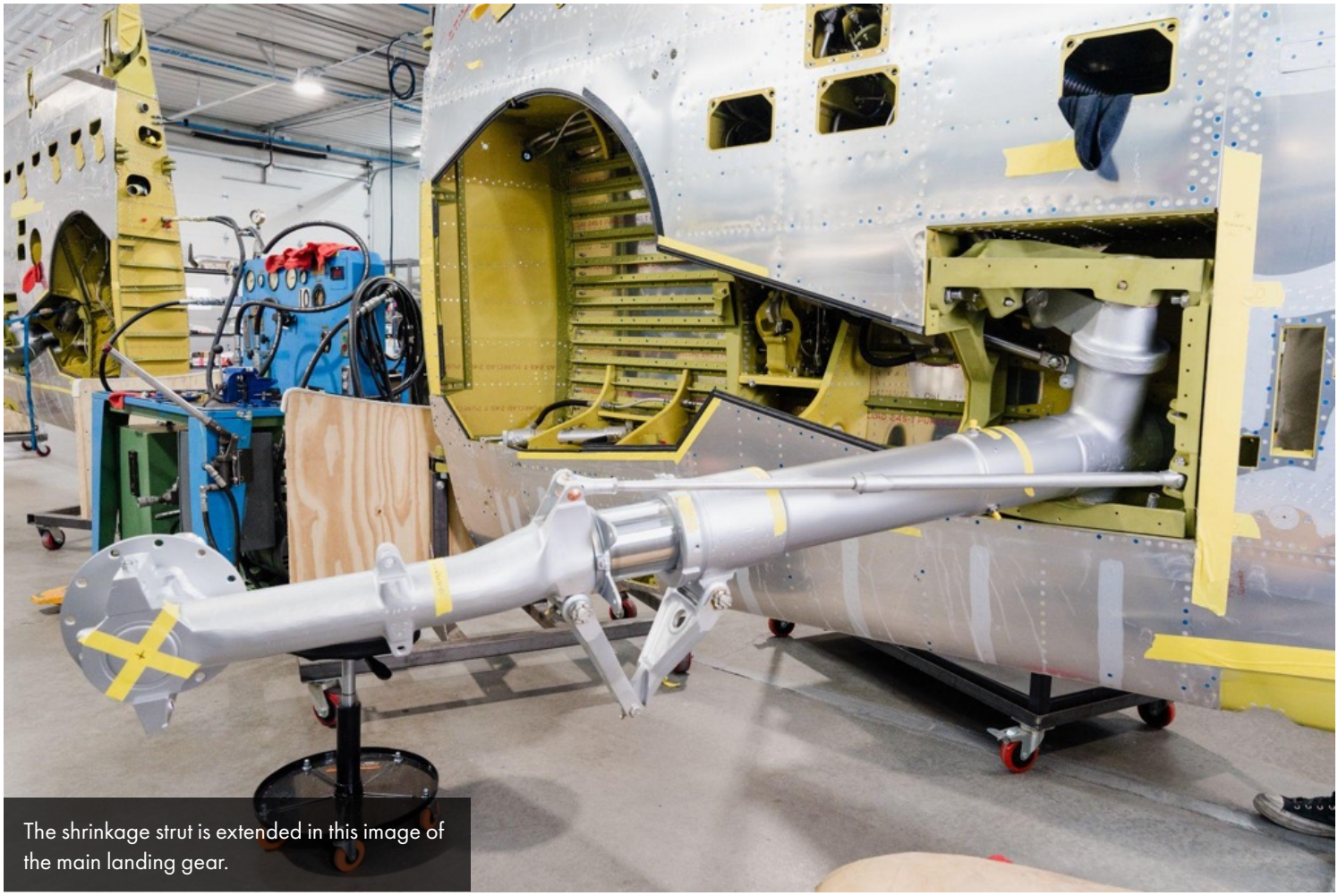
The wing work this month concentrated on finishing up the gun bays and installing the wingtips. The wings were attached to the fuselage, complete with the landing gear, hydraulics, and electrical systems.



These are the leading edge skin sections that form the gun ports



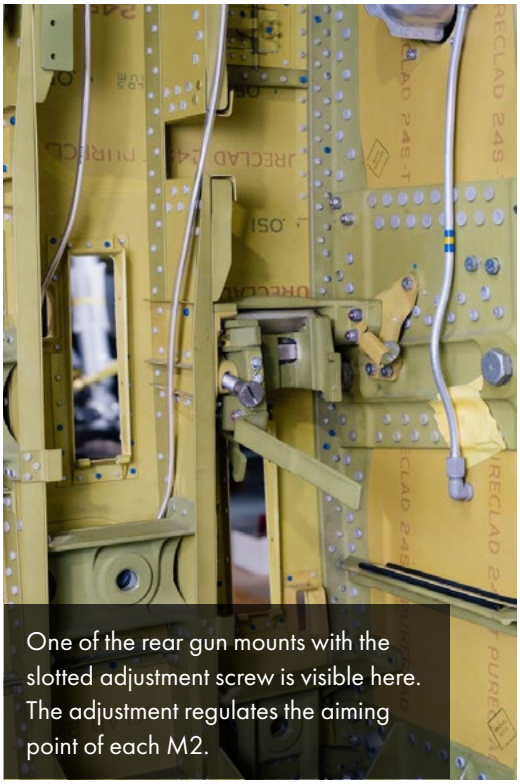
The pushrod shown here actuates the aileron.



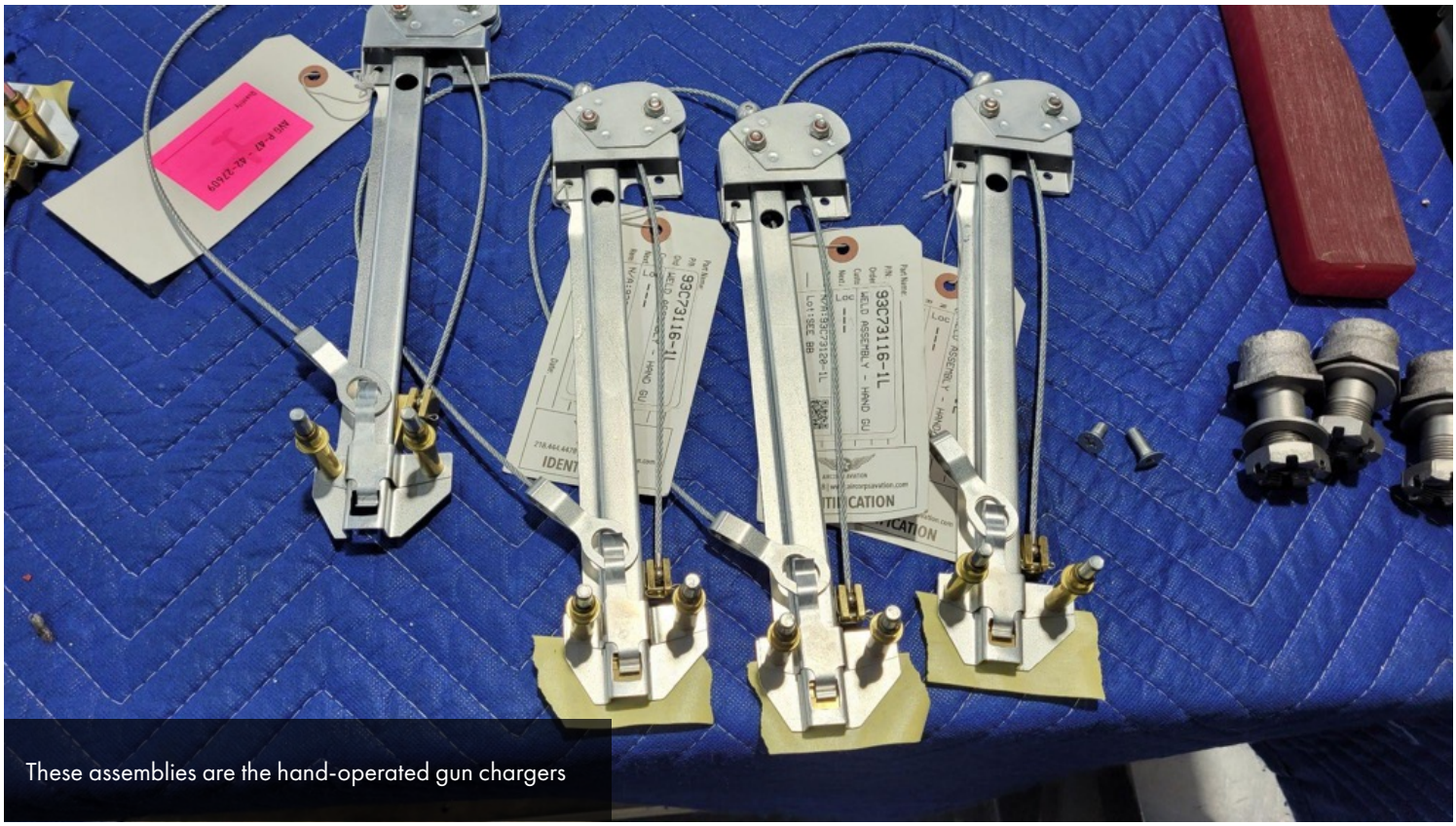
The shrinkage strut is extended in this image of the main landing gear.

Brad and Theo rivet the edge of the ammunition boxes.

The wiring for the gun firing solenoids is visible in this photo.



One of the rear gun mounts with the slotted adjustment screw is visible here. The adjustment regulates the aiming point of each M2.

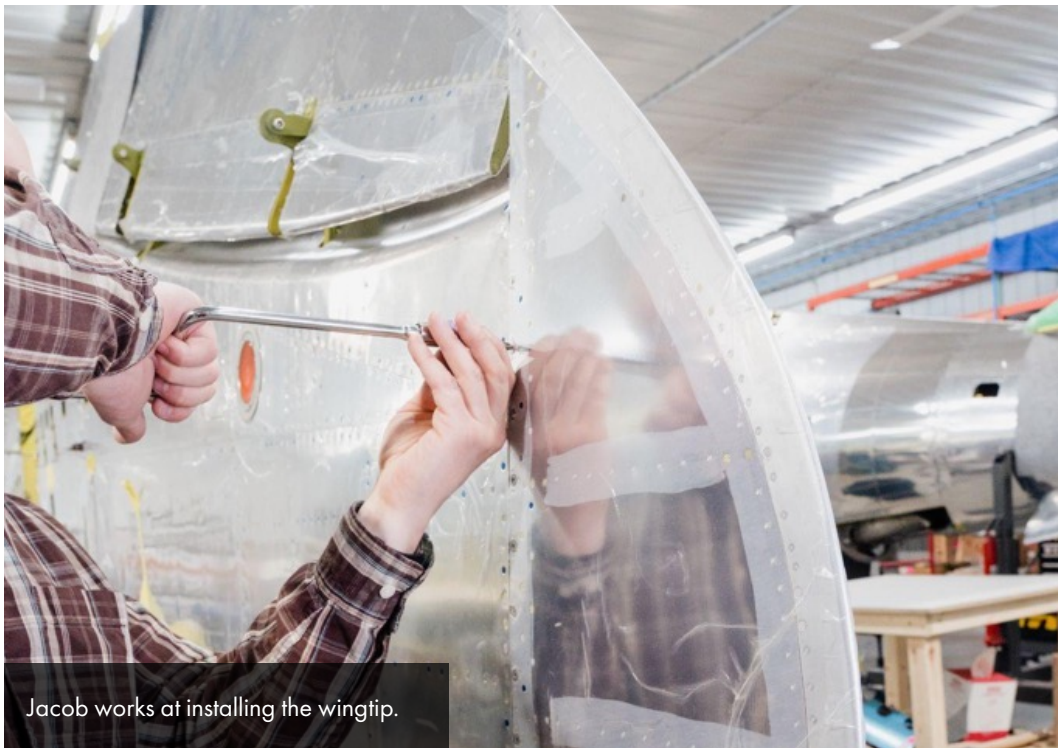


These assemblies are the hand-operated gun chargers

Here is a detailed view of the hand gun chargers.

Wingtips

Jacob installed the completed wingtips this month.



Jacob works at installing the wingtip.

The wingtip is secured by screws.

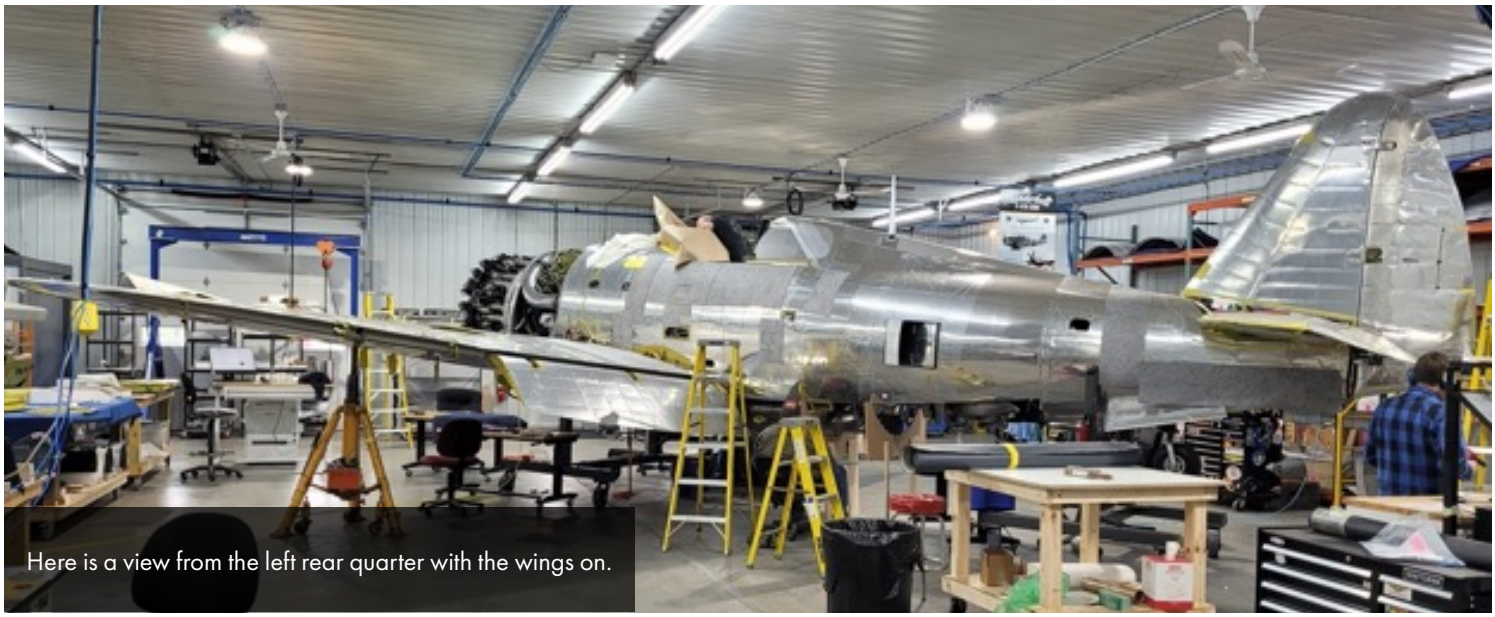
The wingtip light and formed plastic cover are installed in the right wing.

Here is how the wingtip light looks from a bit farther away.

The wings are back on!

Mark and Aaron are working on the wing.

This is a side view with the wings attached.

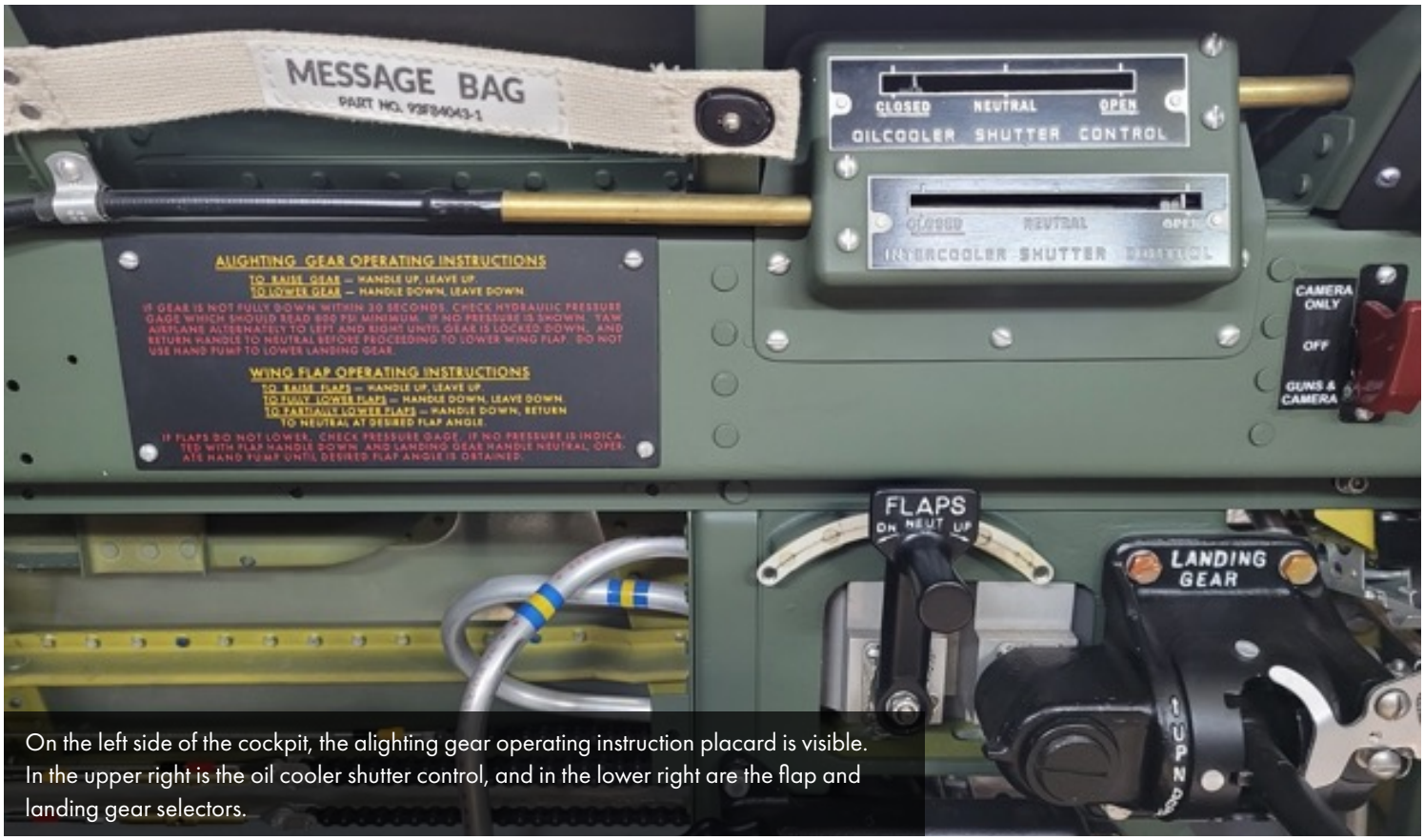


Here is a view from the left rear quarter with the wings on.

Fuselage

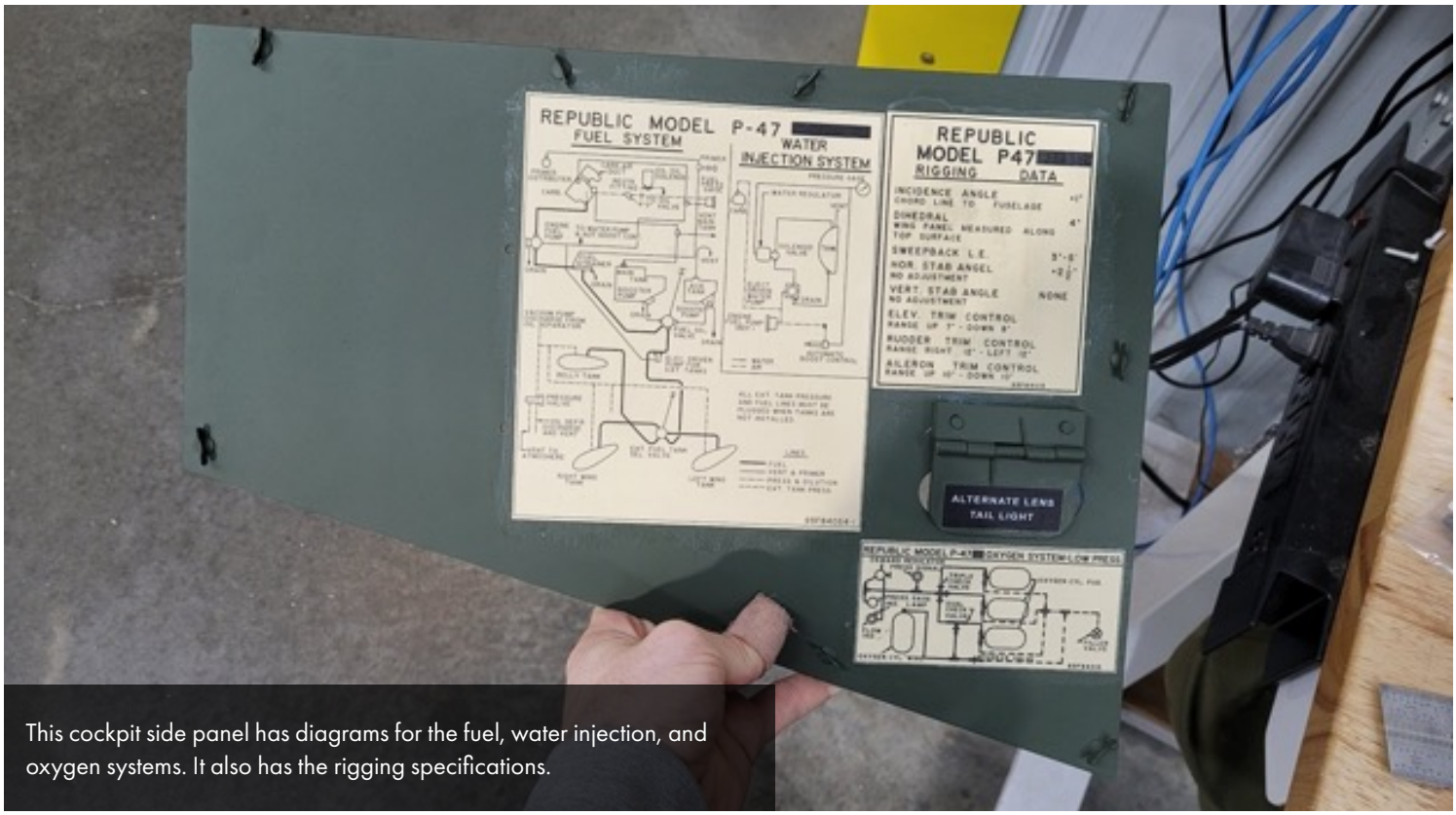
Aaron spent a great deal of time working inside the cockpit, and both Mark and Aaron worked on the supercharger ducting and the oil system.

Here is a nice shot of the instrument panel.



On the left side of the cockpit, the alighting gear operating instruction placard is visible. In the upper right is the oil cooler shutter control, and in the lower right are the flap and landing gear selectors.

This is the right side of the cockpit showing the primer (upper left) and, moving to the right, the round oxygen regulator, and the transmitter control box. The box with three circular controls with knobs in each is the radio control box, and the lever with a knob in the lower left-center is the tail wheel lock.



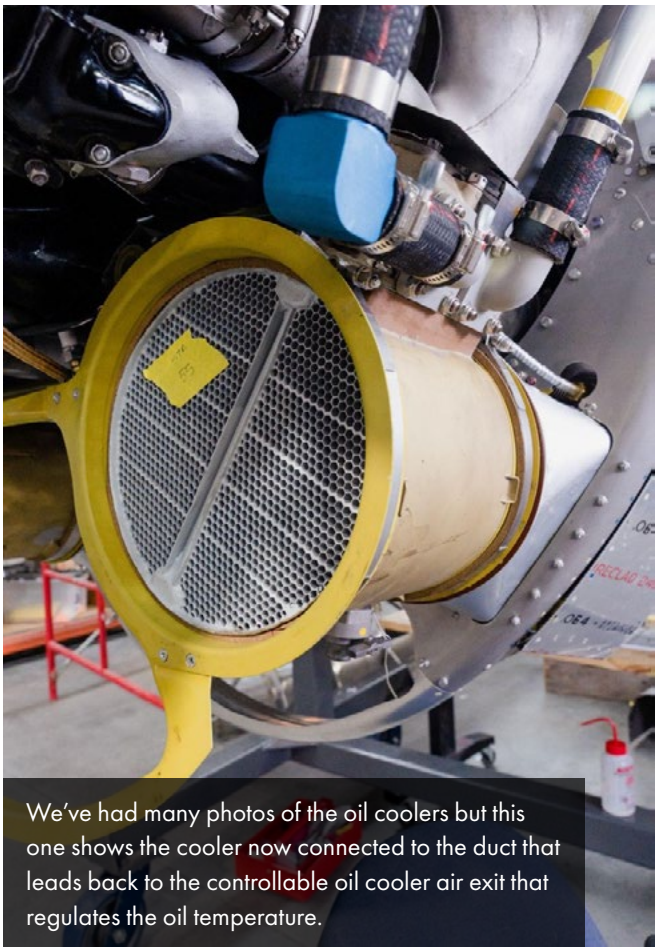
This cockpit side panel has diagrams for the fuel, water injection, and oxygen systems. It also has the rigging specifications.

In the center of this photo, behind the pedals, are the two yellow-painted brake cylinders and their linkage.

The pilot's seat has been installed along with the shoulder harness.

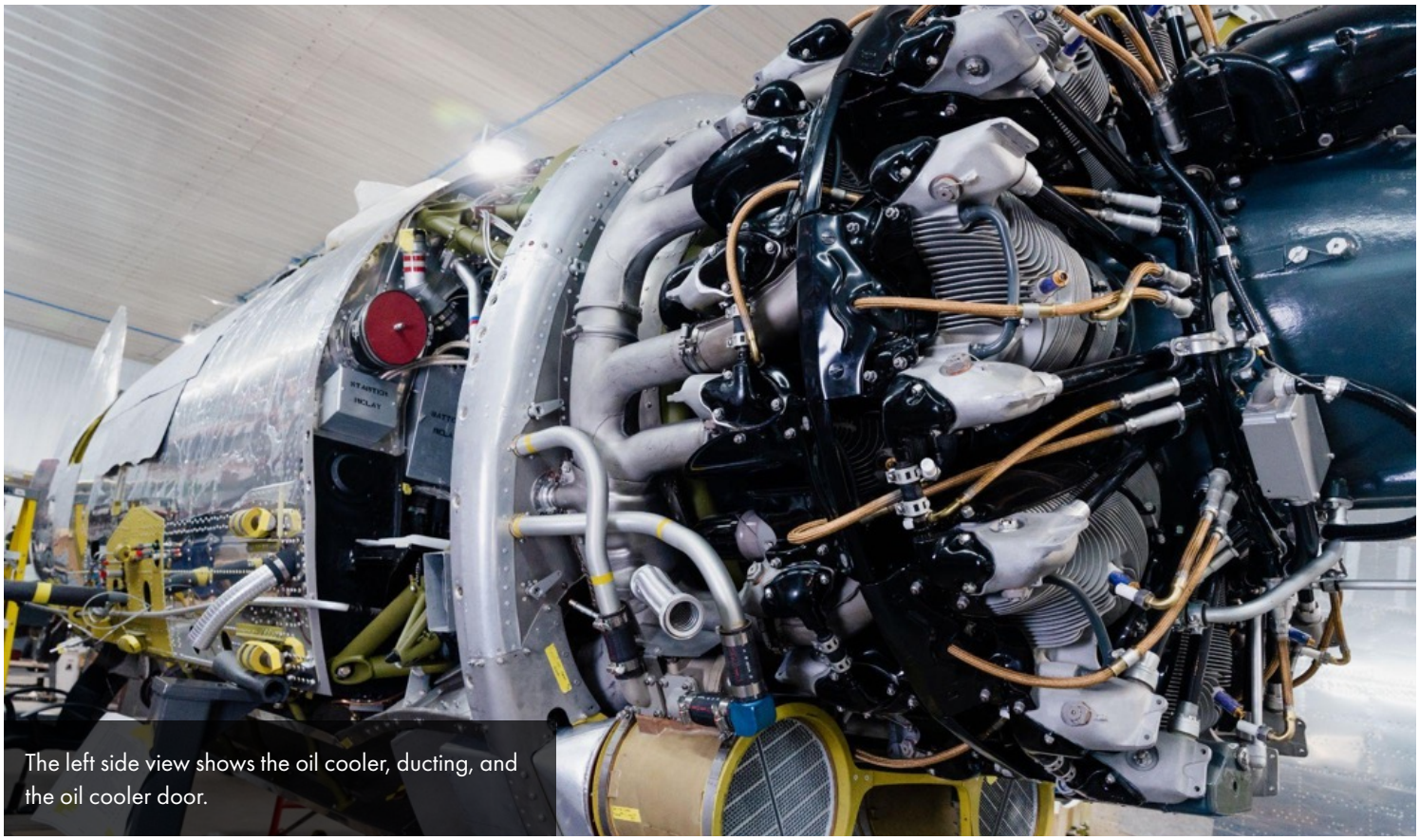
The small screens installed in the raised panel control the comm. radios (left) and the transponder (right). These are modern additions to meet the challenges of safe airspace operations.

Here the headrest is in place on the armor plate behind the pilot seat.

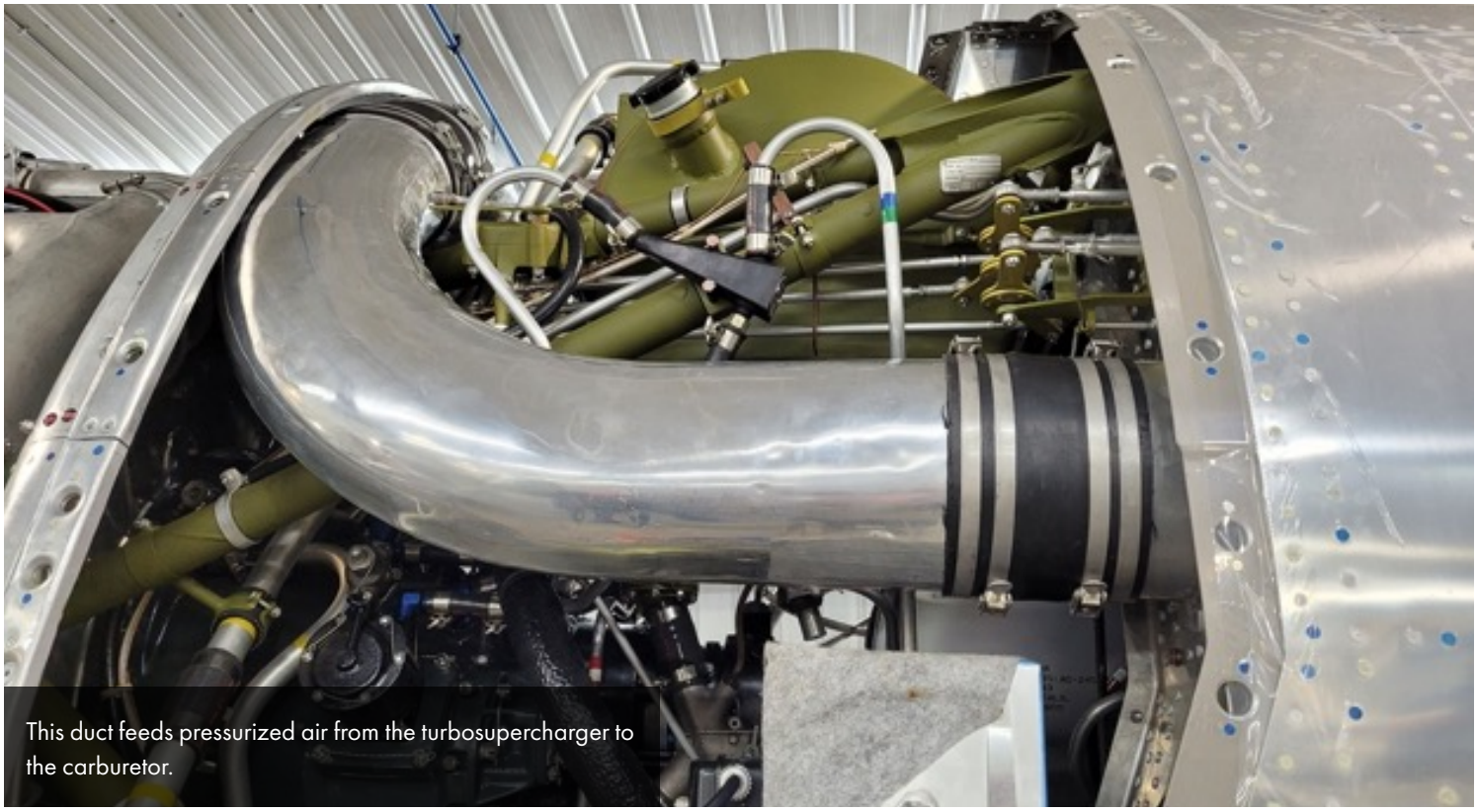


We've had many photos of the oil coolers but this one shows the cooler now connected to the duct that leads back to the controllable oil cooler air exit that regulates the oil temperature.

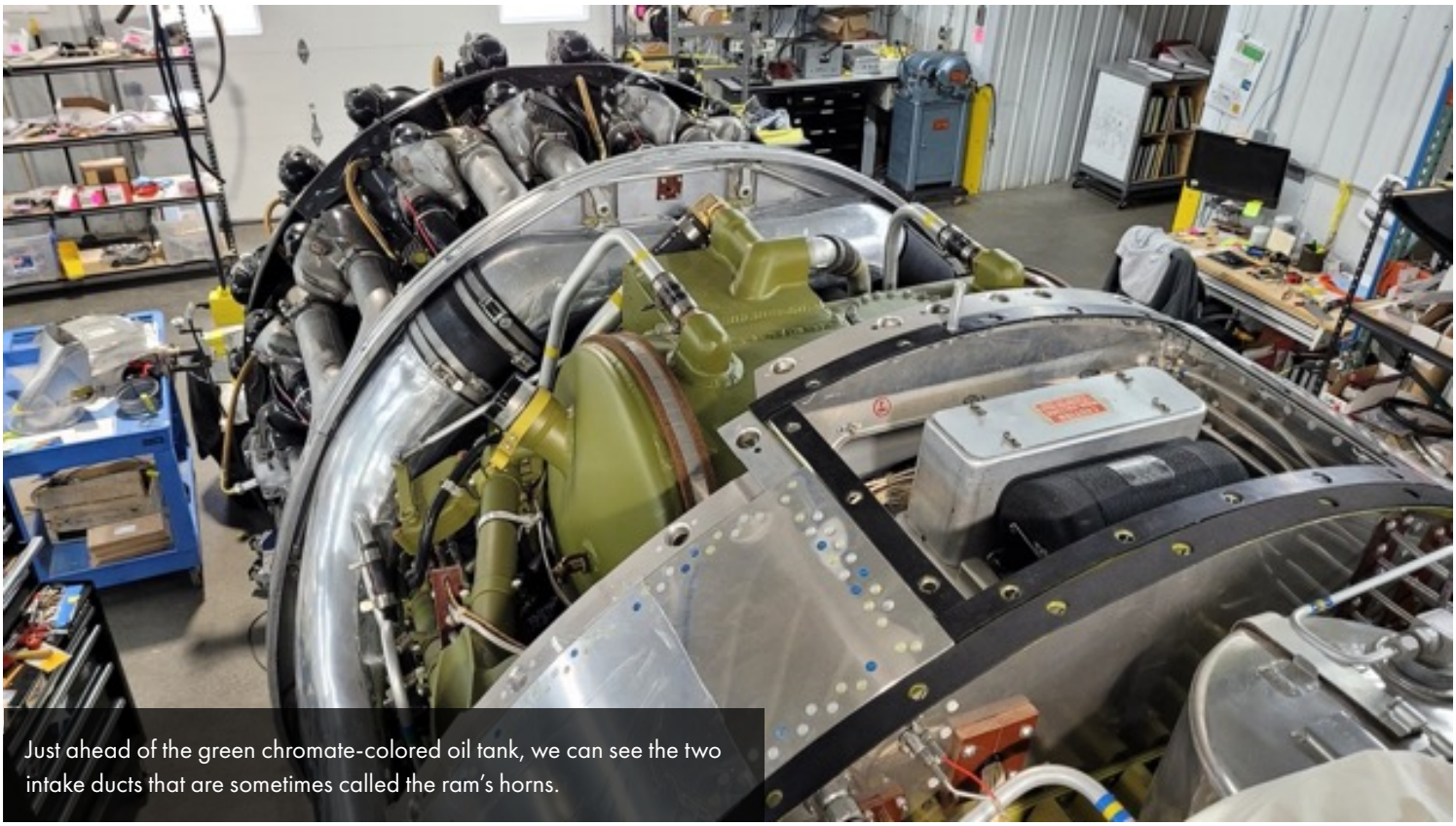
Shining a black light on the instruments and placards shows that they have been restored with fluorescent paint to glow as they would have in 1944.



The left side view shows the oil cooler, ducting, and the oil cooler door.



This duct feeds pressurized air from the turbosupercharger to the carburetor.

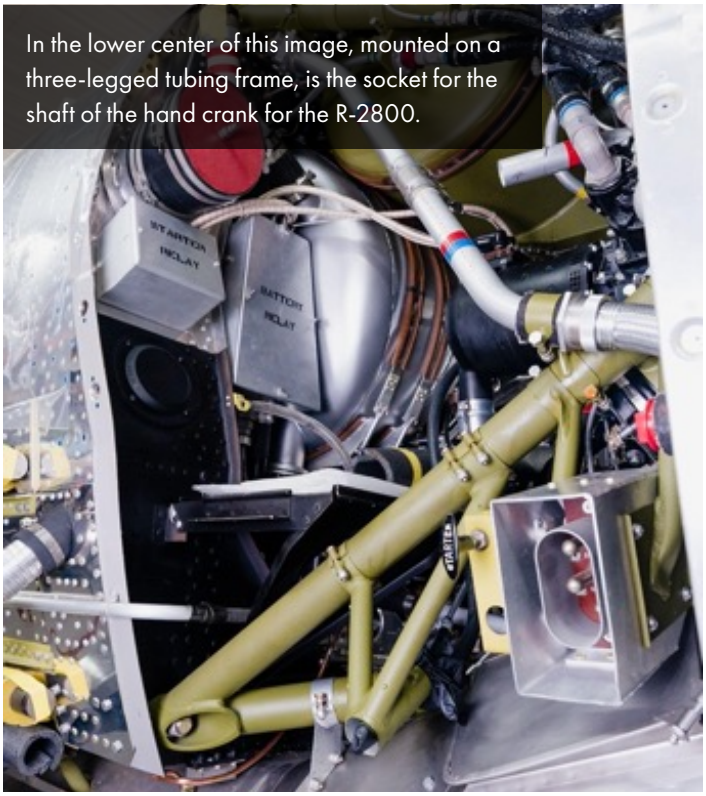


Just ahead of the green chromate-colored oil tank, we can see the two intake ducts that are sometimes called the ram's horns.

The ducting to the intercooler has been installed.

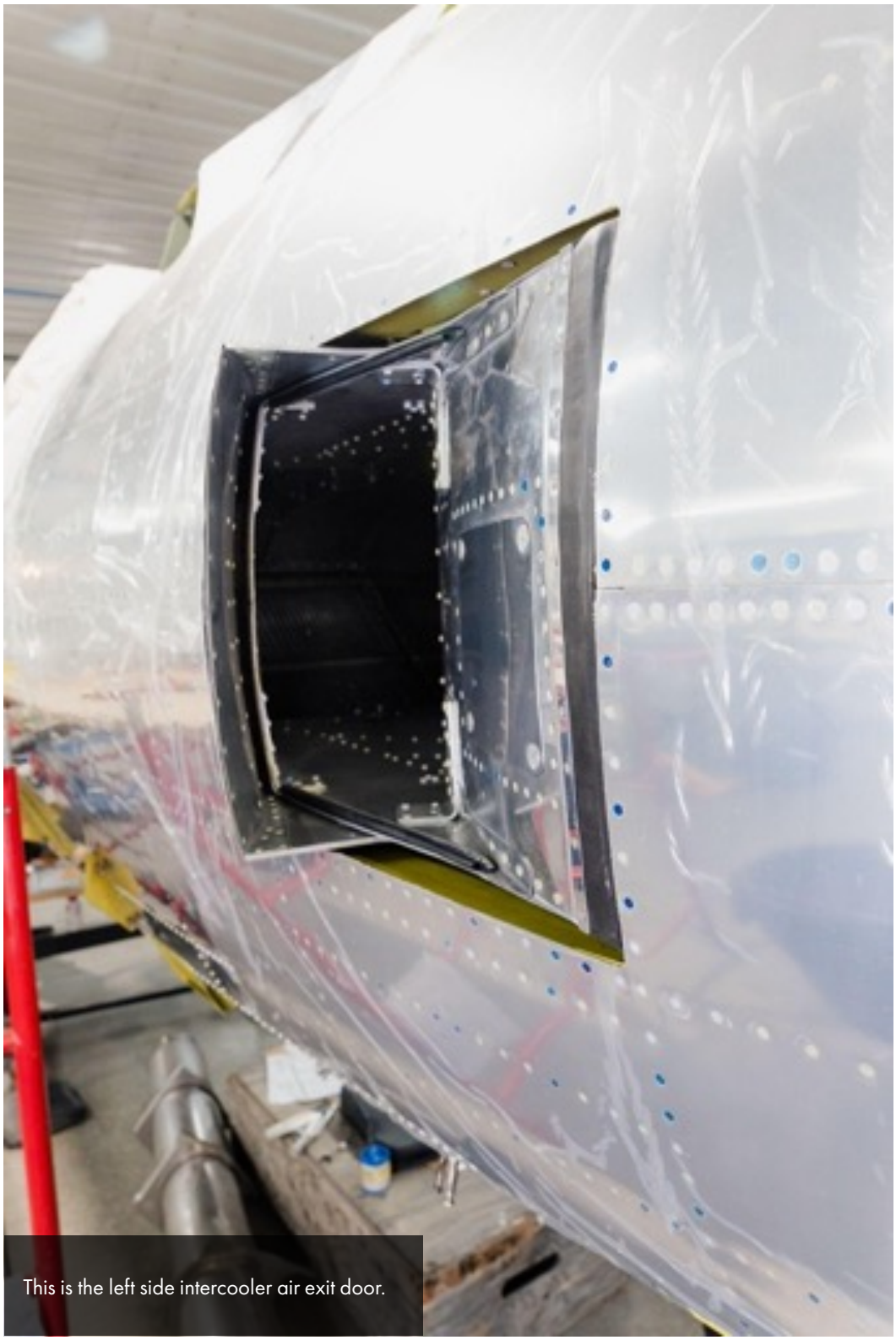
More turbosupercharger ducting leading to the turbosupercharger on the right.

This oil filter is a modern addition that was installed for increased reliability and serviceability.



In the lower center of this image, mounted on a three-legged tubing frame, is the socket for the shaft of the hand crank for the R-2800.

The right side intercooler air exit door is in the open position.



This is the left side intercooler air exit door.

Ignition and Radio Problems in Early Combat P-47s

Republic P-47C Thunderbolt 41-6224 LM-X and P-47C 42-7870 LM-R, 62FS, 56FG, 8AF USAAF taken in January 1943. The Thunderbolt in the foreground, 42-7870, is an early D model, a P-47D-2-RE. USAAF photo

The P-47, like most new fighters in WWII, incorporated some innovative, but untested, technology. So much was new about the P-47 that some malfunctioning was to be expected in the early versions, especially as the new fighter entered operational combat in Europe.

The P-47 was conceived and engineered to be a high-altitude interceptor. Its designed purpose was to act in a defensive role, destroying attacking hostile bombers. However, by the time the P-47 became operational, it had become clear to military planners that an air attack on the continental United States was highly unlikely. The mission of the P-47 then changed to become the defense of American land forces in combat. Another mission that evolved with war experience was escorting bomber formations.

Military thinking before the war held that bombers were capable of defending themselves without fighter escort, but losses experienced by unescorted formations in the early days of the Eighth Air Force proved that thinking to be completely inaccurate.

Due to these changes in military tactics, the first combat missions for the P-47 were much different than the mission for which it had been originally designed.

P-47C Thunderbolts of the 56th Fighter Group retract their landing gear after takeoff. (U.S. Air Force)

Newly classified as an escort fighter, the first P-47s were sent to England to support bomber missions. Even though the Thunderbolt's range was limited to a combat radius of 200 miles, that was still about 50 miles more than the Spitfires of the time. P-38s had a longer range, but were not available in sufficient numbers to completely meet the need. Even with the range limitations of the P-38 and P-47's they were still better than no escort at all. However, once the fighters had to turn back, the bombing forces often suffered heavy losses at the hands of the Luftwaffe.

The first fighter groups to receive P-47Cs were the 4th, 78th, and 56th Fighter Groups. These P-47Cs arrived in Great Britain a few days before Christmas of 1942. Further shipments were planned to equip the three fighter groups with enough Thunderbolts to fill three squadrons in each Group.

[1]Roger Freeman, Thunderbolt, A Documentary History of the Republic P-47, Scribners & Sons, Great Britain, 1978, page 28-31

The 8th Air Force hoped to have all three Fighter Groups operational by mid-February 1943. Unfortunately, radio and engine problems during high altitude testing made that goal unattainable.

The cause of the engine problems was found to be ignition breakdown and distributor leakage fouling plugs, resulting in dangerous power loss. Besides the power loss, radio noise made communications nearly impossible. Both issues had to be corrected before the new P-47s could be flown in combat.

At sea level air pressures, the total voltage the magneto is required to produce to break down both the spark plug and distributor gaps is approximately 11,000 volts. This level of voltage reliably makes a spark at the spark plug.

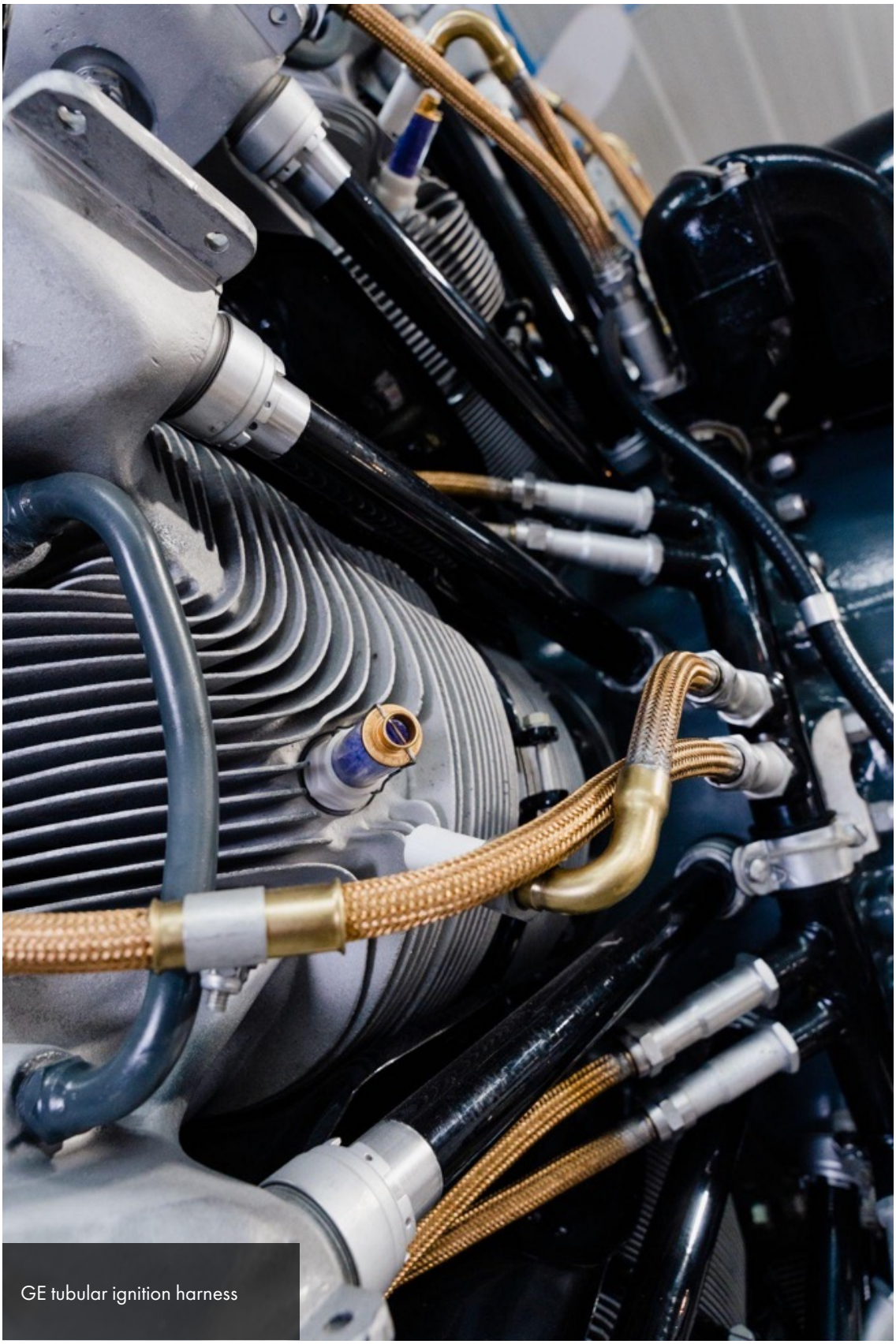
As altitude is increased, the air density drops, and the insulating properties of the air with fewer molecules drop. This means that the necessary voltage to jump the high voltage conductor spacing inside the magneto drops along with the air density. Because of this phenomenon, the magneto sends lower voltage through the ignition harness to the spark plugs at higher altitudes. That works fine with normally aspirated engines at higher altitudes because cylinder pressure at the time of the ignition spark event also drops. It is easier for the current to jump the plug gap because less voltage is required to fire the spark plug, and the ignition works as designed.

High altitude ignition breakdown is a greater problem for turbosupercharged engines like the R-2800 installation in the P-47.

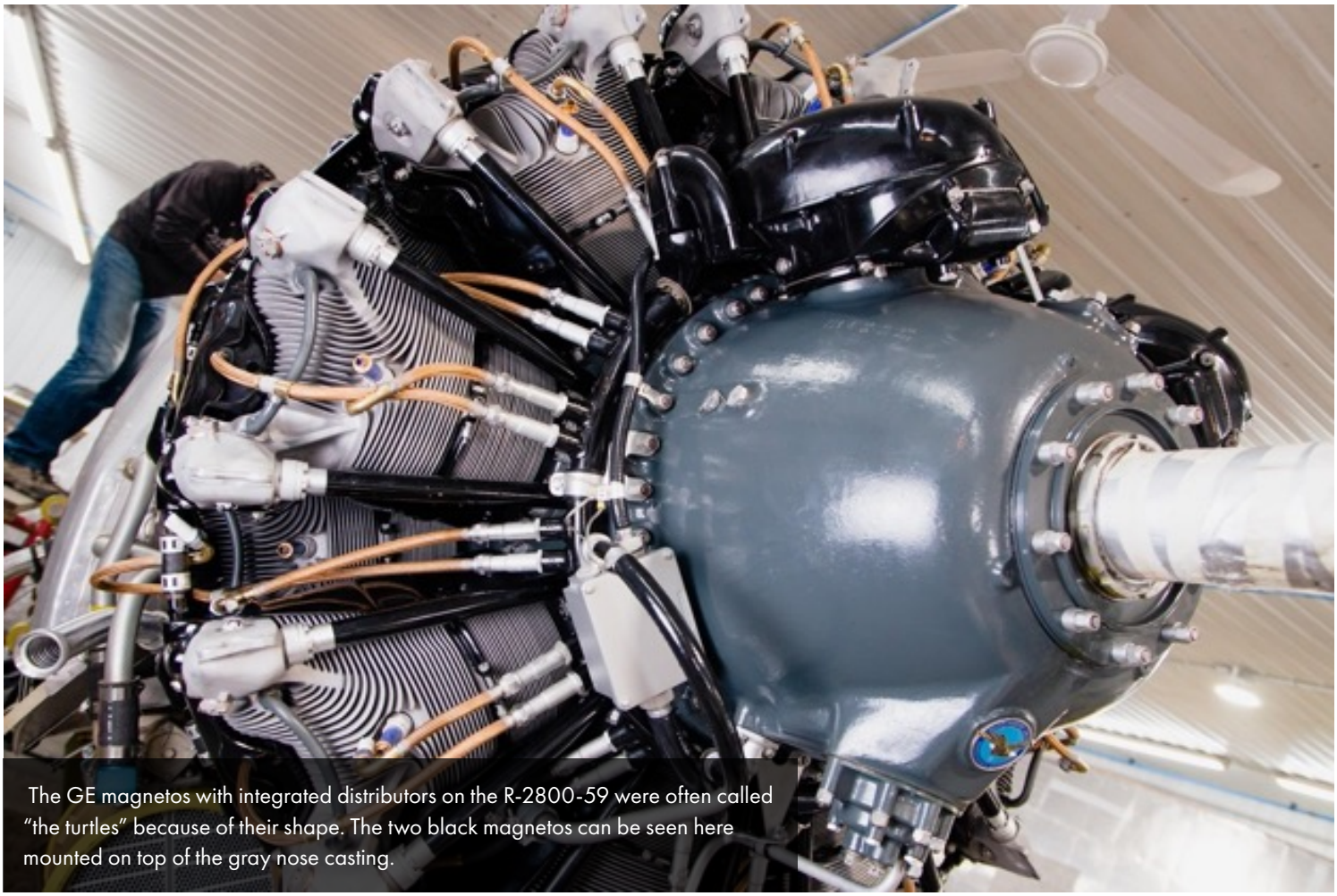
In a turbosupercharged engine, the necessary spark plug voltage remains high because the cylinder pressure is maintained at near sea-level conditions by the turbosupercharger. Therefore, the required voltage to successfully and reliably produce a spark at the spark plug remains high. But, inside the unpressurized magneto, the voltage needed to break down and jump the point and distributor gaps decreases, so the unpressurized magneto puts out less voltage than the spark plugs need, as explained earlier.

As pre-combat testing progressed, it was found that the humidity levels at 25,000 feet over the United Kingdom were much higher than over New England where the previous testing had occurred. That increased moisture level, along with reduced insulating properties of thinner high altitude air made the problem of low voltage from the magneto worse, and the ignition failed to reliably deliver a spark in the cylinder. It was found that tapping pressure from the turbosupercharger in order to also maintain sea-level pressure within the magnetos was the cure for this problem. The higher internal pressure inside the magneto kept the output voltage high, and the spark plugs fired reliably. The rest of the ignition harness was also sealed against moisture intrusion.

[2] Harry Fenton, Magnetos Under Pressure, AviationPros website accessed 5-017-2022, https://www.aviationpros.com/home/article/10388584/magnetos-under-pressure



GE tubular ignition harness



The GE magnetos with integrated distributors on the R-2800-59 were often called "the turtles" because of their shape. The two black magnetos can be seen here mounted on top of the gray nose casting.

After finally solving the ignition problems, the first Thunderbolt combat mission was flown on March 10, 1943. The 4th Fighter Group sent 14 P-47s across the English Channel on a fighter sweep. Unfortunately, the mission turned into a fiasco because static from the ignition system rendered radio communications nearly impossible. No more missions could be flown until the communications problem was solved.

The radio static issues turned out to be a problem related to the ignition system issues. Noise from the ignition system caused by static electricity escaping from corroded magneto seals was what prevented radio communications. The problem was temporarily reduced by adding bonded insulation to the magneto distributor caps. The permanent fix came later with the installation of pressurized magnetos.

With a solution to the communication problem achieved, a sweep of 24 Thunderbolts over the Pas De Calais region marked the real beginning of P-47 combat missions on April 8, 1943.