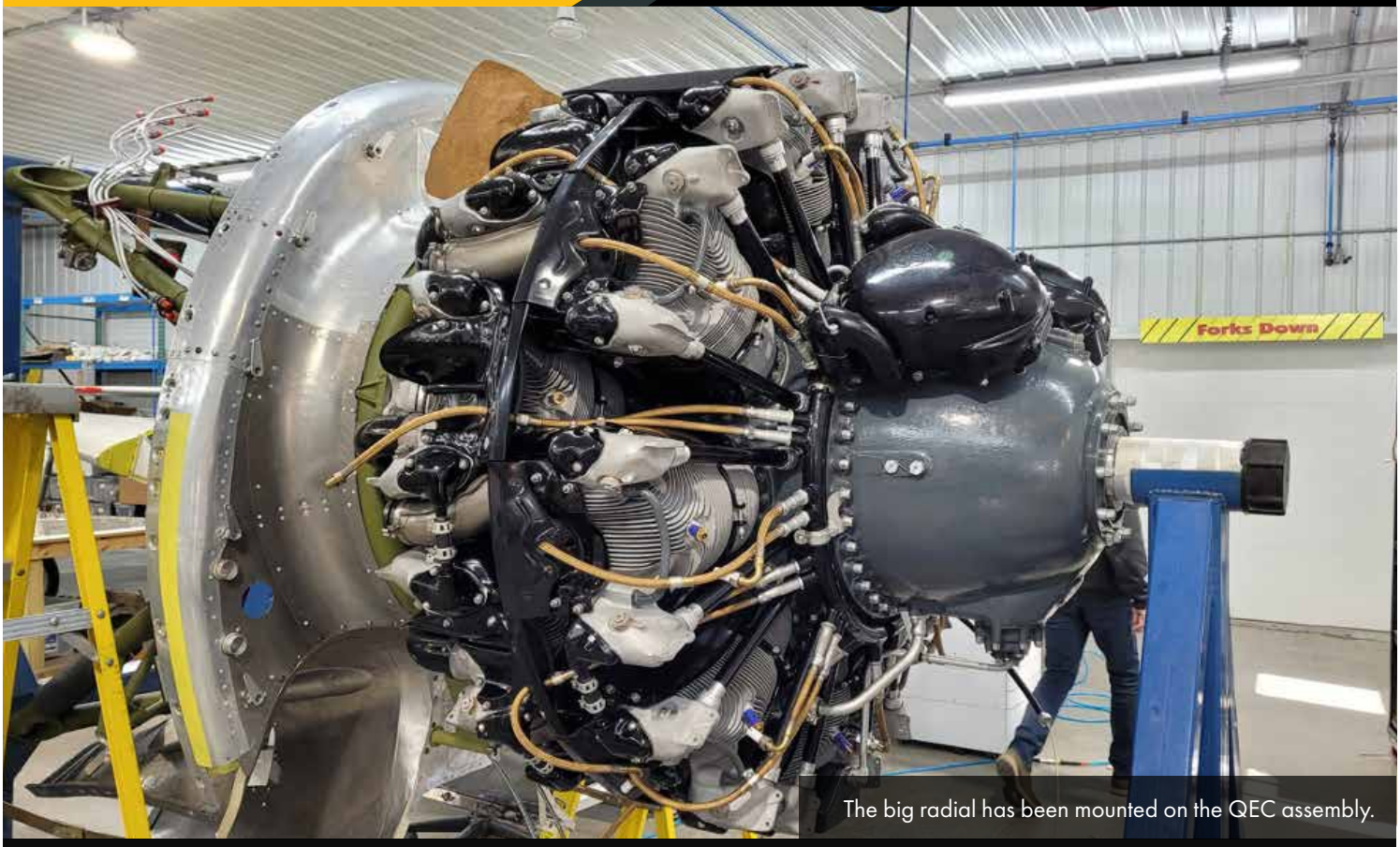
DEC/JAN

Dakota Territory Air Museum's P-47 Update

by Chuck Cravens

AIRCORPS AVIATION



The big radial has been mounted on the QEC assembly.

DAKOTA TERRITORY AIR MUSEUM

www.dakotaterritoryairmuseum.com

Update

The turbosupercharger system, wings, firewall forward section of the fuselage including the cowl, and the control surfaces were all part of the restoration work this month.

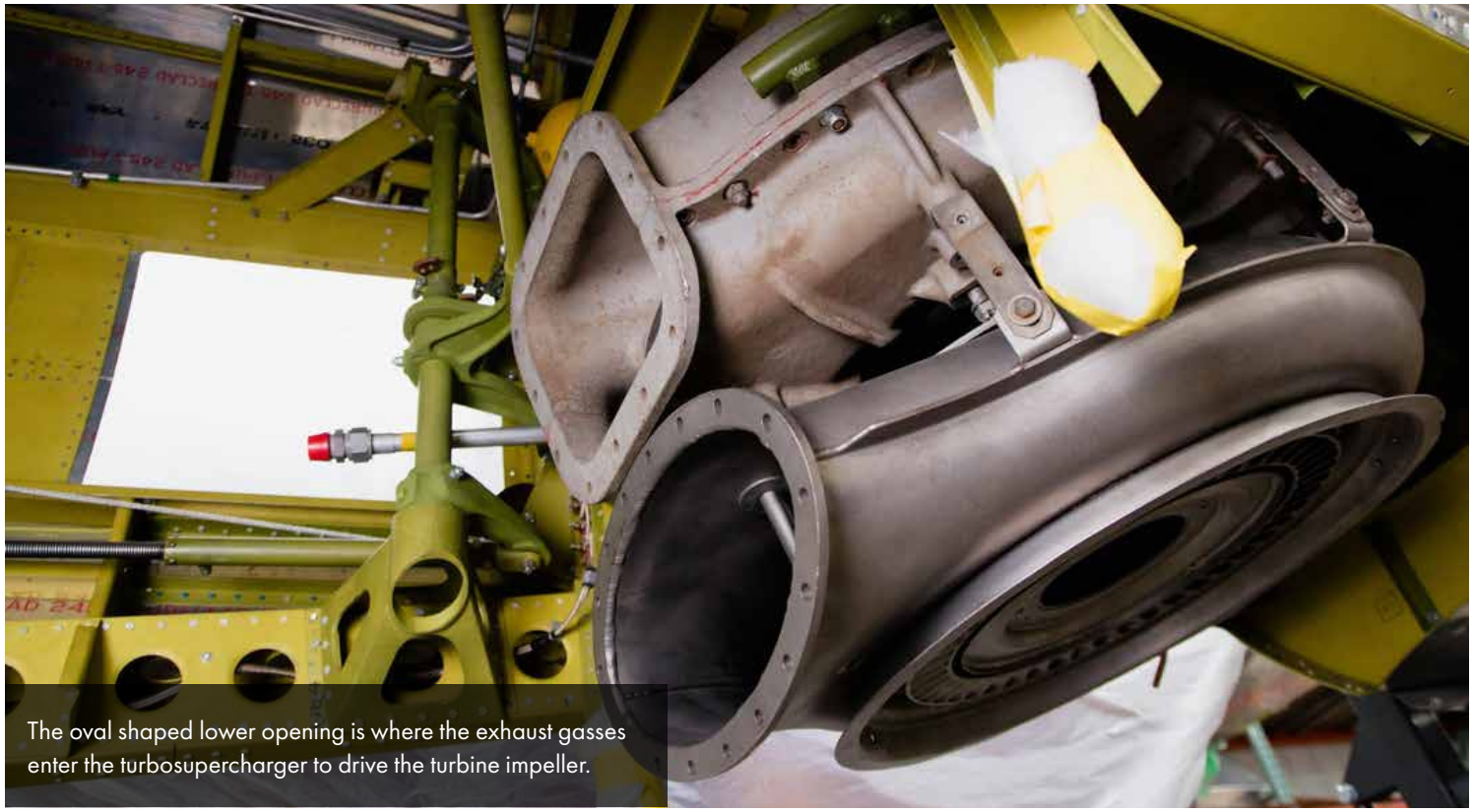
Turbosupercharger System

The turbosupercharger system continues to be a focus of the restoration work. The system gave the Thunderbolt remarkable tactical flexibility. Both high altitude bomber escort and low altitude fighter bomber missions were possible for the P-47 because of the power of the turbosupercharged R-2800.

Work continues on the functional turbosupercharger that will eventually be installed.

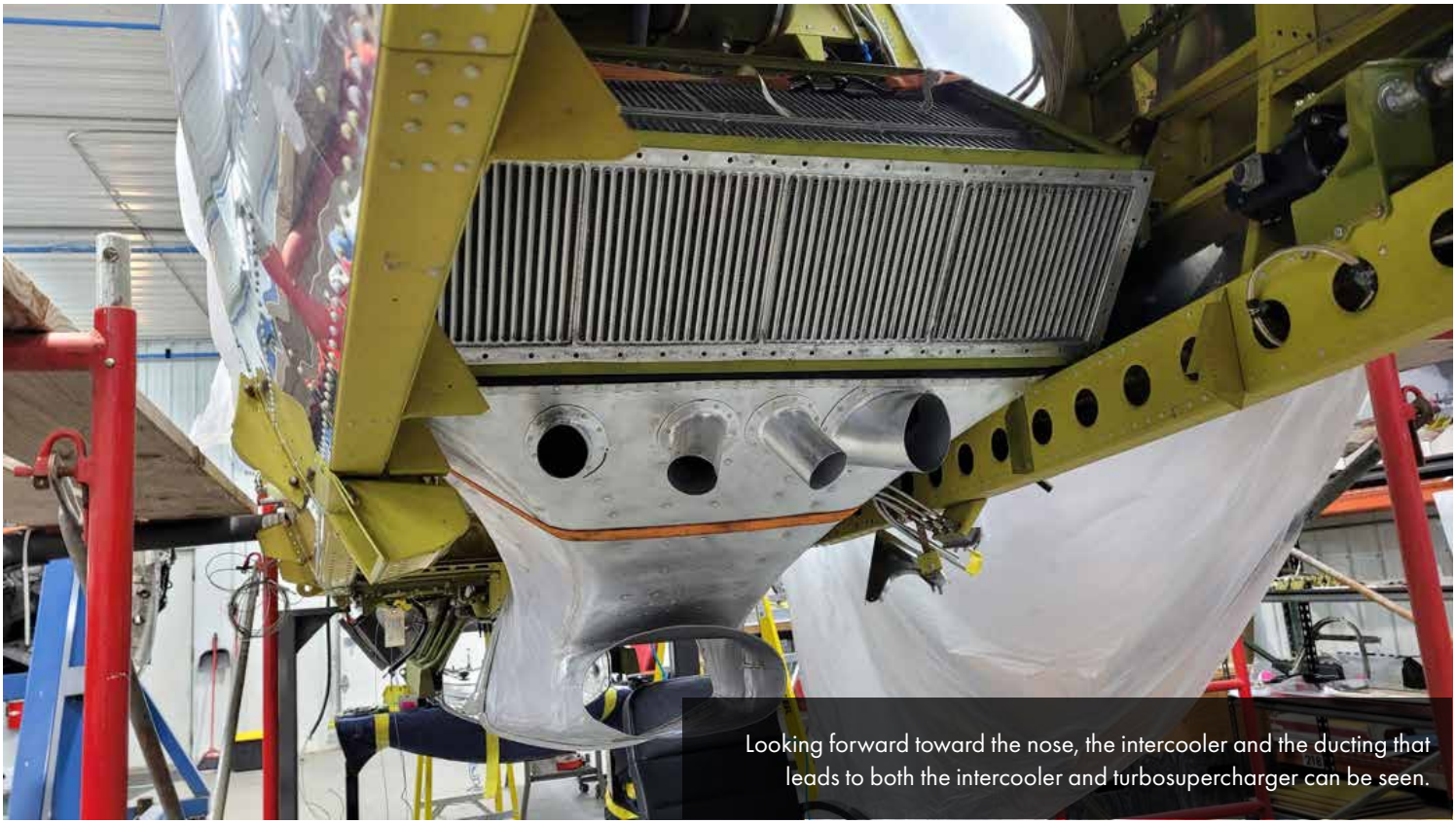
The turbine side of the turbosupercharger is on top in this image.

The turbosupercharger case that is being used to mock up the ducting installation is mounted in the supporting ring.



The oval shaped lower opening is where the exhaust gasses enter the turbosupercharger to drive the turbine impeller.

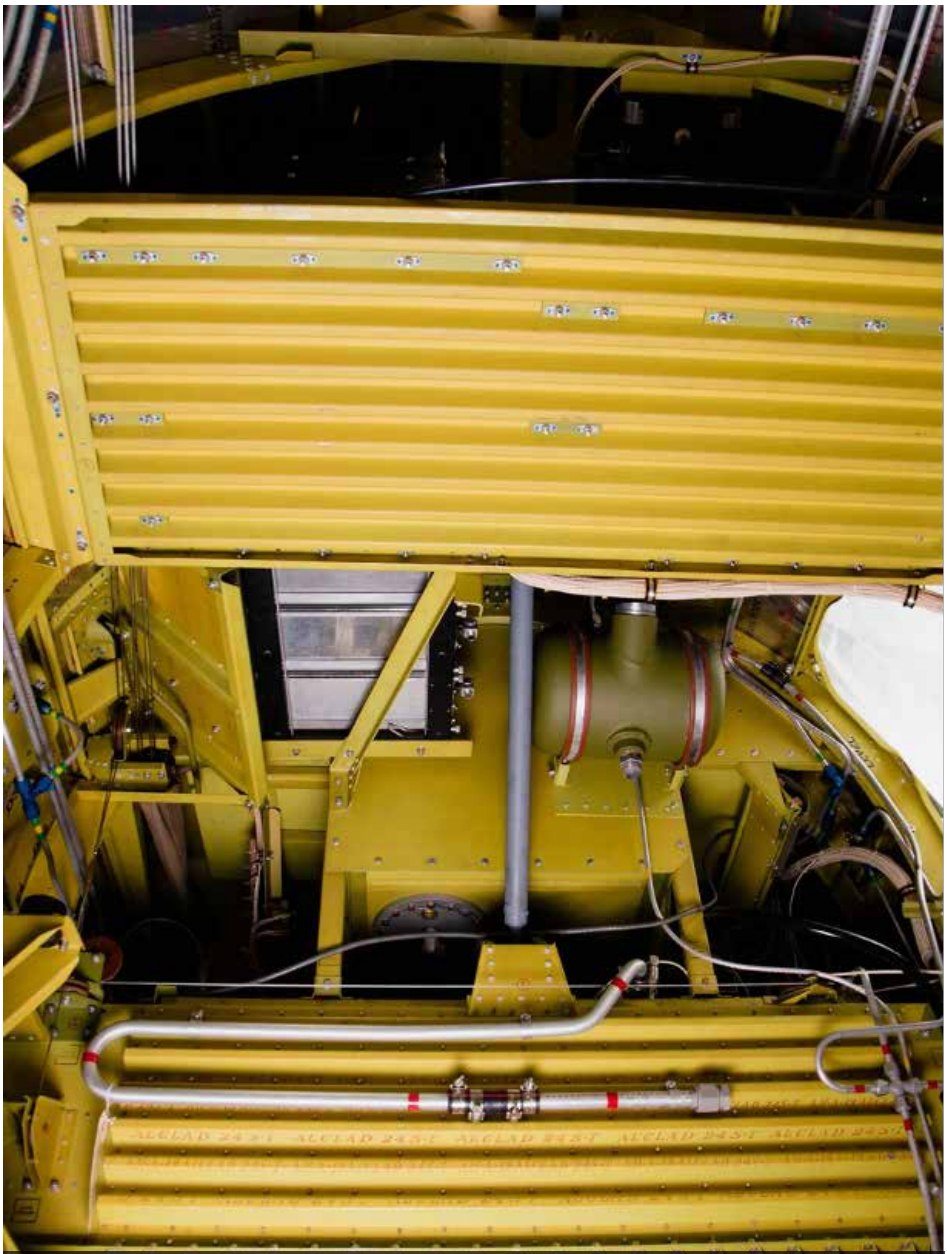
The rectangular opening on the upper section of the turbosupercharger is where the compressed air exits the compressor section on its way to the carburetor.



Looking forward toward the nose, the intercooler and the ducting that leads to both the intercooler and turbosupercharger can be seen.

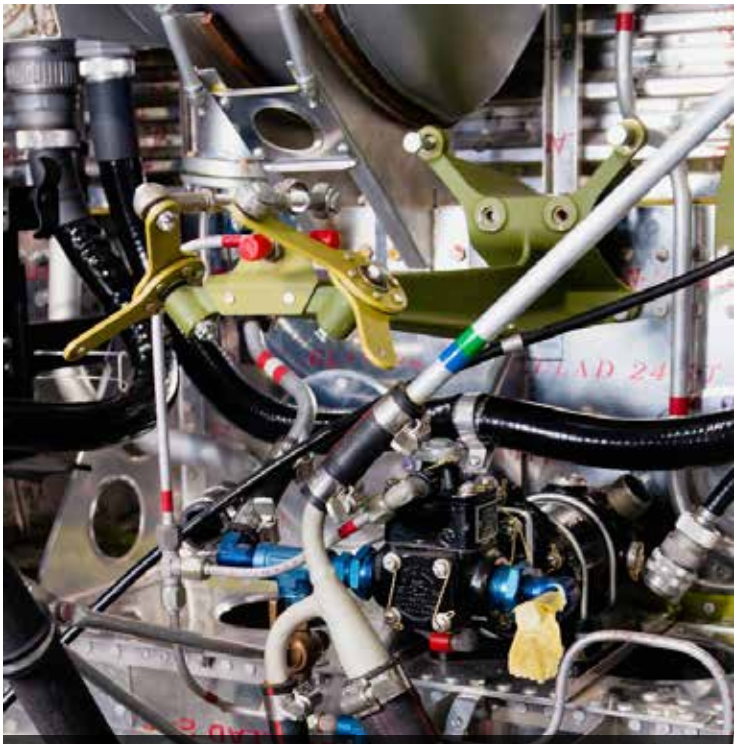
Fuselage

Most of the work on the fuselage this month was firewall forward, encompassing the engine accessory area, cowling, and the QEC or quick engine change.



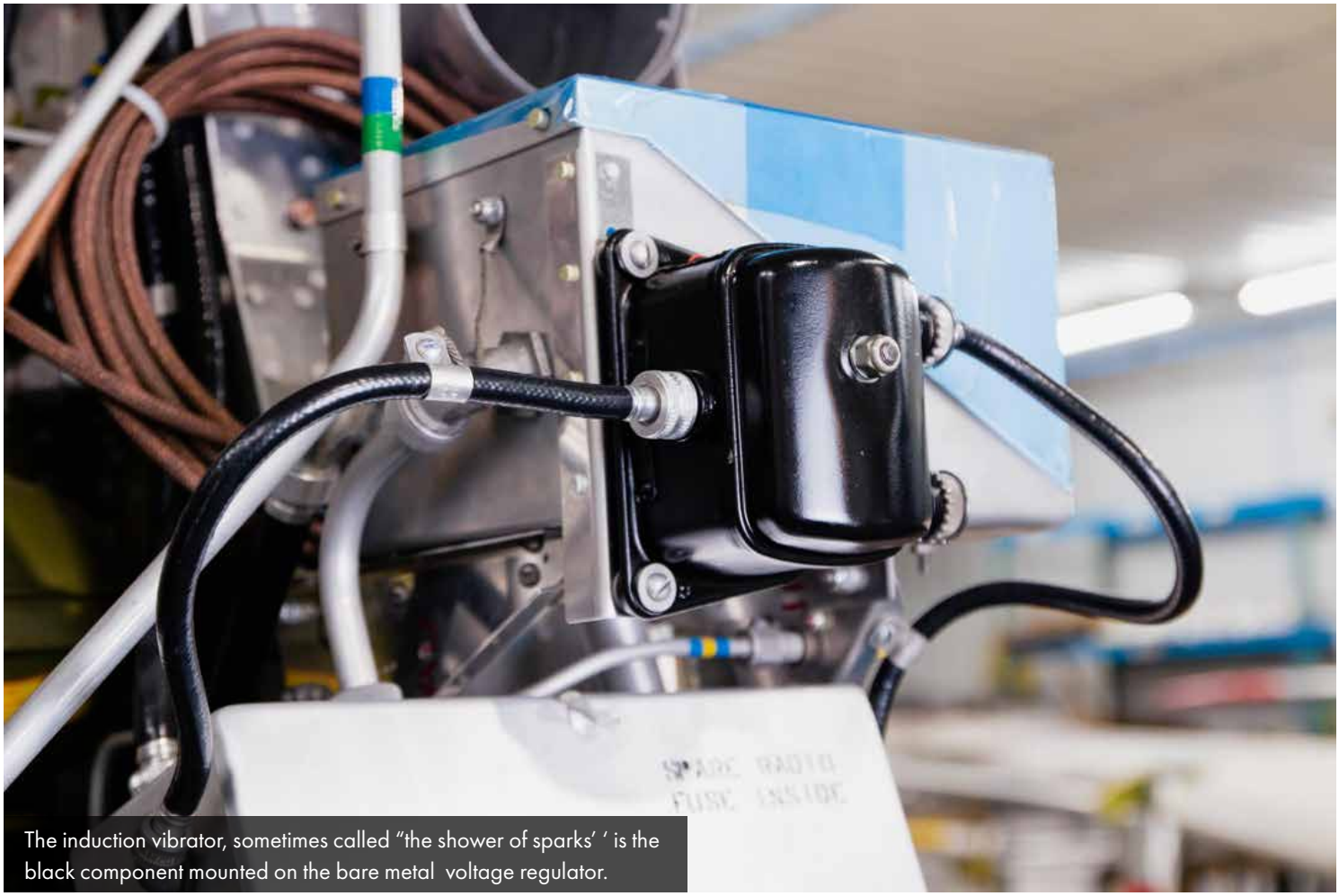
In this view from below the fuselage, the rectangular bare metal component is the bottom of the receiver mount. The receiver is located here as a result of the Christmas tree fuel tank field modification. Just to the right, the turbosupercharger oil tank is painted green and has red and silver straps around it.

Engine and Accessory Section



Two of the control components installed recently are shown in this photo. The water injection pump, which is black and has two blue fittings attached at the left and right; and the drop tank fuel pressure control valve. It has a green face that reads "FUEL TANK PRESSURE CONTROL VALVE" and bears the Standard Aircraft Products, Inc. logo (bottom center).

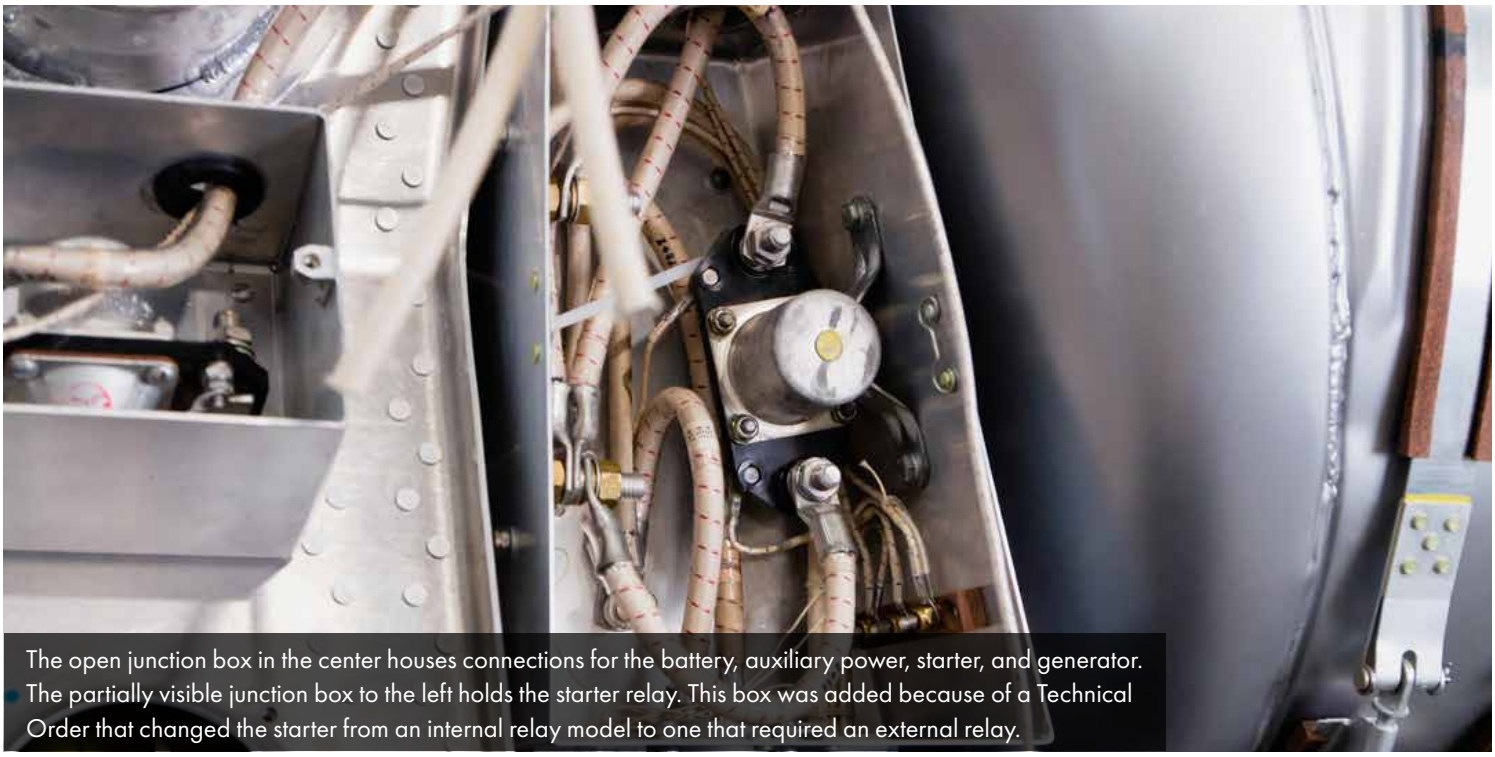
The large tank supplying the water injection system is prominent in this image.



The induction vibrator, sometimes called "the shower of sparks' ' is the black component mounted on the bare metal voltage regulator.

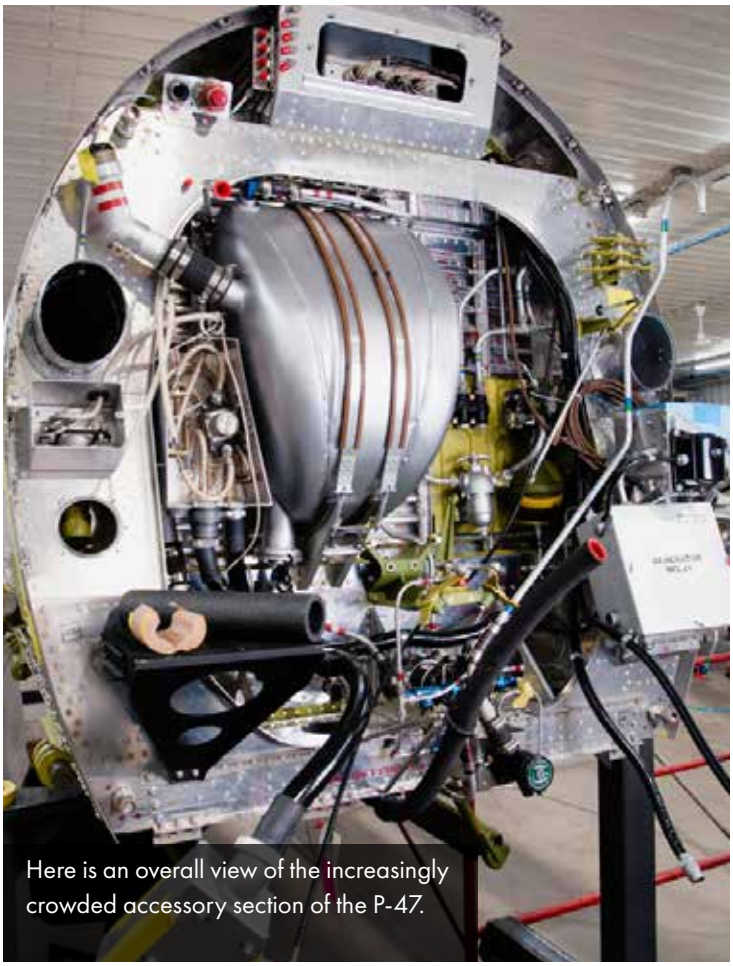
The induction vibrator is necessary to provide a strong spark before the magneto has reached the rotational speed that is required for normal operation. It is an aid in starting the engine that operates by bypassing the magnet portion of the magneto, instead supplying the primary coil of one of the magnetos with a pulsating stream of DC taken from the battery.

As the engine is cranked during start up, these pulses of very high voltage travel to the distributor as a "shower of sparks" and from the distributor to the spark plugs to fire the engine.



The open junction box in the center houses connections for the battery, auxiliary power, starter, and generator. The partially visible junction box to the left holds the starter relay. This box was added because of a Technical Order that changed the starter from an internal relay model to one that required an external relay.

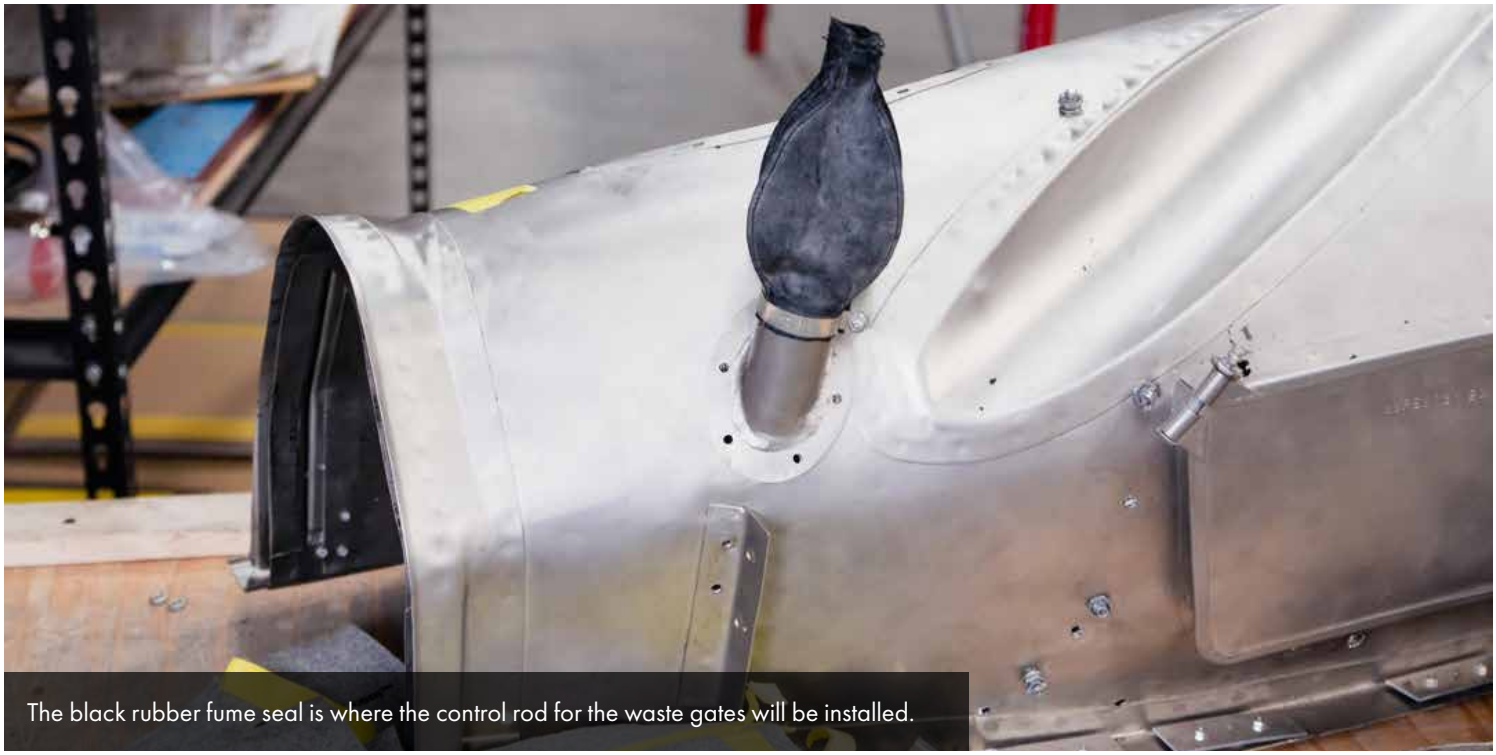
This is an external power receptacle. It was sourced as original new/old stock and, after the terminals were replated, it worked perfectly after sitting for nearly 80 years.



Here is an overall view of the increasingly crowded accessory section of the P-47.

Forward shroud assemblies for each side sit on the workbench. Their function is to direct air to the oil coolers and past the waste gates.

These green/yellow painted levers are part of the control system for the waste gates. Control pushrods connect them to the wastegates after they pass through the black rubber seals on the forward shroud assemblies.



The black rubber fume seal is where the control rod for the waste gates will be installed.

QEC (Quick Engine Change)

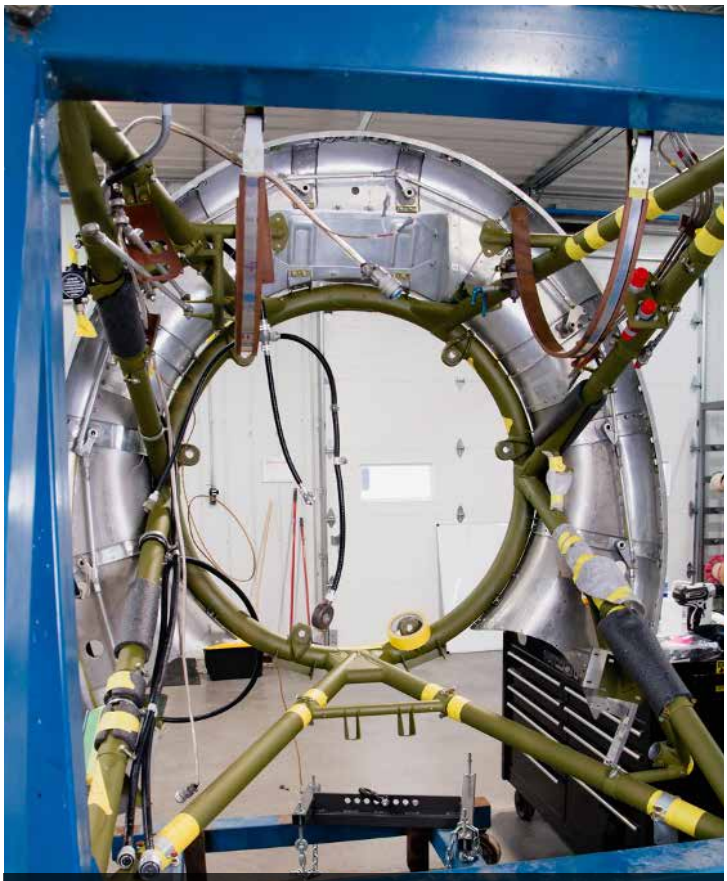
One of the engineering techniques that enabled rapid maintenance turnaround during WWII was the assembly of the engine mounts and many of the linkages and accessories into a unit called a QEC, an acronym for Quick Engine Change. On the early B model Thunderbolts, maintenance crews found engine changes to be very time consuming. Republic responded by a design change first incorporated in the P-47C-1RE. The fuselage was extended 8 inches to allow for the QEC. This change was the first major change to the P-47 airframe and as a by product of the extension, aircraft handling qualities improved.

The QEC assembly meant that the engine and mounts could all be removed as a unit and replaced with a new QEC assembly, saving as much as 60% of the time required for an engine change.

This electrical harness and cap connect to the oil dilution solenoid. Oil was slightly diluted with gasoline from the fuel tanks for cold weather starts.

The box with the light blue protective plastic is the Curtiss Electric propellor relay box.

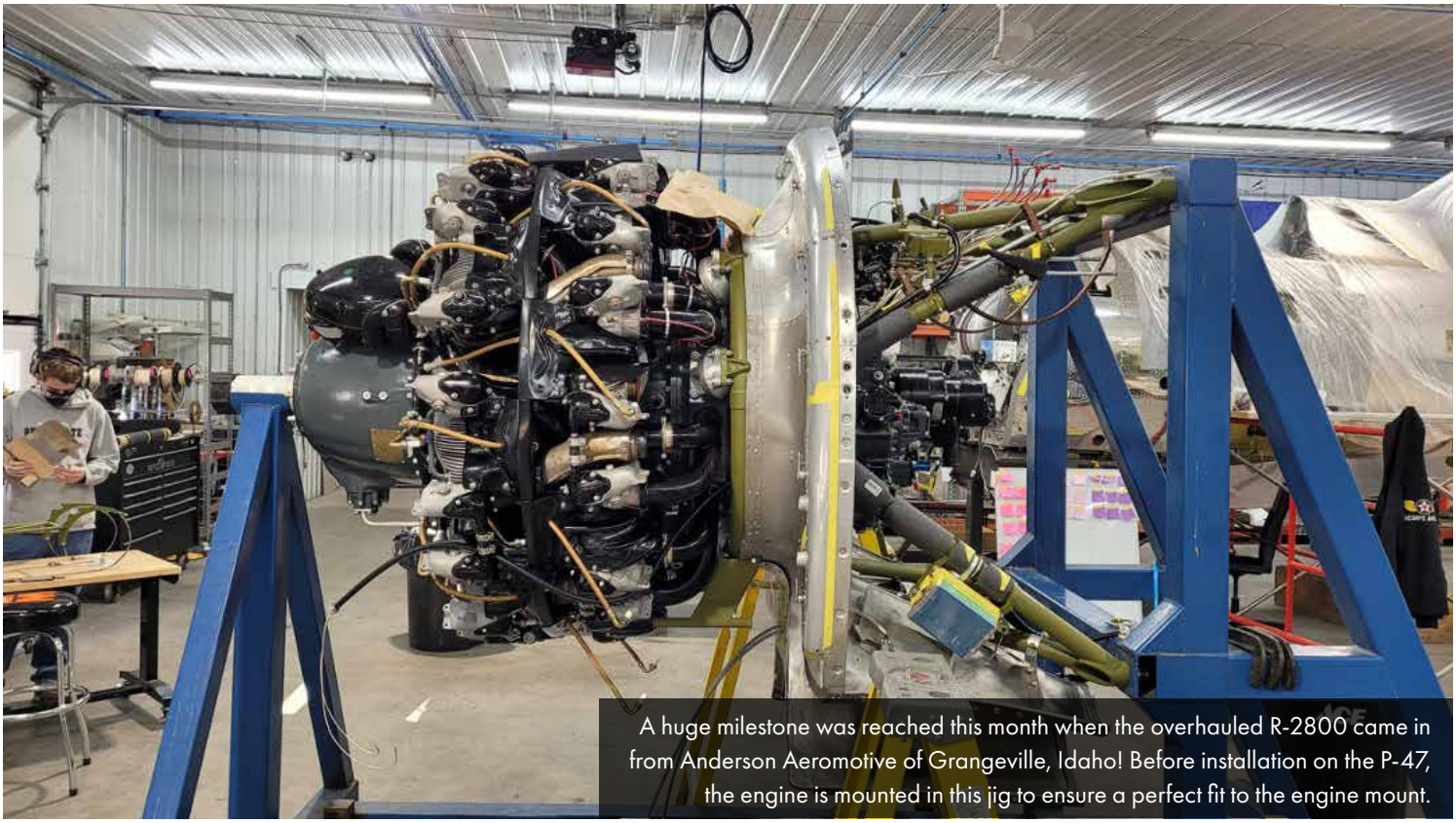
Aaron works on the oil cooler door.



This is a view of the engine mount from behind. Near the cross brace in the lower center are strips of masking tape that demarcate the area that Aaron had to remove paint from. Paint removal was necessary because the ground clamps must attach to bare metal for a good electrical ground connection.

Aaron is assembling the Quick Engine Change assembly (QEC) for the P-47 in anticipation of the overhauled R-2800's arrival.

The bare metal aluminum ring in this photo is called the preheater assembly. Evenly spaced around the edge of the preheater are the levers that are part of the linkage to the cowl flaps.



A huge milestone was reached this month when the overhauled R-2800 came in from Anderson Aeromotive of Grangeville, Idaho! Before installation on the P-47, the engine is mounted in this jig to ensure a perfect fit to the engine mount.

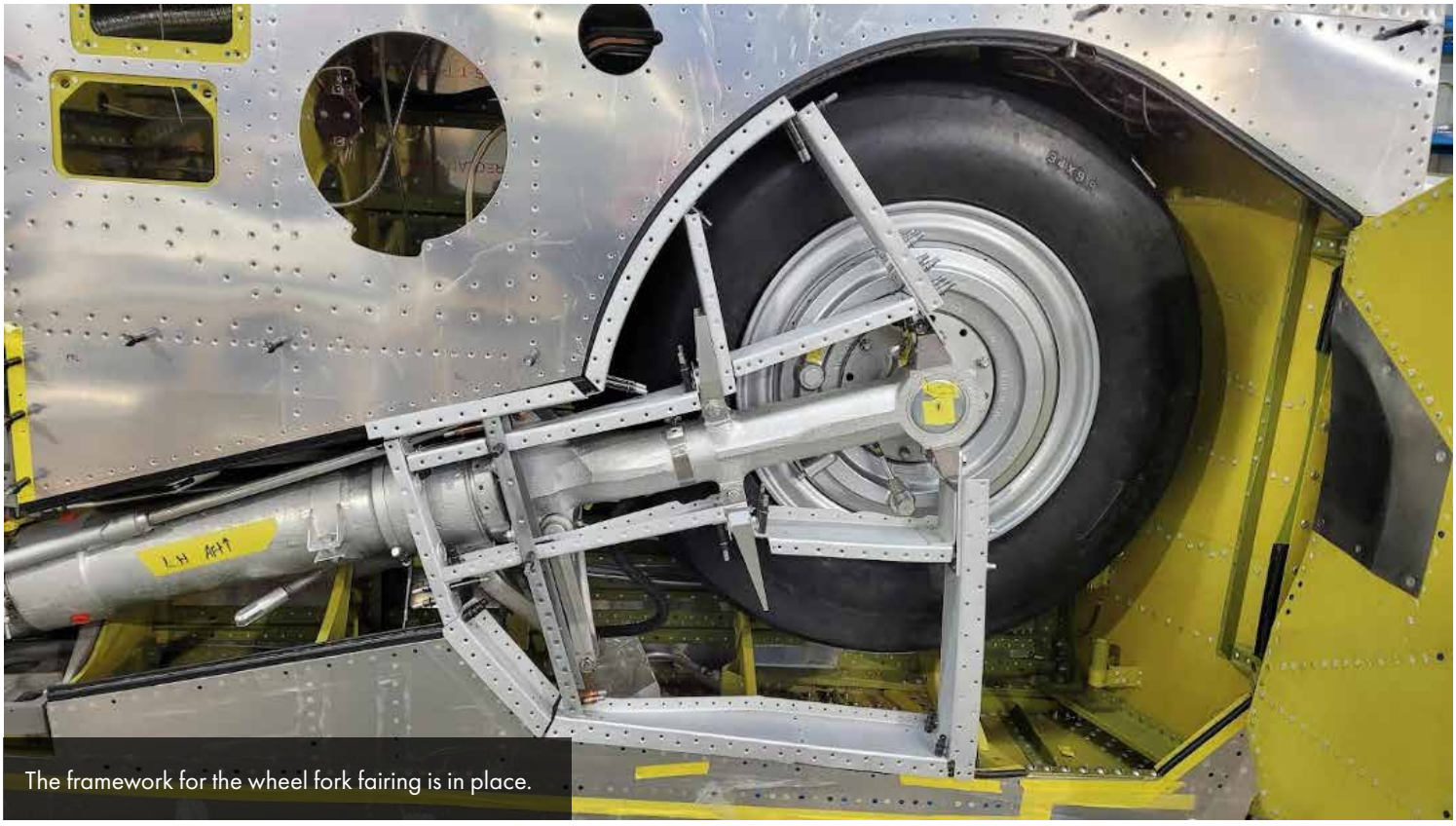
Here is a look at the backside of the R-2800.

Wings

The main structures of the wings are complete, so work on internal systems, access doors and control surfaces occupied the restorers this month.

Mark works on the main landing gear downlock installation.

This image shows the plates that attach to the hub that serve as mounting surfaces for the wheel fork fairing door.



The framework for the wheel fork fairing is in place.

The inner skin for the wheel fork fairing has been installed.

Here is a closer look at the details of the wheel fork fairing.

The door lock mechanism protrudes from the wheel fork fairing.

The gun bay door frame is installed for fitting before the skin is applied.

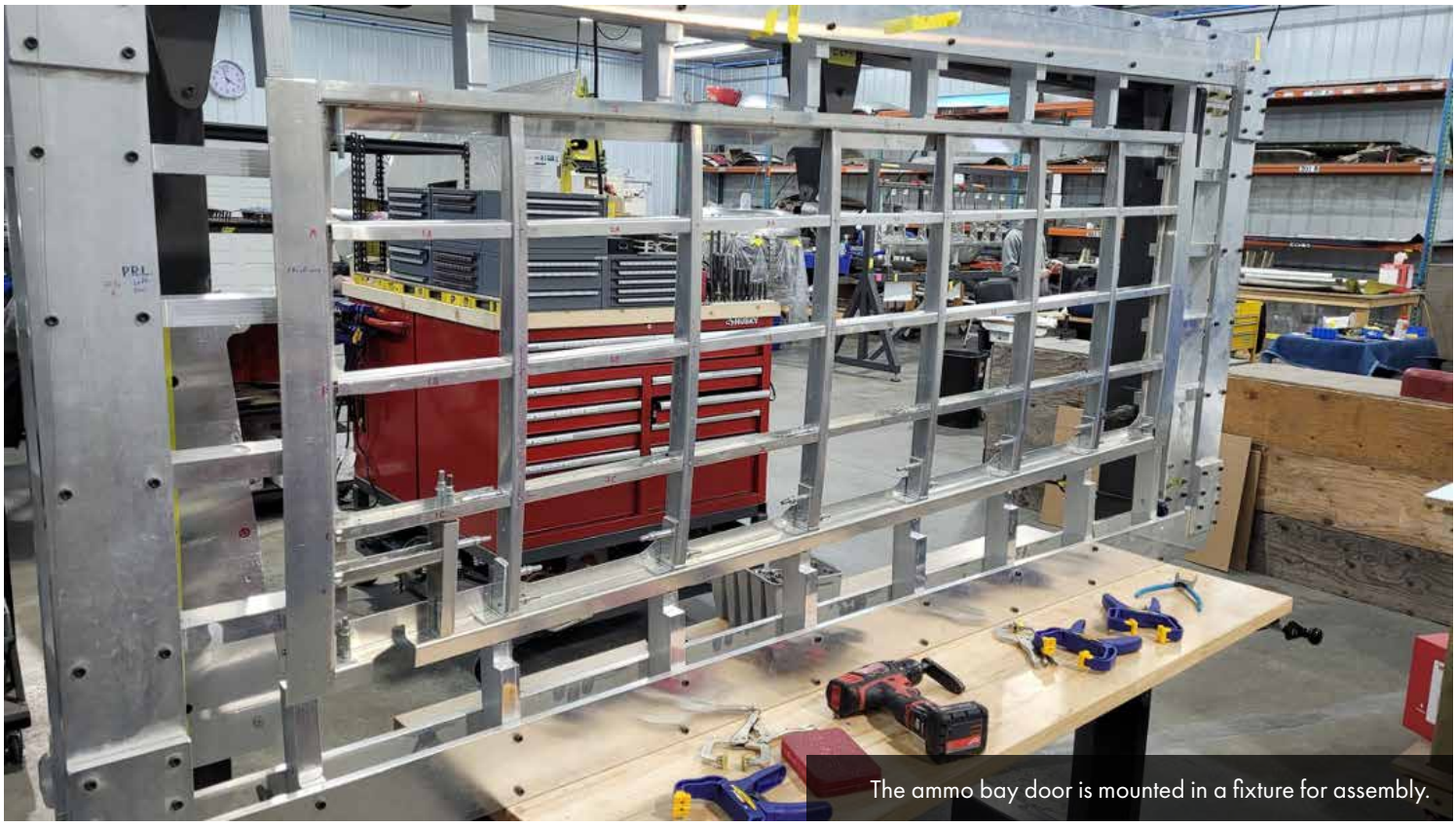
An original ammo bay door was used as a template for the new assembly.

An original skin was also very useful in fabricating a new skin for the ammo door.

Theo works on the gun bay door.

The gun bay door skin has been clecoed in place.

Here is a look at the inner side of the gun bay door with the skin in place.



The ammo bay door is mounted in a fixture for assembly.

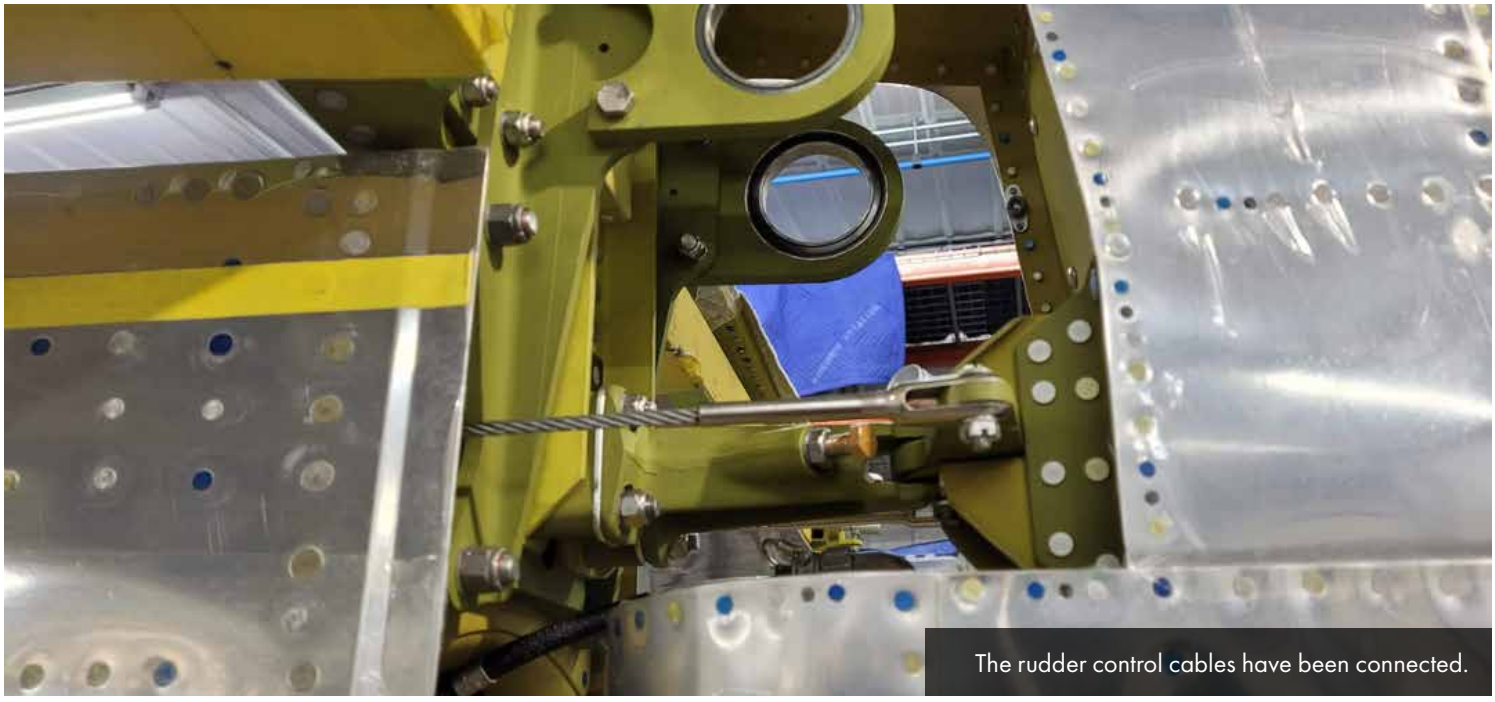
Neil fits the ammo bay door skin with clecoes.

The red lever controls the ammo bay door locking legs.

Control Surfaces

With the primary structures of the fuselage, wings and empennage complete, the last large assemblies to be finished will be the control surfaces. The rudder is done and has been test mounted as the cover photo shows. One of the flaps has also been completed and function tested. Work on the other flap and the elevators continues.

The rudder has been permanently installed.

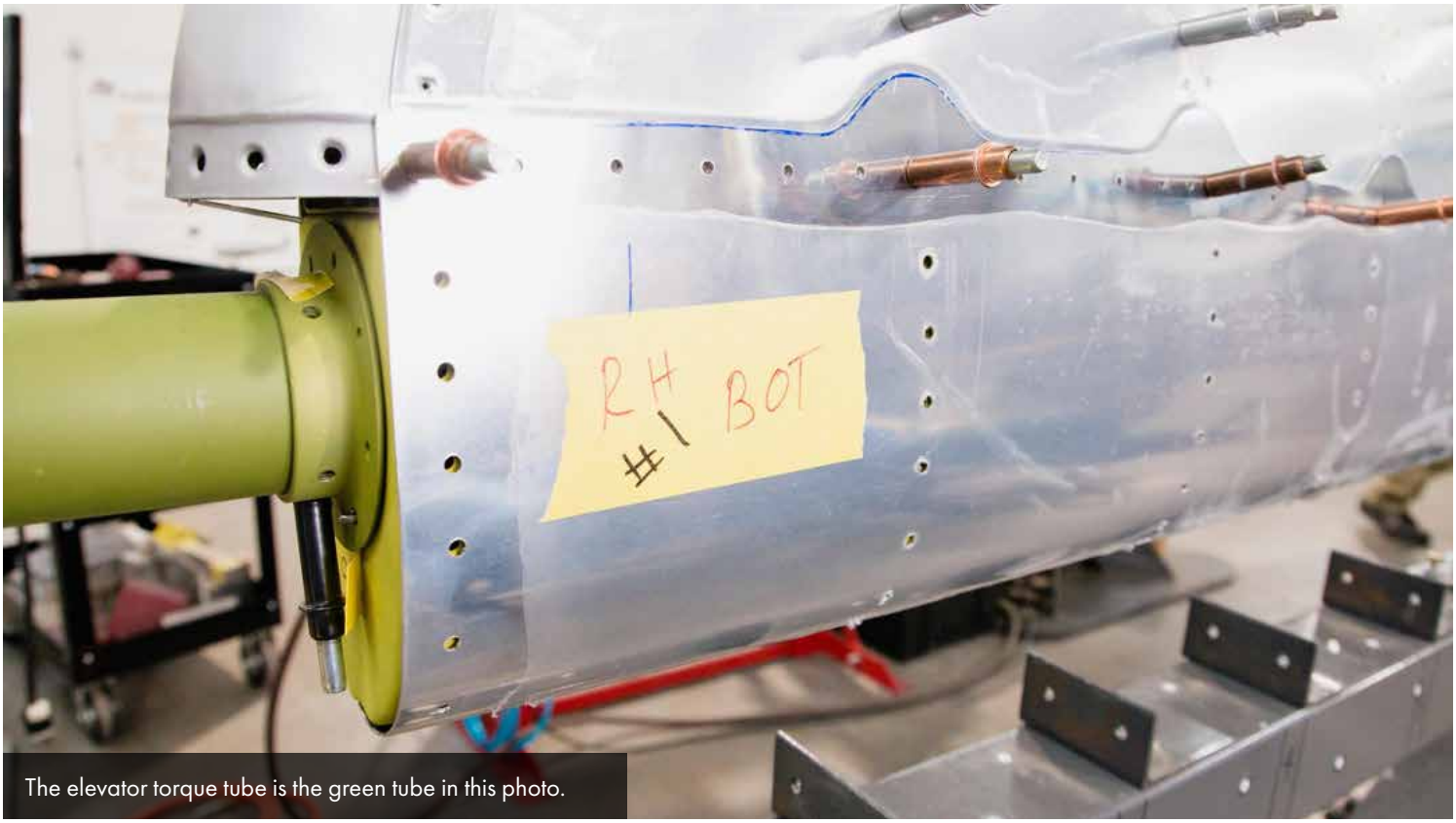


The rudder control cables have been connected.

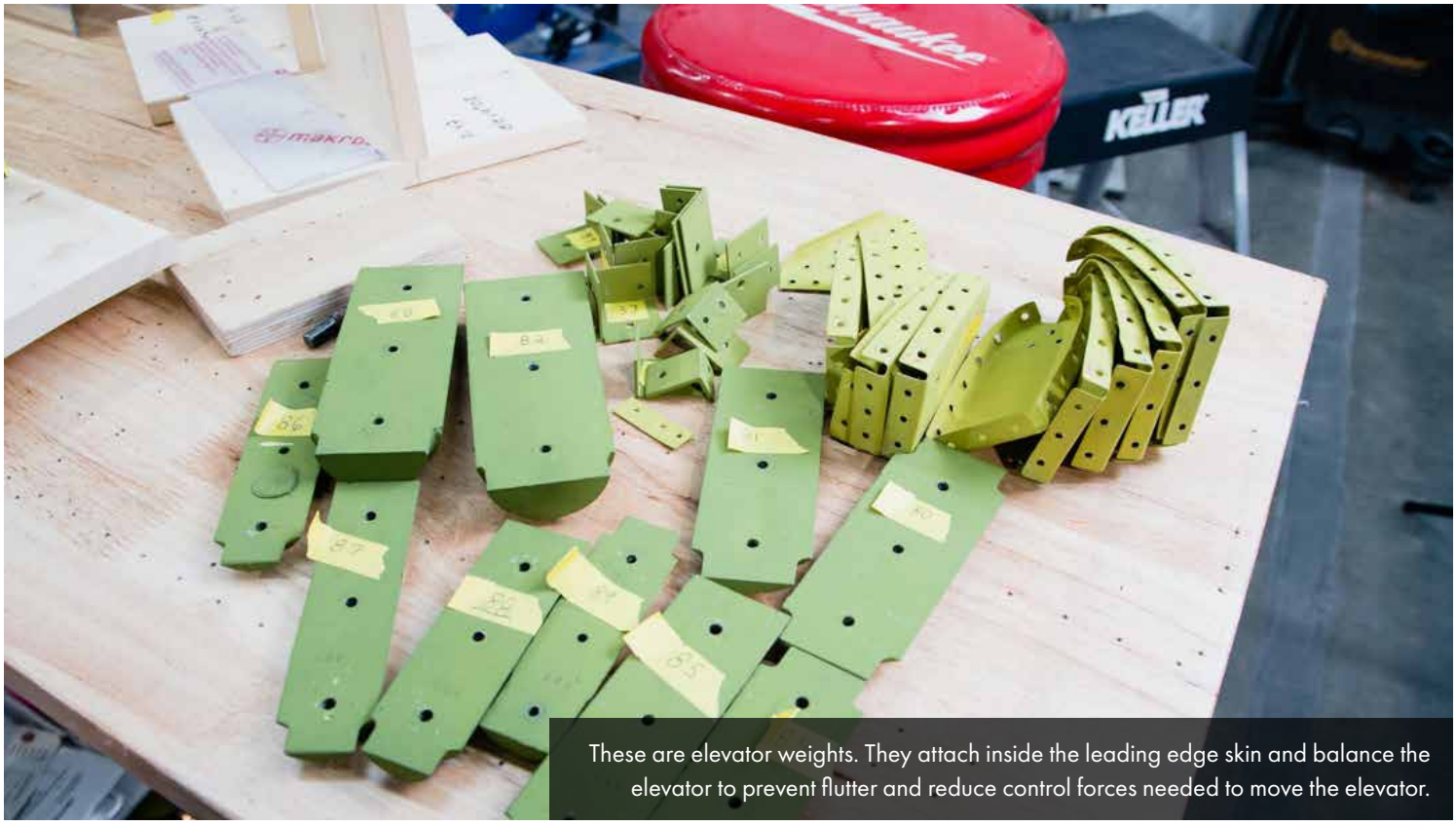
The attachment points for the flap hinge and actuators are visible here.

The control surface leading edges have a complex joint edge.

An elevator is seen here as the skin is fitted.



The elevator torque tube is the green tube in this photo.



These are elevator weights. They attach inside the leading edge skin and balance the elevator to prevent flutter and reduce control forces needed to move the elevator.

Flaps

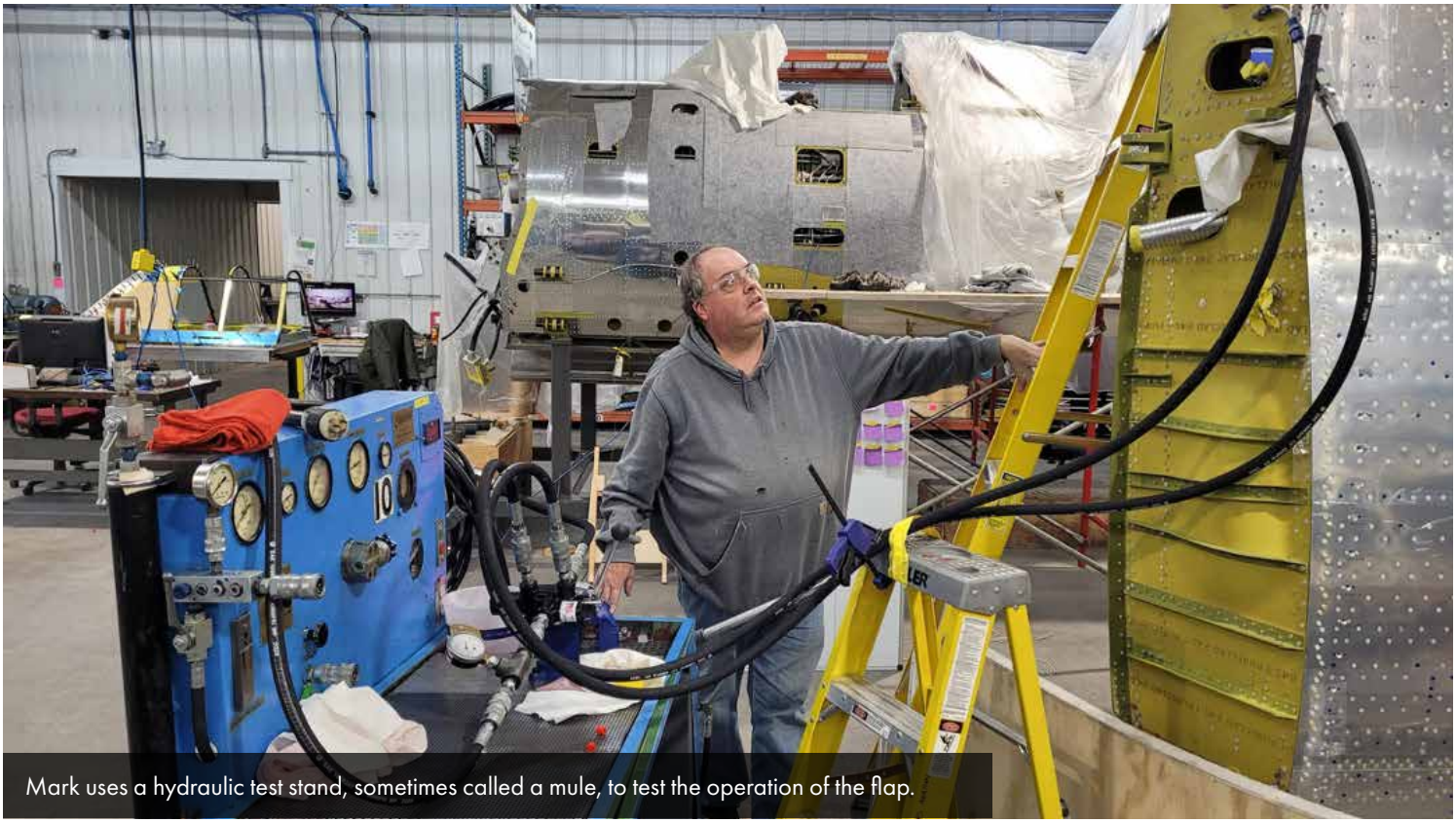
One sign of progress is that a flap has been installed and operated this month.

P-47 flaps are large, comprising about 13% of the projected wing area. Their design is the NACA slotted trailing edge type. Slotted flaps like these open a slot between the flap and the wing; allowing high-pressure air from the bottom of the wing to flow through the slot to the top of the wing. The design delays airflow separation by energizing the boundary layer on top of the wing and adds lift without excessive drag.

Hydraulic fluid pressure operates the flaps, through three trapezoidal linkages that are synchronized by a torque tube connecting them. This system pushes them aft first, and then down.[1]

The flap has been installed on the left wing.

[1]Nicholas Mastrangelo, Chief Technical Publications, Republic Aviation Corporation, Design Analysis of the P-47 Thunderbolt, Reprinted from the January 1945 issue of Industrial Aviation, http://www.rwebs.net/avhistory/history/p-47.htm, accessed 1-27-2022



Mark uses a hydraulic test stand, sometimes called a mule, to test the operation of the flap.

Here the flap is beginning to extend.

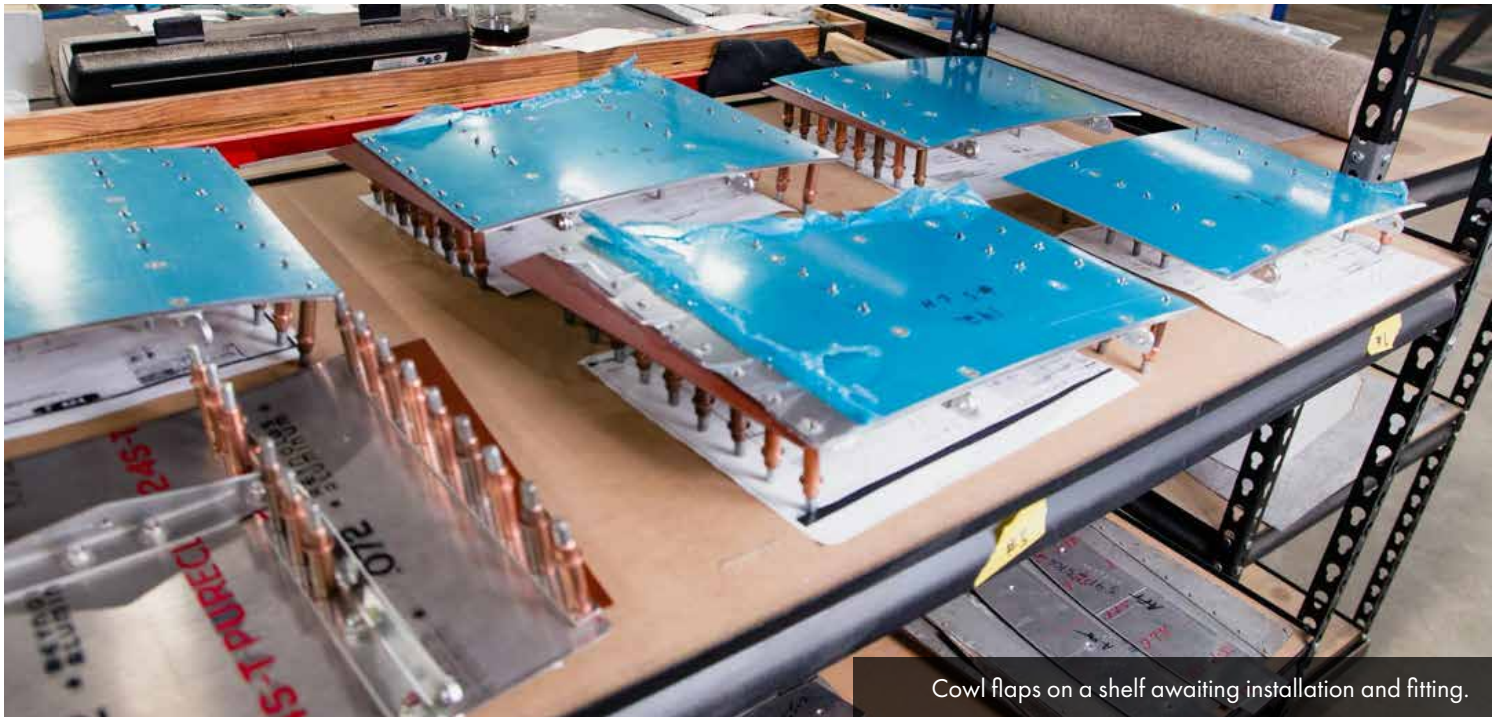
Here the angle of the linkage is shown as the flap is about halfway down.

Detailed view of the flap linkage.

Here are two views of the flap extended.

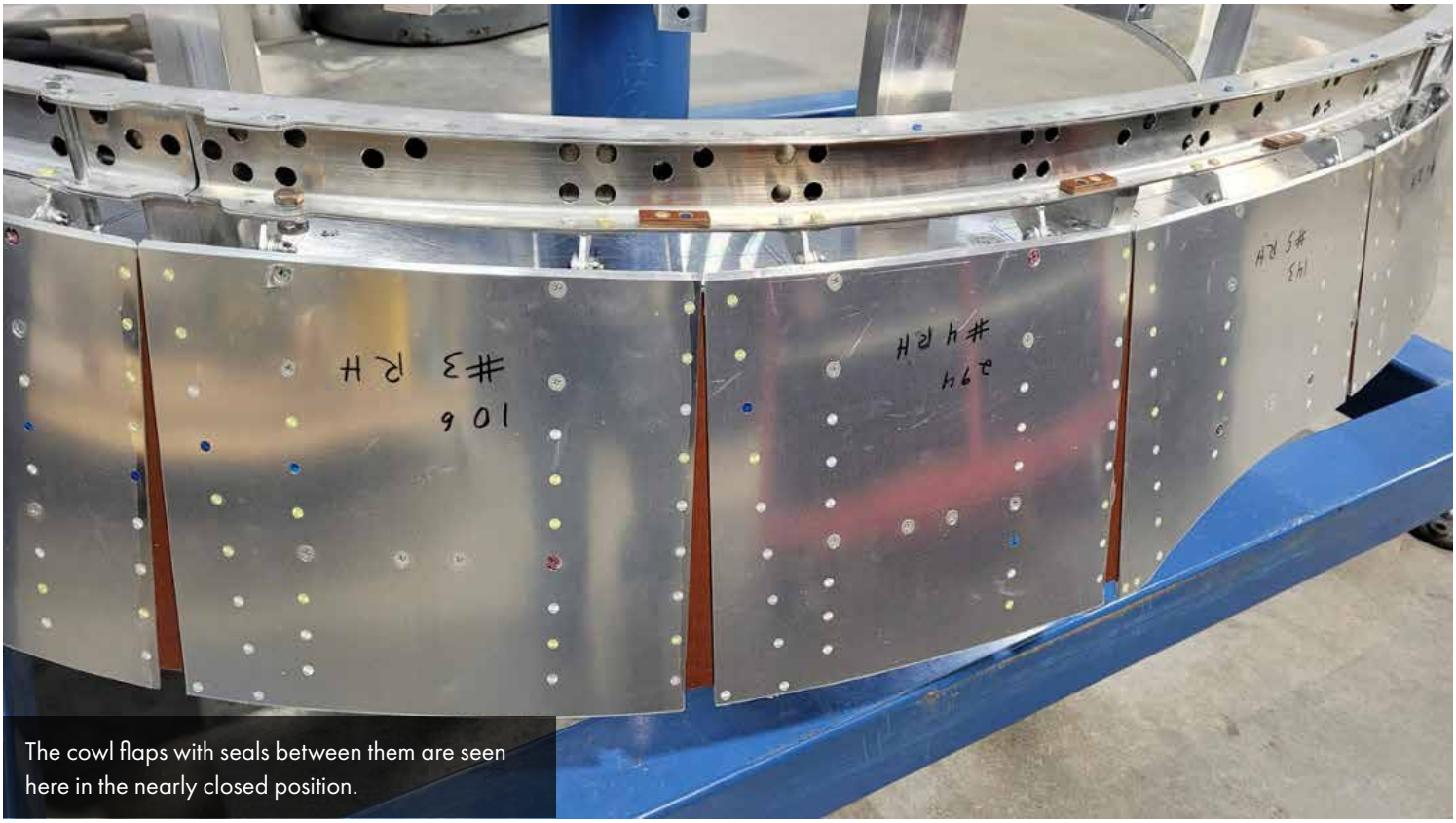
Cowl

The cowl project continues with the cowl flaps.

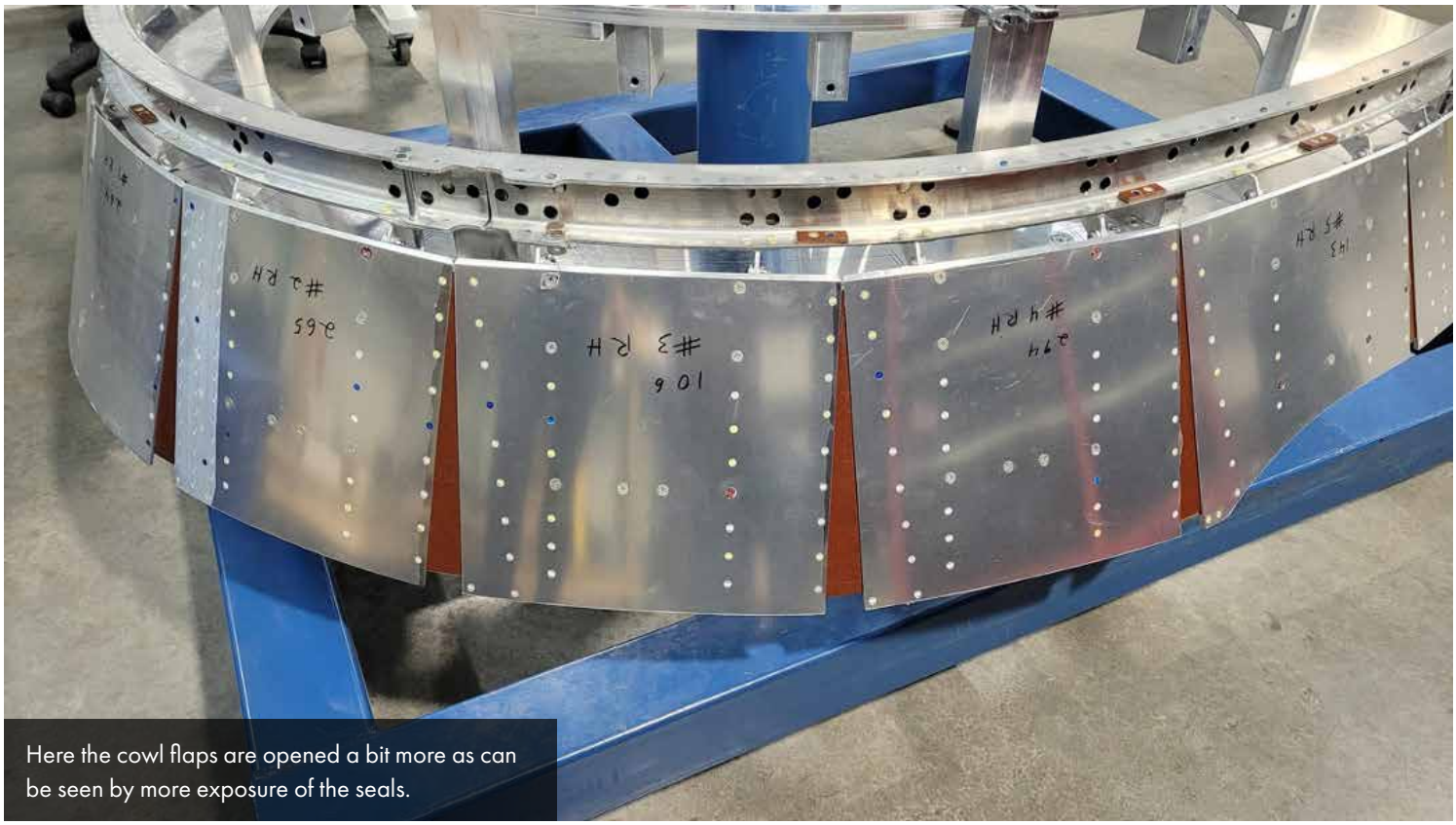


Cowl flaps on a shelf awaiting installation and fitting.

Mike works on mounting the cowl flaps to the cowl ring.



The cowl flaps with seals between them are seen here in the nearly closed position.



Here the cowl flaps are opened a bit more as can be seen by more exposure of the seals.

Fifth Air Force P-47 Tactics in the SW Pacific

When the P-47 first arrived in the SW Pacific theater, it was met with a great deal of skepticism. General Kenney had requested more P-38s because, compared to other USAAF fighters, the P-38 had superior range, speed, and its two engines provided a safety margin in the long overwater flights that missions in the SW Pacific required.

US war planning in 1942-43 held that the war in Europe should take first priority. That meant that aircraft shipments to the Fifth Air Force would be based on what was available after the demands of the ETO had been satisfied. Operation Torch in North Africa also had priority for P-38 shipments, and even the 8th Air Force in Europe was stripped of its P-38s for that effort.

No P-38s were available to General Kenney, so he was offered more P-40s. P-40 performance was marginal in combat with the Japanese fighters in the area and its range was limited. The P-47's range was even more limited without drop tanks, but it had a speed and altitude performance advantage over the P-40 and P-39s still being flown by the 5th AF.

The first P-47 unit, the 348th Fighter Group arrived in Australia on June 30, 1943. Experimentation began immediately on increasing the combat radius of the P-47D-2REs.

These experiments resulted in the 200-gallon belly tanks that were designed and manufactured in Australia, and the Christmas tree tank behind the pilot that 42-27609 is equipped with as a field modificatio. The belly and Christmas tree tanks improved range, but not enough. So, in the summer of 1944, as the Japanese pulled back from Papua /New Guinea and bombing attacks on oil installations in Balikpapan increased, the P-47s were loaded with 3 drop tanks.

The addition of the drop tanks widened the combat radius of the P-47 to as much as 750 miles.

P-47 with 3 drop tanks, probably a P-47M, San Diego Air and Space Archives, https://www.flickr.com/photos/sdasmarchives/15713495834/

This provided an answer to unescorted bomber losses in raids to Balipapan on the island of Borneo, part of the Dutch East Indies. The need for a long range escort in this area was directly related to the enemy's supply of petroleum. Some estimates state that 35% of the refined petroleum products and as much as half of the aviation fuel used by Japan in WWII came from the Dutch East Indies refineries.

"In late September and early October 1944, the US Thirteenth and Fifth Air Forces began long-range bombing raids from Noemfoor. The first two raids suffered heavy losses due to the lack of escort fighters and inflicted minimal damage; however, after a brief pause and a change of tactics by the US airmen, the final three raids resulted in heavy damage to the refineries and the destruction of most of the Japanese aircraft defending."[2]

These and other long range missions demanded specific tactics to achieve success.

P-47s equipped with two 165 gallon drop tanks on the wings and a 75 gallon drop tank on the centerline. USAAF photo

Major John R. Young describes maximum range mission tactics in the book Fighter Tactics inThe Southwest Pacific Area, by Ray Merriam.

The mission Young describes was a long range fighter sweep intended to clear the target area ahead of the B-24 bombers. The target was 835 statute miles from his base at Morotai, Netherlands East Indies, which necessitated hanging 3 external drop tanks on the P-47s. Two were 165 gallon wing tanks and the third was a 75 gallon centerline tank.

The Thunderbolts on this extremne range mission would draw fuel from the large wing tanks until they were emptied or combat necessitated dropping them.

Interestingly, in order to get back home on a long range mission like this, the centerline 75 gallon tank was not dropped in combat. This was a practice that was highly unusual because, in almost all other cases during WWII, the drop tanks were immediately jettisoned when combat was imminent. Dropping the tanks had several desirable outcomes; it improved flight performance and maneuverability, and also greatly reduced vulnerability to fire or explosion should the tanks be hit by enemy fire. In fact, if a drop tank failed to detach, the pilot was usually ordered to

[2] Pratten, Garth (2016). "'Calling the Tune': Australian and Allied Operations at Balikpapan". In Dean, Peter J. (ed.). Australia 1944–45: Victory in the Pacific. Port Melbourne, Victoria: Cambridge University Press. pp. 320–340.

return to base rather than engage in combat with the tank still attached.

However, on a maximum range mission it would have been impossible to return to base without the remaining fuel in the centerline tank, the P-47s on these maximum range missions couldn't get home, so the risk was worth taking. It is also likely that the opposition at this late stage in the war was much less fierce than it had been when Japan's cadre of fighter pilots were experienced veterans. By late 1944 many Japanese pilots were newly trained and inexperienced, and therefore less of a threat.

While it isn't clear from his account which version of the P-47 Major Young was flying, it was probably a D-25 with slightly increased internal fuel over the D-23 version.

In the same book, Captain Leroy Grosshuesch of the 39th Fighter Squadron describes another mission. He specifically mentions the P-47D-16, D-21, and D-23s as having their range stretched to a 750 mile radius of action, with about 15 minutes of combat time over the area of the fight.

The superior maneuverability and the inferior armament and pilot protection of the Japanese fighters along with the P-47's superior armament, ability to survive damage, pilot protection, and diving and level flight speed dictated the tactics.

Grosshuesch explained that once the enemy was sighted, he always tried to position himself and his formation above and behind the enemy aircraft. The P-47s would then make a diving pass on the enemy, firing as they went. Capt. Grosshuesch told his men to keep their speed up to 200 miles an hour at all times in combat and to never chop the throttle.

"One good burst will finish him anyway. My advice is if you don't get him on your first pass, pull off to the side and climb at 200 mph. After you have altitude, come back and do it again."

He also mentioned that he would never refuse a head-on pass because the superior firepower of the eight .50 caliber guns on the P-47 "would take care of that".

Captain Leroy Grosshuesch's P-47 is the nearest in this image. USAAF photo courtesy of Jeff Oerding