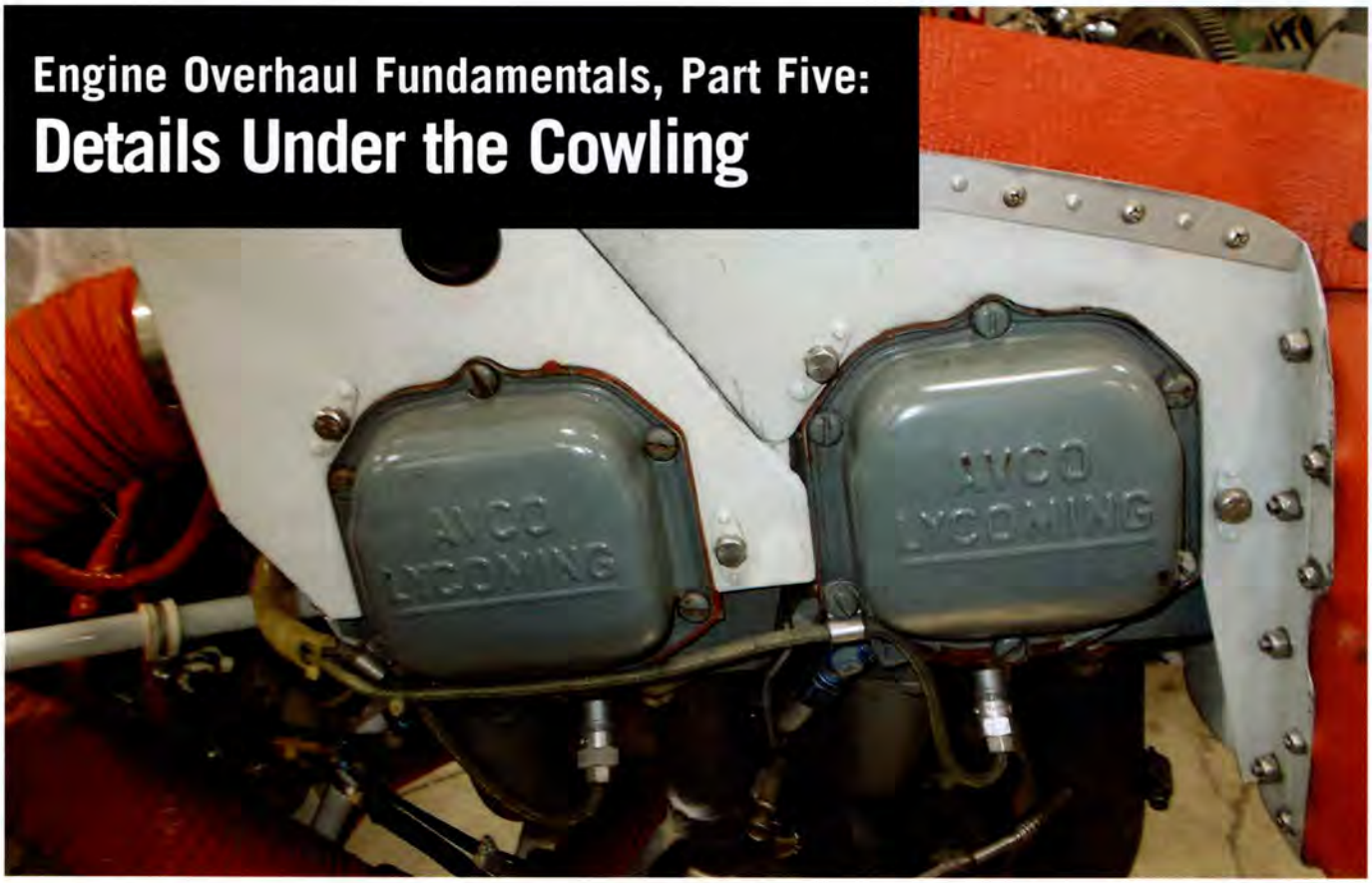
Engine Overhaul Fundamentals, Part Five:

Details Under the Cowling



Last month, DENNIS WOLTER described general cleanup and cowlings. This time around, he dives into the nuts and bolts (as well as bumpers, brackets, clamps and baffles) under the cowling, and how to make sure they're as good as new.

AS we move on in our journey of preparing your airplane for the installation of a newly-overhauled engine, it's time to discuss the next item on the engine bay renovation list—repairs, details and hardware under the cowling.

Many cowlings employ the use of rubber bumpers and mounting brackets that are designed to prevent metal-to-metal contact between the cowling and the hard-mounted engine mount. It's important to inspect the brackets as well as the rubber pads.

If a crack is found in a welded-together bracket, a professional welder should be sourced to facilitate a proper repair. If the mounting bracket is riveted together, have your maintenance technician install a proper repair. Due to the pounding these bumper brackets are exposed to, high-strength riveting processes are required.

While on the subject of brackets, be sure to inspect other brackets such as muffler, alternator, carburetor air box and control cable support brackets. These important components should also be repaired by a licensed technician if necessary. I found three cracked brackets on my own Cessna 172 when I installed a 180 hp engine.

Don't forget to pay attention to the condition of the rubber bumper itself. These important points of contact harden with age and are exposed to a lot of abrasion.

Replacing old hardware

No thorough firewall-forward upgrade would be complete without replacing all the old rusty hardware and clamps.

Two types of hardware are used to hold components together in your engine bay. The first is structural aircraft-grade hardware. The material, manufacturing process, precise dimensioning, design and inspection of this hardware is closely monitored and certified by the manufacturer.

Components such as engine mount bolts, control cables, control linkage and critical mounting brackets are secured with this special hardware. The use of any other type of hardware to secure critical components does not conform to the original Type Certificate of the aircraft. Before replacing these often-rusted or corroded parts, check with your A&P mechanic to determine if they should be the person to replace this hardware.

The second type of hardware used in this area is non-structural hardware. These fasteners are used to secure components that do not perform critical functions or are not exposed to high loads during flight. The screws or bolts that secure the baffles to the engine are a good example of non-structural fasteners.

I like to substitute stainless steel fasteners for these less-critical applications. I have found that marinas and hardware stores can be a great source for corrosion-resistant stainless steel hardware. When in doubt as to which hardware should be used, ask your A&P mechanic.

Clamp use...and misuse

Moving on to the topic of clamps, proper use of the correct clamps to secure hoses, wires and ducting is one of the most frequent incorrectly-executed

items I find when I look in a customer's engine bay.

Unquestionably, the most common misuse of clamping devices is the use of tie wraps where a proper metal clamp should be used. *(Tie wraps are also known as zip ties or cable ties. —Ed.)* Tie wraps become brittle as they age and often break. Worse still, these clamps are made of high tensile strength plastic, that when exposed to vibration, can erode the soft aluminum that instrument, fuel and oil lines are made of. Tie wraps can also erode rubber hoses—ouch!

One of my customers experienced an inadvertent in-flight test of the flame-retardant upholstery fabric we installed in his light twin. A loose tie wrap had finally eaten through a vibrating fuel pressure gauge line behind the instrument panel, resulting in an in-flight cabin fire. Bad stuff can happen in subtle ways.

The proper way to prevent abrasion between two hoses is to use aircraft-grade, rubber-lined Adel clamps secured with proper aircraft-grade hardware. Never secure a flexible duct hose to a flange with a tie wrap. For this job, I'm a big believer in using good-quality American-made screw clamps.

Another clamping issue is that Cessna used steel ratchet clamps on ducting. With time and rust, these clamps become unreliable. Send those bad boys to the landfill! Always check with your A&P for guidance when substituting clamps.

There is one final hose-clamping issue for those of you who fly turbocharged airplanes. The complex induction system that feeds pressurized induction air into the engine is held together with high-tech rubber couplings secured with screw-type clamps. Only OEM clamps are to be used for these critical connections. Any looseness in these clamps can result in a coupling hose separating from an induction tube. Substantial reduction in engine performance can follow.

To help prevent this problem, I use a black permanent marker and put a mark at the edge of every coupling hose. If any slipping occurs, it can be easily detected during preflight inspection by observing the presence of a gap between the black index mark on the induction tube and the end of the rubber coupling. Simple!

Don't be baffled by your baffles

Now, it's on to the biggie in the engine bay refurb process: baffles. Engine baffles and seals must be in good shape in order to direct all-important cooling air around and through the cylinder barrel, head

Mounting bracket repair, secured with bucked aircraft rivets.

Silicone rubber bumper pad, secured with non-structural Marson pop rivets.

Non-structural stainless steel bolt, securing a baffle to a cylinder head.

Non-structural stainless steel machine screws, holding two baffle sections together.

Incorrect use of plastic tie wraps, intended to prevent two hoses from rubbing against one another.

fins and oil cooler to thoroughly cool these critical components.

Over time, engine baffles take a beating from exposure to vibration, heat, maintenance events and, you guessed it, corrosion. If you have an older, high-time airplane, it might be time to invest in an aftermarket FAA-approved baffle kit. Check the internet to source these well-made kits *(or look below in Resources. —Ed.)*.

Cracks as well as broken mounting holes and tabs are the most often-needed repairs when preparing reusable baffles for reinstallation. Let's start with cracks. Begin with drilling a 1/8-inch diameter stop hole at the end of the crack, then fabricate an overlay scarf patch made of 2024-T3 aircraft aluminum of the same thickness as the existing baffle.

Since engine baffles are not considered to be a structural component, an overlay scarf patch can be secured with common hardware store 1/8-inch pop rivets. Locate the mounting holes at least twice the rivet

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shank's diameter from the edge of the repair material. For example, 1/8-inch rivets should be set back 1/4 inch from the edge of the repair material and the center of the rivet.

The rivets should be spaced approximately 5/8 inch to 3/4 inch apart, measured from the center of the rivets. These rivets are available in different lengths and for most baffles, rivets with an unpulled shank length of 5/16 inch are correct. We use AB4-2A rivets sold under the brand name of Marson.

Once the rivets are installed with a rivet puller tool, I like to set them a little tighter by backing the formed head of the rivet with one hammer and carefully striking the factory head of the rivet with a second hammer. This process will spread the formed head of the rivet a little more, increasing the strength of the rivet. It also looks better. Practice this on some scrap metal first.

Replace a missing baffle mounting tab by fabricating a new tab from aircraft aluminum and riveting it in place, using the previously outlined riveting process.

No baffle renovation process would be complete without painting the repaired baffles. Start by thoroughly cleaning the aluminum baffles with lacquer thinner or

The correct use of two rubber-shielded Adel clamps, secured with 10-32 stainless steel machine screw and a self-locking nut.

At left: a less-reliable spring clamp. At right: ratchet clamp.

A black line drawn with a marker helps identify a loose turbo system coupling hose.

A rivet puller and 1/8-inch non-structural Marson rivets, used to repair baffles.

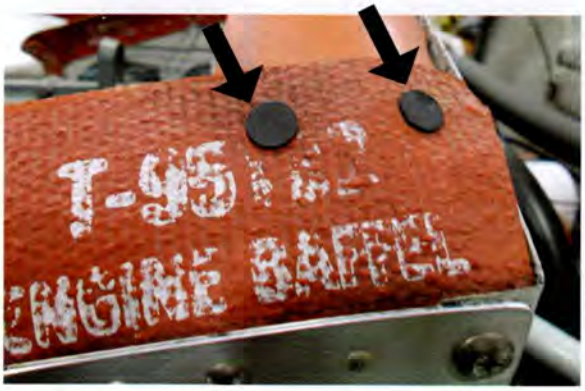
A cracked corner, repaired with rivets and a doubler scarf patch.

Use two hammers to more tightly set a pulled Marson pop rivet.

Scotch-Brite pads for surface prep, SEM Self-Etching Chromate Primer and acrylic professional baffle finish.

New silicone rubber baffles, secured with 6-32 stainless steel machine screws, self-locking nuts and an aluminum doubler strip.

Nylon Auveco fasteners and No. 10 countersunk stainless steel fairing washer.



Airtight, neat-looking corner, secured with Christmas tree-type fasteners and a fairing washer (not visible).

mineral spirits and red Scotch-Brite pads. Then, apply a coat of self-etching, aluminum-compatible primer. We like SEM Self-Etching Primer No. 39693. Lightly scuff the dried primer with a gray fine-grit Scotch-Brite pad, and apply a finish coat of lacquer or enamel base spray paint.

The final step in baffle renovation is to replace the often ratty-looking and poor-sealing soft baffle seals. These seals were originally fabricated from cloth-impregnated black rubber or a more durable orange silicone rubber material. This orange material is available from Aircraft Spruce. I think it's well worth the investment to buy orange silicone rubber material. *(For a list of CFA supporters that offer baffle kits and supplies, see Resources. —Ed.)*

Using the original baffle seals as a pattern, lay out and cut the new material with a pair of sharp industrial scissors. Don't pass up the opportunity to modify the design of the original seals if it will improve the quality of the seal between the baffles and the cowling or engine. Your A&P should be consulted as to any changes you may want to make.

Cessna secured the flexible seal material using either staples or rivets. An easy and more secure method to install and mount the baffle seals is to use stainless steel 6-32 screws, self-locking nuts and a 3/4-inch wide doubler strip made from 0.040-inch aircraft aluminum. The picture at left (center image) shows it all. It looks great, works well and makes future replacement of a worn baffle seal easier.

One final baffle seal issue is how to better connect the seals at standing corners. As originally installed, these corners were left to fend for themselves. Often, when the top cowling was installed, the baffle material would flop away from the incoming side of the flowing air, resulting in a poor seal between the baffle and the cowl.

The fix is to leave a little extra material in these corner areas when cutting the new material. Then, fold the corner seal inward on itself and secure it with a nylon Christmas tree-type mounting fastener manufactured by Auveco, Part No. 14021, pressed into a No. 10 stainless steel countersunk aircraft fairing washer available from Aircraft Spruce, Part No. 04-00398. It holds well, looks good, is easy to remove, and the head of the nylon fastener won't damage the painted surface of the cowl if it rubs against it. I love found-object engineering. Necessity is the mother of invention.

Enough writing for now. It's time to get out in the hangar and work on an anxious customer's interior.

In the next article, we'll wrap up the firewall-forward topic by discussing how to deal with the electrical system, ducting and a few minor details that add up to a like-new renovated engine bay.

Until then, fly safe! CF

Industrial designer and aviation enthusiast Dennis Wolter is well-known for giving countless seminars and contributing his expertise about all phases of aircraft renovation in various publications. Wolter founded Air Mod in 1973 in order to offer private aircraft owners the same professional, high-quality work then only offered to corporate jet operators. Send questions or comments to editor@cessnaflyer.org.

Resources

BAFFLES AND BAFFLE MATERIALS – CFA SUPPORTERS

Aircraft Spruce and Specialty Co.
aircraftspruce.com

Airforms Inc.
airforms.biz

Air Plains (172 baffle assembly parts)
airplains.com/172-baffle-assembly-parts

Knots 2U
knots2u.net/search
php?search_query=engine+baffle

Univair Aircraft Corp.
univair.com/search.php?search_
query=cessna+baffle&Search=

Wag-Aero
wagaero.com/restoration/seals-baffle-material/engine-baffle-gasket-material.html

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HARDWARE

Aircraft Spruce and Specialty Co. (washers)
aircraftspruce.com/catalog/hapages/stainlesswashers.php

AFS Marson (rivets)
afsmarson.net

Auveco (nylon fasteners)
auveco.com/fascia-retainer-14021

BAFFLE PAINT

SEM Products
semproducts.com