INTERIOR RENOVATIONS - PT. 1

by Dennis Wolter, Founder & Owner, AirMod Inc.

Old Airplanes, New Challenges

With the cancellation of this year's convention, Bob Thomason and I discussed the possibility of having scheduled speakers present their programs to the members in the form of articles in the magazine. By doing so, we believe this may help fill the void created by the cancellation of the 2020 convention, as well as benefit both current and future association members in some valuable ways.

Before diving into the topic at hand, I think I should introduce you to Air Mod. Founded in 1973, Air Mod has grown to a company of ten team members who are dedicated to executing the highest quality, thorough aircraft renovations possible. As founder and manager of the company, I have a bachelor's degree in industrial design from the University of Cincinnati, I am a licensed A&P and IA, I learned to fly in the early 1960s and I hold a private license with an instrument rating with 3200+ hours in my logbook.

My company is fortunate to have a dedicated long-term staff, some of whom have been with us for 30 years. We specialize in ergonomic custom interiors, enhanced passenger restraints, ventilation modifications, windshield and glass installations, custom instrument panels, auxiliary fuel system installations, soundproofing and, most importantly, mitigation of aging aircraft issues, particularly cabin area corrosion.

Producing an award-winning Twin Cessna interior like this one in Philip Preston's 310L takes lots of upfront prep work to do properly.

All of the technicians who work on the airplanes have been through, or are currently enrolled in, the airframe and powerplant program at a local technical college. Air Mod was chosen by AOPA to renovate the interiors of five of their sweepstakes airplanes and by EAA to renovate the interiors of more than ten of their sweepstakes airplanes. I can truthfully speak for our great staff when I say that we all share a deep passion for these airplanes and the work we are privileged to do to them.

Now that you know a little about us, I think it's time to get back to some benefits I see in writing these articles.

Dennis Wolter, founder and owner of Air Mod, recently received the 2020 FAA Maintenance Technician of the Year Award.

First: Technical information presented in articles can enhance the purchase and ownership experience by helping owners understand the many challenges of owning a 40 or 50-year-old airplane. Knowing what is hidden behind interior panels and under floors equates to better maintenance decisions, protection of your investment, and safer and more enjoyable airplanes.

Second: Technical articles archived by a type club become permanent records that provide needed technical guidance on maintaining old airframes. Think about what is contained in the maintenance manuals written 40 or 50 years ago when these airplanes were new. These manuals lack the information needed to address the aging airplane issues we deal with today.

Third: Asking speakers to submit written articles that cover their postponed convention topics may motivate these technicians to write additional articles. For some, writing an article can be an intimidating challenge; it certainly was for me. Fortunately, I married a lovely and patient gal who, years ago, actually paid attention in English class. So, I write down my thoughts, throw in a few photos and my chief editor turns my not-so-great writing into a document that is actually understandable (thank you, Cynthia). So, I guess I'm challenging my fellow maintenance technicians to start writing. You'll be surprised at how easy it can be to get the hang of it.

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INTERIOR RENOVATIONS

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Factory support for our legacy airframes is eroding. Older and knowledgeable technicians are retiring or have passed away, taking a very valuable information base with them to the great beyond. Years ago, a truly knowledgeable and generous Beechcraft expert and author named Norm Colvin once told me something that really resonated with me. "It's not what you did on this earth but what you are able to leave behind that really counts". We all need to do what it takes to maintain and preserve these airplanes.

Back in 1973 when I started Air Mod, I was able to complete a new six-place interior in two weeks with the help of one employee and some long days. This would have included all new cabin insulation, new foam, upholstered seats, side panels, headliner, new carpet, painting of cabin trim components and usually a not very long list of add-ons.

Fast forward to today with ten employees working on four to five 40+ year old airplanes in the hangar at any one time. It takes six to eight weeks or longer to complete a four or six-place interior renovation. As these articles will show, the reasons for the significant difference in time required are due to aging airplane issues. Think of it, with the cabin stripped out and floorboards removed, we get to see cabin systems and structure in a way they haven't been seen since the airplane rolled down the assembly line. All of the many things that are not seen during normal maintenance events are now open in plain view. This can be a real reality check.

I have included a few photos (see page 20) of some fairly typical problems we uncover as we go through the process of renovating the interior of a 40 or 50-year-old Cessna twin. Of the many issues we must deal with while doing this work, corrosion is definitely one of the biggest. The days of simply recovering seats and side panels, installing a new headliner and carpet in a 40+ year old airplane are long past.

Other than the big issue of corrosion, factor in old soft ducting, sketchy wiring, old fluid hoses, rusted cables, leaking windows, lots of dirt and critter infestation. These things take the work scope well beyond just doing a new interior. All this talk about old stuff points to how important I believe it is for any shop doing this kind of work to have a full-time licensed A&P technician on staff to evaluate and mitigate all of the issues.

Now it's reality check time. There is no way to predict how long it will take or how much it will cost to execute a thorough renovation project in an older airplane. With that said, it is important to keep an owner informed as to what is found during the initial tear down, as well as to provide weekly progress reports complete with photographs. An informed customer is a happy customer.

I would like to close out this introductory article with some important rules to follow when putting together a good renovation plan.

1. Join your type club. The technical support and communal activities are invaluable to the owner of a legacy airplane.

2. Get a very thorough pre-purchase inspection from a qualified technician sourced through a type club. Don't buy a dog.

3. Fly the airplane for at least a year and build a well-researched and sequenced renovation plan for your new old airplane.

4. Definitely visit any shop before committing your project to their organization.

5. Before agreeing to having a shop perform a major modification to your airplane, ask to see the required FAA paperwork to verify that the mod in question is approved for the make, model and serial number of your aircraft. (We have seen some sketchy things in 47 years in business.)

The time to save these old airplanes is now. The industry is not producing enough new airplanes to replace our aging fleet. So, stay tuned and we will provide tips, tools and information to help save your airplane for the next generation of pilots. Here's the good news: a lot of the work required to address these critical issues can be legally performed by an owner under a provision in the FARs, part 43 appendix A (c). I would advise the supervision of your A&P mechanic. More on this as we go along. Until next month, fly safe!

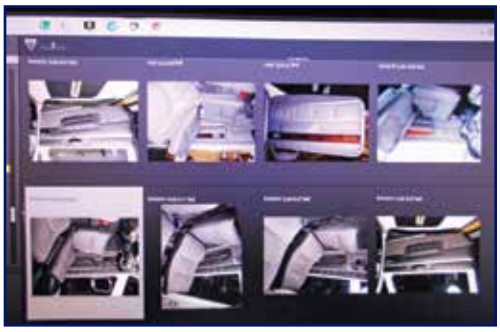
See page 20 for photos of interior issues found while prepping for a new interior installation.

INTERIOR RENOVATIONS - PART 2

by Dennis Wolter, Founder and Owner, Air Mod, Inc.

After thinking about it for perhaps quite a while, it's finally time to renovate your interior and your research has led you to a company like ours. The day arrives when when you drop off your airplane at our shop. Plan to spend three to four hours for a review of all the details involved in renovating the interior. Due to the fact that there is a Beech/Cessna service center on the field, as well as a full-service avionics facility, representatives from those businesses will also be present at this initial meeting to coordinate any avionics upgrades, annual inspection, or other outside work you may want to take care of while we're doing our interior renovation.

This process actually begins long before drop-off day. Over the years as I have presented seminars, written articles and communicated with aircraft owners, I have stressed how important it is for an owner to keep a notebook in the airplane. As you cruise along, take notes on items you or your passengers feel need to be improved, modified, or added to the cabin. Think of such things as better ventilation, lower cabin sound levels, uncomfortable seat issues, air leaks, deficient cabin heating, cumbersome or inadequate passenger restraints, tedious door latches, better cabin and instrument lighting, storage issues, defective seat latches and reclining mechanisms, nonfunctioning components, etc. Pilots and passengers relate to the airplane by the condition, comfort, safety, and design of the cabin. Taking notes of these cabin conditions will help to ensure that important improvements will not be overlooked when the interior is renovated.



Computer images of previously completed projects organized by aircraft make and model.

Forty-seven years of working on customers' airplanes has proven to me that renovating a new-to-you airplane shortly after being purchased can be a big mistake. It's amazing how extensive and detailed some of the wish lists are that our customers put together as they fly the airplane for a year or two.

Here's another good reason to fly your newly acquired airplane before jumping into making changes and improvements: A good renovation plan is one where cosmetic projects such as interior and paint are normally best done last. It seems that owning and flying a new-old airplane almost always leads to some potentially invasive maintenance and upgrade projects that could compromise new paint and interior. Avoid the unnecessary wear and tear, fly the airplane, get systems repairs and upgrades out of the way, then make the airplane beautiful.

> *"...renovating a new-to-you airplane shortly after being purchased can be a big mistake."*

That said, there are some tasks that can be more conveniently undertaken when combined with another project. Installing avionics and autopilots while the interior is removed and the cabin is cleaned and corrosion-proofed allows avionics technicians to have total access to the cabin for removal of old wiring and neat installation of the new stuff. Keep in mind that new windows should be installed before new exterior paint. Actually, an ideal time to install windows is when the interior is removed.

A great source of information in the planning of projects and improvements can be talking to seasoned type club members who have been through this process a time or two. They can also help steer you to quality shops who have provided good results. If applicable, ask about how a shop handled a problem that may have arisen. You want folks

Customer material choices with a hand-drawn design sketch created by me with input from the customer.

who are as enthusiastic about solving an unforeseen post-delivery issue as they were to sell you the job in the beginning. Other owners are the best source for this information. Passion is the main reason most people buy an airplane, and the good technicians out there share that passion. I can honestly say that there are many, many aircraft technicians who love this work and truly support general aviation. It is important to find and support these shops.

OK, it's time to get off my soap box and get down to the business of renovating airplanes. When the airplane arrives at our shop, we begin by taking the owner's previously generated wish list, inspecting the airplane, and going

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One of several mock ups we have in our front office.

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Custom fitting in a seating station to ensure correct ergonomic geometry that accommodates the physical dimensions of the pilot.

over every item on the list. We discuss how best to incorporate those items in the renovation, as well as to discuss any issues we observe that need to be addressed. This meeting will generate an all-inclusive in-house detailed list that we will follow as we progress through the project. We then go into the office, where pictures of previous projects, sketches, and material samples help us design a custom interior. Next, the customer sits in one of several display seats and cabin mockups as we do a complete ergonomic study,

Typical tear-down report and supporting photos.

ensuring that the lumbar, thigh, and cervical (neck) shapes on the seat are carefully dimensioned to comfortably accommodate the person sitting in that seat. The other seating stations will be ergonomically dimensioned to accommodate what the physical design world considers to be the current 'standard measure of man.' Building a seat to these dimensions will comfortably accommodate 90% of adults. It is not uncommon for us to custom fit a favorite seating station for a spouse or other frequent flyer.

We also evaluate such things as armrest height, clearance above the person's head, and glareshield height, again following specific dimensions and measurements according to the customer's need. Going through this process ensures that the new interior will greatly increase comfort and reduce fatigue on long flights.

At this point, we usually take the customer to the Cincinnati airport for a commercial flight home (unless they were lucky enough to have a friend follow them in another airplane).

It's time to get to work! The first thing we do is to fire up the airplane and ground check as many of the systems as possible as we taxi the airplane over to the radio shop for a complete avionics and auto pilot pre-project ground check. Should an existing problem be discovered, the avionics shop will email the owner to see how or if they would like to resolve the issue. At the end of the project with our work completed, we repeat the taxi run-up and avionics check before returning the airplane to the customer. The benefit of all this testing is that we avoid the possibility of returning an airplane to a customer with a problem we may have created during the renovation.

With the airplane back in our hangar after the avionics check, we begin the eye-opening process of disassembling and inspecting the entire cabin, components and systems, and documenting our findings, enabling us to create an itemized "tear- down report" complete with photographs and cost estimates of repairs needed. This information is emailed to the customer within ten days of project start-up. And the pictures don't end here. As we progress through all stages of the project, we send the customer updated images of repairs being made and work being completed. A phone call accompanying the emailed pictures keeps everyone up to date as we progress. Stay tuned next month as we continue to walk through every revealing step in this process. Until then, fly safely!

INTERIOR RENOVATIONS - PART 3

by Dennis Wolter, Founder and Owner, Air Mod, Inc.

Developing the Tear-Down Report

Dennis Wolter, founder and owner of Air Mod, recently received the 2020 FAA Maintenance Technician of the Year Award.

In the previous two articles we discussed the many issues that can be seen when we have the advantage of inspecting the cabin structure, components, and systems of a Twin Cessna with all of the interior components removed. Cessna 310s built in the late sixties are fairly representative of what we typically find in a 50-year-old airframe. All of our findings are recorded in what we call our 'tear-down' report.

With an avionics check and ground-run completed, and before we begin to remove any interior components, we first secure all personal items in a safe place, and then remove and store aircraft documents, logbooks, and related paperwork. A licensed technician will test every electrical component before unhooking the battery.

Now the real work begins as we organize

Inspecting a stripped seat frame for structural integrity and mechanical condition.

The nylon retaining sleeve that snugly holds the shoulder harness in the seatbelt buckle is often badly worn or missing, contributing to possible disconnection of the should harness.

the removal and careful storage of every interior component. We begin by removing, stripping, and thoroughly inspecting the seats. We look for cracked seat frames, worn tracking rollers, feet and seat stops, as well as the function of reclining mechanisms and passenger restraints. These components are what protect the occupant in the event of an accident. It's surprising how often we find seats and seat belts that are in service but not in airworthy condition. Seat issues we see too often involve missing, damaged, or homemade seat stops. These seemingly innocuous little items are a very important part of the seat structure. Missing or incorrect seat stops can lead to a seat coming off its mounting rails during an accident. Need I say more?

As the seats are being removed, careful attention is paid to seat belts and shoulder harnesses. We often find incorrect mounting hardware, worn webbing, and believe it or not, belts that were re-webbed using a home sewing machine; this type of stitching will not hold up in an accident. Everything here must conform to FAA approved standards. Remember this: "You can't write the check on the way down."

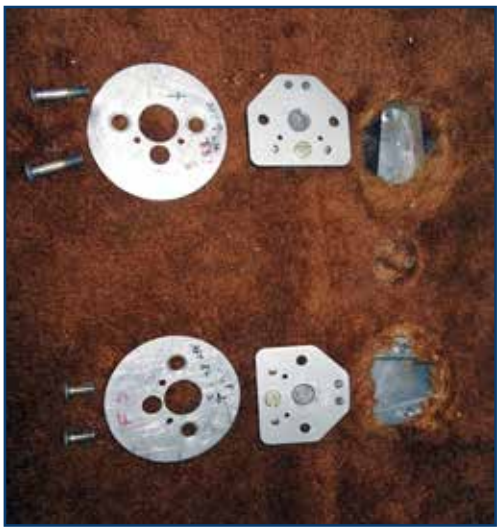
With seats removed, it's time to remove the floor carpets. We get a first look at the condition of the floorboards. Often these thin aluminum floor panels are damaged. We also remove the floor-mounted quick release mountings, which are often so worn or compromised with years of dirt accumulation that they do not latch properly. More on what we often find under the floor later.

Next item on the tear-down list is to remove the plastic window trim, armrests, and side panels. The old plastic window trim often necessitates extensive repair or replacement. Fortunately, Plane Plastics makes most of the replacement plastic parts for almost all of the piston Cessnas, including twins. However, these approved aftermarket parts do require some trimming and fitting to achieve a quality installation. If an original part can be economically repaired, we will rework and reinstall the original piece.

Homemade seatbelts: Note unapproved sewing and stitching pattern and absence of required certification tag.

With the window trim removed, we remove and inspect the armrests and side panels. Cessna originally fabricated the side panels using very thin .016" aluminum. Years of removal and reinstallation due to avionics installations, maintenance, or an interior change or two means these old side panels will have to be newly fabricated using more durable .020" and .025" aircraft aluminum.

Damaged floorboard.



Floor-mounted aft seat mounts.

The armrests in Cessna piston twins are known for being lightly made and poorly mounted. Making new side panels and re-working armrests creates the opportunity to greatly improve the aesthetics, durability, and maintainability of these components.

The next interior component to be removed is the headliner. Cessna employed two different ways to hang a stretched vinyl or cloth headliner in their piston twins. The earlier models used a system of sewing a canvas loop at the edge of each full-length headliner seam. A long, tempered 1/8" diameter tempered steel rod is run through the canvas loop. Cessna installed clips at each bulkhead between the upper aft end of the windshield frame and the aft cabin bulkhead. The clips would hold the rods securely as the headliner is hung, stretched, and bonded to a lengthwise longeron above the cabin windows. Removing this type of headliner involves pulling the outer edges of the material loose and unclipping the rods at each bulkhead.

Typical condition of a 40-year-old plastic window frame.

Almost every older Cessna twin will require new, more durable side panels and armrest mounts.

The second system Cessna employed in the later piston twins is a full-length aluminum extrusion and a plastic C-shaped channel that would hold full length cloth or vinyl panels in place. The design of the rail and channel holds the finish material securely in place when it is wrapped over the edge of the plastic "C" channel, and the plastic channel is pressed up into the aluminum extrusion — simple. To remove this type of headliner, all you need to do is start at one end of the headliner and progressively pull the "C" channel down and out of the aluminum extrusion. This plastic "C" channel is often damaged and must be replaced.

The last item to be removed is that lovely old fiberglass insulation. As this activity is in progress, we are photographing any damaged or worn items to be called out on the tear-down report. We're also organizing all the many interior components in a dedicated storage system so we don't lose track of anything. Reassembly is so much easier if nothing has been misplaced!

With all of the interior components and insulation removed, a thorough inspection is made of the cabin structure, systems, and above and below the floorboards. Seeing what has been hidden from view for 40+ years can be an eye-opening experience for an owner.

Extruded aluminum headliner retention rail system found in newer Twin Cessnas.

Thanks to the convenience of digital photography, we will start a detailed journey next month showing all of the aging airplane issues and how to best repair anything that needs to be fixed. As we work our way through the cabin renovation process we will leave no stone unturned. Until then, fly safely!

INTERIOR RENOVATIONS - PART FOUR

by Dennis Wolter, Founder and Owner, Air Mod, Inc.

Dennis Wolter, founder and owner of Air Mod, recently received the 2020 FAA Maintenance Technician of the Year Award.

The tear-down and inspection procedures described in last month's article involve four to five days of work and documentation. Armed with digital images and notes concerning any aging airplane issues that need to be addressed, it's time to prepare a detailed tear-down report. This comprehensive report will be sent to the customer. It is accompanied by a photograph of each area of concern, and an estimate of what it will cost in labor and materials to resolve the issues.

As mentioned earlier, of greatest interest when evaluating the condition of a now 40- to 60-year-old airframe is corrosion. Due to the existence of so many different moisture retaining, hydroscopic materials - all concentrated inside the cabin - the cabin area never truly dries out in many cases. Carpet, foam, fabric, and insulation all absorb and retain moisture. As the airplane climbs to cruising altitude it can experience a 30-40 degree temperature drop.

This change in outside air temperature causes moisture-laden materials and insulation that are up against the cold aluminum skins to produce condensation on the inner surfaces of the cabin skins. This subtle moisture cycling of the cabin accelerates the corrosion process on the bare aluminum cabin skins and structure. Add leaky windows and doors to the mix, and older airplanes have

Tar-covered cabin skins and structure.

Typical oily mess found in the belly of a 40- to 50-year-old piston Twin Cessna.

become flying humidors. (You can store your cigars in the glovebox.)

There are a number of Twin Cessnas that were not zinc chromated when they were built. Zinc chromate and other corrosion-resistant coatings perform two corrosion-controlling jobs. First, these coatings are dielectric. In plain English that means they have non-electron-conducting properties. When bonded to a metal surface, these coatings stop the flow on the surface of the metal, destroying electrons and reducing oxidation on the surface.

The other corrosion-fighting property is that these products create a moisture barrier, stopping condensation from coming into direct contact with the surface of the metal. This eliminates some major corrosion-causing issues in aluminum airframes. This is why, about 15 years ago, our company committed to thoroughly clean and chromate every unchromated airplane that comes through our facility.

We begin the corrosion clean-up process by pressure-testing door and window seals. This simple process involves having someone inside the cabin blow compressed air at the edge of a window or into a door jamb, while a person outside is brushing soapy water at the same area. The presence of bubbles indicates leaks. Problem areas are then photographed and noted on the tear-down report.

If significant window leaks are detected, it may be necessary to remove the window, inspect for corrosion, and properly reseal and reinstall the window. In the majority of cases, the leaks we find in non-pressurized Twin Cessna twins can be sealed by neatly masking and applying a clear bead of LP Aero aluminum-compatible silicon seal around the entire perimeter on the outside of the window.

Now the fun begins. We thoroughly remove all old glue, corrosion, and dirt from every inch of the cabin, floors and below the floors, in preparation for the application of zinc chromate, which is

Skin damping tar partially removed by careful heating with a heat gun and scraping with a plastic scraper.

applied to all cabin skins and structure below the lower edge of the cabin windows.

We bill this tedious clean-up work at 3/4 shop rate. In an effort to reduce project costs, we don't normally chromate the cabin tops as we rarely find corrosion in the upper cabin areas of low wing airplanes.

The tools required to complete the pre-zinc chromating process are wire brushes, heat guns, plastic scrapers, Scotch Brite, 3M Roloc aluminum-safe abrasive cleaning wheels, lacquer thinner, mineral spirits, compressed air, toothpicks, aluminum foil, personal protection equipment, and most importantly, a lot of patience and tenacity.

The process begins by removing all the old fiberglass residue with handheld wire brushes. Then we carefully use heat guns and plastic scrapers to remove the bulk of old skin damping tar. Next comes the tedious process of using a mix of lacquer thinner and mineral spirits to remove all the remnants of tar residue. Now it's time to use Roloc rotary abrasive wheels and Scotch Brite to remove any corrosion from the bulkheads, stringers, and cabin

One section of a 310 cabin side skin, thoroughly cleaned with Scotch Brite and lacquer thinner.

skins. Next comes detail cleaning deep into tight spots where bulkheads and stringers are riveted to skins.

A particularly important step is to use compressed air and toothpicks to remove any contaminants trapped

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INTERIOR RENOVATIONS

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Corrosion often seen on a cabin side skin once the tar is removed.

All chromated and finally ready to proceed with the interior renovation.

between mating structural components. This entire process takes several days. Antiseptically cleaning the cabin from forward to aft bulkheads, top to bottom, and deep into spar areas allows the zinc chromate to help protect the entire cabin area from future corrosion.

With the inner cabin shining like a new airplane, we use aluminum foil to mask all the stuff that shouldn't be sprayed with zinc chromate. Aluminum foil is great for this, easy to apply, conforms to any shape, stays in place, and is easy to remove. This protection means we won't have issues with wires being pulled out of plugs.

We also use this process in those leaky wing lockers. We have found some serious corrosion in these lockers due to the fact that Cessna glued the liner material to the bare aluminum surfaces. When we reinstall the new floor mats in the wing lockers, we always back them with closed cell foam and secure them in place with velcro. This allows for easy removal and drying of the mats if they become wet from water leaking into the lockers.

A 310 cabin, antiseptically cleaned showing partially masked wiring, cables and servos, almost ready for the application of zinc chromate.

After everything is sprayed with zinc chromate, we will carefully apply Corrosion X or ACF50 to hard-to-reach places in both the main and aft spar areas as an extra precaution in our fight against corrosion. These airplanes are not replaceable, and it's rewarding to see the passion that folks put into their ownership.

Is this investment of time and cost to take the clean-up process to this level worth it? I definitely think so. At delivery we provide customers with a record of all pictures taken throughout the entire renovation process. Over the years, we've been told by many of our customers that the images of the clean-up were of great interest to a prospective buyer at resale time.

Next month we will start with a licensed technician inspecting cabin systems, structure, and components. Then we'll actually get into the process of renovating the interior of your Cessna Twin. Until then, fly safely!

INTERIOR RENOVATIONS - PART FIVE

by Dennis Wolter - Founder and Owner, Air Mod Inc.

The devil is in the details - heard that before? Wow is that true when renovating old airplanes. Now that the cabin is completely stripped out and inspected, we are at the point in the renovation process where we've identified all the stuff that needs fixing. The one word that most drives the level of component repair that a specific renovation project will require is AGE, and almost every seasoned airplane owner knows that word well. Sure, good maintenance, dry enclosed storage, up-to-date completion of service bulletins and AD notes, and non-abusive flying techniques all can help keep an older airplane in good condition. However, our experience over the years has been that the older the airplane, the more extensive the tear-down inspection and fix-it list will be. With regard to fixing aging airplane issues, older 310s lead the pack in the renovation game for Twin Cessnas.

An older 310 is a good airplane to use as an example as we show some of the many issues we uncover during a renovation project. These conditions must be corrected in order to consider that your Twin Cessna cabin renovation is a thorough one. As with any renovation, be careful to start with a good airframe for this kind of project. A thorough pre-purchase inspection by a qualified expert is an absolute must.

After some thought, I decided that the use of numerous photographs would be a good way to illustrate the many common issues we deal with when renovating the entire cabin of a Twin Cessna. One particularly important point that I would like to make is that this level of work should probably be undertaken only on your forever airplane. Whether you're renovating a 172 or a 421, you will have invested more money by the project's completion than can be recouped when selling it. In some cases, you might even have more invested than the entire airplane is worth. The return on investment comes from having made high quality improvements that you can take advantage of for a long time, all while providing the peace of mind that you are flying a beautiful, reliable, capable and, most importantly, safe airplane that is custom-designed and upgraded to your personal taste and needs. One more point as we work our way through all of this is to ask yourself what, if anything, that is uncovered when the cabin is completely stripped out would you want not to have been corrected. What safety-oriented airplane owner wouldn't want to address all of the problems and sub-standard conditions? Be realistic about the time and money involved in this. The images that we've included in this article were chosen because they represent typical problems we find in these now older airframes.

It's important to remember that older Twin Cessnas are handmade machines. The ravages of time and invasive maintenance events have taken things beyond the realm of the original maintenance manuals that were written when the airplanes were new. Thus information contained in articles like this should be included in the list of items that should be inspected and repaired as we continue to maintain the aging fleet of legacy airplanes.

OK, the lecture is over, let's get started. This first and most important group of issues include those that affect safety. Topping the list in this category are seats, seat rails, and passenger restraints. See the photos on page 22. It's disturbing to note that all of these problems were found in airplanes that either were currently in Annual or had recently undergone an annual inspection. This is why we need to go beyond the work specified in maintenance manuals and go deeper in the inspection process in order to identify and correct aging airplane issues.

The safety discussion isn't over yet. Next month we will talk about your cabin and inflight fire prevention. There is a lot an owner can do to prevent the frightening experience of having smoke in the cockpit. Until then, fly safely!

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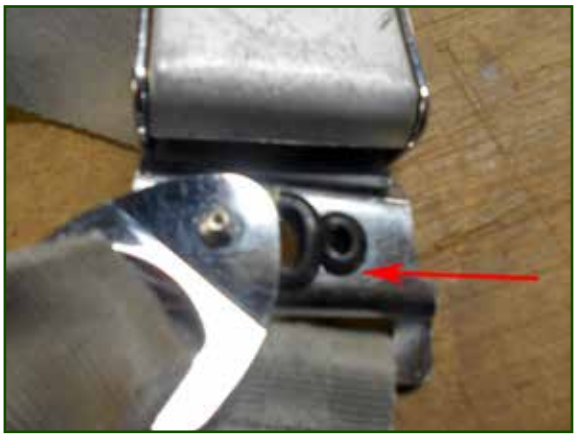
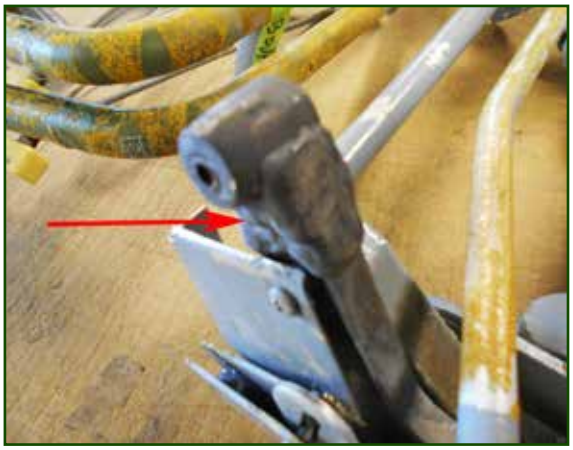
Left: Badly damaged seatbelt attach fitting. All repairs or reconditioning of passenger restraints and their mountings must be done by an FAA certified repair station where they can repair, certify, and quickly ship the belt back to the customer.
Right: An un-airworthy, 'found object engineering' attempt using rubber grommets to replace the nylon locking bushing that secures the shoulder harness to the lap belt. No, thank you.

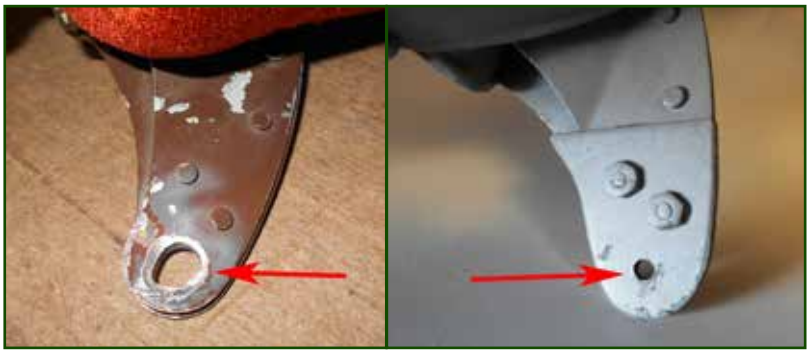


Left: Bent mounting lugs that secure the 5th and 6th seats to the quick release floor hard mounts in a 310. Bent lugs usually result in the seat not being completely locked in place. These mounting lugs also secure the seatbelts to the airframe. Yikes!
Right: Welded repair on an articulating pilot seat back support brace. Cracks are often found in this critical seat component. The best fix is to replace the brace.



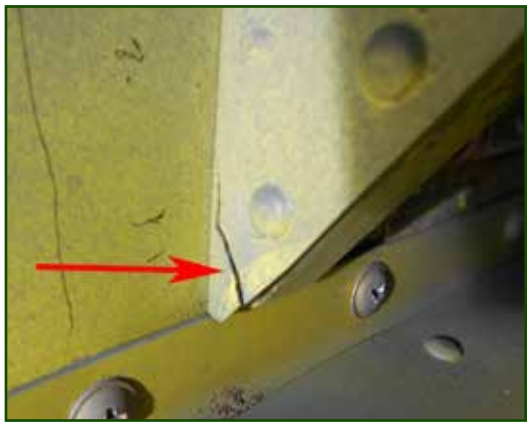
Left: Here's a common problem in all Cessna seats from 150s through 421s: loose or shifting roll pins. The fix is to reset the pins and secure them with safety wire. Be sure to inspect whatever component is being secured with these pins for elongated holes or cracks that would require replacement of the damaged component.
Right: A non-approved sewing job done in the field, securing a seatbelt to a mounting end fitting; note the absence of a certification tag. Again, this work must be performed and documented by an FAA-approved repair facility.

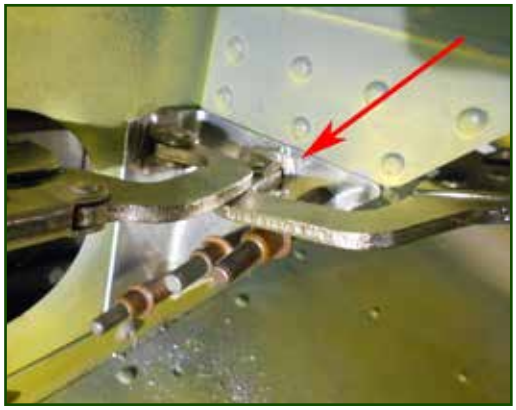
Left: Here is another common seat issue. Almost all seats in Cessna twins have moving parts. In owner-flown airplanes, the pilot seat gets adjusted for the one pilot who flies the airplane and is usually not adjusted for several years. These seats often go without regular lubrication, and corrosion builds between the steel and aluminum parts. The result is a frozen seat adjusting system. In severe cases, the careful application of heat, penetrating oil, and lots of patience is the only fix.



Above: We often find 310 pilot and co-pilot seat back mounting holes that are badly enlarged. The fix is to install a chromoly steel doubler of the correct diameter.

Above: We often find nonstructural aircraft bolts without the proper spacer securing passenger restraints to their mountings. Aircraft hardware is substantially stronger than a hardware store bolt. Also, it's extremely important that the correct aircraft spacer is installed to ensure that the attachment is up to its intended strength.





Left: Cracked pilot seat support bracket in a 310. The fix is a heavy 2024T-3 aluminum doubler.

INTERIOR RENOVATIONS - PART 6

by Dennis Wolter, Founder & Owner - Air Mod, Inc.

PREVENTING INFLIGHT FIRES

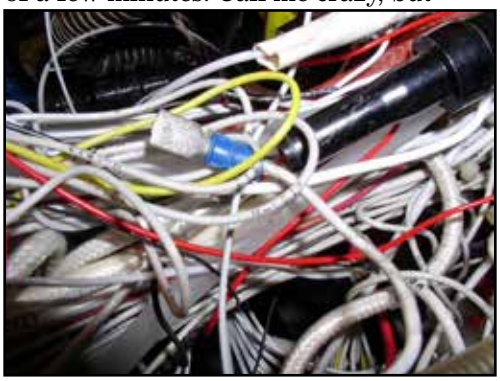
While writing this series of articles about interiors in Twin Cessnas, I decided to deviate a bit and write one segment about the very serious and feared topic of inflight cabin fires. Renovating an interior presents a great opportunity to 1) identify and correct some possible contributing causes of a cabin fire, and 2) increase the ability of the pilot to manage the threat so any event will have a good outcome. The specific examples included in this article are conditions that we frequently discover while going through the process of renovating and modifying your Twin Cessna interiors and instrument panels.

Factory-applied skin damping that can become contaminated with combustible fluids from leaking hydraulic brake systems, over-serviced landing gear, hydraulic landing gear systems and fuel leaks.

So let's get started with step one: reducing the threat of fire. Since most Twin Cessnas are forty-plus years old, it's quite possible to have an accumulation of dirt mixed with combustible oil or hydraulic fluid on the belly skins below the floors. In early production Cessna twins, the factory sprayed vibration-damping tar on the belly and cabin skins. Add in the installation of some aftermarket insulation, a little brake fluid, and landing gear lubricant, and a very combustible mixture of material is just waiting for an ignition source. This hazardous stuff is below the floors where a fire extinguisher will have little effect. Cessna 337s with hydraulic retractable landing gear will often have a lot of flammable 5606 hydraulic fluid pooling in their bellies. It's very important to clean the bellies of these now not-so-young airplanes, and check the condition and age of the actuator seals, fittings, and old hoses.

Years of avionics installations can result in old abandoned wiring being left in the airplane. Add in excessively long harnesses and old circuit breakers and you have a wiring mess that can be a troubleshooting nightmare as well as a potential electrical fire starter. It's not uncommon to find an unprotected connector that is still connected to an avionics buss. The fix is to dive into this mess of abandoned wiring. The photo below shows what is often removed during this clean-up process. It's also not uncommon to find live wires tie-wrapped to oil or fuel lines. This condition clearly led to one of our customers having an inflight fire. An A+ live feed wire was tie-wrapped to the fuel flow gauge aluminum line. Years of vibration finally wore through the insulation on the wire and the resulting arcing broke through the aluminum tubing that was supplying fuel under pressure to a fuel flow gauge. The event ended when the pilot landed on a road and he and his wife exited the airplane.

At the first indication of smoke in the cabin, shut off the master switch immediately and initiate a plan to get the airplane safely on the ground ASAP, even if an airport is not a realistic option. I have read many reports where the length of time from when a pilot calls ATC to report smoke in the cabin and communication with the airplane ends is often only a matter of a few minutes. Call me crazy, but whether I fly IFR or VFR, I keep a paper sectional with the route highlighted that I'm following. Whether it's oil on the windshield, a rough engine, non-running engine, or smoke in the cabin, flat ground is your best friend, and a sectional is the best low-tech and immediately available source of that vital information.



Messy wiring, along with abandoned wiring, unprotected connectors and unidentified inline fuses.

Here's an image of the four most common circuit protection devices used in light aircraft.

Now let's talk about electrical circuit protection. Years of equipment changes, and the fact that Cessna installed non-pullable circuit breakers in some twins, means that good circuit protection can be compromised. At the top of my bad circuit protection list is the use of inline fuses hidden under the panel. We often find unlabeled fuse holders hidden behind a panel which will make it difficult or impossible to correct an inflight component failure. We once found a fuse holder stuffed full of aluminum foil. Go figure!

It's also rather common to find a circuit breaker that is protecting more than the original component it was placarded to protect. When additional equipment is installed over the years, the installing technician, for whatever reason, doesn't want to add another circuit breaker. They simply connect the A+ wire for the new device to an existing breaker. This can potentially create electrical load issues, as well as confusion for a pilot when a device fails and the breaker that opens is labeled for something different.

I am a big believer in pullable circuit breakers. Pullable breakers allow the pilot to better manage electrical and avionics equipment.

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Keep critical systems clean. Dirt can hide a serious problem.

The best way to illustrate the advantages of pullable circuit breakers is to tell a story. Years ago I installed pullable circuit breakers for every circuit in my 172. Leaving Oshkosh on an instrument flight plan, I was in the clouds when we suddenly had electrical-smelling smoke in the cabin. I immediately shut off the master switch, then pulled every circuit breaker in the airplane. I next turned the battery switch on; no smoke came back and no unusual load appeared on the amp meter. This indicated to me that all was well from the alternator through the battery to the main buss. I then turned on the radio master switch and reset the breaker for my NAV COM radio and my transponder, leaving all other breakers pulled off. I called ATC, told them of my problem and asked to be vectored to the nearest VFR airport. Once on the ground I pulled every radio out of its dust cover and found that the #2 COM radio had severe scorch marks on the bottom of the dust cover. With the issue identified, we flew home VFR with a functioning #1 NAV COM and a transponder. (Had non-pullable breakers still been in the airplane, all I could have done while in flight would have been to turn on the radio master and recreate the fault by re-setting the open breaker.)

A corrosion-induced hole found in an aluminum fuel line located deep in the filthy complexity of fuel lines seen in the previous photo.

I sent out the offending radio to Narco for repair and replaced the #2 COM circuit breaker. I definitely like my pullable breakers. The next time your airplane is in the avionics shop, ask them to evaluate the integrity of your circuit breakers and the wiring behind your instrument and circuit breaker panels. You might be surprised at what they find.

Speaking of surprises, finding loose screws inside a 310 voltage regulator explained the issue of an intermittent voltage control. I really wonder how three screws became loose in a voltage control unit.

One often-overlooked fire safety issue is old, long-outdated, pressure hoses. Every flex hose that carries fuel, hydraulic fluid, and oil has an in-service life limit. Being in the business of renovating airplanes, I've had the opportunity to fly many different makes and models of customers' airplanes. Cool deal. Well sort of. Flying an airplane that you know little about can have its downside, and leads me to my next story.

About 10 years ago I was bringing a customer's freshly-painted airplane from the paint shop in Cadiz, OH, to Air Mod. While on let down into Clermont County, my home field, I began to smell fuel and quickly noticed fuel dripping from under the right side of the instrument panel and right on to, you guessed it, the circuit breakers. I instantly shut off the battery switch, put the fire bottle on the co-pilot seat and manually extended the landing gear before I got into the pattern at Batavia's uncontrolled airport. When the airplane was safely in our hangar, I removed the glareshield and easily found the problem. A rubber fuel pressure hose that runs from the firewall to the fuel flow gauge on the panel looked to be quite old. I turned on the fuel boost pump with the mixture in the full rich position, the hose began to swell slightly, and fuel was passing right through the

Every interior trim component shown in this photo of a 20+ year-old aftermarket interior was found to burn, including all of the cabin insulation.

AA-approved flame retardant upholstery materials and insulation will not support the ignition or spread of a cabin fire, especially the insulation shown in this photo.

old rubber. I then looked at the date on the manufacturer's certification tag on the hose. It said 1956, 50+ years old at the time. I said a little prayer of thanks and installed a new hose. As soon as you think you've seen it all, something comes along that makes you realize that you are just getting started!

Now when I get behind an instrument panel, I always check the condition and age of hoses, including pitot static system components. Lots of potentially critical stuff behind old instrument panels falls victim to the old out of sight, out of mind syndrome. Sometimes a serious inflight fire can be due to dirt that hides the deterioration of an important component.

Let's move on to interior safety enhancements with respect to self-extinguishing modern aircraft interior materials. Foam, insulation, leather, fabric, even vinyl, are manufactured to pass FAR 25.853a, appendix F, part 1(a),(1),(i). What conformity to that long Federal Aviation regulation means is that a material has been tested and passes the standards of this FAR, and can be relied on to self-extinguish if exposed to a flame source as specified in the regulation. Interiors properly fabricated using approved materials will be a major part of fire suppression instead of fire support. These part 25 approved materials will not burn and will greatly inhibit the spread of a cabin fire. This is of particular benefit when a fire is located behind a side panel or below a floorboard where a fire extinguisher will have little or no effect. Over the years, I've known two customers who experienced inflight cabin fires. Both customers called me afterward and stated that they believed that the approved materials we used were a major reason that their frightening experiences had good outcomes.

A picture is worth a thousand words: household water heater wrapping used as insulation in a 421.

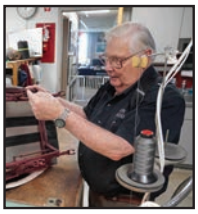
Double-check logbook entries describing any interior installation in your Cessna twin. If you are purchasing an airplane, give serious consideration to verifying that the interior components comply with FAR 25.853a. (You can't write the check on the way down.)

No inflight cabin fire discussion would be complete without talking about fire extinguishers. Here's a low-cost, effective preventative item that we still find either missing or outdated in too many of the airplanes we work on. If yours is an old dry chemical fire bottle, consider replacing it with a modern Halon bottle. Those old dry chemical extinguishers present two problems: First, when discharged in an airplane cabin, the dry chemical creates a cloud of vision-limiting, hard to breathe stuff. Second, the dry chemical material will cause corrosion on electrical parts, electronic components, and instruments. Buying a Halon bottle is one of the most cost-effective safety enhancements you can invest in.

One final note, for those who operate a pressurized airplane. Due to the fact that you are flying at high altitudes and it will take more time to get the airplane on the ground, consider the purchase of a smoke hood, sold under the trade name of iEvac. When minutes count, this hood can make all the difference.

INTERIOR RENOVATIONS - SIDE PANELS

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter.

In previous renovation articles, we thoroughly covered preliminary planning, tear down reports, and inspection steps that lead to good renovation results. With a tear down report sent to and reviewed by the customer, it's time to get to work building a new interior. I'm going to begin this journey by discussing design options and processes that deal with side panels and armrests.

The process of renovating side panels presents a great opportunity to dramatically upgrade the design and function of the cabin environment.

Typical plastic armrest and side panel design in a 60s Cessna twin. One large, very thin sheet of aluminum with a plastic, vacuum-formed armrest, permanently mounted by the pilot seat.

The following is a list of the many specific ways that these changes can be implemented:

Organically shaped molded fiberglass and aluminum multi panel side panels and armrests with high-gloss, epoxy-finished hardwood inlay trim.

Aesthetics

1. Adding wood, Kevlar, or cloth accents.
2. Changing to a more contemporary and ergonomically correct armrest design.
3. Using multi-piece side panel designs mounted with visually appealing aluminum extrusion rails. This allows for more precise fitting of the panels without the use of a lot of awkward looking mounting screws.
4. Using different finishes of the aluminum extruded mounting rails can create a very appealing detail that creates a unique accent to the new side panel design.

Comfort

1. Much improved thermal and acoustic sound proofing that helps to create a quieter cabin that is cooler in summer and warmer in winter.
2. Improved location of air vent outlets.
3. Customizing the height of armrests, especially for the pilot and co-pilot positions.
4. Installing aesthetically appealing and conveniently located reading lights, USB ports, mic & phone jacks, etc.

Durability

1. Replacing flimsy plastic armrests with built-up, sturdy ones.
2. Permanently securing the armrests to the airframe, eliminating the flimsy mountings installed by Cessna.
3. Ensuring the ability to easily remove the multi panel extrusion mounted side panels reduces damage so the interior looks better and lasts longer.

Maintainability

1. The use of multiple panels secured by aluminum extrusions allows for easier removal and reinstallation of the side panels without needing screwdrivers.
2. No more stripped-out mounting screws to deal with.
3. Eliminate the difficulty of disconnecting and reconnecting the cabin heat ducts to the feed hose in 340 and 400 series airframes by modifying the mounting system so that screws are installed from the front side rather than from the back surface of the lower side panel. Your maintenance technician will love it!

Molded fiberglass and aluminum multi piece side panels with recessed armrests and convenient, recessed accessory panel. All wood trim is high-gloss hardwood veneer.

Safety

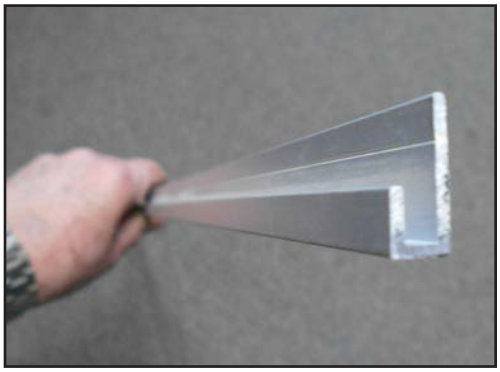
1. All finish materials, foam, and cabin insulation pass FAR 25.853a and will not support combustion.
2. Easier removal and reinstallation of multi-panel, extrusion mounted side panel components in order to access cabin systems saves time and money at Annual time or during maintenance, especially avionics installations. Better access means higher quality installations and improved maintenance, and lessens the potential for inflight failures.

Enough about the mission, let's dive into the process of renovating and/or building new Twin Cessna side panels and armrests. The poster child airplane for this purpose is the 310. This airplane

Top: Typical unusable condition of the large, very thin aluminum factory side panels found in early 310s.
Bottom: Five of 20 new multi section .020" aircraft aluminum side panels required to create the side panel system in a 310L.

typifies Cessna piston twin interior design and construction philosophy, from its beginning in the early 1950s through the end of twin piston and turbo prop production in the 1980s. Due to major differences between early 310 side panel and armrest designs and those installed in later twin Cessnas, this article will focus on early 310s only. We will move on next month to side panels in later model twin Cessnas.

About four years ago, we renovated the interior of a late '60s production 310L that, when it arrive at our shop, presented the usual aging airplane issues you would expect to find in an airplane of this age with at least one previously



Extruded aluminum mounting rail that allows a very secure installation of armrests and side panels.

installed aftermarket interior. The '60s velour interior fits right in with bell bottom pants, sideburns, and Jimi Hendrix coming through the headphones as you cruise along with the Bendix ADF tuned to an AM radio station. Note the "V" shaped plastic armrest installed on a large, flat, thin aluminum side panel.

The old armrests and side panels had to go. On drop-off day, the customer and I spent about four hours discussing design, installation, and detail options for the purpose of creating a new, ergonomically correct interior with updated armrests and all new aluminum extrusion-mounted multi panel side panels —an easier-to-maintain, and aesthetically pleasing cabin environment.

First on the side panel renovation list is armrest design. After discussing several different designs (some of which are shown in the accompanying images), the customer chose a pleasant looking molded armrest that could be installed at a precise height and location to comfortably accommodate the owner. The customer chose to have us design new multi-piece side panel components held in place by aluminum extruded, cabin length support rails throughout. At this time, the customer considered other cabin details (ventilation, lighting, storage features, passenger restraints, new windows, etc) as all of these can relate to the new side panel design.

Next on the agenda is material selection. After reviewing the comfort and durability aspects of the many fabric, leather, vinyl and carpet choices available, the customer chose a very durable combination of synthetic fabric, trimmed in aircraft vinyl, to be used on the side panels (as well as on seats). Fortunately, the customer arrived with a very inclusive wish list, detailing problems he wanted to solve and features that he wanted to include in the new interior. You should do the same when you are anticipating an

The unupholstered interior installed in order to double check everything for fit, function and clearance before it all goes into the sewing room for upholstering.

upcoming interior renovation. Create a list in advance as you fly along, writing down things that you would like to address in a new interior. Here's your chance! Professional interior renovation shops are not miracle workers, but it's surprising what these shops can accomplish in order to put together an interior that is as close to perfect as possible for you and your passengers.

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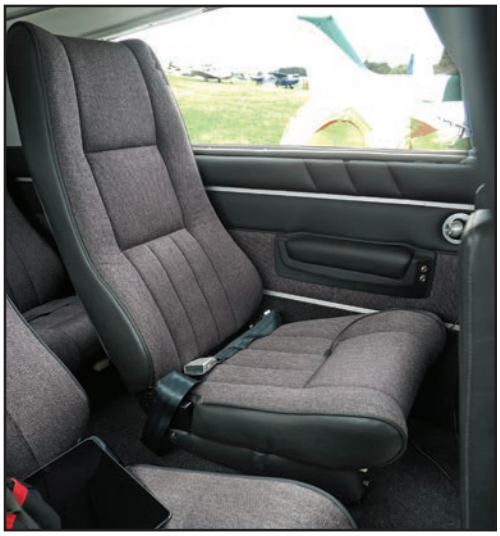


The finished product!

With side panel design decisions made, we get down to business. As removed, the old thin aluminum side panels were beyond repair, so the decision was made to fabricate all new panels using .020" 2024T-3 aircraft aluminum. The process begins by temporarily installing the new extruded aluminum mounting rails. Then each of the approximately eighteen side panel sections are carefully cut and trimmed to be a little oversized so they fit neatly into the mounting rails. Next, we design, fabricate, and install new support brackets for each of the redesigned armrests.

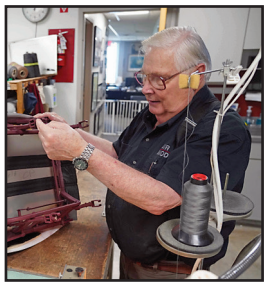
With all the mounting rails and new unupholstered panels temporarily installed in the cabin, we check everything for security and fit. We then use magic markers and draw the pleating designs, mapcase, and document holder locations on the panels. Then all cut-outs and brackets for air vent outlets, USB ports, reading lights, etc. are fit and installed. Finally, the new armrests are trimmed, fit, and test mounted; then the newly padded seats are temporarily installed. With each cabin component installed, we recheck for fit, function, and clearance.

Once the new aluminum side panels are fabricated, fit, and checked, they are brought to the sewing room, where they will be padded, sewn, and detailed per the customer's specifications with mapcases, storage pockets, reading lights, mic and phone jacks, etc. There are numerous stitching patterns and pleating options we can implement as we lay out patterns and cut the various pieces of foam-backed finish material (leather, vinyl, fabric) that will be used on the new side panels and armrests. The aesthetics and design of the side panels will complement the design used on the seats.

Everything we've done to the side panels results in easy-to-remove components that are durable and aesthetically appealing. So much for early 310s. Next month we will thoroughly discuss renovating side panels and armrests in newer production Cessna twins. Until then, fly safe!

INTERIOR RENOVATIONS - ARMRESTS

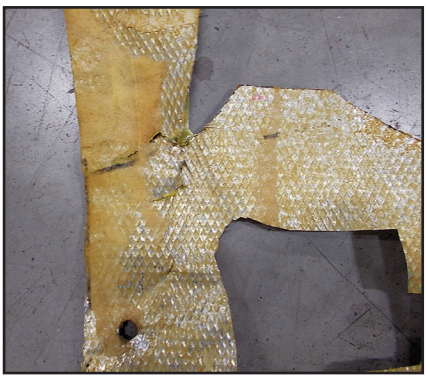
by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

As the 1960s rolled into the '70s, aircraft manufacturing was becoming increasingly competitive and Cessna was challenged to reduce airframe weight and production cost. There were very few options for reducing powerplant, avionics, and airframe cost and weight, so Cessna's engineers focused on the design of the interiors to solve this challenging problem. They were not alone in addressing this issue. Beech and Piper also were redesigning their interiors and fabricating them using lighter, less durable, and cheaper materials for the same reasons.

Enough for the economics lecture. This month we will discuss how Cessna changed their Twin Cessna side panel and armrest designs, why they are now failing, and how to improve the design and material options of these components in an effort to make them better looking, more durable, and easier to remove and reinstall.



The quilting process applied to .016" aluminum didn't solve the delicate nature of original factory side panels.

In later interiors, Cessna stuck with very thin .016" aluminum side panel backing material. However, in an effort to make it more rigid and durable, they developed a process of putting an embossed quilting pattern on this material. Over time, this quilting produced no improvement in the durability of the side panels. The only fix is to fabricate new side panels using more rigid aluminum, either .020" or .025" 2024T-3 tempered structural aircraft aluminum. Fabricating side panels using this more durable material greatly reduces the potential for damage during removal and reinstallation.

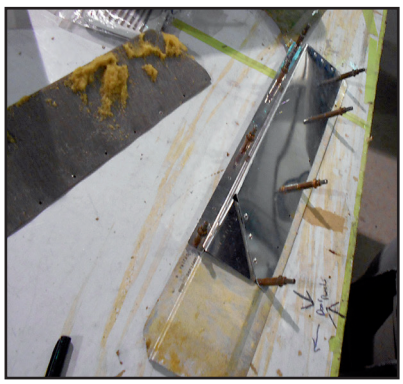
Top: Unusable set of 310R original factory side panels.
Bottom: A new set of 310R side panels, fabricated using more durable .020" or .025" aircraft aluminum.

The formed stainless steel edge molding strips installed by the factory in an effort to create a pleasant looking edge closure. This tedious installation process makes it almost impossible to remove and reinstall the thin upholstery panels without damaging the panels, the stainless edge trim, or both.

Due to the flimsiness of the thin quilted panels, Cessna installed formed stainless steel edge trim pieces in an attempt to neatly hold these thin side panels in place. This made it very difficult to remove and reinstall the panels, and resulted in torn, deformed and ill-fitting side panels and stainless steel edge trim. Side panels fabricated with more rigid .020" or .025" aluminum do not require the complex installation of trim strips to create a nice looking and durable finished edge around doors and windows. And, as we said, these new panels are far easier to remove and reinstall.

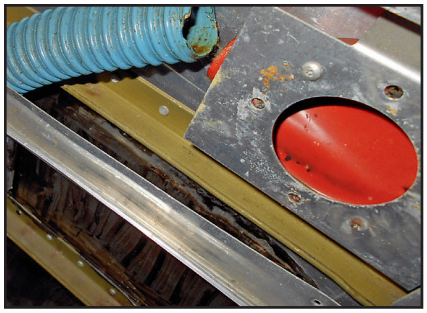
Typical damage found on plastic armrests on later-production wing mounted twin engine airplanes.

Let's take a look at the flimsy armrests that were installed in all 310s through 425s. These cabin length armrests have an aluminum base with plastic armrests riveted to them. That's right, plastic, the same stuff the delicate window frames are made of. The photo illustrates the condition we usually see when we remove the cover material from the armrests. The fix is to fabricate new armrests using .025" aircraft aluminum. With new armrests made, it's time to improve the flimsy way Cessna secured them to the sides of the cabin.



A new sturdy aluminum armrest being riveted to the original armrest base.

The original mounting system employed a "U" shaped, formed, thin aluminum channel riveted along the full length of the cabin. A full length retaining strip located on the upper back of the armrest fit into this open channel, securing the upper edge of the armrest to the cabin. The lower edge of the armrest was secured to the cabin structure with sheet metal screws. Over time, the upper, formed sheet metal mounting strip becomes loose in its



Flimsy U-shaped thin aluminum factory upper armrest mounting channel.

A rebuilt armrest assembly secured to the cabin side structure with sturdy extruded aluminum.

A finished door panel with hardwood inlay, rebuilt armrest and new .025" aircraft aluminum side panels, all securely held in place with nice-looking extruded aluminum divider rails.

mounting and results in ill-fitting armrests.

The fix is to rivet strong full length extruded aluminum rails to both the top and bottom edges of the repaired and upholstered armrests. We then thoroughly secure the renovated armrest to the cabin side structure with screws. This system of extruded aluminum rails creates an aesthetically pleasing mounting rail that allows for the installation of more durable side panels without needing unsightly screws to hold the new panels in place. The new panels fit neatly into the open channels of the extruded aluminum mounting rails creating a well-fitting, easy to install and remove side panel design typically found in corporate jet interiors.

Moving forward to the often damaged, molded plastic armrest/side panel assemblies we find in the flight deck, we're faced with repairing any cracks and reinforcing the armrests with .040" aluminum. If the plastic side panels are badly damaged or they are brittle due to exposure to the sun, new molded plastic panels are available from Plane Plastics. These aftermarket components are molded using a superior, thicker, and more sun tolerant Lustran brand of flame retardant polymer. To ensure long life, we still reinforce the new panels with .040" aluminum and finish them with three coats of color-matched ultraviolet reflective lacquer-based paint.

One final side panel problem we find on most cabin class Cessna twins is the way Cessna attached the main cabin feed hose to the cabin length heat outlet plenum located at the base of the main cabin side panels. This coupling is originally mounted to the back surface of the plenum with two machine screws that are awkwardly installed and removed from the back surface of the big cabin side panel. We often find the back of this plenum is damaged and seals poorly as a result of this difficult installation.

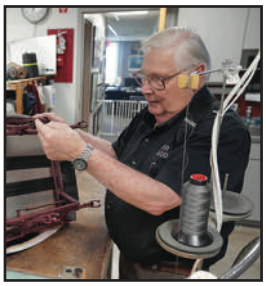
New, reinforced, aftermarket flight deck side panel armrest.

The fix is to repair the damaged area on the back surface of the panel and modify the cabin heat coupling box to allow for it to be mounted from the cabin side using long screws and spacers. This mod increases cabin heat and makes the side panels much easier to remove and reinstall.

These aesthetic and maintenance-friendly improvements will add approximately six pounds of weight in a 340, and eight pounds in a 400 airframe. That's about it for late style Twin Cessna side panels. Next month we'll move on to inspecting, repairing, re-foaming, and upholstering Twin Cessna seats.

INTERIOR RENOVATIONS - SEATS

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

Of all the improvements that renovating an interior can bring to your cabin environment, building an ergonomically correct seat is without question the one change that generates the most enthusiastically positive comments from our customers. Adding correctly designed, located, contoured, and structured ergonomic shapes in a seat so that the seat properly supports an occupant's skeletal structure eliminates a lot of potential fatigue. A poorly designed seat requires the use of your muscles to hold you in a comfortable position, inducing fatigue after a short time. So, let's get started going through the steps that will create a comfortable, durable, and aesthetically pleasing Twin Cessna seat.

Heavy seat belt reinforcement and new heavy dacron canvas seat base sling.

Performing an ergonomic study and recording the data allows our foam builder to create an ergonomically correct and comfortable seat.

Renovated and foamed seat with the new upholstery design laid out and ready for patterning, sewing, and mounting.

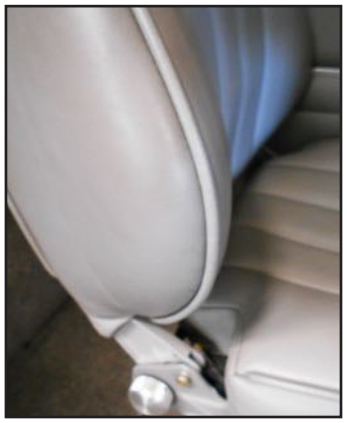
Step 1: Prepping, priming, and painting a mechanically and structurally sound seat frame. This process begins with a thorough structural mechanical inspection of the frame by a licensed aircraft mechanic. Then it's on to a thorough solvent-cleaning of the seat frame and all mechanisms using Scotch-brite pads, stiff wire brushes, lots of mineral spirits, and compressed air in order to remove all traces of loose paint and plain old dirt. If the existing finish is poorly bonded, too thick, or chipping badly, it's off to the media blasting cabinet in order to get the frame antiseptically clean. Then it's time to use aluminum foil and tape to mask any seat components that must not be painted. We then prime all surfaces to be painted with self-etching primer. Finally, we rough up the primed surface with Scotch-brite pads and apply two or three coats of lacquer finish that is custom mixed to match the color of the new upholstery material.

Step 2: Then we install a stable, durable, non-sagging seat base support system known in the industry as a seat sling. Almost all airframe manufacturers relied on a stretched, glued-in-place single layer of a canvas material as the method of supporting the seat cushion material. Over time, this minimal sling material stretches, the glue lets go, and the slings would often sag. This creates two issues. The first problem is that when a person sits in a seat with a loose sling, there can be an uncomfortable perimeter pressure caused by the fact that their body is coming into almost direct contact with the seat frame. The second problem is that if the sling eventually sags an inch or two, support for the cervical spine, thoracic spine, and lumbar spine, as well as thigh support features, are no longer located in the correct places to properly line up and support the skeletal structure of the occupant. Ouch!

The all-important check of temporarily installed but still unupholstered interior components to closely check for proper clearance, security, and function of each component.

French stitch; note the exposed edges of the finish material and the top stitching thread.

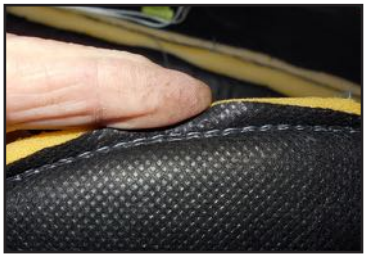
To install new seat slings, we tightly stretch, bond and clamp two lengths of heavy seat belt webbing running fore to aft on the seat base frame. Next, we tightly stretch heavy Dacron canvas that is bonded in place with contact cement to the perimeter of the seat base frame. This two-part foam-supporting seat base sling system will never sag. Moving to the seat back, we tightly stretch and bond Dacron canvas to the frame. Due to reduced loads on the seat back, there is no need to install the seat belt webbing in that area.



Typical corded edge seam that allows for double stitching the seam while protecting the edge of the finish material and the stitching thread.

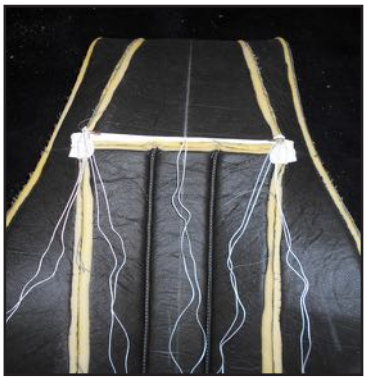
Step 3: Using dimensions that we created when we did an ergonomic study of the customer, we build new seat foam using three different densities of urethane foam. This custom-shaped foam build is applied to the pilot seat. If requested, we can also custom-fit any other cabin seat in the same manner. The other cabin seat foam builds are typically dimensioned to accommodate what designers refer to as the 'standard measure of man'. These dimensions will comfortably accommodate the physical dimensions and geometry of nine out of ten adults.

Step 4: This next step is very important. With the unupholstered side panels, armrests, and foamed seats temporarily installed in the airplane, we check to make sure that everything fits, reclines, and tracks with no interference issues. Also, while the bare side panels are installed, we use magic markers to indicate the layout and patterning of the new side panel designs. This ensures that, once upholstered, every side panel detail will accurately line up when everything is finally installed. We also confirm that all side panel mountings are in the correct locations to properly secure the new side panels.

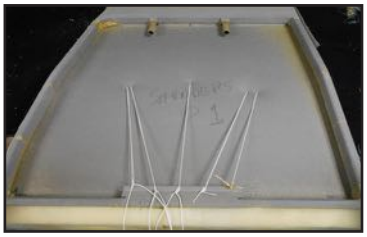


Stronger and more durable double stitched corded seam, shown from the underside on the backing fabric and backing foam.

Step 5: With the seats taken back into the sewing room, it's time to use our magic markers to lay out the aesthetic design of the seat on the new foam. Using thin translucent fabric, we make patterns for each of the face, side, and back panels of the new seat. With the patterns cut out, it's time to efficiently lay out the pieces on the finish material and cut everything out. When covering a seat with leather, you need to carefully select the area of the hide you use so as to avoid imperfections that can often be found in a leather hide. Now it's time to bond " or " foam and a very thin layer of cloth to the back surface of all the seat pieces. The foam with cloth backing will help to create a plush, wrinkle-free look and feel when all the panels are sewn together.



Canvas loops, steel rod, and dacron rigging twine attached to a low point in an ergonomically correct seat back.



All the rigging attached to a secure rack at the base of a seat back.

Step 6: Then the sewing process begins. The first step is to sew a single seam that secures together the various panels that make up the front (or seating surfaces) of the seat base and back. Then we need to sew the side panel pieces of the seat to the faces of the seat base and back, and ultimately the back section to the side panels. There are two popular ways these seams can be made. The most durable and repairable way to hold these materials together is to use a corded seam, where the edges of the seat material are protected from sunlight and wear by cording. This method increases strength and durability by double stitching the seam (not visible on the finished seat). If years of wear degrades the cording, one can remove the seat cover, carefully open the old seam, and sew in a new piece of cording; no need to replace anything else.

The second, more skill demanding type of seam is called a French stitched seam. The initial step in this process is to join together the edge of the face panel to the edge of the side panel as above, but without the cording. Once the pieces are sewn together, we sew two parallel lines of stitching close to the structural seam, one on each side. This creates an aesthetically pleasing seam that many people like, but both rolled edges of the mating materials, as well as the decorative stitching, are exposed to wear and the damaging rays of the sun. If years of service leads to seam failure, the fix in this case is to re-cover the seat.

Fabric and leather interior with corded seats after 27 years and 1000 hours of use. No wrinkles, sagging or seam failures. My wife Cynthia is tired of the color, but it's not getting changed!

Step 7: Now it's time to address how to prevent shifting of the finish cover once it is installed on the seat frame. If seat foam is built to accommodate the human

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body shape, it will have low points in the foam. This contouring creates the challenge of how to permanently secure the finish cover to the foam in these low spots. Multiple methods have been tried over the years, ranging from simply gluing the cover material in place, to the somewhat complex method of employing metal clips and steel wires secured to the seat slings. The methods of bonding or mechanically connecting soft finish material to soft foam and seat slings often fail, resulting in sagging seats and ill-fitting seat covers.

The fix is to sew loops of canvas in the seams that are located at low points in the seat foam, on both the seat base and seat back. Tempered steel rods are run through the sew loops, and long lengths of Dacron rigging twine are attached to the captive rods. We then attach another captive rod rack to the base of the seat frame. With the new upholstery cover now turned right side out and pulled over the seat back or base, we connect the rigging twine to the rack and adjust the tension on the various lengths of twine until we create a wrinkle free, properly contoured cover. Here's the best part of this system: all this rigging establishes a structural connection between the finish cover of the seat and the seat frame. No wrinkles, no sagging, no opening seams, and no shifting of those comfort-enhancing lumbar, thigh, and thoracic supports.

I have included a photo of the front seats in my 172 (p. 21). At the time of this picture, the fabric and leather interior was 27 years old, had flown 1000 hours, and endured 23 weeks at Oshkosh and countless other air shows. Lots of folks have climbed in and out of my airplane to experience firsthand how comfortable a properly designed seat can be. Thorough and carefully implemented seat renovation techniques are really worth the extra effort and do represent a good return on investment.

Next month - carpet.

IMPORTANT NOTE: Members may submit technical questions by emailing them to support@twincessna.org. Because accurate answers depend on precise information about your airplane, you MUST include your aircraft model and serial number with each request in order for us to answer your question.

421 Fuel Flow Issue

Tony, I have a fuel flow issue with my left engine (421C-280, GTSIO-520L). When I reduce the throttle from full power climb to cruise climb of 35" MP, the engine leans itself to 32 gph without me touching the mixture. And when I reach level cruise and set it to 30" MP, I have to retard the mixture more than two inches before it starts leaning.

We have checked and adjusted fuel pressure and flow settings to Continental specs and there is no evidence of any fuel leaks. Any suggestions will be appreciated.

Francesco, TTCF Member

Francesco, this could be a mechanical connection issue between the throttle/fuel set up. Take a look at the connections.

It could also be a problem with the Upper Deck Reference line (turbo pressure) that interconnect the fuel pump, fuel limiter injector nozzles. A leak or disconnect can cause one or all of the components to loose reference.

Could also be in the fuel pump or in the fuel pressure regulator itself.

Tony Saxton - Director of Tech Support, TTCF

AD 2016-17-08 Elevator Trim Tab Hardware Replacement

Tony, why does this AD (2016-17-08) require the removal of perfectly good hardware for replacement given that the castellated nut is cotter pin secured? I have heard no cases of the bolt snapping or failing.

Raymond, TTCF Member

Raymond, I somewhat agree with you but I feel that this was, once again, a case of the FAA grasping at trying to understand the system.

The new installed nut called out, (MS17826-x), is a dual locking fastener which has a cotter pin lock, but also has the function of a self-locking nylon insert thread locking. These types of nuts have long been used by manufacturers in what are deemed critical locations - especially where rotational or high cyclic vibration is present.

Either of these operational inputs can loosen a total self-locking nut causing it to back off or causing a cotter pin only to wear in its slot. The combination of locking types and methods helps achieve a more secure, longer lasting assembly. While it might seem like overkill, both Cessna and the FAA felt that a big improvement in attachment security was needed in this frequently failing point.

In having a self-locking nylon insert as some component of the locking mechanism, it is common instruction that these would have a one-time installation/removal since the process crushes the nylon and negates its self-locking function for reinstallation. Thus, you have the stipulation of a one-time installation.

I really believe that what the wording intended was that once the defined hardware (bolt, nut, washers, and cotter pin) were installed that at any removal thereafter would require the

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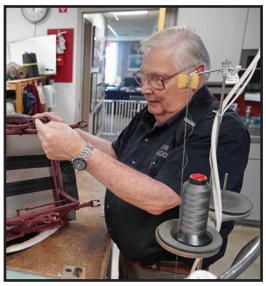
INTERIOR RENOVATIONS - CARPET

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



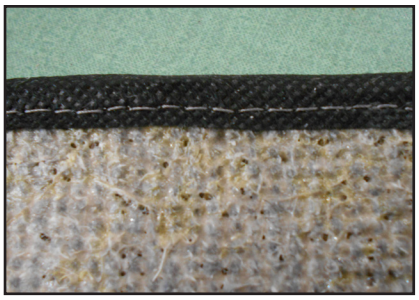
Dennis Wolter - Air Mod Inc

Our journey through renovating Twin Cessna interiors brings us this month to the process of installing new carpet on the lower side walls, spars, and floors. As with all interior materials, we use only aircraft, flame retardant carpet and backing foam that pass FAR 25.853a, appendix F, part 1 (a) (1)(i). Carpet that passes this FAR is available in wool as well as nylon.

With few exceptions, we use 100% wool carpet that, over time, has proven to be the more durable and fade-resistant of the two.

Typical corrosion-prone mess caused by gluing carpet to a spar carry through.

We begin this renovation stage by rolling out the six or 12 foot-wide piece of new carpet on the hangar floor, finish side down. Using a Sharpie marker, we draw "V" shape marks that all point in one direction. This is necessary in order to keep the multiple sections of carpet all properly oriented as they are cut and installed on the floors and side walls in the cabin. If proper orientation of the carpet pieces is not maintained, a color shift will be noticeable between adjoining pieces of carpet. This perceived color difference is caused by the slight angle of the carpet pile created during the manufacturing process when the carpet is woven; viewing the carpet from one direction looks different than from the opposite direction.



After stitching the edge tape material to the edge of the carpet, the edge tape is rolled under and lightly glued in place. A single stitch is sewn along the edge of the tape. The last step is to neatly trim the surplus edge tape material on the back of the carpet.

The next step is to cut and bond the new carpet pieces to the repaired lower cabin kick panels. After the newly carpeted lower kick panels are installed in the airplane, we temporarily reinstall the old carpet pieces on the floors. Using these old pieces as a trial fitting, we can check to see how well the old floor carpet fits. It's not uncommon to find that the old carpeting has shrunk or did not fit that well in the first place. Any anomalies are marked on the old carpet, giving us guidance to accurately cut out the new floor pieces.

The finished product, all done with a walking foot needle feed upholstery sewing machine. No complicated and expensive carpet serger required.

A carpet serger in action sewing a neat loop of color-matched serging thread to the edge of a new section of floor carpet.

We then lay the slightly oversized, rough cut new carpet pieces in position on the cabin floors, and carefully trim them to fit perfectly around seat rails, fuel valves, and spars. Then we trim these pieces so they accurately contour to the previously installed lower carpeted side panels. Initially over-cutting the new carpet pieces and taking the time to precisely trim them ensures a well-fit carpet installation.

Neat and durable serging.

With the floor carpets trimmed and fit, it's time to address fabricating carpet covers for Twin Cessnas with a standing spar carry through. Many of these airplanes come to us with existing spar carpet glued directly to the spar structure. After removing the old carpet, we very carefully use plastic scrapers, soft wire brushes, solvent, and scotchbrite pads to remove all the potentially corrosion-causing glue. With the spar carry through thoroughly cleaned, we inspect for any signs of cracks, working rivets, corrosion pitting, or improperly drilled holes. Over the past 47 years, we've more than once found questionable, large holes drilled in critical locations on a spar carry through – go figure! The resolution was an engineered fix, designed by a factory engineer, fabricated and installed at Air Mod, and signed off on an FAA 337 major alteration and repair form. To prevent potential problems with corrosion, we always fabricate spar carpet so that it mounts to the spar with Velcro. This allows for easy removal and reinstallation for future inspection while not coating the spar with potentially corrosion-causing glue.

Firmly pressing velcro in place with a wood roller.

Now let's discuss finishing the exposed edges of the carpet. There are two basic ways to apply a visually appealing finish

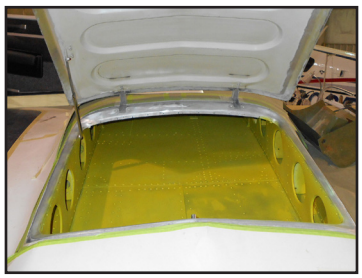
edge to a carpet: The first method is to use thin vinyl or cloth edge tape that can be 1¼ to 2 inches wide. The tape is positioned at the edge of the top surface of the carpet, then stitched in place, about 3/8" in. The tape is then rolled over the raw carpet edge and lightly glued to the back of the carpet. The carpet is then turned right side up and a line of stitching is done along the inside edge of the tape. Depending on the width of the edge tape being used, any excess can be trimmed (from the back) after stitching is complete. The photo shows it all.

Neatly applying adhesive to the rough backing surface of carpet.

This is an inexpensive method of finishing a raw carpet edge and, if done carefully, will produce professional results. A big motivation for using the edge tape system is that all sewing can be done with a walking foot, needle-fed commercial machine that is the same machine used for sewing seats and side panels.

Running a 'stitch in the ditch' that permanently secures the bonded in place Velcro to the back surface of the new floor carpet.

The second method of finishing a raw carpet edge necessitates the use of an expensive and complex carpet serger. This involves applying a closely stitched loop of thick, color matched yarn around the perimeter of the carpet. This process is widely used in the carpet world. The serging method creates a very nice-looking finished edge that is not only faster to execute but can be easily repaired if the serging yarn is damaged. If an edge loop is broken, all one needs to do is tuck off the two broken ends of the yarn and hand-stitch and tie off a short section of serging yarn, neatly filling in the gap created by the break. On the other hand, if the earlier described edge tape is damaged, the only good fix is to remove all of the edge tape on that particular piece and apply new tape. I definitely prefer serging!



A cleaned and chromated wing locker ready for a new Velcro-secured removable floor mat.

If you plan to install new carpet yourself, ask a local carpet store if they can suggest a carpet workshop in your area that will serge-bind your trimmed and fit carpet pieces.

Now let's discuss securing carpet in place using Velcro. I want to begin with a lesson on adhesives. DO NOT use self-stick pressure-sensitive Velcro. The quality of adhesive currently used in these products is, well, not particularly good. In our experience, this stuff has a great potential for failing in time. We use sprayable and brushable adhesive called MC5 (we purchase locally from Miami Corporation). When bonding Velcro to the floor, begin by brushing two coats on the back of the Velcro as well as two coats on the cleaned metal floor surface. Read the instructions on the can and allow proper set-up time in between applying the adhesive and bonding the Velcro to the metal. We use a wood roller to ensure that the Velcro is firmly pressed in place on the floors.

To make certain the Velcro is well attached to the rough back of the carpet, we mask a one-inch-wide area near the edge of the carpet where the Velcro will be bonded, and apply two coats of adhesive with a brush or a spray gun to both the carpet and the Velcro (an inexpensive siphon gun from places like Harbor Freight works great). When the adhesive is properly cured, press the Velcro in place so that the outer edge of the Velcro overhangs the inner edge of the serging yarn or edge tape by approximately ¼ inch. Then firmly press the Velcro down. Next, we flip the carpet over, finish side up, and run a stitch along the inner edge of the serging yarn or tape that will stitch the Velcro in place (this is called a 'stitch in the ditch'). The Velcro is now secured to the back surface of the carpet by stitching as well as adhesive, eliminating the possibility of it coming loose.

The next detail to discuss is heel pads. They can be either color-matched, sewn-in-place vinyl, or they can be screwed-

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CARPET

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in-place formed aluminum. The sewn-in-place type are similar to those we find in our cars and are simply lightly glued to the finish side of the carpet and topstitched around the edge with matching thread. Aluminum heel pads are fabricated from .050" 2024T-3 aircraft aluminum. We roll about a 3/16" formed lip along the forward and aft edges of the metal, creating a soft edge that will not catch the heel of a shoe while giving the heel pad additional strength. We secure the aluminum heel pad to the carpet with six countersunk upholstery screws and flat tinnerman nuts. Finally, each screw is cut off and ground flush with the tinnerman nut.

The final step in the carpet fabrication process is to bond 1/8" or 1/4" thick closed cell (non-hydroscopic) flame retardant foam insulation to the back surface of the floor carpets. We spray a thin coat of the MC5 adhesive to both the carpet and the foam. The foam adds additional acoustical and thermal insulation and results in a plusher feel to the carpet.

No Twin Cessna carpet article would be complete without discussing wing lockers. These leak-prone lockers are very susceptible to moisture-induced corrosion. We have more than once pulled up glued-in-place wing locker floor carpet and removed a good chunk of corroded wing skin with it. After cleaning and chromating the wing locker, we fabricate side liners and removable locker floor mats made of nylon cargo mat material, secured with Velcro. If the mats become wet, one can easily remove them for drying. No corrosion causing glue, no long-term exposure to moisture — problem solved!

Next month, it's on to headliners.

READERS WRITE

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310R Brake Problem

Tony, I'm working on a Cessna 310R model and I am having difficulty getting the right side brakes firm. I installed a new caliper (per owner request) replaced a bad flexible fluid line and rebuilt the master cylinder but the brakes just won't get firm. Any advice would be appreciated.

Ray, TTCF Member

Ray, does the hydraulic fluid in the reservoir go down or is it just not a tight pedal?

If fluid loss, check the multiple aluminum feed lines for the brakes under the cabin floor and in the wing areas. We have found multiple ones with corrosion pinholes allowing for fluid loss. Since this is prevalent where the lines interact with the ducting — the ducting will sort of soak up the fluid and then not show up as a prevalent leak.

Another issue could be the parking brake valve. This can leak internally and then when the pedal is depressed, the fluid will pass to the opposite side and cause a soft brake feel. This can be resealed with standard o-rings but is sort of difficult to remove and reinstall due to its position under the cabin floor.

If the master cylinder upper cap is worn this will allow the shaft/piston to move while cocked in the bore and cause this issue. Also, improper adjustment or worn parts in the lower check valve type washer seal can keep it from sealing properly.

Yet another potential problem is if new brake pads were installed but not new discs. The resulting tilt or very low contact area with a preexisting brake disc can cause this feel. It may be necessary to VERY carefully run the aircraft, and do several of the hardest stops possible, to wear in the linings to the disc, then bled the brakes again. Parker Hannifin Cleveland offers no direction in machining the disc to reestablish the face flatness and calls for replacement if "coning" of the disc exceeds .015" (per figure 308 in the Cleveland Maintenance Manual)

Tony Saxton – Director of Tech Support, TTCF

'55 310 Relays

Tony, my 1955 310 s/n 35095 might have the original Leach relays #7120-24. I can read only one. All three are in left engine nacelle on firewall together. I could remove and clean contacts but would it be better to just replace all three with new ones? Is there a make like Lamar you recommend and do you have the part numbers?

Peter, TTCF Member

Peter, from your description I also would assume that these are original. The installed relay #7120-24, was made for Cessna by Leech Neville Co. of Cleveland, OH, who was a major provider of truck, industrial, and aircraft electrical equipment — especially through WWII. By the late 60s the company was acquired and merged with the Sheller-Globe Corporation and then subsequently passed through various mergers and

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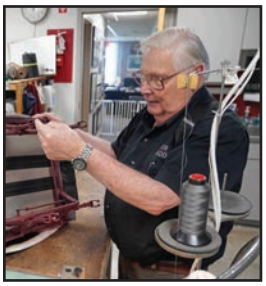
INTERIOR RENOVATIONS - HEADLINERS

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

When working with a customer during the process of designing a new interior, much discussion is focused on seat and side panel design, ergonomics, material choices, passenger restraints, cabin accessories, etc., but headliners seem to be of little concern. How often does an airplane owner open the cabin door to show off a new interior and begin the conversation with "Look at my great headliner"? Headliners don't get much attention unless they are poorly fabricated and installed, showing sags and wrinkles, with misaligned seams and carelessly sewn zippers, or are just a wrong color that does not complement an otherwise beautiful interior. Further, the headliner, along with seats, is the most skill-demanding interior component.

The headliner process begins with prepping the upper cabin and systems. With the old insulation removed, we start with a visual inspection and then by using compressed air (inside) and soapy water (outside) to check windows and antennas for water leaks. No leaks means no stains later. It's important to also check the condition and function of overhead wiring, antenna coax, and ventilation system components. If any of the original black corrosion-causing flexible cat vent hose is still in place, replace all of it with new orange silicon rubber coated non-corrosion causing scat hose.

Canvas loop and bow headliner mounting system used in early Twin Cessnas.

Now let's discuss material choices. I personally believe that high quality, upholstery grade, flame retardant aircraft vinyl is the best choice for headliners. These durable non-fading and easy-to-clean materials hold up better than fabric. Never install a headliner using leather. Leather shrinks as it ages, is heavier than fabric or vinyl, and is easily damaged by water.

Cloth headliners are easier to install than vinyl due to the fact that some fabrics are slightly stretchy. Natural fiber materials such as wool and cotton will shrink slightly when exposed to steam which helps in eliminating wrinkles; that's the good part. But over time, fabric headliners tend to change color and can be easily soiled by water intrusion, dirty hands, or an exploding soda can opened at altitude.

No headliner conversation would be complete without discussing thread. Never sew a headliner with cotton thread. This stuff eventually rots, and seams will open up. Also, always use nylon color matched zippers. Old technology brass or aluminum zippers eventually corrode and fail.

Headliners in Twin Cessnas were installed in two very different ways. Early short cabin 310s and some extended cabin 320s have multi-panel headliners that were held in place by several tempered 1/8" curved support rods or bows, running spanwise from side to side along the top of the cabin. The headliner was secured to these spanwise bows with continuous canvas loops that are sewn to the headliner material at each panel seam. Before actually installing the headliner, it's important to provide an accurate means of locating and cutting the many holes that must be made in order to install vents, reading lights, overhead consoles, etc. The location process begins by partially installing the mounting hardware that secures these various components. We actually use a belt sander to sharpen the hardware to a point. With the sharpened mounting hardware partially installed, one can easily see the location of the mounting components when the headliner is hung.

Spanwise multi-panel headliner typically installed in early Twin Cessnas.

Next, it's time to run the bows through each canvas loop. We hang the headliner by locating the ends of each bow in mounting tabs located along the outer cabin structure immediately above the cabin windows, as well as the bow mounting tabs that are secured to the upper bulkheads along the cabin top. With all the headliner bows in place, and the headliner loosely hanging in position, it's time to begin the stretching process.

Heat is your best friend when installing a vinyl headliner. Warm vinyl is more stretchy than cold vinyl. Installing an unheated vinyl headliner in a chilly hangar during cold weather will likely result in sagging and wrinkling when the headliner vinyl softens in warmer temperatures. Even in summer, we put two electric cube heaters in a closed up the cabin to help ensure that we get a tight, wrinkle-free installation.

Sharpened, partially installed vent outlet mounting screws make for accurate location of holes in the new headliner.

With the headliner good and warm, it's time to use contact cement to begin stretching and bonding the headliner to the upper cabin structure. Due to age, it's possible for thick layers of old glue to have built up along the upper outer cabin structure that will compromise the security of the new headliner. We use a stainless steel wire brush and solvent

to remove all the old glue. It's also a good idea to apply a coat of zinc chromate to control corrosion prior to applying new contact cement. We then stretch and secure the headliner along the forward spanwise structure of the upper windshield frame and along edges of the upper aft cabin bulkhead. Then we move to the center of the cabin and stretch and bond about one foot of the outer headliner to the left and right upper cabin structure. Next we progressively stretch and bond the headliner working from the center of the cabin to the forward and aft corners of the headliner, removing any wrinkles that might begin to develop during the process. This process of bonding and stretching the headliner from center points to the corners works well and results in a taut, wrinkle-free installation.

Full cabin length, multi-panel, later style Cessna twin headliner that can be mounted with either long straight rods and loops or aluminum extrusion mounting rails.

The second type of headliner design is installed in the longer-cabin 310s, 320s, 340s, 414s, 421s and 425s, and it differs from the above-described installations. In these airplanes the support structure for the headliner runs the full length of the cabin from front to back. Earlier iterations of this design consist of four or six sewn together full cabin length panels, with canvas loops and tempered steel rods at each seam as used in the early twins. The installation process for this type of headliner is identical to the spanwise headliner discussed earlier. (If you are unable to sew a new headliner yourself, high quality pre-made headliners can be purchased from companies like Airtex.)

End view of the aluminum extrusion and plastic headliner mounting system (available from Recmar Products).

In the 1970s, Cessna changed to a much-improved mounting system for these long, multi-panel extrusion headliners. Instead of sewn full length loops and rods, Cessna employed the use of cabin length aluminum extrusion and plastic retention strips to secure each individual headliner panel. This resulted in several advantages. It eliminated the tedious process of having to accurately sew multiple headliner panels together. It also allowed for better wrinkle control during installation, as well as the removal of one individual panel for damage repair or antenna access without disturbing an adjacent panel. Here's the best part: the extruded aluminum mounting rails are held in place with countersunk sheet metal screws located at each cabin top bulkhead. This updated system can also be easily installed in older Twin Cessnas; what's not to like?

Installing one of these extrusion mounted headliners begins with using the old headliner pieces as a pattern and cutting new, slightly oversized panels. Then we wrap the material over the plastic retainer strip and press the strip into the aluminum extrusions. It is important to be stretching the headliner in both directions as you are pressing the material retainer in place. We often use a hammer with a leather pad glued to the butt end of the handle as a handy tool to safely and snuggly press the retainer strip and headliner material into the aluminum extrusion; works great! As with earlier twins, the new headliner is secured at the forward windshield end and along the upper aft bulkhead with contact cement. Don't forget to temporarily install the hole-locating pointed screws and always keep the vinyl as warm as possible.

End view of the built up field-fabricated retainer strip.

One last important issue is the challenge of neatly securing the headliner along the upper curved portion of 310 and 320 cabin doors. Cessna solved this problem by installing a delicate, curved retaining strip that relied on sharp points to hold the headliner in place. But this system created three problems. First, when the headliner material was pressed into the sharp points of the retainer strip the material was damaged. Second, after several attempts to remove and reinstall the headliner, the delicate sharp points become bent or broken. Third, the

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retaining rail assembly was fabricated with very thin aluminum that over 40+ years becomes so deformed and cracked that it's not reusable.

The solution begins by using the old retaining strip as a pattern guide to fabricate a curved 5/8" wide by .090" thick aluminum center plate. Next we fabricate two 1-1/4" wide .032" identically shaped curved aluminum pieces. We use a stainless steel wire brush to lightly rough up one side of each of the two .032" aluminum pieces, clamp the two pieces to the .090" aluminum, rough side facing the .090" spacer piece, drill 1/8" rivet holes on 1-1/4" centers, and countersink them on both sides. Next, we install 1/8" hardware store flush pop rivets, and use a hammer to flatten the formed head of the pop rivet so both sides of the retaining strip are perfectly flat. The final step in the process involves drilling 1/8" diameter countersunk mounting holes in between every two flush rivets to accommodate #6 flush head mounting screws. This process creates a sturdy curved and durable retaining strip with a .090" gap into which the new headliner material can be securely tucked with a thin rounded soft edge putty knife. The snug fit of the material and the roughed-up surface of the inner surfaces of the .032" aluminum outer plates ensure a well-secured closure of the headliner material along the curved edge of the upper cabin door frame.

Retainer strip with 1/8" countersunk mounting holes and flush #4 sheet metal screws.

As with all new fabrication processes, I suggest making up a small test assembly and practice tucking the new headliner material into the retainer. If the new material is thicker than the original vinyl or fabric, it may be necessary to open up the gap between the two .032" pieces of aluminum. On one project, we ended up adding an additional layer of .019" aluminum to act as a shim for the .090" piece that is between the two .032" pieces. This resulted in a slightly wider gap to accommodate some thicker material the customer specified for his headliner. You do what you have to do!

Using a thin rounded putty knife to snuggly secure the headliner material.

Here's the best part: Due to the fact that the edge of the headliner is held in place by the snug fit of the material tucked between two pieces of .032" aluminum, and there are no damaging sharp retaining points, the headliner can easily be removed and reinstalled without damaging the material or the retainer. Problems solved!

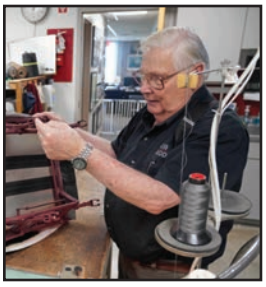
For those who don't mind deviating from the original factory look of a clean edge with no hardware showing along the cabin door jamb, there is a simpler but visible solution. This method simply involves neatly gluing the raw edge of the headliner material in place and installing a .063" thick aluminum strip, padded with 1/8" thick upholstery foam and wrapped with headliner material. It is held in place with #6 sheet metal countersunk upholstery screws and finish washers. Good looking, simpler, faster, reliable, and a lot easier to implement.

Upholstered cabin door headliner trim piece secured with #6 upholstery screws and finish washers.

As you can see, a lot goes into something that most folks don't really notice when the new interior is completed. After reading all this, you may actually take a closer look at those aircraft headliners! Next month we will take an in-depth look into the world of safety enhancing passenger restraints.

INTERIOR RENOVATIONS - SEATBELTS

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

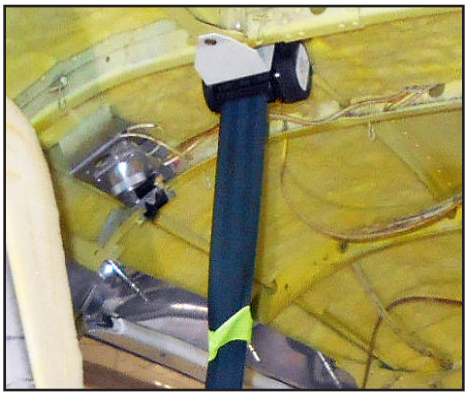
How does one really evaluate an investment? I think it's safe to say that one measure of a good investment is that it improves the quality of our daily lives. This article is partly about investing in something that hopefully will be the worst investment you'll make in your airplane: upgrading and maintaining your aircraft's passenger restraints. But if ever you are faced with a situation where they are put to the test, it could end up being the best investment you've ever made.

BAS four-point inertia reel shoulder harness/ lap belt installation in a Cessna 310.

In my much younger, pre-Air Mod days, I worked for an aircraft metal repair shop. We often found ourselves heading off to some field or woods to recover a wrecked airplane. In a very short time, it became graphically obvious to me that there are two things that have a significant effect on the outcome of an off-airport landing.

The first is airframe structural integrity. Cessna stuck to old school values in designing their airframes. Structural integrity and durability took precedence over being light in weight and inexpensive. Twin Cessna airframes are also pretty tough. We recovered one upside-down twin during my time at that shop, and the pilot came out relatively unscathed other some scratches, bumps, and bruises. That strong airframe helped protect him.

The second survivability factor in these accident outcomes is shoulder harnesses. Growing up in an airport environment, I was more than once the first person to get to the scene of a serious accident. Back in the early '70s, most light airplanes were not equipped with shoulder harnesses. I have removed seriously injured or fatally injured front seat occupants from three badly crashed airplanes. There could have been a far better outcome if state-of-the art shoulder harnesses had been installed. I once saw a statistic stating that wearing a shoulder harness in a light airplane has approximately the same injury reduction benefit as wearing a helmet when riding a motorcycle.



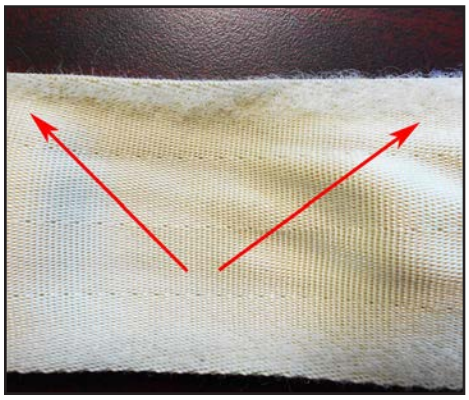
Steel shoulder harness inertia reel mounting bracket and tension strap installed on an upper cabin top bulkhead in a 310.

If you are flying an older Twin Cessna that does not have shoulder harnesses, particularly for the front seats, I would advise that you work with your maintenance technician to purchase and install an approved four-point inertia reel system.

Let's look at various shoulder harness design options. The most common chosen by airframe manufacturers and some aftermarket suppliers is a three-point fixed shoulder harness that is secured to the airframe in three places. There is an attach point at each end of the lap belt, and one where the single strap, fixed shoulder harness is secured to the upper outboard cabin structure behind the pilot or co-pilot seat. For increased comfort and safety, an aftermarket three-point inertia reel can be installed that allows the occupant

Sun faded 45-year-old Cessna lap belt.

free movement while performing pilot duties such as switching fuel tanks or leaning forward while looking for traffic. An inertia reel always keeps the harness comfortably and correctly located diagonally across the occupant's upper body by automatically extending and retracting during movement. If a sudden deceleration force is sensed by the mechanism in the inertia reel, it instantly locks up and holds the occupant in place.



Frayed edge of unairworthy shoulder harness webbing.

If you have a fixed three-point system, you may want to consider replacing it with an approved aftermarket inertia reel system. History has shown that pilots using a fixed shoulder harness will be tempted to loosen it or actually take it off in flight and not remember to put it back on before a time of need arises. One can purchase approved three-point aftermarket shoulder harness kits from Alpha Aviation, Hooker Harness, Aircraft Spruce, Wag Aero, and most airframe manufacturers.

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SEATBELTS

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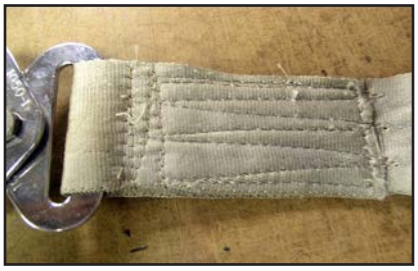
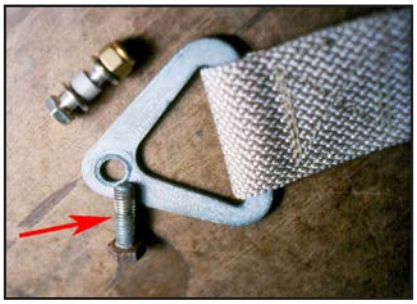


A homemade belt, improperly sewn with an upholstery sewing machine and missing a certification tag.

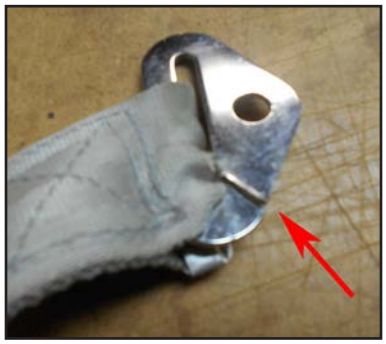
Next on the list of aftermarket shoulder harness designs is a four-point system that secures the inertia reel to a cabin top bulkhead with a strong steel bracket, centered above and behind the pilot and co-pilot seats. A four-point harness system creates better restraint by having two shoulder straps that symmetrically support both shoulders. This eliminates any twisting of the upper body during what engineers call a high G-load deceleration event (and I call a crash!). The effectiveness of the aforementioned three-point single strap harness is very much dependent on the direction of the impact. If an impact force vector is from the same side where the harness is attached to the upper cabin, the resulting force works to tightly hold the occupant's body in the harness. Conversely, if the impact force is from the opposite side of the harness attachment, the resulting deceleration force pulls the occupant out of the harness. Many sudden stops do not always result in a forward impact; there can be multiple impacts where the initial force is off-center, the airplane spins to one side, hits another immovable object and the momentum pulls the occupant out of the harness. Yikes! Asymmetrical impacts are less threatening if both shoulders are supported by a four-point system.



This belt had been mounted with a hardware store bolt and was missing a needed spacer. The correct aircraft bolt, nut, washers and spacer are off to the side.

When I started Air Mod in 1973, very few approved aftermarket four-point shoulder harness installation kits existed. I bought an old cabin section from a wrecked Beech to use as a design and testing tool for designing and installing a four-point inertia reel harness system that would be FAA-approved. An FAA airworthiness inspector observed a 9G pull test to confirm that all materials, design, and processes were adhered to as outlined in AC 4313, and issued a duplicatable field approval that could be used again for installations in the same make and model aircraft. Today, any major modification of a passenger restraint requires that a DER (FAA designated engineering representative) be involved in the engineering process, and the resulting field approval would be a one-time use, non-duplicatable approval, meaning the installation is approved for only that one airplane that was tested.

Fast forward to today and we have the ability to purchase FAA STC (supplemental type certificate) approved, well-designed three- and four-point fixed or inertia reel harness kits. These kits can be installed by an airframe mechanic and signed off on an FAA 337 major alteration and repair form. However, keep in mind that any field modification that is not STC-approved, or is not offered by the original airframe manufacturer as field-installable, necessitates that an engineering study be performed by an FAA DER (designated engineering representative). After the design and engineering is properly vetted, an 8110-3 report will be completed by the DER. After the modification is completed per the specific guidance as stated on the 8110-3 form, an FAA major alteration and repair form 337 must be filled out by an A&P mechanic who holds an IA (inspection authorized) rating and submitted to the FAA.



Completely split seat belt end fitting.

BAS, Inc. offers STC'd four-point, inertia reel shoulder harness kits for the front seats of many Cessna singles, plus the Cessna 310-310Q, and all 320 models. But not the 340 or any of the 400 series. It's possible one could be installed in these models with a field approval but that could prove difficult, especially in the pressurized models. For the singles, the kit cost averages $1500-$1600 and includes new lap belts (the kit includes everything for both pilot and co-pilot seats). Installation takes about eight hours.

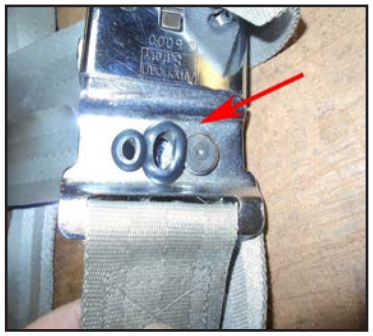
Last, but certainly not least, is the AmSafe airbag three-point inertia reel harnesses and belts. This system adds airbag protection to a three-point restraint system. This product costs approximately $5,000, includes components for both pilot and co-pilot seats, and requires approximately eight hours of installation labor. Once installed, the system necessitates ongoing inspection and testing, and has the potential need for component replacement.

Worn nylon bushing in a shoulder harness attach fitting.

For more information on the design and field installation of shoulder harnesses, refer to chapter nine of FAA AC4313-2b. The FAA has done a great job explaining the engineering, design, and installation processes involved in

installing this most important safety enhancement owners can add to their legacy Cessnas. Remember, you can't write the check on the way down.

We've focused mostly on the pilot and co-pilot stations. What about the other original seat belts and shoulder harnesses that are still in service after forty or even fifty years? It's important to thoroughly inspect the condition of every belt, harness, and mounting system in the airplane. The following are some all too common passenger restraint safety issues we find when disassembling an aircraft in the early stage of interior renovation. As we work through this list of passenger restraint issues, keep in mind that in order for belts, harnesses, and mountings to be certified, the lap belts and mountings had to pass a pull test to 12 Gs, shoulder harness to 9 Gs, at an occupant body weight of 170 pounds. Most of the adult aviation enthusiasts I see roaming around at Oshkosh blew through that weight way back in high school. This means that by today's standards these systems are almost under-designed (my opinion) and it's important to keep them in top condition. So here goes.



Homemade attempted fix for a worn attach fitting that employed the use of a rubber O-ring.

SUN FADED AND FRAYING WEBBING: Without question the most common airworthiness issue we find is faded or worn webbing. After many years of being exposed to ultraviolet sunlight, the nylon or Dacron fibers that are woven into seatbelt webbing and stitching become weak. Also, wherever the webbing rubs against a belt, shoulder harness guide, or inertia reel, it eventually wears and becomes frayed as evidenced by fuzzy fibers developing at these wear points. Either of these conditions render the belt or harness unairworthy and they must be re-webbed.

HOME MADE BELTS AND HARNESSES: Believe it or not, we find belts and harnesses with new webbing that is sewn with an incorrect sewing pattern and no certification or an old certification tag sewn to the belt. Also, who knows if the webbing used was even certified. All aircraft belts and harnesses must have a legible certification tag attached to be airworthy.

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WRONG OR DAMAGED MOUNTING HARDWARE: We often find common non-aircraft grade bolts and nuts used to secure a belt or harness to its mounting structure. Certified aircraft hardware is manufactured to a much higher standard using stronger material than hardware store fasteners. Also, make sure that all required mounting components such as spacers and washers are in place. Check the aircraft manufacturer's parts book to verify what should be installed.

DAMAGED FITTINGS: Badly rusted, worn, or cracked lap belt attachment fittings definitely need to be replaced. Shown in the photo on the previous page is the lap belt end fitting we found on a center seat of a 310 that had just come out of an annual inspection.

WORN SHOULDER HARNESS ATTACH CONNECTORS: It's common to find that the nylon bushing that snuggly secures the shoulder harness attachment to the seatbelt buckle is worn or missing. If your harness does not aggressively snap into the lap belt or if it disconnects easily, have the buckle replaced. Do not attempt a home-made fix (as seen in the photo).

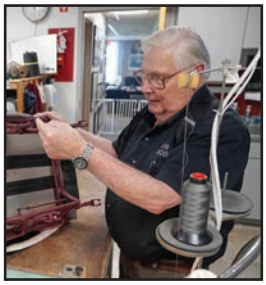
INERTIA REEL MECHANICAL ISSUES: Inertia reel locking mechanisms can develop mechanical problems. If an inertia reel harness does not lock up when the harness webbing is quickly pulled on, it's likely that dirt or worn parts have degraded the reliability of the inertia reel to work properly at a critical time. Definitely send the reel and harness to an approved repair station for rework.

For those do-it-yourself types, removing and reinstalling most passenger restraints can be done by an aircraft owner under the owner performed preventative maintenance provisions as outlined in FAA FAR part 43, provided complex disassembly and reassembly is not required. Check with your maintenance tech before undertaking such a project. Note that any re-webbing, repair, or service must be done at an approved repair station. We use Aviation Safety Products for most of our passenger restraint work. They provide quality and reliable service.

We are pretty close to wrapping up our series on interiors. The next articles will focus on cabin insulation and, finally, the process of drafting a logbook entry that thoroughly describes the fabrication and installation of your new interior. So, next month it's on to insulation. Your cabin will be quieter, cooler in summer, and warmer in winter.

INTERIOR RENOVATIONS
INSULATION

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

Without question, one of the most challenging tasks when renovating light airplanes is dealing with the issue of cabin noise. Corrosion clean-up may be a more arduous task but thermal and acoustic improvements resulting from cabin re-insulation definitely produce less predictable results. Case in point: we thoroughly insulated two identical 172s built the same year, with identical engines, propellers, interiors, and insulation packages. We tested running them wide open in identical conditions. One tested two decibels (db) quieter than the other.

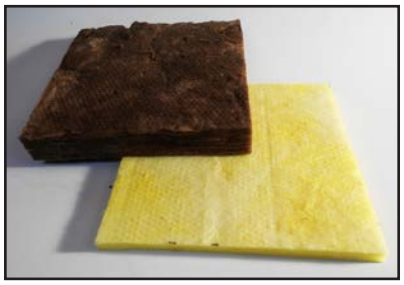
Analog meter indicating a 92 db sound pressure level.

Below I share what I've learned in 48 years of trying to solve this challenging problem using the best materials the industry can provide.

THE PROBLEM: Most wing mounted, twin engine piston airplanes with factory insulation packages create a sound pressure of approximately 92-94 db measured at cruise speed using an analog handheld sound meter at the pilot's ear. Audiologists agree that extended exposure to more than 80 db is damaging to our ears, especially those of children and pets. Here's a reality check. Back in the early 1990s, we had a customer who was willing to spend whatever it would take to make the cabin of his fast airplane as quiet as possible. I flew the 300-horsepower hotrod Beech Bonanza at 70% power, 8,000 feet, and 64 degrees OAT. We got a 94 db reading at my ear, 92 db at my co-worker's ear sitting in the center seats, and 90 db back in the 5th seat.

Thoroughly cleaned, corrosion-free, chromated cabin, ready for the new insulation package.

THE ATTEMPTED FIX: All this glass was double the thickness of the original factory-installed plexiglass: a 1/2" thick windshield, 1/2" pilot and co-pilot windows, 3/8" center windows, and 1/4" aft cabin windows. We then installed a very aerodynamic and efficient fresh air ventilation intake scoop — mounted way back on the top of the fuselage — and all new fresh air ducting, plenums, and much larger and more aerodynamic fresh air outlet nozzles. We sent the engine mufflers out for overhaul, removed the long two-blade prop, and installed a new balanced three-blade prop. We also installed new cabin door and opening window seals, adjusting and thoroughly testing them.



Semi-rigid 5/8" thick base layer skin stabilizing fiberglass and 2" thermal and acoustic lofted fiberglass.

Next came the cabin insulation package. All the materials used in this package were developed in a joint venture between Air Mod and Skandia Inc. We did a lot of test flying and installation modifications using eight different skin damping and sound attenuation materials.

THE RESULTS: We added 23 pounds of window weight, 28 pounds of cabin insulation, and nine pounds of fresh air system components. After several test flights at the same altitude and power setting as earlier, accompanied by Skandia's sound engineer, we measured 84 db at the pilot's ear, 82 db at the center seats, and 81 db at the 5th seat. In my opinion, a reduction of 10 db wasn't that impressive given the amount of work involved, weight gain, and money invested.

Neatly fit double layers of fiberglass insulation being lightly bonded in place with Camie 303 spray adhesive.

Before describing the materials and techniques that can make your twin quieter, warmer in the winter, and cooler in the summer, we should first discuss the three ways to reduce cabin noise.

First: eliminate the sound at its source.

1. Quieter propellers, three-blade versus two-blade (prop noise is a major contributor to cabin noise)

Flame testing a material sample.

Sound Ex composite insulation with inside-facing foil; the foil tape is used to hold the Sound Ex in place.

2. Quieter engines, more efficient exhaust systems, well maintained or newer mufflers
3. Precise engine and prop balancing
4. Relocate large cabin top mounted antennas
5. Less boundary airflow and engine noise (fly slower)
6. More aero-dynamically designed airframes (not an available option)

Second: keep the noise from getting into the cabin.

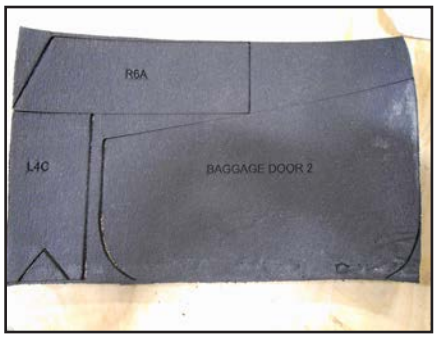
1. Thicker windows
2. Keep cabin skins from vibrating (skin dampers)
3. More aerodynamic fresh air systems and cabin outlets
4. Good, quality seals and well-adjusted door and opening windows
5. More effective cabin insulation

Third: attenuate the sound that gets into the cabin.

1. Choose sound absorbing finish upholstery materials
2. Use fabric rather than sound reflective vinyl in airplanes with stretched headliners
3. More dense backing foams on side panels and carpet
4. More plush and dense carpet
5. Use quality active electronic noise cancelling headphones

OK, enough background information; time to get to work. Before installing a new insulation package, it's important to start with a corrosion free, zinc chromated cabin after which it's safe to use properly applied contact adhesive or self-stick insulation material to establish a good bond between vibration reducing skin dampers and the cabin skins and structure.

When installing cabin insulation, make every attempt to keep wiring, airframe systems, cables, etc, exposed. Hiding these important components behind insulation can create serious inspection and maintenance issues.



Cutting patterns printed on the back of Sound Ex insulation sheets.

At Air Mod we offer three very different cabin insulation options to our customers when we are renovating an interior.
In an effort to install a cost effective, light, and much improved insulation package, our first option employs the use of two types of fiberglass. We first begin by bonding a 5/8" thick layer of semi-rigid fiberglass to the cleaned and chromated cabin skins. Bonding this semi rigid fiberglass to the cabin skins will reduce skin vibration, thus reducing noise transition into the cabin. We actually buy 2" x 4' fiberglass ceiling tiles with the finish layer removed. We use spray contact adhesive, available in 18-ounce cans sold under the brand name of Camie 303. We spray a light coat of adhesive on both the 5/8" semi-rigid fiberglass and the chromated surface of the cabin, and press the cut-to-shape fiberglass in place. In order to get the semi-rigid panels to conform to a curved surface simply make parallel half-thickness cuts to the bonded side of the panel. Never attempt to apply contact adhesive to fiberglass with a brush; this will result in impregnating the non-combustible fiberglass with too heavy a layer of combustible adhesive.

Using a band saw to quickly and neatly cut out the Sound Ex.

The next step is to lightly bond about a two-inch-thick layer of soft, lofted fiberglass on top of the 5/8" semi-rigid fiberglass. The layer of soft lofted fiberglass provides a sound attenuating as well as thermal barrier between the stabilized cabin skin and the interior side panels and headliner. Due to the limited space in some parts of the cabin (doors and above plastic headliners are two areas), it may be necessary to apply only the 5/8" semi-rigid material, or else separate the two-inch lofted layer down to less than one inch thick. Cut to fit as needed.

Properly installing this two-density fiberglass system will reduce cabin sound levels by two to three decibels, improve cabin temperatures in summer and winter, and create a more solid feeling cabin environment; you will definitely notice this when you close the more solid sounding cabin doors. On average for a six place Twin Cessna, this system will add eight to ten pounds to the empty weight of the airplane.

Neatly installed Sound Ex material that allows exposure of cabin plumbing and wiring.

Even though fiberglass will not burn, the FAA requires a composite flame test on all materials used in this process. We used Skandia in Rockford, Illinois, for this. We create three test composite samples that replicate exactly how the insulation will be installed in the airplane. Skandia performs a flame test to the three samples, and issues an FAA 8130 form verifying that all the materials and adhesives pass FAR 25.853a. This helps ensure that the

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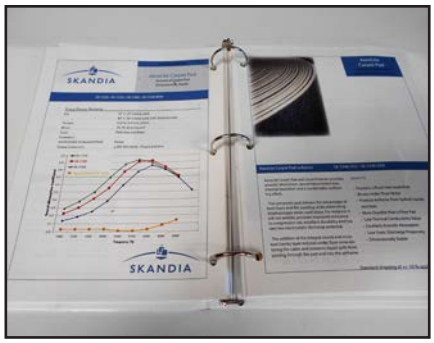
renovated interior is part of the fire suppression system rather than a fire support system.

The second insulation option is a commercially available kit called Sound Ex. The insulation material supplied with this kit is a closed cell, flame retardant foam in two different densities. The various 1" thick flexible composite pieces are backed with heavy aluminum foil, installed in the cabin with the foil side exposed. Sound Ex kits come with index-marked accurate cutting patterns printed right on the foam sheets, as well as having a printed layout guide that makes installation a breeze. We use a band saw to cut out the insulation quickly and neatly by simply following the cutting lines printed on the back side of the foam.



Graphs that depict specific acoustical performance of various damping and attenuating materials included in a Skandia model-specific kit.

Once the cut pieces are snuggly fit in place, foil tape is used to hold the insulation in position against the cabin skins. This foolproof, turnkey system will reduce cabin sound levels by approximately six to eight decibels and adds about 15 pounds to a Cessna 310.

The third system we use involves the installation of eight different engineered foam, lead vinyl, and foil materials, each one of which is designed to attenuate a specific sound frequency and amplitude (db) level. These various materials, available from Skandia Inc, are bonded to cabin skins, the back surfaces of interior panels, firewalls, and floors. By following a sound amplitude and frequency chart created by test flying a stripped-out airplane and analyzing the resulting data, one can create an installation chart identifying which materials are to be installed in what areas to best attenuate the specific amplitudes (dbs) and frequencies located in that particular area of the cabin. This high-tech system will add approximately 28 pounds to the airplane's empty weight and can reduce cabin sound levels by as much as 10 decibels.

Samples of the various materials that make up a Skandia kit.

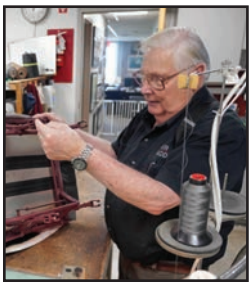
So, here is my takeaway after 48 years of working with this complex problem. I believe fiberglass insulation is the best choice if weight, dollars, and sound reduction are of paramount concern. The improvement will be noticeable. But that said, based on cost relative to the benefit and ease of installation, I think Sound Ex is probably the best upgrade option.

> *"Here is my takeaway after 48 years of working with this complex problem. I believe fiberglass insulation is the best choice..."*

Over the years, insulating light airplanes has been a frequent topic among myself and my fellow renovators, with numerous discussions generating various solutions. This article describes techniques that I have found to be effective in solving this renovation challenge. Next month we will end this interior renovation series with the fun part, paperwork.

INTERIOR RENOVATIONS LOGBOOK ENTRY

by Dennis Wolter, Founder & Owner - Air Mod, Inc.



Dennis Wolter - Air Mod Inc.

Editor's Note: This is the 14th and final installment of Dennis's comprehensive series on interior renovations. The complete version with all installments can be downloaded from our website at www.twincenssna.org.

Back in the early 1970s, as a freshly minted industrial design graduate from the University of Cincinnati, I landed a teaching position in the aviation maintenance program at Cincinnati State Technical College. Being the new instructor on staff, I got stuck with teaching what was considered the most boring and tedious class in the curriculum. You guessed it, Federal Aviation Regulations. Having to teach that class actually turned out to be a blessing in disguise as I pursued my career in aircraft renovation. As you might guess, teaching something to someone else is a really great way to increase your own knowledge on that topic.

An understanding of the very complex world of FARs helps tremendously in putting together an accurate, thorough, and FAA-compliant logbook entry. There are generally four major functions of a logbook entry.

The first is to describe in detail the work that was performed.

The second is to provide supporting documentation verifying that all components, materials, and processes used to complete the work conform to all applicable Federal Aviation Regulations. If the work is performed as an STC (supplemental type certificate), referencing the STC number is all that is required. More on that later.

Third is to include continuing airworthiness instructions for any minor alterations that were installed for which there are no manufacturer factory maintenance manuals (this could include such things as disassembly and reassembly instructions, ongoing maintenance, and required inspections).

The fourth part of the entry is a sign-off identifying the authorized person or organization approving the work. Confirming that the logbook entry meets all of these requirements gives proof that the aircraft conforms to the original type certificate and will perform to the specifications as stated in the manufacturer's flight manual.

It's important to say here that the aircraft owner or operator is the person who is ultimately responsible for the airworthiness of the aircraft, and a thorough logbook entry could be the only proof that you as an owner are operating an airworthy airplane.

> *"...the aircraft owner or operator is the person who is ultimately responsible for the airworthiness of the aircraft, and a thorough logbook entry could be the only proof that you... are operating an airworthy airplane."*

To help maintenance technicians meet the objective of drafting a good logbook entry, the FAA has produced what I consider to be an aircraft owner's bible, and a document that every owner should have. I'm referring to FAA AC 43.13-1B and -2B titled "Aircraft, Inspection, Repair, and Alterations." This manual outlines acceptable methods, techniques, and practices that are to be used to guide technicians maintaining and repairing certified

The job is neither complete nor the airplane ready to fly until the logbook entry is made.

aircraft. Having a copy of this well-written and illustrated manual provides an owner with enough information to better monitor the quality of work that is being done in his or her airplane.

By following the guidance in 43-13, factory maintenance manuals, STC instructions, service bulletin data, airworthiness directives, and other FAA approved methods, your maintenance technician can ensure that a high level of airworthiness is maintained.

Before reading through the sample 310 logbook entry I've chosen for this article and shown on page 22, it's important to understand some of the terminology that describes the work that was done. In aviation, we use a lot of acronyms. The following is a list of some of those most frequently used acronyms and terms in the preparation of a thorough logbook entry.

TC (type certificate): This is the b irth certificate of new aircraft design. This certificate is issued by the FAA after the manufacturer has verified that the aircraft conforms to its original approved design specifications for structural integrity, performance, manufacturing, and handling qualities. The first thing an IA does during an annual inspection is review the aircraft's records to confirm that the aircraft conforms to specs as stated by the type certificate data sheets.

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STC (supplemental type certificate): This acronym refers to an approval granted by the FAA that allows for major modification or repair of an airplane that keeps the aircraft in compliance with the original manufacturer's type certificate.

337 form: This is a two-sided form that must be completed and signed by an A&P mechanic who holds an inspection authorization (A&P IA) for major alterations or STCd installations. This form describes all the approved work performed, parts installed, and any post work testing. Major repairs and modifications performed by an FAA-approved repair station require only a logbook entry and not a 337.

Transforming a cringe-worthy 1970s interior into a 21st century showpiece requires a detailed logbook entry!

Mil-spec: A quality control standard accepted by the FAA that ensures components such as electrical wire, hoses, hardware, etc., were manufactured to meet that high mil-spec technical standard.

TSO (technical standard order): This approval process verifies that an item conforms to rigid FAA standards for material, design, manufacturing, tolerance, and testing.

PMA (parts manufacturing authority): This approval is issued to an after-market manufacturer who has proven to the FAA that they have complied with all specifications of mil-specs and TSOs, and are approved to manufacture an airworthy component.

Major alteration: Simply stated, any alteration that could, if it were to fail, negatively affect the performance of the aircraft in such a way that it would not perform as outlined in the flight manual.

Minor alteration: The FAA broadly describes a minor alteration as an alteration that is not a major alteration. Logbook entries for a minor modification require a thorough description of the work performed, referencing any relevant technical data found in AC 43-13-1B and -2B, manufacturers maintenance manuals, and any other technical specifications.

ICA (instructions for continuous airworthiness): Any major or minor modification that is done to a certified aircraft using approved methods previously described must have a logbook entry that includes ongoing maintenance and inspection instructions. This ensures that maintenance information for the modification, obviously not in the factory maintenance manual, becomes permanently included in the aircraft's maintenance records as part of the logbook entry.

Referencing AC 43.13 and armed with all of this technical lingo should help an owner in understanding all that must be included in a good logbook entry. Obviously, your maintenance technician is quite familiar with following all of these guidelines. But as an owner, the more you know here the better off you are.

One other note: We normally calculate a weight and balance change for every project that goes through our hangar. The revised weight and balance information would appear at the end of our logbook entry, ensuring that it becomes part of the permanent records of the aircraft. In the case of this 310, the customer requested that his airplane be weighed, which can be done on our field. If it has been some time since your airplane was weighed, if existing records are sketchy, or if a significant amount of work has been done, I recommend weighing the airplane.

For those of you who are still awake after reading this exciting stuff, I hope this exercise has given some clarity as to the importance and content of a good logbook entry. As our airplanes continue to age, aftermarket components and unanticipated repairs will become an important part of safely and legally keeping them flying. Owners, maintenance techs, manufacturers, and the FAA need to think beyond the content of maintenance manuals that were written forty or fifty years ago. So far, all parties involved in this effort are doing a good job.

I've enjoyed sharing this information with all of you. If anyone has any questions, please feel free to give me a call. Be sure to reveiw the logbook entry on page 22. Until next time, fly safe!

INTERIOR LOGBOOK ENTRY *(continued from page 20)*

CESSNA 310L N00000 s/n 310L-0000 xxxx hrs Hobbs 01/01/2021

Fabricate new 020" 2024T-3 aluminum side panels and kick panels that are mounted with RecMar extruded aluminum divider rails; the divider rails are secured to existing bulkheads and door jambs with Auveco #4 countersunk upholstery screws. Install four molded Kidex plastic armrests that pass FAR 25.853a; the armrests are secured to the cabin sides using .050" 2024T-3 formed aluminum brackets that are mounted to the airframe with eight AN4704-4 rivets each. The armrest pads are secured to the plastic bases with 3M velcro and the plastic armrest bases are secured with two #6 Auveco countersunk upholstery screws. All seat, emergency exit and cabin fixtures were checked for clearance and function with no discrepancy noted. All sheet metal work as per AC 43-13 1B, chapter 4, section 4, paragraphs 4-53 a, 4-53 b, 4-55 a, 4-55 b, 4-55 c, 4-56 a, 4-56 b (1) (2) (3), 4-57 a (1) (2) (3), 4-57 b, 4-57 c (1) (2), 4-57 e, 4-57 f (1) (2) (3) (5). For continuing airworthiness, inspect side panel and armrest components for security at every annual inspection. To remove side panels; remove the armrest pads by lifting them free of the velcro mountings, then remove the two exposed armrest base mounting screws, and remove all original side panel air vent, door handles, pull straps and securing hardware. Upper side panels are secured by the window frames, which must be removed to allow for the panels to be lifted free of the upper divider rails. To remove the center side panels, start at one end of the panel and carefully bend the panel in order to pull it free of the divider rails. To remove the lower carpeted kick panels, remove the #6 upholstery screw and washers at the base of the panels and pull them inward at the base to release them from the divider rails. Reassemble in the reverse order. Fabricate and install a new interior using the following approved materials. Fabric: GBS Fabrics toystore backgammon, passes FAR 25.853a. Vinyl on seats and side panels: GBS Fabrics eclipse dark secret, passes FAR 25.853a. Carpet: Aircraft Interior Products design accent onyx, passes FAR 25.853a. Headliner vinyl: GBS Fabrics eclipse oxford white, passes FAR 25.853a. Clean inner cabin skins and structure in preparation for the application of zinc chromate; chromate all inner cabin surfaces and insulate with Astraperf and NexGen fiberglass that pass FAR 25.853a per Skandia work order 283069-14. Install Skandia ADC.005 composite insulation on chromated belly skins, passes FAR 25.853a. Replace all seat and side panel foam with Skandia flame retardant urethane foam that passes FAR 25.853a. Clean and properly secure co-pilot seat rail. Troubleshoot and adjust P1 seat back reclining mechanism. Modify pilot and co-pilot seats for the installation of headrests, see 337 this date. Fabricate two new headrests per FAR 21.303b(2), owner approved parts; document on file at Air Mod. Install and adjust four new Cessna #295479 mounting studs for 5th and 6th seats. Repair and reinforce existing cabin trim components as required. Install the following new plastic trim components: K0811704-1 right window post, K0811237-14 forward window trim, K0811237-3 lower emergency window, K0811237-2 left forward window, K0811526-2 door window trim, K0811274-3 window trim cover, K0811704-4 right door post, K0811704-2 right window post, K0811274-2 window trim cover, K0812570-1 right volt reg cover and K0800114-1 left chain seat sup cover. Fabricate new mountings for and trim upper cabin door trim panel. Refinish cabin trim with Dietzler acrylic lacquer and placard as original. Disassemble, prep, paint, placard and reassemble instrument panel subpanel and pedestal. Modify pilot circuit breaker and alternator panel mountings. Power up aircraft to confirm circuit breaker placarding, placard and assemble panel and perform a final breaker/placarding check with no discrepancy noted. Fabricate and install aft bulkhead velcro mounting, upper hat shelf retaining lip, and related trim components. Install the following LP Aero FAA-PMA windows: #716 SG ¼" tinted windshield, #720 SG ¼" tinted pilot window, #333 SG ¼" tinted co-pilot window, #721 SG tinted pilot vent window, #723 SG ¼" tinted left aft outer window, #724 SG ¼" right outer window, #725 left clear aft inner window and #726 right clear aft inner window. Trim and fit pilots vent window; install with new hinges, latches and seal. Install 6-32 nut plates for windshield cuff in place of oversized rivets. Dimple windshield cuff to accept stainless steel 6-32 countersunk machine screws. Modify glareshield to sit higher to allow the pilot to see the top of the instrument panel; remove, prep, paint and reinstall glareshield. Install two 28 volt previously approved Cessna #0513039-7 accessory plugs in the lower pilot side panel, wired to an existing 5 amp Klixon circuit breaker marked 'L Power Outlet' with #18 Astro mil spec wire (MIL-W-22759E). For continuing airworthiness check condition and security of plugs and wiring whenever side panel is removed. Install two previously approved overhead Dialco #2015 reading lights, wired to the existing cabin lights circuit breaker through a DPDT Edmo #MTA206N switch using 18 gauge (ML-W-22759E) wire. For continuing airworthiness inspect wiring behind the headliner and in circuit breaker box whenever these areas are accessed, replace reading light bulbs with GE 1864 28 volt bulb or equivalent. Electrical work for these installations performed per AC 43-13-1B, chapter 11, section 3, paragraphs 11-30, 11-31, 11-32, 11-33, 11-37, section 4, paragraphs 11-47, 11-48, 11-49, 11-50 a, 11-51, section 5, paragraphs 11-66 b, c, d (1), fig 11-2, paragraphs 11-67 a, b, d, 11-68 d (1) (2), b (1) (2) (3) (4) (5) (6) (7), section 6, paragraphs 11-76 a, b, 11-77 a, b (2), c, d, e, 11-78, section 7, paragraphs 11-85 a, c, 11-86, table 11-11, section 8, paragraphs 11-96 a, b, c, d, e, f, g, h, j, k, l, n, o, q, r, s, w, aa, bb, cc, dd, ee (1) (2) (3) (4), 11-98 c, d, e, f, I, 11-104, 11-107 a, section 9, paragraphs 11-117 b, 11-118 a, b, c, 11-125, section 10, paragraphs 11-135, 11-137, 11-138, 11-139 a, b (1) (2) (3) (4), c, d, section 11, paragraphs 11-146 a, b, c, d, 11-147, fig 11-12, 11-13, 11-14. Install BAS inertia reel shoulder harness/lap belt assemblies for pilot and co-pilot seats, serial numbers 89 & 90, STC SA01370SE, see 337 dated 04/22/16. Install BAS-Amsafe lap belts for center and aft seats, TSO C22G and C114. Remove seals and glue from cabin door and baggage door; install new Cessna seal and adjust doors. Remove old seal and glue from pilot emergency window, install new composite seal, fit window and adjust latching mechanism, test for function and final seal with no discrepancy noted. Install two aft inner window seals. Remove old wing locker seals, mats and lining; clean and chromate inner surfaces on both lockers; mask and paint locker doors and jambs; fabricate new velcro mounted, closed cell backed floor mats and linings using G Baker Steeves black grosspoint that passes FAR 2525.853a, install new seals. Strip old degraded bondo and putty from cabin door jamb, apply new bondo, sand and prime. Adjust and lube cabin door latch mechanisms, check door for function and seal with no discrepancy noted. Install Rosen RCS-300-6 sunvisor system, STC SA5137NM, see 337 dated 04/22/16. Remove damaged vent and heat hose and install new scat hose and clamps below floorboards and throughout cabin; remove and reinstall riveted-in-place floorboards to facilitate the installation of vent and heat hoses. Repair damaged floorboards and support structure components. All sheet metal work as per AC 43-13 1B, chapter 4, section 4, paragraphs 4-53 a, 4-53 b, 4-55 a, 4-55 b, 4-55 c, 4-56 a, 4-56 b (1) (2) (3), 4-57 a (1) (2) (3), 4-57 b, 4-57 c (1) (2), 4-57 e, 4-57 f (1) (2) (3) (5). Repair wiring for compass light. Re-route existing wiring and modify pilot upper side panels to accommodate existing avionics wiring. Install new cabin door stop nut plate. Trace and troubleshoot wire and repair wiring for cabin lighting. Install new scat hose for side panel vents and install two serviceable vent nozzles. Mount jacks for 5th and 6th seats in Avionic West flush mounts. Repair and fit rudder pedal base covers; fabricate one new cover on pilot side. Fabricate and install new pitch trim wheel cover. Aircraft to be weighed at Cincinnati Avionics.

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