

# Corrosion II



By Dennis Wolter

In our article last month, we presented an overview of the causes and types of corrosion in aluminum airframes. It's time now to roll up our sleeves, get our hands dirty, and go through procedures that can clean up, treat and control this problem. FAR 43 allows for this work to be performed by certified pilots as preventive maintenance. For in-depth technical guidance, consult AC 43.13-1B chapter 6, titled "Corrosion, Inspection & Protection".

Corrosion is dealt with on three levels. One is removal, the second is treatment, and the third is prevention to slow down or stop corrosion (in certain difficult situations the operative words, unfortunately, are "slow down"). Our overall goal is to take a surface from one that is corroded, to one that is cleaned and treated, and finally to one that is chromated, as illustrated in the photo of the aluminum seat substructure. I would like to focus on removal and treatment in this article, and save prevention as a series wrap-up next month. Before going into the techniques of removing and treating corrosion, let's talk about the tools of the trade.

Location of the corrosion greatly affects how our corrosion removal tools and processes are implemented, and how difficult the task will be. It is critical that your work place be dry, warm, ventilated and well-lit. Following is a

list of the tools we use to perform this challenging task:

1. *Scotchbrite abrasive pads.* Do not use sandpaper. Sand is a low form of glass that can impregnate the aluminum with small glass-like fragments, reduc-

in the shop to accommodate a specific need.

4. *Paint sticks* to help work the scotchbrite pads into tight spaces (can be shaped as needed).

5. *A collection of small sharp pointed awls* and toothpicks to get into really tight areas.

6. *Non-caustic cleaning chemicals*, such as mineral spirits, lacquer thinner and strong detergents. If you do use detergent and water, it must be thoroughly rinsed. Some detergents are high enough in aggressive chemistry to cause

corrosion if not thoroughly rinsed.

7. *Aluminum foil*, masking tape and polyethylene plastic sheet to mask and protect sensitive components such as windows, wiring, autopilot servos, instrument panels, etc.

8. *A fan for ventilation.*

9. *Protection:* a) charcoal mask

for lung protection from petrol chemicals, b) clothing to cover your arms and legs, c) eye protection), and d) nitrile gloves with cotton work gloves worn over them (the nitrile gloves keep the chemicals off your hands and the cotton gloves

extend the life of the nitrile gloves).

10. *Explosion-proof lighting.*

11. *Fire extinguisher* rated for chemical fires.

12. *Zinc chromate primer* (Tempo aviation grade, available through Aviall, is a great self-etching primer).

13. *Aluma-prep and alodine* (aluminum cleaner and conditioner).



The whole story in one picture. Glue-induced corrosion on the left; cleaned and chromated on the right.

ing the adhesion ability of zinc chromate and other finishes.

2. *Stainless steel wire brushes* or stainless steel wool, available from Solo Horton Brushes (800-969-7656). Ferrous steel brushes will leave small particles of steel imbedded in the aluminum (dissimilar metals) and possibly cause



This is the back side of the same piece. No glue and insulation means no corrosion.

corrosion after the chromate coatings are applied. We like the three types of brushes shown, especially the long round rifling ones that do a great job of getting in between small gaps where the outer skin meets a stringer and bulkhead.

3. *Acrylic plastic or aluminum scrapers* that will not scar the relatively soft aluminum surfaces. We make these

14. *Proper recovery provisions* for chemicals used (these cannot be disposed of in sewers or on the ground).

15. *A pan* to hold generous amounts of solvent.

16. *Lots of cotton rags.*

17. *Hot water.*

18. *Compressed air.*

19. *ACF50 or Corrosion X.*

20. *Prep-all* (a pre-painting cleaner).

21. *A companion* (never work alone with flammable chemicals).

*Let's start with filliform corrosion.* Remember, that's the corrosion that forms under paint, usually emanating from a lap joint, sometimes from a random place in the center of a skin panel. Unfortunately the only way to get at this type of corrosion is to first remove the paint and primer. You can remove paint in a small area with an abrasive medium, or strip that entire section of the aircraft. It is very difficult to blend in polyurethane paints in small repair areas, particularly metallic colors, therefore stripping a section of the airplane makes more sense. Due to the effort and expense involved, some owners will leave well enough alone if the corrosion is not spreading, deferring this treatment to a professional or until the aircraft is re-painted.

Once the paint and primer are removed, use scotchbrite to buff off the corrosion until the entire metal surface is bright. If deep pitting exists it is imperative that you consult an approved manufacturer's repair manual or a qualified sheet metal technician to determine if the skin or structure has been compromised by the corrosion. Remember the 10% rule. Treat the surface with Aluma-prep (an aluminum cleaner that removes oxidation and corrosion). It's good to let the Aluma-prep get into a lap joint as much as possible to help remove inaccessible corrosion. Thoroughly rinse with hot water and allow to dry. When rinsing, try to force as much clean hot water into the lap joint to flush out the Aluma-prep and as much corrosion as possible. My personal rule is to rinse a minimum of three times (I'm into cheap insurance). Aluma-prep is caustic, and if left on or in between surfaces it can actually cause corrosion to recur. As with all products, follow the instructions implicitly for safe use and disposal.

After the skin is thoroughly dry, immediately treat the surface with alodine. This conversion coating contains anti-corrosion properties and also provides a favorable surface for the adhesion of self-etching chromate primer such as Dupont 215S, available in spray cans through au-



*Tools of the trade: stainless brushes, an awl and home-made plastic scrapers.*

tomotive paint and body supply outlets. You must thoroughly rinse and dry the surfaces after the alodine treatment and before the application of chromate. Zinc chromate is a dielectric paint that does three things. One, it forms a moisture and contaminant barrier on the surface of the aluminum. Two, because of its dielectric nature, it prevents electrons from flowing on the surface of the now-coated aluminum. Three, it presents a surface that can be top-coated with primers and finish paints. (As you can see, two of the main causes of corrosion in aluminum are effectively dealt with using zinc chromate.)

Once the area has been zinc chromated, painted and thor-

# No Pipes Compare!™

LEES 3-1 US Patented equal length collectors are the best pipes and also have the best warranty in the business, a 2000 hour/20 year transferable warranty. Customer testimonials available upon request. It is not unusual for these exhaust collectors to have accumulated over 5,000 hours total time. At the end of the serviceable life they can be restored to original condition for a fraction of the cost of a new set.

**1670.00 per set**

Ask about fleet or multi-set discounts.

*"We Make You Fly"*  
www.wemakeyoufly.com

*Approved for the following models...*

CESSNA  
210-5(205), 210-5A(205A)  
210B,C,D,E,F,G,H,J,K,L,M,N,R  
3A21 CAR3

CESSNA  
U206,A,B,C,D,E,F,G  
P206,A,B,C,D,E A4CE CAR3

CESSNA  
207,A, A16CE FAR23

US patent # 5768891



**LEADING EDGE**  
EXHAUST SYSTEMS LLC

Orders: 1-888-LDG-EDGE  
(534-3343)  
Tech Info: 1-907-248-1188

# REPLACING YOUR RESTRAINTS?

**FIND OUT HOW INEXPENSIVE THE BEST CAN BE!**

STC/PMA INSTALLATIONS FOR  
**CESSNA 120 TO 210F**  
 ▶ CHAMP ▶ DECATHLON ▶ CITABRIA ▶ SCOUT

Hooker  
 custom  
 Harness

324 E. Stephenson St.  
 FREEPORT, IL 61032

Call us before you replace your current aircraft restraint.  
**815-233-5478 • FAX/815-233-5479**  
 info@hookerharness.com



Leading-edge medical technology for Cessna pilots

# Aeromedix.com

## Flying high without O<sub>2</sub>?

There's no need to spend \$600 or more on a portable oxygen system when you can buy a complete, top-quality E-Ox™ system starting at less than \$200.

E-Ox uses 100% medical-grade components. It's light, is compact, and slips easily into your flight bag.

- Our new 2-, 3-, and 4-place systems with individual Nelson type flow meters range in cylinder sizes from 425 to 680.
- The one- and two-place economy systems come with cylinder sizes from 36 to 680 liters.
- Precision click-stop regulator, 0.5 to 4.0 liters/minute.
- Industry-standard CGA-540 filler port. We can pre-fill.
- Oxymizer cannula extends duration by 3X or more.
- Electronic conserver extends duration by 6X or more.

Custom-design your own E-Ox™ system online at [www.aeromedix.com](http://www.aeromedix.com) or call our O<sub>2</sub> system experts toll-free at 888-362-7123.



## Getting enough O<sub>2</sub>?

New Lower Price (\$325) on the Nonin FlightStat pulse oximeter.

FlightStat lets you know when you're starting to become hypoxic, and measures precisely how much supplemental oxygen you need for unimpaired pilot performance. Nobody beats our pulse-ox prices! **Order online at [www.aeromedix.com](http://www.aeromedix.com) or call toll-free at 888-362-7123.**



## Prepared for an Emergency?

Dr. Blue's Emergency Medical Kit is the finest, most versatile and complete medical kit you can buy for just \$333!

The Emergency Medical Kit was developed by Aeromedix.com founder Dr. Brent Blue from many years as an emergency room physician, frequent traveler, pilot, outdoorsman and father. **Dr. Blue's medical kit is designed to be useful and user-friendly**, not a "break glass in case of emergency" affair. It cuts out all the junk and contains a host of useful items, most of which can be used for a multitude of purposes. It includes stuff you are most likely to actually need. It includes the best and most useful items available, packaged in a fashion that makes the kit truly useful. Get two - one for the plane and one for your vehicle!

**Order online at [www.aeromedix.com](http://www.aeromedix.com) or call toll-free at 888-362-7123.**



Be sure to specify coupon code "CESSNA0406" when you order online or by phone to receive a 5% CPA member discount on these products.

oughly cured, it is a great idea to spray Corrosion X or ACF50 into the back side of any lap joint, then blow into the joint with compressed air to force this anti-corrosion chemistry even further into the tight seam.

Unquestionably, the most common form of corrosion in an airplane not zinc chromated at the time of manufacture is the surface corrosion we find on bare aluminum, inside wings, on empennages, on control surfaces, under floorboards, behind upholstery panels, and other hidden places. The method of removing and treating surface corrosion is the same as in dealing with filliform corrosion, although in this case we are not first removing a top coating, nor will we be using Aluma-prep and alodine. The level of difficulty in dealing with this form of corrosion is due to the fact that we are often faced with an accessibility issue in actually getting to these inner surfaces. Those of you who own new production Cessna airplanes built after 1997 are blessed with machines that were zinc chromated before they were assembled, greatly reducing the likelihood of having to deal with this type of corrosion in the future.

Before we dive into the cabin corrosion removal process, here's an interesting bit of technical information. After thirty plus years of having an intimate relationship with about 40 airplane cabins a year, we have found some trends as to where most of the corrosion is usually located in various models. Note the words "most", "usually" and "trend". This is not a precise science, and since corrosion can be found anywhere, aggressive inspection of the entire cabin area is the mission at hand.

Cabin tops are definitely where the most corrosion is found in Cessna cabins. Makes sense to me, given that moisture vapor rises. Unfortunately, the cabin top is the location of some very important wing spar carry-through structure. This is especially true of 210s and Cardinals where the high alloy forged and machined main spar center sections are located. That means dissimilar metals and moisture in one place hidden by lots of systems components and insulation. This place needs very special inspection and often careful clean-up.

Gain access to the affected area by removing interior components, inspection



*Typical corrosion found on the cabin top of a mid-70s 172.*

panels, insulation, etc. Before applying any combustible solvents, you'll need to remove the years of accumulated dirt and grime using a brush and vacuum cleaner, paying particular attention to the belly skins below the floorboards. Most Cessnas we see are not very well cleaned below the floorboards, adding to corrosion problems. You must be careful to protect sensitive components. I recommend using aluminum foil for wrapping wiring and cables, and polyethylene sheet and masking tape to protect autopilot servos, landing gear relays, windows, instrument panels, etc. Before masking windows we like to perform a very low-tech but effective pressure check to ensure that they are not leaking. Using an air hose and nozzle, have one person on the inside of the airplane blow compressed air at the edge of the window while another brushes soapy water on the outside edge. Bubbles mean a leak. And over time, water leaks mean corrosion.

Working inside the equipment-laden airplane, we must now forgo the use of chemically aggressive paint strippers, Alumaprep and alodine, as these chemicals need large quantities of rinse water to neutralize them. We're limited to the use of abrasives and petroleum solvents to remove the glue used to bond insulation to the bare aluminum skins and the resulting corrosion that has formed. The formula here includes elbow grease, time and tenacity. These surfaces have to be cleaned as thoroughly as the surfaces described earlier in treating exterior corrosion.

In Cessna aircraft the problem is compounded by how difficult it can be to get rid of age-hardened contact cement used to install the insulation at the factory. It is vital that this glue be removed. We have found that corrosion often forms on the skin under the glue, especially around leaky doors and windows. Cessna also sprayed a sound-damping undercoating material on the inner skin surfaces of 50's and 60's airplanes. We have never found corrosion under this damping material, so to save time we usually work around the perimeter and antiseptically clean only the exposed bare aluminum.

It's a good idea to put a plastic tarp on the floor under the airplane fuselage or wherever you are using solvents. Quite often solvent will seep in between skins and run out of drain holes. These solvents will damage cement floor finishes. That brings us to another important issue. These solvents can also

damage the aircraft's paint, so make every effort to keep them from getting on the outside surface of the aircraft. When we are having an airplane painted along with a new interior we clean the corrosion out of the cabin before sending it over to the paint shop to eliminate the potential for solvent damage. New paint is particularly sensitive to solvents.

We often do find, however, that the damping material on the belly skins is so degraded by old fuel, oil and hydraulic fluid that we just go ahead and remove it with solvent. This



*The same airplane after the glue and corrosion is removed with scotchbrite, lacquer thinner and elbow grease.*

# FUEL CELLS

All Makes & Models - Piston - Turbine - Rotor - Jet

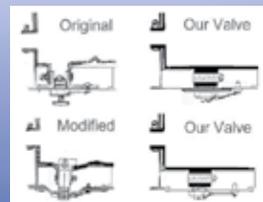
## New Fuel Cells

The highest quality PMA'd replacements available for Cessna aircraft that include complete installation kits.

Custom manufacturing for vintage aircraft.

Factory Overhauls  
Over 40 years of experience  
FAA Certified Repair Station  
NL5R071N

Visit to our website for more info



Stainless steel drain valve kits provide better sumping and easy low cost maintenance. Get 2 stainless steel valves and all the installation hardware for the price of 1 Cessna valve & kit.

**That's HALF THE PRICE!**

## Eagle Fuel Cells

853 Adams Road,  
Eagle River, WI 54521  
Tel: 715-479-6149  
Fax: 715-479-6344



[www.eaglefuelcells.com](http://www.eaglefuelcells.com)

Technical Support 800-437-8732

© 2006 Eagle Fuel Cells-ETC, Inc.

# HOW DO YOU START YOUR CESSNA?

IGNITION/STARTER  
 R L BOTH WOW!  
 OFF MUST BE A SKY-TEC



Start | RIGHT  
**Sky-Tec**  
 FLYWEIGHT™ STARTERS

- Smarter DESIGNS  
 No Bendix Drive to Stick or Fail | Higher Reliability
- Better PERFORMANCE  
 Up To 10 Pounds Lighter | Twice the Spin
- More VALUE  
 Lower Prices | Low Cost to Repair or Overhaul



[www.skytecair.com](http://www.skytecair.com)

800-476-7896

gooey mess is very flammable. (The next owner-performed to-do project on your list should be to get in there and remove this hazardous stuff.) Once this mess is removed, all skins are cleaned and re-cleaned with mineral spirits or lacquer thinner until they are shiny and bright. Then the nit-picking process begins, cleaning all the nooks and crannies and lap joints with a sharp awl, toothpicks and compressed air. We then do a final cleaning with Prep-all contaminant remover, available at auto body supply stores. It is important when using these solvents that you pour a generous amount into a pan and frequently rinse your scotch-brite pads, wire brushes and rags for better results in getting the cabin and belly skins as clean as possible.

When finally these surfaces are antiseptically clean, we spray the self-etching zinc chromate on all bright metal surfaces, being careful to avoid the factory-applied black damping material mentioned earlier. Remember safety precautions when using zinc chromate.

*Things didn't improve in the 70's and 80's.*

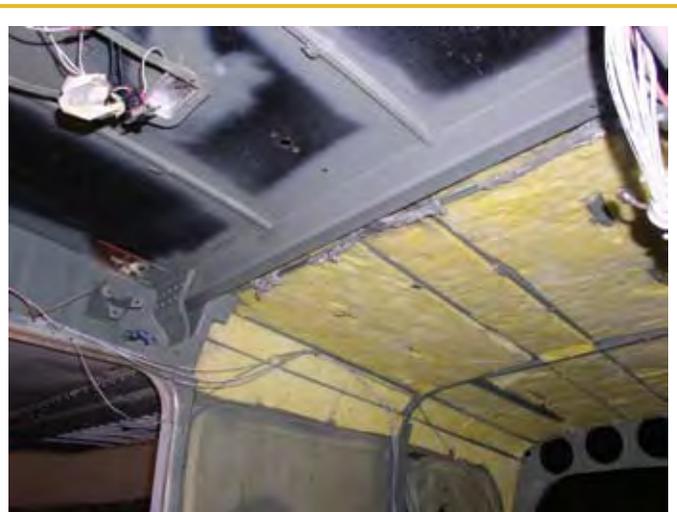
In place of the tar type skin damper Cessna switched to lead vinyl skin damper panels. That's right—lead! Meaning that Cessna bonded lead-impregnated sheets to bare aluminum with a glue that not only reacted with the aluminum to start corrosion, but also held moisture. This means that we have dissimilar metal, a contaminant (glue) and moisture all in one place. These panels are causing serious corrosion



*A thorough application of zinc chromate and we're ready to install new insulation and interior components.*



*Corrosion caused by leaking aft side windows in a 210*



*An early 60s 206 where the damping tar was left in place and only bare metal is chromated.*



*Corrosion found under a lead vinyl panel in an early 70s 182.*

problems. Get them out of your Cessnas ASAP!

Note: In situations where we have removed the sound damping tar material from the belly skins, we replace it with the installation of Skandia ADC124 closed cell self-stick foam skin damper. This engineered material stabilizes the skin to reduce vibration, doesn't cause corrosion, and won't burn. It's really great! (Skandia's number is 800-945-7135.)

If there are areas that you suspect are not as clean as you would like them to be, or were totally in-

accessible, allow the zinc chromate to dry for 24 hours and spot treat the area in question with ACF50 or Corrosion X (sometimes you have to compromise). Most of the time, inner airframe corrosion can be effectively dealt with using these fogging treatments. These chemicals act like zinc chromate by forming an oily film on the skin and to some extent they migrate between lap joints, helping to fight corrosion. Additionally, they are comprised of dielectric chemicals that reduce electron flow and the resulting corrosion. ACF50 and Corrosion X will damage upholstery and insulation material, so they should not be applied in the cabin areas (cleaning and chromating is your method of choice there).

Before moving on to the next type of corrosion challenge, I want to cover two Cessna-specific issues.

The first is corroded bolts in the structurally critical wing spar attach fittings. These bolts are often rusted. If the exposed bolt heads or nuts show severe rusting, it's quite likely that they are rusting down in the holes. Remember, it's about electron flow, and once rust starts that component can become very electrically active, causing it to corrode, even in a place that cannot be seen. The fix is to pull the bolts, clean the holes, spray the holes with ACF 50 or Corrosion X and install new bolts. Good things don't come easy!

The second issue is possible corrosion down inside the spar attach fittings. Even if there is no evidence of corrosion in these areas spray some Corrosion X or ACF 50 into these places after you've cleaned and chromated as much of the surface as possible. An ounce of prevention is worth a pound of cure. If anything other than light corrosion is found in these critical places, get your IA involved.

*Moving on to fretting corrosion, the most common place*



*ACF 50 being sprayed into the deep reaches of an aft spar attach fitting -- cheap insurance.*

for this is around cowlings and access panels where vibration is present and two metal surfaces are able to rub together. Clean the surfaces as previously described and treat with Aluma-prep and alodine. Then apply an anti-chafing material on one surface, such as thin hard rubber, Teflon tape, or black self-stick soft Velcro (I really like Velcro).

Inner-granular corrosion, also discussed last month, is best dealt with by experts with very sophisticated, non-destructive testing equipment. Fortunately it is a rare occurrence in piston-powered Cessna aircraft.

*Cee Bailey's* aircraft plastics Windshields & Accessories  
Hand-Crafted Today, Just Like We Did In The 1950's

"When you want the very best"

**Cessna 172 1/8" Windshield Special**  
**Clear \$295.00 + Shipping**  
**Tints \$315.00 + Shipping**

Our windshields and windows are manufactured under our proprietary FAA/PMA approved process. Any product purchased from us is unconditionally guaranteed to be unsurpassed in quality with special reference to material formulation, manufacturing technique, optical qualities, contour, shape, fit, and resistance to aging.

**Aircraft Interior Sun Shields**

Special!  
\$125.00  
Single Engine

Sun shields that give your aircraft interior and avionics maximum protection against damaging ultra-violet sun rays and heat.

**Cee Shades Special!**  
 Full Set includes Windshield & all Cabin windows, plus a water resistant storage bag

**Cowl Plug Set**

Includes (1) Cowl Plug, (1) Pitot Tube Cover and a FREE 4 oz. Windshield Cleaner/Polish

Special!  
\$59.95  
Single Engine

**Cee Shades Special!**  
 Full Set includes Windshield & all Cabin windows, plus a water resistant storage bag

Special!  
\$119.00  
Twin Engine

**Aircraft Cabin Cover**

Designed to fit tightly around the fuselage and wings, with our non-staining method of fastening using heavy duty snaps, and genuine leather backing which acts as a buffer between the snap and the fuselage. The cover wraps completely around the windshield, side and rear windows, and rear windshield.

Starting at  
\$159.00

**Cee Bailey's Aircraft Plastics**  
6900 Acce St, Mantebello, CA 90640 • Tel. 800-788-0618 or 323-837-1497  
 Fax: 323-721-7886 • Web: [www.ceebaileys.com](http://www.ceebaileys.com) • Email: [sales@ceebaileys.com](mailto:sales@ceebaileys.com)



*Sever rust on aft spar attach bolt in a 1963 205*

Removal of corrosion in our airplanes is a laborious task, but one that can be done effectively in stages, so put together a good plan. Some obvious rules apply. The time for an engine overhaul is the perfect time for the corrosion removal, treatment and refinishing of the engine compartment. For obvious reasons, the cabin corrosion should be dealt with when you're having an interior done. Remember, it could be twenty years until the cabin is stripped out for your next interior, and at that point it may be too late. Insofar as time is concerned, it can take twenty to thirty man-hours to turn that engine compartment into a show-piece. Regarding the cabin, our experience is that it generally takes thirty to sixty man-hours to properly prepare a



*Rust on the bolt heads can mean rust on the bolt shank and corrosion in the bolt hole. This is no time to be an optimist.*

corroding four- or six-place Cessna cabin for chromating. Even if there is very little corrosion present there is always that nasty dirt, tar and glue to deal with.

Since time is money, you may be feeling somewhat concerned at this point about the costs involved in the corrosion removal and treatment process should you decide to have your FBO or qualified mechanic take care of this for you. At Air Mod, we bill this work at half shop rate because, even though it involves a tremendous amount of effort, it does not present technical difficulties or challenges that require the expertise of our highest skilled personnel. Hopefully your shop of choice maintains a similar policy. And whether you attempt to do this work yourself, or engage the

services of a qualified shop, few of us could argue the wisdom of this investment.

Corrosion can certainly find a home in places other than the cabin area, and we have dealt with those challenges over the years as well. In a future article, we will get into airframe corrosion issues.

You would be surprised at some of the unexpected places we have found corrosion in these aging Cessnas.

Now that your airframe is clean, corrosion-free, and in some cases better than new, you may find that your mechanic is more motivated to help keep it that way, by thoroughly cleaning out dirt and grease at every annual. And if you are already fortunate enough to be starting out with a corrosion-free airplane, join us next month when we talk about corrosion prevention. Until then, fly safe!



# COMPREHENSIVE

## Aircraft Oil Analysis

# BLACKSTONE

LABORATORIES

Order kits at 260/744-2380 or [www.blackstone-labs.com](http://www.blackstone-labs.com)