What is CORROSION?

PART II

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In our article last month, we presented an overview of the causes, types and realities of corrosion in Beech airframes. Now it's time to roll up our sleeves, get our hands dirty and go through some of the procedures for removal and treatment that we know can control this problem. FAR 43 appendix A allows for this work to be performed by a certified pilot as preventive maintenance. For in-depth technical guidance, consult AC 43.13-1B chapter 6, titled "Corrosion, Inspection & Protection."

Corrosion can be dealt with on three levels: One is *prevention*, another *removal* and the third is *treatment*, to slow it down or stop it. In certain difficult situations, the operative words are "slow it down." Our overall goal is to take a surface from one that is corroded, to one that is cleaned and treated, to one that is chromated. As illustrated in the photo of the aluminum seat sub-structure below.

Corroded, cleaned, prepped and chromated

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 tools and processes are implemented, and how long and difficult the task will be. It is critical that your workplace be dry, warm, well-ventilated and well-lit. Following is a list of some specifics:

1. Scotchbrite abrasive pads. Do not use sandpaper. Sand is a low form of glass that can impregnate the aluminum with small fragments, reducing the adhesion ability of zinc chromate and paints.
2. Stainless steel wire brushes or stainless steel wool. Do not use *ferrous* steel brushes. They will leave small particles of ferrous steel embedded in the aluminum (dissimilar metals) and cause corrosion after the chromate coatings are applied.
3. Acrylic plastic or aluminum scrapers that will not scar the relatively soft aluminum surfaces.
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. Protective gear: (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. Dupont 215S is a great self-etching primer.
13. Aluma-prep and Alodine. Aluminum cleaner and conditioner.
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 volatile chemicals.

FILIFORM CORROSION forms under paint. It usually emanates 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.

You can either remove paint in a small area with an abrasive medium or you can strip that entire section of the aircraft. It is very difficult to blend in polyurethane paints in small repair areas, particularly metallic colors; therefore, strip-

ping a section of the airplane makes more sense. Due to the effort and expense involved, however, some owners will leave well enough alone if the corrosion is not spreading, deferring this treatment until a later time.

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.

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 a lot of fresh water into the lap joint to help 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, so if it is left on or in between surfaces, it can actually cause corrosion to recur. As with all products, follow the instructions for use and disposal explicitly.

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.

It is very important to thoroughly rinse and dry the surfaces after the Alodine treatment and before the application of chromate. Zinc chromate is a non-electrolytic paint that does three things: One, it forms a moisture and contaminant barrier on the surface of the aluminum. Two, 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 thoroughly cured, it is a great idea to spray Corrosion X or ACF 50 into the back side of any lap joints, then blow into the joint with compressed air to force this anti-corrosion chemistry even further into the tight seam.

SURFACE CORROSION

Unquestionably, the most common form of corrosion in an airplane not zinc-chromated at the time of manufacture is surface corrosion on bare aluminum, inside wings, empennages, control surfaces, under floorboards, behind the upholstery panels and other hidden places.

The method of removing and treating surface corrosion is the same as in dealing with filiform 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 airplanes built after the late '70s are blessed with machines that were zinc-chromated before they were assembled, greatly reducing the probability of having to deal with this corrosion.

Gain access to the affected area by removing interior components, floorboards, inspection panels, etc. Before applying any combustible solvents, you must 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 Beech airplanes that we see are not well-cleaned below the floorboards, adding to the corrosion problem.

PHOTOS COURTESY OF AIR MOD

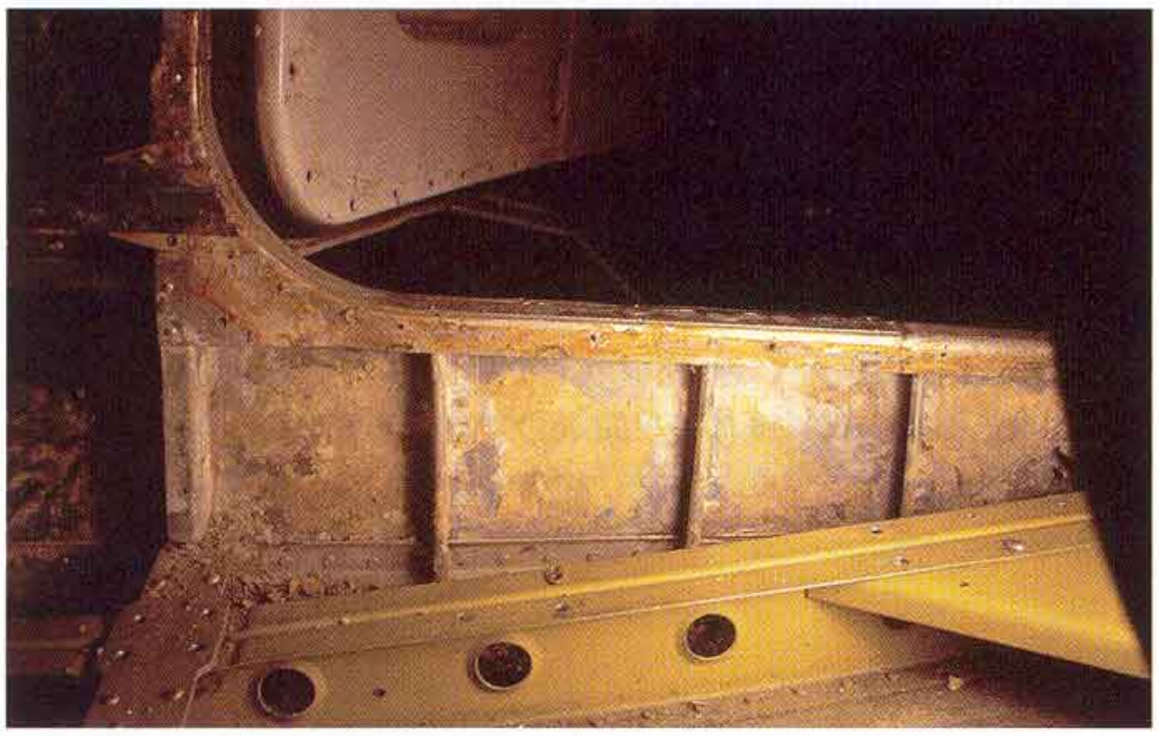
Typical mess under floorboards

Once the dirt is gone, remove old insulation and sound-damping tar as necessary. You must now protect all 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 panel, etc.

Preliminary cleaning and masking of belly

Working inside the equipment-laden airplane instead of on the exterior, we must now forgo the use of chemically aggressive paint strippers, aluma-prep and Alodine, as these chemicals need large quantities of rinse water to neutralize them. We're limited to the use of petroleum solvents and abrasives 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.



Corrosion under glue, below baggage door

Scrubbing with Scotchbrite and lacquer thinner

It's got to be this clean

In Beech aircraft, the problem is compounded by how difficult it can be to get rid of age-hardened contact cement used to install the insulation. It is vital that this glue be removed as we have found that corrosion can often form on the skin under the glue, especially around leaky doors and windows.

Beech also sprayed a sound-damping undercoating material on the inner skin surfaces. We have never found corrosion under this damping material, so we usually work around the perimeter and antiseptically clean only the exposed bare aluminum.

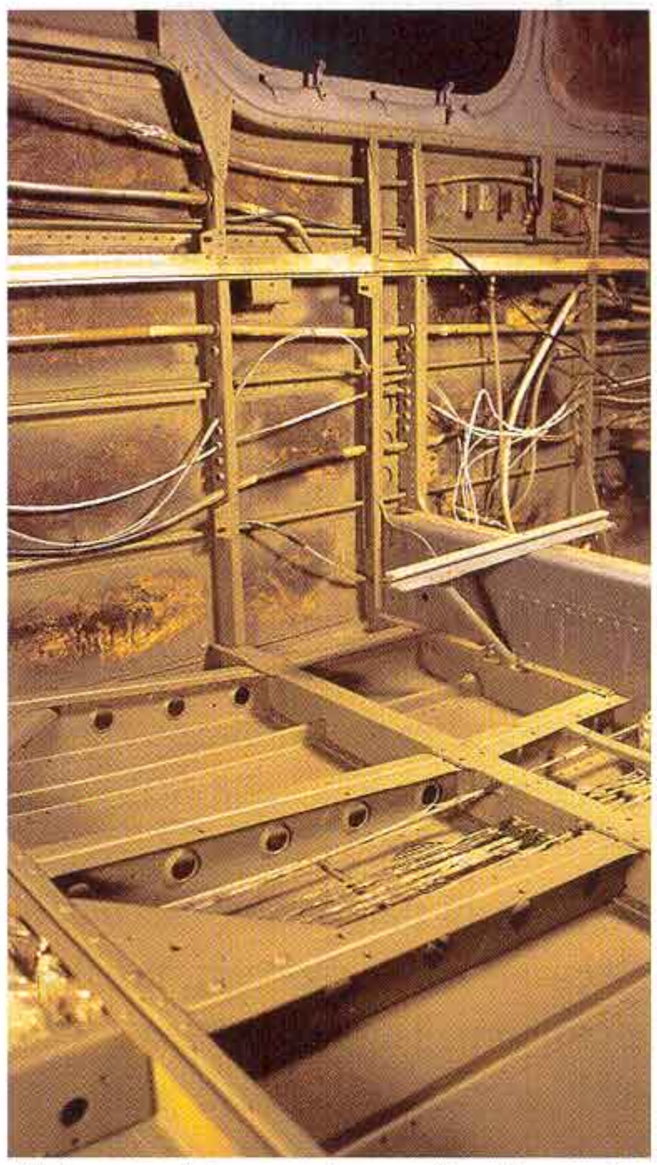
We often do find, however, that the damping material on the belly skins is so degraded by old fuel, oil and hydraulic fluid that we just go ahead and remove it with solvent. (Note: This gooey mess is often flammable.)

Once this mess is cleaned up, all skins are cleaned and re-cleaned with mineral spirits or lacquer thinner until they are shiny and bright. Then the nitpicking 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.

It is important when using these solvents that you pour a generous amount into a pan and frequently rinse your Scotchbrite pad, wire brushes and rags for better results in getting those skins as clean as possible.

When the surface is finally 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 above. Remember the safety precautions when using zinc chromate.

Note: In situations where we have removed the sound-damping tar material from the belly skins, we replace it with the installation of Skandia ADC-124 closed-cell self-stick foam—works great!



All bare and clean surfaces after chromating

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

New Skandia sound-damping on belly skins

compromise). Most of the time, inner airframe corrosion can be effectively dealt with using these fogging treatments. These chemicals act like zinc chromate to form an oily film on the skin and to some extent migrate between lap joints, helping reduce corrosion. Plus, they are comprised of non-electrolytic 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 in the cabin.)

FRETTING CORROSION

The most common place for fretting 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 allodyne. Then apply an anti-chafing material on one surface, such as thin hard rubber, Teflon tape or black self-stick Velcro. (I really like Velcro.)

INNER-GRANULAR CORROSION, also discussed last month, is best dealt with by experts with very sophisticated nondestructive testing equipment. Fortunately, it is a rare situation in piston-powered Beech aircraft.

CORROSION ON MAGNESIUM

Last, but certainly not least, is the issue of corrosion on magnesium. The following is what works for Dick Guenther at Dial Eastern States Aircraft Painting, and is pretty close to the method I used in the '70s when I had a paint shop.

Strip with a magnesium safe stripper (no acid). Rinse thoroughly and bake with heat lamps for at least eight hours. This allows all moisture and vapor residue to dissipate. Then scrub with a soft brush and baking soda solution, neutralizing any remaining stripper residue. Rinse and bake again for eight hours. Finally, treat with Magnadyne, a magnesium-specific anti-corrosive conversion coating that also facilitates primer adhesion.

If there is pitting from a previous corrosion situation, filiform corrosion is likely to recur. As it is nearly impossible to get down into all of the pitted areas and remove the corrosion, the safest bet is to re-skin the affected area. This is not what we Beech-lovers want to hear, but it's about as good as it gets.

Removal of corrosion in our airplanes is a laborious task, but one that can be done in stages, so put a good plan together. 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 20 years until the cabin is stripped out for your next interior, and at that point it may be too late.

Removal of corrosion in our airplanes is a laborious task, but it can be done in stages, so put a good plan together. Cabin corrosion should be dealt with when you're having an interior done. Remember, it could be 20 years until the cabin is stripped out for your next interior, and at that point, it may be too late.

Insofar as timing is concerned, it can take 20 to 30 man-hours to turn that engine compartment into a showpiece. Regarding the cabin, our experience is that it generally takes 30 to 60 man-hours to properly prepare a cabin for chromating. Even if there is very little corrosion present, there is always that nasty dirt, tar and glue to deal with.

HOW MUCH WILL IT COST?

Since time is money, you may be feeling somewhat concerned 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.

Lots of dirty, hard work

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. Once your airframe is clean, corrosion-free and, in some cases, better than new, you may find your mechanic is more motivated to help you keep it that way, thoroughly cleaning out dirt and grease at every annual.

If you are fortunate enough to already have a corrosion-free airplane, join me next month when I talk about prevention.