ASW 20B Wing Refinishing	by Ken Kochanski

Planning

This wing-refinishing project is a continuation of my efforts to make my 1986 ASW-20B look and perform better than new. The project and this document are a work in progress and I will make periodic additions as the project moves down the road. So, If things sometime appear a bit untidy, please bear with me.

As with my fuselage project, I am consulting with experienced, factory-trained and rated glider repair people to provide guidance and inspection of ongoing work. Improper workmanship in gelcoat removal could possibly impact the structural integrity of your glider. Do not undertake this work unless you have glider repair professionals participating in your project.

Although I started my 20 cleanup with the fuselage because I though it was an easier project, the wings are actually easier to work with in many respects. They are much lighter and can I confidently move them around using a crude one-man rig and a couple of saw horses. In addition, your are really workings on 'flat' surfaces and don't have to move them very much to complete your work. However, wing refinishing is typically considered more difficult because you have to remove the old gelcoat and profile the flying surfaces before repainting.

I plan to perform and document the following refinishing steps:

Control Surface Removal

Wing Gelcoat Removal

Spar Bump Smoothing

Leading Edhe Profiling with Templates

Filler Application and Smoothing

Wing gelcoat application and sanding.

Control surface sanding and gelcoating (includes mass balancing).

Control surface installation and sealing (will probably use a rolling seal).

Control surface removal

The control surfaces were removed per the maintenance manual. The ends of the control rods and control rod openings were sealed with plastic bags and tape to reduce dust penetration. I will do a mass balance before working on the surfaces to checkpoint the ranges supplied in the maintenance manual.

Wing Gelcoat Removal

Gelcoat removal is the problem with these projects and my discussions with professional refinishers and others confirm that there is no easy way to get the old gelcoat off. Most folks seem to use a grinder of some type, although I heard one story about someone who chipped the gelcoat off a badly crazed glider using a chisel to remove one chip at a time. Yikes!

The grinders (usually electric high speed) seem to require a fair amount of experience to use correctly. Like Indy Car racers, grinder drivers typically report doing some minor damage (that had to be repaired) before they get the winning technique down. Lose your focus for a second and you could easily 'install' a new NACA duct in the leading edge of your wing!

Although I figured I would eventually wind up using a grinder, the darn things scare me and I decided to start with any other more-forgiving mechanism I could find. Slower would be fine if I could make steady safe progress. I actually started sanding by hand, which was gruesome, and quickly migrated to an 'air file' introduced to me by Richard Kellerman, local pilot, weatherman, and sometimes glider refinisher. I have been subsequently informed that air files are used by some factories for final finishing sanding. The air file is typically used for automotive body repair and is officially known as a straight-line sander. The base moves about an inch in each direction at a relatively slow speed, perhaps 10 cycles a second. Gelcoat removal is slow and controlled, but much faster than sanding by hand.

I purchased my air file at Pep Boys for about $60. I replaced the rubber covered base with a piece of 3/16" x 2" x 14" aluminum stock to get a hard base like a sanding bar. However, this mod is probably not necessary if you are just removing gelcoat. I did it because I plan to use the file to profile my wings.

I also discovered that True Value Master Mechanic 60 Grit open coat resin paper cuts at a good rate for a long time. (I sanded the tops of the wings to the wing glass with two packs of 5 sheets ... total cost less than $6.00) The paper has a sticky back; just cut the sheet in half and line up in the middle of the sanding bar. I'm also sure other open coat resin papers will do a good job.

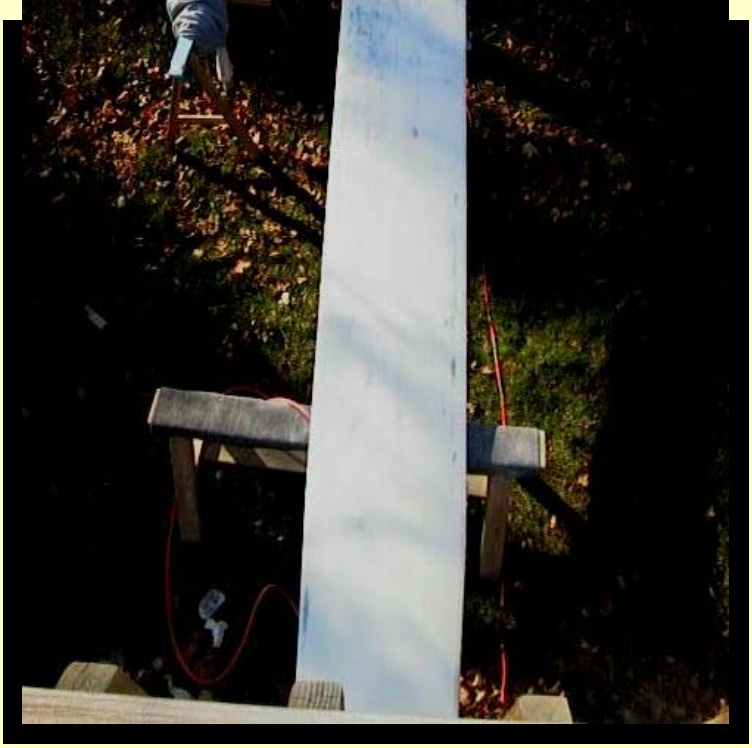
The air file is used just like any other sanding bar; keep the unit perpendicular to the chord line as you apply pressure moving the rig up and back on a 45-degree line. Apply moderate pressure and move the sanding area left and right; overlapping the work area to average out gelcoat removal. It will take 15 minutes or so, but you will soon start to see a dark blotchy pattern appear and as you sand further, you will just start to uncover fiberglass. The 60-grit paper seems to rip the gelcoat off without touching the

fiberglass surface, and you get a pattern of small holes appearing in the gelcoat. (See picture below) Change your pattern, until you run out of working room. Then start a new section and overlap the areas to get a continuous blotchy surface. To tell you the truth, sanding the gelcoat off is pretty boring; you just keep moving the air file and the glass surface slowly appears.

So the big question is, "How much gelcoat do you have to sand off?" Well, everyone I talked to is emphatic about removing all crazing, sanding down to the glass if necessary. Any crazing left behind will propagate through the new gelcoat to the surface. Since my wing surfaces have sparse and light crazing, I was soon able to sand to a point where all the crazing appeared to be removed. I checked the surface with a 10-power scope and could find no indication of crazing. By the way, crazing looks very different than sanding scratches in that sanding leaves a gouge that has a rounded bottom; crazing looks a fracture with sharp vertical edges and no discernable bottom. However, back to question 1 ... did I remove enough material? While I originally thought so, I decided to remove some additional gelcoat just to make sure. (This issue is still not resolved; some refinishing professionals think every bit of gelcoat should be removed, even if it does not show any visible damage. This is clearly the safest approach to insure longevity in the new gelcoat, but is it necessary? I may yet make an effort to remove additional material.)

This picture shows some of my final surface, pending any decision to remove additional gelcoat. This is the bottom of my right wing; the root is on the left and the leading edge is at the lower end of the picture. The wing area on the left (of the two parallel pencil lines running from the LE to mid chord) was first sanded with the air file until the gelcoat was quite thin and the 'high' glass areas just started to break through. The glass is the gray splotches in the picture. I then used a palm-sized random-orbital sander with 100 grit resin paper to sand those areas that were still completely covered by gelcoat. I am working left to right, so the area to the right of the parallel lines only shows the sanding pattern left by the air file; it clearly is less splotchy that the area on the left which was also sanded with the small orbital. While I think this level of sanding is fine for the shallow crazing on my glider, you may have to remove all the gelcoat to fix **your** crazing damage. This may be a good argument to refinish wings earlier rather than later.

I have expended about 10 hours on each wing side to remove gelcoat to this level. In addition, I will have to spend some additional time removing all the gelcoat from my leading edge, which is crazed all the way to the glass surface. I will use a small sanding block and 100 grit

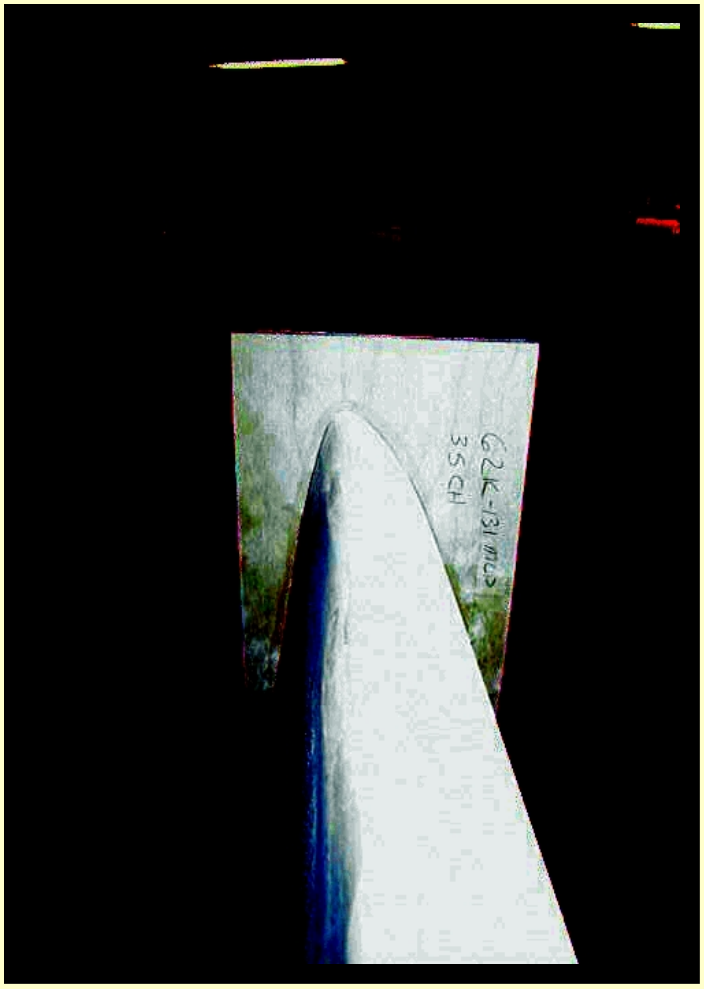


resin paper to finish the job on the leading edge started by the air file and orbital sander; although I may give the air file another try with less coarse paper. The air file was extremely easy to control and I was able to bring it a good distance around the leading edge as I sanded wing surfaces. I also used the orbital to again assist in the low areas. Since we have had a very mild November (1999), I was also able to work outside for two consecutive weekends. I don't know how I would have managed the dust working in my basement as originally planned. A picture of the bottom of my sanded wing follows. The white areas are areas covered by thin gelcoat. All remaining gelcoat was examined with a 10-power scope to insure no crazing was evident.

A magnified (10x) contrast enhanced picture of my leading edge crazing follows. This will be sanded down to the fiberglass surface. The airfile made the more lateral scratches in the upper area of the picture.

As the weather returned to normal November temperatures, I moved indoors to continue working. I fabricated the following collector for my air file. Sump pump hose was uses to fabricate a Y-shaped pickup nozzle, which straddles the air file. The air file does not throw much gelcoat; material tends to gather on each side of the

blade. The nozzle sucks the loose material off the surface and also does a good job pulling dust out of the air around the tool. Suction is supplied by large (low noise) shop vac; the shop vac hose runs up the high-pressure airline to the air file. This mod and the shop vent fan keep the air virtually dust free.



I have to finish sanding the leading edge so I stood the wing up on end to make the work easier. A quick check with the LE templates indicated that the leading edge was amazingly close to the design profile. The wing was most accurate from the root to the flap/aileron junction i.e. the planform break. The leading edge of the outer third of the wing deviated the most in that the nose (the 4 inches from LE) of the airfoil was too flat on top and bottom.

Well, the holidays really slowed up the project, and I had to take some time to build a spray booth. I looked around at some commercial establishments and considered my garage, but eventually decided to build a painting and sanding facility in my basement. The area is roughly 35' long by 10' wide by 7' high. I won't go into too much detail, but I installed fluorescent lights, dropped a ceiling frame, and built detachable 8' by 7' detachable wall sections. All surfaces are covered in 6-mil poly ... and an exhaust fan exiting through a walkout door keeps the unit under negative pressure. I can take down or assemble the unit in one hour. I painted the top surface of my wing and no odor was evident in the house, which was a real concern.

The next step involved spraying the top of the wing with Simtek Sanding Surfacer to smooth out the spar bumps. I applied one quart of material to the upper wing surface, extending the pattern 4 - 6 inches on each side of the spar. I applied three coats of material, at 30-minute intervals, using a quart of Surfacer total. By the way, I used a new gravity feed spray gun, which allowed spraying thick fillers

and gelcoat without thinning. I got this unit at a web site for about $70.

I sanded the next night using a contour sander made out of 1/8' Plexiglas. In 30 minutes, I had the spar section from root to spoiler sanded to a tolerance of 2 mills. The following picture shows the wing after the spar bumps were painted and sanded.

I wasn't sure what to tackle next, but finally decided to spray the leading edge with a coat of Prestec to restore the leading edge sharpness ... and just to build material to prevent breaking through on the final sanding. A couple of commercial refinishers stressed the need to have additional leading edge material on the wing. I basically just sprayed the LE and extended the pattern 6" on top and 3" on the bottom. I then turned the wing leading edge down to insure the gelcoat flowed to the nose of the airfoil. When the Prestec dried, I applied a disclosure agent and sanded using the templates to verify LE profile.

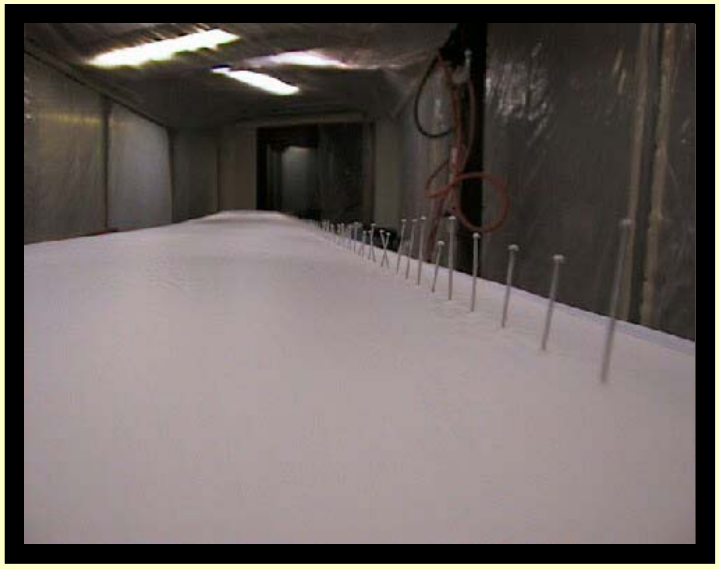
The bottom of the wing was actually pretty smooth, but it was covered with small voids (bubbles between the factory gelcoat and first layer of glass?) which could translate into a sea of pinholes in the final spraying operation. I discussed with my ex-glider works buddy, and he suggested brush painting the wing with filler to insure all the voids were filled. However, before starting to paint, I installed a straight pin in each blowhole. In discussing this with folks, some said no paint could get in the hole, others suggested using compressed air to keep the paint out, and a few said I should use pins. I was too chicken to leave the holes exposed. I used simple #17 silk pins. The box said it held 400 pins, but I was almost out after plugging the 225 blowholes on my wing. As we know, there is no truth in advertising.

I then brush painted the wing with Simtek Sanding Sealer and then immediately sprayed the freshly painted surface to insure I had enough build to insure a smooth finish. The brush marks actually showed through the surface of the sprayed coat, but everything sanded off nicely, removing all the voids. By the way, I noticed that the pins disrupt the spray pattern and you could have a little void behind each pin. This seems to be created by down stream air currents behind the pin. I set my gun to a finer setting as I sprayed the blow hole area. Removing the pins is easy; simply bend the pin a little and spin it to break the bond to produce a nice round hole. I tried pulling the first four with needle nose pliers, and wound up extracting one blow hole needle and breaking the newly painted surface around another,

before coming up with the spin technique.

Although some refinishers hand sand using 4' long straight bar, I again sanded with the 16" bar on my air file, first insuring that the wing was supported levelly using a third horse about mid span. I sighted down the leading edge and added shims to the middle horse to insure the bottom surface was level. After painting and sanding the bottom, it looked so good that I flipped the wing and rechecked the top to get a void count. The top surface was in much better shape then the bottom. The spar bump work had already covered up a lot of voids, the leading edge spraying extended 6" up the top surface, and a fair amount of good original gelcoat remained. I am currently trying to figure out if I should just brush paint the top surface to be sure I have no problems with the final spraying. After agonizing for a day, I simply bit the bullet and brush painted the entire top of the wing with sanding Surfacer to insure all voids were filled before I started the final topcoat painting. I will sand smooth tonight (3/15/00) and prepare for final painting this weekend.

A line of straight pins extends to infinity. I actually have not counted, but remember seeing a note somewhere that each wing had 225 blowholes. Inserting a #17 silk pin into each hole takes approximately 30 minutes. I talked my wife into assisting on this run.



I painted the entire wing in one session using a setup, which allowed the surfaces to be painted flat, reducing the potential for runs. This was pretty easy because I have a BL and used a spare wing tip pin as a support point. I simply had to roll the wing on the spar and wing tip pin to paint each surface. I started on the bottom and applied successive layers of Prestec high build (2481) ... using about three pints total. I then rolled the wing and painted the top with about the same material. I applied a number of extra coats to the leading edge of the wing. The only real problem I has was seeing where I was painting. I eventually just removed my goggles which were covered with overspray.

The paint dried with the typical orange peel. I then applied a mixture of thinned dope over both wing surfaces to disclose sanding progress. You simply have to sand until the blue is gone.

I use the air file to knock the high points off the paint (just about to the bottom of the orange peel) and then hand sand with a two-foot bar sander to remove the remaining blue. I also immediately sanded the spoiler area to see if I had any coverage or fit problems.

The finishing work went very smoothly from this point. I used the air file to do the 400, 600 and 800 grit wet sanding. At this point, I did some experimenting with the 3M Boat Refinishing products Richard Kellerman 'discovered'.

This 3M page has an extensive list of gelcoat polishing products. As directed, I used the 3M High Gloss gelcoat Compound which "is designed to quickly remove P600

dual action or 1000 wet sanding scratches from production gel coat." This produced a reasonable shine, although I could still see 800 grit scratch marks. I then used 3M Finesse-It(TM) II Finishing Material, which was designed to removes light to medium oxidation on gelcoat for boat reconditioning. This stuff worked great bringing out the finish on Richard's new ASW-27. It also brought up the shine on my re-finish, but I could still see some scratches. I concluded that the compounds alone could not produce the finish I desired. I therefore continued sanding the wings through 1000 and 1200 grits before using the compounds. The results were excellent. I will never again use the large buffing wheel and hard wax utilized by most glider manufacturers.

These compounds were applied using the pad systems recommended at the 3M site. I used a big DeWalt Sander/Buffer (DEWALT DW849 7/9" 0-1000/3000 RPM Variable-Speed Electronic Right Angle Polisher) to drive the pads at the correct RPM.The final buffing will produce a mirror like surface, but this is actually just the gloss from the gelcoat surface. The compounds actually are wax free and you have to apply a type and brand of your choosing. I used Mother's canauba, although it probably had some silicone content. And I hate to say it, but the wax will actually lower the gloss a little!The buffing and waxing took about two days.

The original unpainted control surfaces were attached and sealed using an "S" seal recommended by Hank Nixon. Hank uses an aircraft dacron which is glued to the control surface and wing edge using thinned contact cement. The seals are more durable then the Teflon tape and the process does not reduce the bonding area available to the curved Mylar seals installed on top.

I made my seals out of a 2" roll of lightweight aircraft dacron purchased from Aircraft Spruce. First, rough-cut the length to fit in between the hinges and then precise cut just before application. Once the length is correct, hold the strip at the ends and fold it over between your fingers, holding tension and rubbing the strip against the trailing edge of the wing to set the crease. This "V"-shaped piece of dacron is then inserted into the gap. I then used a small stiff solder flux brush to apply thinned contact cement to the wing and the top layer of dacron. The top layer of dacron is then folded onto the wing edge and additional thinned cement is brushed on to insure good adhesion. The other side of the seal is attached to the control surface by folding the dacon back to apply cement to the dacron and control surface. Once I was rolling, each section took about 10 minutes . the entire wing was sealed in about two hours. I let the dacron seals sit overnight and applied the mylar at the next session. The curved mylar seal was applied using transfer tape per the standard procedure. Since the mylar was being attached to a contact cement impregnated dacron surface (not on top of Teflon tape) the work went quickly and the bond was excellent.

I was behind schedule at this point and cleaned up the wing for inspection by my A&P. I was a little nervous on the first take off, but the ship did not cork-screw through the air. Stall testing indicated that the sharpened leading edges did not noticeably change stall characteristics. I think the ship flew better, although this is pretty subjective. I have one season on my new wing finish and I am quite happy with the result. The left wing is now in my basement and I should make progress quickly, as the procedures are now familiar.Going forward, I will also refinish the control surfaces . and finally the elevator. I expect those will happen next year.

Although it took more then a year, I also built a new set of winglets for my 20 using foam cores (Eppler 205) and vacuum bagging techniques used by model airplane builders. I had actually planned to design my own, but was fortunate to acquire a proven design from one of our premier 20 drivers.

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Planning

Do you really have the time to complete this project? Based on the work of others, I estimated that my fuselage-refinishing project would take about 200 hours and would be completed over a 4-month period between November and February. My base hours estimate was about right, but I performed a complete gear system cleanup, installed new tail tank and 'P' systems. And did some other things that easily bumped the time up another 50 hours or so. Although 250 hours is just 15 hours a week over four months, I actually could not spend that much time on the project and completion ran late.

You will also need a place to prep, paint and finish the ship. I did the initial gelcoat sanding, prep and painting in a garage during the late fall, and did the final sanding and polishing in my basement. The latter allowed me to work through the winter. Based on the work of others in my club, I had a good sense of the skills, materials and equipment I would need to complete the job.

You have to obtain gelcoat, solvents, spraying equipment, and sanding supplies well in advance of the project. I ordered German wet/dry from Eastern Sailplane (ES) because it has superior cutting and staying power. I also installed a 220-Volt outlet in my basement and purchased a compressor to run the air- powered sander (jitterbug) used for final sanding. (An electric powered sander is fine for gelcoat removal ... you need a non- electric (air or elbow) sander for the final wet sanding.)

Having experienced people around or accessible to guide you through the process is essential. The work you are doing could impact the structural integrity of your ship and has to be examined and monitored by people with the appropriate credentials. In addition to local A&Ps, I was fortunate to have someone around who worked at Schempp-Hirth building and repairing gliders.

Gelcoat Removal

Removing the old gel coat quickly without damaging the underlying glass structure is the first task. The experience of several refinishing projects indicated that using a random orbital sander with a very coarse grit was the most effective way to achieve these dual objectives. How coarse? Well, how about 10 - 15 grit. The 'rocks' on the paper appear to pulverize the gelcoat, but bounce off the underlying fiberglass. The orbital sander also appears to offer additional protection because the velocities and heat generated by the orbiting pattern are low compared to a rotating wheel sander.