

COVERING a FUSELAGE by "Blanket Method"

(Envelopes no longer recommended or necessary)

When airplanes were covered in cotton, material widths varied but were seldom wider than 42-inches. Fabric was sewn together into an "envelope" that could be put on like a sock to fit the fuselage, wing, or tailfeather component of most airplanes. It was the only way to accomplish the job with fabric so narrow.

Today's polyester fabric (certified cotton is scarce or nonexistent) comes 70-72 inches wide. Such width allows much greater spans to be covered, and in fact, has greatly minimized all sewing needs. More importantly, the quality of the job by covering without using a completely sewn envelope is much improved.

For wings, 2 separate pieces can be used for top and bottom, with appropriate OVERLAP to form a legal seam, on leading and trailing edges. For fuselages, the problems are slightly more complicated because of the unusual protrusions and shapes involved, but the philosophy is the same: Figure out a way to glue and shrink fabric around the fuselage structure with the MINIMUM sewn joint so that the fabric conforms nicely to the frame and can be shrunk to final tightness.

Status of Modern Covering Techniques:

Envelopes may or may not fit well. The problem is that patterns were made to fit new aircraft when they came out of the factory, but over the years aircraft structures become bent or are replaced, thereby changing the structure, and the envelopes made from original patterns may be saggy and cannot properly be shrunk to appropriate tightness. If an "envelope" is too tight, then when shrunk with an iron the additional 12-15%, it will be over-tight and may weaken or endanger the frame.

To overcome the disadvantages of envelopes, which can be laborious and difficult to construct (even with patterns, each airplane is slightly different in details and measurements), a more modern solution has evolved. By sewing two pieces of fabric together, a "blanket" is constructed which drapes across the entire fuselage with the sewn seam glued to the top stringer. These 2 pieces sewn together, along with a SEPARATE belly piece glued and shrunk separately, comprise a complete fuselage covering job.

Concept:

The best way to cover a fuselage is to sew 2 pieces of fabric together and then glue that sewn seam to the "backbone" of the fuselage, which is the center top stringer (wooden or aluminum). By glueing the sewn fabric to the top stringer, it is then allowed to hang down both sides of the fuselage, with some overlap down by the lower longerons. The two ways to cover a fuselage are equally satisfactory but result in a different approach to possible repairs in the future, thus warranting consideration: (1) Cover the bottom (belly) FIRST, and wrap the bottom fabric as far around the lower longerons as possible. Some people like to use a HEAVY fabric bottom for float flying or bush flying particularly. The hanging fabric on the sides of the fuselage are then trimmed, wrapped around the lower longeron(s) and onto the belly piece! All joints and overlaps are trimmed in finishing tape. (2) Cover sides FIRST using enough material to wrap around the lower longerons as far as practical (but not so far that the belly piece that will be glued on SECOND now will interfere with any fabric that has been wrapped too far.

Something to Think About: Your choices

Either way is fine, but there are some things to think about. If you ever anticipate that the BELLY will have to one day be replaced prior to the sides, it will be much easier if the belly piece is put on second, and



thus it's easy to remove by releasing the glue joint's on the bottom and a short way up the side. The SIDES would be left in tact. Conversely, if the belly were put on first with the sides rolled around the lower longerons and overlapped on the belly, to remove the belly alone, the entire airplane would have to be loosened, disrupting both the pieces, sides and belly, to replace either.

So Let's cover a fuselage, Step-By-Step:

(1) Roll out a piece of fabric (usually medium) sufficient to cover the entire fuselage side, from the side(s) FRONT boot cowl to the very tail end of the vertical stabilizer. This is about 17-feet for the cub series. Don't try to skimp on fabric or cut it too exact, leave a yard or two front and rear for sanity and proper overlaps and wrap-arounds. The irregularity of a cub fuselage will need some additional fabric.

(2) Clip one side of the fabric to the lower longeron. Clothes pins will do, but small hand clamps from Home Depot work best to hold the fabric firmly on the lower longeron. Carefully measure enough material to wrap around the longeron onto the belly. Remembering that either the belly will "already" be covered, or that the fuselage "blanket" will be wrapped around the longeron and belly will be covered second, the amount of excess material should be sufficient to either: (1) wrap and glue as far around the longeron as possible, in the case of doing the fuselage "blanket" first, or (2) wrap around the longeron and under the belly enough to have an appropriate overlap (usually 1-2 inches) and be able to accurately trim later and glue to the belly piece already in place and heat shrunk. Again, either way is fine, it's personal choice, but leave sufficient material to LATER trim. Do not try to get this measurement perfect now before the fuselage "blanket" is even made, just leave plenty and worry about trimming well after the glueing process has begun up top on the stringer.

(3) After clipping the factory edge with sufficient extra material to the lower longeron, roll up the fabric informally and then drape the remaining fabric over the top of the fuselage, beyond the stringer. The extra material (remember it's 72-inches wide) can just lay on the frame or be temporarily clipped to keep from sliding off the other side.

(4) Pull all the slack out of the piece from the longeron to the center top stringer, insuring no major wrinkles or bunching exists. Using clips, secure the fabric to the top center stringer. Never pull tight, as fabric just lays across whatever openings it will cover; allow the heated iron to tighten it later. However, the fabric should not be sloppy loose, either. The analogy is "like a bedsheet just laying on the bed spread out," but not pulled and tucked under with hospital corners!

(5) Once clamped along the center stringer from where the bird cage begins all the way to where the vertical stabilizer starts "up hill" in the rear, you are now ready to mark the top stringer. First double check that sufficient fabric is available on top to accommodate whatever bird-cage sun roof arrangement there is, that sufficient material goes past the front boot cowl for wrapping (J-3's and PA-18's for example are slightly different, and therefore have plenty extra, to cut off later) Finally, insure that sufficient material exists to go all the way to the tail of the airplane, with plenty left over to wrap around the vertical tubing on the vertical stabilizer, and trim later. There appears to be a lot of "extra", loose fabric near the tail now, but that's OK. You should also make a mark at the very TAIL (vertical pipe) of the airplane with about 2-3 inches extra, to remember how far the fabric will be needed.

(6) With a # 2 pencil (NEVER use magic markers or pens on polyester fabric), mark a line down the middle of the top stringer. A long straight ruler may be helpful to insure a straight line is drawn. Write on the fabric exactly where the bird-cage meets the top stringer and where it will be wrapped around the formers. This will be the BEGINNING of the sewn seam later. Also mark at the point where the centerline of the fuselage "backbone" starts UPHILL toward the top of the vertical stab. The J-3 approximate distance between the bird-cage and the vertical stab transition is 155-157 inches. These

marks, along with the centerline, are important because they will delineate EXACTLY where the sewn seam(s) will be. Pencil lines in no way affect fabric treatment or show through the final topcoat paint.

(7) Now pause for a moment, and consider. There are two ways to continue at this point:

(A) The clipped, marked, fabric can now be removed, layed out on a clean floor and a PATTERN cut out. To do this, an extra 1-2 inches must be added to the top stringer marked pencil centerline before you cut. Muslin material works well for a pattern and is inexpensive from a fabric store, about \$4 per yard. Use fabric that is at least 72-inches wide if using the muslin. Making a "pattern" may be preferable and easier to work with, depending on abilities and simplicity of operation.

If making a muslin pattern is NOT desired, here's what can be accomplished:

(B) Trim the fabric as depicted along the top stringer pencil line, adding 1-2 inches. Cut it accurately and as straight (parallel to) outside the pencil line as possible. Next repeat the procedure as described from the beginning for the other side, leaving the 1st side piece clamped up as before. Once the 2nd piece (equal length of about 17-feet) of fabric is clipped to its lower longeron, bring it up and drape it past the center stringer and drape (bunch it up and drape it over the other side out of the way) it anywhere beyond the center stringer. Now with the 2nd piece of fabric wrinkle-free and laying across the other one, the PENCIL LINE should be seen through from the 1st piece. Now trace a pencil line on the new piece directly overtop the already-marked line drawn on the 1st piece, the full length once again, from bird-cage to vertical stab beginning. Use clips to hold the 2nd piece of fabric in place while tracing the first line onto the second fabric piece on top. Now trim 1-2 inches "extra" on the 2nd (top) piece of fabric, parallel to the pencil line. This makes 2 identical pieces of fabric, one for each side of the fuselage. Now carefully pin the two pieces together with the pencil lines precisely aligned, one over the top of the other. Pin along the entire length of the center stringer line, about every 4-6 inches. Now let the sewing begin!

Doe, Ray, Me, Fa..... SEW!

Sewing using the Muslin PATTERN:

Place 2 pieces -Dacron Fabric

about 17-18 feet long on top of each other on a CLEAN floor with the edges matching. Place the muslin pattern on top of Dacron making sure that the longeron edge of the pattern is even with the selvage edge of the .

Cut one inch from the line that was drawn marking the top stringer. Leave plenty of extra (2-4 inches) around the vertical stabilizer and birdcage area.

Remove the muslin pattern and pin a line one inch in from the edge as a guide for the sewing machine and also to keep the slippery fabric from sliding around.

Using ONLY Approved dacron machine threat (required by the STC), sew the line where the pins are OR make a mark on the sewing machine that is one inch from the middle of the needle to use as a guide while sewing. You will want to sew from the mark at the edge of the bird cage to a couple of inches up the vertical stabilizer, removing the pins as you get to them to continue.

When the sewing is complete, go back to the beginning and make a second row of stitching about 1/8th of an inch from the first row between the first row and the edge. You may want a helper to hold some of the weight of the fabric to make it a little easier to sew.

Sew by "Golden Tree" method, WITHOUT PATTERN

Take two pieces of marked Poly-Fiber fabric off the fuselage. Using ONLY approved machine spool thread. (required by the STC). Pin the two pieces together, matching the lines that have been drawn (eg. from bird cage to beginning of vertical stab up-slope). Sew two rows of stitching (as described previous section), one at the pencil mark and one that is 1/8th of an inch INSIDE that mark between the first row and the edge of the fabric. Remove the pins as you sew.

Type of Seam?

Refer to Poly-Fiber Manual No.1, Revision No. 20 (July 2001). Appendix "B", page 95, the LOWER RIGHT diagram shows the single stitch seam to close fabric together when the stitches occur over a structure. TWO SEAMS 1/8-inch apart are ideal, as described above.

Glueing the "Blanket" onto the Fuselage

The hard part is done, and after all that, it really wasn't difficult was it? The good news is that there is absolutely NO SUFFERING because some envelope that was ordered and "supposed to fit" is not in the picture at all. The newly sewn fuselage "blanket" will absolutely fit perfectly because the installer (you!) has the material to do it properly, regardless of minor differences in fuselage sizes. A beautiful fuselage covering job every time, WITHOUT ENVELOPES !!!

The newly sewn "blanket" must be carefully draped over the fuselage with the sewn seams right down the center of the top stringer. The overlapped fabric (by 1-2 inches) needs to be flattened (not crumpled or folded irregularly beneath the main fabric) to also lay flat on top of the center stringer. The overlaps beneath won't be seen beneath the blanket fabric, but it still pays to have it trimmed neatly and as short as desirable. One trick is to turn the blanket upside down and lightly (and less than 200-degrees to avoid shrinking before you want it to!) IRON the overlap tabs so they will behave and stay flat on the stringer. Note that with access to the interior of the fuselage, mis-behaving tabs can also be reached and straightened along the center stringer from the inside as the gluing proceeds.

Now for the fun, sticky part.....(!) Let's CEMENT!

Here we go. Mix up some UA-55 Air-Tech Adhesive (or New Super Seam cement for Ceconite users) cement, diluting it 20-30% in a soup can with RA 4000 adhesive reducer (this is an Acetone based reducer which is much safer than MEK). The thinned mixture will enhance the "spot welding" of the new blanket to the center stringer. Starting at the bird cage, brush on about an inch of cement onto the stringer and center the seams right in the middle. Press hard with your fingers (gloved) to let the diluted cement ooze through the weave. Allow it dry in a minute or less, and then stretch the sewn line down the stringer and "spot weld" with the Air-Tech UA 55 adhesive again about 6-8 inches away. Repeat until the "blanket" is spot-glued to the stringer for the full length and will not slip off the fuselage either direction. When happy with this, use the same (Acetone based adhesive reducer) RA 4000-diluted UA-55 Air-Tech Adhesive on the stiff brush, and brush THROUGH the fabric weave along the entire stringer to secure the blanket thoroughly. Careful not to use too much glue, but just enough to insure that it is set and won't pull off the centerline of the seams when the fabric on the sides is wrapped around the lower longerons and ultimately heat shrunk. It should end up that the blanket is neatly glued to the top stringer, with dangling sides of fabric on both sides. Notice how neatly and wrinkle-free the fabric now drapes down across the turtle deck (other stringers), and along the flat side of the steel fuselage tubing. Already, the job is "custom" for your specific airplane, and there will be no saggy areas or extra materials, nor any overly tight areas that don't fit. The dreaded ENVELOPE of yesteryear has been avoided! Welcome to a modern

aircraft covering technique. Let's now continue.

Wrapping & cementing around the lower longerons

Recommended to in the middle of the fuselage. Gently pull the fabric down and clip to the lower longeron. Continue clipping fore and aft along the longeron, insuring that no big wrinkles occur anywhere.

NOTE: The next depends on the choice made, whether to put the belly piece on FIRST or SECOND. For purposes of this explanation, I will assume that the belly piece will be put on SECOND, for easier removal/replacement down the road as necessary. Thus, the next explanations assume NO BELLY fabric installed yet.

Wrap the fabric around the lower longeron as far as possible until it almost touches itself on the inside, but not quite. Mark with a pencil where the fabric can be wrapped and glued and still insure that it won't touch the fabric from the inside. Excess glue and material will both work against a good job, because if the fabric ends up glueing to itself, it will alter the heat shrinking later. THE FABRIC SHOULD BE CEMENTED ONLY TO THE LONGERON. Once marked along the entire longeron, cut the line to eliminate all the excess fabric. You're ready for glueing once again!

This may take your breath away at first! WARNING

Let me warn of something that may startle you in this process, a common reaction to the blanket method. Suddenly you may notice that the fabric is TOO SHORT to reach the lower longeron of the fuselage toward the front of the fuselage, and you'll think you've really made a drastic mistake somewhere. Not true. You've done absolutely nothing wrong.

Making an alligator's mouth in your blanket (!)

The fabric must be slit in the form of an alligator's mouth from the middle of the rear window, forward (stay approximately in the middle) through all the windows, and straight out to the end of the forward fabric. NOW the piece of fabric remaining and hanging from the center stringer where it's cemented, can be used ultimately to cover the bird-cage top, sides, down to the windows, etc. Leave all that fabric LONG for now. The bottom piece of fabric will now in fact, nicely straighten out and allow itself to go flat and have plenty of material to wrap around the lower longeron as far as possible, all the way to where it ends at the boot cowl. The alligator's mouth should be made on both sides, of course.

Cementing in segments, NOT all at once

Let's cement the fabric around the lower longeron. Be careful to cement ONLY where the fabric begins to touch the outside of the longeron (tangent point). If you simply "slop" poly-tak along the edge of the longeron, some will probably draw the fabric inside the outer plain and cause an indentation of the fabric right at the longeron. Not good. You want the fabric FLATLY adhered to the steel tubing. Work in short segments of 4-8 inches and glue the hanging side fabric to the lower longeron. If too much glue causes indentation(s) or inappropriate cementing, release with some MEK on a rag and make it right, while you still have access through the belly (!).

Now glue BELOW the longeron's side, down to and maybe slightly around the bottom of the longeron. Do this process slowly and carefully in similar 4-8 inch segments along the entire longeron. The reason for this method is primarily that the cement dries too quickly to do it all at once, and secondarily you have more

control of cementing the fabric around the curve of the longeron as far as possible by working in small segments.

Now the sides are pretty well cemented to the lower longerons, with maybe about 1/2-1 inch loose and unglued at the bottom. The third step is to brush glue **CAREFULLY** along the inside of the longeron tube, but **NOT** touch the fabric from the inside, and cement the remaining fabric onto the tube. The surface area the side piece is cemented to is as good as can be done. Clean up any gloppy glue slops or where it touches the inside of the fabric with Air-Tech RA 4000 adhesive reducer. Any small bluges on the longeron tubes can be ironed out later, but any large globs should probably be addressed now.

Move to the front of the fuselage project for more cementing!

Adjust the fabric to insure that it is flat, unwrinkled, and suitable for eventual shrinking, from the rear window area forward. Clip the fabric to the window frame or posts to keep it out of the way and approximately in position. **DO NOT** glue fabric to anything in the window area yet. Instead, continue to first wrap and glue the lower longeron all the way to the front, where the boot cowl starts. There should be plenty of material left over to wrap the front "sides" later. There will be plenty up at the window(s) also for later trimming and cementing in the actual window tracks.

It's Bird-Cage time

Keeping the fabric appropriately straight, except for minor wrinkles, glue the fabric to the edge frame of the bird cage. You should slit, trim, and wrap fabric as far around the square frame members on the side, and also on the front. Think about how it is laying at all times to insure that heat shrinking will make it beautiful and tight without errors.

Now Boot Cowl time

Same old story, trim, slit, glue around all members to make it ready for shrinking. Some people glue inside the square members' railing for extra strength, but that's not really necessary. Just wrap and cement it securely to as many edges as feasible.

So everything's almost cemented

You should have flat fabric on both sides of the fuselage, around the boot cowl frame, along the bird cage sides and front, the lower longerons, and down the "spine" of the fuselage all the way to the up-ramp of the vertical stab. Should be just a lot of loose fabric at the very tail of the fuselage. What on Earth do you do now?

The sewn seam ends just as it starts up the slope of the vertical stabilizer. There are two large flaps of fabric just waiting for your attention. After all, the vertical stabilizer begs to be covered, too!

This is probably the most fiddly part of the fuselage covering. Not difficult, just detailed and requires attention. Here are the basic premises and steps:

- Each appropriate leftover "flap" of material will be used to cover its respective side of the vertical stab.
- One side must first be flattened appropriately to trim, wrap around, and cemented to the up-sloped leading edge of the vertical stab as far as possible. Just like any other tubing on the fuselage to give it maximum glue surface area.
- Where the fabric sewn seam stops may be adjusted slightly to make it pretty, appropriate, easier to begin the wrap-around up the slope....all of those things. Your blanket comes sewn to the "maximum" length

needed. If you feel it will work better to slit the seams for an inch or two, that's fine.

- Careful clipping and trimming and cementing is all that is required to make this work pretty.
- Once the first side is wrapped and cemented around the leading edge of the vertical stab, you arrive at the "flat" tube on the top. The transition here must be slit and finagled a little to wrap and cement, and to insure that you don't end up with double thickness fabric anywhere.
- With one side done, you flatten and arrange the other side to OVERLAP the center upslope, carefully mark the overlap (1-inch) and trim very carefully with scissors. Some perfectionists actually mock up a piece of 2-inch tape which will ultimately be used the entire length of the fuselage spine, and plan the overlap up the stabilizer to "hide" perfectly under the 2-inch tape edge as well. It's actually pretty simple, and IS the best idea, to keep the job professional looking. I suppose the SUPER purists could even pink the trimmed edge in hopes that the pinked finish tape applied later will MATCH the pinked overlap edge, and nobody will ever know it was even overlapped. Few are that anal retentive, but I'm just pointing out some things to consider and aim (in part) for. Arrival at the horizontal "top" of the vertical stabilizer requires the same slitting and fiddling to neatly overlap and cement the 2nd side over top of the 1st side.

Yes, you DO do windows!

Windows are fiddly, too. You'll need some popsickle sticks, some thin flat pushers, a metal non-sharp blade, a dull knife, or whatever, plus some patience, to be able to PUSH the fabric down or up into the window grooves. You actually push it down the trough to the bottom, then up the other side as far as you want really, with enough cement to make it stick. The plexi-glass windows will then have a nice bedding to lie in, and of course the multiple coats of Brush, Spray and paint will hold the fabric in the window slots even more. Do this for the UPPER window (down from the bird-cage), and the LOWER window (up from the longerons & boot cowl area).

The tail end of the fuselage covering project!

That's right, we're at the rudder post, the last piece of fixed metal tubing on the fuselage. The drill is the same. Do one side at a time. The 1st side is trimmed, wrapped, and glued around the rudder post as far as possible. Then the 2nd side is trimmed and overlapped the appropriate amount (usually 1-inch) with a nicely cut straight edge, to be hidden beneath a 2-inch trim tape in the end. Voila, the fuselage is covered.

NOTE: It is not uncommon to feel that things are not going as well as you wanted when the fiddling with the vertical stabilizer begins. Sometimes the fabric seemingly cannot be coerced into being flat for all angles and cementing spots, so you may end up with a few "wrinkles" that simply cannot be helped. Rest assured, however, that as long as things are as flat as possible, the wrinkles will pop out during the first heat shrink at 250-degrees, and tighten further after the final 350-shrinking of the fabric. Bottom line: Don't let minor inconsistencies of the fabric bother you. Just do the best you can do, always checking the fabric to get it as straight as possible before cementing.

Don't forget the BELLY piece!

Roll the fuselage over in the fuselage jig (if you don't have one of these, beg, borrow, or longerons and the front bottom boot cowl area and the tail rudder post area.

Best way to do a belly piece SECOND to the sides, is to begin cementing on one side, let it dry then pull it evenly to the other side and repeat. Once in place, the overlap can be carefully measured, marked, and cut to wrap UP around the longerons to the side. Here again, planning with the appropriate finish tape width will allow the overlap edge to "hide" beneath the finish tape and disappear. Remember that putting the

belly piece on last allows for easier removal/replacement in the future if necessary.

If you did the Belly FIRST?

Modify cementing of the blanket method with the following:

- Cement the sides to the longerons, over top of the already-wrapped and cemented belly piece. Yes, fabric over fabric. Do it in 3 stages just like wrapping any tubing or members. Once cemented to the SIDE of the longeron, next incremental cementing is around the bottom, and then after careful trimming and cutting, finally to the belly (fabric to fabric again), in such a manner so as to be hidden by the finish tape which will wrap evenly around the lower longerons and cover the overlap, too!

NOTE 1: The advantage of covering the belly first with a separate piece is to avoid an overlap seam on the SIDE of the fuselage where people might see it. With the belly already covered, the overlap edge will be on the bottom of the fuselage, and rarely seen by anyone, lest they crawl beneath the fuselage, and who would do THAT?

NOTE 2: The advantage of covering the belly LAST is paramount if and when the belly piece needs repair or replacement, because it can more easily be removed without disturbing the already wrapped around sides. Of course, the disadvantage if there is one at all, is that the overlap seam from the belly will now be on the lower bottom of the fuselage, but that, too, can be "hidden" with the longeron finish tape.

I don't know what the Oshkosh judges think, nor do I much care! Both methods are perfectly acceptable, and equally strong and satisfactory.

It's SHRINK time!

That doesn't necessarily mean you need a psychiatrist. Hopefully this process hasn't driven you to that point. That might be the case using an out-dated ENVELOPE, but should never eventuate with the newer, preferred, up-dated, modern SEWN BLANKET method.