

# Dacron—A Canvas Alternative

by Alex Comb

There was a time when most aircraft were built by covering a wood framework with fabric. Perhaps the idea came, in part, from the canvas-covered canoe, which of course was already well established as the most efficient way to build a light weight craft. Interestingly enough, both craft were later built with thin aluminum sheeting over aluminum ribs. Despite all the changes in technology in both the marine and aircraft industries over the ensuing years, the fabric-covered canoe and the fabric-covered aircraft have survived as viable alternatives.

The two types of craft have followed similar paths for obvious reasons. Builders of both have a fundamental interest in maximizing strength while at the same time keeping weight to a minimum. In the early days of cloth-covered aircraft, a light-weight cotton, very similar to what is called Egyptian cotton, was used. This high thread-count, finely-woven fabric was both strong and light—factors which earned it the moniker “aircraft cotton.” At that time, canoes were being built with heavy woven cotton duck. While canoes don’t need to “get off the ground,” they may need to fend off an unexpected rock, so the heavy duck had seemed appropriate. Some canoe builders, however, were lured by the light weights offered with the aircraft construction. Penn Yan Boat Company in upstate New York was an early experimenter in building lightweight canoes and car-top row- and motorboats and adapted a system using lighter cotton treated with an “airplane dope” filler to render the fabric weatherproof. Charles Herrmann, the company founder, began his career in the aviation industry and saw value in transferring some of its technology to his new enterprise.

With E. I. du Pont de Nemours and Company’s development of the proprietary fabric known as Dacron in 1951, aircraft manufacturers found a fabric that could provide similar strength to cotton but at a

lower weight and without the worry of rot. Soon “aircraft cotton” was replaced with “aircraft Dacron.” Dacron has also proved a very serviceable and lighter-weight substitute for canvas in waterproofing a canoe hull.

Chemically, Dacron, which is DuPont’s trade name for the fabric, is the compound polyethylene terephthalate, although it quickly became known as polyester. Two brand-name polyester fabrics developed for the aircraft industry are Ceconite and Poly-Fiber. Each comes in various weights, the heaviest of which weighs 3.4 ounces per yard and is the one appropriate for canoes. Generic polyester fabrics are also available which, while not approved for certified aircraft, work just as well for canoes and at a lower cost. I refer to all these fabrics as Dacron, much the way I call whatever I blow my nose with Kleenex even if it’s a shop rag.

The procedure for applying Dacron is quite different from that for canvas. The weave is not loose enough to be

## If You Try Dacron

Only a few tools and supplies are needed to try Dacron on your next canvasing project. Most of what you need may already be in your shop.

- a clothes iron
- a small tacking iron (optional)
- a temperature calibrator
- a utility knife
- pinking shears (optional)
- 4-inch foam brushes
- a dust respirator for sanding
- a charcoal respirator if spray painting
- an HVLP sprayer (optional)
- an adhesive and filler system.

*A clothes iron and a temperature calibrator are essential to the job; a small tacking iron is also handy to have.*

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*Figure 1. Applying the adhesive along the top half-inch of the planking. Two coats of adhesive will assure a good bond.*

torqued into place by stretching, but it will conform to complex shapes with the application of heat. Instead of the tacks or staples used with canvas, Dacron is fastened at the sheer line with an adhesive. It can also be fastened to the stem the same way and has the obvious advantage of having fewer fasteners that can interfere with screws for gunwales and stem bands.

Which adhesive to use will depend on the method chosen for filling the weave of the Dacron. There are several different manufacturers of aircraft dope and a variety of products to use for this purpose. I suggest using either of two complete systems—Poly-Fiber or Stewart Systems—both of which require using only their products throughout the entire process. The better known is the Poly-Fiber system, which includes the products and methods employed by Ray Stits, a pioneer of the fabric-covered aircraft. When using this system, Poly-Tak cement is the adhesive used at the sheer line and the stems. The other system I recommend, and the one I use, is water based, and therefore less hazardous to your health and to the environment, and not flammable. These products are made by Stewart Systems and are the same products once known as the Blue River System. Its adhesive is called EkoBond. Both Poly-Tak and EkoBond adhesives have the considerable advantage of being heat-activated, which allows the fabric to be temporarily tacked in place and readjusted if the need arises.

## The Process

I normally begin by preparing the surface, vacuuming the hull to free it of dust and making sure there is no foreign matter stuck to the oil or varnish finish that I have already applied to the outside of the hull. I apply the Eko-



*Figure 2. Using the iron to remove any wrinkles and tighten the fabric. Note the wrinkles to the left of the iron.*

*Figure 3 (below) Trimming the fabric at the stem.*

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Bond to the top one-half inch of the planking along the sheer line of the entire canoe, brushing on two coats of the adhesive to insure a good bond (Figure 1). The adhesive should be dry to the touch before the Dacron is draped over the hull of the boat. I take the wrinkles out of the fabric by running my hand along the keel line, smoothing the fabric out in the midsection of the canoe, and then moving my hand from the keel line to the sheer line. Using a household iron calibrated to 250 degrees Fahrenheit, I heat-activate the adhesive in the middle of the boat and begin shrinking the fabric in this area to tighten up any wrinkles (Figure 2). I work my way from the amidships area toward the ends of the canoe, carefully passing the iron over the fabric much the way I iron a dress shirt. I may



Figures 4. Starting the cut at the stem.



Figure 5 (center) The fabric is split.



Figure 6. Once the stem is exposed the adhesive can be applied.

find as I go along that to work out the wrinkles I need to pull the fabric loose from the adhesive and reattach it in a slightly different location. The iron needs to be pointed so that the wrinkles are pushed out while avoiding folding the material over on itself. I continue working in this fashion until I have glued the fabric at the sheer line all the way to the stem. I go back as needed and iron out any wrinkles along the way.

The fabric will not be drum-tight at this point, but once it is essentially wrinkle-free and is tight to the stem where the rocker in the bottom of the canoe meets the sweep of the stem, I can begin fastening the fabric at the

stem. First, I trim the fabric so that it extends about two inches past the stem, roughly following the curve of the stem (Figure 3). This trimming may be done with the sharp knife, but it's a bit easier to use pinking shears. Next I cut the fabric from the point where it comes loose of the stem longitudinally, straight out from the stem, using a very sharp utility knife (Figures 4 and 5).

Once the fabric is trimmed, I apply two coats of adhesive to the leading edge (i.e., the face) of the stem and let it dry (Figure 6). I then gently pull one side of the fabric over the stem, using the iron to bring the fabric toward the leading edge, and rounding the corner of the stem with the



Figures 7 (above, left) and 8 (above, right). Tacking the fabric to the stem.



Figures 9. Applying adhesive to the Dacron bias tape.



Figure 10. Using heat to activate the adhesive.



Figures 11 and 12 (above). After applying the adhesive to the bias tape at the stem (above, left), it's essential to remove the excess adhesive.

iron, tack the fabric into place (Figures 7 and 8). This has to be done all along the stem so that the fabric is attached to the leading edge with no major wrinkles in the fabric. I go back over the leading edge making sure the fabric is secured to the adhesive and that there are no wrinkles. I trim the excess fabric by slicing with the sharp utility knife into the end of the planking on the far side of the leading edge of the stem. This way there is no fabric extending beyond the edge to catch the fabric on the other side of the stem. Next, I apply only one coat of adhesive over the fabric at the leading edge, which will hold this other side in place, being careful not to use too much adhesive since it may loosen the first bond. When this application of adhesive is dry to the touch I pull the fabric from the other side over the stem and adhere it to the glue with the iron (Figures 9 and 10). A small detailing iron set to 250 degrees Fahrenheit works well in this area, though an ordinary clothes iron will do the job well enough.

After fastening both bow and stern at the stems and with the fabric adhered at the sheer, I calibrate the iron a bit warmer, though not to exceed 325 degrees Fahrenheit, and go over the entire hull to further tighten the fabric. I do not want to pass over the glued areas with the iron at this setting as it may loosen the bond. Some steam may come off the fabric during the ironing process, but it is not a problem, as it is just moisture that was locked into the fabric and is now being released as steam. I make sure I go over all the glued areas with the iron to insure a good bond, and then I apply an additional coat of the

adhesive where I had earlier applied the adhesive, brushed through the fabric; doing this strengthen the bond. When using the Stewart Systems, it is essential to wipe off with a cloth or paper shop towel (AKA Kleenex) all the excess glue immediately after brushing on about 12 inches of the EkoBond. Excess glue can interfere with the finish, and the moisture in the glue can actually activate the glue and loosen the bond.

At this point, I go over the entire hull once more with the iron still set to 325 degrees Fahrenheit, lingering with the iron as wrinkles or loose areas dictate. I am careful to watch the fabric as I pull the iron across it, chasing a loose area until it is taut. Temperature is critical. An iron hotter than 325 degrees can permanently distort the weave of the fabric. The instructions for using this system on an airplane indicates a higher temperature for the iron, but this is not advised when working on a canoe. It seems that fabric stretched over the solid mass of the wooden hull of a canoe absorbs the heat more than fabric stretched over an open frame of an aircraft, and the result is the fabric can become damaged at a temperature that is lower than the recommended upper limit for airplanes. Once fabric is heat-damaged, it will permanently lose its tautness and blisters will appear, significantly affecting the appearance of the job. It is well worth the \$10 investment in a calibration thermometer for your iron!

Once the fabric is tight over the canoe, I apply Dacron bias tape to the stems to cover the seams (Figures 9 and 10). This will not only ensure a waterproof joint, but also pro-



Figures 13. The last step before painting is sanding. A foam block hand sander is the ideal tool for the job.

tect the corners where planking meets the stems, which can be a sensitive point when sanding filler. I adhere the tape with the same adhesive in the same manner as described above. I first apply a coat of adhesive, work the tape into place, iron the tape to remove any wrinkles and activate the glue (Figure 11). With the tape in place and wrinkle free, I brush on an additional coat of adhesive, wiping off all excess to insure a permanent bond (Figure 12).

## Filling the Dacron

The Dacron fabric should be filled with a product compatible with the system that has been used to this point. The Poly-Fiber method uses Poly-Brush followed by Poly-Spray, which includes a silver coat for UV protection and the final color coats for the desired color. These products are essentially the same airplane dope as the adhesive and are completely compatible. I have no personal experience with them, however, and so will not discuss them in detail. The Poly-Fiber system, however, is highly regarded and well known throughout the small-aircraft community. If you should use this system, you will likely be able to find a local supplier who can give you practical tips.

EkoFill by Stewart Systems is water-based with a high level of solids that will fill the weave of the Dacron fabric while including sufficient UV inhibitors to protect the fabric. Before the EkoFill can be applied, the fabric must be tightened to the point at which no slack is produced by dragging the iron sideways across the fabric.

Before the first fill coat, the fabric once again needs to be cleaned by vacuuming it to remove any debris and then wiping it down with a cloth dampened with clear water. Then I apply two coats of the EkoFill. The first coat is applied in one direction and the second coat at 90 degrees to the first using a 4-inch wide foam brush. Thin coats are best to avoid any drips or sags. I remove any excess filler from the brush as it builds up by laying the brush flat to the fabric and dragging it off. These two coats begin to fill

the weave, but not completely. After these first two coats, it's OK to continue adding coats with a brush, but it is best to spray the remaining coats to control the amount of filler laid down. Too heavy a coat will cause the filler to sag and drip, requiring unnecessary sanding.

High-volume, low-pressure (HVLP) spray equipment can be used very successfully to apply the successive thin coats of filler. Using a 1.5 to 1.7 mm spray nozzle, I set the sprayer to about 25 psi at the gun, open the fluid control knob a three-quarter turn and lay down a coat of filler first horizontally. Then I do a second coat vertically, at 90 degrees to the first. If the surface is glossy, I cut back the amount of filler being delivered by adjusting the spray equipment. I try to get an even, flat, thin layer of filler. I begin each coat with a light spray over the edge of the tapes, trying to build up the filler faster in these areas without applying too much filler at a time.

It will require at least one more set of cross coats of sprayed filler (a cross coat is two coats at 90 degrees to one another) to complete the job. In all I use about one-third of a gallon of EkoFill to fill the Dacron weave in a canoe. Stewart Systems recommends sanding between each set of cross coats with 320-grit open coat paper. This is best accomplished by hand sanding with a foam sanding block (Figure 13). Do not attempt to wet sand. The product will sand best if allowed to dry thoroughly, which may take two hours or more depending on temperature. When the weave is completely filled, a final sanding is in order.

After a final sanding, I complete the job with the paints available from Stewart Systems since they are simply the most flexible paint I have encountered, though I have also sprayed automotive paints and brushed oil-modified polyurethanes after applying a compatible primer.

I always wear a charcoal-filtered respirator when spraying the filler and a dust respirator when sanding. I really like the relatively low toxicity of the Stewart System products. Airplane dopes are another story—one sniff and you will know why it's called "dope." In fact, I will not use airplane dope indoors, though, unlike the Stewart System water-based products, it can be used outdoors, even in winter. ♫

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*Alex Comb owns and operates Stewart River Boatworks. He is currently completing his new book, The Art and Craft of Canoe Building, which will include a chapter on using Dacron. The water-based products mentioned in this article are available through Stewart Systems (5500 Sullivan St., Cashmere, WA 98815) or through Stewart River Boatworks (P.O. Box 297 • Knife River, Minnesota 55609; 218.834.2506 or [www.stewartriver.com](http://www.stewartriver.com)). Aircraft Spruce and Specialty Company, 225 Airport Circle, Corona, CA 92880 (877/477-7823 or [www.aircraftspruce.com/](http://www.aircraftspruce.com/)) is a source for aircraft-certified Dacron and other dopes/fillers.*