The CAFE Barograph and its free-swiveling pitot-static "missile" are shown mounted in the wing cuff "holster" in the photograph above left. The aft portion of the Barograph has a connector to download data to a laptop computer. The photograph above right shows a typical installation for flight testing with wing cuffs on both wings of a Lancair IVP. One wing cuff carries the actual Barograph and the one on the opposite wing carries a hollow mock Barograph of the same shape.

The 4 photos above show the wing wrapping fiberglass cuff and the fiberglass layup over the 1” foam standoff and 3” holster tube after carving the foam shape. A SmartLevel** is used to set the incidence angle of the tube before glassing. ** http://www.seqair.com/skunkworks/Tools/SmartLevel/SmartLevel.html
After being officially accepted by the CAFE Foundation for flight testing, then:

1. Barograph wing cuff construction: It is much easier if you have a helper! Ask in your EAA Chapter for an expert in fiberglass work if you are not familiar with these techniques.

   To mount our 3.00” diameter by 24.1” long barograph securely to your wing, we use a fiberglass wing cuff, taped over the wing skin near the wingtip. A duplicate cuff is attached to the opposite wing to balance weight and drag. The cuffs must not be mounted in an area subject to propeller or fan thrust. If your wing skin is fabric, a custom attachment of the cuff may be necessary. In such case, please call us about finding a rib location near the tip for the mount.

   Tools and supplies needed: Much of this available at: http://www.aircraftspruce.com/catalog
   1.5 gallon kit EZ-Epoxy II, P/N 01-08850. (http://www.aircraftspruce.com/catalog/cmpages/ezpoxy.php)
   2 ea. 3.005” i.d. x 24.1” thinwall 3 ply fiberglass tubes
   These are made by wrapping a 3-ply wet layup onto 3” steel tubes coated with wax paper
   4-6 oz. of paste wax (automotive or floor wax)
   1 qt. Dynalite (any lightweight body filler or bondo will do)
   1 qt finishing sealer, such as Morton’s Eliminator, FeatherFill or other
   9 yards Rutan bidirectional fiberglass 9 oz., 38” wide, P/N RA 7725
   6 yards 3.16 oz., 38” wide fiberglass, P/N 120-38
   1 rubber or plastic squeegee
   3 paint brushes, disposable, 2” wide
   50 epoxy mixing cups, 8 oz., un-waxed
   100 epoxy hardener cups, 3 oz., un-waxed
   wooden mixing sticks for epoxy and sealer
   3’ x 6’ flat work table (old hollow core door on 2 sawhorses or equiv.)
   2 ea., 1-2 mil thick plastic sheet, 3’ x 6’, (plastic trash bags work well)
   1 roll masking tape
   1 roll polypropylene tape or duct tape
   large scissors
   40-60 grit and 320 grit sandpaper
   Urethane foam, 2 lb./cu. ft., 1” x 24” x 48”

Please read all of these instructions before your begin!!!

Please call 707-544-0141 if you have questions about how to make your cuff. It is very important to not allow any resin or paint to get inside the 3.005” fiberglass tube during fabrication of the cuff. We recommend performing all steps (except the final filler step) on the cuff with it still attached to your wing so as to prevent cuff warpage.

Locate a position on the wing where the wing cuff will be built. Find this area on the right wing leading edge just inboard of the wingtip and well outside of the prop wash. Wash this area of wing skin and lightly wax and polish it with ordinary car wax. Next, completely and smoothly cover the wing top and bottom skins and leading edge in this area using either duct tape or polypropylene tape, carefully applied in chordwise strips with slight overlap. Cover a spanwise dimension of at least 20-24” and apply the tape back to the aileron hinge line or trailing edge as the case may be. The center of this area should be on a wing rib to obtain greater skin stiffness. Do exactly the same preparations on the left wing-tip.

Smear a complete and generous coat of the paste wax over the tape to allow release of the subsequent fiberglass layup, taking care to not lift any tape edge. Do not polish this wax. Perform the next step on the work table placed near your aircraft, preferably in a temperature above 65 degrees F.

Cut out 8 pieces of the Rutan fiberglass cloth, each 12.5” x 72” and cut out 2 pieces of the 3.15 oz fiberglass cloth, also each 12.5” x 72”. Using masking tape, tape the perimeter of a large plastic sheet (plastic trash bag material) to cover the work table over an area of 3’ x 6’. Make sure to keep the plastic flat during the taping. Mix at least 12 oz. of the EZ EPoxy II using the proper weight ratios given on the containers. Place one piece of the 3.16 oz. cloth onto the plastic sheet on the table and cover it with 1 piece of the Rutan cloth. Pour some resin over it. Wear gloves during all work with epoxy and fillers. Use the squeegee to carefully spread the resin over the cloth, using a low angle of attack for the squeegee, gently pulling the resin along toward the edges of the layup so as to not disturb
the fiberglass cloth's weave. When this cloth is thoroughly wetted, apply a succession of each of 3 more of the pre-cut pieces of the Rutan cloth to obtain a total of 5 layers (including the layer of 3.15 oz cloth), wetting out each layer as it is added. Chase out any trapped air bubbles with the squeegee.

Cut full thickness through the wet fiberglass and plastic sheet using a heavy-duty scissors to create a wet layup multilayered piece 10" x 70". Have a helper help to carefully lift this wet layup on its plastic sheet and drape it onto the center of the pre-waxed taped area of one wingtip, placing it fiberglass down, plastic layer outermost. Position it so that about 35" of it are applied to the top skin (chordwise) and 35" are on the bottom skin, wrapping around the leading edge. If your wing is smaller than these chord dimensions, trim off any excess at the wing trailing edge. Make sure that the resin does not get onto your bare wing skin anywhere, and if it does, immediately wipe it off with a paint-safe solvent.

As you apply this wet layup to your wing, make sure that the bottom skin portion is sticking in place, using the squeegee on the plastic sheet to chase out any bubbles and secure the layup to the wing skin. This takes patience and the layup may drip on your clothes. Once the layup is adhering to the wing (2-5 minutes), carefully peel off the plastic sheet, making sure to leave all layers of fiberglass on the wing. Again chase out any bubbles under the fiberglass with the squeegee. Perform the identical layup and application on the other wingtip. Let both layups harden 24 hours or more before sanding. The sanding can be avoided if you wish to use dacron peel ply as a final layer on top of the wet layup on your wing.

Thoroughly sand the surface the layup after it has hardened on the wingtip, using 40-60 grit paper. Test fit the 3.005" fiberglass tube to the bottom wing skin as follows: Cut and pre-carve a piece of 1" wide polyurethane foam, as shown in the photos, to serve as a stand-off for the 3.005" tube under the wing. The tube should have its leading edge 2" aft of the leading edge of the wingtip (though this may be moved forward as much as 3 inches on short chord wings to give clearance for aileron travel); it also must be aligned parallel to the long axis of the fuselage, must be at a 0 degree angle of attack compared to the chord line of the wingtip (tolerance: +1 degree, -0 degree), and must stand-off from the wing skin by 1 to 1.25" at the closest point of the wing's curvature. See photos.

After test fitting and marking a chordwise center line onto the cuff's bottom skin for alignment purposes, use a small amount of 5-minute epoxy to attach the 1" wide, pre-carved foam stand-off to that line. Let dry. Sand the outside surface of the 3.005" tube. Trial fit the tube to the underside of the foam block, aligning it as above. Trim the trailing edge of the foam so that it ends about 2" forward of the trailing edge of the tube. Then, use 5-minute epoxy to attach the 3.005" tube, using a suitable angle measurement device, to the foam block to provide the 0 degree angle of attack as above, making sure that the leading edge of the 3.005" tube is 2" aft of the wingtip leading edge. Let the attachment harden thoroughly before any further work (about 30 minutes minimum).

Perform the same fitting of the 3.005" tube to each wingtip cuff. Leave the cuffs on your wing and sand the foam as needed to get the shape in the photos at the leading edge and trailing edge areas. Shape this foam with sandpaper or file so that it tapers from the 1" thickness to a .1" thickness at its trailing edge. Shape it, using a foam scrap as a file, to have a sharp leading edge about .125" thick, which carries forward of the front of the 3.005" tube all the way to the leading edge of the wing. This sharp leading edge should taper smoothly as it goes aft to reach the full 1" web thickness. See photo.

Apply 4 layers of Rutan fiberglass cloth, wetted with EZ Epoxy II to the 3.005" tube, foam stand-off, and to the bottom of your wing cuff's skin so as to overlap onto the cuff by at least 2" all around the stand-off's base. Let harden thoroughly. Then, sand all surfaces and apply (by spraying, or brushing), a thick coat of suitable filler to all surfaces, again taking care to not allow the spray to get inside the tube. Sand this cuff smooth to 320 grit, refill to get desired smoothness and it's done! Optional: Paint it white with a good acrylic white enamel. See photos. We recommend performing all steps (except the final filler step) on the cuff with it still attached to your wing so as to prevent cuff warpage.

Please ship your finished cuffs to the CAFE Foundation at 4739 Hoen Ave., Santa Rosa, CA. 95405. (phone 707-544-2720). This will allow us to inspect and test fit our barograph in them in advance of your arrival here.
Other Flight Test Preparations Needed

A camcorder mounting bracket or sling located with its centerline 6” to the right of the pilot's right ear is needed. This mount requires a 1/4” hole for the tripod screw in the camcorder bottom.

One hole, about 0.312 “ diameter, is needed in the firewall for routing of the hose for our Manifold Pressure sensor. Our Manifold Pressure sensor requires a "T" fitting into the aircraft's induction system with an 1/8" i.d. hose routed through the firewall and to the area behind the pilot's seat. Hobby store model airplane silicone fuel hose is ideal for this. The hose should be plugged when not in use. Please provide a service loop of about 3 feet length in this hose to coil behind the pilot's seatback.

We also need a “T” fitting with a 3/32 barbed outlet installed into both your pitot line hose and another one into your static line hose in an easily accessible place in the cockpit so that we can measure your pitot and static pressure on our backup Barograph. Make sure that these "T" fittings are blocked off with a secure cap before flight.

Please do not arrive at our test facility with full fuel, since one of the first things we have to do is drain all fuel to obtain the empty weight. If draining requires special tools, please bring them.

Please also provide: c.g. envelope, datum and sample calc’s, P.O.H., valid airworthiness certificate, copy of BFR and annual inspections from pilot and aircraft logbooks. We also need design data including: airfoil, wing area, prop specs, fuel and baggage capacities, design airspeeds Vx, Vy, Va, Vne, Vgear and valid aircraft insurance policy face sheet.

All of us at the CAFE Foundation look forward to working with you!!! Good Luck!