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ADDITIONAL Q2 DOCUMENTATION

TITLE	CONTENTS	DATE OF FIRST PUBLICATION
Q2 Pilot's Manual	Flight and maintenance manual includes normal and emergency procedures, weight and balance, check lists, detailed flying qualities descriptions, operating limitations, performance charts, first flight test procedures, pilot checkout procedures, and systems descriptions.	1 May, 1981
Quickie Newsletter	Published quarterly (Jan, April, July, and October); includes plans changes, builder tips, options, current and future developments, and dates and information on future seminars.	25 May, 1978
Q2 Information Package	Provides general information on the Q2, including performance, construction techniques, and a poster.	9 February, 1981
Quickie & Q2 Composite Materials Introductory Package	Provides an education in the techniques required in the building of a Q2. Includes a booklet, and sufficient materials for several suggested projects. Somewhat redundant with Chapter 3 of the Q2 Construction Plans.	8 April, 1981

DESCRIPTION AND INTRODUCTION

DESCRIPTION AND INTRODUCTION

The Q2 is a high performance, homebuilt aircraft. Its compact external size and extremely efficient design results in superb performance and unequalled fuel economy using a low horsepower engine. Inside, it provides side-by-side seating comfort for a pilot up to 6'8" tall and 250 lbs, plus passenger, as well as some baggage in the roomy compartment behind the seat. Its canard configuration was designed not only for performance, but to provide improved flying qualities and safety as compared to the conventional light plane.

The origin of the Q2 dates back to 1977. Although the Q2 has much in common with the QUICKIE, considerable progress has been made since that earlier effort. As a result, the Q2 has lower drag than any other two place aircraft available to the public. Likewise, it has proven to be the most fuel efficient two-place aircraft ever offered to the public.

The Q2's high-lift canard (forward wing) is fitted with a plain elevator that controls the aircraft's pitch attitude. The canard also serves as the main landing gear spring since the main gear is mounted on the tips of the canard. This feature results in a remarkably smooth ride as well as outstanding ground stability during taxiing, takeoff, and landing.

Roll capability is provided by ailerons on the inboard protion of the main wing.

Yaw control is provided by a rudder mounted on the vertical fin, and is actuated by conventional rudder pedals.

The pitch and roll capability is provided by a side stick controller in the center of the cockpit. This feature permits precise control of the Q2 while reducing pilot fatigue and cockpit clutter.

Optional dual controls provide the option of pilot checkout and instruction.

The tailwheel is actuated directly from the rudder pedals, without any springs, thus providing positive steering at all times while on the ground. Since the tailwheel is not raised on takeoff roll like other taildraggers, this positive steering is available until the aircraft is airborne, making for very safe takeoff and landing characteristics.

Even though the Q2 has low horsepower, it can outperform most general aviation aircraft while retaining unequalled fuel economy. The maximum speed is actually faster than most retractable gear aircraft, such as the Piper Arrow, and the fuel economy exceeds 60 miles per gallon.

The Q2 obtains this remarkable performance <u>without</u> resorting to retractable landing gear, without flaps, without turbochargers, and without variable pitch propellers.

Further, the Q2 was designed to be built by the inexperienced builder, so these Q2 Construction Plans and the Q2 kit contents have been developed for ease of construction. Construction time should require only 500 manhours spread over less than one year of the builders <u>spare</u> time, with no special tools required.

The composite structure of your Q2 provides some important advantages over conventional metal, wood, or fabric construction. It has been tested to loads far in excess of those required for FAA certification. Fatigue margins are higher. Contour is maintained underload, the structure does not "oil can," buckle, or distort. It provides excellent insulation and damps noise. It has no hidden joints, no water traps, and is far less susceptible to corrosion. It is easier to inspect, more redundant, and easier to repair. It is not susceptible to thermal stress due to temperature changes. Properly protected from UV, it has an unlimited life.

Perspective

The builder of an amateur-built aircraft is the manufacturer; he is responsible for quality control on all parts, all construction, and the conduct of his flight tests. While Quickie Aircraft Corporation is not the manufacturer of your aircraft, we do, through these plans and services, provide you with information about how our Q2 was built and what we feel is the best way for you to build a safe, reliable airplane. We do encourage you to build the airplane as shown on the plans because we have found that our airplane provides us with reliability and safety, and any problems that we experience with our aircraft are documented and reported in "The Quickie Newsletter". We have gone to a considerable effort in developing the design, the structure, and the systems, and proving their adequacy with appropriate tests.

If you modify the airplane and then ask us if your modification will work, we cannot give you an answer without conducting the appropriate tests and totally qualifying the modification. This would obviously be quite expensive. Our concern then, is that if your modification is not successful, and causes an incident or accident, this would be attributed to our design, the Q2. Because of this, we must insist that if you modify the airplane with any major change such as an aerodynamic change, primary structural change, or using a non-approved engine installation, that you call your airplane a different name, rather than a Q2. If you make a major change, you must consider yourself involved in <u>basic aircraft design and development</u>, an extremely <u>risky business</u>. As such it is not fair for us to be associated with any results of your development. We state this, not to discourage inventiveness and progress, but to release any connection of your new development efforts with our proven design, the Q2.

We are particularly concerned about individuals using alternate engines to power their Q2's. The Q2 was <u>designed</u> around the engine; any change would require an exhaustive test program to determine not only the new engine's suitability as an aircraft powerplant, but also its suitability as a Q2 powerplant.

These Q2 Construction Plans have been specifically designed to educate you in the construction materials, their use, and to guide you through each step of assembly in the most efficient manner possible. It is our intent to drastically reduce the non-completion rate* common to homebuilt aircraft. With that in mind, we have:

1. Preceded the plans with an education section intended to thoroughly acquaint you with the tools and materials, and how to use them.
2. Laid out the plans in a detailed, step-by-step format to answer the questions of "what do I do next?"
3. Provided all appropriate information to each step adjacent to the words.
4. Provided full-size templates, ready to cutout and use, to avoid the work and confusion associated with scaling up drawings.
5. Provided a complete kit from one source to eliminate time spent looking for materials.
6. Identified the difficult to build items, and included them (prefabricated and ready to install) with the basic Q2 Kit.
7. Set up our newsletter, "The Quickie Newsletter" as a continuing plans updating/correcting system.**

* Over 80% of homebuilt airplane construction projects started, are never finished and flown.

** Because plans updates occasionally are of a mandatory nature, a subscription to "The Quickie Newsletter" is <u>mandatory</u> for those building a Q2.

Building Sequence

The nature of the Q2 structure requires that a part be left alone to cure for a longer period of time than that required to build it. Thus, you will find that when following the step-by-step order, you will often find yourself out of work, waiting for a cure. In most cases,you can skip to another chapter and build another part while waiting. With a little planning and familiarity with the entire manual, you should be able to use all of your time productively.

Questions?

Please use the procedure detailed here if you do not understand something and need an answer. First of all, do not be concerned if you do not understand everything the first time you read through the plans. Many things that may not be obvious just reading the drawings, will be obvious when you have that portion of the airplane in front of you or have built a similar part in a previous chapter. Also, we will be able to help you better if you are looking at that portion of your airplane. So, do not ask for clairfication until you are really working on that particular chapter. We have found through our Quickie and Q2 experience that the majority of questions that the homebuilder asks are already answered somewhere in the plans. We have made considerable effort in the Q2 Construction Plans to make the information visible. If you do not understand something, study the words in the step, study the sketches and all related sections/views/ photos, then look through the fullsize drawings and components that show that portion of the airplane. If the answer is still not found, it may be that the item is covered in detail in another chapter (there is some necessary overlap). It is possible that a question related to the operation of a part of the airplane or its maintenance is answered in your Q2 Pilot's Manual. Also, check your back issues of "The Quickie Newsletter" for plans updates or clarifications. OK, if you have checked everything and you are still stumped, you can do one of three things:

1. Ask a friend. Often a description of an item is unclear to one individual and clear to another.
2. Write to Quickie Aircraft Corporation, leaving room on the paper under each question for our answer. INCLUDE A SELF-ADDRESSED, STAMPED ENVELOPE and INCLUDE YOUR AIRCRAFT SERIAL NUMBER. We do our best to answer all such questions within two days of receipt. We cannot answer questions regarding the application of non-recommemded materials or regarding non-approved modifications.
   Quickie Aircraft Corporation
   P.O. Box 786
   Mojave, CA 93501
3. Call Quickie Aircraft Corporation:
   805-824-4313

Also, let us know if you have found a better way of doing something. If we agree, we'll publish it in "The Quickie Newsletter" so that all Quickie builders can benefit. If it is not a good idea, we'll tell you why, if you include a self-addressed stamped envelope.

Do keep us up to date on the progress of your project. Send us a black and white snap shot of your airplane for publication in "The Quickie Newsletter". Photos in the newsletter are particularly beneficial if they are of an area of the airplane that's not clearly shown with photos or sketches in the plans. Remember, the primary purpose of "The Quickie Newsletter" is to support your airplane project.

If you are not a member of The Experimental Aircraft Association (EAA), do join. This is the only organization who looks out for the homebuilder as far as FAA regulations are concerned. Membership in your local EAA can be extremely beneficial both in building your airplane and in meeting people who share your interests. Their monthly publication, "Sport Aviation," is worth the membership fee in itself.

EAA
Box 229
Hales Corners, Wisconsin 53130

EAA often publishes reports on builder's projects, so send them photos and some words on your progress.

FAA LICENSING PROCEDURES

This procedure applies in the U.S.A. only. The Federal Aviation Administration (FAA) has a definite procedure for registering and licensing homebuilt aircraft. There is nothing complicated about it, but they insist that you follow each step carefully.

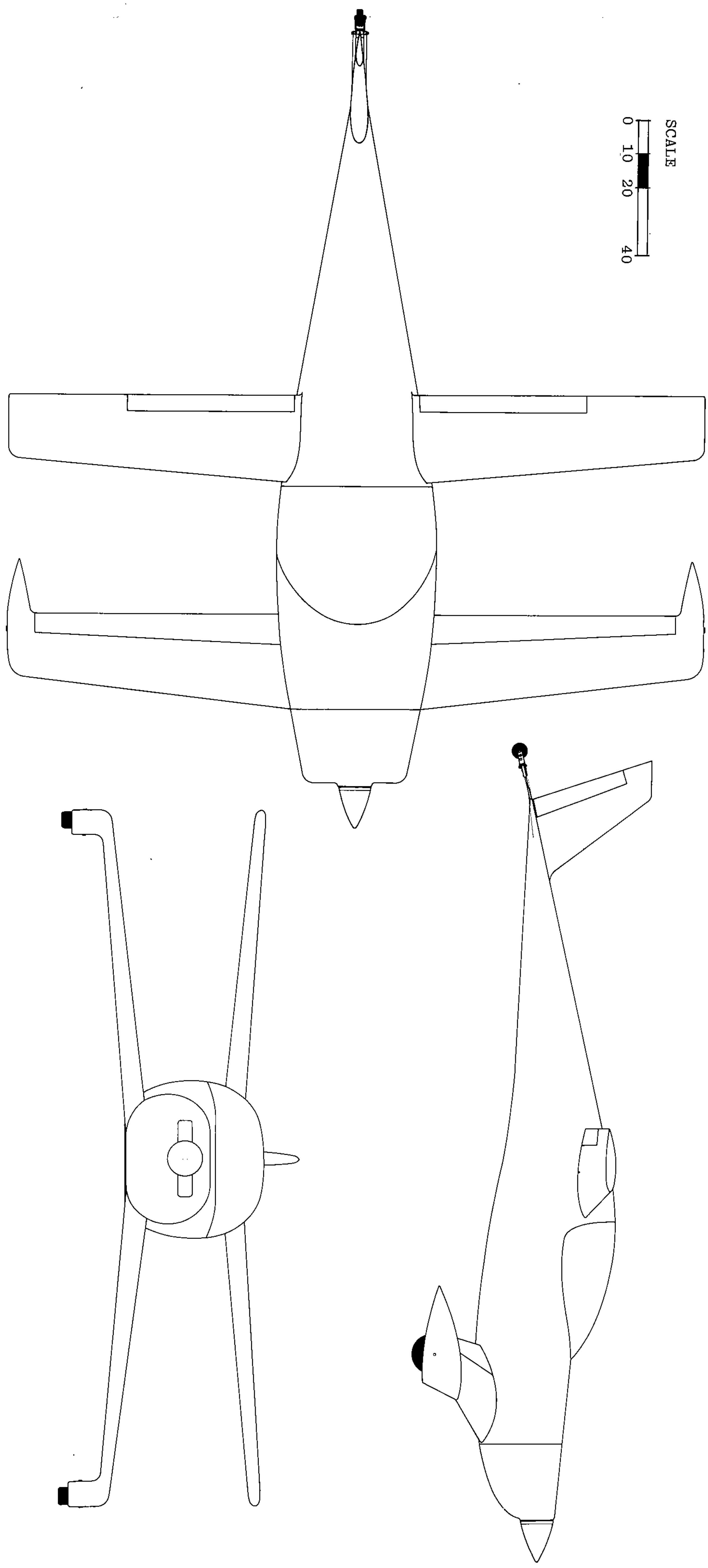
1. Contact your local FAA Engineering and Manufacturing District Office or FAA General Aviation District Office. Tell them you are building a Q2 homebuilt. Give them the following information:
   - 3-View drawing of the Q2
   - Aircraft serial number
   - Aircraft registration number, if available (see step #2)
   - Approximate date of starting construction
   - Engine-type

   FAA will then answer you, and tell you when they want to inspect your airplane, where the approved test areas are, etc.
2. This step is optional, and applies only if you want to reserve a specific registration number (the number you will paint on the tail). You can ask for all numbers, numbers followed by a single letter, or numbers followed by two letters. They are preceded by the letter "N". (For example, N77Q, N8490P, etc.). Be sure to give them your second and third choice, in case the number you want is already taken. Send $10 to reserve your special number to:
   FAA Aircraft Registry
   Box 25082
   Oklahoma City, OK. 73125

   Do not register your aircraft yet, since you don't need to pay registration fees, property taxes, etc., until your airplane is ready to fly. If you do not desire a special number, then the FAA will assign you a random number.
3. When you are ready for inspection* contact your local FAA office. Be sure you have an airframe log book (available from EAA) so that FAA can make an inspection entry.
4. To prepare for your final inspection, be sure you have: The "N" number painted on, the "Experimental" sign (2" high letters) on the canopy frame, the ID plate, and an airframe log book and an engine log book.

   Before final inspection, fill out an application for registration (FAA form #AC8050-1), a notarized affidavit that you built the airplane from parts that you bought yourself, and include $5 registration fee, along with copies of your sales agreement and invoice signed by Quickie Aircraft Corporation. Send those things tp:
   FAA Registry
   Box 25082
   Oklahoma City, OK 73125
5. After you have made a final inspection of your aircraft, run the engine, etc., but prior to any taxi tests or flights, contact your local FAA office and tell them you are ready to fly. They will have you fill out an application for airworthiness (form #8130-6), inspect your airplane, and issue you an airworthiness certificate and a list of operating limitations. When you have completed your initial test period, contact FAA to get your operating limitations amended so you can fly outside your test area.

* Refer to education section - inspection is done to major areas (wing, canard, and fuselage) after the glass is applied, but before the area is painted with any primer, etc., so that the glass structure can be inspected. The FAA office has been supplied with the same inspection criteria that you are given in your Composite Materials Education Chapter.



END OF CHAPTER

BILL OF MATERIALS

TOOLS

There are certain tools which are necessary to complete the aircraft. Three lists of tools are provided here. The first is the absolute bare minimum required, sacrificing efficiency; the second is a recommended list for the best compromise of cost and work efficiency; the third is a list for the "Cadillac" of shops where ease of construction is more important than money. The non-common items are stocked by Aircraft Spruce and Specialty.

FIRST LIST - BASIC REQUIRED TOOLS

- Common household butcher knife
- Coping saw
- 1/4" drive socket set
- Small open-end wrenches
- Sandpaper
  - 50 sheets, 40-grit, 3M Production Paper D-wt.
  - 50 Sheets, 80-grit, 3M Production Paper D-wt.
  - 20 sheets, 240-grit, 3M Wet or Dry Tri-M-Ite Paper A-wt. Silicon Carbide Waterproof.
  - 20 sheets, 320-grit, 3M Wet or Dry Tri-M-Ite Paper A-wt. Silicon Carbide Waterproof.
- Small Weights - Approx. 150 lbs in 5-15 lb pieces
- 6 - 6" C-Clamps
- Square and half-round files
- Pliers
- 1" putty knife
- Hacksaw
- Blade & Phillips screwdrivers
- Box of single-edge razor blades
- 24" carpenter's level
- Carpenter's square
- Felt marking pens
- 3-ft straightedge
- 12-ft decimal steel tape (Stanley #61-112)
- 1/4" drill with set of fraction and number bits, #30, #32, #10, 1/4" and #12 bits
- Taps; 1/4-28, 10-32, 1/8 NPT (Pipe Tap)
- Roll of grey duct tape
- Sabersaw
- Cheap holesaw set or flycutter
- Pop rivet puller
- Homemade balance for rationing epoxy
- Wall thermometer 50 to 100°F
- 6-ft straightedge
- Small set of X-Acto knives
- Dremel-type miniature high-speed hand grinder with saw and router bits

SECOND LIST - RECOMMENDED TOOLS (In addition to those in the first list

- 6" to 9" disc-type hand sander
- Set of 1/4", 1/2" and 1" chisels (wood)
- 1/2"-dia 100° counter sink (piloted)
- 6" machinist steel ruler
- X-Acto razor saw
- 3/8" variable-speed hand drill
- Hand broom/brush
- Bench-mounted belt sander
- Stanley surform plane
- Vacuum cleaner (shop type)
- Dovetail saw
- Epoxy Ratio Pump
- Plumb bob

THIRD LIST - FOR THE FIRST CLASS SHOP (In addition to those in the first and second list

- Drill press
- 18-inch bandsaw
- Vernier Caliper
- 90° drill adapter
- Air compressor with blow nozzle
- Orbital sander
- Nicopress sleeve tool
- Clecos - one dozen 1/8"
- Hotwire Voltage Control

ITEMS USED ONLY OCCASIONALLY AND CAN BE BORROWED

- 1 dozen 1/8" Clecos
- Hotwire Voltage Control
- 5/8" Spotface

PACKING LISTS

Upon receiving your Q2 kit, you should immediately match the packing list in each shipment against the actual contents of each box. Any descrepancies should be reported immediately to Quickie Aircraft Corporation. We will not be responsible for shortages that go unreported for longer than 30 days after receipt of the materials.

Quickie Aircraft Corporation maintains a close liaison with Q2 subcontractors to assure proper materials specification and quality control. Do not make substitutions for the materials provided. The materials provided were selected, developed, tested, and optimized for ease of construction and structural integrity. If you insist on making non-approved substitutions for replacement and spoilage, we insist that you do not call your aircraft a Q2. Quickie Aircraft Corporation will not provide assistance in the application of substitute materials or components.

In addition to the materials provided in the kit, you will need to furnish a few items that are readily available locally. We do this to save you some money. These items are as follows:

- Lumber for a workbench and jigging
- Masonite, hardboard, plywood, etc. for jigging templates, rigging templates, and hot-wire templates
- 12" piece of 1/4" diameter wood dowell
- 6" x 6" piece of aluminum screen door screen
- Battery for electrical system
- Finishing materials: Dupont 70S dark gray laquer primer surfacer, Acrylic laquer paint in the color of your choice
- 1 piece shock cord, 3-4" unstretched length

END OF CHAPTER

COMPOSITE MATERIALS EDUCATION

DON'T SKIP THIS SECTION. Every hour you spend in this preparation section will save you five when you really start building your aircraft.

INTRODUCTION

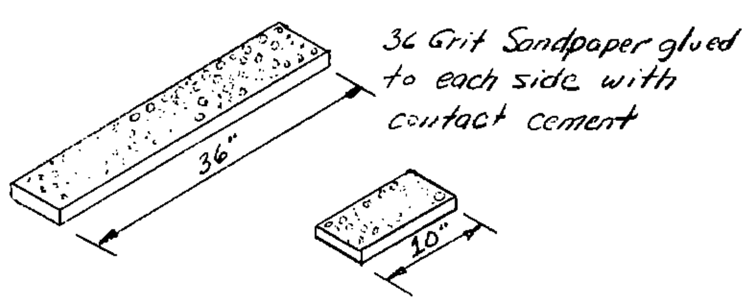
In this section you won't build any part of your airplane. What you will do is learn how to build your airplane the right way. The construction techniques may be radically different from anything you've done before (including building boats, surfboards, airplanes, and gocarts), and you should assume there is only one correct way to do it. We've discovered many wrong ways of doing things and have written the plans to keep you from repeating our mistakes. We insist that you do things our way. If you have a better idea, suggest it to us; we'll test, and if it really is a better idea we'll publish details in the Quickie Newsletter.

This section will teach you all of the techniques required to build your airplane, show you what special tools you need, and how to use them. The educational samples that you will build in this section are designed to give you experience and confidence in all of the techniques that you will use in the construction of your airplane. The steps in construction of each sample are arranged in sequence (as are the steps in construction of the actual aircraft parts) and you should follow the sequence without skipping any steps. You will learn the basic glass layup technique used throughout the aircraft, special corner treatments, foam shaping/cutting, and joining methods. A summary of these techniques is provided on yellow paper for you to tack up on your shop wall.

THE FOLLOWING TOOLS ARE ONES YOU MAKE:

Sanding Blocks

These are required in many areas during construction and for finishing. You may also use a "soft block", which is a block of the blue-white or orange styrofoam wrapped with sandpaper.



Much elbow grease is saved if you replace the sandpaper often.

Long Straightedge

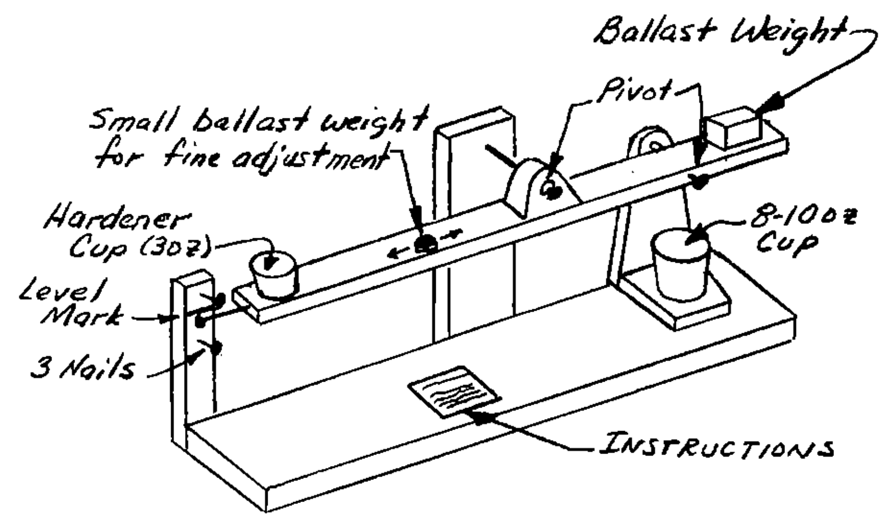
This is not absolutely required, but is quite handy when jigging or checking the straightness of flying surfaces. It is merely a 6-ft or 8-ft 1x3 or 1x4 piece of lumber that is hand-selected to be "eyeball straight". You can get it one of two ways: (1) Order it from Aircraft Spruce & Speciality Co., or Wicks Aircraft Supply - they plane them perfect from dry lumber. (2) Sort through the lumber (dry fir or redwood) at your local lumber yard until you find one that looks straight when you eyeball it from one end. Mark it and hang it on the wall so it doesn't end up as part of a shelf!

Epoxy Balance

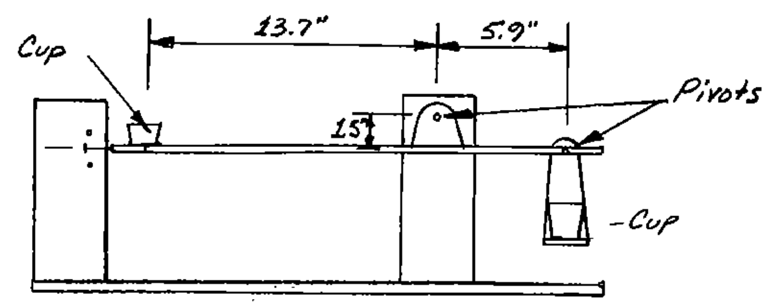
Devices which automatically ratio the correct amount of resin and hardener and dispense it with the pull of a lever are available from Aircraft Spruce & Speciality Co., and Wicks Aircraft Supply, for approximately $150. These save time and epoxy. You can ratio the epoxy by building the following simple balance - don't skip steps!

Follow each step exactly every time you mix epoxy.

1. Place both empty cups as shown (wet the hardener cup).
2. Adjust ballast weight to level mark.
3. Fill resin cup with desired amount of resin - 1 to 6 oz.
4. Add hardener to hardener cup to balance scale on level mark.
5. Pour the hardener into the resin cup and mix.



Pivots - metal tube bushings in wood. Loose fit on nails. The 1/8" dia brass tube available at hobby shops is excellent for the bushings. MUST BE FRICTION-FREE.

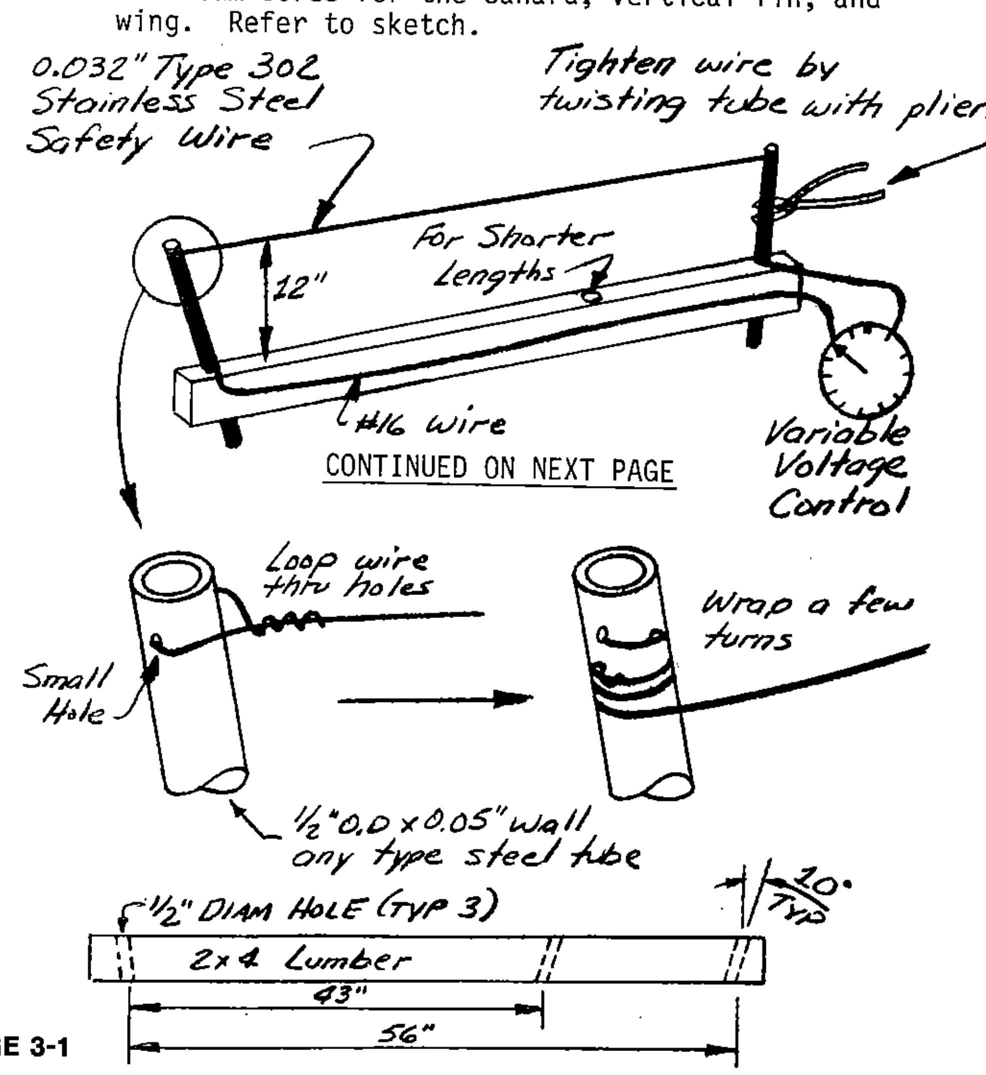


These ratios result in a 43-part hardner to 100-part resin mix.

RATIO BALANCE FOR RESIN/HARDENER
1. Place both empty cups as shown. (Wet the hardener cup).
2. Adjust ballast weight to level mark.
3. Fill resin cup with desired amount of resin - 1 to 6 oz.
4. Add hardener to hardener cup to balance scale on level mark.
5. Pour the hardener into the resin cup and mix.

Hot Wire Cutter

You will need a hot wire cutter to carve all the foam cores for the canard, vertical fin, and wing. Refer to sketch.



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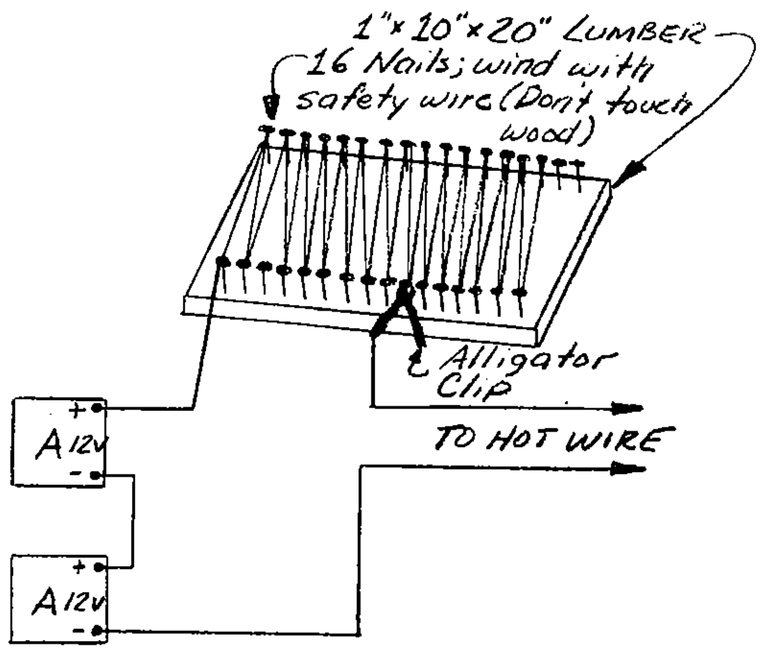
The variable voltage control can be obtained from Aircraft Spruce and Specialty or Wicks Aircraft Supply, or you can substitute any controllable power supply to include the 14 to 20 volt range with at least 4 amp capability. An alternative is to borrow two 12-V battery chargers or auto batteries and lash up the following device. The "A" blocks represent either a battery or a 12-V dc battery charger with a 4 amp capability.



Note: Alligator Clip: move to right to cool wire, move to left to heat wire.

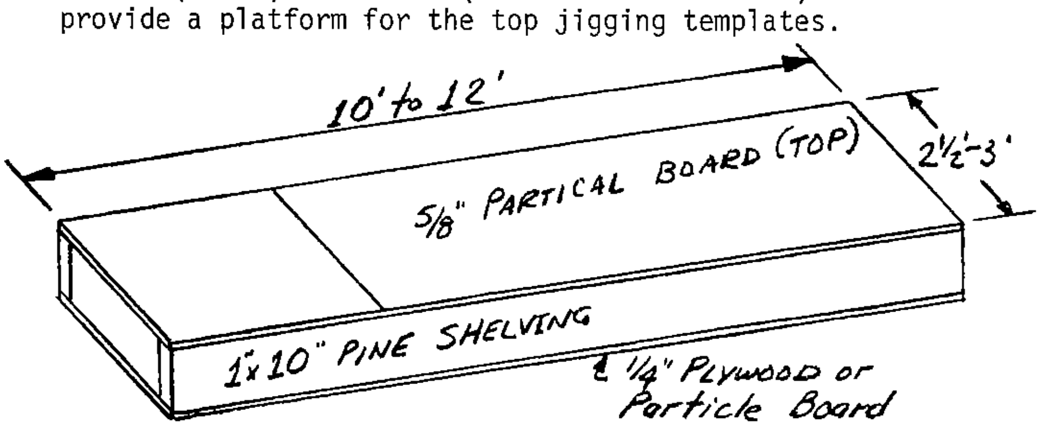
The cutter should only be used on the blue-white or orange styrofoam. A hazardous gas is emitted if you try to cut urethane.

You can substitute .025 nicrome wire which can be run at a lower current (about 2 amp) but nicrome wire is difficult to find. Adjust the current to obtain a wire temperature which will allow the wire to cut the foam at a rate of one inch every four to six seconds when pulled with a light load (less than ½ pound). This can be checked with a small scrap of foam. If temperature is correct, the foam will have smooth hairy surface. A cratered surface means too much heat. If the wire is too cold, the cutter will have to be forced hard, causing the wire to lag. Lag should not exceed ½ inch over the top and bottom of the wing and not over 1/8 inch around the leading edge. If the wire is too hot, it will burn away too much foam, making the part too small and will result in ruts in the foam if the wire is inadvertently stopped during cutting. The wire should be tightened until the wire starts to yield. Check this by tightening the wire while plunking it, listening to the sound. The pitch will increase until the wire yields.

Jig Table

You will need a table to jig and build the wings and canard. It should be at least 2 ft by 10 ft. Any larger than 4 ft. by 12 ft. will just get in the way. Use a little care in making a flat, untwisted surface. The following is a sketch of the one we made and it works fine. The box design makes it stiff in torsion. Set it up with the top 35 to 39 inches above the floor. Don't get carried away with surface finish, since you are going to be gluing blocks to it with Bondo and chiseling them off several times.

When building the wing and canard, which are nearly 17 ft long, one can extend the jig table with lumber (2x4's) and Bondo (see section on Bondo) to provide a platform for the top jigging templates.



JIG TABLE

MATERIALS

The materials, processes, and terminology used in the construction of your Q2 are recent to homebuilding. This section is devoted to familiarizing you with the language, materials, and techniques used in these plans. This information is basic to the construction of your airplane. You should study this section and be sure that you understand all of it before continuing.

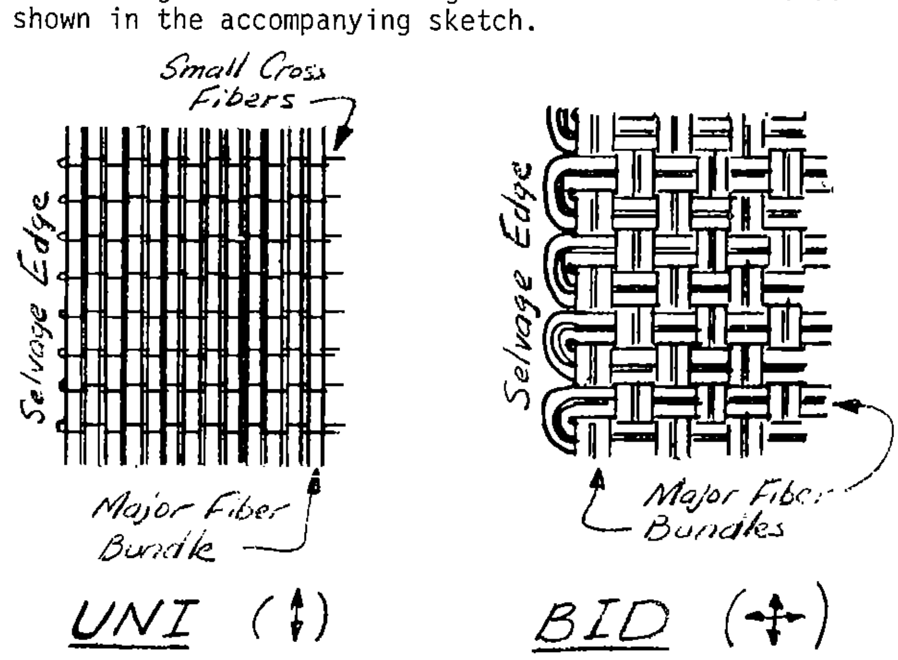
There are five basic materials that you will be working with: fiberglass cloth, epoxy, microspheres, flox, and foam. Each material, its properties, and uses, will be discussed in detail. Basic processes using these materials will also be discussed.

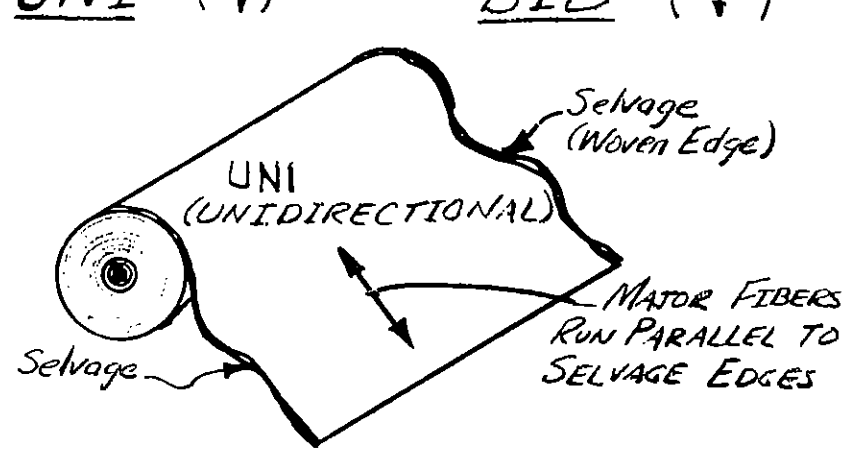
Fiberglass Cloth

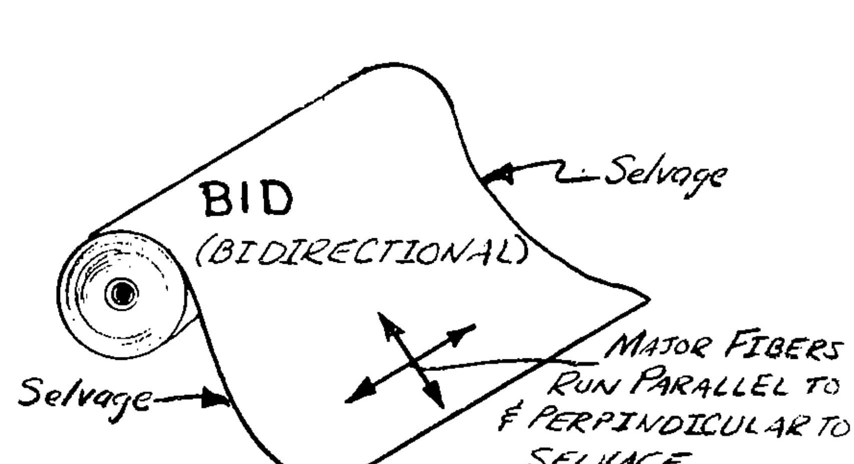
The most basic structural material in your Q2 is glass cloth. Glass cloth is available commercially in hundreds of different weights, weaves, strengths, and working properties. The use of glass in aircraft structures, particularly structural sandwich composites, is a recent development. Very few of the commercially available glass cloth types are compatible with aircraft requirements for high strength and light weight. Even fewer are suitable for the handlayup techniques used in the Q2. The glass cloth used in the Q2 has been specifically selected for the optimum combination of workability, strength, and weight.

The glass cloth in your Q2 carries primary loads, and its correct application is of vital importance. Even though doing your glass work correctly is important, this doesn't mean that it is difficult.

Two types of glass cloth are used, a bi-directional cloth (5277BID), and a unidirectional cloth (5177UND). (Use the full part number for ordering your cloth, but for simplicity the plans will use only BID or UNI designations). BID cloth has half of the fibers woven parallel to the selvage edge of the cloth and the other half at right angles to the selvage, giving the cloth the same strength in both directions. The selvage is the woven edge of a bolt of fabric as shown in the accompanying sketch.







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UNI cloth has 95% of the glass volume woven parallel to the selvage giving exceptional strength in that direction and very little at right angles to it.

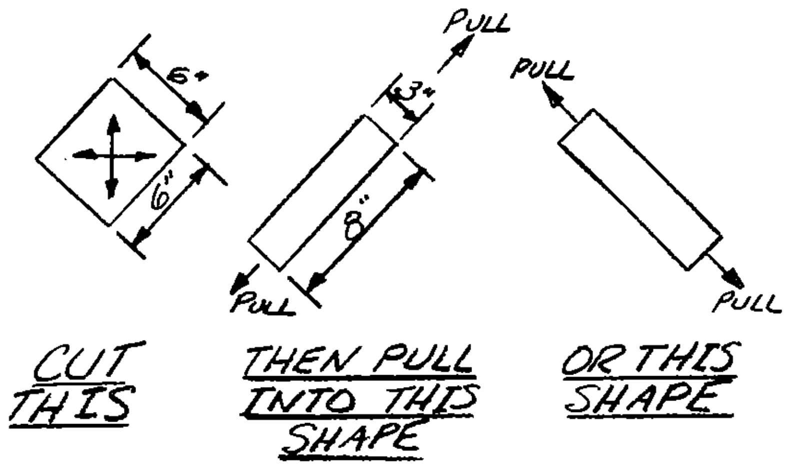
BID is generally used as pieces which are cut at a 45-degree angle to the selvage and laid into contours with very little effort. BID is often applied at 45 degree orientation to obtain a desired torsional or shear stiffness. UNI is used in areas where the primary loads are in one direction, and maximum efficiency is required, such as the wing skins and spar caps.

Multiple layers of glass cloth are laminated together to form the aircraft structure. Each layer of cloth is called a ply and this term will be used throughout the plans.

Marking and cutting the plies of glass cloth is a job that you will repeat often in the construction of your Q2. Glass cloth should be marked, cut, and stored in a clean area with clean hands and clean tools. Glass contaminated with dirt, grease, or epoxy should be discarded. A clean, smooth surface is needed for marking and cutting. The area used for storing and cutting glass cloth should be separated from the aircraft assembly area because otherwise it will be exposed to foam dust, epoxy, and other things which can contaminate the cloth. You will need a good sharp pair of scissors, a felt-tipped marker, a fairly straight board, and a tape measure for marking and cutting. The small amount of ink from marking and numbering plies has no detrimental effects on the glass cloth.

In each step the size, type, and fiber orientation of each ply is given. Take the list to your glass cutting table, roll out a length of the appropriate cloth, straighten the selvage, mark all of the plies, and cut them.

Now is a good time to stop reading long enough to go and cut a square ply of BID and see how easy it is to change its shape by pulling and pushing on the edges as shown in the sketches. Cut a square with the fibers running at 45° and pull on the edges to shape the piece.



It helps if you make fairly straight cuts, but don't worry if your cut is within ½ inch of your mark. As you cut BID, it may change shape, just as the square ply that you are experimenting with does when you pull on one edge. Plies that distort when cut are easily put back into shape by pulling on an edge. Rolling or folding cut plies will help keep them clean and make it easier to maintain their shape. If several plies are called for, it may help to number them before cutting. Save your clean scraps and make an effort to use them for smaller plies. If the cloth is spotted with epoxy, throw it away.

When cutting long strips or large pieces of 45-degree BID, always roll or fold it so it keeps its shape when handled. When it's applied, it can be set on one end of the part and rolled onto it. If you pick up each end, it will distort and not fit the part properly.

The fiber orientation called for in each lamination is important and shouldn't be ignored. UNI is characterized by the major fiber bundles running parallel to the selvage and being much larger than the small cross fibers which run at right angles to the selvage. In BID the cross fibers are the same size as those running parallel to the selvage, giving BID an even "checkerboard" appearance. BID is commonly used for plies cut at 45° to the selvage. Your tailor would call this a "bias" cut. The 45° cut makes it easy to work wrinkles out of a ply locally, without having to chase it to the far edge. The 45° cut also makes it possible to make a ply slightly longer than originally cut by pulling on the ends, or wider by pulling the sides. The 45° orientation isn't critical; you don't need to measure it. Your eyeball of a rough diagonal (45° ± 10°) is adequate when either cutting or laying up the cloth.

EPOXY

In recent years the term "epoxy" has become a household word. Unfortunately, "epoxy" is a general term for a vast number of specialized resin/hardener systems, the same as "aluminum" is a general term for a whole family of specialized metal alloys. Just as the "aluminum" pots and pans in your kitchen, the "epoxy" in your Q2 is vastly different from the hardware store variety.

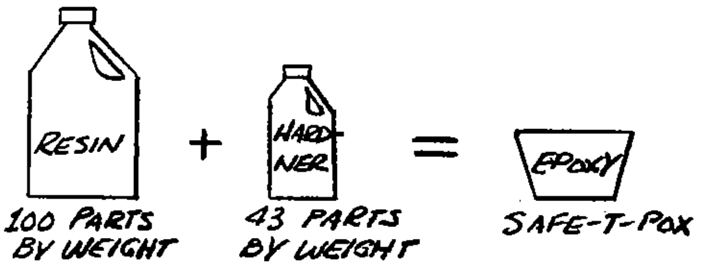
Epoxy is the adhesive matrix that keeps the plies of load-carrying glass cloth together. Epoxy alone is weak and heavy. It is important to use it properly so that the full benefits of its adhesive capability are obtained without unnecessary weight. A large portion of your education in composite structural work will be spent learning how to get the full strength of an epoxy/glass mixture with the minimun weight. This section will discuss the terminology and techniques for working with epoxy resin and its hardener.

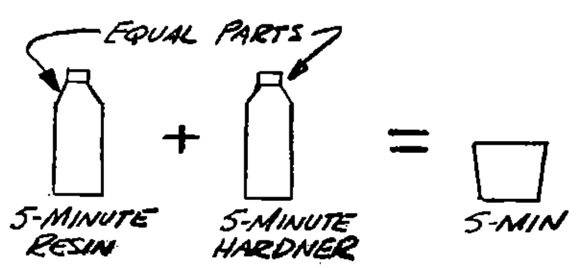
An "epoxy system" is made up of a resin and a hardener tailored to produce a variety of physical and working properties. The mixing of resin with its hardener causes a chemical reaction called curing, which changes the two liquids into a solid. Different epoxy systems produce a wide variety of solids ranging from extremely hard to very flexible. Epoxy systems also vary greatly in their working properties, some are very thick, slow pouring liquids and others are like water. Some epoxy systems allow hours of working time and others harden almost as fast as they are mixed. A single type of resin is sometimes used with a variety of hardeners to obtain a number of different characteristics. In short, there is no universal epoxy system; each has its own specific purpose and while it may be the best for one application, it could be the worst possible in another use.

The epoxy systems used in the construction of your Q2 are tailored for a combination of workability and strength, as well as to protect the foam core from heat damage and solvent attack. These systems are very low in toxicity to minimize epoxy rash. The epoxies are not similar to the common types normally marketed for fiberglass laminating. Two different systems are used in the Q2: a normal curing system, and a 5-minute system. The very fast curing (5-min.) system is used much like clecos are used in sheet metal construction (or clamps in woodwork); for temporary positioning. Five-minute is also used in some areas where high strength is not required, but where a fast cure will aid assembly.

Safe-T-Pox will cure to a firm structure at room temperature within one day. Complete cure takes 14 days.

The Q2 epoxy systems are called Safe-T-Pox and 5-MIN.





Any foam bonding where parts are small and the fast cure allows the next step to be done soon. Also used as a temporary joint for jigging.

CONTINUED ON NEXT PAGE

The working and strength characteristics of an epoxy system are dependent on the resin, the hardener, and on the amount of each in a given mixture. Epoxy systems are engineered for a specific ratio of resin and hardener. It is quite important that the proper mixture be obtained. An accurate balance or ratio pump must be used to accomplish this. A drawing of an inexpensive ratio balance is included in these plans. The mix ratio accuracy is particularly important with Safe-T-Pox. The 5-Min. can be adequately rationed by merely pouring a blob of part A in a cup and adding a blob of part B that looks the same volume before mixing. Never eyeball estimate Safe-T-Pox, always carefully use the balance or pump.

Epoxy resin and hardener are mixed in small batches, usually 6 ounces or less, even in the largest layup. The reason for small batches is that, in large batches, as the hardening reaction progresses, heat is generated which speeds the reaction, which causes even more heat, which ends up in a fast reaction called an exotherm. An exotherm will cause the cup of epoxy to get hot and begin to thicken rapidly. If this occurs, throw it away and mix a new batch. The small volume batch avoids the exotherm. For a large layup, you will mix many small batches rather than a few large ones. With this method you can spend many hours on a large layup using epoxy that has a working life of only a few minutes. If the epoxy is spread thin as in a layup its curing heat will quickly dissipate and it will remain only a few degrees above room temperature. However, in a thick buildup or cup, the low surface area to mass ratio will cause the epoxy to retain its heat, increasing its temperature. This results in a faster cure causing more heat. This unstable reaction is called an exotherm. Exotherm temperatures can easily exceed the maximum allowable for foam (200°F) and damage the foam-to-glass bond.

Unwaxed paper cups are used for mixing and ratioing resin and hardener. Convenient 8-oz cups for resin are provided. The hardener cups are the 3-oz unwaxed bathroom paper cups. Don't use waxed cups; the wax will contaminate your epoxy.

If you are using the homebuilt balance, follow this procedure. Place the resin (8 oz) cup on the right cradle. The resin cup can be either a new clean cup, one with a little uncured epoxy left in the bottom, or a clean cup from a previous layup with hard epoxy in the bottom (smooth, not lumpy). Now, take a clean 3-oz hardener cup - pour a splash of hardener into it then scrape the hardener back into the container. This gives the hardener a wet surface, so its remaining hardener will not be counted in the balancing. Now, place the wet hardener cup on the scale, check that it swings freely and balance it perfectly by moving the small weight. Epoxy is then poured into the 8 oz cup (6 oz or less). Hardener is then poured into the 3 oz cup at the other end of the balance until the arm is level. When ready to mix, pour the hardener into the resin cup and mix completely. If you have the ratio pump, you simply put one cup under the spout, pump out the amount that you want, and mix.

Mixing is done by stirring with a stick, being careful not to spill any. If you spill part of an unmixed cup, the ratio of resin and hardener may be inaccurate and it shouldn't be used. Mix each cup for at least two minutes. You should spend 80% of your mixing time stirring the cup and 20% scraping the sides to assure complete mixing. Do not mix with a brush. The bristles can soak up the hardener, changing the ratio. Use a tongue depressor or wood stick.

The working temperature has a substantial effect on the pot life and cure time. Very hot conditions will cause the cure to speed up. In cold working conditions the cure will be delayed and if it is cold enough, epoxy may not cure at all. Working temperatures must be between 70° and 90°F. A range of 75 to 80°F is best. Be sure to get a wall thermometer (approx. $1.50 at any general store) to check the temperature of your work area. At 75°F, 5-Min must be used within four minutes, and Safe-T-Pox must be used within 20 minutes.

Cold epoxy results in increased time required to do a layup, since it takes longer to "wet" and to squeegee the cloth. A layup at 65° may take almost twice the time as at 75°F. On most layups (except for joining foam cores) its best to have 75 to 80°F room temperature and 80 to 90°F epoxy. Resin and hardener can be kept warmer than room temperature by keeping it in a cabinet with a small light bulb on. DO NOT store your resin or hardener on a cold floor if you plan to use it within the next several hours. If you let your shop get cold between working periods, keep some resin and hardener in the warmest place of your house for use on the next layup.

Save your mixing cups, as they can be used as a quality check of your epoxy. After a day or two take a sharp knife point or scribe and scratch the surface of epoxy in the cured cup. If the epoxy cured properly, the scribe will make a white scratch mark. If the epoxy hasn't cured, the scribe will make a dull ridge, indicating a soft surface. If this occurs, the epoxy has not cured, either due to inadequate time or temperature, or bad mixing, or bad epoxy.

MICROSPHERES

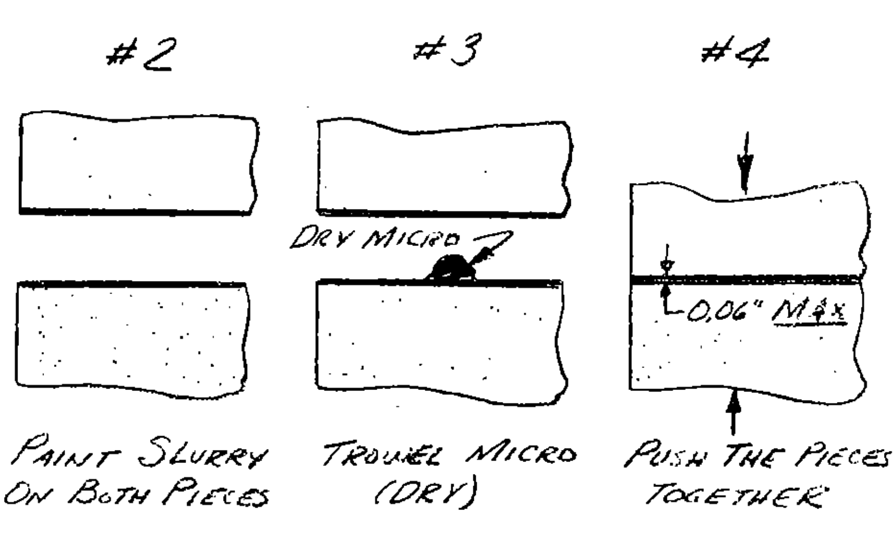
Microspheres are a very light filler or thickening material used in a mixture with epoxy. Micro, as the mixture is called, is used to fill voids and low areas, to glue foam blocks together, and as a bond between foams and glass skins. The glass bubble-type supplied is lighter than most common types. Microballoons must be kept dry. If moisture is present it will make them lumpy. Bake them at 250°F; then sift with a flour sifter to remove lumps.

Micro is used in three consistancies; a "slurry" which is a one-to-one by volume mix of epoxy and microspheres, "wet micro" which is about two-to-four parts microspheres by volume to one part epoxy, and "dry micro" which is a mix of epoxy and enough microspheres to obtain a paste which will not sag or run (about five parts-to-one by volume). In all three, microspheres are added to completely mixed epoxy.

You do not have to accurately mix the microspheres; just dump them in until the desired consistancy is obtained. Micro slurry is used to paint over foams before glass cloth is applied over them. Slurry is almost the same viscosity as the pure epoxy and is runny enough to apply with a brush. However, the easiest way to apply slurry is to pour it onto the surface and spread it out evenly using a squeegee. When skinning urethane foam use a full thick coat of slurry. Inadequate slurry on urethane can result in a poor skin bond. Wet micro is used to join foam blocks, and, while it is much thicker than slurry, it is still thin enough to sag and run (like thick honey). Dry micro is used to fill low spots and voids and is mixed so that it is a dry paste that won't sag at all. In all three micro types, you don't measure, just add microspheres until the desired consistancy is obtained. Use micro only as specifically shown - never use micro between glass layers.

Always use the following method to join foam blocks. This is extremely important.

1. Check that the foam blocks fit closely together. If there are voids over 1/16 inch, sand to fit, or fill the void with a sliver of foam.
2. Paint a light coat of micro slurry on both surfaces. If joining foam to fiberglass, paint pure mixed epoxy (no microspheres) on the fiberglass surface and micro slurry on the foam surface.
3. Refer to the sketch and trowel wet or dry micro in the center of the joint. Thus when joined the micro is pushed outward expelling (rather than trapping) air. If the fit is excellent use dry micro.
4. Push the two pieces together, wiggling each to move the micro toward the surfaces. Be sure the micro is no thicker than 0.1 inch at any place, to avoid exotherm. Wipe off any excess. Do not be concerned if the micro does not completely reach the surface. That void can be filled immediately before skinning the part.



FLOX

Flox is a mixture of cotton fiber (flocked cotton) and epoxy. The mixture is used in structural joints and in areas where a very hard, durable buildup is required. Flox is mixed much the same as dry micro, but only about two parts flock to one part epoxy is required. Mix in just enough flox to make the mixture stand up. If "wet flox" is called out, mix it so it will sag or run.

When using flox to bond a metal part be sure to sand the metal dull with 220-grit sandpaper and paint pure mixed epoxy (no flox) on the metal part.

BONDO

Throughout these plans the term "Bondo" is used as a general term for automotive, polyester body filler. Bondo is used for holding jig blocks in place and other temporary fastening jobs. We use it because it hardens in a very short time and can be chipped or sanded off without damaging the fiberglass. Bondo is usually a dull gray color until a colored hardener is mixed with it. The color of the mixture is used to judge how fast it will set. The more hardener you add, the brighter the color of the mixture gets, and the faster it hardens. This simple guide works up to a point where so much hardener is added that the mixture never hardens. Follow the general directions on the Bondo can for fast setting Bondo. Mixing is done on a scrap piece of cardboard or plywood (or almost anything), using a hard squeegee or putty knife. A blob of Bondo is scooped out of the can and dropped on the mixing board. A small amount of hardener is squeezed out onto the blob and then you mix to an even color. You will mix the blob for about one minute. You will then have two to three minutes to apply it before it hardens.

Be sure to clean the board and putty knife off before the Bondo is completely hard. MEK will clean Bondo off your putty knife and squeegee if it isn't completely hardened.

PEEL PLY

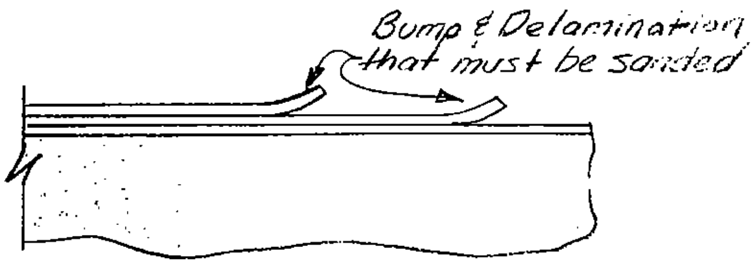
Peel ply is a layer of 2.7oz dacron fabric which is laid up over a fiberglass layup while the fiberglass is still wet, and is later removed by lifting an edge and "peeling" it off. The most convienient form of dacron to use is "surface tapes", normally used in covering fabric aircraft. These are available in rolls. You will need at least one roll, 2" wide. Peel ply is used for two purposes:

(1) Peel ply any area that will later be structurally attached to another fiberglass layup. Once the dacron is peeled off, the surface is ready for another layup, without sanding. If you do not use peel ply, you will have to sand the surface completely dull (no shiny spots). This sanding is hard, itchy work and ruins the strength of the outer ply of fiberglass.

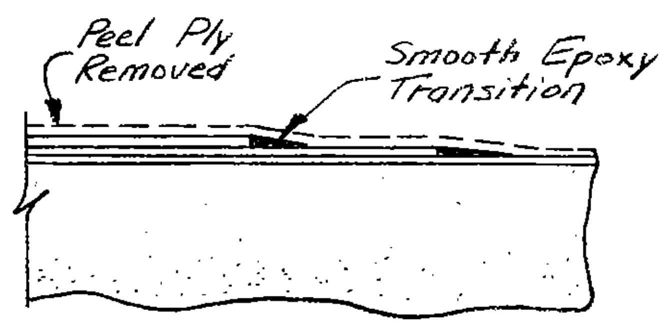
Note that to peel ply the trailing edge overlap area, the peel ply is the First ply made to the foam core. Lay a strip of dacron down on the overlap notch and secure it with tacks or staples so it doesn't move when you layup the skin.

(2) The second use for peel ply is to transition the area where the top ply of a layup terminates on the fiberglass surface.

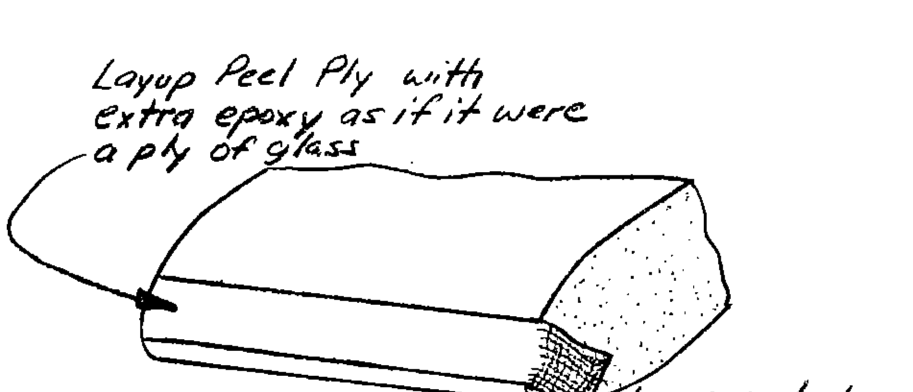
Refer to the adjacent sketches. If the top ply edge is laid up bare it results in a rough edge that can delaminate if a little dry. Sanding the rough edge is hard, itchy work and usually results in damaging the adjacent surface. If the edge is overlaid with a strip of dacron during the layup (lay on the dacron and wet out by stippling or squeegeeing) it will make the edge lay down flat and will form a wedge of epoxy to smoothly transition the edge. After cure, peel off the dacron. The result is a beautifully transitioned smooth edge with no delamination tendency. Use this method in all places where a cloth edge terminates on the surface.



NO PEEL PLY



WITH PEEL PLY



EXAMPLE: PEEL PLY ON LEADING EDGE

FOAM

Three different types of rigid, closedcell foam are used. A low density (nominally 2 lb/ft3) blue-white or orange, large-cell styrofoam is used as the foam core of the wing, canard, vertical stabilizer, and control surfaces. The blue-white or orange foam is exceptional for smooth hot wire cutting of airfoil shapes. The large cell type used provides better protection from delamination than the more commonly used insulation-grade styrofoams.

Low density 2 lb/ft^3 green or light tan urethane foam is used because it is easy to carve and contour, and is completely fuel proof. The urethane used is Urethane 210 or equivalent.

The white styrene modified urethane foam is used in medium density (4-6 lb/ft^3) where higher compression strength is required.

Do not substitute foams for those supplied by Quickie Aircraft Corporation. For example, the Q2 blue-white or orange styrofoam has great glass surface peel strength than the standard blue styrofoam sold by some distributors. Also, we considered using the "fire resistant" BROWN urethane instead of the green 2 lb urethane, but found its physical properties, fatigue life, and fuel compatibility to be much lower than the urethane supplied to Q2 builders. Do not confuse styrofoam with white expanded polystyrene. Expanded polystyrene is a molded, white, low density, soft foam, which has the appearance of many spheres pressed together. This is the type used in the average picnic cooler. It disappears immediatley in the presence of most solvents, including fuel, and its compression and modulus is too low.

All three types of foams, urethane, styrene modified urethane, and polystyrenes are manufactured in a wide variety of flexibilities, densities and cell sizes. Getting the wrong material for your airplane can result in more work and/or degraded structural integrity.

Since sunlight can damage foam, avoid exposure of foam to the sunlight by keeping it covered.

END OF SECTION

CONSTRUCTION TECHNIQUES

HOT WIRE CUTTING

The airfoil-shaped surfaces of your Q2 are formed by hot wire cutting the orange or blue-white styrofoam of 2 lb/ft3 density. The hot wire process given airfoils that are true to contour, tapered, proerly twisted, and swept with a minimum of effort and the simplest of tools. The details for making your hot wire saw were shown earlier.

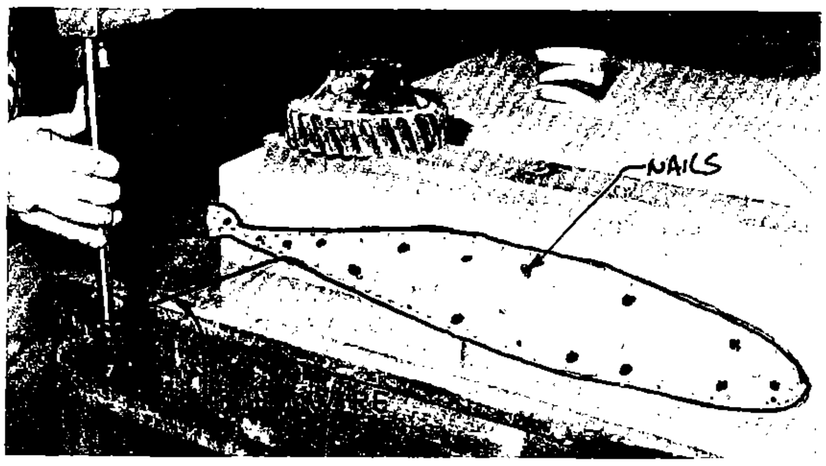
The hot wire saw is a piece of stainless steel safety wire, stretched tight between two pieces of tubing. The wire gets hot when an electricial current passes through it and this thin, hot wire burns through the foam. By making smooth steady passes, the hot wire gives a smooth, even surface. The foam offers little resistance to the hot wire's passage. To get a smooth accurate cut, a template is required. Templates are made from thin plywood, sheet metal, masonite or formica. A variable voltage control is used to supply the electrical current that heats the wire.

The blue-white or orange foam used in your flying surfaces was selected for a combination of reasons and its hot wire cutting ability was one of them. Other types of foams are readily hot wire cut, but some (white expanded polystyrene) have poor physical properties and others (urethane) give off poisonous gases when hot wire cut. Use only the recommended materials!

Hot wire templates can be made from 1/16 to 1/4 inch plywood, formica, or masonite or .032 to .064 sheet metal. It is important to have smooth edges on the templates. A rough edge may cause the wire to hang up and burn into the foam excessively. Templates are required on both ends of the foam being cut. The size, shape, and orientation of the two templates is varied to taper, and twist the foam core as required. The planform (span and sweep) is set by squaring up the foam block before the templates are used. In general, the trailing edge of the wing is the reference.

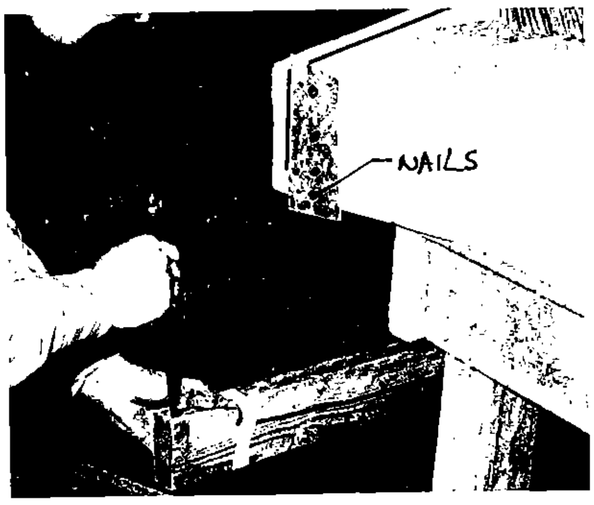
Full-size template drawings are provided in the plans. To make your templates, just glue the template drawings to a piece of plywood or sheet metal and trim to the contours shown. There are a number of markings on each template which aid in the alignment and cutting of the foam core.

Each template has a waterline (W.L.) marked on it which is used to align the twist of the foam core. Each template's waterline is leveled using a carpenter's bubble level. This assures that the relative twist at each template is correct. The template is then nailed to the foam block to obtain the correct planform.

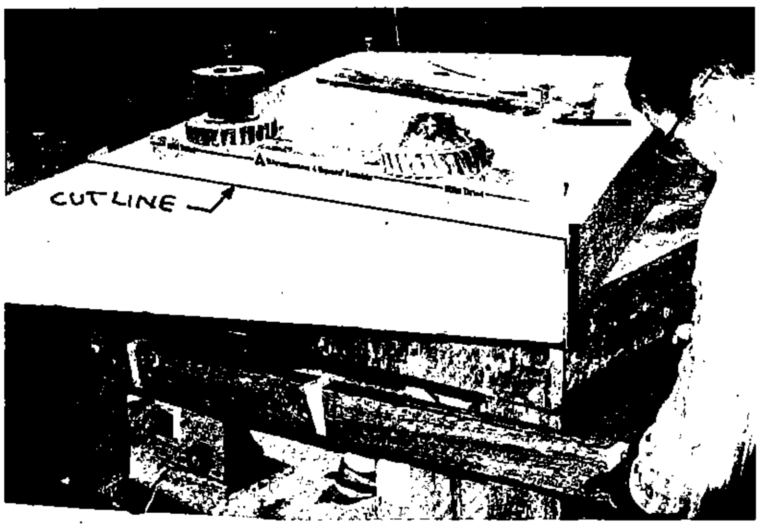


Each template has numbered marks running from the trailing edge around the leading edge and back to the trailing edge. These are called "talking numbers." When the foam cores are cut into their airfoil shape, the talking numbers are used to assure that each end of the hot wire is co-ordinated to obtain the correct, tapered airfoil. The person calling the numbers should be at the largest template. A typical cut would sound like this: "Resting on the tab 1/4" from the foam, moving forward, entering foam now - one, half, two, half, . . ., 34, half, 35, half, 36, coming out of the foam and pausing on the tab, wire's out." As the cut is made, the person on the small rib follows the numbers, passing over them as he hears them called out. Pause marks are indicated in places where it is necessary to pause for a couple of seconds and let the hot wire's center lag catch up with the ends.

Preparing a foam block for an airfoil cut is begun by trimming the rectangular foam block to the basic dimensions for the correct planform. These "trim" cuts are made using two straightedged trim templates. The templates are held against the foam by nails through the template into the foam. Enough nails should be used to hold the template firm so that it won't move when the hot wire is held against it.

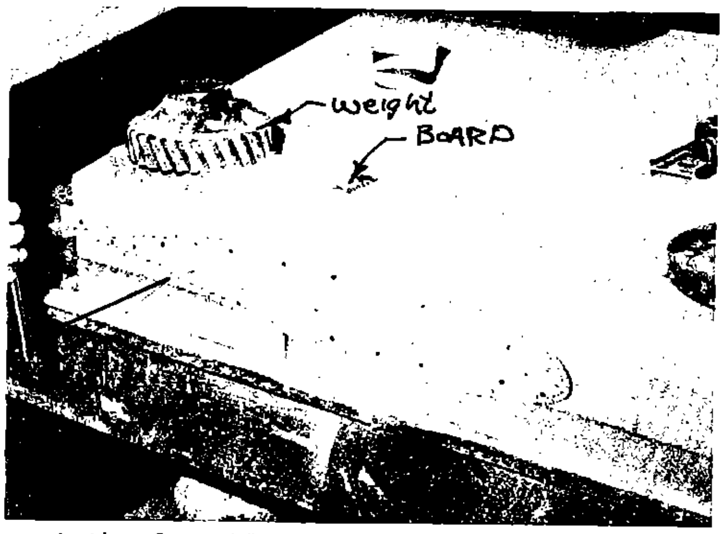


Cutting straight down along template with a hotwire.



Note the diagonal cut being made by correctly positioning the vertical templates and passing the hotwire downward along them.

Each template must have holes for nails to hold the templates to the foam; four penny nails are good for this use. The holes in the templates should be a close fit for the nails. Be careful not to angle the nails so that the hot wire can catch on them! Some rib templates are used several times, for both inboard and outboard, requiring you to transfer the talking numbers, pause marks, trim line, and waterline to the opposite side of the template.

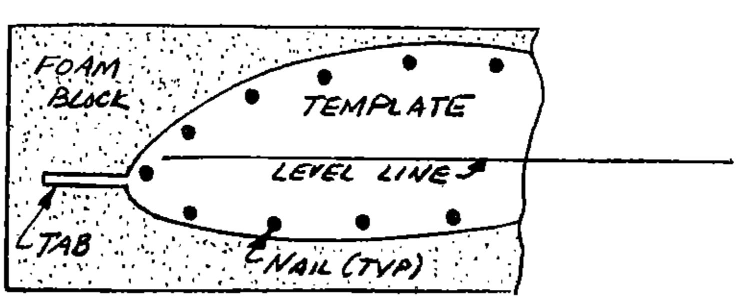


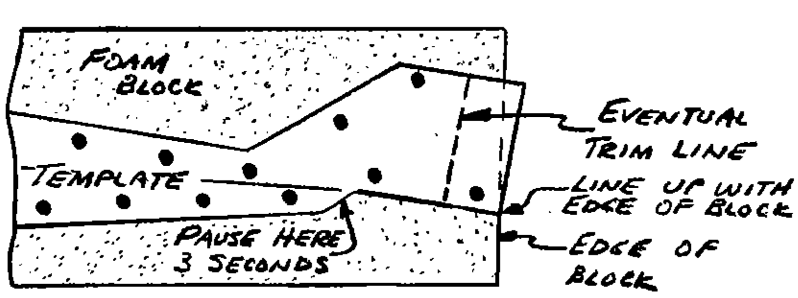
Support the foam block well; don't overhang the block past the edge of the jigging table.

CONTINUED ON NEXT PAGE

The use of the hot wire saw is a simple thing if your equipment is set up properly. Proper wire tension and wire temperature should be maintained for good cutting. The wire tension should be tightened after the wire is hot by twisting one tube with a pair of pliers. The wire should be as tight as possible. The wire should be hot enough to cut one inch of foam in four to six seconds without having to force the wire. A wire that is too hot will burn the foam away excessively. To cool an over-heated wire, simply turn your voltage control to a lower voltage setting. If you use a battery charger, you will have to add length to the wire. To warm up a cool wire, just increase the voltage setting or, with the charger, shorten the wire. Although the foam offers only mild resistance to the hot wire, a long cut will cause the middle of your wire to lag behind the ends. Wire lag can cause problems in tight curves like the leading edge of an airfoil. To reduce lag there, the cutting speed is reduced to about one inch in 8 to 10 seconds. The airfoil templates have notations in the areas where reduced speed cutting is necessary and pause marks where it is necessary to allow the lag to catch up completely.

The most common hot wire error is wire lag which causes a bow in the leading edge. The following method solves this problem and thus we recommend you use it for cutting the canard and wing. Use the tabs on the templates at the waterline at the leading edge by cutting the core in two passes: one from the leading edge up over the top to the trailing edge, the other from the leading edge (under the tab) down under to bottom to the trailing edge. The thin "flash" of foam left on the leading edge due to the thickness of the tab is easily removed with your butcher knife. The result is a perfectly straight leading edge. Care must be taken to assure that both ends simultaneously approach the template at the leading edge. Use the following vocal commands "wire is moving toward the tab, now resting on the tab 1/2 inch from the template (confirm both ends in that position), moving toward template 1/4 inch away, 1/8" away, on the template, moving up (talking number), Y (talking number) . . .". When approaching the trailing edge overlap notch (see sketch) slow down and pause 3 seconds in the notch to assure a full, sharp, accurate surface for the skin overlap.





The hot wire should be guided around the templates with light pressures. Pushing too hard against the template may move them or flex the foam block which results in an under cut foam core.

The correct set-up is just as important as using the correct tools and materials. Foam is a fairly flexible material and an improper set-up can cause deflection. The foam block should be well supported at each end, so that it doesn't sag and doesn't move around while being cut.

You need clearance for the hot wire cutter to pass by the table and the weights used to hold the foam steady.

Foam is manufactured in sizes that are often too small to get a complete core from a single block. It is necessary to use two foam blocks to get the size required for the wing cores. These blocks have to be joined using an epoxy/microsphere mixture. The hot wire won't cut through the micro joint, so all of the hot wire cutting is done with the blocks temporarily joined. Nails or blobs of 5-min epoxy are used for temporary foam joints, but the hot wire won't cut through these. Thus, they have to be placed carefully so that the wire doesn't have to pass through them.

Don't be overly concerned if you don't make perfect foam cuts: ridges on the foam core from inadvertently lifting the hot wire off the templates are easily faired in with a sanding block. A less-than-perfect leading edge can be blended in by sanding after the foam core is assembled. Gouges in the foam can be smoothed and filled with dry micro to contour after applying the glass skins. The foam is too expensive to throw away because of a minor gouge.

A finished foam core may warp out of shape after it is removed from the original rectangular block. This is due to internal stresses in the foam from the manufacturing process, and is no cause for concern.

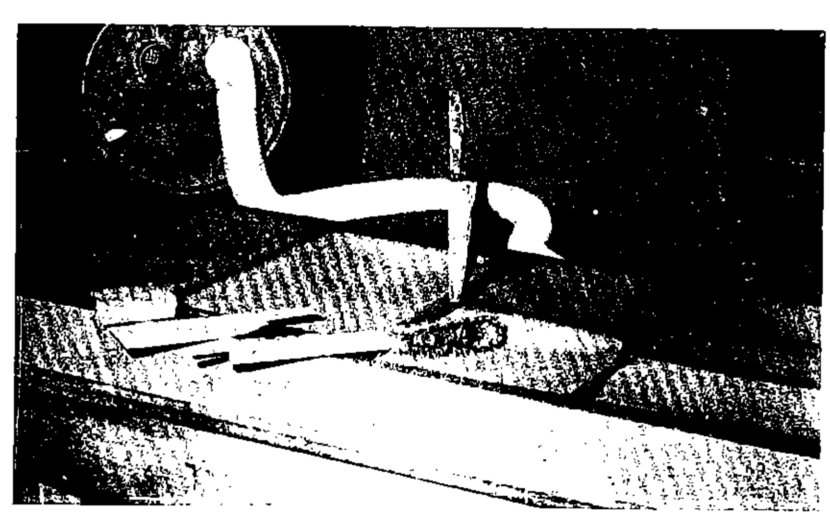
A warped core is simply weighted into the jig blocks and shimmed straight prior to glassing. Once the skin has been installed, the foam is held firmly in position by the sandwich structure.

URETHANE FOAM SHAPING

One of the real treats in the construction will be shaping and contouring urethane foam. Urethane is a delightful material that shapes with ease using only simple tools. A butcher knife, old wire brush, sandpaper, and scraps of the foam itself are the basic urethane working tools. A vacuum cleaner is convenient to have handy since working urethane produces a large quantity of foam dust.

The knife is used to rough cut the foam to size. The knife needs to be kept reasonably sharp; a sander or file is an adequate knife sharpener since it's a frequent task and a razor edge isn't necessary. Coarse grit sandpaper (36 grit) glued to a board is used for rough shaping.

Inside contours or "dishing" is done by using a ragged old wire brush to rough out the bulk of the foam and following up with a scrap foam piece to smooth the surface. The foam scrap conforms to the shape of the surface resulting in a very smooth contour.



Outside contours are roughed out with a sanding block and finished using a foam scrap. Dry micro and flox are used to fill voids and pot fasteners in a number of places. All foam shaping should be finished before any micro filling is done, because the filler is much harder than the foam and this makes smooth contouring very difficult. Your best carving template is your eyeball; an occasional check on the depth of a contour is about the only measurement necessary.

Keep your shop swept reasonably well. The foam dust can contaminate your glass cloth and your lungs. Use a dust respirator mask while carving urethane. Try not to aggravate the better half by leaving a green foam dust trail into the house.

GLASS LAYUP

The glass layup techniques used in your Q2 have been specifically developed to minimize the difficulty that glass workers have traditionally endured. The layups that you will do will be on a flat horizontal surface without the molds, vacuum bags, and other special equipment that are common in glass work. The layups that you do will all cure at room temperature; no ovens or special heating is required. If you have suffered through a project that requires you to build more molds and tools than airplane components, then you are in for a real treat.

The techniques that you will use are quick but they still need to be done correctly. 90% of the work that you will do is covered in the next few paragraphs so make sure that you read and understand this section very well. If you learn these basics, your airplane will be easy. If you skip over this information, you will probably end up frustrated.

STEP 1: PERSONAL PREPARATION

Before you get started with a layup, plan ahead. Some major layups take several hours and before getting your hands in the epoxy, it's a good idea to make a pit stop at the restroom.

Do not start a large layup if tired; get some rest and do it when fresh. It's best to have three people for any large layup; two laminators and one person to mix epoxy. Be sure that the shop is clean before you start.

Take the recommended health precautions (discussed later in detail) using gloves or barrier skin cream. Get your grubby, old clothes on or at least a shop apron. Make sure that your tools are clean from the last layup and ready to use. Your working area should be between 70°F and 90°. Best results are obtained at 75 to 80°F. Below 70°F the epoxy is thicker making it more difficult to wet the cloth. Above 90°F, the possibility of an exotherm is greater.

STEP 2: CUT FIBERGLASS CLOTH

The fine points of glass cutting have been covered earlier. Remember that there isn't any requirement to cut accurate dimensions. Cloth dimensions are given well oversize. You scissor trim them as you go, while laying the cloth up. It is a good idea to keep two pair of scissors: one clean and in the glass storage area, and one in the shop that gets epoxy on it. After cutting, roll or fold the material; keep it clean and handy for the layup.

STEP 3: PREPARE SURFACE

The only difference between layups over different materials is in surface preparation. The layup over foam will be covered here since you will be doing more of it, and other surface preparations will be covered separately.

The foam surface is prepared by leveling uneven areas with a sanding block and brushing or blowing any dust off the surface. Use compressed air or vacuum to remove dust.

Now is the time to accurately check that the foam core is the correct size, shape and contour. Refer to the section views of the part - be sure your core looks exactly like that on the section view. Lay a 12 inch straightedge spanwise on all critical areas of the flying surfaces and be sure you don't have any high or low places or joggles. Measure any areas that involve fiberglass buildups to check for correct depth. Build up is 0.009 inch per ply for UNI and 0.013 inch per ply for BID.

STEP 4: MIX EPOXY

Mix epoxy when you need it, not before. Micro, dry micro, and flox may be required at various stages of the layup. Mixing and composition details were covered earlier. Apply a coat of micro slurry to the foam surface before the first glass ply is laid over it. The slurry can be poured on the foam and spread thin with a squeegee. Fill any dings or gouges in the foam core with dry micro prior to applying the slurry.

STEP 5: LAY ON THE CLOTH

Lay on the cloth in the specified orientation. Pull the edges to straighten the cloth out and to remove wrinkles. Maximum strength and stiffness is obtained if the fibers are not wavy or wrinkled. If the cloth is to be applied around and/or into a sharp corner, you will find the job easier to do if the fiber orientation is at 45° to the corner. Don't get depressed if the layup looks like a hopeless mess at

this point. Press on with patience and things will work out fine. To remove wrinkles, study the direction of fibers, follow the fibers to the outer-edge of the cloth and pull on the outside edge. Pushing a wrinkle off the part is incorrect. Once the part is free of wrinkles use a squeegee and make light passes from the center outwards to smooth the cloth.

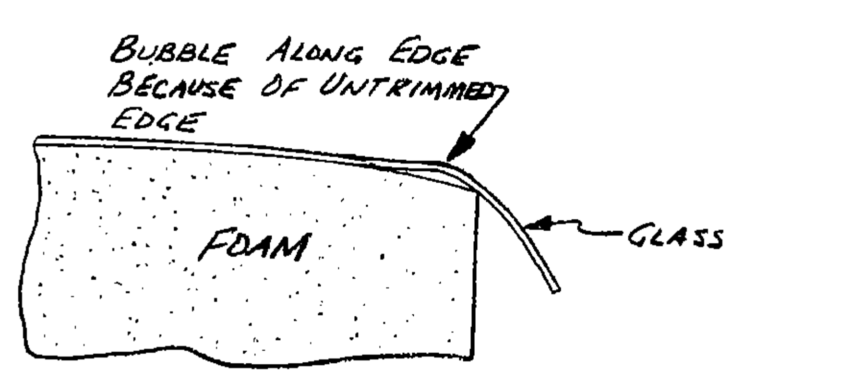
STEP 6: WET OUT THE CLOTH

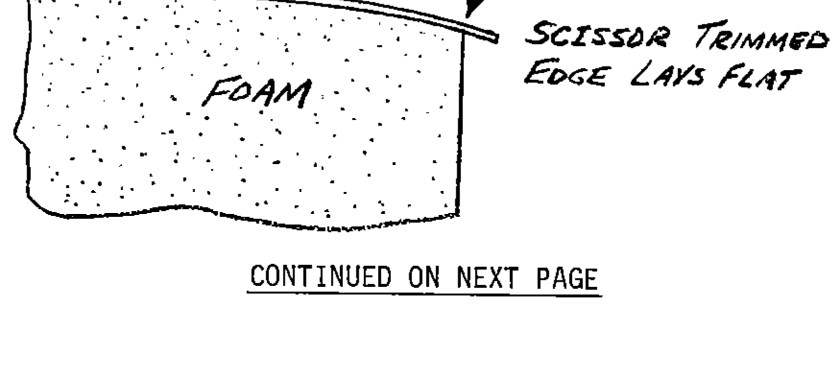
Do not use micro between plies of cloth. Wet out the cloth by pouring on a thin coat of epoxy. This may not be necessary if there is enough epoxy under the cloth to be brought to the surface. This is done by "squeegeeing", which involves drawing the squeegee over the cloth. This brings excess epoxy up from below to wet out the cloth, resulting in a weight savings as compared to adding more epoxy on top. REMEMBER, epoxy adds no strength beyond what is needed to wet out the white color of the cloth and fill air voids; any further addition of epoxy is only dead weight.

Where multiple plies are required, the first plies may be laid up wet and the excess resin brought up by squeegeeing to help wet out the middle plies. To do this, pour epoxy onto the part and move it around the surface with a squeegee. Your work will go much faster if you make the layup too wet, then remove excess epoxy with many light passes with the squeegee. Do not squeegee too hard, as this can starve the surface of micro and introduce air. Continue to inspect for air (tiny white flecks or bubbles) and stipple (a vertical stabbing motion with a paint brush) or squeegee in more epoxy to remove the air. A handy squeegee can be cut from the flexible plastic found on a coffee can lid. You may also find a paint roller handy for spreading around the epoxy. The final plies are ambitiously stippled and additional epoxy is applied sparingly. When in doubt - squeegee it out.

As you wet out each ply, scissor trim to within 1/2" of any overhang (trailing edge, etc.). This ½" will be knife trimmed after the layup cures. If an overhanging ply isn't trimmed, it lifts the edge up and makes a bubble.

After scissor trimming, restipple the edges to be sure there are no voids. Wet the cloth beyond the trim line at least 1/4" to allow easy knife trimming later.





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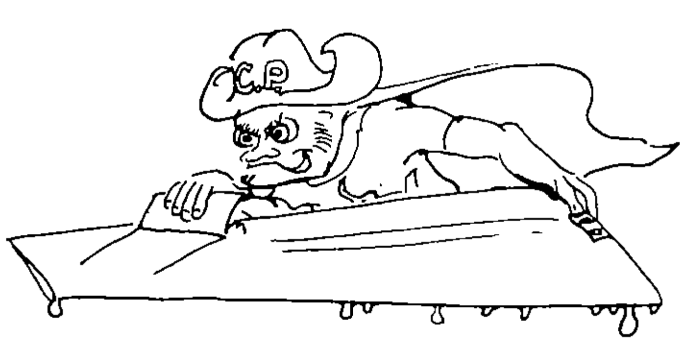
STEP 7: SQUEEGEEING

Squeegee out excess epoxy. This involves drawing a plastic or rubber squeegee over the layup as shown. Plastic squeegees (scrapers) are available at any paint store and included with the kit. If excess epoxy exists, it will be pushed off the edge of the piece. Remember, excess epoxy is much better on the floor than on the airplane. It is possible to squeegee too hard and make the layup too dry. If this occurs, the surface will appear white, indicating the presence of air. If this occurs, wet the cloth by painting on a little epoxy and stippling it down into the layup. The best quality layup is obtained if each layer of a multilayer layup is squeegeed. The excess epoxy which is pushed off the edge can be recovered and returned into the cup. This is easily done by catching the epoxy on the squeegee and scraping it on the side of the cup.

The finished layup should appear smooth and green so that the weave of the cloth is clearly visible, but not so dry that any area appears white in color. If you've done an excellent job, the weight of resin will be about 2/3 of the weight of cloth used.

To check if there is too much epoxy in the layup, pull a squeegee across the surface, stopping before you reach the edge. Lift the squeegee up and look for a large "ridge" of epoxy where the squeegee stopped. The ridge under the top ply indicates that the layup is too wet and you should spend time with the squeegee to remove epoxy off to the sides.

Don't hesitate to use your stippling roller or brush on an area after squeegeeing. Some places are not suited to the use of a squeegee and the dry brush or roller must be used to expel the excess epoxy. On a given layup, about 1/2 of your time should be spent squeegeeing or stippling.



STEP 8: GENERAL INSPECTION

After you have finished the layup, take a few minutes and give it a good general inspection for trapped air, dry glass, excess epoxy, and delamination. It is much easier to correct these things while the layup is wet than to repair the cured layup. Also, have someone else inspect it. Usually a different person can find air flecs or bubbles that are missed by one inspector. Carry a good light around for the inspection. Glance the light off the surface at vari-our angles to look for airflecks. If any air is visible, stipple it out. Be sure the overlaps on the edges are perfect. If, due to a sharp corner etc, you have a problem eliminating an air bubble, use one of the following two methods:

(1) Lift the cloth up off the foam, trowel some wet micro into the troublesome area, add more epoxy as you stipple the cloth back down.

(2) Add excess epoxy over the bubble, cover the surface with saran wrap (thin plastic wrap), then push firmly outwards to force the air out to the sides. The saran wrap will seal the surface to keep air from being drawn in. This method will force the cloth to stay down even around a sharp corner.

STEP 9: PRELIMINARY CONTOUR FILL

Certain areas, like along the trailing edge (see cross section views) require a dry micro fill. It is preferred to apply this fill within 2-3 hours of finishing the fiberglass layup. However, where the micro filler obscures the structure underneath, FAA inspection should be completed before dry micro filling. Areas like the trailing edge where the structure can be inspected from the other side should be filled while the layup is still tacky (within three hours of the layup). If you wait until the layup cures, you will have to sand the fiber-glass surface to a dull finish before applying the micro. So, mix up a "dry" micro mix and trowel it into low areas while the lay-up is still wet, and save the work of sanding where feasible.

STEP 10: CLEANUP

Brushes can be used two to four times if after each layup they are washed with soap and water. Wipe excess epoxy off with a paper towel. Wet the brush and work soap into all fibers by mashing it into a bar of soap (Lava brand is best). Rinse with hot water and repeat 3 times. Be sure they are dry before next use. We generally use a cheap brush (approximately $2.00 to $4.00 per dozen) and discard after two or three layups. Clean squeegees the same way.

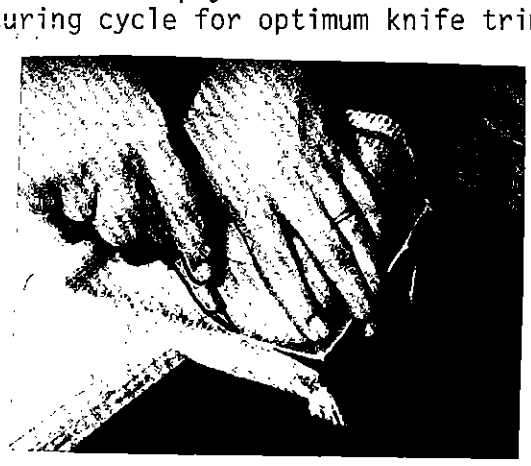
If you use skin barrier cream (Ply No.9), the epoxy and cream will wash off easily with soap and water. When you get epoxy on unprotected skin, Epo-cleanse is used to remove the epoxy. Both of these products are available. Once you are sure your skin is clean, wash again thoroughly with soap and water, even if your hands were protected with plastic gloves. If you get epoxy on tools or metal parts, clean them with acetone or MEK before the epoxy cures.

The only good way to protect your clothing is not to get epoxy on anything that you care for. Use a shop apron and don't make layups in good clothing. A surplus flight suit or other cheap coveralls are a good investment.

You may feel that layups are messy work after your first experience with them. However after you've done several, you will have learned not to wipe your hands on your clothing (keep a roll of paper towels handy), not to scratch your ears, eyes, etc. during the layup. If your tools and work area are clean and organized well and you are disciplined with the epoxy, the job can be less messy than working with other materials.

STEP 11: KNIFE TRIM

When a layup is wet, you can only scissor trim to within about ¼ inch without disrupting the fibers in the ply. An easy clean trim can be obtained by waiting three to five hours after the layup. At this time, the laminate is firm enough to support the cloth from fraying, yet soft enough to cut easily with a sharp knife. This "knife trim" stage is the optimum time for edge trimming with ease and accuracy. Take a sharp, single-edge razor blade or X-Acto knife and trim the edges with a motion downward toward the edge. Experience will help you determine the correct time in the curing cycle for optimum knife trimming.



In the plans, when "knife trim" is called for, this assumes the three to four hour wait, even though not specifically stated. Don't fall apart if you miss the knife trim stage and have to trim the fully cured glass. If you wait until the layup is completely set, then saw along the edge with a coping saw, dremel, bandsaw, saber saw, etc. Smooth the edge with a sanding block. When trimming a cured edge, be careful of the "needles" (sharp protrusions of glass-frayed edges supported with epoxy).

The needles can be avoided by returning three hours after the layup to make the knife trim. Knife trim time varies with temperature: about six hours at 60 degrees and one hour at 90 degrees.

OTHER SURFACES

Surface preparation (step 3 of the basic glass layup) varies with the material that you are laying up over. The layup over foam was covered in detail in step 3. To prepare a cured glass surface for layup, the cured surface must be sanded to a completely dull finish with 36 to 60-grit sandpaper. If any of the glossy surface remains, an incomplete bond results which is weak. Better yet, use peel ply as described later. Micro slurry should not be applied to glass surfaces being bonded; this weakens the joint. Wood requires no special preparation for bonding but should be free of grease, oil, paints, and varnish. Sand wood surfaces with 36-grit sandpaper before layup. Metal bonding is not relied upon for strength but metal surfaces should be free of oil and grease and, except for bolts, nuts, and other fasteners, metal surfaces should be dulled by sanding with 220-grit sandpaper, and coated with epoxy before setting in place. Cured micro surfaces should be sanded dull but be careful not to obliterate surrounding foam surfaces while doing it. In practice you may be glassing over several types of material in the same layup and you will be using most of these surface preparation techniques together.

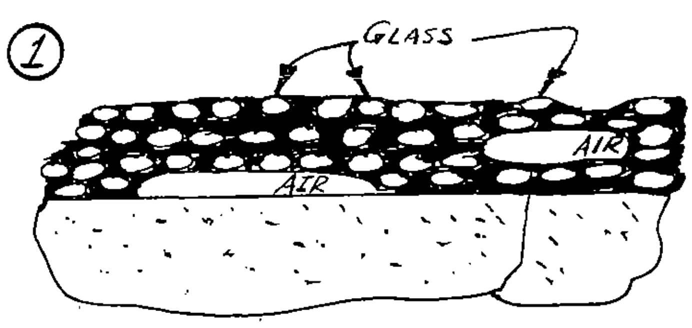
ATMOSPHERIC CONDITIONS

Temperature has the greatest effect on the working properties of your epoxies. 75 degrees farenheit is an ideal temperature. The range from 60 to 90 is acceptable with the precautions mentioned in the section on EPOXY. Humidity has a lesser effect on these materials than it does on aircraft dopes and some paints. Humidity will only create problems if it is over 75%. Don't undertake a layup if it is pouring down rain outside or, if you notice a cloudy "blush" on the wet epoxy surface, or any evidence of whiteness in the epoxy due to moisture.

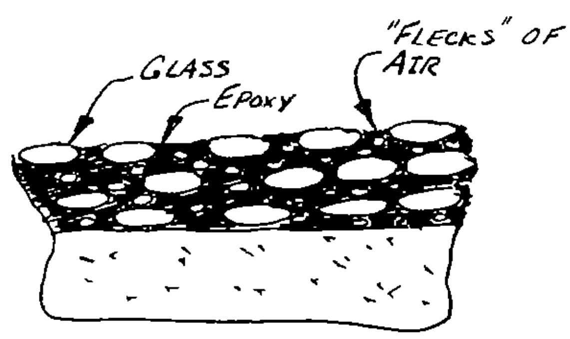
RECOGNITION OF A DRY LAYUP

One of the most important things you must know is how to inspect for the presence of air within a layup. Air leaves somewhat crystal-like flecks of white areas, noticeably different than the white color of the microballoons. The presence of air is shown in the adjacent sketches in 3 forms: (1) A bubble or large void at the foam surface or within the laminate, (2) small bubbles of air scattered throughout an area, or (3) inadequate filling of the outer ply. Make a layup of 3 ply BID in a 6-inch square over a scrap piece of foam, trying to achieve these 3 types of dryness. Let it cure with the defects. This will be a handy sample to use to instruct others who will help you inspect.

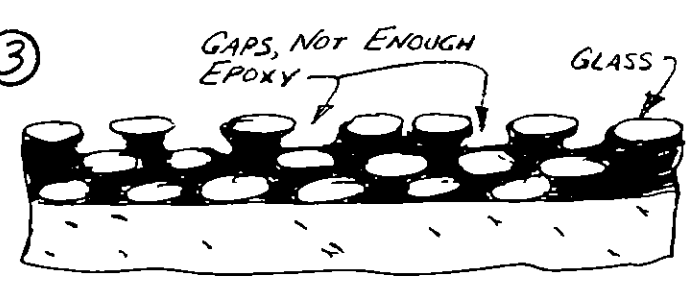
(1)



(2)

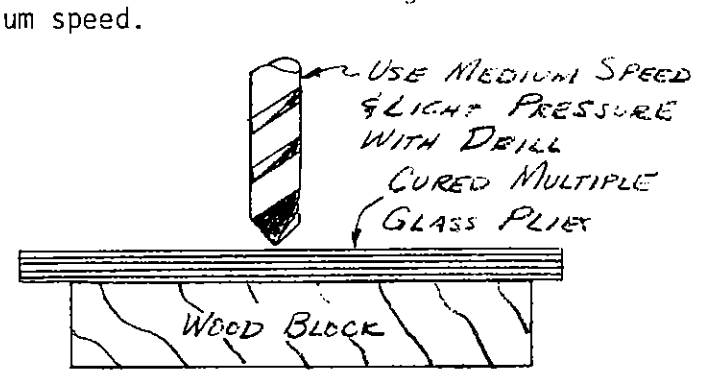


(3)

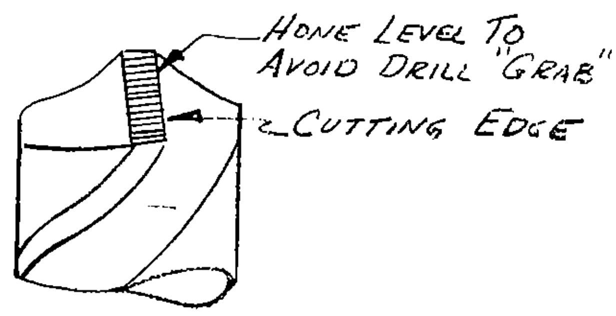


DRILLING, GRINDING, & SAWING

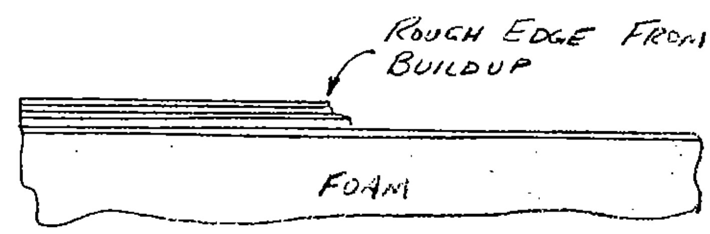
Drilling through cured glass tends to tear the surface plies on the back side. Backup a glass layup with a wood block for drilling as shown and drill at medium speed.

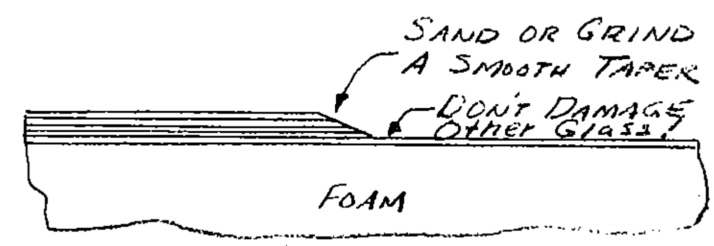


Using a small hone, grind the cutting edges of your drill bit flat as shown (not undercut). This will keep the drill from grabbing into the glass. Don't over-do it, just make a couple of light passes with the hone.

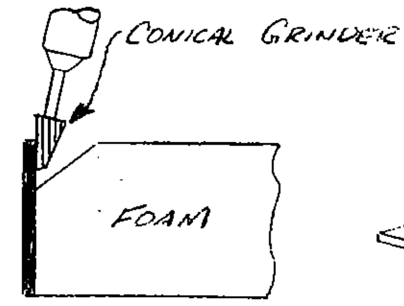


In several places rough, cured glass surfaces occur where overlaps or thick buildups are done. These rough edges should be smoothed as shown using a grinder or sanding block.

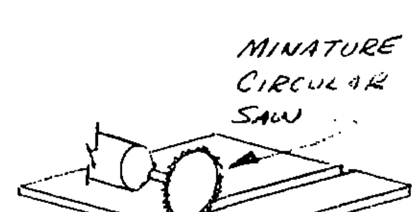




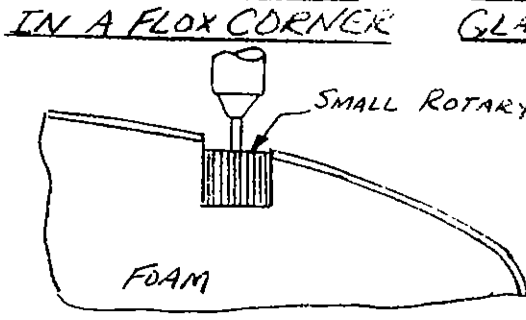
The Dremel (Moto Tool) or Home Shop (Weller) is a very versatile tool with many uses in the construction of your Q2. The kits usually have a nice selection of bits, cutters, grinders, stones, and mandrels for every concievable use. The three types of bits shown here are the most useful for your project. Don't throw the others out, as your next door neighbor might be able to use them on his supersonic ornithoper project.



TO PREP GLASS IN A FLOX CORNER



TO CLEAN UP GLASS EDGES



TO COUNTERBORE
TO GRIND

RIVETING

A pneumatic riveter is not required. The few hard rivets used can be set with a hammer, using your vise as backup. The 'pop-type' rivets are pulled with a low-cost hand puller available at any hardware store.

CUTTING THE UNI SPAR CAPS

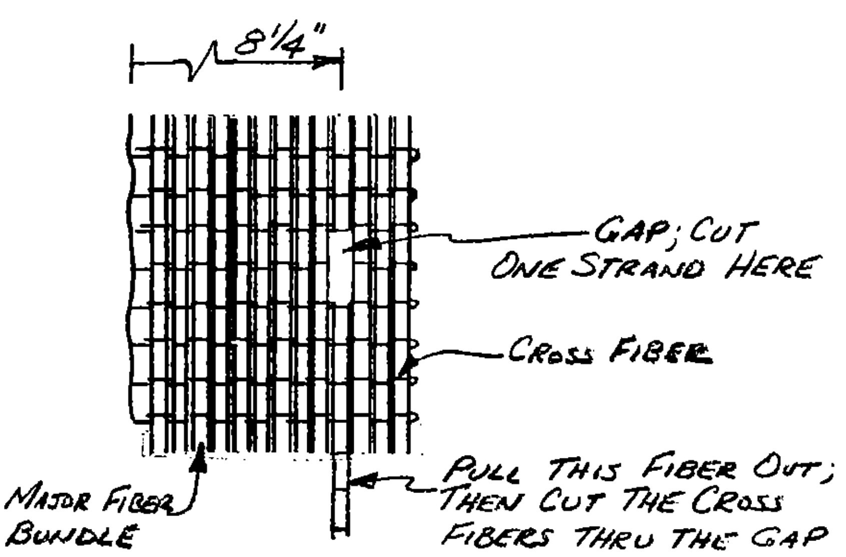
The spar caps used in the main wing, vertical tail, and canard, are strips of UNI cloth that you will cut from the roll provided in the kit.

Begin by unrolling the roll on a long, flat surface. The example to be used here will be a spar cap A that is 8" wide by 50" long. You would measure a 8-1/4" wide piece (to allow for frazzling of the edges) by 50" long, with the fiber orientation running along the 50" edge.

The technique is one of finding the one strand that is at the edge of the 8-1/4" width, cutting it, and then pulling that whole strand the length of the spar cap to remove it. You will now see a clearly visible gap in the UNI cloth where that one strand used to be. Now, using an Exacto knife or razor blade, cut all of the cross fibers along that gap, thus severing the spar cap from the rest of the roll.

Carefully mark the cap with a centerline (in this case at the 25" point, mark it with the letter A and roll it up to keep dirt out of the fibers.

When you next unroll it, you will probably find that the edges are frazzled. As long as you don't reduce the width below the original callout (in this case 8") you may pull off strands that are frazzled. Be carefull to only pull loose one strand at a time or else the whole spar cap will start coming apart!

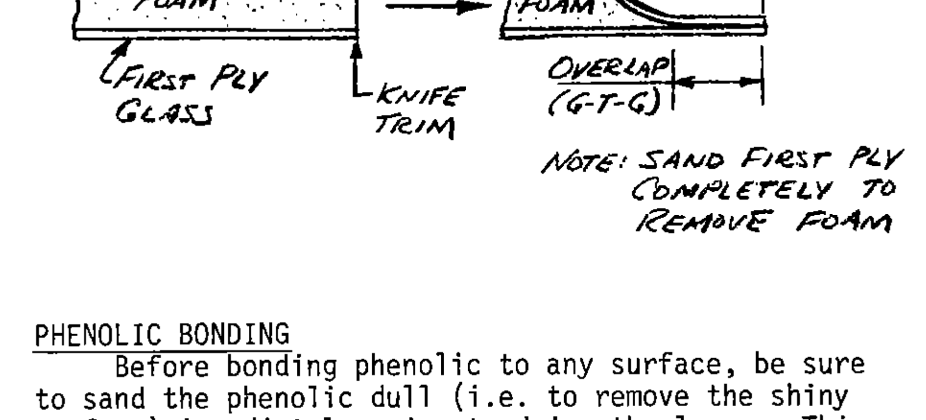


GLASS-TO-GLASS

In order to improve the rigidity of a part, you will occasionally be asked to perform a glass-to-glass layup, sometimes abreviated as GTG.

The example shown here is a glass-to-glass layup on a bulkhead. Begin by glassing one side of the bulkhead as usual. Next, having turned the bulkhead over after curing to prepare the other side for glassing, you will remove foam with a smooth transition so that your next layup will butt up against the previous glass layup.

The amount of "overlap" necessary varies with the loads. On bulkheads, use a minimum of 3/8", on the trailing edges of ailerons and elevators use ¼" minimum, and on the trailing edges of the wing, use 3/8" minimum.



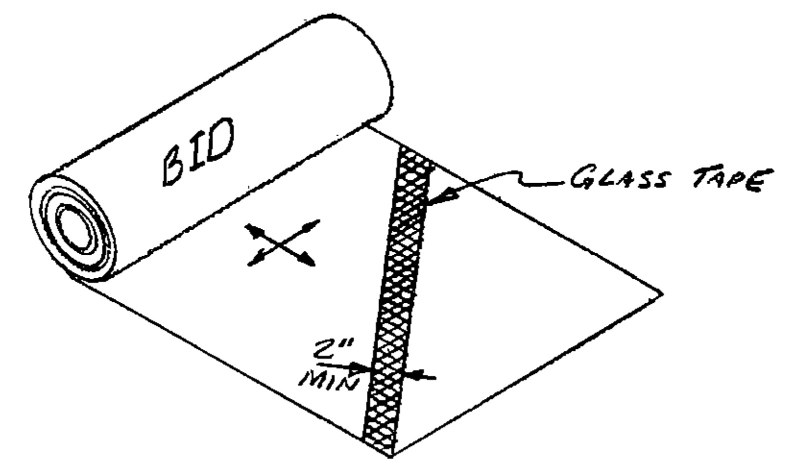
PHENOLIC BONDING

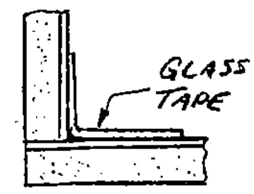
Before bonding phenolic to any surface, be sure to sand the phenolic dull (i.e. to remove the shiny surface) immediately prior to doing the layup. This avoids getting grease from your hands, etc. in the layup, which might cause poor adhesion and subsequent failure of the layup.

TAPES

Quite often during the construction of your Q2, you will be asked to use glass tapes to join two pieces together.

A glass tape is a strip of BID cut at 45 degrees which is used to lap up onto both surfaces that are being joined. For proper strength, the tape should be at least 2" wide.





QUALITY CONTROL CRITERIA

INTRODUCTION

One of the unique features of the glass-foam-glass composite construction technique is your ability to visually inspect the structure from the outside. The transparency of the glass/epoxy material enables you to see all the way through the skins and even through the spar caps. Defects in the layup take four basic forms: resin lean areas, delaminations, wrinkles or bumps in the fibers, and damage due to sanding structure away in finishing. Resin lean areas are white in appearance due to incomplete wetting of the glass cloth with epoxy during the layup.

DRYNESS CRITERIA

Pick any 6"x6" square in the layup in the critical area. Assess carefully if any evidence of air in the layup is present (white flecks, bubbles, air at the foam face). If the dryness is more than 10% of the area, the part MUST be rejected. Reject or repair any evidence of dryness or voids in the trailing edge or leading edge overlaps. Better yet, do an adequate inspection with good light before cure when it's easy to fix. If in doubt on overlaps be sure to stipple in enough epoxy.

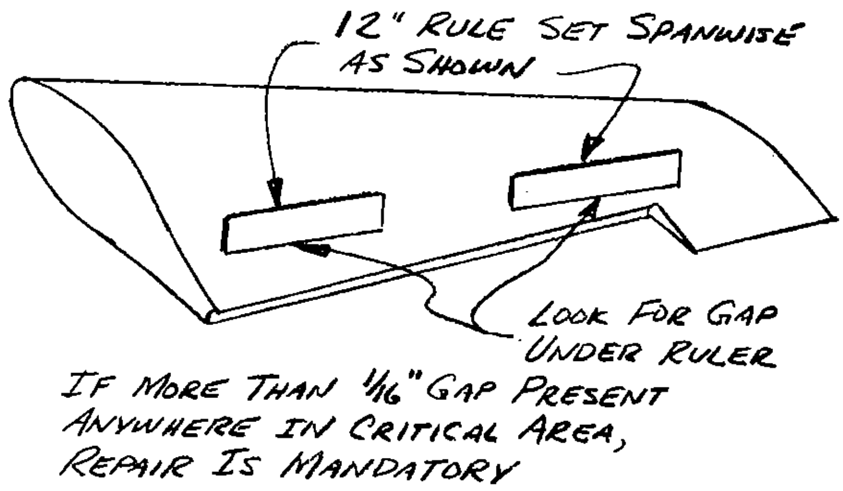
Delaminations in a new layup may be due to small air bubbles trapped between plies during the layup. The areas look like air bubbles and are distinctly visible even deep in a cured layup. Small delaminations, or bubbles up to 2-inch diameter, may be filled with epoxy by drilling a small hole into the bubble and filling the void with epoxy.

When making a layup, do not be concerned if the brush occasionally sheds a few bristles; these do not need to be removed. If the bristle count exceeds about 10 per square foot, change your brush and remove bristles.

Occasional sanding through the weave in the first skin ply is not grounds for scrapping the part. Care should be exercised in areas, such as the skin joints, not to weaken the structure in pursuit of an optimum finish. An excess of resin (wet) will make your airplane heavy and does weaken the layup, but usually not enough to reject the part for strength reasons.

BUMP/JOGGLE/DIP CRITERIA

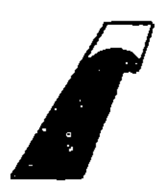
The best way to check this is to lay a 12-inch straightedge on the part spanwise. Move it all over the surface in the critical areas. If you can see 1/16" gap in any area, the part must be repaired. It is best to repair or beef up lumpy areas even if they meet this criteria. Better yet, do a good job in core preparation and use your squeegee well in the layup to avoid the lumps in the first place.



The following is a listing of the "critical areas"; the portions of the Q2 that must meet all the inspection criteria:

1. Entire canard.
2. All portions of the fuselage within 10" of the engine mounts, canard, and wing.
3. All control surfaces.
4. All flying surfaces in the shaded areas shown, plus all overlaps at L.E. & T.E.

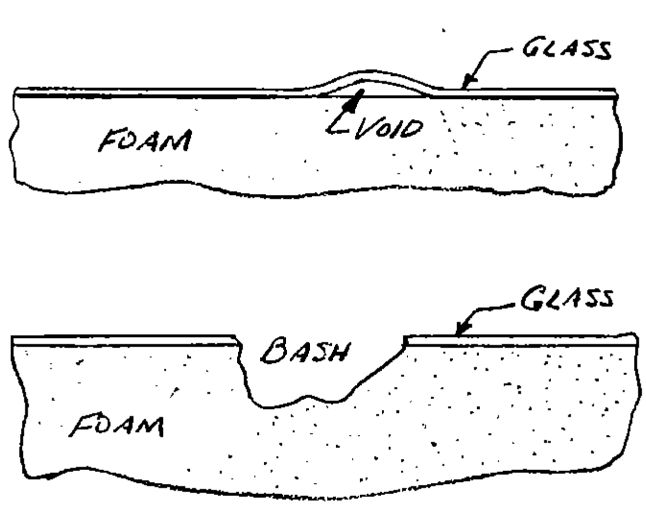
WING (TOP & BOTT)



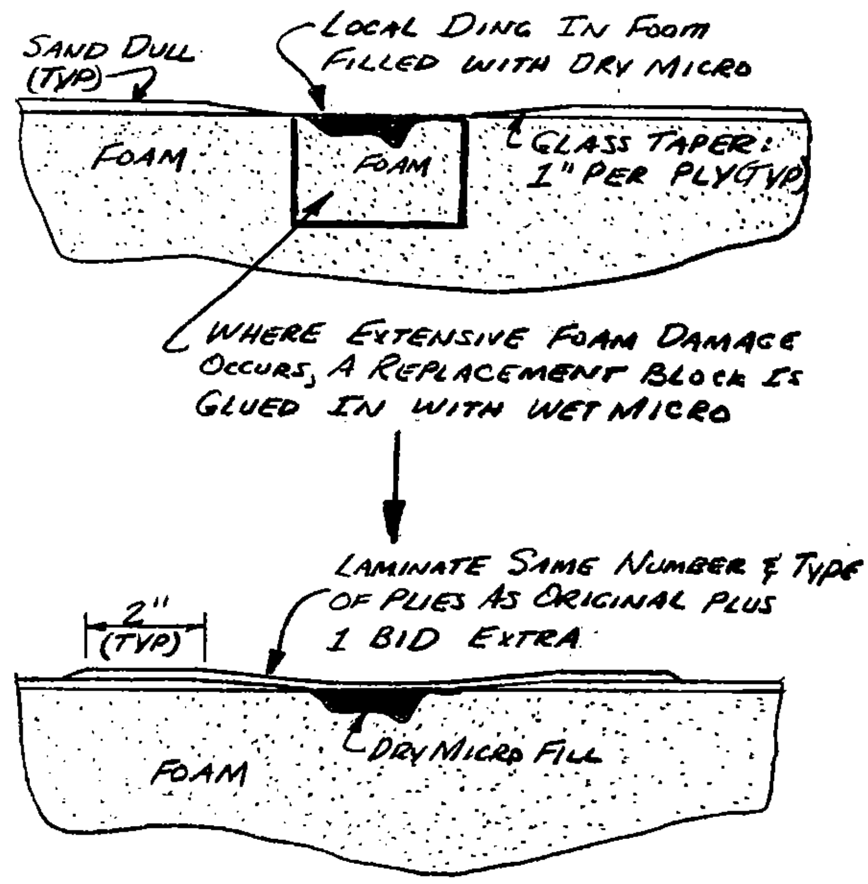
VERTICAL FIN

Major wrinkles or bumps along more than 2" of chord are cause for rejection in the wings, canard and vertical fin, particularly on the top (compression side). This does not mean you have to reject the whole wing - anything can be repaired by following the basic rule: remove the rejected or damaged area and fair back the area at a slope of 1" per ply with a sanding block in all directions. By watching the grain you will be able to count the plies while sanding. Be sure the surface is completely dull, and layup the same plies as you removed, plus one more ply of BID over the entire patch. This will restore full strength to the removed area.

Use this method to repair any area damaged for any reason - inadvertent sanding through plies during finishing, taxiing a wing into a hanger, etc.



TYPICAL DEFECTS



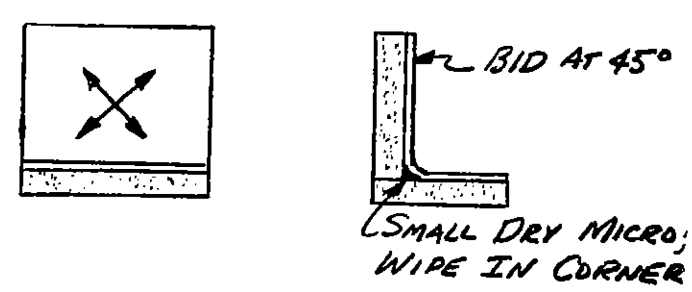
TYPICAL REPAIRS

CORNER TREATMENTS

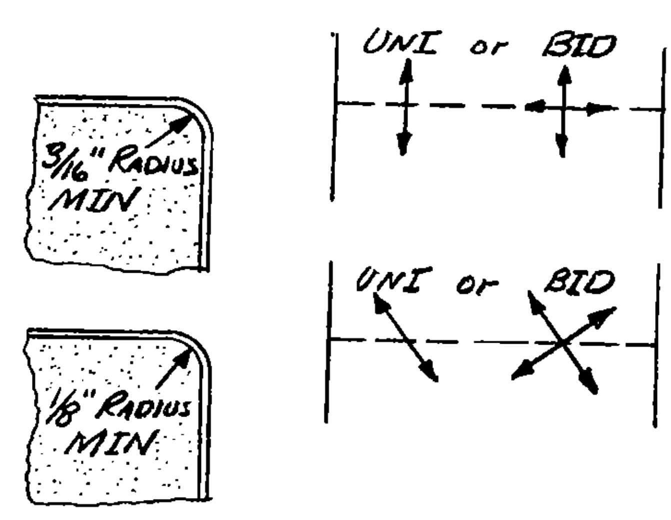
A variety of structural corners are employed in the construction.

There are two basic types of corners: one where the glass fibers are continuous around the corner, and the other where a structural filler is used and glass is bonded to the filler. The corner with the glass fibers running completely around it is used where maximum strength is required.

Inside corners can be laid up quite abrupt and only a very slight wipe of dry micro is needed to get the glass to lay into it. BID cut at 45° is used on this type of corner.



Outside corners require a radiused edge. Where the glass fibers run directly around the corner a minumum radius of 3/16 inch is required. Where the fibers run at an angle to the radius, only a 1/8 inch radius is needed.



FIBER ORIENTATION

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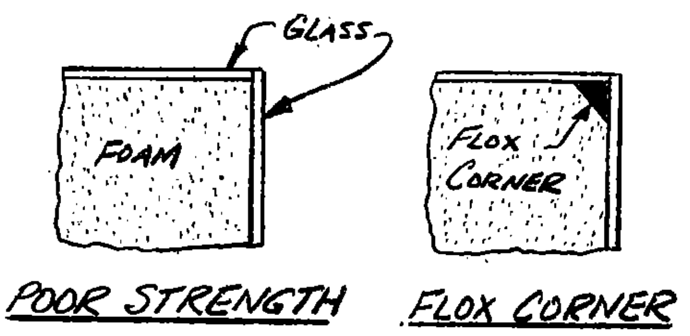
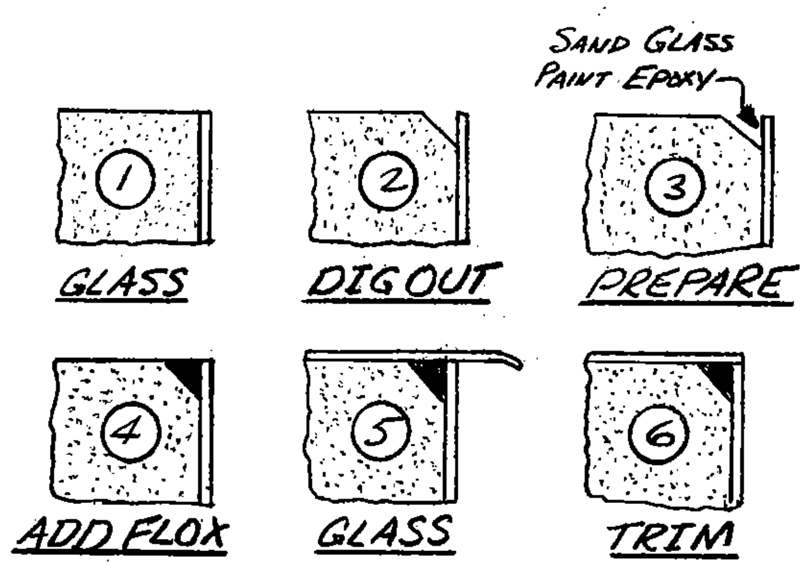
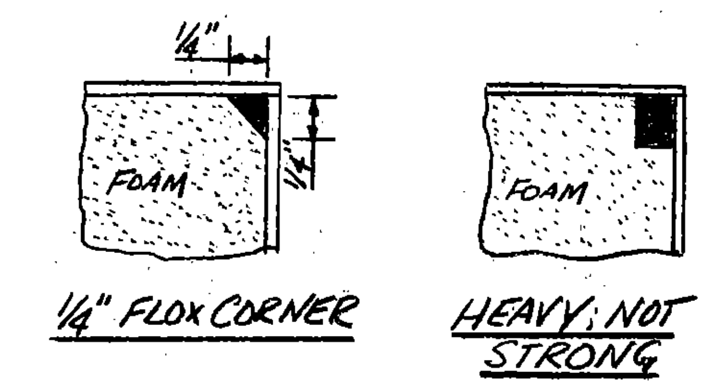
In some areas a sharp corner is desirable and maximum strength isn't required. In these areas a flox corner is used. A simple unsupported glass corner has very poor strength. To strengthen this corner, a triangle of flox is used to bond the glass plies together. The flox corner is done just before one glass surface is applied for a wet bond to one surface. The other glass surface has to be sanded dull in preparation as shown.







HEALTH PRECAUTIONS

SKIN PROTECTION

If you work with epoxy on your bare skin, you can develop an allergy to it. This "sensitization" to epoxy is an unpleasant experience and is to be avoided. You generally have to get epoxy on your unprotected skin to become sensitized. If you use a protective barrier skin cream like Ply No. 9, or disposable plastic medical examination gloves, the allergy can be avoided. The barrier skin cream also allows you to clean up with soap and water after a layup.

The Safe-T-Pox epoxy systems are very low toxicity. However, a few people (about 1 percent) may be sensitive to epoxy. These people can get some help by using doctor prescribed anti-allergy medicines and/or by using elaborate masks/multi-gloves, etc, to reduce exposure. Remember to always use skin protection and never let epoxy come in contact with bare skin, even if you have no reaction to it. Sensitivity is accumulative, such that you may later develop an allergy unless you protect your skin.

DUST PROTECTION

Sanding or grinding fiberglass and foams creates dust that can be harmful to your lungs. Use a dust respirator mask for these operations. Disposable dust masks are available at most paint stores.

VENTILATION

Mix and work your epoxy in a ventilated area. If your shop is not ventilated, set up a small fan to move a small flow of air in or out. Do not hotwire urethane foam.

HEAT DEFORMATION AND CREEP

Several builders have had flying surfaces warp or bend due to being poorly supported until fully cured. Do not hang or support them at each end for long periods as they may "creep" or slowly deform. Store them leading edge down with support in at least three places. Your surfaces can be better protected against "creep" if you post-cure them. Sailplane manufactures do this by putting the entire airplane in an oven at 160°F. You can do it as follows: After you have painted on the black primer put the wing or canard out in the sun. Be sure it is well supported in at least three places along its span. At noon a black surface can reach 140 to 180°F. giving it a relatively good post-cure. After the post-cure, the structure is more stable for warping or creep. If you have a wing or canard that is twisted wrong, apply a twisting force in the opposite direction before and during the post-cure (weights applied to boards,Bondoed or clamped to the surface can be used). Remove the force only after the surface has cooled. A 200 ft-lb torque (50 lb weight on a 4 ft arm) applied twice, once while the top surface is post-cured and once for the bottom, surface, can twist your wing or canard over one degree. The twist correction will be permanent and will stay as long as the surface remains cool (below the post-cure temperature). This is generaly referred to as the heat-deformation characteristic of the epoxy. If it is room-temperature cured only, it will soften above 140°F. But if post-cured it will not soften until over 160°F. Heat for post-curing or for intentional deforming can be applied by other means such as heat lamps, hair dryers or electric radiant heaters (household type), however this is generally not recommended, since it is too easy for the homebuilder to get the part too hot and ruin the part. The foam is damaged above 240°F. If you want to use these heat sources, do so by applying the heat very slowly and checking the temperature often by placing your hand on the surface. If you can hold your hand on the surface five seconds without pain, the temperature is okay-three seconds is too hot.

AIRCRAFT MEASUREMENT REFERENCE SYSTEM

To ease the engineer's task of defining where things go in these odd-shaped gadgets called aircraft, a fairly standard system of references has been developed. Fortunately the Q2 is so simple that an eleborate measurement system is not necessary. It is, however, convenient to use the standard terminology for reference occasionally and you should be familiar with its meaning.

The three basic references are called butt lines, fuselage stations, and water lines. Don't blame us for the absurd names, we didn't set the system up. All three are given in inches from some arbitrarily chosen reference, so, fuselage station 100 is found 100 inches away from fuselage station 0, and similarly for butt lines and waterlines. Being as lazy as anybody else, we abbreviate these as FS, BL, and WL.

Fuselage stations (FS) are used to define the location fore and aft on an airplane. To make things easy, fuselage station 0 is generally located near the nose of an airplane and measurements are made aft. Fuselage stations are the most commonly used of the references and later on you will make a reference mark on your airplane to use as a permanent FS reference point.

Waterlines (WL) are used to define vertical locations. Waterline 0 is generally found near the ground and measurements are made up from WL 0.

Waterlines are utilized in many places to position components or templates relative to each other by leveling reference waterlines with a carpenters level.

Butt lines define positions inboard and outboard. Butt line 0 is the vertical centerline of the airplane and measurements are taken to the left and right of BL 0. Since left and right depends on which way you are facing, it is standard practice to define left and right as the pilot would while seated in the cockpit.

Using these three references, any point in an airplane can be described with a fuselage station, butt line, and waterline. Fortunately, your Q2 is so simple that we don't need to locate very many things this way. When you start on your 4/5 scale replica of a B-1 Bomber, this reference system will be real handy.

SURFACE FINISHING

INTRODUCTION

Finishing the composite airplane is more important than simply obtaining an attractive paint job. The finish on a composite aircraft serves to protect the structure from deterioration due to ultra violet radiation (sunlight). The finishing materials also give the airplane its final aerodynamic shape. Using the proper materials and techniques, the finishing process is pleasing (both esthetically and aerodynamically), and provides for long maintenance-free service. Use of sub-standard materials can limit the life of the finish, result in an overweight airplane, and even limit the service life of the airframe. Sanding is done frequently during the finishing process and extreme caution must be exercised to avoid damaging the structure. A poorly executed finishing job can destroy the structural integrity of the airframe. Even the finished color of the composite aircraft can effect its structure. The finishing process is as important to the structure of the composite airplane as basic materials and techniques used in fabrication are. Proper techniques must be adhered to for safety as well as to obtain an attractive airplane.

The Q2 is sensitive to weight growth. You may easily add 50 pounds during the finishing process if you try to finish the entire aircraft to sailplane standards (smooth, wave-free surfaces).

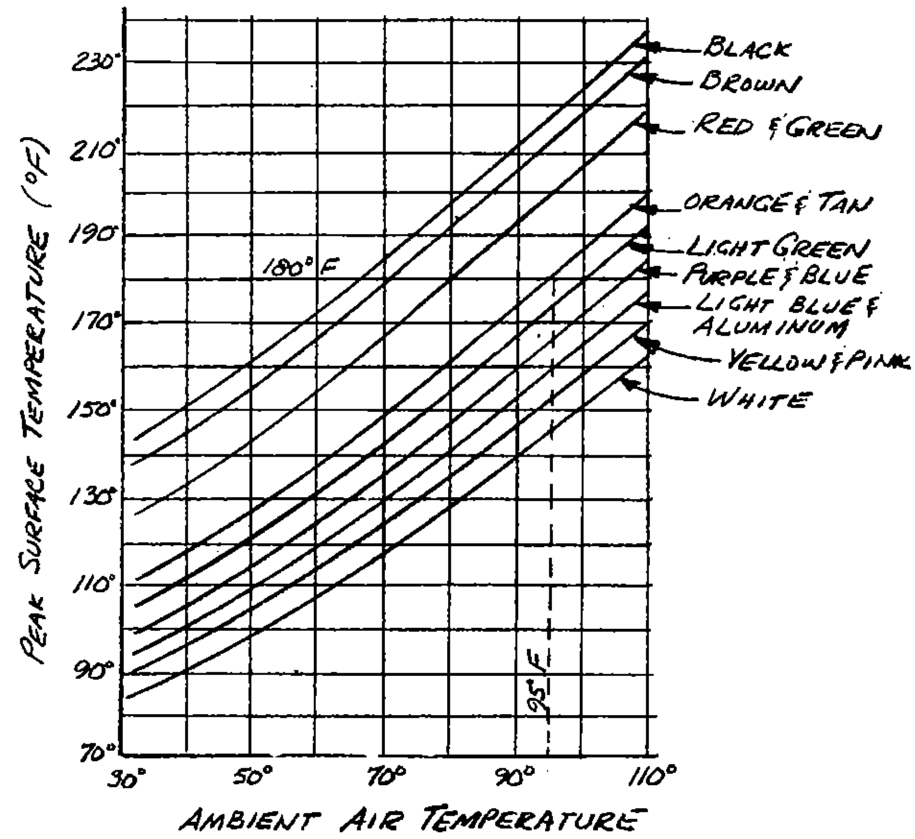
There is one part of the aircraft that must be finished to a smooth and wave-free surface - the canard. We have found that unless the canard is smooth and wave-free, serious degradation of performance and flying qualities results. This section will tell you how to obtain a smooth and wave-free finish on the canard.

The rest of the airplane, in order to keep it as light as possible, should be sanded with very little filling, then primed. and then painted. This will allow some of the fiberglass weave to remain showing, but your Q2 will still look good.

Remember, build it light and finish it light; every pound of weight that you save during the construction and finishing will make the aircraft much more fun to fly in the coming years.

FINISH COLORS AND HEAT

The materials used in amateur-built composite airframes are predominately epoxy resin systems with fiberglass reinforcement over a variety of plastic foam cores. The epoxies and the foams are all sensitive to high temperatures. Some epoxies, cured at elevated temperatures, retain their physical strength to temperatures not found outside an oven. Others, including most room temperature curing epoxies such as the Safe-T-Pox system, soften and loose their rigidity at only moderate temperatures. The common plastic foams are also heat sensitive and tend to soften and (some) swell with moderately elevated temperature. Elevated temperatures could potentially cause a softening of the fiberglass load bearing material, a swelling of the foam core, and general distortion of the airframe. To achieve elevated temperatures you would have to bake your airplane or find some other means of heating it. The sun is a potential source for this heat. In still air, on a hot sunny day it is possible to obtain surface temperatures that approach 250°F. The color of the surface determines how much solar heat it will absorb. White surfaces absorb very little (10%) of the sun's heat while a black surface (95% absorbsion) will heat up tremendously. The accompanying graph shows the relationship between color and surface temperature. White has been choosen as the standard color for fiberglass sailplanes to preclude any possibility of excess temperature due to solar heating. The same criteria apply to the Q2, and white is recommended. Trim colors in less-critical areas such as the fuselage, vertical tail, and the underside of wings and canard, can be other than white. Dark trim colors are definately not recommended on the upper surface of wings and canard! If you would like further information on the subject read the September 1975 issue of Soaring magazine.



COLOR CURVE

(REF: SOARING: SEPT 75)

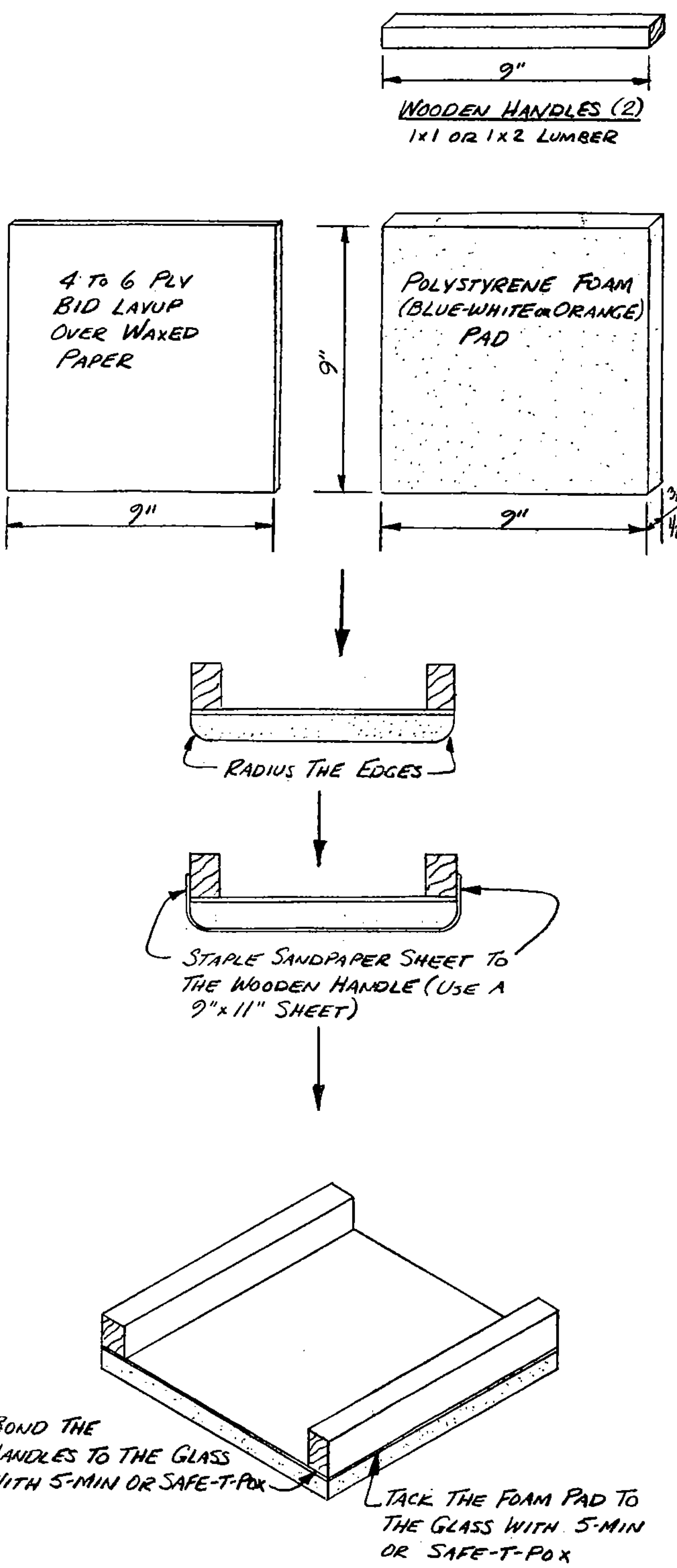
TOOLS AND MATERIALS

The tools and materials used in finishing the composite airplane are simple and straight foreward. A low density microsphere/epoxy mixture (dry micro) is used for coarse filling requirements. Automotive type polyester body fillers (Bondo) are very heavy and not recommended as a primary aircraft finishing material. Medium to light surface filling (less than .030") is done with a light weight polyester spray (or brush) filler/primer called Feather-Fill. Feather-Fill is noteworthy for its ability to fill medium thicknesses in a single spray or brush coat and for its easy sanding to a smooth surface. Dupont 70S dark gray laquer primer/surfacer provides an effective ultra violet radiation barrier with its 15% carbon-black content as well as an excellent finish sanding surface in preparation for the finish paint. The actual finish paint type is largely a matter of the builder's personal preference. Automotive finishes in laquer, enamel, acrylic laquers, acrylic enamels, and the polyurethanes are all acceptable. We find the acrylic laquer is easy to work with, easily patched, and readily polished to a high gloss.

The enamels and acrylic enamels are low cost and easy to apply; however, they are not readily repairable if chipped. The polyurethane finishes offer the best gloss for the longest life, but they are high cost and virtually impossible to repair. There is a polyester paint, known as Prestek, commonly used in sailplane circles to achieve a glass-smooth finish, but it is heavy, requires a tremendous amount of work to get a high gloss finish, and chips easily (brittle).

Sanding will occupy a large percentage of the time spent finishing the composite aircraft. Sandpaper in 36 to 60-grit, 100-grit, 220-grit, and 320-grit roughnesses will be used. Standard 9"x11" sheets are the most versitile. Use a good quality aluminum oxide, or silicon carbide sandpaper. Don't waste your money on the cheap flint-type sandpapers. Power sanders are not recommended; it is too easy to damage the structure while using them. Hard (wood) and soft (foam) sanding blocks and the sanding spline shown will be your primary finishing tools. A paint spraying setup will be desirable for feather fill, U.V. barrier primer and finish painting. Some hand brushing of feather fill and U.V. primer can also be done.

The sanding spline is a finishing tool common to the sailplane industry. It is an easy tool to make and does an excellent job of contouring. You may find it handy to make two, one for coarse grit sandpaper and one for medium or fine sanding. The spline is an easy tool to use but it may require your close attention at first. The spline is always held with handles parallel to the leading edge of an airfoil surface (wing, canard, etc.) as shown in the sketch. The sanding motion is on a diagonal to the leading edge while the spline's handles are held parallel. This takes a little getting used to but becomes second nature after a little practice.



SANDING SPLINE

THE FINISHING PROCESS

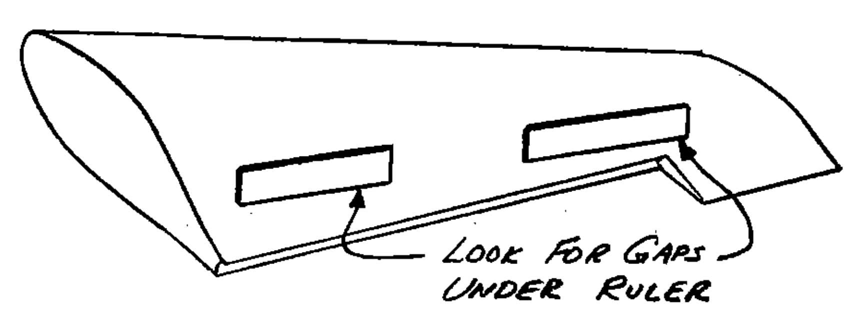
Finishing the composite airplane is a five-step operation. Repairs or rework of structure must be completed first, before the obscuring finish is applied, and final structural inspections must be complete. Second, coarse contour filling is done with microspheres/mixed with epoxy (dry micro) as required in areas requiring .03 inch to .20 inch of fill. Any exceptionally gross filling (over .20 in) is also accomplished at this stage using a foam filler. The initial contour sanding begins with the cured microsphere filler, and exceptional caution must be exercised to avoid damaging the structural skins while sanding. Third, featherfill is applied to fill medium sized surface defects up to .03 inch, and as a general fill of the glass surface weave. The fourth step is the application of an ultra violet barrier primer. Fifth, the final finish paint is applied.

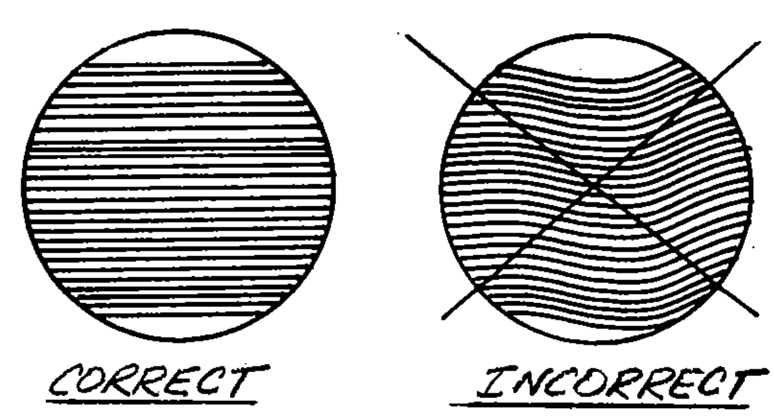
The following sketches are descriptive of the finishing process and its potential pit falls. The sketches use an exaggerated scale to show details more clearly.

STEP ONE: INSPECTION/REPAIRS

Before you begin finishing, the entire structure must be airworthy. You can hide poor workmanship from your own eyes and from the inspector who will finally approve your first flight, but you can't fool mother nature! All structure must be sound before finish materials are applied. The following sketches are a review and clarification of the quality control criteria found in Chapter 3 . Each airplane must have a thorough inspection and required repairs completed as the first step in finishing.

The best way to inspect the structure for bumps or dips is to place a 12" ruler on the wing or canard span-wise, as shown. Gaps under it approaching 1/16" height must be repaired.





UNI FIBERS SHOULD BE STRAIGHT, NOT KINKED, DISRUPTED, OR CROOKED

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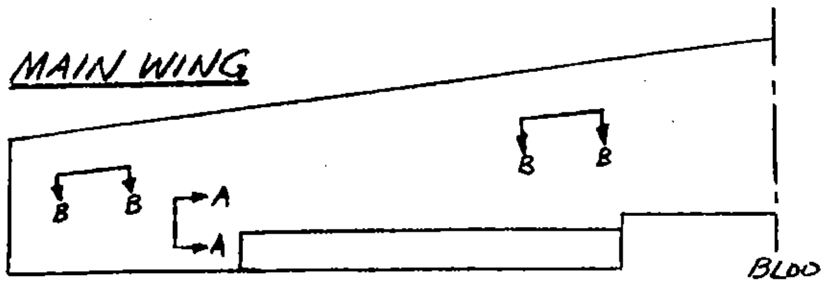

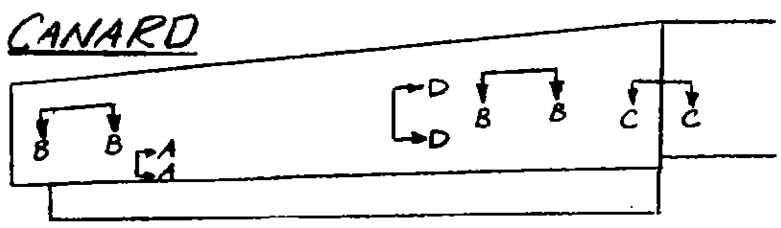

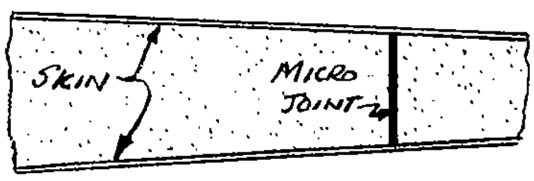

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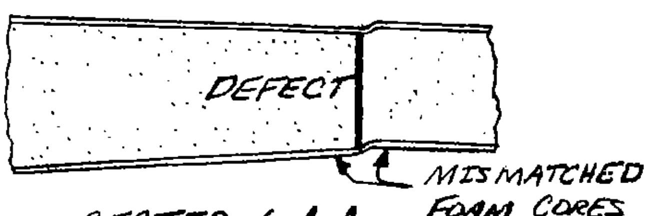

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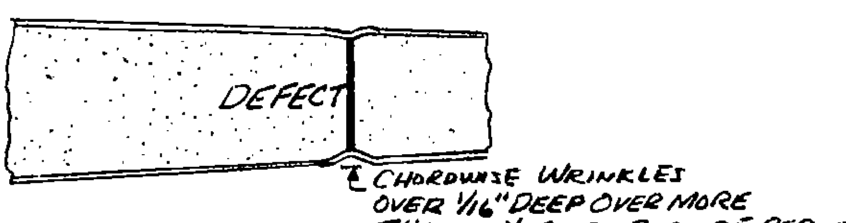

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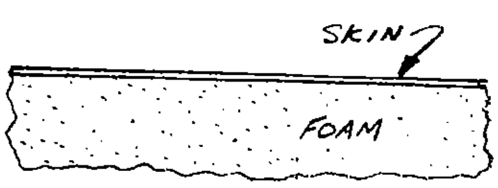

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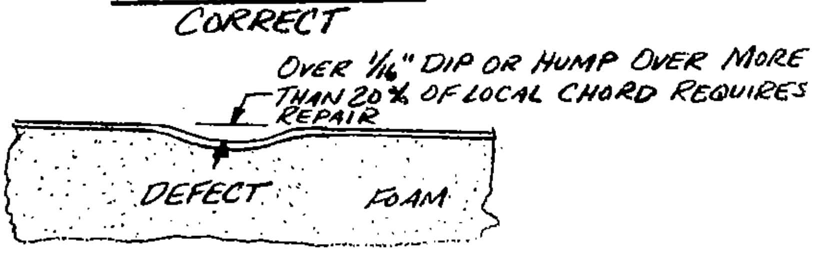

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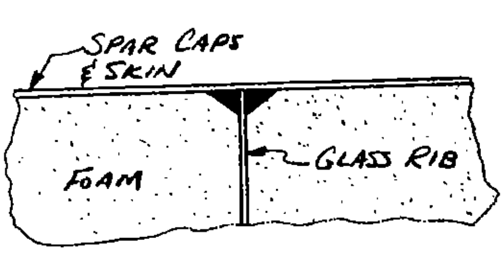

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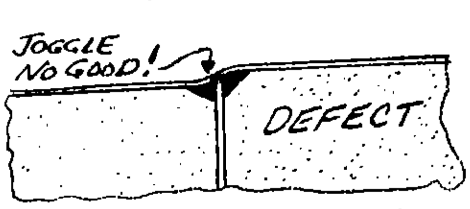

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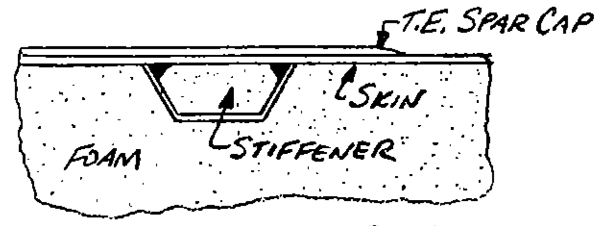

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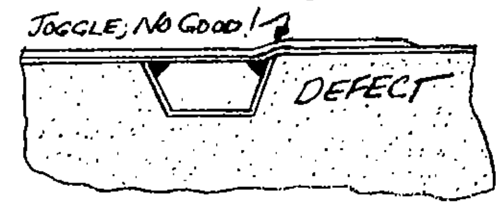

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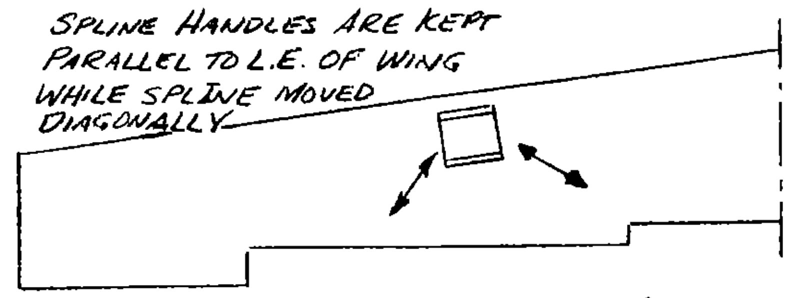
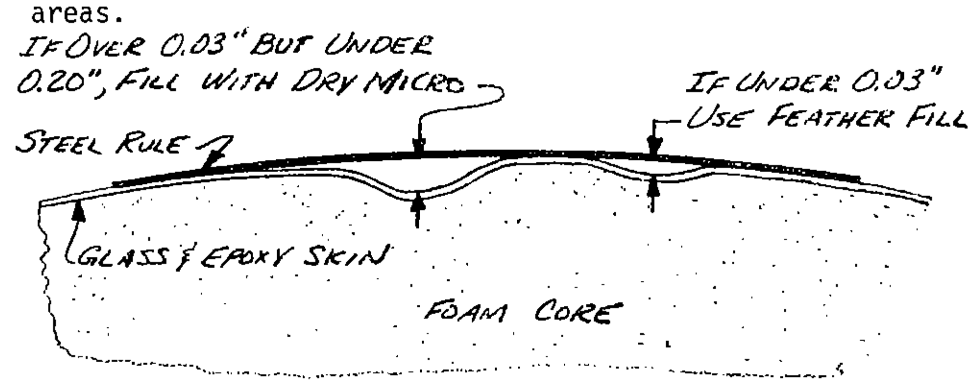


SPLINE MOTION

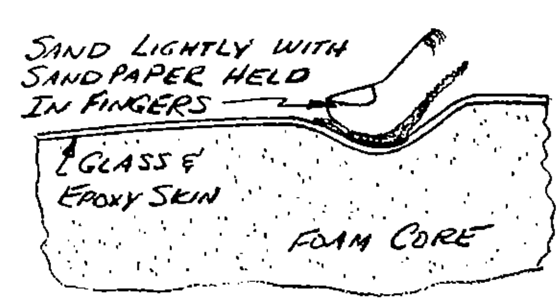
STEP TWO: COARSE FILLING

You must be extra cautious in this step or you may destroy your structure. When you take a peice of sandpaper and start grinding on your composite structure it's like using acid to clean a metal wing spar. It must be done carefully!

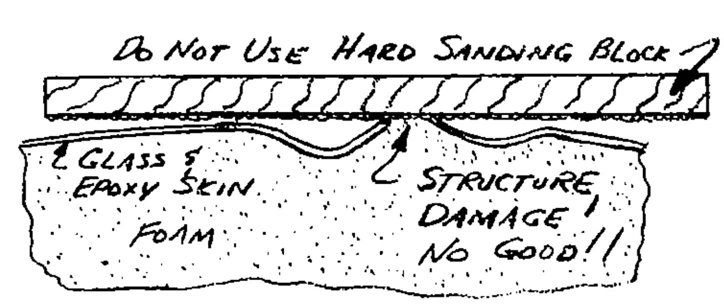
Start by determining which areas require micro filler as shown using a flexible yard stick and a scale. Prepare the areas to be filled by hand-sanding lightly. Do not try to use a sanding block or spline on these areas.



INSPECTION



PROPER SANDING



IMPROPER SANDING

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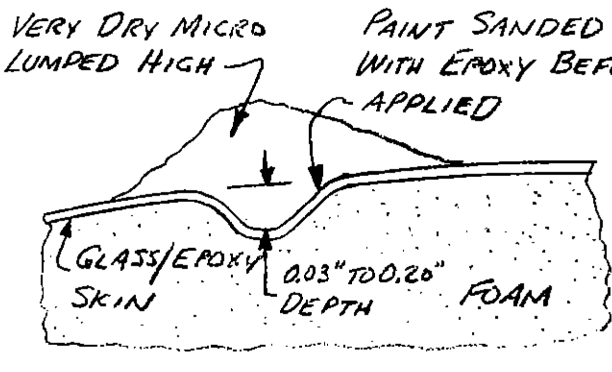
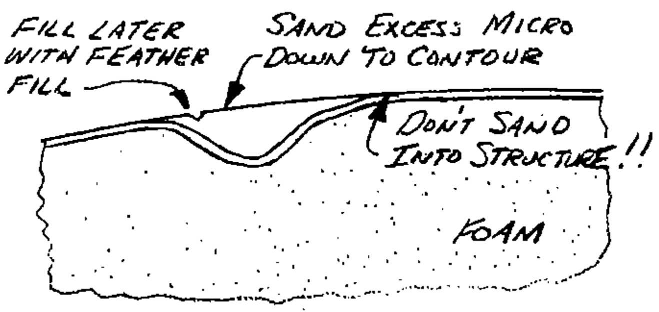
Paint a thin coat of epoxy over the area to be filled. Dry micro is then lumped over the area. The fill must be high, such that material is sanded away to bring the area into contour. The micro should be mixed very dry (lots of microspheres) to save weight. Let the micro cure at least 24 hours.

Sand the micro overfill into contour using a hard sanding block, or spline with coarse (36 to 60-grit) sandpaper. Exercise extreme caution while sanding. A few careless strokes with coarse paper can ruin your structure!

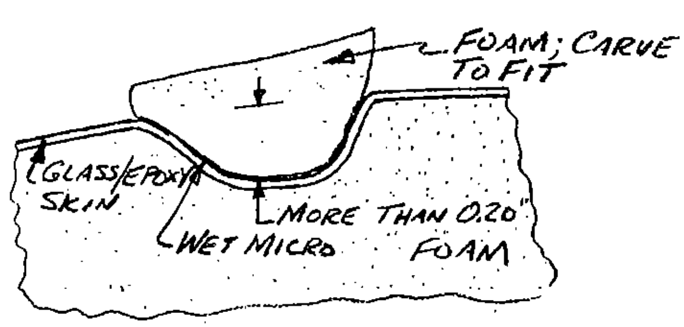


0.03" TO 0.20" FILL

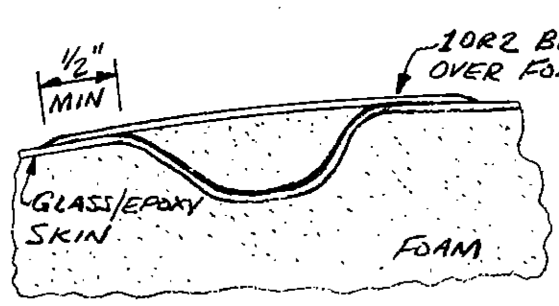


SANDING

NOTE: USE A HARD SANDING BLOCK, SOFT BLOCK, OR SPLINE WITH COARSE 36-60 GRIT SANDPAPER.



OVER 0.20" FILL



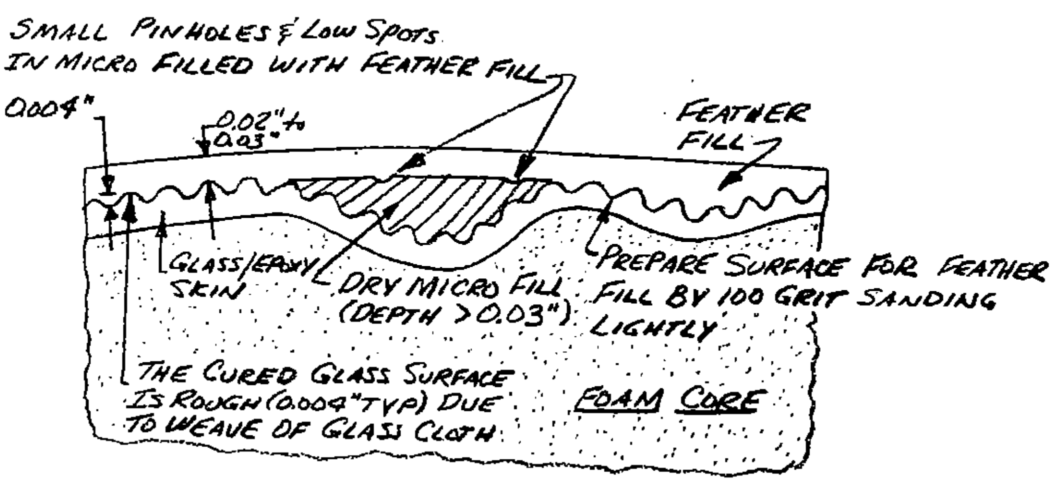
SANDING/GLASSING

STEP THREE: FEATHER FILL

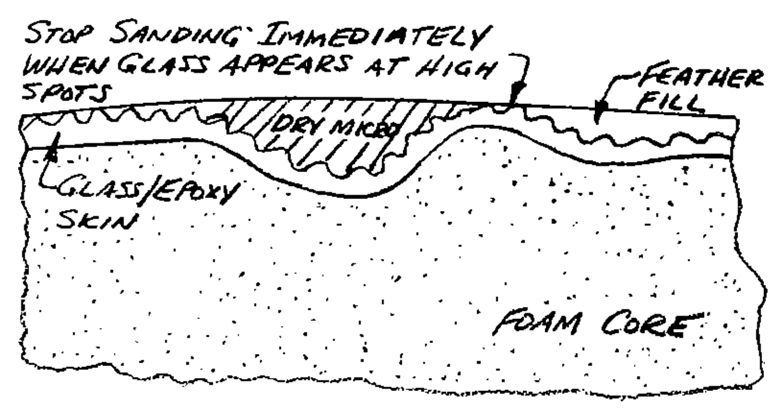
Sand the surfaces lightly by hand or with a soft foam sanding block in preparation for feather fill. A spray or brush coat of feather fill will build up .02" to .03" thick, fill the glass weave and any medium sized out-of-contour spots. Feather fill will require several hours curing time before it can be sanded. The cured feather fill is sanded to contour using a spline or soft block and 100-grit sandpaper. Again, extreme caution must be exercised not to damage the glass structure in pursuit of a good finish. The contouring must stop immediately when the highest glass peaks begin to be visible as the feather fill is sanded away.

If you find that you have underestimated the fill required or just have a thin coat, don't hesitate to use a second coat of feather fill. A well prepared surface generally won't need more than one coat. When you have finished contouring the feather fill, the surface should be basically smooth and fair. The primer to follow is not intended to be contoured heavily, just smoothed with finer sandpaper for a smooth finish while leaving a substantial ultra violet barrier.

After you have filled and contoured, reinspect for sanding damage; it is an easy thing to do! Remember, you are only allowed to sand into the first skin ply in local areas no greater than 2 inches in diameter and all of these areas must total less than 10% of the surface area. Wherever there is only one ply, or where the UNI cloth is crossed for strength (e.g. the canard and wing skins), no sanding of the ply is allowed, except for "scuffing up" the surface. Be Careful!



APPLICATION



SANDING

STEP FOUR: PRIMER

The ultra violet radiation barrier is provided by the heavy carbon black content of the dried primer (Dupont 70S). The primer gives the whole surface a flat black color and the sanding should never remove it completely, exposing the light gray feather fill below. The primer is sprayed on, allowed to dry, and sanded lightly to achieve a smooth surface. The first primer coat is sanded using 220-grit and the second coat very lightly wet sanded with 320-grit. When complete, the primer is very smooth, dark, and ready for finish paint.

STEP FIVE: FINISH PAINT

Follow the manufacturer's directions for the type of finish paint that you have chosen.

COCKPIT INTERIOR

It is not necessary to fill the glass weave, although some very light sanding may be done to smooth the surfaces. Apply one coat of the Dupont 70S primer to the interior glass surfaces for ultra violet protection prior to painting the interior.

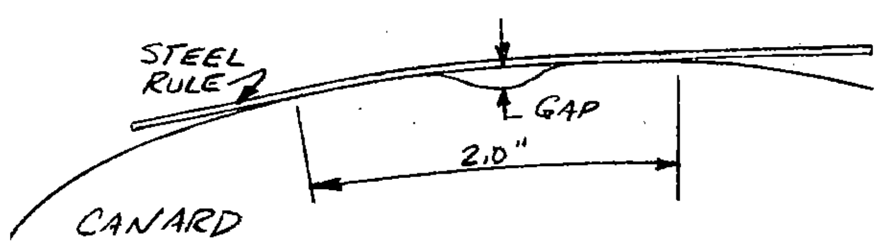
A light color (light grey, green, or blue, etc.) is recommended on the cockpit interior to avoid high heat buildup when the aircraft is parked in the summer sun with the canopy locked. Automotive trunk paint may also be used. Its "speckled" appearance will hide the weave of the glass cloth.

CANARD SURFACE SMOOTHNESS IS CRITICAL

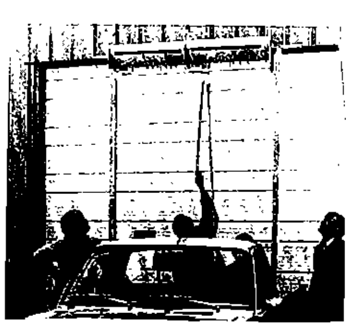
During the Quickie program we built and installed a canard that resulted in very poor low-speed performance. Stall speed was 10 mph higher than predicted and tuft tests showed stall angle-of-attack over three degrees lower than extimated. We later traced the problem to a wavy upper surface; the canard must be smooth.

Of course, the big question is "how smooth"? The best way to check this is with a steel pocket ruler, the flexible kind that's only .02" thick, or with a plastic drafting ruler. Hold the ruler as shown in the sketch, pushing it to the surface with two fingers 2 inches apart. If the surface is a smooth curve between your two fingers the ruler will lay down following the curve with no gaps. If the surface is bumpy or wavy the ruler will touch the surface only in 3 or 4 places. Take a feeler gauge to measure the gaps between the ruler and your surface. If you have a gap of more than .005 inch, your surface is too wavy. Check this in several places from the leading edge back to 50% chord. The bad Quickie wing had gaps of about .012 inch. After refinishing with gaps of less than .005 inch, its stall angle of attack increased from 8 deg. to 12 deg!

The best time to use the ruler and check for smooth surface is when sanding the Featherfill with the spline. Recheck after sanding the 70S black primer. It will not change when white paint is sprayed on.



CANARD WAVINESS TEST



AMATEUR-BUILT Q2INSPECTION CRITERIA

1.0 SCOPE

This document has been prepared to assist inspection personnel by providing recommended acceptance criteria and acceptable repair practices for the Q2 amateur-built composite sandwich structure.

2.0 BACKGROUND INFORMATION

2.1 DESIGN CRITERIA

The materials, methods, and practices employed by the amateur builder in the construction of the Q2 type are new to light aircraft construction and may be unfamiliar to the inspection personnel involved with the licensing of amateur-built aircraft. Structural design criteria for the Q2 exceed F.A.R. part 23 requirements. In-house component testing of the primary flight structure has been conducted to 200% of design limits. Detail documentation of test data is on file at Quickie Aircraft Corporation. The aircraft is considered to be a utility category aircraft. Q2 builders are being supplied with a complete owner's manual which specifies all placards, operating limitations, normal and emergency operations, flying qualities, maintenance sp cifications, inspection procedures, and initial flight test procedures.

2.2 STRUCTURAL APPROACH

The basic structure throughout the design is a composite sandwich of load bearing fiberglass skins separated by a light-weight foam core. While the materials and processes are tailored to the amateur builder, the structural layout is very similar to the honeycomb composite structures stilized in military and transport type aircraft and fiberglass sailplanes. Loads are carried by epoxy/"E"-type fiberglass lamina. Foams of various types and densities are employed as a form (upon which the load bearing material is shaped) and as local buckling support. In no instance are foams used to transmit primary loads, as is the case in some other amateur-built designs.

2.3 INSPECTION TECHNIQUES

The transparent nature of the fiberglass/epoxy material allows for visual inspection of primary structure from the outside prior to finishing. Defects in the structure, as described in paragraph 3.0, are readily visible even in the deepest laminate.

2.4 INSPECTION SEQUENCING

The external visual inspection capability provided by the materials allow inspection of all primary structures at any point before finishing. All primary structures are at the surface, eliminating the requirement for "pre-cover" or "closure" inspections. Opaque filler materials are used throughout the airplane in finishing, and inspection must take place before any areas are obscured. Some areas may have opaque materials applied to one surface where the structure is inspectable from the opposite side (wing trailing edge for example).

3.0 DEFECTS

3.1 VOIDS

Interlaminar voids in a new layup may be due to small air bubbles trapped between plies during the layup. These void areas look white and are distinctly visible even deep in a cured layup. Interlaminary voids up to 1 inch in diameter do not require repair, as long as they do not consist of more than 5% of the surface area.

Interlaminar voids (airbubbles) up to 2 inches in diameter are acceptable when repaired as follows: A small hole is drilled into the void and epoxy is injected into the void area. Small voids such as this may occupy up to 5% of the laminate surface area.

Voids greater than 2 inches in diameter should be repaired as shown in paragraph 4.

CONTINUED ON NEXT PAGE

3.2 LEAN AREAS
Areas where the epoxy/glass matrix is incomplete because of inadequate wetting of the cloth with epoxy (lean areas) are speckled whitish in appearance. The fully wetted laminate will have a consistant transparent greenish appearance. Epoxy lean areas are acceptable, as long as the white speckled area is less than 10% of the surface area. White to green ratios greater than 10% require rejection or repair as shown in paragraph 4.

3.3 RICH AREAS
Resin richness primarily adds weight to the laminate. While some degradation of physical properties does occur, a overly wet (rich) layup is not grounds for rejection.

3.4 INCLUSIONS
Bristle paint brushes are used throughout the layup process. As a brush begins to deteriorate it will shed some bristles into the laminate. The bristle inclusions, up to 20 bristles per square foot, are not cause for rejection. Occasional inclusion of small woodchips or other small foreign objects is not grounds for rejection.

3.5 FIBER DISRUPTION
In all instances, it is good practice to have the glass fibers lying flat and without wrinkles. Major wrinkles or bumps along more than 2 inches of chord are cause for rejection in the wings, canard, and vertical fin, particularly on the upper surfaces (compression side). Disruptions greater than 2 inches require repairs per paragraph 4.

3.6 FINISHING DAMAGE
Damage to the external structure by sanding in preparation for surface fill and paint can occur. Occasional sanding through the weave of the first skin ply is not grounds for rejection. Sanding through areas greater than 2 inches in diameter completely through the first ply or any damage to interior plies must be repaired in accordance with paragraph 4. A damp rag passed over the sanded surface will make the plies show up to determine how many plies have been sanded away.

3.7 SERVICE DAMAGE
Damage to the glass structure will be evidenced by cracked paint, or "brooming" of glass fibers. Both of these indicators are clearly visible. If either type of indication is present, the paint and filler should be sanded away, bare laminate inspected, and repairs made per paragraph 4 as required. Where surface damage has occured it is also likely that local foam crushing has been inflicted.

3.8 DELAMINATIONS
Delamination of glass/epoxy lap joints is evidenced by physical separation of plies. These defects are easily visible and easily repaired. The leading and trailing edges of flying surfaces (wing, canard, vertical fin) should be free of delamination.

3.9 MULTIPLE DEFECTS
Where multiple types of small defects occur in a laminate (voids, fiber dislocations, and lean areas for example), they should not exceed a total of 10% of the surface area of the laminate, or 20% of the wing chord at any one spanwise position.

4.0 REPAIRS

There are seldom single defects so massive that a major component must be scrapped. The repair procedures described here may be applied throughout the QUICKIE and Q2 composite sandwich structures.

4.1 SMALL VOID REPAIRS
Voids up to 2 inches in diameter may be repaired by drilling a small hole into the void and injecting the void full of epoxy. A vent hole opposite the injection point is required to allow air to excape.

4.2 LARGE DEFECTS
Excessively large voids, lean areas, finishing damage, fiber disruptions, major fiber wrinkles, or service damage may be repaired using this procedure. Remove the rejected or damaged area by sanding or grinding the taper the glass laminate on a slope of approximately 1 inch per ply in all directions. The plies are visible as the sanding is done. The tapered glass edges and surrounding two inches of glass surface must be sanded completely dull. Damaged underlying foam should be removed and the void filled with a dry microsphere/epoxy mixture or a replacement foam piece. The damaged area is then laminated over using the same type and orientation of glass plies removed, each ply lapping onto the undamaged glass at least one inch. The whole repair area is covered with an additiona bi-directional glass ply.

4.3 DELAMINATIONS
A delaminated joint should be spread, the mating surfaces sanded dull, gap filled with flox (epoxy/flocked cotton mixture), then clamped shut while it cures.

5.0 MATERIALS

Since a wide range of similar appearing materials exists which exhibit substantial differences in physical (structural) properties, Quickie Aircraft Corporation has established a distribution system to provide the amateur builder with proven acceptable materials. Quickie Aircraft Corporation strongly discourages the substitution of materials. Homebuilder substitutions for the basic structural materials constitutes major structural modification to the Q2 design, and could adversely effect flight safety.

6.0 APPLICABILITY

These acceptance criteria are different from and, in some cases, much looser than for similar structures found in sailplanes and other contemporary composite structures. These criteria apply only to the QUICKIE and Q2 structutes. Design safety factors in excess of three enable somewhat relaxed acceptability criteria compared to other similar structures.

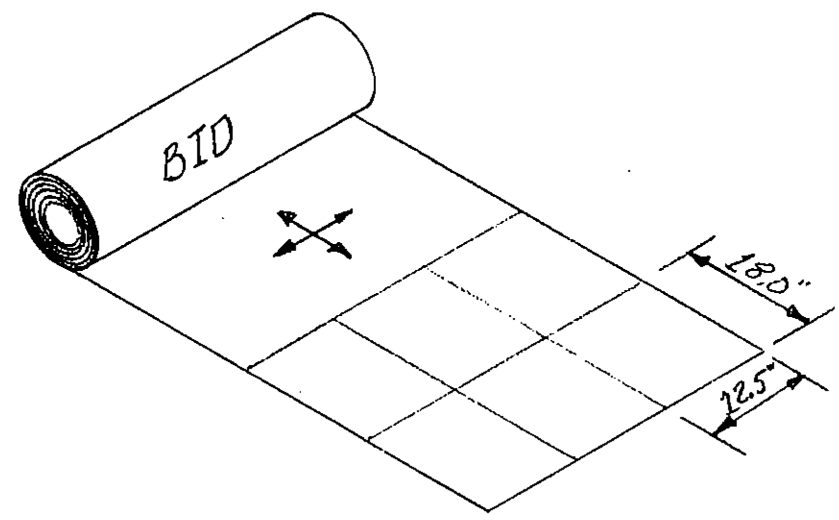
END OF SECTION

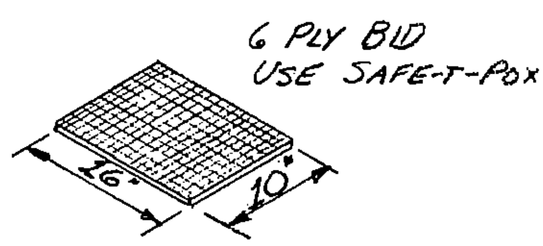
PRACTICE LAYUPS

FLAT LAYUP

The first practice layup that you will make is a layup of six BID plies onto a flat surface. This is intended to give you experience in the techniques of glass/epoxy work and to give you a check on your workmanship. You should be able to complete this layup in about half an hour.

Protect your work bench by taping waxed paper over an area about 24" by 24", (or, find a piece of metal and wax its surface). This will keep the epoxy from bonding to the table top. Cut six plies of BID that are about 12½ inches by 18 inches.





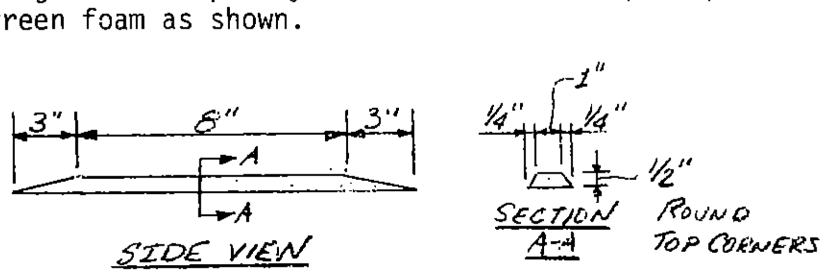
Laminate the six plies on top of the waxed paper. Try to do your best job of stippling and squeegeeing so that the plies are completely wetted but not full of excess epoxy. Let the layup cure to knife trim, about four hours. Carefully mark a 10 inch by 16 inch rectangle and knife trim the layup to that size using a sharp razor blade or trim knife. Allow the layup to cure completely. If you forget the knife trim, cut the cured piece with a coping saw or band saw.

Take the cured 10"x16" piece to your post office, or any accurate scale, and ask them to weigh it for you. Your laminate should weigh between 10½ and 12½ ounces. A 10½ ounce layup is about as light as can be done without voids (white areas). A 12½ ounce layup has too much resin, and if you make all of the layups in the airplane this wet, your Q2 may be as much as 50 pounds over weight. An 11 ounce layup is just about perfect. Save this piece; it will be useful to check future layups against.

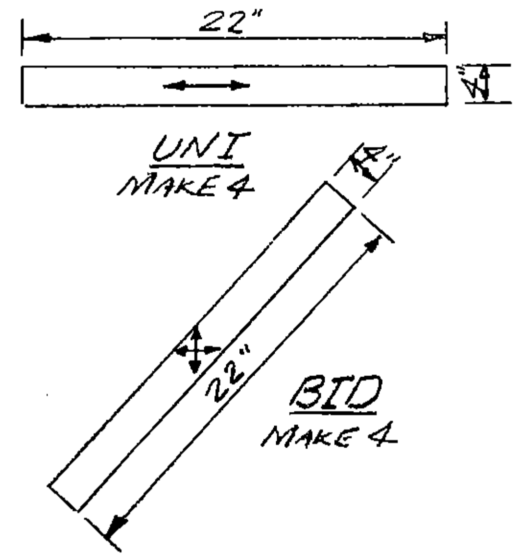
CONFIDENCE LAYUP

The second practice layup is one intended to give you confidence in the strength of your work. This layup is a sample of composite sandwich structure and is typical of the load carrying structures in your Q2. When this layup is finished, and completely cured, you will subject it to a simple load test, and thus demonstrate the strength of your workmanship.

First, tape a piece of waxed paper about 30 inches long to the top of your work table. Shape a piece of green foam as shown.



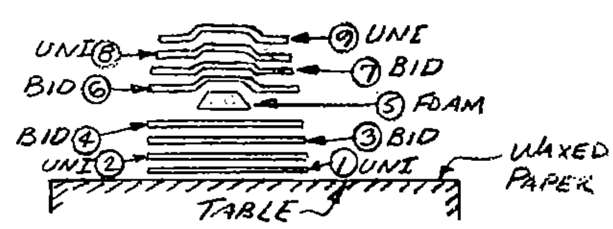
Go to your glass cutting area and cut the glass plies shown.

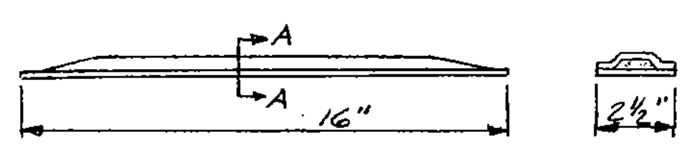


Lay up two plies of UNI, two plies of BID, paint the foam with micro slurry, and press it in the center. Then lay up the other BID and UNI plies.

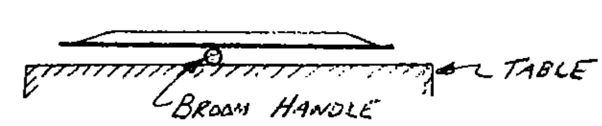
Be careful to work all air bubbles out of the corners. The best way is to stipple with the brush. The glass is oversized so that it can be trimmed to exact dimensions later. Trim to the dimensions shown after curing 24 hours, using a coping saw or band saw.

Allow the piece to cure for four days at room temperature before the load test.



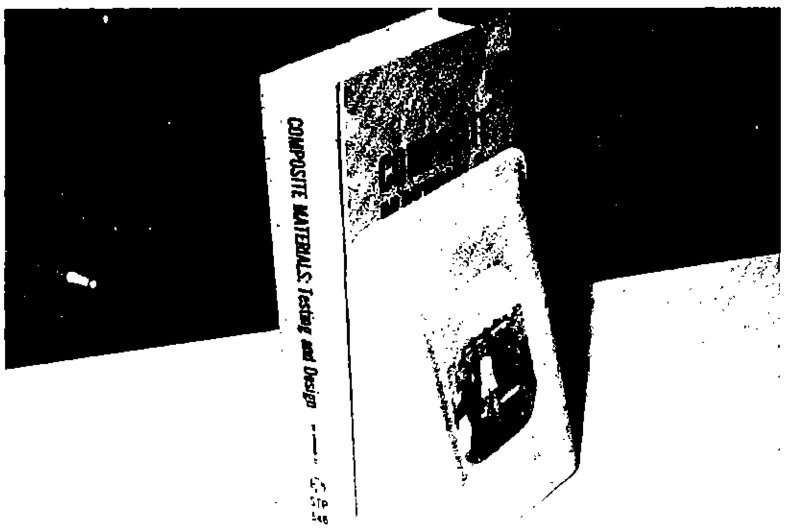


Now for the test: lay a broom handle or piece of tubing on the work bench and try to break the sample by putting all of your weight on the ends. A 200 pounder will stress the sample more than any part of your airplane is stressed at 10 g's.



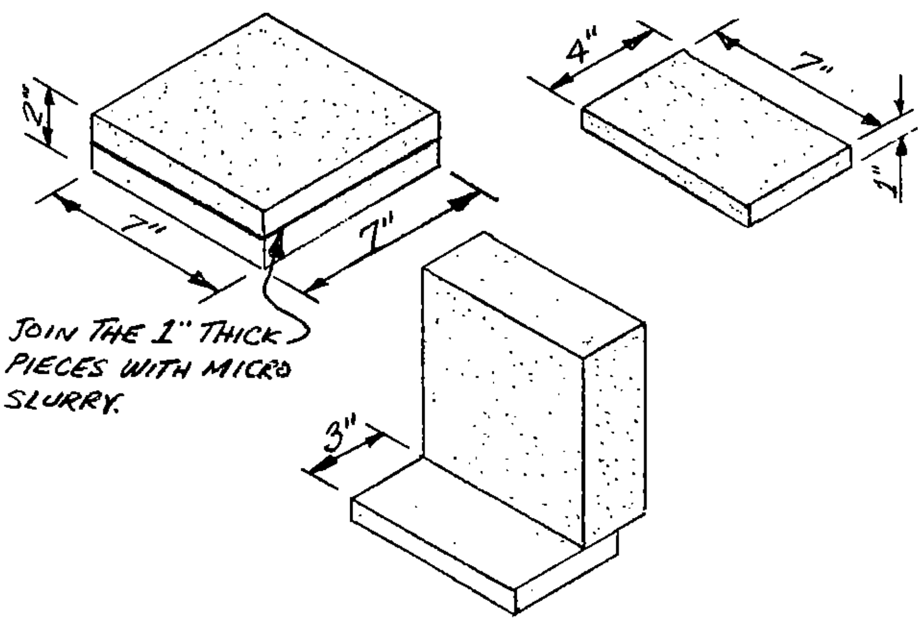
BOOK END

The last practice part that you will make before starting on your airplane is a book end. It takes three layups to make the book end and involves most of the operations that you will need to learn, to build your airplane.

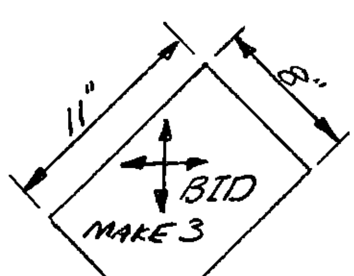


Cut the 3 blocks of green urethane foam (2lb/ft3) as shown.

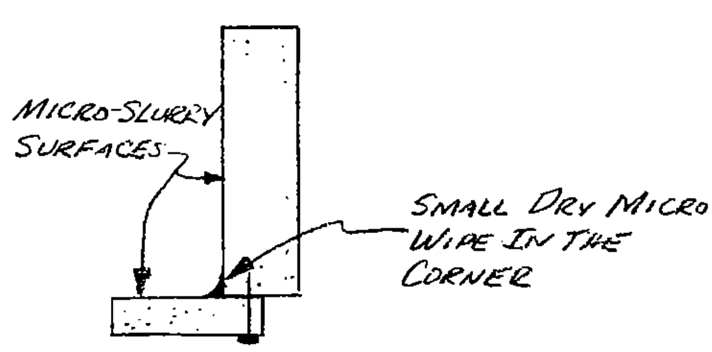
Nail them together.



Cut three plies of BID as shown.

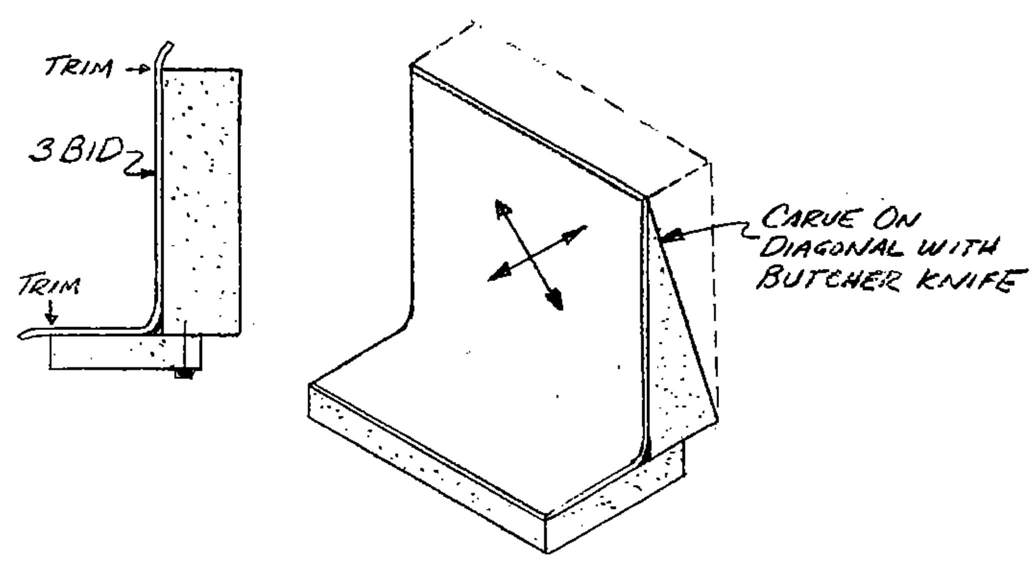


Mix 4 oz. of Safe-T-Pox epoxy; using about 1 oz, make a small batch of micro slurry and coat the foam as shown. Make dry micro from the leftover slurry and a small radius with it as shown.



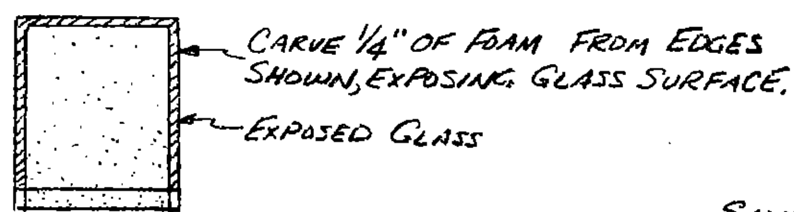
Lay up the first ply of BID as shown.

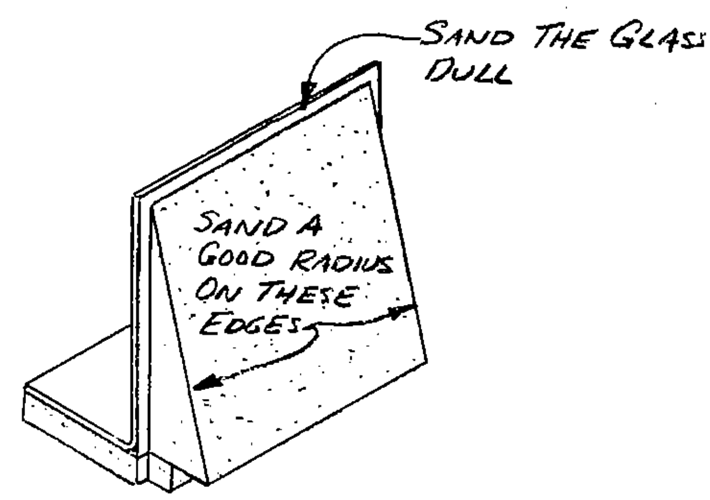
Using plain epoxy (no micro), lay up the other two plies and allow to cure. Note how the 45° fiber orientation allows the glass to lay down completely into the small radius.



Knife trim along the foam edges.

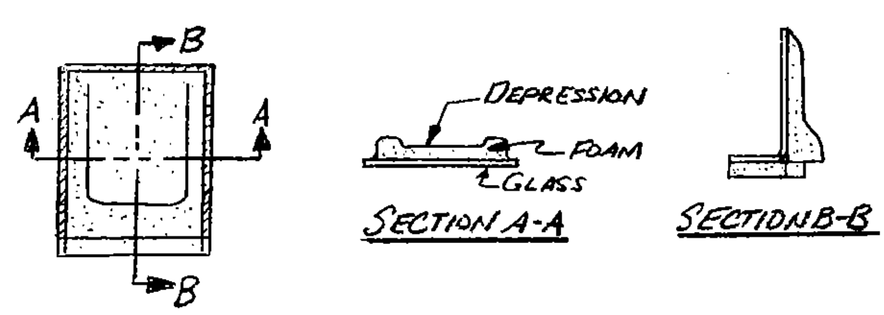
After the first layup has cured and the edges have been trimmed, the thicker foam block is carved and contoured as shown.



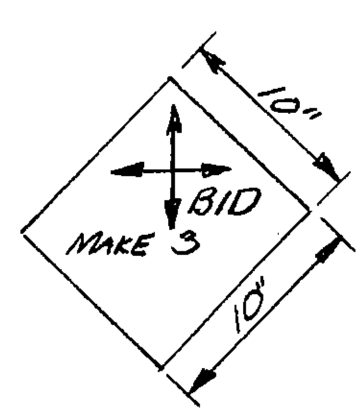


Put a generous radius on the foam edges and sand the ¼" wide glass edges dull for glass to glass bond. Use your wire brush to rough out a depression in the middle of the block.

Finish smoothing the depression by rubbing it with a scrap of green foam. Radius the corners of the depression. Blow or brush all of the foam dust off the surfaces.



Cut three plies of BID as shown.



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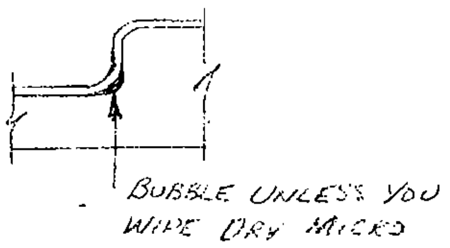
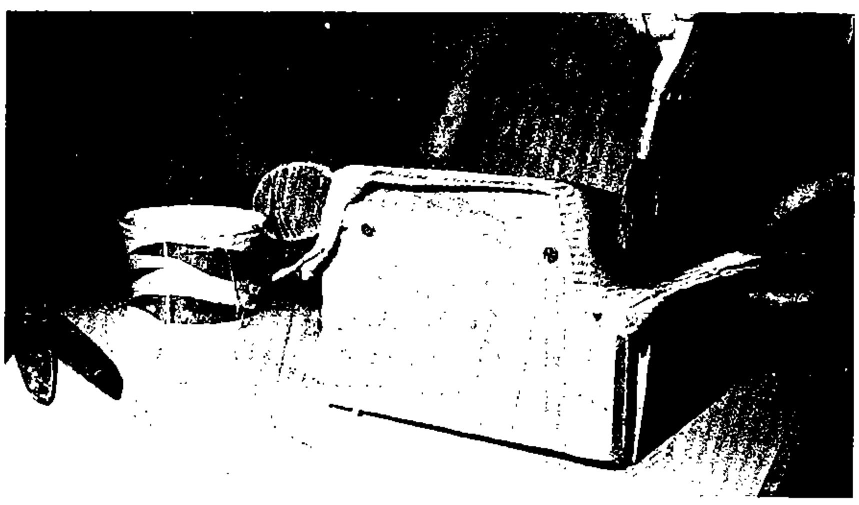
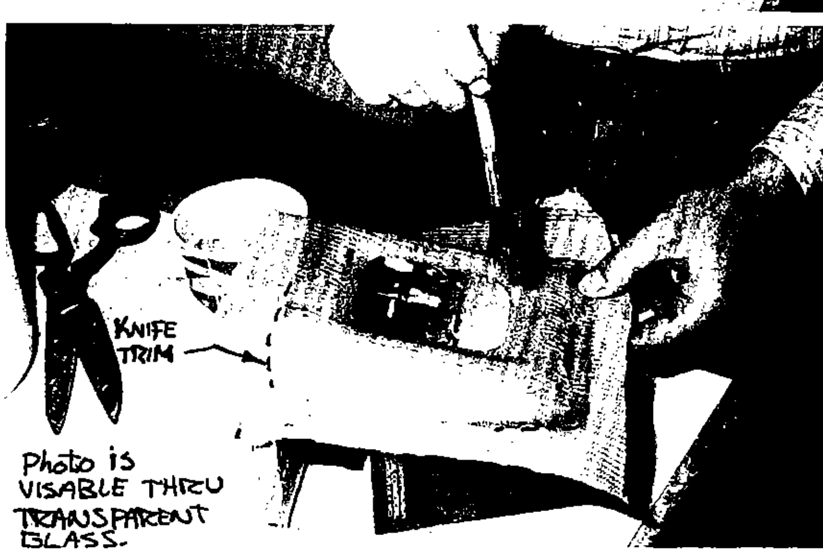
Mix Safe-T-Pox, make a small batch of slurry, and save the remaining epoxy. Slurry the foam surface and apply two plies of BID to the contoured surface. Start the layup in the center and work out toward the edges. If you have trouble getting the glass into the depression corners without bubbles, lift the plies and wipe in a little dry micro. You will then find that it will lay smoothly in without voids (see sketch). This depression is sharper than any in your airplane and is intended to give you a feeling of how sharply you can form the cloth.

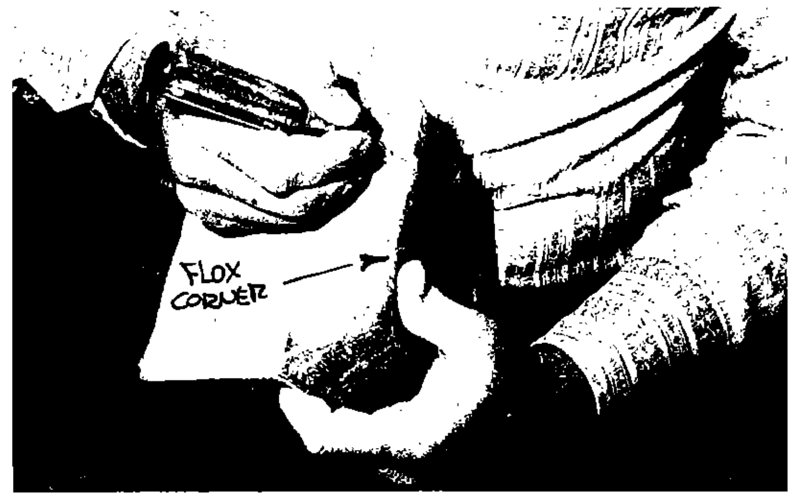


Before laying the third BID ply down, place your favorite photo in the depression, and then lay the third BID ply over it. Scissor trim the excess glass cloth. Allow to cure and knife trim the edges. The lower edge is trimmed flush with the bottom of the foam block.

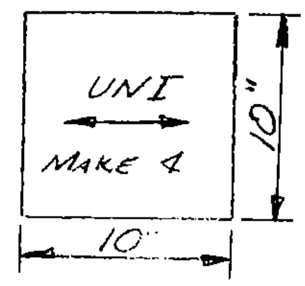


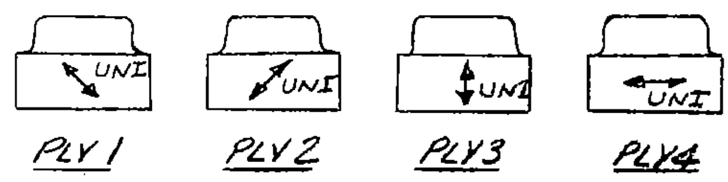


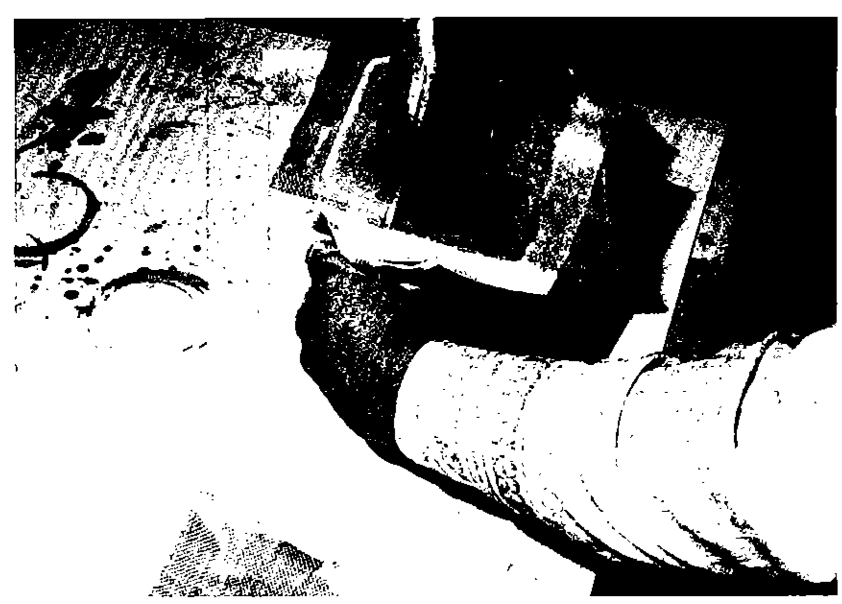
Wait until the second layup is fully cured. Remove the 1 inch foam block with a butcher knife and sanding block. Remove foam for a ¼" flox corner and sand the glass surface dull.



Mix Safe-T-Pox, a small batch of flox, and a small batch of micro slurry. Fill the corner with flox and slurry the foam. Lay up the four UNI plies with the orientation shown.





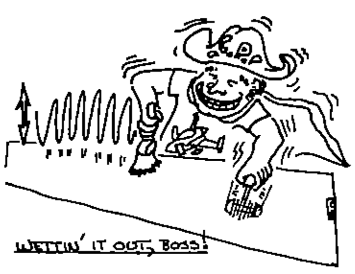


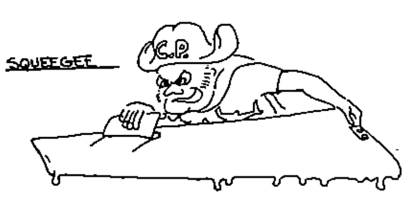
Knife trim the edges. After 12-hour cure, sand the edges with 100-grit sandpaper as required for smoothness and good appearance.

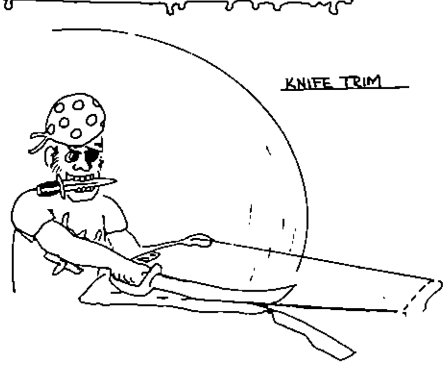
It may at this time seem a bit ridiculous to use three layups, about four hours work, and two days cure, just to make a book end! But remember, this book end was not designed for ease of construction; it was designed instead, to let you get a first hand exposure to the following operations before starting on your airplane; glass cutting, foam preparation (slurry), BID and UNI layups, flat surfaces, corners, and compound curves, flox corner, knife trim, concave and convex foam carving, glass to glass surface preparation, and sanding edges. So, use this experience to your best benefit and spend the curing time studying the plans. Even if you're experienced in glass layups, the book end is a worthwile project to get familiar with the workability of this BID and UNI weave cloth.

EDUCATION SUPPLEMENT

Rip this page out of your plans and staple it to the wall of your shop. While it is a handy reference, it's still a good idea to read all the words in the education chapter once in awhile. Don't skip the details - they're all important.



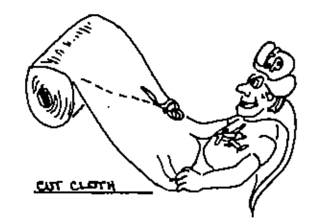


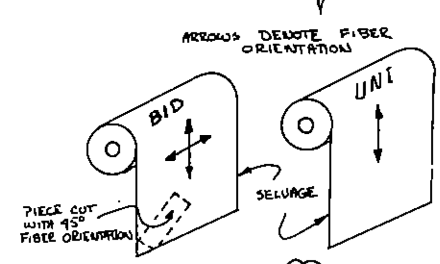


BASIC LAYUP PROCEDURE

1. PREPARATION: Ply 9 or gloves on hands, shop temperature 75° + 10°.
2. CLOTH CUTTING: You can get by with just a standard pair of good fabric scissors, but the job is much easier with the large pair of industrial scissors (Weiss model 20W). They're $25 (gulp!) but worth it in the long run.
3. SURFACE PREPARATION:
   FOAM - Hot-wire-cut surface needs no preparation. Sand ledges or bumps even, fill holes or gouges with dry micro immediately before the layup. Brush or blow away dust.
   GLASS - Always sand completely dull any cured glass surface (36-grit or 60-grit sandpaper). Resand if it has been touched with greasy fingers.
   METAL - Dull with 220-grit sandpaper.
4. MIX EPOXY: Follow all mixing steps shown on your epoxy balance. Mix two minutes, 80% stirring and 20% scraping the sides and bottom. Don't mix with a brush.
   . Micro Slurry - Approx equal volums of mixed epxoy and microspheres
   . Wet Micro - Enough microspheres for a "thick honey" mix.
   . Dry Micro - Enough micro so it won't run.
   . Wet Flox - Thick, but pourable mixture of epoxy and flocked cotton.

   APPLY TO SURFACE:
   Layup Over Foam - Brush or squeegee on a thin micro slurry layer (thick over urethane).
   Layup Over Glass - Brush on a coat of epxoy.
5. LAY ON CLOTH: Pull edges to straighten wrinkles. If working alone on a long piece, roll the cloth then unroll it onto the surface.
6. WET OUT: Don't slop on excess resin; bring epoxy up from below with a vertical "stab" of the brush ("stippling") or a squeegee action. Start in center and work out to sides. Most of the time of a layup is spent squeeging. Stipple resin up from below or if required, down from above. "NOT WET, NOT WHITE."
7. SQUEEGEE: If you have excess resin, squeegee it off to the side. Use squeegee with many light passes to move epoxy from wet areas to dry areas.
8. PRELIMINARY CONTOUR FILL: Save sanding by troweling dry micro over low areas while the glass layup is still tacky. This is done at trailing edges, spar caps, or over any low areas. The low places are overfilled with micro then sanded smooth after full cure.
9. KNIFE TRIM: Save work of sawing and sanding edges by razor trimming the edges at the "knife trim stage," which is about 3-4 hours after the layup.
10. GENERAL INSPECTION: Take a good look for dry glass, excess resin, bubbles, and delamination before walking away from your wet layup.
11. CLEANUP: If you've used Ply 9 skin barrier, you can get all epoxy off your hands with soap and water. Epocleanse is also excellent for removing epoxy and it returns natural skin oils. Brushes - rinse twice in MEK and wash with soap and water. Throw away after two to four uses.





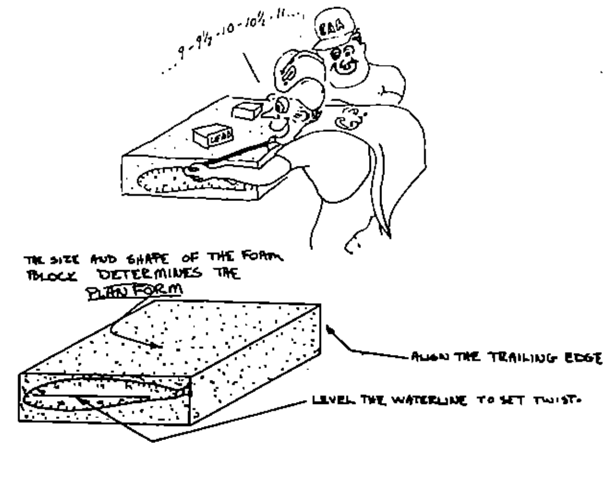
URETHANE FOAM SHAPING

BASIC TOOLS: Sharp butcher knife, sanding block, surfoam file, wire brush and blocks/scraps of urethane. Use a dust mask. Hack away, have fun.

HOT WIRE CUTTING STYROFOAM

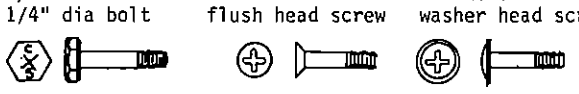
Hot wire tool has a lengths of 56".

Wire must be tight. The adjustable voltage control is best, but the job can be done with 2 12-volt, 6-amp battery chargers or 12-volt car batterys. Foam block must be well supported and weighted. Templates must be nailed on tight. First cut the basic block to size; this determines the planform size and shape. Level the template level lines; this determines correct twist. Set hot wire temperature for about 1" travel through the foam in about 4 to 6 seconds with light pressure. Do the actual cutting at about 1" every 6-7 seconds (8-10 sec. around the leading edge). Practice on scraps first.

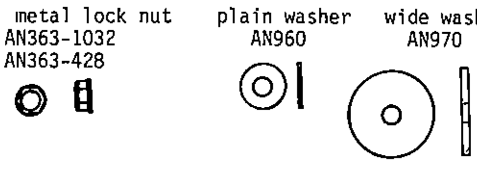


HARDWARE SKETCHES

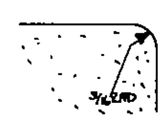
AN3 3/16" dia bolt AN4 1/4" dia bolt	AN509 flush head screw	AN525 washer head screw



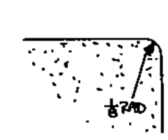
all metal lock nut AN363-1032 AN363-428	plain washer AN960	wide washer AN970



MINIMUM RADIUS FOR GLASSING OUTSIDE CORNERS



Fibers at 90° - 3/16" radius



Fibers at 45° - 1/8" radius

QUALITY CONTROL CRITERIA/REPAIRS
See the Education section

END OF CHAPTER

INDIVIDUAL PART CONSTRUCTION

INTRODUCTION

The first task in the construction of your Q2 is to make many of the small, individual parts required for assembly later. Quickie Aircraft Corporation has found that making these parts at one time is most efficient and will also give the builder a chance to gain experience working with his hands on small pieces that can be easily remade.

The parts include templates that are used for jigging and rigging various portions of your aircraft. Drawings are provided within this chapter, but primarily the templates are provided in a series of large Appendix drawings included with these plans. All templates are printed full size.

Jigging and rigging templates should be constructed from material such as hardboard, plywood, or masonite of 1/4" thickness. Aircraft quality materials are not required. The hot-wiring templates for the main wing, canard, and vertical fin, as well as the control surfaces, should be made out of thin aluminum, masonite, or aircraft quality plywood. These templates must be smooth and wave free, so spend considerable time on each one and sight frequently along the line to check for waves or notches. Any wave or notch will be reflected directly in the shape of your wing, etc. and will be difficult and heavy to correct later on; so do a good job in the beginning.

Template drawings provided for parts made as a sandwich composite (glass-foam-glass) should still be made on the hardboard, plywood, or masonite of 1/4" thickness. It will be much easier to transfer the complicated curves and lines to the actual part if you have a material more durable than heavy paper.

The phonolic bearing block comes delivered to you with all of the important precision holes already drilled and reamed to the proper size. The remaining holes are for bonding strength and are non-critical on a precise diameter and position.

Be sure to identify and number each template and part so that it can be identified easily later when it is needed. Further, group all parts of the same family (e.g. Control System (CS), fuselage female jigging templates, etc.) together.

The drawings may be glued directly onto the material with Contact Cement. Be careful, however, that you do not paste up the drawings crooked. Smooth out all ripples before the glue sets. Do not use a glue that will cause excessive shrinkish.

The drawings are reproduced to within 1% accuracy; in most cases, the accuracy is closer to 0.1%. However, in the final analysis, you must build your aircraft and allow for tolerances and errors during construction. Therefore, you may expect not all templates to fit exactly as the drawings indicate. Large differences, however, are reason to check thoroughly on your previous work to see if you have followed the plans exactly.

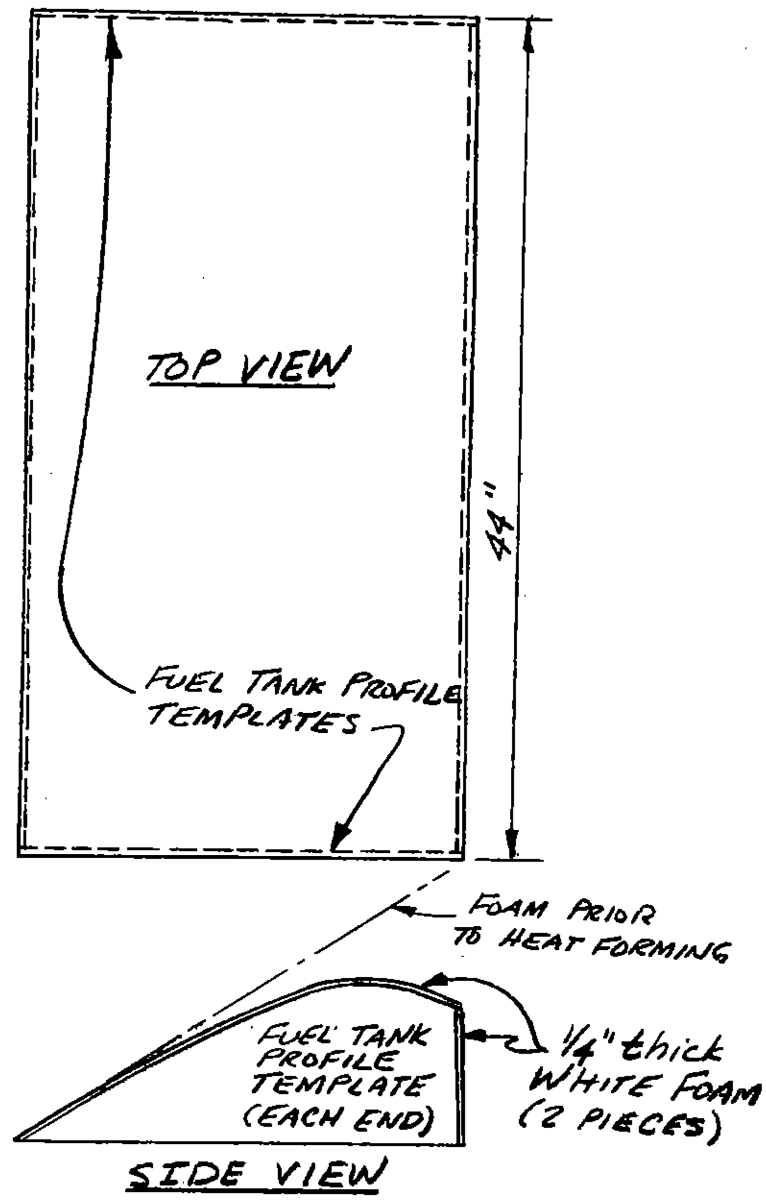
One last comment; we have replacement copies of all of the template drawings in case you destroy one accidentally. Don't be bashful about spending a few bucks for a replacement rather than to soldier on incorrectly trying to piece together a drawing that looks like your dog ate it.

MAIN FUEL TANK CONSTRUCTION

The main fuel tank is a sandwich composite structure that attaches to the bottom of the fuselage for installation in Chapter 14. In this section, you will make the basic main fuel tank, and then set it aside until later.

Find the Fuel Tank Profile Template on Appendix Sheet 2. Basically, to create the main fuel tank shape, you will heat form two pieces of the 1/4" thick white foam around the templates, glass the top main fuel tank surface, and finally glass the inside main fuel tank surface after the first lamination has cured.

The main fuel tank is 44 inches wide, so begin by placing the two Fuel Tank Profile Templates that distance apart on a table. Take an appropriate size piece of the white foam, begin at the trailing edge of the templates, and bend it around the forms until you reach the forward edge of the templates. Carefully heat the foam with a hair-dryer or heat gun until it will hold the shape reasonably well, and then use some 5-MIN to attach the foam to the templates at a few locations. Try to keep the foam from becoming too wavy as you form it.



FUEL TANK CONSTRUCTION

At the leading edge of the templates, another piece of 1/4" thick white foam is fitted vertically until it meets the first piece of white foam; it too is attached with 5-MIN dabs.

Round the joint slightly where the two pieces of foam meet. Next, laminate 2 BID on the outside of the foam oriented 45 degrees to the trailing edge of the white foam.

After allowing the lamination to cure, the next step is to remove the Fuel Tank Profile Templates, turn the foam over, and glass 1 BID at 45 degrees on the inside foam surface. Be careful that the main fuel tank doesn't warp and change shape during this process.

If you have trouble with waves in the center of the tank, additional Fuel Tank Profile Templates may be used; if the hot forming operation does not go well, you may cut-and-join several straight line segments.

Of course, the easiest way to build the Q2 main fuel tank is to buy it prefabricated from Quickie Aircraft Corporation or one of its dealers.

COCKPIT CONSOLE PIECE CONSTRUCTION

Many pieces go into assembling the center and side consoles on your Q2. You will make the individual pieces now, and then assemble them to the fuselage in Chapter 14.

Full-size templates are provided on Appendix Sheets 1,2,&5 for the center and side console vertical pieces, as will as for the top side console pieces. Make 2 of each from the 3/8" thick white foam and number them left, right, and center, to identify where they are assembled in the aircraft. (In airplane talk, left is the pilot's left as he sets in the cockpit.)

Fiberglass 1 BID on the inside face of each piece. The inside face is the side that does not show after the consoles are assembled. Do not glass the other side.

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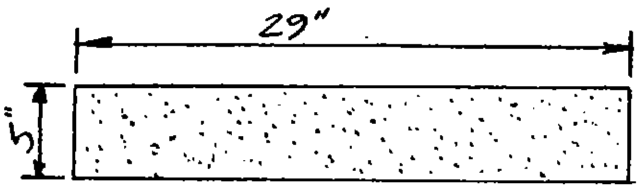


TOP CENTER CONSOLE PIECE

MAKE 1

3/8" thick WHITE FOAM

1 BID; ONE SIDE ONLY

It is important to note that if you modify either your Seatback Bulkhead angle (see Chapter 8) or Instrument panel location, or if you are wider and bigger than normal in the hips, you may wish to change the geometry of the pieces somewhat. If that is the case, wait until later to make these pieces.

INSTRUMENT PANEL

The template provided for the instrument panel on Appendix Sheet 3 is intended to be used with the 1/8" thick aircraft quality plywood provided with the kit. It is suggested that the panel not be mounted in the fuselage permanently until cutouts for all instrument panel gauges, radios, and equipment have been made.

It will at times be useful to install the panel temporarily with Bondo to assist in jigging parts of the fuselage.

PLYWOOD PARTS

In this section, you will construct the following pieces: firewall, LG4, CS10, CS19, CS22, BS2, and BS3. All parts are constructed from 1/4" Marine grade plywood. See Appendix Sheet 3 for the full size template drawings, which can be pasted on the plywood itself.

As indicated previously, the writing on the template drawings can be read when the part is right side up. Also, the drawings indicate the number of each piece to be made.

ALUMINUM PARTS

On Appendix Sheet 2, you will find the full size template for the 0.125" thick 2024T3 Aluminum supplied. Other parts, not detailed here will be made at a later time from aluminum.

PHENOLIC BEARING BLOCK

On Appendix Sheet 2, you will also find the full size template for the predrilled Phenolic bearing block Q2CSP. Refer to the "Introduction" of this chapter for information.

FEMALE JIGGING TEMPLATES

These full-size templates provide the basis for jigging the vertical fin, fuselage, main wing, and canard. They are found on Appendix Sheets 2, 4, and 5. Make 2 of each, except make 1 of each of the vertical fin jigging templates.

RIGGING TEMPLATES

Rigging templates allow the builder to accurately rig the ailerons, elevator, and rudder for proper travel. These full-size templates may be found on Appendix Sheets 1 and 5; make 1 of each.

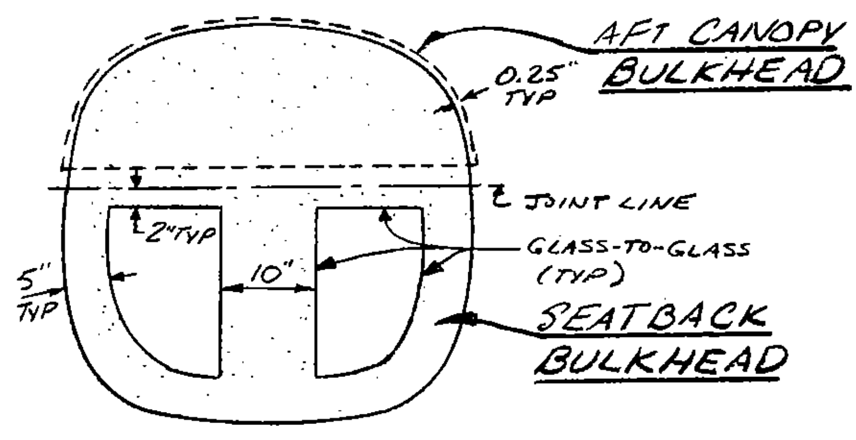
WHEEL PANT PIECES

On Appendix Sheets 1 and 3 you will find full-size templates for the pieces that comprise the wheel pants, including the templates to assist in carving the shape. Thickness of LG1, the wheel pant cores, is 6.7 inches each. The 4 LG2's are made from the / " thick white foam. The 3 carving templates are made from hardboard, plywood, masonite, etc.

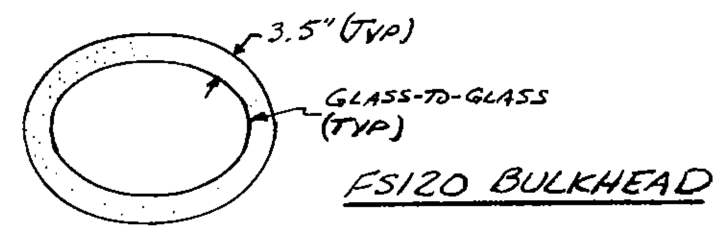
FUSELAGE BULKHEADS

In this section, you will construct the following bulkheads: FS120, FS94, Seatback Bulkhead, and aft canopy bulkhead. All bulkheads are made from the 3/8" thick white foam.

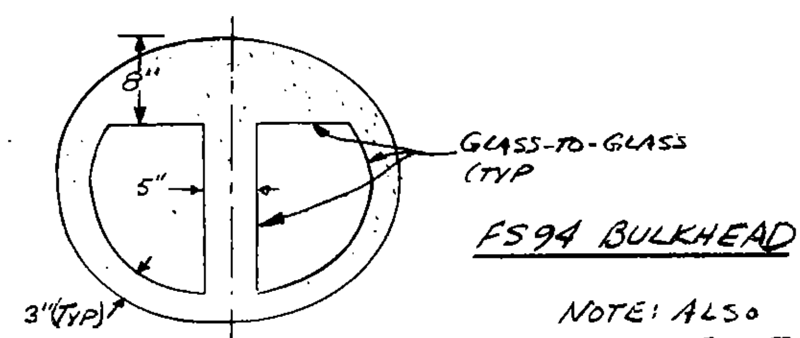
You will find full size template outlines on the large Appendix Sheets 1 and 2. On this sheet, you will find sketches showing the foam layouts. Where two full size template outlines are overlaid with one another, work your way in toward the middle by making the outside template bulkhead first, then trimming the template down so that the inside bulkhead can be made. (e.g. make FS94 bulkhead first, then make the FS120 bulkhead).



1 BID FRONT & REAR



1 BID FRONT & REAR



NOTE: ALSO MAKE FS175 BULKHEAD

1 BID FRONT & REAR

Each full size template outline has a forward face marked on it. Also, the words describing the template are always written so that they can be read when the template is right side up and facing forward. Be sure to mark each bulkhead upon completion with the proper information so that you don't forget which way it is jigged. Each bulkhead will jig into the fuselage only one correct way.

The Seatback Bulkhead is made in two pieces and joined together upon assembly of the fuselage. On Appendix Sheet 2, you will find the full size templates for both the canted piece (i.e. lower piece) and the vertical piece (i.e. upper piece). In order to conserve space, the templates are laid out with the joint between the two pieces as the common line at the top of the template. This is the only case in these template drawings where the presentation is not consistant. Note also that the template drawing for the vertical piece calls it out as being used for the aft canopy bulkhead. To make the aft canopy bulkhead, use the vertical piece of the Seatback Bulkhead and reduce its height to 15 inches by cutting off the bottom of the template. Also, since the canopy is much thinner than the fuselage core, make the vertical piece template curve "fuller" by approximately 0.25 inches. The result will be that when compared to the vertical piece of the Seatback Bulkhead, the aft canopy bulkhead will be not as tall, but will have a larger radius of curvature by about 0.25 inches.

END OF CHAPTER

HOT-WIRING

INTRODUCTION

In this section, you will hot-wire the foam cores for the wing, canard, rudder, vertical fin, ailerons, and elevators.

Begin by reviewing the COMPOSITE MATERIALS EDUCATION chapter. That means more than just glancing through the chapter; study it thoroughly until you can recite it in your sleep.

Hot-Wiring is not difficult, but will require two people and a precise, careful approach to obtain good quality cores.

Before we continue, let's emphasize a few important points that you have already read in the COMPOSITE. MATERIALS EDUCATION chapter:

1. Always hot-wire cut from the leading edge back to the trailing edge to minimize wire lag; always go slowly around the leading edge of any airfoil.
2. Pause at any notches in the templates to let any wire lag catch up.
3. Retain all scraps; they may be used later.
4. All foam blocks must be weighted down carefully; all template level lines must be re-checked just prior to hot-wiring.
5. Hot-wire cores at the top of each block first, to make weighting the cores down easier.
6. Any part of the template projecting aft of the "eventual trim lines" may extend beyond the edge of the foam block; many template locations are critical, so strive to minimuze wasted foam - it will all be used later.
7. Mark level lines on each foam core with a felt tipped marker.
8. Smile! This is one of the funnest jobs in the whole aircraft.

MAIN WING CORES

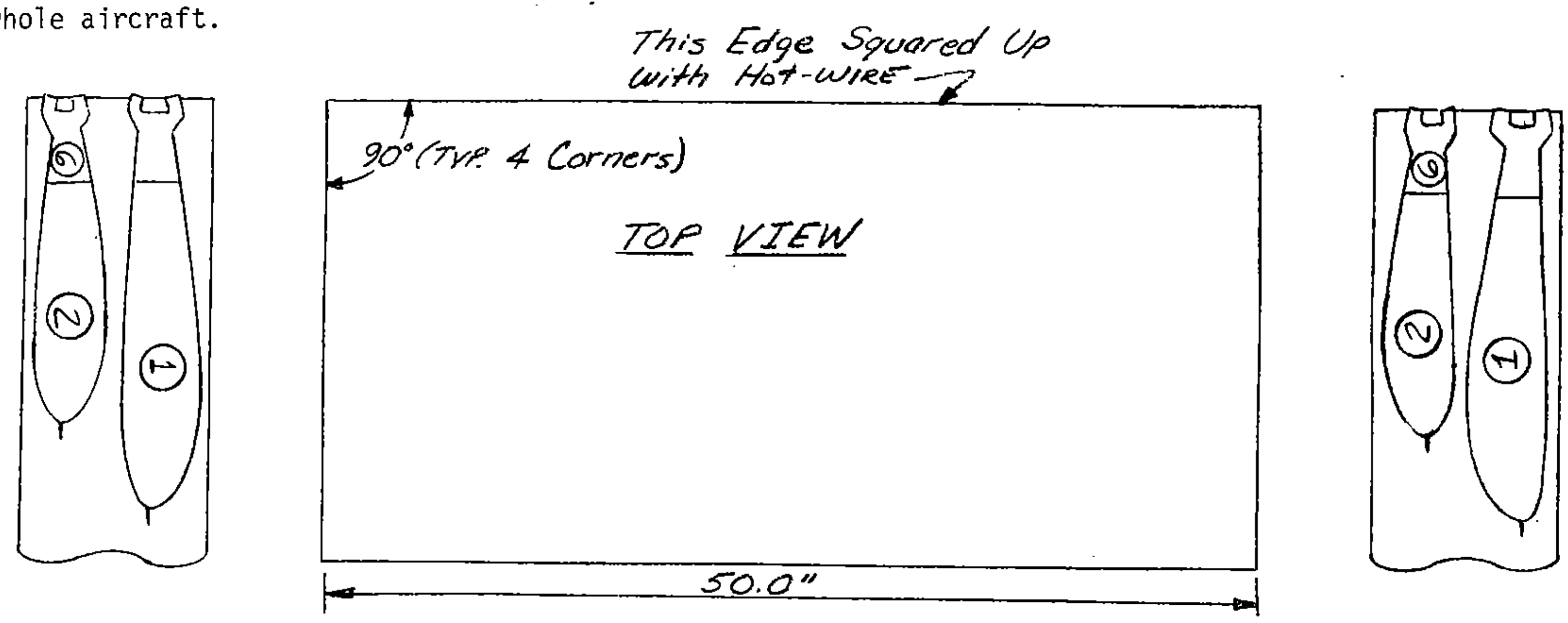
Find the two 10" x 24" x 96" nominal dimension blocks of polystyrene foam.

Using straightedged trim templates, square up three sides of one block to generate a core 50.0" long. The fourth edge (along the 50" side - see sketch) can remain scalloped. The sketch shows the positioning of the appropriate templates on each end of the block. Note that the sketch end views are oriented to duplicate the "picture" one sees looking at each end of the block.

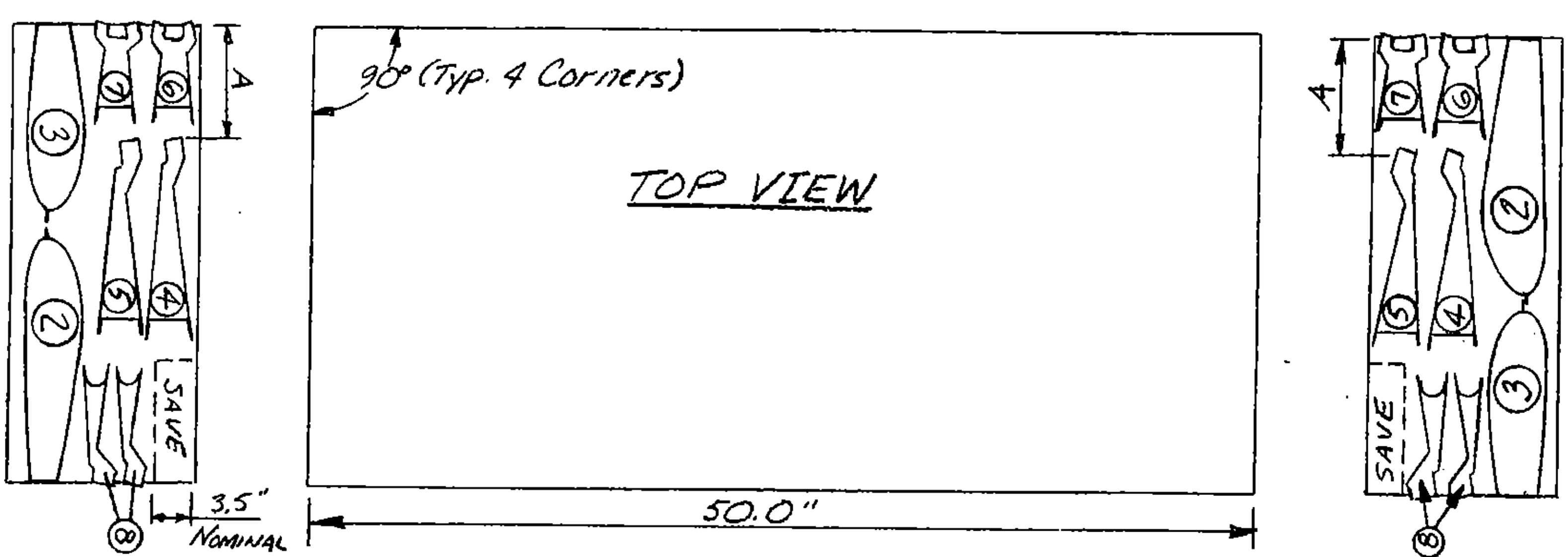
The second block is prepared identically, except the fourth side along the 50" edge needs to be squared up also. Follow the layout sketch to obtain the appropriate cores. Be sure that templates 2 and 3 can face each other without running out of width on the block.

The trailing edge of each template, unless otherwise indicated, must be lined up with the edge of the polystyrene foam. This gives the core the proper geometry for assembly into the main wing female jigging templates.

The aileron cores must be trimmed on either end after hot-wiring to 48" length. Both the Trailing Edge Foam Cores and the Aileron Slot Foam Cores (outboard) are cut considerably oversized, and will be trimmed to the proper length during installation.



MAIN WING
BL00-BL50 LT
BL00-BL50 RT



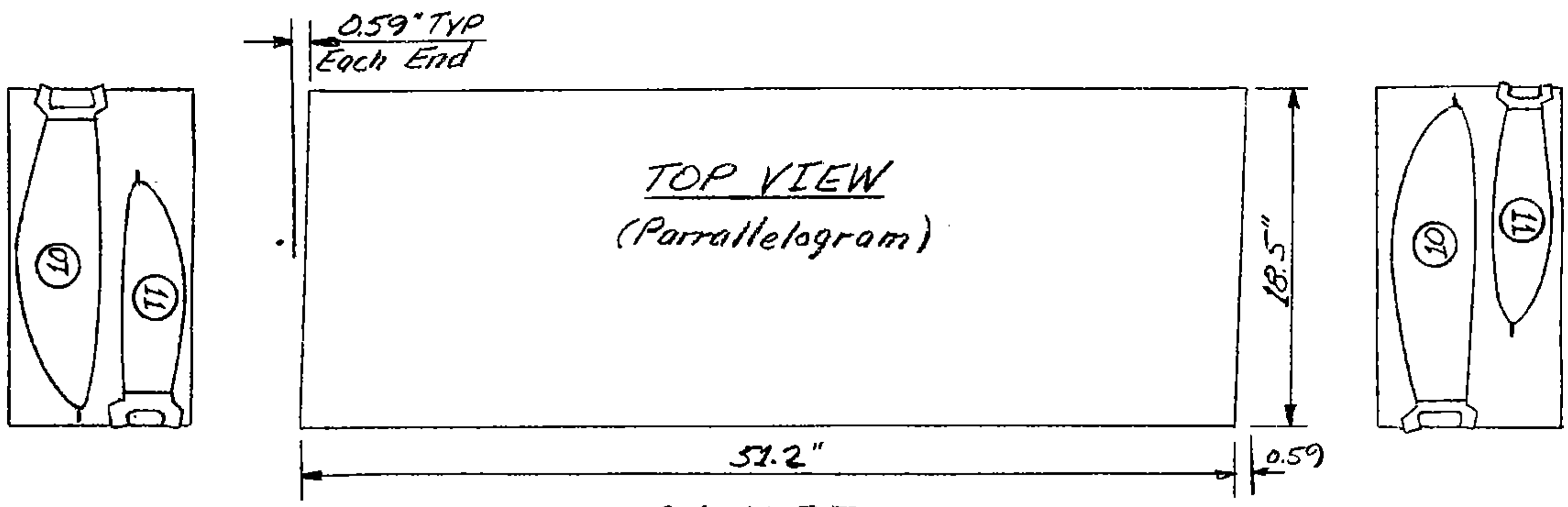
MAIN WING
BL50-BL100 LT
BL50-BL100 RT
AILERON (2)

NOTE: A is nominal 5"

CANARD CORES

The outboard and inboard canard cores are cut from skewed, parallelogram style blocks, with the exception of the canard center section. The reason for this is to obtain the proper sweep of the canard when the cores are jigged together later.

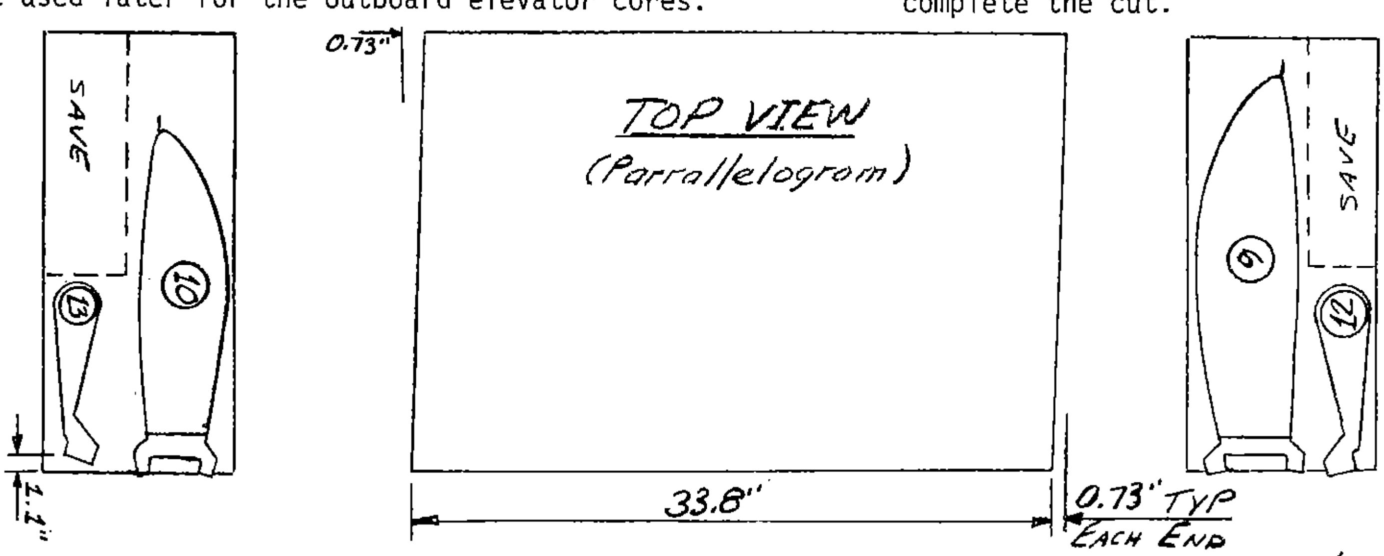
Begin by squaring up the 10" x 20" x 96" nominal dimension block of polystyrene foam to obtain a length of 51.2", with the skew as indicated. Next, using the sketch provided, hot-wire the outboard canard foam cores. Note that the bottom set of templates are upside down, so as to obtain the proper geometry upon jigging.



CANARD
BL48.8 - BL100 LT
BL48.8 - BL100 RT

Next, find the extra pieces from the 10" x 24" blocks (2) and face them up to the dimensions shown. These two blocks are used for the inboard elevator cores and inboard canard cores. The portions not used will be used later for the outboard elevator cores.

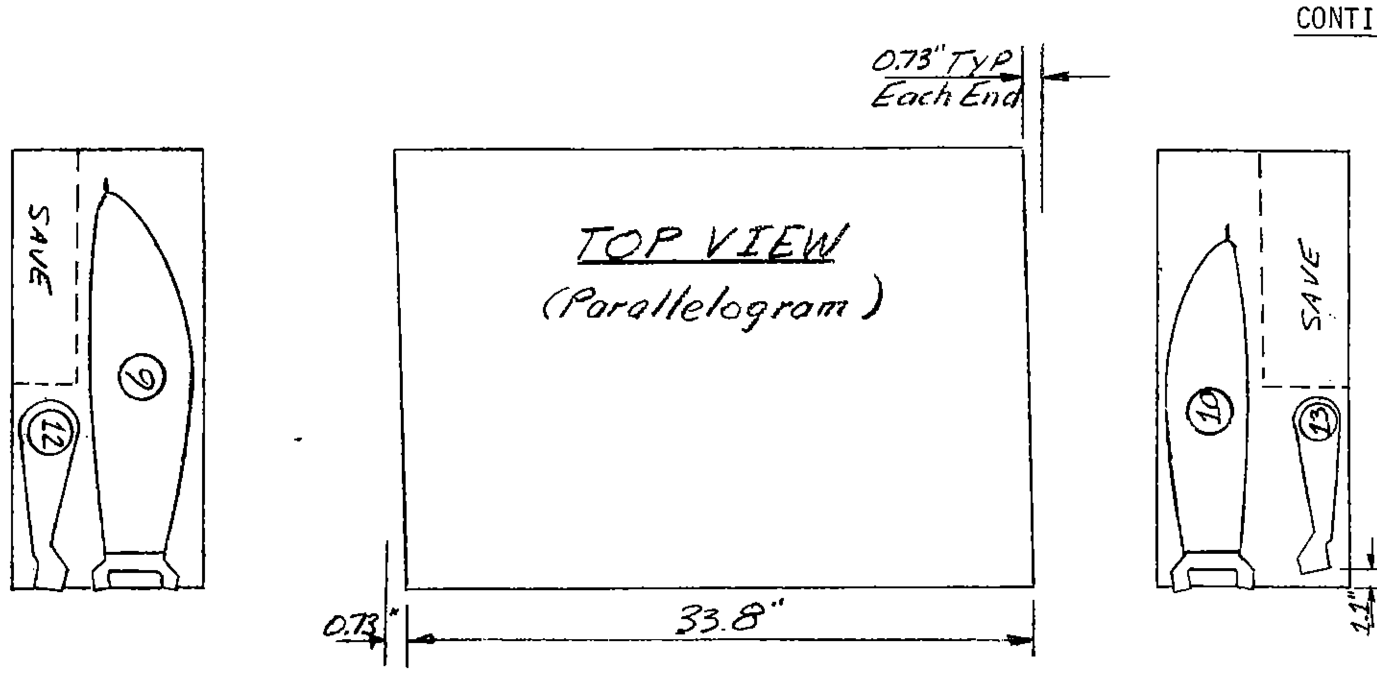
Don't forget the cutouts for the elevator torque tubes. After the elevator cores have been hot-wired, cut along one of the lines (e.g.4-A-B) and hot wire down that slot and around the inside (e.g. 4-A-B-C-D-E-F-G-H-I-B-A-4) and out again. Then cut along the other line (e.g. 4-F) and hot-wire along that slot to complete the cut.



CANARD
BL15 - BL48.8 LT
INC ELEVATOR

NOTE: DON'T FORGET STIFFENER!

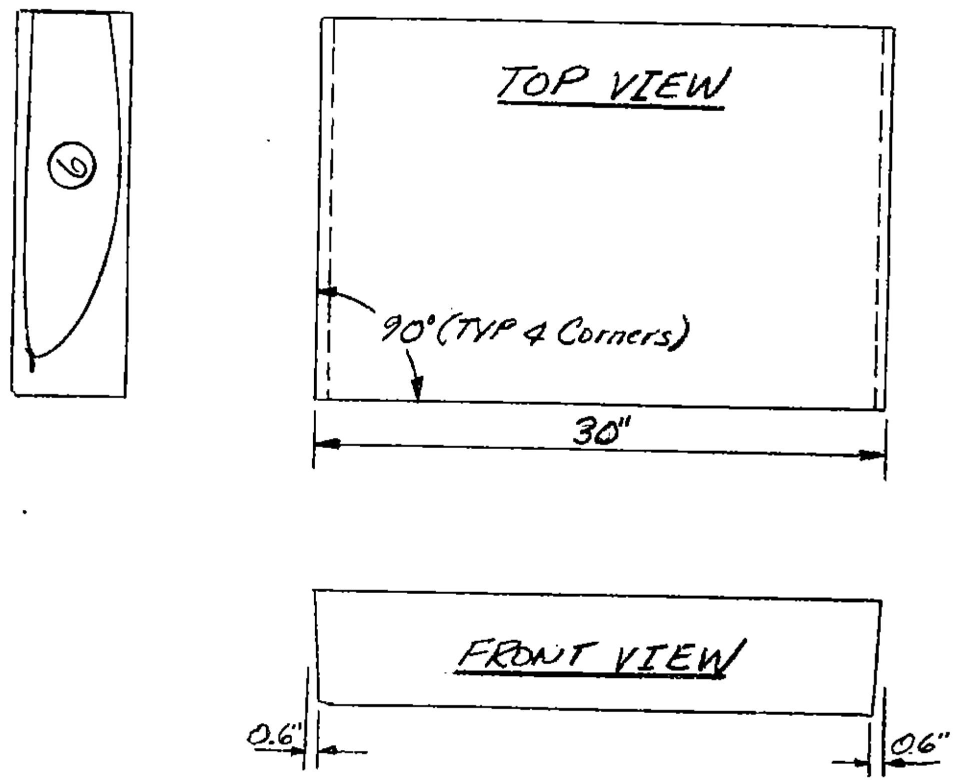
CONTINUED ON NEXT PAGE



CANARD
BL 15 - BL48.8 RT
INC ELEVATOR

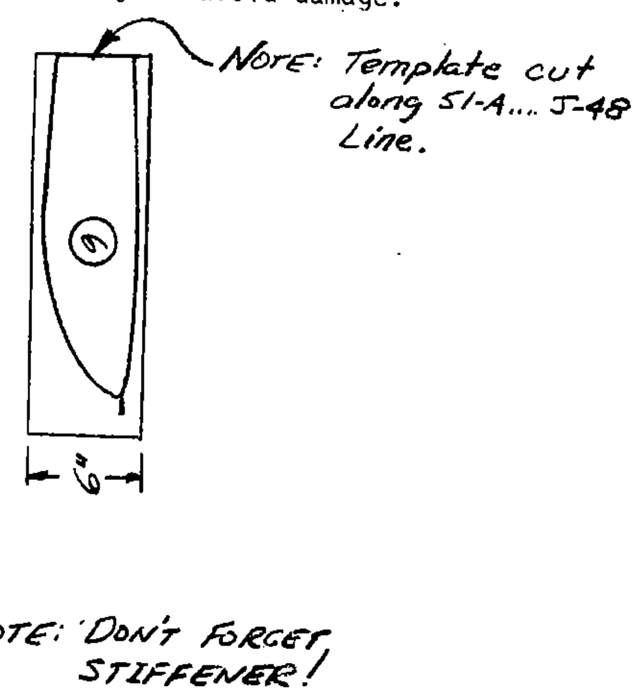
NOTE: DON'T FORGET STIFFENER!

Finally, locate the remaining part of the 10" x 20" block and size it as shown, in order to make the canard center section. Keep the unused portion for cutting the vertical fin, so don't make the height over 6.0". Note the the 0.6" taper dimension is to allow for the proper anhedral angle upon assembly in the canard female jigging templates.



CANARD
BL15LT-BL15RT

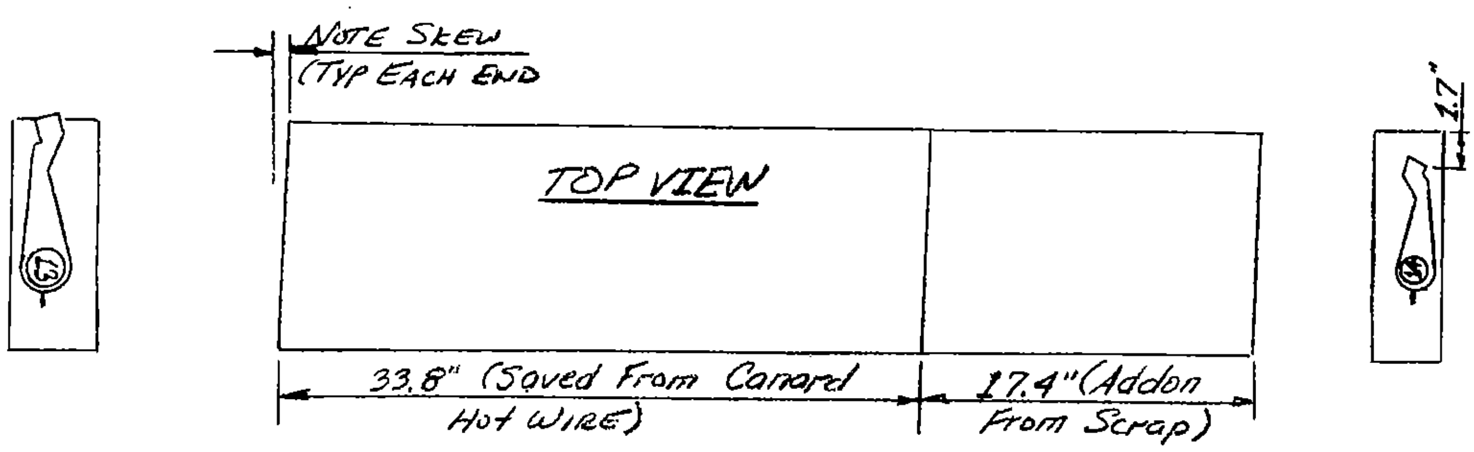
Take the two canard template BL48.8 and BL15 and remove the 33-A-B-C-D-E-F-38 notch in each template. Then, hot-wire the canard stiffener out of each inboard canard and canard center section foam core, being careful to line the templates up properly. Store the stiffeners carefully to avoid damage.



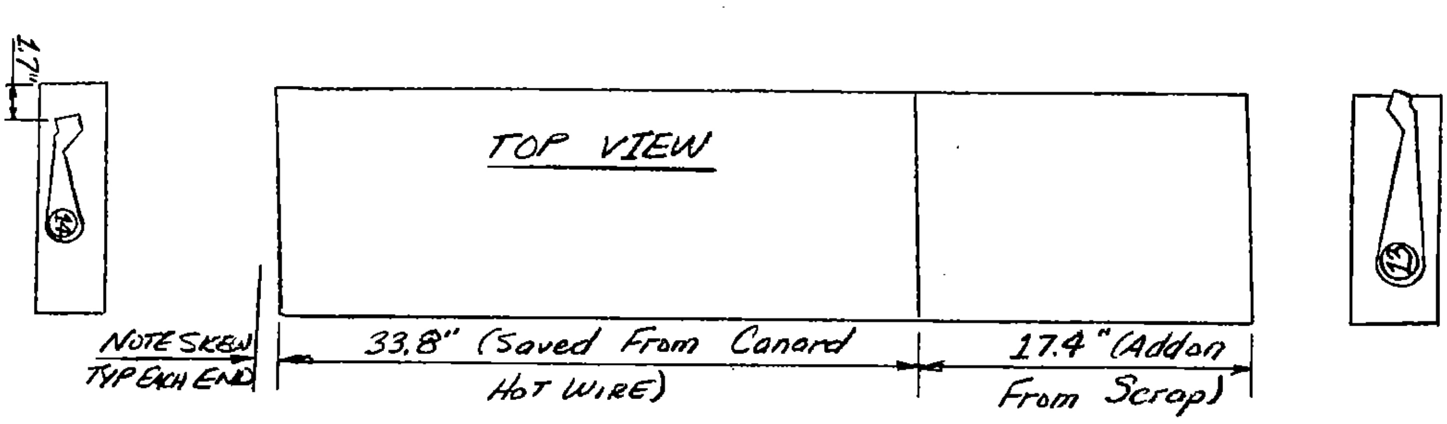
OUTBOARD ELEVATOR CORES

Find the two pieces of foam that you saved after hot-wiring the inboard canard cores. (The areas are marked 'save' on the sketches). Add some additional scrap pieces, being careful to obtain proper skew throughout the setup, and make the inboard elevator cores. The template offsets are necessary to obtain the proper geometry.

Hot wire for the elevator torque tubes like you did on the inboard elevator cores.



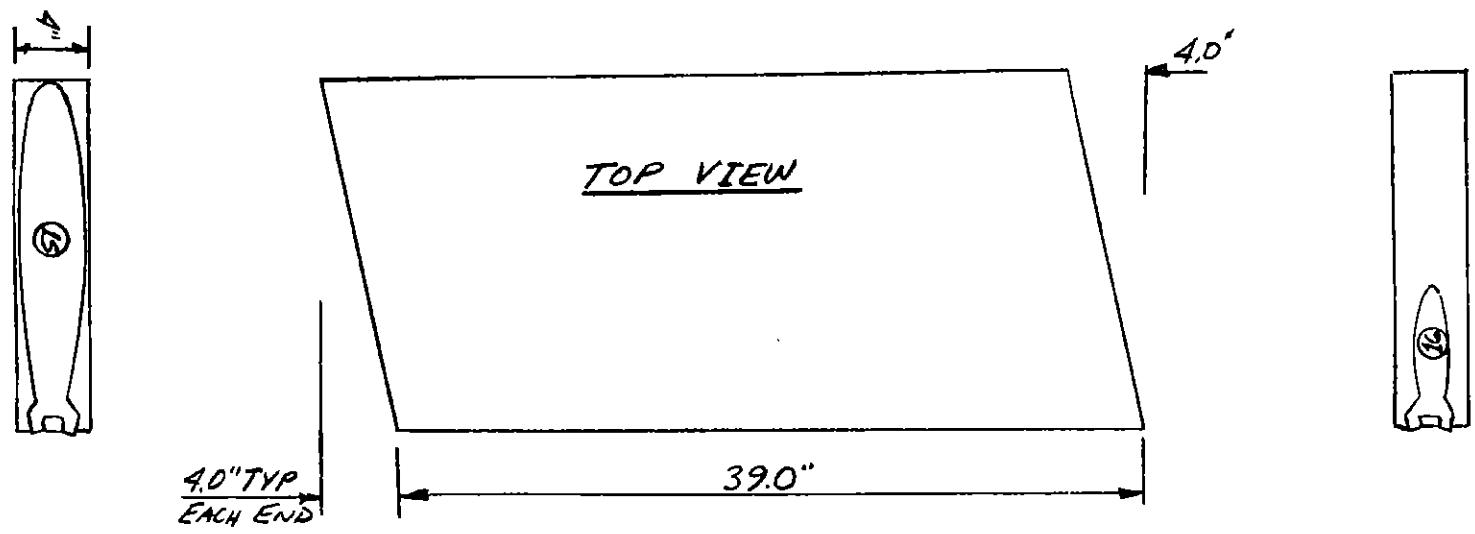
ELEVATOR
BL48.8- BL100 LT



ELEVATOR
BL48.8 - BL100 RT

VERTICAL FIN

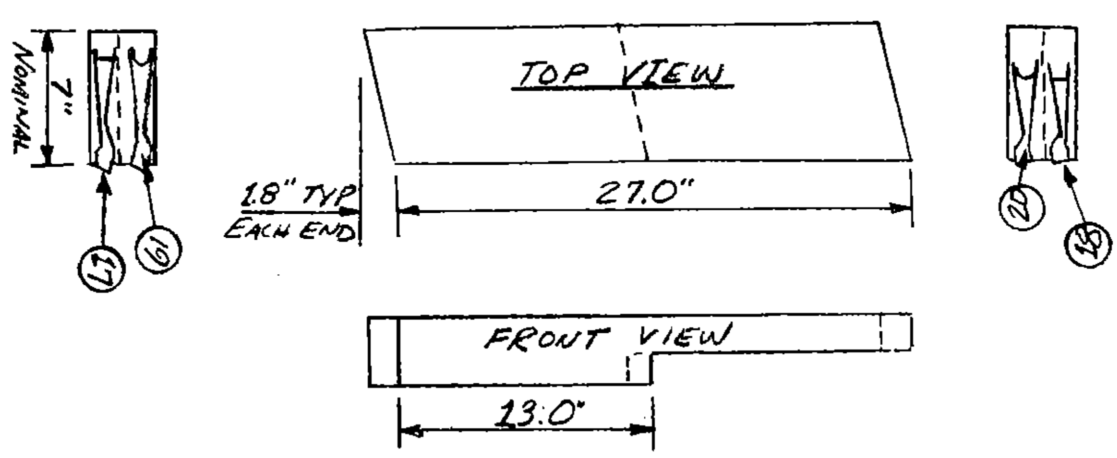
The vertical fin is cut out of the remains of the piece that you used to make the canard center section core. (Remember, the one we told you to keep and not throw away). The sketch is self-explanatory.



VERTICAL FIN

RUDDER AND VERTICAL FIN TRAILING EDGE

These two cores are made from the piece marked 'save' that was left over after hot-wiring the main wing, BL50-100 cores. The stagger shown on the front view is necessary because the rudder core is 27" long, while the remaining trailing edge length is only about 13". It is suggested that you cut the rudder core first, and then reduce the block length to 13" for the trailing edge core. As a note of explanation, the rudder extends up the vertical fin only part way. (Similar to the way that the aileron extends outboard on the main wing only part way).



RUDDER
VERTICAL FIN T.E. CORE

WHEEL PANT CORES

The wheel pant cores are cut out from the scrap pieces that you now have laying around. They needn't be hot-wired, except to obtain the proper thickness, but rather can be cut out by bandsaw or coping saw.

MISCELLANEOUS USES

The remaining scrap can be used for many miscell-aneous purposes, such as supporting major components to avoid damage, soft sanding blocks, filets to clean up airflow, etc.: use your imagination.

END OF CHAPTER

AILERON CONSTRUCTION

Both ailerons may be constructed at the same time. These instructions will only cover the construction of the left aileron, but the right aileron is a mirror image.

Begin by finding CS9, which is a 48" length of 1" O.D. x 0.035" wall 2024T3 Aluminum tubing. You have already hot-wired the aileron foam core, so find it also. The aileron foam core should be trimmed to a 48" length.

Basically, you will join CS9 to the aileron foam core; sand the joints to remove bumps and joggles; layup the bottom skin; layup the top skin; and, finally, trim the trailing edge after installation on the main wing.

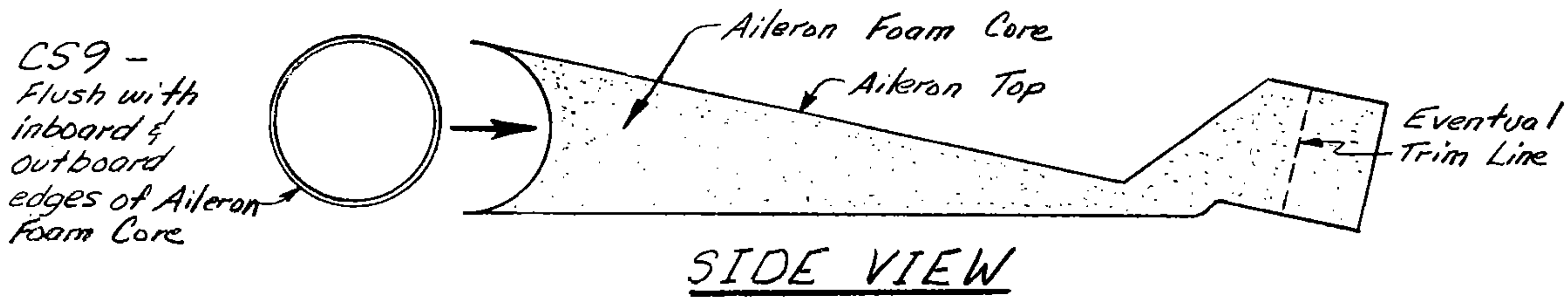
Begin by sanding CS9 to remove grease, finger prints, and the oxidation layer on the aluminum. Trial fit CS9 to the aileron foam core; mix up some micro slurry, and then join CS9 to the aileron foam core on a flat surface. Use nails to hold the two pieces together.

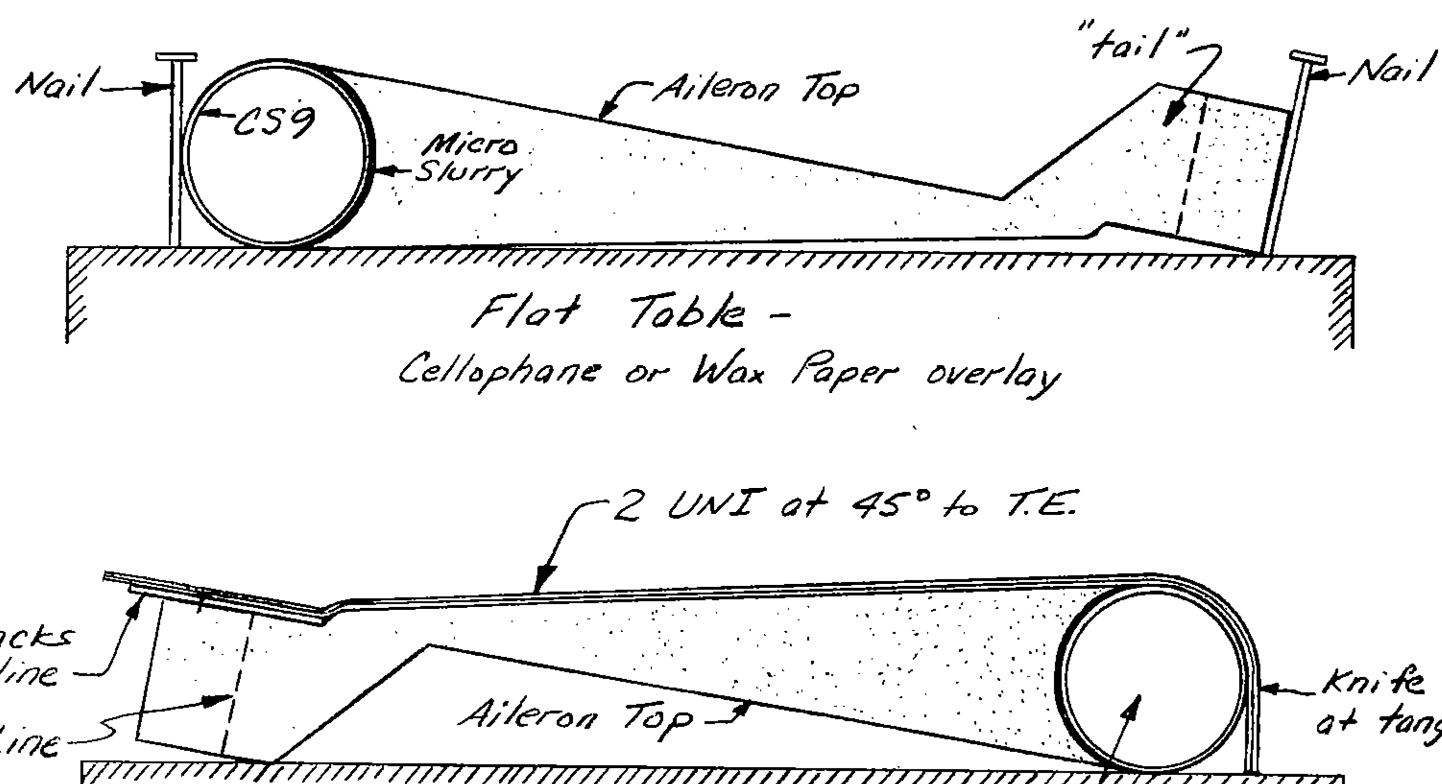
Once this combination has cured, sand away all of the bumps and joggles. Next, turn the aileron over and lay it flat on the table, bottom side up. Put Peel Ply along the trailing edge using small tacks to hold it in place. Layup 2 UNI at 45 Deg. to the trailing edge (T.E.) At the leading edge (L.E.) let the cloth drop vertically to the table and knife trim at the point tangent to CS9. Trim the trailing edge to within ½" of the foam core trailing edge.

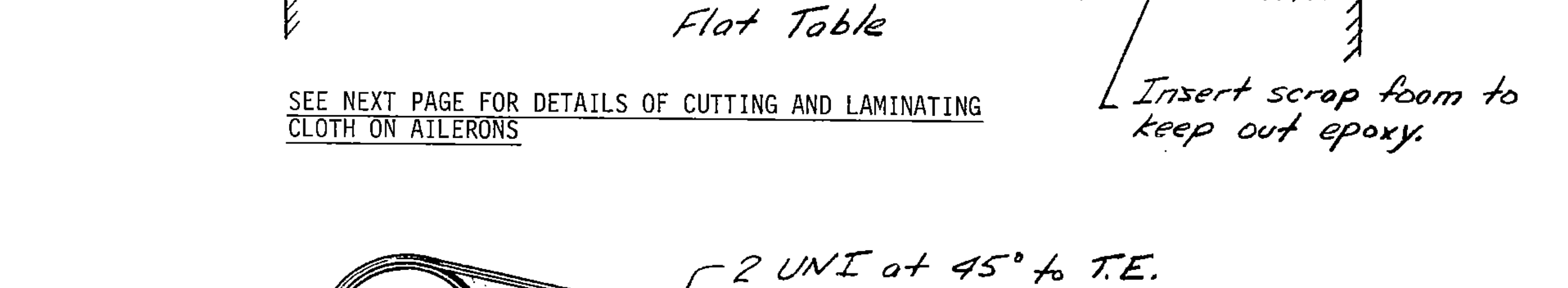
When this layup has cured, turn the aileron over and lay it flat on the table. At the leading edge, feather the UNI plies to the foam to remove the joggle. At the trailing edge, sand off the "tail" until you reach the Peel Ply. Remove the Peel Ply, and sand away any bumps and joggles. Layup 2 UNI at 45 deg. to the trailing edge. At the leading edge, overlap a minimum of 0.5" onto the previous bottom layup. At the trailing edge, layup glass to glass. Leave the aileron alone until it has cured to avoid changing the alignment, and then feather the top surface UNI plies to remove the leading edge (L.E.) joggle.

Leave the trailing edge untrimmed until after the aileron is mounted on the main wing, so that it can be made to match the trailing edge of the wing.

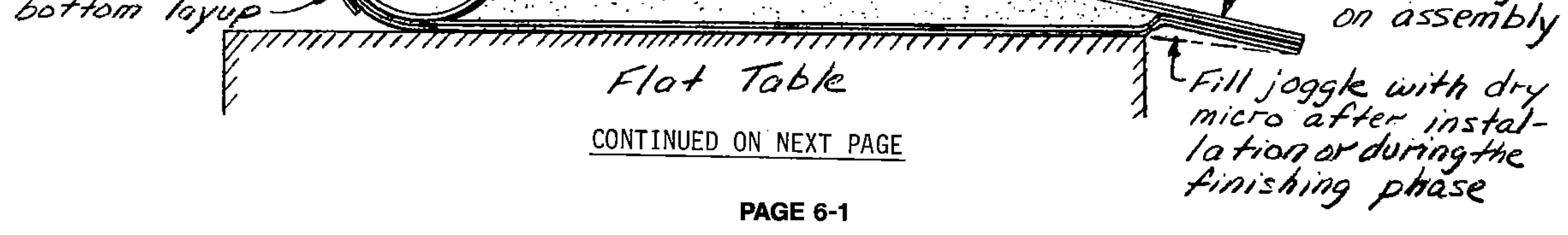
The joggle on the bottom of the ailerons (as well as the joggles on the bottom of the rudder and elevators) is filled with dry micro after installation of the aileron on the wing or during the finishing phase.







SEE NEXT PAGE FOR DETAILS OF CUTTING AND LAMINATING CLOTH ON AILERONS



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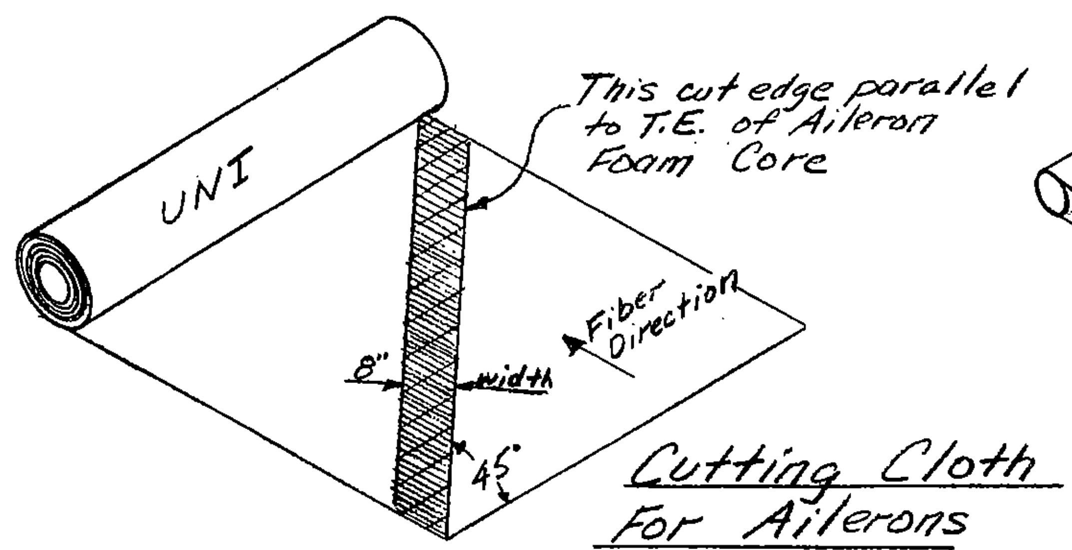
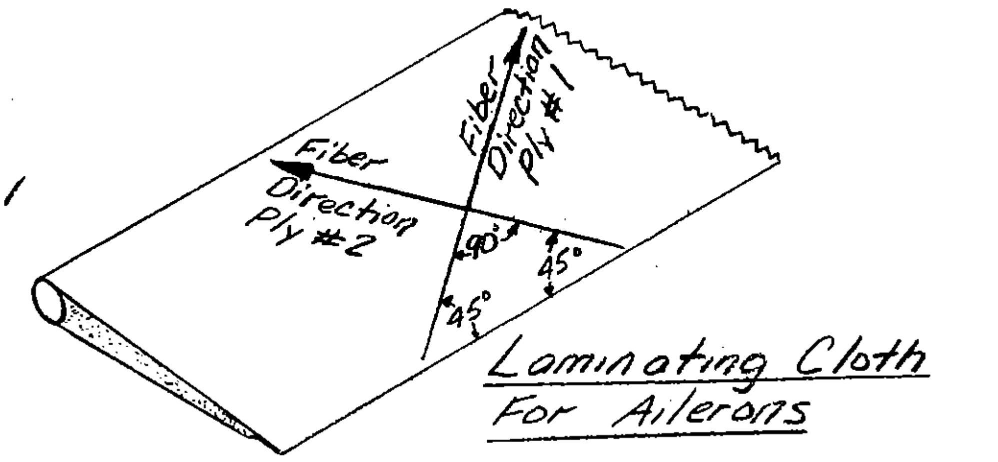




Notes: ① 4 pieces (2 top & 2 bottom) required per aileron
② Turn piece over to change Fiber direction 90° for Ply #2.
③ Sizing correct only for Aileron.

RUDDER CONSTRUCTION

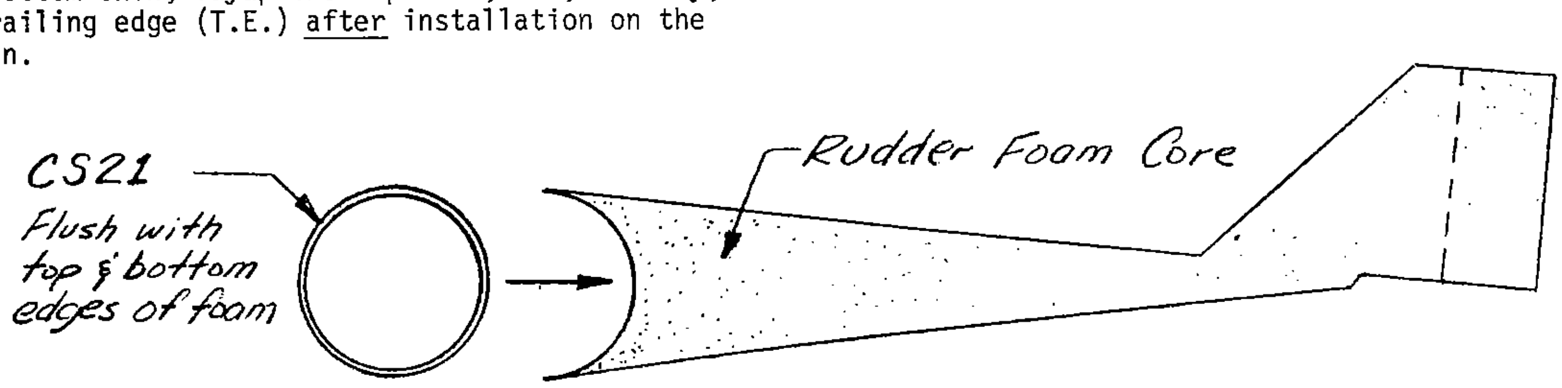
The rudder construction is very similar to the aileron construction that you have already completed. Re-read the AILERON CONSTRUCTION section before proceeding further.

Unlike the aileron, the rudder is a tapered chord, symmetrical surface.

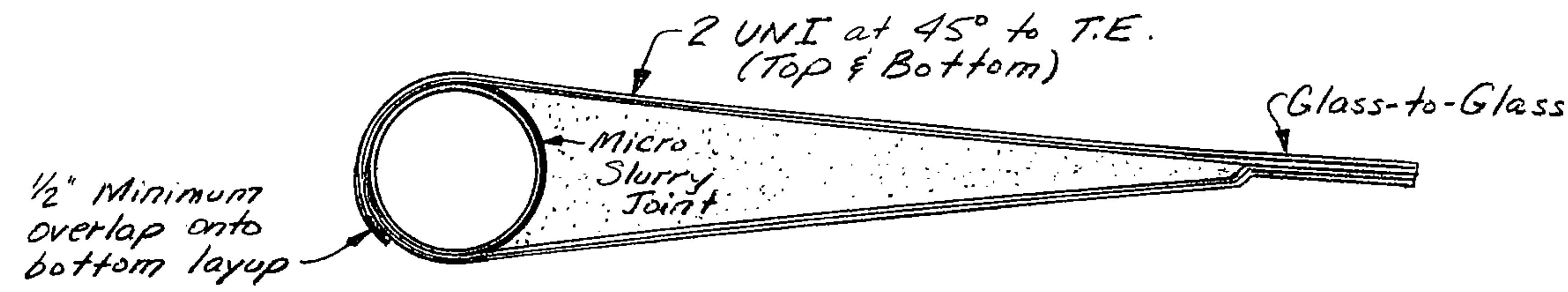
Begin by finding CS21, which is a 27" length of 1"O.D. x 0.035" wall 2024T3 aluminum tubing. You have already hot wired the rudder foam core, so gather that piece also. The rudder foam core should be trimmed to 27" length.

Basically, you will join CS21 to the rudder foam core; sand the joints to remove bumps and joggles; layup the bottom skin; layup the top skin; and, finally, trim the trailing edge (T.E.) after installation on the vertical fin.

The lamination schedule on the rudder is 2 UNI on either side at 45° to the T.E., just like the aileron. Measure the rudder foam core and cut the UNI cloth to the proper size. Follow the AILERON CONSTRUCTION procedures to join CS21 and the rudder foam core, as well as to do the lamination. Because you have already performed the sequences once; guard against becoming sloppy. The finished rudder should look much better than the first aileron because of the practice you have had.



SIDE VIEW



RUDDER COMPLETE

ELEVATOR CONSTRUCTION

The elevator construction is very similar to the aileron construction that you have already completed. Reread the AILERON CONSTRUCTION section before proceeding further.

These instructions cover only the construction of the left elevator, but the right elevator is a mirror image. It is suggested that both elevators be constructed simultaneously. Since the elevator has a tapered chord, BE SURE TO MAKE ONE LEFT ELEVATOR AND ONE RIGHT ELEVATOR.

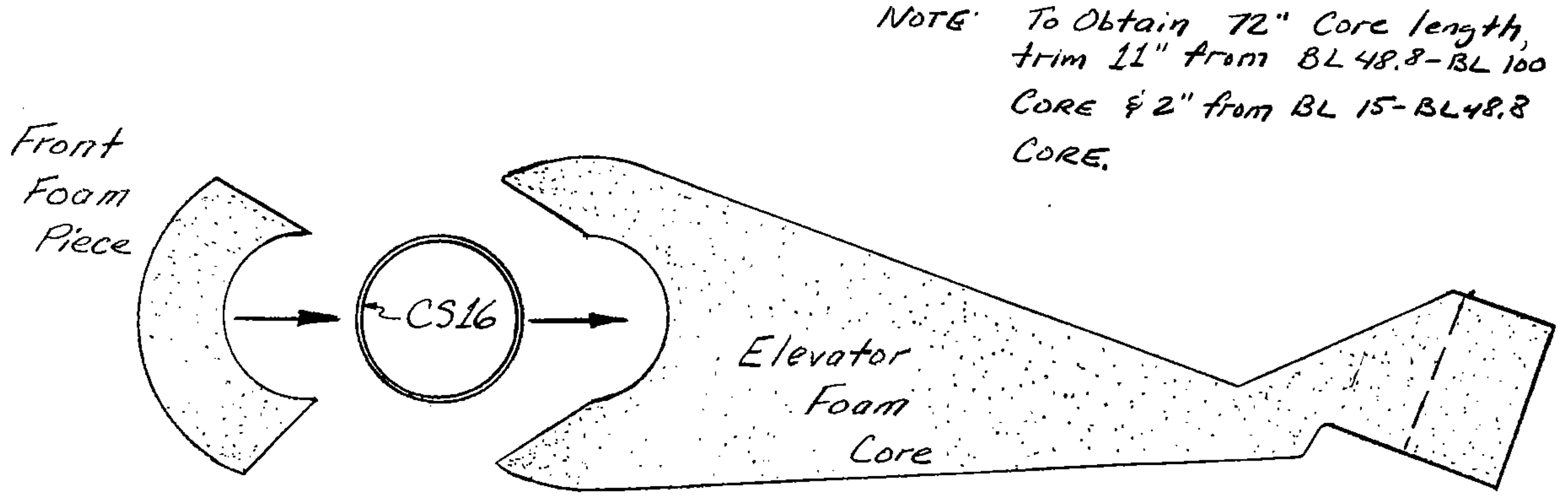
Begin by finding CS16, which is a 72" length of 1" O.D. x 0.035" wall 2024T3 aluminum tubing. You have already hot wired the inboard and outboard elevator cores, so gather these together also. When the cores are joined they should total 6 ft. in length.

Basically, you will join the inboard and outboard core together, insert CS16, replace the front foam pieces, sand the combination after it has cured to remove bumps and joggles, layup the bottom skin, layup the top skin, and final trim the trailing edge after installation.

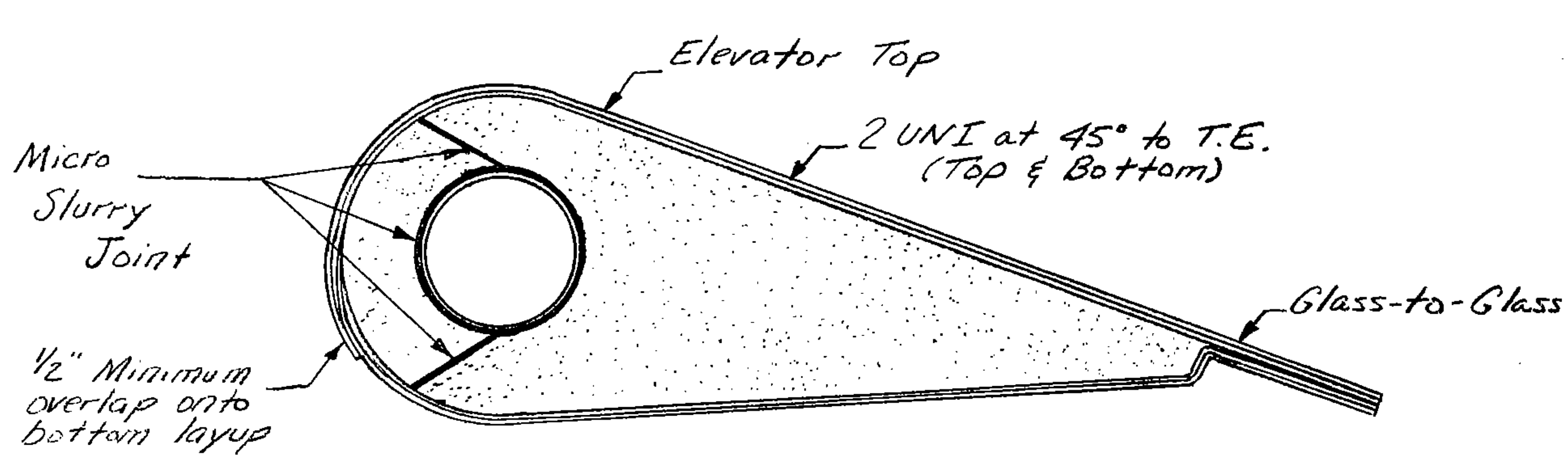
First, verify that the circular cutout for CS16 hot wired in the foam cores is large enough by putting the cores, CS16, and the front foam piece together dry. If the front piece won't clamp up against the core easily, carefully enlarge the cutout for CS16 until it will. The micro slurry will require approximately 1/32 gap.

Next sand CS16. Mix up micro slurry; paint it both on CS16 and on the foam wherever CS16 comes in contact with foam. Join the inboard and outboard foam cores together with micro slurry; insert CS16; then insert the front foam peice. Do not telescope CS16 into the core by pushing it from one end; this will cause voids in the bond. Instead, it should be inserted all along the span at one time. Use nails to hold everything in place while it cures (see AILERON CONSTRUCTION), and verify that both ends of CS16 are flush with the ends of the elevator foam cores.

The elevator lamination is 2 UNI bottom and top at 45 deg. to the trailing edge, just like the aileron. Measure the elevator foam cores and then cut the UNI cloth to the proper size. More than one piece of UNI will be required to cover the entire 72" elevator span. Where the UNI pieces join, no overlap is needed, (i.e. butt joint is OK) but stagger the joints on Ply #2 so that the foam along the butt joint line is covered. Lay up these plies exactly like you did on the ailerons. Don't forget the foam scraps in the end of CS16. Do not trim the trailing edge until after the elevators are mounted on the canard.



SIDE VIEW



ELEVATOR COMPLETE

END OF CHAPTER

VERTICAL FIN CONSTRUCTION

INTRODUCTION

The vertical fin is a symmetrical sandwich composite structure with solid foam core, two layers of UNI at 45 degrees to the trailing dege of the vertical fin for torsional stiffness and surface durability, and spanwise tapes of UNI for bending strength. The skills that you learn in this chapter will come in handy on the more complicated structures like the main wing and canard.

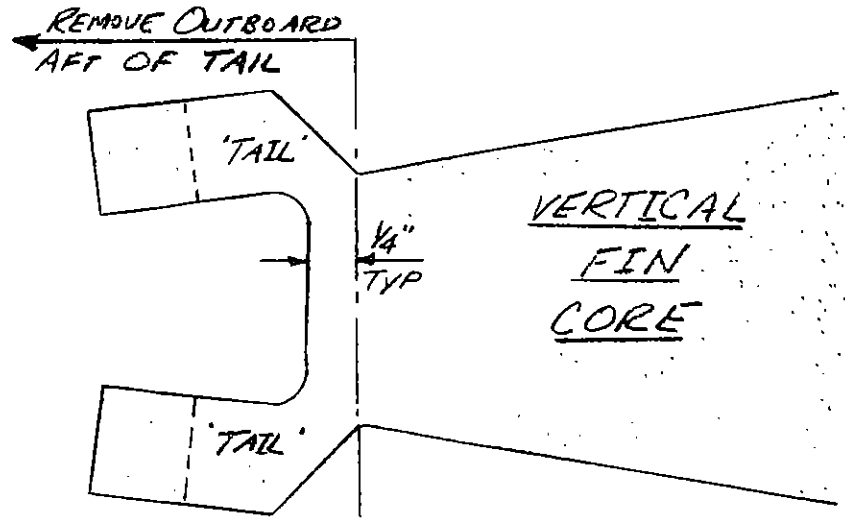
JIGGING THE VERTICAL FIN

Construction begins by jigging the vertical fin core on the jigging table. Locate the vertical fin core that you previously hot-wired, along with the vertical fin trailing edge core.

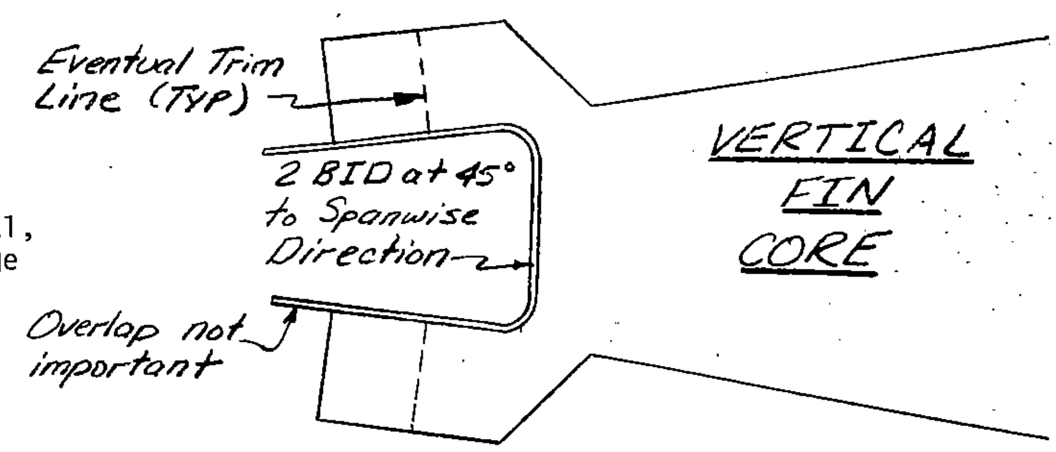
Find the vertical fin female jigging templates(2).

Measure 10.0" down the trailing edge from the tip of the vertical fin (the small chord end) and make a mark. Remove the portion of the vertical fin core shown. This is done because the rudder extends only partway up the vertical fin. Trial fit the vertical fin trailing edge core against the vertical fin core where the surgery had been performed. Note that the vertical fin trailing edge core was hot-wired longer than necessary, and will have to be trimmed to fit properly. When the cores are dry fit together, they should make a smooth transition. If not, any depressions must be filled with micro prior to glassing, and any bumps and joggles can be sanded away. Join the vertical fin core to the vertical fin trailing edge core with micro slurry and a few dabs of 5-MIN to hold the two together. Since the vertical fin is symmetrical, verify upon assembly that the vertical fin trailing edge core is not attached cocked to one side.

Next, glass the vertical fin slot with 2 BID at 45 degrees to the spanwise direction. This will be easier if you support the vertical fin core vertically temporarily.



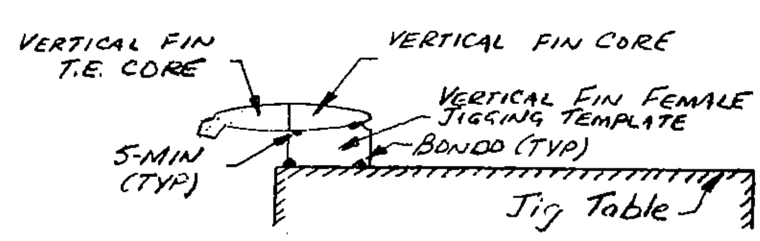
REMOVING PORTION OF VERTICAL FIN CORE



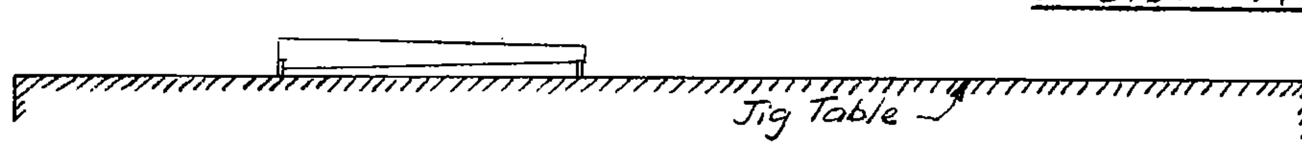
VERTICAL FIN SLOT LAMINATION

Now, study the sketches and jig the vertical fin core to the vertical fin female jigging templates with the 'tail' of the vertical fin trailing edge core pointing down toward the jigging table. Make sure that all level lines are level. Sand the 'tail' of the vertical fin core so that when you laminate the skin, you will obtain a glass-to-glass bond at the vertical fin slot.

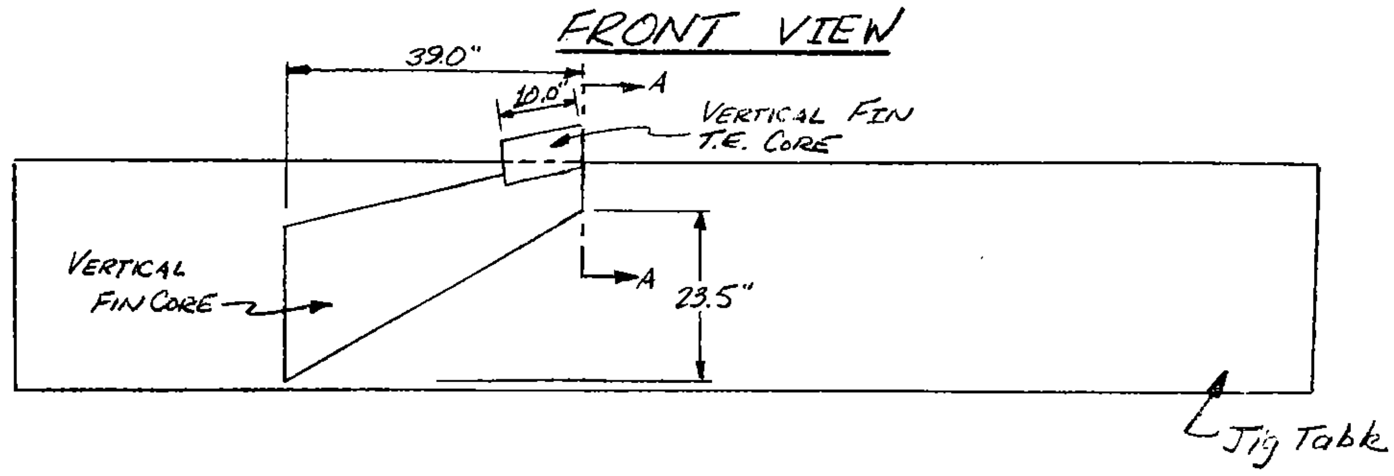
The lamination of the skin and spar caps is very similar to what you have previously accomplished in making the ailerons, elevators, and rudder. It would perhaps be wise to review that chapter at this time.



SECTION A-A



FRONT VIEW



TOP VIEW

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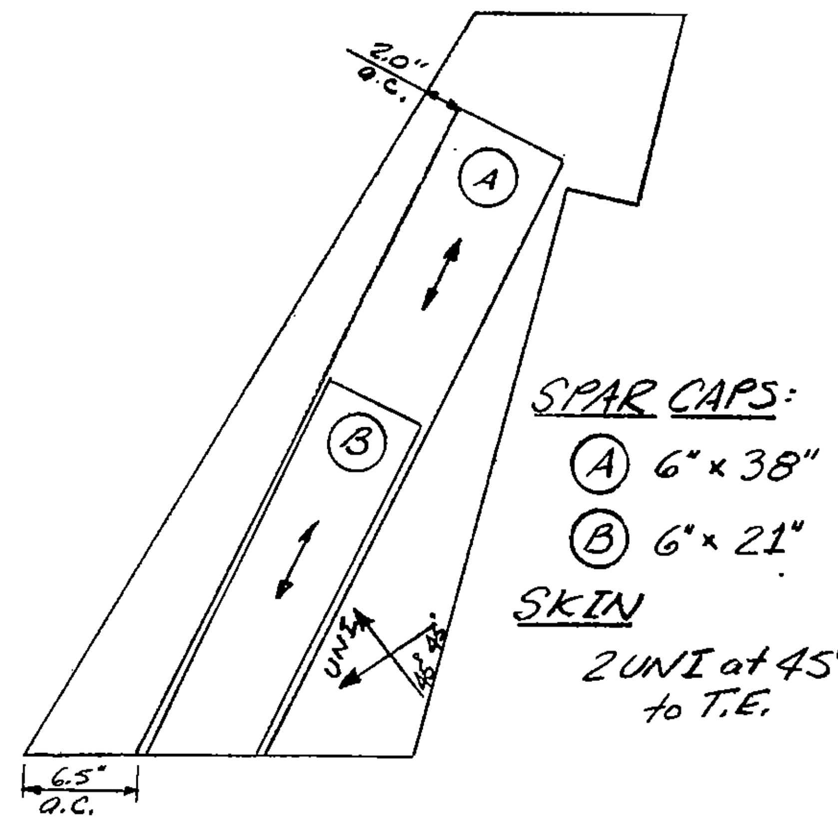
Cut all of the UNI cloth for the skin and spar caps.

Laminate 2 UNI at 45 degrees to the trailing edge of the vertical fin. Don't forget the peel ply tape on the trailing edge of the vertical fin trailing edge core, and remember to knife trim the leading edge at the tangent point,and to obtain glass-to-glass bonding in the vertical fin slot area. Next, laminate the two spar caps. Permit the lamination to set unbothered for at least 24 hours.

After allowing the lamination to cure, you are now ready to turn the vertical fin over and laminate the other side. If you are careful when removing the vertical fin from the vertical fin female jigging template, you will be able to use the templates again in the following lamination. Check all level lines again and again before completing the jigging.

The lamination for the other side of the vertical fin is identical to what you previously accomplished. Remember to sand down the 'tails' on both the vertical fin trailing edge core and the vertical fin slot area. At the leading edge of the vertical fin, feather the previous glass layup. Laminate the skin first (2 UNI at 45 degrees to the trailing edge), overlapping at the leading edge a minimum of 1" and making a glass-to-glass bond at the trailing edges, and then laminate the spar caps. Let the vertical fin cure for at least 24 hours.

Later on, you will modify the shape at the vertical fin root so that it can 'plug into' the aft fuselage. For now, content yourself with adding a small piece of Urethane to the tip, carving it to a pleasing shape, and glassing with 1 BID, overlapping onto the vertical fin.



VERTICAL FIN LAMINATION

NOTE: a.c. means along contour

END OF CHAPTER

BASIC FUSELAGE ASSEMBLY

INTRODUCTION

Jigging the fuselage is your first major assembly task on the Q2. Because the Q2 fuselage shells are provided you in a prefabricated form, jigging is simplified, and there is no messy carving of urethane foam, as is the case with other homebuilts. Perhaps more important, the average builder will find that with the prefabricated fuselage shells, a smoother, aesthetically more pleasing shape will result (carving foam puts the final shape and beauty in the eyes of the carver) and that the final weight will be as much as 30 lbs lighter since all excess material is removed through the prefabrication process and the vast majority of finishing weight is eliminated. But most important probably, is that you can be sitting in the cockpit making airplane noises in a very short time - a most definite incentive to finish the rest of the aircraft!

PRELIMINARY TRIMMING AND JIGGING OF THE SHELLS

The fuselage shells are shipped to you in four sections - upper and lower forward fuselage and upper and lower rear fuselage. The upper/lower longitudinal cut line is arbitrary; the cut line that separates the forward fuselage from the rear fuselage coincides with the fuselage cut line used for making your Q2 trailerable.

The shells are long, and must first be trimmed back to the proper length using the trim lines on the parts. If a particular trim line is difficult to read, trimming the part during jigging will yield the best fit. The parts should be inspected by the builder for quality control using the Composite Materials Education chapter as a guide. In addition, if you measured carefully, you would find that although the shells will look symmetrical left to right, that there is some assymetry from left to right. This is nothing to worry about, just note for future reference.

Locate the 5 fuselage female jigging templates and the bulkheads that you made previously. Study the sketches to obtain a feel for where jigging templates were setup to jig the fuselage approximately level with WL15 when the jigging table is level; note that the longitudinal fuselage spit line does not coincide with a WL. Establishing a WL is important so that the main wing and canard can be mounted later at the proper angle of incidence.

First, you should setup the fuselage female jigging templates at the FS locations called out on the templates. Use some triangular corner blocks made from scrap lumber to hold them vertically temporarily. Next, set the lower fuselage shells into the fuselage female jigging templates. Do not be concerned if you find it necessary to move the fuselage female jigging templates fore and aft to achieve a good fit; remember that you are not looking for a perfect fit, just a resting place for the shells while you assemble the fuselage. Once the locations of the fuselage female jigging templates have been astablished, Bondo them in place so that they will not shift position and rest the two lower shells into them.

Trail fit the upper fuselage shells onto the bottom ones and make any trim line corrections at this time. It looks like an aircraft doesn't it?

PRELIMINARY TRIMMING OF THE CANOPY CUTOUT

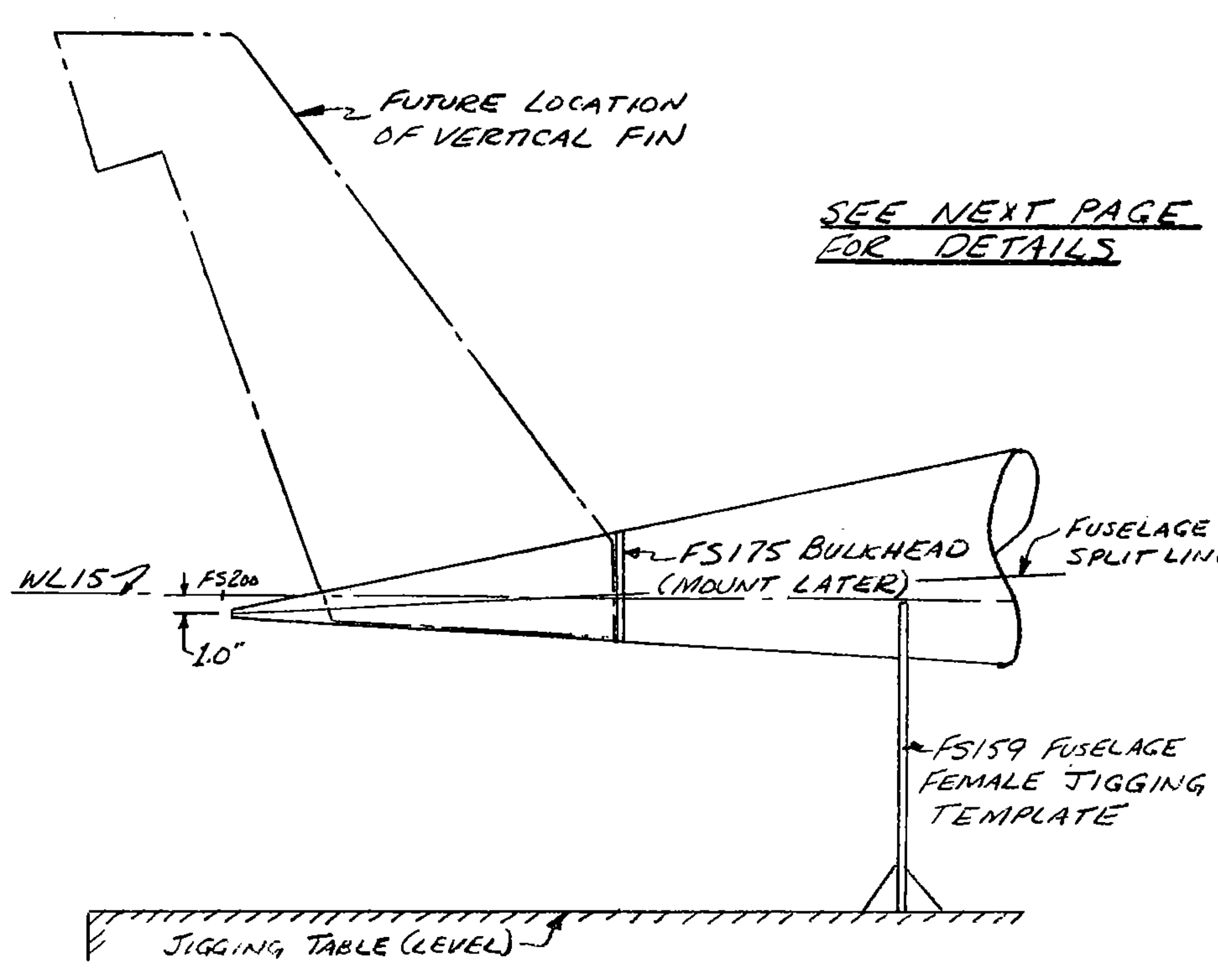
In order to provide access to the interior of the cockpit, you will need to digress for a moment and make a fitting of the pre-trimmed canopy to the upper forward fuselage so that a cutout can be made in the upper forward fuselage.

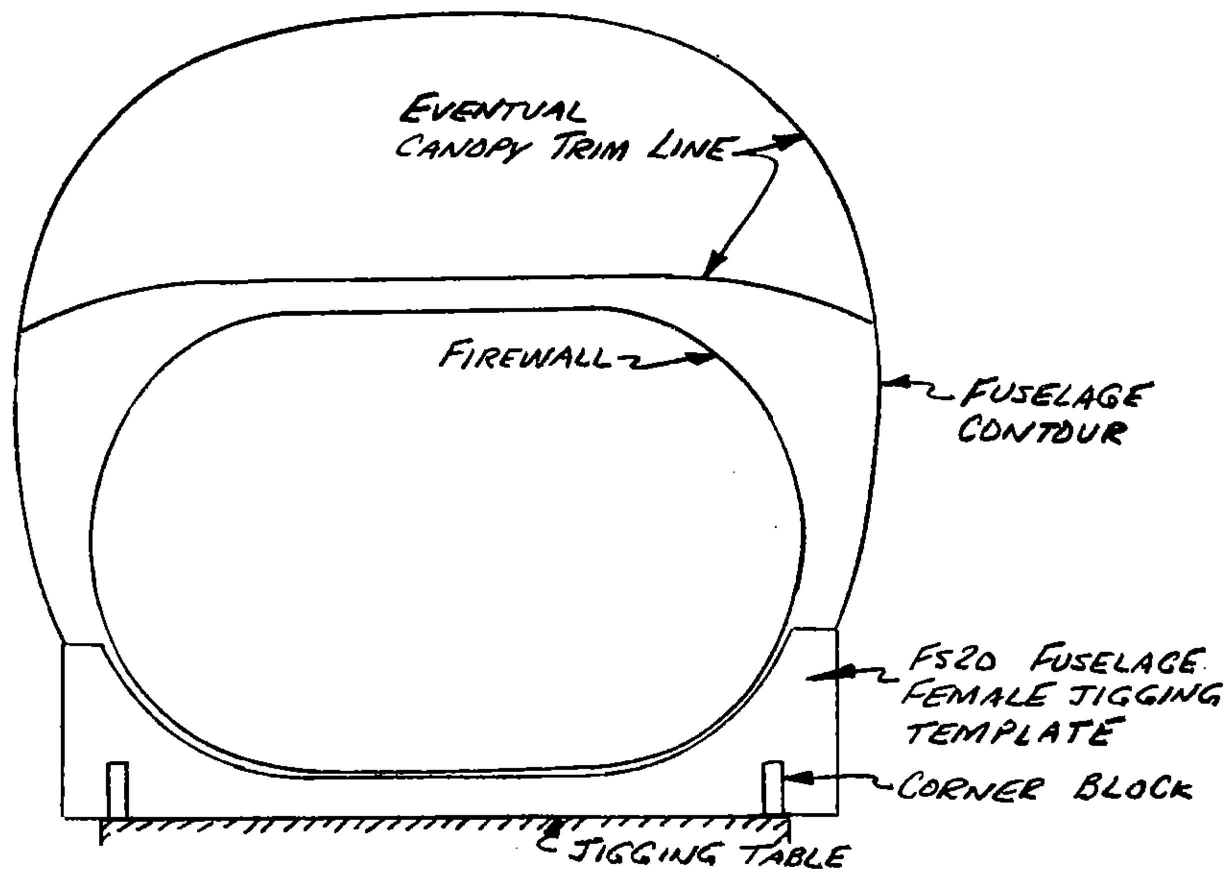
The forward face of the firewall is FS14.0; the forward face of the seatback bulkhead is FS78.0. Therefore, measure 64 inches from where the forward face of the firewall will be located along a WL to establish the aft edge of the canopy. Next, establish a preliminary BL00 line down the forward upper fuselage shell.

Drape the canopy, which is sent to your pre-trimmed to rough shape, over the forward fuselage. Even up the sides by measuring the distance on each side up from the longitudinal fuselage split line and adjusting the canopy until the distances match. Also, check for skewing.

Now, take a marking pen and draw a line around the outline of the canopy where it touches the fuselage. Some trimming of the canopy may be required to make it fit flush against the fuselage shell.

Remove the canopy and make a cut around the upper forward fuselage shell at the line. To be conservative at this point, you may wish to not cut quite all the way to the line, and then final trim the cutout later. All you are trying to do here is to gain access to the inside fuselage and to establish a rough fit on the canopy.





JIGGING OF THE FUSELAGE

In this step, you will want to trim for final fitting the following bulkheads: FS175, FS120, FS94, Seatback Bulkhead, and Firewall. All bulkheads, including the firewall, fit inside the shells, so that they rest against the inside skin of the shells. Begin by drawing BL00 down the bottom fuselage shells, forward and rear. Check the squareness of the lower forward fuselage shell where the firewall is located. It may be necessary to trim the forward edge of the lower forward fuselage shell to make the firewall set square. (i.e. perpendicular to BL00 and WL15). For now, you may assume that a level placed across the longitudinal split line at the firewall attachment point is correct for leveling the fuselage laterally. Don't forget that the firewall fits inside the shell. The FS120 bulkhead location is nominally at FS120 for the forward face, but is uncritical and can be moved plus or minus 1 inch for best fit. The FS94 bulkhead should not be trimmed until after the Seatback Bulkhead. The FS175 bulkhead aft face is located at FS175.

The location and angle of the seatback bulkhead is the prime consideration for comfortably accommodating different pilot sizes. If the primary pilot is over 6'6" tall or less than 5'5" tall, then Quickie Aircraft Corporation should be contacted for assistance in creating a comfortable fit. Basically, moving the break point in the Seatback Bulkhead lower allows the

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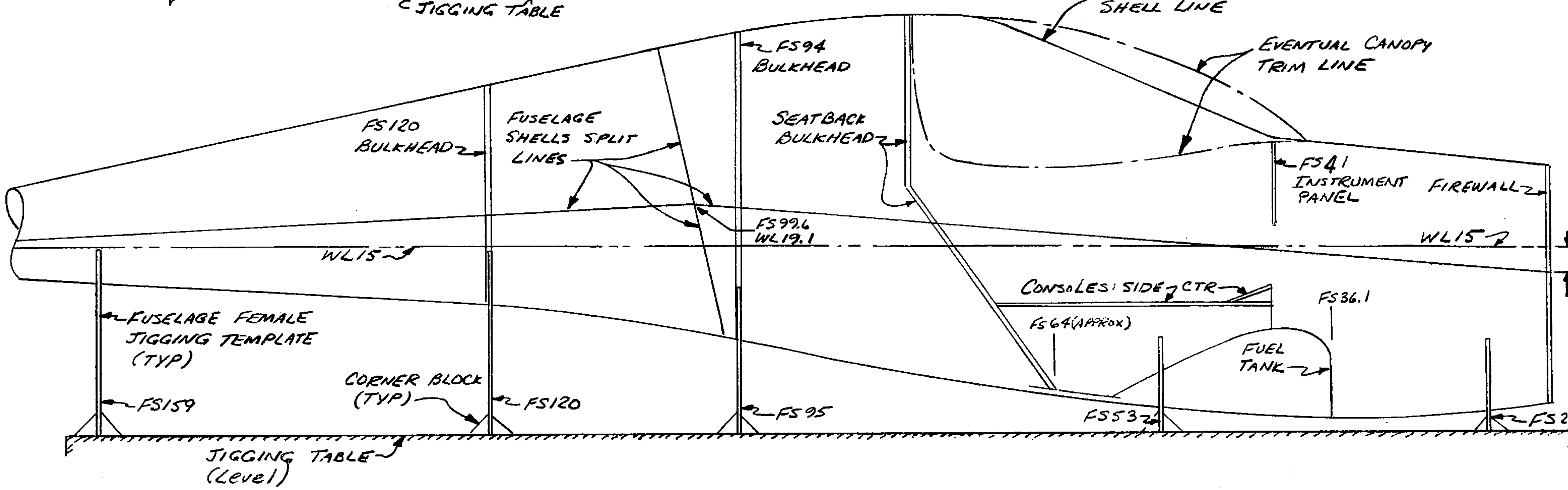


canted portion to be moved aft, which increases cockpit room. Moving the break point up moves the canted portion of the Seatback Bulkhead forward, making the cockpit more comfortable for shorter people. The nominal FS64 shown on the sketch as the intersection of the forward edge of the seatback bulkhead and the fuselage bottom is optimum for people up to 6'6". The forward face of the Seatback Bulkhead must be at FS78.

Once the Seatback Bulkhead is trimmed for position, you may trim the FS94 bulkhead. For many reasons, this bulkhead does not go at FS94, and is the only exception to the relationship between fuselage stations and locations. The FS94 bulkhead should be located so that the forward face of the FS94 bulkhead is at FS95. This is to allow proper clearances and fitting for the main wing upon its installation later.

All bulkheads are mounted vertically (use a level) except for the canted part of the Seatback Bulkhead. When you feel comfortable with the fit, (no, we are not talking about all the cockpit time you've been giving yourself!) then bond the bulkheads to the lower fuselage shells. The FS120 and FS175 bulkheads receive 1 BID tape front and back around the joint with good micro squeeze out, the seatback bulkhead and FS94 bulkhead receive 2 BID tapes front and back, and BID tapes to join the canted and upright portions of the Seatback Bulkhead. (Be sure to bevel the intersection). The firewall is mounted with 3 BID tapes outside, wrapping around the corner (which means you will have to radius the edge) and 2 BID tapes on the inside. Gentlemen and Ladies, each BID tape must lap onto the fuselage and bulkhead a minimum of 1 inch for proper structural joining. Use the level to check for the vertical orientation, and check the squareness of each bulkhead with respect to BL00.

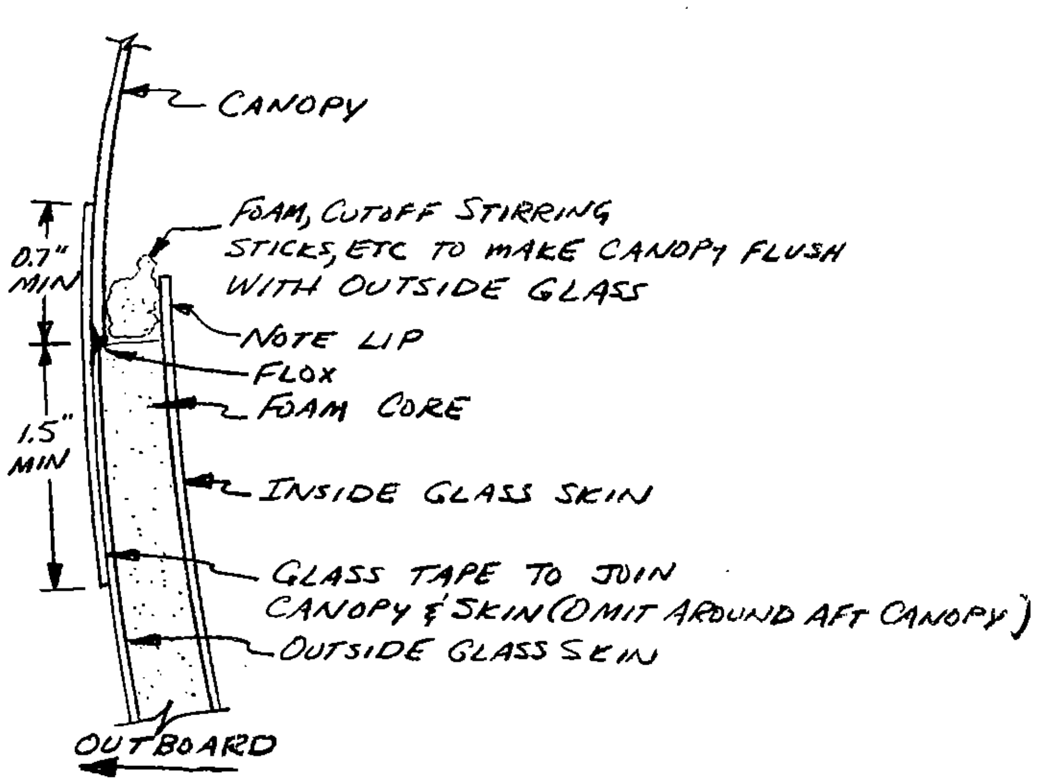
Do not install the instrument panel or fuel tank at this time.

MOUNTING THE CANOPY

Next on the agenda is to permanently attach the canopy to the upper forward fuselage, in preparation for cutting out the canopy frame. The procedures used are basically to final trim the cutout and canopy for fit, then to glass the outside canopy to the outside fuselage, and finally to fit the aft canopy bulkhead and glass the inside of the canopy to the inside of the fuselage.

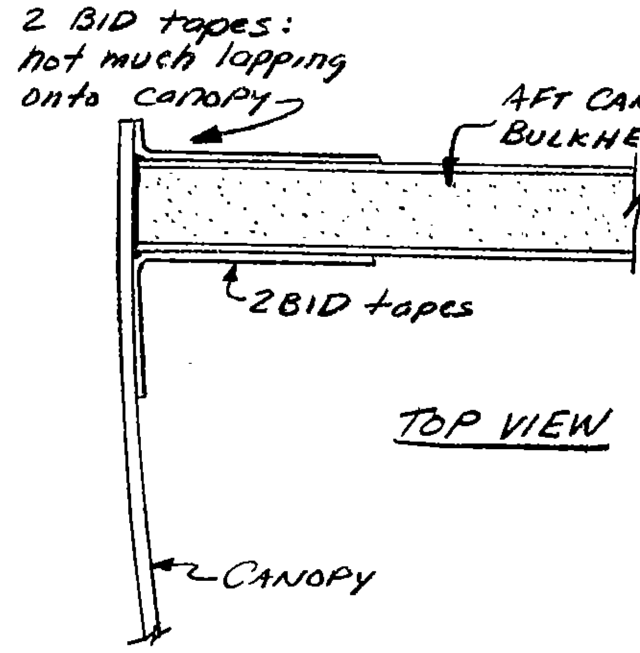
Note that the sketch shows a lip on the inside fuselage glass. This lip is to assist in jigging the canopy in position for those outside fuselage tapes. Since the canopy is much thinner than the fuselage core, stirring sticks, foam, etc. will need to be used to provide a firm surface to laminate the outside tapes against.

The canopy is joined to the outside fuselage with 2 BID tapes, overlapping the fuselage a minimum of 1.5 inches, and the canopy a minimum of 0.7". Liberal Flox is used to fill any voids prior to glassing; peel ply the lamination and allow it to cure 24 hours.



CANOPY MOUNT (OUTSIDE)

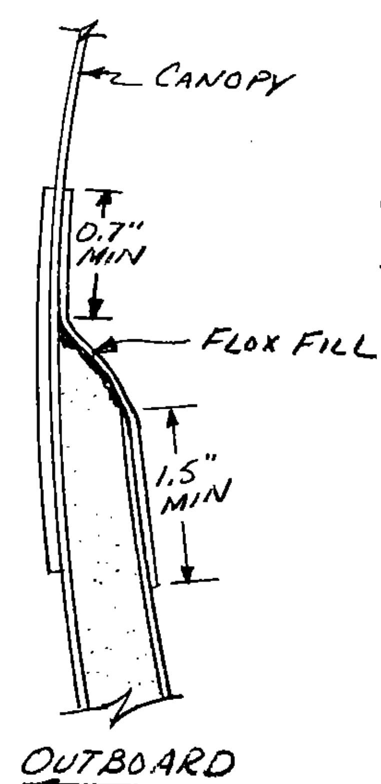
Next, the canopy mounted to the fuselage is turned over and the aft canopy bulkhead fitted into position. The aft face should be located a maximum of 1/8" forward of the forward face of the Seatback Bulkhead with a few dabs of 5-MIN. It is permanently mounted with flox and 2 BID tapes on either side, lapping onto the bulkhead and fuselage a minimum of 1.5 inches, and lapping onto the canopy a minimum of 0.7 inches.



AFT CANOPY BULKHEAD MOUNT

Also, sand down the lip in the inside fuselage skin lamination and contour the inside fuselage skin smoothly into the canopy. Then laminate 2 BID (with liberal Flox to fill the voids prior to glassing) with 0.7 inch minimum lapping onto the canopy and a minimum of 1.5 inches lapping on the existing fuselage inside skin.

Permit the laminations to cure for 24 hours.



CANOPY MOUNT (INSIDE)

JOINING THE FUSELAGE SHELLS

This step is very exiting; you are going to actually complete your first major structure - the fuselage.

In this section, you will join the top forward fuselage shell to the lower forward fuselage shell,and the top aft fuselage shell to the lower aft fuselage shell. Do not join the four shells at the fuselage cut line.

Also, each bulkhead must be joined to the shells with the same number of tapes used previously to attach the bulkheads to the lower fuselage shells.

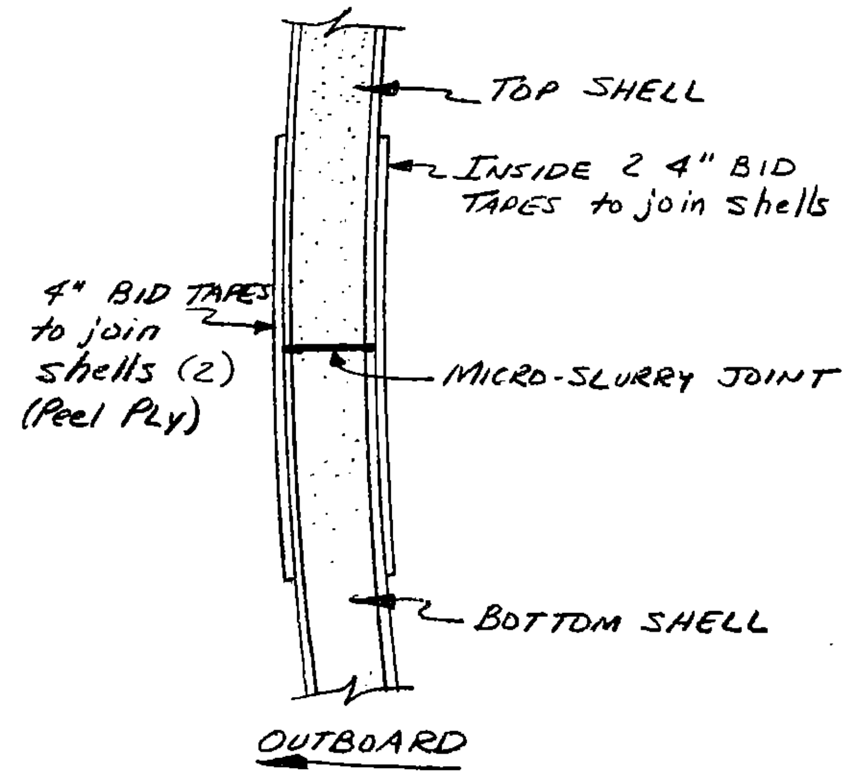
This section will require many cure cycles due to problems in accessing all area at one time.

Begin by joining the rear fuselage shells together. 2 BID tapes of at least 4 inches wide are used along the joints inside and out. 1 BID tape fore and aft is used to join the FS120 and FS175 bulkheads to the top aft fuselage shell. You will have difficulty reaching back into the rear fuselage to laminate the tapes. You may elect to skip ahead to Chapter 14 and cut out the aft top fuselage where the vertical fin assembly is inserted so that you can reach the aft face of the FS175 bulkhead and the inside of the seam. If you elect to do that later, don't forget about it. Of course, micro slurry is used between the parts.

Joining the forward fuselage shells is somewhat more difficult because of the access to the forward fuselage area. Whatever area you cannot reach at this time, can be accomplished after you cut out the canopy frame and thus reestablish access to the forward cockpit area.

The forward fuselage shells also receive 2 BID tapes at least 4 inches wide along the joints on both the inside and outside. 2 BID tapes fore and aft are used to attach the FS94 and Seatback Bulkheads to the top forward fuselage shell. 2 BID tapes, inside, and 3 BID tapes outside, are used to attach the firewall to the top forward fuselage shell. These last tapes should be at least 4 inches wide, and don't forget to round the outside edge of the firewall/shell junction prior to glassing. These firewall tapes are very important to keeping the engine attached to the rest of the aircraft, so do a careful job of laminating them. (Unlike the rest of the joints, the firewall-shell junction should be painted with epoxy, not micro-slurry).

This entire section will consume many hours of work and become very frustrating. Take pride in the fact that you will soon be able to sit in a completed fuselage!

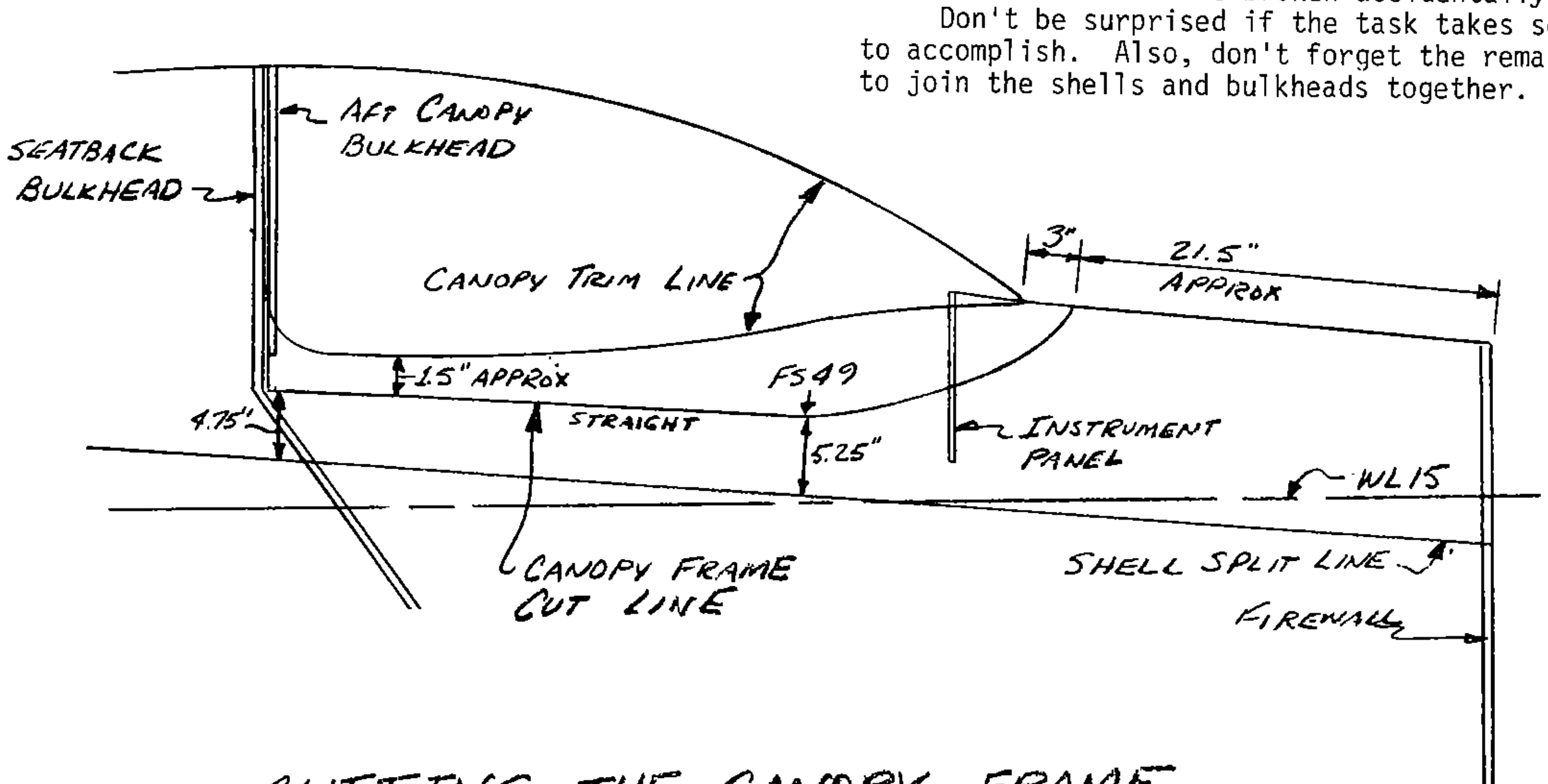


JOINING THE FUSELAGE SHELLS

CUTTING THE CANOPY FRAME

In this section, you regain access to the cockpit area and obtain your canopy frame at the same time. The sketches show the suggested cut line for the canopy frame. This line is somewhat arbitrary on our part, but the rest of the cockpit area is designed around it so be carefull of deviations. Mark the line with a felt tipped marker on the shells and check for symmetry. Use a fine tooth hacksaw blade to carefully cut through the sandwich. Put the canopy frame/canopy assembly aside where it won't be broken accidentally.

Don't be surprised if the task takes several hours to accomplish. Also, don't forget the remaining tapes to join the shells and bulkheads together.

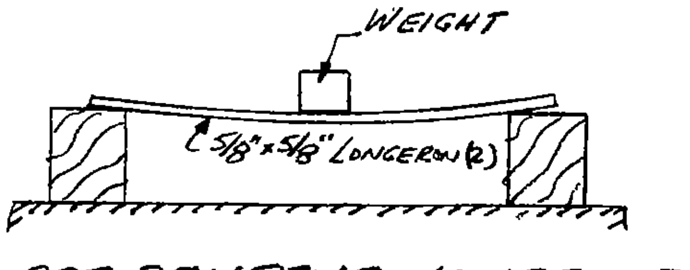


CUTTING THE CANOPY FRAME

INSTALLING THE LONGERONS

A longeron runs on each side of the cockpit forward from the Seatback Bulkhead to the instrument panel. These longerons are made of 5/8" square wood and must first be bowed to shape in order to fit the curvature of the fuselage side.

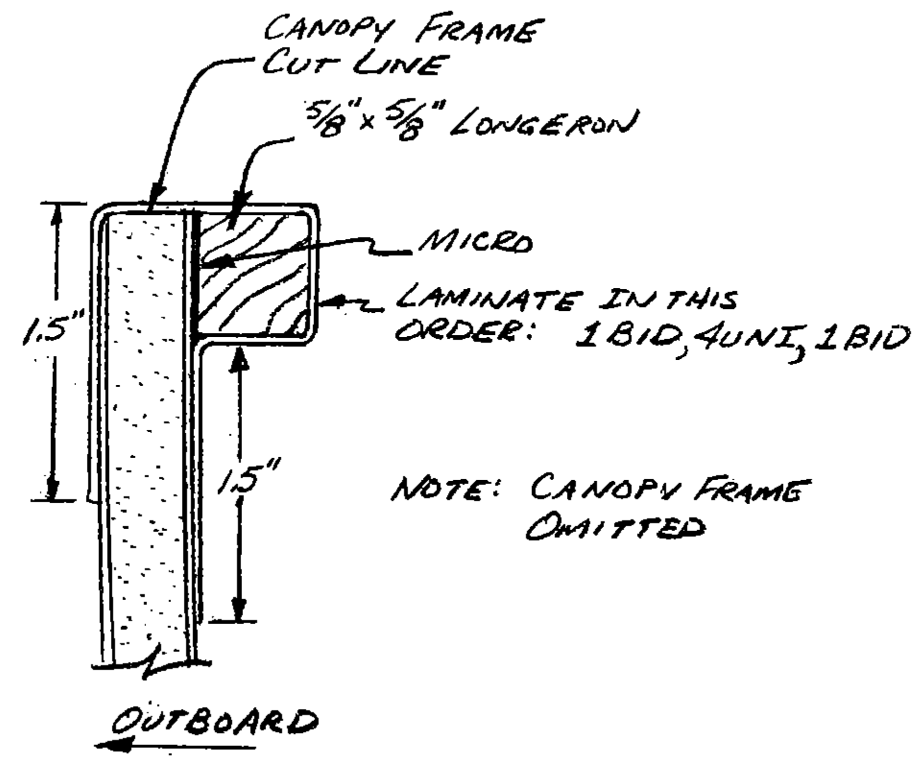
Support the longerons on each end and place weights in the middle, as shown. Permit them to stand this way for at least two days. The wood should bow in the center after a short while. If you wish to be very scientific, you may measure the amount of bow required by skipping ahead and checking the curvature on the fuselage sides where the longerons will be mounted.



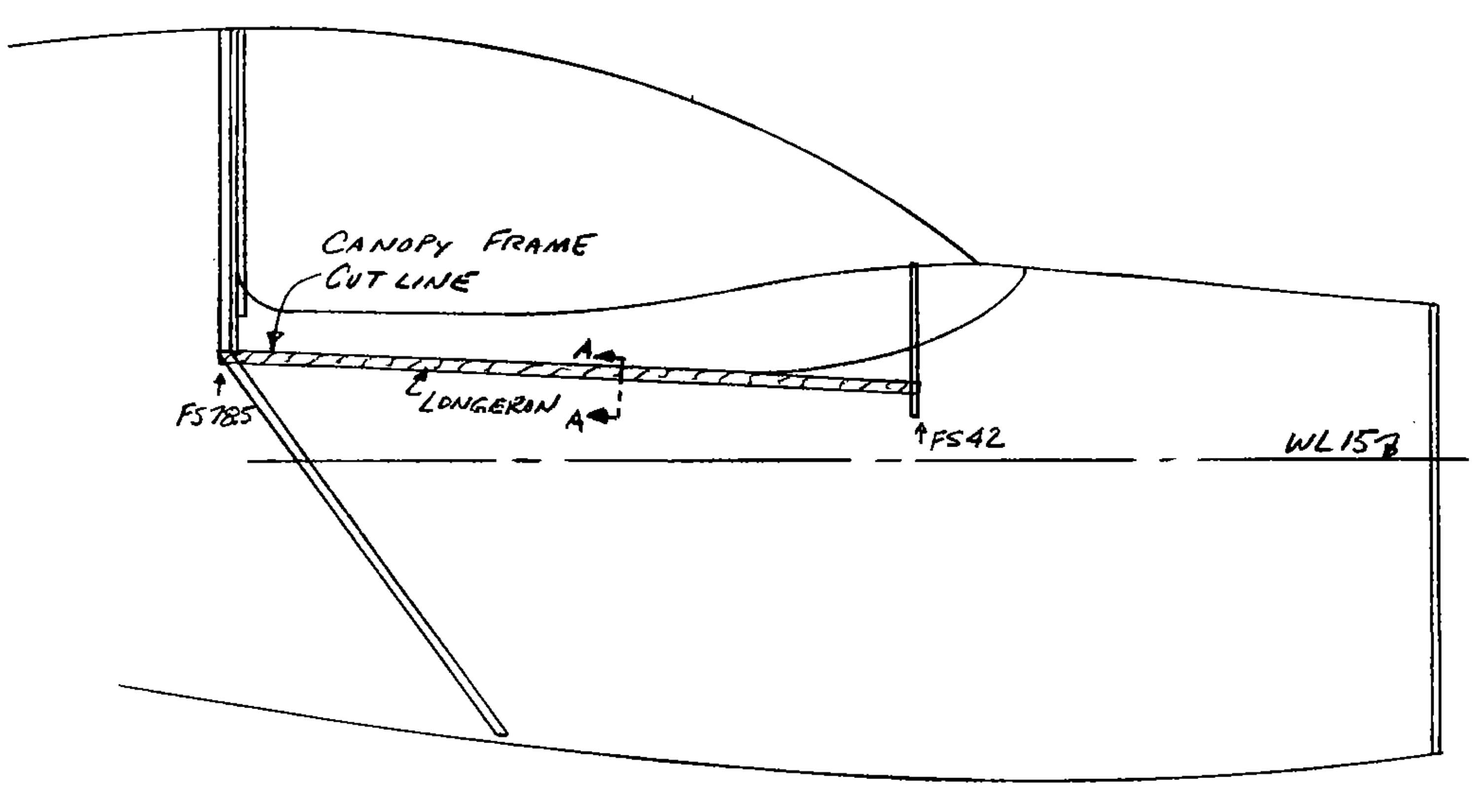
PRE-BENDING LONGEONS

Once the canopy frame has been cut out and the longerons bowed statically, then they should be mounted in the fuselage to increase the strength of the fuselage. The sketch included here shows the location of the longerons; note that they basically go just below the canopy frame cut out line. The longerons must be installed as shown here in order for the canopy hinges to be positioned correctly.

Also note the 4 UNI glass and 2 BID glass used to mount the longerons, in addition to the flox. These tapes significantly increase the stiffness of the longeron, and must be lapped onto the fuselage a minimum of 1.5 inches. The UNI orientation is along the longeron; the BID is laminated at 45 degrees to the longeron line. Do not use micro between the lamination and wood.



SECTION 'A-A'



LONGERON INSTALLATION

END OF CHAPTER

MAIN WING CONSTRUCTION

INTRODUCTION

The main wing is a sandwich composite structure with solid foam core, two layers of UNI at 45 degrees to the trailing edge of the wing for torsional stiffness and surface durability, and spanwise tapes of UNI for bending strength. The T.E. of the wing is perpendicular to BL00. (i.e. the trailing edge of the wing has no sweep). The ailerons are on the inboard section of the wing, and are actuated by an aluminum torque tube. Shear loads are taken by a vertical shear web.

The main wing is constructed in one piece from tip to tip for strength, lightness, and ease of construction.

CUTTING THE SPAR CAPS

Begin by cutting the UNI spar caps using the suggested layout on this page. Letter each one of them with a felt tipped marker for identification later, in addition to marking a centerline in the middle, (where the cap will cross BL00 when installed on the main wing). The technique for cutting the spar caps is described in the Composite Materials Education Chapter and should be reviewed at this time. Be sure to carefully roll up and store the spar caps after cutting to prevent damage.

JIGGING THE MAIN WING

Construction begins by jigging the main wing on the jig table. Locate the main wing cores that you have previously hot-wired. It is not necessary to use either the aileron slot foam cores, or the main wing trailing edge cores, at this time.

Find the main wing core female jigging templates (6).

Now study the sketches. The main wing cores are jigged upside down on the jigging table using the main wing core female jigging templates. If your table is not at least 200 inches long, you will have to extend it with a few 2x4's using bando, in order to locate the BL00 main wing core female jigging templates. Note that the shear web is perpendicular to BL00, and that the main wing core female jigging templates have leading and trailing edges that are tangent, respectively, with the leading edges of the main wing cores, and the main wing shear web.

Begin by drawing a straight line along your jigging table and marking the locations (BL's) of the main wing core female jigging templates. Next, temporarily set the main wing core female jigging templates on the table so that their trailing edges are along that straight line and their positions coincide with the appropriate BL locations. A string stretched spanwise with a weight attached at either end (see CANARD chapter) may be useful.

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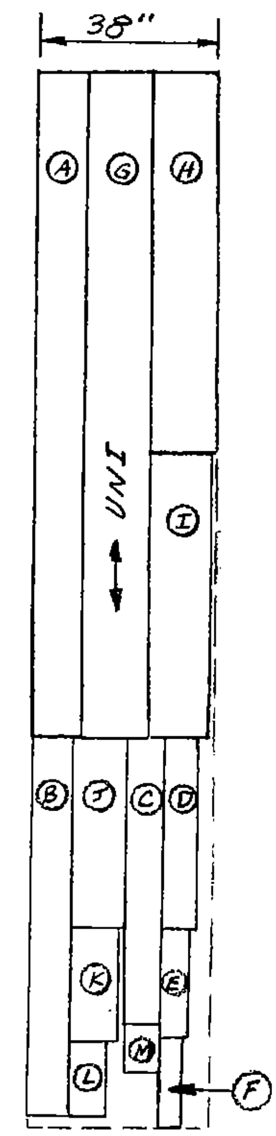
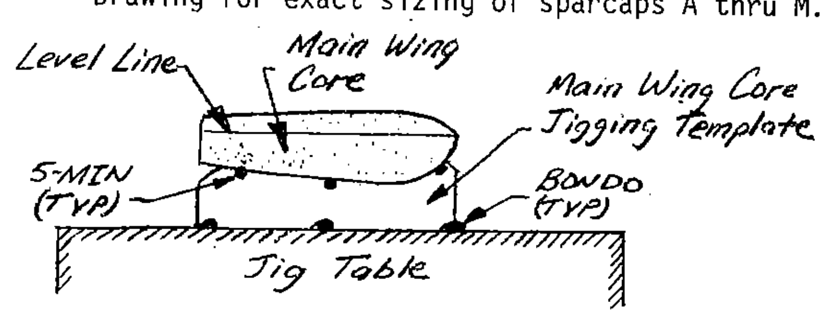
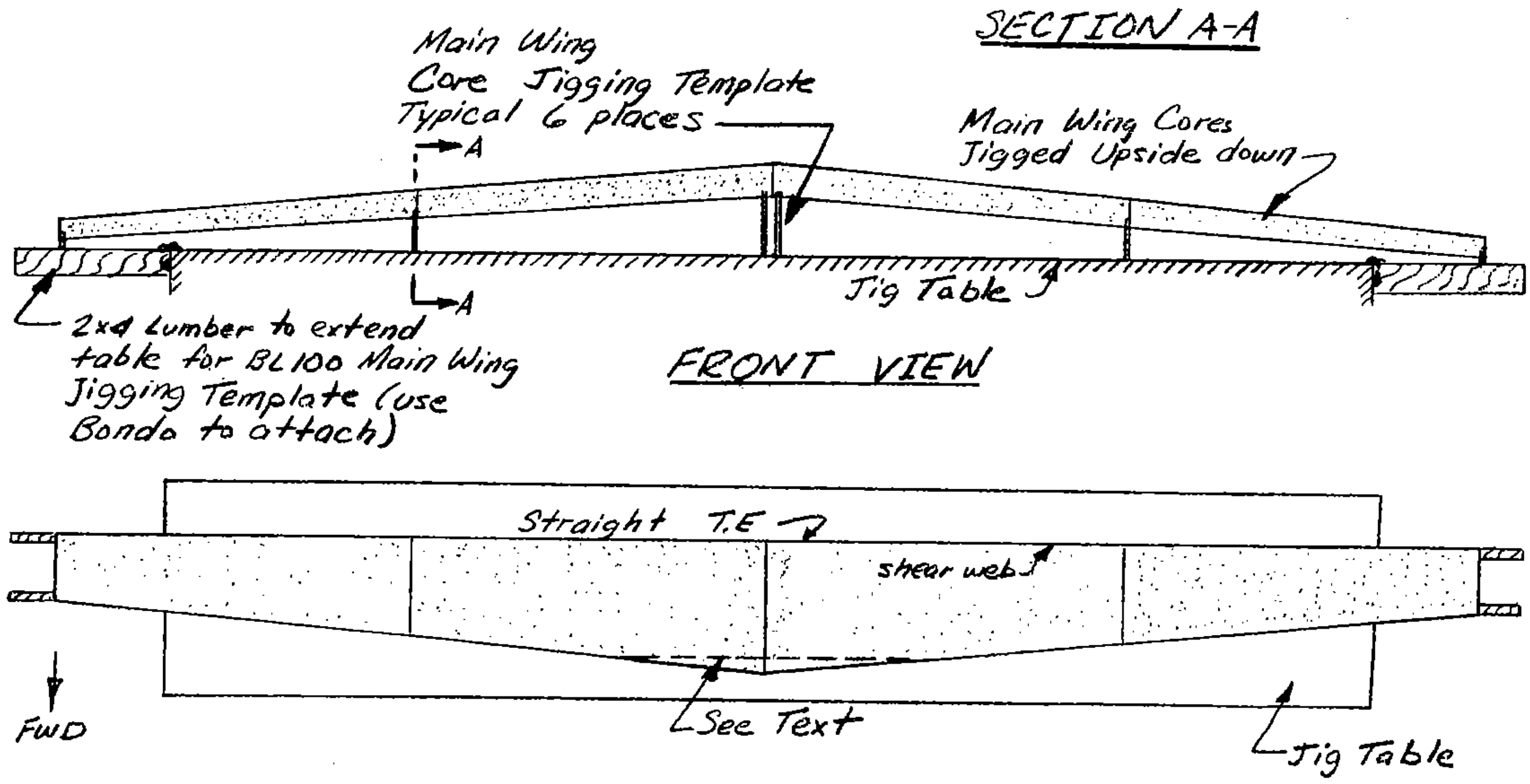


MAIN WING SPAR CAP CUTTING LAYOUT

NOTE: See Bottom and Top Main Wing Lamination Drawing for exact sizing of sparcaps A thru M.

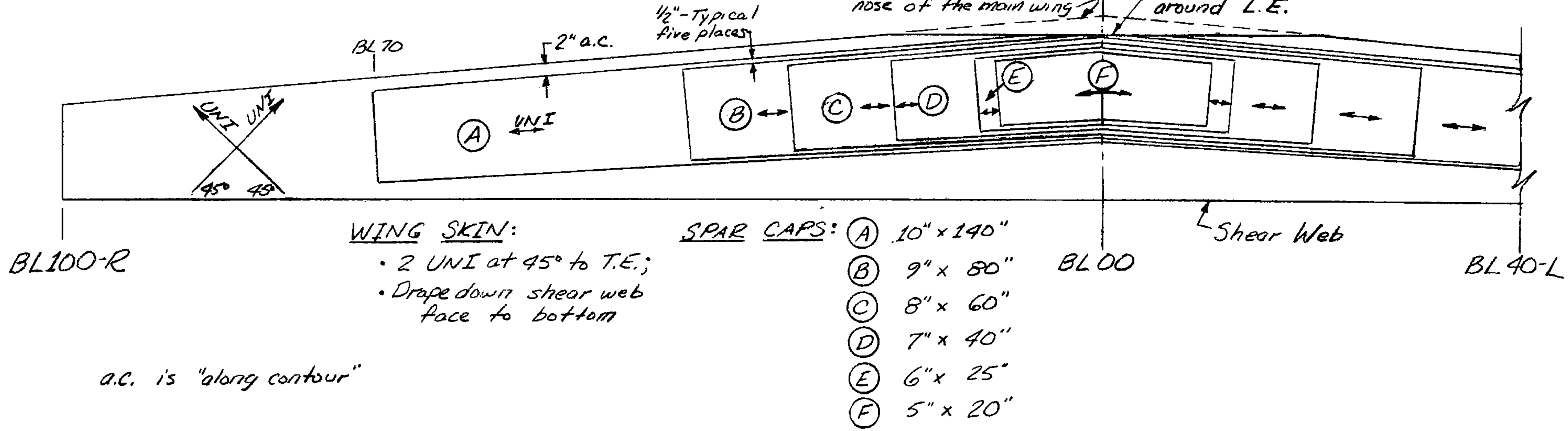


SECTION A-A

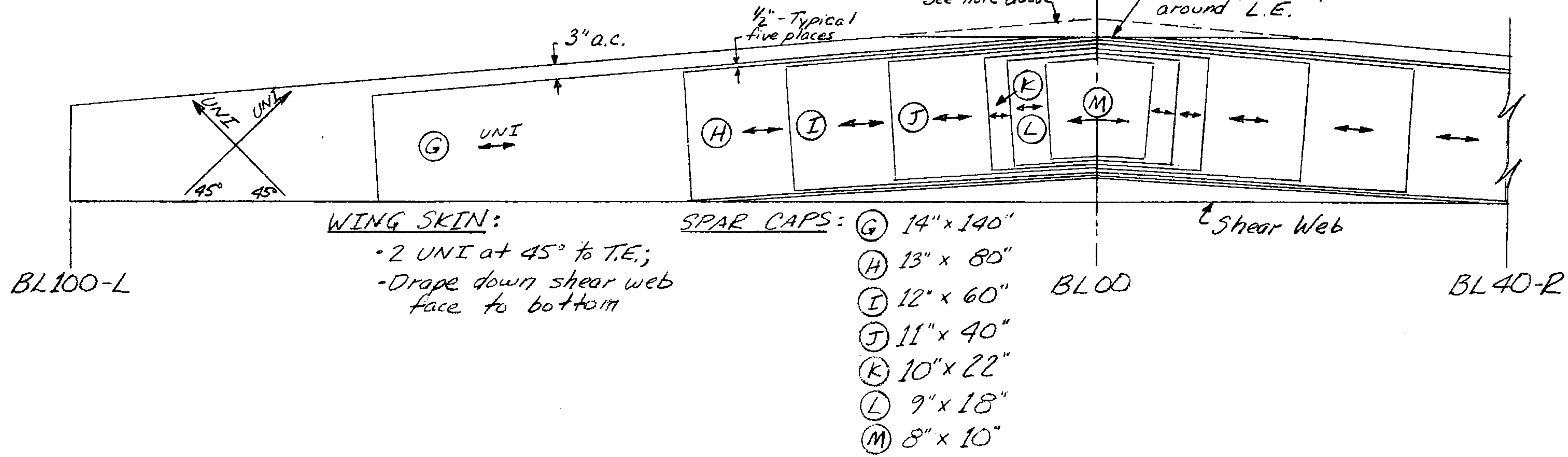


TOP VIEW

BOTTOM MAIN WING LAMINATION



TOP MAIN WING LAMINATION



Now begin to trial fit the four main wing cores into position. Be careful not to put too much pressure on the foam cores and damage them. The two inboard cores will have to be beveled at BL00 by sanding because of the main wing dihedral and the other core joints may have to be sanded to make the cores fit within the maximum tolerance of 1/16". The level lines on all cores must remain level at all times. This is important, so take your time.

Stand back and sight spanwise along the main wing to verify that the main wing is straight, and is not bowed or kinked. Verify that the leading edge is straight from each tip to BL00, and that the trailing edge is straight from tip to tip.

Don't be concerned if the main wing core female jigging templates need to be moved inboard or outboard to remove any bows or kinks. Also, a long straight edge will help you looking for kinks and joggles.

When everything is perfect, mix up some bondo and carefully bondo the main wing core female jigging templates to the table top in the necessary locations. Next, rest the main wing foam cores on the main wing core female jigging templates. Check the alignment and individual level lines again. Then RECHECK the alignment and the individual level lines. Then RE-RECHECK them again; get the message? Stirring sticks, scrap wood, etc. can be used as shims to locate everything properly.

The next step is to join the foam cores together with micro slurry after verifying that the core fit is within 1/16". Check, recheck, and re-recheck each core level line and alignment as the cores are joined.

Finally, attach the main wing foam cores to the main wing core female jigging templates with small dabs of 5-MIN, being careful not to move the cores after the final level line and alignment check.

CAUTION

The main wing foam cores must fit within 1/16" or exotherm damage may result.

TRIMMING THE MAIN WING FOAM CORES

When the main wing is attached to the fuselage, it must fit between the FS78 bulkhead and the FS94 bulkhead. As can be seen from the sketch, this requires that the forward "nose" of the main wing cores be removed. You may wish to skip ahead and read the section on MAIN WING MOUNTING to have a clear understanding how the mating is accomplished.

Go to your fuselage which is laying in the corner and sit in it. This "cockpit time" will help give you confidence that you really can build an aircraft. Don't forget to make airplane engine noises and move the imaginary controls; it helps with the illusion.

When you are tired of this, get out of the cockpit and measure the distance on your aircraft from the aft face of the FS78 bulkhead to the forward face of the FS94 bulkhead. Make these two measurements at WL30, outboard at either fuselage side at the FS78 bulkhead. They should be the same - about 16.3". since you are only human, they will probably each be a little different, end either more, or less, than 16.3". Also measure the width between the two points that you took the measurements at.

You are now ready to transfer the information onto the main wing foam cores with a felt tipped marker pen. Using the main wing shear web and the BL00 foam core joint as the reference mark the two points on the foam cores, and connect them with a line. That line should represent where the FS78 bulkhead will meet the main wing core. Verify by making measurements that this line intersects the main wing leading edge inside the fuselage once the main wing has been mounted. If it doesn't, then you will have to taper and round the main wing core area outside the fuselage sides to avoid an ugly looking flat spot on your main wing. Next, move the line aft about 0.10" to allow for the glass build-up as you laminate the main wing skins and spar caps. This second line on the main wing cores is the trim line.

NOTE

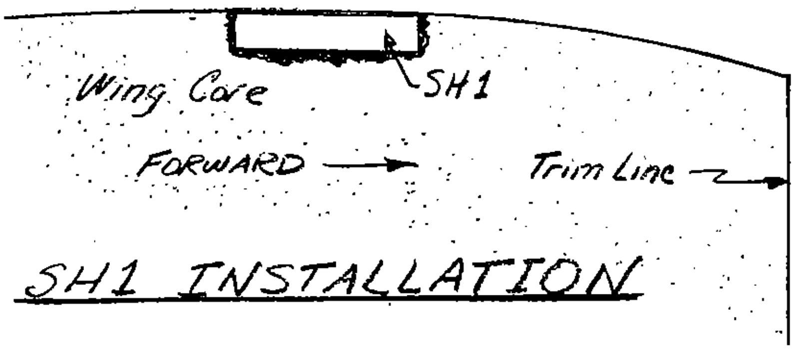
All measurements indicated above should be made along a WL, not along the contour of the wing.

SHOULDER HARNESS INSERT INSTALLATION

Each shoulder harness is installed in a Y fashion to the lower main wing. Prior to glassing the bottom of the main wing, the shoulder harness inserts (2) must be installed.

Find the two 1" square by 3/16" thick mild steel plates provided (SH1).

Install one of them with flox at about BL9 left, about 2" along contour (ac) from the trim line, flush to the surface of the main wing foam core. Install the second SH1 similarly at BL9 right.



PREPARING THE MAIN WING CORES FOR GLASSING

At this point, the main wing cores should be jigged on your jigging table upside down, 5-minuted and bondoed in place, and not about to move under anything short of an earthquake.

Use a hard block to clean up all joggles, excess micro, and any bumps on the main wing cores. At BL00, round the joint so that the glass will flow smoothly across the joint. At the T.E. (shear web), round the corner so that the glass will flow smoothly down the face of the shear web.

This is your last chance to determine the shape of your main wing, so make the main wing cores as perfect as you know how. And, oh yes, RE-RE-RECHECK THE MAIN WING TIP LEVEL LINES. If you are not proud of everything that you have accomplished on the main wing so far, don't go on to the next step until you are.

LAMINATING THE BOTTOM SKIN AND BOTTOM SPAR CAPS

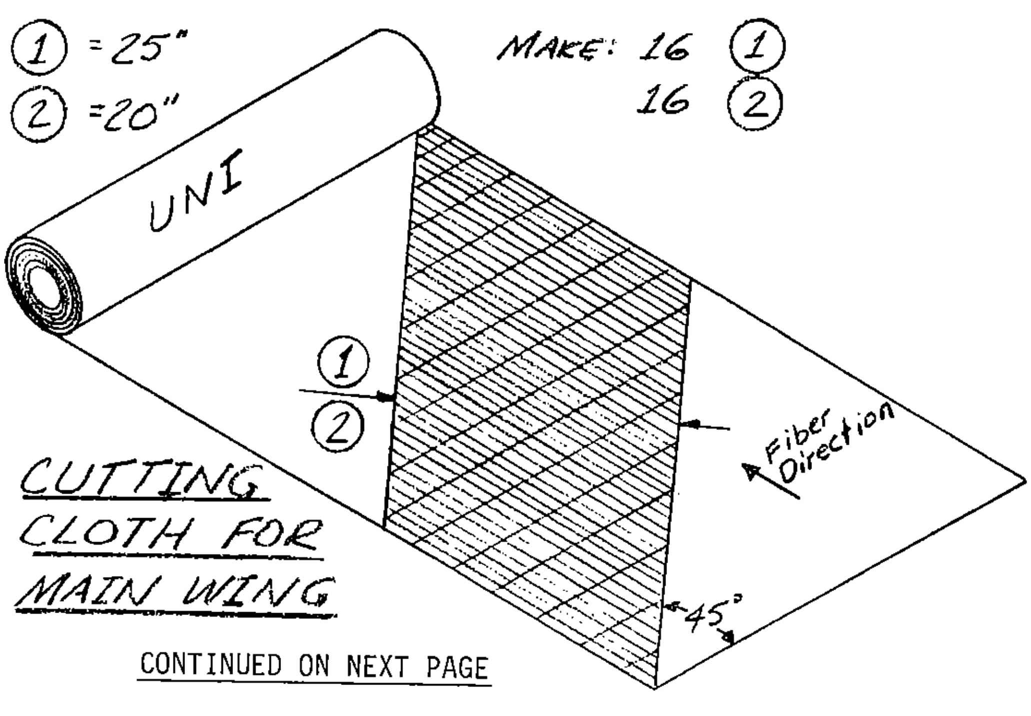
Study the two sketches labled "Bottom Main Wing Lamination" and "Top Main Wing Lamination" very carefully.

Today, you will only be doing the "Bottom Main Wing Lamination", but that one is enough, and will take 3 individuals about 2.5 hours to complete. (The third individual mixes epoxy while the other two do the lamination).

To summarize the lamination, first you will laminate the wing skin, which is 2 plies of UNI at 45 degrees to the main wing T.E., and then you will laminate spar caps A thru F.

Begin by getting your shop organized for a big lay-up. Next, cut the UNI for the main wing skins as indicated on the sketch, labling each one so that you will know where it goes.

Once you start this lamination, you will have to continue it until you finish, so if you want lunch, a cup of coffee, or a nap, now is the time to do it.



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The first UNI ply is put on at 45 degrees to the main wing T.E.. The fibers must be straight, so take your time getting the wrinkles and kinks out. Don't get ahead of yourself on pouring microfoam slurry on the foam; otherwise, by the time you are ready to place the UNI over a particular area, you will have a messy, hard lump of slurry. Work with one piece of cloth at a time, and with small batches of slurry and epoxy. Also, unrolling the UNI cloth as needed is advised to reduce the ackwardness of the large pieces. Scrap UNI can be used to fill in any small spots not covered by the large pieces of UNI.

At the leading edge of the main wing cores, let the UNI cloth hang vertically down. Trim to within 1" of the tangent point, just like you did on the ailerons. At the trailing edge, allow the cloth to drape around the corner and down to the bottom of the shear web so that the UNI is at 45 degrees to the T.E. on that face also. Trim the main wing tip UNI to within ½" of the main wing core. Inboard, along the trim line, also allow the UNI to drape over the edge and down to the bottom.

No overlap is required on the UNI wing skin; just butt fit the skins together. You must, however, squeegee the cloth well to avoid building up excess epoxy in the lamination.

The second ply of UNI is also placed at 45 degrees to the T.E. of the main wing cores but in the other direction from the first ply, so that the two plies of UNI will have their major fiber orientations at 90 degrees to each other. The second ply will be easier because it is being layed up over glass and not the foam. Try to avoid having the butt joints from the first ply of UNI coincide with the butt joints from the second ply of UNI. The second ply of UNI is also draped around the corner and down to the bottom of the shear web, so that the shear web has two plies of UNI at 45 degrees to the T.E. and at 90 degrees to each other. Trim all edges like you did on the first ply.

Spar Caps A thru F are laminated in that order, with the widest cap going on first. To pick up a spar cap and place it on the main wing, use three people. While one person holds each end of the spar cap, the third removes any frazzles, being careful not to reduce the width below what is called out for the particular spar cap. That third person then stands at BL00 and positions the spar cap in the proper location (centerline on BL00 and proper distance from the leading edge of the main wing) while the other two individuals keep the cloth off of the foam so that it won't stick. When the center (third) person is ready, one of the individuals holding an end lays it down spanwise on the main wing in the proper position (in relation to the main wing L.E.) and removes any wrinkles and kinks. This can be a slow process, so stay patient. Then the man (or woman) on the other end does likewise. The center individual makes sure that the spar cap smoothly "turns the corner" at BL00.

Squeegee each spar cap from BL00 outboard to keep the UNI fibers straight. Work out any wrinkles or kinks by pulling carefully on the fibers.

The remaining spar caps are each put on in a similar fashion. We know you are getting tired, but you must squeegee each cap well to avoid building up considerable epoxy on the bottom plies. Use extra epoxy very sparingly on the last spar cap.

Locate the places where you bonded in the two SH1's (the 1" x 1" mild steel plates) and laminate a pad of 20 plies of BID over each one. The BID cloth should be about 2" x 2" dimensionally.

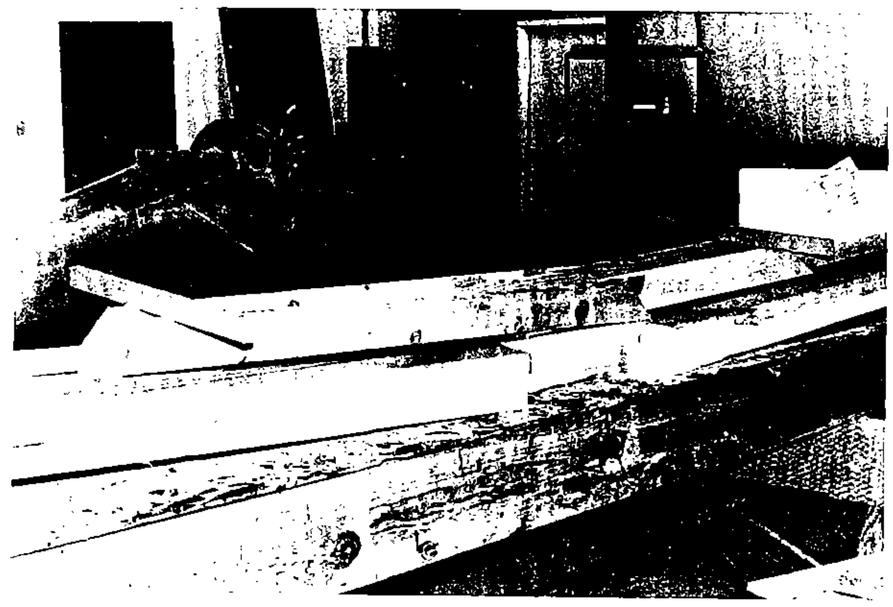
Before quitting, peel ply all joints, and the first two inches of the main wing L.E.. Also, knife trim the L.E. at the tangent point, just like you did on the aileron. Then, clean up your mess and go celebrate your wizardtry as a laminator. <u>DON"T TOUCH THE MAIN WING FOR AT LEAST 24 HOURS.</u>

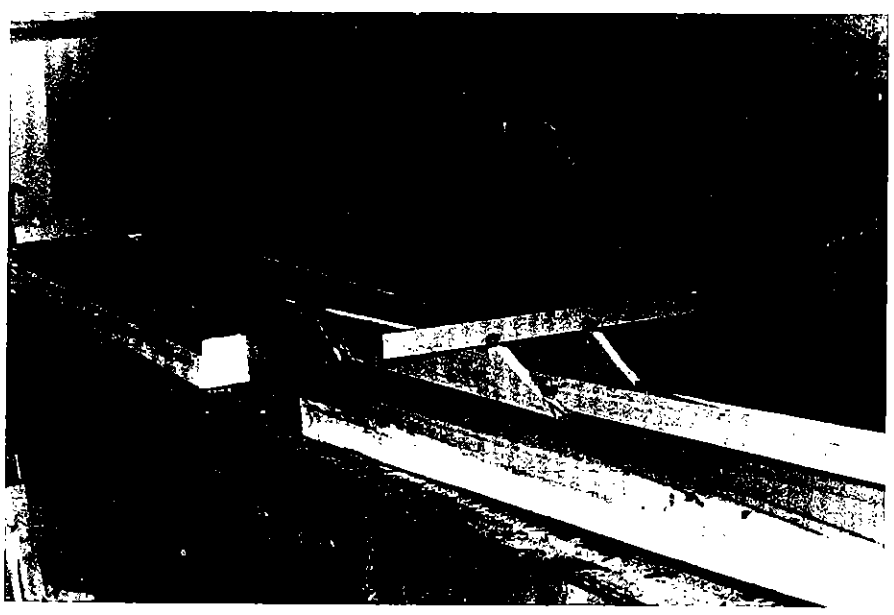
<u>NOTE</u>

If you have room and can be patient, it would be better to permit the bottom main wing lamination to cure for 48 hours plus. In the meantime, you could skip ahead and perhaps do the aileron slot foam core slot laminations. But, if your like everyone else, you won't be able to resist making that jigging table into a main wing for your Q2 as quickly as possible.

<u>LAMINATING THE TOP SKIN AND TOP SPAR CAPS</u>

Build a framework out of scrap lumber and bondo to hold the main wing jigged in place while you turn it over. As shown in the pictures, we suggest that lumber run from tip to tip with a few cross pieces. Don't get fancy, just tie everything together so that the main wing won't move, (and, yes, we know the pictures show the canard, but we forgot to take some of the main wing jigging).





Next, when you are sure of your framework, break loose the main wing core female jigging templates with a hammer (they won't be needed again), and turn the main wing over so that the unglassed cores are upward. Set the main wing on the jigging table once again.

Check the main wing tip level lines. Jig, and shim, and bondo until the main wing tip level lines are perfect; almost doesn't count. Then bondo the heck out of the jigging as if you were expecting a few kids to use your shop for playing cowboys and Indians.

At the leading edge, feather the bottom skin to a feather edge at the tangent point just like you did with the ailerons. Prepare the main wing core top surface just like you did the main wing core bottom surface. (See "Preparing The Main Wing Cores For Glassing")

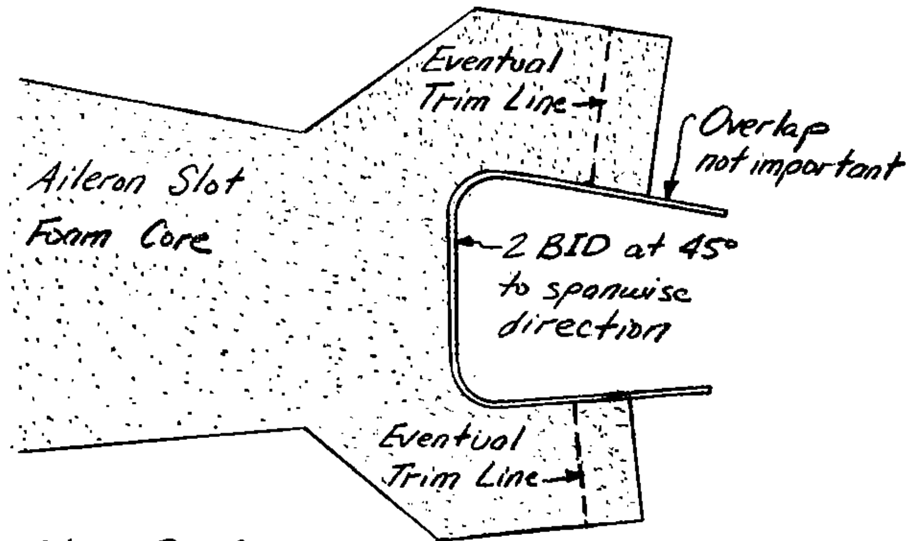
You are now ready to laminate the top main wing skins and top spar caps. Do it similarly to the bottom lamination. The skin is the same two UNI at 45 degrees to the T.E., draping over the T.E. down to the bottom of the shear web and the spar caps are G thru M this time. At the leading edge of the main wing, overlap the bottom skin with the top skin a minimum of 1". Rather than let the spar caps drape over the T.E. and down the shear web, trim the caps at the T.E.

Peel ply the shear web and all joints.

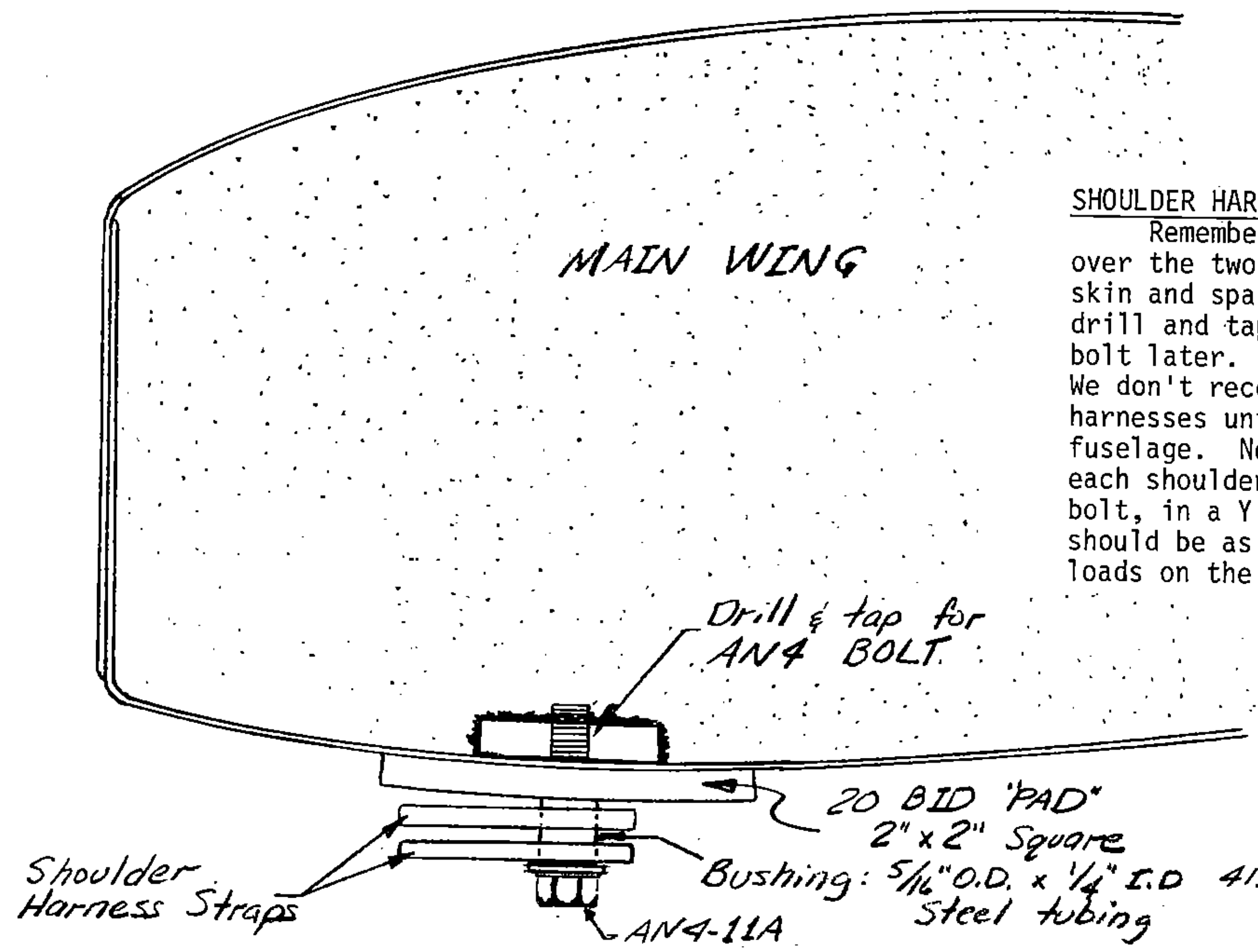
Don't touch the wing for 48 hours after you have finished it. Instead, go sit in the fuselage some more to pass the time, or else skip ahead and keep working. Before removing the lumber, bondo a level board at about midspan on each wing half. This is to help in attaching the main wing to the fuselage later. Attach the level boards carefully, so that they will agree.

GLASSING THE AILERON SLOT FOAM CORE SLOTS

The aileron slot foam core inside slots are glassed with 2 BID at 45 degrees to the spanwise direction. (i.e. T.E.). Knife trim to the edge of the foam core, as shown on the sketch.



AILERON SLOT FOAM CORE INSIDE LAMINATION



SHOULDER HARNESS INSTALLATION

Remember those 20 BID plies that you laminated over the two SH1's when you performed the "BOTTOM" skin and spar cap lamination? Now is the time to drill and tap each SH1 with a ¼ x 28 tap for a AN4 bolt later. The sketch shows the complete assembly. We don't recommend actually attaching the shoulder harnesses until after the main wing is mounted to the fuselage. Note that both shoulder harness straps of each shoulder harness assembly are attached to one bolt, in a Y fashion. Also, the 4130 Steel Bushing should be as short as possible, to reduce bending loads on the bolt.

SHOULDER HARNESS INSTALLATION

INSTALLING THE AILERON SLOT FOAM CORES

This step is critical to having a nice looking main wing and aileron union, so follow the directions carefully.

To start out with, the aileron slot foam cores that you hot-wired way back when were purposely made longer than necessary. Your first task is to size them for the correct length. To do this, you must measure your fuselage width at the fuselage/aileron slot foam core junction. Take measurements of the main wing, skip ahead to the section on "Mounting The Main Wing To The Fuselage", and determine that dimension, on either side of BL00. Mark the proper points on the main wing. Wait to trim the inboard aileron slot foam cores until after they have been installed on the main wing.

Next, determine where to trim the outboard aileron slot foam cores. Since each elevator was made 48" long, measure 48" plus 1 inch (for aileron/fuselage clearance) from your first mark outboard and place another mark. This is where the outboard aileron slot foam core will be trimmed, but, as before, wait until after installation to do it.

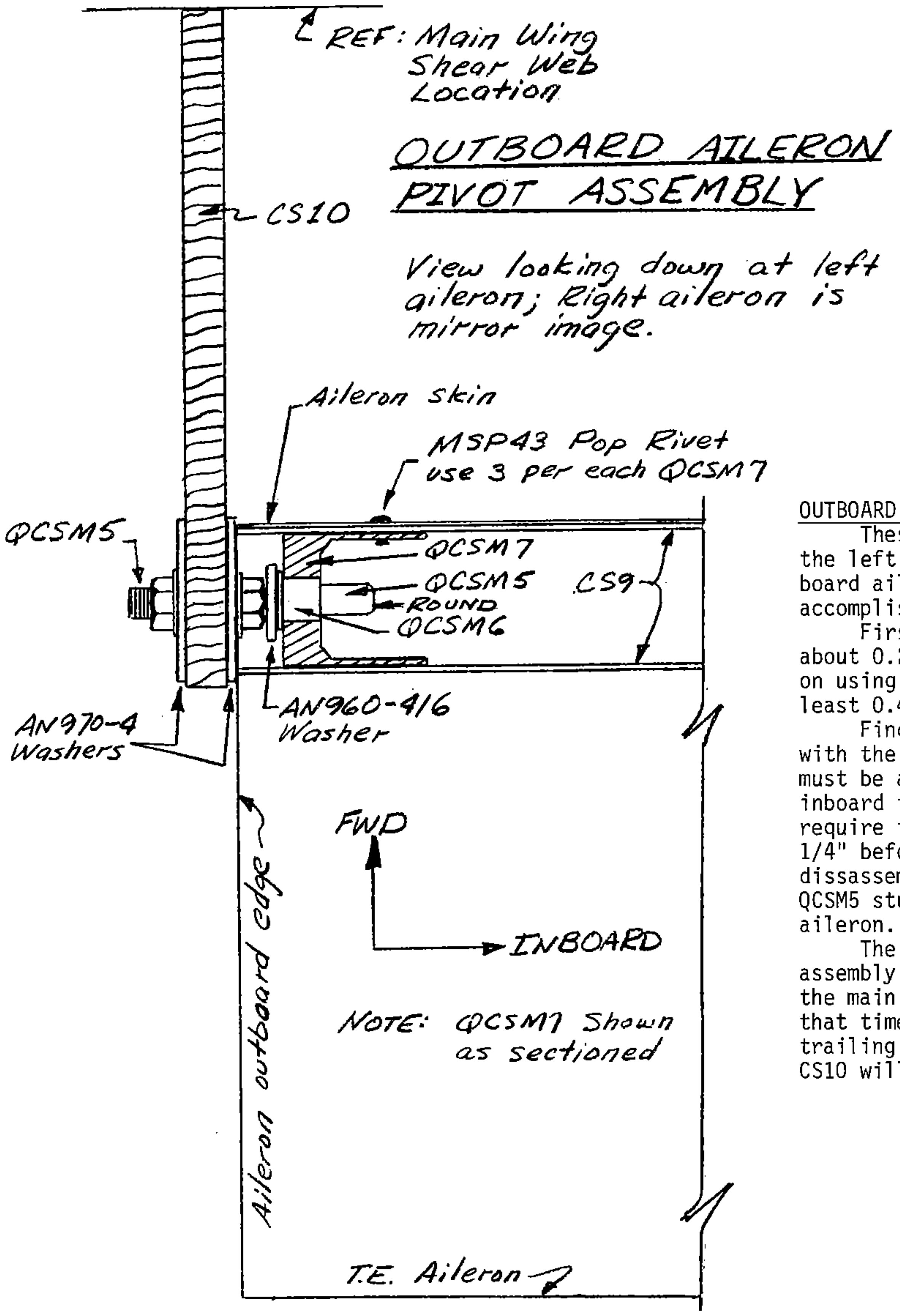
Skip ahead to the CANARD chapter, "Installing The Elevator Slot Foam Cores" section for a sketch showing the geometry of the attachment.

It is easier to check clearances top and bottom if the main wing is jigged vertically on the jig table. This will also keep the joint from running. A few scrap pieces of lumber and bondo should be sufficient.

The important point to remember is that at the shear web attach point along the span, the top and bottom of the aileron slot foam cores should flow smoothly into the top and bottom surfaces of the main wing, respectively. If the aileron slot foam cores want to stick up a little bit, this is OK since that can be sanded later. Any dip, however, will have to be filled with micro. This fit is important cosmetically, so take you time.

The aileron slot foam cores are installed to the main wing shear web with micro-slurry on the foam cores and epoxy on the shear web (don't forget to remove the Peel Ply!), plus a few dabs of 5-MIN to keep the two attached during cure.

Once the attachment has cured, trim the aileron slot foam cores back to the "Eventual Trim Line". (See CANARD chapter, "Installing The Elevator Slot Foam Cores" section for a sketch showing the detail). Next, sand down the "tails" so that you can achieve a minimum of 0.4" of glass-to-glass bond with the inside slot lamination, while at the same time fairing everything nicely into the main wing contour forward of the shear web. At the glass-to-glass bond area, you must sand away all micro and epoxy and get down to the glass. Spend some time looking at the surfaces getting the alignment the best that you can. When everything is ready, laminate 2 BID at 45 degrees to the main wing shear web on the aileron slot foam cores, top and bottom, being sure to achieve at least 0.4" of glass-to-glass bond, and lapping up onto the main wing at least 1". Note that the sketch in the CANARD chapter calls out dry-micro fill if required at the top and bottom of the shear web joint. Trim the inboard and outboard aileron slot foam cores at the marks previously made on the canard.



OUTBOARD AILERON PIVOT ASSEMBLY

These instructions cover only the assembly of the left outboard aileron pivot, but the right outboard aileron pivot is a mirror image, and may be accomplished at the same time.

First, find a QCSM7 pivot and position it about 0.25" inboard of the outboard end of the aileron using 3 MSP43 cherry rivets spaced radially at least 0.4" apart.

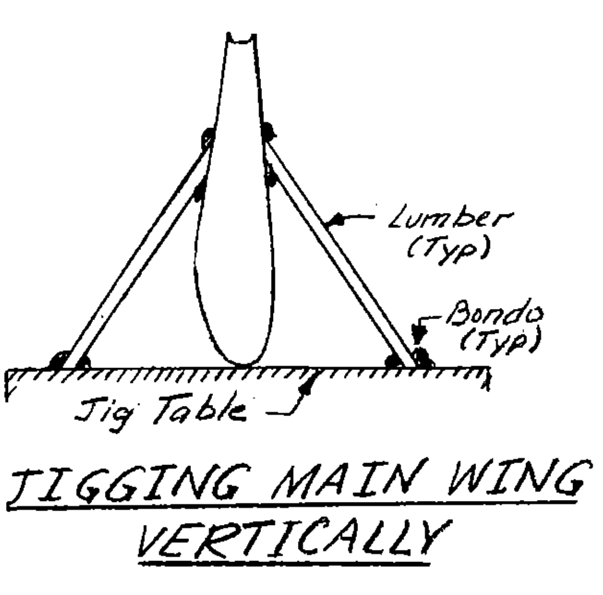
Find CS10, and insert a QCSM5 stud as shown with the 3 washers and the 2 AN363-428 nuts. There must be a minimum of 0.6" from the AN960-4 washer inboard to the end of the QCSM5 stud. This is to require the aileron to be moved inboard at least 1/4" before it "falls off" the QCSM5 stud for dissassembly. Finally, round the end of the QCSM5 stud slightly to assist in mounting the aileron.

The sketch shows the outboard aileron pivot assembly as it will look later when installed on the main wing shear web. Although not shown, at that time, the aileron slot foam core and aileron trailing edge foam core will be trimmed so that CS10 will fit flush against the main wing shear web.

AILERON INSTALLATION

In this section, you will mount the ailerons to the main wing. After the main wing is attached to the fuselage, it will only be necessary to connect the CS5 and CS12 push-pull tubes in order to have a functioning aileron control system. This section is very important, so take your time and read through the entire section several times prior to starting any of the procedures.

Begin by jigging the main wing vertically on your jig table with the L.E. pointed down. This will make it much easier to rig the ailerons.

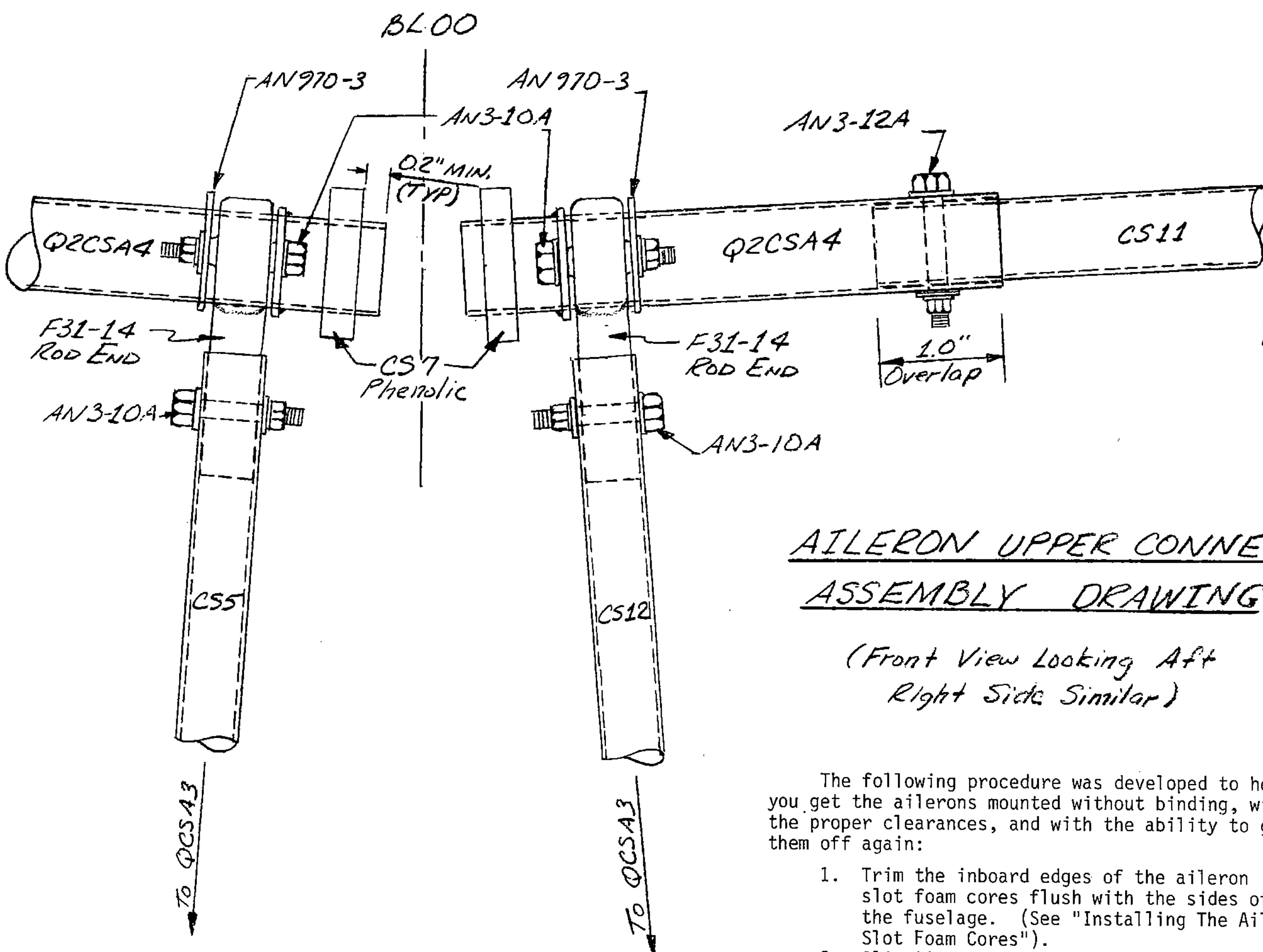


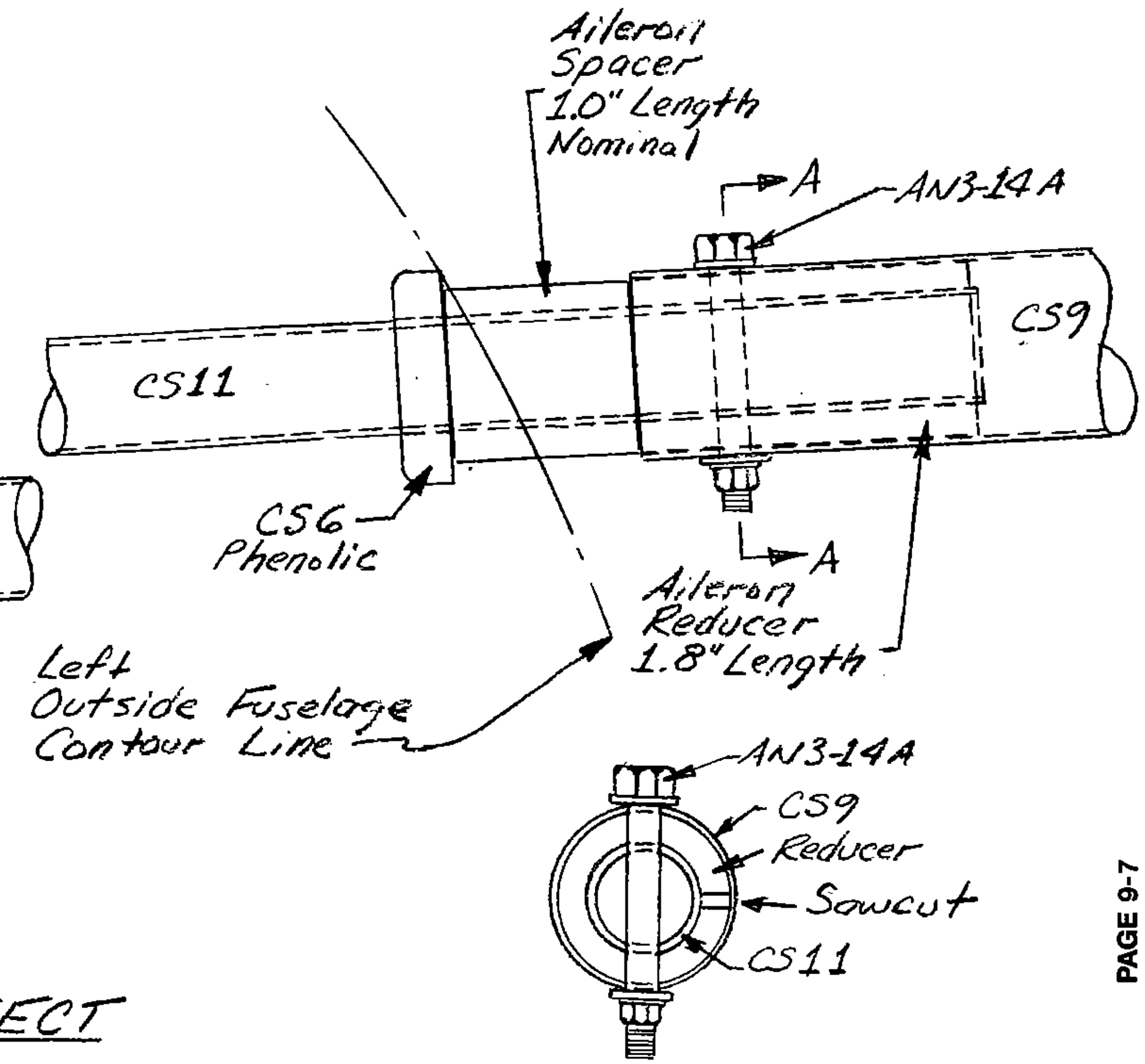
Take a piece of QCSM1 and make two 1.8" length pieces to use as aileron reducers. A sawcut and perhaps some light sanding will be necessary to make them fit snugly and flush with the inboard ends of the two ailerons.

Find the phenolic bearings CS6 (2) and CS7 (2). Dull the phenolic completely with sandpaper except inside the reamed 5/8" diameter holes. Be sure that the other 1/2" diameter holes have been drilled out. These are non-critical on diameter, but must be there to assist bonding of the phenolic to the structure. They are NOT lightening holes.

Find Q2CSA4 (2). Make CS11 (2) from 0.625" O.D. x 0.065" wall 4130 steel tubing. The length of CS11, which can be critical for disassembly, should be about 3/4" less than half the width of the fuselage at the aileron torque tube (CS9)/ fuselage junction.

The right and left aileron mountings are mirror images of one another. Each aileron has an outboard hinge (CS10), an inboard hinge (CS6), and a center fuselage hinge (CS7). The Q2CSA4 slips over a CS11, which passes through the CS6 phenolic and slips into the aileron reducer, which is mounted on the inboard end of the aileron. Clear, heh?





SECTION A-A

AILERON UPPER CONNECT ASSEMBLY DRAWING

(Front View Looking Aft Right Side Similar)

The following procedure was developed to help you get the ailerons mounted without binding, with the proper clearances, and with the ability to get them off again:

1. Trim the inboard edges of the aileron slot foam cores flush with the sides of the fuselage. (See "Installing The Aileron Slot Foam Cores").
2. Slip Q2CSA4 over CS11; slip CS6 over the other end of CS11, and slip that same end of CS6 into the aileron reducer, which you have already mounted flush with the inboard end of CS9, the aileron torque tube - looks like a shiskabob doesn't it?
3. Slip CS7 on the end of Q2CSA4.
4. What follows is a very qualitative fitting process. Using at least two people, dry fit CS10, CS6 and CS7 firmly against the main wing shear web in the appropriate postions (CS10 against inboard end of outboard main wing trailing edge core, CS6, and CS7 held in place) and check for binding. Work slowly, correct any binding or clearance problem by modifying CS10, CS6, and CS7. Please, do one thing at a time.

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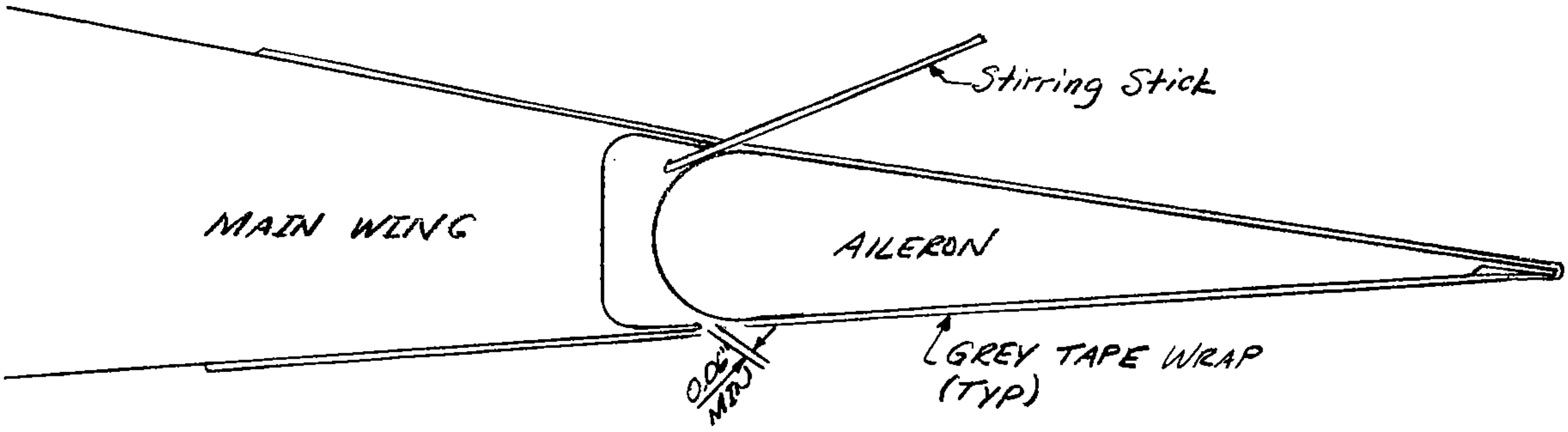
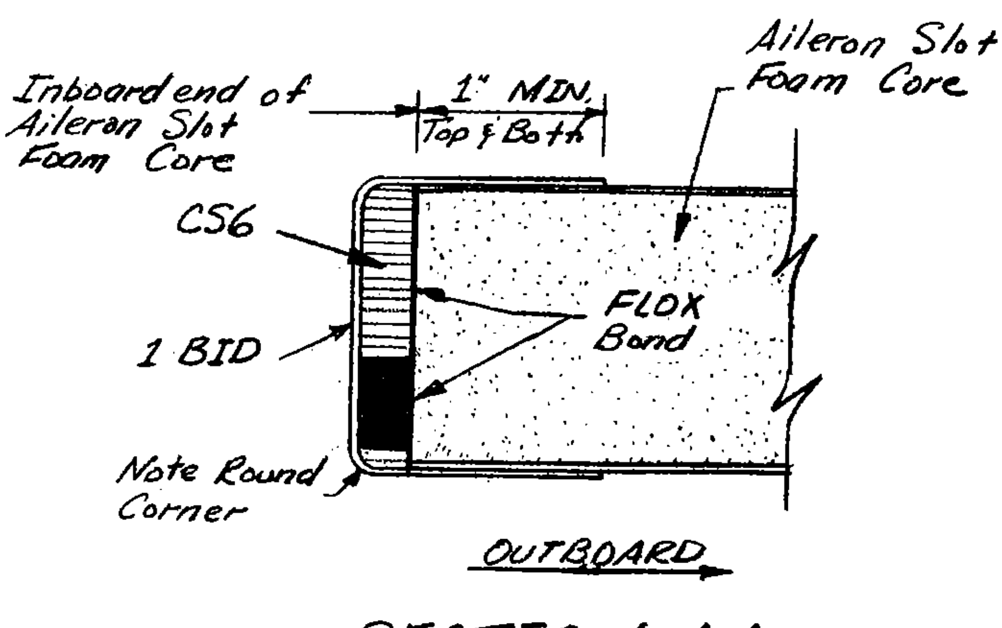
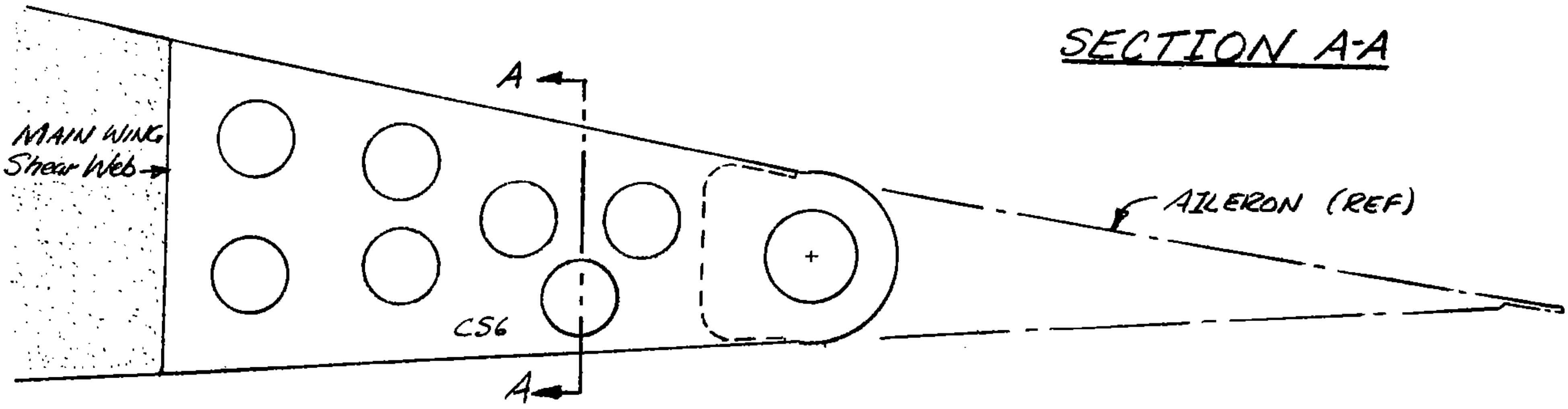


AILERON/MAIN WING CLEARANCE

5. When the complete aileron assembly fits well, and rotates freely, mix up some 5-MIN with flox and temporaily mount CS10, CS6, and CS7 in place against the main wing shear web, again checking for alignment, clearances, and binding.
6. If you haven't already done so, repeat for the other aileron.
7. Remove all of the pieces except CS10, CS6, and CS7. Carefully lay up the BID cloth that permanently holds CS10, CS6, and CS7 in place. These parts must be solidly mounted so that they cannot be accidentally broken off while in service.
8. Once the laminations in step 7 have cured, you are ready to drill in the aileron assemblies. Find your aileron rigging template, reassemble everything and set the ailerons at 0 degrees. Also, the "ear" on each A2CSA4 should point forward and be parrallel to a WL. Verify that the aileron is pushed outboard against CS10. Verify that CS11 overlaps 1.0" into A2CSA4 and 1.8" into the aileron reducer. Now drill in very carefully the two bolts on each side that fasten Q2CSA4, CS11, and CS9/aileron reducer together. BE CAREFUL! Don't let the holes elongate; use a small drill and work up in size.



SECTION A-A



CS6 INSTALLATION (Looking Outboard From Fuselage)

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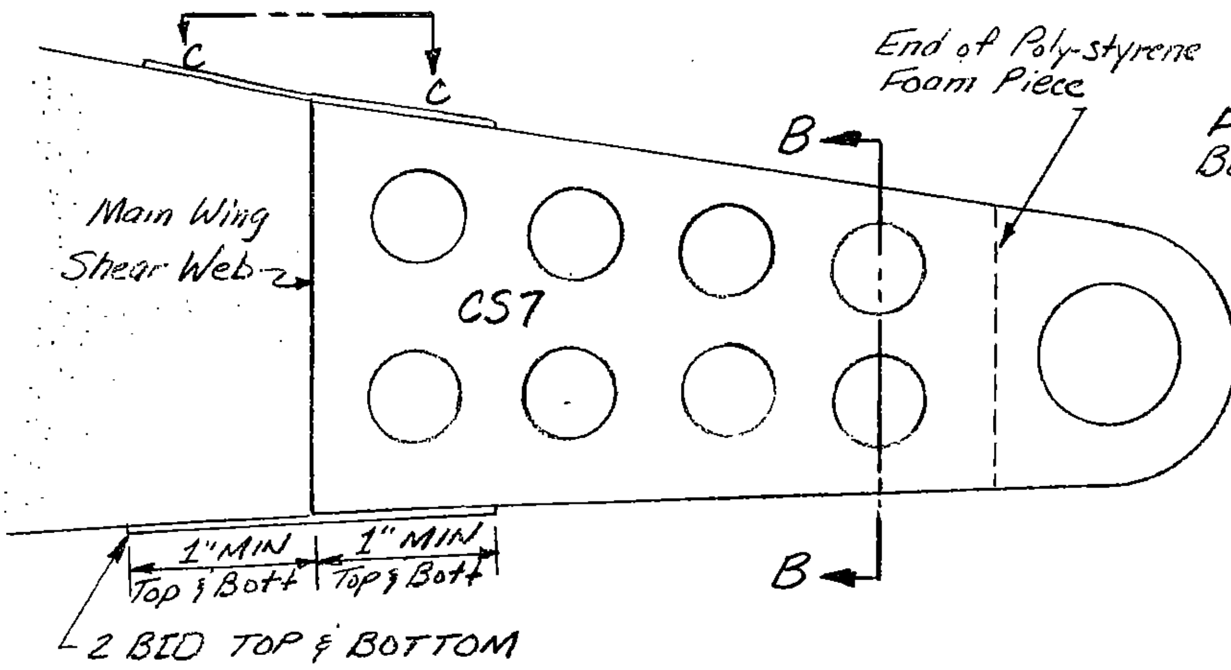
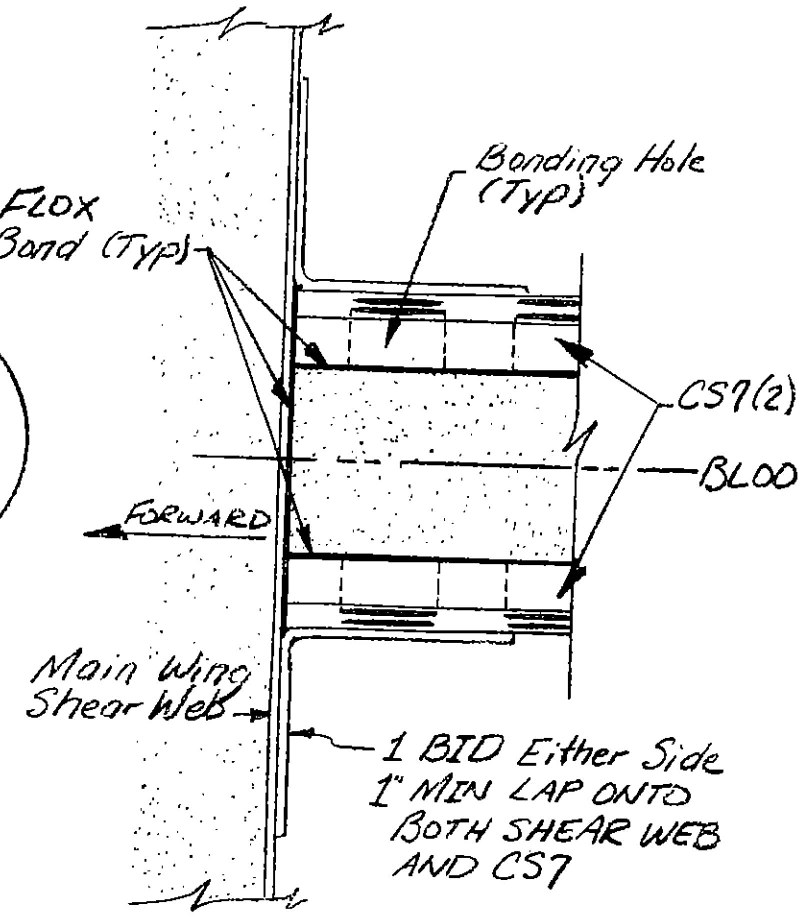
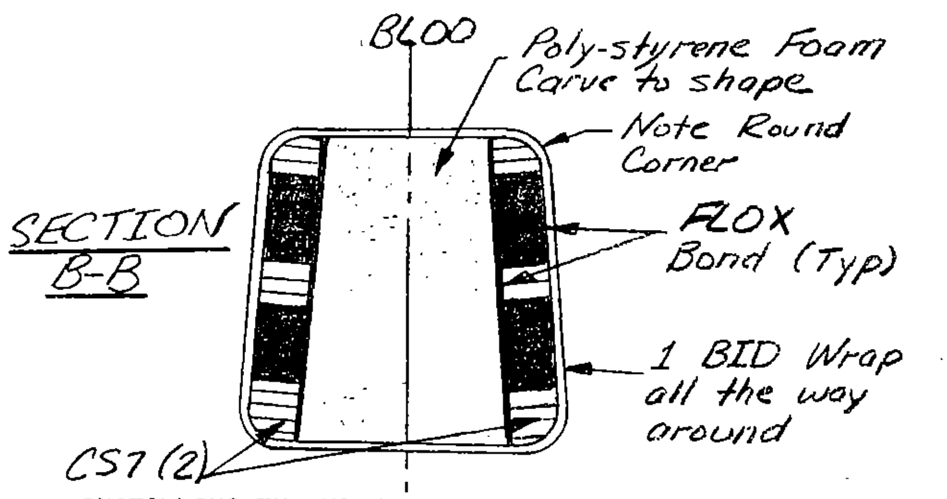


CS7 INSTALLATION (Side View)



SECTION C-C



INSTALLING THE MAIN WING TRAILING EDGE CORES

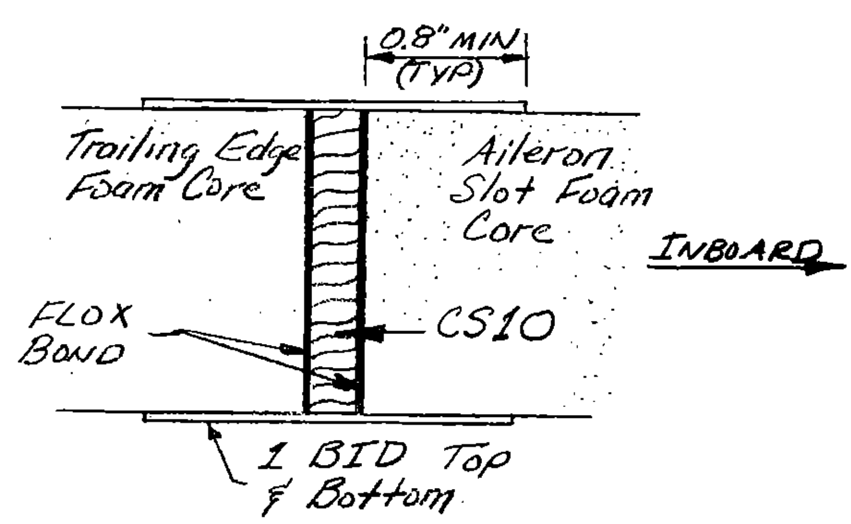
These cores begin at the outboard end of each CS10, and run outboard to the main wing tip. When originally hot wired, they were made longer than necessary on the inboard end, so fit each one into position and trim away the excess.

The bonding and laminating process is very similar to what you have accomplished previously on the aileron slot foam cores. Attach the cores to the main wing with micro slurry on the cores and epoxy on the main wing shear web (remembering to remove the peel ply), making sure that the top and bottom surfaces make a smooth transition to the main wing curvature. Next, laminate 2 BID on the lower surface of the main wing trailing edge cores, overlapping onto the main wing cores a minimum of 1". When cured, laminate 2 BID on the top surfaces, using a glass-to-glass trailing edge treatment exactly like you did on the aileron. If you are careful, you may be able to accomplish the laminations with the wing jigged vertically, to save time; however, beware of epoxy runoff yielding dry lamination. An alternative method would be to do each surface on the flat, instead.

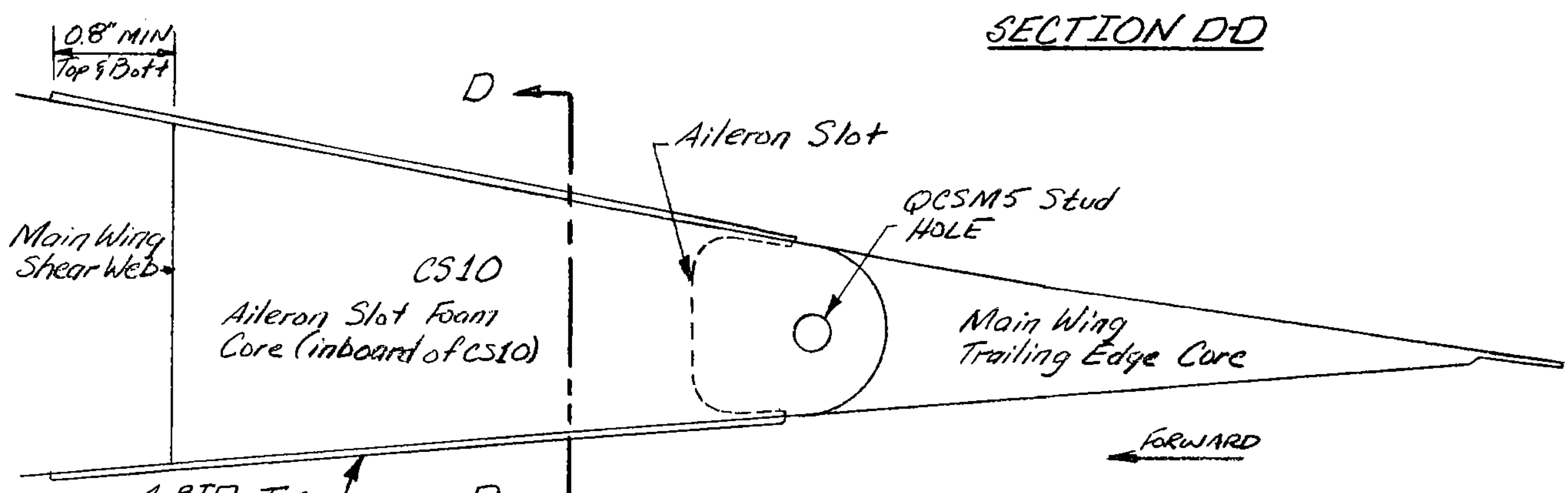
9. Finally, make the aileron spacer, which has a nominal 1.0" length. This spacer should be sized lengthwise to allow the aileron to have a lateral freeplay (i.e. inboard to outboard) of about 0.05". Assemble each aileron, and again check for binding, misalignment, or excessive freeplay.

Note the attachment of each CS10 wedged between the main wing trailing edge core and the aileron slot foam core.

The main wing tips are carved and glassed later on, as an option.



SECTION DD



CS10 INSTALLATION
(Looking Inboard)

END OF CHAPTER

CANARD CONSTRUCTION

INTRODUCTION

The Q2 canard has a swept leading edge, swept trailing edge, anhedral, a plain elevator which also effectively serves as a flap, and, in addition to carrying about 65% of the aircraft's weight, also provides the energy absorption (i.e. "spring") for the main landing gear that is mounted at the canard tips. It is a sandwich composite structure with solid foam core, two layers of UNI at 45 degrees to the trailing edge of the canard for torsional stiffness and surface durability, and spanwise tapes of UNI for bending strength. Shear loads are taken by a vertical shear web, and the elevators are essentially full-span, being actuated by an aluminum torque tube.

The canard is constructed in one piece from tip to tip for strength, lightness, and ease of construction.

Because of these factors, the canard is more complex and more critical than the main wing. However, the basic procedures are identical, and the experience you have gained in completing the main wing for your Q2 should allow you to construct the canard in the same amount of time. You may wish to reread the chapter on the MAIN WING to review the procedures.

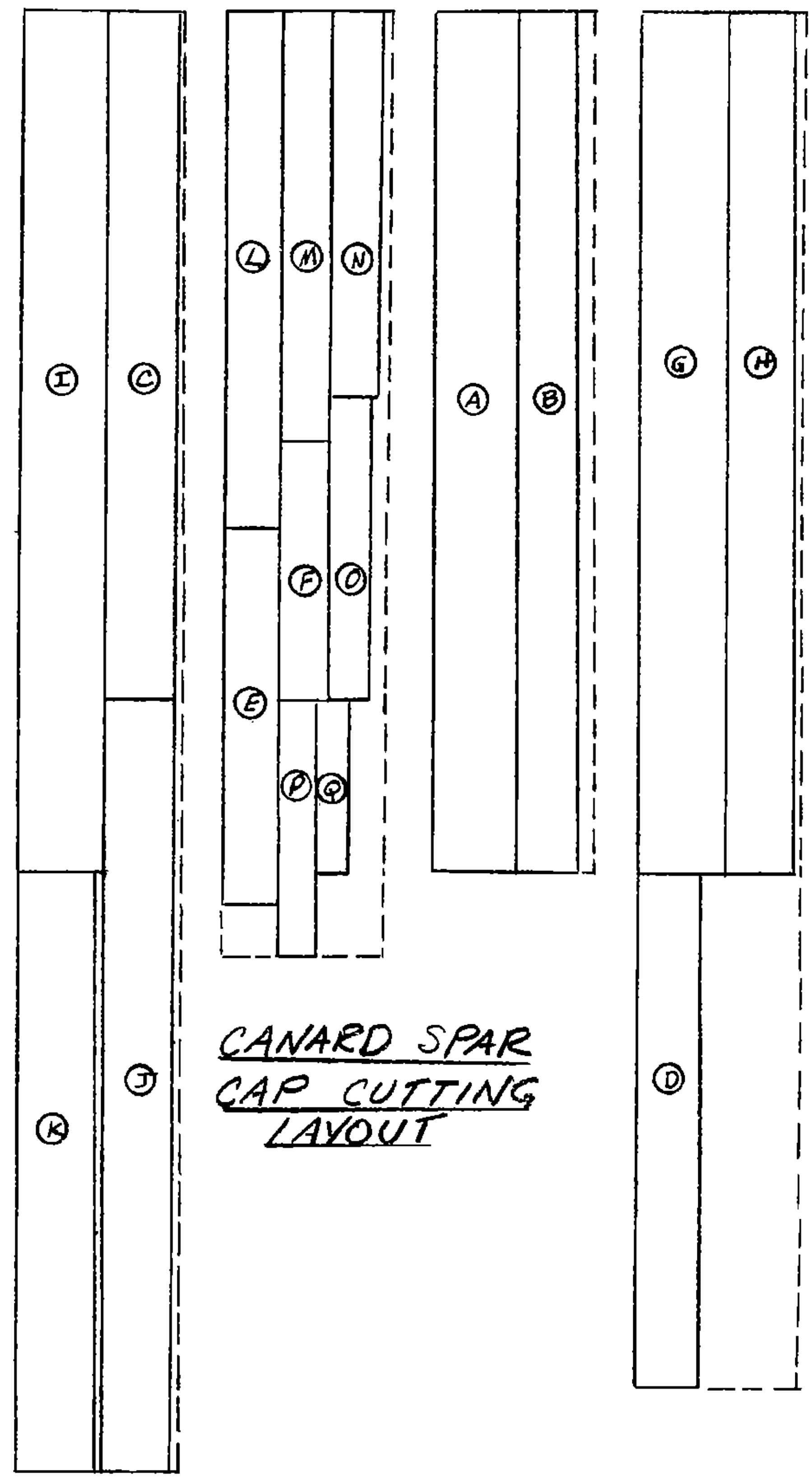
CUTTING THE SPAR CAPS

Begin by cutting the UNI spar caps using the suggested layout on this page. Letter each one of them with a felt tipped marker for identification later, in addition to marking a centerline in the middle (where the cap will cross BL00 when installed on the canard. Be sure to carefully roll up and store the spar caps after cutting to prevent damage.

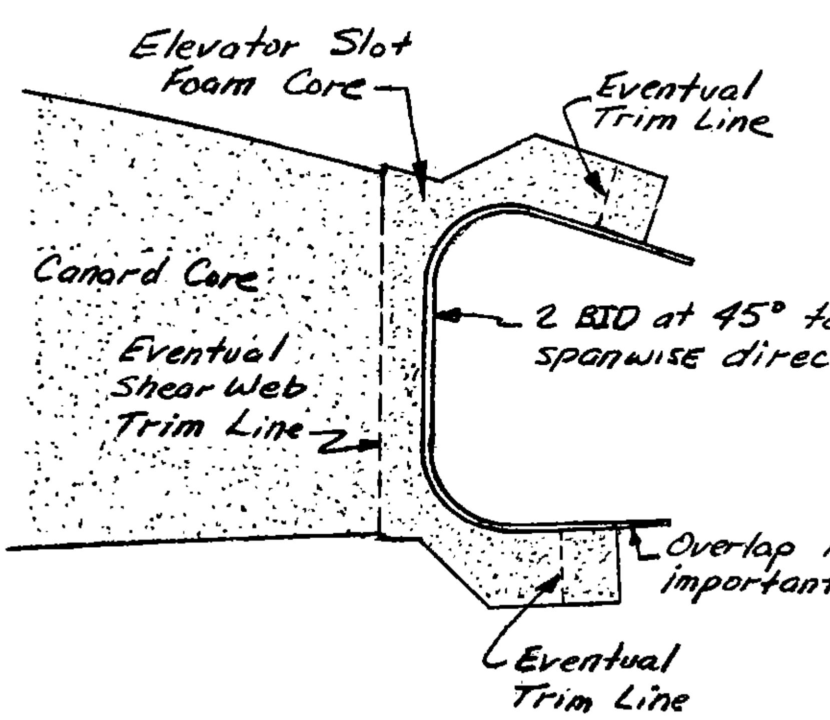
GLASSING THE ELEVATOR SLOT FOAM CORE SLOTS

Construction begins by glassing the inside slot of the elevator slot foam cores with 2 BID at 45 degrees to the spanwise direction (i.e. T.E.). Knife trim to the edge of the foam core.

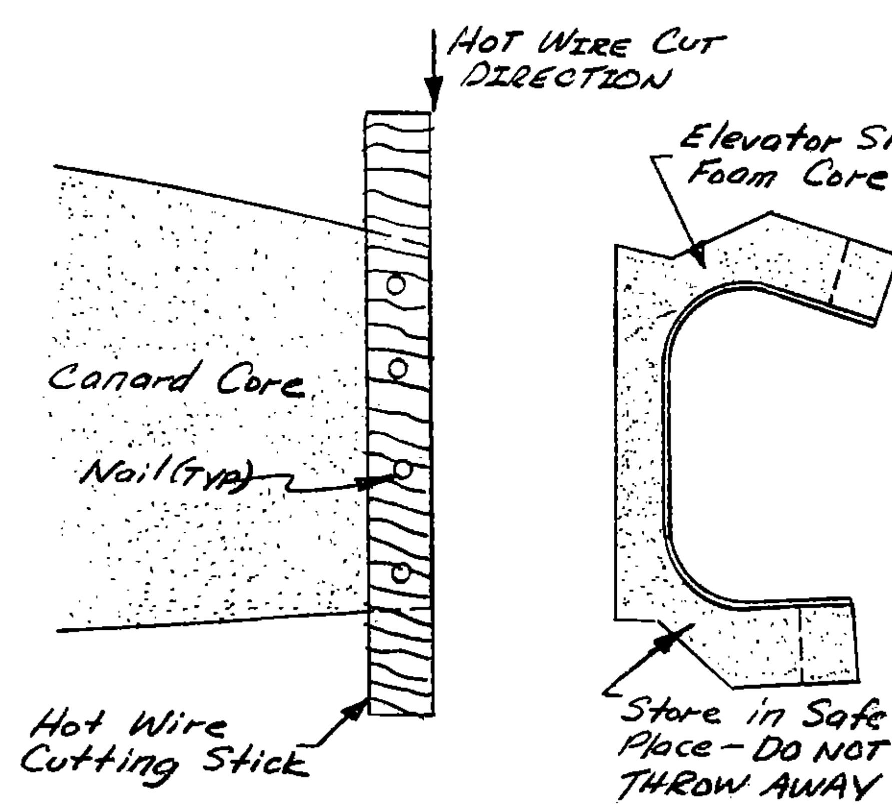
Next, get out your hot-wire cutting equipment and set it up. Take the forward part of each canard core templates, and nail them back onto the already hot-wired cores, being sure to check the level lines and to weight down the cores. Then, hot-wire the 51-A-B-C-...-H-I-J-48 sections on all canard foam cores. Store the elevator slot foam cores for later use.



CANARD SPAR CAP CUTTING LAYOUT



ELEVATOR SLOT FOAM CORE INSIDE LAMINATION



JIGGING THE CANARD

Next, you will need to jig the canard cores on the jig table. It would probably be a good idea to clean off the jig table of any bondo chips, wood, epoxy, etc., so that you start with a clean surface.

Find the canard core female jigging templates (6)

Now study the sketches. The canard cores are jigged upside down on the jigging table using the canard core female jigging templates. If your table is not at least 200 inches long, you will have to extend it like you did on jigging the main wing. As on the main wing, the shear web is perpendicular to WL00, and the canard core female jigging templates have leading and trailing edges that are tangent, respectively, with the leading edges of the canard, and the canard shear web.

Begin by drawing a straight line along your jigging table and marking the locations (BL's) of the canard core female jigging templates. Next, temporarily set the canard core female jigging templates on the jigging table so that their trailing edges are the distances from the straight line, called out in the accompanying illustrations. Note that the outboard canard core female jigging templates (the ones at BL100 right and BL100 left) are right on the straight line. A string stretched spanwise with a weight attached at either end may be helpful in establishing and keeping the straight line.

Now begin to trial fit the five canard cores into position. Be careful in handling the foam cores to prevent damage to the foam. All cores may have to be sanded in order to make them fit together within the maximum tolerance of 1/16". The canard center section core is already beveled to compensate for the anhedral angle, but it may still have to be trimmed and sanded to obtain the fit on the joint within 1/16". The level lines on all cores must remain level at all times. This is important, so take your time.

Stand back and sight spanwise along the canard to verify that the canard is straight, and is not bowed or kinked. Verify that the leading edges are straight, and that the trailing edges are straight also.

Don't be concerned if the canard core female jigging templates need to be moved inboard or outboard to remove any bows or kinks. Also, a long straight edge will help you looking for kinks and joggles, or dips.

When everything is perfect, mix up some bondo and carefully bondo the canard core female jigging templates to the table top in the necessary location. Next, rest the canard cores on the canard core female jigging templates. Check the alignment and individual level lines again; then again and again until every thing is Perfect, with a capital P. The next step is to join the foam cores together with micro slurry after verifying that the core fit is within 1/16". Check, recheck, and re-recheck each core level line and alignment as the cores are joined. Note that the canard center section foam core gets a glass rib of 2 BID and flox corners at each end of the canard center section foam core. The flox corner should be added after the entire series of canard cores have been joined and cured.

CAUTION

The canard foam cores must fit within 1/16" or exotherm damage may result.

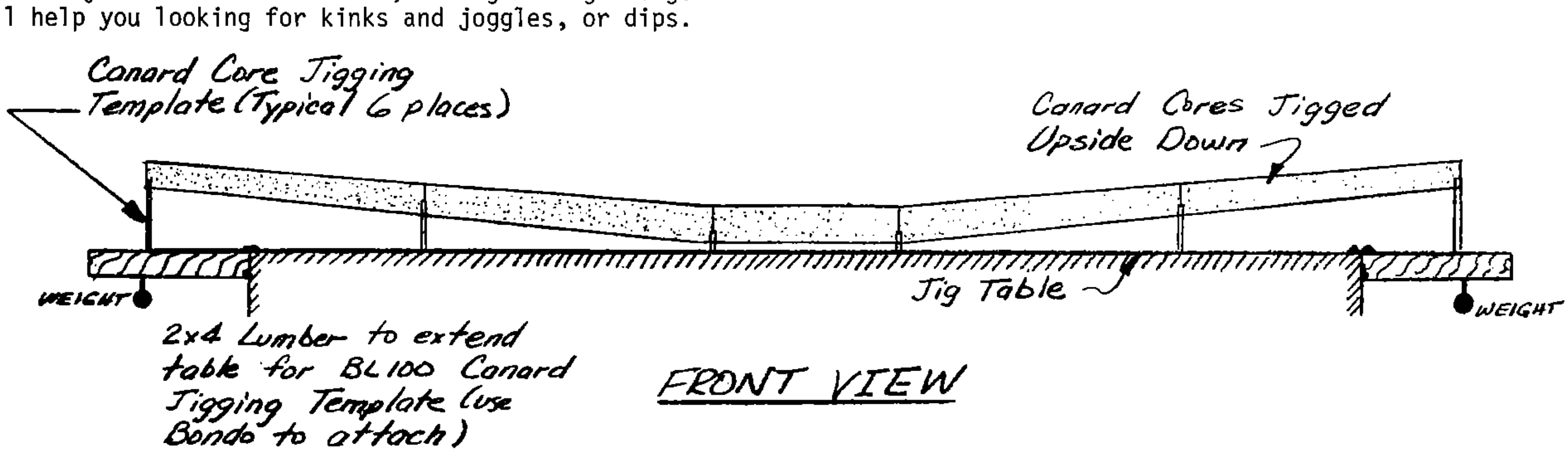
Core preparation is the single most important factor in obtaining an accurate, strong, and lightweight canard, so don't hurry through this section unless you don't mind regretting it for years to come.

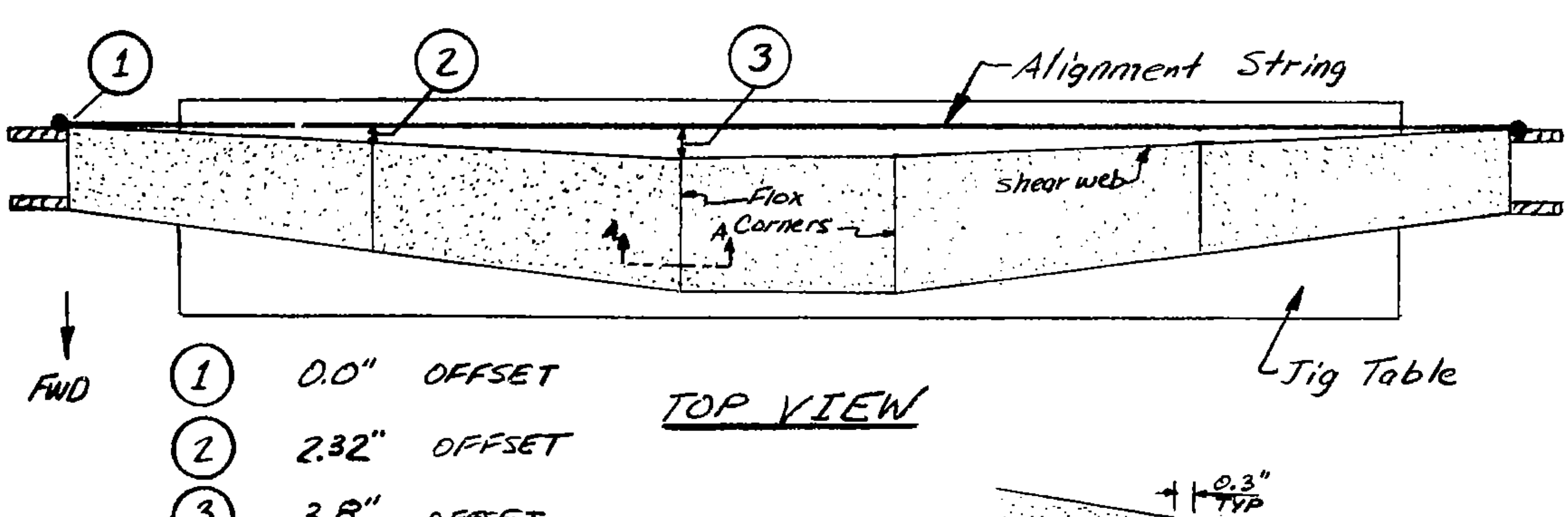
PREPARING THE CANARD CORES FOR GLASSING

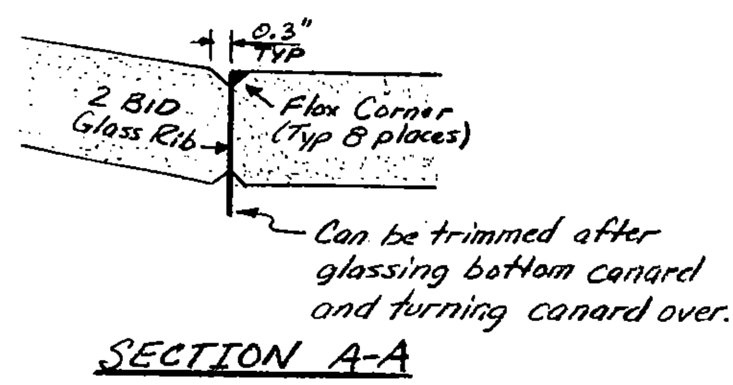
At this point, the canard cores should be jigged on your jigging table upside down, 5-minuted and bondoed in place, and able to take a direct hit from a 88 mm howitzer without budging from its location.

Use a hard block to clean up all joggles, excess micro, and any bumps on the canard cores. At either end of the canard center section core, round the joint so that the glass will flow smoothly across the joint. At the T.E. (shear web), round the corner so that the glass will flow smoothly down the face of the shear web.

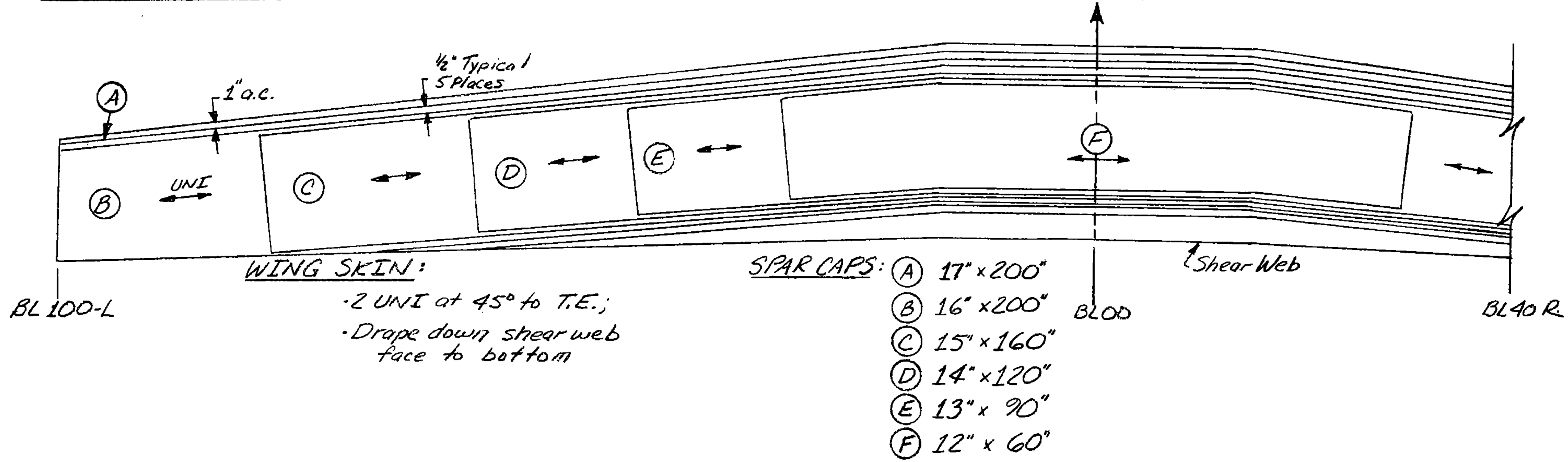
This is your last chance to do it right, so spend at least another hour making these cores as perfect as you know how. While your at it, check, recheck, and re-recheck all the canard level lines that you can see until you can do it in your sleep. If you are not proud of everything sitting on that jig table, don't go on to the next step until you are.



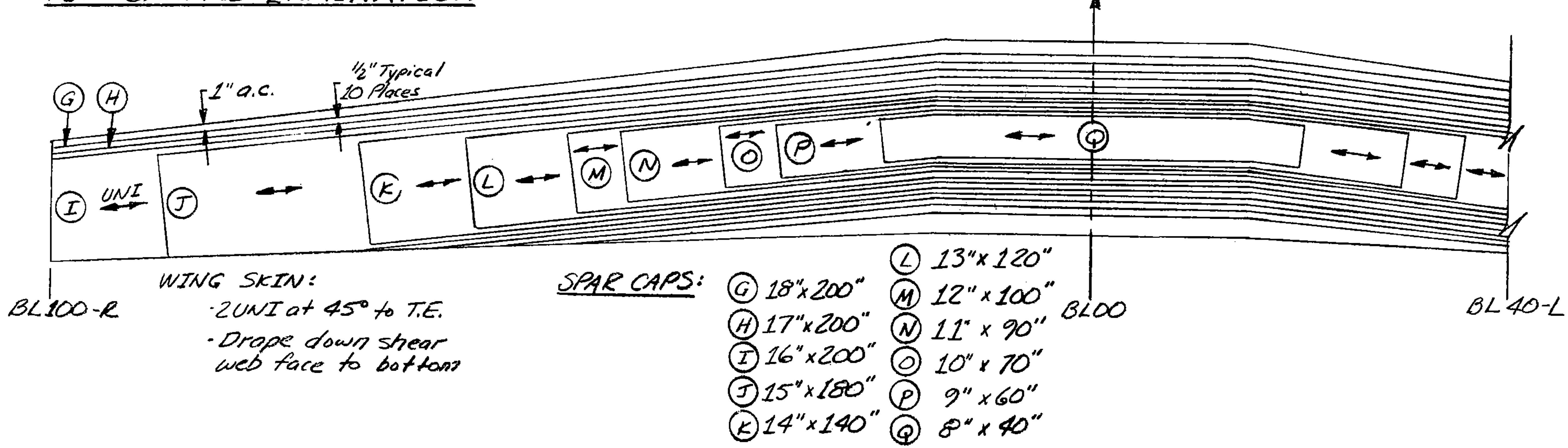




BOTTOM CANARD LAMINATION



TOP CANARD LAMINATION



LAMINATING THE BOTTOM SKIN AND BOTTOM SPAR CAPS

Study the two sketches labed "Bottom Canard Lamination", and "Top Canard Lamination" very carefully.

In this section, you will only be doing the "Bottom Canard Lamination", but that one should keep you and two others busy for about 3 hours. (The third individual mixes epoxy while the other two do the lamination).

To summarize the lamination, first you will laminate the wing skin, which is 2 plies of UNI at 45 degrees to the canard shear web, and then you will laminate spar caps A thru F .

Organize your shop for the big layup. Measure the canard cores, and cut the UNI for the main wing skins, labeling each one for identification.

Rather than have you reread and use the section on "Laminating the Bottom Skin and Bottom Spar Caps" that you used for the main wing, we are going to reprint and rewrite it here. (It helps make the plans look more complex).

The first UNI ply is put on at 45 degrees to the canard shear web T.E.. The fibers must be straight, so take your time getting the wrinkles and kinks out. Don't get ahead of yourself on pouring micro slurry on the foam; otherwise, by the time you are ready to place the UNI over a particular area, you will have a messy, hard, lump of slurry. On the other hand, with the experience you have had on the main wing, you should be within 10% of the miximum laminating speed that you will ever obtain. Work with one piece of cloth at a time, and with small batches of slurry and epoxy. Unrolling the UNI cloth as needed is advised to reduce the awkwardness of the large pieces. Scrap UNI can be used to fill in any small spots not covered by the large pieces of UNI.

At the leading edge of the canard cores, let the UNI cloth hang down vertically. Trim to within 1" of the tangent point, just like you did on the main wing. At the trailing edge (T.E.), allow the cloth to drape around the corner and down to the bottom of the shear web so that the UNI is at 45 degrees to the T.E. on that face also. Trim the canard tip UNI to within ½" of the canard core.

No overlap is required on the UNI wing skin; just use a butt joint.

The second ply of UNI is also place at 45 degrees to the T.E. of the canard core, but in the other direction from the first ply, so that the two plies of UNI will have their major fiber orientations at 90 degrees to each other. Try to avoid having the butt joints from the first ply of UNI coincide with the butt joints from the second ply of UNI. The second ply of UNI is also draped around the corner and down to the bottom of the shear web, so that the shear web has two plies of UNI at 45 degrees to the T.E. and at 90 degrees to each other. Trim all edges like you did on the first ply. As good laminators you will, of course, squeegee to the nth degree to remove any excess epoxy. By this time, if your floor does not contain enough hardened epoxy to build the Q3, you are either very accurate at mixing epoxy, or else you are not working hard enough at squeegeeing off excess epoxy.

Spar caps A thru F are laminated in that order, with the widest caps going on first. To pick up a spar cap and place it on the canard, use three people. While one person holds each end of the spar cap, the third removes any frazzles, being careful not to reduce the width below what is called out for the particular spar cap. That third person then stands at BL00 and positions the spar cap in the proper location (centerline on BL00 and proper distance from the leading edge of the canard) while the other two individuals keep the cloth off of the foam so that it won't stick. When the center (third) person is ready, one of the individuals holding an end lays it down spanwise on the canard in the proper postion (in relation to the canard L.E.) and removes any wrinkles and kinks. This can be a slow process, so keep your cool. Then the individual on the other end does likewise. The center individual makes sure that the spar cap smoothly "turns the corner on either end of the canard center section core.

Squeegee each spar cap from BL00 outboard. Work out any wrinkles by pulling carefully on the fibers.

The remaining spar caps are each put on in a similar fashion. Although you may be getting tired, you must rise up to the occasion and concentrate on squeeging each spar cap well to avoid excess epoxy which leads to excess weight. Use extra epoxy very sparingly on the last spar cap. Every other spar cap (i.e. A, C, E, etc.) is allowed to drape over the T.E. and down the shear web to the bottom. Trim B, D, F, etc. at the T.E.

Before quitting, peel ply all joints, and the first two inches of the canard L.E.. Also, knife trim the L.E. at the tangent point, just like you did on the main wing. Finally, clean up the mess, and DON'T TOUCH THE CANARD FOR AT LEAST 24 HOURS.

NOTE

If you have room, and can be patient, it would be better to permit the bottom main wing lamination to cure for 48 hours plus. In the meantime, you could skip ahead and work on fuel system, canopy installation, etc.

INSTALLING THE CANARD STIFFENER

Build a framework out of scrap lumber and bondo to hold the canard jigged in place while you turn it over. As shown in the pictures in the MAIN WING chapter in the "Laminating The Top Skin And Top Spar Caps" section, we suggest that the lumber run from tip to tip with a few cross pieces. Don't get fancy, just tie everything together so that the main wing won't move.

Next, when you are sure of your framework, break loose the canard core female jigging templates with a hammer (they won't be needed again), and turn the canard over so that the unglassed cores are upward. Set the canard on the jigging table once again.

Check the canard tip level lines. Jig, and shim, and bondo until the canard tip level lines are absolutely perfect; almost, or maybe, doesn't count. Then use bondo to secure all of the jigging so that a jackhammer will be required to remove the canard from the jigging table.

You are now ready to install the canard stiffener. That stiffener runs along the top of the inboard canard foam cores and across the canard center section core. This foam stiffener that you previously hot-wired out of the canard cores will be flimsy, so be careful with it. Clean up the canard slot that the stiffener rests in with a hard block and sand paper, so that the lamination you will be doing will transverse the joints smoothly. The glass ribs at either end of the canard center section will have to be trimmed back so as not to interfer with the stiffener. The lamination schedule, as called out in the sketch, is to layup 1 UNI first, then 2 BID, and then 1 UNI on top for the final ply. Take your time, and make the fibers straight. The 2 BID are laminated at 45 degrees to the spanwise direction. Knife trim the lamination flush with the top surface of the canard cores and let the lamination cure.

Next, install the foam stiffener with micro slurry. It is best to dry fit the part first, since it may be necessary to do some trimming, or else use dry micro to obtain a smooth fit. Don't worry if the top of the foam stiffener projects above the top canard surface a small amount; this can be trimmed back after cure.

Once the foam stiffener installation has cured, dig out the foam as shown and install two flox corners flush with the top canard surface. Also, install the flox corners on either end of the canard center section core.

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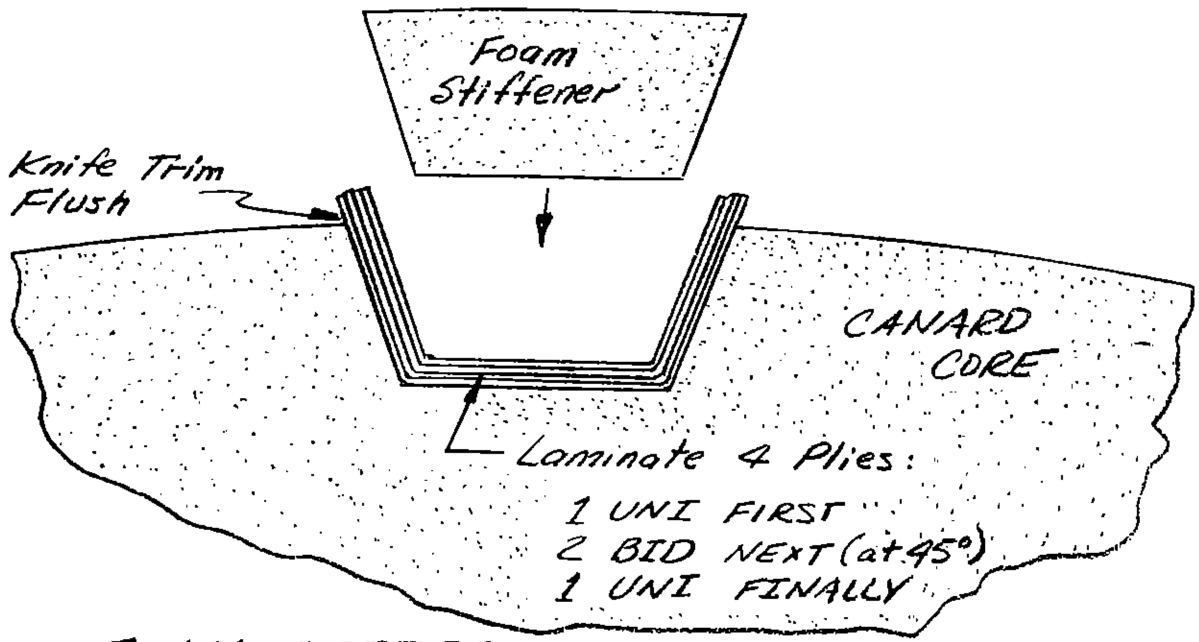
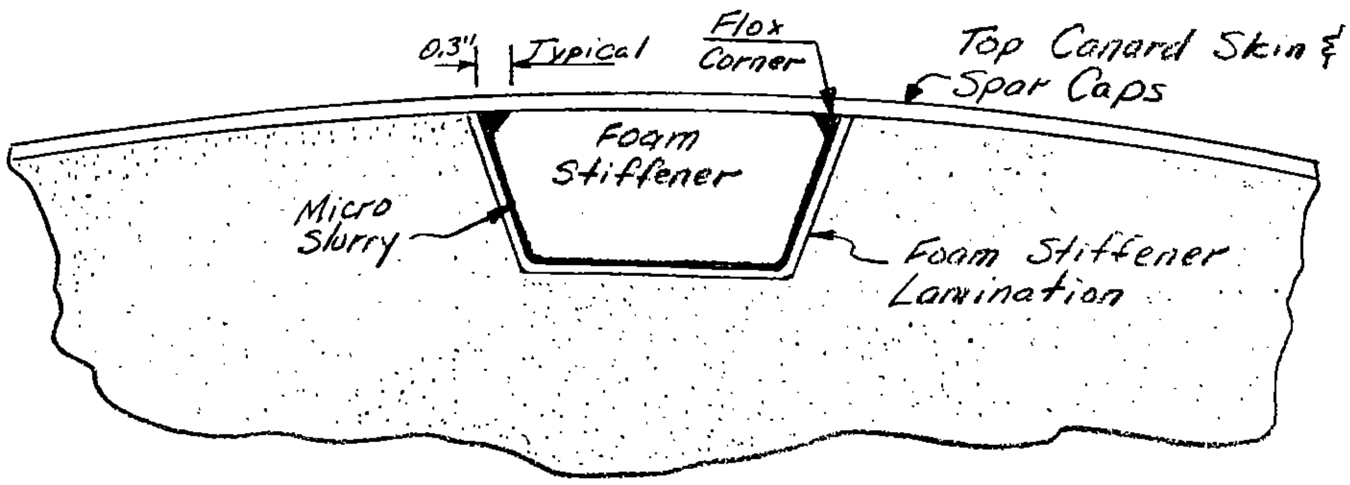
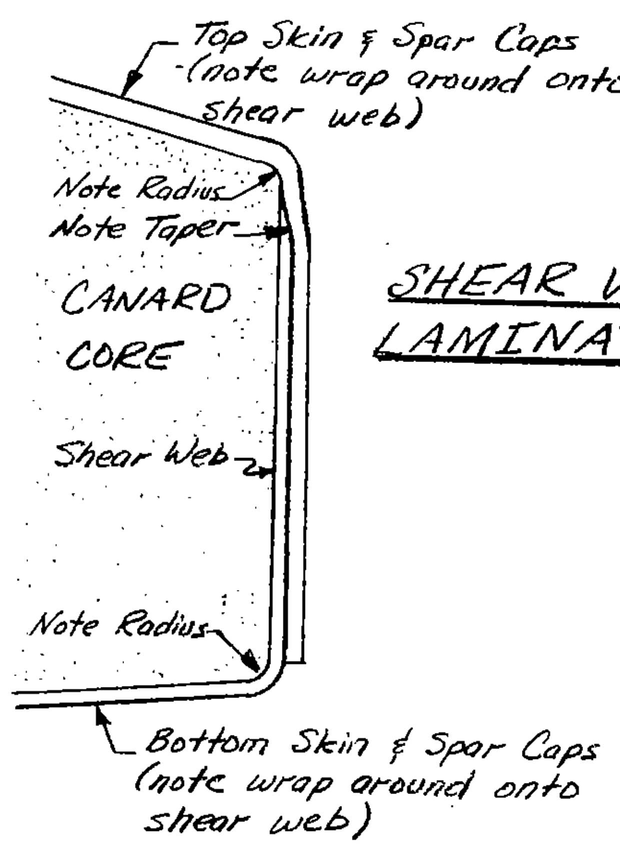


FOAM STIFFENER LAMINATION



FOAM STIFFENER INSTALLATION



SHEAR WEB LAMINATION

PREPARING THE TOP CANARD FOAM CORES FOR GLASSING

At the leading edge, feather the bottom skin to a feather edge at the tangent point just like you did on the main wing. Prepare the canard top surface just like you did the canard bottom surface. (See "Preparing The Canard Cores For Glassing"). Be sure and spend time carefully smoothing out the canard stiffener area, and the flox corners on either end of the center section core. Remember that the flox corners are much harder than the foam surrounding them, so go easy.

You must really prepare the top canard surface well, and remove all bumps, joggles, and other irregularities if you want a pretty looking, lightweight canard on your aircraft. REMEMBER! If you are not satisfied with how the canard top surface foam cores look, Don't go on to the next step.

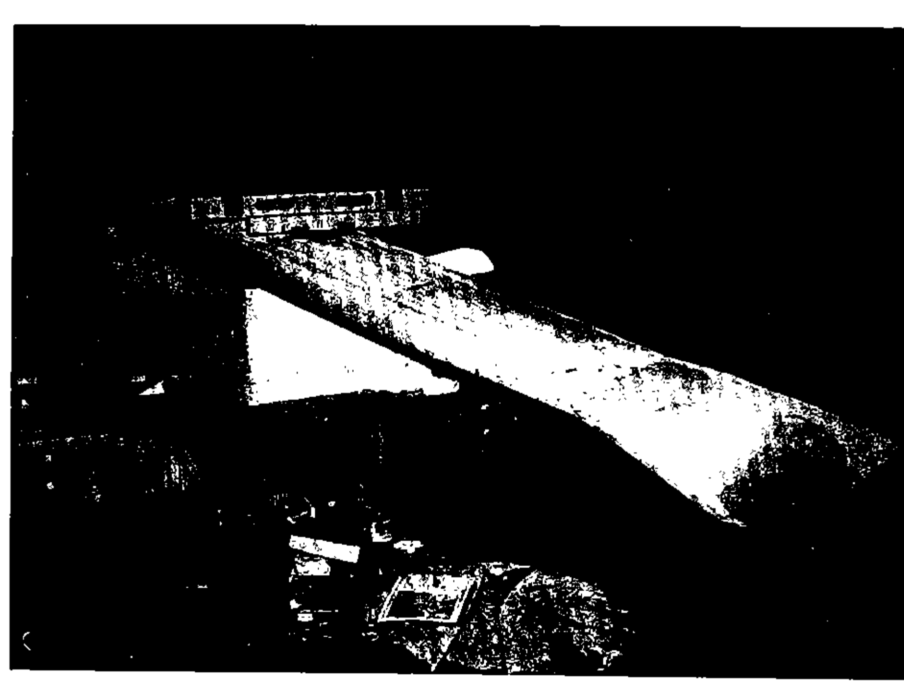
LAMINATING THE TOP SKIN AND TOP SPAR CAPS

Just to be sure, check the canard tip level lines one more time, and shim to get both of them absolutely level. (Have you noticed how they seem to shift by osmosis?)

The top canard skins are laminated similarly to the bottom skin lamination. The skin is the same two UNI at 45 degrees to the T.E., draping over the T.E. down to the bottom of the shear web, and the spar caps are *G* thru *Q* this time. At the leading edge of the main wing, overlap the bottom skin with the top skin a minimum of 1". Rather than let all the spar caps drape over the T.E. and down the shear web, trim every other one off at the T.E.. Peel Ply the shear web and all joints.

Don't touch the canard for at least 48 hours. Before removing the lumber, bondo a level board at about midspan on each canard.

You now deserve to celebrate for two days straight; you have just finished the final MAJOR layup in your aircraft. By the way, that top canard lamination that you just completed was the most difficult and critical lamination in the whole aircraft, and yet we have such confidence in you at this point, that we only devoted a very few words to it.



INSTALLING THE ELEVATOR SLOT FOAM CORES

This step is critical to having a nice looking canard and elevator union, so follow the directions carefully.

To start out with, the elevator slot foam cores that you hot-wired way back when were purposely made longer than necessary. Your first task is to size them for the correct length. To do this, you must measure your fuselage width at the fuselage/elevator slot foam core junction. Take measurements of the canard, skip ahead to the section on "Mounting The Canard To The Fuselage", and determine that dimension, on either side of BL00. Mark the proper points on the canard. Wait to trim the inboard elevator slot foam cores until after they have been installed on the canard.

Next, determine where to trim the outboard elevator slot foam cores. Since each elevator was made 72" long, measure 6 feet plus 1 inch (for elevator/fuselage clearance) from your first mark outboard and place another mark. This is where the outboard elevator slot foam core will be trimmed, but, as before, wait until after installation to do it.

The elevator slot foam cores are unique in that both the brake line conduit and the pitot tube must run through the lower, forward edge as shown on the sketch.

The pitot tube runs out the right canard, exits at about BL40, and is shaped as shown.

In the right canard, the brake line conduit enters the inboard end of the elevator slot foam core within 1/2" of the top edge, and continues all the way outboard to the end of the outboard elevator slot foam core on the right side of the aircraft. Let the Nylaflow tubing extend about 4" beyond the end of the slot foam core. On the left canard, do the same routing. You should use a router bit in the dremel to route out the foam. Any extra "room" in the foam is filled with dry micro. Both the brake line conduit and pitot tube are installed with 5-MIN dabs to hold them in place, and then surrounded with dry micro, as shown. Keep both lines, but particularly the brake line conduit, as straight as practical. The pitot tube tubing should extend into the fuselage about 12".

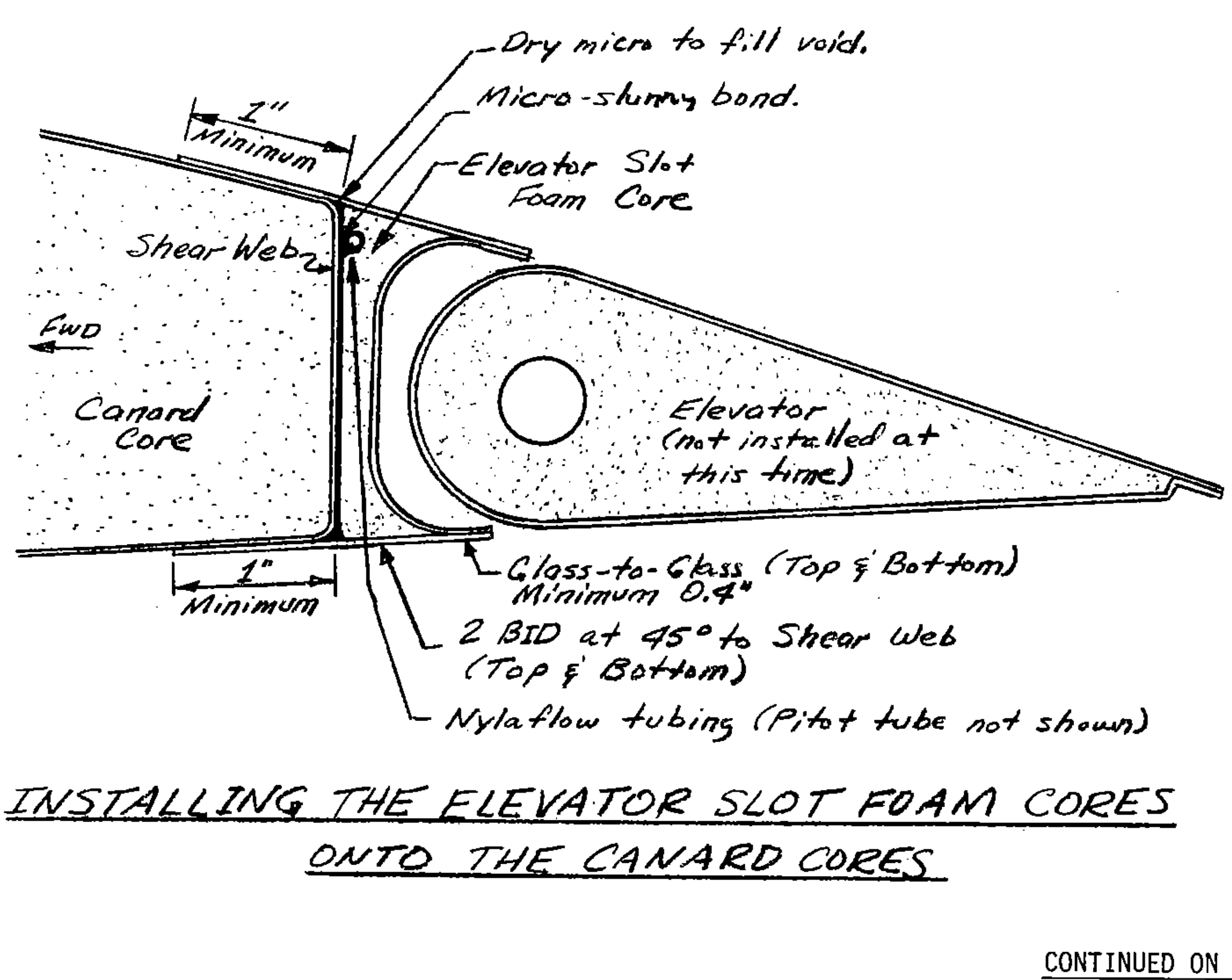
The elevator slot foam cores are installed to the canard shear web with micro-slurry on the foam cores and epoxy on the shear web (don't forget to remove the Peel Ply!), plus a few dabs of 5-MIN to keep the two attached during cure.

It is easier to check clearances top and bottom if the canard is jigged vertically on the jig table. This will also keep the joint from running. By this time, you should be so good at jigging, that we won't even talk about how to do it.

The important point to remember is that at the shear web attach point along the span, the top and bottom of the elevator slot foam cores should flow smoothly into the top and bottom surfaces of the canard, respectively. If the elevator slot foam cores want to stick up a little bit, this is OK since that can be sanded later. Any dip, however, will have to be filled with micro. When you have done your best to carefully fit the shear web joint top and bottom then mix up the micro-slurry and epoxy and join the elevator slot foam cores to the canard.

Once the attachment has cured, then the fun can begin. Trim the elevator slot foam cores back to the "Eventual Trim Line". Next, sand down the "tails" so that you can achieve a minimum of 0.4" of glass-to-glass bond with the inside lamination, while at the same time fairing everything nicely into the canard contour forward of the shear web. At the glass-to-glass bond area, you must sand away all micro and epoxy and get down to the glass. Spend some time looking at the surfaces getting the best alignment that you can. When everything is ready, laminate 2 BID at 45 degrees to the canard shear web on the elevator slot foam cores, being sure to achieve at least 0.4" of glass-to-glass bond, and lapping up onto the canard at least 1". Note that the sketch calls out dry-micro fill if required at the top and bottom of the shear web joint. Trim the inboard and outboard elevator slot foam cores at the marks previously made on the canard.

Your canard should now be looking more like a canard, and less like a lump of foam and glass.



INSTALLING THE ELEVATOR SLOT FOAM CORES ONTO THE CANARD CORES

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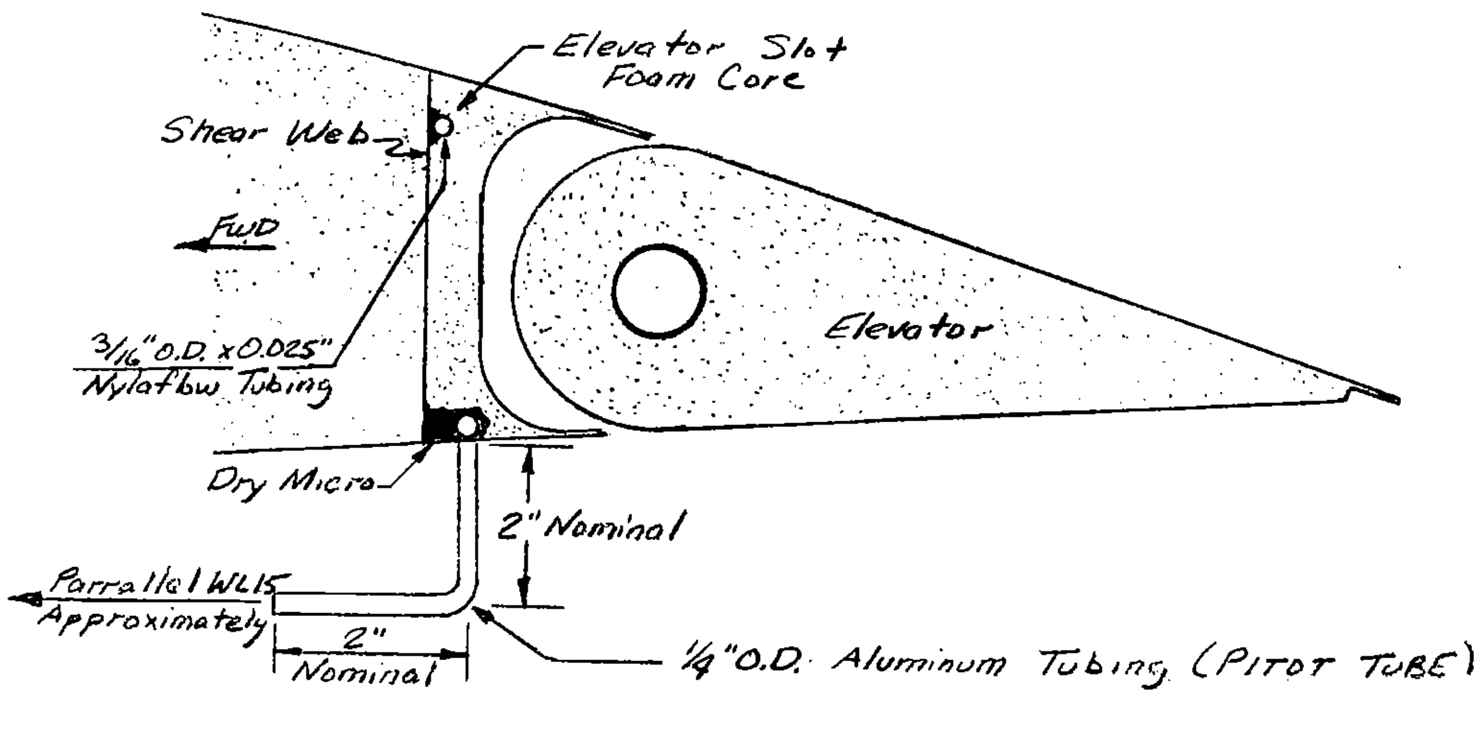

BRAKE LINE CONDUIT & PITOT TUBE INSTALLATION

OUTBOARD ELEVATOR PIVOT ASSEMBLY

These instructions cover only the assembly of the left outboard elevator pivot, but the right outboard elevator pivot is a mirror image, and may be accomplished at the same time.

First, review the MAIN WING chapter section on "Outboard Aileron Pivot Assembly". Except for the part number changes, you will be doing exactly the same operations.

Locate a QCSM7 pivot about 0.25" inboard of the outboard end of the elevator using 3 MSP43 cherry rivets spaced radially at least 0.4" apart. It will be necessary to "tunnel" through the elevator skin and elevator foam core in order to reach the CS16 elevator torque tube for riveting. The holes made by the tunneling operation should be filled after riveting with dry micro.

Find CS19, and insert a QCSM5 stud with the 2 AN970-4 washers, 1 AN960-4 washer, and 2 AN363-428 nuts, just as you did on the aileron outboard pivot assembly. Remember, there must be a minimum of 0.6" from the AN960-4 washer inboard to the end of the QCSM5 stud so that the elevator must be moved inboard at least 1/4" before it "falls off" the QCSM5 stud for dissassembly. Finally, round the end of the QCSM5 stud slightly to assist in mounting the elevator.

When the elevator is mounted, CS19 will fit flush against the canard shear web. At that time, the outboard elevator slot foam core will have to be trimmed to allow that.

MIDSPAN ELEVATOR PIVOT ASSEMBLY

Read this section carefully before doing anything, and take the time to visualize what the words are saying. Otherwise, you may find it difficult to install or remove your elevators!

These instructions will cover the left midspan elevator pivot assembly, but the right midspan elevator pivot assembly is a mirror image.

Find a QCSM3 stud and a QCSM2 pivot. Screw the QCSM3 stud into the QCSM2 pivot, retaining it with AN363-1032 locknut, making sure that the assembly is tight. Next, round the end of the QCSM3 stud slightly, as shown, to facillitate installation and removal of the elevator later.

Measure 30" outboard on the elevator from the inboard end and place a mark. Using a router bit, route out a slot 1/8" wide for about plus or minus 17 degree of elevator travel. (See sketch)

Next, insert the QCSM2 pivot assembly, complete with QCSM3 stud, into CS16, the elevator torque tube, with the stud pointing outboard. (See sketch) QCSM2 pivot assembly through the CS16 elevator torque tube with a small diameter stick until it just reaches flush with the slot that you routed out. Rivet the QCSM2 pivot assembly to CS16 using 3 MSP43 cherry rivets spaced radially at least 0.4" apart. Again, it will be necessary to "tunnel" through the elevator skin and the elevator foam core to reach the tube. Again, you will fill the holes with dry micro.

The routed slot must be expanded so that the CS17 hinge can slide off of the QCSM3 stud and out of the CS16 elevator torque tube while remaining perpendicular to CS16. This is to allow assembly and dissassembly of the elevator. Probably, you will have to open the routed slot up to about 0.6" wide. At the same time, verify that the CS17 hinge can rotate at least 17 degrees up and down to allow proper elevator movement. If not, make the routed slot bigger, as necessary. It is important, however, not to remove any more "meat" from the CS16 elevator torque tube than necessary, so work carefully.

Now we come to the 2 CS18 inserts. These inserts are positioned against the canard shear web on either side of the CS17 hinge, and provide a local beefup to take the hinge loads. To determine exactly which BL the CS18 inserts must go at, you will need to trial fit the elevator in position in the elevator slot foam core, making sure that the inboard end of the elevator coincides with the inboard end of the elevator slot foam core that you have previously trimmed to fit the fuselage.

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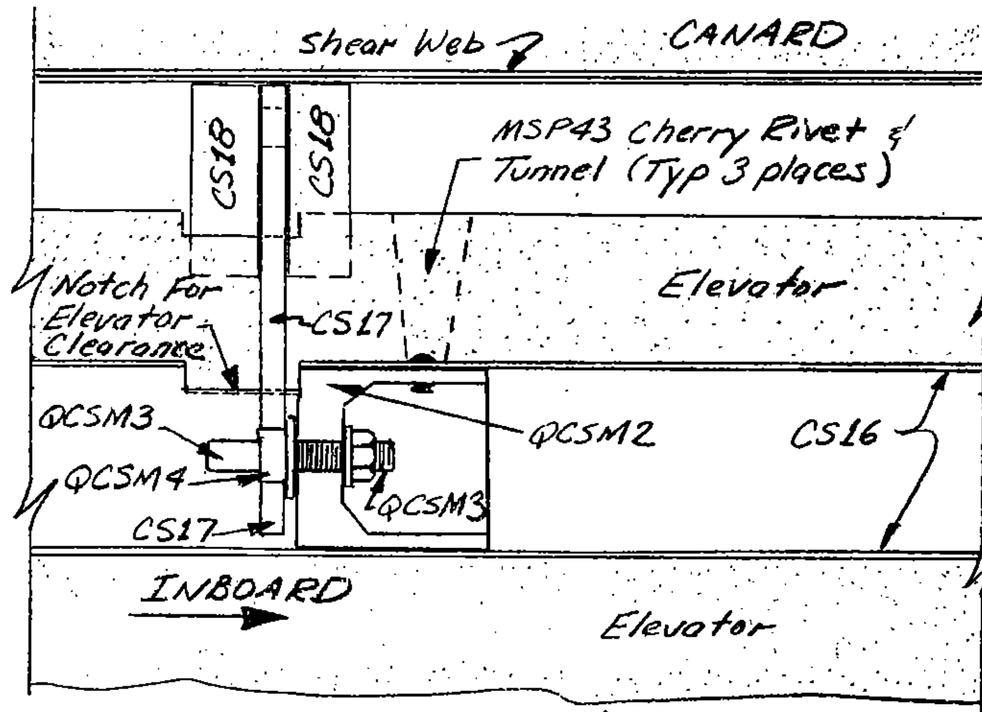
With the CS17 hinge mounted on the elevator up against the end of the QCSM2 pivot, and with the elevator in position in the elevator slot foam core, you can mark on the elevator slot foam core where the 2 CS18 inserts must go. Next, route out the foam in the elevator slot foam core in preparation for later bonding of the CS18 inserts in place. Any excess foam removed can be filled in later with flox during assembly.

Now, let's carefully review how the elevator is removed from the midspan elevator pivot. The elevator is moved inboard, resting on the QCSM3 stud, at least ¼" until it falls off the QCSM3 stud. During this movement, the CS17 hinge remains where it was, since it was permanently attached to the canard (between a sandwich of CS18 inserts) during assembly.

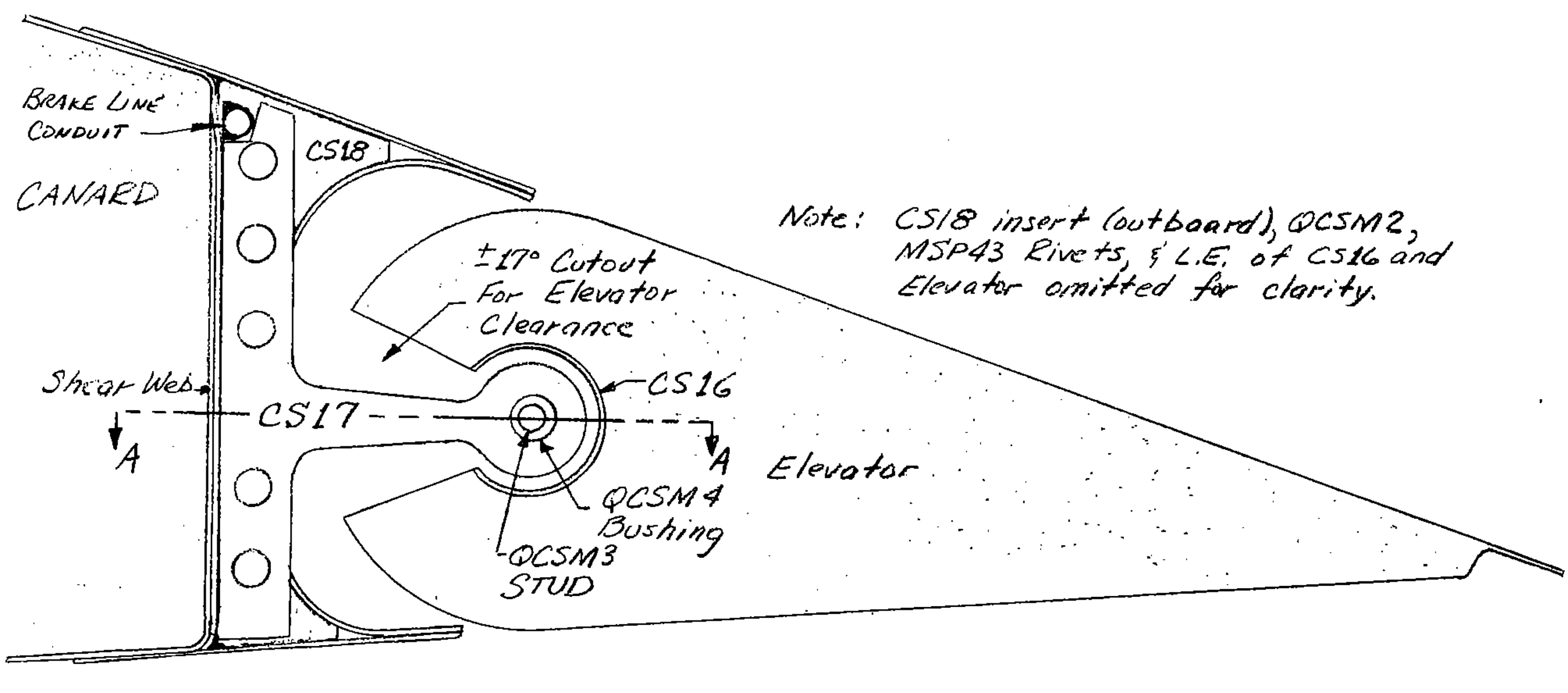
Do you understand? Good, read the above explanation again two times until it is indelibly etched in your memory.

Now you are ready to do the same thing for the right elevator. Remember that the QCSM2 pivot assembly, complete with QCSM3 stud, must be pushed into the CS16 elevator torque tube with the stud pointing OUTBOARD. (A mirror image of what you have already done). Be very careful in setting up the right madspan elevator pivot assembly, and verify that it, too, will function as described in the paragraph above.

It may seem that we are spending too much time on this setup, but it is the "voice of experience speaking".



SECTION A-A



ELEVATOR MIDSPAN PIVOT DETAIL
(Looking Inboard)

INSTALLATION OF THE ELEVATORS

The elevators are installed and rigged prior to the canard being mated to the fuselage. As a result, after mating only CS13 needs to be hooked up for a functioning pitch control system.

The procedures detailed here are similar in scope to what you have already accomplished in mounting the ailerons on the main wing, except that the elevators have a center pivot on each side.

Begin by jigging the canard vertically, with the leading edge at the table.

Take a piece of QCSM1 and make two 1.8" length pieces to use as elevator reducers. A sawcut and perhaps some light sanding will be necessary to make them fit snugly and flush with the inboard ends of the two elevators.

Find the phenolic bearings CS15 (2) and CS14 (1). Dull the phenolic completely with sandpaper except inside the reamed 5/8" diameter holes. Be sure that the other 1/2" diameter holes have been drilled out. These are non-critical on diameter, but must be there to assist bonding of the phenolic to the structure. They are NOT lightening holes.

Find Q2CSA8. Make CS20 from 0.625" O.D. x 0.065" wall 4130 steel tubing. The length of CS20 should be about 5" longer than 1/2 the width of the fuselage where the elevator matches up to the fuselage. The piece is made long initially, and then trimmed back as needed.

The right and left elevators are nearly mirror images of one another. Each elevator has an outboard hinge CS19, a midspan hinge CS17, and a inboard hinge CS15. Q2CSA8 slips into the elevator reducer at the elevator end, and over a AN271-B8 (or MS2071-B8) universal joint near BL00. On the right side, CS20 slips into the elevator reducer at the elevator end, and through CS14 and then over the same AN271-B8 (or MS20271-B8) universal joint near BL00. Clear, heh?

The following procedure was developed to help you get the elevators mounted without binding, with the proper clearances, and with the ability to get them off again:

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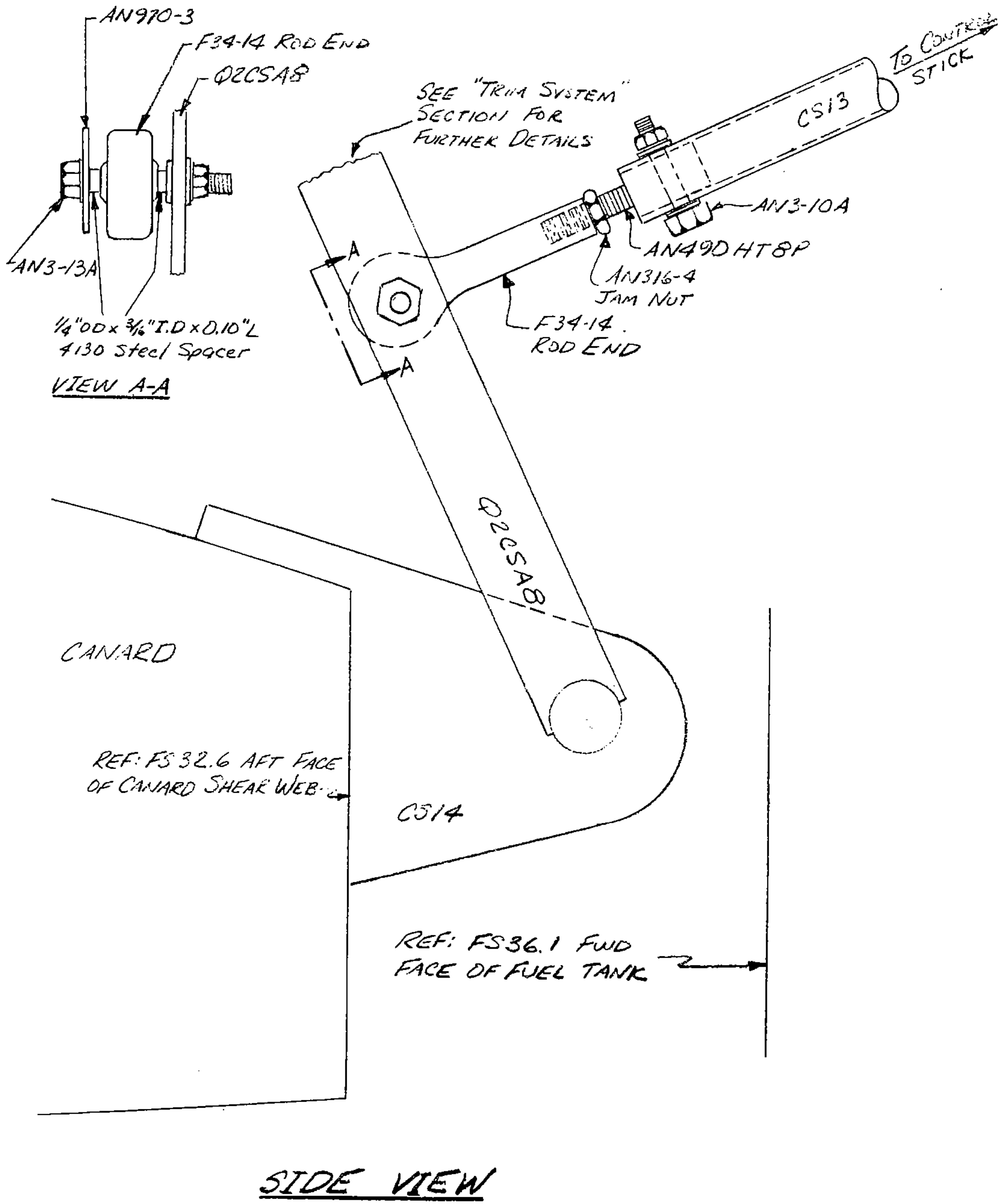

1. Trim the inboard edges of the elevator slot foam cores flush with the sides of the fuselage.
2. Slip CS15 over the outboard end of Q2CSA8, the universal joint into the inboard end of Q2CSA8, and then the outboard end of the Q2CSA8 assembly into the elevator reducer mounted in the inboard end of the left elevator.
3. Slip CS15 over the outboard end of CS20, the CS14 over the inboard end of CS20, then the universal joint into the inboard end of CS20, and then the outboard end of the CS20 assembly into the elevator reducer mounted in the inboard end of the right elevator.
4. What follows is a very qualitative fitting process. Using at least three people, dry fit CS19, CS17, CS15, and CS14 against the canard shear web in the appropriate positions (CS19 against outboard end of elevator slot foam core, CS17 at the midspan slot, CS15 against the inboard end of the elevator slot foam core, and CS14 against the shear web near BL1 Right), check for binding. Working slowly, correct any binding or clearance problem (1/16" MIN elevator clearance applies just like on the ailerons) by modifying CS19, CS17, CS15, and CS14. Please, do one thing at a time. The arm on Q2CSA8 should be at approximately BL00.
5. When the complete elevator assembly fits well, and rotates freely, mix up some 5-MIN with flox and temporarily mount CS19, CS15, and CS14. (DO NOT mount the CS17's).
6. Remove all of the pieces except CS19, CS15, and CS14. Carefully lay up the BID cloth that permanently holds CS19, CS15, and CS14 in place. These parts must be solidly mounted so that they cannot break off while in service. Use the "Aileron Installation" section of the MAIN WING chapter as a guide to the laminations.
7. Once the laminations indicated in step 6 have cured, you will want to install the CS17's permanently. Install the elevators on the inboard and outboard pivots; remember to leave at least a gap of 0.5" inboard for the elevator spacers. (If you haven't lost any inches anywhere up to this point, those spacers will be 1.0" in length). Install CS17 on QCSM3 against the face of QCSM2. Make CS17 the meat of a sandwich with a pair of CS18's as the bread, and trial fit the sandwich against the canard shear web dry through the slot made previously. When satisfied with the fit, and sure that the elevator clearance is a minimum of 1/16" top and bottom permanently mount CS17 and the CS18's with wet flox. It is very important to really pack the flox into the holes so that you get very good squeeze out, and not trapped air. If the flox doesn't ooze out when CS17 and CS18's are pushed into place, then you haven't got enough flox pushed into the holes. Use tape and stirring sticks to maintain the 1/16" elevator clearance top and bottom, while the setup is allowed to cure for at least 24 hours. Obviously, be careful that the excess flox does

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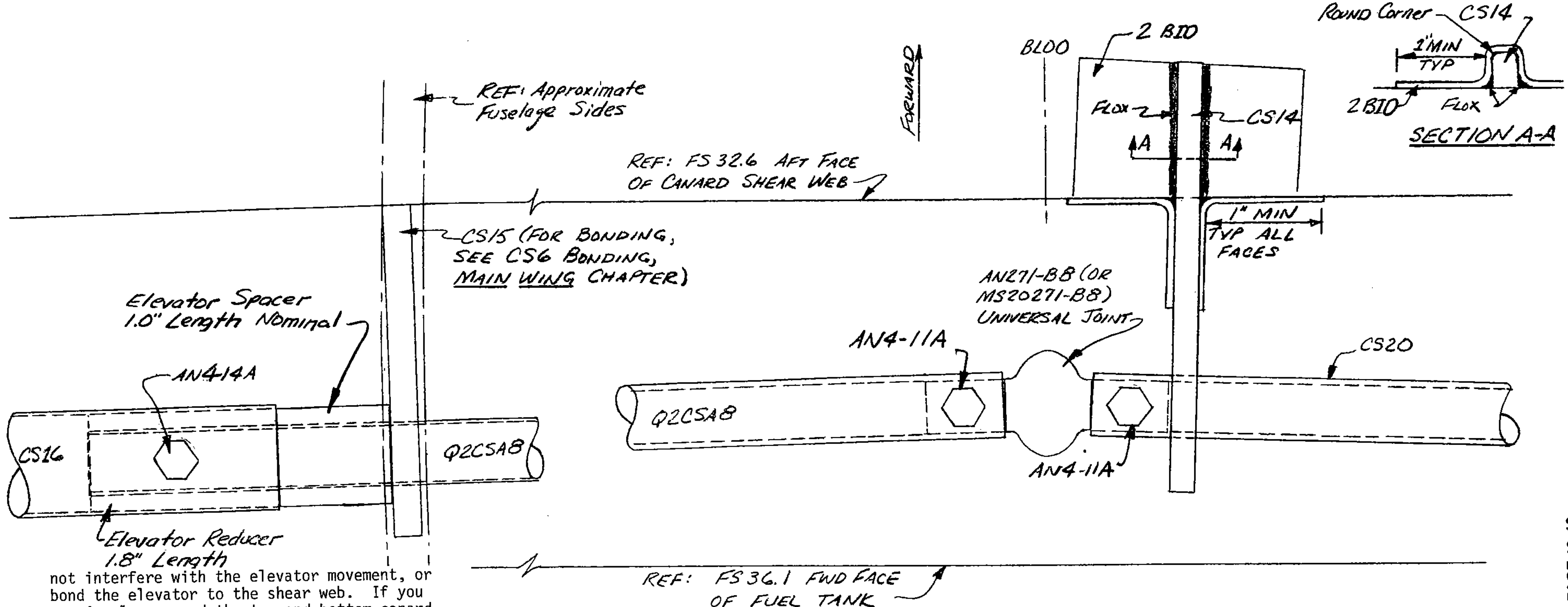


TOP VIEW

not interfere with the elevator movement, or bond the elevator to the shear web. If you previously removed the top and bottom canard skin where the slot was ground out, be sure to laminate 2 BID top and bottom once the laminations have cured. The above procedures are used with both elevators.

8. Once the laminations and installation have cured, you are ready to drill in the elevator assemblies. Find your elevator rigging template, reassemble everything, and set the elevators at 0 degrees. Also, verify that each elevator is pushed outboard against CS19. Verify that both Q2CSA8 and CS20 overlap into the elevator reducers a minimum of 1.8", and that both are pushed up tight onto the universal joint. Now drill in very carefully the four bolts that fasten Q2CSA8, CS20, universal joint, and CS16/elevator reducer together. BE CAREFUL! Don't let the holes elongate; use a small drill and work up in size. Also, be absolutely sure that each elevator is at the same angle (i.e. no assymetry) and that full elevator deflection is available without any interference any where in the system.
9. Finally, make the elevator spacers, which have a nominal length of 1.0" each. The actual length should be sized to allow the elevator to have a lateral freeplay (i.e. inboard to outboard) of about 0.05". Assemble each elevator, and again check for binding, misalignment, or excessive freeplay.

POST-CURING THE CANARD STRUCTURE

In order to minimize creep in the canard, the canard should be post-cured prior to installing it on the aircraft.

Creep is the tendency for the epoxy to deform due to heat and load. In the case of your aircraft, the heat could be obtained on a hot day with the aircraft setting in the sun, and the load is always there when the aircraft is resting on its 'landing gear'. The loading through this means is both bending and torsional in nature.

Creep can be minimized by heating the structure to a higher temperature than it will see while in service. If you own a multi-million dollar corporation, you should use a very large oven with accurate temperature control throughout; if you are like the rest of us, you can obtain equal results by painting the canard black with primer and setting it in the bright sun to effect the post-cure.

If you desire, you may want to finish the canard up to the primer stage before post-curring it. (Note the surface waviness criteria in the finishing section of the Composite Materials Education chapter). However, if you desire to do all of the messy finishing work at one time, you can elect to just shoot some black primer on the canard, and clean it off later. It is important to remember that when you attach the canard to the fuselage later, wherever the BID tapes that secure the canard to the fuselage attach to the canard, the canard must be free of any paint, micro, feather fill, etc.; i.e. just the pristine structure.

The reason you will want to use black is that it makes the job easier by absorbing more heat, thus raising the temperature of the structure quicker.

The technique you will use is quite simple. Expose the top and bottom surfaces of the canard to the sun, changing the angle of the canard periodically to heat the entire surface. Check the temperature frequently by placing the palm of your hand on several locations. If you can hold your hand on the surface for about 5 seconds without screaming out in pain, the temperature is perfect. Permit the canard to set at that temperature for about 10 minutes. DO NOT PERMIT THE CANARD TO GET TOO HOT.

It is not necessary to post-cure any other structure on your aircraft.

END OF CHAPTER

INTRODUCTION

In this chapter, you will make one left wheel pant and one right wheel pant, complete with wheel, tire, and brake assemblies.

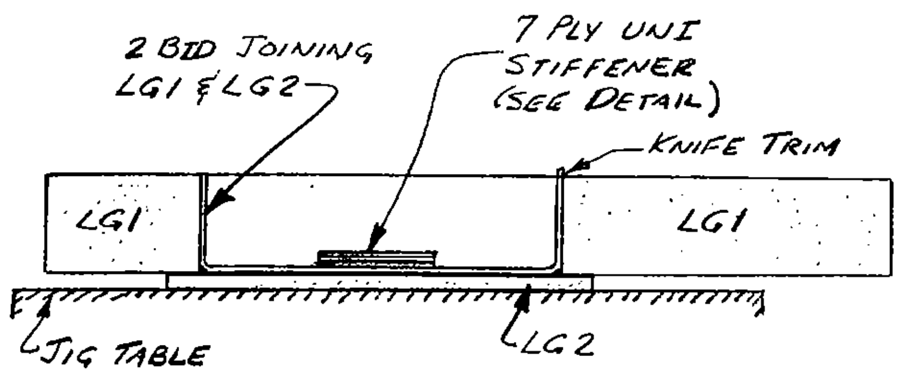
The wheel pants are composite structural shapes that must transfer all landing gear loads into the canard. Therefore, they are made much stronger than the ordinary cosmetic type wheel pants found on many homebuilts. There is some carving required, but you whould find it straight forward.

BASIC ASSEMBLY

Begin by making two Wheel Pant cores (LG1) and four Wheel Pant Covers (LG2). The procedures that follow cover assembling the left wheel pant. Since the right wheel pant is a mirror image of the left wheel pant, you will probably find it easy to assemble both wheel pants simultaneously.

Join LG1 to LG2 with micro-slurry. The template sketch for LG1 shows the outline of LG2; basically, LG2 covers up the hole in LG1. You may need to use some weight to hold LG2 to LG1 until they are cured.

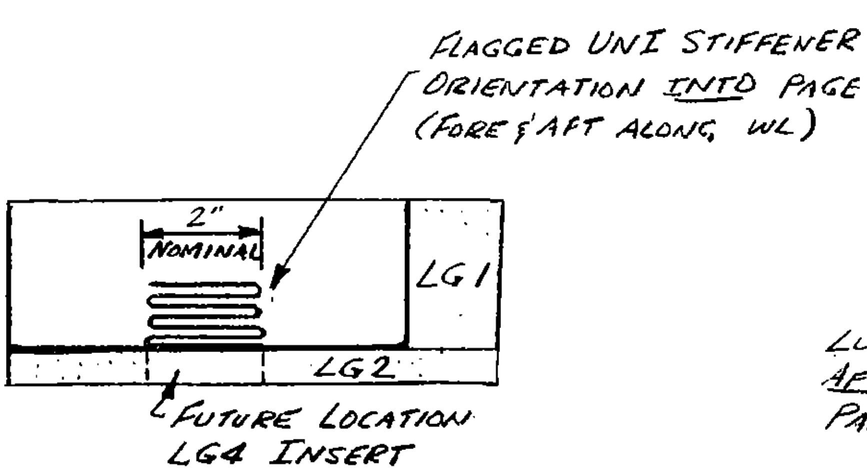
Once the combination has cured, lay it face down on the table with LG2 against the table. Laminate the plies shown in the sketch.



JOINING LG1/LG2

Now, you are ready to flag the UNI stiffener over the future location of the LG4 inserts. The stiffener location is shown on the LG2 template drawing. Begin with a piece of UNI cloth 14" x 7" with the fiber orientation along the 7" edge. Flag the piece 7 times along the 7" edge (i.e. every 2"). Flagging consists of the following procedure:

1. Fold the cloth over on itself.
2. Wet out the cloth.
3. Lightly run a new razor blade across the bubble at the edge.
4. Stipple the cloth down.
5. Repeat steps 1-4 as many times as needed. (7 times)

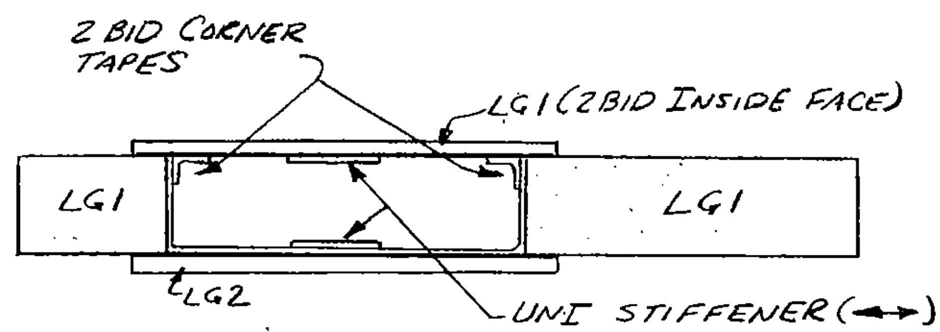


UNI STIFFENER LAMINATION

While the layup is curing, take a second LG2 and layup two BID on the inside face (i.e.) the face that will be inside the LG1 cutout when it is attached. Roughly trim the glass so that it doesn't extend beyond the edges of LG2, but don't be concerned if you trim somewhat inside the edges. Flag a UNI stiffener to this LG2 just like you did with the other LG2, remembering that the stiffener is on the side of LG2 that will be inside the LG1 cutout when LG2 is joined to LG1.

While the second LG2 layup is still tacky, join the second LG2 to LG1 with micro. Now, layup two BID tapes on the inside to join the LG2 glass layup to the LG1 glass, as shown.

At this point, you should have a sandwich, with one LG1 as the core, one LG2 as the outboard face, and one LG2 as the inboard face. Allow the assembly to cure.



JOINING LG1-LG2/LG2

Next, the two LG4 inserts must be bonded into position. Remove white foam from the outside of each LG2 down to the inside glass layup in the areas on the LG2 template drawings which denote the LG4 inserts locations. Then use micro to bond in the LG4 inserts.

After these layups are cured, drill in the pilot holes for the axle with a long 1/4" drill. To do this, with the wheel pant laying flat on the table, drill through both faces, keeping the drill perpindicular to the pant.

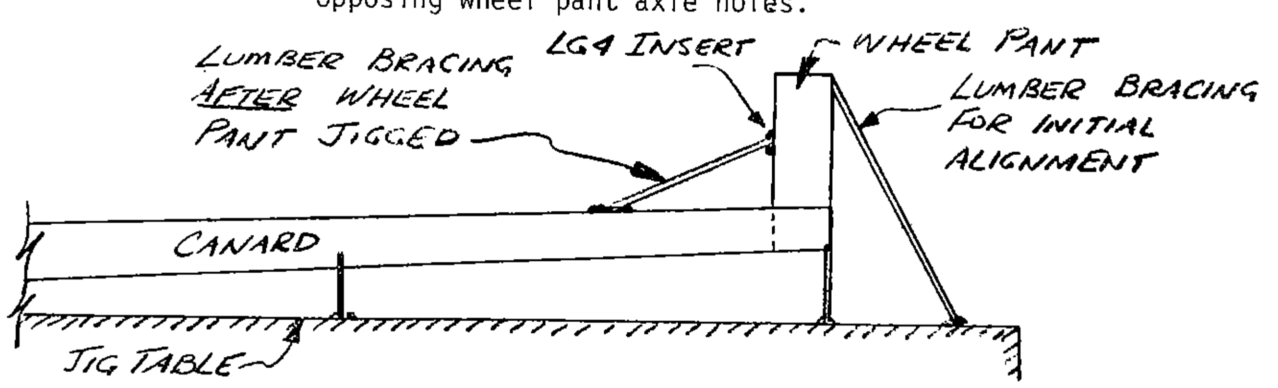
MOUNTING THE WHEEL PANT

The completed canard should be jigged upside down.

Basically, each wheel pant is jigged in place using lumber for bracing, then the toe-in and camber is checked, which usually necessitates some adjustment to the lumber bracing. When everything is jigged properly, 5-MIN blobs are used to attach the pant to the canard and a piece of lumber is attached between the LG4 insert and the canard so that the assembly will not move.

Begin by rigging the wheel pant in the approximate position. The wheel pant slips into place against the canard shear web and canard bottom skin. Since the canard surface is angling upward as fixed to the jigging table, and since the vertical faces of the wheel pant should be vertical, some beveling of the pant where it fits against the canard is necessary. The bevel is approximately 1 to 10. Note that the LG1 core is sized to fit at BL93, so don't modify the inboard edge very much. Once the assembly is trimmed, bracing is used to keep it firmly fixed. Sight thru the axle holes, keeping the two holes in the wheel pant concentric (like sighting thru the sights on a gun). Move the wheel pant until the line of sight approximately intersects the other canard tip where the axle holes on the wheel pant will be located. Bondo the lumber in place.

Next, repeat the operation with the other wheel pant except that now you can actually sight on the opposing wheel pant axle holes.



WHEEL PANT RIGGING

(LOOKING AFT)

CONTINUED ON NEXT PAGE

The objective is to be able to sight through each wheel pant and see the other wheel pant axle hole lined up in the "sight". The process is iterative until you can confirm that a bullet fired along the sightline through each wheel pant will go right thru the opposite wheel pant axle holes. At this point you have 0 toe-in and 0 camber, which is what you want. Some minor trimming of the wheel pant may be necessary so that the wheel pant fits flush against the canard.

Remove the wheel pant and laminate 1 BID along the top of the wheel pant where it will come into contact with the canard shear web or canard lower skin upon assembly. Be sure that the match between the wheel pant and canard is good prior to glassing, to avoid using considerable flox to fill the voids. Peel Ply the lamination.

When the lamination is cured, mount the wheel pants with flox to the canard, being sure to achieve good flox squeeze out. (First removing the peel ply, of course.) Before the joining gets tacky, be sure to recheck and then recheck again the alignment of the two wheel pants through the axle holes. Now is your last chance to affect that alignment. When satisfied, use lumber and 5-MIN to attach the wheel pant to the canard while the flox is curing.

Next, turn the canard over and jig it right side up, being careful not to alter the alignment of the wheel pants.

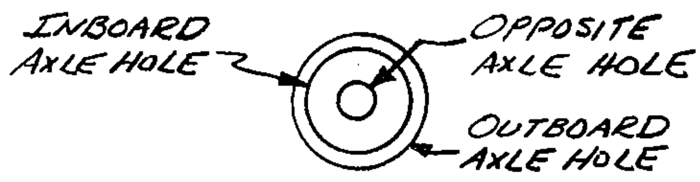
You are now ready for the fun part, contouring the wheel pant! Several templates are provided to visualize what you want the finished product to look like. The templates are provided to help, but use your eyeballs to develop a pleasing shape. Some points to remember are as follows:

1. LG4 should remain .250" thick at the axle hole.
2. A smaller pant will be lighter and cleaner looking, so don't leave excess foam on the pant.
3. The top canard skin will be sanded back for 5"-8" to provide a pleasing, curvaceous contour.

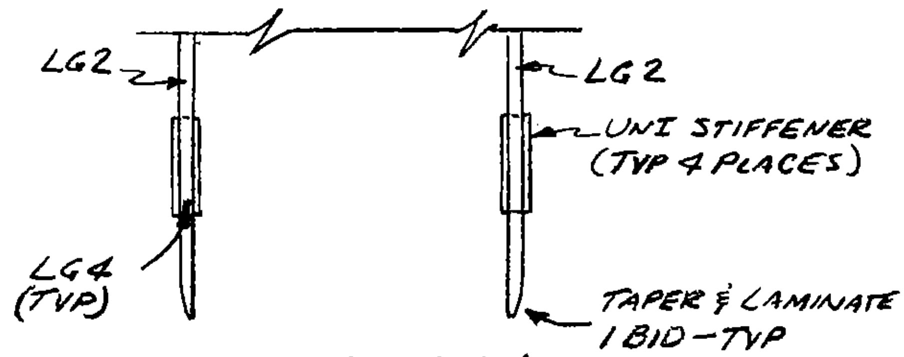
After the wheel pant is carved, you are ready to glass the wheel pant. Layup two BID over the outside face of the canard. Lap up onto the canard a minimum of 1.5" inboard of the contouring, and use a minimum of 1" overlap wherever else you overlap the cloth. After this layup has cured, remove the lumber jigging from the inside face of the wheel pant, roughup the inside face contouring if needed, and then glass two BID on the inside face.

Also, another flagged UNI stiffener will have to be laid up on each LG4, using the same technique as you did earlier.

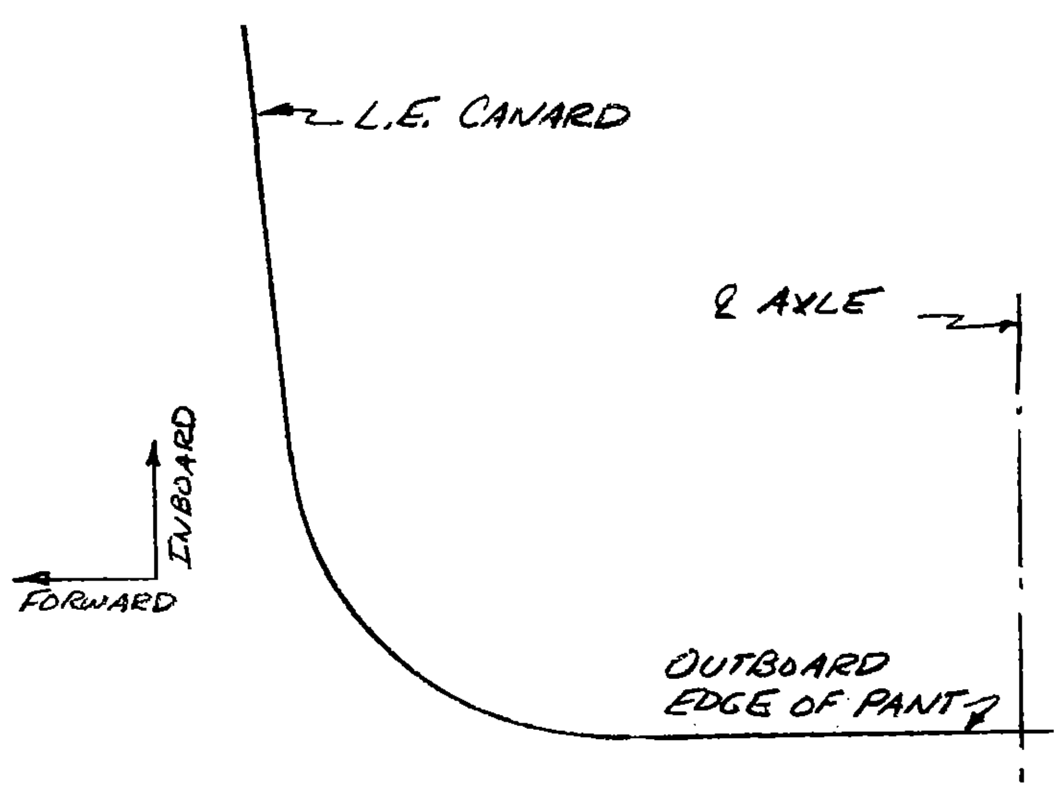
Check the sketches carefully and verify that your construction agrees; wheel pants falling off your aircraft are bad form.



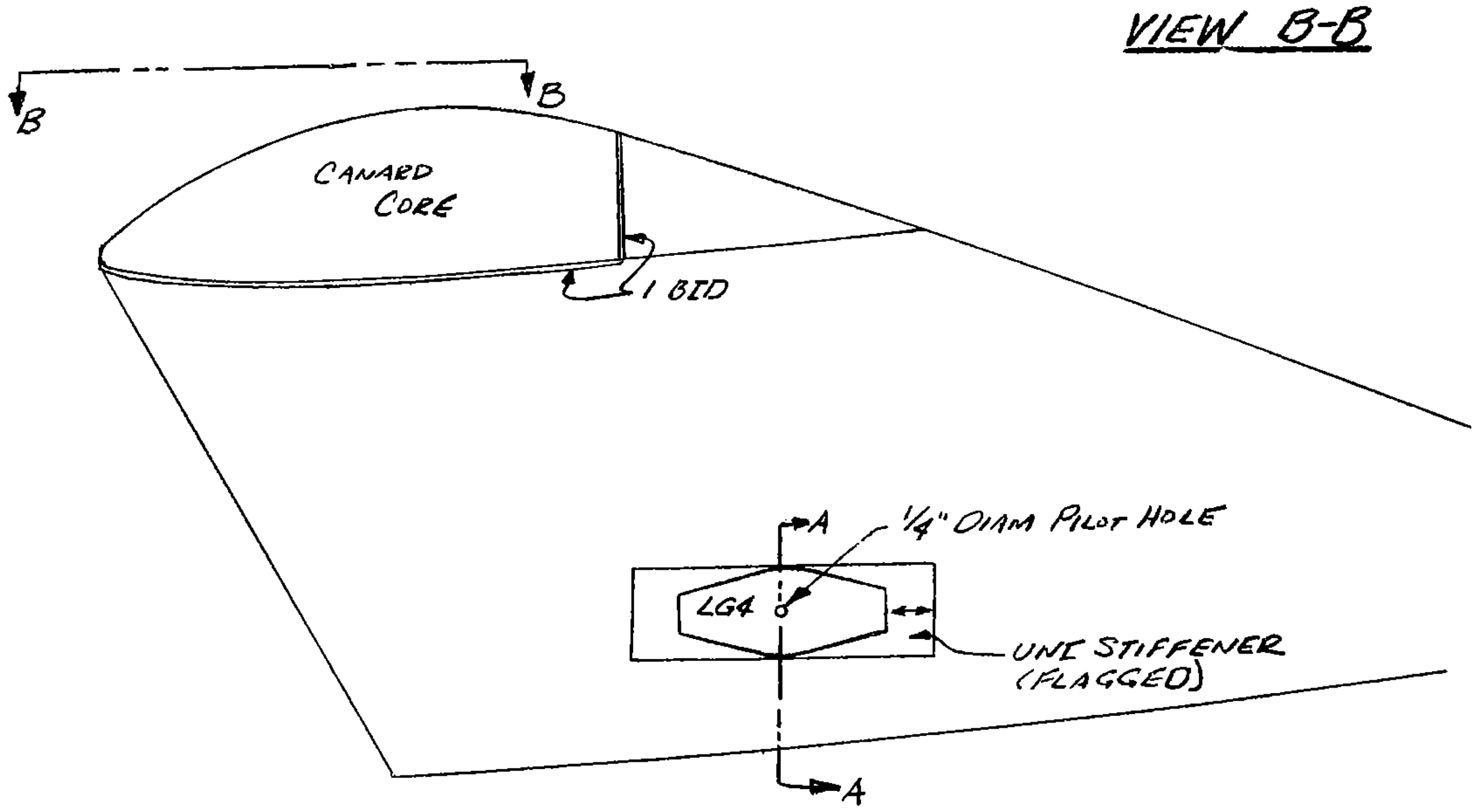
SIGHT PICTURE THRU AXLE HOLES



SECTION A-A



VIEW B-B



MOUNTING THE RUDDER PEDALS

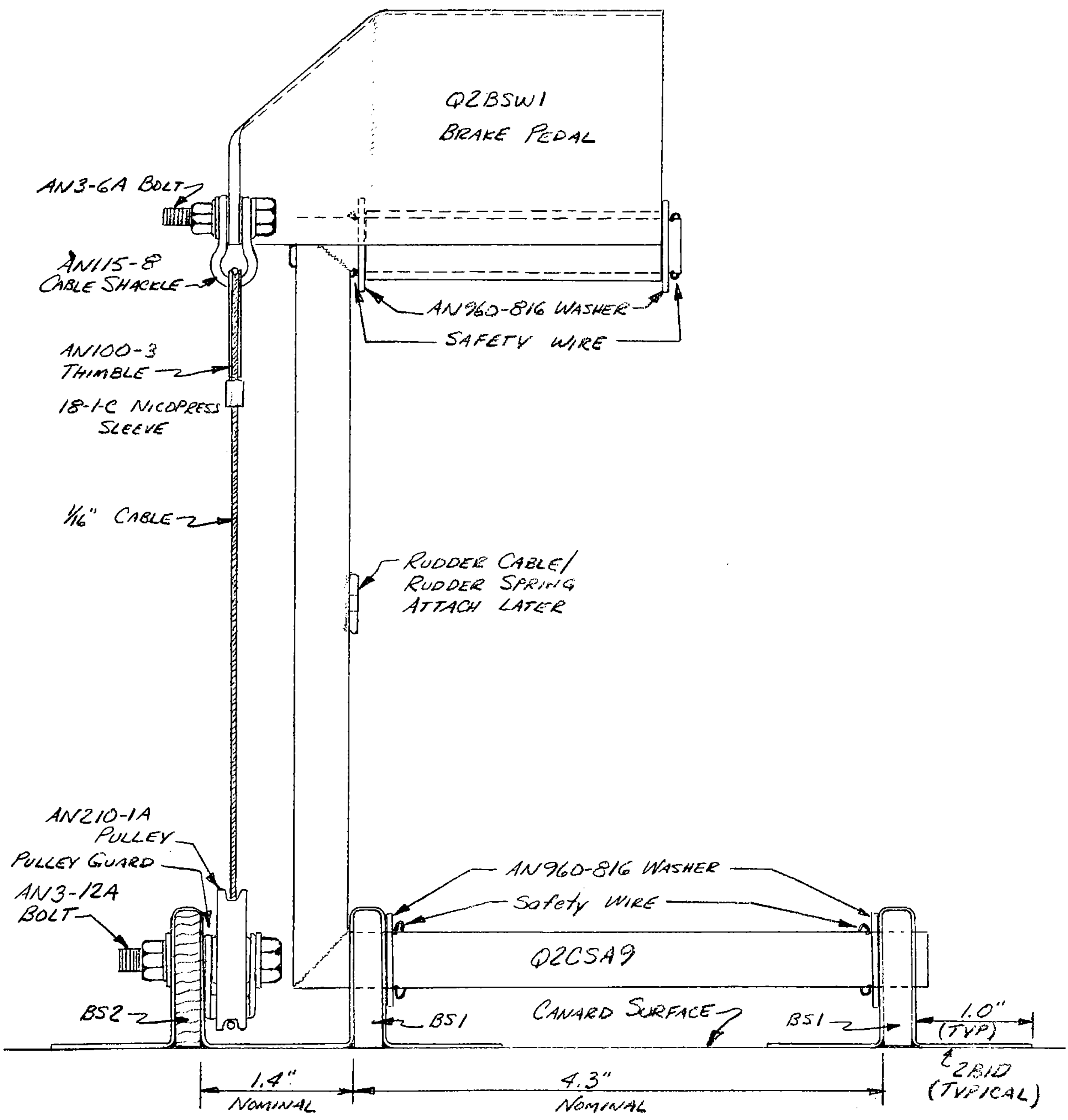
The rudder pedals must be mounted to the canard prior to mounting the canard to the fuselage.

The rudder pedals are not easily adjustable for different pilot heights, (use different cushion thicknesses for that) and, therefore, whoever will be piloting the aircraft most frequently should setup the pedal geometry for his or her comfort.

Begin by roughly placing the canard into position on the fuselage. Set in the cockpit and determine where the rudder pedals should be placed for maximum comfort. They should angle slightly forward, and you should move them fore and aft to represent the extremes of travel. Mark the locations of BS1 when you are sure of their locations. (See sketch.) Be sure that the brake pedal and pulley/cable hardware will clear the side of the fuselage, and that the entire rudder pedal/ brake pedal assembly will not interfere with any of the fuselage structure.

Assemble the rudder pedals (Q2CSA9) and the brake pedals (Q2BSW1) as shown in the sketches. Note the AN960-816 washers and safety wire used to position the brake pedal. The small tab on the upper part of each Q2CSA9 should keep the brake pedal from falling backwards by contacting the joggle in the brake pedal.

Each BS1 pivot is attached to the canard with flox and 2 BID. This is a two step procedure; first flox the two BS1's per side in place, and use a 1/2" piece of tube to line them up, then remove the tube and apply the 2 BID when the flox is cured. The BS2 plywood block must have its center hole on the same axis as the two BS1's and must not be installed until each rudder pedal is assembled to the BS1's permanently. (Otherwise the rudder pedals cannot be installed.) The BS2 plywood block is also attached to the canard with flox and 2 BID.



RUDDER PEDAL / BRAKE PEDAL MOUNT

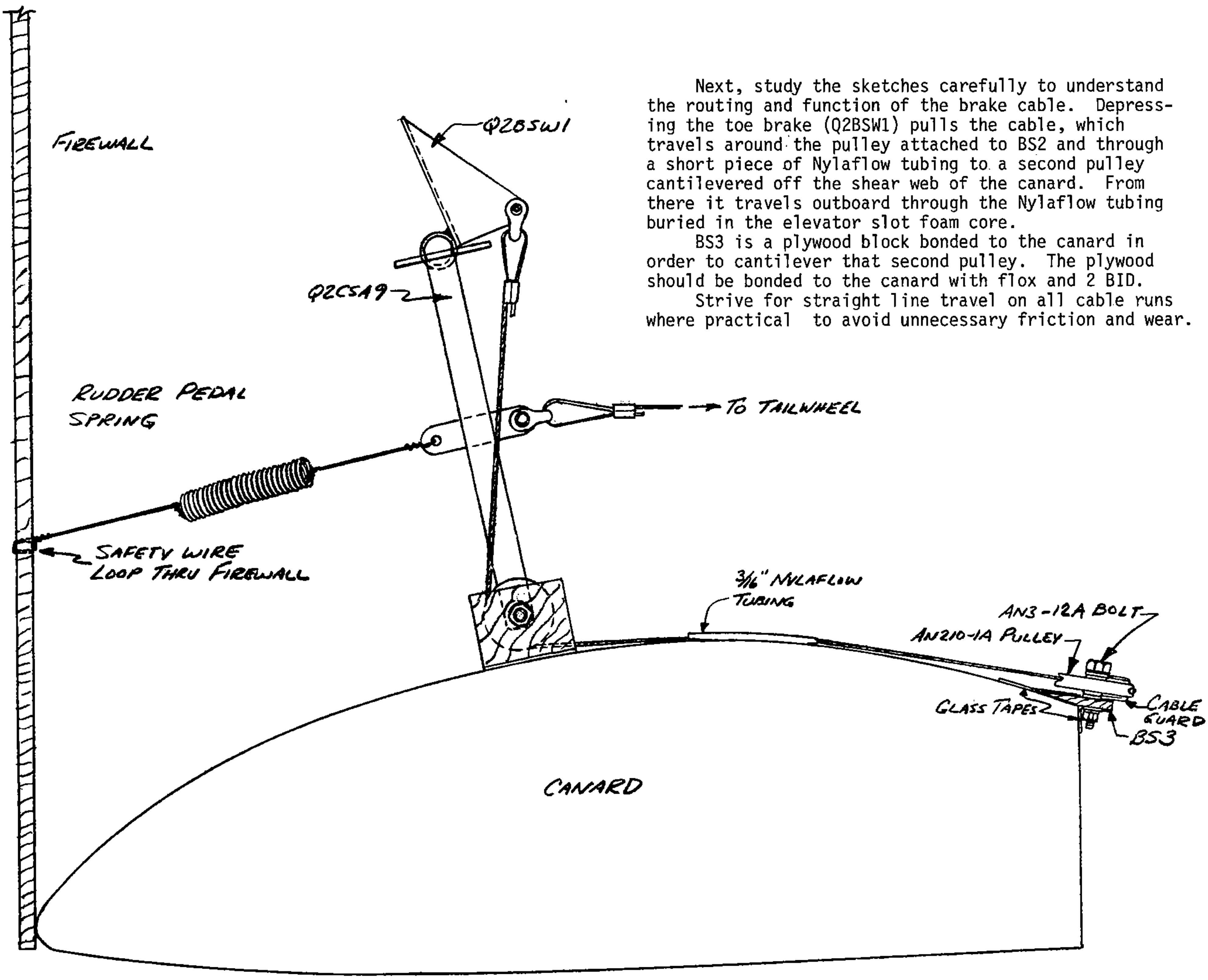
(LT SIDE - RT SIDE MIRROR IMAGE)

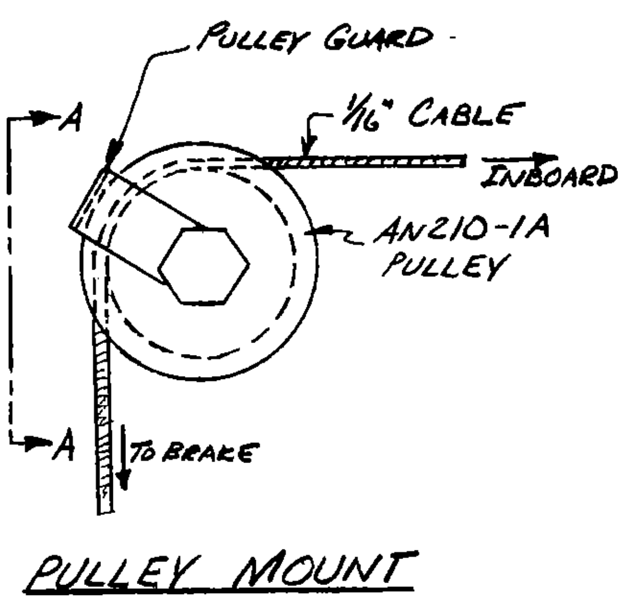
CONTINUED ON NEXT PAGE

Next, study the sketches carefully to understand the routing and function of the brake cable. Depressing the toe brake (Q2BSW1) pulls the cable, which travels around the pulley attached to BS2 and through a short piece of Nylaflow tubing to a second pulley cantilevered off the shear web of the canard. From there it travels outboard through the Nylaflow tubing buried in the elevator slot foam core.

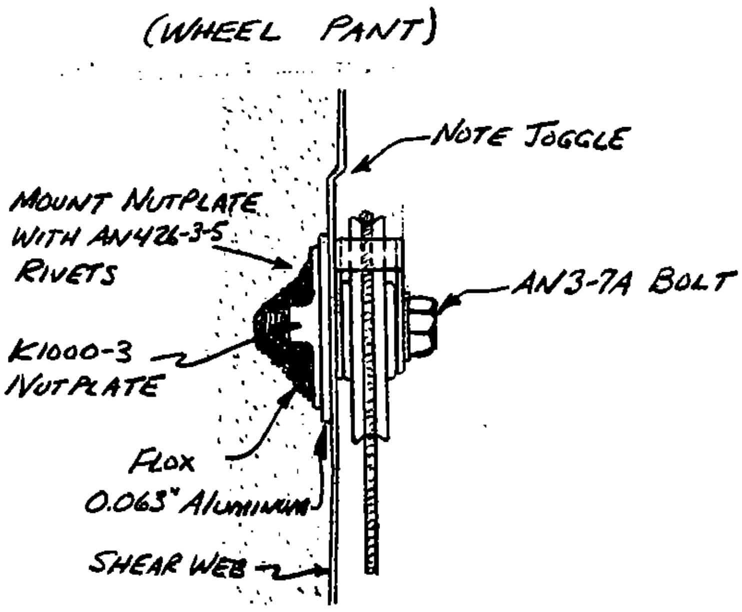
BS3 is a plywood block bonded to the canard in order to cantilever that second pulley. The plywood should be bonded to the canard with flox and 2 BID.

Strive for straight line travel on all cable runs where practical to avoid unnecessary friction and wear.





PULLEY MOUNT
(WHEEL PANT)

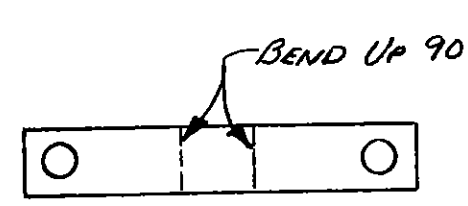


VIEW A-A

On the canard shear web at each wheel pant, there is another AN210-1A pulley to change the direction of the brake cable so that the cable will have a straight pull on the brake arm.

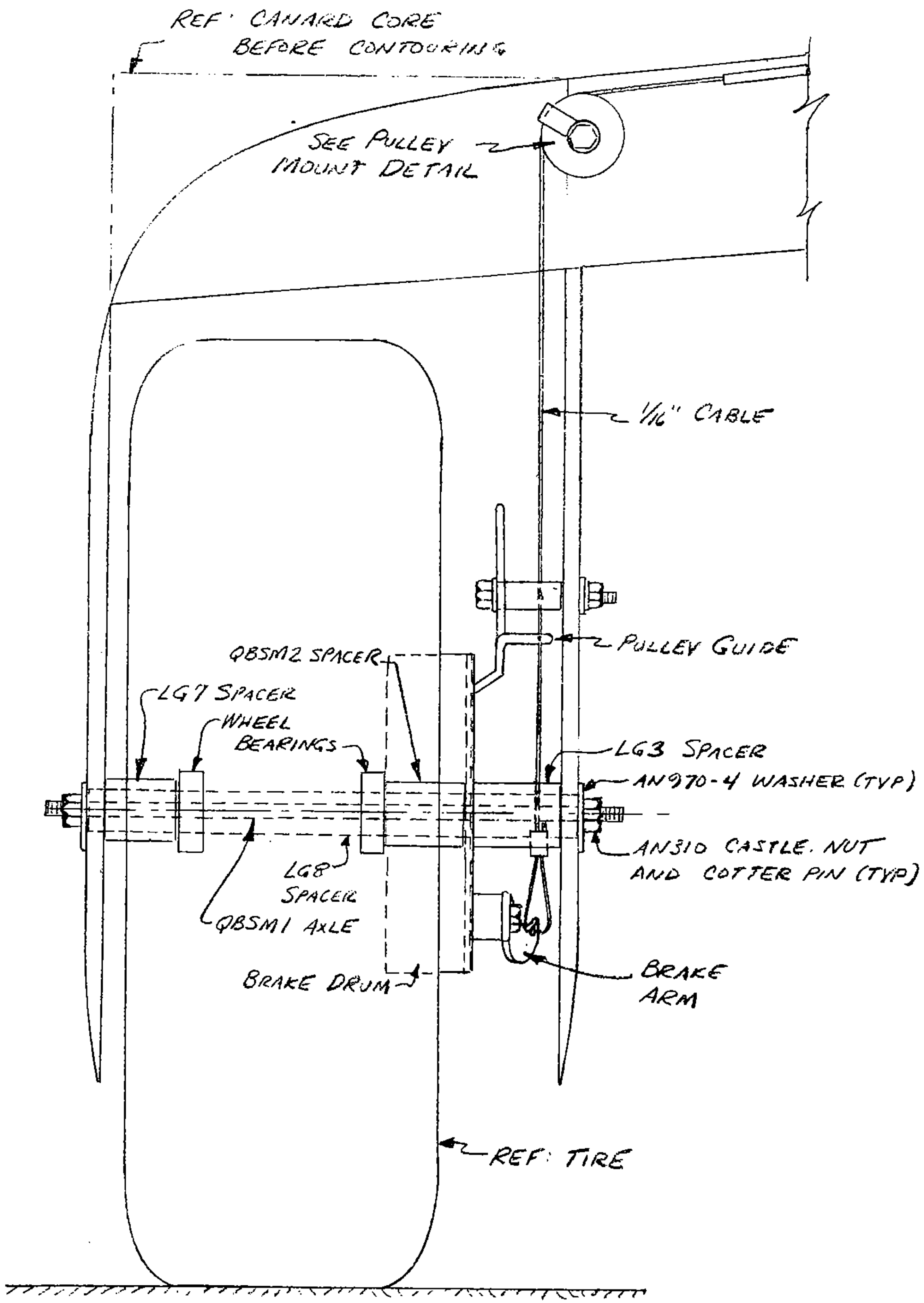
Use a piece of 0.063" thick aluminum one inch square and drill a hole in the center for an AN3 bolt, and then rivet a nutplate to the aluminum so that the bolt can pass through the aluminum into the nutplate. Assemble the pulley combination as shown. Next, trial fit the assembly against the canard shear web, removing foam and the canard shear web glass as necessary so that the cable will not be pulling off at an angle. When satisfied, remove the pulley and bolt, protect the nutplate hole with silicone, and mount the aluminum/nutplate assembly to the shear web with flox. Use 2 BID with a minimum of 1" overlap onto the canard shear web to secure the aluminum/nutplate combination to the shear web. Once the glass has cured, open up the hole and assemble the pulley combination again.

All pullies must have cable guards to prevent the cable form slipping off the pulley and fouling the system. A sample sketch of a pulley guard is included for your reference; they should fit as closely as possible to the outside diameter of the pulley.



LG5 PULLEY GUARD

MAKE 6
.032 ALUMINUM



LEFT WHEEL PANT ASSEMBLY
LOOKING FORWARD

INSTALLING THE WHEELS/TIRES/BRAKES

The Q2 uses 5" diameter wheels, internal expanding drum brakes, and 400 x 5 tires standard. The wheel pant is large enough to accomodate a 500 x 5 aircraft tire.

Begin by assembling the wheel halves and the brake drum using the bolts and nuts provided. Next, mount the tires to the wheels and inflate to about 20 psi. Check the pressure after the assembly has set for several days and verify that there are no leaks.

The left and right wheel pant assemblies are mirror images of one another. The instructions and sketches that follow cover only the left wheel pant, but you will probably wish to save time and do both the left and right together.

To provide clearance for the drum brake assembly, which is located on the inboard side of the wheel pant, the tire is offset slightly toward the outboard edge of the wheel pant.

The LG3 and LG7 spacers are made from 7/8" O.D. x 0.120" wall 6061T6 Aluminum tubing. The sizing will be described shortly. Find QBSM1 axle bolt (2) and the QBSM2 spacer (2). The LG8 spacer is made from 5/8" O.D. x 0.065" wall 6061T6 Aluminum tubing, so find that material.

Open up the 1/4" diameter axle pilot holes in the wheel pant to 5/8" diameter, using a 5/8" spotface to avoid tearing the hole.

The LG8 spacer length is the width between the outside faces of the wheelpant measured at the axle hole; measure carefully. Assemble the QBSM2 spacer between the brake drum and the brake shoe. Note that both the spacer and brake shoe fit down into the drum with the brake arm pointing forward. Now, the LG7 and LG3 spacers can be made. Measure the width of the wheel pant between the inside faces at the axle hole. Size the spacers so that there is about 0.020" freeplay from side to side after they are installed as shown. There should be a minimum of 1/4" clearance between the tire and the inside wheel pant face.

LG6 is a tool made from 5/8" O.D. x 0.065" wall 6061T6 Aluminum tubing. It has slightly rounded ends, and its length should be approximately 1/8" less than the width between the inside faces of the wheel pant measured at the axle hole. By inserting LG6 through the pieces (except LG8) to keep them in the proper position (sort of like a shisk a bob), you can slide the assembly up into the proper position inside the wheel pant. Next, slide and push LG8 from left to right slowly, pushing LG6 out the other side of the wheel pant. When LG8 is resting between the inboard faces of the wheel pant, center the AN970-3 washers on the holes and insert the QBSM1 axle bolt. The axle bolt must be tightened until it clamps up the LG7 and LG3 spacers against the bearings of the wheel. If LG8 is too long, it will prevent this clamping up effect; if the LG7 and/or LG3 spacers are too short, they won't clamp up either. Therefore, you will have to do

CONTINUED ON NEXT PAGE

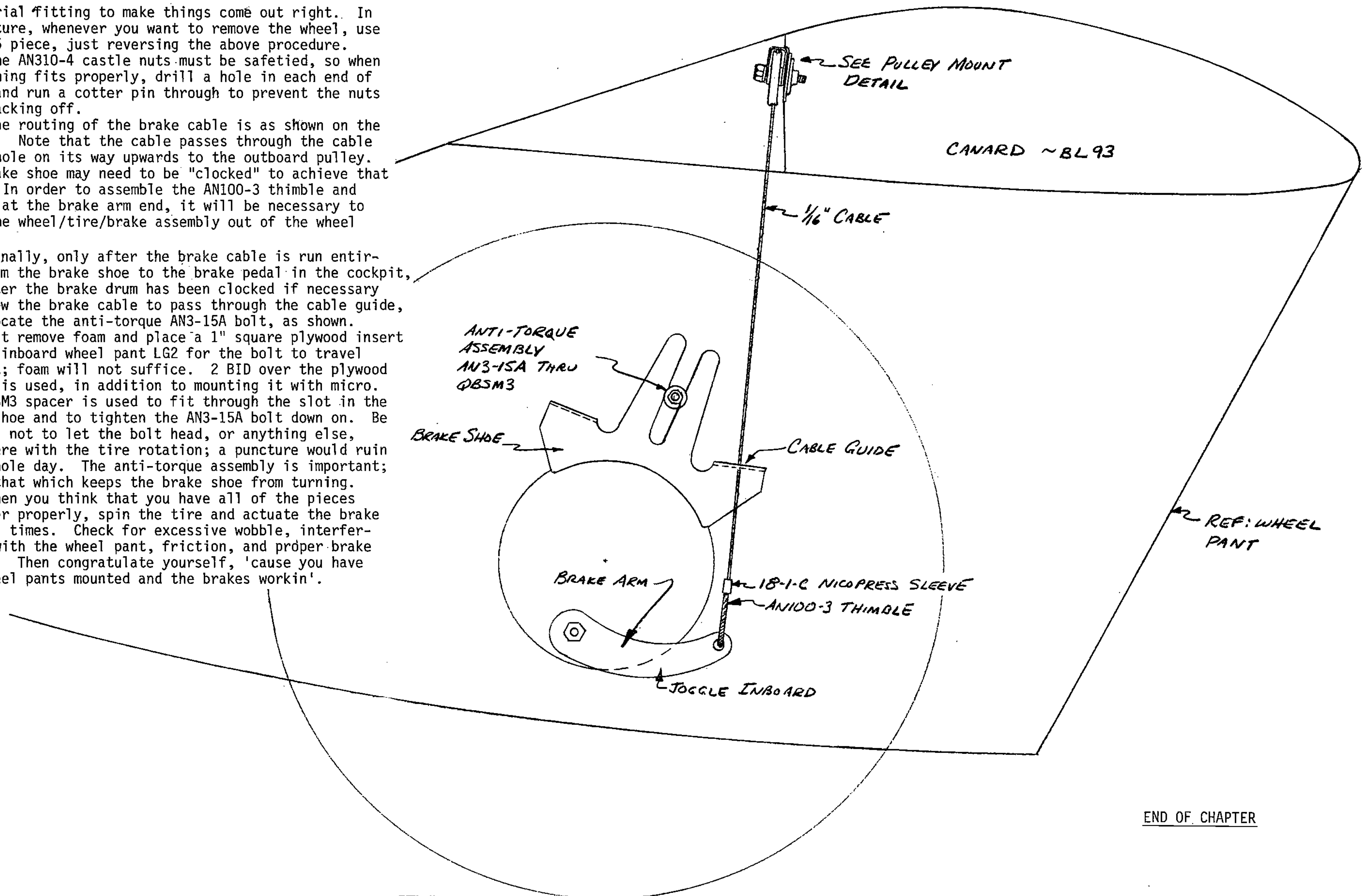
some trial fitting to make things come out right. In the future, whenever you want to remove the wheel, use the LG6 piece, just reversing the above procedure.

The AN310-4 castle nuts must be safetied, so when everything fits properly, drill a hole in each end of QBSM1 and run a cotter pin through to prevent the nuts from backing off.

The routing of the brake cable is as shown on the sketch. Note that the cable passes through the cable guide hole on its way upwards to the outboard pulley. The brake shoe may need to be "clocked" to achieve that path. In order to assemble the AN100-3 thimble and sleeve at the brake arm end, it will be necessary to drop the wheel/tire/brake assembly out of the wheel pant.

Finally, only after the brake cable is run entirely from the brake shoe to the brake pedal in the cockpit, and after the brake drum has been clocked if necessary to allow the brake cable to pass through the cable guide, then locate the anti-torque AN3-15A bolt, as shown. You must remove foam and place a 1" square plywood insert in the inboard wheel pant LG2 for the bolt to travel through; foam will not suffice. 2 BID over the plywood insert is used, in addition to mounting it with micro. The QBSM3 spacer is used to fit through the slot in the brake shoe and to tighten the AN3-15A bolt down on. Be careful not to let the bolt head, or anything else, interfere with the tire rotation; a puncture would ruin your whole day. The anti-torque assembly is important; it is that which keeps the brake shoe from turning.

When you think that you have all of the pieces together properly, spin the tire and actuate the brake several times. Check for excessive wobble, interferences with the wheel pant, friction, and proper brake action. Then congratulate yourself, 'cause you have the wheel pants mounted and the brakes workin'.



END OF CHAPTER

MAIN WING AND CANARD MOUNTING

MOUNTING THE MAIN WING

The main wing is permanently attached to the fuselage with flox and a series of BID tapes.

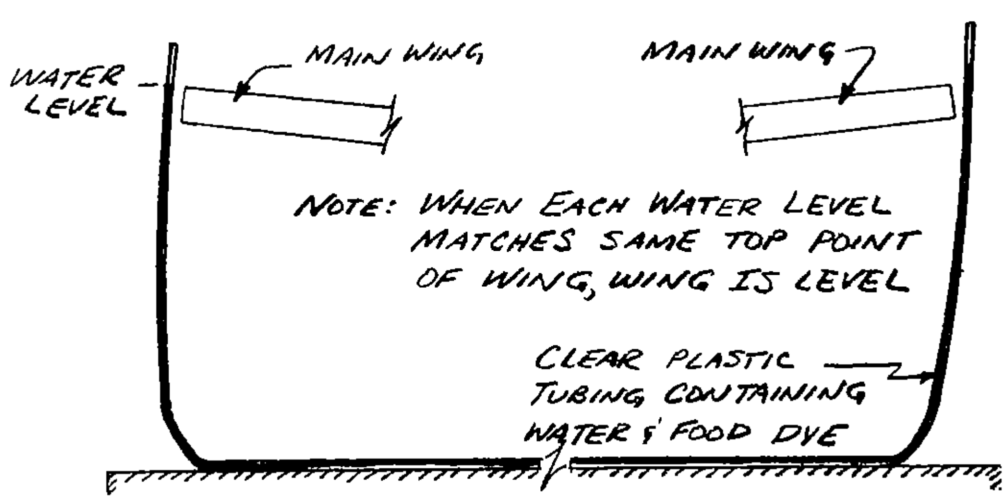
Begin by leveling the fuselage both longitudinally and laterally. Use several pieces of scrap lumber and Bondo to firmly hold the fuselage in position. It is preferable at this time to allow sufficient room for the canard to slip up into position later. (See Mounting The Canard.)

Locate WL30 on each side of the fuselage between the seatback bulkhead and the FS94 bulkhead. Refer to Page 8-2 for information detailing the location of the split line; this will assist in locating WL30.

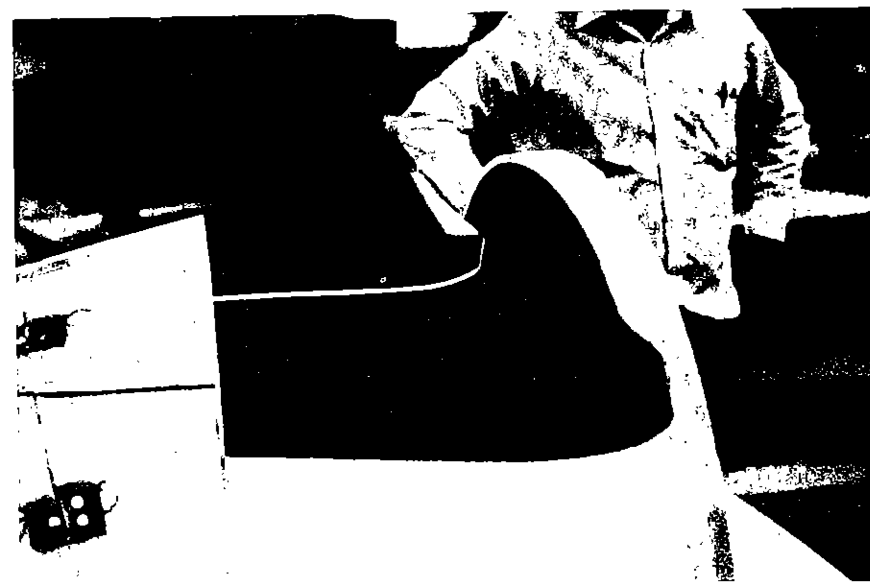
Remove the top portion of the fuselage shell between the seatback bulkhead and the FS94 bulkhead down to WL30. For convenience, allow 1" between your forward cut line and the aft face of the seatback bulkhead.

If you have previously mounted the aileron system on the main wing, you will notice that the inboard phenolic bearings and linkages interfere with the FS94 bulkhead as you attempt to install and fit the main wing onto the fuselage. It will, therefore, be necessary to remove part of the FS94 bulkhead until the main wing is mounted by cutting a slot in the bulkhead. Later, after the main wing has been attached permanently, the slot can be filled in and the phenolic bearings laminated to it.

Next, trial fit the main wing into position and begin trimming away the fuselage sides (downward) until the main wing fits into position. Check the lateral level of the main wing using a water level system consisting of some clear plastic tubing and water colored with food dye. Check that the centerline of the main wing is on BL00.



LEVELING THE MAIN WING



Small variations (0.1" max) in fit between the main wing and the fuselage sides are acceptable and can be filled with flox. Expect this fitting process to consume several hours of intermittent work. Don't forget to verify the fit with the main wing levelled longitudinally using the level board on it.

Before mixing up the flox, recheck the fuselage and main wing level lines and blocks. It is very critical to your Q2's excellent flying qualities to have the proper incidences angles.

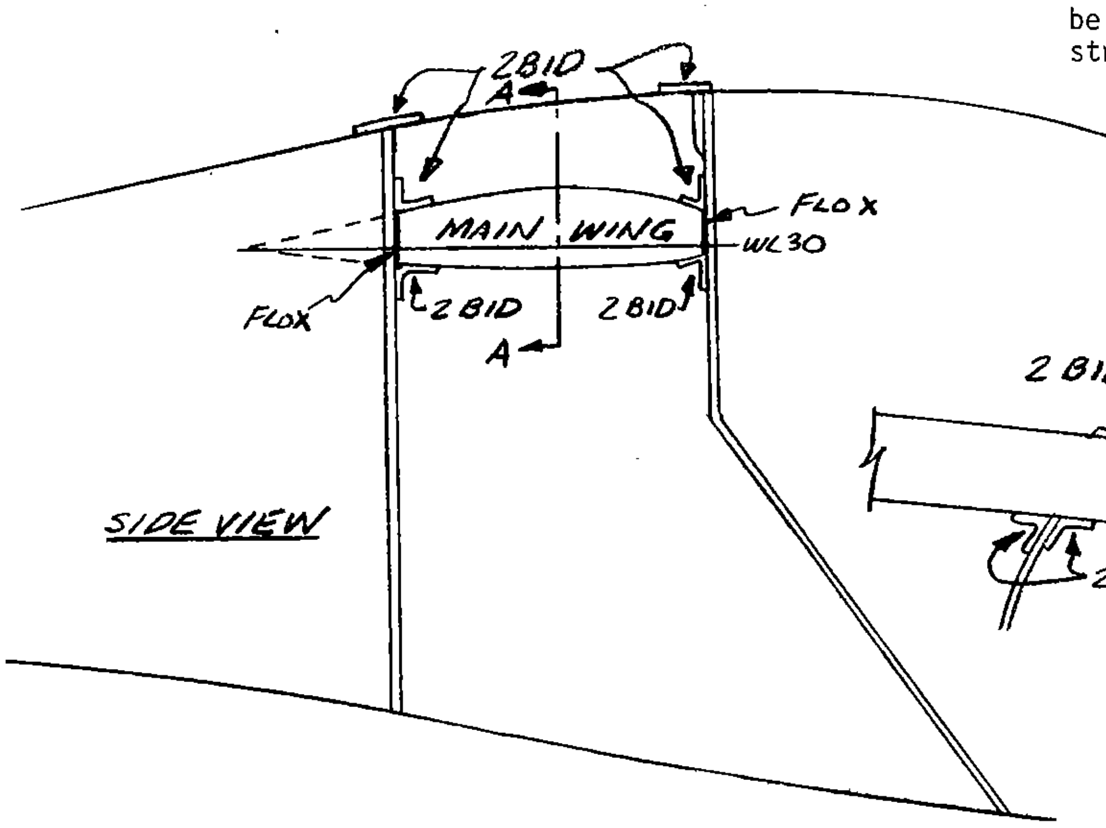
Check the skew of the main wing by measuring the distance from each wing tip to the base of the vertical fin. The two measurements should be the same. If not, some shifting within the confines of the FS94/Seatback bulkhead fit should be accomplished to make the main wing as skew free as possible.

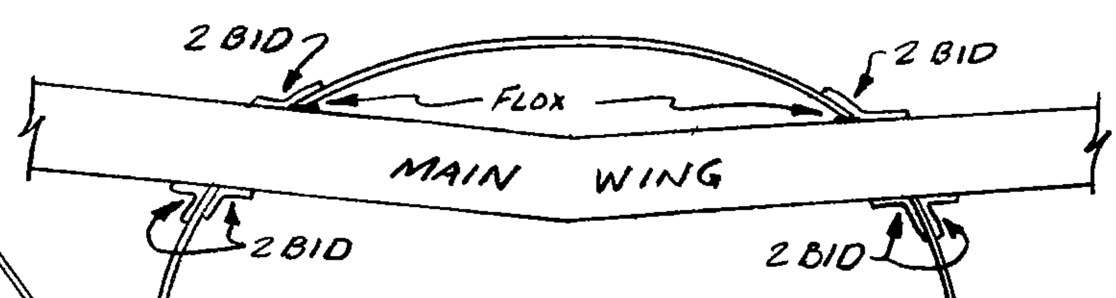
Liberal quantities of flox should be placed wherever the main wing and fuselage will meet upon assembly. Verify good squeezeout of the flox upon assembly. Recheck all level lines and alignment. Permit the flox to cure prior to attaching the BID tapes shown. Two BID tapes are used everywhere, top and bottom, with a minimum width of 3 inches.

Finally, the top section of the fuselage shell that was removed to enable the mounting of the main wing should be trimmed to fit, and bonded in place with liberal quantities of flox. Then, BID tapes are used, as shown, on the outside of the fuselage shell to attach the main wing cover to the main wing and fuselage.

Also, any material removed to allow the aileron mechanism to clear should be replaced.

Remember, this assembly is critical and should be accomplished with great care. Tie all major structure together with BID tapes and flox.





MOUNTING THE MAIN WING

MOUNTING THE CANARD

After mounting the main wing, you should find the canard easy. The canard fits forward against the aft face of the firewall with the leading edge area fairing into the lower part of the firewall. The aft section of the canard is allowed to end up wherever necessary, as long as it is above the bottom fuselage line at the shear web. The part of the lower forward fuselage shell that is removed to fit the canard, is discarded.

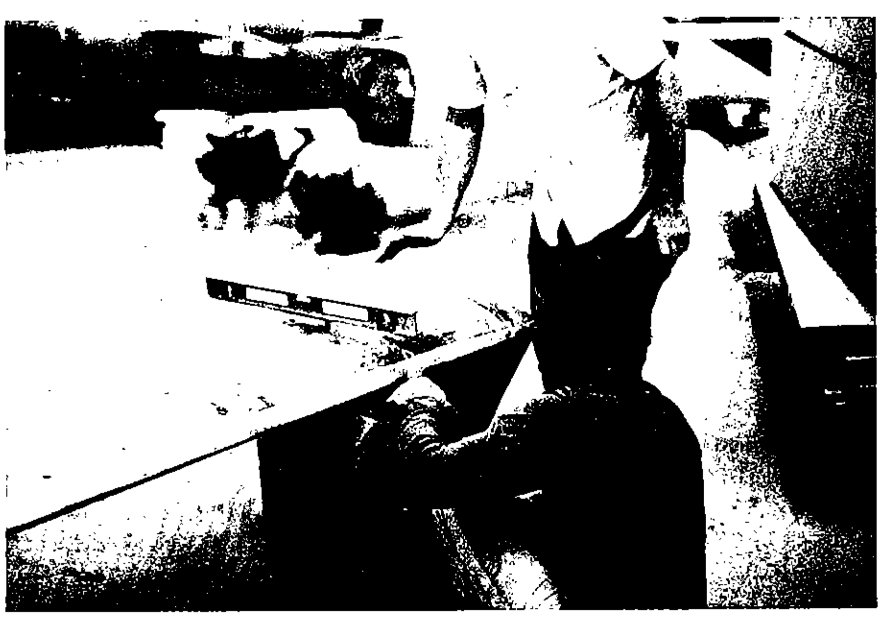
Begin by removing part of the lower forward fuselage shell and trial fitting the canard. Expect to consume several hours of cutting, fitting and retrimming before you have achieved a good fit. Check and recheck skew, and the fuselage and canard level lines. Use the water level system to check the lateral level of the canard. (It is suggested that you use the axle holes as the reference.) Verify that the centerline of the canard is at BL00.

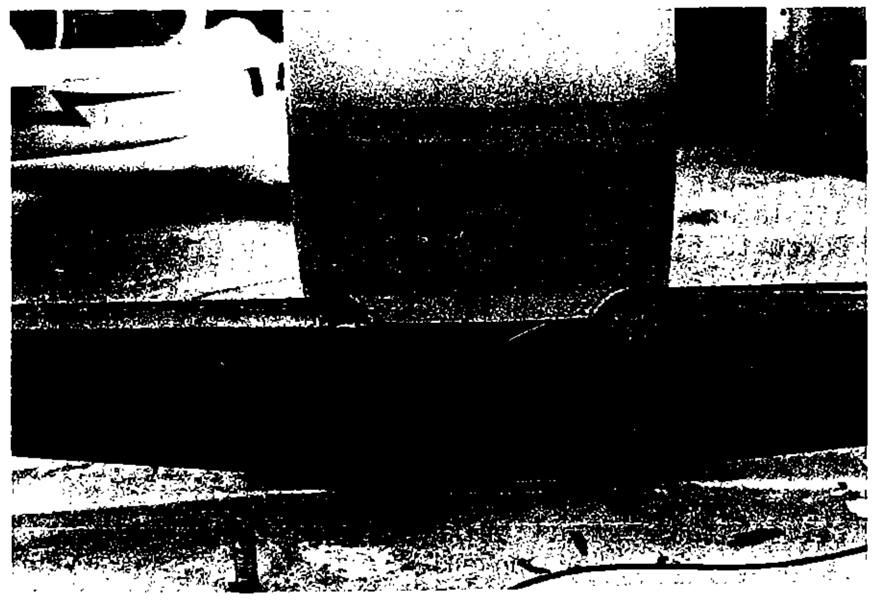
Be carefull that you do not remove a part of your main fuel tank while clearancing the canard! You should end up with about 1/2" clearance between the aft edge of the phenolic bearings and the forward face of the main fuel tank.

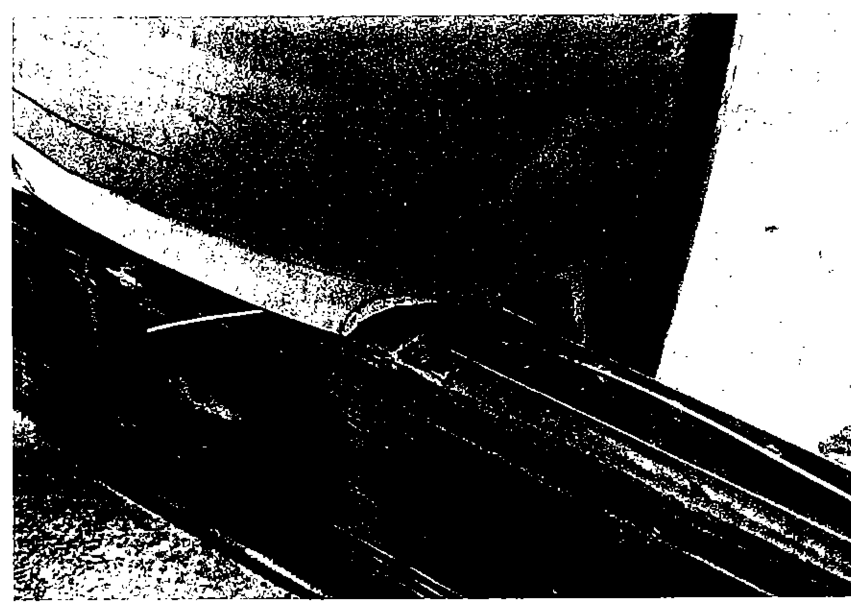
If the level board on the main wing is still installed, verify that the main wing is level prior to mixing up the flox for the canard.

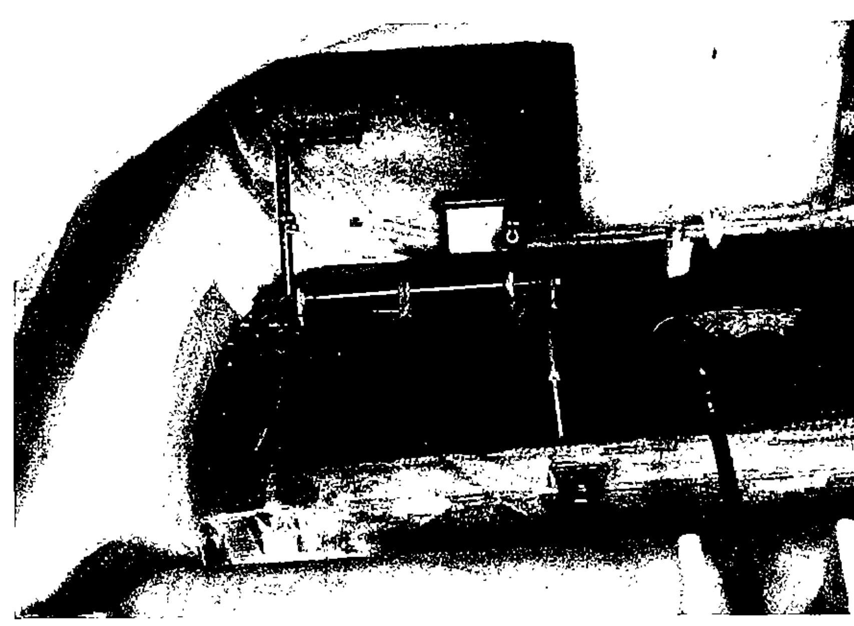
Attach the canard to the fuselage as shown in the illustrations. Be sure that you provide sufficient flox for good squeezeout everywhere. The flox should be allowed to cure prior to installing the BID tapes inside and out. Recheck the level lines and skew before leaving the canard alone to cure.

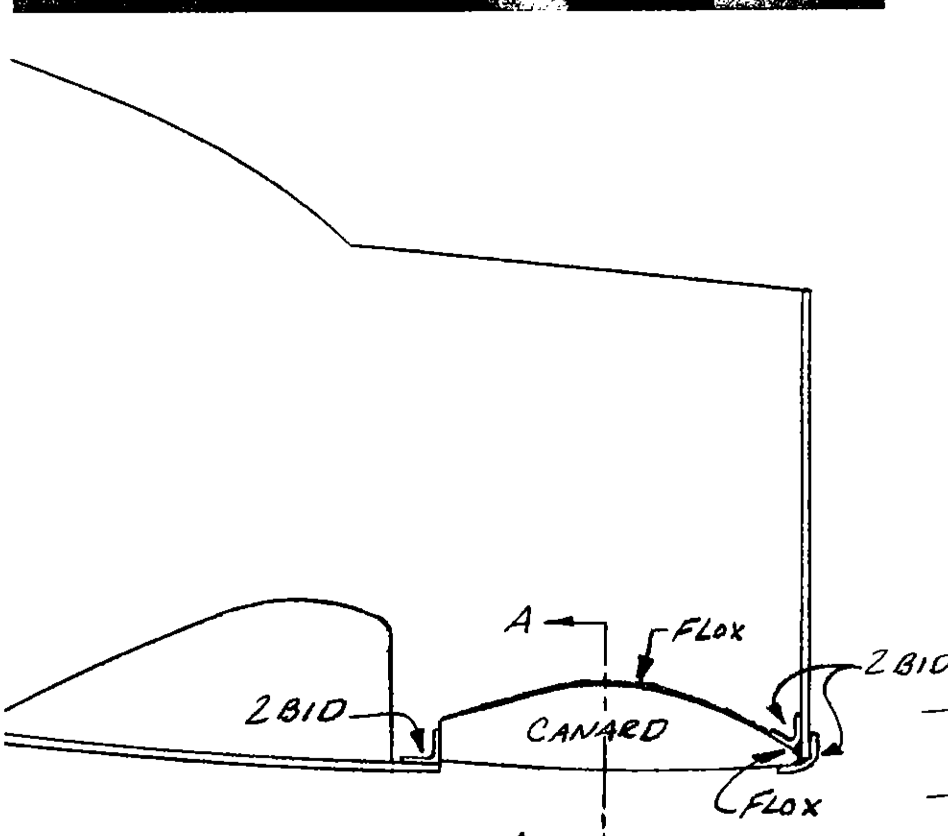
Later, you will construct fairings for the inboard elevators, ailerons, and for the lower part of the canard, in order to make your Q2 aerodynamically cleaner. For now, stand back and admire your Q2 setting on the landing gear; your over 50% completed at this point.



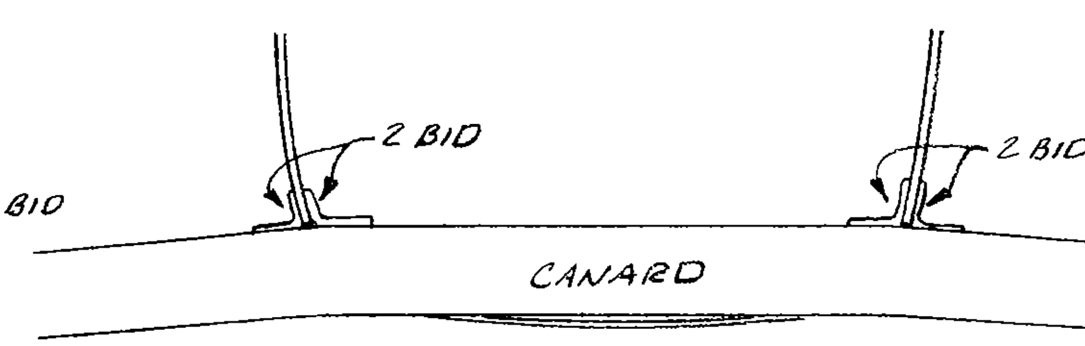








SIDE VIEW

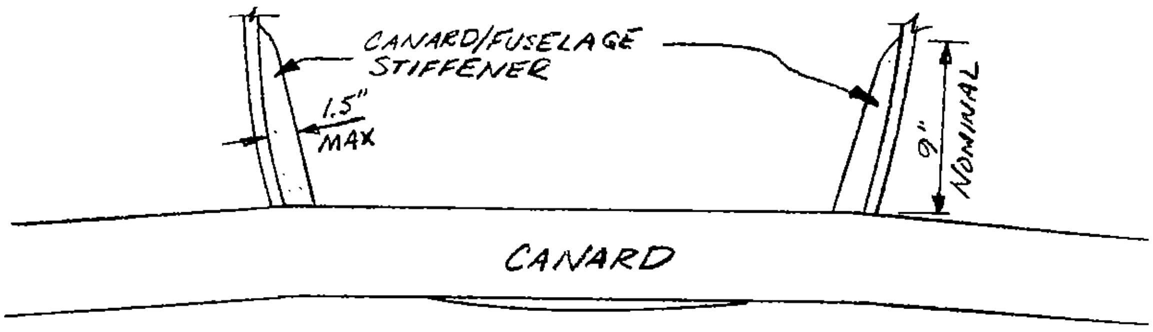


SECTION A-A

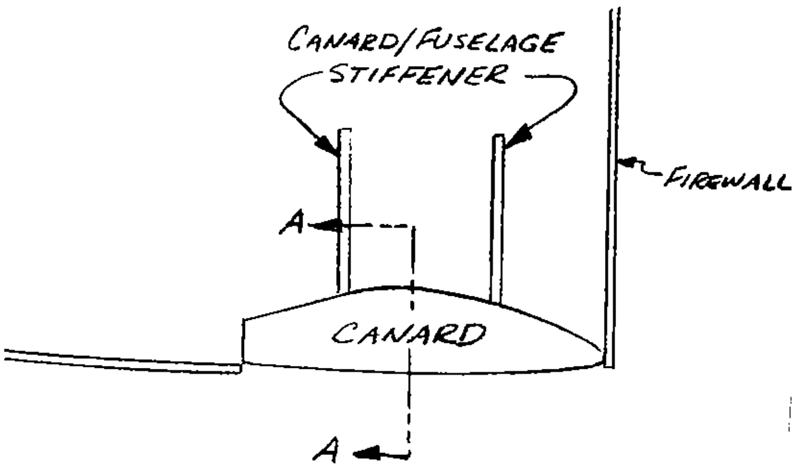
MOUNTING THE CANARD

INSTALLING THE FUSELAGE STIFFENERS

Two stiffeners, fabricated from the 3/8" thick white foam, are placed on each side of the fuselage above the canard. These stiffeners improve the stability of the fuselage sides during hard landings. The sketches show the positioning of the stiffeners. Two BID are laminated over each stiffener to attach it to the fuselage and canard.



SECTION A-A



CANARD/FUSELAGE STIFFENER

PERMANENT ATTACHMENT OF THE FORWARD AND AFT FUSELAGE SHELL

If you have decided not to make your Q2 trailerable, you should now complete the closeout of the fuselage by permanently attaching the forward and aft fuselage shells at the fuselage cut line, or joint.

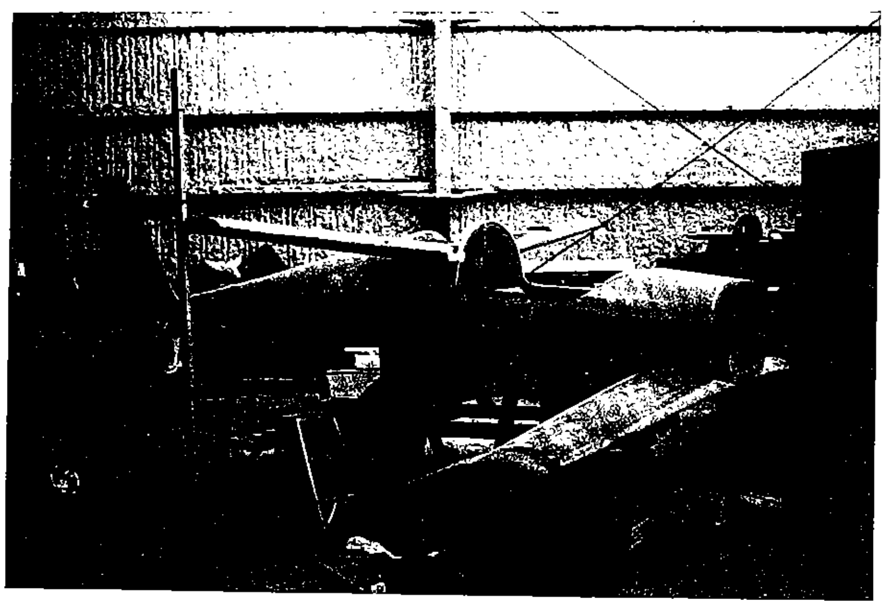
If, on the other hand, you intend for your Q2 to be trailerable, you should skip ahead in these plans to Chapter 15 and complete that work prior to mounting the vertical fin in Chapter 14.

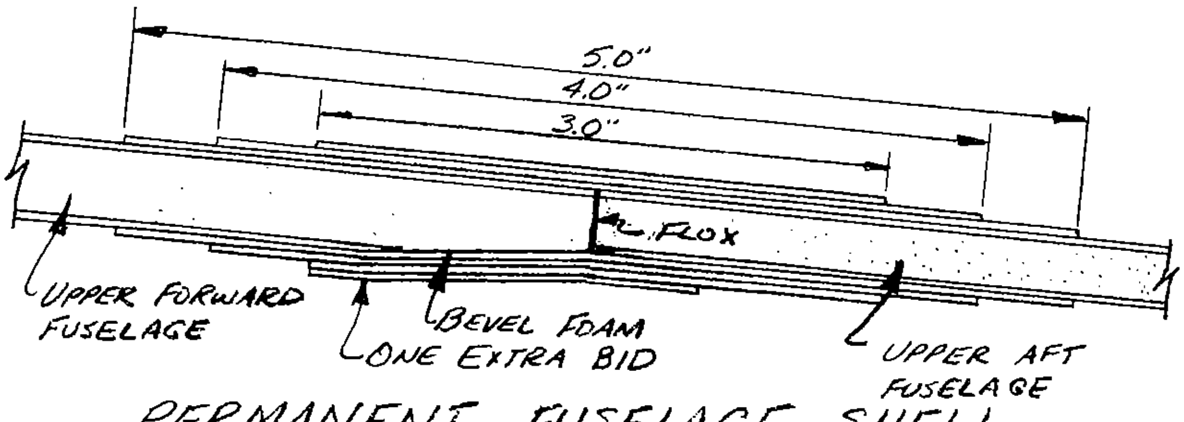
The fuselage shells are permanently attached at the joint with flox and BID tapes on both the outside and inside. Begin by jigging the two shells together and checking for fit at the joint.

Then, since the core thickness of the forward shell is 3/8" and the rear shell core is only 1/4" thick, bevel the forward shell to match the aft core at the joint. Also, sand dull the inside skin glass within 2.5" of either side of the joint, in preparation for the inside joint lamination later. Prepare some scrap lumber for use in holding the jigged position. Mix up flox and spread it on both edges of the shells where they will join. Place the two shells together, hold them in position with the lumber and Bondo, and permit to cure.

Next, laminate the 3 BID tapes shown on the outside of the skin after you have sanded dull the existing glass. Note that the three tapes have the following widths: 5", 4", and 3" and that the orientation should be at 45 degrees to the joint itself. Wherever it is necessary to overlap BID in order to laminate around the entire circumfernce, overlap the BID by a minimum of 1.5".

Once that lamination has cured, crawl inside the fuselage and perform the inside skin lamination as shown, wherever possible. The 4 BID tapes have the following widths: 5", 4", 3", and 2" with a 45 degree orientation to the joint. The extra BID is to make up for the glass strength lost when the foam was bevelled.





PERMANENT FUSELAGE SHELL ATTACHMENT

END OF CHAPTER

CANOPY ASSEMBLY AND MOUNTING

INTRODUCTION

In this chapter, you will install the canopy that you previously mounted and cut out in Chapter 8. It is important to the passengers' safety to have a canopy that is strong, rigid, and securely fastened while in flight. Therefore, do not rush this section.

FORWARD EDGE LAMINATION

Laminate 3 UNI across the front edge of the canopy, with the orientation across the front of the canopy. This lamination of 3 inch wide tapes will increase the stiffness and strength of the canopy at the forward edge.

PROTECTING THE CANOPY PLEXIGLASS

The canopy was shipped to you with a protected coating applied on either side. You should be careful during construction that you do not remove this coating, exposing the canopy to scratches and abrasion. Once the aircraft is completely finished and painted, the coating may be peeled away in strips, exposing the canopy plexiglass itself. Whenever, you laminate onto the canopy surface, you will, however, need to remove the coating where the bond will take place. Protect the edge of canopy/lamination junction with grey tape. This will assist in providing a trim mask for knife-trimming.

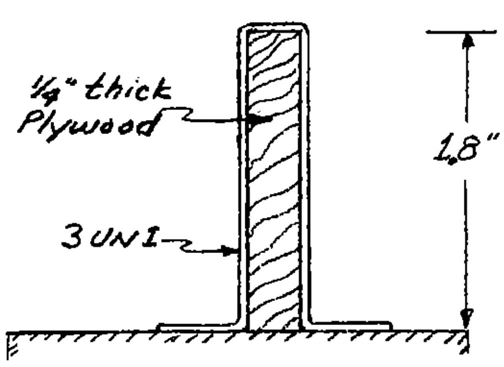
CANOPY FRAME STIFFENERS

Three stiffeners will be fabricated. One each will be installed on each side of the canopy frame longitudinally, and the third will be installed transversly across the bottom of the aft canopy bulkhead. At the lower aft left and right points of the canopy frame, these three stiffeners join together.

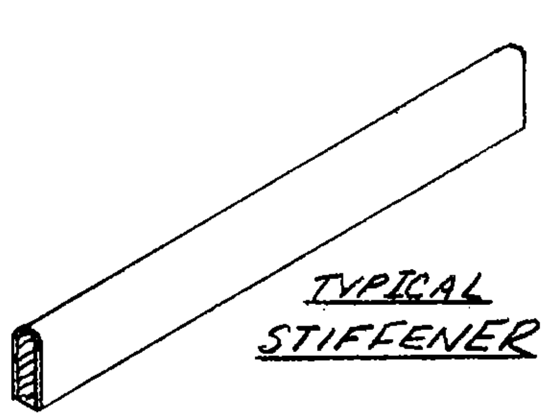
It is recommended that the core materials for these stiffeners be 1/4" thick plywood. An alternative is to use 1/4" thick white foam, but this alternative would require several plywood inserts for local beefup where bolts are inserted.

As installed, each stiffener should be approximately 1.3" wide. Because the canopy frame sides are curved as they travel forward, those two stiffeners should be made about 1.8" wide to allow for fitting. The third stiffener, the one fitted to the aft canopy bulkhead, can be made 1.3" wide.

To construct the stiffeners, cut three pieces of 1/4" plywood with the following sizes: 1.8" x 30", 1.8" x 30", and 1.3" x 44". Set them vertically on the jig table and hold them in place with a dab of 5-MIN on either end of each one. Round the top corners of the plywood so that the glass cloth will flow smoothly around the corners. Laminate 3 UNI with the orientation running lengthwise along the long dimension. The excess cloth that overlaps onto the table can be trimmed later.



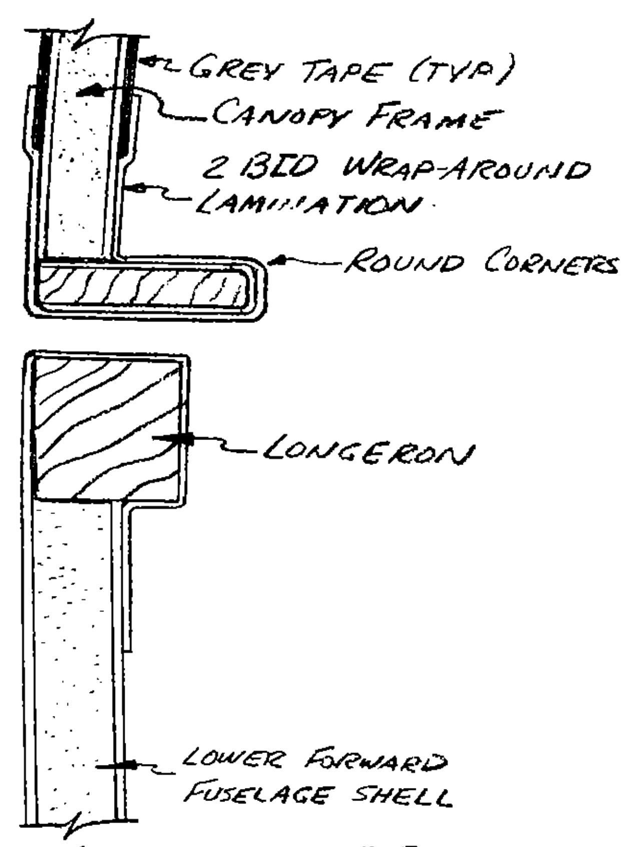
TYPICAL STIFFENER LAMINATION



TYPICAL STIFFENER

Once the laminations have cured, it is time to mount the stiffeners to the canopy frame. Begin by setting the canopy on the fuselage and checking the general fit of the canopy on the airframe. There should not be any trimming required for a good fit.

The two stiffeners, one on each side, fit outboard to the outside skin line as shown. This will require removing a portion of the canopy frame as indicated on the sketch. There should be an approximately 0.1" gap between the bottom of each stiffener and the top of the longeron, to allow the future insertion of a flexible seal to minimize air leaks. Each stiffener runs from the aft edge of the canopy forward as far as practical.

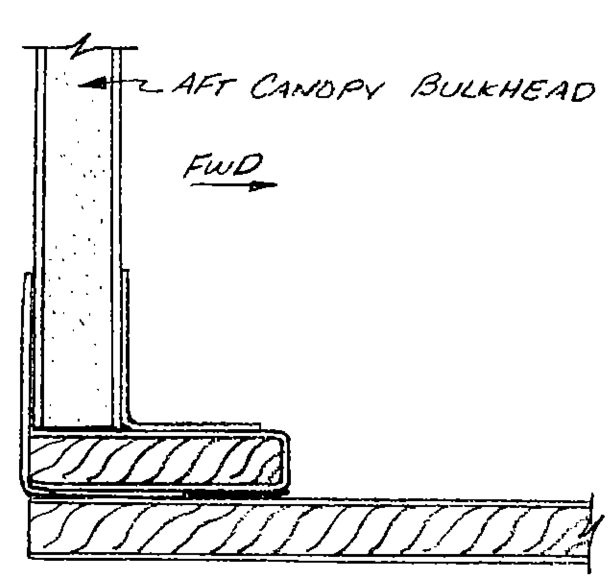


CANOPY STIFFENER FITTING

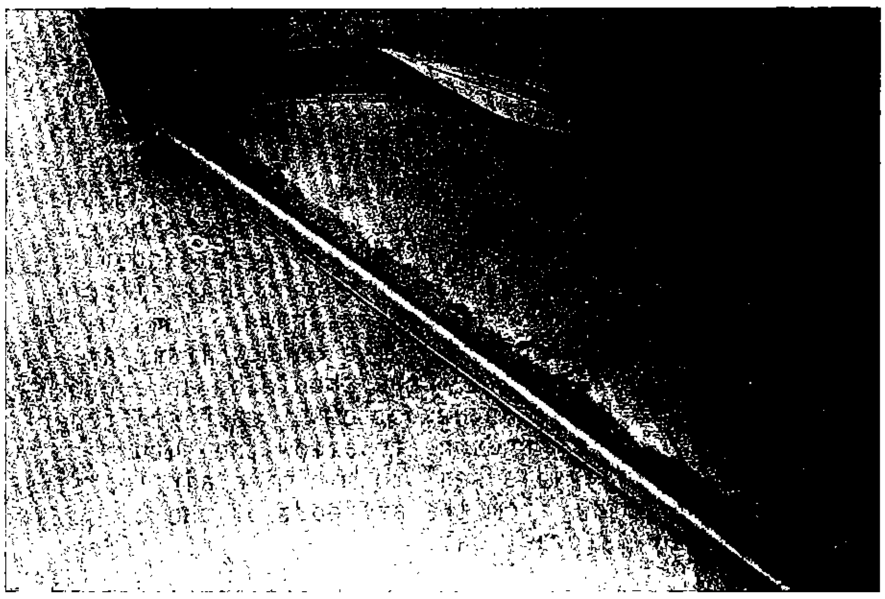
To join each stiffener to the canopy frame, use a 2 BID wrap-around lamination from the inside skin of the frame to the outside skin of the frame, with an overlap onto the frame of a minimum of 0.7". Grey tape may be used as shown to provide a cleaner edge for trimming later. Flox is used where the stiffener meets the frame.

The third stiffener is placed transversely at the aft canopy bulkhead. Ideally, this third stiffener should rest on the top of each side stiffener, and on the bottom of the aft canopy bulkhead. If necessary, a small piece of foam can be used to accomplish this. This third stiffener is likewise attached with flox and 2 BID tapes in a wrap-around configuration.

When completed, these stiffeners will form a very rigid box around the canopy frame to stiffen up the entire assembly considerably, as well as provide hard mounting points for the hinges, pins, latches, etc.



SIDE VIEW



CANOPY HINGE INSTALLATION

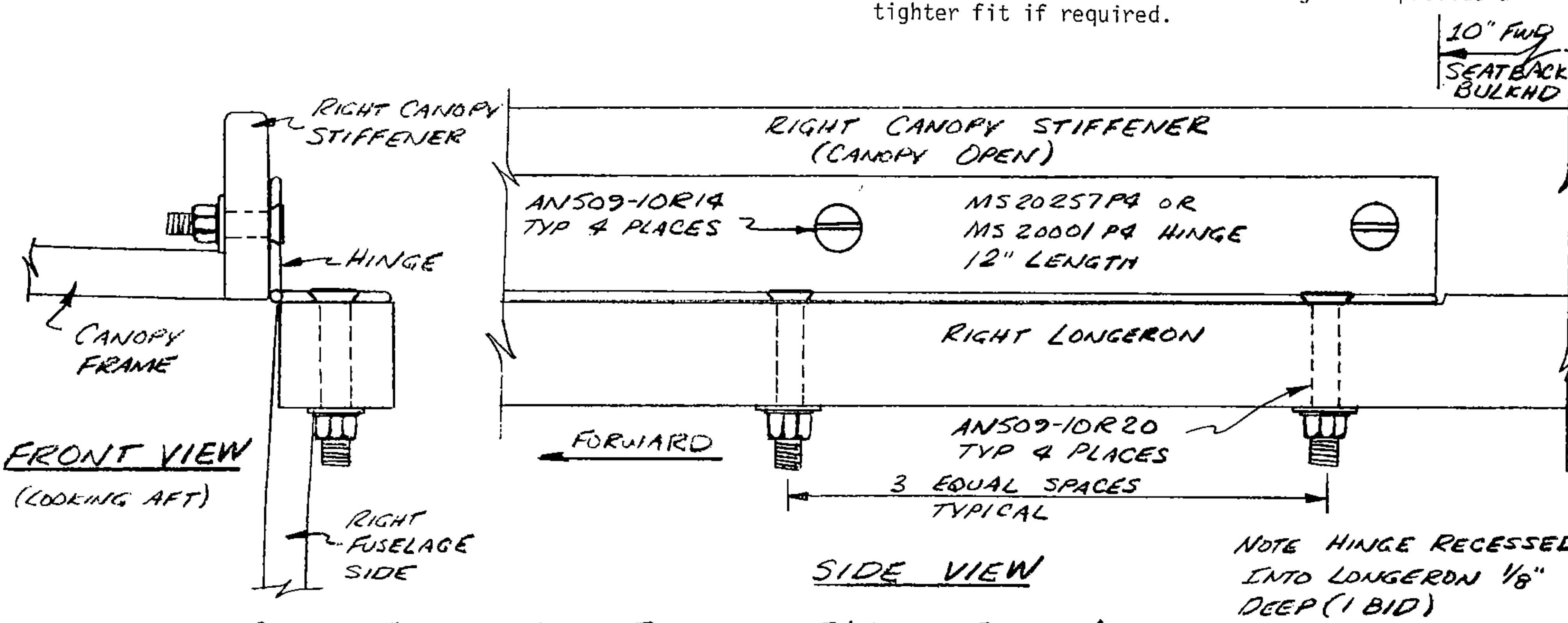
The canopy is hinged on the right side of the aircraft with one 12" length of MS20257P4 hinge. (Or alternative MS20001P4 hinge).

The accompanying drawings give the details of the attachment. Note that recessing of the hinge into the longeron is necessary to provide clearance.

Because the longeron line is curved, it is important to remember that the hinge must be oriented to provide the best compromise for opening and closing of the canopy. Some trimming of both the fuselage outboard skin and canopy frame outboard skin may be necessary to provide clearance for opening of the canopy.

The hinge is nominally located half way along the stiffener. If you have used foam to make the stiffener core, you will need to make and install some plywood inserts wherever the bolts are installed.

The alternative MS20001P4 hinge will provide a tighter fit if required.



CANOPY HINGE INSTALLATION

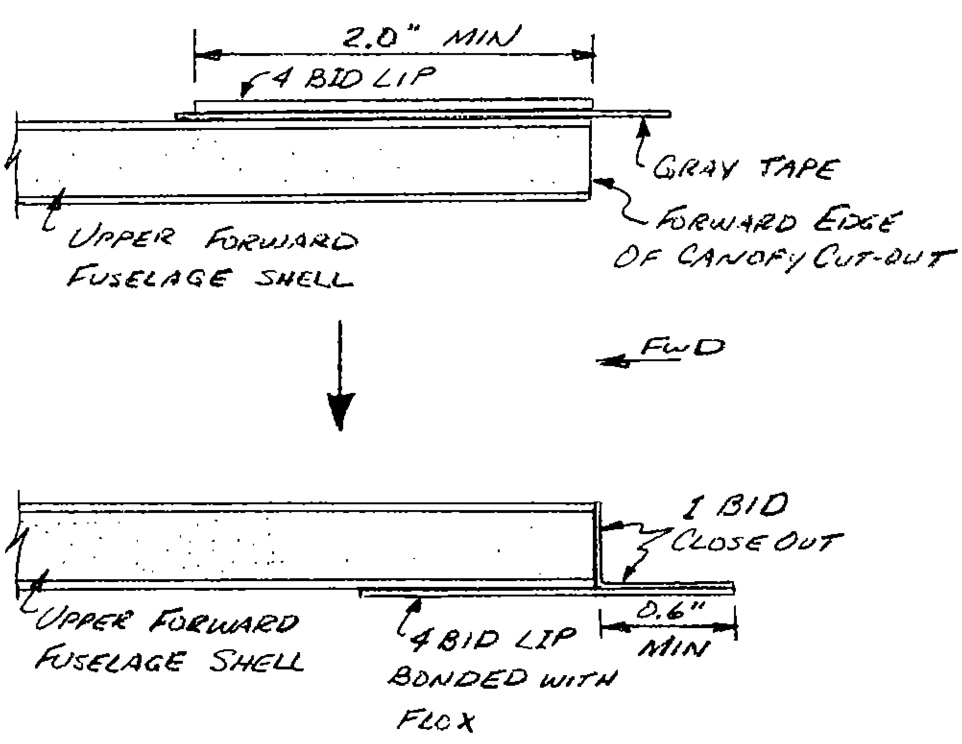
FORWARD CANOPY LIP

In order to provide a secure seal at the forward edge of the canopy frame, a fiberglass lip is fabricated from 4 BID and bonded to the inside of the upper forward fuselage shell as shown.

Since the forward edge of the canopy frame is curved, when viewed from above, the lip will also be curved.

To construct the lip, place some gray tape around the canopy frame cutout on the upper forward fuselage to protect the structure. Next, laminate 4 BID around the cutout with a minimum width of 2". Multiple pieces may be used to make the required curvature.

When the piece is cured, remove it and the grey tape, and bond it to the inside fuselage skin, At least 0.6" must project aft from the cutout to provide the lip. A 1 BID closeout ply is laminated to cover the exposed foam edge of the shell lapping onto the lip, and knife trimmed even with the outside skin of the shell.



FORWARD CANOPY LIP

CANOPY LATCH

The canopy latch is installed on the left side of the cockpit midway along the left stiffener.

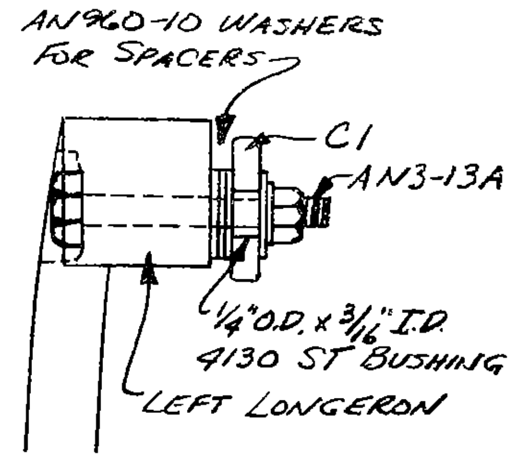
Find C1 and C2. Make C3.

Install C1 on the longeron. Next, take C3, a batch of Bondo, and climb into the cockpit. Close the canopy, and position C3 on the left canopy stiffener to match the position of C1, as shown. Hold C3 in position until the Bondo hardens, then gently open the canopy and drill in C3 as shown. It may be necessary to recess C3 into the canopy stiffener, depending on the location of C1.

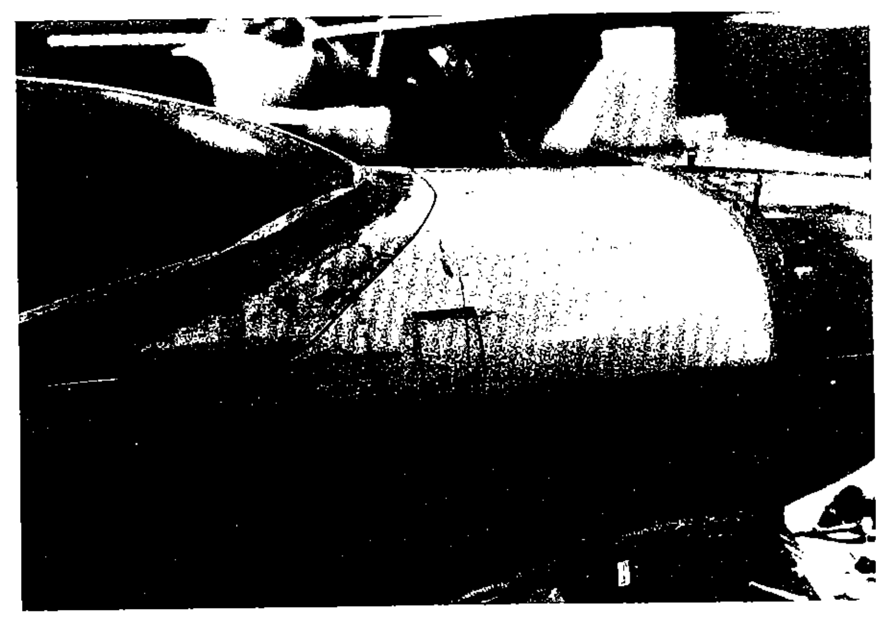
Climb back inside the cockpit, close the canopy, and Bondo C2 into position so that the canopy is clamped down tight when the AN525-10R10 screw is slipped into the hole in C2. Drill in C2 while inside the cockpit.

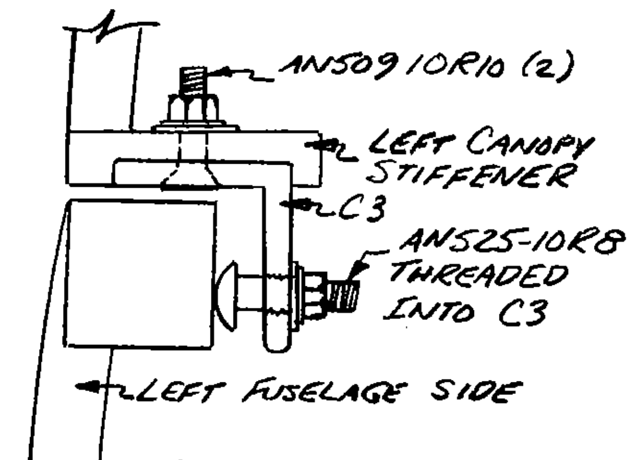
The canopy latch is very important. With some foam sealing material with adhesive backing in place around the canopy area on the fuselage, the latch should be adjusted so that the handle must be forced into the closed position. (Latch and handle rigged to preload toward each other.) In this fashion, it is impossible to inadvertently open the canopy by bumping against the handle. If you omit the foam seal, the canopy can rattle and wear the engaging surface of C1.

The macrame bead is available from nearly any variety store. The foam seal material recommended is MD Foam Tape of size 3/8" thick by 1/2" wide made by the Macklanburg-Duncaun company of Oklahoma City, OK., available at most hardware stores.

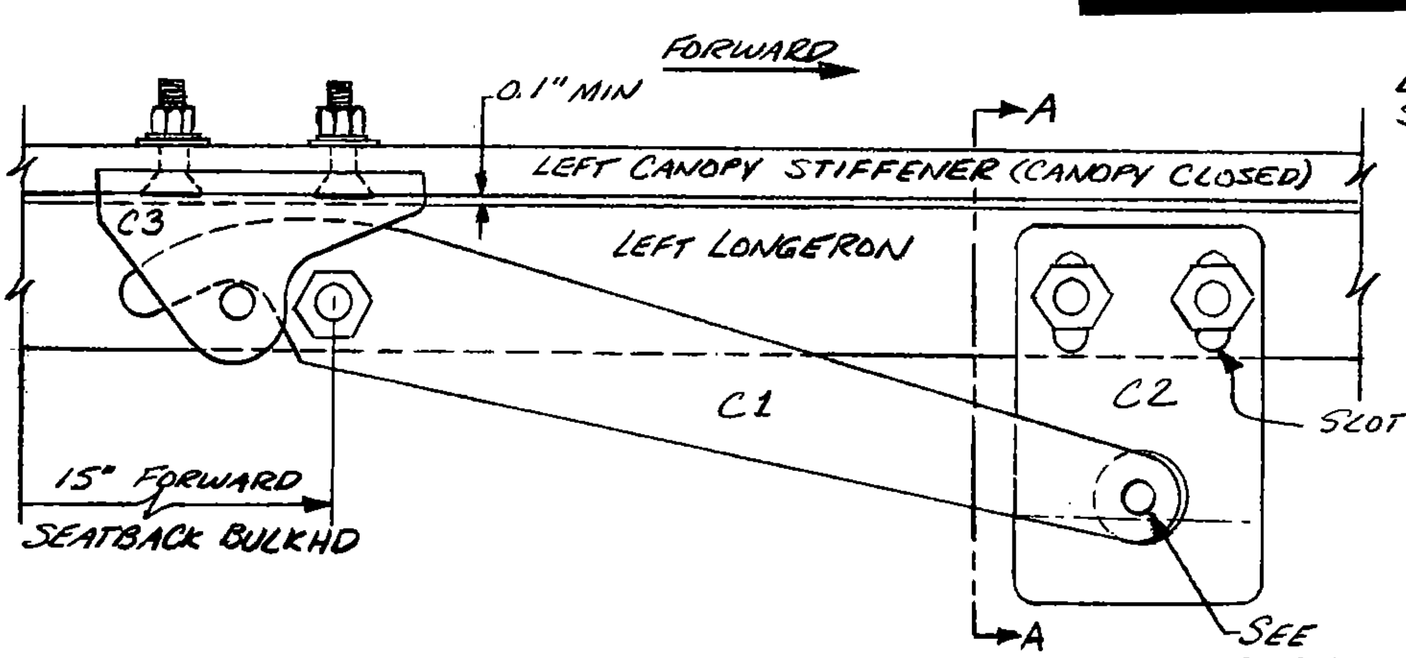


C1 INSTALLATION
(LOOKING FORWARD)

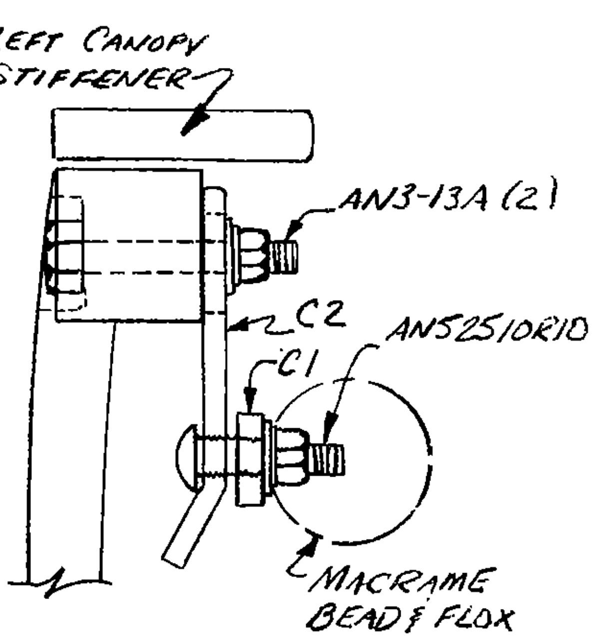




C3 INSTALLATION
(LOOKING FORWARD)



CANOPY LATCH INSTALLATION



VIEW A-A

CANOPY GUIDE PINS

To maintain the canopy in position, and to increase the fuselage stiffness in flight, canopy guide pins are installed at both the front of the canopy and the rear of the canopy.

Begin by cutting the heads and shanks (the threaded part) off of two AN3-12A bolts. Next, round one end of each.

Drill a hole through the left canopy stiffener within three inches of both the forward end and aft end of the left canopy stiffener. Permanently mount the square end of the bolt into the stiffener with flox.

When the flox has cured, mark the location on the left longeron where each cutoff bolt contacts the longeron upon closing. Drill a 5/16" hole at each location, grease up the bolt and surrounding area with vaseline, fill the hole with flox, and close the canopy. Be very careful that the flox squeezeout does not permanently close the canopy!

When the flox has cured, open the canopy and clean up any rough edges.

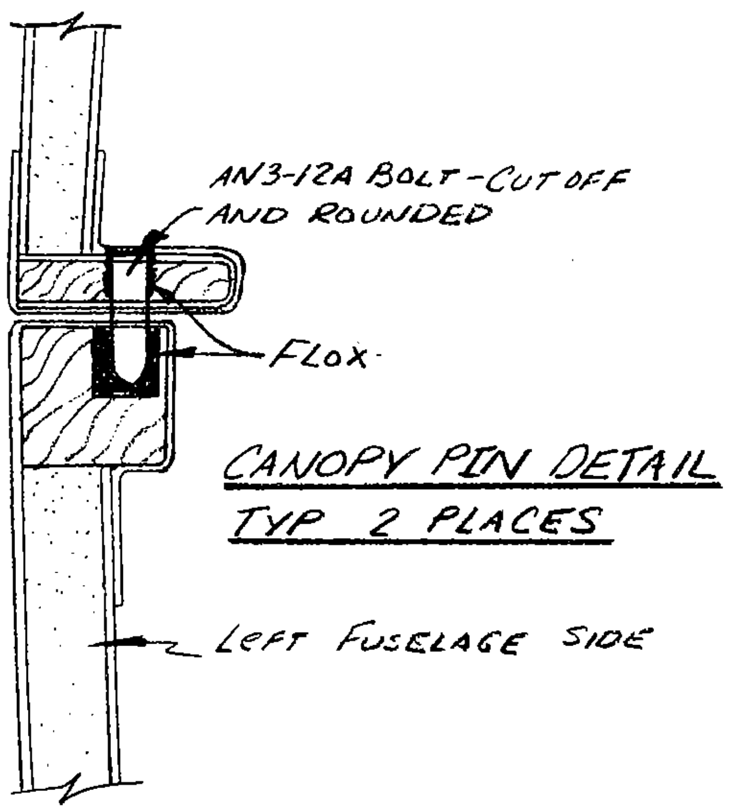
AFT CANOPY SEAL

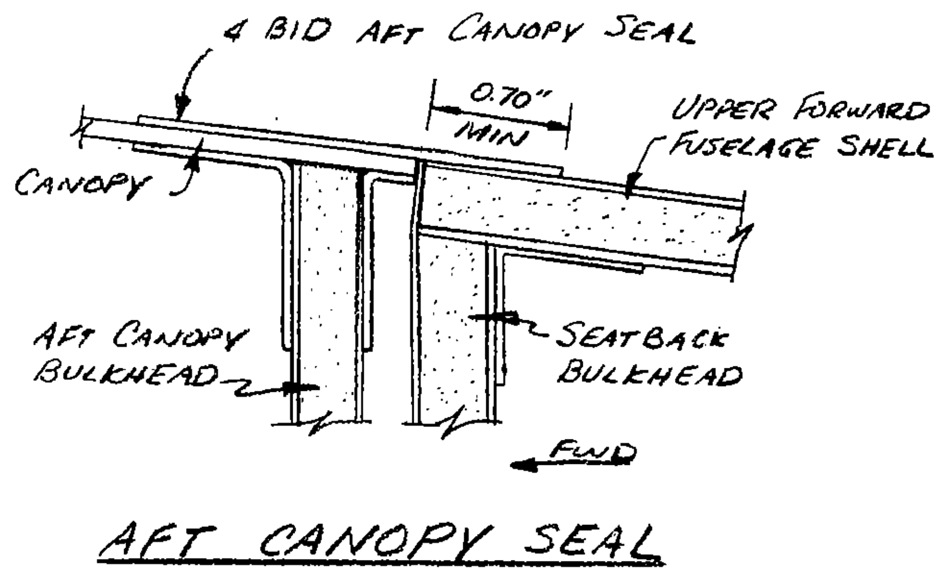
The aft canopy seal can only be fabricated and installed after the canopy/canopy frame assembly has been carefully fitted to the fuselage, with the hinges, latches, and pins in position.

With the canopy in the closed position, place some grey tape along the outside fuselage skin at the seatback bulkhead location. This will protect the structure.

Next, laminate a 4 BID seal around the aft canopy only. This lamination should extend aft along the fuselage shell a minimum of 0.7", and should extend forward along the top of the canopy to match the inside lamination that attached the aft canopy bulkhead to the canopy. Grey tape is used to protect the plexiglass and to provide a trim edge.

After cure, remove the grey tape, and trim the sides of the seal as required to allow the canopy to open properly.





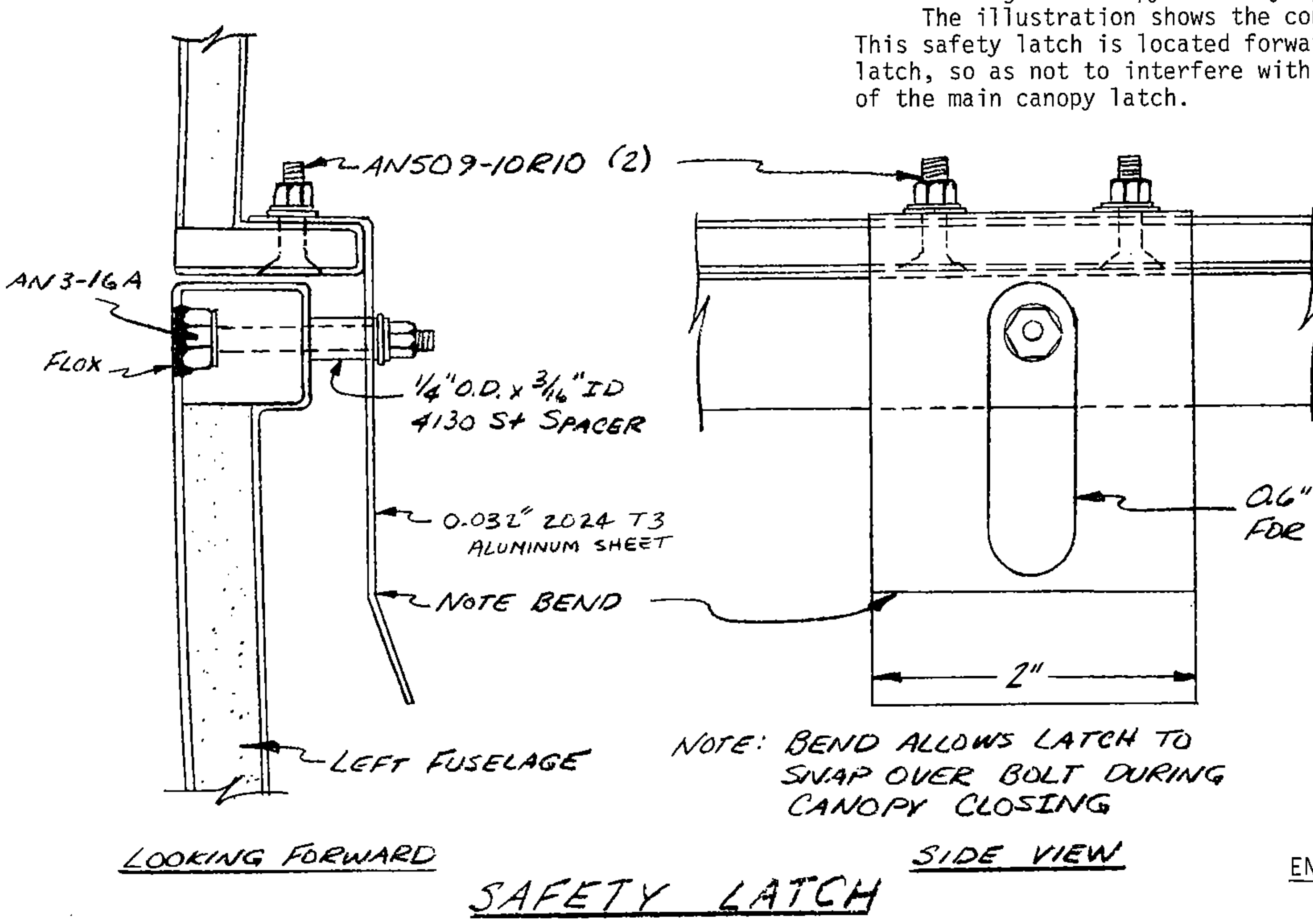
SAFETY LATCH

Failure to properly secure the canopy latch prior to takeoff will allow the canopy to open in flight. The flight characteristics of the Q2 with a partially open canopy have not been explored. A safety latch is assembled to prevent this potentially lethal situation from developing.

Make sure that you install this safety latch, even if you think that "It won't happen to me".

This safety latch catches the canopy in case the pilot forgets to latch the main canopy latch prior to takeoff. To open the canopy, raise the canopy 2" and push in on the safety latch, thus releasing the latch and allowing the canopy to fully open.

The illustration shows the construction procedures. This safety latch is located forward of the main canopy latch, so as not to interfere with normal operation of the main canopy latch.



END OF CHAPTER

FUSELAGE DETAIL ASSEMBLY

WRAPPING THE TAILSPRING

The tailspring provided is a molded S-Glass roving tailspring with extremely good bending strength along the length. Because of the production method, however, the tailspring does not yet have sufficient strength torsionally, to provent torquing up in a tight taxi turn.

To provide this torsional strength you must wrap a piece of BID at 45 degrees to the length of the tail-spring, around the tailspring until you obtain 3 layers of the BID. Needless to say, you will prepare the tailspring by sanding the surface. Pure epoxy is used for the lamination.

MOUNTING THE VERTICAL FIN

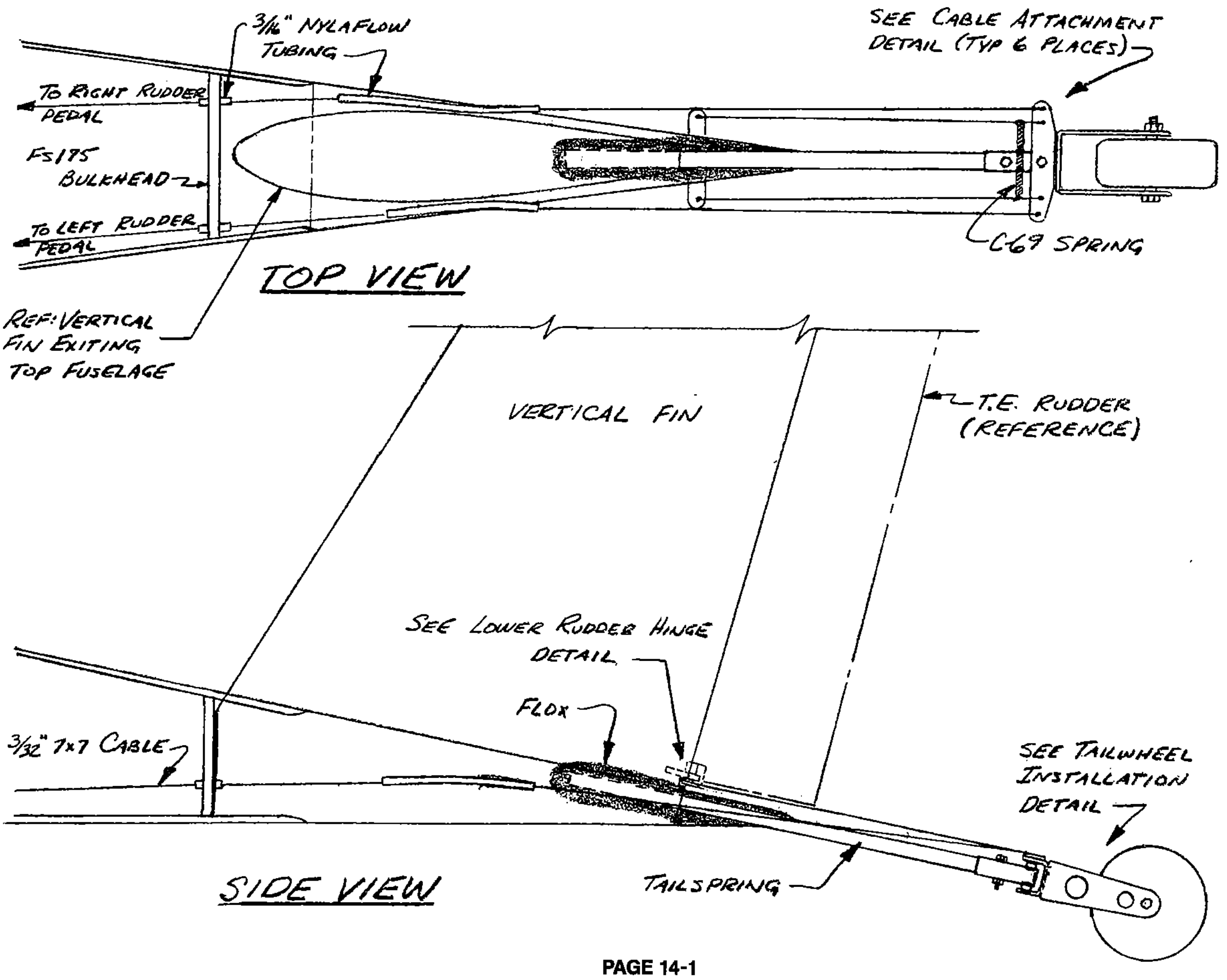
The vertical fin is mounted to the fuselage only after the rear fuselage shells are bonded together.

The vertical fin sets down into the fuselage with the vertical fin root end resting against the bottom of the fuselage. This necessitates considerable trim-ming of the top fuselage to permit the vertical fin to drop down through. Also, the nose of the vertical fin below the top fuselage is trimmed back so that the vertical fin will rest flush against the bulkhead. Trim slowly so as to avoid making a bigger hole than necessary. The general arrangement drawing included here gives the mounting arrangement. The vertical fin slot is located approximately 5" forward of the tail of the fuselage, so that the nose of the vertical fin can fit snugly against that bulkhead.

Use a plumb bob hanging from the trailing edge of the top of the vertical fin, with the fuselage levelled laterally, to verify that the vertical fin is positioned vertically. Your eyeball from a distance is used for a second check.

When the vertical fin fits into the fuselage properly, you are then ready to prepare for mounting the tailspring. The core foam on the vertical fin is hollowed out as shown, so that the tailspring can slide forward from the aft end of the fuselage. The aft fuselage may have to be trimmed forward until the width is 0.75" MIN, which is needed for the tailspring to slip through. The bottom fuselage can be slotted as shown to insert the tailspring. Do not worry about removing excess foam as you tunnel through the vertical fin core. It is necessary to have a minimum of 0.8" of space in all directions around the tailspring in preparation for mounting. Allow approx-imately 9" of tailspring length to protrude aft of the end of the fuselage.

The vertical fin core foam is not dense enough to withstand the tailspring loads. Therefore, when you are ready to insert the tailspring permanently into position, you will mix up a substantial quantity of flox to fill the hole first, so that when the tail-spring is inserted, generous squeeze-out will result. Remember, at least 0.8" of flox must be around the tailspring to spread the loads. Note from the drawing that the flox completely fills the fuselage aft of the vertical fin. Before the flox has an opportunity to set up, verify that the tailspring will cure with its length parallel to the aft top fuselage line, and that it is not crooked laterally.



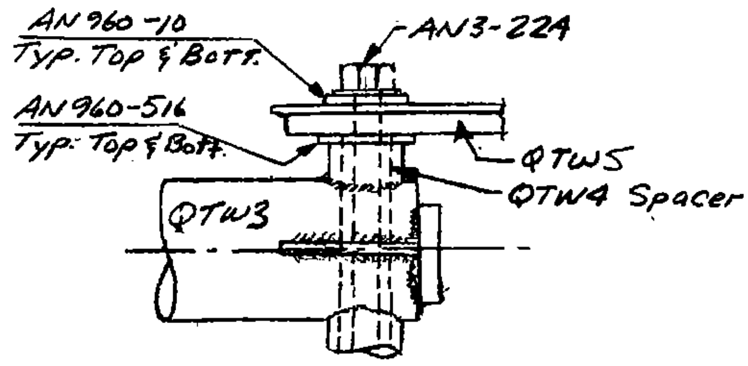
TAILWHEEL INSTALLATION

Once the tailspring has been installed in the fuselage permanently, then you are ready to install the tailwheel.

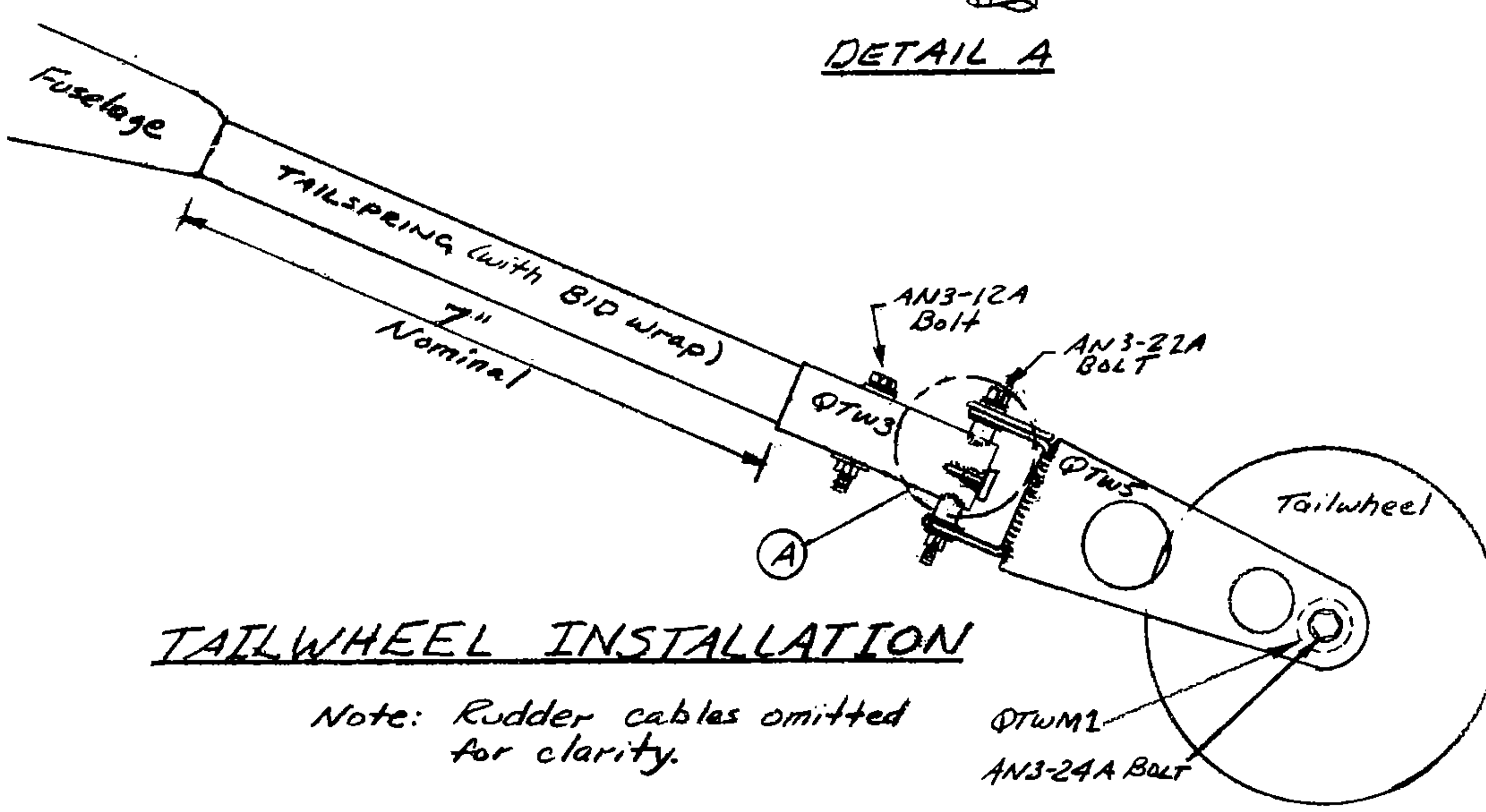
Locate the following parts: QTW3, QTW4, QTW5, QTWM1, and the tailwheel. Insert the QTW4 spacer into the QTW3 weldment as shown. Trial fit QTW5 to the QTW3 assembly with a AN3-21A bolt. It may be necessary to sand QTW3 in order to allow a small amount of vertical freeplay between QTW3 and QTW5. Once all the parts fit together smoothly, assemble as shown.

Next, mount the tailwheel to the QTW5 fork as shown, using the QTWM1 axle and AN3-24A bolt.

The next task is to mount the entire tailwheel assembly to the tailspring. Start by leveling the fuselage laterally, and then trial fit QTW3 onto the end of the tailspring. Trim the tailspring if necessary to permit QTW3 to fit, or to obtain the nominal 7" length from the forward edge of QTW3 to the fuselage. Drill in the single AN3-12A bolt holding QTW3 to the tailspring after making sure that the vertical face of the tailwheel is indeed vertical. (Otherwise the tailwheel will wear unevenly). To mount the Tailwheel assembly permanently to the tailspring, mix up some flox and obtain good squeeze out of the flox upon assembly of QTW3 to the tailspring.



DETAIL A



TAILWHEEL INSTALLATION

Note: Rudder cables omitted for clarity.

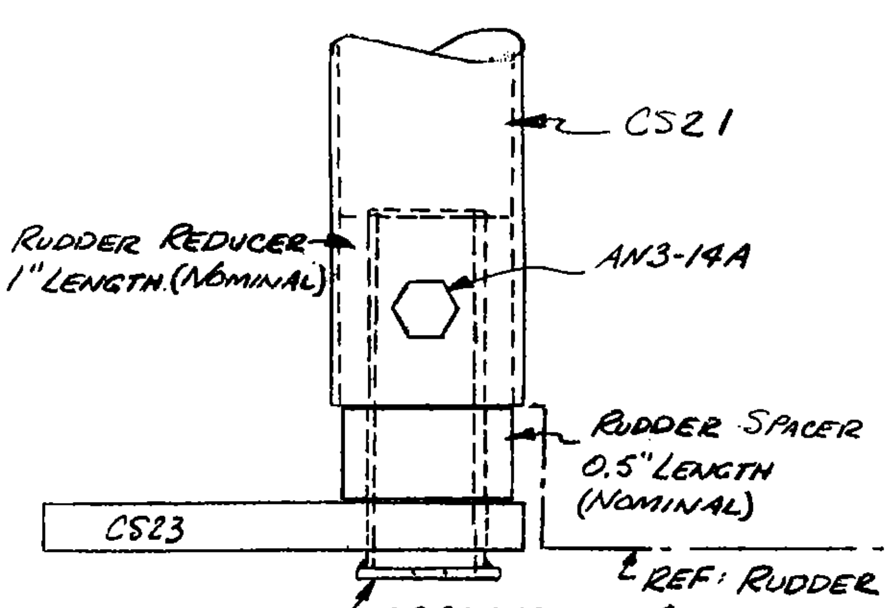
RUDDER INSTALLATION

The rudder hinge assemblies are very similar to those of the ailerons, so review the section on mounting the ailerons before proceeding further.

The upper rudder hinge consists of the CS22 plywood mount, which is bonded to the vertical fin core, and the same hardware and fittings called out in the Main Wing chapter section on 'Outboard Aileron Pivot Assembly', so follow those directions.

The lower rudder hinge is detailed in the accompanying sketch. The QCSM1 material is used for a 1.0" length rudder reducer and a 0.5" length for a rudder spacer. The rudder reducer is pushed into the CS21 rudder torque tube. CS23 is the lower rudder phenolic bearing. CS23 is bonded to the vertical fin foam core with liberal quantities of flox generating good squeeze out. Q2CSA10 is the rudder bellcrank, which is attached to CS21 with a AN3-14A bolt.

Assembly is performed by trial and error fitting of the rudder, complete with all pivots, to the vertical fin until a satisfactory fit is obtained. The clearance on either side of the vertical fin slot should not be less than 0.06". The rudder should be trimmed top and bottom so that a minimum gap between the fuselage and rudder, and between the rudder top and vertical fin exists. When everything is ready, mix up flox and also some 5-MIN and jig the rudder into place and permit it to cure. Stirring sticks and some scrap lumber can be used to hold the rudder in position.



LOWER RUDDER HINGE

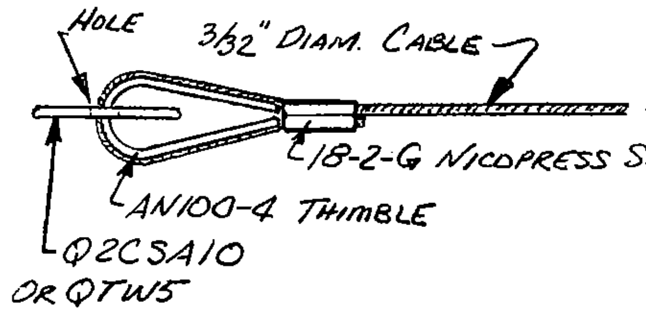
RIGGING THE RUDDER/TAILWHEEL CABLE

The sketch on page 14-1 shows the cable layout to actuate the tailwheel and rudder. Note that from the rudder pedals, the 3/32" cable travels aft through 3/16" Nylaflow tubing fairleads at each bulkhead, exits the fuselage about 10" forward of the tail of the aircraft, and then goes directly to the tailwheel weldment, QTW5, where it is attached to the outboard hole using a thimble and nicopress sleeve attachment. The inboard holes on QTW5 are used to attach cable (using the same type of attachment) that runs forward to Q2CSA10, the rudder bellcrank, where the cable is attached with another thimble and nicopress sleeve arrangement. The left and right sides are mirror images. The C-69 spring is used between the cables traveling to the rudder, to provide tension on the cables at all times.

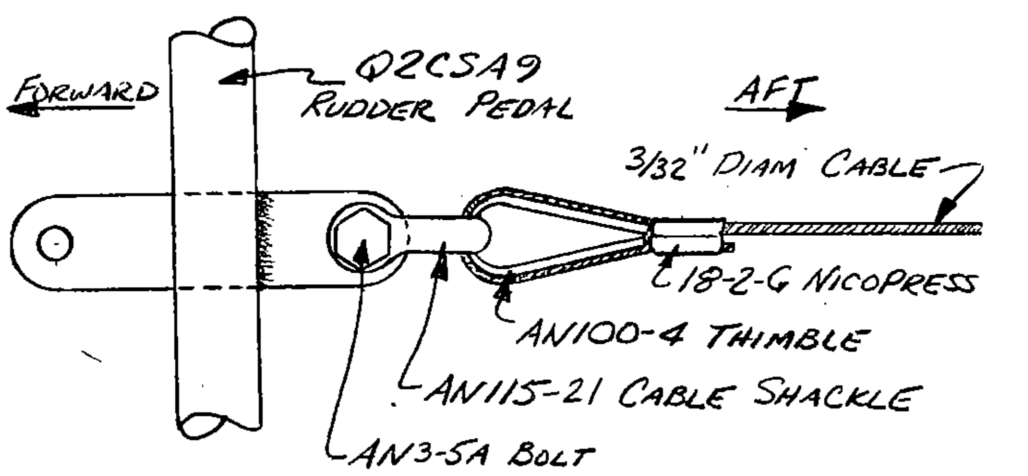
Cable attachments should be accomplished with no weight on the tailwheel, and with the rudder and tailwheel in the neutral position. (Use the rudder rigging template.) It is recommended that the QTW5-Q2CSA10 hookup be accomplished first. Those cables must be as tight as practical. Then, hookup the rudder cables to the outboard holes of QTW5. Since there will be a quick disconnect later at the fuselage cut point, just cut enough cable to reach the fuselage cut point. The stop on QTW5 may need to be modified by filing it back in order to reach the limits of rudder travel indicated on the rudder rigging template.

RIGGING THE RUDDER PEDAL CABLE

The 3/32" cable is attached to the rudder pedal using a cable shackle, thimble and nicopress sleeve, as shown. You may wish to wait until after the quick disconnect fittings are assembled at the fuselage cut point, in order to better set up the angle of the rudder pedals.



CABLE ATTACHMENT
(TYP 6 PLACES ON QTW5 & Q2CSA10)



RUDDER PEDAL ATTACHMENT
(TYP 2 PLACES)

MAIN FUEL TANK INSTALLATION

Once installed, the main fuel tank also serves as a support for the legs of the pilot and passenger. The geometry of the tank was, therefore, laid out to provide not only fuel volume, but also adequate support.

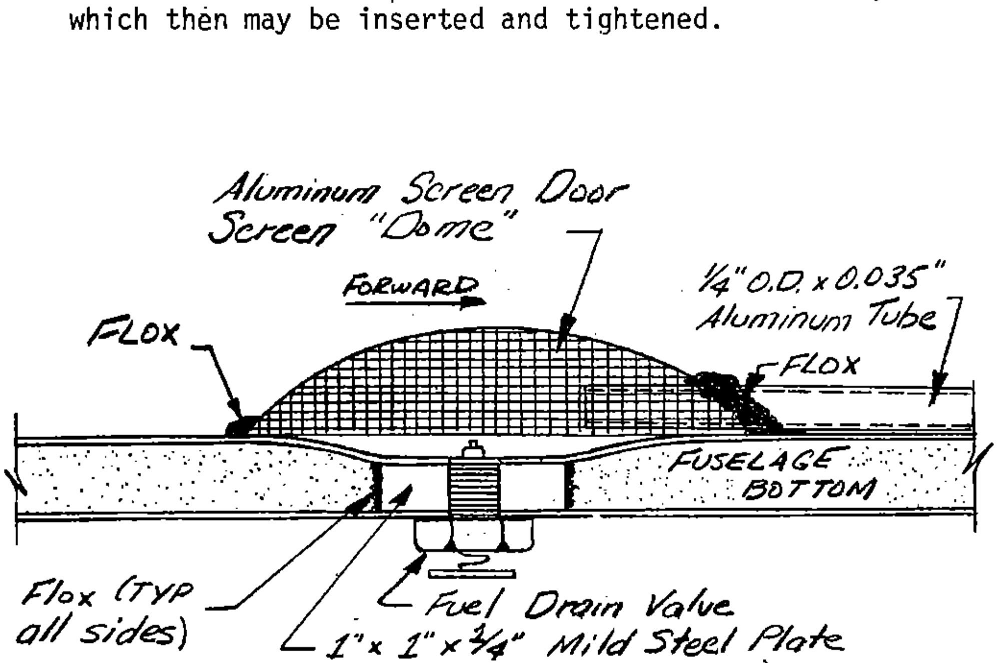
A fuel drain valve must first be installed in the bottom fuselage at the approximate low point of the fuel as part of the normal preflight checklist.

Begin by locating FS45 at BL00. Draw a 2" diameter circle around that point and contour a depression in the center of the circle that is 1" square and results in a foam thickness of 1/4". A toothpick is useful for gauging depth. Make a smooth transition around the area.

Bond in with Flox the 1" x 1" x 1/4" mild steel plate and then laminate 2 BID over the entire depression overlapping a minimum of 1" onto the inside bottom fuselage skin.

Once that lamination has cured, make a 'dome' from some aluminum screen door screen that covers about a 2.5" diameter circle, and attach the dome to the bottom fuselage over the depression with flox all around the perimeter.

From underneath the fuselage, tap a 1/8" NPT hole into the mild steel plate for the fuel drain valve, which then may be inserted and tightened.



Finally, find a piece of Versatube Aluminum tubing of 1/4" O.D. and 20" in length and locate it as shown. The tubing pierces the aluminum screen and points forward, being afixed with liberal quantities of flox at the junction with the screen. Be careful not to flex the tubing unnecessarily to prevent fatigue of the tubing.

The fuel tank must be trimmed to fit your fuselage. Refer back to the chapter on Basic Fuselage Assembly for a sketch showing the fuel tank positioning. The leading edge of the fuel tank is nominally at FS36.1; the trailing edge should be at about FS58.1 in order to provide a nominal 6 inches of clearance between the fuel tank and the Seatback Bulkhead. You will find that the sides of the fuel tank need to be trimmed back to allow the fuel tank to sit down against the fuselage bottom. Verify that the elevator control rod CS13 does not interfere with the top of the main fuel tank as it runs forward to the elevator by skipping ahead in this chapter. If it does, you must trim down the height of the main fuel tank to clear by a minimum of 3/8", or laminate a slot into the fuel tank for this CS13 clearance.

Baffles are used to prevent excessive sloshing of the fuel within the tank, as well as to increase the stiffness of the fuel tank so that it may be stepped on during entry and exit from the aircraft.

Three baffles are used; one spanwise baffle about 18" wide, and two longitudinal baffles that extend from the landing edge of the fuel tank to within 4 inches of the trailing edge of the fuel tank. The sketches illustrate positioning and size. Note that openings are left regularly along the baffles to allow fuel to move back and forth slowly. Particularly note the opening at the top which is part of the venting system. Those openings should be about 2 inches in length and about 1" in height, and need not be accurately shaped.

The baffles are fitted using trial and error until they fit both against the fuel tank and also against the fuselage bottom when the tank is inserted into place. Each baffle should have 1 BID on each side, and the 1/4" thick white foam is used for the core material. Once each baffle is properly trimmed, it should be mounted permanently to the fuel tank with micro and a BID tape on either side with a minimum 1" lapping onto each surface. Upon installation of the fuel tank permanently to the fuselage, these baffles will be coated liberally with flox so that they bond to the fuselage bottom.

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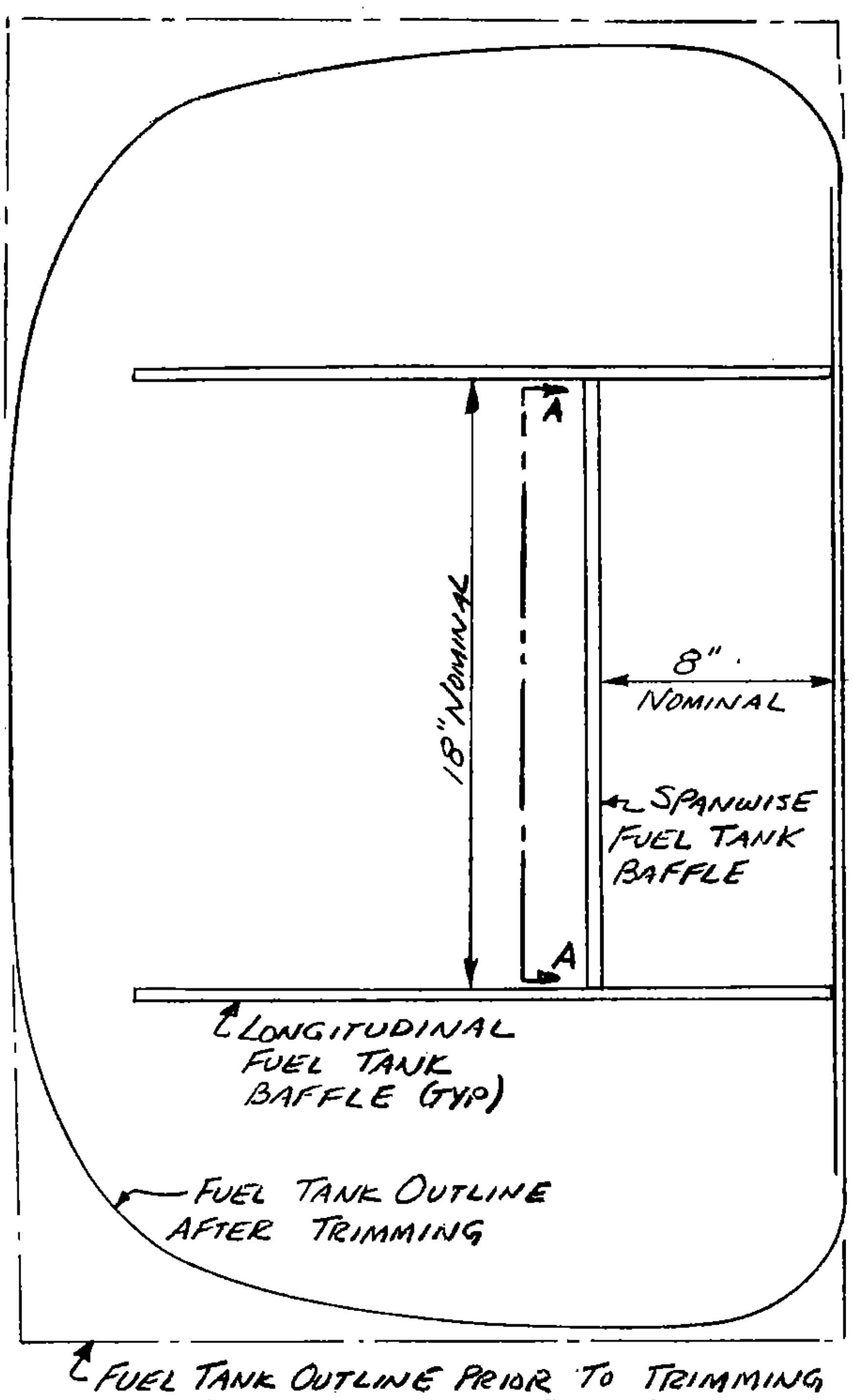
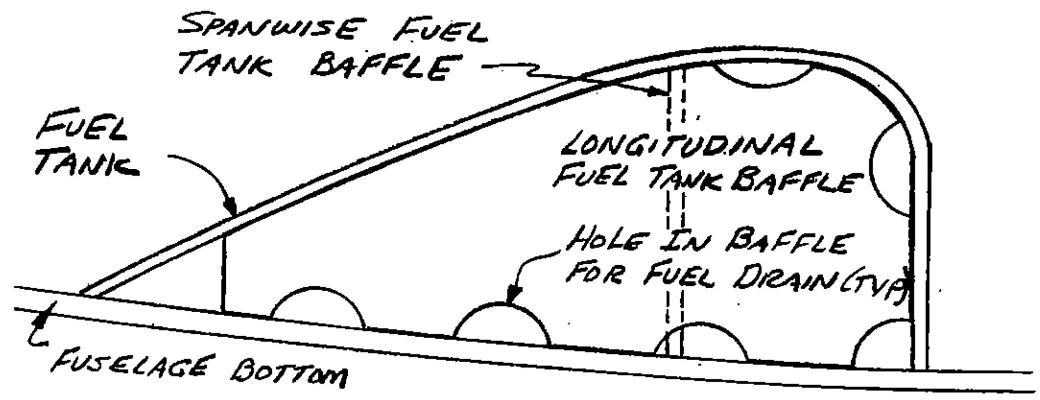
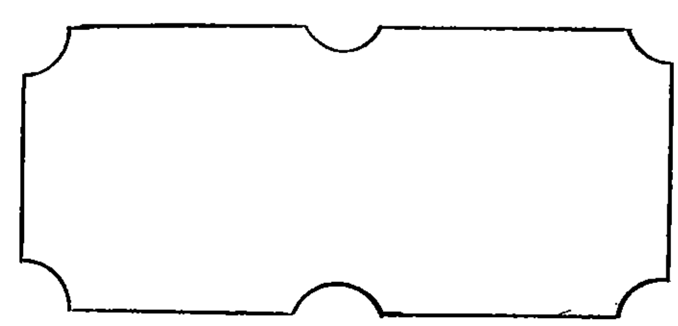


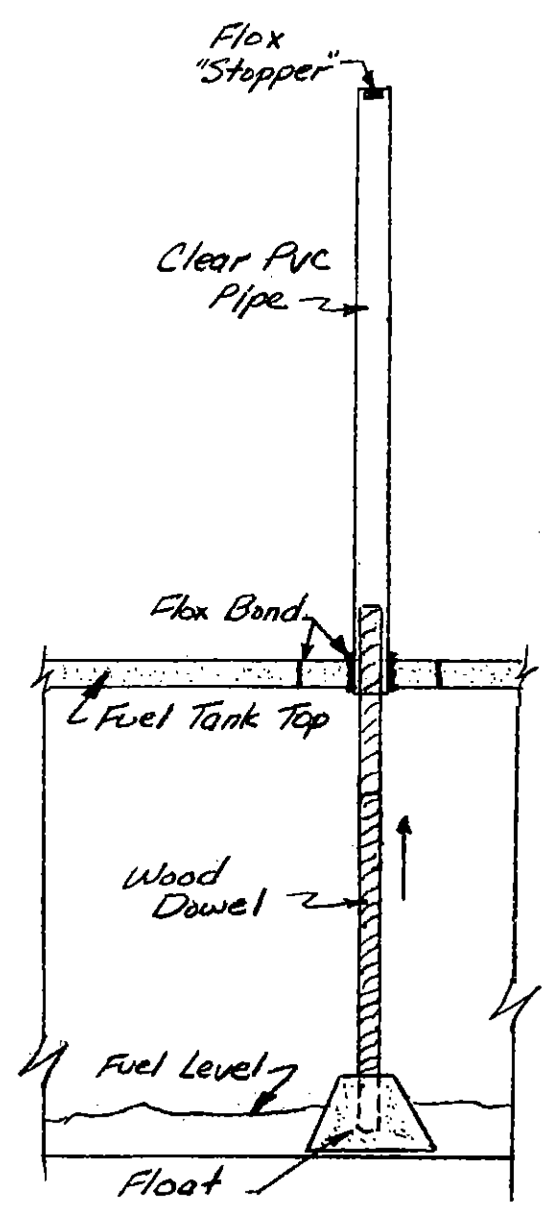
FUEL TANK TOP VIEW



FUEL TANK
(SIDE VIEW)



SPANWISE FUEL TANK BAFFLE
VIEW A-A



FUEL GUAGE
INSTALLATION

The fuel gauge consists of a direct reading float type mounted near the centerline of the aircraft. Before installing the guage permanently, you should make sure that it will not interfere with the elevator control rod CS13 which runs from the control stick to elevators.

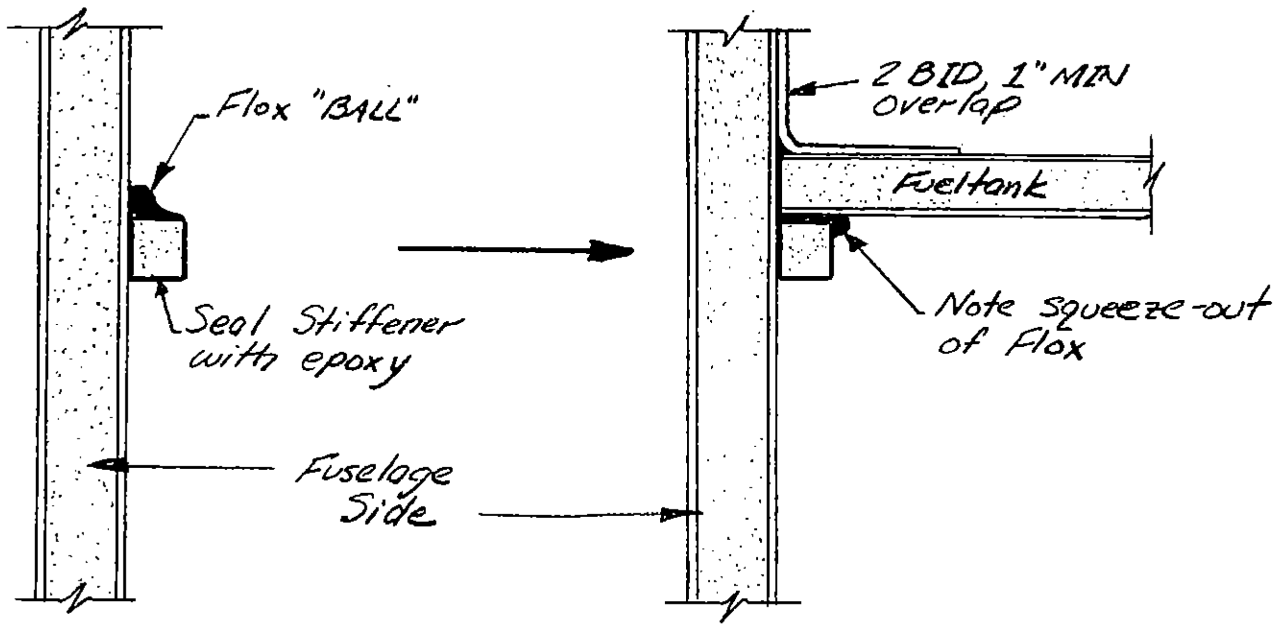
A length of 1/4" wood dowel obtained from a hardware store is bonded with epoxy into a carved urethane foam float nominally 1" diameter by 1.25" high. This float assembly will float up and down with the fuel level. It rides inside a clear PVC pipe tube that you will calibrate with marks showing fuel quantity. Some points to remember are that the wood dowel should extend about 1.5" above the top of the main fuel tank, that the length of the clear PVC pipe is governed by the travel of the wood dowel, and that the float assembly should be fitted to the fuel tank prior to mounting the fuel tank in the fuselage permanently.

CONTINUED ON NEXT PAGE

In order to provide a leakproof seal around the main fuel tank after installation, small stiffeners are placed along the fuselage sides so that, when installed, the main fuel tank will set down on these stiffeners, thus assuring good squeeze out of the flox and a good seal. These stiffeners are nominally of 1/4" square cross section, and made from the thin sheets of white foam. They are positioned by dry fitting the fuel tank in place, tracing around the main fuel tank on the fuselage side, and then lowering the traced lines the thickness of the main fuel tank after removing the tank. The stiffeners are installed with flox, and allowed to cure completely prior to mounting the main fuel tank permanently. Do not be concerned at the number of seperate stiffeners required to cover the tank perimeter.

To install the main fuel tank permanently, it will first be necessary to notch the forward lower edge of the main fuel tank at BL00 so that the fuel line tubing will exit the tank there. Next, mix up both pure epoxy and flox. Paint pure epoxy liberally on all exposed areas of the stiffeners, to prevent contamination of the fuel later. Trough flox liberally on the top of the stiffeners, as well as on the fuselage bottom where the forward and aft edges of the main fuel tank will rest upon assembly. Next, trough flox around the edges of the main fuel tank that will come into contact with either the stiffeners or the fuselage.

Insert the tank in place, and verify that you have good squeeze out of the flox everywhere to assure a good seal. Wipe off the excess flox on the top side as you make a flox radius between the tank and the fuselage. Laminate 2 BID tapes with a 1" minimum overlap to join the man fuel tank to the fuselage. Liberally apply flox around the exit of the fuel line to prevent leaks.



FUEL TANK INSTALLATION

SEATBELT ATTACHMENTS

A very important safety feature of your Q2 is the individual seatbelt/shoulder harness assembly provided for each occupant. Previously, you have mounted the attachments for the shoulder harness in the main wing. In this section, you will install the mounts for the seatbelts, and, finally, install the seatbelts in your aircraft. Do all of the procedures exactly like these plans state; this section is your first line of defense in the event of a mishap.

The seatbelt mounts are installed in the fuselage between the aft edge of the fuel tank and the forward edge of the seatback bulkhead. There is one outboard seatbelt attachment on each side of the cockpit, and a double seatbelt attachment of BL00.

The outboard seatbelt attachment is straightforward and illustrated herein. A piece of 1/4" plywood about 2.2" x 1.2" is sanded to fit the fuselage contour and beveled for the lamination of 7 BID over it; between the plywood and the fuselage skin use epoxy. The 0.7" MIN overlap onto the fuselage is very important, as is making sure that the glass does not turn any sharp corners. The two holes for the AN525-416R14 screws may be drilled from the inside of the fuselage all the way through to the outside; the holes for the screws can be filled with dry micro later. The aluminum angle should be about 1.25" in length, and permit at least 3/8" from the center of each hole to the outside edge. The angle should be installed permanently, and then the hole for the AN4-5A bolt holding the seatbelt itself drilled afterwards, so that the hardware does not interfere. Note that the seatbelt pulls off at about a 45 degree angle. You may wish to sit in the aircraft and pick the optimum FS for the seatbelt fittings prior to bonding the plywood in place. The other side is a mirror image of the one illustrated.

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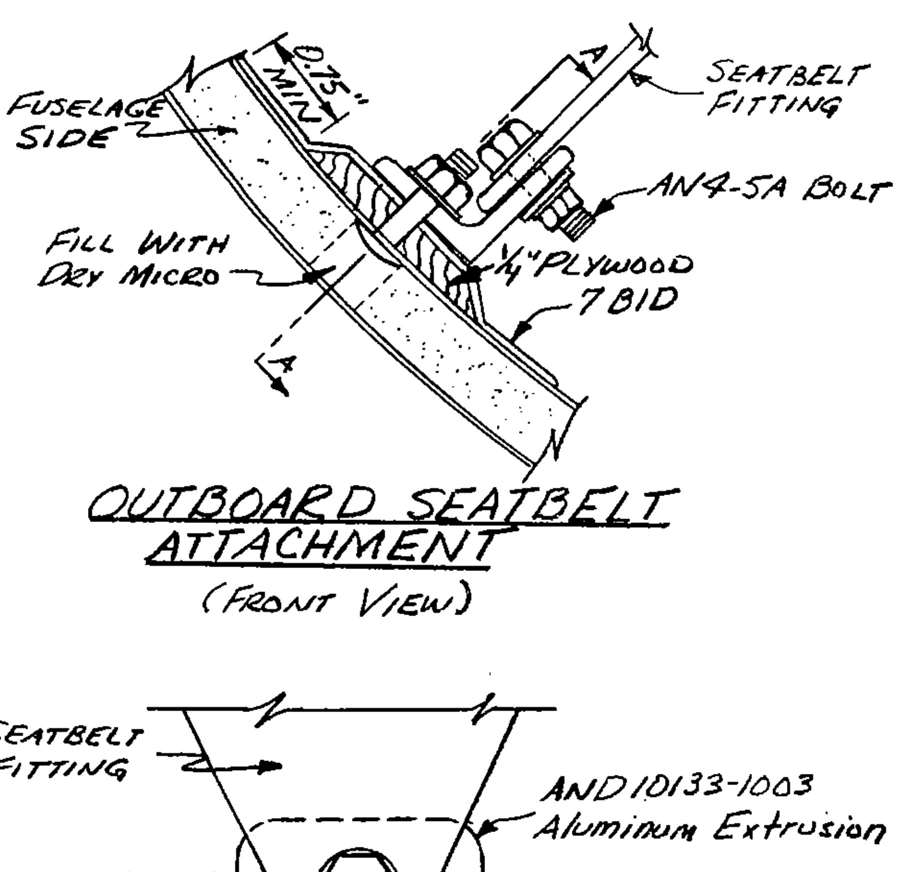
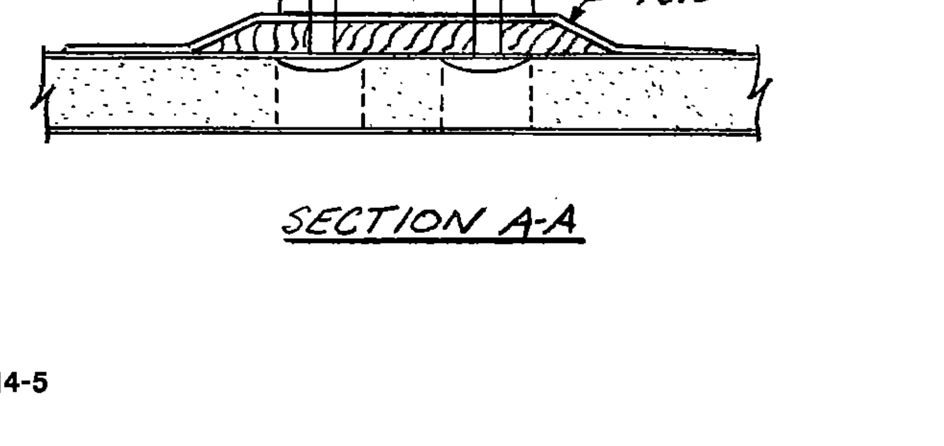
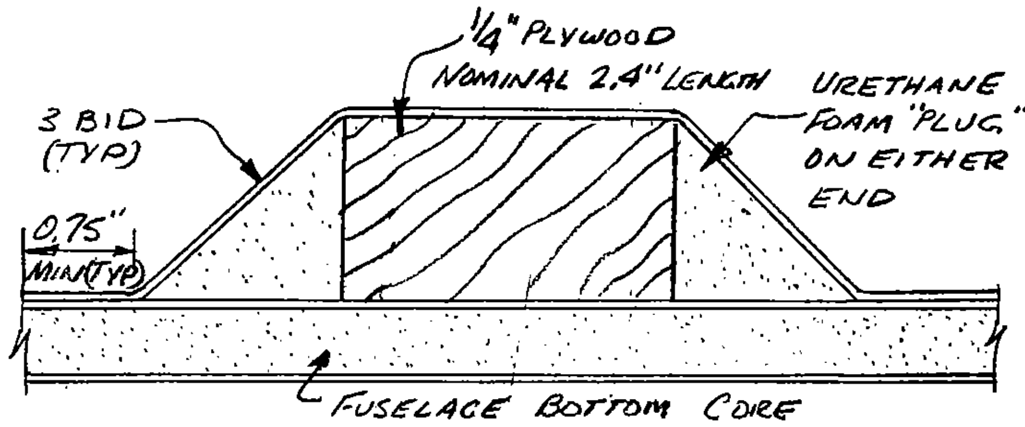


OUTBOARD SEATBELT ATTACHMENT
(FRONT VIEW)



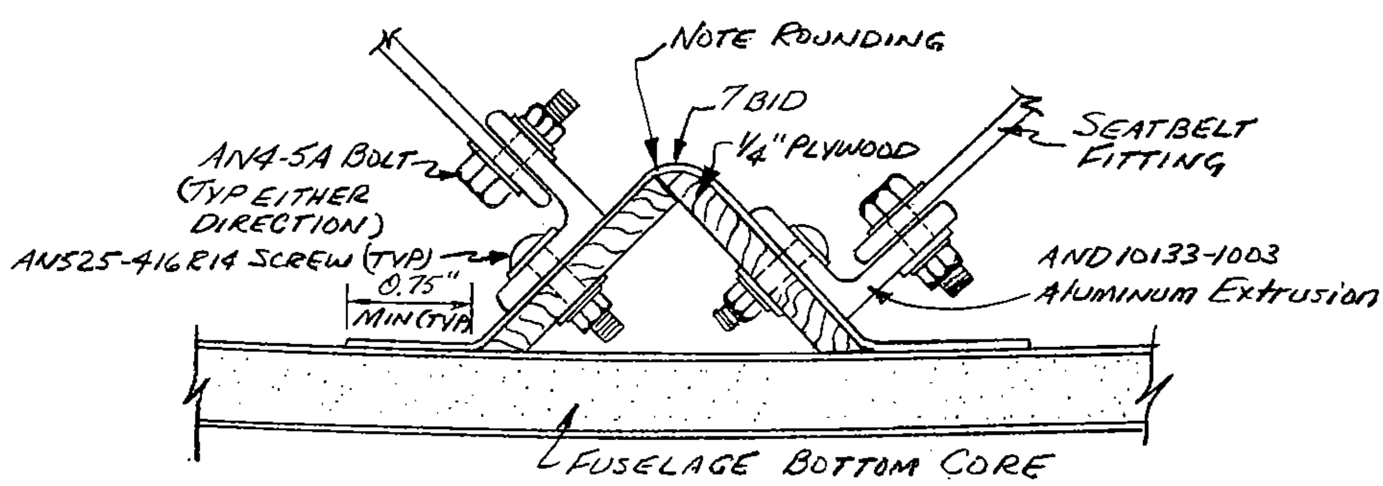
SECTION A-A

At BL00, a common attachment is used. The plywood should be about 2.4" x 1.5" and is beveled to form an A-frame arrangement, so that the aluminum extrusion can again pull off at about 45 degrees. The 7 BID is again laminated in place with the 0.75" MIN overlap onto the fuselage. Next, in order to close out the front and rear parts of the 'tent', carve some urethane for two 'plugs', one on either end; these are installed after the extrusion is permanently mounted so that the AN525-416R14 screws do not need to be accessed. The plywood was made long so that even with the extrusion in place, there will still be room to laminate 3 BID around the plugs up onto the previous 7 BID lamination with a minimum overlap. Finally, install the seatbelts themselves. The extrusion length for both inboard and outboard pieces is a nominal 1.3". When finished, this BL00 mount should be closed in, rounded, and have glass lapping onto the fuselage inside skin in the four directions.



SIDE VIEW

NOTE: HARDWARE OMITTED FOR CLARITY



INBOARD SEATBELT ATTACHMENT

(FRONT VIEW)

Now is a good time to install the shoulder harness assemblies permanently to their attachments. Since each occupant has a Y-harness arrangement from one bolt, there will need to be two slots per side placed in the seatback bulkhead to allow the actual harness to come through into the cockpit. Sit in the cockpit to determine best where these slots should be; they should be no larger than necessary, and should have a glass-to-glass bond lamination around the slots.

COCKPIT CONSOLE ASSEMBLY

Now is a good time to install your center console and the two side consoles in your fuselage. The accompanying sketches show the locations.

Lets begin with the center console, the centerline of which should be on BL00. To gain more hip room the sides may be angled toward BL00 as they go down. The top center console piece is not installed until after all of the control stick mounting and rigging has been accomplished, but it can be used "dry" to help mount the center console vertical pieces. Remember that the glassed side of those pieces is the side not visible after assembly, i.e. the side nearest BL00. Two cutouts will be necessary for the seatbelts to clear the pieces. Use flox along the bottom of each piece to attach them to the fuselage, and laminate 1 BID on the inside lapping onto the pieces and the fuselage a minimum of 1 inch. Do not glass the outside faces of the two center console vertical pieces until after the top center console piece has been permanently installed. The 'kink' is achieved with a saw cut into the foam (not glass) and beveling the foam so that the piece can angle upward.

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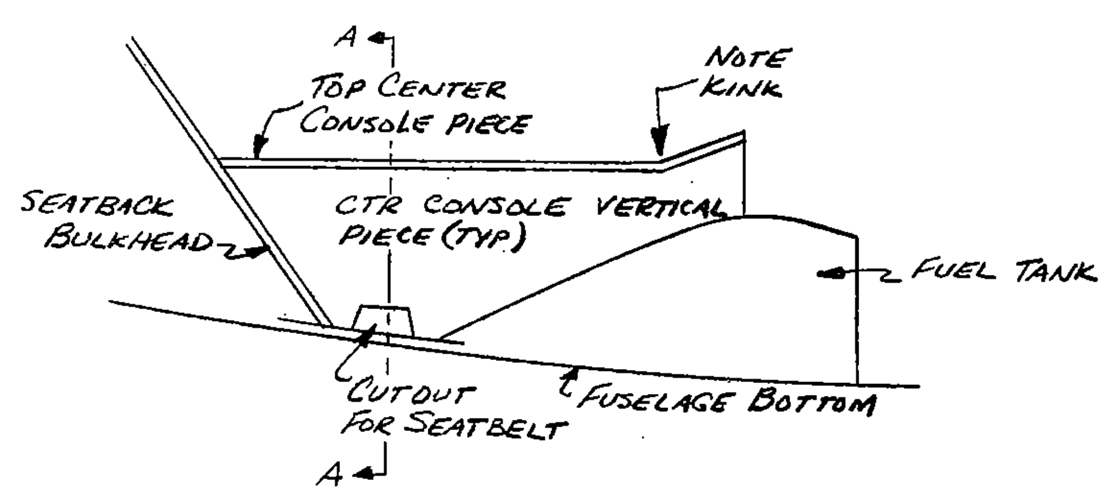
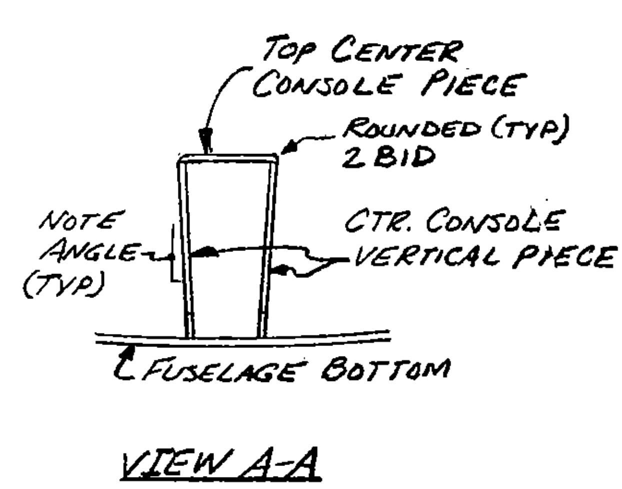


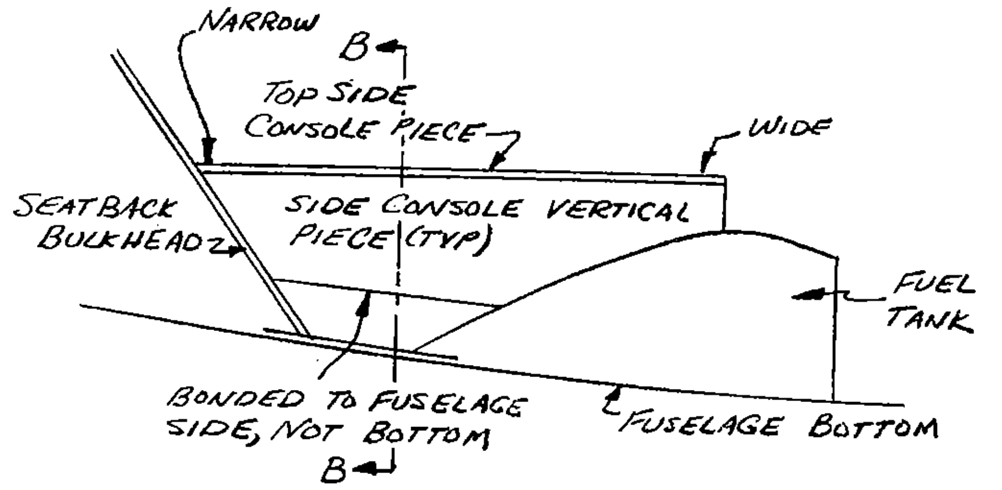
CENTER CONSOLE INSTALLATION



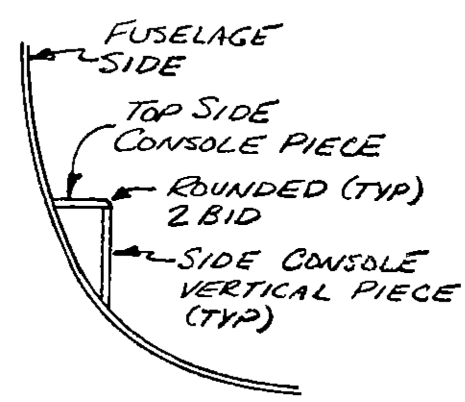
VIEW A-A

The side consoles can be completely assembled permanently at this time. Again, remember that the previously glassed faces go on the outboard and lower sides, so that they are not visible upon assembly. Laminate 1 BID tape at the joints wherever you can reach, and use flox at the joints also. Once each top and vertical piece has been joined, round the common corner and laminate 2 BID around the two faces, starting with a 1 inch minimum lapping onto the fuselage side, and finishing with a 1 inch minimum lapping onto the fuselage side, main fuel tank, or Seatback Bulkhead, depending on FS location. This will give each side console a 'one piece' look and reduce finishing weight later.

Both the side consoles and the center console should be assembled so that each top piece is level when in place. This will be useful later for leveling your aircraft for installation of the main wing and canard, as well as for weight and balance.



SIDE CONSOLE INSTALLATION



VIEW A-A

TOP CENTER CONSOLE ASSEMBLY

Once the control stick assembly is in place, and the CS13 push-pull rod to the elevators in place, you can permanently assemble the top center console piece. Some trimming will be necessary to clear the control stick and its associated hardware. The top piece is mounted with flox.

Round the top corners and laminate 2 BID at 45 degrees to BL00 around the top piece all the way down to the bottom fuselage, using 1" minimum lapping onto the fuselage bottom, Seatback Bulkhead, and main fuel tank.

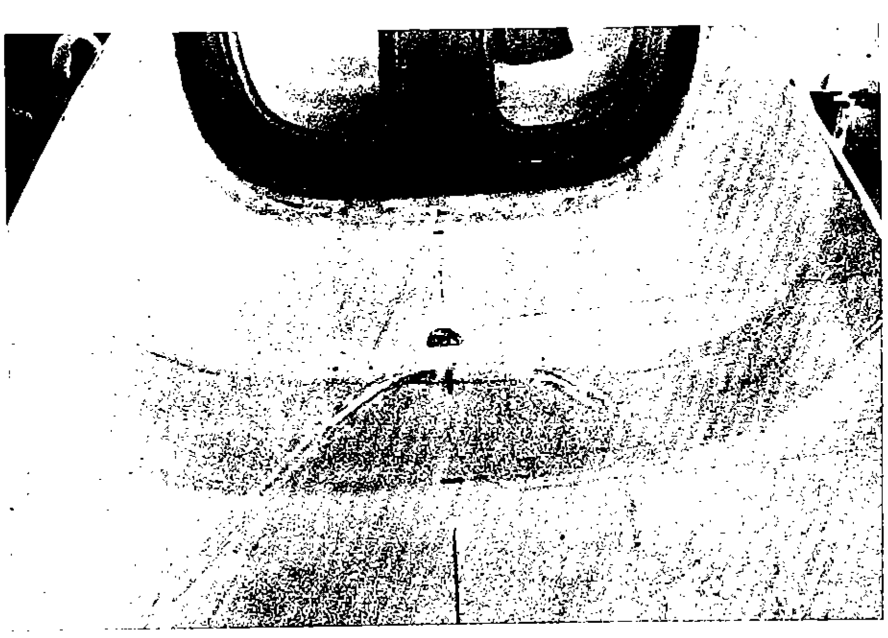
To summarize, at this point in the construction, the center and side consoles are installed with 2 BID over the outside faces of each console, and 1" minimum lapping onto the rest of the fuselage structure. The consoles are now strong enough to put weight on.

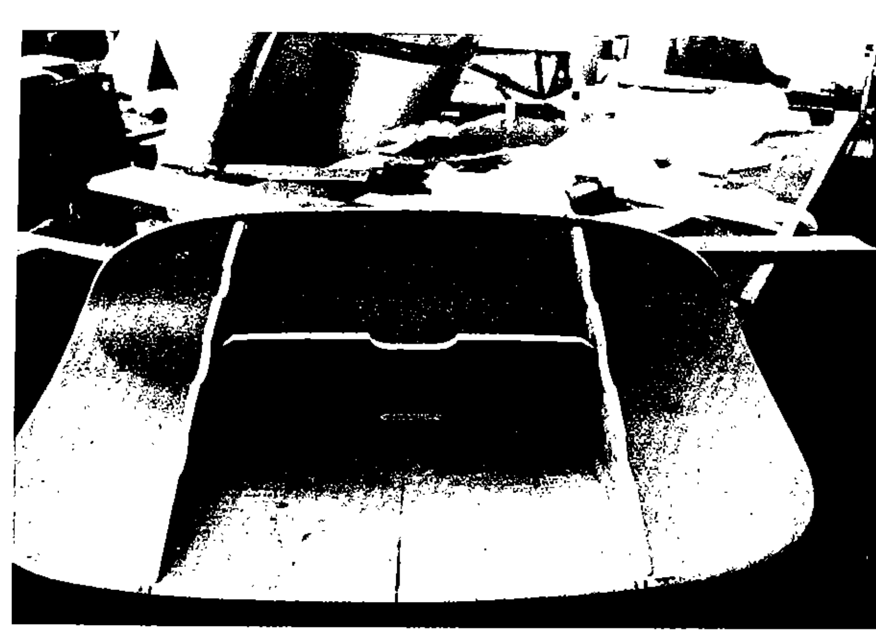
INSTRUMENT PANEL INSTALLATION

It is suggested that the Instrument Panel not be mounted in the fuselage permenently until all cutouts for instruments, radios, and equipment have been made.

However, at this time, you may elect to make the small sub-panels that extend from the bottom of the instrument panel to the top of each side console and the center console. The width should be the same as the width of the console. For material, you may use the 1/8" plywood, 0.063" aluminum, or even 1/4" thick white foam with 1 BID on each side.

These sub-panels are useful for switches, gauges, and as mounts for controls.





Top Left: Fuel Drain Valve installation
Top Right: Side view of baffle installation
Lower Right: Bottom view of baffle installation

CONTROL STICK INSTALLATION

Install the control stick only after the fuselage has been assembled and the fuel tank, center console, and side consoles have been installed.

The control stick is installed on the center console so that it may be actuated by either the pilot's right hand, or by the passenger's left hand.

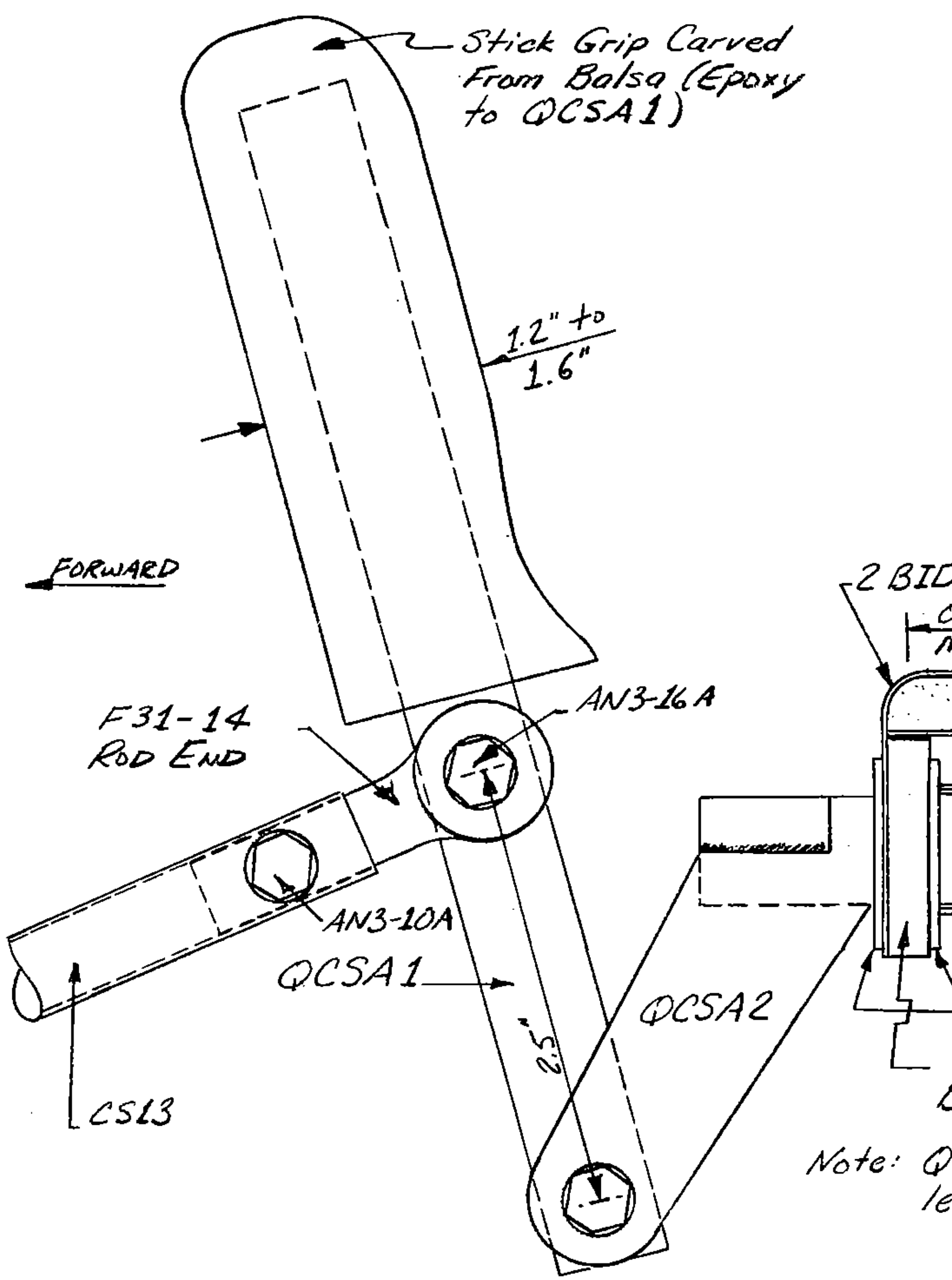
In order to make your Q2 have that "custom fitted" appearance, sit in the cockpit in a comfortable position that allows you to both see out of the cockpit and reach the rudder pedals. Rest your right hand on the center console and estimate where the control stick should be placed fore and aft to be most comfortable; mark that point somehow for future reference.

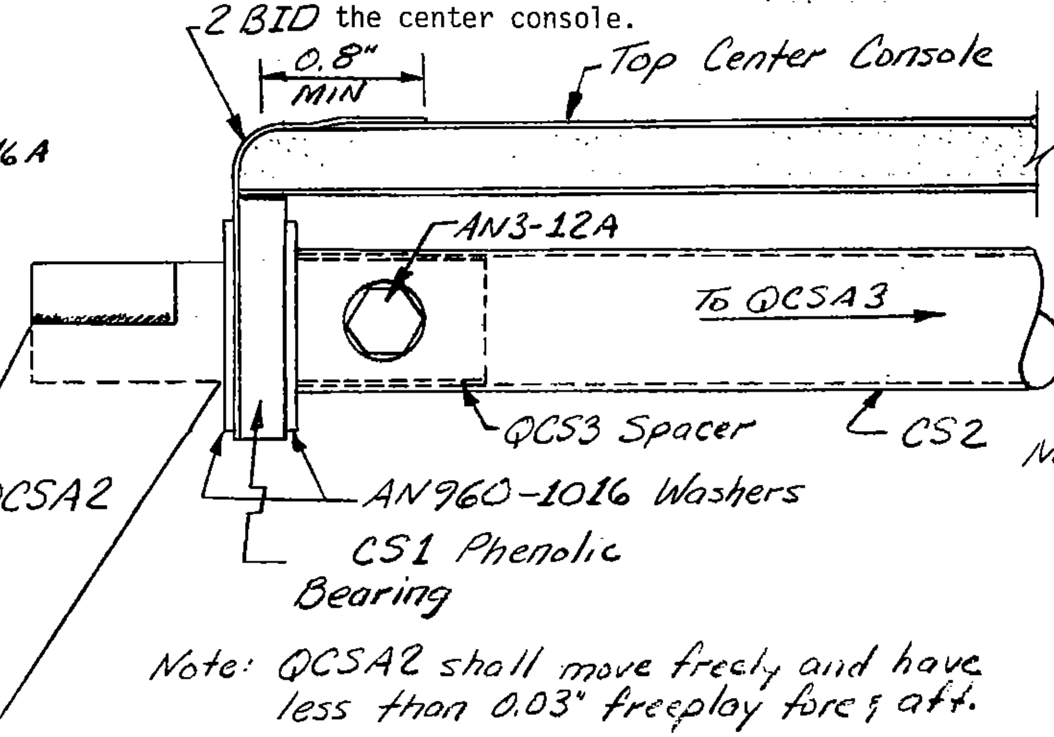
Next, assemble QCSA1 to QCSA2. It is important that the bolt tighten down on the spacer, not QCSA1, to allow the stick to pivot freely.

Find the QCS3 spacer material and cut it into two pieces. Also, find the three phenolic bearings CS1 and CS4 (2).

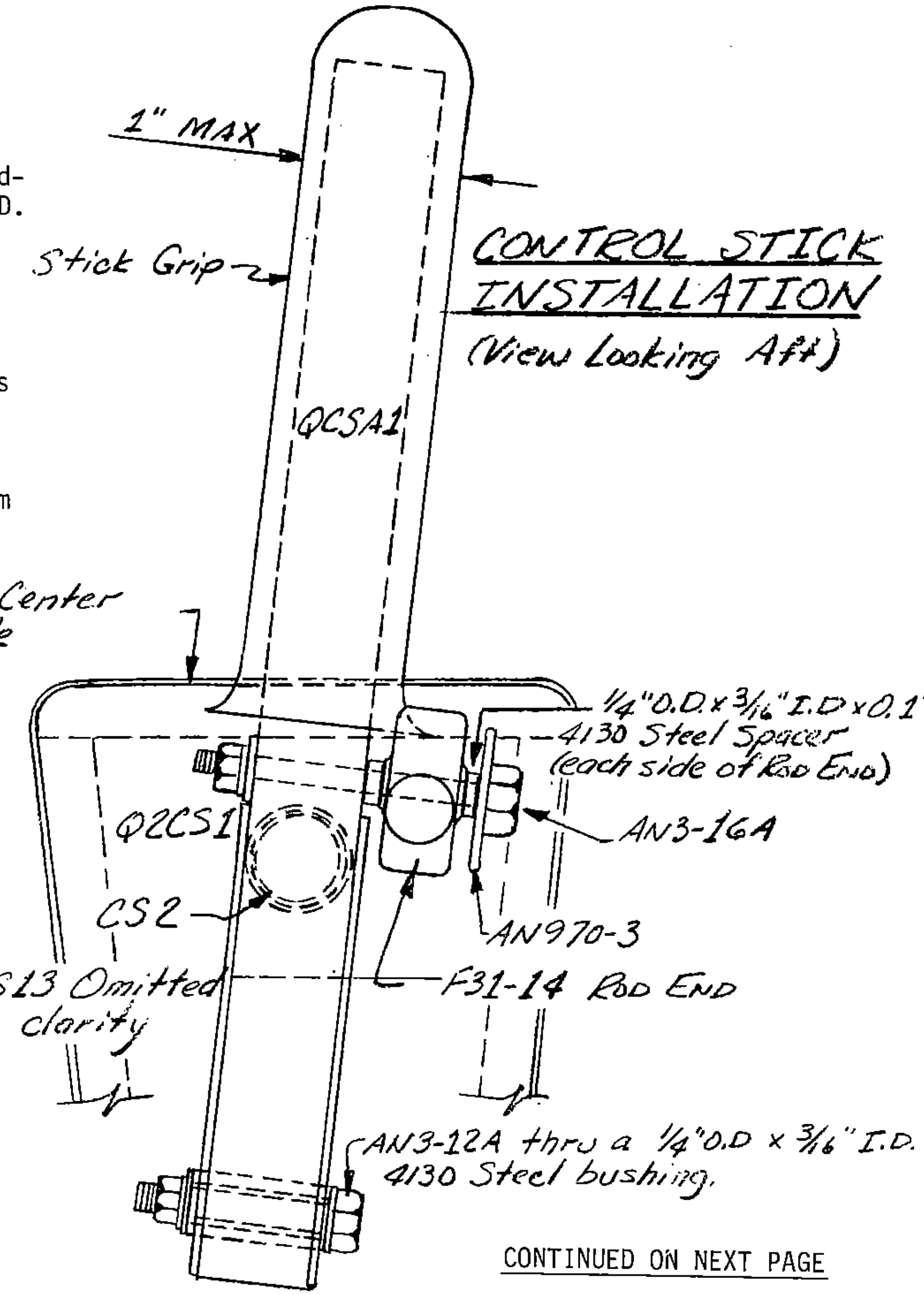
Study the sketches carefully. CS2 is the longitudinal aileron torque tube, which is made out of 3/4" O.D. by 0.035" wall 2024T3 Aluminum tubing. It needs to be approximately 44" long, but, as you can see, the exact length will be determined on installation, so make it long. CS2 translates the rotary motion of the control stick (for roll control) back to QCSA3, the aileron bellcrank, from whence the two vertical push pull tubes CS5 and CS12 actuate the two Q2CSA4's which move the ailerons.

From your previous determination of the proper control stick location, you can decide how much to trim back the center console so that the CS1 bearing can be attached with flox and 2 BID at the forward edge of the center console.





CONTROL STICK INSTALLATION
(Side View)



CONTROL STICK INSTALLATION
(View Looking Aft)

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Once that lamination has cured, trial fit the control stick, the QCS3 spacer, and the CS2 longitudinal aileron torque tube together so that you can locate the CS4 bearings back at the FS94 bulkhead. Be careful to avoid binding. The CS4 bearings should be located on BL00 at about WL14.5. Note that 2 BID and flox are used to attach each of the CS4 bearings to the bulkhead.

Once those laminations have cured, you can assemble the control system as shown. Remember, the stick must be smooth and free in the pitch and roll directions. Also, the fore and aft travel of QCSA2 must not exceed 0.03", as shown.

Work slowly and carefully, being sure not to elongate the holes you are drilling for the various AN3 bolts to connect everything together. Keep checking to make sure the control system remains free and smooth. There is little worse than a fine handling basic aircraft with a very stiff control system.

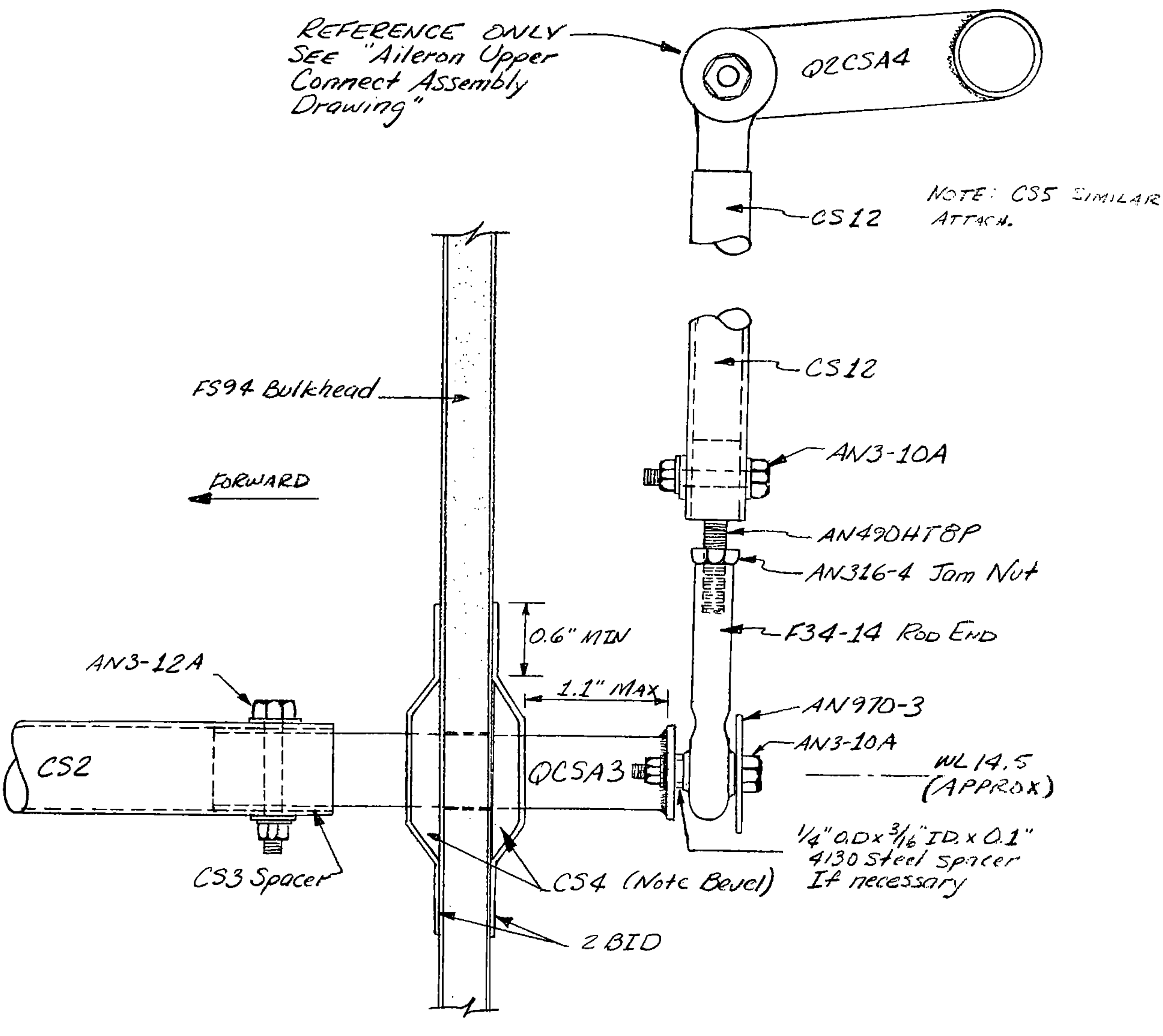
The AN3-12A bolt to connect CS2 to QCSA2 will require a hole drilled in the console. This hole can be left open for future access, or closed back up again. Please note that the control stick with neutral aileron is canted slightly toward the pilot for better stick/hand geometry.

CS5, CS12, and CS13 are made from 1/2" O.D. x 0.035" wall 2024T3 Aluminum tubing. The proper lengths will have to be determined upon installation. Don't forget the length taken up by the rod ends and AN490HT8 adjustable threaded rod ends. Each push-pull tube system has one of the adjustable rod ends to allow for small errors in properly sizing the push-pull tubes for length. You must have at least 2 threads of the adjustable threaded rod ends screwed into the rod ends to be safe. It is recommended that you set up your systems so that the adjustable rod ends are at mid-travel, to allow for future adjustment, particularly with the ailerons.

Use your aileron rigging template and your elevator rigging template to assure that you obtain the proper amount of travel in pitch and roll. Using wood bonded in place, make control limit stops both between QCSA3 and the fuselage bottom, between Q2CSA8 and the canard shear web, and between QCSA1 and QCSA2 to limit surface travel to the proper limits. DO NOT HURRY THIS SECTION it is too important an area to make mistakes in.

The stick grip is carved out of Balsa wood and attached to QCSA1 with epoxy.

Once your aileron and elevator control systems are functioning, climb into the cockpit and spend 5 minutes playing fighter pilot. Then get back to work, or you'll never finish your Q2.



AILERON LOWER CONNECT
(Side View)

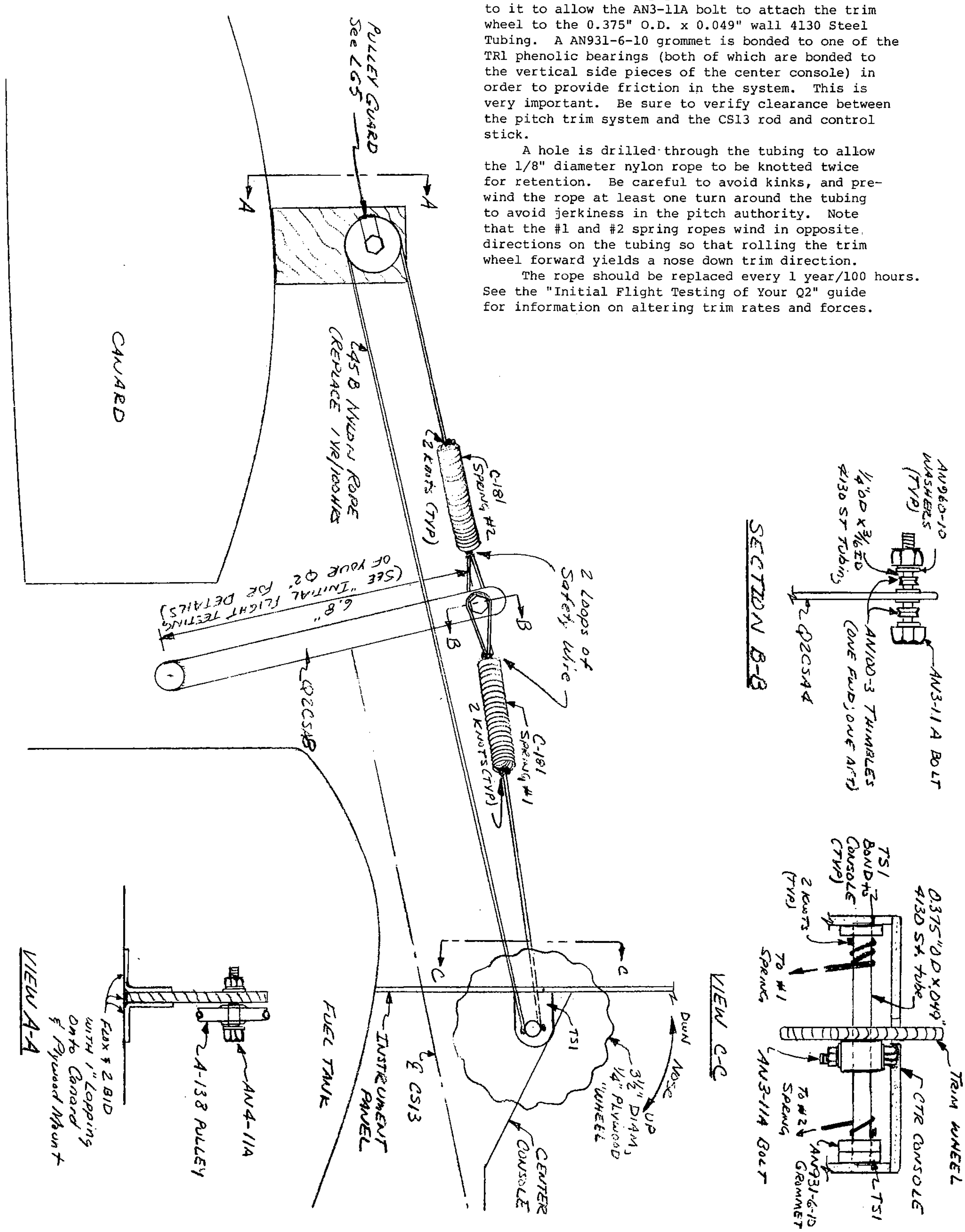
INSTALLING THE PITCH TRIM SYSTEM

The pitch trim system is a simple looking double spring system mounted in the center console forward of the control stick. It must be built exactly as per plans if you are to enjoy the same fine handling qualities as the prototype Q2. In addition to providing pitch trim capabilities, the system also serves to regulate the stick force per g of the control system in pitch.

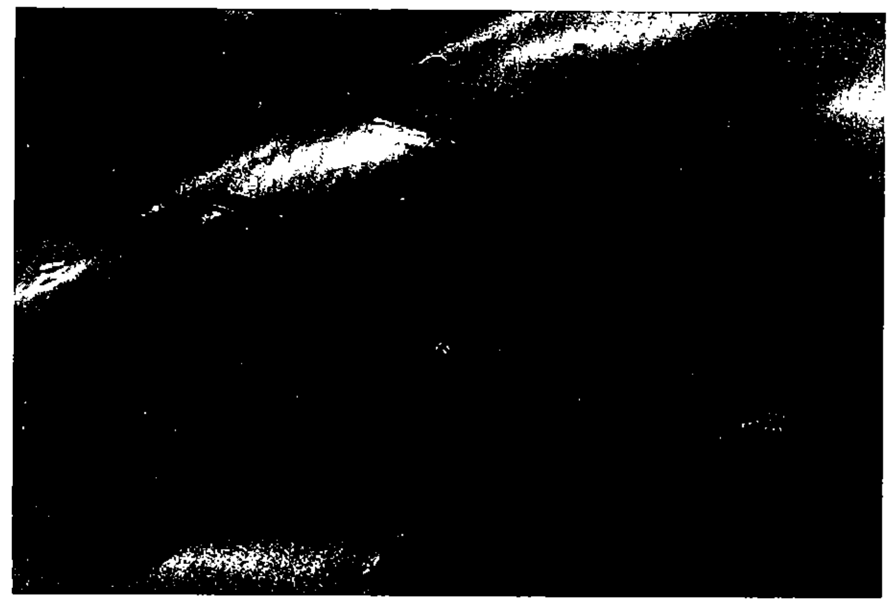
The illustrations are straightforward. The trim wheel is carved from plywood, and a dowell is bonded to it to allow the AN3-11A bolt to attach the trim wheel to the 0.375" O.D. x 0.049" wall 4130 Steel Tubing. A AN931-6-10 grommet is bonded to one of the TR1 phenolic bearings (both of which are bonded to the vertical side pieces of the center console) in order to provide friction in the system. This is very important. Be sure to verify clearance between the pitch trim system and the CS13 rod and control stick.

A hole is drilled through the tubing to allow the 1/8" diameter nylon rope to be knotted twice for retention. Be careful to avoid kinks, and pre-wind the rope at least one turn around the tubing to avoid jerkiness in the pitch authority. Note that the #1 and #2 spring ropes wind in opposite directions on the tubing so that rolling the trim wheel forward yields a nose down trim direction.

The rope should be replaced every 1 year/100 hours. See the "Initial Flight Testing of Your Q2" guide for information on altering trim rates and forces.



MAKING YOUR Q2 TRAILERABLE



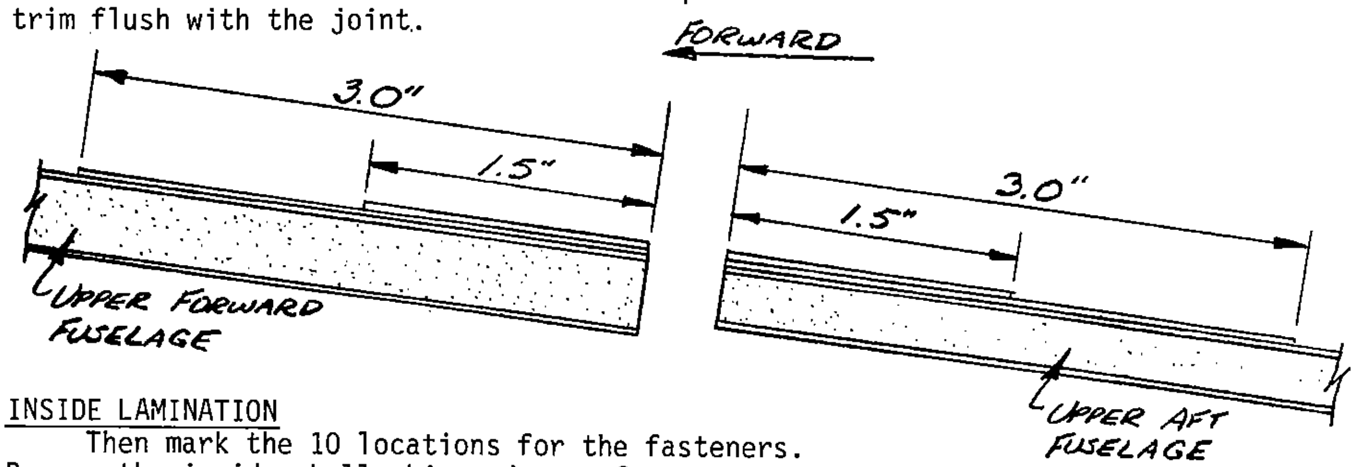
INTRODUCTION

In this chapter, you will make your Q2 trailerable and at the same time join the forward and aft fuselage shells together. As stated in Chapter 12, this task should be accomplished prior to mounting the vertical fin in Chapter 14. Also, Chapter 12 contains information on joining the forward and aft fuselage shells together permanently if you do not desire to make your Q2 trailerable.

EXTERIOR LAMINATION

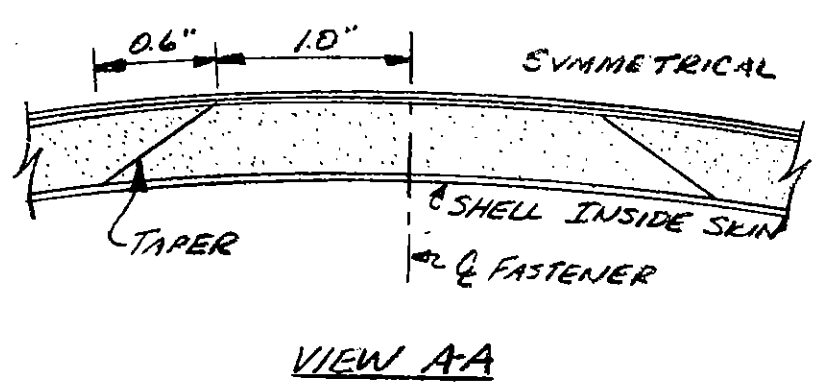
Begin by jigging the two shells together and checking for a good fit. Some sanding may be required for a flush fit.

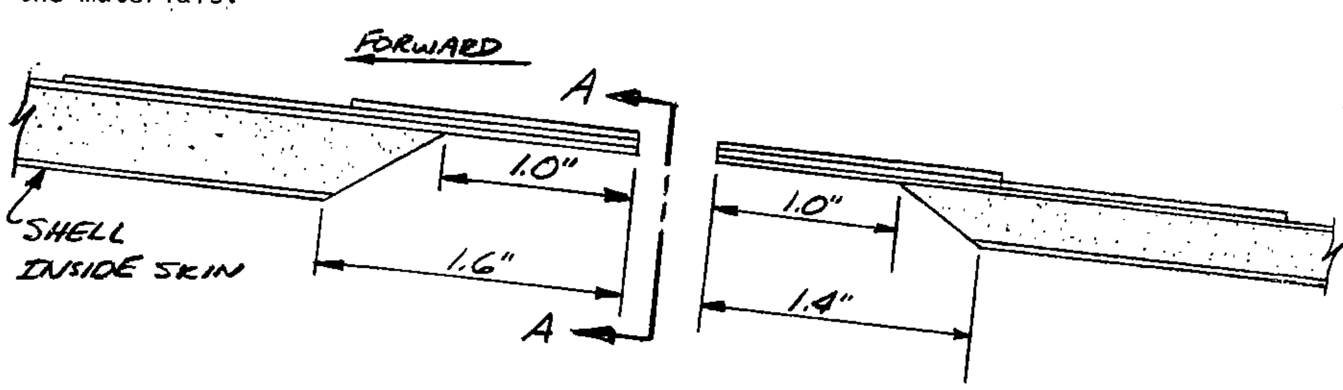
Next, sand the outside skin for 3" on either side of the joint in preparation for the lamination. Laminate 2 BID as shown around the area next to the joint. The first ply is 3" wide and the second ply is 1.5" in width. The lamination should be oriented 45 degrees to the joint line, and any overlapping pieces of cloth should have a 1.5" Minimum overlap. Knife trim flush with the joint.



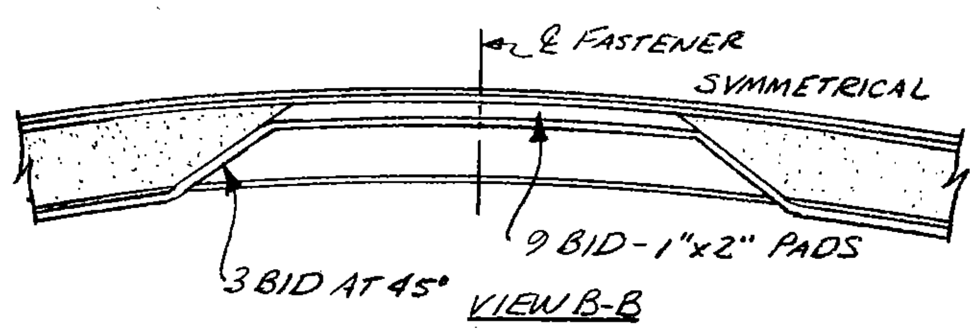
INSIDE LAMINATION

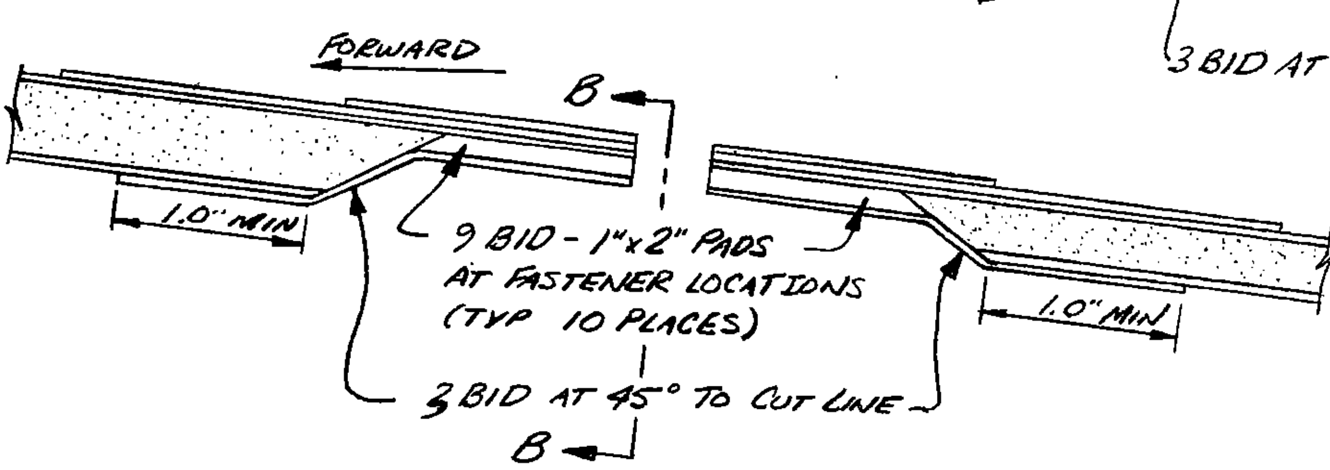
Then mark the 10 locations for the fasteners. Remove the inside shell skin and core foam as shown at the 10 locations. The taper shown is to allow the next laminations to flow smoothly around the corners. Each location will have an area 1" x 2" on each shell (a total of 2" x 2") sanded down to the outside shell skin, as shown. Note from the sketches that only the area around each fastener location is affected. If the FS94 bulkhead interferes with the lower 3 locations, slot the FS94 bulkhead as needed, and then replace the materials.





A pad of BID is laminated at each location and on each shell. A total of 9 BID approximately 1" x 2" are used. An additional 3 BID overlapping 1" minimum onto the inside shell skin are laminated to tie everything together. It is important to taper all laminations carefully to avoid joints, bumps, joggles, etc. Also, these laminations are oriented 45 degrees to the joint line.



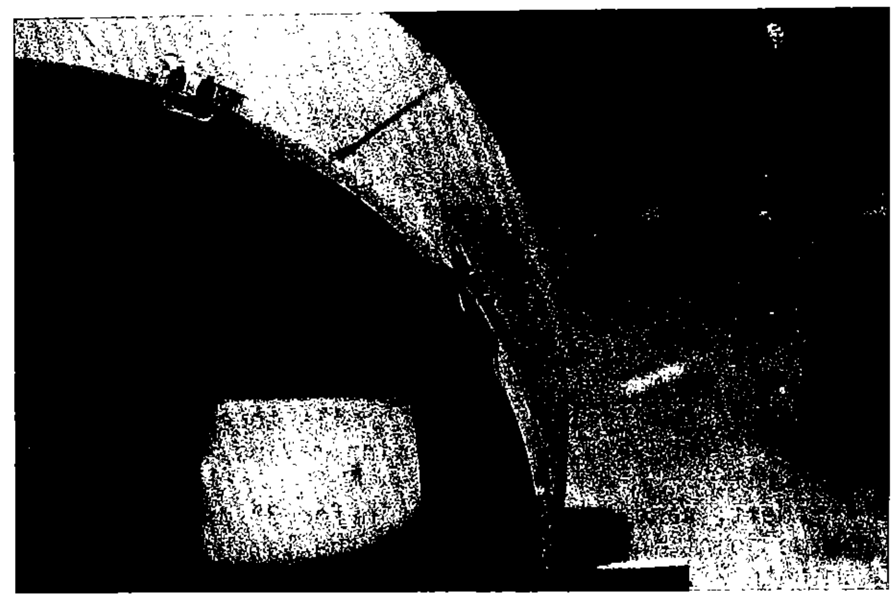


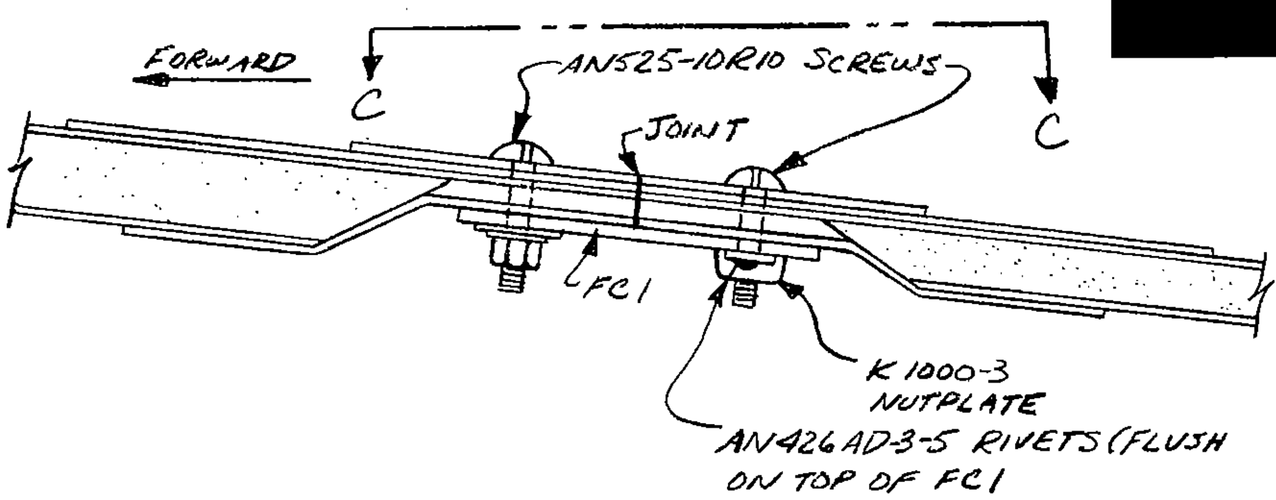
FASTENER INSTALLATION

Make 10 of FC1 and 2 of FC2 using the full size patterns provided. Attach the 10 FC1's to the forward fuselage at the 10 locations using AN525-10R10 screws. (2 per fasterner).

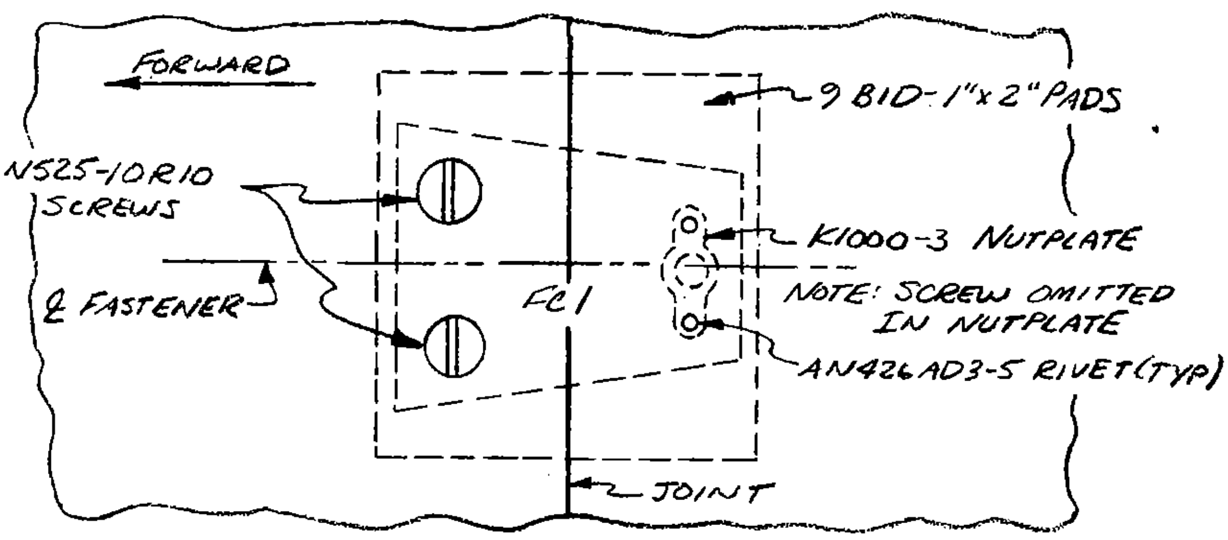
Jig the rear fuselage shell into position flush against the forward fuselage shell using a few dabs of Bondo. By shining a light inside the fuselage at each fastener location in order to see each FC1, drill in the #12 holes (10 locations) for the K1000-3 nutplates. Mount the nutplates to the FC1 fasteners with AN426AD-3-5 rivets, countersinking them flush from the side of FC1 next to the pads.

Install the AN525-10R10 screws (10 locations) to complete the assembly. That is all there is to it.





VIEW B-B



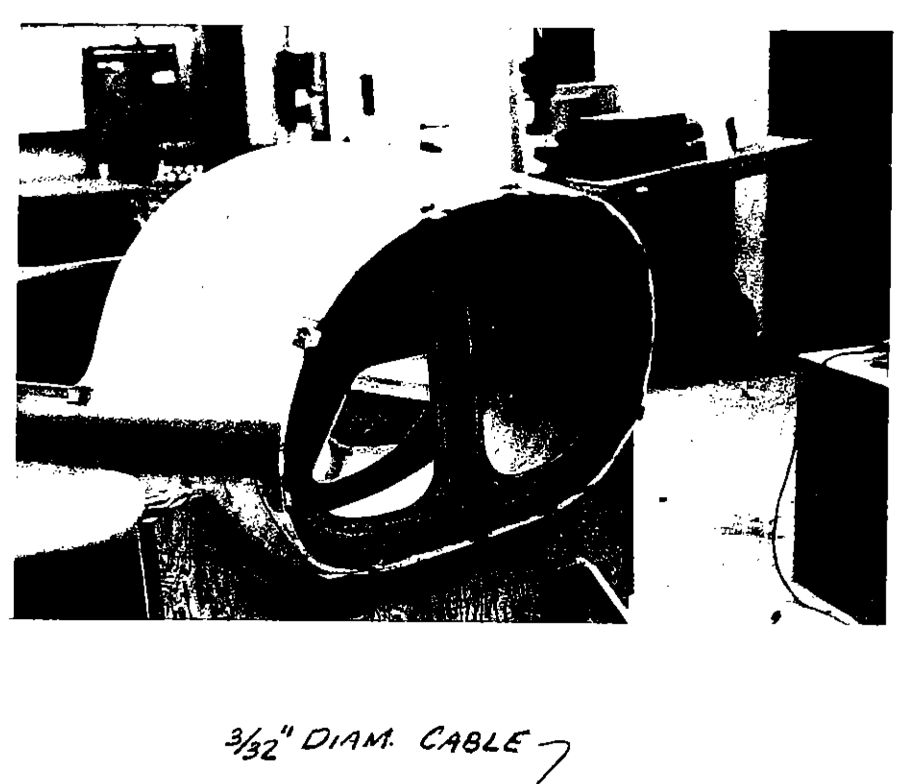
VIEW C-C

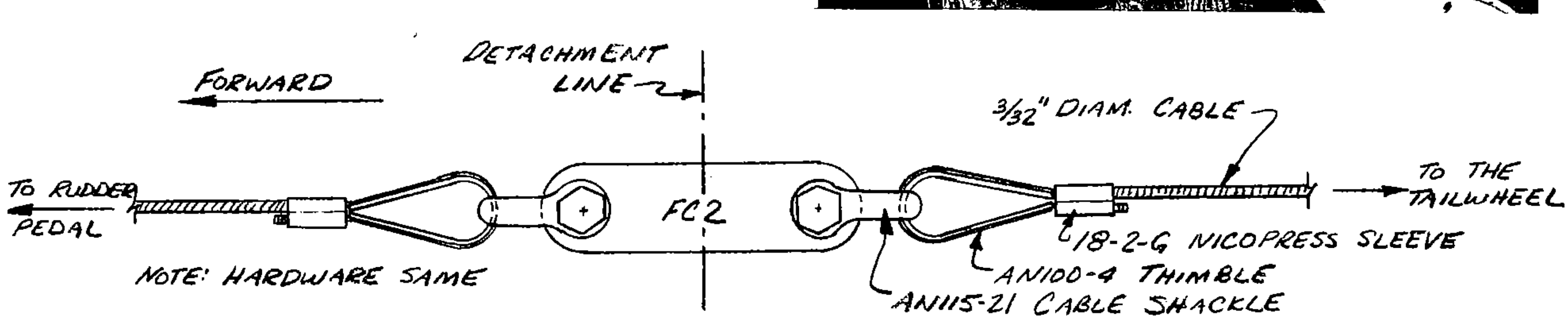
RUDDER CABLE DISCONNECTS

In order to complete making your Q2 trailerable, it is necessary to make quick disconnects for the two rudder cables running aft from the rudder pedals to the tailwheel. A simple method is shown here. To disconnect the cables, remove one of the AN3-5A bolts from each side.

In practice, to remove the rear fuselage, remove the 10 screws in the aft fuselage shell. Next, pull the forward and aft fuselage shells apart using the slack due to the rudder pedals so that you can remove the AN3-5A bolts indicated above.

As a final note, if your Q2 has any antennas located in the aft fuselage, they too will need to have quick disconnect fittings.





END OF CHAPTER

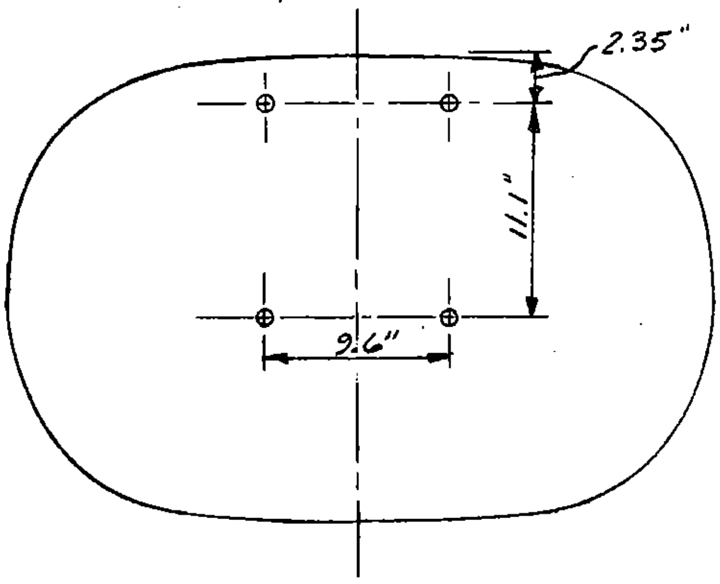
RUDDER CABLE QUICK DISCONNECT

ENGINE MOUNT INSTALLATION

Make 4 EM2 backup plates. A full size drawing is included.

Find the 4 Q2EM1 engine mount weldments. Use a AN6 bolt to stack each Q2EM1 to one EM2. Next, drill in 4 0.190" diameter holes in each Q2EM1/EM2 combination in the corners.

Using the sketch entitled 'Engine Mount Holes', locate the four hole locations on the firewall and drill in 0.375" diameter pilot holes.

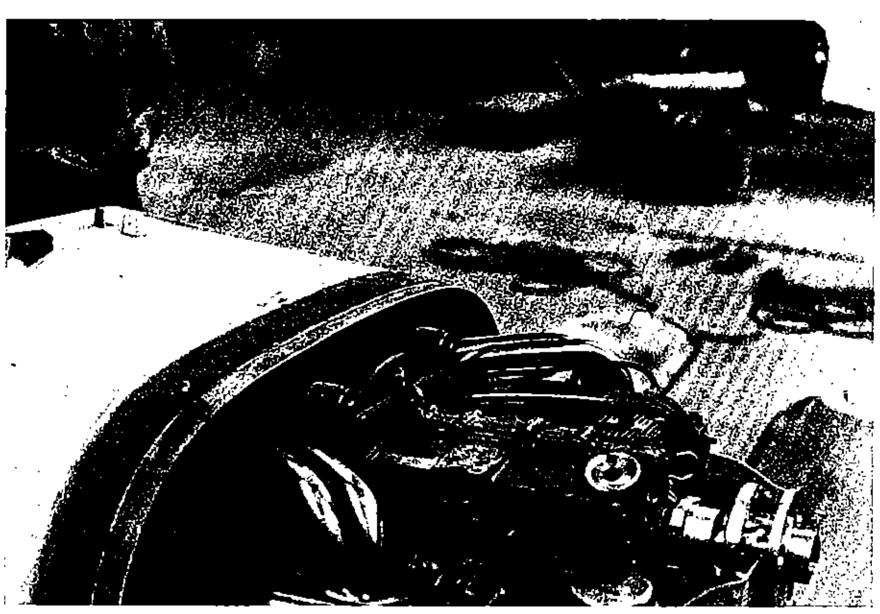


ENGINE MOUNT HOLES

Next, drill in the engine mounts on the firewall by taking each Q2EM1 and using an AN6 bolt to stack the Q2EM1 to the firewall, and then drilling the 4 0.190" diameter holes per Q2EM1 through the firewall. Temporairily mount the EM2 backup plate as shown using some AN3 bolts so that the engine may be temporarily mounted on the firewall.

PRELIMINARY ENGINE MOUNTING

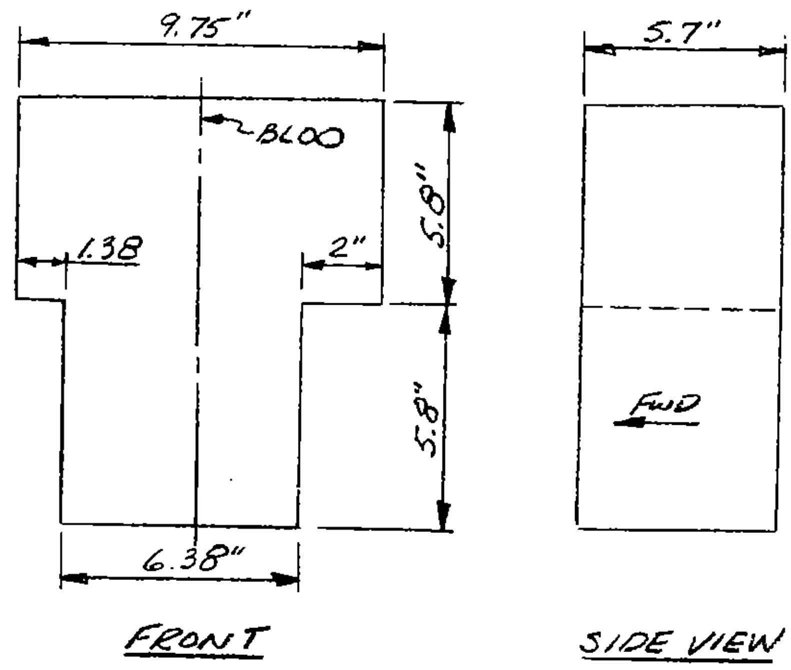
The purpose of this section is only to establish the size of the cutout in the firewall to clear the magneto and starter assemblies. Skip ahead to the section on "Magneto/Starter Box" to understand what the final shape and size must look like. Then, open up a hole in the firewall just large enough to clear everything. During the next section, you will make the final hole. Once the hole has been sized, remove the engine.



MAGNETO/STARTER BOX

On the Q2, the starter and magneto section of the engine projects aft of the firewall into a plywood box. This box is 9 sided and constructed from 1/8" thick plywood. It has the inside dimensions shown. These dimensions are rather critical, so follow them closely. Use a few dabs of 5-MIN to hold the 'jigsaw pieces' together and laminate 1 BID on both the inside and outside of the box.

Enlarge the previous cutout in the firewall until the box will just fit through it. Attach the box permanently using 2 BID tapes on both sides of the firewall. Verify that the magneto/starter accessories will fit within the envelope of the box.



MAGNETO/STARTER BOX

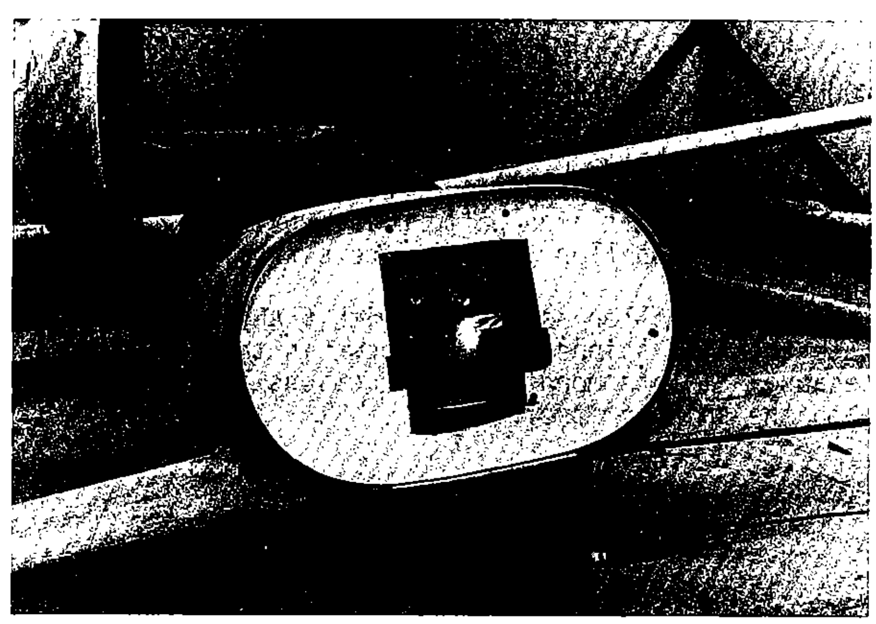
NOTE: All Dimensions are "inside" dimensions

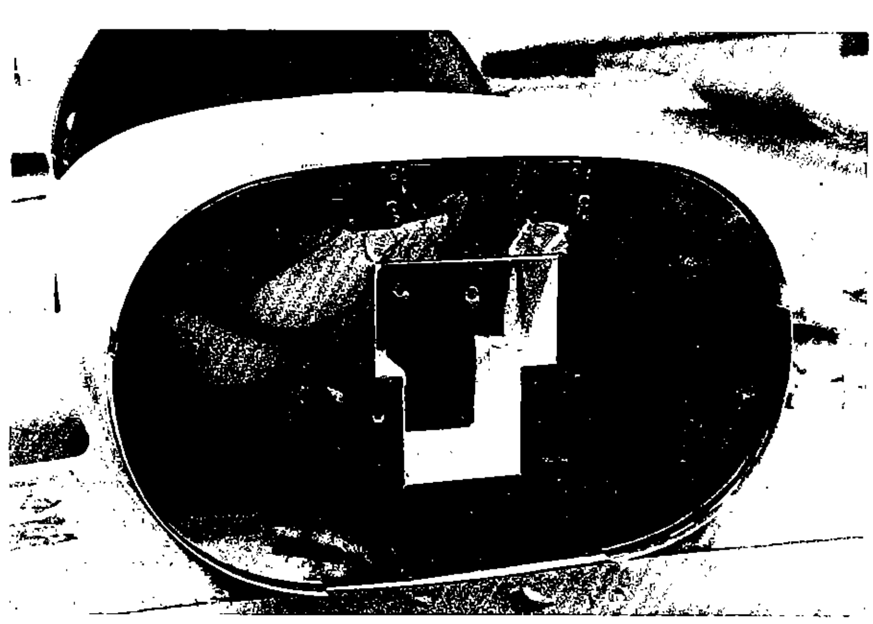
FIREWALL PROTECTION

Prior to mounting the engine permanently to the airframe, it is necessary to shield the firewall with fiberfrax and aluminum sheet.

One layer of fiberfrax must shield all exposed plywood, including the inside of the magneto/starter box. To protect the fiberfrax from abrasion due to normal wear and tear, a thin sheet of aluminum is fastened over the fiberfrax. However, the aluminum sheet does not need to be placed over the fiberfrax protecting the magneto/starter box; you may choose to use 2 layers of fiberfrax wherever a sheet of aluminum is not used.

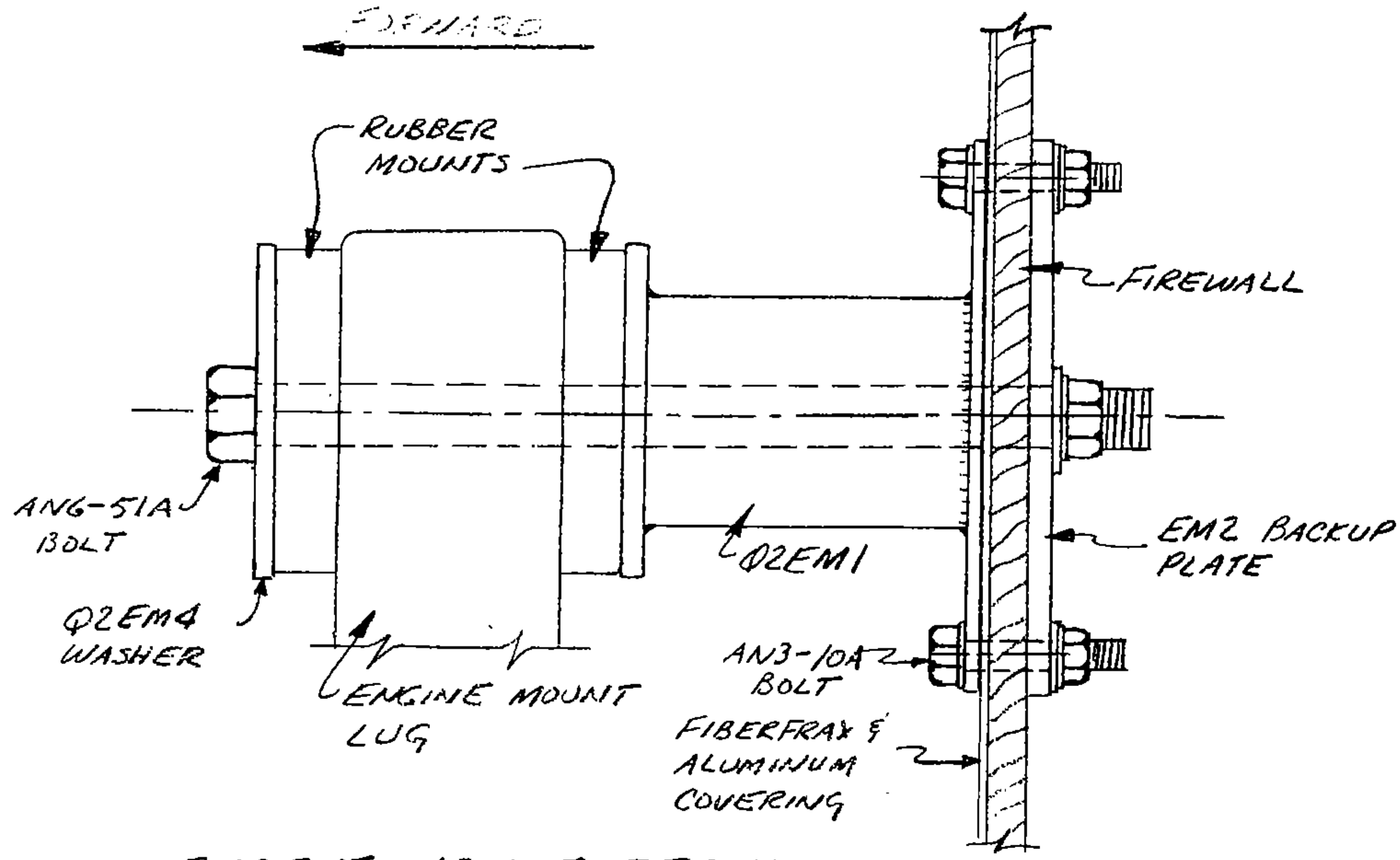
The fiberfrax may be held in position with epoxy. It is fragile, so be careful not to destroy it in handling. To attach the aluminum to the firewall, use a few BSP46 rivets located not closer than 2" to the outboard edge of the firewall. (The cowling flanges will be mounted there later.)





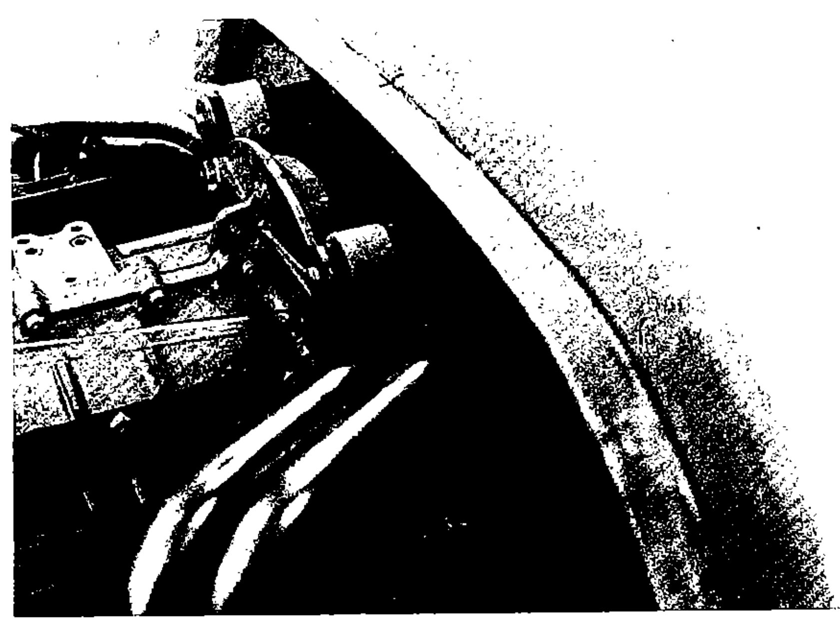
MOUNTING THE ENGINE

A typical engine mount assembly is shown in the sketches. Mount the engine permanently.



ENGINE MOUNT DETAIL

(TYP 4 PLACES)

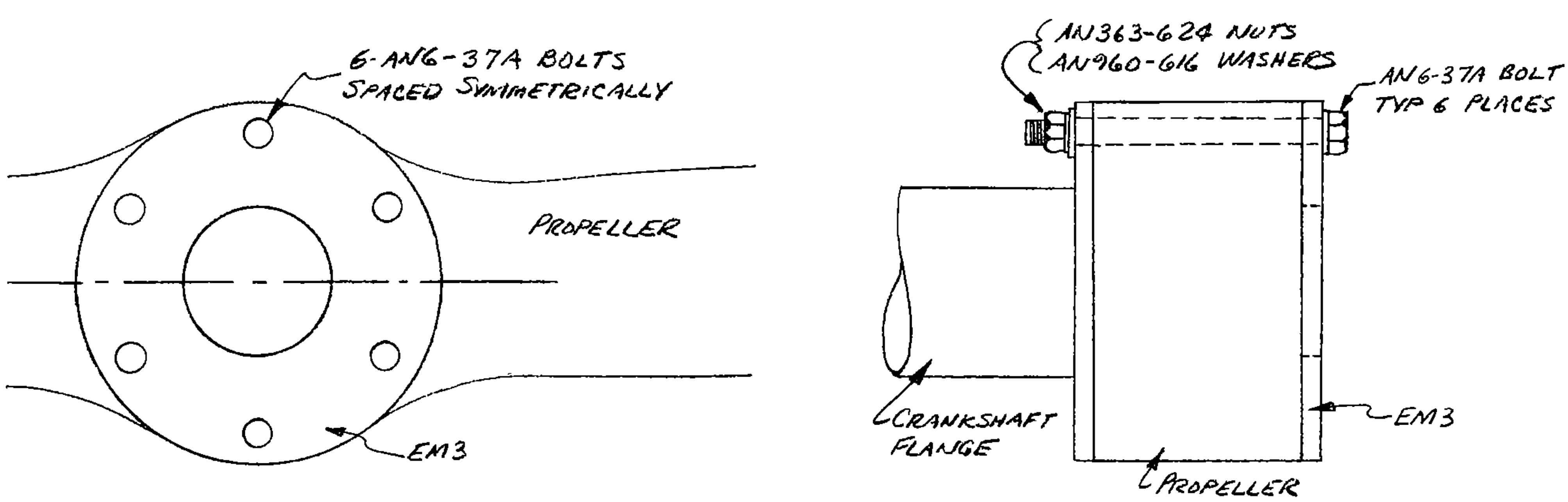


MOUNTING THE PROPELLER

The propeller is delivered to the builder with the mounting holes predrilled.

Make EM3 from a piece of 0.25" thick 6061T6 Aluminum. A full size pattern is provided. Use the predrilled propeller to drill the six bolt holes in the EM3.

The propeller is mounted with 6 AN6-37A bolts. Note that the spinner is not shown in the illustrations because complete mounting instructions are included with the spinner itself.



PROPELLER MOUNTING

NOTE: Spinner not shown but should be mounted at same time as prop.

COWLING FLANGE CONSTRUCTION

In this section, you will make the flange that attaches the cowling to the firewall. This flange will fit around the entire circumference of the firewall.

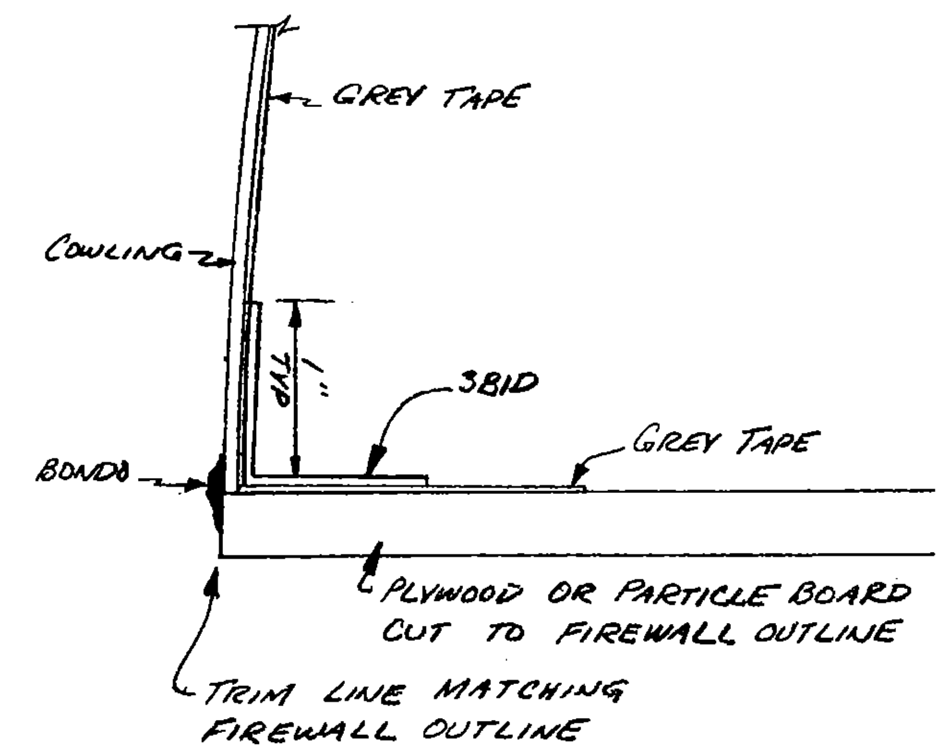
First, use masonite, scrap plywood, or particle board to make an accurate template of the firewall. This template will allow you to form an accurate flange that will produce an excellent fit on the cowling.

Bondo the cowling to the template at the outside edge, so that the cowling is draped like it will be when mounted on the firewall. It is necessary to do only one-half of the cowling at a time.

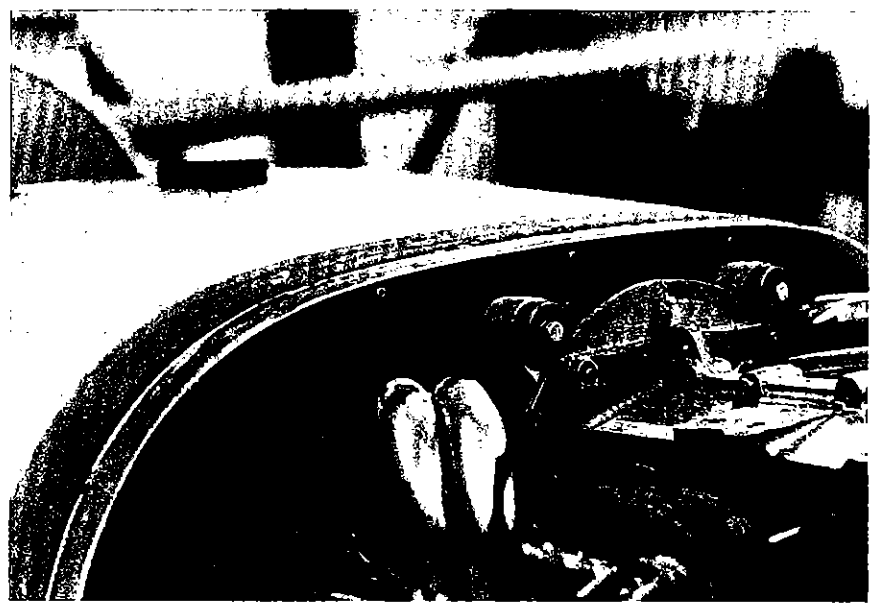
Next, using grey tape, protect two inches of the inside cowling skin and 2" of the template inside surface, as shown. Laminate a 3 BID flange around the inside joint, overlapping 1 inch onto the inside cowling skin and the inside template surface. Allow to cure thoroughly to prevent future warpage.

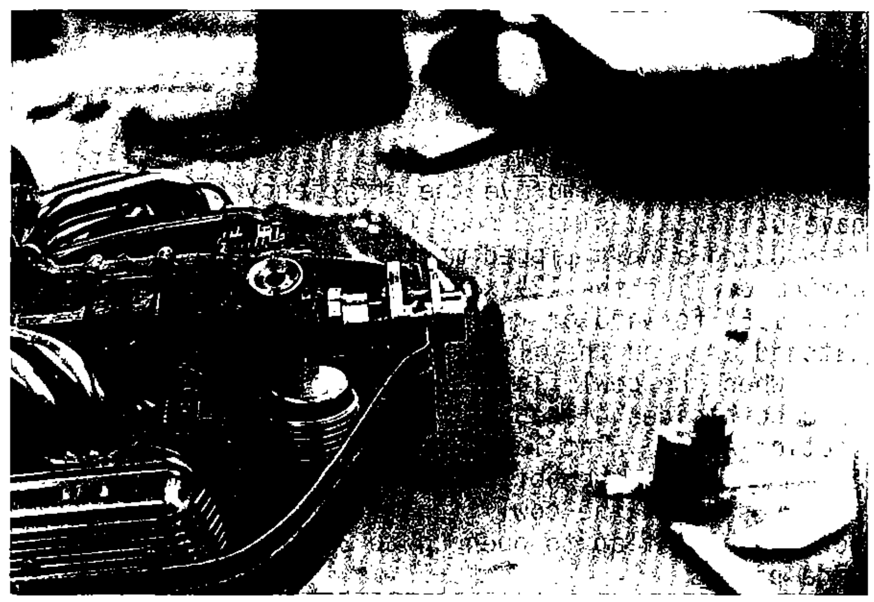
Repeat the process with the other half of the cowling.

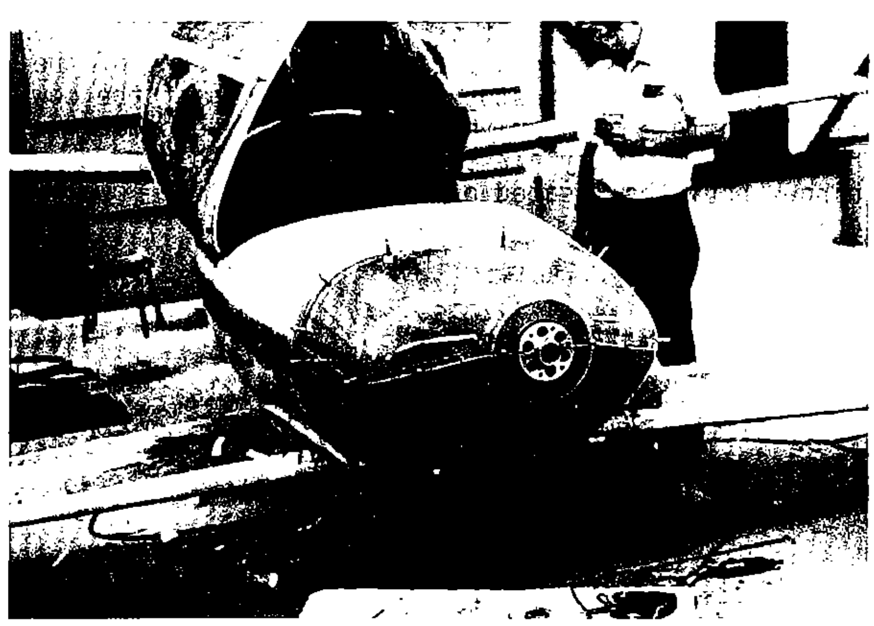
Remove the flanges from this simple "mold" and clean off the grey tape from the cowling.



COWLING FLANGE CONSTRUCTION







TRIMMING THE COWLING

The cowling is shipped to you preformed and rough trimmed to size. Final trimming can only be accomplished with the engine mounted on the airframe and the propeller spinner available for fitting. Do not proceed further until that has been accomplished.

Previously, you fabricated two cowling mounting flanges, one for the top cowling half and one for the bottom cowling half. Locate these two flanges.

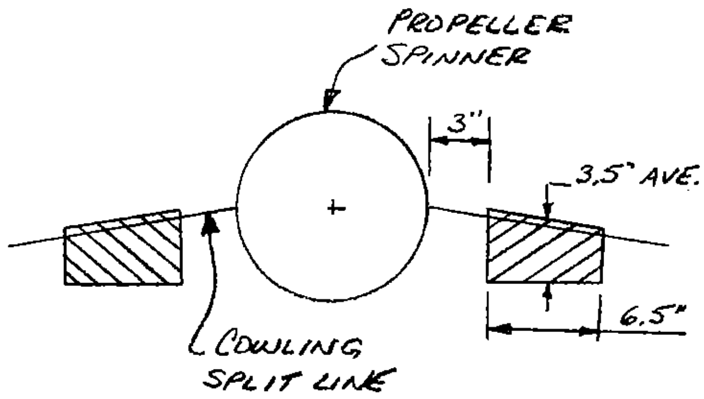
It will be necessary to cut a hole in the nose of the cowling for the crankshaft to pass through. The hole should clear the crankshaft by only 1/4" to minimize air leakage.

The fitting of the cowling is a trial and error operation. By fitting the spinner to the crankshaft flange, you can determine the necessary cowling length to allow only a 1/16" gap between cowling and spinner. Obviously, the cowling is trimmed as necessary on the aft face. Once the length has been arrived at, it is necessary to mount the cowling mounting flanges using BSP46 rivets on about a 3.5" spacing. The flanges are located so that the cowling will fit flush with the fuselage after mounting. The rivets holding the flanges also serve to mount the fiberfrax and aluminum sheet to the firewall.

Some trimming of the junction of the two cowling halves may be necessary to achieve a best fit.

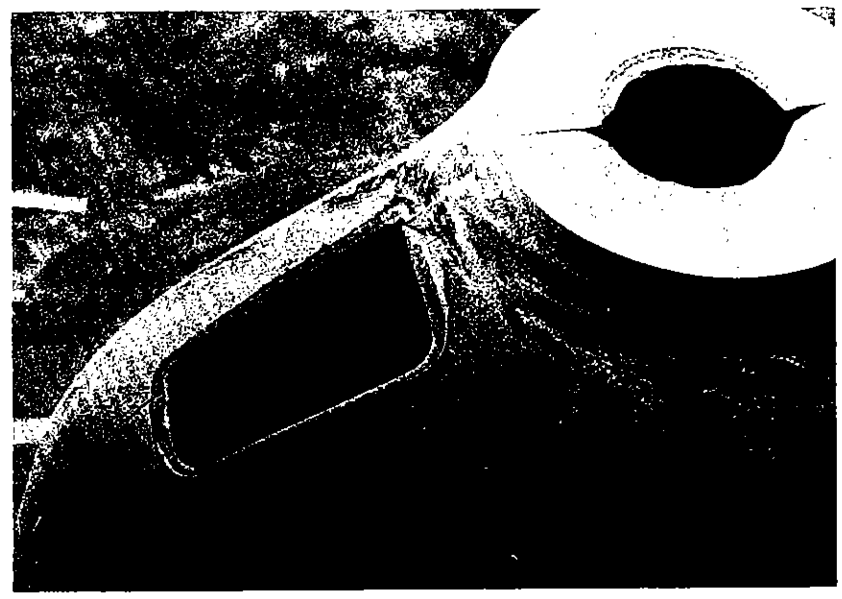
COWLING AIR INLETS

The cowling air inlets can now be cut into the cowling. They are nominally each 3.5" x 6.5" in size, with a 3/8" radius (using Bondo) around the lip. A sketch is included for reference.



COWLING AIR INLET
(FRONT VIEW)

NOTE: RADIUS LIPS 3/8" WITH BONDO



COWL FLAP CONSTRUCTION

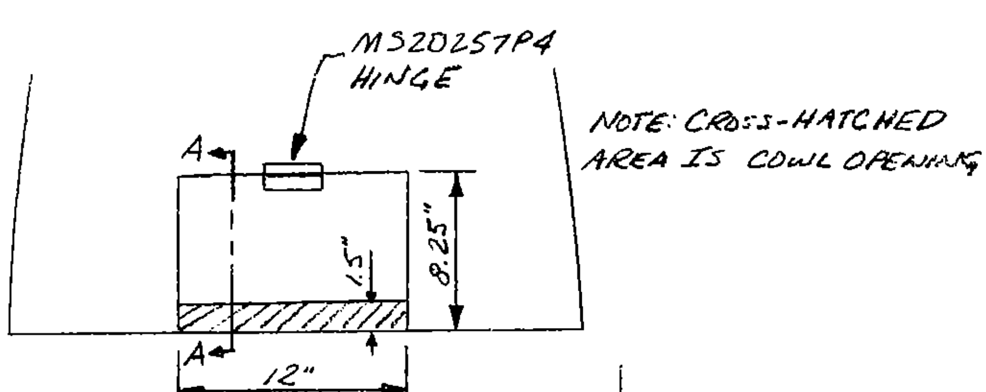
In order to improve the efficiency of your Q2, we have utilized a simple cowl flap.

Using a felt tipped marker, mark on the inside bottom cowling the 12" x 8.25" outline of the cowl flap. Trim 1.5" forward of the aft edge to remove the cross-hatched area on the illustration.

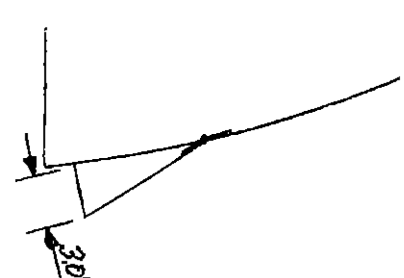
When the cowl flap is opened, it is necessary to have both sides closed off, like a dustpan. (See Section A-A). Flat laminated fiberglass (4 plies) is trimmed to fit the bottom cowl curvature and bonded to either side of the cowl flap with 2 BID. Allow room for the cowl flap to open up to 3.0" when making these side pieces.

Carefully cut out the cowl flap from the lower cowling. Smooth up all rough edges.

A short piece of the MS20257P4 hinge is used to hinge the cowl flap. It is located with 8 BSP42 rivets. To seal the remaining gap at the leading edge of the cowl flap, rivet asbestos along the width of the cowl flap with more BSP42 rivets, to form a secondary hinge and a primary air seal. The asbestos and the hinge should be located on the inside of the lower cowling.



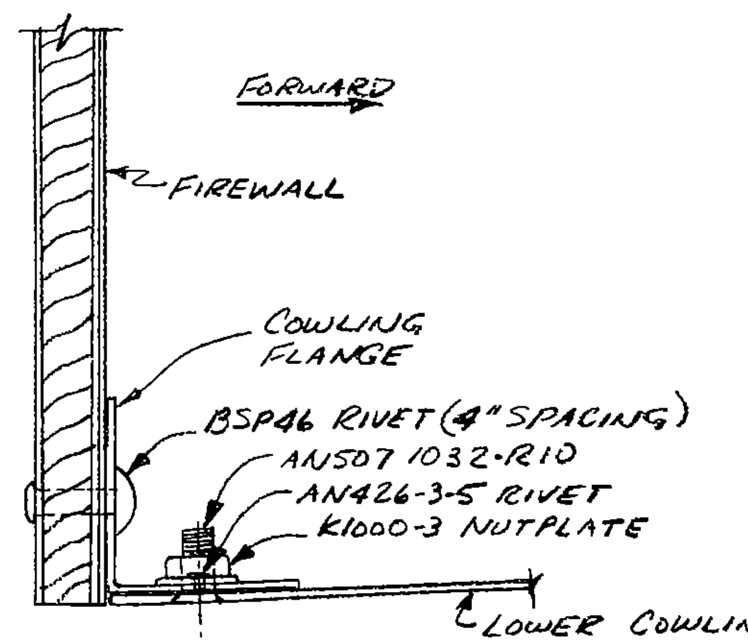
BOTTOM COWLING
(LOOKING DOWN)



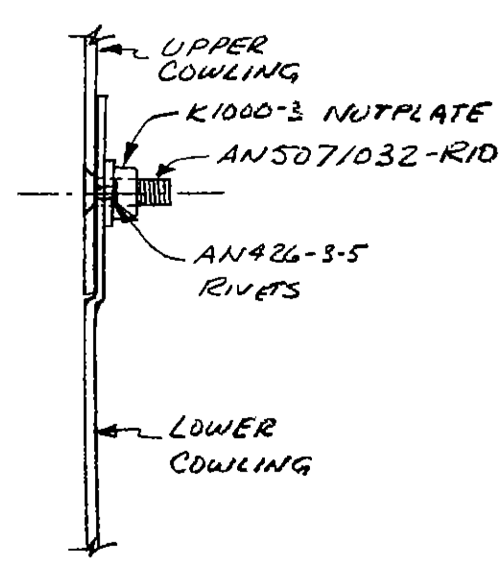
SECTION A-A

MOUNTING THE COWLING

The cowling is mounted permanently using K-1000-3 nutplates and AN507 1032-R10 screws using an approximately 4" spacing. The nutplates are secured using AN426-3-5 rivets. Take time to accurately mount the cowling halves and you will be rewarded with an excellent fit.



COWLING/FIREWALL ATTACHMENT



UPPER/LOWER COWLING ATTACHMENT

CABLE GUIDES

Every push-pull cable except the carb heat control uses a cable guide to provide positive control of cable movement. Make up three cable guides as shown. The mounting bolt hole should be drilled upon assembly later.

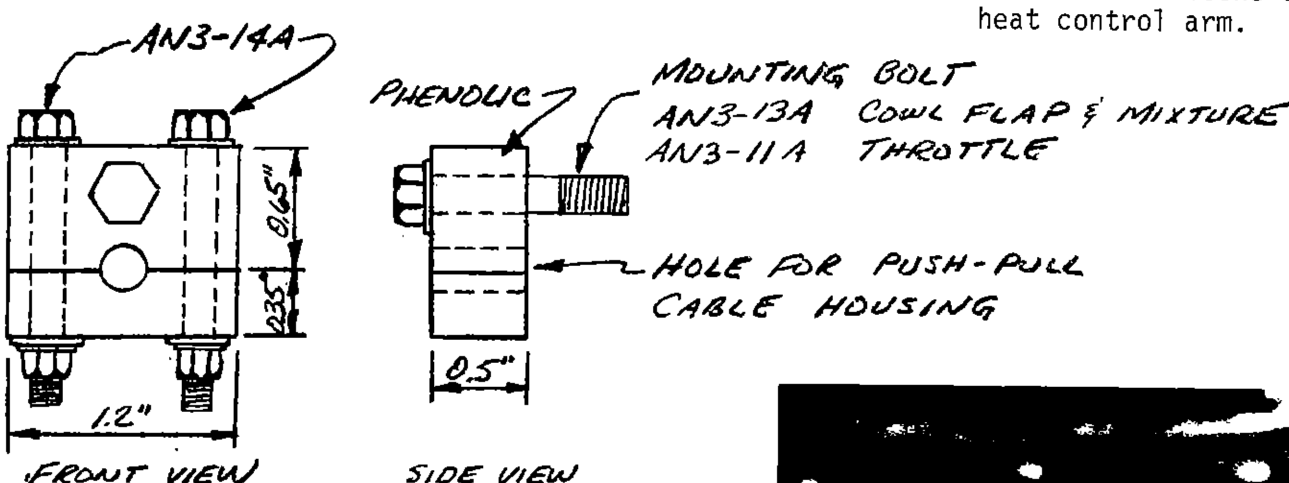
These cable guides function by sizing the hole that the cable housing passes through such that when the AN3-14A bolts are tightened, pressure will be exerted upon the cable housing, preventing slippage. Care must be exercised not to put excessive pressure on the housing, which might damage the cable.

Throttle cable: rivet a piece of the 3/4" x 3/4" x 1/16" aluminum angle to the oil cooler mount, as shown, using BSP42 rivets. Don't rivet through the oil cooler! Then, attach the cable guide and install the throttle cable. A sketch is included to assist you in hooking up the throttle cable to the throttle body arm.

Cowl Flap cable: bolt the cable guide to the firewall such that it can assist the cowl flap actuation. A sketch is included showing the arm on the cowl flap and attachment of the cable.

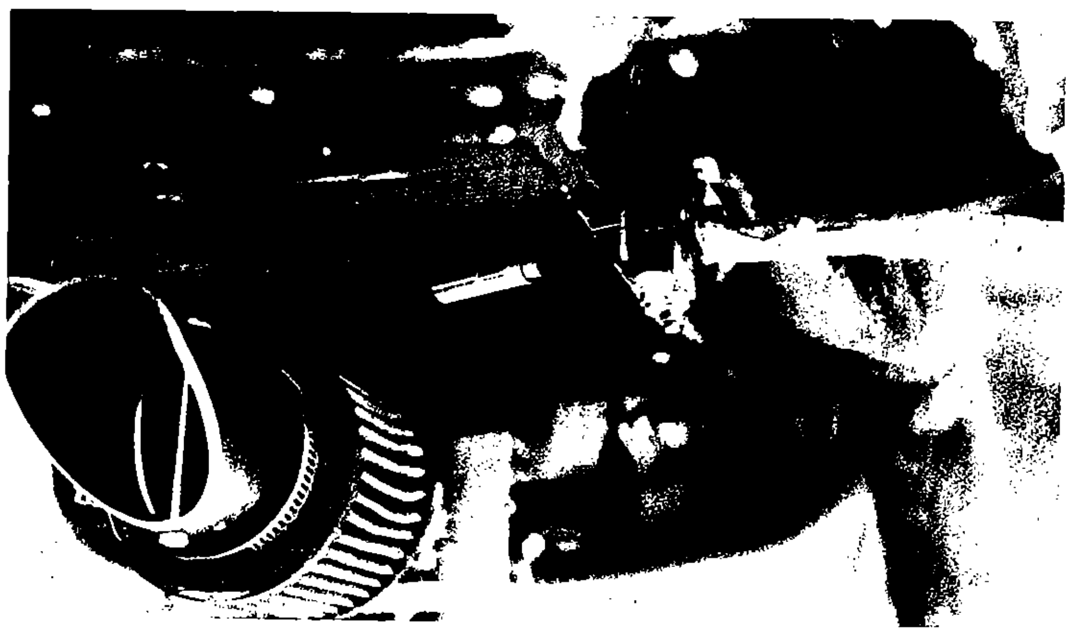
Mixture control cable: again bolt the cable guide to the firewall so that the mixture control can be actuated.

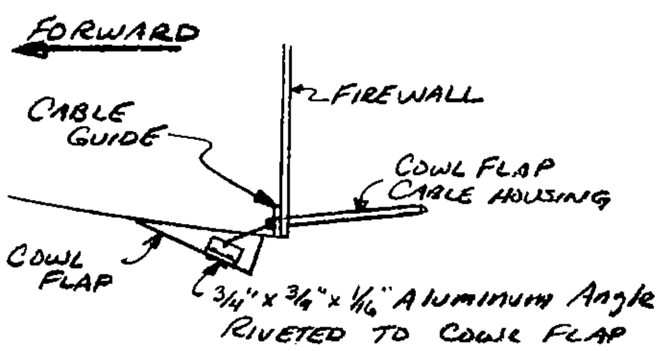
Carb heat: this control is potted into the firewall with silicone or 5-MIN and attached to the carb heat control arm.



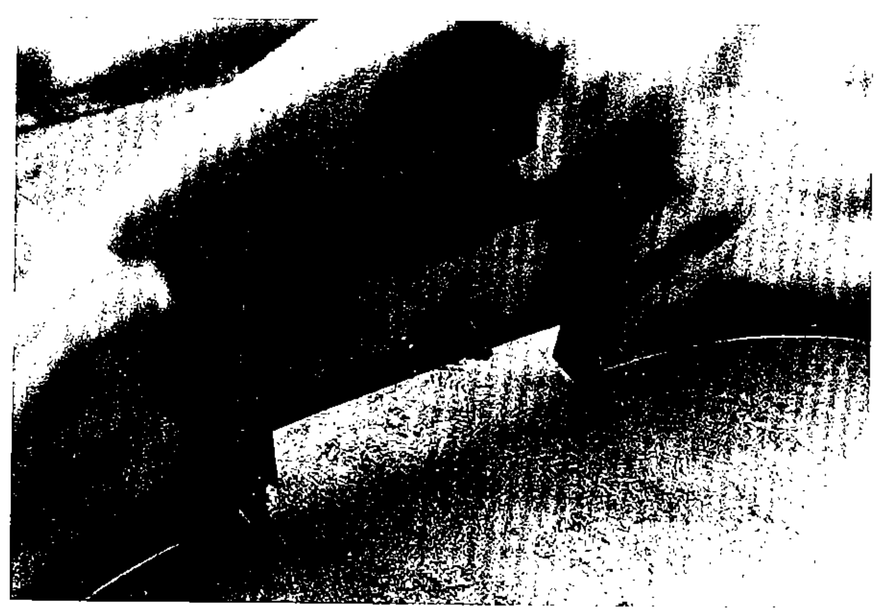
PUSH-PULL CABLE GUIDE

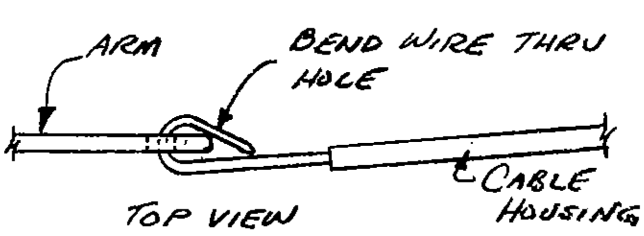
MAKE 3



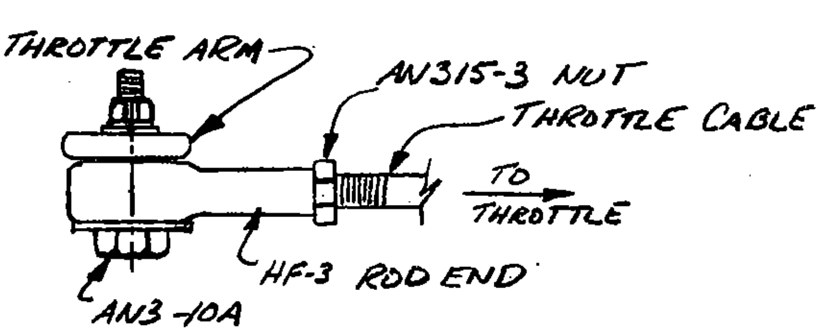


COWL FLAP ACTUATION

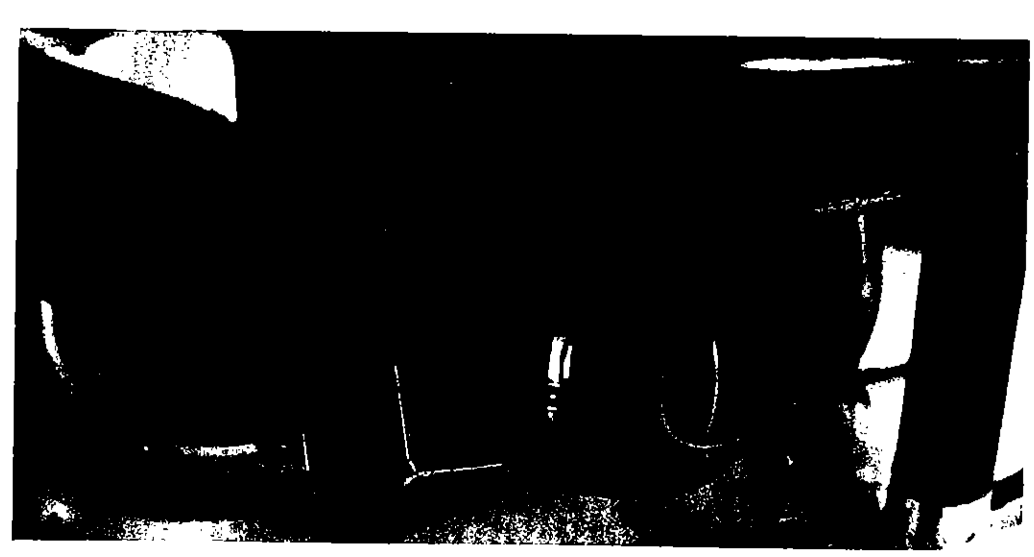




TYPICAL CABLE ATTACH
(EXCEPT THROTTLE)



THROTTLE ATTACH

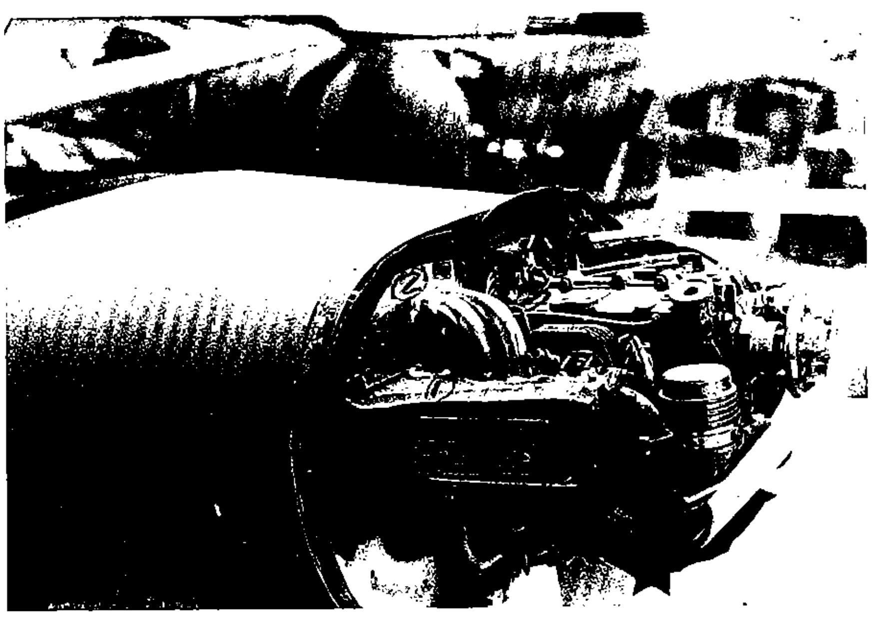


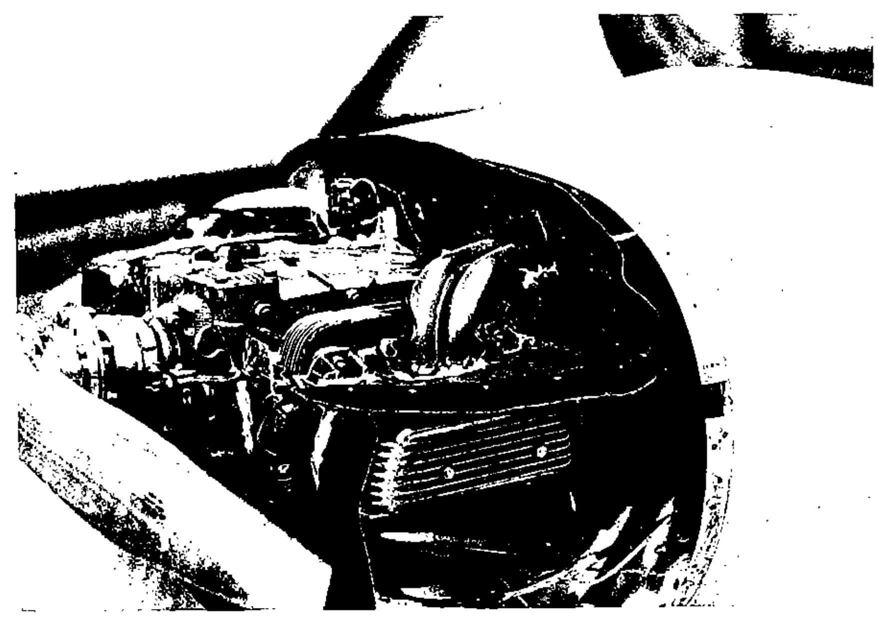
ENGINE BAFFLING

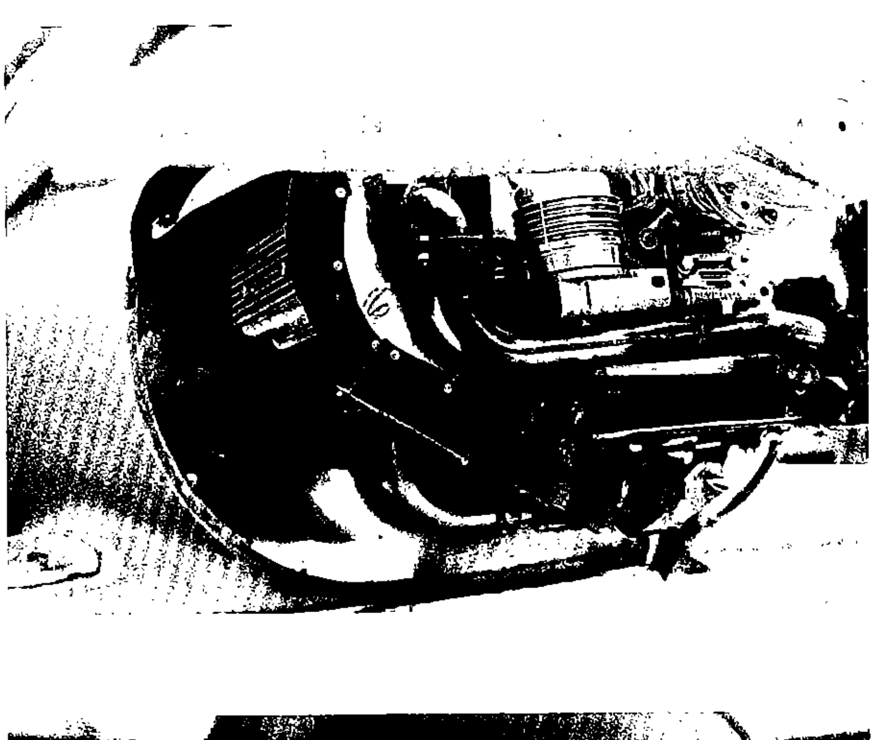
The purpose of the engine baffling is to provide adequate airflow for cooling to all critical areas of the engine and accessories. Air enters through the cowling air inlets located on either side of the spinner. A vertical baffle located in front of the forward engine cylinders forces the incoming air to travel upward across the cylinders and then down through the fins, exiting the bottom of the cowling through the variable opening cowl flap. Another vertical baffle located just aft of the rear cylinders assists in forcing the air down through the cylinder fins. Likewise, baffling between the cylinders and the sides of the cowling performs the same function. An opening in the forward vertical baffle allows airflow into the oil cooler. Once having passed through the oil cooler, this air mixes with the spent cylinder fin air to exit through the cowl flap.

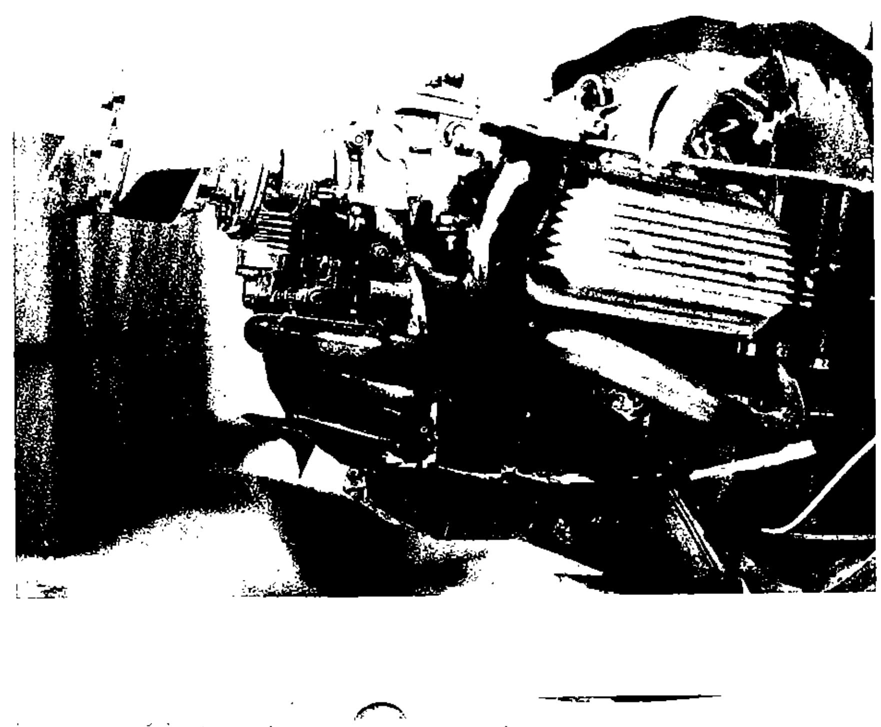
Aluminum with an 0.032" thickness is the primary baffle material. Approximate full size patterns are provided. However, there is no easy way to fit baffling around the complex shape of the engine. Areas of leakage must be closed off with aluminum in the case of large holes, and silicone in the case of small leaks. The black rubber asbestos is used between the aluminum and the cowling to provide a close fit when the cowling is installed. Pop rivets (BSP42) are used to join the pieces of baffling and asbestos together. Small angles can be bent up from the 0.032" thick aluminum to attach the baffles to bolts on the engine painted red. In this manner, the baffling will be removable.

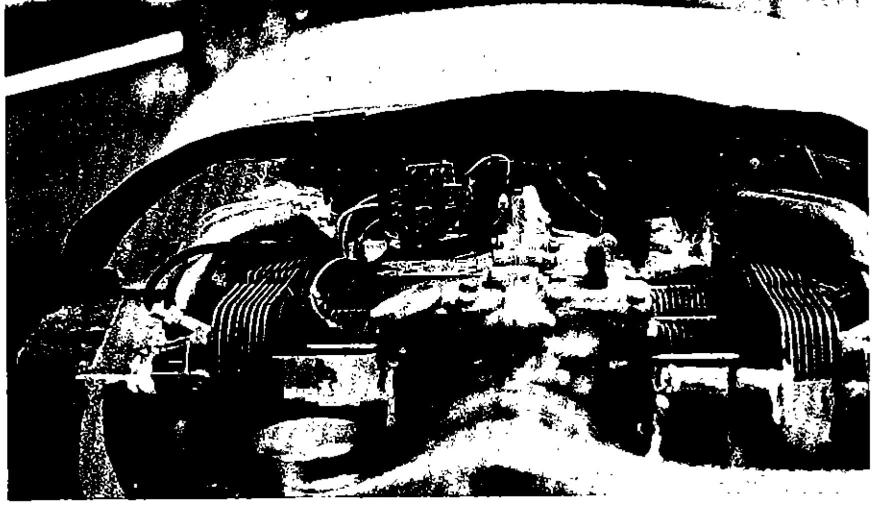
Baffling can easily consume 10 manhours of work, so don't hurry. Inadequate cooling is a major factor in many homebuilt aircraft engine problems.

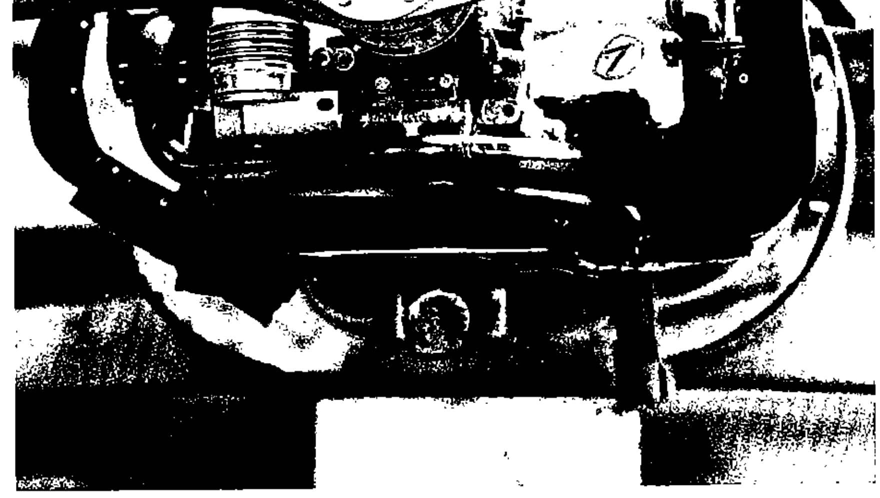












END OF CHAPTER

FUEL SYSTEM INSTALLATION

INTRODUCTION

The Q2 fuel system consists of a main fuel tank that forms part of the seat, and a fuel header tank positioned above the passengers' legs. The carburetor receives fuel by gravity feed from the header tank. The header tank is filled from the main fuel tank by an electric fuel pump, with a manual fuel pump as a backup. An overfill line in the header tank continually recirculates the excess fuel pumped by the fuel pump back to the main fuel tank. Each tank has a seperate fuel gauge. In the event of a complete fuel pump failure, a full header tank is sufficient for over 225 statute miles at economy cruise. The main fuel tank is filled from a fuel cap located on the right side of the fuselage just ahead of the instrument panel. The header tank can only be filled using the fuel pump.

FUEL FILLER SYSTEM

Provided with your Q2 kit is a small storage bottle. By cutting the neck from this bottle, the upper part can be used as the fuel cap. The storage bottle top is compatible with fiberglass/epoxy laminates. As an option, the builder might consider using a conventional aluminum fuel cap, but the mounting will be more difficult.

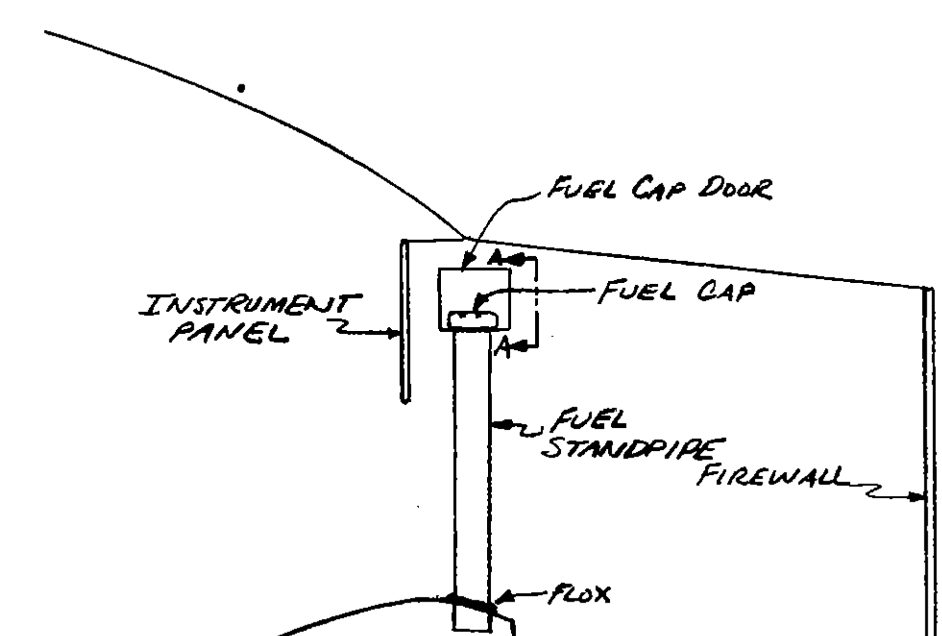
Once the top of the bottle has been cut off, trundle down to your nearest plumbing supply place and find a piece of PVC pipe of approximately the same diameter. Then, trundle back home and laminate the storage bottle neck to the PVC pipe with 2 BID. Be sure to sand both surfaces prior to the lamination.

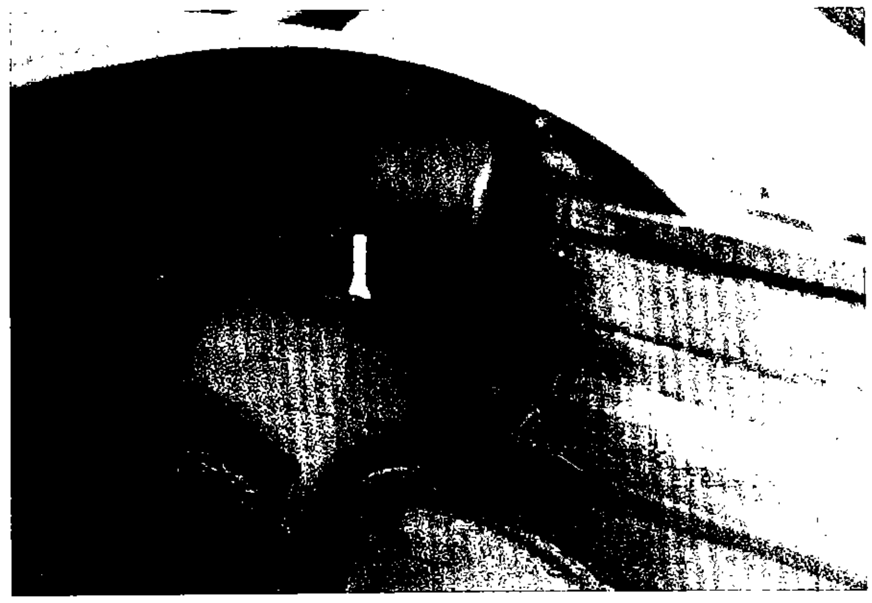
Take a magic marker and mark the location on the outside fuselage skin where the fuel filler door must go. Carefully, cut out a door and save it for later. Next, make a recess for the fuel cap from 1/4" white foam and fiberglass/epoxy.

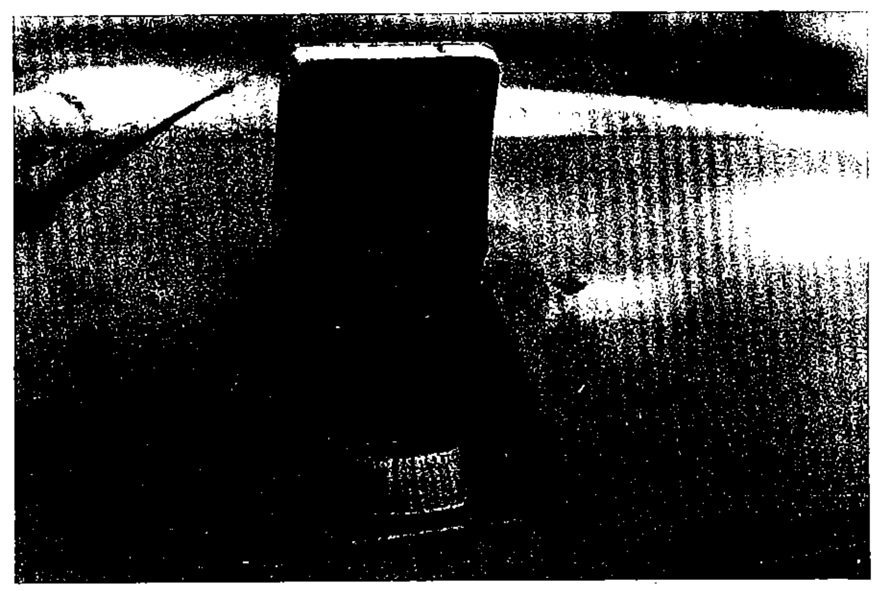
As shown in the sketches and pictures, the PVC pipe is bonded into position with flox. The recess prevents spilled fuel from entering the cockpit.

To hinge the fuel cap door, you could use a small piece of hinge and bond it in place. However, because of the fuselage shape, this may not be satisfactory. An alternative is to make a small pin type hinge. Find a small diameter (about 1/16" diameter) steel rod. Grease it with vaseline to prevent adhesion by the epoxy, and lay it flat against the upper inside portion of the fuel cap door. Laminate 3 BID over it. When cured, the pin will still be able to rotate, but will be restrained by the cured laminate. Finally, fit the door carefully and bond the ends of the pin to the fuselage on either side of the fuel cap door cutout. Presto, a hinged fuel cap door.

Finally, drill a 1/16" diameter hole in the top of the fuel filler cap. This will serve as the main tank vent.







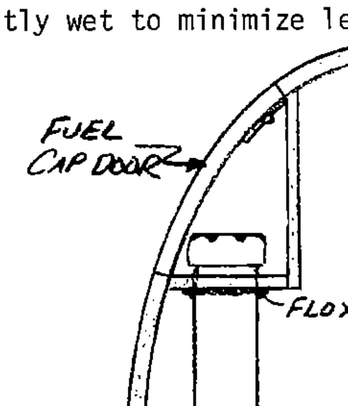
HEADER TANK CONSTRUCTION

Previously, in Chapter 14, you have installed the main fuel tank permanently in the fuselage, along with the main fuel tank fuel gauge.

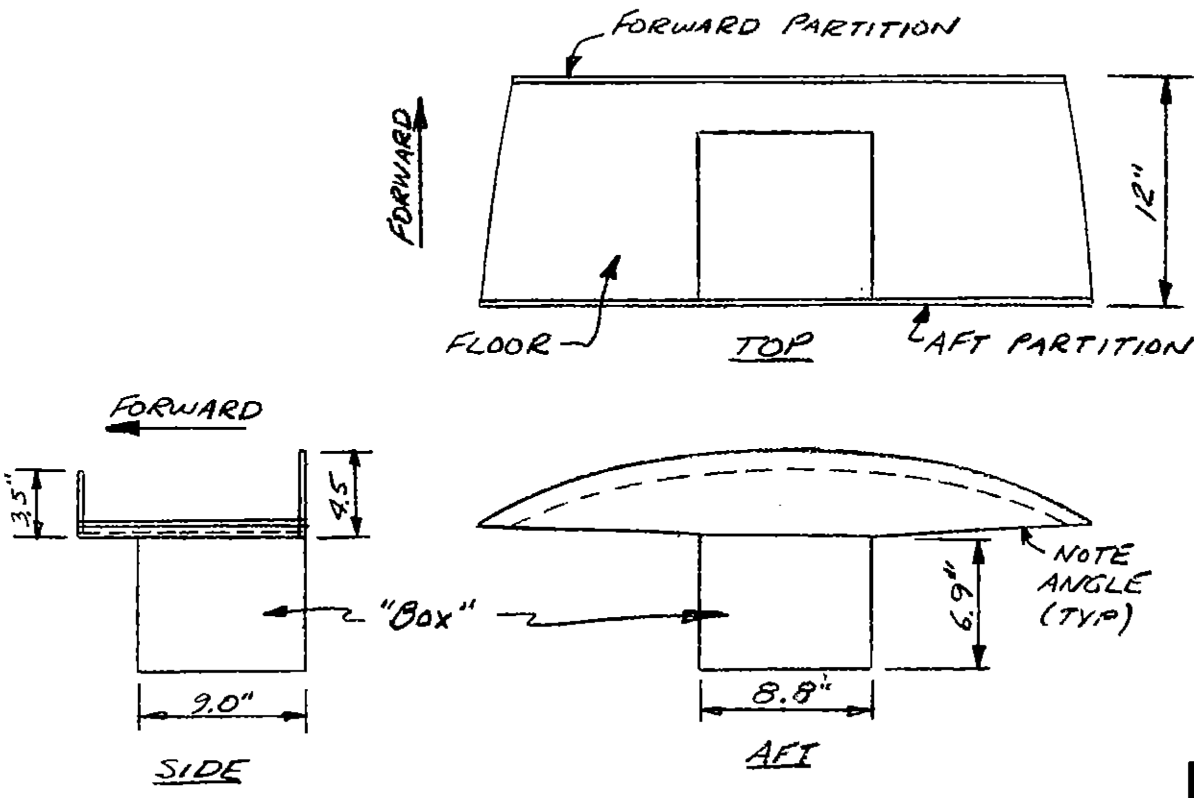
The important fuel header tank dimensions are shown in the accompanying drawings. This fuel header tank is installed against the upper fuselage inside skin approximately 5 inches aft of the firewall. Sufficient room must be left so that the pilot's and passenger's feet will clear the header tank.

The large sump is a simple rectangular box. The upper portion of the header tank is curved to fit within the fuselage. This section must be custom fitted to each individual aircraft. Suggested heights for the front and rear pieces are provided as a guide. The length of 12 inches should provide sufficient clearance for the instrument panel radios and instruments. However, this header tank should be adapted to your particular aircraft, verifying that both the pilot and passenger can be comfortably seated.

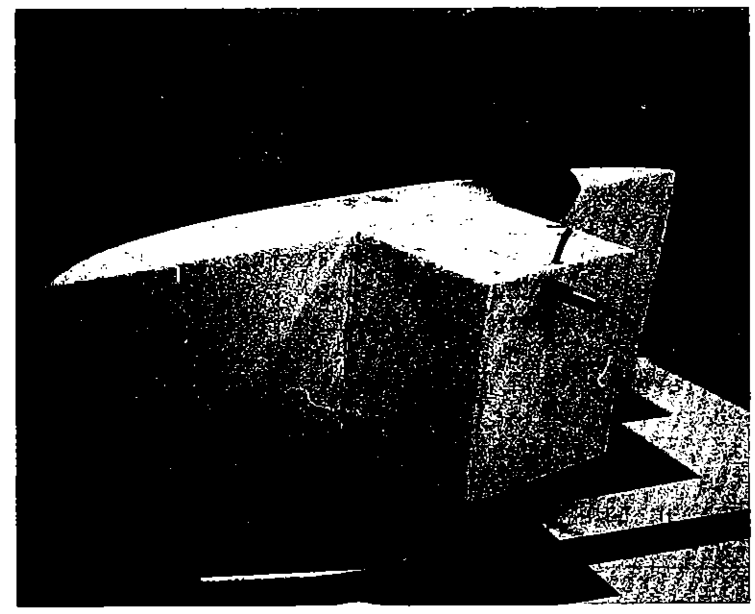
All pieces for the header tank should be cut from the 1/4" thick white foam. One BID on either side of the foam is used when assembling the header tank. The laminations that will 'see' gasoline, should be made slightly wet to minimize leakage.

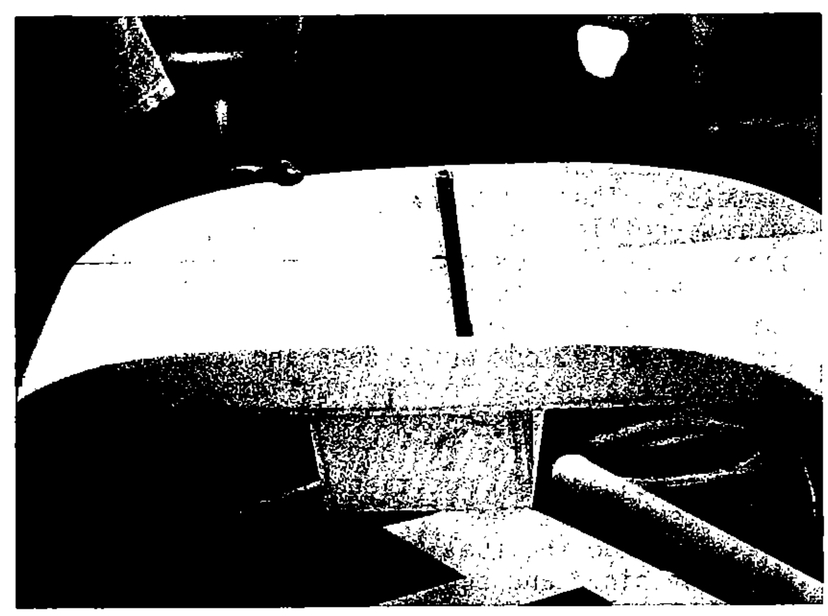


VIEW A-A



FUEL HEADER TANK LAYOUT



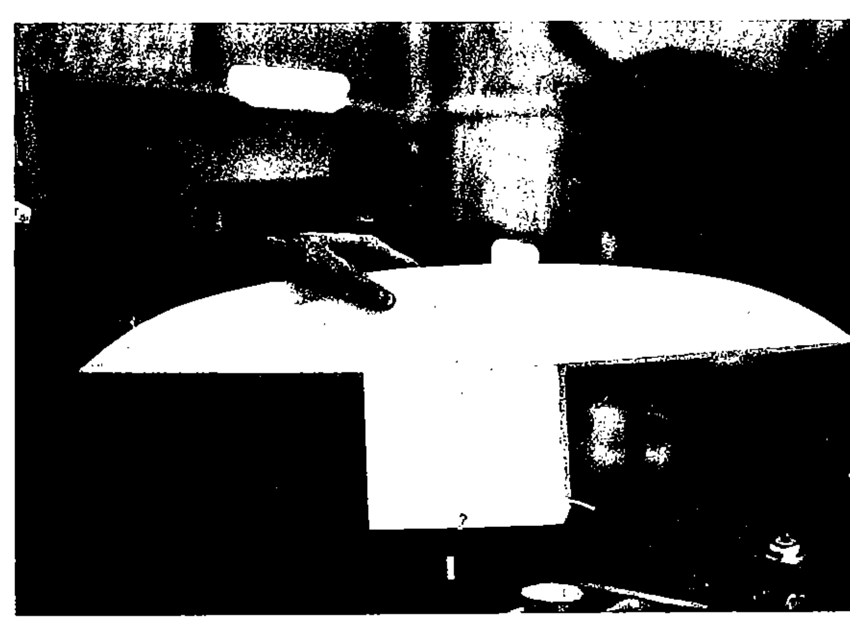


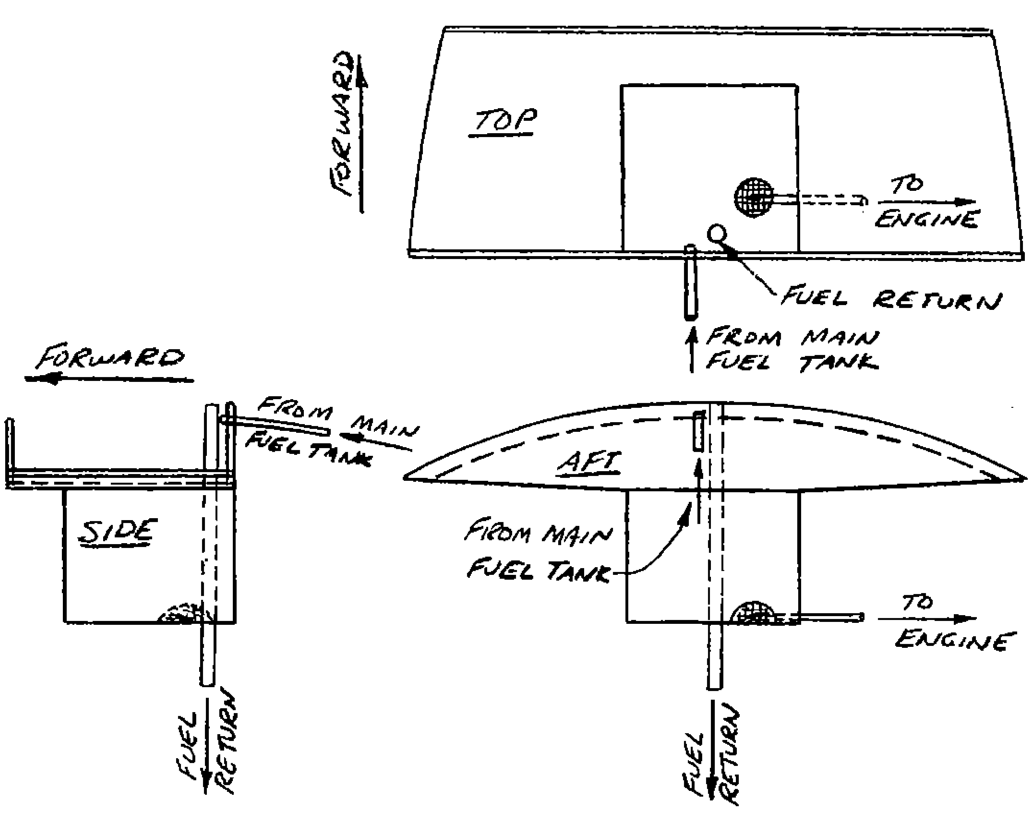
HEADER TANK PLUMBING

Prior to permanent installation inside the fuselage, the plumbing for the header tank should be installed. The accompanying drawing shows the location for all header tank plumbing. The fuel feed to the engine should be patterned after the main fuel tank feed shown on Page 14-3, including the screen and flox, but omitting the drain valve. Both the feed line from the main fuel tank and the feed line from the engine should be made from 1/4" O.D. Aluminum tubing. Allow the tubing to extend out from the header tank about 6 inches. Use liberal amounts of flox to seal the exit points.

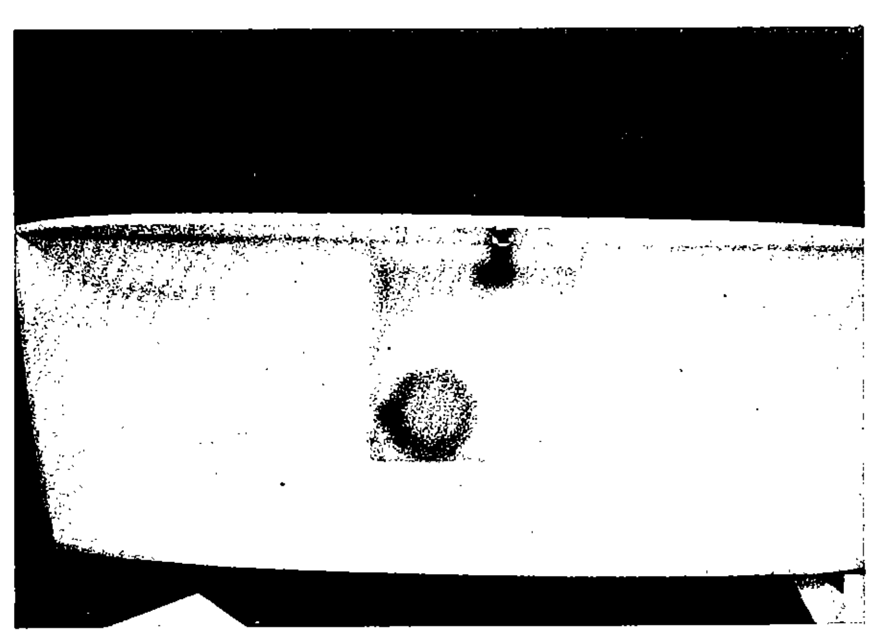
The fuel overflow return tube is made from 5/8" O.D. Aluminum tubing. It should extend to near the very top of the aft part of the header tank, in order to maximize the fuel capacity. Permit it to extend about 6 inches below the header tank, and seal the exit point with flox.

The routing shown for the plumbing is nominal, but will avoid interference.





HEADER TANK PLUMBING

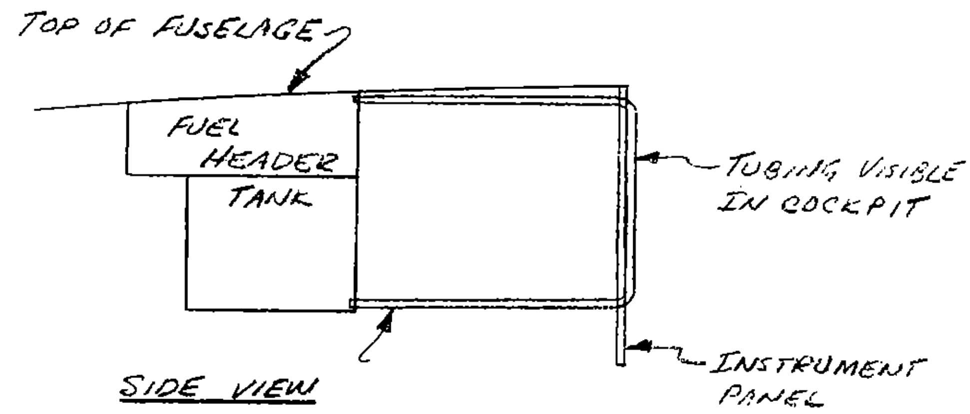


HEADER TANK INSTALLATION

It is much easier to install the header tank prior to mounting the canard to the fuselage.

Install the header tank using 2 BID and flox where it meets the inside fuselage skin.

As a reminder, prior to permanently mounting the fuel header tank, make sure that it will not interfere with instruments, feet, rudder pedals, engine installation, etc. In order to maximize the fuel quantity, it has been made a tight fit in the forward fuselage.



HEADER TANK FUEL GAUGE

HEADER TANK FUEL GAUGE

It is necessary for the fuel header tank to have a fuel gauge to detect any failure of the fuel transfer system that would result in a reduced level of the header tank.

A very simple arrangement of clear plastic tubing is used to create a sight fuel gauge. It is floxed in place at the top and bottom of the fuel header tank, and then run aft through the instrument panel into the cockpit where it is turned vertically as shown.

Later, calibrate the gauge with the fuselage levelled with respect to WL15 by adding fuel in one gallon increments and marking the clear plastic tube. A similar calibration is performed on the main fuel tank guage.

It is important to note that the gauge will only be accurate while in straight and level flight. Particularly in the case of the fuel header tank guage, small changes in aircraft attitude will make large changes in the indication of fuel quantity. The fuel header tank gauge should be used only to verify that the fuel header tank is maintaining a full level in straight and level flight.

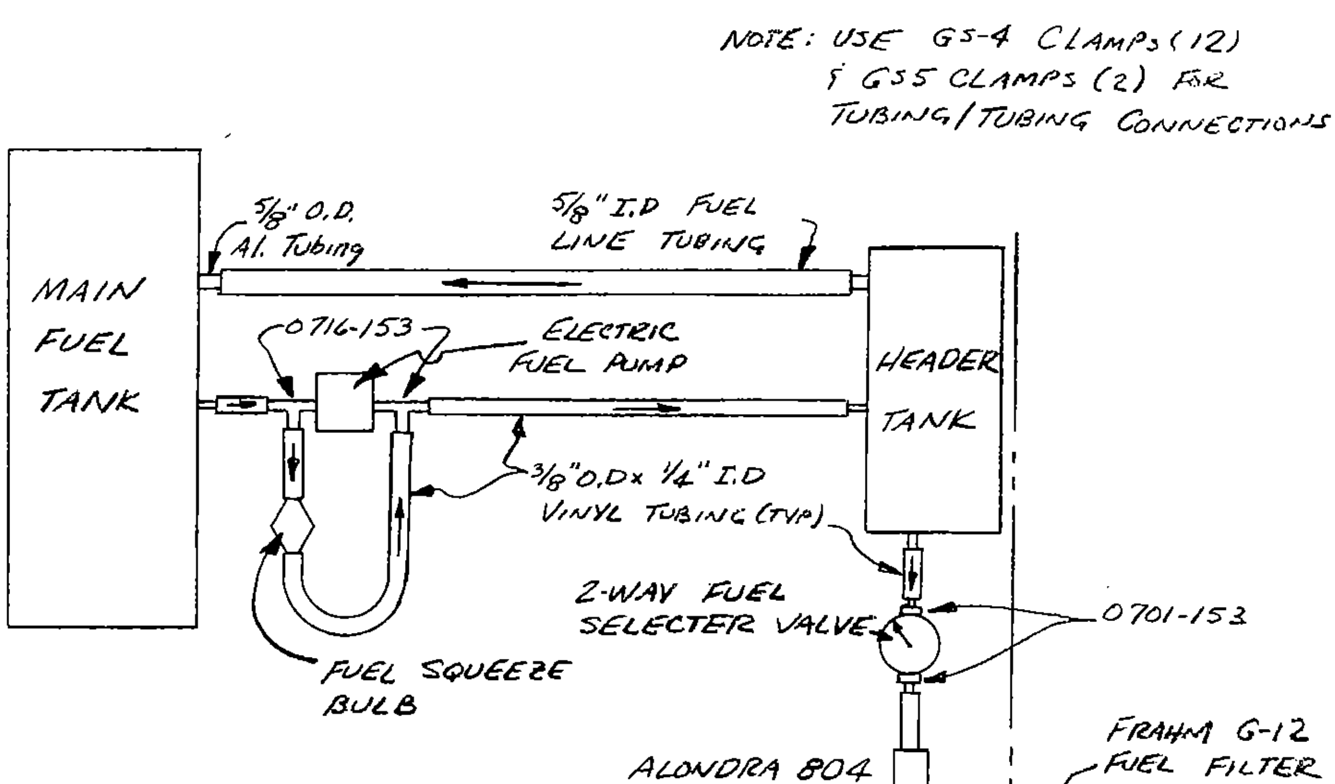
Also note that the fuel header tank gauge cannot be installed until after the instrument panel has been installed.

FUEL SYSTEM INSTALLATION

Included with this section is a schematic of the fuel system for your Q2. It is really quite simple.

Both the squeeze bulb (backup fuel pump) and the fuel shutoff valve must be capable of being actuated by the pilot while seated in the cockpit. However, it is important that the fuel line to the carburetor from the header tank travel a minimum distance. Therefore, it will probably be necessary to fabricate an extension on the fuel valve handle such that the fuel valve can be located near the firewall, in order to reduce the length of the fuel line to the carburetor.

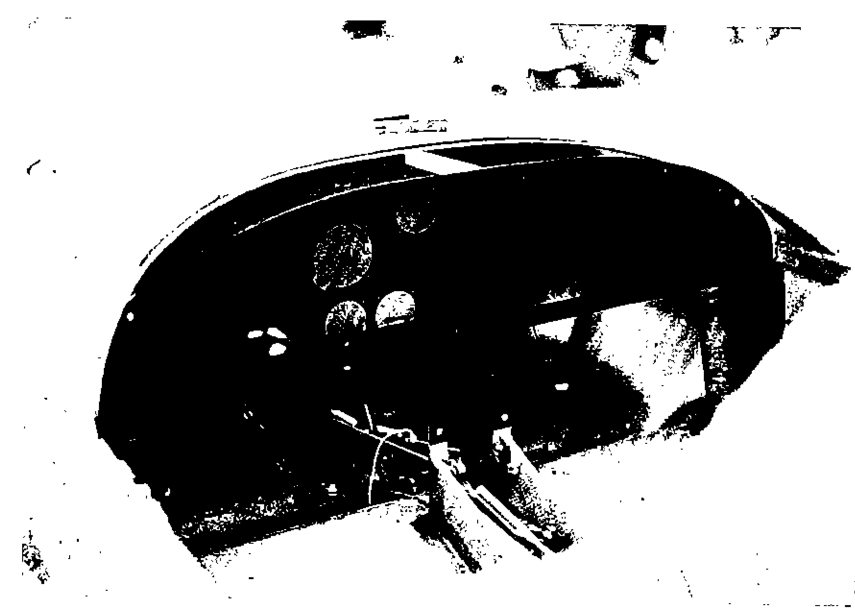
The two filters shown are very important. They must be checked after every engine run for the first 20 hours. Regardless of how good of a job you expect to accomplish in keeping contaminents out of the two fuel tanks, particles will travel through the fuel lines and must be removed. This is a safety-of-flight issue. The vibration of taxiing will break loose particles for several hours. Do not ignore fuel contamination problems.

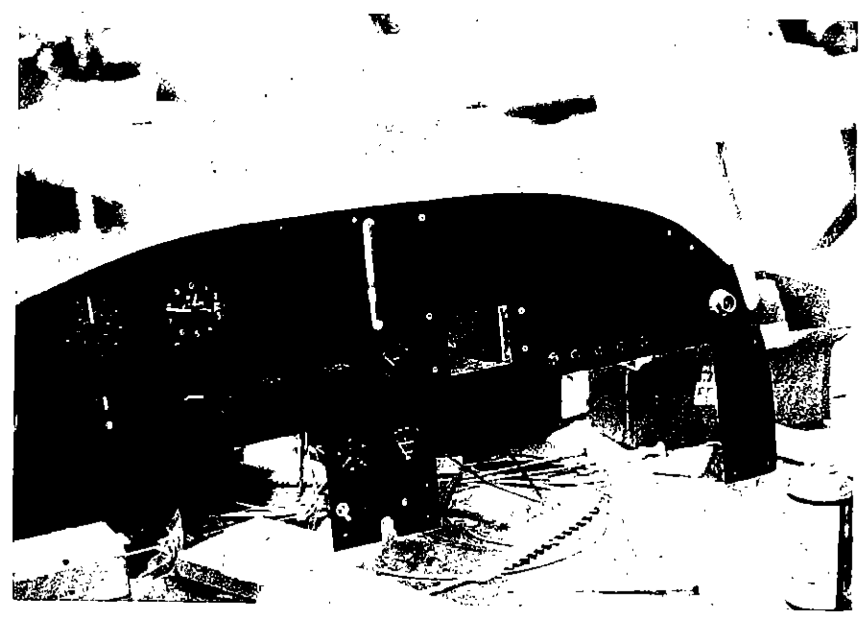


FUEL SYSTEM SCHEMATIC

END OF CHAPTER

INSTRUMENT AND PITOT-STATIC INSTALLATION





INSTRUMENT PANEL INSTALLATION

An infinite variety of instrument panel configurations are possible. Since this area of the aircraft is such a popular focus for that 'custom' look, we have refrained from presenting any specific configurations beyond the pictures of our panel and a few suggestions.

The basic outline of the instrument panel was cutout in Chapter 4. It is suggested that all cutouts for instruments and equipment be completed prior to permanently mounting the instrument panel to the airframe. Nominally, the aft face of the panel is at FS41. This can vary depending on the particular pilot size and positioning to be used by the individual builder. The three sub panels that extend down below the instrument panel to meet the two side consoles and the center console are constructed from either scrap 1/8" thick plywood, or else 1/4" white foam with 1 BID on either side. One BID should be laminated on either side of the complete instrument panel to add rigidity and to seal the plywood.

If the builder wishes to make the instrument panel removable, small tabs can be fabricated. These tabs would be bonded to the fuselage, and the instrument panel bolted to them. Otherwise, permanently mount the instrument panel with BID tapes to the fuselage sides and the consoles. If the attachment is to be permanent, all work forward of the panel should be completed prior to this step, as access will become very difficult.

It is recommended that the following controls be on the center sub panel: cowl flap, carb heat, mixture control. It is further recommended that the throttle be located on the left sub panel. The electrical switches and fuses can be located either on the center sub panel, or else elsewhere accessable to the pilot. Conventionally, flight instruments go on the left side of the panel, engine instruments predominately in either the center of the panel or on the far right, and avionics are mounted in either the center or the right side of the panel.

Provision must also be made for a ground bolt, which is simply a AN3-7A bolt located somewhere on the panel that is used to connect the equipment needing grounding. (See the electrical system schematic).

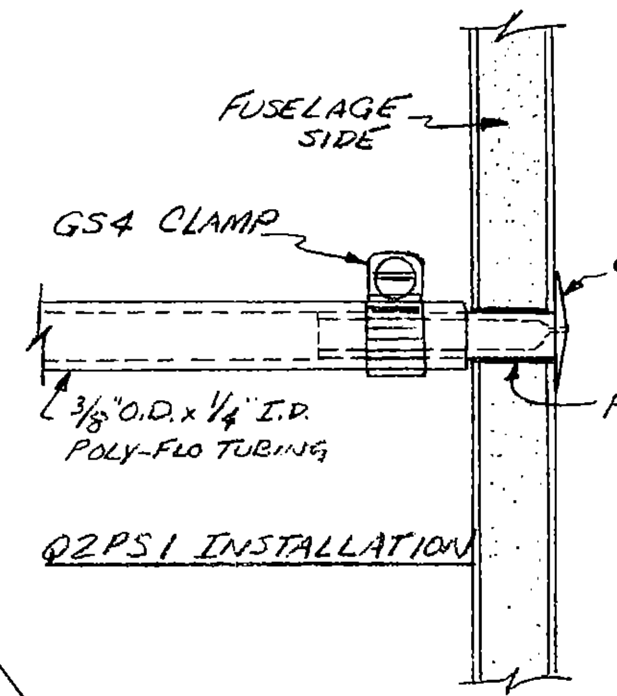
The instruments included with the kit are those required by the FAA for day VFR flight. There is plenty of additional room available for optional instruments and avionics.

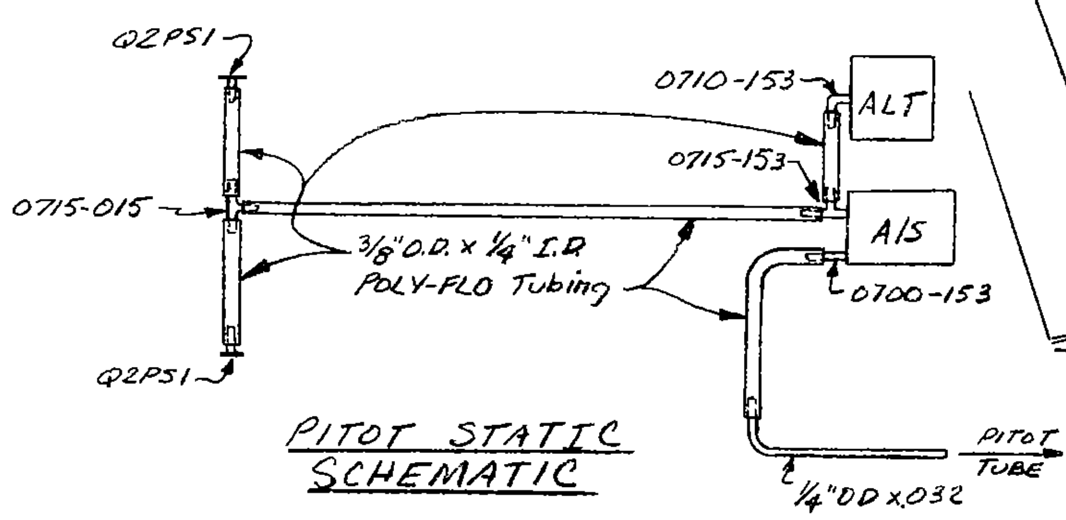
PITOT-STATIC SYSTEM INSTALLATION

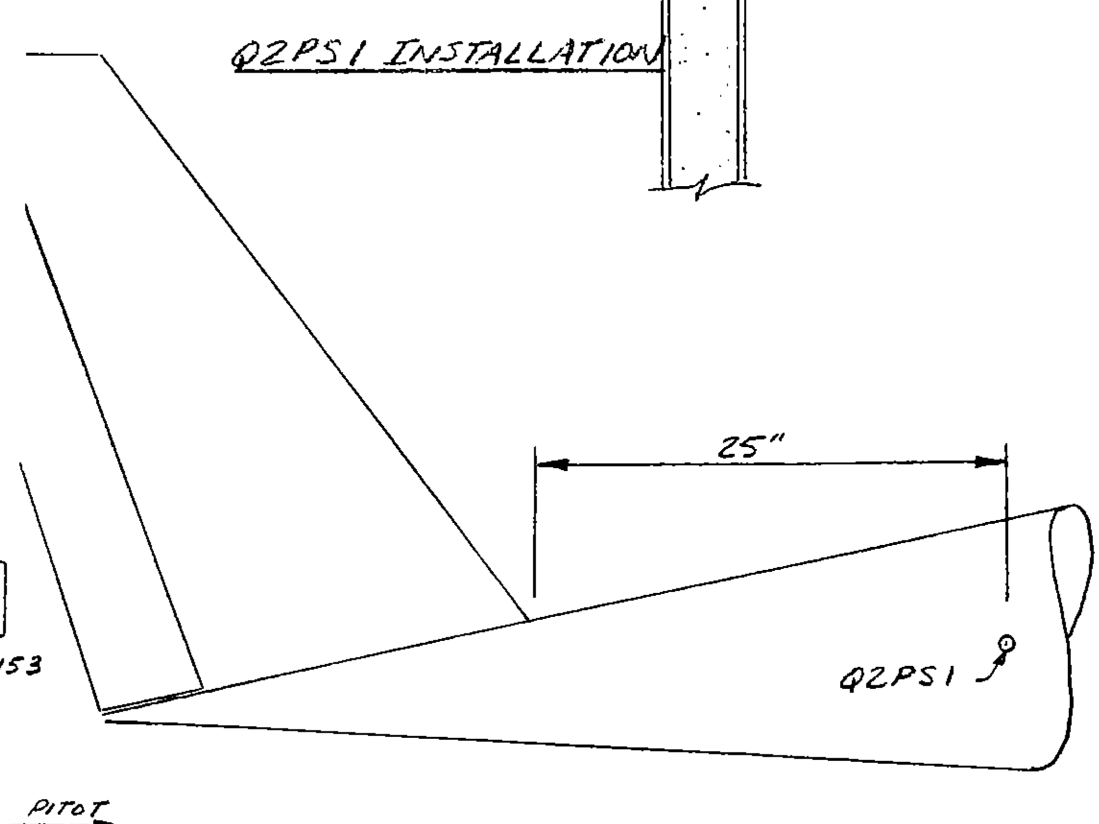
Begin by mounting the two Q2PS1 static ports on either side of the fuselage as shown. Use flox, being careful not to clog up the static hole. Two static ports are used in order to assure accurate readings during sideslip maneuvers.

The schematic indicates the required connections for the Airspeed and Altimeter. Run the tubing so that it does not interfere with baggage or passengers. It is recommended that it travel down the center console before reaching the instruments.

The pitot system must be leak checked. Have one individual watch the airspeed indicator, while the other person blows into the pitot tube and uses his tongue to hold in the presssure. The airspeed indicator should register a speed, which remains constant for a few seconds. If the speed diminishes while the second individual is holding the pressure in the system, then there is a leak somewhere, probably at one of the connections.

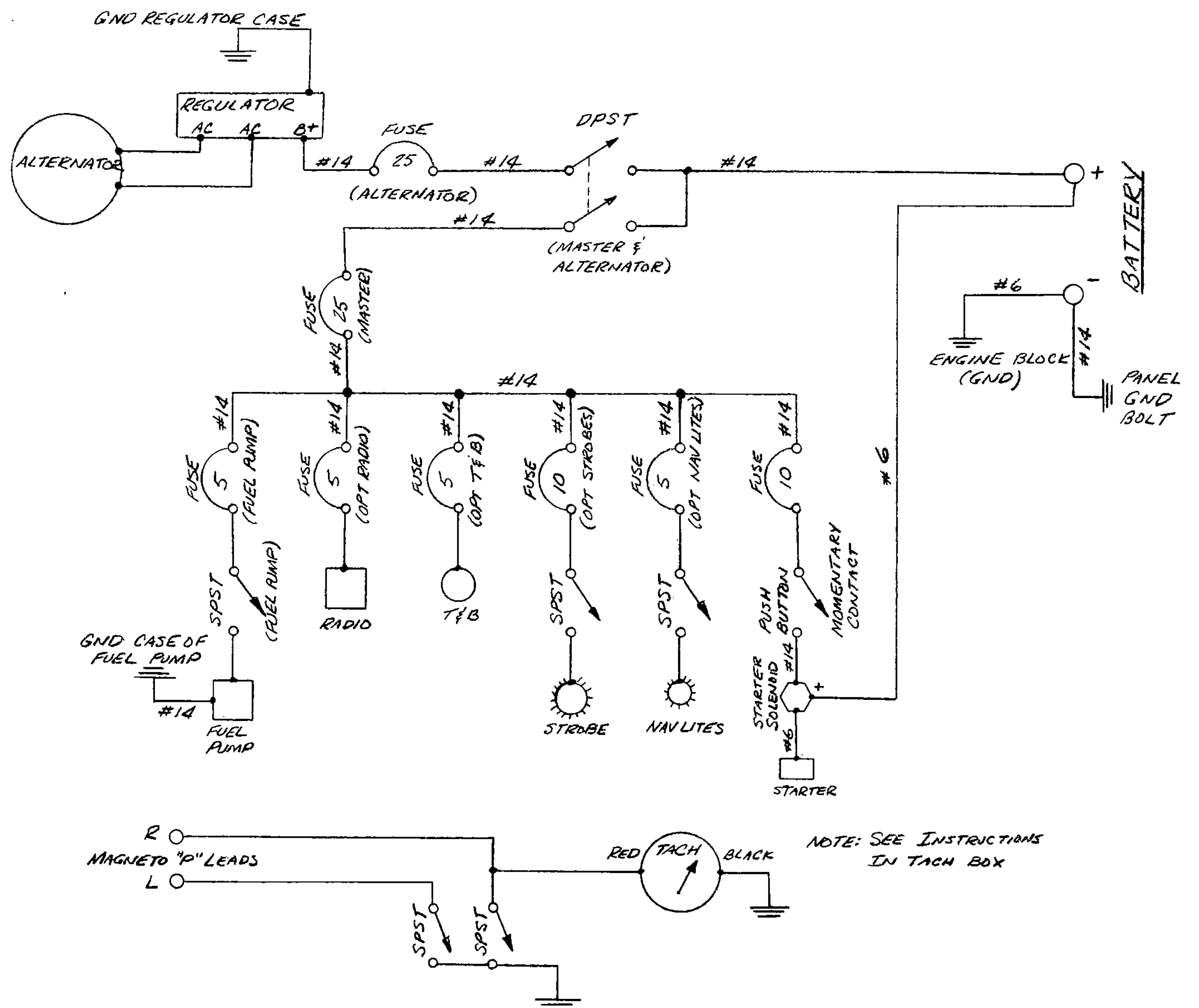






Q2PS1 LOCATION

END OF CHAPTER



INTRODUCTION

The schematic accompanying this chapter details the necessary wiring for the standard Q2 kit. Additional information is provided for wiring the more popular optional equipment items. A separate schematic details hooking up the magneto switches and tachometer.

The panel ground bolt is simply a AN3-7A bolt located on the instrument panel that is used to connect all items that must be grounded.

The fuses, fuse holders, wire (#14 and #6), connectors, and switches for the standard Q2 kit are included. Optional equipment will require additional components. The battery recommended with an electric starter is a 12 v, 18 AH battery.

It is advisable to wait until a weight and balance has been performed (see the Q2 Pilot's Manual) prior to locating the battery, in order to use it as ballast to achieve the desired center of gravity range. In lieu of that, it should be located in the baggage compartment at about FS80.

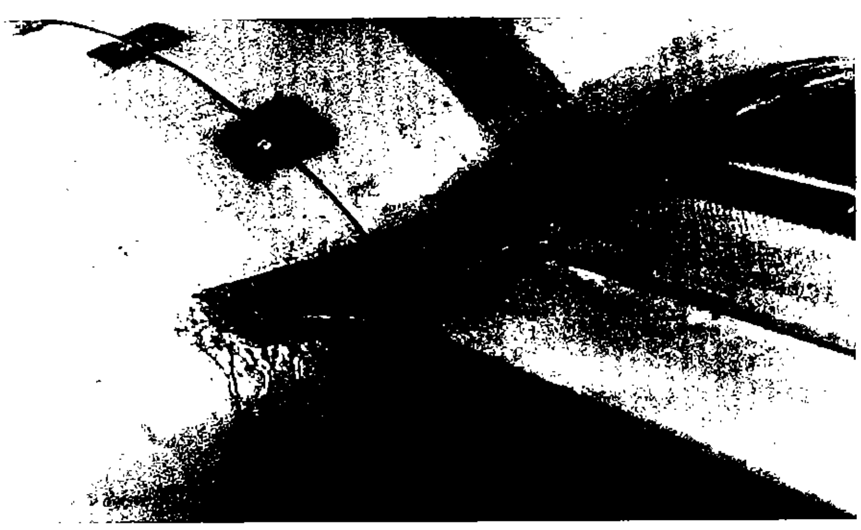
COMPLETING YOUR Q2

STREAMLINING YOUR Q2

A significant improvement in your Q2's aerodynamic cleanliness can be achieved by fabricating fillets and fairings for the major component intersections. A bit of artistic ability is necessary to develop a pleasing and efficient shape, but at this stage of the construction, you'll be up to it.

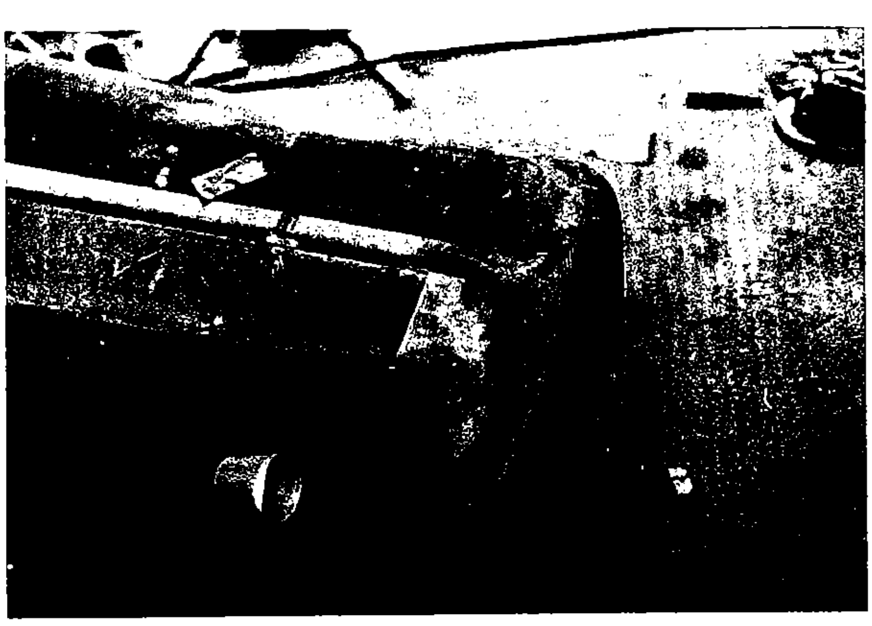
AILERON FILLETS

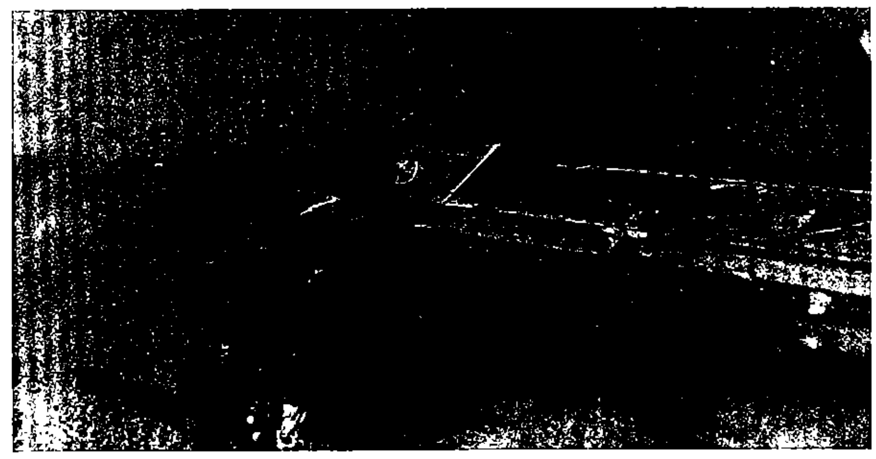
The aileron/fuselage junction should be filleted using scrap foam and 1 BID. Each fillet will need to be 2 piece, as shown, if your aft fuselage is removable. Careful work should allow most of the gap to be filled on the top surface, while leaving a gap on the bottom side to allow removal of the aileron.



ELEVATOR OUTBOARD FILLETS

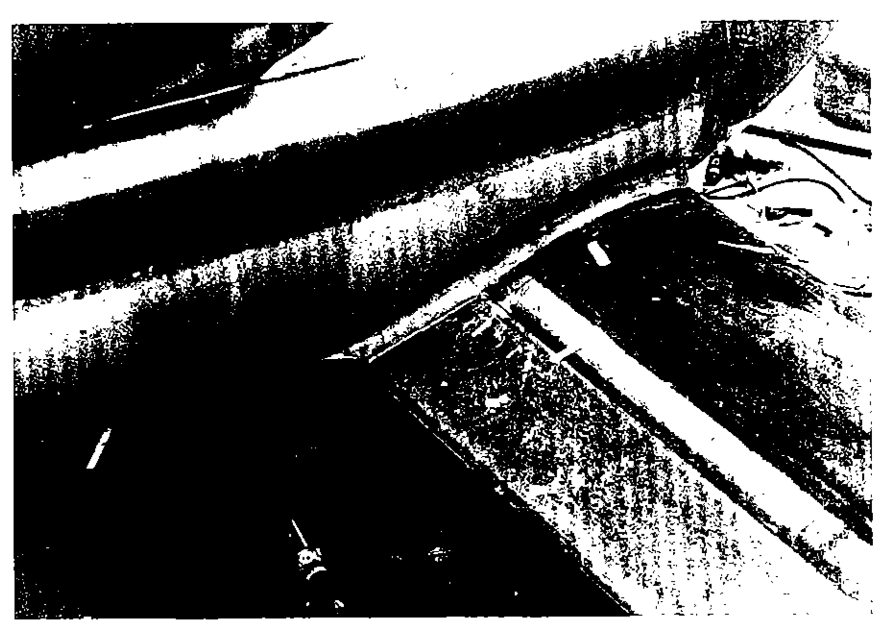
A fillet is also necessary between the inboard face of the wheel pant and the outboard end of the elevator. Set the elevator with the trailing edge approximately 4 degrees up. Use scrap foam and 1 BID to create a fillet similar to the one shown in the picture.





ELEVATOR INBOARD FILLETS

At the elevator/fuselage junction, a more complicated fillet will improve performance. Since the junction angle is more than 90 degrees, you will want to sweep in a radius as shown using scrap foam and 1 BID again. Visualize how the fillet will sweep into the cowling.



CANARD/FUSELAGE FAIRING

At this point, their should be a noticeable and ugly gap under the fuselage where the canard and fuselage meet. A fairing should be made out of scrap foam and 1 BID similar to the picture.

MAIN WING TIPS

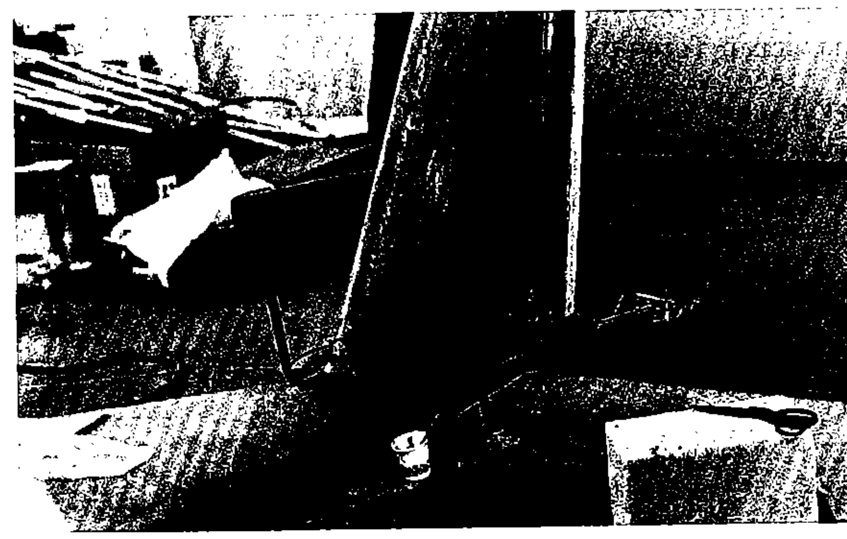
Now would also be a good time to carve wing tips on the main wing. If you wish, you may add up to 3 inches of foam to the wing span to facilitate a smooth looking wingtip. Keep it simple, however.

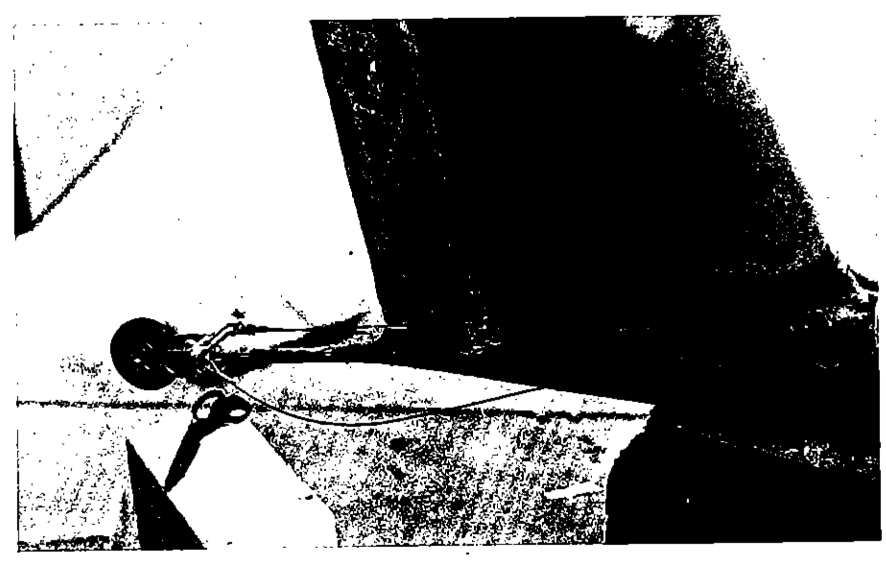
VERTICAL FIN TIP

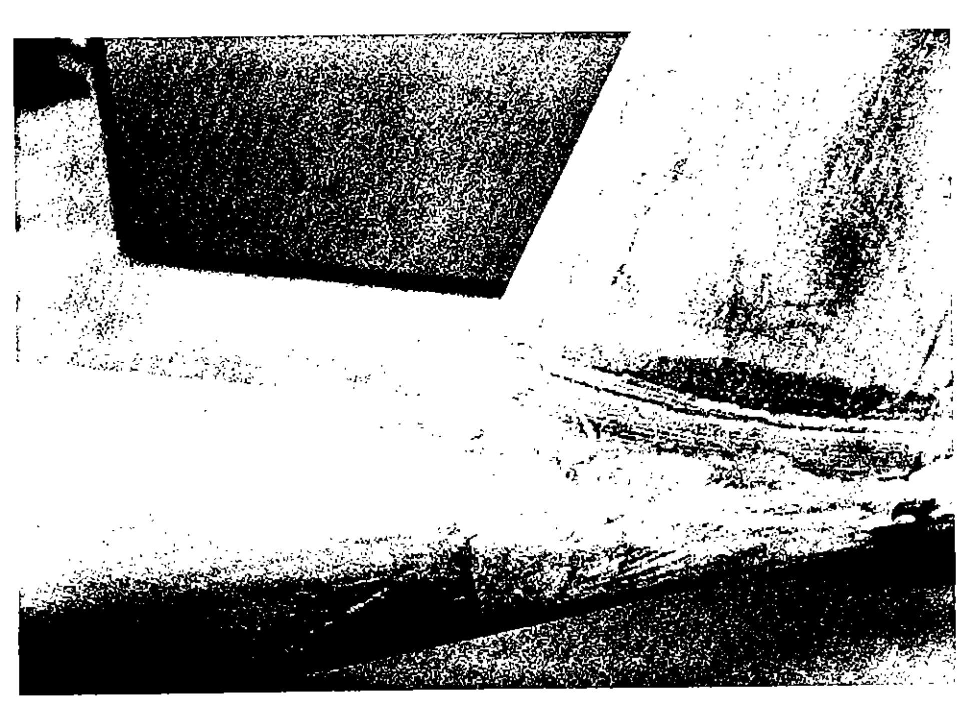
Ditto for the tip of the vertical fin.

VERTICAL FIN ATTACHMENT

Previously, you mounted the vertical fin to the bottom of the fuselage. Now is the time to permanently attach it to the fuselage and create a pleasing fillet shape at the same time. Using pieces of foam, fill the gap between the vertical fin and the aft fuselage. Carve the foam down to a pleasing shape, as shown, and laminate 2 BID overlapping onto the aft fuselage skin a minimum of 2 inches.







CARBURETOR AIR INLET

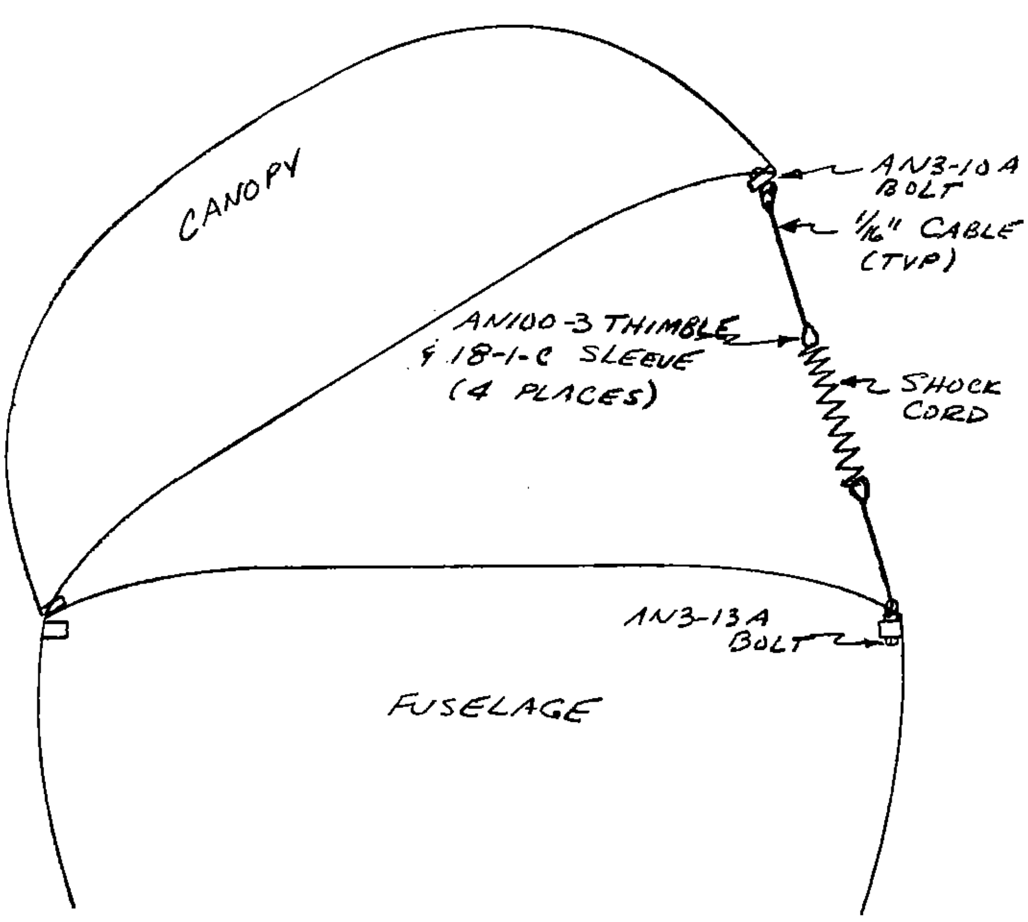
Cut a round hole in the lower cowling for the carburetor air inlet. Fabricate a round tube by laminating 4 BID around a bottle such that the tube will slip over the end of the alternate air source. (Don't forget to use vaseline on the bottle so the lamination can be removed). Bond the tube to the lower cowling carburetor air inlet hole. The result will be a direct ram air flow into the carburetor.

CANOPY RETENTION

It is advisable to have some form of restraint for an open canopy besides permitting it to rest on the main wing. Otherwise, in case of a strong wind, the canopy may be blown off of the aircraft.

The illustration shows a simple shock cord arrangement. The cable is sized so that the canopy will remain open with tension against the shock cord. This will require the canopy to be open approximately 90 degrees.

A more clever solution is to purchase a small gas spring assembly (such as those on automobile hatchbacks) and install it on the aft canopy bulkhead and the seat-back bulkhead. This is the ultimate in sex appeal!

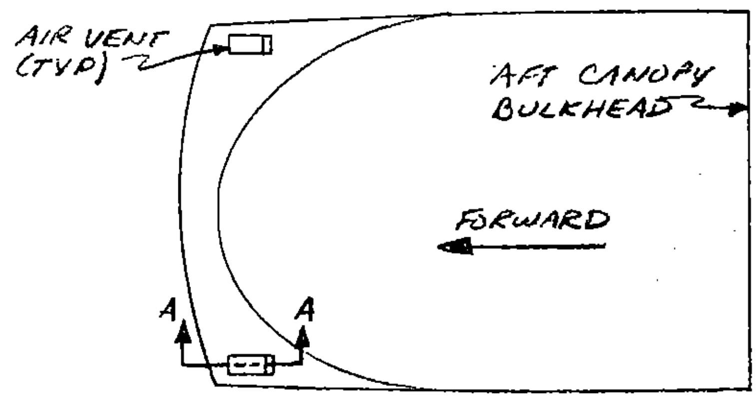


CANOPY RETENTION CABLE
(FRONT VIEW)

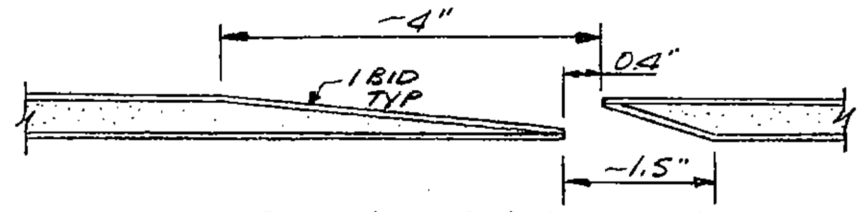
COCKPIT AIR VENTS

A cockpit air vent on either side of the fuselage must be installed prior to first flight. A simple shape, and recommended location, is shown in the sketches.

To exhaust the cockpit air, a hole could be cut in the tailcone, or else an exhaust vent could be cut in the aft top fuselage.



CANOPY VENT SYSTEM
TOP VIEW



SECTION A-A
NOTE: NOMINAL 2" WIDTH

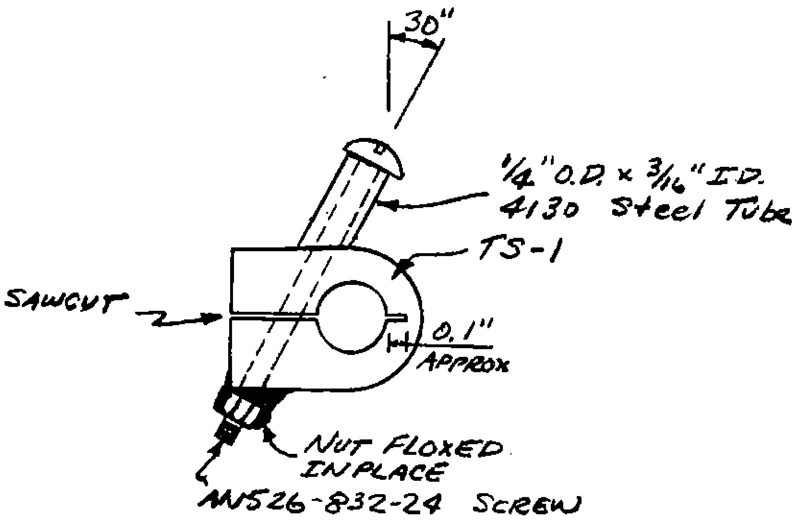
PITCH TRIM SYSTEM TENSION

While writing Section II of these plans, and building N81QA, we built a simple system to vary the tension, or drag, on the pitch trim wheel.

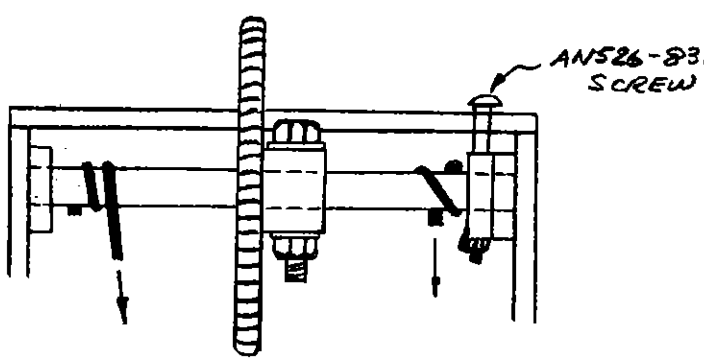
Make a third TS-1 bearing from phenolic. Drill a 3/8" diameter hole as shown. Next, saw-cut the bearing through the hole, but do not go all the way through and make two pieces. The lower half of TS-1 is bonded with resin to the end TS-1 bearing already mounted. Do not bond the top half or the system will not function.

Study the sketch. By turning the screw, the size of the 3/8" hole can be varied slightly, changing the tension on the pitch trim drum. A knob bonded to the screw would make tension adjustable in flight.

CONTINUED ON NEXT PAGE



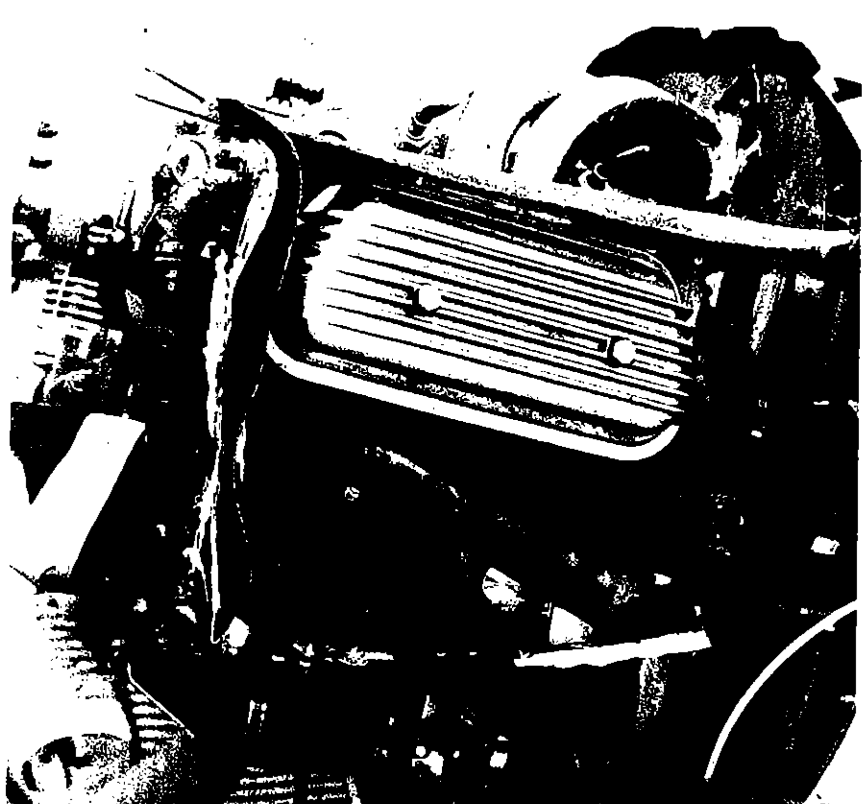
PITCH TRIM TENSION ASSEMBLY



TRIM WHEEL
(LOOKING FORWARD)

EXHAUST SYSTEM MOUNTING

The exhaust pipe exits the cowling next to the cowl flap. In traveling from the cylinders to the exit, the exhaust system will enter and exit the baffling. These holes must be closed up to prevent air leaks, and consequent reduction in cooling. Also, the warm exhaust pipe must not come into contact with fiberglass or any of the engine controls, so use asbestos where necessary.



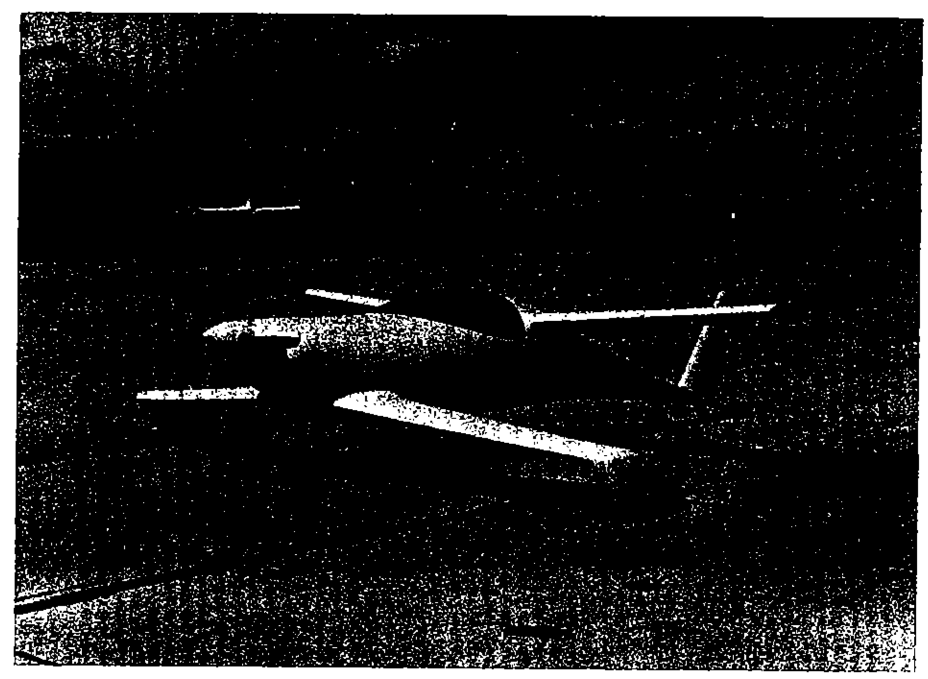
PAINT AND FINISH

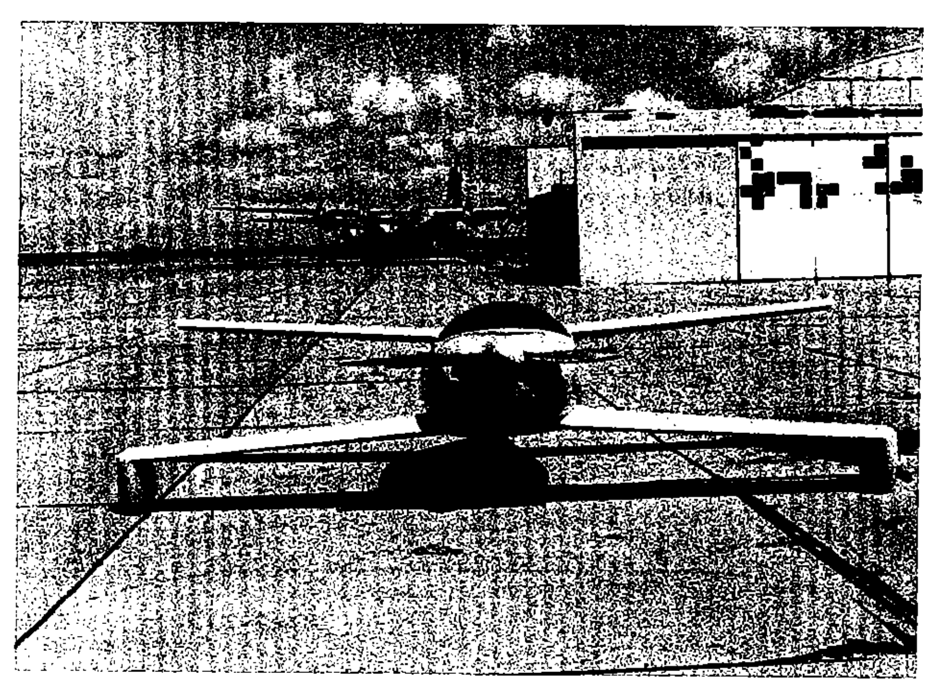
You are now ready for finishing and painting your Q2. Refer to Chapter 3 for recommendations on the finish and paint. Your aircraft may look like the aircraft pictured here, but you still have a ways to go inorder to achieve a sparkling surface finish that will turn heads at all the airports you will be visiting.

Q2 GEOMETRY

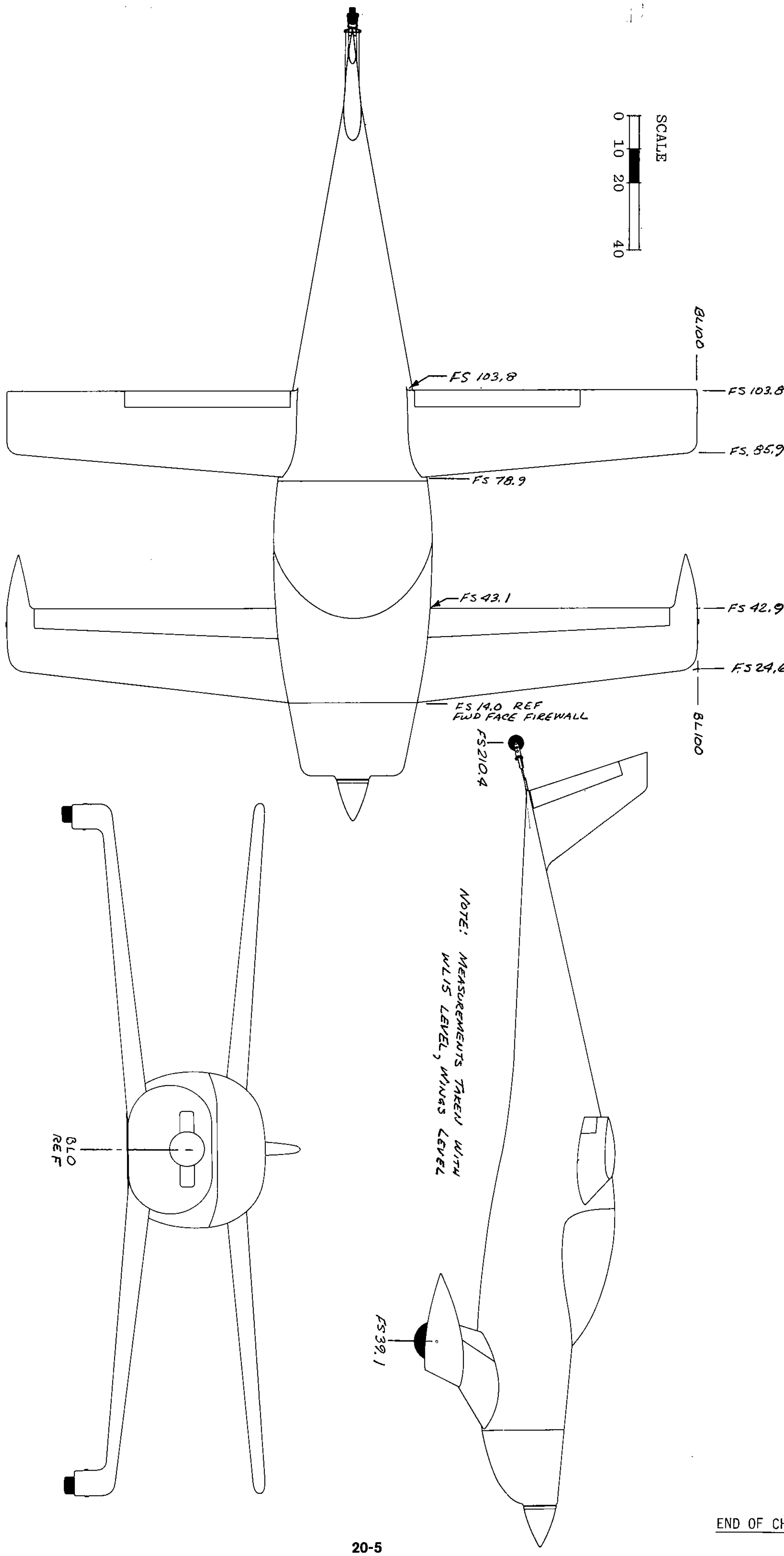
On the following sheet is a three view of the Q2. On it has been indicated the important aerodynamic and geometric references. These have been expressed in terms of your old friends WL, BL, and FS. They represent the geometry of a Q2 built properly from these Q2 Construction Plans. Please check them against your aircraft looking for any major descrepancies. (See Q2 Pilot's Manual.)

It is necessary to mark WL15 location somewhere inside the aircraft for weight and balance measurements.





Congratulations on completing your very own Q2.



END OF CHAPTER

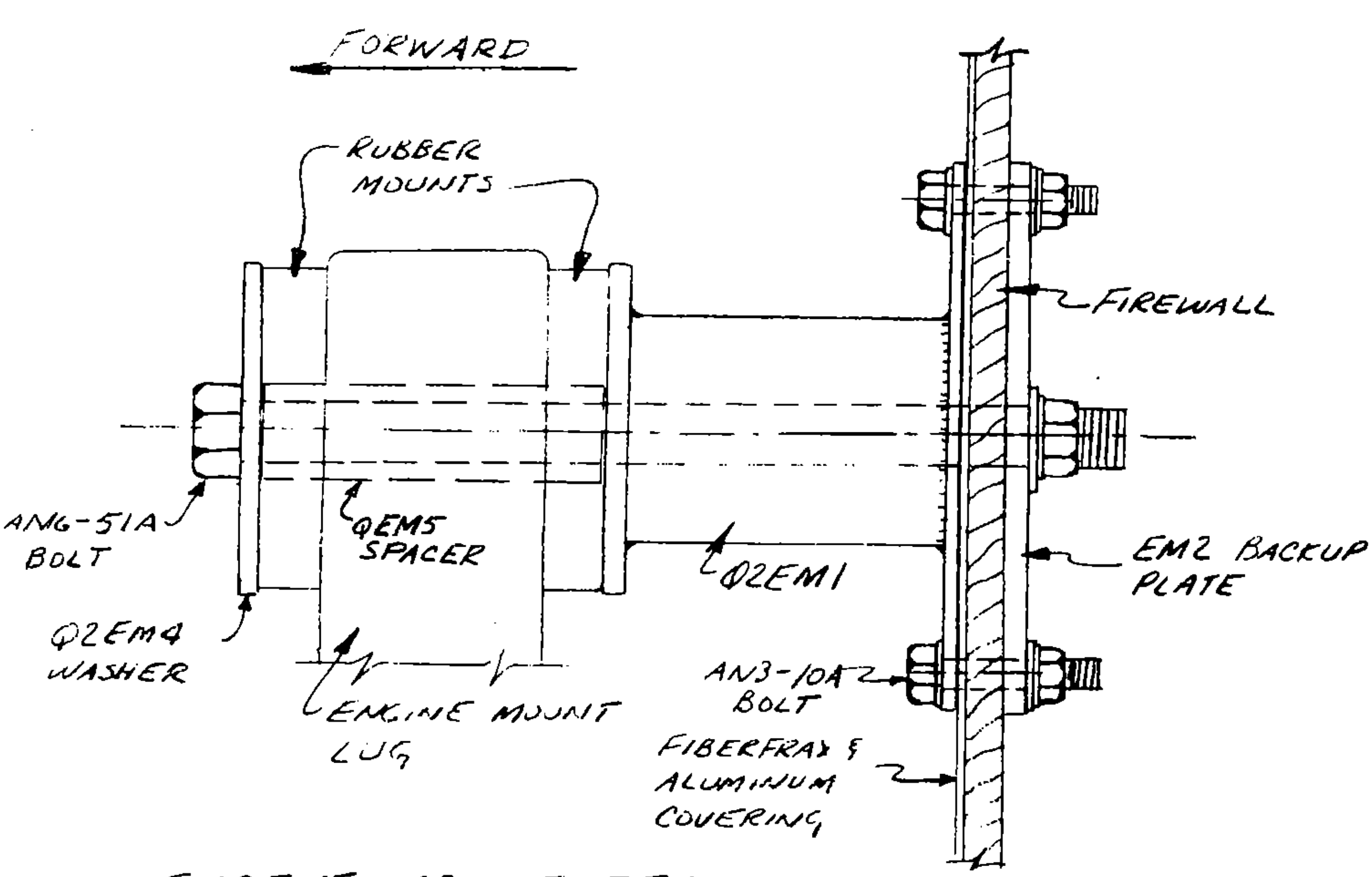
Q2 PLANS ADDENDUM

Q2 Builder Tip Notices (Q2BT9) are intended to provide clarification, guidance, improved construction methods, and helpful hints of a non-mandatory nature. The builder, at his descretion may use or discard any Q2BT. Most àre a result of work accomplished at Quickie Aircraft Corporation building a Q2 from the Q2 Construciton Plans. Any questions on a Q2BT notice should be referred to Quickie Aircraft Corporation. Each Q2BT has a number and a publication date along with a description of the builder tip.

NUMBER	DATE	DESCRIPTION
Q2BT9	1 July, 1981	Q2 CONSTRUCTION PLANS - SECTION I: Some plan sets sent out may have faint reproduction on parts of pages 9-8, 10-1, 10-2, 10-3, 11-4, 14-2, and Appendix Sheet 4. We intend to have those sections reprinted within 30 days. We will send the reprinted sheets to any builder who reports this problem.

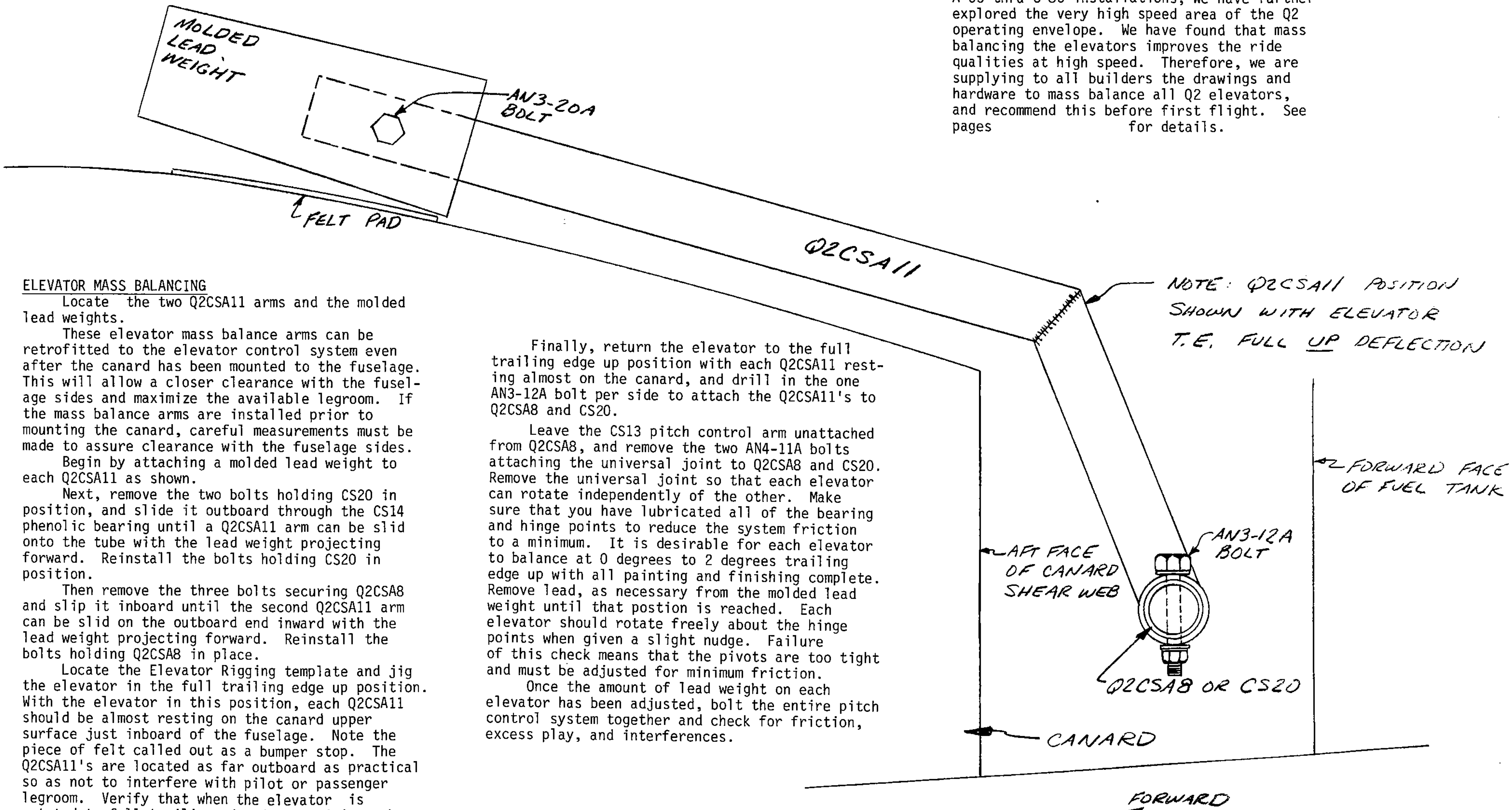
Q2 Plans Change Notices (Q2PC9 & Q2PC10) are mandatory revisions to the Q2 plans. Each Q2PC has a number and a publication date along with a description of the change. All Q2PC notices should be incorporated into the builder's set of Q2 Construction Plans immediately upon receipt by the builder. Any questions on a Q2PC notice should be referred to Quickie Aircraft Corp.

NUMBER	DATE	DESCRIPTION
Q2PC9	1 July, 1981	Q2 GROUND ANGLE OF ATTACK: With the aircraft assembled and WL15 level, and with the aircraft on a reasonable level floor, take a measurement vertically between the floor and the bottom of the tailwheel. The nominal measurement should be 27". A range from 25" to 28.6" should be acceptable. This limitation is to assist tailwheel first landings and three point takeoffs at mid/forward c.g. Small change can be effected by changing the tailwheel diameter. It is a good idea to delay mounting the tailspring until the aircraft is assembled, so that the proper height can be achieved.
Q2PC10	1 July, 1981	ENGINE MOUNT INSTALLATION, P-16-2 does not indicate the required spacer. The material is 4130 steel, or mild steel of 1/2" O.D. x 3/8" I.D. The sketch indicates the location of this QEM5 spacer (4 required).



ENGINE MOUNT DETAIL
(TYP 4 PLACES)

NUMBER	DATE	DESCRIPTION
Q2PC11	21 August, 1981	MASS BALANCING ELEVATORS. In preparation for testing on turbocharged Revmasters and possible A-65 thru C-85 installations, we have further explored the very high speed area of the Q2 operating envelope. We have found that mass balancing the elevators improves the ride qualities at high speed. Therefore, we are supplying to all builders the drawings and hardware to mass balance all Q2 elevators, and recommend this before first flight. See pages for details.



ELEVATOR MASS BALANCING

Locate the two Q2CSA11 arms and the molded lead weights.

These elevator mass balance arms can be retrofitted to the elevator control system even after the canard has been mounted to the fuselage. This will allow a closer clearance with the fuselage sides and maximize the available legroom. If the mass balance arms are installed prior to mounting the canard, careful measurements must be made to assure clearance with the fuselage sides.

Begin by attaching a molded lead weight to each Q2CSA11 as shown.

Next, remove the two bolts holding CS20 in position, and slide it outboard through the CS14 phenolic bearing until a Q2CSA11 arm can be slid onto the tube with the lead weight projecting forward. Reinstall the bolts holding CS20 in position.

Then remove the three bolts securing Q2CSA8 and slip it inboard until the second Q2CSA11 arm can be slid on the outboard end inward with the lead weight projecting forward. Reinstall the bolts holding Q2CSA8 in place.

Locate the Elevator Rigging template and jig the elevator in the full trailing edge up position. With the elevator in this position, each Q2CSA11 should be almost resting on the canard upper surface just inboard of the fuselage. Note the piece of felt called out as a bumper stop. The Q2CSA11's are located as far outboard as practical so as not to interfere with pilot or passenger legroom. Verify that when the elevator is rotated to full trailing edge down position, that the arc of each Q2CSA11 clears the fuselage and all other components.

Finally, return the elevator to the full trailing edge up position with each Q2CSA11 resting almost on the canard, and drill in the one AN3-12A bolt per side to attach the Q2CSA11's to Q2CSA8 and CS20.

Leave the CS13 pitch control arm unattached from Q2CSA8, and remove the two AN4-11A bolts attaching the universal joint to Q2CSA8 and CS20. Remove the universal joint so that each elevator can rotate independently of the other. Make sure that you have lubricated all of the bearing and hinge points to reduce the system friction to a minimum. It is desirable for each elevator to balance at 0 degrees to 2 degrees trailing edge up with all painting and finishing complete. Remove lead, as necessary from the molded lead weight until that postion is reached. Each elevator should rotate freely about the hinge points when given a slight nudge. Failure of this check means that the pivots are too tight and must be adjusted for minimum friction.

Once the amount of lead weight on each elevator has been adjusted, bolt the entire pitch control system together and check for friction, excess play, and interferences.

Q2PC12 21 August, 1981

IMPROVED BRAKING EFFECTIVNESS. We have determined that a single pull brake handle modulating both main gear brakes simultaneously is superior in nearly all situations to the standard toe brakes. Materials and drawings are available for retrofit for all builders returning their unused Q2BSW1's & two AN210-1A pullies to QAC. Current kit shipments incorporate this modification as standard.

Development work continues on a set of retrofittable hydraulic disc brakes, which may be available as early as October, 1981. Those builders not ready to fly before then may wish to wait and decide whether they wish to retrofit that system instead.

SINGLE PULL BRAKE HANDLE INSTALLATION

This section replaces the original section on installing the Brake Pedals (Q2BSW1's) and four inboard pulleys. In place of the individually controlled toe brakes, a single pull handle has been incorporated on the left side of the cockpit.

Begin by fabricating BS3 and BS5 from the 0.125" thick Aluminum and BS4 from 1/4" plywood.

BS4 is mounted in position with flox and 2 BID tapes to the top of the fuel tank near the left side console. Position the BS4 so that the handle will be an easy and comfortable reach for the pilot and so it will not interfere unnecessarilly with pilot comfort.

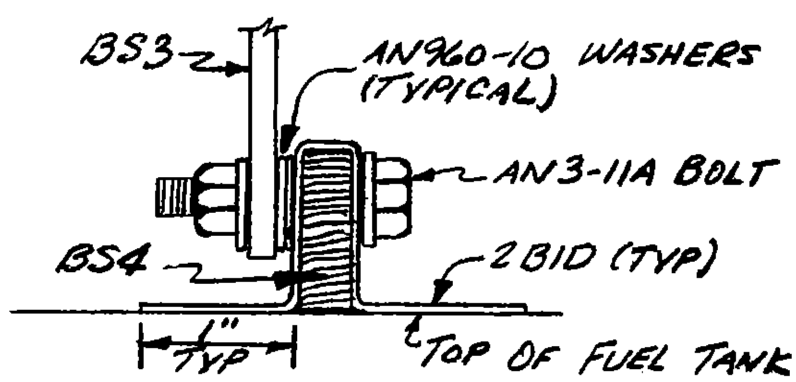
Next, install the Brake Handle as shown in the sketch.

The Brake Equalizer is used to help proportion braking effectiveness equally. The turnbuckle assembly on the left side must be attached directly to BS5 because of the proximity of the cable to the left elevator slot foam core. The turnbuckle for the right side can be mounted in the system outboard of the Canard shear web pulley.

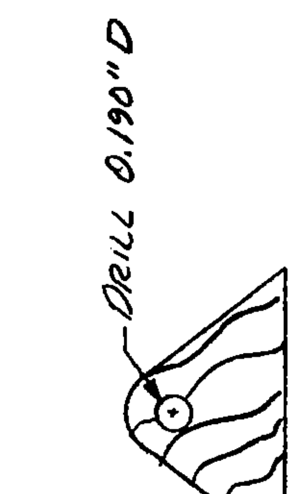
The two BS3 Canard shear web pulley mounts shown on page 11-4 must be modified in location for the proper angles.

The cable routing is from the BS5 Brake Equalizer around the two pullies on the canard shear web, and then outboard through the Elevator slot foam cores as originally indicated.

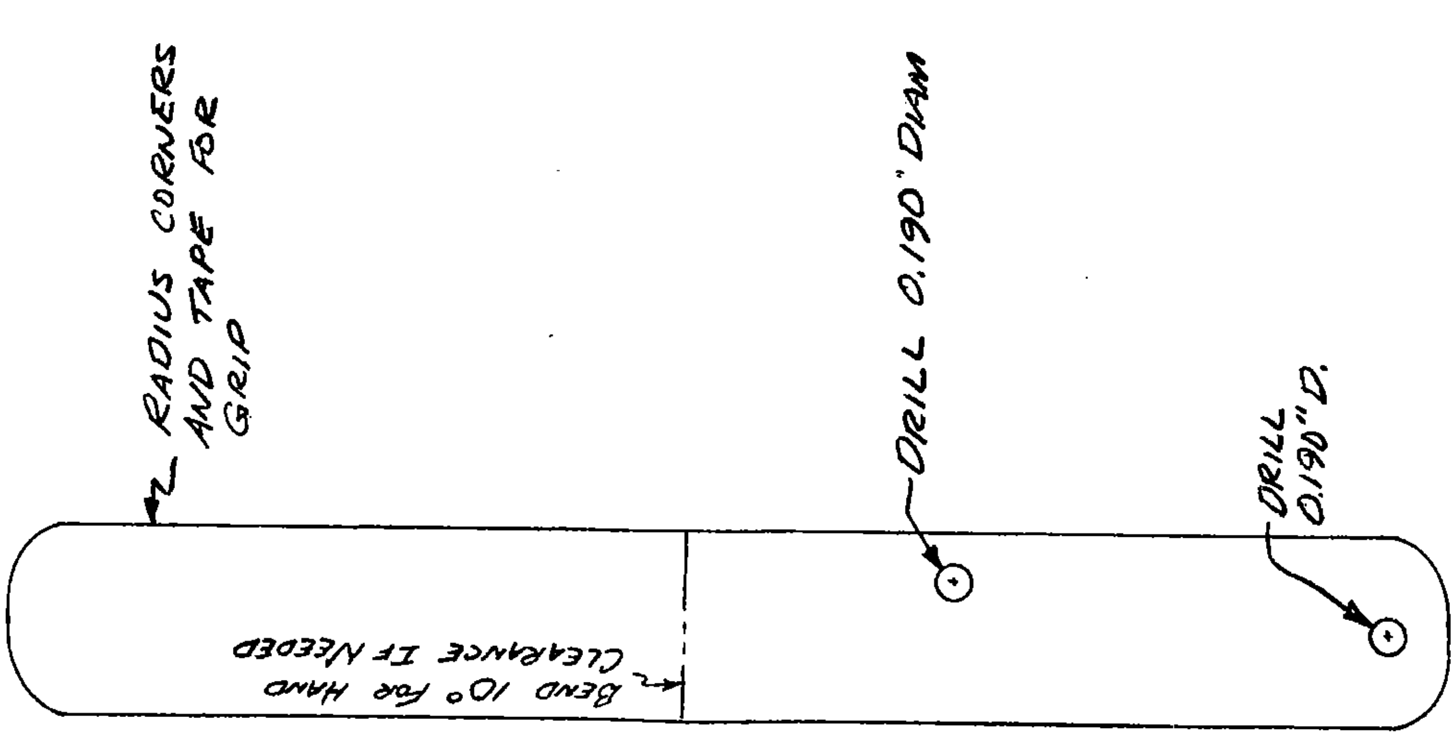
The turnbuckles are adjusted to provide equal braking on each wheel.



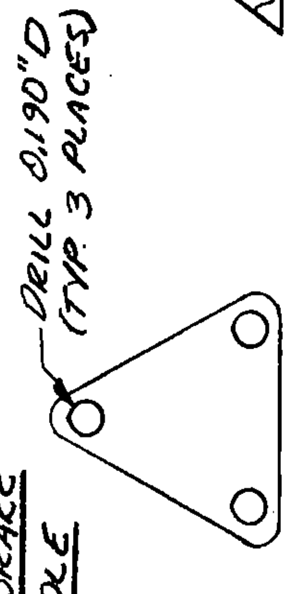
VIEW A-A



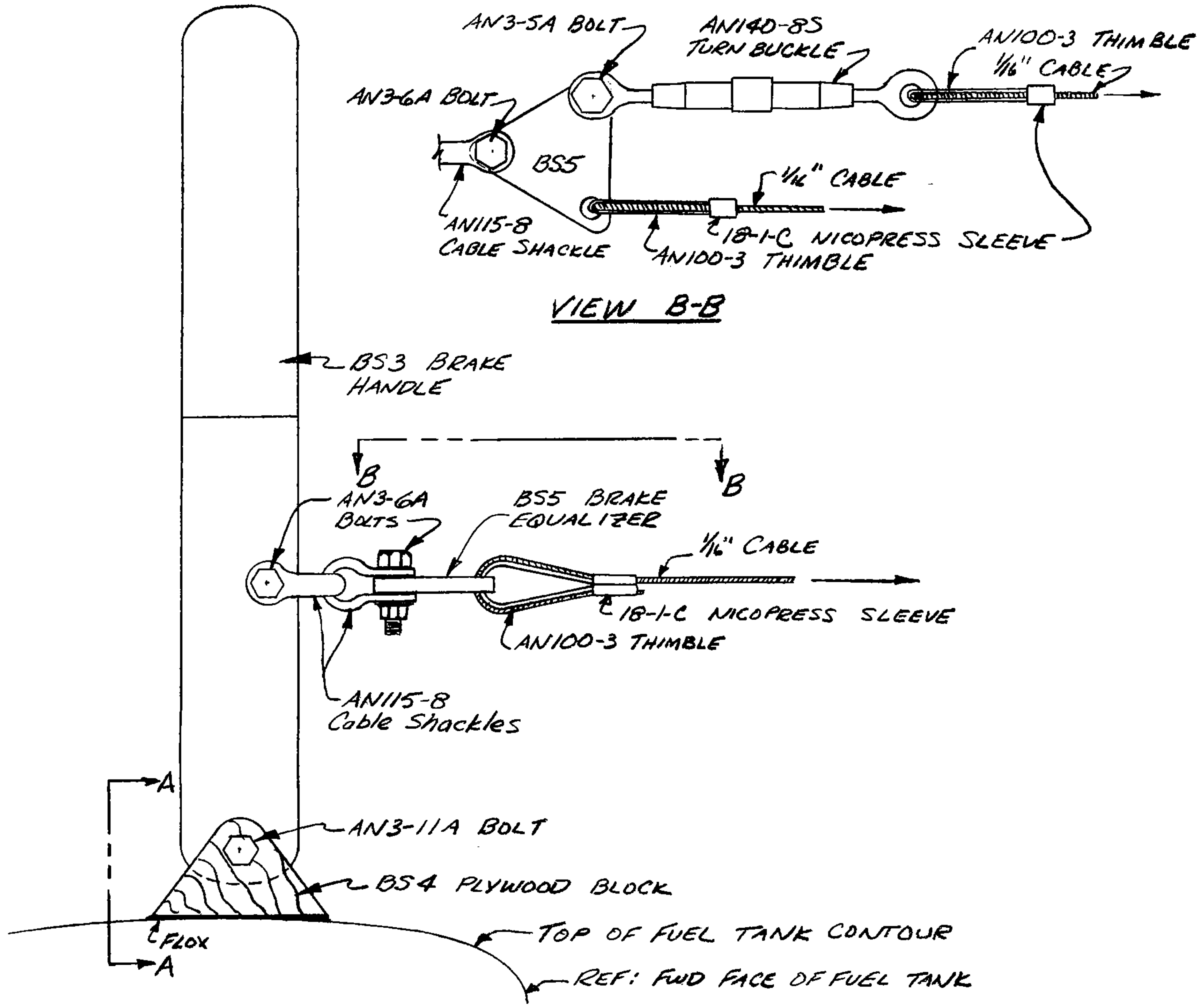
BS4



BS3 BRAKE HANDLE



BS5 BRAKE EQUALIZER


AN3-5A BOLT
AN140-8S
TURN BUCKLE
AN100-3 THIMBLE
1/16" CABLE
AN3-6A BOLT
BS5
1/16" CABLE
AN115-8
CABLE SHACKLE
18-1-C NICOPRESS SLEEVE
AN100-3 THIMBLE
VIEW B-B
BS3 BRAKE
HANDLE
B
B
AN3-6A
BOLTS
BS5 BRAKE
EQUALIZER
1/16" CABLE
18-1-C NICOPRESS SLEEVE
AN100-3 THIMBLE
AN115-8
Cable Shackles
A
AN3-11A BOLT
BS4 PLYWOOD BLOCK
FLOX
A
TOP OF FUEL TANK CONTOUR
REF: FWD FACE OF FUEL TANK