AkroTech Aviation G-202

Fast Build Manual
For the G-202 Aerobatic Aircraft

Part # MAN1.9
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PLEASE NOTE:

This manual does not purport to serve as a primer on composite materials or their care, preparation, or handling. A basic foundation in the mechanics of composite construction is assumed.

As the final assembly details of the G-202 kit evolve, it is anticipated that some of the procedures and instructions included in this manual will later be superseded by more current information. Please use this manual with this caution in mind. If the builder finds procedures that work better than those presented here, or if errors are found, please contact AkroTech Aviation.

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General Information Section

NOTE:
It is important to read and understand this section of this manual before attempting to assemble your G-202. The General Information Section contains techniques and procedures that you will perform a number of times during the construction of your aircraft. If you have any questions concerning any aspect of these procedures, please do not hesitate to call AkroTech for assistance.

Caring for G-202 Components:

Carbon fiber is blessed with an extremely favorable strength to weight ratio, however it does require a few special measures during handling, moving, and storing. These measures are intended to keep you from damaging the carbon fiber parts -- and to keep them from damaging you.

First, be aware of the damage that carbon fiber can do to you: USE CARE WHEN HANDLING ALL CARBON FIBER PIECES. As they come out of the molds, carbon fiber pieces can have razor sharp edges. If handled carelessly, unfinished pieces can produce deep cuts in the hands. We strongly suggest that you **wear leather gloves when handling** all unfinished pieces. This is particularly true of the thinner pieces such as wing skins.

Second, be aware of the damage you can do to carbon fiber components: A carbon fiber component's strength depends on the integrity of its individual fibers. The resin serves merely to hold the carbon fibers in the desired form. The fiber itself provides the strength. If the carbon fibers themselves are scratched, dented, or even sanded incorrectly, some of those individual fibers will be broken. Broken strands of carbon fiber weaken the structure. This can be avoided by using a few simple precautions:

- Do not drop anything on the carbon fiber pieces. They are quite sensitive to impact.
- Do not drop carbon fiber pieces.
- Do not attempt to move large or unwieldy pieces by yourself.
- Find a secure place to store the pieces until you are ready to work on them.
- Protect them from damage in their storage place.

If any components must be stored on edge, protect them by putting pre-slit foam "C" shaped pipe insulation over the edges where they contact the floor of your shop.

When your G-202 kit is delivered, remove all protective wrapping and lay out all of the composite parts on your shop floor. Support the larger composite parts with foam to protect them from damage. Carefully inspect each part for shipping damage. Refer to the packing list included in the shipping crate to check for missing parts. If you find parts

damaged or missing, please contact AkroTech for replacement. **NEVER** attempt to substitute store-purchased supplies or modify the parts supplied with your kit unless you have contacted AkroTech and have been specifically advised to do so. Find a safe place to store your parts when done.

It is very important that the builder take inventory when the kit arrives to be sure the packing list accurately reflects what is actually in the crate. If we made an error, we will take care of the shortage. However, AkroTech will not be responsible for parts that are misplaced or damaged by the builder.

There will be various items that the builder will probably run out of during the construction process, such as HYSOL, laminating resin, fiberglass cloth, mixing cups, sticks, gloves, and probably some miscellaneous hardware. The builder may find it necessary to use a slightly shorter or longer bolt or screw in a certain application. If so, it will be very handy to have a source for additional parts. Additional materials can often be purchased from AkroTech; however, AkroTech does not always have replacement stock available for every item in the kit. We suggest that the builder obtain catalogs from Aircraft Spruce and Wicks Aircraft Supply. These catalogs contain a considerable amount of reference information, as well as lots of nifty goodies. These suppliers are often the best sources for additional supplies and hardware items the builder will need.

Health Hazards:

A discussion of the bonding process is incomplete without strong mention of the health hazards composite materials pose. The resins used in the G-202, while relatively benign compared with the adhesives in use only a few years ago, are still strong chemicals which can have a significant negative impact on your health. Read, understand, and follow all manufacturer's precautions.

Acetone, used to clean spills and mating surfaces just before bonding, is a solvent which can freely penetrate unprotected skin.

The microballoons and structural filler used to thicken the laminating resin (and in a few cases the structural adhesive) is so light that particles can easily become airborne during mixing and may be inhaled. Other airborne particulate hazards include any dust created by sanding. All these sources pose a danger to your lungs. Wear an effective respirator!

The effects of these chemicals and materials are cumulative: the more exposure you incur, the greater the chance that you will suffer a reaction. The unfortunate stories of aircraft builders having to abandon projects due to chemical allergies are too common. Equally unfortunate is the fact that many of those allergic reactions could have been avoided.

Ordinary household rubber gloves will not protect you from adhesive resins and hardeners. Always wear latex gloves on your hands when working with these chemicals.

Paper filter masks are only partially effective against structural filler, microballoons and sanding dust. Always wear paint spray/insecticide respirators featuring replaceable filters.

Significant additional protection may be gained by aggressively ventilating the construction area and by constructing a simple power vented hood from cardboard or Styrofoam for the mixing station. The belt sander is another site where a lot of dust is produced. A shop vac type attachment on the sander will minimize the introduction of dust into the air and help keep your shop, as well as your lungs, clean.

Tools:

If you do not already own them, you will need to invest in some quality tools before you can begin work on your G-202. Do not attempt to build your aircraft using those cheap screwdrivers and rusty, bent pliers that have been sitting in your kitchen drawer since you bought them at that garage sale back in ‘64. Compared with the cost of the aircraft, the cost of quality tools is minimal, so buy the best you can get.

Most of the required tools can be purchased at your local hardware store. Any tools you cannot find locally can be purchased through one of the mail order companies listed below. The following list has been broken down into two categories - tools that are required and tools that are not absolutely necessary but will expedite the construction process considerably.

Required Tools

Hand held 3/8 inch electric drill
Drill bits (both number and fraction sizes)
100 deg. Counter sink
Jig saw
Jig saw blades (fine tooth, metal cutting)
Files
Sandpaper (60, 80, 100, and 150 grit)
Hack saw with fine tooth blades
Dremel tool with an assortment of attachments (a very useful tool)
Sanding block 6" and 12"
Felt tip markers with fine tip
25 ft tape measure
6" precision steel rule
Fabric shears or scissors
4 ft level
Torpedo level
Water level

String level
Nylon twine (50 ft)
Carpenters square
Framing square
Carpenter's chalk line
Spring clamps (all sizes)
C-clamps (all sizes)
Quick grip clamps (extremely useful; buy four of the smaller size)
Automatic center punch
Scribe
X - acto knife
Plastic or rubber faced mallet
Vise: bench-mounted, heavy duty
Pliers (diagonal cutters / channel locks)
Socket set (1/4" drive U.S.)
Combination wrench set
Screwdriver set (straight slot and phillips #1, #2, #3)
Clecos (1/8 inch, about 50 needed - see Aircraft Spruce catalog)
Cleco pliers (see Aircraft Spruce catalog)
Rivet squeezer (for squeezing the solid an type rivets-see Aircraft Spruce catalog)
Blind rivet puller
Torque wrench: in.- lb.
Digital gram scale (for measuring out the resin)
Hot glue gun
Automotive wax
Clear packaging tape (2" width)
Masking tape
37 degree tube flaring tool (for fuel tubing, see Aircraft Spruce catalog)
Tube bending tool (for fuel tubing, see Aircraft Spruce catalog)
Small electric heater
Paint brushes (disposable with natural bristles)
Plastic film (polyethylene "drop cloth" material will work)

Optional Tools:

Drill press
Band saw
Bench grinder
Rotary files and carbide burrs (1/4" shank)
Makita hand held 1 inch belt sander (expensive, but worth it)
Micro-stop countersink
Air compressor
Assorted air tools (die grinder with cutting discs and sanding drum accessories)

Consumable Items:

Latex Glover
Disposable Dust Masks
Epoxy Mixing Cups (NOT WAXED)
Mixing Sticks / Tongue Depressors
Acetone
Clean Shop Towels (Disposable from Paint Store)
Automotive Body Filler (Bondo)

Tool and Consumable Vendor List:

Aircraft Spruce & Specialty
P.O. Box 424
Fullerton CA 92632
1-800-824-1930 or (714) 870-7551
Fax (714) 871-7289

Avery Enterprises, Inc.
2290 W. Hicks Rd., Hanger 54
Ft. Worth TX. 76179
817-439-8400
Fax (817) 439-8402

Brown Aviation Tool Supply
3411 S.W. 29th St.
Oklahoma City OK 73119
1-800-587-3883
Fax (405) 681-7250

Cleveland Aircraft Tool and Material
1804 First Street
Boone IA 50036-4417
515-432-6794
Fax (515) 432-7804

Wicks Aircraft Supply
410 Pine Street
Highland IL 62249
800 221- 9425

Jeffco Products (laminating resin)
800 573-7699

We have recently found a fine line of tungsten carbide hand tools that work extremely well. They are available in a wide variety of shapes and sizes, my personal favorites are the R201 hand tool and the SB140 sanding block. For more information, contact:

Perma-Grit Tools
Phone: (011) 44 1529 240668
Fax: (011) 44 1529 241026
E-mail: Permagrit@aol.com
Web: http://www.permagrit.com

Another item that comes in handy is “Super Glue”. Go to a hobby shop and ask for “Medium CA” or “Gap-filling”. Don’t use the thin stuff, it is like water and runs all over the place. Be careful, the material that super glues work best and cure fastest on is skin. Use care not to permanently attach yourself to your project!

Mixing & Thickening Epoxy Resins

Three different epoxy resin types are utilized in the construction of the G-202: laminating resin, structural adhesive, and tank sealer. Laminating resin is a low viscosity resin used to wet out fiberglass. Structural adhesive is a fairly viscous resin, yellow in color, used to bond the pre-molded composite parts to one another. Tank sealer is a medium viscosity resin, gray in color, used to seal the composite surfaces inside the aircraft fuel tanks. You should become familiar with these three resin types before beginning construction so you can easily identify them later.

All three resin systems used in the construction of the G-202 include two components (resin and hardener) that must be mixed carefully if the full mechanical properties of the resin are to be realized. Always follow the manufacturers instructions when mixing resin. **Never** vary the mix ratio unless specifically instructed to do so.

To accurately proportion the resin and hardener for the epoxies resin systems, you will need an accurate scale. You may either purchase a digital scale (accurate to the gram over 1000 grams) or build a simple wooden scale. The digital scale has the advantage of being accurate even for batches as small as 50 grams (smaller batches than this should not be attempted) but can lead to mix ratio errors if careful calculations are not employed. The wooden scale has the advantage of almost eliminating mix ratio calculation errors but the disadvantage of not being accurate for batches of less than 100 grams.

Laminating resin and structural adhesive are mixed in paper cups. The mixing cups and sticks supplied in your kit will not be sufficient to complete your G-202. When you need more, ensure that the cups and sticks you use are not wax lined. Plastic coated bathroom cups in the 3 oz. and 12 oz. sizes, available in many grocery stores, work very well. Tongue depressors, available in most drug stores, work well as mixing sticks.

Spillage is a fact of life. Unless cleaned up immediately, spills will tend to travel around your shop on rags, gloves, and tools, ending up where they are not appreciated. Use acetone to clean up. Clean-up can be eased by covering flat surfaces of your mixing area with Saran wrap.

If instructions call for thickening the adhesive with filler do the following:

- Thoroughly mix the resin and hardener before adding any filler.
- Identify the correct filler to be used. Do not confuse microballoons with structural filler!
- Put on your respirator before opening the filler containers and keep it on while you are mixing the filler and adhesive.
- Stir slowly when you first add filler to the previously-mixed adhesive. Otherwise you can generate significant amounts of airborne filler.
- Never mix more than 8 oz of resin and hardener at a time. If you have a large adhesive job to do, try to mix several smaller batches of adhesive rather than one large one. This will postpone the onset of an exothermic reaction in the adhesive and increase its useful working life (pot life).

NOTE:
There are two fillers supplied with your kit - microballoons and structural filler. These two filler materials look somewhat similar and are easily confused. Structural filler has a consistancy somewhat like flour, microballoons are more like a fine sugar. Structural adhesive is always thickened with structural filler and never with microballoons. **It is very important that you do not accidentally substitute microballoons for the structural filler when thickening your structural adhesive**. To do so could seriously compromise the structural integrity of your aircraft.

The thickness or consistency of an adhesive is determined by how much filler is added to a resin/hardener mixture of the proper ratio. In many places in this manual, a specific consistency is denoted in terms of the food it most closely resembles:

"Syrup" Consistency:

"Syrup" consistency results from of a thorough mixture of resin and hardener in the proper ratio, without the addition of any other filler. It will be a slow-running liquid.

"Catsup" Consistency:

"Catsup" is the consistency made by a thorough mixture of resin and hardener in the proper ratio, slightly thickened by the addition of a small amount of filler. It will slowly run down a vertical surface in loose globs.

"Mayonnaise" Consistency:

"Mayonnaise" is the consistency that results when a thorough mixture of resin and hardener, in the proper ratio, is thickened by the addition of an approximately equal volume of filler. It will cling to a vertical surface, but peaks will fall over.

“Peanut Butter" Consistency:

"Peanut Butter" consistency results when a thorough mixture of resin and hardener, again in the proper ratio, is extensively thickened by the addition of the maximum amount of filler. It will cling easily to a vertical surface, and it will form peaks that will not fall over.

Bonding Procedures:

Most of the pre-molded composite components included in your G-202 kits are assembled using a two-part structural adhesive. Because the structural integrity of your aircraft is dependent on such bonds, it is imperative that you perform them carefully.

A good bond begins with an accurate dry-fitting of the parts. It is almost impossible to separate the carbon fiber parts after they are bonded; know before you begin to mix the adhesive that the parts fit exactly as they should.

Determine how the parts will be held together while the adhesive cures and make those tools accessible. In many cases the bonding flanges of pre-molded parts can be drilled and tools called Clecos inserted into these holes both properly position the parts and provide the necessary clamping pressure. Parts may also be held in place with clamps, hot glue, five-minute epoxy, jigs, or duct tape. Small parts may not require clamping pressure, while large bonding operations, such as the wing or stabilizer skins, will require weights to hold the mating surfaces together. The manual will alert you if you need a particular kind or number of weights or clamps.

The bond areas of parts to be mated are prepared using a three step process. First clean all bond areas with a clean rag dipped in acetone. Then thoroughly roughen the surfaces using 80 grit sandpaper with medium pressure. Lastly you must clean the bond areas once more with acetone to remove any traces of carbon dust, oil, or grease. After cleaning with acetone, do not touch the surface again with your hands. The surfaces are now ready for bonding.

Thoroughly mix the adhesive according to the manufacturer's instructions. If instructions in the procedure call for a thickening filler, thoroughly mix the adhesive **before** adding the filler. Again, put on your respirator before opening the filler containers and keep it on while you are mixing. Be sure not to confuse the two filler materials. Only structural filler should be used when thickening the structural adhesive for bonding. **Never** use microballoons.

Apply a thin layer of the mixed structural adhesive to the bonding zones of both mating surfaces. Join the two mating surfaces, making sure their positions are correct, and secure the parts in position. After securing, re-measure to ensure the part is accurately located.

Remove any excess adhesive which has squeezed out from between the mating surfaces with paper towels. Excessive adhesive is only dead weight and does not contribute to the strength of the bond.

Wet Lay-ups:

The term "wet lay-up" is used to describe the process of saturating fiberglass cloth with mixed epoxy laminating resin. Most wet lay-ups used in the G-202 are relatively small and involve placing epoxy-wetted fiberglass strips at the juncture of parts which must be joined. A wet lay-up may be used to bond two parts together, or to create a flange which will be used later to bond the two parts together. The procedure for both is the same, with the exception that during flange creation, a barrier such as 3M packing tape is placed between the two parts so that the lay-up bonds to one part, but is prevented from bonding to, and may be separated from, the other after cure.

The procedure outlined below is typical of the wet lay-ups you will perform when building your G-202.

1. Dry fit the parts to be mated.

2. Locate and mark the part and bond zone positions.

3. Thoroughly scuff the mating surfaces with 80 grit sandpaper

4. Clean the mating surfaces with acetone.

5. Cut fiberglass cloth strips as necessary for the lay-up. Be sure to cut these strips on the bias (fibers running at 45 degrees to the edge, also known as BID). Also, you should cut these strips slightly oversize so they can be trimmed down later.

6. Using your epoxy scale, measure out the proper amounts of resin and hardener.

7. Mix the laminating resin and hardener thoroughly using a tongue depressor. Observe all appropriate cautions and procedures mentioned in the earlier section entitled Mixing & Thickening Epoxy Resin. Remember **never** to thicken epoxy laminating resin used to wet out fiberglass. Now is the time to put on latex gloves and turn on the fan at your mixing station.

8. Wet out the strips of fiberglass one at a time on a piece of clear plastic sheet. Use a brush to spread the resin out on the fiberglass. Don't try to force the resin into the cloth. Instead, give the resin a little time to soak into the fiberglass. Keep adding layers of fiberglass cloth and wetting them out until you have the required number of layers built up.

9. Use a plastic squeegee to remove any excess resin from the lay-up. The cloth should now be fully saturated and appear to be translucent. Inspect the lay-up carefully for the presence of small white flecks. These flecks indicate a dry lay-up.

10. Place a second layer of clear plastic sheet on top of the saturated fiberglass strips. You should now have a sandwich consisting of one layer of plastic, the saturated strips of fiberglass, and a second layer of clear plastic.

11. Using scissors, trim the fiberglass strips down to their final size. The plastic sheet will prevent the fiberglass from distorting while you cut it, allowing you to accurately size the strips.

12. Using a paint brush, paint the bond zones of both the pieces you are joining.

13. Remove one layer of plastic from the fiberglass and carefully lay the fiberglass into the junction of the two parts to be joined. Work the strip into the joint with your fingers, then remove the outer layer of plastic. Use a light stabbing motion with the brush to smooth out the fiberglass and remove any air bubbles.

14. Carefully inspect the lay-up once more for the presence of air bubbles or dry areas. Use the brush to work out the air bubbles and add resin as necessary to eliminate any dry areas.

Wet Lay-Up Tips:

Remember, the ideal amount of epoxy is only the amount needed to completely wet out the cloth, and no more. You will find that if you are somewhat generous with the amount of epoxy in the first and second layers, and saturate the subsequent cloth layer by bringing the epoxy up through the weave by stippling (gentle vertical stabbing with the

brush), that fewer air bubbles will be trapped. Do not overdo this trick, however, for if epoxy in the first two layers gels before you have finished applying the last layer, the epoxy will not flow up through and wet out the cloth, and you will pay a weight penalty. On the last layer add only the epoxy needed to wet out the cloth. Excess epoxy adds weight without increasing strength.

Work in small sections. When the cloth seems difficult to wet out, your epoxy batch is probably gelling. Throw it away and mix a new batch. Gelling epoxy will not properly wet out and will not form a secure bond. Often, just before the laminating resin begins to gel, and particularly in larger batches, you may notice the mixing cup begins to get warm, a process termed "kicking-off". A warm mixing cup means the working life of the adhesive is nearly over.

Properly wet out cloth will have a consistent, translucent, satin look without any light colored areas or air bubbles. Shiny areas indicate an excessive amount of epoxy. Use a squeegee to remove excess epoxy.

Fillets:

Some wet lay-up instructions may ask that you lay in a filet between two parts before setting down the cloth layers. Fillet material usually consists of a mixture of epoxy and microballoons of "Peanut Butter" consistency which is spread into the corner created between the two parts using a mixing stick or your gloved finger. The fillet extends for the length of the intersection and should be about a 1/4" radius.

Preparing Carbon Fiber Pieces for the Attachment of Fittings:

There will be many occasions in the building of your G-202 when you will have to attach a metal fitting to a carbon fiber component. While carbon fiber is not particularly difficult to work with, it demands different construction techniques than metal or wood.

Particular attention must be paid when attaching metal fittings to carbon fiber parts. Anyplace carbon fiber contacts metal, there is a potential corrosion problem. The solution to this problem involves both the use of fiberglass to separate metal fittings from the carbon fiber and the use of stainless steel bolts to attach these fittings. In a few areas, stainless steel bushings are used to isolate bolts from the carbon.

There will be several instances when it will be necessary to drill holes through a carbon part to attach a metal fitting. In these cases you will need to use a mixture of structural adhesive and structural filler to seal any core material exposed by the hole. If it is not sealed, any exposed core material will provide a path through which the core might absorb rain water, atmospheric moisture, or fuel. Should this happen, it might eventually diminish the integrity of the structure. Holes or cutouts in load bearing surfaces must be reinforced with an appropriate number of layups of 7725 cloth and resin after the exposed core material is sealed.

NOTE:
G-202 carbon fiber parts have been modified to allow for the installation of most metal fittings without the need to seal core material and install stainless bushings. Such changes have been incorporated in an attempt to completely eliminate this relatively time consuming task. Currently, the factory installs phenolic block and a layer of fiberglass at most locations where a fitting is installed. In addition, standard bolts have been replaced with stainless steel bolts to prevent corrosion. There may be a few areas where you will need to attach a metal fitting to a carbon part which does not have phenolic pre-installed. For these areas, the core material will need to be sealed and a stainless steel bushing will need to be installed. **It is not necessary to seal or reinforce the material between the inner and outer layers of carbon fiber where a phenolic block has been substituted for core material.**

The following steps outline the general procedure for mounting a metal fitting (such as an aluminum hinge) to a carbon fiber part. Note that some of the steps have been marked with an asterisk. If you are installing a fitting in an area that has phenolic block and fiberglass pre-installed, you can ignore these steps.

1. Place A Layer Of Fiberglass Over The Carbon Fiber Part *

Lightly sand the area of the carbon fiber part where the fitting will be installed. Prepare a small batch of fiberglass resin and laminate a single layer of fiberglass on both sides of the carbon fiber part at the fitting area.

2. Clamp The Fitting To The Carbon Fiber Part And Drill The Holes

Precisely position and clamp the fitting to the carbon fiber part using C-clamps. Orient these clamps so that they are positioned diagonally across the face of the fitting. Most likely, these clamps will obscure one or more holes in the fitting. If this happens, drill the accessible holes first, then place two more clamps over the drilled holes and remove the clamps obscuring the undrilled holes. Now drill the remaining holes. *Note: be sure the fitting does not move while you are exchanging clamps. To prevent this from happening, you may wish to use bolts to secure the fitting after the first two holes are drilled.*

3. Remove The Fitting From The Part

Remove any clamps from the fitting and separate it from the carbon fiber part

4. Drill Out The Holes To The Size Of The Bushings *

Use the existing holes as pilot holes to bore new larger holes for stainless steel bushings. Drill a bushing hole that is the exact outer diameter of the bushing that you will use.

5. Remove The Core Material From The Area Surrounding The Holes *

Gently but thoroughly remove the core material at least 1/4 inch back from each hole's edge. **Do not cut, gouge, or damage the surrounding carbon fiber in the process.** In the case of a smaller diameter hole, this may require a little persistence. However, if you

use small scraping tools (such as an X-acto blade) and a gentle hand, you will succeed. If you are careful, you may use a Dremel tool with a small round cutting bit to remove the core material.

6. Seal The Core Material With Structural Adhesive And Install The Bushings *

Clean the bonding area with acetone. You may want to apply a piece of 3M clear tape to the exterior side of the hole in which the bushing will be inserted. This will keep the bushing from being pushed out of the hole and will help minimize adhesive clean up on the taped side.

Make a fairly thick mixture of structural adhesive and structural filler. The mixture should be thick enough so that it is not runny and will not sag. Make sure that you thoroughly fill the area and do not leave any voids where the core remains exposed.

Fill the exposed core recess with the structural adhesive mixture. Apply some structural adhesive to the outside of the bushing. Slip the bushing into the bushing hole for which it was cut and fit. Using a Q-tip, remove any excess structural adhesive from the interior bore of the bushing. Allow the structural adhesive to cure.

Your final finish hole will be protected by a bushing and any previously exposed core material will be surrounded by at least 1/4" of structural adhesive. This will completely isolate the core material from the outside environment and the bolts or fittings that pass through the carbon fiber will be protected from the effects of both corrosion and abrasion.

Cut the bushing material to length. When you insert it in the hole, the bushing must be flush with both the front and back surfaces of the hole. Bushings can be cut to approximate length with a hack saw or a band saw, and then fine fit using a hand file, however a small grinding wheel will greatly accelerate the process. This will require custom fitting and in order to end up with a flush fit, it may be that both end surfaces of the cylindrical bushing are not precisely parallel. You may also find that the bushings required for a single fitting must be of slightly different lengths in order for them all to be flush with the surfaces on both ends of their respective holes. Once you are certain that you have achieved a flush fit for each bushing in question, they are ready to be bonded into the carbon fiber structure.

HINT:
If you are sealing exposed core material that results from the drilling of a small hole, such as for a bolt, or where a piece of tubing passes through a structural member, place a piece of clear 3M tape over one side of the hole, firmly press it into place, then fill the exposed core recess with the structural adhesive mixture from the other side. This will allow you to work the structural adhesive mixture into every corner of the recess without it flowing out through the hole on the other side. Place the tape on whichever side of the hole you would like to maintain a neat appearance. For instance, if you are sealing exposed core in a hole that penetrates your wing skins, place the tape on the exterior surface. That will minimize the amount of clean up and surface preparation necessary in that area prior to painting.

8. Install The Backing Plate With Structural Adhesive And Waxed Bolts

Prepare the backing plate (if a backing plate is to be used) and the mating carbon fiber part for bonding by sanding both surfaces with 80 grit sandpaper. Dip a clean rag in acetone and clean both bond areas thoroughly. Prepare structural adhesive and mix in enough structural filler to achieve “mayo” consistency. Coat both surfaces with the mixture. Leave 1/8 inch surrounding each bolt hole free of structural adhesive. This will minimize the tendency for the structural adhesive to ooze into the bolt holes when clamped down. Coat the shaft of the fitting bolts with automotive wax. (Note: *always be extra careful to keep wax away from any bond areas*) Install the waxed bolts through the fitting and the carbon fiber part and into the backing plate. Tighten the bolts down and remove all excess structural adhesive from around the backing plate.

Since the backing plate is bonded in place using adhesive, it is inevitable that some adhesive will get squished out from behind the plate during the bonding process., Some of this migrating adhesive will unavoidably find its way into the screw holes in the nut plates. Normally, you could deal with this overflow by simply re-tapping the hole. However, the threads of nut plates hold bolts captive because their female threads are deliberately deformed. **Never tap the threads of a nut plate.** If you tap a nut plate you will remove that deliberate deformity and the nut plate will no longer hold the bolts captive. For that reason, it is necessary to wax the threads of one bolt for every nut plate in the backing plate you are bonding into place. When you screw the waxed bolts into

the nut plates, these waxed bolts will keep unwanted structural adhesive from fouling the threads and/or adhering to the bolts themselves. After the adhesive cures the bolts can be removed, leaving the bolt holes and nut plate threads free of unwanted structural adhesive. Also, a layer of clear tape placed over the face of the fitting will prevent any structural adhesive that may be forced through the bolt holes from bonding the fitting in place.

9. Install The Retaining Screw In The Backing Plate

Drill an 11/64 inch hole through the approximate center of the backing plate and through the carbon fiber part. Countersink this hole on the side where the fitting will be attached (side opposite of the backing plate) with a 100 degree countersink. Install an 8-32 stainless steel screw in this hole. Locate the appropriate nut for this screw and install it on the back of the screw.

10. Permanently Install The Fitting With Stainless Steel Bolts

Use stainless steel bolts to permanently install the fitting. (You may use standard bolts if stainless bushings were installed)

Backing Plates:

Backing plates are used throughout the G-202 wherever high load fittings are attached to composite structural members. A significant portion of your building time will be spent preparing and attaching backing plates. They serve to transfer high localized loads to the composite members of the airframe. They do this by mechanically sandwiching the composite structural member between the high load fitting and its backing plate.

It is important to note that **backing plates are always bonded in place** with structural adhesive, whereas the fittings the backing plates are meant to support are not. The backing plates must be made captive since most of them are in areas that will be virtually inaccessible after the builder closes the wing, tail surfaces, or fuselage sections. This allows for the later removal, servicing or replacement of the primary fittings, while still utilizing the backing plates originally installed by the builder.

Even though every backing plate is bonded in place with structural adhesive, AkroTech suggests that a retaining screw also be used to secure the backing plate to the structure. The reason for this is simple. Though highly unlikely, should the structural adhesive bond holding the backing plate fail for some reason, the backing plate will drop away from its proper position. Should this happen, that backing plate will rattle around uselessly inside the permanently sealed wing or tail. The retaining screw is a simple backup that will prevent this. Below are the steps you will need to follow to bond and rivet backing plates in your G-202.

1. Cut Out The Backing Plate

Find the .080 aluminum backing plate material included in your kit. Position the base of the hinge or fitting on this backing plate material. Trace the outline of the fitting using a fine felt tip pen. Carefully cut out the backing plate just outside of this line using a hand-held jigsaw or bandsaw. Smooth any rough edges on the backing plate with a file or belt sander.

2. Drill The Bolt Holes In The Backing Plate Using The Fitting As A Template

Clamp the appropriate fitting to the backing plate using two C-clamps. Mark the location of the holes using the fitting as a guide. Remove the fitting from the backing plate and drill the holes in the backing plate.

3. Install Nutplates In The Backing Plate

Refer to the section labeled “Installing Nutplates” in this section of the manual to install the nutplates in the backing plate.

The backing plate is now ready to install.

Installing Nutplates:

Nutplates are installed wherever there will be limited access to the rear side of a component where a fitting or panel is attached. In most cases, nutplates will be installed on backing plates which will be permanently bonded inside a sealed wing or tail structure.

Two different types of nutplates are included in your kit: fixed nutplates and floating nutplates. Floating nutplates have a threaded section that "floats" on a fixed base to allow for the inevitable slight misalignment of the bolts used to attach fittings. Fixed nutplates have a threaded section that is solidly attached to the base. Fixed nutplates are used on removable panels (such as inspection plates) and as drill guides for the floating nutplates. Floating nutplates are used anyplace a fitting is attached through a phenolic block. All backing plates for the wing and tail hinge fittings use floating nutplates.

The installation of nutplates is a relatively straightforward operation. The following steps outline the process necessary for installing a nutplate on a typical backing plate. A similar procedure is used when installing nutplates for an inspection plate or removable panel with the exception that the floating nutplate is not used for these installations.

NOTE: Some early versions of the G-202 came with pre-made backing plates. If your kit includes these backing plates you may disregard steps 1-4 below.

1. Drill Bolt Holes In The Backing Plate

If you have not already done so, clamp the appropriate fitting to the backing plate and use this fitting as a guide to mark the bolt holes on the backing plate. Drill the holes.

2. Use A Short Bolt To Clamp A Fixed Nutplate In The Bolt Hole

Find a bolt of the appropriate diameter and just long enough to pass through the backing plate and about halfway through the nutplate. If you cannot find a bolt short enough, try

placing several washers under the head of a slightly longer bolt. Save this bolt as you will reuse it many times in the construction of your G-202. Using this bolt, clamp a fixed nutplate of the appropriate size to the backing plate so that is tight and will not rotate.

3. Drill The Holes In The Backing Plate For The Retaining Rivets

Use a 3/32 inch bit to drill a hole through the backing plate using one rivet hole in the nutplate as a drill guide. Now place a rivet in that hole to prevent the nutplate from rotating and drill the remaining nutplate rivet hole through the backing plate. Remove the bolt and fixed nutplate from the backing plate.

4. Countersink The Rivet Holes

Use a 100 degree countersink to countersink the holes on one side of the backing plate. Countersink these holes just enough to allow the AN426 AD3 rivets to sit flush with the surface of the backing plate.

5. Mount The Nutplate

Locate the proper floating nutplate and mount it to the backing plate using two AN426 AD3 rivets. Drive these rivets using a rivet squeezer.

Setting Bearings Into Control Surface Hinge Brackets:

All of the control surfaces of the G-202 employ sealed, self-aligning bearings. These bearings are designed to be press fit into machined receiver holes in the aluminum hinge brackets supplied with your G-202 kit. These are durable bearings, though some care must be exercised in their installation.

NOTE: Use care when installing the bearings! If too much force is used, the bearing will be distorted and will not operate smoothly. Enlarge the hole in the hinge until the bearing can be pressed in fairly easily.

The bearings may be press fit using either an arbor press or a common bench vise. Note that each bearing consists of an outer collar within which a swiveling inner bearing floats. It is imperative that when you press these bearings into place, you **only apply force to the outer collar and never to the inner swiveling portion of the bearing**. The inner swiveling portion of this type of bearing is not designed to tolerate the lateral forces associated with press-fitting.

1. Make Up A Bearing Driving Die.

In order to properly seat the bearings yourself, you can construct a driving die out of a short (2" or less) length of appropriately sized pipe. Cut both ends of the pipe square and parallel. Also, a socket (as used with a ratchet to tighten bolts) of the proper diameter can be used as a driving die.

2. Press Fit The Bearings Into Their Hinge Brackets.

The bearings can be press-fit by placing the hinge against one jaw of an open bench vice with the bearing receiver hole facing away from the jaw. Then put the bearing into place at the mouth of its receiver hole. Place one end of the driving die on center over the outer collar of the bearing, and then slowly and carefully tighten the vice until the driving die has pushed the bearing all the way into its fully seated position.

3. Hone The Bearing Bore Of The Bracket If Necessary.

In the event you can not set the bearing without the use of excessive force, you may need to purchase a brake cylinder honing tool from your local auto parts store. **In no event should you attempt to grind down or file any part of the bearing itself.** Instead, carefully increase the inside diameter of the receiver hole by honing a small amount of metal from the walls of the hole. Remember that the hinge brackets are aluminum, not steel. A little honing will go a long way. After removing any metal shavings that might contaminate the bearing, try fitting the bearing again. It should be a firm (NOT TIGHT) press fit. Hone out the hole until the bearing drives in with light resistance.

4. Stake The Bearings In Place

AkroTech suggests that the builder also employ a technique called *staking* to further anchor the bearings into the aluminum hinge brackets. Bearings are staked in place only after they are fully seated in their aluminum hinge brackets. Using a pointed center punch, make three separate punches in the aluminum of the hinge bracket, equally spaced around the circumference of the bearing, each one being 1/16" from the bearing. Do not punch the bearing itself. Be sure to stake the bearing on both sides of the hinge bracket. These punches minutely deform the metal of the hinge bracket, making it that much harder for the bearing to inadvertently depart from its hinge bracket.

Note: Many builders report having some difficulty installing the bearings, and most have ruined at least one of the bearings. These bearings cost approximately $20 each, so do be careful. The bearings should not require very much force at all to install. Carefully enlarge the holes in the hinges as necessary for proper bearing fit.

Getting Started

Setting up your work space

The G-202 can be built in a minimal space with a minimal number of tools. However, before you start construction, you must look at the space that is available to you and make a few decisions concerning how your particular space is best utilized. You will need to construct a 4 ft by 12 ft work table to serve as a platform for the various jigs required to properly align your G-202 airframe components. You will also need a separate work table on which you will construct some of the smaller assemblies and to act as a repository for the various tools which would otherwise end up scattered all over your shop floor. And you will also need a place to store your G-202 components until you actually need them. If your shop space is limited, it is recommended that you keep most of your components in the shipping crate until they are required. This shipping crate can be left outside if you place a tarp over it to protect it from the weather.

However you arrange your shop space, bear in mind that you will want to allow about 2' of walking space around all sides of your main construction table.

Building Your Construction Table

Brief Task Description:

In order to accurately and efficiently assemble your G-202, you will need to construct a sturdy, rigid work table. This work table will need to be a minimum of 4 ft wide by 10 ft long but we suggest a size of 4 ft by 12 ft as this size will make it easier to perform certain jigging tasks with the wings. The materials needed to build this table can be found at your local lumber store.

Tools & Materials Required:

2	Straight kiln-dried 2" x 6" x 12' construction grade lumber
2	Straight kiln-dried 2” x 6” x 8’ construction grade lumber
2 sheets	3/4" by 4' by 12' particle board for work surface
200	2” drywall screws.
20	3” drywall screws
2	Sturdy sawhorses
1	#2 Phillips bit
1	Electric drill
1	48 inch level

You may set your table on sawhorses, or you may build a more permanent table using 2 x 4 lumber for the legs.

Wing Construction Tasks

TASK W-1 Install Inspection Plates in the Aileron & Wing

Brief Task Description:

In order to inspect and maintain the aircraft in the course of normal usage, it will be necessary to provide inspection plates to access the aileron belcrank, the pitot system, and the aileron hinge components that would otherwise be inaccessible within a closed wing or aileron. To make these inspection plates you will first need to cut holes in the pre-molded inspection plate recesses in the wing and aileron skin. Then you will make the inspection plates themselves by laying up fiberglass near the inspection plate flange. Lastly, you will install the necessary nutplates in the inspection plate flanges.

Step A Cut Holes in the Inspection Plate Flanges

In this step you will cut holes in the pre-molded recesses in the wing and aileron. These holes will be cut somewhat smaller than the recesses themselves, leaving a recessed flange to accept the inspection plate. To do this, cut two strips of posterboard, one 1/2 inch wide and the other 1/4 inch wide. Place these strips up against the inside edges of the recesses and use a felt tip marker or scribe to mark off the edges of the holes. Give the corners of the holes a generous radius. Cut out the holes using a jigsaw with a narrow, fine-toothed metal-cutting blade and smooth the edges of the holes with sandpaper .

Step B Make the Inspection Plates

In this step you will make the inspection plates that fit into the pre-molded recesses in the wing and aileron. To begin, place clear tape on the aileron and the wing beside each pre-molded recess. Try to choose an area that closely matches the contour of the inspection plate recess. The clear tape should be about an inch larger all around than the size of the inspection plate. Prepare some epoxy laminating resin (refer to the section entitled “Wet Lay-ups” in this manual) and lay up five plies of fiberglass a little larger than each respective inspection plate recess on the clear taped areas. Note: fiber orientation is not critical for the inspection plates but you may find it easier to have the fibers running at 45 degrees to the edge. Let these lay-ups cure completely, then mark each one with its position and remove them from the wing and aileron skins.

Cut out each inspection plate using the appropriate inspection plate recess as a guide. Cut out the inspection plates a little oversize then use a belt sander or sanding block get them to fit into the recesses.

Step C Locate and Drill Holes for the Inspection Plate Screws

Mark the screw hole locations on each inspection plate. Use a center punch to place a small dimple at the center of each hole. Tape each inspection plate into its appropriate recess in either the wing or aileron being careful not to cover the dimples just made in the inspection plates with the tape. Now drill the no. 19 inch holes through the inspection plates and the inspection plate flanges (recesses) in the wing and ailerons. Remove the inspection plates from the wing and aileron.

Step D Install Nutplates in the Inspection Plate Flanges

Refer to the section entitled “Installing Nutplates” in the general information section of this manual to install the 8-32 nutplates in the inspection plate flanges. Note that in this application, floating nutplates are not needed.

Step E Countersink the Holes in the Inspection Plates

Use a 100 degree countersink to countersink the holes in the inspection plates so the 8-32 screws will sit flush with the exterior surface.

TASK W-2 Install Backing Plates in the Ailerons

Brief Task Description:

In this task you will make and install the backing plates for both the left and right aileron. These backing plates will receive the bolts that secure the spade brackets to the ailerons. You may wish to review the section entitled “Backing Plates” in the General Information Section of this manual at this time.

Note that you will need to cut slots in the aileron skins to clear the wing mounted aileron hinges first. This must be done prior to drilling the aileron spars for the spade bracket mounting bolts since the skin would otherwise obstruct the drill bit.

Step A Cut Slots for the Aileron Hinges in the Aileron Skins

Remove the peel ply from the bottom aileron skin, if you have not done so already. Cut the three slots for the aileron hinges in the top and bottom aileron skins. Use the rib positions as a reference for centering the slots in the top skin. Be extra careful not to cut into the ribs when cutting the top skin. Each slot should be .5 inches wide and about 3 inches deep (the depth of the slots will be increased later once the ailerons are rigged to the fuselage). Now carefully position the bottom skin over the top skin and mark the positions of the slots on the bottom skin. Proceed to cut the slots in the bottom skin. You may wish to cut the slots slightly undersize at first and, after bonding the bottom skin in place, file the slots out to their full width. Finish the corners of the slots with a generous radius. You can accomplish this by cutting each slot short, then finishing each slot with a round file or Dremel tool.

Step B Cut Out the Backing Plates

Use a fine tip felt pen to trace an outline of the base of the spade bracket on the supplied .080 aluminum backing plate material. Cut out the backing plates from the aluminum sheet using a jigsaw or a bandsaw. Smooth the edges of the backing plates using a file or belt sander.

Step C Drill Holes in the Backing Plates

Clamp the aluminum backing plates to the spade brackets. Using a 3/16 inch drill bit, drill out the backing plates using the spade bracket as a drill guide. This will assure alignment of the holes.

Step D Install Nutplates in the Backing Plates

Refer to the General Information Section of this manual to install the two 10-32 floating nutplates in each backing plate. Be sure to orient the nutplates diagonally as shown on the illustration.

Step E Bed the Spade Brackets with Structural Adhesive

It is imperative that the hinge bolt holes in the spade bracket and the hinge bolt holes in the ribs match up perfectly. The following procedure will assure that these holes will remain in perfect alignment after the spade bracket is affixed to the aileron spar via the two 3/16 inch mounting bolts.

Trial-fit the spade brackets on each aileron using the 1/4 inch hinge bolt. There should be a little clearance (about .010 inch) between the spade bracket and the aileron spar. This space will need to be filled with structural adhesive. Remove the spade brackets from the ailerons and place some clear tape over the side of each spade bracket which faces the aileron spar. Prepare the web of both aileron spars for bonding by sanding with 80-grit sandpaper and cleaning with acetone. Now mix a small batch of structural adhesive and add enough structural filler to achieve “mayonnaise” consistency. Apply the adhesive to the forward face of each aileron spar then reinstall the spade bracket with the 1/4 inch hinge bolt. Remove any excess adhesive using a clean cloth then adjust each spade bracket until it is parallel to the spar web. Hold the spade bracket in this position using a C-clamp.

Step F Drill Holes in the Aileron Spars

Once the structural adhesive has cured, use a long 3/16 inch drill bit to drill through the aileron spars using the holes in the spade brackets as a drill guide. Try to keep the drill perpendicular to the spar web while drilling. If these holes are not drilled perpendicular to

the web, they may not match up with the holes in the backing plates. Now trial fit the backing plates using the 3/16 inch bolts. After you are satisfied the backing plates fit as they should, remove them from the aileron spars (leave the spade brackets in place for now).

Step G Bond the Backing Plates to the Spars

Prepare the aft surface of the spars and the backing plates for bonding. Mix a small batch of structural adhesive and add enough filler to achieve “mayo” consistency. Coat each backing plate and spar web with the adhesive. Wax the 3/16 inch mounting bolts and re-install them through the spade bracket and into the backing plates. Tighten the bolts down and remove any excess adhesive. Allow to cure completely before proceeding.

Step H Install the Stainless Steel Retaining Screw

Remove the spade brackets from the aileron spars. Drill a no. 19 hole through the aileron spars directly between the two 3/16 inch mounting holes for the spade bracket. Countersink this hole on the forward side of the spar using a 100 degree countersink. Insert the 8-32 stainless steel retaining screw through the spar and backing plate. Install and tighten the AN365-832A nut on the retaining screw.

TASK W-3 Build The Aileron Construction Jig

Brief Task Description:

Until this point, you have been working on the ailerons without placing them in a jig. You may have noticed that they are not completely rigid. That is, the ailerons can be flexed to a certain degree. Once the ailerons are closed, they will no longer flex or twist much at all. In order for the ailerons to be absolutely free of twist once closed, they must be secured into a true, twist-free jig as its lower skin is bonded into place. In this task you will make that jig.

The same jig is used for both the left and right aileron. The left aileron will be built first and then the position of the root and tip formers will be switched on the jig to build the right aileron.

NOTE:
The 1-inch square steel tubing used to support the trailing edge and spar in the aileron jig can usually be found at a local steel supplier. Check your yellow pages under “Steel”.

Step A Cut Out the Aileron Jig Formers

Remove the aileron jig former templates from this manual and use spray adhesive to mount them to 1/2 inch particle board or plywood. Cut out the aileron jig formers using a jigsaw. Stay just to the outside of the line when cutting, then use a belt sander or sanding block to bring the surface down to the line.

Step B Mark the Former Locations on the Construction Table

Using a carpenter's chalk line, snap a line parallel to and about 6" in from the edge of your work table. The line should run the entire length of your work table. Draw a line perpendicular to the line just drawn at a location about 6 inches in from the left end of the table using a framing square. This line will reference the position of the root rib former for the left aileron jig. Draw two more lines perpendicular to the chalk line 51 inches and

102 inches from the root rib mark. These lines locate the center and tip rib formers respectively.

Step C Mount the Angle Brackets to the Table

Now it is time to position the steel angle brackets that will support the aileron formers. Clamp four 4-inch steel angle brackets to either side of each former (do not screw them to the formers yet). The brackets should be positioned as indicated on the former templates. Place the formers in position on the table (with the angle brackets clamped to them) so that the left edge of each former is aligned with its appropriate mark on the table and so that the trailing edge of each former is aligned with the chalk line near the edge of the table. Screw the angle brackets to the work surface (but not into the formers yet) so that they will support each former in the proper position on the table. After screwing the angle brackets to the table surface, remove the clamps. Each former should now be snug between its brackets, but still able to slide so that it can be adjusted later.

Step D Cut and Fit the Spar and Trailing Edge Support Tubes

Now you will need to cut the two 1-inch square tubes for supporting the spar and the trailing edge of the aileron while the top skin is bonded in place. These support tubes fit into the notches cut into the formers. Note that the notches are a little deeper than they need to be. This will allow the tubes to be shimmed up to align accurately with the surface of the formers. Cut each tube just long enough to span the length of the jig. Trial fit the support tubes in the formers then remove both the tubes and the formers and set them aside.

TASK W-4 Align the Aileron Construction Jig

Brief Task Description:

In this task you will assemble and precisely align the aileron construction jig. Accuracy is essential here. Your aileron will only be as good as the jig in which you build it.

The first step is to build a simple alignment tool that will allow you to exactly position the formers. It will consist of two pairs of sturdy steel angle brackets with two lengths of monofilament line stretched tight between them. These brackets will be positioned just ahead and just behind the front and rear edges of the formers. That way, the formers can be dropped carefully into place between the monofilament lines (with about 1/16 inch to spare at either end). The ultimate goal is to adjust the alignment tool so that the two monofilament lines are dead level and parallel to each other. Those two lines will then be used as references to which the aileron formers themselves will be aligned.

Step A Mount the Alignment Tool to the Table

This step involves positioning and mounting four 6-inch heavy duty steel angle brackets on your construction table and stretching some monofilament line between these brackets to act as a reference for aligning the aileron formers.

Locate one pair of angle brackets exactly on the chalk line snapped on the construction table earlier. Locate another pair of angle brackets parallel to and 16 1/8 inches from the first pair of brackets. Make sure the faces of each pair of opposing brackets are exactly 16 1/8 inches apart. These brackets need to positioned carefully, so take your time. Once you have them properly located, screw them down to your work surface.

Stretch monofilament line between the 6 inch angle brackets so that you have two parallel lines running the length of the aileron work area. These lines need to be adjustable vertically (so that you can fine tune their position on the angle brackets) and they must be very tight. Regardless of the method used to mount the monofilament line, make sure it is tight and does not sag in the middle. Remember: this is the line you will use to align your aileron - if it sags, so will your aileron

Step B Level the Monofilament Line

In this step you will adjust the monofilament lines so that they are exactly level. Adjust the lines to their starting position three inches above the table surface. Adjust the line by sliding it up and down the angle brackets until level.. Repeat this procedure for the other line. It is perfectly acceptable to raise the monofilament reference lines a little above the arbitrary 3 inch starting height if necessary. It is only critical that the alignment requirements be met. It does not matter if that occurs at 3 1/8" above the surface of the work table, or at some other height. If you find that you have to move the string a lot to get it level then your table is probably not very level. You may wish to level your table before proceeding.

Double-check the alignment of the monofilament lines using an accurate 6' level or a water level. Now is the time to be accurate. The level monofilament lines are the fixed reference points from which the entire aileron will be assembled. Once you are certain the monofilament lines are level, use some tape to secure the lines to the angle brackets so they cannot slide out of place.

Step C Place the Aileron Formers Into Position

Carefully drop the aileron formers back into place. Do not disturb or bump the monofilament reference lines in the process. The formers should have 1/16" to spare on either end. As you did with the alignment tool, clamp the aileron formers lightly into place between their brackets so that you can move them by small amounts with firm taps from the butt of a screwdriver or small hammer -- but tight enough so that they will not move when you do not want them to.

Step D Align the Aileron Jig Formers

There are two alignment conditions that must be met:

1. The reference line printed on each former must be in exactly the same plane as both the monofilament lines.
2. Each former must be centered between the monofilament lines.

Raise or lower each aileron former to bring the reference lines printed on the former templates exactly level with an imaginary plane defined by the two monofilament lines. You can check this with a level, or by simply sighting down the reference lines and adjusting each former until it is aligned with both monofilament lines. Then check that each former is exactly centered between the monofilament lines (if the 6 inch angle brackets were positioned correctly, there should be 1/16 inch between the former and the monofilament line on each side). Alternate between these two adjustments. Once you have the formers precisely positioned, clamp each former in place between the brackets screwed to the work table.

NOTE:
Make sure you check the accuracy of your level regularly during the construction of your G-202. This fairly simple to do. Place blocks or shims under each end of the level until it reads **dead level**. Now, keeping the same surface of the level facing down, lift it off the blocks and spin it end for end 180 degrees and put the same surface of the level back down on the blocks. Be sure you are looking at the same bubble in the same glass tube. Does it still read **dead level**? If so, that one bubble tube **and only that one** is accurate. Use a felt tipped marker and put a "check" mark on the level next to that one bubble tube. If not, use your felt tipped marker and put an "X" over that particular bubble tube so that you will know not to use it. Do the same thing for every other bubble tube on the level, and be sure not to use those that you have X'ed out. If, in the course of building you G-202, you drop or bang the level, take a few minutes and check all the tubes again to be sure it has not been knocked out of alignment. Your airplane will only be as accurate as your level.

Step E Mount the Formers to the Brackets

Once you are sure the formers are correctly positioned, carefully fasten all aileron formers into their support brackets. Take care not to knock the formers out of alignment as you secure them. Use appropriately sized screws and drill pilot holes.

Step F Mount the Trailing Edge and Spar Support Tubes to the Formers

Place some clear tape over the support tubes where they fit into the notches in the formers. This clear tape will prevent the body filler from adhering to the tubes, so that you can remove them later to make the right aileron jig. Cut out six pieces of particle board about 1-1/4 inches wide by 3 inches long from some scrap. Clamp these blocks to the two support tubes where they intersect the formers. These blocks should just barely extend over the sides of the tubes. Prepare a small batch of body filler and put a blob in each notch where the tubes are to rest. Push the tubes into the notches (with the wood blocks clamped to them) and squeeze out the excess body filler. The tube should now rest on the wood blocks which span the notches in the formers. This will perfectly align the top surface of the support tubes with the top surface of the formers. When the body filler has cured, remove the wood blocks from the tubes.

Check the formers and support tubes to be sure that nothing protrudes above the surface. A protrusion may prevent the aileron from properly seating in the jig and might also scratch the carbon fiber skin. Place a layer of clear 3M tape on all the surfaces of the aileron jig that will come in contact with the aileron skin. This will prevent any excess adhesive from permanently bonding the aileron into the jig.

Step G Recheck the Alignment of the Jig

Meticulously recheck the alignment of the entire jig. Be certain that the completed jig is true. It is possible that an unnoticed error crept in. If you find an error, no matter how small, correct it now. It will be easier to correct an error now rather than in the flight test phase.

TASK W-5 Build Up the Bond Area on the Ribs and Spars

Brief Task Description:

In this task you prepare the aileron for closing by building up the bond areas on the wing ribs and spars. This insures that there will be no low spots on the spars or ribs when it comes time to bond the lower aileron skin in place. The goal is to add a layer of structural adhesive to any low areas on the aileron ribs and spars that will allow the final bond layer of structural adhesive to be thin and uniform.

Remember that you are building the aileron upside down. This means that anytime we refer to the upper skin we mean the one with the ribs and spars bonded in (and not the one that is actually on top during assembly). And anytime we refer to the lower skin we mean the one without the ribs and spars.

Step A Place the Left Aileron in the Jig

Place the aileron assembly in the jig. Use spring clamps to secure the aileron trailing edge to the steel support tube that you built into the aileron construction jig. Place sand bags in the aileron to be sure that it is fully seated in the aileron jig.

Check that the jig former contours match those of the aileron skins. The aileron construction jig formers should contact the aileron skin along their entire length. If not, double check that the aileron is in proper side-to-side alignment in the jig.

Step B Mark the Bond Areas on the Skin

Lay the lower aileron skin (which is now on top) in its proper place on the aileron assembly. Locate the bond areas on the lower skin. Cover all the bond areas on the inner face of the lower aileron skin with a layer of clear 3M tape.

The reason you are doing this is that you will be applying structural adhesive to the aileron spars and ribs, then placing the lower aileron skin on that adhesive. The idea is to exactly impart the shape of the inner face of the lower aileron skin onto the adhesive that you have applied to the spars and ribs, but without yet permanently bonding the lower

aileron skin in place. The layer of tape covering the bond zones insures that you will be able to remove the lower skin after the structural adhesive hardens.

This is a good time to dry fit the lower skin to be certain that it mates properly with the spar and ribs. It would be a good idea for you and an assistant to practice putting the aileron skin precisely in place as if there were adhesive on the ribs and spars. A few dry runs will help you place the lower aileron skin with perfect precision the one time that it really counts.

NOTE: The aileron skins are shipped slightly long so they can be trimmed by the builder for a custom fit. Do not worry about trimming the aileron skins until after the ailerons have been closed.

Step C Prepare the Aileron

Carefully place the upper aileron skin into exact position on the spar, ribs, and lower skin assembly. Use tape to secure the lower skin to the upper skin at the leading edge. Place 10 lb. sand bags every foot along the spar.

Drill holes for Cleco fasteners every 4" along the center of the leading edge joggle and through the skin along the root and tip rib flanges. These Clecos will hold the skin in position while you are building up the bond area and when finally bonding the skin in place.

Now remove the lower skin from the assembly. Prepare the bond zones of the aileron spars and ribs for bonding (See the General Information section of the manual). Be sure that all are properly scuffed and cleaned with acetone immediately prior to the bonding operation.

Step D Mix and Apply Adhesive

Prepare a batch of structural adhesive and thicken it to "mayonnaise" by mixing in a volume of structural filler that is approximately equivalent to the volume of adhesive (See the section entitled "Mixing and Thickening Adhesives" in this manual).. Put a

generous but not excessive layer of this mixture on the ribs and spars This layer should evenly cover the entire bond area of the ribs and spars.

Remember that you are trying to accomplish two things. First, you must force the skin firmly and completely onto all the bond areas. Second, you must press a perfect impression of the inner surface of the upper skin into the fairly thick mixture of structural adhesive that is on the ribs and spars.
The goal is to build up the thinnest possible layer of structural adhesive that will still provide a bond area that has no gaps or low spots. Inadequate pressure over the bond areas will allow too thick a layer of structural adhesive to build up, however, you do not want to use so much pressure that you begin to locally deform the upper skin.

Step E Place the Aileron Skin in Position

Carefully and slowly place the upper elevator skin into exact position on the spar, ribs, and lower skin assembly. Try to lower the skin directly onto the ribs and spars without smearing the adhesive. Install the Clecos in the holes drilled into the leading edge and the root and tip ribs earlier. Position the 10 lb. sand bags every foot along the spar. Place an aluminum angle over the trailing edge of the aileron and use spring clamps to sandwich the trailing edge between this aluminum angle and the rear spar support tube. Allow the structural adhesive to cure undisturbed overnight.

Step F Remove the Aileron Skin

After adequate cure time, remove the upper skin. This should be a fairly simple process involving little more than some gentle tugging -- unless you have not done an adequate job of taping off the bond areas of the upper skin.

Inspect the hardened structural adhesive on the bond areas of the aileron and spars. Ideally all the taped surface came into full contact with the adhesive. Look closely at the adhesive surfaces that were supposed to contact the taped and waxed sections of the aileron skin. The areas that contacted properly should appear smooth and glossy. Those areas that did not contact the taped and waxed sections will have a slightly rougher, more irregular surface appearance.

Should you find a rough or irregular areas, it means that there are still some low spots in the bond area. If these low areas fall more than 1/16 inch below the surrounding areas, they will need to be built up until they too are of the proper height and you will need to repeat Steps D, E and F of this task again.

Start by scuffing the bond surfaces of the adhesive you just applied. If the low spots are prevalent over much of the bond area, you may want to apply another full layer of structural adhesive. If there are only a few localized low spots, it may be adequate to merely apply structural adhesive in the vicinity of the low spots. In any event, remember to place the upper skin exactly in position, and fully weight it in place.

TASK W-6 Balance the Left Aileron

Brief Task Description:

In this task you will be installing the counterbalance weight in the left aileron. This counterbalance weight consists of a mixture of lead shot and structural adhesive which is poured into a sectioned off area in the outboard panel of the aileron. This counterbalance weight is necessary to prevent an extremely destructive aerodynamic phenomenon called "flutter". Do not attempt to fly your aircraft without properly balanced control surfaces.

Step A Make the Knife Edge Supports

Cut two 4-inch pieces of 1.5 x 1.5 angle aluminum. Mount them to your construction table so that they are parallel and roughly 1/2 inch further apart than the span of the aileron. Place two long 1/4 inch bolts into the hinge bolt holes in both the root and tip ribs of the aileron. Place the aileron on the two aluminum angle supports mounted to your work table. The bolts protruding from either end of the aileron should now rest on the edges of the aluminum angle supports. The aileron should now be free to pivot on the two "knife edge" supports with very little friction.

Step B Install Cardboard Dam in Aileron

Find a piece of corrugated cardboard about 1 inch wide by 24 inches long. Completely cover this strip with clear tape. Install this strip in the outboard section of the aileron parallel to and 1 inch back from the aileron's leading edge. Use clear tape on the aft side of the strip to hold it in position. Make sure this "dam" is sealed along the entire bottom edge and also where this strip meets the two ribs.

NOTE:
On some early kits the supplied spade was too large. If you have an early kit please contact us at AkroTech and we will advise you on how to modify these spades so that they will provide the proper control response. DO NOT ATTEMPT TO FLY YOUR AIRCRAFT UNLESS YOU HAVE THE PROPER SPADES INSTALLED.

Step C Mount the Spade Arm and Spade to Aileron

Mount the spade to the spade arm using the supplied hardware. Mount this assembly to the aileron using two 3/16 inch bolts. There should be a small gap between the aileron spar and the face of the spade arm assembly. Fill this space with Hysol and be sure the spade arm assembly is properly positioned. The spade plate and spade should be parallel to the chord line of the aileron.

Step D Balance the Aileron

With the aileron free to pivot on the knife edge supports, pour some lead shot into the sectioned-off area of the aileron until the aileron balances. Now place the lower skin on the aileron. Lift up the leading edge and continue to add lead shot to the aileron until it balances with the lower skin in place. Carefully remove the lead shot from the aileron. This is the amount of counterbalance weight needed to balance the aileron. We have found that it usually takes around 5 ½ lbs to balance each aileron.

Step E Prepare the Lead Shot / Adhesive Mixture

Place the aileron back in the aileron jig so that it is level. Prepare a four ounce batch of structural adhesive and mix in the lead shot removed from the aileron in Step D. Carefully pour this mixture into the sectioned-off area of your aileron. Note that the adhesive will add a little weight to the aileron, making it nose heavy (overbalanced). This overbalanced condition will be corrected later with the addition of primer. and paint.

Note: When balancing the aileron, it will be upside down in the jig. This will make the aileron extremely sensitive to balance, as the spade will be above the aileron. Shim the aileron so that the chord line is level, then add weight until the aileron just rocks off the shim.

TASK W-7 Close the Left Aileron

Brief Task Description:

This task involves closing the aileron by bonding the lower aileron skin into place on the (already partially completed) aileron assembly. The aileron gains an enormous amount of structural strength and rigidity thorough the process of bonding on the lower aileron skin. If not done carefully, the result will be a twisted aileron, and an aircraft with undesirable flying characteristics. Take your time. Do not build in twist.

Note that you will first close the left aileron, then you will modify the aileron jig to accept the right aileron. The right aileron will then be placed in the jig and its lower skin bonded in place.

Step A Drill And Countersink Hole For The Aileron Actuator

Before you can close your aileron, you will need to drill and countersink a hole in the root rib for mounting the aileron actuator.

Carefully draw the chord line on the root rib of the aileron. Do this by measuring across the thickness of the rib and marking the center of these measurements at several locations along the length of the rib. Now draw a line through these marks. Use a 1/4 inch bolt to mount the aileron actuator to the aileron root rib through the pre-drilled hinge bolt hole. Adjust the position of the aileron actuator until the second mounting hole is centered on the chord line marked on the rib. Clamp the actuator to the rib then use a 1/4 inch drill to drill through both the root rib and the rib just beside the root rib on the aileron. Enlarge the hole in the second rib until it is just large enough to fit the head of the 1/4-28 countersunk screw through it. Use a 100 degree countersink to countersink the hole on the inside face of the root rib. Trial fit the countersunk screw to be sure it sits flush with the inside face of the root rib.

Step B Drill Pressure Equalization Holes in the Ribs

Drill a 3/32 inch hole in the center of each aileron leading and trailing edge rib (except the tip ribs). These holes will allow air to escape from the compartments in the aileron.

Step C Place the Left Aileron in the Aileron Jig

As you work, remember that the aileron is built upside down, with the spar and ribs factory-bonded into the upper skin. Place the aileron assembly in the jig. Use spring clamps to secure the aileron training edge to the steel trailing edge support tube that you built into the aileron construction jig. Place sand bags in the aileron to be sure that it is fully seated in the aileron jig. This may take quite a bit of force.

Check that the rib former contours match those of the aileron skins. The formers should contact the aileron skin along their entire length. If not, double check that you have the correct aileron, and that the tip end of the aileron is placed in the tip end of the jig.

Step D Dry Fit the Aileron Skin on the Aileron

Dry fit the bottom skin to be certain that it mates properly with the spar and ribs.
It is a good idea for you and an assistant to practice putting the lower aileron skin precisely in place a few times.

Step E Prepare the Aileron for Bonding

Be sure to completely mask off all exposed fittings on the aileron. It will be very difficult to remove any excess adhesive that bonds to hinge assemblies, etc. Good masking will prevent this. Also, remember to use clear 3M tape to mask. Adhesive will soak through standard household masking tape.

Next, prepare all bond zones of the skin, spar, and ribs for bonding. Review the Section entitled “Bonding Procedures” in the General Information Section of this manual. Be sure that all bond areas are properly scuffed and cleaned with acetone immediately prior to bonding. Do not to touch the bond areas after cleaning. Any contamination, including oil from your skin, will compromise the structural integrity of your aircraft. Always be extra careful when bonding.

CRITICAL DOUBLE CHECK:
We cannot over-emphasize the importance of the alignment of the three aileron jig formers. It is still possible to build in twist unless this entire task is approached with great care. With the aileron held in place in the jig, recheck everything. Are the aileron leading and trailing edges **precisely** matched up with the leading and trailing edge marks on the formers? Are those marks all still in **exactly** the same plane? Is that plane still perfectly level? Recheck **everything** before proceeding. This is you last chance to correct any error.

Step F Prepare and Apply Adhesive to the Aileron

Before you start the bonding process, you should be very sure that you have everything ready. Once you start the applying the adhesives, you can not stop. All the tools and materials you need must be close at hand. Here are the things that you will want to have standing by before you start to mix adhesive:

- Latex gloves for mixing and applying adhesive.
- A roll of paper towels for clean up.
- Adequate solvent for clean up.
- A 10' long aluminum "L" section. One wide face of this piece should be protected with clear 3M tape where it will contact the carbon fiber of the aileron skin.
- About 20 spring clamps.
- Clecos
- Eight 10 lb. sand or lead shot bags

NOTE:
Bonding the aileron skin in place requires a helper and the knowledge that you will have the time to complete the following steps in uninterrupted succession:
1. 2 hours to complete the application and clean up of the adhesive.
2. 8 to 12 hours at 65˚ to 110˚ F for the initial cure.

Measure out and mix three 4-ounce batches of structural adhesive (you may wish to refer to the section entitled “Mixing and Thickening Epoxy Adhesives” in the General Information Section of this manual at this time). Measure and mix according to

manufacturer's instructions. Stir slowly at first, then continue to stir for at least two minutes after the mixture assumes a uniform viscosity. After thoroughly mixing the adhesive, add enough structural filler to achieve “mayonnaise” consistency. This will prevent the mixture from flowing out of the joints during cure. Leave one cup of adhesive unthickened (5 oz) for application to the bond areas on the lower skin.

You may find it helpful to place a few sand bags in the aileron, away from the bond areas, before you apply the adhesive. The weight of the sand bags will help to hold the aileron in place as you apply the adhesive.

Apply a thin , even layer of the thickened adhesive mixture to **all the bond zones** of the upper aileron assembly:

- Aileron leading edge.
- Aileron ribs.
- Aileron spar.
- Aileron trailing edge.

When applying the adhesive, try to form it into a triangular shape on the tops of the ribs and spars. This will help prevent voids in the bonded areas.

Use a small brush with stiff bristles to paint the unthickened adhesive on all of the bond zones on the lower skin. Be sure to coat **all** areas that will come into contact with a rib or spar surface.

VERY IMPORTANT: Be very certain to remove all sand bags and tools (or any other foreign matter that you do not wish to become a permanent part of the aircraft) from inside the aileron before bonding the skin in place.

Step G Bond the Lower Aileron Skin in Place

Using a helper, carefully, slowly, and precisely position the lower aileron skin into place over the bond area. Put the skin down as close to it's final position as you can. The less you have to move it to get proper alignment, the less adhesive you will smear, and the better bond you will make.

Align the lower aileron skin with the top aileron assembly. Be sure that the leading edge of the lower aileron skin is fully seated into its joggle recess along its entire length.

Next, start to secure the aileron into the construction jig. In general, you want to move from the leading edge to the trailing edge. The effect will be to gently pull the lower aileron skin aft, thereby seating it into the leading edge joggle, bonding it to the aileron spar and finally to the trailing edge.

Install Clecos into the holes drilled earlier in the leading edge. When inserting the Clecos, start from the center of the aileron and move outward.. Place 10 lb. sandbags every foot along the spar. Place your aluminum "L" section over the lower skin trailing edge and clamp it every foot using spring clamps. Your clamps should sandwich the freshly bonded trailing edge of the wing between the steel support tube and the aluminum "L" section.

Wipe off any excess structural adhesive that has squeezed out along bond lines. Excess adhesive adds weight, but not strength.

Step H Remove Aileron from the Jig After Complete Cure

Only after the bond in the ailerons has completed an initial cure of at least 24 hours at 65 degrees F should you loosen your clamps and remove the aileron from the aileron construction jig. Allow full and complete cure time.

CRITICAL: **You must allow each bonded aileron to cure undisturbed in the construction jig for a minimum of 24 hours at 65 degrees F** -- however it is preferable to allow a minimum of 12 hours cure time at 85 to 110 degrees F. A small electric heater placed under the work table (but away from any combustibles) can help you achieve higher temperatures in the vicinity of your aileron construction jig. **Do not loosen any clamps or move any sandbags during this period.**

Step I Trim the Aileron Skin

Use a Dremel tool or jig saw to trim the aileron skin where it protrudes from the root and tip aileron ribs. Be careful not to damage the ribs while trimming.

TASK W-8 Close the Right Aileron

Brief Task Description:

In this task you will modify the aileron jig to accommodate the right aileron. Then you will use this jig to close the right aileron. Note that the procedure used to close the right aileron is identical to that previously used to close the left aileron.

Step A Remove the Support Tubes from the Aileron Jig

Remove the support tubes from the jig formers being careful not to damage the formers themselves. The clear tape placed on the tubes earlier should have prevented the body filler from adhering to the tubes. If you cannot pull the tubes out by hand, tap the tubes with a hammer to knock them out of the notches.

Step B Switch the Positions of the Root and Tip Formers

Remove the root and tip formers (BL 30 and BL 132) from your construction table. Leave the steel angle brackets attached to your work surface. Switch the positions of the root and tip formers on your work table. Trial fit the support tubes in place in the former notches. Note that the tubes will now protrude slightly above the surface of the formers. You will need to grind some of the body filler out of the notches to get the tubes to sit all the way into them. Remove the tubes from the jig and set them aside.

Step C Align the Aileron Jig

Repeat the alignment procedure you performed in task W-4 to align the aileron construction jig. Double-check to be sure your two alignment strings are tight and level. Once the formers are properly aligned, replace the support tubes using body filler as you did previously.

Step D Build the Bond Area on the Ribs And Spars

Refer to task W-5 to build up a level bond area on the ribs and spars of the right aileron. Remember to properly prepare all bond areas before applying the adhesive.

Step E Balance the Right Aileron

Balance the right aileron following the procedure outlined previously for the left aileron.

Step F Close the Right Aileron

Mount the lower skin on the right aileron using the procedure for the left aileron.

TASK W-9 Install the Pitot System

Brief Task Description:

The hardware and plumbing for the pitot/static system must be installed prior to permanently closing the wing. The pitot system is mounted at the wing tip, with the ram air and static air lines running through a PVC conduit.

Step A Cut and Fit the Pre-molded Pitot Tube Mounting Pad to the Spar

Find the pitot tube mounting pad supplied with your kit. This mounting pad is supplied long and must be trimmed to the proper length. Use a jigsaw to trim this pad down so that it will fit on the front face of the left main wing spar, 3.5 inches inboard of the tip rib. This pad should be cut a little undersize so that it clears the top and bottom spar caps by about 1/8 inch (this will allow you to precisely position the pitot tube later).

Step B Install Nutplates in the Pitot Tube Mounting Pad

Center the aluminum pitot tube fitting on pitot tube mounting pad. Use two C-clamps to clamp the fitting to the mounting pad. Using the fitting as a drill guide, drill two 3/16 inch holes through the mounting pad. Refer to the section entitled “Installing Nutplates” in the General information section of this manual to install the two 10-32 nutplates on the rear face of the mounting pad.

Step C Cut Hole in the Leading Edge of the Wing

Mark the position on the leading edge 3 1/2 inches from the outside face of the tip rib where the pitot tube will extend. Drill a 1/4" pilot hole centered vertically in the leading edge. Now drill out this hole to 5/8 inch using a hole saw. Note that this hole is about 1/8 inch larger than the pitot tube. This is to allow for the insertion of a plastic sleeve which will isolate the aluminum pitot tube from the carbon fiber.

Step D Install the Pitot Tube Mounting Pad and Plastic Sleeve

Prepare the front face of the main spar and the pitot tube mounting pad for bonding. Also prepare the exterior surface of the supplied 5/8 inch x 1 inch plastic sleeve for bonding to the inside of the leading edge skin. Assemble the pitot tube fitting to the pitot tube mounting pad using the supplied AN3C6A bolts. Place some clear tape over the pitot tube and slide it into the hole in the leading edge of the wing. Now assemble the pitot tube to the pitot tube fitting and mounting pad.

Note: Install only the outer aluminum tube at this time. The inner steel tube and aluminum tip do not need to be installed for this operation.

Slide the plastic sleeve over the pitot tube and position it near the hole in the leading edge. Trial fit the mounting pad on the spar face and check to make sure the pitot tube can be slid in and out of the hole in the leading edge without binding. Adjust the position of the mounting pad until the pitot tube clears the hole. Mix a small batch of structural adhesive (about 4 ounces) and add enough 404 filler to achieve “mayonnaise” consistency. Coat the spar, mounting pad, and plastic sleeve with the structural adhesive mixture. Position the mounting pad on the spar face and clamp it into position using a C-clamp. Slide the plastic sleeve onto the pitot tube and through the hole in the leading edge. Adjust its position so that about 1/16 inch is left protruding through the leading edge skin and bond it in place by packing the area between the sleeve and the interior wing skin with the adhesive mixture. Clean up all excess adhesive with a clean rag. After the adhesive has cured, remove the pitot tube to protect it from damage. It does not have to be reinstalled until your aircraft is ready to fly.

Step E Install the PVC Conduit for the Pitot / Electrical System

Use a 1-inch hole saw to drill the holes for the 1-inch PVC conduit through the leading edge ribs in the wing for the pitot lines and electrical lines..

Slide the 1-inch PVC conduit into the holes drilled in the leading edge ribs. If the fit of the PVC conduit is too tight, remove the conduit and enlarge the holes with sandpaper. Mix a small batch of structural adhesive and smear some around each rib-conduit junction to seal the core material and lock the conduit in place. Once the adhesive has

cured, round off the sharp interior edges of the conduit on both ends to prevent chafing of the wires and pitot lines.

Step F Install the Pitot Lines

Find the 1/4 inch Nylo-Seal tubing supplied in your kit. Cut 2 pitot lines that are long enough to run from the pitot tube base to the wing root rib, allowing 12" to spare. Attach the 268P-04x02 fittings to the ends of the lines that will be connected to the pitot tube base. Attach the line fittings to the pitot tube base. Cut both the ram air and static lines so it extends approximately 8" on the inboard (fuselage) side of the root rib. Install the 262-N04 unions to the inboard end of the pitot lines. These fittings will allow you to disconnect the lines when removing the wings. Label the static line at the wing root with a felt tip marker so that you can identify it later.

NOTE:
You will have only limited access to these lines once you have closed the wing. Now is the time to be sure that this system is installed correctly. Are the lines run correctly? Have you labeled which wing root fitting is the pitot source and which is the static source?

NOTE:
If you wish to incorporate optional fuel tanks into the wings of your G-202, this would be a good point at which to perform tasks OPT-1 OPT-2 and OPT-3. Although these tasks can be performed at any point up to the closing of the wing, doing those tasks while you are doing other similar work within the wing structure makes sense.

TASK W-10 Build the Wing Construction Jig

Brief Task Description:

Even though it is not part of the airplane, the wing jig is one of the most important parts of your G-202. The wing jig determines the final shape of the wing, and the final shape of the wing will have everything to do with the flying qualities of your aircraft. In order for the wing to be absolutely free of twist once closed, it must be secured into a true, twist-free jig as the lower skin is bonded into place. In this task you will make that jig.

The same jig is used for both the left and right wing. The left wing is built first, then the position of the root and tip formers will be switched on the jig to build the right wing . This task will be virtually identical to the task in which you built the aileron jig. Accuracy in building the aileron jig was critical. Accuracy in building the wing jig is even more critical. Take all the time you need and get it right.

Step A Cut Out the Wing Jig Formers

Find the templates for the wing jig formers and use spray adhesive to mount them to ½-inch particle board or plywood. Cut out the wing jig cradles using a jigsaw. Stay just to the outside of the line when cutting, then use a belt sander or sanding block to bring the surface down to the line.

Step B Mark the Former Locations on the Construction Table

Remove the aileron jig from the construction table. Draw a line perpendicular to the chalk line used for the aileron jig and about 10 inches from the end of the table. This line will reference the position of the root rib former for the left wing jig. Draw two more lines perpendicular to the chalk line 57 inches and 114 inches from the root rib mark. These lines locate the center and tip rib formers respectively.

Step C Mount the Angle Brackets to the Table

Now it is time to position the steel angle brackets that will support the wing formers.. Clamp four 4-inch steel angle brackets to either side of each former (do not screw them to the formers yet). The brackets should be positioned as indicated on the former templates. Place the formers in position on the table (with the angle brackets clamped to them) so that the left edge of each former is aligned with its appropriate mark on the table and so that the trailing edge of each former is aligned with the chalk line near the edge of the table. Screw the angle brackets to the work surface (but not into the formers yet) so that they will support each former at the proper position on the table. After screwing the angle brackets to the table surface, remove the clamps. Each former should now be snug between its brackets, but still able to slide so that it can be adjusted later.

Step D Cut and Fit the Trailing Edge Support Tube

Now you will need to cut the 1-inch square tubes for supporting the spar and the trailing edge of the wing while the skin is bonded in place. This support tube fits into the notches cut into the formers. Note that the notches are a little deeper than they need to be. This will allow the tube to be shimmed up to align accurately with the surface of the formers. Cut the tube just long enough to span the length of the jig. Place some clear tape over the tube where it intersects the notches. Trial fit the support tube in the formers, then remove the tube and set it aside.

TASK W-11 Align The Wing Construction Jig

Brief Task Description:

Having made the components for the wing jig, and having roughly laid out their location on your work table, in this task you will assemble and precisely align the wing construction jig. This procedure is almost identical to that used to align the aileron jig. Accuracy is essential here. Your wing will only be as good as your jig.

The first step is to build a simple alignment tool that will allow you to exactly position the formers. It will consist of two pairs of sturdy steel angle brackets with two lengths of monofilament line stretched tight between them. These brackets will be positioned just ahead and just behind the front and rear edges of the formers. That way, the formers can be positioned between the monofilament lines (with about 1/16 inch to spare at either end). The ultimate goal is to adjust the alignment tool so that the two monofilament lines are dead level . Those two lines will then be used as references to which the wing formers themselves will be aligned.

Step A Mount the Alignment Tool to the Construction Table

This step involves positioning and mounting four 6" heavy duty steel angle brackets on your construction table and stretching some monofilament line between these brackets to act as a reference for aligning the wing formers.

Locate one pair of angle brackets exactly on the chalk line snapped on the construction table earlier. These brackets will support the monofilament line for aligning the trailing edge of the wing jig. Mount these two brackets to the table using screws. Stretch monofilament line between these two brackets, then adjust the formers until their trailing edges clear this line by 1/16 inch. Now locate another pair of angle brackets on the opposite side of the root and tip formers to support the monofilament line for aligning the leading edge of the wing jig. Carefully position these brackets so that a line stretched between them will clear the leading edge of the formers by 1/16 inch. These brackets need to positioned carefully, so take your time. Once you have them properly located, screw them down to your work surface.

Step B Level the Monofilament Line

In this step you will adjust the monofilament lines so that they are exactly level. Adjust the lines to their starting position three inches above the table surface. Now adjust the line by sliding it up and down the angle brackets until the lines are level. It is perfectly acceptable to raise the monofilament reference lines a little above the arbitrary 3 inch starting height if necessary. It is only critical that the alignment requirements be met. It does not matter if that occurs at 3 1/8" above the surface of the work table, or at some other height. If you find that you have to move the string a lot to get it level then your table is probably not very level. You may wish to level your table before proceeding.

Double-check the alignment of the monofilament lines using an accurate 6' level or a water level. Now is the time to be accurate. The level monofilament lines are the fixed reference points from which the entire wing will be assembled. Once you are certain the monofilament lines are level, use some tape to secure the lines to the angle brackets so they cannot slide out of place.

Step D Align the Wing Jig Formers

There are two alignment conditions that must be met. As before, go sequentially through the below list of alignment conditions. You will need to go through the list several times. With each run through the list, your adjustments will be progressively smaller.

1. Vertical alignment is assured by being certain the reference line printed on each former is in exactly the same plane as both the monofilament lines.
2. Horizontal alignment is assured by being certain each former is centered between the monofilament lines.

Raise or lower each wing former to bring the reference lines printed on the former templates exactly level with an imaginary plane defined by the two monofilament lines. You can check this with a level, or by simply sighting down the reference lines and adjusting each former until it is aligned with both monofilament lines. Then check that each former is exactly centered between the monofilament lines (if the 6 inch angle brackets were positioned correctly, there should be about 1/16 inch between the former and the monofilament line on each side). Alternate between these two adjustments.

Shim up each former as needed, then clamp each former in place between the brackets screwed to the work table.

Step E Mount the Formers to the Brackets

Once you are sure the formers are correctly positioned, carefully fasten all wing formers into their support brackets. Take care not to knock the formers out of alignment as you secure them. Drill pilot holes and use appropriately sized screws.

Step F Mount the Trailing Edge Support Tube to the Formers

Clamp three pieces of particle board 1 1/4 inches wide by 3 inches long and clamp these to the support tube where it intersects the formers. Now prepare a small batch of body filler and put a blob in each notch where the tube is to rest. Push the tube into the notches (with the wood blocks clamped to them) and squeeze out the excess body filler. The tube should now rest on the wood blocks which span the notches in the formers. This will perfectly align the top surface of the support tube with the top surface of the formers. When the body filler has cured, remove the wood blocks from the tube.

Check the formers and support tubes to be sure that nothing protrudes above the surface. A protrusion may prevent the wing from seating properly in the jig and might also scratch the carbon fiber skin. Place a layer of 3M clear tape on all the surfaces of the wing jig that will come in contact with the wing skin. This will prevent any excess adhesive from permanently bonding the wing into the jig.

Step G Recheck the Alignment of the Jig

Meticulously recheck the alignment of the entire jig. Be certain that the completed jig is true. It is possible that an unnoticed error crept in. If you find an error, no matter how small, correct it now.

TASK W-12 Mount the Aileron Hinges on the Wing

Brief Task Description:

In this operation you will mount the aileron hinges onto the rear spar of the main wing. As with the last task, this is a critical operation. Again, take time to check and recheck before you drill. Your accuracy here will have very tangible results. A properly aligned control system will operate smoothly; however, even a slight error here can result in controls that simply are not as smooth and light as they otherwise could be.

CRITICAL ALIGNMENTS:
There are several critical alignments to be maintained in this task. First, the horizontal centerline of each aileron hinge bracket **must** be mounted exactly even with the horizontal centerline of the rear spar. Second, each hinge **must** be placed at precisely the same butt line location as the receiving slots in the aileron. Third, each hinge bracket **must** be mounted plumb, with its hinge arm vertical. Fourth, the bearings need to line up with each other or the ailerons will bind. If necessary, washers may be used as shims between the hinge and the rear spar. If a hinge is shimmed, "bed" the hinge in place using Hysol (clear-tape or wax the hinge first!). Be sure the bolts are long enough when mounting hinges that are shimmed. A little extra care and attention to accuracy in this step could save you a great deal of added work and aggravation later.

Step A Install the Bearings in the Aileron Hinges

First, press the aileron hinge bearings into the hinge brackets. Refer to the section entitled "Setting Bearings into Control Surface Hinges" in the General Information Section of this manual.

Step B Place the Left Wing in the Wing Jig

Like the aileron, the wing is built upside down, with the spars and ribs factory-bonded into the upper skin. Place the wing assembly in the jig. Use spring clamps to secure the wing trailing edge to the aluminum trailing edge support that you built into the wing

construction jig. Place sand bags in the wing and check to be sure that it is fully seated in the wing jig.
Check that the rib former contours match those of the wing skin. The formers should contact the wing skin along its entire length. If not, double check that the wing is correctly oriented in the jig.

Step C Mark Centerlines on the Rear Spar and Hinges

Bisect the height of the rear spar at several locations to find its centerline. Mark this centerline on the aft face of the rear spar along its entire span.

Find the six aluminum aileron hinges supplied with your kit. Note that you have four hinges with a rectangular base and two with a triangular base. The hinges with the rectangular bases are the root and center aileron hinges while the hinges with the triangular bases are the tip aileron hinges.

Use a pencil and a straight edge to mark a horizontal line exactly through the center of the base of each hinge (A pencil works fine on the aluminum fittings.).. Make small pencil "tick marks" on the thin edge of the hinge bases so that the marks can be easily seen when the hinges are clamped to the rear spar. These tick marks will help you align the centerlines on the hinges with the centerlines on the rear spar.

Step D Assemble the Hinges to the Aileron

Assemble the aileron hinges to the aileron using the supplied hardware.. Be sure to use washers on either side of the hinge to properly center them in the hinge slots. If you find it difficult to hold the washers in position while inserting the bolt, use a small amount of super glue to hold the washer to the inner race of the hinge bearing. Be careful not to get any glue into the bearing itself.. Install nuts on the bolts to hold them in place, but do not tighten them.

Step E Fit the Aileron to the Wing

Hold the aileron (with the hinges mounted on it) to the wing and move it inboard or outboard until the tip rib on the aileron is even with the tip rib of the wing. Using the marks made earlier on the hinges, align each hinge with the centerline of the rear spar and

clamp each hinge securely in position. When clamping the hinges to the spar, make sure the base of the hinges are resting flat against the rear face of the spar. If they are not, the hinges will not properly align. After all three hinges are securely clamped to the rear spar, disassemble the aileron from the hinges by removing the hinge bolts.

Step F Drill the Hinge Mounting Holes in the Rear Spar

Before drilling the rear spar, be absolutely sure the hinges are perfectly positioned. Once these holes are drilled, it will not be possible to adjust the hinge positions. Check to make sure the wing is firmly seated in the jig. then sight down the center of the bearing holes to make sure they are aligned. Finally, double check each hinge to be certain it is properly aligned with the centerline on the spar.

Drill through each hole in each hinge using a long 1/4 inch drill. Do not damage the hinges with the drill motor chuck! To prevent the hinges from shifting while drilling the holes, you may want to place bolts in each hole immediately after it is drilled. Remove the hinges from the rear spar when finished.

TASK W-13 Make and Install the Aileron Hinge Backing Plates

Brief Task Description:

In this task you will make and install the aileron hinge backing plates for the left wing. Though only the backing plates for the left wing will be installed in this task, it is suggested that you prepare the backing plates for the right wing simultaneously. You can save time by performing similar operations together. You may wish to review the section entitled “Backing Plates” in the General Information Section of this manual.

Step A Cut Out the Aileron Hinge Backing Plates

Use a fine tip felt pen to trace an outline of the base of each aileron hinge on the supplied .080 aluminum backing plate material. Use a jigsaw or a bandsaw to cut out the six backing plates from this sheet. Smooth the edges of the backing plates with a file or belt sander.

Step B Drill holes in the Backing Plates

Clamp each of the backing plates to its respective hinge. Use the hinge holes as a guide to mark the 1/4 inch holes in the backing plates. Remove the hinges and drill the holes.

Step C Install Nutplates in the Backing Plates

Refer to the General information section of this manual to install the 1/4-28 floating nutplates in each of the six backing plates.

Step D Bond the Backing Plates on the Rear Spar

Prepare the backing plates and the forward face of the rear spar for bonding. Wax all of the aileron hinge mounting bolts. Clear-tape the hinges to keep them from getting bonded to the spar. Mix a batch of structural adhesive and apply enough filler to achieve “mayonnaise” consistency. Apply the adhesive to all bond areas on the rear spar and the backing plates. Try to keep away from the holes on the backing plates and the rear spar when applying the adhesive. Press all three backing plates into position on the rear spar. Install the waxed bolts though the hinges and into the backing plates. Tighten down the

bolts and remove any excess adhesive with a clean rag. Leave the hinges mounted to the rear spar.

Step E Enlarge the Aileron Hinge Slots

Fit the ailerons to the wing and enlarge the hinge slots as required. Allow for 20 degrees of aileron travel both the up (+) and down (-).

TASK W-14 Install the Fuel Level Sensor in the Left Wing

Note: The prototype aircraft have used a fuel level sensor in only one wing. It would be a fairly simple matter to install sensors in both wings if the builder so desires. If sensors are installed in both wings, be sure to use an appropriate fuel gauge or a sensor switch.

Brief Task Description:

The G-202 wing tanks utilize a capacitance-type fuel level sensor mounted in the left wing to provide fuel level information. Since the left and right wing are connected, a separate sensor for the right wing is unnecessary. To install the sensor, you will first cut a hole in the root rib of the left wing. Then you will laminate some fiberglass over the hole to act as a base for mounting the sensor. The sensor is then mounted to the fiberglass laminate and the sensor probe is bent as needed to reach the top of the tank.

Step A Cut a Hole in the Root Rib for the Fuel Sensor

Find the aluminum backing plate supplied with your fuel level sensor. Place this backing plate in its appropriate position on the root rib of the left wing and trace its outline using a felt tip pen. Drill 1/4 inch holes in the corners of this outline then use a jigsaw to cut out the hole. Smooth the edges of the hole using the drum sander attachment on your Dremel tool.

Step B Laminate Fiberglass over the Hole

Find a flat piece of wood that will cover the hole and place some clear tape over one side of the wood. Clamp the wood over the hole on the outside of the root rib (with the clear tape up against the rib).

Cut out three squares of fiberglass about 1.5 inches larger than the holes on all sides. Prepare a small batch of laminating resin and pour about a third of the resin into a separate cup. Use the larger batch of resin to wet out the three plies of glass onto a piece of plastic on your work bench. Mix microballoons in with the remaining resin until it assumes the consistency of peanut butter. Use this mixture to fill the core material surrounding the cutout in the rib and to create a generous radius between the rib and the

clear-taped surface of the wood block. Now install the wet fiberglass over the hole on the inside of the rib. Allow this lay-up to cure completely.

Remove the wood block from the rib. Prepare the fiberglass surface on the outside of the rib for bonding. Also prepare the surface of the rib surrounding the hole for bonding. Mix up some more laminating resin and laminate three more plies of glass over hole on the outside of the rib. This lay-up should also extend at least 1 inch onto the surface of the ribs surrounding the hole. Allow the lay-up to cure completely.

Step C Drill Holes for the Fuel Level Sensor in the Root Rib

Center the backing plate for the fuel level sensor on the fiberglass lay-up. Trace the outline of the holes on the fiberglass. Remove the backing plate and drill slightly oversized holes for the probe and the mounting screws through the fiberglass using the marks as a guide. Trial fit the sensor on the root rib using the supplied mounting screws.

Step D Install the Backing Plate for the Fuel Level Sensor

Prepare one side of the fuel level sensor backing plate and the inside surface of the fiberglass lay-up for bonding. Wax the mounting screws for the fuel level sensor. Prepare a small batch of structural adhesive and thicken it to “mayo” consistency. Apply the adhesive to the backing plate. Try to stay away from the holes on the backing plate when applying the adhesive. Press the backing plate into position on the inside of the root rib. Insert the fuel sensor probe through the backing plate (make sure the gasket is on the base of the sensor) and mount it using the waxed mounting screws. Remove any excess adhesive, then allow the assembly to cure.

Step E Bend the Fuel Level Probe

You will need to bend the fuel level probe so that it dips immediately down to the bottom of the tank and then gradually up to the top of the tank (don't forget the wing is upside down in the jig!). Refer to the manufacturer’s instructions (included in the back of this manual) to do this. Be careful when bending the probe, it can break!

TASK W-15 Seal and Prepare the Interior of the Wing Tanks

Brief Task Description:

If you do wish to use your wings to carry fuel, it is essential that all fuel contact surfaces be sealed. The carbon fiber material in your G-202 is not susceptible to chemical attack by gasoline; however, it is porous to some liquids, including gasoline. Therefore, it is necessary to carefully and thoroughly seal all carbon fiber surfaces that will come in contact with fuel. If this is not done, fuel will weep out of the wing tanks or into the core material.

NOTE: The sealant specified for use in the wing tanks of the AkroTech G-202 is:
Jeffco 9700 FCR resin
Jeffco 9700 FCR hardener

Step A Mark the Tank Area on the Wing Skin

Start the sealing process with a clean tank area. Rub carpenter's chalk liberally onto the spars and ribs that cross through the wet area of the tank. Place the lower wing skin in exact position atop the wing/rib/spar assembly. Remove the skin, note the location of the areas where the chalk transferred onto the lower wing skin.

Use a soapstone pencil to mark the outside perimeter of the area where the skin makes contact with the chalked bond areas. This will provide an accurate picture of the area of the lower wing skin that will be in contact with fuel and thus in need of sealing. If the first attempt at the chalk transfer technique is only partially successful, try again. Try spraying the ribs and spars very lightly with water from a sprits bottle after you have rubbed chalk on them. This may help more chalk to transfer. It may require several attempts to complete. Remember to thoroughly **clean all the chalk** from the bond areas after you are done. Several good scrubbings with a damp sponge will normally do the job.

Step B Clean the Tank Area

On the lower wing skin, run a line of clear 3M tape 1" outside the perimeter of the wet area of the tank. The area inside the tape is what will be sealed in the next operation.

Using acetone, thoroughly clean all the surfaces of the wing skins, ribs, and spars to be sealed. This will help provide a good bond between the sealing compound and the carbon fiber surface to which it is applied. Protect the threads of the fitting holes with clay or silicone and the surface of the sensor probe with tape.

Step C Apply Sealer to the Tank Area

Mix the tank sealer per manufacturer's instructions. Thoroughly and completely coat all the fuel contact surfaces of the tank area. This includes not only the inside of the wing skins but the spars and ribs as well. If fuel can touch it, it must be sealed.. Do not coat the bond areas of the ribs, spar, and lower wing skin with sealer..

Do not forget to seal the fuel contact areas on the lower wing skin. These deserve special attention. Remember that the upper surfaces of the tank will be in contact with fuel some of the time; however, the lower surface of the tank will be in contact with fuel all the time. Remember that any area that does not get thoroughly sealed will be the likely source of a fuel leak.

Before the first complete coat of sealing epoxy has fully cured, we recommend that a second complete coat be applied. The second coat may add a small amount of extra weight, but it will provide extra confidence. If you do not wish to apply a complete second coat of sealing epoxy, you may wish to apply a partial second coat to only the fuel contact surfaces of the lower half of the tank. Allow to cure.

Step D Remove the Skin from the Fuel Cap Flange

Lay the wing panel (upper skin down) on your work table. Locate the gas cap fitting ring that is factory-bonded into each upper wing skin. Drill a 3/4" hole through the wing skin in the center of the fitting. Carefully enlarge the hole with an 1/2" cylindrical abrasive bit or drum sanding attachment. Work cautiously.

When you start to get close to the fitting, switch to sand paper and remove the remaining material by hand sanding. The goal is to remove all the carbon fiber material from the inside of the gas cap fitting without damaging the aluminum fitting itself. (Any damage to this fitting may result in a gas cap that will not seal properly.)

TASK W-16 Install Fittings in the Wing Tanks

Brief task description:

There are three fittings which must be installed in each wing tank: a finger strainer (fuel supply fitting), a fuel vent fitting, and a fuel drain fitting. In this task you will install these fittings into phenolic blocks which have been pre-installed in the wing at the factory.

NOTE: Do not use teflon tape when installing these fittings. The tape could find its way into the fuel system and may eventually obstruct the flow of fuel. To ensure a tight seal, place a small amount of structural adhesive on the threads of the fittings before installing them.

Step A Install the Finger Strainers

Install the supplied finger strainers in the lower pre-drilled and tapped holes (which are now on top) of each root wing rib.

Step A Install the Fuel Vent Fittings

The fuel vent fittings will allow air to enter as fuel drains from the tank. Locate the appropriate fittings and install them into the pre-drilled and tapped holes at the top (which is now on the bottom) of the root wing rib.

Step B Install the Fuel Drain

The fuel drain must be placed at the low point of the tank when the aircraft is at rest on the tarmac in a 3 point attitude. Therefore, the fitting is installed in the lower wing skin at the extreme aft inboard corner of the tank (Remember that the lower wing skin is the one that **does not** have the ribs and spars bonded in place). Locate the pre-installed phenolic block in the lower wing skin and drill and tap a hole for the fuel drain fitting. (See illustration)

NOTE: Remember that you are building the wing upside down. Therefore, as the wing appears when you work on it, the fittings may seem to be incorrectly placed. Make certain that the fittings are in correct position.

IMPORTANT OPERATIONAL NOTE:

Due to their design, it is possible to unport the G-202 wing fuel tanks at moderate or high angles of attack. Such angles of attack are routinely achieved by the G-202 during normal takeoff and climb out. Unporting can result in fuel starvation and engine failure. For that reason AkroTech states that **wing fuel tanks should be used only for level flight**. For other flight conditions such as takeoff, climb out, maneuvering, and landing, the pilot should select the main fuel tank installed in the G-202 fuselage.

Required Placard Language:

DO NOT USE WING FUEL TANKS FOR TAKEOFF, LANDING, OR MANEUVERING. FUEL FLOW TO ENGINE MAY BE INTERRUPTED.

TASK W-17 Install Nutplates for the Sighting Device

Brief Task Description:

Many pilots utilize sighting devices mounted on the wingtips to assist in precisely orienting the aircraft during aerobatic maneuvers. These optional devices are secured to the tip wing ribs with two bolts. In this task you will install nutplates in the tip ribs to receive these bolts. Note that the location of the nutplates is not critical, as long as the holes go through the phenolic in the tip rib. We suggest that the mounting points be 10 inches apart, with the front mounting point 10 inches back from the leading edge of the wing.

Step A Drill Holes in the Tip Ribs

Refer to the illustration to locate the two 3/16 inch holes in the wing tip ribs. Centerpunch then drill these holes through the tip rib. Note that phenolic block has been pre-installed at the factory at the location of the holes.

Step B Mount Nutplates To The Tip Ribs

Refer to the general information section to install 10-32 floating nutplates in each wing tip rib. Use long solid rivets to secure the nutplates to the tip rib.

TASK W-18 Trim the Wing Skins

Brief Task Description:

The wing skins of your G-202 are shipped slightly oversize and will need to be trimmed to fit correctly over the upper wing skin assembly. In this task you will trim the leading and root edges of the wing skins.

Step A Trim the Leading Edge

Locate the pre-molded joggle that runs along the edge of the lower wing skins. Use your belt sander or Dremel tool with the cut-off wheel attachment to trim both skins just outside of the joggle. Use a sanding block to grind the skin precisely down to the joggle. Now position the lower wing skins over the upper wing skin assemblies. Check to make sure you can get the leading edge of the lower wing skin to sit inside the pre-molded joggle of the upper wing skin assembly. If not, continue to trim the skin until you can.

Step B Trim the Inboard Edge of the Wing Skins

Locate the pre-molded recess that runs chord-wise along the root of the wing. Trim the inboard edge of the all four wing skins to one inch from the joggle of this recess. Do not trim either the trailing or outboard edges of the wing skins. The outboard edge of the wing skins will be trimmed flush with the tip rib after the wings are closed and the trailing edge will be trimmed for a custom fit with the aileron later.

Note: When trimming the root end of the skin, do not follow the joggle as it curves outboard around the leading edge! Keep the trim line straight.

TASK W-19 Build Up the Bond Area on the Ribs and Spars

Brief Task Description:

In this task you prepare the wing for closing by building up the bond areas on the ribs and spars. This insures that there will be no low spots on the spars or ribs when it comes time to bond the lower wing skin in place. The goal is to add a layer of structural adhesive to fill any low areas on the wing ribs and spars so that the final bond layer of structural adhesive will be thin and uniform.

Remember that you are building the wing upside down. This means that anytime we refer to the upper skin we mean the one with the ribs and spars bonded in (and not the one that is actually on top during assembly). And anytime we refer to the lower skin we mean the one without the ribs and spars.

Step A Mark the Bond Areas on the Skin

Lay the lower wing skin (which is now on top) in its proper place on the wing assembly. Locate the bond areas on the lower skin. Cover all the bond areas on the inner face of the lower wing skin with a layer of clear 3M tape.

The reason you are doing this is that you will be applying structural adhesive to the wing spars and ribs, then placing the lower wing skin on that adhesive. The idea is to exactly impart the shape of the inner face of the lower wing skin onto the adhesive that you have applied to the spars and ribs, but without yet permanently bonding the lower wing skin in place. The layer of tape covering the bond zones will allow you to remove the lower skin after the structural adhesive hardens.

This is a good time to dry fit the lower skin to be certain that it mates properly with the spar and ribs. It is also a good idea for you and an assistant to practice putting the upper wing skin precisely in place as if there were adhesive on the ribs and spars.

Step B Prepare the Wing

Carefully place the upper wing skin into exact position on the spar, ribs, and lower skin assembly. Use tape to secure the lower skin to the upper skin at the leading edge. Place 10 lb. sandbags over the wing spar every foot and two 10 lb. bags over each rib.

Drill holes for Cleco fasteners every 2" along the center of the leading edge joggle and through the skin along the root and tip rib flanges. These Clecos will hold the skin in position while you are building up the bond area and while finally bonding the skin in place.

Now remove the lower skin from the assembly. Prepare the bond zones of the wing spars and ribs for bonding (See the General Information section of the manual). Be sure that all bond areas are properly scuffed and cleaned with acetone immediately prior to the bonding operation.

Step C Mix and Apply Adhesive

Prepare three 8-ounce batches of structural adhesive and thicken them to "mayonnaise" consistency. Put a generous but not excessive layer of structural adhesive on the ribs and spars. This layer should evenly cover the entire bond area of the ribs and spars.

Remember that you are trying to accomplish two things. First, you must force the skin firmly and completely onto all the bond areas. Second, you must press a perfect impression of the inner surface of the upper skin into the fairly thick mixture of structural adhesive that is on the ribs and spars. **The goal is to build up the thinnest possible layer of structural adhesive that will still provide a bond area that has no gaps or low spots.** Inadequate pressure over the bond areas will allow too thick a layer of structural adhesive to build up; however, you do not want to use so much pressure that you begin to locally deform the upper skin.

Step D Place the Wing Skin in Position

Carefully and slowly place the skin into exact position on the spar, ribs, and wing assembly. Try to lower the skin directly onto the ribs and spars without smearing the adhesive. Install the Clecos in the holes drilled into the leading edge and the root and tip

ribs earlier. place eight 10 lb sand bags or similar weight over the spar and two to three 10 lb sand bags over each rib. Place an aluminum angle over the trailing edge of the wing and use spring clamps to sandwich the trailing edge between this aluminum angle and the rear spar support tube. Allow the structural adhesive to cure undisturbed overnight.

Step E Remove the Wing Skin

After adequate cure time, remove the upper skin. This should be a fairly simple process involving little more than some gentle tugging -- unless you have not done an adequate job of masking off the bond areas of the upper skin.

Inspect the hardened structural adhesive on the bond areas of the wing and spars. Ideally, all the taped surface came into full contact with the adhesive. Look closely at the adhesive surfaces that were supposed to contact the taped and waxed sections of the wing skin. The areas that contacted properly should appear smooth and glossy. Those areas that did not contact the taped and waxed sections will have a slightly rougher, more irregular surface appearance.

Should you find such rough or irregular areas, it means that there are still some low spots in the bond area. If these low areas fall more than 1/16 inch below the surrounding areas, they will need to be built up until they are of the proper height.

Start by thoroughly sanding the bond surfaces of the adhesive you just applied. If the low spots are prevalent over much of the bond area, you may want to apply another full layer of structural adhesive. If there are only a few localized low spots, it may be adequate to merely apply structural adhesive in the vicinity of the low spots. In any event, remember to place the upper skin exactly in position, and fully weight it in place.

Step F Drill Pressure Equalization Holes in the Wing Ribs

Drill a 3/32-inch hole through the aft rear corner of each wing rib (both leading and trailing edge ribs). These holes will allow air to escape from the panels when flying at high altitude. They will also act as drain holes for condensed moisture.

TASK W-20 Close the Left Wing

Brief Task Description:

This task first involves first checking the fit of the lower wing skin one last time, then bonding this skin to the upper wing assembly. As with the aileron, the wing gains an enormous amount of structural strength and rigidity once the lower skin is bonded in place. Be sure the wing is sitting properly in the jig when installing the skin. Take your time, do not build in a warp.

Step A Dry-Fit the Wing Skin

Dry-fit the lower skin one more time to be certain that it mates properly with the spar and ribs. Does the lower wing skin cover all the bond areas on the ribs and spars? Does the leading edge of the lower wing skin mate correctly with the joggle in the leading edge of the upper wing skin? It is possible that the lower wing skin might slightly overhang the bond areas. Any such overhangs will be trimmed later.

It is a very good idea for you to find the **two assistants** you plan to use and practice putting the lower wing skin precisely in place as if there were adhesive on the ribs and spars. A few dry runs will help you place the lower wing skin with perfect precision the one time that it really counts.

NOTE: Before proceeding, it would be a good idea to check the accuracy of your wing jig one last time. Remember that any inaccuracies in your jig will be duplicated in the wings themselves and it will be impossible to fix these errors after the wing is closed.

Recheck the alignment of the jig formers. With the wing held in place in the jig, recheck everything. Are the leading and trailing edges **precisely** matched up with the leading and trailing edge marks on the formers? Are those marks all still in **exactly** the same plane? Is that plane still **perfectly** level? Recheck **everything** before proceeding. This is your last chance to correct any error in the jig.

Step B Prepare the Wing for Bonding

Be sure to completely mask off all exposed fittings on the wing. (If you are building your G-202 with wing tanks, **do not mask off the fuel vent fittings inside the tanks**. Once the skin is bonded into place, you will be unable to remove the masking, thus rendering the vent inoperable! It will be very difficult to remove any excess adhesive that bonds to hinge assemblies, etc. Good masking will prevent this. Also, remember to use clear 3M tape to mask. Adhesive will soak through standard household masking tape.

Next, prepare all bond zones of the skin, spar, and ribs for bonding (See the General Information section of the manual). Remove all clear tape that was applied earlier to the bond areas. Be sure that all bond areas are properly sanded and cleaned with acetone immediately prior to bonding. The structural integrity of your aircraft depends heavily on proper bond surface preparation. Please re-read the section on "Bonding Procedures" in the general Information section of this manual.

CRITICAL NOTE:
The importance of proper surface preparation for bonding cannot be overemphasized. Make absolutely certain that all surfaces have been properly cleaned with acetone, sanded with 80 grit sandpaper, then cleaned once more with acetone. The surface should appear completely dull with no shiny areas anywhere.

Step C Prepare and Apply Adhesive to the Wing

Before you start the bonding process, you should be very sure that you have everything ready. As with the ailerons, once you start applying the adhesive, you cannot stop. Though you now have the benefit of the experience from closing the ailerons, closing the wings is a larger task. You will only have about forty five minutes to work with the adhesive before it starts to cure. Therefor you will need at least two assistants to help mix and apply adhesive to the ribs and spars. It is also be helpful to measure out the adhesive components ahead of time and place them in separate cups on your work table. This way, once you start the bonding process, you do not have to waste time measuring out adhesive.

All the tools and materials you need must be close at hand and ready to use. Here are the things that you will want to have standing by before you start to mix adhesive:

- Latex gloves for mixing and applying adhesive.
- Tongue depressors for applying and cleaning up adhesive.
- A roll of paper towels for clean up.
- Adequate solvent for clean up.
- A 10' long aluminum "L" section. One wide face of this piece should be protected with clear 3M tape where it will contact the carbon fiber of the wing skin.
- About 20 spring clamps.
- Twenty-four 10 lb. sand bags or lead shot bags to provide clamping pressure for the lower skin during cure.
- At least two trained assistants

READ THIS BEFORE PROCEEDING:
Bonding the lower wing skin in place requires at least two helpers and the knowledge that you will have the time to complete the following steps in uninterrupted succession:
1. 4 hours to complete the application and clean up of the adhesive.
2. 24 hours at 65 to 85 degrees F for the initial cure

Measure out and mix four 8-ounce batches of structural adhesive (you may wish to refer to the section entitled “Mixing and Thickening Epoxy Adhesives” in the General Information Section of this manual at this time). Measure and mix according to manufacturer's instructions. Stir slowly at first, then continue to stir for at least two minutes after your mixture assumes a uniform viscosity. After thoroughly mixing the adhesive, add enough structural filler to achieve “mayonnaise” consistency. This will prevent the mixture from flowing out of the joints during cure. Leave one cup (8 oz) unthickened.

You may find it helpful to place a few sand bags in the wing, away from the bond areas, before you apply the adhesive. The weight of the sand bags will serve to hold the wing in place as you apply the adhesive. Remove the sand bags before closing the wing!

Apply an even layer of the thickened adhesive mixture to **all the bond zones** of the upper skin / spar / rib assembly:

- Wing leading edge.
- Wing ribs.
- Wing spar.
- Wing rear spar.

When applying the adhesive, try to form it into a triangular shape on the tops of the ribs and spars. This will help prevent voids in the bonded areas.

Now find the areas on the lower skin which mate to the ribs and spars of the upper skin assembly. Use a small brush with stiff bristles to paint the unthickened adhesive on all of these areas. Be sure to coat **all** areas that will come into contact with a rib or spar surface.

VERY IMPORTANT:
Be very certain to remove all sand bags and tools (or any other foreign matter that you do not wish to become a permanent part of the aircraft) from inside the wing now.

Use a helper to position the lower wing skin into place over the bond area. Get it dead right this time! Be sure that the leading edge of the lower wing skin is fully seated into its joggle recess along its entire length The less you have to move it to get proper alignment, the less adhesive you will smear, and the better bond you will make.

Step D Bond the Lower Wing Skin in Place

Next, start to secure the wing into the construction jig. In general, you want to move from the leading edge to the trailing edge. The effect will be to gently pull the lower wing skin aft, thereby seating it into the leading edge joggle, bonding it to the wing spar and finally into the trailing edge.

Install Clecos into the holes drilled earlier in the leading edge. When inserting these Clecos, start from the center and move outward.. Place 10 lb. sandbags every foot along the spar. Place two or three 10 lb. sand bags over every rib. Clamp the freshly bonded trailing edge of the wing between a steel support tube situated under the top of the rear spar and an aluminum "L" section placed over the trailing edge of the skin.

Wipe off any excess structural adhesive that has squeezed out along bond lines. Excess adhesive adds weight but not strength. This will also help minimize sanding and filling when you finish your aircraft.

NOTE:
You must allow each bonded wing to cure undisturbed in the construction jig for a minimum of 24 hours at 65 degrees F. However, it is preferable to allow a minimum of 12 hours cure time at 85 to 110 degrees F. A small electric heater placed under the work table (but away from any combustibles) can help you achieve higher temperature readings in the vicinity of your wing construction jig. **Do not loosen any clamps or move any sandbags during this period.**

Step E Remove Wing form the Jig After Complete Cure

Only after the bond in the wing has completed an initial cure of at least 24 hours at 65 degrees F should you loosen your clamps and Clecos and remove the wing from the construction jig. Do not rush to remove the wing from the construction jig. Allow full and complete cure time.

Step F Trim the Trailing Edge of the Wing

Trim the trailing edges of the wing skins so that the ailerons can move up and down freely. Trim the skins so that there is about 1/8 to 1/4 of an inch between the skin and the leading edge of the aileron when the aileron is deflected..

TASK W-21 Close the Right Wing

Brief Task Description:

In this task you will modify the wing jig to accommodate the right wing. Then you will use this jig to close the right wing. Note that the procedure used to close the right wing is identical to that previously used to close the left wing.

Step A Remove the Support Tube from the Wing Jig

Remove the support tube from the jig formers being careful not to damage the formers themselves. The clear tape placed on the tube earlier should have prevented the body filler from adhering to the tube. If you cannot pull the tube out by hand, tap the tube lightly with a hammer to knock it out of the notches.

Step B Switch the Positions of the Root and Tip Formers

Remove the root and tip formers (BL 30 and BL 132) from your construction table. Leave the steel angle brackets attached to your work surface. Switch the positions of the root and tip formers on your work table. Trial fit the support tube in place in the former notches. Note that the tube will now protrude slightly above the surface of the formers. You will need to grind some of the body filler out of the notches to get the support tube to sit all the way into them. Now remove the tube from the jig and set it aside.

Step C Align the Wing Jig

Reposition the two steel angle brackets which support the leading edge alignment string. Repeat the alignment procedure you performed in task W-11 to align the wing construction jig.. Double check to be sure your two alignment strings are tight and level. Once the formers are properly aligned, replace the support tubes using body filler as you did previously.

Step D Build Bond Area on Ribs And Spars

Refer to task W-14 to build up a level bond area on the ribs and spars of the right wing. Remember to properly prepare all bond areas before applying the adhesive.

Step E Close the Right Wing

Mount the lower skin on the right wing using the procedure outlined in task W-16 for the left wing.

TASK W-22 Install the Wing Spar Bushings

Brief task description:

In this task you will align the wings outside of the fuselage then install the stainless steel bushings in the pre-drilled holes in the spars.

Step A Jig the Wing Panels on Sawhorses

Arrange three sawhorses in your shop so that they are about 75 inches apart. Carefully set each wing panel on these sawhorses so that the spars overlap at the center. Use shims between the sawhorses and the wing panels to get the panels roughly level in pitch. Now use shims as necessary to get the spar bushing holes in the spars to line up.

Step B Trial Fit The Spar Bushings

Spread the wing spars apart slightly at the center where they overlap. Find the spar bushings supplied with your kit. Note that these bushings have one flat face and one angled face. Insert the two long bushings into the thick section of each spar so that the non-angled faces of the bushings are on the outside of the spar. Rotate each bushing until its angled face is flush with the inside surface of the spar. Place a mark across the outside face of each bushing and spar so that you can properly orient them in rotation later.

Now move the spars so that they are an even 1/8 inch apart. Insert a short bushing into one of the holes at the spar tip. While holding the long bushing in position and sighting down between the spars, press the angled face of the short bushing up against the angled face of the long bushing and rotate it until the faces match up perfectly. Now place a mark across the short bushing and onto the spar face (on the outside surface of the spar) so that you can align it in rotation later. Repeat this procedure for the other short bushing. Before removing the bushings, mark both the bushings and the holes with a number or letter so that you can replace them in the same hole later.

Step C Align the Wing Panels in Pitch

Insert the spar bolts through the spar bushings and spars. Lightly clamp the spars together at the center using a large spring clamp (do not use a rigid clamp, the spars need to be able to move slightly relative to one another). Place a level on the chord line of the tip rib on each wing panel. Adjust the wing panels until they are both level.

NOTE: This is one of the most critical alignments in the entire airframe. Make sure you check it carefully. The wing panels must have exactly the same pitch. If they do not, a strong rolling tendency will result which will not be easy to correct without compromising the flight characteristics of the aircraft.

Step D Adjust the Sweepback of the Panels

Set up a string that runs just aft of the step at the root of each wing panel. Adjust this line in height so that it is level with the centerline marked on the rear spar on each wing panel. Adjust the string further until it is the same distance from the rear spar at each wing tip. Now check to make sure the rear spar of the wing is straight by measuring the distance between this string and the rear spar at the root of each wing panel and comparing this distance to that at the tip. If these measurements are not equal, adjust the wing panels until they are.

Step E Install the Spar Bushings

Secure the shims used to jig the wing panels so that they will not move or fall out when the panels are removed. Remove the spar bolts and bushings from the wing panels. Wax the spar bolts and set them aside. Carefully lift the spar tip of one wing panel so both spar bolt holes are above the opposite wing spar. Place some clear tape over the holes on the inside surface of the spars.. This tape will both prevent the bushings from being pushed in too far and prevent excess structural adhesive from bonding the two spars together. Prepare the bushings and the holes in the spars for bonding. Mix enough structural adhesive for all four bushings. Add enough structural filler to the adhesive to achieve “catsup” consistency. Coat the internal surfaces of the holes and each bushing with

structural adhesive. Insert each bushing in the appropriate spar bushing hole. Refer to the marks made on the bushings and the spars to properly align them in rotation. Use an X-acto knife or equivalent to cut the clear tape away from the spar bolt holes in the bushings. Place the two spars back together and insert the spar bolts. Lightly clamp the two spars together using large spring clamps. Now repeat the alignment procedure outlined in steps C and D. Be certain the two wings are aligned for 0 pitch (level at the tip chord lines) and proper sweep . Once the wings are properly aligned, allow the setup to cure undisturbed for 24 hours.

TASK W-23 Assemble and Install the Aileron Bellcranks

Step A Assemble the Aileron Bellcranks

Find the supplied bellcrank bearings and bellcrank arms. Assemble the bellcrank arms to the bearings using the appropriate rivets.

NOTE: The holes in the bellcrank bearings and the holes in the bellcranks may be slightly misaligned. If so, the builder may drill out the holes and use the next size larger rivets (5/32 instead of 1/8 diameter) to assemble the bellcranks.

Step B Install the Aileron Bellcranks in the Wing

Find the 5/16 inch mounting hardware for the bellcrank. Use this hardware to mount the bellcrank on the pre-installed bellcrank bracket which is accessible through the inspection plate on the bottom of the wing. The bellcrank mounts to the top of this bracket. Install the bolt with the head on top and the nut on the bottom. Tighten the castle nut and secure it with a cotter pin.

Note: The long arm of the bellcrank should be oriented parallel to the trailing edge, and the short arm should be oriented to extend aft from the pivot point of the bellcrank.

TASK W-24 Safely Store the Completed Wings & Ailerons

Brief Task Description:

Remember the 1st Law of Hangar Rash:

> "The likelihood of accidental damage to any experimental aircraft component varies directly with the product of its cost of replacement and the number of hours of work already expended on it."

Step A Find a Safe Place for Your Wings and Ailerons

Find a safe place to store your completed wings and ailerons. A very safe place. If they are where they might get bumped, cover them with moving blankets. Never allow things to fall on them. If you must store them on end, use generous amounts of foam padding to protect them where they contact the floor. Put screw-eyes into the wall and tie your components in place if they are at any risk of falling over.

Empennage Construction Tasks

TASK E-1 Build the Stabilizer / Elevator Jig

Brief Task Description:

In order for the stabilizer and elevator to be absolutely free of twist once closed, they too must be secured into a true, twist-free jig as their skins are bonded into place. In this task you will make that jig.

NOTE: We outline a procedure that allows you to use a single jig for the assembly of both the stabilizer and the elevator. This will save you time and effort since only one jig will need to be built, aligned, and affixed to the work surface.

Step A Cut Out the Stabilizer / Elevator Jig Formers

Cut-out the templates and use spray adhesive to mount them to 1/2 inch particle board or plywood. Cut out the Stabilizer / Elevator jig formers using a jigsaw. Stay just to the outside of the line when cutting, then use a belt sander or sanding block to bring the former surface down to the line.

The 42.875 and 43.0 jig formers will need to be secured together with small drywall screws. These two formers support both the tip of the stab and the inboard side of the elevator counterbalance arm. Make sure the chord lines of these two formers are aligned before screwing the them together.

Just as you did for the aileron and wing jigs, make a cutout near the trailing edge of the elevator in each stabilizer / elevator construction jig former for a 1 inch square steel support tube. You can use the same tubing that was used for the wing jig. This tube will be used to support the trailing edge of the elevator along its entire length.

Step B Mark the Former Locations on the Construction Table

Place a tick mark near the center of the previously marked chalk line on your work table.

This tick mark will reference the center of the stabilizer/elevator jig. Place two tick marks exactly 14 inches from the center tick mark on the chalk line. This will reference the location of the BL 14 formers. Now place two more tick marks exactly 42 15/16 inches from the center tick mark. These tick marks will reference the location of the BL 42.875 and BL 43.00 formers. These formers will be joined together and centered on this mark.

Use a framing square and lay out lines perpendicular to the chalk line and extending away from the edge of the work table at each of the tick marks. These will be the reference lines on which you will set up your stabilizer / elevator construction jig formers.

Step C Mount the Angle Brackets to the Table

Now position the steel angle brackets that will support the stabilizer / elevator formers.. Clamp four 4-inch steel angle brackets to either side of each former (do not screw them to the formers yet). The brackets should be positioned as indicated on the former templates. Place the BL 14 formers in position on the table (with the angle brackets clamped to them) so that the inboard edge of each former is aligned with its appropriate mark on the table and so that the trailing edge of each former is aligned with the chalk line near the edge of the table. Now clamp angle brackets to the BL 42.875 and BL 43.00 formers (which are screwed together) and place these down on your work table so that each formers pair is centered on the outboard mark on your work table. Screw the angle brackets to the work surface (but not into the formers yet) so that they will support each former in the proper position on the table. Remove the clamps holding the angle brackets to the formers. Each former should now be snug between its brackets, but still able to slide up and down so that it can be adjusted later.

TASK E-2 Align the Stabilizer / Elevator Jig

Brief Task Description:

In this task you will assemble and precisely align the stabilizer / elevator construction jig.. Just as was the case with the wing and aileron assemblies, accuracy is essential here. Your stabilizer and elevator will only be as good as the jig in which you build it.

Step A Align the Stabilizer Jig

The alignment procedures you used for the wing and aileron jigs are identical to those that you will use for the stabilizer / elevator construction jig. That being the case, we refer you back to the section of the wing manual that details the wing jig alignment procedure.

CRITICAL:

Just as was the case with the wings and the ailerons; accuracy matters here. Warped and twisted empennage or control surfaces will result in an aircraft that is less than it otherwise would have been. Take the time to get it right. Invest an extra few minutes in accurate work and you will be rewarded with an aircraft that flies straight and true.

Note: Some builders have reported that the stabilizer and elevator jigs do not fit the stabilizer and elevator exactly. Do not be afraid to modify the jigs slightly in order for things to fit. The important thing is to keep the chord lines aligned. There are several ways to build the stab and elevator, use any method that results in straight and true components.

TASK E-3 Insert Bearings in the Elevator Hinges

Brief Task Description:

The elevator hinge receiver brackets, like the aileron hinge receiver brackets, require the builder to install bearings. This is a simple process, but certain precautions are necessary. First, the hinge receiver brackets must be honed out to a diameter appropriate to the bearing. The bearings should install with an easy press fit into their respective hinge receiver brackets. Too tight a fit will cause the bearing to bind and be less readily self-aligning than it should be. Second, dress or de-burr the hole for the bearing so that the bearing will drive in squarely. Third, the bearings should be *staked* in place. This will serve to insure that they remain captive in their hinge receiver brackets.

Step A Install Bearings into the Elevator Hinges

Be certain that you have correctly identified the elevator hinges. Seat the self-aligning bearings into the hinges. This will be done in exactly the same manner as it was done for the aileron hinges. For instruction on this process, refer to the notes on the subject in the General Information Section.

TASK E-4 Mount the Elevator Hinges on the Stabilizer Spar

Brief Task Description:

In this operation you will mount the elevator hinges onto the rear spar of the stabilizer. This is a critical operation. Take time to check and recheck before you drill. A properly aligned control system will operate smoothly, however even a slight error here can result in controls that simply are not as smooth and light as they otherwise could be.

NOTE: There are three critical alignments to be maintained in this task. First, the horizontal centerline of each elevator hinge must be mounted exactly even with the horizontal centerline of the stabilizer spar. Second, each hinge must be placed at precisely the butt line measurement listed in the manual. Third, each hinge bracket **must** be mounted plumb, with its bracket arm perfectly vertical. In this task you will perform operations to precisely position the mid and outboard elevator hinges. A little extra care and attention to accuracy in this step can save you a great deal of totally avoidable added work and aggravation later.

Step A Mark Centerlines on the Hinges and Spar

A process similar to that used to precisely position the aileron hinge fittings is used to position the elevator hinges at BL 41.25 To do this, it is necessary to find the vertical and horizontal center of these fittings. This is not complicated, but accuracy is essential here too.

First, place the stabilizer into the stabilizer jig. The stabilizer should be evenly supported by all the construction jig formers. It should be evenly seated in the jig. If the stabilizer is not resting squarely in the construction jig, gently but firmly force it into place by the use of weights and clamps. Remember, the jig is your "truth" reference. The stabilizer should be made to fit the jig, not the other way around.

Snap a horizontal chalk line along the exact centerline of the rear face of the stabilizer spar. Find BL 00 and both the right and left hand BL 41.25 (See reminder immediately

below). At these points, draw a crisp line that is perfectly perpendicular to the chalk line. These intersecting lines mark the position of the mid and outboard elevator hinges.

REMINDER: **BL 41.25 is 41.25 inches outboard from the centerline of the aircraft**.

Find the BL 00 and BL 41.25 fittings. The BL 00 fitting is 1/4" shorter than the BL 41.25 fitting. (the two BL 41.25 fittings are identical, while the BL 00 differs from the other two). Note that there are four holes drilled through the flat mounting surface of each hinge fitting.

Use a pencil and a straight edge to mark a line that exactly bisects the hole pattern mounting surfaces of those hinges. A common pencil works fine on the aluminum fittings. Using a straight edge, extend both ends of both lines around to the edge of each hinge. Make a small pencil "tick mark" on the thin edge of the mounting flange where it can be easily seen when the hinge is clamped to the stabilizer spar. These tick marks will help you align the centerlines of the fittings with those of the spar. The horizontal pair of tick marks will line up with the chalk line at the horizontal centerline of the stabilizer spar. The vertical pair will line up with the vertical lines that mark BL 00 and BL 41.25.

Step B Align the Elevator Hinges on the Stab Spar

Clamp only the two BL 41.25 hinges in place for the moment, using clamping pads where necessary. Remember to make certain that the hinges themselves are oriented vertically.

Run a length of monofilament fishing line through the bearing hole in the stabilizer tip hinge fitting, then through the bearing hole of the BL 00 hinge (even though you have not yet clamped it into position), and finally through the bearing hole of the hinge bolted into place on the other end of the stabilizer. Leave the monofilament line slack for the moment.

Obtain a piece of 1/4" thick material to act as a spacer in place of the rudder spar that will later cross over the rear side of the stabilizer spar at BL 00. You will need to transfer the

tick marks you made on the stabilizer spar at BL 00 to the spacer. Next, clamp the BL 00 hinge fitting in position matching the tick marks you made on the fitting with the marks you made on the spar.

Now tighten the monofilament line so that it is quite snug. Make sure the line passes through the dead center of the bearing holes in the hinges at BL 00 and BL 41.25. This will place the monofilament line exactly level with and parallel to the horizontal centerline of the stabilizer spar, and exactly on the extended cord line of the stabilizer.

The monofilament line should pass exactly through the center of each bearing hole in each hinge. If it does, it indicates that all your elevator bearings will be in alignment. However, should you find that the monofilament reference line does not intersect the exact center of the bearing hole in the hinge at BL 00, you will need to adjust that fitting until it does. It is more important that all three elevator hinge bearings are in perfect alignment than it is that the BL 00 elevator hinge be mounted on the precise horizontal centerline of the stabilizer spar.

If the monofilament reference line indicates that it is necessary, adjust the position of the BL 00 elevator hinge up or down until it is perfectly aligned with the elevator fittings at the stabilizer tips. Be certain that you keep the BL 00 elevator hinge exactly on BL 00, and perfectly plumb. If you find the hinge needs to be spaced further than ¼ inch from the surface of the spar to get it to line up with the outboard hinges, make and additional spacer from a piece of scrap aluminum. Clamp the hinge securely in place when you are confident it is in position.

Step C Drill the Mounting Holes for the Hinges

Drill through the stab spar with a long 1/4" drill using the mounting holes in each hinge as a template. Make sure the hinges do not shift while you are drilling these holes. To prevent the hinges from shifting, install bolts into each hole immediately after drilling them. When finished, remove the hinges from the stab spar.

TASK E-5 Make and Install the Elevator Hinge Backing Plates

Brief Task Description:

In this task you will make and install the elevator hinge backing plates for the elevator hinges. These backing plates are very similar to the aileron hinge backing plates mounted to the wing earlier. Before proceding, you may wish to review the section entitled "Backing plates" in the General Information Section of this manual.

Step A Cut Out the Elevator Hinge Backing Plates

Trace the outline of the base of each of the three elevator hinges on the supplied .080 aluminum backing plate material. Use a jigsaw or a bandsaw to cut out the three backing plates from this sheet. Smooth the edges of the backing plates with a file or belt sander.

Step B Drill Holes in the Backing Plates

Clamp each of the backing plates to its respective hinge. Use the hinge holes as a guide to mark the 1/4 inch holes in the backing plates. Remove the hinges and drill the holes.

Step C Install Nutplates in the Backing Plates

Refer to the General information section of this manual for information on installing the 1/4-28 floating nutplates in each of the three backing plates.

Step D Bond the Backing Plates on the Stabilizer Spar

Prepare the backing plates and the forward face of the stab spar for bonding. Wax all of the elevator hinge mounting bolts. Mix a batch of structural adhesive and add enough filler to achieve "mayo" consistency. Apply the adhesive to all bond areas on the stab spar and the backing plates. Try to keep away from the holes on the backing plates and the spar when applying the adhesive. Press all three backing plates into position on the forward face of the rear spar. Install the waxed bolts though the hinges and into the backing plates. Tighten down the bolts and remove any excess adhesive with a clean rag.

Step E Install the Stainless Steel Retaining Screws in the Backing Plates

After the adhesive has cured completely, remove the hinges from the stab spar. Use a # 19 drill bit to drill a holes through the approximate center of each backing plate. Countersink these holes on the aft spar face using a 100 degree countersink. Install the supplied stainless steel screws through the spar and backing plates then secure these screws with the appropriate nuts.

TASK E-6 Make and Install the Backing Plate for the Bellcrank Brackets

Brief Task Description:

The optional servo/trim tab system utilizes a bellcrank which is mounted to the stabilizer spar. In this task you will install a backing plate in the stabilizer that will allow you to mount the brackets that support this bellcrank.

Step A Cut Out the Backing Plate

Use spray adhesive to mount a template to the supplied .080 aluminum backing plate material. Cut out the backing plate using a jigsaw or band saw.

Step B Center Punch the Four Holes on the Backing Plate

Center punch the four holes in the backing plate using the hole pattern of the brackets as a guide.

Step C Drill Holes in the Backing Plate and the Stab Spar

Position the backing plate at the proper location on the aft face of the stabilizer spar. Securely clamp the backing plate in position then drill the four 3/16 inch holes through both the backing plate and the stab spar. Insert a bolt through each hole as it is drilled to prevent the backing plate from sliding out of position.

Step D Install Nutplates in the Backing Plate

Refer to the general information section of this manual to install the four 10-32 floating nutplates on the backing plate.

Step E Bond the Backing Plate to the Stab Spar

Use structural adhesive to bond the backing plate to the stab spar as you did with the elevator hinge backing plates. Allow the adhesive to cure completely.

Step F Install a Retaining Screw in the Backing Plate

Use a # 19 drill to drill a hole through the approximate center of the backing plate and the stab spar. Countersink this hole on the aft face of the spar using a 100 degree countersink. Install an 8-32 stainless screw and secure it with a nyloc nut.

TASK E-7 Cut the Elevator Hinge Slots

Brief Task Description:

In this task, slots will be cut in the leading edge of the elevator to clear the stab-mounted elevator hinges.

Step A Mark the Position of the Hinges on the Elevator

Mount the two outboard elevator hinges on the stabilizer using the supplied ¼ inch hardware. Hold the elevator up to the trailing edge of the stabilizer the elevator will be mated to. Position the elevator so its inboard/ outboard alignment is correct. The outboard surface of the stab's tip rib should be spaced 1/8 inch from the inboard rib on the elevator's counterbalance arm. You can accomplish this by inserting 1/8 inch spacers between these ribs. When this is done, the elevator should be properly centered on the stabilizer.

Mark the location where the two outboard elevator hinges intersect the leading edge of the elevator skin. Since the aluminum hinges are 5/16" wide at the point at which they contact the elevator's leading edge, that is how far apart the marks should be on your elevator skins.

Step B Cut The Elevator Hinge Slots

Now cut a 3/8" slot that is centered on the marks you just made. To do that, cut a slot that is 1/32" wider than the marks you made. The slot should extend deep enough to allow the hinge to make contact with the elevator spar, with a little to spare (This slot will be expanded and finished in a later step).

TASK E-8 Locate the Hinge Receiver Brackets on the Elevator Spar

Brief Task Description:

In this operation you will use the hinges that you have just mounted on the stabilizer as a guide to help you precisely locate the mating hinge receiver brackets on the elevator. You will then drill the mounting holes for these brackets into the elevator spar.

Step A Assemble the Hinge Receiver Brackets to the Elevator Hinges

Temporarily bolt the two outboard elevator hinge receiver brackets to the stab mounted hinges. Be sure to place washers on either side of the hinge bearings to properly center the hinges in the receiver bracket.

Step B Trim the Stabilizer Skin

Secure the stabilizer in the stabilizer/elevator jig using weights. Note that the trailing edge of the stabilizer skin has been left slightly long so that it can be trimmed for a custom fit. Install the elevator in the jig and press it up against the trailing edge skin on the stab. Approximate how much you will need to trim from the trailing edge of the stab to allow the hinge receiver brackets to reach the elevator spar. Remove the stabilizer from the jig and carefully trim the correct amount from the trailing edge.

NOTE: Be aware that you will be trimming the stab skin very close to its final dimension in this step. And since it is always much easier to cut material away than it is to put it back on, you should proceed with caution. To guard against trimming off too much, you may wish to trim the skin in incremental steps, each time placing the stab and elevator back in the jig to check the progress. Also, using a long sanding block after each trimming operation will help to keep the trailing edge straight.

Step C Position the Hinge Receiver Brackets on the Elevator Spar

Position the elevator up against the hinge receiver brackets (which are now assembled to the stab mounted elevator hinges).Place 1/8 inch spacers between the counterbalance arms on the elevator and the tip ribs of the stab to properly center the elevator. Adjust the receiver brackets so that they lie flat against the forward face of the elevator spar and are approximately centered. Use a fine felt-tipped pen to place a mark along either side of each hinge receiver bracket on the elevator spar. Remove the elevator from the jig and disassemble the receiver brackets from the hinges.

Step D Clamp the Hinge Receiver Brackets to the Elevator Spar

With the elevator out of the jig, carefully position the hinge receiver brackets between the marks made earlier on the elevator spar. Adjust each bracket vertically on the elevator spar until it is centered between the upper and lower spar caps. Adjust each bracket in rotation until it is level (a small level placed across the top of the hinge will work well). Use small C-clamps to clamp the brackets to the elevator spar once they are properly positioned.

Step E Drill Mounting Holes for the Hinge Receiver Brackets

With the hinge receiver brackets securely clamped to the elevator, drill 1/4 inch holes through the elevator spar using the mounting holes in the brackets as a drill guide.

TASK E-9 Make and Install the Hinge Receiver Bracket Backing Plates

Brief Task Description:

Like the aileron and elevator hinges, the elevator hinge receiver fittings will need backing plates to retain them. In this task you will make these backing plates and install them in the elevator.

Step A Cut Out the Hinge Receiver Bracket Backing Plates

Trace the outline of the base of each hinge receiver on the supplied .080 aluminum backing plate material. Use a jigsaw or a bandsaw to cut out the two backing plates from this sheet. Smooth the edges of the backing plates with a file or belt sander.

Step B Drill Holes in the Backing Plates

Clamp each of the backing plates to its respective bracket. Use the bracket holes as a guide to mark the 1/4 inch holes in the backing plates. Remove the brackets and drill the holes.

Step C Install Nutplates In The Backing Plates

Refer to the General Information Section of this manual to install the 1/4-28 floating nutplates in each backing plate.

Step D Bond The Backing Plates On The Stabilizer Spar

Prepare the backing plates and the aft face of the elevator spar for bonding. Wax the receiver bracket mounting bolts. Mix a batch of structural adhesive and apply enough filler to achieve “mayo” consistency. Apply the adhesive to all bond areas on the elevator spar and the backing plates. Try to keep away from the holes on the backing plates and the spar when applying the adhesive. Press the backing plates into position on the elevator spar. Install the waxed bolts though the hinges and into the backing plates. Tighten the bolts down and remove any excess adhesive with a clean rag.

Step E Install the Stainless Steel Retaining Screws in the Backing Plates

After the adhesive has cured completely, remove the brackets from the elevator spar. Use a #19 drill to drill a holes through the approximate center of each backing plate. Countersink these holes on the aft spar face using a 100 degree countersink. Install the supplied stainless steel screws through the spar and backing plates then secure these screws with the appropriate nuts.

TASK E-10 Separate The Elevator And Install The Elevator Actuator

Brief Task Description:

In this task you will cut the elevator into separate left and right panels. After cutting the elevator in half, you will install the actuator (elevator horn) and root ribs in the elevator panels.

Step A Cut the Elevator in Half

Find and mark the approximate centerline of the elevator. Draw a line perpendicular to the trailing edge through this mark. Cut the elevator in half using a hand held jigsaw with a long blade. You do not have to be very accurate with this cut since you will be trimming the elevator further in the next step.

Step B Trim the Inboard Edge of the Elevator Panels

Trim the inboard edge of the elevator panels close to their final trim line using a jig saw or bandsaw. This trim line should be parallel to each counterbalance arm and exactly 42 7/16 inches from the inboard edge of the counterbalance arm.. Cut just inboard of this trim line, then use a belt sander to trim the skin and spar down to its final size. Once the elevator is trimmed, use the belt sander to round the edge of the spar to match the inside radius on the actuator arms.

Step C Mount the Elevator Hinges on the Stabilizer

Mount the elevator hinges on the stabilizer once again using the appropriate spacers and hardware.

Step D Install the Stab and Elevator in the Stab / Elevator Jig

Install the stabilizer in the stab / elevator jig and secure it with sand bags. Insert the two elevator panels in the jig and align them so that the inboard edge of the counterbalance arms are spaced 1/8 inch from the outside surface of the stabilizer tip ribs. This will

position the elevator in its proper location relative to the stab. Weight the elevator panels down to secure them in the jig

Step E Drill the Hinge Pin Hole in the Elevator Root Ribs

Insert the elevator actuator backing plate without the pin into one of the mushroom shaped root ribs. Orient the backing plate so that its flange lies flat against the flat side of the root rib. Now properly center the backing plate and clamp it in position. Drill a 1/4 inch hole through the rib using the hinge pin hole in the backing plate as a drill guide. Remove the backing plate and repeat this procedure for the opposite root rib.

Step F Assemble Actuator Arms, Backing Plates, and Root Ribs to the Elevator

Now assemble the backing plates, actuator arms, and ribs to the elevator panels. Assemble the left and right actuator arms together using the supplied 3/16 inch bolts. These bolts pass through the blocks that are welded to one of the arms. Install the left and right root ribs in the elevator panels. Hold the actuator arms in position over the center hinge (with the arms pointing up) while installing the backing plate with the pin. Thread the pin through the right rib (left when looking down on the jig), the right actuator arm, the center hinge, the left actuator arm and the left rib. Install the other backing plate over the pin where it protrudes through the left rib.. Clamp the actuator arms and backing plates to the root ribs. Center this assembly on the center elevator hinge and check the fit of the ribs.

NOTE: You may find it difficult to line up the hinge pin holes in the actuator arms with the hinge pin holes in the backing plates. If this is the case, you may cut off the aft flange of the root ribs (the flat section of the rib flange). This will allow the backing plate and root rib to move further aft, thus helping to align the holes.

Step G Bond the Ribs to the Elevator Panels

Disassemble the actuator arms, backing plates, and ribs from the elevator panels. Prepare the flange on the ribs and the inside surface of the elevator skin for bonding. Place some clear tape over the outboard surface of the actuator arms.. Mix some structural adhesive and thicken to “mayo” consistency using structural filler. Apply this mixture to the rib

flange and the inside of the elevator skin. Carefully pull on the elevator skin while inserting each rib into position. Press the ribs firmly into place and remove any excess adhesive with a clean rag. Now carefully reassemble the actuator arms and the backing plates to the ribs as you did in step C. Try not to move the ribs too much while doing this. Clamp the ribs to the actuator arms and align the actuator arms so that they are centered on the center hinge. Double-check the arms to make sure they are plumb (straight up and down) then lightly clamp the ribs to the elevator panels to secure the assembly. Allow the adhesive to cure completely.

NOTE: An optional method of installing the ribs is to install the actuator assembly as a unit, with the ribs sandwiched in place between the actuators and backing plates. Be sure all holes are drilled and nutplates mounted before bonding, as this procedure can be the final installation of the backing plates. Also be sure that the elevators are properly jigged in position.

Step H Drill Holes through the Actuator and into the Elevator Spar

Before disassembling the actuator arms from the elevator, use a 3/16 inch drill and drill into the aft side of the elevator spar using the holes in the actuator arms as a drill guide. Drill only about half way through the spar. These holes will be finished later after the backing plates have been removed.

Step I Finish Drilling the Mounting Holes for the Actuator Arms

Disassemble the actuator arms from the elevator panels and remove the elevators from the jig. Separate the left and right actuator arms from each other. Finish drilling the 3/16 inch holes through the elevator spar. Temporarily assemble the right actuator arm to the right elevator panel by installing a 1/4 inch bolt through the hinge pin hole. Do the same for the left actuator arm and elevator panel. Now install the two 3/16 inch bolts through each actuator arm flange and elevator spar. These bolts do not need to be secured with nuts, just wrap some tape over their heads to retain them. Now drill the 3/16 inch holes through the face of the ribs using the holes in the actuator arms as a drill guide. While drilling these holes do your best to keep the drill bit perpendicular to the face of the actuator.

Step J Install Nutplates in the Actuator Backing Plates

Refer to the section entitled “Installing Nutplates” in the General Information Section of this manual to install four 10-32 floating nutplates in each elevator actuator backing plate.

Step K Paint the Actuator Backing Plates

Paint the two actuator backing plates with a good quality enamel or epoxy paint. This will isolate the steel from the carbon and help prevent corrosion.

Step L Install the Backing Plates in the Elevator

Dry-fit the actuator and actuator backing plates in both the right and left elevator panels. Check to be sure the two panels can be properly aligned in the jig with the hinge pin engaged. Prepare the backing plates and the inside surface of the two elevator root ribs for bonding. Wax the four 3/16 inch actuator attach bolts and a single 1/4 inch bolt. Mix a small batch of structural adhesive and thicken it to “mayo” consistency. Spread the adhesive on each backing plate. Try to stay away from the holes and the pin on the backing plates when applying the adhesive. Carefully place the backing plates in position on the inside of each root rib. Insert the waxed bolts through each actuator and into the backing plates. For the backing plate without the pin, insert the waxed 1/4 inch bolt through the hinge pin hole to keep the backing plate properly aligned. Tighten all bolts and remove the excess adhesive using a clean rag.

TASK E-11 Make and Install the Trim Servo Access Panel

Note: The electric trim system (which includes the servo tab) is an option. If you have not opted for electric trim, disregard the instructions that pertain to the installation of the servo and tab. A ground-adjustable tab may be installed if desired (see rudder section).

Brief Task Description:

The G-202 utilizes an electric trim servo to trim the aircraft in flight. This servo is mounted inside the right side of the stabilizer. Unlike the wings and ailerons, there is no pre-molded recess in the stabilizer for a trim servo access panel. Thus you will have to fabricate an access panel by cutting the appropriately sized hole in the bottom of the stabilizer skin then mounting a fiberglass flange on the inside surface of the skin. Follow steps A-H to build and install the trim servo access panel.

Step A Make the Internal Flange for the Servo Access Panel

Cut out four pieces of fiberglass cloth about 6 inches by 6 inches on the bias. Apply some clear tape on the inside surface of the lower right stabilizer skin at the same butt line location as the servo access panel. Mix up about 3 ounces of laminating resin and wet out the fiberglass on the clear tape on the stab. After the flange has cured, trim the flange to the proper dimensions.

Step B Cut Out the Access Panel from the Lower Stab Skin

Remove the template in this manual for the trim servo access panel. Use spray adhesive to mount this template to the outside surface of the lower stabilizer skin at the proper butt line location.. Drill a ¼ inch hole in the “tongue” of the cut-out then use a jig saw with a narrow, fine toothed, metal cutting blade to trim along the outline on the template. Because the piece you cut out will become the access panel itself, you should stay as close to the line as possible while cutting.

Step C Assemble the Servo Mounting Bracket to the Top Stab Skin

Find the pre-molded servo mounting bracket included with your kit. Secure the servo to the servo mounting plate with clamps. Use the mounting holes in the trim servo itself to drill the four holes into the servo mounting bracket. Refer to the General Information Section of this manual to install the four nutplates in the servo mounting bracket (you may wish to refer to the section of this manual entitled “Backing Plates”). Prepare the flanges on the mounting bracket and the top stabilizer skin for bonding. Mix up a small batch of structural adhesive and bond the trim servo mounting bracket to the top stab skin at the proper location. Save the remainder of the adhesive for the next step.

Step D Install the Access Panel Flange in the Stab Cut Out

Prepare the access panel flange and the area surrounding the access panel cutout (on the inside of the top stab skin) for bonding. Use the left over adhesive from step C to bond the flange to the inside skin surface. Be certain to remove all excess adhesive from the flange or you will not get the panel to sit flat on the flange.

Step E Install Hard Points and Seal the Core in the Access Panel

Remove the core material from the four corners of the access panel where the mounting screws will pass though. Also, remove the core material from the entire perimeter of the access panel to a depth of 3/16 inch. Mix up some laminating resin and add microballoons until the mixture has the consistency of peanut butter. Use a tongue depressor to force this mixture into the edges and corners of the access panel where the core material was removed. Let the mixture cure then smooth the edges of the access panel with sandpaper.

Step F Install Nutplates in the Access Panel Flange

Install the access panel in the center of the cut-out in the stab and use duct tape to secure it in position. Drill the four holes through the corners of the access panel and into the flange. Remove the access panel and install four nutplates in the flange. Use a 100 degree countersink to countersink the holes on the outside face of the access panel.

Step G Seal the Core in the Access Panel Cut-Out

Remove the core material to a depth of 3/16 inch around the entire perimeter of the access panel cut out in the bottom stab skin. Place some duct tape around the perimeter of the access panel to act as a mold release. Make sure the duct tape is smooth on the edges of the panel and extends inboard at least .5 inches from the edge on both sides. Mix some laminating resin and add microballoons until the mixture assumes the consistency of peanut butter. Force this mixture into the edges of the access panel hole where the core material was removed. Now mount the access panel (with duct tape on it) in the hole with the four #8 screws. Force some filler into the gap surrounding the access plate. Allow the filler to cure then remove the plate.. The duct tape should have prevented filler from adhering to the access plate leaving a perfect gap the same thickness as the tape surrounding the access panel.

Step H Install the Servo Wire Conduit

Drill 3/8 inch hole through the leading edge of the stab 2.5 inches to the left of the stab centerline (Don't forget the stab is upside down, so left is right and right is left). Drill another hole through the inboard right rib just ahead of the forward stab spar. Find the .25 inch ID nylon tubing supplied with your kit. Cut a piece long enough to extend from the trim servo through the hole in the right inboard rib and the hole in the stab leading edge. Sand the tubing where it passes through the rib and leading edge. Also sand the end of the tube that terminates at the trim servo. Prepare some laminating resin and mix in enough microballoons to achieve "peanut butter" consistency. Insert the tube through the holes in the stab and use the "micro" mixture to Create a generous fillet around each tube where it passes through the leading edge and the rib. Tack the free end of the tube in place near the access panel for the trim servo using this mixture.

TASK E-12 Build Up the Bond Area on the Stabilizer Spars & Ribs

Brief Task Description:

In this task you prepare the stabilizer for closing by building up the bond areas on the stabilizer ribs and spars. This process is identical to that used earlier on the wing and ailerons. The goal is to add a layer of structural adhesive to any low areas on the stabilizer ribs and spars that will allow the final bond layer of structural adhesive to be thin and uniform.

Step A Place the Stabilizer in the Jig

As you work, remember that the stabilizer, like the ailerons and wing, is built with the spar and ribs factory-bonded into the upper skin. And since the stabilizer is built upside down, the upper skin is actually on the bottom and the lower skin is actually on top.

Place the stabilizer assembly in the jig.. Place sand bags in the stabilizer to be sure that it is fully seated in the stabilizer jig .Check that the jig former contours match those of the stabilizer skins. The stabilizer / elevator construction jig formers should contact the stabilizer skin along their entire length. If not, double check that the stabilizer is in properly located in the jig.

Step B Mark the Bond Areas on the Lower Skin

Using either the wet sponge or chalk method, lay the lower stabilizer skin in its proper place on the upper stabilizer assembly. Locate the bond areas on the lower skin. Cover all the bond areas on the inner face of the top stabilizer skin with a layer of clear 3M tape.

This is a good time to dry fit the lower skin to be certain that it mates properly with the spar and ribs of the upper skin. It is also a very good idea for you and an assistant to practice putting the lower stabilizer skin precisely in place as if there were adhesive on the ribs and spars a few times. A few dry runs will help you place the lower stabilizer skin with perfect precision the one time that it really counts -- that is, when it is covered with adhesive.

Step C Prepare the Stabilizer

Remove all removable fittings. Next prepare the bond zones of the stabilizer spars and ribs for bonding. (See the General Information section of the manual.) Be sure that all are properly sanded and cleaned with acetone immediately prior to the bonding operation.

Carefully place the lower stabilizer skin into exact position on the spar, ribs and lower skin assembly. Generously weight the skin in place by placing small sand bags directly over the bond areas of the spars and ribs.

Drill holes for Cleco fasteners every 4" along the center of the leading edge joggle and through the skin and the rib flanges. These Clecos will hold the skin in exact position while you are building up the bond area and while finally bonding the skin in place.

Step D Mix and Apply Adhesive

Put a generous but not excessive layer of structural adhesive that you have thickened to "mayo" consistency on the ribs and spars. This layer should evenly cover the entire bond area of the ribs and spars.

Remember that you are trying to accomplish two things. First, you must force the skin firmly and completely onto all the bond areas. Second, you must press a perfect impression of the inner surface of the lower skin into the fairly thick mixture of structural adhesive that is on the ribs and spars. **The goal is to build up the thinnest possible layer of structural adhesive that will still provide a bond area that has no gaps or low spots.** Inadequate pressure over the bond areas will allow too thick a layer of structural adhesive to build up, however, you do not want to use so much pressure that you begin to locally deform the lower skin.

Step E Place the Stabilizer Skin in Position

Carefully and slowly place the lower elevator skin into exact position on the spar and ribs of the upper assembly. Insert Clecos into the holes drilled in the leading edge flange. Weight the skin down by placing sand bags directly over the bond areas of the spars and ribs. Allow the structural adhesive to cure completely.

Step F Remove the Stabilizer Skin

After adequate cure time, remove the lower skin. This should be a fairly simple process involving little more than some gentle tugging -- unless you have not done an adequate job of masking off the bond areas of the lower skin.

Inspect the hardened structural adhesive on the bond areas of the stabilizer and spars. Ideally all the taped surface came into full contact with the adhesive. Look closely at the adhesive surface that were supposed to contact the taped sections of the stabilizer skin. The areas that contacted properly should appear smooth and glossy. Those areas that did not contact the taped sections will have a slightly rougher, more irregular surface appearance.

Should you find such rough or irregular areas, it means that there are still some low spots in the bond area. If these low spots cover more than twenty percent of the total bond area, they will need to be built up to the proper height by repeating steps A through F. Start by sanding the bond surfaces of the adhesive you just applied. If the low spots are prevalent over much of the bond area, you may want to apply another full layer of structural adhesive. If there are only a few localized low spots, it may be adequate to merely apply structural adhesive in the vicinity of the low spots. In any event, remember to place the lower skin exactly in position, and fully weight it in place.

Step G Drill Pressure Equilization Holes in the Stabilizer

Drill a 3/32 inch hole through each of the two inboard ribs in the stabilizer. Drill another small hole in the bottom center of the forward stab spar. Leave one of the cleco holes in the leading edge of the stabilizer open. These holes will allow air to escape from the enclosed sections of the stab when flying at high altitude.

TASK E-13 Build Up the Bond Area on the Elevator Spars & Ribs

Brief Task Description:

You will now prepare the elevator for closing by building up the bond areas on the elevator ribs and spars. As with the stabilizer, this insures that there will be no low spots on the spars or ribs that might result in gaps in the structural adhesive. Here too, the goal is to add a layer of structural adhesive to any low areas on the elevator ribs and spars that will allow the final bond layer of structural adhesive to be thin and uniform.

Step A Place the Elevator Panels in the Jig

Place the right and left elevator panels in the jig. Use spring clamps to secure the trailing edge of each panel to the steel trailing edge support that you built into the elevator construction jig. Place small sand bags in each panel to be sure that it is fully seated in the elevator jig.

Check that the construction jig former contours match those of the elevator skins. The jig formers should contact the elevator skin along their entire length. If not, double check that the elevator is properly positioned in the jig.

Step B Mark the Bond Areas on the Lower Skin

Using either the wet sponge or chalk method, lay the lower elevator skins in its proper place on the elevator assembly. Locate the bond areas on the lower skins. Cover all the bond areas on the inner face of the lower elevator skins with a layer of clear 3M tape.

This is a good time to dry fit the lower skin to be certain that it mates properly with the spar and ribs. It is also a very good idea for you and an assistant to practice putting the lower elevator skin precisely in place as if there were adhesive on the ribs and spars a few times. A few dry runs will help you place the lower elevator skin with perfect precision the one time that it really counts -- that is, when it is covered with adhesive.

Step C Prepare the Elevator

Remove all removable fittings. Next prepare the bond zones of the elevator spars and ribs for bonding. (See the General Information section of the manual.) Be sure that all are properly sanded and cleaned with acetone immediately prior to the bonding operation.

Carefully place the lower elevator skin into exact position on the spar and ribs of the upper skin assembly. Weight the lower skin in place by placing sand bags directly over the bond areas of the spars and ribs.

Drill holes for Cleco fasteners every 4" along the center of the leading edge flange and through the skin and the rib flanges. These Clecos will hold the skin in exact position while you are building up the bond area and while finally bonding the skin in place. Remove the lower skin when done.

Step D Mix and Apply the Adhesive

Put a generous but not excessive layer of structural adhesive that you have thickened to "mayo" consistency on the ribs and spars. This layer should evenly cover the entire bond area of the ribs and spars.

As before, the goal is to build up the thinnest possible layer of structural adhesive that will still provide a bond area that has no gaps or low spots**.** Inadequate weight over the bond areas on the lower skin will allow too thick a layer of structural adhesive to build up, however, you do not want to use so much weight that you begin to locally deform the lower skin.

Step E Place the Elevator Skins in Position

Carefully place each lower elevator skin into exact position on the spar, ribs and upper skin assembly. Install Clecos in the previously drilled holes in the leading edge. Generously weight the skin in place. Place sand bags directly over the bond areas of the spars and ribs. Allow the structural adhesive to cure undisturbed.

Step F Remove the Elevator Skin

After adequate cure time, remove the lower skin. Inspect the layer of structural adhesive for low spots. These will need to be built up until they too are of the proper height. Start by sanding the bond surfaces of the adhesive you just applied. If the low spots are prevalent over much of the bond area, you may want to apply another full layer of structural adhesive. If there are only a few localized low spots, it may be adequate to merely apply structural adhesive in the vicinity of the low spots. In any event, remember to place the lower skin exactly in position, and fully weight it in place.

TASK E-14 Close the Stabilizer

Brief Task Description:

This task involves closing the stabilizer by bonding the lower stabilizer skin into place on the stabilizer assembly. The stabilizer gains an enormous amount of structural strength and rigidity thorough the process of bonding in the lower skin. This operation completes the structure of the stabilizer. If not done carefully, the result can be a twisted stabilizer. Take your time. Work accurately. Do not build in twist or error.

CRITICAL DOUBLE CHECK:
We can not over-emphasize the importance of the alignment of the stabilizer construction jig formers. It is still possible to build in twist unless this entire task is approached with care. With the stabilizer held in place in the jig, recheck everything. Are the stabilizer's leading and trailing edges **precisely** matched up with the leading and trailing edge marks on the stabilizer / elevator construction jig formers? Are those marks all still in **exactly** the same plane? Is that plane still perfectly level? Recheck **everything** before proceeding. This is you last chance to correct any error.

Step A Prepare the Stabilizer for Bonding

Be sure to completely mask off all exposed fittings on the stabilizer. It will be impossible to remove any excess adhesive that bonds to internal fittings during the closing process. Good masking will prevent this. Mask in such a way that your masking will prevent adhesive from clogging nut plates etc., but not in such a way that the masking interferes with any of the bond zones. Also, remember to use clear 3M tape to mask. Adhesive will soak through standard household masking tape.

Before you start the bonding process, you should be very sure that you have everything ready. Once you start the applying the adhesives, you cannot stop. All the tools and materials you need must be close at hand. Here are the things that you will want to have standing by before you start to mix adhesive:

- Latex gloves for mixing and applying adhesive.
- Tongue depressors for applying and cleaning up adhesive.
- A roll of paper towels for clean up.
- Adequate solvent for clean up.
- Cleco fasteners and a Cleco tool.
- Small sand or lead shot bags to hold stabilizer in place in the construction jig and for providing clamping pressure while the adhesive cures..

Prepare all bond zones of the skin, spar, and ribs for bonding. (See the General Information section of the manual.) Be sure that all bond areas are properly sanded and cleaned with acetone immediately prior to bonding. Once these areas have been prepared, do not touch them with your bare hands. Remember: the structural integrity of your aircraft is dependent on proper surface preparation prior to bonding.

Step B Mix and Apply the Adhesive

Prepare a batch of structural adhesive. Thicken the adhesive to "mayo" consistency and apply an even layer to **all the bond zones** of the spar and rib assembly of the stabilizer:

- stabilizer leading edge.
- stabilizer ribs.
- stabilizer spar.
- stabilizer trailing edge.

Carefully lower the skin **exactly** into position and press down lightly. Then, lift the lower skin back off the lower skin / spar / rib assembly. Some adhesive will have adhered to the inner face of the lower stabilizer skin where it contacted the ribs and spars. Those smear marks will show you exactly where the bond area is on the lower stabilizer skin. Using those smear marks as a guide, apply a layer of structural adhesive to all the bond areas of the inner stabilizer skin. The net result will be that you will have applied a thin, even **layer of adhesive to both sides of every bond zone**.

NOTE:
Be very certain to **remove all sand bags and tools** (or any other foreign matter that you do not wish to become a permanent part of the aircraft) from inside the stabilizer now.

Step C Bond the Skin in Place

Using a helper, carefully position the lower stabilizer skin into place over the bond area. Put the skin down as close to it's final position as you can. The less you have to move it to get proper alignment, the less adhesive you will smear, and the better bond you will make.

Align the lower stabilizer skin with the top stabilizer assembly. Be sure that the leading edge of the lower stabilizer skin is fully seated into its joggle recess along its entire length.. Next, start to secure the stabilizer into the construction jig. In general, you want to move from the leading edge to the trailing edge. The effect will be to gently pull the lower stabilizer skin aft, thereby seating it into the leading edge joggle, bonding it to the stabilizer spar and finally into the trailing edge.

Secure the leading edge with Clecos then place 10 pound sand bags over the ribs and every foot along the spar.

Wipe off any excess structural adhesive that has squeezed out along bond lines. Excess adhesive adds weight but not strength.

NOTE:
You must allow the bonded stabilizer to cure undisturbed in the construction jig for a minimum of 24 hours at 65 F or higher-- however it is preferable to allow a minimum of 12 hours cure time at 85 to 110 F. A small electric heater placed under the work table (but away from any combustibles) can help you achieve higher temperature readings in the vicinity of your stabilizer construction jig. **Do not loosen any clamps or move any sandbags or Clecos during this period.**

Only after the bond in the stabilizer has completed an initial cure of at least 24 hours at 65 F (but preferably 12 hours at 85 to 110 F) should you loosen your clamps and remove the stabilizer from the stabilizer construction jig. Do not rush to remove the stabilizer from the construction jig. Allow full and complete cure time.

TASK E-15 Balance the Elevator

Brief Task Description:

In this task you will be installing the counterbalance weight in the elevator panels. This counterbalance weight consists of a mixture of lead shot and structural adhesive which is poured into a sectioned off area in the counterbalance arm of the elevator. This counterbalance weight is necessary to prevent a rather destructive aerodynamic phenomenon called “flutter”. Do not attempt to fly your aircraft without properly balanced control surfaces.

Step A Make the Knife Edge Supports

Cut two 4 inch pieces of 1.5 x 1.5 angle aluminum. Mount them to your construction table so that they are parallel and roughly 41.25 inches apart. One support should be offset about 2 inches from the other. Find a piece of steel or aluminum about 1/8 inch thick by 1 inch by 3 inches long. Attach this piece to one of the angle aluminum supports so that it overhangs the center of the opposite support. Place a 1/4 inch bolt through the hinge receiver fitting on both elevator panels. Insert another bolt into the hinge pin hole of the root rib of the left panel. Secure these bolts with washers and nuts.. Place the left elevator panel on the two supports mounted to your work table.. The elevator should now be free to pivot on the two “knife edge” supports with very little friction.

Step B Install Cardboard Dam in the Elevator

Find a piece of corrugated cardboard about 1 inch wide by 24 inches long. Completely cover this strip with clear tape. Install this strip in the forward section of the counterbalance arm of the left elevator panel so that it sits about 2 inches back from the leading edge of the elevator arm. Use clear tape on the aft side of the strip to hold it in position. Make sure this “dam” is sealed along the entire bottom edge and also where this strip meets the two ribs.

Step C Balance the Left Elevator Panel

With the elevator free to pivot on the knife edge supports, pour some lead shot into the sectioned off area of the elevator until the it balances. Now place the lower skin on the elevator. Lift up the leading edge and continue to add lead shot to the elevator until it balances with the lower skin in place. Carefully remove the lead shot from the elevator.. This is the amount of counterbalance weight needed to balance the left elevator panel. Place this lead shot in a cup and label it so you do not confuse it with the lead shot for the right panel later Repeat this procedure for the right elevator panel.

Step D Prepare the Lead Shot / Adhesive Mixture

Set each elevator panel down on your work bench and jig the trailing edge up so that the elevator panels are level. Prepare a four ounce batch of structural adhesive (do not thicken the adhesive with filler). Mix half of the adhesive with the lead shot removed from the right elevator panel and mix the other half with the shot removed from the left panel. Carefully pour each mixture into the appropriate section of the left and right elevator panels. Note that the adhesive will add a little extra weight to the elevator, making it nose heavy (overbalanced). This overbalanced condition will be corrected later when primer and paint is added to the elevator. Allow the adhesive to cure completely, then remove the cardboard dam.

TASK E-16 Close the Elevator

Brief Task Description:

You will now close the elevator by bonding the lower right and left elevator skins in place on the elevator assembly. This operation is almost identical to that just used to close the stabilizer.

Before you start the bonding process, you should be very sure that you have everything ready. Once you start the applying the adhesives, you can not stop. All the tools and materials you need must be close at hand. Here are the things that you will want to have standing by before you start to mix adhesive:

- Latex gloves for mixing and applying adhesive.
- Tongue depressors for applying and cleaning up adhesive.
- A roll of paper towels for clean up.
- Adequate solvent for clean up.
- An aluminum "L" section extrusion for clamping the trailing edge. One wide face of this piece should be protected with clear 3M tape where it will contact the carbon fiber of the elevator skin.
- About 20 spring clamps.
- Cleco fasteners and a Cleco tool.
- Small sand or lead shot bags to hold elevator in place in the construction jig and for providing clamping pressure while the adhesive cures..

Prepare all bond zones of the skin, spar, and ribs of both elevator panels for bonding (See the General Information section of the manual.). Be sure that all bond areas are properly sanded and cleaned with acetone immediately prior to bonding. Once these areas have been prepared, do not touch them with your bare hands. Remember: the structural integrity of your aircraft is dependent on proper surface preparation prior to bonding.

Step C Mix and Apply the Adhesive

Prepare a batch of structural adhesive. Thicken the adhesive to “mayo” consistency and apply an even layer to **all the bond zones** of the spar and rib assembly of the right and left elevator panels:

- elevator leading edge.
- elevator ribs.
- elevator spar.
- elevator trailing edge.

Shape the adhesive on all surfaces into a triangular wedge. This will reduce the chance of trapping air in the adhesive when the close out skin is pressed upon it.

NOTE:
Be very certain to **remove all sand bags and tools** (or any other foreign matter that you do not wish to become a permanent part of the aircraft) from inside the elevator now.

Step D Bond the Lower Skins in Place

Using a helper, carefully position the lower left elevator skin in place over the bond area. Put the skin down as close to its final position as you can. The less you have to move it to get proper alignment, the less adhesive you will smear, and the better bond you will make. Now align the lower elevator skin with the upper elevator assembly. Be sure that the leading edge of the lower elevator skin is fully seated into its joggle recess along its entire length.. Next, start to secure the elevator into the construction jig. In general, you want to move from the leading edge to the trailing edge. The effect will be to gently pull the lower elevator skin aft, thereby seating it into the leading edge joggle, bonding it to the elevator spar and finally into the trailing edge.

Secure the leading edge with Clecos, then place 10 pound sand bags over the ribs and every foot along the spar. Place your aluminum "L" section over the trailing edge and clamp every six inches. Wipe off any excess structural adhesive that has squeezed out along bond lines. Excess adhesive adds weight but not strength.

Repeat the above procedure for the right elevator skin.

Only after the bond in the elevator has completed an initial cure of at least 24 hours at 65 degrees F (but preferably 12 hours at 85 to 110 F) should you loosen your clamps and remove the elevator from the elevator construction jig. Do not rush to remove the elevator from the construction jig. Allow full and complete cure time.

Step E Fiberglass the Leading Edge of the Counterbalance Arms

Prepare the joggle at the leading edge of both elevator panels for bonding. Cut four strips of fiberglass on the bias (fibers running at 45 degrees to the edge) long enough to span the length of the joggle. Mix up a small batch of laminating resin and laminate two strips of fiber glass into each joggle. Clean up any excess resin and allow the assembly to cure.

TASK E-17 Make and Install the Optional Trim Tab

In this task you will make the and install the elevator trim tab. This tab is made by first cutting out a section from the trailing edge of the elevator. Then, the control horn is installed in this tab. Next, the exposed surfaces on the tab and the elevator are "closed out" using a fiberglass laminate. The tab is finished by mounting it back on the elevator using a piano hinge.

Note: There has been quite a bit of discussion regarding the size of the servo tab. Please contact AkroTech for the most up-to-date information.

Step A Cut Out the Tab

Use a Dremel or similar tool to cut out the tab directly from the trailing edge of the left elevator panel. Note that the tab will pivot near its top edge, requiring you to trim the bottom edge of the tab more than the top to allow it clear the elevator when deflected..

Step B Install the Tab Horn

Cut a slot in the bottom skin of the tab at the location of the actuating horn. Prepare the area surrounding the slot on the inside surface of the tab for bonding by sanding with 80 grit sandpaper and cleaning with acetone Prepare the surface of the aluminum horn in a similar manner. Mix a small batch of structural adhesive and add filler to achieve "peanut butter" consistency.. Insert the tab horn into the slot and jig the tab so that it remains straight (hot glue and popsicle sticks work well for holding things in position). Pack the adhesive mixture into the area surrounding the horn on the inside of the tab. When done, there should be about 1/4 inch of the mixture on either side of the horn where it protrudes inside the tab. Jig the tab so that the mixture will not flow out while the adhesive cures. Remove any excess adhesive from the outside surface of the tab.

Step C Lay Up a Fiberglass Panel for the Tab

Lay some plastic sheet down on a smooth flat section of your work table. This fiberglass will be left to cure on your work table so make sure the area is flat and smooth. Cut out four strips of fiberglass cloth about 18 inches long by 4 inches wide. Cut these strips so

that the fibers run at 45 degrees to the edges. Mix up some laminating resin and wet out the four plies of glass on the plastic sheet. Remove any excess resin with a squeegee then allow to cure.

Step D Cut Out the Close-Out Panels for the Tab and the Elevator

Make paper patterns of the front and sides of the servo/trim tab and the mating notch in the elevator. Secure these templates to the fiberglass panel made in step C with spray adhesive. Use a jigsaw or band saw to cut out the panels. These panels will be used to "close out" the exposed surfaces of the tab and elevator. Cut the panels a little over size so that you can sand them flush with the surface of the skins after bonding.

Step E Bond the Close-Out Panels to the Elevator and Tab

Remove any exposed core material on the elevator and tab to a depth of about 1/4 inch. Sand the internal surfaces of the elevator and tab to about 1/4 inch from the cut edge. Prepare the close-out panels for the elevator and tab for bonding by sanding one surface thoroughly with 80 grit sandpaper and cleaning with acetone.

Mix a batch of structural adhesive and thicken to "peanut butter" consistency with structural filler. Use the adhesive mixture to fill the areas in both the tab and the elevator where the core was removed. Build the adhesive up on all of the exposed edges that will contact the close-out panels. You want the adhesive to ooze onto the close-out panels, creating a good bond. Press the prepared surface of each close-out panel into its proper position on the tab and the elevator. Secure these panels with tape and clean up all excess adhesive with a tongue depressor or a clean rag. While the adhesive is curing, jig the elevator trailing edge down so that adhesive will flow onto the close-out panel. Jig the tab in a similar fashion.

Once the adhesive has cured, sand the edges of the close-out panels so that they are flush with the surfaces of the tab and elevator.

Step F Mount the Tab using the Piano Hinge

Find the piano hinge for the trim tab. Clamp the hinge to the trim tab so the hinge line is even with the top surface of the tab. Drill 12 evenly spaced holes through the hinge and

into the tab for the mounting rivets. Countersink the holes on the piano hinge with a 100 degree countersink. Mount the hinge permanently using flathead stainless blind rivets.

Now clamp the hinge (with the tab attached) to the surface of the close-out panel on the elevator. Adjust the tab until the hinge is properly positioned on the elevator. With the tab securely held in position, drill 12 evenly spaced holes through the hinge and into the close-out panel on the elevator. Countersink these holes and install rivets.

TASK E-18 Install the Servo Tab Bellcrank

Brief Task Description:

The G-202 trim tab is designed to function as both a trim tab for trimming the aircraft in flight and an adjustable servo tab for reducing the pitch control forces. In this task you will install the bellcrank and push rod which allows the trim tab to serve as an adjustable servo tab. These components will be mounted to the backing plate installed in the aft stabilizer spar earlier. You will also finish installing the servo itself by connecting the electrical wires which control the unit and installing the tie rod that connects the servo to the stab mounted bellcrank

Step A Assemble the Servo Tab Bellcrank

Find the servo tab bellcrank arm supplied with your kit.. Assemble this to the supplied bellcrank bearing with six solid rivets.

Step B Mount the Bellcrank Brackets and Bellcrank to the Stab Spar

Find the bellcrank brackets supplied with your kit. Install these on the stab spar with the supplied hardware. Insert the bellcrank into position between the bellcrank brackets and secure it with the supplied 1/4 inch bolt, washers and castle nut.

Step C Connect the Trim Servo Wires

Thread the supplied extension cable for the trim servo through the plastic tube built into the stab. Connect the electrical wires on the trim servo to the wires of the extension cable. We suggest using a plug-in connector so that the servo motor can be removed if necessary.

Step D Install the Trim Servo Tie Rod

Mount the trim servo to the servo mounting bracket inside the stabilizer. Find the threaded rod that comes with the trim servo and cut this rod to the proper length. Screw the plastic clevis fork ends onto each end of the tie rod and mount one end of this

assembly to the trim servo. Attach the free end of the push rod to the top hole in the bellcrank.

Step E Assemble the Tab Push Rod

Find the push rod tubing supplied with the kit. Cut this tube to the proper length and tap the tube at each end with a 10-28 tap to accept the supplied fork ends. Thread the supplied jam nuts onto the fork ends and thread the fork ends into the each end of the tube. Set this assembly aside as it will not be installed until after the initial test flights. (AkroTech suggests that the tab be secured in a fixed position for the first few flights. We use clear tape to hold the tab in the neutral position.)

Safely Store The Empennage Components

Remember the 1st Law of Hangar Rash:
"The likelihood of accidental damage to any experimental aircraft component varies directly with the product of its cost of replacement and the number of hours of work already expended on it."

Fuselage Construction Tasks

TASK F-1 Construct a Fuselage Mounting Stand

Brief Task Description:

The fuselage assembly is to be the central assembly point for all remaining and previously constructed components and requires few structural changes from its shipping form. To support the fuselage, we use a sawhorse under the gear saddle and another sawhorse with some padding to support the rear of the fuselage. It can be helpful to construct a contoured cradle to fit the rear of the fuselage at the rudder post.

TASK F-2 Mount and Level the Fuselage.

Brief Task Description:

The lower fuselage will need to be mounted so that it is level. This alignment procedure will require the use of three levels. Follow the instructions in Steps A - C to mount and level the fuselage

Step A Place Lower Fuselage into the Cradles

Separate the front sawhorse and the rear cradle so they are roughly ten feet apart and roughly parallel then place the lower fuselage onto the two supports. Now move the rear cradle forward until it is snug against the fuselage. (The rear cradle should intersect the fuselage close to the rudder post).

Step B Draw Buttline 00 on the Rudder Post

Place a piece of 2 inch wide masking tape vertically along the approximate center of the rear face of the rudder post. Draw a line bisecting the rear face of the rudder post on this tape. Do this by measuring across the width of the rudder post and marking a midpoint at several locations along the length of the rudder post. Draw a line through these points. This line represents buttline 00 and will be used to align the fuselage.

Step C Level the Fuselage

Place one level horizontally across the top of the spar box. Make sure this level is resting flat on the surface of the spar box. Clamp a second level oriented vertically to the aft face of the firewall. Clamp a third level to the aft face of the rudder post so that one edge is lined up with buttline 00. These three levels will be used to align the fuselage. Loosen the clamps holding the rear cradle to the sawhorse and adjust the cradle until the bubbles in both the rudder post level and the firewall level are reading plumb. Now adjust the sawhorse under the landing gear step until the level on the spar box reads level by placing shims under the legs of the sawhorse. Continue to adjust the fuselage until all three levels are reading correctly. Test the stability of the fuselage assembly by trying to rock the fuselage back and forth on the sawhorses. The fuselage alignment should not be easily upset.

TASK F-3 Drill a Drain Hole in the Fuselage

Brief Task Description:

In this task you will drill drain holes in the fuselage just forward of the lower banjo bulkhead to allow any water which may find its way into the cockpit to drain from the aircraft.

NOTE: Remember that whenever you must drill a hole through core material it must be sealed. If the core is not sealed, moisture may eventually cause the core to decay.

Step A Drill Drain Holes in the Fuselage

Drill a 1/8 inch hole through the fuselage bottom just forward of the lower banjo bulkhead.

Step B Remove the Core Material

Use a 3/8 inch drill bit to drill through just the **inside** skin of the fuselage using the 1/8 inch hole as a pilot. Now remove the core material from the area of the 3/8 inch hole.

Step C Seal the Core Material

Place some tape over the 1/8 inch hole on the outside of the fuselage. Mix some laminating resin and microballoons. Use this mixture to fill in the area where the core material was removed (from the inside of the fuse). Allow the filler to cure completely.

Step D Re-Drill the Hole

Remove the tape covering the 1/8 inch hole (which is now filled with filler) on the outside of the fuse. Use this hole as a guide to re-drill the 1/8 inch hole through the filler material.

TASK F-4 Install the Rudder Hinges

Brief Task Description:

In this task, you will align and mount the rudder hinges to the rudder post. These hinges need to be positioned carefully so take your time.

NOTE: Mount the hinges so that the holes for the bearings face in opposite directions. Orient the top hinge so that the bearing is installed from the top, and the bottom hinge so that the bearing installs from the bottom. This will keep the bearings from coming out.

Step A Mark the Hinge Locations on the Rudder Post.

Find the location of WL 00 and WL 29.625 on the rudder post and mark these using a felt tip pen. Remember that waterline 00 is aligned with the top edge of the lower fuselage.

Step B Mark Centerlines on the Rudder Hinges

Measure across the width and height of each hinge. Mark lines that bisect these dimensions on the hinge bases. Place small “tick” marks on the edges of the hinges at the location of these center lines.

Step C Clamp the Hinges to the Rudder Post

Place each hinge on the rudder post and carefully align the tick marks on the edges of the hinges with the lines on the rudder post. Clamp each hinge in place using two C-clamps.

Step D Fine Tune the Position of the Rudder Hinges

Check to make sure each hinge is level and properly centered on the rudder post. If you find the hinges are not level, carefully unclamp them and rotate them until they are (make sure the fuselage is properly leveled before moving the hinges).

Step E Drill Holes through the Rudder Post

Using the hinges as a drill guide, drill the eight 1/4 inch mounting holes into the rudder post. Remove the hinges from the rudder post when done.

Step F Make the Rudder Hinge Backing Plates

Find the .080 aluminum supplied with your kit. Use the base of each hinge as a pattern to make each backing plate. Cut out the two rudder hinge backing plates using a jigsaw or a bandsaw. Smooth the edges of these plates using a file or a belt sander.. Clamp each plate to its matching hinge and drill holes through each backing plate using the hinge as a template. Refer to the General Information Section of this manual to install the four nutplates in each backing plate.

Step G Bond the Backing Plates to the Rudder Post

Prepare the upper and lower rudder hinge backing plates for bonding to the rudder post as described in the General Information Section. Wax the threads of the bolts for the upper and lower hinges. Mix and apply structural adhesive to both the backing plate and the forward face of the rudder post. Press the upper backing plate in place and install upper hinge using the waxed bolts. Tighten these bolts down so that the backing plate is pulled tight against the face of the rudder post. Clean up all excess structural adhesive. Do the same for the lower backing plate and hinge. Disassemble the hinge from the rudder post

Step H Install the Stainless Steel Retaining Screw in the Backing Plates

Drill a hole through the approximate center of each backing plate. Use a 100 degree countersink to countersink these two holes on the rudder post. Install the supplied stainless steel screw and secure with a locking nut.

TASK F-5 Install the Hinge Receiver Fittings on the Rudder Spar

Brief Task Description:

In this task you must accurately position and mount the rudder hinge receiver fittings to the rudder spar. The rudder post mounted hinges are used as a reference to position these fittings on the rudder. This assures that the rudder is properly aligned relative to the fuselage. Note that the upper fitting is a simple hinge receiver fitting identical to those used on the elevator while the lower fitting is a combination hinge receiver fitting and rudder horn. As with all other control surfaces, hinge placement is critical.

Step A Mark the Position of the Hinges on the Rudder Spar and Skin

Secure a piece of 1/8 inch thick material to the bottom of the rudder with some tape. This will act as a shim to correctly space the bottom of the rudder off the bottom fuselage skin. Hold the rudder up to the rudder post at an angle (while resting it on the shim) and mark the locations of the rudder hinges on the rudder skin and rudder spar. You may have to trim the bottom fuselage skin to get the rudder to slide all the way up against the rudder hinges.

Step B Cut Slots in the Rudder Skin to clear the Hinges

Use the marks made on the rudder skin in Step A to cut slots in the rudder skin to clear the hinges. Extend these slots back far enough towards the rudder spar to allow the rudder to slide straight on to the rudder post mounted hinges.

Step C Mark Centerlines On The Rudder Spar For The Fittings

Find buttline 00 on the rudder spar by measuring across the width of the spar at several locations and marking the midpoint of these measurements on the spar. Use the marks made in step A to find the horizontal centerlines (waterline 00 and waterline 29.625) for the fittings on the rudder spar.

Step D Mark Centerlines on the Fittings

Measure across the width and height of the base of each hinge fitting. Mark the midpoint of these measurements on the base. Carry these lines out to the edges of the fittings and place tick marks on the edges of the fittings. These marks will be used to position the fittings on the rudder spar.

Step E Cut a Slot in the Rudder Skin to clear the Rudder Horn Arm

Now you will need to cut a slot in the rudder skin to clear the arm of the rudder horn. Double check that your rudder hinge placement puts the rudder horn exactly where you plan to cut the slot. This slot should be positioned just above the slot cut earlier for the rudder hinge but should extend further back towards the spar.

NOTE:
All slots that are cut in the skin should be rounded to a "U" shape at their ends. Slots that terminate in a square or a vee will act as "stress risers" and may eventually result in stress cracks.

Step F Clamp the Hinge Receiver Fittings to the Rudder Spar

Position the hinge receiver fittings on the spar using the reference lines. Clamp the fittings to the rudder spar using C-clamps. Now double-check that the fittings are correctly positioned by holding the rudder up to the rudder post (with the 1/8 inch spacer between the rudder and the bottom fuselage skin). The rudder hinges should be centered in the fittings. If they are not, adjust them until they are.

NOTE:
Before you drill any holes, go back and double check all your measurements and positions. Are the hinge receiver fittings in the precise horizontal center of the rudder spar? Are the fittings cocked to one side or the other? Is everything clamped securely enough so that it will not shift as you work? Be certain of these factors before you drill the first hole.

Step G Drill the Holes for the Hinge Receiver Fittings

Once you are certain that the hinge fittings are securely held in the correct position, drill the two 1/4 inch holes through the upper fitting and rudder spar.. Now use the lower fitting as a drill guide to drill the four 3/16 inch holes through the rudder spar. Remove both fittings from the rudder when done.

Step H Make fhe Backing Plates for the Hinge Receiver Fittings

Next you must make the three (the lower hinge receiver fitting gets two) backing plates for the hinge receiver fittings. You may wish to review the section entitled “Backing Plates” in the General Information Section of this manual at this time. These backing plates are installed on the rear face of the rudder spar and are made from the supplied .080 inch thick aluminum plate. Position the base of each fitting on the .080 aluminum sheet. Use a fine tip felt pen to trace the outline of the base on the aluminum. Cut out the backing plates from the aluminum using a jigsaw or bandsaw. Cut the backing plate for the lower fitting in half to allow it to straddle the lower rib. Use a file to smooth any rough edges on the backing plates. Refer to the section entitled “Installing Nutplates” to install the four nutplates in the lower fitting backing plate and the two nutplates in the upper fitting backing plate.

Step I Install the Backing Plates

Install the backing plates and secure with stainless steel screws using the same procedure utilized for the rest of the backing plates in the aircraft.

TASK F-6 Install the Rear Inspection Plates

Brief Task Description:

The rear inspection plates are similar to the ones installed earlier in the aileron. There is a slight difference here in that this inspection plates are made of clear polycarbonate sheet instead of fiberglass to allow for inspection of the tail without removing the inspection plate. Follow steps A-D to install the rear inspection plates.

Step A Cut Out the Inspection Plates

Make templates for the inspection plates and attach the templates to the supplied polycarbonate sheet (Note: do not remove the paper backing on the polycarbonate). Cut out the inspection plates using a jig saw or band saw with a metal cutting blade. Leave the paper template in place for now.

Step B Cut Out the Flanges for the Inspection Plates

Cut out the inspection opening. Leave enough flange to mount the inspection plate.

Step C Drill Holes in the Inspection Plate and Flange

Drill the holes in the inspection plates. Tape the inspection plates in place in the pre-molded flanges. Hold the top of the plate flat against the fuselage and use a 1/8 inch drill bit to drill out the two top holes. Install Clecos in these two holes to hold the plate in place. Now hold the bottom of the plate flat against the fuselage and drill the two bottom holes. Remove the plate from the flange. Drill out the holes in both the flange and the inspection plate with a 11/64 inch bit to fit the inspection plate screws. Now countersink the holes in the inspection plate so that the screws will sit flush when installed. Step D

Install Nutplates for the Inspection Plates

Refer to the general information section of this manual to install the four 8-32 nutplates into the corners of each of the pre-molded inspection plate flanges.

TASK F-7 Mount and Align the Stabilizer

Brief Task Description:

The horizontal stabilizer completed earlier will now be mounted to the fuselage. The most challenging aspect of this operation is properly locating the holes for the center elevator hinge on the rudder post. These holes must be carefully positioned or they will not line up with the holes already drilled in the stabilizer spar.

Step A Locate and Drill Holes for the Rudder Post Stabilizer Hinge

Locate and mark waterline 9.00 on the rear face of the rudder post. Center the rudder post stabilizer hinge on waterline 9.00 and buttline 00. Clamp this hinge in place on the rudder post. Double check for proper alignment by placing a level on one side of the hinge. Make sure the hinge side is exactly plumb (vertical). Using the hinge fitting as a template, drill 1/4 inch holes through the rudder post. Remove the hinge from the rudder post. Drill out the holes just drilled in the rudder post using a 9/32 inch bit (This will oversize them to allow play for fine-tuning stabilizer alignment).

Step B Cut a Notch in the Stab

Cut out the notch in the trailing edge of the stabilizer with a hand-held jigsaw. This notch is necessary to allow the rear face of the stabilizer spar to sit flush against forward face of the rudder post. While cutting the notch be extra careful not to cut into the shear web of the stab spar! Use a Dremel tool or the equivalent to carefully grind down the notch close to the stabilizer spar shear web. Finish the notch by hand using sandpaper.

Step C Draw a Chord Line on the Tip Rib of the Stab

To properly align the stab in pitch, you will need to draw a line bisecting the tip rib of the stab. To do this place some masking tape over the tip rib of the stab. Use a ruler with a fine scale to mark the midpoint of the thickness of the rib at several locations. Draw a line through these points on the masking tape.

NOTE: You may also use the appropriate former from the stabilizer / elevator jig to align the stab in pitch. Use a couple of bar clamps to clamp the former upside down over the stab tip rib. Then place a level over the bottom edge of the former (which is now on top) or line the level up with the level reference line printed on the former template.

Step D Trial Fit the Stabilizer to the Fuselage

Slide the stabilizer into place around the rudder post . Insert bolts through the rudder post into the stabilizer and tighten them down just enough to allow the stabilizer to move relative to the rudder post with a little friction. Now check to see if the stabilizer can be aligned properly with the bolts slightly loose. Check for proper pitch alignment by placing a level on the line marked on the tip rib in step C. Measure from the right outboard edge of the stabilizer to the right top edge of the rudder post and the left outboard edge of the stabilizer to the left top edge of the rudder post, these measurements must be equal, for roll alignment. Check for proper yaw alignment by measuring from the right side of the forward face of the firewall at buttline 00 (buttline 00 is coincident with the top edge of the lower fuse) to the right tip of the stab. Do the same for the opposite side of the stab. These two measurements must be equal.

NOTE:
Do not use measurements off of the floor for the purpose of leveling the stabilizer. Concrete floors may have high and low spots that will give you an inaccurate measurement. Also, be sure the fuselage is properly aligned prior to checking stabilizer alignment.

Step E Shim Gaps with Structural Adhesive

Once you have the stabilizer properly aligned, Check to see if you have any gaps exceeding 1/16 inch between the stabilizer and the lower banjo and/or the stabilizer and the rear face of the rudder post. If a shim is required in any location, it can be made by first placing clear tape on the stabilizer where it intersects the banjo and rudder post, applying a layer of structural adhesive mixed to “mayo” consistency to the area with the gap, and finally positioning the stabilizer on the banjo and rudder post so that it is once

again properly aligned. Make sure all excess structural adhesive is removed from the gap. After the structural adhesive has cured, remove the stabilizer and the clear tape.

NOTE:
On early kits the lower banjo bulkhead is about 1/4 inch too short. If you have a short banjo bulkhead, you will have a gap of about 1/4 inch between the bottom of the stab and the top of the lower banjo when the stab is properly positioned at waterline 9.0 and leveled. It is acceptable to fill this gap with thickened structural adhesive.

Step F Permanently Install the Stabilizer

To permanently install the stabilizer , prepare all mating surfaces for bonding according to the procedures outlined in the General Information Section. Coat the top edge of the lower banjo and the corresponding section of the stabilizer with structural adhesive. Coat the forward face of the rudder post and the corresponding section of the elevator with structural adhesive. Install the rudder post elevator hinge with waxed bolts but do not tighten them yet. Position a 5 lb weight over the lower banjo to provide clamping pressure. Check the stabilizer for correct alignment just as you did in Step D. *This is a critical step. If the stabilizer is not properly aligned, the flying qualities of the aircraft will be compromised.* When you are sure the stabilizer is correctly aligned, tighten the rudder post stabilizer hinge bolts. Clean up any excess structural adhesive with a rag and leave the stabilizer undisturbed until the structural adhesive has cured.

NOTE:
The stabilizer will require 24 hours of undisturbed curing at 65 degrees or higher. If your shop temperature is below 60 degrees, cover the stabilizer with a tent of clear plastic and place a small electric heater inside the tent. Also, be aware that some pets (such as cats) love to sleep on the warm surface of a heated stabilizer. This could cause the stab to become misaligned. Take the proper precautions to make sure this doesn't happen.

TASK F-8 Install the Right Fin Skin and Upper Banjo Bulkhead

Brief Task Description:

In this task you will mount the right fin skin, install your antenna in the vertical fin, and install the upper banjo bulkhead. Even though you will not be bonding the top fuselage in this operation, you will need to mount it so you can properly align the forward edge of the fin skin.

Step A Cut Out Stabilizer Opening in Right Fin Skin

Use a jig saw or bandsaw to cut out the opening in the right fin skin for the horizontal stabilizer. The initial cut should be 2 inches in from the edge of the joggle, or indentation, following the shape of the horizontal stabilizer cross section. Fit the fin skin around the stabilizer and check for proper fit. Carefully trim the cutout as needed to properly align the fin skin.

Step B Temporarily Mount the Upper Fuselage on the Lower Fuselage

Check the alignment of the lower fuse once more to be certain it is not twisted. Place levels on the spar box and along the centerline of the stabilizer and check for level. Once you are certain the lower fuse is properly aligned, mount the top fuselage on the lower fuselage. Align the bottom edge of the top fuselage with the pre molded joggle in the lower fuselage. Clamp the top fuselage in position with spring clamps and drill about ten equally spaced holes for clecos through the upper and lower fuselage where they overlap. Remove the top fuselage when done.

Step C Temporarily Mount the Right Fin Skin

Slide the right fin skin over the stabilizer. Mount the top fuselage over the bottom fuselage once more and secure it with clecos. The upper fuse will provide a reference for the forward edge of the fin skin thus ensuring proper alignment of the fin skin. Clamp the fin skin to the top fuselage and to the bottom of the rudder post.

Mount the rudder once more to the rudder post hinges (you may have to trim the fin skin to get it to fit). Now flex the top of the rudder post until the leading edge of the counterbalance arm on the rudder matches up with the leading edge of the fin skin. With these two leading edges matched up, clamp the top of the fin skin to the rudder post. Drill and Cleco the fin to the recessed edge along the top of the lower fuselage, to the rudder post flange, and to the top fuselage every four inches. Drill two holes for Clecos through the upper banjo flange and into the inside layer of the fin skin. Remove the top fuselage, fin skin and rudder when done.

Step D Permanently Mount the Right Fin Skin

Prepare the inboard surface of the right fin skin for bonding where it intersects the upper and lower banjo, rudder post, and lower fuselage. Place some clear tape over the area on the top fuselage that mates with the joggle on the fin skin (you will not be bonding the fin skin to the top fuselage at this time). Mix structural adhesive and add enough structural filler to achieve “mayo” consistency. Coat all mating surfaces with the adhesive. Use Clecos to mount the right fin skin to the lower fuselage, rudder post. and lower banjo. Now mount the top fuselage to the lower fuselage with clecos. Secure the fin skin to the top fuselage along the forward joggle with clecos. Remove all excess structural adhesive using a clean rag.

Step E Mount the Antennae on the Right Fin Skin

Prior to installing the upper banjo bulkhead, you may wish to install any necessary antennae. This is especially true of the flat type of antennae since these are easily mounted directly to the fin skin (this will be difficult to accomplish once the upper banjo bulkhead is in place).

Because there are a number of different antenna options for composite aircraft, we cannot provide specific installation instructions. However, we do offer the following guidelines for installation:

- Mount the antenna securely using fiberglass (a loose antenna will not be easy to secure later)

- Try to get the full length of the antenna within the fiberglass area of the fin (The carbon is conductive and will block radio signals).
- Secure the cable for the antenna with fiberglass at several locations along the length of the fuselage.

If you use the flat type of antenna you can run it just inside the leading edge of the fin and fold it over so that it runs under the fin tip rib. This will allow you to fit it inside the fin without it overlapping the bottom fuselage..

If you have any further questions concerning antenna installation please feel free to call us at AkroTech for assistance.

Step F Install the Upper Banjo Bulkhead

Position the upper banjo bulkhead on the stabilizer so its aft face is exactly 10 inches from the forward face of the rudder post. Align the upper banjo so that its face is plumb (vertical) and its flange lays flat against the right fin skin. With the upper banjo held in position, drill two holes for Clecos through the lower flange and into the top layer of the stabilizer skin. Install Clecos in these holes. Now drill two more holes through the left flange and into the inside layer of the right fin skin (it is not necessary to drill all the way through the fin skin).

Prepare the upper banjo for bonding to the stabilizer. Mix structural adhesive and coat the bottom and side of the upper banjo and the corresponding area of the stabilizer and fin skin with adhesive. Place the upper banjo into position and install clecos into the cleco holes. Allow the adhesive to cure completely.

TASK F-9 Install the Fin Tip Rib

Brief Task Description:

Situated at the top of the vertical fin, the fin tip rib is the final carbon fiber component to be mounted in the tail. In this task you will use the bottom surface of the rudder's counterbalance arm to properly align this rib on the vertical fin.

Step A Position the Fin Tip Rib

Mount the rudder to the rudder post hinges once more. Find some material that is 1/8 inch thick to act as a spacer. Locate the fin tip rib that is supplied with your kit. Position the rib on top of the rudder post so that its flange points downward and its tip even with the leading edge of the fin skin. Clamp the rib to the counterbalance rib of the rudder with the 1/8 inch spacer in between.. Drill and Cleco the rib to the right fin skin and the rudder post.

Step B Install the Fin Tip Rib

Remove the fin tip rib from the fuselage. Prepare all mating surfaces for bonding. Prepare structural adhesive and thicken it with structural filler. Bond the fin tip rib to both the right fin skin and the rudder post. Install Clecos into the previously drilled holes and clamp the rib to the counterbalance arm of the rudder with the 18/ inch spacer as you did in Step A.

TASK F-10 Install the Rudder Trim Tab

Brief Task Description:

In this task you will fabricate and install a simple ground-adjustable rudder trim tab. It will be made of sheet aluminum and manually bent to the desired angle of deflection.

Step A Cut Out the Aluminum Trim Tab

Find the .025 aluminum trim tab material supplied with your kit. Mark out a rectangle 5.25” long by 2.5” wide. Cut out this piece using a jigsaw or bandsaw.

Step B Cut the Recess into the Rudder Skins

Cut a recess in the trailing edge of the rudder to allow room for the trim tab to pass through while still allowing the two ruder halves to mate. This recess should be deep enough to allow for both the thickness of the trim tab and the fiberglass lay-up necessary to separate the aluminum from the carbon.

Step C Lay Up Fiberglass in the Trim Tab Recess

Refer to the section entitled “Wet Lay-ups” in the General Information Section of this manual to lay up a single ply of fiberglass in the trim tab area on both rudder skins. This ply of fiberglass should cover the entire area where the aluminum trim tab would otherwise contact the carbon fiber of the rudder skin. The purpose of the fiberglass is to isolate the aluminum from the carbon fiber.

Step D Bond the Trim Tab to the Rudder

Prepare both the right rudder skin and the part of the trim tab that will be bonded into the rudder for bonding. Bond the tab in place with structural adhesive, so that 1.25” is exposed beyond the trailing edge.

TASK F-11 Install the Counterbalance Weight in the Rudder

Brief Task Description:

In this task you will add counterbalance weight to the rudder. Unlike the aileron and the elevator, the rudder is not balanced 100% (i.e. the weight added to the counterbalance arm will not balance the rudder). Instead, the rudder will be balanced to 50% using a predetermined amount of lead shot.

Step A Measure Out the Lead Shot

The G-202 rudder will need approximately 1290 grams of lead shot in the nose of the counterbalance rib. Measure out the lead shot with your epoxy scale and set it aside.

Step B Prepare the Rudder

Prepare the area inside the tip of the counterbalance arm for bonding. Prepare all areas that will contact the lead shot / adhesive mixture.

Step C Prepare the Lead Shot / Adhesive Mixture

Prepare a three oz batch of structural adhesive and mix in enough structural filler to achieve to mayo consistency. Add the lead shot to the adhesive and mix thoroughly until all of the lead shot pellets are coated.

Step D Pack the Lead Shot / Adhesive Mixture into the Rudder

Jig on your work table so it is resting slightly nose down. Pack the lead shot mixture into the tip of the counterbalance arm. Try to keep the mixture as close to the tip of the arm as possible. Allow the adhesive to cure undisturbed.

TASK F-12 Build the Rudder Jig

Brief Task Description:

The rudder jig is similar to the jigs made previously. Build the jig using the templates provided.

Note: Earlier versions of the manual stated that the rudder could be closed flat on a workbench without using a jig. That procedure is incorrect and will result in a grossly misaligned rudder. Build a jig!

TASK F-13 Close the Rudder

Brief Task Description:

This task involves closing the rudder by bonding the left rudder skin into place on the rudder assembly. Unlike the other flying surfaces, the rudder does not require that the bond surfaces be built up prior closing. Install the rudder skin with the rudder assembly mounted in the jig built earlier to keep everything properly aligned.

NOTE: If you are installing the optional steerable tailwheel, be sure to install the necessary parts inside the rudder before closing!

Step A Prepare the Rudder for Bonding

Remove the hinge fittings from the rudder to prevent any excess adhesive from contaminating these parts. Install the rudder in its jig and place just enough weight on the skin to get it to conform to the jig. Double-check to make certain the rudder is correctly situated in the jig.

As with the elevator and stabilizer, you should be very sure that you have everything ready prior to mixing the structural adhesive . Once you start the applying the adhesives, you cannot stop. All the tools and materials you need must be close at hand. Here are the things that you will want to have ready before you start to mix adhesive:

- Latex gloves for mixing and applying adhesive.
- Tongue depressors for applying and cleaning up adhesive.
- A roll of paper towels for clean up.
- Adequate solvent for clean up.
- An aluminum "L" section extrusion for clamping the trailing edge of the rudder. One wide face of this piece should be protected with clear 3M tape where it will contact the carbon fiber of the rudder skin.
- A couple of flat pieces of wood covered with clear tape for clamping the leading edge flanges.
- About 16 spring clamps.

- Cleco fasteners and a Cleco tool.
- Small sand or lead shot bags to hold rudder in place on your work table and for providing clamping pressure while the adhesive cures..

Prepare all bond zones of the skin, counterbalance arm skin, spar, and ribs for bonding (See the General Information section of the manual.). Be sure that all bond areas are properly sanded and cleaned with acetone immediately prior to bonding. Once these areas have been prepared, do not touch them with your bare hands. Remember: the structural integrity of your aircraft is dependent on proper surface preparation prior to bonding.

Step C Mix and Apply the Adhesive

Prepare a batch of structural adhesive. Thicken the adhesive to “mayo” consistency with structural filler and apply an even layer to **all the bond zones** of the spar and rib assembly of the rudder:

- rudder ribs.
- rudder spar.
- rudder trailing edge.

NOTE: Be very certain to **remove all sand bags and tools** (or any other foreign matter that you do not wish to become a permanent part of the aircraft) from inside the rudder now.

Step D Bond the Skin in Place

Using a helper, position the upper rudder skin into place over the bond area. Put the skin down as close to its final position as you can. Place 10 pound sand bags over the ribs and every foot along the spar. Place your aluminum "L" section over the upper skin trailing edge. Use several spring clamps to clamp the aluminum to the trailing edge to keep it straight as the adhesive cures.

Wipe off any excess structural adhesive that has squeezed out along bond lines. Remember that excess adhesive adds weight but not strength.

Allow the rudder to cure for at least 24 hours at 65 degrees F (or 12 hours at 85 to 110 degrees F) before removing the rudder from the rudder jig.

TASK F-14 Fiberglass the Rudder

Brief Task Description:

In this task you will bond the free edges of the left and right rudder skins together at the top, front and bottom using fiberglass strips. These strips are prepared on plastic sheet using a method similar to that outlined in the General Information Section of this manual. After installing these strips on the rudder you will cut a notch in the leading edge of the rudder to accommodate the elevator.

Step A Prepare the Fiberglass Strips

Cut two strips of fiberglass on the bias about 3 inches wide and long enough to extend from just under the counterbalance arm, down the front of the rudder and back to the trailing edge. Cut another two strips of fiberglass long enough to extend from the tip of the counterbalance arm across the top of the rudder to the trailing edge.

Step B Install the Fiberglass Strips

Thoroughly sand the recessed joggle that runs down the front, top and bottom of the rudder. Clean this area with acetone. Prepare some laminating resin and wet out the fiberglass strips on some plastic sheet (thick drop cloth material will work) on your work table. After removing all excess resin, place another piece of plastic on top of the wet strips of fiberglass. Trace out the final dimensions of the strips (2 inches wide) on the plastic using a ruler and a felt tip pen. Cut out the strips with scissors along the outline. Paint the areas on the rudder where the fiberglass will be installed with resin. Remove one layer of plastic from the strips. Install the strips inside the joggle on the rudder,. removing the outside layer of plastic as you go.

Step C Make a Cut Out to clear the Elevator and Elevator Actuator

Cut out an area in the leading edge of the rudder as necessary for elevator clearance.

Step D Make a Cut Out to clear the Upper Elevator Hinge

Cut out an area in the leading edge of the rudder as necessary for hinge clearance.

Step E Mount the Rudder to the Rudder Post and check for Proper Clearance

If it is not already installed, mount the elevator to the stabilizer . Re-install the hinge fittings on the rudder spar. Temporarily mount the rudder to the rudder post using the supplied hardware. Modify the rudder cut outs as necessary until you can achieve +/- 30 degrees deflection of both the elevator and rudder.

TASK F-15 Install the Stainless Plates and Bushings on the Rear Spar

Brief Task Description:

Stainless steel plates and bushings are used in the rear spar of the wing to increase the strength of the spar where the attach bolts are located. In this task you will install these plates and bushings with structural adhesive.

Step A Locate and Drill Holes in the Rear Spar

Find the proper location for the rear spar bolt holes and mark this location on both spars using an automatic center punch. Use a 3/16 inch drill bit to drill pilot holes for the rear spar bushings. Expand these holes out to full size using a 9/16 inch drill bit. (If you do not have a 1/2 inch hand drill, use a 9/16 inch bit with a stepped-down shank). When drilling, be careful to keep the bit perpendicular to the face of the rear spar.

Step B Prepare the Rear Spar and the Stainless Plates for Bonding

Prepare both the for and aft face of the rear spar for bonding. Prepare the bushings and one side of each stainless plate for bonding. Thoroughly sand these surfaces with 80 grit sandpaper then clean them with a clean rag dipped in acetone.

Step C Bond the Stainless Plates and Bushings to the Rear Spar

Wax the rear spar bolts with an automotive wax. Prepare a small batch of structural adhesive and thicken the mixture to “catsup” consistency using structural filler. Coat all bond surfaces on the spars, bushings and stainless plates with the adhesive. Press the plates onto the rear spar and insert the bushings through the holes in the plates and into the rear spar. Clean out any excess adhesive from the holes in the bushings. Now install the waxed bolts through the bushings. Place some washers or thick spacers (.5 inch thick) over the bolts and screw on the appropriate nut. Tighten this nut just enough to apply clamping pressure to the bushings and the plates. Clean up any excess adhesive and allow the assembly to cure completely.

TASK F-16 Cut Holes for the Rear Spar Plates

Brief Task Description:

The rear spars of the wings are connected to the rear spar carry-through structure with four aluminum plates. These rear spar plates pass through holes in the fuselage at either side of the rear spar carry-through. In this task you will cut these holes and reinforce the edges of these holes with structural adhesive.

Step A Cut Holes for Rear Spar Plates

Use spray adhesive to mount rear spar cut-out templates on the outside skin of the fuselage at the proper locations. Use a 1/4 inch drill bit to drill holes through the fuselage at the corners of the template. Now use a jigsaw with a fine tooth blade to connect the 1/4 inch holes. Trim these cut-outs to their final size using a Dremel tool with a drum sander attachment.

NOTE:
Early versions of the G-202 fuselage did not have the core material removed at the location of the rear spar plate cutout. If your kit does not have the core material removed from this area you will need to reinforce the edges of the hole with structural adhesive. Follow the instructions in step B to accomplish this.

Step B Reinforce the Edges of the Hole with Structural Adhesive

Remove the core material to a depth of ¼ inch around the entire perimeter of the hole. Try not to damage the carbon skins or the rear spar carry-through structure while doing this. Use a vacuum to remove any loose particles from the hole. Mix up a small batch of structural adhesive and add enough structural filler until it assumes the consistency of peanut butter. Use a tongue depressor to force this mixture into the area where the core material was removed. Allow the adhesive to cure then sand smooth.

TASK F-17 Install the Spar Box Bushings

Brief Task Description:

The spar box bushings are designed to transfer the high loads from the spar bolts to the surrounding composite fuselage structure. The holes for these bushings are pre-drilled at the factory slightly oversize to allow the builder to precisely align the wings relative to the fuselage. In this task you will bond these bushings inside the spar box with the wings properly jigged to the fuselage.

Step A Trial Fit the Spar Box Bushings in the Spar Box

Trial fit the bushings in the spar box. The flange on the aft spar box bushings may have to be trimmed to get it to clear the side of the fuselage. Use a grinding wheel or belt sander to trim this flange as necessary. The bushings should be slightly loose in the spar box holes to allow for adjustment of the wing panels relative to the fuselage. If you find that your bushings are a tight fit, grind out the holes slightly with a round file or similar tool until they are about 1/32 inch oversize.

Step B Jig the Wings Panels to the Fuselage

Place some clear tape over the spar bushings on the outside surface of the spars (the side that faces the spar box). Use a sharp knife to trim the tape away from the holes in the bushings so the spar bolts can pass through. Slide the wing panels into the fuselage. Support each wing panel near its center with a sawhorse and some foam padding. Roughly align the spars and install the spar bolts through the spar box bushings and the spars..

Step C Level the Wing Panels

Stretch a line through the hinges of one wing panel and pull it tight. Center this string in the bearing holes. Use a string level or water level to check this line. Adjust the wing panels by placing shims under one tip or the other to get the string level.

Step D Align the Wing Panels

Check the chord line marked earlier on the tip rib of one wing panel to make sure it is level (double check the fuselage to make sure it is level). If the wing is not level in pitch, adjust it until it is.

Measure from the trailing edge of the tip rib on each wing panel to the rear of the fuselage at water line 00. These two measurements should be equal. If they are not, adjust the wings until they are.

NOTE: If you find you cannot achieve the required alignments of the wing panels, call us at AkroTech before proceeding. Sweepback tolerance is plus or minus ¾" at each tip.

Go back and recheck each of the alignments. It is very easy to upset one alignment condition while adjusting the wings to match another alignment condition. Continue to adjust the wing panels until all alignments are correct.

NOTE:
Remember that you are aligning the wing panels relative to the fuselage as well as each other. Thus you should make certain the fuselage alignment has not been disturbed before proceeding to bond the spar box bushings in the spar box.

Step E Install the Spar Box Bushings with Structural Adhesive

Once you are certain the wing panels are properly aligned, remove the spar bolts and spar box bushings. Prepare the bushings and the holes in the spar box for bonding. Mix a small batch of structural adhesive and thicken it to "mayo" consistency with structural filler. Spread the adhesive mixture on both the bushings and the inside of the holes of the spar box. Twist the bushings as you insert them to prevent too much of the adhesive from being pushed out of the hole. Be careful not to get too much structural adhesive between the spar and the spar box or you may end up bonding the spars in permanently! Now wax the spar bolts and insert them through the spar box bushings and spars. Install appropriate castle nuts. Tighten the nuts hand tight and clean up all excess structural adhesive. Leave the setup undisturbed until the structural adhesive has completely cured.

TASK F-18 Install the Rear Spar Carry Through

Brief Task Description:

The rear spar carry through is a pre-molded bulkhead which bonds to the bottom of the fuselage and is attached to the rear spar of the wings via four aluminum plates. This structure helps to transfer loads from the wings to the fuselage and therefor must be carefully installed. In this task you will install the bulkhead and the rear spar plates that attach the rear spar to the fuselage.

NOTE: One of the drawings shows a separate flange that gets bonded to the carry-through bulkhead. Disregard this drawing, this flange has been installed at the factory.

Step A Make Spacers for the Rear Spar Plates

Locate some 1/16-1/8 inch material to use as spacers for the rear spar plates. Place one of the aluminum rear spar plates onto the material and run a marker around the part, drawing an outline on the material. Repeat the procedure, then cut out the two spacers with a jig saw and sand the edges smooth. Cut off the portion of the spacer that would protrude through the outside of the fuselage.

NOTE: Do not use material thicker than 1/8” or the carry-through bulkhead will be positioned too far aft in the fuselage for the wings to fit properly!

Step B Trial Fit the Rear Spar Carry Through inside the Fuselage

Place the rear spar carry through inside the fuselage and roughly align it with the holes cut into the fuselage sides earlier. Slide two of the aluminum rear spar plates into position over the front side of the rear spar carry-through. Secure these plates to the rear spar of each wing panel using the rear spar attach bolts. Leave the bolts loose enough to allow for rotational adjustment of the rear spar plates. Now insert the spacers made in Step A between the spar plates and the rear spar carry-through. Adjust the rear spar plates until they are properly centered on the face of the rear spar carry-through then clamp them to the rear spar carry-through using spring clamps. Check the rear spar

carry-through for proper fit against the fuselage bottom. Mark the outline of the rear spar carry-through flange on the fuselage bottom then remove the spar plates and the rear spar carry-through from the fuselage.

Step C Install the Rear Spar Carry-Through

Prepare the flange of the rear spar carry-through and the mating area of the fuselage bottom for bonding. Mix up some structural adhesive and thicken to “mayo” consistency with structural filler. Spread the adhesive mixture on both the carry-through flange and the fuselage bottom. Now carefully place the rear spar carry-through into position on the bottom of the fuselage. Mount the rear spar plates to the rear spar carry-through and the rear spar of both wing panels as you did in step B. Be certain to use the 1/8 inch spacer when clamping the plates to the forward face of the rear spar carry-through. Place some weight over the center of the rear spar carry-through to seat it fully against the bottom of the fuselage. Use a clean rag to remove any excess adhesive.

Check the entire assembly to be certain it is properly aligned. The surfaces of the rear spar plates should sit flat against the 1/8 inch spacer which itself should sit flat against the rear spar carry through and each rear spar plate should be bolted tight against the bushings installed in the rear spar of each wing panel. Double-check the alignment of the wings and fuselage to be sure that nothing has shifted.

NOTE: Once the rear spar carry-through is drilled for the rear spar plates it will be impossible to adjust the alignment of the wings. Make sure their alignment is correct before proceeding.

Step E Drill Holes through the Rear Spar Carry-Through

Use the holes in the rear spar plates (which are still clamped to the rear spar carry-through) as a drill guide to drill the ¼ inch mounting holes through the rear spar carry-through. Try to keep the drill perpendicular to the face of the spar plates while drilling the holes. Insert bolts into the holes immediately after they are drilled to prevent the spar plates from moving. Remove the rear spar plates from the fuselage when done.

TASK F-19 Install Bushings in the Rear Spar Carry-Through

Brief Task Description:

In this task you will install stainless steel bushings in the rear spar carry-through. These bushings will help better distribute the loads from the ¼ inch rear spar plate attach bolts. While installing these bushings, you will also use structural adhesive to fill the gap between the rear spar plates and the rear spar carry-through.

Step A Drill Out the Rear Spar Carry-Through for the 3/8 Inch Bushings

Drill out the 1/4 inch holes just drilled in the rear spar carry thorough to accommodate the 3/8 inch stainless steel bushings. Use a stepped drill bit (Uni-bit) to start the hole, then finish the holes with a 3/8 inch drill bit.

NOTE: The stepped drill bit will create a chamfer on the edge of the ¼ inch holes allowing the 3/8 inch bit to seat correctly. If you try to enlarge the holes without using the stepped drill bit first, the 3/8 inch bit will catch on the edges of the holes.

Step B Bed the Rear Spar Plates with Structural Adhesive

Prepare the surfaces of the rear spar carry-through that contact the rear spar plates for bonding. Use an automotive paste wax to wax the sides of all four of the rear spar plates to act as a mold release (you **do not** want the adhesive to stick to the rear spar plates) . Prepare the outside surface of all fourteen stainless steel bushings for bonding. Sand the exterior of the bushings then clean them with acetone. Wax the entire surface of the fourteen 1/4 inch bolts that attach the rear spar plates to the rear spar carry through. Prepare enough structural adhesive to fill the gaps between the rear spar plates and the rear spar carry-through. Add just enough structural filler to the adhesive so that it assumes the consistency of mayonnaise. Coat the outside of the bushings with the adhesive mixture and install them in the rear spar carry through. Now thicken the adhesive further with structural filler until it assumes the consistency of peanut butter. Use this thicker mixture to liberally coat the mating surfaces of the rear spar plates and

the rear spar carry through with the structural adhesive mixture. Each surface should get a 1/8 inch thick coating of the adhesive. Assemble the spar plates to the rear spar carry through with the ¼ inch waxed bolts. Insert and tighten the 7/16 inch rear spar attach bolts through the spar plates and the rear wing spars. Install castle nuts on the 1/4 inch bolts and tighten them to clamp the rear spar plates on the bushings. Remove any excess structural adhesive with a clean rag. The object here is to completely fill the gaps between the rear spar plates and the rear spar carry-through. Allow the adhesive to cure completely.

Step C Install the Proper Nuts on the Rear Spar Plate Attach Bolts

Remove the castle nuts used to apply clamping pressure to the rear spar plates. Clean the wax from each ¼ inch bolt then re-install the bolts with the appropriate washers and nyloc nuts supplied with your kit.

TASK F-20 Cut And Install The Firewall Shield

Brief Task Description:

The firewall shield is simply a thin sheet of aluminum placed over the front of the firewall. To install the firewall shield, cut the supplied aluminum to shape using sheet metal snips. Paint one side for corrosion protection, then bond the shield to the firewall using a high temperature silicone adhesive.

Step A Cut and Fit the Aluminum Firewall Shield

Find the .020 aluminum sheet supplied in your kit. Have a helper hold the aluminum sheet up to the firewall and use a felt tip pen to draw an outline of the firewall on the aluminum. Remove the sheet and use tin snips to cut the firewall along the outline. The firewall shield should now be a little oversize. Trim the firewall shield down until it fits onto the firewall with about 1/16 inch clearance all around. Mark and drill the holes for the engine mount bolts.

Step B Paint the Firewall and the Firewall Shield

Coat both the front face of the firewall and the aft face of the firewall shield with a good quality enamel or epoxy based paint. This paint will provide a corrosion barrier between the carbon firewall and the firewall shield.

NOTE: After the engine installation is complete, seal around the edge of the firewall shield with Hi-Temp silicone. You may bond the firewall shield in place using the silicone at any time, but be aware that drilling the holes for mounting various items on the firewall can result in a considerable build-up of chips and burrs between the firewall and the shield. However, removing all items from the firewall to de-burr the firewall shield may be quite time-consuming. Builder's choice!

TASK F-21 Install the Main Landing Gear

Brief Task Description:

The G-202 landing gear is formed from a single piece of high-strength aluminum. The landing gear is secured to the fuselage using a combination of "saddle blocks" and angle brackets. The saddle blocks straddle the gear on the exterior of the fuselage while the angle brackets secure the gear to a composite reinforcement (not yet installed) inside the fuselage. In this task you will fabricate the angle brackets, drill holes through both the aluminum angle brackets and the landing gear step, and assemble the gear to the gear step using the supplied hardware. Follow steps A-D to correctly locate and install the main landing gear. The fuselage will need to be upside down for this task.

NOTE: Early kits with short landing gear step reinforcements (without phenolic) use rectangular backing plates instead of the angle brackets. Refer to the section on installing the reinforcements for more information if you have the short reinforcements

Step A Fabricate the Aluminum Angle Brackets

Locate the aluminum angle material supplied with your kit. Cut two 8-inch long pieces, these will become the angle brackets. Fabricate two brackets per drawing 32-10-1-3-0101. It is helpful to use the saddle blocks as guides for spacing the 5/16 inch holes. Paint the angle brackets to help prevent corrosion.

Step B Align the Gear on the Landing Gear Step

Draw a centerline on the gear step. Place the landing gear on the landing gear step and align the gear so that the hole in the center of the gear is lined up with the centerline on the gear step.

NOTE: Some gear did not have a pre-drilled hole. Drill the hole if it isn't there already.

Place the landing gear saddle blocks over the gear and adjust the gear fore or aft until the saddle blocks are centered inside the gear step. Using the hole in the center of the gear as

a pilot, drill a 1/4 inch hole though the gear and into the landing gear step (be careful not to disturb the gear alignment). Place a 1/4 inch bolt in the hole but do not secure it permanently with a nut (a nut may be installed to temporarily hold the gear in position). Now measure from the tip of each gear leg to the center of the fuse at the rudder post. Adjust the gear by rotating it until the measurements are equal.

NOTE: The builder may need to file a radius on the corners of the saddle blocks that contact the corners of the gear saddle on the fuselage. In addition, the gear may be a tight fit in the saddle blocks. If the gear doesn't fit the blocks, file either the gear or the saddle blocks until they fit.

Step C Drill Holes though the Landing Gear Step

Locate the gear saddle blocks in their correct butt line position on the gear. Hold each block firmly in place while using a 5/16 inch drill to drill through the holes in the saddle blocks and into the landing gear step.

NOTE: For kits with serial numbers prior to 38, the centerline of the saddle blocks should be between 8 1/2 and 9 1/2 inches from the centerline of the fuselage. For kits with serial numbers 38 and up, the dimension should be between 7 1/2 and 8 1/2 inches. There are 3 inch wide phenolic pads built into the fuselage gear step, the spacing of these pads was changed at kit 38. The center of the pads was changed from 9 inches to 8 inches. The reason for the change was to make it easier to mount the saddle blocks on the flat part of the gear (so the saddle blocks are not mounted on the curved part of the gear where the bend starts). Be sure the saddle blocks are mounted on the flat area of the gear, and be sure the saddle blocks are supported by the phenolic blocks.

Step D Install the Bolts and Angle Brackets

Install the bolts and angle brackets inside the fuselage, then install the rubber pads, gear, and saddle blocks. Secure with MS21042-5 lock nuts.

NOTE: Before permanently mounting the gear, drill the holes for mounting the axles. For more information on this task, see the section on assembling the wheels and brakes.

TASK F-22 Assemble the Wheels and Brakes

Brief Task Description:

Your G-202 utilizes Cleveland wheel and brake components. This system has been used for many years on many different types of aircraft and has an excellent record of performance and reliability. To install the wheels and brakes, you must first drill axle mounting holes in the landing gear. Then the wheel pant mounting plates, axles, wheels and brakes are assembled to the gear legs. Follow steps A-E to assemble and install the wheels and brakes.

NOTE: If the axles are not positioned accurately on the gear legs, the airplane will not sit wings-level on the ground. Use care when positioning the axles on the gear legs for drilling. A suggestion would be to place the gear upside-down on a table, clamp the axles in place, then measure from each axle to the table to verify accuracy.

Step A Drill Holes in the Landing Gear for the Axles

Carefully align the axles on the tips of the gear legs and clamp them in place. Use the holes in the axles as a drill guide to drill the 1/4 inch mounting holes though the landing gear. A long drill bit works best for this operation. Remove the axles when done.

Step B Mount the Axles and Related Components to the Gear Legs

Fabricate the wheel pant mounting plates from 6” x 6” x .063 aluminum (reference the wheel pant mounting plate drawing). Find the brake caliper brackets and axle mounting hardware supplied with your kit. Assemble these components to the landing gear using the supplied mounting bolts. Note that the brake caliper plates can be mounted in a variety of positions. Be certain that you have this plate oriented correctly (we mount the calipers aft of the gear legs). You may need to grind away a portion of the bottom of the gear leg for clearance.

Step C Assemble the Tires and Tubes to the Wheel Hubs

Find the supplied tubes and tires. Fill the tubes with just enough air to hold their shape. Sprinkle some talcum powder over the tubes and insert them into the tires. Insert the valve stem of the tube into the valve stem hole in the wheel hub. Assemble the other half of the wheel hub to the tube/tire/hub assembly being careful not to pinch the tube in the process. Hold the brake rotor against the hub assembly (on the side opposite of the valve stem) and install the three bolts through both the brake rotor and the hub assembly. Install the three washers and nyloc nuts on the bolts.

Step D Mount the Wheels on the Axles

Mount the completed wheel assemblies on the axles using the appropriate spacers on either side. Install the retaining nuts and cotter pins on the axles.

Step E Assemble the Brake Calipers to the Brake Caliper Brackets

Find the brake calipers included with your kit. Note that the caliper arms separate so that you can install it over the brake rotor with out removing the wheel. Separate the caliper arms by removing the two bolts which hold them together. Slide the pins on the brake calipers into the holes in the brake caliper brackets. Replace the caliper arm on the caliper assembly.

Step F Turn The Fuselage Upright Once Again

Recruit a helper to turn the fuselage over so it is right side up. Rest the tail of the fuselage on the rudder post cradle and the front of the fuse on the gear itself.

TASK F-23 Install the Landing Gear Step Reinforcements

Brief Task Description:

The landing gear imposes large loads where it attaches to the fuselage. The landing gear step reinforcements are designed to help distribute these loads to the surrounding fuselage structure. In this task you will install these reinforcements between the firewall and the spar box using structural adhesive.

NOTE: If your kit has the shorter landing gear reinforcements (approximately 4 inches tall) you will need to add a 20-ply wet lay-up reinforcement to the reinforcements. See version 1.6 of the manual or call us for details.

Step A Trial Fit the Gear Step Reinforcements

Find the two landing gear step reinforcement bulkheads included with your kit. Trial fit these pieces over the landing gear step between the spar box and the firewall. Be sure to orient the reinforcements so their flanges extend inboard. Slide each reinforcement up against the inboard face of the aluminum angle brackets, then trace the outline of the flange on the firewall, fuselage bottom, and the spar box with a felt tip pen.

Step B Install the Reinforcements

Thoroughly sand the aft face of the firewall, bottom fuselage and spar box where the reinforcements will be located. Clean these areas with acetone. Prepare the flange on the reinforcement in a similar fashion. After the surfaces are properly prepared, bond the reinforcements in place with structural adhesive. Clamp the reinforcements up against the inboard surfaces of the angle brackets. Allow to cure.

Step C Drill Holes through the Reinforcements

Use the 1/4 inch holes drilled earlier into the aluminum angle brackets as a drill guide to drill four mounting holes through each reinforcement. Install the bolts, washers, and nuts that secure the angle brackets to the reinforcements.

TASK F-24 Install the Front Seat Rails and Seat Belt Reinforcements

Brief Task Description:

The front seat of the G-202 is supported by two pre-molded composite “rails”. In this task you will install these rails between the spar box and the rear spar carry-through. In addition to the seat rails, you will install pre-molded reinforcements on the inside of each seat rail. These reinforcements are designed to help strengthen the seat belt attach points.

Step A Trial Fit the Front Seat Support Rails

Find the front seat support rails supplied with your kit. Trial fit these rails between the spar box and the rear spar carry-through. Use the pre-molded instrument panel boxes supplied with the kit to properly space the seat rails. Make certain the rails are properly centered on both the spar box and the rear spar carry-through, then check that each rail is perfectly plumb using a level. Once you have the seat rails properly located and aligned, mark the outline of the seat rail on the spar box, the bottom of the fuse, and the rear spar carry-through using a felt tip marker.

Step B Install the Seat Rails and Seat Belt Reinforcements

After properly preparing all surfaces, bond the seat rails in place with structural adhesive thickened to mayo consistency with structural filler. Check for proper alignment and allow to cure.

After the seat rail bonds have cured, bond the seatbelt reinforcements in place between the seat rails.

NOTE: Pre-molded reinforcements were not included in early kits. Add a 10-ply wet lay-up at least 5 inches by 5 inches to the seat rails. This lay-up should also extend onto the floor of the fuselage at least 2 inches.

TASK F-25 Install the Shoulder Harness Brackets

Brief Task Description:

The shoulder harness brackets for the G-202 come in top and bottom halves which are bonded together and to the inside surface of the top fuselage in one operation. Follow steps A-C to install the shoulder harness brackets.

Step A Cut Out the Pre-molded Shoulder Harness Brackets

Find the pre-molded shoulder harness brackets included with your kit. Each bracket consists of top and bottom pieces which are molded separately. The top left and right brackets are molded as a single piece and the bottom left and right brackets are molded as a single piece. Trim these pieces along the pre-molded scribe line using a jigsaw or a bandsaw. Use a sanding block or a belt sander to smooth the edges of the brackets after cutting.

Step B Install the Shoulder Harness Brackets

Clamp the top and bottom pieces of each bracket together using spring clamps. Position each bracket at its proper location on the inside surface of the top fuselage. Drill four cleco holes through the base of each bracket and into the inside layer of the top fuselage skin. Disassemble the brackets and prepare all surfaces for bonding, then prepare a mixture of structural adhesive and thicken it to “mayo” consistency with structural filler. Apply the adhesive to the mating surfaces of the top and bottom pieces of the shoulder harness brackets. Clamp the top and bottom pieces together with spring clamps and remove the excess adhesive from the edges with a clean rag. Now coat both the surface of the fuselage and the flanges on the brackets with the remaining adhesive mixture. Install the brackets with clecos and remove the excess adhesive. Allow the adhesive to cure completely.

Step C Drill Holes in the Brackets

Find the center of each pre-installed phenolic block in the shoulder harness brackets. Use an automatic center punch to mark the center of these blocks. Drill a small (1/8 inch) pilot hole through the phenolic blocks. Enlarge these holes with a 1/4 inch drill bit.

TASK F-26 Install the Tailwheel and Tailwheel Lock System

Brief Task Description:

The G-202 uses a simple castering tailwheel. To stabilize the tailwheel for take-off and landing as well as straight line taxiing, the tailwheel incorporates a locking feature which is actuated by the pilot via a cable. Follow steps A-E to install the tailwheel and tailwheel lock system.

NOTE: If you are installing the optional steerable tailwheel, none of the parts for actuating the locking mechanism need to be installed.

Step A Mount the Tailwheel to the Tailwheel Spring

Locate the tailwheel assembly and the tailwheel spring supplied with your kit. Slide the tailwheel spring into the tailwheel assembly and secure with the supplied hardware. Use a 1/4 inch bolt to mount the tailwheel to the spring. You may need to enlarge the hole in the tailwheeel and/or the spring. We recommend using loctite on the tailwheel assembly to keep the tailwheel assembly from becoming loose on the tailwheel sping.

Step B Mount the Tailwheel Spring in the Tailwheel Bracket

Insert the supplied tail wheel assembly into the tailwheel mounting bracket located at the rear of the fuselage. Grind a small flat spot on the bottom of the fuselage for the head of a bolt, then install the supplied 5/16 inch bolt into the fuselage and tailwheel mounting bracket and through the tailwheel spring. You may need to drill out the 5/16 inch hole. Secure the bolt in place with the supplied nut (add washers as necessary).

Step C Install the Sliding Pin Housing on the Inside of the Fuselage

Find the supplied tailwheel lock components and determine where you want to locate the tialwheel lock release. Prepare slider tube for bonding by sanding with 80 grit sandpaper and cleaning with acetone. Also prepare the inside of the fuselage for bonding at the location of the tailwheel lock knob. Use hot glue to tack the housing in position. Cut

three strips of fiberglass on the bias (fibers running 45 degrees to the edges). Make these strips large enough to cover the housing and extend at least one inch onto the fuse on either side of the housing. Mix some laminating resin and laminate the fiberglass strips over the housing.

Step D Install the Tailwheel Lock Cable Housing

Drill a small hole near the left side of the tailwheel spring where it enters the fuselage. Elongate this hole a little so the cable can enter at an angle. Drill another hole near the bottom of the lower banjo bulkhead for the cable. Drill a third hole through the rear seat bulkhead at the same height as the lock handle. Feed the cable housing through these holes. Sand the housing where it passes through the bulkheads and at three locations along the length of the cable. Adjust the cable housing until it extends through the seat back bulkhead by at least one inch. Mix some Hysol or laminating resin and add filler until it assumes the consistency of peanut butter. Use this mixture to bond the cable housing into each bulkhead and to the fuse at three locations along the tail. Use the supplied clamp to clamp the cable housing to the tailwheel spring near the tailwheel.

Step E Install the Tailwheel Lock Cable and Knob

Insert one end of the cable into a wire grip. Do not over-tighten the wire grip! Pass the other end of the cable through the housing and into the cockpit area. Install the other wire grip onto the lock slider. Insert the lock slider into the slider tube and install the knob with the supplied screw. Cut the cable to the proper length, insert into the wire grip, and tighten the grip. Test the operation of the mechanism and adjust as necessary.

TASK F-27 Install the Swing Tube

Brief Task Description:

The swing tube acts as the backbone for the entire control system and therefore must be installed first. Follow steps A-G to install the swing tube.

Step A Install the Bearings in the Swing Tube

Find a socket of the correct diameter to fit over the outer race of the supplied swing tube bearings. Locate a ¼ inch bolt about 2 ¼ inches long (length depends on socket) and slip a large washer over the bolt. Slide this bolt through the socket, the bearing, and the machined block on the swing tube. Now place two large washers and a nut over the end of the bolt where it protrudes from the machined block on the swing tube. Carefully align the socket on the bearing and the bearing in the hole. Tighten the nut on the bolt to press the bearing into the machined hole. The bearing should press into the hole fairly easily. Repeat this procedure to install the other swing tube bearing.

NOTE: Remember that you are never to apply pressure to the inner race of the bearings when you are installing them in their housings.

Step B Cut Out the Spar Box for the Swing Tube Mount

Locate the swing tube mount supplied with your kit. Find the proper position for the support pin on the aft face of the spar box. Cut a hole through the outside layer (and partially through the core) of the spar box just large enough to allow the support pin flange to sit flat against the spar box.

Step C Drill a Hole through the Rear Spar Carry Through

Find the proper location for the rear swing tube support bolt on the rear spar carry through. Drill a 1/4 inch hole through the top of the rear spar carry-through structure at this location.

Step D Trial Fit the Swing Tube in the Fuselage

Insert the swing tube through the hole in the rear spar carry-through. Make a spacer from a piece of scrap foam or wood to support the front of the swing tube at the correct installed height. Mount the swing tube to the rear spar using the ¼ inch mounting bolt and use the spacer to support the front of the swing tube. Check once again to make sure the swing tube is correctly positioned then disassemble the swing tube from the rear spar carry-through.

Step E Bond the Support Pin to the Spar Box

Prepare the rear face of the support pin flange and the mating area of the spar box for bonding. Mix a small batch of structural adhesive and thicken it to "mayo" consistency. Apply the adhesive to the support pin flange and the spar box. Place the swing tube back into position and slide the support pin into the forward swing tube bearing (be careful not to get any adhesive into the bearing!). Push the swing tube and support pin up against the spar box. Rest the front of the swing tube on the spacer while you insert a bolt through the rear spar carry-through and the aft bearing in the swing tube. Place a nut on the bolt and tighten to apply a little clamping pressure to the support pin flange. Remove any excess adhesive with a clean rag. Allow the adhesive to cure with the swing tube installed to ensure the proper alignment of the.

Step F Lay Up Fiberglass onto the Mount Flange and Spar Box

Prepare the front side of the support pin flange and the surrounding area on the spar box for bonding. Place some tape over the pin itself to protect it. Cut out six squares of fiberglass that measure six inches on a side. Cut the fiberglass so that the fibers run at 45 degrees to the edges of the squares. Mix up some laminating resin and laminate the fiberglass squares on some plastic sheet on your work table. Place another layer of plastic over the lay-up. Now fold the pad in half and cut a small notch in the center of the fold to allow the lay-up to slip over the pin on the spar box. Paint some laminating resin over the support pin flange and the surrounding area. Unfold the lay-up and remove one layer of plastic from it. Slip the lay-up over the pin on the spar box and press it into place. Remove the remaining layer of plastic from the laminate. Carefully inspect for trapped air and allow the lay-up to cure.

Step G Permanently Install the Swing Tube

Place one thick washer (1/16 inch) over the swing tube mount pin. Install the swing tube over the mount pin and insert the appropriate bolt through both the rear spar and the aft swing tube bearing. Check the spacing between the rear spar carry-through and the aft bearing in the swing tube. Remove the aft support bolt and install thin or thick washers as necessary to eliminate any “play” in the swing tube. Install a large area washer and a castle nut over each bearing to secure the swing tube. Be certain to secure each castle nut with the appropriate cotter pin.

TASK F-28 Assemble the Elevator Control Tubes

Brief Task Description:

The pitch control system in the G-202 employs three control tubes. The forward control tube connects the front control stick to the rear control stick. The middle control tube connects the rear control stick to the elevator idler arm. The rear control stick connects the idler arm to the elevator actuator. In this task you will construct these control tubes by first cutting the supplied tubing to the correct lengths, then installing the proper fittings in the ends of the tubes.

Step A Cut the Elevator Tubes to Length

Find the ¾ inch and 1.5 inch tubing supplied with your kit. These will be used to make the elevator control tubes. Refer to the illustration to find the proper length for each tube. Cut each tube to the proper dimension using a tube cutting tool.

Step B Install the Tube End Fittings in the Elevator Tubes

Find the four ¾ inch and two 1.5 inch tube end fittings supplied with your kit. Use masking tape to secure the fittings in the ends of the control tubes. Find the proper location for the rivet holes and center punch them using an automatic center punch. Drill rivet holes through both the tubing and end fittings with a drill press. Install the smaller tube end fittings with solid aluminum rivets and the larger tube end fittings with blind rivets.

Step C Install the Rod End Bearings in the Tube End Fittings

Screw jam nuts onto each rod end bearing and install these bearings in each control tube. Each bearing should be screwed into each tube end fitting so that about 75 % of the threads are buried inside the fitting.

TASK F-29 Install the Idler Arm, Control Tubes, and Control Sticks

Brief Task Description:

In this task the elevator idler arm will be mounted to the rear seat rails. In addition, the control tubes will be installed in their appropriate locations and the control sticks will be installed in the swing tube. Follow steps A-F to complete the installation of the pitch control system

Step A Assemble the Bearings to the Elevator Idler Arm Plates

Insert the bellcrank bearings into the elevator idler arms. Use six rivets to secure each of the two idler arms to the bellcrank bearings. Note that the bearing does not go on the same side of each arm. Be sure you have the bearing on the proper side of the arms before driving any rivets.

Step B Install the Elevator Idler Arms

Find the proper location for the idler arm mounting bolt in the rear seat rails and drill the holes for the bellcrank pivot bolt. Mount the bellcranks with the appropriate hardware. Be sure to orient the bellcranks correctly.

Step C Install the Control Sticks

Install the two bearings in each control stick. Insert the front control stick into the slot at the front of the swing tube and secure it with the proper hardware. Slide the control tube that connects the front and rear stick into the swing tube and secure it to the bottom hole in the front stick with the proper hardware. Install the aft control stick and secure it to the swing tube with the proper hardware. Now secure the forward control tube to the bottom of the rear stick with the proper hardware.

NOTE: To attach the forward control tube to the control sticks you will need to install the mounting hardware through small slots cut into the sides of the swing tube. This may seem impossible at first but with a little perseverance it can be done.

Step G Install the Remaining Elevator Control Tubes

Install the middle elevator control tube to the bottom of the aft stick and idler arm. Assemble the aft elevator control tube to the idler arm and the elevator actuator. Secure the bolts for both control tubes with proper hardware. Elevator travel should be plus and minus 30 degrees.

Step F Double Check the Entire Elevator Control System

Double check each control tube to make sure it has been installed correctly. Check each bolt to make sure that it is the proper length. Inspect each nut to be certain it has been properly secured with a cotter pin (if required). Also, check to make sure that the rod end bearings in the forward control tube do not bind with extreme left or right movement of the control stick. You can check this by holding the control stick all the way to one side while trying to rotate the middle elevator control tube with your hand. You should be able to rotate the tube back and forth a small amount. If you cannot, check the rod end bearings to be certain they are properly aligned.

NOTE: Wait to install the foam stick grips until the airplane is ready to fly. To install the grips, first lubricate the stick with liquid soap such as Dawn. This makes the grip much easier to install.

If the stick end caps are used, drill a small hole in each one to act as a vent. If no vent hole is drilled, the cap may pop off suddenly when climbing to higher altitudes. This was discovered by one of our pilots the first time he took the plane past about 9000 feet.

TASK F-30 Assemble and Install the Rudder Pedal System

Brief Task Description:

One of the unique features of the G-202 is the linear rudder pedal system. Unlike other rudder pedal systems which pivot around a fixed point, the G-202 rudder pedals slide fore and aft on special bearings. Follow steps A-F to assemble and install the rudder pedal system.

NOTE: The rudder pedal components should be installed on the fiberglass brackets before bonding the brackets to the inside of the fuselage. This allows accurate positioning of the nutplates on the inside of the brackets. The vertical spacing of the blocks that hold the pedal tubes and anti-roll tubes is critical. If the spacing is off, the system will not operate smoothly. Use the assembled components to set the spacing of the nutplates.

Step A Install the Linear Bearings in the Bearing Housings

Find the four 3/4 inch bore and two 1/2 inch bore linear bearings supplied with your kit. Slide the two smaller bearings into the aluminum anti-roll fittings and secure them with the supplied snap rings. Secure the four larger bearings in the aluminum bearing blocks with snap rings.

Step B Mount the Main Tube Bearings to the Pedal System Supports

Find the main tube bearings supplied with your kit and assemble them to the pre-molded supports using the appropriate machine screws.

Step D Install The Main Support Tubes and Anti-Roll Fittings

Install the cable attach tang to the anti-roll fitting with the supplied bolts, washers and nyloc nuts. Orient the bolts so that their heads will face the side of the fuselage (threads point inboard). Do not tighten the nuts down yet. Slide each of the 3/4 inch main support tubes into the aft main tube bearing, through the anti-roll fitting, and finally through the

forward main tube bearing. Properly position each main tube inside the anti-roll fittings (the holes in the main tube should be oriented vertically). Tighten the nyloc nuts down lightly so that the tube will not slide inside of the anti-roll fitting. Slide the main tube for and aft and check for binding. The tube should slide with almost no friction.

Step C Install the Anti-Roll Tubes on the Pedal System Supports

Slide the1/2 inch anti-roll tubes into the bearings in the anti-roll fittings. Place two of the anti-roll tube brackets on either end of the tubes and install each assembly on one of the pedal supports. Adjust the position of the brackets until the system operates smoothly.

Step E Prepare and Install the Pre-molded Rudder Pedal Supports

Prepare the rudder pedal supports and the inside of the fuselage for bonding. Clean all bond surfaces with acetone. Place the pre-molded supports at the proper location on the inside of the fuselage and drill about seven cleco holes through the flange of each support and into the side of the fuselage. These holes do not need to go all the way through the fuselage, just into the inside layer. Prepare a mixture of structural adhesive and mix in enough structural filler to achieve “mayo” consistency. Coat all bond areas with the mixture and assemble the supports to the inside of the fuselage with clecos. Clean up all excess adhesive with a clean rag.

Step F Assemble and Install the Front and Rear Pedal Assemblies

Assemble the pedals and the supplied brake cylinders to the rear pedal assemblies. Slide the front and rear pedal assemblies into the main tube and secure them with the supplied quick release pins. Now slightly loosen the clamp bolts on the anti-roll fittings and adjust the pedal assemblies rotationally until you are satisfied with the angle of the pedals (a slight outward cant is often desirable).

Step F Prepare and Install the Rudder Pedal Supports

Pre-bent aluminum supports are provided for heel support for the rear rudder pedals. Fiberglass flanges will need to be installed in the fuselage for the supports to rest on. One method for constructing the flanges is to temporarily bond a strip of foam around the bottom outside edge of the supports. Trial-fit the supports into the fuselage, and cut and

sand the foam until the supports fit properly. After the foam has been sanded to final shape, clear-tape the foam and top edge of the support. Using this as a mold, make a 6-ply wet lay-up along each edge of the clear-taped support. When cured, remove the lay-up from the support. Trim the edges, and you have flanges ready to bond into the fuselage. Remove the clear tape and foam from the supports, and temporarily attach the flanges to the supports with several clecos. Test- fit the supports into the fuselage. Adjust and trim the flanges as necessary to achieve a good fit. When satisfied, drill the supports and flanges for screws and nutplates. Remove the flanges from the supports and install the nutplates on the flanges. This is much easier to do before bonding the flanges into the fuselage. After the nutplates are installed, attach the supports to the flanges and bond the flanges in place in the fuselage (use HYSOL). Take care not to bond the supports to the flanges!

NOTE: This is just one method of making and installing the flanges. Use whatever method works the best.

NOTE: Be sure to mount the supports high enough to clear the aileron pushrods!

TASK F-31 Install the Rudder Cable Fairleads

Brief Task Description:

The rudder cable fairleads act as low-friction guides for the cable between the rudder pedals and the rudder. They also serve to isolate the cable from the pilot in the cockpit area. These fairleads are made from nylon tubing which is first tacked to the sides of the fuselage with hot glue and then fiberglassed into place. The fairleads should ideally trace out a straight line between the attach point on the rudder pedals and the attach point on the rudder horn. Follow steps A-D to install the rudder cable fairleads.

Step A Install the Aft Cable Fairleads

Drill 1/4 inch holes on either side of the fuselage for the rudder cable just forward of the rudder post. These holes should be located 4 inches aft of the lower banjo bulkhead and at exactly the same waterline as the arm on the rudder horn (which is 1/4 inch below waterline 00). Elongate these holes fore and aft using a Dremel tool with a small grinding bit. Now drill another two 1/4 inch holes through the lower banjo bulkhead at exactly the same waterline. Locate these holes as close to the inside skin of the fuselage as possible. Find the 1/4 inch nylon tubing supplied with your kit. Cut off two pieces about 12 inches long. Thoroughly sand the tubing with 80 grit sandpaper. Install these tubes through the elongated holes in the side of the fuse and into the holes in the lower banjo bulkhead. Tack the tubing in place with hot glue.

Step B Install Fairleads in the Cockpit Area

Cut another two pieces of tubing about 48 inches long to shield the cable where it passes through the cockpit area. Thoroughly sand the tubing with 80 grit sandpaper. Use a 1/4 inch drill bit to drill holes through the seat back bulkhead exactly 1.625 inches below waterline 00 (remember that waterline 00 is even with the top edge of the bottom fuselage). Locate these holes as close as possible to the sides of the fuselage. Use a chalk line to snap lines from the holes in the seat bulkhead to the aft hole on the rudder cable attach tang on each side of the fuselage. Secure the tubing with hot glue along this chalk line every 2 inches so that it extends aft of the seat bulkhead about 10 inches.

Step C Install Fairleads in the Tail

Cut off six 2-inch pieces of tubing. Sand these pieces thoroughly with 80 grit sandpaper. Now install the rudder cables through the aft fairleads. Thread three of the short fairleads onto each cable then thread the remaining cable through the forward fairleads.. Each cable should now have three of the 2-inch fairleads floating free between the front and rear fairleads. Pull the cable tight then use hot glue to tack each of the short fairleads to the inside of the fuse. These tubes should end up being close to the top edge of the lower fuse (waterline 00). Space these tubes equally so they will give adequate support to the cable.

Step D Lay-Up Fiberglass over the Fairleads

Prepare some fiberglass strips about 2 inches wide and long enough to span each fairlead (except the aft-most fairleads which exit the fuselage). Cut these strips so that their fibers run at 45 degrees to their edges

Prepare one 10 oz portion of laminating resin and hardener. After thoroughly mixing the resin and hardener, pour about half of the mixture into a separate cup. Thicken one cup of resin with microballoons to create a mixture with the consistency of peanut butter. Use this mixture to create a generous fillet between the fairleads and the side of the fuselage. Also, use the micro mixture to fair in the aft tube where it exits the fuselage and to secure it where it passes through the lower banjo bulkhead. Now use the unthickened laminating resin to laminate the fiberglass strips over the fairleads and onto the sides of the fuselage. Allow the lay-up to cure completely.

TASK F-32 Install the Rudder Cables

Brief Task Description:

This task covers the installation procedure for the rudder cables. To accomplish this you must first secure both the pedals and the rudder in their neutral position. Then you will slide the cables into the previously mounted fairleads and secure them to the rudder pedals using the supplied fittings. Note that once these cables are installed they cannot be removed without cutting them.

Step A Secure the Rudder and Rudder Pedals in Their Neutral Position

Adjust the rudder pedals so that they are in their neutral position. The pedals are in their neutral position when the forward surface of the forward rudder pedals (when adjusted to their most forward position) are exactly 2.75 inches from the firewall. Cut two blocks of wood 2.75 inches wide and place these between the forward pedals and the firewall. Secure the pedal assemblies in position so they cannot move. Secure the rudder in its neutral position by placing some tape over the tip of the rudder's counterbalance arm and onto the top of the fin.

Step B Insert the Cables and Secure Them to the Rudder Horn

Slide the rudder cables through the fuselage-mounted fairleads. Secure the fork end of the cables to the rudder horn using the supplied bolts. You do not need to secure these bolts with nuts yet as you may wish to remove the rudder later for painting.

Step C Install the Turnbuckles on the Cable Attach Tang

Find the two cable turnbuckles supplied with your kit. Adjust the end fittings on the turnbuckles so that about 75% of the threads on the fittings are buried inside the barrel (this will set the turnbuckle in its neutral adjustment position). Mount the fork end of the turnbuckles to the cable attach tang on the pedal system using the appropriate hardware

Step D Mount the Cable to the Turnbuckles

Locate the nicopress fittings and cable thimbles supplied with your kit. Slide the nicopress fittings over the end of the cables. Now install the cable thimbles into the eye end of the tunbuckles (you may have to open up the thimbles to get them to fit). Feed the cable through the eye on the turnbuckle and around the thimble. Slide the free end of the cable back into the other hole in the nicopress fitting, then slide the fitting up against the cable thimble. Hold the nicopress fittings in position with one hand while pulling on the free end of the cable to remove most of the slack. Wrap some tape around the cable to hold it temporarily in position.

Step E Swage The Cables

Use a cable swaging tool to compress the nicopress fittings just enough to apply some friction to the cable. Do not compress them all the way yet! Now remove the slack in the cables by grabbing the free end with vice grips and then tapping the vice-grips with a hammer. The partially compressed nicopress fittings should keep the cable from slipping back through the nicopress fitting. With the cables tight and the pedals still against the spacers, finish compressing (swaging) the nicopress fittings. When finished, cut off the excess cable using a cut-off wheel on your Dremel tool. Cut the cable about an inch from the fitting. A nice way to finish off the end of the cable is to install a section of heat-shrink tubing. This keeps the end from fraying and protects the builder from the sharp end of the cable.

TASK F-33 Install The NACA Ducts

Brief Task Description:

In this task you install the pre-molded ducts on the fuselage side and canopy frame. Also, you will drill drain holes in the bottom of the fuselage to allow any water that may find its way into the cockpit to drain from the aircraft. A variety of vents are available, it is up to the builder to supply the vents themselves (Aircraft Spruce has some nice aluminum units).

NOTE: The position of these ducts has been carefully selected so as not to interfere with certain internal structural lay-ups in the fuselage. If you choose to move them to a different location, please contact us at AkroTech first.

Step A Make Cutouts for the NACA Vents

Remove the two NACA duct templates from this manual. Use spray adhesive to bond one template to the side of the fuselage and the other to the canopy frame at the appropriate locations. Use a 1/4 inch drill bit to drill holes in the corners of the duct outline on the template. Use a hand held jigsaw to cut out each duct, connecting the holes drilled earlier. Finish the edges and corners of the duct cut-outs using a file. Remove the template when done and use acetone to clean up any excess adhesive.

Step B Trim the Flange on the Pre-Molded Ducts and Make Vent Cut-Outs

Trim the flange on each of the pre-molded ducts back to ¼ inch. Cut an opening in each pre-molded duct for the eyeball vents. Temporarily mount the eyeball vents you have chosen to use. Remove the vents themselves after mounting.

Step C Remove the Inside Skin and Core Material Surrounding the Cut-Outs

Hold one of the pre-molded ducts (with the flange trimmed to ¼ inch) over the cut-out on the inside of the fuselage. Position the duct so that it is positioned correctly over the cut-

out. Trace the outline of the duct flange on the inside fuselage skin. Now use the cut-off wheel on your Dremel tool to cut through the **inside** skin just outside the traced line. After finishing this cut, peel away the skin inside the cut-line by pulling on the skin with pliers. Be careful not to damage the skin outside of the cut-out area. Remove the exposed core material. When finished, the pre-molded duct should fit flush against the inside surface of the outside fuselage skin. Repeat this procedure for the canopy- mounted duct.

Step D Install the Ducts in the Fuselage and Canopy Frame

Prepare the flange on the ducts and the mating areas in the duct cut-outs for bonding. Properly locate each of the ducts in their cut outs and drill six equally spaced cleco holes through each duct flange and the carbon skin. Prepare some structural adhesive and thicken to “mayo” consistency with structural filler. Apply the adhesive mixture to the flange on the ducts and press them into position. Install clecos into the cleco holes to clamp the ducts tight against the interior surface of the exterior fuselage and canopy skin. Install the clecos from the outside to avoid interference with the body of the fiberglass duct. Remove any excess adhesive with a clean rag then allow to cure.

TASK F-34 Mount the Left Fin Skin

Brief Task Description:

In this task you will mount the left fin skin. Even though you will not be bonding the top fuselage in this operation, you will need to mount it so you can properly align the forward edge of the fin skin. This procedure is very similar to that used previously to mount the right fin skin.

Step A Cut-Out the Opening for the Stabilizer in the Fin Skin

Use a jigsaw or bandsaw to cut out the opening in the left fin skin for the horizontal stabilizer. The initial cut should be 2 inches in from the edge of the joggle, or indentation, following the shape of the horizontal stabilizer cross section. Fit the fin skin around the stabilizer and check for proper fit. Carefully trim the cutout as needed to properly align the fin skin.

Step B Trial Fit the Left Fin Skin

Temporarily mount the top fuselage with clecos. Fit the left fin skin over the stab and check once again for proper fit. Once the fin skin is properly aligned, clamp the skin to the rudder post in several places using spring clamps. Use masking tape to hold the leading edge of the left fin skin in proper alignment with the right fin skin. With the fin skin properly aligned, drill holes for clecos about every four inches through the fin and into the flanges of the top fuse, bottom fuse, fin tip rib and rudder post. Remove the top fuselage and apply some clear tape to the top surface of the joggle that mates with the fin skin.

Step C Install the Left Fin Skin

Prepare the bond areas on the fin skin for bonding. Also prepare all mating surfaces on the rudder post, the bottom fuse, and the upper banjo bulkhead. Mix a batch of structural adhesive and thicken with structural filler to achieve “mayonnaise” consistency. Apply the adhesive to all bond areas on the bottom fuse and fin skin. Do not apply adhesive to the joggle that mates with the top fuselage as this will be bonded later. Carefully slide the fin skin over the stab and onto the fuse. Install clecos in the cleco holes. Wrap tape

around the leading edge to hold the skin against the upper banjo. Mount the top fuselage once more and insert clecos through the fin skin and into the top fuselage flange. Clean up any excess adhesive using a clean rag and allow the adhesive to cure completely.

Step D Fiberglass the Fin Leading Edge

Prepare the leading edge joggle on the fin skin for the fiberglass reinforcement by sanding thoroughly with 80 grit sandpaper and cleaning with acetone. Cut three strips of fiberglass cloth on the bias about three inches wide and long enough to span the length of the joggle. Prepare a mixture of laminating resin and lay-up the three plies of glass cloth onto some plastic sheet on your work table. Place another layer of plastic on top of this and trace out the final width of the strip on the plastic sheet using a ruler and pen. Cut out the strip using scissors. Remove one side of the plastic from the strip. Remove the remaining plastic sheet as you lay the fiberglass into the leading edge joggle. Remove any air bubbles and allow to cure.

Step E Fiberglass the Fin Skin and Horizontal Stabilizer Joint

Prepare the surfaces for the fiberglass reinforcement by sanding thoroughly with 80 grit sandpaper and cleaning with acetone. Cut 4 strips of 7725 fiberglass cloth on the bias about 4 inches wide and long enough to cover the joint of the fin and horizontal stabilizer from the trailing edge of the stabilizer around the leading edge top and bottom. If you must splice the tapes be sure to overlap at least 1". Pack the gap between the fin skin cutout and the horizontal stabilizer with micro and create a small fillet of no more than ½" radius. (You may want to crate a larger radius fillet for appearance after the structural joint of this step has been created.) Follow the directions in Step D of this section as regards the preparation and lay-up of the fiberglass tapes onto the fillet/joint. Make sure the fiberglass tape reinforcement overlaps the fin skin and the horizontal stabilizer skin at least 1".

NOTE: Some early kits did not have the core removed and the fin skin sandwich plies tied together. If any core material is exposed or if the core is within 1" of the cutout in the fin skins then you must either fiberglass both sides of the fin skin with 2 plies inside and 2 plies out, or wrap the cutout with 2 plies overlapping the cutout at least 1" before proceeding with the 4 ply lay-up above.

TASK F-35 Install the Canopy Hinge Reinforcements

Step A Remove the Cockpit Rail at the Hinge Locations

Set the top fuselage on your work table upside down. Use a Dremel or similar tool to remove the inside of the cockpit rail at the location of the hinges. Be careful not to damage the outer skin while cutting. Sand the cut edges of the rail down to the outside skin. Chamfer the fore and aft edges of the rail at about 45 degrees. Prepare the entire surface surrounding the cut-out for bonding.

Step B Mount Temporary Lay-Up Surfaces and Lay-Up the Reinforcements

Make up temporary surfaces on which to lay up the fiberglass hinge support flanges by clear-taping two flat pieces of wood or metal that are a little wider than the cockpit rail and little longer than the hinge cut-out. Clear-tape two more flat piece of wood or metal that are the same width, length and thickness as the hinges (total thickness when folded over). These spacers will create recesses in the upcoming lay-ups that will accept the hinge. Center the spacers on the blocks. Mount the blocks on the cockpit rail using hot glue so that the hinge spacers are centered in the cockpit rail cut-outs.

Prepare twelve fiberglass strips about ten inches long by four inches wide. Mix up some laminating resin and lay-up six fiberglass strips out on the inside of the top fuselage at each hinge location. The strips should extend onto both the fuselage and the temporary lay-up surfaces. Remove all excess resin from the lay-up and remove any trapped air. Allow to cure undisturbed.

Step C Drill Out the Support Flanges for the Hinges

Mark the interior side of each hinge for the mounting screws and use a center punch to mark each hole. Place the hinges into position on the support flanges. Place a straight edge along the exterior side of the hinges and adjust them until the hinge pins line up. Move the hinges outboard until hinge line falls outside of the edge of the fuselage (otherwise the canopy will bind). Drill mounting holes through the hinges and the support flanges. Countersink these holes with a 100 degree countersink and mount the hinges to the support flanges with the supplied hardware.

TASK F-36 Mount the Top Fuselage

Step A Level the Horizontal Stabilizer

Place a level on the spar box to make sure the fuselage is level. If the fuselage is not level, adjust it by placing shims under the legs of the sawhorse supporting the forward fuselage. Now check the stabilizer by placing a level along the centerline of the stabilizer spar. If the stab is not level, adjust the cradle supporting the rear of the fuselage until it is. If you adjust the stab, go back and check the spar box once more to be certain it is still level.

Step B Prepare the Top Fuselage

Mount the top fuselage on the lower fuselage. Check the alignment of the cleco holes drilled earlier. With the stab leveled, these cleco holes may or may not line up. Enlarge the holes in the top skin if necessary (if the hole in the bottom skin is enlarged, the cleco may not engage and clamp properly). Drill more cleco holes every four inches through the flanges of the top and bottom fuselage and into the fin skin flanges. Remove the top fuselage when done.

Step C Mount the Top Fuselage

Prepare the flanges of the top and bottom fuselage, forward flange on the fin skin, firewall flange, and the flange on the rear seat bulkhead for bonding. Prepare a mixture of structural adhesive and add enough structural filler to achieve “mayonnaise” consistency. Recruit someone to help you mix and apply the adhesive to all bond surfaces. With one person on either side of the fuselage, spread the top fuselage slightly and lower it very carefully onto the bottom fuselage. Insert clecos in the previously drilled cleco holes and use spring clamps to secure the top fuselage to the firewall flange. Remove all excess adhesive.

TASK F-37 Assemble the Fuel Tank

Brief Task Description:

The G-202 utilizes a pre-molded composite fuel tank specifically designed for aerobatic flight. To construct this tank, you will first install the fuel level sensor. Then you will seal the entire interior of the tank with tank sealer. Next you will install the fuel return tubes and the vent and drain fittings in the tank. Lastly, you will install the tank baffle, tank top and flop tube. Follow steps A-H to assemble the fuel tank.

Step A Install the Fuel Level Sensor in the Fuel Tank

Find the fuel level sensor included in your kit. Follow the manufacturer's instructions (see the appendix of this manual) to install the fuel level sensor in the tank. Locate the area on the bottom of the tank where the core material has been removed. This is where the base of the fuel sensor is mounted. Orient the sensor so that the probe points upward into the tank. .

Step B Seal the Tank and Baffle with the Jeffco Sealer

Lightly sand the interior of the tank, the tank baffle, and the tank top with 100 grit sandpaper. Place some tape over the fuel level probe to protect it from the sealer. Insert some clay or silicone in the threaded holes in the tank to protect them from the sealer. Use masking tape to shield the top surface of the tank flange and the mating area on the tank top. Find the Jeffco 9700 included with your kit. Mix according to the manufacturer's instructions. Using a paint brush, coat all interior areas of the tank, both sides of the tank baffle, and tank top with the mixed resin. Be careful not to get the sealer in the threaded holes for the vent and drain fittings. Repeat this process until all the pinholes are filled completely (two or three coats will usually be enough).

Step C Install the Fuel Return Tubes in the Tank

Mark the position of the tank baffle by placing the baffle into the tank and drawing a line around the perimeter. Find the clear flexible PVC tubing included with your kit. Cut this

PVC tube into two tubes of the proper dimensions to run down either side of the tank. One tube should extend from the aft right-hand corner of the tank baffle down to the bottom corner of the tank and forward to the front of the tank. The other tube should run from the left forward corner of the baffle down to the bottom corner and aft to the rear of the tank. Each tube should rise just above the top surface of the baffle. Tack these tubes in position using dabs of five minute epoxy. Now lightly sand both these tubes and the area surrounding the tubes where they run along the bottom of the tank. Mix a small batch (about 4 oz) of laminating resin. Pour about half of this mixture into a separate cup. Mix in some microballoons with the resin in one cup until the resin assumes the consistency of peanut butter. Use this mixture to create a generous radius between the tubes and the tank along the bottom of the tank.

Cut two fiberglass squares on the bias (fibers running 45 degrees to the edges) about four inches on a side. Using the unthickened resin, laminate these strips over the tubes where the filler was applied. Allow the resin to cure completely.

Step D Install the Fuel Drain and Vent Fittings

Mix a small batch of structural adhesive (you may wish to use left over adhesive from another bonding operation) and apply this adhesive to the threads of the fuel drain and vent fittings. Thread these fittings into the appropriate holes in the tank. Thread the nut onto the vent fitting on the inside of the tank. Clean up any excess adhesive. Clean any adhesive off the exposed threads of the fittings.

Step E Install the Baffle in the Tank

Find the location on the baffle where the fuel probe will intersect it. Drill a 1/2 inch hole at this location through the baffle and seal any exposed core material. Install the supplied plastic bushing in this hole. Now cut holes in the baffle for the fuel return tubes mounted to the sides of the tank. Trial fit the baffle in position over the fuel probe and the fuel return tubes.

Prepare the tops of the tubes, the flange on the baffle, and the mating surfaces inside the tank for bonding. Mix a small batch of structural adhesive and thicken it with structural filler to about “mayo” consistency. Apply this adhesive to the interior of the tank and press the baffle down into position over the adhesive. Thicken the remaining adhesive

further until it has the consistency of peanut butter. Use this mixture to seal the area surrounding the two fuel return tubes where they penetrate the baffle and the open areas at the corners of the baffle.

Step F Install the Vent Line in the Tank

Cut off a small piece of fuel tubing long enough to reach from the vent fitting to the forward corner of the tank. Flare one end of this tubing and install it on the vent fitting on the inside of the tank. When installed, the free end of the tube should be about 1/4 inch from the corner of the tank.

Step G Mount the Fuel Tank Top on the Tank

Trim the flange around the top of the fuel tank back to about 1.5 inches. Accurately position the tank top on the tank (see the illustration). Use a felt tip pen to trace the outline of the tank flange on the tank top. Prepare the top surface of the tank flange and the mating area of the tank top for bonding. Prepare a batch of structural adhesive and thicken it to “mayo” consistency. Apply this mixture generously to the flange on the tank as well as the tank top. Carefully position the top of the tank over the tank and lower it onto the tank flange. Press the tank top down onto the tank, squeezing out the excess adhesive. Use the outline traced earlier on the tank top to position it on the tank and secure it with spring clamps. Clean up all excess resin with a clean rag.

Step H Install the Flop Tube in the Fuel Tank

Screw the flop tube into the flop tube fitting. Apply a thread lubricant to the threads of the flop tube fitting and screw it into the threaded flange on the tank.

NOTE: Do not use Teflon tape to install fittings in the tank. The tape could break loose and find its way into the fuel system. Use a fuel compatible thread lubricant such as “fuel lube” instead.

TASK F-38 Construct the Fiberglass Mounting Tabs for the Tank

Brief Task Description:

The fuel tank is supported by four fiberglass tabs which are layed-up onto the forward corners of the tank and bolted to the firewall. The first step in making these tabs is to mount a temporary lay-up surface on the sides of the tank. The tabs are then made by laminating fiberglass onto the forward surface of the tank and this temporary surface. These tabs are then trimmed and tank is set into position inside the fuselage. Next, the tank tab flanges are made by laminating fiberglass onto three surfaces: the side of the tank, the outboard surface of the tabs and the clear taped surface of the firewall. The tabs are finished by trimming the tab flanges and then drilling mounting holes through these flanges and the firewall. In this task you will also install the nutplates in the hatch flange for mounting the tank to the fuselage.

Step A Mount a Temporary Lay-Up Surface on the Sides of the Tank

Cut out four pieces of 1/8 inch masonite (or any other flat thin material) about 6 inches long by 3 inches wide. Cover one side of these pieces with clear tape. Prepare the forward surface at the tank at the tank tab locations for bonding. Use hot glue to tack the four lay-up flanges on the sides of the tank at the location of the tank tabs.

Step B Lay Up the Tank Tabs

Set the tank on your work table with the front side facing up. Cut out 6 pieces of fiberglass on the bias (fibers running 45 degrees to the edge) 12 inches long by 8 inches wide. Prepare some laminating resin and wet these fiberglass strips out on a piece of plastic sheet on your work table. On a separate piece of plastic trace out a 6 by 10 inch rectangle and bisect this rectangle to make four 3 inch by 4 inch rectangles. Place the plastic with the outline over the lay-up and use scissors to cut out the four rectangular pads from the lay-up. Add some microballoons to the left-over laminating resin until it assumes the consistency of peanut butter. Use this mixture to form a generous radius at the junction of the lay -up flanges and the tank. Now peel one side of the plastic off each pad and place it into position over each of the four temporary lay up flanges mounted to

the tank. Each pad should extend 2 inches onto the flange and two inches onto the front of the tank. Remove the remaining plastic sheet and check for any air bubbles in the lay-up. Allow to cure completely.

Step C Trim the Tabs

Remove the temporary lay-up flanges from the sides of the tank. This should require little more than some gentle tugging to pop the hot glue loose. Remove any remaining hot glue from the tank surface using a putty knife.

Trim the upper and lower tabs so that they will clear the firewall. Insert the tank in the fuselage and center the tank flange in the recess on the fuselage top. Check the tabs to see if they clear the firewall. They should clear the aft face of the firewall by about 1/16 inch. If they do not, remove the tank from the fuse and trim the tabs down using a belt sander until they do.

Step D Drill Mounting Holes for the Tank Top

Place the fuel tank in position in the fuselage. Drill holes through the tank's top flange and into the molded recess in the fuselage top. First drill one hole in each aft corner of the flange. Next drill five equally spaced holes between these two corner holes across the width of the aft tank flange. Finally, drill six holes forward of each of the two corner holes. Countersink these holes on the tank top using a 100 degree countersink. Remove the tank and install nutplates in the fuselage hatch flange.

Step E Lay Up Fiberglass Flanges onto the Firewall

Place some clear tape on the aft face of the firewall at the location of the tank tabs. Prepare the outboard side of the tank tabs and the sides of the tank (about two inches aft of each tank tab) for bonding. Place the tank in position inside the fuselage and install several of the mounting screws to keep the tank from moving. Use spring clamps to secure the tank to the firewall at the front flange.

Cut out 8 pieces of fiberglass on the bias (fibers running at 45 degrees to the edge) 14 inches long by 8 inches wide. Mix some laminating resin and wet out the fiberglass on a piece of plastic sheet on your work table as you did previously for the tank tabs. On a

separate piece of plastic trace out a 6 by 12 inch rectangle and bisect this rectangle to make four 3 inch by 6 inch rectangles. Place this plastic over the lay-up and cut out the four 8-ply pads. Remove the plastic from one side of the pads when done.

Reach up into the space between the tank and the firewall and place the four wet pads into place over the firewall, the outboard surface of the tabs, and the side of the tank. The fiberglass should extend onto the tank surface at least two inches and onto the firewall at least two inches. After the pads are properly positioned, remove the plastic sheet and check for air trapped in the lay-ups. Allow these pads to cure completely.

Step F Trim the Flanges and Drill Mounting Holes for the Tank

Remove the tank from the fuse and trim the tank flanges to the proper shape. Use a center punch to mark the positions of the mounting holes on the tank flanges. Re-install the tank in the fuselage and secure the tank with several mounting screws as you did previously. Make sure all four tank flanges lay flat against the firewall. Use a 1/8 inch drill to drill pilot holes through the tank flanges and the firewall. Now drill these holes out to 1/4 inch.

TASK F-39 Install the Upper Engine Mount Fittings

Step A Prepare the Fittings and the Fuselage for Bonding

Sand the surface of the engine mount fittings and the mating bond areas on the firewall and inside surface of the top fuselage skin. Thoroughly clean these bond areas with acetone.

Position the left fitting on the inside of the fuselage so that the pre-molded dimple on the fitting is centered in the hole in the firewall. Now hold the fitting tightly against both the firewall and the side of the fuselage and drill two cleco holes through the top of the fitting and into the inside skin of the fuselage. Do not drill holes into the lower part of the fitting. Repeat this procedure for the right fitting.

Step B Install the Engine Mount Fittings

Prepare a batch of structural adhesive and add enough structural filler to achieve “mayo” consistency. Apply this adhesive mixture to the engine mount fittings and the mating bond surfaces of the fuselage and firewall. Press the fittings into place and install the clecos in the previously drilled holes. Remove all excess resin and allow the adhesive to cure completely.

Step C Drill Holes in the Engine Mount Fittings

Using the holes in the firewall as a drill guide, drill the two 3/8 inch holes through the engine mount fittings.

Step D Install the Stainless Steel Backing Plates

Find the 1/4 inch thick stainless steel backing plates for the upper engine mount fittings. Temporarily assemble these backing plates to the engine mount fittings using the engine mount bolts. The backing plates should sit flush on the rear surface of the fittings. If they do not, grind down the appropriate edge of the backing plate until they do. Now prepare the plates for bonding by thoroughly sanding with 80 grit sandpaper. Wax two engine mount bolts and place several washers on them to act as a spacer. Push these bolts

through the firewall from the front. Prepare a small batch of adhesive and thicken it to "mayo" consistency. Apply the adhesive to one side of each plate, being careful to keep the adhesive away from the hole. Slide the plates (with the adhesive on them) over the bolts and press them against the aft side of the engine mount fitting. Wipe any adhesive off the threads of the each bolt. Thread a castle nut onto the bolts to apply clamping pressure to the stainless plates. Remove any excess adhesive from the area around the plates with a clean rag. Let the adhesive cure completely, then remove the bolts.

TASK F-40 Install the Mid-Cockpit Brace

Step A Trial Fit the Mid Cockpit Brace

Find the pre-molded mid cockpit brace included with your kit. This structure is designed to support the sides of the fuselage in the cockpit area and to act as a support for the front seat and shoulder harness. Trial fit this brace in its proper location in the center of the cockpit area. The brace should sit on top of the front seat rails and fit fairly snug against the inside of the fuselage just under the cockpit rail.

Step B Install the Cockpit Brace

Prepare the cockpit brace, the top of the front seat rails, and the inside of the fuse for bonding by thoroughly sanding all bond surfaces with 80 grit sandpaper and then cleaning with a clean rag dipped in acetone.

Prepare a mixture of structural adhesive and thicken it to “mayo” consistency. Spread this mixture on all bond surfaces. Now have a helper carefully spread the cockpit rails apart by about 1/2 inch while you insert the cockpit brace. Start by positioning the brace just forward of its final location, then move the brace aft and over the front seat rails. Try not to smear the adhesive while inserting the brace. Once the brace is properly positioned on top of the front seat rails, remove all excess adhesive and allow to cure completely.

TASK F-41 Install the Crankcase Breather Tube and Wiring Conduits

Step A Prepare the PVC Pipe for Installation

The breather tube consists of four lengths of PVC tubing connected by three 45 degree fittings. Cut the PVC to the required lengths but do not install any fittings yet.

Step B Prepare the Wiring Conduit Tubing

Cut the supplied 3/8 inch ID polyethylene tubing into two pieces long enough to extend from the sparbox to the rear seat bulkhead. Sand the outside surface of the tubing thoroughly with 80 grit sandpaper. Sand the inside of the fuse just below the crankcase breather tube on the right side and the same location on the left side of the fuse. Clean all surfaces with a clean rag dipped in acetone.

Step C Prepare the Fuselage for the Tubes

Use a 1 inch hole saw to drill holes for the PVC tube in the firewall, rear seat bulkhead and tail of the fuse. You may have to grind these holes out slightly as the tubing is slightly larger than 1 inch in diameter. Sand a 3 inch wide strip down the length of the cockpit just under the canopy rail to act as a bonding surface for the tube and fiberglass laminate. Also sand the bottom surface of the mid-cockpit brace.

Step D Tack the Forward PVC Tube in Position

Sand the entire outside surface of the forward PVC tube with 80 grit sandpaper. Slide this tube through the hole in the firewall, through the cockpit area and through the hole in the rear seat bulkhead. When fully inserted, the forward end of the tube should protrude about 1.5 inches ahead of the forward face of the firewall. Tack the tube to the inside surface of the cockpit at several locations using hot glue or five minute epoxy. The tube should fit tight into the junction of the mid cockpit brace and fuselage side where it passes through the front cockpit area. Seal the area around the tube where it passes through the firewall with high temperature silicone sealant.

Step E Tack the Wiring Conduit Tubes in Position

Use hot glue to tack the right conduit tube in place just under the crankcase breather tube. Now tack the other conduit tube in position on the left side of the fuselage. To help keep the left tube straight, clamp a straight piece of wood to the side of the fuse so that its top edge is aligned with the position of the tube. Now press the tubing against the top edge of the wood while tacking the tubing in position with hot glue.

Step F Create a Fillet between the Tubes and the Fuselage

Prepare a 6 oz batch of laminating resin and add microballoons until the mixture assumes the consistency of peanut butter Use this mixture to create a fillet between the tubes and the side of the fuselage.

Step G Laminate Fiberglass Strips over the Tubes

Cut out a fiberglass strip on the bias large enough to cover both tubes (the PVC and conduit tube) on the right side of the fuse. Cut out another fiberglass strip large enough to cover just the conduit tube on the left side of the fuse. These strips should be cut on the bias (fibers running 45 degrees to the edge) and be wide enough to cover the tubes and extend onto the fuselage side at least one inch. Prepare about 8 ounces of laminating resin and wet out the fiberglass strips over the tubes. Inspect the lay-up for trapped air, then allow to cure completely.

Step H Install the Remainder of the PVC Tubes

Assemble the remainder of the PVC tubes using the 45 degree PVC fittings and PVC adhesive. Be certain this assembly is long enough to reach from the hole drilled earlier through the bottom of the fuselage to the forward tube with a little left over. Slip this assembly into the tail of the aircraft and drop the aft-most tube into the elongated hole in the tail of the airplane. Now glue the forward end of this assembly to the forward fiberglassed tube. Mix up some structural adhesive and thicken it to “peanut butter” consistency with structural filler. Use this mixture to secure the aft tube assembly to the bottom of the fuselage and to fill in the area surrounding the tube where it exits the fuse.

TASK F-42 Prepare Front Seat and Side Panels for Installation

Brief Task Description:

Five pre-molded pieces comprise the front seat and side panels. All of these panels are removable except for the seat bottom (which is fixed because the lap belts feed through it). This allows easy access to the aft side of the rear instrument panel and the various control system components. In this task you will assemble the seat components inside the fuselage, drill holes for the mounting screws, and install nutplates. You will also bed the front seat rails with filler to achieve a tight fit between the seat and the rails.

Step A Trial Fit the Front Seat Panels and Drill Holes for Nutplates

Find the five panels (front, bottom, back, left side and right side panels) that make up the front seat. Assemble the front, back and bottom panels with clamps. Be certain that the flanges for each panel mate as they should (the back and front panel sit on top of the bottom panel). Install these panels on the front seat support rails. Use clamps to secure this assembly to the mid-cockpit brace at the top and place a weight on the seat bottom to secure it at the front. Adjust the seat until it is centered on the support rails and even with the top of the mid cockpit brace. Assemble the side panels to the seat and cockpit brace with spring clamps.

With all panels adjusted so they are in their correct relative positions, drill holes for the mounting screws. Drill two holes through the top of the seat back and into the mid-cockpit brace. Drill five holes through the each side panel and into the cockpit brace and seat back. Drill two holes through the forward flange of the seat back and into the aft flange of the seat bottom. Drill four holes through the aft flange of the forward panel and into the bottom panel. Do not drill the holes into the seat rails yet.

Step B Bed the Front Seat Rails with Filler

Remove the front seat and place clear tape on the back of the seat over the areas which contact the support rails. Thoroughly sand the top of the front seat support rails and clean them with acetone. Mix a batch of structural adhesive and add enough filler to achieve “peanut butter” consistency. Spread this mixture on the top of the seat support rails.

Now install the seat and press it down onto the adhesive mixture. Place a sand bag on the seat to weigh it down and clamp it to the top of the cockpit brace. Try to reach under the seat and remove any excess filler with a clean rag. Allow the filler to cure completely before moving the seat.

Step C Install Nutplates in the Cockpit Brace and Seat Panels

Remove the seat and trim away excess adhesive as necessary. Remove the tape from the seat. Install nutplates into the seat panels and mid-cockpit brace as required.

TASK F-43 Install the Rear Seat Belt Fittings

Step A Cut Slots in the Seat for the Fittings

Use your Dremel or similar tool to cut slots in the bottom outboard edges of the rear seat to allow the lower seat belt fitting parts to slide through the seat. Try not to damage the fuselage skin while cutting these slots. Slide the lower seat belt fitting parts through the slots in the seat. Check to be certain the lower portion of these fitting sit tight against the fuselage skin under the seat. Hold each lower fitting in position while drilling two cleco holes through the fitting and into the inside fuselage skin. Secure the lower fittings in place with clecos. Locate the phenolic blocks and upper seat belt fittings. Position the upper fittings over the lower fittings and sandwich the ¼ inch phenolic blocks in between. Hold the upper fittings tight against the side of the fuse then clamp the upper and lower fittings together (with the phenolic blocks in between) with spring clamps. Drill two cleco holes through each upper fitting and into the inside skin of the fuselage. Disassemble all of the fitting components when done.

Step B Prepare the Fuselage and The Seat Belt Fittings for Bonding

Prepare the surfaces of the seat belt fittings where they bond to the fuselage and the phenolic blocks. Prepare the surface of the phenolic blocks and the bond areas on the inside fuselage skin for bonding.

Step C Install the Seat Belt Fittings

Prepare some structural adhesive and thicken it to “mayo” consistency with structural filler. Coat the bond areas of the lower fittings and the mating areas inside the fuselage with the adhesive. Install the lower fittings and secure them with clecos. Liberally coat one surface of each phenolic block and press each onto the upper surface of the lower fittings. Use plenty of adhesive to prevent any voids between the phenolic blocks and the fuselage skin. Now coat the upper fittings with adhesive and install them against the phenolic blocks and fuselage side. Secure the upper fittings to the fuselage skin with clecos and use spring clamps to clamp the phenolic blocks between the upper and lower fittings. Remove any excess adhesive with a clean rag. .

TASK F-44 Install the Rear Seat

Step A Prepare the Rear Seat and Rear Seat Bulkhead for Fasteners

Find the short length of piano hinge supplied with your kit. Cut a piece of hinge to the proper length for mounting to the rear seat. Drill holes for the mounting screws in the piano hinge. Clamp the piano hinge at the proper location on the rear seat bulkhead. Use the holes in the piano hinge as a guide to drill the holes in the rear seat bulkhead. Refer to the General Information Section of this manual to install the fixed nutplates in the piano hinge with flush rivets. Now temporarily install the hinge on the top surface of the rear seat bulkhead with the supplied screws. Place the rear seat at the proper location in the pre-molded joggle in the rear seat bulkhead. You may need to trim the seat slightly to get it to fit inside the joggle. Clamp the seat in position and drill holes through the seat and the rear seat bulkhead for the camloc fasteners. Use the holes drilled previously in the piano hinge as a guide to drill the holes through the seat for securing the hinge.

Step B Install Camloc Receptacles and Piano Hinge on the Rear Seat Bulkhead

Remove the piano hinge from the rear seat bulkhead. Use a 100 degree countersink to countersink the holes in the seat and the rear seat bulkhead for the flat head screws. Use the supplied screws with countersunk washers to mount the piano hinge to the bottom surface of the rear seat bulkhead. Install the camloc receptacles behind the rear seat bulkhead (you may use a drill bit to center the receptacle while drilling holes for the receptacle retaining rivets).

NOTE: Though the seat is now ready to install, you may wish to wait until the aircraft is completed. This will facilitate access to the area behind the seat during the remaining construction tasks. Also, you may find it preferable to paint the seat prior to installation.

TASK F-45 Assemble The Canopy

This task outlines the procedure for the installing the canopy, fiberglass hinge reinforcements, and rear bulkhead in the pre-molded canopy frame. Before you can install the canopy in the canopy frame, you will first have to mount the frame on the fuselage and build an external support structure to keep the canopy frame in the proper shape. The canopy frame with its support structure is then removed from the fuselage and the canopy and rear bulkhead are installed. Follow steps A-F to assemble the canopy.

Step A Trim the Canopy Frame down to the Scribe Line.

Use either a jigsaw or a Dremel tool to cut the canopy frame just outside of the pre-molded scribe line. Carefully sand the canopy frame down to the scribe line using a belt sander or sanding block.

Step B Lay-Up the Hinge Reinforcements on the Canopy Frame

Prepare the inside surface of the canopy frame for bonding at the location of the hinges. Cut out eight strips of glass about 3 inches wide and about 9 inches long. Mix some laminating resin and laminate four strips of glass onto each hinge area on the inside of the canopy frame.

Step C Construct the External Support Frame for the Canopy Frame

Trace the outline of the of the front and rear edges of the canopy frame on some 1/2 inch particle board or plywood. Cut out these formers out and set them aside. Mount the canopy frame on the fuselage and check for proper fit. It should fit flush around the entire perimeter. Flex the canopy frame to fit the fuselage where necessary. Set the wooden formers on the fore and aft edges of the canopy frame and use automotive body filler to bond them to the frame. Cut out two more pieces of wood approximately eight inches wide and long enough to span the distance between the formers. Use Bondo to bond these longerons to both the canopy frame and the formers. Check to make certain the entire support frame is dimensionally stable and will not flex out of alignment once it is removed from the fuselage.

Step D Install the Canopy

NOTE: The canopy comes with a special protective coating. Remove only enough of this coating to bond the canopy to the canopy frame. The remainder of this coating should be left on until the aircraft is ready to fly.

Remove the canopy frame (with wooden support structure attached) from the fuselage and place it upside down on your work table. Place the canopy into the canopy frame and mark the canopy where it intersects the frame with a felt tip marker. Trim the canopy back to about one inch from this mark using a cut off wheel or a jigsaw with a very fine metal cutting blade. Remove the protective coating on both sides of the canopy extending from the edge to the mark on the canopy. Sand this area thoroughly with 80 grit sandpaper on both sides of the canopy. Sand the area surrounding the opening on the inside of the canopy frame with 80 grit sandpaper. Clean all surfaces with acetone. Do not spill acetone onto the portion of the canopy that will be exposed later! Prepare a mixture of structural adhesive and mix in enough structural filler to achieve “mayo” consistency. Coat all mating surfaces with a thick layer of the adhesive. Place the canopy into the canopy frame and force out any excess Hysol. You may still have a large gap at the front junction of the canopy frame and the canopy. Add some microballoons to the structural adhesive mixture until it assumes the consistency of peanut butter and fill the remainder of the gap with this mixture. Allow to cure.

Step E Fiberglass the Canopy in Place

Sand the area filled by the adhesive mixture until it is smooth. Sand the area surrounding this area on the canopy frame. Clean all bond areas with acetone. Prepare four fiberglass strips long enough to extend from the rear corner of the canopy around to the front centerline of the canopy. Make these strips a little wider than what is necessary to extend onto the canopy one inch, over the fill area, and onto the canopy frame one inch.. Prepare two 48 inch fiberglass strips to fit along the rear junction of the canopy frame and the canopy. Lay these fiberglass strips onto a plastic sheet and wet them out in pairs with laminating resin. You should now have a total of three strips on your work table, each two plies thick. Cover these strips with another layer of plastic. Cut out each strip from this plastic sandwich with scissors so that the edges are straight. Remove the plastic from

one side of each fiberglass strip and lay it into its appropriate position. When laying the strips into position, make sure the edge that overlaps the canopy is straight. Once each strip is properly positioned, carefully remove the remaining plastic sheet. Remove all air bubbles with a brush and allow the lay-up to cure completely.

Step F Install the Rear Internal Canopy Frame Reinforcement.

Prepare the pre-molded canopy frame reinforcement for bonding. Mix some structural adhesive with enough structural filler to achieve “mayonnaise” consistency. Coat the bond areas with the adhesive and install the reinforcement so that the edge of its flange is lined up with the rear edge of the canopy frame. Use spring clamps about every six inches to secure the reinforcement to the canopy frame while the Hysol is curing.

TASK F-46 Install the Canopy Latch

The G-202 uses a Glasair canopy latch. The directions for assembling and installing the latch can be found in the back of this manual. Please refer to these directions for installing the latch in your canopy frame.

NOTE: Use the 3/8 inch 4130 steel tubing to actuate the canopy latching "bullets". Cut the tube to length and flatten the ends, then drill the ends to fit the latch components.

TASK F-47 Install the Instrument Panel Bulkhead

Brief Task Description:

The instrument panel bulkhead helps to strengthen the forward edge of the cockpit opening in the top fuselage. This bulkhead also doubles as a mounting surface for the forward instrument panel. Follow steps A-D to install this bulkhead.

Step A Install the Fuel Tank in the Fuselage

Before installing the instrument panel bulkhead, you must install the fuel tank to hold the relatively flexible top fuselage in the correct shape. Use the supplied 8-32 screws to mount the top flange of the fuel tank to the pre-molded recess in the top fuselage. Countersink the flange so the screws are flush when installed.

Step B Trial Fit the Panel Bulkhead

Trial fit the instrument panel bulkhead in position under the fuselage top. Drill about four or five equally spaced cleco holes through the flange on the bulkhead and into the inside skin on the fuselage top. Remove the bulkhead when done.

Step C Prepare the Panel Bulkhead and the Fuselage for Bonding

Prepare the area just under the aft edge of the top fuselage and the entire flange on the instrument panel bulkhead for bonding. Thoroughly sand these areas with 80 grit sand paper and clean with acetone.

Step D Install the Bulkhead

Prepare a small batch of structural adhesive and mix in structural filler to thicken to “mayo” consistency. Spread this mixture on both the bulkhead flange and the bond area on the fuselage. Press the bulkhead into position and install clecos into the cleco holes. Remove any excess adhesive and allow to cure.

TASK F-48 Install the Rear Spar Carry-Through Reinforcements

Brief Task Description:

Pre-molded rear spar carry-through reinforcements will now be mounted to either side of the rear spar plates to help secure the rear spar to the fuselage. Follow steps A-C to install these reinforcements.

Step A Trim the Reinforcements

Find the four pre-molded fiberglass rear spar carry-through reinforcements supplied with your kit. Use a jigsaw or bandsaw to trim these reinforcements to the dimensions shown in the illustrations. Each of the four reinforcements is shaped to fit in one position only. Be certain the correct reinforcement is in the correct position before drilling any holes Smooth the edges of the reinforcements with sandpaper.

Step B Drill Holes in the Reinforcements

Hold each of the two forward reinforcements in position against the front sides of the forward rear spar plates then drill two cleco holes through each reinforcement flange and into the side of the fuselage. Install clecos in the cleco holes then clamp the face of the reinforcements to the forward rear spar plate. Now use a 7/16 inch drill to drill through the forward reinforcements using the holes in the rear spar plates as a drill guide. Mark the reinforcements so that you can identify them later. Remove the forward reinforcements when done. Repeat this procedure for the aft reinforcements.

Step C Bond the Reinforcements to the Fuselage

Prepare the flanges on the reinforcements and the mating area on the fuselage for bonding. Mix up a small batch of structural adhesive and thicken it to “mayo” consistency using structural filler. Apply this mixture to the reinforcement flanges and the sides of the fuselage. Press each flange in position on the fuselage and install clecos into the previously drilled cleco holes. Install the rear spar bolts through the reinforcements and the rear spar plates. Place washers and nuts on these bolts and tighten them hand tight. Remove any excess resin with a clean rag.

TASK F-49 Install the Wing Fairings

Brief Task Description:

In this task you will install the fiberglass fairings which act to smooth the airflow at the wing-fuselage junction. The forward section of these fairings attach to the wing and the aft section attaches to the fuselage. This is done to eliminate any gaps near the leading edge of the wing-fuselage junction which might interfere with the air flow.

Step A Trace the Outline of the Wing Skins on the supplied Flat Stock

Locate the pre-molded 1/8 inch foam core fiberglass flat stock supplied with your kit. This material will be used to make ribs to support the outboard edge of the wing fairings. Trim the flat stock to the proper dimensions to fit between the main spar and the rear spar on the wing with about a 1/4 inch gap on either side. Slip the flat stock in between the main and aft spars of the wing and trace the outline of the wing skin on one side of the flat stock. Repeat this procedure for the other wing root rib.

Step B Mount the Wings to the Fuselage

Step C Partially Split the Fairings along the Fore-Aft Split Lines

Find the pre-molded fiberglass fairings included with your kit. Locate each fairing in its appropriate position at the wing-fuselage junction. Place a mark on each fairing at the aft edge of the spar box. Extend this line so that it runs the full width of each fairing. This will be the split line for the fairing. Forward of this line, the fairings will be attached to the wing, aft of this line the fairings will be attached to the fuselage. Now remove the fairings from the aircraft. Use a Dremel tool with the cut-off wheel attachment to split each fairing along the mark between the scribe lines. Do not cut all the way across the fairings, just cut between the scribe lines. This way the fore and aft portion of the fairings will still be attached by the excess material outside of the scribe lines.

Step D Fiberglass the Joggle for the Fore-Aft Split Line

Set each fairing on your work table so the inside of each fairing is facing up. Try to support each fairing so it is not warped or twisted at the split line cut in Step B. Place

some clear tape on the forward side of the split line on each fairing. Insert tape through the split and wrap it onto the opposite side of the fairing to completely protect the forward edge. Now thoroughly sand the area just aft of the split line on each fairing. This will allow the fiberglass lay-up to adhere to the aft portion of the fairings but not the forward section of the fairings.

Cut out twelve fiberglass squares on the bias about 3 inches on a side. Prepare some laminating resin and laminate 3 plies of glass over each of the four split lines. Try to center the fiberglass squares on the split lines. Allow the lay-ups to cure completely.

Step E Trim the Fairings along the Scribe Lines

Use a Dremel tool to trim the fairings just outside of the pre-molded scribe lines. Carefully sand the edges of the fairings down to the scribe lines using a belt sander. The fore and aft sections of each fairing should now be separable. Remove the tape applied to the forward section of the fairings and sand the forward edge of the fiberglass lay-up.

Step F Place Tape over the Inboard Edge of the Forward Fairings

Cut off some strips of duct tape about 5 inches long. Wrap these strips around the inboard edge of the forward fairings so that the tape is smooth on the inside surfaces where they butt up against the fuselage (it's OK to have wrinkles on the outside surface of the fairings). Cover the entire edge that will contact the fuselage, overlapping the tape strips as you go. This tape will prevent the microballoon/resin mixture that you will use to fair in the edge of the forward fairing from sticking to the fairing itself.

Step G Prepare the Fairings for Installation

Set the aft fairings in position inside the fuselage-wing junction. Check the fairings for proper fit. They should fit tight inside the pre-molded joggle on the wing skins and against the fuselage. Use masking tape to secure the fairings inside the pre-molded joggle on the wing. Press the aft fairings (both upper and lower) up against the fuselage while drilling cleco holes every four inches through the fairings and into the outside skin of the fuselage. Use a felt tip pen to mark the outline of the rear fairings on the fuselage side for reference later. Now place the forward fairings in position. Drill and cleco the forward fairings to both the wing and fuselage. Trace the outline of the forward fairing

on each side of the fuselage as you did the aft fairings. Remove all of the fairings when done.

Prepare the fairings for bonding. On the aft fairings, sand the edge that butts up against the fuselage and on the forward fairings sand the edge that butts up against the molded recess in the wing. Prepare the joggle where the forward fairings overlap for bonding. Also prepare the mating bond surfaces on the wing and fuselage in a similar manner.

Step H Install the Aft Bottom and Forward Fairings

Mix up enough structural adhesive to attach the forward fairings and bottom aft fairings (the aft top fairings will be installed later). Thicken the adhesive to "mayo" consistency with structural filler. Apply the adhesive mixture to the edge of the aft bottom fairings which mate to the fuselage. Carefully position each fairing on the fuselage. Tape the fairings into the pre-molded recess in the wing and install the clecos into the previously drilled cleco holes to hold the fairings against the fuselage. Now apply adhesive to the edge of the forward fairings which mate to the wing. Also apply adhesive to the joggle on the forward fairings where they mate at the leading edge. Carefully press these fairings into position and secure with clecos. Remove any excess adhesive.

Step I Make and Install the Fairing Support Ribs

Cut out the support ribs from the flat stock along the line drawn in Step A. Trial fit these ribs in position between the forward and aft spars. The ribs should be parallel to the root wing rib and sit about 1/8 inch inboard from the edge of the wing skin. The bottom of these ribs should fit flush against the inside surface of the bottom fairings and the fore and aft edges of the ribs should clear the spar surfaces by about 1/4 inch. Once you are confident the ribs fit correctly, prepare them for bonding by removing the core material to a depth of 1/8 inch along the bottom of the rib. Prepare the mating area of the wing fairing for bonding. Mix up some structural adhesive (you may use left over adhesive from Step G) and bond the rib to the lower wing fairing. Use tape to hold the rib in position while the adhesive cures.

Step J Install the Aft Upper Fairings

Trial fit the upper aft fairings in position. Check to make sure the fairings just barley clear the top of the support rib when it is pressed into position against the fuselage and wing. Sand the ribs as necessary to get a custom fit. Once you are confident the fairings fit correctly, prepare the top of the ribs, the mating area on the inside of the fairings, the entire upper edge of the fairings, and the fuselage for bonding. Mix up some structural adhesive and thicken it with structural filler. Apply the adhesive to the top of the support ribs and the edges of the fairings which will mate to the fuselage. Press the fairings into position and install clecos in the previously drilled cleco holes. Use tape to secure the fairings inside the pre-molded joggle in the wing. Clean up any excess adhesive and allow to cure.

Step K Fill the Edges of the Fairings

Lightly sand the fuselage where the inboard edge of the fairings mate to it. Now mix up about 6 ounces of laminating resin and add microballoons until it assumes the consistency of peanut butter. Use this mixture to fill in the entire edge of the fairings where they mate to the fuselage (plastic squeegees work well for applying the mixture). Start from the trailing edge of the aft fairings and work around the entire perimeter, generously fairing in the edges over a distance of about three or four inches up onto the fuselage. Allow the filler to cure then smooth it out with a rubber sanding block and 60 grit sandpaper. If you find low spots, repeat the above procedure until all joints are filled to your satisfaction.

Step L Remove the Wings from the Fuselage

Remove the wings from the fuselage. The duct tape placed on the forward fairings should have prevented the filler from adhering to the forward fairings. If you find they do stick a little, some gentle prying should release them..

Step M Cut Holes in uhe Support Ribs to clear the Aileron Control Tubes

Trace the outline of the cutout for the aileron control tubes on the outside of both support ribs. Use a jigsaw to cut out these holes along the line. Smooth the edges of the holes with sandpaper.

TASK F-50 Assemble and Install the Aileron Control Tubes

Step A Cut the Tubing to Length

Find the 5/8 x .049 inch aluminum tubing supplied with your kit. Use a tubing cutter to cut the tubing the proper length (refer to the illustrations). The kit uses approximately 7 Cut both the 4 foot and the 3 foot lengths of tubing in half, then cut the pieces to the proper lengths. This will ensure that the right pieces are used for the respective pushrods. Double-check lengths to avoid cutting the pushrods too short. The drawings show lengths, but we recommend that the lengths be verified by taking measurements on the aircraft.

Step B Install the Tube End Fittings in the Control Tubes

Find the eight 5/8 inch tube end fittings supplied with your kit. Use masking tape to secure the fittings in the ends of the control tubes. Find the proper location for the rivet holes and center punch them using an automatic center punch. Drill rivet holes through both the tubing and end fittings with a drill press. Secure the fittings in the tubes permanently using solid rivets.

Step C Install the Rod End Bearings in the Tube End Fittings

Screw jam nuts onto each rod end bearing and install these bearings in each control tube. Each bearing should be screwed into each tube end fitting so that about 75 % of the threads are buried inside the fitting. Be sure to tighten the jamb nuts after installing the pushrods and rigging the ailerons.

Step D Install the Aileron Stops

Fabricate and install the aileron stops, refer to drawing 27-00-2-1-0103. Use some of the aluminum angle left over from the landing gear installation. Aileron travel should be plus and minus 20 degrees.

TASK F-51 Assemble and Install the Aft Instrument Panel

Step A Layout the Instrument Panel Trays

Use the patterns supplied with your instrumentation to make the cut-outs in the panel trays. The round holes can be easily made with the appropriate drill bit or hole saw. Odd shaped holes can be made by first drilling a 1/4 inch hole inside the outline for the cut-out. The cut out can then be completed using a jigsaw with a narrow fine-toothed blade.

Step B Install the Panel Trays

Decide whether or not the panel trays will need to be removable. If they do not need to be removable, you can use structural adhesive to bond the trays in place. If they do need to be removable, you will need to install nutplates in the trays. Use stainless washer-head screws to install the panel trays to prevent crushing the core material in the seat rails.

Step C Install the Rear Spar Support Panel

Find the rear spar support panel included with your kit. This panel is specially designed to support the rear spar carry-through between the two front seat rails. Unlike the instrument panel trays, which can be positioned as needed, this panel must be positioned as shown on the drawings. You can mount a 2 1/4 inch instrument to this panel if you like (such as the fuel gauge), but you must center the cut-out for the instrument along the width of the panel. The factory aircraft have the fuel gauge and fuel selector valve mounted to this panel. After making the appropriate cut-out in this panel, install it with structural adhesive.

NOTE: The selection, layout, and positioning of the instruments and engine controls (throttle, prop, and mixture) is up to the builder.

TASK F-52 Assemble and Install the Forward Instrument Panel

Brief Task Description:

Because of space restrictions on the rear instrument panel, the primary flight instruments for the G-202 are generally located on the front instrument panel. Although panel lay-out is up to the builder, the front panel generally carries the altimeter, airspeed indicator, compass, and G-meter.

Step A Decide on Your Panel Lay-Out

Decide where you want your instruments to go on the panel. Generally you will want to place your air speed over to the side where you can see it on final approach. The middle of the panel will be difficult to see if you are carrying a front passenger. Remember that the instrument panel will overlap the instrument panel bulkhead by about 3/4 inch. Make sure the housings for the instruments will not interfere with this bulkhead when installed.

Step B Cut Holes in Your Panel for the Instruments

Once you have your panel lay-out completed, use a center punch to punch all of the mounting holes. Drill out these holes using the appropriately sized drill bit (usually no. 19). Drill a 1/4 inch hole in the middle of each instrument hole and use a jig saw with a narrow blade to cut close to the hole outline. Finish the hole with a round file or sandpaper.

NOTE: You may want to get the panel cut at a machine shop or laser cutter. This costs more, but saves a lot of time.

Step C Drill Holes for Mounting Your Panel to the Panel Bulkhead

Note that phenolic blocks have been pre-installed in the instrument panel bulkhead at five locations. Locate the mounting holes in the instrument panel so the mounting screws will go through the center of the phenolic blocks. After drilling the holes in the panel, clamp the panel to the bulkhead and drill through the bulkhead using the holes in the panel as a drill guide (this will assure proper alignment). Countersink the holes on the forward side

of the panel with a 100 degree countersink if you will be using countersunk screws to mount the panel. Install five nutplates to the forward side of the panel bulkhead.

Step D Paint The Instrument Panel

Use a good quality epoxy or enamel based paint to paint the panel. Allow the panel to dry completely.

Step E Mount Instruments to the Panel and Mount the Panel

Mount each instrument to the panel using the appropriate mounting screws and install the appropriate pitot and/or static line fittings to the back of the instruments. Mount the panel to the panel bulkhead.

TASK F-53 Install the Seat Belts

Step A Drill and Install the Crotch Strap Mount

Locate the pre-molded crotch strap mount included with your kit. Drill a 1/4 inch hole in the center of the pre-installed phenolic block in the mount. Prepare the forward side of the rear seat rails and the mating area on the cotch strap mount for bonding. Place the mount in position on the seat rails and drill four cleco holes through the mount and into the flange in the seat rails. Prepare some structural adhesive and thicken it to "mayo" consistency with structural filler. Apply the adhesive to the front seat rails and to the mating area on the crotch strap mount. Press the mount into position on the front of the rear seat rails and install clecos in the previously drilled cleco holes.

NOTE: The standard seatbelts supplied with the kit are 4-point seatbelts and do not utilize a cratch strap. We recommend that you install the crotch strap mount at this time in case you decide to install a crotch strap at a later date.

Step B Drill the Forward Seat Rails and Install the Forward Seat Belt Tangs

Refer to the illustrations to find the proper location for the mounting hole for the forward seat belt attach tangs. Drill a 1/4 inch hole at this location through both seat rails. Locate the seat belt attach tangs supplied with your kit. Use the appropriate hardware to mount the tangs to the outside surface of the front seat rails.

Step C Drill the remaining Mounting Holes

Refer to the illustrations to locate the two holes that go into each lap belt fitting. Use a center punch to center punch the holes. Carefully drill these holes using a right angle drill or an air powered angle grinder with a ¼ inch drill bit installed. Find the proper location on the mid cockpit brace and drill the holes for mounting the front seat shoulder harness.

Step D Install The Seat Belts

Using the appropriate hardware install the seat belts and shoulder harnesses.

TASK F-54 Assemble and Install the Wheelpants

Step A Trim the Wheelpants as Necessary

Trim the wheelpants as necessary to fit over the wheels and brakes. Cut out the cover plates and make the mounting flanges for the cover plates. You may wish to wait until the wheelpants are installed before finalizing the cover plates. Make sure there is enough clearance between the tires and the wheelpants.

Step B Mount the Wheelpants to the Axle

Locate and drill the hole for mounting the wheelpant to the axle. Install a spacer between the end of the axle and the wheelpant if necessary to maintain clearance between the tire and the wheelpant. Mount the axle to the wheelpant using an MS24693-298 screw and countersunk washer. Use a little threadlocking compound on this screw when preparing the airplane for flight. Check this screw on each preflight.

Step C Align and Drill the Wheelpants

Align the wheelpants. When satisfied with the wheelpant alignment, drill the two mounting holes on the inside of the wheelpants. Drill through the wheelpant and the mounting plate that is sandwiched between the axle and the gear. Remove the wheelpant and install the nutplates on the mounting plate.

NOTE: When aligning the wheelpants, be sure to allow enough ground clearance at the aft ends of the wheelpants. If the aft ends of the wheelpants are set too low, the bottoms of the wheelpants will drag and scrape on every surface irregularity.

Miscellaneous

Engine and Exhaust Installations

The installation of the engine, exhaust system, and engine controls is up to the builder. AkroTech recommends the Lycoming IO-360 series. If a constant speed prop will be installed, then an engine with a front mounted governor is suggested. AkroTech does not provide specific engine intallation details or parts other than an engine mount.

The exhaust tunnel on the bottom of the cowl will also need to be fabricated by the builder. When determining the shape of the tunnel, be sure to leave adequate clearance around the exhaust system. If the tunnel fits the exhaust too closely, the cowl will be damaged by heat and abrasion from the exhaust.

Electrical System

The design and installation of the electrical system is the responsibility of the builder. Akrotech does not provide specific electrical system information.

NOTE: There is not a lot of room between the back of the front seat and the rear panel installation. Carbon fiber is a conductor, be sure none of the components or wiring shorts out on the seat.

Fuel System

The design and installation of the fuel system is the responsibility of the builder. There has been considerable discussion on the plumbing of the various fuel tanks, feeding the main tank from the wing tanks, 3-way valves vs 4-way valves, etc, etc. The kit includes fuel line and a variety of fittings. Aircraft Spruce and Wicks carry enough fittings for just about any system a person could dream up. This is a homebuilt aircraft, plumb it the way you want it.

Center of Gravity Information

Note the following station locations (in inches):

Datum (Forward face of firewall)	00.00
Pilot	74.00
Passenger	36.00
Main Fuel	10.50
Wing Fuel	34.50
Aft Baggage (if baggage compartment installed)	88.00
Forward CG limit	25.50
Aft CG limit	32.50

Weigh the aircraft in a level attitude
Leveling points are the cockpit rails

Airspeeds

We have used the following information when range-marking our airspeed indicators:

Green Arc	60-180 knots
Yellow Arc	180-220 knots
Red Line	220 knots

Verify the actual performance of the individual aircraft to determine the stall speed.

BUILDER RESPONSIBILITY

It is up to the kit builder to determine the actual weight and balance data for each individual aircraft. We are including a SAMPLE weight and balance sheet to use for REFERENCE ONLY. Each airplane will come out slightly different and MUST be verified on an INDIVIDUAL BASIS!

The aircraft is good for plus or minus 10 G's up to a weight of 1400 pounds.

Suggested maximum gross weight is 1600 pounds.

Remember, this is a homebuilt aircraft. The builder is responsible for final determination of all safety and performance aspects of the finished project, including but not limited to:

surface prep and paint
engine installation
electrical system
fuel system
empty weight
gross weight
aircraft cg
all reference airspeeds
stall speed

Do not rush into the first flights of the aircraft. Take plenty of time to be sure everything is ready (including the pilot), a considerable amount of time and money are at stake!