Airdrome Aeroplanes Data Sheet

Model	Scale	Wing Span	Empty Wt	Useful Load	Stall Speed	Cruise Speed	Top Speed	Rate of Climb	Engine
Nieuport 11 $7995	87 %	23' 9"	435 Lbs	220 Lbs	35 Mph	74 Mph	88Mph	750 Fpm	Rotax Small Vw
Nieuport 17 $9995	Full	26' 3"	532 Lbs	300 Lbs	39 Mph	87 Mph	97 Mph	1050 Fpm	Vw 2180 Rotec Radial
Nieuport 24 $10,195	Full	26' 3"	545 Lbs	300 Lbs	39 Mph	88 Mph	98 Mph	980 Fpm	Rotec Radial Vw 2180
Nieuport 28 $14,995	Full	27' 3"	812 Lbs	300 Lbs	39 Mph	84 Mph	95 Mph	980 Fpm	Rotec Radial Vw 2180
Fokker Dr1 $10,995	Full	23' 6"	587 Lbs	300 Lbs	32 Mph	76 Mph	89 Mph	1220 Fpm	Vw 2180 Rotec Radial
Fokker Dr1 $8,495	3/4	18' 6"	397 Lbs	242 Lbs	32 Mph	64 Mph	78 Mph	950 Fpm	Rotax 582 Small Vw
Fokker D-VI $5,995	3/4	18' 6"	297 Lbs	242 Lbs	32 Mph	73 Mph	78 Mph	750 Fpm	Rotax 503 Small Vw
Fokker D-VII $8,995	80%	23' 10"	470 Lbs	300 Lbs	34 Mph	94 Mph	102 Mph	960 Fpm	Hirth F30 Vw 2180
Fokker D-VIII $5,495	3/4	23' 6"	263 Lbs	242 Lbs	34 Mph	69 Mph	78 Mph	920 Fpm	Rotax
Eindecker E-III $5,495	3/4	23' 2"	238 Lbs	242 Lbs	32 Mph	63 Mph	82 Mph	1100 Fpm	Rotax Big Twin
Morane "L" $5,995	3/4	23' 4"	376 Lbs	242 Lbs	34 Mph	68 Mph	85 Mph	820 Fpm	Rotax Big Twin
Dream Classic $3,495	Full	36'	228 Lbs	300 Lbs	28 Mph	52 Mph	61 Mph	625 Fpm	Rotax
Dream Classic $3,995	Full Strut	26'	236 Lbs	225 Lbs	30 Mph	56 Mph	65 Mph	645 Fpm	Rotax
Dream Fantasy $4,995	Full	28' 6"	312 Lbs	320 Lbs	27 Mph	49 Mph	61 Mph	525 Fpm	Rotax
Bleriot XI $6,495	3/4	26'	376 Lbs	260 Lbs	30 Mph	45 Mph	61 Mph	920 Fpm	Rotax Small Vw
Bleriot XI 11,995	Full	28'6"	654 Lbs	300 Lbs	34 Mph	55 Mph	65 Mph	940 Fpm	Vw 2180 Rotec Radial
Sopwith Pup 12,995	Full	27'	596 Lbs	300 Lbs	37 Mph	81 Mph	93 Mph	1000 Fpm	Vw 2180 Rotec Radial
Sopwith Camel 13,695	Full	28' 4"	943 Lbs	300 Lbs	40 Mph	93 Mph	103 Mph	960 Fpm	Rotec Radial Vw 2180
DH-2 $5,995	3/4	22' 8"	354 Lbs	225 Lbs	29 Mph	54 Mph	64 Mph	580 Fpm	Rotax Big Twin
Sopwith Tabloid $14,995	Full 2 seat SBS	25' 4"	791 Lbs	410 Lbs	40 Mph	78 Mph	91 Mph	760 Fpm	Large Vw
Sopwith Baby $14, 995	Full 2 seat SBS	25' 4"	895 Lbs	410 Lbs	40 Mph	78 Mph	91 Mph	680 Fpm	Rotec Radial
Sopwith Schneider $14, 995	Full 2 seat SBS	25' 4"	780 Lbs	410 Lbs	40 Mph	78 Mph	91 Mph	760 Fpm	Large Vw

"Movie Aircraft"

Airdrome Aeroplanes' aircraft are featured in both Flyboys & "Amelia". Watch and you will see a full line of our aircraft in action!

Airdrome Aeroplanes offers a builder assist program. In as little as four days, you could be returning home with the fuselage on the gear and tail feathers installed. Who knows? Maybe one day soon you will grab your leather-flying helmet; goggles and white scarf then join the flying circus with us. Feel free to call me anytime with your questions.

929 NW Rd 1571 Holden, MO 64040 (816) 230-8585

www.airdromeaeroplanes.com

Dear Airdrome Aeroplanes Customer,

Thank you for your purchase of the kit associated with this guide.

We at Airdrome Aeroplanes (AA) have ensured that the kit you have purchased contains parts and materials of the highest aircraft quality and grade. You can build this kit simply or add whatever the level of complexity that you desire to make this kit truly a personal statement.

By following this guide carefully and using only aircraft grade materials and utilizing accepted methods of fabrication and assembly, years of fun and enjoyment are yours as you fly the skies in search of adventure and camaraderie with others of the same spirit.

The purpose of this guide is to assist you in the process of taking those parts and pieces you find in the box, identifying, fabricating, assembling and adjusting until the final test of flight arrives. The quality of your work is as important an ingredient as the quality of materials you use. Take your time and remember the carpenter's old saying: "Measure twice to cut once" In this case, a mistake can be very expensive if you are using aircraft grade materials. When it happens, and it will, contact us at AA and we can take care of you much more affordably, as we buy in greater quantities and have spares in stock.

This guide will contain many resources and references. I encourage you to use them. Make time during this build to learn something about the aeroplane and the pilots that flew them that you are building. It will give you a chance to catch your breath and energize you for your next session. The best step you can take to assist yourself in accomplishing a quality build you would be proud and confident for a friend or family to fly is to join the Experimental Aircraft Association (EAA) *http://www.eaa.org/*. There are many resources and like minded builders and pilots at the EAA that have gone before you and can provide insights from their own hard lessons learned. Join a local chapter, they can point you in the right direction for what you need and help you stay motivated.

Well enough talk, it's time to get building and flying!

Robert Baslee
President, Airdrome Aeroplanes

This builders guide is organized functionally into the sections of aircraft that assemble into a complete project. Inside this guide, you will find notes, warnings and builders tips. Each will have its' own label in the margin highlighting it. The following simple definitions apply to each:

WARNING Not following this reference can result in death or injury

NOTE Important information directly related to flight performance

TIP Helpful techniques to improve quality or productivity

The parts and pieces associated with your build, while aircraft grade, are simple to fabricate and install if the plans are followed and the tools used properly. The complicated and difficult to make parts will come prefabricated and in some cases welded, if required.

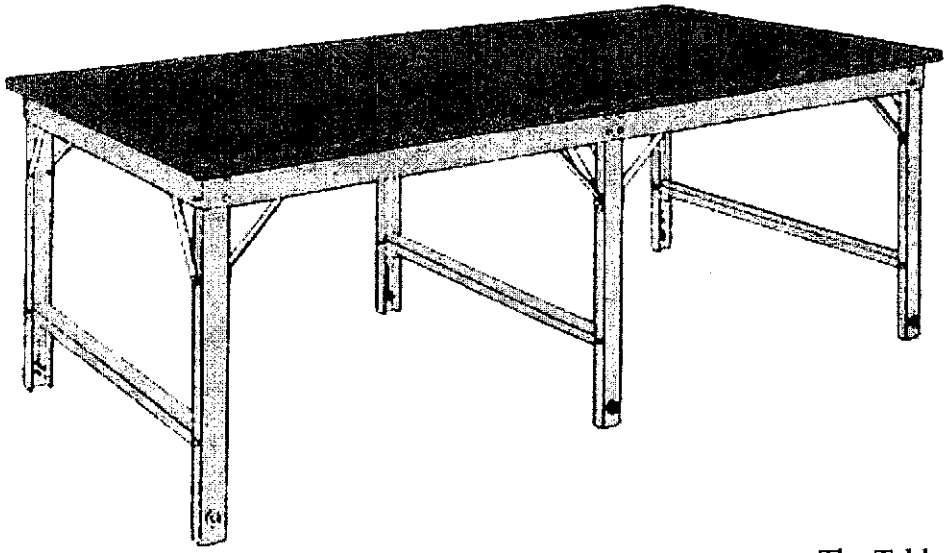
Depending upon the kit and its options that you have ordered, it will come with either an aluminum tube and gusset construction assembled with stainless steel aircraft grade pop rivets or a high grade 4130 steel tube fuselage that requires welding for assembly. Either option will create a very strong and airworthy aircraft. The preparation of parts and assembly techniques (to be discussed later) vary slightly, but all involve the joining of tubes; stringers, fuselage truss members and ribs in a precise geometric shape that will accept the pulleys, levers, and related assemblies that you will test and cover to fly.

Regardless if your aeroplane has a steel or an aluminum fuselage, the wing, landing gear and empennage structure will be aluminum, joined with the same type rivets as the aluminum tube and gusset fuselage.

Take your time to build it straight & true and it will fly straight & true. You will find the video that arrived with you kit informative. Watch it a few times and then review the area you are working on before starting for a refresher. Also, take a look at the links and references in the reference section. You will find the manufacturers all have videos you can easily search for on YouTube or their own sites. Aerodrome Aeroplanes has several showing various assembly techniques. Other manufacturers such as Stewart covering systems, and the welding manufacturers also are well represented. Many junior colleges and vocational schools haveinformative welding videos that can be quite helpful as you are starting out. And don't forget the Experimental Aircraft Association, which has many videos dealing with the basics of fabrication such as rib stitching and covering, to name a few.

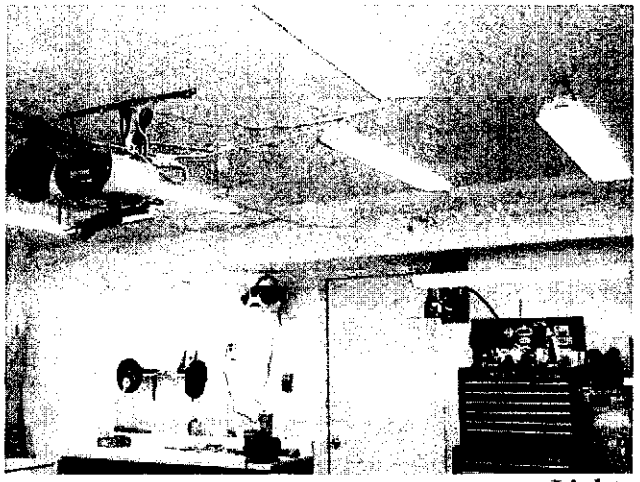
1 **Choose your workspace wisely.**
The aircraft can be fabricated in a single car garage or in a basement with the proper tools, lighting and ventilation. If you build it in a basement, just be sure you have a window or door large enough to get the assembled parts out! After you have selected an appropriate work area and hung enough lighting to make sure you can see the details well it's time to think about "The Table".

2 **The Table is the foundation of the build.**
Make sure it is sturdy and can handle the load. Put your table in the center of the room. Assembly of your plane will take place here. Everything from wings and fuselage parts being fabricated; to the assemblies being mocked up and even a place to put the pages and pages of drawings. The size of the table depends on how much room you have: the more room you have, the bigger the table should be. The table can be on lockable screw mounted adjustable rollers. If you are short on space, you might consider two or more smaller tables that can be clamped together for stability and alignment. The longest wing piece on the Camel is the lower wing, which is 154.5", so two eight foot long tables four feet wide, would be able to accommodate most of the work that you will be doing. If you intend to be welding on this table, it makes good sense to arrange to obtain steel plate at least 1/8" thick for light duty MIG or TIG welding activities on top—with a non-flammable insulator between the table, if wood, and the sheet metal top. This arrangement will allow light metal welding on the top, but avoid heavy metal work without a proper heavy plate surface for activities such as plasma cutting. Group your tools and storage around it. You can store your completed wings below the ceiling to conserve space. Build some storage racks into the overhead ceiling to store long supplies such as tubing or wood.



The Table

3 **Make sure your workspace has plenty of light.**
The one or two light bulbs in the center of your garage or basement isn't enough. Task lighting is crucial to the assembly of your plane; it is all in the details. High quality light will help in the assembly of your kit will help you to see what you are doing.



Lights

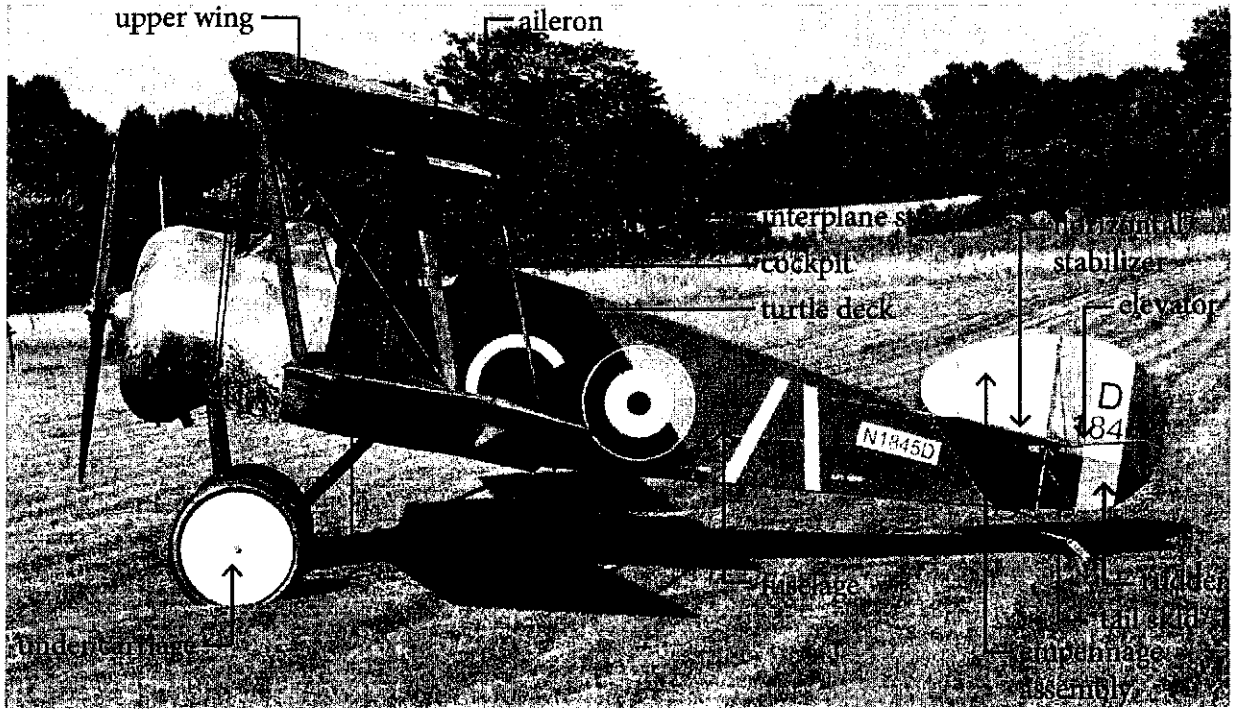
1 **Check your shipment of parts and materials.**
Upon delivery of your kit of parts, check to make sure they are all there. You should find all parts labeled and some packaged individually as necessary. You will have also received one or more video DVD's, a packet of drawings and this guide. All of these things together will be the resources to get you through the assembly of this plane.

2 **The part labels and numbering.**
Since you have looked closely at the parts you received you will notice numbers and letters identifying each piece. It isn't gibberish! To the right you will see a list of the abbreviations. The letters stand for the part of the plane you are assembling and the number indicates the order of the assembly. *For instance if you have a piece in your hand that says* **'FG7'** *it is a piece required for the fuselage (***F***) assembly, the piece is a gusset (***G***) and it is the 7th piece to be used. If you have been following your instructions correctly and in order you would have already assembled parts FG1 through FG6 and would be ready to install part* **FG7**.

3 **Understanding the terminology.**
Airplane parts have unique names and usage and the abbreviations detailed above all have a specific location on the plane. Part of your experience and your ability to communicate with other builders to ask questions or lend assistance will be enhanced by knowing where the assembly is located on the plane and the correct term for the group of parts. For those of you that have not flown yet, this will be your introduction and a lead-in to the experience in the air. To the right you will find a diagram of a Sopwith Camel with its major parts labeled.

Part Abbreviations

R -	RUDDER
G -	GUSSET
F -	FUSELAGE
H-	HORIZONTAL STABILIZER
E -	ELEVATOR
L -	LANDING GEAR
TW-	TAIL WHEEL LANDING GEAR
W -	WING
S -	LIFT STRUTS
C-	CONTROL SYSTEM
FR -	FIREWALL AND FORMERS
1 (any number) -	the order the piece is assembled



Sopwith Camel with Major Parts Labeled

1 **The manual from this point forward is offered in the order of sub-kit assembly. To complete your kit in the most logical and efficient way, follow the instructions in this order. Below is an overview list of sub-kit assemblies:**

1. Rudder Assembly (R)
2. Fuselage Assembly (F)
3. Horizontal Stabilizer and Elevator Assembly (H, E)
4. Landing Gear Assembly (L)
5. Wing Assembly (W)
6. Lift Struts Assembly (S)
7. Control System Assembly (C)
8. Firewall and Formers Assembly (FR)
9. Fuel Tank Assembly
10. Engine Mount Assembly
11. Aircraft Cover Assembly

2 **Every sub-kit assembly starts with a drawing.**
When building the kit, every sub-kit assembly starts with drawing the components out, at full scale, on butcher paper (kraft paper, mask paper, etc.), whatever you choose that is laid on your work table. Using a pencil, sharpie, etc., sketch out the full size component on the paper on your work table. You can find large rolls of masking paper at most any hardware store.

3 **For each of the sub-kits start with piece number one.**
For example; if building the rudder sub-kit assembly, start with piece **R1**. If building the fuselage sub-kit, start with **F1**.

4 **Let's get started!**
Begin with sub-kit number one The Rudder Assembly and start with piece R1. Buckle up, here we go!

1 **Draw out the rudder assembly on paper, full size.**
On the piece of paper on your work table draw out the grid as seen in the drawing packet that came with your kit. The drawing sheet will be labeled with the plane model and the size of the grid pattern. In this example the FOKKER D-VII, R1, 2" GRID PATTERN is shown in **Figure 1** to the right. If you count all the squares up you will see that you need to draw a grid that is 14 squares wide by 22 squares high. The squares are each 2"x 2". Using that grid sketch in the arched shape shown in the drawing. Put dots on the grid and then just connect the dots. Just move along a square at a time placing a dot at the approximate location of where your drawn line will meet the grid and connect. You can draw as many or few dots as you wish, but get the drawing fairly close to the one shown.

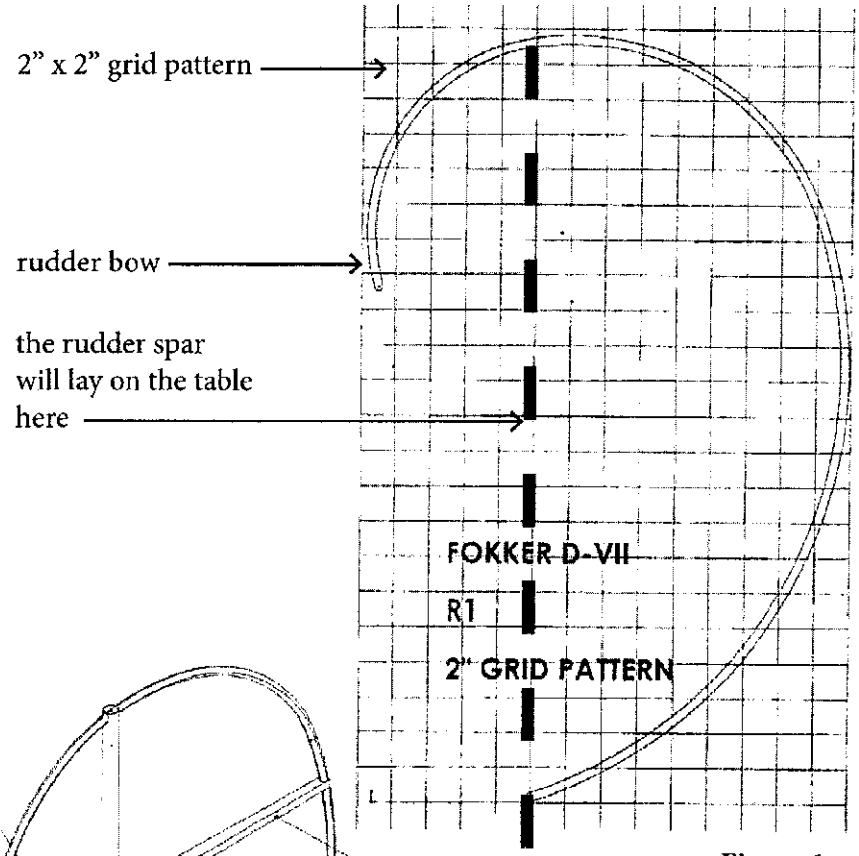


Figure 1

NOTE Drawing out the part you are going to build is helpful in two ways. First, it will help you understand every aspect of the part before you start bending and cutting metal. Secondly, when your part is complete you can save your full size patterns in the event you should ever need to make a repair or replacement part.

TIP If you wish, you can take a thin piece of sheet metal and bend it around to form the arched shape and then lay it on your paper and trace it. This is a similar idea to using a flexible curve in drafting.

2 **Take the rudder spar and place it on the table on your sketch.**
The rudder spar piece will be connected to **the** rudder bow later. But to keep the rudder spar from rolling around on the table, use scrap pieces of wood and screw down on either side of the spar. The isometric graphic in **Figure 2** will help you to see your ultimate goal when the rudder is assembled.

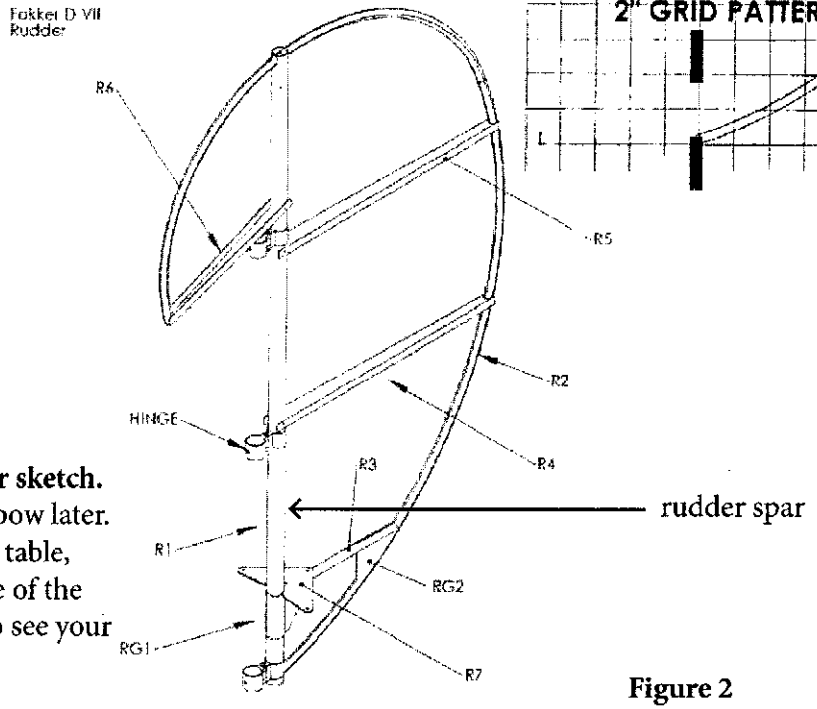


Figure 2

3 **Form the rudder bow.**
Take the rudder bow kit piece and bend it to fit the arc shape you drew at full size on the table. This can be done in several ways as long as when you are finished the result is a nice, smooth curve without any kinks.

TIP A tip for bending the aluminum is to cut a series of circles in plywood; one with a 6" radius, one with a 9" radius and one with a 12" radius. You can temporarily screw or bolt them into your work table or off to the side and bend your tubing around them. Based on the curve you are bending you will have to tighten or relax the bends as you go around to get the final arc you are trying to achieve. When bending the bow be careful to keep it flat in the second plane. See **photo** to the right.

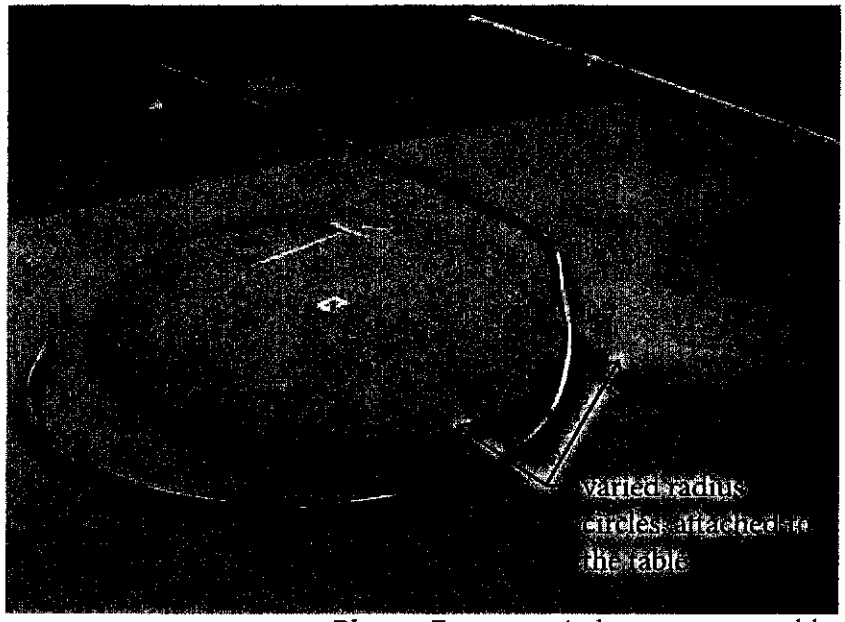


Photo: Forms or circle patterns on table.

4 **After you have done some preliminary bending on the rudder bow, lay it on top of your sketch on the table.**
Once you have it on top of your sketch you can see where you need to tighten or relax your arc to fit your sketch. See **photo**, bottom right.

5 **Trim the top of the spar to match.**
When the rudder bow matches the pattern on the table, with it still laying on the pattern, in place, go ahead and trim the spar to match.

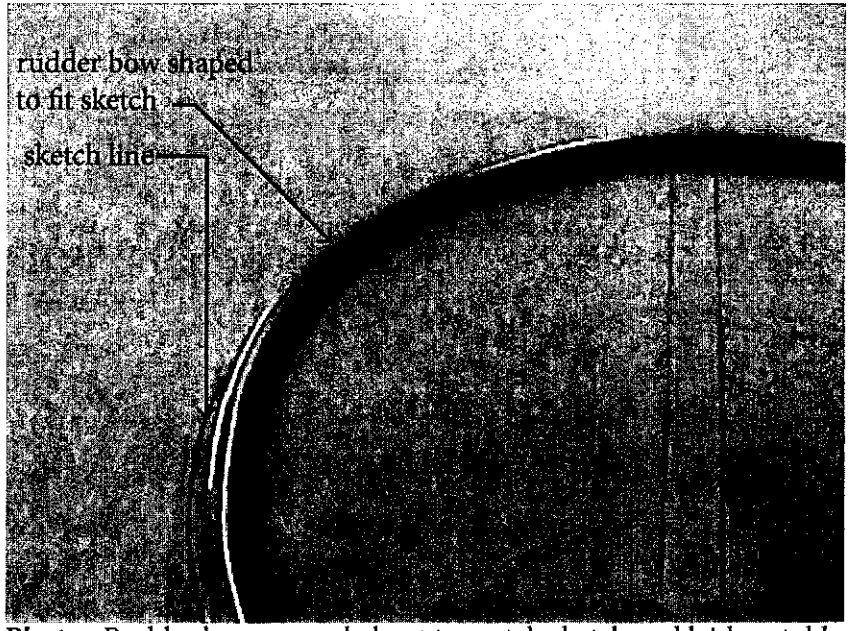


Photo: Rudder bow properly bent to match sketch and laid on table.

6 **Mark and drill the rudder spar where the rudder bow will transition over the top surface of the spar.**
On the top of the spar drill a 1/2" hole in the front and rear edges where the bow will pass through it. Note that the front and rear locations may be different. After drilling it use a pair of tin snips to cut away extra material. This will make a 'slot' at the top of the spar that will 'cradle' the bow. Use a rubber hammer and a 1/2 scrap or drill bit and hammer down the edges (see **photo**) so that they taper inward and will fit the bow snuggly and will then be secured with a rivet on both sides. This step is detailed in a Youtube video called 'Rudder Construction'. Visit that video for more detailed images and steps of the process.

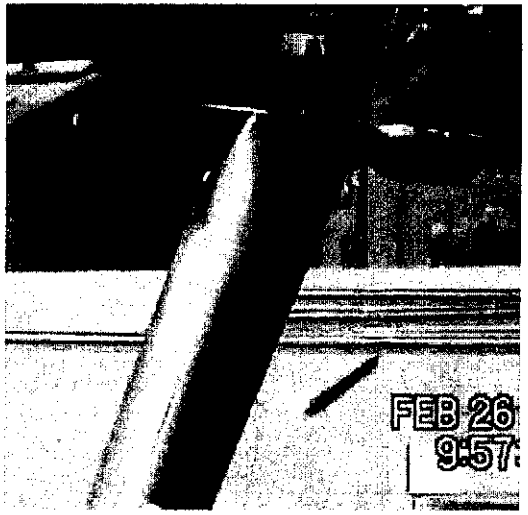


Photo:
Rudder spar angle matches bow, drilled and ready to be hammered.

7 **Next drill a 1/2" hole in the rear of the lower spar. And a 1/2" hole on the front of the spar where the bow will attach near the middle of the spar. You can also drill the 1/2" hole on the rear of the spar where the bottom rib will attach, this rib will have the rudder control horn bolted on to it later. You can also drill the pilot holes for the wood screws on the opposite sides of the 1/2" holes. A dowel will be pressed into each of the tubes and fastened with a screw.**
These holes will be where the rudder bow attaches on both the front of the spar and the rear of the spar and where the rib that supports the rudder control horn will be attached. See **photo**.

Photo:
Upper spar 1/2" hole, front of spar.

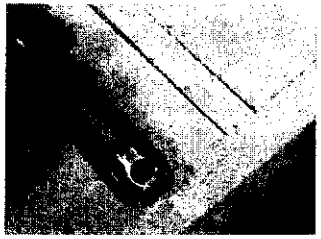


Photo:
Lower spar 1/2" hole, rear of spar.

Photo:
Lower rib location 1/2" hole, rear of spar.

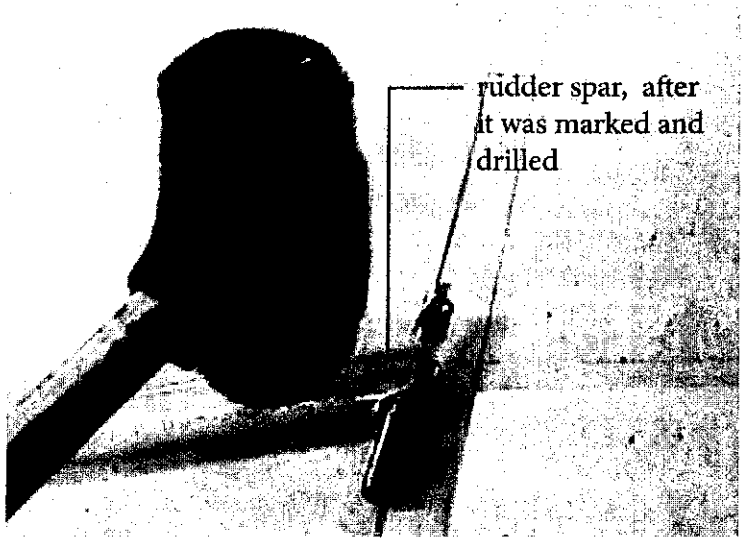


Photo:
Rudder spar slot being hammered so that edges taper to hold rudder bow.

8 **Now that the rudder bow has been formed and the spar drilled you can start putting all the pieces together to make the assembly.**
The slot you previously made at the top of the spar will 'cradle' the bow as it passes through and continues around toward the front where the bow will pierce the front wall of the spar but not the rear. And when the bow reaches the lower part of the spar it will pierce the rear wall of the spar but not the front. See Figure 3.

9 **Before you fasten anything to the spar, slide the hinge pieces onto the spar.**
There will be several pieces marked as hinges in your rudder assembly sub-kit. Slide these over the rudder spar and use tape to temporarily hold them into place. Hinge locations will vary, but see drawing to the left for the general look and location.

10 **Once the hinges are in place connect the rudder bow to the spar using wood screws and dowels inserted into the tubes. Rivet the top of the spar to the bow using a rivet on both sides.**
There will be several pieces marked as hinges in your rudder assembly sub-kit. Slide these over the rudder spar and use tape to temporarily hold them into place. Hinge locations will vary, but see drawing to the left for the general look and location.

11 **Fit the lower rib into the spar.**
Again, refer to the isometric drawing included in your packet to see the location of the lower rib. This rib is a 1/2" tube that you previously drilled a hole for in the rear of the spar.

Note that the lower 1/2" tube rib has a wooden dowel rod inserted 3.5" into the front of it; this provides extra strength/crush protection to the tube when bolting rudder control horn in the future. Attach dowel rod using a wood screw.

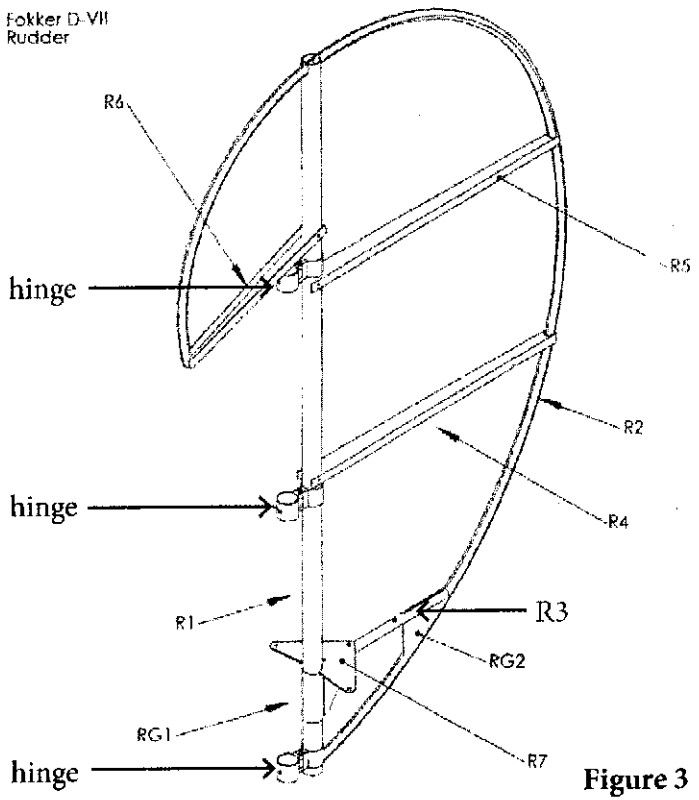
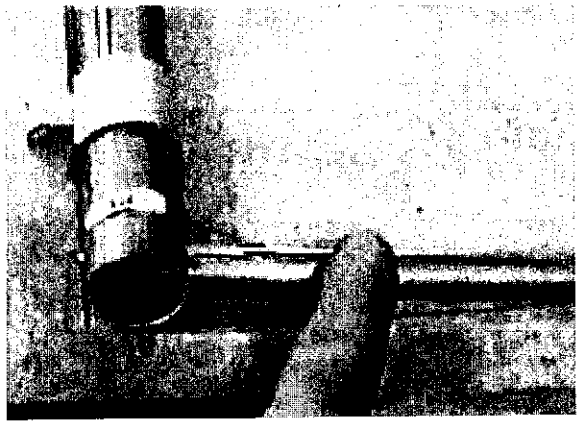


Figure 3

Photo:
Lower spar with rudder attached and hinge in place.



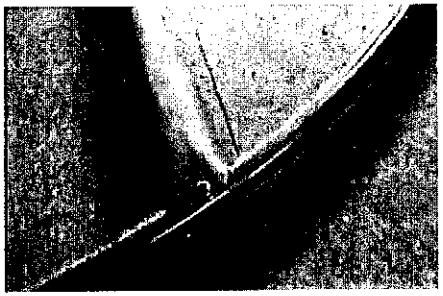


Photo:
Rivets connecting spar to bow.

12 **Form the sheet metal rib pieces.**
In your kit these pieces will be marked and start as flat pieces of sheet metal. These are all formed in the same manner and can be seen on your drawings. The finished length of each pieces is also shown on the drawing, so make note of that. A small version of an example drawing is shown in **Figure 4.** At one end of each piece drill a 1" diameter hole and on the other end a 1/2" diameter hole.

TIP When drilling thin sheet metal use a counter sink. Typically a regular drill will grab and tear up thin sheet metal, using a counter sink prevents this.

13 **Bend the sheet metal rib pieces.**
Bend the edges up 90 degrees to form a tapered C-channel; see isometric view on your full size drawings. The 1" diameter end will fit on the spar and the 1/2" diameter end will fit on the rudder bow or trailing edge. This connection will come later.

TIP A tip for bending sheet metal is to bend at 90 degrees to the grain. Always us a minimum of 3 times the material thickness for radius.
For example a .020 material = .060 radius minimum.

14 **Rivet the rib pieces to the rudder bow and spar.**
Use 1/8" rivets to connect the rib pieces to the rudder bow and spar. Use one rivet on each side of the rib.

TIP Install the rib piece that is on the front of the bow after the fin is mounted on airplane.

15 **Drill holes into the rudder control horn.**
You will receive the rudder control horn as a solid piece, drill the holes according to the drawing you received with your kit. Use **AN3-10A** bolts to attach rudder horn to the 1/2" rib you mounted to the spar. The bolts are labeled and are included with your kit. See **Figure 5.**

NOTE Make sure that the rudder control horn fits snug against the spar when bolting in place.

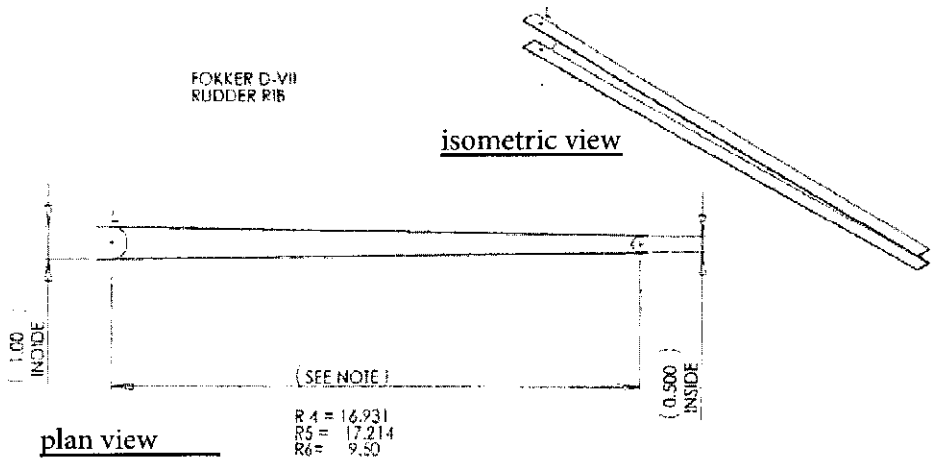


Figure 4

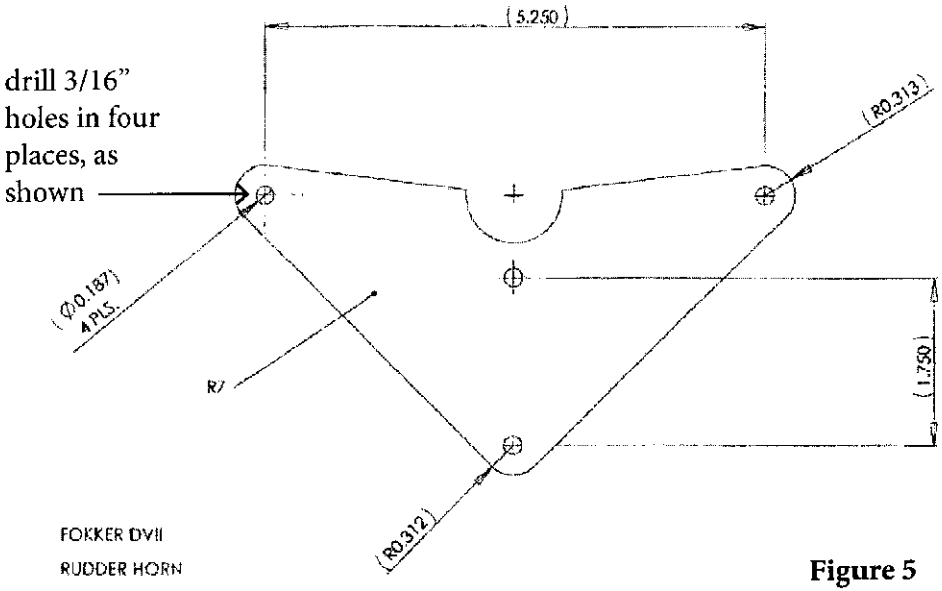


Figure 5

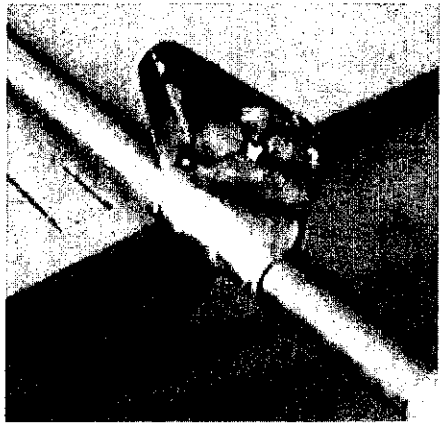
16 **After the rudder control horn is installed wrap RG1 around the front of spar and rivet into side of the rib.**
Piece RG1 starts out as a piece of sheet metal .032 thick, 3" x 6". It wraps around the front edge of the spar and rivets into the spar and 1/2" rib tube. This gusset provides strength to the control horn assembly and helps prevent rocking of the horn on the round rib.

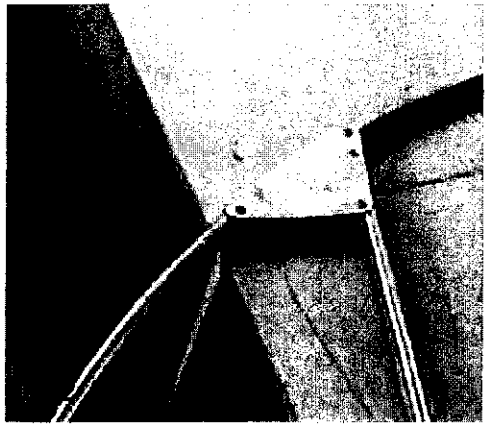
NOTE Only after the fuselage is built, you will come back and set the hinges. You can slide them up and hold them in place with a couple pieces of tap, but don't firmly secure them until after the fuselage is built.

TIP Tight fitting points are important. More so important than dimensional accuracy. For example some of the rib pieces are simply there to support the covering, their exact location isn't critical, but a tight fit is. See **Figure 6**.

17 **Fit and attach the gusset pieces.**
The gusset pieces starts out as two (2) pieces of sheet metal that are 3" square thin aluminum plates. The two plates lay on top of the 1/2" round rib (sandwiched on either side) across rudder bow and trim off excess and rivet in place with three (3) rivets. See **Figure** 7.

That's it for the rudder assembly. Now let's move onto the fuselage.





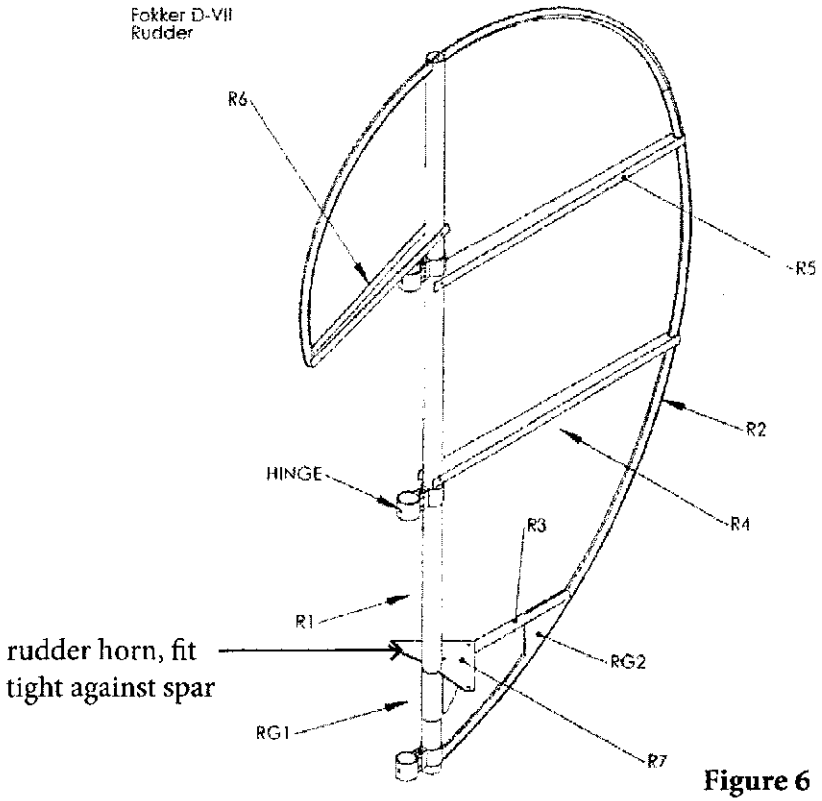


Figure 6

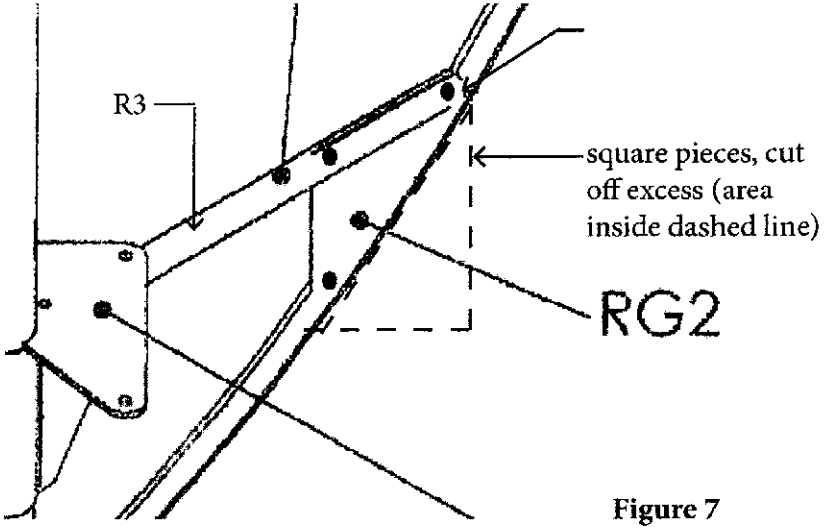


Figure 7

If you have completed your Rudder assembly, it is now time to move onto the Fuselage Assembly. Instructions for the assembly of this sub-kit follow.

NOTE **A few helpful hints and notes before you start assembly of the fuselage:**

- You will need 75 or more wood blocks on hand to build the fuselage. A tip for the blocks is to buy a 1"x2"xX' board(X' being the length you wish to purchase or is available at your hardware store) and cut it up into 2" long pieces, then pre-drill the in each block. The pre-drilling prevents them from splitting.

- The oversleeves will always be cut 2" long and are used in the following locations: four (4) landing gear locations and four (4) cabine attachment locations. The purpose of these sleeves is to increase the diameter of the longeron at these points because the cabines and gear legs are 1.125" wide. If your longeron is 7/8" you will use a double oversleeve which means there will be two sleeves in each location. One would be 1" in diameter cut 2" long, the second is 1-1/8" in diameter and it fits over the first, bringing the diameter up to the 1-1/8" required. If your longeron is a 1" tube then it would only require the 1-1/8" sleeve.

- The fuselage should be as square as possible in all planes. Check and double check this at various times throughout construction to make sure.

- There are a few locations on the fuselage that are critical:
  -Pay particular attention to the front carry through; it's location should be within .062" accuracy. It is very inportant that the left and right are exactly the same.
  -The front and rear cabines and front and rear gear leg locations need to be within .062" accuracy.

- The fin post must be square.

- The rest of the truss work locations are just basic trussing, but make sure the right and left are the same.

- While it is always a good idea to have tight joints and do the best job possible; sometimes you may end up with a joint or two that doesn't fit as nicely as you might like. Most of the time this will not present any problems as long as the workmanship is good and the rivets are tight. While one or two of these are probably okay, if you have more than two you should probably consider doing something different.

1 **The Fuselage assembly starts with a drawing, just like every sub-kit assembly.**
Draw out the assembly full size on butcher paper (kraft paper, mask paper, etc.), whatever you choose that is laid on your work table. **See photo** to the right. Use a pencil, pen, sharpie, whatever you choose. Use the drawing you recieved with your kit. A small sample of the fuselage assembly is shown in **Figure 8.**

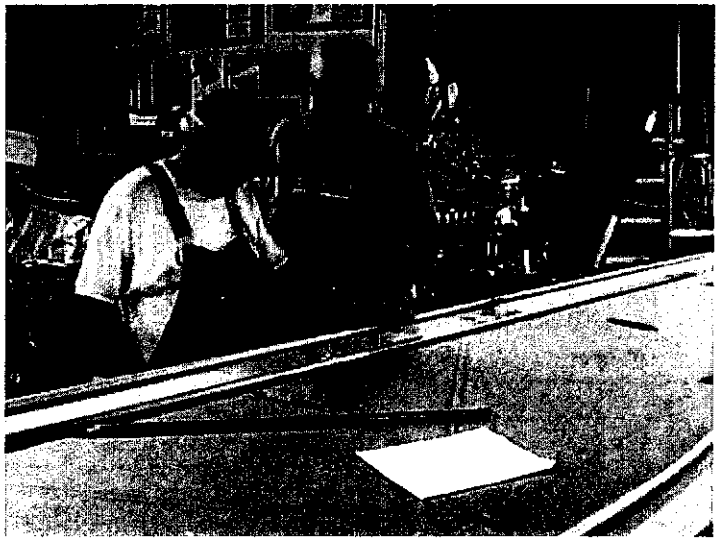


Photo:
Note the drawing on the table, and the top and bottom longerons laying in the correct spot on the full size drawing.

2 **Lay the top longerons on the table and slide the top rear longerons into them.**
The rear longeron will telescope into the front longeron. Slide it in a minimum of 4". If you have more length, use it. See **photo** below.

3 **Join the longerons together with rivets.**
The longerons are joined together with four (4) .187" rivets. Do not drill all of these in a straight line. Drill the first hole then rotate the tube 90 degrees, move over approximately 1" and drill the second then repeat this until you have used a total of four (4) rivets to hold it together.

4 **Join the bottom longerons the same way you did the top longerons.**
You will join the lower longerons in the same manner as the top longerons, but you will notice the bottom longerons have a curve that you will have to form.

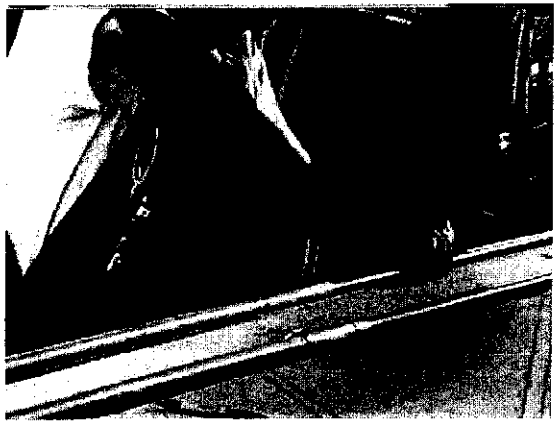


Photo:
Telescoping of the rear longeron into the front longeron and attachment.

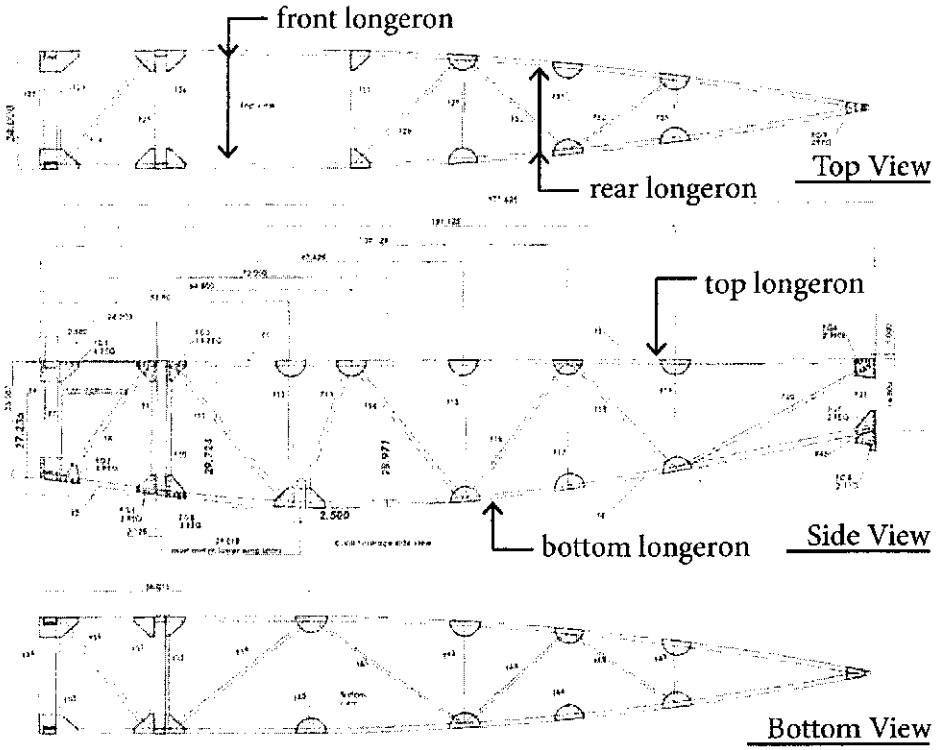


Figure 8

5 **Form lower longeron to match drawing.**
This can be done in several ways but, it's important that no matter how you do it, the result is a smooth curve without any kinks. Typically, I use a 24" plywood circle as a bend fixture, others use a car wheel or something similar. The lower longeron will be bent to match the drawing. It will be bent by hand by forming around your bend fixture (you will receive a template for this and you will have to construct your own) to match the arc or shape you have drawn on the table. **See photo** to right. Again the rear longeron slides into the front longeron a minimum of 4".

Photo: Hand bending the lower longeron on a pre-made wooden form.

6 **Make sure upper and lower oversleeves have been installed on longerons.**
The purpose of the oversleeves is to increase the diameter of the longeron where the landing gear and cabines attach.

7 **Lay both a top and bottom longeron on the table, in the correct place on the full scale drawing, in preparation for coping and fitting the vertical and diagonal members.**

8 **Cope and fit all vertical and diagonal members.**
Start at the front and work your way back to the fin post location. See video for a segment on coping. Some **photo** snapshots from the video are shown to the right and below.

TIP When coping and fitting your verticals and diagonals make two copies of each piece. These will be for both your right and left sides and this way they will identical. Plus, when you are ready to rivet the second side, or half, of the fuselage, the parts will already be made.

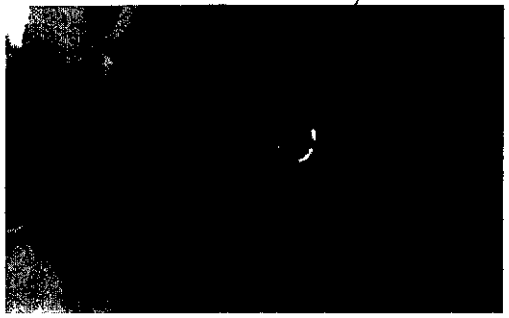


Photo: Sanding and smoothing the pieces after coping them.

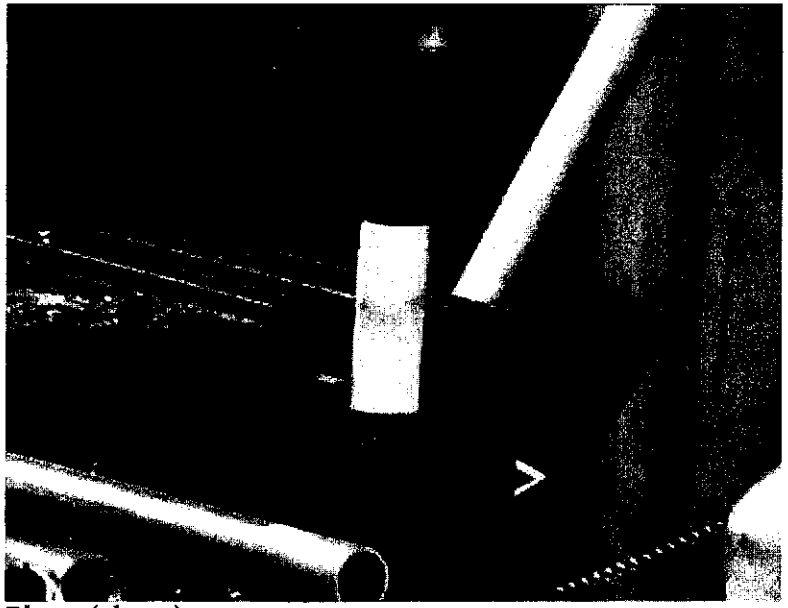


Photo (above): Coping the pieces.

9 **After vertical and diagonal pieces have been coped and fitted, lay them on the table on top of your drawing in the correct places; retain each one with wood blocks.**
Work your way along the drawing with the vertical and diagonal pieces while holding the pieces in place with wooden blocks, they will not be riveted yet. See **photo** at right.

10 **Attach gussets in proper locations with rivets.**
Lay the gussets on the table in the locations where they will be attached and use rivets to fasten them in place. See **photo,** bottom right. There are several drawings of gusset locations in your packet, one example is seen below in **Figure 9**.

TIP There are two types of gussets used on the fuselage; thick gussets (.090") and thin gussets (.032").

The thick gussets will be used in the forward part of the fuselage and the thin will be used everywhere else.

If you are using a thick gusset, use a large rivet. If you are using a thin gusset use a small rivet. Always use four (4) rivets in any tube.

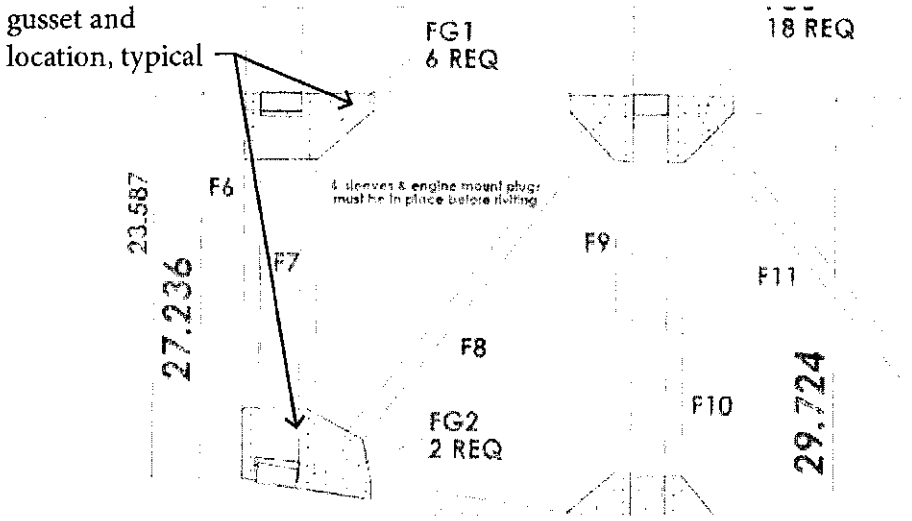


Figure 9

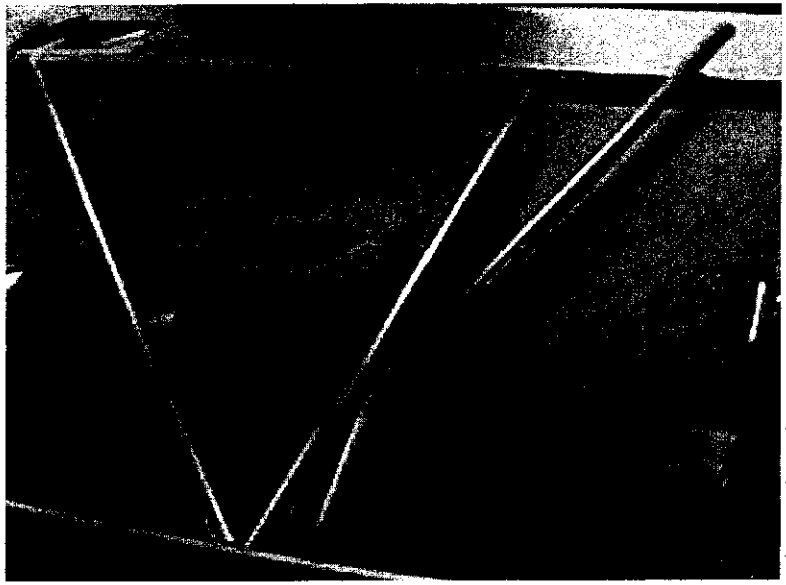


Photo: Coped pieces, laid in place on the drawing and held with blocks.

Photo:
Lay the gussets in their proper places and attach with rivets.

TIP

When fastening 6" round gussets make sure to use caution when centering; keeping in mind that it will wrap around to the top or bottom surface. See **photo** to the right.

Photo:
Attaching round gussets.

11 **After the first side is riveted and complete, remove it from the table, undo the blocks that were holding it in place and remove your drawing from the table.**
Put down a new clean sheet of paper. You will be tracing in the next step.

12 **Now take the first fuselage half you just completed and flip it over on the table so the gussets are facing down.**
With the gusset facing down, use this fuselage half to draw the second side on the paper on the table. Screw down your wood blocks. Now you have made a mirror image and since your previously completed the vertical and diagonal tubes, start riveting and fastening it the same way you did the other side. See **photo** bottom right.

TIP

Make sure you don't make two right sides or two left sides! A few customers have made this mistake in the past. Pay attention and make a mirror image!

Photo:
First side completed and laying gussetted/riveted side down. Building second mirror half on top of other side (new side rivets up).

13 **Symmetry is important! Whatever you do on the left side you must match for the right.**
A CTF (critical to function) dimension is the lower wing carry though which must match the lower wing section. It should be within .062" of the carry through dimension on your drawings. See **photo** far right for carry through example.

Photo:
CTF dimension on the lower wing carry through.

14 **Now that you have both left and right sides of the fuselage done, it is time to join the halves together.**
Clear off your table.

15 **Join the two halves together.**
Put top longeron (flattest side) down on the table so you have a flat surface to work on. It is easier to work on upside down so that the curved piece is not moving all over. See **photo** to the bottom right.

16 **So both pieces should be standing on the table, top longeron down, spaced the correct dimension apart.**
Hold them in place with wooden blocks, spaced the proper width apart. Draw a centerline down the middle of the table. Make sure that you have a square starting point at the front. See **photo** below.

17 **Cope all of the horizontal members that make up the forward fuselage.**
Cope and fit the horizontal members just like you did for the vertical members.

TIP

The first four or five stations in the top and bottom views are the same length, so make and rivet them all at the same time. All of this will be done before pulling the tail together to set the fin post.

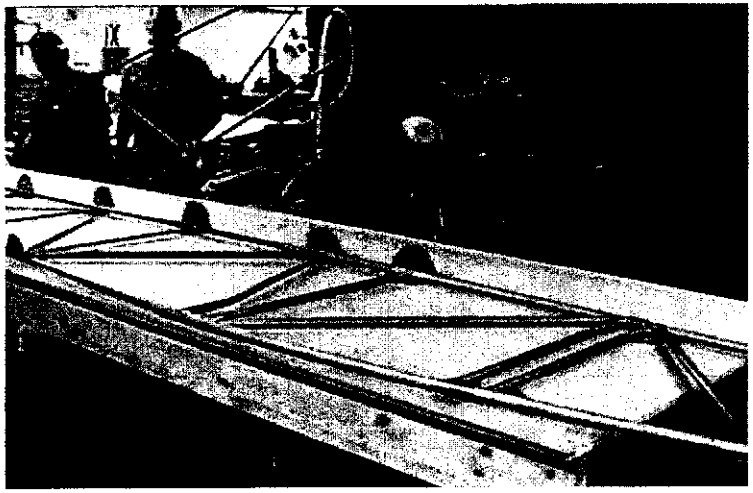


Photo: Round gussets attached and bent.

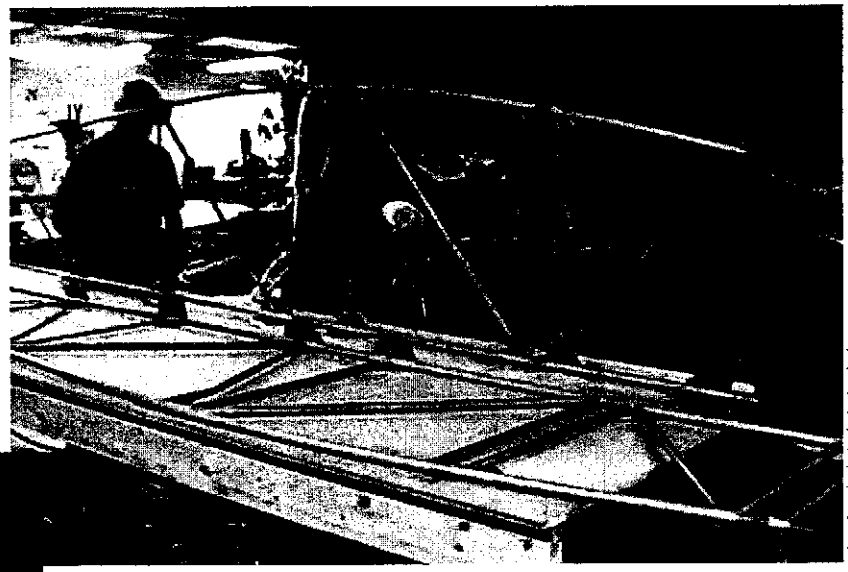


Photo: First half, flat longeron on the table top.

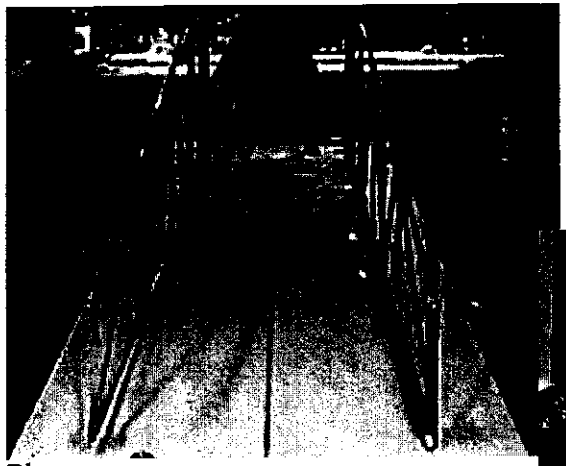


Photo: Both halves correctly spaced about a centerline.

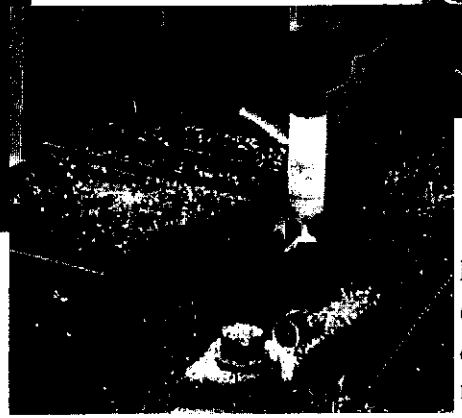


Photo: Once again, coping the members.

TIP Complete everything possible in the forward stations before pulling the tail together.

18 **Start riveting all the tubes that are on the bottom of the plane but top of the table.**

19 **Put in all the cross members and diagonals in from the fuselage forward.**

20 **Pick it up and turn it over and rivet the top.**

TIP Be careful to keep both fuselage sides in plane. During the above few steps, the pieces will be kind of wobbly. Keep fuselage halves parallel in all planes.

21 **Join the two halves together, the next few steps are called setting the fin post.**
Using the centerline (drawn on the table) as a reference, join the two fuselage halves together at fin post. Pull both sides to the centerline and let the fuselage take its natural shape.

TIP Use electrical tape, clamps, rope, whatever you choose to hold together; careful to keep fin post square and on centerline.

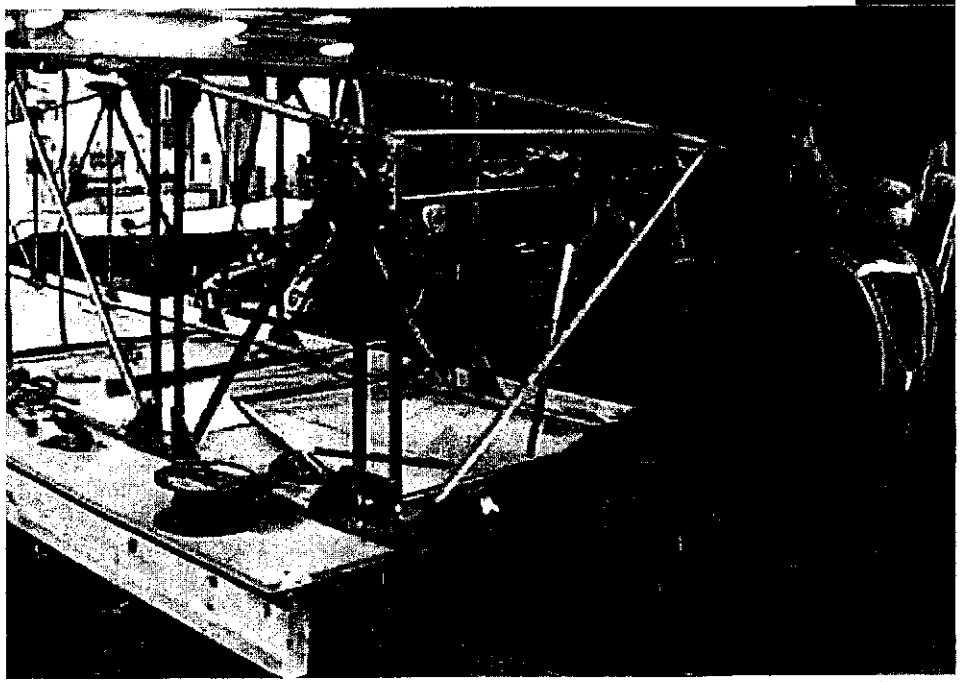


Photo: During the installation of the cross members and diagonals make sure that the two halves stay in plane, check and double check as you move along.

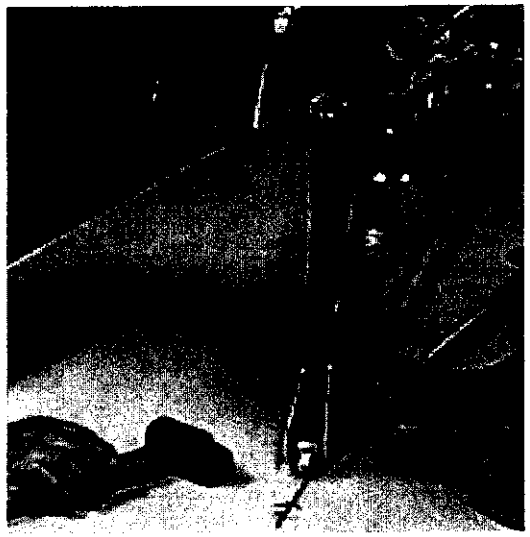


Photo:
Setting the fin post. Use the centerline drawn on the table and use a temporary hold to bring the halves together.

22 **Use one (1) small rivet in both the top and bottom longeron as a temporary fix on fin post.**
Once you have your longerons square and parallel using the temporary small rivets; fix, check and double check to make sure it is square. See **photo** to the right.

23 **Fit and rivet all remaing horizontals and cross bracing.**
See **photo** bottom. Once all the remaining tubes have been place and secured you can drill out the small rivets used as a temporary hold and replace with large rivets.

NOTE The rear longerons will be 3/4" wide each. This will prevent the fin post from fitting because it is only 1", therefore, you will need to flatten the inside wall of each to be around 1/2" to allow everything to flush up.

24 **After the fuselage is complete check it over for missing rivets or errors in construction.**
When you feel you have completed the fuselage and set the fin post, go back and make sure to check for any errors or omissions. Look for things like missing rivets, make sure you replace anything you set temporarily with permanent fixtures. Just check and double check.

Photo:
Make sure everything is level and square and use one rivet at the top and bottom of one side of the longeron to hold in place.

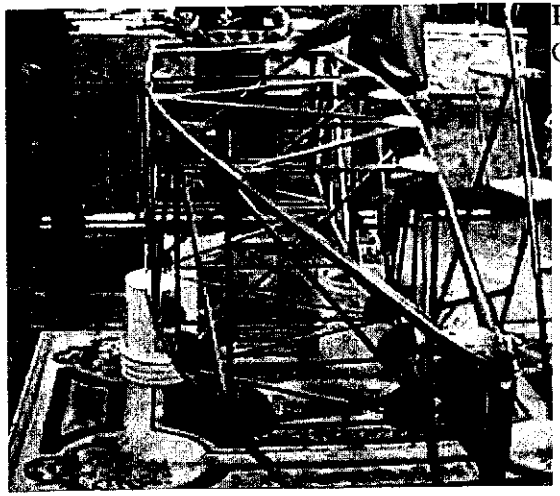


Photo:
Cross Braces

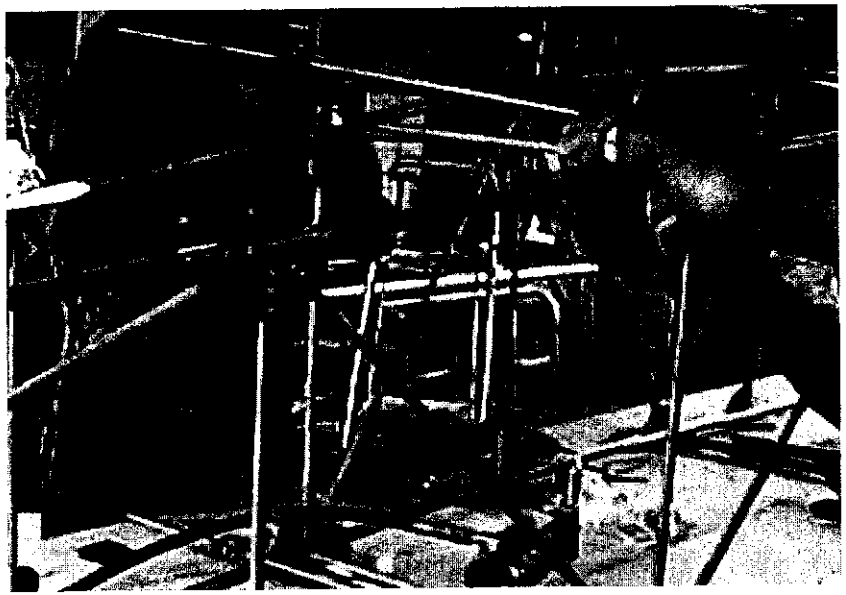


Photo:
Attaching and fitting the horizontals.

1 **Draw out the Horizontal Stabilizer assembly full size on the table.**
Start with horizontal stabilizer spar (will be marked as the first piece in your kit), draw it on your paper on the table. Draw the rest of the pieces.

2 **Bend the H2 pieces.**
See the drawing that accompanies your kit for the angles.

3 **Lay the two (2) inboard pieces on the table.**
Note that the two inboard pieces must match the angle/taper of the rear fuselage longerons.

TIP To get the inboard pieces to match the rear fuselage longerons, turn the fuselage upside down on the table and trace the longerons on the paper. This will get the proper alignment for the two inboard pieces. See **Figure 10**.

4 **Layout all the Horizontal Stabilizer pieces on the table.**
Lay the pieces out and hold in place with blocking, tape, whatever you choose.

NOTE The horizontal stabilizer and elevator will be built just like the rudder was; start with the spar, next the bow and then the ribs.

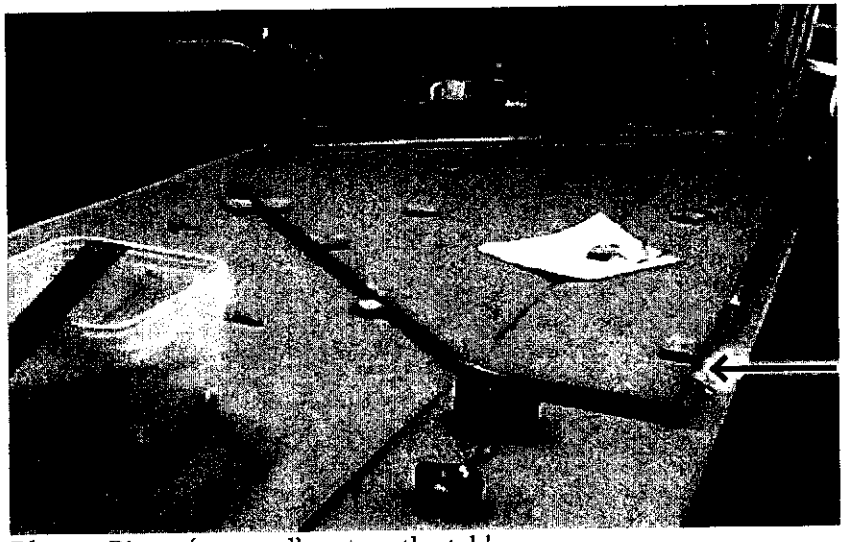


Photo: Pieces 'mapped' out on the table.

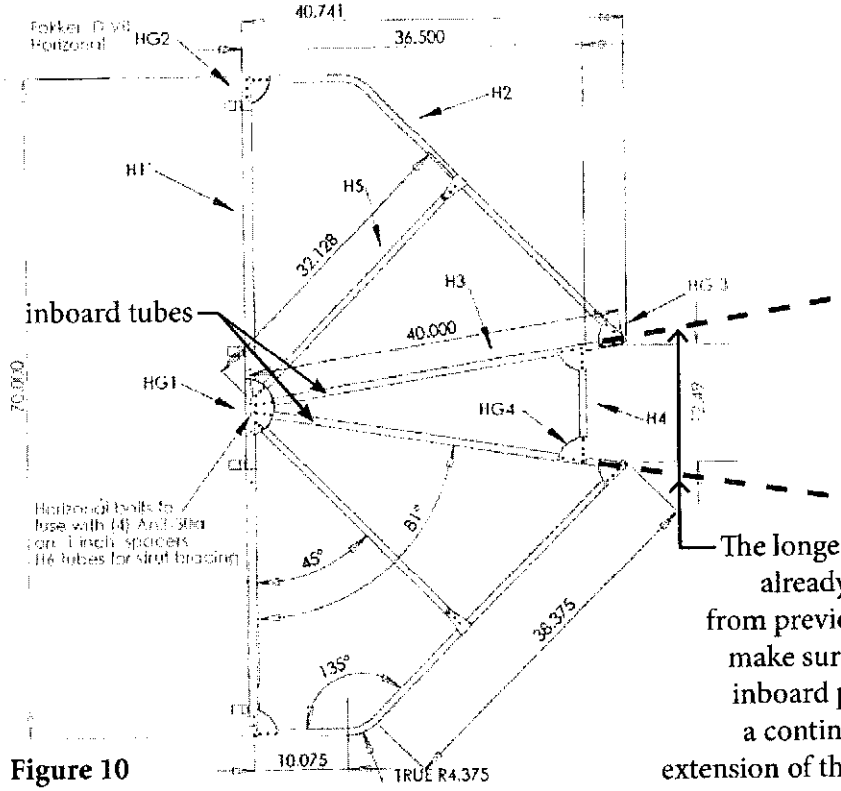


Figure 10

The longerons, you already have set from previous steps; make sure that the inboard pieces are a continuation or extension of those lines.

5 **Continue laying out and assembling the pieces in order.**
Use gussets and rivets as indicated in your drawing to secure pieces. Pay attention to your drawing for the size and configuration of the gusset required for fastening.

NOTE Before you fasten or secure anything to the spar, make sure that the female hinge halves are in place on the spar.

6 **Once the horizontal stabilizer is complete start working on the elevator (Figure 11).**
Draw out the elevator assembly on the table, just as you have with all the other assemblies. The pieces marked with an 'E' are elevator pieces and start assembling those in order, just as you have with other pieces up until this point.

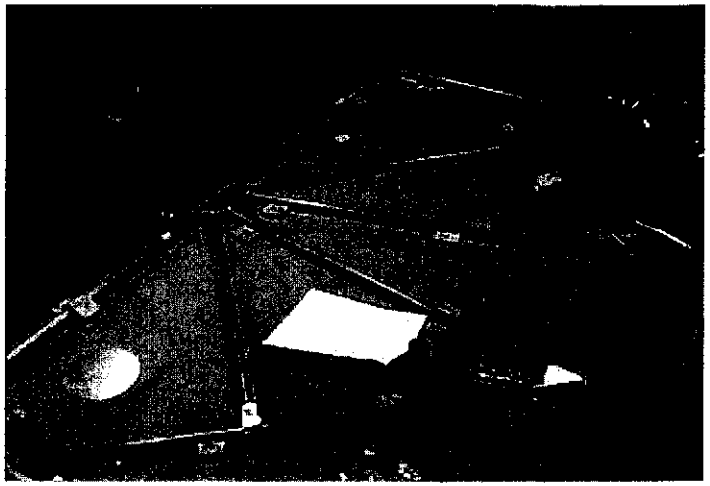


Photo: Horizontal stabilizer pieces laid out on the table for fastening.

7 **Lay the spar on the table and make sure the male hinges are in place before you securely fasten anything.**
When the elevator has been assembled this piece will bolt to the horizontal stabilizer that contains the female hinge halves which you have just completed in previous steps.

8 **Make smooth curves on the aileron pieces.**
It is very important to make nice, even, smooth arcs/curves on elephant ear aileron pieces, also called an elephant ear.

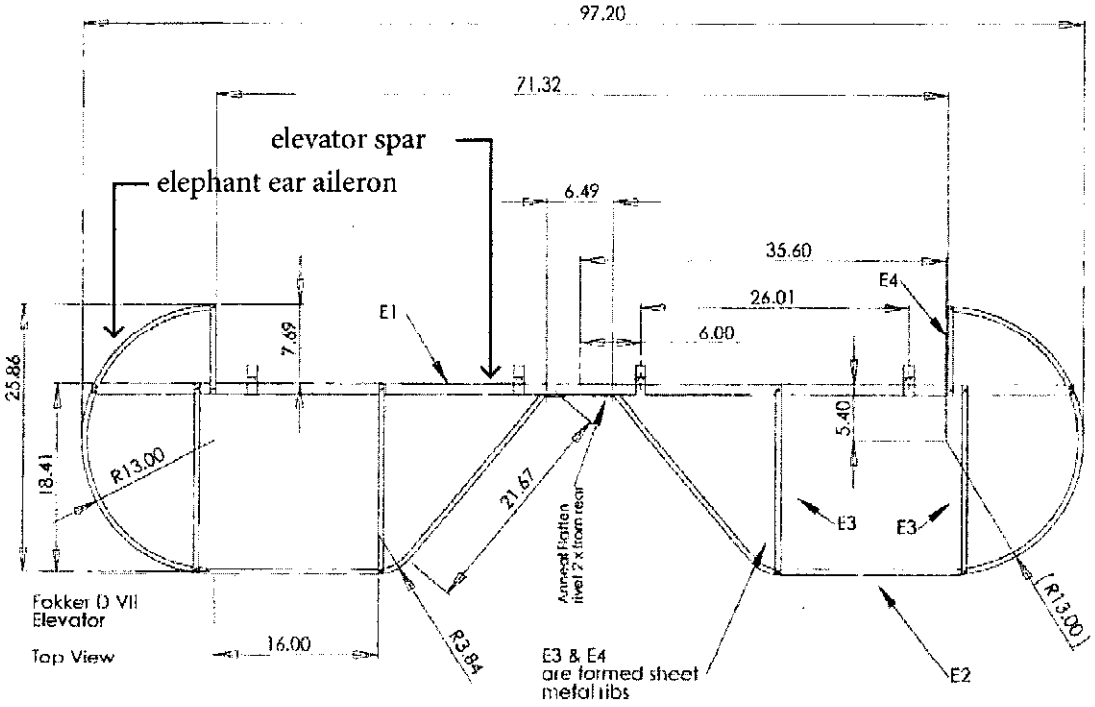


Figure 11

9 **Next build the sheet metal ribs.**
These are just sheet metal ribs, constructed similarly to those earlier as part of the rudder construction. See your drawings for dimensions. **Figure 12.**

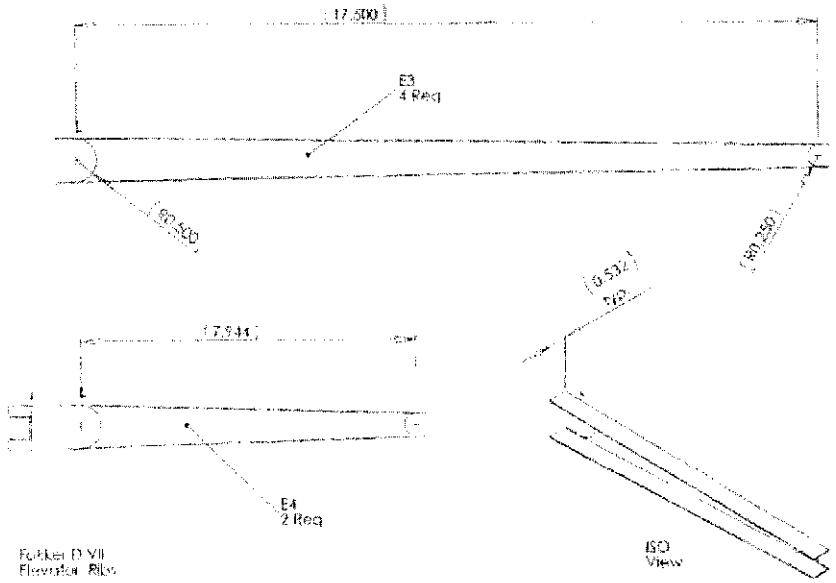


Figure 12

10 **Where the elevator bow (elephant ailerons) goes through the spar it should be coped to fit.**
Just as you did for the rudder construction, the elevator spar will be coped to allow the elevator bow to pass through and be secured. See **Figure 13**. Fasten with a rivet on the top and bottom.

11 **Anneal and flatten the elephant ear ailerons pieces to fasten to the elevator spar.**
At the end of the elephant ear aileron, where it is to meet the spar, anneal and flatten a 1-1/2" section of the tube and secure with two rivets. See **Figure 14** for location.

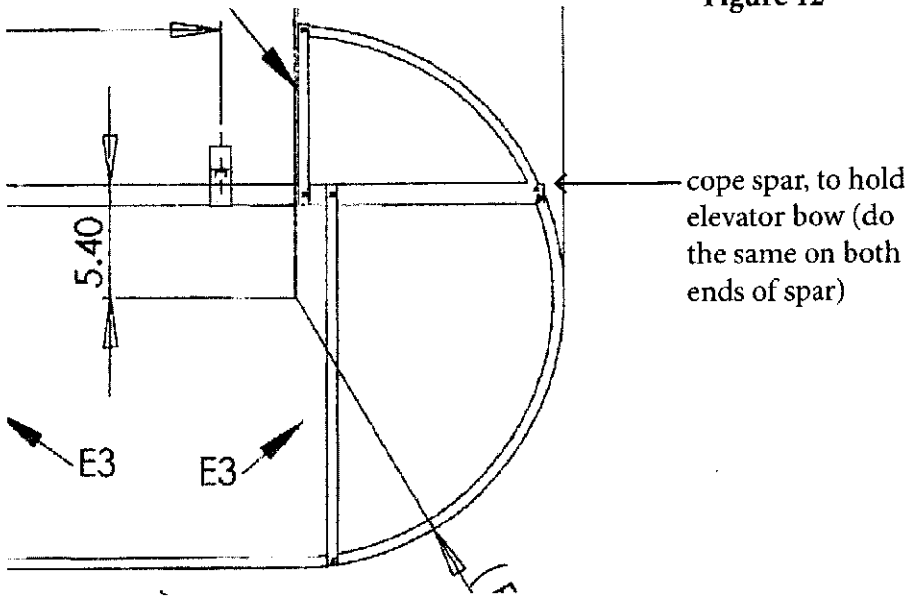


Figure 13

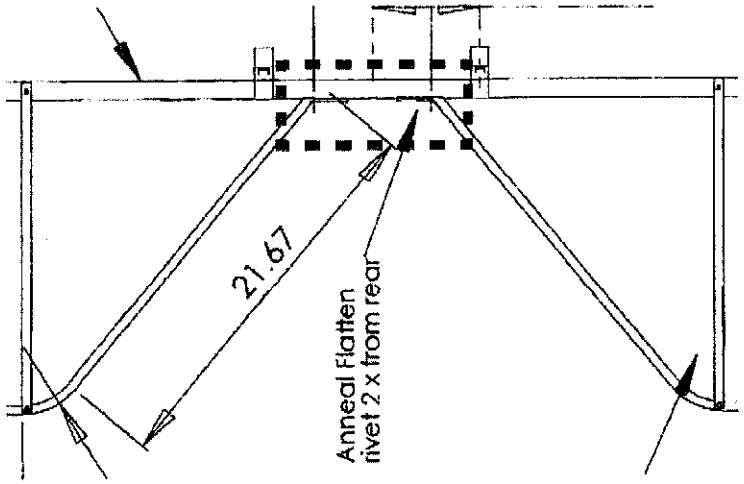


Figure 14

12 **Finish assembling the elevator pieces in order and attach as your drawings indicate.**
After you have the pieces laid out and temporarily fastened in place, go ahead and attach and fasten as your drawings indicate using rivets and gussets where necessary.

13 **Once the Horizontal Stabilizer and Elevator have been assembled, it is time to start mounting them to the airplane.**
The horizontal bolts to the fuselage with (4) An3-30a bolts on one inch spacers. See your drawings for more detail.

NOTE Make sure the horizontal stabilizer is slid far enough forward that the back edge of the elevator spar has clearance of the front edge of the fin post.

14 **Once the Horizontal Stabilizer and Elevator have been assembled, it is time to start mounting them to the airplane.**
The horizontal bolts to the fuselage with (4) An3-30a bolts on one inch spacers. Bolt down through HG1 and through the spar and also bolt through HG4 and H3. All bolts will go through the horizontals, the spacers and through the longeron. See your drawings for more detail.

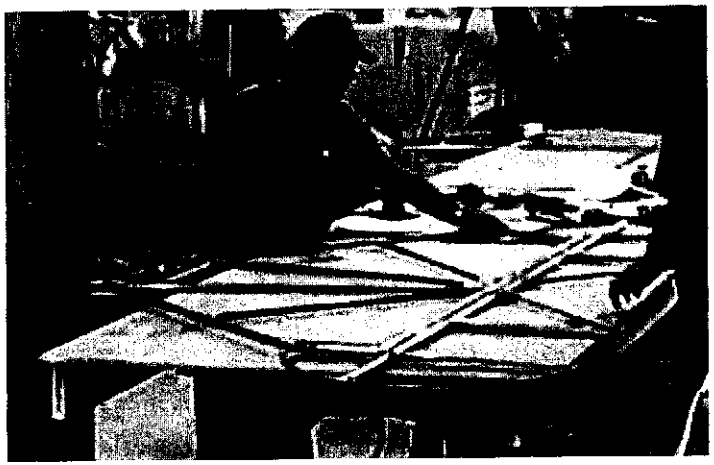


Photo: Horizontal stabilizer and elevator pieces together.

NOTE When mounting the horizontal stabilizer to the fuselage you can shave or shim the one inch spacers so the stabilizer sits perfectly flat on the fuselage. This is where you can compensate for any minor building errors; that is part of the purpose of the spacers.

NOTE Adjusting or changing the shims or spacers here is also how you would adjust the trim speed of the airplane.

15 **Once the Horizontal Stabilizer and Elevator have been bolted to the fuselage, strut brace from the bottom of the fin post.**
Heat, anneal and flatten both ends of the strut pieces. Using AN3-17A bolts, fasten the struts to the fin post and then bolt the other end to the gusset plates. See **Figure 15.**

16 **The topside of the stabilizer will be connected to the fin post with 3/32 cable and tangs.**
Run the cable through the tang, swedge the cable and fasten with a bolt.

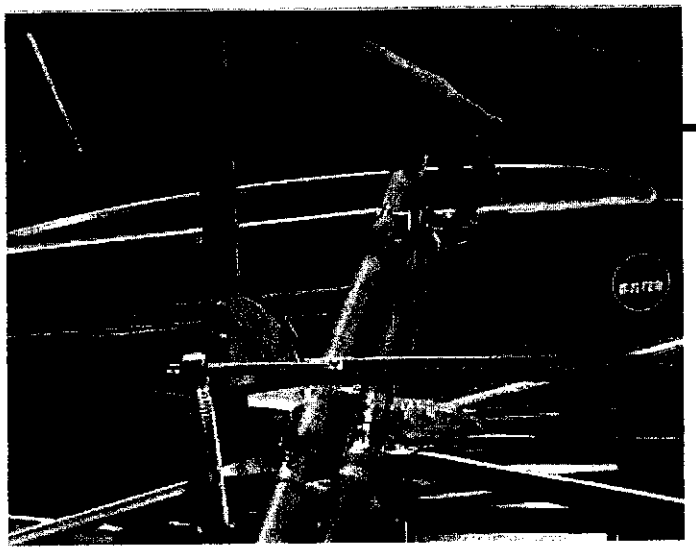


Photo: Attaching the stabilizer and elevator to the fuselage.

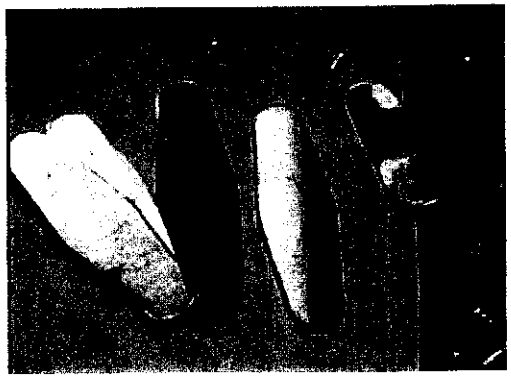


Photo: Double and single drag tangs.

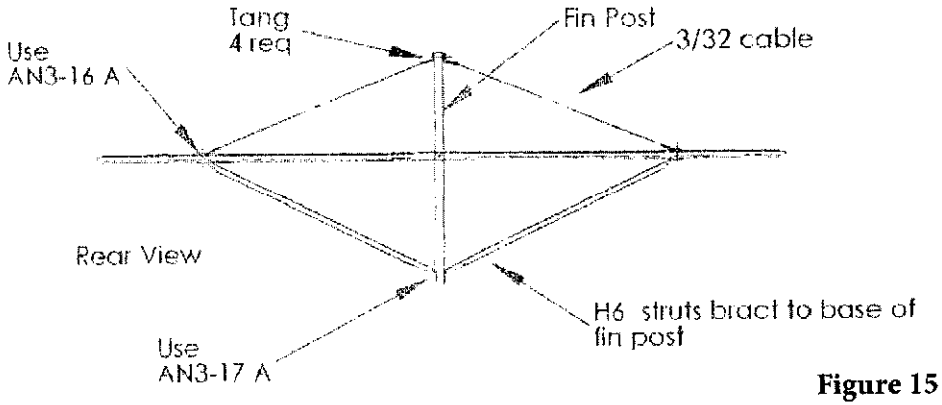


Figure 15

1 **Draw out the landing gear on the table.**
Same step as usual; draw out full size on paper on the table. You will be building and assembling the gear flat on the table.

NOTE The left and right sides of the landing gear will be exactly the same.

TIP Lay the fuselage on its side on the table and trace the longeron curve and pieces that will engage with the landing gear. See **Figure 16**.

2 **Using the fuselage drawing you made, measure straight down the dimension noted on your gear leg drawing. And then measure straight across the noted dimension.**
When you have measured down and over, make a crosshair type mark, see **Figure 17**. This point is that the gear leg will be built around. See **photo** below.

3 **After you have made the crosshair point and using your fuselage drawing as a reference for where the gear legs will attach; lay the gear legs and lower gear plate in position.**
Temporarily secure the two pieces in place with wooden blocks.

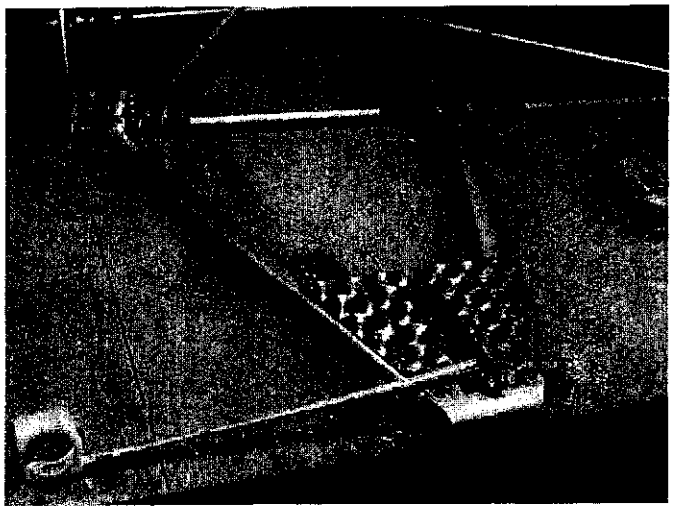


Photo: Fuselage, drawing and landing gear pieces laid in place.

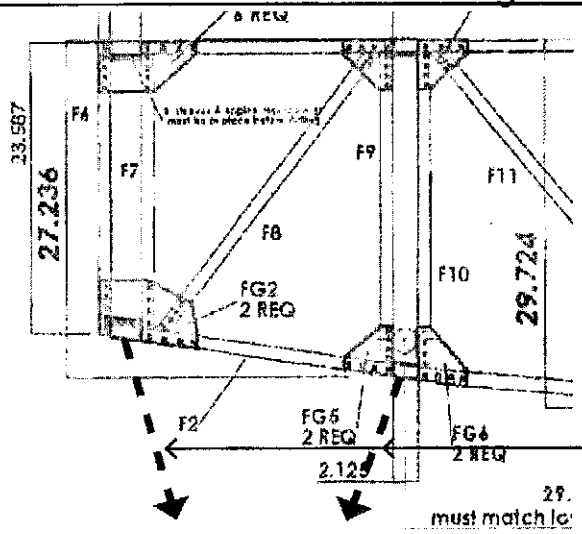


Figure 16

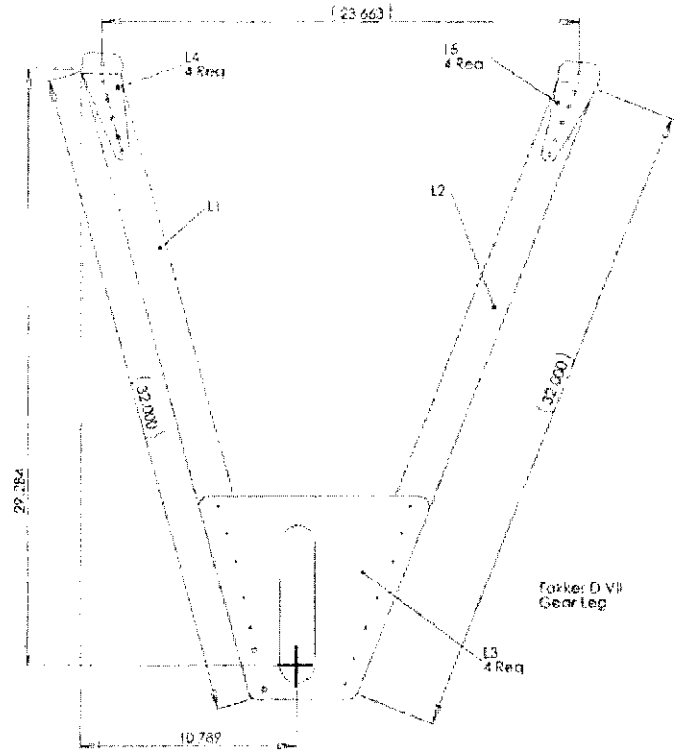


Figure 17

4 **Cope and shave the tubes so they fit nicely into the longeron.**
The gear leg pieces will have to be coped on the top and cut straight on the bottom.

5 **Lay the gusset plates in place and secure.**
Secure gusset plates with seven (7) equally spaced rivets. Flip over and rivet the second side of the leg. See **photo**. Now one gear leg has been completed.

6 **Build the second gear leg just as you built the first.**
Once one gear leg is done, build the other just the same.

7 **Lay the fuselage upside down on your workbench.**
Lay it on the table so the bottom of the fuselage is in the air. Set the two landing gear legs down and let them engage the fuselage. They will engage at the firewall where you previously installed oversleeves. See photo. At this point they are essentially sticking up in the air. Now take the legs and swing them out; then taking a motorcycle strap or wratchet strap hold them temporarily in place.

NOTE Before you attach the gear legs to the fuselage with the bolts called out on your drawings, make sure that you have installed your engine mount plugs. The bolts you use to mount the gear legs will pass through the engine mount plug, so it must be in place.

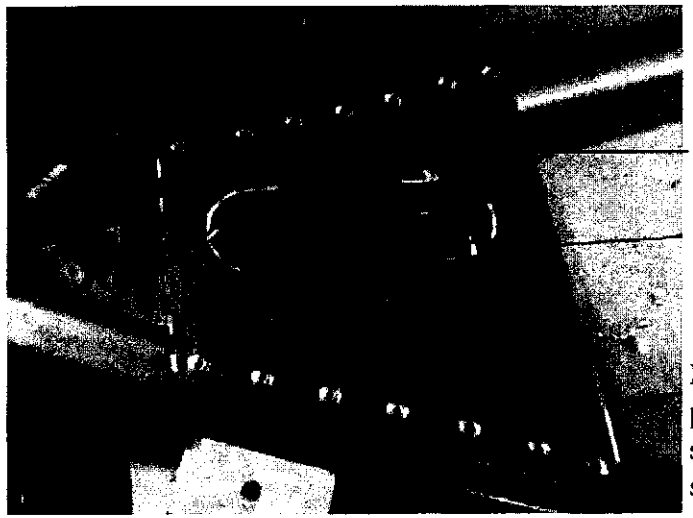


Photo: Gusset plate with seven equally spaced rivets.

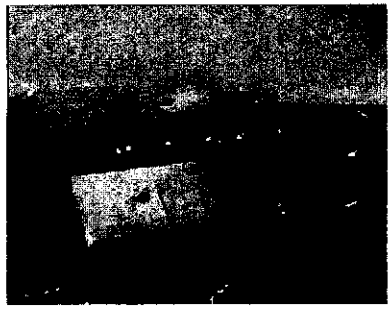


Photo: Gusset plate and five rivets at top of leg

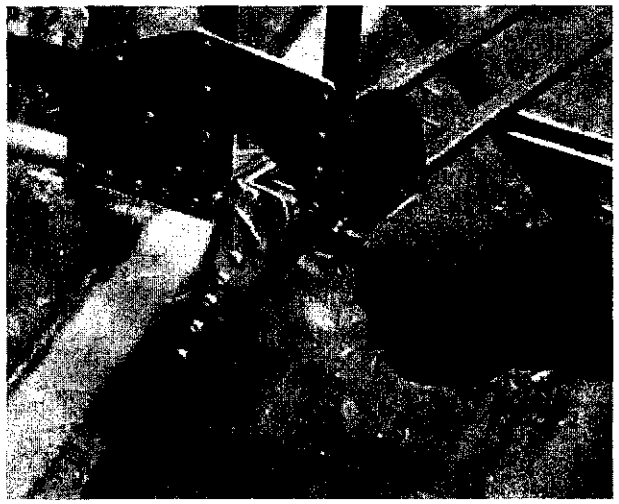


Photo: Landing gear leg engaged with oversleeve on fuselage

NOTE Gear position for and aft or vertical is not the most critical, these should be within .062". However, it's very important that the for and aft distance is as close as possible to one another, this will improve ground handling.

8 **Take the table down or move it aside and out of the way.**
You will need the space to lay the fuselage upside down on the floor.

9 **Set the gear legs in place on the fuselage.**
Set them in place and allow the gear legs to swing out about 20 degrees. Use a wratchet strap to hold it temporarily in place.

10 **Install the spreader bar brackets and spreader bars.**
Drill one bottom rivet hole out and bolt in a 'U' bracket. See your drawings for the dimension at which your spreader bar will be fastened, effectively 'spreading' the two landing gear legs apart.

11 **Mount and cable brace the landing gear.**
Measure corner to corner to make sure everything is square, then drill straight through the upper gear plate and longerons. Use bolt to retain the tang, but do not tighten it up. Put in the rest of the bolts and tangs. Pull the cables as tight as possible, then check to make sure everything is square. When you are sure it is square, swedge the cables. When all the swedging is complete tighten down the bolts, this will pull the cables tight. See **Figure 18**.

12 **Build the axle assembly and slide through the landing gear track.**
Assemble the pieces that make up the axle as provided with your kit. The PVC plastic wear bushings are used to provide a wear point as the axle moves up and down in the slot preventing the axle from becoming worn. Once these are together slide them through the landing gear track.

NOTE Later the wheels will go on and be held in place with wheel retainers that will attach to the axle.

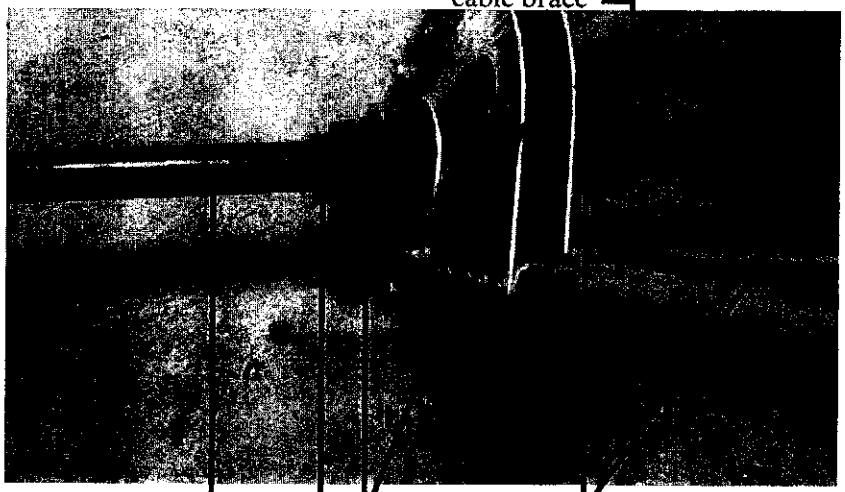


Photo: Axle assembly, gear legs, bungee cord suspension.

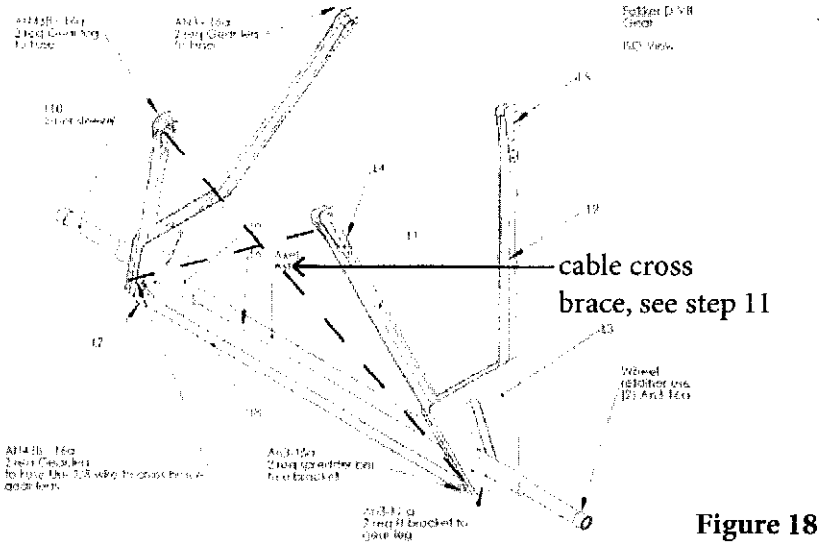


Figure 18

13 **Install the bungee cord suspension.**
The plane has a bungee cord suspension. Install the cord by wrapping around the wearbushing on the outside of the gear leg and then go under the leg and wrap around on the inside of the gear leg. The bungee cords are wrapped around the axle and attached back to themselves with safety wire. After this step is complete, stretch and wrap the bungees in a figure eight pattern and end this process by attaching it back onto itself just the way you started.

NOTE You can control the firmness of the landing gear by the tension you put on the bungees while you are installing them. It is normal for them to stretch and loosen up a bit in the first year or so.

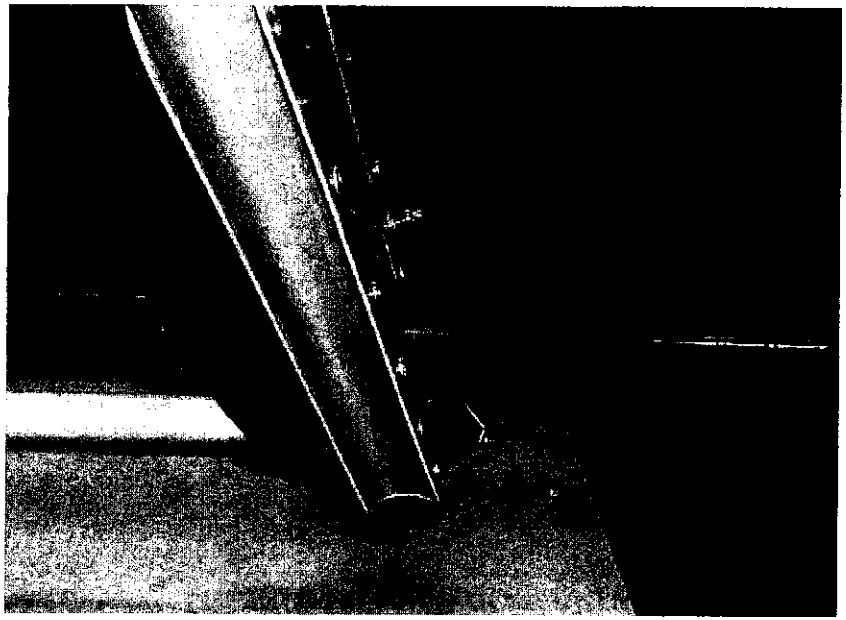


Photo: Bungee cord installed.

14 **Go ahead and assemble the tail wheel landing gear.**
The pieces for this are labeled with a TW prefix. Assemble them as shown in your drawings.

The Spars

This step always starts the same way regardless of it's a mono plane, bi plane or tri plane.

1 **Locate the front and rear spar pieces.**
Lay then out on a pair of saw horses and align them to one another using the center line as a reference.

2 **Insert the inner sleeves.**
Insert the appropriate inner sleeves in the correct locations. See your drawing sfor sizes and locations.

☐ **If you are building a bi plane, locate it's spars and complete the previous two steps.**

☐ **If you are building a tri plane, locate it's spars and complete the previous two steps.**

NOTE **If you are building a bi plane or tri plane, this is a VERY IMPORTANT note:** The outer compression strut is where the cabines or I struts will attach. It is important that all of these line up with one another. Another thing that will affect this is the top wing center section fuselage width. If you widened your fuselage this must be compensated for at this point.

3 **Mark the spars for drilling.**
Always measuring from the centerline, mark all of the spars for drilling locations. See the drawings that came with your kit for these locations.

4 **Start drilling.**
Once all the locations are marked on the spars and you are happy with the alignment, it is time to start drilling. It is useful to use a long drillbit for this. This helps to make sure that you are drilling straight through the centerline and are square in two planes.

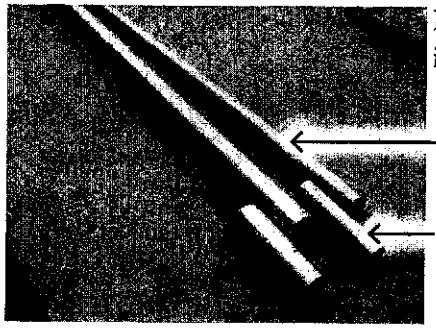


Photo: Spars and inner sleeves.

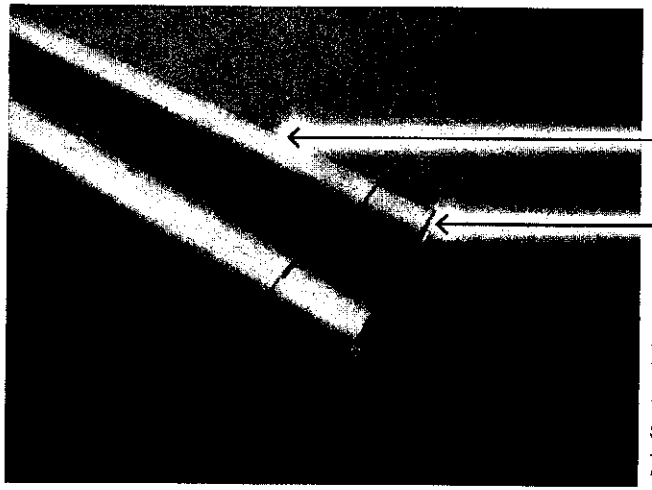


Photo: Front and rear spars with inner sleeves in the correct locations.

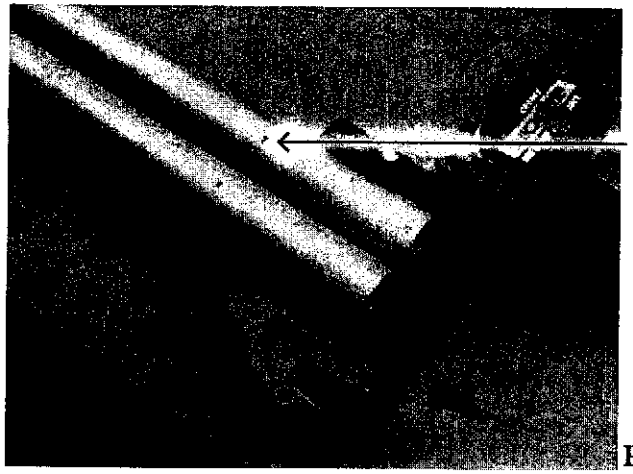


Photo: Marked spars.

NOTE At this point it is a good place to stop and think a little about the hardware installation. Builders in the past have breezed right through this step only to realize much later in the project that their wings were not equipped with the proper fittings for the compression struts. The compression strut has two functions. The first is to hold the front and rear spars apart while the drag/anti drag wires hold everything together and keep things square. The second function is to provide a structure attachment point for the lift and landing wires, as well as the cabines and I struts.

5 **Understanding the hardware to be installed with the compression struts.**

At both the front and back of any compression strut there will always be a drag/anti drag tang. If the strut is either an inboard or outboard strut then it will use a single sided tang. If it is a center compression strut then it will use a double drag tang (a tang with two sides). See **photos** for tangs and how to drill the holes in them.

The second piece of hardware that might be added is a heavy duty lift tang which will be used to attach the lift wires and the landing wires.

The upper wing will always have a lift tang located where the I strut strut attaches. It will also have a heavy duty lift tang located in the inboard compression strut where the cabines attach to the landing wires.

If the upper wing is a three piece wing the heavy duty lift tang would be located on the center sections of the outboard compression struts.

Lower wings will always have a heavy duty lift tang located at the outer compression strut where the I strut attaches.

Now that you have an understanding of where and why tangs are located it will make it easier to read and implement your design plans.

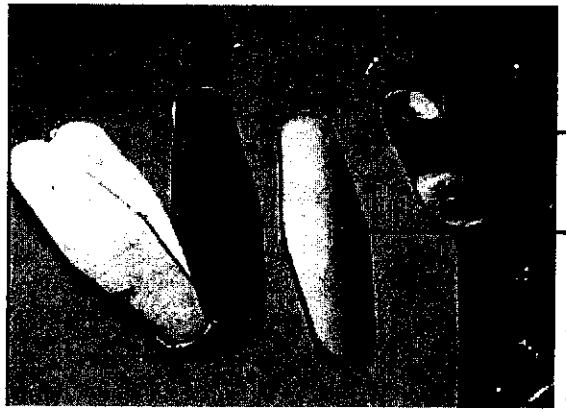


Photo: Single and double tangs.

single sided tang

double sided tang

Note: The tangs in your kit will come as shown (undrilled) you will have to drill the holes yourself.

Photo: Pilot drilling the drag/anti drag tangs.

Pilot drill your single and double sided tangs with a 3/16" drill bit.

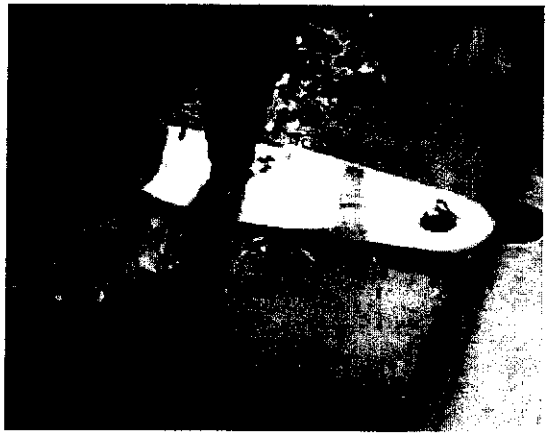


Photo: Drilling holes to correct size.

Use a uni-bit to drill the correct size holes. On the small end(s) on both the single and double drag tangs drill a 1/4" hole; and on the large end of the single and the center of the double drill a 5/16" hole.

NOTE Never drill a hole in the spar that does not need to be there just to add a bracket or other piece of hardware. Never drill a hole in the top or bottom surface of a spar because this will weaken it and possibly cause a complete failure.

6 **Install the hardware on the spars.**
Install the single or double drag/anti drag tangs, and heavy duty lift tangs on the spar where you have previously drilled for their connection. When installing the heavy duty lift tangs on the spars always install these next to the spar. Next install the single or double drag tangs.

7 **Install the compression strut plug and nut.**
This is the final step in installing the hardware for the compression strut on the spar. Once the nut and plug are in place and tightened double check to make sure that you leave at least two threads sticking through the nut. This is very important and you won't ever get to see this part of the plane again, so check now.

8 **Cut the compression struts.**
Now that all the appropriate hardware has been installed it is time to cut the compression struts.

Your objective here is to keep the wing spars exactly parallel and to match the dimensions shown on your plans. In the previous step you installed hardware for the compression struts on the spars and the hardware had some different configurations; therefore different dimensions. This means that some of the compression struts will be different lengths to make up for these dimensional differences. Use your math and plan reading skills and carefully cut the struts so that your final cut product means your wings spars will be parallel and the correct overall dimension after the struts are installed!

NOTE Compression strut lengths will have to be adjusted to keep the spars parallel and on dimension.

9 **Install the struts over the compression strut plugs.**
After the struts have been cut, install them on the strut plugs. See **photo**.

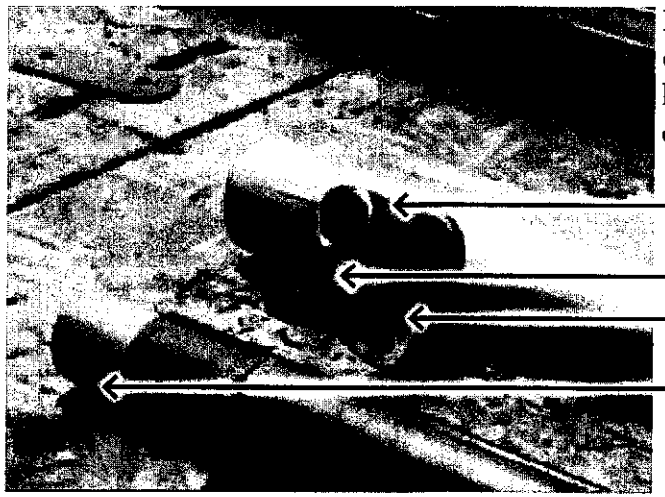


Photo: One of the possible hardware configurations.

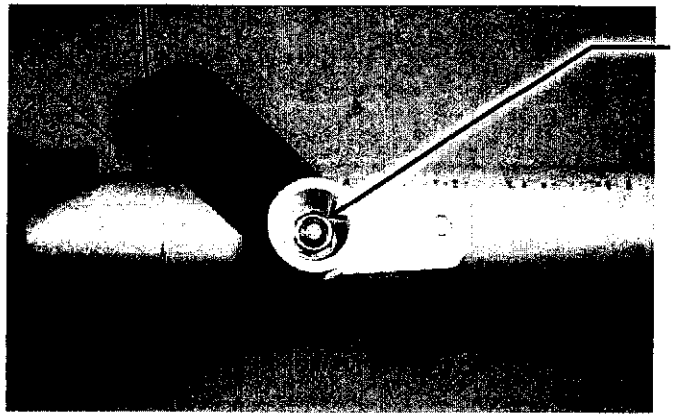


Photo: Compression strut plug and nut. Note that the single drag tang and heavy duty tang shown may look different than what is in your kit.

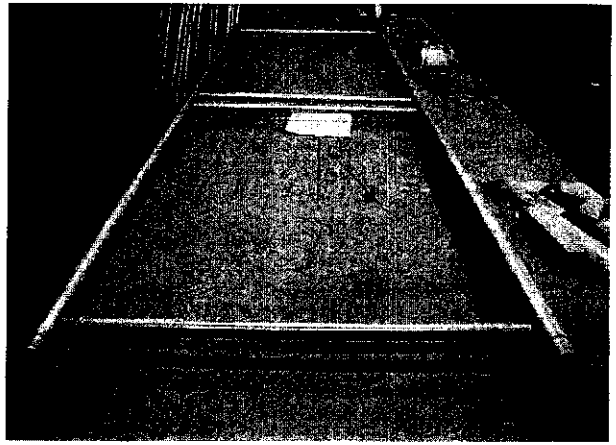


Photo: Compression struts installed.

10 **Square the spar assembly and set the drag/anti drag wires.** If your aircraft has a three piece wing, always start with the center section first then fit the outer wing panels onto the center section making sure that they slid together nice and snuggly. Then set the outer panel wires. The wires need to be as tight as possible to keep the spar assembly square during the building process. In the video there are several neat techniques that will help with this.

This completes the spar assemblies, now it is time to start building the ribs.

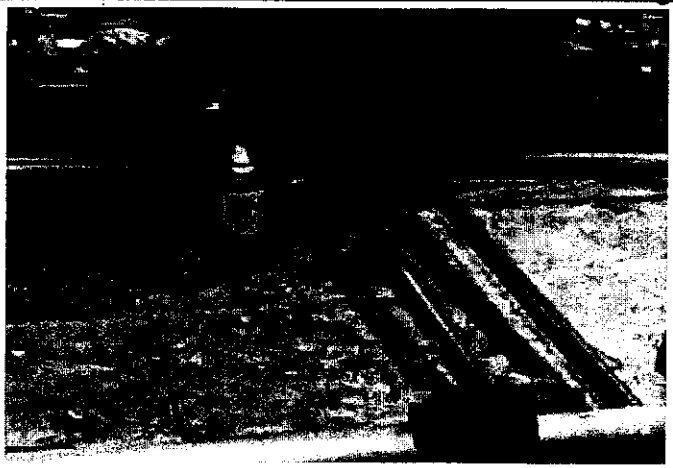
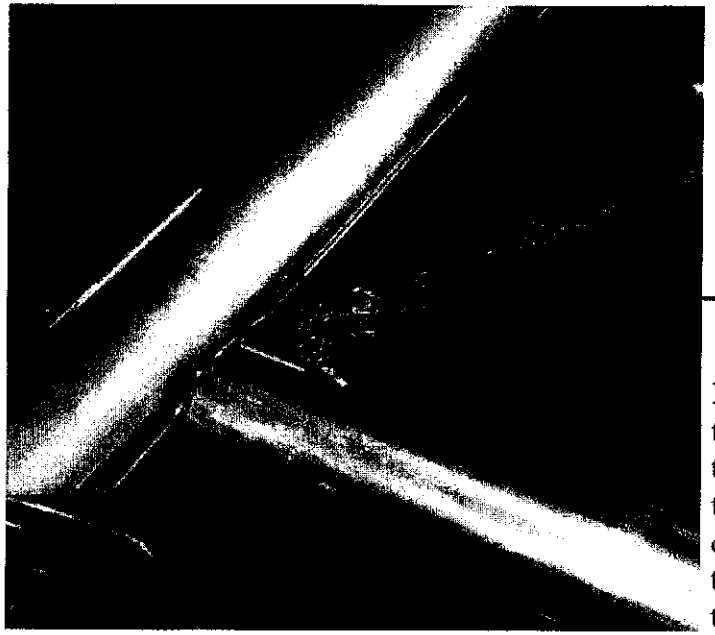


Photo: Sliding the side panel onto the center section.



– drag/anti drag wire

Photo: Setting the drag/anti drag tang wires. Note: this is a photo of a compression strut that does not have the heavy lift tang.

11 **Now it is time to start the rib fabrication for the wings.**
In your kit you have recieved two full size tracing patterns of the airfoil for you to form the correct shaped ribs. You also received a tracing pattern for the bend fixture, which have previously mentioned and used. You will utilize the bend fixture again that you used when you formed the longerons for the fuselage. See photo.

The bend fixture is glued down to a piece of 1/2" plywood and then cut out with a jigsaw. Be careful to keep this arc as smooth as possible because this will be the surface that the ribs are bent on.

NOTE **Be consistent in rib fabrication.**
It is very important that you are very consistent with every step of this process from how you hold the material to where you place your hands on the tube as you move down, even the temperature of the material will affect the bending. It is up to you to develop a process that will give you the closest shape to the airfoil profile for your plane. With a little work you should be able to bend a profile that is and exact match to the the airfoil. If your part doesn't match you will need to work it by hand until it does.

12 **Form the metal tubing to fit the correct airfoil dimensions.**
Using the bend fixture bend your tubing carefully and consistently for each rib. On the bend fixture make a mark that will become your reference mark, you will transfer this mark to the rib pieces. You will go back and use this mark again and again to make sure your formed pieces line up and are consistent. See photo.

TIP Always put a mark on the bend fixture and while bending the ribs transfer that same mark to the rib as a reference point, this way it will be identical on all parts. Because once you remove the rib from the fixture all you have is a constant changing arc and there is no way of locating a point on the tube. This will come in handy when you are cutting the leading edge of the rib to fit tangent to the spar.

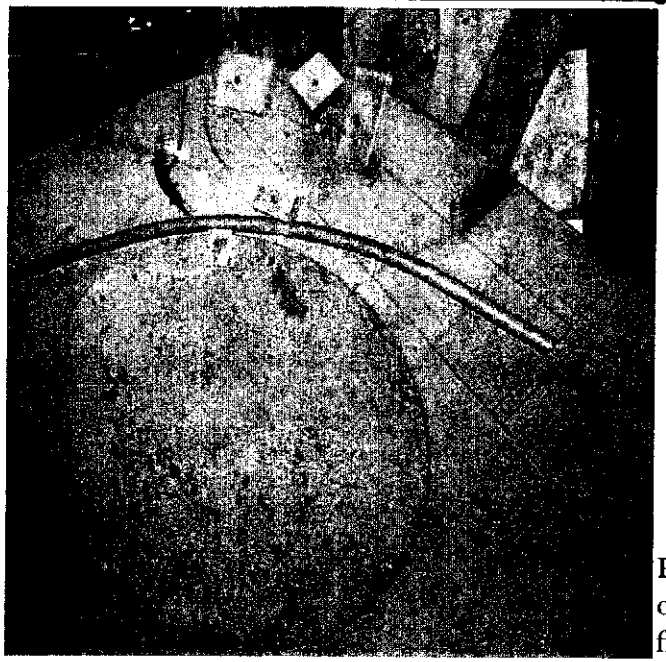
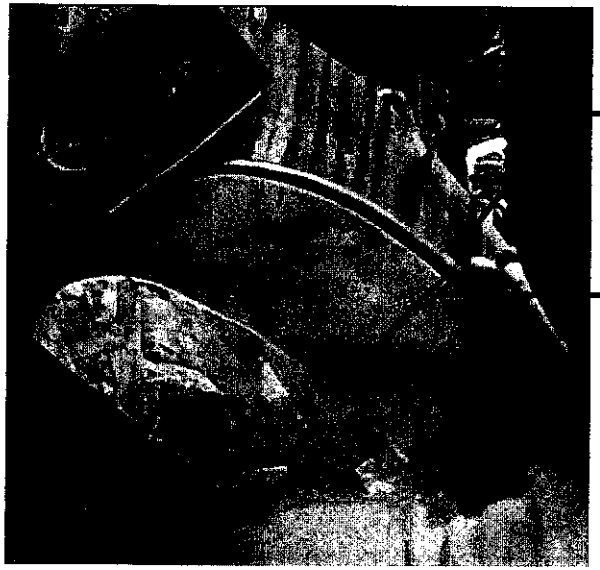


Photo: Example of a type of bend fixture.



making reference mark on tubing that corresponds with mark on bend fixture

bend fixture reference mark

Photo: Bending the tube to form the rib and marking the refernce mark with Sharpie.

13 **After you have done the initial bend on the rib (and made a reference mark), take it over to the full size airfoil template and lay it down to see how it lines up with the template.**
You will have a mark on the template in the same spot at the mark that was on the bend fixture. Line the marks up on the template and the rib and make sure the piece follows the line of the template. Keep doing this for all the ribs.

Photo: Rib laying on the template, reference marks lined up.

NOTE The bend fixture and airfoil will have both upper and lower surfaces.

There will be more upper surfaces than lower surfaces because we add upper surfaces called false ribs in between complete ribs. This is done to help maintain the upper surface airfoil. Be careful to build the right number of pieces of each surface. Ask me why do I point this out? It is real easy to get excited about how nice the ribs are coming along and how fast you can form them, only to realize that you just bent all your tubing into just upper surfaces.

Once you get rolling you can bend a rib every 15 seconds or so and have them perfect. If you get after thie rib building there is no reason that you shouldn't have all the ribs bent, coped and then assembled in 10 hours or less for a biplane and 12 hours for a tri-plane.

14 **After everything has been bent it is time to cope the the leading edge of the rib to fall tangent onto the spar.**
This can be done with a hacksaw and a drum sander or even easier to use a 2" hole saw mounted in a drill press if you have one. Remember the reference mark we talked about earlier? This is another place it comes in handy to help you mark the leading edge for the cope.

Photo: Rib that was cut with the hole saw; will fit tangent to the spar.

14 **Locate the rear edge and cut off the excess.**
After all of the leading edges are coped, locate the rear edge and cut off the excess. Be careful here; not all of them will be the same. For example, where the aileron will fit, the trailing edge might be different.

15 **Bend all of the rib brackets and build the ribs.**
When all of the rib parts have been made, setup a simple fixture on your workbench or table using a couple scrap pieces of tubing to represent the spars. Bend all of the rib brackets and build the ribs flat on the table then move them over to the spars and test fit one at a time as you build them.

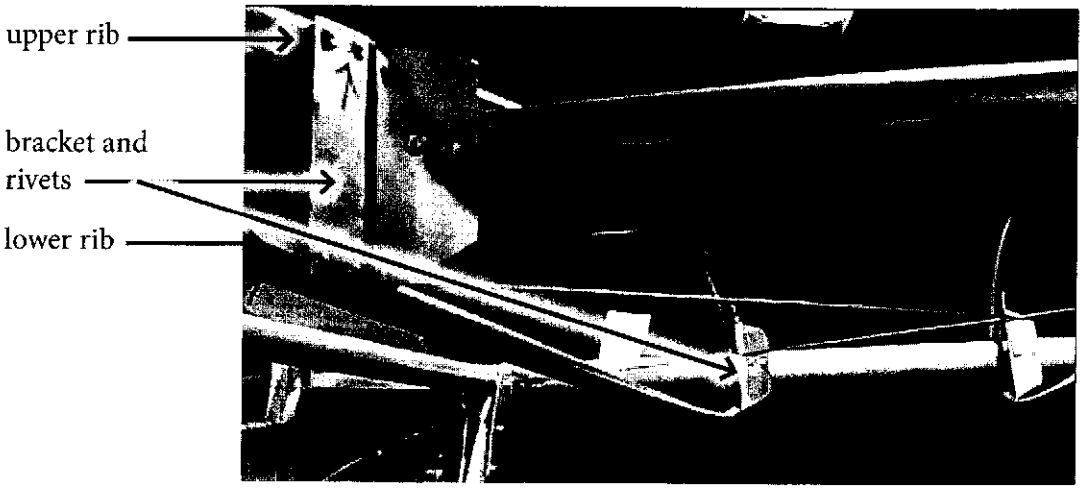


Photo: Attaching the ribs to the plane using brackets and rivets. As noted, this is best to wait to do when the spars have been fitted to the fuselage and the rigging is complete. But above is what it would look like.

NOTE Usually I prefer to wait to install the ribs until after the spar structures have been fitted to the fuselage and all the rigging is complete.

But, at this point I will continue with the wing building process for the sake of this guide.

Installing the Ribs and Trailing Edges

16 **Once all the ribs are installed on the spar it is time to affix the leading edge skin.**
This process can be completed in 6-8 hours or so. Start by bending about 1/4" of the edge of the sheeting down about 20 degrees or so. This will stiffen the edge and help to keep it straight. Next rivet it every 4" or so along the leading edge right on the exact front of the spar. After the first sheet is complete just overlap the next piece by a 1/2" and keep riveting until you have reached the end. At this point all of the sheets will be sticking straight up in the air. Using a motor cycle strap, throw it over the leading edge and then around the rear spar. As you tighten it up the leading edge will pull down and conform to the airfoil. Make sure the strap is located over a rib or it could distort the leading edge. With the use of 4 or 5 straps you can have the entire leading edge pulled in place, then rivet it down with 2 rivets in each rib. Be careful to have the wings straight and level on the saw horses before you rivet this all down. If you don't it is possible that when you rig the wings straight on the aircraft that it will buckle or bow and look bad.

16 **Install the trailing edges next.**

17 **Construct the ailerons.**
If your aileron is cut into the wing like in the Nieuport and Sopwith models, it is time to start thinking about cutting them out.

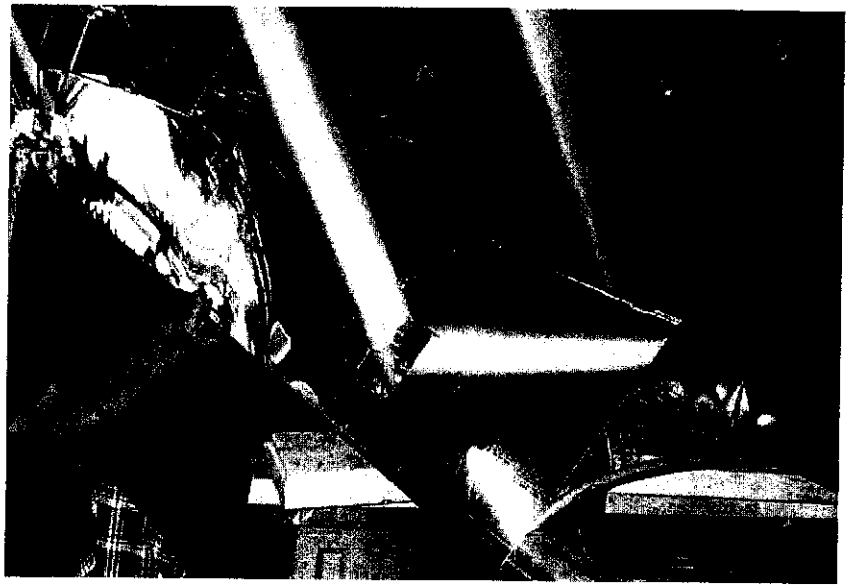


Photo: Attaching the leading edge sheeting.

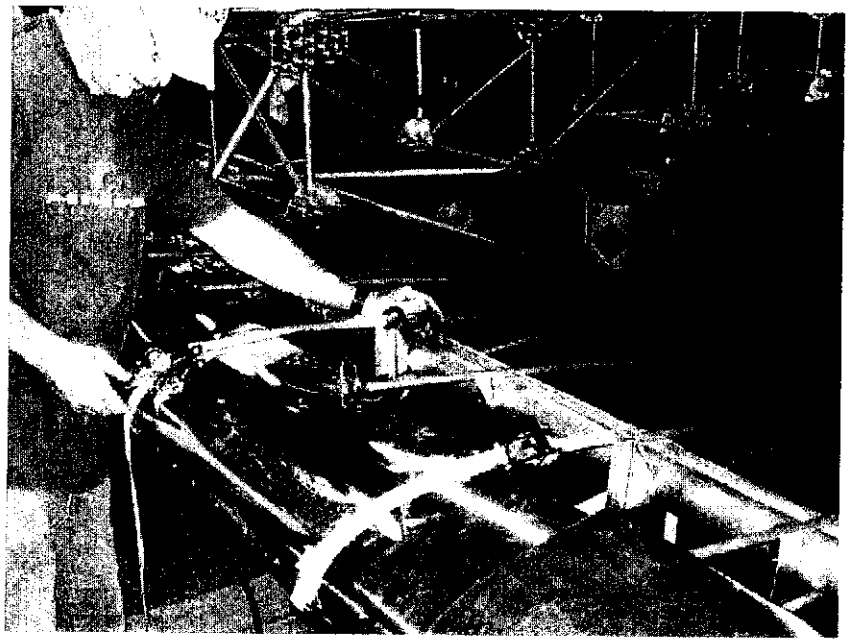


Photo: Using straps to temporarily hold the sheeting in place before riveting.

This project will take about 16-20 hours on a tri-plane, 12-14 hours on a biplane and under 8 hours on a mono plane.

NOTE This is the single most important step in building a quality flying aircraft. Everything you do during this process should be checked and double checked. If you rig this properly now it will be easy to flight trim your aircraft in the future.

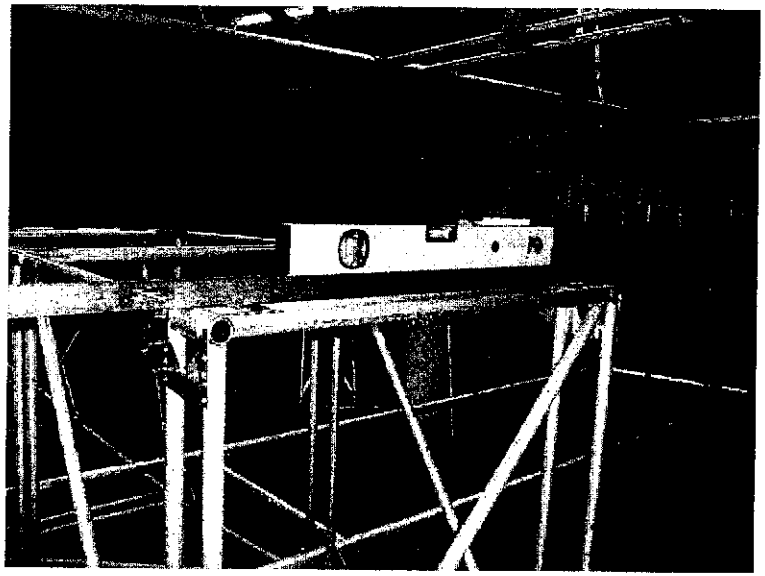


Photo: Leveling the fuselage.

1 **Level the fuselage in two planes.**
First place a level across the upper longerons at the firewall and level it left to right. Then set the level on the top longeron and level the fuselage for and aft. Always use the same two points from this point forward as your reference.

Photo: Lower wing carry through location.

2 **Locate the lower wing carry through.**
All of your measurements must come from the top longeron because it is the only straight, flat point on the fuselage. Since the bottom longeron was hand formed it would not be a reliable reference point.

TIP Mark the carry through center line on the fuselage with a felt tip marker. I have found the best way to hold the carry through in location is to cut a block of wood that will fit tight in between the bottom edge of the longeron and the upper edge of the carry through.

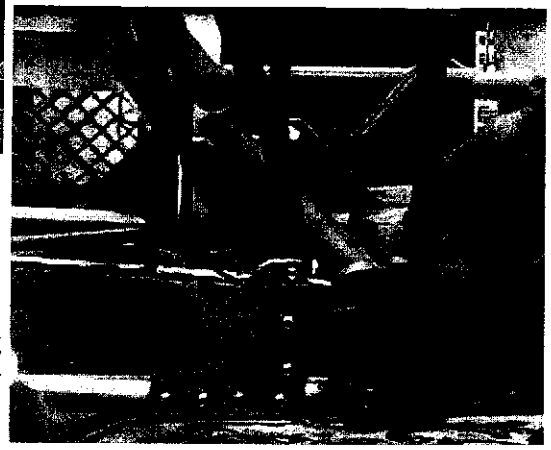


Photo: Locating and fitting the lower wing carry through.

3 **Drill through the fuselage tubing and install the lift tangs and the carry through.**
Be careful to keep the carry through level from left to right because these are the lower wing attachment points.

4 **Install the rear carry through.**
Install in the same manner you did the front carry through. Note the dimension on the rear carry through is different than the front. This dimension sets the angle of incidence in the wing.

5 **After both the front and rear carry throughs have been installed it is time to change the for and aft level point.**
Locate the level across the front and rear carry throughs and start raising the tail of the fuselage until the level reads level again. This will make the next several steps much easier. Now all you need to do is lay your level on top of your spars and look for level instead of the angle of incidence.

6 **Locate and install the lower wing panels onto the fuselage.**
Install the lower wings panels and then level for and aft at the root and the tip. If your plans call for dihedral now is the time to add this in by lifting the tip of the already level wings.

7 **Locate the top wing in three planes.**
On your plans you will find the distance aft of the firewall and the distance above the top longeron. Two more things that need to be tracked are the centerline to the fuselage, and to make sure that there is no twist (i.e. one wing is forward or rearward) when measured from the tip to the fin post. All of these things need to be close. Now for the critical part; the upper wing must have the same angle of incidence as the lower wing. To assist you in holding the wing right where you want it is to build a wood rack as can be seen in the video.

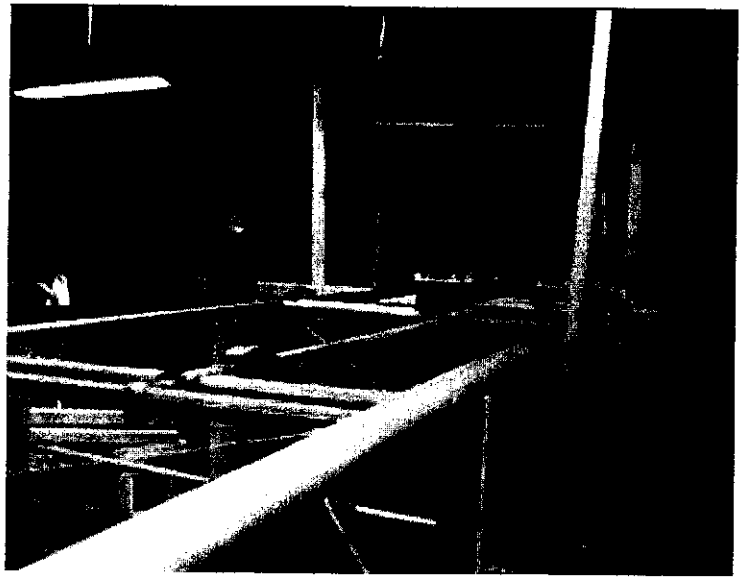


Photo: The wood rack constructed to help with leveling the wings.

8 **Start cutting and fitting all the cabines and struts to fit.**
After you have your wings in place and exactly where you want them be careful not to bump your setup! Start cutting and fitting the struts and cabines to fit. Use a piece of masking tape to hold each strut in location while fitting.

9 **Install all the gusset plates that hold the struts in place.**
Rivet the gusset plates that hold the struts to the structure and bolt the strut to the wing structure by drilling through the compression struts.

10 **Once the end struts and cabines are in place set the wire bracing.**
Run the wire through, similarly as before, crimp and swedge the cable making sure it is tight. See your drawings for the locations of the different wire sizes and turnbuckles to be used on different sections of the wings. This should go without saying but the heavy wires and turnbuckles are used on the lift wires and the lighter wires and smaller turn buckles are used on the landing wires.

11 **Build the landing wire first.**
The reason for this is that gravity is working for you and holding everything down. Always adjust the turnbuckles to that both ends have two threads showing, then pull the cables as tight as possible but be very careful to not move the wings from the rigged position.

12 **Repeat the same steps and build the lift wires.**
Once this is complete you can tighten the landing wire turnbuckles the final two turns that will draw them up tight. Then tighten the lift wires their final two turns. At this point remove all the wing racks and everything should be perfectly rigged. If not, go back and fix the problem right now. It won't take very long and will affect every aspect of the aircraft.

Photo: Cutting and coping the lift struts and cabines.

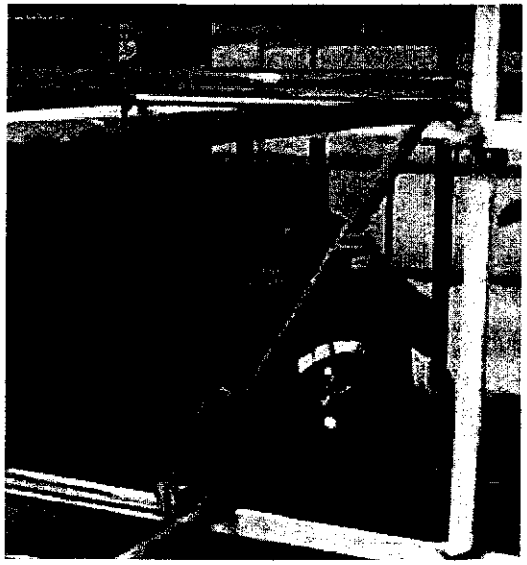


Photo: Measuring and fitting the lift struts to get the correct angle and length.

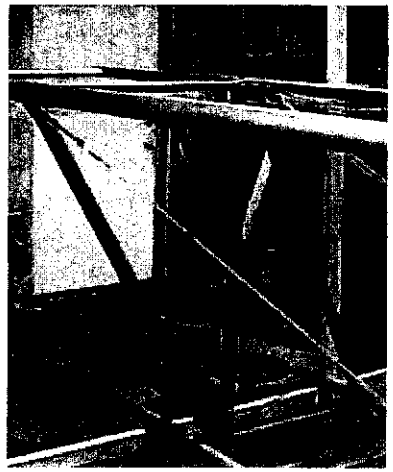


Photo: Installed lift strut and wire bracing.

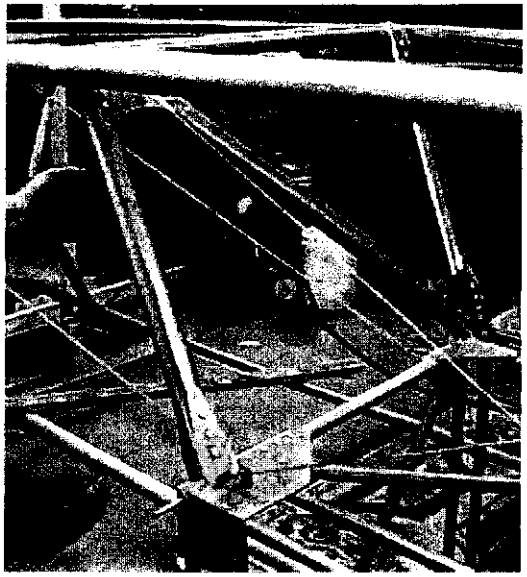


Photo: Cabines installed on fuselage and wings.

There are three basic kinds of Control Systems Assemblies. The different groups are discussed here.

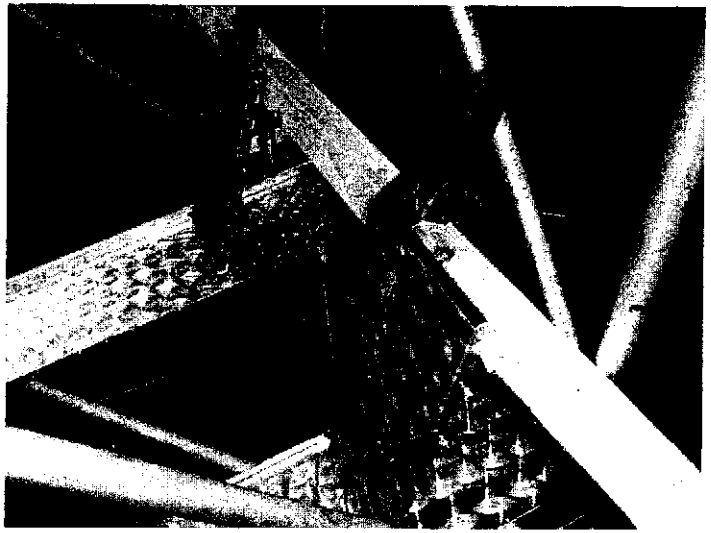


Photo: Rudder control pedals.

1 **Rudder Control.**
Install the floor boards in the belly of the fuselage with 8 large rivets.

Install the rudder pedals to the floor boards via the hinges. The builder has the ability to move the pedals for and aft to suite his likes. The rudder pedals will have a cable attached to it that will route direct to the ruddder. As these cables pass through the cockpit you might want to route them through some small plastic tubing to prevent chaffing or damage.

Rudder bar equipped aircraft are very similar with one major exception: the cable will be routed near the center of the aircraft. These can also be located wherever the pilot prefers and the cables should be inside some type of housing because they will be close to the control stick.

The rudder bar equipped aircraft will have a rudder pedal.

2 **Elevator Control.**
There are two systems used; the push rod system and a cable pull system.

The elevator push rod will attach to the control stick 3" above the stick for and aft pivot. The psh rod will route directly to the elevator and attach to the elevator spar with a AN43B eyebolt that fits through a plastic A spacer. It is not important which side it attaches to; left or right this choice is the builder's. Pull a string through the fuselage and determine which location will give you the most clearance. An additional thing the builder can do is move the attachment point toward or away from the centerline to help find a clear path. It is important that this eyebolt goes through the machined hinge for strength.

2 cont. **Elevator Control, continued**

Always install a push rod stabilizer somewhere around the midpoint of the push rod. The simplest way I have found is with a piece of nylon drill an oversized hole in the plastic. Mount this to a fuselage tube, this will help to stabilize the push rod.

The seat will need to be considered while routing the psh rod through the cockpit area.

The cable system.

3 **Aileron Control**

Use two systems here. One is a flexible push/pull cable and the second is a pull/pull cable closed loop system.

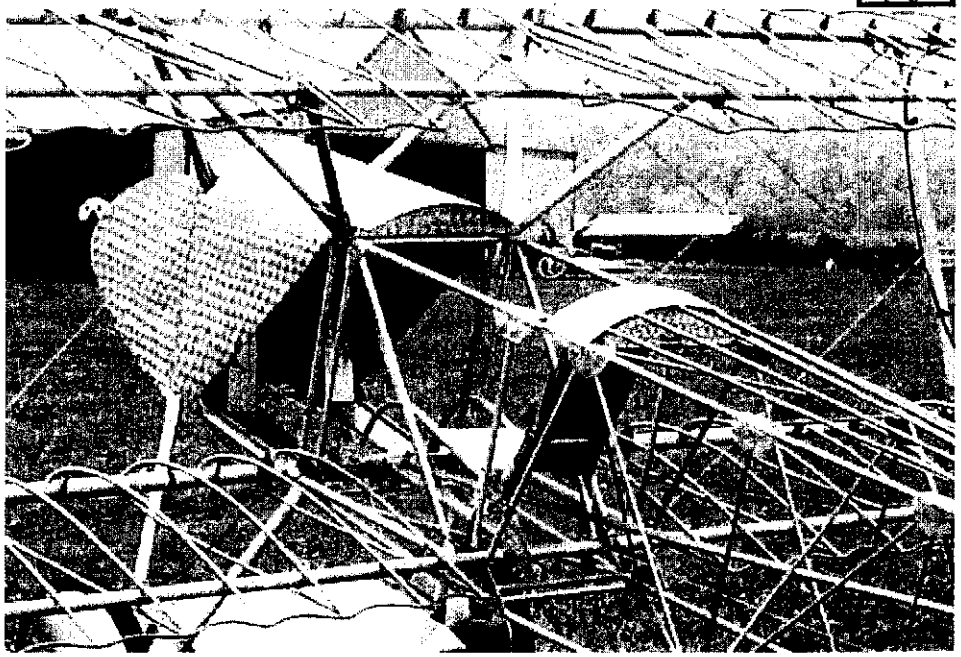


Photo: Control systems installed.

The firewall and formers will be a built in place type of project. The objective is toned up with nice visual lines and the actual dimensions will have no or little effect on the flying qualities of the aircraft.

1 **Install the firewall.**

2 **Install the instrument panel.**

Once these two items have been installed properly all of the lines will flow from these points.

3 **Install the rear cockpit former.**

4 **Install the former that sits right in front of the horizontal stabilizer.**

5 **Build the turtle deck.**

6 **Install the side panels.**
Keep in mind where the fabric will end.

Some builders will install a sheet metal belly panel on the fuselage just aft of the firewall. This will help keep the exhaust stains from damaging the belly. You can leave this area fabric but you would need to pay extra attention to the exhaust.

1 **The fuel tank.**
The fuel tank is welded aluminum and is designed to fit tight in between the front longeron just behind the firewall.

This can be mounted in several ways. The way I prefer is to install foam water pipe insulation over the longeron and on any tube in this area. This will make the tank fit tight. After pushing it as far forward and upward as possible, install two aluminum brackets that bolt to the fuselage vertical tubes. This will provide a flat surface that the tank will sit on. Next make two small tabs that will hold the tank from moving forward and rivet them in place.

All of the fittings on the tank are 1/4" pipe. The tank has been pressure tested but the fittings have not been drilled out. You will need to do this before installing the tank. After the fittings have been drilled you must flush and clean the tank. It is not uncommon to pro-seal the tank. However, if you do this make sure that the sealer is compatible with the fuel being used.

The tank will have two fittings welded into the rear side. These are used to install a sight gauge.

The bottom has a sump built into it. The sump will have two fittings; one on the bottom is used as a sump to drain the tank from. The second fitting welded on the side of the sump is the fuel pickup. I always install a on/off valve here. Next install an inline fuel filter and an inline fuel pump. Be careful with the fuel pump choices. It must be a flow through type in case it would fail the fuel must be able to flow through it allowing the second pump to keep the engine running.

It is important to keep the fuel pump as low as reasonable because a pump will push fuel easier that draw it. It is wise to install a fire sleeve on all fuel lines. Be very careful with the fuel system. If installed properly there will be few concerns, if not you will regret it.

the wording here seemed strange, is it right?

1 **The engine mount.**
The engine mount is a welded unit that bolts to the engine mount plugs extending from the fuselage through the firewall. If you are installing an engine that will weigh less than 200 pounds you will only be required to use the four bolts extending from the fuselage. If you engine is more than 200 pounds it is required to add four addtional straps, one from each corner of the mount through the firewall into the gussets at each corner. It is always good practice to install an engine safety cable.

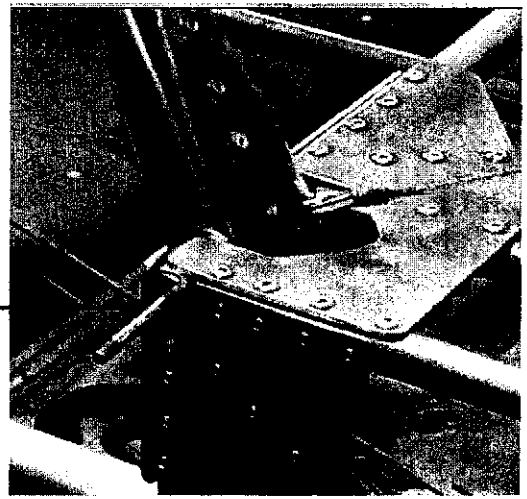


Photo: Engine mount plug and wire bracing.

Often times you hear wild stories about how hard it is to cover an aircraft but it's not difficult at all. There are only a few steps and you just keep repeating them.

This step is the single most important thing to the look of your aircraft. Everything you have done up to this step will be covered up and most likely only ever be seen with a flash light and mirror. However, the covering and paint will be the first thing that anyone who approaches the aircraft will see.

1 **Pay attention to detail.**
We are sure you have done that up until this point but if you aren't careful and are sloppy with the covering it will show. Covering the aircraft is easy, so take your time, pay attention and showoff the beauty of your aircraft!

2 **Start with the rudder.**
If you are new to covering I would recommend that you start with something small like the rudder. This way if you are unhappy with the final product you can start over without wasting a lot of material.

3 **Look over the rudder and make sure you are 100% done with the rudder construction.**
After you put the covering on it is too late to go back and rivet or gusset.

4 **Drill all the required holes for the riveting stage (rib stitching).**
The term 'stitching' comes from the old days where the fabric was stitched to the structure; in the modern process we rivet it down.

5 **Make sure there are no sharp edges or burrs.**
Check for sharp edges or burrs, this will ruin your fabric. If you find any problems, fix them now.

6 **Clean off the part.**
Next it is important that the part is completely clean. No oil or felt tip pen marks; a felt tip marker will bleed right through the fabric into the sealer and right into the final color paint. So, if you don't want the final paint job to look like a kid drew all over it with a marker get it cleaned up now.

7 **Tape any and all edges.**
Typically, masking tape is used. In effect, I'll use 3-4 rolls on the airframe before I'm finished. In the photos you will see examples of the use of masking tape. Applying masking tape over the rivet heads and on transitions will help to achieve a smoother overall finish. Be careful when applying tape to not wrinkle or crease it because this will show up in the finish. Make everything as smooth as you possibly can.

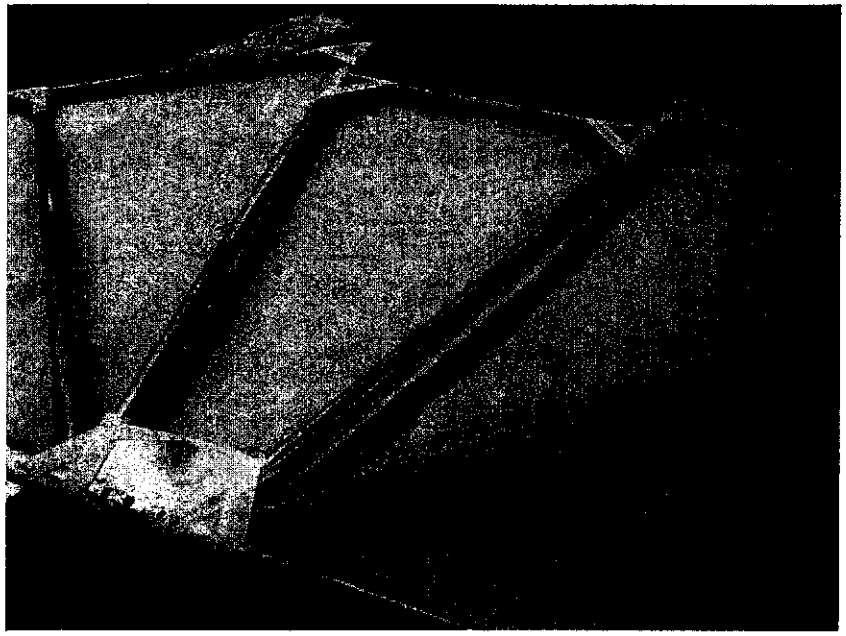


Photo: Taping off the edges on part of the horizontal stabilizer assembly.

8 **Start the bonding (glueing) process.**
It is time to start the bonding (glueing) process; we don't call it glueing because we are working on an aircraft. We call it bonding because no one wants to be flying around in an aircraft with the skin glued on.

NOTE An important thing to note is that you don't want to put tons of glue all over everything! All you really need is a strip of glue that is 3/8" to 1/2" wide. If it is more than that it will waste material and cause problems later.

9 **Apply a strip of glue all the way around the structure.**
Start at one end and work all the way around and back to your starting point. When you get back to the starting point the glue should be just about dry; this is what you want. In effect, you want the entire perimeter to be dry.

10 **Lay the fabric over the part.**
I recommend starting at the bottom of the piece and work your way up to the top. However, some parts like the rudder and fuselage, just pick a side and start.

TIP Use plastic clamps or clothes pins to help you; it is like having an extra set of hands.

Photo: Fabric laid over the fuselage.

11 **Cut the fabric.**
Use pinking shears to cut the fabric about an inch larger than the part to be covered and make sure that there are no wrinkles anywhere. Then press the fabric down with your hand. The fabric will stick with about the tackiness of a post-it. This is exactly what you want; that is why you let the glue dry before applying the covering.

At this point if you are unhappy with the way things are laying out, just peel it back up and re-stick the fabric.

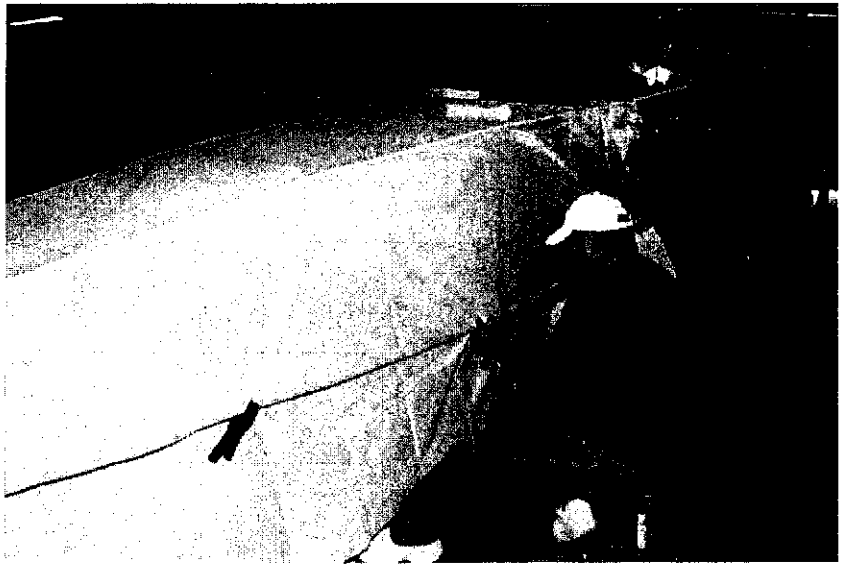


Photo: Using clamps to hold the fabric in place.

12 **Trim the extra fabric away and heat set the fabric.**
When the entire edge is stuck down and you are happy with it, it is time to trim the extra fabric away. Make sure you have enough material to wrap around the tubing 180 degrees. Then it's time to heat activate the glue. Using an iron press down and move towards the edge; this will make the bond that you have been wanting.

13 **Using a glue brush come back and touch up any edges that might be loose.**
When all the edges have been heat set you can go back and touch up any loose edges using a glue brush. Always apply the glue in between the fabric and the structure. Resist the temptation to brush it on top of the fabric; this will only mess up the overall finish. Because glue will build up on the part and when you iron things down the glue will start to ball up and make a mess.

Photo: Activating the glue on the edges with an iron.

14 **Set the iron on it's low to medium setting and iron across the entire section of fabric.**
Using large movements start wanding the iron across the entire section. You will see the fabric start to tighten up. At this point you only want to tighten the fabric just enough to remove any wrinkles or looseness.

15 **Now turn the part over and apply a thin strip of glue on the second side.**
This time the glue will be directly between the fabric layers. Lay the covering over the structure just like before and repeat the same steps up through the first iron.

Photo: Applying glue to the edges with a brush.

16 **When you have your edges stuck tight on the second side, turn the heat on the iron up a little bit and iron over everything.**
This is where the quality of your cover job will become apparent. Apply even more pressure to all edges pressing them down.

17 **Brush on the sealer.**
Once the fabric is tight it is time to begin brushing the sealer on the fabric. The sealer has two jobs; the first is to wick into the fabric and bond it to the structure everywhere it touches. That is why you only applied a narrow strip of glue because the sealer finishes the bond. The second job the sealer does is to provide a base to add finishing tapes on.

NOTE When you brush on the sealer always try to get it as thin as possible. All you are trying to accomplish is a light, thin base coat that wicks into the fabric.

18 **Apply the reinforcing tape.**
This is a small strip of material that the rivet will go through and it prevents the fabric from tearing out under the rivet heads.

19 **Using a soldering iron, melt through into the rivet holes and then rivet.**
After the reinforcing tape is in place use a soldering iron to melt through the tape and fabric where the rivet holes are and then rivet the fabric down.

20 **The finishing tapes.**
The finishing tapes are 2" wide strips of fabric that go over the reinforcing tapes and rivets. There is no right or wrong way of applying them; however it is good practice to make sure that the front edge is covered by another tape if possible. For example, if working on the wing, I would install the rib tapes first, then the trailing edges, the tip bows and lastly would apply the leading edge tape.

Photo: Ironing over the fabric.

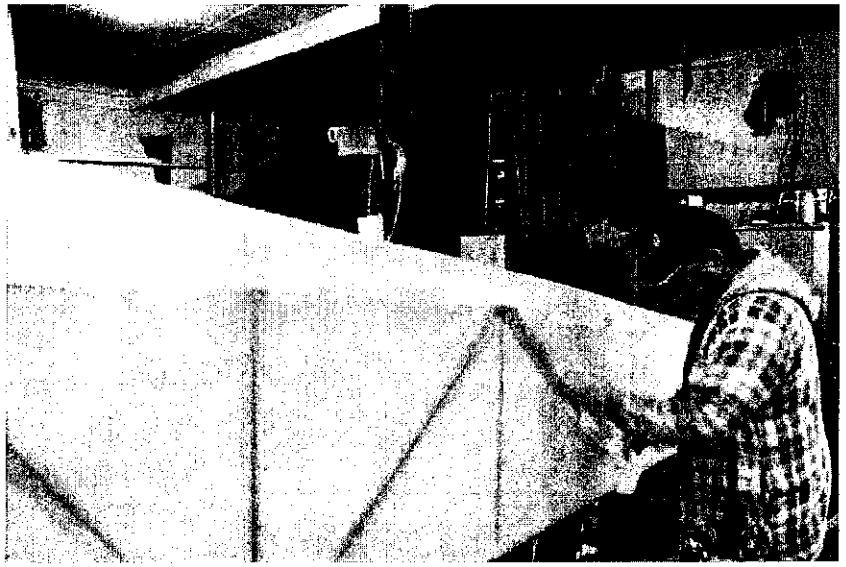


Photo: Applying the finishing tapes.

21 **Apply the finishing tape using the fabric sealer.**
Applying a finishing tape is really pretty simple. Using the fabric sealer brush on a strip of sealer the same width as the tape to be applied. While the sealer is still very wet place the tape in place and very quickly press the tape down with a swipe of your hand. Your goal here is for the glue to wick up into finishing tape from the bottom. The moment you apply the tape you can drag a wet brush across the top of the tape ensuring that the tape is fully saturated with sealer. Be careful about applying too much sealer to the top because you will cause problems later.

22 **Iron the tapes you just applied.**
When you have all the tapes applied and everything is completely dry it is time to iron all of these tapes. If you not careful here you will start making marks in the finish, so be careful. With the edge of the iron push down and drag outward toward the edge; the iron should not touch the fabric more than a second or so. If you stay on the fabric longer that that it will distort the tapes and soften the glue which will cause the marks that you don't want. It is perfectly okay to come back and iron more after the area has cooled. It usually takes around 30 minutes to iron a wing. In fact, I would recommend ironing the entire aircraft at least 3 times; this will make a huge difference in the final quality.

23 **After everything has been ironed to your satisfaction, brush the entire surface with one very light coat of sealer and iron the edges one last time.**
Using long, sweeping strokes and try to avoid brush streaks and build up around tapes. After all of this is dry it's time to iron all of the edges one last time. I know it sounds crazy but the last coat of sealer will fray the edges of tapes that were not completely stuck.

TIP Close your eyes and rub your hand along all of the tape edges and you will be able to feel the edges that need a little more attention.

Photo: Applying the finishing tapes with sealer.

24 **Apply the final color.**
If you want a really slick finish brush on a heavy coat of paint. Let it dry for several days then wet sand everything. Be very careful about sanding over ridges and rivets because it is really easy to damage the finish by sanding through the tape. This will also give you one last chance to identify problems and fix them.

25 **Apply the final color.**
If you want a really slick finish brush on a heavy coat of paint. Let it dry for several days then wet sand everything. Be very careful about sanding over ridges and rivets because it is really easy to damage the finish by sanding through the tape. This will also give you one last chance to identify problems and fix them.

Now it is time to apply that killer paint job you have been dreaming about since day one!

TIP A hint about paint; if you have both light and dark colors on your aircraft, paint the light first then tape and paint the darker colors next. Dark colors always cover light colors better than the other way around.

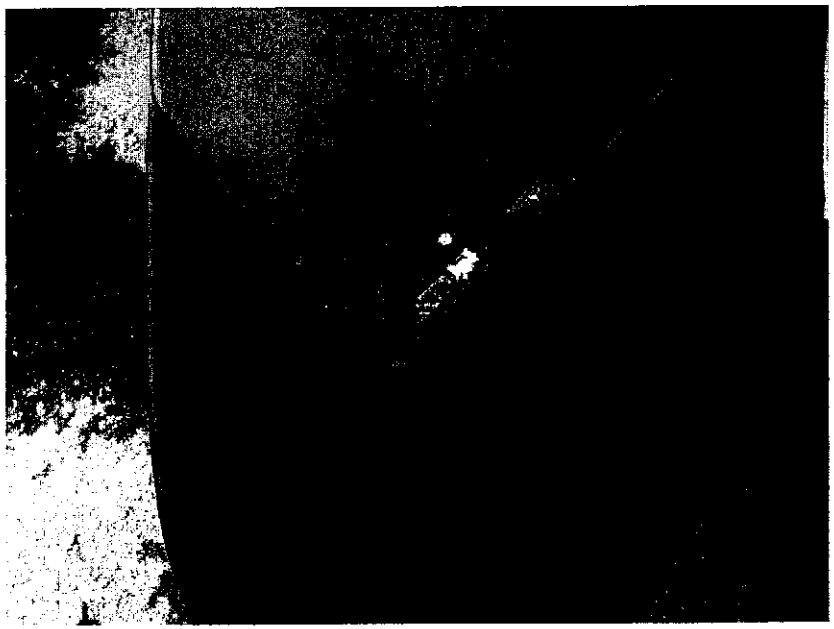


Photo: Final color example.

It is really easy to add a lot of weight to an aircraft in the covering; be mindful of this.

1 **Perform the weight and balance of your aircraft. Measure and weigh the aircraft in level flight.**

If an aircraft is properly balanced it will be enjoyable to fly. If it is not properly balanced it will be dangerous and possibly un-flyable.

To perform a weight and balance you will need to measure and weigh the aircraft while it's in level flight. You must establish a datum; this can be anywhere you want but must always be the same location. I use the firewall as my datum because this is a consistent location it won't change even if you change engines sometime in the future.

Datum= 0

Measure and determine the following:

- ☐ Distance to the main gear
- ☐ Distance to tail wheel
- ☐ Distance to the pilots location
- ☐ Distance to the fuel tank

- ☐ Weigh the aircraft with the aircraft in level flight
- ☐ Weight on main gear
- ☐ Weight on tail wheel

Formulas

(Main gear wt) x (distance to main gear) = moments
(Tail wheel wt) x (distance to tail wheel) = moments
(Pilot wt.) x (distance to pilot) = moments
(Fuel wt) x (distance to fuel tank) = moments
(Total moments)/ (Total weight) = Cg

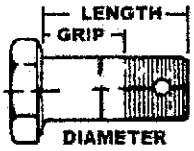
Refer to your design for cg range (xx.xx through xx.xx) your aircraft must fall within these two limits.

Power to weight ratio = (Total wt) / (Horse power)
Wing loading = (Wing area) / (Total wt)
Useful load = (Gross weight)/ (empty weight)

Standard Drill Sizes - Inches

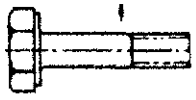
Drill Size · Decimal Equiv.	Drill Size · Decimal Equiv.	Drill Size · Decimal Equiv.	Drill Size · Decimal Equiv.
80 = .0135	43 = .089	8 = .199	25/64 = .3906
79 = .0145	42 = .0935	7 = .201	X = .397
1/64 = .0156	3/32 = .0938	13/64 = .2031	Y = .404
78 = .016	41 = .096	6 = .204	13/32 = .4063
77 = .018	40 = .098	5 = .2055	Z = .413
76 = .020	39 = .0995	4 = .209	27/64 = .4219
75 = .021	38 = .1015	3 = .213	7/16 = .4375
74 = .0225	37 = .104	7/32 = .2188	29/64 = .4531
73 = .024	36 = .1065	2 = .221	15/32 = .4688
72 = .025	7/64 = .1094	1 = .228	31/64 = .4844
71 = .026	35 = .110	A = .234	1/2 = .500
70 = .028	34 = .111	15/64 = .2344	33/64 = .5156
69 = .0292	33 = .113	B = .238	17/32 = .5313
68 = .031	32 = .116	C = .242	35/64 = .5469
1/32 = .0313	31 = .120	D = .246	9/16 = .5625
67 = .032	1/8 = .1250	1/4 (E) = .250	37/64 = .5781
66 = .033	30 = .1285	F = .257	19/32 = .5938
65 = .035	29 = .136	G = .261	39/64 = .6094
64 = .036	28 = .1405	17/64 = .2656	5/8 = .625
63 = .037	9/64 = .1406	H = .266	41/64 = .6406
62 = .038	27 = .144	I = .272	21/32 = .6563
61 = .039	26 = .147	J = .277	43/64 = .6719
60 = .040	25 = .1495	K = .281	11/16 = .6875
59 = .041	24 = .152	9/32 = .2813	45/64 = .7031
58 = .042	23 = .154	L = .290	23/32 = .7188
57 = .043	5/32 = .1563	M = .295	47/64 = .7344
56 = .0465	22 = .157	19/64 = .2969	3/4 = .750
3/64 = .0469	21 = .159	N = .302	49/64 = .7656
55 = .052	20 = .161	5/16 = .3125	25/32 = .7813
54 = .055	19 = .166	O = .316	51/64 = .7969
53 = .0595	18 = .1695	P = .323	13/16 = .8125
1/16 = .0625	11/64 = .1719	21/64 = .3281	53/64 = .8281
52 = .0635	17 = .173	Q = .332	27/32 = .8438
51 = .067	16 = .177	R = .339	55/64 = .8594
50 = .070	15 = .180	11/32 = .3438	7/8 = .875
49 = .073	14 = .182	S = .348	57/64 = .8906
48 = .076	13 = .185	T = .358	29/32 = .9063
5/64 = .0781	3/16 = .1875	23/64 = .3594	59/64 = .9219
47 = .0785	12 = .189	U = .368	15/16 = .9375
46 = .081	11 = .191	3/8 = .375	61/64 = .9531
45 = .082	10 = .1935	V = .377	31/32 = .9688
44 = .086	9 = .196	W = .386	63/64 = .9844

AN BOLTS



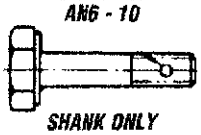
Hex head aircraft bolts are made of high-strength type 4037 or 8740 alloy steel (type 8740 is most commonly used). The bolts are threaded after heat treatment. Minimum tensile strength 125,000 PSI. Cadmium plated per specification QQ-P-416, Type II, Class 3. Available with shank drilled for cotter pin or undrilled for stop nut application, and with or without drilled head for safety wire. Specify bolts to have undrilled shank by adding letter "A" after dash number. For bolts with drilled head add letter "H" after AN number. See illustrated examples. The length of AN aircraft bolts is measured from under the head to the end of the shank. The "grip" is the unthreaded portion of the shank. See table for conversion of length and/or grip to proper AN callout.

FOR UNDRILLED ADD THE LETTER "A" EXAMPLE: AN6 - 10A



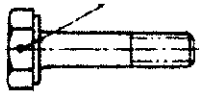
UNDRILLED

FOR DRILLED SHANK NO LETTER EXAMPLE! AN6 - 10



SHANK ONLY DRILLED

FOR DRILLED HEAD ADD "H" AND "A" EXAMPLE: AN6H-10A



HEAD ONLY DRILLED

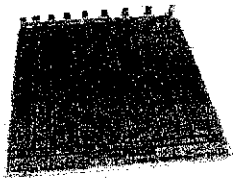
FOR DRILLED HEAD AND SHANK ADD "H" ONLY EXAMPLE: AN6H-10

BOTH HEAD AND SHANK DRILLED

Bolts are sold "EACH" ALL BOLTS		AN3					AN4				
			Cadmium Plated AN3 (10-32)		Stainless AN3C (10-32)			Cadmium Plated AN4 (1/4-28)		Stainless AN4C (1/4-28)	
Dash No.	Nominal Length	Grip Length	Drilled Price	Undrilled "A" Price	Drilled Price	Undrilled "A' Price	Grip Price	Drilled Price	Undrilled "A" Price	Drilled Price	Undrilled "A" Price
-3	15/32	1/16	.	.	.	.	1/16	.	.	.	.
-4	17/32	1/8	.	.	.	.	1/16	.	.	.	.
-5	21/32	1/4	.	.	.	.	3/16	.	.	.	.
-6	25/32	3/8	.	.	.	.	5/16	.	.	.	.
-7	29/32	1/2	.	.	.	.	7/16	.	.	.	.
-10	1-1/32	5/8	.	.	.	.	9/16	.	.	.	.
-11	1-5/32	3/4	.	.	.	.	11/16	.	.	.	.
-12	1-9/32	7/8	.	.	.	.	13/16	.	.	.	.
-13	1-13/32	1	.	.	.	.	15/16	.	.	.	.
-14	1-17/32	1-1/8	.	.	.	.	1-1/16	.	.	.	.
-15	1-21/32	1-1/4	.	.	.	.	1-3/16	.	.	.	.
-16	1-25/32	1-3/8	.	.	-	.	1-5/16	.	.	-	.
-17	1-29/32	1-1/2	.	.	.	.	1-7/16	.	.	.	.
-20	2-1/32	1-5/8	.	.	.	.	1-9/16	.	.	.	.
-21	2-5/32	1-3/4	.	.	-	.	1-11/16	.	.	-	.
-22	2-9/32	1-7/8	.	.	-	.	1-13/16	.	.	-	.
-23	2-13/32	2	.	.	-	.	1-15/16	.	.	-	.
-24	2-17/32	2-1/8	.	.	-	.	2-1/16	.	.	-	.
-25	2-21/32	2-1/4	.	.	-	.	2-3/16	.	.	-	.
-26	2-25/32	2-3/8	.	.	-	.	2-5/16	.	.	-	.
-27	2-29/32	2-1/2	.	.	-	.	2-7/16	.	.	-	.
-30	3-1/32	2-5/8	.	.	-	.	2-9/16	.	.	-	.
-31	3-5/32	2-3/4	.	.	-	-	2-11/16	.	.	-	-
-32	3-9/32	2-7/8	.	.	-	-	2-13/16	.	.	-	-
-33	3-13/32	3	.	.	-	-	2-15/16	.	.	-	-
-34	3-17/32	3-1/8	.	.	-	-	3-1/16	.	.	-	-
-35	3-21/32	3-1/4	.	.	-	-	3-3/16	.	.	-	-
-36	3-25/32	3-3/8	.	.	-	-	3-5/16	.	.	-	-
-37	3-29/32	3-1/2	.	.	-	-	3-7/16	.	.	-	-
-40	4-1/32	3-5/8	.	.	-	-	3-9/16	.	.	-	-
-41	4-5/32	3-3/4	.	.	-	-	3-11/16	.	.	-	-
-42	4-9/32	3-7/8	.	.	-	-	3-13/16	.	.	-	-
-43	4-13/32	4	-	.	-	-	3-15/16	.	.	-	-
-44	4-17/32	4-1/8	.	.	-	-	4-1/16	.	.	-	-
-45	4-21/32	4-1/4	.	.	-	-	4-3/16	.	.	-	-
-46	4-25/32	4-3/8	.	.	-	-	4-5/16	.	.	-	-
-47	4-29/32	4-1/2	.	.	-	-	4-7/16	.	.	-	-
-50	5-1/32	4-5/8	.	-	-	-	4-9/16	.	.	-	-
-51	5-5/32	4-3/4	.	.	-	-	4-11/16	.	.	-	-
-52	5-9/32	4-7/8	-	.	-	-	4-13/16	.	.	-	-
-53	5-13/32	5	-	-	-	-	4-15/16	-	.	-	-
-54	5-17/32	5-1/8	.	.	-	-	5-1/16	-	.	-	-
-55	5-21/32	5-1/4	-	.	-	-	5-3/16	.	.	-	-
-56	5-25/32	5-3/8	.	.	-	-	5-5/16	.	.	-	-
-57	5-29/32	5-1/2	-	.	-	-	5-7/16	.	.	-	-
-60	6-1/32	5-5/8	.	.	-	-	5-9/16	.	.	-	-

HA

AN BOLTS



AN BOLT GAUGE

Automatically sizes all AN bolts up to 5/8" diameter and 5 inches long.

P/N 04-05400.....

POCKET BOLT GAUGE

This new aluminum gauge measures just 3-3/4" x 5-7/8" to fit easily in a shirt pocket. Determines exact part numbers for AN 3 thru AN 8 diameter bolts thru 5" in length. P/N 04-05300.....

APR AN BOLT GAUGE

AN bolt gauge deluxe heavy duty mocel measures diameter and length of AN bolts up to 8", 388 precision conversions. Fraction / decimal / millimeter equivalents, with 8" inch and 20 cm metric rulers. 4 colors. Pocket size. PVC plastic 8-5/8" x 2-1/2" x .030"

P/N 11-07726.....

SAMPLE PART NUMBERS

AN3-4 ..... Cad-plated, drilled shank

AN3-4A ..... Cad-plated, undrilled

AN3C-4 ..... Stainless steel, drilled shank

AN3C-4A ..... Stainless steel, undrilled

AN BOLT KIT

CONTAINS: • AN6-16A (8 qty) • AN6-12A (2 qty) • AN4-15A (20 qty) • AN8-13A (8 qty) • AN6-10A (12 qty) • AN8-33A (24 qty) • AN7-33A (4 qty) • AN9-17 (4 qty)

P/N 04-01727

HA

Bolts are sold "EACH" ALL BOLTS		AN5					AN6				
			Cadmium Plated AN5 (5/16-24)		Stainless AN5C (5/16-24)			Cadmium Plated AN6 (3/8-24)		Stainless AN6C (3/8-24)	
Dash No.	Nominal Length	Grip Length	Drilled Price	Undrilled "A" Price	Drilled Price	Undrilled "A" Price	Grip Length	Drilled Price	Undrilled "A" Price	Drilled Price	Undrilled "A" Price
-4	19/32	1/16	.	.	.	.	1/16	-	.	-	-
-5	23/32	3/16	.	.	.	.	1/16	.	.	.	.
-6	27/32	5/16	.	.	.	.	3/16	.	.	.	.
-7	31/32	7/16	.	.	.	.	5/16	.	.	.	.
-10	1-3/32	9/16	.	.	-	.	7/16	.	.	-	.
-11	1-7/32	11/16	.	.	-	.	9/16	.	.	.	.
-12	1-11/32	13/16	.	.	.	.	11/16	.	.	.	.
-13	1-15/32	15/16	.	.	-	.	13/16	.	.	.	.
-14	1-19/32	1-1/16	.	.	-	.	15/16	.	.	.	.
-15	1-23/32	1-3/16	.	.	-	.	1-1/16	.	.	.	.
-16	1-27/32	1-5/16	.	.	-	-	1-3/16	.	.	.	.
-17	1-31/32	1-7/16	.	.	-	-	1-5/16	.	.	-	.
-20	2-3/32	1-9/16	.	.	-	.	1-7/16	.	.	.	-
-21	2-7/32	1-11/16	.	.	-	.	1-9/16	.	.	-	-
-22	2-11/32	1-13/16	.	.	-	.	1-11/16	.	.	-	-
-23	2-15/32	1-15/16	.	.	-	.	1-13/16	.	.	-	-
-24	2-19/32	2-1/16	.	.	-	-	1-15/16	.	.	-	-
-25	2-23/32	2-4/16	.	.	-	.	2-1/16	.	.	-	-
-26	2-27/32	2-5/16	.	.	-	.	2-3/16	.	.	-	-
-27	2-31/32	2-7/16	.	.	-	.	2-5/16	.	.	-	-
-30	3-3/32	2-9/16	.	.	-	-	2-7/16	.	.	-	-
-31	3-7/32	2-11/16	.	.	-	-	2-9/16	.	.	-	-
-32	3-11/32	2-13/16	.	.	-	-	2-11/16	.	.	-	-
-33	3-15/32	2-15/16	.	.	-	-	2-13/16	.	.	-	-
-34	3-19/32	3-1/16	.	.	-	-	2-15/16	.	.	-	-
-35	3-23/32	3-3/16	.	.	-	-	3-1/16	.	.	-	-
-36	3-27/32	3-5/16	.	.	-	-	3-3/16	.	.	-	-
-37	3-31/32	3-7/16	.	.	-	-	3-5/16	.	.	-	-
-40	4-3/32	3-9/16	.	.	-	-	3-7/16	.	.	-	-
-41	4-7/32	3-11/16	.	.	-	-	3-9/16	.	.	-	-
-42	4-11/32	3-13/16	-	.	-	-	3-11/16	.	.	-	-
-43	4-15/32	3-15/16	.	.	-	-	3-13/16	.	.	-	-
-44	4-19/32	4-1/16	-	.	-	-	3-15/16	.	.	-	-
-45	4-23/32	4-3/16	.	.	-	-	4-1/16	.	.	-	-
-46	4-27/32	4-5/16	.	.			4-3/16	.	.	-	-
-47	4-31/32	4-7/16	.	.	-	-	4-5/16	.	.	-	-
-50	5-3/32	4-9/16	.	.	-	-	4-7/16	.	.	-	-
-51	5-7/32	4-11/16	.	.	-	-	4-9/16	.	.	-	-
-52	5-11/32	4-13/16	.	.	-	-	4-11/16	.	.	-	-
-53	5-15/32	4-15/16	.	.	-	-	4-13/16	.	.	-	-
-54	5-19/32	5-1/16	.	.	-	-	4-15/16	.	.	-	-
-55	5-23/32	5-3/16	.	.	-	-	5-1/16	.	.	-	-
-56	5-27/32	5-5/16	.	.	-	-	5-3/16	.	.	-	-
-57	5-31/32	5-7/16	.	.	-	-	5-5/16	.	.	-	-
-60	6-3/32	5-9/16	.	.	-	-	5-7/16	.	.	-	-

AN FITTINGS

HA

AN837 ELBOW,

FLARED TUBE, BULKHEAD AND UNIVERSAL 45°

Size No. Steel	Size No. Alum.	Tube O.D.	Thread Size	Price Each Steel	Price Each Alum.
2	2D	1/8	5/16-24	---	.
3	3D	3/16	3/8-24	.	.
4	4D	1/4	7/16-20	.	.
5	5D	5/16	1/2-20	.	.
6	6D	3/8	9/16-18	.	.
8	8D	1/2	3/4-16	.	.
10	10D	5/8	7/8-14	.	.
12	12D	3/4	1-1/16-12	---	---

AN844 HOSE ELBOW,

PIPE THREAD, 45°

Size No. Brass	Size No. Alum.	Hose I.D.	Pipe Thread	Price Each Brass	Price Each Alum.
4	4D	1/4	1/8	.	.
6	6D	3/8	1/4	---	.
8	8D	1/2	3/8	.	.
10	10D	5/8	1/2	.	.

AN910 COUPLING

PIPE THREAD

Size No. Brass	Size No. Alum.	Thread Size	Price Each Brass	Price Each Alum.
1	1D	1/8	.	.
2	2D	1/4	.	.
3	3D	3/8	.	.
4	4D	1/2	.	.
6	6D	3/4	.	.

AN911 NIPPLE

PIPE THREAD

Size No. Brass	Size No. Alum.	Pipe Thread	Price Each Brass	Price Each Alum.
1	1D	1/8	.	.
2	2D	1/4	.	.
3	3D	3/8	.	.
4	4D	1/2	.	.
6	6D	3/4	.	.

AN838 ELBOW,

BULKHEAD & HOSE TO UNIVERSAL, 90°

Size No. Brass	Size No. Alum.	Hose O.D.	Thread Size	Price Each Brass	Price Each Alum.
4	4D	1/4	7/16-20	---	.
6	6D	3/8	9/16-18	---	.

AN848 ELBOW,

HOSE BULKHEAD, 90°

Size No. Brass	Size No. Alum.	Hose I.D.	Thread Size	Price Each Brass	Price Each Alum.
---	4D	1/4	7/16-20	--	.
---	6D	3/8	9/16-18	--	.
---	8D	1/2	3/4-16	--	.

AN912 BUSHING

PIPE THREAD REDUCER

Size No. Alum.	Pipe Size	Price Ea.	Size No Alum	Pipe Size	Price Ea.
1D	1/4-1/8	.	8D	3/4-3/8	.
2D	3/8-1/4	.	9D	3/4-1/4	.
3D	3/8-1/8	.	10D	1-3/4	.
4D	1/2-3/8	.	11D	1-1/2	.
5D	1/2-1/4	.	12D	1-3/8	.
6D	1/2-1/8	.	13D	11/4-3/4	.
7D	3/4-1/2	.			

AN840 HOSE NIPPLE,

PIPE THREAD

Size No. Brass	Size No. Alum.	Hose I.D.	Pipe Size	Price Each Brass	Price Each Alum.
4	4D	1/4	1/8	.	.
6	6D	3/8	1/4	.	.
8	8D	1/2	3/8	.	.
---	10D	5/8	1/2	---	.
12	12D	3/4	3/4	.	.

AN842 HOSE ELBOW,

PIPE THREAD, 90°

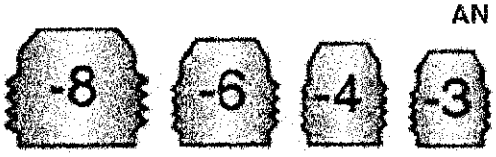
Size No. Brass	Size No. Alum.	Hose I.D.	Pipe Thread	Price Each Brass	Price Each Alum.
4	4D	1/4	1/8	.	.
6	6D	3/8	1/4	.	.
8	8D	1/2	3/8	---	.
10	10D	5/8	1/2	.	.
12	12D	3/4	3/4	.	.

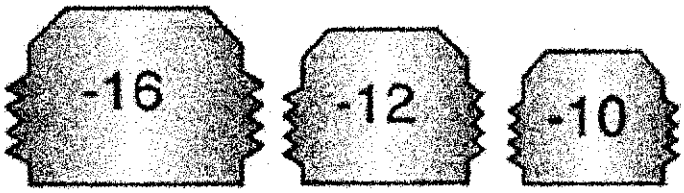
AN913 (MS20913) PLUG

SQUARE HEAD, PIPE THREAD

Size No. Brass	Size No. Steel	Size No. Alum.	Pipe Thread	Price Each Brass	Price Each Steel	Price Each Alum.
1	1S	1D	1/8	.	.	.
2	2S	2D	1/4	.	.	.
3	3S	3D	3/8	.	---	.
4	4S	4D	1/2	.	---	.
6	6S	6D	3/4	.	---	.

AN FITTING SIZES

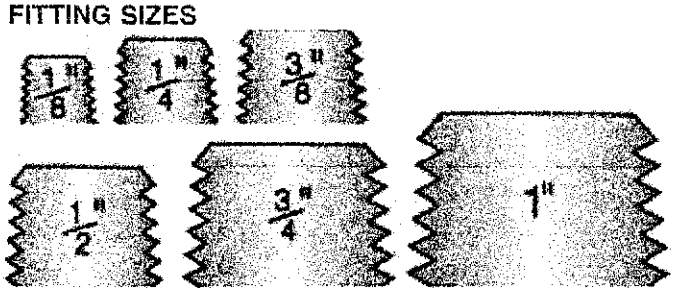




AN Size	Metal Tube O.D.	Thread Size
2	1/8	5/16-24 SAE
3	3/16	3/8-24 SAE
4	1/4	7/16-20 SAE
5	5/16	1/2-20 SAE
6	3/8	9/16-18 SAE
8	1/2	3/4-16 SAE
10	5/8	7/8-14 SAE
12	3/4	1-1/16-12 SAE
16	1"	1-5/16-12 SAE

NPT FITTING SIZES

Pipe Thread Size	Threads per inch	Theoretical I.D. of Fitting	Closest AN FittingSize
1/16"	27	1/16"	
1/8"	27	1/8"	4
1/4"	18	1/4"	6
3/8"	18	3/8"	8
1/2"	14	1/2"	10
3/4"	14	3/4"	12
1"	11.5	1"	16
1-1/4"	11.5	1-1/4"	20
1-1/2"	11.5	1-1/2"	24
2"	11.5	2"	



DIAGRAMS MAY NOT BE ACCURATE AND SHOULD NOT BE USED FOR EXACT SIZING. FOR REFERENCE ONLY