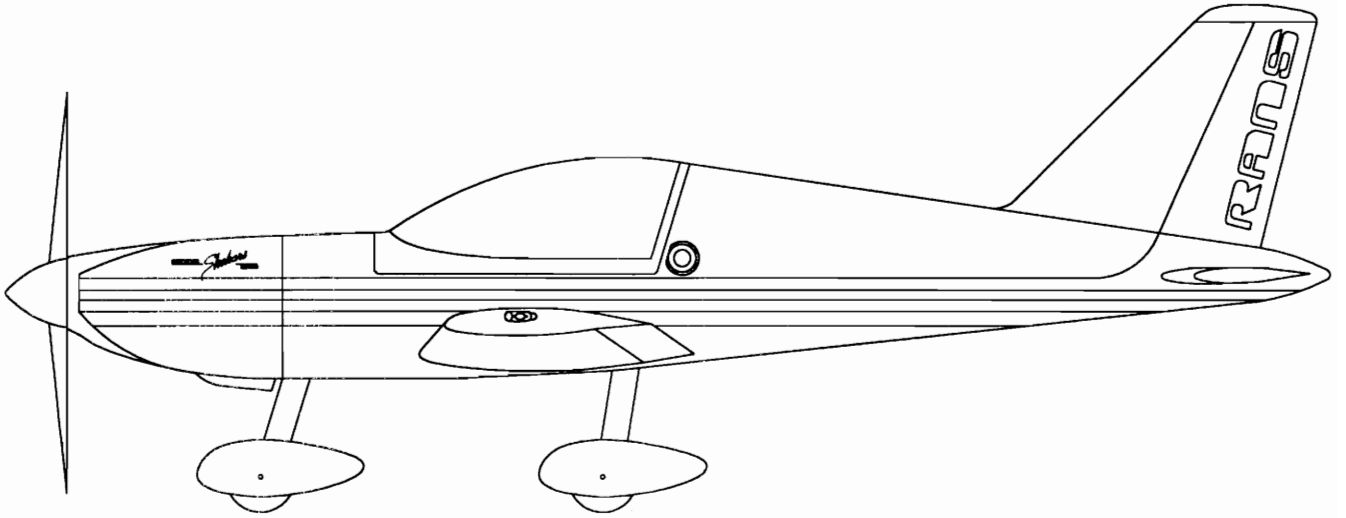
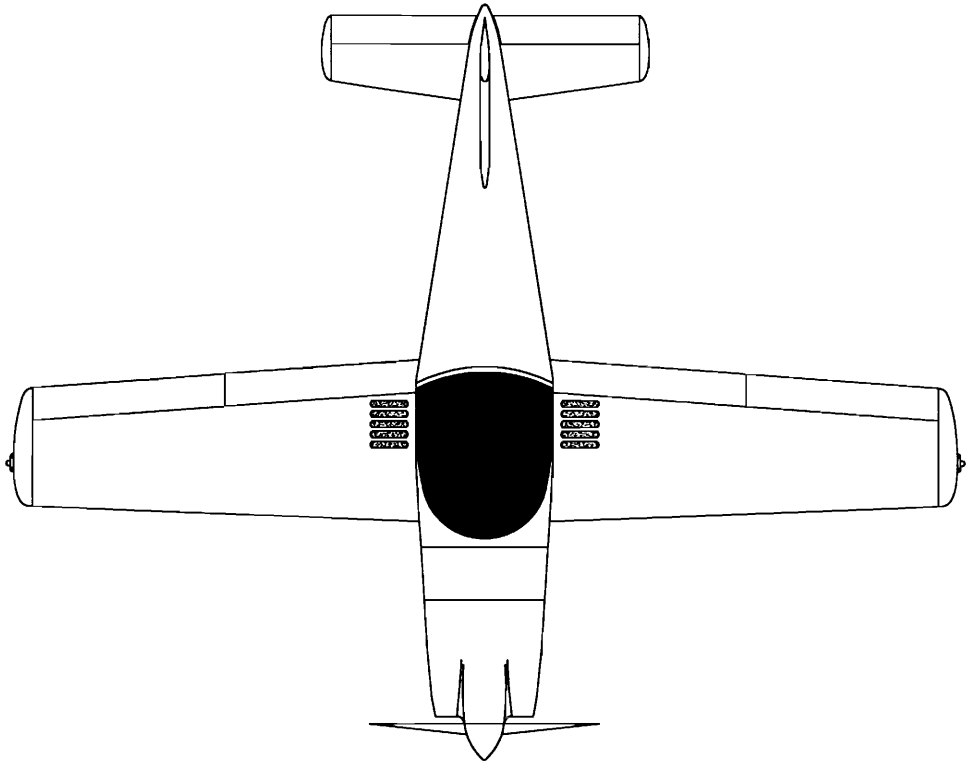
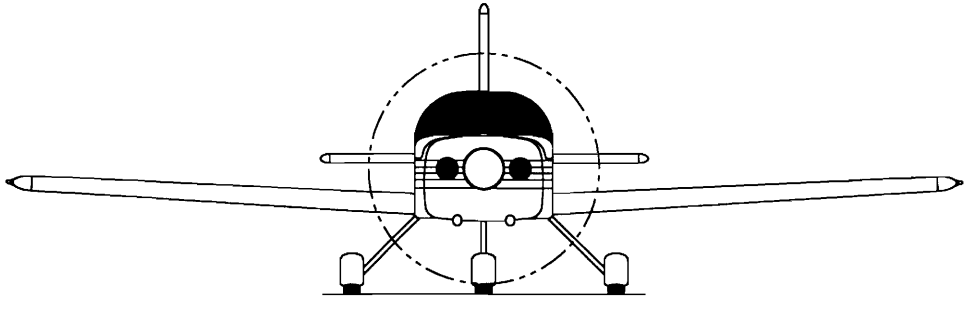
RANS Shekari S-16

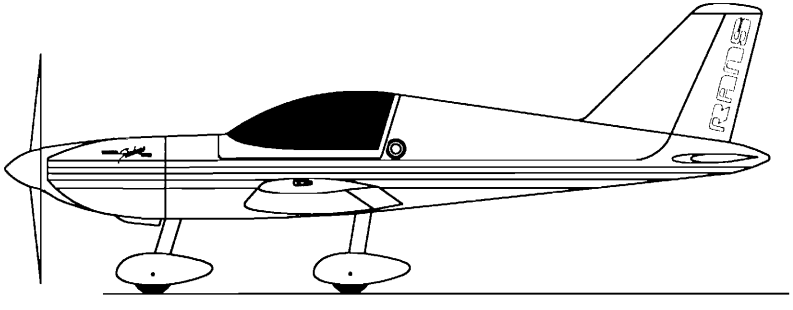


RANS S-16 SHEKARI
TEXT MANUAL

RANS S-16 SHEKARI







RANS
4600 Highway 183 Alternate
Hays, KS 67601
(785) 625-6346

DESIGNED BY:
RANDY SCHLITTER

RANS, Inc.

4600 Highway 183 Alternate
Hays, KS 67601

Technical Support
(785) 625-0069

Parts Department
(785) 625-6346

When calling Technical Support or the Parts Department please have the following ready:

#Aircraft Model
#Serial Number
#Engine Model
#Parts Number Needed (Parts Department Only)
#Your Aircraft Assembly Manual

Note: Please make your questions precise and to the point so that we may assist as many customers as possible.

S-16 SHEKARI ASSEMBLY MANUAL

DIVIDER TAB LABELS

01 - GENERAL	07 - CANOPY
01 - GENERAL	07 - CANOPY
02 - FUSELAGE	08 - COWLING & SPINNER
02 - FUSELAGE	08 - COWLING & SPINNER
03 - WINGS	09 - RIGGING
03 - WINGS	09 - RIGGING
04 - CONTROL SURFACES	10 - FINISHING
04 - CONTROL SURFACES	10 - FINISHING
05 - INTERNAL SYSTEMS	11 - C.G. & LIMITATIONS
05 - INTERNAL SYSTEMS	11 - C.G. & LIMITATIONS
06 - ENGINE & SYSTEMS	12 – MAINTENANCE & INSPECTION
06 - ENGINE & SYSTEMS	12 – MAINTENANCE & INSPECTION

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06 - ENGINE & SYSTEMS	12 – MAINTENANCE & INSPECTION
06 - ENGINE & SYSTEMS	12 – MAINTENANCE & INSPECTION

Designed for 1 ¼" Insertable Tabs

WELCOME TO RANS

CONGRATULATIONS on your purchase of the **S-16 SHEKARI**!

We like to keep in touch with all **S-16 SHEKARI** owners. Below you will find a form, which we ask that you fill out and return to us. In doing so you will be put on our mailing list and in turn receive all updates as to improvements and/or recommended modifications for the **S-16 SHEKARI** and the optional kits available for these changes. In returning this form to us, you will receive two free T-shirts (one for each seat). Order large, they shrink a bit.

We publish a free newsletter to help you keep up with the latest information and new developments. To receive your free issue of the RANS newsletter return this form.

NAME: _____

ADDRESS: _____

CITY: _____ **STATE:** _____ **ZIP:** _____

DATE PURCHASED: _____ **DEALERSHIP:** _____

SERIAL #: _____ **PHONE NO:** _____

SHIRT SIZE: L XL _____ **YES! I WANT TO RECEIVE THE RANS NEWSLETTER.** _____

PLEASE RETURN TO:
RANS, INC.
4600 HWY 183 ALTERNATE
HAYS, KS 67601
785-625-6346
785-625-2795 FAX

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AIRCRAFT TOOL & SUPPLY LIST

HAND TOOLS

Pliers
Needle Nose Pliers
Side Cutters
Aviation Snips
Hammer
Rubber Mallet*
Several Small Clamps (Stanley quick clamps work well)
Wrench Set SAE & Metric
Ruler & Tape Measure
Set of Drill Bits (sizes listed below)
Hack Saw
2 or 4 ft. Level (SMART LEVEL*)
Hole Saws*
Files
Cleco Pliers
Clecos (Quantity determined by builder)
Duckbill Pliers*
Safety Wire Pliers
Linesman Pliers
Electrical Wire Strippers
1/8" tapered pipe tap
Click Punch
Ball Peen Hammer
Scratch Awl
Screwdriver Set
Safety Glasses
Socket Set SAE & Metric
Utility Knife
Adjustable Angle Finder*
Hole Locator*
Fluting Pliers
Cleco Clamps*
Wood – 2x4, 2x6 and 2x10
Allen Wrench Set

POWER TOOLS

Electric Hand Drill (a 90° drill may also be helpful*)
Dremel*
CD Player*
Pneumatic Pop Rivet Tool
Hand-held 4"-7" Sander/Grinder
Portable Jig Saw
Drill Press w/ V-Block

LUBRICANTS, ADHESIVES & CLEANERS

Lithium Grease
Lubricating Oil
EPX applicator for DP-460 Epoxy Adhesive*
Acetone or Lacquer thinner
High Temperature RTV Silicone
Thread Sealant
Clear Silicone
WD40
Isopropyl Alcohol
Loctite® Sleeve Retainer #64040
Super Glue

DRILL BIT SIZES

A full set of fractional drill bits ranging from 3/32" to 5/8" is strongly recommended. In addition to these the following number and letter bits will be required to assemble your S-16 Shekari.

NUMBERED BITS	LETTERED BITS	
#40	D	Micro-Shaver Countersink
#30	Q	
#11		
#19		
#28		

*Not a necessary tool, but helpful.

S-16 SHEKARI - INTRODUCTION

As the builder of the S-16 SHEKARI kit you are considered the manufacturer by law. The rules state that you must build 51% of the total. In essence, we are your parts supplier. You have the final say in regard to every single item that goes into your project. The responsibility of making a safe aircraft is on your shoulders. It is by your hand this box of parts becomes an aircraft. Set up your quality assurance and construction activity according to the level of risk you are willing to take. The manual provided is to be thought of as a suggested guidebook. Use the book, but learn to think things through. This will minimize errors and reduce build time.

S-16 SHEKARI - GENERAL INFORMATION

BEFORE BEGINNING ASSEMBLY

TAKE INVENTORY: You must complete an inventory within 60 days of receiving your kit. We check and re-check, and are 99.9% certain that if we say we shipped it, we did. The first task in building your kit is to inventory the parts using the packing list provided. It is your job to keep all parts organized and accounted for. We can not provide missing parts cost free after 60 days. Use the supplied pack list to verify that everything that we packed is in the box. The fast way to inventory is to use the priority number that appears on the Part Number labels, these will match the pack list in numeric order. See **GET ORGANIZED!** below. Go through the list item by item. If anything is not there that should be, please contact our parts department immediately.

PLEASE READ: We highly recommend that you completely read the manual cover to cover before beginning assembly of your aircraft. This will help to eliminate costly mistakes and considerably speed up your build time. As you read through the Assembly Manual, follow along in the Parts Manual. Study each and every parts drawing. The Assembly and Parts manuals will parallel each other; however, at times the assembly manual will use parts from two or more pages of the Parts manual. ***PLEASE NOTE:*** *Unless otherwise noted, all figure and exploded view drawings are* ***NOT*** *to scale.*

GET ORGANIZED! Prepare your workshop and be sure that what goes in the shop door will be able to come out!!! **FIGURE 1-1** depicts several scenarios with single and double-car garages. A good way to organize your parts is to fabricate a part inventory board from the shipping crate. As each part is inventoried and checked off on the pack list, staple the bag to the board. See **FIGURE 1-5.** Organize your parts so they are easy to find. Bolts with bolts, washers with washers, etc. This allows for quick identification and part selection during assembly. We fabricate "A" frame stands to support the plywood, or attach the plywood to your shop wall.

KEEP IT CLEAN: Wash your hands, tools, and work tables. You will notice most of the parts are labeled with part numbers. These labels are easily removed with a cloth dampened with acetone or lacquer thinner. ***CAUTION****: Do not allow acetone, lacquer thinner, Loctite or fuel to come in contact with the canopy.* These and some other solvents can craze the canopy. ***PLEASE NOTE:*** *Isopropyl alcohol works best on powder-coat finishes.*

WHAT WE MEAN BY SELF-JIGGING: Most sheet metal planes come with a set of plans to build wooden jigs to aid in assembly. The S-16 uses the pre-made welded steel cage and CNC wing parts to reference just about everything. As you move through this kit you will see how important this is, and how it cuts down build time! Typically, a wing-building bench is made. However, the S-16 Shekari's wings are built on sawhorses and then attached to the fuselage cage, which is the fuselage reference and hard point. Presto, we save time and make it right on the mark too!

STEEL PREPARATION: Even though every care is taken to assure safe arrival of your aircraft, thoroughly inspect the fuselage as well as all other parts for the following: unclosed welds, nicks, and dents. If you locate any suspect areas with excessive dents or scratches call our Tech-Staff for information on damage tolerance. Repair any scratches in painted or powder-coated parts with an appropriate matching paint.

ABOUT SHEET METAL WORK: To build an S-16 kit does not require many of the skills normally needed to build an all aluminum airplane. This makes it easy to build; however, it is a good idea to know the basics of sheet metal work. There are many books available on the subject. Check with your favorite bookstore or aircraft supply store for some of these titles. There are volumes of words on working with sheet metal. They all boil down to tell you these basic things: 1. Sheet metal can cut you, be careful! 2. Avoid creating Stress Risers. Do not scratch, bend or mutilate, unless you are supposed to. 3. Drill and debur. Sheet metal assemblies require clean holes, refer to #2. Stress risers, by the way, are imperfections in the surface of the material that causes the loads or stress not to flow through the material in a favorable way, eventually causing cracks, followed by part failure. This is more critical around the highly loaded parts, such as spars. Parts that are not critical, to some extent, are the skins and ribs. Sure, all these parts are affected by surface imperfections, but the loads they see will be low enough that more stress risers can be tolerated. Try not to scratch anything beyond what it is upon arrival. ***Note:*** *Some aluminum is shipped with a protective plastic film. Please remove this film after all fitting is done.* When parts need to be deburred, various tools can be used. A deburring tool is nice, but a 1/2" drill bit can do a good job on most holes. Radius and smooth sharp corners with files or fine grit sanders and grinders. Edges of certain parts also need deburring...a good file works here. ***Note:*** *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.*

ABOUT FIBERGLASS WORK: This kit is truly a lazy mans way of making a sleek and sexy fuselage. The skins are not placed into a high stress role due to the aluminum and steel under-structure. This means that there is no critical bonding. In fact, you could forget to glue the seams and the plane would still be good to go. Why then do we glue the seams? It helps with the shaping and sealing of the fuselage. The glued seam will be more stable and smoother, plus moisture will not be entering at the seams. ***Note:*** *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.*

ABOUT THE "BODY PUTTY" WORK: The above mentioned seams can be left as is with the joggle and rivets exposed, it will only look rough. However, with a little bit of body putty or your choice of filler, the seam can disappear. This will require some skill. Try to apply only what is needed to fill. Put on only what you want to sand off. Use a squeegee to apply and sandpaper and block to fair to shape. It will not be required to putty the whole plane. In fact, the less putty put on the lighter and better flying the plane. The very nature of the S-16 design means it will end up looking more like a sheet metal plane with very excellent sheet metal work. We use the composite as if it were large metal parts, to reduce part count, improve aerodynamics and lower build time. It is a great concept, do not ground it by adding 100 pounds of body filler.

FILLING PINHOLES: Pre-preg composite will have many pinholes. They are easily filled by applying two to three coats of primer filler. We use Dupont URO Primer Filler on the proto-type. More on this later.

E.D.: Stands for edge distance. In sheet metal and other machine work, the edge distance can be very important. It is the measure of material between the hole center and the edge of the part.

CLECO: A small cylindrical object about 2" long used to hold sheet metal together. Extremely handy since they clamp the sheet metal through the pilot hole of the final size holes in the metal, allowing temporary assembly for fitting and drilling without using rivets. Cleco pliers are used to extract and install clecos. To use, simply set cleco in the special pliers, squeeze closed, insert into the hole and release. You'll find clecos to be extremely useful throughout assembly.

FLUTING TOOL: A sheet metal tool used to pleat the edges of a rib to allow the extra material a place to go when forming an outside curve. In this kit, it is used to straighten the ribs and other parts. Get one, you will need it.

SMART LEVEL: Brand name for a very handy and accurate electronic level. It will allow you to measure to the tenth of a degree. Much nicer!...another must have.

SAWHORSES: Specially trained four-legged beast used to hold up work pieces, very portable and can be made or store bought. Should be at least 28" high. The use of sturdy sawhorses is highly recommended, if not a necessity. Shaky sawhorses only invite potential for damage to any assemblies. Padding the work areas of the sawhorses is also recommended.

MICRO-SHAVER/COUNTERSINK: A precision tool used to countersink holes for screws, rivets, etc. Has an outer collar that can be adjusted for the depth of the countersink. It will be used on the composite skins at the joints to install the flush rivets. Not a totally required tool, you can buy a pretty good countersink at your local hardware store, but try it out on something other than the actual parts first.

MEASURING DEVICES: Things used to layout and measure locations or check locations of items. A good 25' tape measure and a 6" or 12" precision steel rule are needed. A good combo square is nice too. Calipers, micrometers and T-gauges are **NOT** needed unless you are really leaning toward the techno-geek side.

AIR POP RIVETER: Get a good one and have a decent compressor to match. At least 1 horsepower should do. Also, get a good hand pull pop riveter. We have found Sears sells some pretty durable ones. Don't tell them it is for an airplane, they will look at you funny.

SAND PAPER, SANDING BLOCKS, FILES AND DISC SANDERS: These all can be useful. The extent and type of these tools will vary with your skill and taste. They are the weapons of choice for cutting, trimming and shaping anything and everything, (mostly the edges of fiberglass). Pick the tools you are most confident with, although there is not much to trim fit or shape, by comparison to an all glass plane, the right tool will make the task fast and accurate.

DUST MASK: Get a box of the throw away type, and really use them when cutting and sanding the fiberglass or anything that spews particles you would rather not have stuck in your lungs.

A POWERFUL LIGHT: During the assembly of the fuselage skins, we will use a technique of shining light from the other side to locate rivet holes in the tail ribs and tail cone bulkheads. Although a few parts are gel-coated, with a strong enough light you will be able to see through.

STAPLE GUN: A light-staple gun is handy to tack up all the little bags of rivets and bolts to one of the shipping crate sides. This makes the little parts easy to find and store. Do not throw the shipping crate away. It will come in handy later.

RIVETS: Your kit is supplied with various sizes of aluminum and stainless steel rivets. Even though we are careful, there is always the chance of the packages being mis-labeled. So before riveting, be sure to double checks that you have the correct aluminum or stainless steel rivets for the particular section you are working on. For some helpful tips on pulling rivets, refer to **FIGURE 1-4.** The head of the rivet must be in full contact with the riveted surface. Be sure there are no burrs under the rivet head or between the joining materials. Where needed, back-up the rivet joint with a woodblock to keep the separate materials in full contact.

MARKERS: Throughout the manual, you are instructed to mark on various parts. Use flairs or any type of felt tip marker. Avoid using pencils. The graphite in the lead will cause the aluminum to corrode.

AN & RIVET CHARTS: All bolts and rivets furnished with the kit are labeled as to their size. In the event they become mixed or you question the size or length of a particular bolt or rivet, we have included an AN bolt chart and a rivet chart.

ANODIZED PARTS: Many aluminum parts in the Shekari kit come anodized. The anodizing imparts a silver-satin finish to the aluminum. Anodized parts do not require priming or painting.

SCRIBE: Sharp hard pointed instrument used to scratch or mark a surface.

STEP DRILL: Practice of drilling a hole in stages. Example: start with 1/8", then 3/16" and final size #11.

ORIENTATION

STATIONS: Throughout the manual, you will be asked to refer to specific stations of the fuselage. Station One (S-1) is the first structural member starting at the nose of the plane. Progressing towards the tail, we pass all stations. Refer to **FIGURE 1-2**.

LEFT & RIGHT: When a left-hand side part is called out, this means the plane's left or your left if you were sitting in the cockpit looking forward.

SERIAL NUMBER: Refer to **FIGURE 1-3** for the serial number location. Please record your serial number and have it handy whenever you call into the factory for assistance.

HAVE FUN: A RANS aircraft is almost as much fun to build as it is to fly and with a little care and planning, your ship could be a show stopper...Send us and the magazines pictures of your work in progress or your finished plane. Send your completion photos to EAA Sport Planes, Experimenter or Kit Planes. They love to see completed kit planes,...don't be shy, SHOW IT OFF!!

AS ALWAYS, WE'RE HERE TO HELP. SO GIVE US A CALL IF YOU RUN INTO A PROBLEM.

FAA PROCEDURES

--Obtaining an "N" Number

--Registration

--Obtaining An Airworthiness Certificate

OBTAINING AN "N" NUMBER

In order to register your plane, it will be necessary to obtain an identification number for the plane. This is referred to as an "N" number.

If any number is acceptable to you, write to the FAA Aircraft Registry, Dept. of Transportation, P.O. Box 25504, Oklahoma City, OK 73125 and ask them to assign you a free U.S identification number of their choice.

If you prefer a number of your own choosing or a smaller number, you may be able to obtain the exact number you want by asking the FAA registry to assign you a specific number of your choice.

NOTE: U.S. identification numbers do not exceed 5 symbols in addition to the prefix "N". These symbols may be all numbers (N55555), one to four numbers and a suffix letter (N5555A or N5A), or one to three numbers and two suffix letters (N555AB).

If you request a special "N" number, it would be best to list at least five choices in case your first choice is not available. A special number of your own choosing will cost $10.00 and you should enclose that fee with your letter.

When To Obtain Your "N" Number

If you plan to complete your kit within a very short time, it is recommended that you obtain your "N" number right away. If your project will be fairly lengthy, you will not need to obtain your number until the last several months of construction. Keep in mind that if you request a special "N" number it can be reserved for no longer than one year. If this number has not been affixed to the fuselage within this time and the registration completed, it will be necessary to pay an additional $10.00 to reserve that number for another year.

AFFIDAVIT OF OWNERSHIP FORM

Enclosed you will find an Affidavit of Ownership Form. This form should accompany your letter requesting the assignment of an "N" number. This form must be notarized. It establishes your ownership to the airplane, even though you know you did build it. It will be used by the FAA to create a file on your aircraft and will serve as a legal document and a **substitute for the Bill of Sale** (AC Form 8050-2) that a buyer gets when he buys any existing airplane.

REGISTERING YOUR AIRCRAFT

After you have written the Aircraft Registry requesting an "N" number, you will receive a form letter giving your number assignment. You will also receive a blank Aircraft Registration Form. (Sample Enclosed.) Complete the Application for Aircraft Registration (Form 8050-1) and return it to the Aircraft Registry along with the $5.00 registration fee. Retain the **PINK** copy of the Registration and mail both the **WHITE** original and the **GREEN** copy. Your **PINK** copy is your authority to operate the aircraft, **when carried in the aircraft with an appropriate and current airworthiness certificate**.

RECEIVING AUTHORITY TO FLY YOUR AIRCRAFT

Registration alone does not authorize you to fly your aircraft. The aircraft must, after it has been properly registered, also obtain an Airworthiness Inspection by an inspector of the FAA, at which time the necessary Airworthiness Certificate may be issued. Then, and only then, is your aircraft ready for flight.

WHAT IS THE PROCEDURE FOR OBTAINING AN AIRWORTHINESS CERTIFICATE

Since the final step in obtaining an Airworthiness Certificate is to obtain an inspection of your airplane by an official of the FAA, it is a good idea to make an early contact with the FAA inspector's office nearest your home. Members of the local EAA chapter or a local flying service may be able to help direct you to this office. The purpose of such an early contact would be to discuss with the FAA representative, your proposed homebuilt project and to generally familiarize yourself with the procedures established by the FAA for homebuilt projects. At this time, you can establish a tentative plan for inspection of the aircraft upon completion. The typical FAA inspector is interested in your project and wants to help you do a good job.

The FAA requires that everyone building an airplane must maintain a construction log of the work he does on his airplane. You can use a notebook of conventional size and keep a daily diary of the work done on your aircraft. Since all our planes come with assembly manuals, it is a good idea to also make notes in the manual as well as listing dates when certain procedures were done. It is a very good idea to take photographs of work on your plane in various stages. This helps to document that you, the builder, actually completed 51% of this kit. (Advisory Circular 20-27C available from the FAA or EAA describes the procedure used so that your logbook will be a verification of having complete at least 51% of the aircraft yourself.)

MY AIRCRAFT IS COMPLETED, ALL MARKING AND PLACARDS ARE IN PLACE. WHAT ELSE MUST I DO TO MY AIRCRAFT BEFORE I AM READY FOR MY PRE-CERTIFICATION INSPECTION?

Included in your manual is a weight and balance sheet. This will need to be completed before the inspection.

You will need to purchase a logbook for the aircraft, engine and propeller. These can be separate books or just one.

Have handy a copy of your Sales Invoice from us.

I FEEL I AM READY FOR INSPECTION BY THE FAA INSPECTOR, WHAT DO I DO?

If you have had prior contact with your FAA inspector, you will probably be familiar with the procedures used by that office. Different offices have slightly different procedures. Some inspectors will help you fill out the paperwork at the time of inspection. Others require that you submit the paperwork prior to inspection. If you are not sure and there are no other builders in your area to ask, you could call and ask the local office. Or you can submit the following to the Inspector's Office.

1. A letter requesting a final inspection.
2. Form 8130-12 Eligibility Statement (sample follows).
3. Form 8130-6 Application for Airworthiness Certificate (sample follows).
4. A 3-view drawing of the aircraft or photos of topside and front view. Include with this the following:
   Horsepower rating of engine and type of prop.
   Empty weight and maximum weight at which the aircraft will be operated.
   Number of seats and their arrangement (tandem, side by side).
   Whether single or dual controlled.
   Fuel capacity.
   Maximum speed at which you expect to operate the aircraft.

5. Estimated time or number of flights required. (Usually 25 hours for aircraft equipped with certified aircraft engine and prop combinations and 40 hours for those with non-aircraft engine propeller combinations.)

6. The area over which you will be testing. (Request an area encompassing a 25 mile radius for day VFR operations.) Exclude congested areas and airways, but try to include nearby airports even if a few miles beyond the 25 mile radius.

Upon satisfactory completion of the necessary final FAA inspection of the aircraft and whatever ground tests may be required, the FAA Inspector will issue your amateur-built "Experimental" Airworthiness Certificate. Along with the certificate you will be given certain **"OPERATING LIMITATIONS"** under which you must operate the aircraft.

AIRCRAFT INSTRUMENT MARKINGS & COCKPIT PLACARDS

Your reference is FAR Part 91.31 Civil Aircraft Operating Limitations and Marking Requirements.

8-1 GENERAL

To insure that each person operating an aircraft does so within the operating limitations prescribed for it, the FAA requires that there is available in it a current Flight Manual, appropriate instrument marking and placards, **or any combination there of.**

The purpose of the flight manual, markings and placards is to detail for the operator of the aircraft, the operational limitations prescribed for the aircraft.

In lieu of a flight manual most amateur builders prefer to mark their instruments and to affix the necessary placards to the instrument panel as the primary means for complying with these requirements.

8-2 MARKINGS AND PLACARDS

The markings and placards necessary for the safe operation and handling of the aircraft should be displayed in a conspicuous place and may not be easily erased, disfigured or obscured. Such placards and markings should include but not necessarily be limited to the following criteria: special emphasis on fuel system markings are very important: such as fuel valves-on-off fuel octane quantity, unusable fuel, minimum fuel for take-off, minimum fuel for inverted flight, etc.

8-3 POWERPLANT INSTRUMENT MARKINGS

Each required powerplant instrument should be marked to indicate the maximum and, if applicable, minimum safe operating limit with a red radial line.

Each normal operating range is to be marked with a green arc not extending beyond the maximum and minimum continuous safe operating limits.

Each engine speed range that is restricted because of excessive vibration should be marked with a red arc.

8-4 AIRSPEED INSTRUMENT MARKINGS

The airspeed indicator should be marked with a **radial red line** to establish the never-exceed speed (Vne).

The takeoff and any precautionary range should be marked with a **yellow arc**. The normal range is marked with a **green arc**. The flap actuation range is marked with a **white arc**.

8-5 AIRSPEED PLACARDS

There should be an airspeed placard in clear view of the pilot and as close as practicable to the airspeed indicator listing:

The design maneuvering speed.
The maximum landing gear operating speed (if applicable).
The maximum flap extension operating speed (if applicable).

8-6 LANDING GEARS

If a retractable landing gear is used, an indicator should be marked so that the pilot can, at any time, ascertain that the wheels are secured in their extreme positions.

Each emergency control should be **red** and must be marked as to method of operation and identity.

8-7 CONTROL MARKINGS

Each fuel tank selector should be marked to indicate the position corresponding to each tank and to existing cross feed position.

If safe operation requires the use of any tanks in a specific sequence, that sequence must be identified.

8-8 POWERPLANT FUEL CONTROLS

Each fuel tank selector should be marked to indicate the position corresponding to each tank and to existing cross feed position.

If safe operation requires the use of any tanks in a specific sequence, that sequence must be identified.

8-9 FLIGHT MANEUVER PLACARD

For non-acrobatic category airplanes, there should be a placard in front of and in clear view of the pilot stating: "No acrobatic maneuvers, including spins, approved."

For acrobatic category airplanes, there should be a placard in clear view of the pilot listing the approved acrobatic maneuvers and the recommended entry airspeed for each. If inverted flight maneuvers are not approved, the placard must have a notation to this effect.

8-10 BAGGAGE PLACARD

The maximum baggage load permitted should be displayed in a conspicuous place adjacent to the baggage area.

8-11 PASSENGER WARNING PLACARD

A placard must be affixed to the aircraft so that it is readily seen in the cockpit. It will state: "Passenger Warning- This aircraft is amateur built and does not comply with the Federal Safety Regulations for "Standard Aircraft". This placard is part of a set available from EAA. See Section 10-5.

OPERATING LIMITATIONS

13-1 MANDATORY TEST FLIGHT PROVING PHASE

All amateur-built sport aircraft as well as standard aircraft have federally imposed operating limitations.

Upon satisfactory completion of the necessary final FAA Inspection of the aircraft and whatever ground tests may be required, the FAA Inspector will issue your amateur-built "Experimental" Airworthiness Certificate.

He will also issue a form letter establishing the operating limitations applicable to your aircraft during its mandatory flight-proving period. These Special Airworthiness Experimental Operating Limitations must be displayed in the aircraft at all times. (See sample Operating Limitations, Figure 13-1).

The operating limitations imposed on the aircraft during its flight-proving period will be more stringent than those issued later after the mandatory flight-testing phase has been completed.

This phase may begin with the issuance of the aircraft's initial airworthiness certificate and the original operating limitations. At this time, the FAA Inspector will acquaint you with the requirement for a mandatory flight test and proving period. This flying will be confined to an assigned flight area approved by the FAA Inspector.

The presence of the FAA Inspector is not required, by regulation, at the initial flight of the experimental amateur-built aircraft. If time permits, however, it is not unusual for him to attend.

If he deems necessary, the inspector could issue a permit for a single flight within the boundaries of the airport and, upon witnessing the safe completion of the test, issue a further permit for more extended flights within the permissible area.

A tremendous responsibility for the safe operation of the experimental aircraft rests on the FAA Inspector. If the plane has any new and unusual features, he will naturally tend to treat its first flights with care. Also pilot qualification and skill is a consideration.

13-2 PURPOSE OF THE FLIGHT TEST PERIOD

A flight test period is necessary to show to the FAA that the aircraft is controllable throughout its normal range of speeds and throughout all the maneuvers to be executed. It will also serve to prove that the aircraft has no hazardous operating characteristics or design features.

13-3 DURATION OF MANDATORY FLIGHT TEST PERIOD

For standard aircraft type engines: When an FAA approved aircraft engine/propeller combination is installed the flight test period is usually limited to 25 hours of flight time.

For non-aircraft type or automotive engines: An aircraft equipped with such an engine is required to be flown for a longer test period, usually at least 40 hours, to prove its reliability.

NOTE: It should be understood that the local FAA Inspector has the prime responsibility in determining the extent of the flight test period to be required for your aircraft. He is permitted to exercise considerable discretion in extending or in reducing the number of hours required to be flown during this period.

13-4 FLIGHT TEST AREA

The FAA Inspector will authorize the flight tests to be carried out in a designated and limited test area, usually, within a 25 mile radius of the aircraft's base of operations.

He will insure that the area selected is not over densely populated areas or in a congested airway.

In assigning the flight test area, the FAA Inspector may modify the size and shape of the area to suit the best purposes of the flight test program. In some locations, particularly around bigger cities where air traffic is heavy, a flight test area may not be practical. The builder must be prepared to except that an approved flight test area may not be the one chosen to him as the most convenient.

13-5 OTHER LIMITATIONS DURING THE FLIGHT TEST PERIOD

As a rule, the carrying of passengers or other crewmembers will not be permitted unless necessary to the safe operation of that aircraft.

13-6 AIRCRAFT FLIGHT LOG

During the flight test period, the pilot should record the aircraft flight history in an appropriate logbook. This should be in addition to any engine tachometer or engine hour meter that may be installed in the aircraft.

Specifically, the duration of each individual flight should be recorded including the number of landings made.

A full description of any mishaps, however minor, or any experiences not entirely normal that occur during the flight experience period should also be duly recorded.

Although not required, it is strongly recommended that all operating data be recorded flight by flight. Such information as airspeeds, cylinder head temperatures, etc., will be very valuable and may be used to determine or establish the various performance figures and operating characteristics of the aircraft.

Although the FAA Inspector is required by law to apply certain basic restrictions permanently to the amateur-built aircraft he is certificating, he can apply whatever other limitations he deems necessary at his own discretion. Unfortunately, nothing in the regulations states that the initial restrictings are required to be removed after successful completion of the test period...they only may be modified.

After the mandatory flight-test period...then what?

REPAIRMAN'S CERTIFICATION

The Repairman's Certificate is applied for using the application from 8610-2, available from the local FAA offices. You should ask for this when you apply for your final inspection on your aircraft. You should also be familiar with the Appendix D of FAR part 43. (Items included in the Annual Condition Inspection.)

The Repairman's Certificate is only available to those who have built 51% or more of the specific aircraft they are having inspected.

Every twelve calendar months a condition inspection is performed in accordance with Appendix D of FAR part 43. The repairman has to include the aircraft total time in service, the name, the signature and the certificate type number of the repairman or A & P, who does the examination.

A & P mechanics must do the Annual Condition Inspection for those who are non-builders who own an amateur-built aircraft. On those aircraft where the builder has a Repairman's Certificate, it is recommended that from time to time the Annual Condition Inspection of those aircraft be done by an A & P simply as a check on the builder/repairman's work. One legal representative recommends that every other Annual Condition Inspection for a builder holding a repairman's certificate be done by an A & P mechanic.

AFFIDAVIT OF OWNERSHIP FOR AMATEUR-BUILT AIRCRAFT

U.S. Identification Number: _____

Builder's Name: _____

Model: _____ Serial Number: _____

Class (airplane, rotorcraft, glider, etc.): _____

Type of Engines Installed (reciprocating, turbopropeller, etc.): _____

_____

Number of Engines Installed: _____

Manufacturer, Model, and Serial Number of each Engine Installed: _____

_____

Built for Land or Water Operation: _____

Number of Seats: _____

The above-described aircraft was built from parts by the undersigned and I am the owner.

(Signature of Owner-Builder) _____

State Of: _____

County Of: _____

Subscribed and sworn to before me this _____day of_____, 19_____

My commission expires _____

_____
(Signature of Notary Public)

AC Form 8050-88 (9-75) (0052-00-559-0002) Supersedes previous edition

RIVETS CROSS REFERENCE LIST

DIA.	RANS	POP RIVET				CHERRY Q			
	NO.	NO.	SHER.	TNSL.	GRIP	NO.	SHER.	TNSL.	GRIP
3/32 (#41)	40APR1/8	AD32ABS	85	135	.031-.125	--	--	--	--
3/32 (#41)	40APR1/4	AD34ABS	85	135	.126-.250	--	--	--	--
3/32 (#41)	40APR3/8	AD36ABS	85	135	.251-.375	--	--	--	--
1/8 (#30)	30APR1/16	--	--	--	--	AAPQ-41	225	250	.0-.062
1/8 (#30)	30APR1/8	AD42ABS	155	235	.063-.125	AAPQ-42	225	250	.063-.125
1/8 (#30)	30APR1/4	AD44ABS	155	235	.188-.250	AAPQ-44	225	250	.126-.250
1/8 (#30)	30APR3/8	AD46ABS	155	235	.313-.375	AAPQ-46	225	250	.251-.375
1/8 (#30)	30SSPR1/16	--	--	--	--	CCPQ-41	700	600	0-.062
1/8 (#30)	30SSPR1/8	SSD42SSBS	550	700	.031-.125	CCPQ-42	700	600	.063-.125
1/8 (#30)	30SSPR1/4	SSD44SSBS	550	700	.188-.250	CCPQ-45	700	600	.188-.312
1/8 (#30)	30SSPR3/8	SSD46SSBS	550	700	.251-.375	CCPQ-46	700	600	.251-.375
3/16 (#11)	12APR1/8	AD62ABS	315	500	.063-.125	AAPQ-62	500	450	.062-.125
3/16 (#11)	12APR1/4	AD64ABS	315	500	.126-.250	AAPQ-64	500	450	.126-.250
3/16 (#11)	12APR3/8	--	--	--	--	AAPQ-66	500	450	.251-.375
3/16 (#11)	12APR1/2	AD68ABS	315	500	.375-.500	AAPQ-68	500	450	.376-.500
3/16 (#11)	12SSPR1/8	--	--	--	--	CCPQ-62	1650	1300	.062-.125
3/16 (#11)	12SSPR1/4	SSD64SSBS	1000	1375	.126-.250	CCPQ-64	1650	1300	.126-.250
3/16 (#11)	12SSPR3/8	SSD66SSBS	1000	1375	.251-.375	CCPQ-66	1650	1300	.251-.375
3/16 (#11)	--	--	--	--	--	SSPQ-68	1050	825	.376-.50
3/16 (#11)	--	--	--	--	--	SSPQ-610	1050	825	.501-.562
	--	--	--	--	--	CCPQ-44	700	600	.126-.250
						AVEX RIVET			
1/8 (#30)	--	--	--	--	--	1691-0410	165	230	.031-.187

AN3 - AN8 AIRFRAME BOLTS

AN3-AN8 CADMIUM-PLATED STEEL BOLTS (DRILLED AND UNDRILLED)

A non-corrosion-resistant steel machine bolt which conforms to Specification MIL-B-6812. Cadmium-plated to Specification QQ-P-416.

Available with or without single hole through shank and/or single hole through head. Examples of part members for a cadmium plated steel bolt having a diameter of 1/4" and nominal length of 1".

AN4-6	For drilled shank
AN4-6A	Designates undrilled shank
AN4H-6	Drilled head, drilled shank
AN4H-6A	Drilled head, undrilled shank

NUT AND COTTER PIN SIZES

AN NUMBER	DIAMETER	PLAIN NUT AN NUMBER	CASTLE NUT AN NUMBER	COTTER PIN MS NUMBER
AN3	3/16	AN315-3R	AN310-3	MS24665-132
AN4	1/4	AN315-4R	AN310-4	MS24665-132
AN5	5/16	AN315-5R	AN310-5	MS24665-132
AN6	3/8	AN315-6R	AN310-6	MS24665-283
AN7	7/16	AN315-7R	AN310-7	MS24665-283
AN8	1/2	AN315-8R	AN310-8	MS24665-283

HOW TO DETERMINE GRIP

For Steel and Aluminum Aircraft Bolts

(Subtract Fractions Shown Below From Length of Bolt)

AN 3 to AN 8	AN NUMBER, Diameter, and Threads per Inch	AN3 10 -32	AN4 1/4 -28	AN5 5/16 -24	AN6 3/8 -24	AN7 7/16 -20	AN8 ½ -20
	Grip = Length Less	13/32	15/32*	17/32	41/64	21/32	25/32

*Formula does not apply for AN4-3. Grip for AN4-3 is 1/16.

DASH NUMBER -- NOMINAL LENGTH

-3 . . . 3/8	-6 . . . 3/4	-11 . . . 1 ⅛	-14 . . . 1 ½	-17 . . . 1 7/8	-22 . . . 2 1/4	-25 . . . 2 5/8
-4 . . . ½	-7 . . . 7/8	-12 . . . 1 1/4	-15 . . . 1 5/8	-20 . . . 2	-23 . . . 2 3/8	-26 . . . 2 3/4
-5 . . . 5/8	-10 . . . 1	-13 . . . 1 3/8	-16 . . . 1 3/4	-21 . . . 2 1/8	-24 . . . 2 ½	-27 . . . 2 7/8
						-30 . . . 3

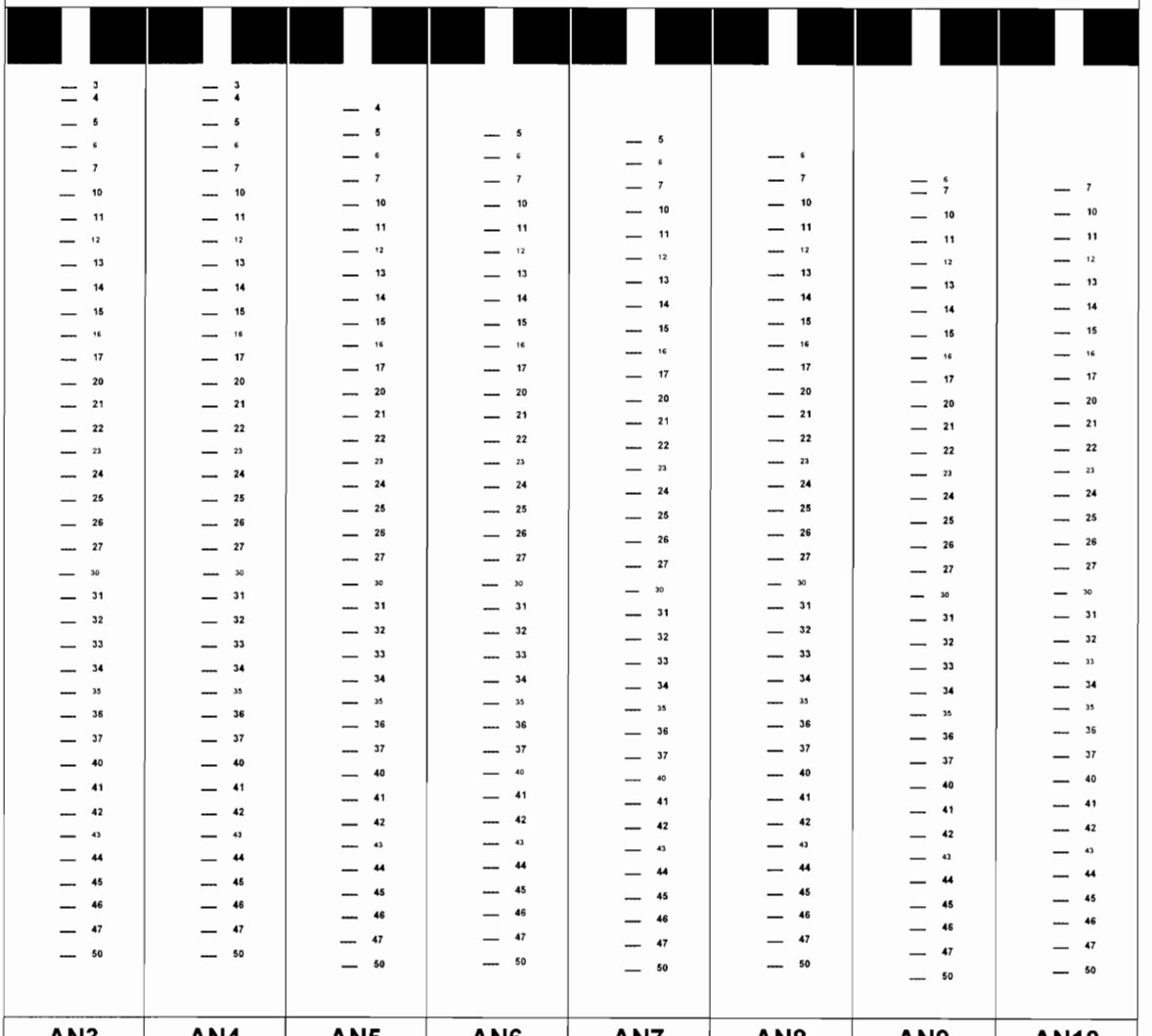
PART IDENTIFICATION

Use the above chart to determine lengths of bolts. Diameters are as follows:

AN3 = 3/16" AN4 = 1/4" AN5 = 5/16" AN6 = 3/8"

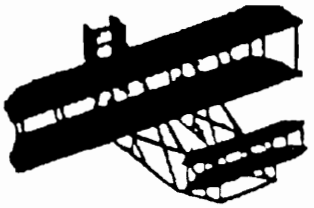
Use the parts manual for other part identification. The drawings depict a fairly accurate likeness of the real thing. Other parts are labeled by part number. Again, reference the parts manual to confirm part identity.

AN Bolt Gauge



AN3	AN4	AN5	AN6	AN7	AN8	AN9	AN10
3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8

EF-116



AIRPLANE PLASTICS
8300 DAYTON RD.
FAIRBORN, OHIO 45324

Phone: (937) 864-5607

PLEXIGLAS HINTS

1. **Cutting:** An abrasive disc powered by a high speed drill, a Dremel tool, or a die grinder is recommended. We have found that abrasive cut-off wheels or aluminum oxide or silicon carbide provide excellent cutting results. A three inch disc is available at most hardware stores for around $3.50. A small grinding disc or Dremel saw disc will also give good results. Reciprocating saws like saber saws are **not recommended** and will probably break your canopy. A tool that progresses slow and hot to grind through the canopy is best. Tape a poly plastic cover on the canopy and mark your outline with a grease pencil. Never cut a cold canopy. Allow the canopy to warm to 70° or more for at least an hour. Don't allow the canopy to vibrate or chatter during the cutting or it may chip and crack. Support your canopy on a flat surface so it will not twist or spread during the trimming. Duct tape is handy to hold things in place. Remember: cut slowly, don't push the cutter. Let the tool do the work. Be sure to use eye protection. Plexiglas chips can be a problem in your eyes since they are clear and difficult to see. After the canopy is trimmed, use a hand held belt sander to sand down to your line. Deburr edge with a scraper or sandpaper before trial fitting to keep from breaking canopy or cutting fingers.

2. **Drilling:** The drill should be ground off to a zero rake angle to prevent digging in, chipping and cracking the Plexiglas. A standard drill bit, ground with no cutting edge pitch, is a safe method of making holes. Be sure to make the holes 1/8" oversize to allow for motion caused by thermal expansion and contraction. Deburr hole with countersink. Use elastic stop nuts and tighten until you can see reflection around screw bend and back screw off 1/2 turn.

3. **Cleaning:** A damp soft cloth or an air blast will clean the saw dust away. The damp cloth will also dissipate static electricity. To clean dirty plexiglas use plenty of water and a non-abrasive soap or detergent. Dry with a clean chamois or soft cloth. **Never** use acetone, benzene, carbon tetrachloride, lighter fluid, lacquer thinners, leaded gasoline, window sprays or scouring components. Grease or oil may be removed with kerosene, white gasoline, naptha or isopropyl alcohol. Small scratches can be buffed out with "Mirror Glaze" HGH-17 and lots of rubbing. Hard automobile paste wax should be applied as a protective coating and buffed with a soft cotton flannel cloth. Do not use cheesecloth, muslin or shop cloths, they scratch. For deep scratch removal, procure a micro mesh kit from a plastic sheet dealer or your canopy supplier.

DRILLING

When drilling Plexiglas, best results will be obtained using standard twist drills which have been modified as described below. High speed steel drills should be used.

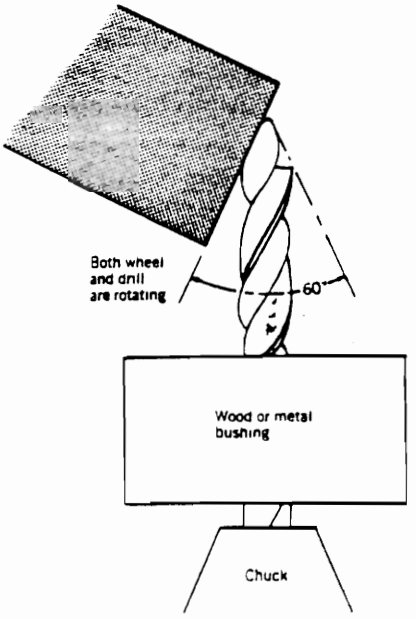
Specially ground drills for Plexiglas are available from Authorized Plexiglas Distributors.

MODIFICATION OF DRILL

Instructions for Sharpening Bits for Use on Plexiglas

Chuck the bit in an electric drill. Insert the bit through a wood or metal bushing clamped to the support rest of an abrasive wheel. The bushing must be so clamped that an approximate 60 degree total included angle is ground on the bit. With the electric drill *operating*, insert the bit through the bushing so that it contacts the face of the rotating abrasive wheel, thus grinding a conical point on the bit. Remove the bit from the chuck.

Using the side of the rotating abrasive wheel, grind a zero rake angle on each of the cutting edges. This provides a scraping, rather than a cutting action.



Then using the face of the rotating abrasive wheel, grind a clearance behind each of the cutting edges of about 8 to 12 degrees. Do not touch the cutting edges!!!!

FIGURE 10b

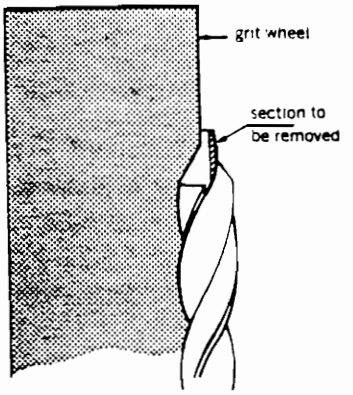
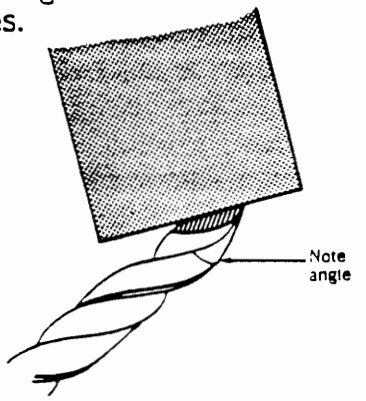


FIGURE 10c

Grinding clearance behind cutting edges.



GENERAL DRILL SPEEDS

Diameter		Speed - RPM
.060"	—	1500-4500
.125"	—	1500-4500
.187"	—	1500-4500
.250"	—	1500-2000
.312"	—	1500-2000
.375"	—	1500-2000
.437"	—	1000-1500
.500"	—	500-1000
.750"	—	500- 800
1.000"	—	500

CAGE INSPECTION & ASSEMBLY

1. SHOP PREPARATION – The use of sturdy sawhorses is highly recommended, if not a necessity, when constructing the fuselage. Shaky sawhorses only invite potential for damage to any assemblies. Padding the work areas of the sawhorses is also recommended.

2. INSPECTION - The fuselage (also referred to as "cage") is shipped pre-welded and powdercoated. It has been painstakingly matched to the wing spars. Your fuselage has been carefully packed for shipping to help prevent damage. Place the fuselage on the sawhorses and check for any damage caused during shipping. Any damage may be considered unacceptable. Check especially for dents, dings and/or excessively deep scratches, which could compromise the fuselage integrity.

3. ATTACH PLATE INSTALLATION - Bolt each trailing edge spar attach plate to the appropriate welded bushings on the cage. These bushings are behind the aft gear truss. See **FIGURE 2-1** for details.

4. MAIN GEAR - Fit-up the main gear.

5. NOSE GEAR - Fit-up the nose gear, if building a tricycle gear aircraft.

6. INTERNAL SYSTEMS – Install the internal cage systems. See INTERNAL SYSTEMS.

S-16 SHEKARI ASSEMBLY MANUAL

MAIN GEAR ASSEMBLY & INSTALLATION

Hint: *The cage can be placed right side up or down, whichever proves more convenient for assembly.*

1. GEAR LEG AXLE SOCKET – There are two (2) #11 holes drilled into one side of the gear leg axle socket. Drill the lower hole in the axle socket to ¼". Drill #11 through the upper #11 hole. ***Note:*** *Be sure to drill squarely through the other side.* ***Hint:*** *Use a drill press for accuracy.* Drill the pre-drilled hole in the gear leg to ¼". Slip the axle socket onto the lower end of the gear leg. Align the bottom hole in the axle socket with the hole in the gear leg. ***Note:*** *It may be necessary to bevel the inserted end of the gear leg to achieve alignment.* Transfer drill ¼" through the axle socket. Temporarily bolt through the socket and gear leg. ***Note:*** *Keep a hole pinned, with a bolt, when drilling to prevent shifting of the parts.* Transfer drill #11 through the upper hole in the axle socket. For accuracy drill half way through the gear leg from each side, Then drill out to ¼". With the holes aligned, final size drill all holes 5/16" and debur. Install the gear leg axle socket using the hardware shown.

2. GEAR LEG INSTALLATI0N - Place the cage on a set of sawhorses. Measure the depth of each gear leg socket in the cage. Transfer this measurement to the top of each gear leg and mark with a piece of masking tape. Install the gear legs with the cage in its upright position. Slide each gear leg into the sockets on the cage until the tape on the gear leg is flush with the socket. ***Important:*** *The gear legs must be completely inserted in their socket. It may be necessary to slightly ream the inside of the socket to allow the gear leg to fully insert. It is also acceptable to lightly sand the upper portion of the gear leg (spinning the gear leg on a disk sander works well for this).* Both gear legs should extend equal length. See **FIGURE 2-2.** ***Note:*** *If minor adjustments need to be made to gear leg length, remove material from the top of the longer gear leg.* Do **not** space a short gear leg out!

3. TIRE ASSEMBLY - The axle and hub assembly will need to be disassembled to allow for installation of the tire and tube. Pay close attention to the disassembly sequence for correct re-assembly.

4. AXLE INSTALLATION - ***Note:*** *If setting up with optional wheel pants and gear leg fairings, bolt on axles with wheel pant and fairing attach tabs placed between the axle and gear leg, as per parts drawing.* Build a jig as shown in **FIGURE 2-3**, to be used to align wheel axles. With axle aligned and clamped to jig, check gear legs for equal extension. Adjust if required, then drill from each side of gear leg socket, just enough to mark the gear leg. Remove legs and complete drilling using a drill press. Deburr and bolt gear in place. ***Note: Bend gear leg fairing mount tabs as per FIGURE 2-2a.***

OPTIONAL GEAR LEG FAIRINGS

Note: *Install the gear leg fairings after the fuselage shells have been fit-up.*

1. TRIM RUBBER EDGING - Locate the parts shown in the parts manual. Install the rubber edging to the top and bottom of the gear leg fairing as shown. Do **not** glue in place at this time.

2. INSTALL FAIRING - Remove the main gear from the cage. Slip the fairing down onto the gear leg until the slot rests around the axle. Re-install gear leg to check the fairing fit. If the gear leg fairing is

tight, it may be necessary to file the lower slot. If the top of the fairing does not match the fuselage perfectly, adjust the rubber edging during the gluing process to fit snug against the fuselage.

3. ROUTE BRAKE LINE – Mark on the fuselage around the fairing. Drill a ½" hole in the fuselage within the marked area. ***Note:*** *Align the fuselage hole with the small pre-drilled hole in the fairing rib.* Route the hydraulic brake tubing through the fuselage and fairing rib hole during final assembly. Re-install the main gear.

OPTIONAL MAIN WHEEL PANTS

1. INSTALL LOC NUT - Remove the cotter pin and castle nut from the axle shaft. Install the ¾" loc nut. The loc nut should be tight enough to prevent any in-out play, but remain free enough to ensure smooth bearing operation.

2. WHEEL CUTOUT - Make a template as shown in **FIGURE 2-4** from poster board to mark the bottom hole for wheel clearance. Locate the hole 5 ½" aft of the forward nose of the wheel pant as shown in **FIGURE 2-4.** Do **not** use the dimple molded into the wheel pant for hole location.

3. BRAKE CUTOUT - Make a template out of poster board as shown in **FIGURE 2-5** for the brake cutout. The location of center should be ½" directly below the dimple on the wheel pant. Mark the wheel pant using the template. Remove the material using a fine blade jigsaw. ***Note:*** *Make a right and a left wheel pant.* The bolt hole on the outside of the wheel pant should also be ½" directly below the dimple on the wheel pant. Drill the outside hole to ¼".

4. AXLE EXTENSION – Drill and tap center of axle to receive the ¼" stud. Install the stud with Loc-tite into axle and insert nut.

5. MAIN WHEEL PANT INSTALLATION – ***Note:*** *The main gear wheel pants will need to be leveled with the aircraft in a flying attitude. Set aside the main gear wheel pants until installation of the nose wheel pant or tailwheel is complete.* Slip the main wheel pant into position. With the bolt and washer in the outside hole, position the main wheel pant parallel with the nose wheel pant and mark the two inside attach holes using the tabs on the axle socket as guides. See fixture idea in **Figure 2-7.** Drill 3/16" and install hardware as shown in the parts manual.

S-16 SHEKARI ASSEMBLY MANUAL

NOSE GEAR ASSEMBLY & INSTALLATION

SPECIAL NOTE: *The S-16 nose gear features a nose gear disconnect. In flight, the nose gear is pulled down by a spring into a centering cam to hold the nose into the slipstream. This eliminates unwanted yaw input and enhances handling. The system has been highly proven on our S-6 Coyote II aircraft, but remains untested on the S-16. Please assemble your aircraft with the disconnect. Once approval is given, you can remove the locking bolt, rather than trying to install it in a finished plane.*

1. INSTALL LOCKING CAM – Select all the parts for the nose gear. ***Note:*** *The nose gear strut is pre-assembled.* Align and bolt the locking cam onto the lower nose gear swivel bushing.

2. FIT GEAR – Slip the nose gear strut into the lower swivel bushing and locking cam. Push the strut until it inserts into the top swivel bushing. ***Hint:*** *Place the cage right side up or down, whichever proves more convenient for assembly.* ***Note:*** *Some filing or reaming of the swivel bushings may be required to allow insertion and free rotation of the nose gear.* However, it is important not to ream any more than necessary to avoid nose gear shimmy. Remove the nose gear strut. Clean any debris from the swivel bushings and strut.

3. INSTALL UNIVERSAL JOINT – Mark front centerline of the strut. See **FIGURE 2-7A.** Extend this line 4" from the top. ***Hint:*** *Support the strut end on a block and rest the axle end of the strut on a table to mark.* Pack and grease the thrust bearing and washer assembly and slip on the nose gear strut. Slip the strut into the lower swivel bushing and locking cam. Position the steer cam and spacer. ***Note:*** *The slot in the spacer goes to the top. Trim off the bottom of the spacer as needed for a snug fit.* Push the strut until it inserts into the top swivel bushing and bottoms out on the bearing assembly. Align the nose gear axle end with the front cage tube. Center the spacer slot on the marked centerline. Mark ¼" below the top of the slot on the centerline. Center punch and drill #30. Bolt the eye bolts to the universal joint. Remove the strut, drill the #30 hole to ¼" through the strut. ***Hint:*** *Use a drill press and v-block for best results.* Mark a second hole below the first on centerline, the same width as the eye bolts on the universal joint. Fabricate (2) aluminum spacers, by cutting length of ½" and drilling trough the center with a ¼ diameter. Install ½" aluminum spacers under head of eyebolt. Re-install the strut and bolt the universal joint to the strut. Finger tighten for now.

4. INSTALL SHIMMY DAMPER – Mark on the outboard battery box support tube, 4" below the centerline of the station 1 crossing tube and drill to #11. See **FIGURE 2-7B.** ***Note:*** *This hole will also be used to mount the battery box.* Remove the plugs from the shimmy damper and fill the cylinder with MIL 5606 Hydraulic Fluid. ***Note:*** *After filling the damper, re-install the plugs.* Cut ¼" bushing and install through universal joint and damper. Tightening the bolt will swell the bushing, making a tight fit. ***This is important****, if play exists, shimmy may result.* Bolt to the universal joint and cage.

5. LOCK STEER CAM - With the cage right side up, push the strut so that the thrust bearing and washers are tight against the lower swivel bushing. View the top of the fork and steer cam from above it. Align the tabs on the steer cam parallel with the fork.

6. INSTALL ROLLER BUSHINGS – Drill roller bushing to ¼". Position a roller bushing tight in the slot of the steer cam. See **FIGURE 2-8.** Transfer drill ¼" through the strut. Be sure the bushing remains tight in the slot. Drill the other side in the same manner. Bolt the roller bushings to the strut so they can still turn, when the strut is unlocked.

7. DRILL AXLE RETENTION HOLES - Locate the center of each axle bushing on the nose gear fork. Drill a #40 hole through the bushings on centerline. See **FIGURE 2-9.** Debur inside and outside.

8. INSTALL WHEEL ASSEMBLY - Install the wheel/tire assembly into the nose fork. ***Note:*** *First, check the axle insertion into the hub bearings. If the axle will not slide into the wheel, spin sand it on a belt or disc sander.* Install the axle with the aluminum bushings on each side. Note that the bushings may need to be filed to fit. Using a #40 drill bit, transfer drill through the pre-drilled holes in the axle bushings on the fork through the axle and install the cotter pins to retain the axle.

9. INSTALL DOWNSPRING – Refer to **FIGURE 2-10** and modify the multi-hole tang. ***Hint:*** *Use the joggle tool.* See **FIGURE 2-27.** Bolt a multi-hole tang to the tab on the lower swivel bushing. Attach the downspring to the multi-hole tang on the lower swivel bushing and the unbent end of the multi-hole tang. Bolt the bent end of the multi-hole tang to the lower eyebolt. Pay attention to the washer placement. ***Hint:*** *It may help to remove the locking bolt from the steer cam.*

10. ATTACH RUDDER PEDALS – ***Note:*** *Proceed with this step once the rudder pedals are in place.* Screw the steering rod linkage onto the threaded end of the steer horn link tube. Screw the eye bolt into the link tube. ***Important:*** *Do* ***not*** *forget to Loctite the threads after a trial fit-up.* ***Note:*** *Remember, it must engage at least ten (10) turns.* Connect the link tube assemblies to steer cam. Center the nose gear, place the rudder pedals in a neutral position and attach the aft end of the link tubes. Adjust the link tubes to maintain the nose gear on a straight course.

11. MAINTENANCE SCHEDULE - While rotating the nose column, lube the swivel bushings with quality grease. This will be required at least every 12 months under normal operations. Disassemble, clean and re-lube the spring every 12 months or as required. To service, weight tail and tie with the nose wheel off the ground. ***Note:*** *Use the weight of the aircraft to compress the nose gear strut.* Remove, clean and re-assemble. Inspect the bolt every pre-flight for wear. Replace if the bolt shows signs of "grooving."

TAIL TIEDOWN INSTALLATION

1. INSTALL TIEDOWN – Using the horizontal stabilizer spar as a guide, mark center on bulkhead #5 near the skin. Place the bearing plate curved side down on centerline and transfer drill #11 into the bulkhead and debur. Bolt the bearing plate to the aft side of bulkhead #5. For the tiedown eye retainer bolts drill #11 through the bearing plate and skin. Debur and bolt on the eye from the bottom. ***Note:*** *This same location attaches the tailspring.*

OPTIONAL NOSE GEAR STRUT FAIRING ASSEMBLY

Note: *Install the nose gear strut fairing after final assembly of the fuselage shells to the cage.*

1. TRIM RUBBER EDGING - Locate the parts shown in the parts manual. Trim the rubber edging to fit the upper fairing.

2. REMOVE NOSE GEAR FORK - Remove the nose gear fork from the nose gear assembly. ***Hint:*** *Use the weight of the aircraft to compress the spring.*

3. INSTALL FAIRING MOUNTS – If installing the optional nose wheel pant continue with this step. Trim and fit-up the nose wheel pant. Temporarily bolt the lower fairing and wheel pant to the nose gear fork. Install the nose fairing mounts into the lower fairing. ***Note:*** *The nose fairing mounts "sandwich" between the forward and aft wheel pant halves.* Unbolt the fairing and wheelpant.

4. ASSEMBLE FAIRINGS - Slip the lower and upper fairings in place and assemble as shown in the parts manual.

5. RE-INSTALL NOSE GEAR FORK - Re-install the nose gear fork and glue the rubber edging to the upper fairing. ***Note:*** *Trim the upper end of the fairing as needed to clear the fuselage.* ***Hint:*** *Use the weight of the aircraft to compress the spring.* ***Note:*** *When installing the fairing for the final time (painted or not), place a small amount of grease between the upper and lower fairings for smoother operation.*

OPTIONAL NOSE WHEEL PANT ASSEMBLY

1. Fabricate the template from a piece of cardboard or poster board as shown in **FIGURE 2-11.**

2. Trim both the forward and aft pieces of the nose wheel pant down to the gel-coat line along the joggle and overlap seam.

3. Slip the aft section of the wheel pant inside the forward section and tape together with wide masking tape. Use this template to mark and trim the wheel hole in the wheel pant for proper tire clearance. The wheel hole will need to begin 4 ½" aft of the nose of the wheel pant as shown in **FIGURE 2-11.**

4. Using the seam line on the aft pant for the centerline mark and cut out as shown in **FIGURE 2-12.** ***Hint:*** *A good tool to use for cutting is a portable jigsaw. Finish trimming is easy with a drum sander on a power drill.*

5. Locate four (4) #11 holes in the pant while they are taped together. Mark and drill as shown in **FIGURE 2-13.** Cleco together. Transfer drill 1/ 4" the two (2) lower holes. Install nut plates to the inside of the top aft section to retain the upper bolts.

6. Refer to the parts drawing. Trim and install the rubber edging as shown. After painting, use quick setting super glue to retain the rubber parts to the wheel pants.

7. Sandwich the two halves around the tire and slip them into place. Locate hardware and check fit carefully. Trim if necessary.

S-16 SHEKARI ASSEMBLY MANUAL

TAIL WHEEL ASSEMBLY & INSTALLATION

Note: *It is necessary to fit-up all bulkheads, and the horizontal stabilizer spar before proceeding.*

1. INSTALL BEARING PLATE – Using the horizontal stabilizer spar as a guide, mark center on bulkhead #5 near the skin. Align the bearing plate curved side down on centerline and transfer drill #11 into the bulkhead. Bolt the bearing block to the aft side of bulkhead #5. For the tailspring retainer bolts drill #11 through the bearing plate and skin. Debur.

2. ASSEMBLE TAILSPRING – Clamp the upper tailspring to the tailspring. ***Note:*** *The upper spring must be on top of the tailspring.* Be sure the sides are aligned. Transfer drill 1/4" through the front mounting hole of the tailspring and debur. Secure the springs together with two (2) pillow block straps positioned as indicated in **FIGURE 2-14.**

3. INSTALL TAILSPRING – Drill the 3/16" large washer to 1/4" and debur. Transfer drill 1/4" through the tailspring mount hole in bulkhead #4 and debur. Bolt the tailspring together through the mount hole in bulkhead #4. Slip the upper mount plate between the springs and fuselage. Bolt to the bearing plate using the indicated hardware.

4. INSTALL TAILWHEEL – Bolt the tailwheel assembly to the springs using the included hardware. ***Note:*** *The full swivel tailwheel comes pre-assembled and ready to bolt on.* The full swivel feature allows pivot turns using brakes. A cam mechanism allows it to engage for steering. For best operation, shim the tailwheel to align vertically with the aircraft.

5. TAILWHEEL STEERING – The rudder must be attached before proceeding. Bolt the rudder cables to the inboard holes of the rudder horn. ***DO NOT CROSS THE CABLES! THEY MUST REMAIN PARALLEL TO EACH OTHER!!!*** Assemble cables and multihole tangs to steer springs by removing steer spring hooks and re-installing. Bolt the multihole tang to the rudder horn outboard holes. Tighten the bolts, to allow the tangs to swivel freely. ***Note:*** *Pay close attention to tang and washer placement.* Bolt the eyebolts into place on the tailwheel steer horn. Attach the "S" hooks to the eyebolts and cable. ***Note:*** *When properly tensioned the springs should be compressed about half of their full length.* Loose steer springs will cause very soft, indefinite steering. Squeeze shut the "S" hooks only after final rigging of the rudder pedals, rudder and tailwheel. See the RIGGING SECTION for more details.

6. RUDDER PEDAL INTERCONNECT – Cut the retainer ring, spacer and strut tube to length from raw stock. Drill two (2) #11 holes centered 180° apart in the retainer ring. With the cage right side up, insert the strut tube into the lower swivel bushing on the cage. Lube interconnect horn with a quality grease. Slip the spacer; interconnect horn and retainer ring over the strut tube. Slide the strut tube until it inserts into the upper swivel bushing. ***Note:*** *Be sure the spacer, interconnect horn, and retainer ring remain against the lower swivel bushing.* Transfer drill #11 through the retainer ring and bolt.

7. ATTACH RUDDER PEDALS – ***Note:*** *Proceed with this step once the rudder pedals are in place.* Screw the steering rod linkage onto the threaded end of the steer horn link tube. Screw the eye bolt into the link tube. ***Important:*** *Do* ***not*** *forget to Loctite the threads after a trial fit-up.* ***Note:*** *Remember, it must be engaged at least ten (10) turns.* Connect the link tube assemblies to the interconnect horn. Center the interconnect horn, place the rudder pedals in a neutral position and attach the aft end of the link tubes. Adjust the link tubes to maintain the aircraft on a straight course.

CANOPY FORMER

1. ATTACH CANOPY FORMER - Slip the canopy former over the canopy former mount stubs on the cage. ***Note:*** *Cut the bottom ends of the former parallel to the top cage longerons.* Do **not** rivet until the fuselage shells are installed and the canopy former is snug against the inside of the fuselage shells.

CAGE FORMERS

Note: *The cage must be mated to the fuselage skins with the stringers fit-up before attaching the formers.*

1. ATTACH FORMERS TO CAGE - Obtain the parts for the cage formers. Cut the aft upper formers from raw stock tubing. See the parts page. Slip the formers into position as detailed in **FIGURES 2-15 thru 2-19.** ***Note:*** *The recessed flange on each cage former fits over the fuselage stringer.* ***Note:*** *Extend the slot in the front bottom former to clear the bottom stringer flange. The front end of the aft bottom stringer will be under the recessed flange of the aft bottom former.* Press the formers tight against the fuselage shells. Transfer drill #30 through the cage tabs and formers. Cleco as you drill. ***Note:*** *The aft upper former tube will need to be partially crushed to fit between the cage and shells. Do so in a vise with boards protecting the tubes from scratching.* Start at one end and crush the tube to fit between the tabs and shells. Transfer drill #30 the tabs and former tube on centerline.

2. ATTACH FORMERS TO SHELLS – With the formers clecoed in place transfer drill #30 through the holes in the formers. Cleco as you drill. Some holes will need to be drilled from the fuselage shell side. ***Hint:*** *Use a bright light inside the fuselage to see the holes through the shell.* Evenly space eight (8) #30 holes on centerline per aft upper former. ***Hint:*** *Again, use a light to see the tube. Remove the formers and debur.* Rivet the formers to the cage as per **FIGURES 2-15 thru 2-19.** Do **not** rivet the fuselage shells to the formers at this time.

SHELL INSPECTION

1. INSPECTION – The shells have been carefully packed for shipping to help prevent damage. However, check each shell for any damage caused during shipping.

2. REMOVE PEEL-PLY – The shells have a layer of white translucent material on the inside called Peel-Ply. **Remove the Peel-Ply from the shells before proceeding further.**

3. IDENTIFICATION – for orientation of the shells refer to the parts manual.

4. TRIM SHELLS – Trim the overlapped shell joggles as detailed in **FIGURE 2-20.**

5. EXTERNAL ATTACHMENTS – Mark and cut out the exit holes for the main wing spar, push-pull tube, gear legs, and trailing edge spar attach plate, teleflex exit and nose gear strut on the shells. See **FIGURE 2-21** for details. ***Hint:*** *The main spar, push-pull tube, attach plate and gear leg holes are scribed on the outside of the shells.*

6. FINAL TRIM – Trim the overlapping shell to fit into the joggles. ***Hint:*** *Use lengths of masking tape parallel and even with the joggle.* Use the known width of the tape as reference to mark your trim line on the shells. This method will be used in other sections as well. Proceed once the shells have been trimmed to a nice fit. See **FIGURE 2-21A.**

----HINT----
To save many hours of tedious sanding, the composite shells should be primed and sanded **before** final riveting to the structure. This avoids sanding around the rivets!

BULKHEAD ASSEMBLY

Note: *As with many parts in the Shekari kit, the bulkheads come anodized and do not require priming or painting.*

1. BULKHEAD #1 ASSEMBLY - For orientation of the bulkhead and splice location refer to the parts page. Cleco the bulkhead splices into the appropriate bulkhead. See **FIGURE 2-23.** The splices must be oriented properly to fit correctly in the bulkhead. Transfer drill #40 through the inner and outer flanges into the splice. Transfer drill # 30 through all #40 holes in bulkhead and splices. Debur and rivet the splices and bulkhead together on the shear web only. ***Note:*** *Do* ***not*** *rivet the outside bulkhead flange to the splice at this time.*

2. MATCH BULKHEAD #1 TO CAGE - Align the pre-drilled #30 holes in the bulkhead with the aft cage outboard bushings. See **FIGURE 2-24.** ***Hint:*** *Drill one side to 1/ 4", bolt to the cage and transfer through the opposite #30 hole from the aft.* Temporarily bolt the bulkhead to the cage as you drill. Transfer drill through the inboard bushings. Remove the bulkhead. Align the bulkhead reinforcement with the 1/ 4" holes. ***Note:*** *The notch in the reinforcement denotes the top.* Transfer drill #30 through the reinforcement corner holes. Debur and rivet.

3. BULKHEAD #2 ASSEMBLY - For orientation of the bulkhead and splice location refer the parts page. Cleco the bulkhead splices into the appropriate bulkhead. See **FIGURE 2-23.** The splices must be oriented properly to fit correctly in the bulkhead. Transfer drill #40 through the inner and outer flanges into the splice. Transfer drill # 30 through all #40 holes in bulkhead and splices. Debur and rivet the splices and bulkhead together on the shear web only. ***Note****: Do* ***not*** *rivet the outside bulkhead flange to the splice at this time.*

4. BULKHEAD #3 ASSEMBLY – No assembly required.

5. BULKHEAD #4 ASSEMBLY - For orientation of the bulkhead, reinforcement plate and tailspring mount angle refer to your Parts Manual. Cleco the reinforcement plate and tailspring mount angle into the bulkhead through the #40 holes. See **FIGURE 2-25.** Transfer drill #30 through the mount holes. Transfer drill the tailspring mount hole to 1/4". Debur & rivet the assembly together. Note the correct usage of rivet type and length.

6. BULKHEAD #5 ASSEMBLY - For orientation of the bulkhead and compression plate refer to the parts page. Cleco the compression plate into the bulkhead. Transfer drill the indicated holes in the compression plate to #30. See **FIGURE 2-26.** ***Note:*** *Do* ***not*** *drill out or rivet the top holes of the compression plate.* Debur and re-cleco the assembly. Do **not** rivet at this time. ***Note:*** *The top row of holes is used to attach the horizontal stabilizer spar.*

BOTTOM SHELL ASSEMBLY

1. ATTACH SHELLS TO BULKHEADS – The shells have divots in their surface. These divots are used to match the shells to the internal structure of the aircraft. Drill #40 the divots of each bottom shell. ***Note:*** *Do* ***not*** *drill the divots in the joggle areas of the shell, transfer drilling through the top shells will locate these.* Drill as close to the center of the divot as possible ***Important:*** *Drill the divots for the bulkheads and horizontal stabilizer only.* Position the bulkheads in the bottom shells. Drill all shell divots for the bulkheads to #30. Cleco the bulkheads to the bottom shells.

2. ADJUST BULKHEADS - Bend the bulkhead flanges to get the best fit. Some flanges may need to be tightened against the shells. Use a hammer, small wood or plastic wedge and a bucking bar. See **FIGURE 2-22** for details. ***Note:*** *Some areas of the shells have a reinforcing layer of fiberglass on the inside layer. Sand these areas down flush to attain a tight fit.* Do **not** rivet at this time. ***Hint:*** *Remember what we said about priming and sanding the shells!*

3. SQUARE THE BULKHEADS - The bulkheads must rest in the shells with no bending or flex. Square the face of each bulkhead and transfer drill #30 through the flanges and shells. ***Hint:*** *Shine a bright light inside the shells to drill the holes not accessible from inside.*

4. POSITION CAGE IN SHELLS - Place the cage in the shells. Bolt the cage to bulkhead #1. Temporarily bolt the firewall in place. ***Note:*** *See the ENGINE & SYSTEMS SECTION for firewall installation details. The extra #40 hole denotes the left side.* Align the bottom shells with the firewall bottom and transfer drill #40. Cleco as you drill. Mark and cutout the shell forward flanges for the engine mount bolts. Align the shell sides with the firewall and transfer drill #40. Cleco as you drill. ***Note:*** *The firewall and bulkhead #1 are used to fix the cage position in the shells.*

5. FIT UP STRINGERS – Refer to the STRINGER INSTALLATION SECTION.

6. STABILIZE TAIL SURFACES - Assemble and cleco the spar to the shells. See the HORIZONTAL STABILIZER SECTION. ***Note:*** *This will help to stabilize the shells.*

STRINGER INSTALLATION

Note: *The stringers are cut from several common materials. Pay attention to the material type. Refer to the parts page for detail. The lengths are standard, so trimming is not required. Label the stringers after cutting to avoid confusion.*
Note: *Prime the stringers after fitting up and before final assembly.*
Hint: *Use a bright light behind the stringers when drilling through the skin.*

CUT STRINGERS TO LENGTH

1. TOP & FORWARD CENTER BOTTOM – Cut one (1) fuselage stringer to 54". This is the top stringer. Cut another 57 3/4". This is the forward center bottom stringer.

2. AFT CENTER BOTTOM & AFT SIDE – Cut an 85 1/2" length and two (2) 80 3/4" lengths from the tailcone stringers. The 85 1/2" piece is the aft center bottom stringer

3. UPPER SIDE – Cut two (2) 44" lengths from the 1" x 1" x .080 stringers.

4. FORWARD SIDE – Cut the two (2) aluminum strips to 70 1/2".

5. BOTTOM SIDE – Cut two (2) 86" lengths from the 1" x 1" x .093 aluminum angles.

SIDE STRINGERS

1. PREPARE FORWARD SIDE STRINGERS – Mark the centerline of each stringer. On the centerline measure and mark 1/2" on each end and mark in 3" increments the rest of the stringer. Center punch on the marks and drill #30. Debur.

2. JOGGLE FORWARD SIDE STRINGER - Make a joggle tool from raw stock provided. See **FIGURE 2-27.** Mark 1 1/8" in on both ends of each stringer. Joggle the stringer ends as depicted in **FIGURE 2-28.** Position the slot in the joggle tool over the mark. Place in a vise and apply pressure. ***Hint:*** *Use aluminum angles on the vise jaws to protect the stringers and obtain a better joggle.* Joggle both ends of each stringer. Store the joggle tool where it can be found, as it will be used later.

3. INSTALL FORWARD SIDE STRINGER - Place the stringer against the inside top of the bottom shell. The front stringer joggle will be against the front shell joggle. Transfer drill #30 through the stringer, clecoing from the inside as you drill. Do **not** rivet at this time.

4. PREPARE AFT SIDE STRINGERS - Mark the centerline on the outboard flange of each stringer. ***Note:*** *The outboard flanges of these stringers need to face downward against the fuselage shell.* Modify the forward end of each stringer as shown in **FIGURE 2-29.** On the forward end mark 1/4" in and 3" increments on centerline thereafter. Center punch and drill #30.

5. INSTALL AFT SIDE STRINGERS - Place the stringer under the aft joggle in the forward side stringer. Align the end holes in the two stringers and cleco together. ***Note:*** *The stringer will be aligned by the slot in bulkhead #2.* Modify the aft end of the stringer to clear bulkhead #3. Transfer drill #30 through the stringer, cleco from the inside as you drill. Do **not** rivet at this time.

CENTER BOTTOM STRINGERS

1. PREPARE BOTTOM STRINGERS - Mark the centerline on the bottom flange of each stringer. ***Note:*** *The bottom flanges of these stringers need to face right.* On the forward centerline of the forward bottom stringer measure and mark 3/4" and 2" increments thereafter. Center punch and drill #30. Mark 1/2" on both ends of the aft bottom stringer and 2" increments thereafter. Center punch and drill #30.

2. INSTALL BOTTOM STRINGERS - Place the stringers on the bottom shell joggles and center on the #30 holes. ***Note:*** *The stringers will nearly touch the aft bottom cage former.* The aft stringer will pass beneath bulkheads #1 and #2 through the slots provided and terminate at bulkhead #3. Transfer drill #30 through the stringers, clecoing as you drill. ***Note:*** *The forward end of the aft bottom stringer must be trimmed for cage clearance. Also, cut away a 1/4" x 4 1/4" portion in the front stringer for wing spar clearance.* ***Hint:*** *Determine wing spar cut away area by extending a straight edge between the wing spar attach assemblies on the cage.*

BOTTOM SIDE STRINGERS

1. PREPARE BOTTOM SIDE STRINGERS - Mark the centerline on the bottom flange of each stringer. ***Note:*** *The bottom flanges of these stringers need to face inboard.* **See FIGURE 2-30.** On the bottom centerline of the stringers measure and mark 3/8" and 2" increments thereafter. Center punch and drill #30. Cut the aft end of each stringer as illustrated in **FIGURE 2-31.**

2. INSTALL BOTTOM SIDE STRINGERS - Install the stringers between the shells and bulkheads. ***Note:*** *Bulkhead #2 has slots cut for aligning the stringers. The stringers will terminate at bulkhead #3.* Clamp the forward end of the stringer to the inside of the metal attach tab on the lower aft of the cage. See **FIGURE 2-30.** Transfer drill #30 through the shells and stringers, cleco as you drill. Do **not** drill through the cage attach tab at this time.

3. SET INCIDENCE ANGLE – Build the horizontal stabilizer, and lock the incidence angle. Refer to the HORIZONTAL STABILIZER SECTION.

4. Position the template provided in **FIGURE 2-32** inline with the cage attach tab. ***Hint:*** *Use a glue stick to hold the templates in position or transfer to heavier paper stock.* Drill through #30 on the template hole centers. Cleco as you drill. Final size drill #11. Cleco.

UPPER SIDE STRINGERS

Note: *Leave the fuselage locked in the incidence angle jig with the top skins clecoed to the bulkheads when performing the following steps.*

1. PREPARE UPPER SIDE STRINGERS – Mark the centerline on the outboard flange of each stringer. ***Note:*** *The outboard flanges of these stringers need to face downward against the fuselage shell.* Modify the aft end of each stringer as shown in **FIGURE 2-33.** On the forward end mark 5/16" in. Mark for a second hole 5/8" in and 2 1/2" increments on centerline thereafter. Center punch and drill #30.

2. INSTALL UPPER SIDE STRINGERS – Cleco the aft end of the stringer to bulkhead #2. See **FIGURE 2-30.** Position the stringer against the top shell. Clamp the front end of the stringer under the attach angle bolted to bulkhead #1. See **FIGURE 2-34** for details. Transfer drill #11 through the attach angle. Cleco in place. Transfer drill #30 through the shells and stringer, cleco as you drill. Do **not** rivet at this time.

TOP STRINGER

1. PREPARE TOP STRINGER – Mark the centerline on the top flange of the stringer. ***Hint:*** *Bulkhead #1 has a slot cut for aligning the stringer.* Modify the aft end of the stringer as shown in **FIGURE 2-35.** On the forward end mark 1/2" in and 3" increments on centerline thereafter. Center punch and drill #30.

2. INSTALL TOP STRINGERS - Install the stringer between the shells and bulkhead #1. ***Note:*** *Bulkhead #1 has a slot cut for aligning the stringer.* Position the stringer against the forward top shell lip. Align the stringer with the top center shell overlap and clamp in place. **Note:** *The stringer will terminate at the forward shell edge of the vertical stabilizer.* Transfer drill #30 through the shells and stringer, cleco as you drill. Do **not** rivet at this time.

HORIZONTAL STABILIZER ASSEMBLY

1. SPAR ASSEMBLY – Cleco the three (3) spars together through the rib mounting holes. For orientation of the horizontal stabilizer spar and parts location, see **FIGURE 2-36.**

2. INSTALL CONTROL SURFACE HINGES - Drill out each hinge pivot hole to 5/16" and debur. **See FIGURE 2-37.** Press the flange bushings into the spar hinges. ***Note:*** *Apply sleeve retainer sparingly to the flange bushings.* Note the orientation of each hinge and bushing. Cleco hinges onto the spar. ***Hint****: Final alignment may be aided here by temporarily bolting the elevators to the hinge pairs.* Final size drill the hinge and spar hinge holes to #11. Disassemble the assembly and debur. Re-assemble and bolt the hinges to the spar.

3. DEBUR RIBS – Debur the edge of the flanges and lightening holes. Do **not** debur the pilot holes.

4. STRAIGHTEN RIBS – The forming process leaves the ribs bowed. Crimp the rib flange with fluting pliers to straighten. ***Note:*** *Do* ***not*** *crimp the rivet hole areas.* Add more crimp to bend the rib toward the flange. Lessen the crimped areas to bend the rib away from the flange. Check the rib for straightness by laying on a flat surface.

5. RIB ASSEMBLY – Cleco the ribs to the spar. ***Note:*** *The rib flanges face inboard.* Transfer drill #30 through the spar holes into the ribs. ***Note:*** *Trim the mounting flange of rib #4 to clear the hinge mounting bolt.*

6. INSTALL REVERSE SPAR – Center the reverse spar between the #1 ribs. Transfer drill #30 through the outer spar. Cleco in place. Drill #40 the shell divots along the trailing edge of the stabilizer surfaces. Cleco the spar assembly to the divot holes in the shells. Transfer drill #30, bulkhead #5 and the reverse spar. Remove the spar assembly from the shells.

Note the correct usage of rivet types & lengths!

7. RIVET ASSEMBLY – Rivet the ribs to the spar assembly. Rivet the reverse spar to the spar assembly. ***Note:*** *Only the inner six (6) holes of the reverse spar get riveted at this time.* Cleco the spar and rib assembly to the bottom shell assembly. Rivet bulkhead #5 to the spar. ***Note:*** *Bulkhead #5 must be in full contact with the spar.* See **FIGURE 2-38** for details.

HORIZONTAL STABILIZER TO FUSELAGE ASSEMBLY

1. DRILL RIBS TO SHELLS – With the stabilizer spar in the fuselage lower shells, square ribs #2 thru #5 with the spar. ***Important:*** *Rib #5* ***must be*** *square with the spar or the elevators will not clear.* Transfer drill #40 ribs #2 thru #5. Cleco as you drill. ***Note:*** *Do* ***not*** *cleco or drill rib #1 to the shells. This will be done at a later time.*

2. TRIM SHELLS - Trim the shells flush with the outboard edge of rib #5. ***Important:*** *Rib #5 must be square with the spar or the elevators will not clear.* Trim the trailing edge of the shells to extend no more than 7/8" aft of the horizontal spar.

Note: *The following steps require the cage–shell assembly to be leveled. Level using the top cage longerons as reference.*

3. SET INCIDENCE ANGLE – Fabricate the jig illustrated in **FIGURE 2-39.** ***Hint:*** *Use plywood from your shipping crate.* Clamp the center jig upright to the horizontal stabilizer spar. ***Hint:*** *Attach aluminum angles to the tooling holes in rib #5 and screw these to 2x4's inboard of the outboard uprights.* Measuring off the centerline of rib #5, set the horizontal stabilizer incidence to –1° (negative 1°) in reference to the top longeron. Lock this angle with long screws through the outboard jig uprights. ***Important:*** *Your tail is now in the correct position to the cage. Don't move the fuselage or re-alignment will be needed.*

4. LOCK INCIDENCE ANGLE – Refer to BOTTOM SIDE STRINGERS for details. Rivet the bottom side stringers to the cage attach tabs. ***Note:*** *Riveting can only be done from the inboard. See* ***FIGURE 2-30*** *for details.*

VERTICAL STABILIZER ASSEMBLY

Note: *Leave the fuselage locked in the incidence jig.*

1. SPAR ASSEMBLY – Cleco the two (2) spars together through the rib mounting holes. For orientation of the vertical stabilizer spar and parts location, see **FIGURE 2-40.** Transfer drill #40 the lower array of holes in the inner spar. See **FIGURE 2-40.** Locate seven (7) addition #40 holes below the rib #1 mounting holes, equally spaced, on the flanges of the spars. See **FIGURE 2-41.** Fabricate the two (2) aluminum reinforcing strips from raw stock. Clamp the strips inside the spar, against the flanges, even with the bottom. Transfer drill #40 through the spar the entire length of the reinforcement strips. Drill all previously drilled #40 holes to #30 and debur.

2. SPAR TO BULKHEAD – Cleco the spar assembly to the face of bulkhead #3. Transfer drill #30 the lower array of holes. Cleco as you drill. See **FIGURE 2-41.** ***Note:*** *The lower end of the spar will clear the flanged push-pull tube hole in the bulkhead.* Remove the spar and debur.

3. INSTALL CONTROL SURFACE HINGES - Drill out each hinge pivot hole to 5/16" and debur. **See FIGURE 2-37.** Press the flange bushings into the spar hinges. ***Note:*** *Apply sleeve retainer sparingly to the flange bushings.* Note the orientation of each hinge and bushing. Cleco hinges onto the spar. ***Hint****: Final alignment may be aided here by temporarily bolting the rudder to the hinge pairs.* Final size drill the hinge and spar hinge holes to #11. Disassemble the assembly and debur. Re-assemble and bolt the hinges to the spar.

4. DEBUR RIBS – Debur the edge of the flanges and lightening holes. Do **not** debur the pilot holes.

5. STRAIGHTEN RIBS – The forming process leaves the ribs bowed. Crimp the rib flange with fluting pliers to straighten. ***Note:*** *Do not crimp the rivet hole areas.* Add more crimp to bend the rib toward the flange. Lessen the crimped areas to bend the rib away from the flange. Check the rib for straightness by laying on a flat surface.

6. RIB ASSEMBLY – Cleco the ribs to the spar. ***Note:*** *The rib flanges face downward.* Transfer drill #30 through the spar holes into the ribs.

Note the correct usage of rivet types & lengths!

7. RIVET ASSEMBLY – Rivet the ribs to the spar assembly. Rivet the reinforcement strips to the spar. ***Note:*** *Do* ***not*** *rivet above rib #1 for now.* Cleco the spar and rib assembly to bulkhead #3 and rivet. ***Note:*** *The outer rivets will need to come through from the aft side. The center rivets will come through from the front.* See **FIGURE 2-41** for details.

VERTICAL STABILIZER TO FUSELAGE ASSEMBLY

Note: *Cleco the top shells in place. Insert a bright light through the spar holes to assist in drilling.*
Hint: *Affix ribs #2 & #3 square to the spar to simplify drilling.*

1. DRILL SPAR TO SHELLS – With the stabilizer spar in the fuselage and clecoed to bulkhead #3; align the divots in the aft edge of the shell with the holes in the spar. Transfer drill #40. Cleco as you drill. ***Note:*** *Some divots may not match the spar holes. Use as alignment references only.*

2. ALIGN STABILIZER – Align the stabilizer with the fuselage. ***Hint:*** *Use the center of rib #4 as a guide.*

3. TRIM LEADING EDGE – Tape the vertical stabilizer leading edge sections of the top shells together. ***Note:*** *The small divots on the lapping shell line up with small reverse divots in the lapped shell.* Trim as needed to allow the shell joggles to match. ***Hint:*** *Drum sand the overlapping shell as shown in* ***FIGURE 2-42.*** Space #30 holes along the leading edge in-line with the divots as detailed in **FIGURE 2-43** and cleco. ***Note:*** *The extra holes between rivets may be clecoed to aid in holding the leading edge tight while the epoxy is curing.*

4. DRILL RIBS TO SHELLS – Drill #40 and cleco rib #4 to the shell through the divots. Square ribs #2 & #3 with the spar. ***Hint:*** *Affix the ribs square to the spar to simplify drilling.* Transfer drill #40 ribs #2 and #3. Cleco as you drill. ***Note:*** *Position rib #1 in the following step.*

5. DRILL RIB #1 TO SHELLS - Move rib #1 into best position and transfer drill #40. ***Note:*** *The best position will be with the rib tight against the shells and level from left and right.* ***Hint:*** *Use a dowel or tube through the spar and bulkheads to align the rib.* Transfer drill #30, all #40 spar and rib holes.

6. TRIM SHELLS - Trim the shells flush with the top edge of rib #4. Trim the trailing edge of the shells to extend no more than 7/8" aft of the vertical spar.

TOP SHELL ASSEMBLY

1. CANOPY FORMER – Slide the canopy former over the cage stubs.

2. PREPARE TOP SHELLS – The shells have divots in their surface. These divots are used to match the shells to the internal structure of the aircraft. Drill #40 the divots of each shell. Do **not** drill the divots in the overlap joggle areas of the shells, transfer drilling through the overlapping shells will locate these. Drill as close to the center of the divot as possible ***Important:*** *Drill the divots for the bulkheads only. Do not drill the divots in the tail surfaces.* Reference the joggles in the top and bottom shells. Remember to reference the joggles on the stabilizers as well. ***Hint:*** *Use lengths of masking tape perpendicular to the joggle. Reference off of the joggle and mark a given distance (i.e. 1").* Drill all shell divots for the bulkheads to #30.

3. ATTACH RIGHT TOP SHELL - Cleco the right top shell to the bulkheads using the #30 holes. Bend the bulkhead flanges to get the best fit. Some flanges may need to be tightened against the shells. Use a hammer, small wood or plastic wedge and a bucking bar. Refer back to **FIGURE 2-20** for details. ***Note:*** *Some areas of the shells have a reinforcing layer of fiberglass on the inside layer. Sand these areas down flush to attain a tight fit.* Do **not** rivet at this time. Transfer drill #30 through the side stringer and both shells.

4. ATTACH LEFT TOP SHELL – Remove the right top shell and cleco the left top shell to the bulkheads. Fit the bulkheads to the shell as in the above step. Align the vertical spar holes with the shell divots. Transfer drill #30 the vertical spar to the left top skin. Again a bright light will be needed. Transfer drill #30 through the side stringer and both shells.

5. SQUARE THE BULKHEADS – Re-cleco the right top shell to the bulkheads. Notice the right shell fits over the joggle area of the left shell. Tape the stabilizer leading edges together. Square the face of each bulkhead and transfer drill #30 through the flanges and shells. Cleco as you drill. ***Hint:*** *Shine a bright light from inside the shells. Drill through the skin into the bulkhead flange holes. Use a long dowel to position each bulkhead.*

6. CLAMP CANOPY FORMER – Clamp the canopy former to the shells. If the shells want to spread because of the former, then trim off equal lengths from each end of the former. ***Note:*** *The former must be tight against the shell flange.* Re-clamp and drill the rivet holes in the former and stubs. Cleco. Drill #30 holes, at 3" spacing through the shells into the former. ***Note:*** *Start at the lower ends and work up to the center.*

7. LOCK SHELLS TO SPARS - Transfer drill the top shells to the horizontal spar and cleco.

8. FINAL TRIM – Trim the overlapping shell to fit into the joggles. Use the reference lines to mark your trim line on the shells. This method will be used in other sections as well. Proceed once the shells have been trimmed to a nice fit.

9. TRIM HORIZONTAL STABILIZER LEADING EDGE – Tape the horizontal stabilizer leading edges together. ***Note:*** *The small divots on the lapping shell line up with small reverse divots in the lapped shell.* ***Hint:*** *Drill each to #40 and cleco.* Trim as needed to allow the shell joggles to match. ***Hint:*** *Drum sand the overlapping shell as shown in* ***FIGURE 2-42.*** When the leading edges have been trimmed for a nice fit, proceed. Tape the leading edges together. Space #30 holes along the leading edge in-line with the divots as detailed in **FIGURE 2-43** and cleco. ***Note:*** *The extra holes*

between rivets may be clecoed to aid in holding the leading edge tight while the epoxy is curing. Trim the trailing edge of the shells to extend no more than 7/8" aft of the horizontal spar.

10. BOND TOP SHELLS – See the parts page for detail. Countersink the shell top seam and vertical stabilizer leading edge holes for the flush rivets. ***Note:*** *Observe the rivet spacing for the stabilizer from* ***FIGURE 2-43.*** Roughen up the mating surfaces with medium sandpaper. Cleco the shells to the bulkheads, stringers, horizontal and vertical spars assemblies. Be sure the shells have been trimmed to fit nicely in the joggles. Apply a ribbon of epoxy adhesive in the joggle area. ***Note:*** *Un-cleco a section at a time. Apply the epoxy and rivet the shells together with flush rivets provided.* Remember to include the top (fuselage) stringer when riveting. **Note the correct usage of rivet types & lengths!**

FUEL SCUPPER INSTALLATION

1. TRIM SCUPPER – Trim the scupper flange to 1". Trim the closed end of the scupper flush with the formed radius. See **FIGURE 2-44** for details. ***Note:*** *A belt or disk sander works well for trimming.*

2. CUT SHELL ACCESS – ***Note:*** *This step will require the left fuel tank to be in place.* Slip the scupper over the filler neck. Cleco the top shell in place. Press the scupper against the shell and trace around the flange. ***Hint:*** *Trim the forward edge of the scupper to clear the shell flange*. Measure in 1" from the line and cut the opening in the shell.

3. INSTALL SCUPPER - Mark and drill six (6) #11 holes around the scupper flange. ***Note:*** *Position the holes to allow tightening of the nuts on the backside.* Place the scupper in the access hole and transfer drill #11. Install the scupper using the hardware shown. ***Note:*** *This method of installation allows easier removal of the fuel tanks. Optionally, the scupper may be riveted and bonded to the fuselage shells.*

TOP SHELLS TO FUSELAGE ASSEMBLY

Note: *Only begin final installation of the top shells after fitting up the front deck, bulkheads, cage and canopy formers, stringers, and both stabilizer spars. Be sure everything is clean and free of debris.*

1. BOND SHELLS – See the parts page for detail. Countersink the shell seam and horizontal stabilizer leading edge holes for the flush rivets. ***Note:*** *Observe the rivet spacing for the stabilizers from* ***FIGURE 2-43.*** Roughen up the mating surfaces with medium sandpaper. Cleco the shells to the bulkheads, stringers, horizontal and vertical spars assemblies. Be sure the shells have been trimmed to fit nicely in the joggles. Apply a ribbon of epoxy adhesive in the joggle area. ***Note:*** *Un-cleco a section at a time. Apply the epoxy and rivet the shells together with flush rivets provided.* Remember to include the side stringers when riveting. **Note the correct usage of rivet types & lengths!**

2. RIVET SHELLS – Rivet the shells to the bulkheads, stabilizer spars, ribs, stringers canopy former and cage formers. See the parts page for rivet size and type. ***Note:*** *Pay attention to rivet length.* ***Important****: Notice the two (2) splice areas of bulkhead #1 use a longer rivet than the rest of the bulkhead.* See the close-up detail on the parts page. **Note the correct usage of rivet types & lengths!**

REINFORCE STABILIZER LEADING EDGES

Note: *Reinforcing of the fuselage seams, other than the stabilizers, is not recommended.*

1. PREPARE SURFACES - Scuff sand the areas where bonding is to occur. See **FIGURES 2-45.** Orientate the fiberglass tapes parallel to the stabilizer leading edge being worked on. Allow 1/2" of each ply to extend beyond the edge of the other. See **FIGURE 2-45.** This will allow a feather area of about 1/2". ***Note:*** *Lap onto the fuselage by 3/4".* Work on only one section at a time. Use the instructions provided with the resin and hardener. ***Hint:*** *Wet out the two (2) layers simultaneously to obtain the best results. A brush and squeegee helps to apply and remove resin.* Mix epoxy resin and hardener in small batches of less than 6 ounces at a time. ***CAUTION:*** *Do* ***not*** *mix in waxed paper cups, as the wax will contaminate the resin.* Use a wooden mixing stick as required. Keep the excess resin to a minimum and work in a clean and neat manner. Once the resin has cured, feather the edges in and sand away any high spots or imperfections. ***Hint:*** *If unfamiliar with working with fiberglass, read the Tony Bingelis series of books. Specifically Chapter 5 of* ***THE SPORTPLANE BUILDER.***

S-16 SHEKARI ASSEMBLY MANUAL

FORWARD DECK INSTALLATION

1. TRIM DECK – Trim the lower edge of the deck to within 3/16" of the scribe line. Trim the front and instrument panel flange to 1" from the radius. Trim the upper side flange to 3/4". See **FIGURE 2-46.**

2. POSITION DECK – Reference the bottom and top shell joggles. Slip the deck over the bottom shells. Cut out the top side flange to clear the welded tabs on top of the longeron. The upper side flange will rest on the top cage longeron. ***Note:*** *Be sure the front flange is flush with the front of the bottom shell.* Align the deck flange with the firewall and transfer drill #40. Cleco as you drill. ***Note:*** *Mark and cutout the front flange for the engine mount bolts.* Align the shell sides with the firewall and transfer drill #40. Cleco as you drill. Final size drill to #30. Trim the deck to fit the shell joggles.

3. ATTACH DECK – Drill #30 through the cage tabs, formers and side stringers. Cleco as you drill.

4. BOND & RIVET - Countersink the deck holes for flush riveting to the lower shells and side stringers. Roughen up the mating surfaces with medium sandpaper. Cleco the deck in place. Be sure the deck has been trimmed to fit nicely in the joggles. Apply a ribbon of epoxy adhesive in the joggle area. ***Note:*** *Un-cleco a section at a time. Apply the epoxy and rivet together. Only the deck to bottom shell joggle area uses flush rivets.* Remember to include the side stringer when riveting. **Note the correct usage of rivet types & lengths!**

TOP AFT SPLICE

1. TRIM SPLICE – Trim the forward edge of the splice until the aft joggle is inline with the fuselage joggles. The forward edge of the splice should just clear the vertical stabilizer spar.

2. RUDDER HORN ACCESS – Using the template, **FIGURE 2-47**, cut the triangular shaped access from the forward end of the splice.

3. POSITION SPLICE – Position the splice centered under the fuselage shells. Drill #30 through the underlying bulkhead flanges. ***Hint:*** *Shine a bright light from inside the shells.* Cleco as you drill. Position two (2) #30 holes between the flange holes, on the joggle areas only. Countersink for flush rivets.

4. BOND AND RIVET – Roughen up the mating surfaces with medium sandpaper. Apply a ribbon of epoxy adhesive in the joggle area and rivet. ***Important:*** *The rivets, which do* ***not*** *insert through a bulkhead flange, must be reinforced with a small brass washer.*

Note the correct usage of rivet types and lengths!

TAILCONE STINGER ASSEMBLY

1. TRIM STINGER – Trim the stinger to within 3/16" of the scribe line. ***Note:*** *This applies only to the scribe line around the base of the stinger.*

2. CUT TORQUE TUBE OPENINGS – Align the rectangular scribe line with the top aft splice. Mark and cut the opening for the horizontal stabilizer and elevator torque tube. See **FIGURE 2-48.** The finished cut should be about 3 1/4" wide by 2 1/4" deep when finished. ***Hint:*** *Slightly dimple the stinger and fuselage near top center for later alignment.*

3. FIT-UP STINGER – Reference the aft joggle on the shells and aft splice. ***Hint:*** *Place a strip of masking tape next to the joggle edge.* Reference off the joggle and mark a given distance (i.e. 1/2") on the tape. ***Note:*** *Temporarily install the elevators and torque tube.* Center the stinger between the elevators and final trim the stinger flush with the joggle. Clearance should be about 3/16" between the stinger and elevators. Layout and drill #19 the pattern as shown in **FIGURE 2-48.** Tape the stinger in position. Check for stinger to elevator clearance. Transfer drill #19 the stinger holes.

4. INSTALL STINGER – Remove the stinger and install the nutplates inside the fuselage shells. ***Hint:*** *Use a bolt to align the nutplate with the hole. Slightly countersink the #40 holes to allow the rivets to sit flush.* Bolt the stinger to the fuselage shells with the indicated hardware.

MAIN SPAR INSPECTION

1. SHOP PREPARATION – The use of sturdy sawhorses is highly recommended, if not a necessity, when constructing the wing. Shaky sawhorses only invite potential for damage to any assemblies. Padding the work areas of the sawhorses is also recommended.

2. INSPECTION - The main spars are shipped pre-assembled. They have been painstakingly matched to each other and to the cage. Your spars have been carefully packed for shipping to help prevent damage. Place the spars on the sawhorses and check for any damage caused during shipping. Any damage may be considered unacceptable. Check especially for dents, dings and/or excessively deep scratches, which could compromise the spar's integrity. Carefully check each spar stiffener for straightness as well.

3. IDENTIFICATION - For orientation of the main spars, see **FIGURE 3-1.** For ease of identification, mark your spars as left and right.

4. Do not torque the bolts holding the wing lugs at this time. You will have to remove them later (refer to wing installation). Do not remove lugs or bolts at this time.

FORWARD RIB INSTALLATION

Note the correct usage of rivet types & lengths!

1. DEBUR RIBS – Debur the edge of the flanges and lightening holes. Do **not** debur the pilot holes. ***Hint:*** *Save time by deburring all wing ribs during this step.*

2. STRAIGHTEN RIBS – The forming process leaves the ribs bowed. Crimp the rib flange with fluting pliers to straighten. ***Note:*** *Do not crimp the rivet hole areas.* Add more crimp to bend the rib toward the flange. Lessen the crimped areas to bend the rib away from the flange. Check the rib for straightness by laying on a flat surface.

3. FORWARD RIB #1 THRU #4 INSTALLATION - Cleco the forward ribs with corresponding stiffeners to the main spar. Final size the outer pair of holes on each rib and stiffener to #11. See **FIGURE 3-3.** Note that the holes in the spar have been pre-drilled to #11. Final size the inner three holes to #30, debur and rivet. Note that the flange of rib #1 faces opposite of the other ribs.

4. FORWARD RIB #5 THRU #8 INSTALLATION - Cleco the forward ribs with corresponding stiffeners to the main spar. Final size holes to #30, debur and rivet.

AFT RIB INSTALLATION

1. DEBUR RIBS – Debur the edge of the flanges and lightening holes. Do **not** debur the pilot holes. ***Hint:*** *Save time by deburring all wing ribs during this step.*

2. STRAIGHTEN RIBS – The forming process leaves the ribs bowed. Crimp the rib flange with fluting pliers to straighten. ***Note:*** *Do not crimp the rivet hole areas.* Add more crimp to bend the rib toward the flange. Lessen the crimped areas to bend the rib away from the flange. Check the rib for straightness by laying on a flat surface.

3. TELEFLEX RETAINER BRACKET - AFT RIB #2: Center the teleflex mount plate between the two aft lightening holes of aft rib #2, make sure the mount plate does not extend past the rib flanges. See **FIGURE 3-4.** Transfer drill #30 holes from mount plate to the rib and cleco. Transfer drill #11 holes from mount plate to rib. Remove mount plate and rivet nutplates to the rib. ***Hint:*** *Use a short bolt to align the nutplates.* Debur and rivet mount plate to rib.

4. AFT RIBS- #1, STEP RIB & #2: Line the large forward hole in aft rib #2 and the step rib with the serrated grommet strip. Line the aft hole in rib #1 with the serrated grommet strip. See **FIGURE 3-22.** Cut to length and glue into place.

Note the correct usage of rivet types & lengths!

5. AFT RIB #1 THRU #4 INSTALLATION - Cleco the aft ribs with corresponding stiffeners to the main spar. Note: The top hole of stiffener #2 needs to have an .040" shim between it and the spar. Cut this shim from raw stock. ***Important: Notice the 1/4" hole in the face of the rib. This hole denotes the top contour of the rib.*** *See* ***FIGURE 3-4.*** Final size the outer pair of holes on each rib and stiffener to #11. See **FIGURE 3-3.** Note that the holes in the spar have been pre-drilled to #11. Final size the inner three holes to #30, debur and rivet. Note that the flange of rib #1 faces opposite of the other ribs.

6. BELLCRANK CHANNEL ASSEMBLY – **Important:** Assemble and install the bellcrank channels before installing aft rib #5. The bellcrank channels will not be able to be installed after aft rib #5 is riveted in place. See BELLCRANK AND PUSH-PULL TUBE SECTION.

7. AFT RIB #5 THRU #8 INSTALLATION - Cleco the aft ribs with corresponding stiffeners to the main spar. Final size holes to #30, debur and rivet.

8. FLAP TELEFLEX INSTALLATION – The flap teleflex will be installed prior to final skinning of the wing.

TIP RIB INSTALLATION

Note the correct usage of rivet types & lengths!

1. DEBUR RIBS – Debur the edge of the flanges and lightening holes. Do **not** debur the pilot holes. ***Hint:*** *Save time by deburring all wing ribs during this step.*

2. STRAIGHTEN RIBS – The forming process leaves the ribs bowed. Crimp the rib flange with fluting pliers to straighten. ***Note:*** *Do not crimp the rivet hole areas.* Add more crimp to bend the rib toward the flange. Lessen the crimped areas to bend the rib away from the flange. Check the rib for straightness by laying on a flat surface.

3. TIP MOUNTING RIB INSTALLATION - Cleco the tip mounting rib to the tip rib. ***Important: Notice the 1/4" hole in the face of the rib. This hole denotes the top contour of the rib.*** *See* ***FIGURE 3-4.*** ***Note:*** *The contour of the tip mounting rib will match the tip rib and the flange will face outboard.* Transfer drill #40 along the rib mount flange into the tip rib and cleco. Final size drill to #30, debur and cleco.

4. TIP RIB INSTALLATION - Cleco the tip rib assembly to the stiffeners on the main spar. Final size drill to #30. Disassemble, debur and re-cleco to the spar stiffeners. Rivet the assemblies together. Pay attention to the type of rivet to use.

5. OPTIONAL STROBE INSTALLATION – ***Note:*** *Refer to INTERNAL SYSTEMS for strobe parts.* Reinforce the strobe mount area inside each wing tip with several layers of fiberglass tape. ***Note:*** *This is the same tape as used on the fuselage.* Cut out the mount area per FIGURE 3-4A. Drill the three (3) strobe light plate holes to #11. Position the strobe light on the wing tip. Transfer drill #11 into the tip. Rivet nutplates inside the tip. Strobe wires will be installed before final skinning of the wing.

6. WING TIP INSTALLATION – ***Note:*** *Install the fiberglass wing tips after final skinning of the wing.* Place the wing tips over the respective mounting rib and trim for a nice fit against the skin. ***Note:*** *You may also want to temporarily mount the ailerons and trim to fit there as well.* Remove the tip. Reference the holes in the mounting tip. ***Hint:*** *Place strips of masking tape on the wing perpendicular to the mounting tip inline with the flange holes.* Reference off the holes and mark a given distance (i.e. 1"). Draw a line from the hole through the reference line. Place the tip on the mounting tip. Use tape to hold in place. Extend the reference lines onto the tip, mark and drill #40. Cleco as you drill. Final size drill #30. Debur and remove all tape. Countersink and rivet the tip rib to the mounting tip using the indicated rivets.

TRAILING EDGE SPAR ASSEMBLY & INSTALLATION

1. CONTROL SURFACE HINGE ASSEMBLY – For orientation of the trailing edge spar and part location, see **FIGURE 3-5.** Drill out each hinge pivot hole to 5/16" and debur. **See FIGURE 3-6.** Press the flange bushings into the spar hinges. **Note:** Apply sleeve retainer sparingly to the flange bushings. Note the orientation of each hinge and bushing. Cleco hinges onto the spar. **Hint**: Check hinge alignment between control surface in question and trailing edge spar before you final drill hinge attach points on either one. To do this, temporarily cleco hinge brackets with pressed in flange bushings to both spars and bolt through hinge points. Check fit, drill #11, debur and bolt hinges to spar. **Note:** During drilling, hinge points should be bolted together through the flange bushing holes.

2. ATTACH PLATE - Cleco the trailing edge spar attach plate onto the spar using the three (3) #40 holes. Note the orientation of the spar attach plate. See **FIGURE 3-7.** ***Important:*** *The spar attach plate must fit flat against the trailing edge spar. If the attach bracket contacts the raised joggles in the spar move the bracket slightly away and clamp in place.* Transfer drill attach plate and spar to #11. Do **not** drill the three #40 rib attach holes at this time. See **FIGURE 3-7.** Debur and re-cleco attach plate to spar. Do **not** bolt or rivet the attach plate to the spar at this time.

Note the correct usage of rivet types & lengths!

Note: *For convenience, place the main spar on sawhorses with the aft ribs up or fabricate the wing washout jig as shown in* ***FIGURE 3-21 & 3-22.***

3. TRAILING EDGE SPAR INSTALLATION – Square aft rib #1 and the tip rib with the main spar. ***Hint:*** *Temporarily clamp the ribs to a 90° angle.* Cleco the trailing edge spar to the squared ribs. Square each rib with the main spar and cleco in place. ***Hint:*** *Bend the aft flanges of the remaining ribs to be flush with the trailing edge spar.* Cleco the trailing edge spar assembly to the bellcrank channels. Final size holes #30. Debur all attachments. Re-cleco, bolt and rivet the assemblies together.

STRINGER INSTALLATION

1. JOGGLE STRINGERS – Make joggle tool from raw stock. See **FIGURE 3-8.** Measure 3/4" in on both ends of each stringer. **Caution:** Only joggle the flange that will be directly under the rib flange. This will denote the outward facing side. Position the slot in the joggle tool over the mark. Place in a vise and apply pressure. See **FIGURE 3-9** for details. **Note:** the stringers are aluminum angles rather than z-strips, but the process is the same. **HINT:** Use aluminum angles on the vise jaws to protect the stringers and obtain a better joggle. Joggle both ends of each stringer. Store the joggle tool where it can be found, as it will be used later.

2. MARK STRINGER CENTERLINE - Mark the centerline of each stringer. Be sure to mark only the flange with the joggle.

TOP STRINGER

1. POSITION & TRIM - Place the joggled end of the wing stringer under the flange of rib #6 and position the stringer into the notches of ribs #2, #3, #4, and #5. Mark where the stringer needs to be trimmed to slide over the step rib. Trim the stringer to fit over the step rib. See **FIGURE 3-10.**

2. POSITION - Reposition the stringer with the joggled ends under the flanges of ribs #1 and #6. Align the stringer centerline with the pre-drilled hole in rib #6. The end under rib #1 is best fit. Tape both ends in place for now.

BOTTOM STRINGER

1. POSITION - Position the stringer with the joggled ends under the flanges of ribs #1 and #6. Align the stringer centerline with the pre-drilled hole in rib #6. The end under rib #1 is best fit. Tape both ends in place for now.

STEP RIB REINFORCEMENT

1. JOGGLE REINFORCEMENT STRIPS – Locate 14 step rib reinforcement strips per side. Use the joggle tool made in the STRINGER INSTALLATION SECTION. Measure 3/4" in on both ends of every strip. This will denote the topside. Place the slot in the joggle tool over the mark. Place in a vise or arbor press and apply pressure. See **FIGURE 3-9** for details. **Hint:** Use aluminum angles on the vise jaws to protect the strips and obtain a better joggle. Joggle both ends of all strips.

2. MODIFY AFT STRIPS - Select four (4) reinforcement strips. Label one of each as "#13 Left", "#14 Left", "#13 Right", and "#14 Right". Trim each reinforcement strip as instructed in **FIGURES 3-11 and 3-12.**

3. MARK CENTERLINES - On the joggled topside of each strip, mark the centerline of the flange. This line will be used as a reference when the top skin is attached.

4. SQUARE RIBS – For best fit of the reinforcement strips square ribs #1 and #2 with the spar and secure. This may be done by clamping squares to the spar and ribs. See **FIGURE 3-13.** Square the step rib and secure in place with wood blocks between ribs #1 and #2. This will hold all three ribs square and in position for placement of the reinforcement strips.

5. POSITION STRIPS - Between the main spar and the top wing stringer, position the first six (6) reinforcement strips. See **FIGURE 3-14.** Ends of the strips are centered under the pre-drilled holes in ribs #1 and #2. The sixth reinforcement strip may need to be trimmed to clear the wing stringer. Position the remaining eight (8) reinforcement strips aft of the stringer. Strips #13 and #14 may not be parallel to the other strips. Note that strip #14 is turned in the opposite direction.

6. TRANSFER DRILL - From the underneath side of the step rib, transfer drill #40 into the reinforcement strips. Before drilling, make sure the centerlines are still inline with the holes in ribs #1 and #2. Cleco the step rib and strips from the bottom. Notice that the strips rest on top of the step rib. Do **not** rivet at this time! The ends of the reinforcement strips will be drilled and riveted with the top skin. Remove securing blocks and squares.

BELLCRANK AND PUSH-PULL TUBE ASSEMBLY & INSTALLATION

1. INBOARD/OUTBOARD BELLCRANK MOUNTS - Cleco the inboard and outboard bellcrank mounts to the bellcrank channels. Final size drill holes to #30 and debur. ***Note:*** *Be sure the 1/4" holes in the mounts and channels align when clecoed.* Rivet the inboard and outboard mounts to the channels.

2. FORWARD BELLCRANK CHANNEL MOUNTS – Cleco the forward bellcrank channel mounts to the bellcrank channels. Drill to #30 and debur. Drill the forward mounting holes to #30 also. Rivet the **outboard** forward bellcrank channel mount to the main spar. Rivet the outboard bellcrank channel to the outboard mount. Note the direction of the rivets. Rivet the **inboard** forward bellcrank channel mount to the spar. Rivet the inboard bellcrank channel to the inboard mount.

3. AFT RIB INSTALLATION – If you were referred to this section from the aft rib installation section return to that section and continue with installation of aft ribs #5 - #8. See AFT RIB INSTALLATION SECTION.

4. ASSEMBLE INNER, OUTER AND AFT AILERON BELLCRANKS - Cleco and rivet bellcrank and bearing flanges together. Remember to insert the bearings. See **FIGURE 3-15** for proper rivet orientation. ***Note:*** *Paired bellcranks are mirror images of each other.* Notice the side of the bellcrank each bearing flange is riveted to.

5. INNER & OUTER BELLCRANK MOUNTS - Bolt bellcrank mounts to main spar. Notice the #11 holes have been pre-drilled in the spar. ***Note:*** *The longer arms of the outer bellcrank mounts are positioned outboard.* Do **not** tighten the bolts at this point.

6. INNER & OUTER BELLCRANK ASSEMBLIES - Assemble aileron inner and outer bellcrank assemblies. Cut and trim the aluminum bushings for proper fit. Ideally, the bellcrank pairs should be parallel to each other when bolted to the rod ends. See **FIGURE 3-16** for proper orientation of the outer bellcrank. Tighten the mount bolts.

7. AFT BELLCRANK ASSEMBLIES - Assemble aileron aft bellcrank assemblies. Trim the aluminum bushings for a snug fit. The bellcranks must be centered between channels. Ideally, the bellcrank pairs should be parallel to each other when bolted to the rod ends. Bolt the aft bellcrank assembly between the inboard and outboard channels. Note: The upper end of the bellcranks will have a forward curve.

8. PUSH-PULL TUBES - Assemble aileron inner and outer push-pull tubes. Assemble aileron forward and aft push-pull tubes. Adjust and lock the fwd aileron push-pull tube to a length of 21.5" (center to center of the rod end bearings). Rod ends must have a minimum of ten (10) threads in the end fittings. Bolt the inner, outer, and forward push-pull tubes to the corresponding bellcranks. Leave one end of the outer push-pull tube unsecured for neutral position adjustment.

9. NEUTRAL POSITION ADJUSTMENT - Use the neutral position templates to set the inner and outer bellcranks. See **FIGURES 3-16 and 3-17.** Rod ends must have a minimum of ten (10) threads in the end fittings. Adjust and bolt the outer push-pull tube to the bellcrank. Loctite and tighten the rod end nuts against the end fittings. Be careful not to change the push-pull tube length.

WING SKIN INSTALLATION

AFT TOP WING SKIN

1. POSITION SKIN - With the step reinforcement strips clecoed to the step rib from underneath, and the wing stringer in place, position the top aft skin on the wing. Note that there are pre-drilled #40 holes for the stringer and reinforcement strips #1, #3, #5, #8, #10, #12, and #14. Cleco every other hole in the skin to all ribs except ribs #1 and #2. ***Hint:*** *Start clecoing at the front center of the skin. Work your way to the root and tip, alternating side to side. Work any ripples out of the skin as you go.*

2. ALIGN STEP REINFORCEMENTS - Line up the step reinforcement strips and the pre-drilled holes in the wing skin by reaching underneath and aligning the strips. Use the line on the strip as a reference. Transfer drill #40 and cleco from the skin into the reinforcement strips. Note that only every other strip is attached to the skin.

3. ALIGN STRINGER - Align the centerline on the stringer with the pre-drilled holes in the skin. Transfer drill #40 and cleco from the skin into the stringer. ***Note:*** *Prime the stringers after fitting up and before final assembly.*

ACCESS PANELS

1. DRILL TO SIZE - Cleco the access panels to the oval access panel rings. Final size the six (6) clecoed holes of each panel and ring to #19. Debur holes. Mark panels and rings for matching up later. Set panels and rings aside until needed.

AFT BOTTOM WING SKIN

1. ALIGN ACCESS RINGS - Determine the inside surface of the aft bottom skin. Align the access panel rings over the access holes on the inside of the skin. Cleco rings into position using #40 clecos. See **FIGURE 3-18.**

2. POSITION NUT PLATES - Position nut plates on the ring and hold in place with # 40 clecos. ***Note:*** *Use a bolt to check alignment with the hole.*

3. ATTACH RINGS TO SKINS - Final size remaining clecoed perimeter holes to #30. Do **not** drill nut plate ears or mounting holes to #30! Debur and rivet rings to skin Use #40 rivets to attach the nut plates and rings to the skin.

4. POSITION SKIN - Position the aft bottom skin on the wing and cleco into position. ***Hint:*** *Start clecoing at the front center of the skin. Work your way to the root and tip, alternating side to side. Work any ripples out of the skin as you go.*

5. ALIGN STRINGER - Align the centerline on the stringer with the pre-drilled holes in the skin. Transfer drill #40 and cleco from the skin into the stringer. ***Note:*** *Prime the stringers after fitting up and before final assembly.*

6. AILERON STATIC BALANCE ARM – Use reinforcement as a guide to trim pre-cut slot. Aileron must be temporarily hinged to wing.

PITOT-STATIC MOUNT PANEL

1. DRILL ACCESS PANEL - Select one access panel. Locate and drill as detailed in **FIGURE 3-19.** Fit the pitot-static head assembly in the access panel. Orientate the pitot-static head perpendicular to the length of the panel. Transfer drill #30 into the access panel. Remove and debur. ***Note:*** *Cut the pitot-static tubes that extend inside the wing to 2.5" length and carefully bend forward and outboard. This bend will let the pitot-static lines clear the outer bellcrank.* Bolt assembly together.

2. PITOT-STATIC MOUNT PLATE – Fabricate the mount plate stiffener from raw stock. See **FIGURE 3-20** for details. Cleco the access panel to the oval access panel ring. Check for proper orientation. Position the stiffener to clear the access panel ring and pitot-static head. Transfer drill #40. Debur and rivet the stiffener to the access plate.

FORWARD WING SKIN

1. ALIGN ACCESS RINGS - Determine the inside surface of the forward skin. Align the access panel rings over the access holes on the inside of the skin. Cleco rings into position using #40 clecos. See **FIGURE 3-18.** ***Note:*** *The pitot-static mount panel is fitted in the left-outboard access hole.*

2. POSITION NUT PLATES - Position nut plates on the ring and hold in place with # 40 clecos. **Note:** Use a bolt to align nut plates with the hole.

3. ATTACH RINGS TO SKINS - Final size remaining clecoed perimeter holes to #30, debur and rivet rings to skin. Do **not** drill nut plate ears to #30! Use #40 rivets to attach the nut plates to the rings and skin.

4. POSITION SKIN – Position the skin over the ribs. Cleco the bottom side into place.

5. FORM LEADING EDGE – Carefully apply pressure on the entire span of the forward skin until it conforms to the top of the ribs. ***Hint:*** *Clamp the skin aft edge between two (2) long wood 1 X 3's. Pull the skin into place using the clamped 1 X 3's for best results.* ***Note:*** *A small amount of body filler can be used on small imperfections. Prevent them in the beginning if possible.* Cleco into place. ***Hint:*** *Start clecoing at the front center of the skin. Work your way to the root and tip, alternating side to side. Work any ripples out of the skin as you go.*

FINAL ASSEMBLY OF WINGS

1. CHECK WING WASHOUT - Fabricate the wing washout jig as shown in **FIGURE 3-21.** Use the pre-drilled tooling holes in the forward and aft of aft rib #1 and the tip rib as reference points. Attach angular stock or similar straight material to obtain a precise measurement. See **FIGURE 3-22.** Measure the inboard and outboard reference angles. Hint: An electronic protractor works best for this. The washout should be 0.5°. In other words, the wing tip at the trailing edge should be 1/2 of 1 degree higher than the leading edge.

2. LOCK WING WASHOUT - Transfer drill #40 through skins into attach angle and rear spar. Use a drill-stop when drilling directly over the main spar and hinges. **CAUTION: Do NOT drill into the spar!**

3. U-SHAPED REINFORCEMENT RING – Before this step may be accomplished the ailerons must be assembled with the mass balance assembly attached. Temporarily attach the aileron to the rear spar hinges. Align the U-shaped reinforcement ring with the aileron mass balance. The mass balance assembly will need to clear the ring when it passes through the wing skin. Align the ring parallel to the pre-cut slot. Note that the open end of the ring should also parallel the aft spar. Make sure the ring will clear the trailing edge spar when in place. Transfer drill #40 and cleco in place. Cut away any skin on the inside of the U-shaped ring. Transfer drill #30. Debur and rivet the ring to the inside of the skin.

4. FINAL SIZE DRILL - Final size drill all holes to #30, disassemble and debur. ***Hint:*** *Start at the front center of the skin. Work your way to the root and tip, alternating side to side. Work any ripples out of the skin as you go.*

5. RIVET STEP REINFORCEMENT – Final size drill the #40 holes in the step rib and strips to #30. Debur and rivet the strips to the step rib from the top. ***Note:*** *Strips #13 and #14 may need to be riveted from the bottom.*

6. FLAP TELEFLEX INSTALLATION – Slide flap teleflex through the grommet lined holes of aft ribs #1, step rib and #2. See **FIGURE 3-23.** Clamp the flap teleflex to the mount plate on aft rib #2.

7. PITOT-STATIC AND STROBE LINES – Install the pitot-static lines and wires for the optional strobes in the area between the forward ribs and leading edge of the skin. Add anti-chafe to the forward edge of the ribs. Optionally, encase the lines in a plastic tube.

CHECK LIST BEFORE FINAL RIVETING OF SKINS

____ Trailing Edge Hinges Installed & Secure
____ Ribs & Stiffeners Riveted To Main Spar
____ Trailing Edge Riveted To Ribs
____ Bellcranks & Push-Pull Tubes Installed
____ Bellcranks Set To Neutral
____ Push-Pull Tube Jam Nuts Locked Against End-fittings With Loctite
____ Flap Teleflex Cable Installed With Anti-chafe In Place
____ Pitot-Static Lines Installed
____ Optional Strobe Wiring Installed
____ All Access Panel Rings & Nut Plates Installed
____ U-Shaped Reinforcement Ring Installed
____ All Holes Drilled To Final Size & Deburred
____ Step Reinforcements Installed
____ Wing Stringers Primed and Installed
____ Wing Washout Set
____ All Rivets Set Properly
____ Wings Clean? Aluminum Chips, Burrs & Other Debris Removed

8. ATTACH THE SKINS – ***Note:*** *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.* Re-cleco the top aft skin into place. Rivet the step rib reinforcement strips to the skin. ***Note:*** *It may be necessary to hold the strips to the skin when riveting.* Use a small block of wood to back-up the pieces being riveted. ***CAUTION:*** *Do* ***not*** *use your fingers. Besides being painful, it can also be very messy!* ***Important:*** *Skins need to be riveted flush to the ribs.* ***No gaps.*** Re-cleco the aft bottom skin and forward skin into place. Remember the forward skin laps on top of the aft skins. Re-check for proper wing washout. Remove the washout reference jigs. Rivet the skins in place. ***Note:*** *Pay close attention to type and length of rivets.*

9. INSTALL ACCESS PANELS – Attach the access panels using the indicted hardware. Modify the access panels for the aft aileron bellcranks as indicated in **FIGURE 3-24** before installing.

WING INSTALLATION

1. PREPARATION FOR WING ATTACH – Check everything related to the wing, to make sure you are ready. Remove all bolts except for the last bolt in each wing lug and the wing root stiffener plates. Mark the wing root stiffener plates with their location before you take them off. This will allow you to place them later in the same position
   Rotate lugs around the remaining bolts, as shown in **FIGURE 3-2.** This is necessary to clear the tubes in the fuselage.

2. WING ATTACH – Have something handy to support the wing outboard. Slide the wing spar through the openings in the fuselage sides, only far enough to have the center lugs inside the fuselage. Be careful not to scratch the spar.
   Have the wing rest on some support outboard, so you can work on the lugs.
   Rotate lugs in position; check alignment and bolt lug-plate-spar assembly together as shown.
   Note: Insert bolts from the back of spar. You have bolts with two different lengths. The longer bolts are used at the spar stiffener plates only. Make sure you place the root stiffener plates in the right position.
   Do not torque at this time. This will be done after center bolts are inserted.
   Repeat procedure for other wing.
   You will need 2 helpers to attach your wings. Place one on each wing tip. Insert outer bolts (at fuselage side) first.
   You might have the helpers move the wing tips up and down to help the wing lugs slide together, use some lubrication. Make sure you position the rudder cables inside the lugs and you clear the center stringer on the fuselage floor.
   After you have installed both outer bolts (do not forget spacer washers) the two inner or main bolts have to be inserted.
   You start with one, it does not matter which one (top or bottom). Have the helpers move the wing tips carefully up and down, until you see one set of holes aligned. Use a light and look through the hole to check alignment. If you use a pin to align the holes, you have to be very careful not to damage the hole. We do not recommend the use of a pin.
   Insert bolt and drive through.
   Have the helpers move the wing tips up and down again until the second bolt holes line up and insert the bolt.
   Tighten the two nuts until washers don't turn any more and then tighten about 1/8 turn more.
   Now tighten nuts on all other bolts.
   To tighten, do not turn bolts, turn nuts.
   Torque bolts by hand but do not over torque. It is easy to strip a 3/16" nut.

3. SPAR TO CAGE – Align the wing spar with the attach assemblies. Temporarily bolt each spar in place through the attach assemblies.

4. SET WING INCIDENCE - Attach angular stock or similar straight material to the wing incidence jig to obtain a precise measurement, refer to the Wing Installation pages in the parts manual, pages 003-39 and 003-40. Use the top cage longeron as reference. Raise or lower the wing trailing edge to obtain a 1° incidence angle. That is, the wing should have a 1° positive (trailing edge down) angle to the longeron.

5. LOCK WING INCIDENCE - Transfer drill 5/16" through the trailing edge spar attach plate. Bolt using the indicated hardware.

WING FILLET FAIRING

1. PLACE REFERENCE LINES – The fillet fairings must be fit up with the wings installed in the fuselage. Do so before painting the wings and fuselage. Mark a line 3/16" edge distance along the length of one edge of the aluminum strip. Place strips of masking tape on the wing perpendicular to the wing root inline with the every other rivet. Referencing off the rivets, mark inboard 5/8" and 7/16". Draw a line from the rivets through the reference lines.

2. TRIM FILLET FAIRING - Tape the aluminum strip onto the wing next to the fuselage. The ends will be slightly long, trim off when finished. Keep the outboard edge parallel to the rivet line. Mark and trim the fairing material until the outboard edge centers on the 5/8" reference line. **Hint:** Place a few alignment marks on the fairing and wing to keep things straight. When done the trimmed fairing should just touch the fuselage body.

3. INSTALL FILLET FAIRING - Align the untrimmed edge of the fairing on the 7/16" marks and tape in place. Don't worry the gap will be filled by the rubber trim. **Note:** Be sure to get a tight fit around the leading edge. Extend the reference lines to the line marked on the fairing. Drill #40 at the line intersections. Start at the leading edge and work your way aft. Cleco as you drill. **Note:** It may be necessary to add an extra rivet 1.125" forward of the lead rivet to hold the fairing tight against the skin. Also, drill through the trailing edge spar in line with the aft row of rivets. Final size drill #30. Trim the aft ends of the fairing flush with the wing skins. Remove the fairing and debur. Trial fit the rubber trim on the fairing. **Hint:** We suggest gluing the rubber trim to the fairing after painting of the wing is complete. Rivet the fairings to the wing.

CONTROL SURFACE ALIGNMENT AND PROFILE

IMPORTANT: *The final shape of the control surfaces is very critical to the performance of the airplane.* Each surface should be straight and true with no camber. Refer to **FIGURE 4-0.** Closely follow the procedures below during the assembly of each surface. ***Important:*** *Skins need to be riveted flush to the ribs.* ***No gaps.*** ***Note:*** *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.*

1. CONTROL SURFACE PROFILE JIG - Several profile jigs are used during the assembly of each control surface. See **FIGURE 4-3 & 4-28.** Fabricate each jig from wood. ***Note:*** *A 2x6 is suggested, but not critical.* See **FIGURES 4-4, 4-5, 4-6, & 4-27** for the corresponding jig measurements. Refer to the individual sections for proper use of these jigs.

2. RIB FLANGE ANGLES – The flanges of each control surface rib need to be 90°. See **FIGURE 4-26.** Use duckbill pliers or similar tool to correct any deviation. ***IMPORTANT:*** *Correct only the skin attach flanges. Do* ***not*** *adjust the spar attach flanges.*

3. HINGE ALIGNMENT – Check hinge alignment between control surface in question and trailing edge spar before you final drill hinge attach points on either one. To do this, temporarily cleco hinge brackets with pressed in flange bushings to both spars and bolt through hinge points. Check fit, drill #11, debur and bolt hinges to spar. **Note:** During drilling, hinge points should be bolted together through the flange bushing holes.

AILERON ASSEMBLY

IMPORTANT: There are two different aileron horns, inner and outer. Check part numbers closely.

1. SPAR ASSEMBLY - For orientation of the aileron spar and part location, see **FIGURE 4-7.** Press the flange bushings into the aileron hinges. ***Note:*** *Apply sleeve retainer sparingly to the flange bushings.* Note the orientation of each hinge and bushing. See **FIGURE 4-8.** Cleco hinges onto the spar. ***Hint:*** *Final alignment may be aided here by temporarily inserting a bolt through the flange bushing pairs.* Final size drill the hinge and spar hinge holes to #11. Remove the hinges and debur. Bolt the hinges to the spar. ***Important:*** *Test fit the aileron hinges against the wing hinges. If necessary, slot the spar holes for proper alignment.*

2. AILERON HORN ASSEMBLY - Align each aileron horn with a horn reinforcement rib and cleco using #40 clecos. **Important Note:** Rib placement is determined by whether the rib flange has pre-drilled holes or not. See **FIGURE 4-9.** Transfer drill horn and rib to #30 and debur holes. Position the correct aileron channel between the inner and outer aileron horns. Rivet rib, horn, and channel. Note the correct usage of rivet lengths.

3. STATIC BALANCE ARM ASSEMBLY - Cleco the inner and outer mount plates for the static balance arm to the reinforcement ribs. **Important Note:** Rib placement is determined by whether the rib flange has pre-drilled holes or not. See **FIGURE 4-10.** Transfer drill the rivet holes to #30 and cleco. Transfer drill the bolt holes to #11. Debur all holes and rivet the mount plates to the reinforcement ribs. Final size drill the pre-drilled bolt holes in the static balance arm to #11 and debur. Bolt the static balance arm between the rib/mount plate assemblies.

4. RIB/SKIN ASSEMBLY - Position the static balance arm assembly into the aileron skin with the balance arm extending through the slot in the skin and cleco. Position the horn assembly into aileron skin and cleco. See **FIGURE 4-11.** Cleco the remaining ribs through the bottom side of the skin. Note the orientation of each rib. Support the assembly, clecos down, on 2x4 or 2x6 blocks on edge. See **FIGURE 4-2.** Ideally, a block should be used near each rib. Cleco the spar to the ribs. Slide the aileron profile jigs onto the assembly as shown in **FIGURE 4-3.** With profile jigs in place, check skin for the correct profile as shown in **FIGURE 4-0.** Clamp or hold the assembly down against the support blocks. Using the skin as a guide, transfer drill #40 into the ribs. Cleco as you drill. Transfer drill the #40 spar holes to the skin. Cleco as you drill.

5. FINAL ASSEMBLY - Position the leading edge wraps on the outside of the skin and cleco. See **FIGURE 4-12.** Pay close attention to the leading edge wrap sequence. Final size drill the holes to #30. Final size drill the holes in the skin and ribs to #30. Disassemble the assembly and debur all holes. Reassemble and rivet. **IMPORTANT:** Before final riveting check assembly on support blocks for undesirable twist. Note the correct usage of rivet lengths.

6. MASS BALANCE ASSEMBLY – Mass balance will be calculated and assembled in the RIGGING SECTION.

FLAP ASSEMBLY

IMPORTANT: There are two different flap horns, inner and outer. Check part numbers closely.

1. SPAR ASSEMBLY - For orientation of the flap spar and part location, See **FIGURE 4-13.** Cleco an aileron rib onto the spar in the center of the middle hinge location. Final size drill to #30 and debur holes. See the parts drawing for the orientation of the rib flanges. Rivet the center rib to the spar. Press the flange bushings into the flap hinges. Note the orientation of each hinge and bushing. See **FIGURE 4-8.** Cleco hinges onto the spar. **Note:** Before final drilling of hinge and spar (hinge attach), check alignment of hinge points between flap and trailing edge spar of wing. Final size drill the hinge and spar hinge holes to #11. Remove the hinges and debur. Bolt the hinges to the spar.

2. FLAP HORN ASSEMBLY - Align each flap horn with a horn reinforcement rib and cleco using #40 clecos. Transfer drill horn and rib to #30 and debur holes. Position the correct flap channel between the inner and outer flap horns. Rivet rib, horn, and channel. Note the correct usage of rivet lengths. See **FIGURE 4-14.**

3. RIB/SKIN ASSEMBLY - Position the flap horn assembly into the flap skin and cleco only on bottom side. See **FIGURE 4-15.** Slide the remaining ribs into the skin, clecoing on the bottom side. Note the orientation of each rib. Cleco the spar to the ribs and final size to #30. Slide the flap profile jigs onto the assembly as shown in **FIGURE 4-3.** With profile jigs in place, check skin for the correct profile as shown in **FIGURE 4-0.** Correct any hole misalignment by final size drilling all top holes in the skin and ribs to #30. Cleco as you drill. Do not drill the leading edge at this time.

4. FINAL ASSEMBLY - Position the leading edge wraps on the outside of the skin and cleco. See **FIGURE 4-12.** Pay close attention to the leading edge wrap sequence. Final size drill the holes to #30. Final size drill the holes in the bottom side of the skin and ribs to #30. Disassemble the assembly and debur all holes. Reassemble and rivet the skin and spar to the ribs. Rivet the leading edge wraps to the skin and spar. Lay the completed aileron assembly on a flat surface to check for twist.

RUDDER ASSEMBLY

1. SPAR ASSEMBLY - For orientation of the rudder spar and part location, see **FIGURE 4-16.** Cleco the ribs to the aft side of the spar. ***Note:*** *Do* ***not*** *match-drill or cleco rib #4 to the spar at this time.* Refer to parts drawing for rib orientation. ***Note:*** *One side of all rib flanges do* ***not*** *have predrilled holes.* Final size drill the holes to #30. Debur the holes and rivet all the ribs to the spar, **except rib #1 and #4.** Press the flange bushings into the rudder hinges. Note the orientation of each hinge and bushing. See **FIGURE 4-8.** Cleco the rudder hinges to the spar. **Note:** Before final drilling of hinge and spar (hinge attach), check alignment of hinge points between rudder and vertical stabilizer. Final size drill the hinges and spar to #11. Debur and bolt the hinges to the spar.

2. REINFORCEMENT ANGLES - Rivet rib #1 to the spar through the **center** hole only. ***Note:*** *Before riveting the torque tube attach backing plate and reinforcement angles to the spar, check for fit on the rudder torque tube.* Debur the large holes as needed. Rivet the torque tube attach backing plate to the spar. Rivet the reinforcement angles to the spar. See **FIGURE 4-17.** Pay close attention to the type and length of rivets.

3. SKIN ASSEMBLY - Cleco rib #4 into the skin. Slide the spar assembly into the rudder skin. Cleco the skin to spar and ribs. ***Note:*** *Only one side of the skin may be clecoed to the spar and ribs at this time.* Clamp the rudder profile jigs onto a flat surface. Place the rudder assembly in the jigs as shown in **FIGURE 4-28.** ***Note:*** *The jigs must remain in position to correctly assemble the rudder.* Position a straight edge across, as shown in **FIGURE 4-0,** and check for straightness. Also check straightness of rib #4. Using a #40 drill bit, transfer drill through the skin into the undrilled ribs. Cleco as you drill. Using a #40 drill bit, transfer drill through the pre-drilled holes in the spar into the #4 rib flange and skin. Cleco as you drill. Locate and drill holes for reinforcement rivets as detailed in **FIGURE 4-29.** Size drill the holes in the skin and ribs to #30. Do **not** size drill the holes in the leading edge of the skin or spar at this time. Size drill the rib #4 and spar #40 holes to #30. Cleco as you drill.

4. TORQUE TUBE ATTACHMENT - Slide the torque tube attach plate onto the top end of the rudder torque tube. See **FIGURE 4-18** to determine the orientation of the torque tube. The bend in the attach plate will match the bend of the welded flange on the torque tube. With the skin clecoed in place, slide rudder torque tube assembly into backing plate and reinforcement angles. Measure the top of torque tube; it must extend past the top reinforcement angle a minimum of 1/8". The large holes in the backing plate and reinforcement angles may need to be slightly enlarged to properly install the torque tube assembly. Cleco the attach plate and the rudder torque tube to the backing plate. Using the aft pre-drilled hole in the torque tube upper flange as a guide, transfer drill from the under side through the mount plate, attach angle and rudder rib #1 with a #11 drill bit and cleco. Using a #30 drill bit, transfer drill from the under side through the pre-drilled holes along each edge of the aft portion of the rudder torque tube attach plate into rib #1. Debur all holes and rivet attach plate to rib.

5. FINAL ASSEMBLY - Bolt the rudder torque tube and the attach plate to backing plate and bottom rib. Reposition the skin and cleco to the ribs. Positioned leading edge wraps #1, #2, and #3 on the outside of the skin and cleco the wraps and skin to spar. See **FIGURE 4-12.** Place the spar doublers inside of the spar flanges. Note that one end of the spar doubler is cut at an angle. The angled end of the doubler is located at the bottom end of the rudder spar. When clecoed in place, the angle of the doubler parallels the spar flange angle. Refer back to **FIGURE 4-18.** Cleco leading edge wrap #4 in place and final size drill all holes to #30. Disassemble rudder and debur holes. Reassemble and rivet

the skin to the ribs. Rivet the leading edge wraps and skin to the spar and doublers. **Note the correct usage of rivet type and length.**

6. FITTING RUDDER HORN - Temporarily install the rudder horn onto the lower end of the torque tube. The large hole in the rudder horn may need to be slightly enlarged to properly install the horn onto the torque tube assembly. Do not bolt rudder horn on at this time. Lay the completed rudder assembly on a flat surface to check for twist.

RUDDER TRIM TAB

1. FABRICATE TRIM TAB – Fabricate the rudder trim tab from raw stock. See **Figure 4-30** for details. Drill five (5) #30 holes in the leading edge of the trim tab and debur.

2. MOUNT TRIM TAB – Determine the direction of propeller rotation as viewed from the rear. For clockwise rotation the trim tab will mount and extend on the left side of the rudder. Tape the trim tab in place. See **Figure 4-30.** Transfer drill #30 the mounting holes. Cleco as you drill. Remove the trim tab and slightly bend on a line 1/2" along the leading edge. ***Note:*** *Be careful to bend the correct direction for your aircraft. Do* ***not*** *over bend. A slight amount of bend can do a lot.* ***Hint:*** *Use a metal brake for best results.* Do not rivet the trim tab to the rudder until after rigging. See the RIGGING SECTION.

ELEVATOR ASSEMBLY

1. ELEVATOR TIP STRIP - Fabricate the elevator tip strips from raw stock as shown in **FIGURE 4-19.** The drawing is 1:1 scale and may be cut out to use as a pattern.

2. SPAR ASSEMBLY - For orientation of the elevator spar and part location, see **FIGURE 4-20.** Press the flange bushings into the elevator hinges. If needed, drill the hole to 5/16". **Note:** Use Loctite® Sleeve Retainer to secure the flange bushings in the hinges. **Caution:** Note the orientation of each hinge and bushing, as Sleeve Retainer makes it very difficult to separate the parts. See **FIGURE 4-8.** Cleco hinges onto the spar. Final size drill the hinge and spar hinge holes to #11. Remove the hinges and debur. Bolt the hinges to the spar.

3. RIB AND ATTACH PLATE ASSEMBLY - Cleco the ribs, root rib and the attach backing plates to the spar. **Note:** The ribs will be orientated with all holed flanges to one side of the spar. Final size drill and transfer drill holes to #30 and cleco. See **FIGURE 4-21.** Cleco the elevator torque tube and torque tube attach plate to backing plate using #11 clecos. See **FIGURE 4-24.** Transfer drill the #30 holes and aft #11 hole to the root rib and cleco. Using a single ear nutplate as a guide, transfer drill the attach plate, root rib, and attach backing plate to #40. On the root side of the torque attach plate, countersink the #40 holes. See **FIGURE 4-25.** Disassemble and debur. Rivet ribs and backing plates to the spar. Note the correct usage of rivet lengths. Rivet the attach plate to the rib. Rivet the single ear nut plates to the root rib and attach plate, and to the attach plate and root backing plate.

4. ELEVATOR TIP RIB ASSEMBLY - Check the flange angle of the elevator tip rib. The angle needs to be 90°. Use duckbill pliers or a similar tool to correct any deviation. Cleco the tip rib to the end rib of the elevator assembly using the #40 tooling holes. See **FIGURE 4-22.** Transfer drill #11 the attach backing plate holes to the tip rib and cleco. Clamp the fabricated tip strip into position. Use a hole locator or a long #40 drill bit to transfer #40 holes from the tip rib and end rib to the tip strip. Cleco as you drill. Disassemble and debur.

5. SPAR TO SKIN ASSEMBLY - Slide the spar assembly inside the elevator skin and cleco with the tip strip in place. Support the assembly, clecos down, on wood. See **FIGURE 4-2.** Ideally, a block should be used near each rib. Slide the elevator profile jigs onto the assembly as shown in **FIGURE 4-3**. With the profile jigs in place, check the skin for the correct profile as shown in **FIGURE 4-0**. Clamp or hold the assembly down against the support blocks. Using the skin as a guide, transfer drill #40 into the ribs. Cleco as you drill. Transfer drill the #40 spar holes to the skin. Cleco as you drill

6. LOCATE MASS BALANCE -Locate the forward mass balance plate hole in the tip rib as shown in **FIGURE 4-23.** Countersink the two balance plate holes on the root side with a 120° countersink tool and debur. Cleco the tip rib to the end rib, attach backing plate and tip strips. Final size drill the #40 tooling holes to #30 and debur.

7. ATTACH LEADING EDGE WRAPS - Position the leading edge wraps on the outside of the skin and cleco. See **FIGURE 4-12.** Pay close attention to the leading edge wrap sequence. Final size drill all holes in the skin, ribs and leading edge wraps to #30 with the tip strips in place. **Note: Do not** final size drill the tip rib to the tip strips at this time. Disassemble and debur.

8. MASS BALANCE FABRICATION – See RIGGING SECTION.

9. FINAL ASSEMBLY - Reassemble elevator & rivet. Note the correct usage of rivet lengths. ***Note:*** ***Do not*** *rivet the tip rib to the elevator at this time.*

10. ELEVATOR TIP INSTALLATION - Install the fiberglass elevator tip after final skinning of the elevator. Place the tips over the respective mounting rib and trim for a nice fit against the skin and inboard edge of the tip rib. Remove the tip. Reference the holes in the tip rib or use a hole finder.. ***Hint:*** *Place strips of masking tape on the elevator perpendicular to the tip rib inline with the flange holes.* Reference off the holes and mark a given distance (i.e. 1"). Draw a line from the hole through the reference line. Place the tip on the tip rib. Use tape to hold in place. Extend the reference lines onto the tip, mark and drill #40. Cleco as you drill. Final size drill #30. Debur and remove all tape. Rivet the tip to the tip rib using the indicated rivets after mass balancing the assembly.

11. MASS BALANCE ASSEMBLY – Mass balance will be calculated and assembled in the RIGGING SECTION.

FLOORBOARD INSTALLATION

Note: *Fit up all cage formers and stringers before applying any opaque interior.*

1. INTERIOR – The interior finish can be customized as desired. Suggested methods that add little weight or cost are:
   a. Paint the inside visible surfaces of the composite. This is recommended to prevent U.V. degradation of the composite.
   b. Glue upholstery fabric to the interior of the composite.
   Note: *Just remember, keep it light to preserve performance.*

2. WEAR PLATES – The floor area has two raised surfaces that are the floorboards. These floorboards are ready as is. However, .020 2420-T3 aluminum wear plates can be attached with small screws. Cut wear plates to the floorboard profile.

RUDDER PEDAL INSTALLATION

1. TORQUE TUBE ASSEMBLY – The rudder pedal torque tube assembly has been pre-assembled at the factory to insure proper fit and ease of movement of all components. Notice how the assembly is put together before any disassembling.

2. POSITION PILLOW BLOCK - Place the rudder pedal torque tube assembly in the fuselage cage. Extend the torque tube until the ends bottom out in the end retainers. Center the pillow block on the square cage tube and clamp in place. Ensure that the torque tubes can rotate freely. Add shim material or thin washers as needed between the pillow block and cage. Transfer drill the pillow block and square tube to #11. Debur and cleco in position.

3. ALIGN RUDDER PEDALS - Clamp a straightedge across the rudder pedal "J" tubes to align them. Transfer drill the right-inner rudder pedal and torque tube to #30. Final size drill to #11. Disassemble and debur. **Note:** Lube tubes inside of tubes with lithium grease.

4. APPLY FINISH TO ASSEMBLY - Due to the tube-in-tube rotation of the torque tube, the rudder pedals and torque tube assemblies are **not** painted or powdercoated from the factory. It is recommended to apply a finish after a trial assembly with rudder pedals and brake linkages attached. **Hint:** Drill a #40 hole in one side of all slideable assemblies on the torque tube (i.e. bellcranks). Insert a small bent wire to prevent the assemblies from sliding out of position, when applying the finish. **Note:** Do **not** coat the inside of the rudder pedal pivot areas. **Hint:** Pre-fit the rudder pedals to the "J" tubes before painting. When completed remove the wire and reinstall the assembly into the fuselage cage using the indicated hardware.

5. ASSEMBLE RUDDER PEDALS – Fabricate four (4) aluminum bushings from raw stock. Drill #40 through the centerline of each bushing and debur. Fit each rudder pedal over its respective "J" tube. Insert the rudder pedal pin. Notice that the inner rudder pedals are fitted with a linkage swivel bushing. The ear of the swivel bushing must point forward. Place the aluminum bushings over the ends of the rudder pedal pin. Transfer drill #40 through each bushing and secure with a large cotter pin. Each rudder pedal must swivel freely.

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RUDDER CABLE SYSTEM INSTALLATION

1. ASSEMBLE S-1 PULLEYS – Assemble four (4) pulley and shackle sets. See the close-up on the parts page. Finger tighten the nut and bolt retaining the pulley. Install the rudder cables in the pulleys in a later step. Notice that the hummertangs go inside of the shackles. Do **not** overtighten the bolt holding the shackles together. The shackles must be able to rotate freely.

2. INSTALL S-1 PULLEYS – The previously constructed pulley assemblies attach to welded bushings on station 1 of the cage. See **FIGURE 5-1** for details. Two (2) bushings are located in the upper left and right corners of the cage just below the engine mount bushings. The remaining two (2) bushings are located near the lower nose gear collar. Bolt the pulley assemblies to the bushings. Tighten the bolts, yet allow the assemblies to move freely.

3. HANGER ASSEMBLY – Drill the top #30 holes in the face of the bulkhead to #11 and debur. **Note:** These holes are on either side of the top center #11 tooling hole. Cleco the top hole of each jib strap to these holes. Align the jib straps with the lower #30 holes and transfer drill #11 through the lower hole and debur. Bolt the jib straps to the bulkhead. Attach the pulleys with the indicated hardware. For now, finger tighten the pulley bolts.

4. INSTALL BELLCRANK BRACE – Bolt the bellcrank braces to the welded bushings on the aft gear leg truss. Transfer drill #11 the welded tabs and bellcrank braces. See **FIGURE 5-2.** The ears of the braces must be on the outside of the welded tabs for the pulley assemblies to fit properly. Debur all drilled holes.

5. AFT CAGE PULLEYS - Install the aft cage pulley assemblies. See the close-up and **FIGURE 5-2** for details. **Note:** The measurements given for the aluminum bushings are approximate. Builder must cut to fit. Trim the cable keepers as depicted in **FIGURE 5-3.**

6. INSTALL RUDDER CABLES – Attach the rudder cables to the rudder cable attach brackets atop the rudder pedal torque tube. See the close-up on the parts page for details. The cables will install through the pulley assemblies on their respective sides. Tighten the bolts retaining the pulleys. Lay the cables down the center of the aircraft to the tail. The cables lay on top of all cage tubes except the aft gear leg truss. At the aft gear leg truss, the cables install under the front pulleys and over the aft pulleys. See **FIGURE 5-2.** Secure with small cotter pins in the inner holes of the cable keepers. ***DO NOT CROSS THE CABLES! THEY MUST REMAIN PARALLEL TO EACH OTHER!!!***
Note: The following steps require the bottom shells and bulkheads to be installed. Tie the cables out of the way on the cage until bulkhead installation. Install the cables over the pulleys hanging from bulkhead #2. Secure with small cotter pins in the inner holes of the cable keepers. Route the cables through the large upper holes in bulkhead #3 and temporarily secure near where the rudder horn will be located. Final installation of the rudder cables will be done during rudder installation.

RUDDER CABLE COVER INSTALLATION

Note: *Install after the fuselage shells and rudder cables are in place.*

1. CUT ATTACH ANGLES – Cut the attach angle into two (2) 18" pieces.

2. DRILL COVER AND ANGLES – Drill five (5) #40 holes, evenly spaced, along the lower edge of each flange of the cover. See **FIGURE 5-3A** for details. Drill seven (7) #30 holes, on centerline, in the lower flange (short leg) of each attach angle.

3. POSITION ANGLES – Place the cover over the rudder cables. Mark on the shells along the outside edge of the cover. Also, mark the forward edge. ***Note:*** *Position the cover centered over the rudder cables and slightly forward of the forward gear truss.* Remove the cover and position the angles inside the lines. ***Note:*** *The short legs of the angles will face inboard.* Transfer drill #30. Countersink and rivet to the shells with flush rivets.

4. INSTALL COVER – Place the cover over the rudder cables and on the outside of the angles. Position the cover to clear the rudder cables. ***Note:*** *The attach angles are long to allow up and down positioning.* Transfer drill #40. Attach the cover to the angles with the screws provided.

CONTROL STICK & TORQUE TUBE INSTALLATION

Refer to the parts page and select the required components for assembly.

1. INSTALL PILLOW BLOCKS – Apply lithium grease to the inside surfaces of the pillow blocks. Assemble the outer edge of the pillow block next to the stop-rings on the torque tube. Tighten the bolts so that the pillow blocks can move freely on the torque tube.

2. TORQUE TUBE ASSEMBLY – Install the four (4) 1/4" plain bolts and nuts into the welded insert-nuts on the torque tube. Adjustment of the stops is covered in the RIGGING SECTION.

3. INSTALL TORQUE TUBE – Measure the position of the pre-drilled hole in the right 3/4" square tube from the underside. Transfer this measurement to the left outboard square tube and mark. **Note:** The torque tube horn will be aft when in position. Bolt the torque tube assembly to the square tube using the top right pillow block hole. Center the top left pillow block hole on the mark, transfer drill #11 and debur. Bolt the torque tube assembly in position. Transfer drill #11 through the bottom hole of each pillow block. **Note:** Be sure the torque tube rotates freely before drilling. Debur all holes and bolt the torque tube in position. Shim the pillow blocks if necessary to allow free movement.

4. INSTALL CONTROL STICKS – Install two (2) rod ends between the horns of a control stick. Cut two (2) aluminum bushings, one for each stick, to take up any play between the rod ends. Remove the rod ends and bushings. Assemble the stick interconnect push rod with the rod ends and plain nuts. Bolt the control sticks to the torque tube. **Note:** Each control stick has a bearing-set pre-installed. Bolt the rod ends and bushings, finger tight, to the control stick. Adjust the rod ends until the control sticks are parallel to each other. Remember, each rod end must be at least ten (10) full turns into the stick interconnect push rod. Lock the stick interconnect length with Loctite and the plain nuts.

5. ELEVATOR PUSH-PULL TUBE – Bolt the elevator push-pull tube to the control stick torque tube. ***Note:*** *Use the top set of holes in the torque tube horn.* See the ELEVATOR PUSH-PULL TUBE AND BELLCRANK SECTION for assembly instructions.

6. AILERON ADJUSTMENT – Rig and adjust the aileron control system after the wings are installed. See the RIGGING SECTION.

ELEVATOR PUSH-PULL TUBE & BELLCRANK ASSEMBLY

1. BELLCRANK ASSEMBLY – Cleco and rivet the bellcrank and bearing flanges together. Remember to insert the bearings. ***Note:*** *These bellcranks have bearings and bearing flanges on both sides.* See the description page for proper rivet orientation. Press the flange bushings into the bellcrank end holes. The flange bushing must be trimmed flush with the face of the bellcrank. See **FIGURE 5-4.** File to the proper thickness. Apply sleeve retainer sparingly to the bushings. Press the flange bushings back into the bellcranks. ***Note:*** *Be sure to press the bushings in from the inboard side. To accommodate the larger push-pull tube, the bellcranks have bends pressed in them.*

2. ELEVATOR PUSH-PULL TUBE ASSEMBLY – Insert the push-pull tube plug into the aft end of the push-pull tube until flush. ***Note:*** *The aft end has 90° offset holes.* Transfer drill #30 through the push- pull tube and tube plug. ***Hint:*** *Use a drill press and "V-block" for best results.* Mark the orientation of the tube plug and remove. Insert the unthreaded end of the tube extension into the plug until 5" extends from the aft. Using a #30 bit, mark one hole location. Remove the extension and drill through on the mark. Reinsert, pin, and finish drilling all holes in the same manner. Reinsert the plug and extension. Final size drill all holes to #11. Debur and bolt together using the indicated hardware. Drill the forward push-pull tube #30 holes to 3/8" and debur. Cut the aluminum anti-crush bushing to fit snugly inside the push-pull tube. Align the bushing with the 3/8" holes. Apply sleeve retainer sparingly to the flange bushings and press into the push-pull tube and aluminum bushing.

3. 7/8" PUSH-PULL TUBE ASSEMBLY – Install the male rod end and plain nut in the threaded end of the 7/8" push-pull tube. Apply sleeve retainer to the flange bushings and press into the push-pull tube. ***Note:*** *These flange bushings are longer.*

4. BELLCRANK INSTALLATION – Temporarily bolt the bellcrank assemblies to both push-pull tubes using the indicated hardware. Fabricate the aluminum bushing to fit between the bearings of the two bellcranks. Remove the bellcranks and bushing from the push-pull tubes. Bolt the bellcrank assembly through the upper 1/4" hole in each bellcrank brace. Reinstall using the proper hardware.

5. PUSH-PULL TUBE INSTALLATION – The aft end of the 7/8" push-pull tube inserts through the aft gear leg truss and is bolted to the bellcranks. Be sure to include the extra washers between the flange bushings. Attach the forward end to the control stick horn. Remember the "10 turn rule" about rod ends. Install the large push-pull tube into the fuselage and through the bulkheads. Bolt the forward end of the push-pull tube to the bellcranks. The aft end bolts to the horn on the elevator torque tube. Final adjust the rod ends during final rigging.

FLAP CONTROL SYSTEM ASSEMBLY & INSTALLATION

1. ASSEMBLE FLAP LEVER – Refer to the parts page for hardware and part location. Press the plastic caps into each end of the 3/4" flap trip release tube. Refer to the TRIM SYSTEM section and install the nut plate to the left side plate. Bolt the flap lever between the two side plates. Tighten the flap lever pivot bolt so it is snug, but still allows the lever to pivot freely. Bolt the side plates together with the two (2) forward 7/8" bushings as spacers. Slip the spring into the flap lever tube and install the flap trip release tube. Depress and rotate the flap trip release tube until the 1/4" hole lines up with the slot. Install the bolt and roller/spacers into the flap lever and trip release tube. Tighten the bolt, yet allow the roller/spacers to roll. Apply light grease to the rollers for the best action. Test operate the lever by pulling up on the lever, then depressing the flap release tube and return.

2. INSTALL FLAP LEVER - Install the flap lever assembly into the cockpit by slipping the assembly over the square mount tube located between the seat tubes on the cage. Refer to the parts drawing. Bolt using the pre-drilled #11 hole in the mount tube and the lower middle hole in the sideplates. Using the holes in the side plates as a guide, center and mark the remaining hole locations on both sides of the steel mount tube. ***Note:*** *Be sure the flap lever can be moved through the complete arc before drilling the remaining mounting holes. The flap lever horn must clear the cage tube.* Pivot the flap lever assembly up, drill marked locations to #11, and debur. Pivot the flap lever assembly down and bolt to the mount tube. ***Note:*** *The aft bolts also mount the teleflex retainer brackets.* Install the brackets and associated hardware. Finger tighten these bolts for now.

3. INSTALL TELEFLEX – Install the teleflex after attaching the wings to the aircraft. The teleflex will route through a small hole cut in the skin. Screw the rod end onto the end of the teleflex cable. The teleflex clamps between the standoff and retainer bracket. Bolt the rod ends to the flap mechanism with the indicated hardware. Tighten all attachment bolts after final rigging of the flaps. See the RIGGING SECTION for adjustment of the rod ends and adjustment of the flaps.

TRIM SYSTEM ASSEMBLY & INSTALLATION

1. TRIM LEVER ASSEMBLY – Refer to the parts page for hardware and part location. Install the nut plate to the inside of the left side plate. Hold the nut plate in position parallel to the length of the side plate and transfer drill #40. Hint: Hold the nut plate in position with a short 3/16" bolt and several washers. Debur and rivet. Assemble and install the flap lever assembly. See the FLAP CONTROL SYSTEM section. Slide the roller/spacer over the threaded knob and screw into the nut plate through the curved slot in the friction lever. Bolt the trim levers to the flap lever assembly. Remember to install the aluminum bushing and plastic washers. Tighten the bolts enough to let the trim levers rotate. Bolt the trim lever knob to the tops of the trim levers.

2. TRIM SYSTEM ASSEMBLY – Cut aluminum bushings to fit between the trim levers and the welded tabs on the push-pull tube. Lay the bungee cords between the welded tabs on the push-pull tube. Slide the trim pulleys over the aluminum bushings and bolt to the push-pull tube tabs. Insert the bolt through the lower hole in the trim lever arm and through the aluminum bushing until flush with the end of the bushing. Slip opposite ends of the bungee cords over the bushing. ***Hint:*** *Loosen the trim lever pivot bolt to ease assembly. Remember to retighten it when finished.* The bungees must run parallel to each other. Insert the bolt through the remaining trim lever hole and tighten the nut.

3. SECURE BUNGEE CORDS – Center the control sticks and the trim lever. Fasten the bungee cords to the push-pull tube with the cushioned clamp. ***Hint:*** *Bolt the clamp together and bend the ears.* See **FIGURE 5-5** for details. After flight tests, the cushioned clamp may need to be moved to effect the desired trim range.

SEAT BELT INSTALLATION

1. SHOULDER BELT INSTALLATION – Refer to the parts page for hardware and part location. Locate and rivet the seat belt guides to the canopy former. See **FIGURE 5-6** for measurement details. Hint: Place an aluminum tube across the span of the canopy former and lightly rub on both sides. This will mark the center of the tube. Place the #40 holes in the guide on the mark and transfer drill. Cleco as you drill. Final size drill to #30 and rivet. Pass the shoulder belt end fitting through the guide and bolt to the seat belt attach bracket.

2. LAP BELT INSTALLATION – Bolt the lap belt end fitting between the welded mount tangs on the gear leg truss. ***Note:*** *The lap belt with the buckle must be on the same side as the shoulder belt.*

3. LAP TO SHOULDER BELT INSTALLATION - Insert the loose end of the lap belt through the bottom side of the adjuster end of the shoulder belt near the belt webbing. Pass the end back down through the adjuster. The belt end should now be looped over the knurled slide of the adjuster end. When properly installed, tension on the belt may be released by pulling up on the loose end of the 3/4" wide webbing on the adjuster. The elastic on the lap belt is provided to retain the loose length of belt.

SEAT ASSEMBLY & INSTALLATION

NOTE: Seat assembly requires the cutting of aluminum tubes squarely. Use a tubing cutter or lathe to assure squared ends.

1. SEAT ADJUSTMENT MECHANISM – Assemble the seat adjustment mechanism. See the parts page for details. Pay close attention to the placement of washers and the seat adjust scissor arms.

2. INSTALL SEAT GUIDES – Bolt the seat bottom guides to the aft set of bushings. ***Hint:*** *Drill the attach bushings to #11, as needed.* The guides will face inward toward the seat frame.

3. SEAT BACK FRAME GUSSETS – Cleco the seat gussets to the seat back frame. The single 1/4" hole in the gusset must be forward. ***Note:*** *The lower lumbar bend in the frame determines the front of each frame.* Transfer drill #11 the middle hole of each seat gusset. Debur and bolt the gussets to the seat frame.

4. CUT SEAT BACK FRAME – Mark the top center of each frame. Drill two (2) #30 holes on front and back side of the tube on each side of the mark as in **FIGURE 5-7.** Cut the seat back frames in two on the mark. Pin each half to the middle attach bushing on the aircraft cage. See **FIGURE 5-8.** ***Note:*** *The three (3) forward bushings are for the seat back frame attachment.* ***Hint:*** *Drill the attach bushings to 1/4" to ease pinning.*

5. SPLICE TUBE & SPACER ASSEMBLY - Pin the seat halves into the cage. Be sure the seat frame gussets will clear the seat bottom guides when in the full aft position. See **FIGURE 5-8.** Using the tube supplied in the raw stock kit, cut two spacers from the 7/8" tube to the gap length. Center the 7/8" spacer tube on the seat splice tube and drill a #11 hole in one side on center. See **FIGURE 5-9.** Cleco the hinge to the assembly. Drill a #40 hole 90° from the #11 hole. Rivet with a 3/32" aluminum rivet. ***Note:*** *The rivet will keep the spacer from turning when pulling the cushion over the seat back frame.* Do **not** rivet the hinge to the splice tube at this time.

6. INSTALL SPLICE TUBE - Install the splice into the seat frame halves and pin the seats into the cage. Pin the seat adjustment mechanism to the cage and seat back hinge. ***Hint:*** *Remove the cleco from the hinge and temporarily hold it in position with a short AN3 bolt.* With the hinge rotated into a tangent position, and with no gaps between seat frames and spacer tubes, transfer drill #30 through the side frames into the splice tube. Debur and rivet.

7. INSTALL SPREADER TUBE - With the seat still pinned to the cage measure between the inside seat gussets. Cut the 1/2" dia. tube to the measured length for a snug fit between the gussets. Debur the inside ends of the tubes and fit them over the middle gusset bolts. Insert the end caps into bottom ends of the seat frame.

8. SEAT BOTTOM FRAME ASSEMBLY – From the 1/2" aluminum tube, cut four (4) splice tubes 1 7/8" in length. Mark the center of each splice tube. Insert the 1/2" splice tubes halfway into the ends of the seat bottom front hoops. Transfer drill #30 through the splice tube and rivet. Insert the hoop onto the seat bottom side tubes. ***Note:*** *The shorter bend in the side tubes denotes the front.* Slide this assembly over the stubs on the seat bottom lace tube. Rotate the seat bottom side frame tubes so they are 90° to the seat bottom lace tube. The bends of the seat bottom side tubes should

match in contour when viewed from the side. Locate and drill two more rivets into the ends of the seat bottom side tubes as per the seat bottom front hoop.

9. LACE TUBE ASSEMBLY - Insert a 1/4" clevis pin into each end of the lace tube. Position the lace tube assembly with the heads of the clevis pins pushed against and down into the guide slots. ***Note:*** *Do not use the pre-drilled hole in the clevis pin for alignment. Push the head of the clevis pin against the seat bottom guide.* Using the top #30 pilot hole in the lace tube drill only halfway into the clevis pins. Remove the bottom seat frame from the cage and drill through the clevis pins from the bottom pilot holes. Secure with a large cotter pin. Move the hoop assembly until the front edge is parallel to the gear truss tube. Drill a #30 hole at 1/2" from the end of the tube and rivet the seat bottom tube to the lace tube.

10. OPTIONAL HEADREST - Lay the seat back frame on its back on a flat workbench. Elevate the frame enough so the hinge is not resting on the table. Place the headrest so the mounting stubs are parallel with the seat frame tubes and centered. Mark the headrest stub positions on the frame on both sides of the tube. See **FIGURE 5-10.** Drill from each side 1/4". Drill out the top hole to 1/2" using first a 3/8" bit, then 1/2". The headrest will be mounted after installing the upholstery. ***Note:*** *This will require a long extension to get to the bolts.* To install the headrest upholstery, slip the cushion over the frame and secure the Velcro.

11. INSTALL SEAT CUSHIONS - Slip the seat cushions onto the frames. Use a hot knife or scissors to cut the notches. See **FIGURES 5-11 & 5-12** for details on notching the flaps and fabricating the retaining wires. The seat bottom aft flap goes around the lace tube. The seat back flap goes around the 1/2" aluminum tube. Pull the zip ties tight once the fabric is in place. ***Note:*** *If installing the optional headrest snug the cushions down and cut the fabric away from the mounting holes and install the headrest before final installing the seat back cushion.* Locate the hole for the hinge through the fabric and cut away. Rivet the hinge to the seat back.

BRAKE SYSTEM INSTALLATION

1. LINK ROD ASSEMBLY – Install the brake link rod to the brake cylinder bellcrank and lever on the rudder pedal using the specified hardware. Orientate the bellcrank with one arm up and the other forward. **Note:** The link rod will bolt to the forward arm. Check for free rotation of the rudder pedal.

2. FABRICATE LINK TUBES – ***Note:*** *This step only applies to* ***single brake system*** *installations.* Fabricate two (2) link tubes and doublers from raw stock. See **FIGURE 5-13** for details. Insert the doubler into the end of the link tube. Using a 3/4" E.D. flatten the tube end. Be sure the doubler is centered and flush with the end of the tube. Drill each end #11 as per **FIGURE 5-13.**

3. INSTALL FITTINGS – Wrap the thread of each fitting with Teflon tape. Install the fittings into each master cylinder. For now, position each fitting toward the shackle end of each cylinder. Be careful not to overtighten the fittings.

4. INSTALL MASTER CYLINDERS – ***Note:*** *Install each master cylinder with the barrel (large) end aft.* The shackle-end mounts to the inner tab of the welded bracket on the front tube of the cage. Orientate the master cylinder with the fittings inward. Bolt the barrel-end to the top arm of the bellcrank. Be sure the jam nut is tight against the shackle. If needed, loosen this nut and adjust the shackle to bring the brake pedals into proper adjustment.

5. PARKING BRAKE – ***Note:*** *Pre-fit the parking brake and control hardware before soundproofing the firewall.* See the ENGINE & SYSTEMS SECTION for location. Wrap the end of each brass fitting with Teflon tape and install in the park brake. See the close-up on the description page for details. Install the parking brake on the aft side of the firewall after installing the soundproofing.

6. CONTROL HARDWARE – Rivet the swivel stop bracket to the aft side of the firewall. See the ENGINE & SYSTEMS SECTION for location. Install the cable housing swivel stop in the bracket. The park brake control cable mounts into the instrument panel. Mounting location is left to the builder's preference. Install the non-cushioned and conduit clamp to the station 1 crossing tube. See the close-up on the description page for details. Route the control cable through the conduit clamp and into the cable housing swivel stop. Determine the correct length of cable and cable housing needed and cut both to length. Remove the cable from the cable housing to cut to length. Leave the cable a little long at this time for adjustment. Trim the cable to final length during final assembly. Route the cable through the cable housing swivel stop and the wire swivel/screw stop in the control arm of the park brake. Adjust the control arm and cable to allow full open with the control knob pushed in, and closed with the control knob pulled out. During final assembly Loctite the screw in the wire swivel stop.

7. BRAKE FLUID RESERVOIR - Teflon tape and install the 90 degree fitting into the bottom of the hydraulic brake reservoir. Locate the hole for the supply line in the firewall; see the ENGINE & SYSTEMS SECTION for details. Point the 90-degree fitting to the firewall. Install the reservoir expansion cap, this will keep unwanted debris out of the reservoir. Install the rubber grommet in the firewall for the supply line from the reservoir. Cut a short piece (about 8" should do) of brake line and insert through the grommet and into the fitting in the reservoir. ***Note:*** *Leave the line a little long, it can be trimmed later.* Fully insert the brake line into the ferrule fittings. ***Note:*** *The ferrules can be completely tightened only once.* Mount the reservoir on the firewall as shown in the parts drawing. The mount strap should be near the top of the reservoir. ***Hint:*** *Pre-fit all items on the firewall before adding the soundproofing.* Final install after soundproofing is complete.

8. BRAKE LINES - We recommend cutting and fitting all brake lines and hand tightening during trial assembly. Fully tighten during final assembly. Install the tee fitting to the reservoir line on the aft side of the firewall. Cut the brake line to length and route according to **FIGURE 5-14** for single brake systems and **FIGURE 5-15** for dual brakes. ***Note:*** *Brake line length and routing is left to the discretion of the builder.* The brake line will exit the fuselage aft of the landing gear sockets. Drill a 7/16" hole through the skin and install the rubber grommets. If you are installing gear leg fairings, the brake line will route through the fairing on the aft side of the gear leg.

Note: *Perform the following steps during final assembly.*
Important: *Use only aircraft-grade brake fluid. Automotive brake fluid will destroy the seals in the system.*

9. FILL THE SYSTEM - Fill the system from the bottom through the bleeder valves in the caliper cylinders. ***Hint:*** *A small hand-held oil pump can, with a short piece of small-diameter hose attached, works well.* With the oil pump full of hydraulic oil, slide the hose on the oil pump over the left bleeder valve. Remove the reservoir cap and open the bleeder valve. Fill the left side of the system until the fluid level is just above the "T." Close the bleeder valve and remove the oil pump. Refill the oil pump, and attach it to the right bleeder valve and follow the same procedure. Continue to fill the system and alternate sides until the system is free of all air bubbles and the reservoir is approximately 1/4 full.

10. BLEED THE SYSTEM - Fill the reservoir to approximately 3/4 full by pouring directly into the reservoir. Bleed the brakes by depressing pedals individually while opening the respective bleeder valve at the caliper. Close bleeder valve before releasing pedal. Repeat until brakes are solid. ***Note:*** *Pump fluid through the caliper bleeder to eliminate all air in the system.* ***Hint:*** *Place a pan under bleeder valve to catch any dripping fluid.* Replenish fluid in reservoir as required. Replace the reservoir cap.

S-16 SHEKARI ASSEMBLY MANUAL

FUSELAGE FUEL SYSTEM

1. DRILL FITTING HOLES – Drill the holes in each fuel tank for the fittings. **See 5-16 and 5-17** for details. ***Hint:*** *A Uni-bit works well for step drilling these holes.* ***Note:*** *If installing the optional vapor return system drill the hole in the right fuel tank according to* ***FIGURES 5-18.*** Carefully debur each hole. Drill "Letter Q" the hole for the vent tube fitting in the filler neck, according to **FIGURE 5-19**. Thread with a 1/8" tapered pipe tap and insert the 90° fitting. Tighten the fitting and face away from the filler opening. Flush out any loose tank pieces or particles.

2. INSTALL TANK FITTINGS – Thread a stiff wire through a fitting hole and out the tank interconnect. ***Hint:*** *An undone coat hanger works well.* Install an O-Ring onto one of the tank withdrawal fittings and slide this assembly over the wire extending from the tank interconnect. Bend a loop in this end of the wire to keep the fitting assembly from falling off. Pull the fitting through the hole. Slide a flat rubber washer, thick washer and a retaining nut over the wire and onto the fitting. Apply Loctite to the threads and then thread the nut on before removing the wire. See **FIGURE 5-20** for sequence detail. Use an Allen wrench to hold the fitting while tightening the nut. ***Important:*** *Do* ***not*** *allow the fitting to turn while tightening or leaks may occur.* Apply thread sealant to the fittings to be installed into the tank fittings and install. Again, do not allow the fitting to rotate. ***Note:*** *It is very important to use a thread sealant on all non-flared fittings.* ***Important:*** *The fuel supply fittings (larger) should point to the left and the fuel sump (smaller) should point to the right when the tanks are installed. The 90° withdrawal fitting for the vapor return on the back of the right tank needs to point down and to the right. The two (2) 90° fittings on the top front of the tanks need to face each other.* Check the seal of all fittings. Cap or plug all exit lines and pressurize the tanks. ***CAUTION:*** *Do NOT pressurize to more than 3 p.s.i!* Use soapy water to check around each tank fitting. If bubbles appear, the fitting needs to be re-sealed. Check for foreign material that could keep the fitting from sealing.

3. INSTALL FUEL MIXER TEE – Install the tee to the welded tab on the left side of the fuselage. See **FIGURE 5-21** for details. ***Note:*** *The tee is a bulkhead style.* The tee side needs to be forward and pointed down. Secure the tee with the nut. Attach the hose nipples and 90° fitting to the tee. Only finger tighten for now.

4. INSTALL OPTIONAL FUEL PUMP – Attach and finger tighten the fittings to the fuel pump. ***Note:*** *The 90° fitting attaches to the inlet side of the fuel pump.* ***Important:*** *The fuel pump has an arrow marked on it to indicate the direction of fuel flow.* Cleco the fuel pump to the mount bracket with the 90° fitting outboard. Align the bracket with the welded tab on the cage. This tab is under the pilots seat area. The mount flange should be slightly inboard of the weld and centered on the tab. This will ensure that the pump will not interfere with the seat and that the fuel line will clear the cage tubes. ***Note:*** *The fuel line from the mixer tee to the pump will route between the cage and fiberglass shell.* Transfer drill #11 through the tab and mount plate. Remove the mount plate and debur. Center the nut plate over the tab hole, transfer drill the ears #40, debur and rivet. ***Note:*** *Final drilling and assembly of the mount must be done with the shells attached to the cage.* Do this later, if the shells are not attached. Transfer drill #11 the two (2) holes in the mount plate and through the fuselage shell. Insert the rubber grommets into the mounting holes of the fuel pump. Bolt the fuel pump to the mount and shell using the indicated hardware.

5. INSTALL FUEL VALVES – Obtain the fittings for both fuel valves. See the description page for details. Apply thread sealant to the fittings and install them into the valves. ***Note:*** *The fuel valves are of different sizes.* The larger valve is the fuel shut-off valve. The smaller valve is for the fuel sump

drain. Tighten the fittings securely into the valves. ***Note:*** *It is very important to use a thread sealant on all non-flared fittings.* Finger tighten the hose nipples onto the nipples in the fuel shut-off valve. Attach the valves to the lower diagonal tubes in front of the front gear truss with the larger hose clamps. See **FIGURE 5-22** for details. ***Important:*** *Locate both valves where either pilot can easily access them.*

6. INSTALL FIREWALL FITTINGS - Drill the holes in the firewall for the bulkhead fittings and debur. See the ENGINE & SYSTEMS SECTION for location and hole size. Temporarily install the fittings in the firewall. Final install the bulkhead fittings after soundproofing the firewall. Temporarily attach the firewall.

7. FIT UP OF CAGE ASSEMBLIES - Fit up the baggage compartment deck and cage formers before installing the tanks. Refer to the FUSELAGE SECTION. ***Note:*** *The two (2) aft cage formers on both sides must be riveted to the cage before the tanks can be final installed.*

8. INSTALL FUEL TANK MOUNT – Insert the threaded bolt and washer combination through the welded bushings on the cage. See the description page for parts and location. With a hotknife or soldering iron burn a 1/2" hole in both ends of the mount strap. ***Hint:*** *Flatten the strap end and cut a half-moon in the center of the crease.* See **FIGURE 5-23** for details. Hold the strap ends together and mark the center of the resulting crease. Slip the strap over the strap attach. The threaded bushing should extend through the strap hole. Thread the bolt into one strap attach, only several threads are needed now. Pass the strap through the diagonal brace below the baggage deck and align the center mark on the brace. Thread the remaining bolt into the remaining strap & attach assembly. Slip the fuel tanks into the cage from the front. Place the mount strap behind the fuel tanks and tighten until the tanks touch the baggage area tubes. ***Note:*** *The strap will rest in the tank area shaped like the back of your knee when bent. This is a pre-fit so do not worry about final tightening the bolts.* Slip the mount angles behind the gear truss and below the fuel tank. The mounts will support the bottom front of the tank when in position. ***Note:*** *The tanks will also rest on the gear truss tube.* Center the mounts on the welded bushings and transfer drill #11. Debur and bolt the mounts to the bushings. ***Note:*** *Before removing the tanks, measure or estimate the length of line needed to route from the tank fittings to the mixer tee.* Remove the fuel tanks. ***Hint:*** *It is easier to remove and install the tanks when the mounts are not bolted in.* Glue rubber trim to the angles.

9. INSTALL FUEL LINE – Obtain the hardware to connect the fuel lines from the tank fittings to the mixer tee and "Y" in the sump line. Insert the hose nipples into the fuel line, clamp, connect and tighten to the elbows in the fuel tanks. ***Note:*** *Use the correct size fuel line for the supply and sump lines.* ***Hint:*** *Use a small amount of light oil inside the hose opening to ease insertion.* Slip the fuel tank interconnect hose and clamps over the left tank interconnect. Position the tanks for re-installation and route the fuel lines. ***Important:*** *Route or secure the lines away from any wear points.* Re-install the fuel tanks. Be sure the interconnect hose is underneath the rudder cables. Tighten the clamps on the fuel interconnect hose. ***Note:*** *There are two (2) clamps for each side. Do* ***not*** *over-tighten.* Tighten the mounting strap evenly side to side. Cut the lines to length. Insert and secure the fittings. Be sure to tighten the fittings on the mixer tee. Using the proper hardware, install the remaining fuel lines inside the cage up to the firewall. Again, route or secure the lines away from any wear points. Bend the aluminum drain tube 90° and mark the position for exit through the belly. Drill a 7/16" hole; insert the grommet and route out the belly through the rubber grommet.

10. INSTALL OPTIONAL VAPOR RETURN – Obtain the fittings for the check valve. See the description page for details. Apply thread sealant to the fittings and install them into the check valve. Tighten the fittings securely into the valve. ***Note:*** *It is very important to use a thread sealant on all non-flared fittings.* Attach the valve under the lower right cage tube about 8" aft of the firewall. See **FIGURE 5-24** for details. ***Important:*** *The arrow on the check valve must point toward the fuel tank.* Install the line from the firewall fitting to the check valve and then back to the fuel tank fitting. Clamp and secure all lines. ***Important:*** *Route or secure the lines away from any wear points.*

11. INSTALL TANK TO TANK VENT – Cut the tank to tank vent line to fit between the 90° fittings on the top front of the tanks. Slip the line over the fittings and clamp.

12. INSTALL FUEL VENT – ***Note:*** *Final install the aluminum vent tube after installing the fuselage shells.* Slip the 3" length of fuel line over the fitting and secure with the small hose clamp. Mark and bend the aluminum tubing 90° to enter the hose and yet clear between the tank and baggage deck. Bend the aft end of the tubing 90° once clear of the tank. Mark the exit location for the tube and drill a 7/16" hole in the shell belly. Insert a rubber grommet in the hole and push the vent tube through. Bevel the protruding tube 45 ° on the forward side. This forward facing bevel will prevent a fuel-starving vacuum from forming inside the tanks. Clamp the upper end inside the fuel line with a small hose clamp.

13. SECURE FITTINGS – Tighten and secure all fittings.

14. VENT COVER – Trim the vent cover to the trim lines. Drill a #30 hole in each ear. ***Note:*** *Position holes to be on cage tube front centerline.* Center the cover over the 90° vent fittings. Transfer drill #30 into the baggage deck and cage tube. Debur. Rivet during final assembly.

BAGGAGE COMPARTMENT ASSEMBLY & INSTALLATION

1. ALIGN BAGGAGE BOTTOMS – Cleco the baggage deck pieces together through the bottom flanges. Refer to the description page for details. Remove the clecos one at a time and rivet the decks together. Center the deck assembly over the cage. ***Hint:*** *Center the pre-drilled holes over the tubes to align the decks in the baggage area.* ***Note:*** *Trim the deck assembly as needed to clear the cage.* **See FIGURE 5-21** for details. ***Note:*** *The aft end of the baggage deck is intentionally left long for supporting the baggage compartment closeout.* Transfer drill #30 through the welded tabs on the cage under the deck. Cleco as you drill.

2. TRIM BAGGAGE BOTTOMS – Remove the deck assembly and debur the holes. Install the fuel tanks. Cleco the baggage deck back in place. Trim the cutout area to clear the filler neck and vent tube. Trim the deck flanges to clear the tops of the fuel tanks. ***Important:*** *The deck flanges must not rub against the fuel tanks.*

3. LOCATE MOUNT HOLES – Locate the mounting holes in the decks as detailed in **FIGURE 5-25.** Locate these holes over the center of the cage tubes and drill #40. ***Hint:*** *Use the pre-drilled holes to line up these new holes.* Cleco as you drill. Final size drill #30. Remove the deck assembly and debur. Glue the rubber trim to the cutout area around the filler neck. Rivet the deck assembly to the cage. ***Important:*** *Install the fuel tanks before riveting the baggage deck to the cage.*

BAGGAGE COMPARTMENT CLOSEOUT INSTALLATION

Note: *The aft end of the baggage deck is intentionally left long for supporting the baggage compartment closeout.*

1. FABRICATE BRACKETS – Fabricate two (2) mounting brackets, from aluminum strip, as shown in **FIGURE 5-26.** ***Hint:*** *Use vise or duckbill pliers to make the bends.*

2. INSTALL BRACKETS – Align the brackets with the #11 pre-drilled holes in bulkhead #1. See **FIGURE 5-27.** Transfer drill #30 through the brackets and rivet.

3. TRIM CLOSEOUT – Trim the aft closure as shown in **FIGURE 5-28.** Be sure to cut out for the seat belts and top stringer. ***Hint:*** *Center the closeout in the baggage area and mark for the stringer cutout area on the closeout.* The closeout should fit tight against the mounting brackets.

4. INSTALL CLOSEOUT - Locate and drill 1/4" holes in the closeout for attachment to the mounting brackets. ***Hint:*** *Place white grease on the face of the bracket and press the closeout against.* Evenly space two (2) 1/4" holes, 3/4" from the bottom front edge of the closeout, and drill through the closeout and baggage deck. ***Note:*** *Be sure to locate these on a flat area of the baggage deck.* Install the seatbelts and fasten the closeout in place with the screw rivets.

S-16 SHEKARI ASSEMBLY MANUAL

INSTRUMENT PANEL INSTALLATION

1. PANEL MOUNT HOLES – Evenly space five (5) marks along the curve of the panel. Measure 5/8" in from the edge and drill to #40.

2. POSITION PANEL – Position the panel against the forward deck. ***Note:*** *The tooling hole in the panel flange indicates the right side.* Position the panel slightly below the top radius of the deck. Trim the panel, where it rests against the deck, as needed. Center the panel and transfer drill the #40 holes. Cleco as you drill. Final size drill to #19. Temporarily bolt the nut plates to the panel side of the deck. Transfer drill #40 and debur. Slightly countersink the #40 holes and rivet the nut plates to the inside of the deck. Be sure the trusshead screws clear the fiberglass.

3. INSTALL PANEL – Attach the panel to the deck with the trusshead screws. ***Note:*** *Since the panel is supplied as a blank. Determine where the instruments will be placed and cut the holes prior to final mounting.* ***Hint:*** *Several supply companies have excellent instrument panel layout templates available. Get them and use them to your advantage.*

AIR VENT INSTALLATION

1. ASSEMBLE VENT BODY – Trim around the 5/8" flange of the thermo-formed plastic air vent. Trim the outlet end of the air vent close to the radius. Use a file or small sanding block to smooth the flange and outlet area flush to the material thickness. Drill the dimples in the air vent flange to #40. Cleco the air vent plate to the air vent. Position the air vent latch inside the air vent with the tab extending 1/8". The latch tab should easily engage the slots in the vent plate. Center the latch and transfer drill #40. Final size drill #30, debur and rivet the latch to the air vent. ***Note:*** *Use brass washers as backups when riveting through plastic.*

2. CUT AIR VENT HOLE – Use **FIGURE 5-29** as a template. Position the template on the lower shell as shown in **FIGURE 5-30.** ***Hint:*** *Use a glue stick to hold the templates to the skin.* Cut around the templates very carefully. The cutouts will be reused to cover the vent holes. Drill the template holes to #40.

3. POSITION AIR VENT – Center the cutout on the air vent plate about 5/8" from the bend. ***Hint:*** *Use small strips of double-stick tape to temporarily hold it in place.* Cleco the plate assembly to the plastic vent. Position the vent assembly on the inside of the skin. Be sure the cutout fills the hole in the skin. Transfer drill #40 through all flange holes of the vent, cleco as you drill. Final size drill the holes to #30 and debur. Transfer drill #40 through the holes in the cutout. Final size drill the cutout holes to #30 and rivet. Counter-sink the vent mount holes and rivet the vent assembly to the skin with flush rivets.

OPTIONAL WHELEN STROBE INSTALLATION

1. MOUNT STROBE BOX – Mount the strobe power supply box inside the cockpit on the upper left side of the cage, forward of the square crossing tube. Use non-cushioned clamps. See **FIGURE 5-31** for details. ***Note:*** *Attach the upper non-cushioned clamps around the top longeron. Position the strobe box so as not to interfere with the rudder pedal horn.* Orientate the box for easy access to the power couplings.

2. BOX POWER CONNECTIONS - Run a 14-gauge yellow wire from the nav. switch back to the strobe box. Connect a brass "Y" to the end of the wire. The yellow wire coming out of each wing will connect to the "Y". ***Note:*** *Wrap the "Y" with electrical tape, after connection, to prevent shorting.* Run a red 14-gauge wire from the strobe switch back to the strobe box. Also, run a black 14-gauge wire for the ground. Connect these wires to the black and red wires coming out of the strobe box.

3. STROBE CONNECTIONS - Connect the ends, provided in the strobe kit, to the three (3) wires coming out of the grey strobe cable. The kit has directions about which way they go on. ***Note:*** *Cut to length and connect the wires after bolting the wings on.* Red connects to #1, black connects to #2, and white connects to #3. Make sure these ends inserted all the way into the connector. The unprotected wire (shield) is grounded to the box by a bolt. The two white connectors, from the grey strobe cable, are plugged into the number 1 and 2 outlets. Check all connections and wires. Test the strobes.

S-16 SHEKARI ASSEMBLY MANUAL

IO – 240 FIREWALL ASSEMBLY & INSTALLATION

Note: *The extra #40 perimeter hole denotes the left side of the firewall.*

1. ACCESS HOLES - Locate and mark the accessory holes as shown in **FIGURE 6-1 & 6-2.** ***Hint:*** *Align and hold* ***FIGURES 6-1 & 6-2*** *to a light to help in determining hole locations and sizes.* ***Hint:*** *Drill to #30 first to help center larger bits and holesaws.* ***Important:*** *Do* ***not*** *drill the hole for the optional vapor return, or optional heater inlet, if not installing.*

2. BATTERY BOX MOUNT HOLES - ***Note:*** *Refer to BATTERY BOX ASSEMBLY later in this section for parts and assembly.* Cleco the battery box to the shimmy damper mounting hole in station 1. See the FUSELAGE SECTION for location. Align the remaining battery box mounting holes with the station 1 tubes and transfer drill #11. Remove the battery box.

3. ENGINE MOUNT HOLES - Drill the four (4) perimeter 1/4" firewall holes to 3/8". Position the firewall against the front edge of the fuselage shells and temporarily bolt through the engine mount bushings welded in station 1. ***Note:*** *Ream the holes slightly, if needed, to let the bolts clear the firewall.* Transfer drill #11 through the battery box mounting holes. ***Hint:*** *Mark the holes with the drill bit and final drill with the firewall off the plane.* Use washers to shim out to the firewall. ***Hint:*** *A small dab of silicone will hold the washers in position during final assembly.*

4. HAT SECTIONS – The hat sections not only help to stiffen the firewall, but also allow easier mounting of several components. Rivet the sections together. Locate the component mounting holes. See **FIGURE 6-3.** ***Note****: Locate one mounting ear and transfer drill for the second.*

5. INSTALL SOUNDPROOFING - Remove the firewall and bond the soundproofing to the aft side of the firewall. Contact cement works well to bond the soundproofing in place. If you decide to use contact cement, it is best to roughen the surface of the firewall first. ***Hint:*** *80 grit paper works well for this.* After installing the soundproofing, use a hot knife to melt through all mount and access holes and to trim the outer perimeter. Install the grommets. Set the firewall aside until the fuselage is painted.

6. FINAL ASSEMBLY - During final assembly, rivet the firewall to the fuselage shells.

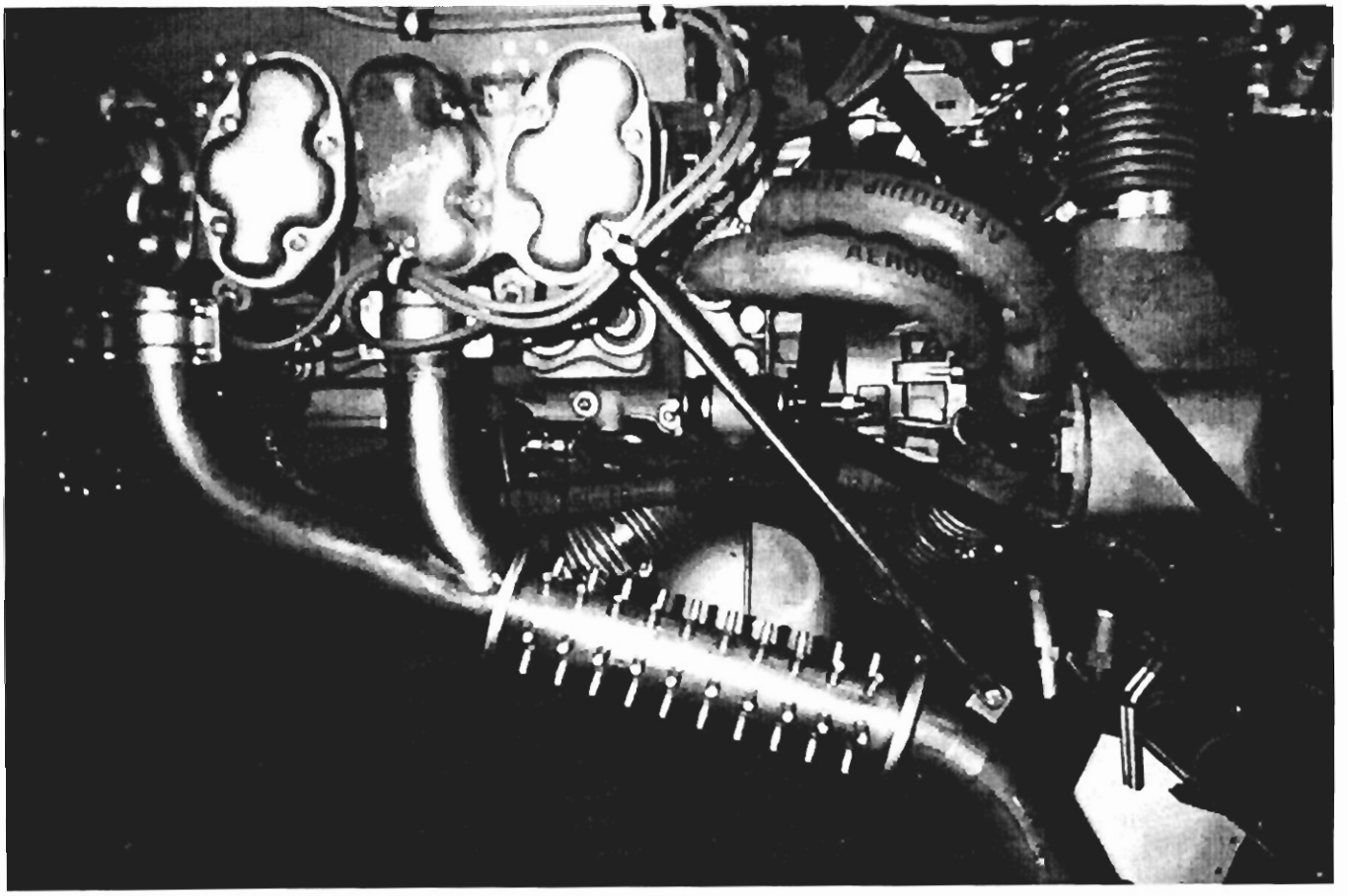
IO – 240 MUFFLER INSTALLATION

1. Bolt the flanges and stud to the cylinders, torque as per engine manufacturers specifications.

2. Assemble the entire muffler assembly, assemble both sides. Check for cowling clearance.

3. Bolt brace on the left hand side as per photo. **Note:** Re-Torque all valve cover screws to prevent oil leaks. Brace is placed under ignition wire clamp.

IO – 240 MUFFLER INSTALLATION



S-16 SHEKARI ASSEMBLY MANUAL

CANOPY SHELL ASSEMBLY

Note: *When fitting the canopy many small holes for clecos will be drilled into the shell. This method of clamping the shells has proven effective and accurate. Later the holes will be filled and sanded smooth.*

1. TRIM OUTER SHELL - Trim inner edge of shell to radius edge. See **FIGURE 7-1.** Trim outer edge of shell to within 1/4" of scribe line. Locate top centerline on fwd and aft of shell and fuselage. Position shell on fuselage with top centerline of shell and fuselage aligned. Start at the top center, trim the fwd/aft edges to fit within the fuselage joggle.

2. POSITION OUTER SHELL – To trim lower edge of shell, position shell centered and flush with fwd/aft edges of the fuselage. Remove, layout and drill #40 holes. See **FIGURE 7-1.** Fabricate angles from raw stock. See **FIGURE 7-2.** Cleco angles to shell using every other hole. Position shell on fuselage with top centerline of shell and fuselage aligned. Position the end of angle over fuselage, transfer drill #40 and cleco. See **FIGURE 7-3.** Trim lower edge of shell to fit into joggle of fuselage. ***Note:*** *Shell should be flush with fuselage.* Attach angles to lower edge of shell and fuselage.

3. TRIM INNER SHELL - Measure from radius of joggle inward 1" and mark. See **FIGURE 7-4.** Position outer shell over inner shell. Line up inner radius of outer shell with mark on inner shell. ***Note:*** *Make sure there is approximately 3/16" space between inner and outer shell where fwd part of bubble will be sandwiched.* When satisfied with fit, drill #40 and cleco holes in divots of outer shell. ***Hint****: Start from the centerline.* ***Note:*** *Make sure to keep 3/16" space in joggle area.* Mark and trim inner shell to match outer shell. Check fit on fuselage. If okay, remove, transfer drill remaining #40 holes from outer shell to inner shell. Position shells on fuselage. Cleco angles to shell and fuselage. Make sure shell is flush with fuselage.

CANOPY FRAME ASSEMBLY

1. DRILL CANOPY SHELLS - Starting from the top aft centerline on the forward (inner) edge of the canopy shells, drill #40 holes at 2 1/2" spacing. Maintain 1/2" e.d. from the edge. See **FIGURE 7-5.** Drill thru both shells.

2. INSTALL CANOPY FORMER - Mark centerline of former. ***Hint:*** *Lay former on a flat surface. With a square or similar tool, mark centerline of tube lengthwise on outside of bend.* Align centerline with #40 holes in canopy. ***Note:*** *The former should be centered evenly from side to side.* Clamp in place. ***Note****: Former should be 1/16" from inner edge. Some tweaking of canopy former tube may be needed.* Transfer drill #40 into former and cleco.

3. TRIM CANOPY FORMER - Mark shell and former 1/8" below joggle edge of inner shell. Position top edge of the upper side former on the mark. ***Note:*** *Side formers have a slight outward bend. Lay formers on a flat surface. With a square or similar tool, mark centerline of tube lengthwise on inside of bend.* Mark and trim the canopy former to clear the upper side former when inserted under the canopy former.

4. ASSEMBLE STIFFENER AND FORMERS – Align the fwd edge of stiffener & fwd edge of lower side former. Transfer drill #40 on centerline of lower former and cleco. See **FIGURE 7-6.** ***Note:*** *The short leg of bend is the formers aft end.* **Hint:** Drill in one direction to conform the stiffener to the formers. Use the lower stiffener holes. Make sure inner bend is toward stiffener. ***Note:*** *The bends on the upper side formers are equal.* Align the aft end of the upper side former even with the aft end of the lower side former. See **FIGURE 7-6.** Transfer drill #40 on centerline and cleco.

5. ALIGN STIFFENER ASSEMBLY - The five (5) aft holes in the stiffener line up on centerline of the canopy former. Clamp stiffener assembly to inside of canopy shell. The upper side former will be (approx.) parallel to joggle of shell and bends of former will match bends in steel cage. Once you are satisfied, formers are in correct position, clamp, transfer drill #40, and cleco stiffener onto canopy former.

6. FIT STIFFENER ASSEMBLY - Measure from the canopy edge to top of upper side former. Transfer this measurement to outside of shell. See **FIGURE 7-7.** ***Note:*** *Remember to add 1/2" (1/2 the diameter of the side former plus 1/16") when marking this line.* The shell bottom edge has a tendency to flare out. Drilling 1/16" below tube centerline rotates it inward. Drill #40 and cleco. See **FIGURE 7-7** for hole spacing. Drill the lower side formers in the same manner.

7. STRUT MOUNT HOLES – Place the canopy shells, with stiffener assembly, on the fuselage. From center of welded attach tabs on cage, measure aft 11 5/8" and mark upper side formers. See **Figure 7-8.** Drill #30 vertically, on bottom and top centerline. Un-cleco the stiffener assembly. Drill the top hole to 5/16". Drill the bottom hole to 1/2". Debur.

8. RIVET ASSEMBLY – Drill #30 and rivet the stiffeners to the upper and lower side formers.

ACRYLIC BUBBLE INSPECTION AND INSTALLATION

1. INSPECTION - The acrylic bubble is pre-formed, yet will require some preparation. The bubble has been carefully packed for shipping to help prevent damage. However, check it for any damage caused during shipping. ***Note:*** *A protective plastic film is on the bubble. Do* ***not*** *remove the film until pre-flight.*

2. CUTTING ACRYLIC – ***Note:*** *Read the Plexiglas Hints in the GENERAL SECTION.* First, a few words on how to properly cut acrylic. Keep the bubble warm. Let the bubble warm to 70° or more for at least an hour. ***Important:*** *Never cut cold acrylic. Cracks $$!@*!!$$.*

3. PREPARE SHELL - Remove outer canopy shell. Cleco inner shell to canopy former tube. Final size drill #30. Remove former and debur. Countersink #30 holes in shell for flush rivets. Cleco former tube in place and rivet. Cleco stiffener assembly onto former. In corner of joggle of inner shell, mark a line with black magic marker. This will assist in marking canopy bubble. Set inner shell on fuselage. To prepare for trimming bubble. Warm bubble to prepare for trimming. ***Hint:*** *A 4" grinder with cutoff blade or a die-grinder works best.*

4. TRIM BUBBLE - Set bubble on shell. Place fwd edge of bubble into fwd joggle. Locate centerline of bubble at fwd & aft. Drill #40 hole, 3/16" e.d., to hold canopy in position. See **FIGURE 7-9.** The aft end is extra long. Trim bubble on aft & fwd ends until it fits into joggle. **Hint:** Use 3/4" masking tape on the bubble as a guide. ***CAUTION:*** *Do* ***not*** *trim off too much.* Trim the side edges. Sand all cut edges to keep them smooth.

5. DRILL CLAMPING HOLES - After the bubble fits in the joggle, the outer shell can be clecoed into place. Trim protective plastic film, close to joggle. Hold plastic film in place with vinyl tape. Follow the edge of the shell. ***Note:*** *Do* ***not*** *cut into the bubble.* The bubble is sandwiched between inner and outer shells. To help make a tight fit on the bubble drill #40 holes starting at fwd centerline approximately 1" e.d. from bubble working outward every 1 1/2" for total distance of 2'. Do **not** drill thru bubble. The extra holes will assist in clamping shells together when bonding. In addition, drill #40 holes on aft side of canopy former 1 1/8" e.d. from bubble every 2 1/2". Drill stiffener assembly holes to #30 and debur. Countersink the outer shell #30 holes for flush rivets.

6. PREPARE SHELLS - Sand mating surfaces of shells to knock off glaze. Clean surfaces. Put protective covering in fuselage. Tape off with masking tape. Sand bonding surface of bubble with 400-grit sandpaper. ***Hint:*** *Have all equipment and supplies ready, i.e. epoxy, silicone, clecos, rivets, angles to help hold canopy to shape of fuselage, and friends to help.*

7. BOND SHELLS - Support inner shell on saw horses. Apply clear silicone to joggle area. Apply epoxy to remaining area. Set bubble in joggle. ***Note:*** *Be careful not to get silicone or epoxy on the viewing areas of the bubble.* Set outer shell in place. Cleco shells together. **SET CANOPY ASSEMBLY ON FUSELAGE.** Cleco alignment angles to fuselage and canopy. Rivet side formers with flush rivets. Let epoxy and silicone cure with the canopy in place. Remove extra clecos the next day and clean.
   Note: *A small fillet of clear silicone may be applied to smooth the shell to bubble transition.*

CANOPY HINGE ASSEMBLY

1. ASSEMBLE HINGES – Select all parts for the canopy hinge assembly. Fabricate four (4) bushings from aluminum raw stock provided. ***Hint:*** *Before cutting, drill each bushing to #11.* Bolt attach angles to canopy hinges. ***Note:*** *The attach angles are slotted for adjustment to the canopy.*

2. HINGE INSTALLATION - Pin hinge assembly to cage bushings. ***Note:*** *it will be necessary to cut out foam on bottom side of deck to clear canopy hinges.* Push hinge assembly against deck underside and trace around. Cut out deck as shown in **FIGURE 7-10.**

3. ATTACH HINGES TO CANOPY - Set canopy in place. Adjust the attach angles to the canopy. Transfer drill #40 through the attach angles and canopy. Cleco as you drill. Final size drill #11. Countersink the outside canopy holes for the countersunk washers and bolt the canopy to the hinge assemblies. ***Hint:*** *Use a 120° countersink bit.* ***Note:*** *Trimming of canopy shell will be required to clear deck when opening canopy.* **Important:** Safety wire Quick Pins to prevent an advertant canopy release during flight. Two bolts of proper length may also be used.

CANOPY STRUT ASSEMBLY

1. INSTALL BALL STUD – Insert the spacer bushing into the 1/2" hole drilled in the canopy former tubes. ***Note:*** *Contour the bushing to fit flush with the top inside and bottom outside of the former tube.* Thread the capscrew and ball stud, with washers, into the spacer bushing and tighten.

2. ASSEMBLE STRUT – Apply Loctite to the strut shaft threads. Screw the I-nut onto the threads. ***Hint:*** *Use needle-nose vise-grip pliers near the threads to hold the strut shaft. Pad the jaws with masking tape.* ***Note:*** *Threading of the plastic receptacle end to the strut may be necessary.*

3. INSTALL STRUT – Bolt the strut I-nut between the welded cage tabs. Remove the plastic lock from the plastic receptacle end with a flat-blade screwdriver. Push the receptacle end over the ball stud and re-insert the plastic lock.

CANOPY LATCH ASSEMBLY

1. INSTALL ATTACH BRACKET – Mark top center of fuselage on canopy formers. Mark tube centerline on the canopy former (the one under the fuselage shells). ***Hint:*** *Place an angle across the shells as reference and mark centerline.* Center the attach bracket on the marks and transfer drill #11 through the former. Temporarily bolt the attach bracket in place.

2. ALIGN LATCH HANDLES – Insert inner handle through mount bracket. Place outer handle over inner handle tube. Align the handles and transfer drill #11. ***Note:*** *The handle part of each face in opposite directions.* ***Hint:*** *Lay the handle assembly on a table edge to align.* Disassemble and debur.

3. INSTALL MOUNT BRACKET – Drill #11 the canopy former 11/16" on both sides of centerline. ***Note:*** *Drill parallel to the canopy shell top.* Drill the canopy shells #30 on centerline 3/8" aft of the canopy former. Final size drill 1/2" through the canopy shells, parallel to the attach bracket. ***Hint:*** *Step drill and adjust for bit drift as needed. The final hole should fit snuggly around the mount*

bracket bushing. Place the mount bracket on the former. ***Note:*** *The long end of the bracket bushing inserts through the canopy.* Transfer drill #11 and bolt. ***Hint:*** *Mark the bracket with a drill bit and final drill in a drill press.*

4. ADJUST CANOPY TIGHTNESS – Bolt the canopy handles together through the mount bracket. Glue the foam rubber seals on the fuselage fwd/aft joggles under the canopy. ***Hint:*** *Quality contact cement may be used.* Trim the lower end of the attach bracket as needed to ensure a tight fit when in the locked position. ***Important:*** *The attach bracket must include the center notch after trimming. This notch will insure proper locking.*

FWD CANOPY SEAL

1. A strip of high density foam is provided to serve as the fwd canopy seal. To install the foam seal the canopy must be installed.

2. Open canopy and lay foam strip centered on location at joggle in top deck. Close canopy to check if seal is located OK and centered. Trim to fit side to side. ***Note:*** *The seal will tend to roll or bunch up when the canopy edges close on it.* Trim to a tapered shape, see **FIGURE 7-11.**

3. Apply a quality weather strip adhesive (we use 3M® BLACK SUPER WEATHER STRIP adhesive). Follow instructions as per adhesive directions. Press the foam seal into place and trim out a clearance notch at the hinges.

AFT CANOPY SEAL

1. A strip of high density foam is provided to serve as the aft canopy seal. To install the foam seal the canopy must be installed.

2. Open canopy and lay foam strip against the joggle in aft top deck. Close canopy to check if seal is located OK and centered. Trim to fit side to side.

3. Apply a quality weather strip adhesive (we use 3M® BLACK SUPER WEATHER STRIP adhesive). Follow instructions as per adhesive directions.

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WOOD PROPELLERS: INSTALLATION, OPERATION, & MAINTENANCE
INTEGRAL FLANGE CRANKSHAFTS

Your Sensenich wood propeller was manufactured from aircraft quality selected lumber. The laminations are bonded with high-strength waterproof resorcinol glue, and were assembled under closely controlled factory conditions. Propeller balance was strictly maintained during manufacture and verified before shipment from the factory. Assembly of Type Certificated propeller/engine/aircraft must be accomplished by personnel holding the appropriate FAA license.

Installation of the propeller will require a front face plate of adequate stiffness (approximately the same size as the propeller hub), a flange adapter (in some cases), and a set of attaching bolts of the proper length.

It can be shown that an engine must deliver its driving torque to a wood propeller through static friction. That is, the force which resists movement of the propeller hub on the engine flange is due to compression of the wood surface against the flange. Therefore it is important to compress the wood to its maximum during propeller installation, but also important to avoid crushing the wood. Although the drive bushings incorporated in most flanges provide a back-up system, a load will be imposed on them only if there is movement of the propeller on the flange. The bushings can carry engine driving-torque loads for only a short period of time.

Forest Products Laboratory (1) data for Yellow Birch wood shows that the optimum compression pre-load of a wood propeller hub is approximately 0.006 inch per inch of hub thickness (i.e.: a propeller hub which is 1 inch thick before installation should be compressed 0.006 inch to a thickness of 0.994 inch by drawing up the propeller attaching bolts). Knowing the hub thickness and the number of threads in each inch of attaching bolt thread, it is possible to calculate the proper additional rotation of each attaching bolt after the front face plate, propeller, and flange (or adapter) are snug. For example, a propeller hub which is 4.50 inches thick should be compressed 0.006*4.50 equals 0.027 inches. If 1/2 inch diameter bolts are used (1/2-20UNF threads), they should be turned 0.027*20 = 0.51, or just over 1/2 revolution after the front face plate, propeller, and flange are snugged. See Table No. 1 for examples of common installations.

Generally recommended wrench torque to achieve proper hub compression against standard flanges are in Table No. 2. These torque recommendations do not consider variations of thread condition, and assume that the threads of the bolts and in the drive bushings are clean.

INSTALLATION PROCEDURE

After study of the preceding discussion of wood propeller installation requirements and of your propeller assembly, the following installation procedure should be followed:

1. Be certain that the magneto switch is "off" and that both magnetos are grounded.

2. Install the flange adapter, if required. Adapter retention bolt wrench torque recommendations can be found in Table No. 3. Lock and safety wire the bolts. NOTE: Some adapters require safety wire through the bolt heads, others incorporate safety-wired set-screws.

3. Locate the propeller on the engine flange, or adapter, in most convenient position for hand-cranking.

4. Remove a spark plug from each cylinder. Chock the aircraft's wheels to prevent movement.

5. Install the propeller attaching bolts "finger tight", so that the face plate, propeller, and flange are snug (but the wood has not been compressed). Check track of the blade tips by rotating the tips past some fixed object on the floor. The tips must track within 1/16" of each other when the installation is completed. Track should be corrected at this time by snugging up the bolts nearest the blade which is forward. This will result in a common starting point for all of the attaching bolts.

6. Tighten the attaching bolts in small increments, moving diagonally across the bolt circle. It is good practice to check track frequently while tightening the bolts. Take care to tighten bolts on opposite sides of the blade centerline evenly so that blade-to-blade conformity of angles is maintained.

7. Since a small part of the wood compression is plastic (permanent), it is good practice to loosen the bolts and allow the wood to relax for an hour. Retighten following the same procedure.

8. Install safety wire. It is good practice to wire the attaching bolts in pairs (not a continuous wire), twisting the wire between bolt heads.

(1) Forest Products Laboratory
US Dept. of Agriculture
Madison, Wisconsin

TABLE NO. 1
OPTIMUM WOOD PROPELLER INSTALLATION
HUB COMPRESSION METHOD

Hub Thickness (in.)	Desired Hub Compression	Bolts	Torque (Bolt Rev.)
3 3/8	0.020	3/8-24 1/2-20	0.49 0.41
4	0.024	3/8-24 1/2-20	0.58 0.48
4 3/4	0.029	3/8-24 1/2-20	0.68 0.57
5 3/8	0.032	3/8-24 1/2-20	0.77 0.65

CAUTION: Final bolt-torque should be within the range shown below, Table No. 2

TABLE NO. 2
WOOD PROPELLER INSTALLATION
TORQUE WRENCH METHOD

Size of Steel Aircraft Bolts Specification	dia. (inches)	Recommended Wrench Torque (in-lbs)
AN6	3/8	200 +/- 25
AN7	7/16	250 +/- 25
AN8	1/2	300 +/- 25

Ref. AN 01-1A-13 (1946)

CAUTION: Over-tightening propeller attaching bolts will cause the wood of the hub to crush, breaking its moisture seal and slightly reducing drive-torque capacity of the installation.

TABLE NO. 3
ADAPTER RETENTION BOLTS
RECOMMENDED WRENCH TORQUE

Size of Steel Aircraft Bolts Specification	dia. (inches)	Recommended Wrench Torque (in-lbs)
AN6	3/8	280 to 300
AN7	7/16	480 to 540
AN8	1/2	720 to 780

OPERATING TIPS:

The following practices will add to the service life of your wood propeller.

1. Do not use the propeller as a tow-bar to move your aircraft

2. Avoid running-up in areas containing loose stones and gravel.

3. Place the propeller in a horizontal position when parked.

4. Inspect frequently for bruises, scars, or other damage to wood and blade leading edge protection.

5. Protect your propeller from moisture by waxing with an automotive type paste wax. Keep the drain holes in metal tipping clean.

6. Assume that your propeller is un-airworthy after any kind of impact until it has been inspected by qualified personnel.

7. Inspect and check propeller attaching bolts for tightness at least every 50 hours or annually. More frequent inspection may be necessary when climatic changes are extreme.

8. All wood and metal tipping repairs must be made at the factory or by an approved propeller repair station. If your propeller was manufactured with synthetic leading edge protection, a kit is available from the factory for repair of damage to the leading edge.

9. Check propeller balance whenever there is evidence of roughness on operation.

If your propeller begins to show any of the following damage, it should be retired from service:

(a) Cracks in hub bore,
(b) A deep cut across the wood grain,
(c) A long, wide, or deep crack parallel to the grain,
(d) A separated lamination,
(e) Oversize or elongated hub bore or bolt holes,
(f) An appreciable warp (discovered by inspection or through rough operation),
(g) An appreciable portion of wood missing,
or (h) Obvious damage or wear beyond economical repair.

Refer to FAA publication AC43.13-1a for further information.

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2008 WOOD COURT
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SERVICE BULLETIN NO. WSB-1

JULY 13, 1999

TO: ALL AIRCRAFT OWNERS AND OPERATORS WHICH USE WOODEN PROPELLERS

SUBJECT: LOSS OF PROPELLER BOLT TORQUE

PROPELLER MODEL(S): SENSENICH FIXED-PITCH WOODEN PROPELLERS

AIRCRAFT MODEL(S) AFFECTED: ALL AIRCRAFT

DISCUSSION:

Several instances of loose propellers in the last year have prompted a review of wooden propeller installation and operating procedures, in particular the proper technique for applying and maintaining propeller bolt torque. All loose propellers have shown signs of burning on the hub mounting face, sometimes accompanied by bolt hole and/or counter bore elongation, indicating relative motion between the propeller hub faces and contacting flanges.

Maintaining proper bolt torque is the most important maintenance item for a wooden propeller. Loss of proper bolt torque will result in the decrease or loss of hub compression and thus the loss of drive friction between the propeller mounting hub face and the engine or spool drive flange. At this point the drive torque is transferred only by the propeller bolts and/or flange drive bushings, which will then begin to elongate the bolt holes and/or counterbores in the mounting face of the wooden propeller and can cause cracking in the hub. The propeller bolt torque must be carefully applied and checked periodically in order to maintain adequate hub compression. Do not torque above the recommended levels as this will crush the wooden hub, breaking its moisture seal and slightly reducing the drive-torque capacity of the installation.

PROPELLER BOLT TORQUE MAINTENANCE:

The main factor that leads to the loss of propeller bolt torque is the variation of wood hub thickness with long term environmental changes. Propeller bolt torque should be checked according to the following schedule:

1. **Stabilization Period** - When installing a propeller, check the propeller bolt torque after first flight, then recheck every 10 hours **OR** 10 days, whichever comes first, until the torque stabilizes. The torque should be completely removed and then re-torqued to the recommended values using the pertinent installation instructions.
2. **After Stabilization Period** - Once the propeller bolt torque has stabilized, a torque check should be performed every 50 hours or annually.
3. **Environment Changes** - Should the operating environment change significantly in temperature and/or humidity for a long period of time, the propeller should undergo another stabilization period.

NOTE: Refer to the Sensenich Wood Propeller website, www.sensenichprop.com, for pertinent installation instructions and bolt torque's.

ADDITIONAL INSTALLATION TIPS

Spinner or Spacer Installations: For propeller installations that use spinner bulkheads or spacers mounted in-between the propeller and mounting flange, ensure that both faces bulkheads/spacer are smooth and clean.
Testing has found that painted surfaces provide the greatest drive friction and larger safety margin if hub compression is not maintained.

Installation Hardware: Ensure that all threads on propeller attaching bolts, lock nuts or drive bushings (where applicable) are clean and dry. Any lubricants on the threads can result in over-tightening and possible crushing of the wood hub.

Wood propellers have been installed on hundreds of thousands of aircraft over the years with excellent service histories. Following the maintenance procedures above will help ensure safe operation of your wooden propeller.

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2008 WOOD COURT
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AIRCRAFT PROPELLER LIMITED WARRANTY

Sensenich Wood Propeller Company (Sensenich) warrants that propeller units it manufactures will be free from defects in material and workmanship for the periods and in respects that follow:

For 6 months from date of sale

or

50 hours of use, whichever comes first.

In the event a unit does not conform to this express warranty, Sensenich will repair or replace the defective material or workmanship at it's place of business at Plant City, FL. Sensenich will decide which remedy, repair, or replacement it will provide. Any replacement of a unit or a part of a unit during the warranty period will not extend the warranty beyond the original duration. The remedy of repair or replacement is exclusive and does not include the cost of shipping, removal, or installation, all of which are the customer's responsibility.

Procedure For Obtaining Warranty Service

Units or parts that are defective must be shipped prepaid to Sensenich at the address listed at the end of this document. The unit must be accompanied by a copy of the original (Distributor or Dealer) invoice, a Return Authorization Number which can be obtained by phoning Sensenich, and a brief description of the material or workmanship considered to be defective.

Conditions, Exclusions, and Disclaimers

This limited warranty applies to units that have been used and maintained properly. It does not cover units that show abuse, alterations, improper installation, or improper packaging for shipment; and it does not pertain to damage due to object strike or excessive blade wear due to operation.

This limited warranty applies to units that have been used and maintained properly. It does not cover units that show abuse, alterations, improper installation, or improper packaging for shipment; and it does not pertain to damage due to object strike or excessive blade wear due to operation.

This limited warranty is the only express warranty provided with respect to covered units, and all implied warranties, including the **IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE PERIOD OF THE EXPRESS WARRANTY GIVEN HEREIN.**

Repair or replacement of a nonconforming unit or part is the exclusive remedy for breach of this limited warranty, and shall constitute fulfillment of all liabilities of Sensenich Wood Propeller Company to a customer or user, whether based on contract, negligence or otherwise. **IN NO EVENT SHALL SENSENICH WOOD PROPELLER COMPANY BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.**

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Sensenich Wood Propeller Company
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Plant City, Fl. 33566

S-16 SHEKARI ASSEMBLY MANUAL

OPTIONAL COWL INSTALLATION

NOTE: *The fuselage shells, engine spinner and spinner backing plate must be installed prior to fitting the cowls.*

1. TRIM BOTTOM COWL - Trim the bottom cowling to the scribe lines on all edges except the firewall (aft) edge. ***Hint:*** *Aviation snips, drum sanders and sanding blocks work well to trim the cowlings.* Be careful not to trim too much off the ram air port flanges. See **FIGURE 8-5.**

2. REFERENCE JOGGLES - Reference the aft edge of the fuselage shell joggles. Reference the lower edge of the bottom cowl joggle. ***Hint:*** *Place a strip of masking tape next to the joggle edge. Reference off the joggle and mark a given distance (i.e. 1/2") on the tape.*

3. FIT LOWER COWL - Tape two (2) 3/8" thick wood strips (or similar material) to the aft side of the spinner backing plate as shown in **FIGURE 8-6.** Clamp or tape the bottom cowling in place with the forward side just touching the 3/8" spacers. The cowl should fit tight around station 1 and be centered around the spinner. Evenly space mark seven (7) bottom cowl mount holes per side. ***Important:*** *Determine the size of ram air exit needed before locating the bottom holes.* ***Note:*** *The top hole should be 5/16" above the cowl joggle and 3/8" forward of the fuselage forward joggle.* Using the joggle reference line drill #40 **only** the upper most mount hole not in the cowling joggle and cleco. Check for proper position and alignment. Do not drill the lower mount holes at this time.

4. FIT TOP COWL - Trim the forward side of the top cowl to match the bottom. Trim both sides of the top cowl to within 3/16" of the scribe lines. Do not trim the aft edge at this time. With the lower cowl on the fuselage, place the top cowl on the aircraft. It should fit tight over the forward deck when the lower side edges are fit into the joggle of the lower cowl. Trim the top cowl as required to gain the best fit. ***Hint:*** *Use the reference line on the bottom cowl.* When the cowl halves are fit together and centered around the spinner backing plate, the split line will be level with the aircraft. Evenly space mark seventeen (17) top cowling mount holes beginning in the center. ***Note:*** *The lowest side holes will be located off the bottom cowl.* Drill #40 the top center hole and cleco. ***Note:*** *Use the same joggle to hole clearance as on the bottom cowl.*

5. TRIM COWLS TO JOGGLES – Trim the aft end of the cowls to fit flush in the shell joggles. ***Hint:*** *Use the reference line on the shells.* Re-cleco the cowls. Be sure the bottom cowl is tight against the fuselage shell. Drill #40 the remaining mount holes. Be sure to use the same joggle to hole clearance as on the bottom cowl.

6. INSTALL OIL DOOR – Locate, mark and cut opening for oil door. Rivet to the cowl, as per hardware in parts drawing. See **FIGURE 8-6A**.

7. INSTALL QUARTER TURNS - Remove the top cowl and layout the hole pattern as shown in **FIGURE 8-7** and drill to #40. Re-cleco the top cowl. Transfer drill #11 through the #40 holes in the top cowl into the bottom cowl. Cleco as you go. Transfer drill #11 through the cowling holes into the shells. Cleco as you go. ***Important:*** *Be careful not to drill into any underlying components.* Remove both cowlings and cleco the quarter turn receptacles to the bottom cowl and inside the fuselage shells. Transfer drill #40 both mount holes for the receptacles. Remove the receptacles and drill the quarter turn hole out to 5/16". Countersink the #40 rivet holes to allow the rivet heads to sit flush. Install the quarter turn receptacles. Drill the #11 holes in the cowls to 1/4". After painting, install the quarter turn studs into the cowls. See **FIGURE 08-8.** To ease cowling removal, do **not** install the retaining rings on the forward two (2) sets of quarter turns.

AILERON STATIC BALANCE

Danger: *The ailerons and elevators must be balanced in a finished state, (painted or polished). The weight of paint will affect balance. If balanced control surfaces are re-painted, they must be re-balanced.*

1. MASS BALANCE FABRICATION – Drill the forward hole of the static balance arm to #11 and debur. Fabricate six (6) mass balance plates per aileron from 1/8" lead raw stock. Use the template in **FIGURE 9-2.** Temporarily bolt one plate to the static balance arm; align with the arm and transfer drill through the aft mount hole.

2. ASSEMBLE MASS BALANCE – Temporarily bolt the mass balance plates to the mass balance arm. See CONTROL SURFACE SECTION for hardware.

3. FABRICATE BALANCE JIGS - Fabricate two (2) balance jigs from 1" aluminum angle and razor blades. See **FIGURE 9-3.**

4. BALANCE AILERON – Clamp the jigs to a bench at the proper spacing to set the aileron attach bolts into the slots. See **FIGURE 9-4** for details. ***Note:*** *Make sure nothing interferes with the free movement of the aileron.* Drill holes into the outside plates to balance the aileron assembly. See **FIGURE 9-5.** Remove a little weight at a time and recheck for correct balance often. The aileron should be balanced to within ±1/4" of level, with respect to the trailing edge. Use the tooling holes in the rib as a reference. Once the aileron is balanced, move the undrilled inside plates to the outside to hide the balancing holes.

AILERON RIGGING

1. ATTACH AILERON – Install the wings and attach the ailerons to the wing. See CONTROL SURFACE ATTACH.

2. RIG AILERON – Use the neutral position templates to lock the wing bellcranks in position. Adjust the aft aileron push-pull tube to bring the aileron aft tip to center on the wing tip. Remember rod ends must have a minimum of ten (10) turns in the push-pull tube. Bolt the rod end to the aileron horn. Tighten the rod end nuts against the push-pull tube. Be careful not to change the push-pull tube length.

3. RIG CONTROL STICKS – With the neutral position templates still locking the wing bellcranks in position, attach the inner push-pull tube rod end to the control sticks. Adjust the inner push-pull tubes so the control sticks are centered left to right. Lock the push-pull tube to length. Remember the 10-turn rule. Remove the neutral position templates.

4. AILERON DEFLECTION – Adjust the stop bolts at the base of the control sticks to allow 25° up travel and 15° down travel. See **Figure 9-1.** Check each aileron for travel. Lock the stop bolts in place.

ELEVATOR STATIC BALANCE

Danger: *The ailerons and elevators must be final balanced in a finished state, (painted or polished). The weight of paint will affect balance. If balanced control surfaces are re-painted, they must be re-balanced.*

1. MASS BALANCE FABRICATION – Fabricate six (6) mass balance plates (3 per elevator) from 1/8" lead raw stock. Use the template in **FIGURE 4-23.** ***Note:*** *Be sure to drill the 3/4" hole in all plates.*

2. ASSEMBLE MASS BALANCE – Bolt the mass balance plates to the tip rib. ***Note: Do not*** *over tighten the bolts. The head of the bolt should be flush with the surface of the tip rib.* See CONTROL SURFACES SECTION for hardware.

3. PREPARE ELEVATORS – Tape elevator tips to the tip rib. Bolt the elevator torque tube to one elevator. ***Note:*** *One elevator gets balanced with the torque tube.* Use proper hardware.

4. PRE-BALANCE ELEVATOR – Clamp the jigs made in the AILERON STATIC BALANCE SECTION to a bench at the proper spacing to set the elevator attach bolts into the slots. See **FIGURE 9-3** for details. **Note:** Make sure nothing interferes with the free movement of the elevator. Remove material from the mass balance weights to balance the elevator assembly. Remove a little weight at a time and recheck for correct balance often. ***Note:*** *The elevator should be pre-balanced to an overbalance state. That is the tip should hang down about one (1) inch.*

5. FINAL BALANCE ELEVATOR – Rivet the elevator tip to the tip rib. Check the balance of the fully assembled and painted elevators. Remove material from the exposed tips of the mass balance weights until the elevator is perfectly balanced.

ELEVATOR RIGGING

1. ATTACH ELEVATORS – Attach elevators to the horizontal stabilizer. See CONTROL SURFACE ATTACH. Bolt the elevator torque tube to the other elevator. Temporarily bolt the elevator torque tube horn to the push-pull tube.

2. RIG ELEVATOR – With the push-pull tubes connected to the elevator and control sticks, adjust the control sticks to a neutral fore & aft setting. Adjust the push-pull tube rod ends to bring the elevator tip to center on the horizontal stabilizer tip. Remember rod ends must have a minimum of ten (10) threads in the push-pull tube. Bolt the rod end to the elevator horn. Tighten the rod end nuts against all push-pull tubes. Be careful not to change the push-pull tube lengths.

3. ELEVATOR DEFLECTION – Adjust the stop bolts at the center of the control stick torque tube to allow 30° up travel and 20° down travel. See **Figure 9-1.** Lock the stop bolts in place. ***Note:*** *The control sticks must have unobstructed travel in all directions from stop to stop (i.e. instrument panel, panel lights, engine controls, etc).* Adjust the push-pull rod ends as needed. Re-check deflection and re-lock rod ends.

CONTROL SURFACE ATTACH

1. AILERONS, FLAPS, RUDDER & ELEVATORS – All control surfaces attach to their respective spars with the same combination of bolts, washers, nuts and cotter pins. ***Note:*** *Common aircraft practice places the bolt heads up and/or outboard, depending on the orientation.* Tighten and secure the bolts, yet allow them to turn under rotational finger pressure. ***Hint:*** *Use needle nose pliers to help insert the bolts.*

FLAP RIGGING

1. ATTACH FLAP – Attach the flaps to the wings. See CONTROL SURFACE ATTACH.

2. RIG FLAPS – Bolt the teleflex rod ends to the flap handle horn and the flap horns. Bring the ailerons to a neutral position. Adjust the flap teleflex rod ends to center the flap on the aileron. Remember rod ends must have a minimum of ten (10) threads inserted. Bolt the rod end to the flap horn. Tighten the jam nuts against the rod ends. Check the flaps for free and symmetrical movement.

Finishing supplies required:

Assorted wet/dry sandpaper
Tack rag
Medium Scotch-Brite
Epoxy or JB Weld

PAINTING FIBERGLASS

1. SURFACE PREP – Fiberglass surfaces such as fuselage, canopy, wheel pants, etc. should be painted as below. ***Note:*** *Always follow the manufacturers recommendations on application, ventilation and respiratory equipment.*

   The RANS process is as follows:

   A. Break the glaze using 80 to 120 grit sandpaper. ***Important:*** *Do not sand into the fiberglass cloth.* ***Note:*** *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.*
   B. Wipe down with a "tack rag".
   C. Use epoxy or JB Weld to fill small holes, divots and over countersunk rivets. Sand smooth.
   D. Prime, according to the manufacturer recommendations, to fill in any pinholes. Reapply primer, as needed, to achieve proper fill. (RANS uses DuPont Uro Prime 1120S or 1140S)
   E. Sand with 220 grit.
   F. Final sand 320 to 400 grit. ***Note:*** *Final sand grit will depend on finish used.*
   G. Apply finish.

PAINTING ALUMINUM SURFACES

1. SURFACE PREP - Aluminum surfaces such as wings, control surfaces, gear leg fairings, etc. should be painted as below. ***Note:*** *Always follow the manufacturers recommendations on application, ventilation and respiratory equipment.*

   The RANS process is as follows:

   A. "Scuff" the surfaces using medium Scotch-Brite to help the primer adhere.
   Note: *Scuffing the area around rivet holes, before assembly, will aid in paint adhesion.*
   B. Clean surfaces using lacquer thinner.
   C. Apply two coats of self-etching primer according to the manufacturers recommendations. (RANS uses Dupont Variprime)
   D. Apply the paint chosen. Use paint from the same manufacturer as the primer you applied to ensure chemical compatibility. If you are satisfied with the finish, painting can be the last step.
   E. Clear coat if even more gloss and protection is desired. (RANS uses Dupont 7800S Clear coat for aluminum surfaces)

CREATING A PILOT OPERATING HANDBOOK

Most pilots are accustomed to flying light planes with comprehensive pilot operating handbooks. This is a result of the standardization required by FAA certification, the fruit of which is fleets of identical aircraft for which specific checklists, procedures and performance figures may be published.

This section includes much information on the operation, limitations and performance of RANS aircraft; however, the nature of kit-built aircraft makes it impossible to publish *specific* checklists and procedures applicable to *all* examples of a particular model. This is because the builder, as manufacturer of the aircraft, has the freedom to assemble, equip and modify his machine as he wishes. The result is fleets of aircraft that share the same name and designation, but vary somewhat in operation and performance.

The builder should consider carefully all aspects of the engine, airframe and equipment when developing checklists and procedures for his plane. For example, he might begin the preflight inspection by opening the cabin and checking that the magnetos are off; this would ensure the engine cannot start if the propeller were moved. With the cabin open, he also might drain fuel from the sump, allowing any water trapped in the system to escape. He then might begin a walk-around, moving about the ship in a logical, straightforward manner, checking the presence, security and condition of hardware and components.

With the walk-around completed, he might seat himself in the aircraft and consider the checks necessary for a safe and mechanically sound engine start. This will depend largely on the specifics of the engine, fuel, ignition and electrical systems he has installed. Again, a straightforward, logically-flowing checklist should be developed that addresses the particulars of his machine.

The same care should go into development of a pre-takeoff checklist. Of particular importance is a proper engine run-up to check the health of the power plant. An essential checklist item often given short shrift is that of free and correct movement of control surfaces; this is particularly important for aircraft that fold or disassemble.

Considerable forethought should be given to potential emergencies. What steps should be taken to deal with balked landings, engine failures or fires? How might these steps vary according to the phase and conditions of flight? Consideration of contingencies now is likely to mean faster, more appropriate reaction to urgent or emergency situations, should they arise.

Since each kit-built aircraft is unique, each builder should expect his aircraft's performance to be unique. The prudent builder will determine carefully the weight and balance parameters of his plane before its first flight. He'll familiarize himself with its flying characteristics during the flight test phase, cautiously exploring its capabilities and limitations while heeding the designer's words of advice. The U. S. Government, the Experimental Aircraft Association and other publishers offer a wealth of information on flight preparation and testing. As a first step, the builder might refer to the FAA's AC-90-89A, "Amateur-Built Aircraft Flight Testing Handbook."

By applying suitable checklists and procedures to his plane and operating it within reasonable limits, the builder helps ensure his safety as well as the reliability and longevity of his airframe, power plant and components.