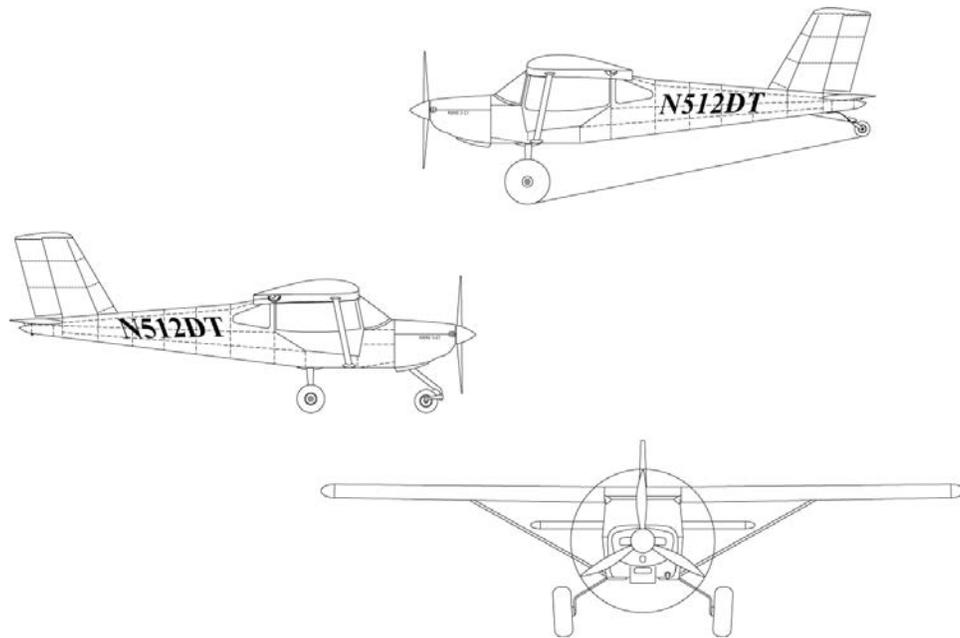


RANS

S-21 OUTBOUND

TEXT MANUAL



Serial Number:

Registration Number:

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**RANS DESIGNS
4600 HWY 183 Alt
HAYS, KANSAS, USA 67601
785-625-6346
www.rans.com**

09/11/2018

ASSEMBLING THE MANUAL

1. Obtain three 2" wide 3-ring binders.
2. Place the TEXT, PARTS and FIGURES manuals in separate binders. Every page has a section number then a page number within that section. (Example: parts page 006-02) Parts pages have an exploded view and a parts listing.

NOTE: The PARTS manual pages will need to rotate to allow easier viewing. Refer to pages at beginning of PARTS manual.
3. Separate the sections with the tab inserts listed below.
4. Cut out on solid lines, fold on dotted line, and slip in the labels to corresponding sections. Tabs are designed for 1-1/4 " Insertable Tabs.

00 - GENERAL	00 - GENERAL	01 - GETTING STARTED	02 - RUDDER	03 - VERTICAL STABILIZER	04 - HORIZONTAL STABILIZER	05 - ELEVATOR	06 - 141 WING	07 - FUSELAGE - TAILCONE	08 - LANDING GEAR	09 - FUSELAGE	10 - FUSELAGE	11 - ROTAX 912ULS	12 - WEIGHT & BALANCE	13 - RIGGING	14 - OPERATIONS	ENGINE/TAIL FUSELAGE - 70
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00 - GENERAL	00 - GENERAL	01 - GETTING STARTED	02 - RUDDER	03 - VERTICAL STABILIZER	04 - HORIZONTAL STABILIZER	05 - ELEVATOR	06 - 141 WING	07 - FUSELAGE - TAILCONE	08 - LANDING GEAR	09 - FUSELAGE	10 - FUSELAGE	11 - ROTAX 912ULS	12 - WEIGHT & BALANCE	13 - RIGGING	14 - OPERATIONS	ENGINE/TAIL FUSELAGE - 70
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TECHNICAL SUPPORT

RANS has taken care to provide clear, comprehensive, and straightforward instructions for assembly, maintenance, and operation by reference to manuals alone. In the event a question arises for which no answer seems apparent, feel free to contact RANS headquarters.

When calling for technical support or parts department, please have the following ready:

- Aircraft Model
- Serial Number
- Engine Model
- Parts Number Needed (Parts Department Only)
- Your Aircraft Assembly Manuals

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

Phone:785-625-6346

Fax:785-625-2795

E-mail (General) .. .info@rans.com

E-mail (Aircraft Tech).....actech@rans.com

E-mail (Aircraft Parts).....info@rans.com

Website:www.rans.com

NOTE: Questions concerning propeller care/adjustment and engine break-in, operation, and maintenance should be directed to respective manufacturers or supplier’s technical support personnel. Refer to the manufacturer’s or supplier’s literature for instructions and contact information.

ENGINEERING DEPT. DRAWING NUMBERING SYSTEM

RANS DESIGNATES DRAWINGS BY EIGHT VARIABLES. THIS SYSTEM CONSISTS OF LETTERS AND NUMBERS. THE FOLLOWING IS A BREAK DOWN OF THIS SYSTEM.

X¹X²XX³XXXX⁴

¹ CLASSIFICATION	² DWG TYPE	³ AIRCRAFT SECTION	⁴ ID NUMBER
K = KIT	A = ASSEMBLY I = INSTALLATION P = PART S = SUPPLIERS V = VIEW	AC = AIRCRAFT AL = AILERON AV = AVIONICS BS = BRAKE SYSTEM CS = CONTROL SYSTEM CV = COVERING CW = COWLING DR = DOOR EL = ELEVATOR EM = EMPENNAGE ES = ELECTRICAL SYSTEM EX = EXHAUST FL = FLAP FS = FUEL SYSTEM FU = FUSELAGE FW = FIREWALL HS = HORIZ. STAB HW = HARDWARE (NOT MS, AN...) IN = INTERIOR IP = INSTRUMENT PANEL JS = JURY STRUT LS = LIFT STRUT MG = MAIN GEAR NG = NOSE GEAR PL = PLACARDS PR = PROPELLER/SPINNER PT = PITOT/STATIC SYSTEM PW = POWER PLANT RD = RUDDER ST = SEAT/HARNESS SY = SYSTEM TG = TAIL GEAR TR = TRIM TAB VS = VERT. STAB. WI = WING	0 - 9999

EF-38E

EXAMPLE : KPWI0001

THIS INDICATES THAT IT IS A (K) = KIT PLANE; (P) = PART DRAWING; (WI) = WING SECTION; (0001) = THE IDENTIFICATION NUMBER OF THE PART

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GENERAL INFORMATION

INTRODUCTION

The S-21 Outbound is a 51% FAA approved kit. Some inspectors may still require a build log, therefore it is recommended to keep a build log. A build log can be as simple as photos of the kits' assembly throughout the process, or using one of the many on-line offers. As the builder of the S-21 OUTBOUND 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 concerning 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.

Check out our on-line photo library of S-21 build photos and helpful captions.

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 cannot 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. Go through the list item by item. If anything is not there that should be, please contact our parts department immediately.

HINT: Use sections of plywood from the packing crate to fabricate a part inventory board. As each part is inventoried and checked off on the pack list, staple the bag to the board. This allows for quick identification and part selection during assembly. Plywood can be attached to shop walls. You may also fabricate "A" Frame stands to support the plywood. Refer to **FIGURES 00-01** and **00-01A**.

IMPORTANT: When hanging the parts on the board, use the aircraft section designator of the part number to organize the parts. For an explanation of the part number and the meaning of the letters in the prefix refer to **ENGINEERING DEPT. DRAWING NUMBERING SYSTEM**.

IMPORTANT: PLEASE READ FIRST

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 the Assembly Manual, follow along in the Parts and Figure Drawings Manual. Study each and every parts and figure drawing. The Assembly, Parts, and Figure Drawing 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; be certain that what comes in the door will be able to go out!

KEEP IT CLEAN: Wash your hands, tools, and work tables. You will notice most of the parts are labeled with part numbers. Most labels will peel off easily, but if some are stubborn then dampen a cloth with acetone or lacquer thinner, apply, let soak a little and peel off. Repeat if necessary. Goo Gone[®] Pro-Power also works well.

CAUTION: Do **NOT** allow Acetone, lacquer thinner, Loctite or fuel to contact Lexan glazing. These and some other solvents will destroy the Lexan.

STEEL PREPARATION: All steel parts have been powder-coated to provide a lasting durable surface. Even though care is taken to assure a safe arrival of your aircraft, thoroughly inspect the fuselage as well as all other parts for 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.

ALUMINUM: All aluminum parts supplied in this kit are either 6061 or 7075. All aluminum parts must be deburred. Much of it is done at the factory but some parts may still need some attention. Any scratches must also be removed. If you can detect the scratch with your finger nail, it must be removed. Remove scratches by wet sanding with wet/dry sand paper. Start with 200 grit or so and finish with at least 600. Each time you change grit, rotate the direction by 90° to remove the scratches from the previous grit. Some part edges may have nicks in them. Remove any nicks in a similar fashion using a file, wet/dry sand paper, or drum sander. Do not remove any more material than necessary. Remove only enough material to smooth out the nick. The aluminum sheet parts come with printing of the type of alloy, we try to locate the printing so it remains on the inside, however if parts show printing on the outside use as solvent such as MEK to remove. Please read all handling instructions for solvents used.

Primer is always a debate when it comes to aluminum aircraft. Part of the decision to use 6061 was to get away from priming, as 6061 exhibits good corrosive resistance. We recommend priming overlaying surfaces. If you live near the ocean, your aircraft will be on floats, or the aircraft will be stored outside it may be a good idea to prime all aluminum surfaces. Formed aluminum parts may require some attention. Ribs will need to be fluted and some ribs may need the flange angles tweaked slightly. Some of the angles on the bulkheads may need tweaked as well. This is an important step and can significantly improve the appearance of the aircraft as any imperfection will be transferred to the skin and visible to any onlooker.

DEBURRING: Many parts will need to be deburred. This is an **IMPORTANT** step and must be performed. Assembly of parts with burrs can cause stress risers and eventual part failure. 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.

CLECOS: These are temporary fasteners that will be used to hold things together while fitting and drilling. A pair of cleco pliers is also required to install and remove the clecos. The clecos are color coded as to hole size.

Silver	#40
Copper	#30
Gold	#11

To use, simply set cleco in the special pliers, squeeze closed, insert into the hole and release. (Reverse for removal). You will find the clecos to be extremely useful throughout assembly.

ROD ENDS: When installing rod ends and similar hardware, be certain at least ten threads are engaged, unless directed otherwise within the text.

CAUTION

Rod Ends must be engaged a minimum of 10 complete turns.

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 mislabeled. So before riveting, be sure to double check that you have the correct aluminum or stainless steel rivet for the particular section you are working on.

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.

ENGINE WARRANTY: Refer to the documentation which is included with the engine.

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.

ORIENTATION: Throughout the Manual, you will be asked to refer to specific stations of the fuselage. Station 1 (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 00-02**. When a left hand side part is called out, this means the planes left or your left if you were sitting in the cockpit looking forward. This rule excludes ribs.

SERIAL NUMBER: Refer to **FIGURE 00-03** for the serial number plate location. Please record your serial number and have it handy whenever you call 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 magazine's 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 ARE HERE TO HELP!
GIVE US A CALL IF YOU RUN INTO A PROBLEM.**

AIRCRAFT TOOL LIST

The following is a list of tools that will be helpful when assembling your RANS aircraft.

HAND TOOLS

Pliers	Safety Wire Pliers
Needle Nose Pliers	Linesman Pliers
Side Cutters	Electrical Wire Stripers Aviation
Snips	Pop Rivet Tool
Hammer	Click Punch
Rubber Mallet*	Ball Peen Hammer
Center Punch	Drift Pin & Punch Set
Screwdriver Set	Safety Glasses
Several Small Clamps (Stanley quick clamps work well)	Wrench Set SAE & Metric
Socket Set – SAE & Metric	Ruler & Tape Measure
2 or 4 ft. Level	Utility Knife
Hole Saw*	Digital Protractor*
Hack Saw	Fluting Pliers
Edge Forming Tool	Scotch-Brite Pads
Files	1/2" & 3/4" Uni-Bit®
Step Drill	Dimple Dies (1/8" 120°)
Pop Grip Dimpler for 1/8" holes	Hand Squeezer
Cleco Pliers	Silver #40 Clecos
Copper #30 Clecos	Gold #11 Clecos

POWER TOOLS

Electric Hand Drill	Small Electric Grinder Dremel*
Drill Press*	Bench Disk Sander*
Soldering Gun/Hot Knife	Heat Gun*
CD/MP3 Player*	Right Angle Drill and Bits
Band Saw*	

It is highly recommended to use a pneumatic riveter.
RANS uses these pneumatic riveters.

Marson V2 lightweight pneumatic riveter P/N 79014
MSC Industrial Supply Co. P/N 04053278

*Not Required.

LUBRICANTS, ADHESIVES, TAPES & ETC

Small Can Lithium Grease	Clear Silicone
WD40	Super Glue
Lubricating oil	Loctite Blue Thread locker
DOW 730 Sealant, PRC or similar	3M Super 77 Spray Adhesive
3M 2216 Adhesive (4 oz.)	PRO-SEAL Sealant
Thread Sealant	1/4" wide Double Stick Tape
Safety Wire	Hi-Temp Silicone Seal (RED) Clear
Plastic Tape (anti-chafe)	1" Acrylic Foam Tape (2-sided)
Adhesive backed Velcro	Masking Tape
White Lightning Bike Chain Lube or similar	Lexan (Polycarbonate)
Adhesive ABS or PVC Glue	Slow-setting Epoxy
1/2" X 3/32" Black Foam Tape	1/2" 3M VHB Tape

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 numbered and fractional bits will be required to assemble your S-21 OUTBOUND.

NUMBERED BITS

#40
 #30 both standard length and (1) 12" long
 #28
 #27
 #21 & 10-32 TAP
 #20
 #11

FRACTIONAL BITS

11/64"
 .249"
 1/4"
 5/16"
 3/8"
 7/16"
 1/2"
 7/8"
 7/16" 12" long
 3/8" 12" long

OTHER SUPPLIES

1-1/4" diameter x 7 ft Tube (Aluminum or PVC)
 1-7/8" to 2" diameter x 7 ft Tube (Aluminum or PVC)
 1" diameter x 1" wood dowel
 1 100 degree countersink for 3/16" diameter
 1 100 degree countersink for 1/8" diameter
 1 100 degree countersink for 3/8" diameter
 1 120 degree countersink for 1/8" diameter

RECOMMENDED AVIONICS LIST**Digital Display**

GARMIN G3X WITH G5 BACKUP

Comm Radios

GARMIN GTR 200

Transponder

GARMIN GTX 335

Encoder

GARMIN GAE

GPS (for non-digital display systems)

GARMIN AERA 660

ELT

ACK Technologies E-04

Push to Talk Switch

RADIO SHACK #275-644 Pushbutton Switch

Local Avionic shops can wire your avionic harnesses for you.

AIRCRAFT REGISTRATION

INTRODUCTION:

All aircraft of U.S. registry are required to have the following documentation onboard. For aircraft registered in other countries contact your National Aviation Authority.

Airworthiness Certificate
Registration
Operating Limitations
Weight and Balance Information

NOTE: The bold letters above spell out AROW. This acronym is often used to help remember the required documents.

OBTAINING AN "N" NUMBER (Registration)

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.

Information and on-line registration can be done by visiting the website:

www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/

If any number is acceptable to you, write to:

FAA Aircraft Registry
Dept. of Transportation
P.O. Box 25504
Oklahoma City, OK 73125

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.

N-Numbers consist of a series of alphanumeric characters.

U.S. registration numbers may not exceed five characters **in addition** to the standard U.S. registration prefix letter **N**.

These characters may be:

one to five numbers (N12345)

one to four numbers followed by one letter (N1234Z)

one to three numbers followed by two letters (N123AZ)

To avoid confusion with the numbers one and zero, the letters "I" and "O" are not to be used.

An N-Number may not begin with zero. You must precede the first zero in an N-Number with any number 1 through 9. For example, N01Z is not valid.

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

Affidavit of Ownership Form (AC Form 8050-88). This form should accompany your letter requesting the assignment of an "N" number. Obtain the most current form at www.faa.gov.

This form must be notarized as 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 in addition to the Bill of Sale (AC Form 8050-2) that a buyer gets when he buys any existing airplane. Have handy a copy of your Sales Invoice from us.

REGISTERING YOUR AIRCRAFT

Refer to the FAA website, www.faa.gov for info on registering your aircraft.

After you have written the Aircraft Registry requesting an "N" number, or applied on-line, you will receive a form letter giving your number assignment. After completion of the aircraft, complete the on-line Application for Aircraft Registration (AC FORM 8050-1) and return it to the Aircraft Registry along with the \$5.00 registration fee.

Retain a copy which 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 for 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 for 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 home built project and to generally familiarize yourself with the procedures established by the FAA for home built 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. A person that has been designated by the FAA for the purpose of inspecting aircraft is a Designated Airworthiness Representative or DAR. It is a good idea to contact the DAR that you plan to use and ask him what he would like to see at inspection.

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. It is a good idea to also make notes in the Assembly 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. (The latest revision of Advisory Circular 20-27 (AC 20-27) is available from the FAA or EAA describes the procedure used so that your logbook will be a verification of having completed 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 a logbook for the aircraft. These can be separate books for the airframe, engine and propeller or just one.

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

If you have had prior contact with your DAR, you will probably be familiar with the procedures used by that DAR. Different DAR's 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, call and ask the DAR. Below is the required paperwork. Obtain the most current forms at www.faa.gov.

1. A letter requesting a final inspection.
2. Form 8130-12 Eligibility Statement
3. Form 8130-6 Application for Airworthiness Certificate.
4. A 3-view drawing of the aircraft or photos of top, front and side 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.

FINAL INSPECTION

Use the 2 lists below for inspection of the aircraft. Refer to www.faa.gov. These should be very helpful in getting your airplane signed off by the FAA Inspector and ensuring that your airplane is safe for operation.

Title 14 Aeronautics and Space

Appendix D to Part 43—Scope and Detail of Items (as Applicable to the Particular Aircraft) To Be Included in Annual and 100-Hour Inspections

(a) Each person performing an annual or 100-hour inspection shall, before that inspection, remove or open all necessary inspection plates, access doors, fairing, and cowling. He shall thoroughly clean the aircraft and aircraft engine.

(b) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the fuselage and hull group:

- (1) Fabric and skin - for deterioration, distortion, other evidence of failure, and defective or insecure attachment of fittings.
- (2) Systems and components - for improper installation, apparent defects, and unsatisfactory operation.
- (3) Envelope, gas bags, ballast tanks, and related parts - for poor condition.

(c) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the cabin and cockpit group:

- (1) Generally - for un-cleanliness and loose equipment that might foul the controls.
- (2) Seats and safety belts - for poor condition and apparent defects.
- (3) Windows and windshields - for deterioration and breakage.

(4) Instruments—for poor condition, mounting, marking, and (where practicable) improper operation.

(5) Flight and engine controls—for improper installation and improper operation. (6) Batteries—for improper installation and improper charge.

(7) All systems—for improper installation, poor general condition, apparent and obvious defects, and insecurity of attachment.

(d) Each person performing an annual or 100-hour inspection shall inspect (where applicable) components of the engine and nacelle group as follows:

- (1) Engine section—for visual evidence of excessive oil, fuel, or hydraulic leaks, and sources of such leaks.
- (2) Studs and nuts—for improper torque and obvious defects.

- (3) Internal engine—for cylinder compression and for metal particles or foreign matter on screens and sump drain plugs. If there is weak cylinder compression, for improper internal condition and improper internal tolerances.
- (4) Engine mount - for cracks, looseness of mounting, and looseness of engine to mount.
- (5) Flexible vibration dampeners—for poor condition and deterioration.
- (6) Engine controls—for defects, improper travel, and improper safety wire.
- (7) Lines, hoses, and clamps—for leaks, improper condition, and looseness.
- (8) Exhaust stacks—for cracks, defects, and improper attachment.
- (9) Accessories—for apparent defects in security of mounting.
- (10) All systems—for improper installation, poor general condition, defects, and insecure attachment.
- (11) Cowling—for cracks, and defects.

(e) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the landing gear group:

- (1) All units—for poor condition and insecurity of attachment.
- (2) Shock absorbing devices—for improper oleo fluid level.
- (3) Linkages, trusses, and members—for undue or excessive wear fatigue, and distortion.
- (4) Retracting and locking mechanism—for improper operation.
- (5) Hydraulic lines—for leakage.
- (6) Electrical system—for chafing and improper operation of switches.
- (7) Wheels—for cracks, defects, and condition of bearings.
- (8) Tires—for wear and cuts.
- (9) Brakes—for improper adjustment.
- (10) Floats and skis—for insecure attachment and obvious or apparent defects.

(f) Each person performing an annual or 100-hour inspection shall inspect (where applicable) all components of the wing and center section assembly for poor general condition, fabric or skin deterioration, distortion, evidence of failure, and insecurity of attachment.

(g) Each person performing an annual or 100-hour inspection shall inspect (where applicable) all components and systems that make up the complete empennage assembly for poor general condition, fabric or skin deterioration, distortion, evidence of failure, insecure attachment, improper component installation, and improper component operation.

(h) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the propeller group:

- (1) Propeller assembly—for cracks, nicks, binds, and oil leakage.
- (2) Bolts—for improper torque and lack of safety wire.
- (3) Anti-icing devices—for improper operations and obvious defects.
- (4) Control mechanisms—for improper operation, insecure mounting, and restricted travel.

(i) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the radio group:

- (1) Radio and electronic equipment—for improper installation and insecure mounting.
- (2) Wiring and conduits—for improper routing, insecure mounting, and obvious defects.
- (3) Bonding and shielding—for improper installation and poor condition.
- (4) Antenna including trailing antenna—for poor condition, insecure mounting, and improper operation.

(j) Each person performing an annual or 100-hour inspection shall inspect (where applicable) each installed miscellaneous item that is not otherwise covered by this listing for improper installation and improper operation.

SAMPLE CHECKLIST FOR A CONDITION INSPECTION

AC90-89 APPENDIX 1

AIRCRAFT IDENTIFICATION:

TYPE/SN _____

ENGINE MODEL/SN _____

“N” NUMBER _____

PROPELLER MODEL/SN _____

A/F TOTAL TIME _____

ENGINE TOTAL TIME _____

OWNER _____

PROPELLER TOTAL TIME _____

GENERAL:	BUILDER		INSPECTOR	
	Sat	Unsat	Sat	Unsat
REGISTRATION/AIRWORTHINESS/OPERATING LIMITATIONS				
AIRCRAFT IDENTIFICATION PLATES INSTALLED				
EXPERIMENTAL PLACARD INSTALLED				
WEIGHT AND BALANCE/EQUIPMENT LIST				
WINGS:				
REMOVE INSPECTION PLATES/FAIRINGS				
GENERAL INSPECTION OF THE EXTERIOR/INTERIOR WING				
FLIGHT CONTROLS BALANCE WEIGHT FOR SECURITY				
FLIGHT CONTROLS PROPER ATTACHMENT (NO SLOP)				
FLIGHT CONTROL HINGES/ROD END BEARINGS SERVICEABILITY				
FLIGHT CONTROLS PROPERLY RIGGED/PROPER TENSION				
INSPECT ALL CONTROL STOPS FOR SECURITY				
TRIM CONTROL PROPERLY RIGGED				
TRIM CONTROL SURFACES/HINGES/ROD END BEARINGS SERVICE				
FRAYED CABLES OR CRACKED/FROZEN PULLEYS				
SKIN PANELS DELAMINATE/VOIDS (COIN TEST)				

POPPED RIVETS/CRACKED/DEFORMED SKIN				
FABRIC/RIB STITCHING/TAPE CONDITION				
LUBRICATION				

WING ATTACH POINTS				
FLYING/LANDING WIRES/STRUTS FOR SECURITY				
CORROSION				
FLIGHT CONTROL PLACARDS				
INSPECT FIREWALL FOR DISTORTION AND CRACKS				
INSPECT RUDDER PEDALS AND BRAKES FOR OPERATION AND SECURITY				
INSPECT BEHIND FIREWALL FOR LOOSE WIRES AND CHAFFING LINES				
CHECK CONTROL STICK/YOKE FOR FREEDOM OF MOVEMENT				
CHECK FLAP CONTROL OPERATION				
CHECK CABLE AND PULLEYS FOR ATTACHMENT AND OPERATION				
PERFORM FLOODLIGHT CARBON MONOXIDE TEST				
ENSURE THE COCKPIT INSTRUMENTS ARE PROPERLY MARKED				
INSPECT INSTRUMENTS, LINES, FOR SECURITY CHECK/CLEAN/REPLACE INSTRUMENT FILTER				
INSPECT COCKPIT FRESH AIR VENTS/HEATER VENTS FOR OPERATION AND SECURITY				
INSPECT SEATS, SEAT BELTS/SHOULDER HARNESS FOR SECURITY AND ATTACHMENT				
CORROSION				
EMPENNAGE/CANARD:				
REMOVE INSPECTION PLATES AND FAIRINGS				
INSPECT CANARD ATTACH POINTS FOR SECURITY				
INSPECT VERTICAL FIN ATTACH POINTS				
INSPECT ELEVATOR/STABILIZER ATTACH POINTS				
INSPECT HINGES/TRIM TABS/ROD ENDS FOR ATTACHMENT AND FREE PLAY (SLOP)				
INSPECT EMPENNAGE/CANARD SKIN FOR DAMAGE/CORROSION				
INSPECT ALL CONTROL CABLES, HINGES AND PULLEYS				
INSPECT ALL CONTROL STOPS				

ENGINE:				
PERFORM COMPRESSION TEST #1 _____ #2 _____ #3 _____ #4 #5 _____ #6				
CHANGE OIL AND FILTER (CHECK FOR METAL)				
INSPECT IGNITION HARNESS FOR CONDITION AND CONTINUITY				
CHECK IGNITION LEAD CIGARETTES FOR CONDITION/CRACKS				
CLEAN AND GAP SPARK PLUGS				
CHECK MAGNETO TIMING/POINTS/OIL SEAL/DISTRIBUTOR				
INSPECT ENGINE MOUNT/BUSHINGS				
CHECK LANDING LIGHT OPERATION				
CHECK POSITION LIGHTS OPERATION				
CHECK ANTI-COLLISION LIGHT FOR OPERATION				
INSPECT ALL ANTENNA MOUNTS AND WIRING FOR SECURITY				
CHECK ALL GROUNDING WIRES (ENGINE TO AIRFRAME, WING TO AILERON/FLAP, ETC)				
INSPECT RADIOS/LEADS/WIRES FOR ATTACHMENT & SECURITY				
INSPECT CIRCUIT BREAKERS/FUSES/PANEL FOR CONDITION				
OPERATIONAL INSPECTION:				
VISUAL INSPECTION OF THE ENGINE/PROPELLER				
ALL INSPECTION PANELS AND FAIRINGS SECURE				
PERSONNEL WITH FIRE BOTTLE STANDING BY				
BRAKE SYSTEM CHECK				
PROPER FUEL IN TANKS				
ENGINE START PROCEDURES				
OIL PRESSURE/OIL TEMPERATURE WITHIN LIMITS				
VACUUM GAUGE CHECK				
MAGNETO CHECK/HOT MAG CHECK				
IDLE RPM/MIXTURE CHECK				
STATIC RPM CHECK				

ELECTRICAL SYSTEM CHECK				
COOL DOWN PERIOD/ENGINE SHUT DOWN				
PERFORM OIL, HYDRAULIC, AND FUEL LEAK CHECK				
PAPERWORK:				
AIRWORTHINESS DIRECTIVES				
RECORD FINDINGS AND SIGN OFF INSPECTION AND MAINTENANCE IN LOGBOOKS				

NUMBERING AND PLACARDS

WHAT ARE THE SPECIAL REQUIREMENTS AS FAR AS ATTACHING NUMBERS AND PLACARDS TO HOMEBUILT AIRCRAFT?

DISPLAY OF MARKS

(Reference FAR Part 45.23)

After you obtain the registration of your aircraft, the Registration numbers or marks must be affixed to the aircraft in some permanent fashion. The marks must be legible and have no ornamentation. They must contrast in color with the background.

The marks displayed on the aircraft shall include the letter "N" signifying U.S. Registry, followed by the registration number issued for the aircraft. In addition, amateur-built (Experimental) aircraft must have displayed on that aircraft near each entrance to the cabin or cockpit, in letters not less than 2" not more than 6" in height, the word, EXPERIMENTAL".

LOCATION OF MARKS ON FIXED WING AIRCRAFT

(Reference FAR Part 45.25)

- (b) (1) If displayed on the vertical tail surfaces, horizontally on both surfaces, horizontally on both surfaces of a single vertical tail or on the outer surfaces of a multi-vertical tail. However, an aircraft on which marks at least 3" high may be displayed and in accordance with 45.29 (b)(1), the marks may be displayed vertically on the vertical tail surface.
- (2) If displayed on the fuselage surfaces, horizontally on both sides of the fuselage between the trailing edge of the wing and the leading edge of the horizontal stabilizer. However, if engine pods or other appurtenances are located in this area and are an integral part of the fuselage side surfaces, the operator may place the marks on those pods or appurtenances.

SIZE OF MARKS

FAR 45.29 (b) (1) (iii) states "Marks at least 3" high may be displayed on an aircraft for which an experimental certificate has been issued under 21.191 (d) or 21.191 (g) for operating as an exhibition aircraft or as an amateur-built aircraft when the maximum cruising speed of the aircraft does not exceed 180 knots Calibrated Air Speed (CAS). And (c) characters must be two-thirds as wide as they are high except "1" which must be one-sixth as wide as it is high and the letters "M" and "W" which may be as wide as they are high. And (d), Characters must be formed by solid lines one-sixth as thick as the character is high. (e) Spacing. The space between each character may not be less than one-fourth of the character width.

IDENTIFICATION PLATE

(Reference FAR Part 45.11)

In addition to affixing the aircraft's registration number to the sides of the fuselage, the builder must also identify his aircraft by attaching an identification plate to the aircraft's structure.

This identification data required to be inscribed on the plate for amateur-built aircraft shall include the following information:

- a. Builder's name and address
- b. Model designation
- c. Builder's serial number

The identification plate containing these essential elements must be of fireproof material and must be secured in such a manner that it will not likely be defaced or removed during normal service, or lost or destroyed in an accident. It must be secured to the aircraft at an accessible location near an entrance, except that if it is legible to a person on the ground it may be located externally on the fuselage near the tail surfaces.

The identification plate information must be marked thereon by etching, stamping, engraving, or other acceptable fireproof marking. Metal plates which comply with these requirements may be purchased from the Experimental Aircraft Association for a very nominal fee.

AIRCRAFT INSTRUMENT MARKINGS & COCKPIT PLACARDS

Refer to FAR Part 91.9 Civil Aircraft Operating Limitations and Marking Requirements

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 thereof**.

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.

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.

POWERPLANT INSTRUMENT MARKINGS

Each required power plant instrument should be marked to indicate the maximum and, if applicable, minimum safe operating limits 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**.

AIRSPEED INSTRUMENT MARKINGS

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

The takeoff and any pre-cautionary 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**.

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).

LANDING GEAR

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.

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.

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

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.

BAGGAGE PLACARD

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

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”.

OPERATING LIMITATIONS

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.

The operating limitations imposed on the aircraft during its flight proving period will be more stringent than those issued later after 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 requirements 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.

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.

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 automotive engines, non-FAA approved engines or propellers, or FAA approved engines and propellers where the combination is not approved, an aircraft equipped with such an engine/propeller combination 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.

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 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 expect that an approved flight test area may not be the one chosen to him as the most convenient.

OTHER LIMITATIONS DURING THE FLIGHT TEST PERIOD

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

AIRCRAFT FLIGHT LOG

During the flight test period, the pilot should record the aircraft flight history in an appropriate log book. This should be in addition to any engine tach, hour meter, 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 restrictions 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 form 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.)

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.

GETTING STARTED

Getting to know the RANS S-21 OUTBOUND

What is it?

If you ask the FAA, it is an Airplane - single engine land.

If you ask an aeronautical engineer, it is a single-engine high-wing fixed-gear airplane of aluminum semi-monocoque construction.

If you ask us, it is the most fun you can have getting from A to B.

Well, let's see... You have your shop in order. Your parts are inventoried and stapled up in order. You have talked to your Airworthiness Representative and you know what he expects. You have read the manual, and know what you will need to complete each assembly

It is time to build something...

If this is your first time building an aluminum airplane, you may want to start with a small part like a rudder. The rudder will teach you the techniques required to build the airframe without risking more expensive parts. The instructions are laid out in three different manuals: **PARTS**, **TEXT**, and **FIGURES**. The purpose in arranging the instructions in three manuals is to allow you to have each manual open to allow you to see all of the information without having to turn many pages. Here are some important points to remember when completing any assembly:

1. Open your manuals to the correct pages before starting an assembly.
2. Use your **PARTS** manual to collect all of the parts needed for the assembly and lay them out in front of you on your work surface.
3. Read the **TEXT** and study the **FIGURE** and **PARTS MANUAL DRAWINGS**. Try to establish a mental picture of how the assembly goes together.
4. Fit the assembly together. Double-check the orientation of all the parts. Make sure the ribs are facing the right direction etc...
5. Mark all of the parts with reference #'s to insure that the alike parts return to the same place in the assembly after drilling and deburring.
6. Lay a straight edge across the ribs to insure that the ribs will lay flush with the skin. Adjust the rib flanges with padded pliers as necessary.
7. Keep your work area clean and free from shavings. If practical, keep a blowgun handy to keep the work surface free from shavings.
8. Whenever the assembly is moved, measure to insure that the part is still square and level.
9. Whenever possible support the underlying part with a wooden block when drilling. If this is not possible, use very light pressure as not to deform the underlying part.

10. Debur all holes and edges as needed. Do **NOT** put a chamfer on holes when deburring, this will weaken the structure and may cause pre-mature failure of the structure.
11. Use the correct rivet. Do **NOT** substitute one rivet for another, even though it may have the same size and grip length.
12. When placing rivets through steel structures, dip the rivet in primer first. This will seal the hole and prevent corrosion.

Don't forget the most important thing when building your aircraft.

HAVE FUN!

Revel in the knowledge that you will soon be part of a select group of people that have escaped the bounds of earth with little more than their own work and ingenuity.

The following pages have information which will be helpful during assembly.

Typical Hardware and Drill Size Table*.

Hardware	Drill Size
40 APR Rivet	#40
AAPQ-41 thru 48	#30
CCPQ-41 thru 48	#30
AAPQ-62 thru 68	#11
CCPQ-62 thru 68	#11
SSPQ-62 thru 68	#11
AACQ-42	#30
CCC-42	#30
AVEX 1691-0410	#30
AN3 Bolt	#11
AN4 Bolt	1/4"
AN5 Bolt	5/16"
AN6 Bolt	3/8"
AN7 Bolt	7/16"
1/4" Quick Pin	1/4"
#4 Machine Screw	#30
#6 Machine Screw	#20
#8 Machine Screw	#21
#10 Machine Screw	#11
3/16" Close Tolerance Bolt	.1885 Ream
1/4" Close Tolerance Bolt	.249 Ream
5/16" Close Tolerance Bolt	.3115 Ream
3/8" Close Tolerance Bolt	.375 Ream

* Use this list only when no other reference is available.

PAINT AND CORROSION PROTECTION

Painting of the S-21 OUTBOUND is optional. The information given below is only one example of how an airplane can be painted. There are many ways to do this and this may not represent the best method for your situation, climate, or chosen paint system.

PRIMING

- Wipe all parts down with acetone before painting
 - Become familiar with all aspects of your paint system. If you don't feel comfortable painting your airplane, seek professional help.
 - Wear rubber gloves and lung protection when performing the following.
1. Clean the parts with acetone.
 2. Scuff the surface of the parts using fine sandpaper or Scotch-Brite pads.
 3. Hang the parts from a simple scaffold using wire.
 4. Apply the paint in several light coats, allowing drying between coats.
 5. Let the parts cure completely before handling.

NOTE: After the parts are fit and drilled it will be necessary to reapply primer before final assembly.

PAINTING

- Wipe all parts down with acetone before painting
 - Become familiar with all aspects of your paint system. If you don't feel comfortable painting your airplane, seek professional help.
 - Wear rubber gloves and lung protection when performing the following.
1. Clean the surface of the aircraft with acetone.
 2. Scuff the surface with Scotch-Brite and blow off
 3. Mask off all areas that you don't want paint applied.
 4. Follow the manufacturer's recommendations for the paint system you have chosen.

RUDDER

Refer to section **2** of parts and figure drawings.

RUDDER SKIN FORMING

Use a tube with a 1 1/4" outer diameter to roll form the leading edges of the rudder skin.

1. See **FIGURE 02-01** for rudder skin bending and orientation.
CAUTION: If bent in the wrong direction, the skin must be replaced.
2. Set the tube on a table and line up the holes in the leading edge of the skin along the top of the tube.
3. Transfer drill (2) holes near the ends from the skin to the tube and cleco in place.
4. Check the alignment of the holes in the skin to the top of the tube. They need to follow the top of the tube pretty well.
5. Transfer drill and cleco the rest of the holes in the skin to the tube.
6. Clean the table to be used from debris and chips. Flip the skin/tube over and place it on the edge of the table with the clecos hanging off.
7. Drill a hole at either end of the 1 1/4" O. D. tube outside diameter and insert a screwdriver or anything handy to be used for leverage.
8. This will probably take 2 people. Force the tube down toward the table and rotate the tube to roll the skin tightly around the tube. Roll all the way until the clecos are about 90° to the table. When finished, the skin should be bent to 85-90°.
9. Repeat this process to form the other leading edge of the rudder skin.

RUDDER ASSEMBLY

1. Press the bronze flange bushings into the hinges before assembly. See part drawing for orientation.
2. Draw a centerline down the un-drilled flange of each rib.
3. Cleco and rivet the Rudder Spar, Upper Rudder Ribs, and Hinges together as shown in the PARTS MANUAL DRAWING.
4. Bolt the rudder horn mount tube to the spar.
5. Cut and deburr the bend tags on both ends of the Rudder Skin.
6. Cleco the rudder skin to the Left side of the frame assembly. The leading edges of the skin curl around to meet each other. Do **NOT** cleco the leading edge at this time.
7. Cleco and rivet the rudder horn rib doubler to the lower rudder rib.

8. Insert the lower rib, with doubler, into the bottom of the rudder and cleco it in place above the tang on the rudder horn mount tube.
9. Cleco and rivet left side of Rudder Skin to Ribs and Spar. Place Rudder, Left side down on a flat surface and check for twist. Make sure Spar and Ribs are straight. Use center line on the Rib flange as a guide to check alignment with side skin holes.
10. Check the rudder for twist. If needed, use boards and weights or straps to fix the assembly and correct any error in twist. Transfer drill from the skin to the undrilled flange of the spar and ribs. Cleco as you drill.
11. Transfer drill #11 through the rudder horn mount tube to the lower rib, and rivet.
12. Rivet the skin to the frame/ribs and finish with the leading edge. Drill the leading edge holes #30.
13. Use a scrap piece of wood to slightly bend the edges of the skin around the spar at the very bottom near the hinge. The purpose is to ensure the edge of the skin does not contact the vertical stabilizer skin and to reduce drag slightly.

RUDDER TO VERTICAL STABILIZER ATTACH

NOTE: The rudder must be installed onto the vertical stabilizer before the whole assembly is mated to the tailcone. The horizontal stabilizer must be mounted before the vertical/rudder assembly is bolted onto the tailcone as the horizontal stabilizer will not slide into place with the rudder present.

1. Ensure the bronze bushings are in place on both the vertical stabilizer and rudder sides of the hinges.
2. Slide the rudder into place on the vertical stabilizer and use bent needle nose pliers or similar to insert the bolts into the hinges with the bolt heads on the top. Take care not to ding or mar the skins.
3. Use the appropriate hardware to secure.
4. Once the rudder is mounted to the vertical stabilizer, the vertical stabilizer tip may be fit up.

VERTICAL STABILIZER

Refer to section **3** of parts and figure drawings.

If installing the Optional – Taildragger Pull Handle it is advisable to do so before final riveting the Vertical Stabilizer Side Skins.

VERTICAL STABILIZER ASSEMBLY

1. Lay ribs on a flat table with the flanges up. Use fluting pliers to straighten the ribs so they lay flat on the table.
2. Cleco the frame assembly together as shown in the PARTS MANUAL DRAWING.
3. Rivet the spars, hinges, and ribs using appropriate hardware. Refer to **FIGURE 003-03** for a Spar riveting schedule.
4. Cleco the side skins to the frame assembly. Do **NOT** cleco to the FWD Spar at this time.
5. Use an edge forming tool to form the aft edges of the leading edge skin.
6. Cleco the leading edge skin to the frame assembly overlapping the side skins.
7. Check the vertical stab for twist by placing clecos in the holes on the end ribs and using a straight edge and digital level to compare. If needed, use boards and weights or straps to fix the assembly and correct any error in twist.
8. Rivet one side.
9. Flip the assembly and check again for twist before riveting the second side.

OPTIONAL - TAILDRAGGER PULL HANDLE ASSEMBLY

- Optional Pull Handle Assembly may be installed during or after Vertical Stabilizer Assembly is complete.
1. Refer to **SECTION 003** and collect all the parts shown on the part pages for the Pull Handle.
 2. Separate the Pull Handle Doubler into 2 pieces.
 3. Cleco doublers to each side of the Vertical Stab as shown on the parts page. Transfer drill all holes to #30.
 4. Find the center of the large hole in the doubler and drill the Vertical Stab Side Skin to 3/4" to match the doubler. **Hint: A stepped drill bit will help.**
 5. Cut the 3/4" raw stock Aluminum tube .080 longer than the outside of the doublers. Cut long and trim a little at a time. Refer to **FIGURE 003-04**.

6. Remove the doublers and final size the side skins to 7/8".
7. Cut the 7/8" raw stock Aluminum Tube to be flush with the outside of the skins. Cut long and trim a little at a time.
8. Apply JB Weld or similar adhesive to the trimmed raw stock tubes. Slide together and install in the Vertical Stab between the doublers. Be sure to center the 3/4" tube inside the 7/8" tube. The 3/4" tube should extend .040" beyond the outside of the doublers on each side. Rivet doublers to Vertical Stab.
9. Fabricate the Pull Handle by cutting Raw Stock Tubes to length as shown in **FIGURE 003-05**. Apply JB Weld or similar adhesive to glue the 3/4" Aluminum Tube flush with the end of the 5/8" Aluminum Tube. Wipe off excess adhesive and allow to dry.
10. Slip Handle Grip over end of Handle Assembly.
11. Insert handle into Vertical Stab until against doubler. Place a mark flush with the opposite doubler. Remove handle from Vertical Stab.
12. Refer to **FIGURE 003-05** and locate a 1/4" hole for the Quick-Release Button to protrude through. The Button will lock the Pull Handle in place when fully inserted.
13. Insert Quick-Release Button into handle. Make sure the button can pop-up fully.
14. Insert handle into Vertical Stab, until locked in place, for easier handling of the S-21 OUTBOUND on the ground. Press the button to remove.

VERTICAL STABILIZER TIP

(AFTER THE RUDDER IS MOUNTED TO THE VERTICAL STABILIZER)

1. Use fluting pliers to straighten the vertical tip rib. Cleco the tip rib to the top rib of the vertical. Check the gap between the tip rib and the top of the rudder. .050-.100 is acceptable. Remove and flute near the vertical aft spar to adjust the gap.
2. Trim the vertical stabilizer tip to the trim line.
3. Test fit the tip. The tip goes between the tip rib and the vertical stabilizer skins.
4. Trim the tip to mate nicely with the tip rib aft of the vertical aft spar. Remove a little at a time. Ensure the tip is in place and recheck the clearance to the rudder after each trim.
5. Use a hole finder to locate and drill the holes in the aft section of the tip.
6. Check the clearance between the tip and the rudder through the full range of travel.

7. Rivet the assembly in place.
8. Recheck the clearance between the tip and the rudder through the full range of travel.

VERTICAL STABILIZER ATTACHMENT

NOTE: The rudder must be installed onto the vertical stabilizer before the assembly is installed to the tailcone. The horizontal stabilizer needs to be installed first as it will not clear the rudder. These assemblies may be installed after painting.

1. Install the rubber trim onto the bottom edge of the vertical stabilizer. Remove and trim to fit. Use a very small amount of Cyanoacrylate (Superglue) to secure the rubber trim onto the bottom edge of the vertical stabilizer.
2. If the rudder is attached to the vertical stabilizer, the rudder horn must be removed to allow the rudder horn weldment to pass through the tailcone skin.
3. Install the vertical stabilizer onto the tailcone through the slots in the top skins.
4. Reach in through the bottom inspection holes to insert the bolts. Install the rudder stop. The stop is asymmetric about the holes. Orientate the stop so the bulk material is above the bolts.
5. Re-install the rudder horn and attach the rudder cables using the appropriate hardware.

HORIZONTAL STABILIZER

Refer to section 4 of parts and figure drawings.

FRAME ASSEMBLY

1. Lay ribs on a flat table with the flanges up. Use fluting pliers to straighten the ribs so they lay flat on the table. Nose ribs may require re-shaping where the metal has bulged out at a rivet hole. Take a duck bill pliers to flatten and use a fluting on either side of the hole to shape to contour.
2. Cleco the frame assembly together as shown in the PARTS MANUAL DRAWING. Note although the spars look identical, there is a forward and aft. For quick and easy reference the rear spar has only one mounting hole near the center. During assembly of the horizontal stabilizer the second hole will be transfer drilled once the stabilizer is square with aircraft. Ensure the pre-drilled holes in the spars and doublers match with each other and the pre-drilled holes in the spars are on one side. This will orientate the spars so that both undrilled flanges are on the same side.
3. Rivet outboard and middle ribs to the front spar, front spar doubler, and nose ribs. This allows the outboard and middle ribs to be flexed to allow the riveter access.

NOTE: There are 2 different ribs (outboard and middle) that vary in length depending on if the spar doublers are between the spar and rib.

4. Rivet the ribs and hinges to the aft spar.

SKIN INSTALLATION

NOTE: THE FOLLOWING INSTRUCTIONS WILL WORK FOR EITHER SPLIT HORIZONTAL OR ONE PIECE SKINS.

1. Remove the bend tags from the skins as shown in **FIGURE 04-01**.
2. Cleco and rivet the inspection tab rings to the inside of the skins.
3. Place the skins on a couple of 2X4 or 4X4. . Place the frame assembly on the skins and cleco the skins to the top of the frame assembly.

NOTE: The skins are the only part which determines the top and bottom orientation of the horizontal. As such, orientation doesn't matter until the horizontal is attached to the tailcone or elevator.

4. Roll the assembly over to cleco the other side. Place the side with the undrilled spar flanges up.

5. Check the assembly for twist and fixture/weight as necessary to remove any twist. Transfer drill from the skin to the spars.
6. Remove the skins and de-burr the transfer drilled holes.
7. The center section of the horizontal stabilizer is cut out to allow it to fit over the fuselage. The rivets in the area are flush to allow the fairing to fit flat on the skin. Dimple the rivet holes in the skin and ribs in this location, and counter sink the corresponding holes on the spars.
8. Re-assemble the skins and check alignment.
9. Rivet one side.
10. Flip the assembly over. Check again for twist before riveting.
11. Trim the Horizontal Tip to fit inside of leading edge skin.

NOTE: You may want to wait for final trimming and attachment until after the elevator has been fit to Horizontal Stabilizer. Tips should be flush with outer ends of elevator and have about 1/8" clearance between the horizontal tip and the elevator balance weights.
12. With the tip in place, push the tip forward into the leading edge of the horizontal skin to ensure the tip conforms to the leading edge shape. Transfer drill the holes into the tip while holding this pressure.
13. Glue the brass washers in place to retain them for assembly.
14. Attach the tip and install rivets for final assembly.

HORIZONTAL ATTACHMENT

NOTE: Horizontal stabilizer must be installed before the vertical stabilizer and rudder. The tail surfaces may be installed after painting.

1. Fabricate bushings as shown in PARTS MANUAL DRAWING. Insert a bushing into the slot of each incidence adjuster.
2. Use the cap screws to set the bushings 1/8" from the bottom of the slots for Titan and 1/8" from the top of the slots for 912 installations.
3. Transfer drill the 2 mounting holes in the front spar and one in the aft spar to 1/4" through the spar doublers.
4. Set the horizontal stabilizer in place. Insert the bolts from inside the horizontal (through the inspection holes) through the bushing and bulkhead.
5. Insert the bolt to attach the aft spar to S-11. The hole for the other bolt is left out of the rear spar of the horizontal stabilizer. This will be drilled out after the wings are attached to the fuselage.

IMPORTANT: Secure the incidence adjusters before flight by using thread locker.

(AFTER WINGS ARE ATTACHED TO THE FUSELAGE AND BEFORE THE ELEVATOR IS ATTACHED TO THE HORIZONTAL)

6. Adjust the tilt of the horizontal stabilizer to match the wings. Use shims as necessary to hold in place.
7. Carefully transfer drill 1/4" hole from the S-11 to the Horizontal Stabilizer AFT Spar.
8. Tighten the bolts attaching the aft spar to station 11.

HORIZONTAL STABILIZER FAIRING**(AFTER FINAL TUNING OF THE HORIZONTAL INCIDENCE)**

1. Place the horizontal fairings on the horizontal outboard of their final position. Tape them in place with the aft edge on the top side 1" behind the rivets in the forward spar.
2. Carefully bend the fairings tightly around the leading edge of the horizontal stabilizer.
3. Remove the tape and place the fairing in place up against the tailcone.
4. Trim to fit tightly around the tailcone.
5. Use a small amount Cyanoacrylate to secure the rubber edging to the fairing.
6. Tape the fairing in place and transfer drill the holes into the skin of the horizontal stabilizer.
7. Trim the inboard ends of the fairings to be flush with no overlap.
8. Remove the fairing and rivet the nut plates in place and secure the fairing with the appropriate hardware. Access through the inspection holes in the horizontal and the holes in the leading edge ribs.

ELEVATOR AND TRIM TAB

Refer to section 5 of parts and figure drawings.

ELEVATOR SKIN FORMING

Use a tube with a 1 1/4" outer diameter to roll form the leading edges of the elevator skins.

10. See **FIGURES 05-01** and **05-01A** for elevator skin bending and orientation.
CAUTION: If bent in the wrong direction, the skin must be replaced.
11. Set the tube on a table and line up the elevator skin leading edge holes along the top of the tube.
12. Transfer drill (2) holes near the ends from the skin to the tube and cleco in place.
13. Check the alignment of the holes in the skin to the top of the tube. They need to follow the top of the tube pretty well.
14. Transfer drill and cleco the rest of the holes in the skin to the tube.
15. Clean the table to be used from debris and chips. Flip the skin/tube over and place it on the edge of the table with the clecos hanging off.
16. Drill a hole at either end of the 1 1/4" O. D. tube outside diameter and insert a screwdriver or anything handy to be used for leverage.
17. This will probably take 2 people. Force the tube down toward the table and rotate the tube to roll the skin tightly around the tube. Roll all the way until the clecos are about 90° to the table. When finished, the skin should be bent to 85-90°.
18. Repeat this process to form the leading edge of the other elevator skins.

ELEVATOR ASSEMBLY

1. Press the bearing into the elevator horn. Use a rivet and 2 washers to retain the bearing in the horn.
2. Cleco together the frame assembly as shown in part drawing. Press the bronze bushings into the hinges before assembly.
NOTE: The rib flanges face inwards toward the center of the assembly, except the (2) ribs at the center which are riveted to the Elevator Horn.
NOTE: The flanges on the (2) outside trailing edge ribs face inwards and the others face outwards.
3. Cleco the elevator horn to the (2) center ribs one at a time and transfer drill #30 the holes in the horn to the ribs.

4. Rivet the frame together using the appropriate rivets.
NOTE: Do not rivet the center ribs to the aft spar. These holes are shared with the trim tab hinge.
5. Drill the mounting holes in the servo ribs to #11 and install the nut plates. Refer to Elevator Trim Tab Assembly.
6. Cleco the trailing edge skins to the trailing edge ribs only.
7. Cleco the top skins and splice to the frame assembly. They overlap the trailing edge skins. Use plenty of clecos in the center section to give the elevator some rigidity.

ELEVATOR TRIM TAB ASSEMBLY

1. Lay out the trim tab parts on a table in their approximate locations and use the PARTS MANUAL DRAWING to gain proper orientation. The long flange of the spars and the long side of the skin are the top of the trim tab.
NOTE: The left half of the trim tab will have 2 more ribs than the right and will have the PPT horns riveted to the additional ribs.
2. The outer (4) rib flanges point inwards. On the ribs at the horn and the ribs at the center of the trim tab, the flanges point away from each other. Rivet the ribs to the spar.
3. Cleco the skin and trim tab horns to the spar/ribs. Place on a flat surface with the top side up. Check for twist and straightness and fixture or weight as needed. Transfer drill the holes in the top part of the skin to the spar.
4. Rivet the skin and horns to the spar/ribs. Do not rivet the (3) areas where the hinges attach.

TRIM TAB INSTALLATION

1. Flip the elevator assembly over and rest the top skin on a couple boards. Place the boards so that they can be used as a support/straight edge to assist with trim tab fit up.
2. Place the trim tab in place on the elevator. Line the trailing edges up and center the trim tab between the aft trailing edges of the elevator.
3. Cut the trim tab hinge into (3) 5.5" strips.
NOTE: Remove Hinge Pin material before cutting. The hinge pins will be cut long as a means to secure as shown in **FIGURE 05-02**.
4. Cut the hinge pins to length (6.25") and reinsert them into the hinges.

5. Fit the hinges to the trim tab/elevator aft spar. See **FIGURE 05-02**. The aft edge of the hinge may need to be trimmed slightly to clear the trim tab spar and allow the trim tab to move forward to align with the elevator trailing edges.
6. With the trim tab and hinges in place, mark the hole locations from the aft elevator spar to the hinges. Remove the hinges and carefully drill the required holes. Cleco back in place.
7. After all (3) hinges are clecoed to the elevator aft spar, flip the assembly over.
8. Re-align the trim tab on the elevator. Mark, remove, and drill the holes from the trim tab to the hinges.
9. Cleco back in place and verify position. Remove the hinge pins and rivet the hinges in place.
10. Drill (2) #40 holes in the elevator aft spar at each hinge to retain the hinge pin as shown in **FIGURE 05-02**. Safety wire the hinge pins in place upon final assembly of the trim tab to the elevator.

ELEVATOR FINAL RIVETING

1. Check the assembly for twist and fixture/weight as necessary.
2. Rivet the top or bottom skin excluding the last row of rivets on the ends where the tip skin will be attached.
3. Flip the assembly over and check for twist before riveting the second side.
4. Cleco and rivet the inner tip ribs to the ends of the assembly. Transfer drill and rivet all holes.
5. Slide the tip skin underneath the elevator skins and cleco in place. Transfer drill the most aft hole from the trailing edge skin to the tip skin.
6. Modify each Tip Skin per **FIGURE 05-03**. Make sure to only drill into the lower surface.
7. Slide the elevator balance ribs in place and cleco to the inner ribs with the flanges pointing forward. Rivet in place.
8. Cleco the outer tip rib in place.
9. Finish riveting the rest of the elevator tips together.

TRIM SERVO INSTALLATION

(AFTER PAINTING OF THE ELEVATOR AND TRIM TAB)

The trim servo will attach to the elevator trim servo ribs inside elevator with nut plates.

1. The Servo Ribs should have been drilled to #11 and nut plates installed during elevator assembly. If not, do so now.
2. Drill the 4 servo mounting holes to #20. Attach servo to ribs.
3. Assemble servo push rod to clevises with jam nuts in place. Attach push rod assembly to servo and trim tab horns. The push rod will be set to neutral length during rigging.

ELEVATOR BALANCING

- Elevator balancing must be performed on a flat work surface.
- Elevator and Trim Tab must be final painted.
- Trim Tab must be installed onto Elevator.
- Servo with Push Rod must be installed in Elevator and connected to Trim Tab.
- Trim Servo Cover with screws must be installed.

WARNING!

LEAD POISONING HAZARD

This aircraft contains Inorganic Lead which is for industrial and commercial use only. Misuse of this product will present a health hazard. Dust or fume created from handling or processing this product may be harmful if inhaled or swallowed. Chronic overexposure to dust and/or fumes may result in severe damage to blood forming, nervous, urinary, and reproductive systems.

Precautions:

- Do **NOT** eat, drink, use tobacco products, or apply cosmetics in work areas.
- Wash / shower thoroughly after handling and before eating, drinking, or using tobacco products.
- Dispose of water in compliance with Federal, State, and Local Regulations.
- Do **NOT** reuse empty containers.
- Avoid Dust / Fume Inhalation, swallowing of dust and contact with skin and eyes.
- Keep containers and material free of moisture

CAUTION: Wear rubber gloves and a particle mask when working with Lead. Lead is a heavy metal and is dangerous for your health. Take care when working with Lead to clean up all shavings and to store Lead products out of reach of children.

The elevator will be balanced by using a lead/epoxy mix placed in the leading part of the elevator tips. This section is sealed by the balance rib and accessed by the builder located 1/2" hole in the elevator tip skin.

1. Place the elevator upside down.
2. Place a bolt in the hinges of the elevator.

3. Make a simple stand with "knives" in which to balance the elevator on. The elevator must balance on the bolts inserted through the hinges. A couple of 2X4s and leftover stringer material works well.
4. Place the elevator on the balancing stand.
5. Tape off the front corners of the balance weight cavities to prevent epoxy from leaking out.
6. Mix up lead shot and slow-setting epoxy.
7. Pour the lead shot/epoxy mix into the 1/2" hole at either end until the elevator balances on the hinges. It is ok if the amount of weight in either side varies, but it should not be all on one side.
8. When satisfied with the balance of the elevator, tip the trailing edge up slightly (balance arm down) while the epoxy cures. This will prevent seepage of epoxy past the elevator balance rib to the aft end of the elevator.
9. Once cured, remove the tape on the corners and sand/file as needed for a smooth corner.
10. The remaining space in the tips can be filled with body filler and sanded flat before painting.
11. If the elevator needs to be re-balanced, a series of holes can be drilled in the 1/2" hole to remove the filler/weight and the process can then be repeated.

NOTE: Rebalancing of the elevator is required when any change to the elevator will affect its center of gravity. This includes painting.

ELEVATOR TO HORIZONTAL STABILIZER ATTACHMENT

NOTE: The horizontal stabilizer should be attached to the fuselage and bolts in both aft attach holes before attaching the elevator.

1. Ensure the bronze bushings are in place on both the horizontal stabilizer and elevator.
2. Slide the elevator into place on the horizontal stabilizer and use bent needle nose pliers or similar to insert the bolts into the hinges. Take care not to ding or mar the skins.
3. Use the appropriate hardware to secure.
4. Once the horizontal stabilizer/elevator is mounted to the fuselage, bolt the elevator Push-pull Tube to the elevator horn as shown in the PARTS MANUAL DRAWING.
5. Run the trim tab servo wires out the S-11 bulkhead, through the S-11 closeout, through one of the holes in the leading edge of the elevator and finally through a hole in the elevator spar. Connect, secure and protect the wires as necessary. Ensure the elevator can move through its entire range of motion without interference or damage with the servo wires due to binding or chaffing.

WING

Refer to section **6** of parts and figure drawings.

WING SPAR ASSEMBLY

1. Clean and debur all 4 wing spars. A grease cutting detergent is recommended.
2. Cleco the Wing Tip Rib to the tip of the FWD Wing Spar. Refer to **FIGURE 06-01** for location. Check to be sure the Spar is flush with the outer side of the Tip Rib. If not, then trim the FWD Wing Spar. If desired, the Wing Spar may be left untrimmed and then trim the wing tip to match the slight joggle the extra bit of spar length causes. Remove Wing Tip Rib when completed.
3. Cleco the FWD and AFT Spar Attach doublers and the FWD and AFT Truss doublers in place.
 - a. The two FWD attach doublers go on the inside of the Forward Wing Spar at the wing root.
 - b. The FWD Spar Truss Doubler goes on the back side of the Forward Wing Spar.
 - c. The AFT Spar Attach doubler is on the backside of the Rear Spar at the wing root.
 - d. The AFT Spar Truss doubler is on the forward side of the Rear Spar.
 - e. On the FWD Spar FWD Doubler, the notch in the doubler points toward the top of the wing and the doubler contours to the inside of the Forward Wing Spar.
4. If the FWD Spar FWD Attach Doubler does not quite sit flat on the inside of the Forward Wing Spar, radius the bottom corner until it sits flat.
5. Rivet the doublers in place using the appropriate rivets excluding holes shown in **FIGURE 06-01**.
6. Use a 5/16" drill to transfer drill through the FWD Spar Truss Doubler and the Forward Wing Spar where the truss bolts to the spar.
7. Refer to Spar Assembly parts manual drawing for the aft spar attach fitting and hardware. Install but do not tighten until mating the wings to the fuselage.

OPTIONAL LANDING LIGHTS INSTALLATION

- Optional landing lights may be installed during or after Wing Assembly is complete.
- 15. Refer to **SECTION 006H** and collect all the parts shown on the part pages for the Landing Lights. Extra care should be taken when working with the Lexan Light Lens as they may scratch easily.
- 16. Cut an opening in each Forward Wing Spar per **FIGURE 06-01A**. Polish all cut edges with fine sand paper. Also polish the tip end of each spar to help prevent scratching the Landing Light Lens when fitting up. Refer to **FIGURE 06-01B** for final cutout dimensions.
- 17. Cut Landing Light Lens about 1/8" outside of the formed trim lines. This will allow final trimming during fit up.
- 18. Slip Lens into Spar. Center raised area within cut-out in spar. The top edge will rest against the spar radius.
- 19. The lower edge will need to be trimmed after riveting the Bottom Wing Skin in place. The lower edge will set against the rivets and will allow the Lens to snap into place. Remove Lens from spar.
- 20. Assemble Landing Light to Landing Light Mounts.
- 21. Position assembly in spar, centered on opening. Refer to **FIGURE 06-01C**. Tape in place and view from the front. Adjust as needed. Transfer drill #30 through Mount holes. Remove and proceed with assembly of wing.

NOTE: Remember to route Landing Light wires during Wing assembly. Route wires in wing and out to the Landing Light through the grommets in the wing ribs. Leave extra length to reach through the fuselage. If wings are assembled the wire may be ran inside the leading edge spar, then routed to the aft closer to the root. Be sure wire does not interfere with any controls.

(AFTER PAINTING OF WING)

22. With Wing Tip removed, slip Landing Light Lens into position. Trim the Lower edge to be tight against the row of rivets. The pressure will keep the Lens pressed against the inside of the spar.
23. Apply painters tape flush to cut opening in spar. Apply tape, on the Lens, flush with the outside edge of the raised area.
24. Apply a small bead of clear silicone seal between the tapes and smoothen with your finger to form a fillet. Remove masking tape before the silicone hardens. This will aid in preventing the penetration of water and dirt.
25. Access Landing Light mounting area through lower inspection opening. Rivet Landing Light with mounts to back side of wing spar using previously drilled holes. Note that the mounts have slots which allow the light to be angled as necessary for proper light beam convergence. After adjusting, tighten bolts.

AILERON BELLCRANK ASSEMBLY

1. Press the bearing into the Aileron Bellcrank Pulley. Use the snap ring to hold the bearings in place.
2. Use a 5/8" drill to drill the bellcrank mount tube in which the spindle slides into. This removes any buildup of powder coat.
3. Slide the aileron bellcrank spindle through the side of the bellcrank closest to the snap ring. Slide this assembly into the taller side of the tube on the aileron bellcrank mount.
4. Use the appropriate hardware along with Loctite Blue and safety wire to secure the bellcrank assembly.
5. Install rod end for the aileron push-pull tube as per parts manual drawing.

FLAP BELLCRANK ASSEMBLY

NOTE: The Flap Bellcrank has a left/right orientation.

1. Press the bearing into the Flap Bellcrank. Use the snap ring to hold the bearing in place.
2. Use a 5/8" drill to drill the bellcrank mount tube in which the spindle slides into.
3. See **FIGURE 06-02** for flap bellcrank mount and flap bellcrank orientation. Notice the snap ring is up, the long arm of the bellcrank and bellcrank mount point in the same direction and the short arm of the bellcrank points opposite of the rear spar.

4. Slide the bolt in place from the bottom side of the bellcrank mount. Slide the Flap Bellcrank Spindle over the bolt sticking up and through the bellcrank and mount similarly to the aileron assembly. Place the Aileron Cable Guide and Cover on the top of the flap bellcrank as shown in **FIGURE 06-02**.

NOTE: There is a Left and Right hand Aileron Cable Guide. Do not tighten the bolt until assembled in the wing and the aileron cables are run through the aileron cable guide.

5. Install the rod end for the flap push-pull tube as per parts manual drawing

WING RIB / SPAR ASSEMBLY

1. Lay the Forward Wing Spar Assembly on a table with the flange up. Locate the wing truss, Lexan wing truss shim, and applicable hardware.
2. Run a 1/4" and a 5/16" drill through the holes in the wing truss where the truss bolts to the front and rear spars to remove the powder coat and allow the bolts to slide freely.
3. Bolt the strut truss fittings to the wing truss. Refer to Lift Strut Assembly PARTS MANUAL DRAWING for parts listing. Note the orientation of the bolts are heads down and nuts up. This is for wing strut fairing clearance. The 4 holes are undersized and must be drilled to 1/4".
 - a. Drill one of the holes in each fitting to 1/4".
 - b. Place one fitting in position on the truss with a bolt through the 1/4" hole and the larger hole that mates with the strut pointing away from the truss.
 - c. Carefully line up and drill the opposite hole through the fitting and the truss. Put another bolt in the freshly drilled hole.
 - d. Drill out the remaining 2 holes.
 - e. The fitting that was just drilled is now matched this particular side of this truss. Mark the fitting and truss so that you know which truss and which side of the truss it goes on.
 - f. Repeat with the other 3 fittings in the 3 remaining positions on the trusses and mark accordingly.
 - g. Finish bolting the plates to the truss using the appropriate hardware with washers between the truss and the fittings. Do not fully tighten the bolts until after the wing is installed on the fuselage and the strut is bolted in place.
4. Deburr and soften the edges on the Forward Spar cutouts next to the wing truss to prevent injury when the bolts are inserted to attach the wing truss.
5. Bolt the truss to the Forward Spar using the appropriate hardware and the lexan truss shim between the truss and the Forward Spar.

NOTE: The nuts and bolts that need to be inserted from the inside of the Forward Spar may be done by reaching into the cutouts in the spar on either side of the truss.
6. Lay the ribs on a flat table with the flanges up and use fluting pliers to straighten the ribs so they lay flat on the table. Bend the flanges on the front and back of the ribs to 90° if needed.
7. Layout the ribs in the proper locations along the front spar. Rib numbering and flange directions are shown in **FIGURE 06-03**.

8. Drill the aileron and flap hinges and hinge arms to 5/16" to allow the bronze bushings to be pressed in. Use a drill press if available. If a drill press is not available, a hand drill may be used.

IMPORTANT: Care must be taken to stay square to the parts. If there is any play detectable between the bronze bushing and the hole, the damaged hinge must be replaced.

9. Locate and cleco the aileron and flap hinge arms, aileron bellcrank outer rib support, and the flap teleflex and bellcrank mount to the proper ribs. 3 holes are pre-drilled in the ribs and must be used to locate the hinge arms and bellcrank mount doublers.

NOTE: The flap teleflex mount has no right and left parts. The slight difference in length required will be made up in the rod ends threading onto the teleflex.

10. Use a #30 drill to match drill and debur the remaining holes.
11. Cleco and rivet the rib AFT attach angles to wing ribs and hinge arms.
12. Rivet the aileron and flap hinge arms, aileron bellcrank outer rib support, and flap teleflex and bellcrank mount to the ribs.
13. Rivet only the bottom holes of the rib AFT attach angles through the rear spar. The top hole is used to rivet the gap seals.
14. Use a 1/4" drill to match drill through the hinge arms, aileron bellcrank outer rib support, and the flap teleflex and bellcrank mount where the bellcrank mounts are bolted to the ribs.
15. Test fit and rivet the attach angle on the front of the inner root rib (rib #1) on the root side of the rib. The flat-sided flange is longer and gets riveted to the inner root rib.
16. Cleco the ribs to the Forward Spar.
17. Cleco the tie down angle in place.
18. Cleco the Rear Spar to the ribs. Refer back to **FIGURE 06-01** for orientation.
19. Bolt the truss to the rear spar using the appropriate hardware. Use washers, as needed, in between the rear spar truss doubler and the wing truss to make sure the bolts don't pull or push on the rear spar. Sight down the rear spar to check for straightness.
20. Triple check the rib direction and hinge, doubler, and bellcrank locations.
21. Do not rivet the inner root rib at this time. It will be riveted in place after the fuel tank is in place. Leave the inner root rib clecoed in place until ready to install the tank to assist in skin installation. Rivet the ribs to the spars excluding locations where the gap seals share the same holes as shown in **FIGURE 06-01**.
22. Bolt the aileron and flap bellcrank assemblies in place with the lexan shims between the bellcrank mounts and the aluminum doublers. Bolt the smaller arm of the bellcranks to the rear spar. Use Loctite and safety wire as necessary.

23. Route the aileron cable through the rear opening in the ribs down to the aileron bellcrank. Position the bellcrank so that the break in the outside diameter is toward the root of the wing as shown in **FIGURE 06-02**.

IMPORTANT: The longer side of the aileron cable is on the FORWARD side of the aileron pulley.
24. Use safety wire to secure the aileron cable to the aileron bellcrank pulley as shown in **FIGURE 06-02**.
25. Make sure the aileron cable is untangled and secure it in the aileron cable guide at the flap bellcrank.
26. Insert the flap teleflex into the wing through the same passage as the aileron cables. Slide the groove on the teleflex cable onto the flap bellcrank mount rib support.
27. Position the flap bellcrank so that the longer arm of the bellcrank points toward the root of the wing while the shorter arm points toward the leading edge of the wing.
28. Attach the teleflex to the shorter arm using the appropriate hardware and rod end.

CAUTION:

The rod end must be threaded on at least 10 full turns.

29. Secure the teleflex to the teleflex mount using safety wire as shown in **FIGURE 06-02**.
30. For the left wing only, run the lines for the pitot tube. Use a piece of tape and safety wire as shown in **FIGURE 06-04** to attach the pitot tubes to the top of each rib and prevent rubbing. A #40 hole must be drilled in each rib.
31. Drill a 5/8 hole as shown in **FIGURE 06-04** and insert grommets on ribs 3 to 11. Run any wires needed out to the wing tip. Protect the wires with loom from between ribs 2 and 3 to the inside of the plane. Join the wires with the pitot/static lines and teleflex at rib 2.

WING SKIN INSTALLATION

PRE-SKIN CHECK LIST

- FWD wing truss doubler is riveted to the front spar.
- AFT truss doubler is riveted to the rear spar.
- Wing truss is bolted in the correct orientation using the appropriate hardware and lexan anti-corrosion shims in the front.
- FWD spar FWD attach doubler is riveted in place.
- FWD spar AFT attach doubler is riveted in place.
- Wing ribs are in the proper locations and flanges are orientated the correct directions.
- All ribs are riveted to the spars (excluding rivets shared with the gap seals on the rear spar and the root rib).
- All flap hinge arms are in the proper locations and riveted to the ribs.
- All aileron hinge arms are in the proper locations and riveted to ribs.
- AFT rib attach angles are in place and upper hole on the spar side is left open for gap seals.
- Aileron bellcrank outer rib support and the flap bellcrank mount rib support are riveted in place.
- Aileron bellcrank is assembled and bolted into the wing in the proper location using blue thread lock, safety wire, and lock washers where necessary.
- Flap bellcrank is assembled and bolted into the wing in the proper location using blue thread lock, safety wire, and lock washers where necessary.
- Aileron cable is correctly routed, secured through the aileron cable guide, and secured on the aileron pulley using safety wire.
- Flap teleflex is pressed into the flap bellcrank mount rib support and safety wired in place.
- Flap teleflex is attached to the bellcrank using rod ends and appropriate hardware. The rod end is threaded on at least 10 turns.
- Ribs have been fluted properly and they are straight enough that the skin can be clecoed to the ribs with ease. Each rivet hole should be in a high point in the rib. If the rivet is located in a flute or a deformity is higher than the rivet, the skin will wrinkle.
- Remove any scratches from the skins on the side that will be inaccessible after the skin is riveted to the wing. Use 600 or 800 grit sand paper to sand the area of the scratch until it is no longer visible. For deeper scratches, courser grit can be used and then finish with finer grit.
- Run wires for the desired wing tip lighting system.
- Run tubing for the pitot tube.

TOP SKIN

1. The wing skins will have the print on opposite sides from each other. This is so that the print can be left on the inside of the skin and won't have to be removed. Select the top skin which puts the print on the inside of the wing.

CAUTION: When working with large pieces of sheet metal such as wing skins, care must be taken to prevent creases or "smiles" from appearing in the sheet metal. If smiles appear, they can be worked out using a large spoon and pressing it against the smile to minimize its visibility.
2. Fabricate the Leading Edge Forming Tool from 1" Nylon or similar material. Refer to **FIGURE 06-04A**.
3. Clamp the skin, top side UP, to a table with 2-3/4" extending forward of the table edge. Draw the Forming Tool down the leading edge of the skin. Make sure the skin is fully inserted into the tool. This will roll a slight edge on the skin, towards the spar, to prevent pillowing.
4. Repeat for the Bottom Wing Skin. Make sure the lower side is UP to roll the edge toward the spar.
5. Remove skins from the table.
6. Set a couple of 4x4s or similar under each end of the wing, spanning from the front and rear spar.
7. Make sure the wing structure is square. Lightly clamp down the wing in a way as to not interfere with the top skin.
8. Place a couple of straight pieces of angle (or other sturdy straight edges) on top of the spars at opposite ends of the wing.
9. Use a level to make sure there is 0° of twist in the wing.
10. If adjustment is needed, add shims under the boards to remove any twist.
11. Place the stringers in place on the wing ribs. Stringers will have to be trimmed and will be cut short of the rib flanges. The stringer flange will point rearward when installed.
12. Put the top skin in place on the wing.
13. Cleco the skin to the ribs including the forward most row of rivets right next to the spar.
14. Drill the leading edge holes to the Forward Spar using a #30 drill. Start at the middle and work your way out. Be sure to lightly press down on the skin until it contacts the spar when drilling to ensure a proper hole is created. Insert clecos as you progress across the spar.
15. Remove about 4 rows of clecos from the leading edge.
16. Use a hand squeezer and 120° dimple dies to dimple the holes in the skin leading edge.

17. Use a 120° countersink (preferably a micro stop countersink) to machine countersink the holes in the Forward Spar to accept the dimples in the skin.
18. Lightly lift the leading edge of the skin and debur the holes in the Forward Spar.
19. Insert (4) tank supports and cleco them to the top skin.
20. Rivet the top skin to the wing. Start with the leading edge and work your way rearward one row of rivets at a time. Leave the holes open for the inner root rib (#1). Push the skin to the ribs between the rivet to be pulled and the cleco in the next row to prevent as much pillowing as possible.
21. Stop riveting about 4 rows from the rear spar. Double check that the wing is square and still has 0° of twist. Match drill the holes from the skin into the rear spar using a #30 drill. Start at the middle and work your way out.
22. Remove clecos back to the rivets and lightly lift the trailing edge to allow removal of any burrs or chips in between the skin and the rear spar.
23. Fit the gap seals to the rear spar and slide the top edge underneath the trailing edge of the top skin. Check for proper alignment to Wing airfoil profile with a straight edge on top of the wing. Refer to **FIGURE 06-05**. Once the gap seal is conformed to the airfoil, transfer drill through the skin into the gap seal.
24. Temporarily install the flap and aileron to check for clearance through the range of motion. If any rivet heads contact the aileron or flap, the bottom surface of the gap seal can be formed to clear by using a round object, such as the ball end of a ball peen hammer. Press the ball of the hammer up and into the bottom of the gap seal and drag along the length to push the metal surface up for more clearance.
25. After satisfied, use a pair of shears to remove the supports at push-pull tube exit holes and end tabs indicated in **FIGURE 06-05A**.

IMPORTANT: Once the supports are removed, the gap seals will be very fragile and prone to damage. Remove the supports only after the top row of holes is clecoed to the rear spar. If it must be removed for some reason before riveting, use extreme caution.
26. The rest of the top skin can now be riveted using the appropriate rivets.

NOTE: Do NOT rivet the Inside Root Rib at this time.
27. On the outboard side of the outboard gap seal, three holes in the gap seal do not have matching holes in the spar and need to be transfer drilled using a #30 drill.
28. Rivet the gap seals to the rear spar using the appropriate rivets.

NOTE: Longer rivets must be used near the truss due to the rear spar truss doubler thickness on the inside of the spar.
29. Assemble the wing jig by screwing 2X2's or similar, flush with the bottom with 33.5" between the inside edges of the stand pieces as shown in **FIGURE 06-06**.

30. Place the wing stands under each end of the wing and secure the stands to the table. Flip the wing over and place it in the stands with the leading edge of the wing up against the tall side of the stands. Adjust the location of the stands to line up with the ribs on the ends of the wing.

BOTTOM SKIN

1. Use clamps to secure the wing to the front of the jigs and down to the table.
2. Use a level and a piece of straight stock across the spars to insure there is no twist in the wing. If there is, use shims between the table and the stands to remove any twist.
3. Place the stringer in place on the wing ribs. Stringers will have to be trimmed and will be cut short of the rib flanges. The stringer flange will point rearward when installed.
4. The stringer will need a notch cut out of the flange in order to give clearance for the wing truss. Mark its location and use a sanding drum or similar to remove material from the stringer to create a notch.

NOTE: Smooth any sharp corners, cutting marks, etc. from the stringer to avoid stress concentrations.

5. Use shears or a Dremel to remove the nut plate supports from the outer inspection hole on the bottom skin as shown on PARTS MANUAL DRAWING 006C-01. Set them aside. The nut plate supports are used on the wing tip installation. Deburr as needed.
6. Place the bottom skin on the wing by lifting the leading edge high and sliding the hinge arms through the slots in the skin before lowering the front and sliding the skin forward. A 3rd person may be helpful to help guide the hinge arms through the skin.

CAUTION: When working with large pieces of sheet metal such as wing skins, care must be taken to prevent creases or "smiles" from appearing in the sheet metal. If smiles appear, they can be worked out using a large spoon and pressing it against the smile to minimize its visibility.

7. Cleco all inspection rings in place by lifting an edge of the skin and sliding them into place on the inside of the wing. Wait to rivet them until after the skin is riveted on the wing to allow the skin to flex as it bends to the shape of the airfoil.

IMPORTANT: Orientate the inspection ring for mounting the Pitot/Static System per **FIGURE 06-07**.

NOTE: Orientate the inspection hole tab ring for the flap bellcrank such that the screws will not interfere with the bellcrank mount. Refer to **FIGURE 06-07A**.

8. Begin by putting a couple clecos in various wing ribs to line up the skin and then in the tank supports. Use an ice pick or similar tool to line up the holes.
9. Begin placing a few clecos in place next to the rear spar. Note the locations of any interference between the bottom skin and the hinge arms. If necessary, remove the skin and widen the slots until the skin does **NOT** rub on the hinge arms.

NOTE: This clearance varies with twist in the wing so ensure any twist is removed before checking for interference.

10. Cleco the rest of the bottom skin to the wing leaving about 3 rows at the front.
11. Use an edge forming tool to roll a slight edge on the leading edge of the skin to prevent pillowing.
12. Cleco the remaining rows of the bottom skin to the ribs.
13. Insert and cleco the wing tank supports (KPWI0651) to the bottom skin. The tank supports overlap onto the wing ribs and go on the inside of the ribs flange.
14. Double check to be sure there is 0° of twist in the wing.
15. Match drill the leading edge holes through the D spar using a #30 drill. Start in the middle and work your way out.
16. Remove the front 4 or so rows of clecos.
17. Debur the skin and the Forward Spar.
18. Dimple the leading edge holes in the skin using 120° dimple dies.
19. Countersink and then debur the holes in the Forward Spar.
20. Insert clecos to secure the front of the bottom skin.
21. Use the appropriate rivets to rivet the bottom skin to the wing. Start at the leading edge and work your way rearward. Stop about 4 rows from the trailing edge.

NOTE: Do **NOT** rivet the Inside Root Rib at this time.

22. Double check to be sure there is 0° of twist in the wing.
23. Match drill the trailing edge holes in the skin to the rear spar using a #30 drill. Start in the middle and work your way out. Lightly lift the edge to clear any burrs or chips.
24. Finish riveting the bottom skin to the wing.

NOTE: Do **NOT** rivet the Inside Root Rib at this time.

25. Rivet the inspection tab rings that are clecoed to the bottom skin.

PITOT/STATIC SYSTEM

1. Locate Doubler Plate on 5" Inspection Cover using **FIGURE 06-08** as a template. Transfer drill #30 and cleco.
2. Transfer drill 1/4" for the Pitot Tube. Refer to **FIGURE 06-08**. If the Pitot Tube fits too tight, open the hole with a deburring tool or file. Deburr and rivet Doubler to Inspection Cover.
3. Insert Pitot Tube through 1/4" hole in Doubler and Cover. Attach to Angle Bracket with 1/4" Conduit Clamps. Adjust Angle and Clamps to allow 7" of Pitot Tube to extend below the Cover. Forward open end of Pitot Tube should face forward when in flight. Adjust after mounting to Wing Skin as needed.
4. Transfer drill #11 through base of Angle. Angle base should be oriented outboard. Debur and rivet to Cover.
5. Push a Union Elbow over the upper end of the Pitot Tube. Pull on the elbow body while holding the inner sleeve to seal. Connect to Pitot line in wing. Pull on tubing to seal. Attach Pitot Assembly to wing opening.
6. Attach Union Elbow at root of wing to tubing.
7. After attaching wings to fuselage, route line behind Station 3 Closeout down to belly of aircraft. Route forward to firewall, then up and connect to pitot side of instruments with correct connectors.
8. Locate and drill a #30 hole in each Side Boot Cowl Skin per **FIGURE 06-09**.
9. Pull rivet and push center mandrel out of rivet with a click punch or similar tool.
10. Connect tubing to each protruding rivet body, on inside of Boot Cowl, and secure with safety wire. Connect lines together with a Union Tee and connect to static side of instruments with correct connectors.
11. After painting Boot Cowl label each static location with a placard reading "STATIC PORT KEEP OPEN".

WING FUEL TANK ASSEMBLY

1. Using a small piece of scrap aluminum sheet, make a drill guide as shown in **FIGURE 06-11**. The jigs purpose is to locate a center hole for the fly-cutter or hole-saw. Make the screw holes about 1/4" outside of the small existing hole in the tank to keep the jigs size down. If the jig is made too large it will interfere with the fly cutter when the hole for the cap is cut.
2. Screw the drill guide to the top of the tank, covering the center of the hole.
3. Slide the fuel tank into position in the wing.
4. Slide the Inside Root Rib into position and cleco to the front and rear spar. Make sure the wing tank supports (top and bottom) are resting on the rib flange.
5. Fabricate a sight gauge location tool as shown in **FIGURE 06-12**. Insert the Sight Gauge Location Tool into the sight gauge locations in the Inside Root Rib and use a long #11 bit to create a centering mark.

NOTE: Drill only deep enough to create a mark and check to see that the hole will be close to the center radius of the depression. Use a long #11 drill bit and drill a pilot hole for the sight gauge. Step drill to 1/2". A 1/2" Unit-bit works well. Refer to **FIGURE 06-13**.

6. Drill a #30 hole in the drill guide at the center of the hole in the top skin for the cap. Mark the hole in the top skin to the top of the tank using a marker.
7. Remove the tank from the wing.
8. Cut a 3" hole for the wing tank cap using a fly-cutter or hole-saw and the previously drilled hole as a guide.
9. Debur the 3" hole.
10. Set the fuel cap assembly into the hole with the cap pointed forward. Mark a line on the outboard side of the cap assembly that passes through the center of the cap parallel to the spars (front and rear of the tank).
11. Set the cap assembly upside down and place the retaining ring on it. Line up the retaining ring so that the big hole lines up with the line drawn in the previous step on the outboard side. The retaining ring should lay flat and maintain a constant separation from the tapered section on the cap assembly.
12. Carefully (don't scratch the cap assembly) clamp the retaining ring in place and use it as a drill jig to drill #11 holes in the cap assembly. Insert clecos as holes are drilled.
13. Remove the retaining ring and place the cap assembly in place on the tank. Line up the outboard mark on the tank with the outboard mark on the cap assembly. Center the cap assembly in the circle drawn on the tank. Transfer drill the holes in the cap assembly through the tank using a #11 drill. Do not drill the outboard hole where the vent is located. Remove the cap assembly and debur the tank and cap assembly.

14. Drill the outboard hole of the fuel cap and retainer ring to 3/8" for the fuel tank vent. Do not drill the hole for the fuel vent in the tank until after leak testing.
15. Use a 3/16" 100 degree countersink to countersink the #11 holes in the topside of the cap to accept the countersunk bolts.
16. Locate and pilot drill the hole for the AFT fuel withdrawal fitting as shown in **FIGURE 06-13**. Step drill to 3/4". A 3/4" Uni-bit works well.
17. Debur all holes and thoroughly clean any debris from the inside of the tank. A shop vacuum works well.
18. Insert a long piece of wire through the inside of the 3/4" Bulkhead Fitting. Slide the O-ring over the wire and onto the Bulkhead Fitting. Refer to **FIGURE 06-14**.
19. Fish the wire through the hole at the rear of the tank for the AFT fuel withdrawal. Pull the Bulkhead Fitting through the tank and into place.
20. Install the rubber washer, 3/4" thick washer, and Reverse Thread Nut. Use blue thread lock on the threads. **DO NOT OVERTIGHTEN THE NUT**. If the rubber washer deforms past the washer, the fitting will leak.

IMPORTANT: Do not allow the fitting or thick washer to rotate while tightening or leaks may occur. **HINT:** Prevent the thick washer from turning by holding with needle-nose Vise-Grips. Carefully remove the wire.
21. Repeat this process for the sight gauges using the appropriate hardware and blue thread lock. To line up the 90 degree sight gauge fittings use a straight edge across them.
22. Let the thread lock set up for at least an hour before installing the withdrawal and sight gauge parts. Do **NOT** allow the fittings to rotate
23. Use thread sealant on pipe thread connections. Orientate the 90° withdrawal fittings for the sight gauge to point towards each other.
24. Install the 90° fitting on the AFT fuel withdrawal. Cut the fuel line to length for:
 - a. Right wing - 85"
 - b. Left wing - 65"
25. Locate, Drill, countersink, and flush rivet the nut plates to the fuel cap retaining ring.
26. Obtain an approximately 2" long 3/16" bolt (AN3-20A or similar). Use the gap in the retaining ring to insert the retaining ring into the tank. Insert the scrap bolt through the fuel cap opposite of the Fuel Vent. Thread into the retaining ring inside the fuel tank. Pull retaining ring up and align holes with fuel tank holes. Raise fuel cap up and rotate out of the way. Insert Fuel Tank Support with shorter side orientated to the AFT. Refer to **FIGURE 06-14A**. The outboard v-shaped cut-out should align with the Fuel Vent opening.
27. The underside of the fuel cap assembly is cone shaped and holds the Fuel tank Support in place by the cone shape. Make sure the Fuel Tank Support is centered and flat against the tank bottom.

28. Ensure everything is ready to go on the fuel cap. With the cap raised, apply a thin layer of Pro Seal to the underside of the flange on the fuel cap.

NOTE: If you desire to remove the cap to apply the Pro Seal. Be sure to capture the retaining ring inside the tank with a couple 3/16" machine screws while the cap is removed.

29. Rotate cap back into place and install the fuel cap to the tank. Remove junk bolt and replace with proper hardware. Do **NOT** apply thread sealant to the machine screws at this time. Tighten the machine screws until the Pro Seal starts to squish out between the tank and cap. Let the Pro Seal set up overnight.
30. Remove the machine screws one at a time. Apply thread sealant and re-install. Tighten them down.
31. The tank needs to be leak tested before assembled into the wing. Slide the tube for the sight gauge on (barely press them on, no clamps needed). Apply a small amount of air pressure to the AFT withdrawal fuel line. 1 PSI is enough. Do not apply enough to deform the tank. Spray soapy water on the tank fittings and cap assembly to find any leaks.
32. Remove the sight gauge tubes
33. Drill the 3/8" hole in the tank for the vent.
34. A clean tank is a safe tank! Vacuum out any debris. If the hose of your vacuum is to large, tape a small piece of flexible hose to the end.
35. Re-install the tank in the wing.
36. Thread the wire, cables, teleflex, and fuel line through the appropriate holes in the Inside Root Rib and slide rib into position and cleco. Make sure the wing tank supports (top and bottom) are toward the inside of the flange on the outer rib so that the skin will rest solely on the rib.

HINT: Slide a nylon string between the skin and the supports to give a gap for the root rib to slide into. Leave the ends accessible so you can get to them once the root rib is in place. Once in place, pull the string out through the exit hole in the Inside Root Rib.
37. Install the sight gauge tube and hose clamps.
38. Rivet the Inside Root Rib to the skin and spars.

NOTE: The top aft end of the Inside Root Rib is bolted in place rather than riveted.
39. Pro Seal is very mess to work with! Tape over the fuel cap assembly with masking tape. Use an exacto knife to cut around the circumference. Also tape the wing skin around the fuel cap. Apply Pro Seal to the gap between the fuel tank cap and the wing skin. Dip a finger in water and create a fillet all the way around the cap. The purpose of this is to prevent fuel from entering the wing when the tank is over filled.

40. After the Pro Seal is cured (24hours), install the fuel tank vent with sealant on the threads. Align vent hole facing forward (towards leading edge).

FLAP & AILERON SKIN FORMING

Use a tube with a 1 7/8" to 2" outer diameter to roll form the top leading edges of the flap and aileron skins.

1. See **FIGURE 06-14B** for flap and aileron skin bending and orientation.
CAUTION: If bent in the wrong direction, the skin must be replaced.
2. Set the tube on a table and line up the skin top leading edge holes along the top of the tube.
3. Transfer drill (2) holes near the ends from the skin to the tube and cleco in place.
4. Check the alignment of the holes in the skin to the top of the tube. They need to follow the top of the tube pretty well.
5. Transfer drill and cleco the rest of the holes in the skin to the tube.
6. Clean the table to be used from debris and chips. Flip the skin/tube over and place it on the edge of the table with the clecos hanging off.
7. Drill a hole at either end of the forming tube outside diameter and insert a screwdriver or anything handy to be used for leverage.
8. This will probably take 2 people. Force the tube down toward the table and rotate the tube to roll the skin tightly around the tube. Roll all the way until the clecos are parallel over the skin (270° of rotation). Insert a rib and check to see if the skin conforms to the ribs. Roll the tube more to increase the bend until the skin conforms to the ribs.
9. Repeat this process to form the top leading edge of the other skins.

FLAP ASSEMBLY

1. Remove the bend guides as shown in **FIGURE 06-15**. Carefully use a pair of snips to cut them off close and finish with a file.
2. Remove the attach tabs of the Flap Hinge - Part Assembly to make individual Flap Hinges. Trim off close and finish with a file. Refer to **FIGURE 06-15A**.
3. Lay the flap skin on a table.
4. Lay out the ribs, hinges and doublers in the proper locations.
5. Drill the aileron and flap hinges and hinge arms using a 5/16" drill to allow the bronze bushings to be pressed in. Use a drill press if available. If a drill press is not available, a hand drill may be used, but care must be taken to stay square to the parts. If there is any play detectable between the bronze bushing and the hole, the damaged hinge must be replaced. (This may have been done in a previous step.)
6. Double check the location and orientation of the ribs, hinges, and Push-Pull Tube Attach and rivet the hinges and Push-Pull Tube Attach to the appropriate ribs.
7. Determine which side of the hinges to press in the bronze bushing. Refer to **FIGURE 06-16** for typical orientation. Use a bench vice or similar to press in the bronze bushings.

NOTE: If any of the bronze bushing do not stay pressed into the hole, set them aside and wait until assembling the flap to the wing. Once in place on the wing the bushings will be retained by the hinge bolts. Green Loctite may be used to retain the bronze bushings.

IMPORTANT: Check for play between the bronze bushings and the hinges. If play is present, the hinges must be replaced.

8. Use a sharpie to draw a line on the bottom flange of the ribs. The line should be .2" from the edge of the flange.
9. Cleco the ribs in place to the top side of the skin. Use a 2X4 or similar to space the flap off the table and prevent damage due to resting on the clecos in future steps.
10. Place the flap with the bottom side up.
11. Fixture or weight the flap to remove any twist.
12. The hinges must not contact the skin. Enlarge the slots in the flap skin if needed.
13. Transfer drill using a #30 drill from the skin to the bottom flange of the ribs. Reach in from the front and move the ribs as needed. Use the line drawn on the ribs to ensure proper edge distance. Cleco as holes are drilled.
14. Slide the flap spar into place from either side.
15. Place the flap right side up on the 2X4s.

16. Rivet the **TOP** side using the appropriate rivets. Start at the AFT edge and work your way forward one row at a time.
17. Flip the flap over and check for twist before riveting. Start at the trailing edge and work forward.
18. Match drill and debur the spar using the holes in the skin and a #30 drill.
19. Finish riveting the skin to the spar.

AILERON ASSEMBLY

1. Remove the bend guides on the aileron skin as shown in **FIGURE 06-17**. Carefully use a pair of snips to cut them off close and finish with a file.
2. Cleco and rivet the inspection tab rings to the aileron skin.
3. Lay the aileron skin on a flat table.
4. Lay out the ribs, hinges, and Push-Pull Tube Attach in the proper locations as shown in **FIGURE 06-17**.
5. Drill the aileron and flap hinges and hinge arms using a 5/16" drill to allow the bronze bushings to be pressed in. Use a drill press if available. If a drill press is not available, a hand drill may be used, but care must be taken to stay square to the parts. If there is any play detectable between the bronze bushing and the hole, the damaged hinge must be replaced. (This may have been done in a previous step.)
6. Double check the location and orientation of the ribs, hinges, and Push-Pull Tube Attach and rivet the hinges and Push-Pull Attach to the appropriate ribs.

NOTE: The hole at the top rear of the Push-Pull Tube Attach is used to bolt the PPT to the rib and must be left open.
7. Determine which side of the hinges to press in the bronze bushing. Refer back to **FIGURE 06-16** for typical orientation. Use a bench vice or similar to press in the bronze bushings.

NOTE: If any of the bronze bushing don't stay pressed into the hole, set them aside and wait until assembling the aileron to the wing. Once in place on the wing the bushings will be retained by the hinge bolts. Green Loctite may be used to retain the bronze bushings in the hinges.

IMPORTANT: Check for play between the bronze bushings and the hinges. If play is present, the hinges must be replaced.
8. Use a sharpie to draw a line on the bottom flange of the ribs. The line should be .2" from the edge of the flange.
9. Cleco the ribs in place to the top side of the skin. Use a short 2X4 or similar to space the aileron off the table and prevent damage due to resting on the clecos in future steps.

10. Place the aileron with the bottom side up.
11. Fixture or weight the aileron to remove any twist.
12. The hinges must not contact the skin. Enlarge the slots in the aileron skin if needed.
13. Transfer drill using a #30 drill from the skin to the bottom flange of the ribs. Reach in from the front and move the ribs as needed. Use the line drawn on the ribs to ensure proper edge distance. Cleco as holes are drilled.
14. Slide the aileron spar into place from either side and cleco the bottom leading edge row to the spar.
15. Rivet the bottom side using the appropriate rivets. Start at the trailing edge and work your way forward one row at a time.
16. Flip the aileron over and check for twist before riveting. Start at the trailing edge and work forward.
17. Match drill and debur the spar using the holes in the skin and a #30 drill.
18. Finish riveting the skin to the spar.

AILERON BALANCING

The plugs for the mass balance are created using spray expanding foam.

1. With the aileron flat on a table, insert the tube on the can of expanding foam at least 14 inches inside the root side of the aileron spar. This will require use of an extension tube or other means. Spray just enough to create a plug.
2. Let the foam set up for at least 8 hours.
3. Place the aileron on a flat table and allow it to rotate on the bottom of the hinges.
4. Add Lead shot or BB's to the root end of the spar until the aileron balances on the hinges when the bottom surface is level.
5. Use expanding foam to create an end plug and isolate the balance weight in the spar. If the foam expands beyond the end of the spar, wait until it completely dries and cut it off flush with the end of the spar.

IMPORTANT: If the aileron is painted after it is balanced, it will need to be re-balanced. Weight can be added by creating a cavity in the foam plug using a drill or other means, adding BBs to balance, and sealing them in with more expanding foam.

LIFT STRUT ASSEMBLY

1. The Lift Struts are cut to length and the attach holes pre-drilled at the factory. Smooth the ends of each Lift Strut with fine sand paper and debur.
2. Mark a straight line between the attach holes at either end of the strut. Use a straight edge or a piece of string. Only marking inside the holes by 8" or so is needed.
3. Place a strut doubler on the strut with a bolt in the attach hole. Align the rest of the holes with the line on the strut. Transfer drill the #30 holes from the doubler to the strut. Cleco the first hole to hold the doubler in place before continuing to drill.
4. Repeat for the remaining 3 strut doubler plates.
5. Slide the Strut Fitting Doublers inside the ends of the strut and cleco in place. Drill the #30 holes out to #11. Rivet the doublers to the strut using the appropriate rivets.
6. Use a 7/16" drill to drill the bolt holes out to final size on the strut/doublers and the strut attach tangs on the cage.
7. The lower strut fitting can be bolted to the bottom of the strut. The side with the generous radius is bolted to the tangs on the cage. Leave the bolt loose enough that the lower attach fitting can swivel freely.

NOTE: The welds between the strut tangs may prevent the fitting from sliding all the way in. Use a file or sander to radius the corner on the lower strut attach fitting just enough to allow it to be inserted until the bolt holes line up.
8. Set the struts aside until final assembly of the airframe.

LIFT STRUT FAIRING INSTALLATION

(AFTER ATTACHMENT OF WING TO FUSELAGE)

1. Trim base of fairing to allow a slight flange edge where it mates to the wing. See **FIGURE 06-18**.
2. Cut out opening to fit snugly over Lift Strut. Refer to **FIGURE 06-19** for a template. Cut small and trim to fit.
3. Locate the dimples in the base of the fairing and drill to #30. Slip fairing over upper end of lift strut.

NOTE: The fairing may be split to the cut-out at the top to aid in removal without removing the strut. If this is the case you may want to install an additional rivet nut on either side of the cut-out to retain.

4. Slide fairing up against bottom wing skin. Transfer drill #30. Slide fairing away from wing. Drill #30 holes in wing to 1/4". Drill fairing to #11.
5. Install Rivet Nuts into bottom wing skin. See **FIGURE 06-20**.
6. During Final Assembly, slide fairing into place and secure with Truss Head Screws.

TAILCONE

Refer to section Z of parts and figure drawings.

INITIAL ASSEMBLY

1. Assemble and rivet the bulkheads as shown in PARTS MANUAL DRAWINGS 007-01, 007-03, 007-05, and 007-07.

NOTE: S-10 AFT bulkhead doubler will need the flanges slightly bent to conform to the shape of the tailcone. It is bent on the same jig as the bulkhead and will be under bent.
2. Carefully bend the flanges on the aft doubler on the S-10 bulkhead to be flush with the S-10 bulkhead.
3. Transfer drill and rivet the holes in the flanges of S-4, S-5, and S-6 bulkhead doublers.
4. Double check the angle of the flanges on the bulkheads to make sure they will mate to the skins. The angle on the bottom should be 97°. The angle on the sides should match the tailcone bottom skin geometry. Set the bulkheads on the tailcone bottom skin to compare. The top bulkhead flanges can be altered prior to installing the top tailcone skins. If the flanges need adjusting, carefully bend the flanges as needed using a pair of duckbill pliers/grips or similar. The amount of bending should be minimized. The angles should be close, but do not bend them back and forth to get them perfect. This will weaken the flange at the bend.
5. Set the bulkheads aside.
6. Cut out and debur the slot covers in the aft inspection hole of the bottom skin.
7. Rivet the inspection cover tab rings to the print side of the tailcone bottom skin. On the aft most access panel do not rivet the forward 4 holes. These will be riveted after installing the belly stringers.
8. Use a few Clecos to attach the lower longerons and stringers in place on the same side of the bottom skin as the inspection cover tab rings. Note stringer orientation on PARTS MANUAL DRAWING 007A-01. The stringers are placed with the bottom flanges pointing to the centerline. The stringers will stick out in either direction until they are trimmed. Notice the stringers overlap the inspection cover tab rings. Mark the stringers .25" from the last hole on each end. Remove and trim the stringers.
9. Remove the assembly from the table and place upside down on two sawhorses. Rivet on the stringers starting 4 holes back from the front. This is needed allow the skin to slide together with the tail cone spacer strip and cockpit cage belly skin. Do not rivet the longerons between Station 3 and Station 4. This is where an extra stiffener angle and the Station 3 to Station 4 support will be installed and where the tailcone slides over the tangs welded to the fuselage. Refer to **FIGURE 07-01** for rivet call outs

10. Cleco the bulkheads to the bottom skin with all flanges pointing forward. The bulkheads will hang below the bottom skin. Rivet the bulkheads to the bottom skin. Refer to figure 07-01 for rivet call outs.
11. Place the tailcone side skins on the table print side up mirrored to each other. Note: We try to cut the skins so the print will face inside, however this is not always practical. In the case where printing will be on the outside, use a solvent such as MEK to remove.
12. Refer to the PARTS MANUAL DRAWING for the tailcone side and top skin assembly. Cleco a stringer stock piece to the each skin. Mark, remove, and trim to .25" from the center of the last hole on each end. Cleco the trimmed stringers in place and rivet starting the fourth hole back from the front. Observe the side longerons. The aft end of the longeron has holes all the way to the end. The front end to the side longeron needs to be trimmed 4.2" from the center of the forward most hole. After trimming, cleco the longeron to the side skin. Do not rivet because the top tailcone skins also rivet to the side longeron.
13. With the bottom skin still upside down on the sawhorses, take a left or right side skin and Cleco in place. Refer to **FIGURE 07-02** for rivet call outs and rivet the side skin to the bottom longeron from Station 4 aft. Also, rivet side skins to bulkheads from Station 4 aft. Neither side nor bottom longerons are riveted from Station 3 to 4 until later when mating to the cage. The support angles and Baggage Floor Supports are installed after the tailcone is mated to the cage. After riveting the assembly flip right side up and place on the work table. Rivet the other side skin to the assembly.

TAILCONE/CAGE ATTACHMENT

NOTE: It is recommended to prime the mating surfaces of the aluminum tailcone that mate to the steel cage for dissimilar metal corrosion resistance. The cage is powder coated which provides corrosion resistance and priming of aluminum surfaces provides an additional layer of corrosion resistance.

IMPORTANT: Insert clecos into the longerons in the forward sections on both the side and bottom skins before lining up the cage to the tailcone to ensure proper alignment. Insert clecos from inside the fuselage to the bottom skin to prevent clecos from interfering with the table.

1. Slide the back of the tailcone off one end of a 12ft table.
2. Place the cage on the other end of the table like it mates to the tailcone.
3. Use scrap wood to shim up the cage and get it to mate with the tailcone. This will require quite a bit more in the front of the cage than the rear.
4. Carefully slide the two together. The tangs on the cage go on the inside of the longerons.

5. The front edge of the side skins should be parallel to the tube on the rear of the cage. Slide them together until the gussets fit with the lower longerons.
NOTE: Front edges of the side skins may not be perfectly parallel to the cage due to slight variation in the cage. After removing twist and squaring the tailcone to the firewall, split the difference of any misalignment.
6. The tailcone bottom skin may need to be raised or lowered so that the skin transfers passed the bottom tube without being deflected and without a gap between the skin and tube.
7. Use a level to ensure both the cage and tailcone are level with each other and there is no twist in the tailcone.
NOTE: The tailcone is still limber at this stage. The purpose of eliminating the twist is to permit an accurate measurement to ensure the tailcone is square to the cage (firewall).
8. Once the tailcone and cage are positioned correctly, use clamps to clamp the longerons to the steel tabs on the back of the cage. Leave room to drill at least one hole in each gusset.
NOTE: The middle longerons may need to be trimmed. Ensure the tailcone is positioned correctly. Mark and trim the middle longerons so they just clear the tube on the cage.
9. Check that all 3 skins (bottom and 2 sides) are parallel to the tubes they overlap. The bottom skin will extend forward of the front edge of the tube when in place.
10. To check for square, measure from the top engine mount bushings on the firewall to a common place in the tailcone. A hole on the aircraft centerline on the large inspection hole on the bottom skin works well.
11. Check the angle between the firewall and the top surface of the middle longeron. This angle should be $88.9^{\circ} \pm 0.2^{\circ}$ with the longeron sloping up toward the tail when the firewall is perfectly vertical.
12. If any adjustments were made to meet the above requirements, make all measurements again to ensure the cage and tailcone are mated correctly. Check the fit of the bottom tailcone skin to the bottom of the cage for height.
13. Match drill through the gussets on the cage through the longerons and skins. Cleco and remove clamps as you progress.
14. Once all the gussets have been drilled and clecos inserted in all the gusset holes, the fuselage can safely be moved or rotated as needed. If placed on saw horses, the fuselage with clecos will easily support itself but care should be taken not to put a lot of weight in the plane until the structure is riveted at a later time.
15. Fabricate and cleco the middle longeron support angle as shown in **FIGURE 07-03**.
16. Fabricate and install the lower longeron support angle and S-3 to S-4 Support as shown in **FIGURE 07-04** and the PARTS MANUAL DRAWING.

17. Fabricate and install the tailcone spacer strips. These are provided as raw stock and must be trimmed just shy of the attach gussets at station 3. They will reinforce the tailcone skin all the way around where the tailcone attaches to the cage and are placed between the tailcone skins and the tabs on the cage as well as the tailcone stringers. Transfer drill from the tabs on the cage to the spacer strips and side/bottom skins. Cleco in place. Do not rivet at this time. Several holes will be transfer drilled from the fuselage side and bottom skins after they are fit up.
18. The front of the S-3 to S-4 support rest on the nut plate tab on S-3. A hole should be drilled in the aft flange of the S-3 to S-4 support and riveted to S-4 bulkhead.

(AFTER LONGERON SUPPORTS, TAILCONE TOP SKINS, FUSELAGE SIDE AND BOTTOM SKINS ARE FIT UP.)

19. Transfer drill any remaining holes between the cage tabs and aluminum skins.
20. Transfer drill any remaining holes between skins.
21. Rivet the tailcone to the cage at the longerons, window support, and attach tabs. Use the appropriate steel rivets and account for varying lengths due to material thickness. Refer to **FIGURE 07-04A**.
22. Rivet the skins and skin supports at S-3.
23. Finish riveting the longeron supports and stringers where they were previously left un-riveted to facilitate tailcone/cage mating.

RUDDER CABLE SYSTEM

1. Drill out the #11 hole on the S-4 bulkhead to 5/8" and install the rubber grommets as shown in **FIGURE 07-05**.
2. Run the rudder cables as shown in PARTS MANUAL DRAWING 009B-01. The cable will have to be fed through the hole in the S-4 bulkhead from the back working forward. Mount the pulleys as you go with the rudder cables in place. In a couple places, the cable will have to be in place before the pulley is mounted.
3. If the aircraft is going to be a taildragger, install the tailwheel steering cables/pulleys/mounts.

NOTE: The tangs that mount the tailwheel steering pulley at S-8 need to have holes drilled in them for a cable keeper. Refer to **FIGURE 07-06**. Insert the appropriate cotter pin to retain the cable.

NOTE: If the bolt will not go through the rudder cable splitter where the tailwheel cable attaches, drill out the hole with a #11 drill.

4. If the aircraft is going to be a trike, cleco the slot covers in place. Note the front rivet will be flush.
5. If the rudder pedals have been installed, install the hardware forward of the rudder pedals shown in PARTS MANUAL DRAWING 009B-01.

AFT BAGGAGE

1. Temporarily remove the middle longeron support angles.
2. Set the baggage sides in place with the aft edge resting on top of the flange on the S-4 bulkhead.
3. The outside edge of the baggage side flanges should be close to the outside edge of the longeron. This will be visible when the plane is finished.
4. Fix in place and use a hole finder to transfer drill the holes in the longeron to the baggage sides.
5. Cleco the longeron support back in place.
6. Transfer drill the hole in the tab on S-3 to the baggage side.
7. Rivet the baggage floor supports to the left and right baggage floor.
8. Place the right baggage floor in place first and then the left. Line up the aft edge with the aft flat surface of the S-4 bulkhead. Press the front and rear corners of the floor tightly into the corners on S-3 and S-4. Clamp in place.
9. Transfer drill the left baggage floor to the right and rivet them together.
10. Locate, mark, and drill the locations for the nut plates. There are 6 nut plates attached to tabs on the welded cage. An additional 3 per side must be located to attach the outside edges of the baggage floor to the side pieces. 2 more per side will attach the floor to the S-3 to S-4 Supports. These will be located on each side of the center about 8.5" apart.
11. Use an edge form tool to form the top edges of the baggage floor.
12. Covering with cloth or painting of the aft baggage section will occur after fitting of the forward baggage compartment.

TAILCONE TOP SKINS

1. Set the fuselage right side up on the 12x4 build table. Place a long piece of angle (48") over the top of station 11. **FIGURE 07-06A** This is used as a sight gauge to make sure the fuselage is square and the horizontal and vertical surfaces are level and square with the cage. Sight for proper alignment by lining up the angle with the top fuselage cage. Check repeatedly during the process of transfer drilling the longerons.
2. Install the rudder cables and the wires for the trim tab servo before installing the top skins. Any other lighting or remote magnetometer etc wires can also be run at this time.
 - a) Run the wires for the elevator trim tab servo down one of the lower longerons.

- b) The wire will exit S-11 and run up into the front of the elevator once the horizontal and elevator are installed. Leave about 12 inches out the back side of S-11 and the rest can be rolled up close to S-3 and run, wired, and trimmed at a later time.
 - c) Use RTV Silicone or hot glue to adhere the wire to the longeron every 12 inches or so.
 - d) To keep the rudder cables from being damaged coil and tape them to the cage at station 3 pr 4.
3. Fabricate and install the window support angle as shown in **FIGURE 07-07**. Rivet the aft side of the support to the longeron but do NOT drill or rivet the support to the top attach gusset on the cage.
 4. Set the 3 top stringers in place on the bulkheads. They will be bent to match the top front skin at a later point.
 5. Cut and trim the aft section of the stringer at the S-8 bulkhead.
 6. Remove any clecos that may be in the middle longerons.
 7. Use an edge forming tool to form the edge on the top skin that overlaps the longerons. Form the top edge of one of the skins (whichever will be on top).
 8. Place the top skin in place on the bulkheads and begin to cleco in place at the top.
 9. Work your way back and forth down to the side longeron. Cleco to the stringers as well.

CAUTION: Care must be taken to avoid kinks in the skin.
 10. Repeat to cleco the other tailcone top skin in place.
 11. The top seam will not be riveted until fitting of the skins between S-3 and S-4.

S-4 CLOSEOUT

1. Trim the S-4 closeout to the outside edge of the trim lines on the top corners.
2. Trim the top middle section and the bottom edges to leave a 1/8" flange for rigidity.
3. Trim the corners for clearance around the window support angles.
4. Cut Spacers from provided stock per **FIGURE 07-07A**. Glue the (2) spacers to the back side of the S-4 closeout at the marker divots in the S-4 closeout. Drill #11 from the bushings through the closeout.
5. Test fit the S-4 closeout and note where trimming is needed to fit the curvature of the top corners to the tailcone top skin.
6. Trim conservatively and test fit. Repeat until satisfied with fit.

7. Transfer drill #11, through the Closeout at the bushing locations into the S-4 bulkhead. Remove the S-4 closeout and drill the locations for nut plates and rivet them in place.
8. Locate and drill (4) #11 holes in the aft section of the baggage floor where the S-4 closeout overlaps and forward of the S-4 bulkhead flange. It is not necessary to locate these holes in the bulkhead flange, as it is not pressed all the way to 90°, which causes problems.
9. Drill (2) additional holes just above the baggage floor into the baggage side panels.
10. Drill these (6) locations for nut plates and rivet nut plates in place.
11. Reinstall the S-4 Closeout. Use a hole finder to transfer drill the (6) holes to the S-4 Closeout.

TAILCONE TOP FRONT SKINS

1. Check alignment of the tailcone to the cage. Refer to figure 07-06A. Check alignment often during final assembly of skins to the tailcone. The top seam will be riveted last, permanently setting the tailcone alignment.
2. Line up the spacer strips just aft of the tubes on the cage. Trim the tailcone spacer strips to fit between the tailcone attach gussets. Transfer drill from the tabs on the cage and cleco in place. Once fit up, the spacer strips may be removed during the fit up of the top front skin.
3. Use an edge forming tool to form an edge on the bottom edge on the top front skin where it overlaps the longeron.
4. Before forming the top front skin edge fit-up and trim as required, this piece is supplied longer than needed for a custom fit-up following the tailcone center-line seam.
5. Form one of the top edges where they overlap each other. Also form the front edge on the side. This formed edge will hold tight against the tube when installed.
6. Cleco the window spacer strip to the top front skin.
7. Cleco the tailcone top front skin to the side of station 4. Ensure the front bend fits snug around the tube at S-3. Lightly clamp in place if needed.
8. Position the window support angle to mate with the top corner of the fuselage and top front skin. Avoid interference with the radius of the angle to the gusset. Trim the window spacer and capture strip slightly to prevent interference with the window support if needed. Ensure the window support and top front skin are securely in place and no pillowing exists between the skin and support. Transfer drill and cleco from the top gusset on the cage to the window support and top front skin.

9. Press the skin against the window support and clamp in place.
10. Pull the skin up and forward and proceed from station 4 up the window support angle. Transfer drill and cleco.
11. Transfer drill and cleco the upper tailcone attach tab to the window support angle and skin.
12. Work your way forward from the bottom of the window support to station 3. Pull the skin down and forward as you go to prevent pillowing. Keep downward tension to keep tension in the front edge between the top attach gusset and the middle longeron. Transfer drill and cleco in place.
13. Place a weight on the station 4 to hold the top front skin down to the bulkhead.
14. Press the skin tight around the top corner on station 3 and down to the outboard tab on the cage. Drill and cleco in place.
15. Pull flat and drill/cleco the remaining tabs.
16. From inside the tail, drill and cleco through the S-4 bulkhead and the top skins and top front skins. Ensure the bulkhead and top skin holes line up when drilling the first couple holes.
17. Repeat the process to fit up the other top front tailcone skin.
18. Cleco the (3) top stringers in place on the top skin. Mark the location where the stringers need to make a bend to follow the top front skin.
19. Remove the stringers from the tailcone.
20. Place the stringer on the edge of a table and carefully bend as needed. Go a little bit at a time and don't overshoot the bend angle.
21. Insert the stringer back into the tailcone and test fit. Remove and re-bend as necessary.
22. Use a straight edge to ensure the stringers are straight from S-3 to the aft section of the tailcone. Transfer drill and cleco. Trim the stringers to the next hole in the stringer closest the tube on the cage. The last rivet on the stringers should catch the spacer strips.
23. Line the center stringer up to the center of station 3 and clamp in place. Add a little weight to the top seam of the top front skins to prevent pillowing. Clamp the stringer in place. Straighten as needed.
24. Transfer drill and cleco from the stringer to the 2 top front skins from inside the tailcone.
25. (2) Additional stringers must be added to the top front skin as shown in **FIGURE 07-08**.
26. The tailcone top skin and top front skins are now ready to be riveted. Rivet the top seam last after making a final check of tailcone alignment.

NOTE: Spacer shims can be added between the bulkheads and the skins to reduce the amount of pillowing. Use scraps of 6061.

27. Install the spacer strips before final riveting. Trim if necessary to prevent interference with the window spacer strip.

FUSELAGE SIDE AND BOTTOM SKINS

NOTE: The sliding seat position rails must be installed before final riveting of the bottom skin. Refer to **Sliding Seat Assembly** in the parts manual and **FIGURE 09D-01**. Check to be sure seat belt bolts will slide into seat belt bushings of fuselage. Clean or drill out powder coat as needed.

NOTE: Orientate all seams on the fuselage/tailcone so that the forward or upper skins overlap onto the aft or lower skins. This is to prevent air and water from entering the fuselage either in flight or on the ground.

1. Flip the fuselage upside down for ease of fitting the belly skin.
2. Fit up the fuselage bottom skin as shown in **FIGURE 10E-30**. Transfer drill from the inside of the cage through the tabs to the fuselage bottom skin. Use a wood block to back skin where transfer drilling. Cleco skin as holes are drilled. To locate where the landing gear bolts penetrate the belly skin use 5/16 and 3/8" drill bits inserted into the bushing and spin by hand until a center mark is made.
3. Flip the fuselage right side up.
4. Prior to fitting and transfer drilling the side skins, make a paper template for any tabs that will not be accessible transfer drilling inside. Key the template by using other holes that can be drilled from the inside. Make a template for each side and mark left and right.
5. Fit up the AFT and FWD fuselage side skins to the cage. The bottom flange of the side skins slips between the cage and the belly skin. Hold pressure rearward while transfer drilling from inside the cage through the tabs welded on the cage to the AFT and FWD side skins. Cleco in place. The purpose of holding pressure rearward is to ensure the top bent flange holds some pressure to the tube after the skin is final installed. Using a sharpie, mark from the inside where the fuselage cage tubes (both bottom longerons and crossing tubes) are located. This is to prevent drilling into the fuselage cage tubes. This line will be used to set the edge distance of the rivet holes for attaching the belly and skins. Use a .30" ED from this line. To locate where the landing gear bolts penetrate the side skins use a 5/16 drill bits inserted into the bushing and spin by hand until a center mark is made.
6. Trim the side skins as needed. The top corner of the AFT side skin and the place where the FWD side skin overlaps the weld on the taildragger gear truss are likely places where trimming will be needed.
7. With the side and bottom skins clecoed in place, transfer drill from the fuselage side and bottom skins to the tailcone side and bottom skins and spacer strips.

8. Refer to **FIGURE 10E-30A**. Cut stringer material to given lengths and quantities. Apply 1/2" Acrylic tape to widest flange of each stringer. Position stringers on the inside of the Bottom Skin in locations shown. Make sure to press firmly to allow the tape to bond.
9. Refer to **FIGURE 10E-30B**. Cut stringer material to length and quantity shown. Apply 1/2" Acrylic tape to widest flange of each stringer. Position stringers on the inside of the Rear Fuselage Side Skin in the location shown. Make sure to press firmly to allow the tape to bond.
10. Remove the belly and side skins. Refer to **FIGURE 10E-30** for hole spacing and count. Locate and drill the holes in the bottom flange of the side skins. Refer to **FIGURE 10E-31** for dimple locations for countersunk rivets for gear clamp plate clearance.
11. Drill the 5/16" and 3/8" holes for gear attach bolts.
12. Deburr all skins prior to final riveting to the fuselage cage. Leave the forward two holes on the forward side skin un-riveted. This is where the boot cowl skin will overlap.
13. Do not rivet the holes along the forward edge of the belly skin, this is where the bottom of the boot cowling will overlap.
14. Transfer drill the holes at the aft of the fuselage bottom and aft side skins to the tailcone side and bottom skins and spacer strips. Debur and install appropriate rivets.

MAIN GEAR FIT UP

1. Become familiar with the Main Gear Installation PARTS MANUAL DRAWINGS and collect the parts shown in the drawings.
2. Examine your Gear Legs. If your inspection reveals any gouges or scratches, polish or sand to remove.
3. Support the fuselage on sturdy sawhorses
4. Install the landing gear using the hardware shown in the PARTS MANUAL DRAWINGS. Refer to **FIGURE 08-04** for location on Fuselage. Center of Landing Gear Spacer Bushings will need to be drilled out to 5/16".
5. Top Main Gear Clamp Plate should be orientated per **FIGURE 08-05**. Be sure the Top Main Gear Clamp Plate fits tight against the Fuselage Longerons. File upper side of clamp plate if required.

NOTE: Oval hole will be orientated fwd or aft depending on whether on left or right side.

6. If any movement is evident where the Clamp Plates intersect the Gear Legs, use a file to remove material from the Landing Gear Spacer Bushings until the movement is eliminated.

IMPORTANT: Be sure to install Anti-chafe Strip between Gear Leg and Bottom Clamp Plate.

IMPORTANT

TORQUE MAIN GEAR MOUNTING BOLTS TO THE FOLLOWING:

AN5 = 140 INCH-POUNDS

AN6 = 190 INCH-POUNDS

7. It is recommended to paint the Gear Legs and Clamp Plates.

!!! CAUTION !!!

Do **NOT** Powder Coat or Heat-Treat Gear Legs.
Doing so may remove required temper and strength.

8. Final install Gear Legs after skinning and painting of Fuselage.

MAIN GEAR WHEEL/BRAKE INSTALLATION

NOTE: Trike and Taildragger Wheel/Brake Installations have different parts for assemblies. Please be sure to refer to the correct parts page when installing.

1. Become familiar with the Main Gear Wheel/Brake Installation **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. Bolt caliper mount and axle to the gear leg assembly as per PARTS MANUAL DRAWING.
3. Assemble the wheel and brake kit as per parts manual and manufacturer's instructions. With the aircraft in a level attitude, the brake assembly will be orientated to the aft and down.
4. The tire pressure should be approximately 20 psi for Taildraggers and 25 psi for Trikes. To install the wheel assembly, the outer brake pad removes via the 1/4" retainer bolts.
5. Clean and pack the tapered wheel bearings. The tapered roller bearings are oiled from the factory for rust prevention, but not greased. The roller bearings should be cleaned, dried, and then packed with suitable grease. Packing grease without first removing the oil will dilute the wheel grease, causing it to run out past the seal and not lubricate properly.
6. Slip the bearings and wheel / tire assembly back onto the axle. Install the washer and castle nut. Tighten the castle nut to manufactures specifications or bearing failure may result. Secure with the large cotter pin.

IMPORTANT INFORMATION:

MATCO Mfg wheels using tapered roller bearings are equipped with Timken bearings utilizing integrated grease seals on the bearing cone to ensure the longest possible life. The torque procedure for bearings with these type seals is different than for tapered roller bearings without them.

A common torque technique for bearings *without integrated seals* is to tighten the axle nut until the wheel stops spinning freely and then back off to the nearest locking feature. **THIS TECHNIQUE WILL NOT WORK ON A BEARING WITH AN INTEGRATED SEAL.**

The reason for a different torque technique is that the grease seal produces some drag and makes the wheel feel somewhat stiff when rotated. Reducing the axle nut torque until the wheel spins freely will allow the grease seal and the bearing cone to improperly rotate with the wheel (the cone must not rotate relative to the axle).

The higher rolling drag is completely normal for this bearing and allows for longer bearing life since the seal will keep most contaminants out. Timken specification state, for example, that the two 1.25 inch tapered roller bearing used on the WE51 will produce 18-26 inch pounds of torque (drag) when properly installed.

A light coating of grease on the seal will help reduce the drag on initial installation. The drag will also reduce after the bearings have been installed and the seal relaxes in the bore. It is important that the axle nut torque be sufficient to keep the seal from rotating with the wheel. With the bearings cleaned, dried, greased, and inserted in the wheel, the axle nut should be tightened until all play is out of the assembly. Rotate the wheel back and forth while tightening the nut to help seat the bearings. When all play is out of the assembly, and the wheel rotates freely, tighten to the next castle slot and insert the cotter pin. The rubber seal on the tapered roller bearing will remain stationary while the wheel rotates around it. If the seal is spinning on the axle, the nut should be tightened further until the seal stops spinning with the wheel.

7. Apply Thread Sealant to the threads of the brake fitting and install the fitting into the caliper. The fitting should face upward.
8. During Final Assembly, route the brake line from the Fuselage bulkhead fitting, down the Gear Leg, to the Brake Assembly.

NOTE: The brake line will press into the groove machined into the aft side of the Gear Leg.

BOOT COWL

IMPORTANT: The strut tangs need to be drilled to 7/16" before the boot cowl is fit up. See below.

1. Locate long 3/8" and 7/16" drill bits.
2. Drill the strut attach tangs to 3/8" from the forward side.
3. Test drill a piece of scrap with the 7/16" drill. Test fit the bolt to ensure a tight fit with no play. Once satisfied, drill the strut attach tangs to 7/16".

ASSEMBLY

(NOTE: Do NOT rivet the boot cowling to the fuselage cage until after transfer drilling the tabs to the floorboard and installing the nut plates.)

1. Refer to the parts catalog and select the required components for assembly.
2. Apply masking tape to the bottom of the wing strut carry-thru (Station 2) and mark the bottom centerline of the tube. This will become your reference line for trimming the aft bottom edge of the boot cowl skin.
3. Rivet the 3 pieces of firewall together per parts manual. Pin the firewall to Station 1 with two 1/4" bolts. Transfer drill #30 through all tabs. Use a wood block on the firewall side for support when drilling. Cleco as you drill. Remove, debur, and apply Truck Bed Liner Spray to the backside of the Firewall.
4. Cleco the firewall back in place. Bend the small tabs into alignment with the boot cowl side skins during assembly.
5. Position Bottom Boot Cowl Skin flush with forward edge of the firewall flange. Center side-to-side.
6. When satisfied with fit transfer drill #30 through welded tabs on the fuselage. Use a wood block on the Bottom for support when drilling. Cleco as you drill.
7. Slip the Skin Stiffeners (aluminum angles) between the tabs and bottom boot cowling skin. Refer to **FIGURE 10E-07** for positioning. Place the 3/4" flange of the Stiffeners against the skin. Do this by removing one cleco, transfer drill through the aft tab, replace the cleco, swing forward end of Stiffener into place after removing the other clecos. Transfer drill through all tabs. The Stiffeners are provided a little long. Trim as needed.
8. Locate and drill #30 holes approximately every 2" between the tabs. Cleco from the bottom, so they are not in the way of the floorboard.

NOTE: The short flange of the stiffeners will need trimmed to clear brake/rudder pedal mounting tabs.

9. Trim as required. See **FIGURE 10E-08**.

10. With the Stiffeners clecoed in place, lay the floorboard in the fuselage. Align mounting holes and mark the Floorboard flange where it intersects the skin stiffeners. Remove material from flange to prevent contact with Stiffeners. Remove floorboard.
11. Apply masking tape to the Station 2 door opening tube for a trim reference for the side panels of the boot cowl. Draw a line on the tape where the centerline line is on the side of the tube. A matched flush fit is what we are going for between the edge of the door, boot cowling skin and windshield.

IMPORTANT: Remove tape only after final fit of doors and windshield.

12. There is one hole located in the upper forward corner of the Side Boot Cowl Skin. Cleco the Side Skin to the upper side tab, before the curve in the firewall, on the Firewall Support Angle. Refer to **FIGURE 10E-11**. Align the aft edge with the line on the tape at Station 2 tube. The notch in the Skin should also line up with the bottom longeron. See **FIGURE 10E-11**.
13. Tape the Side Skins in place and verify position. Transfer drill #30 the top aft welded tab and cleco. Work from the top to the bottom, transfer drill #30 all welded tabs on the sides.
14. Place Boot Cowl Stiffeners between welded tabs and Side Skin. Cut to length, notch and trim as require to clear fuselage tubes. Refer to **FIGURE 10E-13**. Transfer drill #30 through the tabs into the stiffeners. Remove and layout #30 holes approximately every 2" inches on all stiffeners. Deburr and re-cleco the stiffeners in place. Cleco from the inside to allow install of the Sides.
15. Transfer drill #30 through Stiffeners and Side Skins.

NOTE: Insert 1/8" brass washers or shim material where needed between the tabs and Side Skin if there is any buckling present as you cleco the Side Skins to the Stiffeners.

HINT: Leave the washer stacks in place with the cleco on the inside to keep track of how many and where they are used.

16. Transfer drill #30 through the Firewall Support Angle tabs into the Side Skins along the forward edge. The tabs should be either flush or slightly back from the edge of the Side Skins forward edge. The Side Skin will need to be tight against the tabs as it forms around the bottom curve. Use duct tape to pull the skins tight around the corner.
17. Transfer drill #30 through Bottom Skin, Stiffeners and welded tabs where the Side Skins overlap. Cleco as you drill.
18. Cleco the Instrument Panel Frame to the forward side of tabs on Station 2 vertical tube. See **FIGURE 10E-18**. Slight trimming may be required depending on weld beads. Cleco the Instrument Panel to the Panel Frame. This will help hold the Frame straight. Trim the ends as needed to clear any structure or welds.

19. Bend the Panel Frame tabs and Firewall Support Angle tabs as required to allow the Top Skins to lay flat between the Firewall and Panel frame. Lay a straight edge from tab to tab as a guide to bend the tabs into alignment. Refer to **FIGURE 10E-19**.
20. Cleco aft side of Forward Top Boot Cowl Skin to the Panel Frame tabs.
21. Cleco aft side of Top Side Boot Cowl Skins to the Panel Frame tabs.

NOTE: Fuselage Brace Tubes will exit through oval cut outs in the skins.
22. Modify one 5/8" wide Boot Cowl Spacer Strip to 30" length.
23. Insert modified Spacer Strip between Top Skins and Firewall Support Angles. Center and position flush with forward edge of Top Skins.

NOTE: Spacer Strip should end about halfway between tabs.
24. Insert a Spacer Strip, on both sides of Firewall, between remaining tabs of Support Angles. Position flush with end of modified Spacer Strip and flush with forward edge of Top and Side skins. Trim lower end to be flush with inboard edge of skin.
25. All Skins should be flush with each other on the forward end. Trim as necessary. Reposition Spacer Strips as needed.
26. Transfer drill #30 through tabs at firewall. Make sure the tabs are flush with or slightly behind the Top Skin edge. Check for flushness of Spacer Strips. Cleco as you drill.
27. Transfer drill #40 through pre-drilled holes in Top Side Skins. Transfer drill #30 through welded tabs and upper Side Skin Stiffener.
28. Modify one 1.75" wide Boot Cowl Strip to 30" length. Remove top clecos. Position inside of Firewall Support Angle tabs. Center and position aft against Support Angle on firewall. Strip will extend forward of tabs.

NOTE: Strip should end about halfway between tabs. Transfer drill #30 and cleco.

IMPORTANT: If fluting is desired, do so halfway between rivet location on the portion extending forward of the skins only.
29. Insert a Cowl Strip, on both sides of Firewall, inside of remaining tabs of Support Angles. Position flush with end of modified Cowl Strip against Support Angles on firewall. Form Strip to better fit tight in the curved areas. Trim lower end to be flush with inboard edge of skin. Transfer drill #30 and cleco. The 2 side Cowl Strips will need to be trimmed as shown in **FIGURE 10E-29** to allow clearance with Cowling.
30. Insert Instrument Panel Visor between the Top Boot Cowl Skins and Instrument Panel Frame. Transfer drill #30.

NOTE: The visor should extend aft at least 2" to the aft at top center.
31. Final size drill all holes in Boot Cowl to #30.

32. Check for overlap on all fuselage tubes to the aft of the Skins. Trim if required to the centerline of the tubes.
33. Deburr all parts as needed. Apply High-Temp Silicone Seal to flange of Bottom Skin to seal against Firewall. Rivet Boot Cowl Side Skins to the Bottom Skin, but **NOT** to any tabs welded to the fuselage. Also, do **NOT** rivet the top skins, as they must be removed from the assembly for painting. Mark parts and paint as desired.

INSTALLATION **(AFTER SKINNING AND PAINTING)**

34. Install boot cowl once painted and all assemblies in the area have been fit up. When permanently installing the boot cowl, use two-way foam tape to isolate and dampen sound. This will make for a much quieter cabin.

TAIL WHEEL INSTALLATION

1. Bolt the tail spring to the tail wheel assembly. Refer to the PARTS MANUAL DRAWING.
NOTE: It may be necessary to lightly file or grind the tail spring to fit within the spring mount channel. Do **NOT** modify the channel to obtain the proper fit as rotation of the tail wheel swivel block may occur, producing poor directional control.
NOTE: It may be necessary to use a .016 shim in between the spring and the tailwheel spring channel. Center the shim on the channel and drill the hole for the bolt. Place the spring in place with the unbent shim between the spring and the channel. Use a clamp to squeeze the channel over the spring and start bending the shim. Now the tailwheel assembly can be assembled and the bolt will be long enough to grab and finish bending the shim as it is tightened.
2. Bolt the tail spring/ tail wheel assembly to the fuselage as per PARTS MANUAL DRAWING. Refer to **FIGURE 08A-02**.
IMPORTANT: Be sure the crown of the Gear Strap and AFT Lower Saddle Block is oriented toward the tail spring.
3. During final assembly, it is important that all bolts retaining the tail spring are tight.
CAUTION: Check the tightness of these bolts after the first 10 hours of flying.
4. Install the control linkage as per the exploded view drawing. The linkage will be attached to only the tail wheel at this time. Refer to the **RUDDER SYSTEM ASSEMBLY & INSTALLATION** for final assembly and adjustment of the linkage.

5. The tail wheel is full swivel. This allows pivot turns using brakes or full rudder deflection. A cam mechanism allows it to engage for steering.
6. If the tail wheel leans, shim the tail wheel to run vertical.

NOSE GEAR INSTALLATION

Nose gear mounts are specific to the engine used. Please refer to the FWF section applicable to your build for nose gear installation.

TAIL TIE-DOWN INSTALLATION

NOTE: Tail Tie-Down is only used on Trike Installations.

1. Install Trike Tie-Down Eye Bolt thorough bottom skin of tailcone and FWD Attach Block on AFT side of Station 9 Bulkhead.
2. Orientate Ring fore and aft and tighten nut.

OPTIONAL TOW BAR INSTALLATION

1. Modify Nose Gear Tow Plate per **FIGURE 08A-31**.
2. Install Nose Gear Tow Plates as per parts page.

TAILCONE AFT CLOSEOUTS - (FINISHING KIT)

1. Cleco the S-10/11 closeout and closeout angle in place. Transfer drill into the longerons. Refer to **FIGURE 08A-31A**.
2. Rivet the S-10/11 closeout and angle to S-10, S-11, and the longerons.
3. Trim the aft closeout to the trim lines. Trim an opening into the top for the elevator horn and push-pull tube. Refer to **FIGURE 08A-32**. The opening is cut large to allow backing up, when drilling the mounting holes.
4. Fit up in place against the aft side of Bulkhead #11 and tape in position. Refer to **FIGURE 08A-32** for proper alignment of Closeout. Trim as needed.
5. Transfer drill #30 thru the tailcone skins to the aft closeout. Cleco as you drill. Be sure the aft closeout is tight against the tailcone skins when drilling. Remove aft closeout.
6. Cut the aft closeout reinforcement strip into two 4-1/2" and one 8" length. The strips may be cut a little long, if you wish, and trimmed later to length.

7. Tape strips to inside of aft closeout, centered on the drilled locations. Transfer drill and cleco.
8. Final size drill the hole locations in strips, closeout and skins to #11.
9. Locate nut plates on inside of strips and rivet nut plates to strips and closeout.
10. Re-install tailcone closeout during final assembly. Check for proper clearance with Elevator Horn. Trim Closeout as needed to clear.
11. Paint as desired.

FUSELAGE INTERNAL

Refer to section **9** of parts and figure drawings.

FLOORBOARD INSTALLATION

(THE FLOORBOARD MUST BE TRANSFER DRILLED BEFORE FIT-UP OF BOOT COWL)

1. Lay floorboard in place with the bent flanges facing down. Center side to side and front to back. Check the fit, some trimming may be required where welds or tabs protrude. Once satisfied with the fit, tape or clamp in place. Transfer drill up from the bottom through the tabs as shown in **FIGURE 09-01**. Drill to correct sizes as shown. Cleco as you drill.

HINT: Use a wood block to back up the metal floorboard when drilling through the tabs.

2. Deburr holes.
3. Remove floorboard and install nut plates to tabs per parts manual page. Apply Black Foam Tape to all tubes and tabs that contact the floorboard to dampen cabin noise.
4. Rudder Pedal and Control Stick installations will require the floorboard to be final installed after Boot Cowl fit-up.

(AFTER FIT-UP OF BOOT COWL)

5. Position the floorboard in place and mark where it interferes with Boot Cowl Skin Stiffeners. Mark as needed for clearance notches. Remove and cut notches. Glue Rubber Trim to the lower edge of bent flanges and set aside. The floorboard will be final installed after covering and painting of the fuselage.

RUDDER PEDAL ASSEMBLY - (FINISHING KIT)

Floor Board and Boot Cowl should be fit-up before final install of Rudder Pedals.

1. Rivet together the Upper Toe Pedal Assemblies as shown in the parts manual. Be sure to debur all holes before final assembly of the upper toe pedal. Apply desired finish to Upper Toe Pedal Assemblies.
2. Install the toe pedal assembly to the rudder pedals by sliding the swivel bushings in place. See **FIGURE 09A-02**. Be sure to include the 1/2" plastic washers between the rudder pedals and the toe pedal assembly.

3. Line up the tangs on the end of each swivel bushing with the toe pedal assembly and transfer drill the edge of the toe pedal to #11 using the swivel bushings as a guide. See **FIGURE 09A-03** and parts manual for orientation of the swivel bushings.
4. Install Cotter Pins to swivel bushing to retain 1/2" plastic washer.
5. Refer to **FIGURE 09A-05** and fabricate four Brake Saddles from the provided part. Be sure to use a drill press when fabricating to assure a straight hole through the Brake Saddle.
6. Install Floorboard, Rudder Pedals, and Hydraulic Master Brake Cylinders after skinning and painting of fuselage. Refer to **HYDRAULIC BRAKE INSTALLATION** for Master Cylinder installation.

RUDDER SYSTEM ASSEMBLY AND INSTALLATION - (FINISHING KIT)

PRE-SKIN ASSEMBLY

1. The Rudder Cables and Pulleys at Station 8 should have been installed during Station 8 Bulkhead assembly. If not, go ahead and install them over the pulleys at this time to simplify final assembly.
2. If the plane is to be a taildragger, install the Tailwheel Steer Cable Assembly and Pulleys at Station 8 Bulkhead.
3. Drill the holes in lower Station 4 to 5/8" and debur. Route the Rudder Cables through their respective holes. Slip grommets over Rudder Cables and install into Station 4.
4. Route the Rudder Cables forward to Station 3. Roll up Rudder Cables, bag and tape to a fuselage frame member. This will keep the cables clean when painting and moving the fuselage. Bag and secure Tailwheel Steer Cables to Station 8 or 9.

FINAL INSTALLATION **(AFTER SKINNING AND PAINT OF FUSELAGE)**

5. Attach the Rudder with the hardware shown in the parts manual. The Rudder should swivel freely without any excessive friction.
6. Route the Rudder Cables through the top openings of Station 9 Bulkhead Assembly.
7. Attach the Rudder Cables to the Rudder Horn as shown in the PARTS MANUAL DRAWING.

8. TAILDRAGGER – Route the Tailwheel Steer Cables under the Pulleys at lower Station 9. Attach to Tailwheel Steer Spring per Tailwheel Installation PARTS MANUAL DRAWING. Adjust the Spring Tension after the Rudder Cables are completely installed. Spring tension should be tight with the springs compressed about half of the full amount. Adjust spring tension by removing chain links. Loose steer springs will cause indefinite steering.
9. Pull the rudder cables forward and under the pulleys at Station 3. Install Small Cotter Pins to retain the cables. Continue to route cables forward under the pulleys between Station 2 and 2A. Bolt the small pulleys in place and check for free movement.
10. Install the forward cable/pulley as shown on the PARTS MANUAL DRAWING.
11. Bolt the Multi-Hole Tang on the forward cable to lower hole in Horn on Rudder Pedals.
NOTE: The Multi-Hole Tang has several holes which may be used to adjust for equal tension of the Rudder Cables.
12. Attach Rudder Cables to top hole of Rudder Cable Horns on Rudder Pedals.
13. Check that the cables run through all pulleys and guides. Check for free movement and centering of the Rudder.
14. For final adjustment and checks of the rudder system, refer to RIGGING.

HYDRAULIC BRAKE INSTALLATION

(AFTER SKINNING AND PAINTING OF FUSELAGE AND INSTALLATION OF FIREWALL)

1. Rudder pedals and floorboards must be installed and the airplane should be on the main gear with wheel assemblies mounted.
2. Drill the arm of Parking Brake to 1/4".
3. Locate the holes in the firewall for the Parking Brake, Brake Reservoir and Bulkhead Tee per **FIGURE 09C-03**. Install these after the soundproofing has been installed on the firewall.
4. Install fittings in the brake cylinders as per parts manual using thread sealant. Refer to **FIGURE 09C-04**.
5. Bolt brake cylinder to the fuselage tangs and to the Rudder Pedal Cylinder Attach Brackets as shown in the parts manual. Do **NOT** forget the cotter pins securing the bolts.
6. Check that the pedals and the brake pedals move freely.
7. Route brake lines and install to cylinders, park brake valve and "T" fitting as per **FIGURE 09C-04**.

8. Locate brake line exit holes in Fuselage Bottom Skin per **FIGURE 09C-08**. Install 90-degree Bulkhead Elbow. Route brake lines from Park Brake Valve to 90-degree Bulkhead Elbow.
9. Connect lines to the fittings on the wheel assembly. Press into groove on aft side of landing gear and connect to Bulkhead Elbow.

NOTE: Brake Line pressed into groove of Gear Leg should **NOT** have a protective plastic coating installed. If this coating is installed, carefully slit with a razor knife and remove. Do **NOT** cut into the underlying stainless braid.
10. Fill the system from the bottom through the bleed valves in the caliper cylinders.

HINT: A small hand held oil pump can with a short piece of small diameter hose attached works well.
11. With the oil pump full of hydraulic oil, slide the hose on the oil pump over the lower left bleed valve. Remove the reservoir cap and open the bleed valve. Fill the left side until the fluid is just into the reservoir. Close the bleeder valve and pump the brake pedal to help move air into the line. Continue to fill the left side of the system until all air is removed from the system. Close the bleed valve and remove the oil pump. Refill the oil pump, attach it to the right side bleed valve, and follow the same procedure. Continue to fill the system and alternate sides until the system is free of all air bubbles. Do **NOT** overflow the reservoir, so check it often. Repeat as needed until brakes are solid.

IMPORTANT

Use only aircraft-grade brake fluid.

MIL-H-5606 Red Hydraulic Fluid

Automotive brake fluid will destroy the seals in the system.

12. Fill the reservoir to approximately 3/4 full. Install the reservoir cap.

(AFTER INSTRUMENT PANEL AND FIREWALL INSTALLATION)
13. Mount the park brake control cable in the instrument panel as shown in the parts manual and in **FIGURE 09C-14**. Refer to Instrument Panel Installation for recommended location. Cable may be secured as needed with nylon ties.
14. Route the cable to the cable housing swivel stop. Determine the correct length of cable and housing needed and cut both to length.

NOTE: The cable can be completely removed from the housing for cutting. Leave the cable a little longer as needed for final adjustment.
15. Slide the cable friction block on the cable.

16. Route the cable through the cable housing swivel stop and through the wire swivel stop in the control arm of the park brake valve. Be sure to install the short length of blue fuel line to act as an up stop.
17. Adjust the control arm and cable to allow full open valve with the control knob pushed in and closed with knob pulled out. Slide a short piece of fuel line onto the wire between swivel stops to limit travel. Refer to **RIGGING** for more details.
18. Adjust the cable friction using the screw in the friction block as desired.
19. Loctite the screw in the wire swivel stop. Safety wire the cable housing to the Swivel Stop.

SLIDING SEAT ASSEMBLY

FUSELAGE PREPARATION

(BEFORE SKINNING AND PAINTING OF FUSELAGE)

1. Use a 16" x1/4" diameter steel or brass rod. Clamp the rod and seat rails in the location per **FIGURE 09D-01**. Cleco as you drill. .
2. Drill the #11 holes to 1/4". Install Rivet Nuts. If you do not have a Rivet-Nut puller, refer to **FIGURE 09D-02** for the procedure to install them.
3. Fabricate Seat Stop Tubes from raw stock. Using loc-tite, bolt Stop Tubes and Sliding Seat Position Rail to installed rivet nuts.

SEAT ASSEMBLY - (FINISHING KIT)

1. Trim lower end of Seat Back Frames per **FIGURE 09D-04**. Doublers have been installed in the Seat Back Frame prior to the lumbar bend. Drill them out to #11 using the frame holes as a guide. Counter sink the outboard seat side plates of each seat assembly for the flush head bolts. Bolt the Seat Plates to each leg of the Seat Back with countersunk plates on the outside of the Seat Frame. Refer to **FIGURE 09D-04** for orientation. Leaving the nuts slightly loose at this time will aid in installing the Seat Bottom Frame.
2. Modify Seat Bottom Frame per **FIGURE 09D-05**.
HINT: Pull an aluminum tube or straight edge along the bottom to mark a centerline on the each tube.
3. The Slider Block will rivet to the Seat Bottom Frame after the Bottom Cushion is installed.
4. Modify 8 Multi-Hole Tangs per **FIGURE 09D-08**. Rivet Multi-Hole Tangs to inside and outside of each Seat Bottom Frame.

5. Bolt Seat Bottom Frames to Seat Side Plates through the Multi-hole Tangs. Insert washers and bearings between Multi-Hole tangs. Refer to Sliding Seat Assembly parts manual drawing.
6. Tighten nuts retaining Side Plates to Seat Back Frame.
7. Cut the seat internal tube to 13.75". Slide the seat into place to double check length.
8. Countersink the Sliding Seat Rail Plates with a 120 degree countersink as per **FIGURE 09D-12** for flush rivets.
9. With a 1/4" Quick Pin in Side Plate lower hole, pull Seat Back forward slightly and slip Sliding Seat Rail Plate, on top of fuselage tube, between each set of Side Plates. Release Seat Back. Position Rail Plates per **FIGURE 09D-12**. Be sure to center Rail Plate on fuselage tube.

HINT: Use tape to hold in place temporarily.

10. Remove Seat Frame assembly from fuselage. Transfer drill #30 and rivet in place.
11. Continue with Seat Back assembly by positioning the 3 pieces of the Seat Back Plate. Refer to **FIGURE 09D-14**. Drill and rivet.
12. Complete Sliding Seat Bottom Frame by placing Seat Bottom Pan on top of Sliding Seat Bottom Frame. Refer to **FIGURE 09D-06**. Be sure side and front bent flanges are tight against Frame. Transfer drill #30 and cleco in place the Seat Bottom Pan and mark clearance slot location for the slider blocks. Cleco Slider Block to lower side of Bottom Frame. Mark and trim Bottom Pan to clear Slider Block. Refer back to **FIGURE 09D-06** for detail. Radius all sharp corners of Bottom Pan. Rivet Bottom Pan to Bottom Frame. Remove Slider Block.

OPTIONAL HEADREST ASSEMBLY

1. Become familiar with the Optional Headrest Assembly **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. Mark and drill the Headrest Frame as shown in **FIGURE 09D-24**.

HINT: Use an Aluminum Tube or straight edge, as before, to find the forward and aft centerlines of the Headrest Frame for the lower holes.
3. Rivet the Washers to the inside of the Headrest Frame as shown. The Washers will form "buttons" for the Internal Brace Tube to snap over.
4. Measure and mark up from the lower ends of the Set Back Frame aft side. See **FIGURE 09D-25**.

HINT: Use an Aluminum Tube or straight edge, as before, to find the centerlines of the frame.
5. Drill a #11 hole through only the AFT side of the Seat Back Frame.

6. Pin the Headrest Frame in place with 3/16" bolts. Place small piece of 400 grit sand paper between seat and headrest frame with the grit against the headrest frame. Pull the paper out, this leaves a mark where to locate the second bolt hole. Do this on both sides. Remove and drill completely through on the mark using a drill press. Bolt the head rest frame back onto the seat frame, drill the second hole only on the AFT side of the seat frame.
7. Remove the Headrest Frame and drill the Seat Back Frame to 1/4". Install Rivet-nuts. Refer to **FIGURE 09D-27**.
8. Bolt the Headrest Frame to the Seat Back Frame. Cut the Headrest Internal Tube to length from Raw Stock. File the ends of the tube to match the angle of the Headrest Frame for best fit.

HINT: Cut the Internal Tube long, file to length, and chamfer the ends of the Internal Tube to fit over the washers (buttons).
9. Loosen the Headrest Frame from the Seat Back and snap the tube onto the buttons. Check for a tight fit of the Internal Tube.

SEAT FINAL ASSEMBLY

1. Fabricate Lacing Wires per **FIGURE 09D-16** and **FIGURE 09D-16A** for Seat Cushions. Slip Lacing Wires into pockets. Use a hot knife or soldering iron to burn holes above Lacing Wires per **FIGURE 09D-16** and **FIGURE 09D-16A**.
2. Pull Seat Back Cushion over Seat Back Frame. Flap of Seat Cushion will wrap around bottom of Lower Seat Back Plate. Secure Seat Back Cushion with Long Plastic Ties through the melted holes. Refer back to **FIGURE 09D-16**.
3. Pull Seat Bottom Cushion over Seat Bottom Frame. The large pocket in front will slide over the Seat Bottom Frame. Cross tie flaps will wrap under Seat Bottom Frame. Secure with Long Plastic Ties. Refer back to **FIGURE 09D-16A**. Wrap Aft Flap around Seat Internal Tube. Secure with Long Plastic Ties. Refer back to **FIGURE 09D-16A**. Leave all plastic tie ends long to allow re-tensioning at a later date.
4. Velcro the flap of the Bottom Cushion to the Back Cushion.
5. Locate the #11 holes drilled through the lower side of the Seat Bottom Frames (approx 8 1/4" from the aft end of the frame), and burn through the fabric on each frame.
6. Press Slider Block onto covered Seat Bottom Frame with hole aligned with burned hole.

NOTE: The long leg of Slider block should be to inside of Seat Bottom Frame. Rivet in place.
7. Find the locations of the 4 Rivet Nuts for the headrest and melt through with the tip of a soldering iron or hot knife.

8. Bolt on the Headrest Frame with the Internal Brace Tube in place. Slip the Headrest Cover over the frame and close the Velcro flap.
9. Re-install seats during final assembly.

OPERATION OF SLIDING SEAT

1. The sliding feature of the seat allows quick adjustment of the seat position while sitting in the seat. To change seat position grasp the Seat Back and lean forward, pulling the Seat Back forward with you.
NOTE: Lean forward far enough to allow the 1/4" Quick Pins to disengage from the notches in the Sliding Seat Position Rail bolted under the square fuselage seat rail.
2. Grasp the Main Spar Carry-thru Tube as a handhold and use it to pull or push yourself and seat to desired position. Lean back allowing the 1/4" Quick Pins to lock into position between the notches under the square seat rail. Check to be sure seat has locked in position.
3. To aid exiting and entering the aircraft adjust seat to aft most position.
4. The seat is also adjustable in recline by selecting the proper set of holes in the Seat Side Plates for 1/4" Quick Pin insertion.
NOTE: This adjustment may only be done while out of the aircraft.
5. Apply White Lightning bike chain lube, liquid paraffin wax or similar to the Sliding Seat Rail Plates to make seat movement easier. Let dry before using. The seat will slide very easy when lubed with this waxy stuff. Reapply lube when the seats seem to be less easy to move.

CAUTION

It is NOT recommended to move the seat while occupied and operator of the aircraft. If moving is required, allow a qualified second occupant to operate the aircraft until desired position is obtained.

SEAT BELT INSTALLATION - (FINISHING KIT)

(AFTER PRIMING OF FUSELAGE FRAME/ BEFORE SKINNING)

1. Prior to covering drill the welded attach bushings to 5/16". Refer to the PARTS MANUAL DRAWING for attach bushing locations.

(AFTER SKINNING AND PAINTING OF FUSELAGE)

2. After the fuselage has been covered and painted, bolt each Seat Belt to the respective attach bushing as shown in the PARTS MANUAL DRAWING.
3. Use the elastic bands on the lap belts and lower shoulder belts to hold the tail of the belts after adjustment has been made.
4. This seat belt design allows for quick exit out of both lap and shoulder belts simply by opening the buckle. To use, simply pull belts over lap and shoulder and adjust.

NOTE: To exit, un-clip lap belt.

IMPORTANT: The shoulder belt must pass over the **OUTSIDE** shoulder (in either seat) then diagonally across the chest to the lap belt attach point. Always make sure that seat belts are properly positioned and snug prior to and during entire flight.

CAUTION:

**FOR SOLO FLIGHT -
SECURE UNUSED SEAT BELT**

FUSELAGE - CONTROLS AND EXTERNAL

Refer to section 10 of parts and figure drawings.

CONTROL STICK ASSEMBLY & INSTALLATION - (FINISHING KIT)

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Drill out (1) of the control stick's lower hole to 1/4" diameter. Refer to **FIGURE 10-02**. The other control stick has a 3/16" bolt inserted and does not need to be drilled.
3. Locate and drill a 1/4" hole on the inboard side of each control stick for exit of trim control wire and push to talk switch wire. Refer back to **FIGURE 10-02**.
IMPORTANT: Drill above the pivot tube of the control stick.
4. Grease the thrust bearings and the outside of the control stick torque tube's pivot stubs. Slip the control sticks onto the torque tube with the washers and bearings in the order shown in the PARTS MANUAL DRAWING. Tighten the 3/4" Nyloc Nut until it takes out all the play in the stick, but is not too tight causing binding.
5. Assemble the control stick link tube as per **FIGURE 10-05**. Assemble the unit to the control stick connector tubes.
6. Adjust the control sticks to parallel using the rod end.
IMPORTANT: Make sure the Rod End is engaged at least **10 full threads**. Do **NOT** forget the Loctite and Locking Nut.
7. The fixed end of the link tube uses a 1/4" diameter bushing slightly longer than the link tubes bushing to allow the bolt to be tightened, and not bind the bushing.
8. Fabricate the bushing using the 1/4" x .028" aluminum tube provided.
HINT: For easier fabrication, drill out the inside diameter to #11 before cutting to length.
9. Measure the link tube bushing and add 1/32" for the inner bushing cut length. It should measure approximately 21/32". Apply grease to this bushing and the pivot tube prior to assembly. The 3/16" bolt must be tight enough to hold the alignment to obtain proper cable clearance and the link tube must swivel freely. Do **NOT** forget cotter pins where needed.
10. Thread the 1/4" Plain Bolts into the 2 welded threaded nuts on the Torque Tube. These will be used as control throw stops for the tabs on the Link Tube. Do **NOT** forget the Locking Nuts.

INSTALLATION**(AFTER FINAL INSTALLATION OF FLOORBOARD)**

1. Bolt the control stick torque tube assembly through the floorboard and into the nut-plated tabs underneath. Apply light machine oil to the rotational collars. Check for free movement of assembly. If movement is restrictive, add a thin or thick washer between the torque tube and floorboard. Re-check.
2. Route the Trim and Push to talk wires through hole in base of Control Sticks. Install Mac Control Stick Grip per manufacturer's instructions.
3. If not installing OPTIONAL Passenger Seat Electric Elevator Trim, then install Control Stick Grip and End Cap to top of Control Stick.
HINT: A spray of soapy water to inside of Grip will allow it to slide on easier. Compressed air also works well.
4. Proceed with installation of Push-Pull Tube Assemblies and Aileron Cable System.

CONTROL STICK PUSH-PULL TUBE - (FINISHING KIT)**(AFTER SKINNING AND PAINTING OF FUSELAGE)**

1. Refer to the parts catalog and select the required components for assembly.
2. Fabricate elevator stop sleeves from raw stock per **FIGURE 10A-02**. Slip one sleeve onto 35" push-pull tube before inserting tube through Sliding Block. Slip other sleeve onto tube forward of Sliding Block.
NOTE: Stop Sleeves will be riveted in place during rigging of Elevators.
3. Assemble elevator push-pull tubes, side plates and associated hardware per PARTS MANUAL DRAWING. Install Push-Pull Tube Assembly to mount block between seat rails per **FIGURE 10A-03**. Cut 1/4" Aluminum Bushings to length to fit in Rod Ends.
IMPORTANT: Ensure rod ends are engaged at least 10 full threads.
4. Bolt through top of Side Plate should not be so tight as to restrict pivoting of assembly.
5. Bolt the Rod End to the forward end of the 12" Push-Pull tube to the top hole in the Control Stick Torque Tube.
IMPORTANT: Ensure rod end is engaged at least 10 full threads.
6. Modify the small cable keeper per **FIGURE 10A-05** to make individual cable keepers. Feel free to modify all of the parts, just be sure to keep track of them after modification.
7. Bolt small cable keepers, small pulleys, and sliding block to the welded tabs at station 3.

8. Fabricate aluminum bushings as shown in parts pages.
NOTE: The 1/4" Bushing inserted through the Sliding Block should be wider than the Block to allow it to swivel.
9. Rotate the small cable keepers to the bottom of the pulleys and tighten the bolt to prevent rotation. Insert cotter pins after rudder cables are installed.
10. Lubricate the sliding block and 35" Push-Pull Tube with white Corrosion X to allow easy movement. If necessary, the powder coat on the push-pull tube may be smoothed in the contact area with a Scotch-Brite Pad.
11. Check push-pull tube assembly for smooth operation.

ELEVATOR PUSH-PULL TUBE - (FINISHING KIT)

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Slide Elevator Push-Pull Doubler inside the forward end of Elevator Push-Pull Tube.

NOTE: The forward end of Push-Pull Tube only has a through hole drilled in it.

3. Cleco in place. Transfer drill through Doubler #30, the 4 rivet locations. Rivet Doubler in place. Drill the #30 thru-hole in the forward end of the Elevator Push-Pull Tube and Doubler to 1/4".
4. Slide the Elevator Push-Pull Tube Fitting into the aft end of the Push-Pull Tube until bottomed.
5. The bolts at either end of the PPT must be aligned with each other when assembled.
 - a. Lay the assembly on a flat bench or floor. Insert a long 1/4" rod or bolt through the 1/4" holes in the forward end and aft end of Push-Pull Tube Fitting.
 - b. Support each side of the 1/4" rods with scrap lumber of equal height. Refer to **FIGURE 10B-04**.
 - c. Re-check for proper insertion of Elevator Push-Pull Tube Fitting and transfer drill #30 through the PPT into the Fitting. Cleco as you drill.
 - d. Rivet Fitting in place.

INSTALLATION

6. Slip the Elevator Push-Pull Tube Assembly into the tailcone from station 11. The Elevator Push-Pull Tube will pass through the lower openings of Stations 4,5,6,9 and 10.
7. Slide forward end of Elevator PPT over the aft end of previously installed 35" PPT. Bolt through welded bushing of 35" PPT.
8. After Elevator installation, bolt AFT end of the Elevator Push-Pull Tube to Elevator Horn. Check to see if the Elevator moves up and down freely.
9. Up/down Stops on 35" Push-Pull Tube are ready to be set during rigging.

AILERON CABLE SYSTEM INSTALLATION - FUSELAGE **(FINISHING KIT)**

(AFTER SKINNING AND PAINTING OF FUSELAGE)

1. Refer to parts page and select the required components for assembly. Leave the bolt through the U-bracket slightly loose to allow a small amount of rotation.
2. Bolt Pulley Assemblies to bushings welded to Fuselage. If needed run a #11 drill bit through the bushings.
3. Route Aileron - Control Stick Cable, bolted to center of Control Stick Link Tube, through Pulley Assembly outboard of Control Sticks.
4. Route cable aft through tangs welded to Fuselage. Install Small Pulley between Tangs.
5. Attach Turnbuckle to aft end of cable.

(AFTER WINGS MOUNTED TO FUSELAGE)

6. Route longer side (cable that comes from the forward side of the aileron bellcrank) of the Aileron Cable from wing through Pulley Assembly at upper station 3 and down to the Pulley Assembly at lower station 3.
7. Route the cable forward and connect to the turnbuckle attached to end of Aileron - Control Stick Cable. Refer to **FIGURE 10C-06** for a control system overview.
8. Install a small pulley and cable keepers midway up on station 3.
NOTE: Refer back to **FIGURE 10A-05**, if needed, for Cable Keeper trimming.
9. Route cable to outboard side of small pulley located mid station 3. Install cotter pins to retain the cable in the pulley groove. Refer to **FIGURE 10C-07**.
IMPORTANT: Make sure bolt is tight enough to prevent rotation of the cable keepers.
10. Route the short side (aft side of aileron bellcrank) of the aileron cable from the wing under the small pulley at upper mid station 3. Install cotter pins to retain cable in the pulley groove.
IMPORTANT: Make sure bolt is tight enough to prevent rotation of Cable Keepers.
11. Connect the short ends of the aileron cables to each other with a turnbuckle at upper mid station 3.
12. Refer to RIGGING AND PREPERATION FOR FLIGHT for rigging and tensioning of cables.

FLAP LEVER - (FINISHING KIT)

ASSEMBLY

1. Refer to the parts manual and select the required components for assembly.
2. Fabricate the following bushings to the appropriate lengths from Raw Stock:

<u>Qty.</u>	<u>Length</u>	<u>Tube Size</u>
1	1.0"	1/4" X .028
1	5/8"	1/4" X .028
2	3/8"	3/8" X .058

3. Press the plastic end caps into each end of the Flap Trip Release Tube. Transfer drill 1/4" though the hole at the base of the release tube to remove material of End Cap for bolt insertion.
4. Bolt the flap handle between the two side plates with the welded tab facing downward. Tighten the flap handle lever pivot bolt so it is snug but still allows the handle to pivot freely. Do **NOT** forget the washers at the base of the flap handle.
5. Slip the spring into the tube of the flap handle. Install the flap release tube with end caps installed.
6. Depress and rotate the flap release tube until the 1/4" hole is lined up with the slot in the Handle. Install the 1/4" bolt and 3/8" diameter bushings into the flap lever and release tube.

NOTE: The slot should be within the notched area of the Side Plates.

7. The bushings act as rollers as they ride against the notches of the Side Plates. Tighten the bolt to the point the bushings still roll. Apply light grease to the rollers for the best action.
8. Insert 1" long bushing between upper forward end of side plates and bolt into place.

NOTE: The lower holes in the side plates will be used to mount the flap lever assembly to fuselage after skinning and painting.

9. Modify (2) Plastic Shims per **FIGURE 10D-08**.
10. Modify (2) Angle Brackets per **FIGURE 10D-09**. Slip a Tinnerman over the modified end and center on the hole.
11. Temporarily install bolts to retain the angle brackets, plastic shims, 1/4" spacer bushing, and Teleflex retainer brackets to the aft end of the flap lever assembly.

12. Temporarily bolt rod ends to each side of the welded tab on the flap handle. The exact adjustment of the rod end on the Teleflex will be determined when adjusting the flaps during final rigging.

INSTALLATION
(AFTER SKINNING AND PAINTING)

13. Install the flap lever assembly into the cockpit by slipping the forward part of the assembly over the "T" shaped attach fitting located between the seats on the airframe and bolt in place. Refer to the PARTS MANUAL DRAWING. Rotate the aft end of the assembly down and temporarily insert a bolt to retain the lower aft end to the mount block welded to the fuselage.

(AFTER WINGS MOUNTED TO FUSELAGE)

14. Route the Teleflex cables from the aft edge of the wing down the aft side of station 3. Refer to the on-line photo library for specifics on routing.
15. Retain with cushioned clamp half-way down station 3 (refer to AILERON CABLE SYSTEM INSTALLATION - FUSELAGE).
16. Route toward the center of the fuselage under the baggage compartment area and forward through hoops welded to Station 2A.
17. Disconnect the rod ends from the flap lever assembly and screw onto ends of the Teleflex cables.

IMPORTANT: Ensure rod end is engaged at least 10 full threads.

18. Unbolt the aft end of the assembly from the welded mount block. Use the plastic shims, Teleflex retainer and 5/8" long spacer bushing to bolt the end of the Teleflex cable to the inside of the side plates as per the PARTS MANUAL DRAWING.

NOTE: The Teleflex cables will attach between the retainer and plastic shim.

19. Bolt the aft end of the assembly to the welded mounting block.
IMPORTANT: Teleflex Cables should **NOT** interfere with aileron cables, rudder cables or elevator push-pull tubes.
20. Bolt the rod ends to each side of the welded tab on the flap handle. The exact adjustment of the rod end on the Teleflex will be determined when adjusting the flaps.
21. Test operate the lever by pulling up on the lever, then depressing the release tube to return. Operation should be smooth.

BELLY FAIRING INSTALLATION – (FINISHING KIT)

(AFTER ATTACHMENT OF GEAR LEGS TO FUSELAGE)

1. Trim base of fairing to allow a slight flange edge where it mates to the fuselage. See **FIGURE 08B-01**. Trim outboard edge to be flush with no flange.
2. Cut out opening to fit snugly over Main Gear Leg and Top Main Gear Clamp Plate. Refer to **FIGURE 08B-01**. Cut small and trim to fit.
3. Locate the dimples in the base of the fairing and drill to #30. Slip fairing over Gear Leg and position outboard edge just inboard of fuselage side skins.
4. Make sure fairing is tight against Fuselage Bottom Skin. Transfer drill #30. Remove fairing.
5. Drill #30 holes in fuselage skin to 1/4". Drill fairing to #11.
6. Install Rivet Nuts into fuselage skin. See **FIGURE 08B-06**.
7. During Final Assembly, slide fairing into place and secure with Truss Head Screws.

VENT SYSTEM - (FINISHING KIT)

(BEFORE SKINNING AND PAINTING)

1. Refer to the parts catalog and select the required components.
2. Position NACA scoop of Vent System centered on Side Skin cutout. Transfer Drill #30 through Side Skins. Cleco in place.
3. Recommended location for openings in Instrument Panel for eyeball vents is shown in **FIGURE 10E-37**. Use as a 1:1 template. An alternate method is to cut the large opening and place eyeball vent behind panel to locate the perimeter holes.
4. Use the eyeball vent and transfer drill through the hose adaptor flange.
5. After mounting the Instrument Panel in the Panel Frame, route the duct hose and cut to length as needed.
6. Remove assembly and set aside for installation after skinning and painting.

INSTALLATION

(AFTER SKINNING, PAINTING AND INSTALLATION OF BOOT COWL)

7. Apply Silicon Seal to mounting flange of NACA scoop. Rivet to inside of Boot Cowl Side Skin.
8. Install Instrument Panel with eyeball vent and hose adaptor installed.
9. Attach duct hose and secure with hose clamps.

INSTRUMENT PANEL INSTALLATION

ASSEMBLY (BEFORE SKINNING AND PAINTING)

1. A blank instrument panel is provided with the kit. The builder should design and cut his own instrument and switch holes in the panel or contact a commercial aircraft panel manufacturer.
IMPORTANT: Check instrument clearance to the Panel Frame before cutting instrument mounting holes.
2. Double-check your design before cutting the panel. Refer to **FIGURE 10F-01** for a suggested panel design.
3. Refer to **FIGURE 10F-02** and use the provided 1:1 template to mark and drill the three 3/8" holes in the left side of the instrument panel. The control cables for Parking Brake, Cabin Heat and Carb Heat will mount here during final assembly.
4. Drill Panel Mount Holes to #11. If need to lay Panel over frame to determine which holes to drill to #11, Rivet nut plates to forward side of Panel Frame.
NOTE: Instrument Sub-panel will also rivet to lower center frame hole with nut plate rivets.
5. The 5/16" holes in the Panel perimeter are to allow the rubber grommets (vibration isolators) to be installed.
IMPORTANT: Do **NOT** drill holes in the Panel Frame larger than #11.
6. Fit-up Instrument Sub-Panel and Radio Mount Plates at this time.

INSTALLATION (AFTER SKINNING AND PAINTING)

- NOTE:** Application of OPTIONAL - DASH COVER FOAM and FABRIC requires Windshield to be fit-up.
7. Rivet Panel Frame to forward side of welded Fuselage tabs. Refer back to **FIGURE 10E-18**.
 8. Slip Boot Cowl into place. Cleco to welded fuselage tabs. Cleco Boot Cowl Top Skins in place. Check to be sure oval cutouts in Top Side Skins clear fuselage tubes. Trim skins if required.
 9. Modify Oval Glare Shield Rings per **FIGURE 10F-08**. Orientate cut forward. Slip over fuselage tubes and center. Transfer drill #30 to Top Skins. Do **NOT** rivet to Top Skins until Final Assembly.
 10. Rivet Boot Cowl to fuselage through welded tabs. Rivet Top Skins in place. Be sure to include the Panel Visor between the Top Skins and Panel Frame.

11. Application of OPTIONAL - DASH COVER FOAM and FABRIC requires Windshield to be fit-up. Cleco Windshield Hold Down Strip to Top Skins. Mark the upper contact area on the Top Skins. Remove Hold Down Strip.
12. Spread roll of foam and fabric out separately and orientate to cover top skins. Roll each piece up from the sides until the center is reached. This will allow them to be placed on the center of the Top Skins and rolled outward to cover.
13. Using contact cement spray (3M SUPER 77 Multipurpose Spray Adhesive may be used) glue foam to Top Skins up to the marked line and allow to dry. Trim foam to marked line and aft edge of Visor.
HINT: Split the Foam forward of the Top Panel oval cutouts and trim to the edge of the cutout. Spray and glue a small area at a time, from center out, to aid in a smooth wrinkle free application of the Foam.
14. Glue Panel Fabric over foam and allow to dry. Trim to aft edge of Visor.
HINT: Split the Fabric forward of the Top Panel oval cutouts and trim to the edge of the cutout. Spray and glue a small area at a time, from center out, to aid in a smooth wrinkle free application of the Fabric. When gluing in place carefully match the splits to make a hidden seam.
15. Rivet Oval Glare Shield Rings to Top Skins.
16. Push Trim lock onto aft edge of Visor. Tuck fabric into Trim lock when installing.
17. Install Instrument Panel to Panel Frame with Rubber Grommets in Panel Holes. Do **NOT** over-tighten, as the Grommets will aid in vibration isolation.

SUB-PANEL & RADIO MOUNT PLATES

ASSEMBLY **(BEFORE SKINNING AND PAINTING)**

1. Rivet Sub-Panel Reinforcement to forward side of Sub-Panel. Refer to Parts Pages for detail.
NOTE: Locate Reinforcement with #11 hole closest to edge to the Left side of the Sub-Panel. These #11 holes may be used to help locate opening for other engine controls such as choke, mixture, carb heat, etc.
2. Rivet Throttle Brace and Fire Extinguisher Mount to top side of lower flange of Sub-panel.
3. Cleco Sub-Panel to lower center of Panel Frame.
NOTE: Top center hole of Sub-Panel should be drilled to #11 for panel screw.
4. Transfer drill outboard holes to #30. Rivet with 1/8" rivets on outboard edges and 3/32" rivets for nut plate.

5. The aft end of the Mount Plates will be riveted to the instrument panel. Locate 2 #30 holes in the short flange of each Mount Plate for riveting.
NOTE: Mount trays from Comm Radio, Transponder, etc., will be required to position Mount Plates to correct width.
6. Trim the forward ends as needed to clear the fuselage crossing tube.
7. If full height of Mount Plates is not required, trimming to half height is acceptable.
8. Fabricate 2 aluminum angle supports from raw stock. Cut to length to allow to overlap onto sides of Mount Plates and extend upward to fuselage crossing tube.
9. Locate and drill a #11 hole in each support angle and cleco with cushion clamps to fuselage crossing tube.
10. Locate and drill #30 rivet holes into support angles and sides of Mount Plates. Make sure Mount Plates are 90-degrees to panel and rivet angles to Mount Plates.
11. Instrument Panel, Panel Frame and Sub-Panel may be removed as an assembly.

INSTALLATION
(AFTER SKINNING AND PAINTING)

12. Install Sub-Panel along with Panel Frame and Instrument Panel.
13. Install Throttle Cable and other engine control cables as needed in Sub-Panel, route through firewall and connect to engine.

WING INSTALLATION

Please read the entire section before you continue with Wing Installation.

We recommend having all assemblies and installations related to the Wing completed before the Wings are final installed to the airplane. It is NOT necessary to trial-fit the Wings to the Fuselage at an earlier assembly stage.

The following items should be completed at this stage:

- Final check of all rivets, hardware, safety wire. Make sure all rivets in the skins have been pulled. If any mandrels are sticking out they must be filed off.
- Wing tips finished but removed for wing install.
- Wings are painted.
- Fuel Sight Gauges installed to Wing root.
- Lift struts assembled.
- Strut attach tangs on the fuselage are drilled to 7/16".
- Wing truss to Strut truss fitting bolts are loose.

It is recommended to hang both Wings at the same time (one at a time). You will need at least one helper. However, it is more comfortable to have two helpers.

1. Set the wing on saw horses next to the fuselage so that it can be lifted straight up and into place.
2. Follow the following procedures to trim the T-bone on the Fuselage to fit the wing:
 - a) On the wing, Measure from the AFT side of the Forward Spar to the center of the 5/16" bolt on the aft attach fitting.
 - b) Add 3/8" to measurement to account for Forward Spar and doubler.
 - c) On the fuselage, measure from the centerline of the hole for the 5/16" bolt on the AFT attach fitting to the AFT side of the T-bone. Mark the distance previously measured plus the 3/8" allowance.
 - d) Cut the bushing to the mark. Keep as square as possible.
 - e) Measure the inside distance of the Forward Spar.
 - f) Mark this measurement from the AFT side of the T-bone to the forward side.
 - g) Cut off the FWD side of the T-bone at the mark. Keep as square as possible.
 - h) Debur both cuts.

IMPORTANT: It is recommended to apply some corrosion protective primer to the bare metal.

3. Drill through the forward and aft 1/4" pilot holes on the D spar with a 5/16" bit from each side. Finish with a 3/8" long enough to pass through both sides of the D spar.
4. Have one person lift at the wing tip and one person lift at the root.
5. Walk the wing over to the fuselage and slide all the cables and wires through the appropriate place on the fuselage. Then slide the AFT attach fitting bolt through the hole in the fuselage and start a nut on the inboard side.
6. Walk the tip forward slowly to slide the Forward Spar over the T-bone. Insert the correct 3/8" bolt into the hole in the forward side of the Forward Spar to temporarily hold it in place.
7. With someone still holding the wing tip up (if using a step ladder, buffer with a pillow and place on the tip rib) , slide the lower attach fitting on the strut assembly into the tangs on the fuselage. Lift the lift strut up and slide it into place between the wing truss/strut attach doublers. Install the bolt with the nut finger tight. The wing is now attached to the fuselage and no longer needs to be supported.
8. All of the correct hardware should now be in place and can now be tightened. This includes the front spar attach bolt, 3 bolts on the aft attach fitting, the bolts at the top and bottom of the strut, and the bolts on the strut truss fittings.

NOTE: For the 5/16" bolt on the AFT attach fitting, use a flathead screw driver or similar on both sides of the bolt head to keep the bolt head from spinning while tightening the nut. Do not damage the AFT attach fitting while tightening the nut.

9. Once all the hardware is tightened, the second hole in the AFT attach fitting can be drilled and bolted. Make sure the aft spar attach shims are aligned with the aft spar attach fitting. When drilling align drill 90 degrees to the spar fitting in both vertical and horizontal axis.
10. Refer to **AILERON CABLE SYSTEM INSTALLATION** in **SECTION 10C**. Connect the Aileron Cable as shown.
11. Refer to **RIGGING** for information about Bell Crank position and cable tension.
12. Route the Flap Teleflex Cable inside the Fuselage. Route both Flap Teleflex Cables aft of Station 3 down the side of the fuselage and forward through the wire loops welded to the fuselage frame at Station 2A. Both Teleflex Cables route forward and connect to the Flap Handle. Secure Teleflex cables mid-way up on Station 3 with Cushion Clamps.
13. For adjustment of the Flaps, refer to **RIGGING**.
14. Fabricate the Fuel Lines to connect the Wing Fuel System to the Fuselage Fuel System. Refer to **FUEL SYSTEM INSTALLATION - FUSELAGE**.

NOTE: Fuselage section of the fuels system is dependent on engine selection.

15. Refer to **FIGURE 06I-19**. Position the Wing Root Bottom Gap Seal on the bottom side of the Wing so that the flange is tight against the Fuselage frame. Mark and drill #30. Remove gap Seal. Drill Wing Bottom Skin to #11. Install Tinnermans on Bottom Wing Skin.
16. During final assembly, attach the 1/2" Black Foam Tape to the flange that will rest against the fuselage frame. Attach the gap seal to the wing with the screws provided.
17. Installation of Flap Fillet will be done after **WINDSHIELD INSTALLATION**.
NOTE: The fillet flap is installed to the top front skin on the tailcone and closes the gap between Fuselage and Flap.
18. Connect Pitot line to Union Elbow connector in the wing.

WING TIP

NOTE: Mounting Plate for strobes may be installed before or after fit up of wing tip.

ASSEMBLY

1. Cut the round end off the trailing edge of the support rib at the point where it transfers from the round end to the rib.
NOTE: Use a pair of hand shears or a Dremel with a cutoff wheel. Debur as needed.
2. Trim the support rib down to a flange length of $\frac{3}{4}$ " from the face of the rib. Cut out all the rib pockets to $\frac{3}{4}$ " flange as well.
3. The flat side of the support rib will bolt to the rib on the end of the wing and the flange will extend into the wing tip when assembled. As such, the very aft section of the support rib must be tapered to fit inside the wing tip when assembled. Taper the flange length down to $\frac{1}{8}$ " at the very rear to $\frac{3}{4}$ " where the aft most rib support starts.
4. Trim the wing tip to the molded in trim line. Use a sharpie or masking tape and highlight the trim line for ease of seeing the line.
5. Place a masking tape edge around the wing on the very outside edge. Carefully stick the tape down with the very edge of the tape to the very edge of the skin of your wing. This tape can be $\frac{3}{4}$ " or wider tape. Note the width of the tape. It will be used for a measuring reference where the wingtip overlaps the wing during fit up.
6. Position the wing tip on the wing and closely match the profiles. Minimize the overlap but let the tip overlap onto the wing if necessary. Tape in place.
7. Use the edge of the tape as a reference to measure and mark the end of the wing onto the wingtip. Make a series of marks to produce a new trim line. Pay close attention to any areas that holds the wing tip away from the skin and spar. If the spar sticks out slightly from the rib, trim around these spots as well. Take your time and trim precisely.
8. Once trimmed hold the tip back up to the wing and verify fit. Repeat the process until you are satisfied with how the wingtip mates to the wing.
9. Debur all the edges of the wing tip and wing tip support rib. Sandpaper works great.
10. The wing tip and wing tip support rib can now be glued together. Create a fixture out of a piece of $\frac{3}{4}$ " MDF or plywood.
 - a. Lay the support rib on the MDF or plywood and mark the outside perimeter.

- b. Cut out the profile saving the material outside of the profile. A hole can be cut in the inside of the profile for access or it can be cut in half at the ends of the profile and reconstituted with a piece of material. Set the fixture aside.
- c. Place the support rib on the table with the flange up and use .050 thick material to shim the wing tip support rib off the table.
- d. Weight the rib in place with sand bags or weights of some sort.
- e. Test fit the wingtip, support rib, and fixture set up before applying glue.
- f. Apply ABS or PVC glue on the wing tip and wing tip rib where the two will mate. Place the wing tip over the support rib and slide the jig over the wing tip compressing the wingtip to the support rib at the bottom.
- g. Place weights on top of the wing tip and let the glue cure.

INSTALLATION

11. Position the tip on the wing and tape in place. Ensure a proper fit as this will be the wing tips final location.
12. Access through the inspection holes in the bottom wing skin to transfer drill the #11 holes in the wing rib to the wing tip support rib. Cleco as you go.
13. Remove the wing tip and install nut plates and nut plate supports (removed from the bottom wing skin, cut apart and debur if needed) into the wing tip support rib.
14. The wing tips are now ready to paint.
15. Now is a good time to paint the wing, ailerons, and flaps. It is up to the builder to decide when to paint the airplane. Some people will prefer to fly phase 1 before painting. Others will want to paint now before final assembly of the wing. Others may decide to stop at this point and finish the fuselage to ready to paint and paint the wings, fuselage, and tails at the same time.

OPTIONAL STROBES INSTALLATION

1. Route wires in wing and out to the tip through the grommets in the wing ribs. Leave extra length to reach through the wing tip and fuselage.
2. Position the Strobe Light Mount centered inside the flat area of the Wing Tip. Be sure the strobe will be straight when mounted. Transfer drill #40 through the aft set of nut plate rivet holes. Cleco in place. Transfer drill #11 through the center hole for the nut plate. Rivet a nut plate to the Mount inside the Wing Tip.
3. Use a Dremel tool to remove Wing Tip material inside the Mount for the wires and strobe retaining pin.

NOTE: Use the Dremel tool as a router to obtain a clean opening.

4. After painting of Wing Tip, mount Strobes to Wing Tip and connect wiring. Route wire into fuselage when installing Wing to Fuselage.

AILERON AND FLAP ATTACHMENT

1. Make sure all the bronze bushings are in place on the hinges as well as the hinge arms. This is best after surfaces are painted. Refer to the Parts Manual Drawing for orientation of the bushings, bolts, and washers.
2. Place the control surface on the wing in the correct orientation and slide the hinges over the hinge arms. Make sure the bronze bushings stay in place.
3. Place the bolts through the hinges. Lightly tighten the bolts. Leave the bolts just loose enough that the control surfaces move freely.
4. Check for clearance between the aileron and wing. No contact is allowed, trim if required to have at least 1/16" gap.
5. To protect the paint finish place a piece of foam pipe insulation on the aileron hinge arms.

FORMED WINDSHIELD & SKYLIGHT INSTALLATION

(FINISHING KIT)

Windshield and Skylight assembly require wings to be attached and the boot cowling in place

- The windshield is provided in trimmed form and should not need any major trimming. Test fitting will confirm if trimming is required. Please review the link below on tips for successful trimming and drilling of Acrylic.
- Observe all Safety and Health Warnings when handling Acrylic.
- Sandbags or similar weight will be required in part of the assembly to hold the Windshield in place.

Below are some hints from the Acrylic Windshield Manufacturer.

What is the proper technique for cutting a windshield?

- Before you begin trimming your windshield, trim the protective film back away from the line. Tape the edges down with clear packing tape, also tape any seams of the protective film. This will prevent Acrylic chips and dust from getting under the film. An abrasive wheel powered by a drill, Dremel tool, or a die grinder is recommended. Reciprocating saws like jigsaws or sabre saws are not recommended and will probably break your windshield. A tool that grinds the windshield is best. Mark your windshield with a grease pencil or a Sharpie. Allow the windshield to warm to room temperature. Do NOT allow the windshield to vibrate or chatter while cutting or it may chip or crack. Support your windshield so it will not twist or spread during trimming. Duct tape is handy to hold things in place. Cut slowly, do not push the cutter. Let the tool do the work. Use eye protection. Acrylic chips can be a problem in your eyes since they are clear and difficult to see. After the windshield is trimmed, use a hand-held belt sander (we prefer the 3"x18" 40-60 grit) to sand down to your line. De-burr the edge with a scraper or sandpaper before trial fitting to keep from breaking the windshield or cutting your fingers.

What is the proper technique for drilling?

- When drilling Acrylic, best results will be obtained using commercially available acrylic drill bits (We recommend the Diamond Dust drill bits available from Craftics). If the desired hole is larger than 3/16", drill with a Diamond Dust drill bit first and then enlarge with the Unibit #2 (New styles should not be used to drill a 3/16" hole due to the aggressive nature of the SpeedPoint). For holes larger than 3/8", different techniques can be used.

Hole saws and two-flute Vortex router bits are a few options available. Drill several practice holes in scrap pieces of Acrylic to perfect these techniques before drilling your part. Back-up the windshield with a block of wood. Start with a slow speed and light pressure, then increase the speed and pressure. As the drill bit starts to go through the Acrylic, reduce the speed and pressure so the drill bit goes through the Acrylic slowly. Drill holes oversize to allow for motion caused by thermal expansion and contraction. Lightly de-burr the holes with a countersink we prefer the single flute style.

General drill speeds

Diameter	<u>Speed RPM</u>
.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

How should I clean my windshield?

- Use cleaners specifically for Acrylic. A damp cloth or an air blast will clean the dust away. To achieve the best results use fore and aft motion instead of a circular motion. To clean dirty Acrylics use plenty of water and non-abrasive soap or detergent. All-cotton flannel can be used for drying. Never use aromatic solvents such as acetone, benzene, carbon tetrachloride, lighter fluid, lacquer thinners, gasoline, window sprays, concentrated alcohol, ketones or scouring compounds. Avoid using cleaners with ammonia, such as 409. Grease, oil or tape residue may be removed with kerosene, white gasoline, naphtha or isopropyl alcohol (Do not use isopropyl alcohol on extruded Acrylic). Mineral spirits is our favorite. Wash approved solvents off of windshield with Dawn dishwashing liquid or equivalent and water followed by a clear water rinse. To prevent water spots, blow dry with compressed air or wipe dry with soft cotton flannel.

Should I remove scratches?

- Small scratches can be buffed out with Novus #2 or #3 depending on the severity of the scratch. For deep scratch removal, use Micro Mesh or 3M Window Repair Kits. Avoid removing scratches in critical areas where optics are important. The optics are almost always worse after the repair than the original scratch.

What should I do if my windshield cracks?

- Stop-drill the crack. Use a 1/8" drill bit if your window is 12x20 or smaller. 3/16" Drill bit if your window is larger. For even larger and thicker windows you can use up to a 1/2" drill bit. Any permanent repairs should have a doubler made of either Acrylic or aluminum.

What types of Solvents/Structural Adhesives should I use?

- The most common used are Weld-On 3, Weld-On 40, Scotch-Weld 2216, SikaFlex 295 UV with appropriate primers and cleaners. Use each at your own discretion.

DO NOT USE LOCTITE. It crazes the Acrylic.

One source for more information may be found at

<https://www.plexiglas.com/export/sites/plexiglas/.content/medias/downloads/sheet-docs/plexiglas-fabrication-manual.pdf>

Both the literature and the viewing software are free.

Acrylic (windshield) and Lexan (skylight and doors) may scratch very easy. To get a longer service life from your windshield and other Lexan surfaces, we recommend a soft terry cloth and a cleaner made for plastic. RANS uses a product called Brillianize. It is available from RANS or any large aircraft supply company.

IMPORTANT: The big no-no is NEVER dust off a windshield, unless you have sprayed on some sort of fluid. Dry dusting will readily cut millions of fine scratches into the glazing, dimming its clear optics.

If fuel is spilled, wipe clean with a clean cloth immediately to lessen the chance of crazing damage.

CAUTION

AVOID FUEL COMING IN CONTACT WITH LEXAN.

1. Collect all the parts shown on the part pages for the windshield. Extra care should be taken when working with Acrylic and Lexan. Both may scratch easily and as much as possible of the protective plastic should be left in place until the aircraft is ready to be flown.
2. Drill all 3 windshield tabs located on the leading edge spar carry-thru as shown in **FIGURE 10G-02**.
3. With the wings attached to the fuselage, position and tape at least two straight edges from wing root to wing root as shown in **FIGURE 10G-03**. The tape will help to keep them in place, while fitting the Outer and Center Ribs. The straight edges will be used to set the height of the windshield ribs level with the wing root.

NOTE: The straight edges should only rest about 1" on the wings otherwise the wing dihedral will raise the position of the windshield and skylight.
4. The Ribs may require some minor forming to follow the contour of the airfoil at wing root. To conform the ribs gently bend over a curved edge of .75" thick plywood cut to a 12" radius, or similar object. If over bent flatten by pressing against a flat surface. Make small adjustments comparing to the wing root often.
5. Radius the top front end of the each rib as per **FIGURE 10G-02**. Center all three ribs on the S-2 carry thru tabs and drill and cleco #30. These holes will be counter sunk for #30 flush rivets in a later step. Refer to **FIGURE 10G-02**. To prevent the ribs from bending the tabs on the S-2, tape them in place on the aft tabs. Tape the aft end of the middle rib to the top of tab on the S-3 carry thru.
6. Position AFT end of Outer Ribs on the outside of the aft attach tabs forward of Station 3. Push the outer ribs up to touch against the straight edges. Transfer drill and Cleco. See **FIGURE 10G-06**. Trim the end of each as required.
7. Trim to length the middle rib to overlap the tab with sufficient edge distance. Center on the rib on the tab and transfer drill #30 from the bottom.
8. Countersink rib-mounting holes in all forward tabs and rivet in place with flush rivets.
9. The windshield is supplied very close to final shape. If there are any black sharpie lines, trim to these lines. Fit the windshield in place. Refer to **FIGURE 10G-09**. Tape in place. The windshield is held in place by clamping action of the hold down and mating strips, the exception is the 5 fasteners used to secure it to the middle rib. These are the only fasteners to be used to secure the windshield in place. Drilling of these holes is called in a later step. Please pay attention to what type of drills to use and temperature to work with the Acrylic.

10. Using a black Sharpie mark the forward edge of the skylight per **FIGURE 10G-10**. Place the windshield mating strip centered on the skylight with the holes over the black line. Clamp or tape in place and transfer drill #30. In a later step the #30 Skylight holes will be drilled to #28. This is a critical step to prevent the Lexan skylight from cracking. Do NOT drill #28 at this time or it will make for sloppy transfer drilling.
11. Using a black Sharpie mark the forward edge of the skylight spacer strips per **FIGURE 10G-10A**. Place the windshield mating strip centered on each spacer strip, one at a time, with the holes over the black line. Clamp or tape in place and transfer drill #30. Trim ends of spacer strips to match length of mating strip. Debur.
12. Fabricate skylight trim strips per **FIGURE 10G-11**.
13. Lay the outer hold down strip, outer hold down spacer and outer trim strip in position just inboard of the inboard row of wing rivets with the front edge 5/8" from wing skin seam on the leading edge spar. Be sure the outer edges, of each piece, are stacked together flush to each other. Use 2" wide masking tape to secure the parts. Place and transfer drill #30 Cleco as you drill. See **FIGURE 10G-12**.
14. To fit and trim the skylight remove outer trim strip. Re-cleco hold down strip and spacer strip in place forming the space where the skylight is to fit. With the skylight centered trim the outer edges of the skylight to fit between the spacer strips. Trim to length by over lapping 1 1/2" inches past the edge of the top tail cone skin.
15. Lay the skylight against the aft edge of the windshield. Check the fit of the windshield. A proper fit is when the windshield lays on top of the forward section of the three cabin ribs with no space between. Move the windshield as needed to achieve the proper fit. Re-trim skylight if the windshield has been moved aft to achieve proper fit. Mark where the ribs lay under the Lexan with a marker. Trim the upper and lower protective coating out of these areas. Do **NOT** cut into the skylight.

HINT: Lift the protective coating up slightly in the area to be trimmed away. Cut only the protective coating with a razor knife.
16. Re-cleco the outer trim strip in place to hold the windshield and skylight down.
17. Cleco the Upper and lower mating strips, and mating strip support tube to the skylight. Refer to the parts drawing, only the top mating strip has bent edges.

18. Position forward edge of rib trim strips 1/4" away from upper mating strip. Align holes with center-line of ribs and transfer drill #30. Cleco as you drill. See **FIGURE 10G-17**.

19. Position center forward trim strip on the windshield 1/4" forward of the upper mating strip over the center rib. Align holes with center-line of rib and transfer drill #30. Cleco as you drill. To prevent cracking of the windshield the trim strip and windshield will be drilled to #20 after removal.

IMPORTANT: Use an Acrylic drill bit when drilling through windshield.

20. Fabricate and drill AFT mating strip per **FIGURE 10G-22**. Cleco in place.

21. Before installing the windshield Z strips, they will need to be slightly modified for optimum fit. Refer to **FIGURE 10G-20**. Note where they need notched to clear the upper gusset weld and also where the upper corner needs bent to conform to the windshield shape.

22. Follow the same procedure to slightly bend the upper corner of the windshield trim strip. When satisfied with the fit, cleco it and the windshield trim strip spacer to the windshield Z strip. Verify a good fit along the door tube center-line. Refer back to **FIGURE 10G-20**. Trim if required.

23. Sand the upper and lower edges of the fiberglass windshield hold down strip smooth.

24. Mark and drill #40 the windshield hold down strip per **FIGURE 10G-23**. Start by locating the front center of the strip, and drill towards the ends on each side. Use 2" spacing to locate rivet holes stop approximately 8" from the ends. The last three holes will be located by transfer drilling through the tabs welded on the cockpit cage.

25. Tape in place the pre-drilled windshield hold down strip tight against the boot cowl and windshield. Transfer drill #30 into boot cowl. Cleco as you drill. Trim the aft ends to be just forward of the door tube center-line. This will allow the door to close flush with the windshield.

26. The windshield will be painted in a couple places on the INSIDE to hide the glue used to hold on the windshield strip and wing cuffs. Using a Sharpie draw along the top edge of the windshield hold down strip, Hold the wing cuffs in place and trace around.

27. Once satisfied with the fit of all components for the windshield and skylight assembly, mark parts left, right and son on to avoid mix ups during re-assembly Un-cleco, remove and debur.

28. Drill out the five holes in the middle forward trim strip to #20. Drill out the five holes in the windshield using an 11/64" Acrylic drill bit.
29. Drill out all #30 holes to #28 in the Skylight and debur.
30. Install the five rivet nuts into the middle rib forward section after drilling out to #2.
31. Paint all parts as desired. Include the mating strip support tube. Continue with the following steps after painted parts are cured.
32. Apply 1/2" black foam tape to top of the cabin ribs. Extend the foam tape on the center rib onto the carry through tab. Cut the foam tape from the center of the rivet nuts. This can be done neatly using a 1/4" diameter tube sharpened on the end to act as a punch.
33. Apply 1/2" black foam tape across top of fuselage at station 3 where the skylight and AFT trim strip attaches.
34. Place skylight on top of ribs. Cleco in place with trim strips.
35. Place windshield in position. Hold in place with the forward center trim strip and 8-32 screws. Secure the screws with paste type Loctite, being careful to not contact the Acrylic or Lexan. Tighten down gently, over tightening these screws can result in cracking the windshield.
36. Before installing the outer top trim strips apply 1/2" black foam tape on the inside bottom edge. Cleco in place. Refer back to **FIGURE 10G-12**. This in combination with dipping each rivet in silicon will affect a watertight seal.
37. Apply 1/2" black foam tape to the Z-strips in two locations where they contact the cockpit tubing. Cleco in place.

WING CUFF INSTALLATION

38. Trim wing cuffs as in **FIGURE 10G-37**. Hold cuffs on windshield and leading edge spar. Find position of best fit for wing cuff, press down firmly against the windshield and tape securely in place. Use a fine point marker and mark the perimeter edge of the wing cuff onto the windshield if this was not done in a previous step.
39. Mark and trim cuffs flush with edge of windshield.
40. Remove cuff and place 3/4" masking tape on leading edge spar, extending outboard from wing attach bolt. Top edge of tape should be in-line with bolt's center-line. Re-install cuff and mark edge of cuff on tape. Mark top edge of tape on cuff. Remove cuff and measure distance between mark on tape and bolt's center; transfer measurement to cuff and drill 3/4" hole in cuff as per **FIGURE 10G-37**.
41. Remove windshield and mask off for painting where indicated by the lines marked for cuffs and windshield hold down strip. Paint with an Acrylic paint, black is an excellent choice. This will hide glue used to bond the on the cuffs and hold down strip.
42. Paint wing cuffs as desired.

FINAL INSTALL OF WINDSHIELD AND SKYLIGHT

43. Clean off the top back edge of the windshield and underside of the mating strip with rubbing alcohol, making sure no debris is present. This prepares for bonding the mating strip and windshield together.
44. Place 1/2" Acrylic tape (VHB by 3M) under forward edge of the upper windshield mating strip. Do not remove the peel strip on the underside until ready to lower the mating strip. VHB is super sticky and you will have one shot at getting it located properly. To accurately place the mating strip use two #30 drill bits placed in holes near the outside edges. The drill bits act as guides when lowering the mating strip onto the windshield. Pull off the peel strip and lower the mating strip, press down evenly to make a secure seal and bond. Rivet all parts except the windshield hold down strip together. Dip the rivets in clear silicon prior installing to affect a water tight seal

45. Cleco windshield hold down strip to boot cowl. Re-apply, if necessary, masking tape onto windshield flush with top edge of hold down strip. This is to prevent the adhesive from blemishing the windshield. Un-cleco and apply a generous amount of 3M 2216 adhesive to the outside of the windshield below the tape. Apply from center out to the curve. Do NOT allow the adhesive to drip onto the boot cowl. Carefully re-cleco hold down strip to boot cowl and rivet in place, be sure to apply silicon to the rivets. The adhesive not only bonds the windshield to the strip, but helps create a water tight seal.

CAUTION

THE 3M 2216 ADHESIVE BOND BETWEEN THE FIBERGLASS WINDSHIELD STRIP AND ACRYLIC WINDSHIELD IS CRITICAL. A PROPER BOND ASSURES THE STRUCTURAL INTEGRITY OF THE WINDSHIELD INSTALL. WITHOUT THIS BOND, THE WINDSHIELD WILL DEFORM AND PULL AWAY FROM THE HOLD DOWN STRIP.

46. Install the flap gap seal to the fuselage. The skylight and flap will lie under the flap gap seal. Refer to **FIGURE 10G-45**. Locate attachment holes in flap gap seal per **FIGURE 10G-45**. Refer to **FLAP RIGGING** for proper neutral positioning of flap.
47. Apply tape outside of marked perimeter of wing cuff on windshield. Scuff inside of Wing Cuff with Scotch-brite. Apply 3M 2216 Adhesive to inside of cuff. Carefully apply wing cuff to windshield inside of marked line. Tape in place and use sandbags or similar weight to help press wing cuff to windshield until adhesive dries.
48. Remove weight and tape.
49. It is recommended, to apply a fillet of silicon seal all the way around the front of the windshield, at the edge of the trim strips, around wing cuffs and windshield mating strips after installation. Apply a suitable masking tape along the edges and another line of masking tape about 1/8" from the edge. Apply a small bead between the tapes and smoothen with your finger to form a fillet. Remove masking tape before the silicone hardens. This will aid in preventing the penetration of water and dirt.

DOOR ASSEMBLY - LEXAN AND TRIM - (FINISHING KIT)

Lexan windows scratch very easy. To get a longer service life from your window, we recommend a soft terry cloth and a cleaner made for plastic. RANS uses a product called Brillianize. It is available from RANS or any large aircraft supply company.

IMPORTANT: The big no-no is cleaning a window while dry. **NEVER** dust off a window unless you have sprayed on some sort of fluid. Dry dusting will readily cut millions of fine scratches into the glazing, dimming its clear optics.

If fuel is spilled on Lexan, wipe clean with a clean cloth immediately to lessen the chance of crazing damage.

(BEFORE PAINTING OF DOOR FRAMES)

1. Place 2x4 boards (1-1/2" thick) under Door Frame and check dimension of bow tube of door per **FIGURE 10H-01**. Press down on bow tube. Check for proper dimension. Repeat until proper dimension is obtained.
2. Pin Door Frame in Fuselage and check for proper clearance with Fuselage. Tweak Door Frame fwd or aft, as needed for clearance. Door should open and close without hitting the Fuselage tubes. The Door Frame may be painted or powder coated.

(AFTER PAINTING OF DOOR FRAMES)

Re-check Door Frame for proper dimension as above.

3. Position the Upper Trim Strip to the inside of the upper Door Frame with the lower edge of the Trim Strip flush with the inside of the Door Frame tube. Slide the Upper Trim Strip forward until the lower forward corner of the Trim Strip is flush with the forward side of the Door Frame tube. Trim the strip to follow the same angle as the forward Door Frame. Trim AFT edge flush with AFT edge of Door Frame. Refer to **FIGURE 10H-03**. Transfer drill #30 into Door Frame. Locate and drill an additional #30 hole in the AFT end at the intersection of the Door Frame tubes. Remove, debur and rivet.
4. Mark a centerline on the door frame tubes. Refer to **FIGURE 10H-04**. Position FWD, AFT and Lower Door Trim over outboard side of Door Frame. Clamp the Trim to the Door Frame as shown in the parts manual.

NOTE: The row of holes in each Strip will align on the Door Frame centerline. Refer to **FIGURE 10H-04**.
5. Lower Door Trim will be positioned on outboard side of AFT Door Trim.

6. Transfer drill #40 through Door Trim into outboard side of Door Frame. Cleco as you go. Final size #40 holes to #30.
7. Trim forward and lower end of Lower Door Trim to match FWD Door Trim.
8. The upper side of the FWD and AFT Trim should be flush with the top of the Door Frame. Mark and trim excess material from each Trim Strip as required.
9. Trim lower end of AFT Trim to be flush with Lower Trim.
10. Transfer drill #40 where the Trim pieces overlap each other and cleco.
11. Remove Trim and set aside.

IMPORTANT: Do **NOT** remove protective layer on Lexan until after final assembly.

12. Place Lower Lexan on Door Frame. Position lower and aft edges flush to bottom and aft edge of lower door frame tube. The notch should line up close to the bend in the tube. Clamp in place. Use a felt-tip marker and mark on the Lexan protective layer around inside and outside of the Door Frame. Peel back the top layer of protective layer only past the holes in the frame. Transfer drill #30 through Lexan. Cleco as you go.
13. Trim edges to door frame. Mark and trim upper edge to center of door bow tube. Refer to **FIGURE 10H-13**. Position Upper Door Lexan on Door Frame flush with top of door frame at FWD and AFT edges. Refer to **FIGURE 10H-14**. Center upper Lexan front to back. Clamp in place. Use a felt-tip marker and mark on the Lexan protective layer around inside and outside of the Door Frame. Peel back the top layer only past the holes in the frame. Transfer drill #30 through Lexan. Cleco as you go.
14. Trim to outer edge of door frame. Mark and trim lower edge to center of door bow tube.
15. Remove Lexan from Door Frame and trim to outside mark to match outside perimeter of Door Frame. Remove protective film, on both sides, from perimeter to inside mark.

NOTE: Do **NOT** cut the protective layer while it is adhered to Lexan, rather lift edge of protective layer and trim to marked line with a razor knife.

16. Reposition Lexan on Door Frame. Clamp in place. Locate #30 holes in Door Frame and match drill through Lexan. Cleco as you drill. Remove Lexan and drill holes in Lexan parts only to #27 drill size and carefully debur. Refer to **FIGURE 10H-17**. The slightly larger hole will allow the rivet to expand, when pulled, and not place undue stress on the Lexan.

NOTE: Several places will not be drilled to the larger size.

17. Re-cleco all parts to Door Frame. Place Channel Extrusion centered over Door Frame bow tube. Trim ends to match inside of Door Trim. Refer back to **FIGURE 10H-04**. Layout holes per **FIGURE 10H-18** and debur. Re-position over Door Lexan and transfer drill into Door Frame bow tube centerline. Cleco as you drill.
18. Drill through Door Lexan at the lower bushing locations and de-burr.
19. Rivet all parts together.

NOTE: A few of the rivets will require squeezing to flatten the extending inner side. Refer back to **FIGURE 10H-17**. A rivet squeezer or Vise-Grip will work well. This will allow the rivets to set against the Fuselage tubes without chafing.
20. Attach Door Assembly to Fuselage bushings. The FWD Door Trim should extend to 1/32" aft of the Fuselage Station 2 tube centerline. Trim as required.

NOTE: A small gap should be between the FWD Door Trim and the Windshield / Boot Cowl.
21. Paint Door Assemblies as desired.
22. Glue Rubber Edging to top edge of Upper Trim Strip. Open the Edging and apply a small amount of Cyanoacrylate glue (Permabond, Superglue, etc.) in the crease to retain the Edging in place.

IMPORTANT: Only a drop of glue every couple of inches is needed. Do NOT allow glue to squeeze out beyond the Edging.
23. Use clear silicone sealant to seal the edges between the windows and the trim strips.

DOOR LATCH ASSEMBLY - (FINISHING KIT)

1. Paint / Finish all parts of Door Latch Assembly as desired.
2. Bolt the Door Knob to the Handle Plate per parts page drawing.

NOTE: There is a Left and Right Handle Plate.
3. Bolt Door Latch to Handle Plate.

NOTE: The Latch is a rod that slides forward and aft to lock the aft end of the door.
IMPORTANT: Do NOT over-tighten the Acorn Nut. The Latch must be able to pivot as the Handle Plate rotates.
4. Fabricate the Aluminum Spacer Bushings as per **FIGURE 10H-24**. The bushing may later be trimmed to adjust the tightness of the door seal.
5. Insert Handle Plate, with Aluminum Bushing, through forward bushing of Door Frame.

6. Slip Door Pivot Bushing over Latch and install into AFT bushing of Door Frame. Washers may be added or removed later to adjust the tightness of the door seal.
7. Rivet Handle Stop Plate to lower forward corner of Door Frame. Refer to **FIGURE 10H-25**.
8. Operate the Door Latch Assembly through its full range of movement. If the Door Latch has a tendency to bind in the Pivot Bushing, remove the Door Latch and with a drift punch, inserted into the pivot bushing, tweak accordingly.
9. Apply 1/2" Black Foam Tape to inside of Door Trim. The Foam Tape will aid in sealing against the Fuselage.
10. Pin the Door Assembly in place on the Fuselage. Mark the contact locations of the Handle Plate onto the fuselage frame. Using acrylic foam tape, attach the Door Latch Striker Plates to the Fuselage Frame so that the entire contact area is protected by the Striker Plate.

NOTE: The AFT Door Striker Plate will install after the interior is installed.

11. Double-check for tight closing of Door Assembly against Fuselage. Adjust washers under Pivot Bushing and Aluminum Bushing on Handle Plate until a tight seal is obtained. Transfer drill #30 through fabricated Aluminum Bushing and rivet in place.
12. Drill Door Handle per **FIGURE 10H-32**. Position the outer Door Handle parallel to the slipstream with the door latch mechanism fully closed. Clamp the Door Handle and Handle Plate tightly together. Drill #40 through the Door Handle and Handle Plate shank. HINT: You may want to drill just deep enough to mark the shank of the Handle Plate, and then align and drill all the way through the shank, after removing from the Door Assembly.
13. Drill out the lower hole in the Door Handle to 3/16" and press the flange nut in. Refer back to **FIGURE 10H-32**. Drill the top hole to #28, install the button head screw and tighten.
14. Check entire assembly for function.

HYDRAULIC DOOR LIFT - (FINISHING KIT)

1. Install a Ball Stud to the forward side of the welded gusset near the top aft edge of the Door Frame.
2. Install a Ball Stud to the forward side welded bushing on Station 3 vertical tube.
3. After the wings have been attached, Pin the Door Assembly in place on the Fuselage.
4. Press end of Gas Spring over the Ball Stud in the fuselage.

IMPORTANT: The Cylinder portion of the Gas Spring must be oriented upward when final installed to prevent drying out of the shaft seal during operation.

5. Press the Ball Stud on the door into the Gas Spring end. Make sure the Gas Spring is locked in place.
6. During operation the Gas Spring may raise the door part way. A gentle nudge should extend the Gas Spring completely and hold the door in the full open position. If desired, apply Foam Tape on the bottom of the wing, where the Door contacts.

FORWARD BAGGAGE COMPARTMENT - (FINISHING KIT)

ASSEMBLY

1. With AFT Baggage Compartment sheet metal parts clecoed in place, tape Forward Sides into fuselage. Upper forward edge will align to center of fuselage diagonal tube. Forward edge will set on large tabs at Station 2B. Refer to parts page drawing for proper orientation. Transfer drill #11 through all tabs and cleco.
2. Set Forward Bottom in place. Center from front to back and side-to-side. Transfer drill through all tabs. Transfer drill #30 through pre located holes in flanges of Sides. Final size drill to #11.
3. Cut Support Angles to length and locate per **FIGURE 10I-03**. Trim Ends of angles to clear fuselage tubes. Transfer drill #11 through tabs.
4. Mark and drill #30 holes, per **FIGURE 10I-03**. Cleco to lower side of Forward Bottom through #11 holes, transfer drill #30 and rivet.

NOTE: The aft hole of the Center Support Angle will need to be located forward of the Fuselage Tube.
5. Remove Forward Baggage Compartment sheet metal. Install nut plates to all large tabs and to lower flange of Forward Side - Baggage Compartment. Refer to parts manual.

BAGGAGE COMPARTMENT & CARGO NET INSTALLATION **(FINISHING KIT)**

INSTALLATION

1. Cover aluminum sheet metal interior of Baggage Compartment with lightweight fabric or paint as desired.
2. Slip Aft Baggage Compartment into place. Cleco, then rivet or install screws as shown in parts manual.
3. Position Station 4 Closeout. The upper straps of the Cargo Net will attach to the upper corners.
4. Cleco Sides of Forward Baggage Compartment in place. Rivet to small mounting tabs. Place Bottom of Forward Baggage in place. Install screws at front and aft.

NOTE: Lower straps of Cargo Net attach to outer tabs, with machine screws at forward corners of Baggage Compartment.

INSTRUMENTS AND ELECTRICAL

Due to the different instruments and flight systems that builders are choosing, RANS does not supply gauges with the kit.

Refer to ENGINE INSTALLATION and Engine Manufacturer's documentation for specific information on engine electrical systems.

ROTAX 912 ULS INSTALLATION

NOSE GEAR INSTALLATION

NOTE: Nose Gear Mount should be final installed after firewall is in place.

1. Support the fuselage on sawhorses and bolt the Nose Gear Mount to the firewall.
2. Slide the Nose Gear into the Nose Gear Socket. Use a rotary file to remove excess coating in the Nose Gear Socket.

CAUTION: Do **NOT** remove excessive material. The Nose Gear must fit tight in the Socket.

3. Mark a ring 3/8" from the top end of the Nose Gear.
4. Insert the Nose Gear into the Gear Leg Socket until the line is visible in the hole.

NOTE: To verify that the Nose Gear is in the correct position, measure the distance from the end of the Nose Gear to the upper edge of the Gear Socket. This should be about 1/4". See **FIGURE 08A-10**.

5. Rotate the Nose Gear until it is 90-degrees from the Spar Carry-thru on the Fuselage.
6. It may be desirable to build a fixture to hold the gear leg in place. See **FIGURE 08A-12**.
7. Transfer drill #11 the Nose Gear through the Gear Socket hole just deep enough to mark the Nose Gear.
8. Remove the Nose Gear. Drill #11 using a "V-block" in a drill press to center the Nose Gear when drilling.
9. Transfer drill "Letter D" through one side of the Nose Gear Collar. Refer back to **FIGURE 08A-10**.
10. Slip Nose Gear Collar onto lower end of Nose Gear. Align holes and transfer drill "Letter D" through the other side of the Upper Fork Collar.
11. Ream to 0.249" and bolt in place.

NOTE: If using a fixture to lock the leg for drilling leave the Collar off till drilling is complete.

12. Re-install the Nose Gear in the Gear Socket and fixture. Transfer drill through #11.
13. Chase drill 6.2mm, then ream to 0.249". Bolt in place.
14. Seat the Spring Washers by sanding on a sheet of 400-grit sandpaper. Refer to **FIGURE 08A-20**. This will help prevent premature wearing of the Spring Washers.

IMPORTANT: Before installing the Nose Gear Fork to the Nose Gear Strut inspect the Fork for stress risers.

15. This is a high stress part and it is critical to remove any scratches on the surfaces of the Fork. The most critical is the bottom surface where any stress riser could result in eventual failure of the part. Be aware of this during annual inspections also, since the Fork is subjected to possible abuse. If you encounter gouges or scratches you cannot use standard sanding and polishing techniques to remove, the Fork will need to be replaced. Sand and Polish the bottom of the Fork in parallel to the Fork blades.

CAUTION: DO NOT CROSS SAND the Fork blades. Install the Nose Gear Fork according to the **PARTS MANUAL DRAWINGS** and **FIGURE 08A-21**.

16. Using a fish scale, adjust the nut until the required pull is attained at the Axle Attachment on the Fork to move it. See **FIGURE 08A-22**.
17. Drill the Nose Gear #30 from each side for the cotter pin and install.
18. Temporarily assemble Nose Wheel Hub without Tire. Slide Axle through hub bearings. If the Axle will not slide into the wheel bearings, spin sand the Axle on a belt or disc sander.

IMPORTANT: Do NOT remove any more material than necessary.

19. Cut the Bushings to length so as to center the Wheel Hub in the Fork. Refer to **FIGURE 08A-25**.

NOTE: The Bushing material is provided long to allow trimming as needed.

HINT: Add the measurements on each side of the Wheel Hub together. Divide by 2 to obtain equal lengths of the finished Bushings to center the Hub.

IMPORTANT: The Bushings must be tight to allow no side to side play of the wheel.

20. Remove Axle and Wheel Hub. Disassemble Hub and install Tire and Tube. Re-assemble with Tire & Tube.
21. Install U-Bolt and Clamp Block around lower end of Nose Gear Socket.

ROTAX 912 ULS - ENGINE MOUNT INSTALLATION

(AFTER FIT-UP OF FIREWALL & BOOT COWL)

ASSEMBLY

1. Become familiar with the ROTAX 912uls **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.
2. Install parts referring to **PARTS MANUAL DRAWINGS**.

(AFTER INSTALLING ALL ACCESSORIES ON FIREWALL)

ENGINE MOUNT INSTALLATION

1. Become familiar with the ROTAX 912uls **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.
2. Install Engine Mount after making sure all accessories are located on firewall.

ROTAX 912 ULS - BATTERY BOX ASSEMBLY & INSTALLATION

(FINAL INSTALL OF ENGINE) ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Firewall should have been drilled to match Battery Box Mount Plate.
3. Cleco Support Angles to inside of Front Plate. Refer to the PARTS MANUAL DRAWING. Transfer drill #30 and rivet. Base of Battery will set on Support Angles.
4. Align one edge of Battery Box Front Plate with edge of Battery Box Mount Plate. Clamp together and transfer drill #11 through upper and lower mount holes in Mount Plate and cleco.
5. Slip Battery into assembly. Align free edge of Plates; pull Front Plate against battery. Check to see if Battery can be slid in and out. If battery cannot be slid in and out, then loosen fit slightly to allow easier removal. Clamp and transfer drill #11 through upper and lower mount holes and cleco.
6. Transfer drill #30 the center holes in Mount Plate, and rivet from the AFT side.
7. Slide the Battery Bar through the holes in the Battery Box assembly. Modify the Battery Bar per **FIGURE 11A-07/912**. Remove Battery from Battery Box assembly

INSTALLATION

8. Bolt Battery Box assembly to firewall.
9. Install Battery and Battery Bar. Install Small Cotter Pins to retain Battery Bar.
10. Refer to the **ENGINE ELECTRICAL** section for Battery Cable and routing.

ROTAX 912 ULS - FUEL SYSTEM - FIREWALL FORWARD

(AFTER INSTALLATION OF ENGINE)

1. Refer to the parts pages and select the required components for assembly.

INSTALLATION WITHOUT OPTIONAL GASCOLATOR

NOTE: Contact ROTAX for recommended Fuel Filter.

2. Connect Fuel Filter with listed hardware and supplied Fuel Line to Fuel Line from engine fuel pump.
3. Install 90-degree fitting into 3/8" fuel line. Attach to Firewall Fitting.
4. Route line to Fuel Filter Assembly and cut to length. Install Straight Fitting.
5. Install Hose Clamps. Tighten all connections.

INSTALLATION WITH OPTIONAL GASCOLATOR

6. The Gascolator Mount should have been riveted to the firewall during **ENGINE ACCESSORY INSTALLATION**.
7. Install fittings in Optional Gascolator. Orientate fittings per parts page drawing. Remove wire bail from Gascolator and remove bowl. Slip bail into fore and aft holes in Mount. Install top portion over mount and retain with wire bail. Re-install bowl.
IMPORTANT: Gascolator has an INLET and OUTLET side. Orientate INLET side outboard.
8. Connect Fuel Line Assembly from firewall fitting to INLET fitting of Gascolator. Ends of Fuel Line Assembly may be turned as required.
9. Connect fuel line from engine fuel pump to OUTLET side of Gascolator. Tighten all connections.

RETURN LINE INSTALLATION

10. Route line from Restricted Banjo Fitting, atop the Clamp Block attached to Compensating Tube of the engine, to firewall fitting. Cut to length and attach 90-degree fitting. Install Hose Clamps. Tighten all connections.

ROTAX 912 ULS - FUEL SYSTEM - FUSELAGE

1. Locate Header Tank Mount per **FIGURE 11B-01/912**. Transfer drill #30 through each tab. Glue Rubber Edging to top edge of Mount flanges. Rivet Header Tank Mount to top of tabs.

HEADER TANK ASSEMBLY

2. Locate and drill fitting holes in Header Tank per **FIGURE 11B-02/912**. Do NOT drill the sump drain holes until fitting of the tank to the fuselage. For drilling the holes a 1/2" Unit-Bit[®] and 3/4" Unit-Bit[®] work best. Locate center of each hole with a #30 drill bit, then drill full size. Deburr all holes. Thoroughly clean tank several times by rinsing with water. After confirming that all foreign material has been removed, let dry prior to installing fittings.

NOTE: If it is anticipated that the plane will be converted between Trike and Taildragger, then it is recommended to install sump drains in both locations.

DOUBLE & TRIPLE CHECK HOLE LOCATIONS BEFORE DRILLING.
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3. To install the fuel fittings into the tank, obtain a piece of wire. Safety wire works well. Insert wire through one of the fitting holes in the tank and up through the filler neck. Refer to **FIGURE 11B-03/912**. Install an O-Ring onto the tank withdrawal fitting and slide this assembly over the wire extending from the filler neck. Bend a loop in the end of the wire to keep the fitting and O-Ring from falling off. Pull the fitting through the hole. Slide a flat rubber washer, thick steel washer, and a retaining nut over the wire and onto the fitting. Apply Loctite to threads and thread the nut on before removing the wire.

CAUTION: Do **NOT** get Loctite on the rubber washer.

4. Use an Allen wrench inserted into the tank fitting to hold the fitting while tightening the retaining nut.

IMPORTANT: Do not allow the fitting or thick washer to rotate while tightening or leaks may occur.

HINT: Prevent the thick washer from turning by holding with needle-nose Vise-Grips.

5. Apply thread sealant to fittings and install into the tank fittings. Again, allow no rotation of the tank fitting. Refer to the parts manual for the correct parts.
6. Perform a leak test by capping off all fittings and pressurizing the tank to 1 PSI and let set for a period of time.

CAUTION: Damage may result from over-pressurization. While the tank is pressurized, check for any leaks by spraying a soap/water mixture onto the tank and around the fittings. To cap off the fittings use a 1" segment of fuel line with a bolt inserted, and fuel line clamps or similar. An alternate test is to fill the tank with water and let it sit for approximately 48 hours.

7. Modify Header Tank Mount Channel per **FIGURE 11B-08/912**. Position Header Tank flush with front of Mount. Use large hose clamps to secure tank to mount.
NOTE: Modified Mount Channel will position under hose clamps, on top of tank, and be positioned so that Channel ends are flush with sides of header tank.

LOCATING HEADER TANK SUMP VALVE HOLE THROUGH BELLY SKIN

1. Mark on the outside of the tank on each side next to the sump valve as per **FIGURE 11B-02/912**. This allows location of the hole through belly skin with the tank installed.
2. Set the header tank in place. Transfer the marks on the tank to the belly skin. Remove the tank and project the marked lines at 90° to the sides of the tank until they intersect.
3. Drill a #40 in the skin at the intersection. Set the header tank securely in place. Drill #30 through the hole in the skin and the header tank. Use a step drill or several sizes of drill bits to work up to the required size hole for the sump drain fitting.

FUEL VALVE INSTALLATION

1. Install two fittings to the fuel valve using thread sealant. Refer to **FIGURE 11B-09/912** and the parts manual.
2. Remove the handle from the fuel valve and install the valve to the two tabs of the fuselage steel frame. Use the mount brackets as shown in **FIGURE 11B-09/912**. Re-install the handle to the fuel valve.
NOTE: Valve should be "ON" when valve handle is AFT and "OFF" when valve handle is UP.
3. Install the bulkhead fittings in the pre-cut holes on the lower left side of the firewall. Use the hardware shown in the parts manual.
4. If installing the OPTIONAL ELECTRIC FUEL PUMP do so at this time.
5. Fabricate and install a fuel hose assembly from the bulkhead fitting in the firewall to the fuel valve and from the fuel valve to the header tank fitting. Secure as desired using plastic ties. Add a clear plastic tape or split fuel hose as anti-chafe wherever the lines contact the fuselage frame or other parts.

NOTE: The smaller return line routes directly from the bulkhead fitting to the header tank and will not connect through the Fuel Valve.

IMPORTANT: Be sure to include the Check Valve in the Return Line.

6. Drill a #40 hole in edge of Fuel Cap. Screw on the cap and tighten. Using the hole in the cap, safety wire the cap against rotation to the fuselage frame.

(AFTER WINGS MOUNTED TO FUSELAGE)

7. After wings are mounted to fuselage in final assembly, route fuel line from each wing, down behind Station 3 and to Header tank. Secure as desired using plastic ties. Add a clear plastic tape or split fuel hose as anti-chafe wherever the lines contact the fuselage frame or other parts.

OPTIONAL LOW FUEL WARNING KIT

1. Become familiar with the Optional Low Fuel Warning Kit on the Header Tank **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. A 5/8" hole should have been located in the side of the Header Tank. If not, refer back to **FIGURE 11B-02/912**. Replace Silicon Washer provided with Low Fuel Warning Switch with 5/8" Rubber Washer. Install Low Fuel Warning Switch into Header Tank. Be sure to orientate the switch to allow electrical continuity (closed circuit) when installed. Use a continuity tester (Ohmmeter) to be sure. **Refer to FIGURE 11B-10/912**. As the header tank fills with fuel, the switch will open, turning off the LED Indicator Light.
3. Install 5/8" Rubber Washer, 5/8" Steel Washer and plastic nut on outside of tank and tighten. Double check to be sure the switch is orientated correctly.
4. Locate LED Indicator Light in instrument panel. Connect to Low Fuel Warning Switch per **FIGURE 11B-10/912**. Do not forget to include a proper sized breaker or fuse.

OPTIONAL ELECTRIC FUEL PUMP

1. Become familiar with the Optional Electric Fuel Pump **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. Install fittings into Fuel Pump with Thread Sealant.
3. Rivet Nut Plates to bottom of tabs under Left Seat.
4. Bolt Fuel Pump to tabs.
5. Connect Fuel Line from Header Tank to Fuel Pump. Connect Fuel Line from Fuel Pump to Fuel Valve.
6. Connect electrical wires of fuel pump to 12-volt switch on Instrument Panel. Do not forget to include a proper sized breaker.

ROTAX 912 ULS - COOLING SYSTEM INSTALLATION

(AFTER INSTALLATION OF ENGINE MOUNT)

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. The items below should have been done before installing the engine to the Engine Mount. If not, then do so before proceeding.
 - Rotate the water pump inlet on engine to the lower right position. Retighten screws to 90 in. lbs.
 - Completely remove Rotax installed coolant hose attached to AFT cylinder head coolant fitting. Move the Aft end of the remaining coolant hose to the upper water pump fitting. Install the "S" shaped radiator hoses from aft cylinder head coolant fittings to lower water pump fittings. The "S" end will attach to the lower water pump fitting. The "S" hose prevents coolant hose conflict with the engine mount. Install on both right and left aft fittings. Trim hose as required to prevent binding.
3. Attach Radiator Mounts to top of Radiator with Cushion Clamps and hardware shown and attach to Engine Mount tubes as shown. Leave the nuts and bolts slightly loose to allow adjustment. Tighten after final positioning. Refer to **FIGURE 11C-03/912** for Clamp locations.

NOTE: Notice the orientation of the Cushion Clamps.

4. Oil Cooler Mount Bracket will attach to lower end of Radiator after attaching to Oil Cooler.

(AFTER INSTALLATION OF OIL COOLER TO RADIATOR)

5. Rotate bottom of Radiator aft and temporarily bolt through Mount Bracket - Radiator to cushion clamps on lower AFT Engine Mount tubes. Refer back to **FIGURE 11C-03/912**.
6. Cut Pre-formed Radiator "U" Hose into 2 pieces to form 2 90-degree hoses. Install to left side radiator inlet.
7. Route 1" Radiator Hose from right side Radiator Outlet and Coolant Pump Inlet. Insert Hose Spring into Radiator Hose until located at bend area to help prevent possible hose collapse.

NOTE: Unbolt lower end of radiator and rotate out of way as needed to attach.

8. Route 1" Radiator Hose between left side Radiator Inlet and Expansion Bottle on top of engine with a Cooling Tube Union. Insert Hose Spring into Radiator Hose until located at bend area to help prevent possible hose collapse.

9. Fabricate Anti-chafe for Radiator Hoses by splitting a leftover piece and securing around the Hoses with Plastic Ties.
10. Secure all hoses with Hose Clamps.
11. Rivet Coolant Recovery Bottle Mount Bracket with Spacer Shims to firewall. Secure Overflow Bottle with supplied Clamp to the Mount Bracket.
12. Route Overflow Hose from Coolant Bottle to Expansion Bottle on engine. Secure Overflow Hose at each end with Safety Wire.

OPTIONAL HEATER INSTALLATION - RADIANT STYLE

NOTE: Heater Installation will require the 1" Radiator Hoses to be cut to install Tees. Refer to Parts Pages.

13. Drill two 1 1/8" holes in the left hand side of the firewall. Locate holes to avoid Firewall Components and Exhaust System. Cut Serrated Grommet Strip to length and install to inside of holes as anti-chafe.
14. Assemble the Fan to the Heater Core. The fan will have arrows showing the direction of airflow and the rotation. Make sure the airflow arrow is pointing toward the Heater Core. Locate #11 holes in the Fan Mounting Plate to match Fan mounting holes. Attach the Fan Mounting Plates using Truss Head Screws. The screws will self-tap into the plastic housing of the fan. Orientate the fan so the wires come out on the same side as the Heater Core Nipples. Drill two #30 holes into the Mounting Plate and Heater Core sides. Rivet with 1/8" Aluminum Rivets. Refer to **FIGURE 11C-14/912**.

CAUTION: Be careful not to drill into the heater core. Use a drill-stop!

15. Attach the Nipples to the Heater Core.
CAUTION: When working with the Heater Core, be careful not to over-tighten, or cracking may result. When tightening the fittings, it is necessary to use a wrench to support the fitting.
16. Locate the Tees for the heater system. One Tee is located between the Coolant Pump Inlet and the Radiator Outlet. The second Tee is located in the Radiator Hose that comes directly out of the Expansion Bottle on top of the engine.
17. The Heater Core Assembly may be attached to two brace tubes aft of Station 1. Place the Heater Core so the fan is blowing air down and back into the cabin. Check for possible interference with panel instruments and Rudder Pedals. Use Cushion Clamps to secure to the tubes.
18. Route Heater Hose from Heater Core fittings to Tees forward of the firewall.
19. Locate the Control Valve in the Heater Hose attached to the Tee in the line coming from the Expansion Bottle. Locate the Valve in a location that allows connecting of the Control Cable.

IMPORTANT: Make sure you are installing the Control Valve in the "HOT" side connected to the Expansion Bottle on top of the engine.

20. Locate the Control Cable and Fan switch in the instrument panel. Keep this in mind when planning your instrument panel layout.
21. Locate a hole in the Firewall and route the Control Cable to the Control Valve. Trim the control wire after connecting, leaving 2" for adjustments. Check the control wire and housing for a secure installation. Any movement of the housing will reduce the travel stroke. If the valve cannot fully open and close, performance of the heater will be diminished.
22. Drill #40 the center of the Valve control arm post. After retaining the Control Cable housing in the clamp on the Valve, bend the wire to retain it to the valve post. It must be bent in a tight loop around the post. The easiest way is to start to wrap it around, bend it into a hook shape. Slip it off the post and use a pair of pliers to hold it while completing the loop with needle-nose pliers. Twist it tight so it fits snug over the post. Secure with #6 Pan Head Screw, stainless steel washer and small brass washer.
23. With the heater mounted, slip the heater hoses onto the nipples of the core and tighten all the hose clamps. Check all hose and fittings for security and chafing.
24. Connect wires to fan. Route them to the switch and power source.
25. To keep the hoses out of the rudder pedals, use a 1" cushioned clamp bolted to the firewall. Test operate the pedals to assure tangle free movement. After the hoses are clamped to the firewall, install the Hose Covers. The cover of the hose that is clamped to the firewall will need to be cut with a hot knife to fit around the clamp, or remove the cushion off the clamp to allow clearance. Tie the hoses together with Plastic Ties.

IMPORTANT: Double check to be sure there is no interference with Rudder Pedals.
26. After final engine install, check for coolant leaks and proper operation during engine test run.
27. The heater should produce noticeable heat within a few minutes of starting the engine. Depending on how well your cabin is sealed, and the outside air temperature, the heater should be able to keep the cabin warm enough for extended flying on winter days, or at altitude. Do not expect the heater to keep up if you have many air leaks in your cabin, or if it is extremely cold (below 20 degrees F.).

ROTAX 912 ULS - LUBRICATION SYSTEM INSTALLATION

(FINAL INSTALL OF ENGINE) ASSEMBLY

- Oil Tank should be installed to center of firewall.
 - Oil Breather Tube is installed on Firewall
 - **The engine needs to be installed to the airframe.**
1. Refer to the parts catalog and select the required components for assembly.
 2. The Rotax 912ULS installation features an oil cooler mounted under the engine mount.

CAUTION: When working with the oil cooler take care not to induce stress or over tighten fittings or bolts. Damage to the cooler may result. When tightening the lines of the oil cooler it is necessary to use a wrench to support the fitting.
 3. With a band saw or hacksaw, remove the mount tabs from the oil cooler leaving a 1/16" lip past the Oil Cooler body.
 4. Inspect Oil Cooler threaded boss for nicks or burrs in O-ring contact area that might cause O-ring failure. Inspect the Cooler port threads for any buildup of coating. If needed, gently clean threads. Apply light petroleum oil to port threads. Lubricate O-ring of fittings by coating with light petroleum oil and install the O-ring onto the fitting. Install adaptor and fitting into the threaded boss on Oil Cooler. Using two wrenches tighten fitting until hexagon face contacts the face of the hexagon boss on Oil Cooler.

IMPORTANT: Always use two wrenches to tighten fitting onto cooler. Using only one wrench and cooler as leverage will cause cooler to fail. Do **NOT** Over Tighten. Tighten to just snug. The O-ring is the sealing component. This is not a pipe thread.
 5. Cut the provided Silicone Sheets to length to fit in the Oil Cooler Mounts. Trim just short of the outer bolt holes to allow clearance with the threaded bushings. Install to the upper and lower oil cooler mounts as shown in the PARTS MANUAL DRAWING. The sheets provide vibration isolation and should extend past the forward and aft edges of the oil cooler.

NOTE: Use the upper cooler mount as a template. Mark and cut. The piece for the top of the oil cooler needs two holes to allow for the fittings.
 6. Locate Oil Cooler Mount Bracket onto Upper Oil Cooler Mount per **FIGURE 11D-06/912**. Drill, countersink holes on Upper Oil Cooler Mount, and rivet together.
 7. Apply Loctite to bolts and assemble the upper and lower mounts to the Cooler using the Threaded Bushings.

NOTE: To achieve the proper compression on the Silicon Sheets, it might be necessary to add washers between the threaded bushings and the upper and lower oil cooler mounts.

8. Bolt the Oil Cooler Assembly to the AFT side of the radiator through the Oil Cooler Mount Bracket, as shown in the PARTS MANUAL DRAWING. Use Loctite to secure the bolt.
9. Refer to the parts manual for oil line routing.

IMPORTANT: The pickup fitting is the straight fitting (OUT) on the oil bottle and **MUST** route to the left hand fitting on the oil cooler. The return fitting is the angled fitting (IN) on the oil bottle and **MUST** route to the fitting on the bottom of the engine. Failure to route the oil lines properly will result in engine failure.

10. Fill the Oil Cooler and pickup side with oil using a syringe or funnel before engine start-up. Install the Oil Lines onto the Oil Tank. Use a back-up wrench on the Cooler and Oil Tank when tightening fittings.
11. Apply anti-chafe and secure all lines as necessary.
12. Cut to length and install the Overflow Line from the Oil Tank filler neck to the Breather Tube located on the firewall. For tube fabrication, refer back to **ENGINE ACCESSORY INSTALLATION**. Secure ends with safety wire.

PRE-ENGINE START UP

Refer to **ROTAX** for a more thorough Pre-start up procedure.

13. Prior to starting the engine for the first time, install a new oil filter and fill the Oil Tank to the full line on the dipstick. Refer to the Rotax manuals for oil specifications.
14. Remove the spark plugs on all four cylinders.
15. Verify the ignition switch is **OFF**.
16. Turn the prop through several revolutions by hand.
17. With the spark plugs out and from the pilot's seat, turn the key switch to the start position and crank the engine for several seconds. Check for an oil pressure indication on the gauge.
18. If after several seconds, there is no sign of oil pressure, stop cranking the engine. Remove the Tank to Oil Cooler line at the tank. Using a funnel, prime the oil line. Check to be sure Oil Cooler to Pump line is full. Re-attach the line to the tank. Crank the engine. When an oil pressure indication is achieved, stop cranking.
19. Install the spark plugs and start the engine. Watch the oil pressure gauge as the engine starts. After the engine starts, allow 10 seconds for oil pressure to come up. If there is no pressure indication within 10 seconds, shut the engine off and repeat the previous priming procedures. The engine will change sound (quieter) as the oil starts pumping.

20. After running the engine for a few minutes, check the oil level and check for any leaks in the system.

ROTAX 912 ULS - MUFFLER ASSEMBLY

(FINAL INSTALL OF ENGINE) ASSEMBLY

- **The engine needs to be installed to the airframe.**

NOTE: If installing the optional Muffler Style Heater, you may wish to install the Heater Wrap prior to installing the Muffler.

1. Refer to the parts catalog and select the required components for assembly.
2. Cut three segments, each 1 3/8" long from the 1 1/4" O.D. Rubber Hose provided in the 912 Muffler - Raw Stock Kit. Locate the center of each segment lengthwise and drill or punch a 1/4" hole through the top and bottom wall. Install the 6mm bolts and Formed Washers from the inside of each segment. Refer to the PARTS MANUAL DRAWING and **FIGURE 11E-02/912**.
3. Cut three segments, each 1 3/8" long from the 3/4" O.D. Rubber Hose. Insert between the bolt heads, in the isolator assembly, until flush on each end. Safety wire inner hose in place as shown in **FIGURE 11E-03/912**.

NOTE: In order to tighten the bolts, it may be necessary to wait with installing the inner segments and safety wire until after the isolators have been installed on both the Muffler and Muffler Attach Channels.

4. Apply Loctite to the threads of the top bolt and attach the isolator assembly, aluminum washer and thick washers to the Muffler as shown in the PARTS MANUAL DRAWING.

IMPORTANT: Isolators should be final installed laterally (open end to sides).

5. Install the isolator assembly to the Muffler Attach Channels.

NOTE: The left Attach Channel will be installed flanges up, while the right is flanges down.

6. Bolt the Muffler Assembly with Channels to the tab and bushing on the lower tubes of the engine mount.
7. Bolt the FWD Muffler Manifold #1 to the forward cylinder exhaust ports of the engine. Bolt the AFT Exhaust Manifolds to the aft cylinder exhaust ports. Do not fully tighten the nuts, at this time, to allow for adjustment of the manifolds. Slip the FWD Muffler Manifold #2 and Muffler Canister Couplers into place and install Muffler Springs.

HINT: Muffler Springs may be more easily installed using a length of cord wrapped around a dowel.

8. Leave the manifold nuts loose until the cowling has been installed and proper positioning has been verified.
9. Slide the Tail Pipe Extension over the exhaust pipe on the Muffler until bottomed. Attach to the Tail Pipe Support Angle at the firewall.
10. Locate a #11 hole through the top flange of the Tail Pipe Extension and through the flange on the Muffler.
11. Locate and drill a #30 hole in the Hose Clamp and install a 1/8" Stainless Steel Rivet. Install the Hose Clamp on the muffler extension with the rivet extending into the #11 hole in the Extension and Muffler. Tighten Clamp.

NOTE: The 1/8" Stainless Steel Rivet acts as a safety pin to retain the extension.

ROTAX 912 ULS - OPTIONAL MUFFLER HEATER INSTALLATION

- The RANS Muffler Style Heater works well for most cases. If additional heat is required from the Heater, wrap a long spring around the Muffler before installing the Heater Wraps. Stretching the spring to provide air gaps between coils will also aid in efficiency. RANS uses spring #9664K48 from McMaster-Carr.
1. Rivet a Heater Flange to each Heater Wrap.

NOTE: Apply high-temp silicone to the Flange before riveting as a sealant.
 2. Install Heater Wraps to the Muffler using the hardware shown in the parts manual.

NOTE: The Heater Wrap should fit tight around the Muffler. Shim as required using the supplied Heater Wrap Shims. Heater Wraps will need to be formed around the Muffler for a tight fit.
 3. Install the Muffler Assembly to the engine as shown in the parts manual. The Heater Wrap may be safety wired to an Exhaust Spring mount loop to avoid rotation of the Heater Wrap in service.
 4. Secure Heater Duct Hose to inlet Heater Flange on Heater Wrap with a Hose Clamp. Route Duct Hose to Cushion Clamp at right FWD cylinder. Cut duct to length.
 5. Slip Inlet Tube about half way inside Duct Hose and secure with Cushion Clamp, Spacer, Duct Hose and Inlet Tube to right FWD cylinder threaded boss.
 6. Locate hole in Firewall for Air Diverter Assembly.
 7. Install Reverse Cable Stop in end cap of Slide of Air Diverter. Orientate to allow installation and access to the small Set Screws.
 8. Install Adjustable Cable Ferrule to bent end of Air Diverter. Allow room to adjust the Cable Ferrule in and out.

9. Cleco Air Diverter to Firewall. Opening should be orientated downward.
10. Locate and secure Control Cable in Instrument Panel. Keep this in mind when planning your instrument panel layout. Slip Control Friction Block over Control Cable and slide to end of housing. The Socket Head Cap Screw can be tightened to provide friction on the control wire to prevent movement from vibration.
11. Route Cable to Adjustable Cable Ferrule in Air Diverter and trim housing to length.

CAUTION: Pull control knob out at least 5" before cutting to prevent cutting control wire too short.
12. Push control knob in, inserting control wire through Adjustable Ferrule and Reverse Cable Stop. Safety wire Control Cable housing to Adjustable Ferrule.
13. Install small Set Screws with Loctite into Reverse Cable Stop. Make sure control knob and slide of Air Diverter are all the way forward. Trim control wire to length. Tighten small Set Screws to retain wire.

HINT: Removing Air Diverter Assembly with Control Cable attached from Firewall may aid in installing the small Set Screws.
14. Rivet Air Diverter to Firewall.
15. Route Duct Hose from outlet Heater Flange on Muffler Wrap to Air Diverter. Secure with Hose Clamps.

ROTAX 912 ULS - THROTTLE CONTROL ASSEMBLY

(FINAL INSTALL OF ENGINE) ASSEMBLY

- The engine needs to be installed to the airframe.
- Instrument Sub-panel must be installed

NOTE: Adjustable Ferrule in Throttle Support Arm on Carburetor must be removed and replaced with the Slip Fit Conduit Terminals supplied with the Throttle Cable Assembly. Refer to Manufacturer's instructions.

1. Refer to the parts catalog and select the required components for assembly.
2. Remove lock washer and retaining nut from Throttle Cable Assembly.
3. Route Cables through center hole in Instrument Sub-panel. Secure with lock washer and retaining nut.
4. Install Rubber Grommets to lower set of 5/16" holes below Regulator Rectifier on Firewall and route cables through.
5. Route cables to each Carburetor leaving slack to allow for engine movement and maintenance of carburetor.

NOTE: Throttle Control can be pulled out slightly to allow trimming of Control Cable housings.

6. After Choke Control is installed, cut provided Blue Line into segments and secure with Plastic Ties to secure the Throttle and Choke Cable housings together.
7. Adjust to allow full throttle when control is pushed all the way in. Synchronization of the carburetors is very important. There are videos on the internet that show this procedure in detail.

NOTE: <http://www.rotax-owner.com/> has many E-Learning videos available.

ROTAX 912 ULS - CHOKE CONTROL ASSEMBLY

(FINAL INSTALL OF ENGINE) ASSEMBLY

- The engine needs to be installed to the airframe.
 - Instrument Sub-panel must be installed
1. Refer to the parts catalog and select the required components for assembly. Refer to Manufacturer's instructions.
 2. Remove lock washer and retaining nut from Throttle Cable Assembly.
 3. Route Cables through right side hole in Instrument Sub-panel. Secure with lock washer and retaining nut.
 4. Install Rubber Grommets to upper set of 5/16" holes below Regulator Rectifier on Firewall and route cables through.
 5. Route cables to each Carburetor leaving slack to allow for engine movement and maintenance of carburetor.
 - NOTE:** Choke Control can be pulled out slightly to allow trimming of Control Cable housings.
 6. Cut provided Blue Line into segments and secure with Plastic Ties to secure the Throttle and Choke Cable housings together.
 7. Insert Barrel Stop into choke control arm and thread Control Cable through. Refer to **FIGURE 11G-07/912**. Adjust to allow full off (down) position when control is pushed all the way in and tighten Set Screw in Barrel Stop.
 - HINT:** Turn Adjustable Ferrule out slightly to allow easier adjustment. Lock Adjustable Ferrule with lock nut.
 8. Safety wire Cable housing to Adjustable Ferrule and check for operation.

ROTAX 912 ULS - ENGINE ELECTRICAL

(FINAL INSTALL OF ENGINE)

- Due to the wide selection of switches, circuit breakers, connectors, gauges, flight systems, etc, which may be used by S-20 RAVEN builders, RANS does not supply these items with the kit.
 - Electrical wiring can be aided with the use of Buss Bars for Master, Ground and Avionic power.
1. Refer to the parts catalog and select the required components for assembly.
 2. Connect one Universal Cable from the POSITIVE (+) side of Battery to Solenoid post.

NOTE: Other wires in the Electrical System will also attach to this Solenoid post.
 3. Route one Universal Cable from grounding lug on AFT end of Starter housing to the NEGATIVE (-) side of Battery.

IMPORTANT: Do **NOT** attach the ground cable to the battery until all wiring is complete and you are ready to start the engine.
 4. Connect one Universal Cable from un-used terminal on Solenoid to threaded post on Starter.
 5. Install the instruments, switches and breakers into the instrument panel. Set the instrument panel in the fuselage. Referring to the parts pages wiring schematics, Rotax installation manual, and instrument manufacturer's manuals, wire all instruments and switches.

NOTE: The tachometer leads are color-coded. The Tach is not affected by switching these leads. However, it is important that the wire that attaches to the (-) terminal also be grounded.

ROTAX 912 ULS - 12" SPINNER ASSEMBLY

(FINAL INSTALL OF ENGINE)

- Spinner Assembly requires Propeller and Prop Extension
1. Refer to the parts catalog and select the required components for assembly.
 2. The AFT edge of the Spinner Dome and Backing Plate supplied have been trimmed at the factory and should not require any additional trimming.
 3. Check that the Prop Extension fits in the pre-drilled holes of the Spinner Backing Plate. The fit should be tight. If some sanding is required, use sandpaper wrapped around a dowel or tube.
 4. Cut out the Spinner Dome to match the Prop type. See **FIGURES 11J-04/912**.

HINT: Use a compass and draw a circle slightly larger than the spinner diameter. Use a ruler and draw lines from center to outer edge of circle. For a 3-Blade prop use a protractor and make the marks exactly 120° apart. For a 2-Blade prop use a straight edge and draw a line through the center point.
 5. Center the Spinner Dome in the circle and mark the Dome at lines.
 6. Glue the Prop template to poster board and cut out. Align one edge of the template on a mark and tape to the Dome. Draw the opening on the Dome. Repeat for the remaining openings using the same edge of the template for each. The openings may be cut and sanded smooth using a Dremel.

HINT: Use reinforced cut-off wheels and 1/2" sanding drums.

CAUTION: Always use proper safety equipment. Cut the opening slightly small and sand to exact fit.
 7. Fit the Spinner Backing Plate onto the Prop Extension. Press the Prop hub onto the Extension. Test fit the Dome. Sand the openings to an exact fit. Allow at least 1/8" clearance between the Spinner and Prop.

NOTE: Blades may need to be temporarily clamped in place on adjustable props. Be sure the Dome is flush with the backside of the Backing Plate.

HINT: Use 3 or 4 thin boards under the Backing Plate for support.
 8. Remove Dome and mark hole locations on the Dome's perimeter to equally space screws between prop opening cut-outs. Refer to **FIGURE 11J-08/912**. Drill #40 through the marked locations.
 9. Place Dome over Backing Plate/Prop Assembly with the Backing Plate sitting on a flat surface

HINT: Use 3 or 4 thin boards under the Backing Plate for support.
 10. Place the Spinner Dome in position. Press the Dome tight to the surface to ensure that the Dome and Backing Plate are flush. Transfer drill #40 and Cleco.

11. Remove clecos one at a time. Transfer drill #30. Cleco as you go. Final Size drill #11 and cleco. The Dome and Backing Plate must remain tight against the surface as you drill.
12. Dimple the Dome near one opening and dimple the Backing Plate corresponding to that opening for alignment markings. See **FIGURE 11J-12/912**.
HINT: Use a #11 bit and lightly press to make the dimples.
13. Assemble the Dome and Backing Plate each time with the dimples aligned.
14. Remove the dome and the prop from the backing plate and install the nut plates.
HINT: Use a short 3/16" bolt to hold the nut plate centered while drilling the ears #40.
NOTE: Counter sink the #40 holes to allow the heads of the rivets to sit flush with the Backing Plate flange.
15. See **FIGURE 11J-15/912**. "Set" the rivets by resting the head of the rivet against a vise and tapping the pulled end with a small hammer. Check for tightness. The nut plates must be snug.
16. The Spinner Dome is now ready for painting.
17. During final assembly, install the Prop Extension and Backing Plate on the engine prop flange. Install the prop. Refer to **PROPELLER INSTALLATION** and bolt the Spinner Dome in place.
18. The spinner and prop should be balanced and no adjustment required. However, the ultimate test is in the running. If you experience a lot of vibration, it could be caused by out of balance or misalignment. Use a good prop balancer. Check both the prop and spinner assembly, if the misalignment is not correctable then a new spinner may be required. Misalignment occurs through improper alignment of the parts. A slight amount of "wobble" is acceptable and may disappear at higher RPM's. Always pre-flight your spinner.

ROTAX 912 ULS - COWLING ASSEMBLY & INSTALLATION

(FINAL INSTALL OF ENGINE)

- The Engine, Prop Extension, Spinner Backing Plate and Boot Cowl must be installed before installing the Cowling. If Firewall Forward was purchased less prop, contact RANS Parts Department for the proper 1" Prop Extension. Refer to **Propeller Installation** for part number.
1. Refer to the parts pages and select the required components for assembly.
 2. Attach two 3/8" spacers to the flange of the Spinner Backing Plate. See **FIGURE 11K-02/912**. A couple of 3/8" thick wood boards work well for this. Bolt the Extension and Spinner Backing Plate to the engine prop hub.
 3. Set both upper and lower cowls on their aft edges on the floor. Match the cowling together to determine where to trim the lower cowl's forward edges to match to the upper cowl. Trim prop opening flange of upper and lower Cowls to 1". Trim joggle areas of lower Cowl to 3/4". Refer to **FIGURE 11K-03/912**. A Dremel tool with a reinforced cut-off wheel works well for cutting. A drum sander works well for smoothing.
 4. Remove AFT flat section of Radiator inlet area of lower Cowl. Refer back to **FIGURE 11K-03/912**.

HINT: Use a black sharpie to mark the cut-out perimeter.
 5. Apply two rows of 2" wide masking tape to the Boot Cowl aft of the cowling joggle. You want approx 4 inches of tape aft of the cowling joggle all the way around the Boot Cowl.
 6. Mark a line 3" aft of the joggle all the way around the fuselage.
 7. Tape the lower cowling in position against the backing plate with 3/8" spacers. Mark 3" forward from the line on the fuselage. This will place a line on the Cowling directly over the joggle.

HINT: Reinforced packaging tape works well to hold the lower Cowling while fitting up.
 8. Trim the lower edge of the lower cowling to the marked line and tape back in place on the fuselage.

NOTE: The sides of the cowl will be marked and trimmed after the top cowl is fit. Leave the aft edge of the scoop exit long for now.
 9. Slip the upper Cowl into place. The forward edge should touch the 3/8" spacers. The forward end of the upper Cowl should be positioned to allow an undisturbed flow of air off the Spinner Dome and should be centered side to side. Trim area around Prop Flange Opening to allow Cowling to align with Spinner Dome.

IMPORTANT: Check to be sure the air openings appear level from side to side.

10. Re-adjust as needed and re-tape in place. The sides of the upper Cowl will lap over the lower Cowl until trimmed.
11. Mark and trim the upper aft edge of the upper Cowl to allow it to set into the joggle.
NOTE: The sides of the Cowl will be marked and trimmed after the upper Cowl is fit.
12. Tape forward ends of the Cowlings tightly together, check for proper alignment. Re-adjust as needed and re-tape in place.
13. Locate the top center fastener hole per **FIGURE 11K-13/912**. Drill #40 and Cleco. Locate the bottom fastener holes, drill #40 and Cleco. Mark and trim the aft edges of the Cowling to fit in the Cowl joggle.
14. Measure and drill the positions for the aft fasteners #40 and cleco. Refer back to **FIGURE 11K-13/912**.
NOTE: Removing the small square area where the lower Cowl overlaps onto the Boot Cowl Strip will allow the upper Cowl to lay flusher with the Boot Cowl. Refer back to **FIGURE 11K-03-912**.
15. Apply 2" wide masking tape to the lower Cowling below the joggle. You want approx 2" of tape below the joggle all the way along the Cowling side. Mark a line 1.5" below the joggle.
16. Tape the upper Cowling in position and mark 1.5" from the line on the lower Cowl. This will be placing a line on the upper Cowling directly over the joggles.
17. The upper Cowling may need to be trimmed again. Everything changes a little when it settles in the joggle. Sand to final fit.
18. Measure and drill the positions for the fasteners #40 at the cowl to cowl joggle and cleco. See **FIGURE 11K-13/912**.
19. Transfer drill all holes to #11 and cleco.
20. Final trim all of the openings.
21. Refer to **FIGURE 11K-21-912**. Mark the opening position for the Oil Check Door on the upper side of the upper Cowl.
HINT: A Dremel tool with a reinforced cut-off wheel and small sanding drum works well.
22. Position Reinforcement Rings with fastener holes towards aft edge of cowl. Cleco in place. Center Maintenance Hatch in opening. Align holes for 1/4-Turns and transfer drill #30 through hinges. Cleco as you drill.
NOTE: Form the Maintenance Hatch and Reinforcement Ring to better contour to the upper Cowling if desired.
23. Rivet 1/4 Turn Receptacles to bottom of Reinforcement ring.
24. Cleco 1/4 Turn Receptacles through #11 holes to inside of Boot Cowl Strips. Align and transfer drill #40 though Receptacles. Remove Receptacles.

25. Position 4 forward Nut Plates to inside of lower Cowling, temporarily retain with Truss Head Screws and transfer drill #40. Remove Nut Plates
26. Step drill Receptacle holes to 5/16". Refer to **FIGURE 11K-26/912**.
NOTE: Rivet holes in the cowling may be countersunk for a more flush fit.
IMPORTANT: The 4 forward most holes must remain #11 for the #8 Screws.
27. Step drill the fastener holes to 1/4". Refer back to **FIGURE 11K-26/912**.
IMPORTANT: The 4 forward most holes must remain #11 for the #8 Screws.
28. Trim aft edge of lower Cowling air exit per **FIGURE 11K-28/912**.
29. Paint Cowlings and Oil Access Door.

(AFTER PAINTING OF COWLING AND OIL ACCESS DOOR)

30. Rivet 1/4 Turn Receptacles and Nut Plates in place.
31. Install 1/4 Turn Fasteners in Cowlings. Refer back to **FIGURE 11K-26/912**.
32. Install Cowling and admire.

ROTAX 912 ULS - PROPELLER INSTALLATION

(FINAL INSTALL OF ENGINE)

- The Engine, Prop Extension, and Spinner Backing Plate must be installed before installing the Propeller.
1. Refer to the parts pages and select the required components for assembly.
 2. Install the Flange Bushings into the prop flange on the engine from the aft side. A "C" clamp may be required to completely seat the Bushings into the flange. Place a small wood block between the pad of the clamp and the Flange Bushing to protect them from being damaged. Use a piece of tubing approximately 1" long over the Flange Bushings to allow them to seat as the "C" clamp is tightened.
 3. Inspect the Prop for any nicks, crack or dings.
 4. Assemble and mount the propeller as per PARTS MANUAL DRAWING and Manufacturer's instructions using the bolts provided. Set pitch of prop, using measuring tools provided with the prop to the following for a starting point. Adjustment may be required after Static RPM is checked.
 - Whirl Wind = 20.5° per manufacturer's instructions
 5. Note the length of the bolts is critical. Use washers to be certain the bolts are not bottomed out on the threads.

DANGER: If bolts are bottomed out on the threads, the prop is not properly torque, separation from the aircraft during operation may occur.
 6. Use a star pattern and torque the bolt per Manufacturer's instructions. Re-torque bolts after 5 hours of flight and thereafter according to Manufacturer's instructions.
 7. Check prop for tracking by turning blade into a vertical position and placing an object at the tip. A plastic 5 gallon bucket or similar will work well. Rotate the prop to the next blade and check position. If the position is the same, the prop is in track. If not, loosen prop bolts and re-torque until proper tracking is achieved.

HINT: Start torque pattern on the blade that is out of track. See **FIGURE 11L-07/912**. **DANGER:** Track prop with ignition **OFF!!**
 8. Secure Spinner Dome to the Spinner Backing Plate. Refer to **SPINNER ASSEMBLY**.
 9. Before first test flight, lock brakes, chock wheels and tie the tail to prevent unintentional aircraft run-away when checking Static RPM. Static (full throttle) RPM should be between 5100 - 5350 RPM.

RIGGING AND PREPARATION FOR FLIGHT

AILERON AND FLAP RIGGING

1. Install wing tips.
2. The aileron and flap push-pull tubes should be installed with jam nuts not tight and NO loc-tite on either of the rod end or jam nut. If Loc-tite is present it may not allow the rod ends to rotate into position and provide friction free control movement. Mark the push-pull tube so you can count rotations. Screw on the jam nut and push-pull tube to rod end that has been already assembled to the aileron and flap bellcrank 10 turns. Screw the other rod end into the push pull tube 10 turns. One full turn of either rod end or push-pull tube equals .10" at the very trailing edge, use the wing tip for reference.
3. Center control stick in neutral position (aileron neutral) and securely fix in this position.
4. Adjust the turnbuckles to minimize the tension in the cables.
5. Insert a 1/4" bolt into each aileron bell crank rigging hole to hold it in the neutral position.
6. Temporarily bolt the rods ends to the ailerons to measure the gap on the outboard side of the rod end for the bushing. Refer to the part manual drawing for hardware and bushing material used. Cut the bushing material to 1/16" shorter than the gap measured. This is to allow for the thick washer against the rod end on the inside. Bevel one edge of the bushing to allow full movement of the rod end. See **FIGURE 12A-03**.
7. Adjust rod ends until the trailing edges match to the profile of the wing tip. One turn of the rod end will move the trailing edge of the surface .10".
8. With the rigging bolt still in place on the aileron bellcrank, adjust the turnbuckles to set the tension on the aileron cables. With the bolt holding the bellcrank, the tension will vary between the different lengths of cable. Adjust such that each section has the appropriate tension.

NOTE: Without a cable tension meter, adjusting the cables will have to be an educated guess. The correct tension does not overload or "drag" the system, nor will cables feel spongy. If you have a cable tension meter refer back to **FIGURE 12A-03A** for tension information.
9. Tighten all connections and turnbuckles and recheck.

DEFLECTIONS

10. For deflection measurements, center control stick for neutral position, move and hold control stick against stop and measure.
11. Measurement is taken on top surface of aileron at approximate half span on top of aileron rib. Deflection angle is in reference to trailing edge of Aileron.
12. Adjust aileron stops (1/4" Plain Bolts) on Control Stick Torque Tube as required. Make sure the Aileron Leading Edge is not contacting the Aileron Hinge.
 - **Up: 24° (Tolerance is +2.08/ -1.08)**
 - **Down: 14° (Tolerance is +2.08/ -1.08)**

SURFACE CLEARANCE

13. Refer back to **FIGURE 05F-04**.
 - The minimum clearance between aileron and wing tip is 0.13".
 - The minimum clearance between aileron and flap is 0.2".

OPERATIONAL CHECK

14. Move the controls in the cockpit throughout the full range of deflection. Check for:
 - Correct deflections of control surfaces.
 - Interference of controls, linkages, cables, surfaces with other components.
 - Excessive friction.
 - Secure jam nuts against aileron push rods then loc-tite the jam nut on the outer threads. Move the control stick to make sure the ailerons travel smoothly through the full range of motion and are free from play. If binding is present check jam nuts and rod ends.

FLAP RIGGING

NEUTRAL POSITION

(AFTER WING INSTALLATION/ AFTER SETTING OF WASHOUT)

1. Place flap handle in flaps retracted position.
2. Using the modified wing washout rigging board as shown in **FIGURE 11A-11**. Hold the rigging board so that it is contacting the bottom side of the leading edge spar and the bottom side of the trailing edge spar at approximate flap half span. The trailing edge of the flap should rest on the shim (level with lower surface of both spars).

NOTE: Press lightly up on the Flap trailing edge to remove Teleflex Cable play when setting.
3. Adjust the female rod end on the flap cable as required for neutral flap position.

CAUTION: Minimum thread engagement is 10 full turns.

DEFLECTIONS

4. For deflection measurement move flap lever all the way up (fourth notch).
 - Measurement is taken on top surface of flap at approximate half span on top of flap rib. **NOTE:** Press lightly up on the Flap trailing edge to remove Teleflex Cable play when checking.
 - **Down: 45 to 50° (Tolerance is +2.08/ -2.08)**

SURFACE CLEARANCE

5. Refer to **FIGURE 05F-04**
 - The minimum clearance between surface and gap seals is 0.060”.
 - The minimum clearance between flap and aileron is 0.2”.

OPERATIONAL CHECK

6. Move the flap lever in the cockpit throughout the full range of deflection. Check for:
 - Correct engagement of the roller in the grooves of the flap side plates in each flap lever position.
 - Interference of controls, linkages, cables, surfaces with other components.
 - Excessive friction.

HORIZONTAL STABILIZER

NOTE: Ensure the 2nd hole for the aft attach of the horizontal stabilizer to S-11 has been drilled and both bolts are secured. This is in the Horizontal Stabilizer Attachment section.

Due to the various engine options which change the CG and therefore the ideal horizontal stabilizer incidence, incidence adjusters are used to set the incidence of the horizontal stabilizer and minimize drag. The goal is to adjust the incidence such that the elevator is flat with the horizontal when cruising at the desired cruise speed at the most common expected weight and CG.

INCIDENCE ADJUSTMENT

1. Remove the horizontal stabilizer fairing, tailcone closeout, and large inspection panel on the bottom of the tailcone.
2. Loosen the bolts on the front of the horizontal stabilizer/S-10 bulkhead so that the bolts can slide freely in the slots of the incidence adjuster.
3. Loosen the top 4 cap screws
4. Use the bottom 2 cap screws to set the desired incidence. Press down on the front of the horizontal stabilizer to ensure the bushings are against the bottom cap screws.
5. Check the horizontal stabilizer for twist compared to the fuselage and adjust the incidence of each side using the cap screws as needed.
6. Apply the appropriate thread lock to the 4 top screws and tighten them down onto the bushings.
7. Remove the bottom 2 cap screws and apply thread lock. Tighten them back up.

TUNING

1. Set the incidence to initial height depending on engine installation.

NOTE: This should have been completed during the assembly of the horizontal stabilizer to the tailcone.

- a. Titan X-340
 - i. 1/8" from the bottom of the slot
- b. Rotax 912ULS
 - i. 1/8" from the top of the slot

NOTE: Fine tuning can only be completed once the airplane is flying. Fine tuning of the incidence is optional, but will yield a small reduction in drag.

2. Fly the airplane at the weight and CG expected to be used most in cruise. At cruise speed in straight and level flight in smooth air, note the orientation of the balance weights of the elevator.

3. If the front of the balance weights can be seen sticking up above the horizontal stabilizer, adjust the incidence using the method above to raise the nose of the horizontal stabilizer. Lower the nose of the horizontal if the elevator balance can be seen below the horizontal.

NOTE: Replace thread locker after each adjustment and check before and after each test flight immediately following an adjustment.

4. Repeat until satisfied.

ELEVATOR

IMPORTANT:

The elevator must be mass balanced. If this is not yet completed, instructions can be found in the elevator assembly section of this manual

NEUTRAL POSITION

1. In neutral position, the elevator is level with the horizontal stabilizer. Verify by comparing the leading edge of the balance arm portion of the Elevator to the Horizontal Stabilizer with the Control Sticks in neutral position.
2. It is possible to adjust at the connection of the Control Stick Push-Pull Tubes.

CAUTION

Rod Ends must be screwed into fittings a minimum of 10 full threads.

DEFLECTIONS

3. Determine neutral position of elevator as reference for deflection measurement. Use of a Digital Protractor with a zero function works well.
4. Set Elevator to neutral position. Set digital protractor on top of Elevator at half span and zero protractor.
5. Move Control Stick to forward position. Adjust for down deflection and drill Aluminum Stop Sleeve on 5/8" Push-Pull Tube. Rivet Stop Sleeve in place with Stainless Steel Rivet. Control Stick should clear Instrument Panel. Move Control Stick to aft position. Adjust for up deflection. Drill Stop Sleeve and rivet. Measure deflection on elevator at approximately half span.
 - **Up: 33.0° (Tolerance is +1.08/ -1.08)**
 - **Down: 25.0° (Tolerance is +1.08/ -1.08)**
6. If adjustment is needed adjust the Rod Ends at the connection of the Control Stick Push-Pull Tubes. **CAUTION:** A minimum of 10 full turns thread engagement must be assured.

SURFACE CLEARANCE

7. Refer to **FIGURE 11B-09**
 - **The minimum clearance between elevator and horizontal stabilizer is 0.060" all the way along the hinge line.**
 - **The minimum clearance between the elevator balance horn and the horizontal stabilizer tip is 3/16".**

STATIC BALANCE

8. Elevator must be 100% static balanced in reference to the hinge line.
9. For instructions, refer to Section 11 - ELEVATOR MASS BALANCE.

OPERATIONAL CHECK

10. Move the controls in the cockpit throughout the full range of deflection. Check for:
 - Correct deflections of control surfaces.
 - Interference of controls, linkages, surfaces with other components.
 - Excessive friction.

ELEVATOR TRIM TAB

1. The elevator trim tab is operated by an electric servo.
2. In neutral position, the trim tab aligns with the trailing edge of the elevator.

DEFLECTIONS

3. Measure deflection on top of trim tab at push rod attach.
 - **Up: 26° (Tolerance is +3.08/ -3.08)**
 - **Down: 20° (Tolerance is +3.08/ -3.08)**

SURFACE CLEARANCE

4. The minimum gap between trim tab and elevator is 0.060" all the way.

INDICATOR POSITION

5. Verify neutral position of trim position indicator at neutral trim tab.

OPERATIONAL CHECK

6. Operate trim tab through full range of motion.
 - Correct deflections of trim tab.
 - Visual check trim tab for twist.
 - Check free movement of trim tab through full motion and listen for unusual noises from servo.

RUDDER

NEUTRAL POSITION AND CABLE TENSION

1. Remove the tailwheel chain from the tailwheel.
2. Verify neutral position of rudder with rudder pedals neutral (visual).
3. Change the mounting hole on the multi-hole tang at the front of the rudder cable for course cable tension adjustments.
4. Change the hole in which the multi-hole tang on the forward cable bolts to the rudder pedal assembly for fine cable tension adjustments.
5. Cable tension should be 15 to 20 lbs. measured on both cables under seats. If no cable tension meter is available, adjust by feel.
6. Reconnect the tailwheel cables and adjust tension by removing links in the tailwheel chain.

DEFLECTIONS

7. For deflection measurements move rudder pedal in cabin, hold at full travel position and measure at rudder. Adjust stops at rudder as required.
 - **Left: 28° (Tolerance is +3.08/ -0.08)**
 - **Right: 28° (Tolerance is +3.08/ -0.08)**

SURFACE CLEARANCE

8. The minimum gap between rudder and vertical stabilizer is 0.060" all the way.
9. The minimum gap between rudder and tip of vertical stabilizer is 1/8".

OPERATIONAL CHECK

10. Operate rudder pedals throughout full range of travel and check for:
 - Correct rudder deflection.
 - Interference of controls, linkages, cables and rudder with other components.
 - Excessive friction.
 - Slack cables between the tailwheel cable to rudder cable attach point and the rudder horn.

WEIGHT AND BALANCE

Refer to figure drawings.

INTRODUCTION

This Section describes the procedures for establishing of basic empty weight and moment of the airplane.

Procedures for calculating the weight and moment for various loadings are also provided. Sample forms **FIGURE 13-01** and **FIGURE 13-01A** are provided for Reference. Record your aircraft's information on the blank forms.

NOTE: both trike and taildragger versions are available in the FIGURES manual.

Always check your weight and balance during your pre-flight planning. It is recommended to check the data for landing and takeoff due to fuel weight change.

It is the responsibility of the pilot to ensure that the airplane is loaded properly.

AIRPLANE WEIGHING PROCEDURES

1. Preparation:
 - Inflate tires to recommended operating pressure
 - Parking brakes set
 - Drain all fuel
 - Service engine oil as required to obtain a normal indication
 - Move seats to the most aft position
 - Retract flaps
 - Place all control surfaces in neutral position

2. Leveling:

TAILDRAGGER

- Raise tail to measure 90° at aft door frame. Refer to **FIGURE 13-02**. Refer to **FIGURE 13-02A** for optional 10" tailwheel. (A stand between tail wheel and scale is required).
- Place scales under each wheel (500 lb. minimum capacity is recommended)

TRIKE

- Shim scales to measure 90° at aft door frame. Refer to **FIGURE 13-03**.
 - Place scales under each wheel (500 lb. minimum capacity is recommended)
3. Weighing:
- With the airplane level, record the weight shown on each scale. Subtract the weight of the leveling device from the weight indicated at the tail wheel.

Make extra copies of above blank figures and use them to calculate Weight & balance as needed.

Use **FIGURE 13-04** to record history and changes in Weight & Balance.

POST FLIGHT RIGGING

Your first flight in your freshly assembled and signed off S-21 may be one of the most exciting things that you will do. The aim is to keep that excitement limited to experiencing an exhilarating flying machine and not one that is shaking your confidence. First flights need risk management, and that starts with through a pre-flight, a qualified pilot, and a plane that is rigged properly.

Assuming you followed the manual and everything is set as close to the specific tolerances, the plane should fly without significant trim issues. Typically there may be a need to adjust for roll or yaw. Pitch is usually a non-issue, due to the electric trim tab. However angle of incidence may be adjusted depending on engine weight and other modifications from the standard configuration. Understanding the cause and effect of changing rigging from the original settings is very important. Changing only one setting at a time between test flights is also paramount. Otherwise you could be complicating the process many fold.

DETERMINING ACTION

Proper diagnosis of the issue is critical to determine the correct action to take in rigging. At a medium cruise speed and gross weight establish the plane in level flight, pitch trimmed to hands off. Release both the hands and feet from the controls and observe the slip indicator. Gross weight will impact the pitch attitude of the plane and introduce P-Factor.

Plane slowly rolls ball stays centered

This indicates a slight amount of yaw, and can be typical of a large prop. The offset of the engine in the S-21 is slight, so some yaw trim may be required. I prefer to trim rudder versus increasing engine offset, which can compromise performance more than trimming. Coordinated flight with or without rudder is easy because of the ample roll coupling. P-factor is usually a small factor, if pitch attitude is level or near. In a rare case where the engine offset and thrust line is extremely off from spec, P-factor could be involved, and that will become apparent once corrective actions are tried and results are not as expected. When properly rigged, the Outbound can fly hands and feet off, ball centered, with only minor rudder input to hold a heading. And that is with one or two onboard. There is little influence due pilot, passenger, or header tank weight.

The rate the plane rolls is indicative if it is yaw or roll. It can be confusing, since slow application of aileron will also provide a ball centered turn. It may be difficult to tell the difference. That is when trial and error comes into play. In the case of a slow roll while the ball stays centered and a light touch on the rudder pedal corrects the action, add a bump style trim tab to the right side of the rudder.



Using common door self-adhesive D-shaped door seal to affect a trim tab. It is easy to use, since you can try different lengths to gauge impact on trim.

Plane Briskly Rolls Ball Moves Out

This is indicative of roll input, and can also have some yaw. To determine the cause, center the ball and keep on the rudders, and release the stick. If you can center the ball, but remain in a bank, roll trim is needed. Apply the same rubber trim material used on the rudder to the bottom of the opposite aileron of the roll direction. The trim bulb will be more effective on the bottom side due to dynamic pressure. Start with 4 to 5" of bulb and shorten as required. If not totally corrected with roll trim, try adding rudder trim.

Plane Flies Wing Low Opposite of Yaw, Rolls Ball Moves Out, and either slowly changes heading or hold heading

The plane is flying crooked. This will be obvious if you are holding opposite rudder and aileron to keep the ball centered. In flight if you add rudder only to center the ball, the plane will enter and stay in a turn until release of the rudder. The corrective action is to add bump trim strips to both the rudder and aileron. Do so one at a time. While flying, write down where you need to locate the trim bumps. It is easy to install trim bumps opposite of where needed.



D-shaped weather strip makes a fine bump trim.



Permanent bump trim using 1/4" Aluminum tubing.

Adjusting Wing Root Angle of Incidence

In some cases adjusting the wing at the root can be effective. Raising the rear spar may be the better choice over trim bumps, or in combination with trim bumps, if roll is strong. In this case always raise a wing, since this is the better loading on the spar. The amount you raise the wing has to be at least 0.2" to offer adequate edge distance from the existing holes. Prior to removing the two 10-32 bolts in the fitting, mark a line where the fitting meets the spar web, this will create a reference line for the 0.2". Use the fitting as a drill guide. Be sure to raise the wing opposite of the roll. If rolling left, raise the right wing to reduce lift to diminish the roll.

Adjusting Horizontal Stabilizer Angle of Incidence

The Horizontal stab is adjustable for a couple of reasons, one to optimize speed and if pitch trim is unable to hold level flight throughout the speed range, with and without flaps. The latter would be the case where an engine of greater than flight tested weights is installed. The S-21 was designed to accommodate a wide range of engines, from the 100 HP Rotax up to Lycoming 360's with constant speed props. A good test for optimum incidence is the ability to hold a trim speed, and how well it returns to trim speed after a positive or negative pitch diversion. A lack of incidence will also impact the stick pressure in the stall, worst case forward CG and full flaps. Our flight testing has shown this adjustment to be fairly forgiving, and on our demo plane we went to full negative, while the sister ship was about midway. We saw little speed difference and only slight changes in stick pressure in pitch in the stall. This will be the case with the heavier engines, but incidence changes will show a stronger impact on the Rotax 912ULS powered planes. A simple rule of thumb is to start full down adjustment for the Titan, and full up for the Rotax. Check for neutral trim speed by finding the speed the elevator is flush. This can be a wide speed range. We have adjusted from 65 MPH IAS to 85 MPH IAS on the Rotax powered plane. For the Titan shoot for 95 to 100, go back to more incidence if holding trim speed is affected.



An example of using bump trim on the ailerons.
Place trim on the bottom of ailerons for best results.

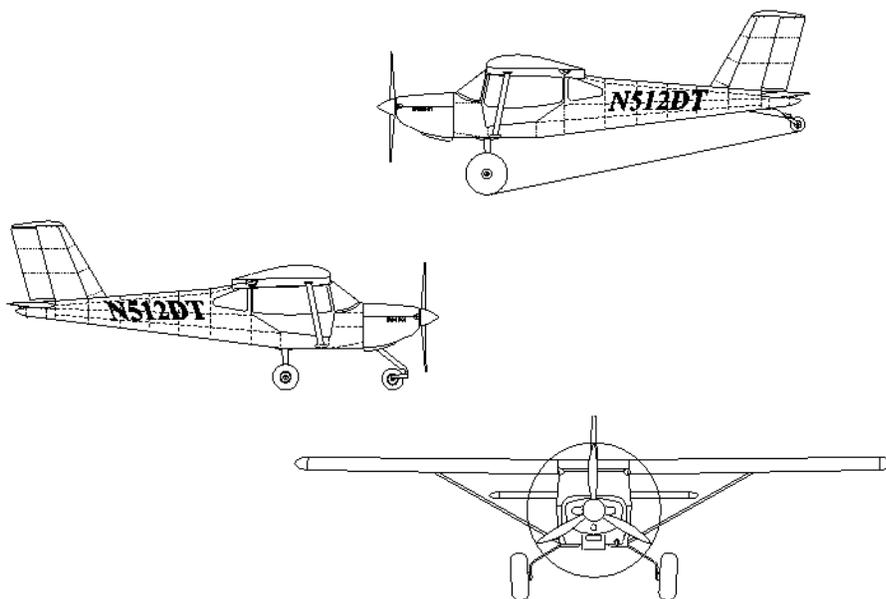
Summary

Take your time on post flight rigging; the end result will be a plane that flies in perfect trim. This will enhance performance and flying qualities. Remember, change one thing at a time and carefully note cause and effect.

RANS

S-21 OUTBOUND

OPERATIONS MANUAL



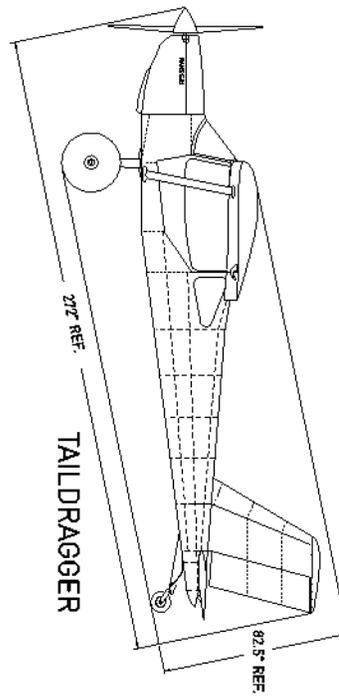
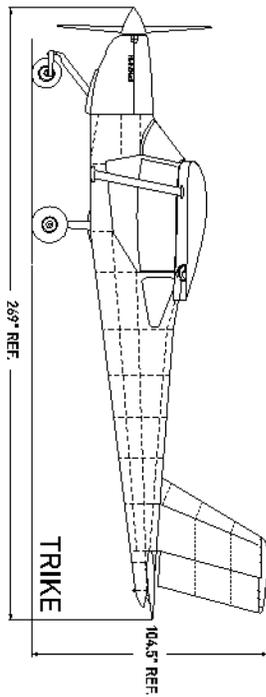
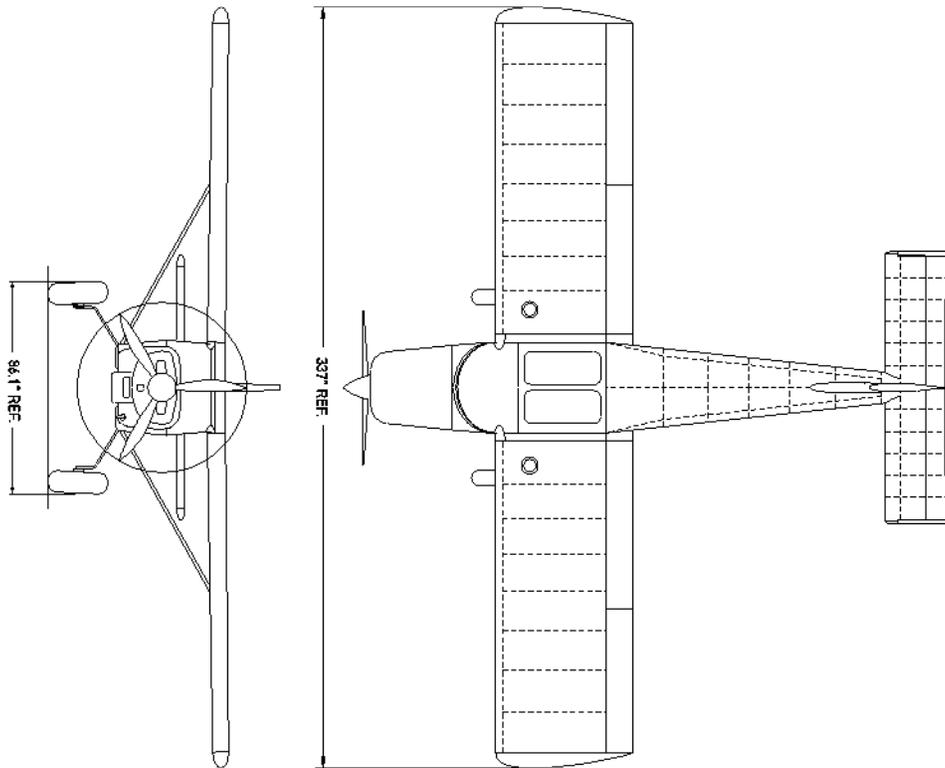
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Registration Number:

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RANS S-21 OUTBOUND - THREE VIEW



GENERAL INFORMATION

Use this Operations Manual as a guide. Every aircraft is slightly different due to such factors as weight, equipment, paint finish and builder skills, just to name a few.

The pilot should study the entire Operations Manual to familiarize themselves with the limitations, performance, and procedures applicable for this aircraft.

ENTERING AND EXITING AIRCRAFT

To enter the S-21 OUTBOUND:

- Open the door by rotating the door handle.
- Pull out on the door handle
- Gas lift struts will hold the door open.
- Adjust seat as desired to an aft position and sit in the seat. Rotate legs into position. For easiest entry place the seat as far aft as possible.
- To adjust seat while in the aircraft, lean forward pulling the seat back forward. Grasp fuselage carry-thru tube and pull yourself and seat into desired position. It helps to push the tilted seat back near the bottom.
- Lean back and check that seat back locks into place. If a different recline setting is desired, exit the aircraft and lift the seat bottom and move the pins to the desired recline setting.
- Close door and check that door handle is fully forward.
NOTE: Seats should be in aft position for easy entry.

To exit the S-21 OUTBOUND:

- Open the door by rotating the door handle aft.
- Push out on door
- Gas lift struts will hold the door open.
- Adjust seat as desired to an aft position and rotate legs out of aircraft.
- Exit aircraft. Close and latch door if desired.
NOTE: Seats should be in aft position for easy exit.

CAUTION

It is NOT recommended to move the seat while operator of the aircraft. If moving is required, allow a qualified second occupant or autopilot to operate the aircraft until desired seat position is obtained.

DOORS

Doors can open in flight if the latches are not secured.

CAUTION: If any door opens in flight, continue to fly the plane, trim to hands-off level flight if possible, slow to 65 mph, then close door.

Flying with doors open or removed

The S-21 OUTBOUND can be flown with the doors open, up to and including 100 mph.

The S-21's doors should not be opened at airspeeds above 65 mph. The S-21 can be flown with (1) or both doors removed up to 100 mph. A loss in lift, climb, and cruise speed is to be expected with the doors open or off.

STEERING AND BRAKING

Proper steering and braking procedure is important, especially with a taildragger. To help prevent nose-over, position your foot per **FIGURE 14-01** below. Press more with the area near the heel when steering, without braking, is desired. To steer, with braking, flex the foot to press closer to the toe area to apply brakes. Caution should be used especially when operating a taildragger.

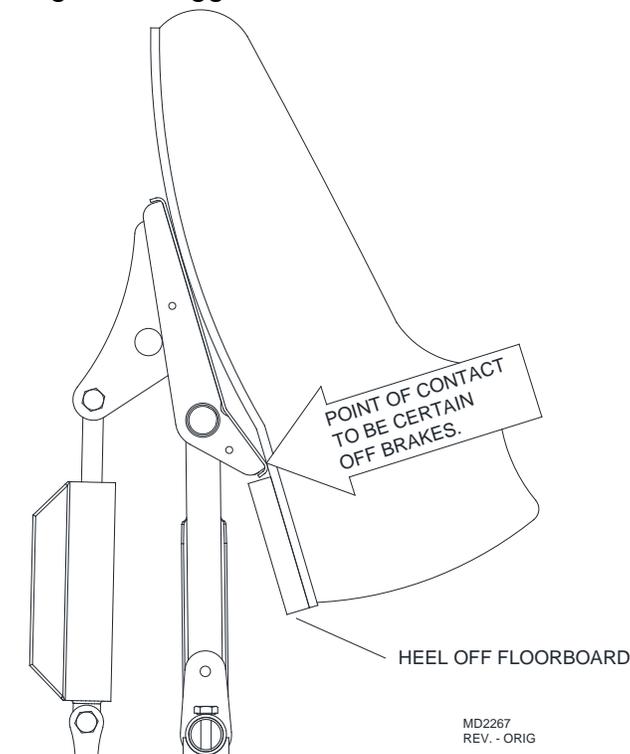


FIGURE 14-01: STEERING AND BRAKING

OPERATING LIMITATIONS

This section includes operating limitations, instrument markings, and basic placards necessary for the safe operation of the aircraft, power plant, and standard equipment.

The Engine Operators Manual must be onboard the aircraft.

AIRSPEED LIMITATIONS

Airspeed limitations and their operational significance are shown in **Table 14A-1**.

All speeds are given for maximum takeoff weight.

Speeds are given in MPH and (KNOTS)

	Airspeed	IAS		Remarks
		ROTAX 912ULS	TITAN X340	
VNE	Never Exceed Speed	160 (139)	215 (187)	DO NOT exceed this speed in any operation
VA	Maneuvering Speed at maximum gross weight	125* (110)*	170* (148)*	DO NOT make full or abrupt control movements above this speed.
VFE	Maximum Flap Extended Speed	110 (96)	110 (96)	DO NOT exceed this speed with flaps extended.
VSO	Stall speed**	38 (33)	40 (35)	Flaps full down
VS	Stall speed**	47 (41)	49 (43)	Flaps up

TABLE 14A-1: AIRSPEED LIMITATIONS

* At weights below maximum gross weight, maneuvering speed should be reduced 3 mph for each 50 lbs. the aircraft weighs below maximum gross weight.

** Power-off configuration

AIRSPEED INDICATOR MARKINGS

Airspeed indicator markings and their color code meanings are shown in **Table 14A-1**. All speeds are given for maximum takeoff weight. Speed are given in MPH and (KNOTS)

Marking	IAS Value or Range		Meaning
	ROTAX 912ULS	TITAN X340	
White Arc	38 – 110 (33 - 96)	40 – 110 (35 - 96)	Full Flap Operating Range - Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 – 125 (41 – 110)	49 – 170 (43 – 148)	Normal Operating Range - Lower limit is maximum weight VS at most forward CG with flaps retracted. Upper limit is maximum structural cruising speed.
Yellow Arc	125 – 160 (109 – 139)	170 – 215 (148 – 187)	Operation must be conducted with caution and in smooth air only.
Red Line	160 (139)	215 (187)	Maximum speed for all operations

TABLE 14A-2: AIRSPEED LIMITATIONS**MAXIMUM DEMONSTRATED CROSSWIND VELOCITY**

Takeoff23 MPH (20 Knots) @ 90 degrees
 Landing23 MPH (20 Knots) @ 90 degrees

This is not considered limiting.

WEIGHT LIMITS

	ROTAX 912ULS	TITAN X340
Maximum Ramp Weight	1320 lbs	1800 lbs
Maximum Takeoff Weight	1320 lbs	1800 lbs
Maximum Landing Weight	1320 lbs	1800 lbs
Maximum weight in Baggage Compartment	80 lbs	180 lbs

CENTER OF GRAVITY LIMITS

Forward: 31.72 inches aft of datum
 Aft: 41.92 inches aft of datum
 Reference Datum: Front face of Firewall

MANEUVER LIMITS

This aircraft is intended for non – acrobatic operations.
 The angle of bank should not exceed 60 ° and the pitch attitude may not exceed 30 °.
 Stalls except whip stalls are approved with slow deceleration.

► Acrobatic maneuvers, including spins are not approved in the RANS S-21 OUTBOUND aircraft.

FLIGHT LOAD FACTOR LIMITS

Flaps Up: + 6.0 g, - 2.0g
 Flaps Down: + 3.0 g, 0 g

FLIGHT CONDITIONS OPERATION LIMITS

Flight into known icing conditions is prohibited.

This aircraft is limited to two occupants only.

Night flights according to VFR, flights according to IFR (by instruments) are approved only when instrumentation required for such flights is installed and maintained according to applicable F.A.R.S. and flight performed by a pilot with applicable rating and currency!

Intentional flights into known icing conditions are prohibited.

FUEL LIMITATIONS

Approved Fuel Grades: Dependent on engine used

Fuel Capacity with 2.75 gallon header tank:

Total Capacity:.....	45.75 U.S. GAL
Total Capacity each Wing Tank:	21.5 U.S. GAL
Header Tank Capacity	2.75 U.S. GAL
Total Usable:	45 U.S. GAL
Total Unusable:	0.75 U.S. GAL

OR

Fuel Capacity with 6.9 gallon header tank:

Total Capacity:	49.9 U.S. GAL
Total Capacity each Wing Tank:	21.5 U.S. GAL
Header Tank Capacity.....	6.9 U.S. GAL
Total Usable:	49.15 U.S. GAL
Total Unusable:	0.75 U.S. GAL

► **NOTE:** Due to cross feeding between fuel tanks, the tanks should be re-topped after each refueling to assure maximum capacity.

The fuel quantity indicator is calibrated to read correct in horizontal level flight (cruise) only.

The readings given by the fuel quantity indicator in 3-wheel ground attitude (taildragger) are therefore not correct.

The fuel remaining in the tanks after the fuel quantity indicator reads zero (in level flight attitude in cruise condition) cannot be safely used in flight.

OTHER LIMITATIONS

Flap Limitations:

Approved Takeoff Range: retracted, 1st or 2nd notch flaps (0° to 17.5°)

Approved Landing Range: retracted to full flaps (0° to 40°)

WEIGHT AND BALANCE

INTRODUCTION

This Section describes the basic procedures for establishing of basic empty weight and moment of the airplane. Refer to **SECTION 13** for complete Weight & Balance information.

Procedures for calculating the weight and moment for various loadings are also provided. Sample forms are provided for reference.

NOTE: both trike and taildragger versions are available in the FIGURES manual.

Always check your weight and balance during your pre-flight planning. It is recommended to check the data for landing and takeoff due to fuel weight change.

It is the responsibility of the pilot to ensure that the airplane is loaded properly.

AIRPLANE WEIGHING PROCEDURES

4. Preparation:
 - Inflate tires to recommended operating pressure
 - Parking brakes set
 - Drain all fuel
 - Service engine oil as required to obtain a normal indication
 - Move seats to the most aft position
 - Retract flaps
 - Place all control surfaces in neutral position

5. Leveling:

TAILDRAGGER

- Raise tail to measure 90° at aft door frame. Refer to **FIGURE 13-02**. For optional 10" tailwheel refer to **FIGURE 13-02A**. (A stand between tail wheel and scale is required).
- Place scales under each wheel (500 lb. minimum capacity is recommended)

TRIKE

- Shim scales to measure 90° at aft door frame. Refer to **FIGURE 13-03**.

- Place scales under each wheel (500 lb. minimum capacity is recommended)
6. Weighing:
- With the airplane level, record the weight shown on each scale and subtract the weight of the leveling device from the weight indicated at the tail wheel.

WEIGHT AND BALANCE

The following will enable you to determine the weight and balance of your aircraft and to operate it within the prescribed center of gravity limitations.

The S-21 OUTBOUND is a simple aircraft and so are the weight and balance calculations.

The S-21 OUTBOUND is limited to two occupants.

For baggage storage, a baggage compartment behind the seats is available.

The compartment is rated for

ROTAX 912ULS 80 lbs

TITAN X340.....180 lbs

Baggage should be secured securely for flight.

To figure the weight and balance use the Sample Loading Problem and Center of Gravity Envelope as follows:

Enter the following data on the chart. Refer to **FIGURE 13-02**, **FIGURE 13-02A** or **FIGURE 13-03**.

- Weight of Main Gear – Left.
- Weight of Main Gear - Right.
- Weight of Pilot.
- Wing Fuel (at 6 lbs. / gal).
- Header Tank Fuel (6 lbs. / gal)
- Weight of Passenger.
- Weight of Baggage (FWD & AFT).
- Weight of Nose wheel or Tail wheel

Calculate the moments (Weight x Arm).

Add moments to obtain total moment.

Add weights to obtain total weight.

Calculate Center of Gravity. (**CG = Total Moment / Total Weight**)

Check that the Center of Gravity calculated for take-off falls inside of the acceptable Center of Gravity limits. Refer to **FIGURE 13-02**, **FIGURE 13-02A** or **FIGURE 13-03**.

Repeat for landing configuration.

EMERGENCY PROCEDURES

INTRODUCTION

This section provides checklists and amplified procedures for coping with emergencies that may occur. Emergencies caused by aircraft or power plant malfunctions are rare if proper pre-flight inspections and maintenance are performed. Emergencies caused by extreme weather situations can be minimized or eliminated by good judgment and proper pre-flight planning. However, should an emergency arise the basic guidelines described in this section should be considered and applied as necessary to resolve the problem.

In any emergency – fly the airplane first- maintain control.

The following material is provided for guidance only.

AIRSPEEDS FOR EMERGENCY OPERATION (IAS)

Engine Failure After Takeoff	Flaps UP	66 MPH
	Flaps DOWN	59 MPH
Maneuvering Speed		
		125 MPH
Maximum Glide	Flaps UP	68 MPH
Precautionary Landing with		
	Flaps UP	60 MPH
Engine Power	Flaps DOWN	55 MPH
Landing without Engine		
	Flaps UP	70 MPH
Power	Flaps Down	65 MPH

OPERATIONAL CHECKLISTS

ENGINE FAILURE

Engine Failure During Takeoff Run:

Fly the Airplane!

- (1) Throttle - IDLE.
- (2) Brakes - APPLY as needed.
- (3) Ignition switch - OFF.
- (4) Master switch - OFF.

Engine Failure Immediately After Takeoff

Fly the Airplane!

- (1) Airspeed - 66 MPH (Flaps up).
59 MPH (Flaps down).
- (2) Brakes - APPLY As Needed.
- (3) Ignition Switch - OFF.
- (4) Master Switch - OFF.

Engine Failure During Flight

Fly the Airplane!

- (1) Airspeed - 68 MPH for best glide
- (2) Select Emergency Landing Area - PROCEED To It.
- (3) Attempt Engine RESTART.
- (4) Ignition - Check ON.
- (5) ROTAX 912ULS - Choke - Check OFF.
TITAN X340 – Mixture – Full Rich
- (6) Throttle Lever - CRACKED (approximately 1/4" forward).
- (7) Turn Switch to START
- (8) If Engine **DOES NOT** Start - Follow Emergency Landing Procedure Without Engine Power.

FORCED LANDINGS**Emergency Landing Without Engine Power**

Fly the Airplane!

- (1) Flaps - As REQUIRED for Landing Site.
Airspeed - 70 MPH (Flaps up).
65 MPH (Flaps down).
- (2) Fuel Selector Valve - OFF.
- (3) All Switches - OFF.
- (4) Unlatch cabin doors prior final approach.
- (5) Touchdown - MINIMUM FLIGHT SPEED.
- (6) Brakes - APPLY As Needed.

Precautionary Landing With Engine Power

Fly the airplane!

- (1) Select Field - FLY OVER, noting terrain, obstructions and wind direction.
- (2) Flaps - AS REQUIRED (for landing site).
- (3) Airspeed 60 MPH (Flaps UP).
55 MPH (Flaps full DOWN) (Use flaps as required for landing site).
- (4) Master Switch - OFF.
- (5) Doors - OPEN.
- (6) Touchdown - MINIMUM FLIGHT SPEED.
- (7) Ignition - OFF.
- (8) Brakes - APPLY As Needed.

FIRES

During Start On Ground

- (1) Cranking - CONTINUE, to get a start which would suck the flames and accumulated fuel through the carburetor and into the engine.

If Engine Starts:

- (2) Power – Cruise Power RPM for a few minutes.
- (3) Engine - SHUTDOWN and inspect for damage.

If Engine fails to Start:

- (4) Continue cranking with throttle full open while ground attendants obtains fire extinguisher; when ready to extinguish fire -
- (5) Ignition - OFF.
- (6) Master Switch - OFF.
- (7) Fuel Selector Valve - OFF.
- (8) Fire Damage - INSPECT, repair damage or replace damaged components or wiring before conducting another flight.

Engine Fire In Flight

Fly the airplane!

- (1) Fuel Selector Valve - OFF.
- (2) Ignition switch- OFF.
- (3) Master switch - OFF.
- (4) Cabin heat - OFF.
- (5) Airspeed - 95 MPH (If fire is not extinguished, increase glide speed to find an airspeed which will provide an incombustible mixture (CAUTION: DO **NOT** EXCEED VNE).
- (6) Forced Landing - EXECUTE (as described in Emergency Landing Without Engine Power).

Electrical Fire In Flight

Fly the airplane!

- (1) Master Switch - OFF .
- (2) All Other Switches (except Ignition switch) OFF.

If fire appears out and electrical power is necessary for continuance of flight:
- (3) Circuit Breakers - CHECK for faulty circuit, do not reset faulty circuit
- (4) Master Switch - ON.
- (5) Radio/Electrical Switches - ON one at a time, with delay after each until short circuit is localized.

RECOVERY FROM A SPIRAL DIVE

If a spiral dive is encountered, proceed as follows:

- (1) Retard Throttle to **IDLE**.
- (2) Stop the turn by using coordinated aileron and rudder in opposite direction of Spiral dive.
- (3) Cautiously apply elevator back pressure to slowly reduce the airspeed to below maneuvering speed .

SPINS

Intentional spins in the S-21 OUTBOUND aircraft are **NOT** recommended. Should an inadvertent spin occur, the following recovery procedure should be used:

- (1) Retard the throttle to **IDLE**.
- (2) Place the ailerons in the **NEUTRAL** position.
- (3) Apply and **HOLD** full rudder opposite to the direction of rotation.
- (4) Just after the rudder pedal reaches the stop, move the control stick forward far enough to "break" the stall.
- (5) Hold these control inputs until rotation stops.
- (6) As rotation stops, neutralize rudder and apply back pressure on the control stick to slowly reduce airspeed to normal cruise speed.

AMPLIFIED PROCEDURES

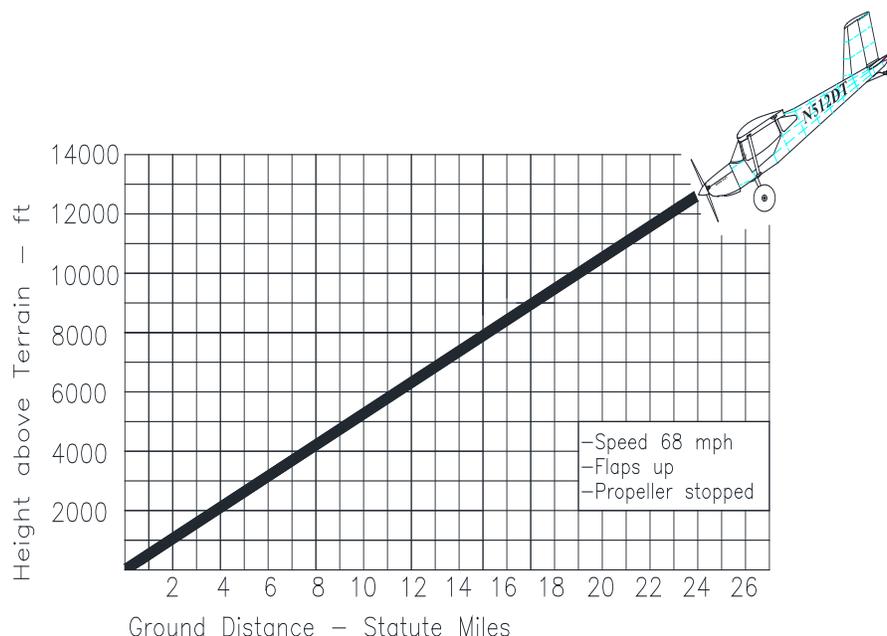
ENGINE FAILURE

If an engine failure occurs during the takeoff run, the most important thing to do is to stop the aircraft on the remaining runway. Those extra items on the checklist will provide added safety during a failure of this type.

The first response to an engine failure, after takeoff, is to promptly LOWER the nose and establishes a glide attitude (check and maintain speed). In most cases, the landing should be planned straight ahead with only small heading corrections to avoid obstructions. Of course, the number one priority is to land the aircraft as smoothly and accurately as possible.

CAUTION: Altitude and airspeed are seldom sufficient to execute a 180-degree gliding turn back to the runway.

After an engine failure in flight, the best glide speed (68 mph) should be established as quickly as possible. While gliding toward a suitable landing site, an effort should be made to identify the cause of the failure. If time permits, an engine restart should be attempted as shown on the checklist. If the engine cannot be restarted, a forced landing without power must be completed.



FORCED LANDINGS

Select a suitable landing site and proceed to it. If all attempts to restart the engine fail and a forced landing is imminent, follow the checklist for Emergency Landing Without Power.

Before attempting an off airport landing with engine power available, fly over the landing site at a safe but low altitude to inspect the terrain. Check for obstructions and surface conditions. Plan your approach and touchdown.

When preparing to ditch, it is advisable to jettison any heavy objects from around the Pilot, including heavy clothing. Of course, if time permits, ditch as close to land or a water vessel as possible.

Transmit Mayday message on 121.5 MHz giving location and intentions.

RECOVERY FROM A SPIRAL DIVE

If a spiral dive is encountered, proceed as follows:

- (1) Retard Throttle to **IDLE**.
- (2) Stop the turn by using coordinated aileron and rudder in opposite direction of spiral dive.
- (3) Cautiously apply elevator back pressure to slowly reduce the airspeed to below maneuvering speed.

SPINS

Intentional spins in the S-21 OUTBOUND aircraft are **PROHIBITED**. Should an inadvertent spin occur, the following recovery procedure should be used:

- (1) Retard the throttle to **IDLE**.
- (2) Place the ailerons in the **NEUTRAL** position.
- (3) Apply and **HOLD** full rudder opposite to the direction of rotation.
- (4) Just after the rudder pedal reaches the stop, move the control stick (yoke) forward far enough to "break" the stall.
- (5) Hold these control inputs until rotation stops.

- (6) As rotation stops, neutralize rudder and apply back pressure on the control stick to slowly reduce airspeed to normal cruise speed.

IGNITION MALFUNCTION

A sudden engine roughness or misfiring is usually evidence of ignition problems. Switching from BOTH to either L or R ignition switch position will identify which circuit is malfunctioning. Select different power settings if continued operations on BOTH circuits is practicable. If not, switch to the good circuit and proceed to the nearest airport for repairs.

CARBURETOR ICE

NOTE: Actuation only applies if Carburetor Heat is installed on your aircraft. If carburetor ice is experienced, transit to an area with less possibility of carburetor ice forming.

A sudden engine roughness or loss of rpm could be carburetor ice problems. Actuate the Carburetor Heat switch.

As soon as the engine roughness or suspected carburetor ice is gone, turn off the Carburetor Heat. Repeat as necessary.

DOORS

The S-21 OUTBOUND can be flown with the doors open, up to and including 100 mph.

The S-21 OUTBOUND doors should not be opened at airspeeds above 65 mph.

The S-21 OUTBOUND can be flown with (1) or both doors removed up to 100 mph.

A loss in L & D, climb, and cruise speed is to be expected with the doors open or off

Doors can open in flight if the latches are not secured.

CAUTION: If any door opens in flight, continue to fly the plane, trim to hands-off level flight if possible, slow to 65 mph, then close door.

The aircraft will fly with open doors. The door will float in a position pending on the speed of the aircraft. To close an open door in flight, slow to 65 mph, push the opposite rudder pedal. This will make the aircraft yaw and help to get the door closed.

NORMAL PROCEDURES

The following checklists are provided for guidance only. It is suggested that the owner of the aircraft adds items they deem necessary.

PRE-FLIGHT INSPECTION

Visually inspect the aircraft for its general condition during the walk around.

In addition to the items listed on the pre-flight checklist, look for signs of visible ice if applicable. The presence of ice on the aircraft wings and tail will adversely affect the aircraft's performance. In all cases, remove the ice **BEFORE** beginning any flight operations. Always exercise due care and good judgment. Remove visible moisture (water) from at least wings and tail surfaces because of its negative effects on performance of the aircraft.

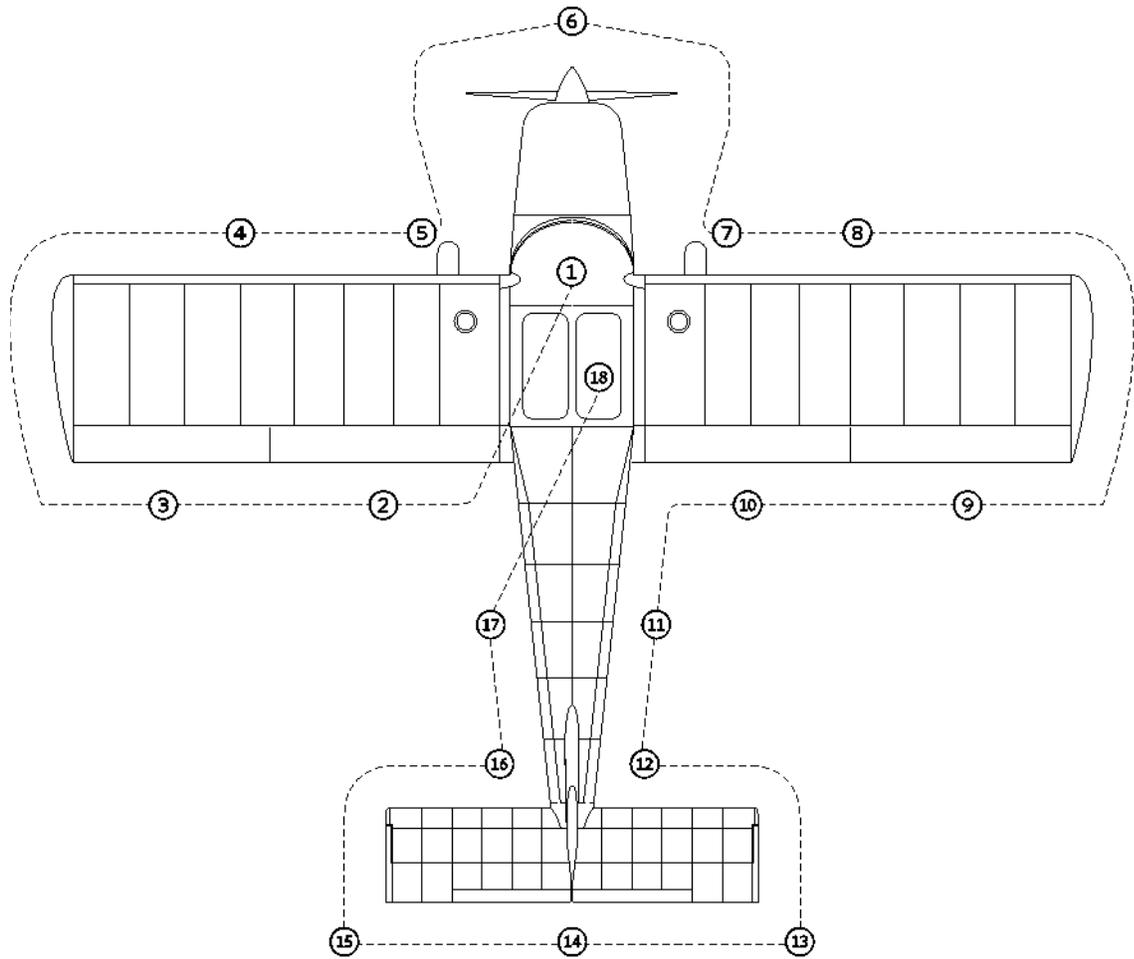


FIGURE 14D-01

The entire outer surface of the aircraft should be inspected for damage of any kind during the pre-flight inspection.

1.

- Aircraft Flight Manual – AVAILABLE IN CABIN
- Required Aircraft Documentation – AVAILABLE IN CABIN
- Parking brake – SET
- Ignition switch - OFF
- Master switch - OFF
- Avionics Master - OFF
- Circuit Breakers - CHECK IN
- Fuel Selector Valve - ON
- Fuel Quantity – CHECK QUANTITY
- Throttle Lever – MOVEMENT- free
- Seats – ADJUST POSITION – CHECK PINS
- Control Sticks - MOVEMENT- free and correct
- Flap lever - Operation - free & correct
- Cabin – CHECK FOR FOREIGN ARTICLES
- Baggage - SECURE
- For Solo flight – SECURE passenger seat belt
- Fuselage interior - CHECK

2.

- Wing Root connection - SECURE
- Flap hinge points - SECURE
- Trailing edge spar - STRAIGHT & INTACT
- Flap connections - INTACT

3.

- Aileron Hinge points - SECURE
- Trailing edge spar - STRAIGHT & INTACT
- Aileron connections - INTACT
- Aileron - Operation - free & correct
- Strut to Wing connection - SECURE

4.
 - Strut to Wing Connection - SECURE
 - Leading edge spar - STRAIGHT, DENT FREE & INTACT
 - Pitot/Static Tube - SECURE
 - Wing tie down - DISCONNECT

5.
 - Main Gear - CHECK
 - Main wheel tire - PROPERLY INFLATED
 - Brakes - SECURE
 - Fuel Filler Cap - CLOSED

6.
 - Remove Cowling if desired
 - Fuel quick drain valve on bottom of cowling (left side); - DRAIN & CHECK for water, sediment and proper fuel grade.
 - Engine oil dipstick/ filler cap - CHECK oil level, than check filler cap secure
 - Carburetor and air filter – CHECK security
 - ROTAX 912ULS - Radiator fluid over-flow bottle – CHECK fluid level

 - Propeller and spinner – CHECK for nicks, dents and security
 - Engine cooling air inlets and oil cooler – CHECK of obstructions
 - Engine cooling air outlet, radiator – CHECK of obstructions
 - Exhaust – CHECK – loose or damaged
 - TRIKE - NOSEWHEEL - CHECK

7.
 - Main Gear - CHECK
 - Main wheel tire - PROPERLY INFLATED
 - Brakes - SECURE
 - Fuel Filler Cap – CLOSED

8.
 - Strut to Wing Connection - SECURE
 - Leading edge spar - STRAIGHT, DENT FREE & INTACT
 - Pitot/Static Tube - SECURE
 - Wing tie down - DISCONNECT

9.
 - Aileron Hinge points - SECURE
 - Trailing edge spar - STRAIGHT & INTACT
 - Aileron connections - INTACT

- Aileron - Operation - free & correct
 - Strut to Wing connection - SECURE
- 10.
- Wing Root connection - SECURE
 - Flap hinge points - SECURE
 - Trailing edge spar - STRAIGHT & INTACT
 - Flap connections - INTACT
- 11.
- Tailcone - Check for dents, holes and scratches.
- 12.
- Fuselage connections - CHECK
 - Horizontal Stabilizer and Vertical Stabilizer - CHECK
- 13.
- Control surfaces - CHECK - free movement and SECURE
 - Hinge points – SECURE
- 14.
- TAILDRAGGER - TAILWHEEL - CHECK - Rudder cable and springs - SECURE
 - TRIKE - CHECK - Rudder cable - CHECK - SECURE
 - Rudder - CHECK and SECURE
 - Tail tie down - DISCONNECT
- 15.
- Control surfaces - CHECK - free movement and SECURE
 - Hinge points – SECURE
- 16.
- Fuselage connections - CHECK
 - Horizontal Stabilizer and Vertical Stabilizer - CHECK
- 17.
- Tailcone - Check for dents, holes and scratches.
 - Fuel quick drain valve on bottom of fuselage forward of Station 3 (left side); - DRAIN & CHECK for water, sediment and proper fuel grade

18.

- Climb aboard
- Cockpit checklist - CHECK
- Move seat into flight position – CHECK SECURE
- Seat belts - SECURE
- CONTROLS - FREE and CORRECT
- Altimeter - SET
- Communication radio - SET
- Transponder - SET
- Fuel – CHECK QUANTITY
- Hour meter - Note reading and time
- Engine controls - SET - throttle closed
- ROTAX 912ULS - Choke on
- Titan X340 – Mixture Rich
- CLEAR AREA!
- Ignition switch - START
- Choke - OFF
- THROTTLE - SET - Smooth Idle
- Weather - CHECK
- Traffic - CHECK
- HAVE FUN!!! - CHECK

*The Checklist should only be used as a guide. Develop your own to match your aircraft.

BEFORE STARTING THE POWERPLANT

- Pre-flight Inspection - COMPLETE.
- Passenger Briefing - COMPLETE.
- Seat, seat belts - ADJUST and LOCK.
- Brakes - TEST and SET
- Radio, Electrical Equipment - OFF
- Circuit Breakers - CHECK IN
- Fuel Selector Valve - ON.

STARTING THE POWERPLANT**COLD START**

- Throttle - CLOSED.
- ROTAX 912ULS - Choke - ON.
- TITAN X340 – Mixture Rich
- Master Switch - ON.
- Propeller Area - CLEAR
- Ignition Switch - START (release when engine starts).
- Throttle adjust – IDLE smooth – ROTAX 912ULS - up to 2000 RPM
TITAN X340 - up to

- Oil pressure - CHECK
- Choke – OFF
- Avionics master- ON.

HOT START

- Throttle - CLOSED
- Choke - OFF
- Master Switch - ON
- Propeller Area - CLEAR
- Ignition Switch - START (release when engine starts)
- Throttle adjust – IDLE smooth – ROTAX 912ULS - up to 2500 RPM
TITAN X340 - up to
- Oil pressure - CHECK
- Avionics master- ON

TAXIING

- Brakes – CHECK
- Control deflections as required for wind

BEFORE TAKEOFF

- Cabin Doors - CLOSED and SECURED
- Parking Brake - SET
- Flight Controls - FREE and Correct
- Flight Instruments - SET
- Elevator Trim - SET FOR TAKEOFF (center of indicator)
- Fuel Selector Valve - ON
- Fuel Quantity - CHECK
- ROTAX 912ULS
 - Throttle – 4000 RPM
 - Magneto - CHECK (Magneto drop should not exceed 300 RPM on either Magneto and the differential between magneto's should not be more than 120 RPM).
 - Engine Instruments and Voltmeter- CHECK
 - Carburetor heat – CHECK – RPM drop

- TITAN X340
 - Throttle – 2000 RPM
 - Magneto - CHECK (Magneto drop should not exceed 300 RPM on either Magneto and the differential between magneto's should not be more than 120 RPM).
 - Engine Instruments and Voltmeter- CHECK
 - Carburetor heat – CHECK – RPM drop

- Throttle – IDLE – adjust friction lock
- ROTAX 912ULS - Choke – OFF
TITAN X340 – Mixture Rich

- Radios - SET
- Fuel pump - ON
- Wing flaps – SET for take off
- Brakes - RELEASE

TAKEOFF**Normal Takeoff**

- Flaps – UP or 1st or 2nd notch
- Carburetor heat – COLD
- Fuel pump - ON
- Throttle – SLOWLY FULL OPEN
- Elevator Control - Taildragger - LIFT TAIL WHEEL
- Trike - RAISE NOSE WHEEL
- Climb Speed – 65 - 70 MPH

Short Field Takeoff

- Flaps - 3rd notch
- Carburetor heat - COLD
- Fuel pump - ON
- Brake - APPLY
- Elevator Control - FULL BACK
- Throttle – FULL OPEN
- Brake - RELEASE
- Elevator Control - Taildragger - LIFT TAIL WHEEL
- Trike - RAISE NOSE WHEEL
- Climb Speed - 55 MPH until all obstacles are cleared
- Flaps - RETRACT slowly after reaching 60 MPH

ENROUTE CLIMB**Normal Climb**

- Airspeed – 70-80 MPH.
- Throttle
 - ROTAX 912ULS - MAX. 5800 RPM for 5 minutes, 5500 RPM continuous.
 - TITAN X340 – MAX.

CRUISE

- Throttle
 - ROTAX 912ULS – 4500 to 5500 RPM (Max. continues)
 - TITAN X340 – MAX.
- Elevator Trim - adjust.
- Fuel pump – OFF

APPROACH

- Throttle - AS DESIRED.
- Engine temperatures – MONITOR
- Carburetor heat – ON AS REQUIRED

BEFORE LANDING

- Seat, Belts, Shoulder Harness - ADJUST.
- Fuel pump – ON
- Carburetor heat – ON AS REQUIRED

LANDING**Normal Landing**

- Airspeed (on approach) – 66-70 MPH (flaps UP).
- Flaps (on final) - AS REQUIRED (below 110 MPH)
- Airspeed (on final) - 64 MPH (with full flaps)
- Touchdown
 - Taildragger - MAIN WHEELS FIRST OR THREE WHEEL
 - Trike - MAIN WHEELS FIRST
- Landing Roll
 - Taildragger - LOWER TAIL WHEEL GENTLY
(AFTER MAIN WHEEL TOUCH DOWN)
 - Trike - LOWER NOSE WHEEL GENTLY
(AFTER MAIN WHEEL TOUCH DOWN)
- Brake - MINIMUM REQUIRED

Short Field Landing

- Airspeed (approach) – 66-70 MPH (flaps UP).
- Flaps (on final) – FULL (below 110 MPH)
- Airspeed - MAINTAIN 59 MPH .
- Power - REDUCE to idle as obstacle is cleared
- Touchdown
 - Taildragger - THREE WHEEL
 - Trike - MAIN WHEELS - LOWER NOSE WHEEL GENTLY
(AFTER MAIN WHEEL TOUCH DOWN)
- Wing Flaps - RETRACT for maximum brake effectiveness
- Brake – Apply as required

Balked Landing

- Throttle – FULL OPEN
- Carburetor heat – OFF
- Airspeed – 55 MPH
- Wing Flaps – RETRACT TO HALF, Slowly
- Airspeed – 60 MPH
- Wing Flaps – RETRACT, Slowly

AFTER LANDING

- Wing Flaps - UP
- Taxi - SLOWLY
- Carburetor Heat - OFF
- Fuel pump - OFF

SECURING THE AIRCRAFT

- Parking Brake - SET
- Throttle - IDLE
- Radio and Electrical Equipment - OFF
- Master Switch - OFF
- Ignition - OFF
- Control Stick – SECURED
- Aircraft - SECURELY TIED DOWN

AMPLIFIED-PROCEDURES

PRE-FLIGHT INSPECTION

The importance of thorough pre-flight cannot be over-emphasized. Develop a systematic, habitual approach. The use of good, sound, reasonable judgment in tandem with the preflight checklist is essential. Ensure "yourself", all parts and components, and the entire aircraft are in an airworthy condition before attempting flight.

Refer to **FIGURE 14D-01** in the Operations Text. Starting at the pilot side cockpit, work around the RANS S-21 OUTBOUND aircraft in a clockwise manner as illustrated.

NOTE: This suggested outline for a pre-flight inspection generally covers the critical areas that **MUST** be checked prior to each flight.

In addition, **EVERY** component should be examined, properly maintained, correctly stored or transported, and inspected before each flight to ensure structural integrity and proper flying characteristics.

NEVER use the brake as a parking brake with the intention of leaving the aircraft unattended. The S-21 OUTBOUND is a light aircraft!

TAXING (Ground Handling)

The S-21 OUTBOUND is a light aircraft. Concentrate on taxiing until the moment the aircraft is tied down.

When taxiing, it is important that speed and use of brakes is held to a minimum, and that all controls are utilized to maintain directional control and balance.

The arrows identify the wind direction. It is very important to hold the controls as described, even when the aircraft is not moving. Refer to FIGURE 14D-02.

When taxiing in strong crosswinds a little extra throttle will help the aircraft turn due to the increased airflow over the rudder. Use caution not to use excessive throttle, sudden throttle movements, or excessive braking.

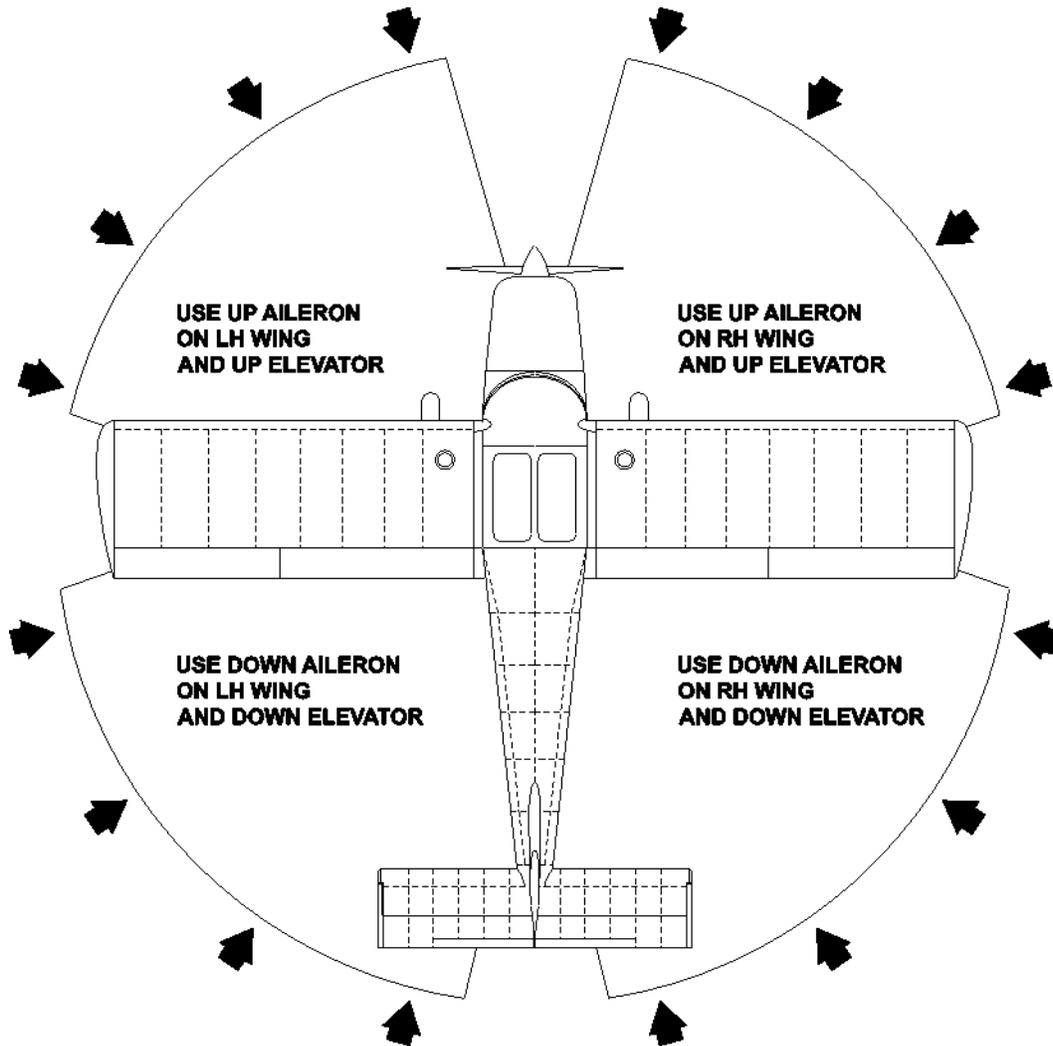


FIGURE 14D-02

The S-21 OUTBOUND is equipped with a steerable full-swivel tail wheel or brake steer nose wheel.

Taildragger - To taxi very small radius turns, push the desired rudder pedal and the brake pedal in the same direction. This will disengage the steering cam and will allow the tail wheel to swivel 360 degree. To re-engage, use opposite rudder and brake to stop the turn. Then roll a few feet straight forward.

Prior to commencing the takeoff roll, align the aircraft in the intended direction of takeoff and allow it to roll forward a few feet to straighten tail wheel and to assure the steering cam is engaged before applying full power. This prevents possible harmful side loading of the tail wheel.

FLAP SETTINGS

Normal takeoffs are accomplished with flaps UP or in the 1st or 2nd notch. Using flaps reduces the ground roll and the total distance to clear an obstacle.

If flaps are used for takeoff, they should be left in that position until all obstacles are cleared and a flap retraction speed of 60 MPH is reached.

SECURING THE AIRCRAFT

If the aircraft must be left unattended outdoors, always secure it with tie-downs.

NEVER use the brake as a parking brake with the intention of leaving the aircraft unattended. The S-21 OUTBOUND is a light aircraft!

The type of tie-downs used is a matter of personal choice. A good "rule-of-thumb" is to ensure that what you secure the aircraft to (and with) will restrain at least 1800 lbs at each tie-down location. Secure the controls in the cockpit and use the following tie down points:

- Tail
 - Taildragger – Tail Gear
 - Trike – Tie Down Ring at aft of fuselage
- Wings – through Tie-Down under each wing, near top of Lift Strut

If strong winds or gusts are advised, seek shelter for the aircraft.

HOT WEATHER OPERATION

Avoid prolonged engine operation on the ground.

Turn the airplane into the wind to assure better airflow through the cowling during run up.

Monitor engine temperatures and adjust climb speed as required. A higher climb speed will provide better engine cooling.

AIRCRAFT CARE

INTRODUCTION

If your airplane is to retain that new airplane performance and dependability, certain inspection and maintenance requirements must be followed. It is recommended to follow a planned schedule of lubrication and preventive maintenance based on the climatic and flying conditions encountered.

GROUND HANDLING

TAILDRAGGER - On the ground, the aircraft is most easily maneuvered by hand using the handles in the tailcone near the horizontal stabilizer. The aircraft has a 360-degree full-swivel tail wheel, which is connected to the rudder by a centering cam. You can disengage the tail wheel through pushing sideways on the rear fuselage (using the handles on the sides of the tailcone near the horizontal stabilizer) and allow it to swivel freely in any direction. This will help you to maneuver the aircraft in tight spaces.

TRIKE - On the ground, the aircraft is most easily maneuvered with the use of a hand tow bar attached to the nose wheel. If no tow bar is available, then back up maneuvering may be done by hand by pushing down on the leading edge of the Horizontal Stabilizer near the spar, thereby lifting the nose wheel and allowing easier maneuvering. Forward maneuvering may be done by pulling at the prop close to the nose cone spinner.

CAUTION: Never pull on the propeller near the tips, always near the hub. Be careful not to dent or deform the sheet metal when performing any ground handling procedure.

WINDSHIELD AND WINDOWS

The windshield is made from Acrylic. The skylight and windows are made from Lexan.

CAUTION

Do NOT allow fuel to contact windshield or doors.

Fuel will harm these surfaces. If fuel is spilled on the Acrylic or Lexan surfaces, wipe clean with a clean cloth immediately to lessen the chance of crazing damage.

IMPORTANT: Always close the doors when you re-fuel the aircraft. Otherwise, it is possible that spilled fuel will run around the wing trailing edge and drop on the open door.

Clean the windshield with plenty of water and if you need to, with a mild detergent in low concentration. Rinse thoroughly and dry with a clean soft cloth or towel.

RANS recommends "Brilliance" for windshield care. Brilliance is available through RANS Parts Department.

CAUTION: Never use gasoline, benzene, alcohol, acetone, thinner or glass cleaner on surfaces.

PAINTED SURFACES

The painted exterior surfaces of your S-21 OUTBOUND aircraft should have a durable and long lasting finish.

No polishing or buffing will be required under normal conditions.

It is recommended to keep your aircraft out of the sun as much as possible.

If you keep your aircraft outside it is recommended to wax the exterior surface.

It is also recommended to clean the exterior surface of your airplane on a regularly base. This can also be accomplished with "Brilliance". It is possible to wash the airplane carefully with water and a mild soap, followed by a rinse with clean water and drying with a soft cloth.

INTERIOR CARE

Use a vacuum cleaner to remove dust and loose dirt from the interior and upholstery.

Household spot removers or upholstery cleaner may also be used for the seat upholstery. Always test it on an obscure place on the fabric to be cleaned.

The plastic baggage enclosure and Station 3 Closeout sides can be cleaned with a damp cloth and an automotive plastic interior care product.

The instrument panel, control knobs need only be wiped off with a damp cloth.

REQUIRED PLACARDS AND MARKINGS

AIRSPPEED INDICATOR MARKINGS

Airspeed indicator markings and their color code meanings are shown in **Table 14F-1**. All speeds are given for maximum takeoff weight. Speed are given in MPH and (KNOTS)

Marking	IAS Value or Range		Meaning
	ROTAX 912ULS	TITAN X340	
White Arc	38 – 110 (33 - 96)	40 – 110 (35 - 96)	Full Flap Operating Range - Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 – 125 (41 – 110)	49 – 170 (43 – 148)	Normal Operating Range - Lower limit is maximum weight VS at most forward CG with flaps retracted. Upper limit is maximum structural cruising speed.
Yellow Arc	125 – 160 (109 – 139)	170 – 215 (148 – 187)	Operation must be conducted with caution and in smooth air only.
Red Line	160 (139)	215 (187)	Maximum speed for all operations

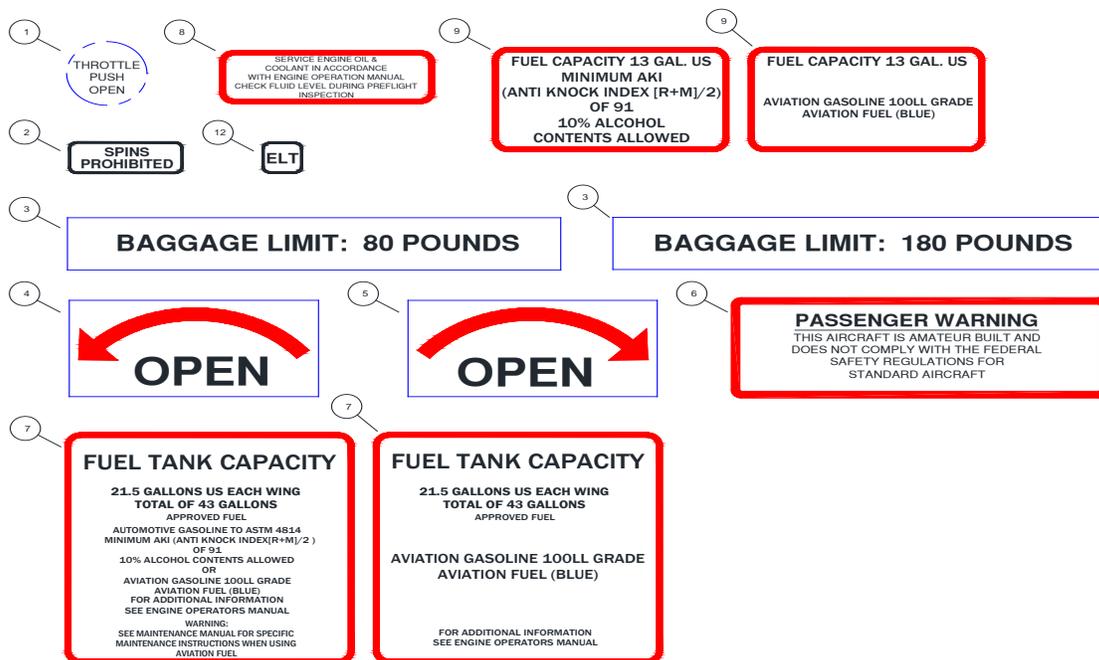
Table 14F-1. Airspeed Indicator Markings

PLACARDS

The following labels and placards contain important information needed for proper operation of the S-21 OUTBOUND and must be displayed in the location described in this section.

All placards are included with the aircraft kit. Replacements are available through RANS Aircraft Parts Department.

Refer to parts manual for individual Placards Sheet part numbers.



Placards are NOT shown to scale.

1. In full view on end of throttle knob.
2. In full view of the pilot on the instrument panel.
3. In full view both sides of Baggage Compartment.
4. Left door besides door latch handle.
5. Right door besides door latch handle.
6. Passenger Warning on lower right side of instrument panel.
7. Wing root enclosure in clear view from the pilot seat.

8. Inside of oil check door (cowling).
9. Near fuel caps of both fuel tanks.
10. On both door top longerons in view of pilot.
11. On left and right fuel sight gauge.
12. Besides ELT remote control on instrument panel
13. All range markings on instrument front face as shown. (Valid for Analog gauges)
14. Placard "**EXPERIMENTAL**" in 2" letters on inside of left and right cabin doors.

SUPPLEMENTARY INFORMATION

FAMILIARIZATION FLIGHT PROCEDURES

The pilot should familiarize themselves thoroughly with this Manual, Engine Operators Manual, applicable Aviation Regulations, and the aircraft itself, before any solo flight is attempted.

Scope and detail of a familiarization flight will depend on level of experience and currency of the pilot.

Any familiarization flight shall include at least all Normal Procedures including a pre-flight inspection.

It is also recommended to perform slow flight, power off stalls in clean and flapped configuration.

All emergency procedures including recovery from a spiral dive or spin shall get at least reviewed.

For pilots with little or no experience in light aircraft, additionally the special characteristics of such shall be reviewed.

PILOT OPERATING ADVISORIES

The S-21 OUTBOUND shall only be operated by pilots with proper training.

Always deflect the controls as required in windy conditions.

The S-21 OUTBOUND is equipped with brakes on the passenger rudder pedals. Always brief the passenger to remove their feet from the pedals, at least for takeoff and landing.

Additional passenger briefings are recommended as required.

Doors can open in flight if the latches are not secured.

CAUTION: If any door opens in flight, continue to fly the plane, trim to hands-off level flight if possible, slow to 65 mph, then close door.

The aircraft will fly with open doors. The door will float in a position pending on the speed of the aircraft. To close an open door in flight, slow to 65 mph, push the opposite rudder pedal. This will make the aircraft yaw and help to get the door closed.