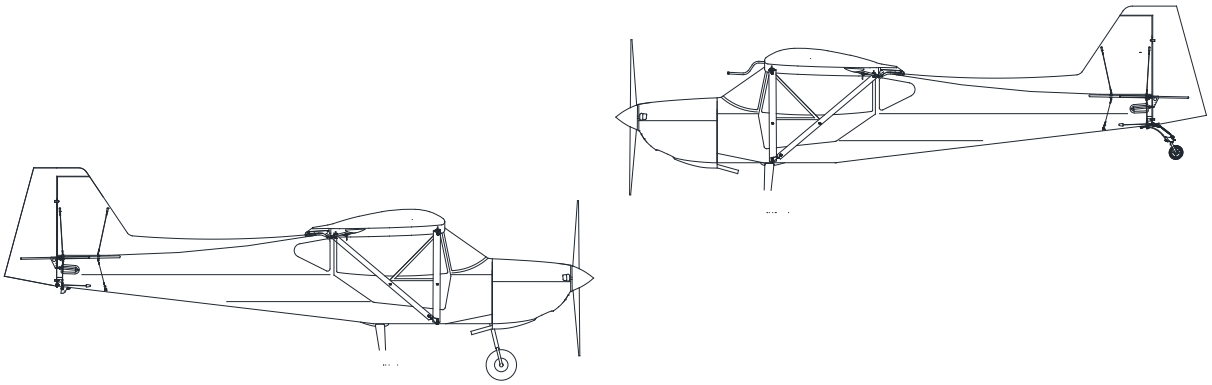
S-20 RAVEN

TEXT MANUAL



Serial Number:

Registration Number:

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

09/01/2013

AFTER PRINTING THE S-20 MANUAL.

HOW DO I ASSEMBLE THE MANUAL?

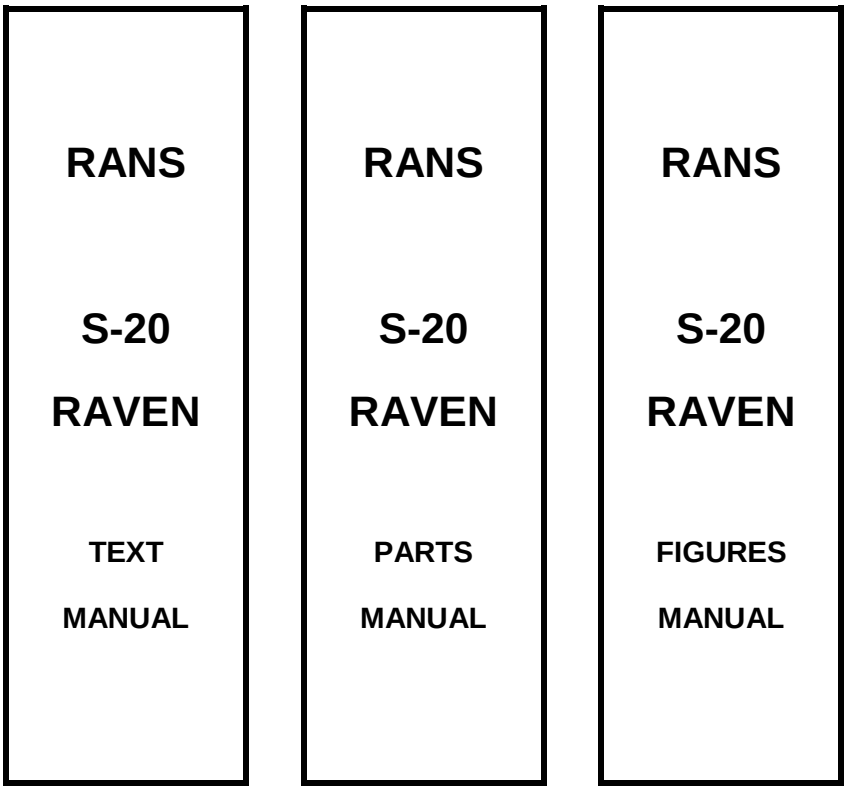
1. Obtain three 2" wide 3-ring binders.
2. Place the TEXT, PARTS and FIGURES manuals in separate binders. Every page has a section number then a page number within that section. (Example: parts page 006-02) Parts pages have an exploded view and a parts listing. ***NOTE:*** *The PARTS manual pages will 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	08 – COVERING
00 - GENERAL	08 – COVERING
01 – FUSELAGE SYSTEMS	09 –SEAT BELTS & INTERIOR
01 – FUSELAGE SYSTEMS	09 - SEAT BELTS & INTERIOR
02 – CONTROL SYSTEMS	10 – OPTIONS
02 – CONTROL SYSTEMS	10 - OPTIONS
03 - ENGINE	11 – RIGGING
03 - ENGINE	11 - RIGGING
04 - INSTRUMENT PITOT/STATIC	12 – WEIGHT & BALANCE
04 - INSTRUMENT PITOT/STATIC	12 - WEIGHT & BALANCE
05 - WINGS	13 - OPERATIONS
05 - WINGS	13 - OPERATIONS
06 - BOOT COWL & PANEL	
06 - BOOT COWL & PANEL	
07 - WINDSHIELD & DOORS	
07 - WINDSHIELD & DOORS	

07 - WINDSHIELD & DOORS	
06 - BOOT COWL & PANEL	
05 - WINGS	13 - OPERATIONS
04 - INSTRUMENT PITOT/STATIC	12 – WEIGHT & BALANCE
03 - ENGINE	11 – RIGGING
02 – CONTROL SYSTEMS	10 – OPTIONS
01 – FUSELAGE SYSTEMS	09 – SEAT BELTS & INTERIOR
00 - GENERAL	08 – COVERING

07 - WINDSHIELD & DOORS	
06 - BOOT COWL & PANEL	
05 - WINGS	13 - OPERATIONS
04 - INSTRUMENT PITOT/STATIC	12 – WEIGHT & BALANCE
03 - ENGINE	11 – RIGGING
02 – CONTROL SYSTEMS	10 – OPTIONS
01 – FUSELAGE SYSTEMS	09 – SEAT BELTS & INTERIOR
00 - GENERAL	08 – COVERING

Labels for the exterior spine of each manual may be made from self-stick labels. The format below may be used.



REVISION FORM

Revision #	Pages Affected	Description	Date
Original	all	Original Issue	09/01/2013

RANS Designs
4600 Highway 183 Alternate
Hays, KS 67601

Technical Support (785) 625-6346
actech@rans.com

Parts Department (785) 625-6346
parts@rans.com

When calling 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.

RANS AIRCRAFT
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.

Physical and mailing address:..... RANS Designs
4600 Highway 183 Alternate
Hays, KS 67601

Voice: 785-625-6346

Fax: 785-625-2795

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

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

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

Internet site: .....www.rans.com

Aircraft Technical Support: 785-625-6346

Aircraft Parts Department:.....785-625-6346

When calling for parts or technical assistance, have the aircraft model, serial number, engine model number, and assembly manuals at hand.

Questions about propeller care and adjustment and about engine break-in, operation, and maintenance should be directed to respective manufacturer's or supplier's technical support personnel. Refer to manufacturer's or supplier's literature for instructions and contact information.

RANS S-20 RAVEN
AIRCRAFT TOOL LIST

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

HAND TOOLS

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

POWER TOOLS

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

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

LUBRICANTS, ADHESIVES, TAPES & ETC

- Small Can Lithium Grease
- WD40
- Lubricating oil
- DOW 730 Sealant or similar
- Thread Sealant
- Safety Wire
- Clear Plastic Tape (anti-chafe)
- Adhesive backed Velcro
- White Lightning Bike Chain Lube or similar
- Clear Silicone
- Super Glue
- Loctite Blue Threadlocker
- 3M Super 77 Spray Adhesive
- 1/4” wide Double Stick Tape
- Hi-Temp Silicone Seal (RED)
- 1” Acrylic Foam Tape (2-sided)
- Masking Tape
- LORD Fusor 703 rep/Cleaner
- LORD Fusor 108B/109B Adhesive, Plunger & Mixer Tips

DRILL BIT SIZES

A full set of fractional drill bits ranging from 3/32" to 5/8" is strongly recommended. In addition to these, the following number bits will be required to assemble your S-20 RAVEN.

NUMBERED BITS	FRACTIONAL BITS
#40	1/4”
#30	5/16"
#11	3/8"
#28	1/2"
#21 & 10-32 TAP	7/8"

*Not a necessary tool but helpful

RANS Designs
RECOMMENDED AVIONICS LIST – S-20

Comm Radios
GARMIN GTR 200

Transponder
GARMIN GTX 335

Encoder
AMERI-KING AK-350

GPS
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.

Switches, circuit breakers, and other electrical parts are also available from RANS. Contact RANS Parts Department for pricing.

RED Illuminated Master Switch		KSES0017		
Non-illuminated Switch		KSES0016		
Panel Post Lights		KSES0018		
Electrical Buss Bar		AMW 636		
W58 Circuit Breakers				
	1 amp	KSES0010	2 amp	KSES0012
	4 amp	KSES0014	5 amp	KSES0015
	10 amp	KSES0013	15 amp	KSES0011

S-20 RAVEN - GENERAL INFORMATION

INTRODUCTION

As the builder of the S-20 RAVEN 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.

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.*

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.

$X^1X^2XX^3XXXX^4$

[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

EXAMPLE : KPWI0001

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

E

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: Even though every care is taken to assure a safe arrival of your aircraft, thoroughly inspect the fuselage as well as all other parts for the following: unclosed welds, nicks, and dents. If you locate any suspect areas with excessive dents or scratches call our Tech-Staff for information on damage tolerance. All Welded steel parts will require primer and top coating. We recommend a good two-part epoxy primer. Be sure the primer and paint you choose will not be affected by the urethane adhesive used to bond the fabric to the airframe. Final painting of certain components will be done after trial assembly. Include these components when designing your paint scheme. If you assemble the aircraft in a humid environment it is best to prime everything first.

ASSEMBLY SEQUENCING: We have tried to format the manual in a step-by-step order as to how to assemble your aircraft. However, there is truly no “one” order in which to follow, as long as the check- lists in the covering section are met prior to covering. If you should choose to build your wings first rather then the fuselage, it is acceptable to do so. ***NOTE: It is not necessary to trial fit wings and tail surfaces to the fuselage frame except for the rudder and elevator fit up described in section 1.*** It is acceptable to complete building of the components and then to final install them. Refer to the assembly sequence flow chart at the end of this section.

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 pliers is also required to install and remove the clecos. The cleco's 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 pop rivets. Even though we are careful, there is always the chance of the packages being mis-labeled. So before riveting, be sure to double check that you have the correct aluminum or stainless steel pop 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: Rotax engines have a six-month warranty from the time of first use. There are however time constraints on this warranty. Please read the following pages on warranty extensions very closely. If there are any questions on engine warranty, please contact the factory.

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.

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 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

In the appendix, you will find an Affidavit of Ownership Form. 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 and a **substitute for 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

After you have written the Aircraft Registry requesting an "N" number, you will receive a form letter giving your number assignment. You will also receive a blank Aircraft Registration Form. (Sample Enclosed.) Complete the Application for Aircraft Registration (Form 8050-1) and return it to the Aircraft Registry along with the $5.00 registration fee.

Retain the **PINK** copy of the Registration and mail both the **WHITE** original and the **GREEN** copy. Your **PINK** copy is your authority to operate the aircraft, **when carried in the aircraft with an appropriate and current airworthiness certificate**.

RECEIVING AUTHORITY TO FLY YOUR AIRCRAFT

Registration alone does not authorize you to fly your aircraft. The aircraft must, after it has been properly registered, also obtain an Airworthiness Inspection by an inspector 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, you could call and ask the DAR. Below is the required paper work. 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 topside and front view.

Include with this the following:

Horsepower rating of engine and type of prop.

Empty weight and maximum weight at which the aircraft will be operated.

Number of seats and their arrangement (tandem, side by side).

Whether single or dual controlled. Fuel capacity.

Maximum speed at which you expect to operate the aircraft.

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

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

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

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 torquing 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 safetying.

(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 torquing and lack of safetying.

(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 _____

	BUILDER		INSPECTOR	
GENERAL:	**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 is 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 is 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 is 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

Your reference is 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 powerplant 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. (Vne).

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 except 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, hourmeter, or engine hourmeter 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.

ROTAX® ENGINE WARRANTY INFORMATION

NOTE: *Most current Warranty information can be found at*
http://www.rotax-owner.com

KODIAK RESEARCH, INC.
P.O. BOX N7113
MARLBOROUGH HOUSE, CUMBERLAND ST.
NASSAU, N.P. BAHAMAS

1) Period

ROTAX® as a manufacturer, warrants through the authorized ROTAX® distributors **FROM THE DATE OF SALE TO THE FIRST CONSUMER**, every ROTAX® non- certified aircraft engine, sold as **NEW AND UNUSED**, and **delivered by an authorized ROTAX® distributor** for a period of the earliest of:

- ☐ 6 consecutive months for private use owners
- ☐ or 12 consecutive months from date of shipment of the manufacturer
- ☐ or the first 100 operation hours

2) Procedure

At the time of purchase the Purchaser will choose which service center he wants to use for warranty service. RANS will register with that service center.

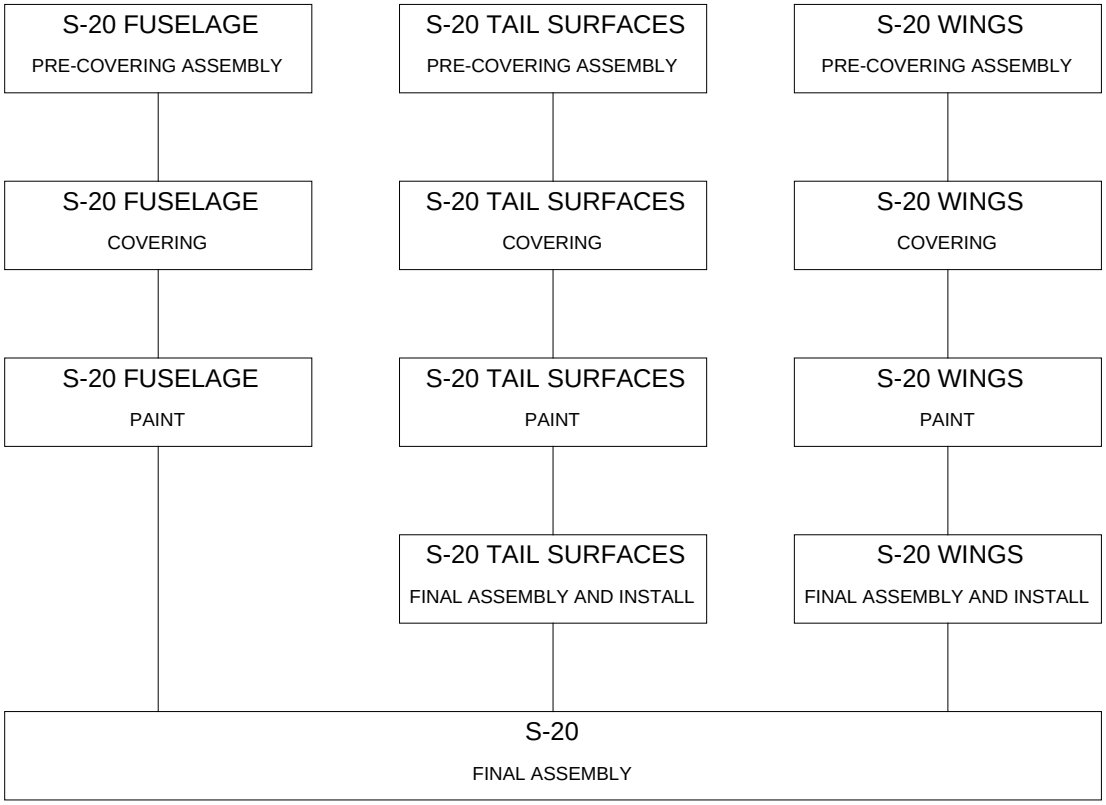
3) Warranty after the warranty period

In case where a new engine is not put into service for some period of time after the end user purchase date, and a service or warranty issue arises, any claim for warranty consideration will be reviewed on a case by case basis. In these circumstances any warranty consideration that may be provided will be done so on a “goodwill” basis only.

In some cases Kodiak Research LTD may require an FAA sign off document or other proof of the first engine operation date to proceed with any “goodwill” warranty claim.

S-20 ASSEMBLY FLOW CHART – GENERAL

For a general overview refer to the following chart. For more detailed information refer to **ASSEMBLY FLOW CHARTS – DETAILED. Note:** The headings in the general chart refer to headings in the detailed flow charts.



S-20 ASSEMBLY FLOW CHART – DETAILED

Note: The headings in the detailed flow charts on the following pages refer to text manual headings.

S-20 FUSELAGE – PRE-COVERING ASSEMBLY

Refer to Section 1 and complete the following items:

- **PREP AND PRIME FUSELAGE FRAME AND RUDDER FRAME**
  - RUDDER FIT-UP AND REMOVED
- **FUSELAGE FORMER INSTALLATION**
  - TOP FORMER
  - LOWER SIDE FORMERS
  - CENTER SIDE FORMERS
  - OUTER BELLY FORMERS
  - CENTER BELLY FORMER
  - VERTICAL STABILIZER RIB
- **ELT AND COMMUNICATION ANTENNA INSTALLATION**
  - ELT ANTENNA MOUNT PLATE
  - COMMUNICATION ANTENNA MOUNT PLATE
- **BAGGAGE WINDOW**
  - BAGGAGE WINDOW FRAME INSTALLED
- **BAGGAGE COMPARTMENT**
  - AFT BAGGAGE FIT-UP AND REMOVED
  - FWD BAGGAGE FIT-UP AND REMOVED
- **RUDDER SYSTEM ASSEMBLY AND INSTALLATION**
  - RUDDER CABLES ROUTED THROUGH PULLEYS AT STATION 7
- **HEADER TANK MOUNTS**
  - HEADER TANK MOUNTS RIVETED
- **SLIDING SEAT ASSEMBLY**
  - SLIDING SEAT BRACKETS RIVETED WITH WASHERS
  - RIVET NUT INSTALLED
- **ELEVATOR TRIM SERVO WIRE**
  - ROUTED INSIDE CENTER SIDE FORMER

- **COVERING** (Refer to Section 8)

- **PAINTING** (Manual does not provide guidance for painting)

S-20 FUSELAGE – FINAL ASSEMBLY

Refer to Section 1 and complete the following items:

- **MAIN GEAR ASSEMBLY AND INSTALLATION**
  - FINAL INSTALLATION
- **TAIL WHEEL / NOSE GEAR ASSEMBLY AND INSTALLATION**

Refer to Section 2 and complete the following items:

- **CONTROL STICK ASSEMBLY AND INSTALLATION**
  - TORQUE TUBE FIT UP
  - FINAL ASSEMBLY AND INSTALLATION
- **ELEVATOR PUSH PULL TUBE ASSEMBLY**

Refer to flow plan section **TAIL SURFACES FINAL ASSEMBLY AND INSTALLATION**

- Complete all items listed.

Refer to Section 2 and complete the following items:

- **AILERON CABLE SYSTEM INSTALLATION - FUSELAGE**
- **FLAP LEVER ASSEMBLY AND INSTALLATION**

Refer to Section 6 and complete the following items:

- **BOOT COWL AND INSTRUMENT PANEL INSTALLATION**
  - BOOT COWL
  - INSTRUMENT PANEL FIT UP

Refer to Section 1 and complete the following items:

- **FLOORBOARD INSTALLATION**
  - INSTALLATION
- **RUDDER PEDAL INSTALLATION**
- **FIREWALL ASSEMBLY AND INSTALLATION**
  - ASSEMBLY
  - INSTALLATION
- **HYDRAULIC BRAKE INSTALLATION**
  - PARK BRAKE
  - BRAKE PEDALS AND CYLINDERS
- **RUDDER SYSTEM ASSEMBLY AND INSTALLATION**
  - FINAL INSTALLATION

- **FUEL SYSTEM - FUSELAGE**
  - INSTALL HEADER TANK
  - ROUTE WITHDRAWAL LINE
  - ROUTE RETURN LINE

Refer to Section 3 and complete the following items:

- **ENGINE MOUNT AND ENGINE INSTALLATION**
- **ENGINE ACCESSORY INSTALLATION**
- **FUEL SYSTEM - FIREWALL FORWARD**
- **COOLING SYSTEM INSTALLATION**
- **RADIATOR DUCT INSTALLATION**
- **LUBRICATION SYSTEM ASSEMBLY AND INSTALLATION**
- **MUFFLER ASSEMBLY AND INSTALLATION**
- **THROTTLE CONTROL INSTALLATION**
- **CHOKE CONTROL ASSEMBLY**
- **BATTERY BOX**
  - ASSEMBLY
  - INSTALLATION
- **ENGINE AND INSTRUMENT ELECTRICAL**
- **SPINNER ASSEMBLY AND INSTALLATION**
  - ASSEMBLY
- **PROPELLER INSTALLATION**
- **COWLING ASSEMBLY AND INSTALLATION**
  - ASSEMBLY

NOTE: *Complete all electrical wiring and check for correct function before final installing the Boot Cowl.*

Refer to Section 6 and complete the following items:

- **BOOT COWL AND INSTRUMENT PANEL INSTALLATION**
  - FINAL INSTALLATION

Refer to Section 7 and complete the following items:

- **WINDSHIELD ASSEMBLY AND INSTALLATION**
  - FIT UP
  - INSTALLATION
- **DOOR ASSEMBLY – LEXAN AND TRIM**
- **DOOR LATCH AND DOOR INSTALLATION**

Refer to Section 1 and complete the following items:

- **SEAT ASSEMBLY AND INSTALLATION**
  - ASSEMBLY
  - INSTALLATION

Refer to Section 9 and complete the following items:

- **SEAT BELT INSTALLATION**
- **INTERIOR INSTALLATION**

Refer to Section 3 and complete the following items:

- **LUBRICATION SYSTEM ASSEMBLY AND INSTALLATION**
  - PRE ENGINE START UP

- **FINAL INSPECTION**

S-20 TAIL SURFACES – PRE-COVERING ASSEMBLY

Refer to Section 1 and complete the following items:

- **HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION**
  - FIT UP AND PRE-COVERING ASSEMBLY

- **PREP AND PRIME HORIZONTAL STAB. AND ELEVATOR FRAMES**
  - FIT UP AND PRE-COVERING ASSEMBLY

COVERING (Refer to Section 8)

PAINTING (Manual does not provide guidance for painting)

S-20 TAIL SURFACES – FINAL ASSEMBLY& INSTALLATION

Refer to Section 1 and complete the following items:

- **HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION**
  - INSTALLATION OF HORIZONTAL STABILIZERS
  - FINAL ASSEMBLY OF ELEVATOR

- **TRIM TAB ASSEMBLY AND INSTALLATION**
  - ASSEMBLY
  - INSTALLATION

Refer to Section 11 and complete the following items:

- **CONTROL SURFACE MASS BALANCE**
  - ELEVATOR

Refer to Section 1 and complete the following items:

- **HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION**
  - FINAL INSTALLATION OF ELEVATOR

Refer to Section 11 and complete the following items:

- **TAIL SURFACES**
  - TAIL ALIGNMENT AND ROD TENSION
  - ELEVATOR (after elevator control system installation)
  - ELEVATOR TRIM TAB (after trim system installation)
  - RUDDER (after rudder system installation)

S-20 WINGS – PRE-COVERING ASSEMBLY

Refer to Section 5 and complete the following items:

- **WING - MAIN STRUCTURE ASSEMBLY**
  - WING SPAR ASSEMBLY
  - WING FRAME ASSEMBLY

- **FUEL TANK ASSEMBLY AND INSTALLATION**
  - ASSEMBLY
  - INSTALLATION
  - FUEL CAP ASSEMBLY

- **AILERON BELL CRANK AND CABLE INSTALLATION WING**

- **WING – RIB & SHEET METAL INSTALLATION**
  - WING RIB ASSEMBLY
  - WING RIB INSTALLATION
  - RIB STRINGER INSTALLATION
  - UPPER AND LOWER ROOT SKINS
  - LEADING EDGE TIP WRAP
  - LEADING EDGE WRAP
  - PITOT AND STATIC SYSTEM INSTALLATION
  - FLAP TELEFLEX CABLE INSTALLATION

- **AILERON AND FLAP ASSEMBLY AND INSTALLATION**
  - ASSEMBLY

- **COVERING** (Refer to Section 7)

↓

- **ROOT SKIN INSTALLATION**
  - FIT UP

↓

PAINTING (Manual does not provide guidance for painting)

↓

S-20 WINGS – FINAL ASSEMBLY & INSTALLATION

Refer to Section 5 and complete the following items:

- **AILERON AND FLAP ASSEMBLY AND INSTALLATION**
  - ASSEMBLY

Refer to Section 5 and complete the following items:

- **AILERON AND FLAP ASSEMBLY AND INSTALLATION**
  - INSTALLATION
- **WING TIP ASSEMBLY AND INSTALLATION**
  - WING TIP FIT UP AND ASSEMBLY
  - INSTALLATION
- **ROOT SKIN INSTALLATION**
  - INSTALLATION
- **LIFT STRUT ASSEMBLY**
  - INSPECTION OF STRUTS
  - ASSEMBLY
- **FUEL LINE AND VENT INSTALLATION - WING**
  - AFTER COVERING AND PAINTING OF WINGS
- **WING INSTALLATION**

Refer to Section 2 and complete the following items:

- **AILERON CABLE SYSTEM INSTALLATION FUSELAGE**
  - POST WING INSTALLATION

Refer to Section 11 and complete the following items:

- **WINGS**
  - WING WASHOUT RIGGING
  - AILERON RIGGING
  - FLAP RIGGING

FUSELAGE FORMER INSTALLATION

IMPORTANT: *The fuselage frame should be primed and painted before formers or anything else is installed.*

NOTE: *All fuselage formers must be cut to length from raw stock provided. Mark and check fit carefully before cutting. In addition, pay attention to the wall thickness of the raw stock called out in the parts manual.*

TOP FORMER

1. Install the Top Former (top of fuselage). The forward end will need to be modified per **FIGURE 01-01**. The aft end will slip over the stub extending from the vertical stabilizer. The forward end will rest on top of the tab aft of Station 3. Bow the former downward to touch the vertical attach tubes on stations 4, 5 and 6.
2. Mark the location of the tubes where they contact the former centerline. Remove the former and drill 1/4" holes at these locations through the bottom side of the former only.
3. Re-install the former, the support tubes will slide into the former and bottom out against the top wall. It may be necessary to slightly bend the support tubes into alignment. Trim the former as needed to clear Station 3.
4. Locate and drill # 40 holes through each support tube just below the stringer. Locate and drill # 40 holes through the former just aft of each support tube. Refer to **FIGURE 01-04**.
5. Hold the former tight against the support tubes and safety wire through the hole pairs to retain former position.
6. Transfer drill #30 through the tab aft of Station 3 and cleco. Drill #30 through the former and vertical stabilizer stub. Refer to **FIGURE 01-04**.
7. Rivet each former end using a stainless steel rivet.

FUSELAGE SIDE FORMERS

8. Each fuselage side uses 2 formers to support the fabric. Refer to **FIGURE 01-08** for the proper location of each side former. Determine the length of each former, mark and check fit before cutting from provided raw stock. Also, note there are two different diameters of formers (1/4" and 1/2").
9. The Lower Side Former is made from 1/4" tubing. Each end is retained by a set of welded stubs that the former slips over. Cut the former to length, drill each end to #11 to allow the former to slip over the stubs. Slightly bow the former to allow it to slide over the stubs.
10. Drill a # 40 hole through the former outboard of the fuselage tube at station 3 as shown in **FIGURE 01-08**.
11. Add anti-chafe tape around the fuselage frame and safety wire former in place.
12. The Center Side Former is fabricated from 1/2" tubing. Each end of the former is attached with rivets from the inside of the fuselage through welded tab. Refer to **FIGURE 01-08**. ***NOTE:*** *The former is spaced away from the fuselage with plastic washers.* Use the washers to achieve a smooth flow of the former. Refer to **FIGURE 01-08** for washers required at each securing location.
13. Drill a # 40 hole through the former outboard of each fuselage tube as shown in **FIGURE 01-08**.
14. Add anti-chafe tape around the fuselage frame and safety wire former in place. ***NOTE:*** *If fuselage is Powder-Coated anti-chafe tape is not required.* Transfer drill #30 through tabs, cleco, deburr, and rivet.

FUSELAGE BELLY FORMERS

15. Belly formers are made from 1/4" raw stock tubing. Each end is retained by a set of welded stubs that the former slips over. Cut each former to length, drill each end to #11 to allow the former to slip over the stubs. Refer to **FIGURE 01-15**. Slightly bow the former to allow it to slide over the stubs.
16. Drill a # 40 hole through the former at each securing location of the fuselage. See **FIGURE 01-15**. ***NOTE:*** *The former is spaced away from the fuselage with plastic washers.* Use the washers to achieve a smooth flow of the former. Refer to **FIGURE 01-15** for washers required at each securing location.
17. Add anti-chafe tape around the fuselage frame and safety wire former in place. ***NOTE:*** *If fuselage is Powder-Coated anti-chafe tape is not required.*

RIB - VERTICAL STABILIZER

18. The vertical stabilizer receives 1 rib formed from aluminum sheet for fabric support. The forming process leaves the rib slightly bowed. To straighten the rib, use fluting pliers and crimp the rib flanges slightly between the holes at the notch locations.

19. The rib is mounted on top of the vertical stabilizer frame cross brace and is riveted from the topside to the 3 welded tabs. Refer to **FIGURE 01-19**. ***NOTE:*** *The rib is symmetrical. There is no front or aft.* The flanges of the ribs are oriented downward. Some minor trimming might be required for a perfect fit around the stabilizer spars.

20. Deburr rib, fit, and transfer drill # 30 through tabs and rivet in place. Refer to **FIGURE 01-19**.

ELT & COMMUNICATIONS ANTENNA MOUNT INSTALLATION

Mount plates for ELT and communication antennas are supplied in kit.

Antennas or the ELT are NOT included.

It is recommended to install the mount plates and to fit the ELT mount before the fuselage is covered.

ANTENNA MOUNT PLATES

21. Refer to the parts manual. Clamp mount plates in place and transfer drill #30 through welded tangs on fuselage. Rivet mount plates in place. ***NOTE:*** *Do NOT rivet the most forward rivet on the ELT antenna mount plate at this time.* This rivet will be installed together with the skylight.
22. Drill ELT Mount Tray tangs to #11.
23. Install Tinnerman nuts to the 4 fuselage tangs at the ELT mount tray location. Tray may be check fit, and then removed for covering.
24. Check antenna fit in mount plates and modify plates as required.

INSTALLING ANTENNAS AND ELT

25. Install Antennas and ELT after Covering and Painting.
26. Burn holes through the fuselage fabric at the antenna locations and install communication and ELT antennas as per manufacturer's instructions.
27. Install ELT as per manufacturer's instructions.

BAGGAGE WINDOW INSTALLATION

INSTALL BAGGAGE WINDOW TRIM PANEL

28. Clamp Baggage Window Trim Panel to outside of fuselage frame, aft of Station 3. Transfer drill #30 through fuselage tabs. *NOTE: Be sure Trim Panel is centered around tabs. Pre-drilled holes in Trim Panel will be used to attach Window and Capture Ring.* Cleco as you drill.
29. Rivet Trim Panel to fuselage tabs.

INSTALLING BAGGAGE WINDOW

30. Install Baggage Window after covering and painting
31. Drill all holes in Lexan Window to #27drill and deburr. ***IMPORTANT:*** *The larger hole size lessens the chance of cracking by allowing the rivet to swell when pulled and not place excessive pressure on the Lexan.*
32. Cleco Baggage Window and Capture Ring to inside of Trim Panel and rivet.

MAIN GEAR ASSEMBLY AND INSTALLATION

NOTE: *Trike and Taildragger Main Gear have different parts for assemblies. Please be sure to refer to the correct parts page when installing. Fuselage should be covered and painted before final installation.*

Refer to **SECTION 10 - OPTIONS** for 26" Alaskan Wheels or 10" Wheels & Tires.

MAIN GEAR FIT UP

1. Become familiar with the Main Gear Installation Parts 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 Drawings. Refer to **FIGURE 01A-04** for location on Fuselage.
5. Top Main Gear Clamp Plate should be orientated per **FIGURE 01A-05**. Be sure the Top Main Gear Clamp Plate fits tight against the Fuselage Longeron. 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 covering and painting 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.*

9. Become familiar with the Main Gear Wheel/Brake Installation **Parts Drawings** and collect the parts shown in the drawings.

10. Bolt caliper mount and axle to the gear leg assembly as per parts drawing. ***IMPORTANT:*** *Trike and Taildragger Assemblies are different. Refer to the correct assembly for installation.* 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. ***CAUTION:*** *Be sure to safety wire the bolts holding the brake disk for Taildragger installations.* 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.

11. 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.

12. 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 torqueing procedure for bearings with these type seals is different than for tapered roller bearings without them. A common torqueing 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 torqueing 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.

13. Apply Thread Sealant to the threads of the brake fitting and install the fitting into the caliper. The fitting should face upward.

14. 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.*

TAIL WHEEL, NOSE GEAR AND TAIL TIE-DOWN ASSEMBLY AND INSTALLATION

NOTE: *Tail Wheel, Nose Wheel and Tail Tie-Down installation is covered in this section. Fuselage should be covered and painted before final installation.*

Refer to **SECTION 10 - OPTIONS** for 10" Tail Wheel.

TAIL WHEEL INSTALLATION

1. Bolt the tail spring to the tail wheel assembly. Refer to the parts 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.
2. Bolt the tail spring/ tail wheel assembly to the fuselage as per parts drawing. Refer to **FIGURE 01B-02**. ***IMPORTANT:*** *Be sure the crown of each Gear Strap is oriented toward the tail spring.*
3. Fabricate 2 small spacer bushings from raw stock provided as shown in the parts manual.
4. The 2 Attach Tangs bolted to the Pillow Block Strap must be modified before bolted in place. For parts callout and modification of these tangs refer to **HORIZONTAL STABILIZER & ELEVATOR ASSEMBLY & INSTALLATION**. It is also possible to only finger tighten these two bolts and to attach the tangs later, when the tail is installed.
5. 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.* ***IMPORTANT:*** *There must also be a minimum clearance of 1/4" between the tail spring and the bottom edge of the rudder spar.* Refer to **RUDDER SYSTEM ASSEMBLY & INSTALLATION** for instructions on installing the rudder. If there is not sufficient clearance, space the tail spring away until the minimum clearance is obtained. This is done by the addition of an aluminum plate between the tail spring and the fuselage. Longer bolts may be required to do this.
6. 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.
7. 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.
8. If the tail wheel leans, shim the tail wheel to run vertical.

NOSE GEAR INSTALLATION

NOTE: *Turn fuselage upside down to ease nose gear assembly.*

9. Select all the parts for the nose gear except for the steering rods and linkages. These will be assembled during the rudder pedal installation.

10. Apply a thin film of grease to the nose gear strut.

11. Pack and grease the thrust bearing and washer assembly and install on the nose gear strut. Slip the nose gear strut into the lower swivel bushing on the fuselage and install the stop ring and steering horn. Push the strut until it inserts into the top swivel bushing and bottoms out on the bearing assembly. Do not bolt the steer horn in place at this time. ***NOTE:*** *Some filing or reaming of the fuselage bushings may be required to allow insertion and free rotation of the nose gear.* ***IMPORTANT:*** *However, it is important to* ***NOT*** *ream any more than necessary.* Nose gear shimmy may result from too loose fit.

12. Locate the center of each axle bushing on the nose gear fork. Drill a #40 hole through the bushings on centerline. See **FIGURE 01B-12**.

13. Mount the tire, with tube, onto the nose wheel. Install the wheel/tire assembly into the nose fork by first checking axle insertion into the hub bearings. If the axle will not slide into the wheel, spin sand it on a belt or disc sander. Install the axle with an aluminum bushings on each side. Note that the bushings will need to be cut to fit. Using a #40 drill bit, transfer drill through the pre-drilled holes in the axle bushings on the fork through the axle and install the cotter pins to retain the axle.

14. Turn the fuselage right side up. Push the strut so that the thrust bearing and washers are tight against the lower swivel bushing. Push down the stop ring and steer horn. View the top of the fork and steer horn from above. Align the tabs on the horn parallel with the fork and drill through from each side of the steer horn with a #11 drill bit and bolt in place.

15. While rotating the nose column, lube the swivel bushings with a quality grease. This will be required at least every 12 months under normal operations. Disassemble, clean and re-lube the spring every 12 months or as required. To service, weight tail and tie with the nosewheel off the ground. Remove, clean and re-assemble. Use weight of aircraft to depress spring for bolt insertion. Inspect bolt every pre-flight for wear. Replace if the bolt shows signs of "grooving".

TAIL TIE-DOWN INSTALLATION

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

16. Select all the parts for the nose gear except for the steering rods and linkages. These will be assembled during the rudder pedal installation.

HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION

ELEVATOR FIT-UP

(BEFORE PRIMING OF HORIZONTAL STABILIZER AND ELEVATOR FRAMES)

1. The elevator hinges must be secured in position. Temporarily bolt the elevators to the horizontal stabilizers. ***NOTE:*** *There is a left and right for stabilizers and elevators.* The stabilizers have bushings for fuselage attachment. These bushings are on the upper inboard side of the frame. The right elevator is identified by the trim tab hinges and the 3 welded tangs (trim servo attach).
2. Adjust elevator side-to-side to create 3/16" to 1/4" gap between the tip of the horizontal stabilizer and the overhang of the elevator.
3. With the elevator correctly positioned, slide each retaining collar against the hinges. Position the retaining collar to allow the hinge to swivel freely with minimal play.
4. Locate and drill a # 30 hole on the interior side of each retaining collar through the aft side of the leading edge spar of the elevator. Rivet in position as per parts manual and disassemble elevators from horizontal stabs.
5. Mark and drill the aft hole for the elevator horn attach on both elevators. Refer to **FIGURE 01C-05.**Temporarily bolt the control horn to the forward attach hole already drilled at the factory and use it to mark the aft hole location on the centerline of the tube. Take horn off and drill both elevators # 11.
6. Prep and prime horizontal stabilizer and elevator frames.
7. Install nut plates to the elevator horn attach holes on both elevators. Refer to parts page.
8. Each horizontal stabilizer receives two ribs formed from aluminum sheet to support the fabric. ***NOTE:*** *The forming process leaves the ribs slightly bowed.* Use fluting pliers and crimp the rib flanges slightly between the holes at the notch locations to straighten ribs.
9. The ribs are riveted to the frame via welded tangs. ***NOTE:*** *The ribs are symmetrical. There is no forward or aft.* Deburr ribs, orientate as per **FIGURE 01C-09**, and transfer drill through tangs and rivet in place.
10. Elevators and horizontal stabilizers are now ready for covering. Refer to **COVERING** for instructions.

INSTALLATION OF HORIZONTAL STABILIZERS

(AFTER COVERING AND PAINT OF HORIZONTAL STABILIZER)

11. Use a hot iron to burn holes through the fabric at the attach points for the tail bracing, the elevator hinges, the drain holes and the seaplane grommet at the right horizontal stabilizer.

12. Modify 14 attach tangs as per **FIGURE 01C-12**. Use the 1:1 drawings to layout the bends. The dimensions are not that critical. Nevertheless, still try to be close. The radius is important. We suggest the use of a block with a radius. Clamp block and tang in a vise. Use a light hammer to form the tang. Take precautions against tooling marks. Mark tangs for identification.

13. Bolt the tangs to the corresponding position on vertical stabilizer, horizontal stabilizer and fuselage. Refer to **FIGURE 01C-13**. Do not forget the washers.

14. The tail brace rods are made from stainless steel rod and are reduced in diameter toward the threaded ends. The transition area should extend over approximate 1" to 1.5" and must be smooth. If this area is **NOT** smooth then modify the tail brace rods as shown in **FIGURE 01C-14.** The setup in **FIGURE 01C-14** makes the task of filing and polishing easy and quick. When clamping the rod in the drill, use some plastic or tape around the end to protect the treads. Use a fine file first and polish afterwards using Scotch-Brite or fine wet dry paper. Do not worry the rods are plenty strong.

15. Install the aluminum bushings into the stabilizer attach bushings on the fuselage top longerons. See **FIGURE 01C-15**.

16. Attach the Horizontal Stabilizer to the fuselage using the hardware shown in the parts manual. It may be necessary to hold the stabilizer in a vertical position to obtain better hole alignment. Install cotter pins.

17. Support the stabilizer in horizontal position. Attach jam nuts and tie rod ends to tail brace rods. Refer to **FIGURE 01C-17**. ***IMPORTANT:*** The tail brace rods have on one end LH and on the other end RH threads. There are also tie rod ends with LH and RH threads. Assemble accordingly.

18. The LH and RH threads will make tension adjustment possible without disassembly. Turn rods all the way into the rod ends. That will assure even thread engagement at both ends when the rods are turned for final tension adjustment. ***IMPORTANT:*** *For rod tension or length adjustment always turn the rod and keep both ends fixed. That will assure even thread engagement on both sides.*

19. Attach the pre-assembled rods with clevis pins and cotter pins in the appropriate positions as per parts manual. Adjust the tension of the upper rods so that the lower rods do not bend.

20. For final adjustment, refer to **RIGGING**.

FINAL ASSEMBLY OF ELEVATOR

(AFTER COVERING AND PAINT OF ELEVATOR)

21. Use a hot iron and burn holes through the drain grommets, the elevator horn attach holes, the holes for the mass balance weight attach at the elevator tips and the 3 servo attach holes on top of the right elevator (through welded tangs).
22. Cut out the fabric inside the trim exit ring on the right elevator bottom side using a sharp blade or utility knife.
23. Attach both elevator horns to the elevators as per parts manual. For orientation of horns, refer back to **FIGURE 01C-05**. ***NOTE:*** *The lower hole of the horns must be drilled out to 1/4" (tight fit).*
24. Install the trim servo in the right elevator. The servo is mounted by 3 screws. The screws enter the elevator from the topside through the covering.
25. Trim the trim exit cover (thermal formed fairing) to fit the glued on exit ring.
26. Drill #40 through the 14 dimpled hole locations in the exit fairing.
27. Place the exit fairing centered on top of the exit ring. Refer to **FIGURE 01C-27** for fairing orientation. Check for clearance to servo and transfer drill # 40 through the exit ring. Cleco as you go.
28. Remove fairing and drill out holes in **fairing only** to # 30.
29. After the trim tab is installed, you will have to make a slot for the push rod and a small hole for the wiring in the fairing.
30. At this point, install the trim tab. Refer to **TRIM TAB ASSEMBLY AND INSTALLATION** for instructions.
31. After the trim tab is installed, modify the exit fairing to allow for the servo push rod travel. Refer to **FIGURE 01C-27** and the template on **FIGURE 01C-31.** Elongate the slot as needed.
32. Also, drill a hole for the trim wiring and slot fairing for easy removal without the need for wiring disconnection.
33. Check that the exit allows for full servo travel. ***NOTE:*** *The servo arm runs through the servo. As the front end retracts, the aft end extends out of the servo. Both sides need clearance.* File exit ring if needed.
34. Install fairing with proper hard ware and rubber grommet in fairing wire exit. ***IMPORTANT:*** Do **NOT** install elevators to horizontal stabilizers at this time.

35. Both elevators are now ready for static mass balancing. For instructions refer to **RIGGING**.

FINAL INSTALLATION OF ELEVATOR

(AFTER COVERING, PAINT, ASSEMBLY AND MASS BALANCE OF ELEVATOR)

36. Bolt both elevators at their hinge points to the corresponding horizontal stabilizer.
37. Lubricate hinge points and check for free movement without binding or excessive friction.
38. Connect elevators to elevator push-pull tubes as per parts manual.
39. **IMPORTANT:** Make sure the rod-ends are at least 10 full threads engaged in the end fittings.
40. Check deflection of elevator and trim tab. For instructions refer to **RIGGING**.

TRIM TAB ASSEMBLY AND INSTALLATION

ASSEMBLY

(BEFORE PAINT OF TAB)

1. Cleco each trim tab half together along the leading edge. ***HINT:*** *Place the halves on a flat surface and clamp or weigh them down.* This will assure that the tab is straight.
2. Remove one cleco at the time, drill out to # 30 and rivet (leading edge).
3. Rivet the single-ear nut plates to both end ribs.
4. Install the end ribs into each trim tab half with the end ribs as far forward in the tab as possible and flush with the end. ***NOTE:*** *There are two sizes of rivets used in each end rib.* Refer to **FIGURE 01D-04** and the parts manual.
5. Using the correct size drill bit, and using the pre-drilled holes in the tab as a guide, transfer drill through the tab and into the rib.
6. Rivet the end ribs in place.
7. Prep, prime and paint both trim tab halves and both horns as desired.

(AFTER PAINT OF TAB)

8. Drill the two holes in center rib doubler and center rib to # 30 and rivet doubler to center rib. Refer to **FIGURE 01D-08** and the parts manual for orientation of parts.
9. Cleco the center rib and doubler into the left trim tab half, lining up pre-drilled holes in the center rib bottom and bottom side of trim tab half. Double check center rib location, drill out 3 holes to # 30 and rivet the two aft holes only at this time.
10. Using the top holes in the tab as a guide, transfer drill through the tab and into the rib. Rivet only the top aft hole at this time.
11. Slide the right hand trim tab half into place. Make sure the two halves line up evenly, are flush and the tab is straight. Transfer drill through the six holes in the tab into the rib and rivet.
12. Drill the two pre-drilled holes in the hinge lock to # 11. This allows the hinge lock to rest flat against the center rib wall. Refer to **FIGURE 01D-08**. ***NOTE:*** *Holes may be enlarged to 1/4" if clearance is required.*

INSTALLATION

13. Attach the trim tab to the right hand elevator as per parts drawing. Safety wire the attach bolts to the End Ribs. ***HINT:*** *There are small openings in each End Rib at the bend, which works well.*
14. Install the hinge lock into the trim tab and slide over the center pivot stub. Hold the hinge lock tight in position and transfer drill # 30 through the top two holes in the trim tab into the hinge lock.
15. Rivet the hinge lock in place.
16. Install the bottom rivets previously omitted.
17. Run the servo to the half travel position. You can do this by applying current to the appropriate wires and moving the servo to its limiting positions. Make a pencil mark on the servo arm for each limit. Mark half travel and move the servo to this position.
18. Attach the 2 trim tab horns to the underside of the trim tab as per **FIGURE 01D-18** and the parts manual. Use the horns to transfer drill in the tab and rivet.
19. Secure the trim tab in neutral position and fabricate the push rod from the supplied all thread rod. **NOTE**: The servo must be in its half travel position and the trim tab neutral.

For further assembly and installation of elevator, refer to **HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION** (FINAL ASSEMBLY OF ELEVATOR).

FLOORBOARD INSTALLATION

(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 01E-01**. Drill to correct sizes as shown. Cleco as you drill. ***HINT:*** *Use a wood block to backup the metal floorboard when drilling through the tabs.* Deburr holes.
2. 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.
3. 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)

4. 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 INSTALLATION

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 01F-02.** Be sure to include the 1/2" plastic washers between the rudder pedals and the toe pedal assembly. ***NOTE:*** *The inboard swivel bushings have a threaded insert nut welded in.* Drill the threads of the insert nut to #11. This is the location of the rudder cable attachment. Make sure the insert nut end of these swivel bushings face inboard on the inboard pedals. ***HINT:*** *Install the 3/16" bolt into the inboard swivel bushings before assembly. Slightly rounding the corners of the bolt head will aid in full insertion. Temporarily retain bolt with a 3/16" Castle Nut.*
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 01F-03** and parts manual for orientation of the swivel bushings.
4. Cotter Pin outboard swivel bushing to retain 1/2" plastic washer.
5. Refer to **FIGURE 01F-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 covering and painting of fuselage. Refer to **HYDRAULIC BRAKE INSTALLATION** for Master Cylinder installation**.**

RUDDER SYSTEM ASSEMBLY AND INSTALLATION

RUDDER FIT-UP

(BEFORE PRIMING OF FUSELAGE AND RUDDER FRAME)

1. Rudder hinges must be secured in position. Temporarily bolt the rudder to the fuselage. Adjust the rudder vertically to create a gap between the tip of the vertical stabilizer and the overhang of the rudder of approximately 3/16". Also, check that the rudder horns at the base of the rudder are approximately in-line with the two threaded bushings for the rudder stop bolts (bottom of fuselage) when the rudder is deflected. Refer to **FIGURE 01G-01**.
2. Slide the hinge retaining collars against the hinges. The collars should be positioned to allow free hinge movement with minimal play.
3. Locate and drill a #30 hole on the interior side of each retaining collar through the leading edge spar of the rudder. Rivet collars in position as per parts manual.
4. Remove rudder from fuselage. The rudder frame is now ready for prep and priming. The rudder frame is ready for covering after priming. There is no further assembly required.

PRE-COVERING ASSEMBLY

(AFTER PRIMING OF FUSELAGE FRAME/ BEFORE COVERING)

5. The rudder cables, and pulleys at Station 7 should be installed before the fuselage is covered. This will simplify final assembly. Refer to parts manual and **FIGURE 01G-05**.
6. Route the rudder cables between the tangs at Station 7 and bolt the pulleys in place. ***NOTE****: The cables route on top of the pulleys.* Check that the pulleys turn freely after installation.
7. 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 off the fabric when covering and painting.

FINAL INSTALLATION

(AFTER COVERING AND PAINT OF FUSELAGE)

8. Attach the rudder with the hardware shown in the parts manual. Lubricate hinges and swivel rudder about 30 degree left and right. The rudder should swivel freely without any excessive friction.
9. Also, check for sufficient clearance (gap) between rudder and fuselage. Excessive paint can make things not only heavy but also tight.
10. Route the rudder cables through the cable exit fairings. ***CAUTION:*** *Cables must cross after the pulleys at Station 7.*

> **!!! CAUTION !!!**
>
> RUDDER CABLES MUST CROSS AFTER PULLEYS AT STATION 7.
> RIGHT HAND CABLE CROSSES OVER TOP OF LEFT HAND CABLE.
>
> CABLES MUST NOT WRAP AROUND EACH OTHER WHEN INSTALLED.

11. **TRIKE** - Attach the rudder cables to the rudder as shown in the parts drawing and in **FIGURE 01G-11**.
12. **TAILDRAGGER** - Attach the rudder cables to the rudder as shown in the parts drawing and in **FIGURE 01G-12**. 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. Bend the upper inner hook of the steer springs to match the angle of the steer chain linkage. Attach the steer springs and chain to the rudder.
13. Bolt the rudder cable guides to the tangs at station 2A. Drill #11 through the small hole in the rudder cable guide and bolt to inboard side of the tang making sure the cable guide portion is upward.
14. Pull the rudder cables forward on top of the pulleys at station 3 and through the cable guides at Station 2A. Cables route forward under the pulleys between Station 2 and 2A. The rudder cables route under the pulleys at this location. Bolt the small pulleys in place and check for free movement.

(AFTER INTERIOR INSTALLATION)

15. Pass Rudder Cables through Rudder Cable Closeout. Refer to **INTERIOR INSTALLATION** in Section 009A of the Parts Manual. ***NOTE:*** *Rudder Cables may be temporarily attached to Rudder Pedals, for rigging, until Closeout is installed.* ***CAUTION:*** *Do* ***NOT*** *proceed with flight with Rudder Cables temporarily attached.*

16. Attach Rudder Cables to bolt extending inboard from Rudder pedals. ***NOTE:*** *There is a different attachment for TRIKE and TAILDRAGGER.* Refer to Parts Manual.

17. Check that the cables run through all pulleys and guides. Check for free movement.

18. For final adjustment and checks of the rudder system, refer to **RIGGING**.

HYDRAULIC BRAKE INSTALLATION

(AFTER COVERING 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. Modify Parking Brake Backing Plate per **FIGURE 01H-02**. Drill arm of Parking Brake to 1/4".
3. Obtain Firewall and locate holes for Parking Brake, Backing Plate, Brake Reservoir and Bulkhead Tee per **FIGURE 01H-03**. Rivet Parking Brake Backing Plate to Firewall. Do **NOT** install other items until Firewall Soundproofing is attached.
4. Drill hole in top of U-brackets to 5/16" for brake cylinder rod.
5. Bolt U-bracket to cylinder attach bracket on Upper Toe Pedal Assembly. Be sure to include the proper washers. U-bracket should be able to swivel when bolted in place. Secure with cotter pin.
6. Install fittings in the brake cylinders as per parts manual using thread sealant. Refer to **FIGURE 01H-06**.
7. Bolt brake cylinder to the fuselage tangs and to the rudder pedals via the U-bracket as shown in the parts manual. Adjust the U-bracket up and down as desired. Do **NOT** forget the cotter pins.
8. Check that the pedals and the brake pedals move freely.
9. Route brake lines and install to cylinders, park brake valve and “T” fitting as per **FIGURE 01H-06**.
10. Install 90-degree Bulkhead Elbow through Brake Line Exit Ring in fuselage belly. Route brake lines from Park Brake Valve to 90-degree Bulkhead Elbow.
11. 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.*

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

(AFTER INSTRUMENT PANEL AND FIREWALL INSTALLATION)

14. Mount the park brake control cable in the instrument panel as shown in the parts manual and in **FIGURE 01H-14**. Refer to Instrument Panel Installation for recommended location. Cable may be secured as needed with nylon ties.
15. 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.
16. Slide the cable friction block on the cable.
17. 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.
18. 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.
19. Adjust the cable friction via screw in friction block as desired.
20. Loctite the screw in the wire swivel stop. Safety wire the cable housing to the Swivel Stop.

AFT BAGGAGE COMPARTMENT

ASSEMBLY

(BEFORE COVERING AND PAINTING OF FUSELAGE)

1. Tape all sheet metal parts of the Aft Baggage compartment together. Refer to parts page drawing for proper orientation in relationship to the flanges. ***HINT:*** *When assembled, flanges will* ***NOT*** *be visible from the inside of the Aft Baggage Compartment.*
2. Transfer drill #30 the 3 lower aft corner pre-located holes on each side and cleco. ***NOTE:*** *1 hole per part per corner will be transfer drilled and clecoed*.
3. Slide taped assembly into place. The Back will rest against the tabs welded to Station 4. The forward end of the Bottom will be on top of the tabs at Station 3.
4. Adjust the assembly up or down at each side until the Sides lap about half way onto the fuselage tube. Tape in place.
5. Press the forward end of the Sides against the small tabs On Station 3 and tape in place. Adjust as needed.
6. Make sure the assembly is tight against all tabs. Transfer drill #30 through small tabs and flanges. Cleco as you drill. The large tabs at the forward edge will require transfer drilling #11 through the 3/16" hole.
7. Cut Support Angles to length. Refer to **FIGURE 01I-07** and **FIGURE 01I-07A**. Trim ends to clear fuselage tubes, Mark Support Angles for hole placement. Orientate, drill #30 and cleco.
8. Rivet all flanged areas together. Do **NOT** rivet to tabs at this time.
9. Rivet Support Angles to Baggage Compartment sheet metal. Do **NOT** rivet to tabs at this time.

FORWARD BAGGAGE COMPARTMENT

ASSEMBLY

(BEFORE COVERING AND PAINTING OF FUSELAGE)

10. With AFT Baggage Compartment clecoed in place, tape Forward Sides into fuselage. Upper side will align to center of 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.

11. 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.

12. Cut Support Angles to length per **FIGURE 01I-12**. Locate per **FIGURE 01I-12**. Trim Ends of angles to clear fuselage tubes. Transfer drill #11 through tabs.

13. Mark and drill #30 holes, per **FIGURE 01I-12**. 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.*

14. 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.

CARGO NET

ASSEMBLY

(BEFORE COVERING AND PAINTING OF FUSELAGE)

15. Position Top Back - Baggage Compartment to align upper flange to centerline of Top Former tube and to centerline of fuselage outer tail cone tube. Transfer drill through tabs #30 and cleco. ***NOTE:*** *Tabs are located on lower side of upper Station 4 fuselage crossing tube.* Transfer drill each outer tab to #11. The Cargo Net will be retained by rivets through these tabs during final install of the baggage compartment.

BAGGAGE COMPARTMENT INSTALLATION

INSTALLATION

(AFTER COVERING AND PAINTING OF FUSELAGE)

16. Cover interior of Baggage Compartment with lightweight fabric or paint as desired.
17. Slip Aft Baggage Compartment into place. Cleco, then rivet to small mounting tabs.
18. Position Top Backs and cleco. Rivet upper straps of Cargo Net through grommets to outer mount tabs. Rivet center of Backs to mount tab.
19. 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.*

SLIDING SEAT ASSEMBLY

FUSELAGE PREPARATION

(BEFORE COVERING AND PAINTING OF FUSELAGE)

1. Locate, mark and drill all 4 fuselage seat tubes per **FIGURE 01J-01**. Cleco as you drill. ***HINT:*** *Best alignment between matching Sliding Seat Rails may be obtained by placing assembled seat in position with the 1/4" Quick Pins resting in matching notches of Seat Rails. Check alignment of Seat Rails with the seat in both the FWD and AFT positions.*
2. Final size drill the previously drilled #11 holes to 1/4". Install Rivet Nuts. Refer to **FIGURE 01J-02** for procedure if you do not have a Rivet-Nut Puller.
3. Fabricate Seat Stop Tubes from raw stock. Bolt Stop Tubes and Sliding Seat Position Rail to installed rivet nuts.

SEAT ASSEMBLY

(BEFORE OR AFTER COVERING AND PAINTING OF FUSELAGE)

4. Trim lower end of Seat Back Frames per **FIGURE 01J-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. Bolt a set of Seat Plates to each leg of the Seat Back Frame. Refer to **FIGURE 01J-04** for orientation. Orientate bolts with nuts facing inward towards each other. Leaving the nuts slightly loose at this time will aid in installing the Seat Bottom Frame.
5. Modify Seat Bottom Frame per **FIGURE 01J-05**. ***HINT****: Pull an aluminum tube or straight edge along the bottom to mark a centerline on the each tube.* The Slider Block will rivet to the Seat Bottom Frame after the Bottom Cushion is installed.
6. Place Seat Bottom Pan on top of Seat Bottom Frame. Refer to **FIGURE 01J-06**. Be sure side and front bent flanges are tight against Frame. Transfer drill #30 and cleco.
7. Cleco Slider Block to lower side of Bottom Frame. Mark and trim Bottom Pan to clear Slider Block. Refer back to **FIGURE 01J-06** for detail. Radius all sharp corners of Bottom Pan. Rivet Bottom Pan to Bottom Frame. Remove Slider Block.
8. Modify 8 Multi-Hole Tangs per **FIGURE 01J-08**. Rivet Multi-Hole Tangs to inside and outside of each Seat Bottom Frame.

9. Bolt Seat Bottom Frames to Seat Side Plates through the Multi-hole Tangs. Insert washers and bearings between Multi-Hole tangs.

10. Tighten nuts retaining Side Plates to Seat Back Frame.

11. Slip assembled Seat Frame into Fuselage. Insert a 1/4" Quick Pin through matching holes in each set of Side Plates. Measure distance between inner Side Plates and cut Seat Internal Tube to fit. ***IMPORTANT:*** *Be sure fuselage tube is centered between each pair of Side Plates.* Ream ends of Internal Tube to slip over the nut and washer. ***NOTE:*** *Cut Internal Tube slightly long and trim as needed to obtain perfect fit.*

12. Modify Sliding Seat Rail Plates per **FIGURE 01J-12** for flush rivets.

13. 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 01J-12**. Be sure to center Rail Plate on fuselage tube. ***HINT:*** *Use tape to hold in place temporarily.* Remove Seat Frame assembly from fuselage. Transfer drill #30 and rivet in place.

14. Position the 3 pieces of the Seat Back Plate (KPST0073-1 thru - 3). Refer to **FIGURE 01J-14**. Drill and rivet.

15. Fit-up **OPTIONAL SEAT HEADREST** at this time.

16. Fabricate Lacing Wires per **FIGURE 01J-16** and **FIGURE 01J-16A** for Seat Cushions. Slip Lacing Wires into pockets. Use a hot knife or soldering iron to burn holes above Lacing Wires per **FIGURE 01J-16** and **FIGURE 01J-16A**.

17. 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 01J-16.**

18. 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 01J-16A**. Wrap Aft Flap around Seat Internal Tube. Secure with Long Plastic Ties. Refer back to **FIGURE 01J-16A**. Leave all plastic tie ends long to allow re-tensioning at a later date.

19. Velcro the flap of the Bottom Cushion to the Back Cushion.

20. 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.

21. 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.

22. Re-install seats during final assembly.

OPTIONAL HEADREST ASSEMBLY

23. Become familiar with the Optional Headrest Assembly **Parts Drawings** and collect the parts shown in the drawings.

24. Mark and drill the Headrest Frame as shown in **FIGURE 01J-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.* 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.

25. Measure and mark up from the lower ends of the Set Back Frame aft side. See **FIGURE 01J-25**. ***HINT:*** *Use an Aluminum Tube or straight edge, as before, to find the centerlines of the frame.* Drill a #11 hole through only the AFT side of the Seat Back Frame.

26. Pin the Headrest Frame in place with 3/16" bolts. Transfer drill #11 the second set of holes. Refer to **FIGURE 01J-26**.

27. Remove the Headrest Frame and drill the Seat Back Frame to 1/4". Install Rivet-nuts. Refer to **FIGURE 01J-27**.

28. 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).* Loosen the Headrest Frame from the Seat Back and snap the tube onto the buttons. Check for a tight fit of the Internal Tube.

29. Remove the Head Rest Assembly and cover the Seat Back Frame. Refer to **SEAT ASSEMBLY**.

30. After covering, find the locations of the 4 Rivet Nuts and melt through with the tip of a soldering iron or hot knife.

31. Bolt on the Headrest Frame with the Internal Brace Tube in place.

32. Slip the Headrest Cover over the frame and close the Velcro flap.

OPERATION OF SLIDING SEAT

33. 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.* 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 buttons riveted under the square seat rail. Check to be sure seat has locked in position.

34. To aid exiting and entering the aircraft adjust seat to aft most position.

35. 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.*

36. Apply White Lighting 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. Re-apply 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.

FUEL SYSTEM - FUSELAGE

FUSELAGE PREPARATION

(BEFORE COVERING AND PAINTING OF FUSELAGE)

1. Locate Header Tank Mount per **FIGURE 01K-01**. 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

Refer to OPTIONAL 6.9 GALLON HEADER TANK ASSEMBLY as required.

2. Locate and drill fitting holes in Header Tank per **FIGURE 01K-02**. 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.

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 01K-03**. 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. If desired, locate Header Tank flush with front of Mount to locate 2" Lexan Exit Ring when covering fuselage.

(AFTER COVERING AND PAINTING OF FUSELAGE)

8. Modify Header Tank Mount Channel per **FIGURE 01K-08**. 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.*

FUEL VALVE INSTALLATION

9. Install two fittings to the fuel valve using thread sealant. Refer to **FIGURE 01K-09** and the parts manual.
10. Remove the handle from the fuel valve and install the valve to the two tabs of the fuselage steel frame. ***NOTE:*** *Valve should be "ON" when valve handle is AFT and "OFF" when valve handle is UP.* Use the mount brackets as shown in **FIGURE 01K-09**. Re-install the handle to the fuel valve.
11. 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.
12. If installing the OPTIONAL ELECTRIC FUEL PUMP do so at this time.
13. 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. ***NOTE:*** *The smaller return line routes directly from the bulkhead fitting to the header tank and will not connect through the Fuel Valve.* Secure as desired using plastic ties. ***IMPORTANT:*** *Be sure to include the Check Valve in the Return Line.* Add a clear plastic tape or split fuel hose as anti-chafe wherever the lines contact the fuselage frame or other parts.
14. 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)

15. 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 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

16. Become familiar with the Optional Electric Fuel Pump **Parts Drawings** and collect the parts shown in the drawings.
17. Install fittings into Fuel Pump with Thread Sealant.
18. Rivet Nut Plates to bottom of tabs under Left Seat.
19. Bolt Fuel Pump to tabs.
20. Connect Fuel Line from Header Tank to Fuel Pump. Connect Fuel Line from Fuel Pump to Fuel Valve.

21. Connect electrical wires of fuel pump to 12-volt switch on Instrument Panel. Do not forget to include a proper sized breaker.

OPTIONAL 6.9 GALLON HEADER TANK

FUSELAGE PREPARATION

(BEFORE COVERING AND PAINTING OF FUSELAGE)

22. Locate Header Tank Mount per **FIGURE 01K-22**. Locate and drill #30 through each tab. Locate Plain Clamp per **FIGURE 01K-22**. Remove Tank Mount. Drill #11 hole in Tank Mount to 3/8" to allow Countersunk Washer to set flush. Glue Rubber Edging to top edge of Mount flanges. After covering and painting install Tank Mount and hose clamps.

HEADER TANK ASSEMBLY

23. Locate and drill fitting holes in Header Tank per **FIGURE 01K-23**. 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.

24. 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 01K-03**. 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.*

25. 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.*

26. 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.

27. 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.

28. If desired, locate Header Tank on Mount to locate 2" Lexan Exit Ring when covering fuselage.

(AFTER COVERING AND PAINTING OF FUSELAGE)

29. Position Header Tank centered on the mount. Locate Mount Channels per **FIGURE 01K-29**. Use Mount Channels and large hose clamps to secure tank to mount. ***NOTE:*** *Use tank as a guide to bend Mount Channels to fit. IMPORTANT: Mount Channels have different height flanges. Please locate per parts manual.*

30. 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. ***NOTE:*** *The smaller return line routes directly from the bulkhead fitting to the header tank and will not connect through the Fuel Valve.* Secure as desired using plastic ties. ***IMPORTANT:*** *Be sure to include the Check Valve in the Return Line.* Add a clear plastic tape or split fuel hose as anti-chafe wherever the lines contact the fuselage frame or other parts.

31. 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)

32. 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

33. Become familiar with the Optional Low Fuel Warning Kit on the Header Tank **Parts Drawings** and collect the parts shown in the drawings.

34. A 5/8" hole should have been located in the side of the Header Tank. If not, refer back to **FIGURE 01K-02** and **01K-23**. 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 01K-34**. As the header tank fills with fuel, the switch will open, turning off the LED Indicator Light.

35. 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.

36. Locate LED Indicator Light in instrument panel. Connect to Low Fuel Warning Switch per **FIGURE 01K-34**. Do not forget to include a proper sized breaker or fuse.

CONTROL STICK ASSEMBLY & INSTALLATION

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Drill out ONE of the control stick's lower hole to 1/4" diameter. Refer to **FIGURE 02-02**. 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 02-02**. ***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 drawing. Tighten the 3/4" Nyloc Nut until it takes out all the play in the stick, but is not too tight to cause binding.
5. Assemble the control stick link tube as per **FIGURE 02-05**. Assemble the unit to the control stick connector tubes. Adjust the control sticks 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. 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. 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.* 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.
6. 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)

7. Bolt the control stick torque tube assembly through the floorboard and into the nut-plated tabs underneath. Apply Light Machine Oil to rotational collars. Check for free movement of assembly. Loosen bolts slightly if movement is restrictive. Re-check.
8. Route Trim and Push to talk wires through hole in base of Control Sticks. Install Mac Control Stick Grip per manufacturer's instructions.
9. 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.*
10. Proceed with installation of Push-Pull Tube Assemblies and Aileron Cable System.

CONTROL STICK PUSH-PULL TUBE ASSEMBLY & INSTALLATION

(AFTER COVERING 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 02A-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 drawing. Install Push-Pull Tube Assembly to mount block between seat rails per **FIGURE 02A-03**. Cut 1/4" Aluminum Bushings to length to fit in Rod Ends. ***IMPORTANT:*** *Make sure Rod Ends are engaged at least 10 full threads.* Bolt through top of Side Plate should not be so tight as to restrict pivoting of assembly.
4. Bolt Rod End in forward end of 12" Push-Pull tube to lower hole in Control Stick Torque Tube. ***IMPORTANT:*** *Make sure Rod End is engaged at least 10 full threads.*
5. Modify Small Cable Keeper per **FIGURE 02A-05** to make individual Cable Keepers. Feel free to modify all of the parts, just be sure to keep track of them after modification.
6. Bolt Small Cable Keepers, Small Pulleys, and Sliding Block to tabs welded to Station 3. 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.* Rotate Small Cable Keepers to top of pulleys and tighten bolt to prevent rotation. Insert cotter pins after Rudder Cables are installed over top of pulleys.
7. Lubricate Sliding Block and 35" Push-Pull Tube with White Lithium Grease 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.
8. Check elevator push-pull tube assembly for smooth operation.

ELEVATOR PUSH-PULL TUBE ASSEMBLY & INSTALLATION

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Drill the #30 thru-hole in the forward (doubler end) of the elevator push-pull tube to 1/4".
3. Drill the #30 thru-hole in the aft end of the elevator push-pull tube to #11.
4. Slip the Elevator Yoke into the aft end of the Push-Pull Tube until 1/16" from bottoming against welds.
5. Lay the assembly on a flat bench or floor. Insert a long 1/4" rod or bolt into the 1/4" hole in the forward end. Support each side of the 1/4" rod with scrap lumber of equal height. Lay a scrap of lumber under the yoke arms. Re-check for proper insertion of Elevator Yoke and transfer drill #11 through the Yoke using the tube as a guide. Drill one side and cleco, flip over the assembly and drill the other side. Remove cleco and drill #11 all the way through. This procedure will assure the yoke is installed 90-degrees to the 1/4" hole at the forward end. Refer to **FIGURE 02B-05.** Bolt Elevator Yoke to Push-Pull Tube.

INSTALLATION

(AFTER COVERING AND PAINTING OF FUSELAGE)

6. Slip the Yoke/Push-Pull Tube assembly into the tailcone from either side of Station 3. Once the yoke is near the Elevator Yoke Exits in the fuselage skin turn it level with the bolt head up and slip yoke arms out of the fuselage skin. Install Rod Ends with 1/4" Plain Nuts into Elevator Yoke. Be sure to include the 1/4" plain nuts on the rod ends. Install Rod Ends into Elevator Yoke. Do **NOT** forget the 1/4" Plain Nuts. ***IMPORTANT:*** *Make sure Rod Ends are engaged at least 10 full threads.*
7. Slide forward end of Elevator Push-Pull Tube over aft end of previously installed 35" Push-Pull Tube. Bolt through welded bushing of 35" Push-Pull Tube.
8. After Elevator installation, bolt the Elevator Horns to the outside of the Yoke Rod Ends. 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

INSTALLATION

(AFTER COVERING AND PAINTING OF FUSELAGE)

1. Assemble Pulley Assemblies with Hummer Tangs and small U-brackets. 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. Then 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)

CAUTION

Do **NOT** allow cables from wings to cross.

6. Route Aileron Cable from wing through Pulley Assembly at upper Station 3 and down to Pulley Assembly at lower Station 3. Cable then routes forward and connects to Turnbuckle attached to end of Aileron - Control Stick Cable. Refer to **FIGURE 02C-06** for a control system overview.
7. Install Small Pulley and Cable Keepers midway up on Station 3. ***NOTE:*** *Refer back to* ***FIGURE 02A-05****, if needed, for Cable Keeper trimming.* Route cable to outboard side of pulley; install Cotter Pins to retain cable in pulley groove. Refer to **FIGURE 02C-07**. ***IMPORTANT:*** *Make sure bolt is tight enough to prevent rotation of Cable Keepers.*
8. Route Aileron Link Cable from wing, under the Small Pulley at upper Station 3. Install Cotter Pins to retain cable in pulley groove. ***IMPORTANT:*** *Make sure bolt is tight enough to prevent rotation of Cable Keepers.* Connect ends of each Link Cable to Turnbuckle at center top of Station 3.
9. Refer to RIGGING SECTION for Rigging and Tensioning of Cables.

FLAP LEVER ASSEMBLY AND INSTALLATION

ASSEMBLY

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

Qty.	Length	Tube Size
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 Trip Release Tube with End Caps installed.
6. Depress and rotate the Flap Trip 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.* 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.
7. Insert 1" long bushing between upper forward end of Side Plates and bolt into place. ***NOTE:*** *Lower holes in Side Plates will be used to mount Flap Lever Assembly to fuselage after Covering and Painting.*
8. Modify 2 Plastic Shims per **FIGURE 02D-08**.
9. Modify 2 Angle Brackets per **FIGURE 02D-09**. Slip a Tinnerman over modified end and center on hole.
10. Temporarily install bolts to retain Angle Brackets, Plastic Shims, 1/4" spacer bushing, and Teleflex Retainer Brackets to aft end of Flap Lever Assembly.

11. 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.

INSTALLATION

(AFTER COVERING AND PAINTING)

12. 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 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)

13. Route Teleflex Cables from aft edge of wing and route down aft side of Station 3. Retain with Cushioned Clamp half-way down Station 3 (refer to AILERON CABLE SYSTEM INSTALLATION - FUSELAGE). Route toward center of fuselage under Baggage Compartment area and forward through hoops welded to Station 2A.
14. Disconnect Rod Ends from Flap Lever Assembly and screw onto ends of Teleflex Cables. ***IMPORTANT:*** *Make sure Rod End is engaged at least 10 full threads.*
15. Unbolt aft end of assembly from welded mount block. Use Plastic Shims, Teleflex Retainer and 5/8" long spacer bushing, bolt end of Teleflex to the inside of the Side Plates as per the parts drawing. ***NOTE:*** *Teleflex will attach between Retainer and plastic shim.* Bolt aft end of assembly to welded mounting block. ***IMPORTANT:*** *Teleflex Cables should* ***NOT*** *interfere with aileron cables, rudder cables or elevator push-pull tubes.*
16. 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.
17. Test operate the lever by pulling up on the lever, then depressing the release tube to return. Operation should be smooth.

ROTAX 912ULS - ENGINE MOUNT INSTALLATION

(AFTER FIT-UP OF FIREWALL & BOOT COWL)

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Position Firewall on forward side of Station 1.
3. Lightly oil the (2) 1/4" bolts used to hold the top of the mount to the firewall. Insert these with a thin washer under the head into the mount lugs. Line up the mount in its proper position and insert the (2) bolts into the top receivers on the fuselage. ***NOTE:*** *The mount may need some "encouraging" to fit.*
4. The bottom attach points of the mount should be on the plate welded into Station 1. Clamp the mount firm against the firewall. Drill through 1/4" using the mount bushings as drill guides. Debur the holes.
5. Before final installing Engine Mount be sure to place two 1/4" Thick Washers between left side of Engine Mount and Firewall. These washers will help set the engine offset.
6. Remove the mount from the firewall. Completion of mount and engine system will occur in final assembly.

(AFTER INSTALLING ALL ACCESSORIES ON FIREWALL)

FINAL INSTALLATION

7. Bolt Engine Mount to Fuselage with Firewall in place. Be sure to place two 1/4" Thick Washers between left side of Engine Mount and Firewall to set engine offset. Install nuts and washers and tighten to 5 to 7 ft. lbs.
8. Place the Rubber Washers into the Engine Mount cups and install the 912 Engine Attachments, Bushings, Washers, and bolts. Do **NOT** tighten bolts at this time. ***IMPORTANT:*** *Place the forward bolts with the heads down for best cowling clearance.*
9. Rotate the water pump inlet on engine to the lower right position. Re-tighten screws to 90 in. lbs.
10. Suspend the engine from an engine hoist or winch.

11. Lower the engine onto the mount between the 912 Engine Attachments. Bolt on the 912 Engine Attachments using 10mm bolts, Loc Washers and Loctite. Torque the bolts to 15 to 20 ft. lbs. ***IMPORTANT:*** *Completely remove Rotax installed coolant hose attached to AFT cylinder head coolant 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. Refer to **COOLING SYSTEM INSTALLATION** for parts.

12. Torque bolts through Rubber Washers to 10 to 12 ft. pounds.

ROTAX 912ULS - ENGINE ACCESSORY INSTALLATION

(BEFORE FINAL INSTALL OF ENGINE MOUNT)

ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. With the firewall clecoed to the fuselage, layout and mark the accessory hole pattern onto the firewall as shown in **FIGURE 03A-02. NOTE: FIGURE 03A-02** *will also show locations for optional Gascolator Mount, Coolant Recovery Bottle Mount, Battery and Optional Air Diverter Assembly. Installation of these items is covered later.* Verify that all holes will miss the fuselage framework. In addition, prior to drilling any of the accessory item mount holes, i.e. Reg/rect., solenoid etc. Verify that the location of the item will not conflict with any other item and that there is accessibility if need be. **N*OTE:*** *The layout shown is for suggestion only. You may choose to design and layout your own firewall pattern depending on the engine and number of options that you are installing.* Drill each hole to its respective size. Other holes may be located and drilled later as they are needed. It is important to note, that all dimensions are for reference only. You must verify all locations. This may require temporary installation of the engine.
3. Locate hole for engine electrical wire pass-thru. This may be a hole with grommet installed or an AMP style CPC connector. Refer to **FIGURE 03A-03**.
4. Bolt the oil tank to the right side of the mount. Use the parts page drawing to assemble. Mark the center and drill a #11 hole on the closed end of each attach bushing. Bolt the attach bushings to the mount angles. Leave loose at this time to adjust for proper angle attachment. Clamp the oil reservoir in place on the Oil Tank Aluminum Angles. Check for clearance with everything in place; including muffler and manifolds. Tighten the bolts holding the attach bushings in place. Drill a #30 hole in the attach bushings and welded stubs to secure oil tankr. Make sure to drill holes at the best orientation for reaching with a rivet gun and rivet.
5. Fabricate Oil Tank Vent Tube per **FIGURE 03A-05** and secure to firewall with 3/8" Plain Clamps. 1 1/2" of Vent Tube should extend below the firewall.
6. Bolt Starter Solenoid and Regulator Rectifier to firewall.
7. Rivet Optional Gascolator Mount to Firewall. Refer to FUEL LINE INSTALLATION - FIREWALL FORWARD.

8. Rivet Mount Bracket for Coolant Overflow Bottle to firewall. Refer to COOLING SYSTEM INSTALLATION.

(AFTER FINAL INSTALL OF ENGINE MOUNT)

9. Route 3/8" Black Overflow Hose from Oil Tank to Oil Tank Vent Tube. Secure both ends with Safety Wire. ***NOTE:*** *Clamps may be bent slightly as needed to allow Overflow Hose to slip on Vent Tube.*

ROTAX 912ULS - 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 1/4" 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 912ULS - 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. Re-tighten screws to 90 in. lbs.
   - Completely remove Rotax installed coolant hose attached to AFT cylinder head coolant 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.
   - Transfer drill lower center welded tab on Station 1 to 1/4".
3. Attach Radiator Support Tube to top of Radiator with Cushion Clamps and hardware shown. ***NOTE:*** *Notice the orientation of the Cushion Clamps.*
4. Drill center hole of Radiator Support Bracket to 1/4" and bolt to lower side of Radiator.
5. Mount Radiator Assembly, using Cushion Clamps to Engine Mount Tubes. Refer to **FIGURE 03C-05** for Clamp locations.
6. Bolt shorter bent end of Bent Radiator Support Bracket to Firewall through lower center tab on Station 1.
7. Rotate bottom of Radiator aft and temporarily bolt through Radiator Support Bracket to Bent Bracket.
8. Cut Pre-formed Radiator "U" Hose into 2 pieces to form 2 90-degree hoses.
9. Install Coolant Tube between right side Radiator Outlet and Coolant Pump Inlet with one of the 90-degree hoses on each end. ***NOTE:*** *Unbolt lower end of radiator and rotate out of way as needed to attach.*

10. Route 1" Radiator Hose between left side Radiator Inlet and Expansion Bottle on top of engine. Insert Hose Spring into Radiator Hose until located at bend area to help prevent possible hose collapse. Fabricate Anti-chafe for the Radiator Hose by splitting a leftover piece and securing around the Hose with Plastic Ties.
11. Secure all hoses with Hose Clamps.
12. Rivet Coolant Recovery Bottle Mount Bracket with Spacer Shims to firewall. Secure Overflow Bottle with supplied Clamp to the Mount Bracket.
13. Route Overflow Hose from Coolant Bottle to Expansion Bottle on engine. Secure Overflow Hose at each end with Safety Wire.

RADIATOR DUCT INSTALLATION

14. Rivet FWD and AFT Inlet Ducts together per parts manual.
15. Cut Trimlock to length to fit AFT flanges of Duct Assembly and press into place.
16. Position Duct Assembly under Engine Mount and secure with Cushion Clamps to Engine Mount tubes. ***NOTE:*** *AFT edge of Trimlock should seal against Radiator.* Mounting holes in Duct Assembly may be slotted slightly to allow positioning for a better seal against Radiator.
17. Cut Trimlock to length to fit lower flanges of Duct Assembly. Press into place. Lower Cowling will seal against Trimlock.

OPTIONAL HEATER INSTALLATION - RADIANT STYLE

NOTE: Heater Installation will require the curved Coolant Tube to be removed from the standard Coolant System and be replaced with other components. Refer to Parts Pages.

18. 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.

19. 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. ***CAUTION:*** *Be careful not to drill into the heater core. Use a drill-stop!* Refer to **FIGURE 03C-19**.

20. 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.*

21. 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.

22. 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.

23. Route Heater Hose from Heater Core fittings to Tees forward of the firewall.

24. 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.*

25. Locate the Control Cable and Fan switch in the instrument panel. Keep this in mind when planning your instrument panel layout.

26. 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.

27. 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.

28. 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.

29. Connect wires to fan and route them to the switch and power source.

30. 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.*

31. After final engine install, check for coolant leaks and proper operation during engine test run.

32. 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 912ULS - 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.

5. 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.

6. 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. Refer to **FIGURE 03D-06**. 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.

7. Locate Oil Cooler Mount Bracket onto Upper Oil Cooler Mount per **FIGURE 03D-07**. Drill, countersink holes on Upper Oil Cooler Mount, and rivet together.
8. 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.*
9. 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.
10. 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.

11. 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.
12. Apply anti-chafe and secure all lines as necessary.
13. 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.

14. 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.
15. Remove the spark plugs on all four cylinders.
16. Verify the ignition switch is **OFF**.
17. Turn the prop through several revolutions by hand.
18. 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.

19. 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.

20. 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.

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

ROTAX 912ULS - 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 two 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 drawing and **FIGURE 03E-02**.
3. Cut two 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 03E-03**. ***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 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 Muffler Extension over the exhaust pipe on the Muffler until bottomed. Position with the lower 45-degree cut facing aft. See **FIGURE 03E-09**. It will be necessary to locate and cut an exhaust hole in the bottom cowling for the muffler extension.

10. Locate a #11 hole through the top flange of the Muffler 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 912ULS - 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. Bolt Angle Bracket to right side of engine gearbox.
5. Secure Heater Duct Hose to inlet Heater Flange on Heater Wrap with a Hose Clamp. Route Hose to Angle Bracket bolted to gear box and cut to length.
6. Slip Inlet Tube about half way inside Duct Hose and secure around Duct Hose to Angle Bracket with Cushion Clamp.
7. Locate hole in Firewall for Air Diverter Assembly. Refer back to **FIGURE 03A-02**.
8. Install Reverse Cable Stop in end cap of Slide of Air Diverter. Orientate to allow installation and access to the small Set Screws.
9. Install Adjustable Cable Ferrule to bent end of Air Diverter. Allow room to adjust the Cable Ferrule in and out.
10. Cleco Air Diverter to Firewall. Opening should be orientated downward.
11. 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.
12. 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.*

13. Push control knob in, inserting control wire through Adjustable Ferrule and Reverse Cable Stop. Safety wire Control Cable housing to Adjustable Ferrule.

14. 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.*

15. Rivet Air Diverter to Firewall.

16. Route Duct Hose from outlet Heater Flange to Air Diverter. Secure with Hose Clamps.

ROTAX 912ULS - 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 remove 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. Refer back to **FIGURE 03A-02**.
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 912ULS - 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. Refer back to **FIGURE 03A-02**.
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 03H-07**. 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 912ULS - 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. Refer back to **FIGURE 03A-02**.
3. Cleco Support Angles to inside of Front Plate. Refer to the parts 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 though 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 03I-07**. 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 912ULS - 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. Refer to **FIGURE 03A-03** for Firewall Electrical Wire Pass-thru.
6. 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, instrument manufacturer's manuals and **FIGURE 03J-05,** 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 912ULS - 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 03K-04** and **03K-04A**. ***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.* Center the Spinner Dome in the circle and mark the Dome at lines.
5. 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.
6. 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.*
7. Remove Dome and mark hole locations on the Dome's perimeter for 4 screws, evenly spaced, between each cut-out. Refer to **FIGURE 03K-07**. Drill #40 through the marked locations.

8. 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.* 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.

9. 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.

10. Dimple the Dome near one opening and dimple the Backing Plate corresponding to that opening for alignment markings. See **FIGURE 03K-10**. ***HINT:*** *Use a #11 bit and lightly press to make the dimples.* Assemble the Dome and Backing Plate each time with the dimples aligned.

11. 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.* See **FIGURE 03K-11**. "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.

12. The Spinner Dome is now ready for painting.

13. 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.

14. 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 912ULS - 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 03L-02.** 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 03L-03**. 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 03L-03**. ***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.* Re-adjust as needed and re-tape in place. The sides of the upper Cowl will lap over the lower Cowl until trimmed.

10. 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.*

11. Tape forward ends of the Cowlings tightly together, check for proper alignment. Re-adjust as needed and re-tape in place.

12. Locate the top center fastener hole per **FIGURE 03L-12**. 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.

13. Measure and drill the positions for the aft fasteners #40 and cleco. See **FIGURE 03L-12**. ***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 03L-03****.*

14. 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.

15. 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.

16. The upper Cowling may need to be trimmed again. Everything changes a little when it settles in the joggle. Sand to final fit.

17. Measure and drill the positions for the fasteners #40 at the cowl to cowl joggle and cleco. See **FIGURE 03L-12**.

18. Transfer drill all holes to #11 and cleco.

19. Final trim all of the openings.

20. Refer to **FIGURE 03L-20.** Mark the opening position for the Oil Tank Access Door on the right side of the upper Cowl. ***HINT:*** A Dremel tool with a reinforced cut-off wheel and small sanding drum works well.

21. Position Oil Tank Access Door with single fastener hole towards aft edge of cowl. Center door vertically in opening, tight against the forward side. Transfer drill #30, then drill to #11 through Access Door and Cleco ***NOTE:*** *The pressed lip of the Access Door will fit inside of the cowling. The Oil Access Door will require some forming to better contour to the upper Cowling.*

22. Cut two Aluminum Strips from 3/4" x .020" raw stock. Drill #30 holes on centerline of each piece. Refer back to **FIGURE 03L-20**. Using Aluminum Strip as a drill pattern, locate #30 holes in cowl 13/16" fwd of opening. Using Aluminum Strip as a drill pattern, locate holes in door 1/2" aft of fwd edge of opening.
23. Remove Upper and Lower Cowling.
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. Cleco 1/4 Turn Receptacles through #11 holes to inside of lower Cowling joggle. Align and transfer drill #40 though Receptacles. Remove receptacles.
26. Position 4 forward Nut Plates to inside of lower Cowling, temporarily retain with Truss Head Screws and transfer drill #40. Remove Nut Plates
27. Cleco 1/4 Turn Receptacle through #11 hole to inside of upper Cowling at aft edge of Oil Access Door opening. Align Receptacle vertically and transfer drill #40 though receptacle. Remove receptacle.
28. Step drill Receptacle holes to 5/16". Refer to **FIGURE 03L-28**. ***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.*
29. Step drill the fastener holes to 1/4". Refer back to **FIGURE 03L-28**. ***IMPORTANT:*** *The 4 forward most holes must remain #11 for the #8 Screws.*
30. Locate opening for Muffler Extension to extend through lower Cowling. This opening may need to be enlarged after the engine is run to prevent contact with Exhaust Extension.
31. Trim aft edge of lower Cowling air exit per **FIGURE 03L-31**.
32. Paint Cowlings and Oil Access Door.

(AFTER PAINTING OF COWLING AND OIL ACCESS DOOR)

33. Rivet 1/4 Turn Receptacles and Nut Plates in place.
34. Install 1/4 Turn Fasteners in Cowlings. Refer back to **FIGURE 03L-28**.
35. Sandwich ends of Vinyl Fabric hinge between Aluminum Strips, upper Cowl and Oil Access Door. Excess material will bulge out to the inside at forward edge of opening to allow door movement. Locate #30 holes through Vinyl Fabric and install rivets. Install 1/4 Turn Fastener.
36. Install Cowling and admire.

ROTAX 912ULS - 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. See **FIGURE 03M-02**.
3. Inspect the Prop for any nicks, crack or dings.
4. Assemble and mount the propeller as per parts 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 = 20.5º per manufacturer's instructions
   - Warp Drive = 14º at tip
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.* 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.
6. 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 03M-06**. ***DANGER:*** *Track prop with ignition* ***OFF****!!*

7. Secure Spinner Dome to the Spinner Backing Plate. Refer to **12" SPINNER ASSEMBLY**.

8. 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.

INSTRUMENTS AND ELECTRICAL

.

Due to the different instruments and flight systems that S-20 RAVEN builders are choosing, RANS does not supply gauges with the kit.

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

2. Refer to parts page for installation of the static and pitot lines. Route the lines to exit the fuselage on the left hand side of the station 3 top cross tube and connect to the fittings on the wing pitot and static lines.

WING – MAIN STRUCTURE ASSEMBLY

NOTE: *LORD brand FUSOR 108B/109B Adhesive is recommended for bonding the sheet metal wraps to the FWD & AFT wing spars. Leading Edge, Root, and Tip Wraps are riveted with 1/8" Stainless Steel Flush rivets. A suitable 1/8" Dimpling Tool and Counter Sink will be required. Aircraft Spruce has an inexpensive 1/8" Pop Grip Dimpler.*

IMPORTANT: *Wings are mirror assemblies, repeat the procedures described for one to both, unless otherwise specified.*

It is **NOT** necessary to trial fit the wings to the fuselage after building the wing frames. We recommend having all assemblies and installations related to the wing completed, before the wings are final installed to the fuselage.

WING SPAR ASSEMBLY

1. Prior to the assembly of the Spars, it is important to familiarize yourself with the orientation of the Spars. When working with long tubes such as Leading and Trailing Edge Spars, padded sawhorses provide an ideal workbench.
2. Locate the root and tip end of both the Leading and Trailing Spars, refer to **FIGURE 05-02 and 05-02A**. You must also determine the forward and aft side to each spar span wise.
3. ***IMPORTANT:*** *Double check that you have the spars correctly orientated to a*ssemble a right and left hand of each spar. Mark all four spars with "left, right, forward, and aft". Lengths of masking tape work well for marking on. ***NOTE:*** *The left hand Leading Edge Spar is also identified by the pitot/static mounting hole.* Refer back to **FIGURE 05-02** for location. Be sure to build a left and right hand set of spars. Be sure the Lift Strut Attach Plates are orientated correctly on each spar. Refer to **FIGURE 05-03**.
4. Locate the root end of both Leading Edge Spars and the 2 slotted Leading Edge Spar Root Doublers.
5. Squeeze the slotted Root Doubler together and slide it in the root end of each Leading Edge Spars, with the slot facing down. Push the doubler in with a block of wood until flush with the Spar root end. Refer to **FIGURE 05-05**. ***HINT:*** *A large hose clamp may be used to squeeze the Root Doubler together to allow easier insertion.*
6. Transfer drill the root doubler # 30 using the pre-drilled holes in the spar as a guide and cleco to the spar as shown in **FIGURE 05-05**.

7. Transfer drill through Spar and Root Doubler #40 in 4 places using the Leading Edge Patch as a guide and cleco. Refer to **FIGURE 05-05**.

8. Remove one cleco at a time and drill out to #30 (4 places) and cleco.

9. Drill out the one hole to #11 as per **FIGURE 05-05**.

10. Remove Leading Edge Patch and deburr.

11. Rivet the Leading Edge Patch to Spar and Root Doubler as per **FIGURE 05-05**. ***IMPORTANT:*** *One hole does not receive a rivet*.

12. Working with only the Leading Edge Spars, find the pilot holes located approximately 47" & 50" outboard from the **ROOT** end of the spar. These holes are drilled in the AFT side of the spar only. Chase drill one hole to #11 and cleco the Long Wing Channel in place. Align the Channel on the Spar centerline so the holes in the Channel match the pre-drilled holes in the Spar. Transfer drill through the Channel into the Spar using a #11 bit and cleco. Transfer drill through the center hole in the Channel through the Spar. Remove the Channel from the spar.

13. Drill out the center hole in the Leading Edge Spar Doubler to #11.

14. Tape the doubler onto an end of a Wing Drag Brace in such a manner that the Drag Brace can be pulled off the Doubler after it is inserted into the Spar. See **FIGURE 05-14**. Using the Drag Brace as a handle, insert the Doubler into the Spar, from the root end, until the center hole in the Doubler is in line with the Channel's center hole in the Spar. Using the center hole, cleco the Doubler and Channel to the Spar. Refer to **FIGURE 05-14**. Pull the Drag Brace loose from the Doubler, making sure that the Doubler remains in alignment with the spar.

15. Using a #11 bit, transfer drill through the outboard holes in the Channel and Spar through the Doubler. Drill one hole at a time and cleco. Remove one cleco at a time and rivet with 3 stainless steel rivets. Refer to the parts drawing. ***NOTE:*** *This Doubler is only installed in the Leading Edge Spar and at this location.*

16. Drill out the holes located approximate 2.5” and 19.5” outboard from the **ROOT** end of the Leading Edge Spars to #11. Rivet a U-Bracket with a single stainless steel rivet to each of these locations.

17. Working with only the Trailing Edge Spars, find the pilot holes located approximately 48.8" & 51.8" outboard from the **ROOT** end of the spar. These holes are drilled in the front side of the spar only. Chase drill one hole to #11 and cleco the Long Wing Channel in place. Align the Channel on the Spar centerline so the holes in the Channel match the pre-drilled holes in the Spar. Transfer drill through the Channel into the Spar using a #11 bit and cleco. Transfer drill through the center hole in the Channel through the Spar. Rivet Channel to Spar using 3 stainless steel rivets.

18. When attaching the Strut Attach Plates to the Spars, it will be necessary to drill out the spars to 3/8" diameter. ***IMPORTANT:*** *Do* ***NOT*** *drill the Strut Attach Plates to 3/8".* The most accurate way to drill the 3/8 " holes is to first drill 1/4" and bolt one end of the Strut Attach Plate to the Spar with a 1/4" bolt.

19. Drill 1/4" and bolt a second hole using the Strut Attach Plate as a guide. Drill the third 1/4" hole, remove the Strut Attach Plate, and drill all three Spar holes to 3/8 ". ***HINT:*** *A Unibit® step-drill produces the best results.* ***IMPORTANT:*** *Make sure the bit you use produces a tight fit between bushing and Spar.* ***REMINDER:*** *When drilling through tubing, drill from each side.* Deburr and insert the Spacer Bushings.

20. When installing the anti-crush Spacer Bushings into the Spars, each Bushing should be flush with the outside surface of the Spar. See **FIGURE 05-18**. ***NOTE:*** *It is possible the Spacer Bushings are slightly too long and may have to be filed down to the outer dimension of the Spar tubing.*

21. Drill out the Long Wing Channel and the U-Bracket to allow for the 1/4" Bolts.

22. Bolt the Strut Attach Plate and Long Wing Channel (Leading Edge Spar), or the U-Bracket (Trailing Edge Spar), to their respective Spar.

23. Step drill the hole 8" inboard from the tip end on the **LEFT** Leading Edge Spar to 3/4" using a Unibit® step-drill on both sides of the Spar. Refer to **FIGURE 05-02.** This is the location for the Pitot/Static Probe.

24. Install the 3/16" Nut Plates to all Flap Hinge locations on the Trailing Edge Spar. Refer to **FIGURE 05-03** for locations. Place the Nut Plates on the forward side of the Spar and secure with #40 aluminum pop rivets. ***HINT:*** *Use a 3/16" bolt to hold the nut plate in place when drilling.* Position nut plates horizontally in-line with the Spar.

25. Install Trailing Edge Spar Root Fittings and Long Wing Channels as per parts manual to both Trailing Edge Spars. Remove equal material from the forward and aft side of the Root Fitting. Profile, with a fine-tooth file, to achieve a perfect fit inside the Spars.

WING FRAME ASSEMBLY

26. Select either a Right or Left hand set of Leading and Trailing Edge Spars. Place on padded sawhorses and bolt in root Inner Compression Tube. ***IMPORTANT:*** *Be sure to install the Aileron Cable Rub Block and the Aileron Cable Retention Plate at the Trailing Edge Spar.* Refer to **FIGURE 05-26**. Install Single-Ear Nut plates to the top of Aileron Cable Retention Plate. ***IMPORTANT:*** *Be sure the nut plates align with the Rub Block.* Refer to **FIGURE 05-26A**. Only finger tighten the 2 bolts at this time.

27. Slide the Compression Tube Doubler inside the Bell Crank Compression Tube so that the holes align with the AFT holes in the Compression Tube. Reference **FIGURE 05-27**. ***NOTE:*** *The Bell Crank Compression tube has two holes that are used for the Bell Crank Brace.* Place the Compression Tube with these holes orientated to the Trailing Edge Spar.

28. Install both the Flap and Bell Crank Compression Tubes into the wing frame. Refer to the parts drawing for orientation of each Compression Tube. ***NOTE:*** *Do* ***NOT*** *tighten the rear bolt on the Bell Crank Compression Tube at this time.*

29. Install the Jury Strut Bracket to the forward bolt retaining the Flap Compression Tube. Refer to **FIGURE 05-26**.

30. Assemble the Teleflex Retainer and the Cable Guide to the Flap Compression Tube as per **FIGURE 05-26**.

31. Cut four bushings, 1" long, from 3/8" x .095" material. These will later be inserted between Bell Crank Braces.

32. Slide Bell Crank Braces into position as per parts manual (between Compression Tube and U-bracket). Refer to **FIGURE 05-27**. Cleco the 2 braces together along their flanges and to the U-bracket. Temporarily bolt to Compression Tube. Transfer drill #11 through 3 forward Brace holes, top and bottom. Cleco. Transfer #30 through remaining holes in Brace along Compression Tube.

33. Remove all clecos and deburr parts. Install 1" bushings. ***HINT:*** *A dab of JB Weld on ends of bushing will help hold then in place.* Re-install Braces with clecos. Remove one cleco at a time and rivet. Refer to parts manual and **FIGURE 05-27** for rivet details. ***NOTE:*** *Three holes for mounting Bellcrank Bearing Mount Blocks on top and bottom do not receive rivets.*

34. Drill out the first hole on each leg of the Tip Bow to #30. Locate and mark the trailing edge side of the Tip Bow. ***NOTE:*** *The trailing edge side has an additional hole drilled (this hole is* ***NOT*** *used on the S-20 RAVEN).* Refer to **FIGURE 05-34**. Insert the Tip Bow into Leading and Trailing Edge Spar and cleco Tip Bow through the FWD side of Leading Edge Spar and the AFT side of Trailing Edge Spar. Make sure the orientation of the Tip Bow is correct. Center the pre-drilled #40 hole in the Tip Bow with the pre-drilled #30 hole in the Spars and chase drill the Tip Bow to #30 and cleco. Remove one cleco at a time and drill out the four holes to #11.

35. ***NOTE:*** *The Tip Bow is purposely under bent.* This forces a curve into the Tip Bow when installed. Once the fabric is installed, this curve will straighten. Rivet the Tip Bow to both the Leading and Trailing Edge Spars with 3/16" stainless steel rivets.

36. Compression Tubes may be final-bolted in place. Do **NOT** final-bolt Drag Braces at this time, as they will need to be removed for installation of Wing Ribs. Instead, temporarily secure Drag Braces with bolts and nuts finger tight.

FUEL TANK ASSEMBLY AND INSTALLATION

ASSEMBLY

(BEFORE COVERING OF WINGS)

Installation of the Fuel Fittings will be easier to accomplish after the hole for the Fuel Cap is located and cut. Refer to **UPPER AND LOWER ROOT SKIN INSTALLATION** in **Section 05C.** Final installation of the Fuel Tank should be done after all fittings are installed.

1. ***NOTE:*** *Each fuel tank is pressure tested from the supplier and guaranteed leak proof.* RANS also performs a pressure test on each fuel tank before they are packed. After you have installed the fuel fittings, it is advisable to perform a final leak test. You may do so 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 tanks and around the fittings. To cap off the fittings use a 1" segment of fuel line with a 1/4" 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.

DOUBLE & TRIPLE CHECK HOLE LOCATIONS BEFORE DRILLING.

2. Locate and drill three (3) 1/2" diameter holes for the fuel fittings at the locations shown in **FIGURE 05A-02.**

NOTE: It is very important, due to tank thickness variations, to be certain the upper sight gauge fitting and aft withdrawal fitting will not have interference with the inside radius of the tank. The dimensions on the figures drawing are for reference only. Using a thin-walled socket, place the socket into the pocket for the upper sight gauge as low as it will go, draw a line around the outside of the socket. Take a small flashlight and tape it to the threaded side of the withdrawal fitting, shining the light through the hole. Place your hand through the 3" hole of the tank and place the withdrawal fitting and flashlight against the wall of the tank where the fitting will go. Start at the bottom of the wall and slide the fitting up until it contacts the radius of the tank, slide the fitting down a small amount and mark the lighted circle with a fine tip sharpie. Ideally the two marks will line up. You can also shine a flashlight into the tank and you can vaguely see the wall of the

tank. From there you can mark the wall and place the withdrawal fitting underneath that mark. Mark the center.

For drilling the holes a 1/2" Uni-Bit® works best. Locate center of the hole with a #30 drill bit, then drill full size. Deburr all holes. Thoroughly clean each tank several times by rinsing with water. After confirming that all foreign material has been removed, let tanks dry prior to installing fittings.

3. To install the fuel fittings into the tank, obtain a piece of wire approximately 40" in length. Safety wire works well. Insert wire through one of the fitting holes in the tank and up through the filler neck. Refer to **FIGURE 05A-03**. Install an O-Ring onto one of the tank withdrawal fittings 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, 1/2" 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 a 1/4" Allen wrench inserted into the tank fitting to hold the fitting while tightening the retaining nut. ***IMPORTANT:*** *Do not allow the fitting or 1/2" thick washer to rotate while tightening or leaks may occur.* ***HINT:*** *Prevent the 1/2" 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 **FIGURE 05A-02** and the parts manual for the correct parts.

6. Perform leak test as described above.

INSTALLATION

(AFTER WING FRAME ASSEMBLY/ BEFORE COVERING OF WINGS)

7. Locate the pre-drilled hole for the U-bracket (S2-SAB) 19.5" outboard from the **ROOT** end of the Leading Edge Spar on the AFT side. Drill spar #11 and rivet U-bracket to the AFT side of the Leading Edge Spar. Drill and rivet a side-by-side nut plate to the top of the U-bracket. ***HINT:*** *Squeeze the rivets with a Rivet Squeezer to allow the Outer Tank Support Tube to clear. A pair of Vice-Grips with tape on the jaws will work to squeeze also.* Bolt the forward end of the Outer Tank Support to U-bracket. With the Fuel Tank in position, resting on both the Root Compression Tube and the Outer Tank Support, pull the Outer Tank Support into place against the

tank. ***NOTE:*** *The AFT end of the Outer Tank Support is cut diagonally to clear the drag brace.* See **FIGURE 05A-07**.

8. Drill the two holes in the U-bracket (KPAC0055) to # 11. Bolt the U-Bracket to the Outer Tank Support. Fasten the U-bracket to the drag brace by drilling two #30 holes in the U-bracket on centerline. Rivet with two 1/8" stainless steel rivets. Refer to **FIGURE 05A-07**. Install a side-by-side nut plate to the topside of the U-bracket. Squeeze the rivets as previously described.

9. Position the Fuel Tank in the wing. Make sure the tank is against the Leading Edge Spar. Bolt the Wing Tank Mount Brackets to the Fuel Tank. ***NOTE:*** *When installing the fuel tank for the final time, apply Loctite to the bolt threads.* Position the tank on the support tubes with light pressure, making sure that the tank is seated flat and contacting the support tubes throughout the length of the tank.

10. Using the Wing Tank Mount Brackets as a guide, transfer drill #30 through the brackets into the support tubes and Cleco. These holes should fall approximate on centerline of each support tube.

11. Rivet the tank mount brackets in place with stainless steel rivets as per parts manual.

FUEL CAP ASSEMBLY

12. Collect Fuel Cap Assembly and metal Retainer.

13. Notice the Flush Fuel Cap must be orientated correctly to insert and lock into its Mounting Flange.

14. Center metal Retainer on bottom side of Mounting Flange. Refer to **FIGURE 05A-14**. Transfer Drill #11. Cleco as you drill. ***NOTE:*** *Mark Mounting Flange to allow re-alignment of Retainer during assembly into tank.* Modify metal Retainer per **FIGURE 05A-14**. Also, drill Mounting Flange to match. ***IMPORTANT:*** *When drilling be sure that the Vent hole will be orientated* ***OUTBOARD*** *and the Fuel Cap opening tab is orientated* ***AFT****.* Final installation will be completed later.

FUEL LINE INSTALLATION WING

(AFTER WING FRAME ASSEMBLY/ BEFORE COVERING OF WINGS)

15. Wing tanks must be final installed.

16. All fuel lines should be cleaned in and outside before installation. Blow out the inside of all lines.

17. Line from aft inboard side of tank to Sight Gauge will be located and installed after the Root Rib is fit-up to wing.

18. Fuel withdrawal line from aft center of tank may be installed after covering and painting.

(AFTER COVERING AND PAINTING OF WINGS)

19. Install Fuel Vent and Cover Ring.

AILERON BELLCRANK AND CABLE INSTALL - WING

(AFTER WING FRAME ASSEMBLY/ BEFORE COVERING OF WINGS)

1. Locate the parts for the Bell Crank Assembly as per parts manual.
2. Assemble 2 Upper and 2 Lower Bell Crank Assemblies per **FIGURE 05B-02** and **FIGURE 05B-02A.**
3. Fabricate 2 Bushings, 1.06" long from provided material. This bushing is used to keep the Bell Crank Mounts parallel to each other.
4. Bolt Bell Crank Mounts to Bell Crank Brace. Install Rib Reinforcement to bottom of Bell Crank Assembly. Refer to parts page for orientation. Refer to **FIGURE05B-04.**
5. Bolt the entire Aileron Bellcrank Assembly In place. Do **NOT** tighten the bolt through the Bell Crank Arm Assemblies at this time. ***NOTE:*** *The Lower Bell Crank Arm will need to be swung out of the way to rivet the Rib to the Rib Reinforcement during Rib Installation.* Do not forget the Spacer Bushing between the Mounts.
6. Install Male Rod End with jam nut to lower side of Bell Crank Arm Assembly.
7. Install the Aileron Cable and Aileron Link Cable to the Bell Crank Upper Arm as per parts manual. ***IMPORTANT:*** *Do **NOT** forget the two stainless steel bushings.* Final install cotter pins and tighten all connections after Wing Ribs are installed.
8. Check entire assembly for free movement, and friction.
9. Route cables through ribs and through the Cable Rub Block as per **FIGURE 05B-09**.
10. Cut white plastic anti-chafe (KPWI0612) to length from raw stock and press onto top of outer Drag Brace as per **FIGURE 05B-09**. The anti-chafe prevents the cables from rubbing on the frame tubing.

WING – RIB & SHEET METAL INSTALLATION

WING RIB ASSEMBLY

NOTE: *LORD brand FUSOR 108B/109B* Adhesive is recommended for bonding the sheet metal wraps to the FWD & AFT wing spars. *Leading Edge, Root, and Tip Wraps are riveted with 1/8" Stainless Steel Flush rivets. A suitable 1/8" Dimpling Tool and Counter Sink will be required. Aircraft Spruce has an inexpensive 1/8" Pop Grip Dimpler.*

IMPORTANT: *Wings are mirror assemblies, repeat the procedures described for one to both, unless otherwise specified.*

A corrosion protection coating is recommended between the Ribs and Rib Clips.

1. Select the necessary parts as shown in the parts drawing. Refer to **FIGURE 05C-01** for Rib location and position numbering.
2. The ribs are pre-pressed aluminum. The forming process leaves the ribs slightly bowed. ***IMPORTANT:*** *Lay the ribs, flange side up, on a flat table. Use "Fluting Pliers" on the depressed areas to take the curvature out of the ribs. Flip the rib over and check that flange surface touches a flat tabletop evenly at all locations. Do this for all ribs.*
3. Separate into Right Hand & Left Hand ribs.
4. The open flange side of the ribs will face toward the wing root. The exception is the root rib (#1) which will face the tip.
5. Each wing will have a root and tip rib, which are different from Ribs #2 thru #11.

INSTALLATION

(AFTER ASSEMBLY OF WING FRAME)

6. Pre-drilled #30 rib mounting holes are located in Leading & Trailing Edge Spars. De-burring of holes may be required. Modify 2 FWD Rib Attach Clips per **FIGURE 05C-06**. Orientate with tabs to the outboard side and rivet to pre-drilled holes at root of Leading Edge Spar.
7. Modify Root Ribs and 2 AFT Rib Attach Clips per **FIGURE 05C-07**. Orientate with tabs to the outboard side and rivet to pre-drilled holes at root of Trailing edge Spar.
8. Cleco Attach Clips to Spars for Rib locations #4 & #11. Orientate with tabs facing inboard. Rivet Clips to Spars.
9. Modify Ribs per **FIGURES 05C-09** thru **05C-09B**. Install Tinnerman Clips to lower flange of Root Rib.
10. Rivet Rib Clips to outboard side of ribs #2, 3, 5, 6, 7, 8, 9, and 10.
11. Rivet Clips to inboard side of Tip Rib. Cleco and rivet Tip Rib to Tip Bow. Refer to **FIGURE 05C-11** for location.
12. Loosen Drag Braces in Wing. Slip Ribs #2 thru #4 over the inboard Drag Brace and Ribs #5 thru #7 over the outboard Drag Brace. Cleco in place.
13. Cleco Ribs #8 thru #11 in place.
14. Transfer drill #30 through Bellcrank Rib Reinforcement into Rib #8. Cleco as you drill. Do **NOT** rivet at this time.
15. Rib # 1 and #2 sandwich the fuel tank and should not be riveted to clips until after fuel tank installation.

RIB STRINGER INSTALLATION

16. Slide Outboard Rib Stringers into wing from the outboard side and cleco to upper and lower tabs on Ribs #3 thru #11. ***IMPORTANT:*** *Outboard end of Outboard Rib Stringer may be identified by hole to hole dimension of 12.75”*. ***NOTE:*** *Flanges of stringers will face downward.*

17. Rivet Inboard Rib Stringers to upper and lower tabs of Ribs #2 and #3. ***NOTE:*** *Un-cleco Rib #2 from the Spars to aid in access for riveting.* Do **NOT** forget to rivet the Outboard Stringers with the Inboard Stringers at Rib #3. Re-cleco Rib #2 to the Spars.

18. Modify Tip Rib Stringer per **FIGURE 05C-18**. ***NOTE:*** *Each Tip Rib Stringer will be modified to create an Upper and Lower Stringer.* Cleco each Tip Rib Stringer from tab on Rib #11 to respective tab on Tip Rib.

19. Rivet Upper and Lower Stringers to Ribs. ***NOTE:*** *Rib #8 must be moved away from the Compression Tube to allow riveting of the Lower Rib Stringer sections*. Rivet Rib #8 to Bellcrank Rib Reinforcement and re-install.

20. Rivet all ribs to Spars and/or Clips.

UPPER AND LOWER ROOT SKINS

21. The root skins consist of an Upper and Lower Skin.

22. ***IMPORTANT:*** *Upper Root Skin orientation is determined by an extra hole in the FWD Tip side of the skin.* Refer to **FIGURE 05C-22** for orientation.

23. The Lower Root Skin has flanges on the Leading and Trailing Edge. ***NOTE:*** *There is a left-hand and right-hand as well as a top and bottom side to the Lower Root Skin.* The Lower Root Skin is positioned such that the flanges point up as to "envelope" the tank. #40 holes are pre-located along the root side of the skin which match to Tinnerman locations in the Root Rib. Refer to **FIGURE 05C-23** for orientation.

24. Most rivet holes in the Upper and Lower Root Skins are dimpled to accept countersunk rivets. Some rivet locations must **NOT** be dimpled. Refer back to **FIGURES 05C-22** and **05C-23** for details. ***IMPORTANT:*** *Be sure the dimpling is done to the correct sides of the Root Skins*.

25. Root Skin Stiffeners will also need to be dimpled.

26. Cleco Root Skin Stiffeners to **lower** side of the Upper Root Skin. Riveted flange of Stiffeners will face AFT.

27. Cleco Root Skin Stiffeners to **upper** side of Lower Root Skin. Riveted flange of Stiffeners will face AFT.

28. Rivet Stiffeners to Root Skins.

29. Cleco Lower Root Skin to Root and #2 Ribs. Cleco Upper Root Skin to Root and #2 Ribs.

30. Refer to **FIGURE 05C-30**. Mark and drill the two #30 holes as shown through the Upper Root Skin and Trailing Edge Spar. ***CAUTION:*** *Do **NOT** locate or drill any other holes in the spar, structural damage to the spar could result.*

31. Using the AFT edge of the Upper Root Skin as a guide, mark a line on the Trailing Edge Spar. Bond the Root Skin to the spars during Leading Edge Wrap bonding. Refer to **LEADING EDGE WRAP** for more details.

32. Using the FWD edge of the Upper Root Skin as a guide, mark a line on the Leading Edge Spar. Bond the Upper Root Skin to the spars during Leading Edge Wrap bonding. Refer to **LEADING EDGE WRAP** for more details.

33. Now is a good time to secure the lower Sight Gauge fittings inside of the Root Rib. Position the Internal Thread Elbow (refer to Fuel Tank Assembly parts page) inside of the lower Sight Gauge hole in the Root Rib. Secure the fuel line to the compression tube with a Nylon Tie and stand-off. Cut fuel line to length as required to connect to the fitting on the AFT inboard side of the Fuel tank.

34. Rivet Lower Root Skin to Root and #2 ribs.

35. Locate the parts for the Fuel Tank Cap Assembly.

36. Modify Capture Ring per **FIGURE 05C-36**. Glue Fuel Scupper edge to Capture Ring. 3M Super 77 Adhesive or similar will work well. ***IMPORTANT:*** *Holes must align!*

37. Place 2" masking tape over hole in top center of Fuel Tank Filler Cap area. Refer to **FIGURE 05C-37**. Locate and mark the center of the opening. ***NOTE:*** *Center-mark may not be centered on pre-located manufacturing hole in tank*.

38. Fabricate a Drill Guide from scrap Aluminum sheet per **FIGURE 05C-37**.

39. Secure Drill Guide to top of Fuel Tank with 2 small sheet metal screws with the center hole centered on the mark.

40. Cut hole into the top of the tank with a fly-cutter or hole-saw using the Drill Guide. Refer back to **FUEL TANK ASSEMBLY** for required hole size. Clean debris from tank. Install fuel fittings if not already done.

41. Modify Cover Ring per **FIGURE 05C-41**. Orientate Scupper per **FIGURE 05C-41A**. Cleo Scupper, Capture Ring, and Cover Ring onto Upper Root Skin. ***NOTE:*** *The Scupper and Capture Ring install under the Upper Root Skin.* Refer to **FUEL CAP ASSEMBLY**.

42. Place Fuel Cap Assembly centered in the opening. Align Fuel Cap Assembly holes with Scupper holes and transfer drill #11. Cleco as you drill.

43. Modify Fuel Cap, Retainer and Scupper for Fuel Vent Tube. Be sure to orientate Fuel Vent Tube hole to outboard. Transfer drill 25/64". Clean debris from tank.

44. Glue Scupper, and Capture Ring to underside of Upper Root Skin. Cleco Cover Ring in place. Be sure Capture Ring is secure to underside of Scupper. Cover Ring will be removed for covering. Secure Fuel Cap Assembly to Fuel Tank. Be sure to use a fuel resistant sealant on the screw threads. RANS uses DOW 730 Solvent Resistant Sealant. Do **NOT** install Fuel Vent at this time; it will be installed after covering and painting.

LEADING EDGE TIP WRAP

45. The Leading Edge Tip Wrap must be pre-fit before final installing the Leading Edge Wrap. The tip wraps are pre-formed at the factory to match the radius of the Leading Edge Spar and the Tip Bow. ***IMPORTANT:*** *The two holes in the front should line up approximately with the forward centerline of Leading Edge Spar and Tip Bow.* If more forming is required, use your hands and push the Tip Wrap around the Leading Edge Spar and Tip Bow to achieve the desired shape.

46. Temporarily lay Leading Edge Wrap on Ribs. Cleco Leading Edge Wrap Stringer to Leading Edge Wrap. Refer to **LEADING EDGE WRAP** installation instructions. Temporarily Cleco top holes of Leading Edge Wrap to top forward hole of each Rib. This will help set proper spacing of Rib #11 for positioning of the Tip Wrap. The Tip Wrap will lay under the Leading Edge wrap when final installed.

47. Slip the Tip Wrap under the Leading Edge Wrap and position the Tip Wrap around the Leading Edge Spar and Tip Bow as shown in **FIGURE 05C-47**. ***NOTE:*** *The two holes in the front should line up approximately with the forward centerline of Leading Edge Spar and Tip Bow.* Drill these 2 holes #40 and Cleco to help hold the Leading Edge Tip Wrap in position. Upper outboard hole in Tip Wrap should align with centerline of Tip Rib. Transfer drill #30 and Cleco to the Tip Rib.

48. Transfer drill #30 using the Leading Edge Wrap as a guide and Cleco to the Leading Edge Wrap and Rib #11. Rivet after the Leading Edge Wrap is bonded. Refer to **FIGURE 05C-47**.

49. Pull Tip Wrap to back side of Leading Edge Spar and Tip Bow. Transfer drill #30 and Cleco. ***NOTE:*** *Trim Tip Wrap as needed for clearance with Rib Clips.*

50. Drill Tip Wrap #40 to match pre-drilled holes in Tip Rib. Refer back to **FIGURE 05C-47**. Use a hole finder or transfer drill from the underside.

LEADING EDGE WRAP

51. LORD brand FUSOR 108B/109B adhesive is recommended for bonding the sheet metal wraps to the FWD & AFT wing spars. Three smaller tubes should be sufficient. A plunger and 3 or 4 mixer tubes will also be required.

52. LORD 703 Prep/Cleaner should also be used. Both products are available online, if not available locally.

53. Unroll Leading Edge Wrap and lay it carefully on the Wing Ribs positioned as illustrated in **FIGURE 05C-53**. Rivet the Leading Edge Wrap Stringer to the underside of the Leading Edge Wrap. ***NOTE:*** *The flange will be forward on the right Wing and aft on the left Wing.* Cleco Wrap to Ribs. Stringer will set into cut-outs in the ribs. ***NOTE:*** *1-inch wide thin double-stick Acrylic foam tape is recommended on the Rib to Wrap contact area. Leave the protective paper on the wrap side of the tape until ready to final install the wrap.*

54. Using the Leading Edge Wrap as a guide, mark a line along the length of the Spar. Remove the Wrap.

55. Cleco the Leading Edge Wrap in place on the Wing. See to **FIGURE 05C-55**. If satisfied, rivet the Leading Edge Wrap to each Rib. Bond the Wrap to the Spar. ***IMPORTANT:*** *The Wrap is retained to the Spar with* ***ONLY*** *the adhesive.* It is important that you make a good bond between the Wrap and the Spar. ***CAUTION:*** *Do* ***NOT*** *drill or install any rivets into the Spar.* ***HINT:*** *Masking tape on the Spar, just forward of the bond area, will help prevent excess glue from bonding in unwanted areas.*

56. Bond the Leading Edge Wrap and Upper Root Wrap to the Leading Edge Spar. Refer to **FIGURE 05C-56** Use a long straight board (1x2x144") and several (6 minimum) “C” clamps (or similar devices, RANS uses Stanley brand cushioned quick clamps) to retain the Wrap in position until the adhesive cures. A piece of wax paper between the board and the Wraps will prevent bonding the board to the Wraps. Placement of the board and clamps on the Wraps when clamping is critical so as not to deform the Wraps. Clamp only to the bonded area. See **FIGURE 05C-56**.

57. Bond the AFT end of the Upper Root Wrap to the Trailing Edge Spar. Clamping is not necessary as 2-inch wide masking tape works well to hold the Upper Root Wrap to the Trailing Edge Spar during bonding.

58. After the epoxy has cured, remove the clamps, tape, and board. Clean off any excess epoxy from the Wraps and Spars. If not already previously done, rivet the Leading Edge Wrap to the Ribs and Upper Root Wrap. Use a small amount of body putty to form a smooth transition from the Wrap to the Spar. See **FIGURE 05C-58**. Carefully sand excess body putty to profile.

PITOT AND STATIC SYSTEM INSTALLATION - WING

(AFTER WING FRAME ASSEMBLY)

NOTE: *The Pitot and Static Lines and the Pitot/Static Probe Assembly are located in the left wing only.*

59. Temporarily install the Pitot/Static Tube through the previously drilled 3/4" hole in the left Wing Leading Edge Spar. Refer to **WING SPAR ASSEMBLY**. Position the Mount Angle to the outboard side of the Pitot/Static Tube on the AFT side of the Leading edge Spar, with the long portion against the Pitot/Static Tube. Transfer drill #11 through the single hole of the Mount Angle. ***HINT:*** *Clamp the mount angle to the Pitot/Static Tube for a tight fit when drilling.* Rivet Mount Angle to Leading Edge Spar.

60. Remove Pitot/Static Tube. Modify and assemble per **FIGURE 05C-60**. ***CAUTION:*** *Drilling too deep into the Pitot/Static Probe Fitting may cause damage to Pitot/Static operated instruments.*

61. Probe Assembly will be final installed after covering and paint.

62. Route the Pitot and Static Lines as per **FIGURE 05C-62.** The lines should be long enough to allow connection to the AFT end of the Pitot/Static Probe Assembly and should extend out of the AFT side of the Wing Root approximately 3” at this time.

63. Use the pre-located hole in each Rib per **FIGURE 05C-62**. Wrap the Pitot and Static Lines with Anti-chafe Tape and secure to the Rib with Safety Wire.

64. Secure the lines with plastic ties as shown, to the Inner Drag Brace. ***NOTE:*** *Secure the Pitot and Static Lines together with the Flap Teleflex Cable to the Inner Drag Brace.* Refer to **FLAP TELEFLEX CABLE INSTALLATION - WING**.

65. ***IMPORTANT****: Make sure the ends of the Pitot and Static Lines are cut square.* Install the two 90-degree Union Elbow fittings to the Pitot/Static Probe Assembly side (outboard end) of the lines only. ***NOTE:*** *To install the fitting, press it on and then* ***PULL*** *to seal.* Make sure the fittings are pressed on firmly (line will penetrate fitting about 5/8”). Then **PULL** the tubing to seal. To disconnect the fitting, push the small ring of the fitting as you pull it off. Reference also **FIGURE 05C-60**.

66. Do not install fittings to the root end of the Pitot and Static Lines at this time. Install these fittings after the AFT Root Rib Closeout is installed.

67. Remove the Pitot/Static Probe Assembly for covering and painting. Tape the line ends closed and mark respective ends with “**PITOT**” and “**STATIC**” as per **FIGURE 05C-62** for ease of identification during final installation.

FLAP TELEFLEX CABLE INSTALLATION - WING

(AFTER WING FRAME ASSEMBLY)

68. Route the Flap Teleflex Cable as per **FIGURE 05C-68** and secure with plastic ties as shown to the Compression Tube and Inner Drag Brace. ***NOTE:*** *In the Left Wing, the Pitot and Static Lines secure together with the Flap Teleflex Cable to the Inner Drag Brace.* Refer to **PITOT AND STATIC SYSTEM INSTALLATION - WING**.

69. Push the flap cable inside the wing frame for covering.

AILERON AND FLAP ASSEMBLY AND INSTALLATION

ASSEMBLY

(BEFORE COVERING)

1. Aileron and Flap Frames are factory assembled.
2. Install nut plates for the hinges to the AFT side (inside) of the Flap Frame Leading Edge Spar before covering. ***NOTE:*** *Aileron Frames do* ***NOT*** *require nut plates for hinge attachment*.
3. To install nut plates, temporary insert a bolt through the hinge hole into a nut plate. Drill # 40 using the nut plate as a guide and rivet. ***IMPORTANT:*** *Before drilling, be sure the nut plate is aligned with the frame spar.* Using this method will assure a perfect fit.
4. The Flap and Aileron Frames are now ready for covering. Refer to **COVERING**.

(AFTER COVERING AND PAINT)

5. Use a hot iron (a soldering iron or wood burning tool works well) to burn holes through the fabric at the attach points for the Flap Hinges, the Flap and Aileron Attach Angles and through Drain Grommets. Refer to parts pages and **FIGURE 05D-05**.
6. Bolt Hinge Brackets to leading edge of Flap Frame.
7. Aileron Hinges must be bolted to the Wing Trailing Edge Spar before bolting to the Aileron Frame. ***IMPORTANT:*** *Be sure to check the orientation of the Aileron Hinge.*
8. Bolt on Flap Horn Attach Angles and Aileron Attach Angles. ***NOTE:*** *Flap and Aileron Attach Angles are orientated 90 degree to the Aileron or Flap Leading Edge.* You will have to fabricate small bushings as per parts manual. Locate and burn small holes through the fabric at the bushing locations. Refer back to **FIGURE 05D-05**. ***NOTE:*** *Flaps require two Attach Angles, whereas Ailerons use only one.* See **FIGURE 05D-08**.

INSTALLATION

(AFTER COVERING AND PAINT OF WINGS)

9. Install Flaps and Ailerons as per parts manual. ***NOTE:*** *Flap Hinges are placed on the root side of the Trailing Edge Spar Hinges*. Refer to **FIGURE 05D-09**.

10. Tighten the castle nuts only to take out excessive play to avoid friction in the hinge point. ***NOTE:*** *It may be required to use additional washers to take out the play between Wing and Flap Hinges.*Check the Flap for free-movement and adjust nuts if required. Install cotter pins and lubricate all hinges with light machine oil. ***HINT:*** *With the bolt pushed in tight, the washer next to the nut should have a slight amount of movement*.

11. Do **NOT** connect the Teleflex Cable or Aileron Push-Pull Tubes at this time.

12. Move Flaps up as far as possible and secure in place with masking tape. This will expose the AFT surface of the Trailing Edge Spar for the Gap Seal installation.

13. The PVC Gap Seal material may be used in its natural white color. For details about the installation, refer to **FIGURE 05D-13**.

14. Measure the distance between the Hinges and cut the Gap Seal to length with 45-degree miters on each end. See **FIGURE 05D-13**. ***HINT:*** *Cut the ends square then use a disk sander to miter the 45-degree ends.*

15. Position the Gap Seal so that it is centered between the Hinges and lined up with the hinge line. See **FIGURE 05D-13**. ***HINT:*** *Use double-sided tape to temporarily hold seals in position.* Where a Bolt Head will not allow the Gap Seal to rest flat against the Trailing Edge Spar, drill a 5/8" hole to allow clearance of the Bolt Head. See **FIGURE 05D-13**. ***HINT:*** *Place Masking Tape between top edges of the Hinges and use a Straight Edge to mark a line to help keep the Gap Seal straight*.

16. With Gap Seal off of the wing pre-drill #40 each piece of Gap Seal off of the wing as shown in **FIGURE 05D-13**. Hole and rivet locations for each piece of Gap Seal will vary according to length. Maintain a 3/4" edge distance on each end and an 8” to 10” rivet spacing thereafter. Maintain a 5/16" edge distance to the bottom of the Gap Seal to allow for riveting.

17. With Gap Seals positioned on the Wing, transfer drill #40 into the Trailing Edge Spar and cleco in place. Drill out all holes to #30. Remove the Gap Seal, debur and remove all shavings. Install Rivets as per parts manual.

18. The Flaps must move freely without rubbing on the Gap Seals. A minimum clearance of 0.060" must be maintained between Gap Seal and Flap Leading Edge. Final fit the Gap Seal by filing, sanding, or planeing until proper clearance is obtained. ***HINT:*** *A miniature Wood Plane works great to shave off excess material.*

19. Trim the Aileron Push-Pull Tube Exit and Flap Teleflex Cable Exit to lay flat on the Wing. Trim out the AFT opening of the Aileron Push-Pull Tube Exit. Refer to **FIGURE 05D-19**. ***NOTE:*** *Cutouts in the Flap Cable Exit will be made during* ***WING INSTALLATION***.

20. Center the Exits on the Exit Reinforcement Rings on the Wing. Transfer drill #40 through the dimpled locations on the Exits. Cleco as you drill. ***CAUTION:*** *Do* ***NOT*** *drill through or install a screw in the forward end of the Aileron Push-Pull Tube Exit. A screw in this location which penetrates through the fabric may cause damage to the Push-Pull Tube or potential locking of the Aileron control.* Do **NOT** install the Exits at this time. For Exit installation and connection of Aileron Push-Pull Tubes and Flap Cables refer to **WING INSTALLATION**.

LIFT STRUT ASSEMBLY

INSPECTION OF STRUTS

RANS airfoil lift struts are made of extruded Aluminum. Extrusions of this nature are sensitive to deformation. Cracks and splits can occur along the length of the strut if the ends are compressed beyond the material limits. Over-tightened bolts can cause cracking.

Each piece of strut material is inspected before shipment to assure you of a quality product. We encourage you to inspect your struts for any deformation or surface imperfection. Deeply grooved struts should not be used and returned to the factory for replacement. The surface should look and feel smooth.

Dents and nicks can occur during shipping. The strut material is very thick skinned and resistant to dents. If dents are present they will usually be large enough to require rejection of the material.

Minor nicks and scratches can and should be sanded out with 250, 350, and finally 400 grit wet or dry sandpaper. Sanding out such defects is an effective way of restoring the strut to a safe full strength status. Any nicks or scratches that require more than light sanding are cause for rejection.

Once the struts are in service, continued inspection is the only required maintenance. Anodized strut material is resistant to corrosion and needs little care.

Include strut inspection in your pre-flight.

ASSEMBLY

1. The Lift Struts are cut to length and pre-drilled at the factory. Locate FWD and AFT Lift Struts and mark with “LEFT” and “RIGHT” on a strip of Masking Tape. Refer to **FIGURE 05E-01** for orientation. At this point it does not matter which one is left or right. The marking will help you to remind yourself to build a left and right set of Struts. Left and right is determined by the direction the Bolts go through the Struts (top to bottom). Refer to the parts manual. ***NOTE:*** *The struts are teardrop shaped. The round side is forward*.
2. Smooth the ends of each Lift Strut with fine Sand Paper and debur.

3. ***NOTE:*** *Due to dimensional variation in extruded material, it may be necessary to shim the Strut Fittings.* No gap should exist between the Fittings and the Struts. ***CAUTION:*** *If a gap exists, do* ***NOT*** *eliminate by tightening down the Bolts. This action may crack the Struts.* Instead fabricate and use the 0.020" shim material between the fitting and the strut. Refer to **FIGURE 05E-03**.
4. Step Drill the lower hole only on each Upper and Lower Gusset Plates to 5/16" as per **FIGURE 05E-04** for attachment to Lift Strut. The other attachment holes need to remain # 30 at this time.
5. Temporary bolt and cleco Upper and Lower Gusset Plates to both Forward Struts as shown in **FIGURE 05E-04**. Mark Gusset Plates to assure they end up in the same place when final riveting.
6. Remove one cleco at the time and drill out the 3 attachment holes on top and bottom to #11. Cleco as you drill.
7. Remove Gusset Plates. Debur Struts and Gusset Plates.
8. Re-install Gusset Plates with Bolt and clecos. Remove one cleco at a time and rivet with Stainless Steel Rivets (CCPQ-64).
9. Check the fit of Upper Strut Fittings on the Strut Attach Plates on the Wing. File out the inside of the fitting as required until the fitting slides onto the Strut Attach Plate. ***IMPORTANT:*** *Do* ***NOT*** *file on the Strut Attach Plate*.
10. Install Upper and Lower Strut Fitting as per parts manual in both FWD Struts. Shim if required. Make Left and Right (note direction of bolts). ***NOTE:*** *Fittings may require drilling of holes to match bolt diameters*.
11. Cut and install Spacer Bushing in Rod End.
12. Drill out Gusset Plates where Rod End of AFT Lift Strut attaches to 5/16" and check fit of Rod End.
13. Install Upper and Lower Strut Fittings in both AFT Struts. Shim if required. Upper AFT Connector will require modification to allow pivoting to proper attachment angle when installed. Refer to **FIGURE 05E-13**. ***NOTE:*** *Fittings may require drilling of holes to match bolt diameters*.
14. Install Eyebolts in Lift Struts for attachment of Jury Struts. Do **NOT** Tighten at this time as Eyebolts will require pivoting to align with Jury Strut Assembly.
15. For Lift Strut installation, refer to **WING INSTALLATION** and **RIGGING**.

WING TIP ASSEMBLY AND INSTALLATION

WING TIP FIT UP AND ASSEMBLY

(AFTER COVERING AND PAINTING OF WINGS / AFTER INSTALLATION OF AILERONS AND FLAPS)

1. When fitting the Wing Tip, work carefully not to scratch the paint on the Wing. Trim Wing Tip at the base of the flared material. The Wing Tip will need some additional trimming and sanding, before the surface finish can be applied.
2. Use a hot iron to burn a small hole through the fabric at each hole along the Tip Rib.
3. Slide the Wing Tip all the way onto the Wing.
4. It will be necessary to trim the Wing Tip to within 5/16” of the centerline of the Tip Rib. Trim the Wing Tip to allow for sufficient clearance to the aileron. Refer to **FIGURE 05F-04**. Tape the Wing Tip in place to avoid movement.
5. Use a hole-finder to mark and drill #40 holes in the Wing Tip to match the pre-drilled holes in the Tip Rib. Cleco as you drill making sure the Wing Tip fits tightly.
6. Slide the AFT Closure (small metal rib) inside the AFT end of the Wing Tip and clamp in place. Mark 3 holes top and bottom on the Wing Tip approximate centered on the Rib Flange and drill # 30. Rivet the Aft Closure in place. ***NOTE:*** *Use the metal rib to align the tip’s aft end with the aileron neutral setting.* Refer to **RIGGING** section.
7. Remove the Wing Tip, final trim, prep, prime and paint.

FINAL INSTALLATION

(AFTER PAINTING OF WING TIPS)

8. Add a length of clear plastic tape along the Tip Rib on the Wing as an anti-chafe provision.
9. Secure the Wing Tip to the Tip Rib using small screws called out in the parts manual.
10. Check for clearance between tip of aileron and wing tip as per **FIGURE 05F-04**.

ROOT SKIN INSTALLATION

INSTALLATION

(AFTER PAINTING OF WINGS)

1. Apply desired finish to Root Rib Closeouts.
2. Final install Root Rib Closeouts and Fuel Sight Gauge parts before the Wings are mounted to the aircraft.
3. Refer to ROOT SKIN parts page and place Grommets and Serrated Strip in correct locations in FWD and AFT Root Rib Closeouts. ***HINT:*** *Cut Serrated Strip slightly long and trim to length to help hold in place.* A few drops of Super Glue on the outboard side can also help if required. Refer to **FIGURE 05G-03**. ***NOTE:*** *The two Small Grommets are installed only in the left AFT Root Rib Closeout for the Pitot and Static lines.*
4. Be sure all hardware is installed in fuel tanks for Fuel Withdrawals and Fuel Sight Gauges. Cleco Root Closeouts to Root Rib. Position Sight Gauge Decal centered between the Grommets. Refer to **FIGURE 05G-04**.
5. Install the 90-Degree Fitting for the upper end of the Sight Gauge. Install the 90-Degree Withdrawal Fitting for the lower end of the Sight Gauge. Orientate each fitting to align to each other. Fabricate the Sight Gauge from the supplied Clear Fuel Line. Refer to **FIGURE 05G-05**.
6. Rivet FWD Root Closeout skin in place.
7. Route the Flap Teleflex Cable, Fuel Line, and Pitot / Static lines through the Grommets in the AFT Root Closeout.
8. Attach Aft Closeout with screws.
9. Final install the Fuel Lines from the Wing to the Fuselage after the Wings are mounted. Refer to **FUEL LINE INSTALLATION - FUSELAGE** for instructions.

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:

- Wings are painted
- Ailerons, Flaps and Gap Seals installed
- Aileron and Flap Cable Exit Fairings trimmed and fit to Wing
- Wing Tips painted and installed
- Wing Root Rib Closeouts (root covers) painted and installed
- Fuel Sight Gauges installed to Wing root
- Lift struts assembled

All of the above items are easier to do with the Wing on sawhorses than on the airplane.

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.

Refer to **parts page 005-01**.

1. Drill out the 1" U-Brackets (stainless steel) to fit a 5/16" Bolt. Drill the attach hole for the Fuselage only.
2. Bolt the 1" U-Brackets at the Left and Right side of the Fuselage to the bushings at Station 3. Use hardware as shown in the parts manual.
3. Install the Hinge Cubes as shown in the parts manual to the Trailing Edge Spar Root Fittings. ***NOTE:*** *The slotted portion will bolt to the 1" U-bracket on the fuselage.*
4. Rest the wing on 2 saw horses beside the fuselage.
5. Previously the Lift Strut Fittings should have been checked for fit on the corresponding Strut Attach Plates on the Wing. If not, use a fine file or sandpaper to remove as little material as possible. ***IMPORTANT:*** *Remove material only from the fittings,* ***NOT*** *from the Strut Attach Plates.*
6. ***IMPORTANT:*** *The FWD attachment hole in the Leading Edge Spar and Spar Patch should have been drilled to 3/8" during Leading Edge Spar assembly. If not, refer back to WING SPAR ASSEMBLY and do so now.*
7. Modify the FWD end of the Carry-Thru Bushing ("T"- Bone) per **FIGURE 05H-07**.

8. Modify both ends of the Fuselage Carry-Thru Bushing ("T"-Bone) to fit tight in the Leading Edge Spar of the Wing. Refer to **FIGURE 05H-08**. The "T"- Bone must be contoured with a file to follow the inside shape of the Spar. Check fit by temporarily attaching the Wing at the Trailing Edge to the U-Bracket on the Fuselage and sliding on the Leading Edge Spar. Check fit of attachment bolt in "T"-Bone and debur the filed area. ***IMPORTANT:*** *It is recommended to apply some corrosion protective primer to the bare metal*.

9. With the assistance of helpers, lift the Wing into position. Have a helper on the Wing's tip end and one on the root end of the Trailing Edge Spar. Slide the Wing's Leading Edge Spar onto the "T"- Bone. Feed all cables into the Fuselage. Bolt the Hinge Cube to the U-Bracket at the trailing edge using the hardware shown in the parts manual.

10. Temporarily insert the forward wing attach bolt through the Leading Edge Spar into the Wing Carry-Thru Bushing.

11. Connect the FWD Lift Strut to the Strut Attach Plate at the Leading Edge Spar.

12. Raise the tip of the Wing as needed to allow the fitting at the lower end of the FWD Lift Strut to slide into the Fuselage bracket. Insert Bolt.

13. Drill the AFT hole in the Leading Edge Spar at the Wing root to fit the 3/8" bolt. A helper is required to hold the wing secure at the wing tip, while drilling. Below is two ways of drilling the AFT hole. You may decide which one you use. RANS' Assembly Crews have done it both ways, but Method #2 is recommended.

    METHOD #1:

    Remove the Leading Edge Spar Attach Bolt. Use the "T"-Bone as a guide and transfer drill through the aft wall of the spar in one-step to 3/8". ***CAUTION:*** *It is very important, to hold the wing completely stationary while drilling the AFT hole. Otherwise, hole elongation will result.* Preferably use a bit with a short cutting area (reduces the danger of elongation in the front hole).

METHOD #2:

Fabricate a drill bushing from a tube with 3/8" O.D. and an I.D. to fit a long drill bit you have (somewhere in the order of 1/4"). The bushing should fit tight in the "T"-Bone and extend long enough out of it to allow pulling it out. RANS uses a steel bushing with a welded on handle. Lubricate the bushing for ease of removal and insert through the front of the Leading Edge Spar and the "T"-Bone until bottomed against the inside of the Leading Edge Spar. Drill through the Leading Edge Spar with the long drill bit using the drill bushing as a guide. After drilling, pull the drill bushing out about 1/5" and drill through the AFT end of the Spar to a size short of 3/8". Remove the drill bushing completely and blow out the interior of the "T"-Bone. Holding the Wing steady, insert a 3/8" drill bit through the FWD end and drill out the AFT wall of the Spar to 3/8". ***CAUTION:*** *It is very important, to hold the wing completely stationary while drilling the AFT hole. Otherwise, hole elongation will result.* Preferably use a bit with a short cutting area (reduces the danger of elongation in the front hole).

14. Insert Leading Edge Spar Attachment Bolt and tighten. Tighten bolt enough to take out play

15. Connect the upper end of the Aft Lift Strut to the Lift Strut Plate at the Trailing Edge Spar.

16. Temporarily install the Rod End in the lower end of the AFT Lift Strut between the Gusset Plates on the FWD Lift Strut. Pin only at this time using the bolt. Do **NOT** forget to insert the bushing in the Rod End. ***NOTE:*** *The Rod End on the lower end of the AFT Lift Strut is used to set the Wing wash-out during rigging.* Refer to **RIGGING** for information. ***IMPORTANT:*** *Both wings must be installed to the Fuselage before wash-out is set*.

17. After wash-out is set, tighten and check all Strut connections.

18. Drill a #11 hole per **FIGURE 05H-18** in the lower end of the AFT Jury Strut.

19. Apply desired surface finish to Jury Struts and install. Support Lift Struts with a block of wood or similar material about halfway down to straighten them. The weight of the Wing causes a slight bend. Look down the Strut to get a good idea if the struts are straight.

20. Temporarily bolt the FWD Jury Strut Assembly in place as shown in the parts manual. Should you not be able to achieve proper fit, then it is possible to space the eyebolts up with washers. You can also use washers at the drilled head bolt locations if needed.

21. Temporarily bolt the upper end of the AFT Jury Strut to the Teleflex Retainer Bracket. Slip the lower end of the AFT Jury Strut over the aft tab of the FWD Jury Strut. Align the hole with the tab centerline. Transfer drill #11. Use the tab on the AFT end of the Jury Strut Assembly to mark the lower end of the AFT Jury Strut. Transfer drill using a #11 bit. ***NOTE:*** *You may want to mark the hole location on the tab with a #11 bit and drill in a drill press.* ***CAUTION:*** *Be sure the lift struts are straight before drilling.* Insert a bolt to temporarily hold in place.

22. Slip the Aft Jury Strut off the tab. Trim Plastic Shims to match the tab. Trim two (2) shims per tab. Align the Shims on each tab, mark and drill #11. Install the AFT Jury Strut with Shims. ***HINT:*** *Tapering Shims will allow easier proper fit.*

23. Disconnect the upper end of the AFT Jury Strut and modify the Flap Cable Exit Fairing as required. Refer back to **FIGURE 05D-19** to allow for the Flap Teleflex Cable, and the AFT Jury Strut. Also, drill a # 30 hole at the lowest point of the Fairing as a drain.

24. Slide the Fairing on the AFT jury strut and bolt the upper end of the AFT Jury Strut and the Flap Teleflex Cable in place. Secure the Fairing to the underlying reinforcement using the supplied small screws. Use Loctite and safety wire the drilled-head bolts of the Jury Struts in place. Tighten all attachment bolts and nuts.

25. Refer to **AILERON CABLE SYSTEM INSTALLATION - FUSELAGE** in **SECTION 2.** Connect the Aileron Cable as shown. Refer to **RIGGING** for information about Bell Crank position and cable tension.

26. Connect Push-Pull Tube to the Bell Crank Arm. Slide the Exit Fairing on the Aileron Push-Pull Tube. Temporarily connect Aileron Push-Pull Tube to the Aileron Horn. Adjust the Push-Pull Tube with the Control Stick centered for the correct Aileron neutral position as per **RIGGING** instructions.

27. 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.

28. Connect the Flap Cable to the Flap Horns on the Flaps as shown in the parts manual. For adjustment of the Flaps, refer to **RIGGING**.

29. Fabricate the Fuel Lines to connect the Wing Fuel System to the Fuselage Fuel System. Refer to **FUEL LINE INSTALLATION - FUSELAGE**.

30. Refer to **FIGURE 05H-30.** Position the Wing Root Gap Seal on the under side of the Wing so that the flange is tight against the Fuselage frame. Use a hole finder and locate the holes in the Root Rib with the Tinnermans. Mark and drill #30.

31. Remove the gap seal and paint. During final assembly, glue the small foam tape to the flange that will rest against the fuselage frame. Attach the gap seal to the wing with the screws provided.

32. Installation of Flap Fillet will be done after **WINDSHIELD INSTALLATION**. ***NOTE:*** *The fillet flap is installed to the Baggage Window Trim Frame and closes the gap between Fuselage and Flap.* ***CAUTION:*** *When installing, do* ***NOT*** *drill into the Fuselage tubes.*

33. Install the assembled Pitot/Static Tube through the previously drilled 3/4" hole in the left Wing Leading Edge Spar. Refer to **WING SPAR ASSEMBLY**. Position the aft end even with the end of the Mount Angle and secure with two hose clamps. ***NOTE:*** *Be sure the end of the Pitot/Static Tube is downward in relation to the wing.*

34. Connect Pitot and Static lines to their respective connectors in the wing.

BOOT COWL ASSEMBLY

ASSEMBLY

(BEFORE COVERING AND PAINTING)

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, deburr, and apply Truck Bed Liner Spray to 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 with the bent flange against the forward side of the firewall. Center side-to-side with the opening near the front centered on the Nose Gear Collar. ***NOTE:*** *Opening may need to be modified for Nose Gear installation.*
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 06-07** 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. Trim as required.* See **FIGURE 06-08**.
9. 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.

10. 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. ***IMPORTANT:*** *Remove tape only after final fit of doors and windshield.* A matched flush fit is what we are going for between the edge of the door, boot cowling skin and windshield.

11. 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 06-11**. 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 06-11**.

12. 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.

13. Pull the sheet metal around the bottom corner of the firewall and mark where the curve starts and stops. Remove the panel to form a tapered curved section. This is done by working the metal over a 1” round tube or rod clamped firmly to a vise or table. It works best to form the large radius and taper to no radius at the aft end of the panel. ***HINT:*** *It may be wise to test your forming skills on a piece of scrap sheet metal.*

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 06-13**. 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 06-18**. 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 06-19**.

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 06-29** to allow clearance with Cowling.

30. Insert Instrument Panel Visor between the Top Boot Cowl Skins and Instrument Panel Frame. Mark and trim Visor as needed to clear flanges of Top Skin. 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 a fuselage tubes to the aft of the Skins. Trim if required to the centerline of the tubes.

33. Rivet Firewall Support Angles to Firewall.

34. 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 COVERING AND PAINTING)

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

VENT SYSTEM INSTALLATION

(BEFORE COVERING AND PAINTING)

36. Refer to the parts catalog and select the required components.
37. Position NACA scoop of Vent System centered on Side Skin cutout. Transfer Drill #30 through Side Skins. Cleco in place.
38. Recommended location for openings in Instrument Panel for eyeball vents is shown in **FIGURE 06-38**. 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.
39. Use the eyeball vent and transfer drill through the hose adaptor flange.
40. After mounting the Instrument Panel in the Panel Frame, route the duct hose and cut to length as needed.
41. Remove assembly and set aside for installation after covering and painting.

INSTALLATION

(AFTER COVERING, PAINTING AND INSTALLATION OF BOOT COWL)

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

INSTRUMENT PANEL INSTALLATION

ASSEMBLY

(BEFORE COVERING 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.* Double-check your design before cutting the panel. Refer to **FIGURE 06A-01** for a suggested panel design.
2. Refer to **FIGURE 06A-02** and use the provided 1:1 template to mark and drill the two 3/8" holes in the left side of the instrument panel. The control cables for Parking Brake and Cabin Heat will mount here during final assembly.
3. Cleco Instrument Panel to Instrument Panel Frame. Transfer drill Panel mount holes to #11. Un-cleco panel and rivet nutplates to forward side of Panel Frame. ***NOTE:*** *Instrument Sub-panel will also rivet to lower center frame hole with nutplate rivets.*
4. Un-cleco panel and drill all panel-mounting holes in the Panel to 5/16” to allow the rubber grommets (vibration isolators) to be installed. ***IMPORTANT:*** *Do **NOT** drill holes in the Panel Frame larger than #11.*
5. Fit-up Instrument Sub-Panel and Radio Mount Plates at this time.

INSTALLATION

(AFTER COVERING AND PAINTING)

NOTE: *Application of OPTIONAL - DASH COVER FOAM and FABRIC requires Windshield to be fit-up.*

6. Rivet Panel Frame to forward side of welded Fuselage tabs. Refer back to **FIGURE 06-18.**
7. 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.

8. Modify Oval Glare Shield Rings per **FIGURE 06A-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.

9. 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.

10. 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.

11. 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.

12. 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.*

13. 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.

14. Rivet Oval Glare Shield Rings to Top Skins.

15. Push Trimlock onto aft edge of Visor. Tuck fabric into Trimlock when installing.

16. 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 INSTALLATION

ASSEMBLY

(BEFORE COVERING AND PAINTING)

17. Rivet Throttle Reinforcement to forward side of Sub-Panel. Refer to Parts Pages for detail.
18. Rivet Instrument Panel Reinforcement to top side of lower flange of Sub-panel.
19. Cleoc Sub-Panel to lower center of Panel Frame. ***NOTE:*** *Top center hole of Sub-Panel should be drilled to #11 for panel screw.* Transfer drill outboard holes to #30. Rivet with 1/8" rivets on outboard edges and 3/32" rivets for nutplate.
20. 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:*** *Mounting trays from Comm Radio, Transponder, etc., will be required to position Mount Plates to correct width.* Trim the forward ends as needed to clear Station 1.
21. If full height of Mount Plates is not required, trimming to half height is acceptable.
22. Fabricate aluminum angle supports from raw stock. Cut one to full width (about 8 1/4") of Mount Plates from outboard edge of each flange. Fabricate another 12" in length.
23. Use the 12" angle support and attach the forward end to the two diagonal nose gear collar frame tubes welded to Station 1 with cushion clamps and to the flanges of the Mount Plates. Locate and drill #11 holes and cleco. Make sure the forward end is 90-degrees to the Panel.
24. Locate the shorter angle support under the Mount Plate flanges where the Panel Reinforcement can intersect and rivet into the centerline of the angle. Transfer drill #30 through Panel Reinforcement and cleco. Drill #11 through flange of Mount Plates into angles and cleco.
25. Instrument Panel, Panel Frame and Sub-Panel may be removed as an assembly.

INSTALLATION

(AFTER COVERING AND PAINTING)

26. Install Sub-Panel along with Panel Frame and Instrument Panel.
27. Install Throttle Cable and Choke Cables in Sub-Panel, route through firewall and connect to engine.

WINDSHIELD & SKYLIGHT INSTALLATION

Lexan windshields 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. We use 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.*

NOTE: *The wing structures must be complete (may be covered and painted) and attached to the fuselage prior to final installation of the windshield and skylight. However, the windshield and windshield hold down strip may be fit-up, before final assembly, without the wings, skylight, and skylight ribs installed. Boot Cowl must also be on the fuselage to fit-up the Windshield.*

CAUTION

NEVER ALLOW FUEL TO COME IN CONTACT WITH LEXAN.

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

(BEFORE ATTACHMENT OF WINGS)

1. Collect all the parts shown on the part pages for the windshield. Extra care should be taken when working with Lexan. Lexan scratches easily and as much as possible of the protective plastic should be left in place until the aircraft is ready to be flown. The windshield will require some minor trimming. Lexan can be easily trimmed with aviation snips or by scoring and snapping off the piece to be trimmed. A sanding block with 80-grit paper works well for dressing up trimmed Lexan.
2. Drill the outboard windshield tabs located on the leading edge spar carry-thru as shown in **FIGURE 07-02**. Drill the center tab #30 as well.

3. Place Windshield on top of fuselage. Remove only enough of the protective plastic to locate the outboard mounting tabs. Position per **FIGURE 07-03**. Be careful not to scratch the windshield. Be sure the Windshield is centered side to side before drilling. Drill #30 through the inboard two holes of each tab. **IMPORTANT:** Do **NOT** drill through the outboard hole or through the center tab. Cleco in place.

4. Wrap Windshield aft to the Station 2 vertical tube (door opening). Windshield should be tight against top skins of Boot Cowl. Tape or clamp to Station 2 tube.

5. Trim Windshield Hold Down Strip per **FIGURE 07-05**. Position Strip tight against windshield, and top skins of Boot Cowl. The lower side of the windshield should fall into the joggle of the Hold Down Strip. Hold Down Strip should be centered from side to side. Tape into place. Secure aft edge at Station 2. ***NOTE:*** *AFT edge of Strip will be trimmed slightly forward of Station 2 Vertical Tube centerline at a later time.*

6. Start at the forward center of the Hold Down Strip, mark and drill #30 per **FIGURE 07-06.** Make sure the windshield stays tight against the Hold Down Strip and is clamped tight to Station 2 Vertical Tube. ***HINT:*** *It may be easier to drill the Strip off the plane, then replace, and drill through Windshield and Cowl Top. Cleco in place.*

7. Drill the Windshield Attach as shown in **FIGURE 07-07**. Place the Attach on the inside of the windshield. Position so that the flange is forward and against the windshield. The lower hole should match to the position for the AFT hole in the Windshield Hold Down Strip. Press the windshield flat against the Windshield Attach with a scrap piece of lumber. Transfer drill #30. Cleco as you drill.

8. Trim AFT edge of windshield per **FIGURE 07-08**. AFT edge of Windshield should be trimmed 1/32" forward of the Station 2 Vertical Tube centerline. This will allow the Door to close flush with the Windshield. Trim aft edge of Windshield Hold Down Strip to the same dimension.

9. Position the Windshield Trim Strip flush with the lower edge of the Windshield Attach and flush with the forward edge as well. Transfer drill #30. Trim AFT edge to be flush with Windshield and cleco. ***NOTE:*** *An additional hole will be located near the top of the Trim Strip after the Wing Cuffs are fit up.*

10. Remove Windshield from Fuselage. Mark Windshield Attach and Trim Strips "L" or "R" to aid in final installation. Paint as desired.

(AFTER ATTACHMENT OF WINGS)

11. 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 07-11**. ***NOTE:*** *The straight edges used should only rest about 1" on the wing.* 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.

12. It is possible that the Ribs require some minor forming to follow the contour of the wing root. The Ribs mount to the underside of each tab.

13. Position the forward end of the Outer Ribs under the Fuselage tabs on the Carry-thru.

14. Position AFT end of Outer Ribs on the outside of the aft attach tabs forward of Station 3. Align ribs straight forward and locate the outer #30 hole in the tab on the carry-thru on the rib centerline. Refer back to **FIGURE 07-02**. Transfer drill Outer Rib and Cleco.

15. Bring the ribs up to contact the straight edges.

16. Drill Outer Ribs # 30 at the aft end through the aft attach tabs (rib mounts to the outside of tab) on the side centerline of the rib. Cut Outer Ribs off just behind the aft attach tab. If aft mount tab extends above rib, then trim tab as needed.

17. The Center Rib mounts to the underside of the forward center tab and on top of the aft tab. Transfer drill Center Rib # 30 through the forward tab and cleco in place. Bring the rib up to contact the straight edges. Mark the aft end just forward of Station 3 top tube. Check, mark and cut off. Position aft end, centered on the tab, and transfer drill #30. Rivet in place.

18. Countersink rib-mounting holes in all forward tabs and rivet in place with flush rivets.

19. Burn small holes through the fabric at the locations of the 6 tabs on the aft top of Station 3. The Skylight will later be riveted to these tabs.

20. The Windshield and Skylight are joined together with two mating strips. Pre-drill the mating strips as shown in **FIGURE 07-20**. ***HINT:*** *Cleco the 2 strips together as you drill.* ***NOTE:*** *The center set of holes should be located to pick up the Center Rib, as well as the corresponding holes to the Outer Ribs.* Lay the windshield and skylight on a clean flat surface. Mate the skylight to the windshield. Center the top and bottom mating strips on the windshield and skylight seam. Use the previously drilled holes as a guide, transfer drill through the mating strips, windshield and skylight. Cleco as you go. Remove mating strips and deburr. Paint mating strips as desired.

21. Drill out all windshield and skylight #30 holes to #28. ***IMPORTANT:*** *Drill only the Windshield and Skylight. Do* ***NOT*** *drill the mating strips to #28.* Run a small bead of Silicone Seal along the holes in the mating strips and rivet the strips to the windshield and skylight. If Silicone squeezes out, do **NOT** try to clean until it has dried. ***HINT:*** *Remove only enough of the plastic protection layer to allow the Mating Strips to be installed. Be careful not to scratch the Windshield or Skylight.*

22. Squeeze the #40 rivets at the ends of the Mating Strips to flatten the extending bottom side. A rivet squeezer or Vise-Grip will work well. This will allow the rivets to set over the wing root and not chafe on the fabric.

23. Allow Silicone Seal to dry before moving assembly.

24. Cut Skylight Trim Strips to the following lengths.

Qty.	Length	Location
1	32 3/8"	Center AFT
2	29 3/16"	Outer AFT
1	15 1/2"	Center FWD
2	14 1/2"	Outer FWD

25. Layout and drill Skylight Trim Strips per **FIGURE 07-25**.

26. Place Windshield Assembly on top of fuselage ribs. Cleco into position using previously drilled holes in Carry-thru tabs. Skylight should be centered on the fuselage. Make sure Ribs are centered on holes in Mating Strip. Use a marker and draw a line, on the protective plastic, on each side of the Outer and Center Ribs. Mark aft edge of Skylight at forward side of Station 3.

27. Remove Windshield Assembly and remove plastic protective layer between the marks and aft of Station 3 mark. This will allow the rib centerlines and mounting tab holes to be seen when drilling. Be careful not to scratch the Windshield or Skylight.

28. Position AFT edge of forward Trim Strips 1/8" from forward edge of Mating Strip. Transfer drill #40 through the windshield making sure to drill on centerline of ribs. Cleco as you drill. ***HINT:*** *Tension the strips to the AFT as drilling to prevent puckering.* ***NOTE:*** *The Trim Strips will* ***NOT*** *overlap the Mating Strips.*

29. Position forward edge of AFT Trim Strips 1/8" from AFT edge of Mating Strip. Transfer drill #40 through the windshield making sure to drill on centerline of ribs. Cleco as you drill. ***HINT:*** *Tension the strips to the AFT as drilling to prevent puckering.* ***NOTE:*** *The Trim Strips will* ***NOT*** *overlap the Mating Strips.* Add an additional hole 1/4" from the aft of all AFT trim strips or trim off as done previously. ***NOTE:*** *Front edge of forward Outer Trim Strips will be captured under the Wing Cuffs and will not require a retaining rivet.*

30. Transfer drill all holes through Trim Strips to #30 and cleco.

31. Drill through Skylight at tab locations aft of Station 3. Trim aft edge to be flush with aft edge of tabs.

32. Use the third Mating Strip to fabricate an aft capture strip to attach the Skylight to the Station 3 fuselage tabs shown in **FIGURE 07-32**. Center the mating strip on the fuselage and the Station 3 tabs. The capture strip should slightly overlap beyond the aft edge of the skylight. Transfer drill #30 through tabs and cleco in place. ***HINT:*** *It is easier to locate the holes by placing the capture strip between the Skylight and fuselage, then transfer drill from the top.* Cleco Strip to top of Skylight.

33. Flap Fillet from Wing Assembly will mount to side of fuselage during final assembly and will retain the outer aft edges of the Skylight. Refer to **FIGURE 07-33**. Hold Flap Fillet against fuselage side. Mark and trim aft Capture Strip where it overlaps the Flap Fillet. If desired, locate a #40 hole on each end of Capture Strip similar to Mating Strips.

34. Remove Windshield Assembly. Drill all holes, in Lexan only, to #28 and deburr. Paint Trim Strips as desired. Make sure to mark Trim Strips as to location.

(FINAL ASSEMBLY)

35. Apply 1/2" black foam tape to the top of each rib and top of center and outer mounting tabs on carry-thru. Apply 1/2" black foam tape across top of fuselage over Station 3 tabs.

36. Install Rubber Trim along the outer edges of the skylight. Open the Trim and apply a small amount of cyanoacrylate glue (Permabond, Superglue, etc.) in the crease to retain the Trim in place. Do not glue the forward or aft ends until the wing cuffs and Flap Fillets are installed. ***IMPORTANT:*** *Only a drop of glue ever couple inches is needed. Do NOT allow glue to squeeze out beyond the Trim.*

37. Countersink the 4 forward mounting holes in the Windshield for countersunk rivets. Cleco the Windshield Assembly, Trim Strips, Hold Down Strip and Windshield Attach, in place and rivet. **I*MPORTANT:*** *Make sure to use the small brass washers to back up the rivets behind the Lexan.*

38. Apply a small fillet of clear silicon seal to the edges of the Mating Strip, Aft Capture Strip, Fuselage and Windshield/Skylight junction. ***HINT:*** *Apply masking tape flush with the edge of the metal strips. Place tape about 1/8" from the metal strips on the Lexan.* Clean Lexan and apply Silicone Seal. Form into a fillet with your finger. Refer back to **FIGURE 07-32**. ***HINT:*** *Spray finger with Formula 409® to lessen sticking of the Silicone Seal.* Remove tape and allow Silicone Seal to dry.

WING CUFF INSTALLATION

PLEASE NOTE: *Before the wing cuffs can be installed the wings and windshield must be on the plane.*

39. Trim cuffs to fit. See **FIGURE 07-39**. Before installing cuffs place a strip of masking tape on the Leading Edge Spar at least 8" long on spar centerline starting at the center of the 3/8" bolt. Mark off the tape in 1" segments from the exact center of the bolt. The tape will serve as a way of marking on the cuff where to drill for the 3/4" diameter bolt access hole. See **FIGURE 07-39**. To locate the bolt under the cuff, measure onto the cuff using the tape as a reference.

40. Hold the cuff in position. Move the cuff around to find the best fit. ***HINT:*** *Place masking tape across the windshield, aft of the cuff, as a straight reference line to make positioning the cuffs parallel to each other easier.* Tape into place.

41. Because of the springy nature of the plastic, the cuffs are a bit tricky to fit up to the windshield. ***HINT:*** *The trick is to start drilling and installing clecos from the **BOTTOM** to the top.* A total of 9 rivets are used to retain the cuff to the windshield. Locate and mark for 9 rivets, along the edge with a 1/4" edge distance.

42. Start at the bottom; drill through #40 at your marks and cleco as you go. Push firmly on the cuff to form it against the windshield as you work your way to the top. Refer back to **FIGURE 07-39** for starting hole location. Size drill all #40 holes to #30.

43. After drilling and clecoing the cuff in place, drill a #30 hole at the top and bottom locations for #8 pan head screws. Before drilling make sure the cuff is tight against the wing by pushing it firmly into the wing. Drill into the root rib on the top and bottom. The screws will self tap into the root rib, but not without an effort. ***NOTE:*** *The bottom hole will also be used to secure the Wing Root Gap Seal.* ***CAUTION:*** *Do **NOT** drill into the Wing Spar.* Be careful not to slip off the screw and punch a hole in the wing.

44. Remove the screws and clecos and drill the 3/4" for the wing bolt in the cuff. ***HINT:*** *A Uni-bit works well.* Clean up the 3/4" hole by rolling a piece of 80 grit sanding paper into a cylinder. Sand the inside of the hole smooth. Paint as desired.

45. Drill the #30 holes, in the Lexan only, to #28. Clean the windshield, cuff, and wing of any debris. Stick 1/2" Black Foam Tape to outboard edge of Wing Cuff to help seal against Wing. Cleco the cuff in place. Install the rivets and screws. ***IMPORTANT:*** *Make sure to use the small brass washers to back up the rivets.* Use extra care in placing the washers; make sure they are up against the Lexan before pulling the rivet.

46. Apply a small fillet of Silicon Seal to the edge of the cuff and windshield junction. A properly installed wing cuff will contour exactly with the wing and windshield as well as provide a watertight joint against the rain.

47. Trim forward edge of Rubber Trim on Windshield edge to aft edge of Wing Cuff. Glue in place as previously instructed.

DOOR ASSEMBLY - LEXAN AND TRIM

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. We use 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 FRAME)

1. Place 2x4 boards (1-1/2" thick) under Door Frame and check dimension of bow tube of door per **FIGURE 07A-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.

(AFTER PAINTING DOOR FRAME)

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 07A-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 07A-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 07A-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 drill to #30 and cleco.

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 07A-13**.

14. Position Upper Door Lexan on Door Frame flush with top of door frame at FWD and AFT edges. Refer to **FIGURE 07A-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 of protective layer only past the holes in the frame. Transfer drill #30 through Lexan. Cleco as you go.

15. Trim to outer edge of door frame. Mark and trim lower edge to center of door bow tube.

16. 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.*

17. 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 07A-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.*

18. 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 07A-04**. Layout holes per **FIGURE 07A-18** and debur. Re-position over Door Lexan and transfer drill into Door Frame bow tube centerline. Cleco as you drill.

19. Drill through Door Lexan at the lower bushing locations and de-bur.

20. Rivet all parts together. ***NOTE:*** *A few of the rivets will require squeezing to flatten the extending inner side.* Refer back to **FIGURE07A-17**. A rivet squeezer or Vise-Grip will work well. This will allow the rivets to set against the Fuselage tubes without chafing.

21. 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.*

22. Paint Door Assemblies as desired.

23. 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 ever couple of inches is needed.* Do **NOT** allow glue to squeeze out beyond the edging.

DOOR LATCH ASSEMBLY

Do NOT install door handles until upper and lower windows and trim strips are assembled to the door frames, otherwise the handles will fit loose and not close properly.

24. Using a tube cutter or similar cut the two door spacer bushings and axle tubes to length as shown in **FIGURE 007A-25**. Debur ends of all cuts.

25. Test fit the outer and inner handles over the axle tube. If these parts do not slide on, use emery cloth, on the axle tube, to sand until they slip on with minimum play. The inside end of the axle tube will be visible, give it a smooth finish to match the handles.

26. Compare each Roll Pin to the Door Handle they will be inserted into. Trim one end slightly, as needed, to allow Roll Pin to fit flush when installed.

27. Insert the axle tube into each inner handle, flush with the inside surface of the handle and drill #40 through each side. Final size drill to 1/8”. Insert roll pin. Press Roll Pin into the handle enough so the roll pin is evenly spaced. Refer to **FIGURE 007A-26**.

28. Cut Handle Stop Plate into 2 pieces. Rivet Handle Stop Plate to lower forward corner of Door Frame. Refer to **FIGURE 007A-27**.

29. Insert inner Door Handle with Axle Tube and Spacer Bushing through forward bushing of Door Frame. This requires drilling the Lexan and Trim Strip.

30. Bolt Door Latch to Inner Door Handle. Remember to use Loctite on the bolt. Refer to parts page detail for proper orientation.

    NOTE: The Latch is a rod that slides forward and aft to lock the aft end of the door. A small dab of light grease can aid in easier movement of the latch

    IMPORTANT: Do **NOT** over-tighten the Acorn Nut. The Latch must be able to pivot as the Door Handle rotates.

31. Slip Door Pivot Bushing over Latch and install into AFT bushing of Door Frame. This requires drilling through the Lexan and Trim strip. Washers may be added or removed later to adjust the tightness of the door seal.

32. Pin the Door Assembly in place on the Fuselage. Mark the contact locations of the Inner Door Handle onto the fuselage frame. Modify Door Latch Striker Plate per **FIGURE 007A-28**. 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.

33. Open the door and rotate the inside handle until it rests on the Stop Plate. Shut the door against the airframe with inner handle sandwiched between the door and the outside of the plane. If the plane is painted protect the finish with thin cardboard or cloth. Slip thick 3/8" washers over the axle tube and slide on the outside handle.

34. Press tight against the airframe, pushing the Outer Door Handle tight against the 3/8” washers. The Outer Door Handle should be tight with no gap.

35. Align the outer handle parallel with the 1/4" door latch rod. Refer to **FIGURE 007A-29**. Drill #40 each side, then final size 1/8" for the roll pin. Insert roll pin. The roll pin is slightly shorter, press it into the handle enough so the roll pin is evenly spaced

36. At the completion of the handle installation fill the roll pin holes with fast curing epoxy to prevent rust from forming from the roll pin.

37. 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.

38. Apply 1/2" Black Foam Tape to inside of Door Trim. The Foam Tape will aid in sealing against the Fuselage.

39. Check entire assembly for function.

HYDRAULIC DOOR LIFT INSTALLATION

40. Install a Ball Stud to the forward side of the welded gusset near the top aft edge of the Door Frame.

41. Install a Ball Stud to the forward side welded bushing on Station 3 vertical tube.

42. After the wings have been attached, pin the Door Assembly in place on the Fuselage.

43. Press end of Gas Spring over Ball Stud on 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.*

44. Press the Ball Stud on the door into the Gas Spring end. Make sure the Gas Spring is locked in place.

45. 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.

COVERING

GENERAL INFORMATION

Read this entire section before starting to cover.

The following additional supplies will be required to cover the S-20 RAVEN.

- Pinking Shears
- Regular Scissors
- Razor Blades
- Covering Irons
- Covering Thermometer
- 2" Brushes
- Containers for Glue and Solvents with lids
- Saw Horses or “A” frame pivot stands
- Methyl Ethyl Ketone (MEK)
- 1/4” double-stick tape

Buy a pair of rotary pinking shears. They will be used to cut all the patches and tapes. The rotary style is so much better than the normal scissors type “pinkers”. It is money very well spent.

Neatness and cleanliness during the covering process will reflect in the finished product. ***CAUTION:*** *Adequate ventilation is necessary.* You may want to obtain the SuperFlite Aircraft Covering Manual from SuperFlite before proceeding.

Before shrinking any fabric, calibrate your covering irons as described. A model airplane iron is also useful in shrinking up tight areas. A regular clothing iron may be used for over all shrinking. The best ones are the old Steel irons. New irons are usually made of Aluminum. They just do not have the mass to work like the old fashion irons. Look for an iron at a garage sale or second hand store, or borrow grannies.

Another problem area is curves. The fabric will want to wrinkle when being glued to a curved corner, like the ones on the tail. The SuperFlite manual points out a slick way to glue down wrinkle free corners. Refer to the manual for basic covering technique.

RANS currently uses SuperFlite U-500 glue, thinned with MEK when required. U-500 will also be used to seal fabric or glue down tapes and patches. References may be made to applying a coat of glue over the entire surface. In general, we do not recommend this, since it prevents adhesion of the base primer coat. Double coating is normally only required in areas of tapes, patches, or underlying sheet metal surfaces. This coating will prevent pinholes.

Thick & Thinned glue is referred to and is normally in the following approximate ratios.

Thick = 3 parts glue : 1 part MEK

Thinned = 1 part glue : 3 parts MEK

Throughout this section, we will be referring to “sizing material”. Sizing material is U-500 adhesive thinned to water like consistency. Keep a container of sizing material handy and apply it to the fabric wherever a cut is to be made. Allow the sizing material to dry before making the cut. This will keep the fabric from fraying and aid in cutting straight.

Patches will have to be applied on top of the fabric as reinforcement or on top of Lexan Reinforcement Rings for exits, Inspection Plates, or drainage holes. The outline of the patches will still be visible after painting. If you want it to look good, then here is how to do it. Use a straight edge or a round template and a soft pencil to mark the outline of the patch on the fabric. Use sizing material and a soft brush to size along the cut line. Let dry and cut the patch out using a pinking sheers. Wherever a cut must be made inside the patch, size and than cut using a razor blade. ***NOTE:*** *Most cuts inside Inspection Rings, Exits and drainage holes should be done after painting.*

To gain experience, cover a Tail Surface first.

IMPORTANT: *However, cut 4 lengths of fabric 6” longer than the Wings. This will assure enough material for the Wings.*

Most all of the covering techniques are used in the tail. The experience gained will greatly enhance the rest of the job. There is enough fabric for at least one mistake. So, if a tail feather is not right, try again. Work toward perfection and neatness. Take your time; a good job is easy to live with. A bad job...you will spend more time making excuses than it would have taken to do right!

WINGS

1. Clean the entire frame thoroughly. Blow out all Ribs and Wing Spars to remove metal shavings.
2. Scotch-Brite all sheet metal surfaces and clean with Acetone.
3. Cut out the 2 formed Bolt Covers to lay flat against the Leading Edge Spar and to cover the 3 FWD Strut Attach Plate Bolts. Glue on Bolt Covers.
4. Apply anti-chafe tape around sharp edges (masking tape). Refer to **FIGURE 08A-04.**
5. Apply one coat of thinned U-500 to the sheet metal using a soft wide brush, let dry. The thinned U-500 applied to the metal under surfaces helps prevent pin-holing in the paint finish. Make sure to remove brush hairs from the surface if necessary.
6. Perform pre-covering check using the following items.

- ❒ Assembly completed as per parts manual
- ❒ Aileron cables installed
- ❒ Flap Teleflex Cable installed
- ❒ Fuel lines installed
- ❒ Fuel system leak tested
- ❒ Pitot and static lines installed (left wing only)
- ❒ All nut plates for Flap Hinges installed
- ❒ Jury Strut Attach Bracket installed
- ❒ Strobe wiring installed (optional)
- ❒ Anti-chafe tape installed around sharp edges of sheet metal
- ❒ Anti-chafe (Longeron Fairing material) installed to Drag Brace
- ❒ Bolt cover glued over the 3 FWD Strut Attach Plate Bolts

7. Position the Wing top side up on sawhorses or other suitable work surface. ***HINT:*** *RANS uses two "A" frame stands with pivots so the Wing can rotate and be locked in any position.* You may consider purchasing or building such a device. Contact the factory for information. If you are using such a stand, it is acceptable to drill a 1/4" diameter hole through the Tip Bow for a pivot pin.

8. With the Wing topside up and level, roll out and cut the top layer of fabric so that it extends approximately 3" on each end of the Wing. Pull as much of the fabric to the Trailing Edge of the Wing as possible leaving enough fabric on the Leading Edge to wrap around the Spar.
9. Trim off the excess fabric leaving enough fabric to wrap around the Trailing Edge Spar. Save these scraps, they will be used to cover smaller parts.
10. Refer to the SuperFlite covering manual and mix up a quantity of adhesive.
11. Bond the fabric along the AFT side of the Trailing Edge Spar (about 11/2" bonding area is enough at this time.
12. Bond the fabric to the forward face of the Leading Edge Spar (about 2'' wide at this time). Pull light tension into the fabric as you go.
13. Bond the fabric around the Tip Bow and the upper Root Rib, pulling in light tension.
14. Iron the surface only enough to take out large wrinkles. You do **NOT** want tension at this time.
15. Glue down the fabric on top of the Fuel Tank Cover (sheet metal) and the Leading Edge Wrap (sheet metal). Apply thin glue with a brush through the fabric surface.
16. Turn the wing bottom side is up.
17. Mark the trim line along the fabric perimeter with a soft pencil, size with thin glue along the trim line and cut using a sharp scissor. Refer to **FIGURE 08A-17** and **08A-17A**.
18. Glue down the extending fabric around the Leading Edge, Trailing Edge, Tip Bow, and Root Rib.
19. Iron out any wrinkles or puckers in the bond area and iron down all edges.
20. Iron the top side to pre-tension the fabric. ***CAUTION:*** *Do not bring the top skin to final tension until the bottom skin has been pre-tensioned.*
21. With the top fabric pre-tensioned, position the wing bottom side up.
22. Roll out and cut the bottom layer of fabric.
23. Following the same procedure as before, bond the bottom fabric to the Wing Frame and pre-tension. Refer back to **FIGURE 08A-17** and **08A-17A** for trimming the lower fabric.
24. Size and cut the fabric around the Lift Strut Attach Plates, and Jury Strut Bracket.
25. Thoroughly iron the entire Wing surface to final tension the top and bottom fabric.

26. The fabric will need to be riveted under reinforcement Cover Straps to the center of each rib. Refer to **FIGURES 08A-26** thru **08A-26C** for details about riveting. ***NOTE:*** *The top Cover Straps stop at the backside of the Leading Edge Skin. The bottom Cover Straps extend the full length.*

27. The Cover Straps should extend a minimum of 1/4” past the first and last rivet. Cut the supplied Cover Straps to length and remove the protective plastic covering.

28. Apply small clear double-stick tape on top of the fabric centered along the holes in each rib and extending 1/4” past the first and last hole. Remove the protective paper on top of the double-stick tape and glue on the Cover Strap. Make sure the Cover Strap is centered over the holes in the ribs.

29. Use a hot knife with a pointed tip or a soldering iron and melt through the Cover Strap and the fabric into the Rib holes.

30. Cut the melted build up on top of the Cover Straps off using a razor blade.

31. Insert a Rivet in each hole and rivet.

32. Scuff up the surface of the 2 Strut Attach Plate Exits and the Jury Strut Bracket Exit per wing and glue over the corresponding parts.

33. Layout and mark the Inspection Rings, Flap Teleflex Exit, Aileron Hinge Exit Rings, and Aileron Push-Pull Tube Exit locations as shown in **FIGURES 08A-33** and **08A-33A**. Modify The Aileron Hinge Exit Rings per **FIGURE 08A-33B**.

34. Bond the Inspection and Exit Rings to the fabric in there respective locations.

35. Glue on the 2 drain grommets as per **FIGURE 08A-33**.

36. Using a pinking shear cut out fabric patches as per **FIGURE 08A-33** and glue over the top of the corresponding parts.

37. Cut to length and glue the 2" and 4" surface tape in place. Refer to **FIGURES 08A-33 and 08A-37** and the following text.

- TOP RIBS - 2" tape - centered on each Rib starting flush with the AFT edge of the Leading Edge Wrap and ending on AFT centerline of the Trailing Edge Spar.
- BOTTOM RIBS - 2" tape - centered on each Rib starting at the FWD centerline of the Leading Edge Spar and ending on AFT centerline of the Trailing Edge Spar, flush with the top Rib Tape.
- LEADING EDGE WRAP - 2" tape - glue span-wise from Root Rib to Tip Rib centered on the AFT edge of the Leading Edge Wrap.
- TOP & BOTTOM ROOT RIB - 2" tape - centered on Rib, wrapping around to the interior side starting at the FWD centerline of the Leading Edge Spar and ending on AFT centerline of the Trailing Edge Spar.
- TOP & BOTTOM TIP RIB - 2" tape - centered on Rib starting at FWD centerline of Tip Bow and ending on AFT centerline of the Tip Bow.
- TRAILING EDGE SPAR & TIP BOW - 2" tape - centered on AFT centerline of the Trailing Edge Spar, over lapping the lower fabric seam by 1/4", starting flush with the root end of the Spar and ending at the Tip Wrap on the FWD edge of the Tip Bow.
- LEADING EDGE SPAR - 4" tape - centered on the FWD centerline of the Leading Edge Spar, starting flush with the root end and ending by tapering the tape down to 2" through the Tip Wrap flush with the 2" Tip Bow tape.

38. Use an iron to shrink out any wrinkles or puckers in the surface tape and patches. ***IMPORTANT:*** *Do not apply heat to the full width of the tape as tape distortion will occur.* Heat the edges or the center allowing one to cool before heating the other. Use the iron to smooth and bond all pinked edges on the tape and patches.

39. Coat all surface tape and patches with thinned U-500 adhesive, concentrating on dry spots and flowing the glue into the pinked edges. ***IMPORTANT:*** *Do* ***NOT*** *apply glue beyond the pinked edges. The edge of the glue will be seen after painting.*

AILERONS AND FLAPS

1. Use a light hammer and form AFT ends of ribs to follow contour of trailing edge spar.
2. Clean the entire frame thoroughly with Acetone or similar.
3. Apply Anti-Chafe tape around sharp edges of ribs (masking tape) as shown in **FIGURE 08B-03**.
4. Perform pre-covering check using the following items.

   ❒ Nut plates for hinge points (Flap) installed.

   ❒ Anti-Chafe tape applied around sharp edges of ribs.

5. Cut 2 pieces of fabric large enough to fit each frame as shown in **FIGURE 08B-05**.
6. ***NOTE:*** *The bottom fabric is glued around the Leading Edge Spar, wrapped around and glued to the Trailing Edge Spar. The top fabric is glued to the fabric at the Leading Edge Spar and then glued to the fabric at the Trailing Edge Spar. Refer to* ***FIGURE 08B-05****.*
7. The fabric should extend past both ends of frames about 2”.
8. Glue bottom fabric to Leading Edge Spar, (cut out to clear ribs) let dry and iron edges down. Wrap around Trailing Edge and glue, (cut out to clear ribs) let dry and iron edges down.
9. Glue top fabric to Leading Edge and wrap under Trailing Edge and glue. Refer to **FIGURE 08B-05**.
10. Cut and glue fabric around both ends of frames (overlap fabric).
11. Let dry and final iron entire surface for tightening of fabric.
12. Apply Drain Grommets and Aileron Exit Rings (to the bottom side), patches, and tapes (in this order). Modify the Hinge Exit Covers and Rings per **FIGURE 08B-12**.
13. Refer to **FIGURE 08B-13** for Ailerons.
14. Refer to **FIGURE 08B-14** for Flaps.
15. Iron along tapes and iron down tape edges.
16. The Ailerons and Flaps are now ready for primer and paint.

FUSELAGE

1. Clean the entire frame thoroughly.
2. Apply anti-chafe tape (masking tape) around sharp edges of vertical stabilizer rib.
3. Perform pre-covering check using the following items.
   - ❒ Top former installed
   - ❒ 1/2" center side former installed
   - ❒ 1/4" lower side former installed
   - ❒ 1/4" belly formers installed (3)
   - ❒ Baggage Window Frames installed
   - ❒ Rib - vertical stabilizer installed
   - ❒ Anti-Chafe tape applied around sharp edges of vertical stab rib
   - ❒ Floorboards fit and drilled (remove floorboard after drilling)
   - ❒ Floorboard attach tabs received nut plates
   - ❒ Rudder pedal attach tabs received nut plates
   - ❒ Control Stick attach tabs received nut plates
   - ❒ Rudder pulleys at Station 7 installed
   - ❒ Rudder Cables routed through pulleys at Station 7
   - ❒ Forward ends of Rudder Cables placed in plastic bag at Station 3
   - ❒ ELT antenna mount plate installed
   - ❒ Communication antenna mount plate installed
   - ❒ ELT mount tabs drilled to #11
   - ❒ AFT Baggage Compartment fit-up and removed
   - ❒ Anti-chafe tape applied to Aft Baggage mount tubes
   - ❒ Forward Baggage Compartment fit-up and removed
   - ❒ Black Foam Tape applied to Station 4 diagonal tube
   - ❒ Header Tank mounts installed
   - ❒ Seat Slide buttons and Stop installed to bottom of inboard seat mount rails
   - ❒ Seat Belt bushings drilled to 5/16"
   - ❒ Elevator trim servo wire installed and taped off at Stations 3 & 7

4. Position the fuselage bottom side up.
5. Roll out and cut a piece of fabric long enough to cover the bottom of the fuselage. Slide the fabric to one side of the fuselage and trim off the excess material. Leave approximately 5" of material on all sides.
6. Secure the fabric to the longerons using cloth pins.
7. Bond one side of the fabric to the bottom longeron from Station 2 to Station 8. ***IMPORTANT:*** *Apply adhesive to the longeron in the bond area only to prevent dips or puckers in the fabric.* See **FIGURE 08C-07** for details.
8. Bond the opposite side to the bottom longeron.
9. Bond the fabric at station 2 around the bottom cross tube.
10. Wrap and glue all fabric to the interior side of the fuselage and trim. Refer to **FIGURE 08C-07**.
11. Let dry and iron out all wrinkles and puckers along the bond area. Iron the surface only enough to take wrinkles out.
12. Position the fuselage left side is up. Roll out and cut the fabric to length. The fabric panel has to cover the entire left side from the bottom to the Top Former (top center of fuselage) including the left side of the vertical stabilizer. Trim off the excess fabric.
13. Bond the fabric to the bottom Longeron. Trim the fabric as shown in **FIGURE 08C-07**. Cover over the Baggage Window openings. Special instructions will follow on how to finish this area.
14. Bond the remaining perimeter of the fabric around the forward fuselage tubes, the Top Former, vertical stabilizer - leading edge, - top and – trailing edge spar.
15. Trim excess fabric off.
16. Let dry and iron out all wrinkles in the bond area.
17. Cut the fabric in the Baggage Window area, wrap to the inside, and glue in place. ***NOTE:*** *Darts ("V' cuts) will need to be cut in the fabric to allow wrapping in the curve areas.*
18. Pre-tension the fabric, only enough to remove bagginess. ***CAUTION:*** *Use care when pre-tensioning, it is possible to pull the Vertical Stabilizer and Top Stringer out of alignment.*
19. Rotate the fuselage to the opposite side and cover following the same procedure. When covering the second side of the fuselage it will be necessary to use a 1-1/2” flat lap joint along the Top Stringer from station 3 to station 7.
20. Let dry, and iron the fabric along all the frame tubes and iron all the fabric edges down.

21. Pre-iron the fabric all the way around to remove wrinkles and to pre-tension the fabric.

22. "Size" the fabric around the Horizontal Stabilizer bushings using thinned glue. Let dry and cut to allow the fabric to slip over the bushings.

23. Final tension the bottom and both sides evenly. Use care when applying heat to the flat lap joint area as heat will soften the adhesive and the bond may separate.

24. Rivet a Lexan Cover Strap over the center of the Vertical Stabilizer Rib. Refer to **WING COVERING - FIGURES 08A-26A** thru **08A-26C** for details about riveting.

25. The Lexan Cover Straps should extend a minimum of 1/4" past the first and last rivet. Cut the supplied Lexan Cover Straps to length. Apply the small clear double-stick tape on top of the fabric centered along each rib and extending 1/4" past the first and last hole. Remove the protective paper on top of the double stick tape and glue on the Cover Strap. Make sure the Strap is centered over the holes in the ribs.

26. Use a hot knife with a pointed tip or a soldering iron and melt through the cover strap and the fabric into the rib holes.

27. Cut the melted build up, on top of the Lexan straps, off using a razor blade.

28. Insert a rivet in each hole and rivet.

29. Bond all exit rings, inspection ring, and rudder cable exits in place as follows.

30. A template is used to locate the elevator yoke exit rings (both sides of fuselage). Fabricate template by gluing together the parts of **FIGURES 08C-30** thru **08C-30C**. HINT: You may want to make copies of the pages just in case. Mark the ring location, scuff surface of rings and glue to fabric.

31. Cut out the Rudder Cable Exit Fairings from supplied sheet and cut out aft opening for rudder cable in fairing. Be sure to leave a flange to bond to fuselage skin. Mark location as per template. Scuff surface of fairing and glue directly to fabric (both sides of fuselage). ***IMPORTANT:*** *Left and Right Rudder Cable Exit Fairings are located in different positions on the fuselage.*

32. Mark location per template on left side of fuselage for the Inspection Ring. Scuff surface of ring and glue to fabric.

33. Mark locations, scuff surface and glue on inspection rings, drain grommets and the 2" ring at the fuel drain location. Refer to **FIGURES 08C-33** thru **08C-33B** for guidance.

34. Apply all patches and surface tapes (in this order) as per **FIGURES 08C-33** thru **08C-33B,** and **08C-34**. ***NOTE:*** *All exit rings, reinforcement rings, drain grommets; the rudder cable exit fairing, and the vertical stabilizer rib receive a fabric patch on top.*

35. Iron all surface tapes and patches, concentrating on the pinked edges. Use care not to distort the tape or patches. Apply one coat of thinned U-500 to all patches and surface tapes.

HORIZONTAL STABILIZERS

1. Clean the entire frame thoroughly.
2. Add anti-chafe tape (masking tape) around sharp edges of ribs similar to Flaps, Ailerons and Vertical Stabilizer.
3. Perform pre-covering check using the following items.
   - ❒ Stabilizer frame is primed.
   - ❒ Ribs installed
   - ❒ Anti-chafe tape applied to sharp edges of ribs

NOTE: *Each side of the horizontal stabilizers is covered with a separate piece of fabric.*

4. Cut fabric large enough to fit the frame and with enough excess to allow gluing all the way around the frame tubes.
5. It does not matter which side you apply first. ***NOTE:*** *It is recommended to apply the fabric to the bottom side first. That will make a smoother finish on the topside.*
6. Glue fabric (first side) all the way around the frame tubes well past the centerline of the tubes as shown in **FIGURE 08D-06**. Cut the fabric in the corners, around the stabilizer - attach bushings.
7. Let dry and iron all fabric edges down.
8. Pre-iron the fabric surface only enough to take wrinkles out.
9. Glue fabric (second side) all the way around the frame tubes and past the centerline as shown in **FIGURE 08D-06.**
10. Let dry and pre-iron the surface only enough to take wrinkles out.
11. Let dry and final iron entire surface for tightening of fabric.
12. The fabric will also need to be riveted under Lexan Cover Strips to the center of each rib. Refer to **WING COVERING - FIGURES 08A-26A** thru **08A-26C** for details about riveting.
13. The Lexan Cover Straps should extend a minimum of 1/4” past the first and last rivet. Cut the supplied Straps to length. Apply the small clear double stick tape on top of the fabric centered along each rib and extending 1/4” past the first and last hole. Remove the protective paper on top of the double stick tape and glue on the Lexan strap. Make sure the strap is centered over the holes in the ribs.

14. Use a hot knife with a pointed tip or a soldering iron and melt through the cover strap and the fabric into the rib holes.

15. Cut the melted build up on top of the Lexan straps off using a razor blade.

16. Insert a rivet in each hole and rivet.

17. Apply drain grommets (to the bottom side), patches, and tapes (in this order). Refer to **FIGURE 08D-17**. ***NOTE:*** *Only the right horizontal stabilizer receives a seaplane grommet on the bottom side.* The opening must face AFT. The trim wiring will exit through the grommet.

18. Iron all surface tapes and patches, concentrating on the pinked edges. Use care not to distort the tape or patches. Apply one coat of thinned U-500 to all patches and surface tapes.

RUDDER

1. Clean the entire frame thoroughly.
2. Perform pre-covering check using the following items.
   - ❒ Hinge stop collars set and riveted.
   - ❒ Rudder frame primed.

NOTE: *Each side of the rudder is covered with a separate piece of fabric.*

3. Cut fabric large enough to fit the frame and with enough excess to allow gluing around the frame tubes all the way around.
4. It does not matter which side you apply first.
5. Glue fabric (first side) all the way around the frame tubes well past the centerline of the tubes. Refer back to **FIGURE 08D-06**. You have to cut the fabric in the corners and around the moving part of the hinge.
6. Let dry and iron all fabric edges down.
7. Pre-iron the fabric surface only enough to take wrinkles out.
8. Glue fabric (second side) all the way around the frame tubes and past the centerline as shown in **FIGURE 08D-06**.
9. Let dry and pre-iron the surface only enough to take wrinkles out. Let dry and final iron entire surface for tightening of fabric.
10. Modify Rudder / Elevator Hinge Reinforcement per **FIGURE 08E-10**.
11. The rudder uses a small piece of .020 Lexan as reinforcement on the bottom forward end on both sides. Fabricate 2 from raw stock according to **FIGURE 08E-11**. Glue reinforcements on.
12. The fabric will also need to be stitched with a single stitch to the center of each rib. Refer to **FIGURES 08E-12** and **08E-12A** for details about stitching.
13. Apply reinforcements, patches and tapes (in this order). Refer to **FIGURES 08E-12** and **08E-12A**.
14. Iron all surface tapes and patches, concentrating on the pinked edges. Use care not to distort the tape or patches. Apply one coat of thinned glue to all patches and surface tapes.

ELEVATOR

1. Clean the entire frame thoroughly.
2. Perform pre-covering check using the following items.
   - ❒ Hinge stop collars set and riveted.
   - ❒ Balance weight mount holes drilled and tapped
   - ❒ Elevator frames primed
   - ❒ Second control horn holes drilled
   - ❒ Nut plates for control horns attached

NOTE: *Each side of the elevators is covered with a separate piece of fabric.*

3. Cut fabric large enough to fit the frame and with enough excess to allow gluing around the frame tubes all the way around.
4. It does not matter which side you apply first. ***NOTE:*** *It is recommended to apply the fabric to the bottom side first. That will make a smoother finish on the topside.*
5. Glue fabric (first side) all the way around the frame tubes well past the centerline of the tubes. Refer back to **FIGURE 08D-06**. You have to cut the fabric in the corners, around the moving part of the hinge and the trim tab attach.
6. Let dry and iron all fabric edges down.
7. Pre-iron the fabric surface only enough to take wrinkles out.
8. Glue fabric (second side) all the way around the frame tubes and past the centerline as shown in **FIGURE 08D-06.**
9. Let dry and pre-iron the surface only enough to take wrinkles out.
10. Let dry and final iron entire surface for tightening of fabric.
11. The fabric will also need to be stitched with a single stitch to the center of each rib. Refer back to **FIGURE 08E-12B** for details about stitching.
12. ***NOTE:*** *On the right elevator inboard stitch only, the top surface is stitched to the frame (the trim exit ring goes on the bottom side).*
13. Glue drain grommet to the bottom inboard side of each elevator.
14. Scuff surface of trim exit ring and glue on as per **FIGURE 08F-14** on bottom side of right elevator.
15. Apply reinforcements, patches and tapes in this order as per **FIGURE 08F-14**.

16. Iron all surface tapes and patches, concentrating on the pinked edges. Use care not to distort the tape or patches. Apply one coat of thinned adhesive to all patches and surface tapes.

SEAT BELT INSTALLATION

(AFTER PRIMING OF FUSELAGE FRAME/ BEFORE COVERING)

1. Prior to covering drill the welded attach bushings to 5/16". Refer to the parts drawing for attach bushing locations.

(AFTER COVERING AND PAINT 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 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

OPTIONS - AVEO STROBE INSTALLATION

(BEFORE COVERING OF WINGS)

NOTE: *Installation may also be done on covered wings.*

Mini-Molex Connectors (or similar) at the Wing Tip and Fuselage can make connecting much easier.

AVEO Strobes use only 12 Volts and do not require High-Voltage wires or Power Boxes.

1. Install grommets in Tip Rib. ***NOTE:*** *Tip Rib was previously drilled for the grommets.*
2. Route wires through root end of Trailing Edge Spar, through grommet in Tip Rib and out to Wing Tip Bow. Tape wires, for covering, to the inboard side of the Wing Tip Bow, approximately 13" aft of the leading edge. Be certain to leave enough length to work with while wiring.
3. Position the Strobe Mount Plates centered inside the flat area of the Wing Tip. Be sure the Strobe will be straight when mounted. Transfer drill #40 and cleco the Mount Plate to the Wing Tip. Refer to **PARTS PAGES Section 05F - Wing Tip Assembly.**
4. Use a Dremel tool to remove the Wing Tip material inside the Mount Plate for the wires. ***NOTE:*** *Use the Dremel tool as a router to obtain a clean opening.*
5. Rivet Light Mount to Wing Tip with the Nut Plate rivets.

(AFTER PAINTING OF WING AND PRE-INSTALLATION OF WING TIPS)

6. Cut out the 4" inspection panel in outer wing skin. Pull wires taped to inside of tip bow through inspection hole.
7. Mount Strobes to Wing Tip and connect wiring.

(AFTER ATTACHMENT OF WINGS TO FUSELAGE)

8. Route wires into fuselage and down aft of Station 3. Connect wires per parts drawing and manufacturer's instructions.
9. Check Strobe and NAV lights for proper operation.

OPTIONS - LANDING LIGHT INSTALLATION

NOTE: *Landing Light used may vary. The mounting shown is one potential mounting method.*

Mini-Molex Connectors (or similar) at the Landing Light will make disconnecting for Cowling removal much easier.

(AFTER COWLING FIT-UP AND ENGINE INSTALLATION)

1. Position Landing Light Bracket under Cowling inlet lip and transfer drill #11. Refer to **PARTS PAGES**. Be sure to allow space between Landing Light and Muffler Heater Inlet Tube.
2. Bolt Landing Light in place. Adjust bracket as needed for alignment.
3. Route wires to avoid high heat. Connect to switch and ground Buss Bar.
4. Check for proper operation.

OPTIONS - PASSENGER SEAT ELECTRIC ELEVATOR TRIM

1. Route Trim and Push to talk wires through drilled hole in base of passenger side Control Stick. Refer to **SECTION 2 - CONTROL STICK ASSEMBLY**.
2. Install Mac Control Stick Grip per manufacturer's instructions.
3. Secure Servo Relay Deck and install per manufacturer's instructions.

OPTIONS - TIE DOWN SHACKLE INSTALLATION

The Tie Down Shackles are designed to accept chain or rope without marring the Lift Struts.

NOTE: *Shackle may be installed during initial build or anytime after.*

Refer to **LIFT STRUT ASSEMBLY & INSTALLATION**.

1. Support outboard end of wing.
2. Remove bolt retaining upper end of FWD Lift Strut Assembly to Strut Attach Plate of Wing.
3. Slip Shackle over Forward Lift Strut Connector.
4. Align holes and re-install bolt without washers.
5. Remove support from wing.

OPTIONS - COVER / PAINT STANDS

Optional Cover / Paint Stands may be purchased from RANS Parts Department or fabricate your own from the plans provided in the **FIGURES MANUAL**. Refer to **PARTS MANUAL** for assembly and required hardware. Below is a list of the provided drawings.

KP-100	A-FRAME STAND
KP-101	FWD FUSELAGE ATTACH
KP-103	WING ROOT ATTACH
KP-107	"T" LOCK HANDLE
KP-108	PAINT STAND FOR FLAPS / AILERONS
KP-109	PAINT STAND FOR HORIZONTAL STABILIZER
KP-112	AFT FUSELAGE ATTACH
KP-117	WING TIP PIVOT
KP-118	AILERON ATTACH
KP-119	ELEVATOR ROOT ATTACH
KP-120	ELEVATOR OUTER ATTACH
KP-121	UPPER RUDDER SUPPORT TUBE
KP-121	LOWER RUDDER SUPPORT

OPTIONS - 26" ALASKAN WHEEL ASSEMBLY AND INSTALLATION

NOTE: *Refer to* ***Taildragger - Main Gear Assembly*** *for complete installation.*

26" ALASKAN WHEEL INSTALLATION

1. Disassemble rims from Wheel Assembly.
2. Install Rubber Grommet into valve stem hole in outer wheel rim.
3. Apply adhesive to Grommet Plug and install to outside of Rubber Grommet. This will form a plug to seal the valve stem hole to prevent foreign matter from entering.

OPTIONS - 10" PNEUMATIC TAIL WHEEL ASSEMBLY AND INSTALLATION

NOTE: *Refer to* ***Tail Wheel Assembly*** *for complete installation.*

10" TAIL WHEEL INSTALLATION

1. Transfer drill Mount Block of Tail Wheel Assembly to 3/8" to match Tail Spring.
2. Transfer drill arms of Tail Wheel Assembly to 1/4" for Eyebolts.
3. Bolt the Tail Spring to the Tail Wheel Assembly. Refer to the parts drawing. ***NOTE:*** *It may be necessary to lightly file or grind the Tail Spring to fit within the Mount Block.*
4. Refer to **Tail Wheel Assembly** for installation of tail spring and control linkages. ***NOTE:*** *Steer Springs should be compressed about 1/3 of full length for 10" Tail Wheel installation.*
5. The Tail Wheel is full swivel. This allows pivot turns using brakes or full rudder deflection. A geometric release mechanism allows it to engage for steering.
6. If the Tail Wheel leans, shim the Tail Wheel Assembly to run vertical.

RIGGING AND PREPARATION FOR FLIGHT

OK, you have built an airplane. It is sitting on the hanger floor before you in all of its majestic glory. What next? At this point, you need to ignore your enthusiasm and slow down. If you set yourself a date for the first flight, forget about it. This is the most critical part of your project. Mistakes and skipped steps here can be both costly and fatal.

ELEVATOR MASS BALANCE

The **ELEVATORS** must be a 100% static mass balanced in reference to the surface hinge line.

Balance each surface separately, before mounting to the airplane.

At the time of balancing the surface and attachments must be completely assembled and painted (ready for mounting).

Balance is achieved through the attachment of external Lead weights.

NOTE: *Lead sheet is* ***NOT*** *provided in the kit.*

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.

(AFTER PAINTING AND ASSEMBLY. BEFORE FINAL MOUNTING)

1. The Elevator must be completely assembled and painted.
2. The Elevator Horns, Trim Servo including push rod, wires, Trim Tab, and Trim Exit Cover with screws must be installed.
3. Refer to **FIGURE 11-03**. Use a flat and level surface and two angles. Lay the elevator on the angles as shown. The “sharp edge” of the angle should be up.
4. Obtain 1/4” Lead plate and fabricate three weights as shown in **FIGURE 11-04**. ***NOTE:*** *The weights will need modification later to achieve final balance.* The right Elevator will require more weight than the left because of the Trim Servo. ***HINT:*** *Thinner Lead Plate may also be used, but will require more layers.*
5. Bolt the weight in place and check the balance. Modify the weight by cutting it down until level balance is achieved.
6. Final attach weight.
7. Repeat for other Elevator.
8. Install Elevator. Refer to **HORIZONTAL STABILIZER AND ELEVATOR ASSEMBLY AND INSTALLATION**.

WINGS

WING WASHOUT RIGGING

(AFTER WING INSTALLATION)

NOTE: *Washout is set after the Wings and Struts are installed.*

Washout is set by adjusting the lower rear strut fitting (rod end).

A Digital Level can simplify rigging procedures.

CAUTION

The Rod End must be screwed into the strut fitting a

minimum of 10 complete turns.

1. Fabricate a rigging level as per **FIGURE 011A-01**. Use a straight board or angle (a straight 2x4 will work). Fabricate three 1/4" thick shims as shown and attach two 1/4" thick shims to the rigging level.
2. Air up the tires to high pressure and set the brakes, or better yet remove main wheels and place axles on wooden blocks. The aircraft must be rigid.
3. On taildragger models, raise the tail of the airplane by placing the Tail Wheel on a sawhorse or other support until the wing root is level. On trike models, raise of lower the nosewheel. Use the fabricated level placed with the 1/4" shims on the bottom of the leading and trailing edge spar to measure. Adjust until level reading is obtained.
4. Do **NOT** move aircraft.
5. Tape an additional 1/4" shim to the level as shown in **FIGURE 11A-01.** Place level just outboard of the Lift Strut Attach Plates with the two 1/4" shims under the trailing edge spar. Adjust Rod End in lower end of AFT Lift Strut until level reading is obtained. ***CAUTION:*** *The Rod End must be screwed into the strut fitting a minimum of 10 complete turns.*
6. Repeat for the other side. ***NOTE:*** *Only one wing root is used as reference. Do* ***NOT*** *adjust airplane to level on other wing root.*
7. Tighten all connections and check.

AILERON RIGGING

Neutral position and cable tension

(AFTER WING INSTALLATION/ AFTER SETTING OF WASHOUT)

8. Center forward control stick in neutral position (aileron neutral) and securely fix in this position.
9. Adjust the turnbuckles to set the aileron bell cranks to neutral position as shown in **FIGURE 11A-09**. With the stick centered and the bell cranks in neutral position, the cables should be tight.
10. 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 11A-09** for tension information.
11. 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 aileron half span. The trailing edge of the aileron should rest on the shim (level with lower surface of both spars).
12. With the control sticks and bell cranks neutral, install the short aileron push-pull tube. ***CAUTION:*** *Rod Ends must be turned into the push pull tube at least 10 complete turns.*
13. Tighten all connections and check.

Deflections

14. For deflection measurements, center control stick for neutral position, move and hold control stick against stop and measure.
15. 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.
16. 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: 33° (Tolerance is +2.0° / -1.0°)
    - Down: 30° (Tolerance is +2.0° / -1.0°)

Surface clearance

17. 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

18. 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.

FLAP RIGGING

Neutral position

(AFTER WING INSTALLATION/ AFTER SETTING OF WASHOUT)

19. Place flap handle in flaps retracted position.

20. 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.*

21. Adjust the female rod end on the flap cable as required for neutral flap position. ***CAUTION:*** *Minimum thread engagement is 10 full turns.*

Deflections

22. 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: 49° (Tolerance is +2.0° / -2.0°)

Surface clearance

23. Refer back to **FIGURE 05F-04**

- The minimum clearance between surface and gap seal is 0.060”.
- The minimum clearance between flap and aileron is 0.2”.

Operational check

24. 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.

TAIL SURFACES

TAIL ALIGNMENT AND ROD TENSION

1. Rotating the brace rod in the tie rod ends sets the tail brace rod tension. Rods and rod ends are left and right hand threaded to allow that.
2. The tension in the rods can cause the tail to warp or to get out of alignment.
3. Perform the following checks after the tail brace rods are tensioned.

    - Check alignment of vertical and both horizontal stabilizers in reference to wing carry through (upper member fuselage frame/ forward wing attach). Take measurements at rear spar of horizontal stabilizers and approximate half span. The misalignment should be no more than ±0.5°.
    - Check both horizontal stabilizers for twist. Take measurements inboard at root and outboard of tail brace rod attach. Use straight edge across surface. Maximum allowable twist is +/- 0.5°.
    - Check vertical stabilizer for twist (optical).
    - Adjust rod tension by feel.
    - Check thread engagement of rod in tie rod ends. Rod should penetrate tie rod end past the check hole. Use a piece of wire for checking.

ELEVATOR

Neutral position

4. In neutral position, the elevators are level with the horizontal stabilizer. Verify using a straight edge across the surface with a 3/16" shim at the elevator trailing edge.
5. It is possible to adjust at the connection of the elevator horns to the elevator yoke tube (rod ends).

CAUTION

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

Deflections

6. Determine neutral position of elevator as reference for deflection measurement. Use a straight edge across horizontal stabilizer and elevator with 3/16” shim at elevator trailing edge for neutral position determination.
7. 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 elevators at approximately half span.
   - Up: 28° (Tolerance is +3.0° / -0.0°)
   - Down: 20° (Tolerance is +3.0° / -0.0°)
8. If adjustment is needed adjust the Rod Ends at the connection of the elevator horns or Control Stick Torque Tube rod ends. A minimum of 10 full turns thread engagement must be assured.

Surface clearance

9. 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

10. Both elevators must be 100% static balanced in reference to the hinge line.

11. For instructions, refer to Section 11 - **ELEVATOR MASS BALANCE**.

Operational check

12. 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

13. The elevator trim tab is operated by an electric servo.

Deflections

14. Measure deflection on top of trim tab at push rod attach.
    - Up: 30° (Tolerance is +3.0° / -3.0°)
    - Down: 25° (Tolerance is +3.0° / -3.0°)

Surface clearance

15. The minimum gap between trim tab and elevator is 0.060” all the way.

Indicator position

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

Operational check

17. 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

18. Verify neutral position of rudder with rudder pedals neutral (visual).

19. Cable tension should be a minimum of 15 lbs. measured on both cables under seats. If no cable tension meter is available, adjust by feel.

Deflections

20. 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 +3.0° / -0.0°)
- Right: 28° (Tolerance is +3.0° / -0.0°)

Surface clearance

21. The minimum gap between rudder and vertical stabilizer is 0.060” all the way.

22. The minimum gap between rudder and tip of vertical stabilizer is 1/8”.

Operational check

23. 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.

CONTROLS

CABIN HEAT

1. Check cabin heat valve is full “closed” with control knob in “OFF” position and full “open” with control knob in “ON” position. Adjust at cable retaining ferrule.
2. Adjust the friction adjustment to provide enough friction on the cable to keep it from moving unintentionally.

PARK BRAKE

3. Check parking brake valve is full open (down) with control knob in “OFF” position and full closed (up) with control knob in “ON” position. ***NOTE:*** *The parking brake valve works as a “one-way” valve when “ON”.* If this is not the case, adjust by loosening the swivel stop for adjustment at the control arm.
4. Adjust the friction adjustment to provide enough friction on the cable to keep it from moving unintentionally. Refer to **FIGURE 11C-04** for location of adjustment points.

THROTTLE

5. Refer to Maintenance Manual for ROTAX® Engine Type 912 Series.

CHOKE

6. Check choke lever is full closed (down) with control knob in “OFF” position and full open (up) with control knob in “ON” position. If this is not the case, adjust by loosening the cable stop for adjustment at the cable guide on the carburetor.

WEIGHT AND BALANCE

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 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

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 level door frame longeron. Refer to **FIGURE 12-01**. Refer to **FIGURE 12-01B** for optional 10" tailwheel. (A stand between tail wheel and scale is required).
    - Place scales under each wheel (360 lb. minimum capacity)

    TRIKE

    - Shim scales to level door frame longeron. Refer to **FIGURE 12-01A**.
    - Place scales under each wheel (360 lb. minimum capacity)

3. 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.

Use **FIGURE 12-02** to record history and changes in Weight & Balance.

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-20 RAVEN is a simple aircraft and so are the weight and balance calculations.

The S-20 RAVEN is limited to two occupants.

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

The baggage compartment is rated for 80 lbs.

Baggage should be secured securely for flight.

To figure the weight and balance enter the following data on the chart. Refer to **FIGURE 12-01, FIGURE 12-01A** or **FIGURE 12-01B**.

- Weight of Main Gear – Left.
- Weight of Main Gear - Right.
- Weight of Pilot.
- Wing Fuel (at 6 lbs. / gal).
- Header Tank Fuel (at 6 lbs. / gal).
- Weight of Passenger.
- Weight of Baggage.
- 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.

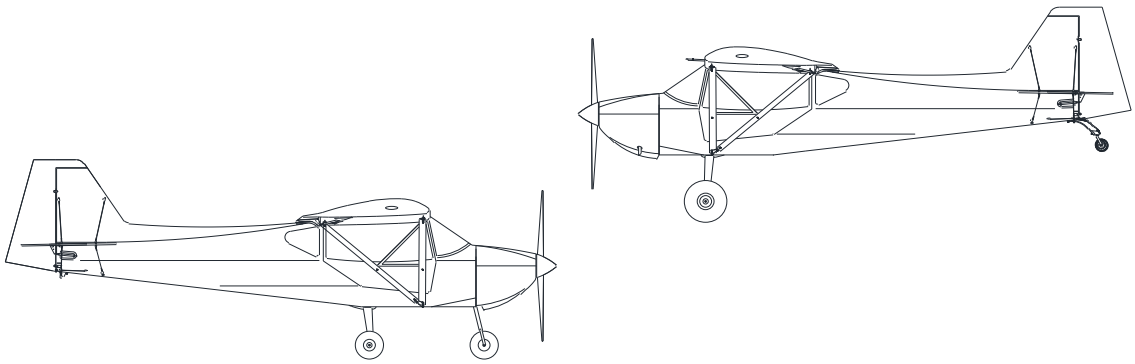
Calculate Center of Gravity. **(CG = Total Moment / Total Weight)**

Check that the Center of Gravity calculated for take-off falls inside of the acceptable Center of Gravity limits. Refer to **FIGURE 12-01, FIGURE 12-01A** or **FIGURE 12-01B**.

Repeat for landing configuration.

S-20 RAVEN

OPERATIONS MANUAL



Serial Number:

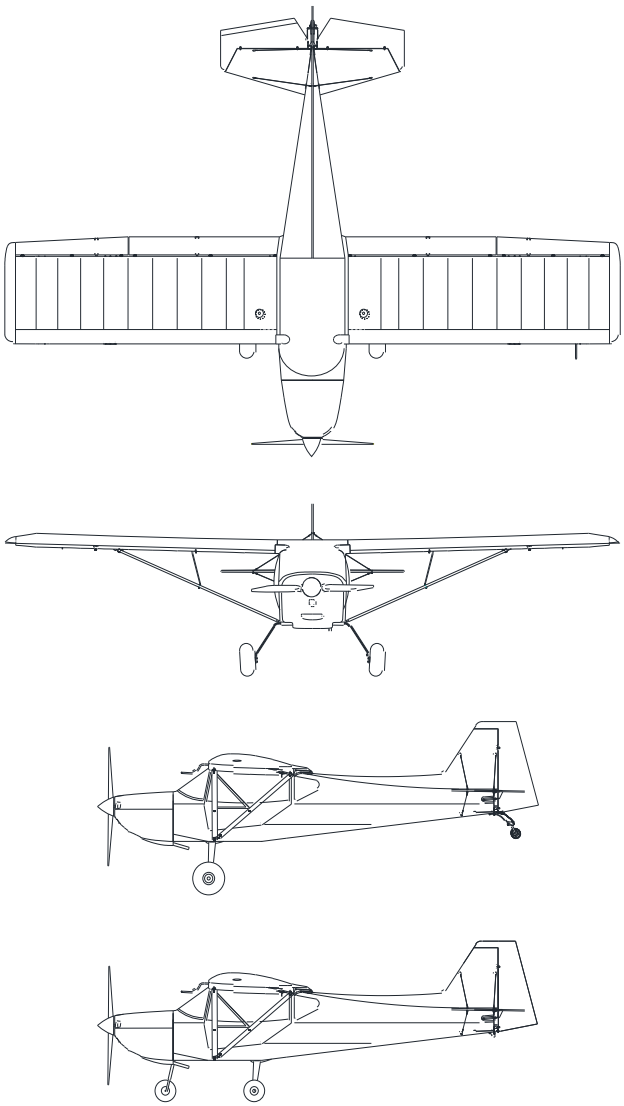
Registration Number:

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

09/01/2013

TABLE OF CONTENTS

RANS S-20 RAVEN - THREE VIEW



13 - GENERAL INFORMATION

This handbook contains sections 13 thru 13G.

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-20 RAVEN:

- 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.
- 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.
- Lean back and check that seat back locks into place.
- Close door and check that door handle is fully forward.

NOTE: *Seats should be in aft position for easy entry.*

To exit the S-20 RAVEN:

- 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.*

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-20 RAVEN can be flown with the doors open, up to and including 100 mph. The S-20's doors should not be opened at airspeeds above 65 mph. The S-20 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

13A - 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 13A-1**.
All speeds are given for maximum takeoff weight.
Speeds are given in MPH and (KNOTS)

	Airspeed	IAS	Remarks
VNE	Never Exceed Speed	135 (117)	**DO NOT** exceed this speed in any operation
VA	Maneuvering Speed at maximum gross weight	105* (91)*	**DO NOT** make full or abrupt control movements above this speed.
VFE	Maximum Flap Extended Speed	80 (70)	**DO NOT** exceed this speed with flaps extended.
VSO	Stall speed**	33 (29)	Flaps full down
VS	Stall speed**	39 (34)	Flaps up

TABLE 13A-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 below.
All speeds are given for maximum takeoff weight.
Speed are given in MPH and (KNOTS)

Marking	IAS Value or Range	Meaning
White Arc	33 – 80 (29 - 70)	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	39 – 105 (34 – 91)	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	105 – 135 (91 – 117)	Operation must be conducted with caution and in smooth air only.
Red Line	135 (117)	Maximum speed for all operations

MAXIMUM DEMONSTRATED CROSSWIND VELOCITY

Takeoff .....23 MPH (20 Knots) @ 90 degrees
Landing.....23 MPH (20 Knots) @ 90 degrees

This is not considered limiting.

WEIGHT LIMITS

Maximum Ramp weight: .....1320 lbs.
Maximum Takeoff weight:.....1320 lbs.
Maximum Landing weight:.....1320 lbs.
Maximum weight in Baggage compartment: TOTAL..... 80 lbs.
Maximum weight in Baggage compartment: FWD of Station 3..... 50 lbs.
Maximum weight in Baggage compartment: AFT of Station 3..... 30 lbs.

CENTER OF GRAVITY LIMITS

Forward: ..... 31.72 inches aft of datum
Aft: ..... 41.92 inches aft of datum

Reference Datum: .....Front 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-20 RAVEN aircraft.

FLIGHT LOAD FACTOR LIMITS

Flaps Up:.....+ 4.0 g, - 2.0g
Flaps Down: ..... + 2.0 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:

Total Capacity:	28.75 U.S. GAL
Total Capacity each Wing Tank:	13.00 U.S. GAL
Total Capacity of Header Tank	2.75 U.S. GAL
Total Usable:	28.45 U.S. GAL
Total Unusable:	0.30 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 Header Tank does not have a fuel level indicator. When the wing fuel indicator first reads Zero, then approximately 2.45 gallons of fuel remains. The fuel remaining in the header tank after the wing fuel quantity indicator reads zero cannot be safely determined in flight.

OTHER LIMITATIONS

Flap Limitations:

Approved Takeoff Range:	retracted, 1st or 2nd notch flaps (0° to 24.5°)
Approved Landing Range:	retracted to full flaps (0° to 49°)

13B - WEIGHT AND BALANCE

INTRODUCTION

This Section describes the basic procedures for establishing of basic empty weight and moment of the airplane. Refer to **SECTION 12** 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

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 level door frame longeron. Refer to **FIGURE 12-01**. For optional 10" tailwheel refer to **FIGURE 12-01B**. (A stand between tail wheel and scale is required).
    - Place scales under each wheel (360 lb. minimum capacity)

    TRIKE

    - Shim scales to level door frame longeron. Refer to **FIGURE 12-01A**.
    - Place scales under each wheel (360 lb. minimum capacity)

3. 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-20 RAVEN is a simple aircraft and so are the weight and balance calculations.

The S-20 RAVEN is limited to two occupants.

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

The compartment is rated for 80 lbs.

Maximum of 50 lbs is allowed forward of Station 3.

Maximum of 30 lbs. is allowed aft of Station 3.

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 12-01, FIGURE 12-01A** or **FIGURE 12-01B**.

- Weight of Main Gear – Left.
- Weight of Main Gear - Right.
- Weight of Pilot.
- Usable Fuel (at 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 12-01, FIGURE 12-01A** or **FIGURE 12-01B**.

Repeat for landing configuration.

13C - EMERGENCY PROCEDURES

INTRODUCTION

This section provides checklists and amplified procedures for coping with emergencies that may occur. Emergencies caused by aircraft or powerplant 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		97 MPH
Maximum Glide	Flaps UP	64 MPH
Precautionary Landing with Engine Power	Flaps UP	59 MPH
	Flaps DOWN	55 MPH
Landing without Engine Power	Flaps UP	70 MPH
	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 - 64 MPH for best glide
(2) Select Emergency Landing Area - PROCEED To It.
(3) Attempt Engine RESTART.
(4) Ignition - Check ON.
(5) Choke - Check OFF.
(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 59 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 – 4500 -5000 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 obtain 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 Switchs (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
Master Switch - ON.
(4) 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-20 RAVEN 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 (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.

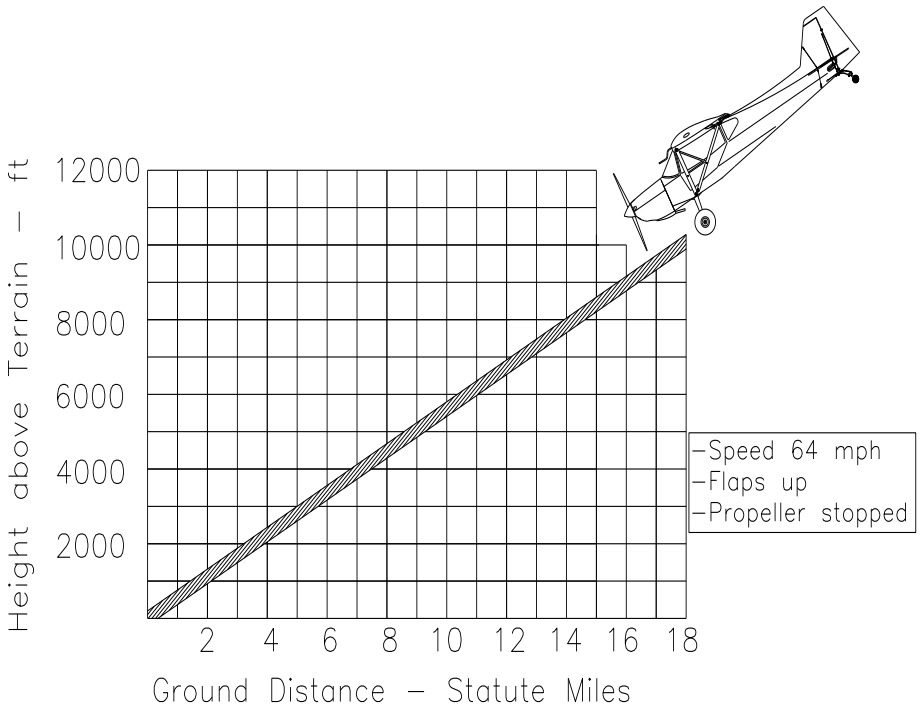
AMPLIFIED PROCEDURES

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 (64 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-20 RAVEN 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 operation 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-20 RAVEN can be flown with the doors open, up to and including 100 mph.

The S-20 RAVEN doors should not be opened at airspeeds above 65 mph.

The S-20 RAVEN 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.*

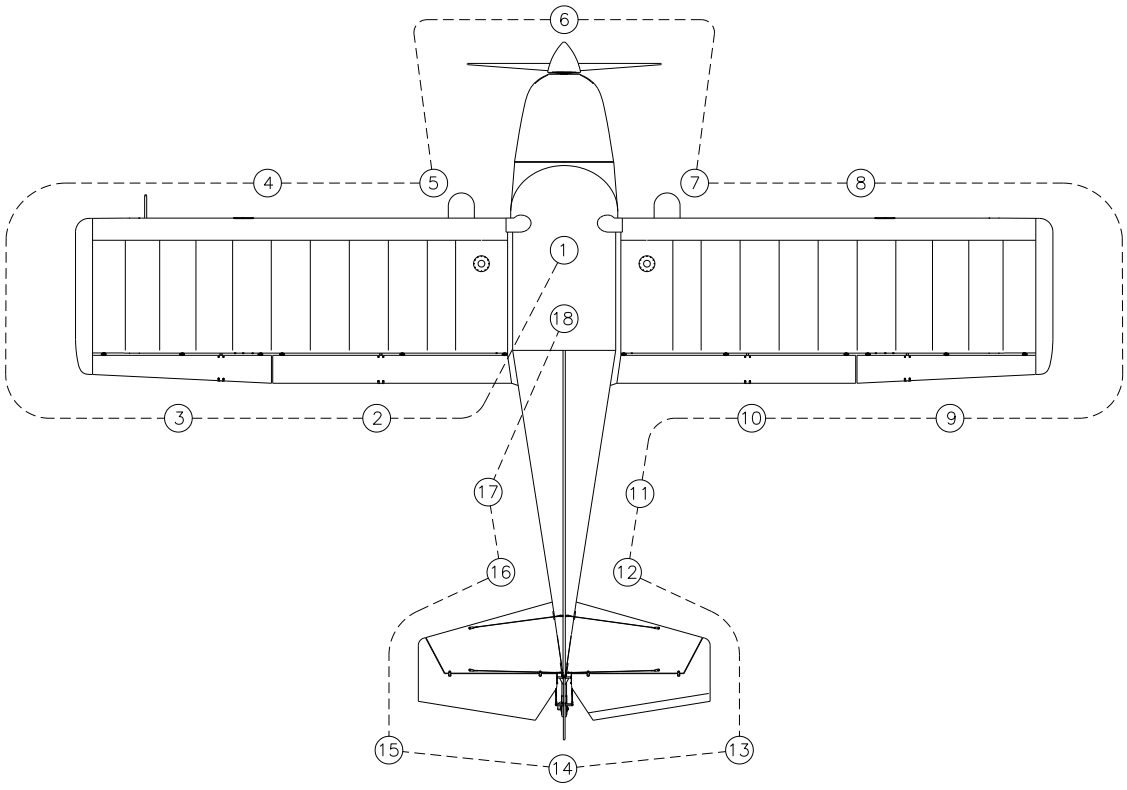
The aircraft will fly with open doors. The door will float in a position pending on the speed of the aircraft. To close an open door in flight, slow to 65 mph, push the opposite rudder pedal. This will make the aircraft yaw and help to get the door closed.

13D - 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.



The entire outer surface of the aircraft should be inspected for damage of any kind during the pre-flight inspection. This is especially important due the fact that the aircraft is fabric covered.

1.

- ❑ Aircraft Flight Manual & 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
- ❑ 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
- ❑ Jury Struts - SECURE
- ❑ Ribs in place
- ❑ Flap hinge points - SECURE
- ❑ Trailing edge spar - STRAIGHT & INTACT
- ❑ Flap connections - INTACT

3.

- ❑ Ribs in place
- ❑ 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
- ❑ Jury Strut Connections - SECURE
- ❑ Wing tie down - DISCONNECT

5.

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

6.

- ❑ Remove Cowling
- ❑ 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
- ❑ 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. Repeat Step #5

8. Repeat Step #4

9. Repeat Step #3

10. Repeat Step #2

11.

- ❑ Tailcone - Check for bent tubes, holes or tears in the fabric.

12.

- ❑ Tail brace rods and attach hardware - CHECK
- ❑ 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. Repeat Step #13

16. Repeat Step #12

17. Repeat Step #11
Fuel quick drain valve on bottom of fuselage behind Station 3 (left side); - DRAIN & CHECK for water, sediment and proper fuel grade.

18.

- ❑ Climb aboard
- ❑ Cockpit checklist - CHECK
- ❑ 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 - choke on
- ❑ 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.
- ❑ Choke - ON.
- ❑ Master Switch - ON.
- ❑ Propeller Area - CLEAR
- ❑ Ignition Switch - START (release when engine starts).
- ❑ Throttle adjust – IDLE smooth – up to 2000 RPM
- ❑ 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 – up to 2500 RPM
- ❑ Oil pressure - CHECK
- ❑ Avionics master- ON

TAXIING

- ❑ Brakes - CHECK

BEFORE TAKEOFF

- ❑ Cabin Doors - CLOSED OR 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
- ❑ 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
- ❑ Throttle – IDLE – adjust friction lock
- ❑ Choke - OFF
- ❑ 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 - MAX. 5800 RPM for 5 minutes, 5500 RPM continuous

CRUISE

- ❑ Throttle - 4500 to 5500 RPM (Maximum continuous setting).
- ❑ Elevator Trim - adjust.
- ❑ Fuel pump – OFF

APPROACH

- ❑ Throttle - AS DESIRED.
- ❑ Engine temperatures – MONITOR
- ❑ Carburetor heat – FULL HEAT AS REQUIRED

BEFORE LANDING

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

LANDING

NORMAL LANDING

- ❑ Airspeed (on approach) – 66-70 MPH (flaps UP).
- ❑ Flaps (on final) - AS REQUIRED (below 69 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 69 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)
- ❑ Brake - APPLY as required
- ❑ Flaps - RETRACT for maximum brake effectiveness

BALKED LANDING

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

AFTER LANDING

- ❑ 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 pre-flight checklist is essential. Ensure "yourself", all parts and components, and the entire aircraft are in an airworthy condition before attempting flight.

Refer to **FIGURE 13-08.** Starting at the pilot side cockpit, work around the RANS S-20 RAVEN aircraft in a clockwise manner as illustrated.

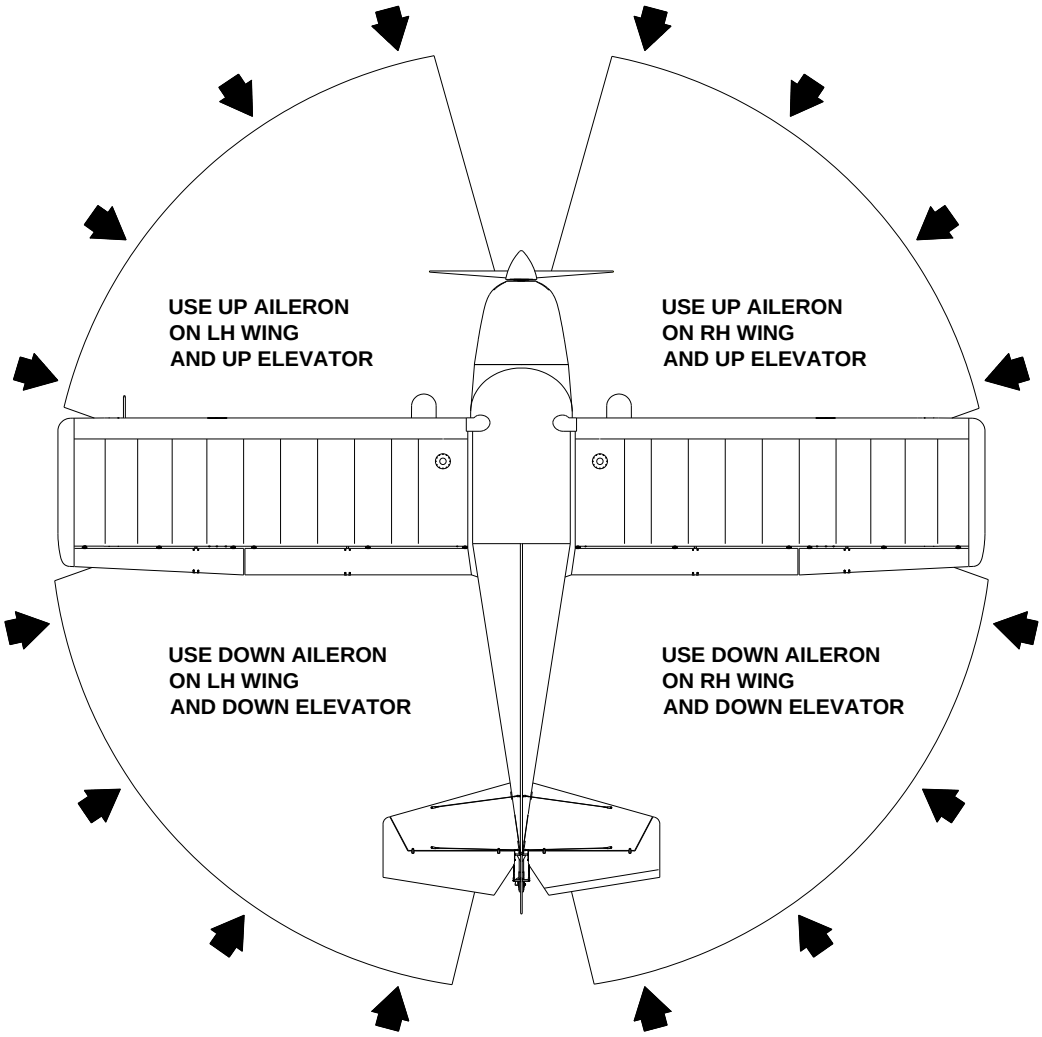
NOTE: *This suggested outline for a pre-flight inspection generally covers the critical areas that* ***MUST*** *be checked prior to each flight.* In addition, **EVERY** component should be examined, properly maintained, correctly stored or transported, and inspected before each flight to ensure structural integrity and proper flying characteristics.

NEVER use the brake as a parking brake with the intention of leaving the aircraft unattended. The S-20 RAVEN is a light aircraft!

TAXING (GROUND HANDLING)

The S-20 RAVEN is a light aircraft. Concentrate on taxiing until the moment the aircraft is tied down.

When taxing, 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.

When taxing 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.

The S-20 RAVEN Taildragger is equipped with a steerable full-swivel tail wheel. 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 turn and 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-20 RAVEN 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 1320 lbs at each tie-down location. Secure the controls in the cockpit and use the following tie down points:

- Tail gear or Tail Tie Down Hook
- Left forward wing strut (top - close to wing attach)
- Right forward wing strut (top - close to wing attach)

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.

13E - 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 at the leading edge handles of 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 (upper longerons) 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 by hand using a tow bar attached to the nose gear. His will help you to maneuver the aircraft in tight spaces.

WINDSHIELD AND WINDOWS

The windshield, 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 Lexan, 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 “Brillianize” for windshield care. Brillianize is available through RANS Parts Department.

CAUTION: Never use gasoline, benzene, alcohol, acetone, thinner or glass cleaner on Lexan surfaces.

PAINTED SURFACES

The painted exterior surfaces of your S-20 RAVEN aircraft should have a durable and long lasting finish.

No polishing of 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 “Brillianize”. 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 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.

13F - REQUIRED PLACARDS AND MARKINGS

AIRSPEED INDICATOR MARKINGS

Airspeed indicator markings and their color code meanings are shown in table below.
All speeds are given for maximum takeoff weight.
Speed are given in MPH and (KNOTS)

Marking	IAS Value or Range	Meaning
White Arc	33 – 80 (29 - 70)	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	39 – 105 (34 – 91)	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	105 – 135 (91 – 117)	Operation must be conducted with caution and in smooth air only.
Red Line	135 (117)	Maximum speed for all operations

PLACARDS

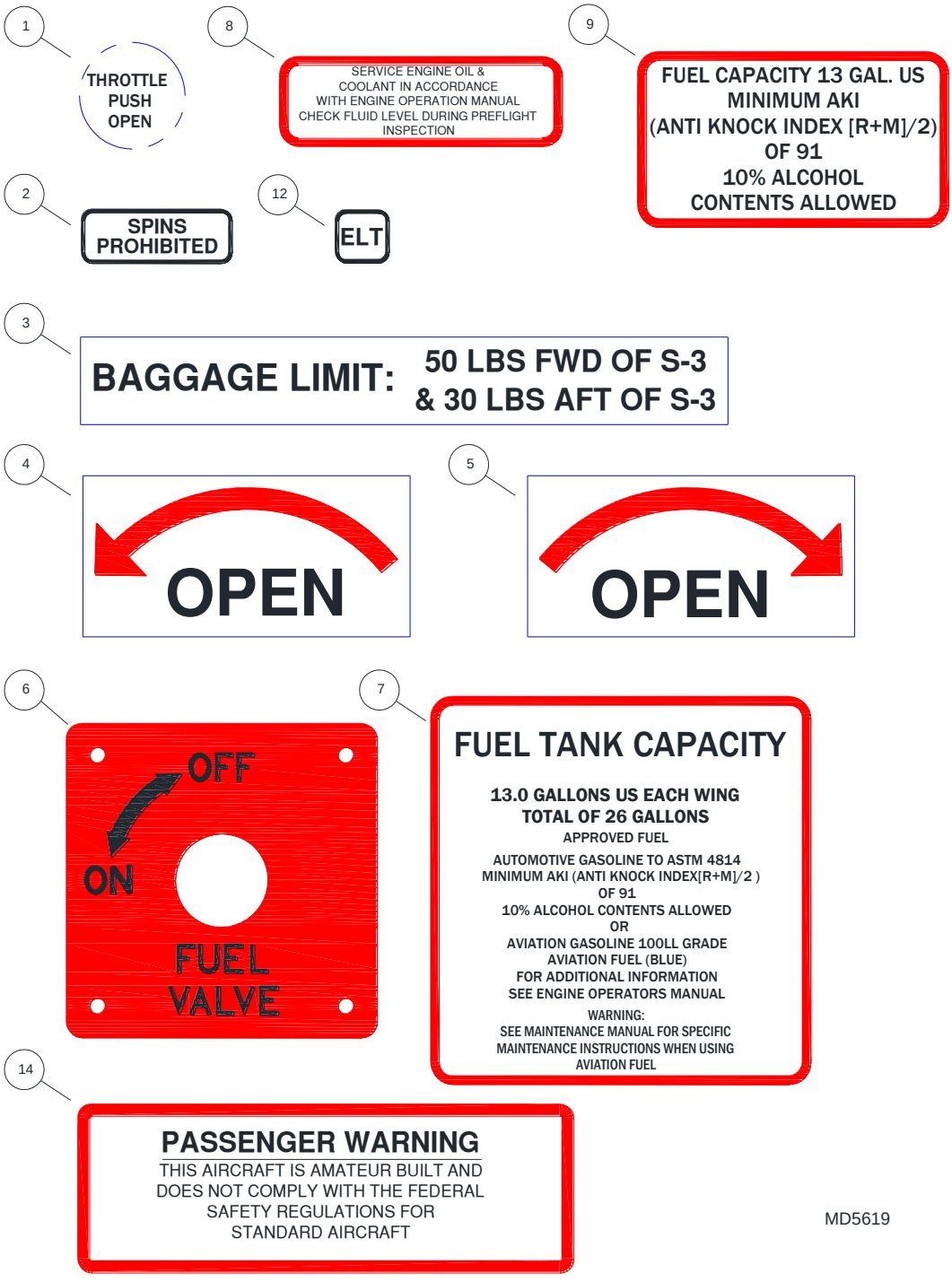
The following labels and placards contain important information needed for proper operation of the S-20 RAVEN and must be displayed in the location described in this section.

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. Centered around fuel shut off valve. Riveted on LH FWD Side Kick 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. Passenger Warning on lower right side of instrument panel.
15. Placard **“EXPERIMENTAL”** in 2” letters on inside of left and right cabin doors.


1
THROTTLE
PUSH
OPEN
8
SERVICE ENGINE OIL &
COOLANT IN ACCORDANCE
WITH ENGINE OPERATION MANUAL
CHECK FLUID LEVEL DURING PREFLIGHT
INSPECTION
9
FUEL CAPACITY 13 GAL. US
MINIMUM AKI
(ANTI KNOCK INDEX [R+M]/2)
OF 91
10% ALCOHOL
CONTENTS ALLOWED
2
SPINS
PROHIBITED
12
ELT
3
BAGGAGE LIMIT:
50 LBS FWD OF S-3
& 30 LBS AFT OF S-3
4
OPEN
5
OPEN
6
OFF
ON
FUEL
VALVE
7
FUEL TANK CAPACITY
13.0 GALLONS US EACH WING
TOTAL OF 26 GALLONS
APPROVED FUEL
AUTOMOTIVE GASOLINE TO ASTM 4814
MINIMUM AKI (ANTI KNOCK INDEX[R+M]/2)
OF 91
10% ALCOHOL CONTENTS ALLOWED
OR
AVIATION GASOLINE 100LL GRADE
AVIATION FUEL (BLUE)
FOR ADDITIONAL INFORMATION
SEE ENGINE OPERATORS MANUAL
WARNING:
SEE MAINTENANCE MANUAL FOR SPECIFIC
MAINTENANCE INSTRUCTIONS WHEN USING
AVIATION FUEL
14
PASSENGER WARNING
THIS AIRCRAFT IS AMATEUR BUILT AND
DOES NOT COMPLY WITH THE FEDERAL
SAFETY REGULATIONS FOR
STANDARD AIRCRAFT

MD5619

15

EXPERIMENTAL

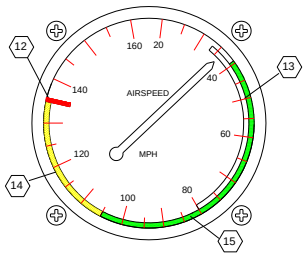
13

10

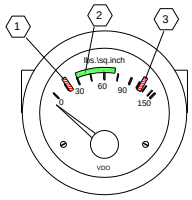
11

11

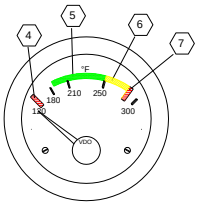
OPEN DOORS AT OR BELOW 65 MPH. RESUME CRUISE. DO NOT EXCEED 100 MPH.



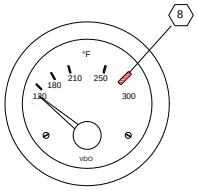
AIR SPEED INDICATOR



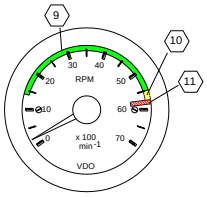
OIL PRESSURE GAUGE



OIL TEMPERATURE GAUGE



CHT GAUGE



RPM GAUGE

1. RED LINE 12 PSI MIN
2. GREEN ARC 29-73 PSI NORMAL
3. RED LINE 100 PSI MAX
4. RED LINE 120°F MIN
5. GREEN ARC 190°F-230°F NORMAL
6. YELLOW ARC 230°F-266°F CAUTION
7. RED LINE 266°F MAX
8. RED LINE 275°F MAX
9. GREEN ARC 1400-5500 RPM NORMAL
10. YELLOW ARC 5500-5800 RPM CAUTION
11. RED LINE 5800 RPM MAX
12. RED LINE 135 MPH MAX
13. WHITE ARC 35-80 MPH
14. YELLOW ARC 105-135 MPH CAUTION
15. GREEN ARC 53-105 MPH NORMAL

NOTE: ACTUAL INSTRUMENT GEOMETRY MAY VARY, MARK ACCORDINGLY

13G - SUPPLEMENTARY INFORMATION

FAMILIARIZATION FLIGHT PROCEDURES

The pilot should familiarize themselves thoroughly with this Manual, ROTAX 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, additional the special characteristics of such shall be reviewed.

PILOT OPERATING ADVISORIES

The S-20 RAVEN shall only be operated by pilots with proper training.
Always deflect the controls as required in windy conditions.
The S-20 RAVEN 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.