

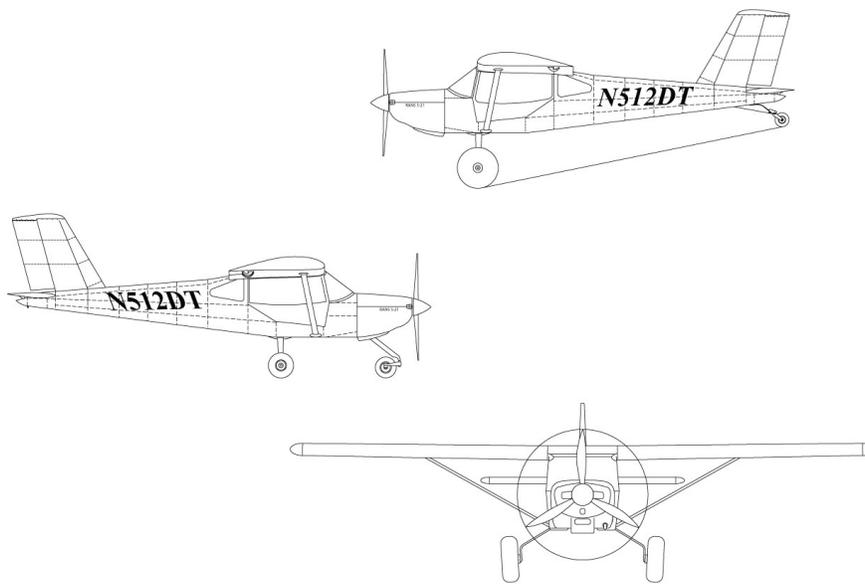
# **RANS**

## **AIRCRAFT**

### **S-21 OUTBOUND**

**ROTAX 915iS INSTALLATION**

**TEXT MANUAL**



Serial Number:

Registration Number:

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**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.

## **ROTAX 915iS - ENGINE MOUNT INSTALLATION**

### **(AFTER FIT-UP OF FIREWALL & BOOT COWL)**

#### **ASSEMBLY**

1. Become familiar with the ROTAX 915iS **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.
2. Modify the firewall in accordance with **FIGURES 11-01/915iS** through **FIGURES 11-01L/915iS**

## **ROTAX 915iS – FIREWALL ITEMS INSTALLATION**

1. Gather the applicable parts shown in the parts manual.
2. Modify the firewall to match **FIGURES 11-01/915iS – 11-01L/915iS**. Fit the firewall to the fuselage before, and double check that the placement of the items will not interfere with the welded cage structure.
3. Cut the spacer bushings from raw stock and attach the oil bottle mount to the firewall. Then secure the oil bottle to the oil bottle mount using hose clamps.  
**NOTE:** The orientation of the top of the oil bottle does matter, but can be repositioned when installing the oil lines, adjust the clamp that holds the oil bottle cap to the oil bottle, so it is easier to service at time intervals and condition inspections.
4. Rivet the mount bracket for the coolant recovery bottle to the firewall and secure the coolant recovery bottle to the bracket via hose clamp.
5. The firewall pass through holes can be made from the raw stock provided or sourced through vendors such as aircraft spruce.

### **(AFTER INSTALLING ALL ACCESSORIES ON FIREWALL)**

#### **ENGINE MOUNT INSTALLATION**

1. Become familiar with the ROTAX 915iS **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.
2. Install Engine Mount after making sure all accessories are located on firewall.
3. Ream the engine mount bushings of the engine mount and the bushings in the cage on the firewall using a 5/16” ream.

4. Bolt the engine mount to the firewall. Note the hardware orientation. **NOTE:** Before torquing hardware, look ahead at the electrical parts page, some of the 4 AWG ground wires attach to the upper right-hand bolt of the engine mount. **NOTE:** If building a trike, place the trike nose gear mount behind the engine mount and leave the two spacer washers out.
5. Torque the hardware to AN Standards.
6. Bolt the ROTAX Suspension Mount (supplied on your 915iS) to the RANS AFT mount using the hardware, spacers and rubber isolators called out in the parts manual. **NOTE:** The ROTAX Suspension Mount holes are 10.5mm, while the hardware called out is 3/8". This is as intended by ROTAX. Also note that they have a supplied welded on nut down by the Turbo that will be used during the installation.
7. Once the ROTAX Suspension Mount is properly torqued to the AFT Mount, safety wire the lower right hand bolt head to the engine mount frame. This is the nut that is welded to the turbo bracket, and the only nut that is not a self-locking nut.

## **ROTAX 915iS - ENGINE ELECTRICAL**

### **(FINAL INSTALL OF ENGINE)**

- Due to the wide selection of switches, circuit breakers, connectors, gauges, flight systems, etc., which may be used RANS 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.

### **(ECU INSTALLATION)**

1. Refer to the parts catalog and select the required components for assembly.
2. Drill four holes in the firewall at the locations depicted on **FIGURE 11-01/915iS & 11-01A/915iS**.
3. Cut the four spacer bushings from raw stock.
4. Attach the Engine Control Unit to the firewall as shown in the parts diagram.

### **(SOLENOIDS INSTALLATION)**

5. Refer to the parts catalog and select the required components for assembly.
6. Drill two holes in the firewall at the locations depicted on **FIGURES 11-01/915iS & 11-01B/915iS** for the start solenoid. These holes will be upsized large enough for the grommet to be inserted.

7. Insert the grommet into the firewall. The isolator plate will go around the grommets and isolate the starter solenoid from the firewall. Pin the Starter solenoid to the firewall through the grommets.
8. Tighten the hardware to a snug fit, but do not overtighten. There should be very little movement in the solenoid.
9. Drill two holes in the firewall at the locations depicted on **FIGURES 11-01/915iS & 11-01B/915iS** for the master solenoid. Bolt the master solenoid to the firewall and tighten the hardware.

### **(FUSEBOX INSTALLTION)**

1. Refer to the parts catalog and select the required components for assembly.
2. Fabricate two pieces from baggage compartment angles to make two fuse box mounting angles. Refer to **FIGURE 11-02/915iS**.

**NOTE:** These measurements are for reference only, please double check them to your fuse box and engine mount.

3. Assemble the fuse box to the two mounting angles. Tighten all hardware.
4. Using the #30 hole called out in **FIGURE 11-02/915iS**, cleco the PCV Mount to the angle, align the mount perpendicular to the fuse box mount angles. Transfer drill the rest of the #30 holes. Debur the holes and cleco back in place.
5. Attach the mounting angles to the engine mount in the location provided in **FIGURE 11-02A/915iS**. Tighten all hardware.
6. Position the PCV mount plate on the backside of the fuse box mount angles.  
**NOTE:** Position in a way that avoids kinks in the tubing coming off the pressure control valve. Install the PCV to the PCV mount. Rivet the mount plate to the angles.
7. Install all supplied battery cables in accordance with the parts manual.

**NOTES:** Where the battery cables attach to the engine mount, it is best practice to sand the powder coat down to bare metal for a good ground. There should be no continuity between the "AIRFRAME" ground and the "EMS" ground of the fuse box. Refer to your ROTAX 915iS Installation manual for further details.

## **ROTAX 915iS – OPTIONAL 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 **FIGURE 11-01C/915iS** or **11-01E/915iS**, depending on which battery you have chosen.

**NOTE:** Depending on the battery option used, these four holes through the firewall will be different.

### **Power Sonic Battery Box**

3. Cleco Support Angles to inside of Front Plate. Refer to the PARTS MANUAL DRAWING. Transfer drill #30 and rivet. Base of Battery will set on Support Angles.
4. Align one edge of Battery Box Front Plate with edge of Battery Box Mount Plate. Clamp together and transfer drill #11 through upper and lower mount holes in Mount Plate and cleco.
5. Slip Battery into assembly. Align free edge of Plates; pull Front Plate against battery. Check to see if Battery can be slid in and out. If battery cannot be slid in and out, then loosen fit slightly to allow easier removal. Clamp and transfer drill #11 through upper and lower mount holes and cleco.
6. Transfer drill #30 the center holes in Mount Plate, and rivet from the AFT side.
7. Slide the Battery Bar through the holes in the Battery Box assembly. Modify the Battery Bar per **FIGURE 11-01D/915iS**. 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.

### **EarthX Battery Box**

1. Rivet nut plates to retainer clips.
2. Cleco the Battery Box Front Plate to the Battery Box Mounting Plate and Rivet using two rivets as depicted in the parts drawing.
3. Fabricate four spacer bushings with the appropriate raw stock.
4. Mount the battery box to the firewall with the hardware called out in the parts manual.
5. If there is any play between the battery and the battery box, the foam supplied with the EarthX battery is there for a shim to tighten the fit up.

## **ROTAX 915iS - FUEL SYSTEM**

### **(AFTER INSTALLATION OF ENGINE)**

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

**INSTALLATION OF FINE FUEL FILTER TO FIREWALL)**

**NOTE:** Fuel Filter comes with the engine.

2. Install the two AN fittings into the filter. Make sure to use the supplied copper crush washers.
3. Mount the Fuel filter to the firewall in the location depicted in **FIGURE 11-01F/915iS**.
4. Install the two firewall bulkhead fittings in the lower left-hand portion of the firewall. See **FIGURE 11-01G/915iS**.
5. Install the fuel lines as per the parts manual and torque to the appropriate AN value.

**INSTALLATION OF FUEL PUMP AND COARSE FILTER**

6. Transfer drill the fuel pump tray to the fuel pump tray support using a #40 drill bit, cleco as you go.
7. Upsize the holes to #30, debur and rivet the tray support to the fuel pump tray.
8. Using 1/4" edge distance, transfer drill the fuel pump tray to the two welded tabs on the fuselage. These two tabs also pickup the aft portion of the pitch servo tray.

**NOTE:** If an autopilot is not being used, it will take an additional fuel pump tray and fuel pump tray support. These two parts, if used, will rotate 180 degrees from the original parts. See **FIGURE 11-03/915iS**.

9. Transfer drill the fuel pump tray support(s) to the fuselage belly skin and cleco in position.
10. Remove the fuel pumps from the stainless steel ROTAX box it is mounted in. Snip the pinch clamp bands and flip the fuel pumps upside down and attach to the ROTAX fuel pump saddle using the appropriate hose clamps.

**NOTE:** Write the serial number of your fuel pumps down. They will be upside down and hard to see later for inspection and service bulletins during condition inspections.

11. Install two fittings to the fuel valve using thread sealant. Refer to **FIGURE 11-03A/915iS** and the parts manual.
12. Remove the handle from the fuel valve and install the valve to the two tabs of the fuselage steel frame. Use the mount brackets as shown in **FIGURE 11-03A/915iS**. Re-install the handle to the fuel valve.

**NOTE:** Valve should be "ON" when valve handle is AFT and "OFF" when valve handle is UP.

13. Install the fuel line from the valve to the fuel pump outlet. This will help locate the fuel pump location.

14. Build up the coarse fuel filter using the parts called for in the parts manual. The filter itself is marked as inlet/outlet. Write the orientation of the filter on the filter shell for future reference. Tighten all the fittings.
15. Install the fuel filter to the fuel pump inlet. Also install the fuel line from the header tank outlet to the fuel filter. This will also help locate the fuel pump on the tray.
16. Find the optimum position of the fuel pump on the fuel pump tray and mark where the studs rest. Remove the fuel pump and drill these four locations. Remove the fuel pump tray and debur all parts. Reinstall the tray and rivet to the belly skin and bolt to the welded tabs. Reinstall the fuel pumps using the hardware called out in the parts manual.
17. Connect fuel lines from the fuel valve to the by-pass block to the outlet firewall bulkhead fitting. From the return firewall bulkhead fitting to the by-pass block. From the by-pass block to the fuel check valve (check orientation) and from the fuel check valve to the return inlet of the header tank.
18. Connect fuel lines on the forward side of the firewall. From the outlet bulkhead fitting to the fine fuel filter. From the fine fuel filter to the fuel inlet rail and from the fuel outlet rail to the return bulkhead fitting at the firewall.

### **ROTAX 915iS – HEADER TANK ASSEMBLY**

1. Locate Header Tank Mount per **FIGURE 11-03B/915iS**. Transfer drill #30 through each tab. Glue Rubber Edging to top edge of Mount flanges. Rivet Header Tank Mount to top of tabs.
2. Locate and drill fitting holes in Header Tank per **FIGURE 11-03C/915iS**. **Do NOT drill the sump drain holes until fitting of the tank to the fuselage.** For drilling the holes, a 1/2" Unit-Bit® and 3/4" Unit-Bit® work best. Locate center of each hole with a #30 drill bit, then drill full size. Deburr all holes. Thoroughly clean tank several times by using a shop-vac and then 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 11-03D/915iS**. 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, install the nut on before removing the wire.

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

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

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

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

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

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

7. Modify Header Tank Mount Channel per **FIGURE 11-03E/915iS**. Position Header Tank flush with front of Mount. Use large hose clamps to secure tank to mount.

**NOTE:** Modified Mount Channel will position under hose clamps, on top of tank, and be positioned so that Channel ends are flush with sides of header tank.

### **LOCATING HEADER TANK SUMP VALVE HOLE THROUGH BELLY SKIN**

8. Mark on the outside of the tank on each side next to the sump valve as per **FIGURE 11-03F/915iS**. This allows location of the hole through belly skin with the tank installed.
9. Set the header tank in place. Transfer the marks on the tank to the belly skin. Remove the tank and project the marked lines at 90° to the sides of the tank until they intersect.

10. Drill a #40 in the skin at the intersection. Set the header tank securely in place. Drill #30 through the hole in the skin and the header tank. Use a step drill or several sizes of drill bits to work up to the required size hole for the sump drain fitting.

#### **(AFTER WINGS MOUNTED TO FUSELAGE)**

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

### **OPTIONAL LOW FUEL WARNING KIT**

1. Become familiar with the Optional Low Fuel Warning Kit on the Header Tank **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. A 5/8" hole will need drilled in the side of the Header Tank. If not, refer to **FIGURE 11-03C/915iS**. 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 11-03G/915iS**. 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 11-03G/915iS**. Do not forget to include a proper sized breaker or fuse.

**NOTE:** Alternatively, the low fuel switch can be wired directly to an EFIS as a discrete. This will allow you to not need the LED and can be user inputted as a LOW FUEL WARNING!

### **ROTAX 915iS - COOLING SYSTEM INSTALLATION**

#### **(AFTER INSTALLATION OF ENGINE)**

#### **ASSEMBLY**

1. Refer to the parts catalog and select the required components for assembly.
2. Attach the two oil cooler mounts to the gear box. Note the two spacer washers, they are not used for Airmaster Propeller Installations.

3. Install the top and bottom oil cooler mount plates and oil cooler bushings to the oil cooler.
4. The AFT oil cooler bushing will attach to the FWD Radiator Mount Tubes.
5. Attach the FWD Radiator Mount Tubes to the Oil Cooler Bushings, through the Radiator mount angles forward hole.
6. Install the AFT radiator mount tubes to the radiator mount angles, radiator and the lower mount strap.

**NOTE:** If there is a bit of play in between the radiator and mount straps, it can be shimmed using a RTV Silicone sheet or similar material.

7. Install the Radiator Mount – Weldment to the case of the engine, using the appropriate spacers and hardware.
8. Bolt the Oil Cooler/Radiator assembly to the oil cooler mounts previously installed to the gear box.
9. Swing the oil cooler/radiator assembly back and bolt the radiator mount to the radiator mount angles.
10. Safety wire all appropriate hardware.

#### **(AFTER INSTALLATION OF OIL COOLER AND RADIATOR)**

#### **INSTALLATION OF COOLANT LINES**

11. Remove the water pump inlet and install the water pump spacer kit. Orientate the water pump inlet in the middle position, clocked pointing to the right of the engine. Torque to 90 in/lbs.
12. Route the 1" radiator hose from the right of the radiator to the water pump inlet.
13. Cut the hose shortly after the radiator hose clears the engine mounts and install the coolant springs and the radiator hose T.
14. Drill holes for the two bulkhead firewall fittings. See **FIGURE 11-01/915iS** for location. Install two coolant bulkhead fittings in the firewall. Loctite and tighten.
15. Route the 5/8" radiator hose to one of the two coolant bulkhead fittings.
16. Install the preformed radiator hose to the left-hand side of the radiator.

**NOTE:** This hose may require some trimming. Avoid any kinks in any hoses.

17. Install the formed aluminum coolant tube and mount it to the exhaust pipe using the hardware in the parts manual.
18. Trim a section off the preinstalled hose of the expansion bottle and insert the second heater T. Use the trimmed of section to join the aluminum coolant tube and the heater T.
19. Route a 5/8" radiator hose to the second bulkhead fitting.

20. Install hose clamps on all lines.
21. Route the overflow hose from the expansion tank to the overflow bottle. Avoid tight bends and kinks. Safety wire the hose to the expansion hose and to the overflow bottle.

**NOTE:** There is usually a small mold line on the nipple of the coolant overflow bottle that may need sanded smooth, if not this can be a source of a small leak.

### **RADIANT HEATER INSTALLATION**

22. On one of the dual fan heater mounts, install the fan speed controller.

**NOTE:** the RTV silicone called out on the parts manual. Tape a dam around the backside of the controller and fill it with RTV Silicone. This is to create a barrier between the electrical components and the metal of the mounting plates.

23. Install the bolts from the fan side of the mounting plate, through the fan speed controller. Snug the hardware, but **DO NOT** overtighten as this could break the controller.
24. Assemble the fans to the Dual Fan Heater Mounts. The fans will have arrows showing the direction of airflow and the rotation. Make sure the airflow arrow is pointing away from the Heater Core. Attach the dual fan heater mounts using Truss Head Screws. The screws will self-tap into the plastic housing of the fan. Orientate the fans so the wires come out on the opposite side of the Heater Core inlet/outlets. Attach the heater core to the dual fan heater mounts on top of the fans. Tighten all hardware.

**CAUTION:** Do not overtighten screws into the plastic! Do not use Loctite in plastic!

25. Install the two 90-degree Swivel fittings into 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 on the cooler itself.

26. Mount the radiant heater assembly to the welded cage using the cushion clamps and hardware depicted in the parts manual. Position with clearance between the firewall and the swivel fittings.

27. Route the 5/8 heater hoses to the lower firewall bulkhead fittings. Make sure to route the hoses in a way to ensure adequate clearance between the hoses and rudder pedals. Trim the preformed hose from a "S" to a 90 degree. Use this section on the left fitting of the heater core to the Control valve. From there it will be a straight shot to the bulkhead fitting. Orientate the control valve so you can access the control arm. Route the hose on the right-hand side in a straight shot from swivel fitting to bulkhead fitting. Operate the pedals to assure clearance between the pedals and the hoses. If needed, tie the hoses together with Plastic Ties.

**IMPORTANT:** Double check to be sure there is no interference with Rudder Pedals.

28. 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.

29. Locate the Control Cable, fan switch and rheostat in the instrument panel. Keep this in mind when planning your instrument panel layout.

30. Route the control cable to the control valve. Mark it where the clamp of the control valve is. Pull the control cable out several inches and trim the control cable housing. Reinsert the control cable.

31. Drill #40 the center of the Valve control arm post. After retaining the Control Cable housing in the clamp on the Valve, bend the wire to retain it to the valve post. It must be bent in a tight loop around the post. The easiest way is to start to wrap it around, bend it into a hook shape. Slip it off the post and use a pair of pliers to hold it while completing the loop with needle-nose pliers. Twist it tight so it fits snug over the post. Secure with #6 Pan Head Screw, stainless steel washer and small brass washer. Trim the control wire after connecting. 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.

32. Connect wires to fan. Route them to the switch and power source.

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

34. 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.).

### **INSTALLATION OF OIL LINES**

35. Oil Tank should be installed to center of firewall. See **FIGURE 11-01J/915iS** for location.
36. Oil Breather Tube is installed on Firewall. See **FIGURE 11-01K/915iS** for location.
37. Locate the applicable parts from the parts manual.
38. Install the two oil cooler adapters with gasket rings. **CAUTION:** Make certain the gasket rings are in place or they will not seal. Torque to the appropriate AN value.
39. Route all the oil lines in accordance with the parts manual. Be certain to avoid sharp bends or kinking the lines. On the oil line from the pump to the tank, you will need to use the banjo bolt that comes with the oil line, not the one that is supplied by ROTAX, it does not have enough thread to be used with the fitting on the supplied oil line. Torque all fittings to AN value.
40. Route the oil breather tubing from the oil bottle to the breather tube located on the firewall. Trim the line to fit your installation. Safety wire to the oil bottle and to the breather tube.

### **PRE-ENGINE START UP**

Refer to the ROTAX 915iS Installation Manual for their specific instructions on filling with oil and purging the oil system before engine startup.

## **ROTAX 915iS – INTERCOOLER INSTALLATION**

### **AIRBOX ASSEMBLY**

1. Gather the parts needed to assemble the airbox for the intercooler.
2. Starting with the top or bottom air scoop cover and the inboard air scoop, line the aft edges up. The inboard air scoop will go inside of the bent flange of the top and bottom cover.
3. Once lined up and with the bent edge of the inboard air scoop facing forward and the bend going towards the engine, begin transfer drilling #30 the tab holes of the top/bottom cover, to the inboard air scoop. Cleco as you go. It will take a solid push to press the inboard air scoop into the curvature of the top/bottom cover.  
**HINT:** A vertical positioned 2 x 4 clamped into a vice makes for a good tool to push on the air scoop while transfer drilling the holes.
4. After either the top or bottom cover is transfer drilled and clecoed, proceed to the other cover. Transfer drill and cleco.
5. Install the Air Scoop Attach Brackets to the intercooler. Ideally, they will fit with the bolts being centered on the slots. Lightly tighten the hardware.

6. Remove the 1<sup>st</sup> two clecos from the top and bottom cover on the aft edge and slide the attach brackets between the top/bottom cover and the inboard air scoop. Transfer drill the attach bracket holes to the airbox assembly. Cleco as you go.
7. Cleco the Outboard air scoop to the air scoop attach bracket and rivet.
8. Remove the inboard air scoop, attach bracket and top/bottom covers from the intercooler. Debur these holes and rivet.

### **INTERCOOLER MOUNTING**

9. The intercooler mounts to the engine mount via cushion clamps and 3 different brackets, two of which will require fabrication/modification. Starting with the support angle, fabricate this attach bracket as shown in **FIGURE 11-05/915iS**.
10. Locate the support angle on the engine mount as shown in **FIGURE 11-05A1/915iS**. Mark and drill the holes into the support angle where the cushion clamps line up on center line. Bolt the support angle in place. Locate the lower inboard mount bracket as shown in **FIGURE 11-05A2/915iS**. Install two 6mm bolts through the support angle and the lower mount bracket into the intercooler and hand tighten.
11. Next, install a cushion clamp on the engine mount that will attach to the intercooler upper mount strap. The upper mount strap will need twisted to help align to the cushion clamp and the intercooler. This can be achieved by clamping in a vise and using a pair of smooth jaw pliers.

**NOTE:** Use a set of soft jaws in your vise as well to keep from damaging the strap. Once clamped in the vise, twist the part with the smooth jaw pliers until the fit is right.
12. Check the positioning of the intercooler, use **FIGURE 11-05A/915iS** to determine if any repositioning is needed. The cushion clamp that is attached to the upper mount strap can be repositioned and the strap can be bent a bit more or unbent slightly if needed. Hand tighten the 6mm bolt into the intercooler.
13. Once satisfied, move onto the third and final attach point. Install the cushion clamp to the engine mount, attach the lower mount strap to the cushion clamp and then hand tighten the 6mm bolt to the intercooler.
14. After checking the position of the intercooler after all the attach points are in position, tighten all the hardware, except the 6mm bolts. Remove the inboard 6mm hardware, insert the inboard air scoop into position, reinstall the hardware and hand tighten.
15. Remove the top outboard 6mm bolt and slide the outboard air scoop into position, reinstall the hardware and hand tighten.
16. Lightly tighten the 6mm hardware with a wrench.

**CAUTION:** Do not over torque, the intercooler is made of aluminum and the lugs can break off with over tightening.

### **TRIMMING THE AIR SCOOP**

17. After the cowling is fit up to the boot cowl, the two halves will be joined on the intercooler itself. This will allow you to position the outboard air scoop up tighter to the cowling. The top and bottom cover of the inboard half will pull up tight to the intercooler. The top and bottom cover will require trimming to fit to the cowling, leaving a small gap for the trim lock to make the seal to the cowling. The bottom cover will require more trimming than the top.
18. With the lower cowling on, pull the covers over to the cowling and mark for trimming, use a pair of hand shears and trim the cover.

**NOTE:** This may need to be done a few times to get it right. The top and bottom cover's aft edge will pull all the way to the intercooler.

**CAUTION:** Measure twice and cut once.

19. Once the top and bottom covers are trimmed to fit the side of the cowling, the outboard air scoop can be pulled over to the cowling along with the top and bottom covers for a nice, tight fit, leaving about 1/8" gap for the seal. Transfer drill the holes of the outboard air scoop to the top and bottom cover. Debur and rivet.
20. The intercooler airbox can be painted if you desire. After assembly or paint, cut lengths of the trim-lock cushion lip to fit the top and bottom cover, as well as the outboard air scoop's vertical edge. There is no need for the seal on the forward edge of the inboard air scoop.

### **INDUCTION SYSTEM**

#### **(AFTER INSTALLATION OF INTERCOOLER)**

21. After the intercooler is mounted, you will need to trim silicone hoses and metal tubing to fit the induction system. Be diligent in not wasting any of the silicone hose. Cut all the silicone hoses as per **FIGURE 11-05B/915iS**. The larger drop off pieces from the 90-degree elbows will be used as well, do not discard.
22. To cut the reinforced silicone hoses, use a sharp razor blade and one of the supplied hose clamps. Slide the hose clamp onto the silicone hose and measure from the end of the hose to the edge of the clamp. The edge of the clamp will serve as a guide to help keep your cut edge straight. Tighten the clamp. Lightly cut around the hose, do not cut all the way through in one pass, this will be more difficult to cut straight. You can also clamp a small piece of the metal intercooler connecting tube inside of the silicone hose, this will help the silicone hose from collapsing from pressure while cutting.

**CAUTION:** Do not cut all the way through with the metal tube inside the silicone hose, you will damage the metal tube and your razor blades edge. Remove the metal tube before making your through cut.

23. A bandsaw also works to cut through the silicone hose, but you will not have as straight of edges, and it is also messy. If you use this method, **BE CERTAIN** to clean out the inside of the hose before installation.
24. Cut the metal intercooler connecting tubes from the raw stock. Use the lengths called for in the parts manual. Work your way from either the intercooler or the engine and connect the tubing and hoses as you go. Install clamps and tighten them down once happy with the fit.

### **AIR FILTER INSTALLATION**

25. The air filter is remotely mounted off the turbo. This is done to isolate the air filter from the heat and potential vibration. The air filter will orientate aft. Trim the 60-degree silicone hose as depicted in **FIGURE 11-05B/915iS**.
26. Slide the air filter connecting tube into the air filter, just enough that the tube is flush on the inside with the mounting flange of the filter. Install a hose clamp.
27. Slide the connecting tube into the 60-degree elbow and install a hose clamp.
28. Last push the assembly onto the turbo and install a hose clamp. Orientate the filter assembly from rubbing on any components. Check that the filter does not rub on the edge of the cowling.

## **ROTAX 915iS - THROTTLE 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.
  2. Drill a 1 1/8" hole in the firewall for the throttle eyeball fitting in the location depicted in **FIGURE 11-01L/915iS**.
  3. Drill the hole of the throttle eyeball fitting to the diameter of the throttle cable housing. This is easily done by leveling the internal portion of the eyeball fitting to the housing of the fitting, tightening the nut, and then clamping the whole unit in a drill press.
  4. Install the eyeball fitting in the firewall and Loctite in place.
  5. Remove lock washer and retaining nut from Throttle Cable Assembly.

6. Route Cables through center hole in Instrument Sub-panel. Secure with lock washer and retaining nut.
7. Route cable through the eyeball fitting to the throttle body. Route to avoid tight radii.
8. Install the adjustable cable ferrule into the throttle cable mount on the engine, next to the throttle body control arm. Route the cable to the ferrule and mark for trimming if needed.

**NOTE:** The Throttle Control can be pulled out slightly to allow for trimming of the Control Cable housings. Pay particular attention to the literature that comes with the throttle control on removal of the throttle pushrod.

**NOTE:** The throttle cable housing may require trimming the sheath away to fit in the ferrule, this is ok. Just use caution while cutting the sheath, the liner is strong, but avoid unnecessary cuts into it.

9. Insert the throttle cable housing into the ferrule and safety wire to the ferrule. Also, safety wire the ferrule to the throttle cable mount. Route the cable through the throttle body control arm cable clamp. Adjust the throttle for wide open throttle, leave approximately a ¼' gap between the throttle knob and the throttle control housing. This helps to ensure that you can reach full throttle when pushed in all the way.
10. Tighten the nut on the throttle body control arm cable clamp to hold onto the cable. Trim excess cable and crimp on the end cap.

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

## **ROTAX 915iS - 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 11-07/915iS**. 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. Trim prop opening flange of upper and lower Cowls to 1". Trim joggle areas of lower Cowl to 3/4". Trim open all the air inlets and the area of the lower trip lip. We typically leave the radius, and trim just on or just past it, this is done for cosmetic reasons. On the intercooler opening, trim just the forward face and leave the "ramp" to the opening. Refer to **FIGURE 11-07A/915iS**. A Dremel tool with a reinforced cut-off wheel works well for cutting. A drum sander and a block sander work well for smoothing rough cuts.
4. Apply two rows of 2" wide masking tape to the Boot Cowl aft of the cowling joggle. You want approximately 4 inches of tape aft of the cowling joggle all the way around the Boot Cowl.
5. Mark a line 3" aft of the joggle all the way around the fuselage.
6. Tape the lower cowling in position against the backing plate with 3/8" spacers. Line the cowling up evenly with the spinner backing plate, the oil cooler and radiator. 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.

7. Trim the edges of the lower cowling to the marked line and tape back in place on the fuselage.

**NOTE:** It is usually best to not cut on your line on the 1<sup>st</sup> cut. Cut just short of it and put the cowling back in place, check your line again, and then trim to your line.

8. Once satisfied with the placement of your lower cowling, drill #40 in four spots where your 1/4 turn fasteners will be on the lower cowling.
9. Slip the upper Cowl into place. The forward edge should touch the 3/8" spacers. The forward end of the upper Cowl should be positioned to allow an undisturbed flow of air off the Spinner Dome and should be centered side to side. Trim area around Prop Flange Opening to allow Cowling to align with Spinner Dome.

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

10. Re-adjust as needed and re-tape in place. The sides of the upper Cowl will lap over the lower Cowl until trimmed.
11. Mark and trim the upper aft edge of the upper Cowl to allow it to set into the joggle.

**NOTE:** The sides of the Cowl will be marked and trimmed after the upper Cowl is fit.

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

**NOTE:** You can drill #40 on the front by the inlets, from the top cowl to the bottom cowl, to help hold the cowling against each other tightly. Later these two holes can be filled with body putty and never seen.

13. Apply 2" wide masking tape to the lower Cowling below the joggle. You want approximately 2" of tape below the joggle all the way along the Cowling side. Mark a line 1.5" below the joggle.
14. 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.
15. The upper Cowling may need to be trimmed again. Everything changes a little when it settles in the joggle. Sand to final fit.
16. Measure and drill the positions for the fasteners #40 at the cowl to boot cowl joggle and cleco. Then on the cowl-to-cowl joggle. See **FIGURE 11-07B/915iS**.
17. Transfer drill all holes to #11 and cleco.
18. Final trim all the openings.
19. Refer to **FIGURE 11-07C/915iS**. Mark the opening position for the Oil Check Door on the upper side of the upper Cowl.

**HINT:** A Dremel tool with a reinforced cut-off wheel and small sanding drum works well.

20. Position Reinforcement Rings with fastener holes towards aft edge of cowl. Transfer drill the #30 perimeter holes and cleco in place. Center Maintenance Hatch in opening. Align holes for 1/4-Turns and transfer drill #30 through hinges. Cleco as you drill.

**NOTE:** Try to get the holes in the hinges all on a flat surface, if the holes begin to drift into the radius of the hinge, it will pull very hard on the oil door or the cowling and deform either part after riveted.

**NOTE:** Form the Maintenance Hatch and Reinforcement Ring to better contour to the upper Cowling if needed/desired.

21. Rivet 1/4 Turn Receptacles to bottom of Reinforcement ring.
22. Cleco 1/4 Turn Receptacles through #11 holes to inside of Boot Cowl Strips. Align and transfer drill #40 through Receptacles. Remove Receptacles.
23. Position 4 forward Nut Plates to inside of lower Cowling and the bottom of the boot cowl joggle, temporarily retain with Truss Head Screws and transfer drill #40. Remove Nut Plates
24. Step drill Receptacle holes to 5/16". Refer to **FIGURE 11-07D/915iS**.

**NOTE:** Rivet holes in the cowling may be countersunk for flush fit.

**IMPORTANT:** The 4 forward most holes must remain #11 for the #11 Screws.

25. Step drill the fastener holes to 1/4". Refer to **FIGURE 11-07D/915iS**.

**IMPORTANT:** The 4 forward most holes must remain #11 for the #11 Screws.

26. Trim aft edge of lower Cowling air exit per FIGURE 11K-28/912.
27. Paint Cowlings and Oil Access Door.

**(AFTER PAINTING OF COWLING AND OIL ACCESS DOOR)**

28. Rivet 1/4 Turn Receptacles and Nut Plates in place.
29. Install 1/4 Turn Fasteners in Cowlings. Refer to **FIGURE 11-07D/915iS**.
30. Install Cowling and admire.

**ROTAX 915iS - 12" SPINNER ASSEMBLY (FOR GROUND ADJUSTABLE PROP)**

**(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 **FIGURE 11-08/915iS**.

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

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

**CAUTION:** Always use proper safety equipment. Cut the opening slightly small and sand to exact fit.

7. Fit the Spinner Backing Plate onto the Prop Extension. Press the Prop hub onto the Extension. Test fit the Dome. Sand the openings to an exact fit. Allow at least 1/8" clearance between the Spinner and Prop.

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

**HINT:** Use 3 or 4 thin boards under the Backing Plate for support.

8. Remove Dome and mark hole locations on the Dome's perimeter to equally space screws between prop opening cut-outs. Refer to **FIGURE 11-08A/915iS**. Drill #40 through the marked locations.
9. Place the Spinner Dome over the Backing Plate/Prop Assembly with the Backing Plate sitting on a flat surface.

**HINT:** Use 3 or 4 thin boards under the Backing Plate for support.

10. Place the Spinner Dome in position. Press the Dome tight to the surface to ensure that the Dome and Backing Plate are flush. Transfer drill #40 and Cleco.
11. Remove clecos one at a time. Transfer drill #30. Cleco as you go. Final Size drill #11 and cleco. The Dome and Backing Plate must remain tight against the surface as you drill.
12. Dimple the Dome near one opening and dimple the Backing Plate corresponding to that opening for alignment markings. See **FIGURE 11-08B/915iS**.

**HINT:** Use a #11 bit and lightly press to make the dimples.

13. Assemble the Dome and Backing Plate each time with the dimples aligned.
14. Remove the dome and the prop from the backing plate and install the nut plates.

**HINT:** Use a short 3/16" bolt to hold the nut plate centered while drilling the ears #40.

**NOTE:** Counter sink the #40 holes to allow the heads of the rivets to sit flush with the Backing Plate flange.

15. See **FIGURE 11-08C/915iS**. "Set" the rivets by resting the head of the rivet against a vise and tapping the pulled end with a small hammer. Check for tightness. The nut plates must be snug.
16. The Spinner Dome is now ready for painting.
17. During final assembly, install the Prop Extension and Backing Plate on the engine prop flange. Install the prop. Refer to **PROPELLER INSTALLATION** and bolt the Spinner Dome in place.

18. The spinner and prop should be balanced, and no adjustment required. However, the ultimate test is in the running. If you experience a lot of vibration, it could be caused by out of balance or misalignment. Use a good prop balancer. Check both the prop and spinner assembly, if the misalignment is not correctable then a new spinner may be required. Misalignment occurs through improper alignment of the parts. A slight amount of "wobble" is acceptable and may disappear at higher RPM's. Always pre-flight your spinner.

## **ROTAX 915iS - PROPELLER INSTALLATION**

### **(FINAL INSTALL OF ENGINE)**

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

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

**HINT:** Start torque pattern on the blade that is out of track. See **FIGURE 11-09/915iS**. **DANGER:** Track prop with ignition OFF!!

8. Secure Spinner Dome to the Spinner Backing Plate. Refer to SPINNER ASSEMBLY.
9. Before first test flight, lock brakes, chock wheels and tie the tail to prevent unintentional aircraft run-away when checking Static RPM. Static (full throttle) RPM should be between 5100 - 5350 RPM.

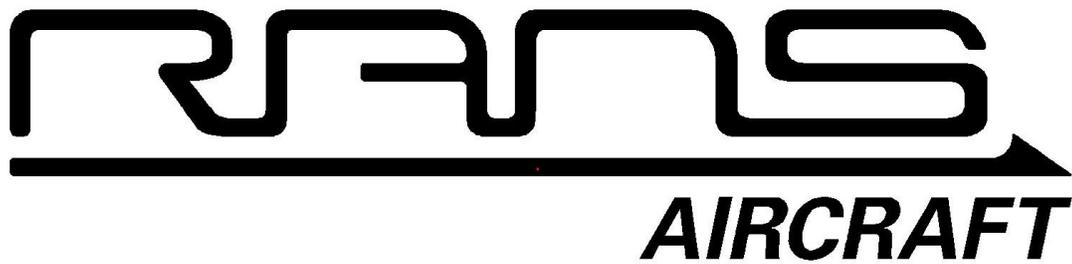
### **ROTAX 915iS – AIRMASTER PROP**

Please Refer to the manual that is included with your Airmaster Propeller for installation instructions.

### **OPTIONAL REMOTE CHARGE POST**

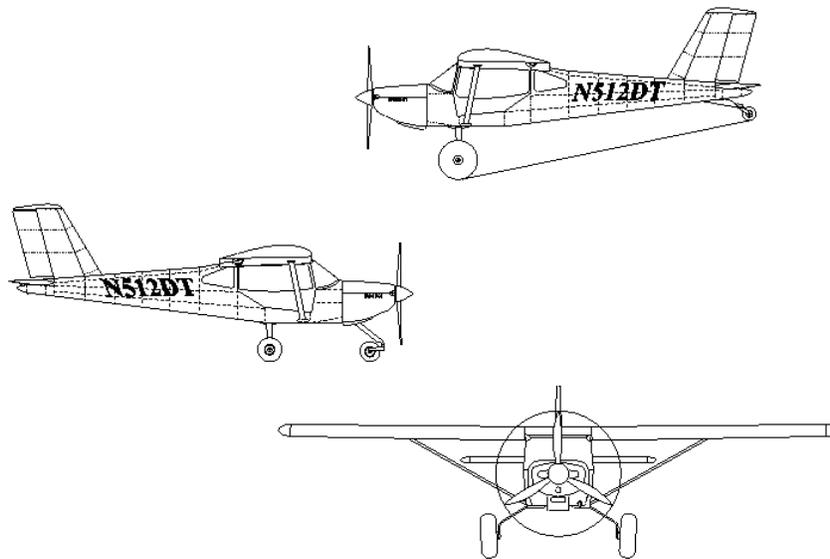
1. Transfer drill the remote charge isolating block mount holes to the lower forward lip of the boot bowl. Be certain that where you intend to mount it, it is out of the way of the cowling once installed. Also be certain the supplied battery cable will make it to your planned mounting spot. If building a trike, be sure it won't interfere with the trike nose gear mount.
2. Push the 1/4" bolt through the isolator block. Silicone the head side of the bolt, in the holes of the isolator block, to keep it from shorting out on any metal.
3. Install the isolator block with the hardware supplied. Silicone the head side of the mounting hardware, in the holes of the isolator block.
4. Route the 4awg electrical cable from the positive terminal of the isolator block to the battery or the hot side of the master solenoid.
5. Install the battery cable terminal covers.

**NOTE:** The supplied remote charging post and battery cable can be used for charging a battery and jump starting. If you jump start, please be careful!!



# ***S-21 OUTBOUND***

## **OPERATIONS MANUAL**



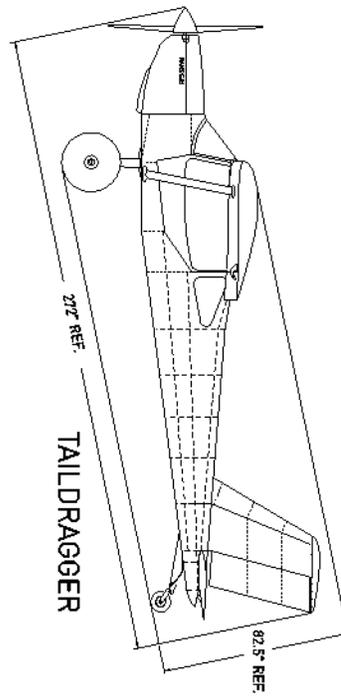
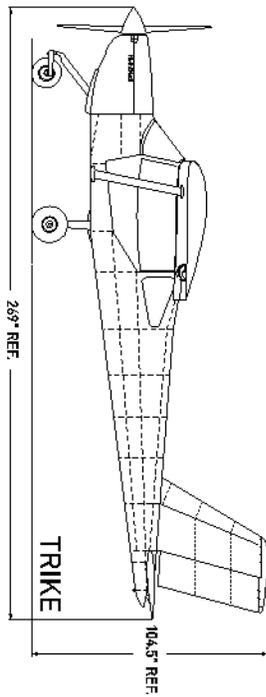
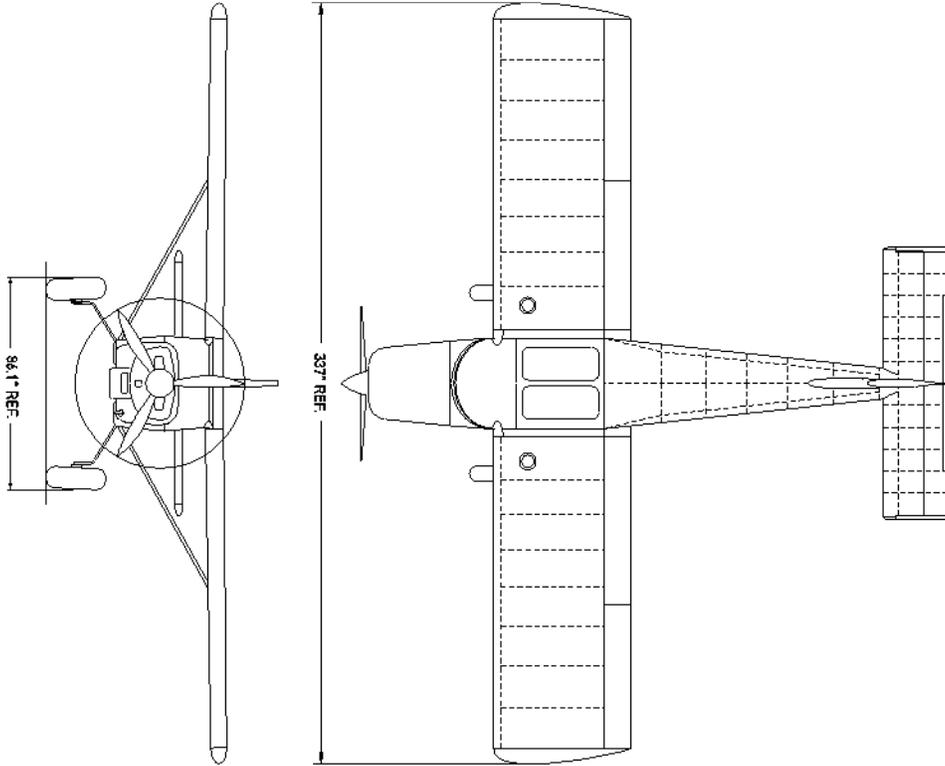
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## **RANS S-21 OUTBOUND - THREE VIEW**



## GENERAL INFORMATION

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

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

### ENTERING AND EXITING AIRCRAFT

To enter the S-21 OUTBOUND:

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

To exit the S-21 OUTBOUND:

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

### CAUTION

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

## DOORS

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

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

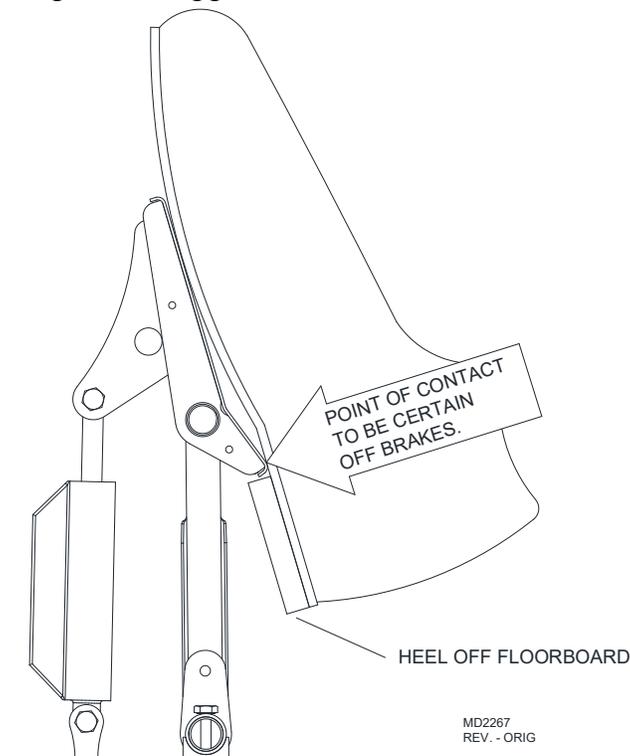
### **Flying with doors open or removed.**

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

The S-21's doors should not be opened at airspeeds above 65 mph. A loss in lift, climb, and cruise speed is to be expected with the doors open or off.

## STEERING AND BRAKING

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



**FIGURE 14-01: STEERING AND BRAKING**

## OPERATING LIMITATIONS

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

The Engine Operators Manual must be onboard the aircraft.

### AIRSPPEED LIMITATIONS

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

All speeds are given for maximum takeoff weight.

Speeds are given in MPH and (KNOTS)

	<b>Airspeed</b>	<b>IAS</b>	<b>Remarks</b>
<b>VNE</b>	Never Exceed Speed	215 (187)	<b>DO NOT</b> exceed this speed in any operation
<b>VA</b>	Maneuvering Speed at maximum gross weight	135* (117)*	<b>DO NOT</b> make full or abrupt control movements above this speed.
<b>VFE</b>	Maximum Flap Extended Speed	80 (70)	<b>DO NOT</b> exceed this speed with flaps extended.
<b>VSO</b>	Stall speed**	40 (35)	Flaps full down. Speed may vary due to your specific aircraft
<b>VS</b>	Stall speed**	49 (43)	Flaps up. Speed may vary due to your specific aircraft

**TABLE 14A-1: AIRSPPEED LIMITATIONS**

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

\*\* Power-off configuration

**AIRSPEED INDICATOR MARKINGS**

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

Marking	IAS Value or Range	Meaning
White Arc	40 - 80 (35 - 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	49 - 135 (43 - 117)	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	135 - 215 (117 - 187)	Operation must be conducted with caution and in smooth air only.
Red Line	215 (187)	Maximum speed for all operations

**TABLE 14A-2: AIRSPEED LIMITATIONS****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 - 1800 lbs.
Maximum Takeoff Weight	1320 – 1800 lbs.
Maximum Landing Weight	1320 – 1800 lbs.
Maximum weight in Baggage Compartment	120 lbs.

**CENTER OF GRAVITY LIMITS**

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

**MANEUVER LIMITS**

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

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

**FLIGHT LOAD FACTOR LIMITS**

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

**FLIGHT CONDITIONS OPERATION LIMITS**

Flight into known icing conditions is prohibited.

This aircraft is limited to two occupants only.

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

Intentional flights into known icing conditions are prohibited.

**FUEL LIMITATIONS**

Approved Fuel Grades: Unleaded automotive (ASTM D 4814) gasoline with minimum AKI (Anti Knock Index) of 91 (R+M)/2 – 10% alcohol permitted.

Or

Avgas 100 LL Grade Aviation Fuel (blue)

► for other fuel see ROTAX Operators Manual supplied with your engine.

**Fuel Capacity:**

Total Capacity:	49.9 US Gal.
Capacity each wing tank:	21.5 US Gal.
Capacity Header tank:	6.9 US Gal.
Total Usable:	44.9 US Gal.
Total Unusable:	5 US Gal.

► **NOTE:** If there is substantial delay (15 minutes) between fueling each wing tank, the tanks should be checked if topped due to possible cross feed.

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

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

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

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

## OTHER LIMITATIONS

### Flap Limitations:

Approved Takeoff Range: ...retracted, 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> notch flaps (0° to 33.5°)

Approved Landing Range: retracted to full flaps (0° to 45°)

## WEIGHT AND BALANCE

### INTRODUCTION

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

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

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

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

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

### AIRPLANE WEIGHING PROCEDURES

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

2. Leveling:

#### TAILDRAGGER

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

## TRIKE

- Shim scales to measure 90° at aft door frame. Refer to **FIGURE 13-03**.
  - Place scales under each wheel (500 lb. minimum capacity is recommended)
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-21 OUTBOUND is a simple aircraft and so are the weight and balance calculations.

The S-21 OUTBOUND is limited to two occupants.

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

The compartment is rated for 80 lbs

Baggage should be secured securely for flight.

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

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

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

Calculate the moments (Weight x Arm).

Add moments to obtain total moment.

Add weights to obtain total weight.

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

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

Repeat for landing configuration.

## **EMERGENCY PROCEDURES**

### **INTRODUCTION**

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

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

**The following material is provided for guidance only.**

### **AIRSPEEDS FOR EMERGENCY OPERATION (IAS)**

<b>Engine Failure After Takeoff</b>	Flaps UP	66 MPH
	Flaps DOWN	59 MPH
<b>Maneuvering Speed</b>		
		125 MPH
<b>Maximum Glide</b>	Flaps UP	68 MPH
<b>Precautionary Landing with</b>	Flaps UP	60 MPH
<b>Engine Power</b>	Flaps DOWN	55 MPH

<b>Landing without Engine</b>	Flaps UP	70 MPH
<b>Power</b>	Flaps Down	65 MPH

## OPERATIONAL CHECKLISTS

### ENGINE FAILURE

#### **Engine Failure During Takeoff Run:**

Fly the Airplane!

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

#### **Engine Failure Immediately After Takeoff**

Fly the Airplane!

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

#### **Engine Failure During Flight**

Fly the Airplane!

- (1) Airspeed - 68 MPH for best glide
- (2) Select Emergency Landing Area - PROCEED To It.
- (3) Attempt Engine RESTART.
- (4) Ignition - Check ON.
- (5) 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 60 MPH (Flaps UP).  
55 MPH (Flaps full DOWN) (Use flaps as required for  
landing site).
- (4) Master Switch - OFF.
- (5) Doors - OPEN.
- (6) Touchdown - MINIMUM FLIGHT SPEED.
- (7) Ignition - OFF.
- (8) Brakes - APPLY As Needed.

## **FIRES**

### **During Start On Ground**

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

If Engine Starts:

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

If Engine fails to Start:

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

### **Engine Fire In Flight**

Fly the airplane!

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

**Electrical Fire In Flight**

Fly the airplane!

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

**RECOVERY FROM A SPIRAL DIVE**

If a spiral dive is encountered, proceed as follows:

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

**SPINS**

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

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

## AMPLIFIED PROCEDURES

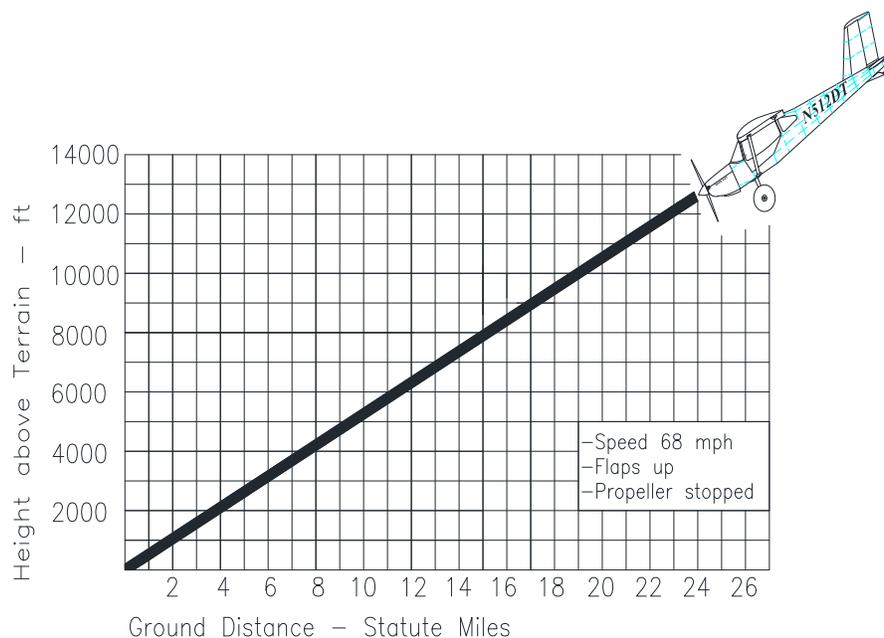
### ENGINE FAILURE

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

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

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

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



## **FORCED LANDINGS**

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

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

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

Transmit Mayday message on 121.5 MHz giving location and intentions.

## **RECOVERY FROM A SPIRAL DIVE**

If a spiral dive is encountered, proceed as follows:

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

## **SPINS**

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

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

### **IGNITION MALFUNCTION**

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

### **CARBURETOR ICE**

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

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

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

### **DOORS**

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

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

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

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

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

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

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

## NORMAL PROCEDURES

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

**PRE-FLIGHT INSPECTION**

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

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

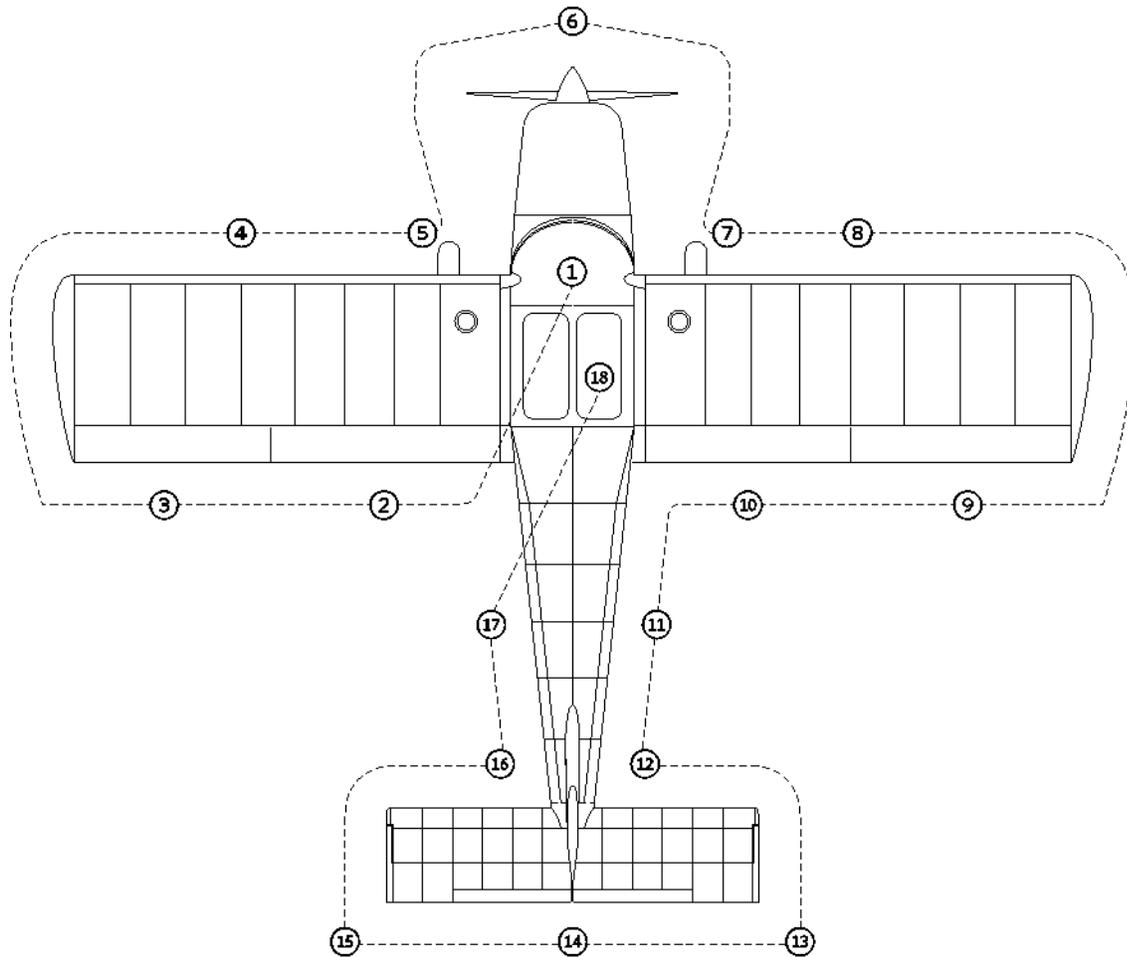


FIGURE 14D-01

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

**1.**

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

**2.**

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

**3.**

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

**4.**

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

5.
  - Main Gear - CHECK
  - Main wheel tire - PROPERLY INFLATED
  - Brakes - SECURE
  - Fuel Filler Cap - CLOSED
  
6.
  - Remove Cowling if desired
  - Fuel quick drain valve on bottom of cowling (left side); - DRAIN & CHECK for water, sediment and proper fuel grade.
  - Engine oil dipstick/ filler cap - CHECK oil level, than check filler cap secure
  - Carburetor and air filter – CHECK security
  - Radiator fluid over-flow bottle – CHECK fluid level
  - Propeller and spinner – CHECK for nicks, dents and security
  - Engine cooling air inlets and oil cooler – CHECK of obstructions
  - Engine cooling air outlet, radiator – CHECK of obstructions
  - Exhaust – CHECK – loose or damaged
  - TRIKE - NOSEWHEEL - CHECK
  
7.
  - Main Gear - CHECK
  - Main wheel tire - PROPERLY INFLATED
  - Brakes - SECURE
  - Fuel Filler Cap – CLOSED
  
8.
  - Strut to Wing Connection - SECURE
  - Leading edge spar - STRAIGHT, DENT FREE & INTACT
  - Pitot/Static Tube - SECURE
  - Wing tie down - DISCONNECT
  
9.
  - Aileron Hinge points - SECURE
  - Trailing edge spar - STRAIGHT & INTACT
  - Aileron connections - INTACT
  - Aileron - Operation - free & correct
  - Strut to Wing connection - SECURE
  
10.
  - Wing Root connection - SECURE
  - Flap hinge points - SECURE
  - Trailing edge spar - STRAIGHT & INTACT
  - Flap connections - INTACT

11.  Tailcone - Check for dents, holes and scratches.
12.  Fuselage connections - CHECK  
 Horizontal Stabilizer and Vertical Stabilizer - CHECK
13.  Control surfaces - CHECK - free movement and SECURE  
 Hinge points – SECURE
14.  TAILDRAGGER - TAILWHEEL - CHECK - Rudder cable and springs - SECURE  
 TRIKE - CHECK - Rudder cable - CHECK - SECURE  
 Rudder - CHECK and SECURE  
 Tail tie down - DISCONNECT
15.  Control surfaces - CHECK - free movement and SECURE  
 Hinge points – SECURE
16.  Fuselage connections - CHECK  
 Horizontal Stabilizer and Vertical Stabilizer - CHECK
17.  Tailcone - Check for dents, holes and scratches.  
 Fuel quick drain valve on bottom of fuselage forward of Station 3 (left side); - DRAIN & CHECK for water, sediment and proper fuel grade
18.  Climb aboard  
 Cockpit checklist - CHECK  
 Move seat into flight position – CHECK SECURE  
 Seat belts - SECURE  
 CONTROLS - FREE and CORRECT  
 Altimeter - SET  
 Communication radio - SET  
 Transponder - SET  
 Fuel – CHECK QUANTITY  
 Hour meter - Note reading and time  
 Engine controls - SET - throttle closed  
 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
- Control deflections as required for wind
- 

#### **BEFORE TAKEOFF**

- Cabin Doors - CLOSED and SECURED
- Parking Brake - SET
- Flight Controls - FREE and Correct

- Flight Instruments - SET
- Elevator Trim - SET FOR TAKEOFF (center of indicator)
- Fuel Selector Valve - ON
- Fuel Quantity - CHECK
- 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 - RELEASETAKEOFF

#### **Normal Takeoff**

- Flaps – UP or 1<sup>st</sup> or 2<sup>nd</sup> 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 - 3<sup>rd</sup> 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 (Max. continues)
- Elevator Trim - adjust.
- Fuel pump – OFF

**APPROACH**

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

**BEFORE LANDING**

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

**LANDING****Normal Landing**

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

**Short Field Landing**

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

**Balked Landing**

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

**AFTER LANDING**

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

**SECURING THE AIRCRAFT**

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

## AMPLIFIED-PROCEDURES

**PRE-FLIGHT INSPECTION**

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

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

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

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

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

**TAXING (Ground Handling)**

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

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

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

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

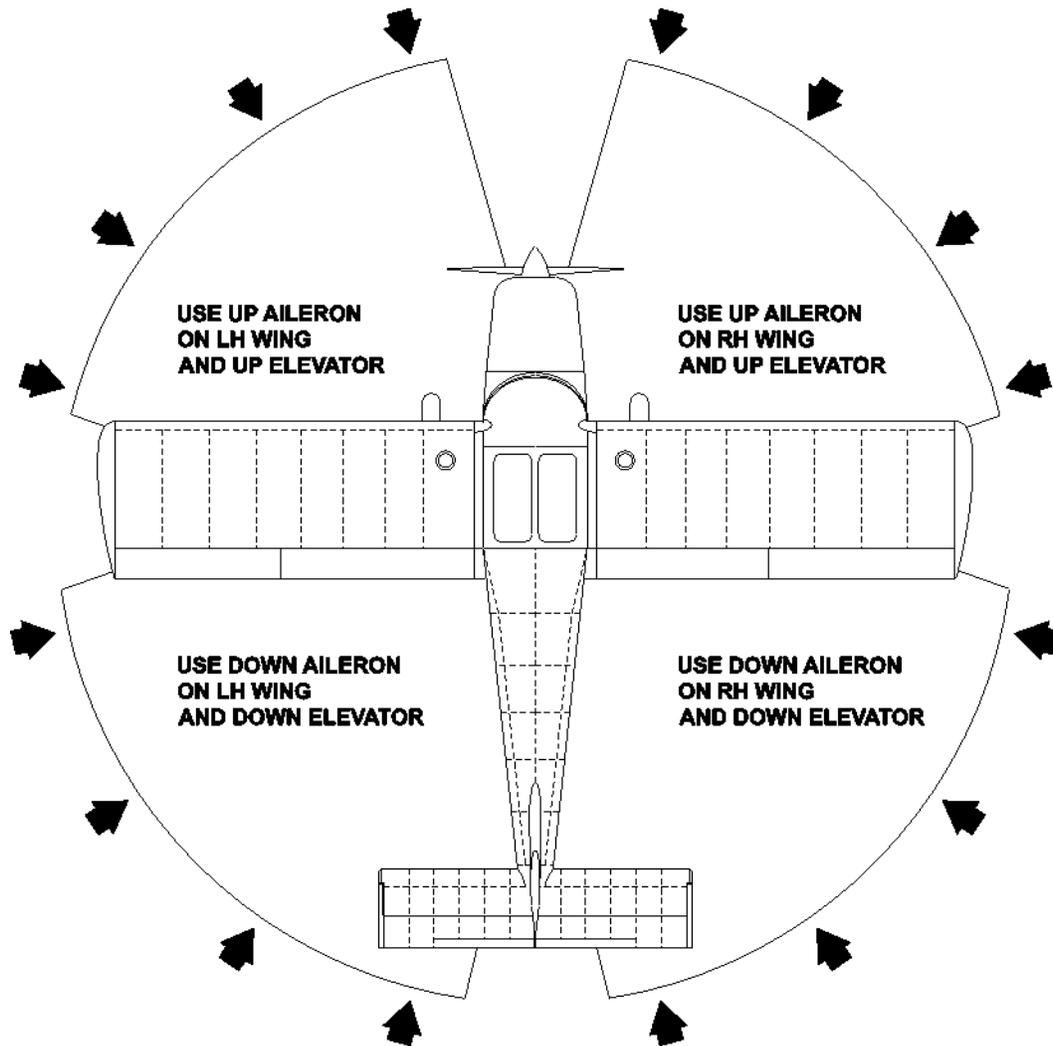


FIGURE 14D-02

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

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

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

### **FLAP SETTINGS**

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

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

### **SECURING THE AIRCRAFT**

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

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

The type of tie-downs used is a matter of personal choice. A good "rule-of-thumb" is to ensure that what you secure the aircraft to (and with) will restrain at least 1800 lbs at each tie-down location. Secure the controls in the cockpit and use the following tie down points:

- Tail
    - Taildragger – Tail Gear
    - Trike – Tie Down Ring at aft of fuselage
  - Wings – through Tie-Down under each wing, near top of Lift Strut
- If strong winds or gusts are advised, seek shelter for the aircraft.

## HOT WEATHER OPERATION

Avoid prolonged engine operation on the ground.

Turn the airplane into the wind to assure better airflow through the cowling during run up.

Monitor engine temperatures and adjust climb speed as required. A higher climb speed will provide better engine cooling.

## AIRCRAFT CARE

### INTRODUCTION

If your airplane is to retain that new airplane performance and dependability, certain inspection and maintenance requirements must be followed. It is recommended to follow a planned schedule of lubrication and preventive maintenance based on the climatic and flying conditions encountered.

### GROUND HANDLING

**TAILDRAGGER** - On the ground, the aircraft is most easily maneuvered by hand using the handles in the tailcone near the horizontal stabilizer. The aircraft has a 360-degree full-swivel tail wheel, which is connected to the rudder by a centering cam. You can disengage the tail wheel through pushing sideways on the rear fuselage (using the handles on the sides of the tailcone near the horizontal stabilizer) and allow it to swivel freely in any direction. This will help you to maneuver the aircraft in tight spaces.

**TRIKE** - On the ground, the aircraft is most easily maneuvered with the use of a hand tow bar attached to the nose wheel. If no tow bar is available, then back up maneuvering may be done by hand by pushing down on the leading edge of the Horizontal Stabilizer near the spar, thereby lifting the nose wheel and allowing easier maneuvering. Forward maneuvering may be done by pulling at the prop close to the nose cone spinner.

**CAUTION:** Never pull on the propeller near the tips, always near the hub. Be careful not to dent or deform the sheet metal when performing any ground handling procedure.

## WINDSHIELD AND WINDOWS

The windshield is made from Acrylic. The skylight and windows are made from Lexan.

### CAUTION

**Do NOT allow fuel to contact windshield or doors.**

**Fuel will harm these surfaces.** If fuel is spilled on the Acrylic or Lexan surfaces, wipe clean with a clean cloth immediately to lessen the chance of crazing damage.

**IMPORTANT: Always close the doors when you re-fuel the aircraft.** Otherwise, it is possible that spilled fuel will run around the wing trailing edge and drop on the open door.

Clean the windshield with plenty of water and if you need to, with a mild detergent in low concentration. Rinse thoroughly and dry with a clean soft cloth or towel.

RANS recommends "Brilliance" for windshield care. Brilliance is available through RANS Parts Department.

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

## PAINTED SURFACES

The painted exterior surfaces of your S-21 OUTBOUND aircraft should have a durable and long lasting finish.

No polishing or buffing will be required under normal conditions.

It is recommended to keep your aircraft out of the sun as much as possible.

If you keep your aircraft outside it is recommended to wax the exterior surface.

It is also recommended to clean the exterior surface of your airplane on a regularly base. This can also be accomplished with "Brilliance". It is possible to wash the airplane carefully with water and a mild soap, followed by a rinse with clean water and drying with a soft cloth.

**INTERIOR CARE**

Use a vacuum cleaner to remove dust and loose dirt from the interior and upholstery.

Household spot removers or upholstery cleaner may also be used for the seat upholstery. Always test it on an obscure place on the fabric to be cleaned.

The plastic baggage enclosure and Station 3 Closeout sides can be cleaned with a damp cloth and an automotive plastic interior care product.

The instrument panel, control knobs need only be wiped off with a damp cloth.

## REQUIRED PLACARDS AND MARKINGS

### AIRSPEED INDICATOR MARKINGS

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

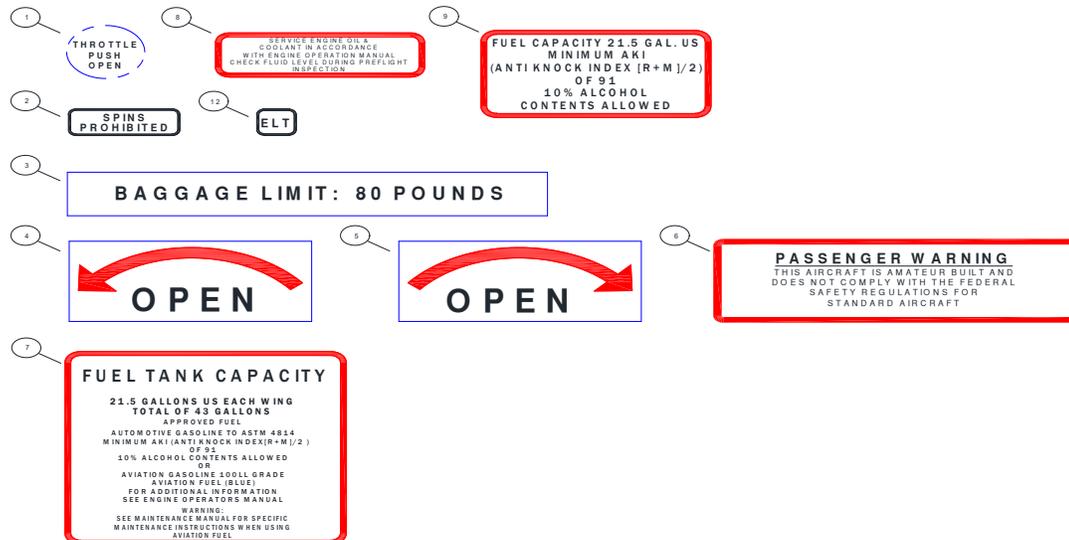
Marking	IAS Value or Range	Meaning
White Arc	38 – 110 (33 - 96)	Full Flap Operating Range - Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 – 125 (41 – 110)	Normal Operating Range - Lower limit is maximum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

**Table 14F-1. Airspeed Indicator Markings**

## PLACARDS

The following labels and placards contain important information needed for proper operation of the S-21 OUTBOUND and must be displayed in the location described in this section.

Placards may be printed by a local graphics shop or are available from RANS Parts Department.



Placards are NOT shown to scale.

In full view on end of throttle knob.

1. In full view of the pilot on the instrument panel.
2. In full view both sides of Baggage Compartment.
3. Left door besides door latch handle.
4. Right door besides door latch handle.
5. Passenger Warning on lower right side of instrument panel.
6. Wing root enclosure in clear view from the pilot seat.
7. Inside of oil check door (cowling).
8. Near fuel caps of both fuel tanks.
9. On both door top longerons in view of pilot.
10. On left and right fuel sight gauge.
11. Besides ELT remote control on instrument panel
12. All range markings on instrument front face as shown. (Valid for Analog gauges)
13. Placard "**EXPERIMENTAL**" in 2" letters on inside of left and right cabin doors.

## SUPPLEMENTARY INFORMATION

### FAMILIARIZATION FLIGHT PROCEDURES

The pilot should familiarize themselves thoroughly with this Manual, Engine Operators Manual, applicable Aviation Regulations, and the aircraft itself, before any solo flight is attempted.

Scope and detail of a familiarization flight will depend on level of experience and currency of the pilot.

Any familiarization flight shall include at least all Normal Procedures including a pre-flight inspection.

It is also recommended to perform slow flight, power off stalls in clean and flapped configuration.

All emergency procedures including recovery from a spiral dive or spin shall get at least reviewed.

For pilots with little or no experience in light aircraft, additional the special characteristics of such shall be reviewed.

### PILOT OPERATING ADVISORIES

The S-21 OUTBOUND shall only be operated by pilots with proper training.

Always deflect the controls as required in windy conditions.

The S-21 OUTBOUND is equipped with brakes on the passenger rudder pedals. Always brief the passenger to remove their feet from the pedals, at least for takeoff and landing.

Additional passenger briefings are recommended as required.

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

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

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