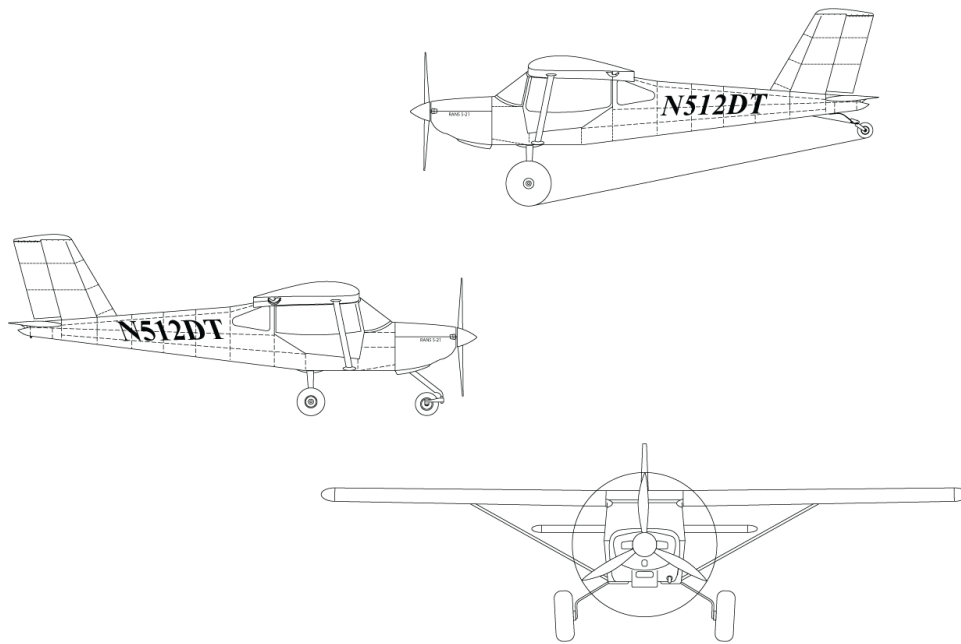




# ***S-21 OUTBOUND***

**ROTAX 912ULS INSTALLATION**

**TEXT MANUAL**



Serial Number:

Registration Number:

COPYRIGHT ©

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

09/11/2018

**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 912 ULS INSTALLATION

### NOSE GEAR INSTALLATION

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

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

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

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

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

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

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

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

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

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

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

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

**IMPORTANT:** Do NOT remove any more material than necessary.

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

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

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

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

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

## **ROTAX 912 ULS - ENGINE MOUNT INSTALLATION**

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

#### **ASSEMBLY**

1. Become familiar with the ROTAX 912uls **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.
2. Install parts referring to **PARTS MANUAL DRAWINGS** and **FIGURES 11-01/912** through **11-11/912**

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

#### **ENGINE MOUNT INSTALLATION**

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

## **ROTAX 912 ULS - BATTERY BOX ASSEMBLY & INSTALLATION**

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

#### **ASSEMBLY**

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

#### **INSTALLATION**

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

## **ROTAX 912 ULS - FUEL SYSTEM - FIREWALL FORWARD**

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

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

### **INSTALLATION WITHOUT OPTIONAL GASCOLATOR**

**NOTE:** Contact ROTAX for recommended Fuel Filter.

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

### **INSTALLATION WITH OPTIONAL GASCOLATOR**

6. The Gascolator Mount should have been riveted to the firewall during **ENGINE ACCESSORY INSTALLATION**.
7. Install fittings in Optional Gascolator. Orientate fittings per parts page drawing. Remove wire bail from Gascolator and remove bowl. Slip bail into fore and aft holes in Mount. Install top portion over mount and retain with wire bail. Re-install bowl.

**IMPORTANT:** Gascolator has an INLET and OUTLET side. Orientate INLET side outboard.

8. Connect Fuel Line Assembly from firewall fitting to INLET fitting of Gascolator. Ends of Fuel Line Assembly may be turned as required.
9. Connect fuel line from engine fuel pump to OUTLET side of Gascolator. Tighten all connections.

### **RETURN LINE INSTALLATION**

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

## **ROTAX 912 ULS - FUEL SYSTEM - FUSELAGE**

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

### **HEADER TANK ASSEMBLY**

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

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

<b>DOUBLE &amp; TRIPLE CHECK HOLE LOCATIONS BEFORE DRILLING.</b>
--

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

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

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

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

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

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



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

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

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

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

### **FUEL VALVE INSTALLATION**

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

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

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

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

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

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

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

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

#### **OPTIONAL ELECTRIC FUEL PUMP**

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

## **ROTAX 912 ULS - COOLING SYSTEM INSTALLATION**

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

#### **ASSEMBLY**

1. Refer to the parts catalog and select the required components for assembly.
2. The items below should have been done before installing the engine to the Engine Mount. If not, then do so before proceeding.
  - Rotate the water pump inlet on engine to the lower right position. Retighten screws to 90 in. lbs.
  - Completely remove Rotax installed coolant hose attached to AFT cylinder head coolant fitting. Move the Aft end of the remaining coolant hose to the upper water pump fitting. Install the "S" shaped radiator hoses from aft cylinder head coolant fittings to lower water pump fittings. The "S" end will attach to the lower water pump fitting. The "S" hose prevents coolant hose conflict with the engine mount. Install on both right and left aft fittings. Trim hose as required to prevent binding.

3. Attach Radiator Mounts to top of Radiator with Cushion Clamps and hardware shown and attach to Engine Mount tubes as shown. Leave the nuts and bolts slightly loose to allow adjustment. Tighten after final positioning. Refer to **FIGURE 11C-03/912** for Clamp locations.

**NOTE:** Notice the orientation of the Cushion Clamps.

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

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

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

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

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

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

### **OPTIONAL HEATER INSTALLATION - RADIANT STYLE**

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

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

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

15. Attach the Nipples to the Heater Core.

**CAUTION:** When working with the Heater Core, be careful not to over-tighten, or cracking may result. When tightening the fittings, it is necessary to use a wrench to support the fitting.

16. Locate the Tees for the heater system. One Tee is located between the Coolant Pump Inlet and the Radiator Outlet. The second Tee is located in the Radiator Hose that comes directly out of the Expansion Bottle on top of the engine.
17. The Heater Core Assembly may be attached to two brace tubes aft of Station 1. Place the Heater Core so the fan is blowing air down and back into the cabin. Check for possible interference with panel instruments and Rudder Pedals. Use Cushion Clamps to secure to the tubes.
18. Route Heater Hose from Heater Core fittings to Tees forward of the firewall.
19. Locate the Control Valve in the Heater Hose attached to the Tee in the line coming from the Expansion Bottle. Locate the Valve in a location that allows connecting of the Control Cable.

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

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

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

## ROTAX 912 ULS - LUBRICATION SYSTEM INSTALLATION

### (FINAL INSTALL OF ENGINE) ASSEMBLY

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

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

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

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

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

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

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

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

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

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

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

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

## **ROTAX 912 ULS - MUFFLER ASSEMBLY**

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

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

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

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

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

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

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

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

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

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

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



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

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

### **ROTAX 912 ULS - OPTIONAL MUFFLER HEATER INSTALLATION**

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

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

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

9. Cleco Air Diverter to Firewall. Opening should be orientated downward.
10. Locate and secure Control Cable in Instrument Panel. Keep this in mind when planning your instrument panel layout. Slip Control Friction Block over Control Cable and slide to end of housing. The Socket Head Cap Screw can be tightened to provide friction on the control wire to prevent movement from vibration.
11. Route Cable to Adjustable Cable Ferrule in Air Diverter and trim housing to length.  
**CAUTION:** Pull control knob out at least 5" before cutting to prevent cutting control wire too short.
12. Push control knob in, inserting control wire through Adjustable Ferrule and Reverse Cable Stop. Safety wire Control Cable housing to Adjustable Ferrule.
13. Install small Set Screws with Loctite into Reverse Cable Stop. Make sure control knob and slide of Air Diverter are all the way forward. Trim control wire to length. Tighten small Set Screws to retain wire.  
**HINT:** Removing Air Diverter Assembly with Control Cable attached from Firewall may aid in installing the small Set Screws.
14. Rivet Air Diverter to Firewall.
15. Route Duct Hose from outlet Heater Flange on Muffler Wrap to Air Diverter. Secure with Hose Clamps.

## **ROTAX 912 ULS - THROTTLE CONTROL ASSEMBLY**

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

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

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

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

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

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

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

## ROTAX 912 ULS - CHOKE CONTROL ASSEMBLY

### (FINAL INSTALL OF ENGINE) ASSEMBLY

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

## ROTAX 912 ULS - ENGINE ELECTRICAL

### (FINAL INSTALL OF ENGINE)

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

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

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

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

## ROTAX 912 ULS - 12" SPINNER ASSEMBLY

### (FINAL INSTALL OF ENGINE)

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

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

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

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

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

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

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

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

## **ROTAX 912 ULS - COWLING ASSEMBLY & INSTALLATION**

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

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

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

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

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

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



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

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

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

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

## ROTAX 912 ULS - PROPELLER INSTALLATION

### (FINAL INSTALL OF ENGINE)

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

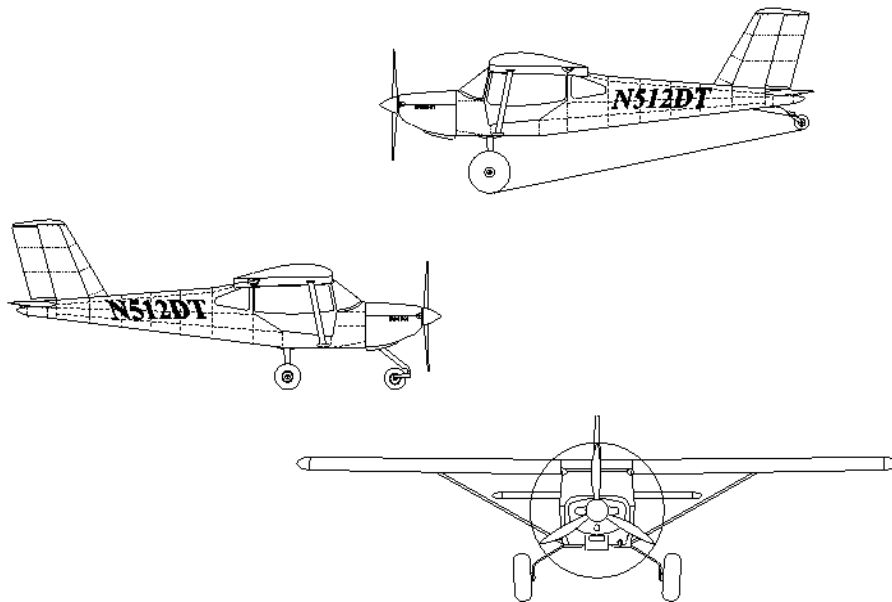
**DANGER:** If bolts are bottomed out on the threads, the prop is not properly torque, separation from the aircraft during operation may occur.
  6. Use a star pattern and torque the bolt per Manufacturer's instructions. Re-torque bolts after 5 hours of flight and thereafter according to Manufacturer's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

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

# RANS

## *S-21 OUTBOUND*

### OPERATIONS MANUAL



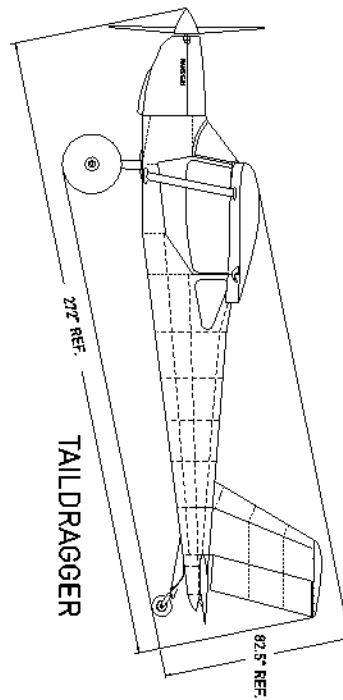
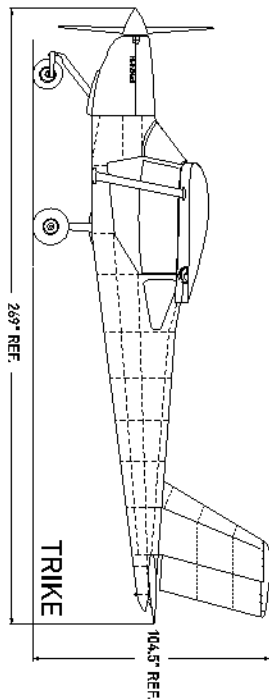
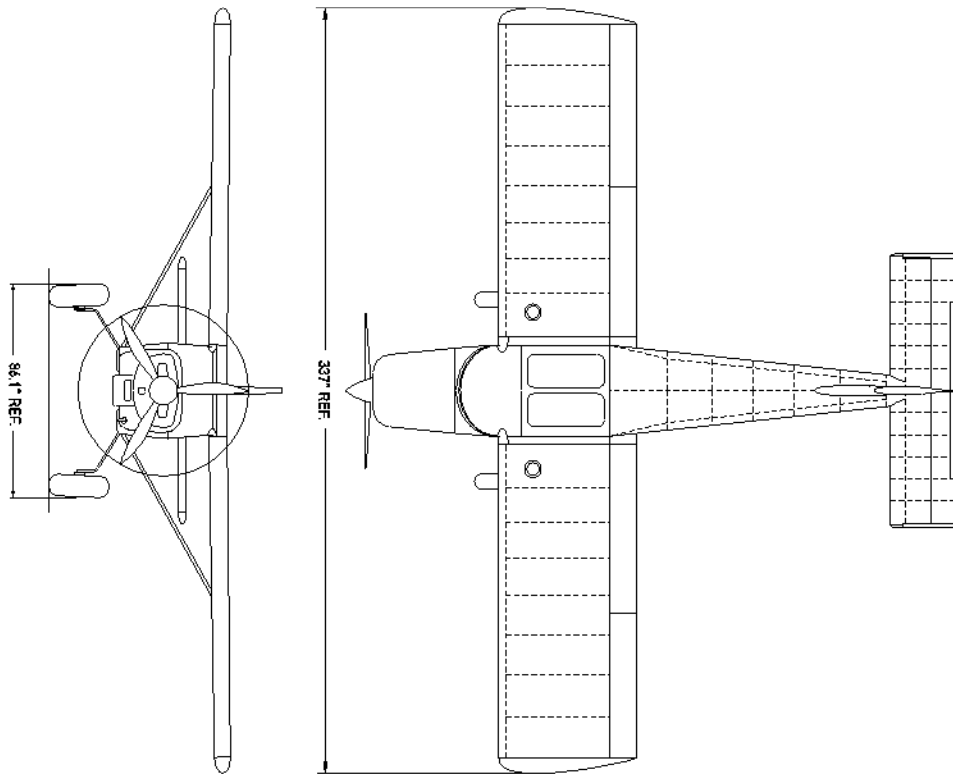
Serial Number:

Registration Number:

COPYRIGHT ©

RANS DESIGNS  
4600 HWY 183 Alt  
HAYS, KANSAS, USA 67601  
785-625-6346  
[www.rans.com](http://www.rans.com)

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



## **GENERAL INFORMATION**

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

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

### **ENTERING AND EXITING AIRCRAFT**

To enter the S-21 OUTBOUND:

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

To exit the S-21 OUTBOUND:

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

### **CAUTION**

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

## DOORS

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

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

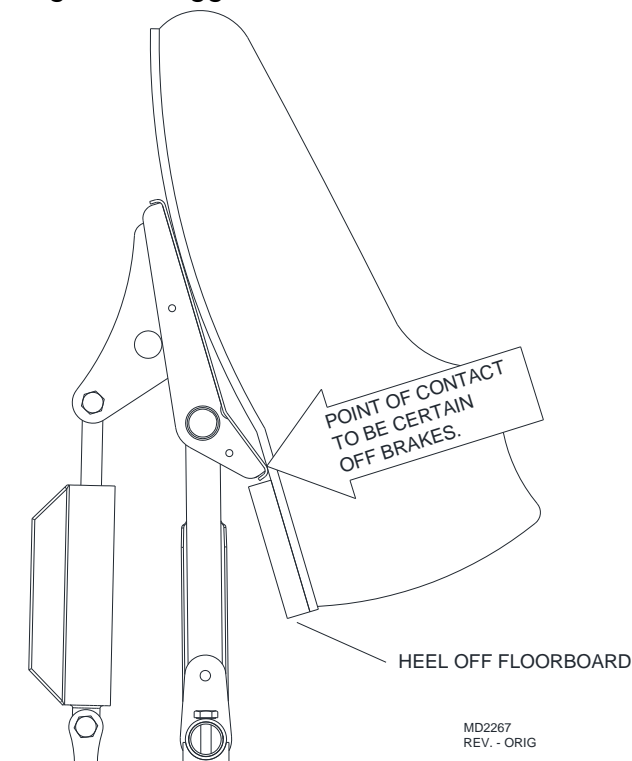
## **Flying with doors open or removed**

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

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

## **STEERING AND BRAKING**

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



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

## OPERATING LIMITATIONS

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

The Engine Operators Manual must be onboard the aircraft.

### 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	160 (139)	<b>DO NOT</b> exceed this speed in any operation
<b>VA</b>	Maneuvering Speed at maximum gross weight	125* (110)*	<b>DO NOT</b> make full or abrupt control movements above this speed.
<b>VFE</b>	Maximum Flap Extended Speed	110 (96)	<b>DO NOT</b> exceed this speed with flaps extended.
<b>VSO</b>	Stall speed**	38 (33)	Flaps full down Speed may vary due to your specific aircraft
<b>VS</b>	Stall speed**	47 (41)	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	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 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 lbs
Maximum Takeoff Weight	1320 lbs
Maximum Landing Weight	1320 lbs
Maximum weight in Baggage Compartment	80 lbs

**CENTER OF GRAVITY LIMITS**

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

**MANEUVER LIMITS**

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

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

**FLIGHT LOAD FACTOR LIMITS**

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

**FLIGHT CONDITIONS OPERATION LIMITS**

Flight into known icing conditions is prohibited.

This aircraft is limited to two occupants only.

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

Intentional flights into known icing conditions are prohibited.

**FUEL LIMITATIONS**

Approved Fuel Grades:           Dependent on engine used

Fuel Capacity with 2.75 gallon header tank:

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

► **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> or 2<sup>nd</sup> notch flaps (0° to 17.5°)  
Approved Landing Range: retracted to full flaps (0° to 40°)

## WEIGHT AND BALANCE

### INTRODUCTION

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

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

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

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

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

### AIRPLANE WEIGHING PROCEDURES

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

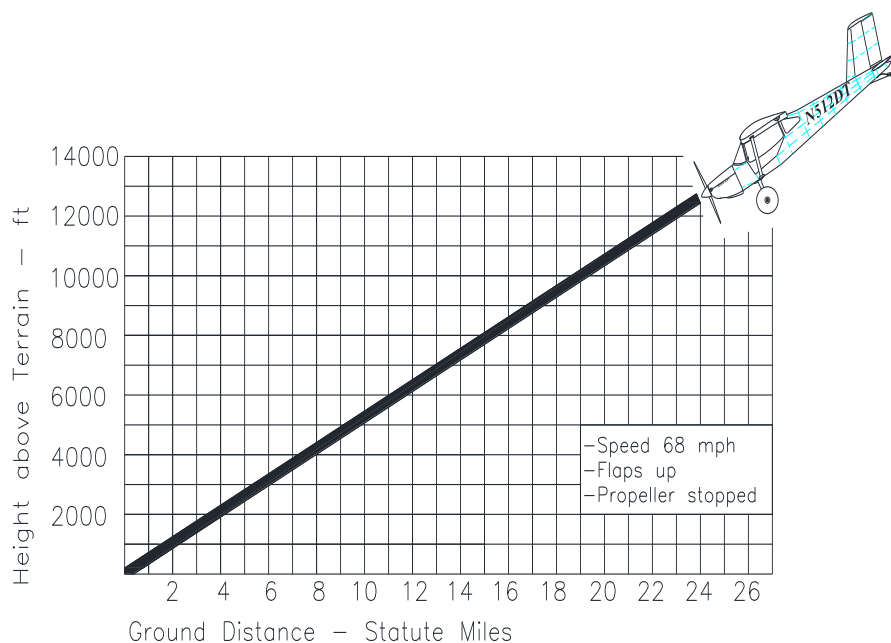
### ENGINE FAILURE

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.

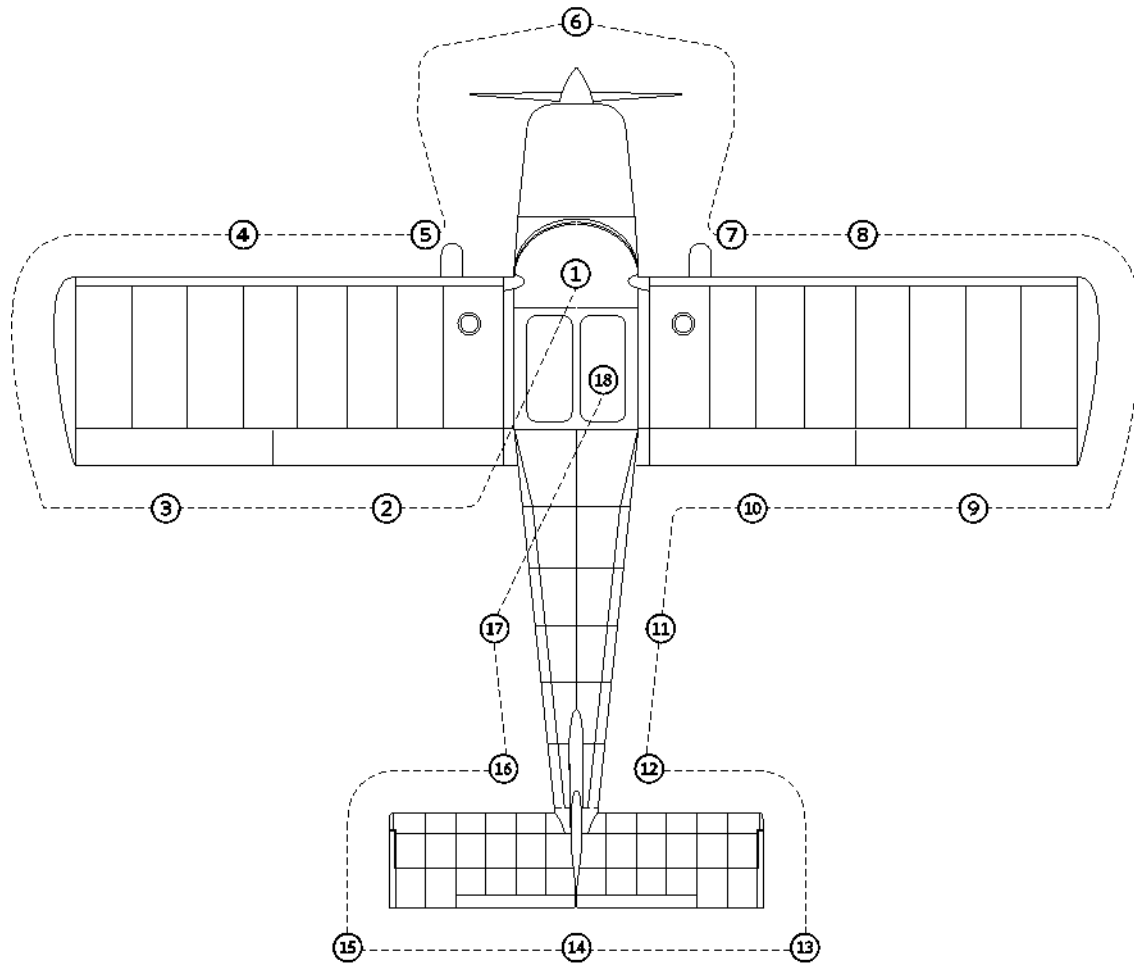


FIGURE 14D-01



**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 - RELEASE

**TAKEOFF****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.

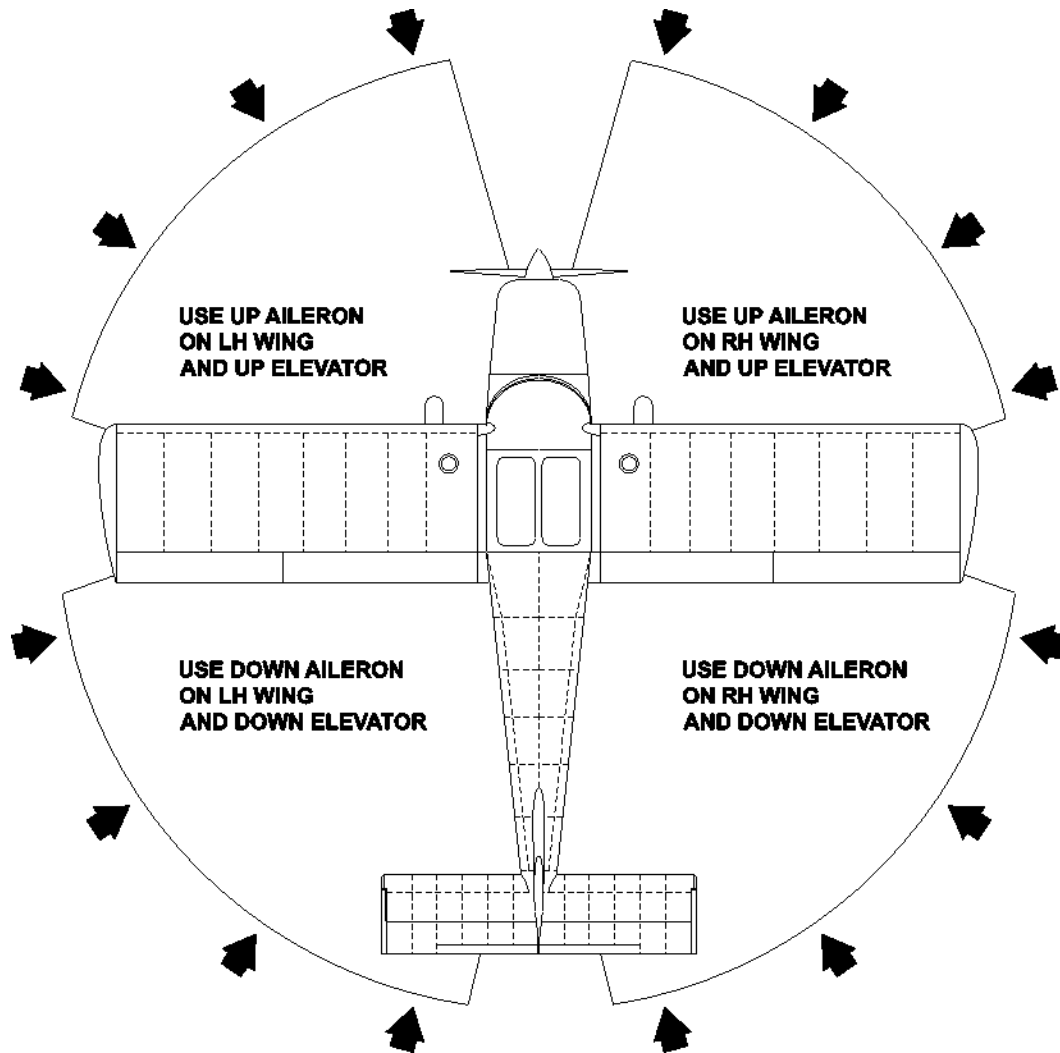


FIGURE 14D-02

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)

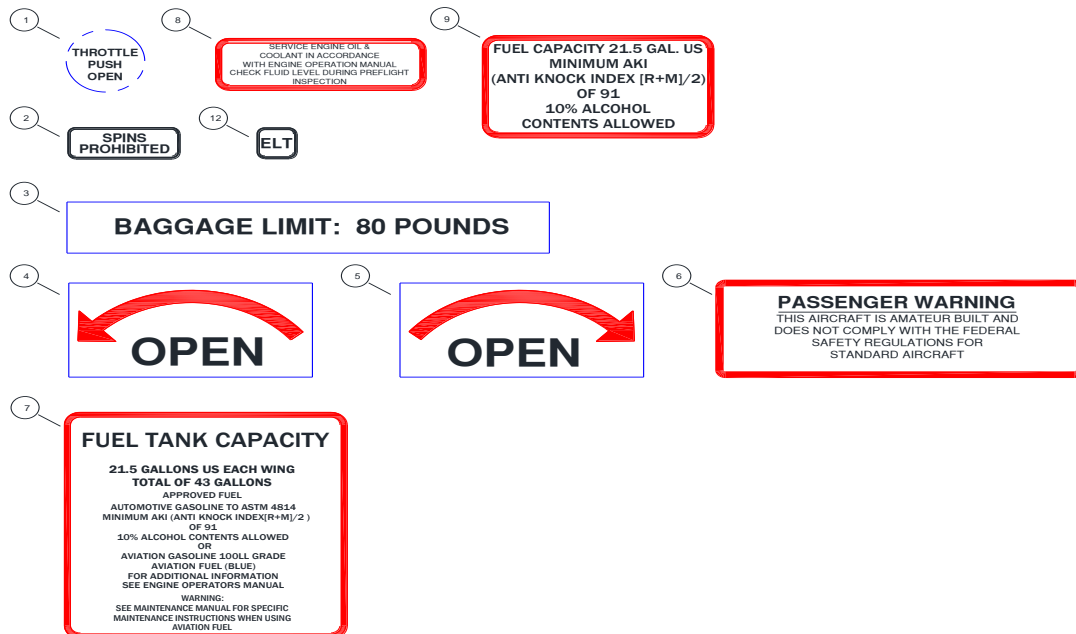
Marking	IAS Value or Range	Meaning
White Arc	38 – 110 (33 - 96)	Full Flap Operating Range - Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	47 – 125 (41 – 110)	Normal Operating Range - Lower limit is maximum 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.

1. In full view on end of throttle knob.
2. In full view of the pilot on the instrument panel.
3. In full view both sides of Baggage Compartment.
4. Left door besides door latch handle.
5. Right door besides door latch handle.
6. Passenger Warning on lower right side of instrument panel.
7. Wing root enclosure in clear view from the pilot seat.
8. Inside of oil check door (cowling).

9. Near fuel caps of both fuel tanks.
10. On both door top longerons in view of pilot.
11. On left and right fuel sight gauge.
12. Besides ELT remote control on instrument panel
13. All range markings on instrument front face as shown. (Valid for Analog gauges)
14. Placard "**EXPERIMENTAL**" in 2" letters on inside of left and right cabin doors.

## **SUPPLEMENTARY INFORMATION**

### **FAMILIARIZATION FLIGHT PROCEDURES**

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

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

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

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

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

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

### **PILOT OPERATING ADVISORIES**

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

Always deflect the controls as required in windy conditions.

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

Additional passenger briefings are recommended as required.

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

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

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