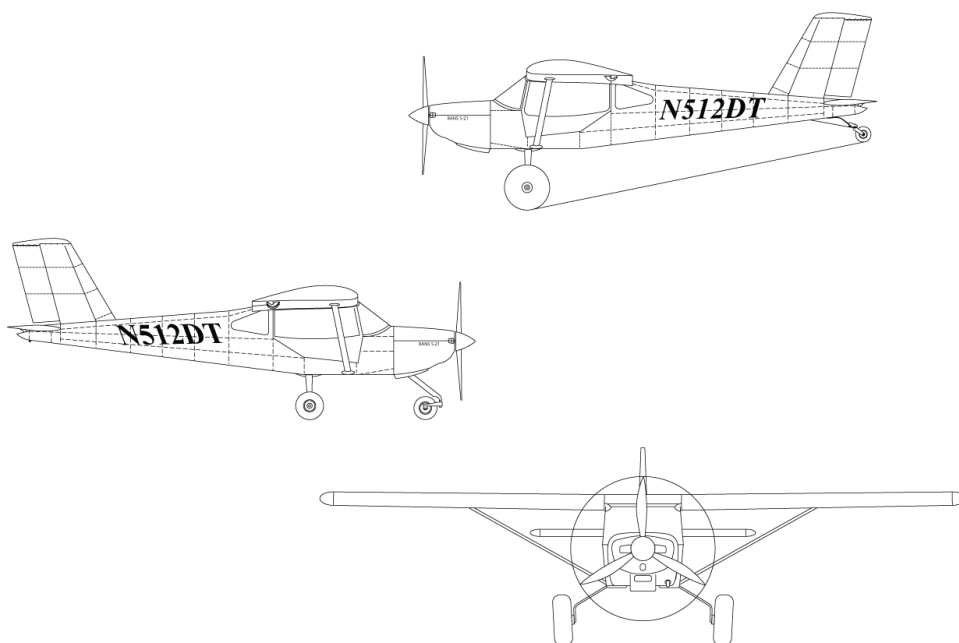




S-21 OUTBOUND

TITAN X-340 INSTALLATION

TEXT MANUAL



Serial Number: _____

Registration Number: _____

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RANS DESIGNS
4600 HWY 183 Alt
HAYS, KANSAS, USA 67601
785-625-6346
WWW.RANS.COM

TITAN X-340 - ENGINE MOUNT INSTALLATION

For easy access to both sides of the firewall: Before installing the engine the firewall, boot cowling should be fitted and removed, and rudder pedal return cable pulley installed.

HINT: For easy install of avionics only cleco the top of the boot cowl to gain access.

For Tailwheel versions: If building a tailwheel version and the tail group and tailwheel are not installed, ballast will be required to prevent nose over.

ASSEMBLY OF FIREWALL MOUNTED ITEMS

1. Install Engine Mount after all applicable accessories are located on firewall. Refer to **FIGURE 11-01/TITAN340** for mounting items on the firewall. Item specific dimensions are shown in other Figures following this one.
2. Locate and install the Rubber Grommet in the lower right hand corner of the firewall for the Battery Cable to pass through.
3. Fabricate a Firewall Closeout with a Grommet in the center for pass-thru of any wire bundles. Seal with high-temp Silicone or similar material.

CABIN HEATER VALVE INSTALLATION

1. Locate and cut or drill the holes required for the cabin heater valve. Install the cabin heater valve as per the parts manual drawing. See **FIGURE 11-02/TITAN340** for location of holes.
2. Locate and drill the hole location for heater cable exit grommet. Refer to **FIGURE 11-02/TITAN340**.
3. Connection to Heater Wrap on Exhaust system will be done during Exhaust Assembly.

GASCOLATOR INSTALLATION

1. Refer to Fuel System – Fuselage. Locate and drill the holes in the firewall for installing the Gascolator Mount. Refer to **FIGURE 11-03/TITAN340**.
2. Install 1/8" Pipe Plug and 90 Degree Fitting in Gascolator. Orientate fitting per parts page drawing.
3. Install Gascolator to Gascolator Mount and bolt to firewall per parts page.

4. Orientate drain fitting outboard toward cowling. A hole may be located in cowling to allow checking fuel with a cylindrical type fuel tester.

TITAN X-340 – ENGINE ELECTRICAL ACCESSORY INSTALLATION

NOTE: Injector lines will need to be GENTLY re-formed to clear Ignition Coil Mount Plate. This will also require loosening and rotating the retaining Cushion Clamps.

1. Refer to the parts catalog and select the required components for assembly.
2. Install Ignition Boxes to AFT side of the firewall. Refer to **FIGURE 11-04/TITAN340**. Transfer drill #11 through firewall at pre-welded tabs as show. Cleco Ignition Boxes to tabs. Orientate and transfer drill through firewall. Install Oil Cooler Mount Angle to forward side of firewall when installing the Right Hand Ignition Box.
3. Locate holes for Throttle and Mixture Cable Exit Grommets. Be sure the locations will not interfere with the electrical connectors of the Ignition Boxes. Refer to **FIGURE 11-04/TITAN340**.
4. Locate hole for Alternate Air Cable Exit Grommet. Refer to **FIGURE 11-04/TITAN340**.
5. Cut Aluminum bushings as per the parts catalog and bolt boxes to firewall.
6. Locate and install Starter Solenoid per **FIGURE 11-04A/TITAN340**.
7. Install Master Solenoid per **FIGURE 11-04A/TITAN340**. Refer to **FIGURE 11-05/TITAN340** for a typical wiring diagram.
8. Refer to parts manual and cut bushings to length for mounting the Ignition Coil Mount Plate to the Cushion Clamps. Refer to parts manual and bolt Mount Plate in place.
9. Refer to parts manual and cut bushings to length for mounting the Ignition Coil Modules to the Ignition Coil Mount Plate on top of the engine.
10. Fabricate the Aft Ignition Brace from provided material per **FIGURE 11-06/Titan340** and rivet to the Mount Plate and Aft Baffles after they are installed.
11. Bolt Ignition Coil Modules to top side of Mount Plate. Use previously cut bushings to space the Coil Modules away from the mount plate.

ENGINE MOUNT and ENGINE INSTALLATION

Become familiar with the TITAN X-340 **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawing.

1. Refer to the parts catalog and select the required components for assembly.
2. Assemble the engine mount to the firewall as per the parts manual. The mount may not line up exactly and will need pulled into place. A good method is to grease the bushings on the mount and fuselage cage, and insert all bolts and slowly and evenly work the mount tight against the firewall.
3. Install the engine using the hardware called out in the parts manual. Torque all bolts as per standard values for bolt size. See list below for reference.

5/16" with tensile nuts 100-140 in-lbs

7/16" with tensile nuts 450-500 in-lbs

TITAN X-340 - BAFFLE INSTALLATION

SIDES, INLET FLOORS AND FORWARD BAFFLE ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Attach Baffle Sides to engine. Leave the bolts slightly loose, until final assembly of baffles, to allow better alignment. Do **NOT** rivet the Baffle sides to each other.
3. Bolt Support Angles to forward sides of engine (both sides behind prop flange).
4. Cleco Right Inlet Floor to Reinforcement. Position on Right Support Angle and against Baffle Side. Tape in place. Transfer drill #30 into Support angle and cleco.
5. Position Left Inlet Floor under the Support Angle bolted to the FWD cylinder and on top of two remaining support angles behind the prop flange. Transfer drill #30 and cleco. Tape Inlet Floor to Baffle Side.

6. Position Barrel and Cylinder Plates under Inlet Floor Assemblies and transfer drill #30. Be sure Plates are tight against the Barrel and Cylinders. Rivet together. A #40 hole may be drilled in the lower flange of each Plate to allow securing tight against the cooling fins with safety wire from lower flange to lower flange.
7. Rivet Cabin Heat Inlet to Right Inlet Floor.
8. Fabricate angles from Inlet Support Angle raw stock to join each Inlet Floor to Baffle Side. Locate #30 holes, transfer drill and cleco.
9. Attach FWD Support Bracket at this time. Re-torque the crankcase to 96 inch lbs. per TITAN X-340 Illustrated Parts Catalog.
10. Position FWD Baffles on top of Inlet Floors. Locate against FWD Support Bracket. Move baffles as needed to allow aligning against face of engine and flush with inlet floors. Mark or use a hole finder to locate and drill #30 through FWD Baffles and FWD Support Bracket.
11. Fabricate angles from Inlet Support Angle raw stock to join each Inlet Floor to FWD Baffle. Locate #30 holes, transfer drill and cleco.

AFT BAFFLE ASSEMBLY

12. Remove Oil Dip Stick Tube to make assembly easier. Plug hole to prevent foreign material falling into engine.
13. Rivet 4 inch Upper Duct, Cylinder Plates, Outer Barrel Plate and Inner Barrel Plate Mount to aft side of AFT Right Baffle.
14. Bolt AFT Right Baffle to engine.
15. Transfer drill #30 through Aft Right Side Baffle into AFT Right Baffle, making sure the edges are flush.
16. Position Inner Barrel Plate against lower side of Plate Mount and against cylinder barrel. Transfer drill #30 and rivet.
17. Rivet Barrel Plates to aft side of AFT Inner Left Baffle. Temporarily bolt AFT Inner Left Baffle to engine.
18. Rivet Barrel and Cylinder Plates to aft side of AFT Outer Left Baffle and position assembly against flange of Inner Left Baffle and cooling fins. Tape in place.
19. Align AFT Support Angle with juncture of Left AFT Baffles and transfer drill #30 into each.

20. Transfer drill #30 through AFT Outer Left baffle and AFT Left Side. Remove Outer and Inner Baffles. Rivet AFT Support Angle in place. Re-bolt assembly to engine and rivet.
21. Transfer drill #11 through AFT Support Bracket and AFT Baffles. Bolt together with previously fabricated Aft Ignition Bracket Brace.
22. Tighten all bolts.
23. Any gaps may be sealed with High Temp Silicon Seal.
24. Re-install Oil Dip Stick Tube and secure with safety wire.

BAFFLE SEAL INSTALLATION

25. Installing the Baffle Seal Material after fit-up of the cowling may make cowl fit-up easier.
26. The Baffle Seals will protrude away from Baffles and seal against the cowling. Cut Baffle Seal Capture Strips into lengths to fit the edges of all baffles. Strips may be cut shorter in curved areas as needed. Locate strips at edges of all baffles and drill #30 through centerline of strips. Most rivets may be spaced about 2.50" apart. Shorter areas will of course need to be spaced closer.
27. Locate Baffle Seal Material flush with bottom edge of Capture Strips. Cut to length as needed. Drill through and cleco to inside of baffles. Be sure baffle seals run around all edges of baffles (sides, AFT, FWD and inlet floors) where they can seal against the cowling. Trimming to height may be done after cowling is in place.
28. Any areas that will not allow a capture strip may be done by overlapping the Baffle Seals and using a Fabric Rivet. Mark and remove baffle seal material and capture strips to allow cowling to be more easily installed.

TITAN X-340 - BATTERY BOX ASSEMBLY & INSTALLATION

1. Refer to the parts catalog and select the required components for assembly.
2. Cleco Support Angles to inner sides of Front Plate. Refer to the PARTS MANUAL DRAWING. Transfer drill #30 and rivet. Base of battery will set on Support Angles.
3. Cleco through the pre-drilled holes in one edge of Battery Box Front Plate and Battery Mount Plate.
4. 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 #30 through all holes and cleco.
5. Rivet as shown in parts manual.
6. Transfer drill the remaining holes to #11. These three locations plus another builder located hole will be used to mount the box to the forward side of Station 3.
7. Slide the Battery Bar through the holes in the Battery Box assembly. Modify the Battery Bar per **FIGURE 11-07/TITAN340**. Remove Battery from Battery Box assembly

INSTALLATION

8. Locate the plain clamps around the Station 3 tubes as shown in the parts manual. Bolt through the clamps using the pre-drilled holes.

NOTE: Wrapping Anti-chafe tape around the tubes in the Plain Clamp locations is recommended.
9. Locate the right-hand 3/8" clamp, mark the hole location and drill the battery box to #11. Bolt in place.
10. Install Battery and Battery Bar. Install Small Cotter Pins to retain Battery Bar.
11. Drill 1/4" through the vertical welded steel bushing forward of Station 3 and through the Fuselage Bottom Skin.
12. Remove the powder coat from the top of the vertical bushing. Bolt the Tang to the top of the vertical bushing with the tang's end angled downward to clear the Aileron Cable. Be sure the 1/4" Pan Head Bolt is installed from below through the fuselage skin.
13. Bolt the Ground Cable to the Tang and to the negative (-) battery terminal.

14. For safety reasons the Battery to Solenoid Cable should only be attached to the positive (+) battery terminal just prior to engine start or other electrical testing.

TITAN X-340 - FUEL SYSTEM - FIREWALL FORWARD

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

FUEL LINE INSTALLATION

1. Connect Fuel Line Assembly from OUTLET side of Gascolator to INLET side of Engine Fuel Pump as shown on Parts Page. Tighten all connections.
2. Connect Fuel Line supplied with engine from Engine Fuel Pump to Fuel Injection Servo with indicated fitting.
3. If installing a Fuel Flow Transducer (i.e. Electronics International FT60), re-route the fuel lines as shown in the parts manual using the Optional – Fuel Line Assembly – Transducer to Fuel Servo. This Optional Fuel Line Assembly is available from RANS Aircraft Parts.

FUEL PUMP DRAIN INSTALLATION

1. Install 90-degree Elbow into Mechanical Fuel Pump.
2. Cut Drain Line from provided Aluminum Tube. Be sure to place a 45° bevel at the lower end of tube. Orientate bevel to the aft when installing.
3. Locate Angle Bracket on lower flange of firewall. Drill #11 and rivet in place. Be sure to place far enough forward to allow drain tube to clear firewall when clamped in place. Also, locate away from exhaust, near center of firewall.
4. Bolt Plain Clamp with drain tube to Angle Bracket. Beveled end of drain tube should extend 1” or more below firewall. Route Black Fuel Line to drain tube. Cut to length, as needed, and attach to hose fitting and drain tube. Tighten or secure all connections.

TITAN X-340 - FUEL SYSTEM - FUSELAGE

IMPORTANT: The header tank is designed to fit on the left side of the cockpit. Changing this location will affect the design of the system and is **NOT** recommended. The weight of the fuel and header tank is low and close to centerline and does not impact wings level rigging.

1. Locate Header Tank Mount per **FIGURE 11-08/TITAN340**. 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

1. Locate and drill fitting holes in Header Tank per **FIGURE 11-09/TITAN340**. Do **NOT** drill the sump drain holes until fitting of the tank to the fuselage. For drilling the holes a 1/2" Unit-Bit® and 3/4" Unit-Bit® work best. Locate center of each hole with a #30 drill bit, then drill full size. Deburr all holes. Thoroughly clean tank several times by rinsing with water. After confirming that all foreign material has been removed, let dry prior to installing fittings.

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

DOUBLE & TRIPLE CHECK HOLE LOCATIONS BEFORE DRILLING.

2. 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 11-10/TITAN340**. 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.

3. 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.

4. 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.
5. 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.

6. Modify Header Tank Mount Channel per **FIGURE 11-11/TITAN340**. 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.

7. 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)

8. 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.

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 11-12/TITAN340**. 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 11-13/TITAN340** 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 11-13/TITAN340**. 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 Fuel Line Assembly from the Gascolator Mount fitting in the firewall to the fuel valve. Secure as desired using plastic ties. Add clear plastic tape or split fuel hose as anti-chafe wherever the line contacts the fuselage frame or other parts.

ELECTRIC FUEL PUMP

1. Become familiar with the Electric Fuel Pump **PARTS MANUAL DRAWINGS** and collect the parts shown in the drawings.
2. Install fittings into Fuel Pump with Thread Sealant. Be aware that the Fuel pump will need to be assembled in "SHORT CONFIGURATION" per documentation at the following link. <https://www.flyefii.com/products/boost-pump/installation-tips/>
3. Drill fuselage tabs to #11 to remove any excess powder coat. Cleco mount plate to tabs. Drill #11 through plate and tabs as needed to make sure holes are aligned.
4. Remove mount plate and rivet Nut Plates to bottom of mount plate, for mounting fuel pump.
5. Rivet Nut Plates to tabs under Left Seat.
6. Attach mount plate to fuselage and bolt fuel pump to mount plate.
7. Connect Fuel Line Assembly from Header Tank to Fuel Pump Filter. Connect Fuel Line Assembly from Fuel Pump to Fuel Valve.
8. Connect electrical wires of fuel pump to a 12-volt switch on Instrument Panel. Do **NOT** forget to include a proper sized breaker.

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 11-09/TITAN340**. MAKE SURE THE LOW FUEL INDICATOR IS IN THE MIDDLE OF THE HEADER TANK. Replace 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 11-15/TITAN340**. 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 11-15/TITAN340**. Do not forget to include a proper sized breaker or fuse.

TITAN X-340 – LUBRICATION SYSTEM ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Oil Cooler Mount Angle should have been bolted to the firewall when the Ignition Modules were installed. If not refer back to **FIGURE 11-04/TITAN340**.
3. Install Nut Plates to lower side of Oil Cooler Mount Angle. Fabricate Spacer Bushings called out in parts manual. Bolt Oil Cooler Duct and Oil Cooler to Oil Cooler Mount Angle, on firewall. Include the spacer bushings.
4. Rivet FWD Oil Cooler Support under lower forward flange of Oil Cooler. Use washers to back up the mount holes in the oil cooler.
5. Locate cushion clamp on engine mount tube below oil cooler. Bolt left hand radiator mount bracket to FWD Oil Cooler Support. Insert bolt and spacer bushing. Through cushion clamp, through lower hole in the left hand Radiator Mount Bracket. Be sure Oil Cooler is 90° to firewall. If not adjust cushion clamp to raise or lower as needed.
6. Bolt remaining mount bracket to right side of FWD Oil Cooler Support. Swing to align with bolt in cushion clamp. Mark where aligned with bolt. Remove and locate a #11 hole on centerline. Trim excess material beyond hole. Re-bolt upper end to support and bolt lower end to cushion clamp.

7. Temporarily install fittings in oil cooler and engine.
8. Install Upper and Lower Oil Hose Assemblies.
9. Re-install fittings and tighten to align with Oil Hose Assemblies.

CAUTION: Use a backup wrench on the oil cooler and engine fittings to prevent damage.

10. Install Oil Drain Valve into crankcase of engine and secure with safety wire.
11. Using hose clamps secure 3" hose to Oil Cooler Duct and 3" flange on aft of engine baffles.

ENGINE BREATHER VENT TUBE INSTALLATION

12. Modify the 90-degree Elbow per **FIGURE 11-15A/TITAN340**.
13. Install 90-degree Elbow into Top Aft of engine.
14. Cut Vent Tube from provided Aluminum Tube. Be sure to place a 45° bevel at the lower end of tube. Orientate bevel to the aft when installing.
15. Locate Angle Bracket on lower flange of firewall. Drill #11 and rivet in place. Be sure to place far enough forward to allow vent tube to clear firewall when clamped in place. Also, locate away from exhaust, near center of firewall.
16. Bolt Plain Clamp with vent tube to Angle Bracket. Beveled end of drain tube should extend 1" or more below firewall. Route 5/8" Oil Line to vent tube. Cut to length, as needed, and attach to hose fitting and vent tube. Tighten or secure all connections.

TITAN X-340 – CROSS-OVER EXHAUST ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly. Please note the Exhaust Assembly is supplied with all parts as needed to install.
2. Refer to manual supplied with Exhaust System for installation. Each hardware kit is supplied in a sealed bag partition.
3. Lubricate the insides of both female thermal expansion joints. **CAUTION:** *Do NOT install them dry as galling can occur. This can ruin the slip joint assembly.* Use high temperature “Nickel” based anti-seize. A small amount of anti-seize is pre-installed to the inside of both female slip joints before shipping.
4. Slip cylinder #1 male segment inside cylinder #2 female slip joint.
5. Slip cylinder #4 male segment into cylinder #3 female slip joint.
6. Install the exhaust gaskets (supplied with engine) on the rear half of the crossover and install the rear half first. **NOTE:** *Gaskets may be installed either way as there is no top of bottom.* **IMPORTANT:** *Hardware must be installed in the flowing sequence from top to bottom. Gasket, exhaust flange, flat washer, internal star lock washer and then exhaust nut.*
7. Install the exhaust gaskets on the front half of the crossover and install.
8. Finger tighten all exhaust nuts. Final torque to 140 – 160 in/lbs.
9. Install cabin heat exchanger/Right muffler assembly to right side exhaust assembly (cylinders #1 - #3). No lubrication on ball swivel joint is required. Install ball joint hardware per instructions in bag of hardware kit.
10. Install Left muffler assembly to left side exhaust assembly (cylinders #2 & #4). Again, no lubrication is required on ball swivel joint.
11. Install tailpipe support kit per parts manual.
12. Slip 2” Tailpipe Support Clamp over aft end of each muffler assembly. Temporarily bolt flattened end of 2 Stainless Steel Tubes to the tang on each clamp. Orient 1 on each upward and the other outboard.
13. Temporarily bolt a SS tube to each 60-degree bent tab. Bolt tab to the engine as referred to in the parts manual.
14. Bolt SS tube to each inboard tab on the engine mount. Check to be sure the individual tubes do not overlap. At least a 1/4” gap must exist between tube ends. Trim as needed.
15. Remove a SS tube and slip a hose clamp over each tube and slip a 3/8” diameter hose over tube until centered on each tube. Replace tube.

16. Align ball swivel joint to neutral alignment before tightening. Tighten nuts per directions supplied with exhaust system. Secure with cotter pins.
17. Tighten 2" clamps. Tighten bolts retaining SS tubes and 60-degree tabs. Tighten hose clamps on 3/8" hoses.
18. Route 2" Duct Hose and secure with hose clamps.

CONTINUED AIRWORTHINESS & MAINTENANCE FOR YOUR RANS AIRCRAFT EXHAUST SYSTEM

This handcrafted exhaust system is manufactured using 100% high quality aircraft grade 321stainless steel. This exhaust system will provide many, many years of trouble- f r e e continuous operation, as long as a few preventative maintenance tasks are performed at various times along the way, this will be outlined below.

Recommended Maintenance Schedule

Pre-flight: Perform visual inspection. In particular, check that your tailpipe support system is intact and keeping both tailpipes stable and secure.

Annual inspection: Perform a thorough visual inspection, specifically check for cracks or signs of exhaust leaks, typically staining, light grey soot or discoloration will occur if leaking. Check torque on all exhaust stud nuts. Check ball joint hardware. Ensure that the cotter pins are secure. Check stability and security of the tailpipe support system. Look inside both mufflers and check the condition of flame cones. Use a flexible optic camera.

Every 200 hours: Remove and disassemble the exhaust system, perform a thorough visual inspection. Clean carbon off the male and female surfaces of the slip joints. Use a toothbrush size stainless steel wire brush or fine emery cloth. Lubricate the thermal expansion joints, use high temperature Nickel based anti-seize. Inspect the condition of the internal flame cones and have replaced if necessary.

Flame Cones what do they do?

Flame cones reduce noise, and control & diffuse the exhaust gas flow to protect the muffler skin from heat damage. Flame cones are being consumed anytime the engine is running. They burn out at a very slow rate, and ultimately depart the tailpipe in little pieces. This is a normal process and occurs at different rates depending on several factors, such as how hard the engine is operated and leaned, as well as the

general environmental climate conditions where the majority of the flight operations occur. 350-450 hours TT is the normal life expectancy of the flame cone. The cone will slowly change shape and will ultimately break up into small pieces that will exit the tailpipe over time until nothing is left inside. Flame cones are replaceable, simply remove the muffler and return them to RANS for the re-coring process.

TITAN X-340 - THROTTLE & MIXTURE CONTROL ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Fabricate 2 Retainer Angles from raw stock per **FIGURE 11-16/TITAN340**.
3. Bolt Retainer Angles to Throttle / Mixture Control Mount. Only Bolt through the pre-drilled #11 holes at this time.
4. Bolt Teleflex Retainers to Retainer Angles. Make sure the slotted flange is forward.
5. Remove 3 of the Fuel Servo Mount Studs on bottom of the engine and replace with Longer Studs as indicated in the Parts manual. These studs must be longer to allow mounting of the Throttle / Mixture Control Mount.
6. Bolt gaskets, Fuel Servo Spacer, Fuel Servo and Control Mount to studs on bottom of engine. Tighten nuts to 204 in-lbs per Titan information.
7. Modify Eyeball Firewall Fittings by drilling center hole of ball to 19/64". Assemble each Eyeball Fitting, tighten the nut to prevent rotation of the eyeball, and clamp the assembly in a drill press.
8. Route Control Cables through Instrument Panel, then through Firewall with Eyeball Firewall Fittings. Insert Control Cables into respective Teleflex Retainers. Install Female Rod Ends and bolt to Control Arms on Servo. Tighten Eyeball Fittings to retain cables.
9. Allow Retainer Angles to align with Control Cables. Transfer drill #11 through Control Mount and Retainer Angles. Bolt Retainer Angles to Control Mount.
10. Safety wire through Teleflex Retainers to secure control cables.

TITAN X-340 - AIRBOX ASSEMBLY

1. Refer to the parts catalog and select the required components for assembly.
2. Rivet Nut plates to inside of Airbox Bottom.
3. Bend side tabs of Airbox Top and Bottom 90 degrees to match the pre-bent perimeter tabs.
4. Cleco Airbox Top, Side and Bottom together at the aft end, using the pre-drilled #30 holes. **NOTE:** *Airbox Side will wrap to the outside of the Top and Bottom flanges.* Wrap side around to the front and transfer drill #30 through Top and Bottom Flanges. Adjust flange on Top and Bottom, as needed, to fit against the Airbox Side. Once satisfied with fit, rivet together. If desired smooth High Temp Silicone Seal on the outside of any gap.
5. Assemble Airbox Filter Cover with Alternate Air Valve parts. Note that the Airbox Filter Cover requires a specific orientation to work properly. Refer to **FIGURE 11-17/TITAN340** for proper orientation. The Airbox Bottom also has a 1/4" hole to allow the rivet retaining the 1/4" Plain Clamp to clear.
6. The Baffle Seal Material will protrude away from the front of the airbox inlet and seal against the cowling. Cut Baffle Seal Capture Strips into lengths to fit the inside edges of the airbox inlet. Locate strips centered on the pre-located #30 holes at front of the airbox top and bottom. Transfer drill #30. Cut strips for sides. They should align with top and bottom strips. Locate three #30 holes on centerline and transfer drill.
7. Fabricate 4 strips, 1-3/4" long from the capture strip material. Locate inside the bottom lip of the airbox and locate a #30 hole at one end to allow to be clecoed in place. These pieces will extend forward and be bent down to help form the seal material to clear the lower lip of the cowling inlet.
8. Locate Baffle Seal Material flush with edge of Capture Strips. Cut to length as needed to complete the seal in one piece with an overlap at the top. Drill through and cleco to inside of Airbox inlet with capture strips. Be sure seal runs around all edges of inlet and will extend forward to seal against the cowling. Trimming to length may be done after cowling is in place.
9. Bolt airbox to Fuel Servo. Insert air filter and secure Airbox Filter Cover to bottom. Be sure the Cable Swivel Stop protrudes through Alternate Air valve. Install Adjustable Cable Ferrule into aft end of 1/4" Plain Clamp. Route Control Cable through Instrument Panel and grommet in firewall.
10. Mark control cable to length and trim. Be sure to pull the control wire out enough before trimming to allow engagement in swivel stop. With the control cable pushed "**IN**" the Alternate Air Valve should be "**CLOSED**". Tighten Swivel Stop Screw and safety wire the cable. Alternate Air Valve should open and close fully. Re-adjust as needed.

TITAN X-340 – IGNITION CONNECTIONS

HIGH TENSION IGNITION LEADS

1. Connect High Tension Lead Wires from Ignition Coils on top of engine through the grommets in the side baffles to Spark Plugs on each cylinder as shown in **FIGURE 11-17A/TITAN340**.

TITAN X-340 - 13" SPINNER ASSEMBLY

- Spinner Assembly requires Propeller and Prop Extension

NOTE: The spinner will **NOT** measure 13" in diameter. Rather it is designed to match up to a 13" diameter face on the cowling.

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 11-18/TITAN340**.

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. Center the spinner dome and place a mark on the dome at each line.
5. Glue the Prop template to poster board and cut out. Align one edge of the template on a mark and tape to the dome. Draw the opening on the dome. Repeat for the remaining opening using the same edge of the template. The openings may be cut and sanded smooth using a Dremel.

HINT: Use reinforced cut-off wheels and 1/2" or larger sanding drums.
CAUTION: Always use proper safety equipment. Cut the opening slightly small and sand to exact fit.
6. Fit the Spinner Backing Plate onto the Prop Extension. Press the Prop hub onto the Extension. Test fit the Dome. Sand the openings to an exact fit. Allow at least 3/16" clearance between the Spinner and Prop. **NOTE:** *Blades may need to be temporarily clamped in place on adjustable props.* Be sure the Dome is flush with the backside of the Backing Plate.

HINT: Use 3 or 4 thin boards under the Backing Plate for support.
7. Remove Dome and mark hole locations on the Dome's perimeter for 5 screws, evenly spaced, between each cut-out. Refer to **FIGURE 11-19/TITAN340**. Drill #40 through the marked locations.
8. Place Dome over Backing Plate/Prop Assembly with the Backing Plate sitting on a flat surface. Use 3 or 4 thin boards under the Backing Plate for support. Place the Spinner Dome in position. Press the Dome tight to the surface to ensure that the Dome and Backing Plate are flush. Transfer drill #40 and Cleco.

9. Remove clecos one at a time. Transfer drill #30. Cleco as you go. Final Size drill #11 and cleco. The dome and Backing Plate must remain tight against the surface as you drill.
10. Dimple the dome near one opening and dimple the Backing Plate corresponding to that opening for alignment markings. See **FIGURE 11-20/TITAN340**.
HINT: Use a #11 bit and lightly press to make the dimples. Assemble the Dome and Backing Plate each time with the dimples aligned.
11. Remove the dome and the prop from the backing plate and install the nut plates.
HINT: Use a short 3/16" bolt to hold the nut plate centered while drilling the ears #40.
NOTE: Counter sink the #40 holes to allow the heads of the rivets to sit flush with the Backing Plate flange. Refer to **FIGURE 11-21/TITAN340**.
12. "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.
13. The Spinner Dome is now ready for painting.
14. 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.
15. 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.

TITAN X-340 - COWLING ASSEMBLY & INSTALLATION

(FINAL INSTALL OF ENGINE)

- The Engine, Starter Ring, Prop Extension, Spinner Backing Plate and Boot Cowl must be installed before installing the Cowling.
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. Reference **FIGURE 11-22/TITAN340**. A couple of 3/8" thick wood boards work well for this. Bolt the Extension to the engine drive flange. Bolt the Spinner Backing Plate to the prop extension. Use the back half of the prop hub or tubular spacers to press the backing plate tight against the prop extension.
 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 1". Refer to **FIGURE 11-23/TITAN340**. 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 airbox inlet area of lower Cowl. Refer back to **FIGURE 11-23/TITAN340**.

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. Be sure the lower cowl is level with the fuselage from side to side. 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 clearance with all components on top of the engine and the starter ring behind the prop. Position the forward edge of the upper Cowl to allow an undisturbed flow of air off the Spinner Dome. The forward face of the cowl should be parallel to the spinner backing plate and centered side to side when completed. 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 11-24/TITAN340**. 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 11-24/TITAN340**.
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 11-24/TITAN340**.
19. Transfer drill all holes to #11 and cleco.
20. Final trim all openings.

21. Refer to **FIGURES 11-25/TITAN340 and 11-26/TITAN340**. 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 Oil Frame Door 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 hinge. Cleco as you drill.

NOTE: Form the Maintenance Hatch and Oil Frame Door to better contour to the upper Cowling as desired.

23. Rivet 1/4 Turn Receptacles to bottom of Oil Frame Door.
24. Position Nut Plates through #11 holes to inside of Boot Cowl Strips. Temporarily retain with 3/16" bolts and transfer drill #40. Remove Nut Plates.
25. Position forward Nut Plates to inside of lower Cowling. Temporarily retain with 3/16" bolts and transfer drill #40. Remove Nut Plates.
26. Step drill 1/4-Turn Receptacle holes to 5/16". Refer to **FIGURE 11-27/TITAN340**.

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

IMPORTANT: The forward most and lower holes must remain #11 for the 3/16" Pan Head Phillips Bolts.

27. Step drill the fastener holes to 1/4". Refer back to **FIGURE 11-27/TITAN340**.

IMPORTANT: The forward most and lower holes must remain #11 for the 3/16" Pan Head Phillips Bolts.

28. Trim aft edge of lower Cowling air exit per **FIGURE 11-28/TITAN340**.
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 11-27/TITAN340**. Note correct 1/4 Turn size for each hole when fitting up painted cowling.
32. Remove cowling.
33. Install 1/4 Turns into top cowling and retain per **FIGURE 11-27/TITAN340**.
34. Install Cowling and admire.

TITAN X-340 - PROPELLER INSTALLATION

(FINAL INSTALL OF ENGINE)

- The Engine, Starter Ring, 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. Inspect the Prop for any nicks, cracks, or dings.
 3. 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.

NOTE: Whirl Wind = 20° as a starting point
 4. 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.
 5. 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.

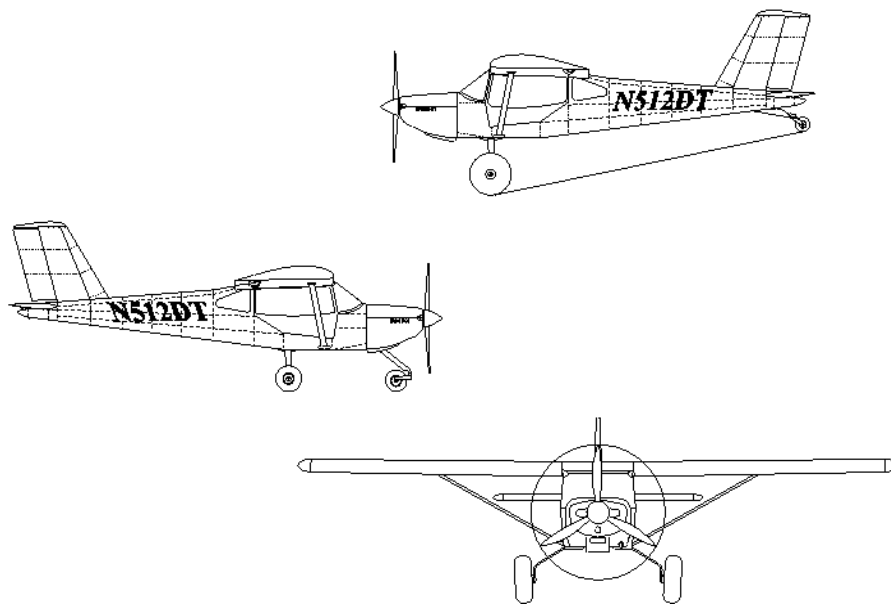
HINT: Start torque pattern on the blade that is out of track. See **FIGURE 11-29/TITAN340**.

DANGER: Track prop with ignition **OFF!!**
 6. Secure Spinner Dome to the Spinner Backing Plate. Refer to **SPINNER ASSEMBLY**.
 7. 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 2000 - 2400 RPM

RANS

S-21 OUTBOUND

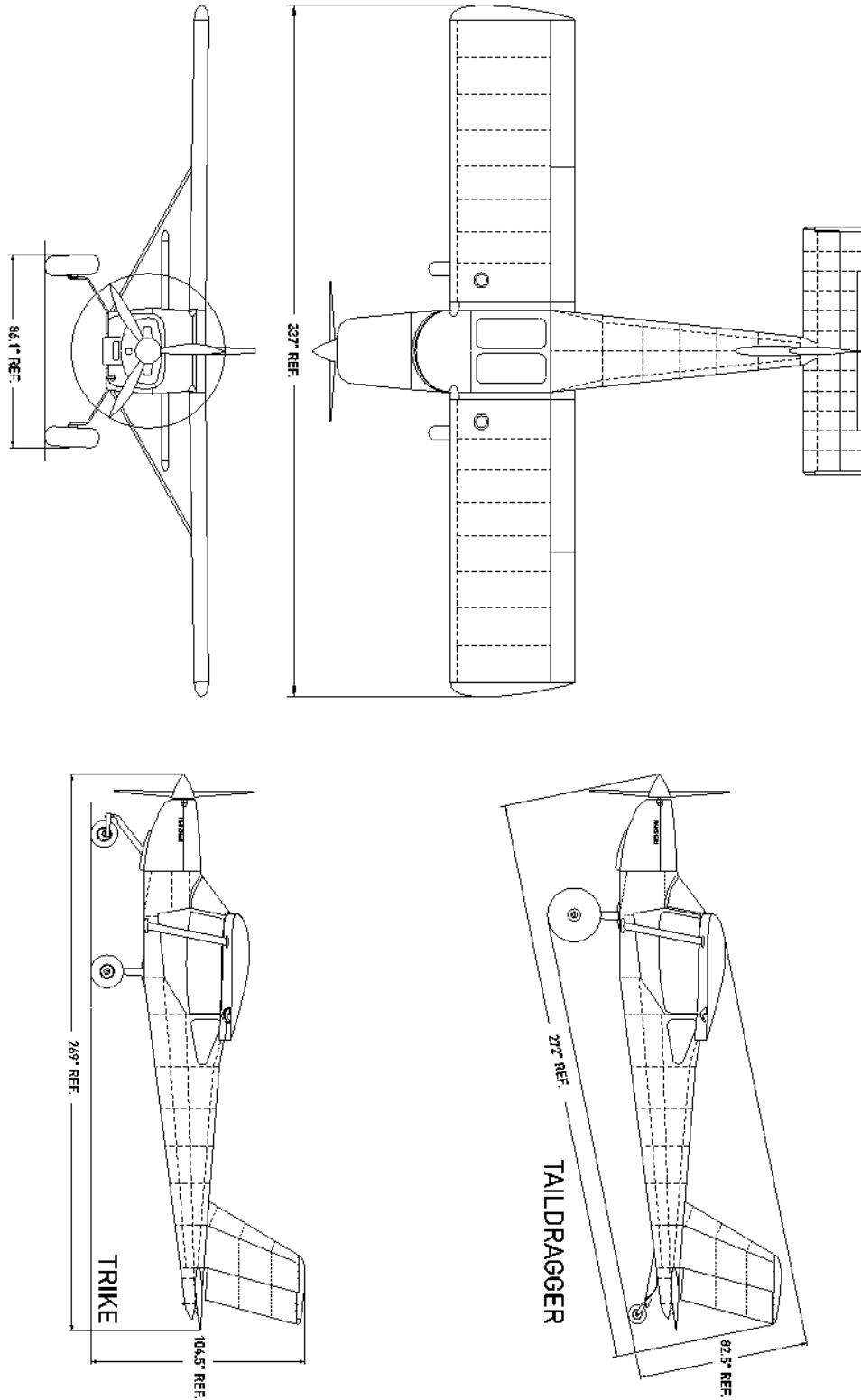
OPERATIONS MANUAL



Serial Number:
Registration Number:

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

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.

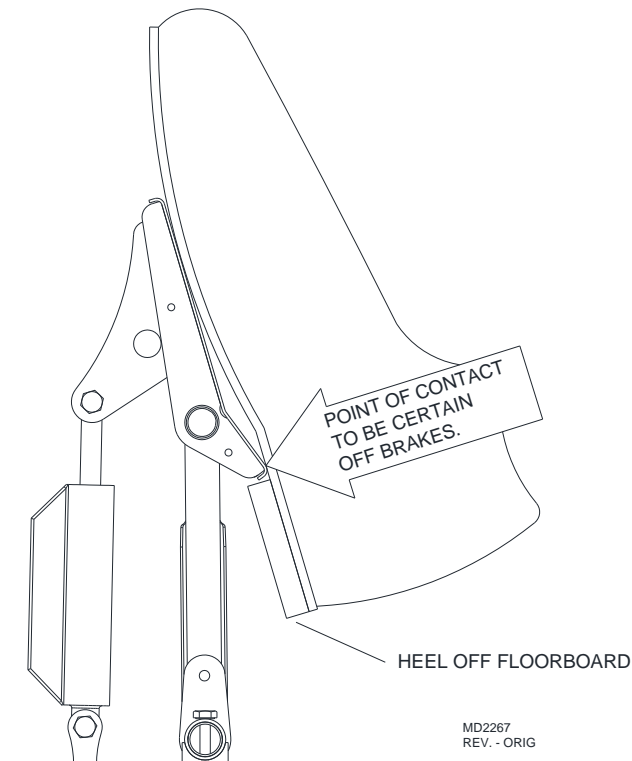


FIGURE 14-01: STEERING AND BRAKING

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 Operators Manual must be onboard the aircraft.

AIRSPPEED LIMITATIONS

Airspeed limitations and their operational significance are shown in **Table 14-2**.

All speeds are given for maximum takeoff weight.

Speeds are given in MPH and (KNOTS)

	Airspeed	IAS	Remarks
VNE	Never Exceed Speed	215 (187)	DO NOT exceed this speed in any operation
VA	Maneuvering Speed at maximum gross weight	135* (117)*	DO NOT make full or abrupt control movements above this speed.
VFE	Maximum Flap Extended Speed	110 (96)	DO NOT exceed this speed with flaps extended.
VSO	Stall speed**	40 (35)	Flaps full down. Speed may vary due to your specific aircraft
VS	Stall speed**	49 (43)	Flaps up Speed may vary due to your specific aircraft

TABLE 14-2: AIRSPEED LIMITATIONS

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

** Power-off configuration

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

	LIMITS
Maximum Ramp Weight	1800 lbs
Maximum Takeoff Weight	1800 lbs
Maximum Landing Weight	1800 lbs
Maximum weight in Baggage Compartment	180 lbs

CENTER OF GRAVITY LIMITS

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

MANEUVER LIMITS

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

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

FLIGHT LOAD FACTOR LIMITS

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

FLIGHT CONDITIONS OPERATION LIMITS

Flight into known icing conditions is prohibited.

This aircraft is limited to two occupants only.

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

Intentional flights into known icing conditions are prohibited.

FUEL LIMITATIONS

Approved Fuel Grades: Octane 100 / AVGAS 100 LL AVGAS 100 LL

Fuel Capacity:

- Total Capacity:50 U.S. GAL
- Total Capacity each Wing Tank:21.55 U.S. GAL
- Header Tank Capacity 6.9 U.S. GAL
- Total Usable:49 U.S. GAL
- Total Unusable: 1 U.S. 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

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

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

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

OTHER LIMITATIONS

Flap Limitations:

- Approved Takeoff Range:retracted, 1st or 2nd notch flaps (0° to 17.5°)
- Approved Landing Range:..... retracted to full flaps (0° to 40°)

WEIGHT AND BALANCE

INTRODUCTION

This Section describes the basic procedures for establishing of basic empty weight and moment of the airplane. Refer to **S-21 TEXT MANUAL** 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 180 lbs.

Baggage should be secured securely for flight.

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

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

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

Calculate the moments (Weight x Arm).

Add moments to obtain total moment.

Add weights to obtain total weight.

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

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

Repeat for landing configuration.

EMERGENCY PROCEDURES

INTRODUCTION

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

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

The following material is provided for guidance only.

AIRSPEEDS FOR EMERGENCY OPERATION (IAS)

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

OPERATIONAL CHECKLISTS

ENGINE FAILURE

Engine Failure During Takeoff Run:

Fly the Airplane!

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

Engine Failure Immediately After Takeoff

Fly the Airplane!

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

Engine Failure During Flight

Fly the Airplane!

- (1) Airspeed - 68 MPH for best glide
- (2) Select Emergency Landing Area - PROCEED To It.
- (3) Attempt Engine RESTART.
- (4) Ignition - Check ON.
- (5) Ignition Backup Battery Switch - ON
- (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.

Ditching

Fly the airplane!

- (1) Flaps - FULL.
Airspeed - 55 MPH.
- (2) Power - RATE OF DESCENT - 200 ft/min or less (adjust with power).
- (3) Approach - High Winds - INTO THE WIND. Light Winds - PARALLEL TO SWELLS.
- (4) Tighten seat belts
- (5) Unlatch cabin doors
- (6) Touchdown - LEVEL ATTITUDE AT ESTABLISHED DESCENT RATE.
- (7) Place folded coat or cushion over face at touch down
- (8) Airplane - Unlatch Seat Belts and EVACUATE through doors.
- (9) Life Raft and Vests - INFLATE (If onboard).

LANDING WITH A DEFECTIVE MAIN WHEEL TIRE

Fly the Airplane

- (1) Approach - NORMAL
- (2) Flaps – as desired
- (3) Touchdown - GOOD TIRE FIRST. Hold the aircraft off of the defective tire as long as possible with aileron control.

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 – 2000 -2300 RPM for a few minutes.
 - (3) Engine - SHUTDOWN and inspect for damage.
If Engine fails to Start:
 - (4) Continue cranking with throttle full open while ground attendants obtain fire extinguisher; when ready to extinguish fire -
 - (5) Ignition - OFF.
 - (6) Master Switch - OFF.
 - (7) Fuel Selector Valve - OFF.
 - (8) Fire Damage - INSPECT, repair damage or replace damaged components or wiring before conducting another flight.

Engine Fire In Flight

Fly the airplane!

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

Electrical Fire In Flight

Fly the airplane!

- (1) Master Switch - OFF.
- (2) All Other 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
Master Switch - ON.
 - (4) Radio/Electrical Switches - ON one at a time, with delay after each until short circuit is localized.

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 establish a glide attitude (checks 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. **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.

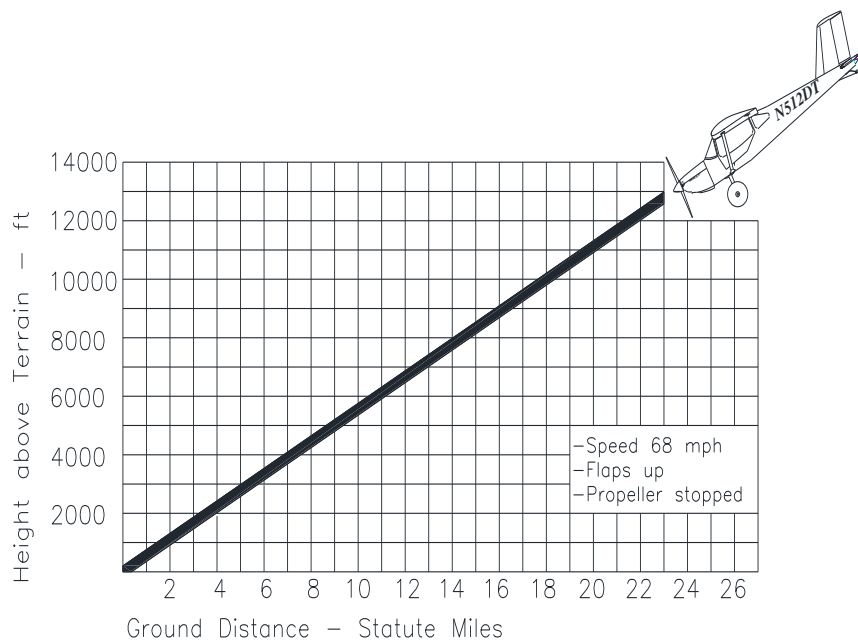


FIGURE 14-03: MAXIMUM GLIDE

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 touch down.

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-21LS 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.

ROUGH ENGINE OPERATION

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 are practicable. If not, switch to the good circuit and proceed to the nearest airport for repairs.

INDUCTION ICE

A sudden engine roughness or loss of rpm could be induction ice. Actuate the alternate air source by pulling on the Alternate Air Control Knob.

As soon as the engine roughness or suspected ice is gone, turn off the Alternate Air source. 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 depending 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.

AIRSPEEDS FOR NORMAL OPERATION

The following airspeeds are based on operations at a Maximum Gross Weight of 1320 lbs.

NOTE: ALL SPEEDS ARE INDICATED AIRSPEEDS (IAS)

Takeoff:

Normal Climb out	70 MPH
Short Field Takeoff, flaps HALF, speed at 50 ft	65 MPH

Enroute Climb, Flaps UP:

Normal	70-90 MPH
Best Rate of Climb, Vy, Sea Level	90 MPH
Best Angle of Climb, Vx Sea Level	70 MPH

Landing Approach:

Normal Approach, Flaps UP	66-70 MPH
Normal Approach, Flaps FULL	64 MPH
Short Field Approach, Flaps FULL	59 MPH

Balked Landing (Missed Approach):

Maximum Power, Flaps half	65 MPH
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Maximum Recommended Rough Air Penetration Speed: 135 MPH

Maximum Demonstrated Crosswind Velocity:

Takeoff	23 mph
Landing	23 mph

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.

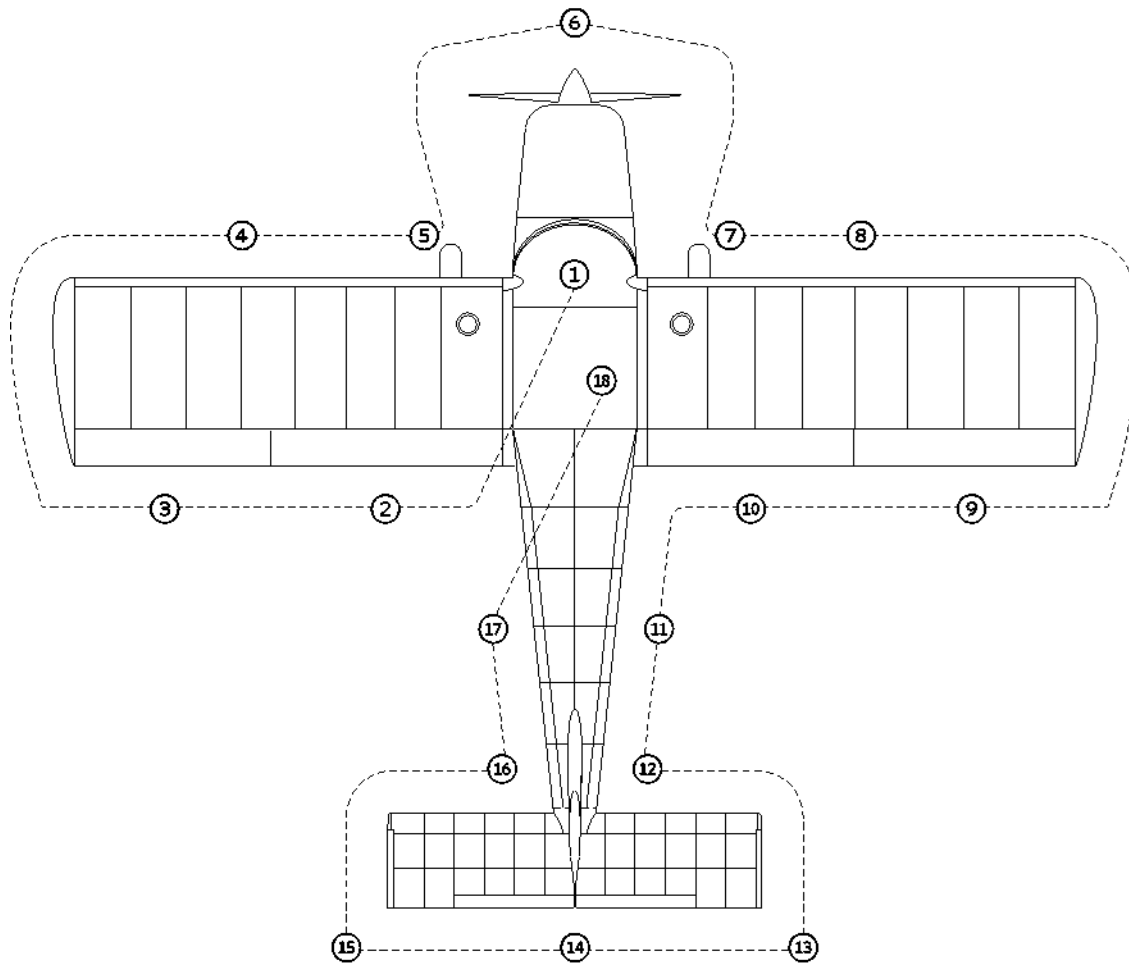


FIGURE 14-04: PREFLIGHT INSPECTION SEQUENCE

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 under cargo net
 - 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.
- 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, then check filler cap secure

 - Propeller and spinner – CHECK for nicks, dents and security
 - Engine cooling air inlets and oil cooler – CHECK of obstructions
 - Engine cooling air outlet – 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
 - 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 open 1/4"
- Mixture rich
- Boost pump on 2 seconds (optional)
- CLEAR AREA!
- Ignition switch - START
- 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

- Preflight 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 – OPEN 1/4”.
- Mixture - RICH
- Master Switch - ON.
- Propeller Area - CLEAR
- Ignition Switch - START (release when engine starts).
- Throttle adjust – IDLE smooth
- Oil pressure - CHECK
- Avionics master- ON.

HOT START

- Throttle – OPEN 1/4”.
- Mixture – FULL LEAN.
- Master Switch - ON.
- Propeller Area - CLEAR.
- Ignition Switch - START (release when engine starts)
- Mixture - Feed in while cranking.
- Throttle adjust – IDLE smooth
- Oil pressure - CHECK
- Avionics master- ON.

TAXIING

- Brakes - CHECK.
- Control deflection 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 – 1700RPM
 - a. Ignition - CHECK (Ignition drop should not exceed 300 RPM on either Ignition and the differential between Ignitions should not be more than 120 RPM).
 - b. Engine Instruments and Voltmeter- CHECK
 - c. Alternate Air – CHECK – RPM drop
- Throttle – IDLE
- Radios - SET.
- Fuel pump - ON
- Wing flaps – SET for take off
- Brakes - RELEASE

TAKEOFF**NORMAL TAKEOFF**

- Flaps – UP or 1st or 2nd Notch.
- Throttle – SLOWLY FULL OPEN.
- Elevator Control - LIFT TAIL WHEEL or RAISE NOSE WHEEL
- Climb Speed – 70 to 90 MPH

SHORT FIELD TAKEOFF

- Flaps - 3rd Notch.
- Brake - APPLY.
- Elevator Control- FULL BACK
- Throttle – FULL OPEN.
- Brake - RELEASE.
- Elevator Control – LIFT TAIL WHEEL or RAISE NOSE WHEEL
- Climb Speed - 70 MPH until all obstacles are cleared.
- Flaps - RETRACT slowly after securely airborne.

ENROUTE CLIMB

NORMAL CLIMB

- Airspeed – 70-90 MPH.
- Throttle - FULL

CRUISE

- Throttle - 2000 to 2600 RPM
- Elevator Trim - adjust.

APPROACH

- Throttle - AS DESIRED.
- Engine temperatures – MONITOR

BEFORE LANDING

- Seat, Belts, Shoulder Harness - ADJUST.

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 - MAIN WHEELS FIRST or
(THREE WHEEL - taildragger only)
- Landing Roll - LOWER TAIL WHEEL or
NOSEWHEEL 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 FIRST - 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
- Airspeed – 60 MPH
- Wing Flaps – RETRACT TO HALF, Slowly
- Airspeed – 70 MPH
- Wing flaps – RETRACT, Slowly

AFTER LANDING

- Wing Flaps - UP.
- Taxi - SLOWLY.
- Control deflections as required for wind.

SECURING THE AIRCRAFT

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

NEVER use the brake as a parking brake with the intention of leaving the aircraft unattended.

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. If you have any reservations, **DO-NOT-FLY!_ALWAYS** do your own preflight.

Refer to **FIGURE 14-04** 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!

BEFORE STARTING THE POWERPLANT

Adjust the pilot's seat to the correct position to ensure the rudder pedals can be reached and actuated in a comfortable manner.

Adjust the seat belts and shoulder straps to ensure all controls can be operated. **MAKE** sure the seat belt buckle is securely closed. Check the fuel selector valve position. **CHECK** to see the avionics switch is OFF and all circuit breakers are set.

STARTING THE POWERPLANT

The powerplant starting procedure on the RANS S-21LS Outbound aircraft involves only a few simple steps. When followed correctly, the powerplant should start with a few turns of the electric starter. The procedure for starting the powerplant when it is cold differs somewhat from a warm engine start.

Starting the engine when it is COLD is done in the following manner. Ensure that the Ignition Switch is OFF and the propeller area is clear (announce "CLEAR PROP"). Place the throttle lever is open 1/4". Mixture full rich.

Turn the Master Switch ON. Turn the ignition switch to "START". After the engine starts, RELEASE the ignition switch (should automatically release to the both position) and advance the throttle slightly.

Starting the engine when it is HOT is done in the following manner. Ensure that the Ignition Switch is OFF and the propeller area is clear (announce "CLEAR PROP"). Open throttle 1/4", mixture lean, start cranking, when engine fires feed in mixture. If the engine stumbles, lean and richen mixture as needed to sustain run.

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 14-07**.

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.

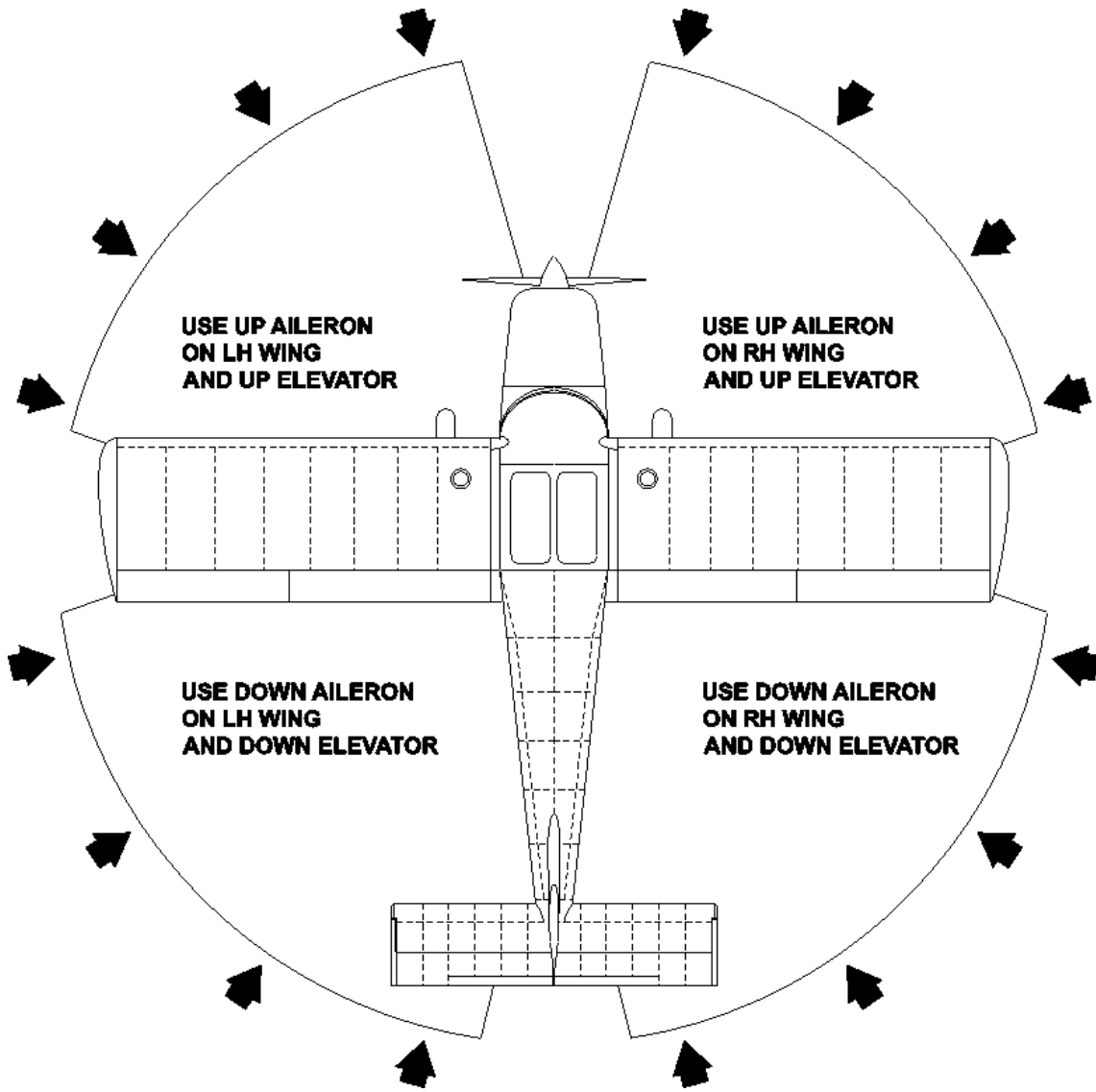


FIGURE 14-05: WIND DIRECTION / CONTROL DEFLECTION

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.

BEFORE TAKEOFF

Warm the engine up.

Be careful about parking and taxiing with tailwinds as this can reduce the airflow over the radiator causing the engine to overheat.

Select an area that is clear of persons and property that could be adversely affected by the propeller and propeller blast. The area should be free of debris that could damage the propeller. If you are operating around other aircraft, ensure you are clear of runway and taxiway areas.

Move the control stick and rudder pedals to full deflection in all directions. Ensure that they move freely. Inspect all flight control surfaces and ensure that they respond in the correct corresponding directions to the control stick and rudder pedal movements.

The ignition system or "mag" check should be made by running the engine up to 1700 RPM as follows. Turn the ignition switch first to the "R" position and note the RPM. Next move the switch back to "BOTH" to clear the other set of plugs. Then move the switch to the "L" position, note the RPM then return the switch to the "BOTH" position. You should observe a slight drop (approximately 100 RPM) in RPM but NO MORE than 300 RPM for either the "L" or "R" position or a differential of 120 RPM between Ignition settings.

The flaps should be moved from FULL UP to FULL DOWN, stopping at each flap setting. Ensure that the flap selector handle seats securely at each setting and visually verify that each flap moves to the correct corresponding position. Set the Trim Indicator to middle position.

TAKEOFF

Power Check and Takeoff Roll

Taildragger - 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 steer-cam is engaged before applying full power. This prevents possible harmful side loading of the tail wheel.

Trike - 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 nose wheel with runway.

When full power is applied, immediately verify that proper takeoff thrust is created. Also, feel for any abnormal vibrations and listen for any abnormal noises.

If you suspect any problem at all, discontinue the takeoff run.

If the takeoff is being made over loose impediments, advance the throttle slowly. This will allow the aircraft to be well into the takeoff roll before high propeller RPM's are reached, and decreases the possibility of propeller damage. The rate the throttle is advanced must be dictated by the available runway and obstructions in the departure path.

Flap Settings

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

If flaps are used for takeoff, they should be left in that position until all obstacles are cleared and a flap retraction speed of 60 MPH, and minimum altitude of 100 feet AGL, is reached.

The pilot must always be prepared for an engine/power system failure and ensure there is always sufficient altitude, airspeed, and a suitable landing site to perform an "Emergency Landing Without Power".

Short Field Takeoff

Short field takeoffs are performed with flaps in 3rd notch. An obstacle clearance speed of 65 MPH should be used.

Crosswind Takeoff

Takeoffs in crosswinds of 5-23 MPH (4-20 kts) normally are performed with the minimum flap setting necessary for the field length in order to minimize the drift angle immediately after liftoff. The aircraft is accelerated to a speed slightly higher than normal, and then pulled off a bit more abruptly than normal to prevent possible settling back to the runway while drifting. When clear of the ground, neutralize controls as required for coordinated flight, and turn the airplane into the wind to correct for drift. At the beginning of the takeoff roll, it is advisable to apply aileron control into the wind.

ENROUTE CLIMB

A normal enroute climb is performed at 70-90 MPH with flaps up. Engine RPM as required for rate of climb and conditions. Monitor engine temperatures and adjust climb speed as required. A higher climb speed will provide better engine cooling.

CRUISE

Normal cruise is performed between 2000 RPM and 2600 RPM. The fuel consumption, speed, and range will vary according to the particular power setting selected and the amount of onboard fuel. A good number for your cross-country planning is 5 hours endurance plus a 30 min reserve.

In your cross-country planning, always consider that the weather and wind can change. Plan accordingly and leave yourself room for alternate procedures.

Get to know the range of your aircraft as your range may vary.

STALLS

The stall characteristics of the S-21LS Outbound aircraft are conventional. Use slow deceleration. The position and feel of the flight controls can be used as an indication of an impending stall. The control stick will be aft of its normal flight position and the aircraft will have a break at the point of stall. . A stall can be terminated by smoothly moving the control stick forward far enough to allow the aircraft to accelerate to normal flight speed, adding power as required to affect recovery at the desired rate.

APPROACH

It is recommended to plan your prolonged descents from high altitudes to allow for small reductions in power every 2 to 5 minutes. This will enhance the life of the engine. Airspeed should be controlled with angle of descent and power. Avoid prolonged descents at low power settings.

LANDING

Normal Landing

Flap position selection for approach and landing should be determined by considering height of obstructions on the approach, wind direction and velocity, and usable runway length.

For taildraggers, touch down on two or three wheels as desired. If touched down on two wheels, lower tail wheel gently.

For trikes, touch down on mains, then after slowing, gently lower nosewheel.

Short Field Landing

Use 59 MPH on short final (with full flaps) and power as required to control the approach angle.

For taildraggers, touch down on three wheels and apply braking as required.

For trikes, touch down on mains, then after slowing, gently lower nosewheel, and apply braking as required.

Hold control stick back and retract flaps.

Crosswind Landing

When landing in a crosswind, use a 0 degree flap setting unless flaps are required for the field length. The wing-low method should be used during approach and touchdown since it will provide the best directional control. This method, when done correctly, will prevent side-loads from being imposed on the landing gear. Continue to hold the ailerons into the wind.

EXAMPLE: When landing with a crosswind from right, place the control stick to the right as required.

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.

HOT WEATHER OPERATION

Avoid prolonged engine operation on the ground.

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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 handle in the Vertical Stab. 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 in the Vertical 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.

TOWING AND TIE – DOWN INSTRUCTIONS

There are no provisions for towing of the S-21LS Outbound Aircraft on the airframe.

If the aircraft must be left unattended outdoors, always secure it with tie-downs. 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 using the seat belts and use the following tie down points:

- Tail
 - Taildragger - Tail gear
 - Trike - Tail Tie Down at aft of fuselage
- Wings - through Tie-Down Shackle at top of fwd Lift Strut.

- If strong winds or gusts are advised, seek shelter for the aircraft.

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 "Brillianize" for windshield care. Brillianize is available through RANS Parts Department.

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

PAINTED SURFACES

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

No polishing or buffing should 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 14-06**. All speeds are given for maximum takeoff weight. Speed are given in MPH and (KNOTS)

Marking	IAS Value or Range	Meaning
White Arc	40 – 110 (35 - 96)	Full Flap Operating Range - Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with flaps extended.
Green Arc	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 14-06: AIRSPEED INDICATOR MARKINGS

POWER PLANT INSTRUMENT MARKINGS

Recommended power plant instrument markings and their color code meanings are shown in **Table 14-07**.

Instrument	Yellow Arc (Line)	Green Arc	Yellow Arc	Red Line
	Minimum Limit	Normal Operating	Caution Area	Maximum Limit
Tachometer	800 RPM	800– 2600 RPM	2600-2700 RPM	2700 RPM
Cylinder Head Temperature	0-300° F	300-425° F	425-475° F	475° F
Oil Temperature	179° F	180° –235° F	235° - 245° F	245° F
Oil Pressure	0-60 PSI	60 – 85 PSI	85-90 PSI	90 PSI

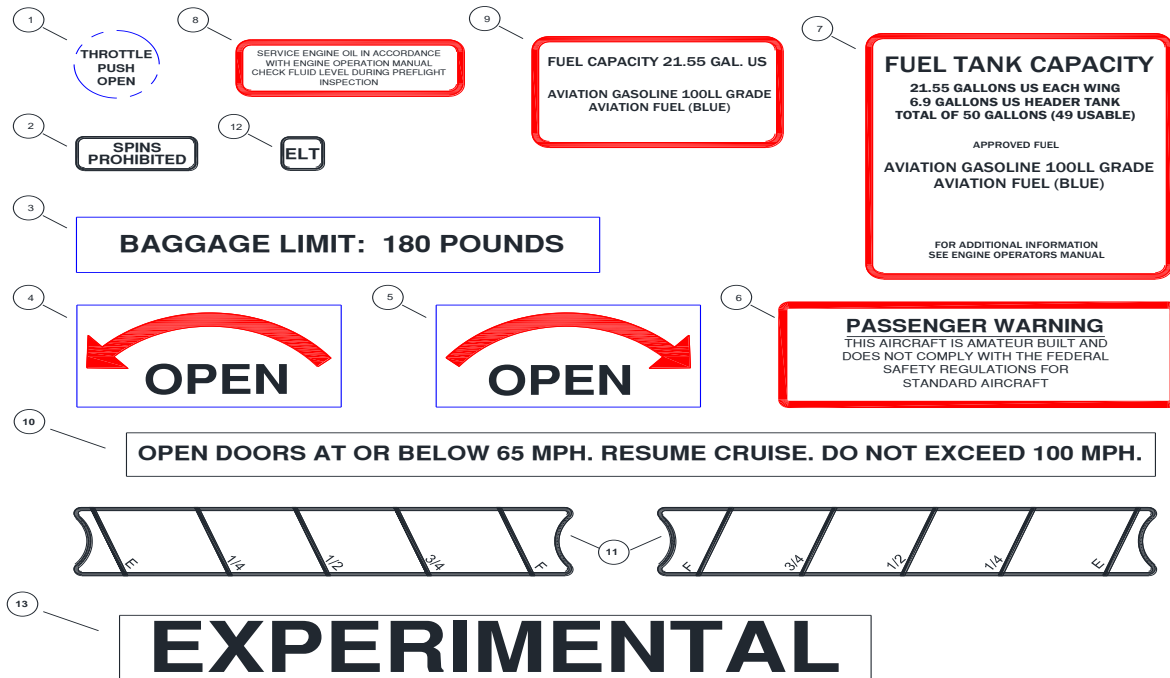
TABLE 14-07: POWER PLANT INSTRUMENT MARKINGS

PLACARDS

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

All placards may be printed by a local Graphics Shop or may be available through RANS Aircraft 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 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 wing root enclosure between fuel sight gauge exits.
12. Adjacent to ELT remote control on instrument panel
13. Placard "**EXPERIMENTAL**" in 2" letters on Station 3 Closeout - Upper.
14. All range markings on instrument front faces of Analog Instruments or programmed into Digital Displays as shown in AIRSPEED AND POWERPLANT MARKING, as shown above.

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.