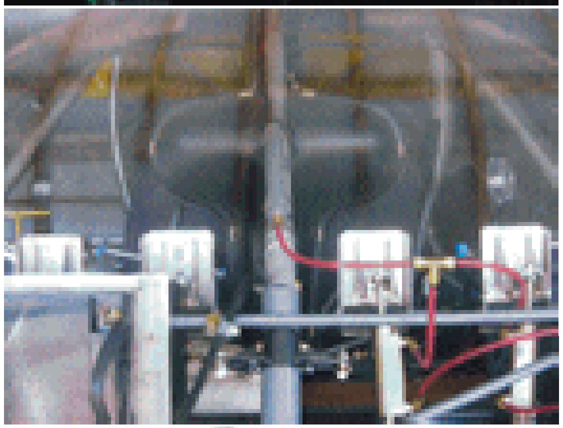
Rans S-12 Airaile



Pilot's Operating Handbook

Aircraft Registration Number N

Airframe S-12XL Airaile Serial No.

Engine Rotax 912UL-2 Serial No.

Propeller Warp Drive 3 Blade Composite Serial No.

Intercom PS-Engineering PM501 Serial No.

ELT Ameri-King AK450 Serial No.

Fire Suppression H3R Inc. Right-Out[tm] 14oz Halon Serial No.

SPECIFICATIONS		Cockpit Width	41 in	Useful Load	490 lbs	Oil Capacity	3.0 qts	PERFORMANCE 0'MSL		Stall Flaps	37 mph
Wing Span	31.0 ft	Number of Seats	2	Wing Loading	7.2 lbs	Coolant Capacity	4.4 qts	Take Off Roll	285 ft	Roll Rate	70deg /sec
Area	152 sq ft	Landing Gear	Fixed Tricycle	Power Loading	13.75 lbs	Propeller Diameter	72 in.	Rate of Climb	900 fpm	Glide Ratio	7:1
Mean Chord	4 ft 10.5 in	Fuel Capacity	18 gal US	Limit Load Factors	+4 -2	Prop Type	Composite 3 blade	Service Ceiling	14,000+ ft	Landing Roll	200 ft
Aspect.Ratio	6.33:1	WEIGHTS AND LOADINGS		POWER PLANT		Gear Reduction	1:2.27	Cruise	75 mph	Endurance	4.4 hrs
Length	20 ft 6 in	Gross Weight	1100 lbs	Engine	Rotax 912 UL 2	Fuel G.P.H.	4.1 gal @ 80%	VNE	100 mph	Range	374 miles
Height	93 in	Empty Weight	610 lbs	Output	80 hp			Stall Clean	42 mph		

Keep this copy in aircraft at all times

(Current weight and balance inside)

Revision Release Codes

001 Preliminary Issue of POH, issued October 27, 1999 after completion of the FAA airworthiness inspection

002 Issued after 5 hours test flight time

003 Issued on November 16th, 1999 after completion of test pilot's full testing phase. This issue is for the most part complete and contains typographical errors as well as content omissions. The next release of the POH should be a practical final release.

004 Issued January 3rd, 2000 after the test pilot had a hard landing resulting from a full flaps high angle climbout with a (simulated) engine failure. This was an effort to expand the operational flight envelop of the aiplane and resulted in at least one data point OUTSIDE the airspeed/altitude envelope. New notes added to the procedures section regarding short field and rough field operations.

005 Issued February 23rd, 2000 with a checklist reflecting the condition inspection and updated maintenance procedures and intervals. There are also changes to the content grammar, readability and flow. Charts have been included electronically (as opposed to 'cut and paste' after printing out the document). This version will be updated again to reflect content changes to the condition inspection about to be carried out on the plane and to finalize the handbook for grammar, readability and content.

006 Issued March 12, 2000 Includes an updated cruise checklist and procedure because of an incident whereby the fuel was not properly feeding from both tanks during cross country flight. Reflects updates as necessary from the 100 hour inspection conducted in March.

007 Issued ??,2000 Minor typographical fixes included.

Table of Contents

Chapter 1 Familiarization

The White/Rans S-12 is a two place, high wing pusher design of low weight and moderate horsepower. Additionally the design has a below average lift to drag ratio due mostly to the large thick wing. The stability of this design configuration is very high. There are no significant divergent tendencies within the operational envelope of flight.

The aircraft kit was manufactured by Rans Aircraft in Hays, Kansas. In its kit form, the airplane came with all welding and sophisticated fabrication completed. The majority of the amateur build requirements are satisfied by drilling holes in components, making the finish cuts on lengths of tubing, running wiring, hoses, etc. and assembling the pre-manufactured sub-assemblies into the completed aircraft. All told, the number of hours spent on the amateur build portion of this aircraft mounted to over 750.

This aircraft does not meet FAR §103.1 and thus does not qualify as an “ultralight” but instead according to FAR §21.175, and an experimental (special) airworthiness certificate must be issued for this amateur-built aircraft. FAR §21.191 A private or recreational pilots license is required to fly this airplane. Because this particular aircraft is not equipped with lights, night flying is prohibited; and because no transponder or communication radio is installed, entry into tower controlled airspace is prohibited. If you need another reason not to fly into weather or other limited visibility conditions, the un-certificated Rotax 912 engine on this aircraft is restricted to daytime VFR use only. For these reasons, flight into instrument meteorological conditions with this aircraft is STRICTLY PROHIBITED. There is an emergency locator transmitter on-board the aircraft capable of transmitting voice and also can be easily removed from the aircraft for portable operation should the survivors need to leave the crash site. Also, this aircraft is prohibited from carrying passengers for compensation or hire and that does include buying the pilot lunch and a motel at your destination.

In-flight behavior of the aircraft is very similar to other high wing designs such as the Cessna 172 with the exception that the S-12 has a considerably higher power to weight ratio (for increased climb and acceleration performance) and a higher drag to weight ratio (when you loose power, the aircraft has very little momentum and drag slows it down IMMEDIATELY). The pusher prop is located above the centerline of the airframe and compared to other more traditional aircraft such as a 172, creates a significant nose-down moment with the addition of power and conversely a nose-up moment with the reduction of power. This tendency is highest for example at the time of a missed-approach. The unwary pilot, adding full power from an idle power setting at very low altitude and low airspeed will notice a very high stick force required to keep the nose in a climb attitude.

This airplane is quite capable of short field operations. Take-off distances of less than 300 feet with full flaps, 1 pilot, and a 10kt headwind are possible. Likewise short landing distances are equally possible but difficult due to minimal braking power provided by the aircraft’s inefficient hydraulic braking system. Rough and soft field operations are possible but should be avoided where possible due to the fragile nature of the aircraft. The nosegear of this airplane is particularly susceptible to damage when mis-treated.

Intentional spins are prohibited in this aircraft. However, even a low time pilot will be able to recover easily from stalls and avoid departures. Stalls are marked with a gentle drop of the nose or in the case of power-on climbing banked stalls, the high wing will in fact drop (provided no pilot rudder input is used). A power on stall with only the pilot on board may be hard to recognize and in fact may never occur. The aircraft is not intended for aerobatics of any nature which would intentionally exceed 2G’s positive loading (4G design limit) and while the structure is designed to ultimately sustain 2G’s negative loading, it is recommended to avoid negative loading of any nature due to fuel starvation problems with the gravity fed fuel system.

In general, maintenance of the aircraft is focused on the powerplant (coolant, oil and other consumables) and the fabric sails. Loosing an engine or a big patch of your wing fabric is just about the most likely and serious threat to your well-being. The sails are coated with a UV resistant clear which extends their life from 350 exposure hours to approximately twice that. In any case, the sails should be treated with care; frequent detailed inspections will avoid any catastrophic failures. Other obvious failures are equally as important such as cracking of structural members, fatigued aluminum, missing rivets, loose bolts and elongated holes. Maintenance of the aircraft should only be performed by the designated repairman Jim White, but by regulation can be performed by virtually anyone. A 12 month condition inspection is a requirement of the airworthiness certificate and can be performed only by the designated repairman or a licensed A&P mechanic. If at any time, a major change is made, a re-inspection by the FAA is necessitated (FAR §21.93). When ownership of the aircraft is transferred, a new repairman certificate will need to be issued through the FAA.

A specific outline of the aircraft’s operating limitations, as issued by the FAA at time of inspection, is given in Appendix A and as a requirement must be on-board the aircraft at all times. All pilots should be aware of the FAA issued operating limitations for this amateur built aircraft.

Chapter 2 Aircraft Performance

Overview
Comprehensive performance charts (takeoff distances, rate of climb, etc.) are difficult to develop in 40 hours of flight testing. It is generally not possible within the scope of basic flight testing to experience the meteorological conditions that would allow a test pilot to generate data for all density altitudes. This factor and the general performance of this aircraft lend themselves to one important performance characteristic: log time in the airplane and learn for yourself the maximum performance characteristics if you need to push the envelope. Suggestions of climb performance and take-off and landing distances charted at the end of this chapter are logical estimations given by the test pilot.

Operational Milestones
This aircraft has been flown to 14,000 feet MSL with a single pilot, it has been operated on very short (300 feet), very rough fields (furrowed field), it has flown in 20 to 25 mph winds, it has flown in formation with other aircraft, and it has been flown at gross weight of 1100lbs. Maximum demonstrated crosswind by the test pilot during the certification phase was about 10 knots.

Typical Engine Performance
As for engine performance, it is best to review the Rotax operating manual. This manual does a very good job of informing the pilot with respect to engine performance and engine operating parameters. As a fundamental means to knowing engine limitations, the following apply and were observed during the first 40 hour test period:

RPM: Maximum 5 minutes at full throttle, Maximum 5500 continuous
Oil Temp: Do not takeoff less than 130 F or operate higher than 270 F
Oil Pressure: Typically comes up to 65psi immediately and stays there
CHT: Should be at least 130 F for engine runup and typically below 200 F
Water Temp: Raises to 130 F for runup and typically below 200 F
Water Pressure: Increases to 12 psi and may drop below that in cruise
Fuel Burn: Calculate flight plans with 4.5gph fuel usage and 65mph cruise

An important consideration for engine performance figures is a result of the very effective cooling system of this aircraft. In cold weather it becomes necessary to block off the air inlet to the radiator to keep the engine temperatures in the green. If you notice unusually cool engine operation in flight, the best thing to do is descend to a lower (and warmer) altitude and land when convenient to cover up the radiator inlet.

Takeoff and Landing Distance
In most any case, the runways typically encountered at modern day airports will be far longer than necessary for the S-12, even on a warm day at gross weight. However, the novice pilot should not attempt to operate on low performance days near gross weight with less than 1000 feet of runway. This is a scenario reserved for the pilot who is familiar with the aircraft. If flying solo and reasonably familiar with the airplane, 500 feet of runway (without obstacles) will usually suffice. With 50 foot obstacles in the same conditions, for takeoff or landing, a good pilot should give himself 750 feet of runway. If all conditions are in the pilots favor (pilot skill, sea level, 15mph headwind, solo pilot, smooth runway, no obstacles) then 200 feet of runway can suffice for takeoff and 300 feet for landing. The main reason for increased landing distance is the lack of braking power.

Figure 2.1 - Take-off and Landing Distance Chart

This take-off/landing distance chart is to be used as a guide for the new pilot. All of these distances are purely estimation (extrapolated from key data points gathered during the testing phase) by the test pilot and should serve as a general reference only. As a pilot of this aircraft, you should be experienced in the plane before trying to fly yourself and a friend into a remote area at high altitudes for an afternoon of hiking. You may find youself commited to an impossible landing with not enough performance to execute a go around.

Density Altitude	Take-off Weight (lb)	Obstacle Clearance (ft)	Surface Condition	Runway Length (ft)
0	820	0	Asphalt	500
5000	820	0	Asphalt	700
10,000	820	0	Asphalt	1500
0	1100	0	Asphalt	650
5000	1100	0	Asphalt	1000
10,000	1100	0	Asphalt	1900
0	820	50	Grass/Dirt	700
5000	820	50	Grass/Dirt	1000
10,000	820	50	Grass/Dirt	2200
0	1100	50	Grass/Dirt	900
5000	1100	50	Grass/Dirt	1300
10,000	1100	50	Grass/Dirt	2600

For any given condition: allow 10 percent runway distance increase per 1000’ density altitude chage; allow 40 percent runway increase from smooth to rough conditions; allow 30 percent runway increase from minimum weight to gross weight; allow 8 feet per foot obstacle clearance; allow 2 percent runway distance decrease per knot headwind.

Best Glide and Rate of Climb
As previously mentioned, this data was collected for one set of conditions only and best estimations must be used to extract the data to meaningful numbers at different weights and altitudes. This rate of climb data was collected at a take-off weight of 880lbs at an elevation of 4000MSL with an ambient air temperature of about 55 to 60 degrees fahrenheit.

As density altitude increases, two factors change the performance characteristics of the aircraft with regard to climb rate:

Engine power output decreases as altitude increases
Propellor effeciency decreases as altitude increases

It is important to understand that both of these effects are additive and will reduce performance to a sub-par level at high altitudes. While testing the service ceiling at around 820 pounds, 6167U was observed to have a 200fpm maximum climb rate at 14,000 indicated altitude. At gross weight and 10,000 density altitude, you may find yourself unable to attain more than a 200 fpm climb.

Figure 2.2 - Power On Rate of Climb Chart

The conclusions reached from the power on rate of climb test data are:

1) Best available rate of climb: no flaps, 50mph IAS, 760fpm
2) Best available angle of climb, 3 notches, 35mph IAS, 650fpm
3) Safest climb (test pilot’s recommendation: no flaps, 65mph, 700fpm

Although the true best angle of climb is obtained with full flaps at 35mph indicated, this is not the safest procedure to follow because it is right at the stall speed of the aircraft and engine failure would be difficult to recover from. Only hours of practice and experience will allow a pilot to make the decision between a climbout over a critical obstacle at 35mph followed

Flaps 0 Notches				Flaps 1 Notch				Flaps 2 Notches				Flaps 3 Notches			
IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle
35	-	-	-	35	-	-	-	35	500	6.16	9.30	35	625	4.93	11.70
40	600	5.86	9.80	40	700	5.03	11.50	40	680	5.18	11.10	40	600	5.86	9.80
45	680	5.82	9.90	45	700	5.66	10.20	45	750	5.28	10.90	45	620	6.39	9.00
50	760	5.79	9.95	50	700	6.29	9.10	50	620	7.10	8.10	50	700	6.29	9.10
55	750	6.45	8.90	55	650	7.45	7.70	55	620	7.81	7.40	55	-	-	-
60	700	7.54	7.60	60	600	8.80	6.50	60	600	8.80	6.50	60	-	-	-
65	680	8.40	6.80	65	600	9.53	6.00	65	650	8.80	6.50	65	-	-	-
70	620	9.94	5.70	70				70	-	-	-	70	-	-	-
75	600	11.00	5.20	75	-	-	-	75	-	-	-	75	-	-	-
80	425	16.56	3.46	80	-	-	-	80-	-	-		80	-	-	-

by a safer climb at 50mph. By spending time examining the data from the above chart, an experienced pilot/aerodynamiscist can make several very important discoveries regarding the configuration of this airplane, but such a discussion is beyond the scope of a simple POH. It is recommended to simply familiarize yourself with the trends left to right and top to bottom, understand the transitions necessary when retracting or extending the flaps as it relates to climb angle and airspeed (kinetic energy).

In addition to the power-on data, the same chart is given below in the power off configuration to aid the pilot in selecting the best glide speed for engine out emergencies.

Figure 2.3 - Power Off Rate of Climb Chart

The absence of data in this chart reflects the importance of knowing just how fast the airplane can be made to descend. It is highly unlikely that it will glide better with full flaps than in any other configuration so that area of testing was ommited. The most important conclusion from this data is as follows:

1) Best glide no wind conditions, no flaps, 50mph IAS, 500fpm, 8.8:1, 6.5 degrees below the horizon.

Flaps 0 Notches				Flaps 1 Notch				Flaps 2 Notches				Flaps 3 Notches			
IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle	IAS	Climb	Ratio	Angle
35	-	-	-	35	-	-	-	35	-	-	-	35	-	-	-
40	-	-	-	40	-	-	-	40	-	-	-	40	-	-	-
45	-	-	-	45	-	-	-	45	-	-	-	45	-	-	-
50	500	8.80	6.50	50	550	8.00	7.20	50	-	-	-	50	-	-	-
55	700	6.91	8.30	55	620	7.81	7.36	55	-	-	-	55	-	-	-
60	800	6.60	8.70	60	650	8.12	7.10	60	900	6.35	9.80	60	-	-	-
65	800	7.15	8.00	65	900	6.35	9.10	65	900	5.86	9.10	65	-	-	-
70	-	-	-	70	1000	6.16	9.30	70	-	-	-	70	-	-	-
75	1100	6.00	9.60	75	-	-	-	75	-	-	-	75	-	-	-
80	1400	5.02	11.50	80	1500	4.69	12.30	80	-	-	-	80	-	-	-

Chapter 3 Standard Procedures

Overview

This chapter is by far the most detailed of the operating handbook and indeed is the primary reason for having a handbook for the aircraft. The test pilot has spent many hours flying the airplane and has presented here the most refined, safest, and preferred procedures for most all flight situations. All of the procedures herein should be reviewed by a pilot new to the aircraft in order to gain familiarization with the philosophy and methods of flying 6167U. At the same time, realize that everything in the handbook is subject to critiscism and the test pilot's operating procedures are no exception.

Starting the Engine

When starting a cold engine, it is of utmost importance to avoid running the motor at very low RPM until it has warmed up. This is because it runs very rough. To start the engine when it is cold, begin with the throttle at idle and the starting carburetor activated. The starting carburetor is the more appropriate name given, by Rotax, to the choke. Engage the starter until the engine starts and immediately begin monitoring the engine instruments. Oil pressure may jump to as much as 100psi for as long as 10 seconds, but as the engine warms up slightly, the oil pressure will return to normal. It is important to never engage the starter for more than 10 seconds continuously and to give it a 1 minute rest period between every 10 seconds, to prevent over-stressing the starter components. After the engine starts, push the throttle open until the engine runs at about 2500 RPM and at this point go ahead and close the starting carburetor (close the choke). This should bring the RPM back to around 2000. In any case it will require a little 'artistry' on behalf of the pilot to get a stubborn engine to idle when cold. The starting carburetor sends a specific fuel air mixture to the engine which lets it run when cold, it is only set for a condition of throttle at idle. After starting the motor, if you close the choke before increasing the throttle, the engine may sputter or die, which is why after a brief period of running the motor with the choke on, you increase throttle to 2500RPM and then turn off the choke. To warm up the engine, set the RPM to 2000 for at least 2 minutes and then increase to 2500RPM until oil temperature reaches at least 120 F. Now it is possible to continue with the run-up procedure to check engine ignition.

If you observe that there is no fuel in the fuel filter, it is best to crank the engine with the ignition OFF until you see the filter fill at least halfway and then continue for a few seconds (do not crank for more than 10 seconds without a break). This condition will occur after you change the fuel filter and also if you inadvertently run the engine with the fuel valve turned off. Cranking the engine with the ignition off will load the supply side of the fuel system with fuel and when you finally start the motor, it will not sputter for lack of fuel, which is something that should be avoided if possible. It is important to note that the engine will run perfectly and the pilot may observe the fuel filter only half full, this is normal.

Engine Run-up

After the engine instruments are in the green and when you are sure the area is clear, set the parking brake and begin the run-up procedure. Increase RPM slowly to 3750 and sequentially turn off and then back on each of the ignition switches. Running the engine on one ignition circuit only will drop the RPM by about 200. There should be a maximum drop of 300 RPM and a difference between the two ignition systems of no more than 115 RPM. It will likely be best to judge the behavior of this check mostly by listening to the motor. After the check, return the throttle to idle. Each of the 4 cylinders in the engine has 2 spark plugs. One ignition circuit controls one spark plug in each cylinder. Two ignition systems increase the efficiency of the combustion (as evidenced by an RPM drop when you turn off one ignition switch) and secondarily provide a redundancy feature that if one circuit should fail, there is a second system to provide adequate power to land the airplane.

Using the Parking Brake Valve

The parking brake valve, if closed while the brakes are held on, will maintain better stopping power than using the brakes alone. This is because most of the hydraulic energy lost in this particular brake system is due to the flexure of the plastic brake line. While holding the brakes on hard, switch the valve to the closed position and release the brakes with your feet. Now the length of brake line holding hydraulic pressure is cut approximately in half, increasing stopping power. This technique should be employed for short field takeoffs and landings where stopping power is critical. It is also recommended for run-up procedure when checking magneto operation (the engine generates an enormous amount of thrust at mag-check RPM of 3750). Although when the valve is closed, it does allow you to apply brakes, it is recommended to hold the brakes on, then close the valve. Due to the ease with which the parking brake valve can be closed and open, it must remain an item on all checklists. It is not wise to takeoff or land when the valve is closed. When taxiing, use the brakes as little as possible and avoid using them lightly for extended periods, it is better to brake hard for a short period than to ride them lightly. If the situation ever becomes critical, cut the engine power and as soon as the aircraft is slow enough, put the airplane off the runway on the grass, there the rolling resistance is greatly increased.

High Wind Taxi Methods

Taxiing in high winds and operating on the runway with high crosswinds is no laughing matter. This is a very light aircraft and can be quite easily tipped over of thrown about by wind. Taxi with the utmost care in control orientation and always fly with authority and decisiveness when in high crosswinds. Once the airplane starts to tip over there is little you can do to stop it. If necessary, treat low wind or no wind days like high wind days. If you create the habit of continuously correcting for wind on the ground, you will likely be much safer when the winds do come. Take the time to create a chart for yourself showing control orientation for each type of cross wind (quartering from the front, quartering from the rear, head on, tail wind, direct crosswind). Remember that wind blowing backwards across the control surfaces (quartering tailwind) causes them to work in reverse of what they normally do.

Take-Off Overview

For take-off it is important for you to remember a few things. First of all, if you loose power in a high angle climb with full flaps or even 2 notches of flaps, you will have to IMMEDIATELY put in a large amount of nose down control inputs to maintain airspeed. It is easy to hesitate for a second or two and in this time your airplane can go from 70mph to 30mph. Second of all, you should treat the nose gear gently. Use a generous amount of elevator control to get the weight off the nosewheel as soon as possible, this also keeps the wheel from spinning any faster than necessary and minimizes vibration. The nose will come off the ground at 35mph with full throttle; with the throttle at idle, it is possible to hold the nose up at 25 to 30mph. This also keeps the rotational speed down for the large front wheel which is not in perfect balance. In high crosswind operations, you may have to compromise a bit and keep some weight on the nose for steering until you attain enough airspeed to keep the plane aligned with the runway.

Take-Off Procedure

Be sure your take-off checklist is complete, add power smoothly and hold a large amount of back stick until you feel the nosewheel come off the ground. Keep reducing back pressure as the airspeed increases so that the nosewheel remains 4-5 inches off the ground. If you keep the nosewheel off the ground you will be able to easily feel when the plane is ready to fly. Be careful not to pull up too hard and scrape the tail skid on the ground. Climb the first 50 or 100 feet at 65mph unless you need to clear an obstacle, in which case use the best angle of climb speed. After reaching 150 feet, ease out the flaps (if used) and continue the climb to your cruise altitude. Always observe the maximum flap extension speed on takeoff and landing. If the flap lever is difficult to pull, it is because there is too much wind pressure on the flaps. Push the nose over and reduce the throttle to cruise. When adjusting the power setting, do so in a slow and even manner. If you treat the engine with respect, it will respond when you ask it to. However if you rev the motor recklessly with rapid and erratic power settings, it will likely develop abnormal wear qualities.

Just As You Leave the Ground

As soon as you are off the ground, tap the brakes and stop the mains from spinning, you may notice a considerable amount of shaking if they are spinning fast. Liftoff speed at gross weight and two notches of flaps is approximately 40mph indicated airspeed. Continue your climb at Vx or Vy as required.

Engine/Throttle Usage

The airplane can be held in a climb attitude at full power setting for as long as 5 minutes. After this period of time you should allow for a short rest period or reduce the power of your climb. The engine is not meant to run at full power indefinitely. Also, if you are in a prolonged decent it is wise to periodically add power for a few seconds to clear the motor of excessive fuel build-up and provide a chance for increased circulation of fluids. Be particularly careful after idling the engine for a minute or so on final approach and then adding power for a go-around, give the engine a moment to respond to the first 1/4” of throttle input. Another important aspect of the aircraft is it’s excess power. With the exception of steep climbs, no matter what attitude the airplane is in, it is possible to quickly exceed 75mph. The throttle in this aircraft becomes just as important as any of the other controls when maneuvering and typically the airplane responds very rapidly to throttle inputs.

Cowl Flaps

This airplane does not have cowl flaps but there is something to be said on this subject. After the initial flight test period and when the weather turned cold, the typical in flight engine parameters started running too low. This is because of the highly effective radiator and the exposed mounting configuration of the engine. If the aircraft is operated in cold weather, the radiator inlet should be blocked either partially or completely. A completely blocked radiator inlet in operational weather of 30 degrees F will yield engine temperatures that are on the verge of too cool. If you discover the engine running too cool (out of the green) in flight, descend to a lower altitude and continue to the nearest point where you can land to cover up the inlet to the radiator. Running the engine at low temperatures is not healthy.

Rudder Usage

The rudder is trimmed for most normal flight conditions, however in a low airspeed high power setting configuration, the aircraft will require a little more right rudder pressure. In power-off descents, the aircraft will require a slight amount of left rudder. These tendencies are a result of the required aerodynamic right rudder trim which is set for a condition of level un-accelerated flight. The pusher prop, rotating counter-clockwise with respect to the longitudinal axis of the aircraft, is generally located above the vertical tail surfaces and as such the prop wash hits the left side of the vertical tail causing a nose-left tendency. Corrected in normal flight with right rudder trim, when the power is cut to idle there is an excess of right rudder moment and the pilot must use left rudder to fly straight.

Landing Overview

To land this aircraft it is important to remember that it has very little momentum (low gross weight) and a relatively large amount of drag (big wing). If you are doing an approach with full flaps and no power, the decent angle will probably exceed 25 degrees and the flare should occur at no more than one and a half feet above the surface. Why? Because if you flare early, the airplane will slow down drastically and settle rather abruptly on to the runway. If you don't like steep approaches and practically non-existent flares, then don't use flaps, keep in just a little power, and if you want a nice gentle and long flare, round out at about 5 feet and add power at the same time to around 3000 RPM. This is enough power to keep you from slowing down too much and gives you some time to allow the airplane to settle gently onto the runway by ever so slightly reducing the power setting and lowering the nose.

Powered Flare Approach

If you are doing the powered flare landing, you should touch down on the main gear with some power (2500 RPM) and once you do, reduce the power to idle and immediately reduce a little back pressure. Remember, the more power you have the more tendency for the airplane to pitch nose down. Even though you are cooking along at 40mph with 2500RPM and you can't hardly keep the nose wheel off the ground, when you cut the power the nose will come up immediately but the airplane will not likely lift off. Let the nose settle to the ground slowly and keep a little reserve elevator movement for the last few inches so that you can really touch down softly. If you hold the nose up with full elevator, the airspeed will drop suddenly and so will the nose, with no more up elevator to stop the motion.

Aerodynamic and Mechanical Braking

For maximum braking effect when on short fields, retract the flaps at touchdown to put weight on the mains, keep the nose high for aerodynamic braking thru 35mph, all the while using as much brake pressure as possible without slamming the nose to the ground. When you are under 30mph, it is best to let the nose wheel down and use maximum brake pressure.

Shutting Down the Engine (on the ground and in-flight)

After you land the aircraft and taxi off the runway, you have already provided an adequate cool down rest period for the engine. Normally after touch down, the throttle goes to idle and there is a certain amount of taxing involved. Set the throttle to idle, turn off both ignition circuits simultaneously and allow the propeller to stop. If you ever decide to turn off the engine while in flight, it is necessary to do a 30 second 'cool-down' run at 3000RPM prior to ignition shut off. Cutting the engine ignition when the engine has been running at high temperatures will cause it undue stress. Running the motor at 3000RPM for 30 seconds will circulate water and put the engine into a state of readiness for shut down. Be sure to reduce from 3000RPM to idle prior to turning off the ignition circuits. Follow the appropriate start up procedure for hot or cold start when it is time to re-fire the motor. Be sure to allow suffecient pre-heat time for the engine to warm up if you shut it off during flight in cold weather.

Emergency Procedures, Off Field Emergency Landings

In the case of an engine that will not start in flight, first focus on flying the airplane at the best glide speed of 50mph and aiming for a suitable landing field. This is the best still-air glide speed and essentially is the slowest sink rate. This will maximize your options in gliding to nearby fields and give you the most time to handle the emergency. If you have enough altitude, go through the checklist for engine starting by first observing fuel quantity and the fuel valve. Try a warm engine start first and if that fails, use the choke to start the engine. All the while, do not fail to fly the airplane and under no condition should you ever try to stretch the glide beyond what the aircraft is capable. Many pilots are killed because they are too ignorant to recognize that the airplane is coming down whether they approve or not. Save the stall for the last 1 or 2 feet of altitude if the terrain is very rough. Don't try to stretch a glide over top of power lines, it would be better to dive under them. If you stall and/or spin the aircraft at low altitude, the NTSB accident report will paint an ugly picture of your piloting skills. You should have enough time after committing to an off-field landing to do the following important steps: 1) Secure your seatbelts and 2) Un-latch the doors for a speedy egress from the aircraft. In addition, if you are certain of a serious emergency, do not hesitate to activate the ELT on your way down...there is no reason to wait for it to activate during the impact. Also if there is time it would be good to shut off the main fuel valve, but this is not a requirement.

Cruise Flight Fuel Consumption

Although it will not pose an immediate problem, if one of the fuel caps were not vented correctly you will find that during flight, fuel will feed from one tank only. If both fuel caps are improperly vented and are exposed to low pressure, the engine will likely starve for fuel before making it to the cruise flight situation. It is highly recommended to make estimated calculations regarding fuel usage, NEVER ASSUME that the quantity of fuel indicated in one tank is also in the other tank. If there is any indication of something that isn't quite right, make a cautionary landing as soon as practicable.

Cruise, Climbs and Descents

This airplane was meant to move at 65mph. Essentially everything is done at 65mph. Climb at 65mph, cruise at 65mph and descend at 65mph. As with any aircraft, the technique is to adjust your pitch for airspeed (elevator stick pressure) and adjust your power for the climb/descent rate. An intelligent reader quickly notes that flying this aircraft at 65mph ALL the time results in moderate throttle usage. Just as mentioned previously, the throttle in this aircraft is just as important as any other control. Learn to use it just like you use your feet on the rudders or your hand on the stick. Add power to increase your climb rate, decrease power to increase your descent rate. If you are flying too high, don't just push the stick forward but also reduce the throttle. If you are too low, don't just pull the stick back but also add power. The plane will cruise most comfortably at around 65mph indicated airspeed but cruising at 70, 75 or even 80mph is easy because of the excess power. Respect the yellow range marking on the airspeed indicator because it is there for a purpose. Higher speeds are reserved for only the smoothest of air.

Pitch Trim

There are two forces that trim the aircraft in its pitch attitude: power and elevator/horizontal stabilizer position. Understand that adding power will add a nose down trim to the airplane and reducing power will add a nose up trim to the airplane (remember the thrust line of the engine is above the center of the airplane). Also understand that increasing airspeed adds a nose up trim and decreasing airspeed adds a nose down trim (due to the decalage settings of the horizontal stabilizer, designed to produce negative lift at cruise airspeeds). The point of this discussion is that the aircraft, by design, will fly approximately level (not climbing or descending) regardless of the power setting. If you are holding forward pressure or back pressure on the airplane to maintain level flight, chances are you have displaced the trim tab or you are at the wrong speed for the power setting. Don't fight the aircraft, allow it to establish an equilibrium before you start to second guess the trim setting.

Add power: the power creates a pitch down moment which increases airspeed. The increased airspeed thus creates a pitch up moment and the aircraft balances at a new higher, cruise speed.

Reduce power: the loss of power creates a pitch up moment which decreases airspeed. The decreased airspeed thus creates a pitch down moment and the aircraft balances a new, lower, cruise speed.

The balance of these forces will change depending on the location of the center of gravity of the aircraft. Be prepared for unusual (more appropriately 'unfamiliar') behavior when you fly the airplane in different loading conditions. Visualize the dynamics of trim and energy balance while in flight to help you understand the interaction between pitch trim, power settings and airspeed.

Steep Turns

Steep turns (60 degree bank) are an approved maneuver in the S-12 and pose no particular threat with the pilots prior understanding of the aircraft's behavior.
Remember that one of the most distinguishing characteristics of this plane is that it has very little momentum because of its low weight. Because of this, it does not have the energy necessary to carry it through a turn. To change the direction of the airplane from straight and level requires acceleration, and acceleration requires energy. In a larger airplane, a slight increase in throttle is enough energy for the turn because a certain amount can be robbed in the form of airspeed, without jeopardizing the safety of the maneuver. In the S-12, the energy to turn is far greater with respect to the stored energy of level flight (momentum) and will rapidly decrease airspeed to the point of a stall. The remedy is to dive rather sharply during the turn or to increase power as you begin banking the airplane. Practice will tell you how much power is required, but for all practical purposes, from a cruise of 65mph, you should imagine adding full power throughout the turn to maintain your altitude. Failure to do so will drop airspeed well below 50mph.

Auto-Steepening Tendency

During the flight testing phase the aircraft was put through nearly every conceivable flight attitude likely to be encountered by the average pilot in most conditions. The plane was not tested for aerobatics and other such maneuvers but during testing, one significant flight mechanics tendency was noticed. After banking into a turn more than about 20 degrees, a certain amount of opposite aileron pressure is required to keep the bank from auto-steepening. This characteristic is due in part to the large wing and low airspeed. In a tight turn at 65mph indicated airspeed, the outside wing is traveling significantly faster than the inside wing and as a result has more lift. The remedy is to use a slight amount of opposite aileron. The effect increases as the radius of the turn decreases (low airspeed steep banks will create the most dramatic tendencies). This can be a dangerous characteristic when flying at low altitudes in gusty winds so be sure to understand the aircraft intimately before taking it to low altitudes.

Power-Off Stalls

Stalls in the Rans S-12 are docile and easy to recover from. Immediately after bring the power to idle, the nose must be aggressively raised to get a stall in the normal attitude. If the nose is not brought up immediately and quickly, even full up elevator will not bring the nose up to the horizon and the plane will stall with a nose low attitude. Either way, recovery from the stall is immediate following reduction of back pressure and the addition of power. There is very little buffeting or any other pre-stall warning. If the airplane is in a coordinated turn (climbing or diving) and the stall occurs rapidly enough, the high wing will drop bringing the aircraft to a level bank attitude when the stall occurs. This behavior is the same when flaps are applied.

Power-On Stalls

Power-on stalls are equally as easy to recover from and require a healthy amount of back stick to perform, especially with only one pilot at lower density altitudes. At low takeoff weights and in high density air, the plane may not stall with full power and could simply mush along at a very nose high attitude. There will be a considerable amount of noise and buffeting of the aircraft and it will require an excessive amount of back pressure to keep the airplane in this near-stall condition, which is instantly recovered from by reducing back stick pressure.

Skid and Slip Stalls

While not intended to be everyday maneuvers, stalls in slip or skid configurations possess no violent tendencies to spin but do require special pilot skill and as such are not recommended in most cases. The S-12 for all practical purposes has shown its ability to recover from such a maneuver and that is about the extent of telling you about it in this manual. Stalls should never be performed intentionally with the plane not in coordinated flight, to do so unknowingly is the first indication of a pilots lack of skill and awareness.

Stall Recovery Procedure

The standard stall recovery procedure is as follows: Stick forward, full power, retract flaps and immediately bring the nose up as airspeed hits 55mph. Stalls will result in no more than 500 feet of altitude lost, with proper piloting skills recoveries of less than 200 feet are common.

Forward Slips

The S-12 seems to behave rather erratically in forward slips and exhibits signs of instability and divergence. For example after depressing the right rudder to get into a slip, the rudder pedal practically keeps itself depressed at low airspeeds, a condition called "overbalance." This airplane is capable of slips and they do allow the pilot to quickly loose altitude but again this is an advanced maneuver for skilled pilots only. The flight instruments are not accurate in a forward slip. Practice slips at a higher altitude and use them only when comfortably above the ground. Do not use slips for the last 500 feet of your decent to land.

The Falling Leaf Maneuver

A falling leaf maneuver can be done by an advanced pilot provided there is sufficient altitude to recover from an unwanted departure (spin). Remember this plane is prohibited for intentional spins and if you are uncomfortable with your ability to keep the plane out of a spin, then don't do a falling leaf. It is a mildly violent maneuver and does cause some significant stress on the airframe, thus should not be a regular maneuver or one that an amateur pilot toys with. Bring the nose up and add a slight amount of power (2500 or 3000RPM), keep the stick nearly full back to keep the plane in a stalled attitude. Use the rudder pedals to maintain directional control by "stabbing" them with your feet. DO NOT push a pedal down and hold it down. If the plane banks left, stab the right rudder and immediately release it, then be prepared for stabbing the left rudder. This maneuver can quickly accelerate into a spin with improper use of the rudders by the pilot. If you loose positive control of the falling leaf maneuver, immediately push the stick forward and recover from the stall. It will take a lot of practice to learn the ability to "predict" which rudder pedal to push and how hard to push it. Falling Leaf is more magical than it is aerodynamically balanced.

Spins and Spin Recovery

While the S-12 is prohibited against intentional spins, it is the test pilot's best recommendation to follow this technique to recover from unintentional spins:

1) throttle to idle and let go of the stick (or stick to neutral)
2) retract flaps (if extended)
3) apply rudder full opposite the direction of yaw
4) push the stick forward the amount necessary to unstall the wing
5) recover from the dive with no more than a 4G pull-up

Though not tested on N6167U, recovery from an unintentional spin using the above procedure should yield prompt and decisive control of the situation.

Lazy Eights and Chandelles

While they were performed in the flight testing phase, these maneuvers are not recommended in the S-12 until the pilot has had some aerobatic training. The S-12 is a fragile aircraft and for the most part, if you are very aware of airspeeds and G-forces, you can execute some rather enjoyable chandelles and lazy eights. However, a low time pilot with no understanding of aerobatics may be quickly overwhelmed with either maneuver and inadvertently overstress the aircraft. Use common sense when approaching these maneuvers.

Rough Field Operations

The Rans S-12 Aircraft is equipped with what the factory calls "tundra tires". While they do allow the airplane to operate from soft and rough fields, they do not indicate that the airplane is well suited for this type of field. The particular concern with rough fields is the nosewheel. For example, after touchdown on a rough field, it is better to taxi the remaining distance required at 30mph with the nose off the ground than it is to taxi at 5mph with the nose on the ground. It will take only one rough field operation to make the pilot aware of this, there is a great deal of noise coming from the nosegear on rough fields. The rough field procedure begins far before touchdown. Use full flaps to get the slowest touchdown speed and attempt to hold the plane 2 inches off the runway until it settles down. Use as much back pressure as necessary to keep the nose off the ground. Similarly on take-offs, the pilot should hold in FULL back stick until the nose comes off the ground, then only use the amount of pressure required to keep the nose off the ground. Use two notches of flaps for rough field take-offs. Three notches may provided a 'lighter' feel but requires some special skills and is for the advanced pilot. Engine failure near the ground with full flaps in a nose high attitude will result in a very hard landing. Force the airplane off the ground as soon as possible and then fly the airplane in ground effect until it accelerates to an acceptable climb-out speed. Steep climbs at low airspeed with flaps extended should be avoided in all but the absolutely necessary cases.

Short Field Operations

Short field landings are about 30 to 40 percent longer than they need to be because of the inadequate braking system. Even with poor brakes, the S-12 can be comfortably operated in most any condition on a 1000ft runway. Although at the time of print, this aircraft hasn't been tested at gross weight on a hot, humid day, the test pilot can comfortably report that 1000ft is enough distance (even on a grass runway) to takeoff and land over 50 foot obstacles, provided the pilot is of moderate skill. In many cases, with a skilled pilot operating at 3000 feet density altitude and without a passenger on board, 500 feet of runway is comfortably sufficient, provided the 50 foot obstacle does not have to be cleared. For a short field take-off, use two notches of flaps. An alternate technique for short field lift-off is to use three notches of flaps but this is kind of an extreme measure and can lead to an accident if things go wrong. Hold the brakes as hard as you can and run the power up to where the airplane is barely able to stand still. Then quickly release the brakes while at the same time pushing the throttle to full power. Keep the elevator essentially in the cruise setting for the most aerodynamic takeoff roll. If it is a rough AND short field then keep the elevator horizontal until you reach 20mph and then briskly and gently use it as necessary to get the nose off the ground. After the aircraft leaves the ground, climb at the best angle of climb speed of 40mph. When you are clear of your obstacles (if any), continue the climb at a safer speed of 65mph and retract the flaps slowly.

Chapter 4 - Weight and Balance

The reference datum for weight and balance is at the center of the front wheel and with the aircraft level, all arms and weights are measured rearward from there. Changes to standard equipment require calculation of the weight and moment and a new 'current' weight and balance sheet should be printed, the old sheet being marked as "superceded."

Installed Equipment, N6167U

Airframe White/Rans S-12XL Airaile Serial No. 04970797
Engine Rotax 912UL-2 Serial No. 4403068
Propeller Warp Drive 3 Blade Composite Serial No. T7760
Intercom PS-Engineering PM501 Serial No. XA-07690
ELT Ameri-King AK450 Serial No. 458 470
Fire Extinguisher H3R Right-Out 14oz Halon Serial No. V-162233

Weight and Balance 11 Oct, 1999

Weight Empty with full oil and antifreeze and no fuel: 610 lbs, Gross Weight 1100 lbs, Useful Load 490 lbs

	Weight	Arm	Moment
Rear tailwheel	14 lbs	+214 in	2,996 lb*in
Left Main	298 lbs	+78 in	23,244 lb*in
Right Main	298 lbs	+78 in	23,244 lb*in
Empty Aircraft Totals	610 lbs	+81 in	49,484 lb*in

Preflight Take-Off Weight and Balance Worksheet

Use the graphs on the following page to lookup the moments for each item. Mandatory data in [] optional in ()

	Weight	Arm	Moment
Empty Aircraft	610 lbs	+81 in	49,484 lb*in
Optional Ballast	75 lbs	+20 in	1,500 lb*in
Pilot	[ ]	+49 in	[ ]
Passenger	[ ]	+49 in	[ ]
Fuel	[ ]	+78 in	[ ]
TAKE-OFF	[ ]	( )	[ ]

Acceptable CG Arm (Total Moment / Total Weight) is +69.5" to +76.5"

If combined pilot and passenger weight are between 108 and 345 pounds that CG will be acceptable regardless of fuel conditions. However, flying at the aft CG limit requires adjustment of the horizontal stabilizer and hence as suggested by the test pilot, a solo pilot should use 50 or 75 pounds of ballast when operating this aircraft. Failure to do so will impose severe limits on the amount of nose down force available even with full forward stick. In any case, always test the authority of the elevators by doing a short crow hop. The center of gravity of the aircraft is the total moment divided by total weight and must fall within 69.5 and 76.5 inches (aft of the datum). The CG envelope is graphed on the following page, a point inside the hatched region is safe with respect to loading.

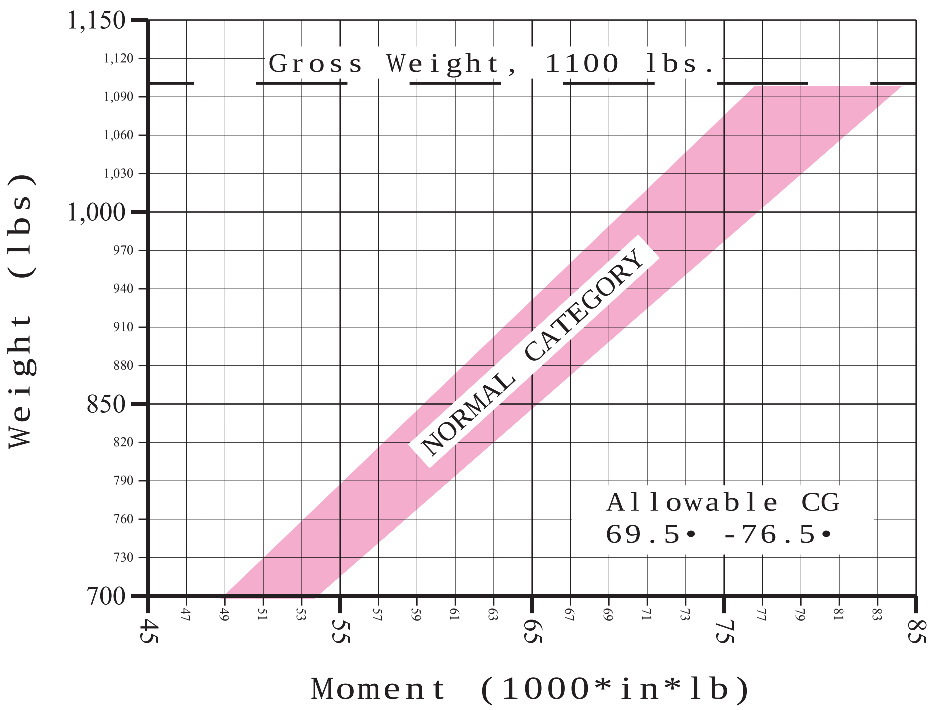
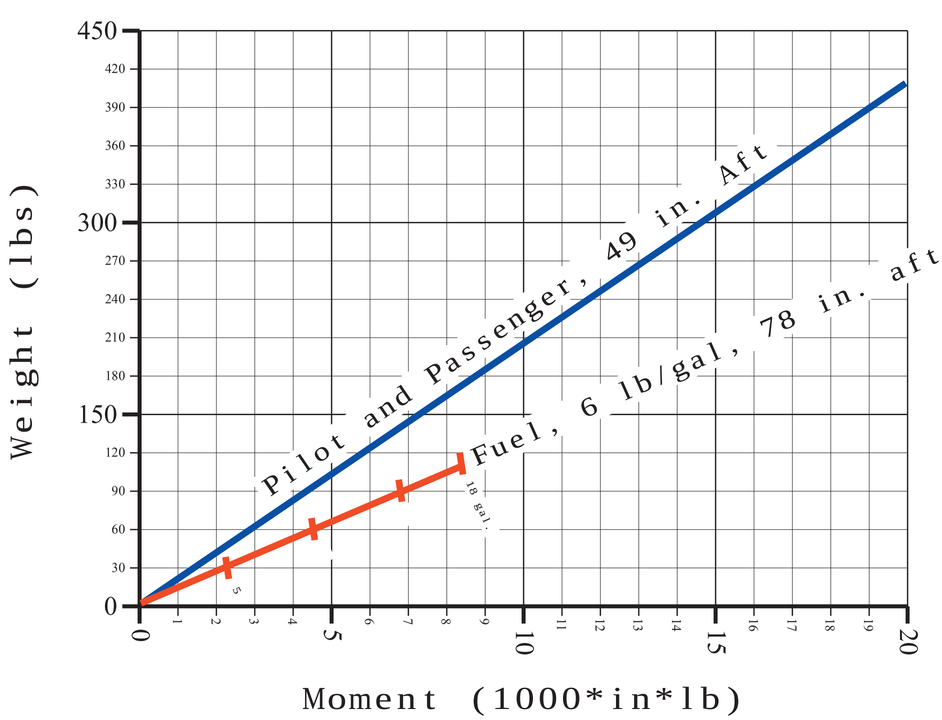


Figure 4.1 - Find the moment of pilot and passenger by moving horizontally from total weight to the pilot/passenger line, then read down to moment. Find fuel pounds and moment by reading along the fuel line to the total fuel on board in gallons, read fuel total weight at left and moment at bottom.



Chapter 5 - Airframe Maintenance

Overview

MAINTENANCE OF THIS AIRCRAFT CAN BE CARRIED OUT BY NEARLY ANYONE, HOWEVER A REQUIRED “CONDITION INSPECTION” EVERY 12 MONTHS CAN ONLY BE PERFORMED BY THE HOLDER OF THE REPAIRMAN’S CERTIFICATE FOR THIS AIRCRAFT (N6167U) OR A LICENSED A&P MECHANIC.

This condition inspection is carried out in much the same manner as an “annual” that production airplane owners are used to. Certificated parts, such as a certified engine, or other parts certified for use on an airplane automatically are designated as unapproved when installed and operated on an amateur-build aircraft. For this very reason, airworthiness directives do not legally apply to this aircraft unless the directive specifically cites N6167U as non-compliant. These technicalities notwithstanding, it would likely be foolish to disregard a factory AD on any component of the aircraft. The safety of this aircraft rests primarily on the owner/operator and designated repairman, not the FAA and not the engine or airframe manufacturer. Use common sense and show respect for the aircraft.

It is recommended to conduct an inspection which is the equal of a condition inspection, at 100 hour intervals. Of course when performed for a 100 hour interval purpose, the inspection does not need to be carried out by the designated repairman.

As the reader might expect, this listing of maintenance is not comprehensive. Refer to records kept in the aircraft logbook for additional practicle maintenance information. In most cases if something requires periodic maintenance, the mechanic will make a meaningful entry in the logbook reflecting what he/she has discovered.

Builder Key Areas

The pulley mount behind the left seat for the aileron cable was not manufactured properly and may allow the pulley to ‘cam over’ into a non-free state whereby friction and control integrity are severely compromised. As an effort to reduce the magnitude of this effect, the hoop was bent slightly. This hoop should be inspected after the first hour, then doubling the interval until it reaches the 100 hour point at which it is included in every 100 hour inspection.

The nut plates for the 3/16” bolts retaining the tail boom were noticed to behave in an unfamiliar fashion, due primarily with the builders inexperience with such fragile hardware and as a result all 3/16” AN hardware used to mount the tailboom to the main fuselage cage should be inspected at 5 hour intervals until the first 100 hours at which time they will be included in every 100 hour inspection.

The mounting points for the control stick were slightly misaligned due in part to to an error by the kit manufacturer and as a result the control stick may exhibit binding or galling when moved fore and aft (elevator). The control stick (primarily elevator control movement) should be inspected at 5 hours then every 25 until the 100 hour point at which time it remains on the 100 hour inspection list. This included the collar at the foremost part of the tail boom where the elevator control rod passes thru to connect to the push-pull tube. This collar should be lubricated with anti-seize at intervals of 25 hours or 1 year.

The manufacturer’s design of the rudder pedal and brake system (including the floor panel to which it is mounted) is such that a great deal of stress is placed on key hardware. The bolts used to secure the rudder assembly to the floor pan produce undue force and may eventually cause failure of the mounting tabs or other associated hardware. This entire sub-system should be inspected (under load) to ensure it’s integrity at 25 hour until reaching the 100 hour mark at which time it will remain on the 100 hour inspection list.

The lower strut attach points were necessarily modified when it was discovered the OEM equipment provided for less than 6 threads of engagement. The blocks into which the ball joint for the rear strut lower attach point engages were manufactured to new specifications from 4130 material and such that over 20 threads were engaged. The threads in this block were NOT roll formed but instead cut and as a result must be inspected closely. This inspection necessitates removal of the bolt thru the rod end (and subsequent replacement of the lock nut after 3 uses) and will remain on the 100 hour inspection list.

The jury struts don’t fit too great and have a lot of slop where the pins attach them to the main struts. As a result of this mis-fit, it is anticipated that there will be some play and movement in the system. At 10 hours then every 25 hours the safety wire should be cut, the pins removed and the pins and holes inspected for wear until reaching the 100 hour mark at which time it will remain on the 100 hour inspection list.

Periodic Inspection Points (100hr, Condition Insp., etc.)

Most items of inspection that are listed in the condition inspection checklist in Appendix E should be included in the 100 hour inspections. In some respects this is unjustified but because this aircraft is not built overly strong and because of the nature of the kit-build process, it is wise to inspect everything closely after 100 hours, afterall that amounts to about 6,500 miles.

The wing struts should be inspected thoroughly (spend 15 minutes) every 10 hours. This includes all bolts, safety wire, cotter pins etc. The struts, because they are extruded aluminum, are particularly sensitive to nicks, dings and scratches. Look carefully for sings of wear particularly at the ends of the struts where hardware is mounted. The integrity of the jury struts is also critical because failure of a jury strut could very quickly and violently lead to buckling of a main strut. The plates and mounts to which the struts bolt on the wings and on the fuselage are equally as important. Failure of the pin at the lower strut attach point, for example, would lead to immediate loss of one wing and departure from controlled flight (serious injury or death would follow). Likewise the integrity of the tail boom and each individual component of the tail is critical to maintaining controlled flight. Failure of the boom or of a major component of the tail (i.e. the tail boom extension) will cause departure from controlled flight.

The hinge bolts with castle nuts and cotter pins should be removed every 100 hours and remain on the 100 hour inspection list. These bolts undergo a large amount of stress, fatigue and especially wear considering the installation. It would not be unlikely for the bolts OR the cages (hinge brackets) to show significant wear. Immediate replacement of the hinge bolts or brackets should be carried out at the first signs of significant wear. Note also that after several replacements of the hinge brackets, the nutplate on the inside of the wing spar will be beyond it’s life limit and will have to be replaced. This level of replacement can be done only by removing or cutting the wing covers and should be scheduled to coincide with the replacement of the airplane's sails. Removing a bolt will necessitate replacement of a cotter pin for the castle nut.

In any case, after the airplane's first 100 hour inspection, all self-locking nuts removed for the inspection shall be replaced. Bolts will be replaced on a wear indicated basis. Thereafter the life of the nuts is to be set at 5 cycles (1 cycle is removal and installation of the nut). After the 5th cycle for the nut, it shall be replaced. Replacement scheduling based on hours of operation will be based on how frequently the nut is removed for inspection purposes.

One of the fuel lines on the engine was over-tightened (hose clamp on rubber hose) and caused immediate cracking of the hose. This was noticed after 1hr of operation in taxi tests and the end of the hose was cut and re-clamped, this time with lighter pressure. This should remain an inspection point for all hoses! Do not over tighten anything.

Every 15 hours, a light machine oil should be used on all control surface hinges, control mechanisms and rudder pedals. If it has been more than one month but less than 15 hours flight time, the lubrication should be done prior to the next flight. The heim ends do not need lubrication. Essentially the most important places to lubricate are those with extremely high pressure (the aluminum bushings in the flap lever assembly, the rudder pedals, the control surface hinges, etc.) It is best to use anti-seize lubricant on the elevator push-pull tube bushing. Also use an extreme pressure grease on the nosegear strut every 150 hours or 12 months. Be sure to thoroughly clean off the old grease, this is a highly exposed area and gets a good amount of dirt inside.

Hydraulic brake fluid level should be checked with a flashlight every 25 hours and of course at 100 hour and condition inspection intervals as well. Before every flight, a quick glance to see if there is air in the line coming from the bottom of the hydraulic resevoir is sufficient.

Washing the aircraft

Wash the aircraft using a soft sponge and a garden hose or bucket. Be very careful with the hose and where you spray water. For the most part, if you avoid spraying directly near holes and joints and so forth, the water will find it's way out of the plane. After washing the aircraft, a good automotive wax will help protect the airplane from the elements. A good wax to use is Zymol. Whatever the case, follow the manufacturers recommendations when waxing. Some of the do's and don'ts of washing:

1) DO NOT spray water near the engine, especially behind the oil tank
2) DO NOT spray water near the pitot/static tubes
3) DO NOT spray water in holes or cavities where it will not readily drain
4) DO use a sponge and mild soap if necessary to scrub the airplane
5) DO use an air blower to remove excess water from joints, bolts, etc.

After the Lexan has dried, use an approved Lexan cleaner and polish to buff out minor scratches, Maguires makes a cleaner and polish to buff out scratches and protect the surface very well. Vacuum the interior of the aircraft as needed and use a dampened cloth to clean the interior components such as the cabanes and fuselage cage. It may be handy to use the air blower to free some of the debris trapped in the cracks of the cabin area, just use good judgement with regard to this process, don't blow the dirt somewhere where it can't be vacuumed out. Another good trick is to gently tap on the outer skin of the cabin, this will let the debris work it's way out from between the frame and the aluminum skin. If there are chemical spills then use the necessary solvents to clean up the spill being especially careful around Lexan and other plastics.

Because you don't want to wash the plane any more than necessary, if you wish to remove a light layer of dust that has accumulated, the best way to do so is with a soft, wet towel. Take a real light pass across the surface with the cloth to get most of the dust onto the towel and then continue with a little bit harder "buffing" motion. Being wet, the towel keeps you from scratching the clear coat and if you are very very gentle, you can use the same wet towel to clean off the lexan if you desire but it is best to rinse the lexan surfaces with water. If you do not have the capacity to rinse the Lexan clean without touching it, use an air blower to get most of the dust off prior to wiping it with a soft wet towel. Try not to buff the Lexan any more often than necessary, just do it once a month if you can get away with it.

Chapter 6 - Powerplant Maintenance

Overview
As the reader might expect, this listing of maintenance is not comprehensive. Refer to records kept in the engine logbook for additional practicle maintenance information. In most cases if something requires periodic maintenance, the mechanic will make a meaningful entry in the logbook reflecting what he/she has discovered.

Propeller
"Re-torque all bolts after first hour of operation and then after every 5 to 10 hours as part of regular maintenance." -Warp Drive Inc. Instructions

Torque 1/4" bolts to 125 inch-pounds (25 increment) using 7/16" wrenches and 5/16" bolts to 175 inch pounds (25 increment) using 1/2" wrenches. Periodically check the track of the blades after torquing the blades or hub bolts. The three blades should track well within 1/8" of each other and if they don't, then something is wrong. Should the prop need to be re-adjusted, the most accurate method is to remove it from the airplane and place it on a perfectly flat table to adjust the pitch of each blade. Do so in a scientific manner to avoid any possibility of mal-adjustment. As well the prop should be inspected briefly prior to each flight to ensure it is in good condition. Always turn off the ignition before rotating the prop by hand and also remember that just because the switch is off doesn't meant the engine won't start! Excessive debris encountered during ground operations will cause nicks and gouges in the prop compromising it's integrity. At the first sign of trouble the prop should be sent to the factory for repair. If known debris conditions will be routinely encountered, the protective leading edge tape should be installed. Blade tip speed on this particular aircraft is approximately 500mph at 5800 engine RPM, 2.2727 reduction ratio to the propellor.

Engine Mount
Torque the 10mm bolts (TYP 4) using a 17mm wrench to 40 lb*ft. Check that the barry mounts are tight using a 9/16" wrench. This maintenance should be done at least every 50 hours.

Engine
Most engine maintenance is done by reference to the ROTAX owners manual! Always check the fluid levels and the quality of the fluids. Replace more often if desired, do not operate the engine with too much or too little fluid or with damaged fluids (burnt oil, dirty antifreeze, contaminated fuel, etc). The oil and oil filter should be changed every 100 hours by using the drill motor operated pump. Warmup the motor so that indicated oil temperature is about 120F. Remove the oil tank cap and dipstick and insert a small diameter tube to the bottom of the oil tank thru the dipstick hole. Pump out all oil possible (approximately .66 gallons). Remove the oil filter carefully avoiding any excessive spills by placing rags underneath and having the necessary clean up items on hand. Not too much oil will come out but enough to make a mess if you don't plan ahead. Wipe a small amount of clean oil around the rubber gasket of the new oil filter and install it to the engine without pre-filling it. Fill the oil tank to the midpoint of the marked region on the dip stick. Be sure the ignition is turned off and slowly rotate the prop 5 to 10 revolutions to fill the oil filter and oil pump. Now start the engine and monitor the oil pressure very closely. Shutdown the engine after 30 seconds or 1 minute and again check the oil level in the sump tank, add more oil if necessary. Do not overfill, it only takes about .2 gallons to go from low to high point on the dip stick.

This engine has been run-in with standard 10W-40 oil?? from 0.9 hours (new hobbs meter) to 25.0 hours at which time the oil used is switched to Mobil1 synthetic. It is important to remember that the Rotax 912 is not designed to run with aviation oil, with or without additives. Aviation grade oils typically have special additives that are not intended to be used in gearbox systems and the 912 UL has a common reservoir of oil for the engine and the gearbox. This engine was designed to be used with automotive grade oils only.

Change the fuel filter every 100 hours. Turn off the fuel valve and be prepared to catch excess fuel that runs out of the lines. Inspect the fuel filter to the extent possible to monitor signs of fuel system trouble. It is a good idea to monitor the condition of the fuel tanks (debris floating in the bottom) and to thoroughly inspect the fuel lines for cracks or other problems.

Throttle
The throttle friction block and mechanism in the cockpit should be inspected for proper operation before every flight. It is a simple matter to open the throttle and then return it to idle to observe if one or both of the cables may be sticking. On the 15 hour interval of airframe lubrication, the red plastic block should be lubricated and the throttle should be operated several times to ensure exact operation of the cable system. Likewise the choke (starting carburetor) should be inspected at the same time. Every 100 hours, the throttle and choke cables should be re-adjusted as well as the idle stop screws, if necessary, to synchronize the throttle opening. This is done with a dual vacuum gage setup attached to the intake manifold ports on each carburetor; it is necessary to completely remove the intake manifold cross tube for this test.

Appendix A FAA Issued Experimental Operating Limitations

This is a reprint of the operating limitations issued by the Designated Airworthiness Representative at the time of aircraft certification.

Phase I - Initial Flight Test in Restricted Area:
1. No person may operate this aircraft for other than the purpose of operating amateur-built aircraft to accomplish the operation and flight test outline in the applicant's letter, dated 06/10/99 in accordance with FAR Section 21.193. Phase I and II amateur-built operations shall be conducted in accordance with applicable air traffic and general operating rules of FAR Part 91 and the additional limitations herein prescribed under provisions of FAR Section 91.319.

2. The initial 40 hours of flight shall be conducted within the geographical area excluding...

3. Except for takeoffs and landings, no person may operate this aircraft over densely populated areas or in congested airways.

4. This aircraft is approved for day VFR operation only.

5. Unless prohibited by design, acrobatics are permitted in the assigned flight test area. All acrobatics are to be conducted under the provisions of FAR Section 91.303.

6. No person may be carried in this aircraft during flight unless that person is required for the purpose of the flight.

7. The cognizant FAA office must be notified and their response received in writing prior to flying this aircraft after incorporating a major change, as defined by FAR Section 21.93.

8. The operator of this aircraft shall notify the control tower of the experimental nature of this aircraft when operating into or out of airports with operating control towers.

9. The pilot-in-command of this aircraft must, as applicable, hold an appropriate category/class rating, have an aircraft type rating, have a flight instructor's logbook endorsement, or possess a "Letter of Authorization" issued by an FAA Flight Standards Operations Inspector.

10. This aircraft does not meet the requirements of the applicable, comprehensive, and detailed airworthiness code as provided by Annex 8 to the Convention of international Civil Aviation. This aircraft may not be operated over any other country without the permission of that country.

Phase II - Flight Operations After Completion of Test Phase
Following satisfactory completion of the required number of flight hours in the flight test area, the pilot shall certify in the logbook that the aircraft has been shown to comply with FAR Section 91.319(b). Compliance with FAR Section 91.319(b) shall be recorded in the aircraft logbook with the following or similarly worded statement:

"I certify that the prescribed flight test hours have been completed and the aircraft is controllable throughout its range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics, or design features, and is safe for operation."

The following limitations apply outside of flight test area:

1. Limitations 1, 3, 7, 8, 9, and 10 from Phase I are applicable.

2. This aircraft is approved for day VFR only, unless equipped for night VFR and/or IFR, in accordance with FAR Section 91.205.

3. This aircraft shall contain the placards, markings, etc., required by FAR Section 91.9.

4. This aircraft is prohibited from acrobatic flight, unless such flights were satisfactorily accomplished and recorded in the aircraft logbook during the flight test period.

5. No person may operate this aircraft for carrying persons or property for compensation or hire.

6. The person operating this aircraft shall advise each person carried of the experimental nature of this aircraft.

7. This aircraft shall not be operated for glider towing or parachute jumping operations, unless so equipped and authorized.

8. No person shall operate this aircraft unless within the preceding 12 calendar months it has had a condition inspection performed, in accordance with FAR Part 43, Appendix D, and has been found to be in a condition for safe operation. In addition, this inspection shall be recorded in accordance with Limitation 10, listed below.

9. The builder of this aircraft, if certificated as a repairman, or an FAA certified mechanic holding an Airframe and Powerplant rating, may perform condition inspections, in accordance with FAR Part 43, Appendix D.

10. Condition inspections shall be recorded in the aircraft maintenance records showing the following or a similarly worded statement:

"I certify that this aircraft has been inspected on (insert date) in accordance with the scope and detail of Appendix D of Part 43 and found to be in a condition for safe operation."

The entry will include the aircraft total time-in-service, the name, signature, and certificate type and number of the person performing the inspection.

Appendix B - Manufacturer Index

Warp Drive, Inc.
1207 Highway 18 East
Ventura, Iowa 50482
(515) 357 6000
FAX (515) 357 7592
(800) 833 9357
Warp Drive 3 Blade 72" S/N T7760

Rans Aircraft, Inc.
4600 Highway 183 Alternate
Hays, Kansas 67601
(785) 625 6346
FAX (785) 625 2795
www.rans.com
S-12XL Airaile S/N 04970797

VDO Instruments
188 Brooke Rd.
P.O. Box 2897
Winchester, Virginia 22603
(540) 665 2428
2 1/16" Tachometer S.O.#08074
www.vdona.com

PS Engineering Inc.
9800 Martel Road
Lenoir City, Tennessee 37772
(423) 988 9800
FAX (423) 988 6619
www.ps-engineering.com
PM501 Intercom S/N XA-07690

Ameri-King Corporation
18842 Brookhurst Street
Fountain Valley, California 92708
(714) 963 6977
(714) 963 6200
AK-450 ELT S/N 458 470

Rotax Authorized Distributor
Leading Edge Airfoils, Inc.
8242 Cessna Drive
Peyton, Colorado 80831
(719) 683 5323
(719) 683 5333
Rotax 912 UL 2 Engine S/N 4403068
www.leadingedge-airfoils.com

H3R Incorporated
1810 Harrison Street
San Francisco, California 94012
Right-Out^{tm} 14oz. Halon S/N V-162233
www.h3r.com

Appendix C - Preflight Inspection

Cockpit
- AROW (airwor./regist./oper./weight)
- Control Lock remove (seatbelts)
- Fuel (quantity)
- Sump Drain (open to drain water)
- Flaps (extend)
- Master Switch (cycle, check for power)
- Ignition (both off)
- ELT (latched, armed)
- ELT lanyard & portable antenna (on-board)
- Optional Ballast (installed, secured)

Cockpit Control Systems and Structure
- Pedals (stops, bolts, rivets, cracks, stops)
- Stick (binding, stops, push/pull tube bolt)
- Cables (thimbles, tension, pulleys, fraying)
- Brakes (air, fluid quantity, hoses, fittings)
- Aileron T (condition, turnbuckles, safety)
- Flaps (safety wire, bolts, binding)
- Throttle (friction, pins, bolts, idle)
- Choke (movement, friction)
- Fuselage Cabanes (nicks, dings, scars)
- Seats (tight, adjustment pins secure)
- Fuel Lines (chaffing, clamps, leaks)
- Electrical (chaffing, loose, cracks, burning)

Right Wing
- Fuel (quantity, cap tight, vent forward)
- Fabric (tears, UV damage, zippers closed)
- Fairings (secure)
- Attachment Bolts (tight, condition)
- Flap (hinges, pins, pushrod, horn)
- Aileron (hinges, pins, pushrod, horn)
- Tip (buckling)
- Struts (bolts, pins/wire, nicks, jury struts)
- Center Cover (secure)

Right Main Gear
- Leg (cracks, bends, brake line, hoses)
- Brake (leaks, safetywire, bolts)
- Tire (inflated)
- Wheel (bolts, cotter pin)

Belly
- Radiator (debris, leaks, damage)
- ELT antenna (condition)

Right Fuselage
- Lexan (scratches, cracks)
- Structure (rivets)
- Doors (hinges, handles)

Nose
- Minipod (secure)
- Tire (inflated)
- Wheel (bolts, cotter pins)
- Leg (cracks, bends, bolts, lubricated)
- Battery (secure, pins, cracks, wiring)
- Pitot/Static (clear, REMOVE COVER)

Left Fuselage
- Lexan (scratches, cracks)
- Structure (rivets)
- Doors (hinges, handles)

Left Main Gear
- Leg (cracks, bends, brake line, hoses)
- Brake (leaks, safetywire, bolts)
- Tire (inflated)
- Wheel (bolts, cotter pin)

Left Wing
- Fuel (quantity, cap tight, vent forward)
- Struts (bolts, pins/wire, nicks, jury struts)
- Tip (buckling)
- Aileron (hinges, pins, pushrod, horn)
- Flap (hinges, pins, pushrod, horn)
- Attachment Bolts (secure)
- Fairings (secure)
- Fabric (tears, UV damage, zippers closed)

Engine and Propeller
- Oil (quantity, cleanliness)
- Coolant (quantity, cleanliness)
- Air Cleaners (secure, cleanliness)
- Muffler (cracks, wire, springs, condition)
- All Hoses and Wires (condition)
- Carb and Choke Cables (cable ends, wire)
- Propeller Blades (cracks, nicks, dents)
- Propeller Hub (bolts, cracks, condition)
- Gearbox (backlash, axial movement)

Tail Boom
- Inspection Plate (secure)
- Collar (welds, tightness, deformity)
- Boom (cracks, scratches, buckling)
- V.Stab Mount (rivets, cracks, condition)

Left Tail
- Stabilizer Hinges (wear, bolts, cotter pins)
- Guy wires (thimbles, fraying, rings)
- Fabric (tears, UV damage)
- Tip (buckling)
- Elevator(hinges, pins/rings, horn)

Rear Tail
- Stabilizer Hinges (wear, bolts, cotter pins)
- Guy wires (thimbles, fraying, rings)
- Fabric (tears, UV damage)
- Rudder Hinges (wear, bolts, cotter pins)
- Rudder (cables, pins, lace cap, horn)
- Rudder Trim (secure)
- Tailwheel (freedom, wear)
- Boom Extension (cracks, bends, bolts)

Right Tail
- Guy wires (thimbles, fraying, rings)
- Fabric (tears, UV damage)
- Elevator (hinges, pins/rings, horn)
- Elevator Trim Tab (hinges, horn)
- Tip (buckling)
- Stabilizer Hinges (wear, bolts, cotter pins)

Appendix C - Operational Checklists

Intentional Spins and Aerobatics Prohibited
Certified for DAYTIME VFR only
Open Throttle During Descents

Operating Parameters

Engine	Rotax 912UL 80hp
Reduction Ratio	2.2727:1
Usable Fuel	17.7 gal.
gal*hr^-1	6.0@5800RPM
gal*hr^-1	4.0@4500RPM
Vs0	35mph
Vs1	45mph
Vr	35mph
Vlof	42mph
Vx	45mph
Vy	59mph
Vl/d	63mph
Vfe	65mph
Va	80mph
Vno	90mph
Vne	100mph
Coolant Pressure	12 to 17psi
Coolant Temp	Max 300^{o}F
Oil Pressure	22 to 73psi
Oil Temp	190^{o}F to 230^{o}F
CHT	Max 300^{o}F
RPM	5Min@5800
RPM	Continuous@5500
RPM	Idle@1400

Before Starting Checklist

Preflight	COMPLETE
Seat Belts	SECURE
Loose Objects	STOWED
Flaps	UP
Flight Controls	CHECK
Sump Drain	CLOSED
Fuel Valve	ON
Parking Brake Valve	OPEN

Engine Start (cold)

Choke	ON
Throttle	IDLE
Area	CLEAR
Ignition	BOTH
Brakes	ON
Starter	ENGAGE
Oil	PRESSURE
Throttle	2500RPM
Choke	OFF
Throttle	2000RPM

Engine Start (hot)

Choke	OFF
Throttle	IDLE
Area	CLEAR
Ignition	BOTH
Brakes	ON
Starter	ENGAGE
Oil	PRESSURE

Engine Warmup

2 minutes	@2000RPM
Continue	@2500RPM
Oil Temp	120F

Taxi Checklist

Brakes	CHECK
Intercom	OPERATIONAL
Radio	AS NEEDED

Engine Runup

Doors	CLOSED
Engine Instruments	GREEN
Brakes	ON
Parking Brake Valve	CLOSED
Throttle	3850 RPM
Ignition	RPM 300/115diff
Throttle	IDLE
Parking Brake Valve	OPEN

Pre-Takeoff

Elevator Trim	TAKEOFF
Flight Controls	CHECK
Flaps	AS REQUIRED
Altimeter	SET
Engine Instruments	GREEN
Fuel	QUANTITY
Wind	DIRECTION
Airspace	CLEAR

Cruise Flight

Fuel Tanks	BOTH FEEDING

Pre-Landing Checklist

Seatbelts	SECURE
Doors	CLOSED
Fuel	QUANTITY
Parking Brake Valve	OPEN
Engine Instruments	GREEN
Power	AS NEEDED
Flaps	AS NEEDED
Approach	60MPH
Approach Flaps	55MPH

Emergency Decent (in-flight fire)

Ignition	OFF
Master Switch	OFF
Fuel Valve	OFF
Seatbelts	SECURE
Doors	AJAR
Flaps	EXTEND
Decent Speed	75MPH

Shutdown

Throttle	IDLE
Ignition	OFF
Master Switch	OFF
Keys	HANG
Fuel Valve	CLOSED
ELT	CHECK
Control Lock	AS REQUIRED
Pitot Tube Cover	REPLACE

Appendix D - Condition Inspection Checklist

Rev 3 (Mar/12/99)

This checklist is written as a "semi-comprehensive" of things to look for. Many inspection points critical to safety are implicit to the skill level required for this type of inspection process. Expect to spend at least 12 hours with this procedure, more if complications arise. Refer to Rotax Owner's Manual for complete engine maintenance procedures at 100 hour, annual and other intervals. FAR Title 14 Chapter 43 Appendix D should add additional scope and understanding to all checklist procedures below.

REVIEW OF THE PROCESS

Inspection must be carried out or closely supervised by the designated repairman or an A&P mechanic with Authorization Inspection authority (AI). The flight test should preferably be conducted by a qualified pilot who is very familiar with the S-12 but who has not been the airplane for the majority of its pre-inspection flight hours. A pilot can spend months in a plane with problems that slowly get worse and worse and this pilot will never perceive the problem because of the graduality with which it occurs. Also, a pilot who is a third party to the aircraft will provide an objective and unbiased review of the performance of the airplane.

TTAE: Date: Completed By:

CHECK SMALL BOXES WHEN COMPLETED, INITIAL LARGE BOXES

☐ Cleaning of aircraft: ☐wash the fabric and metal surfaces of the aircraft with soap and water, ☐use an air blower to quickly remove moisture from all metal components, ☐clean the lexan using an appropriate plastic cleaner and polish (Maguire's or equivalent).

☐ Paperwork review: ☐identify previously unresolved issues in the airframe and engine logbooks, ☐review the status of life limited components and recurring airworthiness directives, ☐research any new or previously skipped airworthiness directives for the airframe, powerplant or propellor, ☐include a copy of any and all background information research papers with a copy of the condition inspection checklist.

☐ Propellor system integrity: ☐torque prop hub bolts to proper specification, ☐inspect blades for nicks, cracks and cleanliness, ☐hub for proper seating and cracks or signs of dammage, ☐gear backlash and axial backlash, ☐check blade pitch settings and blade track.

☐ Exhaust system integrity: ☐header and muffler for cracks, ☐remove and inspect springs and hoops for wear, ☐inspect condition of silicone bead, ☐tighten header nuts to prevent harmonic vibration of header tubes, ☐rewire springs and apply anti-seize to ball-joints.

☐ Ignition system integrity: ☐clean spark plugs, ☐spark plugs torqued properly and in good condition, ☐spark plug wires tight, ☐ignition ground wires, ☐stator area free of debris, ☐other ignition wiring components, ☐lines routed without interference and free of chafing.

☐ Fuel system integrity: ☐all lines for cracks especially cracks in black line where hose clamps are used, ☐all connections for tightness, ☐all lines for chafing and routing interference, ☐operation of sump drain, ☐cleanliness and age of fuel filter, ☐appearance of fuel tank interior (debris, discoloration etc.), ☐discoloration of blue lines or oxidation of black lines, ☐chafing protection on blue lines, ☐fuel cap gasket and vent tube clear and secure, suppleness of lines, ☐routing of sump drain line.

☐ Coolant system integrity: ☐coolant level and mixture to -34F, ☐lines routed without interference and free of chaffing, ☐connections for tightness, ☐hoses for cracks or signs of aging, ☐suppleness of lines, ☐radiator free of debris and dammage, ☐radiator mount secure and free of cracks or dammage, ☐cap gasket quality, ☐routing of coolant overflow line, ☐coolant overflow tank for secure mounting, ☐temp/pressure lines secure.

☐ Carburetion System: ☐clean and re-oil air filters, ☐air filters properly safety wired, ☐return springs on throttle and choke for wear and condition, ☐fuel overflow and vent lines routed properly, ☐carburetor structure free of damage, ☐rubber boot quality and 7mm gap.

☐ Oil system integrity: ☐oil coloration and age (50 hrs.), ☐oil quantity, ☐lines routed without interference and free of chaffing, ☐oil overflow line routing and condition, ☐connections for tightness, ☐oil tank secure, ☐hoses for cracks or signs of aging, ☐suppleness of lines, ☐fittings tight, ☐oil cap gasket quality.

☐ Other engine electrical systems integrity: ☐oil pressure switch, ☐CHT sensor, ☐oil pressure sensor, ☐lines routed free of interference and chafing, ☐connections secure, ☐routing of all lines to the electronic components mounted to the keel, ☐routing of electrical lines to control panel, ☐miscellaneous motor structures, casing for cracks, etc.

☐ Battery system integrity: ☐battery box secure, ☐free of dammage and signs of wear, ☐connections tight (ground, starter, engine ground, ☐battery terminals, starter relay), ☐cables routed free of interference and chafing, ☐crimped ends secure to cables.

☐ Lubrication of moving components: ☐all moving control surface hinges, ☐rudder pedal system including pushrod ball joints, ☐toe brake system, ☐control stick bushings for elevator and one for aileron, ☐flap actuator lever, ☐elevator trim tab hinges and control screw, ☐cable ends to rudder horns, ☐engine control cable ends, ☐door opening mechanism if necessary, ☐throttle lever and red block all with light machine oil, ☐elevator push-pull rod and brake cylinders with anti-seize (do not any lubricate rod-ends).

☐ Engine control system integrity: ☐throttle friction rod clean, ☐friction block adjusted, ☐verify idle and full throttle advance of throttle cables, ☐micro-adjust throttle cables using dual vacuum gauges, ☐idle settings correct, ☐engine tachometer reading correctly, ☐bolts and pins secure in throttle control system, ☐throttle cable housing free to move, ☐throttle and choke cables free of fraying and wear, ☐cable ends, ☐choke actuation satisfactory, ☐chokes close completly and open in synchronization, ☐friction of choke pull is managable.

☐ Brake system integrity: ☐fluid level ok, ☐fluid resevoir secure and cap tight, ☐all tubing for signs of aging or embrittlement, ☐connections tight, ☐cylinder seals connections and lines for leaks, ☐brake cylinders for leaks, ☐rotor and pads for wear, ☐routing of lines free of chaffing and interference, ☐parking brake valve operates properly, ☐rotor bolts safetied properly, ☐brake cylinder free to float, ☐bleed fitting caps, ☐bleed fiting tight, ☐cylinder and brake specific pedal components for mechanical integrity.

☐ Landing gear system integrity: ☐tires inflated to 15psi, ☐tire for wear and aging, ☐wheel hubs and axles for signs of cracking or dammage, ☐main gear leg and nose wheel strut for structural integrity and cracks, ☐nose wheel strut for excessive wear or dammage, ☐nose wheel strut for cleanliness of greased area, ☐maing gear leg and nose wheel strut fuselage attach points for cracks or bending, ☐bolts and cotter pins for security.

☐ ELT system integrity: ☐antenna for condition, ☐cables and routing for connection and chaffing, ☐condition of mounting system, ☐signs of wear or dammage to the support system, ☐operation of the ELT unit itself for transmitter power and activation (during annual only), ☐age of system batteries and remote panel battery including total duration of operation limitations, ☐lanyard and portable antenna onboard the aircraft.

☐ Flap actuation system integrity: ☐console flap lever mechanism for cracks loose connections or dammage, ☐end effectors for tightness and wear, ☐operational check of flaps throughout movement range, ☐flap frame mechanically sound, ☐flap control hinges and bolt for wear and cotter pin, ☐flap fabric for dammage and condition, ☐flap control horn for mechanical integrity and dammage, ☐actuation cables for routing and safety wiring, ☐spring return system for wear and operation and dammage, ☐flap control rod exit fairings for wear and integrity.

☐ Elevator trim system integrity: ☐for proper friction free operation, ☐tightness and security of cable routing for chafing and interference, ☐trim tab for mechanical condition, ☐trim tab hinges for wear and tightness of hing screws, ☐trim tab console mechanism for mechanical condition and wear.

☐ Elevator system integrity: ☐push pull tube for mechanical integrity, ☐push pull tube end effectors for bolt dammage and tightness and for wear or dammage, ☐control stops for wear and rivet integrity, ☐push-pull rod for binding and lubrication and wear, ☐elevator frames for dammage or wear, ☐elevator hinges and bolt for wear and cotter pins, ☐elevator control horns for mechanical integrity, ☐elevator split push-pull tube end effector for cracks and bolt safety rings, ☐control stick for tightness to fuselage cage, ☐control stick mechanism for cracks or other signs of dammage or wear.

☐ Aileron system integrity: ☐cables for tension, ☐cables for fraying or wear, ☐cable thimbles for wear, ☐pulleys and pulley cages for wear and mechanical condition, ☐control tee for signs of dammage or wear, ☐turnbuckles for safety wire and tightness, ☐turnbuckle attach points (cables and tee side) for wear, ☐aileron push-pull tubes for end effector condition or cracks and condition of main bolt and safety ring, ☐aileron servo horns for signs of dammage or wear, ☐aileron rods for wear and end effector condition, ☐aileron frame for mechanical condition, ☐aileron fabric for condition, ☐aileron control horn for dammage or wear, ☐ball joint end effectors for binding, ☐aileron hinges and bolt for wear and cotter pins, ☐freedom of movement throughout operational range of control stick, ☐limit of control movement, ☐aileron rod exit fairings for wear and integrity, ☐control stops for proper operation, ☐control stick safety wire “bushing” for proper operation, ☐dual controls stick connector for wear.

☐ Rudder system integrity: ☐cables for tension, ☐cables for fraying or wear, ☐cable thimbles for wear, ☐pulleys and pulley cages for wear and mechanical condition, ☐plastic cable bushings for wear and operation, ☐rudder pedals for wear or dammage, ☐pedal mounting system for mechanical dammage or wear or binding, ☐pedal bolts for tightness, ☐cockpit floor for signs of dammage from excessive brake system application, ☐pushrod connections to nose gear for tightness and wear and mechanical integrity, ☐control stops for proper funciton, ☐freedom of movement throughout envelope of rudder movement, ☐binding of rudder with elevator, ☐rudder frame for mechanical condition dammage and wear, ☐rudder hinges and bolts for wear and cotter pins, ☐rudder horns for dammage or wear, ☐rudder lacing cap for secure fit, ☐rudder fabric for condition, ☐cable end effectors for tightness and cotter pins, ☐rudder trim tube secure.

☐ Empennage structure integrity: ☐horizontal stabilizer frames for mechanical condition, ☐vertical stabilizer frame for mechanical condition, ☐fabric for condition, ☐fabric lacing for condition and tension, ☐v.stab and h.stab attachment hinges and bolts for condition and cotter pins, ☐vertical stab mount for cracks and other signs of fatigue, ☐vertical stab mount rivets for condition, ☐tail boom extension for cracks or dammage, ☐boom extension hardware for condition and wear, ☐guy cables for fraying and tension, ☐guy cable ends for secure attachment and thimble condition, ☐guy cable attachment points for lock rings.

☐ Tail boom structure integrity: ☐tail boom tube for cracks or any other sign of deformation, ☐tail boom tube for fatigue at any point where it is attached to the frame or something is mounted to it, ☐sight down inside of tail boom with a light at the lower end for back lighting, ☐systems inside boom for interference or signs of dammage, ☐tail boom collar and collar bolts for cracks or deformation, ☐tail boom attach points to fuselage cage for signs of dammage and mechanical condition, ☐flow fence structure for clues indicating tail boom flexure (i.e. popped rivets).

☐ Cockpit systems integrity: ☐pre-flight and standard procedures checklists onboard, ☐fire extinguisher mount secure, ☐fire extinguisher ready for use, ☐intercom system wiring for routing conflicts or chaffing, ☐intercom secure to fuselage keel, ☐intercom jack box mount for mechanical condition, ☐airworthiness and registration and pilots operating handbook with current weight and balance is on board the aircraft, ☐instrument panel for structural integrity, ☐pitot and static tubes for cleanliness and line routing conflicts or chafing, ☐pitot and static system operating correctly (annual inspection only), ☐compass mount for structural integrity, ☐seats for mechanical condition and condition of fabric and tension straps, ☐hour meter operational, ☐fuel quantity/spins/experimental instrument arcs and other placards properly installed and in good visual condition, ☐intercom operational, ☐seat belt mounting structures and belts, ☐floor board for cracks or dammage and floorboard wear plate for condition.

☐ Cockpit cage integrity: ☐for cracks or deformation of any weld or part of the structure, ☐for elongation of bolt holes, ☐for flecked paint indicative of cracks, ☐for overall “squareness” and indications of dammage that is only visible in the big picture, ☐for loose fasteners, ☐for dammaged tabs or mounts welded to the cage.

☐ Fuselage cabanes and keel integrity: ☐for dents or deep scars that would affect the structural strength of these components, ☐for flecked paint or other signs of deformation, ☐for elongated fastener holes, ☐for components loosely mounted to the keel, ☐for loose fasteners.

☐ Motor mount integrity: ☐torque the motor mount bolts (into the engine block), ☐check the tightness of the engine bolts thru the barry mounts, ☐inspect each component of the barry mount system for any sign of dammage such as cracks or deformation, ☐lateral stabilizer supports secure and in good condition.

☐ Wing mount system integrity: ☐hinge blocks and keel standoff and all hardware for cracks or loose fasteners or signs of fatigue or dammage, ☐keel mount point free of elongation, ☐struts for nicks or deformation especially cracking along the length of the extrusion and near the end, ☐strut blocks for signs of overstress such as cracks or deformation, ☐strut fairing for security, ☐jury struts for signs of vibrational wear, ☐jury strut pin safety wire and cotter pins, ☐jury strut pins and sockets for wear, ☐lower strut attachment point to fuselage for cracks or deformation, ☐lower strut pin for lock ring and wear, ☐threaded strut blocks and threaded rod ends for signs of thread dammage.

☐ Wing structure integrity: ☐internal wing structure for any sign of dammage, ☐for loose fasteners, ☐for signs of vibration wear or fatigue or over stress, ☐fuel tank mount system for loose rivets or other dammage, ☐wing fabric for condition, ☐fabric ribs for secure ends, ☐wing structure for signs of buckling with applied load (push up and down rather hard on the wing).

☐ Fuselage superstructure integrity: ☐lexan and sheetmetal for missing or loose rivets, ☐lexan for excessive scratching, ☐lexan and sheetmetal for buckling which would indicate other problems with the airframe, ☐door mechanisms for operation, ☐door hardware for function, ☐center cover sheetmetal and mount system for mechanical integrity, ☐door seals and other seals for signs of aging, ☐lexan for signs of aging.

☐ Aircraft ground operations and flight test: obtain a pilot for the ground and flight test who has not been in the aircraft for the majority of its last 100 hours of service. This pilot will provide an objective and non-emotional evaluation of the aircraft including a ☐basic pre-flight inspection, ☐ground run-up of the engine (check throttle synchronization and tachometer calibration, ☐verify operation of charging system, ☐in-flight performance checks, ☐and any other basic check of flight maneuverability, ☐trailing position of controls in flight.

☐ Airframe and Engine logbook entries: Upon completion of the inspection, make the appropriate entries in the airframe and engine logbooks to reflect the results of the inspection. This must include the endorsement of the designated repairman or an A&P mechanic as required by the Phase II Operating Limitations Part 10 as issued by the FAA for 6167U. Information such as what corrective action was taken or needs to be taken, suggestions to new maintenance intervals and records of the performance of the engine and airframe in flight should all be included in the entries.

End of Condition Inspection Checklist

Full Capacity
18 Gal.

Sight Gauge Markings
Total Fuel On-board

11.4

7.6

3.8

Full Capacity
18 Gal.

Sight Gauge Markings
Total Fuel On-board

11.4

7.6

3.8

FOR	000	090	180	270
STEER	002	088	174	275

SPINS PROHIBITED

Amateur Built Aircraft
This airplane is amateur built and does not comply with the federal safety regulations for standard aircraft

Appendix F - Maintenance Equipment, Tools, Supplies

Tool and Equipment list

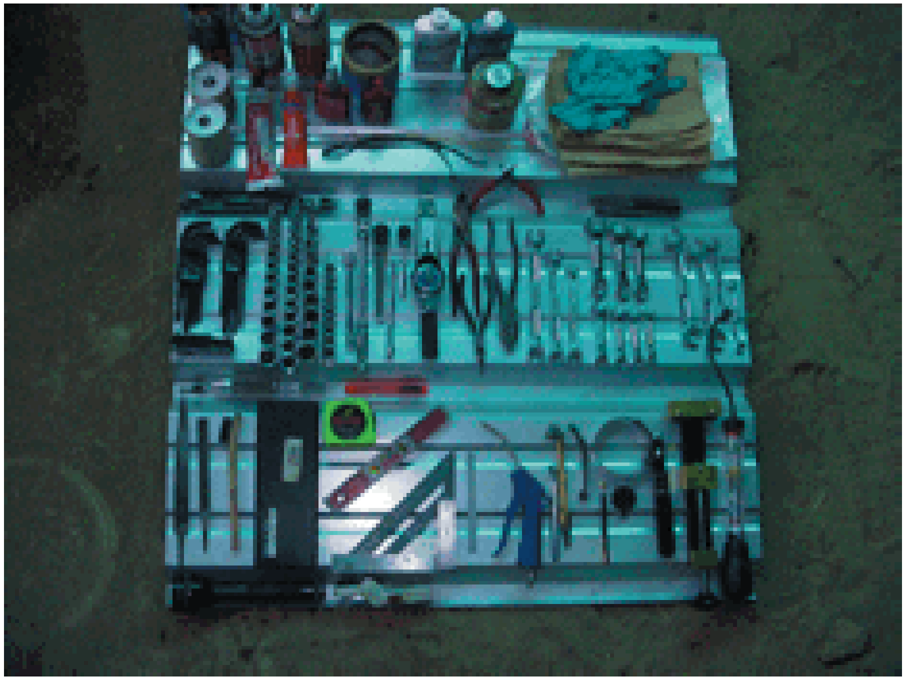
complete assortment of inch and metric sockets and wrenches
complete assortment of inch and metric allen wrenches
in*lb torque wrench
lb*ft torque wrench
flat blade screwdriver
phillips screwdriver
wire cutters
safety wire pliers
oil filter wrench
drill motor driven fluid pump
Step ladder
funnel
air compressor
schrader valve air chuck
tire gauge
air blower
propellor blade pitch tool
measuring tape or ruler
machinist’s square
precision calipers
magnifying glass
flashlight
magnet tool retriever
shop type vacuum
needle-nose pliers
dual vacuum gauges with attachments for engine
oil filter cutting tool
pop rivet gun
voltmeter
optical tachometer
camera and/or video camera
feeler gauges
spark plug gapping tool
plastic brush
floor jack
antifreeze concentration checker

Consumables

paper filters
paper towels, rags
lexan polish (Maguire’s)
copper anti-seize compound
extreme pressure grease
automotive wax
soft sponge
mild car wash soap
chamois
safety wire all diameters
tie wraps all sizes
rubbing alcohol
electrical tape
masking tape
Brakleen or equivalent
blue#242, red#241? and violet#222 loctite
WD-40 or equivalent for lubrication
K&N filtercharger cleaner and oiling kit
glass cleaner (clean instrument panel)
high temperature RTV silicone
solvent

Replacement Parts and Fluids

Rotax oil filters
Napa or equivalent fuel filters
Mobil1 10W-30 for engine oil
antifreeze and anti-corrosion
miscellaneous pop rivets, cotter pins, bolts and fasteners
miscellaneous hose cutoffs and other spare parts



Tuesday Night
-Make list
-Prepare pilot notes to take up on clipboard for observing rigging changes for flight one and two, scheduled for wednesday
-Get ballast strap from mom and ballast bag (1x)
-Try to line up a duffel bag or something of that nature
-Get video, blank video tape, champagne and wine, cooler with ice, cups

Wednesday
-Get digital camera and anything else not gotten Tuesday night
-Arrive 7:30-8:00
-Buy donuts for inspector
-Screw in aileron stops a few turns to increase travel
-Re-torque all prop bolts
-Re-buff lexan if it looks appropriate
-Wash propellor, bugs!
-Take a second look at the interior and everythign else on the airplane
-Dust all surfaces lightly
-Ask about toolboxes, storage etc. in hanger
-Get all tools ready for inspection plate removal if the inspector asks
-Prepare paperwork for inspector, clean up the hanger
-Complete FAA inspection process, take notes
-Comply with all FAA requests
-Get another 5 gallons of premium gasoline, fill it up for test flights
-Fill out aircraft logbooks to reflect FAA inspection status
-Sign off airworthyness/registration and logbook in the final inspection booklet in the contruction book

Weather and Time Permitting (Wednesday afternoon)
-prepare video camera, camera, digital and so forth
-take photos of the aircraft, interview test pilot
-First flight, 1.0hrs approximate flight time
-Goals are
    --climb to 1500AGL in pattern, then leave for a nearby field
    --rigging of
        ailerons (position free in slipstream)
        aileron travel (is it sufficient?)
        flaps (roll tendencies)
        wing washout (wing high or low)
        rudder and vertical stabilizer (ball position wings level)
        horizontal stabilizer (stick position in trimmed flight)
    --prop pitch adjustments (rev to 5800 possible, 5500=Vc?)
    --record all control positions, internally and externally by looking at them including a flight along the runway for observers if the wind is calm (stiction, temperatures, pressure, etc.)
-The plane should not come out of the air until the pilot has recorded a specific adjustment for all of the above rigging and prop conditions!
-Immediately following first flight, make all rigging changes including re-pitch of prop
-Refuel the airplane
-Do a 30 minute preflight inspection before the next flight, check everything twice and look for problems
-Second Flight, 1.0 to 1.5hrs approximate flight time
-Second flight is a repeat of the first at 1500AGL (compressed) to verify rigging changes and then spend a half hour goofing around with the plane, see how things feel and be sure to record temperatures, oil pressure, etc. Record ALL secondary rigging changes and return to the pattern for touch and go’s
-store plane
-maiden voyage celebration
-discuss schedule with Jim
-take photos of celebration and the newly christened aircraft
-Return to Garden

Thursday
-Make personal schedule for flight testing phase Thursday morning
-Work to get all necessary maintenance support for the 40 hour fly off and make an informal schedule
Scheduled Completion of 40 hour flight testing phase:1999.12.01

Remaining
-Execute 912 stator service bulletin; return tools & old stator to LEAF
-Sign off aircraft inspection report in construction book regarding 912 service bulletin

First Flight Operations

On the first flight day, only the necessary personnel will be present. No spectators of any sort unless they are incidental and not in the area. There should be a ground crew with a vehicle capable of tending to the aircraft should it go down, this includes a fire extinguisher and plans to get to the nearest hospital. They should be watching for incoming traffic and alerting the pilot by visual signals when other aircraft are in the area (in case there is no radio communication between aircraft on the ground and/or in the air). Needless to say a thorough preflight inspection should be done by at least one rated pilot in addition to the test pilot. It is easy in such an emotional situation for one person to overlook something. Spend a few hours driving around the surrounding area or survey with another aircraft, identify your alternative landing sites in case of failure.

After initial warmup on the first flight day, several taxi tests will be conducted at intervals of 5mph from 30 up to 45 mph covering the range of minimum aerodynamically controllable speed to full flap stall speed. As speed increases, tendencies should be noted, i.e. rolls to the right, to the left. A tape recorder or video camera will be helpful but a lap board with secure pin will suffice. Taxi tests with and without flaps will be conducted. It should take 10 runs the length of the runway to get a good feel of the aircraft.

Start with no flaps and at 30mph and work into full flaps at 45mph (the airplane may fly at this point). Look for in advertent tendencies that indicate something way out of trim. After taxi tests the following should be able to be corrected:

Align rudder with nose wheel if necessary
Add a preliminary rudder trim tube (be sure to test its effects)
Adjust the horizontal stab position if it is way off
Play with the ailerons and adjust the position of the stick if off-center

As I envision it, the plane rolls down the runway and reaches 30mph, then the throttle is cut back and adjusted until positive speed control can be achieved. All the while the stick is held back somewhat to keep the nose light, but not off the ground. After speed control is attained, the nose can be lifted and held high for the remainder of the run. After this first run it is again repeated, this time adding the element of aileron control to determine effectiveness. Easing into this nose high attitude with feathered throttle control will give the pilot a great deal of feel for the airplane's control charcteristics. This should be done next with one notch of flaps, then go back to no flaps and 35 mph, then 35 with flaps and so forth. Prior to proceding to the next step, a flag or marker should be placed on the runway for the pilot to make the cutoff decision. This is the point where if the aircraft is flying and power is cut, it can still stop safely (factor 2) before the end of the runway.

Make any and all adjustment that are possible at this point! Refuel the airplane, do a complete preflight inspection (again) and go to the runway; this time with the intent of leaving the runway (if the aircraft became airborne before this point it should have been inadvertent and considered a minor mistake). Ease the airplane into it's minimum liftoff speed and add just a little more power to get airborne. This should NOT be done in the nose high attitude used previously because the airplane may jump into the air and settle down hard. Do it easy and gentle. Keep the nose light but not excessively high. Keep the airplane within 10 feet of the ground or less (preferably just a few feet) and continually watch for the end of the runway. Make any notes regarding the rigging of the aircraft after you stop the airplane. Make further adjustments and continue with a couple more 'crow hops'. If there are no poor tendencies in the aircraft rigging you can continue up to 100 feet or more, so long as a healthy safety margin is maintained with respect to the end of the runway. Now is NOT the time to decide to fly a full pattern unless an emergency would otherwise merit such action! With the information from crow hops you will be able to make better decisions with the full flight should an emergency occur, such as gliding distance, lost power procedure. It is important to note that smooth throttle inputs should be used during this crow hop procedure. Pay attention to the moment created by the propeller. I already experienced this today and just realized what happened! I had the nose high with moderate stick pressure, cut the power and with great ease I was able to keep the nose up (because the thrust was no longer imparting a nose-down moment to the aircraft!

And now it is the pilots decision and the pilots decision only wether or not to continue. The whole procedure can continue on another day with only minimal setback. Just come back tomorrow, warm it up, do a little taxing to get in the groove and you will soon be flying. This time off could give you a fresh perspective and keep an otherwise overlooked problem seem trivial.

Take the aircraft to the hanger, inspect it AGAIN and re-fuel it. The next time it leaves the runway is likely to be for an hour or more and it is not prudent to decide to do so with anything less than full tanks.

When you have made the decision to fly, be sure to have a good plan. Start with the most runway remaining and do a high performance take off. You want to climb to a reasonable altitude as soon as possible. Keep your alternatives in mind. Climb to pattern altitude, watch the engine closely and try to focus on keeping the aircraft in moderate control. There may be rigging problems that require constant stick forces but these should not cause departure from controlled flight but rather represent something that needs to be corrected on the ground. If it is severe, land and fix it before continuing with the stresses of such a physically demanding airplane. If possible, continue with the flight to gain as much rigging information as possible. The idea of this first flight is to become familiar with the power characteristics of the engine and the rigging of the airframe. Beyond that, do not push the limits of airspeed, loading or maneuvering!! Just get comfortable with the pattern first and if all is well, leave the pattern for a close-by field for a few circuits. Try releasing the stick and making notes about how the plane flies. Work in a notch of flaps to see if they cause any roll moment when actuated. Play with the elevator trim, use the ball and the string to get an idea of the straightness of the aircraft. Land the airplane uneventfully after 1 hour of flight or sooner if required.

Make adjustements to the airframe and powerplant, inspect everything closely, retorque the prop and so forth and continue with flight two which should focus on the pilot becoming familiar with a few of the finer points of rigging. This flight should be a repeat of the first flight. It will be surprising how much is missed on flight one.

Taxi tests, first flight and second flight will take an 8 hour day if there is much rigging changes to be made so keep this in mind! With respect to all flights after the first two, I have not yet envisioned them and will do so in the near future! -KRO

First Flight Agenda\

A) Review alternate landing sites and emergency procedures discuss agenda with ground crew
B) Preflight inspection by at least two people independently or by the pilot with at least a 30 minute time of rest between both inspections

What is the wind direction and speed?
What is the outside air temperature?

High performance takeoff

Take out all flaps

Climb at 65mph
What is the RPM in the climb attitude?

Immediately at 500AGL
Is aileron authority OK?

Continue climb to 1500AGL (4500MSL) and to a nearby field
What was the approximate takeoff distance?
Is altimeter working correctly?
Is the vertical speed indicator working correctly?
Is the airspeed indicator working correctly?

Trim for level flight at 75mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this airspeed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Observe the flight instruments at 75mph level trimmed flight
What is the RPM?
What is the oil pressure?
What is the oil temperature?
What is the CHT?
What is the water pressure?
What is the water temperature?

Increase power setting to maintain 85mph
What is the RPM?

Trim for level flight at 85mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?

What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this airspeed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Observe the flight instruments at 85mph level trimmed flight
What is the RPM?
What is the oil pressure?
What is the oil temperature?
What is the CHT?
What is the water pressure?
What is the water temperature?

Reduce the power setting to maintain 65mph
What is the RPM?

Trim for level flight at 65mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this airspeed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Observe the flight instruments at 65mph level trimmed flight
What is the RPM?
What is the oil pressure?
What is the oil temperature?
What is the CHT?
What is the water pressure?
What is the water temperature?

Take a short break

Maneuver at pilot’s discretion

Dutch rolls
How does the aircraft respond?

30 degree turns left and right
How does the aircraft respond?

Reduce power setting to obtain 65mph

Trim for 65mph and release controls

Add 1 notch of flaps
What NEW roll tendencies did the flaps create?

What NEW yaw tendencies did the flaps create?
What NEW pitch tendencies did the flaps create?

With 1 notch of flaps, position the controls to obtain straight and level flight
What is the position of the rudder pedals?
What is the position of the control stick?
What is the trailing position of the rudder?
What is the trailing position of the ailerons?
What is the trailing position of the flaps?

Increase flaps to 2nd notch
What NEW roll tendencies did the flaps create?
What NEW yaw tendencies did the flaps create?
What NEW pitch tendencies did the flaps create?

Retract the flaps

Set power at the following settings and record level flight cruise speed, DO NOT EXCEED 90mph
3500RPM?
4000RPM?
4500RPM?
5000RPM?
5500RPM?
5800RPM?

Set the power as required to maintain 90mph cruise
What is the RPM?

Return to the airport

Enter the pattern and execute a flawless first landing!

Review flight test data

Take a break

What adjustments need to be made to the:
prop pitch?
wing washout?
flaps, left to right?
ailerons/flaps to make them trail flat?
horizontal stabilizer?
vertical stabilizer?
control travels?

Make the adjustments and continue with the second flight

Second Flight Agenda, not surprisingly like the first!

Refuel the aircraft
Preflight inspection by the pilot
Pilot, what changes were made and what do you expect?

What is the wind direction and speed?
What is the outside air temperature?

High performance takeoff

Take out all flaps

Climb at 65mph

Continue climb to 1500AGL (4500MSL) and to a nearby field
What was the approximate takeoff distance?
What is the vertical rate of climb?

Trim for level flight at 75mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?

What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this air-speed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Increase power setting to maintain 85mph
What is the RPM?

Trim for level flight at 85mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this air-speed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Reduce the power setting to maintain 65mph
What is the RPM?

Trim for level flight at 65mph and release controls
What is the trim setting required for this condition?
What is the elevator trailing position of the aircraft?
What is the trailing position of the ailerons and flaps?
What is the trailing position of the rudder?
What is the roll tendency of the aircraft?
What is the yaw tendency of the aircraft?
What is the free position of the control stick?
What is the free position of the rudder pedals?

Use the controls to maintain straight and level at this setting
What rudder input is required for straight and level?
What aileron input is required for straight and level?
What other tendencies does the aircraft have?

Release the rudder pedals and use the ailerons to maintain level flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Release the ailerons and use the rudder pedals to maintain straight flight
What is the rudder trailing position?
What is the aileron trailing position?
What aileron input is required for this flight attitude?
What is the yaw tendency of the aircraft?
What is the roll tendency of the aircraft?
What other tendencies does the aircraft have?

Control the airplane in a straight and level attitude at this air-speed

Release the controls
Does the airplane YAW first or ROLL first?
Does the airplane continue to bank?

Take a short break

Maneuver at pilot's discretion

Reduce power setting to obtain 65mph

Trim for 65mph and release controls

Add 1 notch of flaps
- What NEW roll tendencies did the flaps create?
- What NEW yaw tendencies did the flaps create?
- What NEW pitch tendencies did the flaps create?

With 1 notch of flaps, position the controls to obtain straight and level flight
- What is the position of the rudder pedals?
- What is the position of the control stick?
- What is the trailing position of the rudder?
- What is the trailing position of the ailerons?
- What is the trailing position of the flaps?

Increase flaps to 2nd notch
- What NEW roll tendencies did the flaps create?
- What NEW yaw tendencies did the flaps create?
- What NEW pitch tendencies did the flaps create?

Retract the flaps

Add full power and climb to 2500AGL at 65mph
- What is the vertical speed?
- What is the CHT?
- What is the water temperature and pressure?
- What is the oil temperature?
- What is the RPM?

DO NOT STALL THE AIRCRAFT IN THESE EXERCISES!

Reduce power to enter slow flight near Vso
- What is the airspeed?
- What is the RPM?
- What tendencies does the aircraft have?

Add 1 notch of flaps

Reduce power to enter slow flight near Vs0
- What is the airspeed?
- What is the RPM?
- What tendencies does the aircraft have?

Add 2nd notch of flaps

Reduce power to enter slow flight near Vs1
- What is the airspeed?
- What is the RPM
- What tendencies does the aircraft have?

Add 3rd notch of flaps

Reduce power to enter slow flight near Vs
- What is the airspeed?
- What is the RPM?
- What tendencies does the aircraft have?

Return to the airport

Enter the pattern for 3-5 touch and go's without flaps
- What is the typical RPM used on final?
- What is the typical vertical sink rate on final?
- What is the typical approach speed?

Stay in the pattern for 5-10 touch and go's with flaps

Start with 1 notch
- What is the typical RPM used on final?
- What is the typical vertical sink rate on final?
- What is the typical approach speed?

Now use 2nd notch
- What is the typical RPM used on final?
- What is the typical vertical sink rate on final?
- What is the typical approach speed?

Now use 3rd notch
- What is the typical RPM used on final?
- What is the typical vertical sink rate on final?
- What is the typical approach speed?

Review flight test data

Take a break

What adjustments need to be made to the:
- prop pitch?
- wing washout?
- flaps, left to right?
- ailerons/flaps to make them trail flat?
- horizontal stabilizer?
- vertical stabilizer?
- control travels?

Interview with MSNBC

Report to NASA headquarters

Post flight inspection

Post flight photographs and press opportunities

Maiden voyage celebration!

Flight Test Envelope, testing hours 13 thru 20

Stalls, remember to do a LEFT and RIGHT for the turns!

What is the S&L power-off stall speed for these configurations:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

What is the best stall recovery procedure for minimum alt. loss?

What is the 30deg turn power off stall for the follwing:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

What is the power-on climbing stall speed for the following:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

What is the power-on climbing 30deg turn stall for the following:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

What is the power-off descending 30deg turn stall for following:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

CAUTION!!! THINK ABOUT SPIN TENDENCIES BEFORE YOU CONTINUE WITH THESE FLIGHT TESTS!!!

How does the plane behave when you do a skid-stall?

How does the plane behave when you do a slip-stall?

How does the plane behave in 45 degree bank stalls?

What is the best way to do a falling leaf maneuver?

What happens when you do a falling leaf with the following:
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- What tendencies?

What recovery techniques have you been using?

Are there any recovery techniques that could be dangerous?

Return to airport to inspect the aircraft prior to the next flight.

Takeoff and Landing Performance

Record the following takeoff and landing data on asphalt:
- WITH ONE PILOT, LOW FUEL
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- AT GROSS WEIGHT
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?

Record the following takeoff and landing data on grass:
- WITH ONE PILOT, LOW FUEL
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?
- AT GROSS WEIGHT
- No flaps?
- 1 Notch?
- 2 Notches?
- 3 Notches?

Record any runway data you can gather during other flight tests, i.e. with 10mph wind, etc.

Lift and Drag performance Ratios, Power on and off

Climb for 1 minute and record the VSI reading along with actual altimeter readings at start and finish if possible. This data must be duplicated with 2 runs and will be graphed. Do everything one time, then repeat in reverse order to get an average for changing fuel conditions. Do everything at the same altitude on the same day, preferably 3500MSL thru 4500MSL range

Generate the following FPM climb data with no flaps:
- 40mph
- 45mph
- 50mph
- 55mph
- 60mph
- 65mph
- 70mph
- 75mph
- 80mph

Generate the following FPM climb data with 1 notch:
- 35mph
- 40mph
- 45mph
- 50mph
- 55mph
- 60mph
- 65mph
- 70mph

Generate the following FPM climb data with 2 notches:
- 35mph
- 40mph
- 45mph
- 50mph
- 55mph
- 60mph
- 65mph

Generate the following FPM climb data with 3 notches:
- 35mph
- 40mph
- 45mph
- 50mph
- 55mph
- 60mph
- 65mph

Generate the following sink FPM power-off data with no flaps:

40mph
45mph
50mph
55mph
60mph
65mph
70mph
75mph
80mph

Generate the following sink FPM power-off data with 1 notch:
40mph
45mph
50mph
55mph
60mph
65mph
70mph

Generate the following sink FPM power-off data with 2 notches:
35mph
40mph
45mph
50mph
55mph
60mph
65mph

Generate the following sink FPM power-off data with 3 notches:
35mph
40mph
45mph
50mph
55mph
60mph
65mph

Return to the airport to inspect the aircraft prior to the next flight.

Aerobatic Maneuvers

Falling Leaf
What is the procedure
What are the dangers
What are the parameters, FPM, airspeed, etc?

Lazy Eights
What is the procedure
What are the parameters, altitude loss, speed, etc?
What are the dangers?

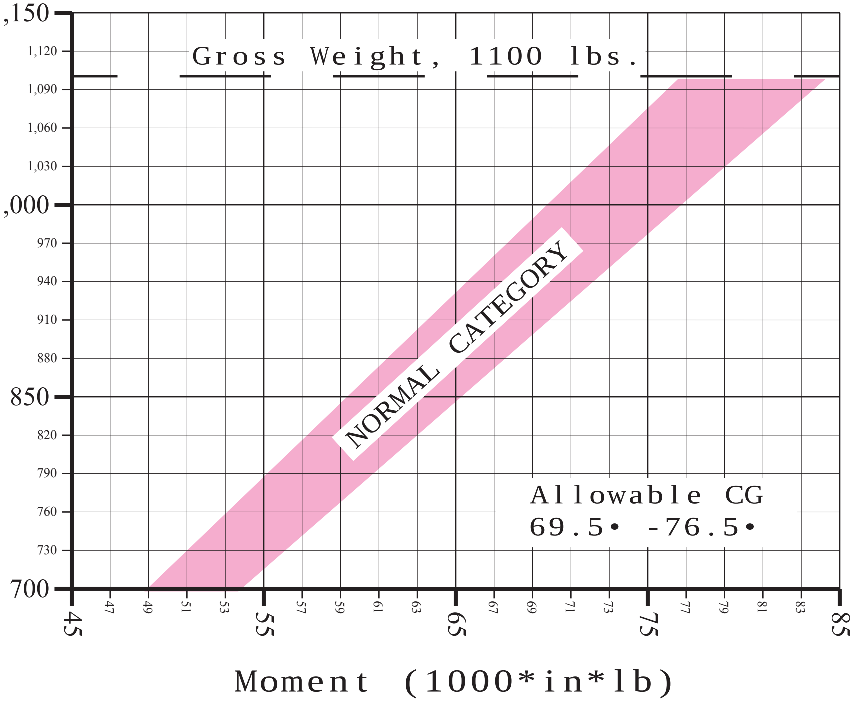
Chandelles
What is the procedure
What are the parameters, altitude, speed, etc.
What are the dangers?

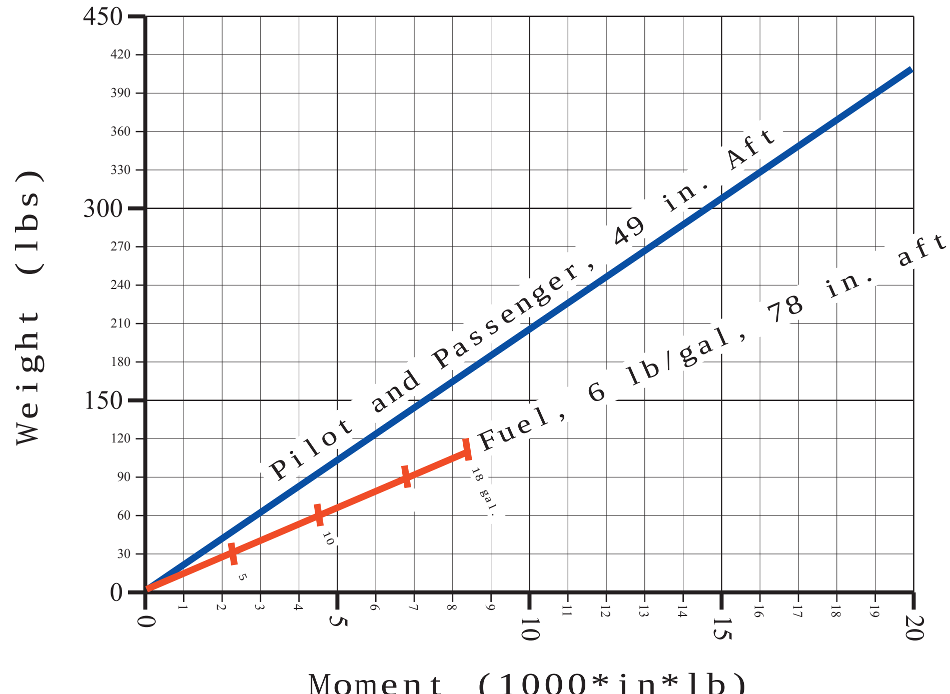
Steep Turns
What is the procedure
What are the parameters?
What are the dangers?

Stalls
What is the procedure
What altitude loss is encountered?
What are the dangers?

Spins
Just testing ya, these are PROHIBITED!!!!
Do not spin unless it really is an accident, then recover and recover fast because this is not an approved maneuver

Next procedures are to move the CG aftward and re-experiment with stalls, etc.





reposition
group to
lower left
at -1 -1