Flight Manual for RANS S-7
N831RS with Rotax 582

Start up procedures:

After a through preflight inspection and removal of all plugs and covers (exhaust, fuel vents[2], pitot, cowl, BRS) proceed with starting as follows:

1) open the wing tank fuel valve
2) both mag switches on
3) give two or three shots of prime
4) advance 1/3 throttle
5) clear area
6) engage starter

Shut down procedures:

1) allow engine to idle at 3000 rpm to remove residual heat
2) kill engine by turning off both mag switches
3) turn off ignition key
4) close fuel valve
5) install all covers & plugs

Take off procedures:

The flap settings are as follows:
up ..... 0 degrees
1 notch .... 8 degrees
2 notches .. 16 degrees
3 notches .. 24 degrees

Solo:
Takeoffs can be accomplished with zero flaps. Or use one notch of flaps. The tail will come up on full application of power if stick is moved forward, otherwise the aircraft will take off in the 3 point attitude within 8-9 seconds.

Rotate at 35-40 mph IAS. Accelerate to 50 mph IAS while slowly retracting flaps. Climb out at 50 mph IAS for best angle. Hold 60 IAS for best rate.

Gross weight:

Use two notches of flaps. The tail will take a little longer to come up. Flying speed is obtained after a ground run of 400-500 feet (depending on temperature and runway surface).

Rotate at 35-40 mph IAS. Slowly retract one notch of flaps while accelerating to 50 mph IAS. Retract final notch of flaps at 200-300 feet. Climb at 50-60 mph IAS.

Rate of Climb:

Solo, no flap, 50 mph IAS	...	700-800 fpm (80-90°F)
" " "	...	800-900 fpm (70 & blo)
Gross, no flap, 50 mph IAS	..	450-500 fpm (80-90°F)
" " "	..	500-600 fpm (70 & blo)

Approach speeds:
(Pattern altitudes flown at 600-700 ft. AGL)
Downwind ..... 60-70 mph IAS
Base leg ..... 50 mph IAS
Final ..... 45-50 mph IAS

Opposite point of touchdown pull power to 4000 rpm. Slow to 50 mph IAS. Pull on two notches of flap. Turn base leg at 300-400 AGL. Maintain 50 mph IAS. Apply last notch of flaps if winds permit. Maintain 50 mph IAS on final. 45 mph over the fence. 40 mph over the numbers. Flare and hold off for 3 point touchdown.

Landings:
Maximum crosswind capability has not yet been determined. However land with zero flaps with any crosswind at all, especially on pavement.

Cruise speeds:

5000 rpm	63 mph TAS
5800 rpm	90 mph TAS*
6800 rpm (full throttle)	100 mph TAS

* Normal cruise power setting

Stalls: (solo)

	(1)	(2)
Departure, no flap	30 mph IAS	35 mph TAS
Power off, no flap	32 mph IAS	37 mph TAS
Power on full flaps	22 mph IAS	27-30 mph TAS
Power off full flaps	22 mph IAS	27-30 mph TAS

Note: It appears there is approximately a 5-8 mph pitot error at the low end of the speed range. Adding 5-8 mph to indicated speeds (column 1) produces more reasonable numbers in line with manufactures claims (column 2). However indicated speeds are what the pilot relies on so column 1 are the speeds of interest.

All stalls are extremely gentle and are recovered with minimum altitude loss by reducing stick back pressure. However, no detectable burble or pre-stall warning can be felt. The aircraft is sensitive to proper coordination and will fall off on the wing opposite the ball. (ie: right ball, left wing break, etc.)

Minimum controllable airspeed:

4500 rpm, full flaps ... 25 mph IAS

Fuel consumption:

Approximately 5.1 gph at 5800 rpm.

The wing tanks hold 8.8 gallons each for a total capacity of 17.6 gallons. All fuel is usable. This yields a maximum flight duration of 4.4 hours (4 hours 24 minutes).

Note: The right fuel tank will empty first before the left when flown continuously. If flown continuously for 2 hours the right tank will be almost dry while the left tank will remain nearly full. Fuel will crossfeed and equalize in both tanks if the aircraft is parked for 30 minutes or more.

Oil consumption:

Preliminary estimates indicate approximately .2 qts per hr at 5800 rpm (1 quart in 5 hours). The oil tanks hold two quarts each or one gallon total. Significant oil remains in the oil supply lines which can be seen in the cockpit. This amount is not considered part of the total oil supply.

The oil tanks should supply enough oil for 20 hours of continuous engine operation, or 4.5 refuelings.

Summer operations (70+° F):

Note EGT on climbout. Should remain at or below 1050°F. EGT will increase as aircraft accelerates to cruise speed. 1100°F EGT at cruise.

Winter operations (below 70° F):

Note EGT on climbout. Should remain at or below 1150°F. 1175-1200°F EGT at cruise.

SPECIAL NOTICE FOR EGT SETTINGS: The EGT will rise if prop overspeeds with fixed throttle setting as in maintaining altitude in a rising column of air or diving the aircraft. This is partially due to the residual gasses in the combustion chamber and partially to the additional air in the cylinders with the same fuel setting causing a lean mixture. Conversely, the EGT will drop if the prop is loaded and/or the throttle is advanced as in climbout.

WARNING:

Be aware that the Westach EGT gauges are **NOT** temperature compensated. They obtain their readings by comparing the differential between the thermocouple in the exhaust gas and the thermocouple in the instrument itself. The colder the gauge (fall-winter)the more the differential and the higher the apparent EGT reading on the gauge. The warmer the gauge (summer) the lower the apparent EGT. The Westach gauges are calibrated at 75°F. Since the thermocouples react linearly to temperature changes, the difference between the ambient cockpit temperature and the calibration temperature must be added to or subtracted from the EGT reading on the gauge to obtain the true EGT. Remember **SCAH:** subtract cold, add hot.

Example #1: The cockpit temperature is 50°F. The EGT is reading 1180°F on the gauge.

Calibration temp	75
Cockpit temp	- 50
Difference	25

Gauge = 1180 - 25 = 1155°F actual EGT

Example #2: The cockpit temperature is 95°F. The EGT is reading 1125°F on the gauge.

Cockpit temp	95
Calibration temp	- 75
Difference	20

Gauge = 1125 + 20 = 1145°F actual EGT

It should be pointed out that the warm condition is more dangerous than the cold. The reason is because the pilot in cool temperatures seeing an apparent high EGT will attempt to richen the mixture until the engine begins to miss due to an overly rich mixture. This will result in a performance loss and if continued possibly fouled plugs but would not result in an immediate engine failure. The pilot in the warm temperature, seeing an apparent low EGT may overly lean the mixture well past the critical point and not realize it. The Rotax will run fine with a dangerously lean mixture, right up to the point where the pistons melt, causing an immediate engine failure.

Cruise ops:
Set cruise power (5800-6000 rpm). Allow speed to stabilize, while monitoring coolant temp. Maintain 160°F.

Decent ops:
Set power to 5000 rpm minimum. Maintain at least 140°F coolant temperature. Avoid coolant temps below 140°F as cold seizure may occur upon application of throttle following prolonged descents.

Note: Do **NOT** engage in high speed descents with reduced throttle settings or an excessively lean mixture will result that could seize the engine. Always maintain power to the engine.
NEVER FULLY RETARD THE THROTTLE AND DIVE FOR THE GROUND!

Over Gross Weight Operations:

The aircraft has been operated approximately 75-80 lbs over gross weight in 85°F temperatures with no discernable degradation of climb performance. It appears that sufficient performance margin exists to routinely operate at 100 lbs above gross weight with the 582 engine. However, at this weight it is assumed that all operations will be at normal category conditions (no yanking and banking). Also ensure that the departure path is sufficiently clear of high obstructions to permit a flatter climb out. Crosswinds and turbulence from trees or other obstructions may create atmospheric conditions that will hinder a normal climb out even at solo weights.

Baggage Loading:

The baggage area is stressed for 50 lbs maximum.

Center of Gravity Calculations:

Center of Gravity (CG) is calculated from the datum, which is the back side of the propeller. CG limits set by the manufacurer are 74-81 inches aft of the datum. However the aircraft has been sucessfully flown with the CG as much as two inches ahead of the forward CG limit (72"). The arms are as follows:

pilot 66
passenger 96
fuel 79
baggage 121

Gross weight is 1025 lbs. Empty weight of N831RS is 528 lbs. Useful load is 497 lbs. Aircraft empty moment is 39316.

Example:

Pilot weight	= 200 lbs	x 66 =	13,200
Passenger	= 175 lbs	x 96 =	16,800
Baggage	= 25 lbs	x 121 =	3,025
Fuel, 15 gal	= 90 lbs	x 79 =	7,110
	490 lbs		40,135
Aircraft	528 lbs		39,316
Gross weight	1018 lbs		79,451

$$CG = \frac{79,451}{1018} = 78.04 \text{ inches}$$

Aerobatics:

NOTE: A G-meter **MUST** be installed in the aircraft. Limit G loading to 4 solo or 3.8 at gross weight.
Spins: This aircraft is approved for spins. Limit spins to 3 turns if loaded near aft conditions.
Loops: entry speed 115 mph
Rolls: entry speed 115 mph; pitch +40-45°
Snap roll: entry speed 80-90 mph
Hammerheads & cuban 8's ok. Limit pullout to 3.8-4 G's as described above.

Author's Note:

Most pilots have heard the axiom "Fly the engine and the plane will follow". This is never truer than flying behind a 2-stroke engine. Although these engines are very robust and have fewer parts to fail, the more TLC given the longer it will last. Here are some very simple rules to follow:

1) Always warm the engine thoroughly before taking off. Never take off with the coolant below 140°F.
2) Ensure the air, fuel and oil filters are clean. Replace them often.
3) Always, always, always filter your gas when filling the tanks.
4) Use the higest grade of auto gas you can obtain, but never less than 93 octane (R+M/2 method). Use brand name gasoline (Amoco, Exxon, Mobile, etc). Try to avoid gas from "Fred's stop & go" or "Marty's quick stop", etc.
5) If using Avgas, use 100LL and change the plugs after 20 hours.