AX2000

Operator's Manual – Issue 5

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IMPORTANT NOTICE

EFFECT OF HIGH CRUISE SPEEDS ON CONSUMPTION AND ENGINE LIFE

Rotax 2 stroke engines

Cruise at excessive engine RPM will cause premature engine wear and possible failure and will result in high fuel consumption. To correctly set up cruise flight on the Cyclone AX2000, in common with most aircraft types, follow the steps, attitude, power, trim (mnemonic APT):

A Attitude - From the climb lower the pitch to the cruise attitude.
P Power - Set the cruise RPM
T Trim - Trim to level flight

The resulting cruise speed will depend upon weight of the aircraft, CG position, weather (pressure, temperature and wind conditions) and balance of the flying controls. Due to the larger differences between dry weight and MAUW of microlights compared with light aircraft, more significant cruise speed changes will occur with differing conditions of flight. Typical AX2000 582 cruise speeds are as follows:

Flight 1 Weight 390 kg, RPM 5500, Hot humid windy day with many control inputs to overcome gusts. Average speed 60 mph, fuel 13½ LPH.
Flight 2 Weight 280 kg, RPM 5500, calm crisp day, speed 66 mph, fuel 13½ LPH.
Flight 3 Weight 390 kg, RPM 5000, hot humid day, speed 50 mph, fuel 10½ LPH.
Flight 4 Weight 280 kg, RPM 5000, calm crisp day, speed 60 mph, fuel 10½ LPH.

Remember - to double the airspeed, approximately 8 time the power is required, guess what happens to fuel consumption! If you reduce RPM from 6000 to 5000 you get a 50% fuel saving. Based on our experience of servicing and repairing Rotax engines for many years, we believe that all other aspects being equal, you can expect to double the engine life before major failure.

TYPICAL FUEL CONSUMPTION FIGURES L/Hr						
RPM	4000	4500	5000	5500	6000	6500
AX2000 582	7	8 ½	10 ½	13 ½	20 ½	27
AX2000 503	7 ½	9 ½	12	14	17	20

These figures are based on matching the propeller to correct engine RPM, 6500 at full throttle on climb out. Some problems resulting from incorrect propeller matching are: Too high RPM (7000) - High engine temperature, particularly at cruise settings and possible piston seizure. Too low RPM (5900) - Low power, crankshaft fatigue, excessive cruise fuel consumption, unstable power delivery.

HKS Four Stroke Engines

The HKS four stroke engine maximum continuous rpm is 5,800. This is set to limit thermal and mechanical fatigue. Engine wear, fuel consumption and noise will all be significantly reduced by operation at lower rpm settings. Warm and cool the engine progressively to minimise thermal shock.

TYPICAL AX2000 HKS FUEL CONSUMPTION FIGURES					
RPM	4000	4500	5200	5500	5800
L/Hr	5.2	7.5	9.5	12	16
MPH solo	45	50	60	66	73
MPH 450kg	-	45	55	62	70

These figures are based on matching the propeller to correct engine RPM, 6200 at full throttle on climb out.

SUMMARY

1. Set cruise RPM and accept the resulting cruise airspeed.
2. Do not cruise at more than 5500 RPM (Rotax 2 stroke) or 5,800 (HKS four stroke).
3. Ensure that the propeller is matched to 6500 RPM (Rotax 2 stroke) or 6,200 (HKS four stroke) full throttle in the climb.

1 PILOT'S HANDBOOK

The Cyclone AX2000 is a three axis control aircraft with conventional control systems. The aircraft is a direct development of the celebrated Cyclone AX3, retaining all its good points and incorporating many new features that aid flying characteristics, visibility, comfort and training. Apart from its light controls and low weight it handles in much the same way as conventional light aircraft. Pilots trained on these will quickly become familiar with the AX2000.

The aircraft was conceived by John Chotia, an ex NASA engineer, who designed it to be strong and simple, and as a result, one of the most economic microlights on the market.

The structure is made of 6261 T6 and 7075 T6 aluminium alloy which combines high strength with corrosion resistance and flexibility. It has been designed to be light and very strong. Many parts of the fuselage and wings are triangulated and form an integrated structure capable of absorbing a great deal of energy without permanent deformation. This type of construction ensures that the aircraft remains in good condition even after a long and hard life.

The fabric covering is Ultralam, a coarse weave, high strength polyester laminated both sides with Tedlar film. The fabric has been specially developed for microlight applications and provides resistance to UV degradation typically twice that of conventional polyester fabrics such as Dacron. This means that the aircraft may be safely stored outside for prolonged periods. Where storage outside is intended, the life of the fabric covering can be considerably extended if the seam stitching is covered with a suitable tape.

A significant part of this manual is devoted to safety, both from a flying and maintenance point of view. It is essential to remember that the pilot is responsible for his own safety. Flying is not inherently dangerous, but is terribly unforgiving of carelessness, incapacity or neglect. Please read this manual thoroughly before taking to the air.

Aerobatics, including spinning, are prohibited. Operation is restricted to daytime VFR conditions.

1.1 PREPARING THE AIRCRAFT

Careful preparation of the aircraft is essential, after you have rigged the aircraft following the instructions in 2.3.2, spend some time looking around the aircraft, removing or stowing loose items before you start your checks proper. If you are unfamiliar with the aircraft get an instructor or experienced owner to go through the systems and controls with you.

1.1.1 FLIGHT WITH COCKPIT DOORS REMOVED

The doors may be removed by withdrawing the hinge pins, when replacing them, refit the hinge pin from the inside. Be extra careful with baggage, maps and items of clothing as they may be blown out of the aircraft. It can quite easily happen that you put a map down in flight because it looks OK to do so, only to inadvertently enter a slight side slip and find it blow out of the cockpit.

Basic AX2000's have thicker wind screens than those fitted with doors, in consequence, the basic model may be flown faster with the doors removed due to greater resistance to wind pressure. If you remove the doors, then airspeed must be limited to 70 mph.

1.1.2 STOWAGE OF BAGGAGE

Stow any baggage that you intend to carry with you carefully. Do not leave any loose luggage or other items of load in the cockpit unsecured. Up to 12.5 kg total of baggage can be stowed in front of each seat under the occupants knees. Baggage stowed in this way needs to be in a hold all type container, small enough to ensure that the stick and the pilot's leg movements are not impeded, and strapped to the cockpit floor tubes in such a way that it cannot move.

1.1.3 FUELING THE AIRCRAFT

The AX2000 (Rotax 2 stroke engines) uses pre-mixed fuel/oil 50 to 1, always mix the fuel and oil in a can prior to fueling the aircraft, do not be tempted to put the fuel and oil into the aircraft tank separately. The aircraft fuel filler cap is fitted in the starboard side of the rear enclosure immediately behind the wing. A sealed tube connects the filler to the tank fitted behind the starboard (P2) seat, where the optional 2nd tank is fitted, the two tanks are interconnected and self leveling.

The AX2000 (HKS four stroke engine) uses premium grade unleaded Mogas. Leaded fuel (four star Mogas or 100LL Avgas) can be used but usage should be minimised as it increases the deposits on the spark plugs.

To fuel the aircraft, remove the cap, stand a funnel with a water screen in the filler neck, (the common large yellow rectangular funnel fits well and the funnel forms a good seal in the filler neck) and carefully pour the fuel into the funnel. It is possible to support the fuel can on the funnel to make pouring easier. If you try to pour too quickly the fuel will back up, so be careful. If 2 tanks are fitted, the starboard tank will fill first and you will have to wait a little while for the fuel to level across to the 2nd tank before continuing the filling process. The second tank will not fill completely, they will cease to level across when the total fuel held is 50 litres.

If you feel that it is difficult to lift a heavy can to the filler cap height, then the tail of the aircraft can be lowered to the floor by a helper, or you can temporarily tie it down. Do not use this trick with the aircraft facing into wind or if there is significant wind on the day.

Fuel spillage on Dacron covers will cause a nasty stain, on Ultralam it will cause the fabric to de-laminate. Ultralam de-lamination is not a structural problem (unless it occurs over large areas of the flying surfaces), but is very unsightly. The answer is to be careful when pouring and maybe to prepare a bib to go around the filler neck if you are not confident.

1.2 THE DAILY INSPECTION

For rigging instructions, see Maintenance Manual, Section 2.

A thorough Daily Inspection (DI) and Pre-Flight Check are essential for safe flying and it is important to be systematic when carrying them out. Give yourself time to do the checks properly and avoid being interrupted. Repeat the DI at the start of each flying day. Before flight, ensure that weight and balance considerations have been addressed.

1.2.1 POWER PLANT

Rotax 2 stroke engines
Carry out the recommended Rotax daily inspection routine given in the Rotax Engine Manual. In addition check:

- the engine support.
- that the anti-vibration mounts are in proper contact with their supports.
- the general appearance of the air cooling fins and that they are not blocked (503 model).
- that there is the proper mix of oil in the petrol (50:1).
- that there is no possiblity of air entering the fuel system on the tank side of the fuel pump.

HKS four stroke engines
Carry out the recommended HKS daily inspection routine given in the HKS Engine Manual. In addition check:

- the engine support and anti-vibration mounts.
- security and condition of exhaust and inlet manifolds and connections.
- the general appearance of the air cooling fins and that they are not blocked.
- that there is the proper type and quantity of oil in the tank.
- that all leads and hoses are secure and undamaged.

1.2.2 AIRFRAME

Starting at the front and working down the aircraft's left side, check:

- front fork assembly and fittings secure.
- front tyre in good condition and properly inflated.
- Wheel rotates freely without excessive bearing play.
- throttle cable freedom and security.
- starter rope where fitted, condition and handle security.
- top and bottom of the front fuselage brace.
- bolts security at the main strut/tie bar connection.
- wing struts at the stainless steel tangs, top and bottom.
- jury struts pins and rings for security, top and bottom.
- static source is clear.
- undercarriage leg secure and undamaged.
- wheel and tyre in good condition and properly inflated, tyre creep marks aligned.
- leading edge to fuselage attachments.
- sail condition at the leading edge.
- leading edge straight.
- wing tip locations in the leading edge and trailing edge fittings.
- sail condition at the trailing edge.
- proper closure of the wing batten pockets and Velcros.
- wing compression struts, both ends.
- aileron bearings security at their attachments to the trailing edge (wing nuts and safety rings)
- trailing edge to fuselage attachments through the inspection flap and from inside the cockpit.
- aileron operation.
- aileron cables and fittings and that they are free running around all diverter pulleys.
- the inboard aileron fitting (wing nut & safety ring).
- fuel filler cap security.

Follow the fuselage to the tail and check:

- elevator horn attachments.
- operation of the elevator.
- stabiliser strut attachments.
- the upper part of the rudder.
- tail general symmetry.
- anti-balance/trim tab connection and operation.
- rear tail support struts.
- water drain holes in the elevator.
- check the elevator leading edge attachment (wing nut & safety ring).
- depress the tail and swing the rudder to check for full and free operation.

NOTE: IT IS ESSENTIAL TO CHECK THAT THE RUDDER CABLES ARE CROSSED.

Move up the right hand side of the aircraft now and check:

- inboard aileron fitting (wing nut and safety ring)
- aileron cables and fittings and that they are free running around all diverter pulleys.
- aileron operation.
- trailing edge to fuselage attachment.
- through the double surface, the main fuselage tube, and leading edge roots.
- seats for security.
- the control stick and the fairleads fitted to the brackets beneath the stick.
- the condition of the rudder cables, especially at the point where they pass under the fairleads.
- drain some fuel from the sump drain valve and check for water.
- fuel tank breather.
- tank supports and pockets
- fuel filter condition, check for water.
- fuel line connections; check particularly that no air leaks can exist at the pump and filter joints.
- open the fuel tank water drain under the passenger seat and check for contamination. Ensure it is closed properly on completion.
- undercarriage leg secure and undamaged.
- wheel and tyre in good condition and properly inflated, tyre creep marks aligned.
- bolts for security at the main strut/tie bar connection.
- the wing struts at the stainless steel tangs, top and bottom.
- jury struts for security, top and bottom.
- wing compression struts, both ends.
- the sail condition along the trailing edge.
- proper closure of the wing batten pockets and Velcros.
- the wing tip locations in the leading edge and trailing edge fittings.
- the sail condition along the leading edge.
- leading edge straight.
- the air speed indicator sensor head and its tube.

- Inside the cockpit, check:
- ailerons, move the stick to the left and check that the right hand aileron moves down and the left one up.
- throttle is free and closes properly.
- elevator control is free.
- baggage is secure in its area and cannot interfere with controls.

1.2.3 WINTER OPERATIONS OR OPERATIONS IN FREEZING CONDITIONS

The AX2000 with its full cabin can be flown comfortably in sub zero conditions. Although the Rotax 582 and 503 engines are not particularly prone to carburetor icing, if regular winter flying is anticipated then we recommend that carburetor heaters be fitted. The 582 model uses an optional liquid coolant type heater and the 503 model an optional electric heater fitted to each carburetor. The HKS engine installation is fitted with rear mounted intake manifolds which allow the intake tracts and carburettors to keep warm. It may be necessary to blank off the oil cooler to obtain a temperature of over 50°C (122°F). A zip-up cover is available from the Factory. Very low oil temperature encourages emulsification.

It is important to clear all snow from the wings before attempting to fly. The AX2000 will fly with frosty wings, however the performance will be impaired and the stall characteristics may change. Frost can be cleared with a broom, taking great care not to damage the stitching.

To ensure reliable operation in freezing conditions carry out the following:

- spray aileron hinges with silicone spray to repel moisture regularly & prior to sub zero operations where possible.
- fit an engine cover when the aircraft is left outside to save water getting into the controls.
- regularly treat the throttle cables with WD 40 to repel moisture - *do not use oil.*
- ensure that elevator drain holes are kept clear.
- check for ice build up in the air frame.
- use full choke - note the throttle must be shut.

- *HKS four stroke:*
- bar the engine over before starting, to free it (SWITCHES OFF).
- warm the engine progressively to avoid exceeding the oil pressure limit.

1.3 PRE-FLIGHT CHECKS

Carry out the following checks before flight.

- Starting at the front of the aircraft check:
- propeller bolts are secure.
- propeller is undamaged.
- spark plug caps are secure.
- hoses and leads all secure, no leaks, no chafing.
- exhaust is secure and there are no cracks in it or broken springs.
- check intake manifolds and carburettor connections for security.
- HKS engine - check oil level and then, oil cap security.

Continue down the left hand side of the aircraft and check:

- wing struts for security, top and bottom.
- undercarriage, wheel and tyre undamaged, creep marks aligned.
- proper location of the left wing tip in its fittings.
- wing rib Velcros properly closed.
- aileron security and operation.
- fuel tank filler cap secure.
- tail empennage secure.
- elevator, elevator horn and control cables secure.
- rudder, rudder horn and rudder control cables secure.
- If the aircraft loading has been changed in any way since the DI, recheck the CG position.

Move up along the right hand side of the aircraft and check:

- aileron security and operation.
- wing rib Velcros properly closed.
- proper location of the right wing tip in its castings.
- undercarriage, wheel and tyre undamaged, creep marks aligned.
- wing struts pins and rings for security, top and bottom.
- nose wheel and nose wheel leg.

Inside the cockpit, check:

- controls for full and free operation.
- throttle is free and closes properly.
- fuel tank(s) contents are adequate.
- fuel cock is ON.

1.4 ENGINE START

1.4.1 ENGINE COLD

Rotax 2 stroke engines

1. Before starting the engine with a recoil type starter, chock the main wheels. The chocks must have ropes attached to enable you to reach out of the aircraft and withdraw them when seated. You will need to carry out steps 2, 3, & 4 and then position yourself in front of the wing on the port side. Have the port door open and practice operating the throttle from this position.
2. Ensure the fuel cock is turned ON. (It should normally be left in this position).
3. Check ignition is OFF.
4. Turn both ignition switches ON, open the choke and close the throttle

NOTE - The Bing carburetor fitted to the Rotax 503 relies on the throttle being completely closed for the choke to operate. Opening the throttle even slightly will make cold starting difficult or impossible.

5. Check that the area in front of the aircraft and within the propeller arc are clear. Shout "CLEAR PROP".
6. Pull the recoil starter firmly. Normally the engine will start within 3 or 4 pulls. Great care must be taken when starting the AX2000 with a recoil starter not to walk forward into the propeller. When the engine has started, reach into the cockpit and increase the revs slightly then reach up and lift the carburetor choke levers. Once the engine has warmed a little and does not require choke, gain access to the cockpit by walking through the wing struts where you have immediate access to the controls at all times. Once you are seated in the cockpit with the brake applied, you can reach out and withdraw the chocks. Stow them carefully in the cockpit where they cannot move or impede controls.
7. If an electric starter is fitted, apply the brakes, turn the master switch on and press the starter push button. Release the push button immediately the engine fires. If the engine fails to start, do not operate the electric starter for prolonged periods, but check for faults, (see the Rotax Operators Manual section of this manual) then allow the starter to cool before trying again.
8. A short period after the engine starts, (normally within a few seconds) carefully close the choke and open the throttle gently. If the engine sounds as if it is going to cut, immediately shut the throttle and open the choke again.
9. Never leave the engine idling at very low speeds; the resulting vibration can cause accelerated wear to gearbox and airframe components. Although the idle speed should be set at between 1600 to 1800 RPM, it is normal to open the throttle to above the excessive vibration level immediately the engine is running, this can be up to approximately 2700 RPM.. The aircraft should only be operated with the throttle completely closed when starting, in the descent or in the final stages of landing.

HKS four stroke engine

1. Ensure the fuel cock is turned ON. (It should normally be left in this position).
2. Check ignition is OFF. (note - leaving the ignition on will flatten the battery).
3. Turn the master switch on, check fuel pressure rises. The battery state monitor should show orange (fully charged battery).
4. Turn both ignition switches ON, open the choke and close the throttle

NOTE - The Bing carburetor fitted relies on the throttle being completely closed for the choke to operate. Opening the throttle even slightly will make cold starting difficult or impossible.

5. Check that the area in front of the aircraft and within the propeller arc are clear. Shout "CLEAR PROP".
6. apply the brakes or chock the aeroplane and press the starter push button. Release the push button immediately the engine fires. If the engine fails to start, do not operate the electric starter for prolonged periods, but check for faults, (see the Rotax or HKS engine manual) then allow the starter to cool before trying again.
7. A short period after the engine starts, (normally within a few seconds) carefully close the choke and open the throttle gently. If the engine sounds as if it is going to cut, immediately shut the throttle and open the choke again. Warm the engine at 3,000 rpm until, when the throttle is opened, the oil pressure stays within limits (usually about 5 minutes).
8. Check that the battery state monitor has changed colour to green, indicating the battery is on charge at 14 volts.

NOTE: If the engine refuses to start when cold, first check that the throttles are not inadvertently slightly open; ensure that the throttle's Bowden cable outers are fully engaged in their sockets and the inners slack.

If the battery is discharged, e.g. if the ignition has been left on, then it will be necessary to recharge the battery. The HKS ignition system requires some battery power to work. In emergency, car jump leads can be used, connected to the battery in the aft fuselage. Note - reverse polarity may cause permanent damage. The engine should then be run for long enough to indicate orange on the battery state monitor before takeoff. It should then gradually turn to green as the battery charges.

The engine can be hand swung, but enough battery power is still required to work the ignition system. Hand swinging must be done only by two experienced personnel, one in the cockpit. Thick gloves are necessary to swing the composite propeller safely. Always treat the propeller as live - the HKS ignition system works down to very low rpm.

1.4.2 ENGINE HOT

1. When restarting with the engine hot, turn the ignition ON, close the throttle and pull the recoil starter or turn the key switch. The engine will normally start immediately.
2. If restarting after more than 10 minutes from engine stop, or if the water or oil temperature (582 and HKS model) or CHT's (503 model) show cold, then open the choke and follow the routine in 1.4.1 above.

1.5 TAXIING AND VITAL ACTIONS

You are now sitting in the cockpit; you have closed and secured the door where fitted and tightened your safety harness. The engine is warmed and running smoothly. Check that you can operate the controls fully and comfortably.

The AX2000 front wheel control is conventional in operation - push the left pedal to go left, the right pedal to go right. Use the brake carefully and slow the aircraft down progressively. If you push too hard on the brake pedal, you risk locking the wheels or damaging the tyres. Always taxi slowly, particularly if on a hard surface, raise the elevator to reduce the load on the front wheel. On very rough fields, where practical taxi at a speed sufficient to lift the front wheel off the ground with the elevator. Steering with the rudder alone starts to become effective at 10 mph.

Prior to take-off, point the aircraft into wind and check:

- Full and free controls (if you press your forehead against the door it is possible to see the effect of elevator control inputs).
- Fuel adequate.
- Fuel cock turned ON.
- Turn each of the ignition switches off in turn and check that the engine runs smoothly.
- Both ignition switches ON.
- Instruments set.
- Harness(es) and doors secure.
- Clear airspace above.
- Power checks: hold the brakes on as hard as possible and open the throttle until the aircraft just starts to move.
- Check there are no other aircraft in the circuit. If necessary turn through 360° to ensure a complete check.
- Ensure that any other checks recommended by your instructor have been carried out.

Additional checks (HKS four stroke engine)

- Check battery state monitor shows green
- Check oil pressure and temperature within limits at 4,000 rpm
- Turn fuel boost pump OFF, check pressure, then ON, check pressure.

If everything is in order, take off.

1.6 TAKE OFF

NOTE! It must be emphasized that the following instructions do not constitute a flying course and cannot take the place of sound professional tuition from a qualified flying instructor.

Make early flights in no more than moderate winds. Ensure the runway is of ample size. Point into wind and progressively open the throttle fully. Check that maximum engine RPM has been attained. Once you are rolling, hold the stick fully back until the nose wheel lifts a little, immediately release the stick back pressure and allow the speed to build with the main wheels still on the ground.

At 28 to 30 mph the aircraft will lift off. Maintain level flight for a few seconds to allow the speed to build up, and then climb positively at 45 to 50 mph up to about 300 feet. See specifications for climb rate, this will depend on the temperature and conditions on the day.

Rotax engines

During the climb check that the maximum cylinder head temperature does not exceed 250°C, 480°F (503 model) maximum coolant temperature 80°C (582 model).

Engine life will be extended if on reaching 300 ft., you make a habit of reducing the throttle setting, but maintain 45 to 50 mph air speed, climb to your intended cruising height. Reduce the throttle setting further to maintain level

flight at around 5000 to 5400 RPM. Remember that fuel consumption increases dramatically when the aircraft is operated at high cruise RPM settings.

HKS four stroke engines
During the climb check that the maximum cylinder head temperature does not exceed 190°C, 338°F, check fuel pressure, oil pressure, temperature and voltage indicator.
After a maximum of three minutes, reduce power to the maximum continuous limit of 5,800 and maintain 45 to 50 mph air speed to your intended cruising height. Set the aircraft cruising attitude. Reduce the throttle setting further to maintain level flight at around 5000 to 5400 RPM. Remember that fuel consumption increases dramatically when the aircraft is operated at high cruise RPM settings. If desired, the fuel boost pump can be turned off - pressure must stabilise between 0.15 and 0.4 bar. Trim the aircraft at the desired speed.

(The maximum speed that the aircraft should be operated in turbulent air is 62 mph).

1.7 POWER FAILURE

Power Failure on Take Off
In case of loss of power or engine failure during the climb out up to 150 feet, immediately push the stick forward to maintain flying speed and try to land ahead. Any bank will result in an increased sink rate. Turn the ignition switches off to avoid an untimely burst of power.

Keep the aircraft pointing into wind to minimise the ground speed on landing, especially if the forced landing is anticipated in a rough field.

Try to relax, the AX2000 glides very well without power, remains perfectly controllable and lands slowly. Try to maintain a speed in excess of 55 mph two up, and 50 mph solo. (Airspeed for minimum sink is 47 mph).

Power Failure En-route
Re-trim the aircraft for minimum sink rate 47 mph) and seek out a suitable landing area. If there is sufficient time, try to establish the cause of the power failure. If it is not quickly apparent, concentrate on the landing. For maximum range in the glide, fly at 50 mph. Turn off the fuel and ignition switches, ensure occupants harnesses and helmets are secure, and if possible make a PAN call. To increase elevator control in the final flare, where practical increase the speed to 55 - 60 mph just before the round out.

Electrical Power Failure
The HKS ignition system is driven from the battery, which is charged by the aircraft alternator/rectifier/regulator. A Battery State Monitor (BSM) is provided as standard to determine the functioning of the electrical system. The monitor indicates red (under 11 or above 15 volts), orange (freshly charged battery), green (on charge).
If the BSM goes to orange then gradually turns red, the alternator power as failed. Turn off any non-essential electrics. Land before the indicator goes completely red, i.e. before the battery is exhausted and the engine stops.

A sudden red light in flight either means short circuit (low volts) or abnormal high voltage (regulator failure). It could indicate starter motor running (low volts) or still engaged (high volts). Turn off unnecessary electrical equipment - this may restore correct voltage. Land as soon as it is safe to do so.

On the Rotax engines the ignition system is separate from the rest of the electrical system, I.E. electrical power failure will not cause ignition failure. A BSM can be optionally installed to detect abnormal voltage faults.

1.8 BANKED TURNS

Banked turns on the AX2000 can be accomplished easily and control is positive. Both pitch and roll control are quite sensitive. At least initially, use small inputs until the effects of the controls are felt.

Maintain your banking attitude as long as necessary; then simply level the wings by returning the stick to the neutral position. To avoid adverse yaw, you will need proper use of the rudder, both when entering a turn and when leveling the wings , properly coordinated turns are easy to achieve and after a little practice will become automatic.

To begin with, limit bank angles to no more than 15° and remember that when banking your stall speed increases with the angle of bank e.g. from 30 mph in horizontal flight, it rises to 42 mph in a 60 bank.

Never forget that aerobatic manoeuvres in microlight aircraft are forbidden and dangerous.

1.9 FLIGHT IN TURBULENCE

While getting to know your AX2000 do not fly in high or gusty winds. With experience, you will be able to fly in some turbulence, but learning is difficult and hazardous under these conditions and must be avoided.

The recommended maximum speed to fly in turbulence (Va) is 62 mph.

It is a mistake to attempt to correct all the disturbances experienced by the aircraft. The AX2000 is very stable, and will return to straight and level automatically from most disturbances.

When flying in high winds, remember that wind gradient can induce stalls at low altitude when landing. The same risk is present when turning quickly out of a head wind into a tailwind, under these conditions, turn slowly and allow the speed to build up gradually.

Refrain from over banking and fly steep turns at 45 mph or more.

1.10 THE STALL

A necessary part of becoming completely familiar with your machine is stall practice. The AX2000 stalls gently and predictably under most conditions and shows little tendency to drop a wing. For HKS powered aircraft, the slotted centre section cover should be installed (modification no. AX291) to give more power-off elevator effectiveness.
Climb to a minimum of 2000 ft. and begin stall practice with the engine at idling speed. Carry out the necessary checks prior to stall exercises and head the aircraft into wind. Trim for a cruise speed of 45 to 50 mph.

Engine Idle Stall
Slowly, but positively, bring back the stick to reduce the airspeed at a rate of around 1 to 2 mph per second. Keep the wings level and use the rudder *not the ailerons* to correct any wing drop at the stall.

At 33-38 mph depending on loading, the nose will begin to sink gently. Open the throttle all the way and return the stick to the neutral position; the nose will drop through about 45° and the speed will build rapidly. The aircraft needs a maximum of 60 feet to recover from gentle stalls such as these. In a turning stall this may increase to 75 feet.

Beware of allowing excessive speed to build up in the recovery; when flying speed is reached, return the aircraft to its normal cruise attitude, and reduce the throttle. Practice stall recovery with the aim of developing a true stall, then recovering flying speed with minimum height loss.

Power on Stalls
At full power there will be more pronounced pre-stall buffet experienced and a steep nose up attitude. The stall speed is lower. It is probable that no height loss will be experienced but in any event height loss should be limited to 50 feet at MAUW, this should not be exceeded in a turning stall.

Pay particular attention to the speed build up on recovery with power on. A fairly fast response is often required immediately following the nose drop to minimise height loss. As soon as the nose starts to drop, return the stick to the neutral position, otherwise the speed will build rapidly. Ease back the stick to regain the normal attitude and reduce the throttle setting.

Asymmetric Stalls
The asymmetrical stall (one wing low) results in a greater loss of altitude. To recover, return the stick to neutral as described above and then lift the dropping wing with the rudder then aileron. If a severe bank has developed,

requiring large aileron inputs, rudder will be required to compensate for the resulting adverse yaw. Avoid trying to lift the wing before the airspeed has built up.

If the controls are fully crossed with full up elevator in the stall, a spin will develop. The AX2000 is not certificated for spinning.

1.11 CRUISING FLIGHT

Normal Cruise Flight
Once your cruising altitude (or flight level) has been attained, level the aircraft attitude, reduce the throttle setting to obtain desired airspeed and set the trim where fitted. Cruise at the lowest necessary airspeed.

We would not recommend a higher cruise speed than 65 mph solo and 60 mph dual for the 582 and HKS models, 5 mph less for the 503 model. Also remember that in our very light aircraft the effect of fuel and baggage has a very significant effect on the ratio of aircraft dry weight to loaded weight. These figures will be dependent on the loading, so we strongly recommend that you limit the engine RPM to a maximum of 5500 in the cruise.

HKS engine: The maximum continuous power setting is 5,800 rpm. However, engine wear, noise fuel consumption will all be significantly reduced at lower rpm's.

High Speed Cruise Flight
Do not fly at speeds above 62 mph in turbulence. Short distances in level flight may be obtained at speeds in excess of the accepted norm. NEVER fly at airspeeds above VNe, although at light loadings it will be possible to achieve level flight in the 582 model at speeds approaching VNe. At high airspeeds the controls will become heavy but at the same time the aircraft will be sensitive to small control inputs. Have plenty of practice before taking the aircraft to the high flying speeds and do not make huge control movements.

1.12 APPROACH AND LANDING

Descent and landing: Choose a landing strip into wind whenever possible. To start the descent, reduce the throttle setting and establish an airspeed of 55 mph. In windy conditions increase this approach speed to 60 mph. Set the trim accordingly.

Remember that you adjust the speed with the stick and the approach angle with the throttle. If it appears you are going to overshoot, reduce the power. If it appears you are going to undershoot, increase the power, but at all times maintain the proper approach speed with the stick.

Keep a safe height above the runway threshold; at the end of the approach, at a height of about 15 to 20 feet, cut the throttle to idle and then round out. To minimise the touch down speed the aim normally should be to touch the ground just as the aircraft is beginning to stall. (In turbulent or windy conditions this method is unsafe and the aircraft should be flown on to the ground).

The principle of maintaining a safe height over the threshold and keeping a reserve of airspeed is safer for landing on non-airport fields. It gives you the opportunity of avoiding last minute obstacles such as fences, wires, stones, ruts etc. The long flat approach, normally adopted by conventional aircraft should be reserved for landing at airports with clear and safe approaches and unobstructed fields. Remember, should you have an engine failure during the descent or landing you can always lose excessive height but you cannot regain reserve height lost.

After touchdown, keep pulling back on the stick until the front wheel touches the ground. In this way the high angle of attack will provide braking and the front wheel will be protected in the event of hitting a stone or rough ground.

NOTE: If you have any doubts about completing a safe landing, don't quote hesitate to overshoot and go round again.

1.13 CROSS WIND TAKE OFF AND LANDING

Although the crosswind capabilities of the AX2000 are very good, high cross wind components demand a high level of pilot skill to remain safe. Never take off with more than 12 mph (10 KTS) of cross wind component until you have accumulated a lot of experience with your AX2000.

Both sideslip (wing down) and crab approaches can be made. In both cases, use the rudder to align the aircraft with the runway just before touchdown. Ground effect will help to align the aircraft with the runway and once the roll is straight down the runway allow the nose wheel to lower. Once down, standard cross wind taxiing control deflections should be used.

Bear in mind that because of its short rolling distance you will almost always be able to take off and land into a head wind. The stronger the wind the shorter will be your rolling distance. In many cases it will be possible to strike a compromise between landing directly into wind and landing in line with a long roll out path. Never be too proud to land diagonally across a wide runway if this represents the safest option in a stiff crosswind.

1.14 FORCED LANDINGS

IMPORTANT: All engines are fallible. Microlight engines are uncertificated. For this reason never forget that it must be assumed that an engine failure can occur at any time.

- ALWAYS keep in practice at forced landings with engine out.
- ALWAYS maintain sufficient altitude to give you the choice of a safe emergency landing field.
- ALWAYS assume that every road and every building WILL have a power line near it.
- ALWAYS plan and update your emergency landing field on a cross country flight.
- NEVER rely on the electric starter (where fitted) when carrying out forced landing practice, the engine will cool significantly with airspeed and will probably require choke to restart.
- NEVER fly over a congested area, a wood or water without climbing high enough to permit a safe landing outside the dangerous area.

Forced Landing On Corn or other Crops
If in the event of a forced landing you have to choose crops, maintain the lowest speed you can and stall the aircraft when the wheels touch the tops of the crop. The main hazard here is that of heavy retardation from the drag of the crop.

Ditching on Water
Take great care estimating your height over water, it is easy to be misled. Proceed as follows:

- If you have a radio, call a MAYDAY.
- Direct the aircraft into wind if the wind is significant, if not, consider landing along the swell.
- Tighten your safety harness and cover the release button with your free hand.
- Unfasten the door.
- Clear away any articles which could impede your exit, e.g. radio, map board, intercom.
- Prepare mentally for your landing, ie. have a clear idea about how you will exit the aircraft, try to determine the best direction to swim away - normally rearwards. Be prepared to swim downwards, if necessary, before surfacing.
- If you are carrying a passenger, make the plan clear to him too.
- Touch the water as slowly as you can, slightly nose up.
- Once in the water, don't panic, leave the aircraft and do not try to take anything with you.

The AX2000 is made of strong and durable materials. It will most probably be salvageable even after immersion in salt water. (One AX3, the forerunner to the 2000, has been recovered from a depth of 60 metres and still flies).

Forced Landing In Trees
If in the event of a forced landing you have to choose forestry land, if you have an option, choose to land in low and dense trees. Tighten your safety harness and maintain normal approach speed; the air is often turbulent over trees. Aim for gaps between trees to allow the wings to absorb the impact. As soon as you hear the first leaves strike the aircraft, pull the stick all the way back to reduce speed to a minimum. Aim to descend as vertically as possible on to the trees.

1.15 PERFORMANCE & LIMITATIONS AT 450 KG AUW

Note - Takeoff distances quoted are factored 1.3 from test.

AX2000 with engine:	ROTAX 582 HP	HKS 700E BETA	ROTAX 503-2V
Minimum flying speed at maximum all up weight	36 mph	36 mph	36 mph
Maximum speed, straight & level @ full throttle	80 mph	75 mph	75 mph
Maximum speed, straight & level @ Max. continuous RPM	69 mph	69 mph	69 mph
Max power rpm	6500	6200	6500
Max continuous RPM	5800	5800	6500
Fuel Pressure BAR	0.15 - 0.5	0.15-0.5	0.15-0.5
CHT max degrees C/F	150/300	190/432	250/480
Oil Pressure (CRUISE) BAR/PSI	N/A	6-7.2bar 85-100psi	N/A
Oil Temperature degrees C/F	N/A	50-90 C 122-188 F	N/A
Fuel consumption: at 55 mph	12 lph	9.5 lph	13 lph
Fuel consumption: at 69 mph	16 lph	12 lph	17 lph
Fuel consumption: at 75 mph	18 lph	16 lph	20 lph
G limits at max loading < 450kg	+4,-2	+4,-2	+4,-2
Non - Aerobatic Manoeuvres only			
VNe (never exceed speed)	90 mph	90 mph	90 mph
Va (turbulent air safe speed) *	62 mph	62 mph	62 mph
Vc (cruise speed)	69 mph	69 mph	69 mph
Vs (stall speed)	35 mph	35 mph	35 mph
Max. climb rate @ 450kg MAUW, ISA S/Level	650 fpm	500 fpm	375 fpm
Min descent rate	400 fpm at 47 mph	400fpm at 47 mph	400fpm at 47 mph
Glide ratio, engine off	8 to 1 at 50 mph	8 to 1 at 50 mph	8 to 1 at 50 mph
Take off roll, no wind	117m	130m	162m
T/O distance to clear 15 m obstacle	221m	260m	325m
Landing distance, without brakes	250 m	250m	250m
Ceiling	18,000 feet	15,000 ft	12,000 ft
Take off and landing cross wind limit	20 mph	20 mph	20 mph
Max roll rate, 45Ú to 45Ú	3½ secs	3½ secs	3½ secs

* Va is also the maximum airspeed at which full control deflection is permitted.

1.16 WEIGHT AND BALANCE

Weights

The AX2000 typical weights are as follows:

188 kg (503 basic model)
202 kg (582 model with most options)
209 kg HKS Beta engine model with most options)

Following modification, repair or at any time required by the CAA the aeroplane must be weighed so that the composition of useful load can be determined. The aeroplane must be dry, clean and in calm conditions for accurate weighing. **The empty weight must be recorded below and on the main cockpit placard after each weighing. The aeroplane empty weight must under no circumstances exceed 266kg.**

The AX2000 registration Mark .....Engine type .....Has been weighed empty, including full oil, electrolyte and unusable fuel

WEIGHT	CG EMPTY	MODIFICATION STATE	DATE

MAXIMUM LOADS TO BE CARRIED: MINIMUM LOAD:

FUEL CONTENTS :	62L	44.5KG	0
PILOT 1 WEIGHT		90 KG	55KG
PILOT 2 WEIGHT		90 KG	0
BAGGAGE		12.5KG	0

THE MAXIMUM ALL UP WEIGHT MUST NOT EXCEED THE EMPTY WEIGHT PLUS THE ABOVE MAXIMUM LOADS, OR 450KG, WHICHEVER IS LEAST.

Centre of Gravity (CG)
The design of the aircraft makes it impossible to displace the centre of gravity beyond safe limits provided that the maximum loadings described above are not exceeded and no heavy items are carried in the fuselage behind the fuel tanks or in the nose. *If the aircraft tips onto it's tail of it's own accord, on level ground in still air, then the cg is outside the aft limit.*

Before a new operator of the aircraft takes to the air, he or she should load the aircraft for flight and carefully calculate the CG and ensure that it falls well within the allowable range.

With the aircraft stood on level ground in this configuration, but without occupants, push down the tail until the aircraft just balances on its main wheels, then take a measurement between the underside of the tail skid and the ground. It may be a good idea to load the aircraft in both forward and aft CG conditions and obtain two extreme measurements.

For future operations the C of G can be readily, if roughly, checked by depressing the tail to find the balance point to ensure that it falls within the expected range.

The maximum authorised take off weight is 450kg, subject to the loading limitations above. The centre of gravity datum is the front face of leading edge root channel fitted to the keel. The permissible range of centre of gravity loaded for flight is shown below.

Maximum Forward CG Position (503 and 582 models)	670 mm	Aft of Datum
Maximum Forward CG position (HKS model)	730mm	Aft of datum.
Maximum Rearward CG Position (all models)	847 mm	Aft of Datum

2. MAINTENANCE MANUAL

2.1 SYSTEMS DESCRIPTIONS AND MAINTENANCE

The systems and structure of the AX2000 are simple and require only basic skills for their maintenance and repair. If a part of the aircraft is damaged, first inspect the area thoroughly for further consequential or concealed damage. Replace the item with a factory supplied part, *remember, it will invalidate your permit and insurance if you use pattern parts not manufactured by a company specifically approved by the CAA to make cyclone AX2000 parts*, at the time of going to press, the only companies approved to make parts for the Cyclone AX3 are PEGASUS AVIATION LTD, CYCLONE AIRSPORTS LTD AND SOLAR WINGS AVIATION LTD. Have the repair checked by a company or BMAA approved inspector. Record the repair in the aircraft's technical logbook.

Where you are unsure of your abilities to repair or maintain the AX2000, refer to Cyclone Airsports Ltd. or an AX2000 main dealer.

2.1.1 ELEVATOR

The elevator is controlled by a simple push tube running from the base of the stick to a relay arm mounted on the keel. A second tube runs from this relay arm to the elevator horn. The push tube is split in this way to increase its strength under compression loads.

The rear tube is in two telescoping parts. The rear tube is factory set by adjustment to the telescopic rear section of the tube; no adjustment should be made without reference to the manufacturer. Oil the elevator bearing sparingly with light oil as necessary. Replace the bearings when significant wear develops.

Trim Tab
The AX2000 is equipped with an anti-balance trim tab. The tab is geared to the elevator, a system which increases the elevator control force felt by the pilot. It also improves stick-free trim stability. The tab is driven by a pushrod to a swivelling arm which is driven by cables from the trim wheel.

Check the security of the linkages, hinge and hinge pin. Check condition of the operating cable. Check full and free movement over the maximum combined elevator and trim settings. Check the security of the operating horn on the trim tab. Oil the hinge sparingly with light oil as necessary.
Adjust the trim wheel castle nut to maintain correct friction, renew the split pin. *Note - Looseness or disconnection of the tab system invites the risk of elevator flutter.*

2.1.2 AILERONS

The ailerons are controlled by cables running from the stick base, around pulleys mounted on the keel, then forwards to connect to the aileron horns. It is important that these cables are set to the correct tension and they should be checked as follows. Apply a load of 1 kg to the mid-point of the cable between the pulley and the aileron horn; the deflection should be between 40 and 50 mm. Minor adjustments may be made by using the turn buckle in the aileron return cable circuit, however ensure that after adjustments are made, the ailerons tips are in line with the wing tips, or only very slightly low - say 1 or 2 degrees. If after adjustment the tension is outside this range, refer to the manufacturer.

The aileron inner bearings only should be lubricated with light oil as necessary. Do not lubricate the plastic bearings attached to the trailing edge with oil but occasionally spray with Silicone lubricant. If you intend to leave the aircraft out side where the bearings can saturate with water and then operate in freezing conditions, it is essential that you regularly lubricate these bearings with Silicone lubricant, preferably from a spray can.

2.1.3 RUDDER

Cables run from the top of the pedals, pass under the seat support, and terminate on the rudder horn.

IT IS ESSENTIAL THAT THESE CABLES ARE CROSSED.

Cable tension should be checked as follows: With the rudder locked approximately 2 degrees to the left of its central position and the nose wheel clear of the ground, the rudder pedals must return to a their neutral positions after a firm push. If significant play exists, it must be removed by adjustment of the steering rose joints. Equal adjustments must be made on each side.

The rudder centralising springs (fitted to the underside of the cockpit pod) should return the rudder to the neutral flight position approximately 2 degrees left of its central.

If during straight and level flight at approximately 60 mph, with rudder pedals in neutral position, the aircraft tends to yaw (the ball is out of its centre position), then the rudder cables require adjustment. Carry out this adjustment using the turn buckles at the rudder horn, adding left rudder if the ball is out to the left and visa versa. Do not just tighten or loosen one turn buckle, make the adjustment using both turnbuckles, if you loosen one then tighten the other. Ensure that at least 8 mm of thread remain in engagement at each end of the turn buckle.

The cable pulleys and pedals should be lubricated with WD40 or similar and the bearings with light oil. Replace the bearings when significant wear develops.

2.1.4 FUEL SYSTEM

Fuel is drawn from a dip tube suspended from the top of the tank (starboard tank if two tanks are fitted). A fuel strainer is fitted to the lower end of the dip tube. The strainer should be checked and if necessary cleaned, every 50 hour or 12 months, whichever comes sooner. If fuel or a container has been used that has been found to contain debris, then it should be checked at the next opportunity.

Where two tanks are fitted they are connected by a pipe between the tank sump drains. As fuel is used from the starboard tank, equal fuel tank levels are maintained through the connecting pipe. A fuel tank sump drain valve is fitted to the starboard suspension bracket, just below the door.

Rotax Powered Aircraft
Fuel is drawn from the tank(s) via a single pipe between the tank and the first pump (to minimise the risk of air ingestion. The first pump is fitted in the cockpit floor between the occupants seats. It important that the area under the pump does not become clogged with dirt, as a tiny hole is present in the brass elbow fitted to the underside of the pump, necessary to prevent a hydraulic lock of the pump diaphragm. A second pump is fitted below the engine to ensure an adequate supply of fuel under worst case conditions. The fuel pumps have been found to be extremely reliable, maintenance should be carried out in accordance with the Rotax engine service section of the manual.

A fuel tap is fitted in front of the pump, there is no need to turn it off when the aircraft is not in use as the fuel system is not gravity fed, however exercise the tap during the daily check to ensure that it has not seized. A filter is fitted forward of the tap under the panel, it can be seen from the cockpit and should be inspected daily for excessive debris. It should be cleaned by back flushing with petrol and replaced at the intervals defined in the Maintenance Schedule.

HKS Powered Aircraft
Fuel is drawn from the starboard tank to the filter, just below the joystick. It then flows via the tap to the inlet side of the electric boost pump. Fuel is delivered from the boost pump to the carburettors by a hose running up the windscreen tube. The engine driven diaphragm pulse pump is situated on the starboard side of the oil cooler. It is actuated by the starboard inlet manifold. The pulse pump is connected in parallel with the boost pump. Either pump can supply the needs of the engine at full power, but the boost pump should be used for takeoff and initial climb. The output from both pumps is monitored by a fuel pressure gauge. The switch for the boost pump is adjacent to it. Check the system for leaks, filter cleanliness, air ingestion and boost pump operation regularly.

2.1.5 BOWDEN CABLES

The control cables for throttle, choke and brakes (where fitted) must be lubricated using only WD40 or equivalent. *Note: do not use oil to lubricate the throttle cables or they will freeze up in below zero temperatures, usually with the carburetor throttle slides open.* The inner cable must be inspected carefully where it exits the outer termination and at its attachment points at each end. The inner cable must be replaced if a strand is broken.

2.1.6 UNDERCARRIAGE

The main undercarriage legs are composite structure (fiberglass) and capable of absorbing landing and taxiing shocks. Each leg is fitted with a stop which restricts vertical movement of the wheel to around 50 mm from its static position. The stop consists of two telescoping tubes which can wear against one another, especially if rough ground taxiing is undertaken. Inspect the tubes at the intervals defined on the schedule and replace them when significant wear is observed.

The front wheel runs on a roller bearing; it should be dismantled, cleaned, and its roller bearing greased at the intervals defined. Check carefully for undue chafing of the plastic wheel material on which the bearing runs. When this gives rise to significant slack in the wheel, replace it. The main wheels run on ball races and the wheels should be removed, cleaned and checked for smooth running at the stated intervals.

The brakes are simple drum brakes whose shoes operate from a cam turned by the brake cables. This cam mechanism should be dismantled, cleaned and greased at the stated intervals. The bearing surfaces of the cam and shoe should be treated with an anti-seize compound such as Copaslip.
Jacking points for the aircraft are beneath each brown polyurethane block on the composite undercarriage. Take care not to damage the composite axle legs during jacking operations.

2.1.7 STRUCTURE

The aircraft structure should be checked for cracks and corrosion at the intervals indicated on the schedule. Where the aircraft is exposed to a salty or otherwise corrosive atmosphere, the frequency of inspection should be increased. Fittings should be examined for security and wear at these intervals.

The main axis is the structure that runs beneath the seats and connects the two pairs of struts to the fuselage. It should be checked for straightness by looking through the centre of the main tube. The cables should be checked for tension by squeezing two cables together between the thumb and forefinger of one hand to check that they are not loose.

Forces should not be applied to the elevator, ailerons or fairing when moving the aircraft. The recommended handling points are the keel, wing struts ends and axles.

2.1.8 PROPELLER

The AX2000 503 Model (2.58:1 reduction gear) uses a GSC 64" ground adjustable pitch propeller with machined aluminium alloy hub and wooden blades. The pitch should be set to 17° at 24" (610 mm), that is, the 17Ú angle should be measured on the flat undersurface of the blade at 24" (610 mm) from the centre of each blade.

The AX2000 582 Model uses an Arplast Ecoprop, 3 blade ground adjustable pitch propeller, 67" (1700 mm) diameter, with machined aluminium alloy hub and composite blades. The pitch should be set to 26° at 21" (535 mm), that is, the 26Ú angle should be measured on the flat undersurface of the blade at 21" (535 mm) from the centre of each blade.

The AX2000 HKS 700E Model (2.58:1 reduction gear) uses an Arplast Ecoprop, 2 blade ground adjustable pitch propeller, type 174/105R/2 1.74m diameter. It is set at 18 degrees pitch at 53.5 cm blade radius.

If the propeller is ever disassembled, the pitch must be correctly set on reassembly, or the Permit to Fly and Noise Certificate will be invalidated. With GSC propellers only, a pitch indicator label is fixed to each blade, and should be

used to check the propeller for correct adjustment. If the pitch indicator label ever becomes defaced, then the propeller must be returned to Cyclone Airsports for resetting and re-labeling. The pitch indication label shows the blade angle at 75% radius.

With the propeller pitch correctly set, the engine should reach its correct rpm at full throttle. A check of full throttle engine rpm on the ground should be carried out at intervals. The engine speed will vary depending on the condition of the engine, and the atmospheric conditions prevailing at the time of test, but in any case must be between 6300 and 6500 rpm (Rotax engines) and 6000-6200 rpm (HKS engine). If it is outside these limits, do not fly, but check the engine for faults and the propeller for correct pitch setting. If in doubt, consult Cyclone Airsports.

Propeller Mounting Configurations

There are two possible propeller mounting configurations depending on the type of flange fitted to the Rotax gearbox output shaft. The HKS engine output flange is similar to the Rotax type.

Configuration 1	**Configuration 2**
Used when the propeller flange has 6 threaded holes tapped 1/4" UNF and 6 threaded holes tapped M8. Six M8 torque studs (spigots) are screwed into the M8 threaded holes in the flange, secured by Loctite. The propeller is secured to the flange by six 1/4 UNF bolts. These bolts require a 7/16" AF spanner. Tighten them in sequence, a little at a time, until the correct torque of 12 Nm (8.5 ft.lb) is reached, then check the torque of the 4 x bolts on the hub arms, 12 Nm (8.5 ft.lbs). Recheck the torque setting of the 6 prop. mounting bolts then, while holding the bolt heads with a spanner, fit and tighten the UNF Nyloc nuts on the protruding threads of the 6 bolts. Make sure that the bolt threads protrude through the Nyloc nuts by at least 1 1/2 threads.	Used when the propeller flange has six 1/4" clearance holes and six threaded holes tapped M8. Six torque studs are screwed into the M8 threaded holes and secured with Loctite. The propeller is secured to the flange by 6 x UNF bolts with Nyloc nuts. The plain shanks of the bolts pass through the clearance holes in the flange; these bolts and nuts require a 7/16" AF spanner. Tighten these in sequence, little by little, by holding the nut with one spanner and tightening the bolt with a torque wrench. Tighten to 12 Nm (8.5 ft.lbs), then check the torque of the 4 x bolts on the hub arms (12 Nm). Recheck the torque setting of the mounting bolts. Make sure that the bolt threads protrude through the Nyloc nuts by at least 1 1/2 threads.

Propeller Inspection, Routine Maintenance and Repair

The propeller must be maintained in top condition to ensure correct performance and safety. Frequently check for cracks, splits and dents in the blades; the tip region is especially susceptible to dents and cracking of the leading edges.

Frequently check that both blades are set to the same (and correct) pitch, otherwise poor performance and severe vibration will result. Check the security of the propeller mounting bolts (6 off) every 10 hours using one of the methods below, depending on configuration.

DETERMINE THIS FIRST as follows:

Slacken the 6 x 1/4 Nyloc nuts behind the flange. If it is not possible, or very difficult, to rotate the 6 bolts clockwise, then you have a configuration 1 mounting with 1/4 UNF tapped holes in the flange. If it is possible to rotate the bolts freely, then you have a configuration 2 mounting, with through holes in the flange.

Configuration 1	**Configuration 2**
With the Nyloc nuts slackened, tighten the 6 bolts to 12 Nm (8.5 ft.lbs.), then hold each bolt head with a spanner and tighten the lock nut behind the flange. Finally check the torque of the 4 bolts on the hub arms 12 Nm (8.5 ft.lbs). WARNING - Configuration 1 mounting cannot be checked by simply testing the tightness of the Nyloc nuts, they must be slackened first, the bolts tightened, then the nuts tightened on the flange.	Hold each Nyloc nut with a 7/16" AF spanner, and tighten the bolts, using a 7/16" socket and torque wrench, to 12 Nm (8.5 ft.lbs) Tighten the bolts little by little. Finally check the torque of the 4 bolts on the hub arms (12 Nm, 8.5 ft.lbs)

Propeller repairs should be limited to small dents. These should be filled with epoxy resin and sanded smooth. Re-varnish with good quality polyurethane varnish and re-balance.

Fine balancing can be carried out with varnish at the propeller tips, or by using washers under the heads of the mounting bolts. If washers are used, check that the bolts still protrude through the Nyloc nuts.

Check propeller balance and tracking at least every 25 hours of operation, and immediately if the propeller is even slightly chipped or damaged. The propeller should be balanced to better than 1 gm meter. Tracking should be within 1/8" at the tips. If in doubt, consult Cyclone Airsports.

2.2 MAINTENANCE SCHEDULE

Maintain the engine in accordance with the Rotax or HKS engine manual as appropriate. Clean, adjust, check or replace items listed below on the aircraft at the intervals indicated. Spaces are left free at the bottom for you to add items which you find from experience require attention in your specific environment.

Every	10 hours	25 hours	100 hrs	250 hrs	300 hrs	500 hrs	750 hrs	1000 hrs
Propeller	Clean	Balance						
Engine					Overhaul (Rotax)	Overhaul (HKS)		
Dacron covering (1)			Inspect			Replace		
Lift strut stainless tangs							Replace	
Lift strut tang bolts				Replace				
Other airframe bolts				Inspect				
Bowden cables	Lubricate	Inspect						
Rudder cables		Inspect		Replace				
Rudder springs/stops		Inspect		Replace				
Rudder post hinge bolts								Replace
Aileron cables		Inspect		Replace				
Aileron bearings (2)		Lubricate						
Cable pulleys	Lubricate	Inspect						
Fuel lines			Inspect			Replace		
Fuel filter		Inspect						
Fuel tank								
Air filter				Replace				
Rivets in tube sleeves			Inspect					
Brake cables		Adjust						
Brake cam levers		Grease						
Brake shoes		Clean						
Nose wheel		Inspect	Note (3)					
Main wheels		Inspect	Lubricate					
Suspension stops				Inspect				
Control bearings		Lubricate						
Structure				Inspect				
Tyre pressure - Main	Check 20 psi							
Tyre pressure - Nose	Check 15 psi							
Main axis cables		Note (4)						
Main axis		Note (5)						

(1) "Ultralam" requires no maintenance, clean with warm soapy water as necessary.
(2) If the aircraft if left out then lubricate ailerons bearings with Silicone spray prior to flight in freezing conditions.
(3) If long distance taxiing is normal then renew nose wheel bearings at 100 hrs
(4) Grip a pair of main axis cables between thumb & finger and check that they are not loose.
(5) Look through the main axis tube to check straightness.

2.3 TRANSPORTING THE AX2000

Wherever possible it is advisable to rig and de-rig on grass or soft surfaces to avoid scuffing the sail covers and scratching the tubes. Before commencing de-rigging, read and understand the whole procedure, then go back and follow the instructions step by step, some procedures will not make sense until later operations are covered.

Two situations have been considered:

Covering a short distance at towing speeds under 50 mph.
Covering longer distances at reasonable towing speeds.

2.3.1. DE-RIGGING FOR SHORT DISTANCE LOW SPEED TRAILERING

For short distances the rudder, horizontal stabiliser and elevator can remain in place. All moving tail surface parts should be secured with ropes or bungees to prevent them from moving in transit. Within the cockpit, the stick should be tied firmly into the neutral elevator position. The pitch trim tab should be set to the neutral position. **WARNING** - when trailering be aware of the stabilisers width.

If you are using a trailer that will transport the fuselage with assembled wings, and you wish to cover only a very short distance, then it may be possible to leave the ailerons in place, consult your trailer manufacturer. Soft packing to avoid abrasion at the wing support points is essential.

De-rigging can be accomplished by one person. To make single handed de-rigging easy,
a wing tip stand should be used, this can be a step ladder or a purpose made trestle. The following procedure assumes one person is carrying out the work, a helper will always be useful and will speed up the operation. Before commencing it may be handy to have a soft mallet, pin punch and a bag to hold the loose pins, safety rings and wing nuts.

1. Release the top centre wing cover attached by Velcro, and likewise the lower centre wing cover from between the wings.
2. Remove the wing tensioning straps from the root battens of each wing. Disconnect the ASI pitot tube at the wing root, at the top of the jury strut and at the pitot head.
3. Remove the safety rings from the following fasteners:
    a. Main wing strut connecting pins (4 each strut)
    b. Jury strut connecting pins (2 each strut)
    c. Aileron hinge wing nuts (3 each aileron)
    d. Aileron inner pivot pins (1 each aileron)
    e. Wing leading edge root pins (1 each wing)
    f. Wing trailing edge root pins (1 each wing)
3. Reach into the access pocket in the top of the rear enclosure and disconnect the aileron Return cable from each aileron horn. The shackle with its pin and safety ring should be refitted to the end of the cable for safe keeping. The two ends of the return cable should be connected together to avoid losing it in transit.
4. Disconnect the aileron control cable from each aileron horn and refit the shackle to the cable. Leave the control cable ends dangling at this point.
5. From here on, work on one wing until it is detached from the aircraft. The aircraft is stable with only the weight of 1 wing attached. You may find it easier to remove pins with a pin punch and mallet, so have one at hand. If a pin is unduly tight then it is probable that a load is present that can be relieved by re-aligning the component *do not use more than a gentle tap with the mallet.* The order of working has been chosen to ensure that each pin being removed has been relieved of load, for this reason if you do find a tight pin, check your working order.
6. Remove the wing nuts from the 3 aileron hinges and, working from the wing tip, ease aileron away from the trailing edge. When the inner hinge has cleared the trailing edge, the aileron root pivot pin can be pulled clear of the root bracket. The pivot bearing is a bush that may be loose in the bracket, if it is at all loose, then remove it and place it on the aileron pivot pin and replace the safety ring. The three aileron hinge bolts should be tucked inside the Velcro flaps provided in the fabric cover. Place the aileron in a safe place away from the immediate de-rigging area.
7. If you are removing the battens then do so at this stage, withdraw them slowly to avoid burning the fabric or the nylon batten ends, as you withdraw them, hold them away from the fabric over the trailing edge.
8. Remove the front jury strut lower connecting pin, angle the jury strut to allow the best access to the top connecting pin and remove it as well. Repeat with the rear jury strut. Place the jury struts in a safe place away from the immediate de-rigging area.
9. Support the wing tip with a trestle, or get a helper to assist (see note 1 below). Working at the top end of the front strut, remove the lower of the two strut connecting pins, rotate the stainless tang downwards until the top

connecting pin head is clear of the leading edge and withdraw it. Be careful that you do not rotate the tang too far or it may tear the fabric. Once the joint has been disconnected the tang should be rotated back into the wing to avoid damage. Repeat this operation on the rear strut top connection. If you have no trestle or helper then see note 3 below.

10. At this point the wing struts are supported by their lower connections only and they are extremely vulnerable, *be very careful not to walk into them.* (See note 2 below). Support the weight of the front strut and remove both lower pins. Repeat with the rear strut. Note that you cannot remove the rear strut pins first if the pin heads are correctly placed towards the wind. Place the struts in a safe place away from the immediate de-rigging area.
11. If you are using a helper, carry on with the next stage. If not then lower the wing tip onto a cardboard box or padded step about 30 centimeters high. If you are working on a hard surface then you should prepare a blanket on the floor. The blanket needs to be placed in a position to allow the wing tip to slide out to clear the fuselage when the trailing and leading edges have been released.
12. Remove the trailing edge root pin and gently lower the trailing edge until it is supported in the rear enclosure pocket. Remove the leading edge root pin and, still supporting the leading edge, ease yourself into position under the centre of the wing root. Lift the wing root until the trailing edge clears the rear enclosure, move the wing out clear of the fuselage and lower it to the floor.
13. Repeat the procedure with the other wing.
14. Place the two aileron control cable ends into the access pocket in the rear enclosure and close the pockets firmly on to the cables, this will keep them secure during transport.
15. To dismantle the wing if necessary: Turn the wing over (lower side up) and ensure that the jury strut stainless steel tangs are tucked away, unzip the top and bottom surface (inside the root of the wing and carefully withdraw the sail cover as a complete sock.
16. Disconnect the tip tube from the trailing edge, remove the 4 safety rings and wing nuts from the compression strut fixing bolts, withdraw the bolts from the compression strut fixings, this will disconnect the outer end of the 2 brace wires. Take a note of the position of the washers and brace wire tang.
17. Fold the wing covers loosely, avoid hard crease lines and place them in the cockpit for transport.
18. The struts, jury struts, trailing edges and leading edges should be strapped together with plenty of protective padding, or stowed in a purpose made wing tube bag. The bag or bundle can be either: stowed on the car roof rack; stowed on the trailer wing rack or if plenty of padding is utilised it can be firmly strapped to the fuselage keel.

2.3.2 RIGGING

To rig the aircraft, simply reverse the above steps and follows these simple tips:

1. Spray the leading edges, trailing edges and battens with silicone before commencing.
2. Ensure that the top to bottom surface zip is completely fastened before the battens are fitted and preferably before the wing is attached to the aircraft.
3. Fit the battens after the wing is attached to the fuselage but before the tension straps are tightened. To engage the rear of the batten in its pocket, use a piece of tube or other implement through the cord in the batten to help push the batten forward. With a finger nail or a blunt screwdriver, lift one side of the batten pocket flap and slide the end of the batten under the flap. As you push the batten, be careful not to force it down onto the fabric covering the trailing edge, it is easy to damage and burn it.
4. Fit and apply tension to the eight tension straps (5 top and 3 lower) before attempting to fit the ailerons, it may be necessary to tease the wing covers along the trailing edge towards the root to expose the aileron hinge attachment holes in the trailing edge.
5. Before fitting the centre covers, give a little extra tension to the wing covers. Utilise a load binder strap temporarily fitted next to the tension strap, pull the covers together, then remove the slack in the tension strap. Do this in the following order (straps numbered 1 - 5 from the front):
    a. Number 3 straps at the top centre cord position.
    b. Number 2 straps.
    c. Number 4 straps.
    d. If creases still exist along the leading and trailing edges then very carefully tension battens no's 1 & 5. *Warning* - don t over do it, tremendous force can be applied with load binder straps. Straps 1 & 5 are particularly vulnerable due to their close proximity to the end of the pocket.
6. If you have removed the rudder cables then *ensure they are crossed* when you re-connect them.
7. When you fit the centre covers ensure that you leave the recoil rope where fitted on the outside.
8. Fit the aileron return cable (inside the rear enclosure) before you attach the main aileron control cables, this should save you having to release tension to make the last connection.

2.3.3 LONG DISTANCES, REASONABLE SPEED DE-RIGGING

1. If you find it necessary to remove the tail, proceed as follows: Disconnect the rudder cables and stow them within the fuselage. Remove the two rudder safety rings, wing nuts and hinge pin bolts and place the rudder aside. Remove the elevator control rod from the elevator horn and remove wing nuts and bolts from trim tab control rod, remove the control rod. Disconnect the stabiliser struts at the bottom end. Remove the safety ring, wing nut and bolt from the centre elevator bearing and the two safety rings, wing nuts and bolts from the aerial plate and stabiliser leading edge. Note that the elevator cannot easily be removed from the horizontal stabiliser, place the assembly aside.
2. The elevator and horizontal stabiliser can be carried in the cockpit, slightly fold them and slip them between the seats. Slide the rudder onto the seats and fix it there. You may find that with the tail surfaces in the cockpit, it will be easier to stow the wing covers in the tow vehicle.

WARNING - Check carefully that there is no chaffing between any of the parts and do not drive over 70 mph (the legal limit is 60 mph in the UK) with the aircraft on the trailer. Microlights normally wear out faster from rigging, de-rigging and transit than they do from flying.

Notes:

a. A suitable trestle can be a step ladder, however be very careful to ensure that it is stable, well padded and cannot slip.
b. The reason for removing the upper strut connections first is that with the wing in place the lower pins are extremely difficult to remove. Particularly so due to the policy of keeping pin heads to wind. By first relieving the load on the pins they can be easily removed without force.
c. If no helper or trestle is available, then with care, the wing can be still be removed. The higher of each of the lower strut fixing pins should be removed. Note that the higher of the rear strut pins cannot be fully withdrawn at this stage, but it should be pushed out far enough to clear the stainless tang. With the wings still in position, these pins may be tight.
d. Follow the procedure in 10 until each strut is free at the top end and can be lowered to the floor with your foot, while supporting the wing on your head and shoulders. Without the ailerons or battens, the weight of the wing at the struts is not unduly heavy.

2.4 SPECIFICATION

2.4.1 CONSTRUCTION

WINGS	Structure	Aluminium alloy equivalent to 6082T6
	Leading edge inner	2 5/8" x 17 swg.
	Leading edge tip	2 ½" x 17 swg.
	Trailing edge inner	2 3/8" x 17 swg.
	Trailing edge tip	2 ¼" x 17 swg.
	Compression struts	48 x 0.9 7075 - T6
	Wing drag bracing	Internal cables 2.5 mm 19 x 1 construction stainless steel
	Wing tip	25 mm x 1.5 mm 6062 - T6
	Wing struts	Streamlined extrusion 74 x 28.4 mm by 1.5 mm
	Profile	Set by wing ribs, 19 x 1 mm
	Sail fabric	Ultralam 91-00, 155 gr/sq m or Dacron
AILERONS	Leading edge	1.5" 18swg or 35 x 1 mm
	Trailing edge	19 x 1 mm
	Ribs	10 x 0.7, pop riveted
FUSELAGE	Fuselage boom	64 x 2 sleeved with 60 x 2 mm inserts or 2 5/8" 17swg sleeved with 2.5" 17swg inserts.
	Seat	Bucket seat
	Front wheel	300 mm dia., steerable
	Main wheels	350 mm dia. wheels
	Brakes	Drum brakes on main wheels (optional)
CONTROLS	Rudder pedals	Linked to front wheel through connecting rods.
	Stick	Central, between legs, dual control.
	Throttle	Bowden cable operated, dual controls
MISCELLANEOUS	Bolts	High tensile - M 8.8
	Tangs	Stainless steel, 3 mm thick

2.4.2 STRUCTURAL STRESS LIMITS

At 450 kg all up weight + 4g - 2g (limit)
+ 6g - 3g (ultimate)

Note: Maximum all up weight may be limited to less than 450kg by the maximum loadings indicated below.

2.4.3 WEIGHTS AND DIMENSIONS

WEIGHTS	
Dry empty weight	187 to 209kg
	(503 basic to HKS Beta full spec)
Max. take off weight	450kg or less, subject to loading
	maxima below
Maximum permitted	P1 90 kg
payload comprises	P2 90 kg
	Fuel 62L 44.5 kg
	Baggage 12.5 kg

DIMENSIONS	
Length	5.00 m
Overall height	1.75 m
Wing	9.4 m
Mean chord	1.667 m
Wing surface	15.77 sq m
Dihedral angle	1.75°
Wing sweep	8°
Wing twist	4°
Sub-fin surface	0.33 sq m
Rudder surface	0.60 sq m
Stabiliser surface	1.37 sq m
Elevator surface	0.87 sq m
Aspect Ratio	5.6 -1
Main wheels track	1800 mm
Wheel base	1310 mm

2.4.4 ENGINES

MODEL	ROTAX 503	ROTAX 582	HKS 700E BETA
MANUFACTURER	Rotax	Rotax	HKS, Japan
TYPE	2-V, Two cylinder, 2 stroke	Two cylinder, 2 Carburetor, 2 stroke	Flat twin cylinder, 2 Carburetor, 4 valves per head, 4 stroke
COOLING	Free air	Free air	Free air and oil cooled
POWER	50 HP at 6500 rpm	64 HP at 6500 rpm	58 HP at 6000 rpm
CAPACITY	496.7 cc	**581 cc**	680 cc
FUEL/OIL MIXTURE	2% (50:1)	2% (50:1)	
LUBRICATION			Dry sump with rotary pressure & scavenge pumps
STATER	Manual recoil pull starter	Manual recoil pull starter	Manual recoil pull starter
STARTER OPTIONAL		Electric starter fitted to E type gearbox	Electric starter fitted
IGNITION	Dual ignition, electronic	Dual ignition, electronic	Dual ignition, electronic
CARBURETION	2 BING, 36 mm carburetors	2 BING, 36 mm carburetors	2 BING, CV carburetors
GEARBOX	Reduction gear box, with cush-drive.		
GEARBOX RATIO	2.58 to 1	3.47 to 1	2.58 to 1
FUEL	Minimum MON 83 or RON 90 octane rating		

Note:
Avgas contains a large amount of lead, regular use will lead to badly fouled spark plugs and combustion chambers. It is imperative that you clean the spark plugs and de-coke the engine at the recommended intervals if Avgas is used. If at all possible use 4 star or UK unleaded Mogas.

HKS installation: Maintenance in the airframe:
The engine installation is more complex than the two stroke engines, having a separate oil circuit and also having the ignition systems on the airframe, separate from the engine. Cables, hoses and leads have been routed as far as possible to minimise chafing. It is still important to watch for wear, looseness or leaks in all connections.

After the first 25 hours and every successive 50 hours, the oil and filter will need changing. The oil tank fitting for the temperature sensor doubles as a drain plug. Tip the aircraft onto it's tail, remove the temperature sensor, and drain the oil when warm. If the tank is removed for any reason, ensure the earth lead is reconnected, or the sensor will not work. Drain the oil hoses and cooler. Drain the crankcase by using the magnetic drain plug at the bottom. Remove the oil filter using a strap wrench. When re-fitting, the drain plugs must be wire locked. The oil filter seal should be lubricated with engine oil, and the filter screwed on with firm hand pressure.

The oil volume in the whole system is approximately 4 litres. We use and recommend Castrol RS, which is a top quality fully synthetic SAE 10W/60 oil developed for motor racing.

For complete technical details of the engine and its running in and maintenance procedures, refer to the HKS 700e V3 Engine Operator's Manual, February 1997, Version 1 or HKS 700e BETA Engine Operator's Manual, July 1999, Version 2, in Appendix A.

2.4.5 PROPELLER

MODEL	503 MODEL	582 MODEL	HKS MODEL
TYPE	GSC, 2 blade, Maple wood	Arplast, 3 blade, composite	Arplast, 2 Blade, composite
DIAMETER	1625 mm (64")	1700 mm (67")	1740 mm (68.5")
MAX. SPEED	2600 rpm	2600 rpm	2600 rpm

2.4.6 PRIMARY STRUCTURE

The structure carrying critical in flight loads consists of the wings leading and trailing edge tubes, the wing struts, The wing strut tie bar, this is the main axis beam (beneath the seat) and the two (near vertical) tubes running from the main axis beam to the keel. The tail empennage and keel must also be considered as elements of the primary structure.

2.4.7 PLACARDS

The following placards are fitted to the aircraft and should be maintained in a legible state:

PLACARD	LOCATION
Max. occupant weight P1 - 90 kg	Main placard situated on instrument panel
Max. occupant weight P2 - 90 kg	
Total occupant weight - 180 kg	
Min. cockpit weight - 55 kg	
Max. maneuver speed Va - 62 mph	
Never exceed speed VNe - 90 mph	
Aircraft empty weight: (to be completed)	
Max. take off weight - 450 kg	
Do not pitch Nose up or down more than 60°	
Baggage Total 12.5 kg	Baggage placard floor tube left & right
Mag 1 - Mag 2 UP FOR ON	Ignition switch - next to magneto switches
Useable capacity 62 litres - (30 if 1 tank fitted)	Useable fuel capacity - (next to filler)
50:1 2 stroke oil (Rotax engines only)	
Pitch trim - **Nose up - take off - nose down**	Trim placard - on keel next to trim wheel
Master ON - OFF / Push to start	Master & Starter - next to switches
Fuel ON - OFF	Fuel tap - next to fuel tap on cockpit floor
For Rotax engines:	
Max. peak RPM 6800 (1)	Marked on instruments
Max. Continuous RPM 6200	Marked on instruments
Max. Coolant Temp 90° (582 model) (1)	Marked on instruments
Max CHT 480° (503 model) (1)	Marked on instruments
Fuel Pressure 0.2 - 0.4 Bar	Marked on instruments (optional)
For HKS 700E engine:	
Max. peak RPM 6200 (3min max)	Marked on instruments
Max. Continuous RPM 5800	Marked on instruments
Min Oil Pressure @ 6200, BETA engine – 85 PSI	Marked on instruments
Min Oil Pressure @ idle – 17 PSI	Marked on instruments
Max. Oil Temp 190° F 90° C	Marked on instruments
Max CHT 338° F 190° C	Marked on instruments
Fuel Pressure 0.2 - 0.4 Bar	Marked on instruments (optional)
Boost Pump ON-OFF	By boost pump switch, next to FP gauge
Green Charge, red high/lo volts (1)	By Battery State Monitor

(1) Battery State Monitor is mandatory for HKS aircraft, optional on others.

3. GLIDER TOWING SUPPLEMENT

(Option for 582 and HKS 700e models only)

The Cyclone AX2000 (582 and HKS models) makes an ideal tug aircraft for class 1 and 2 hang gliders. Once a pilot is familiar with the AX2000, aerotow flying is very simple to master and the aircraft's performance while towing a glider aloft is remarkable. Dual aerotow tug pilot training is approved on the AX2000, performance will of course be reduced with the tug operated dual.

The optional tug system employs a tow line running on a "V" bridle, which is attached to release mechanisms on each wing of the aircraft. Since the tow line is attached to the wings and not the tail of the aircraft, unlike most conventional 3 axis tugs, the glider has very little influence on the controllability of the tug.

Aerotow operations can be carried out with or without doors and rear enclosure fitted to the aircraft. Should the glider get into a mirror blind spot the towed aircraft position can be easily monitored by watching the bridle position.

The tow line has been designed with several features to enable operations to run smoothly. A parachute to make the line fly high once the glider has released, also helps to provide release pressure if the tug pilot wishes to ditch the line prior to landing. The parachute also provides line tension to help stop tangling when landing with the line attached.

A short length of polythene covered cable at the bridle end, helps to keep the quick link from spinning the bridle into a tangle on touch down.

3.1 DESCRIPTION OF AIRCRAFT TUG KIT

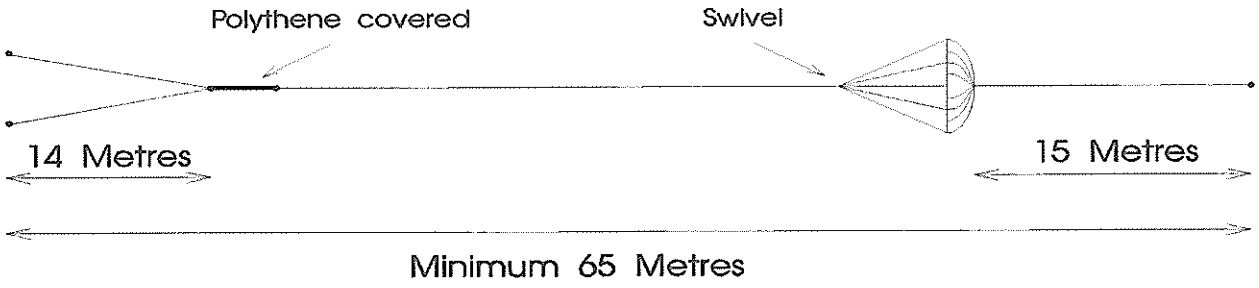
The AX2000 tug kit comprises of the following: pillars dropping vertically down below the wings at the rear strut connections, brace wires from the bottom of the pillars to the leading edge of the wings, two release mechanisms one attached to the bottom of each pillar. The releases are operated by the tug pilot pulling on a cable mounted in the cockpit. A mirror is provided for the pilot to see the towed glider, which is mounted by the lower wing strut connection.

3.2 DESCRIPTION OF TOW LINE AND BRIDLE

The bridle is attached to the aircraft in the form of a "V" extending 14 metres behind the wings. The bridle consists of a length of cord with a 60 kg breaking load weak link at each end. The weak links are attached to the aircraft through the release mechanisms.

The tow line and bridle must conform to the drawing in Fig. 1.

Fig.1



A short length of polythene covered cord between the bridle and the main line keeps the bridle from twisting up on landing. A parachute is provided in the main line approximately 15 metres from the glider. It forms part of the tow line itself and therefore closes under towing tension and opens automatically once the glider has released. The main line cord is made from stiff material with very good stretch properties.

The overall length of the towline is left to the operator and should be decided with reference to the aerotow operations manual being used, the glider manufacturers recommendations and the preferences of the towing group operating the aircraft. During our extensive testing of the system, our test pilots determined that the overall line length should be at least 65 metres and preferably 75 metres. As supplied it is 85 metres. Our hang glider test pilots found that at the shorter length, it was difficult to keep station, particularly if the towed hang glider was not very yaw stable. The shorter towline length did not appear to present problems for three axis gliders.

We recommend that our range of Rumour, Scandal and Breeze hang gliders and the Superfloater class 2 hang gliders are particularly suitable for aerotowing, as they are all very stable aircraft in yaw.

WARNING - DO NOT FIT THE SWIVEL OR ANYTHING HEAVY AT THE VEE BRIDLE APEX. A LINE BREAK CAN CAUSE IT TO CATAPULT INTO THE TAIL.

3.3 FITTING THE TUG KIT TO THE AIRCRAFT

Refer to the aerotow GA drawing SW-90600 for the basic system configuration.

3.3.1 TUG KIT PARTS

The optional tug system consists of the following parts:

PART	DESCRIPTION	QUANTITY
100327	M6 x 40 clevis pin	1
201538	Release handle, yellow	1
201539	Release mechanisms with cable	2
201542	Tug brace cable	2
201643	Cable support	1
201645	Tug pillar	2
201646	Tug pillar spacer	2
201650	Towline assembly	1
FBM6-55	M6 x 55mm hex ht bolt	2
FBM6-80	M6 x 80mm hex ht bolt	2
FBM8-80	M8 x 80mm hex ht bolt	1
FEM8-80	M8 x 80mm eye bolt	2
FNM6-NT	M6 nyloc nut T type	6
FNM8-NT	M8 nyloc nut T type	2
FNU5-NP	5/16UNF P type nyloc nut	1
FP-002	36mm push pin	2
FP-004	Push pin secure cord	2
FPSR-001	5/8" safety ring	1
FW4-T3	¼" T3LP washer	10
FW4-T4	¼" T4LP washer	2
FWM8-B	8mm form B washer	3
FWM8-BEL	M8 belville washer	1
FWM8-SW	8mm s.coil sq. sec washer	1
FWP-006	Plastic washer 6mm x 3mm	2
HCC-001	No 12 cable cleat	3
HTW-003	Cable tie, white medium	5
PMS-8-001	8mm plastic saddle washer	4
RS-4	Strip shackle	2
RT-DMT	Double mast tang, R type	2
TM-001	10" x 6" convex mirror	1
TM-002	Mirror arm assembly	1
VNR-FY3	3mm hibrite	1.6m
ZPL-028	Tug pillar plate	4
ZSP-047	Nylon spacer (15mm)	4

3.3.2 FITTING

To fit the optional tug system take the following steps:
1. Lay out and identify all of the parts.
2. Lubricate the two release cables with WD 40 or equivalent over the full length.
3. Remove the the aircraft wings following the instructions given in section 2.3.
4. Fit pillar mounting plates (ZPL-028) to the channel at the trailing edge/rear lift strut junction.
5. Fit double mast tang (Pt No. RT-DMT) to the leading edge/lift strut junction.
6. Refit wings following the instructions given in section 2.3.
7. Fit the cable bracket to the front vertical bolt on the rear spar/keel channel fitting.
8. Fit the release handle remstrap to the upper seat cross tube, and fit the handle to it with the M8 x 50 bolt and washer.
9. Fit the stop cord behind the handle , between the two seat support cables. This stops the handle falling backwards and becoming inaccessible.
10. Feed each release cable through the Velcro inspection panel at the rear spar/lift strut junction towards the rear spar root.
11. Feed the cockpit end of each release cable into the neoprene rear spar wing root cockpit seal.
12. Find the cockpit cable end and feed it through the cable bracket, using as smooth a bend as possible.
13. Attach both cables to the release handle using the M6 x 40 clevis pin with a washer each side over the cable eyes, and finally the safety ring.
14. Fit pillars (Pt No. 101645) into plates at the trailing edge/strut junction, using spacer (Pt No. 101646), pip pins and tab washers .
15. Attach forward end of pillar brace wires to the clevis using clevis pin and safety ring .
16. Connect the release mechanism mounting cable to the eyebolt at the bottom of pillar using the small shackle, clevis pin and ring.
17. Tidy the release cables, connecting them to the pillars with tie wraps. Ensure that bends in the cable have large radius and are free from kinks, check that the releases operate freely at all possible towline angles.
18. In the cockpit, tie wrap the cable outers to the cable bracket to prevent movement of the ferrules in the bracket.

3.3.3 INSPECTION

The tow system and tow mirror must be inspected by a Pegasus or BMAA inspector before initial use. The aircraft technical log book must be endorsed by Pegasus or a BMAA inspector to show that the approved tow system is fitted to the aircraft.

3.4 PRE-FLIGHT CHECK.

Working inside the cockpit check that:
- Cockpit release handle is free to operate and the separate inner cables are not kinked.
- Cables are attached to the cable bracket and cables are routed smoothly.
- Stop cord is in place to prevent handle falling backwards
- Inner cables are slack enough to provide a little play before operating releases.
- With helpers, check that when the release is pulled both wing mechanisms operate together.
- Release cables from cockpit to wings are not kinked or snagged and are free of other controls.

Working on each wing in turn check that:
- Release cables in the wings are not kinked or snagged and form large radius curves.
- Release cables from the wings to release mechanisms form a natural curve.
- The release mechanism attachment cable is correctly shackled to the pillar.
- Each release mechanism operates freely and its return spring is un-kinked & free.
- Pillars are straight - pillars are designed to fail sideways before wing structure is damaged.

Working on the bridle and tow line check that:

- Run the whole bridle through your fingers and check for knots, kinks and abrasions.
- 60 kg weak links at each end of the bridle are supple and free of abrasions.
- The quick link is polished where the bridle runs through and is locked in place.
- Main line is un-knotted and free from abrasions.
- Parachute is not torn, the parachute harness is not tangled & free from abrasion.
- Connections between the main line, parachute and fittings are all intact.
- Glider release ring is intact and compatible with glider release.

3.5 PREPARATION FOR AEROTOW OPERATIONS

Aerotowing is an advanced skill and pilots of both the tug and the glider must have the necessary capabilities. Operations must be carried out in accordance with the particular regulations in force in your local area. In the UK, aerotow operations must be British Hang Gliding and Paragliding Association (BHPA) approved, the pilot must hold an aerotow tug rating and towed glider pilots must have an aerotow rating.

The aircraft must be check flown and all systems tested before aerotowing operations commence each day.

Initial aerotows must be in smooth conditions, preferably in a 5-10 mph wind straight up the runway.

Only carry enough fuel necessary for the immediate operations, as any un-necessary weight will degrade the performance. The aircraft is approved for Aerotow operations up to 390kg All Up Weight. The purpose of approval at this weight is to facilitate dual instruction in aerotow techniques, it is not intended for normal operations. The change in performance between dual and solo operations is significant.

Ensure that the runway length is adequate. We recommend that at least 350 metres into wind runway is available with clear approaches when operating the tug solo, 500 metres when dual.

Unless tug and glider pilots have direct radio contact, always operate with two signal persons and follow the relevant association's aerotow manual.

Carry out normal aircraft pre-flight checks and additional tug system checks. Position the aircraft on the runway some 70 metres from the threshold. Lay out the bridle behind the tug and attach one end with its weak link to one of the release mechanisms. Thread the other end of the bridle through the main line quick link and then attach it to the other aircraft release. At this stage get a helper to pull on the main line and from the cockpit pull the release cable to check the release operation. If all is satisfactory repeat the bridle attachment.

Lay out the main tow line and parachute, hook up the glider, start up, warm up the engine, carry out pre-take off checks, take up slack, all in accordance with normal practice as laid out in the relevant association's aerotow manual.

3.6 BRIEFING THE GLIDER PILOT

The briefing will be in accordance with normal practice as laid out in the relevant association's aerotow manual. Ensure that the glider pilot has an aerotow rating. You should brief the glider pilot to try to get into position where the tug mirror is in view (if he can see the mirror then you can see him), either above or just below the tail.

Allowing the glider to climb too much while the tug is still on the ground lengthens the tug takeoff run considerably, due to the greater towline force required. The glider pilot must aim to keep straight and fly at no more that about 20ft AGL whilst the tug is on the ground. The pilot must be briefed to release if he cannot maintain station.

During the tow, the only really uncomfortable position for the glider pilot will be in the propeller wash if he/she gets very low. If this happens the tug pilot may feel some yaw, although it is unlikely to cause a problem, but look out for a premature release by the glider pilot as it can get very uncomfortable for him.

3.7 TAKE OFF, CLIMB AND DESCENT

When the "all-out" signal is received, smoothly and progressively open the throttle to full, hold the stick in its full back position until the nose wheel lifts, then immediately relax stick pressure. At this point the glider will probably have been airborne for a few seconds. For comfort to both you and the glider pilot, the initial climb speed should be held at approximately 45 to 48 mph until both aircraft are settled into the climb.

Always remember that the release at the tug end is designed to be used. The release action must be practiced so that it is automatic by the pilot in an emergency. For example, abnormally high drag in the later stages of the takeoff may indicate the glider is too high or in an uncontrolled bank. Operation of the release must be checked regularly.

Once the combination are stable in the climb, the climb speed must be held at the best tow speed for the glider. This will depend upon the particular glider being aerotowed. With the "Superfloater" class 2 hang glider, the best climb speed is 42 mph, although much slower speeds can be achieved but the climb rate will be slightly degraded.

The flight and engine limitations of the aircraft MUST NOT BE EXCEEDED. See the main aircraft operators manual. Do not be tempted into aerobatic manoeuvres in the interest of getting down for the next tow. So long as the airspeed is kept below Va (turbulent air safe speed) of 62 mph then side slipping the aircraft will get you down plenty fast enough. Harsh on/off operation of the throttle should also be avoided - allow the engine to warm up and cool down smoothly. Release of the cable has been tested in a full sideslip, but should normally be done in straight flight. Dropping the cable on the approach will minimise cable twisting and wear.

3.8 LIMITATIONS

LIMITATION	AX2000 582	AX2000 HKS
Maximum weak link strength - tow line	100 kg	100 kg
Maximum weak link strength - each wing release	60 kg	60 kg
Maximum towing speed – Vt	62 mph	62 mph
Maximum tug weight for aerotow operations	390 kg	390 kg
Maximum glider weight when tug is flown dual	200 kg	110 kg
For 2 place glider towing max. combined tug & glider weight	590 kg	500 kg

3.9 PLACARDS

The following placards are to be fitted within the pilots vision in the cockpit and should be maintained in a legible state:

PLACARD	LOCATION
Pull to release glider	On the yellow release handle .
When dual max. glider weight 200 kg	In view of pilot
Max towing speed 62 mph	In view of pilot
Max weak link 60kg each wing Apex of vee bridle 14 m + behind	On each wing release catch

3.10 MAINTENANCE

- Check the release mechanism before each days operations.
- Regularly lubricate the release cable with WD40. It is preferable to disconnect cables from the cockpit, lift
- them above the aircraft, form a funnel around the end (Rotax carburetor cable grommets make an excellent funnel) and pour/spray WD40 into the funnel.
- Tip - when removing releases and cables from the wing for maintenance or storage, tie nylon cord onto the cable end which can be easily used to pull the cables back into position when refitting the aerotow system.
- Release catch pivots should be greased occasionally . WD40 will also help prevent corrosion of the release assembly and return spring.
- Check the release mechanism catchplate return spring and replace with the approved Cyclone part 101023 if necessary.
- Check that the release cables are un-kinked and do not form tight radius bends.
- Release cables MUST be wirelocked to the release assembly to prevent snatch-induced releases and to prevent disengagement of the release cable nipple.

3.11 AEROTOWING PERFORMANCE

Note - takeoff distances have been factored by 1.3.

Takeoff	Tug weight	Glider weight	HKS 700E	Rotax 582
Takeoff to 15m agl	300 kg	100 kg	390m	325m
Takeoff to 15m agl	300	180	470m *	350m
Takeoff to 15m agl	390	200	Not Permitted	390m
Climb				
Climb to 1000 ft	300	100	350 fpm	500 fpm
Climb to 1000 ft	300	180	260 fpm	410 fpm
Climb to 1000 ft	390	200	Not Permitted	300 fpm

* = calculated value.