

Aircraft designed & manufactured by
RAJ HAMSA ULTRALIGHTS PVT LTD, INDIA

X-AIR

USER'S MANUAL

AND

MAINTENANCE MANUAL

For Airframe & Rotax 582 2V UL engine

SUMMARY

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RAJ HAMSA ULTRALIGHTS PRIVATE LIMITED

X-AIR

USER'S MANUAL

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MAINTENANCE MANUAL

I. Description and usage:

The X-AIR is a fixed wing ultralight aircraft, two-seater side by side, front engine mounted, high wing, tricycle undercarriage, fitted with conventional 3-axis controls: ailerons, elevator and rudder.

In its standard version equipped with complete dual controls, the X-AIR can be used for recreational flying as well as for instruction: the unique aerodynamic qualities of the X-AIR in terms of responsiveness, docility, forgiveness (the X-AIR refuses the spin !), slow landing speed, make it ideal for this activity.

The X-AIR is an inexpensive aircraft in terms of capital investment and cost of operation: However the controls layout and the feeling in flight are very similar to those of a conventional light aircraft, therefore the X-AIR offers an alternative for imparting flight training within the constraint of limited budgets.

II. List of controls, instruments and equipment:

1. Controls:

- Control stick 2 Nos:
controls elevator (pitch) and ailerons (roll)
- Rudder pedals (2 pairs):
controls rudder (yaw) and nose wheel steering
- Throttle lever 2 Nos, left hand, controls power
- Toe brakes: differential, on left hand side rudder pedals only, control 1 brake on each main undercarriage wheel
- Trim handle: between pilot and passenger, controls elevator trim
- Two engine ignition switches (dual electronic ignition)
- Main switch (key operated)
- Self starter switch (press type)
- Fuel pump switch (toggle)
- Choke lever (press down is open)

Please note that all the controls are strictly conventional

Action on controls	<u>Effects of controls</u>	Effect obtained
Press right foot		aircraft yaws to the right
Press left foot		aircraft yaws to the left
Stick to the right		aircraft banks to the right
Stick to the left		aircraft banks to the left
Stick forward		aircraft nose down
Stick back		aircraft nose up
Throttle forward		increase power
Throttle back		reduce power
Any switch up		device on

2. Instruments (Standard):

- ASI
- Tacho
- Altimeter
- Ball
- Charge indicator
- Options: Compass, CHT, EGT, Intercom, GPS etc...

3. Fuel tank(s):

- Standard capacity 60 liters: located in 2 tanks behind seats
- Drain on each
- Breather on each

III. Pre-Flight Check:

A good pre-flight is the foundation of safe flying. We suggest that you go through the following checks before each flight session.

1. Engine: Stand in front of the engine and check:

- the propeller and its bolts
- the reduction gear: no oil leak
- the engine support (ensure that the rubber foundations are in good condition)
- the cooling system: condition and tension of fan belt
- aspect of the ignition units
- spark plug caps properly fitted
- the exhaust fittings and the exhaust rubber foundations
- no cracks developing in the exhaust
- throttle and choke cables
- carburetors and air filters properly secured.

2. Airframe: Start from left, looking at the aircraft from front and check the following attachments:

- top of the front fuselage tube
- base of the same tube plus check the bolts at the main axle assembly
- the wing struts at the stainless steel tangs and pins/Safety rings.
- Check the right wing :

- the sail condition at the leading edge
- the wing tip tube properly located
- the sail condition at the trailing edge
- battens properly positioned
- the wing struts from bottom tang to wing tang
- the compression struts at both ends
- the jury struts
- the root attachments of the trailing edge and leading edge
- check ailerons attachments and safety rings
- check ailerons cables, fittings, turnbuckles and pulleys
- follow the fuselage up to the tail and check the following attachments:
- the elevator hinges
- the elevator struts on top and bottom
- the elevator control plates
- the elevator leading edge connection to the keel
- the upper part of the rudder & its general aspect
- the lower part of the rudder
- the rudder cables connection with the rudder plates
- the trim tab connections
- check:
- the sticks and corresponding pulleys/cables
- the rudder cables condition especially between the seats and make sure that they are crossed in the fuselage (ref. annex 4)
- the fuel tanks air breather is free, that the content is sufficient for the flight
- the fuel filter condition
- the fuel line connections
- check the left wing:
- the wing struts stainless steel tangs at the axle
- the wing struts till the upper tangs on the wing
- the compression struts at both ends
- the jury struts (and remove the ASI venturi cover)
- the battens properly positioned and the look of the sail
- the wing tip position
- check:
- the throttle cable and choke cable connections in the cockpit are free-moving and exempt of fray or damage

3. Instruments:

- verify ASI functioning and set altimeter
- verify the proper functioning of all installed instruments
- before take-off for a cross-country flight the reading of the compass must be checked against a known reference: runway markings for example.

IV. Starting the engine (503 Rotax):

If you respect the following procedure, you will avoid problems while starting your engine:

a. Cold engine :

1. Check throttle **closed**
2. Prime the carburetors by mean of electric pump

3. Keep ignition off and choke closed
4. Press starter button & rotate the propeller for a few seconds
5. Choke full open (down). Throttle closed
6. Switch both ignitions on
7. Check for **CLEAR PROP !**
8. Press the self starter button; the engine should start at once
9. As soon as started open throttle up to 3000 RPM and reduce progressively the choke till closed
10. Warm up the engine for 3 minutes at 2500 RPM.

!! WARNING !! NEVER FORGET TO CLOSE THE CHOKE as it will dramatically affect your power in flight.
 NEVER FORGET TO SWITCH OFF THE ELECTRIC PUMP:
 a pump permanently on increases fuel consumption by 30 % ! This pump is a primer & a back-up only.

b. Warm engine: pressing the starter is sufficient to restart.

V. Taxiing and the vital actions:

Before anything, you should have investigated your aircraft limitations!

Please refer to annexe I.

You are now sitting on board, you have tightened your shoulder harness. The front wheel control is connected with the rudder. Push the left pedal to turn left, the right pedal to turn right. On rough surface we recommend to taxi faster with front wheel up. Steering control with the rudder becomes efficient from 15 Km/h onwards.

At the end of the taxiway, check carefully the proper functioning of the rudder, ailerons and elevator, that the choke is closed and the fuel level sufficient for the flight. Use the brakes to stop the aircraft and check the engine highest revolutions you can obtain.

Make sure that no other aircraft is in the pattern, then line up on the runway.

Everything in order, you may take off.

VI. Take Off:

!! WARNING !! It is clear that the following advices are not a flying course and that you are submitted to pass with success the theoretical and practical tests under an authorised Instructor as requested in your Country.

Well, The wind is not too strong. You are in line. Push progressively the throttle to full open and gradually release the pressure on the front wheel. At 45 Km/h, pull back progressively the stick maintaining your heading by foot control. At 50 Km/h indicated you are rotating; ease the stick forward to level off and increase your speed, then climb at 50-60 Km/h up to 100 meters (300 ft) full throttle: Your rate of climb is about 3 meters per second with passenger.

Note: The normal engine RPMs in the take-off run should be in the range of 6000 to 6400. In the event of your engine not reaching at least 6000 rpm at full throttle YOU MUST ABORT TAKE-OFF and investigate the cause of lack of power.

When you reach the altitude of 100 meters, reduce throttle keeping at 60 Km/h airspeed and climb up to the safe altitude of 300 m AGL (1000 ft). At this altitude you may level off, reducing throttle to 5800 rpm, and maintaining an economy cruise speed of 70 Km/h IAS. This air speed is also the best handling speed and should be given preference in turbulent air.

Note: Please keep in mind that you are using a NON-CERTIFIED ENGINE; therefore, tree top height circuits are not recommended... 200 m (600 ft) is just fine.

In the case of loss of power, or worst, of engine failure during take off, push immediately your stick forward to maintain maneuverable speed and try to land ahead. Avoid a bank which will increase your loss of altitude.

It will help you to relax if you remember that an X-AIR glides very well without engine and remains perfectly maneuverable. For safety do maintain an air speed of at least 70 Km/h. However it is good to keep in mind that your engine reliability will be fairly high if you scrupulously observe the maintenance schedule given by the manufacturer: please refer to annex 3.

VII. Turn and Evolutions:

- The X-AIR responds neatly to any stick input in roll.
- Be very gentle with the stick: the effect is immediate.
- Keep your banked attitude as long as you wish; then simply come back to neutral helping the maneuver with your feet.
- To begin with, limit yourself to a gentle bank of not more than 10 degrees to the horizon. Watch your ball and seek for perfection.
- Never forget that while banking your stall speed increases with your angle. From a mere 45 Km/h in horizontal flight, it shoots up to 60 Km/h in a 60 degrees bank!
- You will quickly enjoy the superb maneuverability of the X-AIR but never forget that, in spite of the fact that the X-AIR may eventually endure the loads applied while executing drastic manoeuvres, it has not been designed to perform aerobatics of any sort and furthermore, aerobatic maneuvers are forbidden with an ultralight aircraft and may prove to be dangerous.

VIII. Flying in turbulence:

Avoid flying the X-AIR in turbulence before building up experience and preferably stick to calm conditions at the beginning. Once your confidence has grown up and you feel in tune with the aircraft, you will find no difficulty in turbulent weather; do avoid high speeds and maintain an air speed of 70 to 80 Km/h which will prove to be most comfortable to handle.

The X-AIR, because of its dihedral and swept-back wings is auto stable and will return to a normal attitude on its own; in strong wind conditions, never forget the gradient effect which may induce unexpected stalls at low altitude while landing. The same danger exists while turning 180 degrees from headwind to tail wind: misjudgment of gradient is a too frequent cause of accident on slow flying aircrafts, so beware...

Don't bank too much and fly at 70 Km/h or more.

IX. Stall:

To understand perfectly the flight envelope of your machine, you have to perform some stalls. To do so, climb at a minimum of 1000 ft altitude and begin with stalls, engine idling.

At about 45 Km/h the aircraft becomes less responsive. If you pull the stick further backwards, the aircraft will execute a gentle stall break. Open throttle and push stick forward, the aircraft will recover with less than 10 meters altitude loss.

At full power, the angle will be more impressive and the break rougher: the maximum altitude loss will be 30 meters in a fully loaded two seater.

An asymmetrical stall generates a larger loss of altitude:

Recovery comes with stick forward and opposite aileron.

By design, the X-AIR refuses the spin.

X. Flying at High Speed :

Beyond 80 Km/h the back pressure on the stick due to the excellent longitudinal stability of the X-AIR will force you to maintain a forward pressure on the stick to maintain level flight or to make use of the trim to cancel the nose-up tendency. High speeds are not fuel efficient and submit your engine to unnecessary stress. Do avoid them.

XI. Approach and Landing:

To begin the descent, reduce throttle and set 70 Km/h indicated air speed in the approach pattern: Remember that you adjust the speed with the stick and approach angle with the aircraft tends to overshoot, reduce throttle and vice versa if you undershoot, but in both cases **do maintain your airspeed constant.** It is airspeed which will give you protection against turbulence and gradient while landing.

Maintain a safe altitude before the threshold of the runway, then come-in throttle reduced at 3500 RPM (no less to keep a clean airflow on the elevator/rudder) and execute a neat rounding-off avoiding fiddling with ailerons but rather using rudder if you have to correct the course at the last moment. This method is the safest for landing on unprepared fields.

A speed reserve will allow you to keep clear of non visible obstacles such as fences, wires, big rocks etc...

A shallow angle, powered approach should be used only for landing on proper airports with a clear and safe approach.

After touch-down, keep flying the aircraft till your front wheel naturally touches the ground. This is a way to protect your front wheel from hitting roughly a stone or a clod of earth.

In case of a small field with obstructions, a side-slip may come handy: the X-AIR is perfectly fit for this maneuver, at the condition again that you watch your airspeed.

ADVICE: If you feel that your landing pattern is imperfect, don't hesitate to overshoot and start a fresh circuit.

XII. Flying in Cross Wind:

Don't take off with a cross wind in excess of 20 Km/h unless you have a good experience of your X-AIR.

While landing, do a crabwise approach and first touch the ground with the wheel in the wind, then rectify your heading putting the second wheel on the ground. Keep nose wheel up and steer with rudder for as long as possible, till your speed has dropped so much that the wheel will drop on its own. Taxi with stick towards the wind.

In any event, relax, since in most cases, thanks to the short rolling distance required by an X-AIR, you will be able to take-off and land head-wind, eventually across a runway... Also, stronger the wind, shorter the rolling distance.

IMPORTANT ADVICE:

Never forget that an ultralight aircraft due to its very concept has lower engine reliability than a certified aircraft and may be submitted to unexpected engine failure.

Therefore, keep enough altitude to have the choice of a safe emergency landing field.

Never fly over a congested area or a forested area without climbing to a sufficient altitude allowing you to land away from the hostile area.

XIII. Behavior of the aircraft with respect to weight :

By the concept of the aircraft, it is impossible to locate any load out of the C.G.range. However, there is a slight tendency towards tail-heaviness increasing with load to be aware of, although the C.G. remains always well within limits. (Refer to the Weight and Balance Schedule of your aircraft). The trim (a standard feature) is there to take care of these small variations and allow you to fly hands-off at any load and speed (within the respective permitted ranges: refer to aircraft limitations, annex 1.)

Of course it is clearly understood that:

The volume of fuselage behind the fuel tanks is NOT a cargo bay!

The cockpit rear partition is there to remind everyone that NOTHING should be stored behind, a further complication being the possible interference with the control push-pull rods and cables.

When flown at lower weights, solo for example, be prepared for a short take off and steep rate of climb; while landing you should avoid any abrupt flare to prevent the aircraft from ballooning (remember that an important characteristic of a microlight is its low wing loading)

XIV. Emergency procedures & forced landings:

a. Emergency Procedures:

Before attempting a forced landing:

- Switch both ignitions OFF
- fasten seat belts full tight (except over water)
- pickup the largest field available, oriented in the wind if possible
- if field is ploughed, do land along the furrows

b. On Corns and Crops:

Bring the aircraft in final at the lowest possible speed and stall when your wheels are almost to touch the corns or crops. This will protect you against a violent braking effect from whatever the plantation.

c. On Water:

Altitude over water is difficult to judge!

- Undo your safety belt.
- Make a mental preparation for your landing and try to figure out the best direction to swim away. Touch the water as slow as you can, slightly nose up.
- Once in the water, don't panic, quit the aircraft without haste and don't try to take anything with you.

d. In the Trees:

If possible, select preferably low and dense trees, fasten your safety belt full tight. Keep good speed in final: the air is often turbulent on trees. As soon as you hear the first leaves brushing your wheels, nose up full stick your aircraft to cut the speed and good luck !

XV. Disassembling the X-AIR for transport :

It is suggested to operate on grass or soft surface to avoid scratching the tubes and spoiling the sail.

1. Disassembly:

The rudder and the tail plane will remain in place; However the mobile surfaces will be held with bungees to prevent shaking during transport.

1. Remove upper and lower root covers as well as the 8 straps connecting the 2 wings
2. Remove lower surface battens.
3. Remove upper surface battens, proceeding from tip to center.
4. Disconnect the ailerons control cables.
5. Disconnect the jury struts on top only.
6. Have a helper holding the wing level at the tip, remove the pins from the wing struts and take the struts away.
7. Disconnect the pins connecting leading-edge to keel as well as trailing edge to keel and take away the wing. Keep all pins at respective places on struts and brackets.
8. Proceed identically with the other wing.
9. To disassemble the wing further, you may separate the aileron and disconnect the two compression bars on the trailing edge as well as the cable on the trailing edge. Extract gently the sail from the structure and fold it carefully.
10. All components in aluminium should be handled with care and wrapped in plastic or cloth for transport. Salient fittings should be further protected with foam.

NOTE: It is a well known fact that careless transportation generates more wear and tear than many flying hours.

2. Reassembly:

Follow exactly the same procedure in the reverse: Enter the structure of the wing in the sail, connect the wing to the keel, assemble wing struts and jury struts, reconnect ailerons and ailerons control cables enter all battens from root to tip, reconnect both wings with belts,

cover the root, and proceed with a careful and complete preflight check as described in para III.

XVI. Maintenance:

We cannot insist enough on the importance of the maintenance of your aircraft: only a strict maintenance discipline applied to both engine and airframe will give you peace of mind in flight...

In addition to the daily inspection schedule (Preflight Check para III), you will find in annex 3 a comprehensive maintenance schedule for both engine and airframe; this schedule is based on for more details specific to your engine.

It is also important that you maintain an up to date **AIRCRAFT MAINTENANCE LOG BOOK** where you will record any problem, work, modification, etc.. related to your aircraft:

! This is compulsory as per DGCA rules !

You will have to comply with the maintenance schedule of annex 3, then sign & date the sheets in the bottom box after having executed and ticked the respective operations.

! ATTENTION !

At the time of renewal of your PERMIT TO FLY
you will have to provide an up to date
Journey Log Book and an up to date
Maintenance Log Book along with the duly
filled Maintenance Schedule sheets (ann.3)

The in-between 100 hours operations of maintenance are very simple, and anybody with a sense of cleanliness and method can do it. On the other hand We recommend that you send your engine to us

EVERY 100 HOURS.

We have the expertise for decarbonising and overhaul and it is easy enough for you to remove the engine and crate it to us: the work will be done quickly and safely at a reasonable fee. To make our task easier, we request you to send your Maintenance Log Book along with the engine.

XVII. Conclusion:

We have tried to give a maximum of usefull informations in this manual, however, it is possible that in the course of your flying activities some questions will raise in your mind. When in doubt, do not hesitate to contact us at the phone numbers given at the beginning of this manual. Always remember that in our sport, mistakes may be heavy in consequences, so check and recheck your aircraft till you are fully satisfied: you -- none else -- are responsible for your maintenance, your aircraft airworthiness, your flying ! This axiome is the foundation of Ultralight Aviation. So, never take anything for granted, do not underestimate situations, keep your judgement sharp at all time, and, above all, NEVER SHOW OFF !

We wish you many happy landings in your X-AIR !

Annex 1
AIRCRAFT LIMITATIONS

Maximum all up weight permitted	:	490 kg
VNE	:	145 km/h (IAS)
Maximum engine revs	:	7000 rpm
Maximum revs in constant utilisation:	:	6200 rpm
CG range: refer to weight & balance schedule		
Maximum cross wind component	:	20 km/h

ALL AEROBATIC MANEUVERS ARE PROHIBITED ON THIS AIRCRAFT
NO INTENTIONAL SPIN

Annex 2
TECHNICAL DATA & PERFORMANCE

Wings:

- Leading edge	:	64 x 2 mm (sleeved with 60 x 2)
- Trailing edge	:	50 x 2 mm (sleeved with 45 x 1.5)
- Compression struts	:	38 x 1.5 mm
- Thrust/drag spars	:	cables 3 mm
- Wing tip	:	25 x 1.5 mm
- Wing struts	:	special Raj Hamsa aerofoil tube
- Profile	:	11 ribs per wing 13 x 1.3 mm
- Sail fabric	:	Dacron Polyester 185 gr/sq.m.

Ailerons:

- Leading edge	:	38 x 1.5 mm
- Trailing edge	:	12.7 x 1.2 mm
- Profile	:	ribs 10 x 1 mm riveted

Fuselage and tail surfaces:

- Fuselage keel	:	64 x 2 mm sleeved with 60 x 2 mm
- Fuselage tubes	:	28 x 2 mm & 10 x 1.2
- Tail surfaces	:	25 x 1.5 mm
- Seat	:	Upholstered bucket seat with adjustable head-rest
- Nose and main wheels	:	Aluminium cast alloy, 8"
- Tyres	:	4 plys 3.50 x 8
- Landing gear	:	Hydraulic suspension front & rear
- Brake	:	Drum brakes on main landing gear

Controls:

- Type	:	3 Axis conventional
- Rudder pedals	:	acting on front wheel through connecting rods and on rudder through cables
- Stick	:	double, between legs
- Throttle	:	double, at left hand
- Stick to elevator connection	:	By push-pull rod

- Stick to aileron connection	: By cables dia 3 mm
<u>Miscellaneous:</u>	
- Bolts	: High tensile grade 8.8. quality
- Fitting tangs	: Stainless steel 3 mm thickness
- Paint	: Epoxy
<u>Structural stress resistance:</u>	
at 400 Kg all up weight	: + 6G and - 3G
Maximum load on controls	: Rudder : 1380 NEWTON Elevator : 480 NEWTON Aileron : 1300 NEWTON
<u>Weight and size characteristics:</u>	
- Empty weight	: 230 kg
- Maximum All Up Weight	: 490 kg
- Length	: 5.7 m
- Overall height	: 2.35 m (rudder top)
- Wing span	: 9.8 m
- Mean chord	: 1.6 mý
- Wing area	: 16 mý
- Dihedral angle	: 1.2ø
- Swept back wing angle	: 18ø
- Washout angle	: 3ø
- Fin surface	: 0.8 mý
- Rudder surface	: 0.8 mý
- Elevator fixed part surface	: 1.4 mý
- Elevator surface	: 0.9 mý
- Aspect ratio	: 6
- Wheel base	: 1.7 m (lateral) 1.5 m (longitudinal)
<u>C.G. Load Displacement</u>	: Due to the concept of the aircraft, it is impossible to locate any load out of the CG limits. There is only one possible load configuration. (Ref. Weight & Balance Report provided with the aircraft)
<u>Engine:</u>	
Brand	: ROTAX-BOMBARDIER
Type	: 503 (std) or 582 (option)
Cooling	: Air (forced) Liquid
Power Maximum	: 50 BHP 60 BHP
At	: 6400 RPM 6500 RPM
Duration maximum	: 3 minutes
Capacity	: 460 CC
Type of fuel	: ordinary automotive petrol
Mixture	: 2% TT oil
Fuel tank capacity	: 27 ltrs std (54 ltrs in option)
Self starter	: Electricatio
Ignition	: Double electronic Ducati
Carbuertor brand and number	: 2 BING

Reduction gear type	: Gear box
Ratio	: 2.58 to 1 or 3.0
Generator output	: 170 wats at 6000 RPM
D.C. supply	: 12 volts
<u>Propeller:</u>	
Type	: Carbon, 2 blades
Size	: 1.6 m
Rotational speed	: 2600 RPM

Performances, standard version (400 kg AUW at seal level)

Empty weight to power ratio	: 4.6 Kg/hp
Total weight to power ratio	: 9.0 Kg/hp
Maximum static thrust	: 130 Kg
Minimum flying speed	: 55 Km/h (CAS)
Maximum speed, level flight	: 120 Km/h "
Turbulent air best speed	: 70 Km/h "
Economic cruise speed	: 90 Km/h "
Stall speed	: 45 Km/h "
Maximum climb rate	: 3 m/sec
Minimum descent rate	: 2 m/sec
Glide ratio engine off	: 9.0 to 1
Take off roll without wind	: 60 m
Take off distance to clear a 15 meter obstacle	: 140 m
Landing roll without brakes	: 80 m
Landing distance to clear a 15 meter obstacle	: 140 m
Useful ceiling at max AUW	: 3000 m
Take off and landing cross wind limits	: 15 KTS
Bank 30 degrees to 30 degrees	: 2 sec
Fuel consumption at full load	: 15 l/h
Endurance with 60 l fuel tank	: 3 ¾ h
Range (nil wind) with 60 l fuel tank	: 300 Km
