Report No. 81011

Revised December 1981

Lazair™ Microlight Aircraft

SAMPLE ONLY

OPERATING MANUAL

ULTRAFLIGHT MANUFACTURING LIMITED

1. INTRODUCTION TO THE LAZAIR

1.1 HISTORY

The Lazair was designed in the fall of 1978 by Dale Kramer of Port Colborne, Ontario, Canada. The Lazair was produced as the best of three designs Dale conceived between the summer of 1977 and November of 1978, and has consistently won awards for excellence in design and workmanship. A product of the flat lands of Ontario, it has taken a 180 pound pilot beyond 7,000 feet. It is soarable and restartable in the air.

1.2 DESIGN CONCEPT

Basically, the Lazair is a rigid wing, three-axis, aerodynamically controlled, lightweight aircraft weighing approximately one hundred and eighty pounds. Being that it has full three-axis control, no weight shift is involved in controlling the craft. The Lazair features an inverted V-tail, upswept wing tips, a single stick controlling all three axes, and two independently controlled engines situated on the leading edge of the wing approximately two and one half feet from the fuselage centreline.

The design rationale for using these features is as follows: The inverted V is indisputably the most aerodynamically efficient tail design. The reason this tail is not used more often is structural; the problems being that the tips of the tail are close to the ground and subject to ground obstructions and with the tail tips so close to the ground, there is a rotation problem for slow takeoffs and landings. We have overcome these problems by cable bracing each tail tip to the forward fuselage and by setting the wing to boom incidence at 10 degrees so that in effect, we have a tail dragger aircraft that can be rotated to takeoff and to land. Upswept wingtips are used to increase stability and aileron effectiveness and reduce drag at the wingtips (due to the fact that wingtip vortices transition more smoothly).

The Lazair does not have rudder pedals. It is controlled by a single overhead stick. Yaw and roll functions are co-ordinated through a mixer situated between the wings. We feel the benefits of having a single control outweigh the benefits of having separate controls on this type of aircraft. For pilots of conventional aircraft, who have flown for many years with rudder pedals and wish to continue doing so, we have a rudder pedal kit available as an option. However, most experienced Lazair pilots prefer to fly with the rudders and ailerons coupled together as originally configured. Rudder pedals provide the pilot with the means to cross the controls for sideslips or crosswing takeoffs, but sideslips have not been necessary in any of the flying we have done to date. Crosswing takeoffs pose little problems as you gain experience in ground handling the Lazair. Most takeoffs can be made directly into wind because of the short takeoff distance especially with a headwind component and takeoff speeds of approximately 17 mph.

The Lazair features two of the highest quality two-cycle engines available. Single engine aircraft require the mounting of the power system either in front of, or behind the pilot. When the engine is situated in front of the pilot, the pilot is directly in the accelerated airflow caused by the propeller, making flying less comfortable. When the engine is situated behind the pilot, the propeller is usually mounted behind the engine. This creates overheating problems with the engine and puts the propeller in a more vulnerable position. With either case, in the event of a mishap, it is more hazardous to have the engine directly in line with the pilot rather than offset to the sides, as in a twin engine craft, such as the Lazair. As an added bonus,mounting the engines on the wing creates induced lift which reduces stall speed and increases climb rate.

The first three hundred Lazairs were equipped with a pair of 100 cc engines which were originally designed for an industrial

chainsaw. These engines have proven to be reliable, and perform very well under all normal flying conditions. However, to facilitate takeoffs on floats, a new larger engine was introduced in November 1981, and is now standard on all new Lazairs. This engine, a 185 cc, 9.5 HP, two-stroke manufactured in Austria by Rotax, is a universal industrial engine designed for a multitude of applications, one of the most common being a portable water pump used for fighting forest fires (where lives can often depend on the performance of the engine). Before selecting this engine for the Lazair, we questioned the people who manufacture and distribute the water pumps as well as the people who use and maintain them. In every case it was obvious that this particular engine has earned an excellent reputation for performance and reliability. Although this engine cannot be considered a modern design and its power-to-weight ratio is not as high as some of the "screamers" designed for motocycles, go-carts or snowmobiles, it has a long stroke (relative to most two-stroke engines) and develops its peak horsepower at the relatively low speed of 5,700 RPM, making it ideal as a power plant for a microlight aircraft.

Using the latest in available technology, the Lazair comes equipped with computer designed propellers molded from carbon fibre filled nylon. The 185 cc engine uses the same propellers as the 100 cc engine, but *two* propellers are mounted on each engine. When first tested, the two propellers were mounted at ninety degrees in a four-bladed configuration. With the engine mounted on a test stand so its performance could be monitored, the angle between the two propellers was gradually changed in order to determine the angular displacement which produced the maximum thrust. Surprisingly, the thrust changed by no more than one percent over the whole range of angle from 90^{o} to 0^{o}. Consequently, the production configuration now has one propeller mounted directly on top of the other (somewhat like the wings on a biplane). This unusual looking configuration is not quite as efficient as an

optimized two-bladed propeller, but it provides more than adequate thrust with a very small propeller disc (thereby keeping the propeller farther from the pilot) and creates much less aerodynamic drag when gliding than would a conventional four-bladed propeller.

1.3 REQUIRED PILOT ABILITY

The Lazair is an *aircraft.* It does everything a full size aircraft does except at slower speeds. Consequently, it is very important that the pilot of a Lazair should have at least a student pilot permit and have gone solo in a conventional aircraft. A basic ground school concentrating on aerodynamics and meteorology is also a must. The importance of having flying experience cannot be overstated---the more the better. One could not be expected to jump in a small aircraft with no dual training and have any hopes of flying it successfully. The Lazair flies like an aircraft, not like a hang glider. The Lazair kit contains a small book entitled *Learning to Fly the Lazair.* We suggest that you read it carefully before your first flight----whether you are an aeronautical neophite *or an experienced pilot.*

2. THE AIRCRAFT

2.1 CONTROLS

The Lazair has a single overhead control stick with rudder and ailerons interconnected to produce a co-ordinated turn when in flight. The stick may take some getting used to for most pilots because of the overhead pivot point. Although the stick moves in the conventional directions (i.e. back is up, forward is down, left is left and right is right), confusion may be caused by the rotational motion due to the pivot point location. It is *not* the same as steering a car (when holding the bottom of the steering wheel).

It is important that the pilot sit in the aircraft and move the stick while visualizing what the aircraft would do with a certain control movement. One should do this until he feels totally at home with the overhead stick. A *light* grasp on the stick may also help to offset the feeling of something not being normal. The actual in-flight control response is very light. The Lazair has very good pitch response, while the roll rate is average (about four seconds 45^{o} to 45^{o}). This combination may take a little getting used to.

The throttles and ignition switch are situated so that they are easily accessible at all times. Prior to running the engines and taxiing, one should sit in the cockpit and practice moving the throttles together as well as individually. Knowing the location of the ignition switch and being able to get to it quickly is very important, especially on first taxiing attempts.

2.2 INSTRUMENTS

Included in your kit is a hang glider airspeed indicator which is usually consistent, but not totally reliable, especially in

moist air conditions. Consequently, flight attitude should be used for airspeed control with the airspeed indicator acting as a reference. In steep turns, the g forces tend to pull the float in the airspeed indicator down, making it indicate a very low speed for such a high angle of bank. This is another good reason for airspeed control by the flight attitude method. An altimeter, while not usually required, might occasionally facilitate flying within the prescribed air regulations.

Seat belts, which are necessary in any car or aircraft, are now included as standard equipment in the Lazair kit. The seat belt should be installed securely on the axle as described in the Assembly Instructions.

2.3 ASSEMBLY FOR FLIGHT

Before trailering your Lazair to the airfield, count the nuts and bolts used for rigging to make sure you have them all. It is also prudent to take along a few extra nuts and bolts to replace the ones which may be accidently dropped in the grass while rigging the aircraft. The Lazair can be rigged with nothing more than 3/8 inch and 7/16 inch wrenches and a pair of pliers, but the task can be simplified significantly with the addition of a battery powered electric drill with 3/8" and 7/16" nut drivers to fit it.

Start by attaching the struts to the fuselage, and put the nuts on finger tight. The wings are then put on one at a time. At the tip, the wing should be held with one hand on the leading edge of the D-cell and the other on the aluminum rib beside the aileron. *Do not* hold onto the curved wing tip, as it is quite fragile. The wing root should be placed in position with the front root fitting bolt put in from the back to the front. The nut then faces forward for easy tightening. The rear spar bolt

is then slipped in. This wing tip can then be lowered to rest on a handy block or some other type of object which would be high enough to ensure that the trailing edge is *not* resting on the ground. This block should be positioned such that the wing is resting on the main spar at the tip.

Attach the root fittings of the second wing and, while still holding the wingtip, attach the upper strut end. *Do not leave go of this wingtip until the upper strut of the other wing has been attached.* The wingtips may then be released and nuts put on all the bolts and tightened.

Prior to putting on the gap covers, all bolts should be rechecked and the stick should be moved in all directions to ensure that the mixer and ailerons are working smoothly. Gap covers should then be put on and the edges should be taped. *NOTE: Never fly without the gap covers in place.* The engines are bolted on, the fuel lines, magneto wires and throttle linkages are attached and the throttles are then checked to make sure that they give full power and return to idle. This will avoid any surprises when the engines are started. Safety wire *ALL* fuel line connections. Before starting the engines, perform a complete pre-flight check of all nuts, bolts, bearings, pushrods, cables, covering, etc.

2.4 FUEL MIXTURE

As with virtually all two-stroke engines, the engines on the Lazair require the lubricating oil to be mixed with the gasoline. Many types of two-stroke oil are available and each has it advantages and disadvantages. With the smaller engines previously used on a Lazair, we recommended the use of Granberg, a eutectic oil designed to operate with a fuel/oil ratio of 100 to 1. This oil was recommended by the engine manufacturer and our own testing showed that unlike most other types of lubricating oils, it did

not cause spark plugs to foul. It does, however cause the cylinder head to operate at a slightly higher temperature than when using some of the less exotic oils which are used in higher concentrations. The Rotax engine has shown in testing and in service that it is not as prone to spark plug fouling as most other two-stroke engines, and therefore a conventional mineral based two-stroke oil should be quite adequate. All the testing and flying at the factory to date has been done using Sunoco two-cycle oil mixed in a ratio of 25 to 1. The performance of this oil has been excellent, and we would expect that a mineral oil from any of the reputable manufacturers would work equally well. As more operational data is compiled, information on various oils and recommendations will be published in the Lazair Techincal Update (the "green sheet") which is distributed free of charge to all Lazair owners. Regardless of what kind of oil you use *it is imperative that it be thoroughly mixed with the gasoline before the engines are started.* Use the fuel/oil ratio recommended by the oil manufacturer.

Experience has shown that leaded gasoline runs much cleaner than unleaded, and therefore *leaded gasoline should always be used.* Spark plugs should be checked every ten hours and cleaned or replaced as necessary.

3. ENGINES

3.1 SPECIFICATIONS

Bore:	62 mm (2.44 in.)
Stroke:	61 mm (2.40 in.)
Displacement:	184 cc (11.2 $in.^3$)
Compression Ratio:	8.5:1
Power Output:	5.2 HP @ 3,000 RPM
	7.6 HP @ 4,000 RPM
	9.2 HP @ 5,000 RPM
Ignition Type:	Bosch Flywheel Magneto with Breaker points
Carburetor Type:	Tillotson Model 229A Diaphragm Type with Integral Fuel Pump

3.2 SERVICE DATA

Spark Plug Type:	Bosch M240T1 (18 mm) or Champion K-7
Spark Plug Gap:	.016 to .020 Inches
Ignition Point Gap:	.014 to .018 Inches
Ignition Timing:	.14 to .16 Inches BTDC
Magneto Air Gap:	.010 to .013 Inches
Crankshaft End Play:	.001 to .009 Inches
Spark Plug Torque:	30 ft. lb.
Cylinder Head Nuts Torque:	17 ft. lb.
Flywheel Hub Nut Torque:	35 ft. lb.
Propeller Hub Nut Torque:	35 ft. lb.

3.3 OPERATION

CAUTION: *Always be extremely careful around the propellers as you would with any aircraft. The Lazair propellers may be small but they are quite capable of inflicting serious injury.*

3.3.1 Priming

The Tillotson carburetors on the Lazair engines incorporate a check valve which will hold the fuel in the fuel lines for several hours or even days. However, if the engines have not been operated for some time, the fuel will gradually drain back into the tank and it will be necessary to prime the fuel system. This is a simple procedure, made possible by the use of fuel lines with a relatively small inside diameter, and the elimination of the primer bulb which was a source of problems on some of the early Lazairs. To fill the fuel lines, make sure both magneto switches are off, then open both throttles. Close both chokes by *pushing* the choke knobs in. Note that closing the choke automatically activates the compression release to make it easier to pull the starter cord. Pull the starter cord until fuel is visible in the clear fuel line where it enters the carburetor (this usually requires eight to ten pulls). Then pull the starter two more times to ensure that the carburetor fuel passages are filled.

3.3.2 Starting Procedure

Every two-stroke engine seems to have its own unique character, and in time you will discover the exact starting procedure which works best for *your* engines. However, the sequence outlined below works well and should be followed until you discover a better way.

1. Close the choke (and open the compression release).
2. Set the throttle approximately 1/4 open.
3. Set magneto switch on.
4. Pull starter cord until engine starts (use a quick but steady pull).
5. Allow the engine to run for a few seconds then slowly open the choke.
6. Allow the engine to warm up for at least two minutes before using full throttle.
7. Move the throttles from idle to full power several times and check for smooth response.

If an engine hesitates or sputters when the throttle is advanced, it indicates that either the carburetor is not properly adjusted or the engine is not sufficiently warmed up.

NOTE: *As soon as the engine fires, the compression release will be closed (pushed out) automatically. If you want to restart an engine with the choke open, it will be necessary to push the choke knob in (to open the compression release), then pull the knob out again to open the choke.*

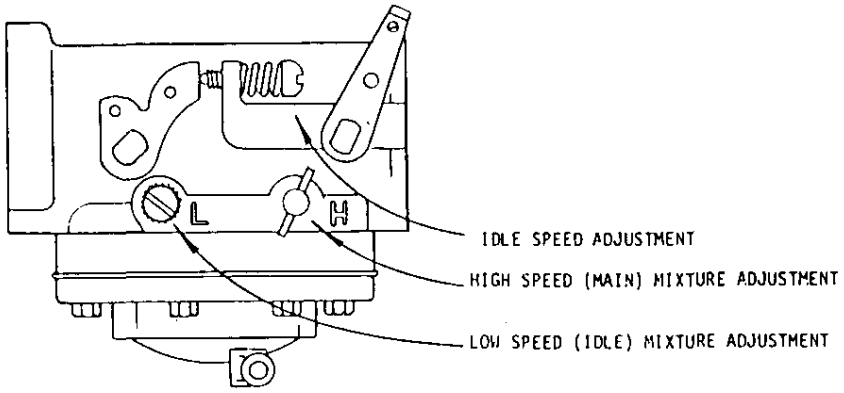
As with most two-stroke engines you will probably notice a tendency to four-stroke at some operating speeds. Four-stroking can be recognized by a very severe vibration (made very obvious by the soft rubber engine mounts used on the Lazair) and a loud irritating exhaust noise. While four-stroking is a normal occurance and is not considered a serious problem, it should obviously be avoided as much as possible to prevent damage to the airframe from excessive engine vibration. Proper carburetor adjustment will reduce the tendency to four-stroke, and most engines will four-stroke less after they are broken-in than when they are new.

NOTE: *The engines provided in your Lazair kit have been run briefly at the factory but they are not fully broken in. It is recommended that before the first flight, the aircraft be taxied for a minimum of two hours.*

If an engine tends to four-stroke in service, advance the throttle slightly until it runs smoothly. *Do not run an engine continuously in the four-stroke mode.*

3.3.3 CARBURETOR ADJUSTMENTS

The carburetors on your Lazair engines have been adjusted at the factory to allow the engines to be started, but they will require subsequent "fine tuning" at least twice (before and during the break-in period).



There are three adjusting screws on the carburetor:

1. High speed (main) fuel mixture adjustment (labeled "H").
2. Low speed (idle) fuel mixture adjustment (labeled "L").
3. Idle speed adjustment (throttle stop).

To adjust the throttle, use the following procedures.

CAUTION:	*When making carburetor adjustments with the engine running, be very careful to avoid the propeller. Keep the aircraft securely tied down and have a friend sit in the cockpit to operate the throttles and magneto switches. Crouch down behind the engine, under the wing and keep one hand on the strut to avoid losing your balance. Do not stand between the propeller and the leading edge of the wing.*

1. If the carburetor is known to be out of adjustment, close both the main and idle adjustment screws by turning them clockwise until the needle just touches the seat. Do not force the needle into the seat.
2. Open the main adjustment screw 1 1/4 turns.
3. Open the idle adjustment screw 3/4 of a turn.
4. Set the idle speed adjustment so that the throttle butterfly is open slightly.
5. Start the engine and allow it to warm up for several minutes.
6. When the engine is thoroughly warmed up, close the throttle and adjust the idle speed adjustment screw and the idle mixture adjustment screw so that the engine runs as slowly as possible without a tendency to stop.or four-stroke. This should be approximately 1,000 RPM.
7. Open the throttle gradually to full power. Adjust the main mixture adjustment screw (H) to achieve maximum RPM. *Then turn the main adjustment screw 1/4 turn counterclockwise.* This will result in the proper fuel mixture to assure proper lubrication of the engine.

NOTE:	*Do not run the engine with the main mixture adjustment too lean or serious engine damage may occur.*

8. Run the throttles up and down a few times to ensure that the engine responds smoothly.

4.1 TAXIING

All first taxi attempts should be done in no wind to minimize the number of different variables. The ideal way to taxi is with the tail slightly off the ground and the engines running at a syncronized speed using the stick for all directional control. Syncronizing the engines may be difficult at first as the throttle levers do not move in phase to keep them syncronized. It takes practice to hear when the engines are in sync. This is why we recommend at least 2 hours of taxiing. Don't be afraid to use the ignition switch to stop the sequence of events while on the ground. The initial tendency is to control direction with the engines because it is a far more positive and instantaneous way to control direction. However, this tends to make one weave considerably. When the engines are syncronized and the stick is used for steering,use minor power changes once all the stick control is used up. This is a far more *controllable* way of taxiing. Learning to taxi in windy conditions you may find is a real challenge. In crosswinds of over 7 mph we recommend you have a wing walker. Crosswind takeoffs are achieved by keeping the upwind engine at a higher power setting on the takeoff roll than the downwind engine. Steering should be done with the stick. The upwind wing will need to be high to get a straight ground track.

4.2 THE FIRST FLIGHT

The first flight should take place in no wind on a large, long grass strip. Once you have mastered taxiing and feel at home with the overhead stick, the hard part is over. Now comes the relatively easy part....*flying!!* The standard pre-flight should be done. A long run up at full power should be done to make sure the engines are producing maximum RPM and the ignition switch should be checked.

Apply full power and start your takeoff roll keeping the nosewheel just skimming the ground. The aircraft will start to feel light. Gently apply back pressure and the aircraft will lift off. If you feel the tail dragging, then ease forward until you have more airspeed. If rotation occurs at a higher airspeed you may find the initial climb angle quite alarming. The tendency to over-rotate seems to be a normal occurence for most people on their first flight. Easing off back pressure and continuing with a normal climb out has been no problem. If the runway is long enough, you can reduce power and fly straight and level for awhile. If everything feels in trim and you feel comfortable, apply full power and go for a flight. On your first climb out, you will probably climb out at a higher airspeed than is normally used for best rate of climb. It is not until the Lazair gets down around the 20 mph mark on the airspeed indicator that it really starts to climb well. Once you have reached a comfortable altitude you may now begin gentle turns. When initiating a turn, there will be a noticeable adverse yaw. This is normal, and once a bank angle is established, the turn will be well co-ordinated. The more you turn on your first couple of flights, the better. This helps in becoming more at home with the overhead stick.

Stalls are straight ahead and fully controllable. Trying to spin the Lazair results in a spiral dive. Stalls in turns usually result in the Lazair rolling to the opposite direction. This roll can be stopped as the wings go through level flight. If, for some reason, one engine fails, you will require about one half aileron movement to maintain straight and level flight at full power. Depending on your weight, you may be able to maintain altitude or you may descend gradually. *In either situation, begin immediately to select a suitable landing place.* Make all turns towards the good engine. Throttling back the good engine will increase the roll rate towards the engine. If the inside engine fails in a turn reduce power on the good engine to level out. Stalls on one engine have been straight

forward to date. Many times the Lazair has been descended controllably in a mush below stall speed. This maneuver should be performed only by a very experienced pilot using extreme caution.

4.3 LANDING

Landing the Lazair is begun with a long approach descending at a constant airspeed with the engines just above the "shake" speed. Once you are sure you have made your field, reduce power to idle and begin to flare at 2 to 3 feet. The Lazair will float for a couple hundred feet and you should settle in at a stalled attitude. In the proper landing attitude, the skids touch just before the wheels. There are three things that deserve note:

1. Once you get below 50 or 100 feet, *do not* turn the engines off unless you have *plenty* of airspeed. With power on at a low airspeed there is quite a lot of induced lift, and when you turn the engines off you could lose some height or go directly into a mush.
2. Do not flare too high and land five feet above the runway. This leads to bruised posteriors and egos.
3. Once on the ground again, you are taxiing the Lazair, so plan ahead which way you are going to be blown and what taxiing techniques to use.

Finally, a word about weather conditions: The Lazair is capable of being flown in very severe weather as long as the pilot is totally familiar with the aircraft and with wind gradient, wind shear, low level turbulence, downwind turns, rotor, thermals, wind shadow and many more wind and weather conditions too numerous to explain here. Knowledge of these micrometeorological phenomenon is best obtained from various texts as well as *a very gradual transition from calm air up to your personal limitations.*

Back of Lazair II Manual

ULTRAFLIGHT
SALES
LIMITED

P.O. BOX 370
PORT COLBORNE, ONTARIO
CANADA L3K 1B7

G.M.GRAHAM & CO.LIMITED
TORONTO CANADA
82-20738

Back & Side of
Lazair II Manual
in Beige 3 ring
Binder

P.O. BOX 370
PORT COLBORNE, ONTARIO
CANADA L3K 1B7

Lazair

OWNER'S MANUAL

G. M. GRAHAM & CO. LIMITED
TORONTO CANADA
82-20738