GLIDING NEW ZEALAND INCORPORATED

ADVISORY CIRCULAR
AC 2-14

POWERED GLIDER
BASIC AERONAUTICAL KNOWLEDGE

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Acknowledgement

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1 Introduction

A logbook endorsement for a powered glider launch (self-launch) requires the pilot to complete the training detailed in the syllabus at Appendix 2-D of the Gliding NZ MOAP and at least a 70% pass in a multi-choice examination.

This AC provides the basic aeronautical knowledge required for powered glider operations and should adequately prepare the pilot for the examination.

It is important to note that an XCP is a pre-requisite for powered glider endorsement, so the syllabus focuses on covering the differences from a conventional glider.

Guidance is provided in the following aspects of powered gliders:

- The basic configurations
- Definition and rules
- Systems
- General engine operating procedures
- Human factors
- Principles of flight
- Dealing with emergencies such as power failure or fire
- ATC procedures and airspace

GNZ maintains on its website (Training > Safety Information) best practice information and articles on safety. Included amongst these is the series on Threat and Error Management, which has particular significance for powered glider operations.

2 The Basic Configurations of Powered Glider

There are several basic configurations of powered gliders; each with differing characteristics and operating considerations:

Self-Launching

As the name suggests, these are gliders that are equipped with engines powerful enough to enable them to launch without assistance. The engines may also be used to sustain flight if soaring conditions deteriorate. These gliders have different engine and propeller configurations, and different performance characteristics, so it is practical to categorise them further, as follows:

- **Touring Motor Gliders (TMG):** These are generally equipped with a fixed, nose-mounted engine and propeller than may have a feathering capability. They resemble an aeroplane to the untrained eye, albeit with a longer wingspan. They certainly have some commonality with basic aeroplanes, and some may be registered as an aeroplane, but are often registered as a glider. Glide ratio with the engine shut down, and propeller feathered, is typically around 30:1.

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- **High-Performance self-launching gliders:** These generally have the engine mounted behind the cockpit, and they retract fully into the fuselage when not in use, for maximum gliding performance. Their propellers may fold, or they often will align vertically with the engine, and retract fully. These high-performance gliders have the same glide angle as their conventional version (around 45:1 to 60:1 depending on wingspan) but at a higher speed, because of the added weight. Minimum sink is slightly increased for the same reason.

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Sustainer Motor (non self-launching)

Some high-performance gliders carry lighter-weight motors to sustain flight when soaring condition deteriorate, but do not have enough power for takeoff. These gliders are launched conventionally (eg aerotow, winch) and the retractable motor is usually only used as a "get-you-home" engine, sometimes called a "turbo". The engine is usually a simple fixed-throttle 2-stroke engine, with a multi-blade folding propeller for simple extension/retraction. A Powered Glider endorsement is not required to operate gliders with sustainer motors, *but they do still require type instruction from a suitably qualified gliding instructor.*

Typical Schempp-Hirth glider with sustainer motor extended

3 Powered Glider Definition and Rules

The logbook Endorsement

The MOAP specifies the training syllabus and flight instruction required to obtain a Powered Glider endorsement. It should be referred to for further details, but the following gives guidance.

Note that a Powered Glider endorsement is required for *each individual glider type*. There is no blanket Powered Glider endorsement that covers all types. This is because all powered glider types are different in configuration and operating characteristics, and specific flight instruction is required for that glider type.

Training consists of:

- Ground Training consisting of a classroom course of instruction, followed by a written multi-choice knowledge exam.
- Flight training following the MOAP syllabus, which will take place over several flights under the guidance of a suitably qualified instructor.
- After each element of training, the pilot's logbook syllabus must be signed to indicate completion to proficiency.

Once an XCP has attained a Powered Glider endorsement on one type, addition of a further type requires further flight training applicable to the new type; the amount and content being at the discretion of the suitably qualified instructor.

Powered Glider Definition

A powered glider is an aircraft with one or more engines which has, with the engine(s) not operating, the performance characteristics of a glider. The performance parameters will be assessed by CAA at the time of original type acceptance, to determine if it comes under the provisions of Part 104 of CAA Rules, or Part 103 if it is classified as a microlight aircraft.

Microlight Flight Criteria

If the powered glider is classified as a microlight, Part 103.155 applies. Essentially this means that, in addition to the normal rules for type-certificated gliders, microlights *shall not operate over any congested area of a city, town or settlement*. Also, the Part 104.53 criteria for flight in IMC are not available to microlight gliders.

Summary of Pilot Qualification Requirements

Refer to Civil Aviation Rules Part 61, 104, and the MOAP for detail. The following is intended to summarise the requirements:

a) *For a powered glider that is registered as a glider (NZ-Gxx):*

The pilot must hold an XCP, or a PPL(G) or CPL(G) under Part 61, with a powered glider endorsement and relevant type rating; and operate within and under the operational standards and procedures of a gliding organisation.

b) *For a powered glider that is registered as an aeroplane, but the intention is to operate it as a glider at any time: (This means a TMG, as described earlier.)*

The same requirements as for a) above.

c) *For a powered glider that is registered as an aeroplane, but the intention is to operate it solely as a powered aircraft:*

The pilot must hold a Part 61 RPL, PPL or higher licence and applicable type rating.

4 Powered Glider Systems

Two-Stroke Engines

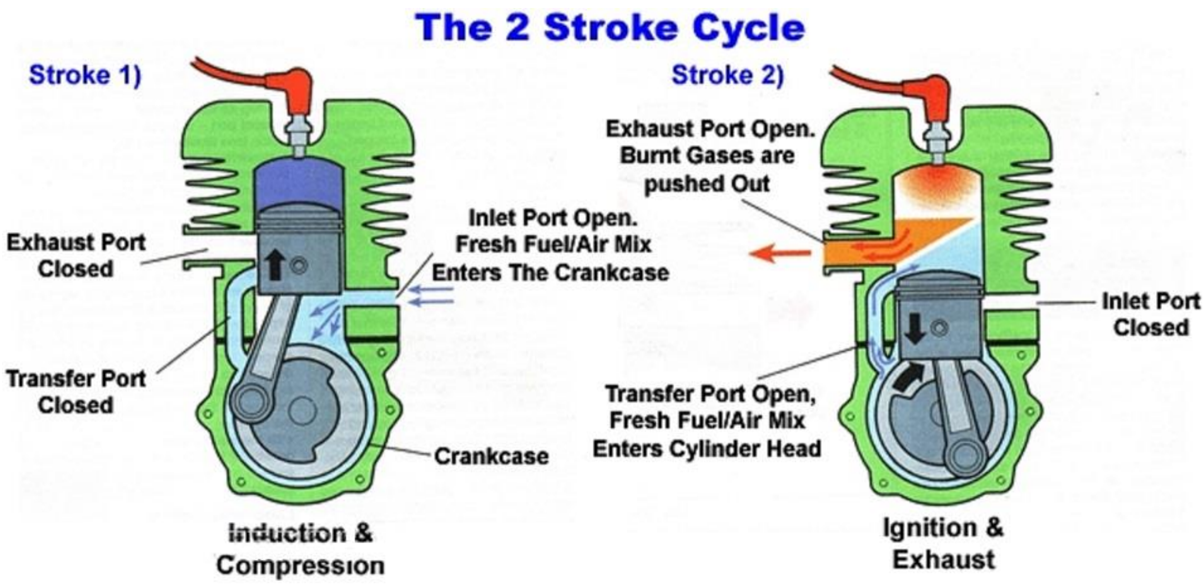
A *two-stroke engine* is a type of internal combustion engine which completes a power cycle in only one crankshaft revolution and with two strokes, or up and down movements, of the piston in comparison to a "four-stroke engine", which uses four strokes. This is accomplished by the end of the combustion stroke and the beginning of the compression stroke happening simultaneously and performing the intake and exhaust (or scavenging) functions at the same time.

Two-stroke engines fire once every revolution (twice as often as a four-stroke). Compared to 4-stroke engines, they have a greatly reduced number of moving parts (no valves for example), are more compact and significantly lighter. As a result, they provide a high power-to-weight ratio, usually in a narrow range of rotational speeds called the "power band".

Special 2-stroke fuel is required – a suitable mixture of fuel with oil added (at a ratio of approximately 30:1). Thus an oil sump as found in 4-stroke car engines is not required. This also makes a 2-stroke engine suitable for being retractable into the fuselage, into a horizontal position, whereas 4-stroke engines must remain vertical.

For all these reasons, two-stroke engines are ideal for high-performance powered gliders.

Fuel and specialised 2-stroke oil should be selected and mixed in accordance with the Flight Manual specifications. Synthetic oil may be used but only if the Flight Manual specifically approves its use. The mixing ratio may differ (approximately 50:1 but check the Flight Manual.)



Disadvantages of a Two-Stroke Engine

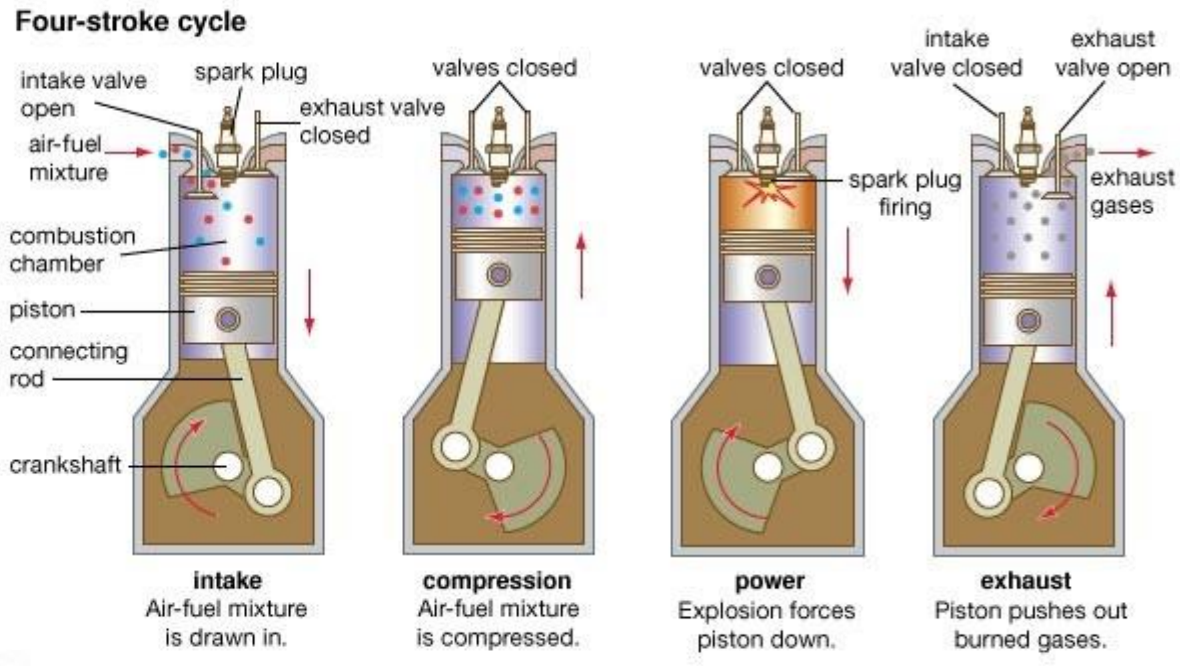
- Two-stroke engines don't last as long as four-stroke engines. The lack of a dedicated lubrication system means that the parts of a two-stroke engine wear a lot faster.
- Two-stroke oil is relatively expensive.
- Two-stroke engines do not use fuel as efficiently as four-stroke engines.
- Two-stroke engines produce a lot of pollution, from two sources. The first is the combustion of the oil, which makes all two-stroke engines smoky to some extent. Also, each time a new charge of air/fuel is loaded into the combustion chamber, part of it leaks out through the exhaust port.
- Therefore two-stroke engines require daily cleaning after use, both the engine and engine bay. Additionally, the rear fuselage, fin and tailplane will require cleaning after engine use.

Four-Stroke Engines

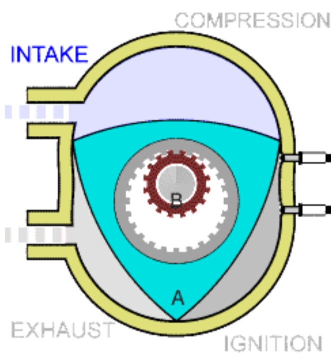
Most pilots will be familiar with four-stroke engine to some degree at least, since these are the common type of engine used in cars. There are subtle differences with aircraft engines:

- Aircraft engines run at high power settings for significant periods of time, unlike car engines.
- They are often air-cooled and require more awareness of operating temperatures.

- Reliability is critically important – maintenance is more important.
- They require a dual ignition system for reliability.
- Engine instrumentation is usually more detailed, providing accurate engine parameters instead of just warning or failure lights as in some cars.

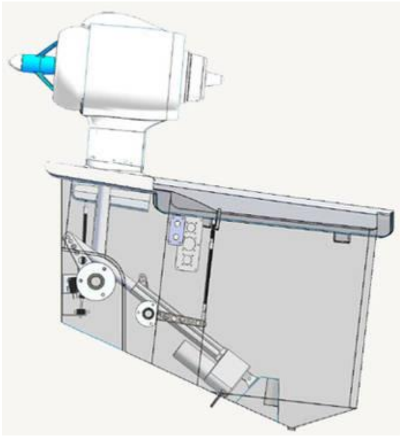


Rotary Engines



The **Wankel engine** is a type of engine that uses an eccentric rotary design to convert pressure into rotating motion. Over the commonly used reciprocating engines, it delivers advantages of: simplicity, smoothness, compactness, high RPM, and a high power-to-weight ratio. The engine is commonly referred to as a *rotary engine*, although this name applies also to other designs as well. All parts rotate moving in one direction as opposed to the common piston engine which has pistons violently changing direction.

Jet Engines



Jet engines utilise a simpler extension / retraction process, with no propeller alignment considerations. They provide a higher thrust to weight ratio, albeit with a high fuel flow. Additionally, they require a longer cool-down time before retraction (approx. 1.5 minutes) but they cause a lot less drag than a propeller while extended.

Fuel Systems

Powered gliders will normally have one fuel tank, mounted in a fixed position that is separate from any engine extension/retraction system to minimise the risk of fuel leaks.

An electric fuel pump may be installed to ensure positive fuel pressure to the engine. A fuel pressure bulb may be fitted in the cockpit, to enable the pilot to press it several times to pressurise the fuel line prior to engine start (2-stroke engines). It is essential to only use fuel as specified in the Flight Manual. It is important to prevent moisture getting into fuel as much as possible, and to remove any by following Flight Manual procedures to check water traps before flight. For both 2-stroke and 4-stroke engines, fuel tanks should be filled before leaving it overnight, or longer period, to prevent condensation from air in the tanks adding moisture (water) to the fuel. Also note that many fuel gauges are quite inaccurate (or at least a coarse volume scale) and should not be relied on.

Fuel Supply / Carburettor Systems

Engines may have electronic fuel injection (2-stroke or 4-stroke engines), or a fuel carburettor (4-stroke nose-mounted engines), to control the supply of fuel to the engine. Aircraft carburettor systems are prone to carburettor icing because of the lower temperatures even at quite low altitudes, and because of cooling caused by pressure drop in the carburettor system. Many aircraft engines have carburettor heating, using exhaust air to warm the carburettor intake area. When carburettor heat is fitted, it MUST be used correctly. Incorrect use of carb heat can lead to significant power loss. Some types, for example some Rotax engines, have no carb heat at all.

Ignition Systems

All light aircraft are required to have dual ignitions systems for added safety and reliability. Additionally this improves combustion efficiency. Powered gliders are no different. Most will have dual magnetos which should be checked as part of the engine run-up procedures, and the engine should continue to run on each magneto alone, with a small RPM drop, usually around 125 to 200RPM depending on engine type. Check the Flight Manual for the acceptable RPM drop.

Electrical Systems

All gliders have an electrical system, including one or more batteries to power a radio, transponder, electric variometer, navigation system, artificial horizon etc as fitted. Many of these have a low current draw, and batteries last many hours before requiring recharging. With a powered glider, the additional equipment requires electrics for engine extension / retraction, engine starting, ignition, engine instrumentation and warning systems. Some of these have a large current draw, requiring one or more heavier-duty batteries, plus an engine-driven generator. Additionally circuit breakers will be fitted to protect the electrical circuits and services from overload.

Of course, the generator (if fitted) will only recharge batteries while the engine is operating, and this will probably be a relatively short time. A pilot should NEVER assume an engine will extend and start successfully, and therefore never rely on the motor to get you out of a paddock landing situation, or worse – to get you clear of un-landable terrain.

Engine Instrumentation

In addition to the usual glider flight and soaring instruments, powered gliders are required to have at least the following equipment and operative instruments (Part 104):

- A fuel quantity gauge for each main fuel tank

- An oil pressure gauge or warning device for each engine (other than a two-stroke)
- A tachometer, RPM indicator, or engine governor light for each engine

Propellers

There is an increasing variety of propellers fitted to powered gliders, depending in part whether they are high performance, training, cruising gliders, or sustainer (Turbo) engines. Propellers may be fixed, fixed but retractable, feathering, folding, two blade or multiblade. As a generalisation, it is fair to say that propellers are critical to takeoff performance, and the condition and drive components must be carefully checked and maintained in accordance with the Flight manual. Keep them clean and clear of oil or fuel, and clean insects or dirt off before every flight. Propellers often have their own logbook which of course should be kept up to date with flight hours.

Extension / Retraction Systems

As a generalisation, powered glider systems come into two most common groups. The first group utilises a fixed engine (often but not always in the nose) with a propeller that may be fixed, variable pitch or folding. This configuration is often used in touring motor gliders. The second group utilise a retractable engine and propeller, mounted immediately behind the cockpit. The entire assembly is retracted leaving a high-performance glider configuration.

In order to retract this assembly, the propeller must be folded, OR stopped and aligned vertically, to allow complete retraction into the fuselage. The alignment may be accomplished electrically, or by using windmilling and a brake to achieve the correct position. Whatever system is used, the Flight manual procedures must be diligently followed. It is highly recommended that pilots practice these procedures on the ground before attempting them while flying.

Emergency Equipment

Powered gliders must carry a first aid kit (same as gliders). When refuelling taking place, there must be no smoking within 15m, and a serviceable fire extinguisher must be available for immediate use. Parachutes are not mandatory but strongly recommended. Remember there are a few possible emergency situations associated with a powered glider that do not apply to conventional gliders, such as fire.

5 Maintenance

CAA Rules state: An operator of a glider must maintain the glider, including the airframe, any engine or propeller, component, survival equipment, and emergency equipment, in accordance with the applicable requirements prescribed in Subpart G of Part 91 and:

- the current maintenance schedule recommended by the manufacturer
- or a maintenance programme and procedures authorised by a gliding organisation's exposition

- or as approved by the Director in accordance with rule 104.109.

The engine and propeller are subject to their own maintenance requirements. It is *not* acceptable to do your own maintenance unless it is under the direct supervision of a suitably rated LAME or GNZ Engineer. You are however allowed to change the oil and pressure oil filters (4-stroke engines), and spark plugs (reference MOAP Appendix 3-C).

6 General Engine Operating Procedures

Flight Manuals give specific guidance on engine operating procedures relevant to each type, however the following gives an indication of typical procedures and values where appropriate.

<u>*Engine start*</u>*:* Powered gliders – like any aircraft - demand a high level of self-discipline to ensure all procedures are followed meticulously, and all safety factors are considered. Prior to engine start, strap in and be ready for an unforeseen issue such as a runaway full throttle, engine fire etc.

<u>*Warm-up*</u>*:* Most Flight Manuals specify a minimum cylinder head or oil temperature, before the engine power is increased above idle power (or power required for taxi). This minimum temp should be strictly observed to minimise possible cylinder head cracking etc. Note that this minimum temperature may apply in the air as well – and of course the engine may have been cold-soaked at soaring altitudes. Therefore do not restart the engine in the air and immediately apply climb power. (This does not apply to "Turbo" sustainer engines that operate at a fixed throttles and lower thrust ratings, and are not used for takeoff.) Refer to individual Flight Manuals.

Run-up*:* Flight Manuals will often specify that a minimum temperature must be reached before carrying out a run-up to check maximum power (or something close to maximum in accordance with the Manual). At that power setting, check each magneto in turn to ensure that (a) the engine runs smoothly on each mag, and (b) the maximum RPM drop is not exceeded. This will usually be around 125 to 200 RPM depending on engine type. Additionally, an engine fitted with a carburettor heat system will specify a pre-flight check. This will also involve a slight RPM drop, as warm air is supplied to the engine. Refer to the Flight Manual.

<u>*Take-off*</u>*:* engine handling, and parameters such as RPM, temperatures and pressures, will be specified in Flight Manuals, and must be strictly observed. Always check parameters during application of thrust for takeoff, and stop the takeoff if maximum thrust is not achieved, or there are any suspicious symptoms such as unusual vibration.

<u>*Climb*</u>*:* Almost all powered glider motors are air-cooled (some have a combination of air and liquid cooling.) Care must be taken to keep engine temperatures within limits, by climbing at recommended speeds (or faster), and appropriate use of engine cowls in accordance with Flight Manual procedures. As a general rule, time spent with high power and slow speed should be minimised.

<u>*Cool down*</u>*:* After take-off and climb, which will be at a high power setting and high operating temperatures, it is important to idle the engine for 30 seconds (or as specified in the Flight Manual) prior to shutdown, to reduce thermal shock to the engine. Some Flight

Manuals allow immediate shutdown, but leave engine extended for a specified period (or until it has cooled to a specified temperature) before retraction.

7 Human Factors in Operating Powered Gliders

Powered gliders introduce a degree of flexibility and independence, but they also add complexity and significant threats to conventional glider operation. Pilots require awareness of the human factors considerations, and must employ good Threat and Error Management, to avoid the errors that have occurred in the past.

The intent of having an engine is to give independence, therefore pilots of powered gliders may be conducting pre-flight, start-up, taxi and take-off on their own. This demands a high level of self-discipline to ensure all procedures are followed meticulously, and all safety factors are considered.

Always ensure the area is clear before engine start. Do not start-up near to hangars or other buildings where someone might appear unseen and place themselves at risk of being hit by a propeller.

High performance self-launching gliders are capable of being taxied, either with a “wing down” at slow speed (over smooth grass), or at sufficient speed to be able to lift the wing to level using aerodynamic forces. Each of these techniques carries inherent risks. They can both be carried out safely if pilots are aware of all safety factors and these are mitigated. Both require sufficient room either side to allow for directional control problems. Obviously, a crosswind or tailwind make taxiing more difficult. It is much safer to tow the glider behind a car, or employ a wing-runner to assist – this also protects the wingtips from possible scrapes. Additionally, do NOT taxi over winch cables. A number of fatal accidents have demonstrated how easy it is to pick up a cable in the wheel assembly, with often disastrous results.

Any activity involving the engine – extension and start, cooling, stopping and retraction – will distract the pilot from airmanship and decision making requirements such as lookout, height monitoring, and even basic speed control. Therefore intersperse these activity procedures with careful lookout scans, and monitoring basic flying skills. For example, do not try to climb and join a thermal with other gliders, then cool and retract the motor while staying centred in a thermal with other gliders in close proximity. Airmanship and continual lookout will suffer!

<u>Failure to restart</u>:
One of the major threats to the safety of powered glider operation is in the area of restarting the engine in flight. Considerations are as follows:

- Engines may have been shut down, and the glider flown at several thousand feet at cool temperatures, for several hours. Additionally, batteries may have low charge remaining. For these reasons, the engine cannot be relied on to start when required. NEVER rely on the engine to get you out of a sticky situation. Do NOT assume the engine will always be available to prevent an outlanding. While carrying out the extension / restart procedure, *always* fly the aircraft first, and concentrate on flying the circuit and landing.

- ***When you intend to restart the engine in flight, choose a landing field and plan your circuit. Remember that once you extend the engine (or un-feather the propeller as appropriate) the performance is degraded. In the case of a retractable engine in a high-performance glider, the glide angle is possibly worse than a full-airbrake glide. (The best way to assess this degradation in glide performance in your glider is to practise landing with the engine out and the propeller stationary.)***
- Additionally, it is undesirable to start the engine and immediately apply full thrust as required for a climb. After all, it is a requirement to warm-up the engine prior to take-off, and on climbing out on final approach to a paddock is a more high-risk situation. It is strongly recommended that the engine should be restarted with enough altitude to allow running the engine at a low power setting for a short period before applying high thrust.

Noise:
Motor gliders are generally very noisy. Ear defenders or radio headsets are essential during motor operations. Even then, radio operation may be difficult, and it may be necessary to reduce engine power if ATC requests / clearances are required. Additionally, spare a thought for local residents and vary your takeoff and climb-out path.

8 Principles of Flight for Powered Gliders

(Differences from a pure glider of equivalent performance.)

Thrust Line: With retractable engine mountings, the propeller thrust vector is located above the glider's longitudinal axis and centre of gravity. When thrust changes are made, there is a noticeable effect on the glider's pitch attitude. Additionally, the propeller wash effects the elevator and rudder's effectiveness, depending on the RPM of the motor. Also when the motor is extended or retracted, the movement of the weight of the engine pod will affect the centre of gravity of the glider, and the change in drag will affect the aerodynamics, both requiring elevator adjustment and re-trim to maintain speed. These interactions can lead to PIO at times – be smooth with control inputs, and apply / reduce thrust smoothly to allow time to adjust control input and pitch attitude.

To summarise these effects:
- Application of thrust will cause a nose-down pitch change.
- Thrust reduction will cause a nose-up pitch change.
- With the engine at high RPM, for example on takeoff and climb, the elevator and rudder will have increased effectiveness due to prop wash.
- Also the propeller's down-going blade produces more thrust than the upgoing, due to a difference in angle of attack. This will move the thrust line left or right of glider centreline (depending on the direction of blade rotation), causing a slight turning effect that will require correction.
- When the engine is retracted, the C.G. moves rearward causing a slight nose-up effect. However total drag reduces, allowing a slightly nose higher attitude for a given speed.

Takeoff: Taking off in a powered glider requires a good understanding of the aerodynamics involved. A high thrust line will tend to cause the tail to lift, and this will be compounded by rough surface or long grass causing drag on the wheel. It is important that Flight manual recommendations are followed – typically this will say to hold the stick hard back at first, to prevent the tail lifting. This also holds some weight on the (usually steerable) tailwheel, assisting in directional control during takeoff.

To be completely independent, powered high-performance gliders need to be able to taxi and commence takeoff with one wing on the ground. This wing will of course have extra drag on it, depending on the airfield surface, length of grass etc. and this can lead to tendency to swing until the aircraft has sufficient airspeed to level the wings. This can lead to a ground-loop. For all takeoffs, this possibility must be considered, and allow clear room either side for possible a ground-loop. Following Flight Manual technique as discussed above will reduce this possibility but it is always there. In a crosswind, commence takeoff with the into-wind wing down. This might appear to add to the possibility of swing due to weather-cocking as well, however remember that the slipstream adds to rudder effectiveness to help keep straight, and having this wing down into wind is considerably safer.

Takeoff Distance: Flight manuals will always have data giving takeoff distance required. There are a number of factors that increase takeoff distance, including:

> Tailwind, low pressure, high temperature, wet wings, adverse airfield surface conditions (rough, soft ground, long grass, wet surface, uphill slope), increase in takeoff weight.

All must be taken into account when considering airfield length and takeoff distance required. Takeoff should NOT be commenced with wet wings, or when all the above considerations have not been factored into takeoff distance.

Use Flight Manual takeoff charts to check takeoff distance required, depending on weight, wind, temperature, pressure altitude etc.

Pressure Altitude: to assess the PA for your takeoff, consider airfield altitude AMSL and QNH (greater or less than standard 1013 HPa.) There are 2 ways of doing this:

- Note the airfield altitude: *Example: 150 ft AMSL*
- Correct for low /high QNH at 30 feet per HPa from 1013. *Example: 1003 HPa – need to add 10 HPa to 1013, so add (10 x 30 feet = 300 feet). Pressure Altitude = 150ft AMSL plus 300ft correction = 450 feet PA.*
- OR….sit in your powered glider at the takeoff area, and set 1013 HPa on the altimeter – the altitude shown on the altimeter is your Pressure Altitude today.

Additionally, use of flaps has an effect on takeoff distance. Refer to Flight Manual, but as a generalisation:

- Increasing positive flap will reduce takeoff ground roll (useful with adverse surface conditions), but often will result in a poorer climb performance. Some powered gliders also recommend some positive flap for best rate of climb (such as ASH31), but not as much flap as for the takeoff ground roll. Many will recommend zero flap for best rate of climb.
- Always use Best Angle of Climb procedures and speed to clear obstacles on takeoff, then when well clear, follow best Rate of Climb procedures and speed.

- Taxi and commence takeoff roll with negative flaps. This will improve aileron / flaperon ground clearance, and improve aileron control during the start of takeoff (assist with levelling the wings).

*Climb: A*s above, climb at best rate of climb speed and configuration. Climbing at a slower speed may cause engine overheating, and although a higher nose may give an impression of a better climb, in fact the rate of climb will reduce. Additionally, lookout may be more difficult.

Lookout: On aerotow, glider pilots' attention is focussed, by necessity, significantly on the towplane, and it is the tow pilot's responsible to avoid other aircraft and gliders. A self-launching glider pilot is completely responsible for lookout during the climb. Visibility over the nose is sometimes limited, so it may be necessary to keep turning while climbing. Don't forget to look above and behind you as you climb (to ensure you are not climbing into a level or descending aircraft or glider.)

Stalling: Stalling characteristics for a powered glider have slight differences from a conventional glider. These vary depending on type and configuration, however the following considerations apply:

- When operating with engine operating, or even with an engine pod extended, and /or a stationery fixed propeller, there is likely to be a small amount of airframe vibration due to disturbed airflow over the glider. This may mask stall symptoms such as stall buffet. Be alert.
- The stall speed with the engine operating may be a few knots less than stall speed without engine operating, due to induced airflow over the wing delaying airflow separation. Additionally, a small component of thrust acts opposite to weight, reducing total lift required = lower stalling speed. Note that the delayed airflow separation over the inner area of wing *may* result in stall occurring at the tip first, leading to wing-drop.
- The stall speed with engine extended but not operating may be a few knots higher than the clean stall speed, due to extra drag and disturbed airflow. Certainly it will stall at a lower nose attitude than clean, as a result of extra drag and higher descent rate. Monitor airspeed carefully.
- A powered glider will reach stalling angle of attack in a wide variety of nose attitudes, depending whether climbing at full power, descending with engine extended, operating as a clean glider, turning etc. Know your operating and minimum speeds for all these configurations. Stalling characteristics may be different from the typically docile stall most gliders exhibit, and involve a more dramatic stall and/or wing drop. You must *practise* stall prevention and recovery regularly.

Stall recovery:

- First recovery action is **always** to apply nose-down pitch control – lower the nose to reduce angle of attack.
- Roll wings level, and apply rudder as required to balance and assist.
- Apply engine power smoothly, up to full power.
- Recover to level flight (or as appropriate)

9 Emergencies

<u>Engine Failure</u>: Engine failure is an obvious emergency situation that applies to powered gliders, in addition to possible emergencies for conventional gliders. Engines can suffer a subtle loss of power, or complete failure. Causes can be mechanical damage, fuel contamination or fuel starvation. Some failures can be foreseen by careful monitoring of engine parameters (temps and pressures) over time. If any increase in temperatures over a few weeks should be referred to an engineer. The possibility of fuel contamination – through water or debris – can be reduced by diligent procedures and checks. Nevertheless it should be assumed that an engine failure could happen at any time, and the pilot should be prepared with regular self-training in procedures, with thinking about eventualities, and with the right attitude.

<u>Engine Failure on Takeoff</u>: A smart pilot, on every takeoff, will say "Today is the day – today I'm going to have an engine failure on takeoff". Priorities with a failure:

Lower the nose: Establish a glide. On a high performance glider with extendable motor, the nose will need a positive pitch forward, because the glider will be trimmed with stick back pressure to counter the engine thrust line, and the extra drag from the engine pod will cause a slight pitch-up effect.

Land straight ahead: on the airfield if possible, or the best suitable paddock within about 30° of the nose.

If high enough (or too high to land ahead): turn back (if light winds) and carry out an abbreviated circuit. Remember the drag from an extended but not operating engine could be equivalent to half airbrakes or more.

Of course, follow Flight Manual instructions in the event of engine failure. **Do not attempt to retract the engine, and do not concentrate on trying to restart unless you have sufficient height to carry out a normal circuit AND restart the motor. The first priority is flying the glider to a safe landing.**

<u>Fire</u>: An in-flight fire is the most serious emergency any aircraft can experience. If a fire occurs, or you smell smoke, do everything you can to minimise a fire spreading, and land immediately.

- Reduce thrust to idle, shut off fuel valve, turn ignition off, land ASAP and evacuate the glider.
- Move upwind of the glider, keep onlookers away. Burning fibreglass or carbon fibre resin can produce toxic fumes. There is also a risk of explosion from fuel.
- If the in-flight fire is significant, consider jettisoning the canopy to ensure you are not exposed to toxic fumes (and this will aid a parachute exit if required.)
- Consider abandoning the glider by parachute if the fire is significant, and likely to affect the structural integrity. If in doubt, it is better to parachute out at say 2000ft, in preference to continuing an approach and losing control at 500ft, when it is too late to jump.

NOTE: A powered glider's engine failing to start should not be considered as an "emergency" but an everyday possibility. Pilots should NEVER put themselves in a situation where they rely on the motor to avoid landing or to get over unlandable terrain.

When a decision is made to restart the engine, particular an extendable engine pod, a pilot should assume that it will not start, and that there will not be time to retract the engine again. Plan a circuit and landing at an airstrip or paddock accordingly.

10 Airspace and ATC Procedures

As an XCP, you should already have knowledge of NZ Airspace applicable to cross-country glider flights and be able to interpret controlled airspace boundaries and altitude limits. Make sure you know when you need to call ATC for clearance into or through controlled airspace etc.

As a powered glider operator you are more likely to consider a cruising flight from A to B, instead of a purely cross-country soaring flight. In that context, ensure you follow planning and procedures applicable to a powered aircraft in the same situation.

Flight Plans: The requirements to lodge a flight plan are the same for gliders and powered gliders as that for powered aircraft. Specifically, CAA Rule 91.407 requirements (abbreviated) are:

A pilot-in-command must submit a VFR flight plan to ATC before starting any VFR flight if:

- the pilot-in-command plans to proceed more than 50 nm from shore; or
- the pilot-in-command requires an alerting service.

In addition, the pilot-in-command may submit a VFR flight plan for any flight if desired.

If you are planning any cross-country flight, you should *always* ensure someone knows your plans and expected landing time. Filing an ATC plan is a formal way of ensuring that if you have to land out, particularly if you suffer damage or injury, you *know* Search and Rescue will start at the time you specify on the plan. Don't forget to cancel the SAR Watch after landing!! Just call ATC by radio and advise "Cancel SARWatch".

ATC Reports under VFR: Requirements to call ATC are the same for gliders, powered gliders and powered aircraft.

Position Reports under VFR are required as follows (NZ AIP ENR 1.1):

- when requesting clearance to enter Class C and D airspace
- when requested by ATC when operating within Class C and D airspace
- prior to entry, at specified interval while operating within, and exiting a MBZ
- prior to entry into a Restricted Area or Military Operational Area where ATC is the controlling authority

Visual Position Reports should contain the following *as applicable* to the reason for the report:

- identification, transponder code
- position and time;
- altitude;
- intended route;
- next landing point and ETA

An **ATC Clearance** (and compliance with it) is required by VFR flights in Class C or D airspace.