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DAILY INSPECTOR'S HANDBOOK - POWERED SAILPLANES

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All references to Gliding Australia in this document means the Gliding Federation of Australia Inc.

REVISION RECORD

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Précis of changes

General revision of existing content.

New sections to include daily inspection of jet turbine and electric propulsion systems.

Update to include changes to refuelling requirements in CASR 91.

New section to include recharging of high voltage batteries.

TABLE OF CONTENT

1. INTRODUCTION

1.1 General

This handbook is a supplement to the GFA Daily Inspector's Handbook and specifically covers sailplanes with all types of power systems – sailplanes, motorgliders and power assisted gliders. You are expected to be an experienced Daily Inspector of unpowered sailplanes before you embark on this much more complex subject.

The checks described in this handbook are general in nature and cover the basic principles and level of care required that may not be detailed in specific manuals and specifically to appraise you of Australian requirements. Hence this manual is for guidance only and it is important when inspecting a powered sailplane for the first time, that the manufacturer's flight and/or technical manuals are studied. These manuals contain specific checks that must be complied with – every daily inspection must comply with the requirements of the manufacturer's manuals.

Historically, powered sailplanes are the subject of most of the insurance claims and defects, for both operational and airworthiness faults! Powered sailplanes are much more complex than normal sailplanes. With a retraction system, a powered sailplane becomes more complex than a simple power plane. In addition to the normal sailplane systems, a powered sailplane has an engine, fuel, fuel lines, drive system, propeller, cooling, and an exhaust. Electric powered sailplanes have an electric motor, high current wires, motor controllers, high voltage batteries, battery management system, control wiring, cooling, and a propeller. If a powered sailplane has a fire at 2,000 ft, the pilot is in a lot of trouble. It is worth putting in the effort to learn about it and do the right thing to make it as safe as possible.

This handbook has made reference to the General Aviation, "Maintenance Guide for Pilots", CASA, 2005, available for download from the CASA website. It is worth a read to broaden your perspective and is available for more detailed information. This handbook will put the requirements into a gliding context.

GFA members are subject to the same regulations, Civil Aviation Regulations (CARs) and Civil Aviation Safety Regulations (CASRs), concerning airworthiness as any other General Aviation VH registered aircraft. See the MOSP 3 for guidance.

2. DAILY INSPECTION OF POWERPLANTS

2.1 The Purpose of a Daily Inspection of a Powerplant

The purpose of the daily inspection is laid out in Section 2.1 of The Daily Inspectors Handbook. In addition to this, a powered sailplane daily inspection needs to ensure that the powerplant and its associated systems are fit to fly for the days operations.

The most dangerous time for a powered sailplane is at take-off. Powered sailplanes tend to be underpowered and have longer ground rolls and lower climb rates than an aerotow launch. As a result, a powered sailplane is going to be in more trouble with less options than a glider on aerotow if the engine fails during take-off. Another high risk is re-starting the engine in flight. Too often the pilot has left the decision to re-start till too late and they are low with very limited options. A good Daily Inspection of the powerplant helps in avoiding incidents and accidents, by finding faults in or issues with the powerplant before the sailplane flies.

The daily inspection of the powerplant must be a systematic and thorough look at the sailplane in accordance with the appropriate approved schedule. Make sure you have studied the manuals and have the required knowledge and checklists. Remember that you will be certifying for the inspection, which means that you are signing that you are taking responsibility for completing ALL of it.

2.2 Powerplant Classifications

Powerplants are classified into the following endorsements as listed in Section 10.17 of MOSP 3:

a. Four Stroke Engines = Eng4S

b. Four Stroke Turbo Engines = Eng4STurbo

c. Two Stroke Engines = Eng2S

d. Two Stroke Turbo Engines = Eng2STurbo

e. Radial Engines = EngRad

f. Rotary Engines = EngRotary

g. Electric Motor = ElecMot

h. Jet Turbine = JetTur

In addition to these, there are further endorsements for:

i. Fixed Pitch Propellers = Prop

j. Variable Pitch Propellers = Prop(VP)

k. Folding Propellers = PropFold

l. Propulsion System Retraction Mechanisms = PropSysRetMech

m. Magnetos = Magnetos.

Members must work within the limitations of their authority and seek further training and endorsement before signing out inspection for other powerplant classifications.

2.3 Additional Minimum Equipment for Powered Sailplanes

In the case of a powered sailplane, the minimum equipment must be supplemented with:

a. An engine tachometer. In the case of an electric motor, this may alternatively be a power output meter.

b. A carbon monoxide detector for internal combustion engine installations fixed into the fuselage. Carbon monoxide detectors are not all equal, but if it indicates carbon monoxide the problem MUST be rectified before further flight. Carbon monoxide is insidious and the pilot's faculties will be significantly reduced and they could die. Suggested reading: http://www.avweb.com/news/aeromed/186016-1.html

c. An engine temperature indicator. For internal combustion engines this may be a cylinder head temperature or water temperature gauge (not required if the powered sailplane type was originally Type Approved without one fitted, but strongly recommended). For jet turbines, this may be an exhaust gas temperature gauge or a turbine inlet temperature gauge. Electric motors will be a motor temperature and possibly a battery temperature indicator.

d. An oil pressure and temperature gauge (if applicable).

e. A fuel contents gauge or dip stick for internal combustion engines or jet turbines. Electric motors will have an indicator for remaining battery charge (this may be in kWh or percent of capacity).

f. Static earthing point for re-fuelling purposes for internal combustion and jet turbine sailplanes.

g. An elapsed time indicator (not applicable for all types).

h. A rear view mirror.

i. The minimum placarding given in MOSP Part 3.

Many of the engine / turbine / electric motor instruments may be combined into a single display panel with the engine / turbine / electric motor control unit. All of the minimum equipment MUST be checked for correct function and serviceability at each Daily Inspection.

2.4 Powered Sailplane Daily Inspector Requirements

The requirements to be a Powered Sailplane Daily Inspector are listed in Section 10.7 of MOSP 3.

2.5 How to Train as a Daily Inspector

A person wishing to become a Daily Inspector can receive training from Annual Inspectors, and Gliding Instructors of Level 1 who is rated for the powered sailplane classification being issued. The primary references for the training are AIRW-M007 Sailplane Inspector Training Syllabus, the sailplane Flight Manual, and this Daily Inspector's Handbook – Powered Sailplanes.

When the training has been carried out, the person is tested by an Annual Inspector or Daily Inspector Examiner who is rated for the powered sailplane classification being issued.

If the DI Examiner is satisfied, the person's logbook is appropriately endorsed. If not satisfied, the person shall be provided with guidance as to appropriate skill and experience development needed towards gaining the authority. The endorsement may be restricted to a particular model of powered sailplane. This can be expanded through further experience to become unrestricted for the powerplant classification.

A person receiving a Daily Inspector rating is authorized to carry out DIs only on powered sailplane classes listed on the logbook sticker.

2.6 What Tasks may a Daily Inspector Perform

Daily Inspectors are authorised to perform tasks listed in Section 2.7 of the Daily Inspectors Handbook. In addition to this, Daily Inspectors with a powered sailplane endorsement may certify the following maintenance:

a. Replacement of bulbs, reflectors, glasses, lenses or lights.

b. Replacement, cleaning, or setting gaps of spark plugs.

c. Service and replacement of instrument system batteries.

d. Changing oil filters or air filters.

e. Changing or replenishing engine oil or fuel.

f. Lubrication not requiring disassembly or requiring only the removal of non-structural parts, cover plates, cowlings or fairings.

g. Replenishment of hydraulic fluid.

h. Application of preservative or protective materials, but only if no disassembly of the primary structure or operating system of the aircraft is involved.

There is useful guidance on some of the above in the “Maintenance Guide For Pilots”, CASA, 2005.

2.7 Further Engine / Motor Training and Ratings

Powered sailplane authorisations are in Section 10.17 of MOSP 3. A rating on engines / motors will initially be restricted to Routine Inspection which allows members to perform periodic maintenance. This rating can be extended with experience and training to cover further engine / motor classifications, Replacement of Components, propellers, minor overhauls and major overhauls.

3. INTERNAL COMBUSTION ENGINES

3.1 Internal Combustion Engine Daily Inspection

At the very start of the DI, it is essential to check the Maintenance Release thoroughly. In addition to the normal sailplane checks eg registration, valid dates, etc; check for total, engine, and propellor times and when the next maintenance is due.

The following is a generic list of checks for powered sailplanes with internal combustion engines. Refer to the specific Flight manual for the powered sailplane for specific daily checks required by that type.

ACCESS:

If necessary, extend the engine / propellor pylon. Pay attention for unusual noises or slow extension of the pylon.

Remove cowls or open access panels as required.

IGNITION:

Check that the ignition switches are OFF. Some powered sailplanes have odd systems with multiple switches - make sure you understand these switches and are certain the ignition is OFF.

> **WARNING**
>
> IGNITION SWITCHES IN AIRCRAFT ARE DESIGNED TO FAIL "LIVE". IF THE PROPELLOR IS TURNED AND THERE IS FUEL IN THE CYLINDER, THE ENGINE MAY FIRE. THE PROPELLOR WILL SUDDENLY KICK AND SOMEONE MAY BE INJURED.

FUEL:

Check that the mixture control is lean, the throttle is closed, and the fuel selector is on

Turn on all fuel pumps to pressurise the fuel system. Inspect the fuel lines and engine for fuel leaks. Listen for correct pump operation.

Check that each tank sump and fuel filter is free from water and foreign matter by draining a suitable quantity of fuel into a clean transparent container. Some systems require a large quantity is removed to move the water out.

PROPELLOR:

Check that the propeller blades are free from cracks, dents and detrimental nicks.

Check that the propeller spinner is secure and free from cracks.

Check the propellor attachments bolts are secured and the bolt secondary locking eg safety wire, is intact and functional.

Check that there is no evidence of oil or grease leakage from the propeller hub or actuating cylinder. Inspect the propeller hub, where visible, for any defect which would prevent safe operation. Check the seals at the root of Hoffman props are undamaged.

Check the propellor folding mechanism.

PYLON:

Check the pylon structure is free from cracks, delamination or signs of impact damage.

RETRACTION SYSTEM:

Inspect the retraction system actuator.

Check the uplock(s) of the retraction system. If there is an over centre mechanism, all over centres must have a good over centre lock.

Check that all fasteners are secure.

Check the limit switches electrical connections and wiring.

CAUTION

DUE TO THE ENGINE TORQUE AND THE GYROSCOPIC FORCES FROM THE SPINNING PROPELLOR, THE PYLON STRUCTURE AND RETRACTION SYSTEM WILL EXPERIENCE ASSYMETRIC LOADS ON EACH SIDE. IF THERE IS AN UPLOCK OR OVER CENTRE MECHANISM ON EACH SIDE OF THE PYLON / RETRACTION SYSTEM, BOTH MUST BE FUNCTIONAL.

PROPELLOR DRIVE: Make sure all drive systems; belts, pulleys, gearboxes are operating correctly.

COOLING SYSTEM: Check that the air induction system and all cooling air inlets are free from obstruction.

Check for suitable coolant levels in the radiator (if required).

LUBRICATION: Check that the engine, where visible, has no oil leaks.

Check that the oil quantity is within the limits specified by the manufacturer for safe operation and that the oil filler cap, dipstick and inspection panels are secure. Refill only with the specified oil using the correct procedures. Makes sure you check all the oil levels as some engines have multiple oil systems.

EXHAUST: Check that the engine exhaust system is secure and free from cracks.

Check that all electrical connections are secure and all wiring insulation is undamaged.

Check that there is no chafing of the insulation and the grommets are intact to prevent electrical shorting where wiring passes through bulkheads or baffles.

ENGINE BAY: Check engine bay door hinges are intact and the elastic cord is in good condition.

Inspect the engine bay for foreign objects.

COWLS: Refit engine cowls (if required) and check that the engine cowlings and cowl flaps are secure and work.

Retract engine / propellor pylon if necessary.

Replace access panels.

COCKPIT: Check the instrumentation for the engine system.

Verify adequate fuel quantity and the fuel gauges are reading correctly.

Check the engine, propellor and drive system controls are fully functional.

Check condition of Carbon Monoxide detector.

FIRE WARNING: Push the test button for the fire warning system and ensure both the buzzer and warning light function.

4. ELECTRIC MOTORS

4.1 Electric Motor Daily Inspection

At the very start of the DI, it is essential to check the Maintenance Release thoroughly. In addition to the normal sailplane checks eg registration, valid dates, etc; check for total, engine, and propellor times and when the next maintenance is due.

The high voltage battery system and its associated cockpit control unit is typically powered by a separate avionics battery (similar to an unpowered sailplane). If this avionics battery is not sufficiently charged, or runs down during flight, the electric motor system may not be able to function on the ground or in flight (for an in-flight restart). If the sailplane has not been used for some time, or if the avionics battery is not recharged by the high voltage battery during flight, consider recharging the avionics battery with an appropriate charger before and/or after flight.

The following is a generic list of checks for powered sailplanes with electric motors. Refer to the specific Flight Manual for the powered sailplane for specific daily checks required by that type.

ACCESS: If necessary, extend the motor and propellor pylon. Pay attention for unusual noises or slow extension of the pylon.

Remove cowls or open access panels as required.

ISOLATION: **Check that the electric motor master and / or high voltage battery isolation switches are OFF.** Some electric powered sailplanes have an emergency stop switch for the battery system – use the master switches where possible and be certain the electric motor system is OFF.

> **WARNING**
>
> ELECTRIC MOTOR SYSTEMS USE VERY HIGH VOLTAGE. THERE IS A RISK OF SEVERE ELECTRIC SHOCK IF A PERSON COMES INTO CONTACT WITH AN EXPOSED TERMINAL OR CABLE AND THE ELECTRIC MOTOR MASTER SWITCH IS ON.

PROPELLOR: Check that the propeller blades are free from cracks, dents and detrimental nicks.

Check the propellor attachments bolts are secured and the bolt secondary locking eg safety wire, is intact and functional.

Check the propellor folding mechanism.

ELECTRIC MOTOR: Check that the electric motor is securely mounted.

Inspect mounting bolts and ensure and the bolt secondary locking eg safety wire, is intact and functional.

Turn the propellor through 360 degrees – it must turn smoothly without resistance or grinding noises.

HIGH VOLTAGE CABLES: Check all plug connections are firmly connected.

Check cables for signs of damage eg chafing or discolouration of insulation from overheating.

PYLON STRUCTURE: Check the pylon structure is free from cracks, delamination or signs of impact damage.

RETRACTION SYSTEM:

Inspect the retraction system actuator.

Check the uplock(s) of the retraction system. If there is an over centre mechanism, all over centres must have a good over centre lock.

Check that all fasteners are secure.

Check the limit switches electrical connections and wiring.

> **CAUTION**
>
> DUE TO THE MOTOR TORQUE AND THE GYROSCOPIC FORCES FROM THE SPINNING PROPELLOR, THE PYLON STRUCTURE AND RETRACTION SYSTEM WILL EXPERIENCE ASSYMETRIC LOADS ON EACH SIDE. IF THERE IS AN UPLOCK OR OVER CENTRE MECHANISM ON EACH SIDE OF THE PYLON / RETRACTION SYSTEM, BOTH MUST BE FUNCTIONAL.

AIR COOLING SYSTEM:

Check that all air inlets are free of blockages or obstructions.

Check that all air exhausts are free of blockages or obstructions.

MOTOR CONTROL UNIT:

Check the electronics box is securely mounted.

Check that the control wiring is secure, free from damage eg chafing, and kinks.

BATTERIES:

If batteries are fitted in the fuselage, check they are fitted correctly and secure.

ENGINE BAY:

Check engine bay door hinges are intact and the elastic cord is in good condition.

Inspect the engine bay for foreign objects.

COCKPIT:

Power up the electric motor control panel.

Check for error messages.

Verify that all high voltage batteries have a suitable level of charge. Note some sailplanes require each battery to have a similar level of charge. If the sailplane has a battery balancing system that operates when the high voltage batteries are energised, consider leaving the system powered up until the battery balancing operation has completed.

Verify that the avionics battery has a suitable level of charge. Note some electric sailplanes have an avionics battery that is recharged from the high voltage battery during normal operation. If the high voltage batteries are only used for a short period during launch and then turned off, the avionics battery may not be sufficiently recharged and need periodic charging with an appropriate charger before flight.

FIRE WARNING SYSTEM:

If fitted, push the test button for the fire warning system and ensure both the buzzer and warning light function.

ACCESS:

Replace cowls or close access panels as required.

If necessary, retract the motor and propellor pylon.

5. JET TURBINES

5.1 Jet Turbine Daily Inspection

At the very start of the Daily Inspection, it is essential to check the Maintenance Release thoroughly. In addition to the normal sailplane checks eg registration, valid dates, etc; check for total, engine hours, and engine cycles (some jet engines have maintenance intervals based on the number of engine starts) and when the next maintenance is due.

The following is a generic list of checks for powered sailplanes with jet turbines. Refer to the specific Flight Manual for the powered sailplane for specific daily checks required by that type.

ACCESS: If necessary, extend the turbine pylon. Pay attention for unusual noises or slow extension of the pylon. Note: With some jet turbine installations, engine inspection is carried out in partially extended position.

Remove cowls or open access panels as required.

ELECTRICAL POWER: **Ensure that the jet turbine control system is turned OFF.** As necessary disconnect the engine/instrument battery, or trip the circuit breaker as required.

> **WARNING**
>
> JET TURBINES HAVE VERY HIGH EXHAUST TEMPERATURES. CONTACT WITH THE TAIL PIPE COULD RESULT IN SERIOUS BURNS. ALWAYS PERFORM CHECKS ONLY ON A COLD ENGINE.

JET TURBINE: Check that the jet turbine is securely mounted. Inspect mounting bolts and / or clamps and ensure and the secondary locking eg safety wire, is intact and functional.

Check tail cone is secure.

Check engine case for any evidence of heat damage due to escaping gases.

Ensure intake is free of foreign objects.

Check compressor and turbine discs for any damage – dents, nicks distortion, rubbing on casing.

Carefully turn the turbine through 360 degrees – it must turn smoothly without resistance without resistance, rattling or grinding noises. If OK, spin the turbine with a finger and ensure smooth run down.

ELECTRIC STARTER: Check the starter is secure and is not cracked or damaged.

Check wiring secure.

> **WARNING**
>
> PROPANE GAS IS HEAVIER THAN AIR. ANY PROPANE LEAK WILL ACCUMULATE IN THE ENGINE BAY. ANY SPARK OR FLAME CAN CAUSE FIRE OR EXPLOSION.

PROPANE STARTER	Where a propane start is fitted be absolutely sure that there are no propane leaks. Ensure propane contents are sufficient for start(s). Ensure all electrics are secure with no possibility of sparking.
PYLON:	Check the pylon structure is free from cracks, delamination or signs of impact damage.

> **CAUTION**
>
> PAY PARTICULAR ATTENTION FOR FUEL LEAKS OR ANY SIGN OF FUEL POOLING IN THE FUSELAGE.

FUEL:	Check fuel lines for tight fit and no signs of leakage (with the jet turbine control system off, the fuel lines will be unable to be pressurised). Inspect the fuel lines for signs of chafing or damage. Check no fuel tank leaks. Check the engine compartment for pooled fuel. Check all fuel system drains and vents Check that each tank sump and fuel filter is free from water and foreign matter by draining a suitable quantity of fuel into a clean transparent container. Some systems require a large quantity is removed to move the water out. Check operation of fuel shut off valve(s)
RETRACTION SYSTEM:	Inspect the retraction system actuator. Check pylon limit switches for security Check the uplock(s) of the retraction system. If there is an over centre mechanism, all over centres must have a good over centre lock. Check that all fasteners are secure.
ELECTRICAL:	Check that the control wiring is secure, free from damage eg chafing, and kinks. Pay particular attention to the Exhaust Gas Temperature sensor wiring and the RPM sensor wiring. Check wiring secure.
TURBINE CONTROL UNIT:	If accessible, check the electronics box is securely mounted.
ENGINE BAY:	Check engine bay door hinges are intact and the actuating rods / elastic cord are in good condition. Inspect the engine bay for foreign objects. For internally mounted engines check for any evidence of heat damage in engine bay due to escaping hot gases.
COWLS:	Refit turbine cowls (if required) and check that the turbine cowls are secure. Retract engine if necessary. Close access panels.

ELECTRICAL POWER:	Verify engine area is clear. Turn the jet turbine control system on. Replace the fuse, or connect the instrument battery, or close the circuit breaker as required. Be alert to any uncommanded, automated pylon/engine movements.
RETRACTION SYSTEM:	Conduct full up and down cycle to ensure normal function. Check that the pylon fully extends and retracts and, if fitted, uplocks and downlocks engage.
COCKPIT INSTRUMENTS:	Check for error messages at jet turbine control panel. Check battery voltage. Where possible, check RPM indications by carefully spinning turbine with a finger tip, and check EGT by confirming ambient temperature by pinching the EGT probe between the fingers looking for EGT rise. Verify adequate fuel quantity and the fuel gauges are reading correctly.
FIRE WARNING:	Push the test button for the fire warning system and ensure both the buzzer and warning light function.

6. REFUELLING

WARNING

BOTH AVGAS AND MOGAS HAVE A FLASH POINT AROUND -40º CELCIUS. THIS IS THE TEMPERATURE AT WHICH THERE IS SUFFICIENT FUEL VAPOUR TO SUPPORT IGNITION. UNDER NORMAL TEMPERATURES AVGAS AND MOGAS IS EASILY IGNITED BY A SPARK OR A HOT SURFACE.

Most fuel accidents happen on the ground whilst performing maintenance in the workshop or hangar or when refuelling. Always be careful with fuel and follow appropriate procedures for fuel in drums, open fuel containers, bulk fuel storage, and finally refuelling. Be very aware of what you and others around you are doing and don't take risks.

During refuelling, air and fuel vapour is displaced from the sailplane fuel tanks. This potentially explosive vapour is either expelled via the fuel tank vents or via the refuelling inlet. The vapours are heavier than air and can accumulate around the sailplane at ground level.

CAUTION

REFUELLING **SHOULD NOT** BE CARRIED OUT INSIDE A HANGAR.

REFUELLING SHOULD BE CARRIED OUT IN THE OPEN AIR IN AN AREA APPROVED BY THE AIRFIELD OPERATOR.

THE REFUELLING AREA SHOULD BE SITED SO THE SAILPLANE CAN BE MOVED AWAY IN THE EVENT OF A FUEL SPILL.

6.1 Refuelling Outside

During refuelling a spark generated by static could very easily start a fire. The best way to prevent a static discharge is to electrically connect (ie bond) the sailplane to the fuel supply source and any other equipment used during refuelling eg funnels. All electrical connections between the sailplane and refuelling equipment should be made before the filler caps have been removed and should not be disconnected until the filler caps have been replaced.

During refuelling operations, the aircraft and ground refuelling equipment should be located so that no fuel tank filling points or vent outlets lie:

a. Within 5 metres of any sealed building[1]

b. Within 6 metres of other stationary aircraft or vehicle

c. Within 15 metres of any exposed public area

d. Within 15 metres of any unsealed building.

[1] *For the above, a "sealed building" is one for which all the external parts within 15 metres of an aircraft's fuel tank filling points or vent outlets or ground refuelling equipment is of non-flammable materials and has no openings or all openings are closed.*

The area in which fuelling operations are carried out must be clearly placarded as a 'No Smoking' area.

The pilot-in-command and the refueller shall take reasonable steps to ensure that a person does not, during fuelling operations:

a. Smoke or use a naked flame within 15 metres of the aircraft and ground fuelling equipment;

b. Operate an internal combustion engine or any electrical switch, battery, generator, motor or other electrical apparatus (mobile phones included) within 15 metres of the aircraft's fuel tank filling points or vent outlets, and ground fuelling equipment unless these comply with the provisions CASR 91.485 and has been approved for use during refuelling;

c. At least two fire extinguishers of approved type and capacity for extinguishing a fuel fire. They must be positioned within 15 metres, but not less than 6 metres, from the sailplane and the fuelling equipment. If the fire extinguishers are attached to the fuelling equipment, they must be fitted with quick release brackets, be readily available from either side of the equipment and be located as far as is practicable from the vehicle fuel tanks and fuelling points. Refer to CASR 91.475.

Where mobile fuelling equipment is used, the equipment shall be so placed that it can be rapidly moved in the event of fire.

6.2 Refuelling in Hangars

Refuelling of any aircraft in a hangar is not recommended due to the risk of fuel vapours building up in an enclosed space. Airfield operators and sailplane operators should have agreed procedures to allow in hangar refuelling only when it is impracticable to refuel / defuel outside the hangar.

Agreed procedures should give consideration to having the hangar doors open during refuelling to aid ventilation, provision of suitable fire extinguishers, and ensuring escape routes are kept clear.

6.3 Electrical Bonding

During refuelling a spark generated by static could very easily start a fire. The best way to prevent a static discharge is to electrically connect (ie bond) the sailplane to the fuel supply source and any other equipment used during refuelling eg funnels. All electrical connections between the sailplane and refuelling equipment should be made before the filler caps have been removed and should not be disconnected until the filler caps have been replaced.

The sailplane, fuelling equipment, hose coupling or nozzle, filters, funnels or any other device through which fuel passes, must be effectively bonded to each other throughout the fuelling operation (refer to CASR 91.480). Electrical connection should be made to designated points or to clean unpainted metal surfaces of the sailplane and fuelling equipment. Plastic fuel containers, unless specifically designed to have anti-static properties, should not be used to transport or move fuel around airfields for the purpose of filling aircraft, as the sloshing of fuel can allow electro-static charge to build up.

Common practice is to "ground" the aircraft to the fuelling equipment and allow static to dissipate by touching the nozzle before exposing fuel. This may not be sufficient unless the nozzle is always kept in direct contact with the sailplane refuelling port. Static may build up during refuelling and arc across any gap between the nozzle ant the refuelling port and ignite the vapours being displaced out of the tank by the incoming fuel.

Plastic filler funnels or pipes, unless specifically designed to have anti-static properties, should not be used to guide fuel into sailplane tanks. Where appropriate, it is recommended that a metal container and funnel is used. If necessary, make up a proper bonding device from copper braid and heavy duty crocodile clips. The funnel and fuel container must be electrically bonded.

7. RECHARGING HIGH VOLTAGE BATTERIES

Lithium batteries are presently very popular in consumer products. They are light weight, store a lot of energy, and can discharge this energy very quickly. Unfortunately, many serious house fires each year are caused through improper recharging of Lithium batteries. Once a Lithium battery starts to combust, it is extremely difficult to extinguish, as all the ingredients for fire – fuel, oxygen, and heat; are contained within the battery itself. The smoke from the battery fire is very toxic.

WARNING

RECHARGING OF HIGH CAPACITY LITHIUM BATTERIES IS A POTENTIAL FIRE HAZARD. ALWAYS USE THE PROPER CHARGER. **ALWAYS FOLLOW THE SAILPLANE FLIGHT OR MAINTENANCE MANUAL WHEN RECHARGING BATTERIES**.

7.1 Recharging Location

Where possible, it is recommended to recharge the batteries outside the sailplane, either under supervision or in a location where a battery fire will cause minimum damage. If batteries are being recharged in the sailplane, it is recommended that the sailplane being recharged be separated from other aircraft similar to the refuelling practices listed in Section 6 to prevent a battery fire spreading to other aircraft.

Installation of a smoke or heat alarm in the recharging location if it is in a hangar may give early warning of a battery fire.

7.2 Recharging Temperature

Lithium batteries should not be recharged if it is either too hot or too cold. Recharging at higher temperatures can cause battery damage. Recharging at lower temperatures will result in a reduced charging capacity of the battery. Always follow the recharging temperature limits in the sailplane's Flight or Maintenance Manual. Some automated recharging systems have these temperature limits built in and will not recharge the battery if it is outside recommended temperature limits.

7.3 Long Term Battery Storage

It is recommended that high voltage lithium batteries are stored in a partially charged state and not fully charged. **One fatal in flight fire has occurred where the storing of the batteries fully charged, contrary to the maintenance manual, was considered a contributing factor.** The state of charge should be checked periodically and the batteries partially recharged if the state of charge has decreased. Some recharging systems have a 'storage' mode for long term storage.

The sailplane avionics battery is typically required for the high voltage system controller to be operated. Some sailplanes do not have a physical master / disconnect for the support battery, and there may be system components e.g. electronic control boards and / or solar charge controllers, that present a small, but constant, energy drain on the avionics battery. For these sailplanes (without a 'hard' disconnect switch for the support battery), the avionics battery needs to be periodically recharged during storage, to avoid it discharging to the point of shutting down and rendering the entire sailplane electric motor system unusable.

7.4 Firefighting Lithium Battery Fires

WARNING

SMOKE FROM LITHIUM BATTERY FIRES IS EXTREMELY TOXIC. AVOID SMOKE INHALATION AND EVACUATE THE AREA IMMEDIATELY.

This information is provided for general safety guidance only. For definitive advice on Lithium battery firefighting, refer to contemporary advice from State and Territory Firefighting Services. For example: WA Department of Fire and Emergency Services advice.

There are now fire extinguishing agents eg F-500, which are specifically intended to fight lithium battery fires. For example: Fire Extinguisher Australia.

However, the current best practice in the event of a Lithium battery fire on the ground is to immediately evacuate the area and avoid inhaling any smoke. Once the area has been evacuated, notify the local emergency services.

If it is safe to do so, best practice is to prevent the fire spreading to other aircraft, vehicles, hangars, or buildings. Directly fighting the lithium battery fire is difficult and to be successful requires the battery to be cooled below the self ignition temperature. If the battery is damaged and has a short circuit, the internal electrical discharge is likely to heat the battery to above the ignition temperature and restart the fire. This will continue until the battery is completely discharged electrically.

8. GLOSSARY OF ACRONYMS AND TERMS

AA	Airservices Australia, the regulatory body responsible for Air Traffic Services and aviation administration at Federal level.
AA	Airservices Australia, the regulatory body responsible for Air Traffic Services and aviation administration at Federal level.
AAF	Airworthiness Administration Fee, payable to the GFA for the issue of the paperwork associated with the annual "Form 2" inspection.
AC	Aerodynamic Centre, the point on a wing about which the sum of the aerodynamic forces act.
AD	Airworthiness Directive (Mandatory).
AN	Airworthiness Advice Notice (non-mandatory).
AIP	Aeronautical Information Publication.
ASI	Air Speed Indicator.
ATSB	Air Transport Safety Bureau, a division of the Department of Transport and Communications and the body responsible for accident investigation.
BCAR	British Civil Airworthiness Requirements, the standard to which British gliders are certificated and to which Australian gliders used to be certificated.
Boom	The term used to describe the spanwise beams of a glider main spar and which carries the main bending loads of the wing.
Box spar	A spar constructed of two booms, top and bottom, joined together by shear webs (q.v.) at front and rear of the booms.
CASA	Civil Aviation Safety Authority.
CAR	Civil Aviation Regulation.
CAO	Civil Aviation Order.
Chord	The distance between the leading and trailing edges of a flying surface such as a wing or tailplane, etc.
C of A	Certificate of Airworthiness.
Control circuit friction	The friction present in a control circuit resulting from the cumulative friction of all the components in the circuit.
Control circuit stiffness	The flexibility of a control circuit, resulting from components deforming under load.
CG	The point on the aircraft through which the total weight acts at right angles to the earth's surface.
CP	Centre of Pressure, the point on a wing through which the lift acts at right angles to the airflow.
CRP	Carbon Reinforced Plastic
CTOA	Chief Technical Officer, Airworthiness, the GFA Officer delegated by the CAA to supervise the airworthiness functions of the GFA
DI	Daily Inspection
D-nose	The D-shaped front section of a wing, forward of the main spar and consisting of a load-bearing skin and numerous internal ribs. Resists the torsional or twisting loads exerted on a wing.
DoTC	Department of Transport and Communications
FRP	Fibre Reinforced Plastic, a generic term for all forms of plastic structures
GFA	Gliding Federation of Australia
GRP	Glass Reinforced Plastic
"I" spar	A spar constructed of two booms, top and bottom, joined together by a single shear web equidistant between front and rear of the booms.

JARs	Joint Airworthiness Requirements, a European standard, Section 22 of which applies to gliders. Hence "JAR 22 requirements".
MAC	Mean Aerodynamic Chord, the average chord of a flying surface, taking into account taper of the surface.
MAR	Mandatory Airworthiness Requirements, a set of GFA requirements for new glider types
MOSP	The GFA Manual of Standard Procedures
MR	Maintenance Release, the document which annually validates the Certificate of Airworthiness or Permit to Fly. Must be kept in the aircraft at all times.
OSTIV	A French acronym which translates into "Scientific and Technical Organisation for Gliding".
OSTIVAS	Airworthiness standards according to OSTIV.
RTOA	Regional Technical Officer, Airworthiness.
Shear	A load tending to deform a structure by sliding one section against another
Shear web	The vertical facing used to join together the top and bottom booms of a glider spar and carrying shear loads when the spar is deflected up and down. A single or double shear web may be used, usually the latter in the thicker part of the wing toward the root and possibly reducing to a single web outboard.
Torque tube	A metal tube which transmits a force to a control surface (e.g. flaps) by means of twisting the tube.
Torsion box	A structure designed to resist torsional (twisting) loads.