GLIDING NEW ZEALAND INCORPORATED

ADVISORY CIRCULAR AC 3-16

NOTES ON THE USE OF TECH 22 MAINTENANCE PROGRAM

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Introduction

The New Zealand Civil Aviation Rules (CAR) state that the operator of a glider must maintain it under an approved maintenance program (CAR Part 104.107). Tech 22 is an approved maintenance program for gliders and powered gliders in terms of this rule.

Tech 22 consists of four different inspections. All must be signed out prior to flight:

- a *Daily Inspection* before the first flight of the day
- an *Annual Inspection* performed within the preceding 12 months
- a *Supplementary Inspection* - applicable only to certain gliders (see note below)
- an inspection before further flight after exposure to *Unusual Flight or Ground Loads*

Annual and Supplemental Inspections

The Annual Inspection requires the glider to be de-rigged, with seat pans removed, to ensure a detailed inspection of internal areas, including wing root ribs, pins and fuselage bulkheads. This inspection should be a thorough visual and functional check of the glider and all its components, assemblies and installations. It is recommended that the fuselage be turned upside down to fully inspect the underside and undercarriage.

A Supplemental Inspection is an additional inspection between Annual Inspections, usually 6-monthly, and is also a thorough functional and visual check of the entire glider and its components, assemblies and installations. De-rigging the glider and removal of seat pans is not required, but would be ideal, and is at the discretion of the certifying engineer.

Supplemental Inspections are required on any glider that is subject to high usage by a number of different pilots of varying skill levels and training regimes. No glider can be flown for more than 200 hours without an inspection. All two-seat gliders used for flight training, club single seaters, and gliders offered for hire are subject to supplemental inspections. Ref MOAP Part 3-1, section 8.

Section 1: Required Documents, Manuals and Data

Inspection, maintenance, adjustment, repair and any change to a certificated aircraft must be performed in accordance with Acceptable Technical Data (ATD). In the case of inspections, ATD includes all information and instructions issued by the original manufacturer, plus other documents such as Airworthiness Directives issued by the NZ Civil Aviation Authority (CAA). These data should be assembled and thoroughly reviewed prior to commencing any inspection or maintenance work. It is not unusual for document review (including obtaining updates) to require as much time and effort as the physical inspection, so be prepared for this.

1.1 These 7 documents must be carried in the glider on every flight. The only exception is that the Flight Manual can be left out of the aircraft provided it is available for pre-flight planning, and that all essential information for flight is placarded clearly in the aircraft (Ref CAA Part 104.9).

Check that the DI book is being filled out correctly each day. If the aircraft requires a Supplemental Inspection between Annuals, confirm that these are being carried out.

1.2 Revision status of Flight and Maintenance Manuals: These manuals need to be updated to incorporate the latest known changes and additions. Verifying revision status can be tricky. Check the manufacturer's web site first. With older gliders the manufacturer may no longer support these documents, and there may have been no change for many years.

Other web sites may have later manuals available. Some manufacturers now charge for manual updates, and these need to be purchased (DG for Rolladen-Schneider LS-4, LS-6).

CAA maintains a Flight Manual status for each certificated aircraft on its web site, but is changing its approach. Do not rely on the CAA status.

1.3 Tech 22 requires that all "mandatory" items in the glider's MM are transferred into this inspection schedule. Such items will appear on pages *Approved* or similarly stamped by the Certifying Authority in the state of manufacture - eg LBA for Germany.

1.4 Pages not annotated as described above are viewed as recommendations, and the inspecting engineer has discretion as to the extent to which the recommendation is followed each year. Maintenance items which may not be in Tech 22 include items like tail braking parachutes in older Schempp-Hirth gliders, adjustable solid ballast systems in DG-1000.

1.5 Log Books: check that the flight times are filled out correctly, and that the airframe hours and launches totals make sense. Certain checks are triggered by these totals. Add engine hours if applicable. Separate recording of aero-tow, winch and self-launches is desirable.

1.6 Note any uncleared defects or pilot reports in the Tech Log, and ask the operator whether there are any further concerns.

1.7 Airworthiness Directives: CAA Rule Part 39 requires that the operator of an aircraft must comply with every Airworthiness Directive (AD) applicable to that aircraft and components or equipment permanently installed in it. An "Applicable AD Schedule" must be included in the maintenance records for each glider, along with a signature certifying compliance with each applicable AD.

Current AD's are available from the CAA web site. The categories which include AD's which may be applicable to any glider are: Airframe Manufacturer, GLIDER, SEAT, RAD, BRAKE, ELEC, EMY, INST. For motor gliders add Engine Manufacturer and Propeller Manufacturer if these categories exist. Examples are Solo engines (includes 2350 engines used in some sustainer systems), Rotax engines and Hoffman propellers.

In the case of a "Recurring AD" a certifying entry must be made in the aircraft (or engine or propeller) log book each time the AD is carried out. This can be on a loose-leaf entry affixed in the log book, or written in directly.

There is no requirement to maintain a list of AD's that have never been applicable to a specific glider, despite this being a common practice in general aviation.

1.8 Review of previous worksheets: It is useful to write down any concerns on the worksheet to guide future inspections. Examples would be wear approaching tolerance limits, signs of corrosion which need to be watched, "recommended" inspections which might be performed in alternate years, and areas of gradual degradation which could need attention in future.

Section 2: Expiry Dates for Non-Annual Items

Some items do not require inspection or maintenance every year. Some of these become due only every few years, and others are triggered by cycles (eg number of launches) or hours flown. All non-annual items need to be reviewed every year to determine whether they have become due.

2.1 Tow hooks are rated for 2,000 launches or 10 years between factory overhaul, whichever comes first. GNZ has obtained a dispensation which only requires replacement or overhaul at 2,000 launches. If an aircraft has both nose and belly hooks connected, then both hooks will require factory overhaul after 2,000 launches.

2.2 If a transponder is fitted: transponder, altitude encoder and altimeter checks must be carried out every two years by a suitably qualified person or organisation. Currently, radio checks are not required. Certification is required in the log book and the expiry date noted in the Tech 19a blue form. If no transponder is fitted then a 2-yearly altimeter check is not required, but the altimeter still needs to be "operative" (CAA Rule Part 104.101).

2.3 ELT(AF) Beacon: The requirements for maintaining a fixed, automatically-activated ELT installation are in CAA Advisory Circular AC 43-11. Gliders have a dispensation to carry a portable, manually-activated beacon instead. These PLB's are the responsibility of the pilot.

2.5 Oxygen regulators: The older A8A instruments (combined pressure regulator and flow regulator) are installed in the instrument panel and require testing and maintenance every four years. A certification from a qualified inspector is required in the log book.

Many pilots have changed to Electronic Delivery System (EDS) units. These are not usually permanently installed in the panel. The manufacturer in USA (Mountain High) recommends that these units are returned to the factory for checking and calibration every two years. This is the responsibility of the pilot or owner. Note that some of the newer digital units have malfunctioned in service, or given incorrect oxygen delivery, even when new.

2.6 A glider needs to be reweighed if there is any significant change in the weight of the aircraft, and the change in centre of gravity (CG) cannot be accurately calculated. An example would be after the installation or removal of significant equipment, a repaint or a significant repair. There is no longer a requirement to reweigh every 10 years.

The handling of a glider will be affected by different CG positions even within the allowable range. If the CG is well forward the glider may feel unresponsive and climbing in weak lift can be difficult. If the CG is well aft the glider becomes less stable and may require frequent control corrections. At the aft limit, spin recovery can take much longer and require aggressive control inputs. Some private owners weigh their gliders with pilot on board, and adjust the in-flight CG for optimal performance. A useful starting point is 30% forward of the aft limit.

2.7 Gliding NZ Form Tech 11 is used to certify that an oxygen cylinder is part of an aircraft installation. This is sufficient authority for a test house to conduct a routine pressure test of the cylinder even when the cylinder does not appear on a list of approved cylinders in NZ. There is more information for both the glider engineer and the test house on the form.

2.8 Seat harness webbing: The MM for older gliders usually calls for replacement of webbing on condition of the webbing or stitching. For newer gliders the MM typically specifies a maximum service period of 12 years regardless of condition.

Check the MM for the specific requirement for each glider. If there is a rated load on the label of each strap, test to that. If in doubt, and if the buckle still functions reliably, have the webbing replaced by an authorised aircraft harness repairer.

2.9 Other non-annual inspection or replacement items: All manufacturer-specified maintenance items must be performed on schedule, even if they are not identified in Tech 22, unless a specific exemption exists. Examples to look for in the MM include:

Control cable replacement

Hydraulic brake fluid replacement

Rubber bungee cords used to remove cable slop or balance trim control

Rubber undercarriage shock-absorber blocks

Major Airframe Inspections at multiples of 3,000 hours

Section 3: Airframe Inspection (This schedule also applies to Supplemental Inspections)

3.1 Unauthorised changes: Some owners make changes to their aircraft without having the proper rating, without reference to Acceptable Technical Data, or without having the changes signed off and recorded in the log book. Operation of a certificated aircraft requires compliance with these three conditions, and the Annual Inspection should confirm this.

For ATD refer to *GNZ AC 3-14 Requirements for Acceptable Technical Data.* Aircraft owners should be familiar with *GNZ AC 3-15 Operator Responsibility for Maintenance.*

Gliders of wood and fabric construction have their own issues with wood rot, fabric aging and delamination of glued joints. If they are stored in damp trailers or hangars this can accelerate deterioration. Establish a schedule for fabric testing. Also check for borer. The British Gliding Association web site has some helpful material on glue joint inspections.

Motorised gliders are subjected to vibration, so screws, bolts and locknuts can easily loosen. Check bolts and screws more carefully: for example, screws which hold the canopy sliding window rails, and bolts on the instrument panel.

3.2 Aft static ports in some gliders are prone to collect water, especially if water ballast is dumped from inboard wing outlets while on descent, as in a racing finish. It is acceptable to suck very gently on one static port at a time, while leaving the opposing port clear. It may be possible to draw out a few drops of water. Sucking too vigorously could draw water into the opposing port.

3.3 Battery installations: The battery needs to be securely mounted, taking into account its weight and possible load on the mounting in severe turbulence or heavy landings. Be aware of terminal posts in close proximity to metal mounting brackets or fuselage members.

The electrical installation is acceptable if it remains as originally fitted by the manufacturer. If changes are made, *CAA AC 43-14 Avionics Installations - Acceptable Technical Data* Appendix 10 may be used as ATD. Appendix 12 of the same document may be used as ATD for the installation of Flarm or other situational awareness devices.

3.5 *GNZ AC 3-03 Glider Tow Releases* contains guidance on the maintenance of glider tow release systems. For older gliders check that the tow release is compatible with the tow rings. If incompatible towing rings are used, there can be excess wear on the tow hook.

3.8 Control surface deflections: Initially perform a simple check to satisfy yourself that the deflections are close to specification. If there appears to be any discrepancy, such as left and right travel not equal, then investigate further and adjust the control stops as necessary.

Rudder: Check control cables at the foot pedals. DCA/GLIDER/1C must be carried out and certified on every glider at every annual inspection. Also check the S-tubes at the pedals if applicable, as these can wear through. Another place to check the rudder cable carefully is at the rudder horns - verify that the thimbles rotate freely and are not clamped against the horns - which would cause the cables to flex every time the rudder was moved.

Flaps: If fitted check that the flap lever drops crisply into its detents. Unintended flap changes at critical phases of flight are best avoided. Nimbus 2 gliders are susceptible.

Airbrakes: Some gliders (eg Std Cirrus) have a maximum closing load to prevent damage to parts of the actuating mechanism (eg. ball joint couplings). If the brakes do not firmly latch closed, they could spring open on the take-off roll, especially on rough ground.

Mylar Seals: If these are fitted, be familiar with GNZ AC 3-07 which has notes applicable to the annual inspection. Check that the seals do not reduce control surface range of movement. Sometimes sealing tape shrinks over time and reduces control surface travel. The control column should contact all its mechanical stops without undue pressure.

3.10 Emergency Equipment: A First Aid kit is mandatory, and the required contents are specified in GNZ AC 3-06. If the glider is flown in mountainous territory, or cross-country flights are being attempted, a survival kit is also recommended.

A glider is required to have a 406 locator beacon if operated more than 10 nautical miles from an aerodrome. This can be a fixed installation, in which case the manufacturer's maintenance requirements must be adhered to, including a logbook entry every time the battery is replaced.

As an alternative, a glider can carry a survival Emergency Locator Transmitter (ELT) or one of the pilots can carry a Portable Locator Beacon (PLB). If the ELT is not a permanent installation in the glider the responsibility for the ELT lies with the pilot - likewise a PLB. The pilot should be aware of any self-test procedures issued by the manufacturer.

Section 4: Certification

4.1 A *Release to Service* (RTS) is a limited certification of the work done by a maintenance engineer, and only applies to that work. By comparison, *airworthiness* is a much broader term which encompasses the entire aircraft design (including the design of any modifications), and which is generally beyond the scope of the maintenance engineer, who can only certify compliance to ATD.

Release to Service after inspection: The wording of the statement entered in the log book needs to follow this wording exactly. This is specified in CAR Part 43.105.

4.3 Duplicate Inspections after a control system has been disturbed: Ref CAR 43.113. Two signatures are required in the log book under this item.

We certify that a duplicate safety inspection has been carried out, and the <specify> control system of the aircraft/component functions correctly, and in respect of the maintenance performed the control system is assembled and locked correctly.

4.4 Tech 19a: A copy of the Release to Service statement is made on Form Tech 19a, which is the blue form in the centre of the DI book. This ensures a copy of the RTS is always available in the aircraft.

A fresh copy of this form can be downloaded from the GNZ web site, printed onto blue paper, and stapled into the centre of the DI book. This form is signed by the certifying engineer. The Tech 19a shows the date when the next annual inspection is due, whereas the log book records the date of the inspection.

The engineer also transfers the expiry date of the ARA onto the Tech 19a for the sake of completeness. This space can be left blank until the ARA is done, if it is imminent. Or the date can be amended and initialed if the ARA is out of phase with the Annual Inspection.

In Block 4 list all non-annual items which might become due within the next 12 months.

4.5 Glider Maintenance Records: In addition to the Tech 22 inspection program, every glider is required to periodically undergo a Review of Airworthiness (RA). The completed RA report is submitted to CAA as proof of continuing airworthiness. The RA is carried out by a person holding an Inspection Authorisation (IA) or IA-G qualification. The Tech 22 work sheet is reviewed as part of that inspection, so needs to be kept with the aircraft maintenance records. Many owners use a box or file to keep the maintenance documents in one place.

A Review of Airworthiness is normally valid for one year. However, there is an exemption from CAA which extends the validity of an RA to 2 years for any glider in the standard airworthiness category not used for training purposes, and not available for hire or reward. Details of the exemption are in 14/EXE/27, listed in the MOAP section of the GNZ web site or visit the CAA web site under "Exemptions".

Section 5: Engine and Propeller

There are three types of engine installation used in gliders:

- sustainer engine, air-started (sometimes referred to as a turbo)
- self-launch retractable engine and propeller
- self-launch non-retractable engine with feathering or folding propeller

These installations are quite different from each other. This engine inspection and maintenance schedule needs to be used in conjunction with the manufacturer's check list. Check only the items which apply or are relevant to your aircraft. An E3 or E4 rating is required to certify an annual inspection. Begin the inspection by assembling and reviewing all relevant and applicable technical data for the engine and propeller.

Section 6: Inspection after Abnormal Flight or Ground Load

Inspection is required after any abnormal flight or ground load has been applied to the aircraft - before further flight. This is a condition of the Tech 22 maintenance program. This inspection can be performed by a GNZ Class 2 engineer, but a Class 3 or 4 engineer should be consulted if there is any doubt or if the incident seems relatively unusual or severe.

If no damage is found the aircraft can be released to service again. Note that the imposition of an abnormal load automatically invalidates the existing release to service. A new release requires a new statement in the aircraft log book - see bottom of the page for the required wording.

If damage is found the aircraft needs to be withdrawn from service and sent to a suitably authorised person for repair. A full description of the incident should be prepared to assist the repairer to trace all the damage. Certification of release to service after repair is beyond the scope of this document.

Each abnormal load event potentially over-stresses and damages different parts of a glider, and this needs to be kept in mind during the inspection. It is not practical to give precise details of inspection requirements for every type of incident because of the wide variation in aircraft design and construction, and the nature of the structural loads that may occur. This section offers guidance on how to find and assess the extent of damage.

Before conducting the inspection, the pilot involved should be consulted regarding the nature of the loads applied. Care and curiosity are necessary when making these inspections, since undetected defects can have catastrophic results. If damage is found, the inspection must be extended to its logical conclusion, as loads sufficient to cause damage at one point can be expected to have caused damage elsewhere, particularly where there is a change in structural section. Follow the trail.

F = Flight Loads

The engineer relies on honest pilot reporting, particularly in aircraft used for aerobatics, where aerobatic manoeuvres gone wrong can cause the structural envelope of the glider to be exceeded. Here are some causes of abnormal structural loads in flight (more than one can occur in a flight):

- encountering severe turbulence when exceeding maximum rough air speed
- over speed - exceeding Vne - may cause flutter damage to control surfaces and linkages
- excessive G-loads - may over-stress wings or the wing-fuselage attachment
- backwards flight (tail slide) - control surfaces may be slammed against their stops

G = Gear-Up Landings

Do not lift the tail of the glider to lower the undercarriage as more damage can be caused as the nose of the glider is loaded, particularly with two-seaters. If the glider can not be otherwise lifted, it must be de-rigged before lifting the fuselage and lowering the undercarriage.

If the pilot reported lowering the undercarriage, the latching mechanism could be at fault or incorrectly adjusted, and the undercarriage could have retracted on touchdown. This can be overlooked in the process of repairing damage, and prepares the way for a further similar incident. Look for free play in the over-centre latch, insufficient over-centre action, or poor latching action.

During a gear-up landing, a fibreglass fuselage skin may distort and tear away from bulkheads - but at rest the skin may return to the original shape, leaving almost no visible sign of damage. Check carefully.

H = Heavy Landings

Primary damage can occur to parts which contact the ground heavily - undercarriage, wing tip, tail boom or nose. Extend the check list accordingly, and look for secondary effects. For example, if the tail slams down on the ground, the tailplane fittings or elevator hinges can be damaged - but if the landing was not witnessed, the pilot may not recall this happening during the turmoil of a ground loop.

It is useful to check the wing natural bending frequency – excite vertically at a wingtip and check for discontinuity or asymmetry in the response of the wings.