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THE FAI INTERNATIONAL GLIDING COMMISSION (IGC)
GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)
FLIGHT RECORDER APPROVAL COMMITTEE (GFAC)

References:
FAI web site:http://www.fai.org
IGC web site: http://www.fai.org/gliding
IGC GNSS web site: http://www.fai.org/gliding/gnss
IGC GNSS site for software: http://www.fai.org/gliding/gnss/freeware.asp

To:	IGC GNSS web site under "List of Approvals"
Notification to:	IGC email mailing list <igc-discuss@fai.org>
	Internet newsgroup rec.aviation.soaring
Copy:	Manufacturer concerned

8 August 2005

IGC APPROVAL FOR ALL FLIGHTS
FOR NTE EASY MATCHBOX GNSS FLIGHT RECORDER

(i) General. This document gives formal approval from the above date for the GNSS FR equipment described below to be used for validation of flights under the FAI Sporting Code Section 3 (Gliders and Motor Gliders), subject to the conditions and notes given later. IGC reserves the right to alter this approval in the future.

(i-i) Versions. This document is the initial approval for this type of recorder and only applies to the recorder module. Other units that are linked by cable to the recorder (such as displays), have not been tested and their performance is a matter between customers and the manufacturer.

(i-ii) IGC-approval Level. This is for "all flights", including world records. The Levels of IGC-approval are listed in Annex B to the Sporting Code for Gliding, para 1.1.3.3.

(ii) GFAC tests. These are concerned primarily with data accuracy, security, data transfer, conversion to and conformity of the output data with the standard *.IGC file format. Other aspects of the equipment may not be tested and are a matter between the recorder manufacturer and customers.

(iii) Sporting Code for Gliding. The attention of NACs, officials and pilots is drawn to the latest edition of the FAI Sporting Code Section 3 (Gliding) including its annexes and amendments. Annex A to this code (SC3A) deals with competition matters, annex B to the Code (SC3B) deals with equipment used in flight validation, Annex C to the Code (SC3C) consists of guidelines and procedures for Official Observers (OOs), pilots, and other officials involved in the flight validation process. Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the IGC web site. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" and is available through the IGC/GNSS web site shown above.

(iv) Exclusions. This approval is not concerned with, and FAI has no responsibility for, matters related to: (a) Intellectual Property (IP) and Intellectual Property Rights (IPR) or, (b) the relations of the Organisation with any others except with FAI and its agents or as they affect FAI, its agents and this approval.

(v) Standards and Procedures. This approval document is concerned solely with the standards of, and procedures relating to the hardware, firmware and software for the type(s) of recorder described below and manufactured, updated or serviced by the Organisation listed below under "Manufacturer" and updated or serviced by official agents authorised by the Organisation to carry out such work.

(vi) Copies of this IGC-approval. It is recommended that a copy of this approval including its two annexes is kept with each unit of the equipment.

MANUFACTURER:
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info@glider.it and www.glider.it

IGC Manufacturer codes: Three-letter, NTE. One letter, N
Contact: Marcello Bonini

EQUIPMENT

HARDWARE

Version. Version 012 or later (for IGC-approval of later versions, see para 6 below). The version number is shown in the IGC file header record after "HF RHW HARDWARE VERSION".
Dimensions. The Recorder unit consists of a rectangular metal case about 132 x 90 x 90mm and weighs about 850gm. It is designed to be used with other units such as a separate one for Display.
Connectors and lights. All are on one of the 90 x 90mm ends. Connectors include a 9mm BNC bayonet fitting for a GPS antenna, four 4mm diameter pressure probes (for tubes to be fitted for capacity, pitot, static and Total Energy), an 8-contact RJ45 female connector labelled CN1, a rectangular 15-pin female connector labelled CN2 and a rectangular 15-pin male connector labelled CN3, and finally a fuse unit (see below under "permitted connections"). At the top of the RJ45 connector are two lights, yellow on the left and green on the right.
GPS Receiver board. Japan Radio Corporation model JRC CCA-450.
Pressure altitude. The Intersema MS5534-AP sensor/transducer is used. The Recorder case is vented to atmosphere and pressure altitudes in the IGC file are "cockpit static" pressure (the "static" pressure tube connector on the case is for connecting to an external module).
National regulations
These may apply to electrical and electronic equipment, such as the European Union "CE" mark for compliance with EC directives on EMC and voltages. Compliance with such regulations is not the responsibility of FAI. It is understood that this equipment has the EU "CE" mark.

FIRMWARE

Firmware version 030 or later (for IGC-approval of later versions, see para 6 below). The version number is shown in the IGC file header record after "HF RHW FIRMWARE VERSION".

SOFTWARE

Downloading of flight data uses the Microsoft Windows-based IGC Shell system that is available on the IGC GNSS web in the file igcdll.zip. Download these IGC Shell files into a specific directory that you have named in advance (the name IGCshell is recommended). For the shell program to work with a recorder, the appropriate Data Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory. For the NTE Matchbox, the file IGC-NTE.DLL is available on the IGC GNSS web site and on the manufacturer's CD-ROM.

Latest versions. The latest versions of the files in igcdll.zip and the manufacturer's DLL files must be used, obtained from the IGC GNSS site for software given at the beginning of this document.

Free availability. The DLL file is copyright of the FR manufacturer but is freeware.

CONDITIONS OF APPROVAL

1. Permitted Connections to the Recorder.

1.1 External antenna. This connects to a 9mm circular BNC bayonet connector on the upper left side of the FR case.

1.2 RJ-45 connector. A male 8-pin RJ-45 connector has NTE proprietary wiring that includes connections for 12V external battery power and an RS232 female 9-pin connector for upload and download of data to and from the recorder.

1.3 15-pin connector. A female 15-pin D-type connector with the Pilot Event (PEV) and fast-fix button, plugs into the male 15 pin D-type connector on the recorder unit.

1.4 Pressure connections. Four pressure connections for tubes for capacity, pitot (airspeed), static and Total Energy pressure values.

2. **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment. See paras 4.1 - 4.2 on security seals. GFAC reserves the right to inspect production-standard equipment from time to time for security and general compliance with the IGC Specification.

2.1. Installation in a glider. From a technical aspect, the FR may be fitted anywhere in the glider, subject to paras 2.2 (Motor Gliders) and 2.3 (sealing). However, the position of any displays and operating buttons and controls used in flight in single-seat gliders should not be remote from sight-lines used for pilot lookout and scan for other aircraft and gliders. If the GPS antenna is accessible to the crew in flight, no attempt must be made to inject any false data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew.

2.2. Motor gliders. A microphone and frequency filter and weighting system designed by NTE automatically produces an ENL (Engine Noise Level) value with each fix. ENL figures recorded vary between 000 and 999 in steps of 001. The system is designed to emphasise any engine noise but produce only low ENL values in normal quiet gliding flight. The FR must be positioned in the glider so that it can receive a high level of engine and/or propellor noise when power is being generated. GFAC has tested the FR in motor gliders with two-stroke and 4-stroke engines, but not with Wankel or electric power sources. For details of typical ENL values, see para B.4.

2.2.1. Electric engines. If an electric engine is to be used, GFAC should be notified beforehand so that tests can be carried out in order to establish ENL values in various cockpit positions.

2.3. Sealing of data ports and plugs: no present requirement, but no attempt must be made to pass unauthorised data into the FR.

3. **Check of Installation in the Glider**. There must be incontrovertible evidence that the FR was in the glider for the flight concerned, and was installed in accordance with IGC procedures. This can be achieved either: by observation at takeoff or landing, or by sealing the FR to the glider at any time or date before takeoff and checking the seal after landing.

3.1. Observation of Installation before Takeoff or at Landing. For observation, either a preflight check of the installation must be made and the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is in accordance with the rules, and that another FR has not been substituted before the data is transferred to a PC after flight.

3.2. Sealing to the Glider before Flight. If para 3.1 cannot be met, the FR must be sealed to the glider by an OO at any time or date before flight so that it cannot be removed without breaking the seal. The sealing method must be acceptable to the NAC and IGC. Paper seals must be marked in a manner such that there is incontrovertible proof after the flight that seals have not been tampered with, such as by marking with the glider registration, the date, time and OO's name and signature. It should be possible for the OO to recognise the seal markings afterwards. The use of adhesive plastic tape is not satisfactory for IGC-approved sealing because it can be peeled off and re-fitted. Gummed paper tape is recommended, as used for sealing drum-type barographs. The OO must seal the FR unit to glider parts which are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the FR is sealed to such removable part, if such a part is transferred between gliders, any FR seal for the previous glider must be removed.

4. **Security - Physical and Electronic**.

4.1. Physical Security. A tamper-evident seal with the manufacturer's name is fitted over one or more of the case securing screws. In addition, an internal security mechanism activates if the case of the FR is opened.

4.2. Electronic Security. If the internal security mechanism has been activated (such as by opening the case), the security record (G-record) will be removed from subsequent IGC files and a line placed in the IGC file header record that includes the words "SECURITY MICROSWITCH OPERATED". Also, such files will fail the IGC Validation test for electronic security. This test will also fail if the *.IGC file being analysed is different from that originally downloaded from the FR, even by one character in the flight data area.

4.3. FR found to be unsealed. If either physical or electronic security is found to have failed, the FR must be returned to the manufacturer or his appointed agent for investigation and resealing. A statement should be included on how the unit became unsealed.

4.3.1. Checks before re-sealing. Whenever any unit is resealed, the manufacturer or agent must carry out positive checks on the internal programs and wiring, and ensure that they work normally. If any evidence is found of tampering or unauthorised modification, a report must be made by the manufacturer or agent to the Chairman of GFAC and to the NAC of the owner. The IGC approval of that individual unit will be withdrawn until the unit is re-set and certified to be to the IGC-approved standard.

5. **Analysis of Flight Data**. Analysis for flights to be validated to IGC criteria must be through the use of a program which complies with IGC rules and procedures and is approved for this purpose by the relevant NAC.. For a list of

programs which are capable of reading and displaying flight data in the *.IGC file format, see the IGC/GNSS web site under the link button to SOFTWARE (the full web reference is at the beginning of this document). Before a Flight Performance is officially validated, the authority responsible for validation must check that the data in the *.IGC file has originated in a valid way from the Recorder concerned, and is identical to the file that was downloaded from the Recorder to a PC. This is simply done by checking the IGC data file with an authorised copy of the IGC Shell program and using the Validate function on the IGC Shell menu. The manufacturer's DLL file will also be needed in the IGC Shell directory The shell program and DLL file must have originated from the current FAI/IGC web site for software at the beginning of this document. See Annex B for how to use the IGC Shell program with any IGC flight data file.

6. **Manufacturer's Changes, later Versions of Hardware, Firmware and Software**. Notification of any intended change to hardware, firmware or software must be made by the manufacturer to the Chairman of GFAC so that a decision can be made on any further testing which may be required to retain IGC-approval for the change. It includes changes of any sort, large or small. This includes details of later Versions of hardware, firmware and software, also any changes to modules such as GPS receiver boards, pressure altitude transducers and the layout of the security microswitch and its shielding from possible interference. If in doubt, GFAC should be notified so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan
Chairman, IGC GFAC

Annexes:
A. Notes for owners and pilots
B. Notes for Official Observers and NACs

Any Queries to:
Chairman IGC GFAC, Bentworth Hall West, Alton,
Hampshire GU34 5LA, England
Tel: +44 1420 564 195; Fax: +44 1420 563 140;
email: ian@ukiws.demon.co.uk

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Annex A to IGC-approval document

NOTES FOR OWNERS AND PILOTS
PART OF IGC APPROVAL FOR NT EASY MATCHBOX GNSS RECORDER

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of the approval document including annexes is kept with the equipment concerned, for the use of pilots and Official Observers.

Pilot's Responsibility. It is the responsibility of the pilot to ensure or to note the following:

A.1. **Antenna** - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No deliberate attempt must be made to inject data via the antenna, and any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

A.2. **Geodetic Datum**. For IGC purposes, all latitudes and longitudes recorded by the FR must be to a Geodetic Datum (earth model) of WGS84. This type of recorder is fixed on the WGS84 datum and no selection or switching is required except to ensure that other lat/long data such as for start, turn and finish points, is entered also to the WGS84 Geodetic Datum (IGC rule).

A.3. **Setting the Fix Interval**. The fast-fix facility operates when the Pilot Event (PEV) button is pressed and gives 60 fixes at one second intervals after the PEV event. The fix interval for cruise flight between PEV events (such as between Waypoints) is set by the pilot before flight through the set-up program provided by the manufacturer. There is therefore no need to set a very short fix interval for cruise flight because points of interest can be marked by PEV events and take advantage of the fast fix facility. Setting a short fix interval for cruise flight leads to IGC files of large byte size, particularly for long flights. This uses up more of the recorder's memory, causes downloading after flight to take a long time, increases the chance of data corruption and may also cause problems with some analysis programs because of the large number of fixes that have to be processed. IGC rules on fix intervals for cruise flight are an absolute maximum of 60 seconds (SC3 para 4.3.1 and Annex C to SC3, para 7.1) and 10 seconds for competitions complying with Annex A to SC3 (SC3A para 5.4C). SC3C para 7.1 says: "10 to 20 seconds has been found to be suitable, and does not use up as much memory as a more frequent setting for the whole flight. A more frequent fix interval is recommended near a Waypoint to ensure that a fix is recorded within its observation zone".

A.4. **Observing the FR installation in the glider**. The pilot must ensure that an OO has checked the place of the equipment in the glider and how it is fixed to the glider. If it may be difficult to obtain an OO immediately before takeoff, or to witness the landing, you should ask an OO to seal the FR to the glider, and **this can be done at any time or date before flight**. See para 3 in the conditions of approval. Regarding the position of displays concerned with the FR, see para 2.1 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

A.5. **Takeoff** - The pilot must ensure that the time and point of takeoff has been witnessed and recorded for comparison with that recorded by the GNSS FR, see para B1.2.

A.6. **Connection to Ports**. Although this approval does not presently require sealing of any ports or plugs, no attempt must be made to pass unauthorised data into the FR. See paras 2.3 and 3 in the conditions of approval.

A.7. **Use in Motor Gliders** (including self-sustainers): The internal microphone and associated circuitry automatically records an ENL (Engine Noise Level) value with each fix. The recorder must be placed so that engine noise is clearly received when the engine is giving power and must not be covered or insulated (even so, automatic gain should continue to ensure high ENL readings under power).

A7.1 Cockpit Noise. Pilots should note that other cockpit noises will produce ENL readings, and avoid those which could be mistaken for use of engine. Generally the frequency filtering built in to the FR will avoid any problems, but it should be noted that **sideslipping or high speed flight with the cockpit Direct Vision (DV) or ventilation side-panel(s) open can produce a low-frequency sound (organ pipe note) which will register as high ENL** and this should be avoided. So will spins and stall buffet, particularly in Motor Gliders if the engine bay doors flutter (move rapidly in and out). Flight close to powered aircraft should also be avoided, except for normal aero-tow launches. For ENL levels that have been recorded on GFAC tests, see B.4.2.

A.8. **After Flight**. The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with that recorded by the GNSS FR (see para B2.1). Until an OO has witnessed the FR installation to the glider, the pilot must not alter the installation or remove the FR from the glider. The OO will carry out the actions given in para B2.3, and the OO's copy of the transferred flight data will be sent to the NAC. The OO does not personally have to transfer the data from the FR, but witnesses the transfer and takes or is given a copy on electronic media. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to IGC record and badge rules, the above continues to apply.

A8.1 Use of Portable PC at the glider. So that there is no need to disturb the cockpit installation or any sealing to the glider, a portable (laptop/notebook) PC can be used for downloading of data at the glider. The portable PC may be owned by any person including the pilot. It should be set up for ease of downloading, such as by easy access to the current IGC Shell program with the NTE DLL file. Downloading of flight data is witnessed by the OO, and the flight data in IGC format is given to the OO on portable media such as a floppy diskette or memory stick.

A.9. **Calibration of Barograph Function**. Pilots are advised to have a barograph calibration carried out either by the manufacturer or by an NAC-approved calibrator before any GNSS FR is used for a claimed flight performance. For the procedure, see para B5. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the FR for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

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Annex B to IGC-approval document

NOTES FOR OFFICIAL OBSERVERS AND NACs -
PART OF IGC APPROVAL FOR NT EASY MATCHBOX GNSS RECORDER

B(i). Status. To be read together with the main terms of approval to which this is an Annex.
B(ii). IGC-Approval level. This recorder may be used for all flights including world records.
B(iii). Copy of this document. It is recommended that a copy of this approval document is kept with the equipment concerned, for the use of pilots and Official Observers.

B.1. **Installation and Takeoff Records**

B.1.1. Installation in the Glider. It should be noted that, due to the portability of this Recorder, it would be easy to transfer it from one glider to another, or from a powered aircraft to a glider. Therefore, an OO shall witness and record the position of the FR in the glider, the type and serial number of the FR, the glider type and registration, date and time. Before flight, if requested, the OO shall then seal the FR to the glider in a way acceptable to his NAC and to IGC, and such sealing may be at any time or date before flight. If sealing is not used, either a preflight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight. Alternatively, an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is correct, and another FR has not been substituted in the glider before the data transfer (B2.3). See paras 2 and 3 of the Conditions of Approval. Regarding the position of displays concerned with the FR, see para 2.1 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

B.1.2. At Takeoff. The time and point of takeoff shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the takeoff data from the Recorder.

B.2. **Landing**.

B.2.1. At Landing. The time and point of landing shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the landing data from the Recorder.

B.2.2. Checking the Installation of the FR. As soon as practicable after landing, an OO shall inspect the installation of the FR in the glider (including any sealing to the glider), so that this can be compared to the check described in para B1.1 above. The transfer of flight data shall then take place in accordance with B2.3.

B.2.3. Transferring the Flight Data. If a portable PC is available, the flight data may be transferred at the glider without disturbing the installation of the FR; if a portable PC is not available, the OO shall check and break any sealing to the glider, and take the FR to a PC. If the OO is not familiar with the actions required, the pilot or another person may transfer the data while the OO witnesses the process. Security is maintained by electronic coding embedded in the FR which is then independently checked later at the NAC (and at FAI if the claim goes to them).

B.2.3.1 Method: Use the manufacturer's cable that has an RJ45 connector for the recorder, a female 9-pin RS232 for connecting to a PC and 12 volt power connections to power the recorder. Make sure that the PC has the IGC Shell program files in a specific directory (the name IGCshell is recommended). These files are available on the IGC GNSS web pages through the file igcdll.zip. For the shell program to work with a recorder, the appropriate Data Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory. For the NTE Matchbox, the file IGC-NTE.DLL is available on the IGC GNSS web site and on the manufacturer's CD-ROM. After copying it to the directory that contains the IGC Shell files, execute IGC-SHELL.EXE. Set the path to the IGCshell directory using the "Set Directories" button. The IGCshell menu will now appear in a grey rectangular box with 9 software buttons for selecting the recorder type, recorder settings and flight logs. The recorder software box at the top should now include the line "NT New Technologies s.r.l. 1.0 Easy Matchbox". This should be selected. With the recorder connected to the PC and the correct Com Port selected on the IGCshell screen, selections for data Download, file Conversion to IGC format and Validation can now be made using the screen buttons provided.

B2.3.1.1 Latest File Versions. The latest versions of the IGC shell and DLL files must be used. These can be obtained from the IGC GNSS site for software listed at the beginning of this document.

B.2.3.2 Files Produced. This process will automatically produce both a *.NTE binary format file and an *.IGC-format ASCII flight data file with the file name YMDEXXXF.NTE (binary) and YMDEXXXF.IGC (ASCII), where Y=year, M=month, D=day, E= manufacturer, XXX = FR Serial Number/letters and F = flight number of the day (full key, Appendix 1 to the IGC GNSS FR Specification, copied in Annex C to the Sporting Code, SC3C).

B.2.3.3 OO's Copy. A copy of both the *.NTE and *.IGC files shall be retained securely by the OO such as by immediately copying them to a separate diskette or PC card, or by the use of the OO's own PC. These files shall be retained by the OO in safe keeping for later checking and analysis under NAC procedures. The OO may keep the required data files on a floppy diskette or other industry-standard portable storage media. The hard disk of a PC may also be used but the OO must be able to positively identify the flight data files as being from the flight concerned.

B.2.3.4 Competitions. Different rules may apply for competition flights, for which a central data transfer facility may be used. For ease of identification within the competition, file names may be changed, for instance to the glider competition number or the pilot's name. Integrity of data within the file is preserved by the electronic security system and may be checked at any time by using the validation process described in B2.3.1 above.

B.3. **Analysis of Flight Data Files**. A Data Analyst approved by the NAC will then evaluate the flight using an analysis programme approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking flight data, the Validation process (see B2.3.1 above) shall be used by the NAC and by FAI (if the data goes to them). This checks the electronic security coding, that the FR had not been interfered with, and that the flight data in the *.IGC file is identical to that which was transferred from the FR. The latest versions of the files needed for the validation process must be used and are available from the IGC GNSS web site for software given at the beginning of this document. **Method:** Use the IGC Shell program together with the manufacturer's DLL as explained in B2.3.1 above. Scroll to the IGC file to be checked and use the Validate software button.

B.4. **Means of Propulsion (MoP) Record - Motor Gliders**. The MoP must either be sealed or inoperative, or the built-in microphone system used that records a three-number Engine Noise Level (ENL) with each fix on the IGC file. See para 2.2 for more details on the ENL system. ENL values recorded on GFAC tests are given below, in the sequence of a flight.

B.4.1. ENL during launching. During winch and aerotow launches, higher ENL values are to be expected than when soaring (B4.3), typically up to ENL 300 for winch and 200 for aerotow. During the ground roll, short-term high values have been recorded due to wheel rumble, and ENL 400 has been seen for one or two fixes.

B.4.2. ENL during engine running. On engine running at powers needed to climb, an increase to over 900 ENL is expected. 999 is typical for a two-stroke engine, over 900 for a 4-stroke. During engine running, these high ENLs are produced for a significant time, and when altitude and speed are analysed it can be seen that substantial energy is being added, which can therefore be attributed to energy not associated with soaring. The values quoted above are for 2- and 4-stroke engines, Wankel (rotary) and electric engines have not been tested. There is no reason to believe that Wankel engines will not produce similar values to 4-strokes.

B.4.2.1 Electric Power. If an electric engine is to be used, please contact GFAC as soon as possible so that tests can be carried out.

B.4.3. ENL during gliding flight. ENL readings of less than 050 indicate normal gliding flight in a quiet cockpit environment. In a high-speed glide or in an aerodynamically-noisy glider, ENL may increase to about 100. Short periods of higher ENL while gliding (up to about 300 ENL) may indicate aerodynamic noises such as due to airbrakes, lowering the undercarriage, sideslip, etc, and are normal before landing. **Flight with the canopy ventilation panel open can produce low frequency noise, particularly with sideslip ("organ-pipe" effect)**. With canopy panel(s) open, ENL readings of up to 250 have been recorded while thermalling and up to 500 at higher speeds such as 100 knots (during which a descent will normally be recorded). High ENL may also be recorded during stalling and spinning, particularly if the engine doors flutter or vibrate (where the doors move slightly in and out due to stall buffet, producing a clattering noise). Finally, where the engine is mounted on a retractable pylon, a high ENL reading will be shown if flying with the pylon up and engine not running, due to the high aerodynamic noise.

B.4.4. ENL during the approach to land. ENL values are always higher on a landing approach due to aerodynamic noises such as due to airbrakes, undercarriage, sideslip, turbulence, etc. Short-term peaks due to specific actions such as opening airbrakes, lowering undercarriage, etc., will be noted as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 200 have been recorded, although 120 is more typical in an aerodynamically noisy glider, and 80 in a quieter machine.

B.4.5. ENL during landing. During ground contact during landing, short-duration ENL readings up to about 600 have been recorded due to wheel rumble. Unlike engine running these last only for a short time, showing a short spike on the noise/time trace.

B.4.6. ENL analysis. It is normally easy to see when an engine has been running and when it has not. Other data such as rates of climb/descent and groundspeed, will indicate whether or not non-atmospheric energy is being added. Short term peaks in ENL (10 seconds or so) may be due to the other factors mentioned above such as undercarriage and/or airbrake movement, sideslip, open cockpit panel/sideslip, the nearby passage of a powered aircraft, etc. If in doubt, email the *.IGC file to the GFAC Chairman for further analysis and advice (see earlier for email address).

B.5. **Altitude analysis and calibration**

Flight data files will be analysed in accordance with Sporting Code procedures. Part of this is to compare the general shapes of the GNSS and pressure altitude fix records with time and to ensure that no major differences are seen that could indicate malpractice or manufactured (false) data. As part of this process, the FR is calibrated in an altitude chamber in the same way as a drum barograph.

B.5.1. Calibration method, making a calibration table. You are advised to set the normal fix rate to a small time interval such as 5 seconds or less. Recording starts after a pressure change of 1 metre per second for 5 seconds, and no GPS fixes are required for a pressure altitude trace to be produced. The calibrator should be advised to make a short pressure change to trigger recording before starting the calibration itself. The calibrator will record the pressure steps used, for later comparison with the flight file. The stabilised pressure immediately before the altitude is changed to the next level, will be taken as the appropriate value unless the calibrator certifies otherwise. After the calibration, the data file containing the pressure steps is transferred to a PC as if it was flight data (see B2.3 above); this may be done by an NAC-approved person other than the calibrator who may not have this knowledge. The IGC format calibration data file will then be analysed, compared to the calibration pressure steps, and a correction table produced and authenticated by an NAC-approved person (for instance an OO or GNSS Recorder Data Analyst). The correction table will list true against indicated altitudes. This table can then be used to adjust pressure altitudes which are recorded during flight performances and which require correction before validation to IGC criteria. These include takeoff, start and landing altitudes for altitude difference and for comparison with independently-recorded QNH readings, and low and high points on gain-of-height and altitude claims. Only pressure altitude is valid for IGC altitude purposes except for proof of flight continuity (no intermediate landing) where GNSS altitude may also be used.

B5.2 GPS altitude figures recorded in the IGC file. Occasional short-duration differences in the shape of the GPS Altitude/time graph have been noted compared to the pressure altitude figures. This is not unusual with GPS receivers operating without a local differential beacon. The altitude accuracy from satellite-based systems will not be as good as accuracy in lat/long, because satellite geometry is not as favourable for obtaining accurate altitude fixes compared to horizontal position. This effect may be increased by less-than ideal antenna positioning in some gliders. Data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records. Lat/long fix accuracy is not affected and tests on this recorder show it to be typical of that for a 12 channel GPS system. From GFAC tests after 1 May 2000 when the GPS Selective Availability error was removed, the lat/long error taken from a moving vehicle at a surveyed point, averages between 11 and 12m for all 12 channel recorders tested since that date.

B.5.2. **Maximum Altitudes Recorded in the IGC file.** The pressure altitude sensor and the GPS system itself are capable of recording to almost unlimited altitudes, certainly up to 30km/100,000ft. However, the type of processor in the recorder and the need for good resolution (lack of large steps) across the altitude range, results in limitations in altitudes that can be recorded in the IGC file. The maximum altitudes for figures in IGC files that apply to this recorder are given below.

B5.3.1 Pressure Altitude. Pressure altitudes are recorded up to 8,000 m (26,247 ft).

B5.3.2. GNSS altitude. GPS altitude is recorded up to 9,000 m (29,528 ft).

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