FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE
Avenue Mon-Repos 24 - CH-1005 Lausanne - Switzerland
Tel +41 21 345 1070; Fax +41 21 345 1077; sec@fai.org

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

10 January 2007

IGC-APPROVAL FOR GNSS FLIGHT RECORDER
Type of Approval: All Flights
Recorder: NTE Easy

(i) General. This document gives formal approval from the above date for the Recorder 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) Document Versions. This document is the initial approval for this type of recorder and only applies to the recorder module. The performance of other units that may be linked by cable to the recorder 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.

(i-iii) GNSS System. The Global Navigation Satellite System (GNSS) used in this Recorder is the US Global Positioning System (GPS).

(ii) This IGC-approval document is concerned with the functions of the equipment that record data. More specifically, with the accuracy and reliability of recorded data for the exclusive sole purpose of validation and certification of flight performances to the criteria of IGC and FAI. FAI is the legal entity and Swiss law applies. FAI Commissions such as IGC are agents of FAI; GFAC and its advisors are agents of IGC. Tests made by GFAC on behalf of IGC and FAI concern accuracy and security of data, transfer and conversion to and conformity of the output data with the standard *.IGC file format in relation to the validation and certification purposes mentioned above. Other functions of the equipment are not part of this IGC-approval and the relevance of this document does not extend beyond the specific validation and certification purposes mentioned above. In particular this applies to any function linked with aspects that could be critical to flight safety such as navigation, airspace avoidance, terrain avoidance and any aircraft proximity-warning and/or anti-collision functions. This document does not constitute any approval, guarantee and/or any statement by GFAC, IGC and/or FAI as to the reliability or accuracy of the equipment for operation in flight and any liability in connection therewith is hereby expressly excluded.

(iii) This approval is not concerned with, and FAI has no responsibility for, matters related to: (a) Intellectual Property (IP) and Intellectual Property Rights (IPR) and/or, (b) the relations of the Manufacturer listed below with any other entities except with FAI and its agents or as they affect FAI, its agents and this approval.

(iv) The attention of National Airsport Control (NAC) authorities, 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) with equipment used in flight validation, Annex C to the Code (SC3C) with guidelines and procedures for Official Observers, 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 also available through the IGC/GNSS web site shown above.

(v) It is recommended that a copy of this approval including its two annexes is kept with each unit of the equipment so that it is available for pilots and Official Observers

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MANUFACTURER

N.T. New Technologies s.r.l., Via A. Colombo N 130, Gorla Minore (Varese), Near Milan, Italy
Tel: +39 0 33 160 4417 ; Fax: +39 0 33 160 4413
email/web: info@ntsrl.it and www.ntsrl.it Contact: Luca Bonini
IGC-allocated manufacturer codes: Three letter NTE, single letter N

EQUIPMENT

1. HARDWARE

1.1 **Recorder Name**. New Technologies Easy Flight Recorder.

1.2 **Hardware Version**. Version 011 was the original IGC-approved hardware standard. Later versions may be used if they are IGC-approved, see para 11 below about IGC-approval of updates. The Version number is shown in the header record of IGC-format flight files in the form "HF RHW HARDWARE VERSION:011" which can be seen by using a text editor to view the start of the IGC file.

1.3 **Dimensions, Weight, Power Source**. The recorder is in a rectangular case in hard black plastic 106 x 65 x 29mm in size and weighs about 170 grammes. It is powered from an external 12V source and has no internal battery except a small one to sustain the memory, security algorithms and Real-Time Clock.

1.4 **Connectors and light.** All connectors are on an end face, the other end face is blank. There is an antenna connector and two multi-pin sockets, described in more detail later in para 4. A small red light is on one of the large 195 x 65 mm faces together with a button that is used for marking a Pilot Event (PEV) starting a set of fast fixes.

1.5 **GPS receiver**. The GPS receiver is the16-channel LEA-4A by uBLOX of Switzerland (www.u-blox.com)

1.6 **Pressure altitude sensor.** The Pressure Altitude sensor is the MS 5534-BP by Intersema Sensoric SA of Switzerland (www.intersema.ch). This is compensated for temperature variation and calibrated to the ICAO ISA. The recorder case is not pressure-sealed and "cockpit static" pressure is recorded on the IGC file.

1.7 **National and other regulations**. These may apply to electrical and electronic equipment. Compliance with such regulations is not the responsibility of FAI. It is understood that this equipment has the EU "CE" mark that implies compliance with EU directives on EMC and voltages.

1.8 **Other modules**. Other modules may be connected but are not part of this IGC-approval and are a matter between the manufacturer and the customer.

2. FIRMWARE

Version 024 was the original IGC-approved firmware standard. Later versions may be used if they are IGC-approved, see para 11 below for IGC-approval of updates. The firmware version is listed in the header record of IGC files in the form "HF RFW FIRMWARE VERSION:024" and can be seen by using a text editor to view the start of the IGC file.

3. SOFTWARE

Downloading of flight data is through the Microsoft Windows-based IGC Shell system that is available without charge from the IGC GNSS web site in the file igcdll.zip. The IGC Shell files should be downloaded into a specific directory that is 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 this recorder, the file IGC-NTE.DLL is available on the IGC GNSS web site.

3.1 **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.

3.2 **Free availability**. The IGC Shell program is free and the manufacturer's DLL file is freeware but is copyright of the Recorder manufacturer.

3.3 **Validity of Flight Data**. The IGC standard for electronic flight data is that the IGC file must pass the IGC VALIDATE check. That is, by using the Validate function of the IGC Shell program together with the IGC-NTE.DLL file in the same directory and interrogating the IGC file that is to be Validated. This checks that the IGC file has correctly originated from the recorder and that it is identical to when it was initially downloaded (that is, the data has not been changed later so that it is different). See B3.3.1.1 for more details.

CONDITIONS OF APPROVAL

4 **Permitted Connections to the Recorder.**

4.1 External antenna. This connects to a 4mm circular Sub-Miniature Type C (SMC) screw connector on an end face of the case.

4.2 RJ-45 connector. A 8-pin RJ-45 socket is on the same face as the antenna connector. This is used with a manufacturer's cable with IGC-standard wiring. This cable includes connections for 12V external battery power and may also have a RS232 female 9-pin connector for upload and download of data to and from the recorder.

4.3 6-pin RJ-11 connector. A 6-pin RJ-11 socket on the recorder case is between the antenna and RJ45 connectors and is for connecting other modules. Such modules are outside the scope of this document and are a matter between the manufacturer and the customer.

5 **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment in terms of the integrity of the recorded flight data. See paras 8.1 and 8.2 on security seals. GFAC reserves the right to inspect production-standard equipment from time to time for security, general compliance with the IGC Specification and the calibration of sensors such as for pressure altitude and Engine Noise (ENL).

6 **Installation in a glider**. From the point of view of data recording, the unit may be fitted anywhere in the glider, subject to para 8 on sealing and, for Motor Gliders (para 7), that the position is suitable for recording Engine Noise Levels (ENL). However, the position of any displays, lights 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.

7. **Cockpit Noise Level Recording - ENL system**. An ENL (Engine Noise Level) recording system is fitted and is permanently enabled so that acoustic noise levels at the recorder are always recorded with each fix. This is essential for Motor Gliders in order to show that the engine was not run during the part of the flight that contains the claimed glide performance. ENL data has also been shown to be useful for non-motor gliders in the case of accidents and incidents.

7.1 ENL Recording System Manufacturer. The ENL system in this recorder is made by NTE.

7.2 ENL figures. ENL figures in each fix in the IGC file are between 000 and 999 in steps of 001.

7.3 ENL IGC-approval - Engine Types. This document gives IGC-approval for the use of the above system for the validation of glide (non-powered) performances to IGC standards of evidence when flown with Motor Gliders that have internal-combustion engines that give substantial acoustic noise levels in the cockpit.

7.3.1 Electric or other Quiet Engines. This approval does not include use with Motor Gliders with electric or other engines that produce little noise in the cockpit, particularly under reduced power such as for level flight. If an electric or another quiet engine is to be used, GFAC should be notified beforehand so that tests can be carried out.

7.4 ENL System and Cockpit Positioning. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. The system is designed to highlight any engine noise but produce low ENL values in gliding flight. The recorder must be positioned in the glider so that it can receive a high level of engine and propellor noise when forward thrust is being generated.

7.5 ENL testing. GFAC has tested the Recorder in motor gliders with different types of internal-combustion engines, but not with electric or other power sources that produce little noise in the cockpit. For details of typical ENL values, see para B.4.

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

8.1 Observation of Installation before Takeoff or at Landing. For independent Observation, either a preflight check of the installation must be made by by an IGC Official Observer (OO) 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 Recorder installation is checked. This is to ensure that the installation is within the rules, and that another Recorder has not been substituted before the data is transferred to a PC after flight.

8.2 Sealing to the Glider before Flight. If direct observation under para 8.1 cannot be achieved, the recorder 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 Recorder 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 Recorder is sealed to such removable part, if such a part is transferred between gliders, any Recorder seal for the previous glider must be removed.

9 **Security - Physical and Electronic**.

9.1 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 Recorder is opened.

9.1.1 Sealing of data ports and connectors: no present requirement, but no attempt must be made to pass unauthorised data into the Recorder.

9.2 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 Recorder, even by one character in the flight data area.

9.3 Recorder found to be unsealed. If either physical or electronic security is found to have failed, the Recorder 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.

9.3.1 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.

10 **Analysis of Flight Data**. Analysis for flights to be validated to IGC criteria must be through the use of a program that 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 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.

11 **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. This includes changes of any sort, large or small. It 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 questions to: Chairman IGC GFAC,
Bentworth Hall West, Alton, Hampshire GU34 5LA, UK
Tel: +44 1420 564 195; Fax: +44 1420 563 140;
email: ian@ukiws.demon.co.uk

NOTES FOR OWNERS AND PILOTS
PART OF IGC APPROVAL

A(i). Status. To be read together with the main terms of approval to which this is an Annex.
A(ii). IGC-Approval level. This type of recorder is IGC-approved for all flights including world records.
A(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.

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

A1 **Antenna** – The 4mm diameter SMC antenna has a screw fitting. Since this could work loose, owners and pilots are recommended to ensure that the connector is firmly screwed and lightly fixed with locking agent so that it cannot be loosened or become detached due to vibration or turbulence in flight. The locking agent used should prevent it from inadvertent un-screwing but enable it to be unscrewed later if required.

A1.1 Reception. The antenna should be positioned to give sufficient signal strength for fix recording. No deliberate attempt must be made to inject data via the antenna. Any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

A2 **Geodetic Datum (Earth Model)**. For IGC purposes, all latitudes and longitudes recorded by the Recorder 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).

A3 **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.

A3.1 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".

A4 **Checking the Recorder before a Claim Flight**. Pilots should check and analyse a selection of IGC files from their recorder before attempting flights that will require Validation. This is to ensure that the recorder is performing correctly and in accordance with this approval. Particularly that GPS fixes, pressure altitude and ENL values are recorded as expected. In particular, ENL values should be in accordance with the figures given in para B5. See also A8 on ENL and A13 on pressure altitude calibration.

A5 **Observing the Recorder 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, an OO should be asked to seal the Recorder to the glider, and **this can be done at any time or date before flight**. See para 8 in the conditions of approval. Regarding the position of displays concerned with the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

A6 **Independent Check of Takeoff**. The pilot must ensure that the time and point of takeoff has been independently witnessed and recorded for comparison with takeoff data in the IGC file from this recorder, see para B1.2.

A7 **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 Recorder. See para 9.1.1 in the Conditions of Approval.

A8 **Use in Motor Gliders** (including self-sustainers): The internal microphone and associated circuitry automatically records the level of acoustic noise at the recorder. This is recorded in the IGC file 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 engine power).

A8.1 Cockpit Noise. Pilots should note that cockpit noises other than the engine will produce ENL figures on the IGC file, and should avoid those that could be mistaken for use of engine. **Flight with the cockpit Direct Vision (DV) and/or ventilation panel(s) open can produce a low-frequency sound (organ-pipe note) which will register as high ENL. This is magnified if sideslip is present and in particular at high airspeeds. High airspeeds with cockpit panels open should therefore be avoided in case the ENL recorded is mistaken for use of engine**. High ENL may also be produced by stall buffet and spins, particularly in Motor Gliders if the engine bay doors flutter (vibrate or move 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.

A8.2 Pilot check of ENL figures. Pilots should check that the ENL figures produced by their recorder show a clear differentiation between engine-on and engine-off flight. ENL figures should be in accordance with those found in GFAC tests and listed in para B5. This may be vital on a later flight when a claim is made. If ENL figures are found to be significantly different to those in para B5, the recorder should be returned to the manufacturer for the ENL system to be re-set.

A9 **After Landing**. Until an OO has witnessed the Recorder installation to the glider, the pilot must not alter the installation or remove the Recorder from the glider. The pilot must ensure that there is evidence of the landing independent of the flight recorder data, see A9 below.

A9.1 After-flight calculation of security. After landing, the recorder calculates a digital signature for the IGC file for the flight, using a Public/Private Key encryption system. This process places security codes at the end of the IGC file for the last flight, which is then complete and stored in the memory ready for downloading. These codes are used to verify the integrity of the whole file at any later time by using the Validate function of the IGC Shell program with the IGC-NTE.DLL file in the same directory. The digital signature is calculated and the IGC file is ended after one of the following conditions: (1) The FR has had no external power for at least 5 minutes (see A11), or, (2) the FR is connected to a PC for downloading or setup change (see A13 and B3.3).

A10 **Independent Check of Landing** - The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with IGC file data from the recorder (see para B2.1).

A11 **Switching Off**. This is by switching off the external power or disconnecting the RJ45 connector from the recorder.

A12 **Downloading the Flight Data**. This is by connecting a PC to the RS232 plug that is part of the manufacturer's cable that plugs in to the RJ45 socket in the recorder. The OO will carry out the actions given in para B3.3, and the OO's copy of the transferred flight data will be sent to the organisation that will validate the flight, such as the National Airsport Control authority (NAC). The OO does not personally have to transfer the data from the Recorder, 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 the rules for IGC records and badges, the above continues to apply.

A12.1 Use of Portable PC at the glider. The PC used may be owned by the pilot or any other person. The PC should be set up for ease data transfer, such as by easy access to the IGC Shell program with the IGC DLL file for this recorder in the same directory. Transfer of flight data is witnessed by the OO, and the flight files in IGC format must be given to the OO for safe keeping and analysis, such as on portable media such as a memory stick, disketteor equivalents.

A13 **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 Recorder is used for a claimed flight performance. For the procedure, see para B6. 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 Recorder for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

---------- end of Annex A ----------

NOTES FOR OFFICIAL OBSERVERS AND NACs - PART OF IGC APPROVAL
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 type of recorder is IGC-approved 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.

B1 **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 Recorder in the glider, the type and serial number of the Recorder, the glider type and registration, date and time. Before flight, if requested, the OO shall then seal the Recorder 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 Recorder installation is checked. This is to ensure that the installation is correct, and another Recorder has not been substituted in the glider before the data transfer (B3.3). See para 8 of the Conditions of Approval. Regarding the position of displays concerned with the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

B2 **Takeoff - Independent Evidence**. 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. After flight, this will be compared to the takeoff data from the Recorder.

B3 **Landing**

B3.1 Independent Evidence of 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. After flight, this will be compared to the landing data from the Recorder.

B3.2 Checking the Installation of the Recorder. As soon as practicable after landing, an OO shall inspect the installation of the Recorder in the glider (including any sealing to the glider), so that this can be compared to the check described in para B1 above. The transfer of flight data shall then take place in accordance with B3.3.

B3.3 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 Recorder; if a portable PC is not available, the OO shall check and break any sealing to the glider, and take the Recorder 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 Recorder which is then independently checked later at the NAC (and at FAI if the claim goes to them).

B3.3.1 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. Download the free IGC Shell program and place all the files in one directory (the name IGC Shell 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 Dynamic Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory. 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 on the screen. 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" or later version numbers. 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 and Validation can now be made using the screen buttons provided. You can now download the flight data which appears directly in IGC format.

B3.3.1.1 Validation of IGC files. With the recorder connected to the PC and the IGC Shell program menu selected, select the manufacturer from the top menu box, press the "Validate" button and select the IGC file that is to be checked. If successful, the message "File has been successfully validated" appears.If security has been breached the message "Validation check failed" appears with a likely reason.

B3.3.1.2 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.

B3.3.2 Files Produced. This process will automatically produce 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 = Recorder Serial Number/letters and F = flight number of the day (full key, Appendix 1 to the IGC GNSS Recorder Specification, copied in Annex C to the Sporting Code, SC3C).

B3.3.3 OO's Copy. A copy of the IGC file shall be retained securely by the OO such as by immediately copying them to a separate diskette, PC card or memory stick, or by the use of the OO's own PC. The file shall be retained by the OO in safe keeping for later checking and analysis under NAC procedures. The OO may keep the required data file 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 file as being from the flight concerned (for this purpose, takeoff and landing data independent of the IGC file must also be available, see above in B2 and B3.1).

B3.3.4 Competitions. Different rules may apply for competitions, 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 B3.3.1 above.

B4 **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 B3.3.1 above) shall be used by the NAC and by FAI (if the data goes to them). This checks the electronic security coding, that the Recorder had not been interfered with, and that the flight data in the IGC file is identical to when it was transferred from the Recorder. The latest versions of the files needed for the validation process must be used and are available at no cost from the IGC GNSS web site for software given at the beginning of this document.

B4.1 Method. Use the IGC Shell program together with the manufacturer's DLL as explained in B3.3.1 above. Scroll to the IGC file to be checked and use the Validate software button.

B5 **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.

B5.1 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.

B5.2 ENL during engine running. On engine running at climbing power, 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 with this recorder, but previous tests with Wankel engines indicate that they produce similar ENL values to 4-strokes.

B5.2.1 Quiet engines. This approval does not include use with Motor Gliders with electric or other engines that produce little noise in the cockpit (see Para 7 in the Conditions of Approval) If a particularly quiet engine is to be used such as electric or otherwise, contact GFAC as soon as possible so that tests can be carried out.

B5.3 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 panels and ventilators open can produce low frequency noise, particularly with sideslip ("organ-pipe" effect)**. With canopy panel(s) open, ENL readings of up to 300 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 flying engine-off with the pylon up, due to the high aerodynamic noise.

B5.4 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.

B5.5 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.

B5.6 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).

B6 **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 Recorder is calibrated in an altitude chamber in the same way as a drum barograph.

B6.1 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 B3.3 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.

B6.2 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 in average reception conditions, shows an average error of between 11 and 12m for all recorders tested since that date.

B6.3 Maximum Altitudes Recorded in the IGC file. The GPS system is capable of recording to almost unlimited altitudes, certainly up to 30km/100,000ft. The pressure altitude sensor is also capable or recording to high altitudes, although as air density reduces at height, a small pressure step becomes a large altitude difference. However, the type of processor in the recorder and the need for good resolution (small 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.

B6.3.1 Pressure Altitude. Pressure altitudes are recorded up to 11,000 m (36,089 ft).

B6.3.2. GNSS altitude. GPS altitude is recorded up to 18,000 m (59,055 ft).

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