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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-approval documents: http://www.fai.org/gliding/gnss/approvaldocs
IGC GNSS site for free software: http://www.fai.org/gliding/gnss/freeware.asp

To: IGC GNSS web site under "List of Approvals", for permanent reference
Copy: Manufacturer concerned
Notice of issue: FAI for IGC email information list
Internet international newsgroup: rec.aviation.soaring

Date of issue: 30 May 2006

IGC-APPROVAL DOCUMENT FOR GNSS FLIGHT RECORDER
APPROVAL LEVEL - ALL FLIGHTS
RECORDER TYPE - AIRCOTEC XC PROFI (Gliders)

(i) This document gives IGC-Approval from the above date for the GNSS Flight Recorder equipment described below to be used for validation of flights under the rules and procedures in 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 history. This is the initial IGC-approval document for this equipment.

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

*(ii) This IGC-approval document is concerned with the functions of the equipment that are concerned with recording of data. More specifically, with the accuracy and reliability of the resulting data for the exclusive sole purpose of validation and certification of flight performances to the criteria of IGC and FAI. 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 above mentioned validation and certification purposes. 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) 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) deals with equipment used in flight validation, Annex C to the Code (SC3C) consists of 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.

(iv) 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.

MANUFACTURER
AIRCOTEC Flight Instruments

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IGC-allocated manufacturer codes: Three letter ACT, single letter I

EQUIPMENT:

1. **HARDWARE**

1.1 **Model Name.** Aircotec XC Profi (Gliders), short name Aircotec XCP(G). Note that there is also a Hang-glider model and this IGC-approval does not apply to this model which has different characteristics.

1.2 **Hardware Version**. Hardware Version 1.0 is the original IGC-approved firmware standard. Later versions may be used if they are IGC-approved. The Version number is shown in the header record of IGC-format flight files in the form "HF RHW HARDWARE VERSION: 1.0" which can be seen by using a text editor to view the IGC file.

1.3 **Dimensions**. The recorder case is about 136mm long, 65mm wide and 30mm deep. One 136 x 65mm side contains a 70 x 40mm LCD, three buttons and a green charging light. Weight is about 180 grammes and connectors are described later.

1.4 **GPS receiver**. The GPS receiver board is the12-channel Position GPS-54 by the Koden Electronics Company Ltd of Japan (www.koden-electronics.co.jp and www.posit.co.jp).

1.5 **Pressure altitude sensor**. The pressure altitude sensor is the Intersema MS 5534B from Intersema Sensoric SA of Switzerland (www.intersema.ch). This is compensated for temperature variation and calibrated to the ICAO International Standard Atmosphere. The recorder case is not pressure-sealed and "cockpit static" pressure is recorded on the IGC file.

1.6 **National regulations**. These may apply to electrical and electronic equipment although compliance with such regulations is not the responsibility of FAI. However, this recorder has the European Union (EU) "CE" mark that denotes compliance with EU directives on EMC and voltages.

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

2. **FIRMWARE**.
Firmware Version 1.0 is the original IGC-approved firmware standard. Later versions may be used if they are IGC-approved. The firmware version is shown on the second line of the first screen after switching on, the screen being shown for 15 seconds before changing. It is also listed in the header record of IGC-format flight files in the form "HF RFW FIRMWARE VERSION: 1.0", which can be seen by using a text editor to view the IGC file.

3. **SOFTWARE**.
External software can be used by connecting a PC USB socket to the 7 x 3mm female USB Mini-B connector on one side of the recorder unit. Downloading uses the Microsoft Windows-based IGC Shell system that is available free from 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, the appropriate Data Link Library (DLL) file from the Recorder manufacturer must be copied to the IGC Shell directory. For this type of recorder, the latest version of the file IGC-ACT.DLL is available on the IGC GNSS web site.

3.1 Validity of Flight Data. The criterion for validity of data is that the IGC-format file must successfully pass the VALIDATE program. That is, by using the Validate box in the IGC Shell program with the IGC file that has been downloaded for the flight concerned.

3.2 Use of Latest Files - Free Availability. The DLL file is copyright of the Recorder manufacturer but is freeware. The IGC Shell program is freeware and can be used with all manufacturers' DLL files though a single menu. The latest versions of these programs must be used and can be obtained directly from the IGC GNSS Internet site for software or through the main IGC site through a link. See the web site titles given at the beginning of this document.

CONDITIONS OF APPROVAL

4. **Permitted Connections**. Connectors are on the longer side faces.

4.1 GPS antenna. A SMC (Sub-Miniature type C) screw-type connector with 4mm female and 3.5mm male components is on one of the side faces near the top of the LCD.

4.2 Connector for power. A female 12 volt power and charging point is on the bottom face below the three buttons on the main face. The circular male fitting is 3mm in diameter with negative on the outside and positive in the middle.

4.3 Connector for other units. A 6mm diameter custom-wired female connector is next to the power connector below the three buttons and is for connecting to other units. Such other units are not part of this IGC-approval and are a matter between the manufacturer and customers. See para (ii) above.

4.3 Data transfer to a PC. Through the 6 x 4mm USB Mini-B connector on the side face to the right of the LCD.

5. **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment. See para 8 on installation and para 9 on security and seals. GFAC reserves the right to inspect production-standard equipment from time to time for security and general compliance with the IGC Specification.

6. **Installation in a glider**. If the recorder's display is to be used in flight, the position of the recorder should not be remote from sight lines used for pilot lookout and scan for other aircraft and gliders. 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, that the position is suitable for recording Engine Noise Levels (ENL). If the GPS antenna is accessible to the crew in flight, no attempt must be made to inject false data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew.

7. **Motor gliders**. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. The system used is from Aircotec. ENL figures range between 000 and 999 in steps of 001. 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 power is being generated. GFAC has tested this recorder 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.

7.3 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.

8. **Check of Installation in the Glider**. There must be incontrovertible evidence that the particular recorder was present in the glider for the flight concerned. This can be achieved either by 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. The recorder may be sealed to the glider in accordance with 8.2. Either a pre-flight check of the installation must be made and the glider must be under continuous observation by an Official Observer (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 in accordance with 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 across the join in the seal with the glider registration, the date, time and OO's name and signature. It must 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 Seals, Physical and Electronic**.

9.1 Physical Security. A silver-coloured tamper-evident seal with the manufacturer's name, is fitted over at least one

of the case-securing screws on the back of the case on the opposite side to the LCD. In addition, an internal security mechanism is included that activates if the case of the recorder is opened. If the recorder case has been opened, breaching physical security, a message indicating that the unit is insecure will appear on the LCD on switch-on, and subsequent IGC files will fail the VALI check (see para B3).

9.1.1 Sealing of data ports and plugs. 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), any data in the memory will be lost, settings will revert to defaults, and the electronic security algorithms in the recorder will be trashed. Any flight data files subsequently produced will fail the VALI test for electronic security. This test will also fail if the IGC file being checked differs in any way from that initially downloaded from the recorder.

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.

9.4 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 returned 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 fai.org/gliding/gnss web site under the link 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 has not been altered after it was download from the Recorder to a PC. This is done by checking the IGC data file by using the validate function in the IGC Shell program. The IGC Shell program must have originated from the current FAI/IGC web site for software listed at the beginning of this document. See Annex B for detail on how to use the validate systems.

11. **Manufacturer's Changes**. 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. This includes changes of any sort, small or large. If in doubt, notify the change so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan
Chairman, IGC GFA Committee

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

Any Queries to:
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---------- start of Annexes ----------

Annex A to IGC Approval

NOTES FOR OWNERS AND PILOTS
PART OF IGC-APPROVAL FOR GNSS FLIGHT RECORDER
RECORDER TYPE - AIRCOTEC XC PROFI (Gliders)

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:

A.1 **Antenna** - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No attempt must be made to inject false 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**. Latitudes and longitudes recorded by the Recorder must be to the WGS84 Geodetic Datum, or the flight data will be invalid for IGC purposes. This recorder is fixed on the WGS84 Datum. No pilot action is required except to ensure that other lat/long data such as for start, turn and finish points, is also entered to the WGS84 Geodetic Datum (IGC rule).

A.3 **Recorder installation in the glider**. The pilot must ensure that an OO has checked the place of the Recorder module in the glider and how it is fixed to the glider. If it may be difficult to find an OO immediately before takeoff, or to witness the landing, you are advised to ask an OO 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. On the position of any other displays connected to the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

A.4 **Switching On**. Press the left of the three buttons. After a short time a menu will appear at the bottom of the screen by the buttons. Press the right button when "NEXT" appears on the screen above the button. Then press "NEW" above the centre button and "NEXT" twice above the right button and the unit should be ready to record a flight.

A.5 **Independent Check of Takeoff** - The pilot must ensure that the time and point of takeoff has been independently witnessed and recorded for comparison with that in the IGC file from this recorder, 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 Recorder. See paras 8 and 9 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 between 000 and 999 with each fix. The recorder must not be covered or insulated, although even so, automatic gain should continue to ensure high ENL readings under engine power.

A7.1 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. Generally the frequency filtering built in to the Recorder will avoid any problems, but it should be noted that **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, particularly if sideslip is present**. 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.

A.8 **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).

A.9 **Switching Off**. Press the left and right buttons together and after a short time the recorder should switch off. If it does not, follow the menus that appear on the LCD above the buttons and press "OFF" when it appears.

A.10 **After Landing**. Until an OO has witnessed the recorder installation to the glider, the pilot must not alter the installation or break any sealing. 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 organisation that will validate the flight, normally 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.

A9.1 After-flight calculation of security. On switching off for more than 5 minutes and then switching on again, the recorder calculates a digital signature for the IGC file for the previous flight, using a Public/Private Key encryption system. Power must be off for 5 minutes or longer for the flight file to be ended and the security calculation to take place (the 5 minute "power-off protocol" is to allow for events such as changing the battery in flight although with the internal battery in this recorder this should not apply). 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-ACT.DLL file in the same directory.

A9.2 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 of transferring the data, such as by easy access to the the IGC Shell program with the IGC-ACT.DLL file 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 floppy diskette or memory stick.

A.10 **Calibration of Barograph Function**. Pilots are advised to have a barograph (pressure altitude) 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 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 Recorder for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

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

Annex B to IGC Approval

NOTES FOR OFFICIAL OBSERVERS AND NACs -
PART OF IGC-APPROVAL FOR GNSS FLIGHT RECORDER
RECORDER TYPE - AIRCOTEC XC PROFI (Gliders)

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.

B.1 **Installation and Takeoff Records**

B.1.1 **Installation in the Glider**. An OO shall witness and record the position of the Recorder in the glider, the type and serial number (s/n) of the particular Recorder, the glider type and registration, date and time. The s/n of each individual recorder consists of three characters made up of letters and/or numbers. The first screen after switching on shows "AIRCOTEC XC PROFI" with the battery voltage at the bottom. After about 6 seconds this changes to a screen with the three-alphanumeric serial number for the recorder, its security state and the hardware and software version numbers. This screen is visible for 30 seconds. If the recorder is not sealed to the glider, either a pre-flight 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, 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 correct, and that another Recorder has not been substituted in the glider before the data transfer (B2.3). See paras 5 and 6 of the Conditions of Approval. On the position of any extra displays connected to the Recorder, see para 6 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 by sources independent of the Recorder, 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 then be compared to the takeoff data recorded on the IGC file.

B.2 **Landing**

B.2.1 **At Landing**. The time and point of landing shall be recorded by sources independent of the Recorder, 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 recorded on the IGC file.

B.2.2 **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 B1.1 above. The transfer of flight data shall then take place in accordance with B2.3.

B.2.3 **Transferring the Flight Data**. The flight data can be transferred to a portable PC at the glider, without disturbing the installation of the Recorder (see para A7). 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) through the VALIDATE (VALI) software program for the recorder.

B2.3.1 Methods. Downloading of flight data is by connecting a USB port of a PC to the USB Mini-B female socket on the side of the recorder. On the PC, a current version of the IGC Shell Program with the file IGC-ACT.DLL in the same directory, must be available. The IGC Shell programs and the IGC-ACT.DLL file are available free from the IGC GNSS web site for software given at the beginning of this document, or through a link from the main fai.org/gliding/gnss web site.

2.3.1.1 IGC Shell for Download and File Validation. 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 "Aircotec XC Profi" which 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.

B2.3.1.3 Latest versions. The latest versions of the free 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.

B2.3.2 Files produced. One of the processes above will produce an *.IGC-format flight data file with the file name YMDLXXXF, where Y=year, M=month, D=day, L= manufacturer, XXX = Recorder Serial Number/letters and F = flight number of the day (full key, Appendix 1 to the IGC GNSS Recorder Specification, also listed in Annex C to the Sporting Code, SC3C).

B2.3.3 OO's Copy. A copy of the *.IGC files shall be retained securely by the OO such as by immediately copying them to industry-standard storage media. These flight data files shall be retained by the OO in safe keeping for later checking and analysis under NAC/IGC procedures.

B2.3.3.1 Storage media. The OO may keep the required data files on industry-standard portable storage media such as the hard disk of a PC, USB memory stick or other type of portable memory card. Integrity of flight data on the IGC file is preserved by comparing checks on takeoff and/or landing from sources different to the recorder, and by the VALIDATE check (2.3.1.1) that can be carried out at any time.

B2.3.4 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, IGC file names may be changed by the organisers, 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 VALI program file. The data summarised in the original IGC file name is repeated in the IGC file header, is protected by the IGC security system (VALI check) and can be read at any time through a text editor.

B.3 **Analysis of Flight Data Files**. A Data Analyst approved by the NAC will then evaluate the flight using an analysis program approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking

flight data, an authenticated version of the IGC Shell Validation program shall be used by the NAC and by FAI (if the data goes to them). This checks the electronic security coding in the file, that the Recorder had not been interfered with, and that the flight data in the file has not been altered since it was transferred from the Recorder. The latest version of the Validation program must be used and is available free from the IGC GNSS web site for software given at the beginning of this document. Use the Validate function in the IGC Shell directory. For more detail on the IGC Shell program, see paras B2.3.1.2 and B2.3.1.3.

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 7 in the main body of this document 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 average ENL values are to be expected than when soaring (B4.3). On aerotow, a reading of 110 has been recorded and 150 during a winch launch. During the ground roll, short-term higher values up to 300 have been seen, probably due to wheel rumble, particularly on hard surfaces.

B.4.2 ENL during engine running. On engine running at powers needed to climb, an increase to over 800 ENL is expected. Over 850 is typical for a two-stroke engine, over 700 for a 4-stroke. An ENL value of 999 has been recorded with a two-stroke engine running at full power. During engine running, these high ENLs are produced for a significant time, and when altitude and speed are analysed it can be seen that a large amount of energy is being added, which can therefore be attributed to energy not associated with soaring. 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.

B4.2.1 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 030 indicate normal quiet gliding flight with a well-sealed cockpit.

B.4.3.1 Higher Speed. In a high-speed glide, or in a glider with more cockpit noise, the ENL may increase to 100. With canopy panel(s)open, a much louder noise may be present and pilots are recommended to avoid this so that high ENL readings cannot be mistaken for engine running, particularly if the glider is climbing such as in wave lift. At 100 knots IAS with canopy panels open, an ENL value of 350 has been recorded.

B.4.3.1 Thermal Turns. Thermalling with the cockpit panel(s) open can produce low frequency noise ("organ-pipe" effect), particularly if sideslip is present. ENL readings of up to 325 have been recorded under these conditions. High cockpit noise when climbing should be avoided so that high ENL readings cannot be mistaken for engine running.

B.4.3.1 Stalling and Spinning. High ENL may also be recorded during stalling and spinning, particularly if the engine doors flutter or vibrate (move slightly in and out due to stall buffet, producing a clattering noise). An ENL value of 350 has been recorded in a spin.

B.4.3.1 Pylon movement. 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 100 have been recorded and 030 in a quieter machine.

B.4.5 ENL during landing. During ground contact during landing, short-duration ENL values up to 550 have been recorded, probably due to wheel squeak and rumble, particularly on hard surfaces. Unlike engine running these last only for a short time, showing a short spike on the noise/time record.

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 combined with sideslip and /or high airspeed, 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 Recorder can be calibrated in an altitude chamber in the same way as a drum barograph.

B.5.1 Calibration method, making a calibration table. No GPS fixes are required for a pressure altitude trace to be produced. However, before a calibration, you are advised to set the normal (cruise) fix rate to a small time interval such as 5 seconds or less. Recording at the pre-set fix interval starts when power is connected to the recorder and the pressure altitude change threshold is exceeded (about 1 m/sec for 5 sec). The calibrator should be asked to cycle the pressure briefly up and down before starting the calibration itself, so that recording will start. 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 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.

B.5.2 GPS altitude figures recorded in the IGC file. Occasional short-duration differences in the shape of the GPS altitude/time graph have been noted when compared to the pressure altitude figures. This is not unusual with GPS receivers operating without a local differential beacon or other accuracy-enhancing systems. 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 will be increased by poor antenna positioning in the glider. 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.5.3 Maximum Altitudes Recorded in the IGC file. The maximum altitudes in IGC files that apply to this recorder are given below.

B.5.3.1 Pressure Altitude. This is recorded up to 9.5 km (31,168 ft) on the ICAO ISA.

B.5.3.2 GNSS altitude. This is recorded up to 18 km (59,055 ft) above the WGS84 ellipsoid.

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