GNSS FLIGHT RECORDER APPROVAL COMMITTEE (GFAC)
FAI INTERNATIONAL GLIDING COMMISSION (IGC)

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www.fai.org/gliding under Technology, then under IGC-approved FRs
GFAC web site for FR data: **www.ukiws.demon.co.uk/GFAC**

To:	IGC and GFAC Web sites
Notification to:	IGC email mailing list <igc-discuss@fai.org>
	Internet newsgroup rec.aviation.soaring
Copy:	Manufacturer concerned

1 October 2013

IGC-APPROVAL FOR GNSS FLIGHT RECORDER

Recorder Name: **Streamline Digital Instruments (SDI) PosiGraph Models 1 and 2**
Level of Approval: **Badge flights up to and including Diamonds**

(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. The initial issue of this document was dated 8 March 1999, an update was issued on 10 December 2001, and in February 2003 the Posigraph Model 2 was added. The 2011 paper on FR Security by the IGC ANDS and GFA Committees that was approved at the 2012 IGC Plenary meeting recommended a reduction to "Diamonds" and this was made in two stages, to "All Badges" on 1 October 2012 and to "Diamonds" on 1 October 2013.

(i-ii) IGC-approval Levels. The Levels of IGC-approval are listed in para 1.1.4 of Annex B to the Sporting Code for Gliding (SC3B), and cover the use of FRs in flights for FAI/IGC badges, diplomas, records and in competitions.

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

(ii) This IGC-approval document is concerned with the functions of the equipment that record data, particularly 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 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. 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 traffic alert, 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. Annex A to this code (SC3A) deals with competition matters, Annex B (SC3B) with equipment used in flight validation, Annex C (SC3C) with guidelines and procedures for Official Observers, pilots, and other officials involved in the flight validation process, Annex D (SC3D) with the IGC Pilot Ranking List . 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.

(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 easily available for pilots and Official Observers.

Manufacturer:
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1. **Hardware**. The PosiGraph recorder unit is the same size and shape as the LX Navigation Colibri Model 1. It was designed by LX Navigation to a specification from SDI and has different connectors to the Colibri 1.

1.1 Models. IGC-approval applies to Hardware version 1.0 or later. This is shown on the LCD on start up and in the IGC file header record after "HF RHW HARDWARE VERSION". Model 2 Has the following differences: Hardware version 2.0 or later; the Garmin GPS15H GPS board; data transfer connector, the 8-pin RJ-45 replaces the 6-pin RJ-11; the buttons on the case are replaced by a flat key pad with the same functions as the buttons. For manufacturer notification of updates, see para 11.

1.1.1 National regulations. These may apply to electrical and electronic equipment, such as the EC "CE" mark for compliance with EC directives on EMC and voltages. Compliance with such regulations is not the responsibility of FAI. This equipment has the EU CE mark.

1.2 Dimensions and Weight. The FR consists of a rectangular metal case about 99 x 59 x 34 mm, and weighs about 220 grammes.

1.3 Display and connectors. A LCD 30 x 14 mm is on the 99 x 59 mm face together with seven buttons. Two electrical connectors and a BNC bayonet antenna connector are on the end face below the buttons.

1.4 GPS receiver board. Originally Koden (Japan) FDK/GSU 15D, after Sep 2001 Japan Radio Corp JRC/CCA-450. These are both 12-channel parallel receivers.

1.5 Pressure altitude sensor. Intresema (Switzerland) MS 5534A, compensated for temperature variation. The FR case is vented to atmosphere and records "cockpit static" pressure.

2. **Firmware**: IGC-approval applies to Version 1.0 or later, as shown on the LCD for a short time after applying power, also in the IGC file header record after "HF RFW FIRMWARE VERSION". For manufacturer notification of updates, see para 11.

3. **Software**: The short program file DATA-SDI.EXE is for transferring flight data from the FR to a PC and automatically produces a *.SDI binary file and an *.IGC file for the last flight, leaving a menu on screen for transfer of other flight data. The file CONV-SDI.EXE is for conversion of a *.SDI flight data file to the IGC format, if the IGC file is not available, or as a later check of the IGC file. The file VALI-SDI.EXE checks the security and integrity of an *.IGC file, and ensures that data that is designed to be secure has not been altered since it was transferred from the FR.

3.1 Versions to be used. For correct operation, Version 5.0 or later must be used. The version number appears on the screen when the file is executed.

3.2 Free availability. DATA, CONV, and VALI files are copyright of the FR manufacturer but are freeware. The latest versions may be obtained from the IGC GNSS Internet site for software or through the IGC/GNSS site through a link. See the site titles given at the beginning of this document.

CONDITIONS OF APPROVAL

4. **Permitted Connections to the Main (FR) Module**. The antenna connector is a 9mm BNC bayonet, but there are two types of other connectors. One is a two-connector variant for use with a special shoe-fitting into which the FR can be placed, and a straight single-connector variant.

4.1 Shoe-fitting variant. Two 8mm diameter female plastic subminiature connectors are used. These are circular and have an IP40 dirt & moisture-proof rating. One has a three-pin socket for voltage supply, the other has a 4-pin socket for other signals. The BNC antenna socket is between the two IP40 sockets. All three are on the end face of the case farthest from the LCD. The three sockets can either be connected directly, or through a special SDI "shoe" fitting which can be fixed to the glider and into which the Flight Recorder (FR) fits. The FR is fixed to the "shoe" by the BNC bayonet, because the FR antenna connector is long enough to project through a hole in the base of the shoe and be secured from the other side. The IP40 sockets on the FR fit into receptors in the shoe, which in turn are connected to two IP40 sockets on the outside of the shoe.

4.2 Straight connector variant. The connector for data in and out and DC power is a female RJ-type multi pin connector on the end of the case next to the BNC antenna connector. In the Posigraph 1 it is a 6-pin 9 x 6 mm RJ11 and in the Posigraph 2 it is an 8-pin RJ-45.

5. **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment. See para 4 on security seals.

6 **Installation in a glider**. The FR may be fitted anywhere in the glider, subject to para 3.2 on sealing and that in Motor Gliders 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 data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew.

6.1. Position of displays. Particularly in single-seat gliders, the position of any displays concerned with the recorder should not be remote from sight lines used for pilot lookout and scan for other aircraft and gliders.

7. **Motor Glider Engine Recording**. When the Environmental Noise Level (ENL) system is enabled (see Annex A for method), acoustic noise is recorded through a microphone inside the FR case.

7.1 ENL system. A microphone and frequency filter and weighting system inside the recorder case automatically produces an Environmental Noise Level (ENL) value with each fix. This is designed to highlight any engine-related noise but to produce low ENL values in gliding flight. The ENL system is essential for Motor Gliders in order to show that the engine was not used to produce forward thrust 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.

7.1.1 ENL Recording System . The ENL system in this FR is made by LX Navigation.

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

7.1.3 Engine Types. This document gives IGC-approval for the use of the above ENL system for the validation of glide performances to IGC standards when flown in Motor Gliders that have piston engines that give high acoustic noise levels at the recorder, including when run at low power. For other types of engines, see para 7.2.

7.1.4 ENL System and Cockpit Positioning. The FR must be positioned in the glider so that it can receive a high level of engine-related noise whenever forward thrust is being generated.

7.1.5 ENL test values. For details of typical ENL values found on GFAC tests, see para B.4.

7.2 Low-ENL Engine/Recorder combinations. This approval does not include cockpit mounting of the FR when used with engines that produce small ENL values at the Recorder, particularly at low power when just producing positive forward thrust. Such engines include those that are electrically or jet powered, the latter because the noise is at higher frequencies than those for which the ENL system is designed. It may also apply to some 4-stroke engine/propeller combinations that are particularly quiet. If the FR position produces low-ENL values when the engine is run at low powers, there are two alternatives: (1) either the FR must be moved closer to the source of engine noise, or (2) another variable additional to ENL must be recorded in the IGC file under the MOP code, in accordance with Annex B to the Sporting Code for Gliding, para 1.4.2, particularly 1.4.2.4. A copy of the current SC3B para 1.4.2.4.1 follows, and is particularly applicable to this type of recorder because it is small and can be mounted near to the engine of a jet or the propeller of an electric motor glider.

7.2.1 Extract from SC3B para 1.4.2.4.1: FR mounting near the engine or propeller. Where cockpit or other mounting of an FR results in low ENL figures when the engine is run, an alternative to using an FR with an external MOP sensor is to mount an IGC-approved FR with ENL facilities in or near the engine-bay close to the engine and/or propeller. Such an installation of the FR in an individual motor glider must be inspected by an OO or NAC Official and documented for use in future claims. Flight testing must show substantially higher ENL figures when the engine is run at low power, compared to conditions met in engine-off soaring such as thermalling with cockpit panels and vents open. Claim documents must include evidence that the FR installation was as inspected, and that ENL figures in the IGC file are similar to those previously tested.

8. **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.

8.1. 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.

8.2 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 across the joint 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 FR unit to glider parts that 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 a removable part, if such a part is transferred between gliders, any FR 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 European "CE Mark" and the manufacturer's name, is fitted over at least one of the case securing screws. In addition, an internal security mechanism is included that activates if the case of the FR is opened. If the FR case has been opened, breaching physical security, on switching on the LCD screen (if fitted) will show the unit model number, the screen will show "SEAL NOT VALID!" and audible bleeps will be heard which can be canceled by pressing the ENTer button.

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 FR will be trashed. Any flight data files subsequently produced will fail the VALI test for electronic security. This test will also fail if the data in the *.SDI or *.IGC file has been altered in any way after being transferred from the FR.

9.3. 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.

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 to the IGC-approved standard.

10. **Analysis of Flight Data**. Analysis for flights to be validated to IGC criteria should 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 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 individual recorder concerned, and has not been altered after it was transferred from the Recorder to a PC. This is simply done by checking the IGC data file with an authorised copy of the VALI-SDI.EXE short program. The VALI program is on a single file and 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 VALI program file with any IGC flight data file.

11. **Manufacturer's Changes to 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 details of later versions of hardware, firmware and software, also any changes to modules such as the GPS receiver, pressure altitude transducer, the layout of the security microswitch and any other factor that could affect the security of the FR and the IGC files produced from it.

Ian W Strachan
Chairman, IGC GFAC

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

Any Queries to:
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Annex A to IGC Approval - **NOTES FOR OWNERS AND PILOTS**

A(i) *Status. To be read together with the main terms of approval to which this is an Annex.*
A(ii) *IGC-Approval levels. See Page 1, main heading and para (i-ii).*
A(iii) *Copy of this document. It is recommended that a copy of this approval document is kept with the equipment, for the use of pilots and OOs*

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

A1. **Antenna** - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No 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**. Latitudes and longitudes recorded by the FR are to a fixed Geodetic Datum of WGS84. No pilot action 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..

A3. **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.

A4. **Takeoff** - The pilot must ensure that the time and point of takeoff has been independently witnessed and recorded for comparison with that recorded by the GNSS FR, see para B1.2.

A5. **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.

A6. **Use in Motor Gliders, including self-sustainers** See para 7 of the main body of this document before the annexes. The recorder must be placed so that engine-related noise is clearly received when the engine is giving any forward thrust and must not be covered or insulated (even so, automatic gain should continue to ensure high ENL readings under engine power).

A6.1 **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 cockpit panels open can produce a low-frequency sound (organ pipe note) which will register as high ENL**. So will spins and stall buffet, particularly in Motor Gliders if the engine bay doors vibrate. 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.

A6.2 **Enabling the ENL system**. For models without an LCD, use the manufacturer's setup program with the recorder connected to a PC. For models with an LCD, the ENL system is enabled through the SETUP MENU which is selected by pressing the left/right buttons (model 1) or the equivalent on the touch-pad (model 2). The term "selector" is used to describe either the buttons or use of the pad, as applicable. Then use the up/down selector to select LOGGER MENU, and press ENTer. Use the up/down selector until "I-RECORD DATA" appears. Press ENTer and use up/down selector until "DATA: ENL" appears, press ENTER and use up/down to select "Y" for "Yes". Then press ESCape until SETUP MENU appears, and left/right to regain the screen required. Note that it is also possible to set ENL and other functions through the full LXFAI program using TRANSFER then SETUP LOGGER, see the manufacturer's instructions for this program.

A7. **After Flight**. The pilot must ensure that the time and point of landing has been independently 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.

A7.1 **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 transfer of data at the glider. The portable PC may be owned by the pilot or any other person. It should be set up for ease of transfer of data to a PC, such as by easy access to the current DATA-SDI.EXE program file. Transfer of flight data is witnessed by the OO, and the flight data in both SDI and IGC formats is given to the OO on portable media such as a floppy diskette.

A8. **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.

B(i) Status. To be read together with the main terms of approval to which this is an Annex.
B(ii) IGC-Approval levels. See Page 1, main heading and para (i-ii).
B(iii) Copy of this document. It is recommended that a copy of this approval document is kept with the equipment, for the use of pilots and OOs

B1. **Installation and Takeoff Records**

B1.1. **Installation in the Glider**. It should be noted that, due to the small size and weight of the FR, it would be easy to transfer it from one glider to another, or from a powered aircraft to a glider. 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 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 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.

B1.2. **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 FR takeoff data.

B2. **Landing**.

B2.1. **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 FR landing data.

B2.2. **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.

B2.3. **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 module 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 and in the data transferred, which is then independently checked later at the NAC (and at FAI if the claim goes to them).

Method: Shoe fitting models: connect the FR to a battery through the 3-pin IP40 socket, and connect the PC to the 4-pin IP40 connector by the cable provided.
RJ-connector models: connect the RJ-11 (Posigraph 1) or RJ-45 (Posigraph 2) to a PC and a 12V source via the cable provided, wired to the IGC standard.
Transferring data: execute the data transfer program. For instance, the file DATA-SDI.EXE can be used on either a floppy diskette or on the PC hard disk. See under "software" on page 1. This program file executes in the normal way such as by typing "DATA-SDI, enter", at a DOS prompt or RUN function, or by double-clicking "DATA-SDI" in a file list (File Manager/Windows Explorer, etc), and then following the menu actions in the DATA-SDI file. In the event of any problem in transferring the data, use a self-booting floppy diskette containing the DATA file.

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

OO's Copy. A copy of both the *.SDI 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/IGC procedures.

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 VALI-SDI program file.

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 file VALI-SDI.EXE shall be used by the NAC and by FAI (if the data goes to them) to check the electronic security coding, that the FR had not been interfered with, and that the flight data in the *.IGC file has not been altered since it was transferred from the FR. The version number of the VALI file (see at the beginning under Software) is shown when the file is executed.

Method: at the appropriate prompt or run function, type VALI-SDI followed by a space and the name of the file to be checked. The message "integrity OK" should appear, not "integrity Bad!" which indicates either that the FR security seal has been broken, or that the IGC file has been altered or has become corrupted since it was transferred from the FR. The VALI check may be applied to either the SDI or IGC file formats.

B4. **Means of Propulsion (MoP) Record - Motor Gliders**. See para 7 of the main body of this document before the annexes. The MoP must either be sealed or inoperative, or the built-in microphone system used that records a three-number Environmental Noise Level (ENL) with each fix on the IGC file. ENL values recorded on GFAC tests are given below, in the sequence of a flight.

B4.1 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 279 has been recorded. During the ground roll, short-term higher values have been recorded, probably due to wheel rumble, and values of 400 have been seen for one or two fixes.

B4.2 ENL during engine running. On engine running at powers needed to climb, an increase to over 800 ENL is expected. Over 900 is typical for a two-stroke engine, over 800 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 substantial energy is being added, which can therefore be attributed to energy not associated with soaring. Wankel (rotary) and electric engines have not been tested, but there is no reason to believe that Wankel engines will not produce similar values to 4-strokes.

B4.2.1 Electric and Jet Engines. See para 7 of the main body of this document before the annexes.

B4.3 ENL during gliding flight. ENL readings of less than 060 indicate normal quiet gliding flight. Short periods of higher ENL while gliding may indicate aerodynamic noises. In a high-speed glide, or in a noisy glider, the ENL may increase to 200. Particularly, sideslip or high speeds with the cockpit Direct Vision panel open can produce low frequency noise ("organ-pipe" effect) and ENL readings of up to 350 have been recorded. 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). 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.

B4.4 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 300 have been recorded, although 240 is more typical in an aerodynamically noisy glider, and 120 in a quieter machine.

B4.5 ENL during landing. During ground contact during takeoff and landing, short-duration ENL readings between 300 and 400 have been recorded, probably due to wheel rumble and tyre squeak, particularly on hard surfaces. Unlike engine running these high values last only for a short time, showing a short "spike" on the noise/time trace.

B4.6 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 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 DV 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).

B5 **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 can be calibrated in an altitude chamber in the same way as a drum barograph.

B5.1 Calibration method, making a calibration table. Before a calibration, you are advised to set the normal fix rate to a small time interval such as less than 5 seconds. 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 analyzed, compared to the calibration pressure steps, and a correction table produced and authenticated by an NAC-approved person (for instance an OO or GNSS FR 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. 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.

B5.2.1 Koden (Japan) FDK/GSU 15D receiver. With the Koden board fitted, there is a time delay in the GPS altitude figures when compared to the pressure altitude. In some flight files the shape of the GPS altitude trace differs from the shape of the pressure altitude trace. This was investigated with the GPS board manufacturer but no conclusion was reached. Lat/long fix accuracy is not affected and is typical of that for a 12 channel GPS system, but data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records.

B5.2.2 Japan Radio Corp JRC/CCA-450 receiver. 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 or other form of accuracy enhancement. This is thought to be a combination of the generally poorer altitude performance compared with lat/long due to satellite geometry, added to by less-than ideal antenna positioning in some gliders. Lat/long fix accuracy is not affected and is typical of that for a 12 channel GPS system, but data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records.

B5.3 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 across the altitude range (small steps between the digital altitudes that can be recorded), results in limitations in the range of altitude 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. Recorded up to about 9 km (29,528ft).

B5.3.2. GNSS altitude. Recorded up to about 18km (59,055ft)

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