



# FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE

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

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

### References:

FAI web site: [www.fai.org](http://www.fai.org)

IGC web site: [www.fai.org/gliding](http://www.fai.org/gliding)

FR web: [www.fai.org/gnss-recording-devices/igc-approved-flight-recorders](http://www.fai.org/gnss-recording-devices/igc-approved-flight-recorders)

IGC site for FR software: [www.fai.org/gnss-recording-devices/free-software](http://www.fai.org/gnss-recording-devices/free-software)

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

20 November 2011

### IGC-APPROVAL FOR GNSS FLIGHT RECORDER

Level of Approval: All Flights (see para i-ii)  
Recorder Name: LX Navigation Colibri II

(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 and Scope. This document is the initial approval for this type of recorder and only applies to the recorder function. The performance of other modules and functions in the recorder and external units that may be linked by cable to the recorder is a matter between customers and the manufacturer.

(i-ii) IGC-approval Level. This recorder is IGC-approved for all flights including world records, all IGC badges and distance diplomas, and all competitions to IGC rules and procedures. The various 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 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 Airspace 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.

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## MANUFACTURER

LX Navigation d.o.o. Address: SLO, Tkalska 10, 3000 Celje, Slovenia  
Email & Web: [support@lxnavigation.si](mailto:support@lxnavigation.si) ; [www.lxnavigation.si](http://www.lxnavigation.si)  
Tel & Fax Tel: +386 63 490 46 70 ; Fax: +386 63 490 46 71  
Contact: Crtomir Rojnik  
Manufacturer Codes: Single letter: L, three letters: LXN

## EQUIPMENT

### 1. HARDWARE

1.1 **Recorder Names.** LX Navigation Colibri II. This is shown in the header record of IGC-format files in the form: "HFFTYFRTYPE:LXNAVIGATION,LX\_Colibri\_II".

1.2 **Hardware Version.** The original IGC-approved hardware standard was Version 0.1. Later versions may be used if they are IGC-approved, see para 10 below. The Version number is shown in the header record of IGC files in the form "HFRHW HARDWAREVERSION:0.1".

1.3 **Dimensions, Weight, Power Source.** This is a very small Flight Recorder. The front of the unit is 63 x 41mm in size and the unit is 21mm deep. It weighs about 80 grammes without external cables. It is powered by an internal battery but can also be powered through a micro-USB connector on an end face, which also charges the internal battery.

#### 1.4 External Features.

1.4.1 **Display.** A 30 x 38 mm colour LCD is on the front face.

1.4.2 **Controls.** One knob is on the front face under the LCD. It can be pressed, and also moved left and right, and up and down, giving a total of five possible selections.

1.4.3 **SD Card.** A receptacle for a micro SD Card is on the 63 x 21 mm face to the left of the LCD.

1.4.4 **Connector.** A micro-USB socket is on the 41 x 21 mm face under the LCD.

1.5 **GPS receiver.** A 66 channel GlobalTop PS6B receiver is fitted ([www.gtop-tech.com](http://www.gtop-tech.com)). This is shown in the header record of IGC files in the form "HFGPS:GlobalTopPA6B,66ch,max18000m". The last figure is the maximum GPS altitude in metres that is processed by the recorder.

1.6 **Pressure altitude sensor.** A MS 5607 Pressure Altitude sensor by Intersema Sensoric SA of Switzerland ([www.intersema.ch](http://www.intersema.ch)) is fitted. This is shown in the header record of IGC files in the form "HFRSPRESSALTSENSOR:INTERSEMA,MS5607,max8000m". The last figure is the maximum altitude in metres processed by the recorder to the altitude resolution requirements of para 4.4.1 of the IGC Specification. The pressure altitude system 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 regulations may apply to electrical and electronic equipment, but compliance with such regulations is not the responsibility of FAI.

### 2. FIRMWARE.

Version 0.9 was the original IGC-approved firmware standard. Later versions may be used if they are IGC-approved, see para 10 below for IGC-approval of updates. The firmware version is listed in the header record of IGC files in the form HFRFWFIRMWAREVERSION:0.9".

### **3. SOFTWARE.**

3.1 Downloading of Flight Data. Downloading is to a micro SD (Secure Digital) card that can be fitted into a receptacle on the left side of the LCD on the front face of the recorder. See A3.3 for more details

3.2 Validation of Flight Data. Validation of the data in the downloaded IGC file is through the Validation function of the Microsoft Windows-based IGC Shell system that is available without charge from the IGC GNSS web site in the file igcdll.zip.

3.2.1 IGC Shell Files. The IGC Shell files should be downloaded into a specific directory that is named in advance (for instance "IGCshell"). For the shell program to work with a particular type of recorder, the Dynamic Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory. For this recorder, the appropriate DLL is available on the IGC GNSS web site.

3.2.2 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.

3.2.3 Free availability. The IGC Shell program is free. The manufacturer's DLL file is freeware but is copyright of the recorder manufacturer.

3.2.4 IGC Standard for Flight Data Validity. The IGC standard for electronic flight data is that the IGC file must pass the IGC Validate check. The Validate function of the IGC Shell program is used to interrogate the IGC file that is to be Validated. The IGC Validate procedure checks that the IGC file has correctly originated from a specific recorder and that the IGC file is identical to when it was initially downloaded. See B3.3.1.1 for more details.

## **CONDITIONS OF APPROVAL**

### **4 Connections and GPS Antenna.**

4.1 Micro-SD socket. The only connection is a micro-SD socket under the end face under the screen and control button.

4.2 GPS Receiver Antenna. The GPS receiver antenna is inside the recorder case and no external connector is required.

5 **Security of the Equipment.** GFAC is presently satisfied with the physical and electronic security of this equipment in terms of the security of the FR, the integrity of the recorded flight data and the level of this approval for the types of flights concerned. 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.

6 **Installation in a glider.** The position of any displays and operating buttons and controls used in flight in single-seat gliders should not be remote from sight-lines used for pilot lookout and scan for other aircraft and gliders, subject to para 7.4 on ENL and para 8 on sealing. However, the position of any displays and operating buttons and controls used in flight in single-seat gliders should not be remote from sight-lines used for pilot lookout and scan for other aircraft and gliders.

7 **Motor Glider Engine Recording.** All models are fitted with an Environmental Noise Level (ENL) system that records acoustic noise 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 ENL (Environmental Noise Level) value with each fix. The system 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 is made by recorder manufacturer 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.

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 very small and can easily 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.

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

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

8. **Check of Installation in the Glider**. This Recorder is small and light and could easily be transferred from one glider to another or even to a powered aircraft. ***It is therefore of particular importance*** that 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. For how this is to be done, see para B1 later in this document.

## 9 **Security - Physical and Electronic**

9.1 Physical Security. Tamper-evident seals with the manufacturer's name must be fitted over one or more of the screws that secure the case, and also across any joints in the case that allow access to the internal modules in the Recorder. Also, an internal security mechanism activates if the case has been opened.

9.2 Electronic Security. If the internal security mechanism has been activated, the security record (the G-record in the IGC file) will be marked as insecure. The message "Seal not valid!" will be shown on the FR screen on start-up. Later IGC files will fail the IGC Validation test for electronic security. In addition, the IGC Validation 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, before it can be used again for flights to the IGC standard, 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 his 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 **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 inside the recorder such as GPS receivers, pressure altitude transducers and anything related to either physical or electronic security. If in doubt, GFAC should be notified so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian W 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](mailto:ian@ukiws.demon.co.uk)

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## 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. All flights, see para (i-ii).

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 GPS Antenna and SD Connectors. The GPS antenna is inside the Recorder, which should be positioned to give sufficient signal strength for fix recording. A micro-SD socket is on end face of the case under the screen. No attempt must be made to pass unauthorised data into the Recorder through the antenna or the micro-SD socket .

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. In the "GPS INFO" screen, a Pilot Event (PEV code) is produced on the next fix when the main button is pressed, followed by fast-fixing at one or two second intervals for the period selected. The fix interval for cruise flight between PEV events (such as between Waypoints) is set by the pilot before flight through the manufacturer's set-up program that allows fix intervals up to 60 seconds. 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. 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). 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". For competitions complying with Annex A to SC3, a fix interval of 10 seconds or less is required (SC3A para 5.4C).

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. It is the pilot's responsibility to ensure that the recorder is performing correctly and in accordance with this approval, for instance ensuring that GPS fixes, pressure altitude, ENL and other 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 Pre-flight Declaration in the IGC file. Electronic pre-flight declarations of Waypoints are made by selecting Start, Finish and Turn Points from Waypoint (WP) data that has been uploaded into the recorder either from the manufacturer's LXe program, by copying a WP file or files in CUP format to the micro-SD card, or manually inserting WP data in CUP (comma-separated) format on the micro-SD card. It should be ensured that there is always a comma "," after the lat/long, otherwise the longitude will default to "E". Before making a flight that is to be claimed and requires a pre-flight declaration, pilots are advised to check that they can successfully carry this out, and that an IGC file is produced that satisfies the Sporting Code on electronic pre-flight declarations.

A6 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. *As this recorder is small and light, it would be easy to transfer it from one glider to another, and for a flight to be validated it is essential that the pilot ensures that an OO can certify that the Recorder was in the glider for the flight concerned.* 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.

A7 **Switch on.** The recorder is switched on by pressing the button under the screen. Pilots should switch on at least 5 minutes before takeoff and check that GPS lock-on has occurred in time to establish a baseline of fixes before takeoff starts.

A8 **Takeoff - Independent evidence.** 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 the recorder, see B1.2.

A9 **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 as three ENL numbers. The recorder must be placed so that engine-related 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). See para 7 in the Conditions of Approval, particularly 7.2 for low-ENL engines.

A9.1 **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.

A9.2 **Pilot check of ENL figures.** Pilots should check that the ENL figures produced by their recorder show a clear difference 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.

A10 **After Landing.** Until an OO has witnessed the Recorder installation to the glider, the pilot must not alter the installation or remove the FR from the glider. The pilot must ensure that there is evidence of the landing independent of the flight recorder data, see A11. **Pilots are advised not to switch off the recorder for 5 minutes after landing.**

A10.1 **After-flight calculation of security.** After landing and when fixing in the IGC file ends, the recorder calculates a coded digital signature. 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-LXV.DLL file in the same directory.

A11 **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).

A12 **Switching Off.** This is by pressing the button until either the screen goes blank or the message appears "Do you wish to end the flight - yes/no".

A13 **Downloading the Flight Data.** Downloading is to a micro SD card that fits into a socket on the side of the Recorder to the left of the screen. On the "LOGBOOK" page of the screen, highlight the flight concerned and press the main button. Then select the "copy to SD" option from the menu on the screen and press the button again, the message "Copying" will then be shown. The Card is very small and light, take care that it is not dropped in a place where it may be difficult to find again. The OO will then 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 Airspace 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.

A13.1 **Competitions.** 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 rules in A13 continue to apply.

A14 **Calibration of Barograph Function.** Pilots are advised to have a barograph calibration carried out 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. All flights, see para (i-ii).*

*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.** An OO must 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. For the position of displays used 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 Downloading the Flight Data.** The OO should download the flight data to a micro SD card fitted in the socket on the side of the Recorder to the left of the display. Switch on the Recorder by pressing the button, then press the button to the right three times until the "Logbook" screen appears. Move the button up or down to select the required flight, and press the button until "Copy to SD" appears. Press the button again to save the selected flight. Security is maintained by electronic coding embedded in the Recorder which is then independently checked later at the NAC through the IGC Validation program, described below.

**B3.3.1 Files Produced.** This process will produce an IGC-format ASCII flight data file with the file name YMDMXXXXF.IGC, 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).

**B3.3.2 Validation - the IGC Shell Program.** Download the IGC Shell program from the IGC GNSS web pages under "software" and place all the files in one directory (for instance "IGC Shell"). Individual files are available through the file "igcdll.zip". For the Shell program to work with a particular type of 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". The IGC Shell 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 words "LX Navigation, Colibri". This line should be selected and then the grey "Validate" button should be pressed, followed by selecting the IGC file that is to be checked. If successful, the message "Log File has been successfully validated" appears. If there is a security problem, the message "Integrity Bad" appears.

**B3.3.2.1 Latest File Versions.** The latest versions of the IGC shell and DLL files must be used. These can be obtained from the IGC GNSS site for software listed at the beginning of this document.



B3.3.3 OO's Copy. A copy of the IGC file for the flight shall be retained securely by the OO such as by immediately copying it to a separate memory stick, PC card or diskette, or the hard disk of the OO's own PC. The IGC file shall be retained by the OO in safe keeping for later checking and analysis under NAC procedures, and no access must be possible by the pilot or anyone associated with the pilot. 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 (the IGC file itself contains the data that are normally in the file 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. Before a Flight Performance is analysed and 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 originally downloaded from the Recorder. This is done by checking the IGC data file with an authorised copy of the IGC Shell program and using the Validate function in the IGC Shell menu, as show in 3.3.2 above.

B5. Means of Propulsion (MoP) Record - Motor Gliders. The MoP must either be sealed or inoperative, or the built-in Environmental Noise Level (ENL) system used. This has a microphone in the recorder that enables the acoustic noise at the recorder to be transformed into three numbers that is added to each fix on the IGC file. 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, typically up to 300 for winch and 200 for aerotow. During the ground roll, short-term higher values have been recorded, probably due to wheel rumble, and values of 400 have been seen for a few fixes.

B5.2 ENL during engine running. On engine running at powers needed to climb, an increase to over 750 ENL is expected. Over 900 is typical for a two-stroke engine, over 750 for a 4-stroke. ENL values of 999 have 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. The values quoted above are for 2- and 4-stroke engines. Tests with Wankel (Rotary) engines indicate that they produce ENL values between those of 2- and 4-strokes.

B5.2.1 Quiet engines. This approval does not include use with Motor Gliders with electric, jet, or other engines that produce low ENL values, particularly at low engine powers (see Para 7 in the Conditions of Approval), **unless the FR is mounted close to the jet pipr of a jet engine or the propeller of an electric engine**. ENL values of over 900 have been recorded with this FR mounted close to the propeller of an Antares 20E electric motor glider with the engine at full power, and over 550 with the engine at power for level flight (compared to below 200 if mounted in the cockpit). See para 7.2 in the Conditions of Approval before the annexes.

B5.3 ENL during gliding flight. ENL readings of less than 050 indicate normal quiet gliding flight. Short periods of higher ENL while gliding may indicate aerodynamic noises. In a high-speed glide, particularly in a glider with a noisy cockpit, the ENL may increase to 300. 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 500 have been recorded. High ENL may also be recorded during stalling and spinning, particularly if the engine doors flutter or vibrate (move 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 may be shown if flying with the pylon up and engine not running, 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 cockpit 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 recorded as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 500 have been recorded.

B5.5 ENL during landing. During contact with the ground during takeoff and landing, short-duration ENL readings of up to 600 have been recorded, probably 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 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 and sideslip, or nearby 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.** For a pressure altitude calibration, you are advised to set the normal fix rate to a low fix interval such as 1 or 2 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.

**B6.1.1 After Calibration.** 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, and the file should be kept with the calibration paperwork so that it is not confused with other calibration files. As the original IGC file will have a nominal date/time, the file can be copied and the file name changed to one that can be identified as the calibration. A text editor can be used to change add a realistic date and time, although this will mean that the Validation check will fail and the original IGC file must also be kept unaltered.

**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, lat/longs taken from a moving vehicle at a variety of surveyed points in average reception conditions, show an average error of between 11 and 12m.

**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 of 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 16,000m (52,493ft).

**B6.3.2. GNSS altitude.** GPS altitude is recorded up to 9,000m (29,568ft).

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