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

References:

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

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

31 March 2007

IGC-APPROVAL FOR GNSS FLIGHT RECORDER

Level of Approval: All flights

Recorder Name: LX Navigation Colibri series

(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 history.** The original IGC-approval document for the LXN Colibri recorder was dated 31 August 1998. Version 2 dated 26 Oct 1998 made some refinements. Version 3 dated 10 December 2001 added the BB model and the JRC GPS receiver board. Version 4 dated 20 June 2005 added the Colibri Version 4 model with a USB Mini-B connector and other additions. The uBLOX GPS receiver was added on 24 February 2006 and this version adds the Flarm (Flight Alarm) proximity warning function.

(i-ii) **IGC-approval Level.** The 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.

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

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

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

(v) **Keep with the Equipment.** 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

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EQUIPMENT

1. HARDWARE

1.1 Models

1.1.1 Colibri LCD model. This is the original and has seven buttons and a 30 x 14 mm LCD on the 98 x 58 mm face.

1.1.2 Colibri BlackBox (BB) model. In this model there are no buttons or LCD.

1.1.3 Colibri model 4. Introduced in 2005, this is the LCD model with two extra buttons, a membrane keyboard and a USB mini-B port for downloading of data.

1.1.4 Colibri 4F. Introduced in 2007, this is a Model 4 with a Flarm (Flight Alarm) proximity warning module.

1.2 Hardware Versions. IGC-approval applies to V1.0 or later, subject to specific IGC-approval for later versions. The version number is shown on the LCD (where fitted) on start up and in the IGC file header record after "HF RHW HARDWARE VERSION".

1.3 Dimensions & Weight. A rectangular metal case is about 97 x 58 x 34 mm in size and weight is about 210 grammes.

1.4 Connectors. A 6-pin RJ11 external connector wired to the IGC-standard is on an end face. A 9mm BNC bayonet-type GPS antenna (AE) connector is on the same end face, except for some models that have an integral antenna mounted on the opposite end. Model 4 adds a USB mini-B connector on the end face with the other connectors.

1.4.1 Model 4F. The letter F stands for Flarm (Flight Alarm). This model has a 6mm diameter screw-fitting antenna socket on the end face opposite to the GPS receiver (RX) antenna. This is for the transmit/receive (TX/RX) function of the Flarm proximity warning system. The Flarm display is on the end of a cable attached to the case next to the RJ11 socket and the GPS RX antenna. The Model 4F also has a micro-SD card slot on one of the side faces.

1.5 GPS receiver boards. Early Colibri models had the FDK/GSU 15D receiver by Koden of Japan (www.koden-electronics.co.jp). After September 2001, the JRC/CCA-450 12-channel receiver by Japan Radio Corporation (www.jrc.co.jp/eng/products/gps) was used. From 2006 the 16 channel u-blox (Switzerland) TIM-LP or LEA 4P boards were fitted (www.u-blox.com). The GPS receiver type is shown in the header record of IGC files in the form "HFGPS: u-blox TIM-LP" which can be seen by using a text editor to view the start of the IGC file.

1.6 Pressure altitude sensor. A MS 5534-A pressure sensor by Intersema Sensoric SA of Switzerland is fitted (www.intersema.ch). This is compensated for temperature variation and calibrated to the ICAO ISA. The recorder case is not pressure-sealed and "cockpit static" pressure is recorded on the IGC file. The type of sensor is shown in the header record of IGC-format flight files in the form "HFPRSPRESSALTSSENSOR:INTERSEMA,MS5534A" which can be seen by using a text editor to view the start of the IGC file.

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

1.7.1 Flarm Proximity Warning function. The Flarm Proximity Warning function is not part of this IGC-approval, which concerns only the recording function (see para (ii) on page 1). Users of the Proximity Warning function are advised to check their National regulations before using it. For instance, at the date of this document, it is understood that for insurance reasons the Flarm Proximity Warning system should not be used in the USA and Canada. FAI, IGC and GFAC have no responsibility or liability for such use, see para (ii) above.

1.8 Other modules. Other modules such as for cockpit in-flight displays may be connected but are not part of this IGC-approval and are a matter between the manufacturer and the customer.

2 **FIRMWARE**

Version 1.0h was the original IGC-approved firmware standard. Later versions may be used if they are IGC-approved. The firmware version is shown on the LCD (if fitted) for a short time after applying power. It is also listed in the header record of IGC files in the form "HF RHW FIRMWARE VERSION: 1.0", which can be seen by using a text editor to view the IGC file.

3 **SOFTWARE**

3.1 Windows DLL system. The MS Windows-based IGC Shell program is available from the IGC GNSS web in the file igcdll.zip. For the shell program to work, the IGC shell files should be downloaded into a specific directory and the appropriate Data Link Library (DLL) file from the recorder manufacturer copied to that IGC Shell directory. The file IGC-LXN.DLL is available on the IGC GNSS web site and on the manufacturer's CD-ROM.

3.1.1 Latest file versions. It is recommended that the latest versions of igcdll.zip and the manufacturer's DLL files are used, obtained from the IGC GNSS site for software given at the beginning of this document.

3.1.2. Colibri Versions - Connectors. The RJ11 connector in all Colibri versions can be used for downloading IGC files and uploading set-up information. In addition, the basic Model 4 also has a USB Mini-B connector for the download process only and does not power the GPS system for operation in flight. In the 4F (Flarm) version the Flarm display is attached to an end face.

3.2 Manufacturer's Programs. The manufacturer's proprietary programs (LX-FAI and LXe) may also be used for the above functions. If a manufacturer's program is used, it must be authenticated as such and not altered in any way so that the downloaded files can be shown to be genuine.

3.3 Validity of Flight Data. Whatever program is used for downloading from the FR and conversion to the IGC format, the criterion for validity of data is that the IGC-format file must pass the IGC VALIDATE check. That is, by using the MS-Windows-based IGC Shell program with the IGC-LXN.DLL file in the same director, or for DOS systems, by using the VALI-LXN.EXE file. The IGC Validate system checks that the IGC file has correctly originated from the recorder, that the recorder is still secure and has not been tampered with. It also checks that the data in the file is identical to when it was initially downloaded. See also B3.3.1.1.

3.4 Use of Latest Files - Free Availability. The IGC-LXN.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 DOS-based DATA, CONV and VALI files are copyright of the Recorder manufacturer but are freeware. The latest versions of these programs and files 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 to the Main (FR) Module. The position of the connectors is described above under Hardware.
 - 4.1 GPS Receiver Antenna. A 9mm circular BNC bayonet connector is fitted, except for models with an integral antenna.
 - 4.2 Data transfer to a PC. A female 6-connector 9 x 6 mm RJ11 socket is fitted for downloading data after flight and for uploading setup data.
 - 4.3 Colibri 4 USB Mini-B. The Model 4 also has a 6 x 2.5mm USB Mini-B connector for downloading flight data. When a PC is connected, it will power the Colibri through the Mini-B for downloading but the GPS receiver is disconnected automatically in order to save power.
 - 4.4 Colibri 4F with Flarm.
 - 4.4.1 Transmit Antenna. A 6mm diameter screw fitting Transmit/Receive (TX/RX) antenna on the top face is for the Flarm proximity warning system.
 - 4.4.2 Flarm Display. A cable near the RJ11 socket and GPS antenna has a male RJ11 connector on the end. This is for connecting to the Flarm display unit.
 - 4.4.3 microSD card. A microSD card slot is on the right side of the case. IGC flight files are automatically downloaded to this card when the unit is switched on again after a landing has been registered
5. Security of the Equipment. GFAC is presently satisfied with the physical and electronic security of this equipment in terms of the integrity of the recorded flight data and the level of this approval for the types of flights concerned. See paras 9.1 and 9.2 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. . From the point of view of data recording, the unit may be fitted anywhere in the glider, subject to para 9 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 false data and any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew.
 - 6.1 Sight Lines. 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. Cockpit Noise Level Recording - ENL system. An ENL (Engine Noise Level) recording system is fitted and when enabled (see Annex A for method), acoustic noise levels at the recorder are recorded with each fix. This is essential for Motor Gliders in order to show that the engine was not run during the part of the flight that contains the claimed glide performance. ENL data has also been shown to be useful for non-motor gliders in the case of accidents and incidents.
 - 7.1 ENL Recording System Manufacturer. The ENL system in this recorder is made by LX Navigation.
 - 7.2 ENL figures. ENL figures in each fix in the IGC file are between 000 and 999 in steps of 001.
 - 7.3 ENL IGC-approval - Engine Types. This document gives IGC-approval for the use of the above system for the validation of glide (non-powered) performances to IGC standards of evidence when flown with Motor Gliders that have internal-combustion engines that give substantial acoustic noise levels in the cockpit.
 - 7.3.1 Electric or other Quiet Engines. This approval does not include use with Motor Gliders with electric or other engines that produce little noise in the cockpit, particularly under reduced power such as for level flight. If an electric or another quiet engine is to be used, GFAC should be notified beforehand so that tests can be carried out.

7.4 ENL System and Cockpit Positioning. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. The system is designed to highlight any engine noise but to 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 propeller noise when forward thrust is being generated.

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

8. Check of Installation in the Glider. There must be incontrovertible evidence that the 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 8.1 cannot be met, the FR must be sealed to the glider by an OO at any time or date before flight so that it cannot be removed without breaking the seal. The sealing method must be acceptable to the NAC and IGC. Paper seals must be marked in a manner such that there is incontrovertible proof after the flight that seals have not been tampered with, such as by marking with the glider registration, the date, time and OO's name and signature. It should be possible for the OO to recognise the seal markings afterwards. The use of adhesive plastic tape is not satisfactory for IGC-approved sealing because it can be peeled off and re-fitted. Gummed paper tape is recommended, as used for sealing drum-type barographs. The OO must seal the FR unit to glider parts which are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the FR is sealed to such removable part, if such a part is transferred between gliders, any FR seal for the previous glider must be removed.

9 Security Seals, Physical and Electronic.

9.1 Physical Security. A silver-coloured tamper-evident seal with the European ACE 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.

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

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 IGC Validate test for electronic security. This test will also fail if the *.LXN or *.IGC file has been altered in any way after being transferred from the FR.

9.2.1 Flarm security aspects. In the Flarm version, electronic security is entirely through the recorder manufacturer's firmware and software and direct input to the Flarm module is disabled.

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

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

10. Analysis of Flight Data. Analysis for flights to be validated to IGC criteria should 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 with an authorised copy of the VALI-LXN.EXE short program or, for the Colibri model 4, by using the validate function in the IGC Shell program. The VALI and IGC Shell programs 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, later Versions of Hardware, Firmware and Software. Notification of any intended change to hardware, firmware or software must be made by the manufacturer to the Chairman of GFAC so that a decision can be made on any further testing which may be required to retain IGC-approval for the change. This includes changes of any sort, large or small. It includes details of later Versions of hardware, firmware and software, also any changes to modules such as GPS receiver boards, pressure altitude transducers and the layout of the security microswitch and its shielding from possible interference. If in doubt, GFAC should be notified so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan,
Chairman, IGC GFAC

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

Any questions to: Chairman IGC GFAC,
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----- Annexes follow -----

**NOTES FOR OWNERS AND PILOTS -
PART OF IGC APPROVAL**

A(i). **Status.** To be read together with the main terms of approval to which this is an Annex.

A(ii). **IGC-Approval level.** This recorder is IGC-approved for all flights including world records.

A(iii). **Copy of this document.** It is recommended that a copy of this approval document is kept with the equipment concerned, for the use of pilots and Official Observers.

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

A1. **Antenna** - The antenna should be positioned in order to give sufficient signal strength for IGC purposes. No attempt must be made to inject false data via the antenna; any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

A2 **Geodetic Datum (Earth Model).** For IGC purposes, all latitudes and longitudes recorded by the Recorder must be to a Geodetic Datum (earth model) of WGS84. This type of recorder is fixed on the WGS84 datum and no selection or switching is required except to ensure that other lat/long data such as for start, turn and finish points, is entered also to the WGS84 Geodetic Datum (IGC rule).

A3 **Setting the Fix Interval.** The fast-fix facility operates when the Pilot Event (PEV) button is pressed and gives the number and interval of fixes that were set before flight by the pilot through the setup program under the heading "On event button". The fix interval for cruise flight between PEV events (such as between Waypoints) is set by the pilot before flight through the set-up program under the heading "Normal operation". 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) and 10 seconds for competitions complying with Annex A to SC3 (SC3A para 5.4C). SC3C para 7.1 says: "10 to 20 seconds has been found to be suitable, and does not use up as much memory as a more frequent setting for the whole flight. A more frequent fix interval is recommended near a Waypoint to ensure that a fix is recorded within its observation zone".

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

A5 **Observing the Recorder installation in the glider.** The pilot must ensure that an OO has checked the place of the equipment in the glider and how it is fixed to the glider. If it may be difficult to obtain an OO immediately before takeoff, or to witness the landing, an OO should be asked to seal the Recorder to the glider, and **this can be done at any time or date before flight**. See para 8 in the conditions of approval. Regarding the position of displays concerned with the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

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

A7 **Connection to Ports.** Although this approval does not presently require sealing of any ports or plugs, no attempt must be made to pass unauthorised data into the Recorder. See para 9.1.1 in the Conditions of Approval. For versions fitted with Flarm, see also 9.2 in the Conditions of Approval about the relation of the Flarm firmware with the recorder manufacturer's firmware.

A8 **Use in Motor Gliders** (including self-sustainers): The internal microphone and associated circuitry automatically records the level of acoustic noise at the recorder. This is recorded in the IGC file with each fix. The recorder must be placed so that engine noise is clearly received when the engine is giving power and must not be covered or insulated (even so, automatic gain should continue to ensure high ENL readings under engine power).

A8.1 **Cockpit Noise.** Pilots should note that cockpit noises other than the engine will produce ENL figures on the IGC file, and should avoid those that could be mistaken for use of engine. **Flight with the cockpit Direct Vision (DV) and/or ventilation panel(s) open can produce a low-frequency sound (organ-pipe note) which will register as high ENL. This is magnified if sideslip is present and in particular at high airspeeds. High airspeeds with cockpit panels open should therefore be avoided in case the ENL recorded is mistaken for use of engine.** High ENL may also be produced by stall buffet and spins, particularly in Motor Gliders if the engine bay doors flutter (vibrate or move in and out). Flight close to powered aircraft should also be avoided, except for normal aero-tow launches. For ENL levels that have been recorded on GFAC tests, see B.4.2.

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

A8.3 **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. Then use the up/down buttons to select LOGGER MENU, and press ENTER. Use the up/down buttons until I-RECORD DATA appears. Press ENTER and use up/down buttons until DATA: ENL appears, press ENTER and use up/down buttons to select Y for Yes. Then press the ESCape button until SETUP MENU appears, and left/right buttons 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.

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

A9.1 **After-flight calculation of security.** After landing, the recorder calculates a digital signature for the IGC file for the flight, using a Public/Private Key encryption system. This process places security codes at the end of the IGC file for the last flight, which is then complete and stored in the memory ready for downloading. These codes are used to verify the integrity of the whole file at any later time by using the Validate function (see paras 9.2 and 10 earlier).

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

A11 **Switching Off.** This is by switching off the external power or disconnecting the RJ11 connector from the recorder.

A12 **Downloading the Flight Data.** This is by either connecting a PC to the RS232 socket that is part of the manufacturer's cable that plugs in to the RJ11 socket in the recorder, or for the basic Model 4, using a USB Mini-B connector to a USB port of a PC. For the model 4 with Flarm (Colibri 4F), in addition, the IGC files are automatically written to the micro-SD card, when it is fitted. The OO will carry out the actions given in para B3.3, and the OO's copy of the transferred flight data is sent to the organisation that will validate the flight, such as the National Airspace Authority (NAA). 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 standard electronic media such as a memory stick, diskette or equivalents. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to the rules for IGC records and badges, the above continues to apply.

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

A13 **Calibration of Barograph Function.** Pilots are advised to have a barograph (pressure altitude) calibration carried out either by the manufacturer or by an NAA-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 NAA 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.

A14 **Caution – microSD Card.** The microSD card is very small (11 x 15 x 1 mm) and light (0.4 grammes). It is very easy to lose it. Also, if it is removed from the recorder by pressing lightly on it and then releasing the pressure, the card can spring out from the recorder and travel up to 2 metres. The card could then be very difficult to find, particularly if this occurs on the airfield.

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

NOTES FOR OFFICIAL OBSERVERS AND NACs - PART OF IGC APPROVAL

*B(i). **Status.** To be read together with the main terms of approval to which this is an Annex.*

*B(ii). **IGC-Approval level.** This recorder is IGC-approved for all flights including world records.*

*B(iii). **Copy of this document.** It is recommended that a copy of this approval document is kept with the equipment concerned, for the use of pilots and Official Observers.*

B1 Installation in the Glider. It should be noted that, due to the portability of this Recorder, it would be easy to transfer it from one glider to another, or from a powered aircraft to a glider. Therefore, an OO shall witness and record the position of the Recorder in the glider, the type and serial number of the Recorder, the glider type and registration, date and time. Before flight, if requested, the OO shall then seal the Recorder to the glider in a way acceptable to his NAC and to IGC, and such sealing may be at any time or date before flight. If sealing is not used, either a preflight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight. Alternatively, an OO must witness the landing and have the glider under continuous observation until the Recorder installation is checked. This is to ensure that the installation is correct, and another Recorder has not been substituted in the glider before the data transfer (B3.3). See para 8 of the Conditions of Approval. Regarding the position of displays concerned with the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

B2 Takeoff - Independent Evidence. The time and point of takeoff shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. After flight, this will be compared to the takeoff data from the Recorder.

B3 Landing

B3.1 Independent Evidence of Landing. The time and point of landing shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. After flight, this will be compared to the landing data from the Recorder.

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

B3.3 Transferring the Flight Data. If a portable PC is available or the recorder is one with the microSD card, the flight data may be transferred at the glider without disturbing the installation of the Recorder; if a portable PC is not available, the OO shall check and break any sealing to the glider, and take the Recorder to a PC. If the OO is not familiar with the actions required, the pilot or another person may transfer the data while the OO witnesses the process. Security is maintained by electronic coding embedded in the Recorder which is then independently checked later at the NAC (and at FAI if the claim goes to them).

B3.3.1 Method 1 - IGC Shell and DLL file via the RJ-11 connector. Use the manufacturer's cable that has an RJ11 connector for the recorder, a female 9-pin RS232 for connecting to a PC and 12 volt power connections to power the recorder. Make sure that the PC has the IGC Shell program files in a specific directory (the name 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 Data Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory.

B3.3.1.1 Colibri - Method. For the LXN Colibri the file IGC-LXN.DLL is available on the IGC GNSS web site. After copying it to the directory that contains the IGC Shell files, execute IGC-SHELL.EXE. Set the path to the IGC shell directory using the "Set Directories" button. 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 line "LX Navigation v1.1, Colibri, LX7000du" (or later versions). This box 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.

B3.3.1.2 Latest versions. The latest versions of the IGC shell and DLL files must be used. These can be obtained from the IGC GNSS site for software listed at the beginning of this document.

B3.3.2 Method 2 - IGC Shell and DLL via USB Mini-B connector. For models with the USB Mini-B connector, use a cable with a USN Mini-B connector at the recorder end and the standard USB connector at the PC end. This system is powered from the PC and no battery is needed to power the recorder. The PC must have the IGC Shell files and the manufacturer's DLL in a specific directory, as described above in B2.3.1.2 which also describes the method of operation. Because the USB port is used, drivers that recognise the recorder through this port are also needed and are available through the IGC GNSS web site together with the IGC Shell and DLL files and a file describing how to install them.

B3.3.3 Method 3 – microSD card. For models with the microSD card, IGC files are automatically written to the card after a landing is detected. These files can then be copied via a Card Reader attached a PC. Most microSD cards are supplied with a full-size SD card adapter that can be used if the Card Reader does not have a microSD card slot. The microSD card is very small and light (see para A14) and care should be taken when extracting it from the recorder and in handling it generally. If the microSD card method is not available, the other downloading methods for the model concerned are available.

B3.3.4 Files produced. This process will automatically produce both a *.LXN 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. The full key to the file name is in Appendix 1 to the IGC GNSS FR Specification and is also listed in Annex C to the Sporting Code, SC3C.

B3.3.5 OO's Copy. A copy of both the *.LXN 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.

B3.3.6 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 IGC file validation system.

B4. 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). There are two aspects to data analysis, checking the flight performance that is being claimed by using the fixes and other data in the IGC file, and Validation of the integrity of the downloaded data itself.

B4.1 Validation of Flight Data. The IGC Validation system checks three elements. (1) That the flight data in the IGC file is identical to that originally downloaded from the Recorder That is, that data has not been changed after the initial download. (2) Checks the electronic security coding and general structure of the IGC file. (3) Checks that the Recorder has not been modified in an unauthorised way.

B4.2 Validation Method. Use the Validate function of the free IGC Shell program that should be in the IGC Shell directory of the PC being used. For more detail, see para B3.3.1. The file IGC-LXN.DLL and the IGC shell program that are used by the authority validating the flight performance shall be identical to those available on the current IGC GNSS web pages. This system shall be used by the OO, the competition organisers, or the NAC as appropriate. Also by FAI if the data goes to them such as for a World Record.

B5. Means of Propulsion (MoP) Record - Motor Gliders. The MoP must either be sealed or inoperative, or the built-in Engine 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 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.

B5.2 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. The values quoted above are for 2- and 4-stroke engines. Wankel (rotary) and electric engines have not been tested with this recorder, but previous tests with Wankel engines indicate that they produce similar ENL values to 4-strokes.

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

B5.3 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.

B5.4 ENL during the approach to land. ENL values are always higher on a landing approach due to aerodynamic noises such as due to airbrakes, undercarriage, sideslip, turbulence, etc. Short-term peaks due to specific actions such as opening airbrakes, lowering undercarriage, etc., will be noted as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 300 have been recorded, although 240 is more typical in an aerodynamically noisy glider, and 120 in a quieter machine.

B5.5 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. 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 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).

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

B6.1 Calibration method, making a calibration table. Before a calibration, owners are advised to set the normal fix rate to a small time 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 (start) the recording of fixes, 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 if pressure altitude is not available.

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 or regional augmentation system. The altitude accuracy from satellite-based systems will not be as good as accuracy in lat/long. Because the geometry of the position-lines is not as favourable for altitude compared to horizontal position. This effect will be increased by poor antenna positioning. 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 for civilian receivers, errors average between 11 and 12m. This is the average lat/long error taken from a sample of fixes from a moving vehicle at a number of surveyed points near 51N 001W for all recorders with 12 or more channels tested since that date.

B6.2.1 Koden (Japan) FDK/GSU 15D receiver. With the Koden board that is fitted to some early Colibri models, a time delay has been noted in the GPS altitude figures when compared to those for 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.

B6.2.2 Other receivers. Occasional short-duration differences in the shape of the GPS Altitude/time graph have been noted compared to the pressure altitude figures. This is thought to be a combination of satellite geometry (poorer for altitude calculations) and different processing for GPS altitude within receivers compared to processing to horizontal position. This can be added to by poor antenna positioning or faults in the antenna cable or connectors. Lat/long fix accuracy appears not to be affected and GFAC tests show typical accuracies in lat/long positions recorded in IGC files. Data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records.

B6.3 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 (lack of large steps) across the altitude range, results in limitations in altitudes that can be recorded in the IGC file. The maximum altitudes for figures in IGC files that apply to this recorder are given below.

B6.3.1 Pressure Altitude. Recorded up to about 9 km (29,528ft).

B6.3.2. GNSS altitude. Recorded up to about 18km (59,055ft)

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