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

References:

FAI web site: <http://www.fai.org>

IGC web site: <http://www.fai.org/gliding>

IGC GNSS web site: <http://www.fai.org/gliding/gnss>

IGC-approval documents: <http://www.fai.org/gliding/gnss/approvaldocs>

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

To: IGC GNSS web site under "List of Approvals", for permanent reference

Copy: Manufacturer concerned

Notice of issue:

FAI for IGC email mailing list

Internet newsgroup: rec.aviation.soaring

Date of issue: 17 March 2006

**IGC APPROVAL FOR ALL FLIGHTS
VERSION 3 IGC-APPROVAL DOCUMENT FOR
LX NAVIGATION LX7000 SERIES OF GNSS FLIGHT RECORDERS**

(i) This document gives formal approval from the above date for the GNSS Flight Recorder (FR) equipment described below to be used for validation of flights under the rules and procedures in FAI Sporting Code Section 3 (Gliders and Motor Gliders), subject to the conditions and notes given later. IGC reserves the right to alter this approval in the future.

(i-i) Document history. The original IGC-approval document for the LX 7000 recorder was dated 14 March 2003. Version 2 dated 20 July 2005 added the LX7007 model with a faster microprocessor and additional connectors that are listed below. This Version 3 adds the uBLOX TIM-LP GPS receiver and a FLARM module inside the recorder case.

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

(ii) This IGC-approval document is concerned with the functions of the equipment that are concerned with recording of data. More specifically, with the accuracy and reliability of the resulting data for the exclusive sole purpose of validation and certification of flight performances to the criteria of IGC and FAI. Tests made by GFAC on behalf of IGC and FAI concern accuracy and security of data, transfer and conversion to and conformity of the output data with the standard *.IGC file format in relation to the above mentioned validation and certification purposes. Other functions of the equipment are not part of this IGC-approval and the relevance of this document does not extend beyond the specific validation and certification purposes mentioned above. In particular this applies to any function linked with aspects that could be critical to flight safety such as navigation, airspace avoidance, terrain avoidance and any aircraft proximity-warning and/or

anti-collision functions. This document does not constitute any approval, guarantee and/or any statement by GFAC, IGC and/or FAI as to the reliability or accuracy of the equipment for operation in flight and any liability in connection therewith is hereby expressly excluded.

(iii) The attention of National 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) deals with equipment used in flight validation, Annex C to the Code (SC3C) consists of guidelines and procedures for Official Observers, pilots, and other officials involved in the flight validation process. Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the IGC web site. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" and is also available through the IGC/GNSS web site shown above.

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

MANUFACTURER

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IGC-allocated manufacturer codes: Three letter LXN, single letter L

EQUIPMENT:

1. HARDWARE

1.1 Model Numbers.

LX7000. This was the original model first produced in 2003.

LX7007. This was a new model first produced in July 2005. The Display and recorder Unit (7007DU) had a faster microprocessor and extra connectors on the rear side of the unit. The extra connectors were a female 9-pin sub D connector for use with a PDA, a female RJ-45 8 pin IGC-standard connector for transfer of data and a 6-pin RJ11 user port.

LX7007E. This model was first produced in February 2006. The final letter stands for FLARM, a proprietary air-to-air proximity warning system manufactured by Flarm Technology of Zurich, Switzerland (www.flarm.com). In this model a FLARM module is incorporated inside the LX7007 recorder case and the GPS receiver is the uBLOX TIM-LP. See para (ii) above on the status of FLARM with respect to IGC and FAI and the manufacturer and operator of this recorder.

1.2 Hardware Version. Version 1.0 or later (V2.0 for the LX7007), where later versions are IGC-approved. The Version is shown in the header record of IGC-format flight files in the form "HF RHW HARDWARE VERSION: 1.0" which can be seen by using a text editor to view the IGC file.

1.3 Dimensions. The recorder is designed for mounting in an instrument panel with a 79 mm (3.11 inch) circular cut-out. The recorder case is of square cross section about 81 x 81mm and is about 86 mm long. Three electrical connectors are on the back and project up to a further 13 mm.

The front contains a 59 x 41mm LCD, six buttons and four control knobs. The knobs project about 23 mm from the metal case. Weight is about 550 grammes and connectors are described later.

1.4 **GPS receiver board.** Early models had the JRC/CCA-450 12-channel parallel receiver by Japan Radio Corporation (www.jrc.co.jp/eng/products/gps). From 2006 the 16 channel uBLOX (Switzerland) TIM-LP board may be fitted (www.u-blox.com).

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

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

1.7 **Other modules.** The LX7000 system is modular and includes other units that can be connected. These include functions such as pitot and static pressures, variometer and glider performance information. This approval is for the GNSS Display Unit (short title "LX7000DU" or "LX7007DU") that also contains the GNSS Flight Recorder. Note that some basic LX7000 modules do not have GPS or a pressure altitude sensor and are therefore not IGC-approved recorders. These units can be connected by cable to an external off-the-shelf GPS unit and can then be downloaded to produce an IGC-format file but without the features that are produced by an IGC-approved system, such as security encoding. Such units are not covered by this document.

2. **FIRMWARE.**

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

3. **SOFTWARE.**

External software can be used by connecting a cable to the male 9-pin RS232 port on a PC to the LXN proprietary 15-pin connector on the back of the recorder or, for the 7007 model, also to the RJ45 connector. The recorder must be set to its "Transfer" mode before data can be transferred either to or from the recorder. For setting the Transfer mode, see para A7.

3.1 **Short Program Files DATA, CONV & VALI.** The short program file DATA-LXN.EXE is for transferring flight data from the recorder to a PC. Executing DATA-LXN when the recorder is in "Transfer" mode and connection has been established, produces a menu of the data files that are in the memory. Data transfer produces a *.LXN binary file and an *.IGC file for the selected flight, leaving the menu on screen for transfer of other flight data. The file CONV-LXN.EXE is for conversion of a *.LXN flight data file to the IGC format if the IGC file is not available. The file VALI-LXN.EXE checks the security and integrity of an *.IGC file, and ensures that the secure part of the file is the same as it was when transferred from the Recorder.

3.2 Windows-based IGC Shell and DLL system. In addition to the above, the LX 7007 can also be downloaded through the Microsoft Windows-based IGC Shell system that is available from the IGC GNSS web in the file igcdll.zip. Download these IGC Shell files into a specific directory that you have named in advance (the name IGCshell is recommended). For the shell program to work, the appropriate Data Link Library (DLL) file from the Recorder manufacturer must be copied to the IGC Shell directory. For this recorder, the file IGC-LXN.DLL is available on the IGC GNSS web site and on the manufacturer's CD-ROM.

3.3 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.

3.4 Validity of Flight Data. Whatever program is used for downloading from the Recorder and conversion to the IGC format, the criterion for validity of data is that the IGC-format file must pass the VALIDATE check in either the DOS or MS Windows versions. That is, by using the VALI-LXN.EXE file (DOS systems) or the IGC Shell program (Windows systems, together with the IGC-LXN.DLL file in the same directory).

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

CONDITIONS OF APPROVAL

4. **Permitted Connections**. All connectors are at the opposite end of the case to the instrument face which has the LCD, buttons and control knobs. This recorder is designed to be panel-mounted and cable connectors, once installed, may be difficult to access unless the design of the instrument panel allows easy access to the back of the recorder.

4.1 GPS antenna. A BNC 9mm diameter bayonet-type connector is fitted.

4.2 Connector for power and other units. A custom-wired 26 x 9 mm 15 pin D type male connector for power and connections to other compatible units such as the LX Analogue Unit (AU) that gives variometer, airspeed and speed-to-fly information. These other units have not been tested as part of this IGC-approval and are a matter between the manufacturer and customers.

4.3 Data transfer to a PC. Data transfer connectors are listed below. If the type of glider panel mounting makes access to this connector on the recorder case difficult, an extension lead should be provided from the transfer connector (s) on the recorder case to an IGC-standard fitting on the other end for connecting to a PC for downloading flight data.

4.3.1 7007 model. A female fitting is on the recorder case for use with a 11 x 8mm RJ45 8 pin connector, wired to the IGC standard. The RJ45 also supplies power and can be used to run the recorder as an alternative to the 15-pin D-type connector.

The 15-pin D-type connector can also be used for data transfer using an LXN-proprietary cable that has a 9-Pin RS232 female connector for use with the male RS232 on a PC.

4.3.2 Models other than the 7007. A female fitting is on the recorder case for use with a 8 x 8mm 6 pin RJ-11 connector, wired to the IGC standard. This includes a connection to a cable that has a 9-Pin RS232 female connector for use with the male RS232 on a PC.

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

6. **Installation in a glider**. The recorder is designed for mounting in an instrument panel, but may be fitted anywhere in the glider, subject to para 8 on sealing and, for Motor Gliders, that the position is suitable for recording Engine Noise Levels (ENL) in recorders where the ENL system is fitted. If the GPS antenna is accessible to the crew in flight, no attempt must be made to inject false data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew. Particularly in single-seat gliders, the position of any other displays connected to the recorder should not be remote from sight lines used for pilot lookout and scan for other aircraft and gliders.

7. **Motor gliders**. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. The system used is the LX Navigation ENL system that is also used in other LXN recorders, Filser recorders and the SDI PosiGraph series. ENL figures range between 000 and 996 in steps of 001. The system is designed to highlight any engine noise but produce low ENL values in gliding flight. The Recorder must be positioned in the glider so that it can receive a high level of engine and propellor noise when power is being generated. GFAC has tested this recorder in motor gliders with two-stroke and 4-stroke engines, but not with Wankel or electric power sources. For details of typical ENL values, see para B.4.

7.3 Electric engines. If an electric engine is to be used, GFAC should be notified beforehand so that tests can be carried out in order to establish ENL values.

8. **Check of Installation in the Glider**. There must be incontrovertible evidence that the particular recorder was present in the glider for the flight concerned. This can be achieved either by observation at takeoff or landing or by sealing the recorder to the glider at any time or date before takeoff and checking the seal after landing. As this system is designed primarily for panel mounting, a signed and dated OO's seal applied to the recorder at an appropriate place on or behind the instrument panel, will fulfil this requirement until the seal may require replacement due to damage or wear.

8.1 Observation of Installation before Takeoff or at Landing. The recorder may be sealed to the glider in accordance with 8.2. As it is designed to be mounted in the instrument panel, this should be straightforward. Otherwise, either a pre-flight check of the installation must be made and the glider must be under continuous observation by an Official Observer (OO) until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the recorder installation is checked. This is to ensure that the installation is in accordance with the rules, and that another recorder has not

been substituted before the data is transferred to a PC after flight. This is less critical with a panel-mounted instrument compared to one that is mounted elsewhere in the cockpit, but nevertheless the possibility still exists that the installation could be changed in an unauthorised way unless independent checks are made.

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

9. Security Seals, Physical and Electronic.

9.1 Physical Security. A silver-coloured tamper-evident seal with the manufacturer's name, is fitted over two of the case-securing screws above the maker's label on the back of the recorder case. In addition, an internal security mechanism is included that activates if the case of the Recorder is opened. If the Recorder case has been opened, breaching physical security, a message indicating that the unit is insecure appears on the LCD on switch-on, and subsequent IGC files will fail the VALI check (see para B3).

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

9.2 Electronic Security. If the internal security mechanism has been activated (such as by opening the case), any data in the memory will be lost, settings will revert to defaults, and the electronic security algorithms in the Recorder will be trashed. Any flight data files subsequently produced will fail the VALI test for electronic security. This test will also fail if the IGC file being checked differs in any way from that initially downloaded from the Recorder.

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

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

10. **Analysis of Flight Data**. Analysis for flights to be validated to IGC criteria must be through the use of a program that complies with IGC rules and procedures and is approved for this purpose by the relevant NAC. For a list of programs which are capable of reading and displaying flight data in the *.IGC file format, see the fai.org/gliding/gnss web site under the link to SOFTWARE (the full web reference is at the beginning of this document). Before a Flight Performance is officially validated, the authority responsible for validation must check that the data in the *.IGC file has originated from the Recorder concerned, and has not been altered after it was download from the Recorder to a PC. This is done by checking the IGC data file with an authorised copy of the VALI-LXN.EXE short program or, for the LX7007, 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**. Notification of any intended change to hardware, firmware or software must be made by the manufacturer to the Chairman of GFAC so that a decision can be made on any further testing which may be required. This includes changes of any sort, small or large. If in doubt, notify the change so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan
Chairman, IGC GFA Committee

Annexes:

- A. Notes for owners and pilots
- B. Notes for Official Observers and NACs

Any Queries to:

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----- start of Annexes -----

Annex A to IGC Approval

NOTES FOR OWNERS AND PILOTS

PART OF IGC APPROVAL FOR THE LXN LX7000 SERIES OF FLIGHT RECORDER

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

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

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

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

A.1 **Antenna** - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No attempt must be made to inject false data via the antenna, and any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

A.2 **Geodetic Datum**. Latitudes and longitudes recorded by the Recorder must be to the WGS84 Geodetic Datum, or the flight data will be invalid for IGC purposes. This recorder is fixed on the WGS84 Datum. No pilot action is required except to ensure that other lat/long data such as for start, turn and finish points, is also entered to the WGS84 Geodetic Datum (IGC rule).

A.3 **Recorder installation in the glider**. The pilot must ensure that an OO has checked the place of the Recorder module in the glider and how it is fixed to the glider. If it may be difficult to find an OO immediately before takeoff, or to witness the landing, you are advised to ask an OO to seal the Recorder to the glider, and **this can be done at any time or date before flight**. See para 8 in the conditions of approval. On the position of any other displays connected to the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

A.4 **Independent Check of Takeoff** - The pilot must ensure that the time and point of takeoff has been independently witnessed and recorded for comparison with that recorded by the GNSS Recorder, see para B1.2.

A.5 **Connection to Ports**. Although this approval does not presently require sealing of any ports or plugs, no attempt must be made to pass unauthorised data into the Recorder. See paras 8 and 9 in the conditions of approval.

A.6 **Use in Motor Gliders** (including self-sustainers). The internal microphone and associated circuitry automatically records an ENL (Engine Noise Level) value between 000 and 996 with each fix. The ENL system should be enabled on delivery but pilots are advised to check that it is by following the procedures in the manual for the recorder. The Recorder must not be covered or insulated, although even so, automatic gain should continue to ensure high ENL readings under engine power.

A6.1 **Cockpit noise**. Pilots should note that cockpit noises other than the engine will produce ENL figures on the IGC file, and should avoid those that could be mistaken for use of engine. Generally the frequency filtering built in to the Recorder will avoid any problems, but it should be noted that **flight with the cockpit Direct Vision (DV) and/or ventilation panel(s) open can produce a low-frequency sound (organ-pipe note) which will register as high ENL, particularly if sideslip is present**. High ENL may also be produced by stall buffet and spins, particularly in Motor Gliders if the engine bay doors flutter (vibrate or move in and out). Flight close to powered aircraft should also be avoided, except for normal aero-tow launches. For ENL levels that have been recorded on GFAC tests, see B.4.2.

A.7 **Independent Check of Landing** - The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with IGC file data from the recorder (see para B2.1).

A.8 **After Landing**. Until an OO has witnessed the Recorder installation to the glider, the pilot must not alter the installation or any sealing. The OO will carry out the actions given in para B2.3,

and the OO's copy of the transferred flight data will be sent to the organisation that will validate the flight, normally the National Airport Control authority (NAC). The OO does not personally have to transfer the data from the Recorder, but witnesses the transfer and takes or is given a copy on electronic media. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to the rules for IGC records and badges, the above continues to apply. As this recorder is designed to be mounted in the instrument panel, data transfer should be at the glider to avoid disturbing the mounting.

A8.1 After-flight calculation of security. On switching off for more than 5 minutes and then switching on again, the recorder calculates a digital signature for the previous flight, using the RSA system of Private Key encryption. Power must be off for 5 minutes or longer for the flight file to be ended and the security calculation to take place (the 5 minute "power-off protocol" is to allow for events such as changing the battery in flight). The security calculation takes between 1 and 1.5 minutes and the screen displays a message "CALCULATING SECURITY". If this process is interrupted, such as by turning the power off, it will start again next time the power is turned on. While security is being calculated, other functions such as data transfer or the start of another flight are not possible. 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 either the VALI-LXN program or the Validate function of the IGC Shell program with the IGC-LXN.DLL file in the same directory.

A8.2 Use of Portable PC at the glider. If the type of panel mounting makes access to the connectors on the back of the recorder difficult, an extension lead should be provided for downloading using an IGC standard connector to a PC. The LX7000/7007 Display and recorder Unit (DU) can be switched on using glider power and the PC used may be owned by the pilot or any other person. The PC should be set up for ease of transferring the data, such as by easy access to the current DATA-LXN.EXE program file, the IGC Shell program with the IGC-LXN.DLL file or an equivalent program from the manufacturer that carries out the same function. The Recorder must be in "Transfer" mode which is available for about 20 seconds after switching on. Alternatively, select the special TRANSFER function that is provided as part of the Setup menu (one left on the MODE button from the Lat/Long screen, then 4 down on the menu list that starts with "QNH RES"). Transfer of flight data is witnessed by the OO, and the flight files in IGC and binary (*.LXN) format must be given to the OO for safe keeping and analysis, such as on portable media such as a floppy diskette or memory stick.

A.9 Calibration of Barograph Function. Pilots are advised to have a barograph (pressure altitude) calibration carried out either by the manufacturer or by an NAC-approved calibrator before any GNSS Recorder is used for a claimed flight performance. For the procedure, see para B5. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the Recorder for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

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**NOTES FOR OFFICIAL OBSERVERS AND NACs -
PART OF IGC APPROVAL FOR THE LXN LX7000 SERIES OF FLIGHT RECORDER**

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

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

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

B.1 Installation and Takeoff Records

B.1.1 **Installation in the Glider**. An OO shall witness and record the position of the Recorder in the glider, the type and serial number (s/n) of the particular Recorder, the glider type and registration, date and time. The s/n of each individual recorder consists of three characters made up of letters and/or numbers. The first screen after switching on shows "LX7000DU" or "LX7007DU" on the first line and the s/n and firmware version number on the second line. This screen is visible for 15 seconds during the start-up sequence before the second screen appears, headed "LX navigation". It is recommended that, before flight, the OO should 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 pre-flight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the Recorder installation is checked. This is to ensure that the installation is correct, and that another Recorder has not been substituted in the glider before the data transfer (B2.3). See paras 5 and 6 of the Conditions of Approval. On the position of any other displays connected to the Recorder, see para 6 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

B.1.2 **At Takeoff**. The time and point of takeoff shall be recorded by sources independent of the Recorder, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will then be compared to the takeoff data recorded on the IGC file.

B.2 Landing

B.2.1 **At Landing**. The time and point of landing shall be recorded by sources independent of the Recorder, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the landing data recorded on the IGC file.

B.2.2 **Checking the Installation of the Recorder**. As soon as practicable after landing, an OO shall inspect the installation of the Recorder in the glider (including any sealing to the glider), so that this can be compared to the check described in para B1.1 above. The transfer of flight data shall then take place in accordance with B2.3.

B.2.3 Transferring the Flight Data. The flight data can be transferred to a portable PC at the glider, without disturbing the installation of the Recorder (see para A7). If a portable PC is not available, the OO shall check and break any sealing to the glider, and take the Recorder to a PC. As this Recorder is designed for mounting in the instrument panel, this should be avoided wherever possible. If the OO is not familiar with the actions required, the pilot or another person may transfer the data while the OO witnesses the process. Security is maintained by electronic coding embedded in the Recorder which is then independently checked later at the NAC (and at FAI if the claim goes to them) through the VALIDATE (VALI) software program for the recorder.

B2.3.1 Methods. Downloading of flight data can take place either during the 15 seconds during which the second screen is shown after switch-on (the second screen is headed "LX navigation"), or by using the special TRANSFER mode covered in A7.2. If the connectors at the back of the recorder are accessible, for the original LX7000 model use a cable with a 6-pin RJ-11 male connector for the Recorder and a RS232 female connector for the PC, wired to the IGC-standard for RJ11 connectors. For the later LX7007 model, use a cable with an 8-pin RJ45 male connector for the Recorder and a RS232 female connector for the PC, wired to the IGC-standard for RJ45 connectors. For the LX7007, download can also be through the LXN-provided 15-pin D-type connector on the Recorder case. If the rear of the recorder is not accessible, the pilot must provide a connected extension cable so that an IGC-standard connector can be used from the recorder end to the PC. On the PC, a current version of the short program file DATA-LXN.EXE, the IGC Shell Program with the file IGC-LXN.DLL in the same directory, or a Manufacturer's program for downloading data (Such as LXFAI or LXe) must be available. The DATA-LXN and IGC Shell programs and the IGC-LXN.DLL file are available free from the IGC GNSS web site for software given at the beginning of this document, or through a link from the main fai.org/gliding/gnss web site.

2.3.1.1 IGC Shell. Download the free IGC Shell program and place all the files in one directory (the name IGC Shell is recommended). These files are available on the IGC GNSS web pages through the file [igcdll.zip](#). For the shell program to work with a Recorder, the appropriate Data Link Library (DLL) file from the recorder manufacturer must be copied to the IGC Shell directory. For this Recorder, the file IGC-LXN.DLL is available on the IGC GNSS web site and on the manufacturer's CD-ROM. After copying it to the directory that contains the IGC Shell files, execute IGC-SHELL.EXE. Set the path to the IGCshell directory using the "Set Directories" button. The IGCshell menu will now appear in a grey rectangular box with 9 software buttons for selecting the recorder type, recorder settings and flight logs. The recorder software box at the top should now include the line "LX Navigation v1.1, Colibri, LX7000DU" or a later equivalent. This should be selected. With the recorder connected to the PC and the correct Com Port selected on the IGCshell screen, selections for data Download, file Conversion to IGC format and Validation can now be made using the screen buttons provided.

B2.3.1.2 DATA-LXN. This is a DOS-based program and, depending on the Operating System on the PC that is used, may have to be executed in DOS mode. The MS Windows XP Operating System does not have a straight DOS option. If DATA-LXN does not work in a PC with Windows XP, a self-booting floppy disc can be created through the file menu and the command "create an MS-DOS start-up disk". The three short program files DATA, CONV and VALI-LXN can then be added and DATA-LXN used in the normal way. When the DATA program is executed, the software version is shown at the top of the menu (see under software on page 1, which gives the required version). This program file executes in the normal way such as either by typing "DATA-LXN, enter" at a DOS prompt (DOS window or re-boot into DOS mode); or by clicking "DATA-LXN" in a Windows file list (File Manager for W3x, Windows Explorer for later Windows systems). If settings such as the COM port, Baud rate, etc. need to be changed, the help menu is accessed by typing the file name, space, hyphen, then the letter h. In the event of any problems in getting DATA-LXN to work through the PC's hard disk, install it on a self-booting floppy diskette, re-boot to the diskette and type "DATA-LXN" with the recorder showing its second screen, headed "LX navigation".

B2.3.1.3 Latest versions. The latest versions of the free DATA, IGC shell and DLL files must be used. These can be obtained from the IGC GNSS site for software listed at the beginning of this document.

B2.3.1.4 Manufacturer's Programs. Downloading of flight data can be made using the manufacturer's own programs that also include other functions such as recorder set-up, insertion of turning points, tasks, etc. These programs include LXFAI and LXe and are provided by the manufacturer via the web and on CD-ROM under normal commercial arrangements.

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

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

B2.3.3.1 Storage media. The OO may keep the required data files on industry-standard portable storage media such as the hard disk of a PC, USB memory stick or other type of portable memory card. Integrity of flight data on the IGC file is preserved by comparing

checks on takeoff and/or landing from sources different to the recorder, and by the VALIDATE check that can be carried out at any time.

B2.3.4 Competitions. Different rules may apply for competition flights, for which a central data transfer facility may be used. However, as this model or recorder is designed for panel mounting, arrangements should be made with the organisers for data transfer at the glider rather than having to remove the recorder after each flight. For ease of identification within the competition, IGC file names may be changed, for instance to the glider competition number or the pilot's name. Integrity of data within the file is preserved by the electronic security system and may be checked at any time by using the VALI program file. The data summarised in the original IGC file name is repeated in the IGC file header, is protected by the IGC security system (VALI check) and can be read at any time through a text editor.

B.3 Analysis of Flight Data Files. A Data Analyst approved by the NAC will then evaluate the flight using an analysis program approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking flight data, an authenticated version of the file VALI-LXN.EXE or the IGC Shell equivalent Validation program shall be used by the NAC and by FAI (if the data goes to them). This checks the electronic security coding in the file, that the Recorder had not been interfered with, and that the flight data in the file has not been altered since it was transferred from the Recorder. The latest version of the Validation program must be used and is available free from the IGC GNSS web site for software given at the beginning of this document.

B3.1 Method 1 - VALI-LXN Program. At the appropriate prompt or run function, type VALI-LXN.EXE followed by a space and the name of the file to be checked. The message "integrity OK" should appear, not "integrity Bad!" which indicates either that the Recorder security seal has been broken, or that the IGC file has been altered or has become corrupted since it was transferred from the Recorder. The VALI check may be applied to either the LXN or IGC file formats.

B3.2 Method 2 - IGC Shell program. Use the Validate function in the IGC Shell directory. For more detail on the IGC Shell program, see paras B2.3.1.2 and B2.3.1.3.

B3.3 Method 3 - Manufacturer's programs. Use the Validate function in the appropriate Manufacturer's proprietary program LXFAI or LXe. If a manufacturer's program is used, it must be authenticated as such and not altered in any way, so that a correct Validation can be made. If in any doubt, use one of the two free Validate programs listed above in B3.1 and B3.2.

B.4 Means of Propulsion (MoP) Record - Motor Gliders. The MoP must either be sealed or inoperative, or the built-in microphone system used that records a three-number Engine Noise Level (ENL) with each fix on the IGC file. See para 7 in the main body of this document for more details on the ENL system. ENL values recorded on GFAC tests are given below, in the sequence of a flight.

B.4.1 ENL during launching. During winch and aerotow launches, higher average ENL values are to be expected than when soaring (B4.3). On aerotow a reading of 279 has been

recorded. During the ground roll, short-term higher values up to 400 have been seen, probably due to wheel rumble, particularly on hard surfaces.

B.4.2 ENL during engine running. On engine running at powers needed to climb, an increase to over 800 ENL is expected. Over 900 is typical for a two-stroke engine, over 800 for a 4-stroke. An ENL value of 996 has been recorded with a two-stroke engine running at full power. During engine running, these high ENLs are produced for a significant time, and when altitude and speed are analysed it can be seen that substantial energy is being added, which can therefore be attributed to energy not associated with soaring. Wankel (rotary) and electric engines have not been tested, but there is no reason to believe that Wankel engines will not produce similar values to 4-strokes.

B.4.2.1 Electric Power. If an electric engine is to be used, please contact GFAC as soon as possible so that tests can be carried out.

B.4.3 ENL during gliding flight. ENL readings of less than 060 indicate normal quiet gliding flight. In a high-speed glide, or in a glider with more cockpit noise, the ENL may increase to 200. Particularly, sideslip or high speeds with the cockpit panel(s) open can produce low frequency noise ("organ-pipe" effect) and ENL readings of up to 350 have been recorded under these conditions. 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.

B.4.4. ENL during the approach to land. ENL values are always higher on a landing approach due to aerodynamic noises such as due to airbrakes, undercarriage, sideslip, turbulence, etc. Short-term peaks due to specific actions such as opening airbrakes, lowering undercarriage, etc., will be noted as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 300 have been recorded, although 240 is more typical in an aerodynamically noisy glider, and 120 in a quieter machine.

B.4.5 ENL during landing. During ground contact during landing, short-duration ENL values up to 400 have been recorded, probably due to wheel squeak and rumble, particularly on hard surfaces. Unlike engine running these last only for a short time, showing a short spike on the noise/time record.

B.4.6 ENL analysis. It is normally easy to see when an engine has been running and when it has not. Other data such as rates of climb/descent and groundspeed, will indicate whether or not non-atmospheric energy is being added. Short term peaks in ENL (10 seconds or so) may be due to the other factors mentioned above such as undercarriage and/or airbrake movement, sideslip, open cockpit panel combined with sideslip and /or high airspeed, the nearby passage of a powered aircraft, etc. If in doubt, email the *.IGC file to the GFAC Chairman for further analysis and advice (see earlier for email address).

B.5 Altitude analysis and calibration. Flight data files will be analysed in accordance with Sporting Code procedures. Part of this is to compare the general shapes of the GNSS and pressure altitude fix records with time and to ensure that no major differences are seen that could indicate

malpractice or manufactured (false) data. As part of this process, the Recorder can be calibrated in an altitude chamber in the same way as a drum barograph.

B.5.1 Calibration method, making a calibration table. No GPS fixes are required for a pressure altitude trace to be produced. However, before a calibration, you are advised to set the normal (cruise) fix rate to a small time interval such as 5 seconds or less. Recording at the pre-set fix interval starts when power is connected to the recorder and the pressure altitude change threshold is exceeded (about 1 m/sec for 5 sec). The calibrator should be asked to cycle the pressure briefly up and down before starting the calibration itself, so that recording will start. The calibrator will record the pressure steps used, for later comparison with the flight file. The stabilised pressure immediately before the altitude is changed to the next level, will be taken as the appropriate value unless the calibrator certifies otherwise. After the calibration, the data file containing the pressure steps is transferred to a PC as if it was flight data (see B2.3 above); this may be done by an NAC-approved person other than the calibrator who may not have this knowledge. The IGC format calibration data file will then be analysed, compared to the calibration pressure steps, and a correction table produced and authenticated by by an NAC-approved person (for instance an OO or GNSS Recorder Data Analyst). The correction table will list true against indicated altitudes. This table can then be used to adjust pressure altitudes which are recorded during flight performances and which require correction before validation to IGC criteria. These include takeoff, start and landing altitudes for altitude difference and for comparison with independently-recorded QNH readings, and low and high points on gain-of-height and altitude claims. Only pressure altitude is valid for IGC altitude purposes except for proof of flight continuity (no intermediate landing) where GNSS altitude may also be used.

B.5.2 GPS altitude figures recorded in the IGC file. Occasional short-duration differences in the shape of the GPS altitude/time graph have been noted when compared to the pressure altitude figures. This is not unusual with GPS receivers operating without a local differential beacon or other accuracy-enhancing systems. The altitude accuracy from satellite-based systems will not be as good as accuracy in lat/long, because satellite geometry is not as favourable for obtaining accurate altitude fixes compared to horizontal position. This effect will be increased by poor antenna positioning in the glider. Data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records. Lat/long fix accuracy is not affected and tests on this recorder show it to be typical of that for a 12 channel GPS system. From GFAC tests after 1 May 2000 when the GPS Selective Availability error was removed, the lat/long error taken from a moving vehicle at a surveyed point, averages between 11 and 12m for all 12 channel recorders tested since that date.

B.5.3 Maximum Altitudes Recorded in the IGC file. The maximum altitudes in IGC files that apply to this recorder are given below.

B.5.3.1 Pressure Altitude. This is recorded up to 8 km (26,247 ft) on the ICAO ISA.

B.5.3.2 GNSS altitude. This is recorded up to 9 km (29,528 ft) above the WGS84 ellipsoid.

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