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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 and Internet newsgroup rec.aviation.soaring
Copy:	Manufacturer concerned

20 January 2008

IGC-APPROVAL FOR GNSS FLIGHT RECORDER

Recorder Name: **Garrecht Volkslogger**
Level of Approval: **All flights**

(i) General. This document gives IGC-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 the terms of this approval in the future.

(i-i) Document history. The original IGC-approval document for this recorder was dated 15 April 1998 and the Engine Noise Level (ENL) function was added in the edition dated 10 May 1999. This document generally updates the wording to that used in recent IGC-approvals.

(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) This IGC-approval document is concerned 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) This approval is not concerned with, and FAI has no responsibility for, matters related to: (a) Intellectual Property (IP) and Intellectual Property Rights (IPR) and/or, (b) the relations of the Manufacturer listed below with any other entities except with FAI and its agents or as they affect FAI, its agents and this approval.

(iv) The attention of National Airsport Control (NAC) authorities, officials and pilots is drawn to the latest edition of the FAI Sporting Code Section 3 (Gliding) including its annexes 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) 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 <u>Hardware Versions</u>. IGC-approval applies to Hardware version 3.2 (V3.2) or later, subject to specific IGC-approval for later versions. Version 3.3 and later includes the Engine Noise Level (ENL) function that records ambient noise at the recorder.   The version number is shown in the IGC file header record after "HF RHW HARDWARE VERSION".

    1.1.1 <u>Model Numbers</u>.

       Model VL1.0 has an integral antenna.

       Model VL1.0C (C = Combined) has both an internal antenna and the plug for an external antenna. When an external antenna is connected, the internal antenna is disabled.

       Model VL1.0E (E = External) has a BNC-plug for an external antenna.

1.2 <u>Dimensions & Weight</u>. The recorder is in a rectangular metal case about 100 x 50 x 54mm, and weighs about 320 grammes.

1.3 <u>Connectors and external features</u>. A 60 x 17 mm LCD is on the 100 x 50mm face together with three buttons. A 5-pin circular Binder 711 or a RJ45 connector is on one of the 20 x 54mm faces.

1.4 <u>GPS receiver boards</u>. The GPS receiver type is a Garmin GPS25 with 12 parallel channels, although early units were fitted with the 11-channel Koden (Japan) FDK-GSU/14 GPS receiver.

1.5 <u>Pressure altitude sensor</u>. In early models, the pressure altitude sensor was a Silicon Microstructures SMI 5310 (www.si-micro.com) and from 1999 a Intersema 5534 (www.intersema.com).   These are 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 <u>National and other regulations</u>. 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 <u>Other modules</u>. 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 3.4 was the original IGC-approved firmware standard and current firmware is V3.6, build number 177. The build number can be read from the diagnostic screen on start-up, or in the VTINFO sub-menu.

3. **SOFTWARE**.

Program files for Downloading and Validating IGC flight data files, are available from the IGC GNSS web site: www.fai.org/gliding/gnss/freeware.asp Look under the heading "Garrecht version 1.32" for the DLL file that works with the IGC Shell program for downloading and IGC file validation. See also under "Garrecht download" for the DATA and VALI short program files.

3.1 **File functions**.

3.1.1 <u>IGC-GCS.DLL</u> - this file works with the Windows-based IGC Shell program that downloads IGC files from the recorder and carries out the IGC Validation function both on initial download or at any time later. The DLL file should be placed in the same directory as the IGC Shell program and when the program is executed, the Garrecht logo can then be selected from the list of manufacturers whose DLL files are also in the IGC Shell directory. Menu buttons allow the directory in which the IGC files will be put to be selected, and then allow the appropriate download and Validation functions.

3.1.2 <u>DATA-GCS.EXE</u> - this file is for transferring flight data from the recorder to a PC and produces an *.IGC file for each flight. The DATA-GCS.EXE file menu provides two modes of transfer, a "Test" mode and a "High Security" mode. Only the High Security mode provides the electronic security signature which is required for validation of FAI/IGC record and badge flights. **Data transferred by the "Test" mode will not be accepted for flights that require IGC standards of data**. IGC files downloaded using the Test mode will not pass the IGC Validation check, although competition organisers may allow it for competition flights where rapid data transfer rather than security is a priority in well-supervised centralised competitions.

3.1.3 <u>VALI-GCS.EXE</u> - this file is for validation by NACs and FAI of the security and integrity of the *.IGC files.

3.2 **Latest versions**. The latest versions of the above programs must be used. The DLL, DATA and VALI files can be obtained from the IGC GNSS site for software given in para 3 above and at the beginning of this document, and are backward-compatible to previous versions of this recorder.

3.3 **Free availability**. The DLL, DATA and VALI files are freeware, copyright of the recorder manufacturer.

3.4 **Validity of Flight Data**. The IGC standard for electronic flight data is that the IGC file must pass the IGC VALIDATE check. That is, by using the Validate function in the IGC Shell program, having selected the IGC file to be Validated. Alternatively, the VALI-LXN.exe program can be used with the IGC file in the same directory and interrogating the IGC file that is to be Validated. The IGC Validation system checks that the IGC file has correctly originated from the recorder and that it is identical to when it was initially downloaded (that is, the data has not been changed later so that it is different). See B4.2 for more details.

CONDITIONS OF APPROVAL

4. Permitted connections and fittings on the main recorder module.

4.1 <u>External connector</u>. A 5-pin circular Binder 711 or a RJ45 connector is on one of the 20 x 54mm faces. This is for inward and outward data and also for 12V DC battery power to the recorder. A Y-shaped external cable connects the this connector to a DC source and also to a 9-pin female RS232 socket for connecting to a RS232 COM port of a PC. In flight, the external connector can provide NMEA data to other glider instruments.

4.2 <u>GPS antenna</u>. Model VL1.0 has only an integral antenna mounted on the top of the case. Model VL1.0C (C = Combined) has both the integral antenna and a 9mm BNC connector for an external antenna. Model VL1.0E (E = External) has only a 9mm BNC connector for an external antenna.

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. 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 for 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 <u>Sight Lines</u>. Particularly in single-seat gliders, the position of any displays attached to 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**. When the Engine Noise Level (ENL) system is fitted and enabled (see Annex A for the enabling 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 used to produce forward thrust during the part of the flight that contains the claimed glide performance. ENL data has also been shown to be useful for non-motor gliders in the case of accidents and incidents.

7.1 ENL Recording System Manufacturer. The ENL system in this recorder is made by Garrecht

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 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. A glide performance in a Motor Glider is where the engine has not been used to develop forward thrust at any time during the performance (but can be used either before or after the glide performance that is claimed).

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. For details of typical ENL values found on GFAC tests with internal combustion engines, see para B.5.

8. **Check of Installation in the Glider**. There must be incontrovertible evidence that the Recorder 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 Recorder to the glider at any time or date before takeoff and checking the seal after landing.

8.1 Observation of Installation before Takeoff or at Landing. If manual Observation is to be employed (instead of sealing, see 8.2 below), there are two ways 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. One of the following must be carried out:

8.1.1 A pre-flight check of the installation is made and the glider is under continuous observation by an OO until it takes off on the claimed flight,

8.1.2 An OO witnesses the landing and has the glider under continuous observation until the Recorder installation is checked.

8.2 Sealing to the Glider before Flight. If para 8.1 cannot be met, 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 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 Recorder unit to glider parts that are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the 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 European CE Mark and the manufacturer's name is fitted over at least one of the case securing screws. In addition, an internal security mechanism is included that activates if the case of the Recorder is opened. On switching on, after the LCD screen shows the unit serial number, it should then show "Security Seal OK" for a short time.

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), configuration settings will revert to default settings and the private security key in the Recorder will be erased. Any flight data files produced after this will fail the IGC Validate test for electronic security. This test will also fail if the *.IGC file has been altered in any way after being transferred 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.

9.3.1 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. The VALI program file 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 W Strachan,
Chairman, IGC GNSS Flight Recorder Approval Committee (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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                   Tel: +44 1420 564 195; Fax: +44 1420 563 140;
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----------- Annexes follow --------------

NOTES FOR OWNERS AND PILOTS - PART OF IGC APPROVAL

A(i). *Status*. *This Annex should be read together with the main terms of approval earlier in this document.*
A(ii). *IGC-Approval level*. *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. Latitudes and longitudes recorded by the FR are to a fixed Geodetic Datum of WGS84. No pilot action is required except to ensure that other lat/long data such as for start, turn and finish points, is entered also to the WGS84 Geodetic Datum (IGC rule).

A3 **Setting the Fix Interval**. The fast-fix facility operates when the Pilot Event (PEV) button is pressed and gives up to 30 fixes at a one second interval, the number being set before flight through the set-up program. The fix interval for cruise flight between PEV events (such as between Waypoints) is also 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 each Waypoint to ensure that a fix is recorded within its observation zone".

A4 **Checking Recorder operation 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. 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 **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 **Check of Takeoff Independent of the Recorder**. The pilot must ensure that the time and point of takeoff has been witnessed and recorded in a way independent of the recorder, for comparison with takeoff data in the IGC file from the recorder, see para B2.

A7 **Connection to data Ports and connectors**. Although this approval does not presently require sealing of any ports or connectors in or on the recorder, no attempt must be made to pass unauthorised data into the Recorder, either on the ground or in flight. Para 9.1.1 in the Conditions of Approval, refers.

A8 **Use in Motor Gliders** (including self-sustainers): When fitted (Hardware versions 3.3 or later) 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 in the form of three numbers from 000 to 999 under the IGC Three-Letter Code (TLC) Engine Noise Level (ENL). 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 from 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. Connect to the 9-pin RS232 plug on the case with the other end of the cable connected to a PC. Use the manufacturer's program LXFAI or equivalent and follow the instructions for enabling ENL. If it is enabled, an IGC file from a short ground test (such as from a car drive) will confirm that ENL is being recorded with each fix.

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 the RSA Public/Private Key (PPK) encryption system. This process places security codes at the end of each IGC file, 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 before the Annexes).

A10 **Check of Landing Independent of the Recorder**. The pilot must ensure that the time and point of landing has been witnessed and recorded in a way independent of the recorder, for comparison with the IGC file data from the recorder (see para B3.1).

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

A12 **Downloading the Flight Data**. This is by connecting a PC to the 9-Pin RS232 socket on the case of the recorder and executing the download program. For IGC standards of security such as badges, diplomas and records, the "High Security" option must be used and not the "Test" option; see para 2.4 of the Conditions of Approval. 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 Airsport Control authority (NAC). The OO does not personally have to transfer the data from the Recorder, but witnesses the transfer and takes or is given a copy on standard electronic storage 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 and should be set up for ease of data transfer. 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 NAC-approved calibrator before any GNSS Recorder is used for a claimed flight performance. For the procedure, see para B6. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the Recorder for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

A14. **Caution - fitting the Binder Plug**. It should be noted that the 5 pins on the Binder plug are symmetrical, and the plug inner is made of soft plastic with only a shallow keyway that is designed to maintain correct pin alignment. It has been found possible to over-ride the keyway, and to fit the plug in any of five different orientations, some of which may damage the equipment if power is then applied. It is recommended that the correct orientation be marked on the connector plug and the FR unit.

A15 **Caution - Download Modes**. This type of recorder has two modes of downloading data, a "Test" mode and a "High Security" mode. Only the High Security mode provides the electronic security signature which is required for validation of flight to IGC standards, including flights for badges, diplomas and records. **Data transferred by the "Test" mode will not be accepted for flights that require IGC standards of data,** and IGC files downloaded using the Test mode will not pass the IGC Validation check.

A16 **Caution - Memory Freeze**. With this type of recorder, when the memory is full, further recording of flight data stops. Pilots are advised to download data from the recorder memory to a PC storage device regularly so that the probability of recording stopping during a flight to be claimed, is minimsed.

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

NOTES FOR OFFICIAL OBSERVERS AND NACs - PART OF IGC APPROVAL

B(i). Status. This Annex should be read together with the main terms of approval earlier in this document.

B(ii). IGC-Approval level. 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**. 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 Official Observer (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.   There are two ways of doing this, by manual observation at the time, or by sealing the recorder to the glider, see also para 8 in the main body of this document before the annexes:

   B.1.1 Observation of Installation before Takeoff or at Landing.   If manual Observation is to be employed (instead of sealing, see 8.2 below), one of the following must be carried out:

      B1.1.1 A pre-flight check of the installation is made and the glider is under continuous observation by an OO until it takes off on the claimed flight, or,

      B1.1.2 An OO witnesses the landing and has the glider under continuous observation until the Recorder installation is checked.

   B1.2 Sealing. The OO shall 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. 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.

B2 **Takeoff – Evidence independent of the Recorder**. 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. This comparison is an important check on the integrity of the data in the IGC file and, combined with the IGC VALI check, indicates that it has not been made up before the flight.

B3 **Landing**

   B3.1 Landing - Evidence independent of the Recorder.   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. This comparison is an important check on the integrity of the data in the IGC file and, combined with the IGC Validation check, indicates that it has not been made up before the flight.

   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, 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 FR and in the data transferred in the "High Security" mode which is then independently checked later at the NAC (and at FAI if the claim goes to them). The "High Security" download mode must be used for any flight that may have to be validated to IGC standards, the "Test" mode is not adequate for this purpose, see para A13.

B3.3.1 Methods. Connect the PC to the data port on the recorder case using the cable supplied by the manufacturer or an equivalent. For downloading, use the IGC Shell program with the IGC-GCS.DLL file in the same directory, or use a current version of the short program file DATA-GCS.EXE.

B3.3.1.1 IGC Shell Program. Put the free IGC-GCS.DLL file in the same directory as the IGC Shell files. Both are available from the IGC GNSS web site. When the IGC Shell program is executed, the Garrecht logo can be selected from the list of manufacturers whose DLL files are also in the IGC Shell directory. Menu buttons allow the directory in which the IGC files will be put to be selected, and then allow the appropriate download and Validation functions.

B3.3.1.2 DATA-GCS file. The file DATA-GCS.exe is available free from the IGC GNSS web site for software given at the beginning of this document, or through a link from the main IGC/GNSS site. The file DATA-GCS.EXE can be executed on either storage media such as a USB memory stick, floppy diskette or on the PC hard disk. The software version is shown at the top of the menu (see under software on page 1, which gives the relevant versions). This program file executes in the normal way such as either by typing at a DOS prompt DATA-GCS, enter; the help menu is accessed by typing the file name, space, hyphen, then the letter h.. When the DATA file is executed, select "N" for new Recorder, make sure that the PC is connected to the female 9-pin computer port provided on the cable which goes to the Recorder, and connect the power supply. A 10-second count-down will be shown on the LCD immediately after switching on, during which contact should be made with the PC. If not, disconnect the power from the FR and re-connect with the PC connected and DATA-GCS and "N" already selected.

B3.4 Flight data files produced. This process will automatically produce both a *.IGC-format flight data file. Both have the file name YMDCXXXF, where Y=year, M=month, D=day, C= manufacturer, XXX = Recorder 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 Recorder Specification and is also listed in Annex C to the Sporting Code, SC3C.

B3.5 OO's Copy. A copy of the *.IGC file shall be retained securely by the OO such as by immediately copying it to a separate PC memory stick or diskette, or by the use of the OO's own PC. This file shall be retained by the OO in safe keeping for later checking and analysis under NAC/IGC procedures.

B3.6 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, (1) checking the flight performance that is being claimed by looking at the fixes and other data in the IGC file, and (2) 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 free IGC Shell program with the IGC-GCS.DLL file in the same directory and the IGC file to be validated in the directory set in the IGC Shell program. Then select the file concerned and the Validate button. Alternatively, use the VALI-LXN.exe program file that is available from the IGC GNSS web site. One of these systems 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. For more detail, see para B3.3.1.

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 ENL values are to be expected than when soaring (B4.3), typically up to 300 for winch and 200 for aerotow. On one winch launch a single ENL reading of 450 was 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 050 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 400 have been recorded, although 200 is more typical.

B5.5 ENL during landing. During ground contact during takeoff and landing, short-duration ENL readings of up to 700 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 Recorder 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, the normal fix rate should be set to a small time interval such as 2 seconds. Recording starts after power is applied, and no GPS fixes are required for a pressure altitude trace to be produced. The calibrator will record the pressure steps used, for later comparison with the flight file. The stabilised pressure immediately before the altitude is changed to the next level, will be taken as the appropriate value unless the calibrator certifies otherwise.

B6.1.1 After 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 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 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.

B6.3 **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. Pressure altitudes are recorded up to unlimited altitude, but above 20,000m (65,617ft), a correction must be applied to the altitude generation algorithm. The manufacturer will supply details on request.

B6.3.2. GNSS altitude. GPS altitude is recorded up to 13km (42,651) with the Koden receiver and up to 19,470m (63,878ft) with the Garmin 12-channel GPS-25 receiver fitted to nearly all units.

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