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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"
FAI for IGC email mailing list
Internet newsgroup rec.aviation.soaring

Copy: Manufacturer concerned

25 November 2003

IGC APPROVAL OF CAMBRIDGE 302 GNSS FLIGHT RECORDER FOR ALL FLIGHTS TO IGC/FAI CRITERIA MANUFACTURER - CAI INC., HORN LAKE, MISSISSIPPI

(i) Status. This document gives formal approval for this GNSS FR equipment to be used for the validation of all flights (including world records) under the rules and procedures in FAI Sporting Code Section 3 (Gliders and Motor Gliders), subject to the conditions and notes given later. This document replaces those with earlier dates and only the terms of the IGC-approvals posted on the IGC web site are valid for use for IGC/FAI claims. IGC reserves the right to alter the terms of this approval in the future.

> (i-i) Approval history. The original IGC-approval for the 302 recorder was issued on 30 October 2001 to the original Cambridge operation in Vermont. An update adding an ENL system for motor gliders was issued on 13 January 2003 and another adding the simpler 302A model on 25 August 2003. This version changes the Manufacturer's details to the Horn Lake, Mississippi, operation.

(ii) GFAC tests. These are concerned primarily with the data from this recorder that is included in the IGC data format. Particular concerns are its accuracy and security, ease of transfer from the recorder to a PC, and conformity of the IGC file and the recorder design generally with the IGC Technical Specification for such recorders. Other aspects of the recorder system may not be tested and are a matter between the FR manufacturer and customers.

(iii) References. The attention of NACs, 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 (SC3B) deals with equipment used in flight validation (Chapter 1, GNSS Flight Recorders). Annex C (SC3C) is entitled "Official Observer and Pilot Guide" and consists of guidelines and procedures for the flight validation process. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the main IGC web site.

(iv) Exclusions. This approval is not concerned with, and FAI has no responsibility for, matters related to: (a) Intellectual Property (IP) and Intellectual Property Rights (IPR) or, (b) the relations of the Organisation with any others except with FAI and its agents or as they affect FAI, its agents and this approval.

(v) Standards and Procedures. This approval document is concerned solely with the standards of, and procedures relating to, the hardware, firmware and software for the type(s) of recorder described below and manufactured, updated or serviced by the Organisation listed below under "Manufacturer" and updated or serviced by such Organisation or its agents authorised by it to carry out such work.

(vi) Keep with recorder. It is recommended that a copy of this approval including its two annexes is kept with each unit of the equipment.

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Manufacturer codes: Three-letter, CAM. One letter, C.
President: Roy A Ridgeway

EQUIPMENT

HARDWARE
Models - 302 and 302A. The description below refers to the main 302 model with LCD. In the simpler model 302A, the front face has a green GPS status light and a Pilot Event (PEV)/fast fix button instead of the LCD and changes from the main 302 model are shown below between brackets.
Hardware Versions. Version 2.0 or later. This is shown in the header record of IGC-format flight files in the form "HF RHW Hardware version: 300 Series 2.0". Further hardware details are in the Logbook L record in the IGC file.
Dimensions, connectors, display, s/n marking. The FR metal case is about 138 long with ends about 62 x 62 mm in size, designed for mounting in an instrument panel with a 57mm (2.2 inch) circular cut-out. Three pressure tube connections project about 17mm at the back and a control knob projects about 15mm at the front (302A model, no pressure tube connections or front control knob). Weight is about 400 grammes (302A model, 350gm). A 50mm diameter circular display is at the front end and electrical connectors are at the back. The instrument display includes an analogue variometer needle and an outer scale, with a 35mm diameter LCD inset in the middle and a knob on the bottom left corner that can be pushed and rotated (302A model, the LCD is replaced by a green GPS status light and a button that when pressed gives a Pilot Event (PEV) and a series of fast fixes). The unique three-character serial number for each individual recorder is inscribed on the variometer scale at about the 4 o'clock position (for the 302A on the front face). Connectors are described below.
GPS receiver board. Garmin GPS25-LVC parallel receiver capable of receiving data from up to 12 satellites for any one fix.
Pressure altitude sensor. Intersema (Switzerland) MS 5534-AP barometer module, compensated for temperature variation. The FR case is vented to atmosphere and "cockpit static" pressure is recorded on the IGC file.
National regulations. These may apply to electrical and electronic equipment, such as the EC "CE" mark for compliance with EC directives on EMC and voltages. Compliance with such regulations is not the responsibility of FAI.

FIRMWARE
The version is shown in the header record of IGC-format flight files in the form "HF RFW Firmware Version: 2.6". Further firmware details are in the L (Logbook) record in the IGC file.
Version 2.0 or later for initial models without the ENL system for motor gliders.
Version 2.6 or later for recorders with the ENL system.

SOFTWARE
Program file functions. The short program file DATACAM2.EXE is for transferring flight data from the FR to a PC and automatically produces an IGC file for the last flight, leaving a menu on screen for transfer of other flight data. The file VALICAM2.EXE checks the security and integrity of an IGC file, and ensures that data that is designed to be secure has not been altered since it was transferred from the FR. These program files are not backward compatible with the earlier models 10, 20 and 25 Cambridge recorders for which the file name is DATA-CAM.EXE.
Versions to be used. For units without the ENL function, DATACAM2 Version 1.0.0 or later.
For units with ENL system, DATACAM2.EXE Version 1.0.2 or later.
Free availability. The DATA and VALI files are copyright of the FR manufacturer but are freeware. The latest versions may be obtained from the IGC GNSS Internet site for software or through the main IGC/GNSS site through a link. See the site titles given at the beginning of this document.

CONDITIONS OF APPROVAL:

1. **Permitted Connections**. All connectors are at the opposite end of the case to the instrument face.

1.1 External antenna to SMC Coaxial Cable Connector, screw fitting with 4mm diameter thread and 3.5mm centre connector.

1.2 Custom-wired plug-in PCB Mounting terminal block (type Weidmuller BL3 5/10) with 10 pins at 3.5mm pitch. This is for power (auxiliary battery and glider power), Ground Hold/Gear/Spoiler switches, External Speaker, and Pilot Event (PEV marker).

1.3 Male 9-pin RS232 connector to the 9-pin female RS232 connector on the case, for transfer of flight and other data to and from a PC, including to a Palm PC during flight.

1.4 Female 6 pin RJ-11 connector. Mainly for connection of the company's GPS-Nav LCD. This connector uses IIC protocols.

1.5 Three 6mm diameter pressure connectors from top to bottom when mounted in the panel at the correct orientation: static, pitot (airspeed), and total energy static (not fitted to 302A model).

1.6 The extra peripheral units such as the switches for glider functions, PalmPC and external LCD have not been tested as part of this IGC-approval and are a matter between the manufacturer and customers.

2. **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment. See para 5 on installation and para 6 on security and seals.

3. **Installation in a glider**. The FR is designed for mounting in an instrument panel, but may be fitted anywhere in the glider, subject to para 5 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 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 ancillary displays connected to the recorder should not be remote from sight lines used for pilot lookout and scan for other aircraft and gliders.

4. **Motor gliders**

4.1 Recorders without ENL system. Early models were not fitted with the Engine Noise Level (ENL) system. Where these are used in motor gliders, the Means of Propulsion (MoP) must either be sealed or inoperative, or a separate approved MoP recorder fitted.

4.2 Recorders with ENL system. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. ENL figures vary between 000 and 996 in steps of 004. The system is designed to emphasise any engine noise but at produce only low ENL values in normal quiet gliding flight. The FR should be positioned in the glider so that it can receive a high level of engine and/or propellor noise when power is being generated. GFAC has tested the FR 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.

4.3 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.

5. **Check of Installation in the Glider**. There must be incontrovertible evidence that the particular FR was present in the glider for the flight concerned. This can be achieved either by observation at takeoff or landing or by sealing the FR to the glider at any time or date before takeoff and checking the seal after landing. As this system is designed primarily for panel mounting, a signed and dated OO's seal applied to the FR 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.

5.1 **Observation of Installation before Takeoff or at Landing**. The recorder may be sealed to the glider in accordance with 5.2. As it is designed to be mounted in the instrument panel, this should be straightforward. Otherwise, either a preflight check of the installation must be made and the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is in accordance with the rules, and that another FR has not been substituted before the data is transferred to a PC after flight. 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 prudent checks are made.

5.2 **Sealing to the Glider before Flight**. If direct observation under para 5.1 cannot be achieved, the FR must be sealed to the glider by an OO at any time or date before flight so that it cannot be removed without breaking the seal. The sealing method must be acceptable to the NAC and IGC. Paper seals must be marked in a manner such that there is incontrovertible proof after the flight that seals have not been tampered with, such as by marking with the glider registration, the date, time and OO's name and signature. It should be possible for the OO to recognise the seal markings afterwards. The use of adhesive plastic tape is not satisfactory for IGC-approved sealing because it can be peeled off and re-fitted. Gummed paper tape is recommended, as used for sealing drum-type barographs. The OO must seal the FR unit to glider parts which are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the FR is sealed to such removable part, if such a part is transferred between gliders, any FR seal for the previous glider must be removed.

6. **Security Seals, Physical and Electronic**.

6.1 **Physical Security**. A silver-coloured tamper-evident seal with the manufacturer's name, is fitted over one of the case securing screws next to the maker's label. In addition, an internal security mechanism is included that activates if the case of the FR is opened. If the FR case has been opened, breaching physical security, 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).

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

6.2 **Electronic Security**. If the internal security mechanism has been activated (such as by opening the case), any data in the memory will be lost, settings will revert to defaults, and the electronic security algorithms in the FR will be trashed. Any flight data files subsequently produced will fail the VALI test for electronic security. This test will also fail if the IGC file has been altered in any way after being transferred from the FR.

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

6.4 **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.

7. **Analysis of Flight Data**. Analysis for flights to be validated to IGC criteria should be through the use of a program which complies with IGC rules and procedures and is approved for this purpose by the relevant NAC. For a list of programs which are capable of reading and displaying flight data in the IGC file format, see the fai.org/gliding/gnss web site under the link to SOFTWARE (the full web reference is at the beginning of this document). Before a Flight Performance is officially validated, the authority responsible for validation must check that the data in the IGC file has originated from the Recorder concerned, and has not been altered after it was download from the Recorder to a PC. This is simply done by checking the IGC data file with an authorised copy of the VALICAM2.EXE short program. The VALI program is on a single file and must have originated from the current FAI/IGC web site for software at the beginning of this document. See Annex B for how to use the VALI program file with any IGC flight data file.

8. **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 GFAC

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, dated 25 November 2003

NOTES FOR OWNERS AND PILOTS
PART OF IGC APPROVAL FOR CAMBRIDGE 302
MANUFACTURER - CAI INC., HORN LAKE, MISSISSIPPI

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of the approval document including annexes is kept with the equipment concerned, for the use of pilots and OOs.

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, and that the connector is firmly screwed and lightly fixed with locking agent so that it cannot be loosened or become detached due to vibration or turbulence in flight. The locking agent used should prevent it from inadvertent un-screwing but enable it to be unscrewed later if required. No deliberate attempt must be made to inject 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 FR 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 **FR installation in the glider**. The pilot must ensure that an OO has checked the place of the Flight Recorder 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 should ask an OO to seal the FR to the glider, and **this can be done at any time or date before flight**. See para 5 in the conditions of approval. Regarding the position of any ancillary displays connected to the FR, see para 3 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

A.4 **Takeoff** - The pilot must ensure that the time and point of takeoff has been witnessed and recorded for comparison with that recorded by the GNSS FR, 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 FR. See paras 5 and 6 in the conditions of approval.

A.6 **Use in Motor Gliders** (including self-sustainers)

A.6.1 Recorders without ENL system. Any Means of Propulsion (MoP) must either be sealed or inoperative, or a separate approved MoP recorder used.

A.6.2 Recorders with ENL system. The internal microphone and associated circuitry automatically records an ENL (Engine Noise Level) value between 000 and 996 with each fix. The ENL system is automatically enabled and no pilot action is required. The FR should not be covered or insulated, although even so, automatic gain should continue to ensure high ENL readings under power.

A6.2.1 Cockpit noise. Pilots should note that cockpit noises other than the engine will produce ENL readings, and should avoid those that could be mistaken for use of engine. Generally the frequency filtering built in to the FR will avoid any problems, but it should be noted that **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**, as will spins and stall buffet, 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. Pilots should analyse their flights and ensure that their

recorder produces ENL values similar to those given in B4.2. If not, the recorder should be returned to the manufacturer or agent for re-calibration to B4 values.

A.7 **After Flight** - The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with that recorded by the Recorder (see para B2.1). Until an OO has witnessed the FR 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 NAC. The OO does not personally have to transfer the data from the FR, but witnesses the transfer and takes or is given a copy on electronic media. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to IGC record and badge rules, the above continues to apply. As this system is for instrument panel mounting, data transfer should be at the glider to avoid disturbing the mounting.

A7.1. Use of Portable PC at the glider. A portable (laptop/notebook) PC should be used for transferring data at the glider. The portable PC may be owned by the pilot or any other person. It should be set up for ease of transferring the data, such as by easy access to the current DATACAM2.EXE program file or an equivalent program from the manufacturer that carries out the same function. In the event of any problems in getting DATACAM2 to work through the hard disk of the PC, install it on a self-booting floppy diskette, re-boot to the diskette and type "DATACAM2". Transfer of flight data is witnessed by the OO, and the flight data in IGC format is then given to the OO on portable media such as a floppy diskette.

A.8 **Calibration of Barograph Function**. Pilots are advised to have a barograph calibration carried out either by the manufacturer or by an NAC-approved calibrator before any GNSS FR is used for a claimed flight performance. For the procedure, see para B5. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the FR for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

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

Annex B to IGC Approval dated 25 November 2003

NOTES FOR OFFICIAL OBSERVERS AND NACs -
PART OF IGC APPROVAL FOR CAMBRIDGE 302 GNSS FR
MANUFACTURER - CAI INC., HORN LAKE, MISSISSIPPI

To be read together with the main terms of approval to which this is an Annex. 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 FR in the glider, the type and serial number of the particular FR, the glider type and registration, date and time. The serial number of each individual recorder consists of three characters made up of letters and/or numbers and is shown on the outside of the variometer scale at about the 4 o'clock position. Before flight, if requested, the OO shall then seal the FR to the glider in a way acceptable to his NAC and to IGC, and such sealing may be at any time or date before flight. If sealing is not used, either a preflight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is correct, and that another FR has not been substituted in the glider before the data transfer (B2.3). See paras 2 and 3 of the Conditions of Approval. Regarding the position of any ancillary displays connected to the FR, see para 3 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, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the FR takeoff data.

B.2 **Landing**

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

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

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 FR (see para A7.1). If a portable PC is not available, the OO shall check and break any sealing to the glider, and take the FR to a PC. As this model is designed primarily for panel mounting, 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 FR which is then independently checked later at the NAC (and at FAI if the claim goes to them) through the VALIDATE (VALI) program.

Method: Use the standard IGC connector cable that has a 9-pin RS232 male connector for the FR and a RS232 female connector for the PC. A current version of the short program file DATCAM2.EXE (or the manufacturer's equivalent Windows-based program) must be available on the PC. The DATACAM2 program 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 fai.org/gliding/gnss web site. The DATA program file can be executed on either a floppy diskette or on the PC hard disk. 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 "DATACAM2, enter" at a DOS prompt (DOS window or re-boot into DOS mode); or by double-clicking "DATACAM2" in a Windows file list (File Manager for W3x, Windows Explorer for W95/98/ME or NT/2000/XP). 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 DATACAM2 to work through the hard disk of a PC, install it on a self-booting floppy diskette, re-boot to the diskette and type "DATACAM2".

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

OO's Copy. A copy of the *.IGC files shall be retained securely by the OO such as by immediately copying them to a separate diskette or PC card, or by the use of the OO's own PC. These files shall be retained by the OO in safe keeping for later checking and analysis under NAC/IGC procedures.

Storage media. The OO may keep the required data files on a floppy diskette or other industry-standard portable storage media. The hard disk of a PC may also be used but the OO must be able to positively identify the flight data files as being from the flight concerned such as by comparing checks on takeoff and/or landing from sources different to the recorder.

Competitions: Different rules may apply for competition flights, for which a central data transfer facility may be used. However, as this model is designed for panel mounting, arrangements should be made with the organisers for data transfer at the glider rather than having to remove the FR after each flight. For ease of identification within the competition, file names may be changed, for instance to the glider competition number or the pilot's name. Integrity of data within the file is preserved by the electronic security system and may be checked at any time by using the VALI program file.

B.3 **Analysis of Flight Data Files**. A Data Analyst approved by the NAC will then evaluate the flight using an analysis program approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking flight data, an authenticated version of the file VALICAM2.EXE shall be used by the NAC and by FAI (if the data goes to them) to check the electronic security coding, that the FR had not been interfered with, and that the flight data in the *.IGC file has not been altered since it was transferred from the FR. The version number of the VALI file is shown at the top of the screen when the file is executed. The latest version of VALICAM2 should be used and is available from the IGC GNSS web site for software given at the beginning of this document.

Method: at the appropriate prompt or run function, type VALICAM2.EXE followed by a space and the name of the file to be checked. The following messages should appear:
Log Data Integrity OK
Signature Data Integrity OK
Security OK

Log Data Integrity refers to a 32 bit CRC check sum of all of the data in the file except the Security Signature (G-Record). This check sum is calculated on the data as it was transferred from the recorder. It does not indicate whether the recorder itself was secure.
Signature Data Integrity refers to a 32 bit CRC check sum of the Security Signature (the G Record at the end of the IGC file). This check sum is calculated on the signature data as it was transferred from the recorder. It does not indicate whether the recorder itself was secure.
Log Data Integrity and Signature Data Integrity indicate to a high probability whether the data in the file is the same as the data that was supposed to be transferred. The purpose of these is to indicate any errors during the transfer of data from the recorder to the PC.
Security OK indicates that the IGC file contents passed the electronic security check, which uses the DSA system with a large key length.
If there is a problem, OK will be replaced by "Fail". In this case the NAC or other validating authority must investigate the reason. It should be noted that GFAC tests include ensuring that the change of a single character in an otherwise-correct IGC file, cause the VALI program to fail as indicated above.

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 4.2 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). Up to ENL 200 for winch and 150 for aerotow have 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 an average of over 700 ENL is expected. Over 850 is typical for a two-stroke engine, over 700 for a 4-stroke. An ENL value of 996 has been recorded with both two- and four-stroke engines 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. 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 050 indicate normal gliding flight in a quiet cockpit environment in a well-sealed glider. In a high-speed glide or in an aerodynamically-noisy glider, ENL may increase to about 200. Short periods of higher ENL while gliding (up to about 300 ENL) may indicate aerodynamic noises such as due to airbrakes, lowering the undercarriage, sideslip, etc, and are normal before landing. Particularly, sideslip or high speed with the cockpit Direct Vision (DV) or ventilation panel(s) open can produce low frequency noise ("organ-pipe" effect) and ENL readings of up to 450 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.

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 200 is more typical in an aerodynamically noisy glider, and 100 in a quiet machine.

B.4.5 **ENL during landing**. During ground contact during landing, short-duration ENL values up to 500 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 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 FR 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 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 FR Data Analyst). The correction table will list true against indicated altitudes. This table can then be used to adjust pressure altitudes which are recorded during flight performances and which require correction before validation to IGC criteria. These include takeoff, start and landing altitudes for altitude difference and for comparison with independently-recorded QNH readings, and low and high points on gain-of-height and altitude claims. Only pressure altitude is valid for IGC altitude purposes except for proof of flight continuity (no intermediate landing) where GNSS altitude may also be used.

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. The altitude accuracy from satellite-based systems will not be as good as accuracy in lat/long, because satellite geometry is not as favourable for obtaining accurate altitude fixes compared to horizontal position. This effect may be increased by less-than-ideal antenna positioning in some gliders. Data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records. Lat/long fix accuracy is not affected and tests on this recorder show it to be typical of that for a 12 channel GPS system. From GFAC tests 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 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 in IGC files that apply to this recorder are given below.

B.5.3.1 **Pressure Altitude**. Recorded up to 20km (65,617ft).

B.5.3.2 **GNSS altitude**. Recorded between -1.5 to 18km (-4,921 to 59,066ft), as specified by the GPS receiver board manufacturer.

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