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

FAI web site: www.fai.org
IGC web site: www.fai.org/gliding

To: FAI for IGC email mailing list
Internet newsgroup rec.aviation.soaring
IGC GNSS web site under "List of Approvals"
Copy: Manufacturer concerned

1 October 2004

# IGC-APPROVAL FOR GNSS FLIGHT RECORDER

**Recorder Name: Peschges VP-8**
**Level of Approval: All IGC Badges and Distance Diplomas**

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

*(i-i) Document Versions and Scope. The original IGC-approval for these recorders was issued on 31 May 1996. Edition 2 dated 28 March 2004 contained updated wording. This version updates the situation to October 2004 and sets the IGC-approval level at "all badges and distance diplomas".*

*(i-ii) IGC-approval Level. This recorder is IGC-approved for all flights including world records, all IGC badges and distance diplomas, and all competitions to IGC rules and procedures. The various Levels of IGC-approval are listed in Annex B to the Sporting Code for Gliding, para 1.1.3.3.*

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

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

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

*(iv) The attention of National Airsport Control (NAC) authorities, officials and pilots is drawn to the latest edition of the FAI Sporting Code Section 3 (Gliding) including its annexes. Annex A to this code (SC3A) deals with competition matters, Annex B (SC3B) with equipment used in flight validation, Annex C (SC3C) with guidelines and procedures for Official Observers, pilots, and other officials involved in the flight validation process, Annex D (SC3D) with the IGC Pilot Ranking List . Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the IGC web site. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" and is also available through the IGC/GNSS web site.*

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

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**MANUFACTURER:**

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Email: info@peschges-variometer.de
Web: http://www.peschges-variometer.de
Manufacturer codes: Three-letter, PES. One letter, P. Binary file flight data, *.PSF.

**HARDWARE**

**Description, size, weight.** The recorder has a rectangular metal case about 110mm long, 64mm broad and 46mm high. An integral antenna is mounted on the top surface and has a curved profile, increasing the overall height to about 70mm. Weight is about 450 grammes. A Pilot Event (PEV) button and an LCD about 35 x 12mm in size are on one end and two multi-pin connectors are on the other end. Details of connectors are given below under Conditions of Approval.
**GPS receiver board**. Motorola with 6 parallel receiver channels, set to record at a constant fix interval of 6 seconds.
**Versions**. Hardware Version 1.8 dated March 1996 or later.
**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. This equipment is understood to have the EU CE mark.

**FIRMWARE**

**Versions**. Firmware Version 1.8 dated March 1996 or later. The version number of the firmware in the recorder is shown on the LCD on start up in the form "VP8 V1.8".

**SOFTWARE**

**Short program files**. These have file names DATA-PES, CONV-PES, and VALI-PES. The DATA program is for transferring flight data from a recorder to a PC and also converts the downloaded binary *.PSF file to the *.IGC file format if the CONV file is in the same directory. The CONV file may also be used on its own to convert a PSF file to the *.IGC ASCII format. The VALI program is for validation of the security and integrity of *.IGC files at any time after initial downloading from the recorder. The DATA, CONV and VALI files are copyright of the FR manufacturer but are freeware. The latest versions may be obtained from the FAI site for free software given at the beginning of this document, and when the VALI program is used it must be the version from the web site.
**Peschges software program**. The Peschges VPLOG program includes facilities for configuring the recorder, downloading data to a PC and also post-flight analysis.
**Other programs.** For downloading data after flight from the recorder to a computing device, any program or sub-routine may be used. Such a program may be embedded in a larger program, such as in software that is designed so that Official Observers and others can download many different types of recorder. The criterion for valid flight data is that the resulting flight data file passes the VALI check that is described above using the VALI program from the IGC web pages.

**CONDITIONS OF APPROVAL**:

1. **Permitted Connections to the Recorder**. The connections are on the opposite end of the case to the LCD and Pilot Event (PEV) button.

1.1 6-pin circular plug with 12V external battery power and Motor Glider MoP sensor input.

1.2 PC to 9-pin RS232 male fitting on the recorder case. The cable connecting the recorder to the PC needs female RS232 connectors at both ends. However, this cable does not have straight-through connectors and is a "crossover", "null modem" or "laplink" type. A PC must not be connected between the takeoff of the claimed flight and the transfer of data after flight by an OO.

2. **Security of the Equipment**. GFAC is presently satisfied with the security of this equipment for IGC Badge and Distance Diploma flights, subject to para 4 overleaf on the physical security seal.

2.1. **Installation in the glider** The FR may be fitted anywhere in the glider, subject to paras 2.2 and 3.2 and that the position of any displays in single-seat gliders is not remote from sight lines used for pilot lookout and scan for other aircraft and gliders. 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.

2.2. **Motor gliders**. In the case of Motor Gliders where the operation of the Means-of-Propulsion (MoP) is to be recorded, the fitting must be such that the wires between the FR and the MoP sensor must not be accessible to the crew during flight. An engine-run of at least one minute must be carried out during the flight to be validated in order to demonstrate the correct working of the engine recording system (detail, A6.2).

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

3. **Check of Installation in the Glider**. There must be incontrovertible evidence that the recorder was in the glider for the flight concerned. This can be achieved either by observation at takeoff or landing or by an OO sealing the recorder to the glider at any time or date before takeoff and the seal being checked after landing.

3.1. **Observation of Installation before Takeoff or at Landing**. For observation, either a preflight check of the installation must be made and the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the 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.

3.2. **Sealing to the Glider**. If para 3.1 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. 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 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 seal for the previous glider must be removed.

4. **Security Seal**. The VP8 is sealed with silver-coloured adhesive paper-based tape across two screws which have to be taken out to remove the outer case. If it is found to be unsealed, it must be returned to the manufacturer or his appointed agent for investigation and resealing, with a statement of how the unit became unsealed. Whenever any unit is resealed, the manufacturer or agent must carry out positive checks on the internal programme and internal 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.

5. **Analysis of Flight Data**. This may be through any analysis programme that is approved by the relevant NAC. For a list of those which use the *.IGC file format, see the IGC GNSS web site under SOFTWARE).

5.1 Flight declaration. It is understood that some external software exists that inserts a flight declaration (C-record) into the IGC flight data file for this recorder, but this has not been submitted to GFAC for checking for security and data integrity. Therefore, the use of electronic task declarations with this recorder is not approved for any claim that requires IGC or FAI standards. Paper declarations in the traditional format are completely valid when used with electronic flight data.

5.2 VALI check. The validating agency must check that the IGC file is valid and unaltered, by the use of the latest version of the VALI-PES.EXE short program file that is available on the FAI gliding/gnss web site for free software given in the header above. See para B3.2 for how to use.

6. **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.

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

*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 including annexes 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**. Check that the recorder and its integral antenna is positioned in order to give sufficient signal strength for IGC purposes. No deliberate attempt must be made to inject 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**. - Note that the VP8 is set to a fixed Geodetic Datum (GD) of WGS84. Lat/longs in the file outputs from the VP8 will all be to the WGS84 GD, as required by IGC.

A3 **Cockpit Indications**. No cockpit read-out of lat/long is given. For validation of presence in an IGC Observation Zone, pilots are recommended to fly a sufficient distance into an Observation Zone to ensure fixes in the Zone.

A3.1 Fix intervals. The recorder is set to a constant fix interval of 6 seconds although an extra fix is generated by pressing the Pilot Event (PEV) button on the VP8 chassis to the right of the LCD.

A3. **Observing the FR 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, 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 3 in the conditions of approval.

A4. **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.

A5. **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 2.3 and 3 in the conditions of approval.

A6. **Use in Motor Gliders (including self-sustainers)**. Unless the Motor Glider Means of Propulsion (MoP) is sealed or inoperative, there must be proof that the system in the recorder gives a positive indication of the operation of the MoP under power that satisfies the organisation that will validate the flight concerned (the NAC and, where required, FAI).

A6.1 Operation in the VP8. Voltage generated from the MoP is recorded by the VP8 through wires which connect to the circular 6-pin socket through which the 12 V DC power is also connected to the VP8. The MoP voltage produces codes of EON (Engine On) and EOF (Engine Off) in the *.igc file of flight data. The wires between the FR and the MoP sensor must not be accessible to the crew during flight (Para 2.1 refers).

A6.2 Flight demonsrtation. The engine shall be run during flight for a minimum period of about one minute, so that the working of the recording system can be demonstrated and shown on the IGC flight data file for the flight. For self-launching motor gliders this will normally be achieved during the launch, for self-sustainers a specific engine-run should be carried out after launch and before the start of the task.

A7. **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 GNSS FR (see para B2.1). Until an OO has witnessed the FR installation to the glider, the pilot must not alter the installation or remove the FR from the glider. 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 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.

A7.1 Retaining both the IGC and PSF files. Downloading from the recorder to a PC is initially in the binary *.PSF format. This is then converted to the ASCI *.IGC format which is used for post-flight data analysis. You are strongly advised to keep a copy of the binary PSF file in case any problem arises with the IGC format file. The IGC file can be re-created at any time from the PSF format by the use of the CONV-PES.exe program that may be obtained from the FAI site for free software given at the beginning of this document

A8. **Calibration of Barograph Function**. Pilots are advised to have a barograph calibration carried out by an NAC-approved calibrator before any GNSS FR is used for a claimed flight performance. An IGC-format file showing the pressure steps used in the calibration must be recorded and kept. Altitude and height claims obviously require a calibration, but speed and distance claims also need a calibration for calculating the accurate altitude difference of the glider between 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.

A9. **Flight Declarations**. The use of electronic task declarations with this recorder is not approved for any claim that requires IGC or FAI standards. See para 5.1 in the main section before the Annexes.

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**NOTES FOR OFFICIAL OBSERVERS AND NACs - PART OF IGC APPROVAL**

*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.*

B1. **Installation and Takeoff Records**

B1.1. **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 FR, the glider type and registration, date and time. The procedures in this paragraph and the sub-paras below are to ensure that the installation is correct, and that another FR has not been substituted in the glider before the transfer of flight data (B2.3). See paras 2 and 3 of the Conditions of Approval.

B1.1.1. Sealing to the glider. At any time or date before flight, if requested, the OO may seal the FR to the glider structure in a way acceptable to his NAC and to IGC. This is the preferred option because it makes it easier for the pilot on the day of flight.

B1.1.2. If sealing is not used. Either a pre-flight check of the installation must be made on the day of flight or an OO must witness the landing, but see the qualifications that follow. After the pre-flight check on the day, the glider must be under continuous observation by an OO until it takes off on the flight concerned. Where an OO witnesses the landing, the glider must be under continuous observation until the FR installation is checked.

B1.2. **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 shall be compared to the FR takeoff data.

B2. **Landing**.

B2.1. **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 shall be compared to the FR landing data.

B2.2. **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.

B2.3. **Transferring the Flight Data to a PC**. If a portable PC is available, the flight data may be transferred at the glider without disturbing the installation of the FR. 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. 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 downloaded file. This is then independently checked later at the NAC (and at FAI if the claim goes to them).

Method: Connect the PC to the male 9-pin RS232 data port on the recorder by a cable with female RS232 connectors at each end. Note that this cable does not have straight-through connectors and is a "crossover", "null modem" or "laplink" type. Either use an authenticated version of the free DATA-PES.EXE (a floppy disk can be used or a computer hard disk), or use the manufacturer's full PC programme "VPLOG", following the instructions given in the menu.

A binary-format flight data file with a suffix of "PSF" will be produced with the file name YMDPXXXF.PSF, where Y=year, M=month, D=day, C= manufacturer, XXX = FR Serial Number and F = flight number of the day (full key, Appendix 1 to the IGC GNSS FR Specification).

A copy of the downloaded file shall be retained securely by the OO such as by immediately copying it to a separate diskette or PC card, or by the use of a PC independent of the pilot. The downloaded file for the flight shall be retained by the OO in safe keeping for later checking and analysis under NAC procedures.

Competitions: Different rules may apply for competition flights, for which a central data transfer facility may be used, but for flights to IGC record and badge rules the above must be followed, and allowed for in competition procedures.

B.3. **Conversion to IGC format and analysis of flight data**.

B3.1 **Conversion to *.IGC File Format**. After landing or at a future time, an OO or an NAC-approved data analyst must use approved software to convert the binary file to the *.IGC file format. Such software includes the CONV-PES.EXE program, or the Peschges VPLOG programme, see Page 1 under "SOFTWARE". During the file conversion, the screen should show "OK, the flight data has not been changed", not "Error", plus an error message. The *.IGC file of flight data thus created should then be copied to the same storage device and directory that already has the *.PSF file which was originally downloaded, so that both the PSF and IGC files for the flight are kept together.

B3.2 **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. For a list of programs that analyse the IGC flight data file format, see the IGC GNSS web site under SOFTWARE. First, the version of the program VALI-PES.EXE that is on the FAI gliding/gnss web site shall be used by the organisation validating the flight to check the integrity of the file for the flight. This organisation may be the NAC and later FAI for data sent to FAI for checking. The VALI program checks the electronic security coding in the file, that the FR from which it was downloaded has not been interfered with, and that the flight data is identical to when it was initially downloaded.

Method: at the appropriate prompt or run function, type VALI-PES.EXE followed by a space and the full name of the file to be

checked (which must be in the same directory as the VALI program file and can be on a floppy disk). If the file data integrity is good, the following message should appear: "OK, The flight data has not been changed", not "Error" plus an error message. In the latter case the flight data is invalid and the circumstances of the failure should be investigated before the recorder security is re-set by the manufacturer or an agent authorised to carry out such work.

B.3.2.1 **Flight Declarations**. The use of electronic task declarations with this recorder is not approved for any claim that requires IGC or FAI standards. See para 5.1 in the main section before the Annexes.

B4. **Means of Propulsion (MoP) Record - Motor Gliders**.

B4.1. **Installation and Evidence from the Glider**. There must be proof that the cable from the FR to the Means of Propulsion (MoP) sensor is intact, any joints are sealed by an OO, and the cable has not been tampered with. The cable must not have been accessible to the crew in flight. The cable must be inspected carefully to ensure that a probe has not been inserted (and then withdrawn) in an attempt to cut out the MoP sensor.

B4.2. **After-Flight Analysis and Checks**. A positive check must be carried out that the MoP sensor indicated that no MoP operation took place during the claimed flight performance, and also that the MoP recording system was working correctly both before the start and after the finish of the claimed flight performance. The MoP voltage produces codes of EON (Engine On) and EOF (Engine Off) in the *.IGC file of flight data. Data analysts must check that the engine-run required by paras 2.2 and A6.2 is recorded correctly in the IGC flight data file.

B4.3. **Gliders**. In gliders without a motor, a permanent (fail-live) EON record may be produced. For the purpose of flight validation, this record should be ignored as long as it is certain that the glider had no means of propulsion of any sort.

B.5 **Altitude analysis and calibration**. Flight data files shall be analysed in accordance with Sporting Code procedures. Part of this is to compare the general shapes of the GNSS altitude and pressure altitude records with time and to ensure that no major differences are seen that could indicate a problem in recording or even artificially-manufactured (false) data. As part of this process, the FR must be calibrated in an altitude chamber in the same way as a drum barograph.

B.5.1 **Calibration method, making a calibration table**. The FR can be calibrated in an altitude chamber in the same way as a drum barograph. Before placing the VP8 in a pressure chamber, connected to its battery, the event-button must be pressed as power is connected until the message `CLEAR MEM' and then `OK' appears (about 12-15 seconds). After releasing the button, the flight display appears, showing "ST" on the right hand side. By pressing the event button until the display switches from "ST" to "15" (the hours of recording available), which takes about a further 20 seconds, the normal groundspeed gate is by-passed, and recording starts immediately. The recorder and its battery can then be placed in the pressure chamber and the calibration started. The calibrator should be asked to record the pressure steps used, for later comparison with the IGC file for the calibration. 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, at a non-gliding calibration centre, may not have this knowledge. The IGC format calibration data file will then be analysed, compared to the calibration pressure steps, and a correction table produced and authenticated by an NAC-approved person (for instance an OO or GNSS 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 for flights 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 fixes of 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. 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. The VP8 has a 6-channel recorder so accuracy will not be quite as good as for 12 channel recorders, but still more than acceptable for FAI and IGC purposes.

B.5.3 **Altitudes Recorded in the IGC file**

B.5.3.1 **Pressure Altitude**. The maximum pressure altitude tested by GFAC (March 1996) was 40,000 ft.

B.5.3.2 **GNSS altitude**. This is recorded as distance above the WGS84 ellipsoid. GNSS altitude is not used for the purpose of IGC altitude measurement (for instance gain of height and altitude performances), for which pressure altitude to the ICAO ISA is required.

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