AMENDMENT LIST NUMBER 6 TO
TECHNICAL SPECIFICATION
FOR IGC-APPROVED GNSS FLIGHT RECORDERS

EFFECTIVE 7 APRIL 2003
ISSUED BY FAI
ON BEHALF OF THE INTERNATIONAL GLIDING COMMISSION

Glossary

3D position, add: "The geometry of the lines-of-position between the satellites and the surface of the earth is such that errors in recorded GPS altitude are between 1.8 and 2.2 times those in latitude and longitude. In addition, probably because of less-than-ideal installations in gliders, significant short-term additional inaccuracies in GPS altitudes have been recorded in IGC files, including GPS altitude unlocks and short-term occasionally major variations compared to pressure altitude. Source: GFAC report to IGC in 2001, reported on the fai.org/gliding web site."

Authentication. Change to: see under "Validation". Reason: more correct, current usage.

Download, add: Normal usage in avionics is to refer to data being transferred from an aircraft module such as a flight recorder to a PC and unless indicated to the contrary this should be taken as the meaning.

Fix, add: Fixes are recorded as individual lines in the B record in the IGC file, separated by CRLF.

FL, Flight Log, delete. Obsolete term, originally used by Cambridge Aero Instruments.

FR, Flight Recorder, replace "flight log" by "IGC data file".

GPS system time, replace 2000 by 2003 (leap seconds are still 13 since Jan 1980).

Latitude, delete the word "log".

Longitude, delete the word "log".

OO ID, delete, no longer part of the IGC security system. Originally used in some first generation electronic barographs.

PGP, delete the word "some" in the last sentence.

Proof drive, replace "flight log" by "IGC format file".

UTC, change 2002 to 2003.

Add the following:

Grandfather rights. This term is used for a situation where the approval of a type of equipment is continued unaltered although the Specification conditions have changed with time (generally,

increased). Detail on its application to IGC-approved GNSS Flight Recorders is in para 1.1.3.3.5.

Validation, VALI check. For GNSS FR data, the process of determining that electronic flight data has the integrity to be used in the overall flight validation process. Electronic flight data is validated by using the appropriate VALI-XXX.EXE program (XXX = manufacturer identification letters) or its MS Windows equivalent (see Appendix 3). This program checks the Digital Signature that is part of the IGC-format file that was transferred from the FR, indicates that data has originated correctly from the FR, and that the data in the IGC file is the same as that initially transferred from the FR. The VALI programs for all IGC-approved recorders are available on the IGC/GNSS web pages. (AL6)

Waypoint, way point (WP). Either (a) A precisely specified point or point feature on the surface of the earth using a word description and/or a set of coordinates, or (b) a set of coordinates not represented by any specific earth feature. A waypoint may be a start point, a turn point, or a finish point and has an associated observation zone (Sporting Code Section 3, definitions, para 1.1.2). It may also be used as a reference point for defining an area that is to be reached as part of a task. The area concerned is within the clockwise angle between two true bearings from the point and a minimum and maximum distance from the WP. (Based on Sporting Code Section 3 Annex A para 19, Assigned Area tasks). (AL6)

CHAPTER 1

1.1.3.3 **Levels of IGC-approval**. Main para, delete "in addition to no approval or withdrawal of an existing approval" (this is covered below). New sub paras as follows:

1.1.3.3.1 IGC-approval for all flights. This applies to Flight Recorders that may be used for evidence for all flights up to and including FAI/IGC world records. For new types of recorders, complete compliance with the current Specification is required. For types with existing IGC-approvals to this level, "Grandfather Rights" apply (1.1.3.3.5 below).

1.1.3.3.2 IGC-approval for IGC/FAI badge and Diploma flights. This applies to Flight Recorders that may be used for evidence for all IGC/FAI badge and distance Diploma flights, but must not be used for IGC/FAI world record flights. For competition flights, see 1.1.3.3.6. This level may be used for new recorders that do not meet the current Specification in some areas. For types of recorder that are already IGC-approved, this level may be used for those whose characteristics are now significantly below the current Specification standard, particularly on security and accuracy of data. These assessments will be at the discretion of the IGC GFA Committee (GFAC). For types of recorder with existing IGC-approvals to this level, Grandfather Rights apply (1.1.3.3.5 below).

1.1.3.3.3 IGC-approval for badge flights up to Diamonds. This applies to Flight Recorders that may be used only for evidence for FAI/IGC Silver, Gold and Diamond badge flights, although for competition flights, see 1.1.3.3.6. This level may be used for recording systems that have significantly lower standards of security and other characteristics compared to those with higher levels of approval. For instance, this level includes systems that use a separate off-the-shelf GNSS unit (for the design and security of which, IGC has no influence) connected to the Flight Recorder unit by cable. These assessments will be at the discretion of the IGC GFA Committee (GFAC).

1.1.3.3.4 No IGC-approval. This applies to types of Flight Recorders that have either not been tested and approved by GFAC to IGC standards, or have not been awarded an IGC-approval as above, or to previously IGC-approved recorders where a major security or other problem has been shown to exist which could compromise the integrity of flight data from other recorders of the same type in service.

1.1.3.3.5 Grandfather rights and approval levels. The term "Grandfather Rights" is used for a situation where the conditions of an original IGC-approval are continued with time even though the provisions of the IGC Specification or Sporting Code have changed. That is, the recorder would be subject to additional limitations or would not be approved for particular categories of flights if it were submitted for IGC approval as a new model. Continuity of the original approval is so that owners and manufacturers are not constantly required to carry out updates as the Specification of Sporting Code changes with time, unless a major anomaly is found to exist in the type of recorder. A similar policy is adopted in civil aviation by the FAA and JAA with regard to already-certificated designs. Where GFAC proposes to reduce the approval level of an existing type of IGC-approved recorder, as much notice as possible will be given to the manufacturer so that he can inform owners and offer upgrades where possible that will retain the existing approval level. The notice will be at least one calendar year unless an urgent security problem can be shown to exist which could lead to false or corrupt flight data being submitted in a claim.

1.1.3.3.6 Competitions. The above sub paras apply to record, badge and distance diploma flights to be validated to FAI/IGC rules and procedures. For competition flights, the types of recorders that may be accepted are (a) at the discretion of the competition organisers and (b) subject to any higher level rules and procedures that may apply to the organisers. For instance, Regional or National competition rules or Sporting Code Annex A procedures for World and other Championships that use Annex A rules.

1.1.8 **Security of the Flight Recorder module**. No policy change, but to express more clearly what we do, the last two sentences to read: "Also, a system must be incorporated that trashes the internal electronic security system if the recorder case is opened or otherwise becomes insecure. Flights made after any such event must continue to produce IGC-format data files, but such files must be clearly marked as insecure. These files must also fail the electronic VALIDATE check that is available through free software from the gliding/gnss web pages. Re-set of a recorder to a secure state must only be through the manufacturer or his authorised agent and the knowledge of the details of any re-set procedure must be restricted to the minimum number of people".

CHAPTER 2

2.1.3.2 add: See 1.1.3.3.5 on Grandfather Rights.

2.4 Add after "fix validity recording": "; error circle recording; recording of IDs of satellites used in position determination;" . Also, delete the words: "if required by the terms of the IGC-approval the ability of an OO to input a personal code (OO ID, see glossary) before flight".

2.4.3 Delete the words: "record satellites used in position determination;"

2.4.4 New para on fix intervals: 2.4.4 **Fix Interval (Sampling Rate) Settings**. The Sporting Code

for gliders states that for a flight to be validated to IGC rules, the setting for fix interval (sampling rate) must not be greater than one minute. This maximum interval could apply to cruising flight between waypoints for recorders that have settings for variable fix intervals including the facility for fast fix rates near Observation Zones (OZ). However, for recorders with a fixed setting for fix interval, one minute is too long because in a short transit of an OZ fixes might not be recorded in the OZ. Also, a short fix interval is required for barograph calibrations (see 2.4.4.2). Manufacturers are encouraged to provide variable fix intervals that allow for cruising flight and short fix intervals for flight near and in Observation Zones and for pressure altitude calibrations. Requirements are as follows:

2.4.4.1 Recorders with variable fix interval settings. The fast-fix setting for use near or within Observation Zones shall include settings for 5 seconds or less, 1 or 2 seconds being preferred. The fast-fix system must be activated after a pilot event (PEV) mark and may also be initiated automatically on detecting a particular range from a OZ or Waypoint. The cruise fix setting for use between waypoints shall not be greater than 60 seconds and shall allow for choice of intermediate settings such as 10 and 20 seconds. It should be noted that in thermalling flight, fix intervals of over 30 seconds may not record the turns clearly whereas with 20 seconds or less, turns can be identified during after-flight analysis.

2.4.4.2 Recorders with fixed fix intervals. The maximum fix interval for flight shall be 10 seconds and for calibration of the pressure altitude sensor, 5 seconds. Preferred settings are 5 seconds for flight and 2 seconds for calibration. The calibration setting may be obtained through a special calibration mode which must be capable of being set before the recorder is taken to the calibration laboratory and must continue without additional switching until the calibration is complete and the recorder can be returned to flight mode. It must also be easy to be set to the calibration mode and back to flight mode, for instance by the calibration laboratory. Although some calibration officials cannot be expected to make adjustments to the recorder settings except to switch it on and carry out the calibration, others may want to make the switching and such a capability must be incorporated.

2.6.3 **Memory used for flight data**. Add a sub para:

2.6.3.1 Preservation of memory data. The design shall preserve memory data wherever possible so that recent flight data can be transferred to a PC either by normal or emergency methods. This should cover conditions of impact (for instance, accidental dropping of the recorder), damage, and crash. Wherever possible, non-volatile memory should be used that does not depend on a sustainer battery for retention of data. If a sustainer battery is used, its position and wiring to the memory unit should be made as secure as possible with respect to impact or other damage.

2.6.4, add: This is mainly achieved by the use of the VALI-XXX.EXE program file and its MS Windows equivalents, but all other measures should be taken to preserve the integrity and security of data in IGC data files.

2.6.5.5 New para: "**Fix interval during Calibrations.** A short fix interval is required so that the pressure level in the altitude chamber, once set, does not have to be held for an extended period. Ideally it should be possible to set a 1 or 2 second fix interval before the calibration starts. The minimum requirement is that during a pressure altitude calibration it shall be possible to set a fix interval of 5 seconds or less. For recorders with non-variable fix rates in excess of 5 seconds, this

may be set through a special calibration mode. Any such special calibration mode should be easy to set by the pilot or owner of the recorder and subsequently be continued until re-set to flight mode later. This is so that a calibration centre only has to switch the recorder on and carry out the calibration without any extra switching. Some calibration officials may want to make the switching and such a capability must be available."

2.6.6.2 **Geodetic Datum.** Add: ", and any GPS fix data that is not to the WGS84 Geodetic Datum will not be validated for flights to IGC/FAI criteria."

2.6.7.3, **PEV**, delete the words: "but is not mandatory," (words not needed, no change of policy).

2.6.7.5 **Motor glider MoP record**. Second sentence to read: "Systems must have a microphone inside the FR that records cockpit noise with every fix using the ENL system, unless the proposed alternate system can be shown to have a similar integrity and security protection against mis-interpretation and misuse, either accidental or deliberate. For ENL systems, a low but positive ENL value in normal gliding flight shall be recorded so that the system is self-validating with each fix. ...."

Also, the second sentence from the end to start: "In the case of microswitch- or vibration- based systems, any IGC-approval will include the provision that an OO must carry out a MoP test both before and after flight, and for the FR having to run continuously between these two supervised MoP tests, unless it can be shown that integrity can be proved without these procedures."

At the end of 2.6.7.5, add: "Further information on the preferred ENL system is in para 2.11.1"

2.6.8 **Units and Conversion Factors**. New para: Where conversions have to be made, the following are agreed by FAI, shall be used and are taken from international agreements:

Feet to metric distances:	1 inch = 1/12 foot = 2.54 centimetres exactly
Miles:	International Statute Mile = 5280 feet exactly
	International Nautical Mile = 1852 metres exactly
Speed:	Knots are Nautical Miles per hour
	"mph" refers to Statute Miles per hour (AL6)

2.7.2.2.1 **Electrical power**. Add: The power input must be designed for use with a 12V DC battery system and the recorder must not produce anomalies in output data in the range between 10 and 16 volts.

2.7.2.2.2 **Antenna cable**. Replace the sentence after "serviceable ones" by: "Therefore, for FRs with external antenna connections, any antenna connector on the FR case must be to a type of antenna cable connector that is commonly-available worldwide, be separate from other connectors and be designed and specified for low energy antenna signals, including the GPS frequencies around 1.5 GHz. It is recognised that some FR designs have antennas that are integral with the recorder case and an external connector does not apply. The IGC standard external antenna connectors on the FR case are the 9mm BNC bayonet, and, where a smaller connector is desired, the SMC (Sub-Miniature type C) screw fitting with 4mm female and 3.5mm male components. Where a screw fitting is used in a glider installation, it is recommended that it is prevented from un-screwing by the use of locking agent that will hold it firm but allow it to be unscrewed later if required. Push-pull antenna connectors will not be IGC-approved because they can become disconnected in a glider installation if the wire is inadvertently put under tension (push-pull connectors are those that can be disconnected solely by a

pull-action rather than by a turn or screw action)."

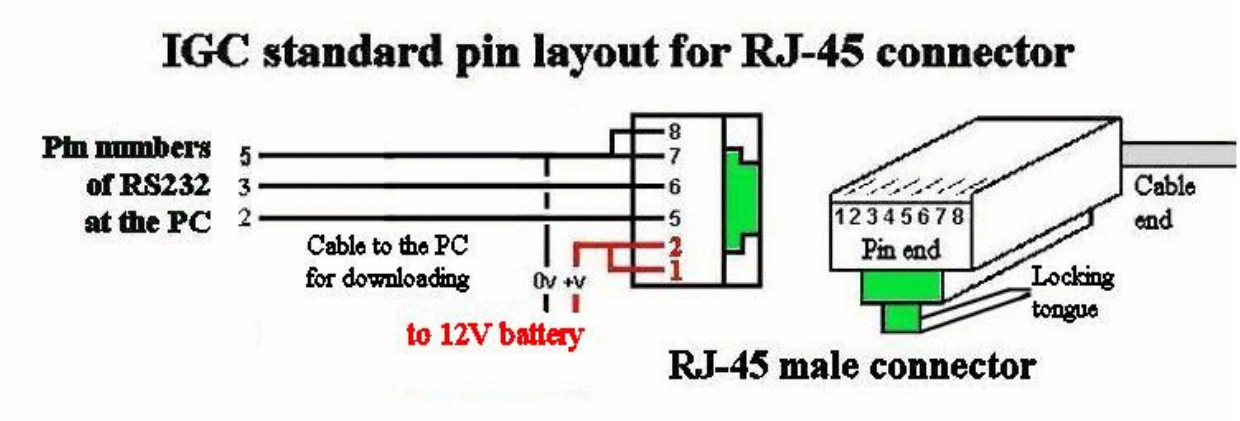
2.7.2.2.4 **Cables**, second sentence, change "is to be" to "must be".

2.7.2.2.6 **Connectors**, after "FR case", add "for data transfer".

2.7.2.2.7 Replace the heading and first two sentences by: "**Connectors on the FR case - data transfer and other functions**. IGC-approved types of connectors for data transfer to a PC are listed below, one of which shall be fitted on the FR case. The RJ-45 is recommended because the IGC-standard wiring includes both power and data transfer facilities. Connectors that include functions other than the transfer of data are covered in 2.7.2.2.7.3 below".

2.7.2.2.7.2 **RJ-11 connector**. Re-number as 2.7.2.2.7.4 and now to read:
"Grandfather Rights" for RJ-11 telephone connector with 6 pins. The RJ-11 was an IGC-approved connector but was withdrawn for new types of recorder by Amendment 6. This was because it had been found that after repeated use the locking tongue can break off, leading to the use of sticky tape or other methods to secure the connector to the recorder. The slightly larger RJ-45 is a significant improvement over the RJ-11 because it is stronger, has more pins and its cable is (normally) shielded. The details of the RJ-11 pin layout continue to be included below so that users of equipment with RJ-11 connectors that has "Grandfather Rights" know what pin layout to use when making up connectors for transfer of data. The IGC RJ-11 system used a female 9 x 6 mm RJ-11 socket on the recorder with pin assignments as follows: (AL6):

2.7.2.2.7.2 (new numbering) to read **Option 2 - RJ-45 connector**. To read: "This is a female 12 x 6 mm RJ-45 socket with 8 connections. It is also used for ISDN and Ethernet connections (but with different pin allocations). In the IGC layout, with the male plug end held towards the observer and the pins uppermost, the locking tongue underneath and the cable running away from the observer, pins are numbered 1-8 from left to right. IGC functions are listed below and also in the diagram.



2.7.2.2.7.3 (new numbering) new para: "**Connectors for other functions**. Connectors that include functions other than the transfer of data can be of any type as long as the cable connector can be securely attached to the FR case (that is, it can be secured by screws or clips and cannot be detached by a straight pull force). Power and backup download facilities may be included. Such functions include connections to other units such as those with variometer, speed-to-fly or final glide facilities".

2.7.2.2.8 **Antenna connector**. Delete, covered in 2.7.2.2.2.

2.8.1 **Levels of IGC-approval**. Shorten to: "Security aspects are important factors in the types of flights for which a recorder is given IGC-approval. The detail on approval levels is in para 1.1.3.3."

2.8.3.1 **Message Digest**. In the second sentence from the end, delete: "(currently Diamonds and below)".

2.8.3.2 **Checking at the NAC**. Delete the first sentence (duplicated later). Also, revise the sentence that begins: "The VALI file at the NAC" to read: "The NAC will use the VALI program to check the IGC format flight data file."

2.8.4. **Unauthorised Changes**. Preamble, not for publication: The present wording about deletion of the security algorithm dates from the days when symmetric algorithms were in use. Asymmetric systems such as DSA and RSA have public algorithms but a private key system. It is the private key that must be kept secret to protect security. Also, with improvements in data storage it is possible to retain flights in the memory without compromising their security, and there is no need to deliberately delete them when they could be vital in an accident or crash situation.

Expand the second sentence to read: "This shall be achieved by a system that operates if the FR case is opened and deletes the encryption key(s) required to compute a valid DS, such as a microswitch or equivalent system. The principle being that if the security mechanism of the FR is activated, any data originated after such activation must not have a valid security signature from the FR, until the recorder is re-set by a secure and authorised method. It is permissible to retain data for flights that were in the memory when the security system operated. If such flight data has the previous valid security signature and will pass the VALIDATE check, it must be stored in such a way that it cannot be altered even though the recorder itself is insecure. Otherwise such retained files must fail the VALIDATE check once downloaded".

2.9 **DATA FORMAT, TRANSFER, CONVERSION, AND VALIDATION PROGRAMS**
First sentence to be replaced by: "This refers to the DATA, COM and VALI functions that are executed through either the MS Windows-based system described in Appendix 3 or the DOS-based short program files. References in the document to the DOS files should be taken as also applying to their Windows-based Appendix 3 equivalents where the context makes this possible. For new types of recorder the Appendix 3 system is mandatory and the DOS files may be produced as an addition. For existing types of recorders, Appendix 3 software shall be produced by 1 July 2004. This software will be made available by IGC as freeware .... " etc.

2.9.3 **Short Program Files** New second sentence, modified start of next sentence: "The Windows version in accordance with Appendix 3. The DOS version of these program files ..." etc.

Note, not part of the amendment wording. The rest of 2.9.3 will have to be re-worded to differentiate between general requirements and those specific to either the DOS or Windows versions. This will be done for the next draft.

2.9.3.2.3 **CONV file** Replace the second sentence with: "This is for conversion of the manufacturer's binary file (where one is created) to the IGC ASCII format".

2.10 **Calibration accuracy of Pressure Altitude Sensor**. Note, not part of the amendment wording: Add resolution criteria by modifying this para as shown below. A 16-bit Analogue-to-Digital converter should be capable of giving a 1/3 hPa step at sea level and a reasonable maximum altitude. The new 2.10 follows:
"**Accuracy of Pressure Altitude Sensor - Calibration and Resolution**. An IGC-approved FR must have a pressure-altitude sensor and is an electronic barograph in its own right. Electronic sensors used inside electronic barographs and FRs have settings that can be adjusted by the FR manufacturer for sea level pressure and there is also a gain setting for the rest of the altitude range. The output from the sensor system will be converted to digital altitudes through an Analogue-to-Digital converter and these digital altitudes will be used as the pressure altitude element in the IGC data file. The capability of the A-to-D converter (10-bit, 16-bit, etc) will govern the size of any steps (altitude resolution) in the altitude output to the IGC file, for which a limiting value is given below in 2.10.2. (AL6)

2.10.1 **Calibration**. The pressure altitude sensor adjustments must be set by the manufacturer so that the output corresponds closely to the FAI pressure altitude criteria (the ICAO International Standard Atmosphere, Document 7488 tables 3 and 4). Large corrections must be reduced by adjustment so that, for instance in competitions, constant reference to calibration tables for individual FRs can be avoided. On set-up and calibration before or immediately after initial sale:
(a) the sea level setting must correspond to the required ISA (1013.25 mb) within 1 millibar;
(b) up to an altitude of 2000 metres, calibration correction must be within 3 millibars;
(c)above 2000m, calibration correction must be within one percent of altitude.
(Source: Annex B to Sporting Code, Chapter 3).
If larger calibration corrections are found due to drift with elapsed time, it must be possible to re-set the altitude sensor to the above criteria by returning the FR either to the manufacturer or his authorised agent. Such agent must also be qualified to re-set security on re-sealing the FR.

2.10.2 **Size of pressure altitude steps - Resolution**. The maximum permissible step in digital recording of altitude in the IGC file is one third of a hectoPascal (millibar) throughout the height range of the FR. On the ICAO ISA at sea level, one hPa is 27.0 ft (8.23m) in altitude. Therefore, 0.33 hPa is 9 feet or 2.74m. The height difference for 1/3 hPa increases with altitude in accordance with the ICAO ISA. (AL6) "

2.11 **MoP detection systems**. Add at the end, after the general statement on production standards: "Individual recorders must be tested before sale to ensure that the MoP detection system is producing results similar to those described in Annex B of the IGC approval document for that type of recorder."

2.11.1.1 ENL Default settings. Second sentence to be replaced by: This is because in gliders without a motor, an ENL record has still been found useful as additional evidence during flight analysis. See also 2.6.3.1 on preservation of memory data.

2.11.1.2 Recorded ENL values. Add at the end: Other cockpit noises in gliding flight such as flight with cockpit ventilation and other panels open (with and without sideslip) must be recorded at sufficiently low values so that they cannot be mistaken for use of engine. In the case of sideslip with panels open at thermalling speeds, ENL should be less than 300 and preferably 200. See also Appendix 2 para 8.5 on flight testing of ENL systems.

2.11.1.4. New sub-para: **GFAC ENL testing**. It is strongly recommended that with a type of ENL

system that is not yet IGC-approved, the recorder that is sent for initial GFAC testing has special facilities so that the frequency of peak sensitivity and also the ENL gain settings (and any other variables relevant to the ENL system concerned), can be adjusted. This is so that recorders for which the ENL settings are found unsatisfactory for IGC-approval, do not have to be returned to the manufacturer for adjustments that could easily have been made during GFAC testing itself. Experience has shown that a peak frequency sensitivity of between 50 and 100 Hz discriminates between engine noise (both 2- and 4-stroke) and cockpit noises during gliding flight. It is emphasised that an IGC-approval, once given, applies to all types of motor gliders worldwide. An ENL system must not only work with a noisy engine and a quiet, well sealed glider cockpit. Tests will also be made with quieter motor glider engines and in glide conditions of high cockpit noise such as with canopy panels open. For more detail on ENL tests, see Appendix 2 para 8.5.

Appendix 1

2.4 **Units**. Line 1, replace "flight log" by "IGC file".
Line on Time to read: Time - UTC. Note that UTC is not the same as GPS internal system time which is different by 13 seconds in 2003 due to the addition of 'leap seconds' since the GPS system first became operational in January 1980. The correction to UTC available within the GPS system must be applied to time data in IGC files. (AL6)
Line on Distance, add: "for FAI/IGC conversions from feet and miles, see para 2.6.8".
Line on Speed, add: "For FAI/IGC conversions from nautical miles per hour (knots) and statute miles per hour (mph), see para 2.6.8."
Line on Date to read: "Date (of the first line in the B record) - UTC DDMMYY (day, month, year). See 2.5.4."

2.5.4 **Date of flight**. Date anomalies have been seen with some recorders operated in Australia and New Zealand where they are switched on close to midnight UTC. The date at the beginning of the header record in the IGC file must be the date applicable to the first recorded fix in the B-record, or there can be some confusion. Add to 2.5.4: "That is, the date applicable to the time in the first line in the B (fix) record, not the date at the time of switching on, or of take-off. This is particularly important for recorders operated in time zones where they are switched on close to midnight UTC."

3.3 H RECORD - FILE HEADER. To start: The H-Record is used to store data such as the date on which fixes are first recorded in the B-Record of the IGC file (that is, the day of a flight unless made in a time zone many hours from UTC), the name ..... etc

3.3.1. In the line "HFFXAAAAAcr/lf", delete one of the As. Reason: after FXA there are 3 bytes to follow, not 4 (see table following para 3.3.1).

3.3.1, table. HF FRS line, last column. The sentence after CRLF to read: "Must be used where security is suspect, for instance if the recorder's physical security system (microswitch) has operated." Also, in the third sentence after, delete the words "small element in some DATA programs ".

3.4 Before "The format of the I Record is as follows:", insert: "Note that although the SIU number is optional in the B record, the F Record (satellite constellation used) is mandatory, see para 4.3".

3.6 C-RECORD - TASK. Main and sub-paras to read: "The C Record is used to specify tasks and to make flight declarations. It is placed in the IGC file before the first fix (B) record and after the H, I and J records.

3.6.1 Lines in the C Record. The first line contains the UTC-date and UTC-time of the declaration, the local date of the intended day of flight, the task ID, the number of turn points of the task and a textstring which can be used to describe the task (500k triangle, etc). The recorder must be configured so that a pilot can enter the intended flight date in local time, not the UTC date which will be different in countries with large time offsets from UTC (The Three-Letter Code for Time Zone Offset is TZN, see the list in para 7). The other lines contain the WGS84 lat/long coordinates and a textstring for the place or point concerned. These include the take-off airfield, start point, turn points, finish point and landing airfield. After the first line, the other lines contain the WGS84 lat/long co-ordinates of the point followed by a text string for the place or point concerned. The text describing the type of point (see example below) is mandatory so that the nature of the points can be clearly seen by viewing the IGC file, other text descriptions of the point are optional. (AL6)

3.6.2 IGC terminology. "Waypoint or way point " refers to a either a start-, turn- or finish-point. The term "Turn Point" refers to a point in a measured course between the start and finish point. The points that must be specified exactly in an official IGC flight declaration are the intended start-, turn- and finish-points (Sporting Code Section 3, para 4.2). The number of turn points will be nil for a straight goal flight, one for an out-and-return, two for a triangle, three for 3-TP distance, more for some competition tasks. (AL6)

3.6.3 Takeoff and Landing. The two lines in the C-record format for takeoff airfield and landing airfield (or out-landing location if this applies), are for general information rather than being part of the official IGC Flight Declaration. They can be entered approximately or, if the co-ordinates are difficult to obtain or are not entered, the recorder shall default to 00000000N000000000E for these two lines. (AL6)

3.6.4 Number of Turn points and C-Record lines. From the above it can be seen that the number of turn points will be four less than the number of lines after line 1 (that is, those lines that contain lat/long data). These four non-turn point data lines are for takeoff airfield, exact start, exact finish, and landing airfield/location. The number of turn points is included as a sub-field in line 1 of the C-record and is placed immediately before the optional text string at the end of the line (in the form TT in the illustration below). (AL6)

3.6.5 Area Tasks. The incorporation of this facility in a Flight Recorder is optional. In some competitions, an area to be reached is specified with respect to a Waypoint in terms of distances and true bearings from the point. If a recorder has a facility to enter this in the C record, the following system shall be followed in the IGC file: At the end of the relevant Waypoint line in the C record, minimum and maximum distances follow in kilometers from the WP, followed by bearing 1 and bearing 2 in degrees true from the WP and then the word AREA after the type of point. In the case of competitions using units other than kilometres (such as statute or international nautical miles), a conversion must be made so that the IGC file continues to be in kilometres (and decimal kilometres as necessary). The area is clockwise from bearing 1 to 2. In the case of circular areas round a point the two bearings used shall be 000 to 360 and the minimum distance will be zero. Where an area referenced to a Waypoint is

to be specified, after the C record line that defines the Waypoint but before CRLF at the end of the line, add:
"DDDDdddDDDDdddBBBbbbBBBbbbAREA". The two distances Dd are first minimum distance from the WP in km and decimal kilometres, then maximum distance. The two bearings Bb are in degrees and decimal degrees true from the WP, the task area extending clockwise from bearing 1 to 2.
For instance: "C....0012000 0032000 122000 182000TURN AREA" would be an area from 12 to 32 km from the WP between the bearings 122 and 182 from the Point." (AL6)

Example C-records.
Delete the word "FIELD" after TAKEOFF and LANDING, it refers to an airfield but could be confused with a data field. Also, the landing may not be at an airfield.
Delete the word "POINT" after START, TURN and FINISH, not essential, the first word says it all.
Also, add:
"And for an area referenced to a Turn Point:
C DD MMMMMN DDD MMMMME 0012000 0032000 122000 182000TURN AREA CR LF (AL6)"

7. **Three-letter codes**. FRS second sentence to read: To be used where a security fault has been detected such as the recorder internal security system (microswitch) having operated.

Appendix 2

Para 8.5 on ENL testing to read:

8.5 Means-of-Propulsion (MoP) recording system. Tests will be made on systems for recording the operation of the Means of Propulsion for motor gliders. Where Engine Noise Level (ENL) or vibration sensors are used, tests will be made with the FR in a number of types of glider and motor glider. These will include glass-construction machines with low aerodynamic cockpit noise, also machines with higher cockpit noise in gliding flight. If the required conditions are not shown, modifications to the ENL system must be made until they are. For other aspects of ENL systems, see the main body of this Specification, para 2.11.1.

8.5.1 Tests with MoP running. Operation of both two-stroke and four-stroke engines will be tested at all available power settings. Results will be analysed to ensure that a clear difference in the IGC file data is shown between all types of gliding flight, and any engine running at positive thrust settings. A critical test will be with a relatively quiet engine, typically a 4-stroke engine in a motor glider at power for level flight.

8.5.2 Tests without MoP running. For gliding flight, tests will be made with the cockpit ventilation and other panels open, both straight at high speed and during turns. In many gliders an "organ pipe" noise can be heard in the cockpit and ENL will be recorded for this condition. A particular test that will be made is thermalling with cockpit panels open because this is often done when it is hot, and if the ENL is too high under this condition it could be mistaken for a climb under power. (AL6)

Appendix 3

Para. 3.10 (IdentifyFR), add: "For types of recorders with original IGC-approvals dated before 2003, if the FR Serial Number cannot be returned (for instance due to firmware limitations), a Serial Number of 000 shall be used. (AL6)."

------- amendment ends --------