To: Recipients of IGC Agenda
From: Chairman IGC GNSS Flight Recorder Approval Committee (GFAC)

GFAC CHAIRMAN'S REPORT

This report is dated 10 January 2002 and an update will be given at the IGC meeting.
Note that IGC decisions are required on items 9 and 10

1. **GNSS FR Approvals**. A total of 20 models of GNSS Flight Recorders from 9 manufacturers have so far been approved. Since the last IGC meeting on 10 March 2001, the following approvals and updates have been issued:

1.1. Cambridge 302, new type of recorder, approval issued on 30 October 2001

1.2. Zander/SDI GP941, new type of recorder, approval issued on 30 October 2001

1.3 Updated approval documents were issued on 10 December 2001for the following 5 types of recorder.
Filser DX50 (1), LX20 (2), LX5000IGC (3)
LX Navigation Colibri (4)
Streamline Digital Instruments (SDI) PosiGraph (5)
These documents added a new type of GPS receiver board that had been tested by GFAC. The opportunity was also taken to update the format of the documents to that used in the new approvals in 1.1 and 1.2 above

2. **Future applications for IGC-approval** - one application from a new manufacturer is being processed. After initial testing, the recorder has been returned for modifications. In addition, two other new manufacturers have contacted GFAC with a view to submitting recorders later in 2002.

3. **Analysis Programs for Flight Data**. 26 programs have been notified to GFAC which are capable of analysing data in the IGC file format. For details available on the Web, see at the end under "References".

4. **Technical Specification**. Amendment 4 to the IGC Flight Recorder Specification was issued on 25 May 2001. This included some new glossary items and various electronic security matters including a description of the DSA system that has been used in two recent recorders. The Specification Web address is at the end under "References".

5. **Security**. No breaches of electronic or physical security have been reported to GFAC since the last report to IGC. Request: please report any suspected breaches in confidence to the GFAC Chairman.

6. **Anomalies in IGC-format flight data files**. Occasional unexplained anomalies in IGC-file GNSS altitude continue to occur. In one case, GPS altitude was lost for most of a flight while lat/long fixing continued apparently normally. This was believed to be a firmware and compatibility problem, and is thought to have been corrected by modification action. More commonly, excursions of GPS altitude in the IGC file have been observed that are not reflected in the recorded pressure altitude. These excursions have varied from a few seconds to several minutes. An extreme case was from a flight in New Zealand where a sudden increase of GPS altitude occurred that averaged about 5500m (18,000ft) for 40 minutes. Fortunately the combination of apparently normal lat/long fixes and pressure altitude maintained flight evidence. Request: Please email the IGC file for any suspected anomaly to the GFAC Chairman for record purposes and analysis.

6.1 Flight Recorder Specification for Altitude Records. The IGC GNSS committee and GFAC are working on the Specification for a future type of GPS flight recorder optimised for altitude records where the high point is in the Stratosphere (above 11,000m on the ICAO ISA). The intention is to use GPS altitude for measurement purposes at altitudes where the pressure gradient is small. This would require a Sporting Code change after a future proposal to IGC. The existing Specification that enables low-cost "domestic standard" GPS receiver boards to be used, would not be changed in this respect and there is no suggestion that pressure altitude should be replaced for measurement in the lower atmosphere.

7. **GPS Lat/Long Accuracy**. As a result of normal GFAC testing, lat/long accuracy figures continue to be added to the database. This indicates an average error of 11.6m for lat/long fixes recorded in IGC data files from a sample of over 1000 test points. These tests are made from a moving ground vehicle at various accurately-surveyed points at about 51N 001W.

8. **Drafting of Documents**. Work has included:

8.1 A paper for FAI on earth models and altitude measurement, by Tor Johannessen and Ian Strachan, for the FAI

Air Sport General Commission (CASI) on which Tor is a member and Ian is the Secretary.

8.2 Annex B to the Code (SC3B) - drafts of new Edition 3 for Bureau approval. The sixth draft has just been circulated as this report is finalised. In March 2001, IGC authorised the Bureau to approve issue. It is hoped that this will occur before the March 2002 Plenary. If so, comments on the new Annex B will be welcome.

9. **Grandfather Rights (IGC decision required)**. To avoid invalidating approved recorders already in use, an IGC-approval, once issued, is not withdrawn even though requirements may subsequently be changed. This system is sometimes called "grandfather rights". However, the original IGC-approval criteria date back to 1995. Since then they have been tightened, particularly on security aspects. Some models of recorder approved early in this cycle would not now gain approval. It is suggested that it is time to review this system and to seek IGC guidance. Some background and proposals are in Appendix 1.

10. **FAI rule changes (IGC decision required)**. At the FAI CASI meeting on 17 October, the WGS84 ellipsoid was adopted as an FAI world model for distance measurement purposes, as recommended in the Johannessen/Strachan paper referred to in para 8.1. As a result, FAI has asked each Air Sport Commission (ASC) to review the world model used in their own Sporting Codes, and consider adopting the ellipsoid which is more accurate than the sphere which was previously the only FAI world model. The General Aviation Commission of FAI have already decided to use the ellipsoid. For IGC, flights affected would include future World Records and badge distance flights where distance is marginal. Some additional background is at Appendix 2, together with possible wording for SC3.

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References:
All IGC-approval documents: http://www.fai.org/gliding/gnss/approved_gnss_flight_recorders.asp New or revised approvals are also announced on newsgroup r.a.s. and on the IGC email mailing list.
Free short program files for all IGC-approved Recorders: http://www.fai.org/gliding/gnss/freeware.asp For downloading data from a recorder to a PC, and checking the IGC file as being valid and un-altered.
Analysis software for IGC files: http://www.fai.org/gliding/gnss/gnss_analysis_software.pdf
Technical Specification for IGC-approved Recorders: http://www.fai.org/gliding/gnss/tech_spec_gnss.asp

Appendices: 1: "Grandfather rights" and recorder categories
2: Distance measurement using the WGS84 ellipsoid

Attachment to email version: Free FAI Calculation program for WGS84 ellipsoid

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Appendix 1 to GFAC report dated 10 January 2002

"GRANDFATHER RIGHTS" AND RECORDER CATEGORIES

1. **Number of recorder types**. As covered in para 1 of the main report, we now have 20 different models of IGC-approved Flight Recorders from 9 manufacturers, and are corresponding with a further three new manufacturers with one new recorder under test and two others possible. In a few months we could have 23 models from 12 different manufacturers. Despite the existence of an IGC-specification, models inevitably have widely different characteristics, due to different design features and also due to amendments to the Specification as time goes on.

2. **IGC-approval criteria** The original approval criteria date back to 1995 and since then have been tightened, particularly on security aspects. Some models of recorder approved early in this cycle would not now gain approval without substantial changes, some of which may not be possible due to the original design.

3. **"Grandfather rights" policy**. An IGC-approval, once issued, is not withdrawn even though requirements are changed for new equipment. This is to avoid previously-approved models having their IGC-approval constantly withdrawn when the Specification is amended, the so-called "grandfather rights" system. This is similar to FAA and JAA policy when dealing with older generations of aircraft and equipment compared to new designs. However, we have now reached a stage where recorders with better security compared to those that were approved early in the cycle (and are still IGC-approved for world record flights), would not meet the current security requirements and so would not gain IGC-approval today. Manufacturers of recorders put forward for IGC-approval over the last year have commented on this as an anomaly. It has been suggested that it is unfair to manufacturers of new types of recorders who have to fulfil more demanding requirements than in the past despite the fact that older recorders with less advanced security continue to be approved for world record flights. It is therefore time to review the "grandfather rights" system, which in any case in its

existing form could not last for ever as standards of computing and security protection change with time.

4. **Confidentiality aspects**. Many aspects of electronic security are necessarily confidential between GFAC and the manufacturer concerned. However, it can be said that in terms of technical standards, five levels can be identified. This does not mean that 5 levels of capability should be defined by IGC, but does indicate that some thought should be given to the present universal "grandfather rights" system.

5. **Current IGC Flight Recorder flight approval levels**. At present, we have two levels of approval for types of flights, world record level and secondly badge flights up to the three Diamonds (SC3 para 4.6.4). The latter applies to recorders that are connected to a stand-alone GNSS unit by cable. This is a very coarse distinction both in design/security terms and in flight achievement.

6. **Badge and record flights**. Many people have made the point over the years that badge achievements are fundamentally different to records. Records require the ultimate level of control, supervision and security because a problem with a claim affects the previous and the next holder of the record as well as devaluing the system itself, which being a record is automatically high-profile. Problems may involve poor evidence, malpractice, or even cheating. However, with badges, in the worst case (cheating) it has been said that a cheat is only cheating himself or herself.

7. **Badge and record flight approval levels**. There is therefore the opportunity for IGC to recognise Flight Recorder approvals for badges only (that is, not for records), or some variant of this such as badges up to 1000km. This would allow GFAC to look at the technical characteristics of some early recorders, and have the opportunity, after appropriate consultation and notice, to revert some approvals to one of these new levels where security was well below current standards for world record flights. It would be unfair to consider the "up to Diamonds" level for this purpose, because IGC-approvals at this level are for Recorders that are connected to a separate GNSS receiver by cable, and the recorders being considered for re-assessment are some early integrated designs with their own GPS receivers. It is difficult to be more specific without giving away confidential information on the security systems and detailed design of individual types of recorders. Another advantage of more flexibility would be in the case of a future security breach such as a hacker breaking the electronic security protection of a particular type of recorder. In this case, rather than withdrawing the IGC-approval pending modifications, the type of recorder could simply be lowered in the category of flights for which it could be used.

8. **Proposal to IGC**. IGC-approval of GNSS Flight Recorders should include categories of "badge flights only" and "badges up to 1000km". If IGC agree, either the Sporting Code could be amended or the matter handled through the IGC-approval document for the type of recorder concerned. Sensitive negotiations would be needed with the manufacturers concerned. An action date well in the future should be set such as 1 Jan 2003, 2004 or even 2005 in order to give time for upgrade kits to be made available (if technically feasible) or for owners wishing to attempt world records to make other arrangements. Where necessary, the Bureau could be given appropriate information under conditions of confidentiality. In sum, since the system started in 1995, a wide variety of Recorder characteristics now exist, particularly in security aspects. Therefore, more flexibility is needed in the IGC-approval process in order to match Flight Recorder characteristics to the types of flights for which the evidence is approved.

Appendix 2 to GFAC report dated 10 January 2002

FAI WORLD MODELS FOR DISTANCE MEASUREMENT PURPOSES
INTRODUCTION OF THE WGS84 ELLIPSOID

1. **FAI Policy**. As a result of a paper by Tor Johannessen and Ian Strachan to the FAI Air Sport General Commission (CASI), the WGS84 Ellipsoid has been accepted as an FAI earth model for the measurement of distance, with effect from 1 January 2002 . The relevant para from the 2002 edition of the Sporting Code General Section follows:

2. **General Section (GS) of the FAI Sporting Code**. GS 2002 para 7.3.1.1 Distances on the earth's surface. For FAI distance calculations, the earth model used may either be the WGS84 ellipsoid or a sphere of radius 6371 km exactly. For accurate measurement and calculation of distance, Air Sport Commissions shall choose which model is to be used in their area of activity. The WGS84 ellipsoid is very close to the real shape of the earth, the FAI sphere is an approximation. For further details on the WGS84 ellipsoid and the FAI Sphere, see the Glossary. A short PC-based distance calculation program for both earth models is available by email from the FAI office. (AL5)

3. **Sphere compared to Ellipsoid** The paper submitted to the FAI General Sporting Commission (CASI) by Johannessen and Strachan included the following:

"The current FAI sphere is not recognised outside FAI and as time goes on it will be progressively less credible for use by an aviation organisation of international standing. Whereas the WGS84 ellipsoid is in common use for measurement purposes, is universally accepted as a world model by other organisations such as ICAO and is used in modern navigation systems such as GPS. The intention could be to phase out the sphere in due course, as experience is gained with use of the ellipsoid and as the various Sporting Codes are revised. ..... some point-to-point distances listed in Appendix 4 (not copied here but available if required) show an average difference of over 0.4% in distances between using the sphere and the ellipsoid, a significant amount if FAI is concerned about accuracy of measurement (*Note for IGC: these differences were near the equator and are less at mid-latitudes*). Finally, it should be noted that refinements to WGS84 such as the International Terrestrial Reference System (ITRS) and some regional variants such as the European Terrestrial Reference System (ETRS), are only significant when measurements to the centimetre level are required, such as for tracking tectonic plate movements. For instance, ETRS is arranged so that it does not move with the Europe continental plate. Therefore, the WGS84 ellipsoid should be appropriate as an earth model for the foreseeable future for the purposes of recording, measuring and calculating FAI distances."

4. **Current FAI situation**

4.1 Free Calculation Program from FAI. A free calculation program for the ellipsoid is available from FAI that requires storage of only 7kB zipped and 21kB unzipped. The program executes in Javascript (embedded in most Windows installations) but can be viewed by an ASCII text editor, and is attached to email recipients of this report. The calculation part of this program is in HTML format and can be extracted for insertion into other programs as required, and a C/C+ program is also being developed for insertion into other programs that exist already for distance calculation. Other programs for multiple-leg flights are also being developed for use by FAI.
Request: If readers of this report have access to other WGS84 distance calculation programs, they are invited to correspond with the GFAC Chairman in order to see whether such programs might be suitable for use by FAI.

4.2 Other FAI Commissions. The FAI General Aviation Commission (GAC) adopted the ellipsoid at their meeting in late 2001. Each FAI Air Sport Commission has been asked to consider using the ellipsoid at their next meeting, and this annex is designed to fulfil that requirement for IGC.

5. **Implications for Gliding**

5.1 Records, badges, competitions. Only world records and badge claims that were marginal in distance would necessarily be affected. NACs and Competition organisers would not have to make any changes to existing programs unless they wanted to.

5.2 Rules. If IGC were to adopt the Ellipsoid, SC3 para 4.4.1.a would have to be changed. A draft is offered below. If something like this were agreed, some small changes in Annex C would follow.

5.3 Transition. The date of effect of SC3 changes is 1 October. The most straightforward way of handling any transition is simply to accept that changes take place on this date. This is what happens with other rule changes and any small anomalies have always been accepted between the rule that applied on 30 Sep and the new one on 1 Oct. In the case of distance measurement from 1 Oct 2002, calculations for world records and marginal badge claims would be made to the ellipsoid instead of the sphere. The alternative is to consider re-calculating existing records to WGS84 and ensuring that new records exceeded the old one by the required percentage, based on the WGS84 calculation. The FAI office state that there are about 70 World Gliding records and theoretically they could be re-calculated if IGC wished. But the question is, is such a re-calculation really worthwhile? If NACs wished to follow such a procedure with their own National records, this would be even more work. Unlike the balloonists, general aviation and microlights, we do not make round-the-world flights (for which the underestimate if the sphere is used is some 45km compared to the ellipsoid). It is suggested that a straight transition on 1 October with no re-calculation of previous flights, should be acceptable.

5.4 Example and reputation of IGC within FAI. There is no doubt that IGC has a high reputation within FAI as a progressive and active Commission that has already used modern technology to good effect. For instance in our initiative over GNSS Flight Recorders, we lead other FAI Commissions and are held in respect by them for what we have done. The GPS system makes calculations based on WGS84 in the first instance, only transforming to other earth models from the WGS84 figures. If we do not take the opportunity to transition to the more accurate world model now made available by FAI, other Commissions will wonder why, and we may lose some of our reputation for being modern and progressive. After all, the earth is not a sphere, in many ways it is as simple as that now that the more accurate earth model has been made available by FAI. Finally, it is suggested that we will have to change to WGS84 sometime (FAI might well withdraw the sphere in the future) and we might as well do it now with a good grace.

Sporting Code Section 3. Existing SC3 4.4.1.a RADIUS OF THE EARTH. For the purpose of the calculation of FAI great circle distances, the earth is considered to be a sphere with a radius of exactly 6371 kilometres.

If IGC decides to adopt the ellipsoid, this could be changed to:

SC3 4.4.1.a FAI EARTH MODEL FOR DISTANCE MEASUREMENT. For calculation of distances, the earth model used shall be the WGS 84 ellipsoid (FAI GS 7.3.1.1refers).

Something like this could follow or be in Annex C: A free calculation program for distances on the surface of this ellipsoid is available by email through the FAI web pages. Details on the WGS84 ellipsoid are commonly available worldwide and are also in the Glossary to the General Section of the FAI Sporting Code and in the Glossary to the Technical Specification for IGC -approved GNSS Flight Recorders, both available through the FAI web pages.

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