5 January 2012

Report from Chairman,
IGC GNSS Flight Recorder Approval Committee (GFAC)
to the IGC 2012 Plenary

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General: This has been a very busy year for GFAC which has had to deal with several important issues as well as the routine of testing FRs and issuing and amending IGC-approval documents

1 **GNSS Flight Recorder IGC-approvals**. A total of 50 types of Fight Recorders (FRs) from 19 different manufacturers have been approved since the IGC-approval system started in March 1995. This is an increase of three types of FR since the last report to the Plenum dated 10 January 2011. For links to approval documents, see www.fai.org/igc-documents then look for "GNSS Recording Devices". Approvals since the last report are:

1.1 LX8080F. On 14 March 2011 an initial approval was issued for the LXNAV LX8080F. The letter F indicates that it has a Flarm proximity warning module in addition to the GPS recorder.

1.2 DSX SaFly. On 31 August 2011 an initial approval was issued for the DSX SaFly. As well as the GPS recording function, this has an in-flight tracking capability so that real-time positions can be passed to a ground control centre through satellite links.

1.3 LXNAV MOP box. On 31 October 2011 an approval was issued for the LXNAV MOP (Means of Propulsion) box for use with jet engined motor gliders, when connected by cable to an LX8080F recorder mounted in an instrument panel. The MOP box has an acoustic sensor optimised for the higher frequencies of jets, compared to the lower frequencies of piston/propeller systems. IGC-approval for the same MOP box with the LX9000 has been applied for.

1.4 Colibri II. On 21 November 2011 an initial approval was issued for the LX Navigation Colibri II. This is the smallest FR so far IGC-approved. It measures only 63 x 41 x 21mm and weighs about 80 grammes, including its own battery and GPS antenna. *It should be noted that LX Navigation is the original LX company and LXNAV (paras 1.1 and 1.3 above) is a different company operating independently. For more details, see the manufacturer details in IGC-approval documents.*

2 **GPS Lat/Long Accuracy**. Results of GFAC accuracy tests in Lat/Long position are similar to last year and are listed at Appendix 1.

3 **Anomalies found during the year**. Many IGC files have been analysed including those from FRs being tested, and those sent to GFAC by a number of organisations. Advice has been given to NACs, competition organisers, pilots and OOs.

4 **Annex B to the Sporting Code - Low-ENL engines**. Amendment 7 dated 1 October 2011 is at Appendix 2. It contains no new policy, but amplifies previous advice on the recording of engine running in motor gliders with electric and jet engines. ***SC3B states that the critical case for recording use of engine in the IGC file not when operating at high power, it is when operating at lower powers that still give enough positive thrust to climb or to extend a glide.***

4.1 Low-ENL engines. As in previous reports to IGC, there is still concern about the recording of use of engine in motor gliders with electric and jet engines. The Environmental Noise Level (ENL) system that is fitted to many IGC-approved FRs consists of a microphone inside the FR case and a noise-processing system

that is designed to be sensitive to the frequencies appropriate to piston engines [1] driving a propeller.

4.2 Electric Engines. Electric engines are very quiet compared to piston engines. Where the engine is pylon-mounted behind the cockpit, it gives very low ENL figures on FRs mounted in the cockpit. Such figures can be lower than the ENL signature in some types of soaring flight, such as thermalling with canopy panels open, particularly in turbulence with small amounts of sideslip.

It is therefore possible to run such an electric engine at low power while climbing in a circle. The ENL figures can easily be assumed (or claimed) to be due to thermalling rather than use of engine.

4.2.1 Sporting Code - Alternatives. Para 1.4.2.4 of SC3B gives two alternatives.

(1) MOP system. The first alternative is to use an FR with an IGC-approved MOP (Means-of-Propulsion) sensor that is connected to the FR in the cockpit by cable. The sensor could measure electric current used by the engine or be an acoustic (noise) sensor mounted close to the engine/propellor system. Three MOP numbers between 000 and 999 are included in each fix in the IGC file. For analysis, the latest version of the SeeYou program includes both MOP and ENL figures and no doubt other analysis programs will also add the MOP function in addition to ENL.

(2) FR mounted close to engine. The second alternative is to mount an existing IGC-approved FR in the engine bay close to the engine/propeller system. GFAC tests on a Lange Antares 20E motor glider have shown good ENL response with a complete small FR mounted in the engine bay near to the engine and propeller. Several types of IGC-approved FR are small. The size and other details are given in the IGC-approval document for the type of FR concerned.

4.2.2 SC3B - Installation. Para 1.4.2.4 of SC3B continues: "Such an installation of the FR in an individual motor glider must be inspected by an OO or NAC Official and documented for use in future claims. Flight testing must show substantially higher ENL figures when the engine is run at low power, compared to conditions met in engine-off soaring such as thermalling with cockpit panels & vents open."

4.2.3 Nose-mounted engines. Tests with the Front Engine Sustainer (FES) system from LZ design of Slovenia, mounted in a Lak 17, showed good ENL response with an IGC-approved recorder in the instrument panel. SC3B para 1.4.2.4 is satisfied because the FR is close to the engine and propeller and no special FR installation or extra MOP system is required.

4.3 Jet Engines. As reported to the Plenary last year, the problem in recording the use of jet engines is that the frequency of their noise is higher than that for which ENL systems were designed. Also, the majority of noise is propagated to the rear of the engine, not to the front. For these reasons, the engine recording situation is similar to that described above in 4.2, 4.2.1 and 4.2.2 for electric engines, particularly if a jet engine is run at low power, which is the critical case for IGC recording of use of engine.

4.3.1 Sporting Code - Alternatives. Para 1.4.2.4 of SC3B can be satisfied either by using either an FR with an IGC-approved external MOP sensor, or mounting a complete FR near the engine. In each case, the position should be near the jet-pipe from which most of the noise is propagated. As para 1.3 above shows, an external-mounted MOP box by LXNAV is IGC-approved for use with jet engines. It should be noted that the frequency sensitivity of this MOP box is optimised for Jet engines and a lower-frequency model is being designed for electric engines driving propellers.

Another external MOP system is being developed which has a small microphone on the end of a cable. This is fitted to the EW Avionics microRecorder and has similar characteristics to its ENL system. Tests have shown good response with the external microphone near a jet engine and near the propeller of an Antares 20E. Development continues, particularly of a security system to prevent unauthorised interference with the system.

[1] Piston engines include 2- and 4-strokes and rotary engines using the Wankel principle

5 **FR ANDS/GFAC Security Review 2011**. A significant security breach occurred in 2011. An IGC file submitted to a National OLC passed the IGC electronic Validation check, but critical data in the file was obviously false. The NAC referred the circumstances to GFAC for analysis and action.

5.1 Actions. The ANDS and GFA Committees amended the IGC FR Specification to increase future FR security, for instance increasing the length of the private key for future "all flights" approvals to 1536 bits. At the same time, a security survey was started for existing IGC-approved FRs and their IGC files. The survey has so far showed that several types of early IGC-approved FRs are particularly vulnerable to the breaking of their electronic security codes ("hacking") using 2011-2 technology. If hacked, false IGC files from these FRs can be produced that will continue to pass the IGC electronic Validation check.

5.2 Recommendations - were made to the IGC Bureau and included lowering the IGC-approval level of some FRs of 1990s design, withdrawing approval from some early FRs which had little security, streamlining procedures for Grandfather rights, and tightening up OO procedures.

5.3 IGC Bureau Position - October 2011 . At their meeting in October 2011, the Bureau agreed the proposed changes of IGC-approval level for the old Flight recorders listed in the paper. The ANDS/GFAC security paper was to be posted on the FAI/IGC web pages, but due to difficulties with the FAI web site, this was not possible until considerably later. The paper has been available for some time on the GFAC Chairman's web site www.ukiws.demon.co.uk/GFAC and in due course will be posted on the FAI/IGC web site.

5.4 The Future. Further details are at Appendix 3 and include the list of FRs for reduction in IGC-approval level, simplification of Appendix A to the Sporting Code Annex B (SC3B) and tightening up OO procedures, particularly after flight. The FR manufacturers concerned have been contacted who have made no objections to the changes, which are recommended to take place on 31 March 2012.

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Appendices:
1. IGC FR accuracy results
2. October 2011 SC3B amendment
3. IGC FR Security and Recommendations (this is in the agenda separately as para 8.2.4)

Web references - due to difficulties with the FAI web site, at the time of this report the FAI/IGC has incomplete FR information. For a complete set of FR-related references,
see the GFAC Chairman's web site: www.ukiws.demon.co.uk/GFAC

FAI/IGC web site for FRs: www.fai.org/gnss-recording-devices/igc-approved-flight-recorders
Links from the FAI/IGC/FR reference above:
Look for: **"Technical Specification"** for the IGC FR Technical Specification.
Look for: **"List of IGC-approved FRs"** with links to complete IGC-approval documents.
Look for: **"IGC-approval documents"**: This pdf document also contains a brief history of the US GPS system and early developments of FRs for gliding. New or revised approvals are also announced on newsgroup Recreation Aviation Soaring (r.a.s). and on the IGC-discuss email list.
Look for: **"Freeware".** This gives programs for downloading data from a FR to a PC, and checking the IGC file as being valid and the same as that initially downloaded from the FR. They include the appropriate IGC-XXX.dll file (XXX is the IGC code for the particular manufacturer) that works with the IGC Shell program for download and Validation functions.
Low-ENL Motor Gliders (electric or jet): Sporting Code: www.fai.org/igc-documents
ENL system, all Annex B (SC3B): General: para 1.4.2. Critical ENL: para 1.4.2.2. Low ENL Mgs: para 1.4.2.4.

GFAC Flight Recorder Accuracy Tests

Tests are made from a moving ground vehicle at a n umber of accurately-surveyed points at about 51N 001W. These points include several with a clear horizon, one with terrain masking of about 5 degrees above the horizontal and some with nearby low-rise buildings.

For FRs mounted in gliders, this represents a case where the FR antenna is mounted in less-than-optimal conditions or where the antenna or its cable has been damaged or is less than ideal.

The average error figure using this method has been between 11 and 13m since the Selective Availability (SA) error was removed from civil GPS systems by the US Government on 1 May 2000.

The overall results give an average (50% probability) of 11.47m, with:

99% probability of being within 26m,
95% of being within 20m,
90% within 18m,
80% within 16m,
70% within 14m,
60% within 13m
50% within 11.5m.

For points with a clear horizon, the average (50% probability) figure falls to 6.84m, with:

99% probability of being within 19m,
95% of being within 16m,
90% within 12m,
80% within 10m,
70% within 8m,
60%within 7m,
50%within 6.8m.

SC3B Amendment 7 dated 1 October 2011
Amplification on engine recording for low-ENL situations

Existing wording at the end of 1.4.2.4 was put in a separate sub-para and expanded. This emphasises that a legitimate alternative to an external MOP sensor is to fit a small IGC-approved FR close to the engine or propeller.

1.4.2.4 Low-ENL Motor Gliders. Where an FR and engine system produces low ENL values that make it difficult to differentiate between power-on and power-off flight (using the criteria in 1.4.2), unless the FR can be re-positioned so that ENL figures comply with 1.4.2.2, an additional signal shall be provided from a sensor external to the FR and securely mounted in a position that registers any use of engine, particularly at low power.

When any forward thrust is produced, this system must produce a positive signal that is shown in the IGC file under the three-letter code "MOP", standing for Means of Propulsion (for more detail, see Chapter 5 of the FR Specification).

The installation of the MOP sensor on an individual motor glider must be inspected by an OO or NAC Official and documented for use in future claims. Flight testing must show significant MOP values when any positive thrust is produced. Claim documents must include evidence that the MOP sensor installation was as previously inspected, and that MOP figures in the IGC file are similar to those previously tested.

Low ENL may apply to cockpit-mounted FRs when used with quiet engines such as those with electrical power, and others such as jets for which the frequency response or direction of noise does not register highly enough on ENL sensors that are some distance from the source of noise. MOP systems for FRs are subject to GFAC evaluation and approval on typical low-ENL motor gliders, but GFAC is not responsible for installations on individual motor gliders.

1.4.2.4.1 FR mounting near the engine or propeller. Where cockpit or other mounting of an FR results in low ENL figures when the engine is run, an alternative to using an FR with an external MOP sensor is to mount an IGC-approved FR with ENL facilities in or near the engine-bay close to the engine and/or propeller. Such an installation of the FR in an individual motor glider must be inspected by an OO or NAC Official and documented for use in future claims. Flight testing must show substantially higher ENL figures when the engine is run at low power, compared to conditions met in engine-off soaring such as thermalling with cockpit panels and vents open.

Claim documents must include evidence that the FR installation was as inspected, and that ENL figures in the IGC file are similar to those previously tested.

A table of of IGC-approved recorders with ENL facilities is on the IGC web pages: www.fai.org/gliding/system/files/igc_approved_frs.pdf *. Sizes and weights are given in the IGC-approval document for each type of FR. (AL7)

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* This is the web reference from the old FAI web site before it crashed.
On the new FAI site this is changed to: www.fai.org/gnss-recording-devices/igc-approved-flight-recorders

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Appendix 3 to GFAC Chairman's report **- IGC FR Security and Recommendations**

This is in the agenda separately as para 8.2.4.