IGC APPROVALS FOR GNSS FLIGHT RECORDERS - SUMMARY

Updated 8 August 2005

Note: For links to current IGC-approval documents, see the last section under Dates of IGC-Approval documents. The most recent documents are at the end of this section.

Contents

Web references

FAI web site:	http://www.fai.org
IGC web site:	http://www.fai.org/gliding
IGC GNSS web site:	http://www.fai.org/gliding/gnss
This document:	http://www.fai.org/gliding/gnss/igc_approved_frs.pdf

Sporting Code for Gliding (SC3) and its annexes (SC3A, SC3B, SC3C):
http://www.fai.org/sporting_code/sc3.asp

Technical Specification for IGC-approved GNSS Flight Recorders:
http://www.fai.org/gliding/gnss/tech_spec_gnss.asp

IGC-approved Flight Recorders, complete list and all IGC-approval documents (this document): http://www.fai.org/gliding/gnss/igc_approved_frs.pdf

Free software for IGC-approved Flight Recorders:
http://www.fai.org/gliding/gnss/freeware.asp

List of Manufacturers (11)

Serial Number	Name of manufacturer in alphabetical order	Country	IGC codes 3 letter	IGC codes 1 letter (used in IGC file name)
1	Cambridge Aero Instruments	USA	CAM	C
2	EW Avionics	UK	EWA	E
3	Filser Electronic GmbH	Germany	FIL	F
4	Garrecht Computersysteme GbR	Germany	GCS	A
5	LX Navigation d.o.o. (LXN)	Slovenia	LXN	L
6	New Technologies s.r.l.	Italy	NTE	N
7	Peschges Variometer GmbH	Germany	PES	P
8	Print Technik	Austria	PRT	R
9	Scheffel Automation	Germany	SCH	H
10	Streamline Digital Instruments (SDI)	Germany	SDI	S
11	Zander (Peter Zander)	ZAN	Z	

27 Models of IGC-approved recorders

In alphabetical order.

(For the key to *asterisks* and approval levels, see the motor glider engine recording below)

1. Cambridge Model 10* ("all badges" level from 15 March 2006)
2. Cambridge Model 20* ("all badges" level from 15 March 2006)
3. Cambridge Model 25* ("all badges" level from 15 March 2006)
4. Cambridge 302 including C302 with ENL*
5. Cambridge 302A* (C302 without LCD)
6. EWFR Model A** (Diamonds level with cable connection to one of an approved list of stand-alone Garmin GPS units)
7. EWFR Model B** (Diamonds level with cable connection to one of an approved list of stand-alone Garmin GPS units)
8. EWFR Model C** (Diamonds level with cable connection to one of an approved list of stand-alone Garmin GPS units)
9. EWFR Model D (Diamonds level with cable connection to one of an approved list of stand-alone Garmin GPS units)
10. Filser LX20* Version 1 with Checksum electronic security ("all badges" level)

11. Filser LX20* Version 2 with RSA electronic security
12. Filser LX20-2000*
13. Filser LX21*
14. Filser DX50
15. Filser LX5000IGC
16. Garrecht Volkslogger VL1.0*
17. LXN Colibri V1.0*
18. LXN LX7000*
19. NTE Easy Matchbox*
20. Peschges VP8*** ("all badges" level)
21. Print Technik GR1000* ("all badges" level)
22. Print Technik GR1000A with updated security*
23. Scheffel Themi ("all badges" level)
24. SDI PosiGraph V1.0*
25. SDI PosiGraph V2*
26. Zander GP940***
27. Zander/SDI GP941* including GP941A* with GPS15 board

Motor glider engine recording

Asterisks denote the Motor Glider means-of-propulsion (MoP) recording method. No asterisk means that no Motor Glider MoP is fitted. Asterisk codes are listed below. Details on MoP recording are in the full version of the approval document. The key to the number of asterisks is as follows:

* = ENL (Engine Noise Level) value recorded with each fix. This is the IGC-preferred system because it does not require any extra wiring or any other actions by the pilot, and is self-checking because an ENL value is recorded with each fix

** = recording of microswitch in motor system, cable connection to FR
*** = recording of voltage from motor generator, cable connection to FR
**** = Vibration sensor recording system within the FR

Levels of approval

IGC has established three levels of approval to which different types of flight apply. For details, see Annex B to the Sporting Code for Gliding, para 1.1.1.3.

1 All Flights approval. Type of recorders given IGC-approval for "all flights" must comply with all of the provisions of the IGC Technical Specification as it applies at the time that the approval is first given.

2 All Badges approval. Applies to types of recorders that do not fulfil the Specification in some areas at the time of approval. However, it is decided that they may be given an approval that excludes World Record flights but includes all IGC/FAI Badges and Distance Diplomas.

3 Diamonds-level approval. This is for FAI Silver, Gold and Diamond badge flights only. This was originally introduced for recorder units that connect by cable to a separate stand-alone commercial GNSS unit such as the Garmin range. It can also used for single-unit recorder/GNSS units where there are significant differences to the Specification at the time of approval but it is decided that a limited approval can be given rather than a refusal.

Competition Flights

Types of recorders that may be used in a competition are at the discretion of the competition organisers. The organisers may have to operate under other rules such as those of the National Airsport (NAC) or under Annex A of the Sporting Code for Gliding which applies to World Championships and other competitions that also use Annex A rules.

Grandfather rights

This term describes a system where the level and other provisions of an IGC-approval are continued without alteration even though the Technical Specification is changed with time (generally, provisions are increased). For details, see Annex B of the Sporting Code for Gliding, para 1.1.3.3.5

Brief History of GPS recording and IGC procedures

GPS - General. The US Global Positioning System (GPS) first came on line in January 1980 and was initially for military use with receivers that had special codes to access the data. Later, civil GPS receivers were produced for general use but these were subject to a deliberate reduction in accuracy by the GPS controlling authority (the US Department of Defense, later also the US Deportment of Transportation) so that the military receivers would always have more accurate data. The accuracy-reduction system was called "Selective Availability" or SA. Average error in lat/long for civil receivers in the early days was about 50 metres for single fixes, this improving to about 40 metres as improved multi-channel receiver boards came on the market. Without the SA system such errors improved to an average of between 10 and 12m for single fixes from a moving vehicle. Increased accuracy can be obtained from

a receiver in one position, by averaging a large number of fixes, but this does not apply to aircraft or gliders in the air.

Principle of operation. A GPS receiver on the ground records the very small time-differences between low-powered transmissions at about 1500 MHz from the array of GPS satellites that are in view above the horizon at any one time. The satellites are in an orbit 55 degrees oblique to the equator at an altitude of about 20,200 km (12,552 Statute Miles). Today, 24 are normally active at any one time with some as in-orbit reserves (their transmission state is controlled from the ground). Each satellite has an atomic clock accurate to better than a nanosecond and its accuracy is monitored from the ground and updated as necessary. Due to earth shielding, a maximum of up to 12 transmitting satellites may be in view to a receiver at any one time. The exact number depends on where the receiver is placed on the earth's surface. Terrain shielding reduces the number of satellites in view, also very high latitudes. Satellite orbits are highly predictable, therefore because a GPS receiver is constantly updated with GPS system information, it knows the exact position in space of each satellite at any one time. Each time-difference recorded by the receiver from a satellite provides a line-of-position which is used be the receiver's computer to construct the Most Probable Position (MPP) from the several available position lines for each fix. With modern 12-channel receivers, between 6 and 8 satellite position lines are typical for an individual fix. With sensitive receivers with good antenna layouts in clear horizon positions, 12 satellites have been observed to be locked on as far north as 51 degrees.

Possible use in World Gliding Championships. In 1987, discussions were held in the IGC Championships sub committee on the use of GPS flight recorders for validation of flights and for display of position.

In 1991, Dr David Ellis of Cambridge Aero Instruments presented a paper on GPS recording at the OSTIV Conference in Uvalde, USA, the site of the World Gliding Championships. Also at Uvalde were Alf Ingesson-Thoor and John Roake, the Directors of the future World Championships at Borlange, Sweden, in 1993 and at Omarama, New Zealand, in 1995. Bernald Smith (then a Vice President of IGC) was in charge of photo interpretation at Uvalde, heard Ellis' paper and became an advocate of the use of GPS recording. John and Alf then had meetings with Dave Ellis with a view to using GPS recording in future World Championships.

In 1993, trials supervised by Bernald on behalf of IGC were made during the World Championships in Borlange, Sweden, using pre-production Cambridge recorders. For the next World Championships, specifications for GPS recorders were sent to a number of manufacturers by the New Zealand organisers led by John Roake. It is understood that Cambridge were the only company to respond with a definite proposal.

In 1994 IGC approved the use of the Cambridge design of recorder as the primary recording system for the World Championships in 1995. This was after tests of pre-production recorders in the 1994 New Zealand Nationals and later in the year in the pre-world competition ("KiwiGlide"). This IGC decision was a "break-through", for the first time giving primacy to GPS recording over photographic evidence. This design, which became the Cambridge Model 10, included pressure altitude recording, both physical and electronic security and had the

GPS receiver and memory units in one sealed case. IGC was particularly sensitive to security issues after a case of cheating on photographic evidence at Borlange had resulted in a pilot being sent home. The Cambridge system used a microswitch to show whether the (sealed) case had been opened and an electronic checksum system to check whether the output data file was valid for use in flight validation. Cambridge was to deliver the recorders for hire to all championships pilots at Omarama in January 1995.

1992 - first GPS recorders on the gliding market. Independent of the Cambridge design, in 1992 a GPS recorder was developed by avionics supplier RD Aviation Ltd (Oxford, UK) to a specification by its Managing Director Dickie Feakes who was also a glider pilot of long standing. It connected by cable to a stand-alone GPS receiver such as one of the Garmin range and was a simple memory module with no pressure altitude sensor or built-in security. The format of its data output was an ASCII file with the suffix "dat", short for data. The software compiler of this so-called "dot.dat" format was Vince May, the founder and owner of the UK company Skyforce, with inputs from Phil Jeffrey of the BGA Competitions Committee. The DAT format was later developed into the IGC data format that we use today. In 1992 this recorder was sold and badged by RD and in subsequent years by Skyforce.

In 1993, two other organisations that had been producing electronic barographs, developed versions with larger memory capacity that would connect to a GPS receiver unit and record GPS fixes as well as pressure altitude. These were EW Avionics (UK, MD Wayne Richards) and Borgelt Instruments (Australia, MD Mike Borgelt).

In 1994 Cambridge (USA, MD Dr David Ellis) produced early versions of the Model 10 recorder that was to be used at the Omarama World Championships in New Zealand in January 1995 (see above). The software writer was John Good. As well as built-in security, this design also had the ability to electronically store flight declarations. A separate display module gave range and steering information to a list of waypoints that were stored. Cambridge also developed the Engine Noise Level (ENL) system for recording motor glider engine without needing wires external to the recorder case or requiring secure connections to glider structure as in earlier systems that use vibration-sensors.

1993-94 - Development of the IGC flight data standard. The IGC ASCII data format was developed during 1993 and 1994 from the BGA "dot.dat" format by a group of experts led by Bob Fletcher in the USA and Hans Trautenberg in Europe. This format was finalised by October 1994, was used in the New Zealand world championships in January 1995 and was included in the new Annex B to the Sporting Code that was approved by IGC in March 1995. The original IGC file suffix was *.GPS but this was soon changed to *IGC which is what we use today.

January 1995 - New Zealand World Gliding Championships. In January 1995 the World Gliding Championships were held at Omarama in New Zealand with John Roake as Director. Cambridge successfully supplied all competitors with their model 10 recorder. This was the first time GPS recording had been used for scoring purposes in a World Championship. The Chairman of the IGC GNSS Committee, Bernald Smith, independently checked the GPS recorder results on behalf of IGC with a view to their future use for flights to IGC/FAI criteria.

Development of IGC procedures on GNSS recording. IGC officials at the New Zealand championships assessed the GPS recording in the championships as a success, and asked other IGC committees and technical experts to draft a definitive set of rules for the more general use of GPS recorders in world gliding. The next IGC Plenary was only 6 weeks away on 17 and 18 March 1995 so this was a "tall order". The option of delaying until the next IGC Plenary was not really practical as this would have resulted in a delay of a further 12 months during which criticism would build up from those who wished to develop and use the new technology. Ian Strachan, then Sporting Code editor working for Tor Johannessen, had the task of making an initial draft and co-ordinating suggested changes. Fortunately he had some GPS knowledge, having previously tested some GPS recorders and was the author of an article on GPS recording in the UK magazine "Sailplane and Gliding". Bernald Smith, then Chairman of the IGC GNSS Committee, also took a major part in this process and drafted chapter 1 of the new IGC document. Intensive international effort followed by these people and others. This involved the circulation of several drafts, and a meeting on 15 March in Paris between IGC officials and potential recorder manufacturers. This resulted in a draft of a new Annex B to the Sporting Code being produced in time to be approved by the IGC Plenary on 18 March 1995.

IGC GFA Committee. The IGC GNSS Flight recorder Approval Committee (GFAC) was formed by IGC on 18 March 1995 at the same time that IGC approved the issue of the first edition of Annex B to the Sporting Code. The first members of GFAC were Angel Casado (Spain), Arnie Hartley (Australia), Ian Strachan (UK, later elected as Chairman), Kilian Grefen (Germany) and Mike Strang (USA). GFAC has the authority to test and evaluate GNSS Flight Recorders on behalf of IGC and to draft, finalise and issue documents giving IGC-approval for the use of such recorders for flights to IGC standards of evidence.

Testing, issue of IGC-approvals. The first type of recorder was submitted to GFAC for testing later in 1995 and the first IGC-approval documents were issued in January 1996 by FAI on behalf of IGC. A list of approval documents issued, follows in order of date.

List of IGC approval documents and dates

The following approvals have been issued on behalf of IGC by the IGC GNSS Flight Recorder Approvals Committee (GFAC). For details of the current IGC-approval document for each type of recorder, click the links below:

16 Jan 96 - Cambridge Models 10, 20 and 25, initial issue (see below for later versions).

31 May 96 - Peschges VP8, initial issue.

12 Aug 96 - Filser LX20, initial issue (see below for later versions).

10 Nov 96 - Zander GP940, initial issue.

20 Mar 97 - Print Technik GR1000, initial issue.

25 Mar 97 - Filser LX20 Version 2 Approval, with the addition of motor glider engine recording.

19 Apr 97 - EW “EWFR A & B” for badges up to and including Diamonds, when connected

by cable to one of a list of approved GPS units, listed in the IGCapproval document. (see below for later versions).

13 May 97 - Amendment to EWFR A/B approval to add Garmin 12XL to list of approved stand-alone GPS units.

20 Jul 97 - Cambridge 10, 20, 25; Version 2 Approval, adding the 12 channel board, variable time interval fixing, and updating wording to that used in other approvals.

3 Apr 98 - Garrecht Volkslogger VL1.0, initial issue.

24 Apr 98 - Filser LX21, initial issue.

19 May 98 - Filser DX50, initial issue (see below for later versions).

30 Jun 98 - Filser LX5000IGC, initial issue.

24 Aug 98 - Issue 2 of EWFR approval to add model C, add some additional Garmin GPS units, and generally bring the wording up to date.

31 Aug 98 - LX Navigation Colibri 1.0 initial issue (see below for later versions).

26 Oct 98 - LX Navigation Colibri 1.0, Issue 2 with ENL recording.

16 Nov 98 - Filser DX50, Amendment 1 to allow for three tube static pressure system.

29 Jan 99 - Amendment 1 to EWFR approval to add new Model D with improved memory.

8 Mar 99 - Streamline Digital Instruments (SDI, Germany) PosiGraph Model 1.0, initial issue.

10 May 99 - Garrecht Volkslogger Model Vl1.0, Issue 2 including Motor Glider ENL Function.

21 Jun 99 - Cambridge Issue 3 Including Pilot Event (PEV) Function and the Palm-Nav Display.

19 Nov 99 - Amendment 2 to EWFR approval to add 5 new Garmin GPS units.

10 Mar 2000 - Amendment 3 to EWFR approval to add 2 new Garmin GPS units.

21 Mar 2000 - Filser LX20, Version 3 including the LX20-2000 and updated wording.

15 May 2000 - Filser LX5000IGC series, addition of LX5000IGC-2 and update of earlier approvals.

30 October 2001 - Cambridge 302, initial issue.

30 October 2001 - Zander/SDI GP941, initial issue.

10 December 2001, updated approval documents issued for the following 5 types of recorder:
Filser DX50
Filser LX20
Filser LX5000IGC
LX Navigation Colibri
Streamline Digital Instruments (SDI) PosiGraph.

31 October 2002 - Scheffel Themi, initial issue, to "Diamonds" level.

10 January 2003 - Cambridge 302, introduction of ENL system.

12 February 2003 - Zander/SDI GP941, introduction of A model with GPS15 board.

14 February 2003 - SDI Posigraph, introduction of Model 2.

14 March 2003 - LX Navigation LX7000, new type of recorder, initial issue.

5 May 2003 - Scheffel Themi increased from Diamonds to "all badges" level.

20 May 2003 - Cambridge 10, 20 and 25, update to approval document.

25 August 2003 - Cambridge 10, 20 and 25, update to approval document.

25 August 2003 - Cambridge 302, update to approval document.

25 November 2003 - Cambridge 10, 20 and 25, changed level of approval.

25 November 2003 - Cambridge 302

1 January 2004 - Filser LX20, Version 5 with 2 Approval levels

28 March 2004 - Cambridge 10, 20, 25, Issue 4A.

28 March 2004 - Filser LX20, Version 5A.

28 March 2004 - Peschges VP8, Edition 2.

28 March 2004 - Print Technik GR100, Edition 2.

12 September 2004 - Cambridge 10, 20 and 25, Issue 5.

20 September 2004 - Zander 940, Version 2.

1 October 2004 - PrintTechnik GR 1000 and GR 1000A, Edition 3.

1 October 2004 - Filser LX20, Version 5.

1 October 2004 - Peschges VP8, Edition 2A.

10 April 2005 - EW Models A-D, update of manufacturer details

10 April 2005 - Cambridge models 10, 20, 25, update of manufacturer details and notice of change of IGC-approval level to take place 15 March 2006

20 June 2005 - LX Navigation Colibri, new version, adds Colibri Version4.

20 July 2005 - LX Navigation LX7000, approval document update, new model LX7007.

8 August 2005 - New Technologies (NTE) Easy Matchbox, initial approval