APPENDIX A THE IGC DATA FILE FORMAT

A1. INTRODUCTION

A1.1 **The IGC File**. The IGC Data File Standard was initially developed by a group consisting of representatives of IGC, glider FR manufacturers, and a number of independent software developers who were mainly concerned with analysis programs for flight data . It was approved by the IGC Plenary in March 1995 for use with the new concept of IGC-approved Flight Recorders, and has been refined and developed through regular amendments. It provides a common world data format for the verification of flights to IGC criteria, and several other FAI sports and aviation bodies also use the format.

A1.1.1 Production of Flight Data File. It must be possible to produce a separate and complete IGC flight data file for each flight including all record types relevant to the flight such as header records, flight declaration, fixes, security record, etc (see para A2.2 for list of record types in an IGC file). Position fixes in the IGC file are in B-record lines in the form of lat/longs and altitude before, during and after flight. Unless the type of FR employs continuous fix recording after switching on, the thresholds for starting fix recording after initial switch-on are a speed of 15 kph or a pressure altitude change of 1 metre per second for 5 seconds.

A1.1.1.1 Pre-take-off Baseline. For types of FRs that start recording fixes in the IGC file after movement is detected (compared to types of FRs that record fixes in the IGC file after switch-on), a pre-take-off baseline must be provided consisting of a continuous series of at least 30 valid fixes at a steady fix rate throughout the minute before take-off movement is detected (Chapter 3 para 3.5.1 also refers). For this, when movement is detected, the pre-take-off baseline fixes are placed in the first B-record lines in the IGC file (in current IGC-approved FRs this is achieved through a memory loop that continuously stores the correct number of fixes ready for insertion into the B record at the appropriate time).

A1.1.1.2 Ending recording. Under flight conditions of little horizontal or vertical movement such as when ridge or wave soaring, the IGC file must continue to record data and must not be ended while flight continues. For more detail, see para 3.7 earlier on how IGC files are ended.

A1.1.1.3 Data for Different Flights. Where the data for several flights is held in the FR memory, it must be ensured that when the data is downloaded, all record types in IGC files after the first file in the memory are those relevant to each later flight. If any record types are changed between flights (such as declaration, pilot name, etc.) the changes must be included in the later flight data files, but not in earlier files.

A1.2 **Revision Control**. The IGC flight data file format is revised through the normal amendment process for this document. See amendment procedures and list of amendments on page (i).

A2. GENERAL

A2.1 **File Structure**. An IGC-format file consists of fields of characters, in some cases all on one line, each giving a set of data such as for a GNSS fix and other information. Each field starts with an upper-case letter denoting one of the Record types listed in para A2.2., and ends with CRLF (Carriage Return Line Feed). Generally, the B, I, J, L and K records have a maximum of 99 characters, excluding CRLF which is hidden and does not appear in text form. Some Record types are on only one line, others can be on several lines. The Header (H-) Record includes separate lines for GNSS FR type, type of GNSS receiver and Pressure altitude sensor, pilot name, glider identification, etc, and the Flight Declaration (C) Record includes lines for the co-ordinates of each Waypoint. The order of Record types within an IGC file is given in A2.3. Some Record types occur only in only one place in the file ("single instance Records"), others such as fixes re-occur as time progresses ("multiple instance Records").

A2.1.1 Characters. Only characters listed as valid in para A6 shall be used in the file. If others such as accented characters (acutes, hatcheks, umlauts, etc) in names of airfields and turn points, are used such as in a manufacturer's proprietary file format, such characters shall be changed to a valid character when converting to the IGC format. This is so that analysis programs designed for the IGC format are not confused by non-standard characters.

A2.1.2 Examples. Descriptions and examples in this document may have spaces between various elements and the CRLF characters at the end of each line may be omitted, so that the elements may be more clearly seen on the page.

A2.2 **Record Types**. Each record type is identified by an upper-case letter that appears in the IGC file as the first character of the field concerned:

IGC DATA FILE FORMAT - RECORD TYPE IDENTIFICATION LETTERS	
A - FR manufacturer and FR serial no. B - Fix C - Task/declaration D - Differential GNSS E - Event F - Satellite constellation G – Security H - File header	I - List of additional information after the basic B-record data J - List of information in K-record data (Security signed) K – Multiple instance data, security signed. L - Logbook/comments M - List of information in N-record data (Non-security signed) N – Multiple instance data, (Non-security signed.) O, P, etc. – Spare

A2.3 **Record Order**. The A-Record is always the first in the file, and the last that is relevant to the data recorded in flight is the Security (G) Record that allows the validity of fix data to be checked at any time through the IGC VALI system. After the single-line A record is the multi-line Header (H) Record, followed by the I and J Records that identify data included in B and K record lines later in the file. These are followed by other Record types including the task declaration (C) Record, and the Satellite Constellation (F) used for the fixes (B) that follow. Time-specific Record lines are placed in the file in time order using either GNSS fix-time if the GNSS is locked on, otherwise time is taken from the recorder's Real Time Clock (RTC); these are B (fix), E (event), F (constellation change) & K (additional data). The logbook/comments (L) Record data may be placed anywhere after the H, I and J Records and there may be several L-record lines in the file.

A2.3.1 After-flight Data. In some FRs, extra data is calculated ***after flight*** such as statistics for the flight. This must be placed at the end of the IGC file after the G record in the form of another L record, but ***it is essential that*** the integrity of fix data before the G record and the VALI system for checking the flight data, are not affected by such additions. In particular, no B-record fix lines must appear after the G-record because this could be false data added after the flight. If any B-record data is detected after the G-record, this must cause Validation of the IGC file to fail. (AL8)

A2.3.2 Sequence of Record Types. The following sequence of Record types is typical, although in a real IGC file there will be many more fix (B) record lines than shown here:

TYPICAL ORDER OF RECORD TYPES IN AN IGC FILE	
A - FR manufacturer and identification (always first) H - File header (always after the A-record) I - List of other data added at end of each B record J - List of other data added at end of each K record M - List of other data in each N record C - Task/declaration (if used) L - Logbook/comments (if used) D - Differential GNSS (if used) F - Initial Satellite Constellation B - Fix plus any additional data listed in I Record B - Fix plus any additional data listed in I Record E - Pilot Event (PEV) B - Fix plus any additional data listed in I Record K - Additional data as listed in J Record N – Additional unsigned data B - Fix plus any additional data listed in I Record	B - Fix plus any additional data listed in I Record B - Fix plus any additional data listed in I Record F - Constellation change B - Fix plus any additional data listed in I Record K - Additional data as defined in J Record N – Additional unsigned data B - Fix plus any additional data listed in I Record E - Pilot Event (PEV) B - Fix plus any additional data listed in I Record B - Fix plus any additional data listed in I Record B - Fix plus any additional data listed in I Record K - Additional data as defined in J Record N – Additional unsigned data L - Logbook/comments (if used) G - Security record L - Data added after the flight is completed

A2.4 **Units**. Data in the IGC file uses the following unit system. For international conversion factors to be used, see para 2.2.9 in the main body of this document.

Date (of the first line in the H record) – DDMMYY (day, month, year, with respect to UTC).

Time - HHMMSS (hours, minutes, seconds) UTC, for source, see para 3.4 in the main body in this document. Note that UTC is not the same as the internal system time in the U.S. GPS system because so-called "Leap seconds" must be applied to GPS system time to obtain UTC, see under "GPS system time" in the Glossary.

Latitude and Longitude - Degrees, minutes and decimal minutes to three decimal places, with N,S,E,W designators

Altitude - Metres, separate records for (1) ICAO ISA pressure altitudes, and (2) GNSS altitude above the WGS84 ellipsoid.

Pressure Settings (where used) - HectoPascals (the same as millibars) to two decimal places, see on the next page under Pressure Settings and PPPPpp

and, where calculations (optional) are made based on successive fixes:

Direction - degrees True, clockwise from 000 (North)

Distance - Kilometres and decimal kilometres. For conversions from feet and miles, see para 2.2.9

A2.4.1 **The previous items shall be recorded as follows:**

Date - DDMMYY

DD - number of the day in the month, fixed to 2 digits with leading 0 where necessary

MM - number of the month in year, fixed to 2 digits with leading 0 where necessary

YY - number of the year, fixed to 2 digits with leading 0 where necessary

Time - HHMMSS (UTC) - for optional decimal seconds see "s" below

HH - Hours fixed to 2 digits with leading 0 where necessary

MM - Minutes fixed to 2 digits with leading 0 where necessary

SS - Seconds fixed to 2 digits with leading 0 where necessary

s - number of decimal seconds (if used), placed after seconds (SS above). If the recorder uses fix intervals of less than one second, the extra number(s) are added in the B-record line, their position on the line being identified in the I-record under the Three Letter Code TDS (Time Decimal Seconds, see the codes in para A7). One number "s" indicates tenths of seconds and "ss" is tenths and hundredths, and so forth. If tenths are used at, for instance, character number 49 in the B-record (after other mandatory codes such as FXA, SIU, ENL), this is indicated in the I record as: "4949TDS".

Lat/Long - D D M M m m m N D D D M M m m m E

DD - Latitude degrees with leading 0 where necessary

DDD - Longitude degrees with leading 0 or 00 where necessary

MMmmmNSEW - Lat/Long minutes with leading 0 where necessary, 3 decimal places of minutes are mandatory, followed by N, S, E or W as appropriate. If additional digits are used, for the fractional minutes define the positions through codes LAD and LOF in the I record.

Altitude - AAAAAaaa there are 2 altitude figures in metres: (1) GNSS altitude above the WGS84 ellipsoid, and
(2) Pressure Altitude to the ICAO ISA

AAAAA - fixed to 5 digits of metres with leading zero and if necessary with leading minus sign

aaa - where used, the number of altitude decimals (the number of fields recorded are those available for altitude in the record concerned, less fields already used for AAAAA)

GNSS altitude drop-out. Where GNSS altitude is not recorded such as in the case of a 2D fix (altitude drop-out), it must be recorded in the IGC file as Zero so that the lack of valid GNSS altitude can be clearly seen during post-flight analysis.

Pressure Settings (where recorded)

PPPPpp - Pressure in hPa (mbar / mb) with two decimal places, PPPPpp fixed at 6 digits with leading zero for settings in the 900 range). For altimeter subscale settings, 1013.25 mb (ICAO ISA Sea Level) has an PPPPpp code of 101325, and 980.75 mb has a code of 098075. An altimeter setting and any change to it may be recorded (three-letter code ATS), for instance where the FR feeds a cockpit display. However, the pressure altitude recorded in the IGC file must always be in metres with respect to the ICAO ISA with its sea level datum of 1013.25 mb.

and, where calculations (optional) are based on successive fixes:

Direction (calculated from successive fixes) - DDDddd.

DDD - fixed to 3 digits with leading 0 where necessary

ddd - where used, the number of direction decimals (the number of fields recorded are those available for direction in the Record concerned, less fields already used for DDD)

Distance (calculated from successive fixes) - DDDDddd, kilometres up to 9999 with leading zeros as required and then three decimal places (the last figure will therefore be metres)

Speed (calculated from successive fixes) - SSSsss. SSS - fixed to 3 digits with leading 0

sss - number of speed decimals (the number of fields recorded are those available for speed in the Record concerned, less fields already used for SSS)

Temperature - TTTttt. TTT with leading zeros (and leading minutes if required). TTT fixed to 3 characters. ttt - number of temperature decimals. The number of fields recorded are those available for temperature in the Record concerned, less 3 already used for TTT. (AL7)

A2.5 **FR FILE NAME (FILE ID)** New types of FRs must use the IGC long File Name/ID format as defined in A2.5.3.

A2.5.1 Long file name style. This uses a full set of characters in each field, a hyphen separating each field, the field order being the same as in the short file name which was the original IGC FR name format. For instance:

Long file name example: 2021-05-15-MMM-XXXXXX-01.IGC
2021-05-15 = date
MMM = manufacturer's three-letter IGC identifier (see table on next page)
XXXXXX = unique FR Serial ID (S/ID); 6 alphanumeric characters (see the note below)
01 = second flight of the day, 02 for second flight, etc.

Note: The XXXXXX field has 6-characters, with hyphens at the start and end, with leading zeros if necessary to make up the 6 characters. It can also be used by a manufacturer to differentiate between different FR types, such as using the first characters to indicate each FR type. (AL7)

A2.5.2 Short file name style: YMDCXXXF.IGC
This was the first IGC system and for recent and new types of FR it may be replaced by the long name style above
Y = Year; value 0 to 9, cycling every 10 years
M = Month; value 1 to 9 then A for 10, B=11, C=12.
D = Day; value 1 to 9 then A=10, B=11, C=12, D=13, E=14, F=15, G=16, H=17, I=18, J=19, K=20, L=21, M=22, N=23, O=24, P=25, Q=26, R=27, S=28, T=29, U=30, V=31.
C = manufacturer's single-letter IGC identifier (see table on next page)
XXX = unique FR Serial ID (S/ID); 3 alphanumeric characters
F = Flight number of the day; 1 to 9 then, if needed, A=10, B=11, etc

A2.5.3 FR Serial ID (S/ID). This is the identifier for an individual IGC Flight Recorder. For an individual IGC FR, its S/ID must be used in the A-record and be imprinted on the case of the recorder unless the case includes a display which includes the S/ID. For older recorders it is a 3-character Alphanumeric text string. For all new types of recorder it must be a 6-character string of which the first character is Upper Case Alphanumeric (omitting I and O to avoid confusion with numbers Zero and One) and the remainder characters numeric. The use of the first character to designate an individual model of recorder in the manufacturer's range is recommended.

A2.5.4. Date of flight - the date used in the file name and in the H-record (DTE code) is the UTC date of the first valid fix in the B-record of the IGC file downloaded after flight. In time zones where a flight starts close to midnight UTC, this is not necessarily the local date.

A2.5.5. Security of file name. The file name outside the contents of the file is not protected by the electronic security system. The IGC electronic security system applies to flight data within the file itself. File names may therefore be changed for purposes such as competitions, where it may be more convenient to use glider competition number or pilot name. There is no loss of data or security, since all data in the original file name is in the file A and H records.

A2.5.6 Manufacturer codes. Single- and three-character codes are tabulated below. Manufacturers applying for IGCapproval who are not listed should apply to the Chairman of GFAC for allocation of codes. Manufacturers using the IGC file format but not applying for IGC-approval should use the X and XYY codes, see note 2 at the end of the table.

A2.5.6.1 Name of Intermediate Format file. If a manufacturer chooses a system where data is download from the recorder in an intermediate format such as binary, the file name for the intermediate format shall be as for the IGC file but with the Manufacturer's three letter code used instead of "IGC" after the dot. It shall then be possible to convert the intermediate format to the IGC format through the Conversion utility that is part of the IGC Shell program (see Appendix C) when used with the manufacturer's IGC-XXX.DLL file (see Appendix D).

IGC-APPROVED FLIGHT RECORDERS - MANUFACTURER CODES				
	Manufacturer Name	Three Character Code	Single Character Code	Remarks
1	Aircotec	ACT	I	
2	Avionix	AVX	n/a	Full file name used, no need for single character code
3	Cambridge Aero Instruments	CAM	C	No longer making IGC FRs
4	ClearNav Instruments	CNI	n/a	Full file name used, no need for single character code
5	Data Swan/DSX	DSX	D	No longer making IGC FRs
6	EW Avionics	EWA	E	No longer making IGC FRs
7	Filser	FIL	F	Transferred to LX Navigation 2006
8	FLARM (Flight Alarm)	FLA	G	
9	Flytech	FLY	n/a	Full file name used, no need for single character code
10	Garrecht	GCS	A	
11	IMI Gliding Equipment	IMI	M	
12	Logstream	LGS	n/a	Full file name used, no need for single character code
13	LX Navigation	LXN	L	
14	LXNAV d.o.o.	LXV	V	
15	Naviter	NAV	n/a	Full file name used, no need for single character code
16	New Technologies s.r.l.	NTE	N	No longer making IGC FRs
17	Nielsen Kellerman	NKL	K	now Clearnav Instruments (one FR under NKL name)
18	Peschges	PES	P	No longer making IGC FRs
19	PressFinish Electronics	PFE	n/a	Full file name used, no need for single character code
20	Print Technik	PRT	R	No longer making IGC FRs
21	RC Electronics	RCE	n/a	Full file name used, no need for single character code
22	Scheffel	SCH	H	No longer making IGC FRs
23	Streamline Data Instruments	SDI	S	No longer making IGC FRs
24	Triadis Engineering GmbH	TRI	T	
25	Zander	ZAN	Z	No longer making IGC FRs
	Other manufacturers using the IGC file format		X	For non-IGC-approved devices, see notes below table

Note 1. New types of IGC FR must use the long file name that includes the manufacturer's three-letter code (also see A2.5.1 and A3.1). Manufacturers making only such FRs have no need for a single-character code and this is listed as "n/a" (not applicable) above.

Note 2. X and XYY are general designations for IGC files for devices where IGC-approval does not apply. The use of the prefix X designates that the device is not IGC-approved, and the letters YY may be replaced by characters that identify the manufacturer of the device. Such devices will not have been evaluated by GFAC and may not comply with some aspects of the IGC Specification such as security protection, recording of pressure altitude, ENL, MOP or other variables. There is no guarantee that the file will conform exactly to the IGC format, although specimen files will be checked if emailed to the GFAC chairman for evaluation. It should be noted that although the file name will not contain the information, the details of the manufacturer and the recorder model concerned will be identifiable (if the file conforms to the IGC standard) because they will be included in the H (Header) record, see below under for an H Record line (with extra spaces for clarity):

HF FTY FR TYPE : Manufacturers Three letter Code, FR Model Name CRLF.

Some other FAI air sports have their own systems for non-IGC recorders; for example, for Hang Gliding (FAI Commission CIVL), see http://vali.fai-civl.org/supported.html

Note 3. The codes PFC, PLT and OOI must not be used because they could cause confusion in the L record.

A2.5.7 Mandatory Records. The following records are mandatory for an IGC file from an IGC-approved FR:

Mandatory Record type in file order	Appendix A reference	Remarks
A	3.1	Manufacturer code and unique ID for the individual FR
H	3.2	Header record
I	3.3	Additions to B-record FXA (fix accuracy), ENL (Environmental Noise Level) for motor gliders, MOP for motors with low ENL figures
B	4.1	Fix records (lat/long/alt etc.)
F	4.2	Satellites used in B record fixes
G	3.6	Security record

A3 SINGLE INSTANCE DATA RECORDS.

These records only occur once in each IGC-format data file, but each record type may contain several lines prefixed with its type letter. The order below is the sequence in which they normally appear in the IGC file.

A3.1 **THE "A" RECORD - FR IDENTIFICATION (ID).** The A Record must be the first record in an IGC FR Data File, and includes the FR manufacturer's code, the GNSS FR Serial ID (S/ID) for the particular FR, and an optional text string The format of the A Record is as follows, with extra spaces for clarity:

A MMM XXX TEXT STRING CR LF or A MMM XXXXXX TEXT STRING CR LF

A record - Description	Size	Element	Remarks
Manufacturer ID	3 bytes	MMM	Alphanumeric, see para A2.5.6. For Non-IGC FRs this will be XYY (see 2.5.6 table). The full manufacturer name will be seen later in the Header record in the form: HFFTYFRTYPE:MANUFACTURERSNAME,FRMODEL
Unique FR ID (S/ID)	3 or 6 bytes	XXX or XXXXXX	The FR Serial ID, valid characters alphanumeric. New types of FR must use the IGC long File Name/ID format and 6-character S/IDs, see A2.5 for IGC file names. If data follows the FR ID, a hyphen must be used to separate the file name from data that follows, see under Additional Data below. Note that non-IGC FRs may not conform and use different ID systems
Additional data	Optional	Text String	Valid characters alphanumeric. If used, start with a hyphen separator to distinguish it from the earlier characters for Unique ID (because later FRs have S/IDs of more than 3 characters). Short extra data may be added unless this is already covered in the Header record under FRTYPE.

A3.2 **H RECORD - FILE HEADER**

The H- (Header) Record includes the date, pilot's name, glider type and registration, the type of FR used, type of GNSS receiver and pressure altitude **sensor**, amongst other things. There are several different subtypes of the H-Record which are recorded on separate lines prefixed H. All Three Letter Codes listed in section 7 that have the H flag are possible subtypes of the H-Record.

A3.2.1 Source Codes. The line entries in the H-record are created by the FR (source code F). In recent types of FR, they may also be created after flight under Source Code O by the OO or others. See the line "Data Source" in the table in 3.2.5.

A3.2.2 General format. The general format of H-Record lines is: H, data source (F=FR, O=other source), the three letter code for the subject of the line, the long name for the subject of the line, colon, then a descriptive text string. The long name and text string are intended to make it easier for people reading the file to see what data is recorded.

A3.2.3 Earth Model. The U.S. GPS system uses the WGS84 ellipsoid, and for IGC-approval the FR must record lat/longs and GPS altitudes with respect to the WGS84 Ellipsoid.

A3.2.4 Required records. The following H records are required. In what follows, extra spaces between items are added so that it is easier to see the items; these spaces are not present in actual IGC files when viewed in text format:

H F DTE DATE: DD MM YY, NN CRLF
H F PLT PILOT IN CHARGE: TEXT STRING CRLF
H F CM2 CREW 2: TEXT STRING CRLF
H F GTY GLIDER TYPE: TEXT STRING CRLF
H F GID GLIDER ID: TEXT STRING CRLF
H F DTM GPS DATUM: WGS84 CRLF
H F RFW FIRMWARE VERSION: TEXT STRING CRLF
H F RHW HARDWARE VERSION: TEXT STRING CRLF
H F FTY FR TYPE: HARDWARE MANUFACTURERS THREE LETTER CODE , FR MODEL NAME CRLF
H F GPS RECEIVER: MANUFACTURERS NAME, MODEL NAME, CHANNELS, MAX ALT CRLF
H F PRS PRESS ALT SENSOR: MANUFACTURERS NAME, MODEL NAME, MAXALT CR LF
H F FRS SECURITY OK or SECURITY SUSPECT / SECURITY MS OPERATED (as relevant): TEXTSTRING CRLF

Notes:

DATE line: NN is the flight number on the day, prefixed by a comma to separate it from the date group.

FIRMWARE line: In the text string after the Firmware version number, where a type of FR has been updated so that GPS altitude is recorded as height above the WGS84 Ellipsoid (where this was not the situation before), to make this clear to pilots, OOs, and NACs using a text editor to read the header records, the following words shall be added: "with WGS84 Ellipsoid GPS altitude datum". This update shall also have a new Firmware edition number. In this situation, the updated H record line for new firmware edition XX will be:
"HFRFWFIRMWAREVERSION: XX with WGS84 Ellipsoid GPS altitude datum"

FRTYPE line: Both Manufacturer's name and FR model Name are required, separated by a comma (,) character

GPS DATUM line - In FRs before Amendment4 the IGC number 100 refers to the WGS84 datum.
See also para A8 on Earth Models that have radii close to WGS84.

GPS RECEIVER LINE - If a GNSS other than the US GPS system is used, the three letter code for the GNS System is added after MAX ALT, preceded by a comma. Codes are listed in A7 and include GLO for Russian GLONASS, GAL for European Galileo, BEI for Chinese BeiDou 2. For receivers processing data from more than one system, use all of the appropriate codes after at the end of the line, such as ... MAX ALT, GPS, GAL for a receiver using the US GPS and European Galileo systems.

FRS SECURITY line - see next page in the A3.2.5 table under HF FRS (AL6)

MOP line. Where FR firmware includes provision for an MOP sensor, an additional line is required that describes the type of sensor as follows:
H F MOP SENSOR: Maker, ON/OFF, type and model of sensor + what it records, CRLF
If more than one type of MOP system is fitted, these must be numbered MOP2, MOP3 etc in the header record, followed by the details of each system as given above. In the I-record line for additional data these are identified as MP2, MP3, etc. For more detail see the MOP entry in the table that follows.

A3.2.5 A table follows with more detail on Header records:

H record – Description	Size	Element	Remarks
Data source	1 byte	F or O	Placed after a leading H letter: F=FR for data downloaded from the FR including pilot inputs before flight such as task, etc. Data entered before flight is protected by the security system and if it is changed after flight, the IGC file will fail the VALI check., O=other source entered after flight (such the OO) as allowed by this Specification. Data entered after flight is NOT protected by the security system.
Record subtype	3 bytes	CCC	Alphanumeric, placed after data source, see para A7 for TLCs
UTC Date	6 bytes	DDMMYY	Valid characters 0-9
Lines on Glider Pilot in Charge and Crew Member 2	At least 30 characters	Text String	After relevant TLC. PLT for name of Pilot in Charge, CM2 for name of Crew Member 2, if any
GNSS Datum	5 bytes or as required	GGGG	GGGG = Geodetic Datum/Earth Model used. WGS84 is the default, see A3.2.3 and A8
Lines on FR name, firmware, hardware	As required	Text String	After relevant TLC (e.g. RHW for FR Hardware version)
FR Type line	As required	F	Includes Hardware Manufacturers 3 letter code, and model data including sub-types. For instance, not only Model XXX 1 but 1a,1b, etc
HFGPS line	As required	Text String	Gives the GNSS receiver manufacturer and type, number of channels, and the maximum GNSS altitude in metres that could be recorded in the IGC file. Use comma separators between each piece of information. Where a GNS System other than the US GPS is used, see the note headed "GPS Receiver Line" in 3.2.4 on the previous page.
HFPRS line	As required	Text String	Gives the pressure altitude sensor Manufacturer and type, and the maximum pressure altitude in metres that could be recorded in the IGC file. Use comma separators between each element.
HF FRS line	As required	Text String	Format: HF FRS SECURITY OK , or HF FRS SECURITY SUSPECT: Text String with reason CRLF Line 2 above is used where security is suspect, for instance if FR firmware has changed in an unauthorised way or if the security microswitch has operated. The text string should be a description of the likely fault and recommended action, such as: "internal firmware changed FR re-set needed" or "Security Micro Operated FR re-set needed" (AL6)
HFMOP line	Required when MOP facility is included in the FR firmware	Text String	H F MOP SENSOR: Maker, ON/OFF, type and model of sensor/brief description of what it records, CRLF Under "what it records", some alternatives are: Acoustic + peak frequency sensitivity Hz/KHz; or Ecurrent (for electric engines); or Engine Management System data (describe what is recorded); or other system. The sensor model name and its characteristics is described in the FR IGC-approval document, see para 5.4 on the MOP Code. The ON/OFF field allows for an FR with the MOP facility in its internal firmware, but its external MOP sensor is not connected, for instance if the FR is used to record a piston engine for which the FR's internal ENL system gives high enough readings. When the external MOP sensor is OFF or Inoperative, the MOP number in fix records shall be 000.

For non-IGC FRs, see extra H-records in the table in para A3.2.7.5

A3.2.6 Additional H records. These are optional and use the Three Letter Codes given in para A7. Additional data may follow after the mandatory records. Two additional records (Competition ID and class) are shown below, with extra spaces for clarity.

H S CID COMPETITION ID : TEXT STRING CR LF
H S CCL COMPETITION CLASS : TEXT STRING CR LF

A3.2.7 Names and identifications.

A3.2.7.1 Similar names. Where there may be people with names which are similar or the same (Smith/Schmidt), full initials or other names should be used. In addition, a TLC of DOB for Date-of-Birth is available, and if used, this should be in the line following the pilot's name in the format DDMMYY (as date of flight in the H record).

A3.2.7.2 Name of Crew Member 2. This is under code CM2, with family name first then other names or initials without punctuation but separated by spaces (for instance, SMITH B S, or SMITH BERNALD).

A3.2.7.3 Long names. Sufficient characters should be made available to allow for long names and identifications. Such as, for glider registration, allow for a registration such as XXXX-AAAA (where XXXX is the designator of the Nation or National Airsport Body), requiring at least 9 characters to be available in this field. Manufacturers should provide for more characters in these fields so that flight declarations are easily made in full.

A3.2.7.4 Country, Club or organisation - from which flown or operated (code CLB), with nation (for instance LASHAM UK, ELMIRA US). Where there is not space to put the Nation in full, the two-letter codes from the ISO 3166 list of National designators should be used (these are also used for Nations in Internet addresses). Some ISO 3166 two letter National Codes are in the following table:

ISO 3166 TWO-LETTER NATIONAL CODES - EXTRACT
for the full table, see: www.iso.org

AR = Argentina	FI = Finland	NL = Netherlands
AT = Austria	FR = France	NO = Norway
AU = Australia	GR = Greece	NZ = New Zealand
BE = Belgium	HR = Croatia (HR = Hrvatska)	PL = Poland
BR = Brazil	HU = Hungary	PT = Portugal
CA = Canada	ID = Indonesia	RU = Russia
CH = Switzerland	IE = Ireland	SE = Sweden
CL = Chile	IL = Israel	SI = Slovenia
CN = China (PRC)	IN = India	SK = Slovakia
CO = Colombia	IS = Iceland	TR = Turkey
CZ = Czech Republic	IT = Italy	TW = Taiwan
DE = Germany	JP = Japan	UK = United Kingdom
DK = Denmark	KR = Korea (S)	US = United States
EC = Ecuador	LT = Lithuania	UY = Uruguay
EE = Estonia	LV = Latvia	VE = Venezuela
EG = Egypt	MX = Mexico	ZA = South Africa
ES = Spain	MY = Malaysia	

A3.2.7.5 Non-IGC FRs. For Non-IGC FRs, the following H-records apply :

Non-IGC-FRs: TLC & Description	**Size**	**Element**	**Remarks**
HO SOF	As required. To describe software name, version and date/ time of download	Text string	This is download software external to the Recorder other than the IGC Shell program or the earlier IGC DATA short program file. The text string gives the program name, program version and the date/time of the download (Format: DDMMYYHHMM). Use comma separators between each piece of information. The date/time uses the B-record format up to minutes of time (no need for seconds). For example: GpsDump,4.53,1907102039
HF FSP (Variant on the IGC File Specification). Or, if not embedded in the Recorder, HO FSP	Up to 30 characters	Text string	For instance, CIMA 1a, GAC 2b together with other useful details
HF ALG (GNSS Altitude)	Three characters	TLC in Rema r k s column	ELL for WGS84 Ellipsoid (mandatory zero datum for IGC FRs) GEO for WGS84 Geoid (approx. Sea Level datum) NKN = GNSS altitude datum not known NIL = GNSS altitude not recorded, In which case B records must have V for the fix validity and 00000 for GNSS altitude
HF ALP (Pressure Altitude)	Three characters	TLC in Rema r k s column	ISA = ICAO ISA (mandatory setting for IGC FRs) MSL = Above Mean Sea Level NKN = Pressure altitude datum not known NIL = Pressure Alt not recorded, and 00000 must appear in IGC file

A3.3 **I RECORD - ADDITIONS TO THE FIX (B) RECORD**. The I record defines any additions to the fix (B) Record in the form of a list of the appropriate Three-Letter Codes (CCC), data for which will appear in subsequent B Records. Only one I-Record line is included in each file, located after the H record and before the first B Record. For IGC FRs, Fix Accuracy (FXA) must be included, in the form of the Estimated Position Error figure (see Glossary under EPE). Also, Environmental Noise Level (ENL) is mandatory, and FXA must be followed by SIU, ENL and MOP (if MOP is recorded in the FR). The F Record (satellite constellation used) is mandatory, see para A4.3. The format of the I Record with extra spaces for clarity, is:

I NN SS FF CCC SS FF CCC CR LF

I Record – Description	**Size**	**Element**	**Remarks**
Number of additions	2 bytes	NN	Valid characters 0-9
Start byte number	2 bytes	SS	Valid characters 0-9, start byte on each B-record line
Finish byte number	2 bytes	FF	Valid characters 0-9, finish byte on each B-record line
3-letter Code	3 bytes	CCC	Alphanumeric subject, see para A7 for list of codes

The byte count starts from the beginning of the B Record, taking the first B in the line as byte one.
Example: I 01 36 38 FXA CR LF

The above line shows that the three numbers for Fix Accuracy (FXA) are recorded between bytes 36 and 38 on each B-record line.

For a device that also records Satellites In Use (SIU), Environmental Noise Level (ENL) inside the FR, and the external MOP sensor: I 04 3638 FXA 3940 SIU 4143 ENL 4446 MOP CR LF

The above line shows that on each B-record line, Fix Accuracy (FXA) is recorded between bytes 36 and 38, Satellites In Use (SIU) between bytes 39 and 40, Environmental Noise Level (ENL) between bytes 41 and 43 and MOP between bytes 44 and 46. To aid clarity, some spaces have been inserted in the example line.

A3.4 **J RECORD - ADDITIONS TO THE K RECORD**. The J record is a single line that defines what data will be in subsequent K-record lines, the K record being used for data that is updated during the flight but is not required as often as the regular fix (B-) Records. The data stored in the J-record is to be signed (see A3.6 on signing and the G record). The J-record fulfils the same function for the K Record as the I Record (3.3 above) does for the fix (B) record, and operates in the same way. It is placed in the file immediately after the I record line, before the first B Record. The format of the J Record with extra spaces for clarity, is:

J NN SS FF CCC SS FF CCC CR LF

Description	Size	Element	Remarks
Number of additions	2 bytes	NN	Valid characters 0-9
Start byte number	2 bytes	SS	Valid characters 0-9 (from start of K Record)
Finish byte number	2 bytes	FF	Valid characters 0-9
3-letter Code	3 bytes	CCC	Alphanumeric, see para A7

A3.5 **C RECORD - TASK (Pre-flight Declaration)** The C Record is used to make pre-flight declarations, and a declaration continues to be valid until it is replaced by a new one. It is placed in the IGC file before the first fix (B-) record and after the Header, I and J records. The C Record group has at least 5 lines, 6 or more if there are Turn Points. The first is a header line with the declaration date and time, followed by lines with coordinates for the waypoints: Take-off, Start, Turn Points (if any), Finish and Landing. The lines for Take-off and Landing are for information and are not part of the official IGC Declaration which runs from the declared Start via Turn Points to the declared Finish.

A3.5.1 Lines in the C Record. The first line contains the UTC-date and time at which the declaration was made, the number of Turn Points in the task (excluding the Start and Finish points), and a text string to describe the task ("500k triangle", etc). The other lines contain the WGS84 lat/long coordinates and a text string describing the point. These include Take-off, Start Point, Turn Points, Finish Point and Landing. The text describing the type of point (see below) is so that the nature of the points can be clearly seen by viewing the IGC file.

A3.5.2 IGC terminology - Waypoint/Turn Point. In IGC terminology, "Waypoint" refers to a either a start point, turn point or finish point. The term "Turn Point" (TP) refers to a point-of-turn between a start and finish point. The points that must be specified exactly in an official IGC flight declaration are the start-, turn- and finish-points either declared before the flight, or, for IGC "Free Flights", selected after flight. The number of TPs 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 competition polygon tasks.

A3.5.3 Take-off and Landing. Two lines in the IGC file C-record are for take-off and landing. They are for general information rather than being part of an IGC Flight Declaration and can be the airfield's position or the points of take-off and landing. They can be entered approximately or, if co-ordinates are difficult to obtain, 00000000N000000000E should be entered.

A3.5.4 C-record format. In the examples below, spaces have been added between data fields to aid clarity.

Line 1. DD MM YY is the UTC date on which the declaration was made; followed by the time of declaration in hours, minutes, seconds UTC in the format HH MM SS. This can be before the day of flight, unless a later declaration is received by the FR which replaces the earlier one. For the characters used in Flight Date, XXXX and TT, see the right-hand column below.

C DD MM YY HH MM SS DD MM YY XXXX TT TEXT STRING CR LF

Other lines. DD = degrees latitude, MM = minutes; mmm = decimal minutes: DDD = degrees longitude; The Text String is for the name and short description of the Point. The first and last lines are for the co-ordinates of the intended airfields of take-off and landing (or the intended take-off and landing points), but the official IGC declaration is from the Start Point to the Finish Point
via any Turn Points in the declared order, in the example below a triangle with 2 TPs with N latitude and E longitude.

C DD MM mmm N DDD MM mmm E TAKEOFF TEXT STRING CR LF

C DD MM mmm N DDD MM mmm E START TEXT STRING CR LF

C DD MM mmm N DDD MM mmm E TURN TEXT STRING CR LF

C DD MM mmm N DDD MM mmm E TURN TEXT STRING CR LF

C DD MM mmm N DDD MM mmm E FINISH TEXT STRING CR LF

C DD MM mmm N DDD MM mmm E LANDING TEXT STRING CR LF

C record – Description	Size (bytes)	Element	Remarks
Declaration date UTC	6	DDMMYY	
Declaration Time UTC	6	HHMMSS	
Flight date	6	DDMMYY	
Task number for the flight date	4	XXXX	
Number of Turn Points	2	TT	
T.O. or A/F LatLon	as required	DDMMmmmN DDDMMmmmE to the WGS84 Geodetic Datum	The exact declared point is defined by the WGS84 latitude and longitude. The text string may include local waypoint code numbers, letters, name or description. The declared start point, turn points (if any), and the finish point are mandatory for a valid IGC pre-flight declaration. Take-off and landing data are not part of an IGC pre-flight declaration and including Lat/Long data in these lines is optional. It may be useful, for instance where remote starts or finishes are used. If exact data is not available, the take-off and landing data should be set to zero, such as 0000000N 00000000E
Start LatLon			
T/P LatLon			
T/P LatLon			
Finish LatLon			
Land or A/F LatLon			

A3.5.4.1 The following is a example of a declaration for a 500 km triangle to be flown from Lasham Gliding Centre in the UK, with spaces between elements added to make it easier to read:

C 21 08 15 09 38 41 000000 0000 02 500K Triangle
C 51 11 359N 001 01 899W TAKEOFF Lasham Clubhouse
C 51 10 179N 001 02 644W START Lasham Start S
C 52 09 092N 002 55 227W TURN Sarnesfield
C 52 30 147N 000 17 612W TURN Norman Cross
C 51 10 179N 001 02 644W FINISH Lasham Start S
C 51 11 359N 001 01 899W LANDING Lasham Clubhouse

A3.5.5 Area Tasks. These are set in some gliding competitions but are not relevant to the flight declaration section of IGC files. Competition scoring is based on the fix record in IGC files and does not need a Declaration in the file.

A3.6 **G RECORD - SECURITY**. The G record is the digital security signature in the form of a coded sequence of characters. It is used to verify that flight data recorded inside the FR is identical to the flight data in the IGC file that is being checked. The signature is generated using a system described in Appendix G. The FR manufacturer must provide a method to check via this signature that the flight data in the IGC file is identical to that recorded in the FR. The G-record checks all of the Records required to be security-protected, as specified in the definition of each Record in this Appendix. G-records may consist of several lines, larger character counts generally implying higher security.

Format of G Record: G S S S S S S S S S S S S S S S S S S S S S S S S S S S S S CR L F
G S S S S S S S S S S S S S S S S S S S S S S S S S S S S S CR L F etc

G record - Description	Size	Element	Remarks
Security code	As required for the appropriate security level.	SSSSS	Valid characters alphanumeric, see Annex G para G2.1.2 on security key length.

The G Record must not use any non-printing character, because whitespace is often removed when ASCII files are transmitted across data communication networks.

A3.7 **M RECORD - ADDITIONS TO THE N RECORD**. The M record is a single line that defines what data will be in subsequent N-record lines, the N-record being used for data that is updated during the flight but may not require as often as the regular fix (B-) Records, and is not to be signed (see A3.6 on signing and the G record). The M-record (para. A4.7) fulfils the same function for the N Record as the J Record (3.3 above) does for the K record, and operates in the same way. It is placed in the file immediately after the J record line, or the I record if the J record is not present before the first B Record. The format of the M Record with extra spaces for clarity, is: M NN SS FF CCC SS FF CCC CR LF

Description	Size	Element	Remarks
Number of additions	2 bytes	NN	Valid characters 0-9
Start byte number	2 bytes	SS	Valid characters 0-9 (from start of K Record)
Finish byte number	2 bytes	FF	Valid characters 0-9
3-letter Code	3 bytes	CCC	Alphanumeric, see para A7

A4. **MULTIPLE INSTANCE DATA RECORDS**.

These are record types that can re-occur at different times in the course of the IGC file, unlike single instance records that occur only in one place.

A4.1 **B RECORD - FIXES**. The data stored in the B-record is part of the data to be signed (see A3.6 on signing and the G record). Not counting the last CRLF, a B record line includes 35 bytes for basic fix data, plus mandatory characters that are defined in the I Record including Environmental Noise Level (ENL), Fix Accuracy (FXA) in the form of the figure for Estimated Position Error (see the Glossary under EPE), MOP (Means of Propulsion), and Satellites In Use (SIU) (AL8).

A4.1.1. The required basic data is: UTC, WGS84latitude, WGS84 longitude, fix validity, pressure altitude, GNSS altitude with respect to the WGS84 Ellipsoid. All of the information within each B-record must have a data issue time within 0.1 seconds of the time given in the B-record. Where NMEA data is used within the FR, fix data should be taken either from the GGA or GNS sentences. GGA is specific to the US GPS system. GNS is intended for all GNS Systems (GPS, GLONASS, Galileo, BeiDou2 and other GNS Systems), and should be used if it is available from the GNSS receiver.

A4.1.2 In the B Record FXA shall be recorded as a three-figure group in metres and SIU as a two-group number. Leading zeros should be included as necessary. Because earlier IGC approved GNSS FRs may not have FXA and SIU in their B-records, the position of this data in each B record line must be indicated (for instance to analysis programs) by including them in the I record which designates the positions of additional fields in the B record. FXA should be placed after the two groups for altitude, followed by SIU and ENL. In each B-record line, FXA would therefore normally occupy bytes 36, 37 and 38, SIU bytes 39 and 40, ENL 41-43.

A4.1.3 The format of the basic data, with extra spaces for clarity, is:

B HHMMSS DDMMmmmN DDDMMmmmE V PPPPP GGGGG CR LF

A4.1.4 In tabular form, with notes:

B record – Description	Size	Element	Remarks
Time UTC	6 bytes	HHMMSS	Valid characters 0-9. The leap-second correction must be applied to all recorded fixes so that UTC always appears in the B-record. When a GNSS system initially locks on, in the short period before the current leap-second data is available from the ephemeris data of the GNSS system, the leap-second correction that was used when that recorder was last locked on should be used
Latitude	8 bytes	DMMmmmN/S	Valid characters 0-9. The leap-second correction must be applied to all recorded fixes so that UTC always appears in the B-record. When a GNSS system initially locks on, in the short period before the current leap-second data is available from the ephemeris data of the GNSS system, the leap-second correction that was used when that recorder was last locked on should be used
Longitude	9 bytes	DDDMMmmmE/W	Valid characters N, S, 0-9. Obtained directly from the same GNSS data package that was the source of the UTC time that is recorded in the same B-record line. If no latitude is obtained from satellite data, pressure altitude fixing must continue, using times from the RTC. In this case, in B record lines must repeat the last latitude that was obtained from satellite data, until GNSS fixing is regained
Fix validity	1 bytes	A or V	Use A for a 3D fix and V for a 2D fix (no GNSS altitude) or for no GNSS data. Note that pressure altitude data must continue to be recorded using UTC times from the RTC
Press Alt.	5 bytes	PPPPP	Altitude in metres relative to the ICAO ISA 1013.25 HPa datum, valid characters 0-9 and negative sign "-". Negative values to have negative sign instead of leading zero
GNSS Alt.	5 bytes	GGGGG	Altitude in metres above the WGS84 ellipsoid, valid characters 0-9 and negative sign "-". Negative values to have negative sign instead of leading zero

A4.1.4 Other data in Fix lines. To append the Fix Accuracy (FXA, mandatory), Satellites in Use (SIU, mandatory), internal Environmental Noise Level (ENL, mandatory), signal from the external MOP sensor (see para 5.4), or any other variable in each fix line, these must be defined earlier in the IGC file I Record (so that the data will be recognised by analysis programs). For instance, with extra spaces for clarity:

I 04 3638FXA 3940SIU 4143ENL 4446MOP CRLF

This shows that on each B-record line, Fix Accuracy (FXA) is recorded between bytes 36 and 38, Satellites In Use (SIU) between bytes 39 and 40, ENL between bytes 41 and 43, and MOP between bytes 44 and 46. The resulting B Record becomes (with extra spaces for clarity):

B HHMMSS DDMMmmmN DDDMMmmmE V PPPPP GGGGG AAA SS EEE MMM CRLF

B record - Description	**Code**	**Size**	**Element**	**Remarks**
Fix Accuracy	FXA	3 bytes	AAA	Valid characters 0-9, metres
Satellites in Use	SIU	2 bytes	SS	Valid characters 0-9, metres
Environmental Noise inside FR	ENL	3 bytes	EEE	Valid characters 0-9
Propulsion Sensor external to FR	MOP	3 bytes	MMM	Valid characters 0-9, for FRs with MOP sensor system in FR firmware.

A4.2 **E RECORD - EVENTS**. The data stored in the E-record is part of the data to be signed (see A3.6 on signing and the G record). The E-record is used to record specific events in the IGC file that occur at irregular intervals. Such events include a pilot-initiated event (PEV code), switching a Blind Flying instrument on or off (BFION or BFIOFF), or, for recorders fitted with proximity sensing devices with respect to other aircraft (for traffic avoidance purposes), a proximity event using one of the appropriate Three-Letter Codes as defined in para A7. The E Record is placed before the individual fix (B) Record for the same time that shows where and when the event occurred. Events must have a Three Letter Code (TLC) from the list in section 7. More than one event record may be used at the same time, but Events initiated within the FR (compared to those made by the pilot such as PEV) are only expected to be occasional in the time-history of the flight file and should not be used for an Event record after every fix (B-record line), so that the IGC file does not become unnecessarily large.

A4.2.1 If a manufacturer wants to add a new type of event, a new Three Letter Code (para A7) should be requested from GFAC. The manufacturer must provide an exact definition of the event and a proposed coding. GFAC may decide that the proposal should not be treated as an event but that the information should be incorporated into the B- or K-record in the normal way for these records by listing in the I and J records.

A4.2.2 The form of the E-Record is record identifier, time, TLC, text string. Examples follow, with extra spaces to show the different elements in the line:

E 104533 PEV CR LF

B 104533 49 45 333 N 011 32 444 E A 01357 01501 CR LF

This indicates a pilot-initiated event (PEV) at 10:45:33 UTC, and the associated B record shows the location 49:45.333 N 11:32.444 E, at the pressure altitude 1357 metres and GNSS altitude 1501 metres.

Some events require more than just the Three Letter Code for interpretation, for instance, with extra spaces for clarity: E 104544 ATS 102312 CR LF. This shows that the altimeter setting in a display device connected to the FR was changed to 1023.12 hPa at the time 10:45:44

A4.3 **F RECORD - SATELLITE CONSTELLATION**. For IGC FRs, this is a mandatory record. However, there is no requirement to update the F-record at intervals of less than 5 minutes, so that transient changes of satellites received due to changing angles of bank, flying in valleys, etc do not lead to unnecessary F-record lines.

In the US GPS system, SVN is the Space Vehicle Number of each satellite, and PRNs are "Pseudo-Random Noise" sequences, or Gold codes, that each satellite transmits to differentiate itself from other satellites (SV Numbers are not transmitted).

For other GNS Systems such as the Russian GLONASS , European Galileo or Chinese BeiDou 2 the ID is the nearest equivalent. Where NMEA data is used within the FR, the ID should be taken from the GSA sentence that lists the IDs of those satellites used in the fixes which are recorded in the B record. The F Record is not recorded continuously but at the start of fixing and then only when a change in satellites in use is detected.

Format of F Record (with extra spaces for clarity): F HH MM SS AA BB CC DD EE FF GG CR LF

Description	Size	Element	Remarks
Time UTC	6 bytes	HHMMSS	Valid characters 0-9
Satellite ID	2 bytes for each satellite used	AABBCC Or 01, 02 etc	Valid characters alphanumeric

A4.4 **K RECORD - DATA NEEDED LESS FREQUENTLY THAN FIXES**. The K record is for data that is needed less frequently than fix (B) records. The K record should have a default interval of 20 seconds. As an example, if the B-record records every 2 seconds, the K-record could be set to record every 20 seconds. The contents of the K record are listed in the J record. The following J Record specifies the information in the K Record in the next line (with extra spaces for clarity):

J 08 12 HDT CR LF
K HHMMSS 00090 CR LF (This K Record shows that the true heading (TLC = HDT) is 090 (East)).

A4.5 **L RECORD - LOG BOOK / COMMENTS**. Logbook Records are comments that can be placed anywhere in the file after H, I and J records and the term "comment record" may be a better description. In the IGC file they may either be before the G (security) record at the end of the in-flight data, or after the G-record. If before the G-record, ***it is essential*** that the security of the in-flight data and its after-flight Validation check is not affected. See A2.3 on Record Order within the file and A7 on how new TLCs are to be notified to GFAC. The L-Record allows free-format text lines to be added, although this record is not time-stamped. It can be initiated by a program in the FR, by pilots or official observers. If the data is not from the FR (source letter F), the Element field in the table below will also be three characters, initiated by the pilot (code PLT), Official Observer Input (code OOI), or by other sources allowed by this Specification such as external Download Software (code SOF).

A4.5.1 Validation check. L-records with the Manufacturer's ID (MMM) must be included in the Validation check but L-records from other sources must not be. The data stored in the L-record which has the manufacturers TLC as the first 3 characters after the letter L is part of the data to be signed (see A3.6 on signing and the G record).

A4.5.2 Free Flights - Post Flight Declarations. In the case of Free Flights where waypoints are claimed after flight by the pilot, the PFC (Post-Flight Claim) code may be used as a Logbook Record line starting LPFC followed by Waypoints in the same format as the C Record (Pre-flight declaration). The PFC data may be inserted after initial download of the flight data either manually or by a software program, so that it can be recognised by analysis programs designed to read PFC data and show the flight on screen together with the Post Flight Claim (PFC) waypoints. Since it is added after download of the flight it is not part of the data to be signed (see A3.6 on signing and the G record).

A4.5.3 Length. This record in the IGC file should not be taken as encouragement or permission to include long entries. L-record data should be restricted to data that is best placed inside the IGC file itself and is difficult to cover elsewhere. To reduce the length of L-record entries, where appropriate, a brief cross-reference should be included (to web, other documents etc) rather than be included in full inside the IGC-file itself.

A4.5.4 FRs with Flarm. For FRs that use the FR manufacturer's own firmware and systems but where there is also a Flarm module inside the FR, the Flarm state must be recorded in the L-record in the same way as FRs that use Flarm firmware as primary firmware. They form part of the data to be signed (see A3.6 on signing and the G record).
In particular:
For Stealth mode, the following format must be used: LFLAnnnnnn STEALTH OFF/ON
For the Flarm ID, the following format must be used: LFLAnnnnnnID 2 XXXXXX
Where nnnnnn is the time and XXXXXX is the six Hex-decimal Flarm ID, replacing 'FLA' with the manufacturer's three-letter code as required.

A4.5.5 Format. The general format of the L Record is as follows (with extra spaces for clarity):
L MMM TEXTSTRING CR LF
L PLT TEXTSTRING CR LF
L PFC TEXT FORMAT AS C RECORD CR LF

Description	Size	Element	Remarks	Included in data signed by the G-record?
Manufacturer input	3 bytes	MMM	Manufacturer's code, see para A2.5	Yes
Pilot input	3 bytes	PLT	Text string after PLT	No
OO input	3 bytes	OOI	Text string after OOI	No
After flight pilot input	3 bytes	PFC	For free flight after-flight choice of course	No

Examples of pilot inputs: L PLT This was my second 1000km attempt L PLT from Eagle Field

A4.6 **D RECORD - DIFFERENTIAL GNSS**. This indicates that differential GNSS is being used and can be a multiple-instance record if, during the flight, more than one differential beacon is used. The data stored in the D-record is part of the data to be signed (see A3.6 on signing and the G record). It is placed in the IGC file before the first fix (B) record after the H, I, J and C records. The format of the D Record is (with extra spaces for clarity):

D Q SSSS CRLF

Description	Size	Element	Remarks
GPS Qualifier	1 byte	Q	Use 1=GPS, 2=DGPS
DGPS Station ID	4 bytes	SSSS	

These parameters correspond to the NMEA GGA GPS quality indication. The absence of a D Record indicates that differential GPS was not used. The facility to use DGPS is subject to GFAC approval, and it must be shown that it preserves the integrity of basic lat/long and other flight data.

A4.7 N **RECORD - DATA NOT SIGNED BY THE SECURITY SIGNATURE** The N record is for data that may be recorded less frequently than fix (B) records, and is not included in the data signed by the G-record. The N-record will record at 20 second intervals or at a significant change in data to be recorded, whichever is the shorter period. The following M Record specifies the information in the N Record in the next line (with extra spaces for clarity):

M 02 08 10 HRT 11 13 OXY CR LF
N HHMMSS 112 098 CR LF (This N Record shows that the pilots Heart Rate was 112 bpm and Oxygen Saturation 98%)

A5. DEFINITIONS

These relate to use in the IGC file. Also see the Glossary of Terms at the start of this Specification.

Airspeed - The true airspeed of the aircraft in kph, for systems with air data input.
Alphanumeric - Valid alphabetical and/or numeric character from the list of valid characters (para A6).
Calibration – the creation of a table of pressure altitude correction values
Competition Class - The IGC/FAI competition class of the aircraft, such as Open, 15metre, 20 m, Standard, Club etc.
Constellation - The precise satellite IDs from which data was used to determine the GNSS fix, see A4.3 for IDs
Course - The direction between two lat/long points expressed as degrees magnetic or true.
Datum, Geodetic - see below under Geodetic Datum
Engine Down - The engine and/or propeller is stowed and cannot generate forward thrust.
Environmental Noise Level (ENL) - low frequency acoustic noise at the FR in three numbers, maximum 999.
Engine Off - The engine is in a condition where thrust cannot be generated.
Engine On - The engine is in a condition when thrust could be generated.
Engine RPM - Covered under the MOP code, see below
Engine Up - The propulsion unit pylon is extended or the engine or propeller doors are open.
Equipment Events - These are events generated solely by the FR (such as detecting take-off), as opposed to events generated after flight by the analysis of the FR flight data (such as establishing presence in a Turn Point Observation Zone or crossing a start or finish line).
Finish - The formal end of a task, such as crossing a finish line, entering a finish observation zone, or (for some distance flights) landing. For definitions see the Sporting Code (SC3) main volume.
Fix Accuracy - The accuracy of a fix expressed as Estimated Position Error (EPE) in metres, normally to a 2-sigma (95.45%) probability.
FR Serial ID (S/ID) - a multi-character alphanumeric which identifies an individual FR. It is used in the first (A) record (para A3.1) and in the IGC file name (para A2.5).
Geodetic Datum - The GNSS datum (earth model) used for Lat/long and GPS altitude figures in IGC files, for IGC-approval this must be the WGS84 Ellipsoid
Glider ID - The unique registration alphanumeric of the individual aircraft.
Glider Type - The manufacturer and precise model number of the aircraft.
GNSS Altitude - A five numeric character group indicating the GNSS altitude in metres above the WGS84 ellipsoid.
Ground Speed - Speed over the ground in kph.
Heading - The direction in which the aircraft is pointed (the longitudinal axis) in degrees true or magnetic (which should be stated as T or M).
Latitude - A seven-character alphanumeric group referenced to the WGS84 ellipsoid and expressed as two figures for the degrees, two figures for the minutes and three figures representing tenths, hundredths and thousandths of minutes followed by the N or S character. Where this used in a FR as part of a flight declaration, the N/S character must be capable of being entered in either upper or lower case.
Longitude - An eight-character alphanumeric group referenced to the WGS84 ellipsoid and expressed as three figures for the degrees, two figures for the minutes and three figures representing tenths, hundredths and thousandths of minutes followed by the E or W character. Where this is used in a FR as part of a flight declaration, the N/S character must be capable of being entered in either upper or lower case.
MOP - Means of Propulsion - when used in an IGC file, this refers to an engine function in addition to ENL, from a separate sensor either inside the FR or separate from the FR and positioned close to the engine and/or propeller. See para 2.2.5 and 5.4.
On Task - The pilot is attempting a Task.
OO ID - A series of alphanumeric that may be entered by an OO into the FR before flight, with a minimum of four characters.
Pilot Event (PEV code) – A fix in an IGC file where the pilot has pressed a button or switch to mark a particular time and place. PEV may record events such as crossing a start line or arriving at a particular point. After a PEV event, a sequence of fast fixes follows (see para 3.6).
Pressure Altitude - A five number group indicating the pressure altitude in metres above the 1013.25 HPa sea level datum of the ICAO ISA.
Pressure Reference An instrument with traceable accuracy to a standard with better uncertainty than 0.1 hPa, used for comparison with an Approved Flight Recorder for calibration purposes
RAIM - Receiver Autonomous Integrity Monitoring (when used) - indicates the quality of GNSS navigation data, see the Glossary.
Record Addition - This allows extra information to be added to the fix (B) and extra data (K) records.
Security data (Digital Signature) - A security system to verify that the flight data has not be altered since the flight was originally recorded.
Start - A point marking the start of an official soaring performance. For definitions, see the Sporting Code (SC3).
Task - The main points of a flight intended or declared by the pilot. Includes start, turn points and finish.
Total Energy Altitude - The combination of an aircraft's potential and kinetic energy expressed in metres of effective altitude.
Traceability – the establishment of an unbroken chain of comparisons to stated references each with a stated uncertainty
Track - The true track (flight path) over the ground that the aircraft has achieved.
Turn point Validation - Proof of presence (such as a valid GNSS fix) in the relevant Observation Zone for the point concerned.

A6. VALID CHARACTERS.

These consist of all printable ASCII characters from Hex 20 to Hex 7D, except those tabulated below as reserved. The IGC file must not use characters outside this range, except the CRLF line ending. A text string is a sequence of valid characters. The following table shows the character first and then the hexadecimal code, and the second table has the same information in hex order:

NUMBERS	LETTERS				SYMBOLS Res = reserved		RESERVED CHARACTERS
	Upper Case		Lower Case				
0 = Hex 30	A = Hex	N = 4E	a = Hex 61	n = 6E	Space= Hex	. = 2E	CR = 0D
1 = 31	41	O = 4F	b = 62	o = 6F	20	/ = 2F	LF = 0A
2 = 32	B = 42	P = 50	c = 63	p = 70	*Res = 21*	: = 3A	$ = 24
3 = 33	C = 43	Q = 51	d = 64	q = 71	" = 22	; = 3B	* = 2A
4 = 34	D = 44	R = 52	e = 65	r = 72	# = 23	< = 3C	! = 21

5 = 35 6 = 36 7 = 37 8 = 38 9 = 39	E = 45 F = 46 G = 47 H = 48 I = 49 J = 4A K = 4B L = 4C M = 4D	S = 53 T = 54 U = 55 V = 56 W = 57 X = 58 Y = 59 Z = 5A	f = 66 g = 67 h = 68 i = 69 j = 6A k = 6B l = 6C m = 6D	s = 73 t = 74 u = 75 v = 76 w= 77 x = 78 y = 79 z= 7A	*Res = 24* % = 25 & = 26 ' = 27 (= 28) = 29 @ = 40 ` = 60 *Res = 2A* + = 2B , = 2C - = 2D	= = 3D > = 3E ? = 3F [= 5B *Res = 5C*] = 5D *Res = 5E* _ = 5F { = 7B | = 7C } = 7D *Res = 7E*	\ = 5C ^ = 5E ~ = 7E *These characters are reserved (not to be used) because they could be confusing if used in a text string, for instance due to other meanings or keystrokes*

The same information in hex order:

VALID CHARACTERS IN HEX ORDER ***Res = reserved***					**RESERVED CHARACTERS**
20 = space 21 = Res 22 = " 23 = # 24 = Res 25 = % 26 = & 27 = ' 28 = (29 =) 2A = Res 2B = + 2C = , 2D = - 2E = . 2F = / 30 = 0 31 = 1 32 = 2	33 = 3 34 = 4 35 = 5 36 = 6 37 = 7 38 = 8 39 = 9 3A = : 3B = ; 3C = < 3D = = 3E = > 3F = ? 40 = @ 41 = A 42 = B 43 = C 44 = D 45 = E	46 = F 47 = G 48 = H 49 = I 4A = J 4B = K 4C =L 4D = M 4E =N 4F =O 50 = P 51 = Q 52 = R 53 = S 54 = T 55 = U 56 = V 57 = W 58 = X	59 = Y 5A = Z 5B = [5C = Res 5D =] 5E = Res 5F = _ 60 = ` 61 = a 62 = b 63 = c 64 = d 65 = e 66 = f 67 = g 68 = h 69 = i 6A = j 6B = k	6C = l 6D = m 6E = n 6F = o 70 = p 71 = q 72 = r 73 = s 74 = t 75 = u 76 = v 77 = w 78 = x 79 = y 7A = z 7B = { 7C = | 7D = } 7E = Res	0D = CR 0A = LF 24 = $ 2A = * 21 = ! 5C = \ 5E = ^ 7E = ~ *These characters are reserved (not to be used) because they could be confusing if used in a text string, for instance due to other meanings or alternative keystrokes*

A7. THREE-LETTER CODES (TLC)

These are shown as CCC in the formats earlier in this appendix. Their meanings are listed below together with the first letter of the fields in the IGC file where they may be used, such as B for a fix, E for event, etc. If a manufacturer proposes to use a TLC not listed below, they should inform GFAC giving its proposed initials, its general purpose, a definition suitable for publication in this document, number of bytes, units to be used, etc. If agreed by GFAC, the new TLC will be added to the list below at the next Specification update. Meanwhile, this system of early notification will enable GFAC to inform manufacturers if another manufacturer has already submitted a TLC for the same function, or there is already a proposed TLC that uses the same code letters but for a different function.

TLC	**IGC File Records used with the TLC**	**Three Letter Code - meaning - notes on how it is to be used**
ACX ACY ACZ	I, B	Linear accelerations in X, Y and Z axes, for aerobatic aircraft equipped with appropriate sensors feeding to the recorder and IGC file. X = longitudinal, Y = lateral, Z = vertical (so-called "G")
ANX ANY ANZ	I, B	Angular accelerations in X, Y and Z axes, for aerobatic aircraft equipped with appropriate sensors feeding to the recorder and IGC file. Pitch = X, roll = Y, yaw = Z in degrees per second
AOA	I,B,J,K	Angle of attack is in tenths of degrees. Four signed digits in range from -999 to 9999, (eg.: AOA=13.4 is encoded as 0134, AOA=-7.5 is encoded as -075).
AOP AOR	I, B	Attitude Pitch Angle, Attitude Bank/Roll Angle in degrees (for nose down or left bank angle, start with "-") (AL8)
ATS	H, E	Altimeter pressure setting in hectoPascals (the same as Millibars) as a 6 digit number PPPPpp including 2 decimal places, see A2.4 under Pressure Settings. For instance, ICAO ISA Sea Level (1013.25 mbar) has an PPPPpp code of 101325, and 980.75 mb has a code of 098075. Although an altimeter pressure setting may be recorded (for instance where the FR feeds a cockpit display), it must not be used to change the pressure altitude recorded with each fix, which must remain with respect to the ISA sea level datum of 1013.25 mb at all times.

BEI	H	BeiDou 2 GNS System from the People's Republic of China
BFI	E	Blind Flying Instrument. Recorded as ON or OFF in the format BFION or BFIOFF, followed by a space and then AH (Artificial Horizon) for an instrument displaying the horizon, or TI (Turn Indicator) for one giving rate of turn, change of heading, or similar. If the ON/OFF status is uncertain, use the format BFIUN (for Status Unknown). A Text String (optional) may follow to give more detail of the instrument and its status. The initial state shall be reported in an E record at the time of the first B record in the IGC file with the Fix Validity byte set to A (3D Fix, see A4.1.2 table under Fix Validity).
CCL	H	Competition class
CGD	E	Change of geodetic datum
CID	H	Competition ID
CLB	H	Club or organisation, and country, from which flown or operated (eg Elmira US, Lasham UK). For Nation, use the ISO 3166 two-letter codes, some of which are given in A3.3.3
CM2	H	Second Crew Member's Name, family name first then given name(s) as required (same format as PLT for pilot-in-charge). For aircraft with more than two crew, use CM3 and so forth if required.
COT	J, K	Controller temperature (for instance for FES) in degrees C. (AL5)
CUR	I, B,J,K	Electrical current, Amperes. (AL9 I, B allowed)
CU1	J, K	Electrical Current, Amperes, of the first propulsion battery where 2 batteries are installed (AL8)
CU2	J, K	Electrical Current, Amperes, of the second propulsion battery where 2 batteries are installed (AL8)
DAE	I, B, J, K	Displacement east, metres. For West use negative sign
DAN	I, B, J, K	Displacement north, metres. For South use negative sign
DB1	H	Date of Birth of the pilot-in-charge (aircraft commander) in the previous line of the H record (DDMMYY)
DB2	H	Date of Birth of second crew member in format DDMMYY. For more than two crew, use DB3, DB4 etc
DTE	H	Date UTC, expressed as DDMMYY
DTM	H	Geodetic Datum in use for lat/long records (for IGC purposes this must be set to WGS84)
EGT	J, K	Exhaust gas temperature in degrees C (for jet engines) AL5
ENL	I, B	Environmental Noise Level. The ENL system is inside the FR and is intended to record when an engine is running in three numbers between 000 and 999 in the fix records of the IGC file. See para 2.2.5
FIN	E	Finish
FLE	J, K	Fuel level, centilitres. AL5
FFL	J, K	Fuel flow, litres per minute (AL8)
FLP	E	Flap position, three characters such as FLP060 for 60 degrees of positive flap. If negative, use a negative sign before the numbers, such as FLP-20 for minus 20 degrees flap.
FRS	H	Flight Recorder Security. To be used where a security fault has been detected such as the recorder internal security system (microswitch) having operated.
FTY	H	FR Type (Manufacturer's name, FR Model Number)
FXA	B, I, J, K	Fix accuracy. When used in the B (fix) record, this is the EPE (Estimated Position Error) figure in metres (MMM) for the individual fix concerned, to a 2-Sigma (95.45%) probability
GAL	H	Galileo (European GNS System), followed by receiver maker, type & version letter/number. See para 3.3.1
GID	H	Glider Identification (ID)
GLO	H	GLONASS (Russian GNS System), followed by receiver maker, type & version letter/number. See para 3.3.1

GPS	H	GPS (US GNS System), followed by receiver maker, type & version letter/number. See para 3.3.1, also 3.3.4 for other GNS Systems such as European Galileo, Russian GLONASS, and Chinese BeiDou 2
GSP	B, E, I, J, K, L	Groundspeed - used in some FRs, figures derived from algorithms based on successive fixes. Note: GSP can also be calculated after flight, derived from a series of fixes
GTY	H	Glider type, manufacturer, model
HDM	I, B, J, K	Heading Magnetic, three numbers based on degrees clockwise from 000 for north
HDT	I, B, J, K	Heading True, three numbers based on degrees clockwise from 000 for north
IAS	I, B, J, K	Airspeed, three numbers in kilometres per hour
JPT	J, K	Jet Pipe Temperature, for jet engines. AL5
HRT	M, N	Heart Rate, 3 numbers, beats per minute. Usage only in M & N records to allow deletion of personal data without affecting the file security signature
HUM	J, K	Relative Humidity, percent (AL8)
LEB	J, K	Battery - state of charge, percent. AL5
LE1	J, K	Battery 1 - state of charge, percent, first propulsion battery where 2 batteries are installed (AL8)
LE2	J, K	Battery 2 - state of charge, percent, first propulsion battery where 2 batteries are installed (AL8)
LAD	I, B	The last places of decimal minutes of latitude, where latitude is recorded to a greater precision than the three decimal minutes that are in the main body of the B-record. The fourth and any further decimal places of minutes are recorded as an addition to the B-record, their position in each B-record line being specified in the I-record
LCU	L	Data from the SeeYou system after flight, not needed for Validation but used in some flight analysis systems
LOD	I, B	The last places of decimal minutes of longitude, where longitude is recorded to a greater precision than the three decimal minutes that are in the main body of the B-record. The fourth and any further decimal places of minutes are recorded as an addition to the B-record, their position in each B-record line being specified in the I-record.
LOV	E	Low voltage. Must be set for each FR at the lowest voltage at which the FR will operate without the possibility of recorded data being degraded. Not to be used to invalidate a flight if the flight data appears correct when checked in the normal way, but a warning to check fix data particularly carefully.
MAC	E	MacCready setting for rate of climb/speed-to-fly (m/sec)
MCU	E	Data from SeeYou after flight, not needed for Validation but used in some flight analysis systems
MP2 MP3, etc	I, B	Means of Propulsion systems fitted in addition to the basic MOP system, see MOP below
MOT	J, K	Motor temperature, degrees C
MOP	H, I, B	Means of Propulsion. A signal from an engine-related function from a sensor separate from the ENL system in the FR, giving three numbers. See A.3.2 note.
NET	I, B,J,K	NETTO - NETT (=overall) Vertical Air Movement Vertical speed of air in metres per second (AL9 I,B allowed)
OA1 OA2 OA3 etc	E	Position of other aircraft (if this is recorded by the system), data fields after the Codes being separated by colons. Format after the Three Letter Code is the identification of the aircraft concerned (if this is recorded by the system, otherwise insert NK for not known) followed by a colon, letter P for polar or C for Cartesian followed by the co-ordinates. Polar co-ordinates are with respect to the recorder. Format is numbers for horizontal distance in metres from the recorder followed by a colon, followed by 3 numbers of degrees clockwise from 000 for north, followed by a colon and vertical distance in metres from the recorder, a negative sign before the numbers meaning negative vertical distance. After the numbers for vertical distance, the letter G should be used for GNSS data and P for Pressure Altitude, both can be used if the data is available. Alternatively, Cartesian co-ordinates can be used for the 3D position of the Other Aircraft (for instance from ADS-B and similar position reporting systems). Format is lat/long followed by pressure and GNSS altitudes (if these are recorded by the system) in the same order and format as for the B record (para A4.1), omitting the fix validity character. Where a type of altitude is not recorded, zeros should be substituted

OAT	J,K	Outside air temperature (Celsius). If negative, use negative sign before the numbers.
ONT	E	On Task – attempting a specific task
OOI	H	OO ID – Official Observer Identifier
OXY	M, N	Oxygen Saturation, 3 numbers for % saturation. Usage only in M & N records to allow deletion of personal data without affecting the file security signature
PEV	E	Pilot EVent - Pilot initiated action followed by a series of fast fixes (see para 3.6)
PFC	L	Post-Flight Claim. For Free Flights where the pilot decides after the flight which waypoints are to be claimed
PLT	H	Pilot-in-charge (aircraft commander), family name first then given name(s) as required
PRS	H	Pressure Altitude Sensor, manufacturer, model, etc (in the H record line this is followed by the maximum altitude processed by the FR)
RAI	I, B, J, K	RAIM - GPS Parameter, see Glossary under Receiver Autonomous Integrity Monitoring
REX	I, B, J, K	Record addition - Manufacturer defined data defined in the I or J record as appropriate, normally in the form of a TLC (which, if a new variable is agreed, may be a new TLC allocated by GFAC at the time). Any use must be approved by GFAC, and published so that there will be no doubt on how it is being used.
RFW	H	Firmware Revision Version of FR
RHW	H	Hardware Revision Version of FR
RPM	J, K	Revolutions Per Minute (of engine) AL5
SIT	H	Site, Name, region, nation etc.
SIU	I, B	Satellites in use. A two-character field from the NMEA GGA or GNS sentences, or equivalent data agreed by GFAC.
STA	E	Start event such as starting a pre-declared task
TAS	I, B, J, K	Airspeed True, give units (kt, kph, etc.)
TDS	I, B, J, K	Decimal seconds of UTC time, for use with systems recording time to this accuracy. Time in seconds is recorded in the main body of the B-record and decimal seconds are recorded as an addition to the B-record, their position in each B-record line being specified in the I-record. Similarly with the K and J-records. For an example see A2.4 under Time
TPC	E	Turn point confirmation - Equipment generated event (not to be used for IGC flight validation which requires independent checking of fixes and relevant Observation Zones)
TRT	J, K	True Track - used in some FRs based on algorithms that calculate track from a number of fixes
TZN	H	Time Zone Offset, hours from UTC to local time.
UND	E	Undercarriage (landing gear), recorded as UP or DOWN, in the format UNDUP or UNDDN
VAR	J, K	Uncompensated variometer (non-total energy) vertical speed in metres per second and tenths of metres per second with leading zero and no dot (".") separator between metres and tenths. Valid characters 0-9 and negative sign "-". Negative values to have negative sign instead of leading zero
VAT	J, K	Compensated variometer (total energy/NETTO) vertical speed in metres per second and tenths of metres per second with leading zero and no dot (".") separator between metres and tenths. Valid characters 0-9 and negative sign "-". Negative values to have negative sign instead of leading zero
VOL	I, B, J, K	Voltage of propulsion battery if only one is installed (AL9 I,B allowed)
VO1	I, B, J, K	Voltage of first battery where two propulsion batteries are installed (AL9 I,B allowed)
VO2	I, B, J, K	Voltage of second battery where two propulsion batteries are installed (AL9 I,B allowed)
VXA	I, B, J, K	Vertical Fix Accuracy, Three characters in metres from the VDOP part of the NMEA GSA sentence, or equivalent data agreed by GFAC

WDI	J, K	Wind Direction (the direction the wind is coming from). Three numbers based on degrees clockwise from 000 for north – recommended to be replaced (together with WSP) by WVE
WSP	J, K	Wind speed, three numbers in kilometres per hour– recommended to be replaced (together with WDI) by WVE
WVE	J, K	Wind Velocity - wind direction (degrees from True North) and strength (kph) to 2 d.p. such as "2702210" meaning due West (270 degrees) at 22.1 kph (AL9). **Recommended to replace WSP and WVE**
X**	As Appropriate	The X prefix is intended to allow a trial with a new code before deciding whether it should be added to the full list. The asterisk symbol (*) is any character. The manufacturer must specify its meaning and use in the documentation for the recorder and its use must be approved by GFAC before IGC-approval.

A7.1 Obsolete Three Letter Codes (TLCs) - these may be still in use in old types of Recorders:

CCN	E	Camera Connect
CDC	E	Camera Disconnect
DOB	H	Date of Birth of the pilot, now use DB1
PHO	E	Photo taken (shutter-press)
SCM	H	Second Crew Member Name, now use CM2
SEC	G	Security - Log security data

A7.1.1. Old Engine codes. In some old models of recorders where ENL (now mandatory) and MOP (where required) are not used, the EON/EOF or EUP/EDN codes were used. EON/EOF was based on functions such as ignition ON/OFF, generator output, etc. EUP/EDN was used for a microswitch sensor for engine bay doors open/closed or pylon up/down.

EDN	E	Engine down
EOF	E	Engine off
EON	E	Engine on
EUP	E	Engine up

A8. GNSS GEODETIC DATUM AND EARTH MODEL.

The Sporting Code for Gliding (SC3) states that the WGS 84 Geodetic Datum shall be used for all lat/long co-ordinates and GNSS altitudes in the IGC file. This appears in the Header record of IGC files as shown in A3.2.4.

A8.1 The WGS84 Earth Model is a three-dimensional ellipse (ellipsoid) with an equatorial radius of 6378.1370 km and a polar radius of 6356.7523 km, for more details see the glossary under WGS84.

A8.2 For IGC-approved FRs, earth models with radii within 1 metre of WGS84 will also be accepted. These include the European Terrain Reference Frame (ETRF) which is used by the European Galileo GNS System and has the same equatorial radius as WGS84 and a polar radius within 1 centimetre of WGS84.

A9. EXAMPLE IGC-FORMAT FILE

A9.1 The IGC file format starts with the A Record and is followed by the H (header) and other records. The record letter is at the start of the line when it is viewed in text format. For full details of record order and the formats of individual records, see the relevant paragraphs earlier in this Appendix. In this appendix, spaces are added between subject lines to make this easier to understand.

A9.2 In the following, spaces are used to show the different elements on a line, but in the IGC file itself there should be no spaces except within a text string to separate different words. Notes are in italics and are not part of the file format.

A CAM XYZ *(Cambridge FR serial XYZ)*
HF DTE DATE: 16 08 19 02 *(Flight on 16 August 2019, second flight of the day)*

HF PLT PILOT IN CHARGE:Bloggs Bill D
HF CM2 CREW2:Nil
HF GTY GLIDER TYPE:Arcus M
HF GID GLIDER ID:G-GLID
HF DTM GPS DATUM:WGS84
HF RFW FIRMWAREVERSION:6.4
HF RHW HARDWAREVERSION:3.0
HF FTY FR TYPE:Cambridge CAI 302
HF GPS RECEIVER:Marconi Superstar,12,10000
HF PRS PRESS ALT SENSOR:Sensyn,XYZ1111,11000
HF CID COMPETITION ID:111
HF CCL COMPETITION CLASS:20m Motor Glider
HF FRS SECURITY OK or SECURITY SUSPECT / SECURITY MS OPERATED (as relevant) : TEXTSTRING CRLF

I 03 3638 FXA 3940 SIU 4143 ENL *(The I record shows the extra data that will be added to each B records, in this case FXA, SIU and ENL, the numbers showing where the data is along a B record line, for instance for ENL, characters 41-43)*

J 01 0810 HDT *(The J record shows what will be recorded in K record lines that follow, in this case True Heading HDT)*

C 210815 093841 000000 0000 02 500K Triangle *(for the reason for the two fields with zeros, see A3.5.4)*
C 5111419N 00101915W TAKEOFF Lasham Clubhouse
C 5110185N 00102647W START Lasham LA4
C 5209092N 00255227W TURN Sarnesfield
C 5230147N 00017612W TURN Norman Cross
C 5110185N 00102647W START Lasham LA4
C 5111419N 00101915W LANDING Lasham Clubhouse

F 160240 04 06 09 12 36 24 22 18 21 *(The initial F record shows the time and then 9 two number satellite Idents)*

B 160240 5407121N 0 0249342W A 00280 00421 055 09 950 *(in this B record, after the time and Lat/Long, it shows a pressure altitude of 280m, GNSS altitude of 421m. FXA (error radius) 55m, SIU 9 satellites and noise (ENL) 950)*
B 160245 5107126N 00149300W A 00288 00429 050 09 970
B 160250 5107134N 00149283W A 00290 00432 045 09 980
B 160255 5107140N 00149221W A 00290 00430 032 09 965
F 160300 06 09 12 36 24 22 18 21 *(Satellites in use reduces from 9 to 8 because Ident 04 is no longer received)*
B 160300 5107150N 00149202W A 00291 00432 026 08 022 *(the last three numbers show that the engine is now stopped)*
E 160305 PEV *(Pilot Event followed by a period of fast fixing at 1 second intervals (not shown here))*
B 160305 5107180N 00149185W A 00291 00435 024 08 015
K 160310 090 *(The K record contains the values listed in the J record, in this case a true heading of 090)*
B 160310 5107212N 00149174W A 00293 00435 020 08 024
B 160315 5107220N 00149150W A 00494 00436 015 08 018
B 160320 5107330N 00149127W A 00496 00439 013 08 015
(followed by many more B and other time-ordered records)

L PLT Ruritanian Standard Nationals Day 1 *(L=logbook data, entered as required, in this case by PLT (the pilot))*
L PLT My first 500k triangle *(This is a post flight comment by the pilot)*

G JNJK2489IERGNV3089IVJE9GO398535J3894N358954983O0934
G SKTO5427FGTNUT5621WKTC6714FT8957FGMKJ134527FGTR6751 *(the G record contains security coding that allows the whole IGC file to be checked for integrity by IGC Shell and the manufacturer's VALI program)*
