**AMENDMENT LIST NUMBER 10 TO THE TECHNICAL SPECIFICATION FOR IGC-APPROVED GNSS FLIGHT RECORDERS**

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**ISSUED BY FAI ON BEHALF OF THE INTERNATIONAL GLIDING COMMISSION**

# Glossary

**Add the following** and update WAAS and RAIM:

ADS-B - Automatic Dependent Surveillance - Broadcast. The ADS-B system uses Global Navigation Satellite System (GNSS) position data and a relatively simple broadcast communications link. It is automatic, in that it is always live and requires no operator action. Dependent, in that it depends on a GNSS system such as GPS for position data. Surveillance, in that it provides this 3D position data to ground controllers and other aircraft. Broadcast, in that it broadcasts data on pre-set radio frequencies to any ADS-B-equipped aircraft or ground station that is listening. It has been said that the ADS-B system is the future for worldwide Air Traffic Management (ATM) and for proximity warning between aircraft. (AL10)

EGNOS - European Geostationary Navigation Overlay Service. Designed for the European area, EGNOS is a GPS-enhancement system that makes the same kind of corrections as the North American WAAS (see below). It has been shown to reduce position errors to about one quarter those of un-enhanced GPS systems. EGNOS has a series of Ranging and Integrity Monitoring Stations (RIMS) which receive GPS signals. Master Control Centres (MCC) then process RIMS data and calculate corrections based on the known accurate position of the RIMS stations. The correction data is then sent to three special EGNOS satellites that are geostationary over the equator. GPS users on the ground in the area of EGNOS cover can receive data from the EGNOS satellites so that the corrections for the European area can be applied to raw GPS positions. EGNOS is part of a European GPS initiative and became operational in July 2005. (AL10)

Enhancement systems, for GNSS - This term is generally used for Satellite-Based Augmentation Systems (SBAS) that apply corrections to GPS receivers over a specified area. These systems increase accuracy by monitoring errors over their area and making corrections available to compatible receivers. More detail is under SBAS below. (AL10)

EUROCAE - European Organisation for Civil Aviation Equipment. The Regulatory agency for certifying aviation equipment in Europe. It is a non-profit organisation formed from manufacturers of aircraft, airborne equipment, Air Traffic Management (ATM) systems and ground equipment, Service Providers, National and International Aviation Authorities and Users (Airlines, Airports, operators) from Europe and elsewhere. EUROCAE develops performance specifications and other documents that are referenced as a means of compliance to European Technical Standard Orders (ETSOs) and other regulatory documents. EUROCAE works with US standardisation bodies, including RTCA (see later) and SAE, to produce harmonised specifications where possible. EUROCAE documents also take into account ICAO standards and ARINC specifications. (AL10)

RAIM - Receiver Autonomous Integrity Monitoring. A system inside a GPS receiver that automatically compares the position-line obtained from each satellite with other position-lines being received at any one time. Any anomalous ("rogue") position lines are then discarded for the purpose of calculating the fix for the time concerned. A numeric code is used which indicates 0 if RAIM is satisfied and 5 when not. In theory, RAIM calculations can be based on a minimum of four position lines (three good ones and the "rogue") but in practice, six satellite position-lines are needed for the system to operate properly. With a 12- or 16-Channel receiver and the antenna in a good position, this is not normally a problem. See also SBAS. (AL10)

SBAS - Satellite-Based Augmentation System. A system that increases GNSS accuracy by monitoring errors at ground stations in the area concerned and making corrections and other data available to compatible receivers. For GPS, systems in service include WAAS (North America) and EGNOS (Europe). Other future SBAS systems include GAGAN (India) and MSAS (Japan). A Ground-Based Augmentation System (GBAS) is being developed in Australia. (AL10)

WAAS - Wide-Area Augmentation System. A system that corrects GPS positions based on the actual position of monitoring stations in North America. It consists of an integrity and reference monitoring network, processing and control facilities, and special WAAS geostationary satellites above the equator. Reference stations receive data from the GPS and WAAS satellites and measure differential corrections, ionospheric delay information, GPS/WAAS accuracy, WAAS network time, GPS system time and UTC time. These measurements are sent to Data Processing sites for calculation of corrections for the area of WAAS cover. In addition, residual errors can be calculated for data from each satellite. The Data Processing sites also generate navigation messages. This information is broadcast to users from the WAAS geostationary satellites and the resulting GPS/WAAS fixes are more accurate than those using GPS alone. See also EGNOS and RAIM. (AL10)

-------- end of Glossary section ---------

Para 1.1.3.1.1 Pilot checks on individual recorders. To end: It also applies to pressure altitude calibrations. These must be close to the ICAO standard atmosphere, see para 2.6.1. For more detail on the critical cases in ENL recording, see para 2.6.7.5.2 (AL10)

Para 1.1.3.2 Document kept with the Flight Record. Add at the end: A copy of the current IGC-approval document in either written of electronic form must be included with each recorder sold or updated. (AL10)

2.6.7.5.1 Fix sampling time for MoP record. Add at the end: The same applies to RPM values of 050 (out of 999) or over (where the RPM code is recorded). (AL10)

2.6.7.5.2 New para on ENL systems, from the paper approved by the IGC Plenary in March 2007:

2.6.7.5.2 ENL System - General. An ENL system must be designed to differentiate between any engine running that generates forward thrust, and any flight condition encountered in normal soaring flight without the use of engine. The critical engine-on case with all motor gliders is not when the engine is run at high power. The critical engine-off case is not a quiet glide with a well-sealed cockpit. These cases are expanded below. (AL10)

2.6.7.5.2.1 High Engine Power. A combination of engine and propellor noise at high power are expected to give ENL figures over 800 out of the maximum ENL in the IGC file of 999. Most two-stroke systems give over 900 and some ENL systems give the maximum of 999. Four stroke and Wankel rotary engines give lower figures but still enough to differentiate between power-on and power-off. Electric engines at high power have also been shown to give reasonably high ENL (much is propellor noise), but high power is not the critical case in terms of differentiating between power-on and power-off flight, see below. (AL10)

2.6.7.5.2.2 Critical Noise-level Recording Cases

2.6.7.5.2.2.1 Power-on. The critical power-on case that is used for testing ENL differentiation is power for low-speed cruise, that is, just sufficient power for level flight in still air. At this condition, recorded ENL must be high enough to differentiate from the Power-Off cases below. A more critical condition is where engine could be used to extend glide angle rather than fly level or climb, but is more difficult to test than the "level flight" case. (AL10)

2.6.7.5.2.2.2 Power-off. The critical ENL power-off case is not a quiet, well-sealed cockpit. It is a noisy cockpit, typically thermalling with air vents and cockpit panels open. This can produce ENL figures up to 300, more if sideslip is present and 400 has been seen on some recorders. Another noisy case is high speed flight with the cockpit panel(s) open, but this is not as realistic as thermalling with panels open because in the latter case the glider will be climbing. (AL10)

2.6.7.5.2.3 ENL numbers. The three ENL numbers as recorded in IGC files must therefore differentiate between the "quiet engine" and the "noisy cockpit" cases. This is done by carefully selecting the frequency and gain at which the ENL system is most sensitive. The ENL system is then tested by GFAC in a range of motor gliders, gliders and powered aircraft. Experience has shown that peak sensitivity at frequencies between about 70 and 100Hz gives good (high) response to engine and propeller noise and less response to cockpit noises, combined with a typical "bell curve" (normal distribution curve) overall shape of sensitivity with frequency. (AL10)

2.6.7.5.2.4 Low noise Motor Gliders. Where the engine system produces low ENL values that make it difficult to differentiate between power-on and power-off flight, an additional system shall be provided in the motor glider concerned. This system must produce a signal that is shown in the IGC file under the three-letter code "RPM" (as defined in the Technical Specification for IGC-approved Flight Recorders), as an indication of forward thrust generated by the engine system. This will be subject to GFAC evaluation and decision on the type of motor glider concerned. (AL10)

2.7.2.2.7.6 New para: Other Plugs and Sockets. The IGC standard of wiring is published above. The wiring of any other plugs used on the recorder must be such that, if the other plug is put in the IGC socket by mistake, damage will not occur to the recorder. The pinning for any voltage wiring is particularly

2.11.1.1 Default settings. Change the first sentence to: Where a motor glider Engine Noise (ENL) function is incorporated, it must not be possible to disable it. This is because ...

# Appendix 1:

Appendix 1, Para 1.1.1.4 New para:

1.1.1.4 Recorders operating on internal power. Some recorders are designed so that all of their functions are available on internal power. For these recorders, external power is used for charging and as a backup for long flights. When operating on internal power it must be ensured that under flight conditions of little horizontal or vertical movement (such as in ridge or wave flying), the IGC file continues be able to record data and is not ended while flight continues. The IGC file shall be ended after one of the following three conditions: (1) if no horizontal or vertical movement has been detected for 10 minutes (thresholds as in 1.1.1.1 above); (2) after the recorder is switched off by deliberate action, or; (3) if the recorder is still powered after the flight, when the user establishes a connection for purposes of downloading from the recorder. (AL10)

Appendix 1, para 2.5.6 Manufacturer codes:

Add: D – DSX - Data Swan/DSX

Add: G – FLA - Flarm (Flight Alarm)

Add: T – TRI - Triadis Engineering GmbH

Appendix 1, Para 3.3, second paragraph, first sentence. The words at the end to read " by the Pilot or OO (P and O source records) after flight (see the line "Data Source" in the table below)."

Appendix 1, Para 7 Add the following Three Letter Codes (TLC):

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 GPS altitudes (if these are recorded by the system) in the same order and format as for the B record (para 4.1), omitting the fix validity character. Where a type of altitude is not recorded, zeros should be substituted. (AL10)

RPM - Change remarks to: A group of three numbers from 000 to 999 associated with the generation of forward thrust. Examples include propellor or engine RPM or another MoP variable agreed with GFAC that varies in a similar way. Such variable must always be recorded and must not be able to be switched off by the pilot, for instance through a cockpit switch, circuit-breaker or fuse. The whole range of numbers up to 999 shall be used. For instance, if RPM is recorded and maximum RPM is 3000, this shall be recorded in the B-record as 999 or close to it. The baseline minimum value must produce positive but low RPM numbers on the IGC file (such as 010 but not above 025) as a continuous check that the circuit is still live. GFAC will look particularly at the recording of lower powers that give forward thrust and ensure that they produce high enough numbers to clearly show any use of engine. (AL10)

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