Deviations requests for an ETSO approval for CS-ETSO applicable to GPS receivers (ETSO-C129a)
Consultation Paper

1. Introductory note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004[1] products certification procedure dated 30 March 2004, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

2. ETSO-C129a#6 – Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

Deviate from EUROCAE ED-72A Section 3.2.2.4.j.(4), -(5) and provide a smooth full scale cross track deviation transition instead of full scale switching.

Requirement:

(4) At a distance of 3 NM inbound to the final approach fix, the equipment shall indicate that an automatic non-numeric display sensitivity change will occur. If the approach mode was not previously activated, the approach enable alert shall be repeated (for manual selection only).

(5) At a distance of 2 NM inbound to the FAF, if the approach has been enabled, the equipment shall automatically verify that satellite vehicle geometry will be suitable during the approach. This must be done using the RAIM function defined in paragraph 3.2.2.3d(1). If the RAIM is predicted to be available, the equipment shall switch to approach mode and:

- immediately transition from terminal integrity performance to approach integrity performance as specified in paragraph 3.2.1.
- provide a smooth transition from 1 NM non-numeric display sensitivity to 0.3 NM sensitivity at the final approach fix.

Industry:

The ETSO calls for transition to 1.0 NM scaling during the approach transition phase, then changing to 0.3 NM scaling at a point 2 NM from the FAF. In our opinion (based on computer simulation), this relatively abrupt scaling change will cause erratic and unsatisfactory autopilot captures when the deviation is interfaced in place of a standard 2° to 3° beam width localizer signal for which the autopilot ILS control laws were designed.

Industry proposes the following alternative: When the approach is activated, instead of scaling as proposed in the ETSO the FMS will revert to a 2° full scale deviation (i.e. localizer look-alike), based upon a hypothetical 10,000 foot runway fife miles from the FAF. At the point where the 2° scaling becomes equal to 0.3 NM, the unit will then transition to linear deviation with 0.3 NM full scale for the remainder of the approach, as per ETSO. This transition point will occur approximately at the FAF.

[1] Cf. EASA Web: http://www.easa.europa.eu/doc/About_EASA/Manag_Board/2004/mb_decision_0704.pdf

Some FMS has used this concept (i.e. ILS look-alike) for many years and has never encountered any problems with interface to current autopilot / flight director ILS input control laws. This concept had been evaluated many times during FMS certification and has been found acceptable. The 2° beam width provides more sensitive deviation scaling than the 1.0 NM scaling as specified in the ETSO. Therefore the flight technical error will be reduced.

EASA: We accept the deviation as alternate means to meet the requirement.

3. ETSO-C129a#7 – Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

a) Deviate from EUROCAE ED-72A Section 3.2.2.4.j(4) and enable the approach 3 NM prior to the FAF or the FACF, if a CF leg is coded as start of the sequence.

b) Provide the scale change alert 15 seconds instead of 3 NM prior to the FAF or FACF

Requirement:

(4) At a distance of 3 NM inbound to the final approach fix, the equipment shall indicate that an automatic non-numeric display sensitivity change will occur. If the approach mode was not previously activated, the approach enable alert shall be repeated (for manual selection only).

Industry:

a) In many cases the coding of the final approach segment begins with Final Approach Course FIX (FACF) about two miles prior to the Final Approach Fix (FAF). This is the point to be used for the transition from Approach Arm state to Approach Active state. Consequently a deviation is requested to allow the approach enable alert message, when required, 3NM before either FACF or FAF whichever is the first waypoint of the final approach segment, rather than always before the FAF as stated in the ETSO.

b) The scale change alert shall be provided 15 seconds before the FAF or FACF rather than using a fixed three mile distance from the FAF. This will allow more consistent alerting based upon time rather than distance, and will work equally well in slow as well as fast airplanes.

EASA: a) We agree to allow the starting point of the first leg of the approach sequence to be used as the point for the approach mode alerting.

b) We agree to use a time period of 15 seconds before reaching instead a distance of 3NM for the approach mode enable alert. The system knows the speed as well the position. For a dedicated speed the requirements can be seen as identical. As the equipment may be installed in different types of aircraft a time related alerting can be seen more precise than a distance related one as it allows the same pilot reaction period independent from the aircraft speed.

4. ETSO-C129a#8 – Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

Deviate from EUROCAE ED-72A Section 3.2.2.4.f(3) and allow automatic leg sequencing for procedure turns vs. the ETSO requirement of manual leg sequencing.

Requirement:

(3) The equipment shall provide the capability for accomplishment of holding patterns and procedure turns. Activation of this function shall at least :

- Change automatic waypoint sequencing to manual.
- Permit the pilot to readily designate a waypoint and select a desired course (by means of a numerical keypad entry, HSI course pointer, CDI omni-bearing selector, etc...) to or from the designated waypoint (TO/FROM mode operation is acceptable).
- Retain all subsequent waypoints in the active flight plan in the same sequence.

- Permit the pilot to readily return to automatic waypoint sequencing at any time prior to the designated fix ("TO" waypoint) and continue with the existing flight plan.

Industry:

Holding patters currently comply with this requirement, as the aircraft will repeatedly fly over the holding fix with no pilot intervention. Exiting a holding pattern requires pilot action either by pressing Direct-To or by pressing PROCEED line select key on the holding page. No deviation is requested in regards to holding patterns.

Procedure turns are coded in the data base as a series of ARNIC 424 leg types, and the legs automatically sequence with no pilot intervention. Guidance to the aircraft is provided by roll steering interface, therefore providing smooth leg transitions throughout the procedure turn leg sequence. Procedure turns have been evaluated by test pilots and operation has been found to be acceptable. To require manual leg sequencing would increase pilot work load, and therefore be an undesirable change to the operation. A deviation is requested to allow automatic leg sequencing for Procedure Turns.

EASA: We accept the automatic leg sequencing for procedure turns as alternate means.

5. ETSO-C129a#9 – Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

Deviate from EUROCAE ED-72A Section 3.2.2.4.j(2) and enable the approach alert at 50 NM from the destination airport vs. the requirement of alerting at 30 NM.
Use a two step operation to select the approach mode after the alert message has been received if not displaying the typically selected NAV page.

Requirement:

(2) The equipment may enable the approach manually or automatically.

- If the approach is enabled manually, the equipment shall provide an approach enable alert at a radial distance of 30 NM from the destination airport. After display of this alert, a means shall be provided to enable the approach mode with a single action by the pilot. Concurrent with the approach enable alert, if applicable, a suitable means to alert the pilot of the need to insert the barometric pressure setting shall be provided (unless the automatic altitude input uses barometric corrected altitude data).
- If the approach is enabled automatically, the equipment shall activate the approach mode prior to a distance of 3 NM inbound to the final approach fix. The approach should not be enabled automatically more than 30 NM from the destination airport. An indication that the approach has been enabled shall be provided. Concurrent with this indication, if applicable, a suitable means to alert the pilot of the need to manually insert the barometric pressure setting shall be provided (unless the automatic altitude input uses barometric corrected altitude data).

Industry:

It is proposed to provide the ability to enable approach mode earlier by making ARM APPR option available on NAV page 1 at 50 NM rather than 30 NM. If the pilot has not enabled approach mode by the time he reaches 30 NM from the destination than the message “APPR ARM AVAIL <NAV>” will be presented to him as a reminder. There are several advantages to this operation:

1. Flight experience in high performance aircraft has shown that 30 NM is some times too close to the airport to have to wait before approach can be enabled. The 30 NM point is typically when in-range checklist is being performed, and the pilot may be involved with matters other than GPS/FMS operation.
2. ATC sometimes clears aircraft via heading vectors to intercept the final approach course of the published at a distance greater than 30 NM.
3. This operation gives the pilot a 20 NM buffer zone in which he can enable approach without having to acknowledge a nuisance message. The message will

only be presented if he hasn't enabled the approach by the time he reaches 30 NM.

4. This operation meets the intend of the ETSO in that the pilot is not required to enable approaches at 50 NM, but may do it only if he so wishes. He may still wait until the 30 NM point if that meets the requirements of his particular operation.

Terminal integrity will still occur at 30 NM from the destination airport, regardless of whether the approach has been enabled or not. Scaling change from enroute to terminal will, however, occur only when the approach has been enabled (i.e. ARM APPR is pressed).

The GPS/FMS will be compliant with the requirement of "single pilot action" if the pilot is currently viewing NAV 1 page, which is probably 98% of the time. In the small percentage of time that the pilot might be viewing another page, the message "APPR ARM AVAIL <NAV>" at 30 NM will indicate that approach can be armed by pressing the NAV key, then ARM APPR line select key.

EASA: In our opinion no deviation is necessary to allow the approach mode selection at a position outbound of 30 NM. The requirement request only an alert if the approach mode has not been enabled.

EASA agrees to allow a two step operation to select the approach mode in case the typically monitored NAV page is not active, which is needed to perform this input

6. ETSO-C129a#10 – Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

Deviate from EUROCAE ED-72A Section 3.1.2.1 table 3-2 and use the interference levels as specified by RTCA DO-229C Appendix C.

Requirement:

3.1.2.1 In-band Interference
The equipment must maintain the GPS signal in the presence of an in-band interfering signal in the frequency range of 1575.42 ± 15 MHz that is not more than the following levels as a function of interfering signal bandwidth, BW. All values are referenced at the receiver input with 1.5 dB maximum allowable cable loss and 4.5 dB minimum antenna gain. If a preamplifier or active antenna is used, an equivalent link budget should be used.

0 Hz δ BW < 1 kHz	121.0 dBm
1 kHz δ BW < 10 kHz	121.0 + 6 $\log_{10}$(BW/1000) dBm
10 kHz δ BW < 100 kHz	115.0 + 3 $\log_{10}$(BW/10000) dBm
100 kHz δ BW	112.0 dBm

Table 3-2: Interference with AMSS

Industry:

The In-band Interference requirement in ED-72a, paragraph 3.1.2.1, specifies that the equipment shall maintain the GPS signal in the presence of interfering signals at the levels shown Table 3-2 of ED-72a. DO-229C, Appendix C , Table C-2 specifies slightly higher levels for the interfering signals when in Tracking Mode. This specification is more recent than ED-72a required by ETSO-C129a, and is intended to cover all of the phases of flight covered by ETSO-C129a.

The justification for this request comes from the fact that the In-band Interference requirement in DO-229C is slightly more demanding than the requirement in ED-72A, the EUROCAE equivalent to RTCA/DO-208. By meeting DO-229C in-band interference requirements for Tracking, the equipment also meets the ED-72a requirement. DO-229C contains the latest performance standards for GPS receivers and is intended as a replacement for the older DO-208, which is the United States equivalent of ED-72a.

DO-229C is used as the basis for equipment with capabilities and safety constraints far exceeding those of equipment designed to meet the requirements of the older specifications. The GPS Receiver hardware has been designed to meet the requirements of DO-229C.

EASA: RTCA DO-229C is the requirement for GPS receivers having the WAAS/EGNOS capability and is the certification basis for ETSO-C145 (DO-229A) and ETSO-C146 (DO-229B). Consequently EASA has already agreed to the modified requirements. We agree to substitute the requirement with the more detailed one as an alternate means of compliance.